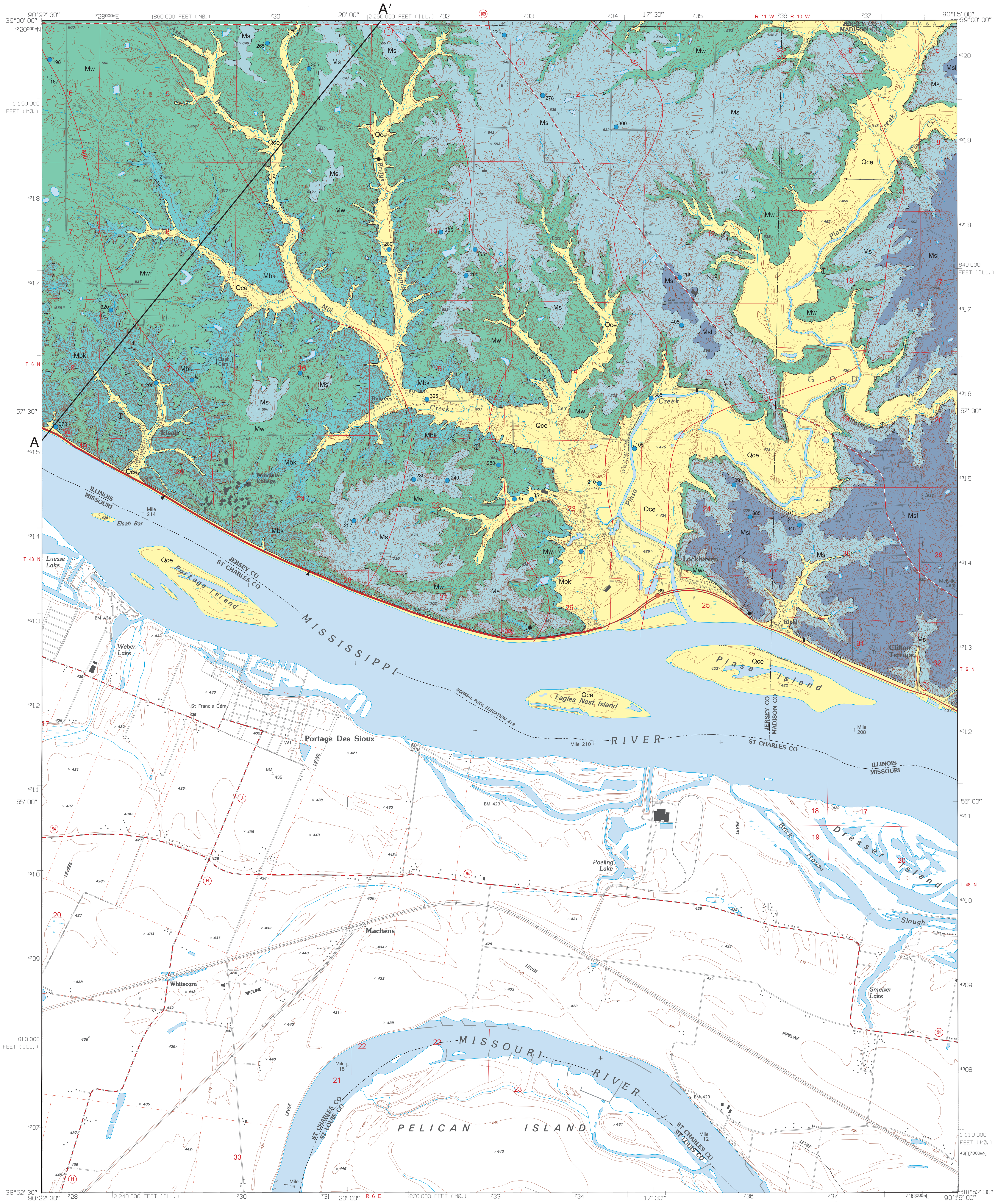
Illinois Department of Natural Resources
ILLINOIS STATE GEOLOGICAL SURVEY
William W. Shilts, Chief

