Institute of Natural Resource Sustainability
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ILLINOIS STATE GEOLOGICAL SURVEY
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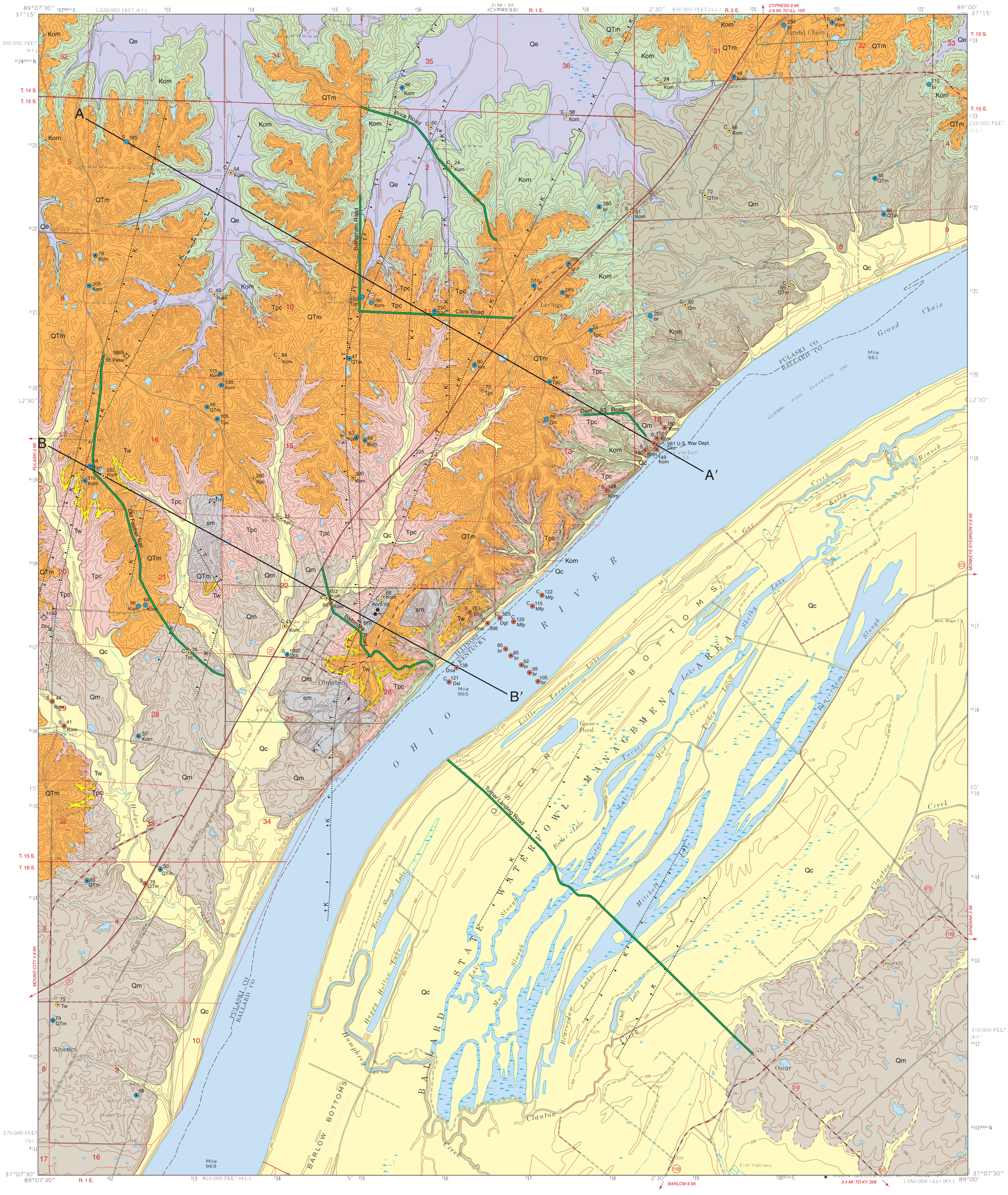
GEOLOGY OF OLMSTED QUADRANGLE
PULASKI COUNTY, ILLINOIS

W. John Nelson, F. Brett Denny, John H. McBride, and Laura Williams
2009

Illinois Geologic Quadrangle Map
IGQ Olmsted-G



GEOLOGIC UNITS

Quaternary	sm	Surface mine (clay)	Holocene
	Qc	Cahokia Formation	
	Qe	Equality Formation	Wisconsinan
Unconformity			
	Qm	Metropolis Formation	Illinoian and older
	QTm	Mounds Gravel	Pliocene and Miocene
Unconformity			
Tertiary	Tw	Wilcox Formation	Eocene
Unconformity			
	Tpc	Porters Creek Clay and Clayton Formation	Paleocene
Unconformity			
Cretaceous	Kom	Owl Creek and McNairy Formations	Maastrichtian

Note: Loess units are not mapped.

