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Plum River Fault Zone of Northwestern Illinois

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PLUM RIVER FAULT ZONE OF NORTHWESTERN ILLINOIS

Dennis R. Kolata and T. C. Buschbach

ABSTRACT

The Plum River Fault Zone extends westward from Leaf River, Illinois, across Ogle and Carroll Counties to an area south of Maquoketa, Jackson County, Iowa. Field observations, well records, cores, and refraction seismic data from Illinois indicate that the fault zone is generally less than half a mile wide, with strata downthrown 100 to 400 feet on the north. The faulting occurred after Niagaran (middle Silurian) time and before mid-Illinoian (Pleistocene) time. Four minor structural features adjacent to the Plum River Fault Zone are herein named; they are the Forreston Dome, the Brookville Dome, the Leaf River Anticline, and the Uptons Cave Syncline.

INTRODUCTION

Geologic studies of proposed sites for nuclear power plants and underground gas storage projects in northwestern Illinois have furnished new information about the structural geology of the area and have shown the need for detailed understanding of the structural setting. This investigation was undertaken to determine the nature and extent of known faulting near Savanna, Carroll County, Illinois. Although previous investigators have attributed the anomalous elevations of Ordovician and Silurian bedrock in central Carroll and western Ogle Counties largely to an anticline, the Savanna-Sabula Anticline, it now appears that the principal structural anomaly is due to a fault zone, herein identified as the Plum River Fault Zone.

The Plum River Fault Zone, named for exposures along the Plum River valley in Carroll County, Illinois, is a narrow belt of high-angle faults with 100 to 400 feet of vertical displacement. It trends generally east-west approximately 60 miles through northwestern Illinois and east central Iowa (fig. 1). Well data and outcrop patterns indicate that the fault zone extends from north of Leaf River, Ogle County, westward through Savanna, Carroll County, to a point southeast of Maquoketa, Jackson County, Iowa. In those areas where control points are closely spaced, the fault zone is less than half a mile wide. Throughout its length the north side is downthrown.

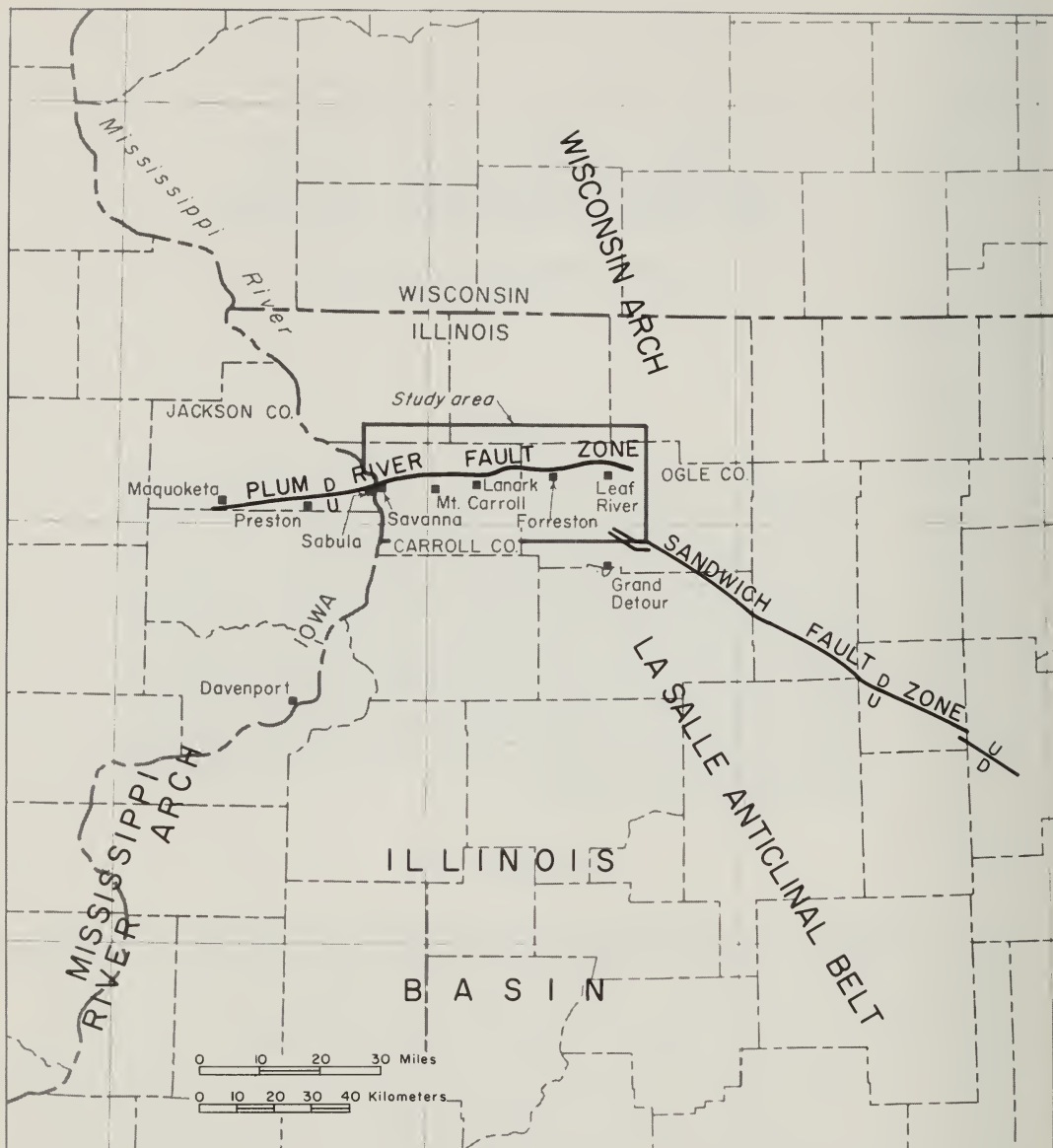


Fig. 1 - Upper Mississippi Valley region showing prominent structural features and location of study area.

The basic data utilized in this study were obtained from field observations, well records, cores, and a limited amount of refraction seismic information. The well records consist of drillers' descriptions and Illinois State Geological Survey sample studies. Although an attempt was made to determine the full extent of the Plum River Fault Zone, only the part in Illinois was studied and mapped in detail. The study area includes most of Carroll County and western Ogle County.

Previous Studies

The earliest report of geologic structure in the study area was made by Worthen (1866, p. 5), who briefly described the northern extension of what later became known as the La Salle Anticlinal Belt. Chamberlin (1882, p. 425-426; pl. 8) was the first to show an east-west axis of flexure in the Savanna, Illinois, area; however, he provided little discussion of the structure. McGee (1891, p. 342) noted the high altitude of Trenton limestone between Sabula, Iowa, and Grand Detour, Illinois. He named this structural anomaly "Maquoketa Anticlinal" and indicated that its axis trended northwest from Grand Detour into northeastern Iowa.

Hershey (1894, p. 176) studied exposures of the St. Peter Sandstone in the Elkhorn Creek area of Carroll and Ogle Counties and attributed the high altitude of the St. Peter Sandstone to the intersection of two east-west anticlines with his "Grand Detour-La Salle Anticline." Later Hershey (1897, p. 254) presented a north-south cross section from Elkhorn Creek to the Leaf River area showing the Ordovician and Silurian bedrock surface with a structural high in the Elkhorn Creek area. This structure was later named the Brookville Uplift by Templeton and Willman (1952, p. 8).

Savage (1905, p. 640-641) described a "low arch" extending westward for a distance of 20 miles, from Savanna into Iowa. He examined outcrops of Maquoketa and Silurian rocks and noted that equivalent strata were 90 to 115 feet higher on the south side of the structure than on the north.

