

2. 1811-1812 earthquakes

Have image as almost Biblical cataclyms

Often claimed to have

-been the largest in North America

- rung bells in Boston

- predicted by Indians

- reversed flow of river

Hidden Fury

The New Madrid Earthquake Zone

The danger posed by the New Madrid earthquake zone along the Mississippi River.

27 minutes

DVD-R version available

Color

Closed Captioned

Grade Level: 7-12, College, Adult

US Release Date: 1993

Copyright Date: 1993

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Produced by Doug Prose/Earth Images Foundation

The New Madrid earthquake zone, located along the Mississippi River near Memphis, Tennessee, has received little attention in recent years. But in

1811 it was the site of the most powerful series of earthquakes ever known on earth. Some two million square miles were affected, and shocks were felt as far away as Montreal, Canada - 1,200 miles from the epicenter.



"Interesting, easy to follow, full of good information."
***** *Journal of Geological Education*

What actually happened?

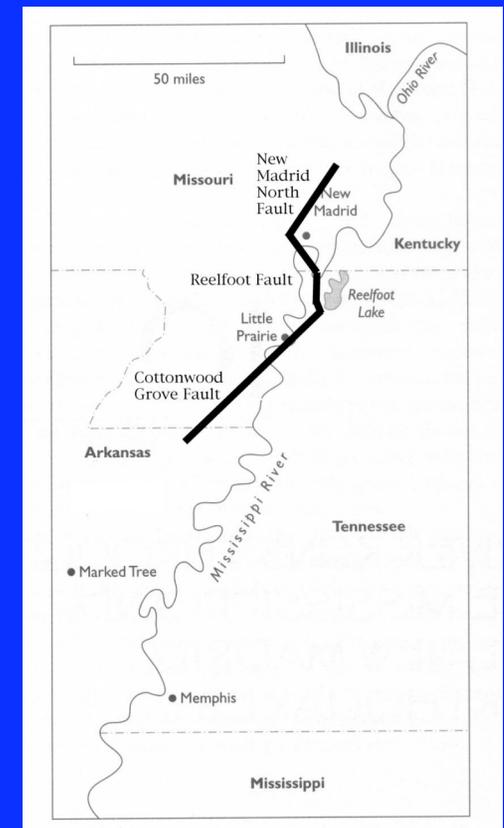
New Madrid 1811

The Mississippi river valley was the frontier. New Madrid, which claims to be the oldest city west of the Mississippi, was settled in 1789. It was named in hope of pleasing the Spanish, who controlled the area. In 1803, the Louisiana Purchase passed Congress by a vote of 59-57. It doubled the size of the U.S. and opened the Mississippi, all for about \$15 million.

The river became the major transportation route for settlements west of the Appalachians. Most people in the area lived in small towns along the river. St. Louis was small, and the city of Memphis didn't exist yet. The New Madrid area had about 3000 residents.



<http://www.enchantedlearning.com>



DD 5.5

A bad time

Tension with England had been building for years, and war seemed forthcoming. The country was bitterly divided. “War hawks” from the south and west favored war to expand the country, while New Englanders and New Yorkers were opposed.

The U.S. was already fighting frontier Indians, backed by England. Although in November 1811 U.S. forces defeated a coalition of Indian tribes led by Shawnee chief Tecumseh at the battle of Tippecanoe, the Indian threat remained.



<http://www.legendsofamerica.com/>

<http://www.ohiohistorycentral.org/>



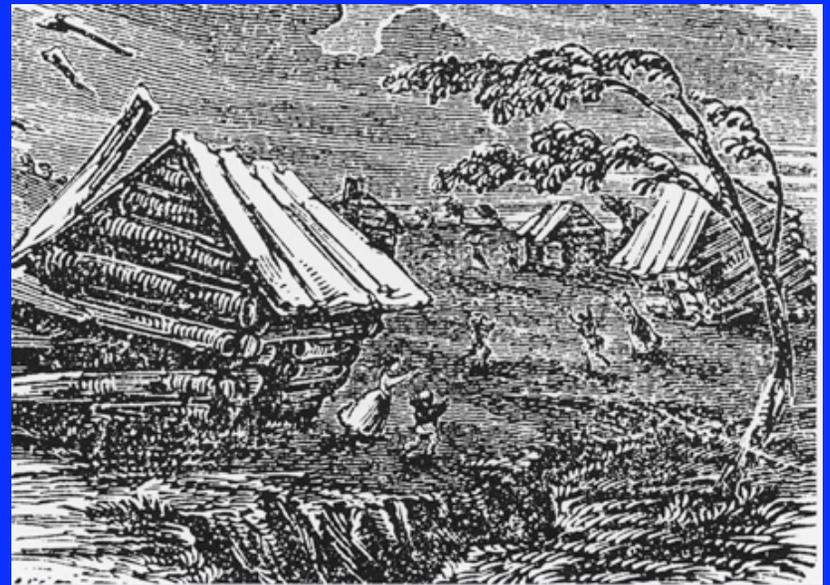
New Madrid:

