Prairie Research Institute
ILLINOIS STATE GEOLOGICAL SURVEY

Bedrock Geology of Oraville Quadrangle
Jackson County, Illinois

Illinois Geologic Quadrangle Map
IGQ Oraville-BG

W. John Nelson, Joseph A. Devera, Laura M. Williams, and James R. Staub
2011

EXPLANATION

sm	Surface mine		
Qc	Cahokia Formation	Quaternary	Holocene
Qce	Cahokia Formation over Equality Formation	Quaternary	Pleistocene
	Unconformity		
IPc	Carbondale Formation	Pennsylvanian	Desmoinesian
IPt	Tradewater Formation (m, Murphysboro Coal; c, Curlew Member)	Pennsylvanian	Desmoinesian
	Unconformity		
IPcv	Caseyville Formation	Pennsylvanian	Morrowan
	Unconformity		
Mk	Kinkaid Formation	Mississippian	Chesterian
Md	Degonia Formation	Mississippian	Chesterian
Mc	Clore Formation	Mississippian	Chesterian

Symbols

- 40 — Strike and dip of bedding; number indicates degree of dip
- Horizontal bedding
- Vertical joints
- Inclined joints
- Shaft mine
- Slope mine
- Outcrop of special note, where unit or contact was well exposed at time of mapping

Drill Holes
from which subsurface data were obtained

- Dry oil - test hole
- Dry hole with show of oil
- Stratigraphic boring by ISGS, with name of landowner
- Water well
- Coal test
- SGC 109 Tpc — Labels indicate samples (S), geophysical log (G), or core (C). Numeric label indicates total depth of boring in feet. Unit label denotes formation at bottom. (br = bedrock) Dot indicates location accurate within 100 feet.

Line Symbols
dashed where inferred, dotted where concealed

- Contact
- Normal fault; bar and ball on downthrown side
- Monocline, arrows on downwarped side

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

Base map compiled by Illinois State Geological Survey from digital data provided by the United States Geological Survey. Topography compiled 1965. Planimetry derived from imagery taken 1993. PLSS and survey control current as of 1996.

North American Datum of 1927 (NAD 27)
Projection: Transverse Mercator
10,000-foot ticks: Illinois State Plane Coordinate system, west zone (Transverse Mercator)
1,000-meter ticks: Universal Transverse Mercator grid system, zone 16

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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 20 FEET
SUPPLEMENTARY CONTOUR INTERVAL 5 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

Geology based on field work and data analysis by W.J. Nelson, L.M. Williams, and J.A. Devera, 2000–2011.

Digital cartography by J.E. Johnshoy Domier and M. J. Widener, Illinois State Geological Survey.

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1	2	3
4		5
6	7	8

ADJOINING QUADRANGLES
1 Willisville
2 Ava
3 Vergennes
4 Raddle
5 Murphysboro
6 Altenburg
7 Gorham
8 Pomona

1½°
TRUE NORTH
MAGNETIC NORTH
APPROXIMATE MEAN DECLINATION, 2011

ROAD CLASSIFICATION

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

Introduction

This map depicts the bedrock geology of the Oraville Quadrangle in southwestern Illinois. Quaternary surficial deposits are not shown, except for alluvium and valley fill sediments of the Mississippi and Big Muddy Rivers and smaller streams. Bedrock in the Oraville Quadrangle is heavily mantled by Quaternary glacial and windblown deposits, which in most areas range from 10 feet to more than 50 feet thick. Rock outcroppings occur mainly in bluffs and steep hillsides and along the beds of flowing streams. The gently rolling eastern part of the map area has almost no outcrops.

Laura Williams initially mapped the geology of the Oraville Quadrangle as part of a master's thesis (Williams 2003). The Illinois State Geological Survey (ISGS) subsequently published the thesis map as Williams et al. (2005). The present map is considerably revised from these earlier products by the addition of new borehole information, including core drilling, and revised interpretation of the outcrop geology. Field notes made by previous ISGS geologists were consulted. They provide information on outcrops we did not visit, including some currently submerged by Kinkaid Lake.

The oldest large-scale geologic map that covers the Oraville Quadrangle is that of Shaw and Savage (1912). Smith (1958), Jacobson (1983), and Nelson and Lumm (1985) addressed aspects of the local bedrock geology.

