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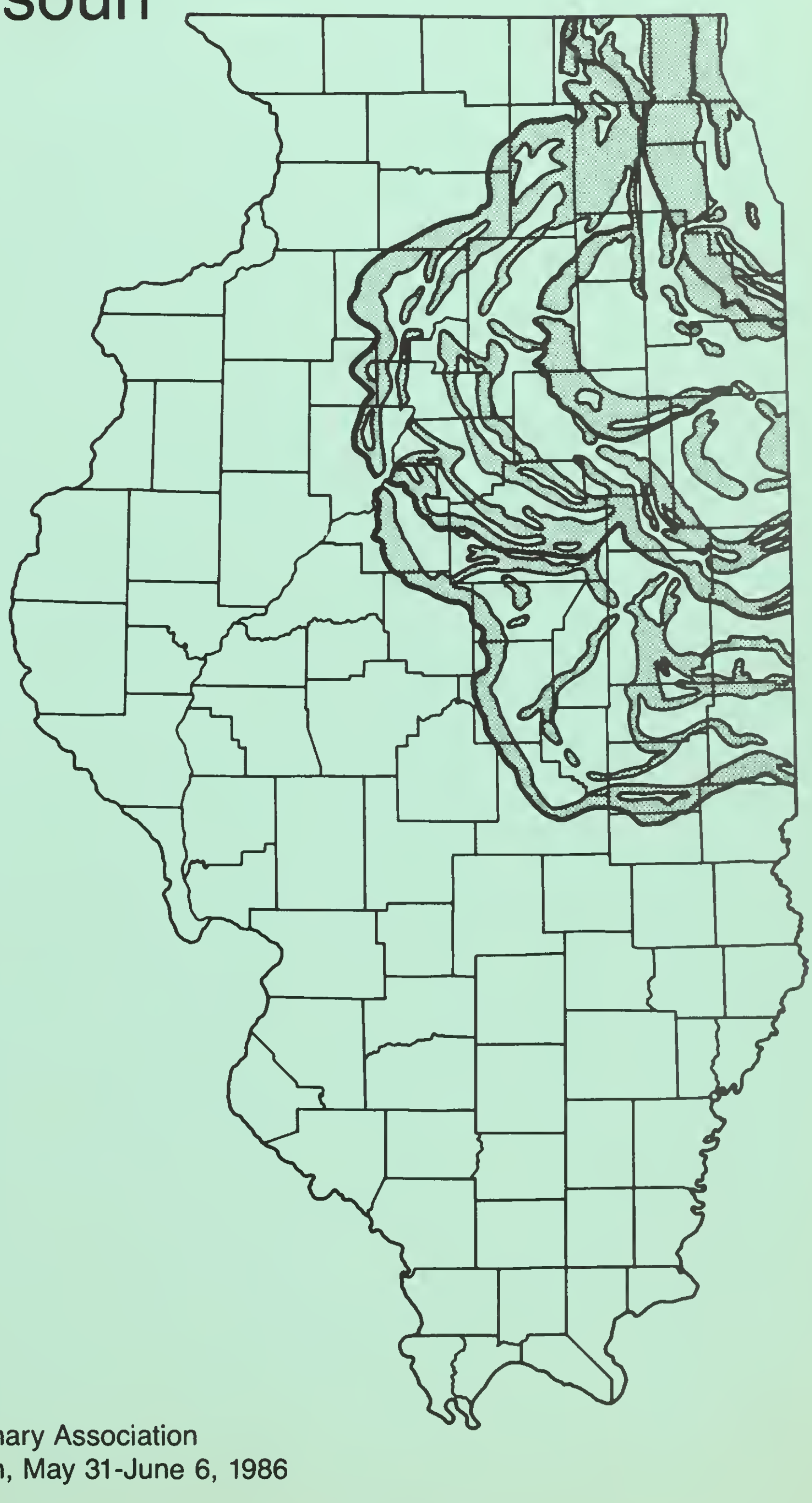
Quaternary records of southwestern Illinois and adjacent Missouri



Russell W. Graham
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Ninth Biennial Meeting, American Quaternary Association
University of Illinois at Urbana-Champaign, May 31-June 6, 1986

Sponsored by the Illinois State Geological and Water Surveys, the Illinois State Museum, and the University of Illinois Departments of Geology, Geography, and Anthropology

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American Quaternary Association
Ninth Biennial Meeting, May 31-June 6, 1986
Champaign, Illinois

ISGS Guidebook 23
Reprinted 1989

ILLINOIS STATE GEOLOGICAL SURVEY
Morris W. Leighton, Chief

615 East Peabody Drive
Champaign, Illinois 61820

Contents

The papers in this guidebook were compiled for the Ninth Biennial Meeting of the American Quaternary Association (AMQUA) in Champaign, Illinois, May 31-June 1, 1986. The Illinois State Geological Survey (ISGS) originally printed these guidebooks for AMQUA for use on the field trips held in conjunction with the meeting. Only papers authored principally by ISGS staff received formal internal ISGS technical review. This publication was prepared by staff members of the Illinois State Museum in Springfield.

Printed by the authority of the State of Illinois (1989/550)

STRATIFIED ILLINOIAN-SANGAMONIAN POLLEN, PLANT MACROFOSSIL, INVERTEBRATE AND VERTEBRATE RECORD AT HOPWOOD FARM

J.J. Saunders and J. E. King

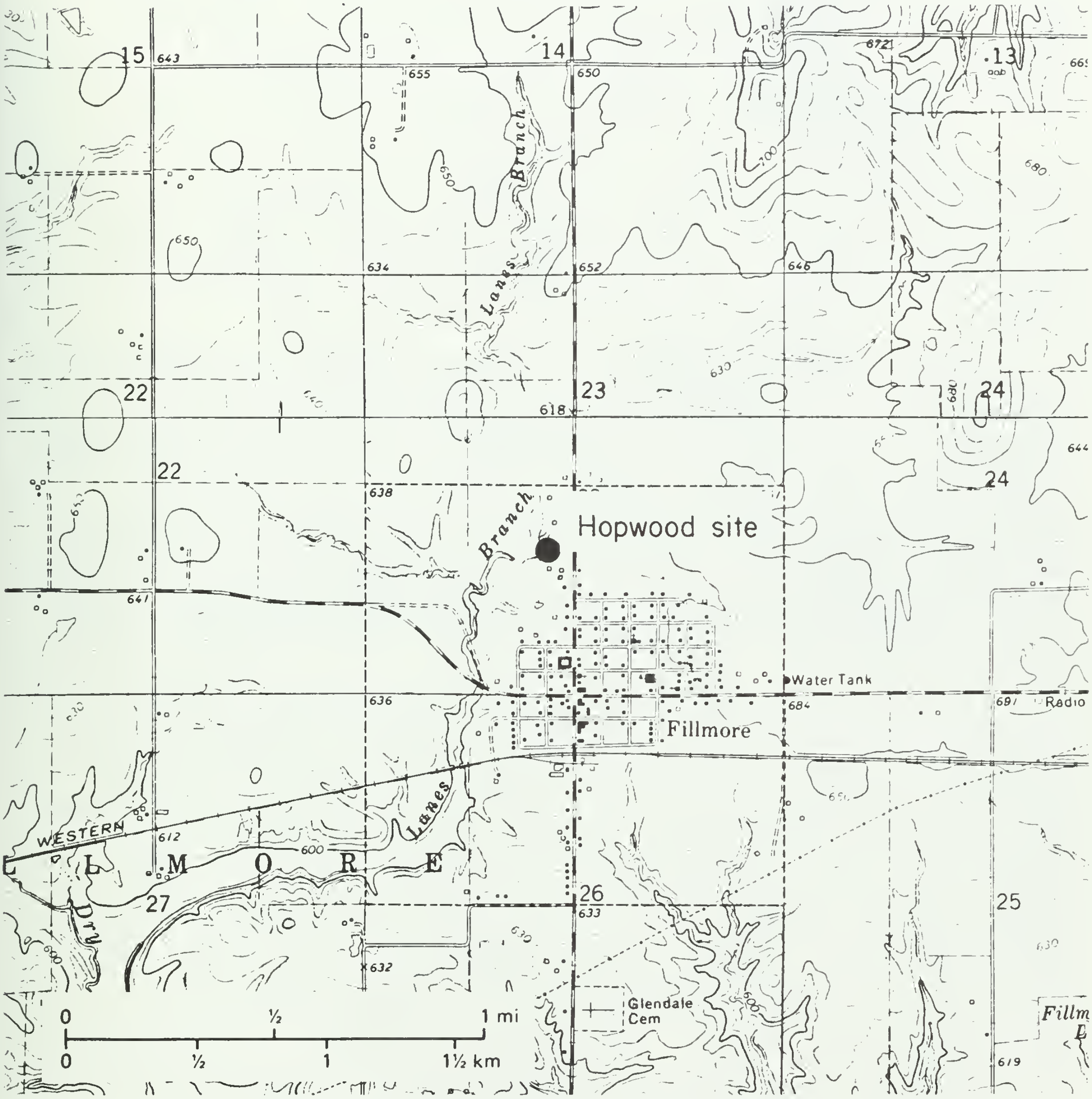

Figure 1-1
STOP 1
Hopwood Farm
SE NE SW Sec. 23, T8N, R2W, Montgomery County, IL
Filmore 7.5 minute Quadrangle

The Hopwood Farm locality (Stop 1, Fig. 1-1, Fig. 1-2) is a filled and buried late Illinoian (Jubileean) kettle (Fig. 1-3) undergoing dissection on the Curtis Hopwood farm in Montgomery County. It provides a basis for refining and augmenting previous paleoenvironmental reconstructions for central Illinois during the late Illinoian to middle or late Sangamonian. The Hopwood Farm locality has yielded, for the first time, diverse biotic assemblages (pollen, plant macrofossils, invertebrate and vertebrate faunas) from glacial/interglacial deposits for each of these stages in their type regions (King and Saunders, 1986).

Pollen from the locality (Fig. 1-4) indicates a shift from high Picea and Pinus (strata 5 and 6) to deciduous trees (stratum 4) followed by grass and herbaceous taxa (stratum 3b, lower stratum 3a) and then a return of deciduous trees (upper stratum 3a). This sequence appears to correlate with marine isotopic stages 6 through 5d. The Sangamonian/Illinoian boundary is placed at the stratum 3b/stratum 4 contact.

Faunal remains are abundant throughout the sequence (stratum 6 through lower stratum 2). Molluscs first appear in stratum 6 and continue in great abundance throughout the fossiliferous sediments. The first vertebrates appear in stratum 4 - large and small fish, e.g., Esox cf. lucius (northern pike), reptiles, and large birds, e.g., Branta (goose). Stratum 3 contains fish, amphibians, reptiles, large and small birds, and small mammals. Mammut americanum, American mastodont, occurs in lower stratum 2 and upper stratum 3a. Stratum 2 contains amphibians and reptiles as well as Castor sp. (beaver), Castoroides ohioensis (giant beaver), microtine rodents, including Ondatra sp. (muskrat), as well as Procyon sp. (raccoon), and ungulate tooth fragments.

Four fossils of Geochelone crassiscutata (giant tortoise) (e.g., Fig. 1-5) have been recovered to date at the Hopwood Farm locality. These represent the northern-most Pleistocene record of giant tortoises and the first record of tortoises from the Great Lakes region. Three of these specimens were found as float and thus their stratigraphic context was not certain. Pollen spectra from matrix washed from within these (Fig. 1-4) suggest a primary context in upper stratum 3a (Sangamonian-age). The fourth fossil, recovered last April, occurred loose but in lower stratum 3b. All fossils relate to a single immature individual with an inferred carapace length of approximately 680 mm. The previously known Sangamonian range of G. crassiscutata was restricted to Florida and Texas although Wisconsinan records occur in Florida, Georgia, Mississippi, and Texas. The presence of large giant tortoises indicates above freezing temperatures in central Illinois throughout the year during at least the portion of the Sangamon represented. Associated pollen indicate that during this time giant tortoises inhabited a xeric grassland at Hopwood.

In June 1980 an excavation (Fig. 1-6) conducted at the

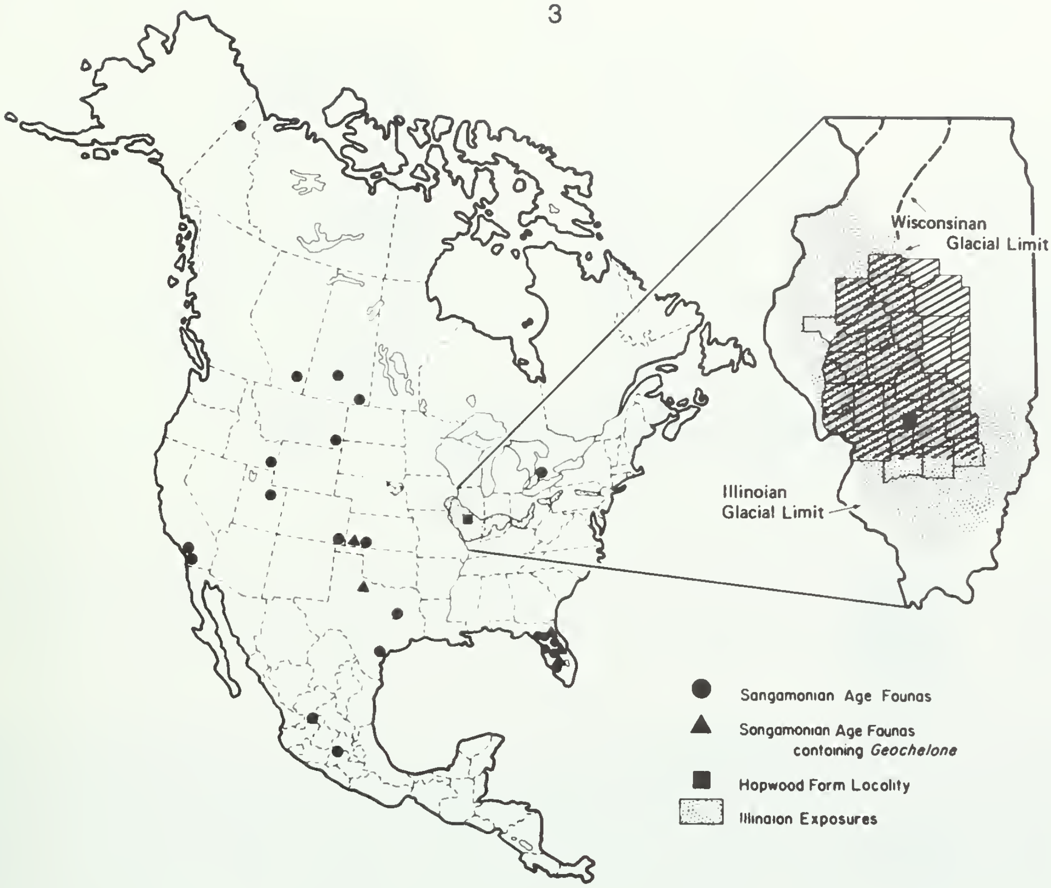

Figure 1-2. The location of Sangamonian-age mammalian faunas also containing Geochelone in North America (from Kurten and Anderson, 1980) and the distribution of Illinoian glacial exposures. The crosshatched portions of the indicated counties comprise the Sangamonian-type region as defined by Follmer (1979).

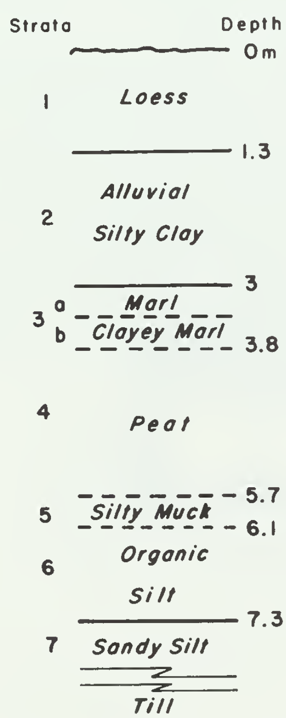

Figure 1-3. The stratigraphic sequence at the Hopwood fauna locality.

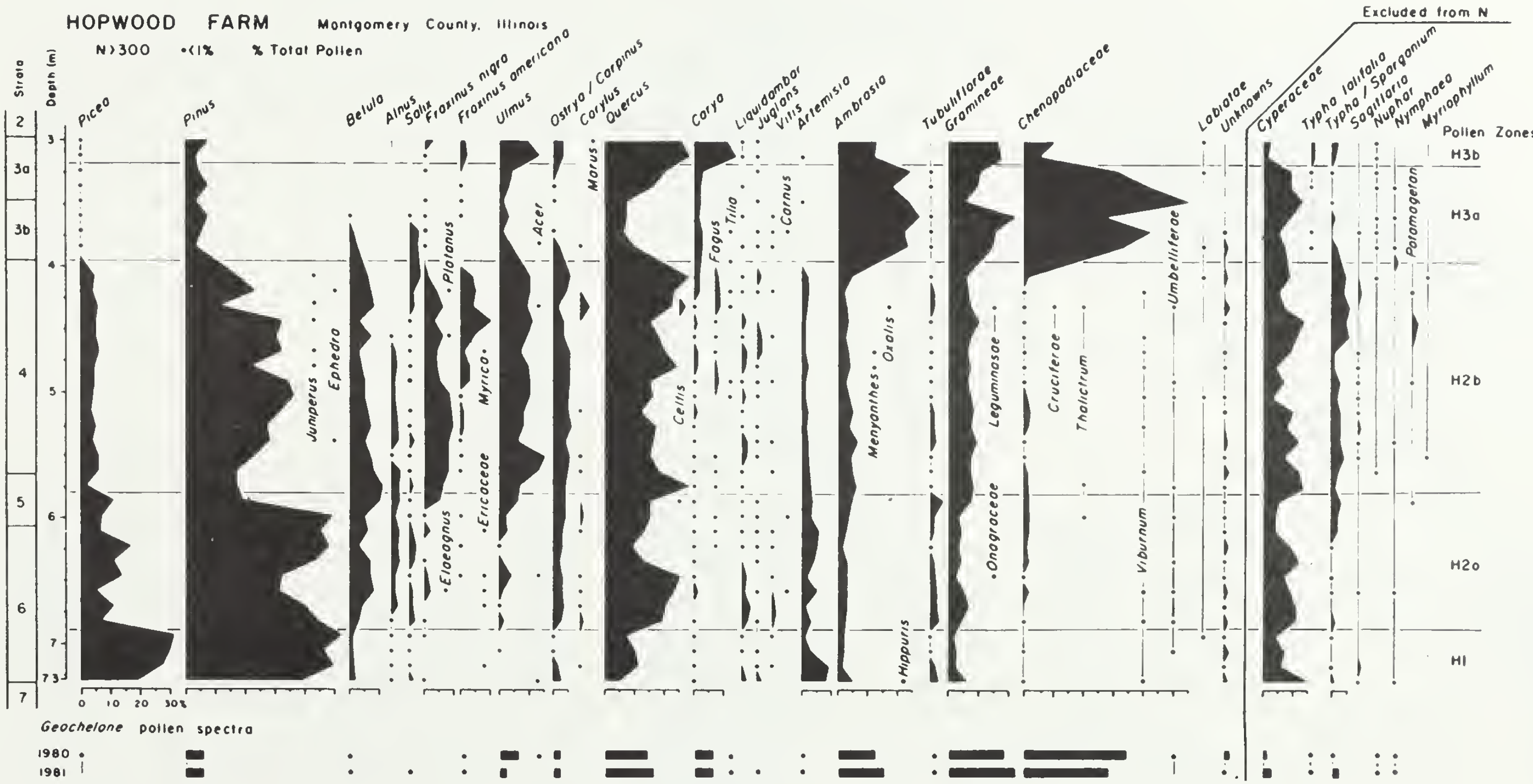

Figure 1-4. Relative pollen diagram from the Hopwood Farm locality, Illinois. Pollen spectra from the Geochelone fossils are shown at the bottom.

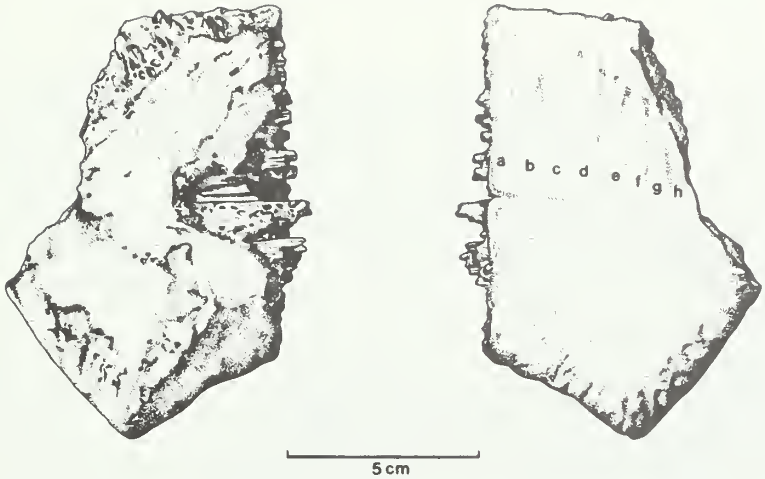

Figure 1-5. Partial left xiphiplastron of Geochelone crassiscutata from the Hopwood Farm locality. The letters h through a identify growth areas. Dorsal view on the left, ventral view on the right, anterior edge at top.

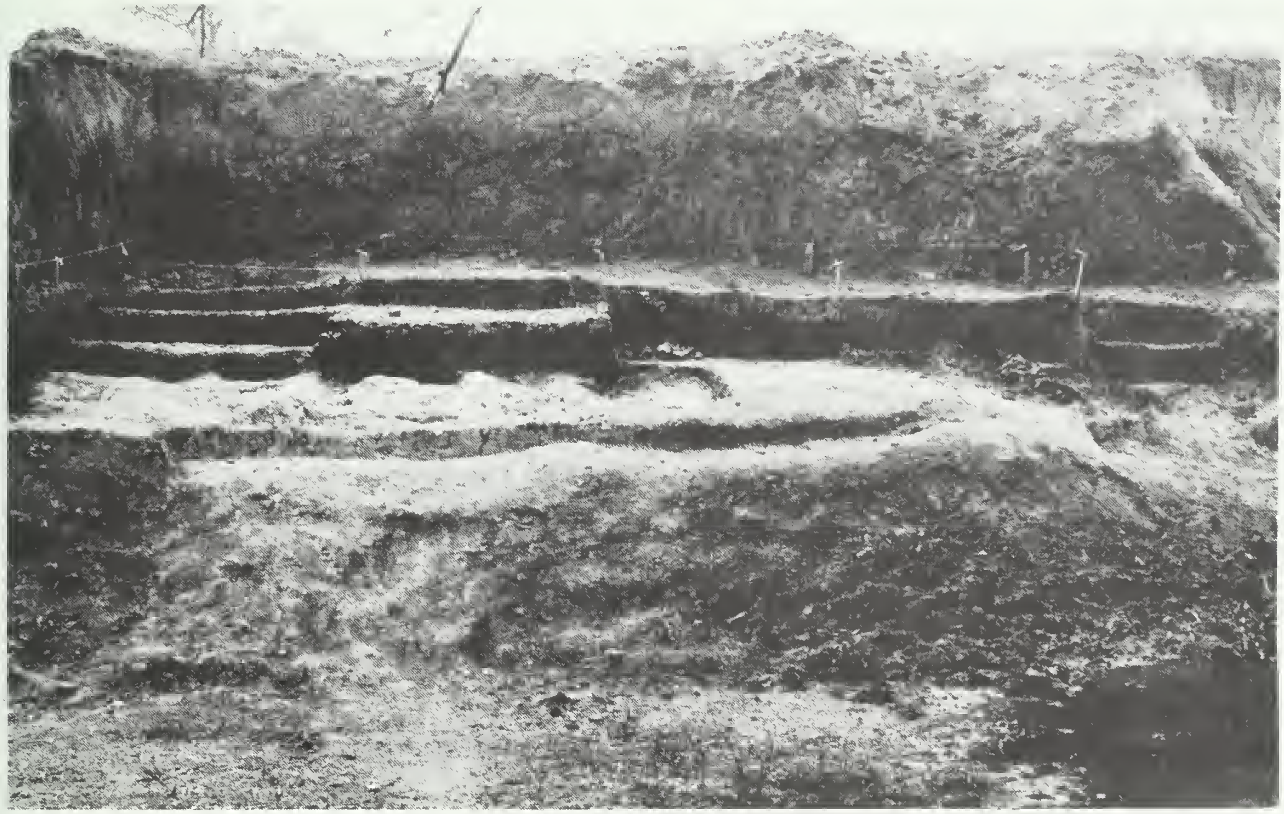

Figure 1-6. The Hopwood Farm excavation, Area 1, June 1980. View to west. Lanes Branch (right foreground) is dissecting the kettle in-filled sequence; the creek bed is in peat, stratum 4. To the left of the creek is the gravel bar (foreground) on which the first specimen of Geochelone crassiscuta was recovered. In the excavated exposure above the gravel bar is ca. 0.7 m of marl, strata 3a and 3b, overlain by ca. 1.85 m of dark gray organic clay, stratum 2, and ca. 0.8 m of gray clay containing Peoria Loess (light colored here) capped by Recent soil, stratum 1. The mastodont and other excavated fossils occur just above, on, or just below the stratum 2/stratum 3a contact, often in depressions in stratum 3a (shown in relief here in the left middle ground) that are believed to be mastodont footprints. The grid stakes (background) are set at 2 m intervals.

locality yielded fossils of a mastodont and other taxa from lower stratum 2 and upper stratum 3a. The mastodont fossils, broken but complete and well preserved, often occurred in depressions in the top of stratum 3a (Fig. 1-6). This suggests trampling by mastodonts on a shallow marl-filled lake bed on which the remains of at least one other individual had accumulated.

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A MISSISSIPPIAN CENTER AT THE CAHOKIA MOUNDS STATE HISTORIC SITE

Bonnie W. Styles

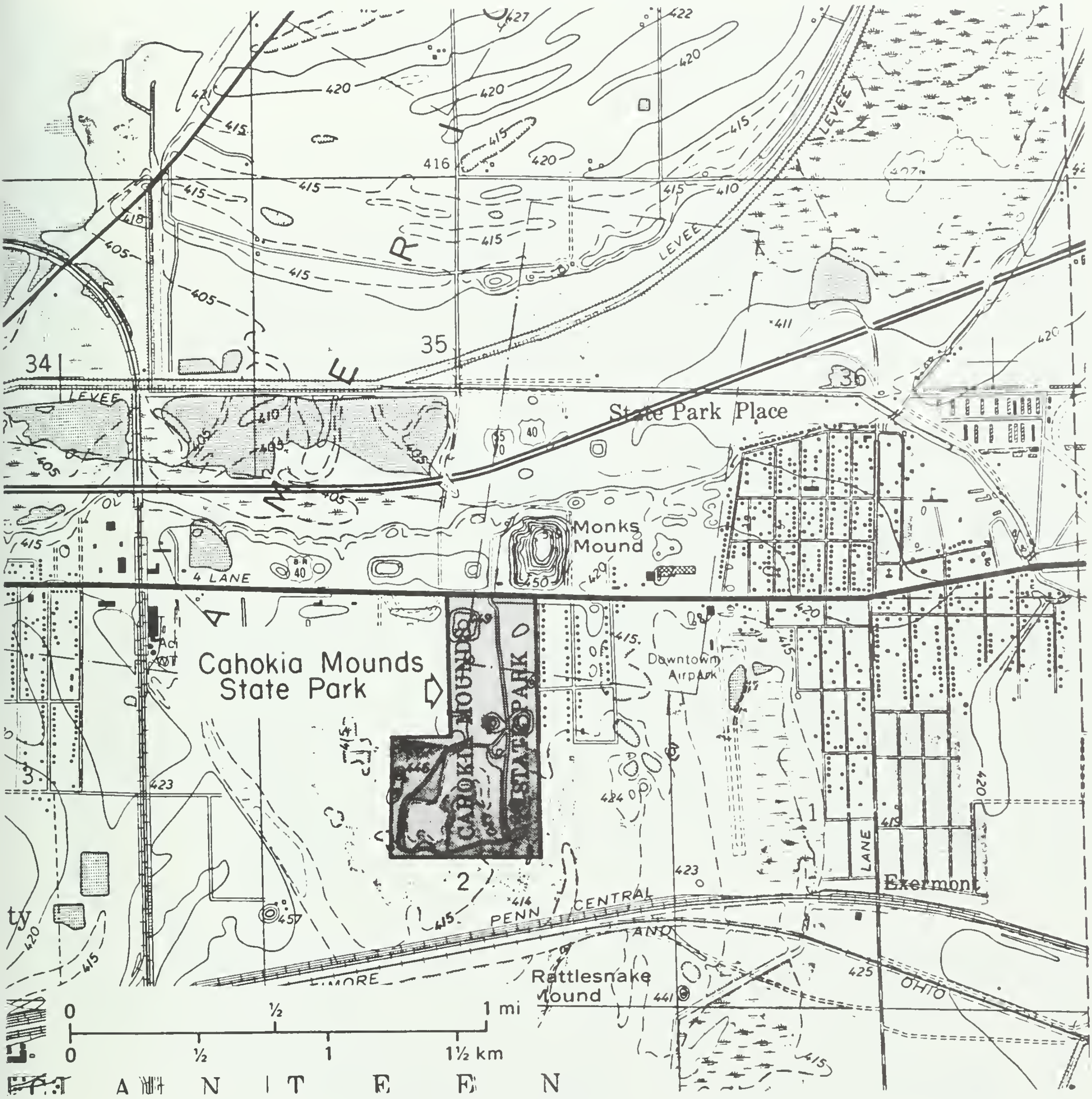

Figure 2-1
STOP 2
Cahokia Mounds State Historic Site
Sec. 1, 2, 3, 10, 11, 12, T2N, R9W, St. Clair County, IL
Sec. 34, 35, 36, T3N, R9W, Madison County, IL
Monks Mound 7.5 Minute Quadrangle

The Cahokia site covers over 15 square kilometers, and around 950 B.P. constituted the largest prehistoric political and religious center in the midwestern United States. It's influences are recorded in the southeastern United States and extended as far north as Wisconsin. In recognition of its significance, the Cahokia Site has been listed on the National Register of Historic Places, and has also been declared a World Heritage Site by the United Nations Educational, Scientific and Cultural Organization (UNESCO).

The Cahokia site is situated in the American Bottom in Madison and St. Clair counties, Illinois (Fig. 2-1). The modern Mississippi River flows within about 10 km of the site, but meander scars, currently supporting swamps, occur within the site boundaries. The site is well situated for the exploitation of aquatic resources; it lies in close proximity to Canteen and Cahokia creeks, and large lakes in the Horseshoe, Edelhardt, and Spring lake meander scars. The floodplain in this area was historically covered with wet and mesic prairie, marshes, and deciduous forest (Schwegman, 1973).

The site consists of Late Woodland and Emergent Mississippian (1250-950 B.P.) villages and a large village and mound complex attributed to Mississippian Indians (950-550? B.P.). The florescense at the site is attributed to the Mississippian period, and occurred around 950 B.P.

The earthen mounds at Cahokia probably number over 100, but only 87 have been recorded (Fig. 2-2). The mounds extend over an area greater than 13 square kilometers running from Canteen Creek on the east to Highway 111, and from just to the north of Cahokia Creek to the south of the modern railroad tracks (Fowler, 1979:3). The mounds were constructed with basket loads of sediment and exhibit three types: flat-topped platform mounds, conical mounds, and ridgetop mounds. The platform mounds are the most common and were probably the sites of ceremonial activities and residences of elite. Some of the conical and ridgetop mounds were burial mounds; but they may have served other functions as well.

Monks Mound, named for a group of Trappist monks who gardened on the first terrace of the mound, is the largest earthen mound in North America (Fig. 2-3; Fowler, 1979). Its basal dimensions are approximately 320 m by 290 m. It rises to over 30 m above the floodplain and once supported a large structure. The mound exhibits four terraces. A radiocarbon date obtained from village debris beneath Monks mound of 1190 $\pm$ 70 B.P. (ISGS 1252) suggests that construction was initiated some time after A.D. 840 (McGimsey and Wiant, 1984). Studies of a recent mound slope failure indicate that slumping occurred prehistorically as well (McGimsey and Wiant, 1984). Lobes on the sides of the mound have been interpreted to represent slumps and/or ramps.

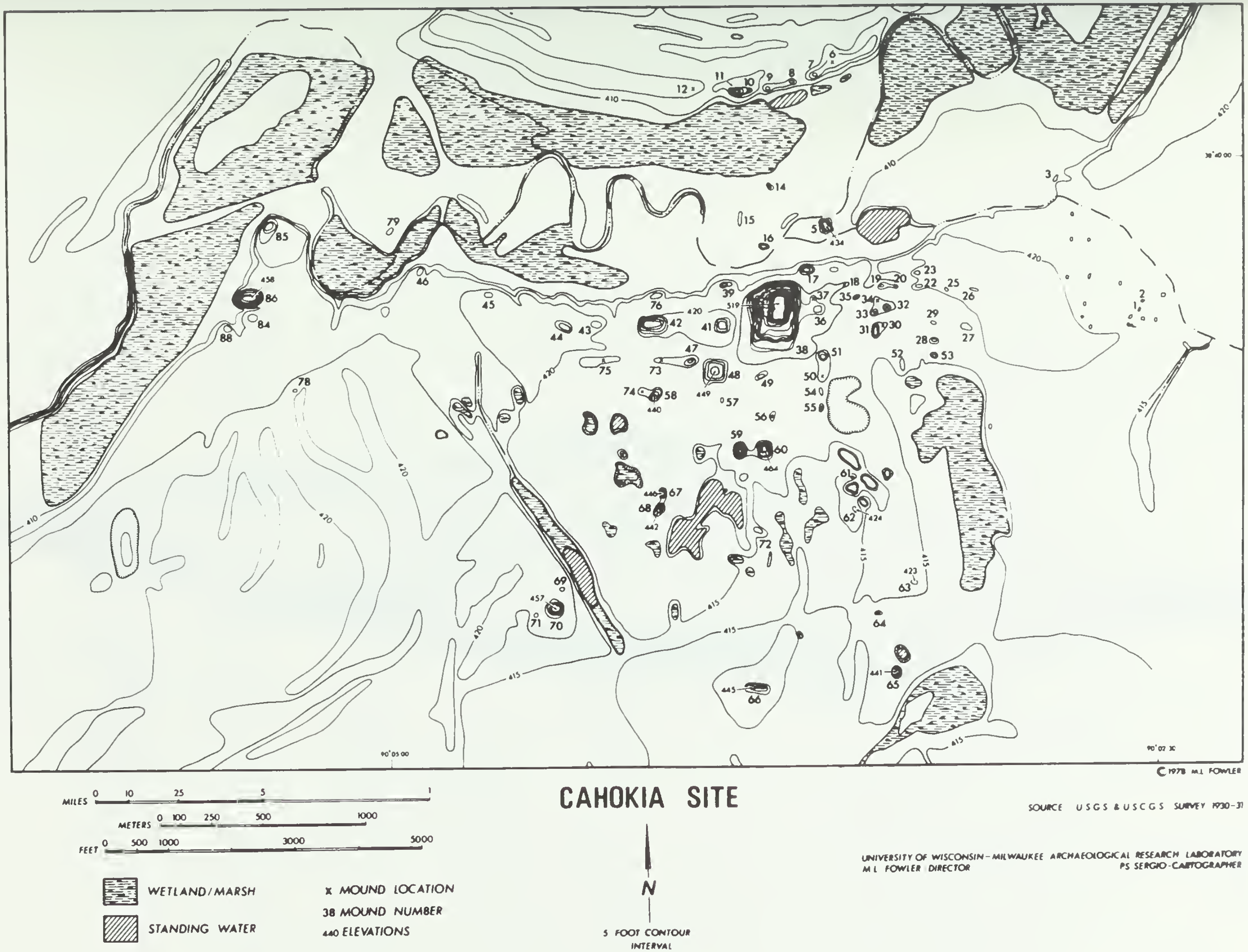

Figure 2-2. Distribution of mounds at the Cahokia site (Fowler, 1979:94).

