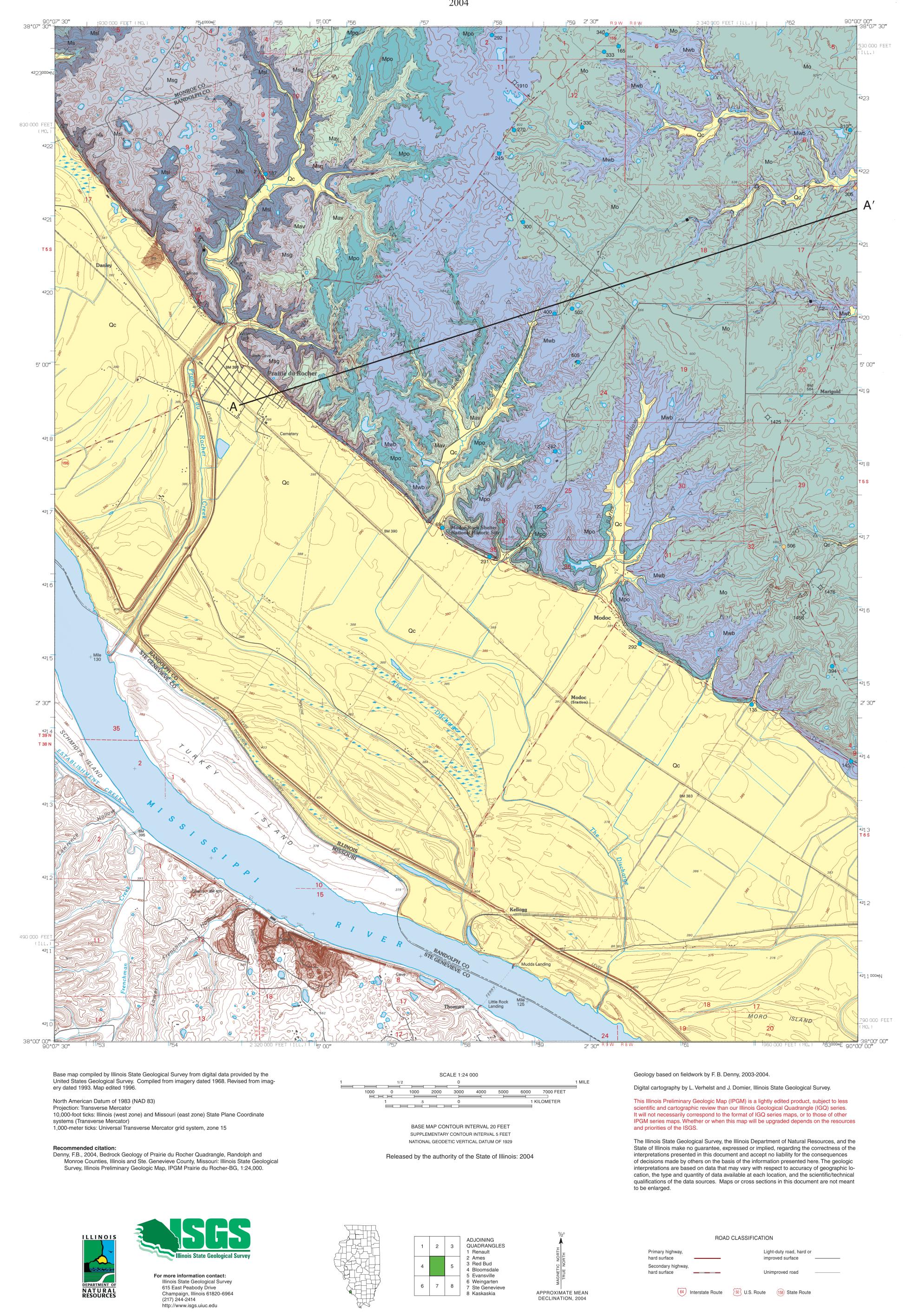
BEDROCK GEOLOGY OF PRAIRIE DU ROCHER QUADRANGLE

RANDOLPH AND MONROE COUNTIES, ILLINOIS STE. GENEVIEVE COUNTY, MISSOURI

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

F. Brett Denny



Illinois Preliminary Geologic Map IPGM Prairie du Rocher-BG

Quaternary	Qc
<pre>></pre>	
	Мо
	Mwb
	Мро
Mississippian {	Mav
	Msg

	Мро	
sissippian {	Mav	
	Msg	
	Msl	

Salem Limestone

Symbols
- ,

Strike and dip of bedding; number
indicates degree of dip

EXPLANATION

includes Glen Dean, Hardinsburg, Haney Ls,

includes Cypress, Ridenhower, Bethel Ss.

includes Downey's Bluff Ls, Yankeetown,

Chesteriar

Fraileys Shale, Beech Creek Ls.