BEDROCK GEOLOGY OF ELSAH QUADRANGLE
JERSEY AND MADISON COUNTIES, ILLINOIS

Illinois Geologic Quadrangle Map
IGQ Elsah-BG

F. Brett Denny and Joseph A. Devera
2008



EXPLANATION

Quaternary	Qce	Cahokia-Equality Formation undifferentiated	Holocene and Pleistocene
Mississippian	Msl	St. Louis Limestone	Valmeyeran
	Ms	Salem Limestone	
	Mw	Warsaw Formation	
	Mbk	Burlington-Keokuk Limestones	

Symbols

- Strike and dip of bedding; number indicates degree of dip
- Horizontal bedding
- Vertical joints
- Outcrop of special note, shown where unit or contact was well exposed during mapping
- Abandoned quarry

Drill Holes
from which subsurface data were obtained

- Water-well boring
- Engineering boring
- Other boring
- CSG 620 — Labels indicate samples (s), geophysical log (c), or core (c). Numeric label indicates total depth of boring in feet.

Line Symbols
dashed where inferred

- Contact
- 250 — Elevation of top of Burlington-Keokuk Limestones; contour interval 50 feet
- 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 provided by the United States Geological Survey. Compiled from imagery dated 1952. Topography and planimetry revisions from imagery dated 1991.

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 15

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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 10 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

Released by the authority of the State of Illinois: 2008

Geology based on field work by F.B. Denny, 2000–2001.

Digital cartography by J. Domier, L. Verhelst, A. Schultz, and S. Radil, Illinois State Geological Survey.

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ILLINOIS DEPARTMENT OF NATURAL RESOURCES

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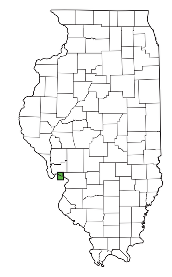

1	2	3
4		5
6	7	8

ADJOINING QUADRANGLES
1 Otterville
2 Jerseyville South
3 Brighton
4 Grafton
5 Alton
6 St. Charles, MO
7 Florissant, MO
8 Columbia Bottom

APPROXIMATE MEAN DECLINATION, 2008

ROAD CLASSIFICATION

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

Introduction

The Elsah Quadrangle is located along the western edge of the Illinois Basin in southwestern Illinois in Jersey and Madison Counties. The Mississippi River flows east-southeasterly through the center of the quadrangle and separates Illinois from Missouri. The bedrock geology in the Illinois portion of this quadrangle is depicted on the map. Mississippian age bedrock units are exposed in the upland portions of the map sheet underlying Pleistocene loess. The loess units have not been depicted on the map. Pleistocene age glacial sediments occur along Piasa and Mill Creeks and the Mississippi River underlying Holocene Age sediments of the Cahokia Formation (Grimley 2002). These units are mapped collectively and are depicted as Cahokia Formation on the geologic map.

Stratigraphy

The Burlington Limestone is a coarsely crystalline cherty and dolomitic limestone. The unit is dominated by poorly sorted crinoidal packstone to grainstone that grades upward into an argillaceous limestone. In general, the Burlington becomes more argillaceous and thinner bedded upward and grades almost imperceptibly into the Keokuk Formation; chert of the Keokuk may be slightly darker than that of the Burlington. Due to the lithologic similarities of the upper portion of the Burlington and the lower portion of the Keokuk Formations, the two units have been mapped together as a single unit (Burlington-Keokuk). This unit is very well exposed in bluffs in the western part of the quadrangle along Illinois Highway 100.

The Warsaw Formation is typically poorly exposed in outcrop and is dominantly a silty carbonate with intervals of siltstone, shale, limestone, dolomite, and mudstone. The Warsaw can be divided informally into an upper and lower unit, and there is a disconformity surface (condensed section) near the top of the lower Warsaw (Lasemi et al. 1999). A good faunal and chronostratigraphic break occurs at this boundary, and Kammer et al. (1990) used this break to mark the Osagean-Meramecian boundary (Lasemi et al. 1999). This contact is well exposed in Sec. 13, T6N, R11W where an intraclastic, pyritic, and phosphatic unit marks the boundary. Several conularids were found at this location, and some of these conularids had archaeogastropods attached. The Warsaw Formation was deposited in moderate- to low-energy conditions with periods of high-energy influx. Carbonate production was periodically cut off by the transportation of siliciclastics into these quiet-water environments. Fenestrate bryozoans dominate the shaly, silty, quiet-water niches. However, crinoids were also common in inter-shoal areas in this formation. A 25-foot thick transition zone, which contains lithologies of both the Salem and Warsaw, makes it difficult to discern the top of the unit at most locations. The Warsaw is unconformable with the overlying unit, but due to the lithologic similarities of the upper Warsaw and the overlying Salem Limestone, the contact is difficult to locate.

