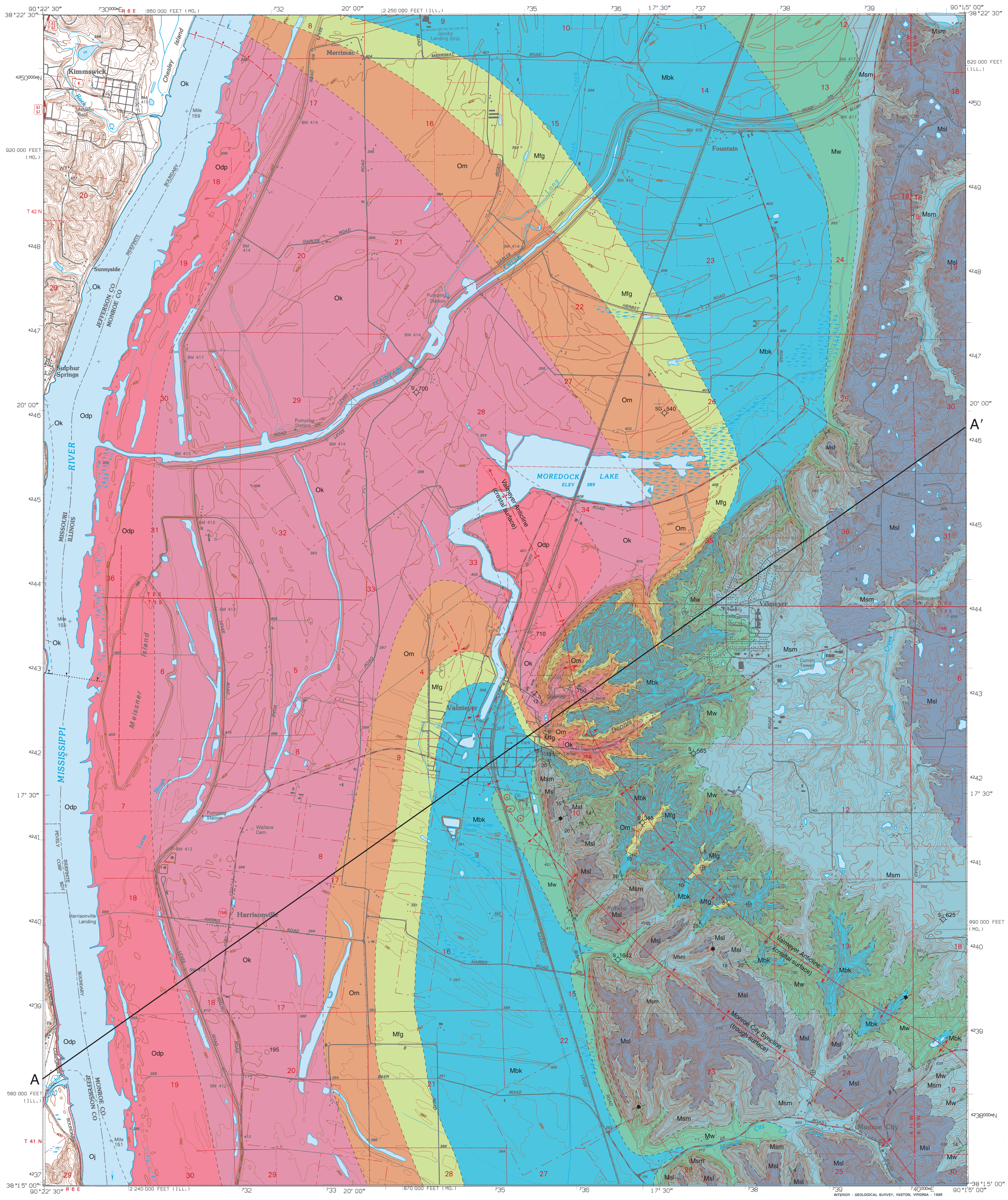
Institute of Natural Resource Sustainability
William W. Shilts, Executive Director
ILLINOIS STATE GEOLOGICAL SURVEY
E. Donald McKay III, Interim Director

