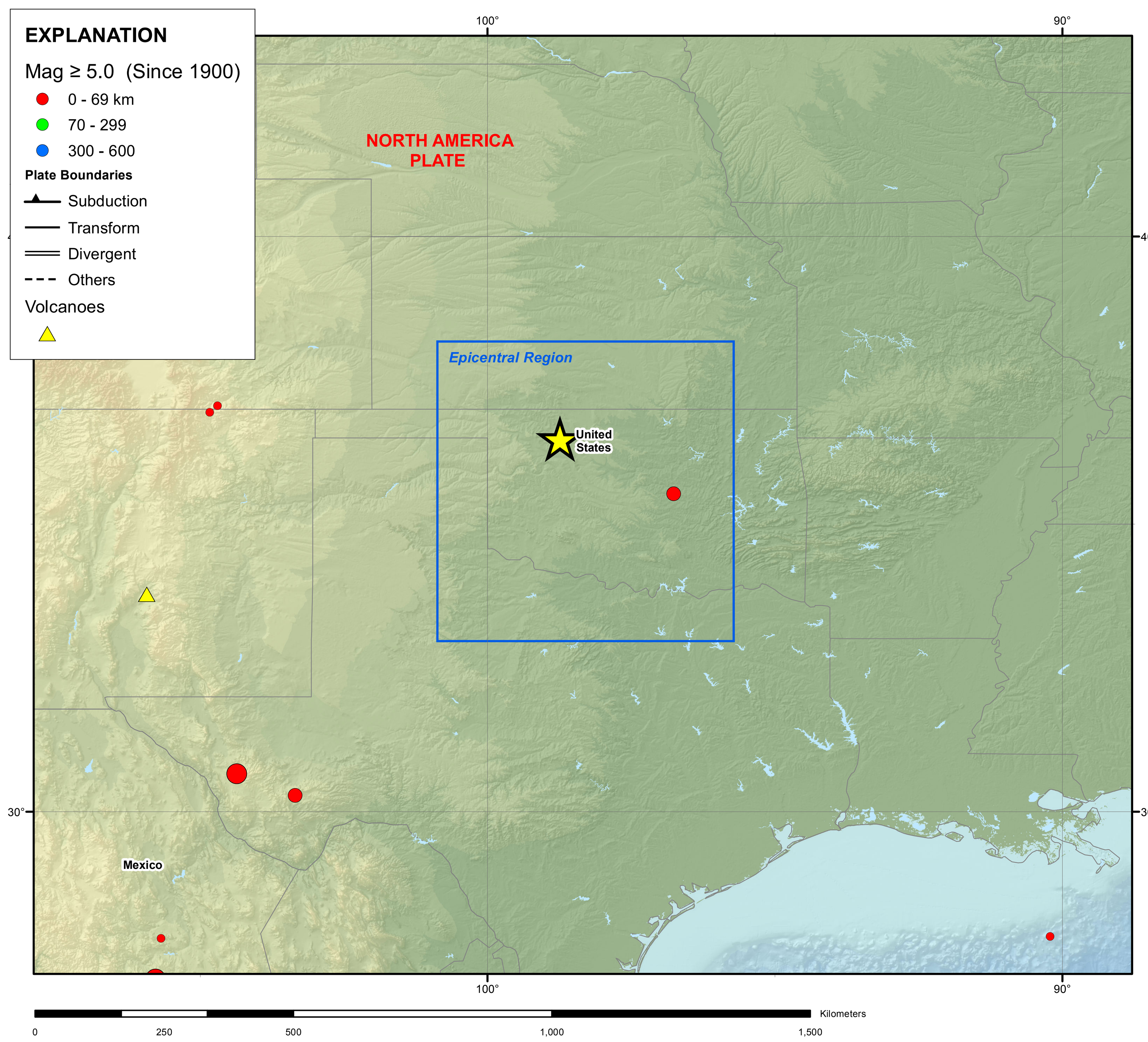
U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

