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GEOLOGICAL SURVEY AND RESOURCE ASSESSMENT DIVISION

GEOLOGIC INVESTIGATIONS SERIES
MAP I–2744 (SHEET 1 OF 2)
Explanatory pamphlet accompanies map

Table 1. Thermoluminescence data and age estimates for samples from English Hill, southeastern Missouri.

[Analyses from the University of Illinois Luminescence Dating Research Laboratory. TL, thermoluminescence; IRSL, infrared stimulated luminescence. The 8 hours ultraviolet exposure is thought to result in full resetting of thermoluminescence, particularly for bases that received extended light exposure during deposition and prior to burial, and is the favored age estimate. See figure 3 (sheet 2) for trench locations and figure 4 (sheet 2) for geologic map of the English Hill area]

Sample no.[1]	Field no. and trench name	Lab no.	Method[2,3]	Temp. (°C) for TL or time (s)[4] in IRSL	Equivalent dose (grays)	Estimated luminescence age (ka)[5]	Anomalous fading ratio[6]	Field identification of unit
1 (8)	6–11–96–1 Old Quarry	UIC594	TL-Total bleach: 8 h UV TL-Total bleach: 16 h SL IRSL-Total bleach: 1 h SL	250–400 250–400 2–90	84.4±10.6 79.2±10.6 93.2±5.7	22.7±3.5 21.3±3.4 25.4±2.5	0.98±0.03	Peoria Loess
2 (8)	6–11–96–2 Old Quarry	UIC595	TL-Total bleach: 8 h UV TL-Total bleach: 16 h SL	250–400 250–400	78.8±11.8 73.6±11.8	21.9±3.3 20.5±3.2	0.98±0.03	Peoria Loess
3 (8)	6–11–96–3 Old Quarry	UIC611	TL-Total bleach: 8 h UV TL-Total bleach: 16 h SL	250–400 250–400	98.4±10.6 97.3±10.2	28.3±3.4 28.0±3.4		Roxana Silt
4 (19)	6–11–96–4 Upper Rainbow	UIC610	TL-Total bleach: 8 h UV TL-Total bleach: 16 h SL	250–400 250–400	106.5±10.7 106.4±10.7	31.8±3.0 31.8±3.4		Roxana Silt
5 (19)	6–11–96–5 Upper Rainbow	UIC601	TL-Total bleach: 8 h UV TL-Total bleach: 16 h SL	250–400 250–400	61.6±9.8 63.6±9.8	17.0±2.7 17.6±2.8		Peoria Loess
6 (19)	6–11–96–6 Upper Rainbow	UIC605	TL-Total bleach: 8 h UV TL-Total bleach: 16 h SL IRSL-Total bleach: 1 h SL	250–400 250–400 3–59	73.6±7.5 74.8±7.5 75.8±2.4	18.4±2.2 18.7±2.2 19.3±1.7		Colluvial wedge
7 (35)	6–29–96–1 Tuesday	UIC599	TL-Total bleach: 8 h UV TL-Total bleach: 16 h SL	250–400 250–400	103.2±3.8 103.9±3.7	28.0±2.6 28.0±2.6		Roxana Silt
8 (35)	6–26–96–2 Tuesday	UIC600	TL-Total bleach: 8 h UV TL-Total bleach: 16 h SL	250–400 250–400	75.9±8.6 76.8±8.6	20.6±2.7 21.0±2.7		Peoria Loess
9 (35)	6–28–96–1 Tuesday	UIC602	TL-Total bleach: 8 h UV TL-Total bleach: 16 h SL IRSL-Total bleach: 1 h SL	250–400 250–400 2–90	92.4±9.2 94.0±9.4 93.5±4.4	25.6±2.6 26.0±2.6 25.6±2.5		Peoria Loess
10 (19)	4–6–97–2 Upper Rainbow	UIC625	TL-Total bleach: 8 h UV TL-Total bleach: 16 h SL	250–400 250–400	122.9±11.9 121.0±11.9	42.0±5.0 40.0±5.0	0.98±0.01	Roxana Silt
11 (19)	4–6–97–3 Upper Rainbow	UIC629	TL-Total bleach: 8 h UV TL-Total bleach: 16 h SL	250–400 250–400	133.1±16.6 137.5±16.6	42.0±5.0 44.0±5.0	1.00±0.01	Roxana Silt

[1] Number in parentheses refers to figure no. on sheet 2 showing sample location and age.
[2] All thermoluminescence measurements were made with a Corning 5-58 and HA-3 filters in front of the photomultiplier tube. Samples were preheated to 124 °C for 48 h prior to analysis.
[3] Hours of light exposure to define residual level for thermoluminescence analysis. SL is natural sunlight in Chicago, Ill. UV is light from 240 watt General Electric sunlamp bulb which is dominated by ultraviolet spectra.
[4] Temperature range used to calculate equivalent dose.
[5] All errors are at one sigma and calculated by propagating the errors across the temperature or time range.
[6] All samples were tested for anomalous fading by storing irradiated (100–450 gy) samples for at least 32 days and comparing the luminescence signal to an unstored aliquot. Anomalous fading ratio between 0.90 and 1.00 indicates little or no fading within analytical slit resolution.