Symbols

Vertical joints

Inclined joints or fractures

Drill Holes
from which subsurface data were obtained

Stratigraphic boring

Water well

Engineering boring

Oil test hole

Labels indicate samples (s) or core (c).
Numeric label indicates total depth of boring in feet.
Unit label denotes formation at bottom (br = bedrock (formation unknown), Kpc = Post Creek Formation, Mfp = Fort Payne, Dna = New Albany Shale, Dsl = St. Laurent, Dgt = Grand Tower, Dcc = Clear Creek).
Dot indicates location accurate within 100 feet.

Line Symbols
dashed where inferred, dotted where concealed

Contact

Normal fault; bar and ball on downthrown side
Displaces top of Paleozoic bedrock and at least the lower part of Cretaceous McNairy and Owl Creek Formations, but not overlying Tertiary strata

Normal fault; bar and ball on downthrown side
Displaces Tertiary strata in addition to Cretaceous and Paleozoic

Line of seismic reflection profile

A —— A′ Line of cross section

Note: Well and boring records are on file at the ISGS Geological Records Unit and are available online from the ISGS Web site.

Base map compiled by Illinois State Geological Survey from digital data (Digital Line Graphs) provided by the United States Geological Survey. Topography of Illinois area by photogrammetric methods from aerial photographs taken 1965. Field checked 1967. Planimetry of Kentucky area by photogrammetric methods from aerial photographs taken 1952. Topography by planetable surveys 1954. Revised 1967. Photoinspected 1975.

North American Datum of 1983 (NAD 83)
Projection: Transverse Mercator
10,000-foot ticks: Illinois State Plane Coordinate system, west zone (Transverse Mercator) and Kentucky coordinate system, south zone
1,000-meter ticks: Universal Transverse Mercator grid system, zone 16

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SCALE 1:24,000

1 MILE
1000 0 1000 2000 3000 4000 5000 6000 7000 FEET
1 .5 0 1 KILOMETER

BASE MAP CONTOUR INTERVAL 10 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

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Geology based on field work by W. John Nelson, F. Brett Denny, John H. McBride, and Laura Williams, 1996–2004.

Digital cartography by Jane E. J. Domier and Shannon Geegan, Illinois State Geological Survey.

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1	2	3
4		5
6	7	8

ADJOINING QUADRANGLES
1 Dongola
2 Cypress
3 Karnak
4 Pulaski
5 Bandana
6 Cairo
7 Barlow
8 La Center, KY

APPROXIMATE MEAN DECLINATION, 2009

ROAD CLASSIFICATION

Primary highway, hard surface
Secondary highway, hard surface
Light-duty road, hard or improved surface
Unimproved road
State Route

SYSTEM	SERIES	STAGE	FORMATION	GRAPHIC COLUMN	THICKNESS (FEET)	UNIT
QUATERNARY	HOLOCENE		Cahokia		0–100	A
	PLEISTOCENE	Wisconsinan	Equality (Peoria, Roxana)		0–50 (6–12, 2–8)	B (C, D)
			Loveland Silt		4–7	E
		Illinoian	Metropolis		0–55	F
		Pre-Illinoian	Mounds Gravel		0–45	G
TERTIARY	PLIOCENE					
	MIOCENE					
	EOCENE	Lower or Ypresian	Wilcox		0–15	H
	PALEOCENE	Thanetian	Porters Creek Clay		0–70	I
		Danian	Clayton		6–18	J
CRETACEOUS	UPPER OR GULFIAN		Owl Creek		3–9	K
		Maastrichtian	McNairy		90–600	L
		Campanian	Post Creek		0–30+	M
MISSISSIPPIAN	VALMEYERAN OR OSAGIAN		Fort Payne (Indicates altered or silicified limestone or dolomite)		0–200+	N
			Springville Shale		15–45	O
	KINDERHOKIAN		Chouteau Ls		3–5	P
DEVONIAN	UPPER	Famennian	New Albany Shale		150–180	Q
		Frasnian				
	MIDDLE	Givetian	St. Laurent		37–75	R
		Eifelian	Grand Tower Limestone		40–100	S
	LOWER	Emsian	Clear Creek		550	T