West Baden Formation

Aux Vases Sandstone

Ste. Genevieve Limestone

St. Louis Limestone

Cahokia Formation

Okaw Formation

Paoli Limestone

- \times Active quarry
- ☆ Abandoned quarry Vertical joints
- \triangle Outcrop from field notes

Drill Holes

from which subsurface data was obtained

- ³⁵ Stratigraphic boring
- ●²¹⁰ Water well Note: Numbers indicate total depth of
- Line Symbols
- dashed where inferred, dotted where concealed ----- Contact
- A—A′ Line of cross section

Stratigraphy

The bedrock exposed in the quadrangle is dominated by limestones and dolomites of the Valmeyeran Series in the northwest, and Chesterian limeston and shales to the southeast. The Valmeyeran carbonates represent a prolonged marine transgression which covered the region for millions of years. The oldest Valmeyeran unit exposed in the quadrangle is the Salem Limestone. Th unit is approximately 200 feet thick in the region and is dominantly an open marine system. This Formation has been studied in detail by Cluff (1984) and Baxter (1960). Cluff suggested that the Salem was composed of up to 4 cycles consisting of a marine shoal overlain by a thin bedded, fine grained, tidal flat unit. The cycles can be observed on electric logs (figure 1). This example is from an oil test 32-5S-8W and the thin bedded limestone and shales show as anomalously high porosity on neutron logs. Northwest of Prairie du Rocher, the upper 100 feet of the Salem can be observed along Bluff Road. At this location the shoals and thin bedded tidal flat limestone, dolomite, and shales can be observed. The contact with the overlying St. Louis can be observed along a reentrant of the bluff.

The St. Louis Limestone may be divided into an upper and lower unit. Lasemi and Norby (1999) described the lower St. Louis as a near-shore restricted marine facies consisting of pelleted and fenestral lime mudstone, algal limestone, collapsed breccia beds, and microcrystalline dolomite. The upper St. Louis is characterized by bioclastic wackestones to packstone, lime mudstone, and peloidal grainstones which are interpreted as a return to normal open marine conditions. There is an acme zone of the colonial coral *Acrocyathus floriformius* (Lithostrotionella) about 20 feet up from the base of the St. Louis Formation. This colonial coral is an excellent stratigraphic marker. Higher in the unit there is a significant break in the conodont fauna which occurs just above a bryozoan rich cherty limestone bed named the Lost River Chert zone (Lasemi and Norby, 1999). The contact with the overlying Ste. Genevieve Formation is placed just above this chert zone.

The Ste. Genevieve Limestone consists of oolitic, crinoidal, cross bedded limestones and dolomites. Thin beds of sandy limestone are present and in par the unit is very similar to the underlying St. Louis Limestone. Oolitic shoals are well developed and extensively cross bedded, and a few sandy lenses occur within the unit indicating this is shallow marine limestone. The upper portion of the Ste. Genevieve is unconformable with the overlying Aux Vases Sandstone, which in places has down cut several feet into the Ste. Genevieve or the St. Louis Limestone.

Above this thick sequence of limestone lies a complex sequence of siltstones, claystones, limestones, and sandstones. The Aux Vases Sandstone is well developed in this region and is exposed in the hillside along Bluff Road south o Prairie du Rocher to Modoc. This unit is dominantly a fluvial unit and contains rooted zones, clay rip up clasts, and is bioturbated near the base. It is locally present in incised valleys of the older marine limestone units. The sedimentation appears to back fill these paleo-valleys in the lower portions which are shaly and exhibit tidal laminations. The center of the section is rooted and cross bedded, and contains desiccation cracks and limestone conglomerate. The upper most portion is cross bedded fine-grained sandstone. Most portions of the unit are cemented with calcite and the lower portion is bioturbated, but no marine fauna were observed. Because this is a fluvial-dominated unit, it is highly variably and sections may vary considerably over short distances. The Aux Vases has been studied by Swann (1963). Cole (1990), and Leetaru (2000). The Aux Vases produces petroleum at several fields in the southeastern portion of the Illinois Basin.