December 16, 1811: "The house danced about, and seemed as if it would fall on our heads. I soon conjectured the cause of our trouble, and cried out that it was an Earthquake, and for the family to leave the house, which we found very difficult to do, owing to its rolling and jostling about. The shock was soon over, and *no injury was sustained, except the loss of the chimney.*"

The earthquakes went on and on. Most were small, but one on **January 23, 1812** was large enough to disrupt riverbanks and create more sand blows.

February 7, 1812 : " A concussion took place much more violent than those preceding." The town's houses, which sustained some damage like broken chimneys in the previous earthquakes but had not collapsed, *were "all thrown down."*

Sequence of earthquakes over months, with three major shocks



Historical Society of Missouri

DD 5.3

USGS
DD 5.2



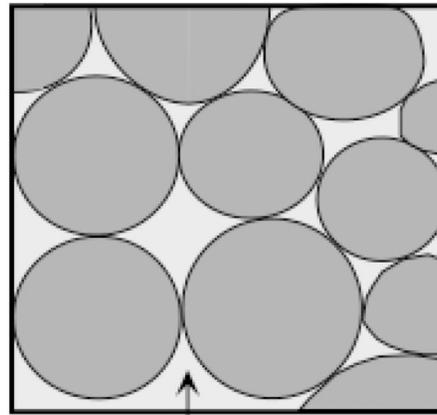
Photo by M. Fuller, 1904

“Trees were falling in every direction — some torn up by their roots, others breaking off above the ground, and limbs and branches of all sizes flying about us.”

John Walker, camped near Little Prairie, near present-day Caruthersville, Missouri.

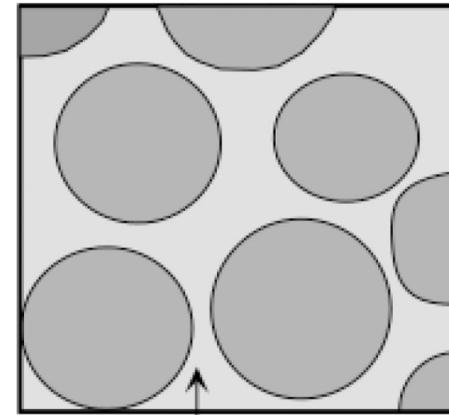
“The earth was horribly torn to pieces. The surface of hundreds of acres was, from time to time, covered over of various depths of the sand which issued from the features, some of which closed up immediately after they had vomited forth their sand and water.”

