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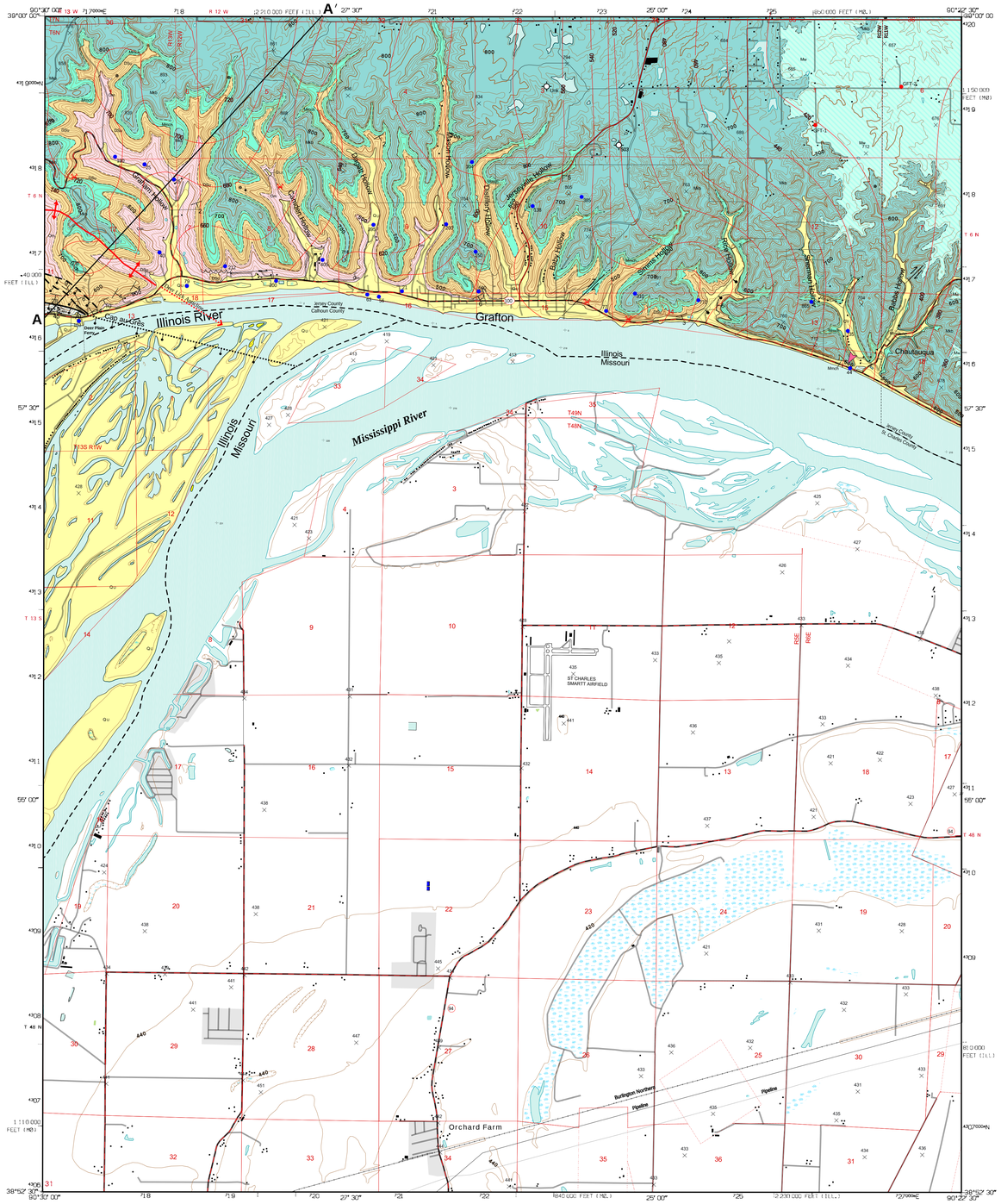
ILLINOIS STATE GEOLOGICAL SURVEY
William W. Shilts, Chief
Illinois Geologic Quadrangle Map: IGQ Grafton-BG
2002