variable in composition. Previous workers have put the shales above and below the limestone into either the Aux Vases or the overlying Yankeetown. Swann (1963) observed a red bed at the top of the Renault in this region. This red bed during was not observed during field work for the project and therefore it includes only the main limestone that is 10 feet thick into the Renault. We observed a red bed about 5 feet below the Renault which we included in the Aux not well developed in this region, but may be correlated with a siltstone and red Vases Sandstone. The Aux Vases grades upward into the overlying Yankeetown. claystone, just below the base of the Glen Dean. The Okaw represents a major

As originally defined, the "Yankeetown Chert" (Weller, 1913) is composed of sandstone and limestone that has been altered to chert by long continued weathering. The Yankeetown is described by Weller (1939) as being rarely over 20 feet thick, and this unit contained beds that were undoubtedly equivalent in age to the Bethel Sandstone with the lower portion equivalent to the Renault Formation in southern Illinois. Swann (1963) stated that the sandstone in the Yankeetown, informally called "Benoist", was not equivalent to the Bethel. The Paint Creek was defined by Weller to include all of the strata above the Yankeetown to the base of the Ruma "Cypress" Formation. Swann (1963) utilized the term Yankeetown to include all of the section between the Renault and the Downeys Bluff Formations, and raised the Paint Creek from Formation to Group status (Table 1). The Downey's Bluff is a well lithified limestone with large pelmatozoan fragments. It represents a major marine transgression across the region. This limestone package from the base of the Renault upward to the Downeys Bluff is called the Paoli Limestone Group. This unit was lowered in rank to formation by Nelson (1996). The Paoli Formation makes a good mappable unit for this portion of the section from the Renault to Downeys Bluff.

The Cypress, Bethel, and Hardinsburg Sandstones normally present in the Chesterian of southern Illinois are poorly developed in this area. The absence of sandstone in the region makes stratigraphic correlation extremely difficult. There are several paleosols in western Illinois that correlate with the well-developed sandstones southern and southeastern Illinois. These paleosols and claystones probably represent a topographic high during the time of sedimentation. This regional topographic high has previously been referred to as the eastern extension of the Ozarks (Workman, 1944) and the Sparta Shelf (Meents and Swann, 1965). The Bethel, Ridenhower, and Cypress have been grouped into a mappable unit that correlates with the West Baden Group for this report. The West Baden Group, which was originally designated to be used in areas where the limestone portions of the Ridenhower were so thin that differentiation of the units is impractical (Swan, 1963). Nelson (1996) adopted the term West Baden Sandstone for this interval and reduced the unit from a Group to Formation

Swann correlated the thick red claystone of the Paint Creek with the Bethel. This unit represents a thick paleosol at the base of the West Baden. Above the Bethel is a variable series of siltstone, sandstone, shale, and limestone of the Ridenhower. The Ridenhower is a calcareous siltstone at the base that grades into a siltstone with plant debris and upward into a marine limestone. There are **Sand and gravel** thin to laminated red and green siltstones that are tidal to supertidal that grade upward into a 15 to 20 feet thick limestone at the top of the unit.

The Cypress is composed of red claystone and fine grained sandstone at the base

sandstones typical of the Cypress Formation are not well developed in this area.

The term West Baden Formation is utilized for the section from the base of the

Bethel to the top of the Cypress. The sandstones are not well developed in this

area the unit is dominantly composed of siltstone and shales, with limestones of

Baden Formation.

the Ridenhower in the middle of the unit. Therefore the unit is termed the West

and grades upward into a calcareous shale with carbonaceous plant debris. The

The Renault is generally a thin limestone and shale unit in this area that is highly Above the Cypress is a package of limestones named Okaw that was first described by Weller (1913). These limestones correlate with the Beech Creek through Glen Dean of the standard southern Illinois section. The Okaw is 150 to 200 feet thick and is composed of a variety of limestones and shales, with several red beds. The unit represents a marine incursion across the region with little siliciclastic influx into this immediate area. The Hardinsburg Sandstone is sea level rise over the region.

Structural Geology

The Prairie du Rocher Quadrangle is located in Randolph County, southwestern Illinois. This quadrangle is in line with the Waterloo-Dupo Anticline, Columbia Syncline, Monroe City Syncline, and the Valmeyer Anticline.