Water-Saturated Sediment

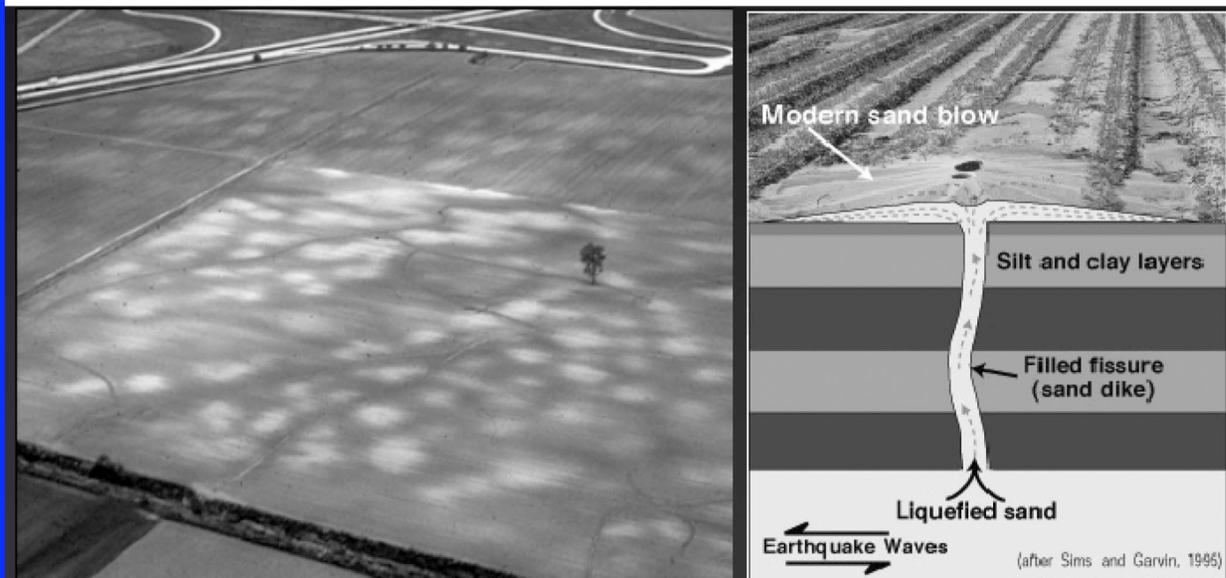


Water fills in the pore space between grains. Friction between grains holds sediment together.

Liquefaction



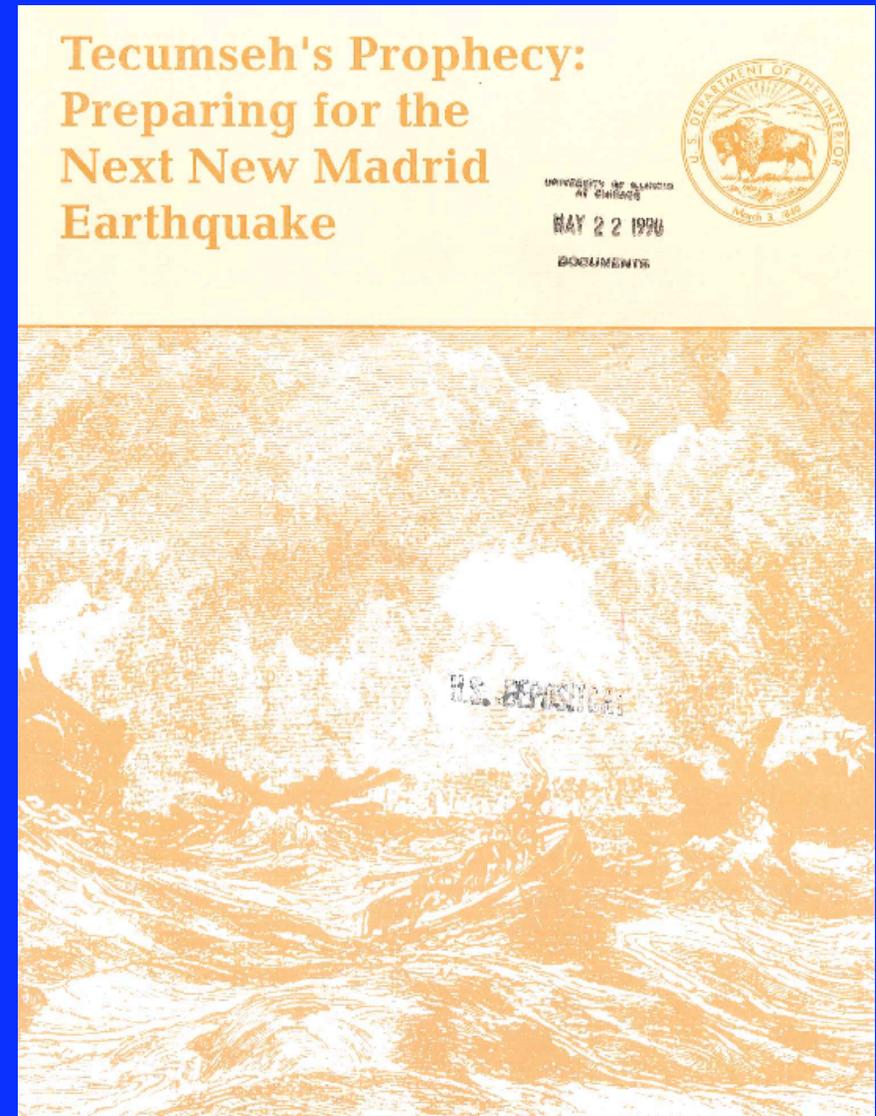
Water completely surrounds all grains and eliminates all grain to grain contact. Sediment flows like a fluid.



Postdiction, not prediction

Shawnee chief Tecumseh didn't prophecy the earthquakes

Addressing tribes *after the earthquakes*, he pointed to what had happened as divine support for his cause: “The Great Spirit is angry with our enemies. He speaks in thunder, and the earth swallows up villages.”



