

## **Faulting In Perry and Spencer Counties, Indiana**

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### **Introduction**

Perry and Spencer Counties border on the Ohio River in southwestern Indiana at the juncture of the Wabash Lowland and Crawford Upland physiographic provinces. Spencer County lies in the Wabash Lowland where the exposed bedrock formations of the county are composed of shales, clays, coals, sandstones, and thin limestones of the Pottsville and Alleghenian Series of the Pennsylvanian System. Pennsylvanian rocks that have been faulted in southern Spencer County are covered by alluvial deposits of the Ohio River and other Pleistocene to Holocene sediments.

Perry County lies immediately east of Spencer County within the Crawford Upland. The erosion of alternating sandstones, shales, and limestones of the Chesterian Series (Mississippian) and sandstones and shales of the lower Pottsville Series has resulted in rugged, angular topography, which facilitates surface mapping of the faults in the southern part of the county.

Faulting in Perry County has been known for more than a century. Small faults in a coal-mine tunnel near Cannelton were mapped early by E. M. Kindel, who also noted a fault with 35 feet of throw in a bluff near Cannelton (1). Faulting near Deer Creek was noted by Joseph Lesley, Jr., before 1862 (11); later workers viewed this possible fault with some doubt until it was confirmed after 1900. Many small tunnel coal mines were opened near Cannelton beginning about 1835 (5), and the early miners encountered small faults in some mines (1).

In 1951 Hughes (8) mapped faults in the Deer Creek area, and more recently the Indian Creek Fault was shown on a regional geologic map at a scale of 1/250,000 by Gray, Wayne, and Wier (7).

During the past several years geologists of the Indiana Geological Survey have conducted intensive investigations of the faults in all of southwestern Indiana. This study of the faults in Perry and Spencer Counties was part of a project funded in part by the Nuclear Regulatory Commission to study the tectonic processes within a 200-mile radius of the active seismic center of New Madrid, Missouri.

### **Tectonic Setting**

Perry and Spencer Counties lie on the eastern flank of the Illinois Basin, which is bounded on its northeast side in Indiana by the Cincinnati Arch.

The faults in Perry and Spencer Counties are 50 to 80 miles east of the more extensive Wabash Valley Fault System, which is well developed in southwestern Indiana in Posey and Gibson Counties (2, 13, 14).

The Wabash Valley Fault System, which includes faulting in northwestern Kentucky and southeastern Illinois, trends north-northeastward, as do the faults in Perry and Spencer Counties. Three of the faults in Perry and Spencer Counties are extensions of faults mapped in Kentucky by Goudarzi and Smith (6), Johnson and Smith (9), Bergendahl (3), and Mayfield and Chisholm (10).

The vertical displacements of the rocks faulted in Perry and Spencer Counties

are considerably less than those of the major faults in the Wabash Valley Fault System. All known faults in both areas are of the high-angle normal type. Although faulted rocks at the bedrock surface in Perry and Spencer Counties are older than those in the Wabash Valley area, the time of faulting of the Pennsylvanian beds in Perry County probably relates closely to the post-Pennsylvanian and pre-Pleistocene time of faulting of the Wabash Valley Fault System.

The relationship of the Perry County and Spencer County faulting and the similar-trending faulting southward in Kentucky to the east-westward-trending Rough Creek Fault Zone in western Kentucky is unclear, and the relationship may not be a close one.

### Method of Study

The faults in Perry and Spencer Counties were mapped by using subsurface information from all available petroleum, coal, mineral, and stratigraphic test holes on file at the Indiana Geological Survey. Both Perry and Spencer Counties have been explored extensively for oil and gas since the late 1920s. About 3,000 petroleum tests have been drilled in Spencer County, and about 650 have been drilled in Perry County. Subsurface control, however, is sparse in those areas where the faults are mapped. Most of the holes were drilled with cable tools, and geophysical logs, which are particularly useful in well-to-well stratigraphic correlation, are not common. Driller's logs provide the basic data in southern Spencer County, where there are no visible surface expressions of the faults. In Perry County, however, where the upper Chesterian rocks are exposed in the rugged topography of the Crawford Upland, several good marker beds crop out and provide the basis for detailed surface mapping.