Figure 2-3. Three dimensional plot of Monks Mound, Cahokia Site. Illinois State Museum, Geographical Information System. (Monks Mound 1984, from the southeast).

The Mississippian village areas cover over 15 square kilometers, and are dominated by rectangular houses arranged around open plazas. A portion of the complex was surrounded by a wooden stockade, part of which has been reconstructed to the east of Monks Mound. An estimated 25,000 individuals may have lived in the Cahokia area during its zenith (Gregg, 1975), but estimates vary from 10,000 to 40,000. The settlement system included a network of smaller towns with mounds, villages with mounds, farmsteads, and camps (e.g. Fowler, 1974; Milner and others, 1984). The Mississippian economy of the American Bottom was focused on cultivation of maize, squash, starchy seeds from maygrass, knotweed, and goosefoot (see Johannessen, 1984), and on fishing and hunting of deer and waterfowl (Parmalee, 1975; Kelly and Cross, 1984). By 650 B.P. population levels at Cahokia began to decline perhaps due to over-exploitation of the environment and/or to socio-political factors. By the mid-fourteenth century, Cahokia's influence on other sites in the American Bottom began to wane (Milner and others, 1984:186) and by 450 B.P. the site had been totally abandoned.

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WISCONSINAN LOESSES AT THE PLEASANT GROVE SCHOOL SECTION

E. D. McKay

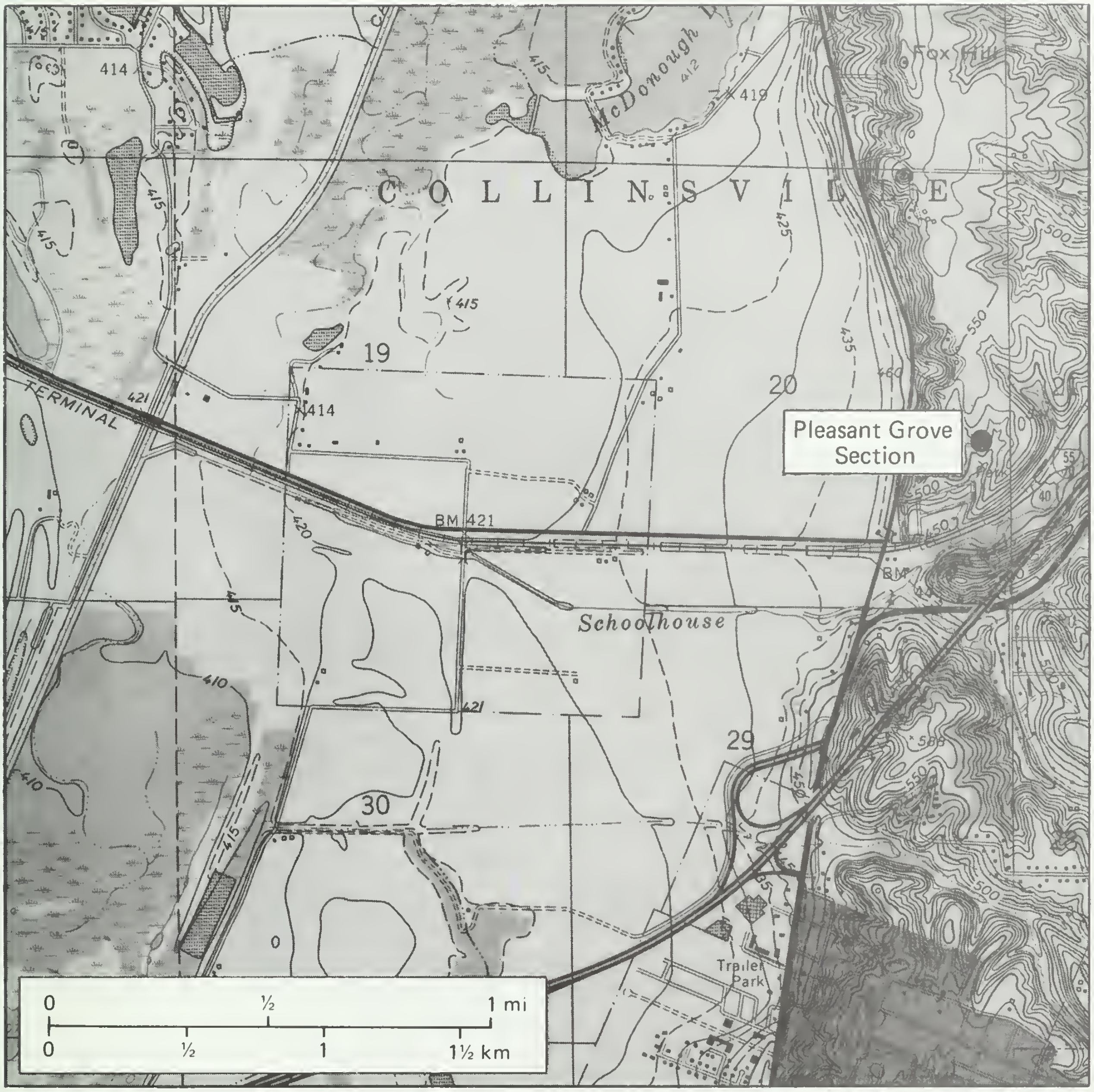


Figure 3-1
STOP 3
Pleasant Grove School Section
SE Sec. 20, T3N, R8W, Madison County, IL
Monks Mound 7.5 Minute Quadrangle

The Pleasant Grove School Section is an active borrow pit exposure in the bluff of the Mississippi Valley (Fig. 3-1). The section is the type section for the Roxana Silt, Meadow Loess Member, McDonough Loess Member, and the Pleasant Grove Soil (Frye and Willman, 1960; Willman and Frye, 1970; Frye and others, 1974), and it exposes a thick section of Peoria Loess at the top (Figs. 3-2 and 3-3). The following discussion is taken from a report by McKay (1979a).

The purposes of revisiting the much described Pleasant Grove School Section are to examine an exposure typical of thick Wisconsinan loess in the bluffs along the Mississippi Valley, to show the Farmdale Soil in the upper part of the Roxana, to examine the four color zones of the Roxana, to examine the clay bed in the Peoria, and to examine the soil- and rock-stratigraphic relations in the lower part of the Roxana. The condition of the site at the time of the field trip will determine which of these goals we will be able to accomplish.

Auger borings to depths of about 4.5 m in the floor of the borrow pit near the base of the vertical face penetrate the Fort Russell till, called the Kellerville Till Member by Willman and Frye (1970). Their data for the till correlate well with the unit now called Fort Russell and are very different from the silty, high expandable clay mineral Kellerville Till Member of Lineback (1979). Their oxidized sample of the unit, sample P-1A, has a grain-size composition of 36% sand, 40% silt, and 24% >4)m clay, a clay mineral composition of 22% expandable clay minerals, 58% illite, and 20% kaolinite plus chlorite, and a carbonate composition of 6% calcite and 19% dolomite, values very close to the average composition of the Fort Russell till at Maryville and elsewhere.

The Teneriffe Silt overlies the Fort Russell till. In its lower part the Teneriffe is bedded, has a moderately high illite content, and appears to be an outwash or lacustrine sediment. In its upper part, however, the Teneriffe is loessial, contains over 70% expandable clay minerals, and is uniform and unbedded.

The base of the Roxana Silt rests conformably on the Sangamon Soil in the Teneriffe Silt. Color zone r-1, the lower tan or gray zone, is 1.0 to 1.5 m thick and contains by definition (Frye and others, 1974) the record of deposition of the first Wisconsinan sediments on the Sangamonian landscape of Illinois. The zone is thin and pedologically complex, and its interpretation is critical to the reconstruction of early Wisconsinan events. Within the zone, Willman and Frye (1970) and Frye and others (1974) have recognized two depositional units, the Markham Silt and McDonough Loess Members, and two soils, the Chapin and Pleasant Grove Soils.

This lower zone of the Roxana Silt at the Pleasant Grove Section is leached of carbonates, shows weakly expressed soil

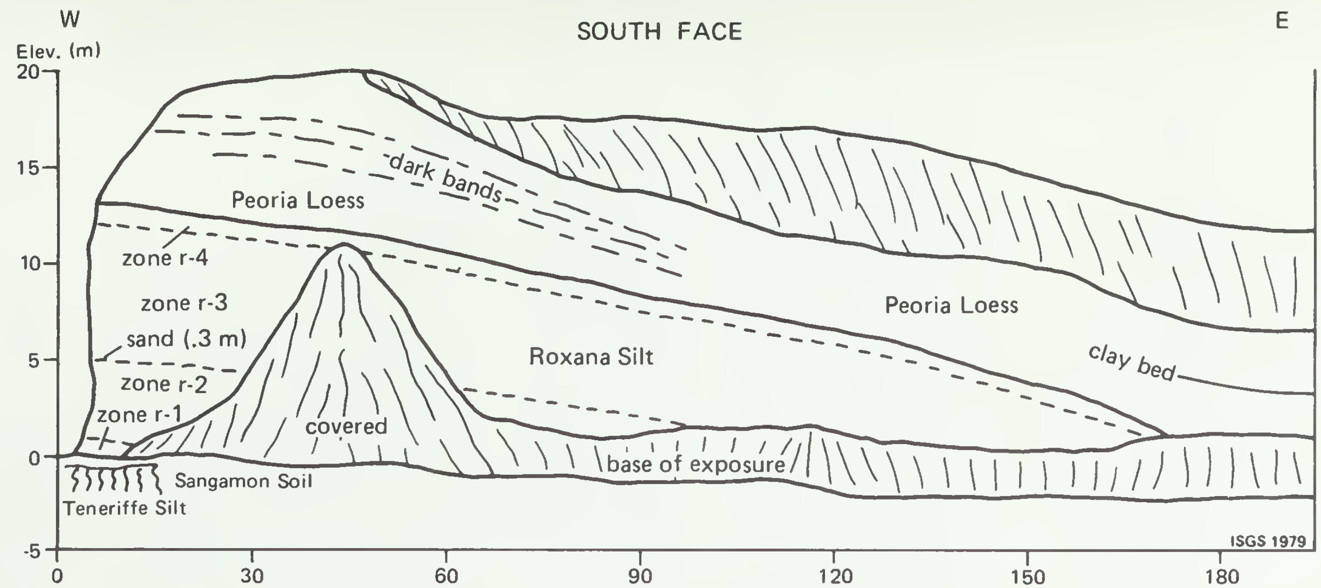
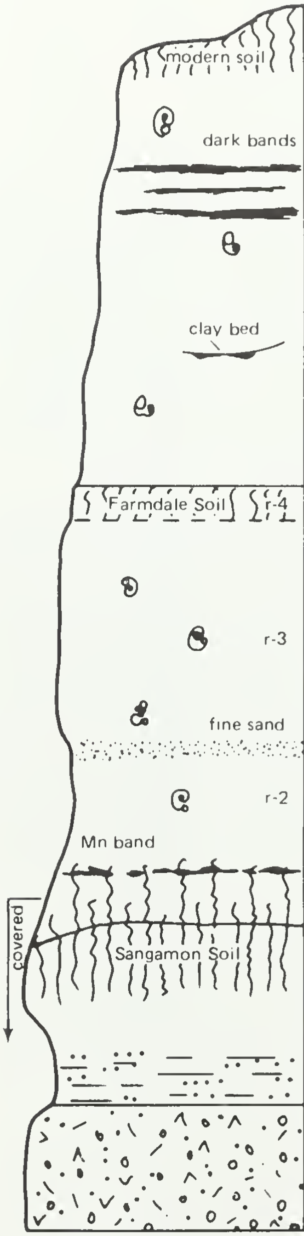


Figure 3-2. Sketch of the south face of the Pleasant Grove School Section as it appeared in June 1979.



Unit	Description	(m)
Peoria Loess	Loess, coarse yellowish brown (10YR 5/4) massive dolomitic silt; uniform and unmottled; thin Modern Soil truncated by burrow operations and slope erosion; numerous dark bands in upper one third best observed in south face; abundant gastropods; 2 to 10 cm thick waterlaid clay bed occurs within deoxidized loess in east end of the south face.	10.5
Roxana Silt	Loess, color zone r-4, uniform brown (9YR 5/4) massive weakly dolomitic coarse silt; Farmdale Soil; common burrow fillings; few charcoal flakes, gradational boundaries.	0.8
	Loess, color zone r-3, brown to yellowish brown (10YR 5/3 to 5/5), dolomitic, massive coarse silt; unmottled in upper part; lower part contains weakly expressed dark bands with common fine Fe-Mn concentrations and light mottles.	5.0
	Sand, fine, yellowish brown (10YR 5/4) dolomitic, bioturbated with underlying pinkish silt masses within unit; common small Fe-Mn concentrations.	0.3
	Loess, color zone r-2, brown (7.5YR 5/4) massive weakly dolomitic coarse silt; common coarse faint pinkish gray (7.5YR 6/2) mottles and fine Fe-Mn concentrations in upper part; gradational boundaries.	2.7
	Loess, color zone r-1, brown (10YR 5/3) massive to weak blocky leached coarse silt loam with discontinuous very dark grayish brown (10YR 3/2) Mn band in upper 5 cm; small secondary carbonates.	1.5
Teneriffe Silt	Silt; Sangamon Soil in upper part; B1 horizon, weak blocky yellowish brown (10YR 5/5) heavy silt loam, 30 cm thick; B2 horizon, blocky yellowish brown (10YR 5/5) silty clay loam, 45 cm thick; B3, weak blocky brownish yellow (10YR 6/6) heavy silt loam, 30 cm; C1 horizon, leached massive yellowish brown (10YR 5/6) silt loam, 75 cm; C2 horizon, calcareous light brownish gray (2.5Y 6/2) to light yellowish brown (2.5Y 6/4) massive silt, 120 cm.	3.0
	Silt, calcareous thinly bedded light olive brown (2.5Y 5/4), some fine sand.	1.5
Fort Russell till*	Till, calcareous massive light olive brown (2.5Y 5/4) loam texture.	

ISGS 1979

*Informal name

Figure 3-3. Generalized description of stratigraphic units exposed in the Pleasant Grove School Section.

structure, and contains more clay than the overlying reddish brown loess of zone r-2. At Pleasant Grove School and at many other sites in southwestern Illinois it is texturally and mineralogically gradational upward from the top of the highly weathered Sangamon Soil to the unweathered dolomitic loess of zone r-2 (McKay, 1977, 1979a). The upward change in composition is accompanied by a gradational decrease in the expression of soil characteristics. This uniform upward change toward less weathered loess can be interpreted as resulting from an upward increase in (1) the degree of mixing of the loess with underlying soil material and (2) the ability of weathering to keep pace with sedimentation. This sequence probably represents the accelerating accumulation of the initial increments of Roxana Silt on the surface of the Sangamon Soil and suggests that the loess events that produced these materials were not interrupted by any substantial cessations or soil-forming intervals.

These interpretations have some important consequences for stratigraphic nomenclature and interpretation of the geologic history of the early part of the Wisconsinan Stage in Illinois. First, the difficulty of recognition of either the two depositional units or the two soil profiles in the lower zone of the Roxana makes the Markham Silt and McDonough Loess Members and the Chapin and Pleasant Grove Soils marginally useful stratigraphic units in this area. Second, the interpretation of the early Wisconsinan sedimentation and weathering events in southwestern Illinois are somewhat simplified. The long intervals of time, up to 35,000 years, previously estimated for the accumulation and weathering of the Markham and McDonough Members (Frye and others, 1974) are shortened in the present interpretation, and previous estimates of 75,000 B.P. for the age of the base of the Roxana are probably excessive. An age of 45,000 to 50,000 B.P. is more in line with available evidence.

The color difference between the reddish brown zone r-2 and yellowish brown zone r-3 probably represents a change in the color of the Altonian outwash reflecting reddish sediments in the upper part of the Mississippi Valley. The boundary between r-2 and r-3 coincides with a carbonate mineral (Fig. 3-4) and grain-size discontinuity. Zone r-3 is higher in dolomite and finer grained. It has a lower proportion of coarse silt to medium to fine silt than does zone r-2. Shell material from zone r-2 in the Pleasant Grove School Section has been dated at 35,200 ± 1,000 B.P. (W-729) (Frye and Willman, 1960). Other dates suggest that the boundary between zones r-2 and r-3 is about 40,000 B.P. (McKay, 1977; 1979a; 1979b).

The Farmdale Soil at Pleasant Grove School consists of little more than a slight reddening, partial leaching, minor charcoal accumulation, and burrow disturbance of the upper 1.0 m of the Roxana Silt. It is similar to that found in core G39, 2.75 km to the northeast of Pleasant Grove (Fig. 3-4). The minimal development apparent in the Farmdale Soil in near-valley

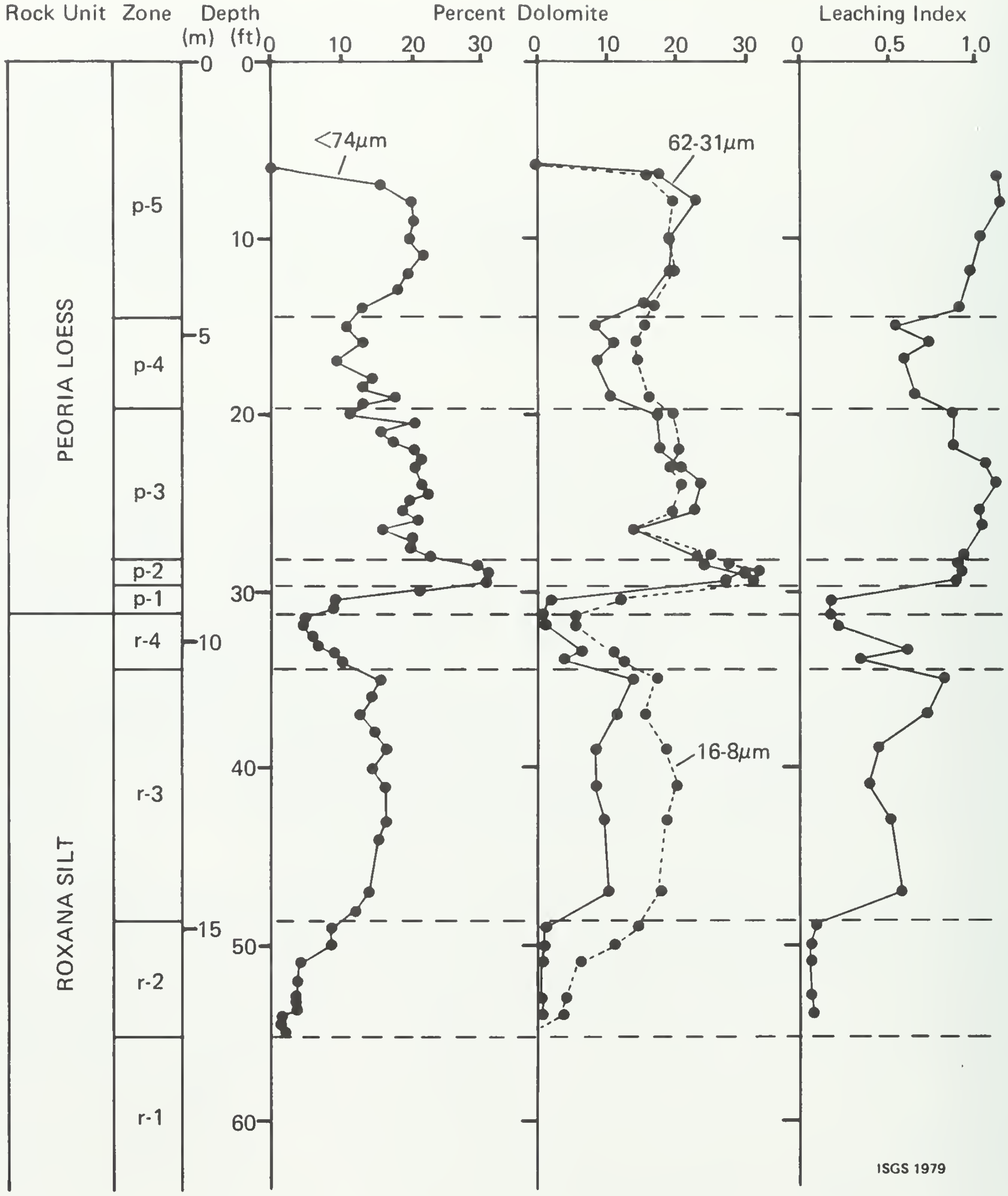


Figure 3-4. Carbonate mineral data for the <74 um, 62-31 u, and 18-8 um fractions of loesses in core G39, 2.75 km northeast of the Pleasant Grove School Section.

areas suggests that the pause in loess accumulation during the Farmdalian was brief.

The Peoria Loess exposed at Pleasant Grove School is over 10 m thick. It is a uniform, coarse, dolomitic, yellowish brown silt and contains several dark bands that can be seen in the west end of the south face. The Peoria contains a complex dolomite zonation like that encountered in core G39 (Fig. 3-4). These zones record major compositional changes in Woodfordian valley train sediments. Numerous dates indicate that Peoria Loess accumulation along the Mississippi Valley in southwestern Illinois began about 25,000 B.P. The first increments were mixed with the underlying Roxana. The resulting transition zone is included in zone p-1. As the Roxana was buried below the effective depth of mixing, a very high dolomite, zone p-2, was deposited. Zone p-2 probably represents high dolomite outwash derived from the Lake Michigan Lobe as it overrode the Silurian dolomites of northeastern Illinois and southeastern Wisconsin. Zone p-2 gave way to a lower dolomite zone p-3 about 23,400 B.P. as the Lake Michigan Lobe advanced onto the lower carbonate content Pennsylvanian bedrock in central Illinois and low dolomite outwash entered the Mississippi Valley from northwest of Illinois.

Zone p-3 accumulated along the Mississippi Valley in southwestern Illinois until about 20,000 B.P. when the Ancient Mississippi was blocked in north-central Illinois by ice from the Lake Michigan Lobe and the Mississippi was diverted to its modern course. Immediately after the blockage, the Mississippi Valley in southwestern Illinois yielded a low dolomite, high expandable clay mineral loess, zone p-4, that gave way to high dolomite loess, zone p-5, about 18,000 B.P. as the Lake Michigan Lobe outwash was channeled into the Illinois Valley.

The contact of zones p-3 and p-4 where it occurs at an elevation of about 151 m (495 ft) is marked by a clay bed and occasionally some bedded fine sand. The clay bed contains as much as 52% <2 μm clay. These deposits are waterlaid and probably represent a very high water level that occurred about the time that the Ancient Mississippi River was blocked by the Lake Michigan Lobe and diverted to its modern course. They occur nearly 11 m above the next highest Woodfordian outwash and lacustrine deposits in the area. The clay bed has been exposed at the east end of the south face at Pleasant Grove.

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ILLINOIAN AND OLDER LOESSES AND TILLS AT THE MARYVILLE SECTION

E. D. McKay

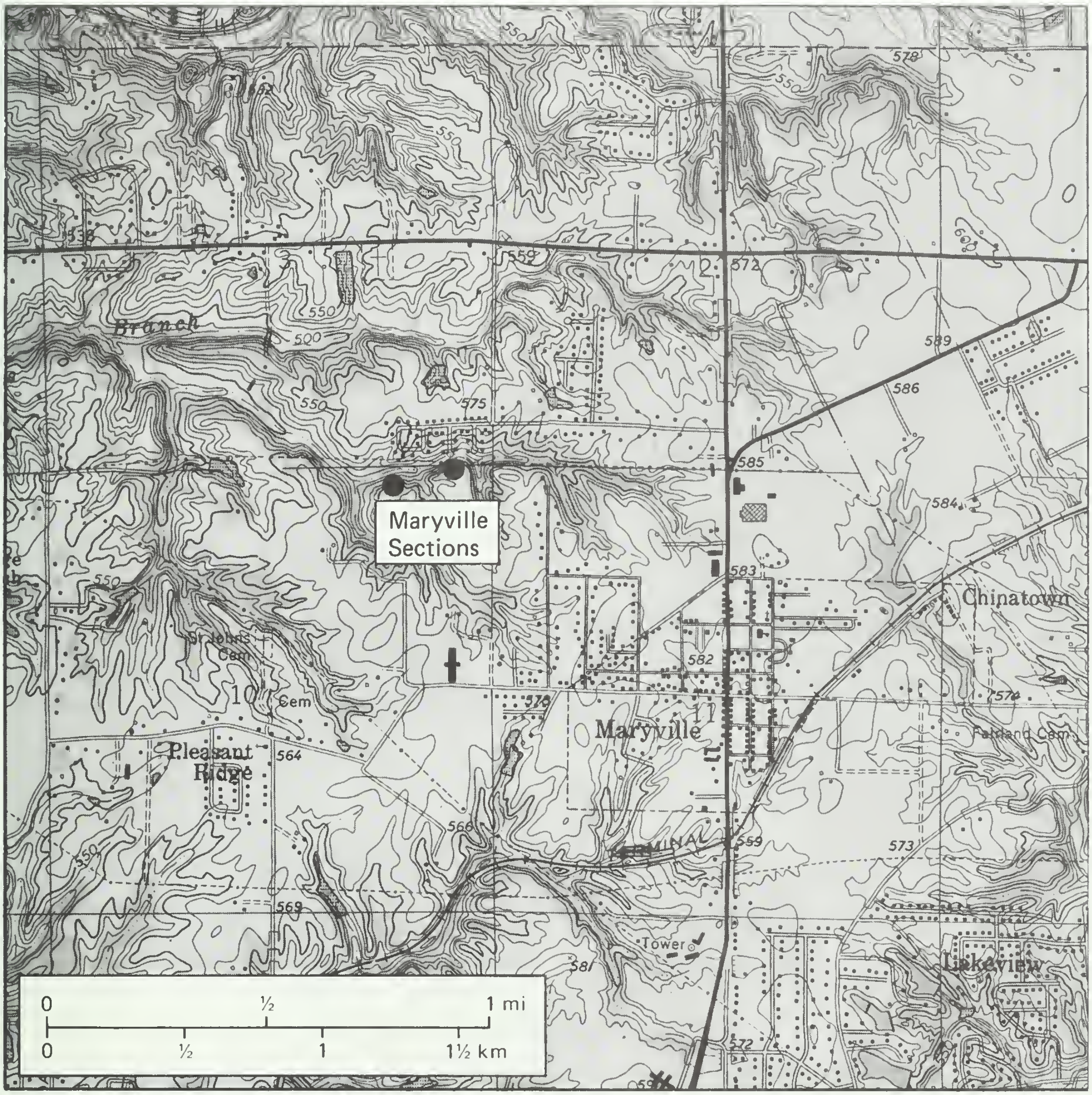


Figure 4-1
STOP 4
Maryville Section
SE SE SE Sec. 3, T3N, R9W, Madison County, IL
Collinsville 7.5 minute Quadrangle

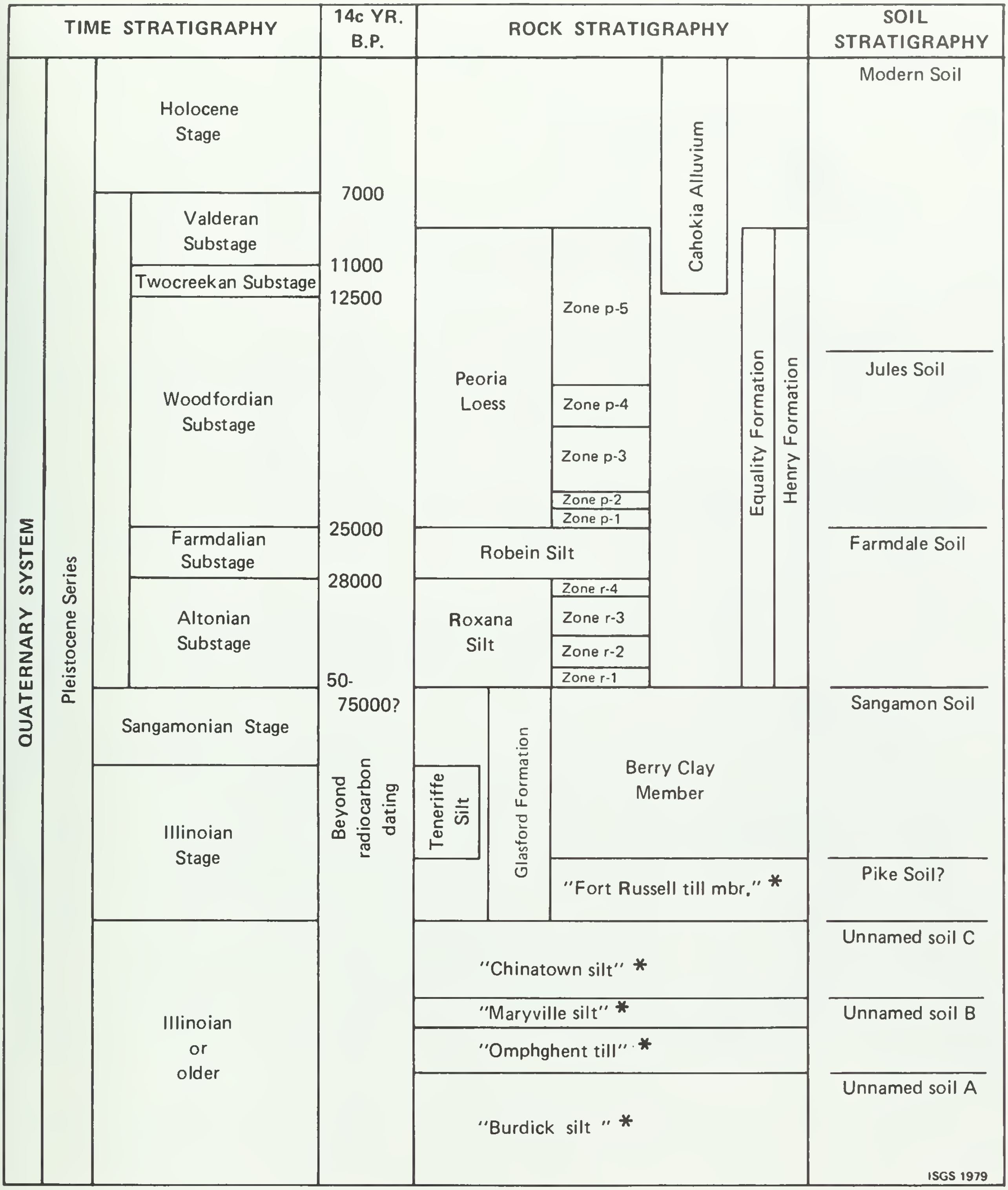
The Maryville section is a stream-cut exposure 3 km east of the Mississippi bluffs along the south bank of a small tributary to the Burdick Branch (Fig. 4-1). The following discussion is largely taken from a report by McKay (1979), but is supplemented by recent observations.

The stratigraphic record (Figs. 4-2 and 4-3) from the Maryville area is the most complete Quaternary sequence known in southwestern Illinois. The outcrop section exposes only a portion of the column, the lower part of the Roxana Silt, the Berry Clay Member, the Fort Russell till, and the Chinatown silt, and has been supplemented by several deep cores and auger borings in the vicinity. Two cores, MV6 located approximately 550 m northeast of the section in the SE NW SW Sec. 2, T3N, R8W and core MV8 located approximately 180 m northeast of the section in the SE SE SE Sec. 3, T3N, R8W, penetrated 26.5 and 24.7 m of Quaternary deposits over Pennsylvanian siltstone and sandstone of the Modesto Formation. Both cores penetrated each of the units shown in Figures 4-3 and 4-4.

The purposes of this stop are to introduce three Illinoian or pre-Illinoian loesses, the Chinatown silt, the Maryville silt, and the Burdick silt to show the occurrence of the Chinatown silt beneath the Fort Russell till, and to discuss the problems of stratigraphic classification posed by the multiple loesses, tills and buried soils found in the Maryville area.

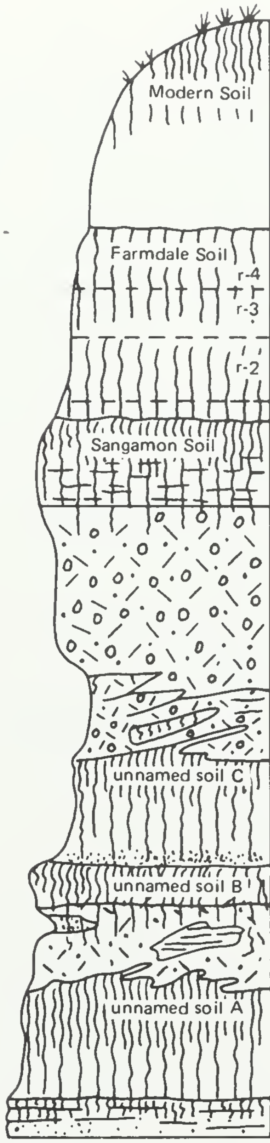
The Burdick silt is the oldest and lowermost Quaternary deposit in the Maryville area. It is described from occurrences in cores MV6 and MV8, where it ranges in thickness from 2.5 to 5.4 m. The Burdick is a leached, unbedded silt loam to silty clay loam. Grain-size analyses (Fig. 4-4) show uniformly high silt and low sand contents through the deposit. A ratio of coarse silt (62-31 μm) to medium silt (31-16 μm) averages about 0.9, a value that is typical of Wisconsinan loesses 2 to 5 km from the valley in this area. Clay mineral analyses (Fig. 4-3) indicate that the Burdick, like the Peoria Loess and Roxana Silt, contains a high proportion of expandable clay minerals, and relatively low amounts of illite and kaolinite plus chlorite in the <2 μm fraction. In addition, the clay mineral composition of the loess differs markedly from that of the underlying kaolinitic bedrock or the overlying illitic Omphghent till, indicating that the Burdick could not have been derived locally from these units. The Burdick is interpreted to be a loess.

There is a well developed soil profile, unnamed soil A, developed in Burdick silt. In core MV6 the B2t horizon of this soil is 1.6 m thick and contains as much as 38% <2 μm clay. The soil is as strongly developed as both the Modern and Sangamon Soils and was probably formed during at least one period of interglacial warmth that followed the glaciation that produced the loess deposit. The ages of the Burdick silt and the subsequent soil-forming interval are not known, but available data indicate that the Burdick silt may record one of the oldest



* Informal names

Figure 4-2. Time-stratigraphic, rock-stratigraphic, and soil-stratigraphic units in southwestern Illinois.



Unit	Member	Description	Thickness
Peoria Loess		Loess, dolomitic light brownish gray (10YR 6/2) to light yellowish brown (10YR 5/4) coarse silt; Modern Soil in upper part leached to 2.5 m below ground surface; base gradational with underlying unit.	4.5 to 5.0
Roxana Silt		Loess, leached coarse silt to silt loam with four color zones: r-4, brown (7.5YR 5/3) 1.4 m thick, r-3, dark brown (10YR 4/3) 1.1 m thick, r-2, brown (7.5YR 5/4) 1.6 m thick, and r-1, yellowish brown (10YR 5/3) 0.4 m thick; lower 0.2 m of zone r-3 contains dolomite.	4.0 to 4.5
Glasford Formation	Barry Clay M.	Silt, leached silty clay loam; gleyed profile of Sangamon Soil.	0 to 4.5
	"Fort Russell till"* M	Till, calcareous massive loam texture oxidized to yellowish brown (10YR 5/4) and light yellowish brown (10YR 6/4); unoxidized dark gray (5Y 4/1) at base in core MV8; upper part of unit leached; lower part contains sheared silt from underlying unit.	5.0 to 7.0
"Chinatown silt"*		Silt, leached massive silty clay loam to silt loam; strong brown (7.5YR 5/5) in upper part grades to yellowish brown (10YR 5/5); profile of unnamed soil C truncated into B horizon; gradational increase in sand and clay in lower 0.5 m.	0.9 to 2.5
"Maryville silt"		Silt, leached massive silty clay loam (2.5Y 5/4), profile of unnamed soil B.	1.9 to 3.0
"Omphghent till"*		Till; leached in upper 2.1 m; unnamed soil profile B; lower part massive silty clay loam calcareous, oxidized to light olive brown (2.5Y 5/4) grading to gleyed olive (5Y 5/3) at base; many silt and sand, inclusions; large shale blocks.	3.6 to 4.5
"Burdick silt"*		Loess; leached; massive; strongly developed profile of unnamed soil A; yellowish brown (10YR 5/4) silt loam A horizon (.5 m), strong brown (7.5YR 5/5) silty clay loam B2 (2.0 m); unit thickest in core MV6 (5.0 m).	2.5 to 5.4
Pennsylvanian		Siltstone; non-calcareous, thinly bedded, micaceous; residual soil developed in upper part.	