BEDROCK GEOLOGY OF VALMEYER QUADRANGLE
MONROE COUNTY, ILLINOIS

F. Brett Denny, Russell J. Jacobson, and W. John Nelson
2009

Illinois Geologic Quadrangle Map
IGQ Valmeyer-BG



EXPLANATION

Mississippian	Msl	St. Louis Limestone	Valmeyeran and Kinderhookian
	Msm	Salem Limestone	
	Mw	Warsaw Formation	
	Mbk	Burlington-Keokuk Limestones	
	Mfg	Fern Glen Formation and Chouteau Limestone	
		Unconformity	
Ordovician	Om	Hannibal Shale and Maquoketa Formation	Cincinnatian
		Unconformity	
	Ok	Kimmswick Limestone	Mohawkian
	Odp	Decorah Formation and Plattin Limestone	
	Oj	Joachim Dolomite	

Symbols

40 Strike and dip of bedding; number indicates degree of dip

Horizontal bedding

Vertical joints

Abandoned quarry

Drill Holes
from which subsurface data were obtained

Dry oil and gas test hole

Other boring

SG 745 Boring with samples (s) or geophysical log (g). Numeric label indicates total depth of boring in feet.

Line Symbols
dashed where inferred, dotted where concealed

Contact

Fault; ball and bar on downthrown side

Anticline
direction of plunge indicated by arrow

Syncline

Monocline

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 (Raster Feature Separates) provided by the United States Geological Survey. Compiled by photogrammetric methods from imagery dated 1986. Field checked 1989. Revised from imagery dated 1993. PLSS and survey control current as of 1989. Base map edited as of 1996. New Valmeyer area compiled from digital orthophotos dated 2005.

North American Datum of 1983 (NAD 83)
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 15

Recommended citation:
Denny, F.B., R.J. Jacobson, and W.J. Nelson, 2009, Bedrock Geology of Valmeyer Quadrangle, Monroe County, Illinois: Illinois State Geological Survey, Illinois Geologic Quadrangle Map, IGQ Valmeyer-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

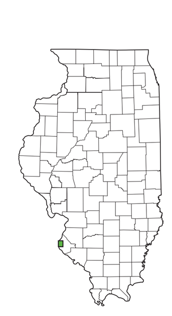
Geology based on field work by F. Brett Denny and Russel J. Jacobson, 2001–2002.

Digital cartography by Jane E.J. Domier, Steven M. Radil, and Alex J. Beata, Illinois State Geological Survey.

This research was supported in part by the U.S. Geological Survey National Cooperative Geologic Mapping Program (STATEMAP) under USGS award number 01HQAG0103. The views and conclusions contained in this document are those of the authors and should not be interpreted as necessarily representing the official policies, either expressed or implied, of the U.S. Government.

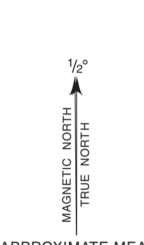
ILLINOIS
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

For more information contact:
Institute of Natural Resource Sustainability
Illinois State Geological Survey
615 East Peabody Drive
Champaign, Illinois 61820-6964
(217) 244-2414
http://www.isgs.illinois.edu



1	2	3
4		5
6	7	8

ADJOINING QUADRANGLES
1 Maxville, MO
2 Oakville
3 Columbia
4 Herculaneum, MO
5 Waterloo
6 Festus, MO
7 Selma
8 Renault