Correlations of electric logs and driller's logs generally uncover only those faults with more than about 20 feet of vertical displacement. Displacements of faults mapped on the surface were calculated by the difference in elevation of closely spaced outcrops of marker beds rather than by direct mapping of the fault planes, which are mostly covered by unconsolidated materials.

Some outcrops mapped near faults in Perry County showed steeply inclined bedding, some dipping in opposite directions than would be expected from normal drag features near the faulting. This suggests that the faulting is complex, that more than one fault plane is in a zone, and that beds dip erratically between the planes. We also found that inclined beds of sedimentary structures could be mistaken easily for fault-affected beds, especially at the Mississippian-Pennsylvanian unconformity. Some previous investigators may have been misled by such structures.

### Fault Descriptions

Faults in Perry and Spencer Counties, Indiana, trend N. 5° E to essentially an east-west direction with north-northeast being the most prevalent trend (FIGURE 1). The faults are all normal type, with high-angle dips on the fault planes. The Little Hurricane Island Fault was the only fault where a dip calculation was possible, and it was greater than 70°. In general, the faults in Spencer County are downthrown eastward, and the faults in Perry County are downthrown westward.

Our depictions of the faults as single planes are oversimplifications in that there is undoubtedly more complex faulting near major faults. This is borne out in the area near Cannelton where several small faults were observed in at least one of the early coal mines near the Hawesville Fault. Also, a small accessory fault

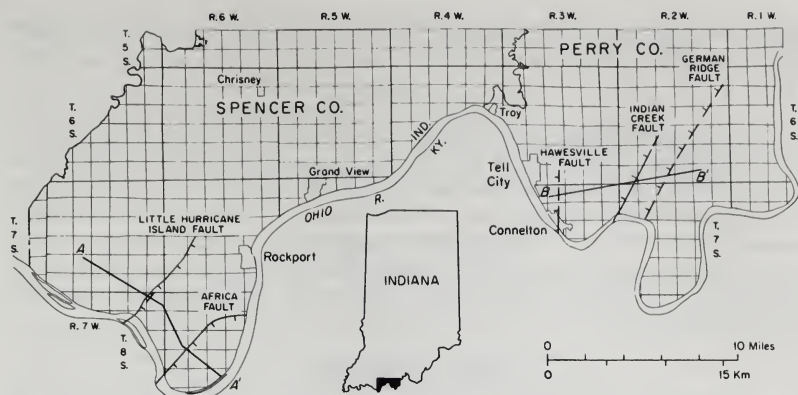


FIGURE 1. Map showing faults in southern Spencer and Perry Counties, Indiana.

creates a 1,000 foot wide graben associated with the major Little Hurricane Island Fault (FIGURE 2).

Isopachous maps do not indicate any thickening or thinning of stratigraphic units due to differential sedimentation on opposite sides of faults; therefore, there is no indication of growth faulting. The following described Little Hurricane Island, Africa, and German Ridge Faults are newly named in Indiana. The Hawesville and

