

# **Evidence for a Major East-West Structural Discontinuity in Southern Indiana — A Possible Marginal Fault Zone of the Rough Creek Graben\***

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## **Abstract**

Research on the attitude of jointing and small-scale thrust faulting in Indiana by Smith and Ault (1985) resulted in a proposed stress-field boundary in the southern part of the state. The boundary separates two major stress fields: the Midcontinent Stress Province north of the boundary and the Ohio Valley Stress Province south of the boundary. The Midcontinent Stress Province is currently under the contemporary geotectonic stress field shown by the rest of eastern North America -- maximum horizontal compression along an axis trending slightly north of east. The Ohio Valley Stress Province exhibits a strongly different stress field -- maximum horizontal compression along an axis trending north or slightly east of north.

A major structural discontinuity closely tracks the proposed stress-field boundary in southern Indiana. Evidence comes from two geotectonic features. First; detailed mapping, using a LANDSAT-7, infrared, color-composite, space image; has revealed a 70-mile- (112-kilometer)- long, discontinuous, composite lineament zone that strikes east-west from west-central Harrison County westward to the northwest corner of Warrick County. Second, an aeromagnetic map of Indiana shows flattened anomalies that strikingly align along the lineament zone.

The large structural discontinuity may be a major east-west fault zone similar to the Rough Creek - Shawneetown fault system of southeastern Illinois and northwestern Kentucky. If ground-truth checks verify this hypothesis, the discontinuity could be a marginal fault zone of the Rough Creek graben arm of the New Madrid rift complex.

## References

Ault, C.H., D. Harper, C.R. Smith, and M.A. Wright, 1985, Faulting and jointing in and near surface mines of southwest Indiana: Tech. Rep. NUREG/CR-4117, Indiana Geological Survey.

Braile, L.W., G.R. Keller, W.J. Hinze, and E.G. Lidiak, 1982, An ancient rift complex and its relation to contemporary seismicity in the New Madrid seismic zone: *Tectonics*, v. 1, p. 225-237.

Furer, L.C., 1996, Basement tectonics in the southeastern part of the Illinois Basin and its effect on Paleozoic sedimentation: *GSA Special Papers*, v. 308, p. 109-126.

Henderson, J.R., Jr. and I. Zietz, 1958, Interpretation of an aeromagnetic survey of Indiana, geophysical field investigations: USGS Survey Professional Paper 316-B, prepared in cooperation with Indiana Department of Natural Resources, p. 19-37.

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Smith, C.R. and C.H. Ault, 1985, Major stress field boundary in southern Indiana: Maps on Permanent File at Indiana Geological Survey.

# Evidence for a Major East-West Structural Discontinuity in Southern Indiana -- a Possible Marginal Fault Zone of the Rough Creek Graben