APPROXIMATE MEAN DECLINATION, 2009

ROAD CLASSIFICATION

Primary highway, hard surface

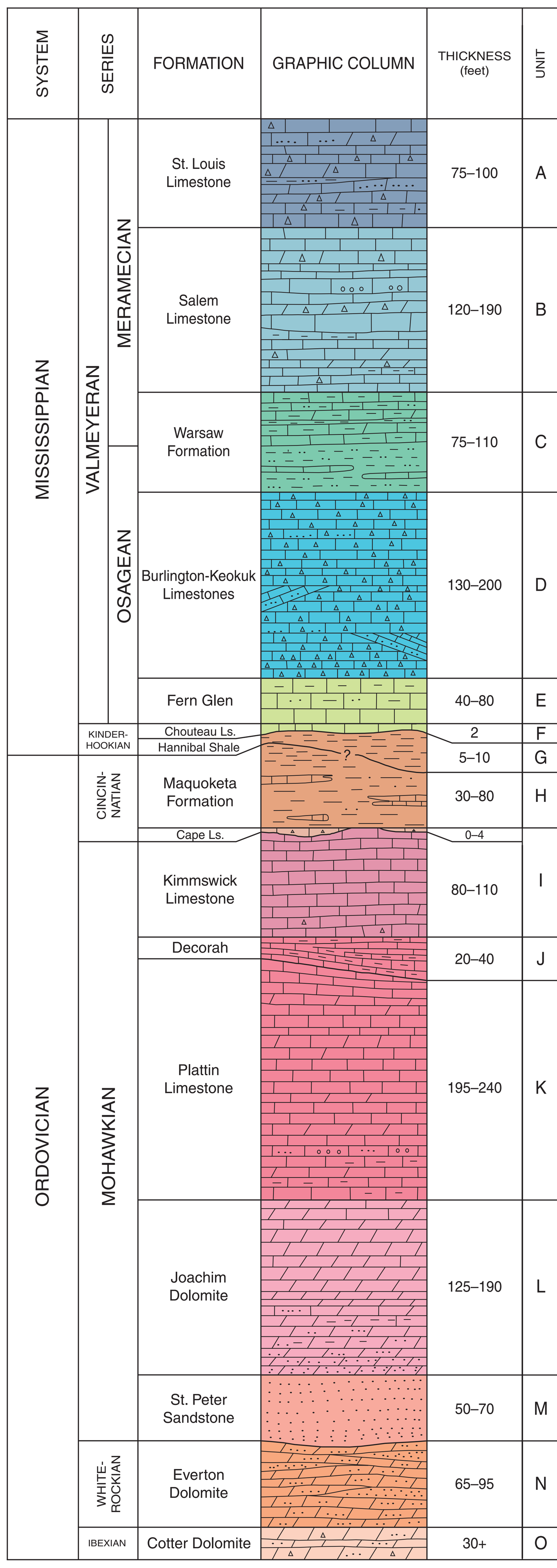
Light-duty road, hard or improved surface

Secondary highway, hard surface

Unimproved road

U.S. Route

State Route



A St. Louis Limestone Limestone, dolostone, minor siltstone, and shale. Light gray to medium gray dense lime-mudstone and fossil wackestone are prevalent. Some beds contain quartz sand and breccia of subangular limestone clasts. Oolitic grainstone, greenish oncolitic packstone, peloidal grainstone, stromatolitic boundstone, carbonate intraclastic conglomerates, and yellow-weathering dolostone beds add to the mix of lithofacies. Gray to dark gray chert occurs as nodules and stringers throughout the formation. Siltstone and shale occur as thin interbeds; the siltstone is calcareous and greenish gray; the shale is greenish gray and reddish brown, calcareous, soft, and non-fissile. *Acrocyathus floriformis*, a colonial coral, occurs in the lower part of this formation; the "finger coral" *Acrocyathus proliferus* is widespread near the base. The contact with the Salem Limestone is gradational. In this study, the contact was placed about 20 feet below the lower *Acrocyathus floriformis* zone. Locally, an erosional karstic surface was observed near the contact; however, as Lineback (1972) and Lasemi and Norby (2000) showed, the St. Louis-Salem contact is time-transgressive, becoming younger to the north in this area.