A Cahokia Formation Silt, sand, and gravel. Silt is mottled in light to medium gray and brown; sand is mostly light gray to buff and fine- to coarse-grained. Most sand is loose, but some is cemented by iron oxide. One or more upward-fining sequences, grading from gravel at the base to sand at the top, commonly are present. On the Ohio River floodplain in Kentucky, the Cahokia rests on an irregular erosion surface and is as thick as 94 feet. Long arcuate ridges, evident in the field and on the topographic map, represent former point bars and longitudinal bars. These are separated by swales, many of which are lakes or wetlands where organic-rich silt and clay accumulate. Along small streams in the Illinois part of the map area, the Cahokia is generally less than 20 feet thick and contains a large component of silt derived from upland loess.

B Equality Formation Clay and silt, minor sand and gravel. Sediment colors vary from greenish and bluish gray to olive and yellowish brown. Texture varies from soft and plastic to stiff; structure massive to finely laminated. Thin peat layers and plant matter are locally present, as are weakly developed soil horizons. Sand and gravel occur as lenses, mostly in the lower part of the formation. Pebbles are mostly chert and quartz derived from the Mounds Formation, but include fragments of ironstone concretions derived from the McNairy Formation. This unit occupies bottomlands of streams tributary to the Cache Valley in the northern part of the map area. The unit represents slackwater sediments that were deposited outside the main valley during times of high glacial meltwater runoff. Cahokia Formation generally overlies Equality, but the two units are difficult to differentiate in the field. The lower contact is unconformable.

C Peoria Silt Silt is mottled in light to medium yellowish gray to yellowish brown and lacks stratification. The Peoria has lower clay content than the Roxana. The modern soil is developed within this unit. The Peoria is at the ground surface in uplands throughout the map area and is not shown on the geologic map. This unit is loess, deposited by the wind. The lower contact is gradational within a few inches.

D Roxana Silt Silt is weakly mottled in medium to dark yellowish brown and in some cases has a reddish cast. Layering is absent. The Roxana has a higher clay content than the Peoria and holds water better; fresh core samples tend to be plastic. The weakly developed Farmdale Geosol (ancient soil) is in the upper part; it is expressed by mottles, clay skins, and manganese oxide pellets and stains. Scattered sand grains and granules are present. The Roxana underlies the Peoria in uplands throughout the quadrangle. The unit is not shown on the map. This unit is loess, deposited by the wind. The lower contact is gradational within a few inches.

E Loveland Silt Silt is strongly mottled in gray, yellowish brown, and orange. It has a high clay content and tends to be stiff. The lower part becomes sandy and contains scattered small pebbles. The strongly developed Sangamon Geosol (ancient soil) is within this unit and is shown by intense mottling, weathered appearance, and blocky structure with abundant clay skins. The Loveland occurs throughout upland portions of the map area but is not shown on the map. This unit is loess, deposited by the wind. The lower contact generally is gradational and irregular.

F Metropolis Formation Clay-rich silty sand and sandy silt with gravel. This unit is yellowish orange and yellowish brown, strongly mottled with gray, brown, and locally with bright reddish orange. It typically comprises a series of upward-fining sequences with stratification weakly developed. The sediments are thoroughly burrowed, and multiple soil horizons are developed. The upper part is dominantly massive silt that resembles loess but contains scattered sand and pebbles. Portions are calcareous and contain abundant small calcite concretions. Gravel occurs as lenses and discontinuous layers. The gravel is dominantly composed of chert pebbles derived from the Mounds but abraded and bleached, losing much of the original bronze patina.