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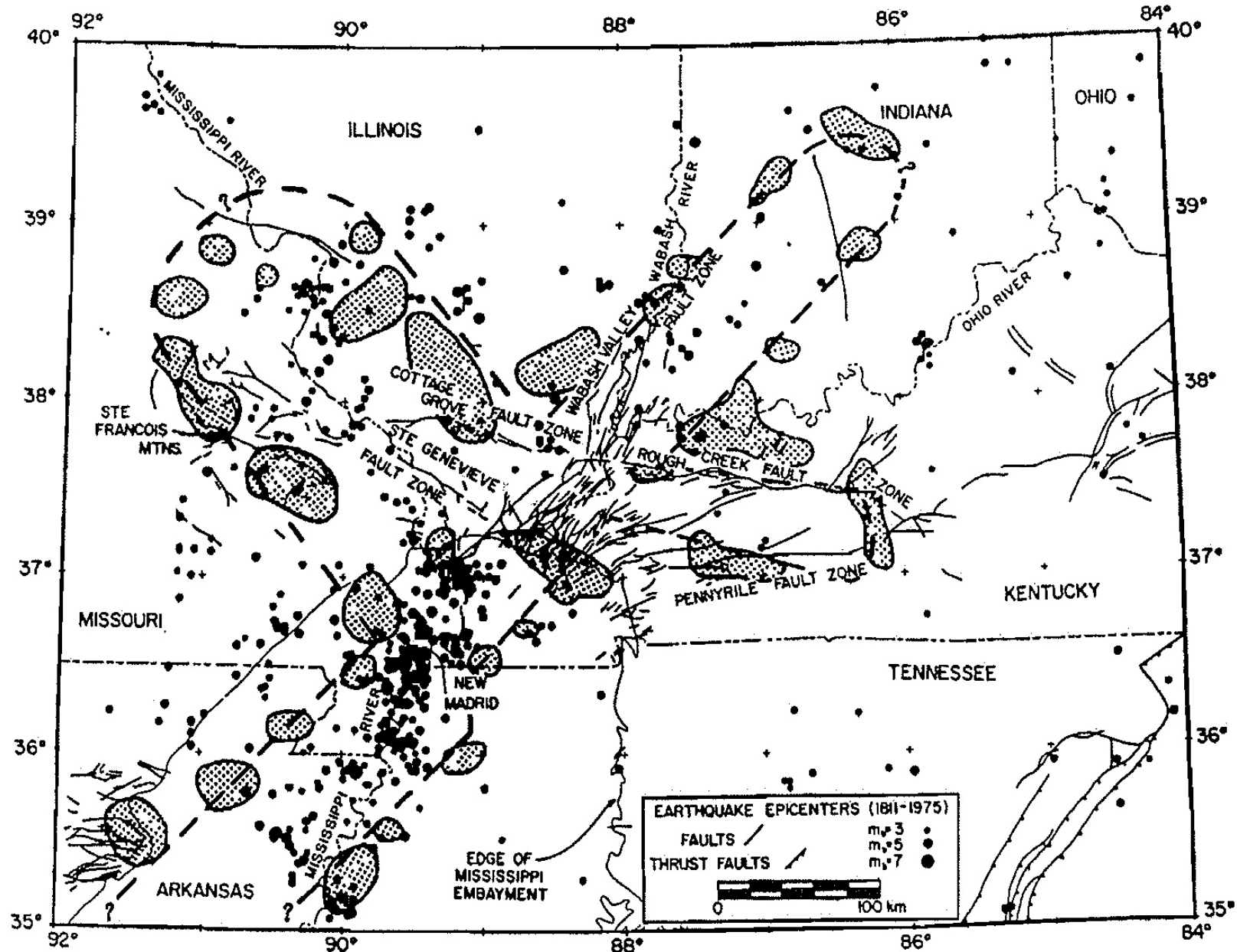
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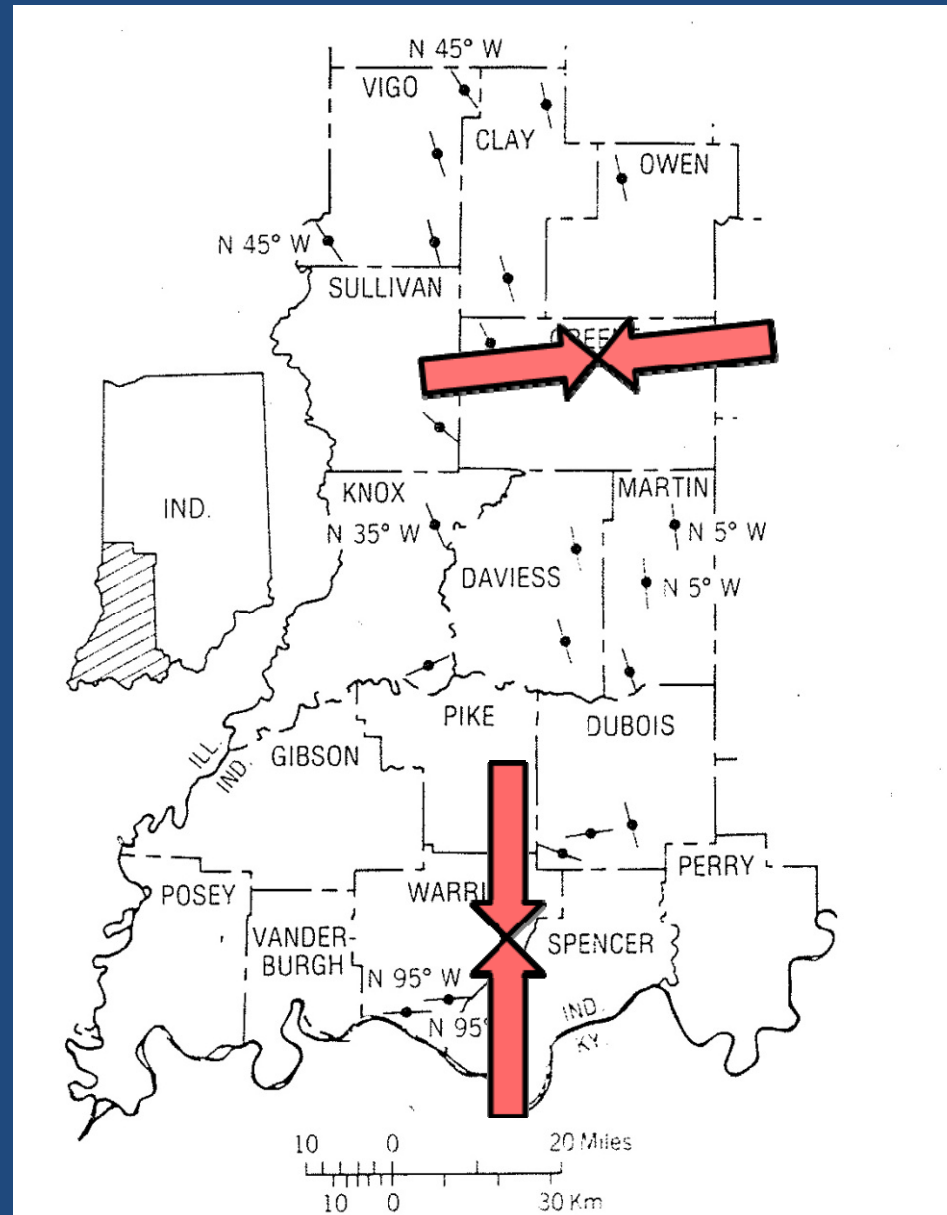
## Thesis:

