Faulting in Posey and Gibson Counties, Indiana

Curtis H. Ault, Dan M. Sullivan, and George F. Tanner
Indiana Geological Survey, Bloomington, Indiana 47405

Introduction and History of Study

In the fall of 1977 we began our investigation of the Wabash Valley Fault System to help characterize the tectonic processes in southwestern Indiana. It was part of a project funded by the Nuclear Regulatory Commission for geologists and geophysicists from various universities and geological surveys to study the tectonics, seismicity, and structure of the area within a 200-mile radius of New Madrid, Missouri.

Since the early 1900's more than 6,000 petroleum test wells and other tests have been drilled in Posey County and southern Gibson County, which contain nearly all known faults of the Wabash Valley Fault System in Indiana. Detailed subsurface structural mapping by petroleum companies was conducted from the 1930's and 1940's until the late 1960's, when oil activity declined. But these studies have been proprietary, and the companies have released little or no structural data. Further, oil companies have usually focused attention on the reservoir rocks near the faults rather than on the complexity of the faults themselves.

Part of the Ridgway Fault of the Wabash Valley Fault System in Illinois was early described by Cady in 1919 (4). As drilling for petroleum and mining for coal progressed in Illinois, the fault system was further defined in county reports and maps and other fault studies (Stonehouse and Wilson (11) for example). The most recent mapping of the faults in Illinois was completed by Bristol and Treworgy in 1979 (2).

Faults of the Wabash Valley Fault System that extend into Kentucky have most recently been mapped in detail by geologists of the U.S. Geological Survey (7, 8).

Available Indiana studies of the fault system include a 1940 study by Patton (9), which shows a small part of the faulting near Griffin Consolidated Field, and a study by Butler in 1967 (3) in Posey County, which was based on about one control point per square mile except in a few areas near the faults where additional data were used. The faults are shown on a regional geologic map published by Gray, Wayne, and Weir in 1970 on a scale of 1/250,000 (5).

Our study is the first using nearly all available geophysical and other data to construct detailed maps and to closely locate and characterize the faulting. Two maps of Posey County and southern Gibson County, on a scale of 2 inches to the mile, will be published by the Indiana Geological Survey in 1980 (13, 14). These maps will show faults, well control, and depths on two horizons, the top of the Springfield Coal Member (V) of the Petersburg Formation (Pennsylvanian) and the top of the Cypress Formation (Mississippian). They are the basis for the description of the faults in this report and should be

referred to for detailed fault interpretations. A report on the economic implications of faulting in southwestern Indiana is a companion study to this report (12).

Tectonic Setting

The Wabash Valley Fault System is entirely within the Illinois Basin, a dominant tectonic feature bounded on its northeast side in Indiana by the Cincinnati and Kankakee Arches. Faults of the system, some extending more than 30 miles along the Wabash Valley in both Indiana and Ililnois, are confined to Posey and Gibson Counties in southwestern Indiana. The entire Wabash Valley Fault System, which includes extensions of Indiana faults and additional parallel and subparallel faults in northwestern Kentucky and southeastern Illinois, trends north-northeastward from the more extensive and more structurally complex Cottage Grove and Rough Creek Fault Zones in southern Illinois and northwestern Kentucky (Fig. 1).

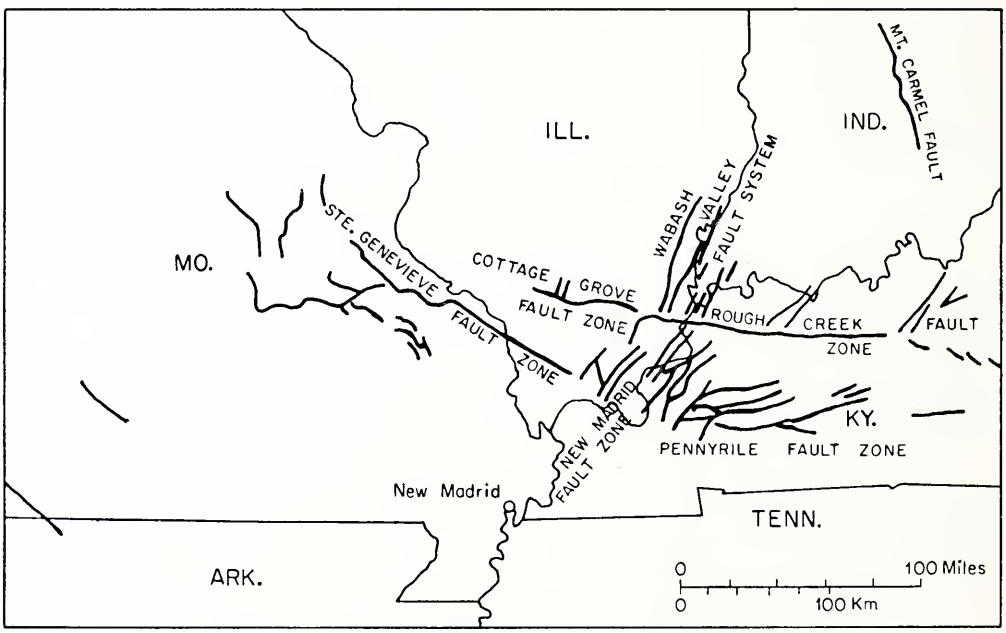

FIGURE 1. *Fault systems near New Madrid, Missouri.*

The Cottage Grove and Rough Creek Fault Zones are part of the 38th Parallel Lineament, a band of structural features which trend generally east-westward across the eastern United States along the 38th parallel. The most seismically active area in eastern North America is the New Madrid Fault Zone, which is on a trend with the Wabash Valley Fault System south of the Cottage Grove and Rough Creek Fault Zones.