BEDROCK GEOLOGY MAP

Grafton Quadrangle (Illinois Portion), Jersey and Calhoun Counties, Illinois

F. Brett Denny and Joseph A. Devera



Digital base map compiled at the Illinois State Geological Survey (ISGS) from digital line graphs (DLG) provided by the U.S. Geological Survey

1927 North American Datum is shown by dashed corner ticks
1983 North American Datum Projection and 1,000-meter ticks
Universal Transverse Mercator grid, zone 15, 10,000-foot ticks

Original base map compiled from photogrammetric methods from 1952 photography. Field checked 1954 and updated 1995

Buildings and structures are omitted in Grafton, Chautauqua, and gray-colored areas

Scale 1:24,000

0 2 miles
0 2 kilometers
0 2,000 feet

Contour Interval 20 Feet

NATIONAL GEODETIC VERTICAL DATUM OF 1929

Recommended Citation

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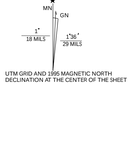
ADJOINING 7.5-MINUTE QUADRANGLES



UTM GRID AND 1995 MAGNETIC NORTH DECLINATION AT THE CENTER OF THE SHEET

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IMPORTANT INFORMATION ON THE USE OF THIS DOCUMENT

This document has been carefully reviewed and edited and meets the scientific and technical standards of the Illinois State Geological Survey. It is suited to the purposes and uses intended by its authors and presents reasonable interpretations of the geology of the area described based on the data then available. The interpretations are based on data that may vary with respect to accuracy of geographic location, the type and quantity of data available at each location, and the scientific and technical qualifications of the data sources. Consequently, the accuracy of unit boundaries and other features shown in this document may vary from place to place. Any map or cross section in this document is not meant to be enlarged. Enlarging the scale of a published map or cross section, by whatever means, does not increase the inherent accuracy of the information and scientific interpretations it portrays.

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Acknowledgments

This geologic map was funded in part by the USGS National Cooperative Geologic Mapping Program. It is one of a series prepared for the USGS 7.5-minute Grafton Quadrangle (Illinois portion) by a multidisciplinary team of geologists from the Illinois State Geological Survey (ISGS). This series will characterize surface landscapes and surface, bedrock, and engineering geology and will delineate coal and sand and gravel resources. This map was significantly improved through review, suggestions, and comments by the following individuals: Dennis R. Kolata (ISGS), David A. Grimley (ISGS), Fred Marshall (Principia College), Rodney D. Norby (ISGS), W. John Nelson (ISGS), Zakaria Lasemi (ISGS), B. Brandon Curry (ISGS), Jonathan H. Goodwin (ISGS), and Tom Miller (IEPA). Digital cartography by Pamella K. Carrillo, F. Brett Denny, and Barbara J. Stiff. Photography by Joel M. Dexter.

SYSTEM	SERIES	GROUP OR SUBGROUP	FORMATION		GRAPHIC COLUMN	THICKNESS (feet)	DESCRIPTION UNIT
QUATERNARY	Holocene		Alluvium			0-100	A
	Pleistocene						
MISSISSIPPIAN	Valmeyeran	Mammoth Cave Group	St. Louis Limestone	Chert Breccia Zone		0-75	B
			Salem Limestone			0-90	C
			Warsaw Shale			0-90	D
			Burlington-Keokuk Limestones			190-200	E
	Kinderhookian	North Hill	Fern Glen Formation			0-30	F
			Meppen Limestone			0-20	G
			Chouteau Limestone			40-55	H
		New Albany	Hannibal Shale			20-35	I
			Glen Park Fm			0-10	J
DEVONIAN	Erian		Cedar Valley Limestone			0-8	K
	Niagaran		Joliet Formation				L
			Kankakee Formation			100-130	M
SILURIAN	Alexandrian		Edgewood Limestone				N
ORDOVICIAN	Cincinnatian		Maquoketa Formation	Phosphatic zone		100 -140	O
	Mohawkian		Kimmswick Limestone	Trenton in the subsurface		70-75	P
			Decorah Formation			40	Q
			Plattin Limestone			145	R