Mineral Resources

Coal

The Oraville Quadrangle lies on the edge of the Illinois Basin coal field. Several small mines formerly operated within the map area; much larger mines lie a few miles north and east. The Murphysboro Coal, near the middle of the Tradewater Formation, is the primary seam of economic interest.

Shaw and Savage (1912) mapped the outcrop and elevation (structure contours) of the Murphysboro Coal. Their map shows an intricate outcrop pattern, closely adjusted to topographic contours. Smith (1958), Jacobson (1983), and Treworgy and Bargh (1984) all copied the coal outcrop from Shaw and Savage. We cannot replicate their intricate outcrop line because we found no definite surface exposures of the coal and only a few drilling records that indicate its presence. Our Murphysboro crop line therefore is approximate and generalized, particularly in the southern part of the map area.

Drilling records and field notes from long-abandoned mines indicate that the Murphysboro Coal in the Oraville Quadrangle consists of multiple benches or splits of coal within a shale interval as thick as 75 feet. Coal benches typically contain layers of "bone coal" (high ash/clay content) or carbonaceous shale and are separated by gray to black shale that has many coal laminae, abundant and well-preserved fossil plants, and paper-thin lamination. Underclays or rooted zones appear to be absent. Due to paucity of data, individual coal layers cannot be mapped, and defining the limits of the Murphysboro Coal zone is difficult. Closely spaced core drilling would be required to map reserves and assess minability.

Several small mines in the Murphysboro (?) Coal are documented in Sec. 26, T8S, R3W. H.E. Culver (1924, unpublished field notes, ISGS library) reported two abandoned slopes and an abandoned shaft in the northwest quarter of the section. One of the slopes (about 400′ NL, 2000′ WL) was reported to enter a 6-foot coal seam, of which the top 22 inches was clean and the remainder shaly. The mine dump showed papery black shale and gray shale. Culver also saw outcrops of coal along the stream in this area (now partially under Kinkaid Lake). G.H. Cady (1930, unpublished field notes, ISGS library) visited the Young slope mine, located about 500′ NL, 1700′ WL of Sec. 26. Young exploited a split seam having 1.6 feet of good coal at the top, 2.3 feet of poor quality bone coal in the middle, and 0.7 feet of good coal at the base. The roof was gray shale, overlain by interlaminated coal and black shale. Mining depth was shallow; apparently the coal mined by Young cropped out along the stream. The Imhoff's strip mine was located about 1300′ NL, 1600′ EL of Sec. 26. Imhoff worked a seam about 4½ feet thick having a 6-inch layer of bony coal near the base. Overburden included 10 feet of medium to dark gray, sandy shale overlain by 1.3 feet of marine limestone.

As Jacobson (1983) proposed, split Murphysboro Coal flanks a north-trending linear feature, more than a mile wide in places, where the coal is largely if not entirely replaced by siltstone and sandstone. This feature, the Oraville channel, represents a river or estuary that existed contemporaneous with peat accumulation. The Oraville channel parallels the downthrown (eastern) side of the Lake Kinkaid Monocline, and it is evident that the monocline controlled the location of the channel and of thick Murphysboro Coal. The eastern side of the monocline evidently subsided so rapidly that peat accumulation could not keep pace with submergence and burial. Hence, the Murphysboro seam split into multiple, thin layers of shaly coal without the usual underclays (ancient soils) beneath.

An unnamed coal bed near the base of the Tradewater Formation was exploited in the Walter E. Heiple slope mine in Sec. 10, T9S, R3W. The Heiple mine was active circa 1927 to 1936 and produced a few hundred tons annually (Illinois Department of Mines and Minerals, annual Coal Reports). The coal seam averaged 4 feet in thickness and contained a parting of bone or carbonaceous shale about 2 inches thick 4 inches below the top of the seam. The roof was sandstone, the floor claystone (M.W. Fuller 1933). In the Gorham Quadrangle, a cored test hole (ISGS #1 Hill), ½ mile southeast of the Heiple mine, encountered sandstone at the position of the coal; evidently the coal was eroded in a channel and has small lateral extent.