Braile and others (1) reported a magnetic and gravity anomaly in the southwest corner of Indiana, roughly on strike with the New Madrid Fault Zone, but they did not observe a direct connection between the two structural areas. Recently completed geologic mapping of northwestern Kentucky by the U.S. Geological Survey shows that faults

of the Wabash Valley Fault System die out as they approach the Rough Creek Fault Zone, and a study of the system in Illinois by Bristol and Treworgy (2) found no evidence that the Wabash Valley faults intersect the east-westward-trending faults in southern Illinois.

Some geologists believe much of the present structure within the Illinois Basin was influenced by structures developed by the end of Precambrian time. Seismic data partly supported by subsurface studies indicate that Paleozoic structures, such as the Rough Creek Fault Zone in Kentucky and the LaSalle Anticline in eastern Illinois, are underlain by basement ridges and scarps. In 1965 Rudman and others (10), on the basis of seismic studies, projected a Precambrian scarp or ridge from the LaSalle Anticline southward across the southwest corner of Indiana and postulated such a ridge as the primary control in the developing structure during late Paleozoic time. More recently, Braile and others (1) suggested that continental rifting is significant in the tectonism of southwestern Indiana.

Method of Study

Faults of the Wabash Valley Fault System were mapped by using subsurface information from petroleum, coal, stratigraphic, and other drill tests to a maximum of one control point for every 10 acres in most areas and by using all available information near the faults. The faults were detected by structure mapping and by well-to-well correlation of geophysical logs, mostly electric logs, to ascertain rock sections missing because of faulting. More than 200 wells drilled through normal faults have been recorded in the area of study (13, 14). No repeated rock sections due to reverse faulting have been found.

Although only maps showing faults on the Springfield Coal Member (V) and the Cypress Formation are included in this report (Figs. 2 and 3), structural data have also been recorded for the West Franklin Limestone Member of the Shelburn Formation (Pennsylvanian), the base of the Menard Formation (Mississippian), and the top of the Renault Formation (Mississippian). Data from the latter three structural markers have been used in locating and interpreting the faulting shown in Figures 2 and 3, which are simplifications of the detailed large-scale mapping by Tanner, Stellavato, and Mackey (13, 14).

Detailed interpretation of the geophysical logs, essential for the close correlation necessary for determining rock sections missing because of faulting, was aided by examination of rock cores of Pennsylvanian age from reference wells drilled by the Indiana Geological Survey, by examination of lithologic strip logs of drilling samples, and by use of coal-test (core-hole) data.

Correlations of electric logs usually uncover only those faults with more than 20 feet of vertical displacement, although there undoubtedly are faults with less displacement in the fault zones. The larger faults are readily mapped in areas of dense drilling, but they were traced as far as possible by abrupt changes in elevation on marker beds in areas where only three or four wells had been drilled per section and no wells which cut the faults had been drilled.

