

# **A Tale of Earthquakes Past and Yet to Come: A Cautionary Account of New Madrid Faulting from the Mississippi River**

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## **Abstract**

The New Madrid seismic zone (NMSZ) is the second highest risk area for earthquake hazard in the United States. Its fame arises from a cluster of at least three great earthquakes during the winter of 1811/1812 that shook most of the North American continent. A repeat of these earthquakes would deeply impact the mid-continent region and potentially be devastating to the nearby cities of St. Louis and Memphis. Holocene-scale patterns of behavior for the NMSZ are challenging to constrain with traditional paleoseismic methods because of reworking of the proximal stratigraphic record and the vastness of the more-distant affected region.

Alternatively, the Mississippi River transects the key faults, is known to respond to subtle tilts, and records in its strata its own record of long-term fault slip. Detailed reconstruction of Mississippi River courses shows a pattern of straightening and meandering reflecting a pattern of slope change from uplift and quiescence along the main Reelfoot thrust. This record confirms the known pattern of three month-scale clusters of earthquakes from AD900 to today.

The same record, however, also reveals a similar pattern of faulting in the middle Holocene, separated from the post-AD900 set by roughly two millennia of quiescence. This observation has some ramifications for earthquake hazards that are now folded into the hazard matrix for the U.S. mid-continent and are part of the larger set of works changing views for hazard elsewhere. Particularly, earthquakes in the NMSZ are not just month-scale clustered, but are also millennia-scale clustered. These earthquakes are thus hierarchical/fractal in nature. More directly pertinent to earthquake forecasting, the NMSZ appears to shut down for long periods between episodes of activity. During these quiescent episodes, other nearby faults potentially awake to become new hazard sites. The broader implication of this and similar works is that sites with no near-historic record of seismicity cannot be dismissed as sites of potential seismic hazard as sudden emergence of seismic activity after long hiatus is normal fault behavior.