The Waterloo Anticline is an asymmetrical structure that trends approximately N20°W to N25° W and the Chesterian and older units have dips over 40° on the southwest side and gentle 2^0 to 4^0 degrees on the northeast side. The structure is called the Waterloo Anticline near Waterloo, Illinois and the Dupo Anticline in the vicinity of Dupo, Illinois. In the Waterloo Quadrangle, the structure apparently plunges to the south and the feature can not be traced much south of Waterloo. Silurian and Devonian units thin over the structure (Tikrity, 1968) which indicates that the structure may have been active during Silurian and early Devonian. At the extreme southern edge of the Columbia Quadrangle the Chesterian Series Aux Vases Sandstone dips about 22^o to the west and Pennsylvanian units are horizontal over the Chesterian units producing an angular unconformity.

In the Prairie du Rocher Quadrangle, two outcrops were observed striking nearly north-south with beds dipping 10 to 15 degrees to the west. These outcrops were observed at slightly more than 1 mile east of Prairie du Rocher and may be the southern extension of the Waterloo-Dupo Anticline. A large Aux Vases Sandstone channel is present along this trend which complicates the mapping in this area. The Aux Vases thickens from a feather edge at this point to over 100 feet in less than 1 mile eastward, and the Chesterian units also thicken along this hinge-line. We can not positively draw a fault in this area, but one s strongly suggested. If present this fault would trend parallel to the strike of the dipping beds in this area, which is N10 -15 degrees west. Several large blocks of basal Okaw were observed in section 8 T5S R8W (1800 WL, 2500 SL) striking N45^oW to N50^o W and dipping about 45^o NE. This may either be a tectonic feature or the result of slumping on the underlying shales of the upper West Baden. The conclusion at present is the blocks are a result of slumping but detailed mapping should clarify the nature of this structure

Economic Geology

Sand and gravel are located in the Mississippi River Valley. No significant mining of these deposits is currently in operation.

Limeston

estone is being mined underground northwest of Prairie du Rocher. This operation mines the upper portion of the Salem Limestone. There are several small abandoned open pit quarries that have mined the St. Louis and Ste Genevieve Limestones in the northwestern portion of the quadrangle. The Okaw Limestone, which consists of the Glen Dean and Haney Limestones,

SYSTEM	SERIES	FORMATION	MEMBER	GRAPHIC COLUMN	THICKNESS FEET	DESCRIPTION UNIT				
QUATERNARY	HOLOCENE	Cahokia			0–100	A				
			Glen Dean Limestone		+45	В				
			Hardinsburg		10	С				
		Okaw	Haney Limestone		40-45	D				
			Fraileys Shale		20-25	E				
	AN		Beech Creek Ls.		15	F				
	ESTERI	West Baden	Cypress		25–30	G				
MISSISSIPPIAN	CH		Ridenhower		60-70	Н				
2			Bethel Ss.		35-40	I				
			Downey's bluff Ls.		10	J				
		Paoli	Yankeetown		15-20	к				
			Renault		10	L				
						Aux Vases Sandstone			85–115	М
		Ste. Genevieve Limestone			30-65	N				
	VALMEYERAN	St. Louis			80–100	0				
	VALME	Salem			+200	Ρ				

A Clay with sand and gravel Silt loam, gray-brown to gray with sand and minor amounts of gravel mainly confined to stream valleys. Alluvium mainly clay and silt from eroded loess and Pleistocene lake deposits. The sand and gravel in the Mississippi River valley is interbedded with silts and clays.

B Glen Dean Limestone, limestone and shale Light to medium gray, crinoidal grainstone, oolitic and finely cross bedded limestone in upper part. Dark gray calcareous shale and argillaceous limestone in lower part. The lower portion of this unit is poorly exposed but probably is conformable with the underlying unit.

C Hardinsburg, siltstone and claystone Dark gray siltstone with black carbonaceous plant debris at the top that grades into a gray calcareous siltstone. A red claystone with light gray mottles occurs near the base.

D Haney Limestone, limestone, and shale Medium to light gray, lime mudstone with interbedded calcareous shales and crinoidal grainstone. Limestones may have a few dark gray chert lenses. Fossils are composed of brachiopods, crinoids, blastoids, and bryozoans. Shales are dark gray commonly fossiliferous and calcareous. The contact with the underlying unit is gradational.