M.W. Fuller (1933, unpublished field notes, ISGS library) reported a coal seam 1.4 feet thick in the NW¼ SW ¼ of Sec. 8, T8S, R3W. Fuller's outcrop description confirms that the coal is essentially at the Caseyville-Tradewater contact. Specifically, the coal directly overlies quartzose sandstone at the top of the Caseyville and is overlain by 1 to 2 feet of gray shale containing abundant well-preserved fossil plants. The shale in turn is overlain unconformably by hematitic sandstone containing rare marine fossils (gastropods, crinoids), along with numerous quartz pebbles and ironstone rip-up clasts. Such sandstone is characteristic of the basal Tradewater in this area and may correlate to the marine zone observed in the southern part of the map area. The coal might correlate to either the Reynoldsburg or Bell Coal. Outcrops in the neighboring Raddle and Willisville Quadrangles (Devera 2005, Nelson 2005) show coal having the same stratigraphic relationships. The coal is obviously lenticular, but locally is thick enough to mine.

Oil and Gas

No oil or natural gas production has taken place in Oraville Quadrangle. Approximately 14 test holes have been drilled, all of which were dry and abandoned. Most were drilled on the high side of the Kinkaid Lake Monocline, the most promising place to find hydrocarbons. Deepest of these was the Magnolia Oil #1 Smith Heirs (Sec. 9, T8S, R3W), which reached a total depth of 3,893 feet. This well drilled entirely through the Kimmswick (Trenton) Limestone of Middle Ordovician age, the oldest formation that has yielded gas or oil in Illinois.

The closest producing areas are the Ava-Campbell Hill and Vergennes fields, located respectively four miles northwest and four miles northeast of the Oraville Quadrangle. Developed in the 1920s, the Ava-Campbell Hill field produced gas and a small amount of oil from Chesterian sandstones. This field is essentially depleted. The Vergennes field, discovered in 1975, yields oil from Devonian limestone at average depth of 3,300 feet. There are currently 10 unplugged wells in the field, but the last production was recorded in February 2000. Cumulative production through that date is 142,399 barrels (Bryan Huff, ISGS, written communication, June 2005).

Structure

The Oraville Quadrangle is situated near the southern margin of the Illinois Basin. The border between the Illinois Basin and Ozark Dome lies along the Ste. Genevieve Fault Zone, which follows the Missouri shore of the Mississippi River about 6 miles southwest of the Oraville Quadrangle. Within the map area, rock strata regionally dip northeast (into the basin) at a fraction of one degree.

The prominent structural feature of the map area is a monocline here named the Kinkaid Lake Monocline. This feature was first recognized by Shaw and Savage (1912). Nelson and Lumm (1985) observed that the monocline aligns with the Bodenschatz-Lick Fault Zone to the southwest, as mapped in the Gorham Quadrangle (Seid et al. 2009). Within the Oraville Quadrangle, the fold strikes north-northeast with the southeastern side downthrown. At the surface it is a stair-step fold having a maximum flank dip of 5° to 15°. The flank averages about ½ mile wide, with dips of 5° or greater confined to a zone 1,000 to 1,500 feet wide. In map view, the fold is slightly sinuous. The overall trend changes from about N30° E in the southern part of the map area to N10° E in the northern part. The fold is well expressed in topography, reflecting the fact that the Caseyville and lower Tradewater sandstones, which are resistant to erosion, are elevated west of the structure.

Well records near the southern edge of the quadrangle (on the Mississippi River floodplain) indicate that the Menard Limestone (Chesterian; Upper Mississippian) is about 500 feet lower southeast of the Kinkaid Lake Monocline. The base of the Kinkaid Limestone (Chesterian) rises 300 feet across the structure from the Berry hole to outcrops one mile west along the bluff face. North of Lake Kinkaid, the top of the Caseyville Formation (Lower Pennsylvanian) drops 300 to 400 feet from outcrops west of the monocline to wells east of the fold. The monocline loses surface expression near the northern edge of the map area, but it may continue in the subsurface.