*Informal names

ISGS 1979

Figure 4-3. Generalized description of stratigraphic units in the Maryville region.

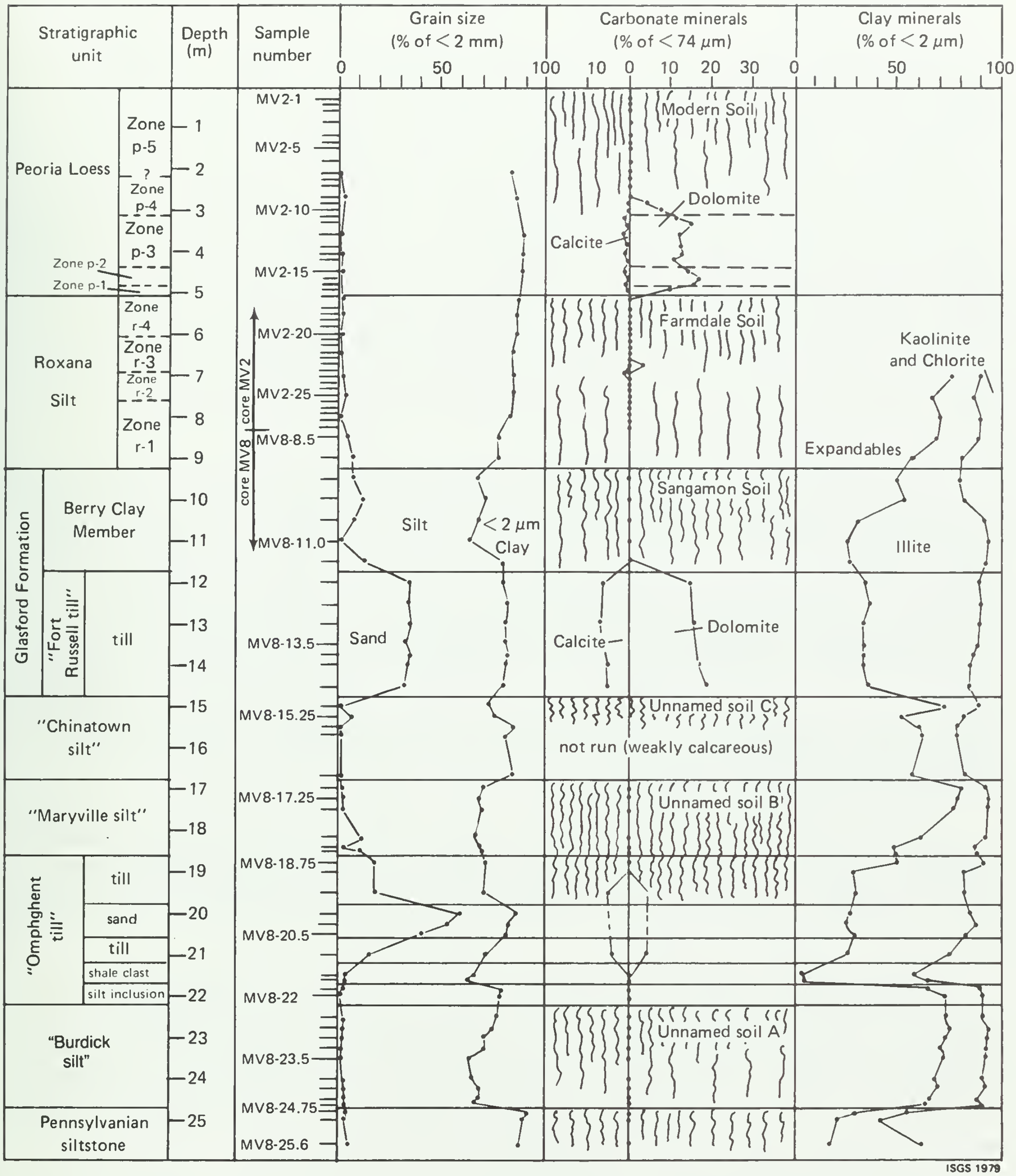


Figure 4-4. Grain size, clay mineral, and carbonate mineral data for Quaternary deposits in the Maryville area.

glacial events yet discovered that produced a loess deposit along the Mississippi Valley in southwestern Illinois.

The Omphghent till overlies the Burdick silt and ranges in thickness from 3.6 to 4.5 m in the Maryville cores. It has an average grain-size composition of 18% sand, 45% silt, and 37% <4 μm clay, and contains large shale and silt inclusions and beds of sand. It contains approximately equal amounts of calcite and dolomite and has an average unoxidized clay mineral composition of 25% expandable clay minerals, 49% illite, and 26% kaolinite plus chlorite. A hand auger boring at the base of the stream-cut exposure penetrated 3.0 m of Omphghent till from 0.5 m below the base of the exposure. The upper 2.0 m of the till are leached and contain the lower part of the profile of unnamed soil B. This includes a 0.9 m thick yellowish brown silty clay B2t horizon, a 0.75 m thick silty clay loam B3 horizon, and a 0.45 m thick leached C1g. The Omphghent till and unnamed soil B represent the second glacial-interglacial cycle recorded by the drift succession at Maryville.

The Maryville silt overlies the Omphghent till in several of the sections along tributaries of the Burdick Branch and has been found in cores in the vicinity. It is thickest in auger borings at the base of the Maryville West section, the westernmost exposure along the creek. There, it is nearly 3 m thick. It is about 2 m thick in core MV8 (Fig. 4-4). The Maryville has gradational boundaries with the overlying Chinatown silt and with the underlying Omphghent till. Indistinct gradational boundaries are characteristic of contacts in loess deposits, where pedogenic and biogenic processes mix new loess increments with pre-existing surficial sediments. The Maryville is somewhat coarser than the overlying Chinatown and Wisconsinan loesses. Its coarse to medium silt ratio averages 1.2.

The Maryville contains the upper part of the profile of unnamed soil B, which has a solum that is approximately 3.6 m thick. This soil is the Yarmouth Soil as used by most previous researchers. However, its correlation from the Maryville area to the type Yarmouth region in Iowa is unclear.

Evidence is not yet available to allow us to determine whether the Maryville silt is a loess deposited during the retreat of the Omphghent ice or a loess deposited during a later glacial period. However, soil profile characteristics in the subsurface suggest that the profile of soil B is polygenetic and that substantial weathering of the surface of the Omphghent till may have occurred prior to Maryville deposition.

The Chinatown silt overlies the Maryville silt and is overlain by the Fort Russell till in the Maryville Section. The thickness of the Chinatown in the Maryville area ranges from 0.9 m in core MV6, to 2.0 m in core MV8, and 2.5 in the stream-cut exposure. Like the Burdick and Maryville, the Chinatown silt has a clay mineral composition that is high in expandable clay minerals and contrasts strongly with the illitic clay mineral composition that is high in expandable clay minerals and contrasts strongly with the illitic clay mineral composition of the underlying and overlying tills. The upper part of the unit has a uniform silt and low sand content, but in the lower 0.5 m of the Chinatown, clay increases as the loessial silt grades into underlying B2 of unnamed soil B. The profile of unnamed soil C is developed through the entire thickness of the Chinatown silt in some stream-cut exposures. Elsewhere, the soil is completely absent and the Chinatown is dolomitic and unweathered. In the eastern exposures the soil is truncated into the strong brown silty clay loam B2 horizon, and zones of B-horizon material have been sheared and incorporated into the overlying till. Like the Burdick silt, and possibly the Maryville, the Chinatown silt and unnamed soil C probably represent a glacial interval followed by at least one interglacial. The Chinatown represents the third or fourth glacial recorded at Maryville.

The Fort Russell till in the Maryville area overlies the Chinatown silt and ranges in thickness from 5.0 to 7.0 m. Its grain size and mineral compositions are typical of the youngest Illinoian till in the region (Fig. 4-4). The Fort Russell represents the fourth or fifth glacial deposit represented in the Maryville drift succession and is overlain in the stream-cut by the Sangamonian Berry Clay Member of the Glasford Formation, an accretion gley that includes some loessial sediment. The gray leached accretionary silt and silty clay loam are within the Sangamon Soil. The Berry Clay is overlain by the Roxana Silt, but only the lower part of the Roxana is exposed.

Borings on drainage divides in Maryville indicate that the Peoria Loess and Roxana Silt have local average thicknesses of 4.8 and 4.5 m respectively. Four color zones are present in the Roxana, and dolomite zones p-1, p-2, p-3, and p-4 are distinguishable with carbonate mineral analyses of the Peoria. The Peoria Loess and Roxana Silt represent the fifth or sixth glacial cycle recorded in the Maryville drift succession. These Wisconsinan loesses were previously discussed (see Stop #3).

The number of glacials and interglacials not recognized or not recorded in the deposits and soils at Maryville is unknown. It is possible that some soils in the succession represent more than a single period of interglacial warmth. Similarly, deposits from some glacial events that affected the Mississippi River basin may be absent from the Maryville area.

Recently, some new dating techniques have been used to obtain better estimates of relative ages of deposits at Maryville and to confirm correlations between old loesses in southwestern Illinois and other parts of the Mississippi Valley. Canfield (1985) reported the results of thermoluminescence dates of samples collected by McKay and Canfield from Maryville, from the Powdermill Creek Section 21 km (13 mi) to the southwest, and from sections along the Missouri Valley in Nebraska and the

Mississippi Valley in Arkansas. These are summarized in Table 4-1 along with TL dates from Mississippi reported by Johnson and others (1984).

Although TL dates of Wisconsinan loesses have been found to generally correlate with available radiocarbon ages, older loesses tend to yield ages that are presumably too young (Canfield, 1985). The dates on the Chinatown silt (Table 4-1), which underlies an Illinoian till containing the profile of the Sangamon Soil, range from 77,000 to 82,800 TL years B.P. The Loveland Loess also sampled beneath the Sangamon Soil, ranges in TL age from 82,700 to 89,200 B.P. These are clearly underestimates of the age of pre-Sangamonian deposit. This observation led Canfield (1985) to conclude that the TL phenomenon must undergo a time-dependent loss, which leads to systematic underestimation of the true age of older samples. Using a lifetime of 100,000 years for this loss of TL, a value consistent with the findings of Debenham (1985a; 1985b), Canfield recalculated the ages (called the transformed TL age in Table 4-1). These transformed ages are more consistent with an Illinoian age for the Chinatown (150,060 to 176,030) and a correlation of the Chinatown with loesses called Loveland elsewhere (175,450 to 192,350).

Regeneration TL ages from loesses at Vicksburg, Mississippi have been interpreted as being from either "Early to Middle Wisconsinan" loess or from "Early Sangamon" loess (Johnson and others, 1984). However, the TL dates suggest that the two loess units, each of which contains a very well developed paleosol, may correlate to the Chinatown (Loveland) and the Maryville silts of the upper Mississippi and Missouri Valleys rather than some previously unknown deposits.

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Table 4-1. Thermoluminescence dates from pre-Sangamonian loesses along the Mississippi and Missouri Rivers.

Unit	TL Age*	Lab No.	Trans. TL Age**		Reference
Maryville, Illinois					
Teneriffe Silt***	64,000±6,400	Alpha 2068	130,930	+31,520 -23,930	1
Chinatown silt	82,800±11,300	Alpha 1227	176,030	+107,000 -50,500	1
Maryville silt	not sampled				
Burdick silt	not sampled				
Powdermill Creek, Illinois					
Chinatown silt	77,000 ±10,000	Alpha 2067	150,060	+59,500 -37,050	1
Maryville Silt	>140,000		----		1
Wittsburg Quarry, Arkansas					
Loveland Loess	85,300±7,200	Alpha 1226	192,350	+67,890 -40,070	1
Plattesmouth, Nebraska					
Loveland Loess	82,700±7,260	Alpha 1228	175,400	+54,410 -35,040	1
Treynor, Iowa					
Loveland Loess	89,200±9,230	Alpha 516	222,560	+192,850 -61,770	1,2
Vicksburg, Mississippi					
Early to Middle Wisconsinan loess	75 to 95,000	----	----	----	3
Early Sangamon loess	120 to 130,000	----	----	----	3

*Determined using the regeneration technique.
**Transformed TL age recalculated by Canfield, 1985.
***Called Berry Clay in this guidebook.

References:

1 Canfield, 1985
2 Norton and Bradford, 1985
3 Johnson and others, 1984

HOLOCENE ARCHAEOLOGY AND GEOLOGY OF THE MODOC ROCK SHELTER SITE

Bonnie W. Styles, Steven R. Ahler, and Edwin R. Hajic

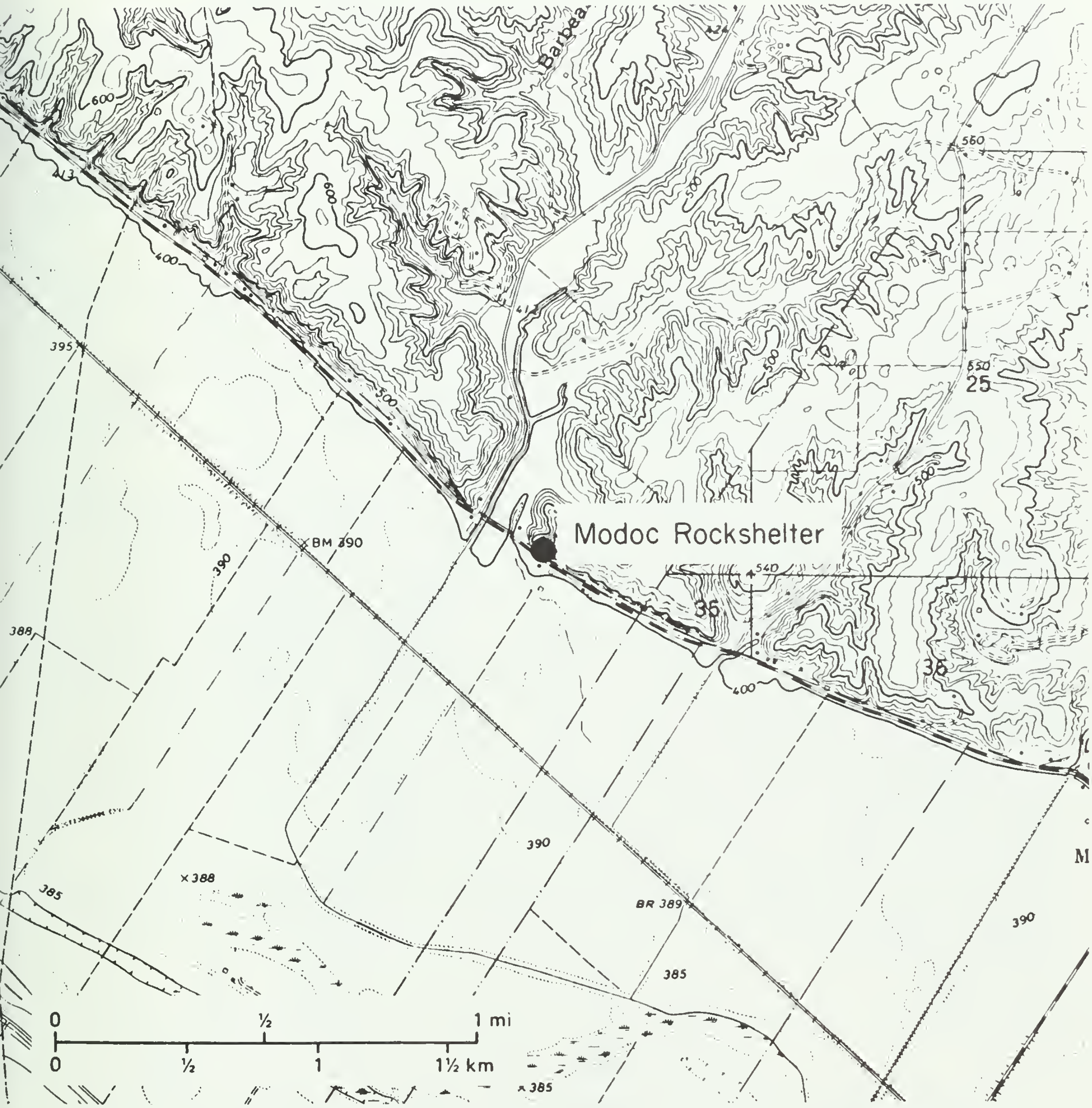

Figure 5-1.
STOP 5
Modoc Rock Shelter National Historic Landmark
SW of SE Sec. 26, T5S, R9W, Randolph County, IL
Prairie du Rocher 7.5 Minute Quadrangle

INTRODUCTION

Modoc Rock Shelter, situated in the Mississippi River Valley in Randolph County, Illinois (Fig. 5-1), is a deeply stratified archaeological site containing superbly preserved records of early and mid-Holocene archaeological and paleobiological remains. First excavated by the University of Chicago and the Illinois State Museum in the 1950s (Fowler and Winters, 1956; Fowler, 1959), early studies established the significance of the site by documenting 8.5 m of primarily undisturbed cultural deposits, most of which accumulated during the Archaic Period (10,000-3,000 B.P.) of midwestern prehistory. In 1966 Modoc Rock Shelter was listed on the National Register of Historic Places, and in 1978 it was declared a National Historic Landmark.

The Illinois State Museum and the University of Wisconsin, Milwaukee returned to the site in 1980 and 1984 to redefine the stratigraphy, refine chronological controls, and excavate a series of test squares using natural levels and small-scale recovery techniques (B. Styles and others, 1981; 1983). At this stop we will examine the profile of a 1984 excavation trench and discuss environmental and cultural trends.

The site lies at the base of the bluffs of the Mississippi Valley at the junction of Barbeau Creek, a rank order three tributary. The shelters at Modoc are formed in vertical rock cliffs consisting of about 30 m exposures of the Rosiclare Sandstone Member of the Aux Vases Sandstone Formation. The sandstone disconformably overlies the St. Genevieve Limestone; both are upper Mississippian (Willman and others, 1975). The bluffs in this area trend from northwest to southeast, and are capped with 12-15 m of Roxana Silt and Peoria Loess. Hill prairies are apparent on the steep, dry slopes above the site (see Addendum to Stop #8 for a description of hill prairies). The uplands are covered with Illinoian glacial drift that supported timber prior to European clearing. The Mississippi River currently flows within 5 km of the site, but numerous meander and channel scars in the floodplain suggest it once flowed closer. The floodplain historically sustained backwaters, wet prairies, marshes, and bottomland forest (See Styles and others, 1983).

GEOLOGICAL, ARCHAEOLOGICAL AND ECOLOGICAL RESEARCH

Stratigraphy and Chronology

The 1980'S excavations sampled remains from two discrete shelters in the western and central portions of the site that are separated by an area of rock fall (Fig. 5-2). Cultural materials recovered from these shelters in the 1950's were combined for analyses based on altitude, a factor that we now know contributed to the linking of materials of disparate ages. Based on the

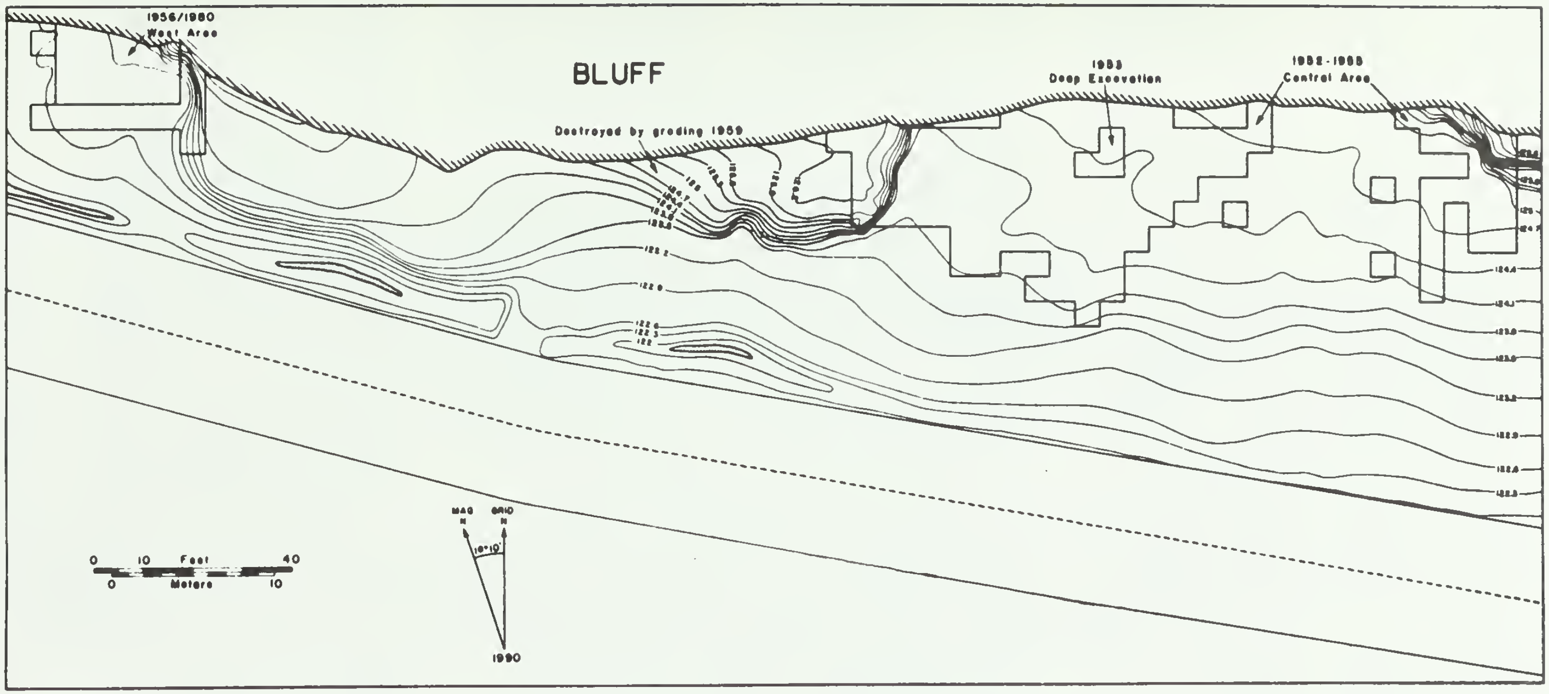

Figure 5-2. Contour map of Modoc Rock Shelter Site showing western and central (main) excavation areas.

1980's excavations, 19 strata were defined in the west shelter (Fig. 5-3) and 30 strata were defined in the central area (Fig. 5-4). Field strata designations for the two areas are not numerically equivalent; however, it is now possible to correlate the strata based on age. For the purposes of current studies, the 1950's radiocarbon dates have been ignored due to the problems of the solid carbon dating technique. Twelve radiocarbon assays from the west shelter (Fig. 5-5) and 17 assays (some have been averaged) from the central or main shelter (Fig. 5-6) provide the basis for the chronological control at Modoc.

The extent of buried cultural debris at Modoc was investigated by coring in 1980 (T. Styles, 1981) and 1984 (Hajic, in prep.). Buried cultural material along the bluff continues across the eastern limit of the state-owned property, and also extends westward into the Barbeau Creek Valley. It is likely that all rock shelters along this reach of the valley contain buried cultural materials.

Cultural material does not extend more than a few meters past the drip line to the south of the excavation areas. There is a marked disparity in the preservation of sedimentary structures and in pedogenesis beneath the overhangs and in exposed areas. Laminae are well preserved beneath the overhangs because the lack of soil moisture within the shelters inhibited pedologic and biologic activity. Immediately beyond the drip line, most evidence for fine stratification, especially in the upper parts of cores, is lost due to the increased activity of processes dependent on soil water. This difference in preservation is evident in the southernmost part of the main trench profile. Cores from the Barbeau Creek fan to the west of the shelter have evidence that several paleosols (T. Styles, 1981; Hajic, in prep.) developed in Holocene deposits outside the shelter where pedogenic processes were unimpeded by dryness. Evidence for paleosol development within the shelter has been noted for the west area (T. Styles, 1981), as well as for the central shelter (Hajic, in prep.), but A horizons are only weakly expressed.

The main shelter profiles (Fig. 5-4) show several major trends in both the depositional and cultural history of the site. Sedimentation trends in the Modoc Rock Shelter are in part a consequence of the varying significance and timing of depositional processes contributing sediment to the rock shelter: Barbeau Creek alluvial fan sedimentation, colluviation and wash of loess-derived sediments over the drip line, rock fall, grain attrition of sandstone, and eolian influx. A nearby notch in the sandstone overhead also provided a conduit for upland-derived sediments resulting in some deposition from a point source as well.

Where the base of the shelter was reached in the central (main) excavation, blocks of bedrock in a sandy loam to coarse silt matrix (Strata 31, 30A, 30, 28, and 25) indicate local roof

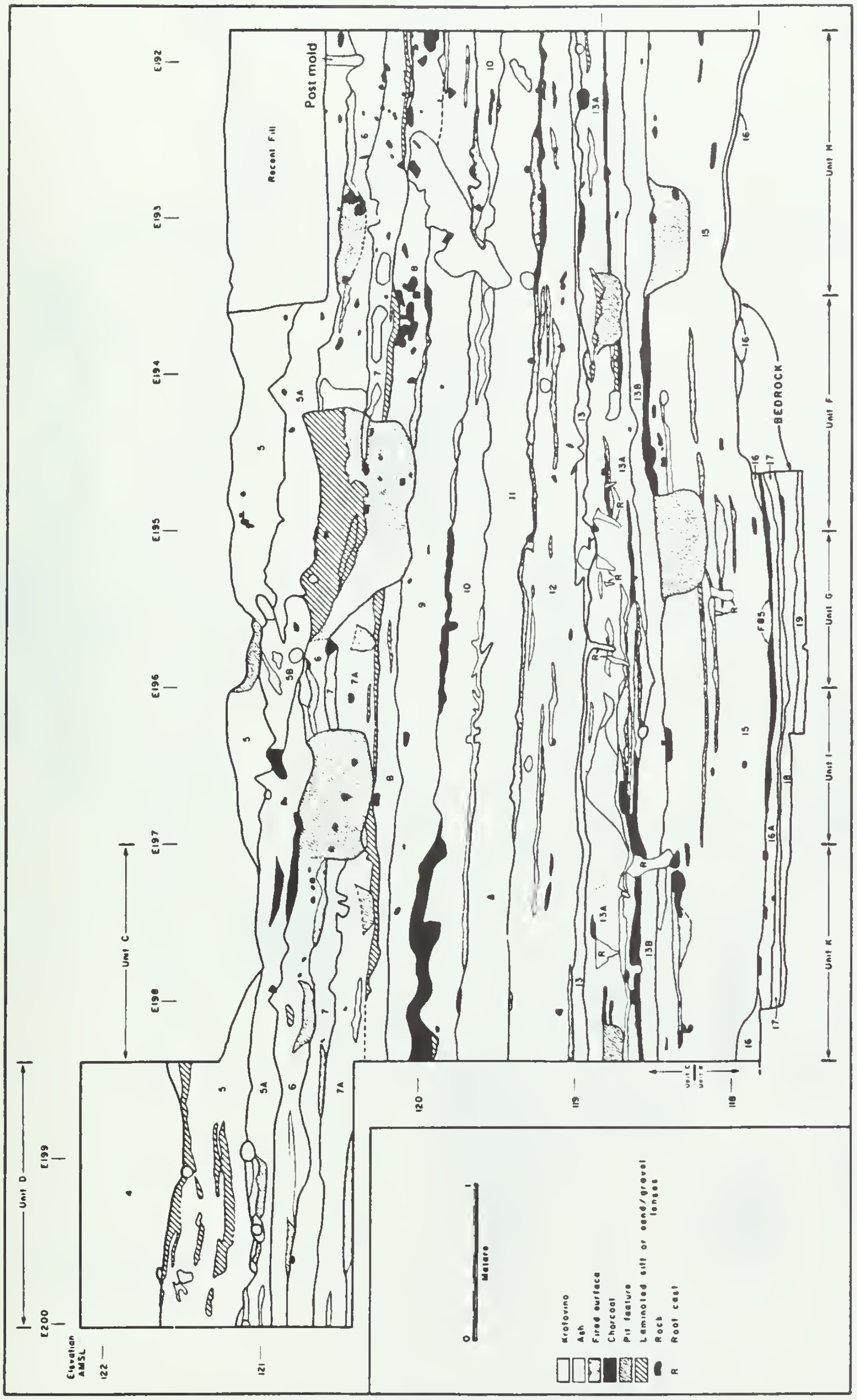

Figure 5-3. Profile of south wall of west shelter excavations (Styles and others, 1983:273).

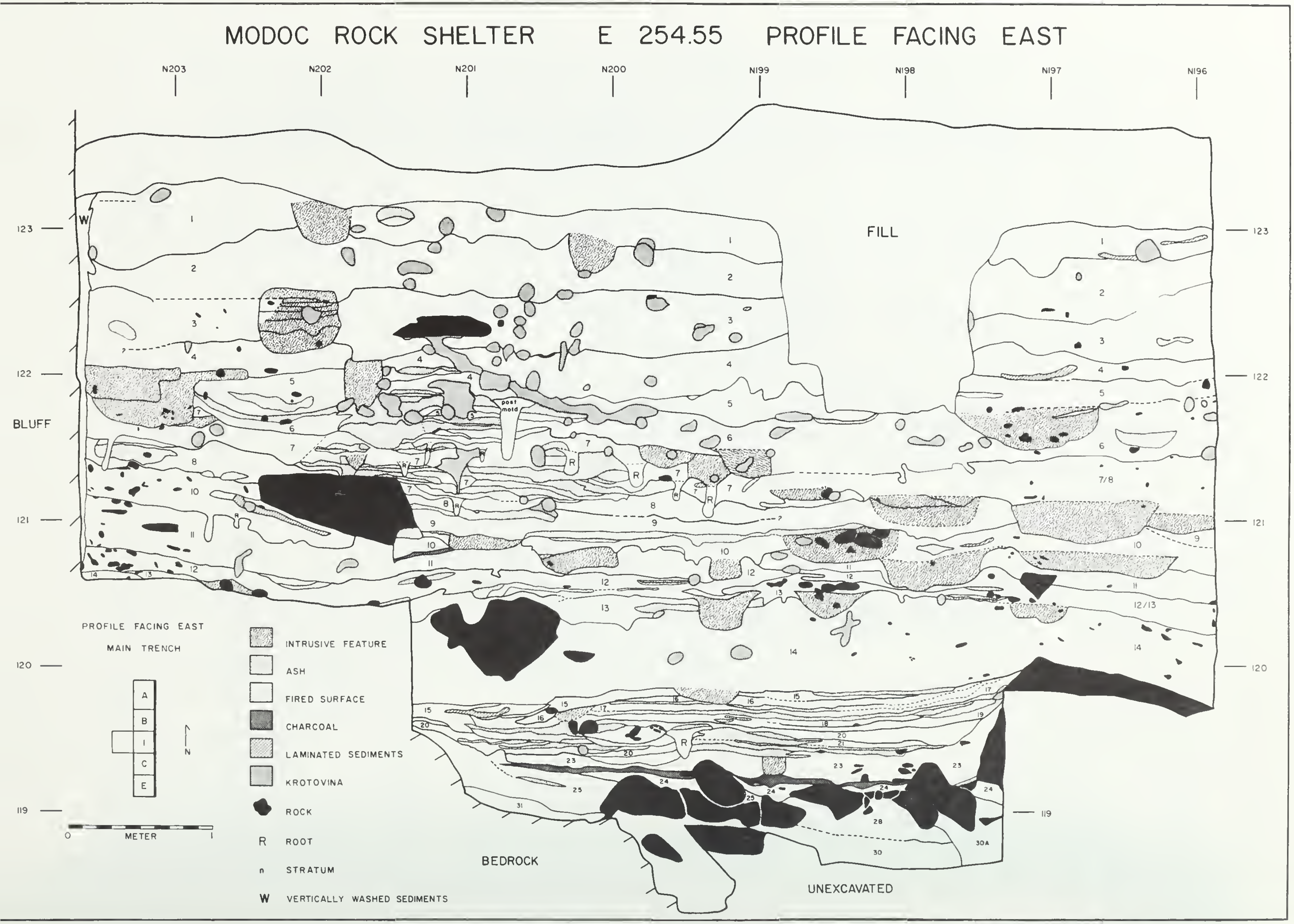

Figure 5-4. Profile of east wall of central (main) shelter main trench excavations

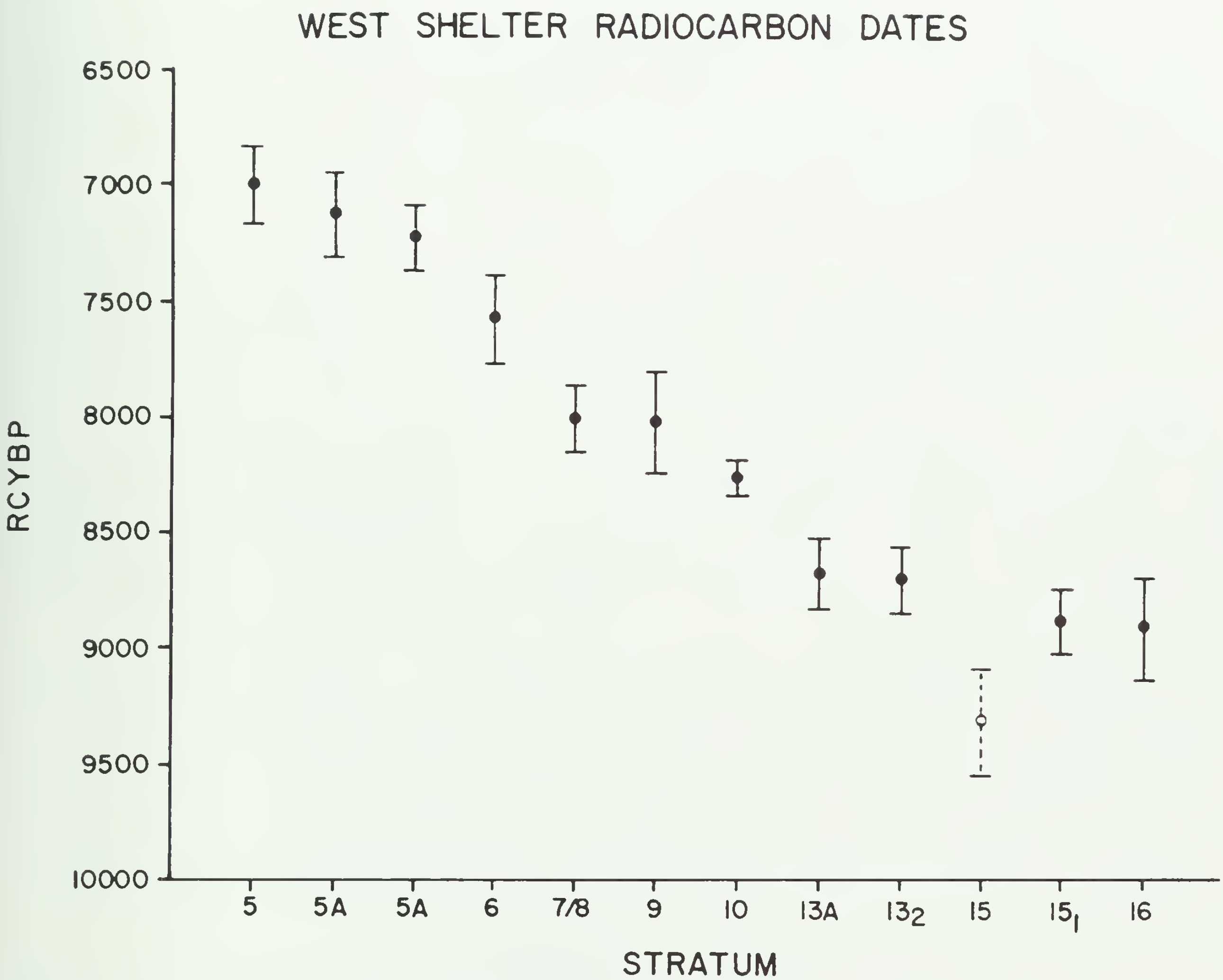

Figure 5-5. Radiocarbon dates for west shelter strata. One standard deviation is plotted (Ahler, 1986).