In Kentucky, Olive (1969) identified the Metropolis as an "upper silt and sand unit of continental deposits" and noted its equivalence to "terrace deposits" mapped in Illinois by Pryor and Ross (1962). (Pryor and Ross incorrectly assigned Wisconsinan age to the terrace deposits.) On Olive's map, the terrace in the southeast corner of the Olmsted Quadrangle was mapped as loess. This terrace is composed of Metropolis Formation mantled in loess, as shown by the outcrop on the left bank of Clanton Creek 1.6 miles northeast of Oscar. The terrace is mapped as Metropolis Formation on our map, which omits loess units.

The Metropolis underlies loess on low terraces that border the Ohio River in the northeastern, southeastern, and southwestern parts of the map area. It is interpreted as sediments of small, meandering streams that occupied the lowermost Ohio River valley while the main flow of that river was diverted through the Cache Valley, north of the Olmsted quadrangle (Nelson et al. 1999). The lower contact to the Mounds Gravel generally is gradational.

G Mounds Gravel Gravel and sand. Gravel is composed principally of well-rounded chert pebbles, mostly smaller than 1 inch but reaching 2 inches or more. These pebbles bear a distinctive, glossy bronze to yellowish brown patina of iron oxide that permeates outer layers of the pebbles. Quartz granules are common in the finer fraction. Gravel is crudely stratified, with lenticular bedding and low-angle accretion surfaces. Sandstone boulders as large as 6 feet and balls of clay are locally present. Sand of the Mounds is red to brownish orange, coarse and poorly sorted, and commonly cross-bedded. Gravel and sand are partially cemented by iron oxide, particularly at the base of the unit. The Mounds underlies loess on hilltops in upland areas, and it underlies the Metropolis Formation in lowlands. This unit represents alluvial, braided-stream deposits. The lower contact is unconformable.

In Kentucky, Olive (1969) identified the Mounds as a "lower gravel, sand, and silt unit of continental deposits." His detailed lithologic descriptions leave no doubt that the lower and upper continental deposits of Kentucky equate, respectively, to Mounds and Metropolis Formations in Illinois. The gravel is as thick as 95 feet in Kentucky (Olive 1969).

H Wilcox Formation Sand, silt, and clay. Sand can be white, yellow, orange, or red; fine to coarse; with granules of chert and quartz; and with clay rip-up clasts. The chert granules are gray, brown, and black, well rounded and polished, but lack an iron patina. Clay and silt come in many colors, including pink, brown, magenta, and ochre. Clay, silt, and sand are commonly interlaminated. In some cases, rhythmic lamination suggests tidal action. The Wilcox thickens southward from an erosional feather-edge in the central part of the map area. It is the youngest marine deposit of the Mississippi Embayment within Illinois. The lower contact is unconformable.

I Porters Creek Clay Clay is dark gray, silty, and micaceous; it breaks with a blocky or conchoidal fracture. Bedding generally is indistinct, marked by sandy layers and iron stains. Pryor and Ross (1962) reported radiolaria, hystrichospheridae, foraminifera, casts and molds of pelecypods and gastropods, and abundant fish scales and shark teeth. The lower part becomes increasingly sandy, glauconitic, and burrowed. Wayne Pryor (1958, ISGS field notes; available from ISGS library) reported abundant sand dikes in an outcrop southeast of Levings (SW¼ SW¼ SE¼ Sec. 12, T15S, R1E). Near Olmsted the Porters Creek has been mined extensively to manufacture absorbents. Maximum thickness is about 70 feet in Illinois and 120 feet in Kentucky (Olive 1969). The lower contact is gradational.

Thomas and Murray (1989) reported that the Porters Creek from Olmsted and elsewhere is largely calcium montmorillonite or smectite, along with lesser proportions of kaolinite and illite. The kaolinite portion increases upward through the formation and northward in the Embayment. Non-clay constituents include quartz and lesser amounts of mica, feldspar, and siderite. The Porters Creek is interpreted as marine sediment that records a rapid transgression followed by gradual regression.

J Clayton Formation Sandy clay to clayey sand is greenish gray to nearly black when fresh and weathers to an orange-brown. The sediment is massive, mottled, heavily burrowed, and highly glauconitic. It is commonly iron-cemented and contains small limonite concretions. Chert pebbles and occasional cobbles as large as 8 inches across occur in the lower part of the unit. Collecting fossils mainly in the now-abandoned Golden Cat clay pit on the north side of Olmsted, Cope (1999) reported an extensive fauna of bryozoans, annelids, bivalves, gastropods, crabs, lobsters, sharks, rays, ratfish, crocodiles, and turtles. These fossils signify brackish waters, as in an estuary. A potassium-argon date from glauconite 3 feet above the base of the Clayton yielded an early Late Paleocene age of 60.6 ± 1.3 million years (Reed et al. 1977). The lower contact is unconformable and, in the Olmsted area, represents a hiatus of approximately 5 million years.