Table 3. Drill-hole data, Scott City quadrangle, Missouri.

[Elevations, in feet, based on mean sea level. Qc, Quaternary colluvium; Qaf, Quaternary alluvial fan; Qma, Mississippi River alluvium; Qt, Quaternary terrace; Qso, terrace deposit of the ancestral Ohio River; Qt, Quaternary loess, dominantly Peoria Loess; Tmg, Mounds Gravel; Tw, Wilcox Group, undivided; Tm, Midway Group, undivided; Tpc, Porters Creek Clay; Koc, Owl Creek Formation; Km, McNairy Sand; Ku, Cretaceous Sand, Kpc, Post Creek Formation; Klb, Little Bear Formation; Op, Plattin Group, undivided; Ope, Pecatonica Formation; Od, Joachim Dolomite; Odt, Dutchtown Formation; Osp, St. Peter Sandstone; Oe, Everton Formation; Ospow, Smithville and Powell Dolomites, undivided. Numbers in parentheses indicate duplicate drill-hole nos. In some drill holes, such as 4477, the Cretaceous Formation was not separated from the overlying Plattin Group. Queries indicate uncertain control]

Drill-hole no.	Location	Collar elevation	Contact elevation	Bottom elevation
9277	N-center sec. 4, T. 28 N., R 14 E.[1]	373	348 Qt-Km 283 Km–Paleozoic, undifferentiated	258
8594	NW¼,SE¼4 sec. 21, T. 29 N., R 14 E.	434	409 Qt–Tmg? 394 Tmg?–Km 339 Km–Oe	199
M–29–1432–7	NE¼,NW¼4 sec. 32, T. 29 N., R 14 E.	495	490 Qt–Tw 460 Tw–Tpc? 451 Tpc?–Km	383
7202	SW¼4,NW¼4 sec. 16, T. 29 N., R 14 E.	430	410 Qt–Km 365 Km–Oj 265 Oj–Od 115 Od–Osp	112
6850	SE¼,SE¼4 sec. 24, T. 29 N., R 13 E.	505	470 Qt–Km	332
9279	SW¼4,SW¼4 sec. 3, T. 29 N., R 14 E.	410	400 Qt–Tw 335 Tw–Km 230 Km–Osp	172
23159	SE¼,NW¼4 sec. 8, T. 29 N., R 14 E.	380	335 Qt–Od 220 Od–Osp 137 Osp–Oe	75
27742	SW¼,NE¼4 sec. 7, T. 29 N., R 14 E.	440	No sample to 355 355 Qt–Od 93 Od–Osp 40 Osp–Oe 180 Oe–Ospow	-260
5140	NW¼,SE¼4 sec. 7, T. 29 N., R 14 E.	433	385 Qt–Oj 225 Oj–Od 75 Od–Osp	65
6862	NE¼,SE¼4 sec. 2, T. 29 N., R 13 E.	350	329 Qt–Od 270 Od–Osp	250
8450	SE¼,NE¼4 sec. 8, T. 29 N., R. 14 E.	378	298 Qt–Oj 223 Oj–Oj	43
18438	NW¼4,NW¼4 sec. 3, T. 29 N., R. 14 E.	422	377 Qt–Op	-38
27750	NW¼4,SW¼4 sec. 25, T. 30 N., R. 13 E.	335	205 Qma–Od -5 Od–Osp	-500
21390	NW¼,NE¼4 sec. 5, T. 29 N., R. 14 E.	361	296 Qt–Oj 281? Oj–Od 258 Od–Osp -58 Osp–Oe	-61
4196	NE¼,NE¼4 sec. 5, T. 29 N., R. 14 E.	366	313 Qt–Oj 126 Oj–Od -64 Osp–Oe	-67
8328 (8329)	SW¼4,NW¼4 sec. 36, T. 30 N., R. 13 E.	335	320 Qaf–Qma 185 Qma–Od 110 Od–Osp 407 Osp–Oe	-5
9998 (14777)	SW¼4,SW¼4 sec. 33, T. 30 N., R. 13 E.	367	334 Qt–Op 132 Op–Oj -73 Oj–Od -258 Od–Osp -338 Osp–Oe	-668
6857	NW¼,NW¼4 sec. 1, T. 29 N., R. 13 E.	337	317 Qaf–Qma	260
6853	NE¼,NW¼4 sec. 1, T. 29 N., R. 13 E.	341	311 Qaf–Qma 234 Qma–Osp	231
6802	center, sec. 3, T. 29 N., R. 13 E.	340	300 Qaf–Qma	265
8326	NW¼4,NW¼4 sec. 13, T. 29 N., R. 13 E.	515	490 Qt–Osp[2]	316
22066	SE¼4,NE¼4 sec. 1, T. 29 N., R. 13 E.	390	295 Qt–Od 225 Od–Osp	215
8444	NE¼4,NE¼4 sec. 12, T. 29 N., R. 13 E.	375	325 Qt (fill?)–Od 280 Od–Osp	273
6851	north-center sec. 1, T. 29 N., R. 13 E.	385	350 Qt–Osp	300
11114	SW¼,SW¼4 sec. 35, T. 29 N., R. 13 E.	455	425 Qt–Km 375 Km–Oe 80 Oe–Ospow	-20
3390	NW¼4,NW¼4 sec. 33, T. 30 N., R. 14 E.	510	425 Qt–Clay and boulder residuum 440 Residuum–Op	404
27364	SE¼,NW¼4 sec. 32, T. 30 N., R. 14 E.	440	400 Qt–Op -240 Op–Ope -140 Ope–Oj 90 Oj–Od -175 Od–Osp -255 Osp–Oe	-260
6858	NE¼,SE¼4 sec. 4, T. 29 N., R. 13 E.	338	318 Qaf–Qma	278
6852	NE¼4,SW¼4 sec. 18, T. 29 N., R. 14 E.	400	370 Qt–Residuum 325 Residuum–Od 260 Od–Osp	220
2083	NE¼4 sec. 1, T. 29 N., R. 13 E.	342	No samples to 267 157 Od–Osp 47 Osp–Oe	-113
2722	SE¼,NW¼4 sec. 3, T. 29 N., R. 14 E.	397	No samples to 375 -65 Op–Oj -300 Oj–Od -460 Od–Osp -515 Osp–Oe	-522
6859	SW¼4,NW¼4 sec. 3, T. 29 N., R. 13 E.	337	330 Qaf–Qma	280
BH–1	SW¼4,NW¼4 sec. 34, T. 29 N., R. 14 E.	459	459 Tmg–Tw 441 Tw–Tm 404 Tm–Kmc 393 Kmc–Km 284 Km–Kc 261 Kc–Kpc 237 Kpc–Klb 232 Klb–Oj	227
BH–2	center, W½2 sec. 34, T. 29 N., R. 14 E.	371	356 Qc–Km 255 Km–Kc 226 Kc–Kpc 196 Kpc–Klb 178 Klb–Oj or Od	176
BH–8	SW¼4,SE¼4 sec. 33, T. 29 N., R. 14 E.	403	379 Qt–Km 288 Km–Od	283
BH–9	SW¼4,SE¼4 sec. 33, T. 29 N., R. 14 E.	371	280 Km–Od	275
BH–10	NE¼4,NE¼4 sec. 5, T. 28 N., R. 14 E.	372	339 Otn–Kc 266 Kc–Od	259