Carman (1910, p. 11), in his study of the Mississippi Valley between Savanna, Illinois, and Davenport, Iowa, discussed the low east-west anticline passing through Savanna and showed the nature of the bedrock in a cross section along the Mississippi Valley from north of Savanna to the Rock River. Cady (1920, p. 130) summarized the literature on this structure and applied the name "Savanna-Sabula anticline," stating, "The chief flexure crossing northern Illinois transverse to the direction of the La Salle Anticline is the deformation the westward extension of which crosses into Iowa at Sabula." Cady (1920, p. 132) also introduced the name "Stephenson and Ogle county line syncline" for the "syncline extending parallel to the Savanna-Sabula anticline and north of it along the line between Stephenson and Ogle Counties."

Weller (1935, p. 49, fig. 32) applied the name "Preston-Savanna-Mt. Carroll Anticline" to the Savanna-Sabula Anticline and properly noted that "no detailed work has been done on it and the exact nature of the structure has not been determined." Horberg (1950, p. 94) provided a structure map of northern Illinois, with contours for the top of the Galena, that shows the Savanna-Sabula Anticline as a prominent east-west structure extending from western Ogle County through the center of Carroll County into Iowa. On the Tectonic Map of the United States, Cohee et al. (1962) shortened the name to Savanna Anticline and showed the structure extending in an arcuate pattern from Preston, Iowa, to near Byron, Illinois. The fact that the Savanna structure is in part due to faulting was first recognized by Willman and others (1967). They show an east-west fault north of Savanna that extends for about 4 miles east of the Mississippi River.

Acknowledgments

Paul C. Heigold, Illinois State Geological Survey, furnished the seismographic information for this study. Henry E. Scoggin, Illinois State Geological Survey, supervised the core-drilling operation.

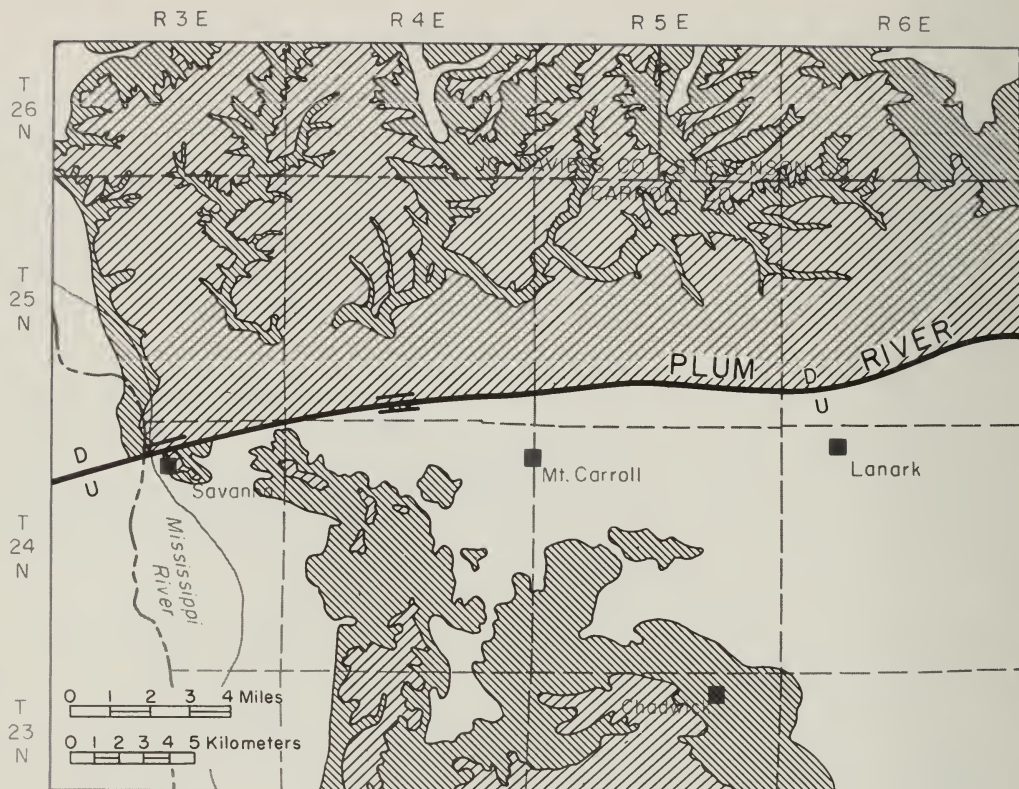
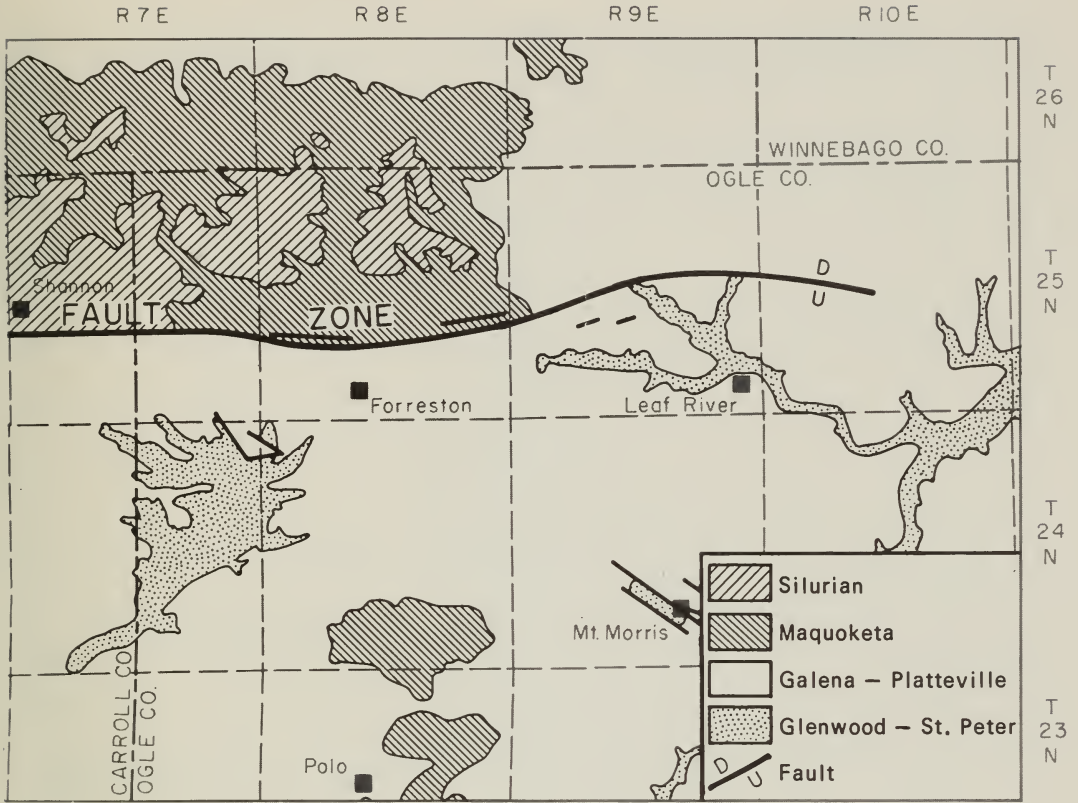


Fig. 2 - Geologic map of parts of Carroll County and of western Ogle County, Illinois.

GEOLOGIC SETTING

The study area is located on the southwest flank of the broad, gently sloping Wisconsin Arch (fig. 1). The La Salle Anticlinal Belt and the Mississippi River Arch gradually diminish and are not significant structural features in this area. There is no evidence that the Plum River and Sandwich Fault Zones are connected (Willman and Payne, 1942, p. 186), although both structures are formed chiefly by relative uplift to the south. The Paleozoic strata have a regional dip of 20 to 30 feet per mile to the southwest, except where affected by local structure.