Description

A. Alluvium: *clay, silt, sand, gravel, and cobble.* The upland sediments are composed of a mixture of clay, silt, sand, gravel, and cobbles. The clay, silt, and fine sand fraction is colluvium derived from loessal deposits that thickly mantle the upland areas. Most of the gravel originated from the underlying bedrock, but some glacially derived cobbles are basalt, granite, and metamorphic rocks weathered from diamicton that occurs above the bedrock. Small, reworked geodes filled with calcite and quartz crystals were observed. These geodes weather out of the Mississippian bedrock and are more abundant in the western half of the quadrangle. Alluvium in the bottomland is composed of a thick sequence of clay, silts, sand, and gravel that ranges from Pleistocene to Holocene. Slack-water lake deposits composed of gray, laminated silt with wood fragments were observed in some of the valleys at elevations near 450 feet (Grimley 1999).

B. St. Louis Limestone: *limestone, limestone breccia, siltstone, and shale.* Light gray to medium gray dense lime-mudstone with fossil wackestones. Part of the unit contains quartz sand and subangular limestone breccia clasts. Brecciation is attributed to ancient karstification of gypsum and anhydrite (Saxby and Lamar 1957). Oolitic grainstones, greenish oncolitic packstones, peloidal grainstones, stromatolitic boundstones, and carbonate intraclastic conglomerates make up a highly variable mix of microfacies. *Acrocyathus floriformis,* a colonial coral, occurs in the upper part of the basal portion of this formation. *A. floriformis* is widespread near the base of the unit. Yellowish dolostone beds are also present in this formation. Gray to dark gray chert occurs as nodules and stringers. Siltstones are calcareous and greenish. The shales are greenish gray and reddish brown, calcareous, soft, and non-fissile. This unit was only exposed along a fault slice in the extreme southwest corner of the Illinois portion of the quadrangle.

C. Salem Limestone: *limestone, dolomite, chert, and siltstone.* Limestones are tan-brown to light gray and contain laminated tidallites, wackestones to grainstones composed of rounded and broken fossils and coated grains. Bedding styles range from tabular to undulatory. Cross-beds are present in grainstone facies. The unit has a dirty gray-brown grainy appearance. The diagnostic character of this formation is alternating beds of laminated, fine-grained (calcisiltite) facies with coarse bioclastic, peloidal to oolitic grains in shoaling-upward cycles. Dolomites are brown and have moldic porosity. Cherts are light gray and may be bioclastic and weather with a porous rind. Cherts occur between grainstones and laminated beds as elliptical nodules containing concentric rings that spall off like egg shells when weathered. Siltstones are brown to light gray and thinly bedded, typically less than 1 inch thick. Oolitic beds are rare. The foraminifera, *Globoedothyra baileyi,* is an index fossil for this unit. Other microfossils include calcareous algae, conodonts, and ostracodes. Fossil invertebrates include spiriferid and productid brachiopods, rugose corals, conularids, and crinoids. Ramose, fenestrate, encrusting, and bifoliate bryozoans are also present. The contact with the underlying unit is gradational.

D. Warsaw Shale: *dolomitic limestone, siltstone, and mudstone.* Medium-gray, crinoidal, bryozoan wackestones and packstones that contain a few brachiopods. In the lime-mudstone beds *Archimedes* sp. are preserved with coil and fronds attached. Dolostone beds are gray-brown, thinly bedded, and contain chlorite-rich shale clasts with some small quartz geodes. The upper half of the unit is dominated by shaly limestone and dolostone beds. The lower half contains bluish gray mudstones up to 20 feet thick interbedded with thin lime-mudstones. Conularids and gastropods occur in the shaly portion of this unit. Siltstones are calcareous and fossiliferous and thinly bedded in the lower part. Quartz geodes are common in the shaly sequences. The geodes weather out and are very common in the drainages in the lower portion of the unit. The basal contact is poorly exposed but thought to be sharp and conformable with the underlying carbonate beds.