Did the Mississippi run backwards after February shock?



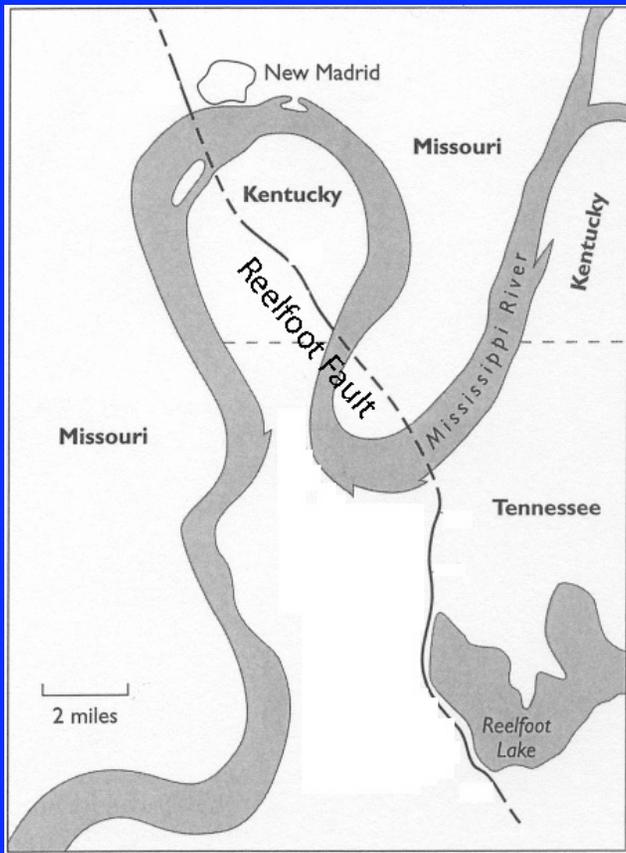
Historical Society of Missouri DD 5.4

“The current of the Mississippi was driven back upon its source with the greatest velocity for several hours in consequence of the elevation of its bed. But this noble river was not to be stayed in its course. Its accumulated waters came booming on, and overtopping the barrier thus suddenly raised, carried everything before them with resistless power.”

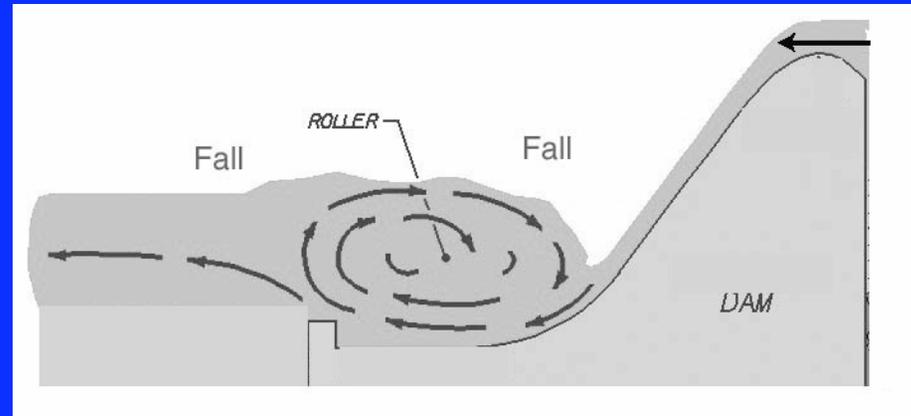
Reverse current lasted a few hours.

Real or legend?

Vertical motion on Reelfoot fault created temporary dams on riverbed that disrupted flow until current cleared them away



Sieh and LeVay, 1998



Flow over low head dam creates zone where surface water flows backwards, with waterfalls on upstream and downstream sides

Boatmen perhaps encountered bigger & more complicated version, with back flow downriver from natural dams and slower current upriver