The bedrock formations exposed at the surface in the study area (fig. 2) range in age from Champlainian (middle Ordovician) to Niagaran (middle Silurian) and consist of dolomite, limestone, shale, and sandstone. Silurian strata formerly were present throughout the area, but as a result of extensive erosion are confined largely to the higher hills in northern Carroll County and northwestern Ogle County. Silurian bedrock, however, is present in southern Carroll County and farther south in Whiteside County as a result of the regional dip to the southwest. The Plum River Fault Zone forms a sharp linear boundary between the down-thrown Silurian bedrock on the north and the upthrown Ordovician bedrock on the south (fig. 2). Borings indicate that approximately 2,000 feet of Croixan (late Cambrian) strata underlie the Ordovician and rest unconformably on Precambrian crystalline rocks. There are many outcrops of bedrock near the Plum River Fault



Ogle County (modified from Willman and others, 1967).

Zone in the Mississippi River bluffs and along Plum River and Carroll Creek, but elsewhere exposures are scattered, largely in quarries and roadcuts.

Unconsolidated surficial deposits of glacial drift, loess, and alluvium overlie the bedrock in most places. These deposits are as much as 200 feet thick but more commonly are less than 50 feet thick. The surface of the region is characterized by moderate to high relief. There are sharply entrenched valleys and flat bottomlands in the major tributaries. Steep bluffs with as much as 200 feet of relief occur along the Mississippi River and its tributaries.

STRATIGRAPHY

The generalized columnar section (fig. 3) shows the bedrock stratigraphy of the study area. The stratigraphic nomenclature used here is after Templeton and Willman (1963) and Willman (1973); these two studies also provide detailed descriptions of key outcrops of Ordovician and Silurian rocks in northwestern Illinois. Discussions of stratigraphic units useful in structural interpretation of the study area are given in Willman and Reynolds (1947) and Bevan (1926).

A composite stratigraphic section measuring approximately 600 feet is exposed in the area. The youngest bedrock unit exposed is the Niagaran Racine Formation and the oldest is the Champlainian St. Peter Sandstone.



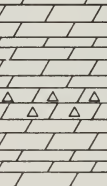
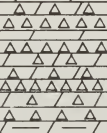



SYS-TEM	SERIES	GROUP	FORMATION Thickness, ft	LITHOLOGY	DESCRIPTION
SILURIAN	NIAGARAN		Racine 300		Dolomite, pure, gray, thin-bedded to massive; local reef structures; local areas of brownish gray, argillaceous dolomite.
			Marcus 35-45		Dolomite, very pure, buff, vesicular, massive; contains <i>Pentamerus</i> in great abundance in lower 5-15 ft.
			Sweeney 45-55		Dolomite, pure, pinkish gray; in thin wavy beds with green shale partings; corals abundant; 3-5 ft cherty zone near middle contains <i>Microcardinalia</i> and <i>Pentamerus</i> .
	ALEXANDRIAN		Blanding 25-35		Dolomite, pure, brownish gray; contains many layers of white chert; silicified corals abundant; lower 3-5 ft slightly argillaceous.
			Mosalem 6-60		Dolomite, gray, cherty, medium-bedded; lower part is very argillaceous dolomite grading to dolomitic shale at base.
			CINCINNATIAN	Maquoketa	Brainard 0-50
Fort Atkinson 0-10		Dolomite, yellowish gray, fine-grained, argillaceous, thin-bedded; interbedded with greenish gray shale.			
Scales 125		Shale, gray, dolomitic; conchoidal fractures; <i>Isotelus</i> common in upper part; dark brown, carbonaceous, laminated shale in lower 15 ft; one or two beds of brown argillaceous dolomite at base containing depauperate fauna, pyrite, and phosphatic pebbles.			

Fig. 3 - Stratigraphic column from base of Champlainian (middle Ordovician) (Silurian section modified from

SYS-TEM	SERIES	GROUP	FORMATION Thickness, ft	LITHOLOGY	DESCRIPTION	
ORDOVICIAN	CHAMPLAINIAN	Galena	Dubuque 30-45		Dolomite, argillaceous, light gray to buff, fine- to medium-grained, thin- to medium-bedded; brown shale partings.	
			Wise Lake 70-80		Dolomite, pure, light gray to buff, medium-grained, thick-bedded to massive; abundant molluscan fauna; <i>Receptaculites</i> abundant near middle.	
			Dunleith 130		Dolomite, gray to buff, medium-grained, thin- to thick-bedded; white to dark gray chalky and vitreous chert, particularly in upper part; <i>Receptaculites</i> abundant. Lower part argillaceous, sandy, fossiliferous, with green shale partings.	
			Guttenberg 2-15		Dolomite and limestone, argillaceous, gray to brown, fine- to medium-grained, thin-bedded; reddish brown shale partings; abundant and diverse fauna.	
		Platteville	Quimby's Mill 12		Dolomite, slightly argillaceous, light gray to buff, fine-grained, thin- to medium-bedded.	
			Nachusa 20		Dolomite, pure, light gray to buff, thick-bedded, medium-grained, vuggy, fucoidal; white to light gray chert.	
			Grand Detour 15-45		Dolomite and limestone, light gray to buff, thin- to medium-bedded, fine-grained; reddish brown shale partings; fossiliferous.	
			Mifflin 15-25		Dolomite and limestone, argillaceous, light gray to buff, thin-bedded, fine-grained; greenish gray to blue-gray shale partings; fossiliferous.	
			Pecatonica 20-30		Dolomite and limestone, light gray to buff, thin- to medium-bedded, fine-grained; brownish gray shale partings; corrosion surface at top; well-rounded sand grains in lower part.	
			Ancestral	Glenwood 5-20		Shale, sandstone, and dolomite, greenish gray; poorly sorted, fine- to coarse-grained sand.
				St. Peter 50-200		Sandstone, white, fine-grained, well-rounded, well-sorted, friable, thick-bedded to massive.

to top of Niagara (middle Silurian) in Carroll and Ogle Counties.
Willman, 1973, p. 28.)

An attempt was made to locate lithologically and faunally distinct beds, the tops of which could be used as structural horizons from which to construct a structure map of the study area. The top of the Glenwood Formation was selected as the structure map datum because the Glenwood is widespread and many datum points are available. Also, the silty and sandy gray-green shale at the top of the Glenwood provides a sharp break in lithology from the limestone or dolomite of the overlying Platteville Group. Other structural horizons were identified and were used with isopach maps of the Maquoketa, Galena, and Platteville in order to estimate Glenwood tops.

Some of the more useful structural horizons include the top of the fine-grained, buff to gray Platteville Group; the top of the Guttenberg, distinguished by red-brown shale partings; and the top of the Dunleith Formation, which is the top of the cherty dolomite in the Galena Group. The sharp lithologic break between dolomite of the Galena Group and shale of the overlying Maquoketa Group also provides an excellent structural horizon. This contact is well marked both in outcrop and drilling samples by pyrite, phosphatic pebbles, and small molluscan fossils (depauperate fauna) that occur in the basal Maquoketa beds.

The contact between the Maquoketa Shale Group and overlying buff dolomite of the Alexandrian (lower Silurian) Mosalem Formation is sharp at most localities. It is an erosional surface with relief probably exceeding 50 feet in places. The superjacent Blanding Formation consists of dolomite with numerous layers of white chert that is quite distinct both in outcrop and in drilling samples. The overlying Sweeney Formation is characterized by thin, wavy beds of dolomite with green clay partings and numerous fossil corals. The base of the overlying Marcus Formation is well marked by 5 to 15 feet of fossiliferous dolomite containing a great abundance of fossil brachiopods, *Pentamerus oblongus*. In addition, the Marcus is characterized by pure, vesicular, massive beds of dolomite.

