

# Oklahoma quakes this year top tremors in California

**Marlena Baldacci and Mariano Castillo, CNN, 6-19-14**

California may be known for its earthquakes, but so far this year it has been surpassed by an unlikely state: Oklahoma.

Experts say wastewater wells are likely linked to the big increase in the number of quakes recorded in Oklahoma.

Between 1978 and 2008, Oklahoma experienced an average of just two quakes of 3.0 magnitude or greater. In 2014, as of Thursday, there have been about 207 such quakes recorded in the state, according to the U.S. Geological Survey.

The upward trend started in 2009, with 20 quakes of 3.0 magnitude or greater, then 43 the following year, and jumping every year with the exception of 2012.

Oklahoma has now surpassed California in quakes, and seismologists see no end in sight, CNN meteorologist Chad Myers said.

California has recorded about 140 3.0-magnitude quakes or greater, compared to 207 in Oklahoma.

The oil and gas industry's injection of wastewater deep into the Earth apparently is linked to the shift in seismic activity in Oklahoma, Myers said.

The fracturing fluid seems to be lubricating existing faults that have not moved in recent years, he said. The fracturing process is not creating new faults, but are exposing faults that already exist, he said.

On Wednesday, at least seven earthquakes were recorded in Oklahoma, according to the USGS.

There were no reports of significant damage, but that doesn't mean that these quakes are not of concern to scientists.

"The fact that the number of earthquakes in Oklahoma is even comparable to California is unusual," USGS geophysicist Rob Williams said.

"We've seen swarms of earthquakes over the interior of the U.S., but this is on a completely different scale, for the area where all the earthquakes are occurring is bigger than any previous swarm," he added. "It's not really a swarm, it's really a collection of swarms."

It cannot be ruled out that the spike in earthquakes is a once-every-10,000-years thing, but scientists don't know and are surprised by the numbers.

"Given the rate of earthquakes over the last six months, it's concerning enough to be worried about a larger, damaging earthquake happening, let alone what might happen in the future," Williams said.

Many of these quakes are being linked to wastewater injection, he said.

Some earthquakes have been linked to hydraulic fracturing, or fracking, but for the most part, the Oklahoma earthquakes are linked to wastewater wells, Williams said.

Geophysicists have not been able to gather data to pin down the certain set of wastewater wells that are causing the earthquake problem, but they're hopeful to learn more about the problematic wells in the future.

Research into the links between the wastewater wells and quakes started about four years ago, Williams said.

To better gauge the increased quakes, USGS and Oklahoma officials have added monitoring stations, which now stand at 15 permanent facilities and 17 temporary stations.

The Oklahoma Independent Petroleum Association last month urged a wait-and-see approach in judging the USGS's assertions on links between wastewater disposal and earthquakes.

"Because crude oil and natural gas is produced in 70 of Oklahoma's 77 counties, any seismic activity within the state is likely to occur near oil and natural gas activity. The OIPA and the oil and gas industry as a whole support the continued study of Oklahoma's increased seismic activity, but a rush to judgment provides no clear understanding of the causes," the industry group said.