The Salem is composed of several fining-upward cycles composed of thick beds of wave-generated, coarse-grained bioclastic limestone that alternates with fine-grained tidally laminated bioclastic limestone. The coarse phase represents carbonate shoals (Lasemi et al. 1999) that were deposited on a deeper middle shelf environment. The finer laminated carbonate beds represent shallow tidal flat conditions. Either sea level was fluctuating during the deposition of the Salem or the northern shelf of the Ozarks was tectonically "bobbing" at this time. Riehl Quarry (Sec. 31, T6N, R10W) offers excellent exposures of the Salem Limestone. At this quarry, 75 feet of Salem can be observed with the basal portion of the overlying St. Louis Limestone at the top of the quarry. Within the Salem at this quarry, 21 (non-hindeodellid) conodont species per kilogram of sample were identified (Collinson et al. 1979). Endothyrid foraminifers are common, and the index fossil *Globoendothyra baileyi* was identified at this location. The contact with the overlying St. Louis Limestone in adjacent quadrangles is unconformable and in places forms a karstic limestone conglomerate or breccia.

The St. Louis Formation is dominantly a blue-gray to white lime mudstone and grainstone. The lighter-colored grainstone units are coarsely fossiliferous and contain brachiopods, bryozoans, coelenterates, and echinoderms. Chert is nodular and light gray. Limestone breccia and conglomerate occur and sometimes are associated with glauconite and a dolomitic zone. A breccia zone was also identified as occurring 20 feet above the lower contact with the Salem. Saxby and Lamar (1957) suggested that the breccia was formed as a product of solution collapse of thin evaporite layers and secondary replacement with drusy quartz. The St. Louis can be informally subdivided into an upper and lower unit (Lasemi et al 1999). The lower unit is characterized by lime mudstones with green-gray shale and carbonaceous limestone, dolomites, and evaporite. The coral *Acrocyathus* is common in the lower St. Louis and less common in the upper St. Louis. The upper St. Louis contains skeletal and bioclastic packstones to wackestones and cross-bedded oolitic limestones. The lower St. Louis is representative of a restricted marine basin; the upper St. Louis can be interpreted as an open marine facies. The unit is unconformable with the overlying Cahokia Formation.

Structural Geology

At the western side of the quadrangle, the bedrock strikes N40° W to N80° W and dip is nearly horizontal to 40° to the northeast. The regional dip averages about 0.5° easterly. The strikes tend to swing to the north in the center of the quadrangle, and on the east end of the quadrangle, the strikes are to the northeast with dips to the southeast. East of Piasa Creek, beds strike N40° E to N50° E and dip between horizontal and 4° to the southeast. The change of strike east of Piasa Creek would suggest that there may be a small northeast-trending fault that parallels Piasa Creek. No solid evidence for a fault along Piasa Creek was observed. Several large northeast-trending joints with little or no vertical displacement were observed throughout the quadrangle, and one small northeast-trending fault was observed toward the west edge of the quadrangle. Evidently the bedrock in this area has been warped with little evidence of brittle fault movements. The area appears to be located on the gentle northeast side of the Lincoln Anticline and removed from the Cap au Grès Faulted Flexure. The Lincoln Anticline trends southeasterly across Missouri and bends easterly as the structure enters Illinois, where it is called the Cap au Grès Faulted Flexure (McBride and Nelson 1999). The Cap au Grès Faulted Flexure is observed in the adjacent Grafton Quadrangle to the east where over 900 feet of vertical offset can be observed (Denny and Devera 2002). The east end of the Cap au Grès disappears beneath Mississippi River alluvium and can not be accurately traced. Bedding along the south or southwest flank commonly dips 60° or steeper, and in places it is overturned. Detailed mapping near the Cap au Grès in the Grafton Quadrangle indicates that the lower Mississippian sediments thin toward the Cap au Grès, suggesting that the structure was active starting in Upper Devonian and continuing sporadically through the lowest Pennsylvanian (Denny and Devera 2002). Analysis of joint patterns, slip indicators on faults, and small conjugate strike-slip faults along the Cap au Grès led Harrison (1995 and 1997) to conclude that the principal compressive stress axis was oriented northeast-southwest during mid-Carboniferous deformation (McBride and Nelson 1999).