B Salem Limestone Limestone and dolostone, minor chert, and siltstone. Limestone, the dominant lithology, is light to medium brown to light gray wackestone, packstone, and grainstone composed of rounded and broken fossils and coated grains. Outcrops present a dirty gray-brown, grainy appearance. True oolitic limestone is rare. The Salem also contains gray lime mudstone and microgranular dolostone similar to the overlying St. Louis Limestone. Dolostone generally is brown and has moldic porosity. Bedding varies from tabular to undulatory; cross-bedded grainstone is locally present. Some beds show rhythmic lamination with tidal cycles. Beds of laminated calcisiltite alternate with coarse bioclastic, peloidal, and oolitic limestone in shoaling-upward cycles, as described by Lasemi and Norby (2000). Chert is light gray, commonly bioclastic, and weathers with a porous rind. Chert commonly occurs between grainstones and laminated beds as elliptical nodules containing concentric rings that spall off like eggshells when weathered. Siltstone is brown to light gray and typically occurs in layers less than 1 inch thick. Fossils of the Salem include spiriferid and productid brachiopods, rugose corals, conularids, crinoids, and ramose, fenestrate, encrusting, and bifoliate bryozoans. The diagnostic microfossil is the foraminifer *Globoendothyra baileyi*, formerly called *Endothyra baileyi*. Baxter (1960) extensively studied the Salem Limestone in Monroe County and vicinity and divided the Salem into four members. These members were not recognized during the present study and, as Lasemi and Norby (2000) stated, appear to represent local facies. The contact with the underlying unit is gradational.

C Warsaw Formation Limestone, dolostone, siltstone, and mudstone. Limestone is medium gray crinoid-bryozoan wackestone and packstone with brachiopods. Dolostone is grayish brown to brownish gray, is thinly bedded, and contains chlorite-rich shale clasts. Siltstone and mudstone are bluish gray, calcareous, and fossiliferous. The upper half of the Warsaw is dominantly shaly limestone and dolostone, whereas the lower half contains intervals of mudstone up to 20 feet thick with thin limestone interbeds. Fossils include conularids and gastropods in mudstone and brachiopods (especially spiriferids), bryozoans, and echinoderms in limestones and dolostones. The lower contact is poorly exposed, but appears to be sharp and conformable.

D Burlington-Keokuk Limestones Cherty limestone, minor siltstone, and shale. The dominant lithology is white to light gray crinoidal grainstones with abundant nodules and bands of light gray to black chert that weather white. Chert comprises at least 25 percent of the lowermost beds. Alternating with grainstone are thinner beds of argillaceous to sandy, cross-bedded limestone that weather to light brown. Large spiriferid brachiopods are common along with crinoids, bryozoans, and corals. Thin interbeds of dark gray to greenish gray, calcareous shale and siltstone are present. Originally described in southeastern Iowa as separate formations, the Burlington and Keokuk Limestones cannot be differentiated in the map area. The lower contact is gradational.

E Fern Glen Formation Limestone, siltstone, and shale. Limestone is red to greenish gray, thin-bedded, and argillaceous; it contains small calcite geodes and nodules of greenish gray, fossiliferous chert. Crinoid stems are the only common fossils. Green and red shaly calcareous siltstones are diagnostic and increase toward the base.

F Chouteau Limestone Limestone and thin shale. Limestone is light gray and fine grained. Collinson et al. (1981) reported this unit to be 2 feet thick. Due to lack of exposures and the thickness of this unit, it is mapped together with the Fern Glen Formation. The lower contact is poorly exposed.

G Hannibal Shale Shale. Greenish gray shale. This unit can be separated from the underlying shale of the Maquoketa Formation only through microfossil "conodont" analysis (Norby 1987). The lower contact of this unit is a major unconformity defined by absence of Devonian and Silurian strata. Upper Devonian rocks occur in the Missouri part of the Valmeyer Quadrangle (Middendorf and Whitfield 1992), but have not been identified in the Illinois portion of the map area.

H Maquoketa Formation Shale and limestone; minor siltstone and sandstone. Shale is greenish to brownish gray, silty, and calcareous; some layers grade to siltstone or very fine-grained sandstone. Argillaceous limestone, the same color as the shale, occurs as nodules and lenticular bands a few inches thick and spaced a few inches to 2 feet apart. A "depauperate zone" composed of small fossils and phosphatic nodules, was observed about 9 feet above the base (Templeton and Willman 1963, p. 238–239). The Maquoketa is poorly exposed and erodes to vegetated gentle slopes. The lower contact is unconformable.