- Ault et al. (1985) have proposed an east-west stress-field boundary in southern Indiana separating two major stress fields:
  - 1) Midcontinent Stress Province north of the boundary (ENE), and
  - 2) Ohio Valley Stress Province south of the boundary (NNE).
- No fracture zone has been found along the stress-field boundary. The Leavenworth Lineament Zone appears to be a major east-west structural discontinuity that closely tracks the proposed boundary.

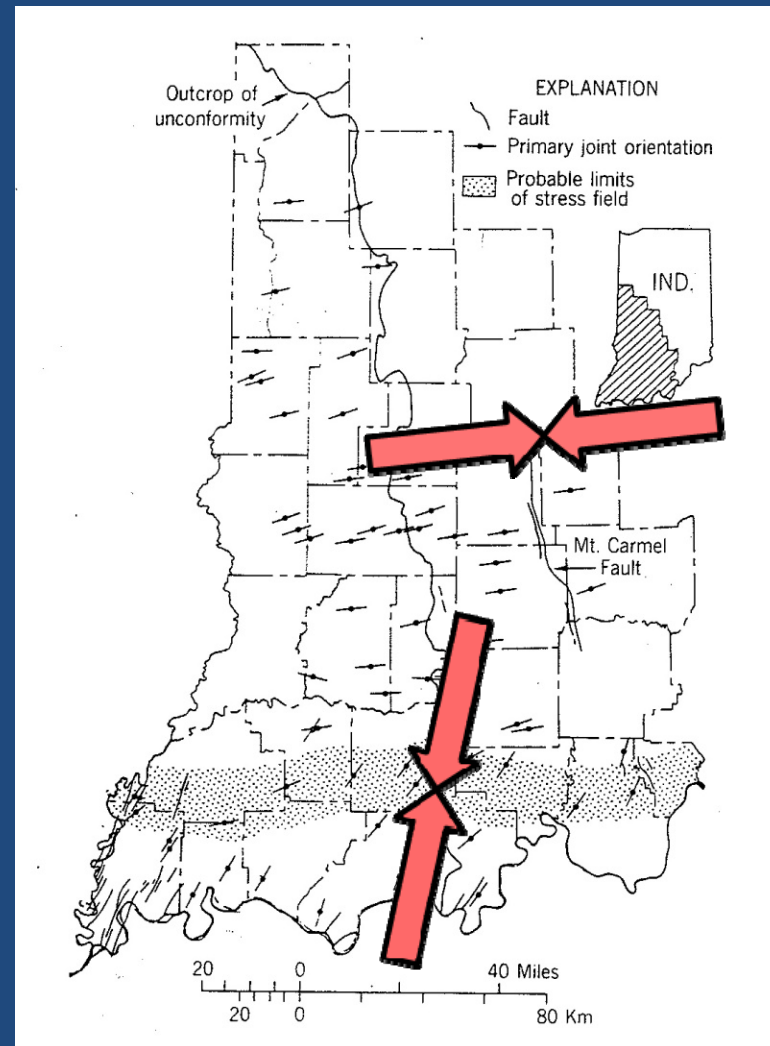
# New Madrid Rift Complex (after Braile et al., 1982)



