SEISMICITY OF THE NEW MADRID FAULT SYSTEM:
A Microearthquake Study in Western Tennessee

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The New Madrid seismic zone is located at the northern extent of the Mississippi embayment. It was the site of a series of disastrous earthquakes in 1811-1812. Since 1974, with the installation of the USGS telemetered microearthquake array, St. Louis University has been closely monitoring the seismic activity in and around this region. Several interesting features of the activity have begun to emerge. In particular, the pattern of seismicity has revealed distinct linear trends (presumably representing vertically inclined faults) and marked areas of concentration. Understanding in detail what this seismic pattern represents and how it relates to the occurrence of large earthquakes is crucial to a realistic assessment of the seismic hazards for the central United States. Unfortunately, establishing the geological structures directly related to the seismicity has proved difficult because several hundred feet of unconsolidated sediments cover the most active areas, and because the particular network configuration, dictated by the local topography, does not allow sufficient resolution.

To improve precision and coverage of the existing seismicity, the network of permanent stations was temporarily augmented by a high density array of portable seismographs. The study was conducted in the Ridgely area of western Tennessee from May 10 to June 11, 1978. This site was chosen as it previously exhibited a high rate of microearthquake activity and because it was one of the more readily accessible sites. Eight high-gain instruments were deployed with an average station spacing of four kilometers. The detection threshold

was $m_b = -0.5$. During 32 days of operation, 122 microearthquakes were detected, of which 90 were located. For the events near Ridgely, the epicenters indicate a broad northwest-southeast trend, representing the projection of a dipping fault surface. Fault geometry was confirmed by the vertical distribution of the hypocenters and by the composite focal mechanism which indicated a northwest trending reverse fault with strike $N30^\circ W$ and dip $40^\circ SW$. Other consistent composite focal mechanisms were determined for nearby regions, though coverage in these areas was not quite as good.

All of these solutions are in general agreement with a regional compressive stress field striking north-east and favoring either right-lateral strike-slip motion on northeast trending faults or reverse motion on faults trending northwest and north. The study also revealed a higher level of background seismicity than previously anticipated and, for the first time, an active segment of the New Madrid fault system was mapped in detail using the profile of the seismic activity, thus providing a basis for further investigation into the nature of the regional tectonic framework.