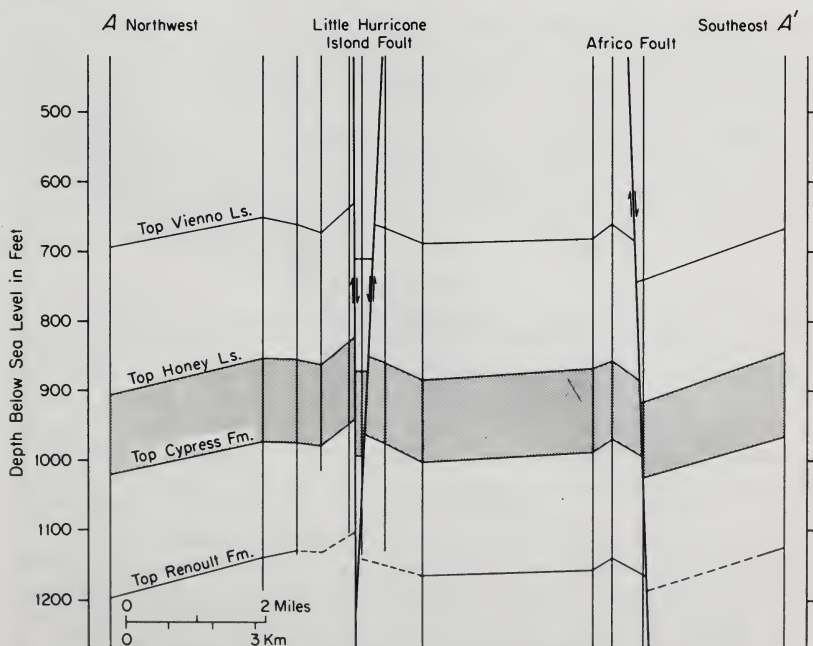


FIGURE 2. Cross section showing faulting in southern Spencer County, Indiana. See FIGURE 1 for line of section.

Indian Creek Faults are extensions of faults mapped in Kentucky; their names have been adopted for formal use in Indiana.

### Hawesville Fault

The Hawesville Fault enters Indiana in sec. 16, T. 7 S., R. 3 W., from Hancock County, Kentucky, and trends N 5° E for 2½ miles. The fault was named for the small river town of Hawesville, Kentucky (9). The upthrown side is to the east, and the maximum vertical displacement is 75 feet in sec. 16, T. 7 S., R. 3 W. The throw as expressed on the top of the Cypress Formation (Mississippian) decreases northward to 25 feet in less than 2 miles (FIGURE 3). The fault is not mapped north of sec. 33, T. 6 S., R. 3 W., where regional dips of 40 feet per mile are on the top of the Cypress Formation.

### Indian Creek Fault

The Indian Creek Fault enters Indiana in sec. 12, T. 7 S., R. 3 W., from Hancock County, Kentucky, and trends N 27° E up the Deer Creek Valley about 4½ miles. The upthrown side of the fault is to the east. The fault was named for Indian Creek, an Ohio River tributary in Hancock County, Kentucky (9). Maximum vertical displacement in Indiana is 90 feet in sec. 12, T. 7 S., R. 3 W., on outcrops of the

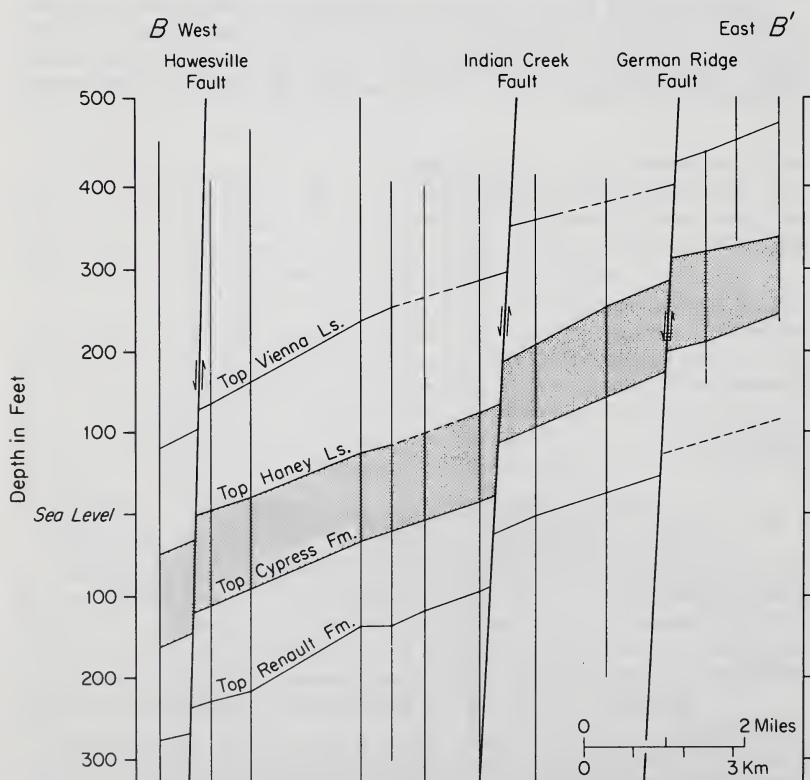


FIGURE 3. Cross section showing faulting in southern Perry County, Indiana. See FIGURE 1 for line of section.