The Kinkaid Lake Monocline was active during Pennsylvanian sedimentation. Well records show that the Caseyville and older units are nearly the same thickness on opposite sides of the fold, but the Tradewater thickens dramatically on the eastern, downwarped side. In particular, the Murphysboro Coal thickens and is split into multiple coal layers separated by shale. A linear belt of no coal, which Jacobson (1983) termed the Oraville channel, parallels the monocline on the east. The channel represents the axis of maximum subsidence where open standing or flowing water prevented accumulation of peat. Shale and siltstone within this basin contain abundant fossils of land plants that grew in swamps flanking the margins. The absence of underclays (ancient soils) and rooting structures suggests that subsidence was too rapid for soil formation and water was too deep for land plants to grow. Thick intervals of shale-pebble conglomerate and contorted bedding in cores drilled along the monocline suggest repeated landsliding and slumping caused by earthquakes and fault movements. Sandstone dikes in the Murphysboro Coal (Jacobson 1983) may be earthquake liquefaction features.

Although direct evidence is lacking, the Kinkaid Lake Monocline is probably the surface expression of a high-angle reverse fault at depth. Such a geometry is demonstrated by seismic reflection profiles on similar folds elsewhere in Illinois, including the Du Quoin Monocline, Louden Anticline, La Salle Anticlinorium, and many others. All these folds were active chiefly during Pennsylvanian time and are attributed to the Ancestral Rocky Mountain orogeny, which affected a vast area of the North American midcontinent (McBride and Nelson 1999).

The only surface faulting in the map area is along the Mississippi bluff (Sec. 1, T9S, R4W and Sec. 6, T9S, R3W). Here a pair of high-angle normal faults outline a narrow, wedge-shaped block of Caseyville downdropped between Chesterian rocks on either side. We were unable to trace these faults northeast of the bluff face. The graben may reflect tensional faulting or, perhaps, a component of right-lateral shearing along the monocline.

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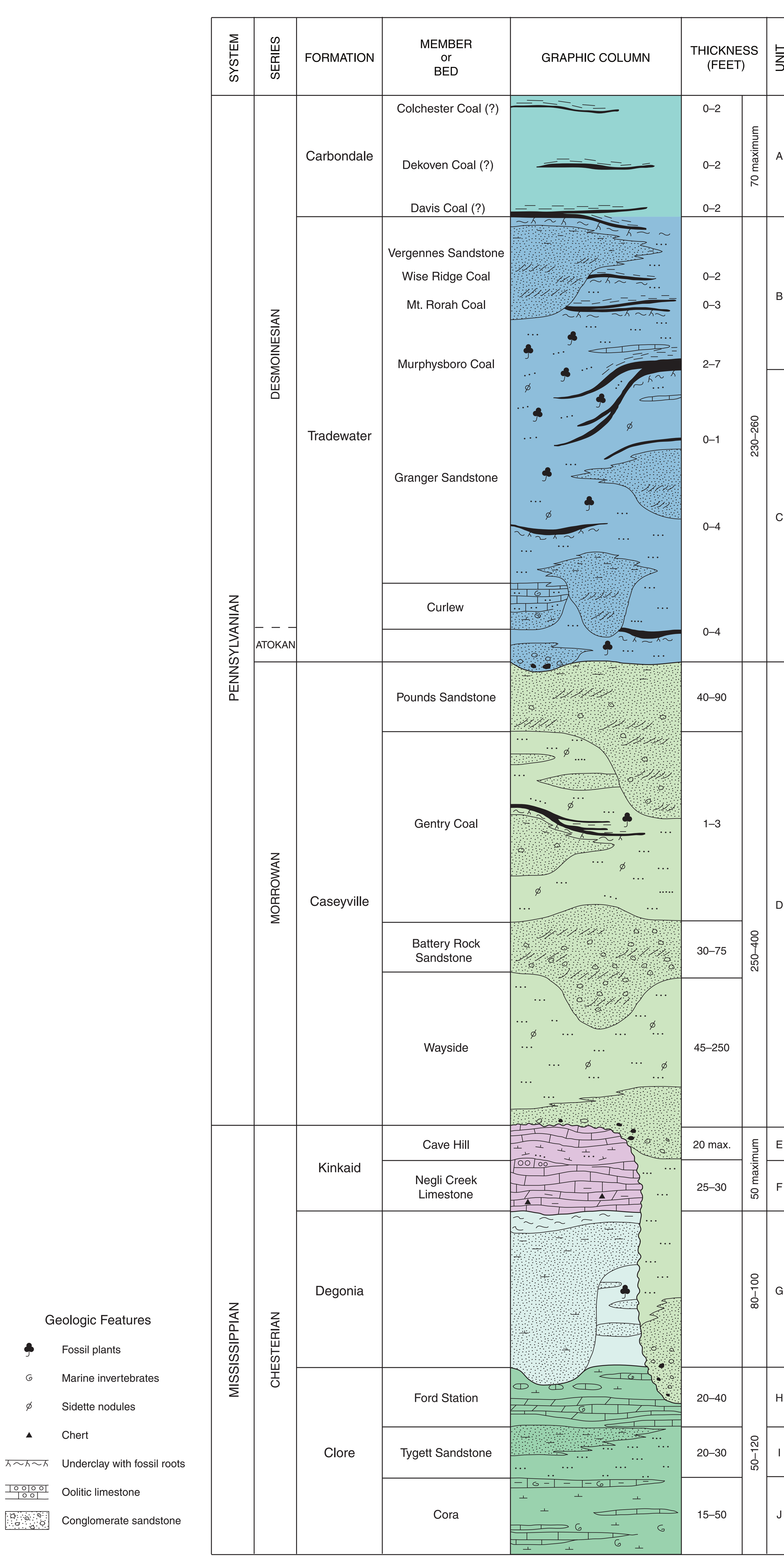

