BEDROCK GEOLOGY OF SMITHLAND QUADRANGLE
POPE AND MASSAC COUNTIES, ILLINOIS

Prairie Research Institute
ILLINOIS STATE GEOLOGICAL SURVEY

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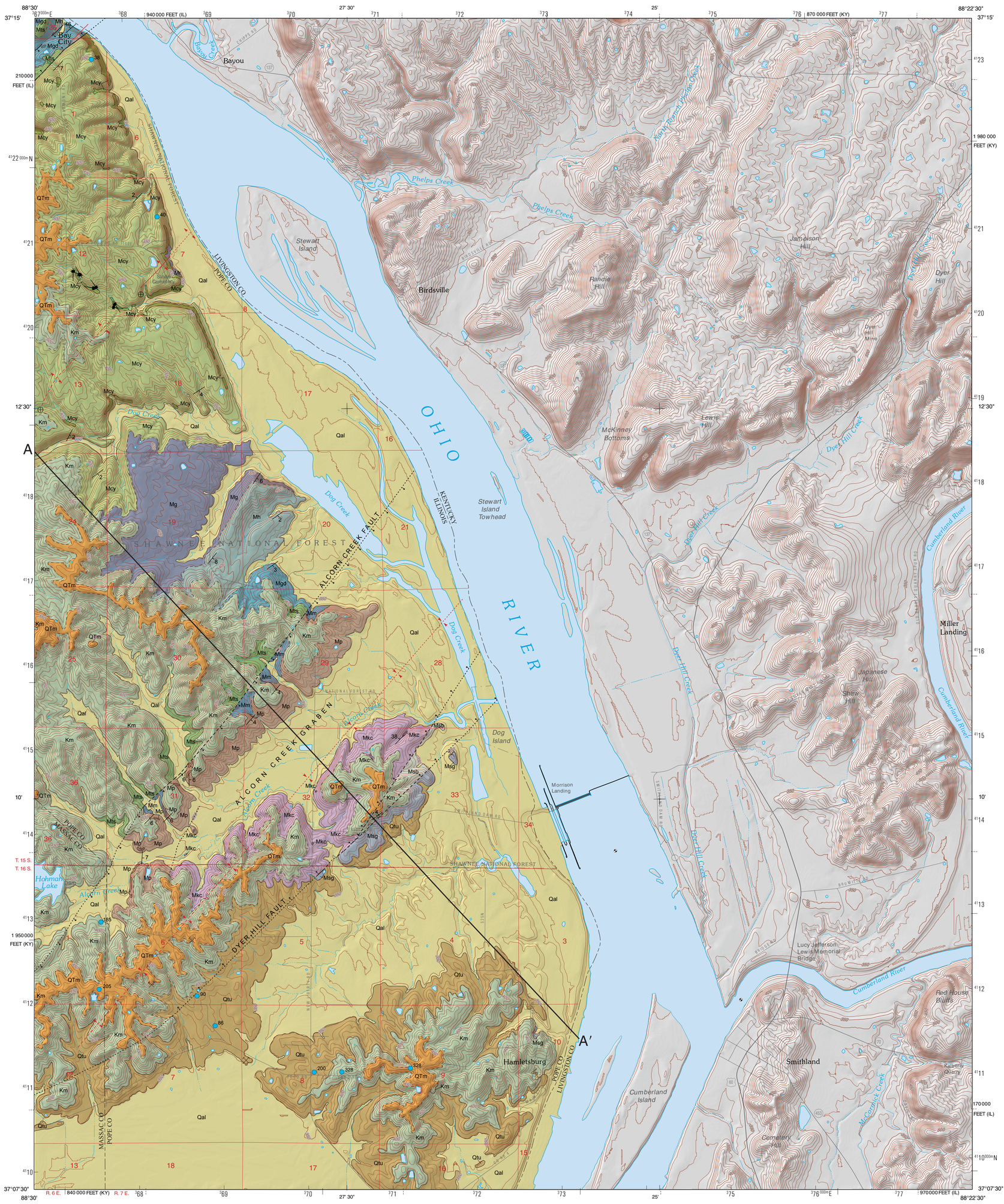
2013