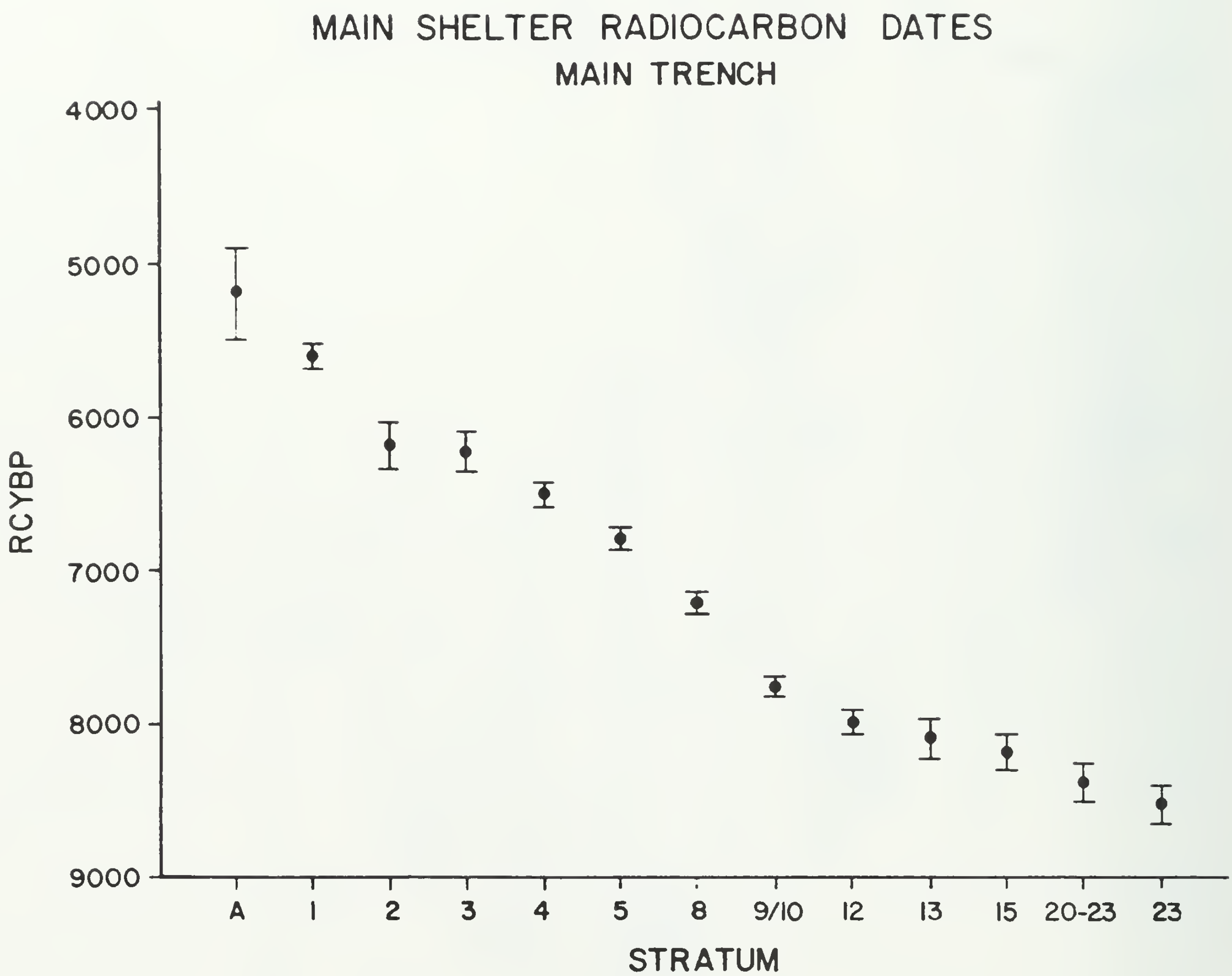

Figure 5-6. Radiocarbon dates for central (main) shelter strata. One standard deviation is plotted (Ahler, 1986).

fall with a mix of colluvial and possibly eolian sediment. Evidence of rock fall occurs throughout most of the section. Strata 24-10 primarily consist of horizontally laminated and thin bedded silt, possibly deposited as overbank alluvium on the Barbeau Creek fan between ca. 8500 and 7700 B.P. at the beginning of the mid-Holocene Hypsithermal climatic episode. Sedimentation was relatively rapid, particularly around 8200-8100 B.P. Increased porosity and organic matter content of Strata 10 may suggest development of a weakly expressed A horizon as sedimentation rates slowed. The remainder of strata exposed in the main trench were deposited between about 7700 and 6000 B.P. They consist of fairly distinct massive beds of colluvial/eolian and wash silt and silt loam with sandstone clasts. Some beds exhibit a slight slope away from the drip line towards the bedrock wall. From N200 to N202, stratigraphic relationships suggest an anthropogenic depositional source for some beds.

Younger sediments at the site, deposited between about 4000 and 2000 B.P., have been largely removed or destroyed. A sequence exposed about 26 m to the east of the main trench consisted of massive beds of colluvial silt loam. At Modoc and elsewhere along the valley, this sequence tends to occur as locally thick wedges at the back of the rock shelters. Historically, they have provided convenient sources for fill.

Holocene sedimentation at Modoc follows a pattern that is repeated in valley margin environments throughout the fieldtrip area. Rapid valley margin sedimentation rates began with the onset of the Hypsithermal, generally slowed in the latter part of the Hypsithermal, and was followed by comparatively little deposition in the post-Hypsithermal period.

No undisputed cultural material was recovered from the basal zone of coarser sediment and rock fall. Early Archaic debris representing short-term occupations is occasionally interbedded with laminated silt of Strata 26-12 (ca. 8500 through 8000 B.P.). With deposition of Stratum 10 near the beginning of the Middle Archaic Period, utilization of the site began to shift toward longer-term occupation. Feature density, feature diversity, and artifact diversity are all higher than in deposits bearing Early Archaic material.

At about 6800 B.P. (Stratum 5) there appears to be another major increase in the occupational intensity of the site. Assemblage diversity peaks and features show a tendency toward large deep facilties. This intensive use of the site continues for the duration of the Middle Archaic (to 5000 B.P.). In the Late Archaic there seems to be a shift back to periodic rather than continuous intensive use of the site area, but data are scarce for this period. The most intensive and long-term periods of site use correspond to the later portions of the Hypsithermal climatic interval.

Subsistence and Settlement Trends

Shifts in lithic artifacts, flora, and fauna for the west shelter parallel the trends recorded for the central shelter (B. Styles and others, 1981; 1983). Early Archaic occupations were relatively brief with sparse accumulations of plant remains (wood charcoal and variety of nuts) and fauna (primarily small mammals). Middle Archaic artifacts and debris, and the quantity of features, suggest occupations of greater duration, a wider range of activities, more intensive use of aquatic resources, and a greater reliance on hickory nuts. The latter two trends have been linked elsewhere with improvement of aquatic habitats during the mid-Holocene (B. Styles, 1986), and development of stone boiling (Talalay and others, 1984) and possibly early silviculture (Munson, 1986). The trend towards more long-term use of the locality is evident in the west shelter by 7600 B.P.

Although the timing of these subsistence trends varies in different regions, similarities particularly in the abundance of small mammals at sites of the early and/or mid-Holocene and the increased exploitation of aquatic resources during the mid-Holocene are noted at Rodgers Shelter in west central Missouri (Wood and McMillan, 1976; Kay, 1980), Graham Cave in central Missouri (Klippel, 1971; McMillan and Klippel, 1981), and Koster in the lower Illinois River Valley (Brown and Vierra, 1983; Neusius, 1982; see Stop #11). Increased use of hickory nuts at Middle Archaic sites has been noted at a number of sites in the lower Illinois River Valley, including the Koster site (Asch and Asch, 1976; 1980).

Intensive systematic surface survey of the Barbeau Creek drainage basin suggests a major change occurred in settlement strategies between the Early and Middle Archaic periods (Ahler, 1984). Early Archaic settlement is characterized by a widespread distribution of sites in upland and valley margin settings that has been interpreted to reflect high residential mobility. The Middle Archaic period shows occupation of a few large sites located at the bluff base and bluff crest in optimal locations for both floodplain and upland resource exploitation. Scattered small sites suggest special-purpose use of remote upland areas. This pattern suggests a shift towards more sedentary and complex settlement strategies using large permanent base camps in conjunction with small special-purpose camps. A similar pattern of settlement change has been proposed for the Koster locality in the lower Illinois River Valley (Carlson, 1979; Brown and Vierra, 1983).

The proposed change in settlement pattern in the Modoc locality, for the midwestern United States in general, has been at least indirectly linked to climatic, vegetation, and fluvial changes of the Hypsithermal Interval. During the Hypsithermal, differences in resource productivity between upland and floodplain environments became more pronounced (e.g. Brown, 1985). Deterioration of upland resources and mid-Holocene floodplain evolution (see Hajic, 1983; 1985) resulting in enhancement of aquatic resources (B. Styles, 1986) contributed to shifts in settlement pattern and subsistence.

Evidence for Climatic Change at Modoc

Direct evidence for Hypsithermal climatic and vegetational change in the Mississippi Valley is recorded by gastropods and vertebrate fauna from Modoc. Some species of snails showed clinal variation in body size reflecting a drier climatic regime fro strata deposited during the Hypsithermal (Theler and Baerreis, in press). Occurrences of mammels with southern and/or western affinities such as spotted skunk (Spilogale putorius) and common cotton rat (Sigmodon hispidus) also provide evidence for climatic differences during Middle Archaic times (Purdue and Styles, 1987). Certainly the faunal changes are not as dramatic as noted for sites west of the Mississippi River (Purdue and Styles, 1986); however they do document a climatic impact on a midwestern riverine site. Other factors related to Hypisthermal climate, such as opening of the forest, erosion of uplands and hillslopes, and floodplain evolution, had a greater influence on subsistence and settlement patterns than the minor range shifts recorded for mammalian taxa.

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STRATIGRAPHY AND TAPHONOMY OF FAUNAL SEQUENCES AT BARNHART, MISSOURI

Russell W. Graham

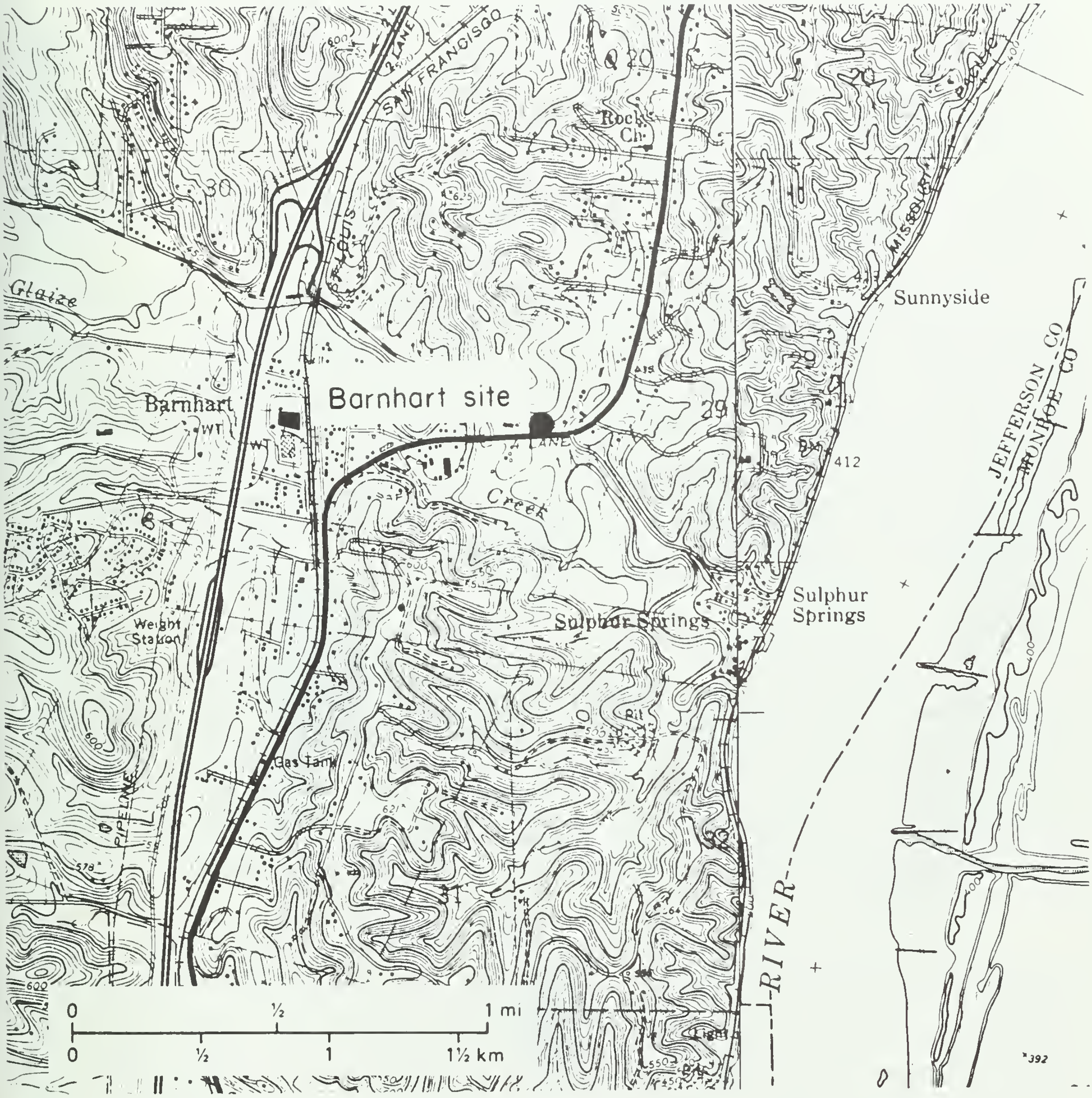

Figure 6-1
STOP 6
Barnhart Site
T42N, R6E, Jefferson County, MO
Herculaneum 7.5 minute Quadrangle

INTRODUCTION

The Barnhart site is located about 3.2 km (2 mi) southeast of the Kimmswick site (Stop #7), Jefferson County, Missouri and 0.4 km (0.25 mi) east of the Mississippi River (Fig. 6-1). The physical settings at the Barnhart and Kimmswick sites are similar. Both sites are located along small tributaries to the Mississippi River. Barnhart occurs on Glaize Creek; whereas, Kimmswick is situated at the confluence of Rock and Black creeks. Both sites are near mineral springs; and they both are formed by terraces which lie against south facing limestone bluffs. Because both sites contain stratified faunal sequences, it appears that the combination of these physical factors served effectively as attractants for animals. Unlike Kimmswick, human artifacts have not been found in association with extinct fauna at Barnhart.

The Barnhart site was discovered in 1976 by Albert Heinze who found mastodon bones eroding from a cut bank near the bluff. Contractors were using the Barnhart site as a barrow pit but after the initial discovery of bone, local citizens were able to stop the barrow activities. With permission from Franke Buick and Pontiac and the land owner, the Barnhart Volunteers initiated excavations at the site. During the summer and winter of 1977-1978 several areas were excavated and several hundred bones were recovered. In 1979 the Illinois State Museum (ISM) was invited by the Barnhart Volunteers to coordinate and direct excavations for the recovery of scientific information. Excavations were also conducted by the ISM during the summers of 1980 and 1981.

METHODS OF EXCAVATION

A conventional 2m X 2m grid system (Fig. 6-2) with a designated site datum was used to conduct controlled excavations. Each grid unit was excavated by skim shoveling and trowelling 10 cm levels within natural stratigraphic units. The location of each specimen was documented by standard horizontal and vertical measurements. Additionally, the trend and plunge of the long axis of the bones was measured by Brunton compass. Furthermore, black and white photographs as well as color slides were taken of bones in each level.

During the first summer, 1979, all sediments removed by excavation were dry screened through 0.6 cm (0.25 in.) mesh. In addition, 50 cm X 50 cm bulk samples from each grid unit were wet-sieved through 0.16 cm (0.062 in.) mesh in order to recover microfaunal remains. However, these screening techniques failed to yield any bones or bone fragments from sediments in the lower stratigraphic units. Screening was, therefore, not employed in the 1980 and 1981 excavations. All sediments from a test square in the upper tan colluvium were wet-sieved through 0.16 cm screen and they yielded a rich and diverse microfauna (Fig. 6-3).

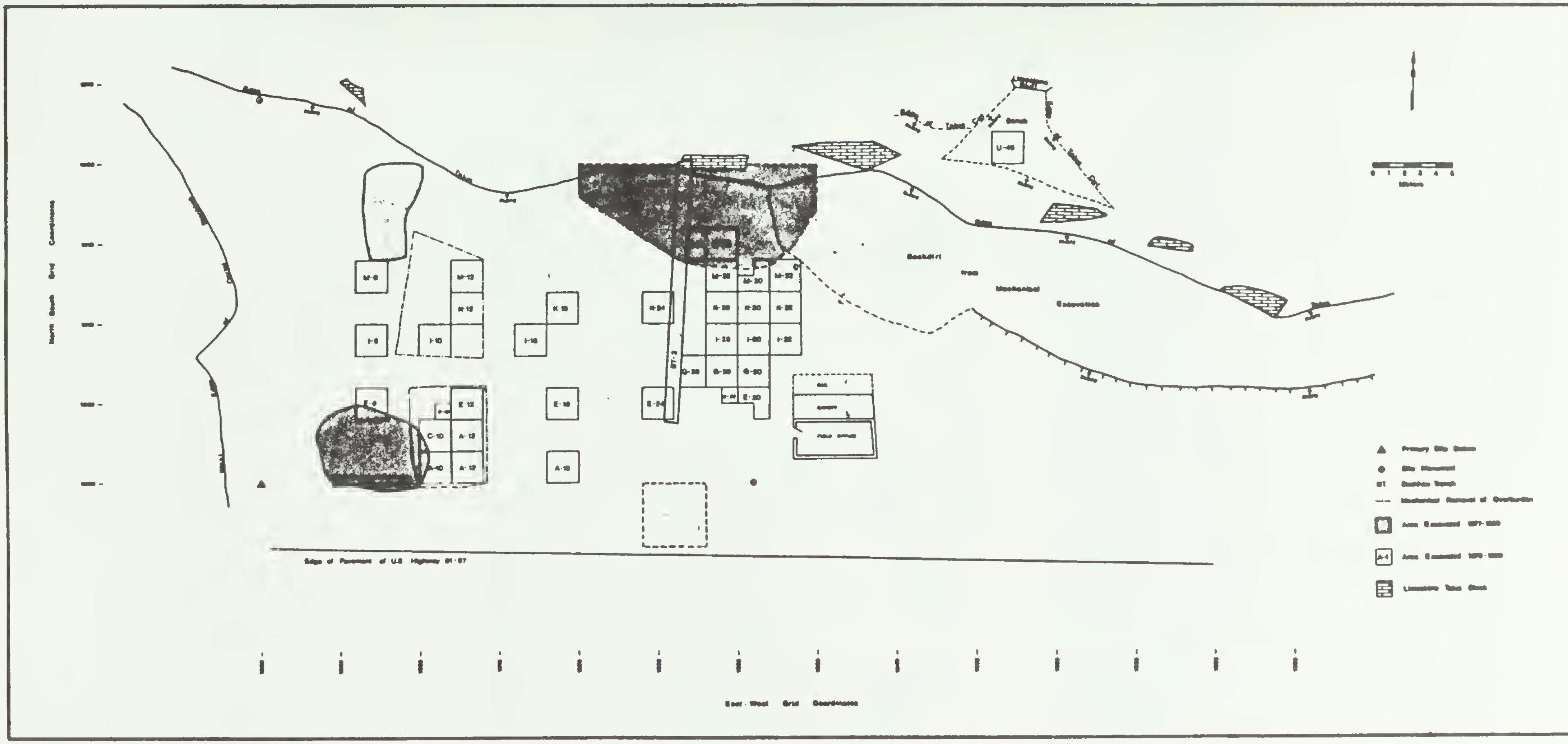

Figure 6-2. Site map of Barnhart.

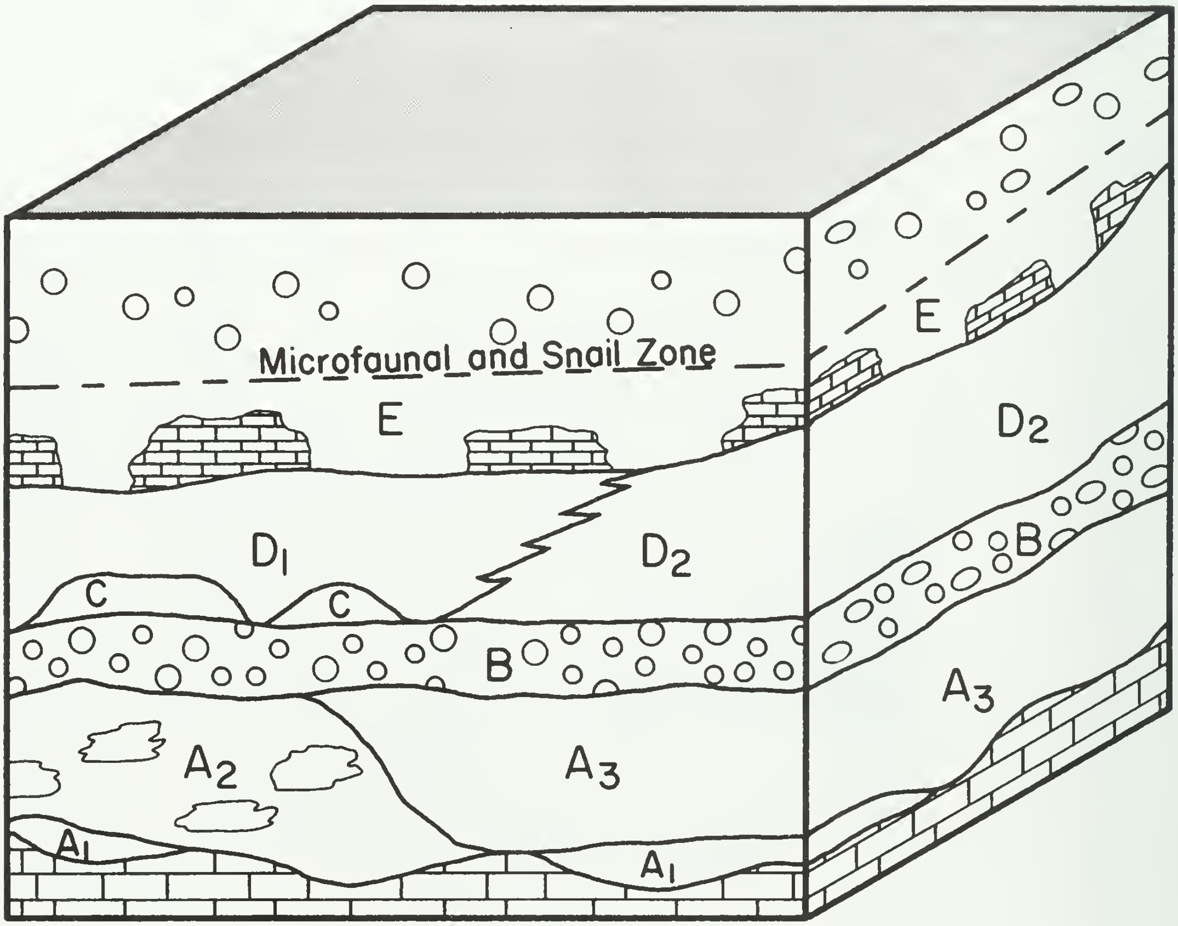

Figure 6-3. Schematic block diagram of stratigraphy at the Barnhart site. See text for description of sedimentary units. Facing edge is west and diagram is not to scale.

STRATIGRAPHY AND BONE PRESERVATION

Excavations at Barnhart have revealed a stratigraphic sequence representing numerous depositional environments and facies (Fig. 6-3). The two primary depositional systems are colluvial sediments and slackwater deposits. The colluvial sediments are derived from the disintegration of the limestone bluff and slope wash. They generally form wedges of clastic sediments that thicken towards the bluff. The slackwater deposits are formed by either back-flooding or hydraulically damming (Patton and others, 1979) of Glaize Creek by the Mississippi River. These deposits consist of a variety of facies that relate to the energy of the depositional system. In general, these deposits are part of the proximal facies of a slackwater depositional system (Patton and others, 1979).

The Quaternary deposits unconformably rest on a bench that has been cut into the Paleozoic limestone. There are at least four Pleistocene and perhaps, one Holocene bone-bearing stratigraphic units at Barnhart. Below the lowest fossiliferous stratum, a fluvial channel lag gravel (Unit B, Fig. 6-3), is a complex sequence of slackwater sands, silts and clays as well as colluvial fans. For simplicity, in this discussion all of these units have been lumped into Unit A of Figure 6-3. These older sediments were exposed in a north-south backhoe trench (Fig. 6-2) as well as in controlled excavations. They do not appear to contain any vertebrate fossils.

The fluvial channel lag gravel (Unit B) is primarily composed of rounded limestone cobbles and boulders. Interstices are filled with gray silt and clay. Many of the limestone clasts are imbricated towards the east. In addition, rounded igneous and metamorphic pebble clasts are sporadically intermixed. These clasts are interesting because the Glaize Creek drainage is primarily formed in a localized Paleozoic carbonate terrain. There are no known outcrops of crystalline rocks or tills in the drainage system. Therefore, these clasts may have been derived as bedload from the Mississippi River, from unknown pre-Quaternary deposits in the uplands, or as ice-rafted clasts from the Mississippi. The latter interpretation is preferred and suggests that mastodon bones may have also been derived from carcasses that had floated great distances. Thus the mastodon bones in Unit B may not represent a local population.

Bone from the fluvial gravel (Unit B) is extensively fragmented with heavy abrasion from being transported by stream currents. These deposits exhibit selective preservation for the more durable skeletal elements, especially mastodon teeth (Fig. 6-4). More specifically, the size and squarish shape of the upper second molar (M2) is similar to the average limestone clast and thus, frequently preserved intact. Whereas, the upper third molar (M3) is longer and as a consequence the M3 is frequently broken so it will conform with the size and shape of the limestone clasts.

Bones at the upper contact of the fluvial gravel may be more

Figure 6-4. Mastodon tooth in fluvial gravel (Unit B).

Figure 6-5. Mastodon right mandibular ramus and first rib in upper contact of fluvial gravel (Unit B). An articulated distal tibia and astragalus of a stag-moose is also visible in the photograph.

complete than those incorporated within the gravel but less complete than in the overlying gray clay (Unit D_1). For instance, at the upper contact mandibular rami (the right or left half of a mandible) may be preserved with all of their teeth intact (Fig. 6-5). However, complete mandibles have not been found in this facies but they do occur in the gray clay (Fig. 6-6).

An iron stained, yellowish-tan silt (Unit C, Fig. 6-3) which occurs as pockets of erosioal remnants conformably overlies the fluvial gravels. This silt has the lowest frequency of vertebrate remains of any of the fossiliferous units. The bones from the silt are remarkably complete but all specimens are isolated and disarticulated.

Stratigraphically above the silt is a gray, highly contractable, massive clay (Unit D_1) that probably formed as slackwater deposits. Desiccation cracks are stained yellow with oxidized iron. This gives the clay a mottled appearance. Calcium carbonate nodules occur throughout the clay and there are also random clasts of limestone and chert incorporated into the clay. Clasts of the yellowish-tan silt (Unit C), as large as 15 cm in diameter, occur as rip-up clasts in the gray clay. These clasts may occur as much as 50 cm from the basal contact of the gray clay.

Vertebrate fossils in the gray clay are concentrated at the lower contact with either the fluvial gravel (Unit B) or colluvial gravel (Unit D_2) at the east side of the site. The bones are relatively complete but frequently cracked (Fig. 6-5). This cracking is caused by the expansion and contraction of the gray clay in response to fluctuating moisture content. Also, orientation and imbrication of the bone indicate some transport by current. However, completeness of the bones suggest that they have not been transported far from their source (Fig. 6-7). Thus, the transition from fluvial gravel, fluvial gravel contact, yellowish-tan silt, and gray clay reflects decreasing energy in the depositional system. The degree of bone breakage and selective preservation seem to be a direct function of this energy regime. The concentration of bones along the edge of the colluvial gravel (Unit D_2) suggests a damming affect by the colluvial fan.

The colluvial gravel (Unit D_2) directly overlies and interfingers with the fluvial gravel (Unit B). It can be differentiated from the fluvial gravel by the absence of igneous and metamorphic clasts, larger size and more angular nature of the limestone clasts, and greater clay content. This unit thickens towards the the bluff to the north and east. Only the leading edge of the colluvial fan has been excavated. Bones are abundant in this sedimentary unit but they are commonly fragmented (Fig. 6-8), although not heavily abraded as in the fluvial gravel.

The late Pleistocene deposits and faunules at Barnhart may be stratigraphically equivalent to the deposits and faunules below the Clovis horizons at Kimmswick. Furthermore, the physical settings at Barnhart and Kimmswick are almost identical. Therefore, an

Figure 6-6. Mastodon mandible in gray clay (Unit D_1).

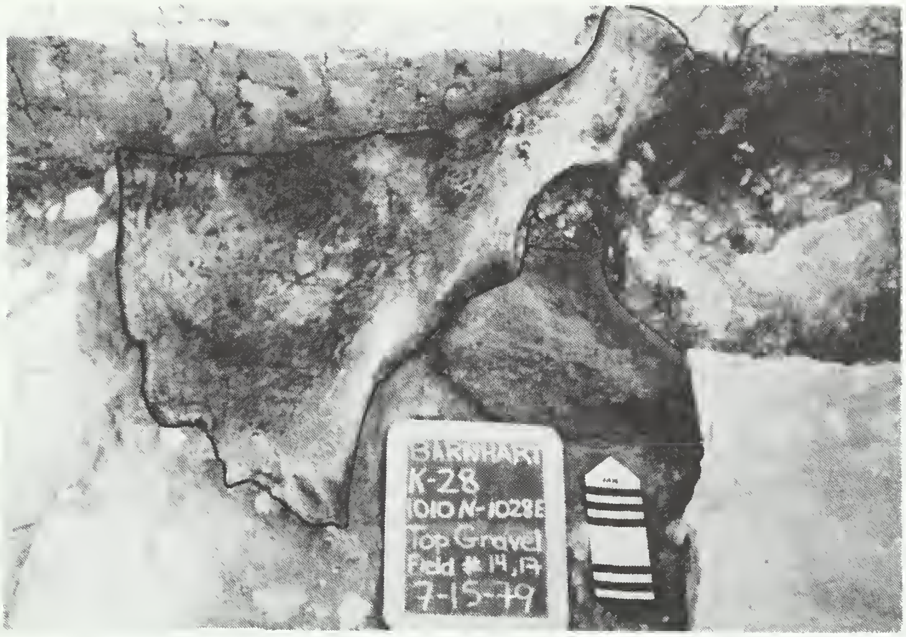

Figure 6-7. Mastodon innominate imbricated on mastodon scapula at base of gray clay (Unit D_1). Photograph is looking north.

Figure 6-8. Fragment of right mandibular ramus with m2 and m3 of stag-moose and mastodon rib in colluvial gravel (Unit D_2).

understanding of the taphonomy and paleoecology of the Barnhart faunules will enhance our understanding of the early prehistory at Kimmswick as well.

Overlying the gray clay is a massive colluvium (Unit E) composed of limestone and chert clasts and slope washed loess. The contact of the gray clay and tan colluvium is marked by large limestone blocks that must represent a single event of bluff collapse. Several different stratigraphic units can be discerned in the tan colluvium. A molluscan zone occurs near the base of this unit. Wet-seiving of this zone indicates a rich and diverse vertebrate microfauna. Some of the mammalian species, e.g., meadow vole (Microtus pennsylvanicus) and red-backed vole (Clethrionomys gapperi) do not occur in the Barnhart area today. The majority of this faunal assemblage was probably derived from owl pellet accumulations along the base of the bluff which were eventually washed down slope. However, stone flakes suggest that humans may have been responsible for part of the accumulation.

The tan colluvium (Unit E) at Barnhart is probably equivalent with the early Holocene tan colluvium from Kimmswick. In turn, both of these stratigraphic units are probably equivalent with the Rodgers Shelter Formation of western Missouri (Haynes, 1985) and the Peyton Colluvium and Cahokia Alluvium of western Illinois (Willman and Frye, 1970). There are no radiocarbon dates for any of the stratigraphic units at Barnhart. However, the occurrences of the meadow vole and red-backed vole suggest that the base of the tan colluvium may be latest Pleistocene.

PALEONTOLOGY

The Barnhart local fauna is composed of at least five distinct faunules that range in age from late Pleistocene to perhaps, early Holocene. The four late Pleistocene faunules (fluvial gravel, tan silt, gray clay, and colluvial gravel) are composed of megafauna that is not diverse even though skeletal remains are relatively abundant. Remains of the American mastodon, Mammut americanum, predominate in all four of the late Pleistocene faunules. In fact, they compose more than 95% of the remains from these faunules. The stag-moose (Cervalces scotti) comprises the other 5% of these faunules. Two rodent incisors are known from the gray clay.

Bones in the fluvial and colluvial sediments were probably derived from decaying carcasses along the stream courses. Modern studies of the distribution of African elephant carcasses at Tsavo National Park, Kenya demonstrate that the highest densities were along the stream banks and near limestone bluffs. This is an environment that is identical to those of Kimmswick and Barnhart.

As carcasses disintegrated the bones were transported in the streams or down the colluvial fans. The distance of transport and degree of bone breakage are directly related to the energy of the depositional system. Bones in the fluvial gravel (Unit B) show the highest amount of breakage, abrasion, and selective preservation;

and thus, they were probably transported the furthest. Transportation in the colluvial gravel (Unit D_2) was probably localized but the down slope movement of large boulders contributed to extensive fragmentation of the bone. The quiescent environments of the silt (Unit C) and gray clay (Unit D_1) did not favor long distance transport and consequently many of the bones are complete. However, the expandable characteristics of the gray clay produced *in situ* fragmentation of many of the complete specimens.