A Carbondale Formation (?) Shale, sandstone, and coal. Shale is medium to dark gray, laminated, and partly silty; black fissile shale overlies coal seams. Sandstone is medium gray, fine-grained, micaceous lithic arenite. Coal is bright-banded; seams are less than 2 feet thick. Unit does not crop out; well records (driller's logs) near the eastern edge of the quadrangle are the source of information. The identity of coal seams is uncertain.

B Tradewater Formation (upper part) Shale, siltstone, sandstone, coal, and limestone. Shale is medium gray to black, fissile or thinly laminated, partly silty, and containing laminae of siltstone and sandstone and nodules or concretions of siderite. Much of it is carbonaceous; well-preserved plant fossils are common, particularly in the lower part of the interval. Black, highly carbonaceous shale commonly has paper-thin lamination and grades laterally to and overlies coal. Siltstone is light to medium gray, is laminated to thinly bedded, and contains trace fossils including *Cruziana* and *Zoophycos*. Sandstone is light to medium brown and brownish gray, very fine- to medium-grained, lithic arenite containing abundant mica, feldspar, lithic grains, and interstitial clay that is white to light gray. Coal varies from bright-banded to dull, hard, and massive; the Murphysboro Coal in particular is split by shale into multiple benches. In the Gass core (Sec 11, T8S, R3W), a 2-foot bed of dark gray, crinoidal packstone with brachiopods was cored 13 feet below the Murphysboro Coal. Limestone is reported above the Murphysboro in several drillers' logs. Outcrops are few; description is based largely on borehole records.

C Tradewater Formation (lower part) Shale, siltstone, sandstone, limestone, and coal. Shale, siltstone, and most sandstones resemble the upper part of the Tradewater. The Curlew Member consists of fossiliferous sandstone and limestone that crop out south of Big Muddy River in Secs. 1, 2, and 11, T9S, R3W. This sandstone is medium brown to reddish brown, iron-rich, poorly sorted, and laminated to thickly bedded. Limestone is dark gray, argillaceous wackestone. Fossils include brachiopods, echinoderm fragments, and the trace fossils *Zoophycos*, *Gordia*, *Rabdoglyphus*, *Cochlichnus*, *Olivellites plummeri*, and arthropod scratches—all of which have marine affinities. Conodonts examined by Carl Rexroad of Indiana University indicate early Desmoinesian age, comparable to the Curlew Limestone of western Kentucky and the Seville Limestone in northwestern Illinois. Peppers (1993) discussed these outcrops and concurred on likely Curlew equivalence based on palynology of adjacent coal beds. The member is as thick as 60 feet. The Berry core (Sec. 35, T7S, R3W) and other cores reveal thick intervals of shale-pebble conglomerate (angular and flat pebbles of shale in fine sandstone matrix) having contorted and slumped lamination. A coal bed 4 feet thick about 20 feet above the base of the Tradewater was mined in the W.E. Heipel slope mine in Sec. 10, T9S, R3W. Near the base of the Tradewater are lenses of coarse, brown, iron- and clay-rich sandstone containing many quartz granules reworked from the Caseyville Formation. This sandstone also contains clasts of siderite and red hematitic shale, suggesting prolonged weathering and oxidation of a nearby source area. The lower contact is erosional and probably unconformable, with all or nearly all of the Atokan Series omitted.