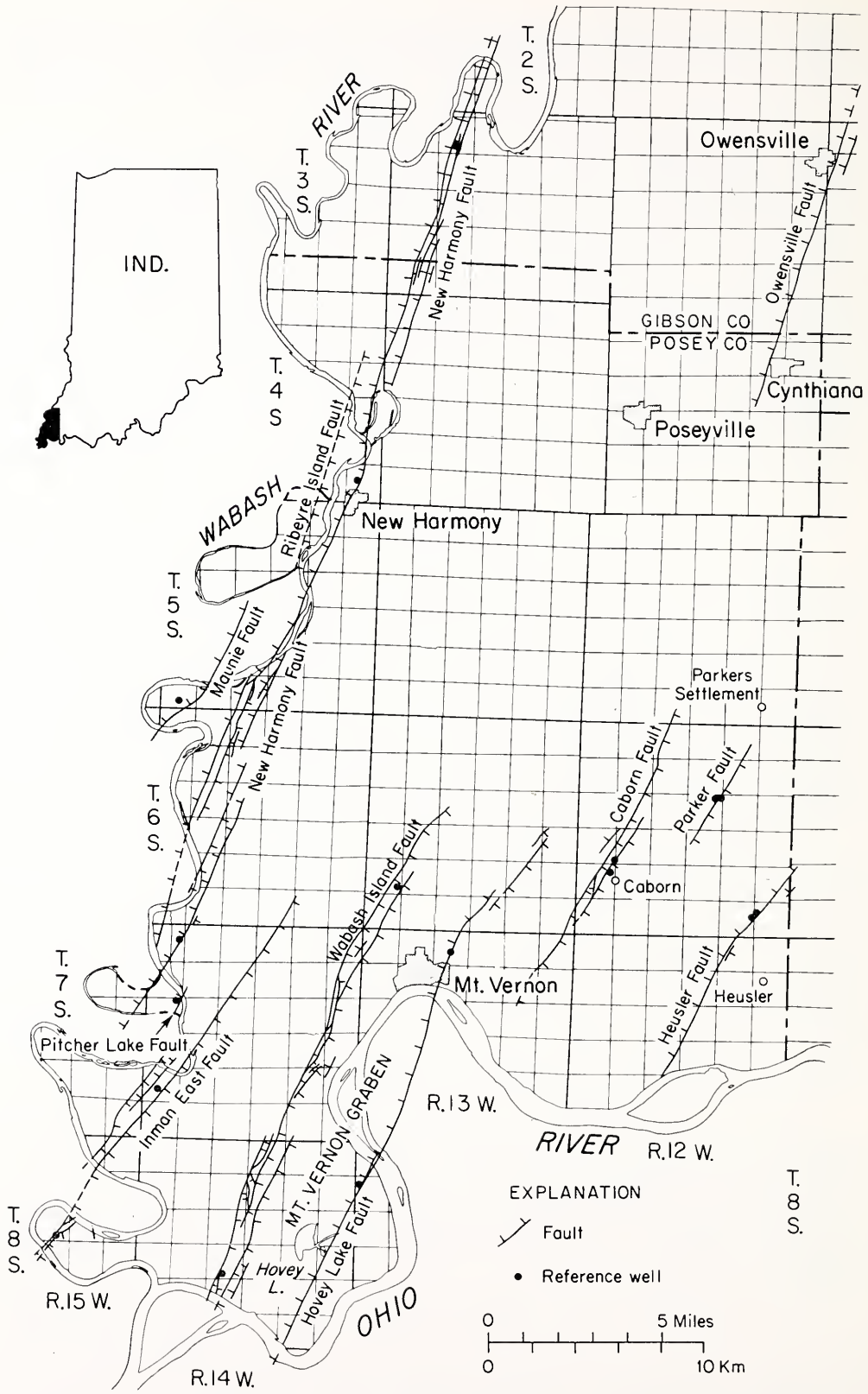

FIGURE 2. *Map of Posey County and southern Gibson County showing faulting on the Springfield Coal Member (V) of the Petersburg Formation (modified from Tanner, Stellavato, and Mackey (13)).*

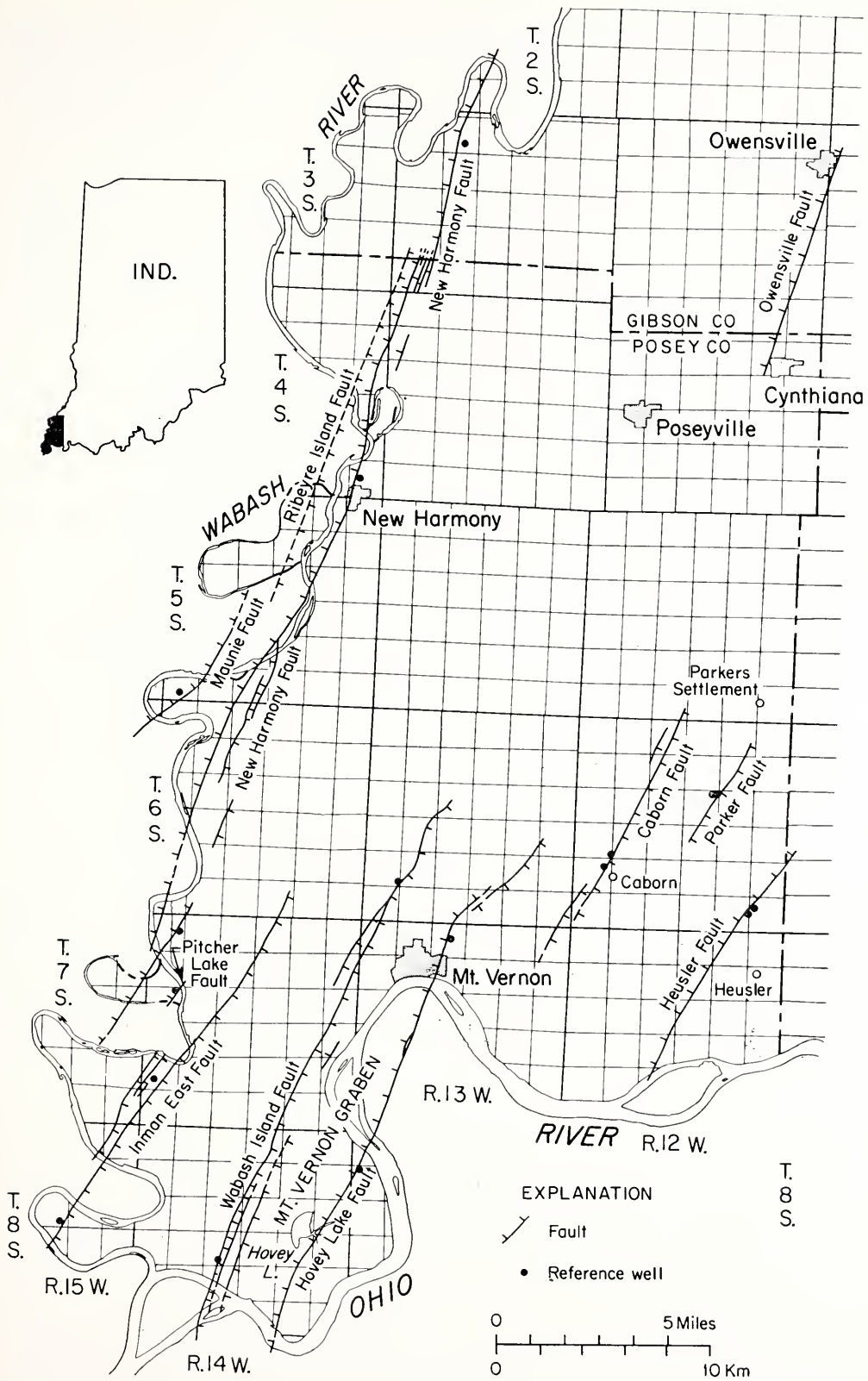

FIGURE 3. *Map of Posey County and southern Gibson County showing faulting on the Cypress Formation (modified from Tanner, Stellavato, and Mackey (14)).*

Only a small amount of structural data came from wells drilled in rocks below 3,000 feet. As most of the petroleum wells have been drilled to test the Cypress Formation or deeper rocks, subsurface control is nearly as complete for the Cypress as for the Springfield Coal Member some 1,800 feet shallower. Our confidence in the accuracy of the mapping for both horizons is high.

Numerous cross sections were constructed for correlating fault planes from well to well, determining angles of fault dip, and resolving the complexity of compound faulting. Accurate dip angles were calculated where single fault planes could be correlated from well to well from shallow to deeper horizons. But in some complex zones, we were unable to follow single fault planes between wells.