[1] This location was changed by senior author from the drill-hole position originally given by the Missouri Department of Natural Resources, Division of Geology and Land Survey.
[2] Abnormally thick Osp section.
[3] Rb. indicates reworked loess.

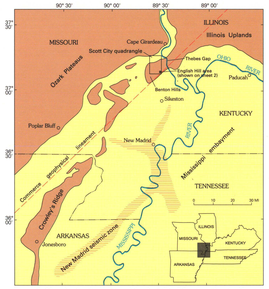


Figure 1. Map showing the location of the Scott City 7.5-min quadrangle, Missouri, (outlined in black) and location of the English Hill area within the quadrangle. Brown areas are uplands and yellow areas are lowlands of the Mississippi embayment and Mississippi River basin.

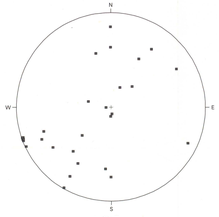
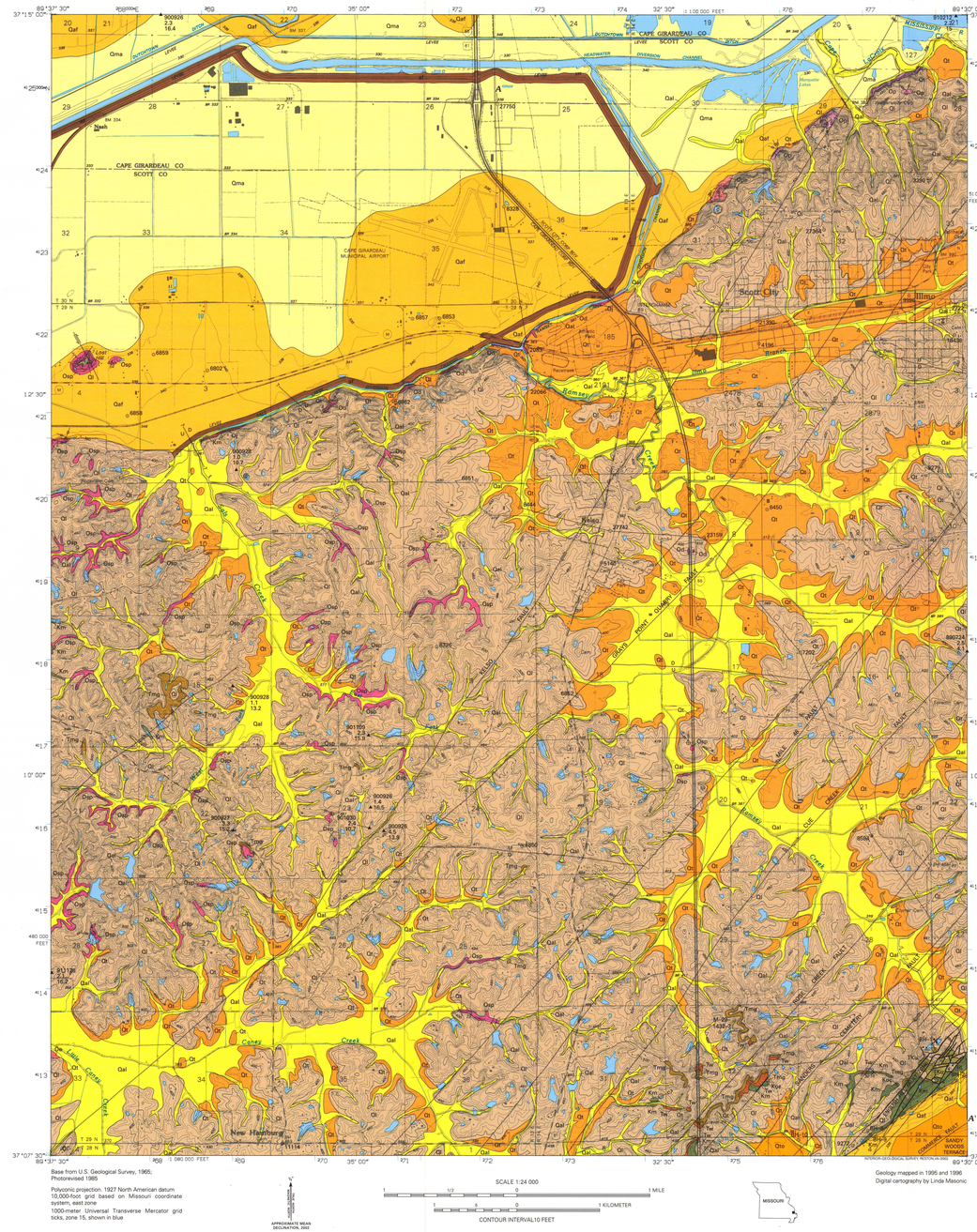
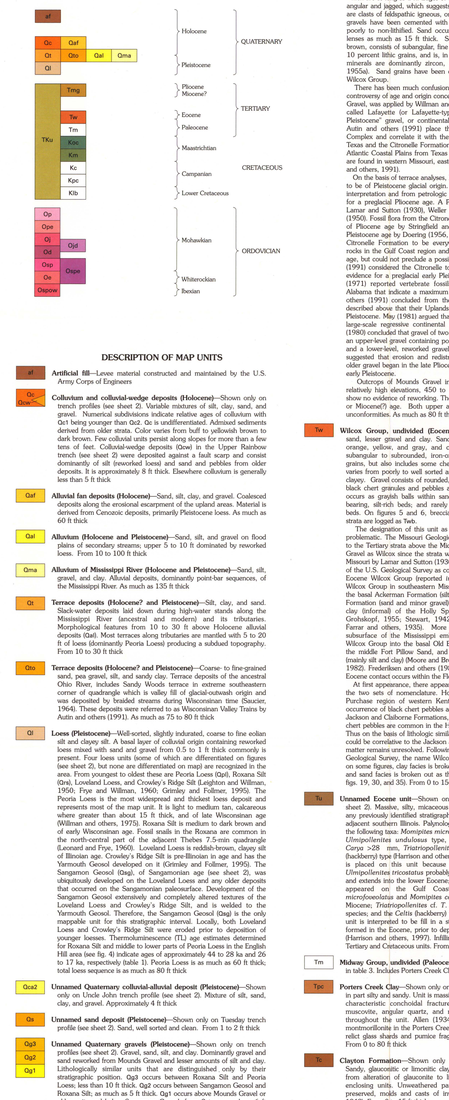


Figure 2. Equal-area stereographic projection of poles to cataclastic shears (deformation bands) at Lost Hill. N = number of measurements.



CORRELATION OF MAP AND DRILL-HOLE UNITS



DESCRIPTION OF MAP UNITS

af **Artificial fill**—Levee material constructed and maintained by the U.S. Army Corps of Engineers

Qc, Qcolluv **Colluvium and colluvial-wedge deposits (Holocene)**—Shown only on trench profiles (see sheet 2). Variable mixtures of silt, clay, sand, and gravel. Numerical subdivisions indicate relative ages of colluvium with Qc1 being younger than Qc2. Qc is undifferentiated. Admixed sediments derived from older strata. Color varies from buff to yellowish brown to dark brown. Few colluvial units persist along slopes for more than a few tens of feet. Colluvial-wedge deposits (Qcw) in the Upper Rainbow trench (see sheet 2) were deposited against a fault scarp and consist dominantly of silt troworked loess and sand and pebbles from older deposits. It is approximately 8 ft thick. Elsewhere colluvium is generally less than 5 ft thick

