

# AN INTEGRATED GEOPHYSICAL ASSESSMENT OF LATE QUATERNARY NEOTECTONICS ALONG THE NORTHERN MISSISSIPPI EMBAYMENT EXTENSION OF THE FLUORSPAR AREA FAULT COMPLEX

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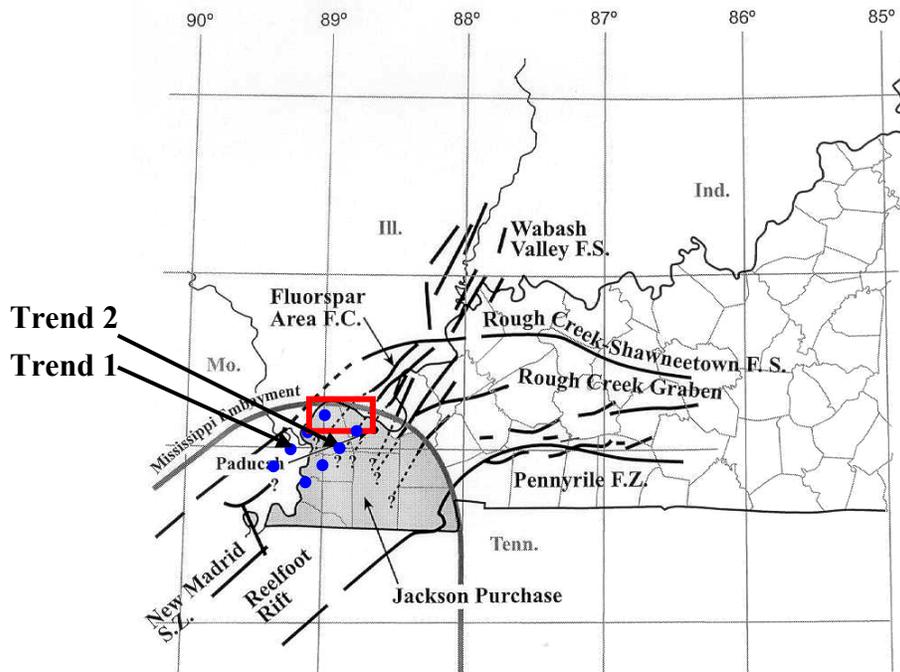
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## INVESTIGATIONS UNDERTAKEN (Year 1)

The northeast–southwest-oriented Fluorspar Area fault complex (FAFC), exposed in parts of southern Illinois, is believed to continue southwest beneath the sedimentary cover of the northern Mississippi embayment, where it appears to form the northwest margin of the Reelfoot rift [Kolata and Nelson, 1991] (Fig. 1). In addition, strands of the FAFC in the area of McCracken County and Ballard County, Kentucky, are coincident with, and near the terminals of, two diffuse northeast zones of seismicity that Wheeler [1997] called Trends 1 and 2 (Fig. 1).



**Figure 1. Major structural features in the central Mississippi Valley (modified from Kolata and Nelson, 1991). The blue-filled circles represent the diffuse trends of seismicity. The red box is the area of study. We are using integrated geophysical techniques to consider the seismogenic potential of selected**