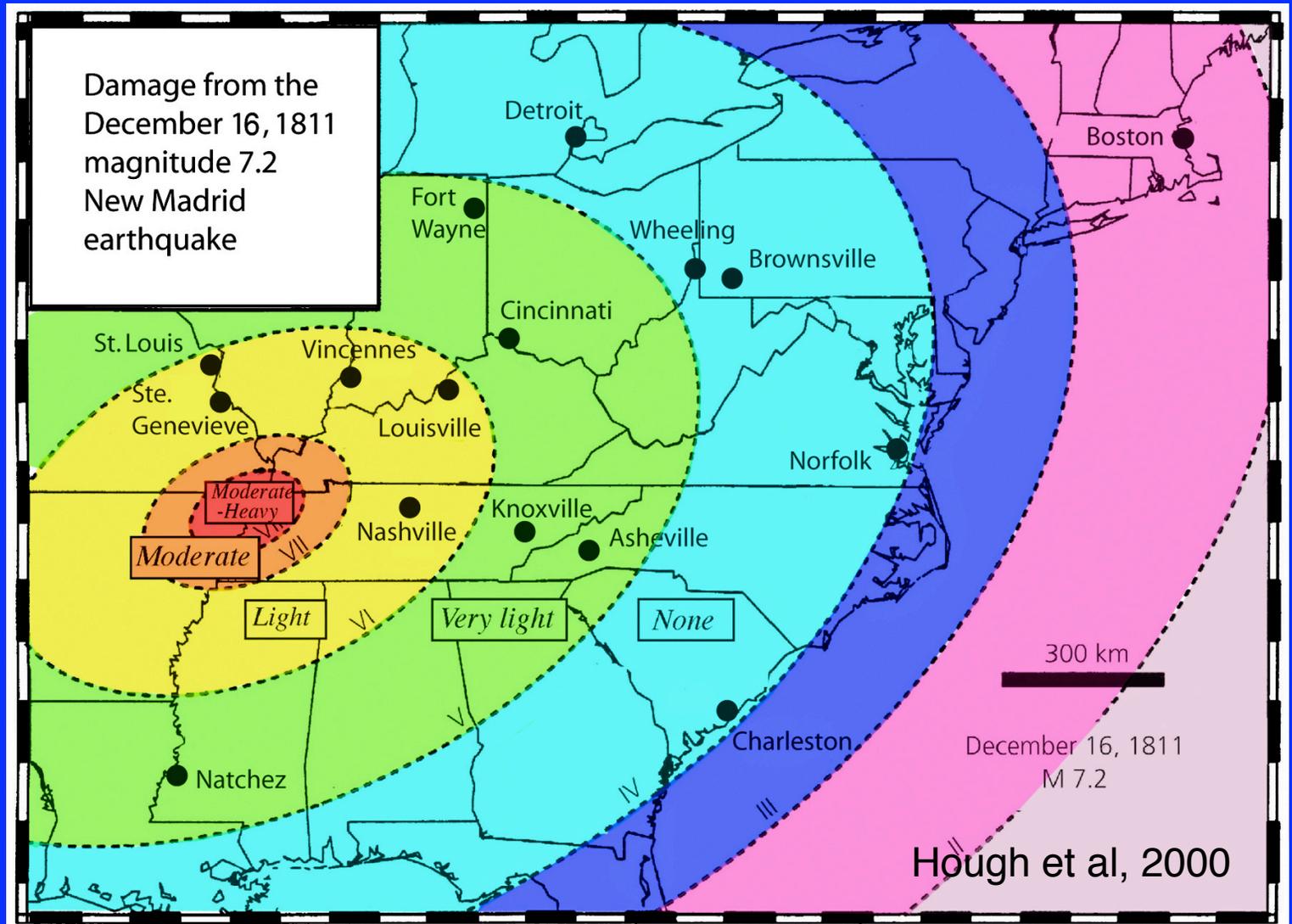
Shaking intensity yields low magnitude 7 first inferred, not subsequently quoted 8

DD 5.8

Log cabin damage at New Madrid

Minor damage in St Louis, Nashville, Louisville, etc.