STRUCTURAL MAPPING

The structure map of northern Carroll County and northwestern Ogle County (fig. 4) was drawn using the top of the Glenwood Formation as a datum. Datum points were plotted on a computer-constructed base map (ILLIMAP, see Swann et al., 1970) and contoured at 50-foot intervals. Datum points were obtained from drill holes (largely water wells) in which the depth to the Glenwood is known; from outcrops and water wells that contain distinctive beds whose stratigraphic position and distance above the Glenwood are known; and from outcrops that show the Platteville-Glenwood contact.

The most reliable information was obtained from cores cut in densely spaced exploratory borings drilled in investigations of proposed sites for nuclear power plants and for underground gas storage projects. Reliable data were also obtained from examination of drilling chips acquired from municipal and farm wells. Many of the datum points were determined from outcrops. Some drillers' logs were used.

PLUM RIVER FAULT ZONE

Outcrop and subsurface information strongly suggests that faulting, the Plum River Fault Zone, is primarily responsible for the structural anomaly that

trends east-west through Carroll and western Ogle Counties. There are strong indications that the faulting continues westward across the Mississippi River and extends as far as Maquoketa, Iowa. Although no single outcrop shows the total displacement, stratigraphic and structural relationships indicate the presence of a narrow zone of fractures that is less than half a mile wide.

During this study we found relatively flat-lying rocks close to the fault zone, and throughout Carroll County the Maquoketa Shale Group was present along the fault zone only in narrow strips, apparently fault blocks, a few tens of feet across. There are not enough data to rule out the possibility that the displacements of 100 to 400 feet are partly the result of a sharp flexure in this zone. Nevertheless, apparent dips plotted from subsurface data and measured dips from nearby outcrops and quarries suggest that the displacement is principally the result of faulting and that along its entire length the structure is best interpreted as a narrow fault zone.

The best field evidence for faulting can be seen in the bluffs and ravines in the unglaciated region between Savanna and Mt. Carroll. A displacement of 100 to 150 feet can be detected in the Mississippi River bluffs on the north side of Savanna (NE $\frac{1}{4}$ NE $\frac{1}{4}$ SE $\frac{1}{4}$ Sec. 4, and SW $\frac{1}{4}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$ Sec. 3, T. 24 N., R. 3 E.). Thin-bedded, argillaceous strata of the Mosalem Formation are exposed in a roadcut on the east side of Ridge Road across from the parking lot of the Savanna Hospital. In places the beds are broken by numerous small joints, but generally they are flat-lying at an elevation of approximately 800 feet. Massive beds of the lower part of the Marcus Formation, which contain numerous pentamerid brachiopods, crop out 600 feet west of Ridge Road in the descending bluffs behind the hospital. Here, too, the beds are broken by small joints, but are generally flat-lying at an elevation of approximately 770 feet. Strata at this point appear to be on trend with equivalent strata in the bluff 400 feet to the northwest on the north side of Calhoun Street. In this area the Marcus generally occurs about 80 to 90 feet above the top of the Mosalem; thus it appears that the fault zone strikes northeast-southwest between the hospital and the Ridge Road outcrop with the displacement of Mosalem (upthrown) against Marcus (downthrown). The presence of faulting is further supported by the fact that the nearby Savanna city water well no. 5, located 800 feet south of the toll bridge on the west side of State Route 84, encountered a stratigraphic section that is about 200 feet lower than an equivalent section in the Times Theatre water well located 3,000 feet to the south (fig. 5).

The fault zone crosses the north edge of the Plum River valley in Sec. 2, T. 24 N., R. 3 E. Massive blocks of Silurian Niagaran dolomite (Marcus Formation or higher) are exposed in the south-facing bluffs at an elevation of 650 feet. The strata are highly brecciated, and the attitude of bedding is difficult to determine. The strata also contain striations formed apparently by pressure solution. The linear topographic expression suggests that the base of the bluffs lies along the strike of faulting. Flat-lying beds of the Dubuque Formation (Galena Group) occur 3,000 feet to the south under the Plum River bridge on State Route 64 at an elevation of 610 feet.

Beds of brecciated Niagaran dolomite occur at an elevation of 680 feet in a hill near the center of the southern edge of Sec. 36, T. 25 N., R. 3 E. These beds dip approximately 12° to the south. Large jumbled blocks of the Galena Dolomite Group containing *Receptaculites* occur at an elevation of 620 feet in a stream bed less than 300 feet to the southwest in Sec. 1, T. 24 N., R. 3 E. Galena strata (flat-lying) also occur in the same hill (NE $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ Sec. 31, T. 25 N., R. 4 E.) 4,000 feet east of the Niagaran exposure at an elevation of 640 feet; this occurrence suggests that the two units are in juxtaposition.