EARTHQUAKE SUMMARY MAP

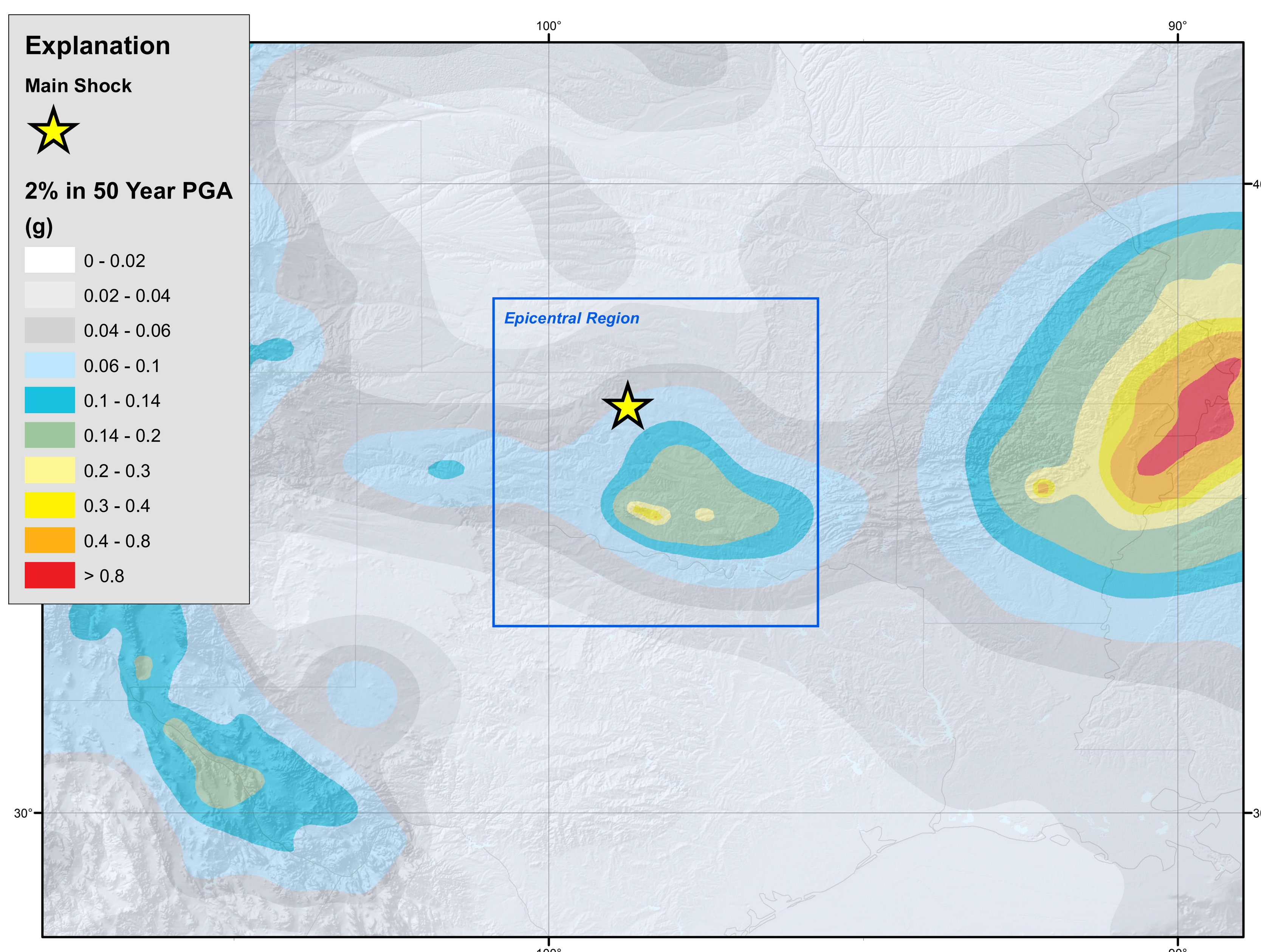
Prepared in cooperation with the Global Seismographic Network