Economic Geology

Stone

Several limestone quarries formerly produced lime for making cement in the lower Salem-upper Warsaw interval along Illinois Highway 100 and along Beltress Road in Sec. 13, T6N, R11W (marked on the map by outcrop of special note). The old lime kilns can be viewed from the roads. Currently, none of these operations is active. The grainstone beds within the Burlington-Keokuk offer a resource of high-calcium stone. One chemical analysis from the area to the west of this quadrangle determined that the unit was composed of 96% calcium carbonate, 2% silica, 1% clay, and less than 1% iron oxide and sulfide (Rubey 1952). Hindering the mining and crushing of this unit is chert, which in some exposures can constitute up to 10% of the total volume of the rock, but in other outcrops it is almost negligible. A thick chert-free zone in this unit would be a potential resource of high-calcium stone for cement, agricultural lime, or other fine-grinding applications. A relatively thick chert-free zone within this unit is possible in this quadrangle and would be valuable as chemical stone. Drilling is necessary to prove any reserves in this formation.

The St. Louis and Salem Limestones are extensively quarried in the Alton Quadrangle to the east, and Silurian age dolomites have been quarried to the west in the Grafton Quadrangle. The limestone and dolomite are an excellent source of road aggregate, and some portions of the St. Louis and Salem are suitable for chemical stone and fine-grinding applications.

Sand and Gravel

Sand and gravel deposits are located in the alluvial sediments of the Mississippi River and Piasa Creek. See Grimley (2002) for more information concerning the potential economic aspect of these deposits.

Oil and Gas

There is a possibility of hydrocarbon resources in the Ordovician Kimmswick ("Trenton") (not shown on column) or in deeper stratigraphic units in the quadrangle. The shales and the limestone of the Ordovician Decorah (not shown on column) are known to contain petroleum. Two oil wells have been drilled to the west in the Grafton Quadrangle, and several wells have been drilled to the east in the Alton Quadrangle, but no deep oil or gas test has been drilled in the Elsah Quadrangle.

Acknowledgments

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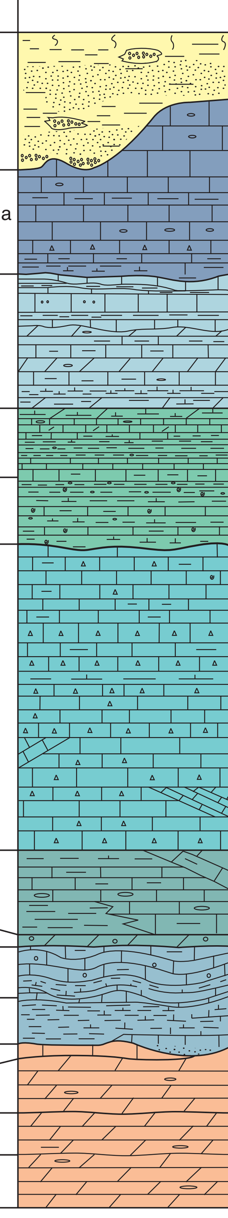