Without microfaunal and palynological evidence, a detailed and precise paleoenvironmental reconstruction of the late Pleistocene faunules is difficult. However, both *Mammut americanum* and *Cervalces scotti* appear to represent a forested environment. Furthermore, the absence of other taxa of similar size and the selective preservation of these two taxa may be a function of backwater lake environments as suggested by the sedimentary record. Both the mastodon and stag-moose may have browsed on aquatic vegetation in these backwater lakes. These environments may not have been readily accessible to more terrestrially adapted species like musk ox (*Symbos cavifrons*), and ground sloth (*Megalonyx jeffersonii* and *Glossotherium harlani*). Consequently, the bones of these animals were not incorporated into the deposits at Barnhart.

Study of the faunule from the tan colluvium (Unit E) at Barnhart is in its preliminary stages. However, the occurrence of northern species like the red-backed vole and meadow vole indicate that there have been significant environmental changes. These taxa have been recovered from other late Pleistocene faunas in the area (e.g., Crankshaft Pit, Cherokee Cave, and Meyer Cave). However, the red-backed vole and other boreal taxa are not yet known from the Clovis components at Kimmswick, although the meadow vole does occur in these deposits. Neither the red-backed vole nor the meadow vole occur in early Holocene deposits at Modoc Rock Shelter, Graham Cave, or Rodgers Shelter. Thus, analysis of this faunule should provide important information on the extirpation of these species from the central Midwest and the concomitant environmental changes.

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STRATIFIED CULTURAL AND FAUNAL HORIZONS AT KIMMSWICK, MISSOURI

Russell W. Graham

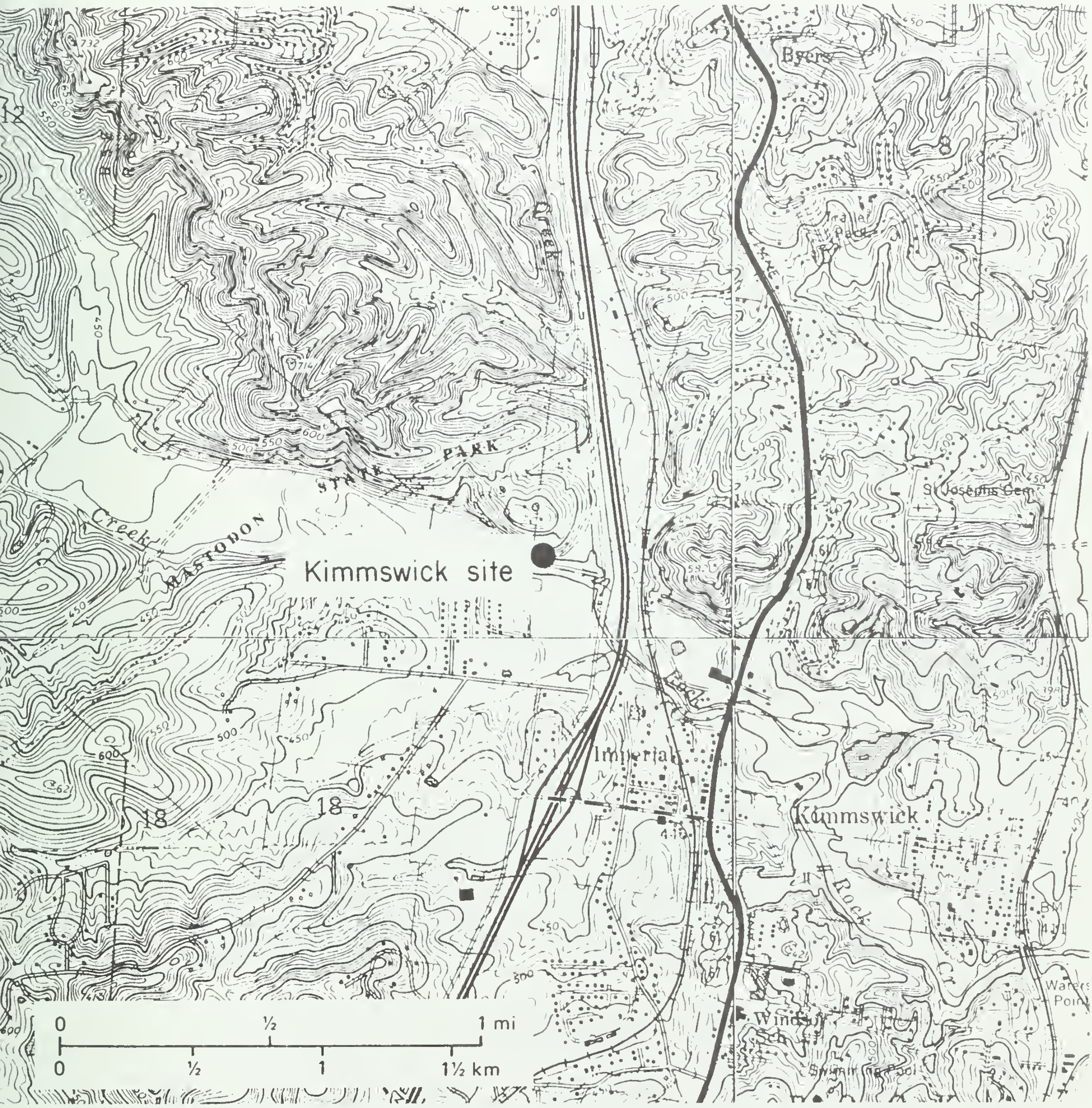

Figure 7-1
STOP 7
Kimmswick Site
T42N, R6E, Jefferson County, MO
Maxville 7.5 minute Quadrangle

HISTORICAL PERSPECTIVE

The Kimmswick site (Fig. 7-1), approximately 32 km south of St. Louis, Missouri, has a long and rich history (Graham, 1980). Fossil deposits have been known since at least 1806 but the first systematic collections were not made until 1839. During this year Albert Koch came to Kimmswick in response to reports of large bones eroding from the banks of Rock Creek. Koch conducted excavations at the site and amassed a large collection of vertebrate fossils. Perhaps, the most significant find, at least in Koch's mind, was a skull of an animal that he thought was new to science. Koch called his new animal the Missouri Leviathan (Koch, 1841).

From bones of various species and from different sites, Koch constructed a skeleton of his famous beast and exhibited it in his St. Louis museum. However, Joseph Leidy and Sir Richard Owen, eminent paleontologists of the time, finally convinced Koch that the original skull of the Missouri Leviathan was nothing more than an American mastodon, *Mammut americanum*. Koch eventually sold the composite skeleton of the Leviathan to the British Museum of Natural History. Richard Owen disassembled the skeleton and then properly reassembled it as an American mastodon. Today, it is being refurbished but will be placed back on exhibit at the British Museum in the future.

Near the turn of the nineteenth century, C. W. Beehler convinced a group of St. Louis citizens known as the Humboldt Exploration Company to finance new excavations at the Kimmswick site. The purpose of these excavations was to procure a large collection of fossil bones for a new museum in St. Louis. Beehler, instead, used the fossils he excavated to establish his own private museum at the site. This museum and Beehler's excavations became well known and were visited by laymen as well as by many famous scientists (e.g. W. H. Holmes, Gerard Fowke, De Lancey Gill, O. P. Hay, and W. C. Mills).

Unfortunately, Beehler did not keep any records of his excavations and the extensive fossil collections have been lost. Most of our knowledge of Beehler's work is based on photographs and newspaper reports, advertisements circulated by Beehler and his cohorts and accounts of scientists who visited the site. After a visit to Kimmswick in 1901, W. H. Holmes (1903: 237-238) provided the following account about the possible association of humans with extinct fauna:

> The question of the association of human remains with those of the mammoth and mastodon has been raised at this place also, but up to the present time the evidence is not at all conclusive. It is believed that the bones found, which so closely resemble the humerus of man, may be portions of the fibulae of young mastodons, and that the flint implements reported as occurring with fossil remains may have recently been introduced, since identical forms are plentiful on the surface of the site. At any rate, it

seems wise to suspend judgement in the case until more critical and exhaustive studies have been made.

In 1902, Holmes returned to Kimmswick with Gerard Fowke and conducted excavations at the site. They concluded that there was insufficient evidence to support the contention of human association with extinct fauna (Fowke, 1928).

In 1905, a large lime kiln was built on the Kimmswick site. The local limestone was quarried and converted to cement which was shipped by rail to St. Louis. This quarry became the type section for the Kimmswick Formation which was named by E.O. Ulrich. The quarry faces, with evidence of core holes for blasting, are preserved on the ledge above the site and on the outcrop at the eastern edge of the site. The kiln burned in the 1930's and only its foundation is preserved at the site today.

Sometime around 1907, W.F. Parks, a St. Louis dentist and amateur archeologist, conducted excavations at the Kimmswick site. During these excavations, stone tools were presumably found in association with the bones of extinct animals. We know little about the circumstances of this discovery and in fact, it would have probably been unknown except for a report by Byron Knoblock (1939) in his famous book, Bannerstones of the North American Indian. However, it is not clear if these are the artifacts referred to by Holmes (1903:237). According to an interview with R. Bruce McMillan in 1984, Knoblock claimed that these artifacts were recovered by excavations conducted for Parks after Beehler left the site. Fortunately, these artifacts have been preserved at the Field Museum of Natural History. One of them is a resharpened Clovis projectile point with a large impact fracture at the tip. A variety of current evidence suggests that this artifact may have actually been associated with the extinct fauna but we will never know for certain.

In the early 1940's, Robert McCormick Adams, a professional archeologist affiliated with Washington University and the St. Louis Academy of Sciences conducted excavations as part of the Work Projects Association (WPA) programs. Collections made by Adams have been lost but his field records have been preserved as well as a published account. Adams (1953) noted that a stone flake had been found with a tooth of a juvenile mastodon but he concluded that the evidence for the contemporaneity of humans and extinct fauna was uncertain.

The Kimmswick site was purchased and donated to the State of Missouri during the early 1970's. Today, it is located on Mastodon State Park. The efforts of local citizens must be commended for the preservation of this unique treasure. In 1979, the Missouri Department of Natural Resources (DNR) contracted with the Illinois State Museum (ISM) to conduct a survey and test excavations in order to assess the impact of previous excavations and industrialization on the site. In these and subsequent excavations (Fig. 7-2), two Clovis projectile points and other stone tools were recovered from stratified deposits and in direct association with

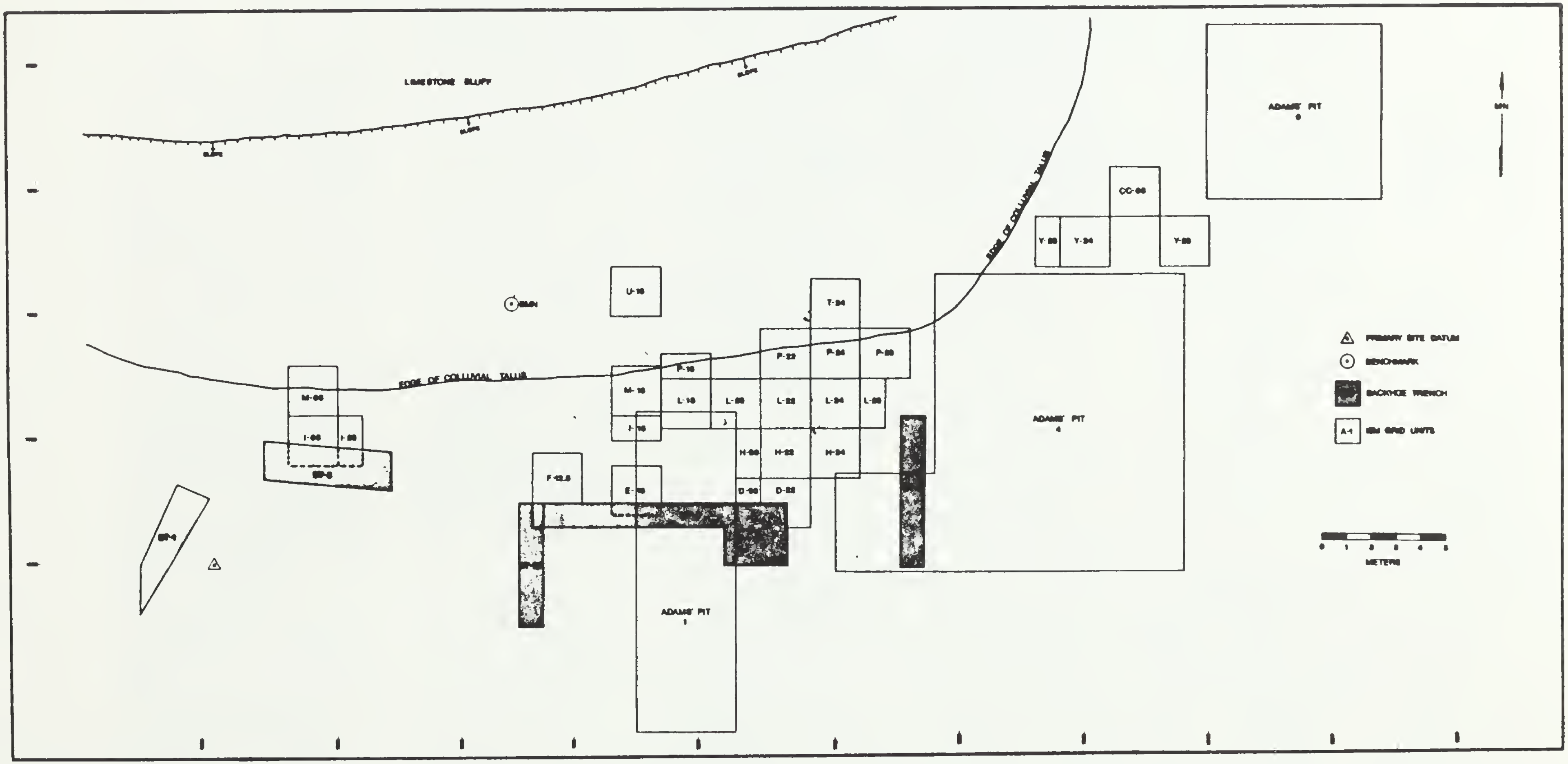

Figure 7-2. Site map of Kimmswick.

the bones of *Mammut americanum* and other fauna at Kimmswick (Graham and others, 1981).

This is the first unquestionable evidence for the association of the American mastodon and the Clovis culture as well as one of the best documented human-*Mammut* associations. Furthermore, the association between humans and mastodons at Kimmswick is a direct contrast to Clovis-mammoth sites in the western United States. For the first time, differences in Clovis strategies of procurement, processing and utilization can be compared for two different proboscideans. Also, because of the relative completeness of the faunal record from the site, Kimmswick may provide the first understanding of Clovis adaptations to midwestern environments.

LOCATION AND STRATIGRAPHY

The Kimmswick site lies on a terrace about 126 m (416 ft) above mean sea level abutting a 20 m (66 ft) limestone bluff to the north (Fig. 7-1). The terrace, occupying a small area at the confluence of Rock and Black creeks approximately 1.6 km from the confluence with the Mississippi River, was formed by a combination of overbank alluviation from the two creeks and colluvium from the bluff to the north (Fig. 7-3). These types of late Quaternary deposits occur in similar environments throughout the central Mississippi-Missouri river valleys and their tributaries.

At Kimmswick, the basal terrace deposits consist of colluvial gravels and alluvial clays and silts containing Pleistocene vertebrate fossils. No human artifacts have, as yet, been found in these deposits. The basal terrace deposits at Kimmswick are topographically and stratigraphically correlative with the megafaunal bone beds at Barnhart (Stop #6). As at Barnhart, the preservation of bone is distinctly different in the colluvial and alluvial facies. Preservation and taphonomy in these deposits also differ from the overlying sediments with Clovis artifacts. Specifically, the alluvial deposits preserve relatively complete bones, although they have been fragmented by the swelling of expandable clays. Frequently, bones in these alluvial deposits are clustered together. Bones from the gravel are disassociated, fragmented, scratched and in some cases extensively abraded. Dense bones and teeth appear to be preferentially preserved.

The upper surface of the colluvial gravel has several shallow depressions, or basins, which may have filled with overbank alluvium and colluvium. Three of these basin fills have been discovered so far and partially excavated. All contain the remains of extinct megafauna, extant and extirpated microfauna, and artifacts. Diagnostic Clovis tools have come from two stratified and superimposed basin deposits on the east side of the excavations (Fig. 7-4). To the west, the third basin is stratigraphically isolated from the other two and no diagnostic artifacts have been found in it.

The lower of the two stratified basins rests on the lower

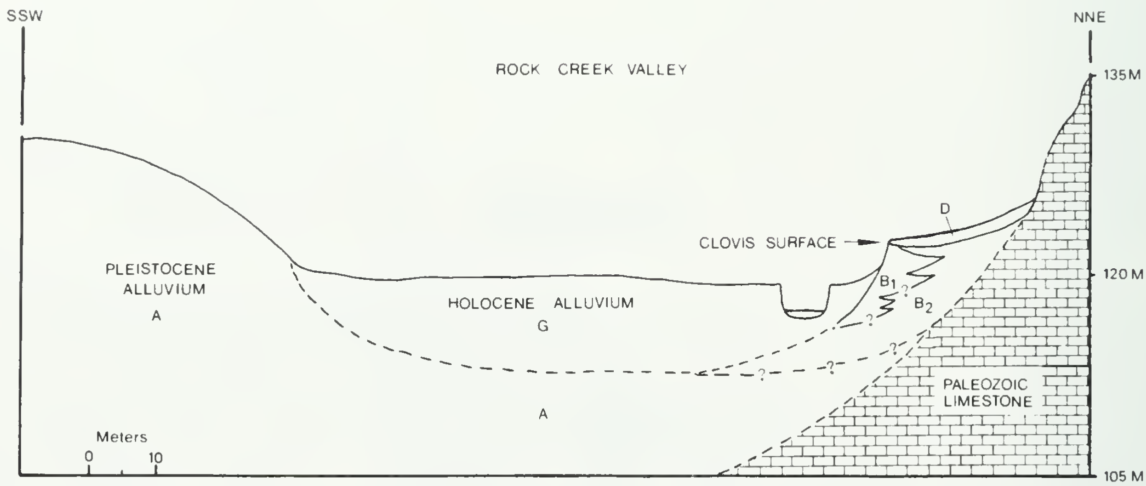

Figure 7-3. Schematic geologic cross section of Rock Creek Valley: A - fluvial silts and sands of high terrace (T-2); B_1 - fluvial clays of intermediate terrace (T-1); B_2 - colluvial gravels of T-1; D - brown clayey silt of "tan colluvium"; G - fluvial silts, sands and gravels of low terrace (T-0).

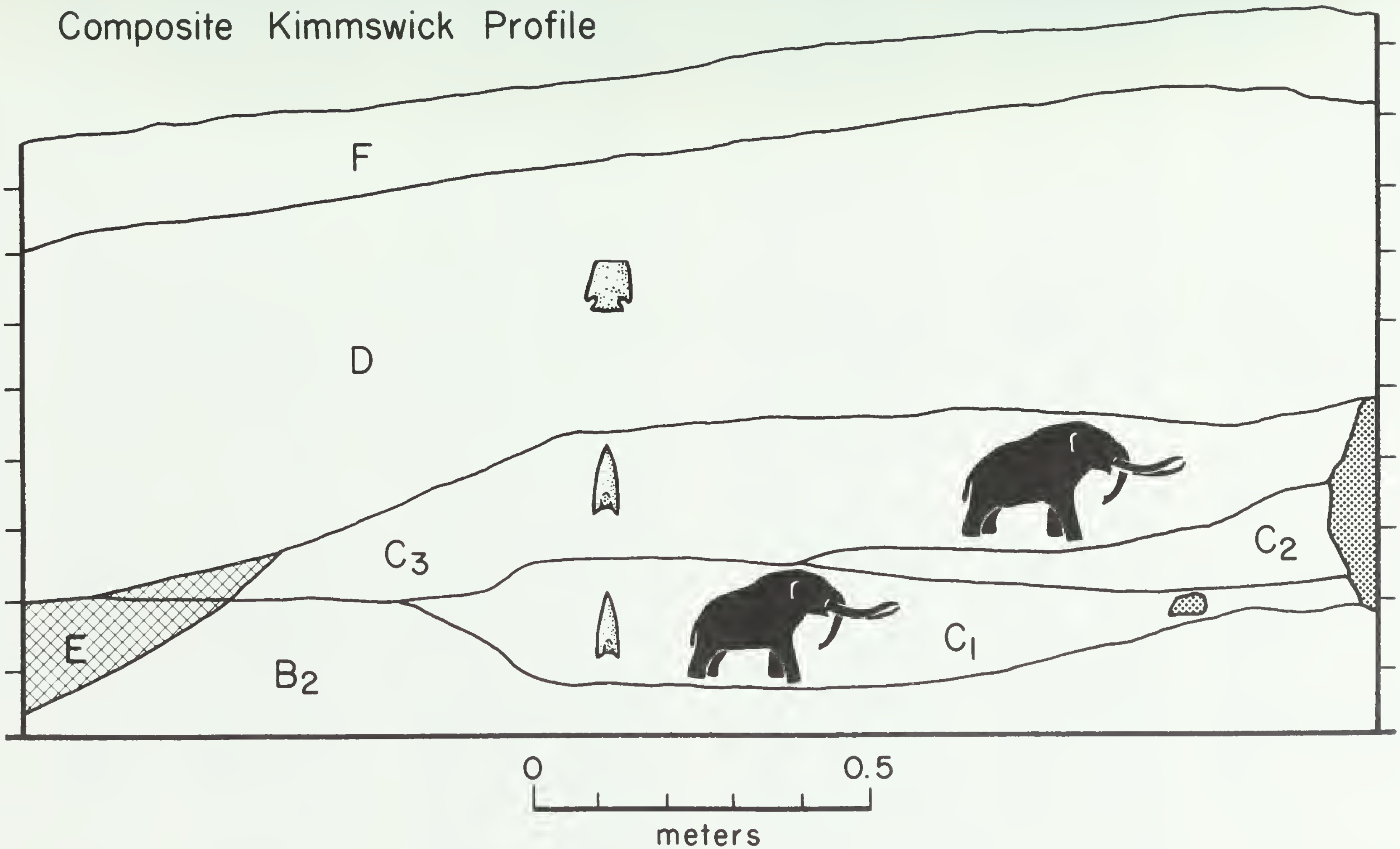

Figure 7-4. Schematic geologic cross section of Kimmswick site excavations: B_2 - colluvial gravels of T-1; C_1 - blueish gray silty clay of "lower basin deposit"; C_2 - brown, clayey, silty gravel of "upper colluvial gravel"; C_3 - olive green silty clay of "upper basin deposit"; D - brown clayey silt of "tan colluvium"; E - beta horizon developed in B_2 and C_3, F - "organic matter darkened zone" of disturbed surface.

colluvial gravels, is approximately 20 cm thick, was exposed in five 2m X 2m grid units, and extends into the north profile wall of the excavation. This basin deposit is composed of a blue gray, silty, calcareous clay (C1, Fig. 7-4) that grades into a blue gray, clayey silt with gravel to pebble size clasts of limestone and chert. An angular colluvial gravel (C2, Fig. 7-4) with some manganese staining overlies this deposit and separates it from the superior basin sediments. No artifacts and only one deer phalanx has been found in this colluvial gravel.

The upper basin deposits (C3, Fig. 7-4) are olive green calcareous clays. Thickness of these sediments varies between 5 to 25 cm. Flecks of hematite and manganese occur throughout this deposit. In fact, large concentrations of manganese are encountered near large limestone boulders. The upper boundary of this unit is conformable with the Holocene tan colluvium. The lower boundary overlies several different stratigraphic units depending upon its position on the site (Fig. 7-4).

The third identified basin fill rests on a rounded, medium sized gravel that occurs above small isolated pockets of olive green silt and in turn, above the lower colluvial gravel. To the south, the dark brown noncalcareous facies, which is the upper part of a beta horizon, rests on the lower colluvial gravels. Diagnostic artifacts have not been recovered from this unit but stone flakes have been found in association with the remains of extinct fauna. It may, therefore, represent a third Clovis component.

These basin fill sediments lie beneath early Holocene tan colluvium which derived from the disintegration of the limestone bluff and slope washed loess. These Holocene deposits may contain alluvial facies nearer Rock Creek. Stratigraphically, this unit appears to be correlative with the Rodgers Shelter Formation in western Missouri (Haynes, 1985) and the Peyton Colluvium and Cahokia Alluvium of western Illinois (Willman and Frye, 1970). The Holocene colluvium contains diagnostic chipped stone artifacts of Early to Middle Archaic age that are easily differentiated, stylistically and stratigraphically, from the Clovis tools.

Absolute dates are not available for the basin deposits but their age can be estimated by geologic correlations and comparison with other Clovis sites. The basal terrace deposits at Kimmswick may be equivalent to terraces on the Mississippi and Meramec rivers that have been radiocarbon dated on wood between 13,000 and 12,000 B.P. (Goodfield, 1965). This would be a minimum age for the terrace deposits at Kimmswick though they could be somewhat older. The overlying Holocene deposits have been correlated with stratigraphic units whose lower boundaries have been dated 11,000 - 10,000 B.P. (Willman and Frye, 1970; Haynes, 1985). Thus, it appears that the basin deposits with Clovis artifacts date between 10,000 and 12,000 B.P.

Sediments at the Kimmswick site are being pedogenically altered by the formation of a beta horizon (Bartelli and Odell, 1960). Specifically, clays leached from the tan colluvium are deposited by illuviation along textural and geochemical boundaries in other sedimentary units below it. Thus, thickness of the beta horizon is an inverse function of the thickness of the Holocene tan colluvium. The beta horizon is, therefore, thickest towards the south where the tan colluvium is thinnest. For this reason, the beta horizon transgresses stratigraphic boundaries and appears to be migrating northward across the site (Fig. 7-4).

At the southern edge of the excavations, the beta horizon completely altered the Clovis horizons and penetrated 10-50 cm into the basal colluvial gravel. Along the west walls of excavational squares H20 and D20 (Fig. 7-2), the alteration of the Clovis deposits is clearly apparent. Above the illuvial horizon the deposits are dark brown, oxidized, noncalcareous and enriched with clays. Below the beta horizon the deposits are olive green and calcareous.

It is interesting to note that the chert clasts also appear to be altered by beta formation. In the beta horizon the local chert clasts are extremely white; whereas, in the unaltered state the chert is more gray. Finally, the more acid environment of the beta horizon is destroying bone that was originally preserved in the sediments. Destruction of the bone surfaces has impeded studies of bone modification and analysis of butchering marks.

ARCHAEOLOGY AND PALEONTOLOGY

Two virtually complete Clovis lanceolates, simple unifacial tools, a biface fragment, and hundreds of chert flakes were found in the upper basin deposits. The two projectile points were 1.25 m apart horizontally and were vertically separated by less than 1.5 cm. One of these (K-L22-32) is a large, steel gray projectile point with minor impact damage to the tip (Fig. 7-5). This specimen was at least 14 cm below the highest mastodon bone, a pisiform, and lay horizontal among disarticulated foot bones of an adult mastodon and adjacent to a lenticular concentration of botryoidal manganese. Heavy coatings of manganese covered this point and other artifacts from this stratum.

The second projectile (K-H22-83), made from an olive green chert and extensively reworked, was discovered directly beneath a large mastodon bone fragment. Inclined at 34° from the horizontal with the tip down, the base was in contact with the bone. The projectile may not have entered the bone but does show minor damage to the tip due to impact; it could have easily been embedded in the animal's flesh next to the bone.

Stratigraphically beneath these finds, in the blue gray silty clay basin deposit (C1, Fig. 7-4), were additional Clovis artifacts: the basal ear of a laneolate, a basal fragment of a projectile point preform (Fig. 7-5), and chert flakes. These artifacts were also in association with bones of mastodon and other

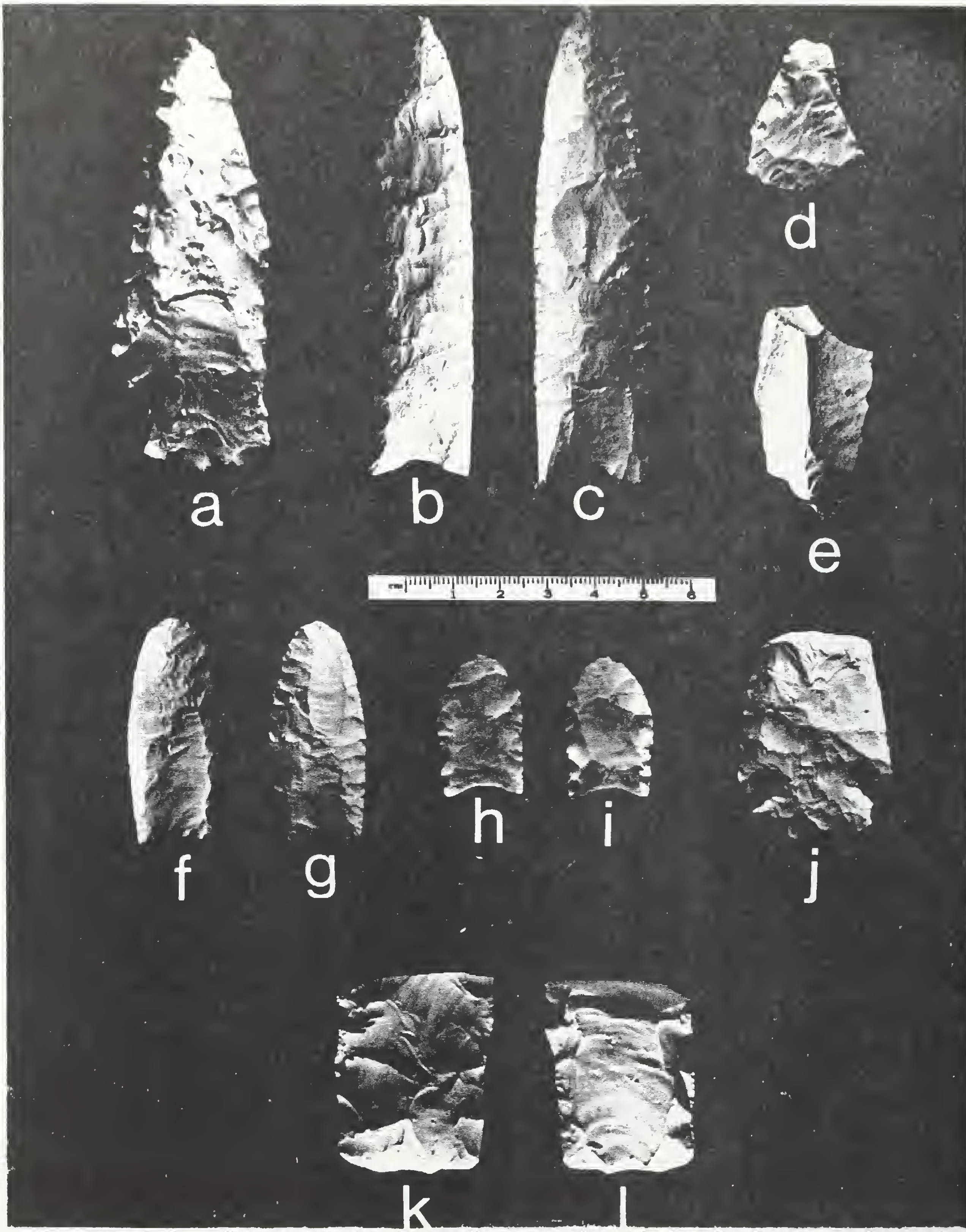

Figure 7-5. Stone tools from Kimmswick: a) knife-like implement (FMNH 205527); b-c) obverse and reverse sides of Clovis projectile point (K-L22-32) from C_3; d) bifacial tool fragment from C_3; e) utilized flake from C_3; f-g) obverse and reverse sides of resharpened Clovis projectile point (FMNH 205526), note impact fracture at tip (g); h-i) obverse and reverse sides of resharpened Clovis projectile point (K-H22-83) from C_3; j) base of St. Charles projectile point (K-P26-21) from D; k-l) obverse and reverse sides of "fluted" preform with reverse hinge fracture from C_1. Specimens FMNH 205527 and 205526 were found presumably in association with mastodon bones at Kimmswick in the early 1900's. However, specimen FMNH 205527 has sediments of D still adhering to it. FMNH - Field Museum of Natural History, Chicago.

extinct fauna. The basal ear is made from a chert identical to that of the Clovis point found at the turn of the century; their basal grinding and fluting are also correspondent. Thus, the discovery of this artifact lends credence to the early twentieth century discovery.

The second bifacially flaked artifact from the lower basin deposit is a preform with a reverse hinge fracture. It is both wider and thicker than the finished points and clearly illustrates end thinning, "preform fluting", executed prior to final lanceolate shaping. This technology is compatible with preform preparation at other Clovis sites, especially the Lincoln Hills site in Jersey County, Illinois. This artifact and other debitage indicate that both maufacture and maintenance of chipped-stone armatures occured at Kimmswick. Also, the superimposed stratigraphic horizons reflect repeated use of the site by Clovis peoples.

The teeth of an adult and juvenile mastodon from the upper Clovis component (Unit C3) may indicate that the Clovis people killed a cow and her calf. Adams (1953) found a tooth of a juvenile individual associated with a stone flake. In addition, a semi-articulated vertebral column of a juvenile mastodon may reflect processing activities. The mastodon bones preserved in the Clovis horizons are quite different than the bone distributions in the other fossiliferous horizons at both Kimmswick and Barnhart. Also, the remains of other species (white-tailed deer, turtle, squirrel, etc.) from the Clovis-age sediments suggest a diverse economy for the Clovis hunters. Thus, lithic and faunal evidence suggest that Kimmswick may represent a Clovis-mastodon kill and processing site with limited occupation.

Finally, the mammalian fauna from the basin deposits contains species adapted to deciduous woodland with open grass areas (Graham and others, 1981). A similar reconstruction is also suggested by extrapolation of the contemporary pollen data from southern Missouri, central Illinois, and western Tennessee. Such an environment is contrary to the spruce forest habitat usually assumed to characterize the mastodon and strengthens arguments for broader ecological adaptations for mastodons. Furthermore, this environment is markedly different from those encountered by Clovis hunters in the Great Plains and southwest. Kimmswick therefore may illustrate different adaptive strategies of Clovis hunters in the eastern woodlands.