Qaf **Alluvial fan deposits (Holocene)**—Sand, silt, clay, and gravel. Coalesced deposits along the eastern segment of the upland areas. Material is derived from Cenozoic deposits, primarily Pleistocene loess. As much as 60 ft thick

Qal **Alluvium (Holocene and Pleistocene)**—Sand, silt, and gravel on flood plains of secondary streams; upper 5 to 10 ft dominated by reworked loess. From 10 to 100 ft thick

Qma **Alluvium of Mississippi River (Holocene and Pleistocene)**—Sand, silt, gravel, and clay. Alluvial deposits, dominantly point-bar sequences, of the Mississippi River. As much as 135 ft thick

Qt **Terrace deposits (Holocene? and Pleistocene)**—Silt, clay, and sand. Slack-water deposits laid down during high-water stands along the Mississippi River (ancestral and modern) and its tributaries. Morphological features from 10 to 30 ft above Holocene alluvial deposits (Qal). Most terraces along tributaries are mantled with 5 to 20 ft of loess (dominantly Peoria Loess) producing a subdued topography. From 10 to 30 ft thick

Qto **Terrace deposits (Holocene? and Pleistocene)**—Coarse- to fine-grained sand, pea gravel, silt, and sandy clay. Terrace deposits of the ancestral Ohio River, includes Sandy Woods terrace in extreme southeastern corner of quadrangle which is valley fill of glacial-outwash origin and was deposited by braided streams during Wisconsinan time (Saucier, 1964). These deposits were referred to as Wisconsinan Valley Trains by Autin and others (1991). As much as 75 to 80 ft thick

Ql **Loess (Pleistocene)**—Well-sorted, slightly indurated, coarse to fine eolian silt and clayey silt. A basal layer of colluvial origin containing reworked loess mixed with sand and gravel from 0.5 to 1 ft thick commonly is present. Four loess units (some of which are differentiated on figures see sheet 2), but none are differentiated on map) are recognized in the area. From youngest to oldest these are Peoria Loess (Qpl), Roxana Silt (Qrx), Loveland Loess, and Crowley's Ridge Silt (Leighton and Willman, 1950; Frye and Willman, 1960; Grimley and Follmer, 1995). The Peoria Loess is the most widespread and thickest loess deposit and represents most of the map unit. It is light to medium tan, calcareous where greater than about 15 ft thick, and of late Wisconsinan age (Willman and others, 1975). Roxana Silt is medium to dark brown and of early Wisconsinan age. Fossil snails in the Roxana are common in the north-central part of the adjacent Thebes 7.5-min quadrangle (Leonard and Frye, 1960). Loveland Loess is reddish-brown, clayey silt of Illinoian age. Crowley's Ridge Silt is pre-Illinoian in age and has the Yarmouth Geosol developed on it (Grimley and Follmer, 1995). The Sangamon Geosol (Dsg), of Sangamonian age (see sheet 2), was ubiquitously developed on the Loveland Loess and any older deposits that occurred on the Sangamonian paleosurface. Development of the Sangamon Geosol externalely and completely altered textures of the Loveland Loess and Crowley's Ridge Silt, and is welded to the Yarmouth Geosol. Therefore, the Sangamon Geosol (Dsg) is the only mappable unit for this stratigraphic interval. Locally, both Loveland Loess and Crowley's Ridge Silt were eroded prior to deposition of younger loesses. Thermoluminescence (TL) age estimates determined for Roxana Silt and middle to lower parts of Peoria Loess in the English Hill area (see fig. 4) indicate ages of approximately 44 to 28 ka and 26 to 17 ka, respectively (table 1). Peoria Loess is as much as 60 ft thick; total loess sequence is as much as 80 ft thick

Qca2 **Unnamed Quaternary colluvial-alluvial deposit (Pleistocene)**—Shown only on Uncle John trench profile (see sheet 2). Mixture of silt, sand, clay, and gravel. Approximately 4 ft thick

Qs **Unnamed sand deposit (Pleistocene)**—Shown only on Tuesday trench profile (see sheet 2). Sand, well sorted and clean. From 1 to 2 ft thick

Qg3, Qg2, Qg1 **Unnamed Quaternary gravels (Pleistocene)**—Shown only on trench profiles (see sheet 2). Gravel, sand, silt, and clay. Dominantly gravel and sand reworked from Mounds Gravel and lesser amounts of silt and clay. Lithologically similar units that are distinguished only by their stratigraphic position. Qg3 occurs between Roxana Silt and Peoria Loess; less than 10 ft thick. Qg2 occurs between Sangamon Geosol and Roxana Silt; as much as 5 ft thick. Qg1 occurs above Mounds Gravel or older units and below Sangamon Geosol; from 2 to as much as 6 ft thick. These deposits are distinguished from Mounds Gravel by their stratigraphic position and by relatively high concentrations of silt and clay

Qca1 **Unnamed colluvial-alluvial deposit (Pleistocene)**—Shown only on Tuesday trench profile (see sheet 2). Silt, with lesser sand and clay. Modified by soil development. Approximately 1 ft thick