Attempting to locate faulting by seismic refraction in northern Posey County was unsuccessful because of the lack of shallow reflector beds in which displacement by faulting could be recognized.

Limited surface fieldwork in areas of known faulting found no surface expression of faulting. Eventually some faulting may be detected on the surface, but undoubtedly it will be minor.

Fault Descriptions

Faults of the Wabash Valley Fault System in Indiana trend N. 15° E. to N. 50° E. as single fault planes or as well-defined compound faults in zones usually less than half a mile wide but as much as 1½ miles wide. The faults bound blocks tilted as much as 6° and horst and graben blocks as much as 5 miles wide. The faults are normal type, and strata may be downthrown either eastward or westward.

The fault planes dip at angles ranging from 60° to 80°, and compound faults may consist of as many as five individual fault planes, each with more than 20 feet of vertical displacement. Rock slices between individual fault planes of compound faults include narrow horst and graben structures and downslipped slices among individual en echelon faults (Fig. 4). The number of individual fault planes in a zone decreases with depth from rocks of Pennsylvanian age to rocks of Mississippian age, and our cross sections show that most shallow faults are splinters of deeper faults, although some faults may have displacements dissipated in softer strata.

Growth faulting was not detected; thickening or thinning of stratigraphic units due to differential sedimentation on opposite sides of faults was not found, nor was evidence found indicating differential erosion across faults at the Mississippian-Pennsylvanian unconformity. As far as could be determined, all faults in deeper rocks cut all shallower rocks but did not cut unconsolidated surface materials. All known faulting is therefore post-Pennsylvanian and pre-Pleistocene in age.

The following described Heusler, Parker, Caborn, Owensville, Hovey Lake, and Wabash Island Faults are newly named. The first four are wholly within Indiana. The Hovey Lake and Wabash Island Faults have their maximum vertical displacement in southern Indiana but extend southward into Kentucky, where their displacement decreases. The Inman

East, Pitcher Lake, New Harmony, Ribeyre Island, and Maunie Faults are extensions of faults in Illinois whose names have been adopted for formal use in Indiana.

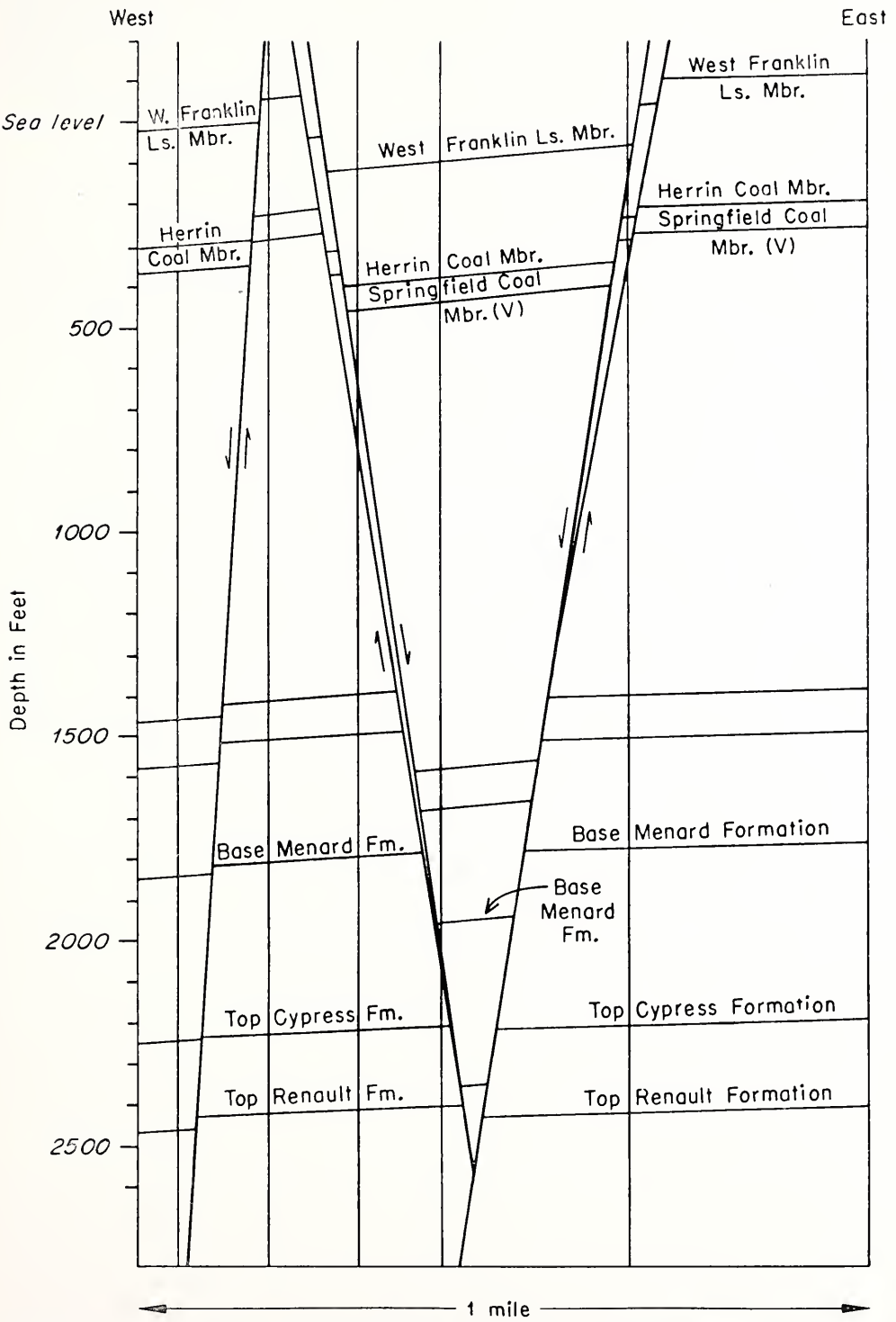

FIGURE 4. *Cross section of compound faulting of the New Harmony Fault (secs. 33 and 34, T. 5 S., R. 14 W.).*