base of the Negli Creek Limestone Member of the Tobinsport Formation (Mississippian) and in the subsurface on the top of the Cypress Formation. Throws decrease to 65 feet on top of the Cypress Formation in sec. 6, T. 7 S., R. 2 W. (FIGURE 3), and gradually decrease to less than 20 feet in sec. 21, T. 6 S., R. 2 W. A drag feature exists on the west side of the road in the SE1/4NW1/4NE1/4 sec. 6, T. 7 S., R. 2 W., in the Mount Pleasant Sandstone Member of the Tobinsport Formation.

#### **German Ridge Fault**

The German Ridge Fault trends N 30° E about 8 miles, and the upthrown side of the fault is to the east. The fault was named after the highland area known as German Ridge and is not shown on mapping by the U.S. Geological Survey in Kentucky. The southern end of the fault extends to the Ohio River in sec. 8, T. 7 S., R. 2 W., and trends north-northeastward 8 miles before dying out in sec. 1, T. 6 S., R. 2 W. (FIGURE 1). The maximum vertical displacement is 60 feet in the NW1/4 sec. 23, T. 6 S., R. 2 W., on the top of the Cypress Formation and the Vienna Limestone Member of the Branchville Formation (Mississippian). The throw decreases to the southwest from sec. 23, T. 6 S., R. 2 W., to 30 feet on top of the Cypress Formation in sec. 33, T. 6 S., R. 2 W. (FIGURE 3).

#### **Little Hurricane Island Fault**

The Little Hurricane Island Fault in Spencer County, Indiana, trends N 35° E from sec. 11, T. 8 S., R. 7 W., about 5 miles to sec. 20, T. 7 S., R. 6 W. (FIGURE 1). The upthrown side is to the west. The fault was named for Little Hurricane Island in the Ohio River.

The major fault has a short parallel fault about half a mile long in the NW1/4 sec. 1, T. 8 S., R. 7 W., and SW1/4 sec. 36, T. 7 S., R. 7 W. The splinter fault is upthrown to the east and has 30 feet of displacement on top of the Cypress Formation (FIGURE 2). The Johnson Kelly No. 1 Howard well in the NW1/4NW1/4 sec. 1, T. 8 S., R. 7 W., has about 20 feet of missing section in the Sample Formation (Mississippian) due to faulting at a depth of about 1,465 feet. The dip of the fault plane is greater than 70°. The major fault has a maximum vertical displacement of 50 feet on the top of the Cypress Formation in sec. 1, T. 8 S., R. 7 W. (FIGURE 2), and throw decreases northeastward and southwestward.

#### **Africa Fault**

The fault was named for the hamlet of Africa in sec. 10, T. 8 S., R. 6 W. The Africa Fault trends N 40° E from sec. 25, T. 8 S., R. 7 W., on the Ohio River to the NE1/4 sec. 9, T. 8 S., R. 6 W., where the trend changes to eastwest, leaving Spencer County, Indiana, in sec. 11, T. 8 S., R. 6 W., and entering Daviess County, Kentucky (FIGURE 1). The E. M. D. & G. Drlg. No. 1 Snyder well in NE1/4NE1/4NE1/4 sec. 19, T. 8 S., R. 6 W., has about 40 feet of section faulted out in the Sample Formation at a depth of 1,470 feet. The maximum vertical displacement based on interpretation of structure on top of the Cypress Formation is 75 feet in sec. 19, T. 8 S., R. 6 W.

FIGURE 2 shows decreasing throw on the fault with depth. The vertical displacement is about 60 feet on top the Vienna Limestone Member and 35 feet on top of the Renault Formation (Mississippian). The throw decreases 25 feet in 460 feet of vertical section, which suggests that the fault is dying out at depth.