I Cape and Kimmswick Limestones Limestone, dolostone, and minor shale. The Cape Limestone, zero to 4 feet thick, is light to medium brownish gray and bluish gray limestone that is coarsely granular and cherty. Fossils, typically silicified, include gastropods, small bivalves, crinoids, and the brachiopods *Spirifer* sp., *Rafinesquina* sp., *Strophomena* sp., and *Rhynchotrema* sp. (L.E. Workman and G.E. Ekblaw, unpublished field notes, 1930, ISGS Library). The contact to the underlying Kimmswick is "ferruginous, pitted, and penetrated by Fernvale [Cape]" (Templeton and Willman 1963 and unpublished field notes). The Kimmswick Limestone is dominantly white to gray, coarse-grained, cross-bedded crinoidal grainstone. It emits a faint petroliferous odor when cracked. Fossils include the problematic, sunflower-like alga(?) *Receptaculites* sp.; the trilobites *Illaenus* sp. and *Isotelus gigas*; brachiopods; and gastropods. Fossils are commonly broken. Bedding is generally thick to massive. Shale occurs as uncommon partings and thin interbeds; the shale is calcareous and may contain pyrite. Chert is uncommon; it is white to light yellowish gray and occurs chiefly near the base of the unit. The basal contact is a distinct hardground omission surface.

J Decorah Formation Limestone and shale. Light brownish to greenish gray, very fine to coarse granular and micritic limestone is argillaceous and silty and contains thin interbeds of organic-rich reddish brown shales. Dark gray chert nodules are present. Some beds are highly fossiliferous; strophomenid brachiopods are most abundant. This unit is exposed at the crest of the anticline on the bluff just north of the Valmeyer Quarry. The base is not exposed.

K Plattin Limestone Limestone and dolostone, minor shale. Limestone and lesser dolostone are mottled in light to medium brown and grayish brown and are finely granular to sublithographic. Chert is uncommon. On the outcrop in Missouri this rock is highly burrowed and contains scattered brachiopods, gastropods, and horn corals (Middendorf and Whitfield 1992). A few thin layers of fossiliferous shale and sandy, obscurely oolitic limestone occur near the base. This and older units are entirely in the subsurface in the Illinois part of the quadrangle.

L Joachim Dolomite Dolostone and dolomitic limestone. These rocks are light to medium gray and brownish gray and dominantly microgranular, and they exhibit micro-vuggy porosity. Thin interbeds of medium dark gray shale occur in the lower part. Near the base is sandy dolostone to dolomitic sandstone of fine to medium, well-rounded quartz grains like those of the St. Peter Sandstone.

M St. Peter Sandstone Sandstone is white to light gray, largely medium-grained but poorly sorted, and composed of well-rounded quartz sand grains in calcite cement.

N Everton Dolomite Sandy dolostone and sandstone. Dolostone is light to medium brownish gray and grayish brown and microgranular, containing abundant quartz sand like that of the St. Peter. Dolostone has pronounced intergranular and micro-vuggy porosity. Sandstone of the Everton resembles the St. Peter, but is darker colored and has dolomite cement.

O Cotter Dolomite No samples or sample descriptions are available for this unit from the Valmeyer Quadrangle. In the adjacent Herculaneum Quadrangle in Missouri, the Cotter is described as dolostone that is light to medium brown, very fine-grained, sandy, fossiliferous, and commonly vuggy. The unit is reported to contain 5 to 20% chert nodules and interbeds of white, very fine-grained sandstone (Middendorf and Whitfield 1992).

Introduction and Methodology

This map shows Paleozoic bedrock geology of the Valmeyer Quadrangle. It portrays the bedrock formations as they would appear if all unconsolidated surficial sediments, including loess, glacial drift, and alluvium, were removed. The cross section depicts the Quaternary sediments along the floodplain of the Mississippi River, but does not depict the loess that blankets the uplands.