E. Burlington and Keokuk Limestone: *limestone, siltstone, and shale.* Light gray to white crinoidal grainstones dominate and are interbedded with nodular and bedded light gray to black cherts. The cherts are white when weathered, and some have bioclasts of crinoids and brachiopods. Sandy limestones weather light brown, are cross-bedded, and contain brachiopod and crinoid molds. The unit is characterized by alternating layers of light gray to white crinoidal grainstones with beds of argillaceous and sandy limestones. This cyclic sequence of crinoidal limestone over sandy cross-bedded limestone is common in the lower part of the unit. Large spirifers are common along with crinoids, bryozoans, and corals. Siltstones are dark gray with a greenish tint and are calcareous. Calcite and quartz-filled vugs from 0.5 to 2 inches in diameter were observed. The unit is weathered on the upland surface where cherty residuum is 20 feet thick. The unit is conformable with the underlying unit.

F. Fern Glen Formation: *limestone, siltstone, and shale.* On the eastern side of the Illinois portion of the quadrangle, the limestone is greenish gray, thin-bedded, and argillaceous; it contains small calcite geodes and crinoid stems. Green and red shaly calcareous siltstones are diagnostic and are well exposed on the river bluffs near Chautauqua, Illinois. The cherts are greenish gray, nodular, and fossiliferous. In Dagett Hollow and westward, the unit is dominantly thin, irregularly bedded, lime mudstone with cherty, crinoidal wackestone and packstone facies; these facies are indistinguishable from the lower part of the overlying unit E. Yellowish dolostone facies are also present. The basal part is gradational with underlying formation.

G. Meppen Limestone: *dolomitic limestone.* Light gray to tan, massive dolomite limestone, containing small (0.5 to 1.0 inch diameter) calcite geodes, light gray chert nodules, and locally calcareous siltstones. The unit is less than 12 feet thick and normally forms a small resistant weathered face that is fairly well exposed in most drainages. A minor unconformity exists between this unit and the underlying formation. On the river bluff just west of Chatauqua, an angular relationship between the underlying unit and this formation can be observed (fig. 1).

H. Chouteau Limestone: *limestone and siltstone.* Light brown to greenish gray irregular to wavy, thin beds of lime mudstone with thin beds of silty dolostone. Calcite geodes with diameters from 0.5 to 2 inches are common. Some of the calcite geodes are replaced with quartz. Chert nodules are locally abundant and typically are dark gray with light gray rims. Crinoidal wackestones containing fenestrate bryozoans and brachiopods occur in southwest dipping beds near Chatauqua. The unit appears to be gradational with the underlying unit.

I. Hannibal Shale: *shale, mudstone, and siltstone.* The upper portion may interfinger with the overlying argillaceous lime-stone. Non-fossiliferous, gray, fissile, silty shale to laminated siltstone having brown iron oxide and manganese on fractures of weathered surfaces. The lithology is dominated by a soft, greenish to light gray mudstone, silty at base and fines upward to a non-fissile mudstone that fractures conchoidally. A thin, black, silty shale near the base of the unit (NE1/4, NE 1/4) Section 1, T6N, R13W, had a very strong petroliferous odor. Typically, the mudstone is not well exposed; however, good sections were observed at the head of Graham, Dagett, Distillery, and Jerseyville hollows. On the western side of the quadrangle, this unit is conformable with the underlying unit.

J. Glen Park Formation: *limestone.* Identified only in the eastern portion of the quadrangle. The limestone is poorly exposed and was only identified at two locations. At one location it was composed of an argillaceous lithographic limestone with small concretions (1/8 inch diameter) of pyrite and some glauconite. At the second location it was composed of a fossiliferous and oolitic limestone. The fossils were mostly chonetid and spiriferid brachiopods with crinoid fragments in an oolitic grainstone. The limestone interfingers with the overlying shales. It is unconformable with the underlying unit.

K. Cedar Valley Limestone: *limestone and sandstone*. Thin and discontinuous fossil packstone with quartz sand. 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 and contains *Mucrospirifer* sp. and *Paraspirifer* sp. brachiopods, rugose corals, and platycerid gastropods. In the quarry east of Grafton, an arthrodire tooth was found in the sandy limestone. The sandy limestone is unconformable with and may downcut several feet into the underlying formation.

