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Geoslices and trenches among liquefaction features in New Madrid seismic zone, central United States

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Some of the largest earthquakes in the brief documentary history of the United States occurred far from active plate boundaries. These were the series of earthquakes in 1811 and 1812 at the New Madrid seismic zone. Four earthquakes of M7.5 occurred on December 16 (twice), 1811, January 23, and February 7, 1812 along the Mississippi River. Ground shaking from the earthquakes was felt as far away as the Atlantic coast and Gulf of Mexico. Although crustal deformation associated with these events changed the course of the Mississippi River, fault apparently did not rupture to the surface.

Paleoseismological surveys of liquefaction features, in many cases at archaeological sites, have focused primarily on liquefaction features and have identified several prehistoric earthquakes that occurred around AD1450, AD900 and probably AD500.

In the fall of 2001, a joint US-Japan survey was made at two sites in Blytheville, Arkansas (sites JP and HF). The group studied the roots of liquefaction features in hopes of improving methods for estimating ground motions from New Madrid earthquakes.

A trench wall at the JP site shows a sand blow composed of fine to medium sand that contains many mud clasts. On the ditch wall at HF site, the sand blow intrudes a paleosol with artifacts about 1m below the surface, almost reaching the ground surface. The sand blow is composed of several fining upward units, suggesting that the sand blow is a compound structure that founded as the result of several earthquakes separated by short time intervals.

Geoslicing at JP site showed that silt and silty sand extends to depths of 7 m, where they overlie medium to very coarse sand. The silty unit, deposited on a natural levee and perhaps also in a backswamp, includes silt intruded by sand exposed in the trench. The 7 m thickness suggests persistence of overbank conditions. The sand beneath, locally cross-bedded, probably accumulated on a bar or channel bottom. Such sand, fluidized, probably fed the sand blow and its feeder dikes.

At HF site, beds of silt (units 1, 3, and 5) alternate with sand (units 2, 4, and 6). A sand blow on the ditch wall is continuous with a dike recovered in a geoslicer to 4 m beneath the sand blow. In the long slice, massive sand with mud clasts penetrated units 1 through 3. We noticed no liquefaction or fluidization features in sand units 2 and 4. Sand in unit 6 shows many liquefaction features and widely spread horizontally, suggesting that the source of sand blow is this unit. Liquefaction features in unit 6 are summarized as follows: 1) consist of massive sand, 2) contains mud clasts, 3) penetrates or erodes bedded structures, 4) small high-angle faults develop near intrusive sand truncate structures in silt and sand layers.