SOURCE PARAMETERS AND SEISMOTECTONICS OF THE CENTRAL NEW MADRID SEISMIC ZONE

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The New Madrid Seismic Zone (NMSZ) is the most seismically active area of the central and eastern United States. During the winter of 1811 and 1812, three catastrophic earthquakes (moment magnitude ~ 8) occurred. The possibility of recurrence of such large earthquakes and the greatly increased population of the area provides an impetus for seismotectonics investigation for reducing earthquake hazards. Current seismicity delineates four major fault segments of the NMSZ. The geometry and nature of the active faulting in the central NMSZ are still not well understood.

To understand the seismotectonics of the NMSZ, source parameters were determined, using three-component PANDA data and waveform modeling techniques. These were combined with the JHD relocation to obtain a three-dimensional picture of fault slips.

Body wave propagation in the sediment of the NMSZ was modeled. A wave modeling procedure to determine source parameters was developed. A source parameter data set consisting of focal mechanisms and seismic moments was obtained. A seismotectonic model of the NMSZ was developed. The stress field of this area, the geometry and nature of the active faults in the central NMSZ, as well as the relationship to geologic features were inferred. Seismogenesis of the NMSZ was discussed.

The depth distribution of microearthquake hypocenters indicates a seismic surface that dips to the W or SW with variable dip angle in the central NMSZ. We divided the central NMSZ into three segments.

The SE segment is oriented N30°W, 45°SW and is characterized by thrust type focal mechanisms. A striking NE conjugate fault with right-lateral oblique reverse motion was also found. The central segment strikes NS, dips 30°W and displays thrust mechanisms. The NW segment is a listric fault with a strike N40°W and a dip 70°SW near the surface and 35°SW at depth >10 km. Focal mechanisms along this segment imply left-lateral oblique-reverse slip. The Reelfoot scarp, its northern extension, the Lake County Uplift are the surface expressions of faulting along the central and NW segments. A N84°E maximum horizontal stress was inferred in the central and SE segment by averaging P-axes direction, whereas N65°E maximum horizontal stress was inferred for the northern end of the central NMSZ. At the southern intersection of the central NMSZ with the right-lateral southern axial arm, we observed both right-lateral strike-slip and thrust faulting. Two cross fault systems occur at the northern intersection of the NW segment with the right-lateral N-E arm and the left-lateral westerly arm of the NMSZ. We defined a new active arm of the NMSZ that strikes NE with right-lateral strike-slip that is parallel to the southern axial arm and is located in the southern most of NMSZ. The seismicity in the SE segment of the central NMSZ may be explained by the intersection with the new arm.

The existence of the interpreted weak zone and/or increased pore pressure may be contributing factors for the occurrence of earthquakes of the NMSZ. The stress concentrated around the periphery of the individual intrusions may also be a contributing factor.