E Fraileys Shale, shale, claystone, and limestone Shale is dark gray to red and calcareous. Claystones are red and green with small rootlets. Limestone is thin layers and interbedded with the shale. A dark gray laminated claystone to siltstone is present near the base of the unit. The contact with the lower unit is undulatory.

F Beech Creek Limestone, Limestone and shale Light gray coarsely fossiliferous packstone to grainstone. Portion of the limestone is oolitic. Brachiopods and echinoderm fragments are common in both limestone and shale. The lower portion grades into fossiliferous shale that grades into the underlying siltstone.

G Cypress Formation, siltstone, claystone, sandstone, limestone. Siltstone at top is medium to dark gray and calcareous. Several small disarticulate brachiopods observed along with plant debris. Argillaceous limestone or calcareous siltstone is present in the upper portion of the unit. Sandstone is greenish gray, very fine grained, non calcareous and thinly bedded to laminated. Desiccation cracks are present and the unit is bioturbated. This sand is interbedded with red-brown shale which probably represents tidal couplets. This unit grades into a green gray non calcareous claystone with red mottles. The unit is unconformable with the underlying unit.

H Ridenhower Formation, limestone, claystone, siltstone, **sandstone** Red, light green-gray, claystones at the top which is probably a paleosol. The lower part is composed of interbedded limestone, siltstone, and claystone. The limestone is light gray and the claystone is dark gray. The siltstone near the base is calcareous and contains marine fossils and carbonaceous plant debris. A very fine grained tan sandstone is present lower in the section. The base contains a claystone and siltstone interval with carbonaceous plant debris. The unit rests on a thick paleosol.

I Bethel Sandstone, claystone, siltstone, sandstone Claystone at the top is over 30 feet thick in places with paleosol development. The claystone is non-calcareous but fractures in the red clay are replaced with calcite. This red clay grades into a blue gray siltstone to claystone. The lower portion of the unit contains a white to light gray fine to medium grained sandstone which is cemented with calcite. Small green fragments in the sandstone appear to be chlorite. The unit appears to be gradational with the underlying limestone.

J Downeys Bluff Limestone, limestone, sandy limestone, **siltstone** The limestone is light gray and peloidal to oolitic. The upper limestone is sandy with interbedded thin green siltstones. The unconformable with the underlying unit.

K Yankeetown Formation, siltstone, limestone, sandstone, **chert** The sandstone is white, light gray, red, yellow to orange, fine to very fine grained, and cemented with calcite. Thin bedded cherts are composed of silicified silt to fine quartz sand that has been altered by weathering. Chert is present in outcrops but may not be present in unweathered sections or core. This unit displays numerous types of primary sedimentary structures i.e. current ripples, linguloid ripples, ladder-back ripples, wave ripples, load structures, and tool marks. The siltstone is gray-green and red and bioturbated. Very thin limestone lens are present lower which grade into the lower unit.

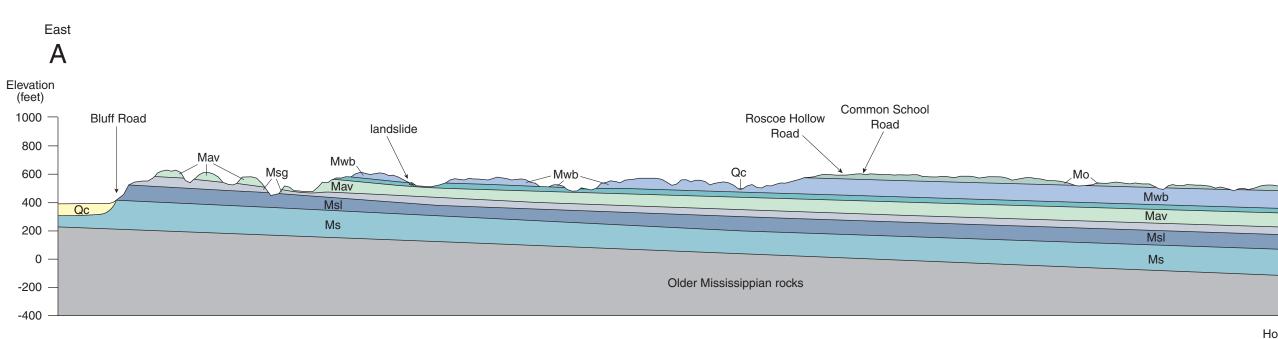
genus Pentremites.

and portions are calcareous.

ottumwa being characteristic (Willman, 1975).

as breccia is present that contains limestone with what appears to be angular clasts in a micritic limestone matrix is common in this unit.

banded, and nodular.