Heusler Fault

The Heusler Fault trends N. 30° E. from sec. 28, T. 7 S., R. 12 W., about 7½ miles to sec. 30, T. 6 S., R. 11 W., at the Posey-Vanderburgh county line (Figs. 2 and 3). It dips northwestward and borders the west side of the Heusler Consolidated and Crunk East Fields. It was named for Heusler, 1½ miles east of the fault in sec. 12, T. 7 S., R. 12 W. Two petroleum tests that cut the fault have been designated reference wells: the Moco Drilling Co. No. 1 George P. Martin and the Mayhew Oil Co., Inc., No. 3 Irma Short and Paul Sanders (Table 1).

Two accessory faults have been mapped in rocks of Pennsylvanian age, both less than half a mile long. One dips southeastward in sec. 2, T. 7 S., R. 12 W., and the other dips northwestward in sec. 25, T. 6 S., R. 12 W., and sec. 30, T. 6 S., R. 11 W. The Heusler Fault dips 60° between two wells cut by the fault in sec. 35, T. 6 S., R. 12 W. Maximum observed vertical displacement (missing stratigraphic section) is 140 feet in the No. 3 Irma Short and Paul Sanders.

Parker Fault

The Parker Fault trends N. 35° E. for about 3 miles from sec. 22, T. 6 S., R. 12 W., to sec. 2, T. 6 S., R. 12 W. (Figs. 2 and 3). It borders the east edge of the Parker Consolidated Field and was named for Parkers Settlement, 1.5 miles north of the fault at the junction of State Road 66 and St. Wendel Road. Two petroleum tests in sec. 15, T. 6 S., R. 12 W., the B. M. Heath No. 1 Herman A. Boeke and the G. L. Reasor No. 2 Olus Justus, cut the fault and have been designated reference wells (Table 1). A dip on the fault plane of 66° to the southeast has been calculated between the two reference wells. Maximum observed vertical displacement is 60 feet. No accessory faulting has been detected.

Caborn Fault

The compound Caborn Fault trends about N. 30° E. for 9 miles from sec. 1, T. 7 S., R. 13 W., to sec. 33, T. 5 S., R. 12 W. Its southwestern limit is uncertain, and it can be mapped as far as sec. 14, T. 7 S., R. 13 W., in rocks of Pennsylvanian age (Figs. 2 and 3). It borders on or is near the southeast edge of the Caborn Consolidated Field for much of its length. It was named for Caborn, which is less than 1 mile southeast of the fault on both sides of the line between secs. 29 and 30, T. 6 S., R. 12 W. Two petroleum tests near Caborn that cut the fault, the W. Duncan No. 1 J. Seifert and the Ooeth Drilling No. 1 Tennison, have been designated reference wells (Table 1).

The Caborn Fault includes individual faults that are discontinuous. Three parallel faults in the Springfield Coal Member in secs. 19 and 20, T. 6 S., R. 12 W., have been mapped, and two parallel faults on the Cypress Formation near the north and south ends of the fault have also been mapped. Dips on the fault planes are difficult to determine because of multiple faulting, but they average near 80°. The fault planes dip southeastward except for the accessory fault in sec. 19, T. 6 S., R. 12 W., which dips northwestward. Maximum vertical displacement determined for the fault is 140 feet in the No. 1 J. Seifert (Table 1).

TABLE 1. *Reference wells for faults in Posey and Gibson Counties.*

Fault	Operator	Farm	Location (Sec-T-R)	Fault displacement, depth, and elevation (ft)
Heusler	Moco Drilling Co.	No. 1 George P. Martin	SW¼SW¼NW¼ 36-6S-12W	100 at 880 (–370)
Heusler	Mayhew Oil Co., Inc.	No. 3 Irma Short and Paul Sanders	NE¼NE¼SE¼ 35-6S-12W	140 at 1,230 (–748)
Parker	B. M. Heath	No. 1 Herman A. Boeke	SW¼NE¼NE¼ 15-6S-12W	60 at 465 (–63)
Parker	G. L. Reasor	No. 2 Olus Justus	SE¼NE¼NE¼ 15-6S-12W	30 at 1,720 (–1,309)
Caborn	W. Duncan	No. 1 J. Seifert	NW¼SE¼NE¼ 30-6S-12W	30 at 2,110 (–1,672) 140 at 2,288 (–1,850)
Caborn	Oeth Drilling Co.	No. 1 Tennison	SE¼SE¼SE¼ 19-6S-12W	70 at 670 (–205)
Hovey Lake	Calvert Drilling Co.	No. 1 Harlem & Louisville & Nashville Railroad Co. Comm.	NW¼NW¼SE¼ 4-7S-13W	80 at 570 (–193)
Hovey Lake	Carter Oil Co.	No. 1 M. E. Dixon	SE¼NW¼NW¼ 7-8S-13W	50 at 1,190 (–830) 110 at 1,540 (–1,188) 90 at 1,800 (–1,748) 60 at 1,910 (–1,558)
Wabash Island	Carl Miles	No. 1 Lynn M. Strack	SE¼NE¼SE¼ 30-6S-13W	60 at 550 (–165) 70 at 1,180 (–786)
Wabash Island	Yingling Oil & Mining Co.	No. 5 Maggie Murphy	SE¼NE¼SW¼ 21-8S-14W	370 at 1,070 (–709)
Inman East	C. E. Brehm Drilling & Producing	No. 1 Eugene M. Fuhrer	NW¼NE¼SW¼ 30-7S-14W	60 at 2,120 (–1,761)
Inman East	Carter Oil Co.	No. 25-W Skiles Unit	1100′ FSL x 1340′ FEL 15-8S-15W	330 at 1,320 (–976)
Pitcher Lake	Harry B. Mortimer	No. 2-A Greathouse Heirs	330′ FNL x 3950′ FWL 18-7S-14W	50 at 2,660 (–2,303)
New Harmony	Cherry & Kidd	No. 3 Gyger	2550′ FNL x 594′ FEL 6-7S-14W	130 at 615 (–260)
New Harmony	Joe Resnik	No. 1 K. D. Owen	1950′ FNL x 2150′ FWL 36-4S-14W	450 at 1,630 (–1,260)
New Harmony	Ryan Oil Co.	No. 1 Mary Alice Kelley	800′ FSL x 330′ FWL SW¼SE¼ 8-3S-13W	270 at 1,270 (–889)
Maunie	Gulf Refiining Co.	No. 1 Albert Aldrich	665′ FSL x 333′ FEL 31-5S-14W	50 at 1,914 (–1,554)