# Low-angle thrust faults in SW Indiana (modified from Ault et al., 1985)

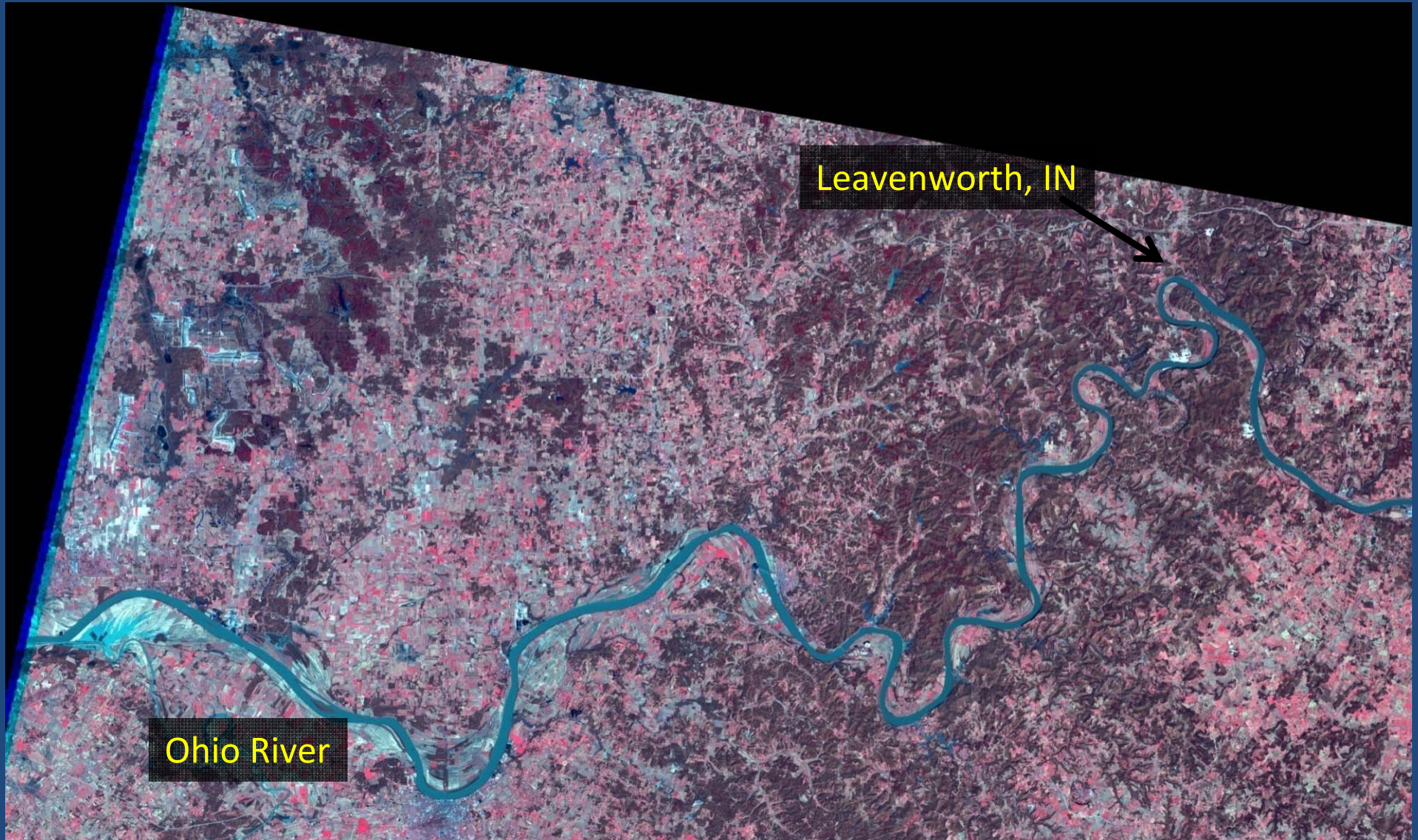


# Typical primary joint orientation