D Caseyville Formation Sandstone, siltstone, shale, thin coal, and mudstone. Sandstone is white to light gray, very fine to coarse quartz arenite: nearly pure quartz with a trace of mica and silt-sized black grains. Rounded quartz granules as large as 0.6 inch are common. Sandstone varies from laminated to massive; sedimentary structures include planar, wavy, and flaser lamination, asymmetrical and lunate ripples, and trough, tabular-planar, and wedge-planar crossbedding. Cross-bed orientations vary, but unidirectional south to southwest dips are prevalent on cliff-forming sandstone. Some outcrops, however, display multi-directional cross-bedding. Fine-grained rocks display rhythmic lamination with well-developed neap/spring tidal cycles. The contorted lamination observed in the Berry core may represent earthquake liquefaction features. Siltstone and shale are medium to very dark gray, laminated to thinly bedded, and interlaminated with sandstone. Thick shale overlying the basal sandstone contains siderite nodules. Caseyville fossils include *Calamites* and *Lepidodendron* as casts in sandstone, *Neuropteris* and lycopod leaves as carbonized impressions in shale, and the trace fossil *Teichichnus* in siltstone. Coal, consisting of one to three layers less than 1 foot thick and separated by shale or claystone, correlates with the Gentry Coal. Massive mudstone and siltstone to very fine sandstone, containing root traces, are interpreted as paleosols.

Devera (2005) mapped the Pounds and Battery Rock Sandstone Members in the adjacent Raddle Quadrangle. These members can be identified in drill holes in the Oraville Quadrangle, but are not mappable at the surface because of extensive glacial cover. The lower contact is unconformable and locally angular. Well logs indicate the basal Caseyville fills valleys eroded as deeply as the upper Cora Member of the Clore Formation.

E Kinkaid Formation, Cave Hill Member Limestone and shale. As much as 10 feet of gray limestone overlies 5 to 10 feet of shale that is olive to greenish gray, silty, and calcareous.

F Kinkaid Formation, Negli Creek Limestone Member Limestone. Dark gray, argillaceous, cherty lime mudstone and wackestone constitute the bulk of the unit; light to medium gray crinoidal and oolitic packstone occur in the upper part. Fossils include productid brachiopods, echinoderm fragments, bellerophontid gastropods, *Girvanella* oncoids, and the sponge *Chaetetes*. Both contacts are sharp, but apparently conformable.

G Degonia Formation Sandstone, shale, and mudstone. Sandstone, the dominant lithology, is white to light gray, very fine to (rarely) medium-grained quartz arenite that lacks quartz granules. Thin-bedded sandstone displays ripple marks, load casts, tool marks, simple trails and burrows, and casts of plant stems including *Lepidodendron*. Thick-bedded to massive sandstone forms cliffs. Siltstone and shale are light to dark gray and commonly interbedded with sandstone. Herringbone cross-bedding is present. Sandstone commonly becomes finer grained and shaly near the top. Greenish and reddish gray, massive claystone 5 to 10 feet thick is at the top of the formation. The lower contact may be conformable or slightly disconformable.

H Clore Formation, Ford Station Member Shale and limestone. Shale is dark gray to greenish gray, clayey and calcareous, containing lenses and thin interbeds of limestone. Limestone is light to dark gray, lime mudstone to crinoidal wackestone and packstone, with red productid brachiopods. The most prominent bed, 10 to 12 feet thick, is dolomitic and weathers yellowish orange.

I Clore Formation, Tygett Sandstone Member Sandstone and shale. Sandstone is light gray, very fine to fine-grained quartz arenite having laminae of shale. The horseshoe-shaped trace fossil *Rhizocorallium* is common. Shale is dark gray and silty, with laminae of sandstone. Well records typically show the interval coarsens upward.

J Clore Formation, Cora Member Shale and limestone. Shale is medium to dark gray and greenish gray, blocky to fissile, clayey to silty, and commonly calcareous. Limestone is dark gray, argillaceous lime mudstone to wackestone that contains abundant brachiopods and bryozoans. The base is concealed.