Illinois Geologic Quadrangle Map
IGQ Smithland-BG



EXPLANATION

	Qal	Alluvium	Holocene
	Unconformity		
Quaternary	Qtu	Terrace deposits undifferentiated	Pleistocene
	Unconformity		
Tertiary	QTm	Mounds Gravel	Pliocene
	Unconformity		
Cretaceous	Km	McNairy Formation	Upper Cretaceous
	Unconformity		
	Mkc	Kinkaid Limestone, Degonia Sandstone, and Clore Formation	Chesterian
	Mp	Palestine Formation	
	Mm	Menard Limestone	
	Mts	Tar Springs Formation	
	Mgd	Glen Dean Limestone	
Mississippian	Mh	Hardinsburg Formation	
	Mg	Golconda Formation	
	Mcy	Cypress Formation	
	Mr	Ridenhower Formation	
	Msb	Sample Sandstone and Bethel Sandstone	
	Msg	Ste. Genevieve Limestone	

Note: Outcrops of each unit are shown with a darker shade of color.

Symbols

- 40 — Strike and dip of bedding; number indicates degree of dip
- Horizontal bedding
- Vertical joint
- Gravel pit
- Mineral prospect pit

Drill Holes

Numbers indicate total depth of boring in feet

- 205 — Water well

Line Symbols

Dashed where inferred, dotted where concealed

- Contact
- Fault: bar and ball on downthrown side
- Anticline
- Syncline
- 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 website.

Base map compiled by Illinois State Geological Survey from digital data (2010 US Topo) provided by the United States Geological Survey.

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

Recommended citation:
Devera, J.A., 2013, Bedrock Geology of Smithland Quadrangle, Pope and Massac Counties, Illinois: Illinois State Geological Survey, Illinois Geologic Quadrangle Map, IGQ Smithland-BG, 2 sheets, 1:24,000.

SCALE 1:24,000

1 — 1/2 — 0 — 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

Geology based on field work by Joseph A. Devera, 1996–1997.

Digital cartography by Jane E. Johnshoy Domier, Trisha S. Rentschler, and Coy E. Potts, Illinois State Geological Survey.

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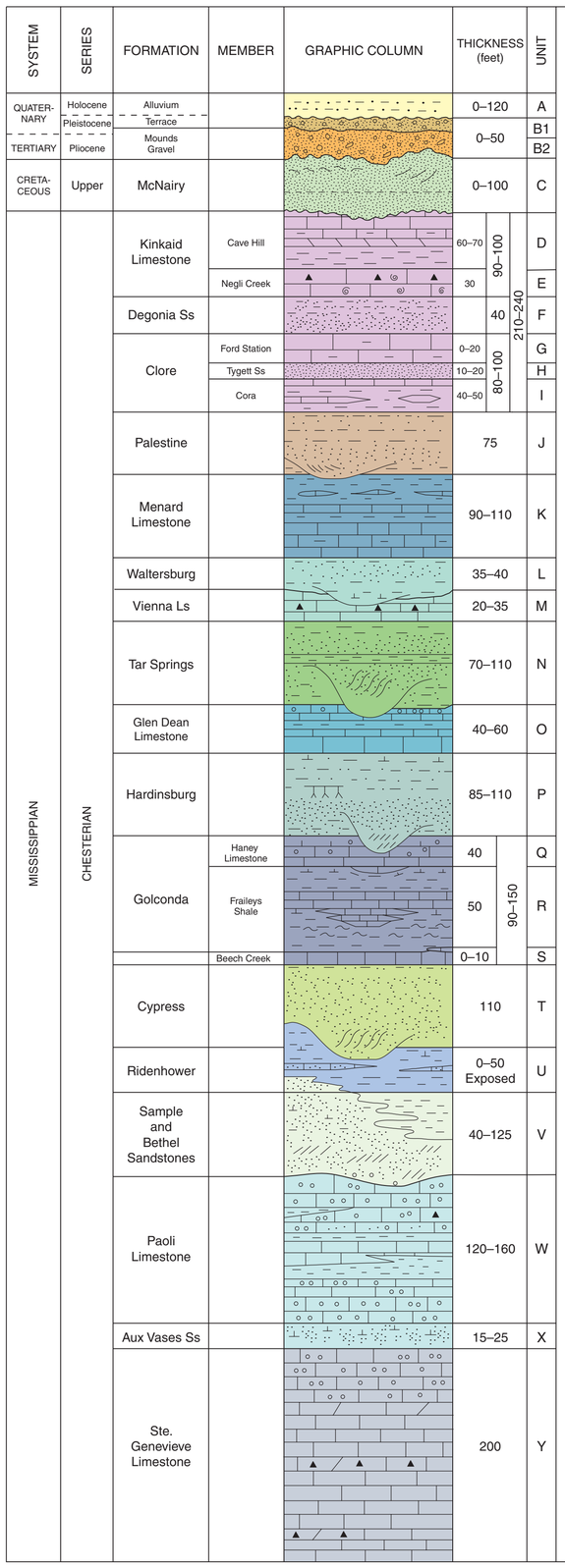
1	2	3
4		5
6	7	8