and proposed stress – field boundary in SW Indiana (modified from Ault et al., 1985)



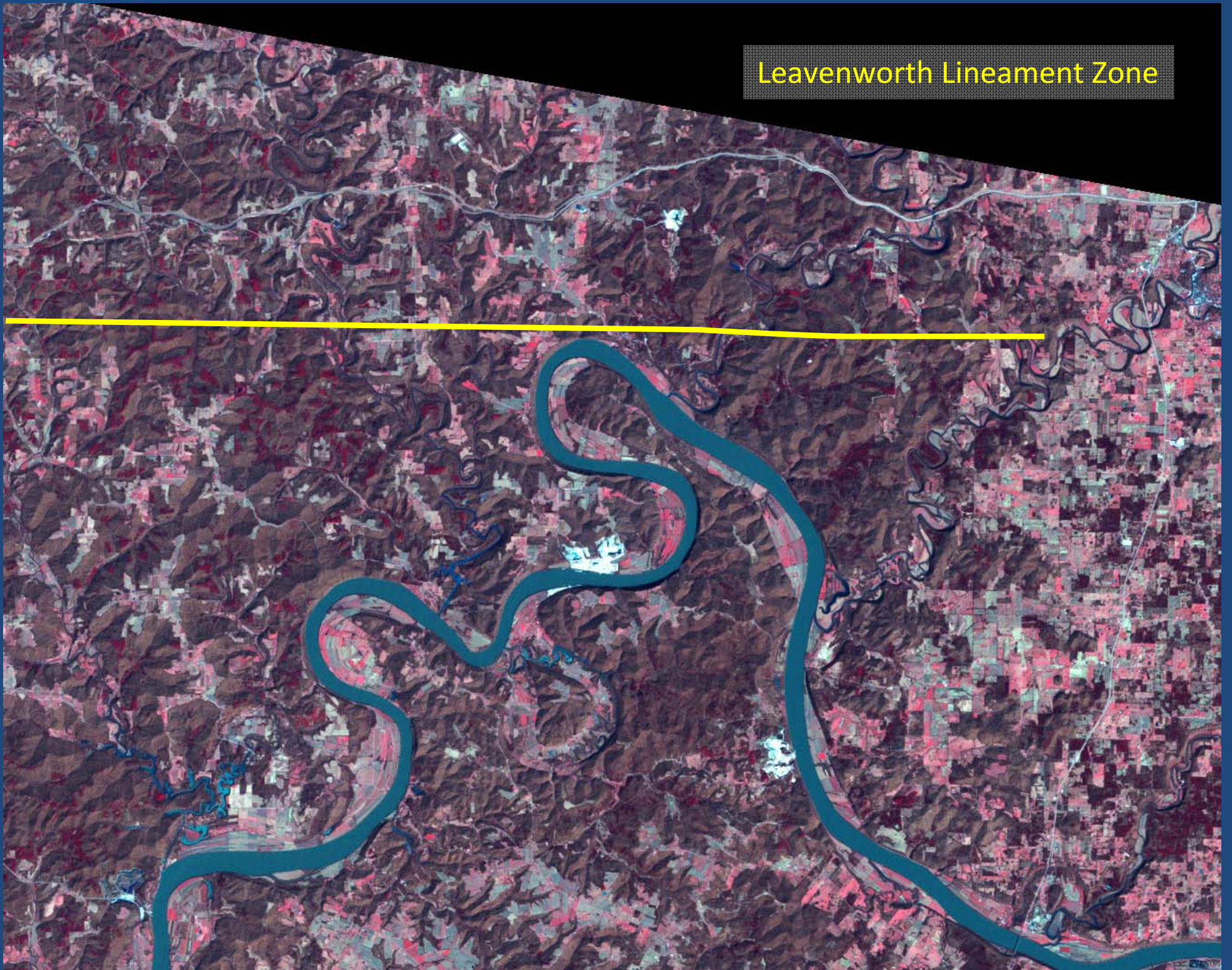