M5.1 Oklahoma Earthquake of 13 February 2016

Tectonic Setting

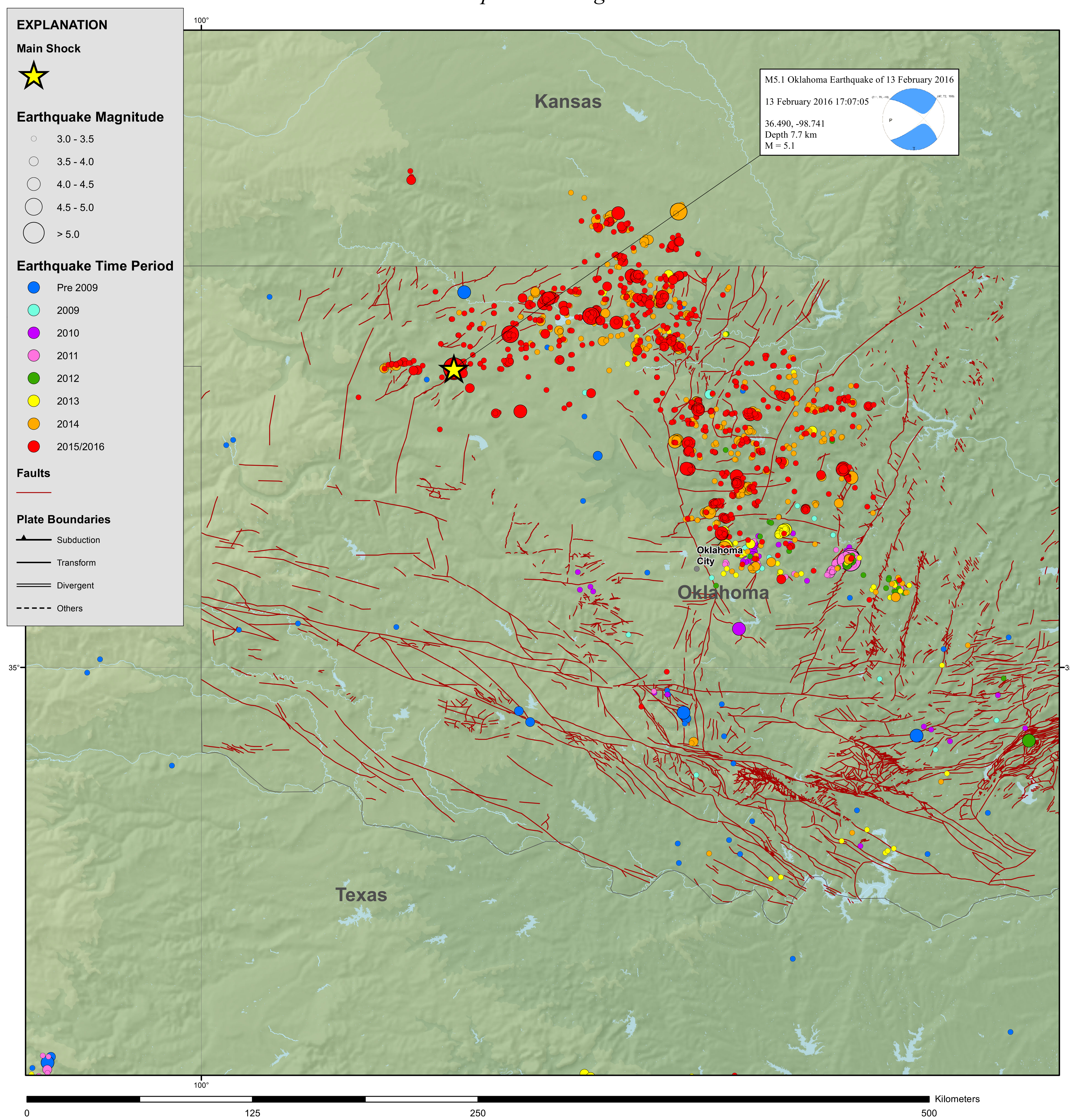


Seismic Hazard

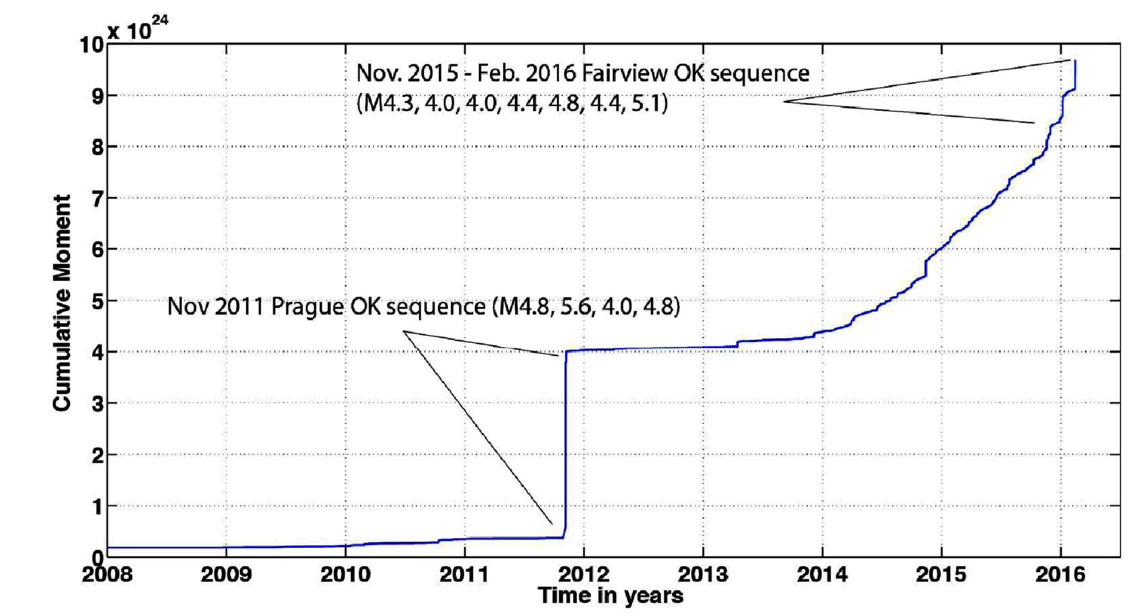


Seismic hazard is expressed as peak ground acceleration (PGA) on firm rock, in g, expected to be exceeded in a 50-yr period with a probability of 2 percent.