ADJOINING QUADRANGLES
1 Brownfield
2 Golconda
3 Lola KY
4 Paducah NE
5 Burna KY
6 Paducah East
7 Little Cypress
8 Calvert City KY

APPROXIMATE MEAN DECLINATION, 2013

ROAD CLASSIFICATION

Interstate Route		State Route	
U.S. Route		Local road	



A Alluvium Clay, silt, sand, and gravel. The predominant sediments along the creeks are clay and silt-sized particles. Loess, brown to light brown and rich in clay and silt, was observed in cut banks. Coarse angular sandstone and occasional chert debris occur in smaller drainages to the north. Talus is abundant along the fault zone near Bay City and along faults both north and south of Alcorn Creek. Rounded gravel with a tan patina is reworked from slopes containing Mounds Gravel in the southern part of the quadrangle.

B1 Terrace deposits (Metropolis Formation) Sand, clay, and gravel. Contains dark brown to gray silty clay. Finer grained quartz sand is common in ravines where the McNairy Formation is thick. Gravel contains rounded chert with little or no tan patina on the exterior of the clasts.

B2 Mounds Gravel Gravel and sand. Gravel is composed of subrounded to well-rounded chert pebbles and minor amounts of rounded quartz pebbles. Most exposures have a tan-yellow to bronze patina on the chert pebbles, with a red clay and sand matrix. A clay skin is well developed around the rounded chert clasts. Occasional silicified fossil crinoid stems and other fossil fragments are observed in the gravel. In places, the upper part contains gravel mixed with purple-stained loess. The gravel is typically unconsolidated, but ferruginous cement is common in the lower part. An area on the map differentiated as "terrace deposits" contains a similar lithology, except the patina is worn thin and clay skins are poorly developed or not present. The unit is marked by an unconformity at the base.

C McNairy Formation Sand, clay, and gravel. Sand interbedded with clay. The sand is rusty red with orange and yellow stains. It is unconsolidated fine-grained, well-sorted sand that is predominantly composed of quartz and mica. The sand is reddish brown in places because of ferruginous Liesegang bands. Clay is gray to white and laminated with silt and mica. Gravel and sand near the base is composed of chert pebbles and cobbles. The sand is unconformable at the base.

D Kinkaid Limestone, Cave Hill Member Limestone, dolostone, and shale. Interbedded, dark gray argillaceous limestone and light yellowish dolostone with *Anthracospirifer increbescens*, *Composita* sp., and fenestrate bryozoans. The shale is dark gray and poorly fossiliferous and is interbedded with the lower unit.

E Kinkaid Limestone, Negli Creek Member Limestone. Limestone is dark gray and weathers bluish gray. Dense lime mudstones and fossil wackestones yield a conchoidal fracture. Common fossils include large *Bellerophontid* gastropods, echinoid spines, rugose corals, and *Archimedes* sp. axes. Occasional dark gray chert nodules with fenestrate bryozoans are seen within this unit. Medium bedded and conformable with the underlying unit.

F Degonia Sandstone Siltstone, sandstone, shale, and chert. Siltstone is olive brown and thin-bedded with green shale laminae. Sandstone is an olive brown fine-grained, well-sorted, quartz arenite interbedded with greenish silty shale containing carbonaceous plant debris. Shale is greenish gray and weathers greenish brown and platy. Chert in the upper part is thin-bedded and brown. It weathers light gray and has a silty texture, with microlaminated primary sedimentary structures. The basal contact is sharp.

G Clore Formation, Ford Station Member Limestone. Limestone is dark gray lime mudstone to fossil wackestone and packstone containing *Composita* sp., *Agassizocrinus* sp., *Anthracospirifer increbescens*, *Spirifer* sp., rugose corals, ramose bryozoans, pelmatozoans, blastoids, whole *Archimedes* sp., and large derbyid brachiopods. Yellow dolostone beds are present. Limestone shows hourglass weathering. The lower contact is gradational.