Not felt in Boston, no church bells ring

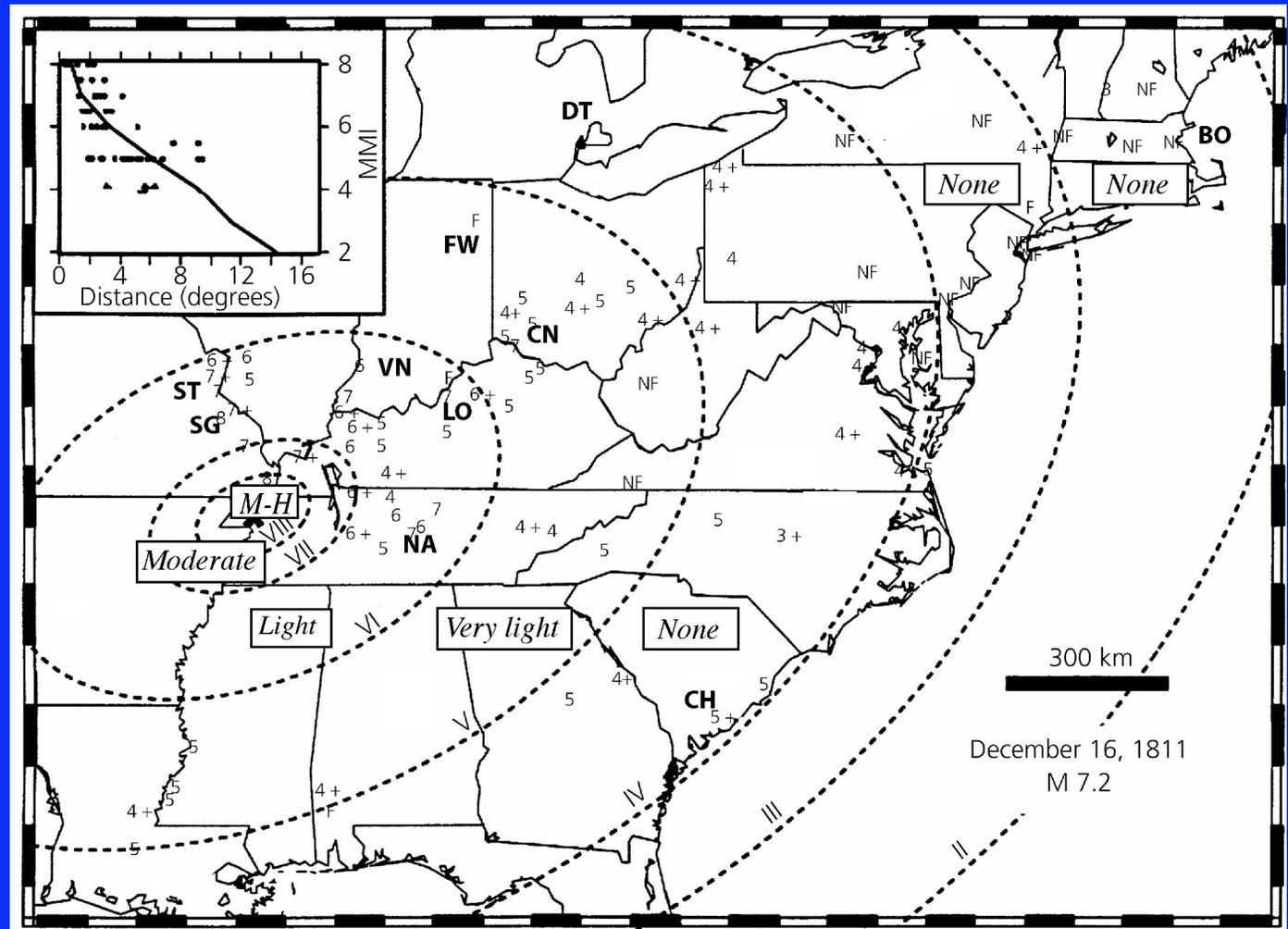


Use map to infer the shaking that would have happened in your community

-What intensity value is that?

- What might you expect today if a similar earthquake happened?

Activity 2.1: If 1811-12 happened today



News

Quake analysis rewrites history books

**Magnitude
keeps
shrinking**

New Madrid quakes were smaller than originally thought.

Richard A. Lovett

A series of earthquakes that hit the North American heartland nearly 200 years ago were considerably smaller than reported in the history books, according to research presented at a meeting this week.

The quakes struck the New Madrid fault zone 200 kilometres south of St Louis, Missouri, in 1811 and 1812, long before modern seismometers allowed accurate measurements of their intensity. In the 1980s, however, some scientists estimated that the magnitudes of these quakes were over 8.0, says Susan Hough, a seismologist at the US Geological Survey's Pasadena office in California.

"You'll still find claims that these were the largest earthquakes ever in the contiguous United States," says Hough, who presented her findings on 23 April at a meeting of the Seismological Society of America, in Portland, Oregon.

Previously, Hough had stated¹ that the earthquake magnitudes were only about 7.5. Now, she has reduced her estimates by another half point, to "right around magnitude 7."



The New Madrid earthquakes may have been considerably smaller than scientists had estimated.

These were big earthquakes

Hidden Fury The New Madrid Earthquake Zone

The danger posed by the New Madrid earthquake zone along the Mississippi River.