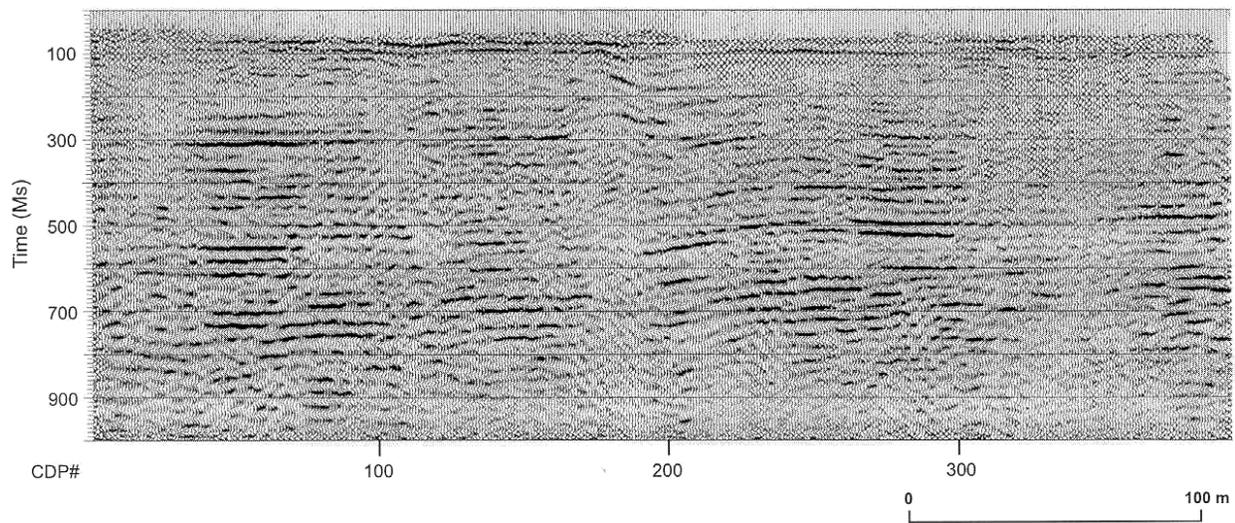
FAFC structures in the vicinity of these northeast trends of seismicity. The procedures for the investigation are to (1) perform reconnaissance P-wave reflection surveys to identify locations exhibiting potential Post-Paleozoic tectonic deformation, (2) collect high-resolution SH-wave reflection profiles to further assess the style, geometry, and timing of the neotectonic structure, and (3) identify/evaluate additional targets amenable to very high-resolution, near-surface, ground-penetrating-radar methods.

During the late spring and summer of 2001, approximately 18 kilometers of seismic reflection data have been acquired. Of the total, 10 km represents reconnaissance P-wave data. The remaining 8 km of data was collected by high-resolution SH-wave methods. As per the recommendation of the review panel, we have communicated with investigators performing related research in the area. Consequently, we have coordinated efforts with the Illinois State Geological Survey (ISGS) to obtain nearly 5 km of the P-wave reconnaissance data in an area of common interest. The cost savings realized from this institutional cooperation has allowed us to collect additional S-wave data, as well as drill and sample a 13-meter correlation hole in western McCracken County. We appreciate the cooperation and assistance from the ISGS.

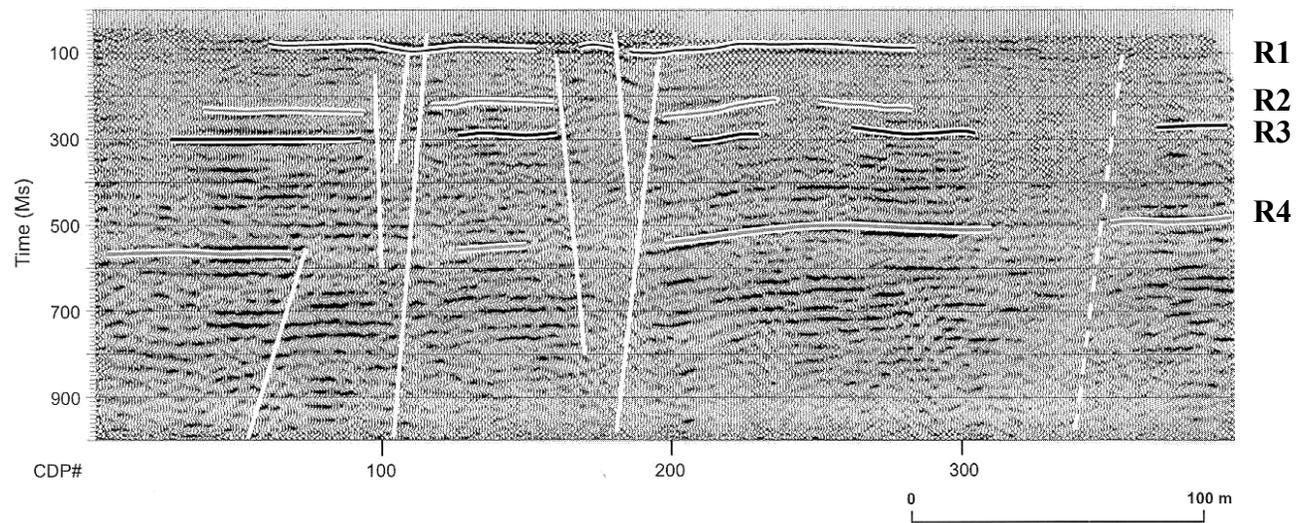
Additional work planned for the first year effort includes the acquisition of 1 to 2 kilometers of reflection data, final data processing, and preliminary target selection for the next year's GPR surveys. If legal obstacles can be overcome, we also hope to drill one additional hole in the Ballard County Wildlife Management Area.