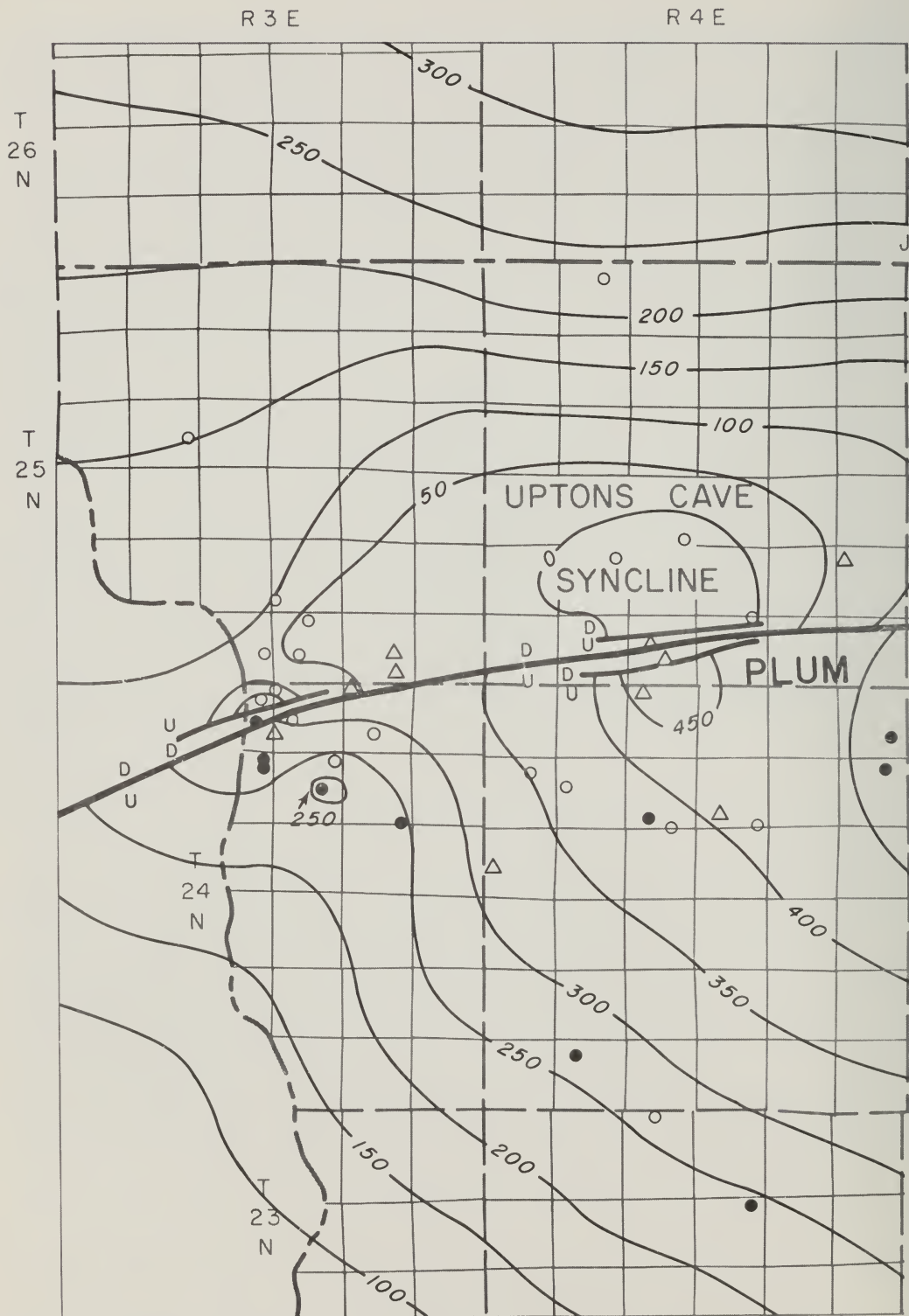
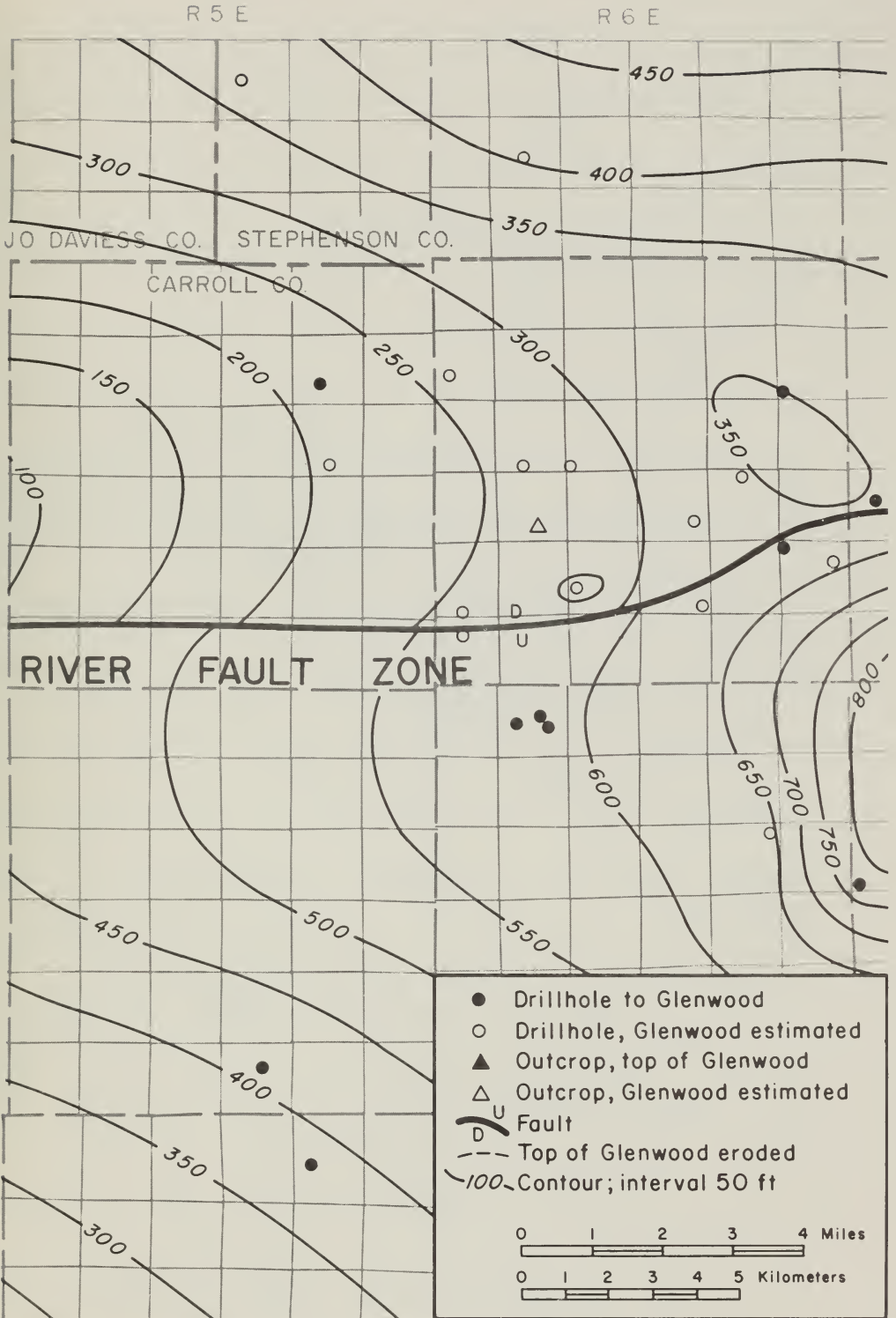


Fig. 4 - Structure of top of the Glenwood Formation in parts of Carroll County
 Glenwood was estimated from shallower horizons.



and in western Ogle County. In some drillholes and outcrops, the top of the (Figure continued on pages 12 and 13.)

