

USGS Account 2 New Madrid Earthquake  
<http://wwwneic.cr.usgs.gov/neis/states/missouri/1811.html>

## The Mississippi Valley Earthquakes of 1811 and 1812

Shortly after 2 o'clock on the morning of December 16, 1811, the Mississippi River valley was convulsed by an earthquake so severe that it awakened people in cities as distant as Pittsburgh, Pennsylvania, and Norfolk, Virginia. This shock inaugurated what must have been the most frightening sequence of earthquakes ever to occur in the United States. Intermittent strong shaking continued through March 1812 and aftershocks strong enough to be felt occurred through the year 1817. The initial earthquake of December 16 was followed by two other principal shocks, one on January 23, 1812, and the other on February 7, 1812. Judging from newspaper accounts of damage to buildings, the February 7 earthquake was the biggest of the three.

In the Mississippi and Ohio River valleys the earthquakes did much more than merely awaken sleepers. The scene was one of devastation in an area which is now the southeast part of Missouri, the northeast part of Arkansas, the southwest part of Kentucky, and the northwest part of Tennessee. Reelfoot Lake, in the northwest corner of Tennessee, stands today as evidence of the might of these great earthquakes. Stumps of trees killed by the sudden submergence of the ground can still be seen in Reelfoot Lake.

Uplift of over 3 meters was reported at one locality several hundred kilometers to the southwest of the epicentral zone where a lake formed by the St. Francis River had its water replaced by sand. Numerous dead fish were found in the former lake bottom. Large fissures, so wide that they could not be crossed on horseback, were formed in the soft alluvial ground. The earthquake made previously rich prairie land unfit for farming because of deep fissures, land subsidence which converted good fields to swamps, and numerous sand blows which covered the ground with sand and mud. The heavy damage inflicted on the land by these earthquakes led Congress to pass in 1815 the first disaster relief act providing the landowners of ravaged ground with an equal amount of land in unaffected regions.

Some of the most dramatic effects of the earthquakes occurred along rivers. Entire islands disappeared, banks caved into the rivers, and fissures opened and closed in the river beds. Water spouting from these fissures produced large waves in the river. New sections of river channel were formed and old channels cut off. Many boats were capsized and an unknown number of people were drowned. There are some graphic eyewitness descriptions in contemporary newspapers made by the boatmen caught on the Mississippi River near Little Prairie, not far from the present-day town of Caruthersville, Missouri.

Although the total number of deaths resulting from the earthquakes is unknown, the toll probably was not large because the area was sparsely populated and because the log cabin type construction that was prevalent at that time withstood the shaking very well. Masonry and stone structures did not fare so well, however, and damage to them was reported at distances of 250 kilometers and more. Chimneys were thrown down in Louisville, Kentucky, about 400 kilometers from the epicentral area, and were damaged at distances of 600 kilometers.

Although it is impossible to know the precise epicentral coordinates of the earthquakes, contemporary accounts of the events suggest that the epicenter of the December 16 shock was close to the southern limit of the area of sand blows. The epicenter of the February 7 shock was closer to the northern limit of the sand blows, near the town of New Madrid, Missouri. There is not sufficient information about the second main shock on January 23 to know its epicenter. Thus the common practice of calling the entire earthquake sequence the "New Madrid earthquakes" is

somewhat misleading. From what is known about the present seismicity of the area, it can be inferred that their focal depths were probably between 5 and 20 kilometers. The fault plane -- or planes -- on which the Earth rupture occurred are inferred to have had a NNE - SSW strike direction, more or less parallel to the Mississippi River.

The felt areas of the three largest earthquakes were extremely large. They extended south to the gulf coast, southeast to the Atlantic coast, and northeast to Quebec, Canada. The western boundary cannot be established owing to a lack of population. However, it can be estimated that the area of intensity V or greater effects was approximately 2½ million square kilometers. This can be contrasted with the 1906 San Francisco earthquake, for which the area of intensity V or greater effects was about 150,000 square kilometers. The large difference in felt areas between the Mississippi Valley and San Francisco earthquakes, which had approximately the same magnitude and focal depth, can be explained by differences in attenuation of earthquake waves traveling through the Earth's outer crust. The crust in the Western United States tends to "soak up" earthquake energy, whereas in the central and eastern regions of the country the seismic energy experiences a much lower rate of absorption. Quantitative studies of recent earthquakes confirm this explanation.

Invariably the three questions that are asked when one describes the 1811-12 earthquakes are (1) could such earthquakes occur again, (2) if so, when will they happen, and (3) what would be the effect of such an earthquake if it were to occur now?

The answer to whether such earthquakes can happen again is yes. Field studies by M. L. Fuller of the United States Geological Survey published in 1912, provided topographic and geological evidence of large magnitude earthquakes predating the 1811-12 sequence. This evidence included ground cracks as large as any caused by the 1811-12 earthquakes in which trees fully 200 years old grew from the bottoms and slopes. Indications of more recent faults and of sandstone dikes filling old earthquake cracks were also found by Fuller. Furthermore, studies of the seismicity since 1812 show that the region is behaving in a manner more or less typical of active seismic zones.

The second question -- when will another great earthquake happen -- is much more difficult to answer. Extrapolation of magnitude and intensity recurrence curves is presently the only method of prediction available, but this is full of difficulties because the earthquake record covers far too brief a period of time and because earthquakes do not follow an exact cyclical pattern. Although extrapolations of recurrence curves for the region indicate return periods -- depending on the investigator -- of anywhere between about 400 to 1,000 years for an earthquake the size of the December 16, 1811 event, there is a possibility that such an earthquake might occur as soon as next year or as late as several thousand years hence.

It is easier to speculate on the effects that an earthquake the size of the 1811-12 series would have if it were to occur today than it is to predict when it will happen. In the epicentral area, a repeat of the kind of surficial damage experienced in 1811-12 can be expected. However, this would result in a much greater loss of life and property today because of the much larger number of people and man-made structures in the region than were there 162 years ago. Even more awesome is the size of the area that would be affected. The dispersion of the surface waves, combined with their low attenuation, would result in a large amplitude, long duration sinusoidal type of motion with periods in the same range as the natural periods of tall buildings. Although damage to buildings located outside of the immediate earthquake zone would be mostly nonstructural in character, the monetary amount should be expected to be very large. The emotional and psychological effects of a large earthquake in the central part of the country would probably also be considerable, particularly if the earthquake had a long aftershock pattern as the

1811-12 sequence did.

Perhaps the greatest danger of all arises from the sense of complacency, or perhaps total ignorance, about the potential threat of a large earthquake. The frequency of occurrence of earthquakes the size of those that took place in 1811-12 is very low; however, continuing minor to moderate seismic activity in the central Mississippi Valley area is an indication that a large magnitude tremor can someday be expected there again.

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