# Southern Indiana and Kentucky Landsat Thematic Mapper Imagery



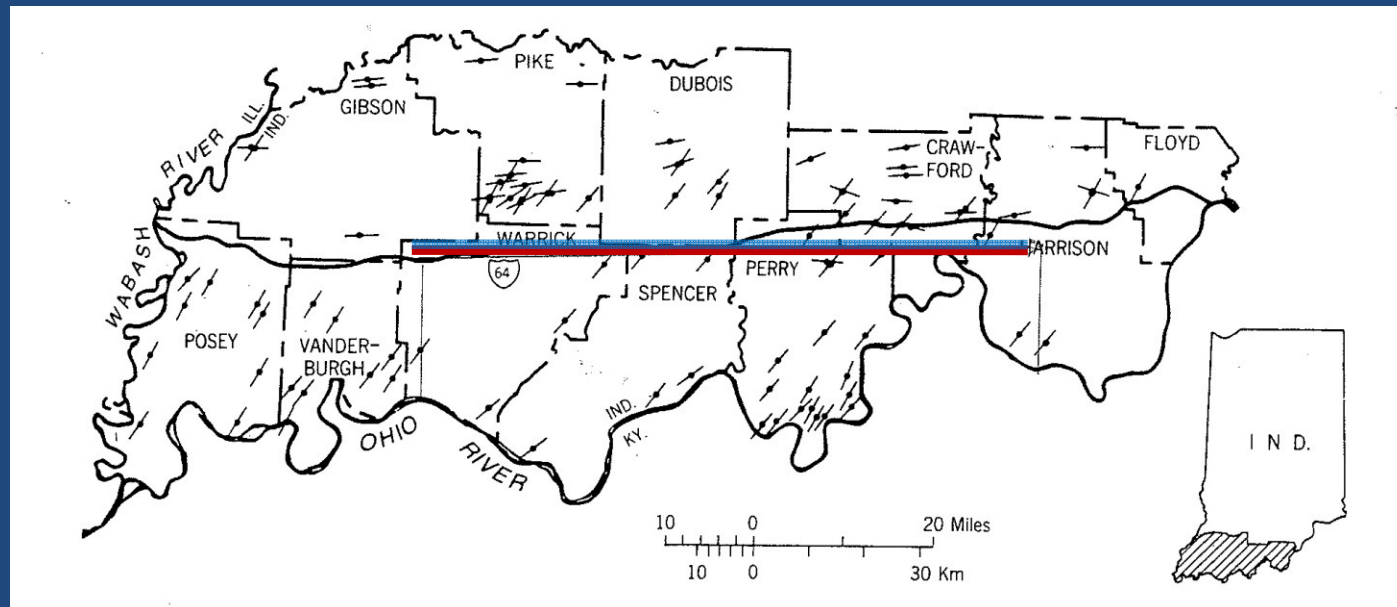


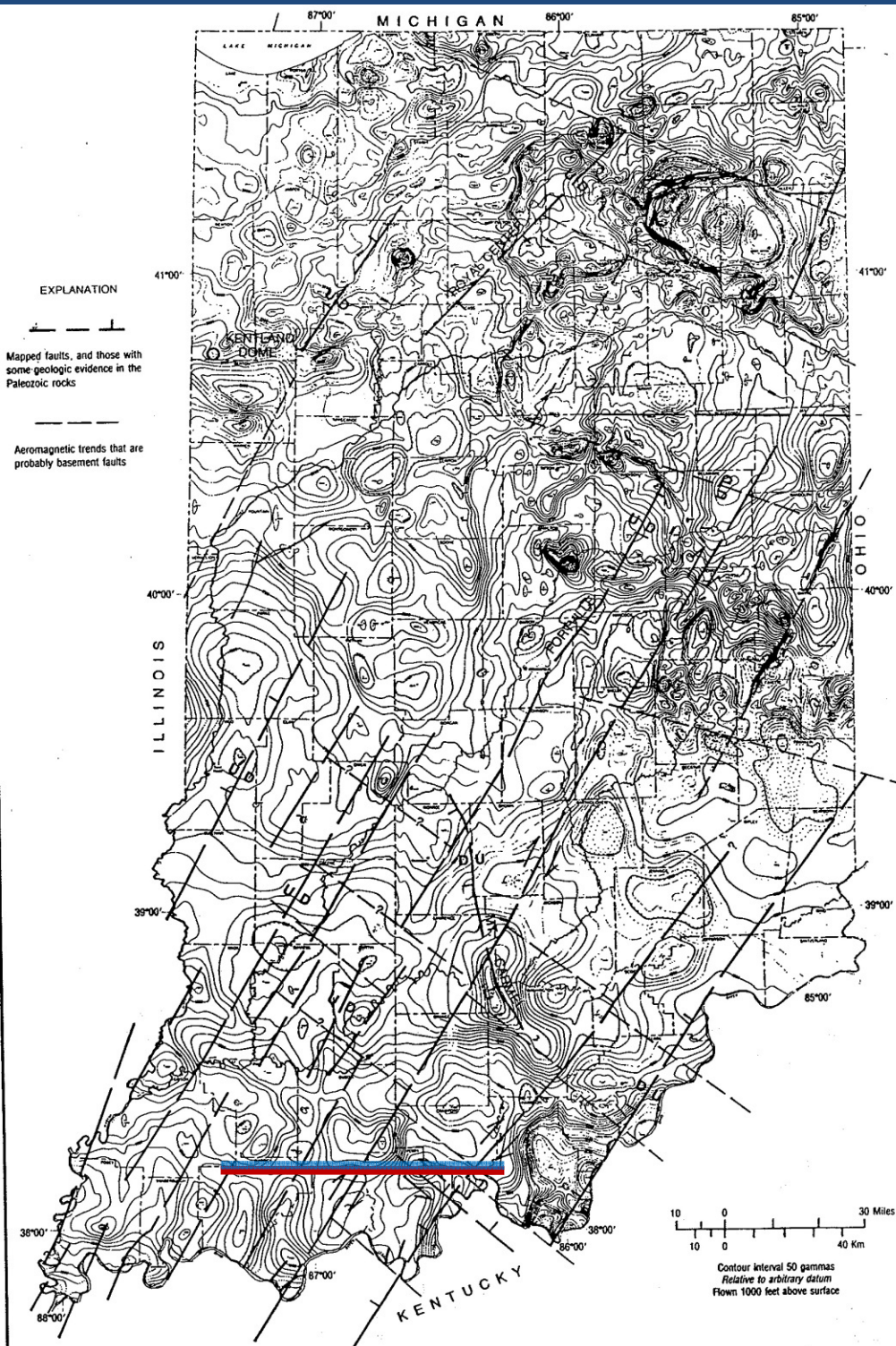