Mapping the Kentucky portion of the Olmsted Quadrangle, Olive (1969) combined the Clayton and McNairy Formations into a single unit. Partly he did this because many well records were insufficiently detailed to separate the two units. However, Olive's description of the Porters Creek Clay includes highly glauconitic, burrowed sand containing chert pebbles identical to Clayton Formation as outlined herein. Olive examined outcrops on the Illinois shore of the Ohio River and cited pollen analysis that equated glauconitic, pebbly sand with the lower part of the Porters Creek. In view of the findings of Reed et al. (1977) and Cope (1999) and others, we stand behind our identification of the Clayton Formation.

K Owl Creek Formation Sand and silt are light greenish gray to brown, medium- to coarse-grained, cross-bedded, and glauconitic. The upper part is more clay-rich and finer grained, more glauconitic, and riddled with *Ophiomorpha* and other burrows. The Owl Creek is interpreted as littoral (shoreline) to shallow subtidal, marine. A potassium-argon age of 65.7 ± 1.4 million years, obtained from pelletal glauconite 2 feet below the top of the Owl Creek, is very close to the end of the Cretaceous Period (Reed et al. 1977). A weathered zone reportedly occurs at the top of the Owl Creek (Pryor and Ross 1962). The lower contact is gradational in some places and scoured in other places, marked by rip-up clasts derived from the McNairy Formation below it.

L McNairy Formation Sand, silt, clay, and lignite. Sand is white to light gray, buff, orange, and red; very fine- to medium-grained, and weakly lithified to tightly cemented by iron oxide. Silt and clay vary from nearly white through all shades of gray to black. Abundant muscovite mica is characteristic of the McNairy. Sand, silt, and clay commonly are interlaminated; rhythmic planar lamination indicates tidal activity. Thicker sand units can be cross-bedded and, in many cases, contain rip-up clasts of light-colored clay. Both upward-fining and upward-coarsening sequences are developed.

The McNairy contains much more organic matter in the Olmsted area than elsewhere in southern Illinois, including highly carbonaceous clay and silt along with stringers and beds of lignite as thick as 2½ feet. Fossil plants are common; W.A. Pryor (1959, ISGS field notes; available from ISGS library) identified foliage of walnut, willow, wax myrtle, and pondweed from an outcrop near Lock and Dam 53. These leaves indicate environments ranging from aquatic to well-drained uplands. Pryor and Ross (1962, p. 19) gave the name Levings Member to an interval of lignitic silt and clay, stating that this member occurs throughout the northern Mississippi Embayment. We have been unable to trace the Levings away from its type area and interpret it as a local facies rather than a widespread, tabular unit.

The ISGS Johnston test boring (SE¼ Sec. 22, T15S, R1E) penetrated 455 feet of Cretaceous sediments without reaching the base. The upper 160 feet comprises burrowed and laminated, micaceous clay, silt, and sand of typical McNairy aspect. Downward this unit grades to darker, highly organic sediments that include many stringers and thin beds of lignite. There are multiple rooted zones and layers of kaolinite that represent buried soils. White chert gravel near the bottom of the hole resembles that of the Post Creek Formation but is underlain by more clay and lignite. Fossil pollen from lignite layers at depths of 61, 219, 328, and 490 feet was examined by Norman O. Frederiksen of the U.S. Geological Survey. Frederiksen reported (written communication 2003) that all samples are Maastrichtian age—coeval with McNairy Formation and younger than the Campanian pollen age reported for the Post Creek (Harrison and Litwin 1997). Evidence strongly indicates that the Johnston borehole penetrated a fault block that rapidly subsided during Maastrichtian time, trapping a thick succession of terrestrial sediment in advance of initial marine transgression (Bexfield et al. 2005). See cross section B–B′.

In Kentucky, Olive (1969) reported only local "fragments of lignitic plant material" in the McNairy Formation. Only one well in the Kentucky portion of the Olmsted Quadrangle completely penetrated the McNairy. In that hole, which is not shown, located on the north side of Turner Landing Road just west of Mitchell Lake, the McNairy is 220 feet thick with the top eroded.