Oil and Gas

lower 4 feet is a grainstone to packstone with orange pelmatozoan fragments which grades into a green and black siltstone. The unit is

L Renault Limestone, limestone and siltstone White to light gray, bioclastic grainstone, dark gray wackestone interbedded with gray to greenish gray siltstone. Commonly a crinoidal wackestone to packstone. Onychocrinus sp. preserved as a whole articulated crinoid has been found within the shaly zones of this unit. The limestone is dense in certain beds and may contain numerous blastoids of the

M Aux Vases Formation, sandstone, siltstone, limestone breccia Gray to green siltstone present at the top of the unit grading into a red and brown siltstone to claystone, with some black carbonaceous material, soil structure, and portions of the unit are rooted This grades into a light gray, calcareous, and fine grained to very fine grained friable sandstone. The sandstone is fairly clean quartz sand at top, and grades lower into a gray sandstone with slightly higher clay content. A sandstone with small clasts of limestone is present near the middle of the unit. This conglomerate is about 5 feet thick and lies on top of a gray to red siltstone which exhibits desiccation cracks. This is underlain by thinly bedded sandstone and siltstone with green clay rip up clasts. Bioturbation is common in the lower portion of the unit

N Ste. Genevieve Limestone, limestone, sandy limestone, chert Light gray, oolitic limestone and crinoidal grainstone, thick bedded. Some parts of the section are argillaceous and may be dolomitic in places. Stylolites and shale partings and sandy limestone layers are present locally. Sandy limestone layers some of which show cross bedding. Chert is generally gray to red. Usually fossiliferous with the crinoids *Platycrinites penicillus* and the brachiopod *Pugnoides*

O St. Louis Limestone, limestone, sandy limestone, chert Light to medium gray crystalline to limestone and dolomitic limestone. Portions are micritic to wackestones, sandy, and oolitic to peloidal. Cherts are light to dark gray. Horn corals and the colonial coral Acrocyathus floriformis are locally present. A texture that is described

P Salem Limestone, limestone, dolomitic limestone, shale, and chert Tan-brown to gray limestone and dolomitic limestone with occasional shale partings. The beds range from several inches to a few feet thick. Texturally, the unit is dominated by some ooids and microfossils (foraminifera) and fossil fragments, predominantly disarticulated echinoderms and fenestrate bryozoans, which are abraded into a fossil hash. Cross beds are common. The shales are gray and usually less than two feet thick. Chert is white to light gray,

> Sun Oi Structure test TD 305 ft St. Leo Church Road _____ Horizontal scale: 1inch = 2,000 feet Vertical scale: 1 inch = 666 feet Vertical exaggeration: 3 times

offers a potential source of limestone for construction purposes. In this area, the Hardinsburg Sandstone, which typically separates the Glen Dean and Haney Limestone, is not well developed. In the southeastern portion of the quadrangle and to the east this unit is a potential source of aggregate.

Three oil wells have been drilled in the Prairie du Rocher Quadrangle. All of hese wells were drilled to the Kimmswick and were dry and abandoned. A water well (32-T5S-R8W) was reported to produce oil. The land owner of the well reported to the Illinois State Geological Survey (ISGS) in 1966 that his water well was producing oil. Wayne Meents, an ISGS geologist, was dispatched to investigate. The water well was completed in the Ste. Genevieve Limestone. A synopsis of the report indicates the water well was drilled to a depth of 378 feet and produced a show of oil, which the driller cased off. In September of 1966, the pump lowered the water level and a slug of petroleum was pumped through the washing machine and faucets of the house. Mr. Meents directed the well to be pumped for 15 minutes which produced 75 gallons of water and many small globules of oil.