Owensville Fault

The Owensville Fault trends N. 20° E. from sec. 14, T. 4 S., R. 12 W., in the northeast corner of Posey County, about 10 miles into sec. 31, T. 2 S., R. 11 W., in Gibson County (Figs. 2 and 3). It is bordered on the east by the Owensville Consolidated Field and was named for Owensville, centered in sec. 6, T. 3 S., R. 11 W., immediately west of the fault. A short parallel fault half a mile east of the main fault in secs. 6 and 7, T. 3 S., R. 11 W., has been recognized in the Springfield Coal Member.

The fault is presumed to be normal type and to dip northwestward, but since no petroleum tests have been drilled through the fault, the fault type, whether normal or reverse, has not been substantiated. No reference wells for the fault have been designated.

Hovey Lake Fault

The compound Hovey Lake Fault extends from Union County, Kentucky, into Indiana in sec. 35, T. 8 S., R. 14 W. (8). The northwestward-dipping fault trends generally N. 25° E. from sec. 35 about 17 miles into sec. 24, T. 6 S., R. 13 W. (Figs 2 and 3). Five of the 17 miles are immediately south of Mt. Vernon, Indiana, in Township Q-20 (Carter coordinates) of Union and Henderson Counties, Kentucky (7). The fault marks the eastern boundary of the Mount Vernon Graben (described below) and was named for Hovey Lake, which is immediately west of the fault in secs. 13, 14, 23, and 24, T. 8 S., R. 14 W. The Calvert Drilling Co. No. 1 Harlem & Louisville & Nashville Railroad Co. Comm. and the Carter Oil Co. No. 1 M. E. Dixon were drilled through the fault and have been designated reference wells (Table 1).

The No. 1 M. E. Dixon was drilled through four separate fault planes of the compound Hovey Lake Fault (Table 1). Because of the close horizontal distances between the fault planes, the Hovey Lake Fault is depicted as only two traces near the No. 1 M. E. Dixon in Figure 2. In sec. 34, T. 6 S., R. 13 W., where one northwestward-dipping fault of the Hovey Lake Fault dies out, an adjacent parallel-fault plane dips southeastward and continues 2½ miles northeastward. A short accessory fault has been mapped in rocks of Pennsylvanian age in secs. 23 and 24, T. 6 S., R. 13 W., at the northeast end of the Hovey Lake Fault. Fault-plane dips are 70° or greater. Maximum observed vertical displacement in wells that have been drilled through the fault is 310 feet in the No. 1 M. E. Dixon.

Mt. Vernon Graben

The Mt. Vernon Graben, here named for Mt. Vernon, Indiana, is a fault block, 2 to 2½ miles wide, extending from the center of T. 6 S., R. 13 W., southwestward through the center of T. 8 S., R. 14 W., into Union County, Kentucky (Figs. 2 and 3). It is bounded on the east by the Hovey Lake Fault and on the west by the Wabash Island Fault (described below). It is downthrown to about 310 feet at the Hovey Lake Fault and to about 270 feet at the Wabash Island Fault in T. 8 S., R. 14 W. But it shows decreasing displacement toward its northeasterly

end and southwestward into Kentucky. The Spencer Consolidated Field produces from a domal structure which has been mapped in the graben in the northeast quarter of T. 8 S., R. 14 W., in rocks of Pennsylvanian and Mississippian age.

Wabash Island Fault

The compound Wabash Island Fault extends from Union County, Kentucky, into Indiana in sec. 28, T. 8 S., R. 14 W., trending about N. 27° E. for 15 miles to sec. 16, T. 6 S. R. 13 W. (Figs. 2 and 3). It parallels the east side of the College Consolidated and Mt. Vernon Consolidated Fields, is the eastern boundary of a westward-tilted fault block, which is 2 to 5 miles wide, and is the western boundary of the Mt. Vernon Graben. The fault was named for Wabash Island, at the confluence of the Ohio and Wabash Rivers in Kentucky. Two petroleum tests that cut the fault, the Yingling Oil & Mining Co. No. 5 Maggie Murphy and the Carl Miles No. 1 Lynn M. Strack, have been designated reference wells (Table 1).

The Wabash Island Fault is a compound fault with at least three fault planes in rocks of Mississippian age in T. 8 S., R. 14 W. The westernmost plane dips southeastward and has as much as 370 feet of vertical displacement. The two fault planes to the east dip northwestward and southeastward and form narrow horst and graben structures with as much as 150 feet of vetrical displacement. North of T. 8 S., the Wabash Island Fault is mapped on the Cypress Formation as a single fault plane except for a small accessory fault in secs. 24 and 25, T. 7 S., R. 14 W., and an accessory fault in the northeast corner of T. 7 S., R. 14 W., the northwest corner of T. 7 S., R. 13 W., and the southwest corner of T. 6 S., R. 13 W.