TKu **Tertiary and Cretaceous units, undivided**—Composite unit used where various Cretaceous and Tertiary units were not differentiated at map scale. Includes Mounds Gravel, Wilcox Group, unnamed Eocene unit, Midway Group, Owl Creek Formation, and McNairy Sand

Tmg **Mounds Gravel (Pliocene or Miocene?)**—Gravel and sand. Gravel is heterolithic, very poorly sorted, well rounded to subrounded, and matrix supported. Detailed descriptions of lithology and mineral composition are given by Lamar and Reynolds (1951) and Potter (1955a). Gravel lithologies are dominantly different colored varieties of chert and lesser white and light-pink quartz. Chert clasts have a characteristic yellowish-brown patina. Clasts are typically 3 in or less in diameter, but cobbles having diameters of 6 in or more are relatively common. Sparse clasts of petrified wood (silica replaced) also occur within the gravels, some of which are as long as 1 ft. Edges of the petrified wood are generally very angular and jagged, which suggests in situ petrification. Notably absent are clasts of feldspathic igneous, or carbonate material. In places, the gravels have been cemented with iron oxides, but typically they are poorly to non-lithified. Sand occurs as matrix in gravel beds and as lenses as much as 15 ft thick. Sand is typically iron-stained reddish brown, consists of subangular, fine to very coarse quartz and less than 10 percent lithic grains, and is, in part, micaceous and clayey. Heavy minerals are dominantly zircon, staurolite, and tourmaline (Potter, 1955a). Sand grains have been derived largely from the underlying Wilcox Group.

There has been much confusion of nomenclature and long-standing controversy of age relations concerning this unit. The name, Mounds Gravel, was applied by Willman and Frye (1970) to deposits previously called Lafayette (or Lafayette-type) Gravel, Tertiary gravel, "Pre-Pleistocene" gravel, or continental deposits by many other workers. Autin and others (1991) place the Mounds Gravel in the Uplands Complex and correlate it with the Wilbs Formation of Louisiana and the Texas and the Citronelle Formation, which extends along the Gulf and Atlantic Coastal Plains from Texas to Virginia. Similar upland deposits are found in western Missouri, eastern Kansas, and Oklahoma (Madole and others, 1991).

On the basis of terrace analyses, Fisk (1944) considered these gravels to be of Pleistocene glacial origin. Potter (1955b) contradicted Fisk's interpretation and from petrologic and physiographic evidence argued for a preglacial Pliocene age. A Pliocene age also was suggested by Lamar and Sutton (1930), Weller (1940), and Leighton and Willman (1950). Fossil flora from the Citronelle Formation was interpreted to be of Pliocene age by Stringfield and LaMoreaux (1957) and of early Pleistocene age by Doering (1956, 1958). Doering (1960) showed that Citronelle Formation to be everywhere unconformable on Miocene rocks in the Gulf Coast region and argued for a preglacial Pleistocene age, but could not preclude a possible Pliocene age. DuBar and others (1991) considered the Citronelle to be of Pliocene age and found no evidence for a preglacial early Pleistocene age. Isphording and Lamb (1971) reported vertebrate fossils in the Citronelle Formation in Alabama that indicate a maximum age of middle Pliocene. Autin and others (1991) concluded from their correlations and considerations described above that their Uplands Complex must be older than early Pleistocene. May (1981) argued that the Citronelle represents part of a large-scale regressive continental deposition of Miocene age. Olive (1980) concluded that gravel of two ages are present in western Kentucky: an upper-level gravel containing pollen of Miocene(?) and Pliocene age and a lower-level, reworked gravel containing Pleistocene pollen. He suggested that erosion and redistribution to lower elevations of the older gravel began in the late Pliocene and probably continued into the early Pleistocene.

Outcrops of Mounds Gravel in the Scott City quadrangle are at relatively high elevations, 450 to 500 ft above mean sea level, and show no evidence of reworking. They are therefore assigned a Pliocene or Miocene(?) age. Both upper and lower contacts are pronounced unconformities. As much as 80 ft thick

Tw **Wilcox Group, undivided (Eocene and Paleocene?)**—Dominantly sand, lesser gravel and clay. Sand occurs in various shades of red, orange, yellow, and gray, and consists mostly of fine to coarse, subangular to subrounded, iron-oxide-coated, clear to milky quartz grains, but also includes some chert and heavy mineral grains. Sand is poorly to well sorted and is, in part, micaceous, silty, and clayey. Gravel consists of rounded, clear to milky quartz and pebbled, black chert grains and pebbles as much as 2 in. in diameter. Clay occurs as grayish balls within sand; as massive, gray-brown, lignite-bearing, silt-rich beds; and rarely as variegated yellow-red-pink-gray beds. On figures 5 and 6, brecciated and contorted beds of Wilcox strata are logged as Twb.