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McADAMS PEAK SCENIC OVERLOOK

Thomas R. Styles

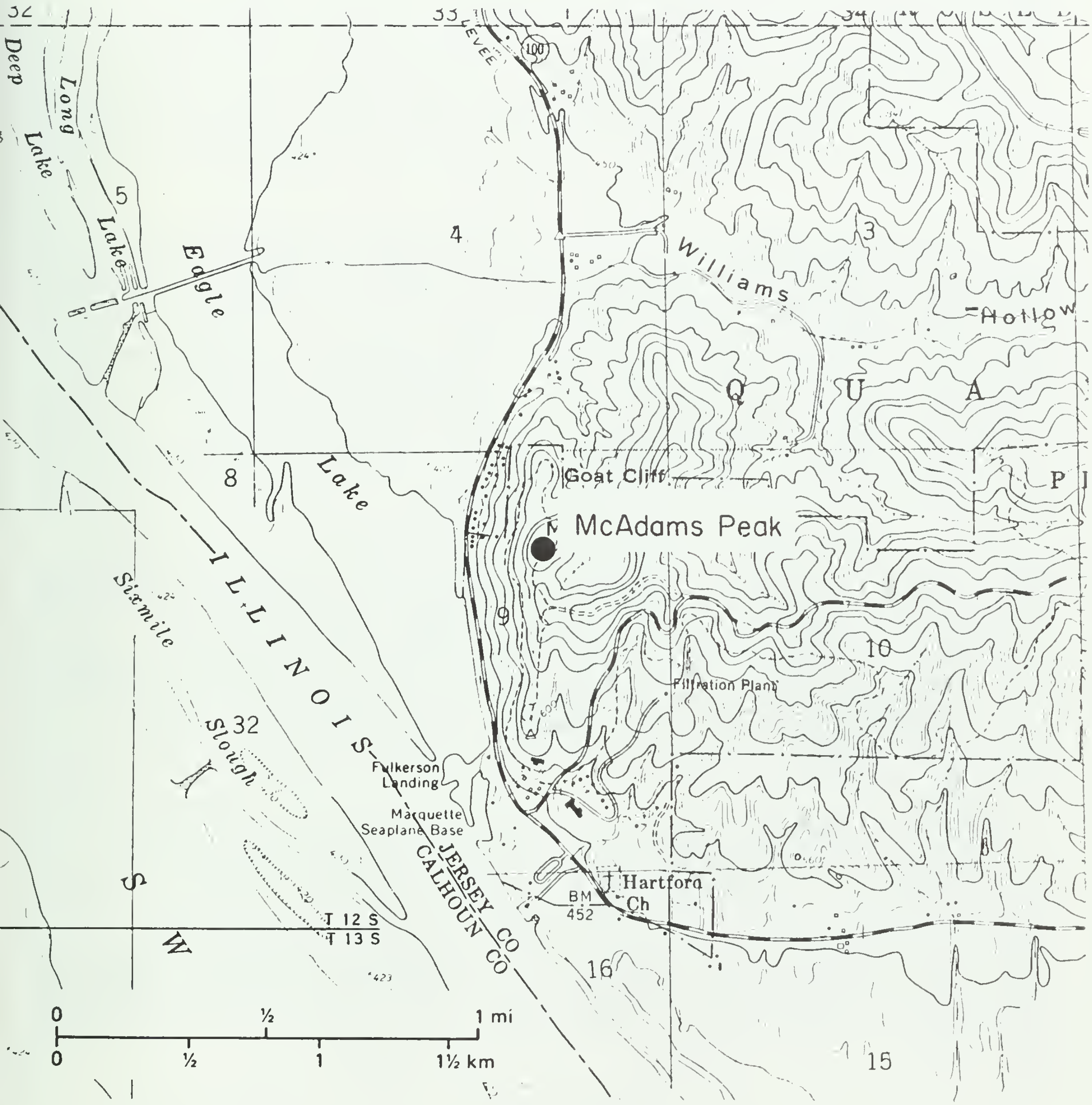


Figure 8-1
STOP 8
McAdams Peak Scenic Overlook, Pere Marquette State Park
NW SE Sec. 9, T6N, R13W, Jersey County, IL
Brussels 7.5-minute Quadrangle

INTRODUCTION

McAdams Peak is a high point (252 m; 828 ft ASL) on the east bluff near the mouth of the Illinois River Valley (Fig. 8-1). The bedrock stratigraphy, structural geology, and geomorphology of this locale are interesting and pertinent to understanding the development of landforms during the Quaternary. A lookout platform near the summit offers an excellent view of the major features of the regional physiography. The hike to the lookout is moderately strenuous. The round trip trail distance up the bluff will be about 1.5 km, climbing a total of 100 m.

Historical Notes

Pere Marquette State Park is named after a 17th century Jesuit missionary who accompanied the first European expedition to explore the middle Mississippi Valley. In the spring of the year 1673, Marquette left the settlement of St. Ignace at the Mackinac Straits in the company of a small band of men under the leadership of the French explorer Louis Jolliet (see Howard, 1972, for a brief account of the Jolliet-Marquette expedition and a bibliography). The expedition traversed Lake Michigan and what is now the state of Wisconsin, entering the Mississippi Valley from the Wisconsin River. They continued down the Mississippi River to past the mouth of the Ohio River searching for a passage to the Pacific Ocean. When they realized that the Mississippi must empty into the Gulf of Mexico they turned back. On their return trip, Jolliet and Marquette decided to reach Lake Michigan via the Illinois River. They stopped near the mouth of the Illinois River and climbed a bluff in order to survey the territory ahead; quite possibly the bluff they chose was McAdams Peak. Jolliet's records and maps of the expedition were lost in a canoe accident in the final days of the expedition. As a result, Marquette's journal is the earliest firsthand account of the Illinois country.

McAdams Peak is named after William McAdams, a naturalist who conducted investigations of the archaeology, geology and paleontology of the Midwest during the late 19th century. McAdams collected artifacts and excavated numerous sites in the Mississippi and Ohio River drainages. He published several articles and, in 1887, a book titled <u>Records of Ancient Races in the Mississippi Valley</u>. McAdams was especially active in the Mississippi Valley around Alton and in the lower Illinois Valley. He excavated some mounds of probable Late Woodland age on McAdams Peak.

Local Ecology

Vegetation zones in the lower Illinois Valley occur as belts which parallel the valley margins and the river channel (Zawacki and Hausfater 1969). As we climb the trail to the overlook we will pass through the hillside-talus slope forest which forms a narrow zone along the bluff. This zone is relatively mesic due to the sheltering effects of the bluff and to groundwater discharge. Species diversity is high.

Natural openings in the forest known as hill prairies are abundant on the valley side near the crest of the bluff. The observation deck to which we are hiking is located on one. Hill prairies reflect locally extreme xeric micro-habitats caused by rapid drainage on steep slopes and high rates of evaporation due to exposure to sun and wind. The exposure factor explains why they are best developed on south and west facing slopes which are exposed to the most direct sunlight and to the prevailing winds. A detailed description of hill prairies can be found in F. King's following addendum.

The summit of McAdams Peak is primarily covered by upland forest. The upland forest zone is a drier habitat than that of the valley side, but much moister than that of the hill prairies. Prior to extensive clearing of timber, the upland forest formed a belt of about 5 to 10 km in width covering the rugged, highly dissected uplands immediately adjacent to the major valleys. As slopes diminished and interfluves widened with distance from the valleys, the upland forest was replaced by tall-grass prairie.

GEOLOGY AND GEOMORPHOLOGY OF THE MCADAMS PEAK VICINITY

Bedrock Geology

Pere Marquette State Park is located on the west flank of the Illinois Basin, a large crustal depression which slowly subsided and filled during the Paleozoic (Willman and others, 1975). Local outcrops of sedimentary rocks range in age from Ordovician through Pennsylvanian (see Treworgy, 1979 for a bibliography and a more complete description of the geology of Pere Marquette State Park). McAdams Peak lies on a large monoclinal fold (the Cap au Gres flexure) which has the effect of bringing most of the formations in the regional sequence to the surface within a short stretch of the valley bluff. The Cap au Gres flexure is part of a complex of large-scale structures in the region. Deformation was well underway before the youngest Paleozoic beds were laid down and intermittently continued to at least the Tertiary. The flexure originated under brittle conditions giving rise to numerous minor faults within the folded strata. Evidence of the Cap au Gres flexure is well exposed (by Illinois standards!) and we will pass by steeply dipping, faulted strata along the trail to the overlook.

Glacial History and Deposits

McAdams Peak is part of a small unglaciated area which is isolated from a larger unglaciated upland to the west by the entrenched valley of the Illinois River. During the Pleistocene glaciers advancing from the northeast came within a few kilometers of McAdams Peak (Lineback, 1979), but the peak and neighboring hills were high enough and resistant enough to divert the ice. Illinoian ice probably surrounded the Pere Marquette State Park area on three sides (Fig. 8-2), entering the Illinois Valley about 12 km to the north, advancing to within 4 km on the east, and spreading into the Mississippi Valley near St. Louis. It is likely that one or more pre-Illinoian glaciers approached the Pere Marquette State Park area in a similar fashion. Tills older than classic Illinoian, usually mapped as "Kansan", are common east of the lower Illinois Valley (Willman and Frye 1970).

The close proximity of McAdams Peak to outwash valley trains in the Illinois, Mississippi and Missouri valleys led to deposition of thick loess deposits on the unglaciated uplands. The major part of the loess sequence is comprised of Peoria Loess and Roxana Silt of Wisconsinan age, but older loesses like those we saw at Maryville (Stop #4) and will see at Pancake Hollow (Stop #10) are probably present in protected areas in tributary valleys and in high terrace deposits on the main valley sides.

REGIONAL GEOLOGY AND GEOMORPHOLOGY FROM MCADAMS PEAK OVERLOOK

The Calhoun County Upland

The view to the west from McAdams Peak provides a panoramic perspective of Calhoun County, Illinois. This peninsula of unglaciated upland forms a narrow divide between the lower stretch of the Illinois Valley and the Mississippi Valley (Figs. 8-2 and 8-3). The Cap au Gres flexure cuts across the Calhoun upland at a point directly west of McAdams Peak. North of the flexure the upland surface is underlain by resistant limestones of Mississippian age. South of the flexure Mississippian rocks are capped by softer units of Pennsylvanian sandstone and shale. The effects of the change in lithology are dramatic. North of the flexure the bluffs of the Illinois Valley and the valley sides of most tributaries are steep and rocky. Cultivation is limited to narrow strips along the valley bottoms and the crests of the upland divides. Most of the valley sides are timbered. South of the flexure the landscape becomes more open and rolling. Most of the area is cultivated and tracts of timber are small. The Illinois Valley bluff becomes less distinct, without rock slopes, and retreats behind a high loess covered terrace (Brussels terrace). Relatively recent deformation has dropped the upland surface south of the Cap au Gres flexure by about 40 m relative to the north side, further accentuating the surficial expression of structure.

The flat-topped appearance of the Calhoun upland, especially north of the Cap au Gres flexure where it appears almost like a timbered mesa, is an illusion. Later in the day we will see that this is actually an area of rugged hills and valleys. The illusion is created by the very regular accordance of interstream divides to the same general elevation. The crests of the divides are remnants of an old erosion surface which Rubey (1952) referred to as the "Calhoun peneplain" and correlated with

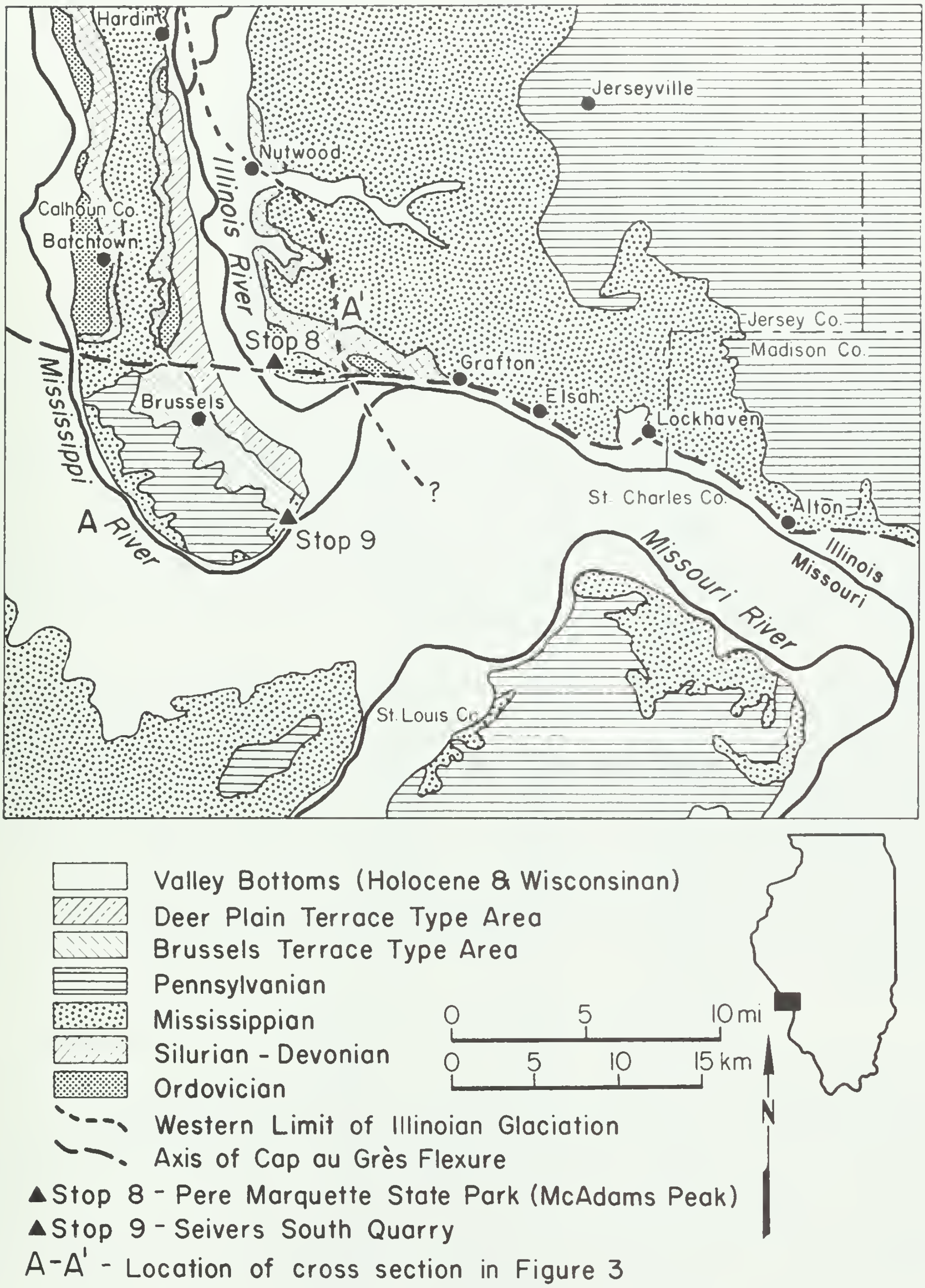


Figure 8-2. Geology of the Pere Marquette State Park area and the adjacent river valleys (adapted in part from Treworgy, 1979).

similar old surfaces in southwest Wisconsin and Missouri. The surface pre-dates entrenchment of the main valleys into bedrock. Thick deposits of cherty "residuum" on many ridges suggest that the erosion surface formed over a very long span of time in which tens or hundreds of meters of Paleozoic bedrock were removed by solution. Parts of the Calhoun surface may have been inherited from Paleozoic and Mesozoic erosion surfaces; however, the final stage of development was the work of streams during the late Tertiary and perhaps the early Pleistocene. Thin fluvial deposits of the Grover Gravel are scattered across the ridge crests where they cap the "residuum" and are buried by Pleistocene loess.

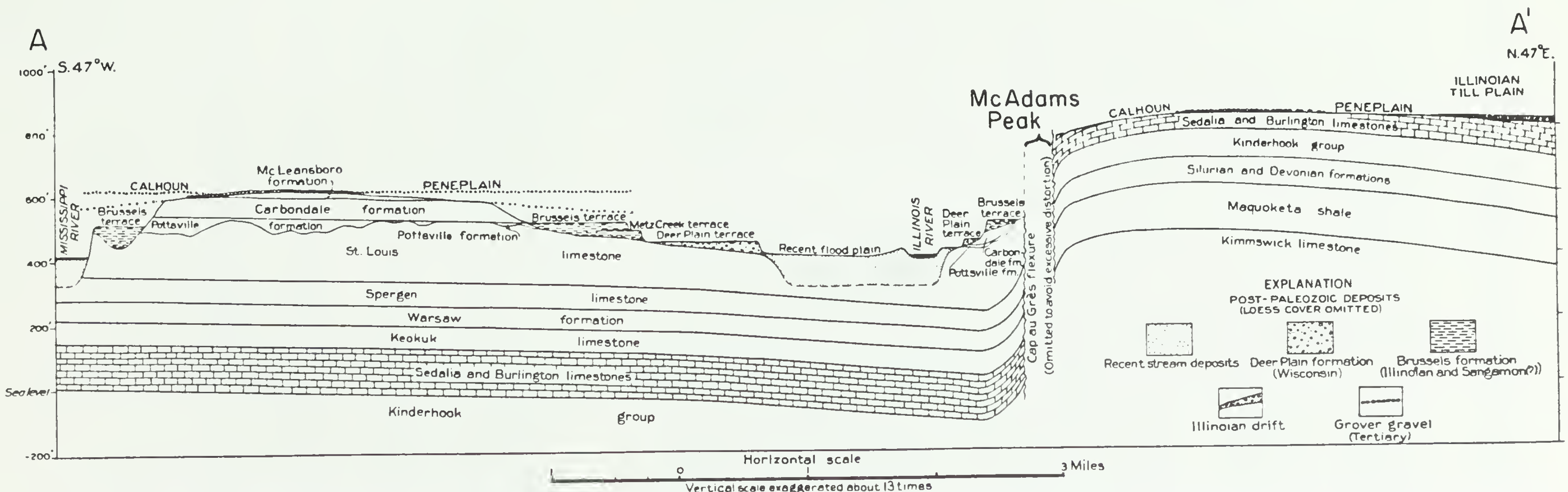
Dating of abandonment of the Calhoun surface and the entrenchment of valleys into bedrock remains a matter of debate. Rubey (1952) favored the interpretation that valley incision was caused by regional uplift in the Pliocene or early Pleistocene. Willman and Frye (1969) argued that the uniformity of distribution of old outwash across the uplands bordering both sides of the Mississippi Valley (in northwest Illinois) required glacial deposition prior to valley incision. They also identified drift at the base of the Mississippi bedrock valley as "Kansan", and suggested that entrenchment to maximum valley depth proceeded relatively rapidly following "Nebraskan" glaciation, but preceeding "Kansan" glaciation.

Evidence from the Calhoun upland suggests that valley incision occured in at least two stages and possibly several:

1. The higher slopes on the interfluves form a sloping "intermediate level surface" (Fig. 8-3) which apparently was graded to river levels at least 40 m higher than the modern river floodplains, suggesting a lengthy pause in downcutting.
2. There is a relatively high outwash filled channel through the upland on the west side of Calhoun County ("Batchtown channel") identified by Rubey (1952) as "Kansan" in age.

Features of the Illinois Valley

McAdams Peak overlook provides a grand view of the lower Illinois Valley which was once the valley of the Ancient Mississippi River. During the Pleistocene almost unimaginable quantities of meltwater passed through this stretch of valley. In pre-Illinoian times the Illinois Valley carried both the upper Mississippi River drainage and much of the Ohio River drainage via the Mahomet-Teays valley system which entered from the east at a point about 130 km upstream from here (Willman and Frye, 1970). Illinoian glaciers buried the Mahomet-Teays valley, but the Mississippi River continued to occupy this river until it was permanently diverted by Woodfordian ice ca. 20,000 B.P. Large discharges of outwash and meltwater from retreating glaciers in northeastern Illinois and northern Indiana continued to about 14,000 B.P. From 14,000 to about 11,000 B.P. the Illinois Valley



GENERALIZED CROSS SECTION NORTHEASTWARD FROM THE LOWER END OF PERUQUE ISLAND TO THE NORTHEAST CORNER OF THE BRUSSELS QUADRANGLE, SHOWING THE BEDROCK STRUCTURE, THE DEFORMED CALHOUN PENEPLAIN, THE INTERMEDIATE POST-MATURE UPLAND SURFACE, THREE RIVER TERRACES, AND THE RECENT FLOOD PLAINS OF THE MISSISSIPPI AND ILLINOIS RIVERS

Figure 8-3. Cross section across the southern Calhoun County upland, the Illinois Valley, and Pere Marquette State Park (reproduced from Rubey, 1952).

continued to carry large discharge from the ancestral Great Lakes which entered from the Lake Michigan Basin via the Chicago Outlet (Hansel and others, 1985).

At the south edge of our field of view the Illinois Valley joins the Mississippi Valley, and just 10 km across the Mississippi Valley from that point is the mouth of the Missouri Valley. For this reason the lower Illinois Valley has a complex history of interaction with other major river systems. Since the diversion of the Mississippi River to its present valley, ca. 20,000 years ago, the Illinois River has generally been subordinate to, and controlled by, the large Mississippi and Missouri river systems. A common recurring event has been the drowning of the lower Illinois Valley either by direct flooding from major discharge events in the Mississippi/Missouri system, or by alluvial damming of the Illinois Valley mouth. A terrace on the west side of the valley opposite us (Deer Plain terrace) was created by such an interaction in late Wisconsinan time. The Deer Plain terrace displays an anomalous up-valley gradient from a relatively coarse alluvial dam facies at the valley mouth to a clayey lacustrine facies up the Illinois Valley. These deposits will be seen at Stop #9.

During the Holocene, the Mississippi River continued to deposit bars in the mouth of the Illinois Valley forming Calhoun Point (Fig. 8-2), a spit of land which diverts the Illinois River to the east side of its valley and prevents the rivers from joining for several kilometers downstream from the valley mouth. In the immediate foreground, is the channel of the Illinois River, flanked by backwater lakes. Backwaters such as these were common features in the Illinois River floodplain in early historic time. The timbered strips which separate the river channel from the lakes are natural levees, which are well developed along the Illinois River.

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ADDENDUM TO STOP #8: HILL PRAIRIES

Frances B. King

Most of the original upland prairies of Illinois have been converted to cropland. The remainder exist primarily as small remnants in environments unsuitable for agriculture. The most abundant remnants are the hill prairies that occur on steep, usually south-facing slopes, along the Illinois, Mississippi, and lower Sangamon Rivers (Fig. 8-4). The AMQUA field trip follows along the Illinois and Mississippi river valleys, and hill prairies will frequently be seen from the bus.

Although the name "hill prairies" was not formally coined until 1943 by Vestal, they had been described much earlier by Worthen (1868) in a discussion of loess-capped bluffs. The majority of the hill prairies do not occur on hill-tops but on upper west- and south-facing slopes adjoining the rivers. Kilburn and Warren (1963) found that slopes varied from approximately 17.3 to 56.3%, with an average of 32.8% The bedrock of the bluffs on which hill prairies occur can be limestone, dolomite, shale, or sandstone, or a combination of these. The surficial material is usually loess, with varying amounts of sand and clay. Kilburn and Warren (1963) reported a series of hill prairies along the lower Illinois Valley with soils comprised of 79 to 85% sand.

The vegetation of hill prairies differs greatly from that of prairies in floodplains or level uplands. The dominant grasses are bunch grasses rather than sod-formers and they tend to be mid-sized rather then the tall grasses characteristic of the mesic prairie. The most common is little bluestem (*Schizachyrium scoparius*), comprising an average of 45% to 86% of the vegetation of hill prairies (Kilburn and Warren, 1963; Voight and Mohlenbrock, 1964). Other species listed by Evers (1955) as occurring in 80% or more of the hill prairies he studied include side-oats grama (*Bouteloua curtipendula*), daisy-fleabane (*Erigeron strigosus*), purple prairie clover (*Petalostemum purpureum*), flat-topped spurge (*Euphorbia corrolata*), beard-tongue (*Penstemon pallidus*), big bluestem (*Andropogon gerardi*), hoary vervain (*Verbena stricta*), and false boneset (*Kuhnia eupatoriodes*).

Species that are considered characteristic of the hill prairies because they are more common here than in other types of prairie include side-oats grama, scurf pea (*Psoralea tenuiflora*), white prairie clover (*Petalostemum candidum*), flax (*Linum sulcatum*), and puccoon (*Lithospermum incisum*). The species most likely to be blooming in early summer are spiderwort (*Tradescantia ohioensis*), purple prairie clover, white prairie clover, and groundsel (*Senecio plattensis*).

The hill prairies are usually bordered by shrubs and small trees such as sumac (*Rhus glabra* and *R. aromatica*), rough-leaved

Figure 8-4. Map showing the distribution of extant hill prairies in Illinois (based on Evers, 1955); arrows point to stops on this fieldtrip; MP stands for McAdams Point; MO stands for Modoc Rock Shelter. Inset shows profile of bluffs along major stream valleys in Illinois; the bluff includes a talus slope, a cliff, a rock ledge, and an upper slope which often support hill prairies (Evers, 1955).

dogwood (Cornus drummondii), prairie crab apple (Malus ioensis), redbud (Cercis canadensis), and sassafras (Sassafras albidum). Such plants occur at the McAdams Point hill prairie in the coves between the grass covered spurs.

The persistence of prairie species in hill prairies is apparently favored by a combination of the high sand content of the soils, rapid runoff because of the steep slopes, high temperatures, and exposure to prevailing winds on these south-facing and river-facing slopes. Despite the hostile environment, trees and shrubs do invade the prairies from the adjacent forested ravines and uplands. In many cases tree and shrub seedlings that become established during wet years die during years of normal climatic conditions or drought (Evers, 1955; Voight and Mohlenbrock, 1963). In less xeric situations however, fire may be an important factor in maintaining the hill prairies (Kilburn and Warren, 1963).

Perhaps because they already lack many of the plants that decrease in abundance under heavy grazing pressure, hill prairies have been surprisingly successful in resisting destruction by grazing animals and human activities (Evers, 1955). Nonetheless, occasional occurrences of prairie species along the edges of cultivated fields on the upper slopes suggest that hill prairies may have been much more extensive in the past than they are today.

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The LATE WISCONSINAN DEER PLAIN TERRACE IN THE LOWER ILLINOIS RIVER VALLEY

Edwin R. Hajic

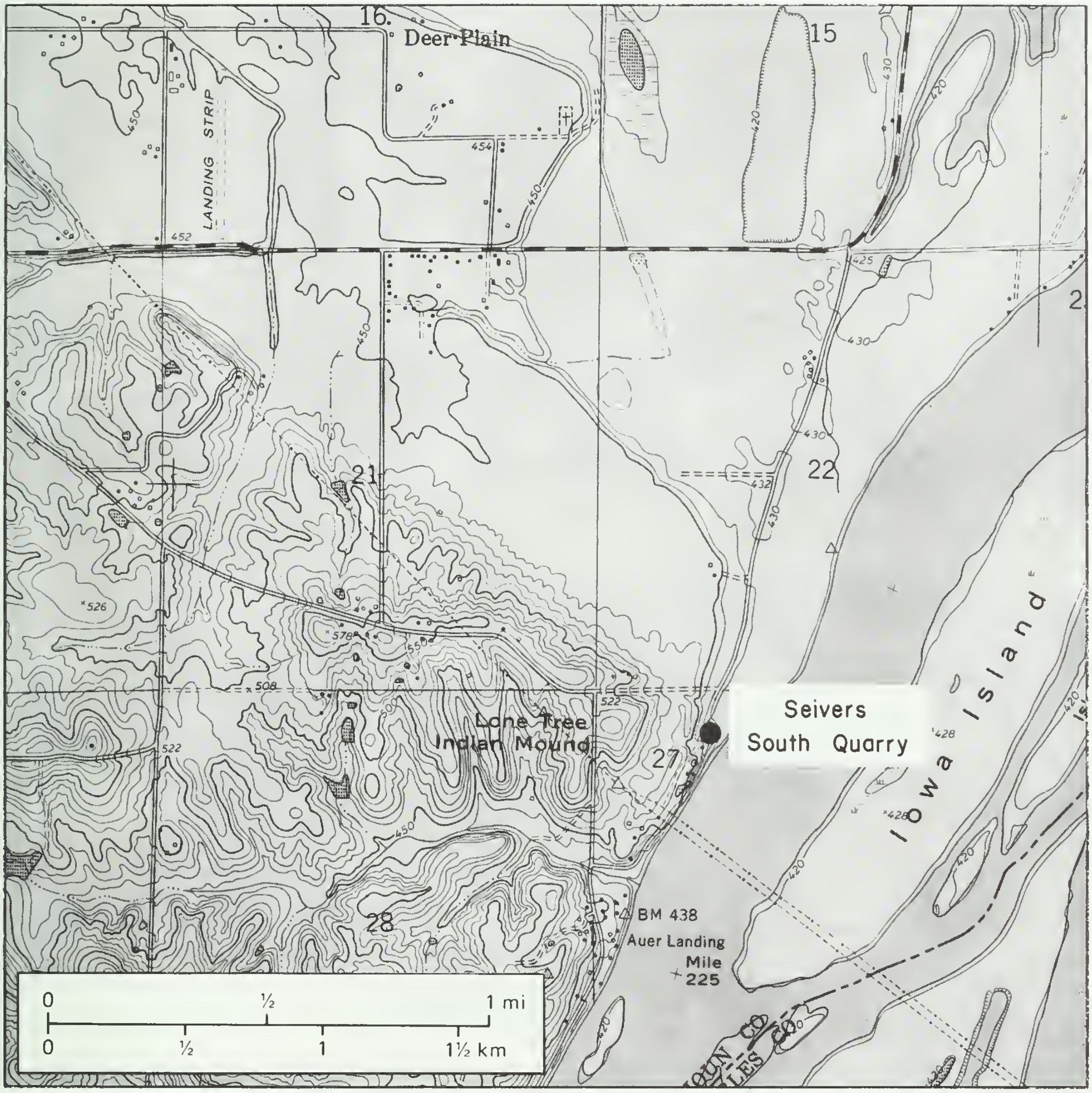

Figure 9-1
STOP 9
Seivers South Quarry Section
NE NW NW Sec. 27, T13S, R1W, Calhoun County, IL
Brussels 7.5 minute Quadrangle

INTRODUCTION

The purposes of this stop are to examine lithofacies of the extensive Deer Plain (Savanna) terrace and a lower surface at Seivers South Quarry (Fig. 9-1). In addition to the outcrops, cores taken from the Deer Plain terrace in the lower Illinois Valley will be displayed at this stop, providing an opportunity to view the laminated silt and clay lithofacies encountered there. Terrace age and late Wisconsinan valley history also will be discussed.

Seivers South Quarry is located at the junction of the Illinois Valley with the Mississippi Valley. Immediately south and east of the quarry lies a narrow late Holocene floodplain and the Mississippi River. Loess-mantled terrace surfaces, mapped by Rubey (1952) as Brussels terrace, rise to the northwest. In 1982 limestone quarrying operations exposed cross-stratified and horizontal bedded sand fining upward to laminated and thin bedded silt and clay (Fig. 9-2, Section A), in addition to cross-laminated sand and sandy loam in a small remnant of a terrace slightly lower than the Deer Plain terrace (Fig. 9-2, Section B). Further quarrying in 1985 destroyed Sections A and B leaving only the Deer Plain silt and clay exposed (Section C). Although the original morphology of the lower surface remnant was destroyed, a composite section of related sand and silt is still exposed (Sections D and E).

DISTRIBUTION AND MORPHOLOGY

The Deer Plain Terrace, defined and mapped by Rubey (1952) in both Illinois and adjacent Mississippi valleys, is locally the highest terrace lacking a loess mantle. In the lower 33 km of the Illinois Valley it constitutes narrow continuous belts along both sides of the valley and is present in tributary valleys. In the upvalley direction, remnants are fewer and they merge with the floodplain where they eventually become buried by younger deposits. In the Mississippi Valley, remnants are preserved only in tributary valleys.

Within the Illinois Valley the Deer Plain terrace exhibits a striking reverse slope relative to the river gradient (Fig. 9-3). At the confluence with the Mississippi Valley the surface stands about 140.2 m (460 ft), about 11 m above local flood basins. In an upvalley direction it slopes steeply at first and then levels out at an altitude of about 131.1 m (430 ft). Except for the southernmost 4.7 km, Illinois Valley Deer Plain terrace surfaces are nearly featureless but may slope slightly towards the valley axis. At and near the mouth of the Illinois Valley the surface is covered by dunes continuously along its margin and sporadically on the interior.

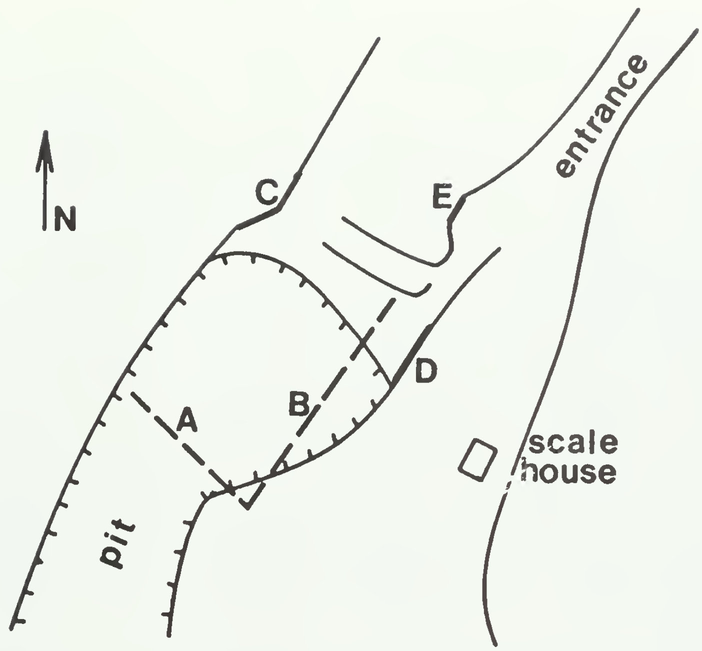

Figure 9-2. Location of sections at Seivers South Quarry.

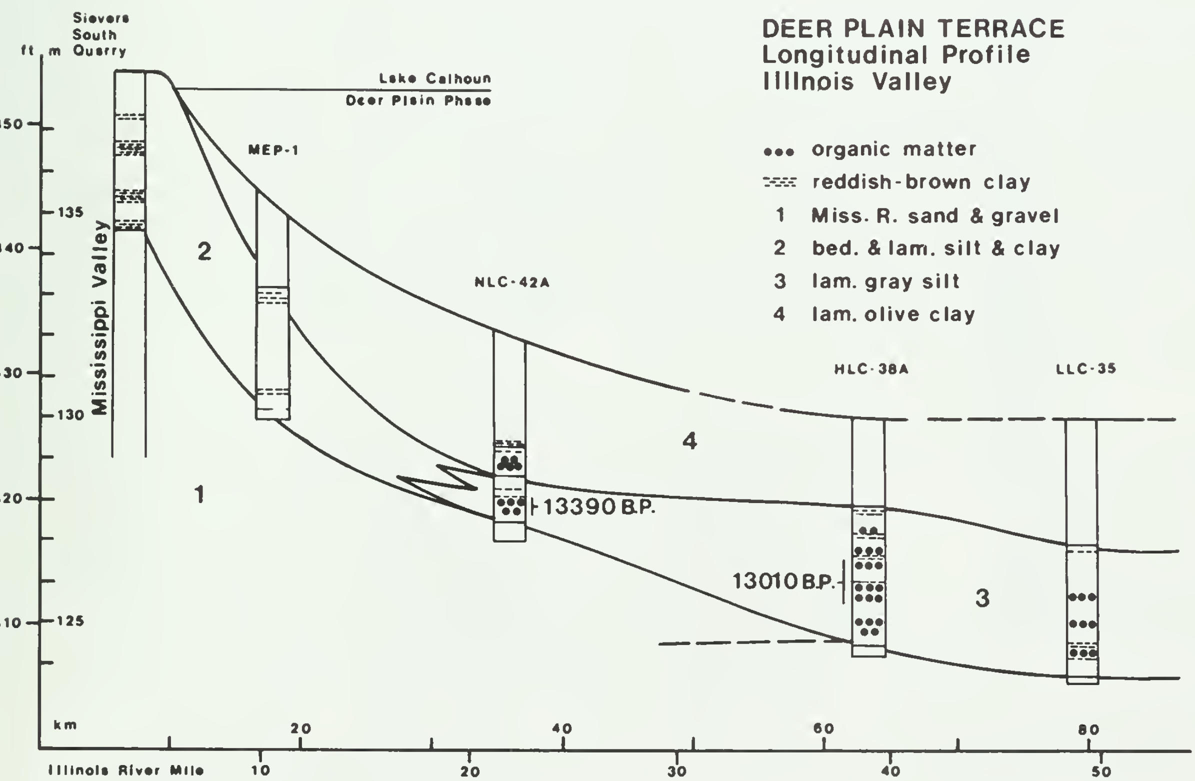

Figure 9-3. Longitudinal section and lithofacies relationships of the Deer Plain terrace in the lower Illinois Valley.