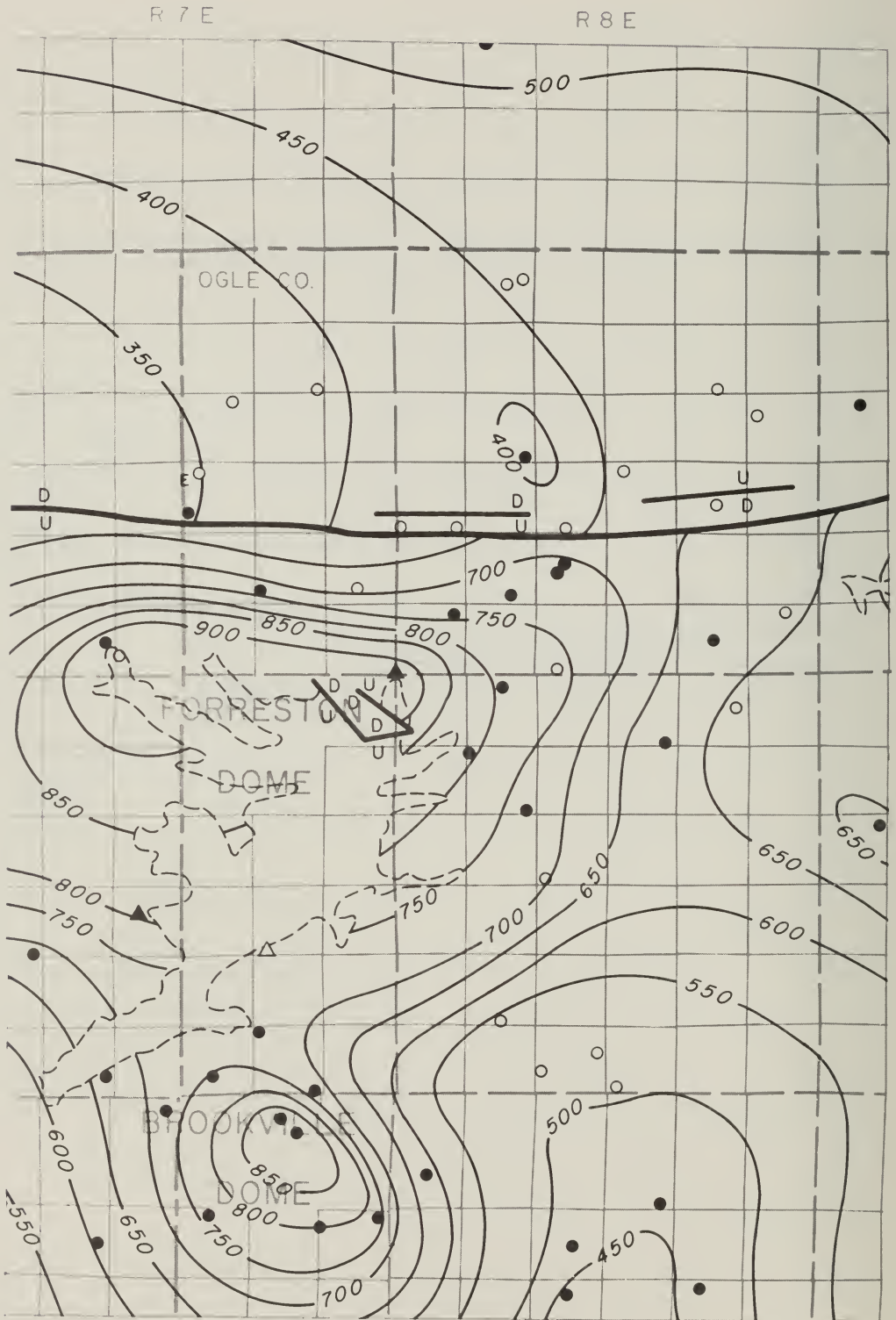
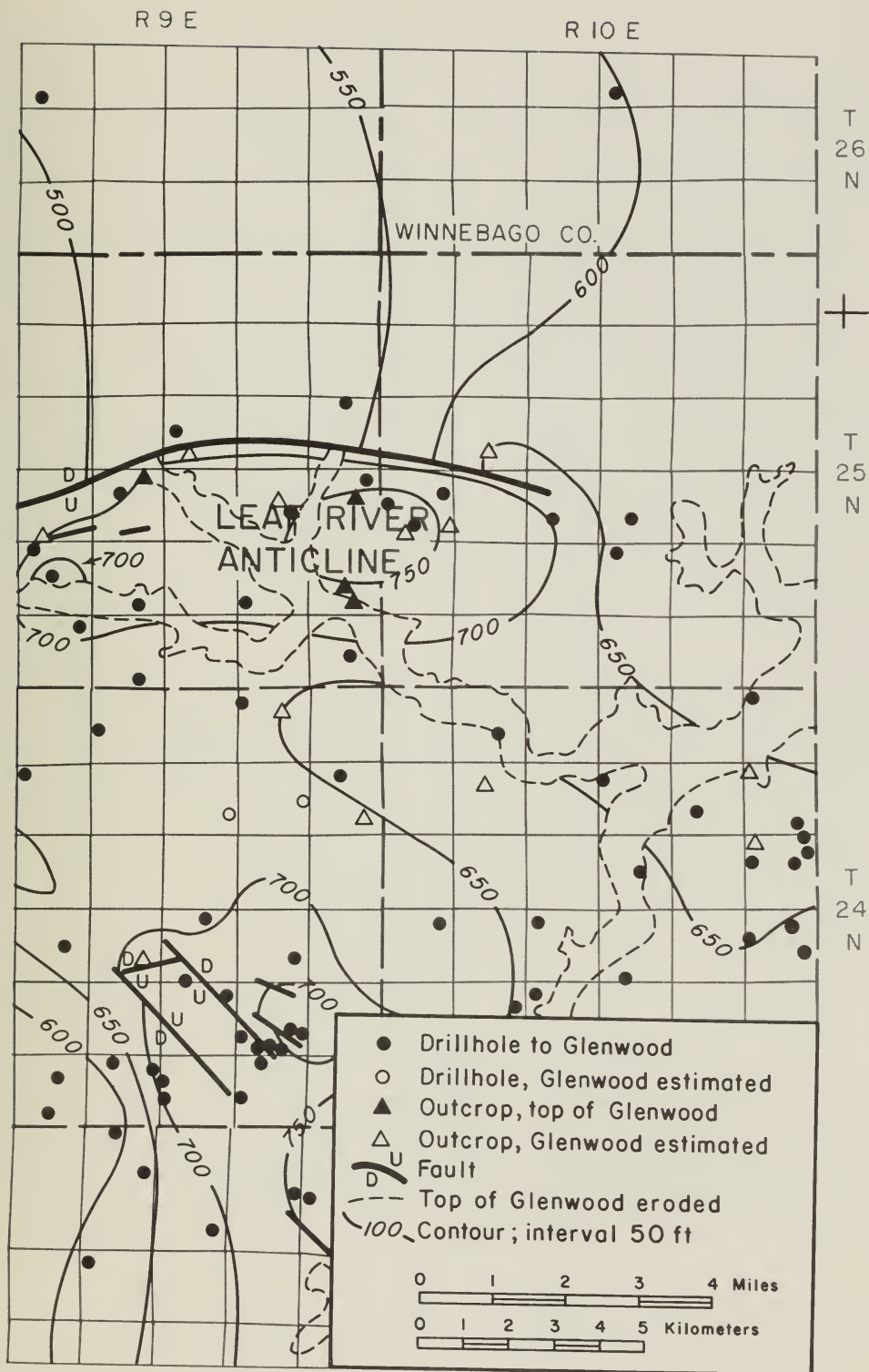


Fig. 4 (continued from pages 10 and 11) - Structure of top of the Glenwood Formation and outcrops, the top of the Glenwood



in parts of Carroll County and in western Ogle County. In some drillholes was estimated from shallower horizons.