The designation of this unit as strictly Wilcox Group is somewhat problematic. The Missouri Geological Survey has consistently referred to the Tertiary strata above the Midway Group and below the Mounds Gravel as Wilcox since the strata were first recognized in southeastern Missouri by Lamar and Sutton (1930) and were identified by E.W. Berry of the U.S. Geological Survey as containing plant species typical of the Eocene Wilcox Group (reported in Farrar and others, 1935). The Wilcox Group in southeastern Missouri subsequently was divided into the basal Ackerman Formation (silty clay), the overlying Holly Springs Formation (sand and minor gravel), and, locally, the uppermost Idalia clay (informal) of the Holly Springs Formation (Koenig, 1961; Grohskopf, 1955; Stewart, 1942; Farrar and McAnamay, 1937; Farrar and others, 1935). More recently, workers investigating the subsurface of the Mississippi embayment region have divided the Wilcox Group into the basal Old Breastworks Formation (mainly silt), the middle Fort Pillow Sand, and the upper Flour Island Formation (mainly silt and clay) (Moore and Brown, 1969; Frederiksen and others, 1982). Frederiksen and others (1982) determined that the Paleocene-Eocene contact occurs within the Flour Island Formation.

At first appearance, there appears to be a close correlation between the two sets of nomenclature. However, from work in the Jackson Purchase region of western Kentucky, Olive (1980) described the occurrence of black chert pebbles as being characteristic of the Eocene Jackson and Claiborne Formations, but not of the Wilcox Group. Black chert pebbles are common in the Holly Springs Formation in Missouri. Thus on the basis of lithologic similarities, the Holly Springs Formation could be correlative to the Jackson and (or) Claiborne Formations. This matter remains unresolved. Following the nomenclature of the Missouri Geological Survey, the name Wilcox Group is used in this report, and on some figures, clay facies is broken out as the Ackerman Formation, and sand facies is broken out as the Holly Springs Formation (Tw on figs. 19, 30, and 35). From 0 to 150 ft thick

Tu **Unnamed Eocene unit**—Shown only on Bollinger trench profile (see sheet 2). Massive, silty, micaceous clay. Unit does not correlate with any previously identified stratigraphic unit in southeastern Missouri or adjacent southern Illinois. Palynological analysis of this material found the following taxa: *Momipites microfoveolatus, Momipites coryloides, Ulmipollenites undulosus* type, *Ulmipollenites tricostatus* type, *Carya* >28 mm, *Triatriopollenites cf. T. intermedius*, and *Celtis* (hackberry) type (Harrison and others, 1997). An apparent Eocene age is placed on this unit because of the following considerations. *Ulmipollenites tricostatus* probably originated in the latest Cretaceous and extends into the lower Eocene; the large specimens of *Carya* first appeared on the Gulf Coast in the Eocene; *Momipites microfoveolatus* and *Momipites coryloides* range from Paleocene to Miocene; *Triatriopollenites cf. T. intermedius* resembles an Eocene species; and the *Celtis* (hackberry) type originated in the Eocene. This unit is interpreted to be fill in a structural depression or graben that formed in the Eocene, prior to deposition of Wilcox Group sediments (Harrison and others, 1997). Infilling material was derived from older Tertiary and Cretaceous units. From 15 to 60 ft thick

Tm **Midway Group, undivided (Paleocene)**—Only noted in drill holes listed in table 3. Includes Porters Creek Clay and Clayton Formation

Tpc **Porters Creek Clay**—Shown only on trench profiles (see sheet 2). Clay, in part silty and sandy. Unit is massive, light- to dark-gray, and contains characteristic concholadal fractures when dry. Small amounts of muscovite, angular quartz, and minute feldspar are disseminated throughout the unit. Allen (1934) and Sims (1972) showed that montmorillonite in the Porters Creek is of volcanic origin by identifying relict glass shards and pumice fragments; it is thus a true bentonite. From 0 to 80 ft thick

Tc **Clayton Formation**—Shown only on trench profiles (see sheet 2). Sandy, glauconitic or limonitic clay. Unit is typically yellowish brown from alteration of glauconite to limonite and better indurated than enclosing units. Unweathered parts contain abundant, but poorly preserved, molds and casts of invertebrate marine fossils (Stewart, 1942). From 0 to 15 ft thick

Kmc **Owl Creek Formation (Maastrichtian)**—Glauconitic, silty to sandy clay and silt. Unit is generally massive and green or brown. Farrar and others (1935) reported fossil marine invertebrates and plant remains from outcrops in the adjacent Thebes 7.5-min quadrangle in east-central sec. 26, T. 29 N., R. 14 E. Unit was identified to be of early to middle Maastrichtian age by Sohl and Mello (1970). From 0 to 15 ft thick