## **RESULTS (Year 1)**

Borehole data and high-resolution reflection profiles have indicated that Paleozoic bedrock in the McCracken and Ballard counties area of western Kentucky is overlain by an approximately 100-m sequence of non-lithified Cretaceous, Tertiary, and Quaternary sediments. Moreover, the SH-wave surveys have imaged clear evidence of fault and apparent fold propagation into the near-surface Quaternary units (Fig. 2). The profiles also exhibit evidence of various structural styles associated with episodic movement. To date, we have identified structure that extends to within 7 meters of the ground surface (Fig. 2). Adjacent borehole information places this deformation at the Pleistocene loess–Metropolis Formation contact. This places the time of displacement between 135,000 and 75,000 BP, depending upon the specific loess unit present. In order to better constrain the upper time boundary, we will work with Quaternary stratigraphers at the ISGS to gain consensus on the identity of the loess unit.



(a)



(b)

**Figure 2.** Example of an (a) uninterpreted and (b) interpreted high-resolution, SH-wave profile from western McCracken County, Kentucky. The R4 to R1 reflectors correspond to the top of the Paleozoic bedrock, McNairy Formation (Cretaceous), Mounds Gravel (Pliocene–Pleistocene), Metropolis Formation (Pleistocene), respectively.

## **NONTECHNICAL SUMMARY**

Subsurface images of deformed sediments within the northern Mississippi embayment are providing direct physical evidence of relatively recent tectonic activity. The images are enabling us to estimate the time of movement, as well as, to understand the style and geometry of the deformation. Results have shown that deformation extends to within at least 7 meters of the ground surface. Preliminary age estimates suggest that the movement occurred between 75,000 and 135,000 BP.

There are limitations to the resolving power of each geophysical technique being used; consequently, the exact timing of the latest tectonic episode at some locations will be uncertain. In such instances, we hope to coordinate with, and provide target information to, researchers specializing in trenching/ paleoseismology.

## **PUBLICATIONS**

Woolery, E., and R. Street (2002). Quaternary fault reactivation in the Fluorspar Area fault complex of western Kentucky—Evidence from shallow SH-wave reflection profiles. *Seismological Research Letters* (accepted).

Woolery, E., Z. Wang, and R. Street (2001). Neotectonic deformation in the Fluorspar Area fault complex of western Kentucky—Evidence from shallow SH-wave reflection profiles. *Geological Society of America Annual Meeting, Abstracts with Program, Boston, MA*. T63.

## **DATA AVAILABILITY**

P- and SH-wave seismic reflection and refraction data acquired in the study are being organized by site, and will be archived at the Kentucky Geological Survey as field and stacked files. In addition, there will be information as to the location of the site, recording parameters, and other pertinent information. The seismic data will be stored in standard SEG format at the completion of the study, and available upon request. Requests for information should be directed to the PI.

## **REFERENCES CITED**

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