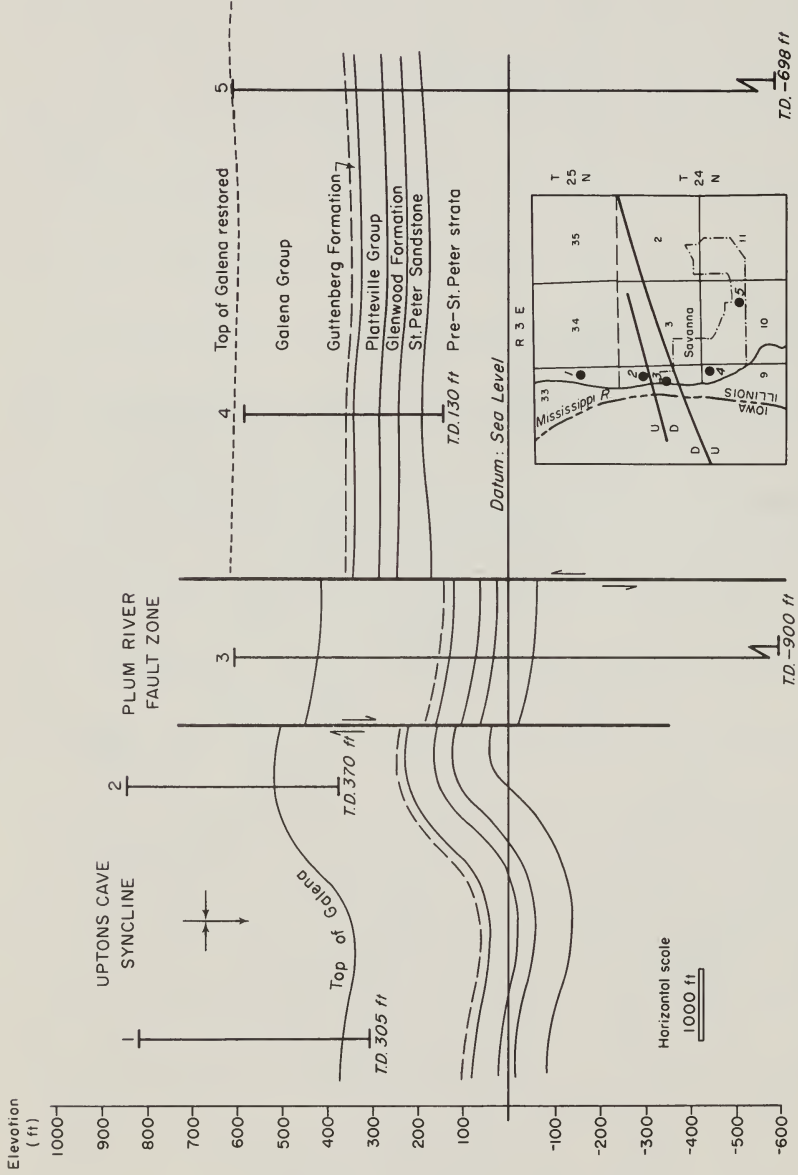


Fig. 5 - Structural cross section showing stratigraphic relationships in Savanna, Illinois. Interpretation is based on sample studies of five water wells (shown on inset map): 1-Mississippi Palisades State Park well no. 2, NE-NE-SE 33-25N-3E; 2-Stransky farm well, SE-NE-NE 4-24N-3E; 3-Savanna city well no. 5, NW-NE-SE 4-24N-3E; 4-Times Theatre well, SE-NE-NE 9-24N-3E; 5-Savanna city well no. 4, SE-SW-NE 10-24N-3E.

Further evidence of displacement can be observed in the ravines and bluffs facing the Plum River valley in Sec. 33, T. 25 N., R. 4 E. Massive, vuggy, flat-lying beds of the Marcus and Racine Formations are exposed beginning at the base of the bluff (elevation 640 feet) in the $SE\frac{1}{4}SE\frac{1}{4}NW\frac{1}{4}$ Sec. 33. Approximately 1,000 feet southeast of the Silurian exposures, near the head of a deep ravine ($SW\frac{1}{4}NW\frac{1}{4}SE\frac{1}{4}$ Sec. 33), flat-lying shale of the Maquoketa Group containing *Isotelus* fragments crops out at an elevation of 720 feet. Although no faults can be observed between the two outcrops, Silurian strata appear to be downthrown about 250 feet. An additional fault apparently exists between the Maquoketa Shale Group and exposures of cherty, flat-lying dolomite of the Galena Group (Dunleith Formation) that are present 3,000 feet south in the bluffs along Carroll Creek in the northern half of Sec. 4, T. 24 N., R. 4 E.

Similar stratigraphic relationships can be observed a mile and a half east in the stream valley that crosses Sec. 34, T. 25 N., R. 4 E. Flat-lying beds of the Sweeney Formation crop out at an elevation of 760 feet in a north-south-trending ravine in the $SE\frac{1}{4}NE\frac{1}{4}NE\frac{1}{4}$ Sec. 34. The Maquoketa Shale Group is exposed approximately 500 feet south of the Sweeney outcrop, along the banks of a small stream at an elevation of 750 feet; the attitude of bedding, however, could not be determined. Thin-bedded, flat-lying Galena strata crop out at an elevation of 740 feet in the $SW\frac{1}{4}SE\frac{1}{4}NE\frac{1}{4}$ Sec. 34 and are intermittently exposed along the banks of the main east-west-trending stream. It appears that at least two faults cross the northern half of Sec. 34, with a total displacement of more than 300 feet.

Refraction Seismography

A refraction seismograph (GEOSPACE 2B 12-channel) equipped with a 600-foot line with 50-foot geophone spacings was used to try to locate anomalies in the bedrock surface and thereby determine the position of the fault zone. The most successful of three attempts by the refraction technique was made along a country road in Secs. 30 and 31, T. 25 N., R. 6 E., northwest of Lanark, Carroll County, Illinois (fig. 6). A continuous north-south line 5,400 feet long was made in nine profiles beginning at a point 3,000 feet south of the north line in Sec. 31, and continuing north to near the center of Sec. 30 (fig. 7). All nine profiles were reversed by shooting at each end of the geophone spread. Upon completion of the seismic program, two holes were drilled, one on each side of the fault zone, as interpreted from the profiles, and bedrock was cored. Thickness and nature of the surficial deposits and age of bedrock were thus determined.

Stratigraphic control was provided by two large quarries located 1,500 feet west of the first shot point ($NE\frac{1}{4}NW\frac{1}{4}SW\frac{1}{4}$ Sec. 31, T. 25 N., R. 6 E.). Approximately 30 feet of flat-lying, massive Wise Lake strata (Galena Group) is exposed on both sides of Straddle Creek at a maximum elevation of 840 feet. Weathered pieces of Silurian dolomite containing specimens of *Pentamerus* were excavated from a ravine along the road in the $SE\frac{1}{4}NE\frac{1}{4}SW\frac{1}{4}$ Sec. 30, T. 25 N., R. 6 E., at an elevation of 870 feet. In addition, 68 feet of noncherty Silurian dolomite was encountered at an elevation of 795 feet in a water well drilled in $NE\frac{1}{4}NW\frac{1}{4}SW\frac{1}{4}$ Sec. 25, T. 25 N., R. 5 E.

In general, the profiles show a layer (probably weathered loess and till) ranging from 16 to 47 feet in thickness with seismic velocities as high as 6,000 feet per second. The underlying bedrock ranges in velocity from 13,500 feet per second to 19,100 feet per second.

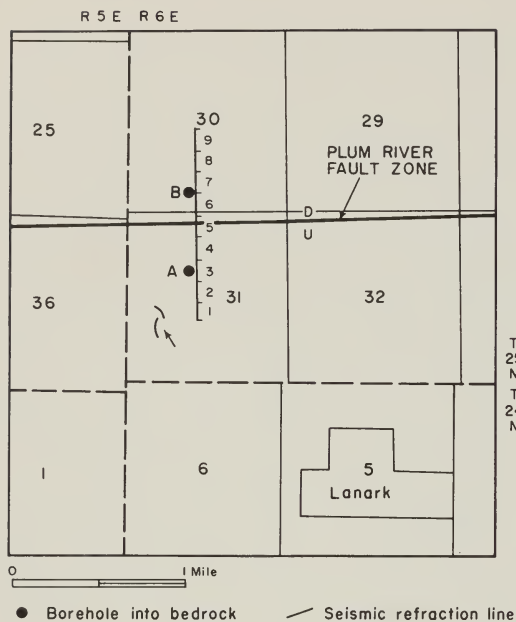


Fig. 6 - Map showing location of seismic refraction transect (profiles 1-9) and boreholes (A and B) northwest of Lanark, Illinois. Arrow shows location of quarries in flat-lying Wise Lake strata (Galena Group) along Straddle Creek. (See geologic cross section in fig. 7.)