The Wabash Island Fault as mapped on the Springfield Coal Member of the Petersburg Formation is more complex. There are as many as four fault planes in zones as much as 4,000 feet wide in places along its length. The faults are parallel, but our data suggest that some are interconnected with cross faults and some anastomose with each other (Fig. 2). Bristol and Treworgy (2) reported cross faults between overlapping parallel faults in Illinois.

Because of the multiple fault planes, dips on the faults are difficult to calculate and substantiate. Our data indicate that some of the fault planes have about 65° dips.

Inman East Fault

The compound Inman East Fault extends from Gallatin County, Illinois (2), into southwestern Posey County in sec. 22, T. 8 S., R. 15 W., and trends about N. 35° E. for 12 miles into sec. 34, T. 6 S., R. 14 W. (Figs. 2 and 3). The Springfield Coal Member is displaced by at least four fault planes in secs. 14, 15, and 22, T. 8 S., R. 15 W., but only one fault has been mapped in this area on the Cypress Formation. Several accessory faults forming narrow horst and graben structures have been mapped on both the Springfield Coal Member and the Cypress Formation in the southwest corner of T. 7 S., R. 14 W., the southeast

corner of T. 7 S., R. 15 W., and the northeast corner of T. 8 S., R. 15 W. The Inman East Fault borders the east side of the Inman East, West Hovey, and Black Chapel South Fields. Two petroleum tests drilled through the fault, the C. E. Brehm Drilling & Producing No. 1 Eugene M. Fuhrer and the Carter Oil Co. No. 25-W Skiles Unit, have been designated reference wells (Table 1). Dips where determined on parts of the fault are about 60°. Maximum observed vertical displacement on the fault is 330 feet in the No. 25-W Skiles Unit.

Pitcher Lake Fault

The short Pitcher Lake Fault trends N. 20° E. from White County, Illinois (2), into Indiana in sec. 18, T. 7 S., R. 14 W., to sec. 8, T. 7 S., R. 14 W. (Figs. 2 and 3). It dips northwestward between 62° and 80° and borders parts of the Welborn Consolidated and Black Chapel South Fields. Observed vertical displacement is 50 feet in the designated reference well, the Harry B. Mortimer No. 2-A Greathouse Heirs (Table 1).

New Harmony Fault

The New Harmony Fault is the longest and has the most displacement of any fault in the Wabash Valley Fault System in Indiana. It is compound and trends about N. 25° E. for nearly 30 miles along the Wabash Valley from White County, Illinois (2), into Posey County, Indiana, in sec. 13, T. 7 S., R. 15 W., to sec. 28, T. 2 S., R. 13 W., Gibson County, where it enters Wabash County, Illinois (Figs. 2 and 3). The fault, which has about 450 feet of vertical displacement in the reference well, the Joe Resnik No. 1 K. D. Owen (Table 1), has been called the Mt. Carmel-New Harmony Fault in Illinois. The name of this fault in Indiana is confined to the New Harmony Fault, since the name Mt. Carmel as already been used for a major fault in south-central Indiana. Part of the New Harmony Fault was called the Maunie Fault on a regional geologic map by Gray, Wayne, and Wier (5) but has been confirmed as the New Harmony Fault by Bristol and Treworgy (2) and by our study.

The New Harmony Fault borders parts of the Welborn Consolidated, Welborn North Consolidated, Springfield Consolidated, Black River Consolidated, Mumford Hills, and Griffin Consolidated Fields. Dips of about 65° northwestward have been measured on the major fault planes, but some dips may range higher.

The New Harmony Fault and the Ribeyre Island Fault (described below) are a complex zone, 1½ miles wide, with at least five fault planes as mapped in the western half of T. 6 S., R. 14 W., in rocks of Pennsylvanian age. In the same area, only three fault planes of the New Harmony Fault have been mapped on the Cypress Formation. As many as five parallel-fault planes, all dipping northwestward, have been mapped in sec. 6, T. 4 S., R. 13 W., at the Posey-Gibson county line. The New Harmony Fault continues as a single fault plane on the Cypress Formation north of this area into Illinois but is more complex on the Springfield Coal Member, where two fault planes or more have been mapped.

Two petroleum test wells, besides the No. 1 K. D. Owen mentioned above, have been designated reference wells: the Cherry & Kidd No. 3 Gyger and the Ryan Oil Co. No. 1 Mary Alice Kelley (Table 1).

Ribeyre Island Fault

The Ribeyre Island Fault, described in Illinois by Bristol and Treworgy (2), is conjectural in Indiana in the eastern part of T. 4 S., R. 14 W., on the basis of elevation differences of as much as 150 feet per half a mile on rocks of Mississippian and Pennsylvanian age (Figs. 2 and 3). On the basis of sparse data, the fault mapped on the Cypress Formation trends about N. 15° E. from White County, Illinois, into Indiana in sec. 15, T. 5 S., R. 14 W., to sec. 31, T. 3 S., R. 13 W. The elevation differences are less apparent on the Springfield Coal Member for the northern part of the fault, but the fault has been mapped only to sec. 12, T. 4 S., R. 14 W., on that horizon. Since no well has been drilled through this fault in Indiana, no reference well has been designated.

Maunie Fault

The Maunie Fault, in sec. 6, T. 6 S., R. 14 W., and secs. 31 and 32, T. 5 S., R. 14 W., trends about N. 50° E. in Indiana (Figs. 2 and 3) but trends N. 27° E. northward where it enters White County, Illinois (2). The fault dips northwestward probably between 65° and 80°, although the amount of dip has not been measured directly. The Gulf Refining Co. No. 1 Albert Aldrich, the designated reference well (Table 1), shows 50 feet of vertical displacement on the fault.