DESCRIPTION AND INTERPRETATIONS

Rubey (1952) recognized the terrace and associated deposits as recording a period of Mississippi Valley outwash aggradation resulting in impoundment of the Illinois River and lacustrine deposition in the Illinois Valley. When the sediment dam at the Illinois Valley mouth was breached and the Illinois River downcut, the drained lake plain remained in a terrace position. More recently Butzer (1977: 18) suggested that the marked reverse slope of the terrace in the Illinois Valley may have developed "during successively lower stages of river level" as the river downcut. Hajic (1985a) described four lithofacies associated with the Deer Plain Terrace (Fig. 9-3): Mississippi Valley fluvial/glaciofluvial sand and gravel that formed a sediment dam in the Illinois Valley mouth; Mississippi Valley overbank silt and clay overlying the sand and gravel; and slackwater or lacustrine silt overlain by lacustrine clay in the Illinois Valley.

The sand and gravel facies below the Deer Plain terrace currently is not exposed because of relatively high bedrock surface altitudes in section locations. In 1982 about 4 m of sand was exposed in Section A (Fig. 9-2) in a drainage gully with a base at about 132 m where bedrock was not encountered. In the lower part of the section, trough and planar cross-bedded, medium sand graded upwards to ripple-drift cross-laminated, fine to loamy sand and horizontal laminated and bedded, very fine sand to silt. Towards the upper part of the sequence reddish-brown clay and silty clay laminae draped starved climbing ripples. Thin continuous horizontal interbeds of similar clay were common.

In the lower to middle part of the sequence flame structures, small sand dikes, and other soft-sediment deformational structures were common. Sediments exposed in Section C (Figs. 9-2 and 9-4) are similar to what was exposed in the upper part of Section A. The basal unit exposed in the pit at the base of Section C consists of interbedded silt and loam and silty clay loam resting on bedrock. This basal unit is not related to the Deer Plain terrace; it is probably related to the Brussels terrace.

Unconformably overlying the basal unit are interbedded and cross-laminated fine sand to very fine sandy loam, and silty clay loam to silty clay. In places, beds of the latter exhibit microfaults. The lowermost beds contain rip-up clasts of the finer material. A thinly bedded and laminated grayish to light olive brown silt, very fine sandy silt, and silt loam facies greater than 2.5 m thick overlies the sandier basal beds. In Section C the former sediments primarily are filling a broad swale. Discontinuous thin sand lenses occur in the lower part. Reddish-brown, silty clay laminae and thin beds, with a relatively large kaolinite plus chlorite content, increase with frequency upwards. Stratification is slightly deformed and

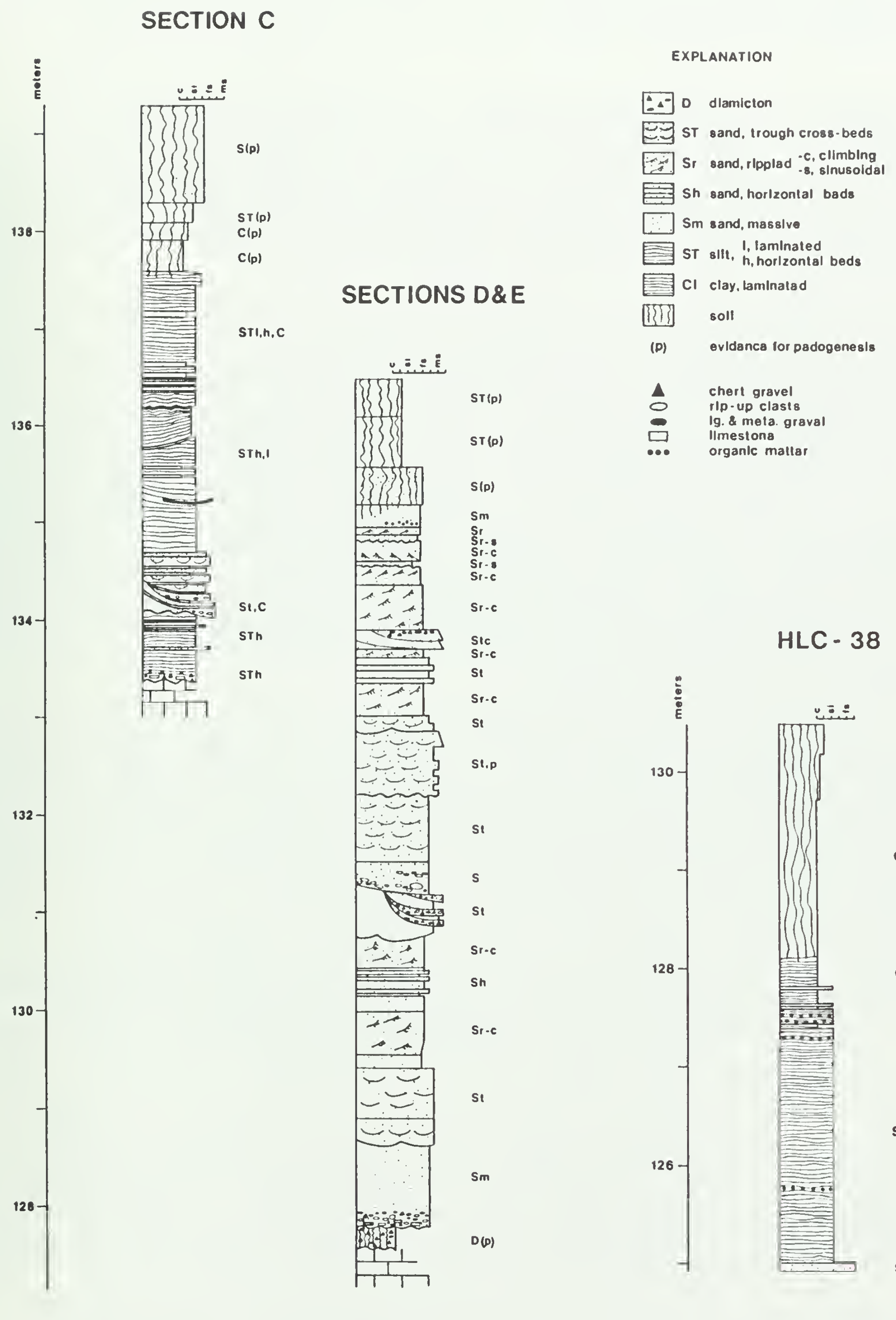

Figure 9-4. Lithofacies of Seivers South Quarry Sections C, D and E, and lower Illinois Valley core HLC-38.

individual laminae are sometimes ruptured. The fining upward sequence culminates in a smectitic, olive gray silty clay, loam to clay loam. The uppermost facies is a fine sandy loam, slightly thicker than 1.0 m.

The surface soil is developed in roughly the upper 2.0 m of the section. It exhibits subangular blocky structure except in the olive gray, silty clay loam where the structure is strongly expressed as angular blocky. The entire section is leached and much of it is mottled. Some of the vertical mottles suggest root penetration. Only a few of the finer textured units exhibit clay skins or pores.

The bedded sand facies that was exposed in the lower part of Section A represents aggradation of fluvial channel deposits, probably by a succession of floods. The shift upsection to cross lamination and starved ripples with clay drapes are due to decelerating flow associated with the waning stages of flood. The horizontal bedded and laminated silt and clay facies exposed in Section C are interpreted as a series of overbank floodplain deposits. A final increment of eolian dune sand is suggested by the fine sandy loam facies at the top of the section. Although carbonates are absent and mottling prevalent, there is little, if any, indication that deposition ceased for any considerable period of time. The lack of significant pedogenic modification of the unit along with the occurrence of soft-sediment deformation features suggests that deposition was rather continuous and probably rapid.

A composite of sediments beneath the lower terrace is exposed in Sections D and E at Seivers South Quarry (Figs. 9-2 and 9-4). A strongly oxidized and leached strong brown to yellowish-red, clay diamicton discontinuously overlies bedrock at the base of the section (Section D). Chert clasts are common and a few degraded igneous pebbles also were found.

The remainder of the composite section unconformably overlies the clay diamicton. It is entirely leached except for the lowest 0.10 m. The section consists of several fining upward sequences, most between 2 and 3 m thick. Sequences exhibit similar vertical patterns of sedimentary structures. Sets of primarily trough cross-bedded, coarse to medium, and fine sand occur in the lower part with basal cut and fill structures. Rip-up clasts, pebbles, and coarse sand are incorporated in these scour fills. In Section D many rip-up clasts consist of Deer Plain-related silt and reddish-brown clay, the largest over 0.25 m in diameter. Igneous pebbles, flaggey pieces of limestone attaining lengths of 0.40 m, and calcareous silt clasts, of local but questionable origin also are incorporated near the section base. Rip-up clasts range from angular to subrounded.

Upsequence, structures abruptly change to ripple-drift cross-laminations of fine to very fine loamy sand. In the basal fining-upward sequence (Section D), a set of thin horizontally bedded and laminated sand occurs between two rippled zones. The uppermost surface of this sequence has small burrows filled with coarser sand from above. The uppermost fining-upward sequence (Section E) grades upward into sinusoidal ripples of very fine sand grading upward to coarse silt.

The composite of Sections D and E represent a series of waning flood cycles with accretion of channel deposits with decelerating flow. The frequency of silt and the fining upward sequence exhibited by some of the rippled units suggests decreasing discharge and possibly a relatively large suspended sediment load. Some lateral channel migration into the adjacent Deer Plain silt and clay facies is indicated by the quantity of rip-up clasts.

Coring of Deer Plain terrace remnants in the Illinois Valley has revealed a stratigraphy consistent with that displayed in core HLC-38 (Hajic 1985a) (Figs. 9-3 and 9-4). In all but the lowermost 5 km of the Illinois Valley, the basal Deer Plain terrace-related sediment is a laminated, unleached, gray silt facies up to several meters thick. It typically overlies oxidized sand abruptly. The facies is also marked by interstratified, reddish-brown, clay and silty clay laminae and thin beds. Organic material consisting of conifer wood, bark and needles with seeds and fine plant material is common. It can occur as organic laminae with or without a sediment matrix or dispersed. Gastropods and fine pebbles rarely are found.

Laminated gray silt is conformably overlain by a second facies consisting of laminated, unleached, olive to gray, smectitic clay (Figs. 9-3 and 9-4). Occasionally reddish-brown clay and silty clay interbeds occur in the lower part of this facies as well as laminae of biogenic calcite. The olive clay in places exceeds thicknesses of 14 meters and often exhibits slickensides. Fossils have not been found in this facies. The Darwin silty clay loam series is developed in this facies where the Deer Plain terrace is not buried by alluvial fans or wash.

Based upon their laminated structure and fine texture, both Deer Plain facies in the Illinois Valley are interpreted as lacustrine in origin. The basal gray silt may have been deposited under slackwater conditions with a minor current.

DISCUSSION

Rubey's (1952) model of a sediment dam in the Illinois Valley mouth and lacustrine deposition in the Illinois Valley accounts for the reverse slope of the Deer Plain terrace (Hajic, 1985a). This model is supported by lithofacies, stratigraphic, geomorphic, and pedologic relationships between Deer Plain-related deposits and morphology along the Illinois Valley. These relationships are apparent in both the Illinois Valley mouth and the nearby reach of the Mississippi Valley. The lake that formed periodically in the lower Illinois Valley, one phase of which is recorded by Deer Plain-related deposits, has been informally referred to as Lake Calhoun (Hajic, 1985a).

Mississippi Valley aggradation and Illinois Valley mouth sediment dam construction was nearly completed by 13,300 B.P. (Hajic 1983; 1985a; 1985b). This is confirmed by radiocarbon dates and the continuity of reddish-brown clay from solums of surface soils which developed into the valley-mouth sediment dam to the basal lacustrine laminated gray silt in the Illinois Valley (Fig. 9-3). A date of 13,010 ± 140 B.P. (ISGS-900) has been recorded from the basal laminated gray silt in core HLC-38. In addition, coniferous wood and needles collected in the lower Illinois Valley, also in direct association with reddish-brown clay, dated 13,390 ± 190 B.P. (ISGS-894). This sample was from the basal laminated gray silt facies (Hajic, 1985b). A date of 13,360 ±100 B.P. (ISGS-875) was derived from lake-margin sediments beneath the Koster site excavations (Hajic, in press; Wiant and others, 1983; see Stop #11). Wood from laminated silt, with occasional reddish-brown silty clay laminae, infilling a broad sluiceway and preserved in the uppermost segment of the lower Illinois Valley, yielded dates of 13,360 ± 240 B.P. (ISGS-1264) and 13,340 ± 180 B.P. (ISGS-1284) (Hajic, 1986).

Final accumulation of Deer Plain-related deposits, lake drainage in response to Mississippi River downcutting, and exposure of the lake plain may have occurred between 12,000 and 12,400 B.P. Wood collected from the Keach School terrace (Butzer, 1977), a younger terrace remnant inset into the Deer Plain terrace, has been dated at 12,000 ± 100 B.P. (ISGS-911) (Hajic, 1985b). A date of 12,325 ± 75 B.P. (ISGS-415) (Butzer, 1977) was obtained from lake-margin sediments associated with the Deer Plain phase of Lake Calhoun (Hajic, 1986).

The continuity of reddish-brown clay from near the surface of the Deer Plain terrace in the Mississippi Valley and at depth in the lower Illinois Valley suggests that the latter occurrence is due to backwash over the sediment dam. However, it is possible some reddish-brown clay in the lower illinois Valley entered through Glacial Lake Chicago. Hansel and others (1985) indicate reactivation of the Chicago Outlet near the head of the Illinois Valley shortly after 13,000 B.P. This follows initiation of the Glenwood II Phase of Lake Chicago with readvance of Lake Michigan Lobe ice. During the preceeding Intra-Glenwood Low Phase, reddish-brown clay from the Lake Superior basin entered the Lake Michigan basin and the Chicago Outlet was inactive. With Chicago Outlet reactivation, increased discharges entraining reddish-brown clay also may have reworked floodplains and transported organic debris to the lower Illinois Valley. The Deer Plain dates are within the time span estimated for the Intra-Glenwood Low Phase (Hansel and others, 1985).

The Deer Plain terrace is correlative with the extensive Savanna terrace (Flock, 1983) in the Mississippi Valley. Flock described the upper 1 to 3 m of Savanna terrace sediment as primarily interbedded red clay, gray clay, and silt. The red clay, containing substantial amounts of chlorite plus kaolinite, was from the Lake Superior Basin. The montmorillinite gray clay was from Lake Agassiz and possibly other temporary lakes west of the Superior basin. These sediments are identical to the uppermost deposits of Savanna (Zwingle) terrace remnants described along the Mississippi Valley in Iowa (Bettis and Hallberg, 1985) and exposed in Seivers South Quarry Section C. Flock (1983) applied several of the aforementioned radiocarbon dates fom basal Deer Plain lacustrine deposits in the lower Illinois Valley to the Savanna terrace in general. He concluded that deposition of basal Savanna terrace sediments began about 13,000 B.P. However, this interpretation is inconsistent with the lithofacies associations of the Deer Plain terrace. Radiocarbon dates indicate that most Mississippi Valley aggradation related to the Savanna terrace occurred before about 13,300 B.P. Dates from material from well within the Savanna terrace in Iowa suggest sedimentation was initiated before 17,000 B.P. (Bettis and Hallberg, 1985). The basal age of Savanna (Deer Plain) terrace-forming deposits in the Mississippi Valley at the mouth of the Illinois Valley is unknown. Minimum altitudes of the lacustrine olive clay facies in the Illinois Valley and altitude of the valley mouth sediment dam indicate that the Mississippi Valley locally aggraded at least 20 m.

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PRE-WISCONSINAN LOESSES AND PALEOSOLS AT PANCAKE HOLLOW, WEST-CENTRAL ILLINOIS

Edwin R. Hajic

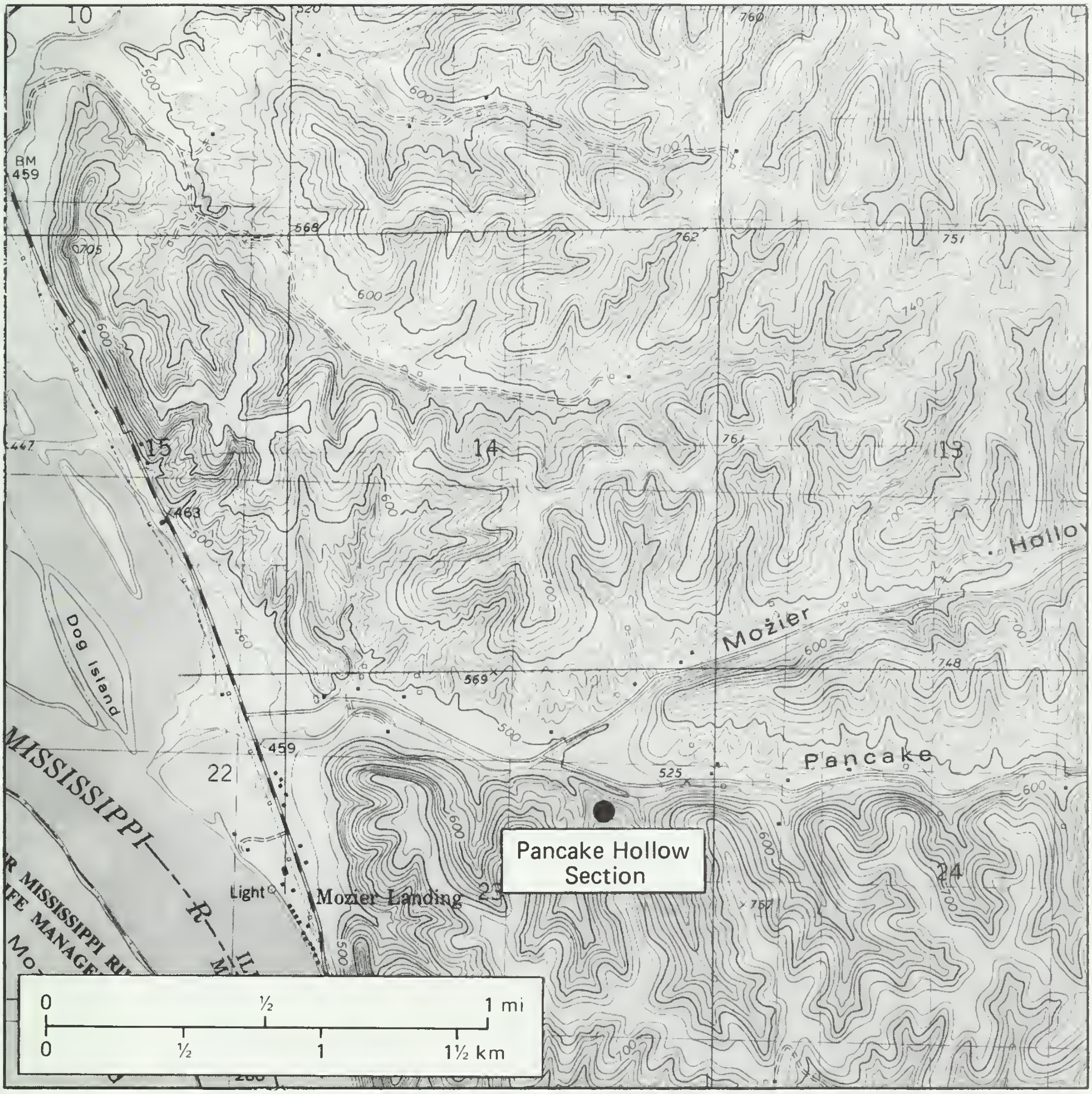

Figure 10-1
STOP 10
Pancake Hollow Section
NE SW NE Sec. 23, T9S, R3W, Calhoun County, IL
Pleasant Dale Valley 7.5 minute Quadrangle

INTRODUCTION

Pancake Hollow Section 1, 1 km east of the Mississippi Valley at the junction of Mozier and Pancake hollows (Fig. 10-1), is a previously undescribed cutbank exposure. It formed in 1982 when Pancake Hollow Creek undercut its south bank. This is the first reported exposure in unglaciated west-central Illinois of multiple pre-Wisconsinan silts of loessial origin with intervening paleosols. The roughly 15 m cut exposes at least two, and possibly four, pre-Wisconsinan paleosols and four silt-dominated loess or loess-derived deposits. All of these deposits are below relatively high level tributary creek chert gravels, Loveland Silt, Sangamon Soil, Roxana Silt, Farmdale Soil, and Peoria Loess. All deposits are continuous across the outcrop. The section was described and sampled in November, 1985, although investigations of this section and other cutbank exposures to the east are still in early stages.

LANDSCAPE POSITION

Deposits exposed at Pancake Hollow Section 1 are associated with a remnant of a high level surface that slopes toward the hollow axis from about 170 to 180 m (560 to 600 ft). This high level surface locally forms a dissected bench up to 1.5 km wide, typically at about 188 m (620 ft), along the east side of the Mississippi Valley south of Pancake Hollow. Drainage divides in the area are at about 224 m (740 ft) and the nearby Mississippi Valley flood basin is at about 132 m (435 ft). To the south, the surface forms a dissected bedrock-walled valley that Rubey (1952) called the "Batchtown channel". The outlet of the "Batchtown channel" is obscured south of the Cap au Gres faulted flexure, an east-west trending monoclinal fold with downthrown side to the south, where the landscape contrasts sharply with that north of the fault.

DESCRIPTION AND INTERPRETATION

At the base of the section (Fig. 10-2), Unit 1 is a leached dark yellowish-brown to dark brown silty clay loam diamicton that grades upward to a pebbly silty clay loam with decreasing pebble frequency. Pebbles also rapidly decrease in frequency near and below creek level. Clasts are subangular to angular chert and can be in excess of 0.40 m in diameter. Sand content (about 4 %, primarily consisting of chert) and a ratio of very coarse (31-63 um) to coarse silt (16-31 um) of about 1.1 $\pm$ 0.1 remain nearly uniform throughout the unit. The unit is at least 2.73 m thick; its base is not exposed at this section but to the east, Unit 1 overlies the Hannibal Shale.

The entire unit is pedogenically altered with strong soil expression; it exhibits subangular and angular blocky soil structure, a Bt horizon roughly centered on the zone with the largest frequency of chert clasts, large oxide concretions up to

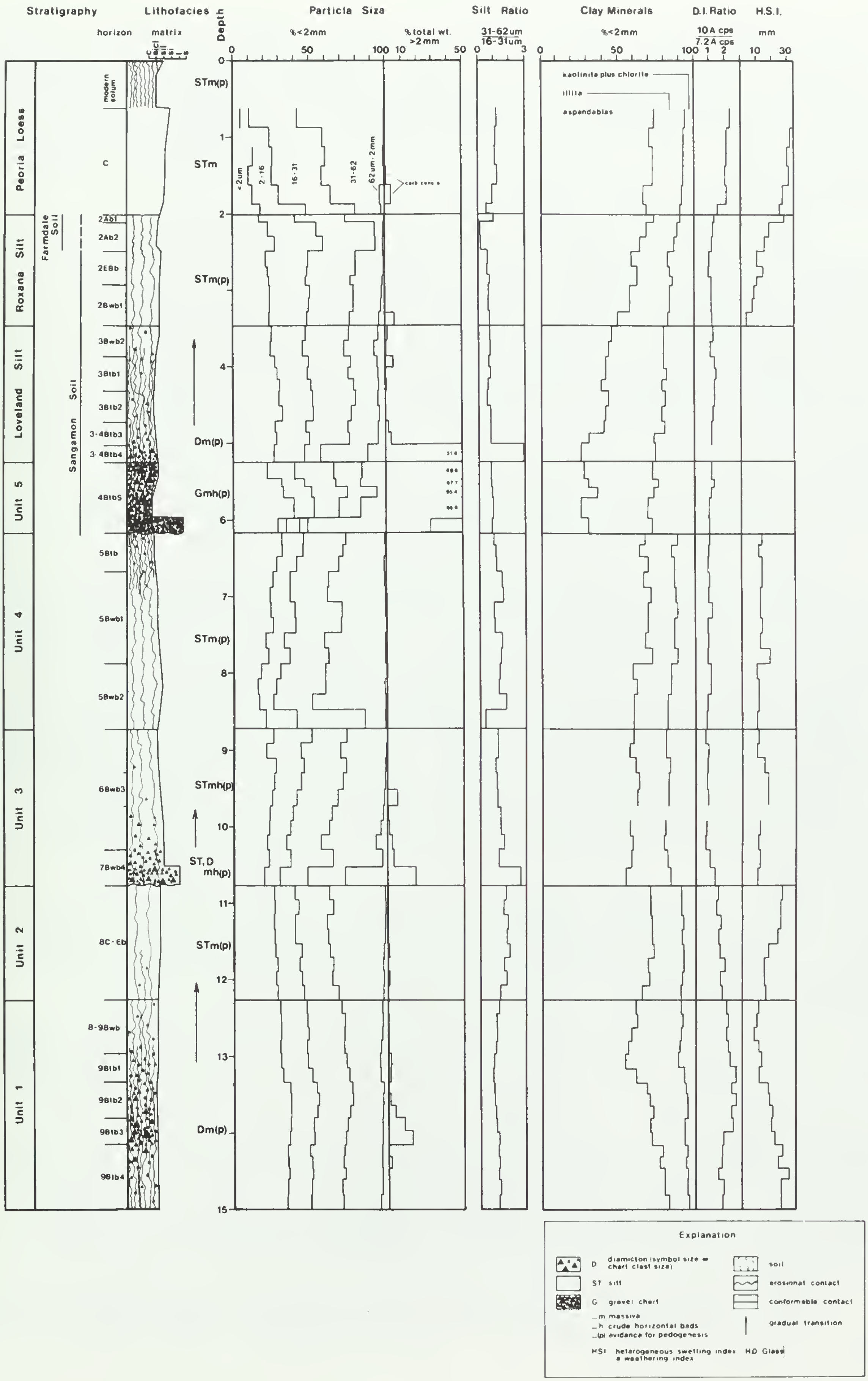

Figure 10-2. Pancake Hollow Section 1 stratigraphy, lithofacies, particle size and clay mineralogy.

3 cm in diameter, and many pores. The apparent decrease in percent expandable clays centered slightly above the Bt maximum is a result of weathering and is reflected in the Heterogeneous Swelling Index (HSI). Clay mineralogy (<2 um) averages 79% expandables, 15% illite and 6% kaolinite plus chlorite in the lower 0.85 m of the sampled unit where clay mineralogy apparently is least altered by weathering.

The diamicton facies of Unit 1 are interpreted as colluvium and the upsection decreases in pebbles, in part, may reflect initial eolian influx of the overlying silt. Unit 1 differs markedly from the relatively thick, strongly oxidized, cherty clay diamicton weathering mantle. The material, often referred to as "residuum", is commonly found on upland divides overlying bedrock and underlying Wisconsinan loesses in Calhoun County. The matrix of Unit 1 is texturally and clay mineralogically similar to loess, implying it is probably loess derived with further implications that the original eolian deposit records a glacial interval. The strong degree of soil expression, similar to both Sangamon and modern soils, suggests the paleosol developed during at least one interglacial interval.

Unit 2 is a 1.5 m thick unbedded, primarily leached yellowish to olive brown heavy silt loam. Krotovina 2-3 cm in diameter in the uppermost part of the profile are filled with sediment from the overlying unit. Sand content is small, and along with clay content, decreases slightly upward. The silt ratio is nearly uniform, averaging about 1.7, with appreciably greater very coarse silt content than Unit 1. Unit 2 conformably overlies Unit 1, grading downward into it; the gradual boundary is reflected in transition zones of the very coarse silt component, very coarse to coarse silt ratio, clay mineral percentages, and occasional very fine chert pebbles in the lower part of Unit 2. Similar to Unit 1, it contains abundant expandable clay minerals and relatively small amounts of illite and kaolinite plus chlorite. The composition is nearly identical to the clay mineral composition of the Peoria Loess. Expandable clay minerals and kaolinite plus chlorite average 8% less and 3% more, respectively, than the least altered clay mineral assemblage of Unit 1.

The massive character and uniform silt-dominated texture of Unit 2 suggest that it is a loess. Larger silt ratios than Unit 1 and clay mineral differences indicate that Unit 2 was not derived from Unit 1 but rather is a distinct deposit. The gradual boundary between the two units suggests that the rate of Unit 2 deposition initially was relatively slow creating a cumulative profile with pedogenic mixing. Unit 2 was modified by pedogenic processes related to a younger upper solum of the underlying soil. Unit 2 loess signifies a second glacial interval.

Unit 3 and Unit 4 are both fining upward sequences, leached and pedogenically altered to varying degrees. The lower sequence, Unit 3, 2.04 m thick, unconformably overlies Unit 2 and consists of a basal bed of crudely stratified brown sandy loam diamicton, silt loam and pebbly silt loam. To the west this bed thins and exhibits a sharper contact. It is overlain by three crudely defined massive beds of silt loam and heavy silt loam with few chert pebbles decreasing upwards. Sand content decreases rapidly upward.

The upper sequence, Unit 4, is a 2.55 m dark yellowish brown silt loam that grades up to silty clay loam and exhibits no visible bedding. The boundary with Unit 3 is clear to gradual. There is negligible sand throughout. Very coarse silt, reaching 40%, decreases as clay increases upward. Silt ratios are similar to Unit 3 but are more variable. Few fine chert pebbles occur in the uppermost 0.30 m as do krotovina filled with sediments from overlying units. The entire unit is modified by the lower horizons of an erosionally truncated soil. The base of the Bt horizon of this soil is preserved but the weathering is not reflected in the HSI.

Clay mineral content of Units 3 and 4 is again dominated by expandables, but they comprise a lesser fraction than in underlying Units 1 and 2, as kaolinite content is greater. Within Unit 4, approximately 0.85 m from its base, there is an abrupt but slight change in relative clay mineral frequencies. Expandable clay minerals increase while kaolinite plus chlorite decrease to a lesser degree.

Unit 3 is interpreted as a fluvial and/or colluvial deposit that was eventually swamped by loess accumulation. The abrupt basal erosional contact suggests some initial fluvial activity. Chert pebbles in the silty matrix suggest colluviation or fluvial overbank deposition. Pedogenic alteration of the entire unit indicates either relatively slow loess accumulation with concomitant soil formation, or modification by the soil in Unit 4.

Unit 4 is interpreted as a loess based upon grain size, clay mineralogy and its massive character. Some colluvial additions at the top of the sequence are suggested by the presence of a few chert clasts. Clay mineral similarities and the lack of a strong soil at the top of Unit 3 suggest that Units 3 and 4 are closely related. Along with the strongly developed soil in Unit 4, they represent at least one glacial interval followed by at least one interglacial.

Crude thin beds of Unit 5, consisting of chert pebbles and cobbles and containing relatively small amounts of leached sand and fines, unconformably overlie Unit 4. Beds range from 0.10 to 0.27 m thick and have a cumulative thickness of about 0.95 m. Beta horizon development modifies the whole unit; it is enriched with translocated clay related to development of the Sangamon Soil in sediment immediately overlying Unit 5. In addition, a later generation of calcareous silans occurs sporadically.

Unit 5 is interpreted as alluvium; it is texturally similar to local modern stream bedloads and bars while the crude bedding and general lack of matrix argue against a colluvial origin.

At Pancake Hollow the overlying unit is in the stratigraphic position of the Illinoian Loveland Silt. It is a leached silty clay loam diamicton grading up to a pebbly silty clay loam that probably overlies Unit 5 conformably. Sand content is nearly uniform, pebbles generally decrease in frequency upward, and silt ratios, except for the basal sample, are uniformly small throughout. The entire unit is modified by pedogenic processes; Bw and Bt horizonation is expressed downward through the unit. Expandable clay minerals show an apparent decrease in percent downward and the HSI was unmeasurable reflecting the increase in intensity of weathering.

The diamicton comprising Unit 5 is interpreted to be a colluvial facies of Loveland Silt, possibly with an initial alluvial overbank component. The uppermost chert pebbles and associated slight increase in sand content may be pedisediment reflecting the complex interaction of slope processes and soil formation. The soil is interpreted to be the Sangamon Soil.

Loveland Silt is conformably overlain by a 1.86 m increment of leached, dark brown to dark yellowish brown silt interpreted to be Wisconsinan Roxana Silt. At Pancake Hollow there are two Roxana Silt components. The lower is a heavy silt loam with sand decreasing upward. It is modified pedogenically and is interpreted to be the upper horizons of the Sangamon Soil. The upper component primarily is a massive, light silty clay loam to heavy silt loam with little very coarse silt and negligible sand. It is modified by the Farmdale Soil. Roxana Silt is overlain by up to 5.0 m of Peoria Loess, the upper part of which has been modified by pedogenesis related to the modern soil at the ground surface. Color change at the Roxana Silt-Peoria Loess contact is abrupt but textural and clay mineralogical trends across the boundary suggest there may be some minor pedogenic mixing. Peoria Loess is an unleached light silt loam to silt primarily consisting of very coarse and coarse silt. Banding may reflect original bedding to some degree, but is prmarily due to different weathering zones. Secondary carbonate nodules are common towards the base of the Peoria Loess. The base of the modern soil Bt horizon is abrupt. The abrupt change likely represents the contact of a slip plane due to mass movement of the overlying pedogenically altered material.

DISCUSSION

There is evidence at Pancake Hollow for a minimum of 5 pre-Wisconsinan glacial intervals (loess-derived silt in Unit 1, loesses of Units 2, 3, and 4, and loess-derived silt in the Loveland) and 3 interglacial soil-forming intervals, not including the 2 weaker soils developed in Units 2 and 3. The truncated Bt horizon in the upper part of Unit 4 probably represents a distinct pre-Sangamonian interglacial soil-forming interval. Clay mineralogy and the HSI indicate translocation of weathered clay during the Sangamonian did not cross the boundary between Units 4 and 5. Furthermore, if the fluvial interpretation of Unit 5 is correct, these deposits must predate the Sangamonian because Sangamon Soil is developed in deposits at lower altitudes along tributary valley slopes in the area. Also, the relative altitude of the Sangamonian Ancient Iowa River flowing in the Mississippi Valley was considerably lower than the river to which Unit 5 was graded.

At this early stage of investigation, possible regional correlations are speculative at best; the geographic extent of pre-Wisconsinan loesses and paleosols, except for the Sangamon Soil, is not well know. Further complications arise from the present lack of any direct link to till units, erosional gaps in the record, and the potential complexity of the paleosols. Nevertheless, Pancake Hollow is not unique and other sections with multiple Illinoian and older loesses and paleosols hold promise for development of a regional stratigraphy.

Within the "Batchtown channel" Rubey (1952) identified crudely bedded outwash gravel and sand that he related to pre-Illinoian ("Kansan") glaciation in Missouri with an ice margin in the Mississippi Valley. This coarse deposit is overlain by a 3-4 m thick paleosol in strongly weathered, locally gravelly, sandy clay which in turn is overlain by brown clayey silt "that is indistiguishable from loess". Water wells in the channel indicate that over 20 m of unlithified deposits overlie bedrock. Field reconnaissance has identified mutliple silts in cutbanks around the town of Batchtown. Based upon similar landscape positions, altitudes, and general degree of weathering, the basal paleosol at Pancake Hollow and the paleosol in the "Batchtown channel" described by Rubey likey are correlative.

If the "Kansan" drift in the "Batchtown channel" and on the uplands in nearby Missouri is the youngest pre-Illinoian drift, correlative with the Wolf Creek Formation defined in Iowa (Hallberg, 1980), then the basal paleosol at Pancake Hollow is probably the Yarmouth Soil. If the basal paleosol is the Yarmouth Soil, then Units 2 through 5 belong to the Loveland Silt by definition (Willman and Frye, 1970). Alternatively, the till may correlate with the older Alburnett Formation (Hallberg, 1980) and the basal soil would be pre-Yarmouthian. In either case, the paleosol indicates a pre-Illinoian Ancient Iowa River Valley floor at a relative altitude probably no higher than the modern Mississippi Valley.

Exploratory cores at and south of the Cap au Gres fault on the east side of Calhoun County indicate that at least part of the pre-Woodfordian landscape is developed on multiple pre-Sangamon silts, similar to those exposed in Pancake Hollow, and possibly deposited in the lee of bedrock highs to the west and north. It is probable that one or more of the loesses at Pancake Hollow correlate to the Burdick, Maryville, or Chinatown silts examined at Stop #4 (McKay, this volume; 1979).