Km **McNairy Sand (Maastrichtian)**—Sand, sandstone, clay, and interbedded lignitic silt and clay. Sand is white to gray to reddish brown to orange, consists generally of friable, very fine to fine-grained clear quartz, is very micaceous, and in places (such as the Fayville, Ill., area in adjacent Thebes 7.5-min quadrangle) is predominantly fine muscovite sand. Thin beds of glauconitic sand and pebble gravel also occur locally. A discontinuous bed of case-hardened sandstone to orthoquartzite occurs near the base of the McNairy Sand. This bed is as much as 15 ft thick and is informally known as the Commerce quartzite (Stewart, 1942; Johnson, 1988). Clay is typically plastic and occurs as thin, gray to brown layers interbedded with sand and as massive, brown to black, lignitic, pyritic lenses as much as 28 ft thick that contain thin muscovite-filled seams. This massive clay is known informally as Zadoc (or Zodoc) clay in Missouri (McQueen and Weller, 1939; Stewart, 1942; Grohskopf and Howe, 1961) and roughly is correlative with the Levings Member of Pryor (1960) and Pryor and Ross (1962) in the McNairy in Illinois. Zadoc clay contains dinoflagellates and foraminifers (Harrison and others, 1996). McNairy Sand in the Scott City quadrangle ranges from 0 to as much as 138 ft thick

Kc **Coffee Sand (Campanian)**—Only noted in drill holes listed in table 3. Brownish-black, lignite-rich, pyrite-rich, silty to sandy clay. Sand is composed of fine- to medium-grained, clear and milky quartz and angular to subrounded chert. Sparse grains of aphalerite also occur in the unit. Unit does not crop out in the quadrangle, but occurs in the subsurface. The preceding description is derived from exposures of this unit in the adjacent Thebes 7.5-min quadrangle. Originally, this unit was called the Coon Creek Formation (Maastrichtian) by McQueen and Weller (1939), but from descriptions of Cretaceous sediments in the upper Mississippi embayment by Pryor (1960) and Russell and Parks (1975), it more closely resembles the Coffee Sand. Analysis of fossil pollen from this unit in the Thebes quadrangle indicates a Campanian age (Harrison and Litwin, 1997), which agrees with that of the Coffee Sand at its type locality (Tschudy, 1965). Grohskopf and Howe (1961) also regarded pre-McNairy clastic strata in the subsurface of the Mississippi embayment to be part of the Coffee Sand. As much as 73 ft thick

Kpc **Post Creek Formation (Campanian)**—Only noted in drill holes listed in table 3. Heterolithic pebble to very coarse gravels containing clasts of subangular to subrounded, light- to dark-gray to black chert in a sandy clay matrix. Pyrite nodules also are present. Sand consists of fine-grained, rounded to subrounded, frosted quartz. A silicified interval that contains abundant and conspicuous rodlet impressions occurs locally. The preceding description is derived from exposures of this unit in the adjacent Thebes 7.5-min quadrangle. In Illinois and western Kentucky, this unit traditionally has been referred to as the Tuscaloosa Formation. However, pollen analysis from drill holes BH–1 and BH–2 (table 3), and type locality in southern Illinois indicates a Campanian age (Harrison and Litwin, 1997), which makes this unit approximately 12 to 15 m.y. younger than the Tuscaloosa Formation. From 0 to 30 ft thick

Klb **Little Bear Formation (Lower Cretaceous?)**—Only noted in drill holes listed in table 3. Rubble zone of convoluted and variegated clays mixed with heterolithic, angular chert fragments and sand. Pods of pyrite and iron oxides are common. Occurs as isolated erosional remnants in adjacent Thebes 7.5-min quadrangle. Malkin (1937) gave the name Little Bear Formation to an argillaceous buried soil or regolith formed on Paleozoic rocks in the eastern part of the Mississippi embayment. Whereas Mellen (1947) concluded an Early Cretaceous (Comanchean) age for most of the unit, he noted that regolith-forming processes probably operated throughout the Mesozoic. From 0 to 20 ft thick

Op **Plattin Group, undivided (Middle Ordovician, Mohawkian)**—Limestone and minor shale. Brownish-gray, micritic, fossiliferous limestone containing gray to black, stylolitic, clay or shale partings throughout. Limestone is locally fetid and contains scattered chert lenses. Fine-grained fossiliferous chert is abundant in the upper part. Very fine grained, calcareous sandstone occurs as laminae on bedding planes and along joints in upper and middle parts (Johnson, 1985). A 10- to 30-ft-thick interval of green, calcareous shale and interstratified, dark-gray to dark-brown, argillaceous micritic limestone (equivalent to the Bloomsdale Limestone of Missouri Survey nomenclature, or lower part of the Mifflin Formation of Illinois Survey nomenclature) occurs at the base of the unit. Chips out only in northeastern quarter of quadrangle. As much as 420 ft thick

Ope **Pecatonica Formation (Middle Ordovician, Mohawkian)**—Limestone and chert, minor dolomite. Unit consists dominantly of micritic, locally fossiliferous, locally fetid, brownish-gray limestone. Upper part is strongly burrowed, and the burrows commonly contain infilled brown dolomite. Dark, fine-grained chert is prominent in middle part. Lower part contains thin shale partings and interbedded dolomite. In many drill holes logged in southeastern Missouri, such as 4477 in this quadrangle, this unit was not separated from the overlying Plattin Group. As much as 140 ft thick

Odj **Joachim Dolomite and Dutchtown Formation, undivided (Middle Ordovician, Mohawkian)**—Shown only on cross section *A–A'*

Oj **Jo