H Clore Formation, Tygett Sandstone Member Sandstone and shale. Sandstone is an olive brown to tan fine-grained, well-sorted quartz arenite that is interbedded with dark gray nonfossiliferous shale. The lower part of this thin-bedded sandstone is calcareous and has a gradational base. This unit is poorly exposed.

I Clore Formation, Cora Member Shale and limestone. Dark gray, fossiliferous calcareous shale contains fenestrate bryozoans and brachiopods. Limestone occurs as thin beds or lenses of dark gray, dense, fossiliferous wackestone within the shale. The unit is poorly exposed because it is predominantly shale. The lower contact is conformable.

J Palestine Formation Sandstone, siltstone, and shale. The lower part is largely sandstone. It is a light brown to tan, fine-grained, well-sorted quartz arenite. Sandstone ranges from medium- to thick-bedded and is cross-bedded in part. Above lie siltstones with interbedded shales that are laminated and contain ripple marks. The upper part is poorly exposed. Local disconformity occurs where a channel has been cut into the underlying unit.

K Menard Limestone Limestone and shale. Dark brownish gray lime mudstones interbedded with dark gray soft, platy shales. The formation is dominated by argillaceous lime mudstones interbedded with thin packstones and wackestone layers. Some limestone beds show laminations and polygonal mud cracks. Fauna are predominantly composed of bryozoans, brachiopods, and crinoids. Grainstones containing coarse crinoidal debris are also present as lenses. Dark gray chert is rare but is present in the middle portion of the unit. Shales interbedded with wackestones mainly occur near the top. The shale is dark gray and calcareous in part. The lower contact is gradational.

L Waltersburg Formation Siltstone, shale, and sandstone. Siltstone is greenish gray, thin-bedded, and poorly exposed but weathers brown and in places weathers into rhomboidal fragments. Shale is dark gray, is silty, and weathers to a rusty brown. Sandstone is an olive brown fine-grained, well-sorted quartz arenite that is medium- to thick-bedded in the lower part. This unit is poorly exposed in the quadrangle. The lower contact is locally unconformable.

M Vienna Limestone Limestone and shale. Argillaceous dark gray limestone with brown, waxy chert is common. Fossils are mainly fenestrate bryozoans and small cleiothyridinid brachiopods. Shale in the upper part is dark gray to light gray and calcareous in part. Siliceous limestone at the base has a sharp lower contact.

N Tar Springs Formation Sandstone, siltstone, and shale. Sandstone is tan to light gray, fine-grained, well-sorted quartz arenite. Thin- to thick-bedded sandstone is silty and shaly near the top. The primary sedimentary structures in the sandstone are ripple marks and large-scale trough crossbeds. Two sandstone units are separated by a light gray silty shale in the middle of the formation. Local unconformity occurs at the base of this unit, which is also gradational in places with the unit below.

O Glen Dean Limestone Limestone and shale. Limestone is either crinoidal grainstone that is cross-bedded, oolitic in part, and medium- to thick-bedded or packstones with pelmatozoans, bryozoans, blastoids, and brachiopods. Shale is dark to medium greenish gray, weathers to platelets, and contains chalky white fenestrate bryozoans, *Anthracospirifer increbescens*, and shark's teeth. Limestone is interbedded with gray shale in the middle to lower part. The triangular bryozoan *Prismopora* sp. is common locally in this unit. The lower contact is interbedded and gradational.

P Hardinsburg Formation Sandstone, siltstone, and shale. Sandstone is a white to light gray fine-grained, well-sorted quartz arenite that is medium- to thick-bedded, contains cross-bedding, and is locally ripple marked. Interbedded siltstones and greenish gray, poorly laminated shales occur in the upper part. Siltstone is calcareous and is burrowed with tidal bundles seen as "pinstripe" layering. Stigmarian roots are common in the uppermost part. The lower contact is locally unconformable where a channel form is present. The other areas are conformable.