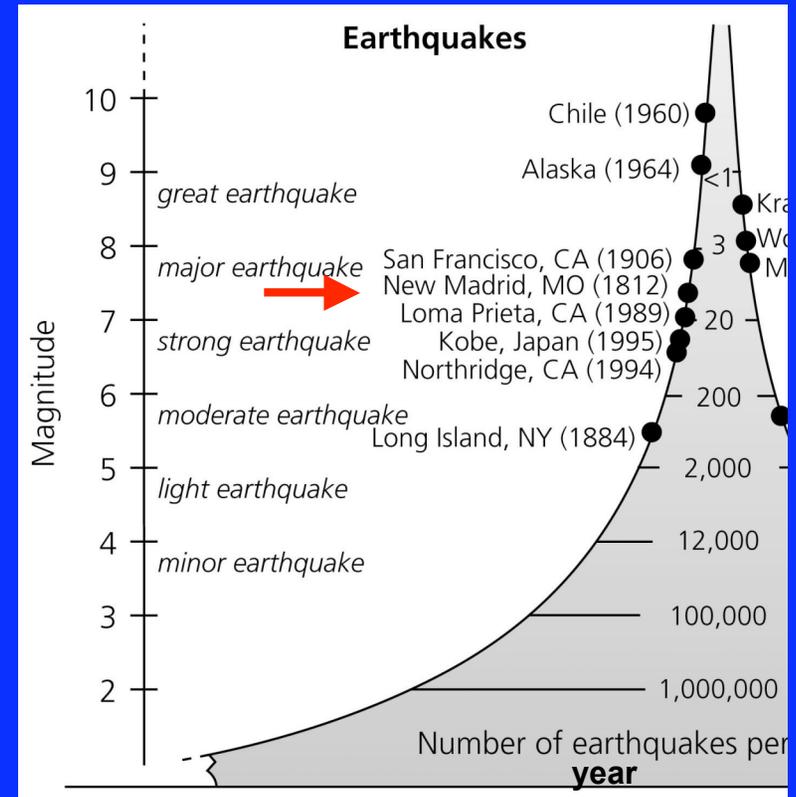


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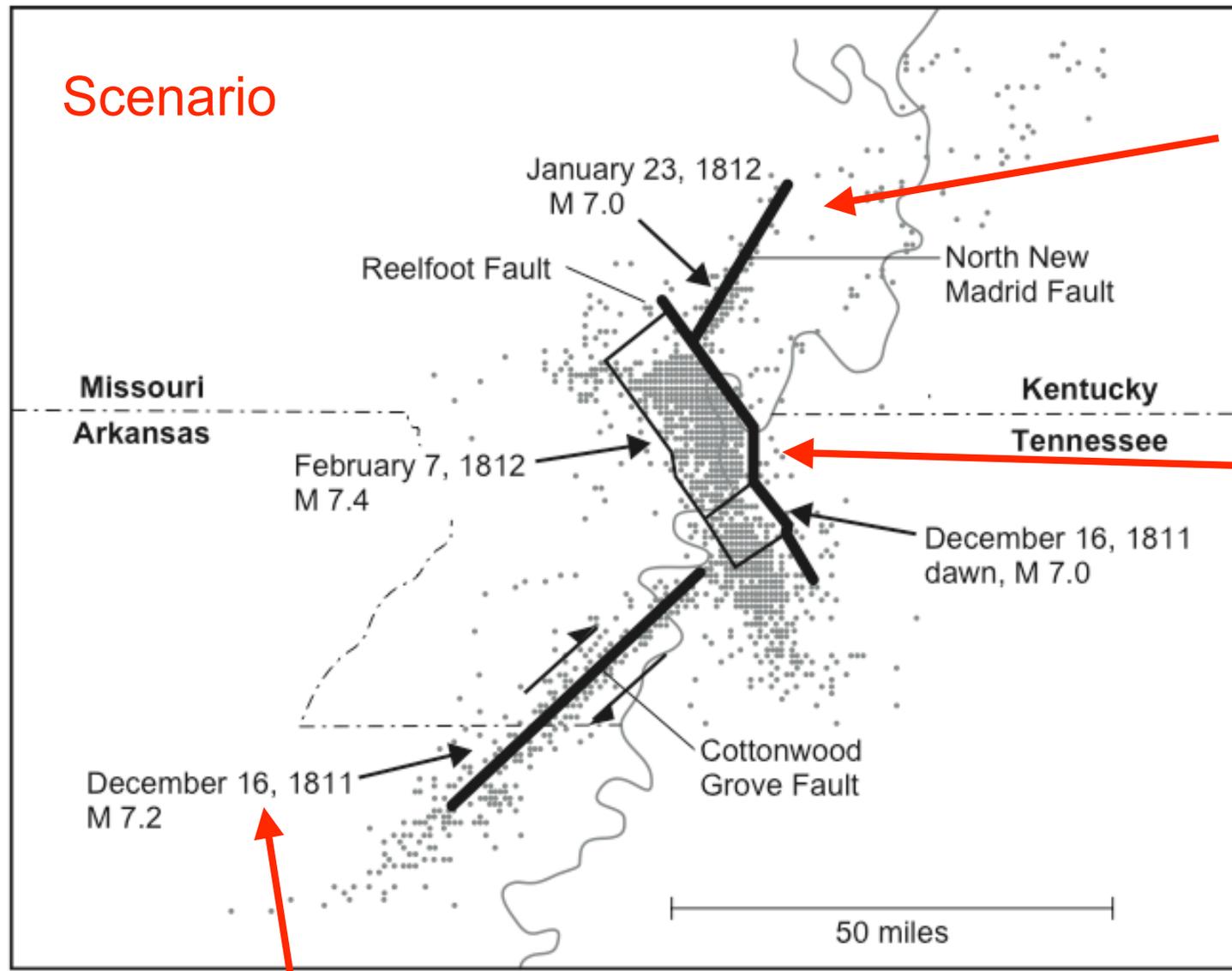