## Leavenworth Lineament Zone





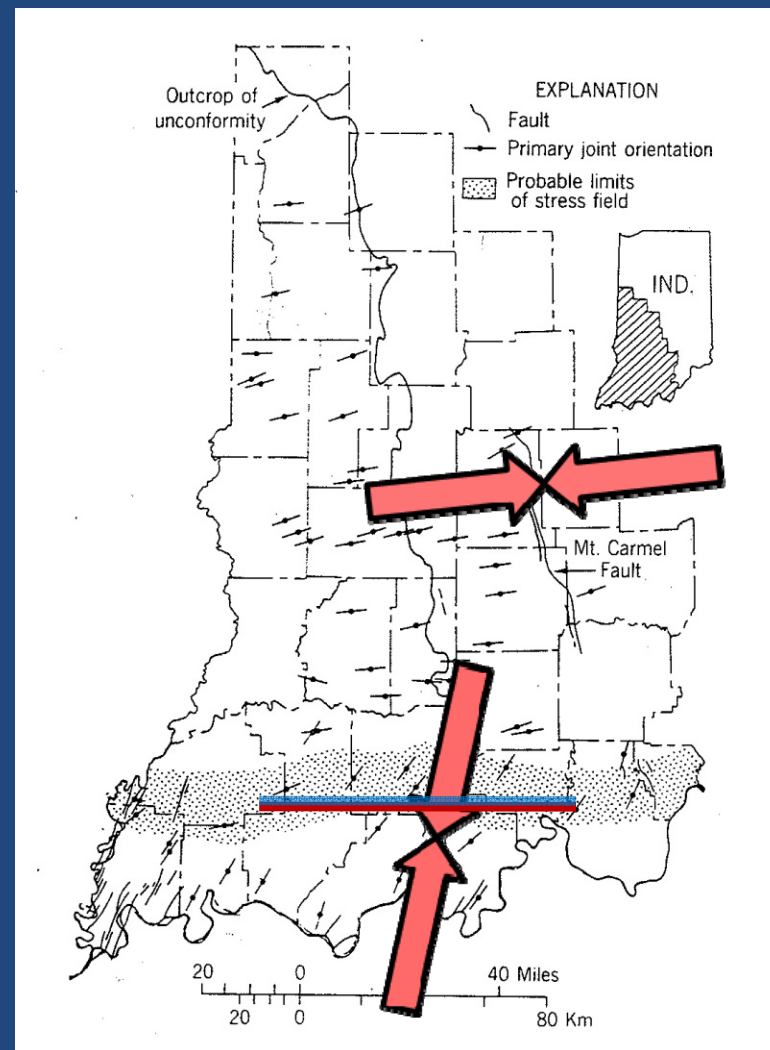
# Large-scale location map of Leavenworth lineament zone (modified from Ault et al., 1985)





