RESILIENCE

# Fracking in Texas Connected to Past Earthquakes, Study Finds

A study found that earthquakes before 2017 in Texas' Delaware Basin originated at shallow depths that correspond to where wastewater from fracking was disposed. Nearly 2,000 earthquakes hit West Texas in 2021.

Aug. 21, 2024 • **Miriam Fauzia, The Dallas Morning News, TNS**

In recent weeks, North Texans felt the aftershock of several earthquakes originating near Hermleigh in Scurry County, about 250 miles west of downtown Dallas.

The cause of these quakes has yet to be determined, but a scientist with the United States Geological Survey told *The Dallas Morning News* that they were likely induced by oil and gas operations.

A recent study led by scientists at Southern Methodist University underscores this link by revealing how earthquakes in the past were connected to fracking.

In a paper published in June in the journal The Seismic Record, the researchers found that earthquakes before 2017 in the Delaware Basin — part of the Permian Basin in West Texas and southern New Mexico — didn't originate as deep in the Earth as previously thought. Instead, they occurred at shallow underground depths that correspond to where wastewater from fracking was disposed.

The study represents an advancement in how scientists can detect and determine the cause of an earthquake, especially those before the fracking boom of the last decade, said Dino Huang, a research assistant professor at the University of Texas at Austin's Bureau of Economic Geology who was not involved in the study.

## Pinpoint the Source

Wastewater injection is one way of disposing water produced by fracking, a process that typically uses millions of gallons of water mixed with sand and other chemicals to break up underground rock formations containing oil and natural gas.

Leftover wastewater may be reused for further fracking or injected underground into saltwater disposal wells. If the injection is near a fault line — a vulnerable fracture between two blocks of rock — the stress can trigger an earthquake. A 2019 study investigating quakes in North Texas found that pressure changes from disposal wells made fault lines more likely to rupture.

ates including Oklahoma and Kansas, wastewater injection has been ked to seismic activity. That link has also been observed in Texas, said

Heather DeShon, department chair for SMU's Roy M. Huffington Department of Earth Sciences and co-author of the new study.

The Fort Worth Basin, located in North Texas and southwestern Oklahoma, was one of the first shale basins — a geological formation containing natural gas — exploited by fracking, DeShon said. "Since 2008, SMU has been studying earthquakes in the basin and we and other collaborators eventually tied those earthquakes to wastewater disposal."

The key to that inquiry is knowing where the tremor starts, said Nadine Igonin, an assistant professor of geophysics at the University of Texas at Dallas, who was not involved in the new study.

"If your location or depth is completely wrong, then you might attribute the cause of the earthquake to something else," Igonin said.

Before 2017, there was a lot of uncertainty regarding an earthquake's depth, especially in the Permian Basin, a region rich in domestic oil and natural gas. This was due in part to not enough seismic stations in proximity to where tremors occurred.

"The rule of thumb is that to get a good earthquake [resolution], you want to have a seismic station within two times the depth of the earthquake," DeShon said. "So if your earthquake is really shallow, like at two kilometers depth, you would want to have at least one seismic station within four to five kilometers."

The state-funded seismic network, known as TexNet, was authorized in 2015 and implemented in 2017. This expanded the number of earthquake sensors available to detect seismic activity, as well as do that more precisely and accurately.

To clear up that uncertainty about pre-2017 earthquakes, DeShon and Asiye Aziz Zanjani, the study's first author and a postdoctoral researcher at SMU, looked at seismic activity in the southwestern region of the basin called the Delaware Basin. Since 2009, this area, along with the rest of the Permian Basin,

has seen a surge in small earthquakes.

The researchers combined earthquake data from 2009 to 2016 with high-quality TexNet data from 116 earthquakes occurring in the Delaware Basin after 2020. They used a mathematical tool called hypocentroidal decomposition to help find patterns between the older and newer data. This led them to recalculate the depth of 73 pre-2017 earthquakes that measured at greater than 1.5 magnitude.

“This method helps us to show that earthquakes that we see at, like, four kilometers [nearly 2.5 miles], they [move] to much shallower depths that correlate with the depths they are injecting water,” Aziz Zanjani said.

**Mitigation Efforts**

With the rise of earthquakes in West Texas — nearly 2,000 hit the area in 2021, a record high — understanding what triggers a tremor and mitigating its effects has become of the utmost importance, DeShon said.

One mitigation effort has been to stop wastewater injections. For example, in 2021, the Texas Railroad Commission, which oversees the oil and gas industry, suspended wastewater injection in Northwest Midland County after earthquakes greater than magnitude three rocked the area. In 2023, after a series of earthquakes above a 5.0 magnitude, the agency suspended wastewater injection permits in the Permian Basin.

When natural gas production slowed down in the fossil fuel-rich Barnett Shale around Dallas-Fort Worth due to economic reasons, there was a decrease in how much wastewater was being injected, DeShon said, leading to a drop in earthquakes over the last decade.

“Peak [wastewater] in the Dallas-Fort Worth area was in 2012, so they inject much less wastewater in the deep rock than they used to here in the Fort Worth Basin and we rarely have felt an earthquake now,” she said. “You can definitely see that even though it was economically driven and not done

intentionally, it's an example of a mitigation strategy

But because of the country's reliance on oil and natural gas, at least for the time being, it's not possible to stop fracking entirely and, by extension, wastewater injection. It therefore becomes important to do it responsibly, at certain volumes and with a better understanding of Earth's underlying geology (like where fault lines lie), DeShon, Huang of UT Austin and Igonin of UT Dallas said.

Igonin added that the findings hold significance for environmental efforts like carbon capture and storage, a process where carbon dioxide emissions are trapped and stored underground.

"If you're not monitoring in real time and don't know where your carbon is going, that's a problem," she said. "So all the same learning we have from the oil and gas industry, many of us are actively trying to apply [it]... to carbon capture projection because we don't want to repeat the same mistakes as [the oil and gas] industry has made."



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