Times Standard

# Not My Fault: It was a shaky July in Texas

Lori Dengler for the Times-Standard
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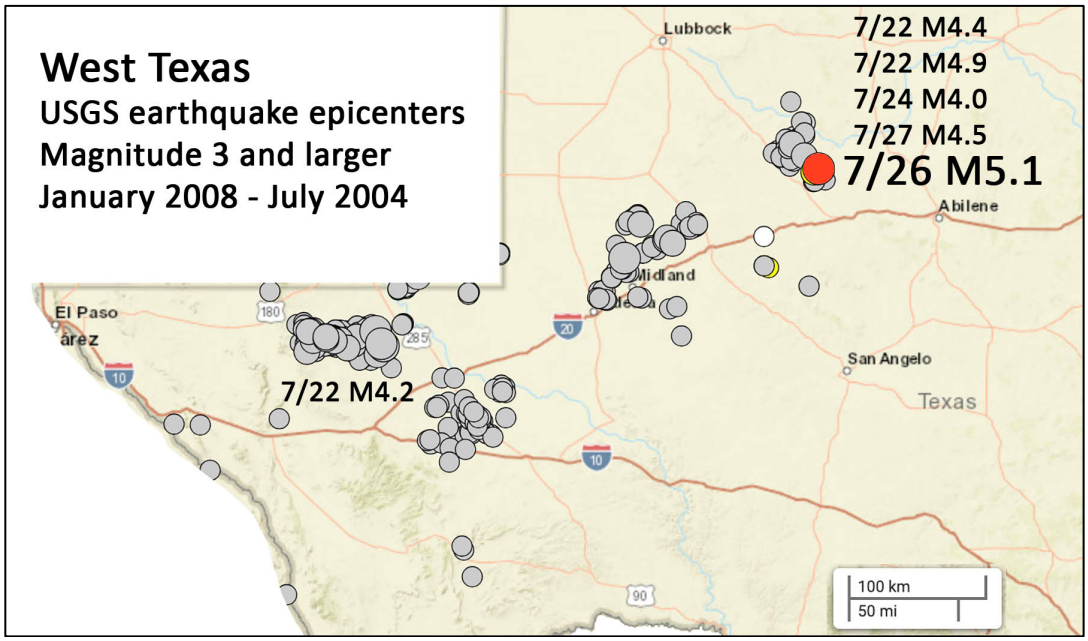


*USGS magnitude 3 and larger earthquakes since 2008. Epicenter clusters are likely related to waste drilling disposal. Magnitude 4 and larger earthquakes in the last week of July are listed and the 5.1 near Snyder is shown in red.*

Where is the shakiest place in the U.S. right now? For July 2024, Texas gets the clear nod. The USGS reports 24 earthquakes of magnitude 3 and larger in Texas over last month and only 21 in California in the same time window. But the clear kicker is that six of the Texas quakes were magnitude 4 or larger and only one of the California quakes made it into that range. It's even more unusual that most of these Texas tremors were packed into the last ten days of the month.

Texas has always had earthquakes. The largest earthquake in the State's history was magnitude 5.8 in 1931 near the west Texas town of Valentine. The M5.7 Marathon earthquake of 1995 takes second place, also before the current era of oil drilling disposal methods. Over the last century, the State averaged a couple of earthquakes a year in the magnitude 3 range, large enough to be felt lightly.

Seismic activity began to increase in the first decade of the new millennium. In 2008, a new seismic hotspot emerged near the city of Snyder in the west central part of the State. Roughly midway between the cities of Lubbock, Midland, and Abilene, 18 earthquakes in the magnitude 3 range were reported in this area over the following four years.

Why the sudden emergence of a new earthquake hotspot? We have a pretty clear idea of the culprit. 2008 is when drilling waste fluids in the United States could no longer be discharged on the ground surface but were required to be injected into deep disposal wells far below ground water levels.

How might fluid injection cause earthquakes? Rock ruptures when its internal strength can no longer withstand external forces that pull, push, or distort the rock fabric. The overwhelming majority of earthquakes and all of the very large ones are caused by natural "tectonic" forces in the planet. That's why we see most earthquakes near the boundaries of tectonic plates where such forces are concentrated.