L. Joliet Formation: *dolostone and minor shale.* The dolostone is yellowish brown to buff gray and has a pitted weathered surface; sucrosic texture with molds of fossils are common. The upper part of the dolostone is truncated by overlying strata. Bedding planes are flat to wavy in places, and beds are typically several feet thick but can be thinly bedded. In Dagett Hollow the upper surface contains polygonal mud cracks. Chert occurs as nodules sporadically throughout the unit. The thin shales have a greenish gray tint. The trilobite *Sthenarocalymene celeba* is common in the quarries east of Grafton. A cheirurid trilobite was also collected from the upper part of the dolostone. Dolomitization of this and lower formations within the Silurian makes mapping the Silurian units separately difficult. This unit is unconformable with the underlying units.

M. Kankakee Formation: *dolostone and shale.* The dolostone is yellowish brown to buff gray and has a characteristic pitted weathered surface. Dolostone beds range from thick to thin. Bedding planes are flat to wavy in places and are separated by thin green clay laminae. Chert occurs as nodules sporadically throughout the unit. Shales have a greenish gray tint. Glauconite is present within this formation. Fossils include brachiopod molds, straight cephalopods, and trilobites. This unit is unconformable with the underlying units in some places.

N. Edgewood Limestone: *dolostone and minor shale.* The dolostone is brown to buff gray. Beds are thick to thin, argillaceous, and sandy in places. Chert occurs as nodules sporadically throughout the unit. Shales have a greenish gray tint. Glauconite was present in a few of the beds, and few fossils were observed. This unit is unconformable with the underlying units.

O. Maquoketa Formation: *dolostone, siltstone, mudstone.* This unit is poorly exposed and forms gentle hill slopes that are well vegetated. The lower part of the formation is calcareous and grades upward into bluish green, thin calcareous siltstones interbedded with bluish gray mudstones. The upper part is shaly buff-gray to greenish gray and has interlaminated silts and shales. A thin black shale having phosphatic nodules, fossil fragments, and abundant disseminated pyrite was identified near the base of the unit. This black shale was only observed at one location in Section 13 (SW, NE) T6N, R13W. The base of this formation was not observed, but drill logs indicate that it is unconformable with the underlying units.

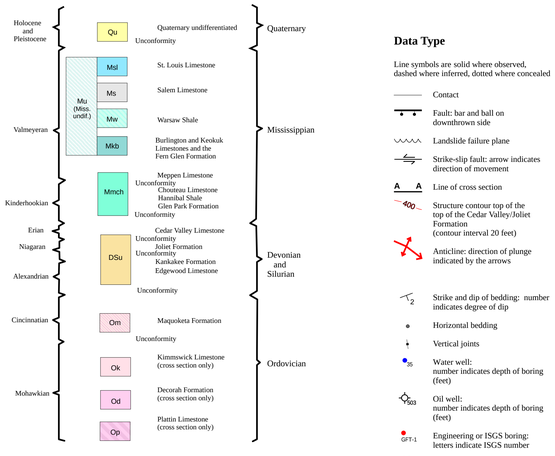
Subsurface only (described from drill logs and reports).

P. Kimmswick Limestone–Trenton Limestone in the subsurface: *limestone, dolostone, and minor shale.* White to gray, coarsely crinoidal grainstone is the dominant facies in this formation. Other fossils include *Receptaculites* sp., *Illaenus* sp., *Isotelus gigas* (trilobites), brachiopods, and gastropods that are commonly broken in the cross-bedded coarse bioclastics of the formation. Shales are calcareous and may contain pyrite. Cherts are not very common and are white with slight yellow tones. When cracked, the limestones have a faint petroliferous odor. The basal contact is a distinct hardground omission surface.

Q. Decorah Formation: *limestone and shale.* Light brownish to greenish limestone or lime mudstone interbedded with organic-rich reddish brown shales. The cherts are dark gray, and the dominant fossils are strophomind brachiopods.