An apparent anomaly in the bedrock was encountered along the fifth profile within a distance of 600 feet south of the north line of Sec. 31. In shooting from south to north, there is evidence of a velocity inversion; that is, immediately below the soil layer a velocity of 18,513 feet per second is encountered, but farther out on the time-distance plot a velocity of 9,459 feet per second persists. Conversely, the north to south shooting indicates a velocity of 7,909 feet per second directly below the shot and 19,020 feet per second away from the shot. It appears that dense carbonate rock underlies the soil at the south end of the fifth profile and that rubble or clastic rock with much lower velocity occurs below the soil at the north end. Approximately 1,400 feet south of the north line of Sec. 31 (near center of third profile), a hole was augered 25 feet to bedrock and a core was cut from the Galena Dolomite Group (probably Wise Lake Formation) at an elevation of 836 feet. A second hole, located 600 feet north of the south line of Sec. 30 (south end of seventh profile), was augered

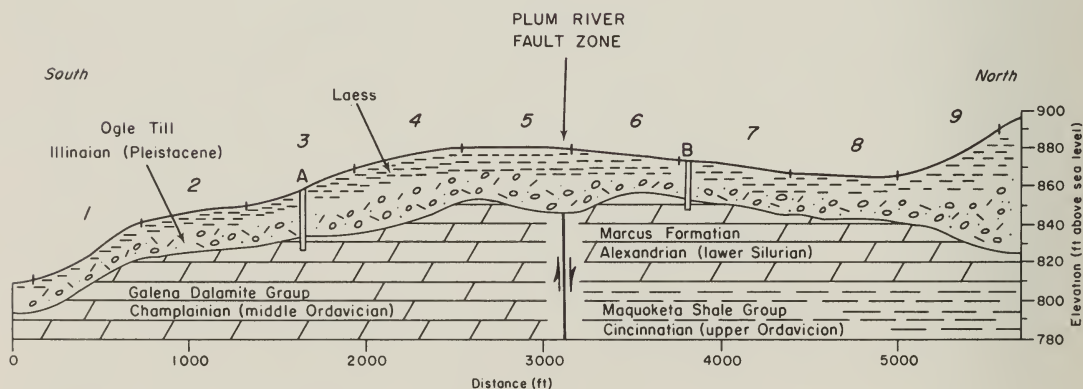


Fig. 7 - Geologic cross section across the Plum River Fault Zone northwest of Lanark, Illinois, from a north-south transect through Secs. 30 and 31, T. 25 N., R. 6 E. Interpretation is based on seismic refraction (profiles 1-9) and boreholes (A and B). (See line of cross section, fig. 6).

20 feet to bedrock and a core was cut from the Silurian Mosalem Formation at an elevation of approximately 850 feet. At both locations about 15 feet of loess and 5 to 10 feet of till were encountered. A displacement of 250 to 300 feet is indicated from stratigraphic relationships within the area, and it is suspected that the fault zone crosses the seismic refraction transect at the fifth profile (fig. 7).

It does not seem likely that at this locality the structural anomaly is due to strata dipping to the north between the two holes. A dip of 10° , for example, would require a truncated strip of the Maquoketa Shale Group more than 1,000 feet wide at the bedrock surface; however, the seismic profiles do not indicate a zone of truncated Maquoketa.

Age of Faulting

Niagaran strata are preserved on the north, or downthrown, side of the Plum River Fault Zone, but for the most part they are eroded from the south side. In close proximity to the faults there are numerous jumbled blocks of Niagaran dolomite. Clearly, the maximum age of observed faulting is post-Niagaran.

Elevations of the top of the bedrock are relatively constant across the fault zone. This flat bedrock surface indicates that, after the south side was uplifted 100 to 400 feet relative to the north side, erosion leveled the bedrock surface, leaving little evidence of a scarp. In early Pleistocene time (pre-Kansan glaciation), lowering of the base level and increased runoff resulted in entrenchment of streams, development of mature topography, and topographic adjustment to stratigraphy. During Illinoian time the bedrock was covered with a relatively thin layer of till or loess.

Illinois Geological Survey borings on both sides of the fault zone in Secs. 30 and 31, T. 25 N., R. 6 E., Carroll County, show the bedrock mantled by several feet of glacial till that is overlain by 10 to 15 feet of loess (fig. 7). The till is identified as the Ogle Till Member of the Glasford Formation, which was deposited during the Illinoian Stage (Frye et al., 1969, p. 24) more than 200,000 years ago. No discernible faulting displaces the Pleistocene deposits.

No rocks representing the interval between Niagaran and Pleistocene time are present in the study area; thus, more precise dating of the faulting is not possible. Major movements, however, occurred on the La Salle Anticlinal Belt and probably also on the Mississippi River Arch near the beginning of Pennsylvanian time and again in post-Pennsylvanian time (Payne, 1939, p. 173). It seems likely that the Plum River Fault Zone was formed at the same time as those structural features.

MINOR STRUCTURAL FEATURES

Near the Plum River Fault Zone are a number of smaller structural features (fig. 4). Of particular interest are the anticlinal structures, some of which have been studied as potential gas storage reservoirs.

Forreston Dome and Brookville Dome

The Forreston Dome and the Brookville Dome (new names) are adjacent anticlinal structures located along the boundary between Carroll and Ogle Counties. As revealed on the structure map, the combined domes form one of

the most prominent geologic structures in the study area (fig. 4). The entire structure was previously called the Brookville Uplift (Templeton and Willman, 1952, p. 8); however, subsequent investigations for potential underground gas storage sites in the area have revealed the presence of two distinct domes.

The Forreston Dome is herein named for the city of Forreston, which is located on the northeast flank of the dome. The structure is an east-west elongate dome with 175 feet of closure (fig. 4). It is 10 miles long and 7 miles wide and is located on the upthrown (south) side adjacent to the Plum River Fault Zone in Tps. 24 and 25 N., R. 7 E., Ogle County. Elkhorn Creek and its tributaries have deeply dissected the Forreston Dome, thus exposing rocks as old as the St. Peter Sandstone. Platteville and St. Peter strata are displaced by several relatively small faults in the northeastern part of the dome (Sec. 1, T. 24 N., R. 7 E.).

The Brookville Dome is herein named for the town of Brookville, located 3 miles northwest of the center of the dome. The structure is about 4 miles long and 3 miles wide and has 138 feet of closure (fig. 4). It borders the south side of the Forreston Dome in the northern part of T. 23 N., R. 7 E., Ogle County. Water pumping tests and gas injection were performed here in order to evaluate the potential for a gas storage reservoir in the Cambrian Mt. Simon Sandstone. The project was abandoned because injected gas migrated from the Mt. Simon to porous zones above the caprock (Buschbach and Bond, 1974, p. 67).

Leaf River Anticline

The Leaf River Anticline (new name) is located north of the town of Leaf River, Ogle County, Illinois, in T. 25 N., Rs. 9 and 10 E. It is an east-west-trending structure that is approximately 6 miles long by 2 miles wide and has about 80 feet of closure. It is located near the termination of the Plum River Fault Zone and is probably genetically related to the fault zone. Leaf River, Mud Creek, and Otter Creek dissect the structure and expose rocks as old as St. Peter Sandstone. Small faults with associated breccia, slickensides, green clay gouge, and variously dipping beds occur in Secs. 20 and 21, T. 25 N., R. 9 E., and in Secs. 17 and 20, T. 25 N., R. 10 E.

The Leaf River Anticline was tested as a potential gas storage reservoir (Buschbach and Bond, 1974, p. 68), but the project was abandoned because of leaking caprock.

Uptons Cave Syncline

North of the Plum River Fault Zone, near Savanna, Illinois, is a broad shallow syncline that extends east-west, parallel to the fault zone. The structure is herein named the Uptons Cave Syncline after Uptons Cave, which is located just east of the Mississippi River, in the northeast corner of Sec. 4, T. 24 N., R. 3 E., Carroll County (Savanna 7.5-Minute Quadrangle Map). The syncline is best exposed on State Route 84 along the bluffs of the Mississippi River. Silurian and Ordovician strata dip north from a point near the Savanna-Sabula Toll Bridge to a synclinal axis about 500 feet north of Uptons Cave, then rise gently to the north. The presence of the syncline is also reflected in the subsurface data (fig. 4). It appears to extend eastward through Carroll County and to be continuous with the "Stephenson and Ogle county line syncline" shown by Cady (1920, plate 2).

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