SYSTEM	SERIES	GROUP OR SUBGROUP	FORMATION	MEMBER	THICKNESS (FEET)	UNIT
QUATERNARY	HOLOCENE / PLEISTOCENE		Cahokia-Equality undifferentiated		0–100	A
MISSISSIPPIAN	VALMEYERAN	MAMMOTH CAVE GROUP	St. Louis Limestone	chert breccia zone	0–150	B
MISSISSIPPIAN	VALMEYERAN	MAMMOTH CAVE GROUP	Salem Limestone		0–120	C
MISSISSIPPIAN	VALMEYERAN	MAMMOTH CAVE GROUP	Warsaw	upper / lower	0–120	D
MISSISSIPPIAN	VALMEYERAN	MAMMOTH CAVE GROUP	Burlington-Keokuk Limestones		0–250	E
MISSISSIPPIAN	VALMEYERAN	MAMMOTH CAVE GROUP	Fern Glen		0–40	F
MISSISSIPPIAN	VALMEYERAN	MAMMOTH CAVE GROUP	Meppen Limestone		0–12	G
MISSISSIPPIAN	KINDERHOOKIAN	NORTH HILL	Chouteau Limestone		80–90 (40–45)	H
MISSISSIPPIAN	KINDERHOOKIAN	NEW ALBANY	Hannibal Shale		80–90 (38–45)	I
MISSISSIPPIAN	KINDERHOOKIAN	NEW ALBANY	Glen Park		80–90 (0–5)	J
DEVONIAN	MIDDLE		Cedar Valley Limestone		0–6	K
SILURIAN	NIAGARAN		Joliet		125–150	L
SILURIAN	ALEXANDRIAN		Kankakee		125–150	L
SILURIAN	ALEXANDRIAN		Edgewood Limestone		125–150	L

A Silt, clay, gravel, cobbles Upland alluvial sediments composed of a mixture of sand, silt, clay, and gravel size particles. Most have been derived from the underlying bedrock, but some glacially derived gravels, cobbles of basalt, and small boulders of igneous and metamorphic rocks were observed in the uplands throughout the quadrangle. Small geodes filled with calcite and quartz derived from the Mississippian bedrock were observed in the western half of the quadrangle. Thicker sands, silts, and gravels of the Pleistocene and Holocene ages occur on the floodplain of the Mississippi River. These gravels are overlain by recent floodplain deposits of silt, sand, and clay. Additionally, outcrops of Pleistocene lakebed deposits composed of gray clay and silt with wood fragments were observed in some of the valleys at elevations near 450 feet (Equality Formation). These lake deposits occur underneath terraces at approximately 470–480 feet elevation along Piasa and Mill Creek valleys.

B St. Louis Limestone Limestone, chert, siltstone, and shale. The St. Louis Limestone is light gray to medium gray dense limestone and light gray to white wackestone, packstone, and oolitic limestone. The lighter-colored bioclastic units are coarsely fossiliferous and contain brachiopods, bryozoans, coelenterates, and echinoderms. The darker gray units are lime mudstone to wackestone, and portions may be dolomitic. The siltstone and shale are calcareous and dark gray to green-gray. Chert is dark gray and nodular. Subangular to angular limestone breccia fragments are present in portions of the lime mudstone. The brecciation may be a result of near surface dissolution of gypsum and anhydrite, which are known to be present in the unit. The contact with the underlying unit is unconformable.

C Salem Limestone Limestone, dolomite, chert, siltstone, and shale. The Salem Limestone is light brown and gray mudstone to grainstone composed of rounded and broken fossil fragments. Bedding styles range from tabular to undulatory. The beds range from several inches to a few feet thick. Cross-beds are common and usually dip to the southwest. The unit is composed primarily of small rounded fragments of disarticulated echinoderms and fenestrate bryozoans that are abraded into a fossil hash. Other macrofossils are corals, brachiopods, and *Pentremites*. Peloidal to oolitic limestone is also present, and portions may be dolomitic. Chert is light gray, may be bioclastic, and may weather with a porous rind. Siltstone is brown to light gray and thinly bedded, typically less than 1 inch thick. The shale is blue-gray to green-gray. The foraminifera, *Globoendothyra baileyi*, is an index fossil for this unit. The contact with the underlying unit is unconformable but difficult to identify.