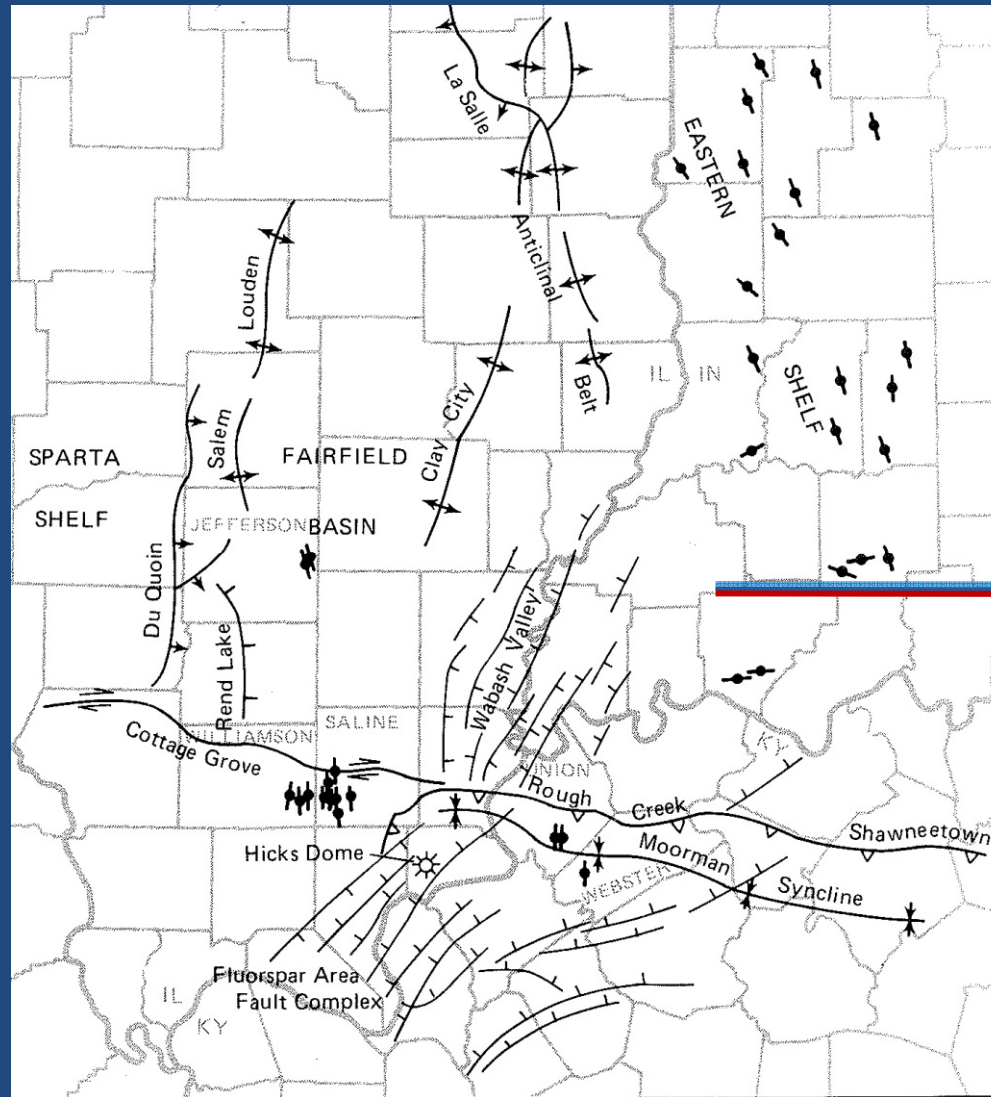
Leavenworth  
lineament zone  
tracking flattened  
aeromagnetic  
anomalies  
(after Furer, 1996;  
modified from  
Henderson & Zietz,  
1958)

# Leavenworth lineament zone tracking proposed stress-field boundary (modified from Ault et al., 1985)





# Possible marginal fault zone of the Rough Creek Graben arm (modified from Nelson and Bauer, 1987)



## Conclusions:

- The Leavenworth Lineament Zone appears to be a major east-west structural discontinuity that is aligned along a proposed stress-field boundary in southern Indiana.
- The Leavenworth Lineament Zone could be a marginal fault zone of the Rough Creek Graben arm of the New Madrid Rift Complex.
- The Leavenworth Lineament Zone may be a petroleum guide for both shale-gas and Albion-Scipio-type prospects— particularly at ~~fracture-zone~~ intersections.