Tectonic forces are at play everywhere on our planet, even far from plate boundaries. Rock has a long memory, and some stresses may go back millions of years when plate orientations were different. The melting of glaciers causes uplift of large regions, also changing stress levels. Human activities can make small changes in the stress, and in some cases, be just enough to nudge a previous stable area into a seismically active one. Induced earthquake is the term used to label tremors linked to such activities.

Most of these induced earthquakes of the 21st century are not directly linked to drilling or hydrofracturing, a process that forces large quantities of water, sand, and sometimes added chemicals into the rock causing small fractures that allow gas and oil to be extracted more easily. It's the disposal of the high volumes of contaminated water into deep wells that has been problematic.

We've got a pretty good idea why waste fluid injection triggers earthquakes. Forcing fluids into the ground increases the pore pressure. Pore pressure pushes against the overlying weight of the rock and makes it weaker and more vulnerable to rupture. I should note that most disposal wells seem to be unaffected by the higher fluid pressures. There are roughly 180,000 Class II wells (where drilling wastes are injected) in the U.S. and the number of sites linked to increased seismic activity is on the order of a few percent.

The change showed up almost immediately in Oklahoma where the pre-injection era earthquake activity increased from a few quakes per year to many hundreds. The shift was a bit slower in Texas but became newsworthy in 2012 when a few earthquakes were felt in the Dallas – Fort Worth area and reached alarm levels in January 2015 when four earthquakes rattled residents in a single evening.

The earthquake outcry led to strict reduction in waste fluid injection in the Dallas area and no earthquakes of magnitude 3 or larger have been detected in north Texas in the past seven years. But oil extraction and disposal continued in other parts of the State, and new seismic centers have emerged.

Culberson County Texas, the sparsely populated area roughly halfway between Odessa and El Paso, has been the most consistent producer of induced earthquakes. Over 600 earthquakes of M3 and larger have been detected since 2016, including 51 of magnitude 4 and larger, including Texas' third and fourth largest earthquakes, a 5.4 and 5.2. It was no surprise to me when a 4.2 struck the area at 9:31 PM CDT on July 22.

My eyebrows lifted a bit when the 4.2 was followed by a 4.9 at 10:38 PM and a 4.4 eight minutes later in another part of Texas. It was the first time in the Texas record where three earthquakes in the M4 range occurred within such a short time window. The 4.9 and 4.4 were centered near Snyder over 200 miles away from the 4.2 and were much more widely noticed than the Culberson County quake. The USGS estimates at least 1.6 million people felt the 4.9 and responses to the USGS "Did You Feel It?" website included locations in Colorado and Arkansas.

The State's fourth M4 range quake came two days later with a 4.0 near Snyder. The biggest (so far) was on July 26 when the Snyder area was struck by a 5.1. It was felt throughout Texas. Numerous reports of items off shelves, damage to infrastructure, and a few reports of cracked walls and ceilings came from Snyder and other communities in Scurry County near the epicenter. County officials declared a local disaster. A M4.5 occurred in the same area the next day, bringing the five-day Texas total of M≥4 earthquakes to six.

The official response has been quick. The Railroad Commission of Texas, the organization that regulates drilling and waste disposal, has shuttered two of the disposal wells near Snyder in an effort to reduce the earthquake activity. The Commission is looking at other possible regulatory methods including switching to shallower wells.

Waste fluid disposal and hydrofracturing have been the primary focus of induced earthquake studies since 2008, but some researchers are now taking a broader perspective and argue that oil drilling activities may have triggered earthquakes for a far longer time.

Water flooding, where water is injected directly into oil fields to increase production can be traced back over a century and has been linked to increased earthquake activity in the Midwest beginning in the 1970s. Sue Hough and Morgan Page at the USGS examined Southern California earthquakes in the early 20th century and published a paper in 2016 suggesting that four major earthquakes were centered close to oil fields and occurred soon after drilling operations began. The costliest of these quakes was the M6.4 1933 in Long Beach that killed 120 people.

The complex relation between resource extraction and earthquake hazards appears to have a long history and new pages continue to be written. The current chapter is in Texas.

Note: see https://www.its.caltech.edu/~pagem/Hough_and_Page_2016.pdf for the complete story of Southern California earthquakes and oil production

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