Epicentral Region

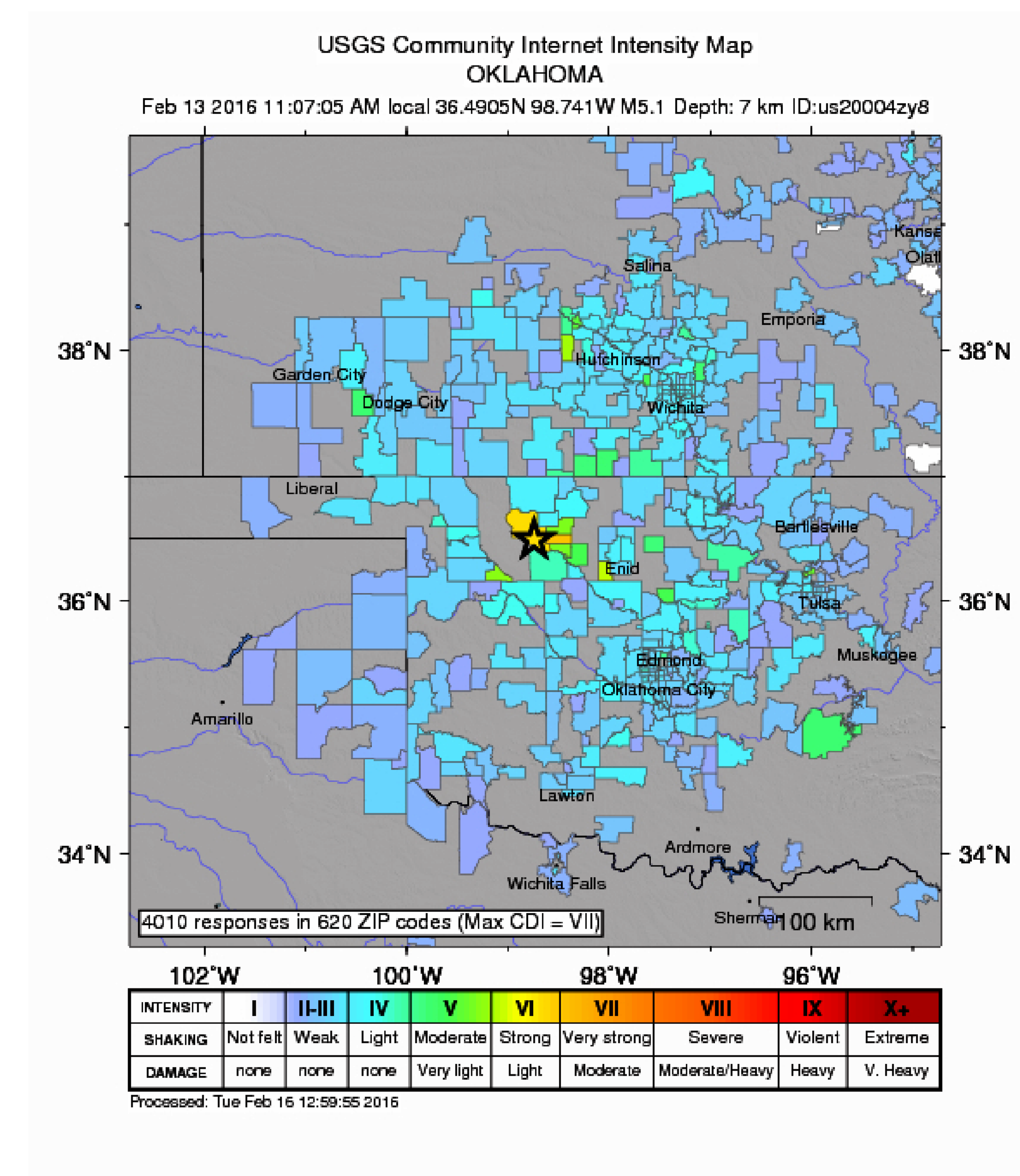


Cumulative Moment Release



Cumulative moment from 2008 to February 13, 2016 shows accelerating energy release beginning in 2013. The recent Fairview earthquake sequence is the most active since the 2011 Prague earthquake sequence.