R. Plattin Limestone: *limestone, dolostone, and shale.* Light brown to chocolate brown sublithographic limestone with alternating fossiliferous shales and sandy limestones near the base.

Figure 1 Contact between the Chouteau Limestone and the Meppen Limestone. The contact at this location is clearly angular. It may be an angular unconformity or a depositional feature related to a mud reef facies. Location: 13-6N-12W.



Data Type

Line symbols are solid where observed, dashed where inferred, dotted where concealed

- Contact
- Fault: bar and ball on downthrown side
- Landslide failure plane
- Strike-slip fault: arrow indicates direction of movement
- A A — Line of cross section
- 400 — Structure contour top of the top of the Cedar Valley/Joliet Formation (contour interval 20 feet)
- Anticline: direction of plunge indicated by the arrows
- 2 — Strike and dip of bedding: number indicates degree of dip
- Horizontal bedding
- Vertical joints
- 35 — Water well: number indicates depth of boring (feet)
- 693 — Oil well: number indicates depth of boring (feet)
- GFT-1 — Engineering or ISGS boring: letters indicate ISGS number
- Abandoned quarry
- Location of photograph
- 691 — Elevation (feet) of benchmark or survey point

Economic Geology of the Grafton Quadrangle

Stone

Several quarries once mined Silurian dolomites in the quadrangle. Currently, none of these operations are active. According to local residents, most of the quarries were operated for local supply of aggregate and building stone.

The Burlington and Keokuk Formations in the Grafton area are nearly identical in lithologic character and were mapped as a single unit. Both units are composed in part of calcium-rich limestone. Portions of these units contain white crinoidal grainstones to packstones, which commonly are high in calcium carbonate. Hindering the quarrying in this unit are the cherty intervals located above and below the high-calcium zones. Relatively thick chert-free beds of economically important limestone are present locally.

Oil

Two oil tests have been drilled in the quadrangle. According to an oil well report written by consulting geologist Lawrence Bengal, the first well had a show of oil, and the second well drilled in 1984 (Section 2, T6N, R12W) was interpreted by the geologist as intersecting a fault and repeating the Devonian and Silurian units (Bengal 1984). This interpretation would require at least 150 feet of vertical displacement. No field evidence to support a fault of this size was identified. The chance for economic oil production in this quadrangle is marginal because of the shallow depth to the pay zones along the anticlines and because of faulting in the area along the Cap au Grès. Nevertheless, the shales and the limestone of the Ordovician Decorah contain hydrocarbons. Qualitative distillation tests in the area have reported the Decorah to produce between 15 to 25 gallons of crude oil per ton (Rubey 1952).

Sand and Gravel

Sand and gravel are available in the alluvial deposits of the Illinois and Mississippi Rivers (see Grimley 1999).

Structural Geology of the Grafton Quadrangle

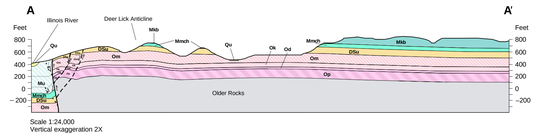
The major structural feature of the quadrangle is the Cap au Grès Faulted Flexure (Keyes 1894). The Cap au Grès is the southeastern extension of the Lincoln Fold, which extends over 165 miles into northeast Missouri (Nelson 1995). The axis of the Lincoln Fold follows a general northwesterly trend but turns easterly at its southernmost exposures. The south-easternmost portion of this structure in Missouri and Illinois is called the Cap au Grès.

In this quadrangle, the Cap au Grès is a faulted monocline with dips averaging less than 30° to the southwest and less than 4° to the northeast. The faulted blocks strike N80° W and dip between 40° to 80° to the south. The fault in this quadrangle juxtaposes Silurian age dolomites with Mississippian carbonates. Geologic reconstruction of the flexure indicates as much as 950 feet of vertical displacement may be present along this fault zone at the Deer Plain Ferry location. Evidence for the structure can be observed in road cuts along Illinois Highway 100 just west of Graham Hollow north of the Deer Plain Ferry landing. At this location the Mississippian St. Louis Limestone dips to the south up to 70°.