Subsurface Only

M Post Creek Formation Chert gravel. Two water-well drillers' logs record "gravel." Other logs report "chert" underlying sand or clay of the McNairy Formation but do not distinguish between chert gravel that might be Post Creek and bedded or massive chert of altered Paleozoic bedrock. In nearby areas, the Post Creek is largely white to gray chert gravel in which the pebbles have dull surfaces, lacking polish or patina.

N Fort Payne Formation Cherty limestone and siliceous rock. Where unaltered, the Fort Payne is composed of dark gray, micritic, siliceous limestone containing numerous chert nodules. Where altered, the rock is a dark brown, porous residue that resembles siltstone. This material is porous, low density, and bedded or laminated. Sponge spicules, crinoid stems, and shell fragments are rare. Layers of dull, opaque, banded, dark-colored chert are 2 to 4 inches thick and spaced several feet apart in cores. The lower contact is sharp.

Note: Mississippian units younger than the Fort Payne probably occur within the Olmsted Quadrangle, but no information on such rock units is available.

O Springville Shale Shale and siltstone. Dark gray and greenish gray siltstone in the upper part grades downward to greenish gray shale in the lower part. Both contacts are sharp.

P Chouteau Limestone Limestone and siliceous rock. Light to medium brown, microgranular limestone containing few fossil fragments is partially altered to a gray, porous, and spongy siliceous residue. Both contacts are sharp.

Q New Albany Shale Shale is greenish and olive-gray to black, moderately to very fissile, pyritic, and contains a sparse fauna of conodonts and fish remains. Three members can be identified with reference to Cluff et al. (1981). The Selmier Shale Member at the base is 75 to 80 feet thick and consists of layers of black shale alternating with layers of greenish to olive-gray shale that is partly silty and pyritic. Overlying the Selmier with a sharp but conformable contact is the Grassy Creek Shale Member, 75 to 100 feet of uniformly very dark gray to black, pyritic, well-laminated shale. At the top is less than 10 feet of greenish gray, calcareous shale probably belonging to the Hannibal Shale Member. In some cores, the New Albany contains laminae and thin interbeds of microgranular limestone and dolomite. The lower contact is unconformable.

R St. Laurent Formation Cherty and shaly limestone is largely medium to dark gray, microgranular to bioclastic (lime mudstone, wackestone, and packstone), with thin layers of dark gray to black shale. Bedding is thin and commonly wavy to nodular. In some cores, this unit has been leached to a residuum of clay and chert fragments. The lower contact was not observed but generally is sharp.

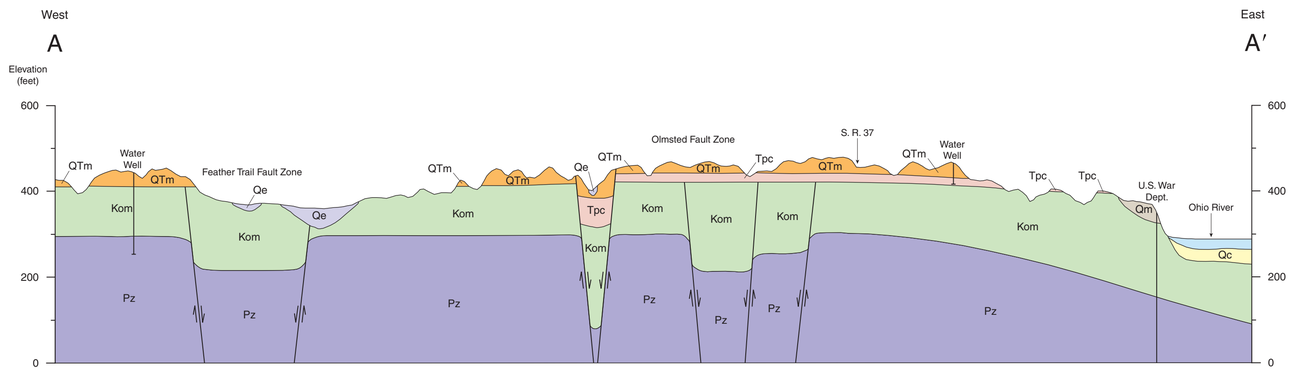
S Grand Tower Limestone Limestone and sandstone. Light gray, fine- to coarse-grained, bioclastic limestone (skeletal packstone and grainstone) is the dominant rock type. It is commonly sandy and contains numerous trilobites, brachiopods, and other marine fossils. The Dutch Creek Sandstone Member at the base is white, fine- to medium-grained sandstone composed of rounded, frosted quartz grains cemented by calcite. In some wells the limestone has been dissolved away, leaving a residuum of clay and chert fragments overlying loose basal sand. The lower contact was not observed; in most of southern Illinois, it is unconformable.