Q Golconda Formation, Haney Limestone Member Limestone and shale. Grainstone is light gray, oolitic, and mixed with pelmatozoa and yellow to gray fossiliferous shales. The grainstone is cross-bedded in the upper part. Shale with crinoid packstone lenses contains articulated *Phanocrinus* sp., *Zeacrinus* sp., and *Pterotocrinus capitalis*, with large *Pentremites obesus* and other small species of blastoids. Fossil wackestones weather yellowish and are argillaceous and dolomitic. The wackestones are thin-bedded. The unit becomes shaly toward the base and grades into the unit below.

R Golconda Formation, Fraileys Shale Member Shale, limestone, and mudstone. The upper part is dark greenish gray, calcareous shale. Not exposed, but known from local boreholes, is a variegated red and green soft, platy claystone. Below this is a blocky, earthy, dark gray calcareous mudstone. Limestones range in thickness from 10 to 45 feet. Limestones are gray to light gray and contain grainstones that grade into packstones and wackestones. Lime mudstones are also present. The dominant fossils are crinoids and bryozoans. The lower part of the unit differs from the upper shale in that it contains more fissile shale that is dark greenish gray, is calcareous, and has siderite nodules and thin pavement layers of fossils made up of disarticulated crinoids, including *Pterotocrinus capitalis* "wing plates" and rhomboporoid bryozoans. The basal contact is sharp and conformable.

S Golconda Formation, Beech Creek Member This unit varies from dolostone to lime mudstone to argillaceous crinoidal wackestone and packstone facies. This unit is conformable with the underlying unit. Denny and Nelson (2005) observed this member only in the Paducah Northeast Quadrangle but did not observe it at the surface in the Smithland Quadrangle.

T Cypress Formation Sandstone, siltstone, and shale. The sandstone forms bluffs and is the dominant lithology. However, at the top, greenish gray shale interbedded with siltstone is common. Thin-bedded flaggy sandstones containing trace fossils of *Lockeia* isp. and *Planolites* isp. occur in the upper parts. Sandstone is white to light gray, weathers tan, and is a very fine- to fine-grained, well-sorted quartz arenite. It is thin-bedded at the top and becomes more thickly bedded at the base. The sandstone is cross-bedded, showing lenticular and irregular bedding. Ripple marks, flaser bedding, and planar laminations are common primary sedimentary structures seen in exposures. The lower contact is erosional.

U Ridenhower Formation Shale, siltstone, and limestone. Shale is the dominant lithology. The shale is dark gray, silty, siliceous, and dense; contains siderite nodules; and is calcareous. Siltstone is interbedded with the silty shale and weathers rusty brown, is calcareous in part, and contains molds and casts of brachiopods. The siltstone is thin-bedded, contains ripple marks, and is irregularly bedded. Lower in the unit, a dark gray shale contains medium gray, dense limestone lenses up to 2 feet thick that are composed of sandy wackestone. Limestone lenses yield red crinoid columnals and carbonate clasts coated with clay. Iron oxide-stained mud rip-up clasts also are associated with the limestone. Fauna consist of crinoids, bryozoans, rugose corals, brachiopods, and rarely goniatites. The base is not exposed in this quadrangle, but based on surrounding drill holes, it is conformable with the underlying unit.

V Sample and Bethel Sandstones Sandstone. Sandstone is a white to light gray fine-grained quartz arenite. The upper part is very fine-grained and thinly bedded to laminated. This unit is an upward-fining sequence. It contains wavy laminations to ripple marks. Planar cross-bedding and lenticular bedding are present. Only the fine-grained portion was observed along a fault slice (NE, Sec. 33, T15S, R7E). From drill hole data and observations in adjacent quadrangles, the lower part of this unit ranges from coarse to medium grained and has a sugary texture. Small quartz granules occur near the base. The base is locally erosional.

W Paoli Limestone Limestone and shale. This unit is known only from the subsurface in the quadrangle. It contains greenish gray shales with red mottling and is calcareous because of an abundance of crinoid and bryozoan fragments. The limestone below is light gray to brownish gray oolitic, crinoidal grainstone. Crinoid stem fragments are typically orange. Cherty, dark gray packstones are also common beds in the upper middle part. The middle portion of the unit contains variegated red and green claystone. The lower part contains argillaceous lime mudstones and crinoidal wackestones that grade into oolitic packstones and grainstones. The basal part consists of white to light gray oolitic grainstones that contain some red to pink oolites. The contact is gradational.