Along the bluffs west of Grafton, several large blocks of Silurian dolomite are exposed that are interpreted to be rotational slumps. Several more slump blocks were observed along a drainage on the west side of Graham Hollow. The basal failure plane of these slumps occurs in the underlying Maquoketa Shale. The failure plane was not observed because of the lack of bedrock exposures of the Maquoketa in the immediate area of the slump blocks.

Rubey (1952) mapped the Hardin and Brussels 15-minute quadrangles to the west of the Grafton Quadrangle. He identified an oval-shaped uplift located in Deer Lick Hollow just west of the Grafton Quadrangle, which he named the Deer Lick Dome. We traced this feature into the Grafton Quadrangle and determined that it was more accurately described as a plunging anticline. The Deer Lick Anticline is closely related to the Dome described by Rubey and may be considered the eastern limit of the Deer Lick Dome. A second anticline was identified on the structure contours to the northeast of the Deer Lick Anticline. This second anticline roughly parallels the Deer Lick Anticline but the dips of both limbs are less than 4°. This anticline also plunges to the southeast where it is concealed by the alluvial sediments of the Illinois and Mississippi Rivers. The Florissant Dome observed on the *Bedrock Geologic Map of the St. Louis 30 × 60 Minute Quadrangle and Report* (Harrison 1997) appears to be a continuation of the second unnamed anticline in the Grafton Quadrangle.

Cross Section A-A Looking Northwest



Two northeasterly trending strike-slip faults were identified in the eastern half of the quadrangle. The first was located in the bluff just east of Grafton. The fault zone was 10 feet wide and contained breccia fragments, gouge, and secondary calcite veinlets. No vertical offset could be observed in the Silurian dolomite. The fractures were nearly vertical with smooth wavy mullion-like planes, which had general trends of N50° E. The direction of movement was probably horizontal, but the sense of displacement to the right or left was not readily apparent. A second strike-slip fault was identified along Babbs Hollow (1,100 feet WL, 500 feet SL; Section 7, T6N, R11W). The fault zone was less than 5 feet wide and appeared to have the central breccia zone down-dropped less than 2 feet. The fault zone strikes N30° E to N40° E and is located in the basal portion of the Burlington-Keokuk Limestone. Indications are that the movement is probably right lateral. A third fault is concealed under alluvium at Rice Hollow. This fault was inferred from the 10 to 15 feet elevation difference on the top of the Devonian and Silurian units across the Hollow.

These faults and the anticlines suggest a northeast to southwest maximum principal stress direction. The most plausible explanation for the Cap au Grès feature was postulated by Rubey (1952), Harrison (1997), Nelson and Lumm (1985), and Nelson (1995) who discuss the possibility of a deep-seated reverse basement fault. The Cap au Grès resembles monoclinal drape folds found on the Colorado Plateau that formed in sedimentary strata overlying reactivated basement faults (Harrison 1993). Nelson and Lumm (1985) compared the Cap au Grès flexure with Laramide monoclines in the Rocky Mountains and Colorado Plateau, where folds in sedimentary cover overlie faults in the Precambrian crystalline basement.

The timing of the Cap au Grès/Lincoln Fold event is constrained by stratigraphic relationships. Facies variations near the structure occur in the Kinderhookian through lower Valmeyeran succession. Detailed mapping near the Cap au Grès indicates that these lower Mississippian rocks apparently thin toward the structure. Therefore, we suggest that the structure was active starting in Late Devonian and continued sporadically through the earliest Pennsylvanian. Outliers of Pennsylvanian Carbondale Formation occur at only slightly different elevations on either side of the Cap au Grès in Calhoun County (Rubey 1952). The St. Louis Formation is the youngest unit significantly displaced, which indicates that major movement took place on the structure between Valmeyeran and Desmoinesian times.

The eastern quarter of the quadrangle is not significantly influenced by the Cap au Grès and has a regional easterly dip of roughly 50 feet per mile.

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