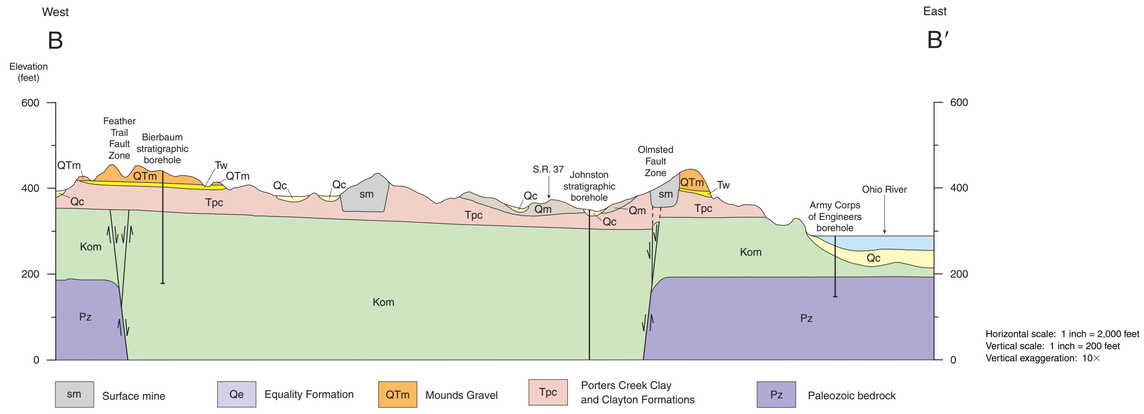
T Clear Creek Formation Limestone and chert. The upper part is entirely chert that is white to buff, opaque to translucent, and dense to porous; it contains casts and molds of dolomite crystals. This material probably was originally cherty limestone that underwent dissolution. In some wells, the lower part is light gray, very fine-grained limestone that is cherty and fossiliferous.

Only one well, the R.G. Williams Number 1 Richey (or Rickey) oil test (in Sec. 9, T15S, R1E) penetrated strata below the Clear Creek Formation. The following summary of deeper formations in the Richey well is based on a sample study by ISGS geologist Frank E. Tippie, 1941:

Formation	Thickness (feet)	Description
Backbone Ls (?)	70	White to light gray crystalline, cherty limestone
Grassy Knob Chert and Bailey Ls	630	Cherty and siliceous light gray dolomite, silt and clay increasing downward; green near base
Moccasin Springs	140	Reddish brown to green very silty limestone
St. Clair Ls	30	Light buff to pink limestone with red fossils
Sexton Creek Ls, Girardeau Ls	92	Micritic limestone and dolomite, darker downward; upper part cherty, lower part shaly.
Maquoketa Sh	185	Silty shale and siltstone, nearly black; 18 feet of sandstone near the middle, phosphatic at base
Kimmswick ("Trenton") Ls	155	White to light brown, medium to coarse dolomite
Plattin	844±	Gray to dark brown, micritic to very fine-grained limestone and dolomite with few fossils
Joachim Dol	142±	Sandy dolomite, very fine, beds of white sandstone
Dutchtown Ls	169±	Very dark brown dolomite and limestone, lithographic to very fine, shaly interbeds, base sandy
St. Peter Ss	10+	White, medium-grained dolomitic sandstone.

See accompanying report for references.





Horizontal scale: 1 inch = 2,000 feet
Vertical scale: 1 inch = 200 feet
Vertical exaggeration: 10×

sm Surface mine
Qe Equality Formation
QTm Mounds Gravel
Tpc Porters Creek Clay and Clayton Formations
Pz Paleozoic bedrock
Qc Cahokia Formation
Qm Metropolis Formation
Tw Wilcox Formation
Kom Owl Creek and McNairy Formations