

Sand Blows and the New Madrid Earthquakes of 1811-1812

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Sand blows and related sand dikes result from liquefaction of water-saturated, sandy sediment in response to ground shaking produced by earthquakes of $M > 5$. As seismic waves pass through the sediment, pressure builds up in the water between the sand grains. If the pore-water pressure increases to the point that it equals the weight of the overlying soil, the sediment liquefies. Once liquefied, the pressurized water with entrained sand forcefully flows towards the ground surface. It intrudes pre-existing cracks or cracks and fissures that form as the overlying sediment founders into the liquefied sand or slides down slope. In cases, where the pressurized slurry of water and sand erupts to the ground surface, fountains may be observed and sand may be deposited on the surface around the vent to form a sand blow or sand volcano. Over time, soils form in the sand blows or they are buried by other deposits preserving them in the geologic record. Cultural artifacts, organic material, and sediment above and below sand blows can be used to estimate their ages and the earthquakes that caused them.



Large liquefaction features resulting from strong earthquake-shaking in the New Madrid seismic zone. Exposed through trenching, the wall and floor of the excavation reveal a portion of a sand blow and related sand dikes. The degree of soil development above and within the sand blow suggest that the earthquake that formed this feature occurred prior to the 1811-1812 New Madrid earthquakes. Photo by Martitia Tuttle.

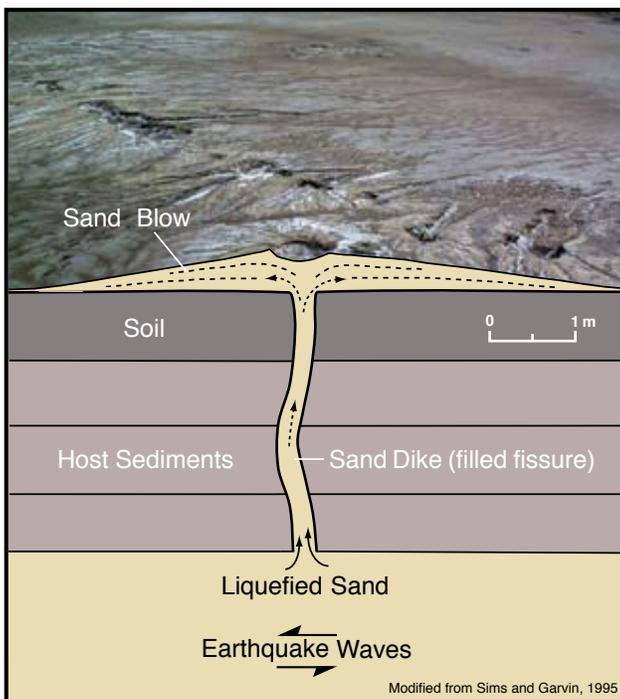


Illustration of a cross section of a modern sand dike superimposed on a photograph of actual sand blows, also known as “sand boils” or “sand volcanoes”. (Sims, J.D., and Garvin, C.D., 1995, Recurrent liquefaction at Soda Lake, California, induced by the 1989 Loma Prieta earthquake, and 1990 and 1991 aftershocks: Implications for paleoseismicity studies, *Seismological Society of America Bulletin*, v. 85, p. 51-65.)

Evidence for liquefaction during the 1811–1812 New Madrid Earthquakes

During the 1811-1812 New Madrid earthquakes, large sand blows formed over a very large area, about 10,000 km², and smaller sand blows formed more than 240 km from the inferred epicenters. Similar broad distributions of sand blows from other earthquakes around the world suggest that the New Madrid earthquakes were very large ($M > 7$) in magnitude. In addition to these more recent events, hundreds of ancient sand blows, like the one shown in the cover photo, have been mapped and dated across the New Madrid region. Many formed about 1450 C.E. and 900 C.E. These are similar in size and in internal stratigraphy to sand blows that formed during the 1811-1812 New Madrid earthquakes. Their age, size, and areal distribution suggests that the New Madrid seismic zone produced earthquakes similar to those in 1811-1812 at least twice before. The paleoearthquake record of the region is incomplete prior to 900 C.E., but there are hints of other large earthquakes about 1000 and 2350 B.C.E.

For more information and additional references please see:

<http://mptuttle.com/newmadrid1.html>

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