X Aux Vases Sandstone Sandstone and limestone. The sandstone is a greenish gray to light gray fine-grained quartz arenite. The sandstone is thin-bedded, is calcareous, and contains glauconite. The rocks grade downward into a sandy limestone. The limestone is a light gray wackestone composed of crinoid columnals, oolites, and quartz sand. The lower contact is gradational.

Y Ste. Genevieve Limestone Limestone. Light gray oolitic, crinoidal grainstone interbedded with lime mudstone. The grainstones show cross-bedding. Thin laminae of greenish gray shale are also present. The dominant lithology is limestone. Fauna consist of echinoderm fragments, brachiopod fragments, ostracodes, and fossil debris. This unit is poorly exposed along the south side of the Alcorn Creek Graben.

Structural Geology

The Smithland Quadrangle occurs at the northeastern margin of the Fluorspar Area Fault Complex. Paleozoic bedrock is well exposed in the northern portion of the quadrangle. Cretaceous and Tertiary strata deeply mantle the Paleozoic bedrock in the southern part of the study area. The bedrock is disrupted by numerous, high-angle, northeast- to southwest-trending faults that are overlapped by Cretaceous and younger sediments. Mississippian rocks are overlain, with an angular unconformity, with Cretaceous Embayment sediments, which are in turn unconformably topped by late Tertiary sediments. Exposures of these structures are mainly seen along the Ohio River, where Cretaceous and Tertiary sediments are thin because of erosion along the river bluffs.

Two major fault zones occur within the Smithland Quadrangle: the Bay City Fault Zone in the extreme northwestern corner of the quadrangle and the Alcorn Creek Graben in the southern part of the map area. Both fault zones trend northeast and are an extension of the Illinois-Kentucky Fluorspar Fault Complex. They are direct extensions of faults mapped in Kentucky by Amos (1967).

The Bay City Fault Zone is well exposed on the west bank of the Ohio River at Bay City, Illinois. The zone is defined by two parallel faults that outline a graben. Numerous other smaller, subparallel faults also occur. The main southern fault juxtaposes the Glen Dean Limestone on the north side of the fault with the Cypress Formation on the south side of the fault. Farther to the southwest along the same southern fault, the Cypress is juxtaposed with the Tar Springs Formation, yielding 300 to 350 feet of displacement. Exposures showing compression along this leg of the fault can be observed on the west bank of the Ohio River (SE, Sec. 36, T14S, R6E). This fault had two periods of movement. The first was compressional and produced three small-scale anticlines. The second was extensional and produced a normal fault. The crests of these small anticlines parallel the major northeast- to southwest-trending fault. A parallel fault to the north has about 40 feet of offset with the Glen Dean Limestone to the south in juxtaposition with the upper part of the Hardinsburg Formation on the north side of this fault. Together, these two parallel faults form a narrowly deformed graben.

The Alcorn Creek Graben is defined by a northeast-trending fault on the north side of Alcorn Creek and an extension of the Dyer Hill Fault (Amos 1967) on the south side of Alcorn Creek. The northern fault juxtaposes the Tar Springs Formation with the Menard Limestone, which has been down-dropped about 50 to 60 feet. Evidence of the northern fault is well exposed in the SW, NW, NE, Sec. 31, T15S, R7E. Here, the Palestine Formation strikes N 40°E, and dips range from 61° to 71° to the southeast. This fault was not previously known to exist in Illinois. The southern fault, the Dyer Hill Fault, parallels the northern fault, the Alcorn Creek Fault. The Dyer Hill Fault juxtaposes upper Chesterian rocks on the north side of the fault with the Ste. Genevieve Limestone on the southern side of the fault. The offset is about 1,200 feet. In the southeast corner of Sec. 32, T15S, R7E, the Dyer Hill Fault splits, juxtaposing upper Chesterian rocks with the Bethel and Sample Sandstones in the central sliver and with the Ste. Genevieve Limestone to the south.

The northern fault that defines the Alcorn Creek Graben was not previously known to exist in Illinois. This fault and the stratigraphy in the area differ considerably from those shown by Ross (1964). However, they do appear to align with faults mapped by Amos (1967), who mapped the geology of the Kentucky side of the Smithland Quadrangle.

Rocks are deformed within the Alcorn Creek Graben. The graben contains a large asymmetrical syncline with an axial trend of N 45°E, paralleling the trends of the faults that define the graben. The north limb of the syncline dips 4° to 6° to the southeast, whereas the south limb yields dips as steep as 38° to the northwest. In the southwestern part of the Alcorn Creek Graben, the strike of the rocks changes from N 45°E to N 10°E because a minor fault is suspected in the area. Rocks on the center of the north line of Sec. 6, T16S, R7E have been brecciated and recrystallized.