Deep Faulting

Few wells have been drilled beneath rocks of Late Mississippian age in Posey and Gibson Counties, the deepest part of the Illinois Basin in Indiana. Precambrian structures are concealed by about 13,000 feet of overlying strata, of which only the upper 2,000 to 3,000 feet have been extensively drilled. Even so, from the scarce data available, the New Harmony and Wabash Island Faults can be recognized in deeper strata, such as the Salem Limestone (Mississippian), the New Albany Shale (Devonian and Mississippian), and the Trenton Limestone (Ordovician) (Fig. 5). Depth to the Trenton surface is about 7,000 feet.

Although not shown on Figure 5 because of sparse drilling data, two lines of evidence lead us to believe that other major faults mapped on shallower horizons are also present at depth. Similar displacements at depth along single fault planes indicate deeper faulting, and the decrease in complexity of the faulting with depth from rocks of Pennsylvanian to Mississippian age appears to be due primarily to splintering of deeper faulting and not to dissipation of fault displacements into surrounding faulted rocks.

Knowledge of the location of faults in basement rocks not only is important in exploring for petroleum and mineral resources at depth but also is necessary in identifying major structural elements in the base-

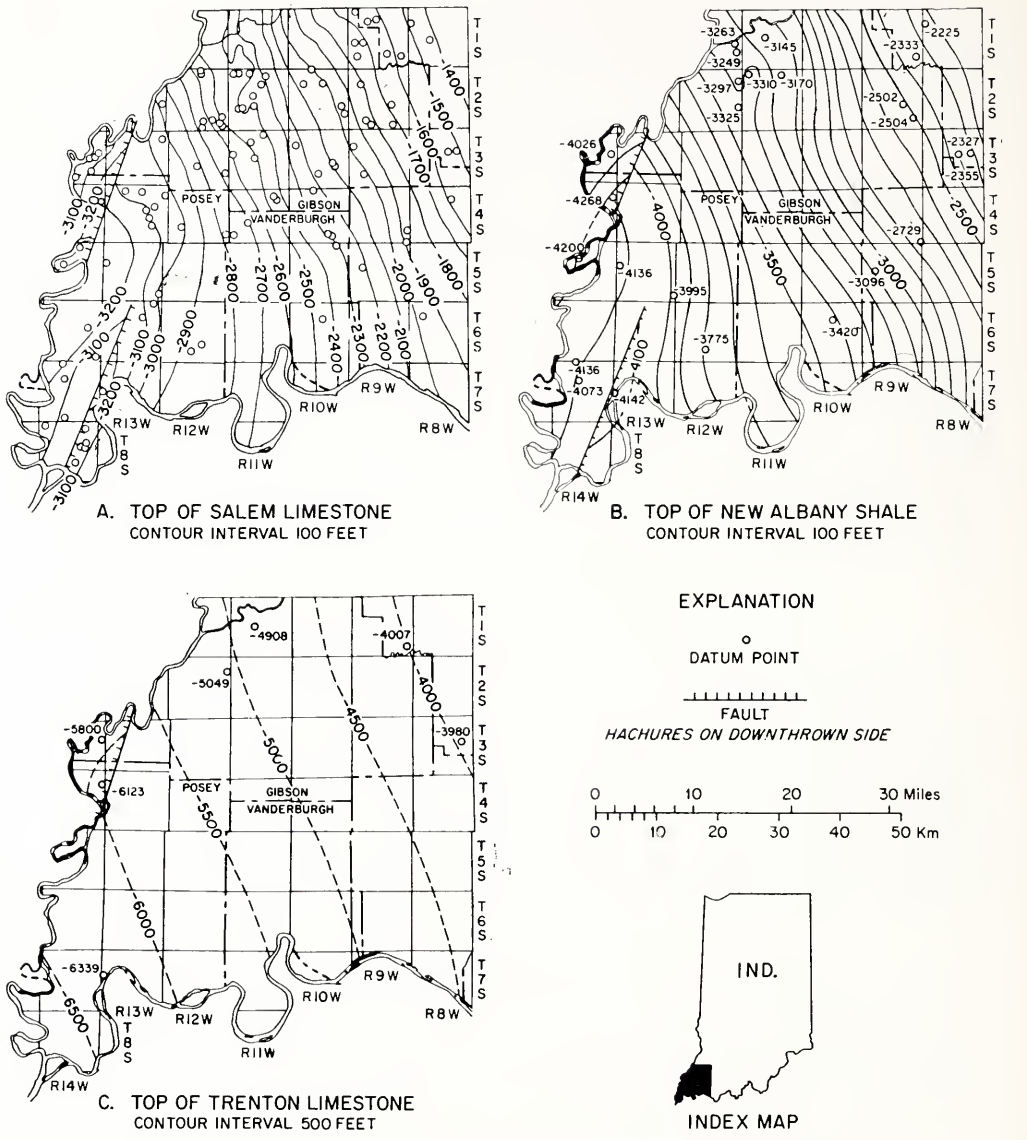

FIGURE 5. *Map of southwestern Indiana showing structure on tops of the Salem Limestone, the New Albany Shale, and the Trenton Limestone (from Hasenmueller and Bassett (6)).*

ment and tectonics which have affected them. If fault dips observed in shallow rocks are similar to dips on the faults at depth, some faults may migrate horizontally more than a mile when they are projected to the basement. Migration of the Wabash Island and Hovey Lake Faults suggests that they may be part of one major fault zone in basement rocks. The Pitcher Lake, New Harmony, Maunie, and Ribeyre Island Faults may also be part of one major fault zone. Migration of the Caborn, Heusler, and Parker Faults appears to be insufficient to be one fault zone, but these faults may still be closely related at basement depths.

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