Pancake Hollow illustrates the complexities that can arise from the interaction of loess accumulation, colluviation and pedogenic processes. The proximity of the section to the uplands explains why colluviation was a significant and at times dominating process. The next cutbank to the east (Pancake Hollow Section 2) was even closer to the uplands and exhibits a larger colluvial component. The pattern exhibited by the Loveland Silt colluvial facies, Sangamon Soil, Roxana Silt and Farmdale Soil is repeated by the soil and deposits of Units 1 and 2, and to some degree, the roots of the soil at the top of Unit 4. Colluviation is followed and probably accompanied by interglacial soil formation. The contact with the overlying loess is gradual with varying degrees of pedogenic mixing and physical reworking. With relatively thin or slow loess deposition as the next glacial cycle begins, further soil formation modifies the loess and appears as an over thickened upper solum associated with the Bt horizon of the underlying interglacial soil.

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GEOLOGY AND ARCHAEOLOGY OF A HOLOCENE ALLUVIAL/COLLUVIAL FAN AT THE KOSTER SITE

Michael D. Wiant, Edwin R. Hajic, Bonnie W. Styles, and Thomas R. Styles

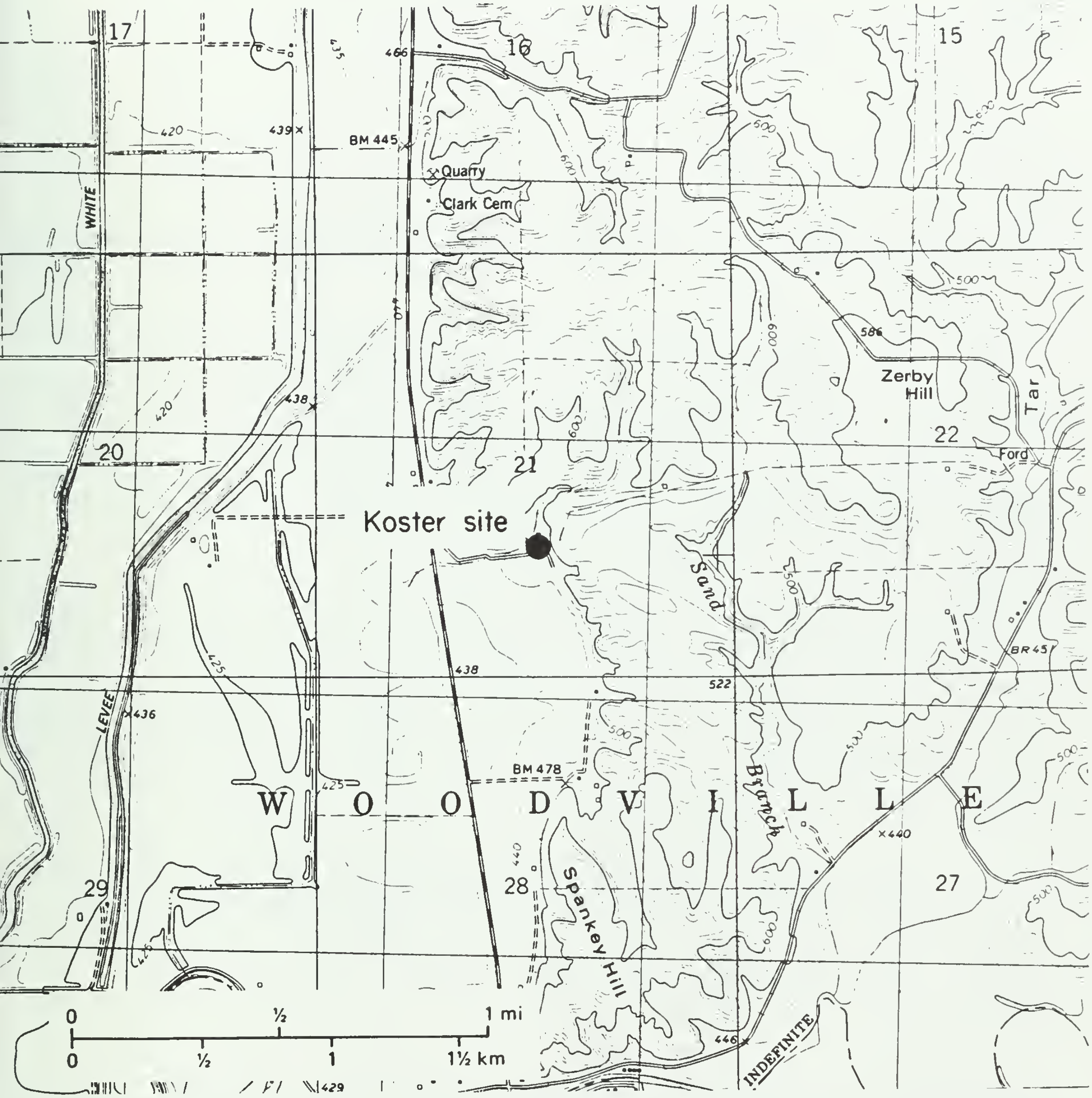

Figure 11-1
STOP 11
Koster Site
SW SE Sec. 21, T9N, R13W, Greene County, IL
Hardin 7.5 minute Quadrangle

INTRODUCTION

The Koster site is located along the eastern edge of the Illinois River Valley in Greene County, Illinois (Fig. 11-1). Each summer for a decade, fieldwork was conducted here under the direction of Drs. Stuart Struever and James A. Brown, of Northwestern University, who assembled a multidisciplinary team to study the site and its environs (Brown and Struever, 1973). This research has provided one of the best dated Holocene clastic depositional and archaeological records in North America. Early Archaic through historic cultural periods are represented at the site. At this stop we will examine sediment and soils in cores from the site. We also will discuss the timing, causes, and archeological implications of Holocene valley margin sedimentation, and summarize cultural adaptations to mid-Holocene climatic change.

Koster is situated in a small oversteepened bedrock valley, a tributary of the Illinois River, on the north side of a reentrant in the valley bluffline. The Brussels terrace (Rubey, 1952) forms the eastern edge of the reentrant. The Brussels terrace, bluffs and other upland surfaces are blanketed with varying thicknesses of Wisconsinan loess. Artifacts are found throughout the local area: on and within a 61 ha alluvial fan beyond the mouth of Koster Creek hollow; on and within a thick (12m+) bluff-base colluvial wedge within the mouth of the hollow where major excavations were focused; on the Illinois Valley bluffs where Perino (1973) excavated the Koster mound group; and on the loess and dune-mantled surface of the Brussels terrace to the east. Remains of at least 23 stratigraphically distinct occupations ranging in age between ca. 9000 and 900 B.P., containing well-preserved animal and charred plant remains, were identified within the colluvium (Table 11-1 and Fig. 11-2) (Brown and Vierra, 1983). Research to date has focused on identifying changes in Holocene environments and in adaptations by Archaic peoples.

STRATIGRAPHY AND GEOMORPHOLOGY

Koster site geomorphology was originally described by Butzer (1977). He had a limited number of long profiles and cores to examine, all from the colluvial slope. Subsequent investigation by Hajic (1981; in press), based upon more extensive exposures and a larger number of cores collected throughout the area, led to several geological and geomorphic interpretations alternative to Butzer's.

The entire alluvial/colluvial fan complex is perched on a large Deer Plain terrace remnant (see Stop #9) and Holocene changes in the Illinois River had no affect on fan deposition (Fig. 11-3) (Hajic, in press). Koster Creek alluvial deposits of massive silt loam and a basal silt facies comprise the main body of the fan. These deposits overlie those of a small proto-fan formed in what was a wave cut shoreface created during the Deer Plain phase of Lake Calhoun. The lower fan consists of crudely bedded silt loam

Table 11-1. The Koster Site Sequence of Components (after Brown and Vierra, 1983)

Cultural period	Cultural phase	Archaeological components	Approximate age (RCYBP)[a]
Historic	--		est. 100
Mississippian	--		est. 900
	(Late Bluff)		est. 1000
Late Woodland	(Early Bluff)	1A,B[b]	est. 1200
	(White Hall)		est. 1400
Early Woodland	(Black Sands)		est. 2550
Late Archaic	([Late Archaic])	4A[c]	2950
	(		
	(Titterington	4B	3950
	(Helton	6A,B[d]	4900-5700
	([Middle Archaic 3]	7A[e],B	5800-est.65
Middle Archaic	(		
	([Middle Archaic 2]	8A[f],B,C,D	6850-7300
	([Middle Archaic 1]	8E,F, 9A/B,C,D, 10A,B	7600-8200
	([Early Archaic 2]	11,12	8450-8700
Early Archaic	(		
	([Early Archaic 1)	13	est. 9000

[a] Based on ^{14}C half-life of 5568 years.
[b] Includes former "Horizon II" (Houart, 1971).
[c] Includes former "Horizon III" (Houart, 1971).
[d] Former "Horizon V" represents an eroded part of 6A redeposited in Stratum V, 6A,6B = 6MID, 6LOW respectively.
[e] Horizon 7A lies partially in Soil f.
[f] Horizon 8A is largely eroded and redeposited at the base of Stratum IV (Hajic, 1981).

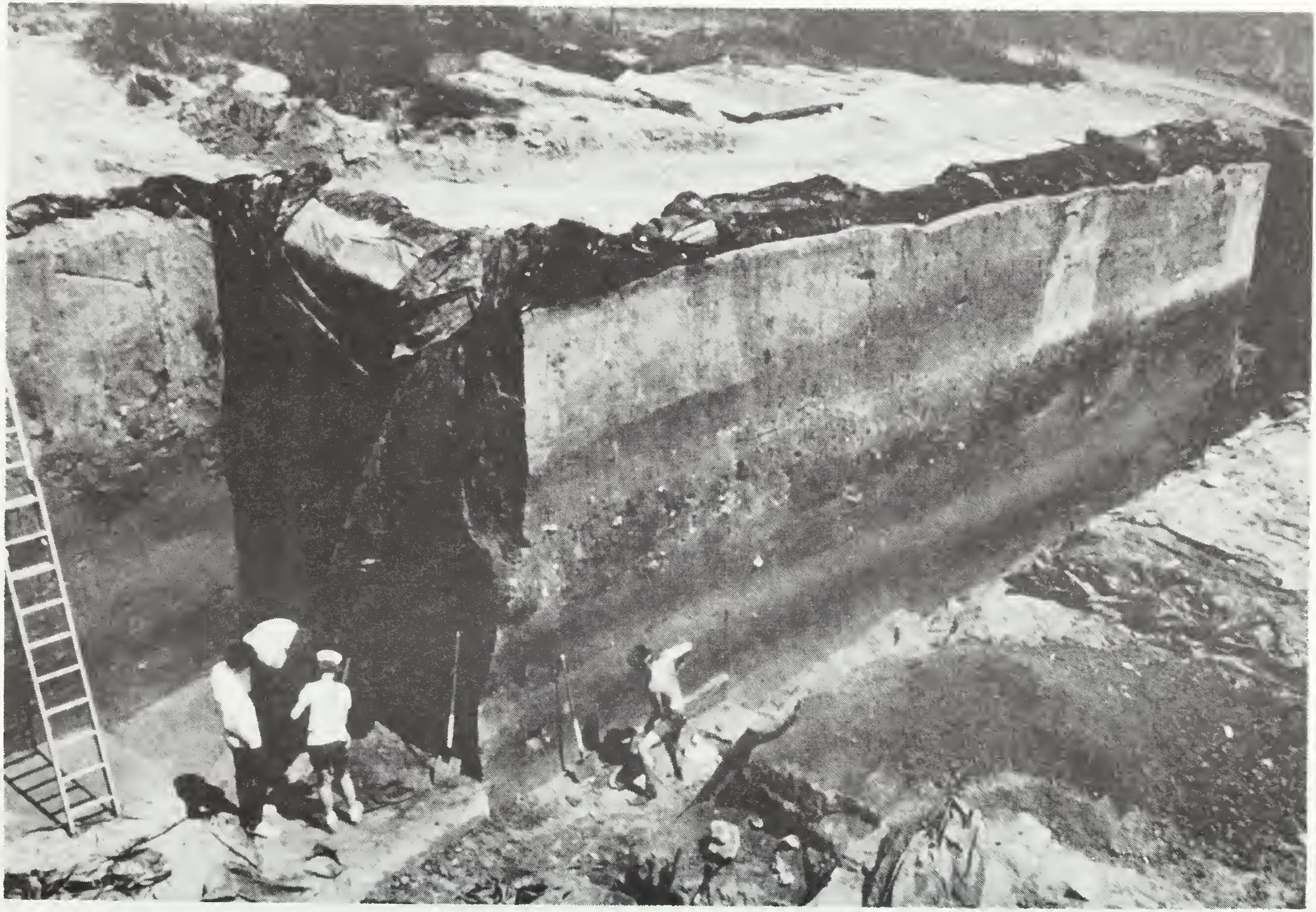

Figure 11-2. Photograph of north wall of macroblock excavations illustrating mid-Holocene through modern deposits.

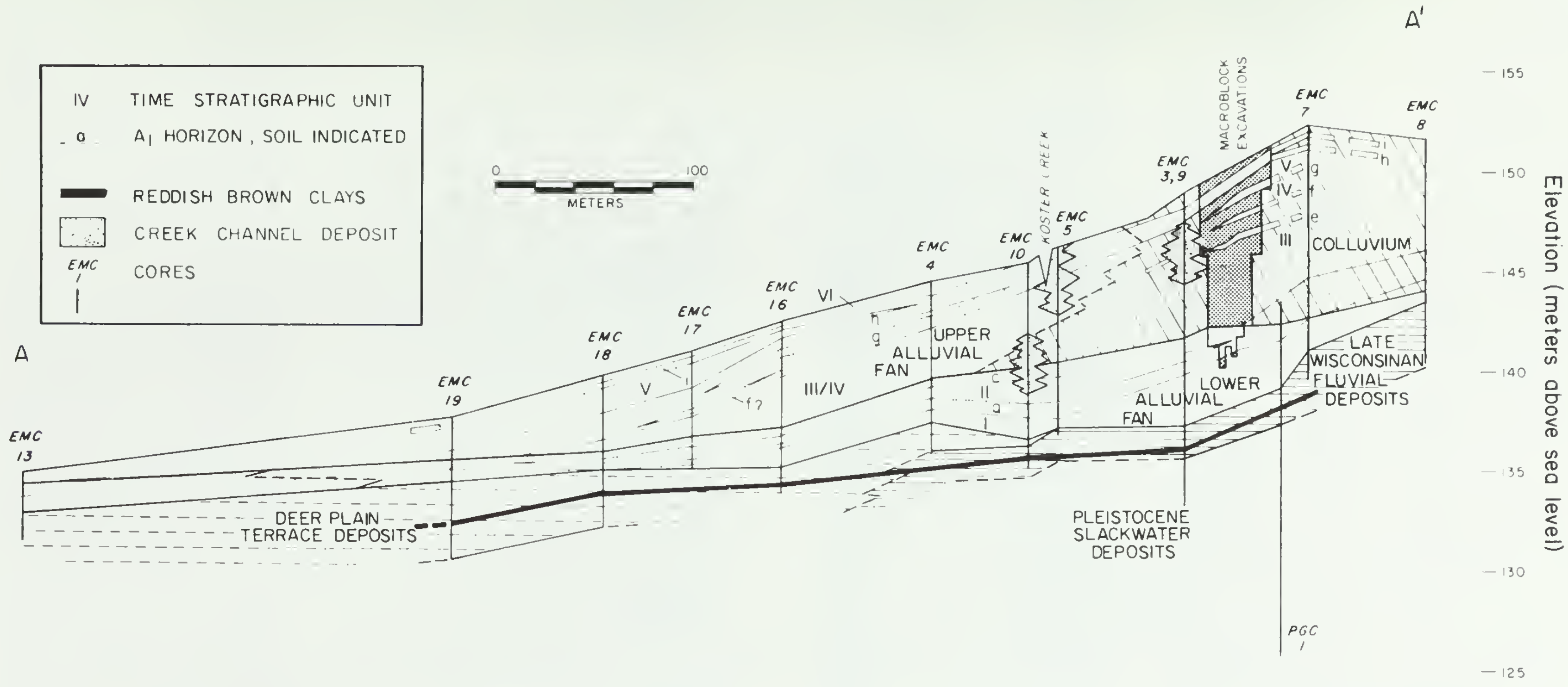

Figure 11-3. Cross section of Koster site alluvial/colluvial fan complex (after Wiant and others, 1983).

and is thickest in the macroblock area. The colluvium is primarily massive silt loam with a basal silt facies that locally exhibits some platey structure, possibly reflecting original stratification. Koster Creek periodically incised the colluvial toe slope and proximal fan, especially in the latter half of the Holocene. Abandoned creek channels are filled with laminated silt loam and often incorporate reworked cultural material.

Forty-two charcoal samples (summarized in Table 11-1) from cultural units provide a detailed chronology for both geological and cultural changes at the site. Two uncarbonized samples of spruce (Picea spp.) from below colluvium and proto-fan yielded dates of 13,360 ± 100 B.P. (ISGS-875) and 12,325 ± 75 B.P. (ISGS-415). The wood was collected from lake margin and fluvial sediments associated with the Deer Plain phase of Lake Calhoun.

Nine paleosols (labeled a through i, oldest to youngest) (Hajic, 1981), reflecting variable depositional and environmental conditions, were identified in colluvium in the macroblock excavation area (Figs. 11-2, 11-3, 11-4). They were traced in cores into alluvial fans indicating coeval deposition (Fig. 11-3). The oldest (pre-8450 B.P.) and particularly youngest paleosols (post-5000 B.P.) are the best expressed and generally exhibit A-structural B-C horizonation. Near the top of the sequence soils g and h are erosionally truncated and exhibit weak stone lines. The remaining paleosols exhibit A-C profiles, a strong cumulic character and minor enrichment in organic carbon and depletion of dolomite (Fig. 11-4).

During the earliest Holocene, formation of soils a through c was interrupted by minor intervals of colluvial and alluvial fan aggradation. Rapid and large scale colluviation and alluviation of upland-derived silt began burying cultural Horizon 11 about 8450 B.P. and continued at an overall waning rate until about 4000 B.P. During this interval of large scale upland erosion, sedimentation periodically slowed to the extent that cumulic soils e and f, formed. Between 4800 and 4000 B.P., erosion of the colluvial slope stripped soil g. The late Holocene record at Koster is characterized by limited fan and colluvial sedimentation, at least two intervals of soil formation, soil erosion and limited gullying of the colluvial slope.

CULTURAL RECORD

The cultural remains from Koster document a major adaptive transition from highly mobile hunter-gatherers to increasing degrees of sedentism (Brown and Vierra, 1983; Carlson, 1979; Hewitt, 1983; Hill, 1975; Lurie, 1982; Neusius, 1982). All but the three earliest occupations (Horizon's 11, 12, 13) have been analyzed in detail. In general, the earliest settlements at Koster are characterized by small, diffuse scatters of artifacts and facilities (e.g. hearths) suggesting short term, limited activity occupations. After 7500 B.P. the occupations are characterized by factors indicating occupations of greater duration and intensity;

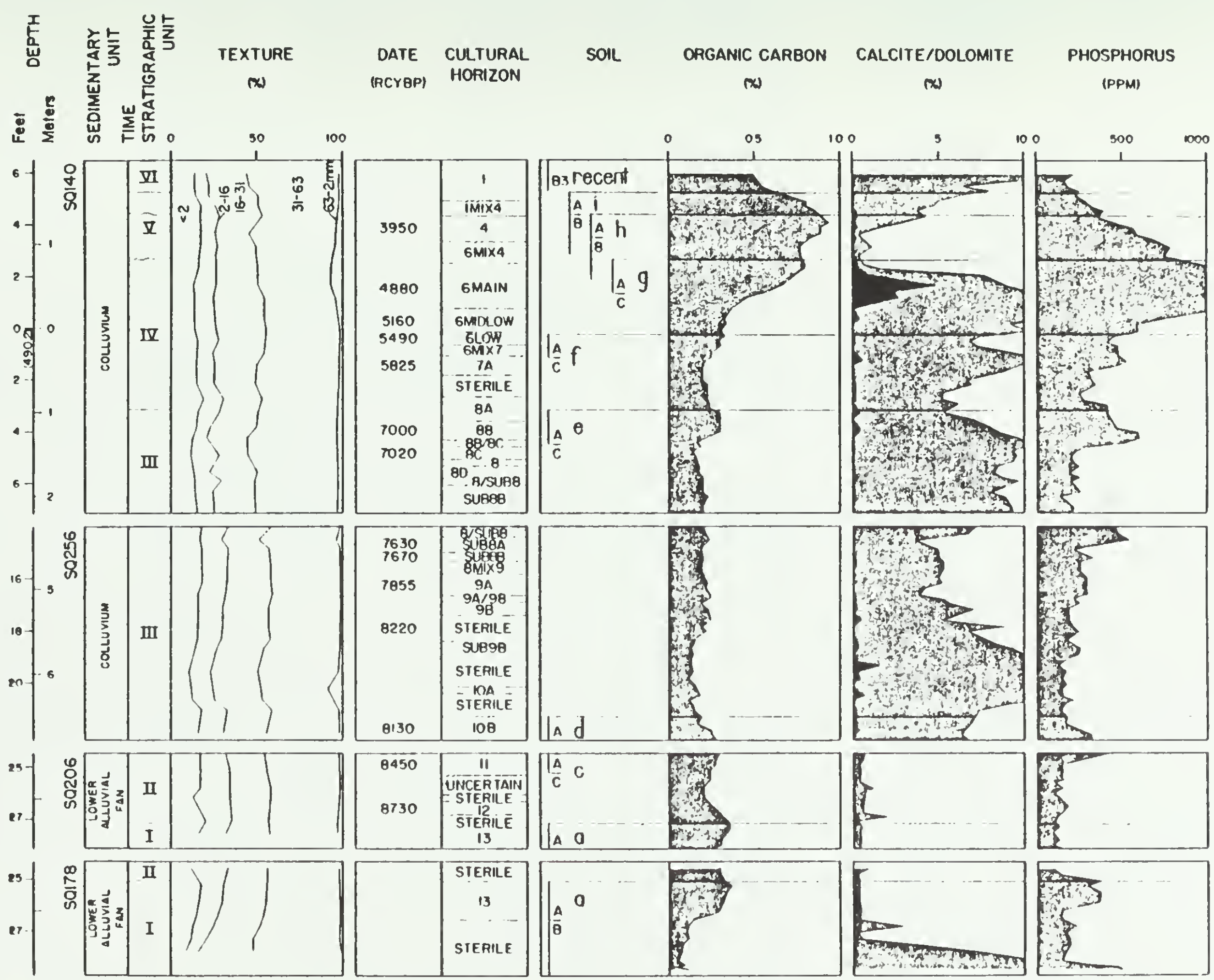

Figure 11-4. Composite geological sections of the Koster site, macroblock excavations.

dense middens, structures, evidence of food storage, and diverse artifact assemblages. Preliminary analysis of Horizon 11 (8450 BP) suggests the trend to longer term occupations may have begun earlier (Wiant and others, 1984).

SUBSISTENCE CHANGE

The Early to Middle Archaic transition at Koster is marked by increased use of aquatic fauna and white-tailed deer (Neusius, 1982). The late Early Archaic (Horizon 11) assemblage is diverse and contains abundant remains of squirrels, white-tailed deer and freshwater mussels. The relatively great abundance of small mammals has been noted for a series of early and mid-Holocene archaeological sites in the Prairie Peninsula (see Stop #5). The diverse late Early Archaic assemblage at Koster has been attributed to opportunistic procurement and residential mobility strategies (Neusius, 1982). The increased use of deer in the Middle Archaic (clearly evident by 7300 B.P.) has been attributed to increased patchiness in the environment during the Hypsithermal and use of settlement strategies incorporating large base camps used in conjunction with special purpose camps (Neusius, 1982). Proportional representation of aquatic resources, specifically riverine species of mussels, increased dramatically around 7300 B.P. (Neusius, 1982; Styles, in press). Increases in proportional representation of quietwater mussels, bowfin, and bullheads are apparent around 5700 B.P. apparently heralding the development of productive, shallow floodbasin lakes (Styles, in press). These trends in aquatic resource exploitation have been linked to the evolution of the floodplain (e.g., Styles, in press), and to increased differences in resource productivity between upland and floodplain settings during the Hypsithermal Interval (e.g., Brown, 1985). Similar trends in aquatic exploitation have been recorded for other sites in the Prairie Peninsula and the southeastern United States (see Styles, in press, and Stop #5).

The changes in floral exploitation show two major trends that are replicated at other sites in the lower Illinois River Valley and at Modoc Rock Shelter in the Mississippi Valley (see Stop #5). The Early Archaic floral assemblage shows a relatively large proportion of pecans; the Middle Archaic assemblage is dominated by hickory nut (Asch and Asch, 1976). The trend towards increased use of hickory nut has been attributed to potential changes in nut processing and/or early silviculture (see Stop #5).

Research on the shifts in subsistence in settlement practices has focused on envrionmental factors, specifically, changes in vegetation attributed to the Hypsithermal and the expansion of food-rich aquatic environments in the Illinois River floodplain. Paleobotanical (Asch and others, 1972), geomorphic and stratigraphic (Butzer, 1977; Hajic, 1981; in press), and malacological studies (Jaehnig, n.d.) do not provide a consistent opinion about the degree of impact of climatic change on the immediate Koster site environs. Based on differences in the species composition of snail assemblages from the site and surrounding modern habitats, Jaehnig (n.d.) concludes that Koster environs reflect mid-Holocene drying. Butzer (1977; 1978), using indirect evidence, attributed increased rates of colluviation to a radically different hillslope vegetation. However, to account for general consistency in the botanical record through time Asch and others (1972:20-24) argue that the heavily dissected valley margins moderated the effects of climatic change. Hajic (in press) has suggested radical changes in upper hillslope vegetation need not occur to account for changing depositional rates if thinning of the understory was accompanied by a shift to more severe storms during the Hypsithermal. Brown and Vierra (1983:173) also conclude the valley margin was forested throughout most of the Holocene.

An essentially-modern fauna is represented in the subsistence remains from Koster (see Neusuis 1982). Presence of swamp rabbit (Sylvilagus aquaticus) in the Middle Archaic assemblage, however, suggests a northward expansion for this species during the Hypsithermal Interval (Purdue and Styles, in press).

REGIONAL HOLOCENE COLLUVIAL/ALLUVIAL FAN DEPOSITION

Koster is an appropriate forum to discuss the origin of valley margin deposits seen during the course of the fieldtrip. A comparison of the Holocene sequence at Koster with that of the Russell fan, a smaller colluvial body at the Napoleon Hollow Site, 50 km up the Illinois Valley, outlines the major episodes of valley side deposition and illustrates the general synchroneity of events across the region (Fig. 11-5). By about 9000 B.P., minor erosion of local slopes had led to progradation of thin proto-fans over fluvial and lacustrine deposits at Koster and Napoleon Hollow. A slow rate of deposition in this earliest phase of fan construction is indicated by paleosols in the proto-fan deposits. After 8500 B.P. colluvial deposition at Koster accelerated rapidly. The onset of rapid colluviation is not dated so precisely at Napoleon Hollow, however a similar pattern there is evident. In the Russell fan an undated paleosol with possible Early Archaic debris was buried by approximately 3 m of colluvium prior to 6700 B.P. (T. Styles, 1985). Once intiated, relatively large rates of colluvial deposition continued on the fans to about 4000 B.P. Fan sediments record intervals of rapid deposition alternating with periods of slowed deposition in which paleosols formed. Both fans contain paleosols that were formed between ca. 7000 to 6700 B.P. At Koster two additional paleosols formed during the interval from about 5900 to 4800 B.P. Coeval deposits at Napoleon Hollow are thinner and offer less resolution. Only a single cumulic paleosol is recognized on the Russell fan for the same interval. At both sites stone lines indicate that fan surfaces were eroded after 4000 B.P. By about 3000 B.P. colluvial deposition had diminished to a near standstill. Woodland occupation horizons on both fans occur at the ground surface or just below the plow zone.

Patterns of Holocene sedimentation at Koster, Napoleon Hollow, and lower Illinois Valley alluvial fans in general are in good agreement with other Holocene sites in the region: with Modoc Rock

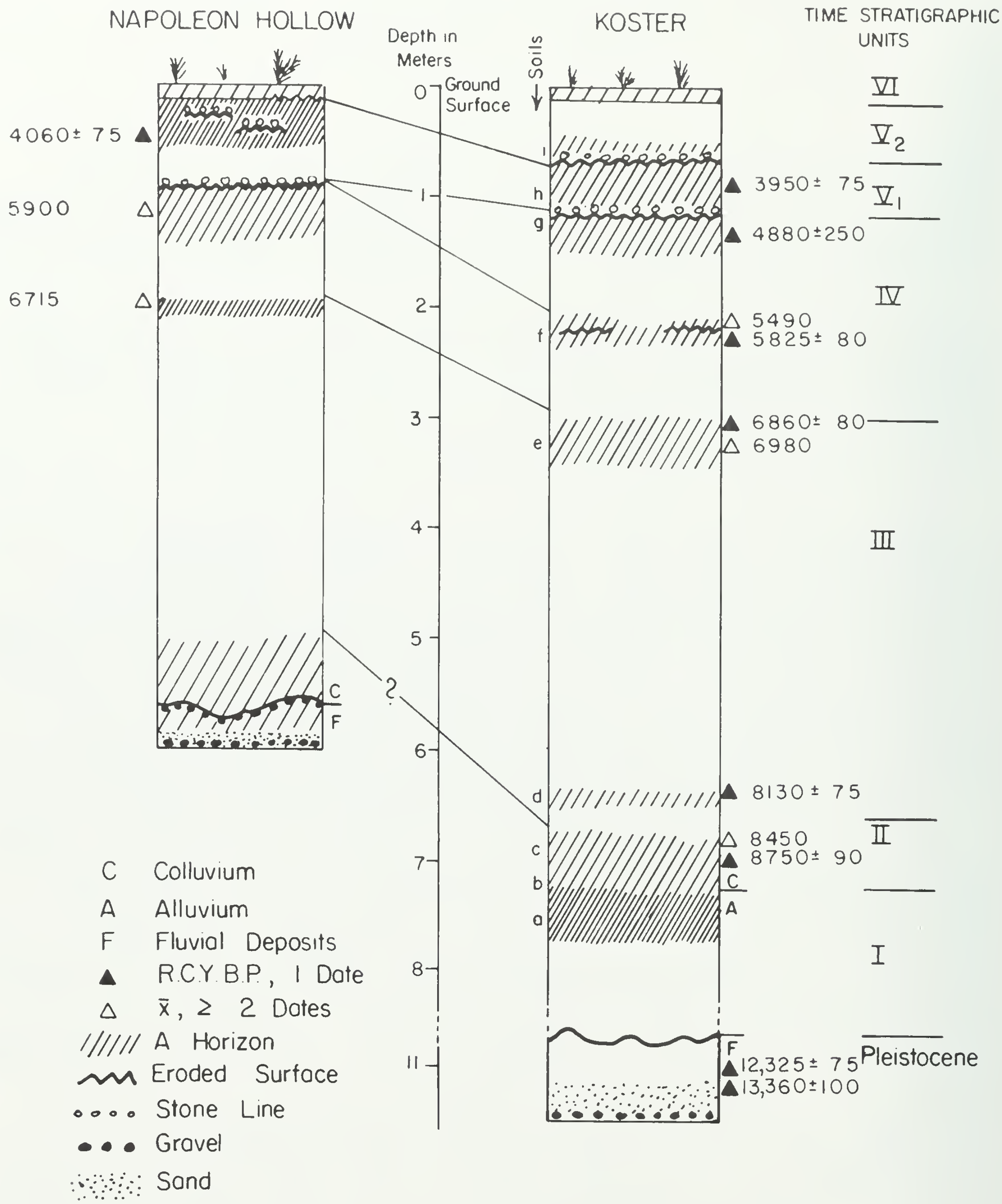

Figure 11-5. Stratigraphic comparison of the Napoleon Hollow and Koster site sequences (after Wiant and others, 1983).

Table 11-2. Comparison of Holocene Climatic Episodes with Pollen, Paleosol, and Sedimentation Records from Within 300 km of Napoleon Hollow. (after T. Styles, 1985)

Major Climatic Discontinuity[a]	Napoleon Hollow (Russell Fan)	Koster Fan[b]	Old Field Hydrology[c]	Chatwsorth Sedimentation Rates[d]
	Slow colluviation, cumulic soil forms, post-3000 B.P.	Minor deposition modern soil form, post-2950 B.P. Weak Soil i form ca. 2950 B.P.		Clastic sedimentation nearly ceases after ca. 3370 B.P.
	Fan surface eroded, ca. 3900-3000 B.P.	Fan surface eroded, ca. 3950-2950 B.P.		
	GS-e soil forms, ca. 4080-3920 B.P.	Soil h form, ca. 4880-3950 B.P.		Rates increase again 4155 B.P.
Sub-Boreal period begins ca. 5060 B.P.	Fan surface eroded, then buried ca. 5140-4080 B.P.	Fan surface eroded, then buried ca. 4880-3950 B.P.	Swamp conditions return ca. 5000 B.P.	Rates increase again ca. 5330 B.P.
End of Atlantic Period drought	GS-d soil forms, ca. 6080-5140 B.P.	Soils f + g form, ca. 5825-4880 B.P.		
	Rapid colluviation, ca. 6630-6080 B.P.	Rapid colluviation, ca. 6860-5825 B.P.	Water table rise ca. 6000 B.P.	
	GS-c soil forms, ca. 7050-6630 B.P.	Soil e forms, ca. 5825-4880 B.P.	Maximum dryness ca. 7000-6500 B.P.	Reduced rates from ca. 7680-5330 B.P.
	Rapid colluvlation, ca. 8500?-7050 B.P.	Predominately rapid colluviation, ca. 8450-7000 B.P.		Greatest rates from ca. 8300-7680 B.P.
Atlantic Period drought begins ca. 8490 B.P.	Rapid colluviation begins, ca. 8500? B.P.	Rapid colluviation begins, ca. 8450 B.P.	Onset of drought ca. 8700 B.P.	Rates accelerate quickly ca. 8300 B.P.

[a] Wendland and Bryson (1974)
[b] Hajic (1981c, In press)
[c] King and Allen (1977)
[d] King (1981)

Shelter, with pollen data recording the fluctuations of the spring-fed Old Field Swamp in Missouri (ca. 275 km southeast of Koster) (King and Allen, 1977), and with sedimentation rates in Chatsworth Bog on the upland prairie 250 km northeast of Koster (King, 1981) (Table 11-2). It is now possible to outline a rudimentary chronology of valley side sedimentation cycles for the eastern and southern portion of the Prairie Peninsula. At the beginning of the Holocene loessial upland slopes were relatively stable, despite the probability that they were steeper than at present. This period of stability ended when erosion of upland slopes and rapid valley margin deposition began with the onset of the mid-Holocene Hypsithermal climatic episode. Rates of fan deposition accelerated dramatically and synchronously about 8500 B.P. throughout the region. Superimposed on a general pattern of rapid Hypsithermal deposition are shorter episodes of deposition followed by periods of soil formation with little or no sedimentation. Because these shorter episodes are synchronous regionally they too probably record fluctuations in climate. Of interest is the fact that slope erosion and colluvial deposition actually slowed during the interval associated with maximum dryness leading to paleosol formation at Koster and Napoleon Hollow. Cessation of major valley margin sedimentation also was synchronous regionally, slowing around 4000 B.P. and ending about 3000 B.P. Alluvial and colluvial fans in the region now tend to be relict landforms, bypassed by incised drainages.

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