Rock outcrops in the map area were examined by Denny and Jacobson over the winter of 2001–2002. Observations are supplemented by field notes of previous geologists on file at the ISGS. In 2008, drill-hole records, also on file at the ISGS, were used to refine thickness and lithologic descriptions of stratigraphic units and to interpret geology beneath the Mississippi River floodplain. Only four boreholes within the Valmeyer Quadrangle provide information on bedrock beneath the floodplain, and one of these has a doubtful record. A fifth hole, having a reliable record, is a short distance north of the map area. Bedrock formation contacts beneath the floodplain therefore had to be largely extrapolated from outcrops in the flanking bluffs in Illinois and Missouri (Middendorf and Brill 1991, Middendorf and Whitfield 1992).

Structural Geology

The Valmeyer Quadrangle is situated along the northeastern margin of the Ozark Dome, where sedimentary strata strike northwest and dip northeast toward the Illinois Basin. The average dip is between 1 and 2 degrees.

The Valmeyer Anticline, first mapped by Weller and Weller (1939), is the most prominent structure within the map area. Like the larger Waterloo-Dupo Anticline to the northeast, the Valmeyer is strongly asymmetrical. Rocks along the southwestern flank dip as steeply as 15 to 25 degrees, whereas dips on the northeast flank average about 2 degrees. The belt of steepest dips is narrow and lies 1,500 to 2,000 feet southwest of the broad, gentle crest of the fold. The axial trend curves from N 40°W in the southeast to N 15°W in the northwest, where the fold intersects the Mississippi floodplain. The highest point structurally is near Valmeyer, where the Middle Ordovician Kimmswick Limestone comes to the surface.

The anticline plunges abruptly and dies out a short distance north of Valmeyer. In the T. Kerwin #1 Wessel borehole, drilled directly in line with the fold axis 2½ miles north of the Valmeyer quarries, the base of the Kimmswick Limestone is 250 feet lower in elevation than it is in the quarries. The anticline is not expressed in outcrops on the Missouri side of the river (Middendorf and Brill 1991, Middendorf and Whitfield 1992). However, the Eureka-House Springs Anticline, farther west in Missouri, is in line with the Valmeyer and has a similar asymmetry (McCracken 1971, McBride and Nelson 1999).

The Valmeyer Anticline is part of a large family of structures in western Illinois and Missouri that all exhibit northwest trend, strong asymmetry, and, commonly, faulting on the steep limb. Although the Valmeyer structure is not faulted at the surface, there is little doubt that the steep limb overlies a deep-seated fault along which a block of basement rock was raised and tilted. Direct evidence for age of the Valmeyer Anticline is lacking, aside from being younger than the St. Louis Limestone. Other structures of this family are of Pennsylvanian age and are associated with the Ancestral Rocky Mountains orogeny (McBride and Nelson 1999).

The Monroe City Syncline is a subtle feature, the trough of which parallels the Valmeyer Anticline 3,500 to 4,500 feet to the northeast. The syncline is defined by the steep southwest flank of the anticline on the northeast and the regional dip off the Ozark Dome on the southwest.

Economic Geology

Stone

The Kimmswick Limestone (Ordovician) formerly was quarried and mined underground adjacent to the old (pre-1993 flood) town of Valmeyer. The Kimmswick is a high-calcium limestone and thus is suitable for a large range of uses. Ready availability of river and rail transport and proximity to the St. Louis metropolitan area enhance the value of this resource. Excessive thickness of overburden is the primary reason the Kimmswick has not been exploited more extensively in the Valmeyer area. The Kimmswick is close to the surface in only a small area near the crest of the Valmeyer Anticline. Future development will probably have to take place largely by underground mining.

Several small quarries south of Valmeyer formerly worked the Salem Limestone for local use. The Salem is being quarried commercially both south of the study area in Randolph County and, in conjunction with the overlying St. Louis Limestone, north of the report area in northern Monroe and St. Clair Counties. The Salem and St. Louis are suitable for a variety of purposes, including aggregate, surfacing secondary roads, and riprap. In addition, the Salem contains beds of high-calcium limestone in the report area (Baxter 1960). These units underlie large areas of the Valmeyer Quadrangle with thin or absent overburden.