Stein & Wyssession (2003) after IRIS

But a lot smaller &
more common
than often stated

~15 earthquakes
of this size occur
each year

Scenario



40x15 km;
2 m slip

30x30 km;
5 m slip

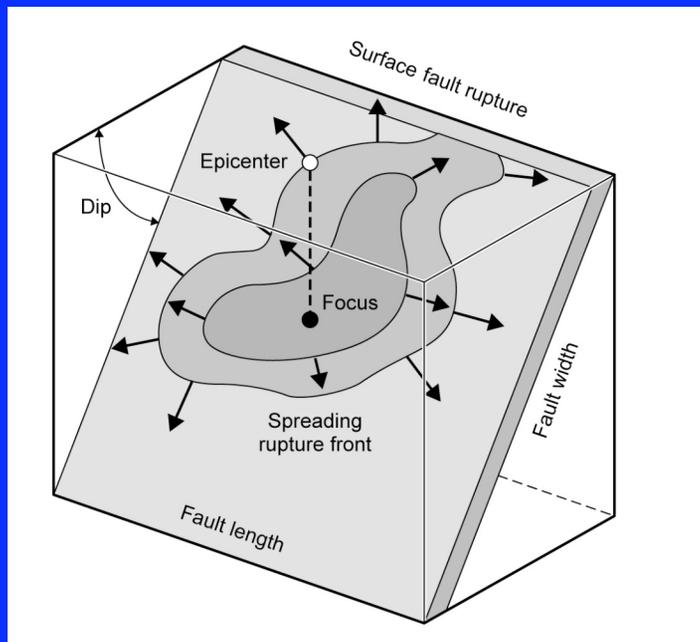
60x15 km; 3.7 m slip

Hough, 2004 DD 8.10

Activity 2.2: Fault parameters, seismic moment and magnitude

**SEISMIC MOMENT $M_0 =$
fault area * slip * rigidity
(dyn-cm)**

**MOMENT MAGNITUDE $M_w =$
 $\log M_0 / 1.5 - 10.73$**



Assuming the largest 1812 NM shock took place on a fault 30 km long x 30 km wide and involved 5 m slip, assume a rigidity of 3×10^{11} dyne-cm

Convert all lengths to centimeters and calculate the seismic moment and moment magnitude

If it were magnitude 7.0, what would the slip have been?

AFTERMATH

“Loss and suffering were brought to the attention of Congress, but in the light of subsequent events *it is not certain to what extent assistance was the real object of the agitation or to what extent it was a pretext for land grabbing on the part of certain unscrupulous persons.*” (M. Fuller, 1912)

People whose lands had been destroyed could get certificates to replace them. Most stayed and sold their certificates for a few cents per acre. Of 516 certificates issued, original claimants used only 20. Speculators in St. Louis acquired most of the others, and “*perjury and forgery became so common that for a time a New Madrid claim was regarded as a synonym for fraud.*”

The earthquake legend grew...