Tertiary sediments of the Mounds Gravel have a lower elevation within the Alcorn Creek Graben. North of the graben, the base of the Mounds Gravel ranges from 550 to 570 feet in elevation, whereas the base of the Mounds Gravel within the graben occurs at an elevation of 450 feet. Ross (1964) also suspected displacement of beds of "Lafayette" Gravel. Ross noted that earthquake activity in the area suggests the fault systems are still active.

A broad anticline was mapped near the center of Sec. 7, T15S, R7E. The older Ridenhower Formation is exposed along the axis of the anticline. The trend of the anticlinal axis is N 40°E, paralleling most of the structure in the area. The north limb dips 2° northwest and the south limb dips 4° southeast.

Economic Geology

Fluorspar
No commercial fluorspar mines are located in the Illinois portion of the quadrangle. It is possible that fluorspar may exist southwest along the strike of the southern fault that defines the Alcorn Creek Graben. The southern fault is a southwestern extension of the Dyer Hill Fault (Amos 1967) in western Kentucky. The Dyer Hill mine complex is located at a change in strike of the Dyer Hill Fault in western Kentucky 3.5 miles northeast along the strike of a prospect pit located in Illinois. This fluorspar prospect pit is located in the N½, Sec. 33, T15S, R6E of the quadrangle. This location yields a small island knob of Ste. Genevieve Limestone, which occurs on the upthrown side, south of the Alcorn Creek Graben. No spar was ever mined at this locality. Mineralization in the Dyer Hill mine consists of fluorite with minor amounts of galena, barite, and sphalerite (Amos 1967). Cretaceous and Tertiary cover thickens southward and therefore has hampered surficial exploration along this fault in Illinois.

Calcite-filled veins within a compression zone of the Glen Dean Limestone occur in the SE, SE, Sec. 36, T14S, R6E. However, no other minerals are associated with the calcite mineralization.

Gravel
The Mounds Gravel is useful for surfacing local county and township roads. A number of small gravel pits within the Mounds Gravel are intermittently active in the quadrangle. Three gravel quarries are located near the Audubon Church, two that are active a few weeks during the year and one inactive quarry that exposes the Mounds Gravel and McNairy Formation. Another quarry in the Mounds Gravel, located one mile west of Hamletsburg, Illinois is active only a few days per year.

Reworked Mounds Gravel found at a lower elevation is also quarried in several pits southwest of Hamletsburg, Illinois. These gravels have been mapped as an upper Quaternary terrace that occurs from 340 to 400 feet above sea level. A small new pit was recently opened in the SE, SE, NW, Sec. 8, T16S, R7E. The gravel resembles Mounds Gravel; however, the tan patina is worn and no clay skins can be seen on the chert clasts.

Limestone
No limestone quarries currently exist in the map area, but potential high-calcium limestone resources exist near Hamletsburg, Illinois. In this area, the Ste. Genevieve Limestone is near the surface. A water well in Hamletsburg reached the Ste. Genevieve Limestone at a depth of 19 feet below the surface. The Ste. Genevieve Limestone can be used in making Portland cement, limestone aggregate, agricultural lime, and particles for roofing shingles. Two areas potentially exist for quarry development in the Ste. Genevieve Limestone: 1) Secs. 9 and 10, T16S, R7E, and 2) Sec. 33, T15S, R7E (Lamar 1959).

Oil and Gas
One oil and gas test hole was drilled just off the Smithland Quadrangle. The Rigney and Dodson Oil Company drilled the No. 1 J.H. Lewis well in the SW, SW, NE, Sec. 18, T16S, R7E in the northernmost portion of the Little Cypress Quadrangle. The borehole was drilled to 1,842 feet. A slight show of oil was detected in the beds of the St. Laurent Formation (Lingle Formation), which is in the upper part of the Middle Devonian carbonate sequence.

Possible oil traps may occur along the broad, gentle anticline striking N 40°E at the center of Sec. 7, T15S, R7E. Potential horizons would be the Aux Vases Sandstone, oolitic zones in the Ste. Genevieve Limestone, lower Mississippian rocks, and Middle Devonian carbonates.

References

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