Oil and Gas

Several test holes have been drilled in the map area for oil and gas; all were dry and abandoned. These tests targeted the crest of the Valmeyer Anticline. The fold has ample structural closure; unfortunately the deepest prospective producing unit, the Kimmswick ("Trenton") Limestone, has been breached by erosion. Outcrops of the Kimmswick commonly emit a petroliferous odor when hammered, signifying that the rock formerly contained hydrocarbons. The Kimmswick was the producing horizon in the Waterloo and Dupo oil fields north of the Valmeyer Quadrangle. Those fields lie in a similar anticlinal structure, but the Kimmswick is entirely in the subsurface and capped by shale of the Maquoketa Formation, which serves both as seal and source rock. No oil has ever been produced in Illinois from rocks older than the Kimmswick.

Acknowledgments

This mapping was supported in part by funding from the U.S. Geological Survey under the National Cooperative Geologic Mapping Program (STATEMAP), Award Number 01HQAG0103. The view and conclusions contained in this document are those of the authors and should not be interpreted as necessarily representing the official policies, either expressed or implied, of the U.S. Government.

References

Baxter, J.W., 1960, Salem Limestone in southwestern Illinois: Illinois State Geological Survey, Circular 284, 32 p.

Collinson, C., J.W. Baxter, R.D. Norby, H.R. Lane, and P.D. Brenckle, 1981, Mississippian stratotypes: Illinois State Geological Survey, A field trip held in conjunction with the 15th Annual Meeting of the North-Central Section of the Geological Society of America, April 1981, 56 leaves.

Lasemi, Z., and R.D. Norby, 2000, Middle Mississippian carbonates in the St. Louis Metro East area, stratigraphy and economic significance, *in* Norby, R.D., and Z. Lasemi, editors, Paleozoic and Quaternary geology of the St. Louis Metro East area of western Illinois: 63rd Annual Tri-State Geological Field Conference, Illinois State Geological Survey, Guidebook 32, 82 p.

Lineback, J.A., 1972, Lateral gradation of the Salem and St. Louis Limestones (Middle Mississippian) in Illinois: Illinois State Geological Survey, Circular 474, 23 p.

McBride, J.H., and W.J. Nelson, 1999, Style and origin of mid-Carboniferous deformation in the Illinois Basin, USA—Ancestral Rockies deformation? Tectonophysics, v. 305, p. 249–273.

McCracken, M.H., 1971, Structural features of Missouri: Missouri Geological Survey and Water Resources, Report of Investigations No. 49, 77 p. and map, 1:500,000.

Middendorf, M.A., and K.G. Brill, Jr., 1991, Bedrock geologic map of the Oakville 7.5′ quadrangle, Jefferson and St. Louis Counties, Missouri: Missouri Division of Geology and Land Survey, Open-File Map OFM-91-266-GMR, 1 sheet, 1:24,000.

Middendorf, M.A., and J.W. Whitfield, 1992, Bedrock geologic map of the Herculaneum and Valmeyer 7.5′ quadrangles, Jefferson County, Missouri: Missouri Division of Geology and Land Survey, Open-File Map OFM-92-265-GMR, 1 sheet, 1:24,000.

Norby, R.D., 1987, Valmeyer anticline of Monroe County, Illinois: Geological Society of America Centennial Field Guide, North-Central Section, p. 237–240.

Templeton, J.S., and H.B. Willman, 1963, Champlainian Series (Middle Ordovician) in Illinois: Illinois State Geological Survey, Bulletin 89, 260 p.

Weller, S., and J.M. Weller, 1939, Preliminary geological maps of the pre-Pennsylvanian formations in part of southwestern Illinois: Illinois State Geological Survey, Report of Investigations 59, 15 p. and 3 map sheets, 1:62,500.