D Warsaw Formation Limestone, dolomite, mudstone, and siltstone. The Warsaw is medium gray and contains crinoids, brachiopods, and bryozoans. *Archimedes* is common and well preserved in some beds. Dolomite is gray-brown, is thinly bedded, and may contain glauconite and chlorite. Some of the thicker beds are dolomitic, while others are fairly pure limestones (packstone). The unit is dominantly shaley dolomitic limestone at the base and contains more limestone and dolomite in the upper half. The upper Warsaw is thicker bedded and contains crinoids, brachiopods, and bryozoans. The lower Warsaw is dominated by shales and siltstone with occasional thin dolomite beds. Mudstone is dark olive-brown and weathers to blue-gray. Mudstone occurs in beds as thick as 20 feet. Siltstone is calcareous, fossiliferous, and thinly bedded. The unit is characterized by small grains of rounded to subangular bioclastic limestone interbedded with thin shale partings. Disseminated pyrite and glauconite were observed in a few outcrops but were a very minor constituent. Geodes of calcite and quartz are common in the shale zones, particularly near the base of the formation. These geodes are excellent for collecting, and some reach diameters of over 8 inches.

E Burlington-Keokuk Limestones Limestone, chert, siltstone, and shale. The Burlington-Keokuk Limestones are white to light gray and bioclastic to argilaceous. In places, the limestone is a light gray to white crinoidal grainstones interbedded with nodular to bedded light gray to black chert. The limestone weathers to light brown, is cross-bedded, and contains brachiopod and crinoid molds. Several well-preserved samples of the large spiriferid brachiopods were observed along with crinoids, bryozoans, and corals. The chert is usually light gray, but when weathered is white to buff with orange iron oxides on fractures. The weathered chert commonly contains bioclastic molds of crinoid stems, sponge spicules, and bryozoan debris. The chert is nodular and may coalesce along bedding planes to form beds up to 1-foot thick. The unit is characterized by layers of light gray to white crinoidal grainstones with alternating beds of argillaceous limestone. This repetitive sequence of crinoidal limestone over argilaceous cross-bedded limestone was observed in the lower part of the unit. Siltstone and shale are dark gray with a greenish tint and are calcareous. Calcite- and quartz-filled round vugs from 0.5 to 2 inches in diameter were observed. The unit is conformable with the underlying unit.

Subsurface Only

F Fern Glen Argillaceous cherty limestone, siltstone, and shale. The Fern Glen is characterized by green and red siltstones and thin-bedded cherty argillaceous limestones. The cherts are nodular and greenish gray. The limestone is thin-bedded, argillaceous, and contains small calcite geodes and crinoid stems.

G Meppen Limestone Dolomitic limestone. The Meppen Limestone is light gray to tan, thick-bedded, and contains small (0.5 to 1 inch diameter) calcite geodes, light gray chert nodules, and occasionally calcareous siltstones. The unit is less than 12 feet thick. The unit is probably unconformable with the underlying units.

H Chouteau Limestone Fine-grained lithographic, cherty, argillaceous limestone and calcareous siltstone. The Chouteau Limestone is thin-bedded, normally several inches, but it can be up to 2 feet thick. The unit has distinct wavy bedding surfaces. Chert is dark gray to light gray and is fairly abundant. The limestone and siltstone are light to dark gray. Crinoids were the only macroscopic fossil found in abundance, and vugs lined with calcite are common. The unit appears to be gradational with the underlying unit.

I Hannibal Shale Fissile siltstone and mudstone, greenish gray, calcareous siltstone, and dark gray to black siltstone and mudstone. The upper portion may interfinger with the overlying argillaceous limestone.

J Glen Park Lithographic and oolitic limestone. This light gray fossiliferous to oolitic limestone is unconformable with the underlying units.

K Cedar Valley Limestone Fossiliferous limestone, sandy limestone, fine-grained sandstone. The Cedar Valley Limestone is thin and discontinuous. Where exposed in the Grafton Quadrangle, the lowest unit is a brownish gray sandstone overlain by fossiliferous and sometimes argillaceous limestone. It is gray where fresh and weathers to a brown tint. It is unconformable with the underlying unit and may downcut several feet into the underlying unit.

L Lower Devonian and Upper Silurian Cherty dolomite with minor shale partings. The dolomite is yellowish brown to buff gray. Chert occurs as nodules sporadically throughout the unit. Shales have a greenish gray tint. The trilobite *Calymene celebra* is common within this unit in quarries in the Grafton Quadrangle to the west. This unit is probably unconformable with the underlying units.