#### **Deeper Faulting**

In the faulted areas of Perry and Spencer Counties, only one test hole has

penetrated below upper Valmyrean (Mississippian) rocks. The lack of sufficient deep subsurface data, therefore, does not provide a good basis for determining deep faulting in lower Paleozoic strata or basement rocks, and the relatively small displacement of rocks faulted in the Chesterian section compared with that of rocks faulted in the Wabash Valley Fault System does not enhance the possibility of deeper faulting. Rudman and others (12) have postulated a possible basement scarp underlying the Wabash Valley Fault System, and more recently Braille and others (4) have suggested a basement rift feature in southwestern Indiana. Involvement of the faults in Perry and Spencer Counties as an expression of the eastern boundary of any such model does not seem justified.

#### Literature Cited

1. ASHLEY, G. H. 1899. The coal deposits of Indiana: Indiana Dept. Geology and Nat. Resources Ann. Rept. 23, p. 1255-1298.
2. AULT, C. H., D. M. Sullivan and G. F. Tanner. 1980. Faulting in Posey and Gibson Counties, Indiana: Indiana Acad. Sci. Proc. for 1979, v. 89, p. 275-289.
3. BERGENDAHL, M. H. 1965. Geology of the Cloverport Quadrangle, Kentucky-Indiana and the Kentucky part of the Cannelton Quadrangle: U.S. Geol. Survey Geol. Quad. Map GQ-273.
4. BRAILLE, L. W. and others 1978. An integrated geophysical and geological study of the tectonic framework of the 38th Parallel Lineament in the vicinity of its intersection with the extension of the New Madrid Fault Zone: West Lafayette, Ind., Purdue Univ., 67 p.
5. COX, E. T. 1872. Perry County: Indiana Geol. Survey Ann. Repts. 3 and 4, p. 61-143.
6. GOUDARZI, G. E. and A. E. SMITH. 1971. Geological map of part of the Owensboro West Quadrangle in Daviess County, Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ-890.
7. GRAY, H. H., W. J. WAYNE and C. E. WIER. 1970. Geologic map of the 1° x 2° Vincennes Quadrangle and parts of adjoining quadrangles, Indiana and Illinois, showing bedrock and unconsolidated sediments: Indiana Geol. Survey Regional Geol. Map 3.
8. HUGHES, JOHN H. 1951. The geology of the Deer Creek Fault area, Perry County, Indiana [unpub. M.A. thesis]: Bloomington, Indiana Univ., 31 p.
9. JOHNSON, W. D., JR. and A. E. SMITH. 1968. Geological map of part of the Owensboro East Quadrangle in Daviess County, Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ-751.
10. MAYFIELD, F. M. and D. B. CHISHOLM. 1952. Geologic and structure map of Hancock County, Kentucky: Kentucky Geol. Survey, Ser. IX, Map.
11. OWEN, RICHARD. 1861. Report of a geological reconnaissance of Indiana, made during the years 1859 and 1860, under the direction of the late David Dale Owen, M. D., State Geologist: Indianapolis, Ind., H. H. Dodd and Co., 368 p.
12. RUDMAN, A. J. and others 1956. Geology of basement in Midwestern United States: Am. Assoc. Petroleum Geologists Bull., v. 49, p. 894-904.
13. SULLIVAN, D. M., C. H. AULT and J. N. STELLAVATO. 19\_\_\_. The Wabash Valley Fault System in Indiana and its economic implications: Kentucky Geol. Survey Ser. X, Spec. Pub. \_\_\_\_.
14. TANNER, G. F., J. N. STELLAVATO, and J. C. MACKEY 1980. Map of Southwestern Gibson County, Indiana, showing structure of Cypress Formation (Mississippian): Indiana Geol. Survey Misc. Map 29.
15. TANNER, G. F., J. N. STELLAVATO and J. C. MACKEY. 1980. Map of Northern Posey County, Indiana, showing structure of Cypress Formation (Mississippian): Indiana Geol. Survey Misc. Map 30.
16. TANNER, G. F., J. N. STELLAVATO and J. C. MACKEY. 1980. Map of Southern Posey County, Indiana showing structure of Cypress Formation (Mississippian): Indiana Geol. Survey Misc. Map. 31.