Oil was discovered while drilling a water well in the 1920s, about 10 miles to the north of the Prairie du Rocher Quadrangle, in the Waterloo Quadrangle. The field was abandoned in 1930, revived in 1939 and converted to gas storage in 1951 (Schwalb, 1968). Initial production of the wells was 75 to 125 barrels per day quickly decreasing to 25 to 50 barrels per day. Structure contours on the top of the Kimmswick in the Waterloo area reveals at least 300 feet of closure (Bristol and Bushbach, 1973). Over 405,000 barrels of oil have been produced from this structure, all from the Ordovician Kimmswick Limestone (Nelson, 1995). This structure strikes N20⁰ to N25⁰ degrees west and the projection of this structure to the southeast would intersect the Prairie du Rocher Quadrangle just east of the community of Prairie du Rocher. The depth to the Kimmswick "Trenton" in the Prairie du Rocher area is less than 1500 feet, making this a very interesting petroleum prospect. Two outcrops were observed striking nearly north-south with beds dipping 10 to 15 degrees to the west, similar to the trend of the Waterloo Structure. These outcrops were observed at slightly more than 1 mile east of Prairie du Rocher and may be the southern extension of the Waterloo-Dupo Anticline. The nearest oil test to this feature is over 2 miles to the northeast. Structure contours on the top of both the Aux Vases Sandstone and the Ste. Genevieve Limestone show regional dips to the east and no closure. More data is necessary to determine the petroleum potential of this quadrangle.

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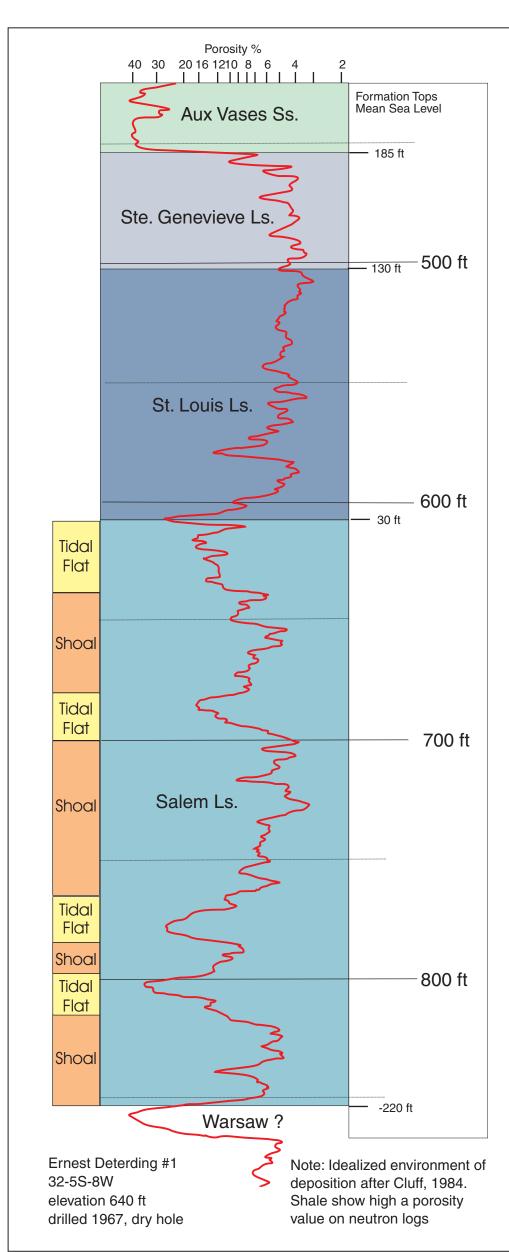


Figure 1 Neutron log of Earnest Deterding #1.

Weller, 1939 Randolph County		Swan, 1963 Southwestern, Illinois		Prairie du Rocher Quad Randolph & Monroe Counties This study	
Okaw Limestone	(<u>Members</u>) Glen Dean Hardinsburg Golconda	Okaw Group	<u>(Formations)</u> Glen Dean Hardinsburg Haney Fraileys Beech Creek	Okaw Formation	<u>(Members)</u> Glen Dean Ls. Haney Ls. Hardinsburg Fraileys Beech Creek Ls.
Ruma		Cypress Sandstone		West	<u>(Members</u>) Cypress Bidenhower
Paint Creek Ls.		Paint Creek Group	<u>(Formations)</u> Ridenhower Bethel Downeys Bluff	Baden Formation	Bethel
					(Members) Downeys Bluff Ls.
Yankeetown Chert		Yankeetown Sandstone		Paoli Formation	Yankeetown
Renault Formation		Renault Limestone			Renault
Aux Vases Ss.		Aux Vases Sandstone		Aux Vases Sandstone	
Ste. Genevieve Ls.		Ste. Genevieve Ls.		Ste. Genevieve Ls.	
St. Louis Ls.		* Not part of Study*		St. Louis Ls.	
Salem Ls.		* Not part of Study*		Salem Ls.	