Did You Feel It?



TECTONIC SUMMARY

As is the case elsewhere in the world, there is evidence that some central and eastern North America earthquakes have been triggered or caused by human activities that have altered the stress conditions in earth's crust sufficiently to induce faulting. Activities that have induced felt earthquakes in some geologic environments have included impoundment of water behind dams, injection of fluid into the earth's crust, extraction of fluid or gas, and removal of rock in mining or quarrying operations. In much of eastern and central North America, the number of earthquakes suspected of having been induced is much smaller than the number of natural earthquakes, but in some regions, such as the south-central states of the U.S., a significant majority of recent earthquakes are thought by many seismologists to have been human-induced. Even within areas with many human-induced earthquakes, however, the activity that seems to induce seismicity at one location may be taking place at many other locations without inducing felt earthquakes. In addition, regions with frequent induced earthquakes may also be subject to damaging earthquakes that would have occurred independently of human activity. Making a strong scientific case for a causative link between a particular human activity and a particular sequence of earthquakes typically involves special studies devoted specifically to the question. Such investigations usually address the process by which the suspected triggering activity might have significantly altered stresses in the bedrock at the earthquake source, and they commonly address the ways in which the characteristics of the suspected human-triggered earthquakes differ from the characteristics of natural earthquakes in the region.

Event Observations

- One of 7 M4 or larger earthquakes within the last four months near Fairview, Oklahoma
- Largest earthquake in Oklahoma since the M5.6 Prague earthquake on November 06, 2011.
- Currently the 3rd largest earthquake in Oklahoma state history.
- The distribution of seismicity and near-vertical right-lateral strike-slip focal mechanisms of the largest earthquakes in the sequence suggests seismic activity on a NE-SW striking buried fault.
- There have been 3 aftershocks located by USGS-NEIC in the first 2 hours after the main shock. The largest was a M3.9 10 minutes after the main shock.
- Maximum reported intensity from USGS Did You Feel It data in the epicentral area is VII.
- Felt from Dallas, TX to Kansas City, MO.
- Maximum recorded accelerations is 4%g at 25 km distance (station OK035).
- Without knowing more specifics about the wastewater injection and oil and gas production in this area, we can not conclude whether or not this particular earthquake was caused by industrial-related, human activities. However, we do know that many earthquakes in the area have been triggered by wastewater fluid injection.
- No definitive damage reports yet at the time of this writing

DATA SOURCES

EARTHQUAKES AND SEISMIC HAZARD
USGS, National Earthquake Information Center
NOAA, National Geophysical Data Center
IASPEI, Centennial Catalog (1900 - 1999) and extensions (Engdahl and Villaseñor, 2002)
EHB catalog (Engdahl et al., 1998)
HDF (unpublished earthquake catalog, Engdahl, 2003)
Global Seismic Hazard Assessment Program
Volcanoes of the World (Siebert and Simkin, 2002)

FAULT MODEL
Darold, A. P., A. A. Holland (2015) Preliminary Oklahoma Optimal Fault Orientations Oklahoma Geological Survey Open-File Report, OF4-2015

BASE MAP
NIMA and ESRI, Digital Chart of the World
USGS, EROS Data Center
NOAA GEBCO and GLOBE Elevation Models

REFERENCES

Bird, P., 2003, An updated digital model of plate boundaries: Geochem. Geophys. Geosyst., v. 4, no. 3, pp. 1027-80.

Engdahl, E.R., and Villasenor, A., 2002, Global Seismicity: 1900-1999, chap. 41 of Lee, W.H.K., and others, eds., International Earthquake and Engineering Seismology, Part A: New York, N.Y., Elsevier Academic Press, 932 p.

Engdahl, E.R., Van der Hilst, R.D., and Buland, R.P., 1998, Global teleseismic earthquake relocation with improved travel times and procedures for depth determination;Bull. Seism. Soc. Amer., v. 88, p. 722-743.

DISCLAIMER

Map updated by U.S. Geological Survey National Earthquake Information Center
16 February 2016
http://earthquake.usgs.gov/
Map not approved for release by Director USGS