

Scientists look for what's causing Texas earthquakes

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Swarms of small quakes rippled up from unknown faults beneath the soil. They rustled Cleburne, Azle and Irving. Fifteen recent earthquakes around the old Texas Stadium in Irving site included the strongest yet in Dallas County, and their waves shook downtown office towers.

But after six years and more than 130 quakes, scientists are just beginning to map the fissures beneath Texas,. figure out why they woke up and predict what they might do next.

No one knows for sure whether the quakes are signs of a geological realignment, the aftermath of gas drilling or something else entirely.

What lies under Irving? That may be the biggest mystery facing the team of scientists investigating the latest earthquake swarm to hit North Texas.

"There are no known faults near the earthquake site," said Beatrice Magnani, one of nine Southern Methodist University researchers studying the quakes.

That means about three dozen quakes that have rocked Irving since April are coming from a previously undiscovered fissure, deep underground.

"In this area of the world, researchers don't know a lot about these faults, because the faults don't come to the surface," said Heather DeShon, a

seismologist with the university.

Science can tell us only so much. Geological earthquake records are spotty before 1970, though they show no evidence of anything like the current spate in North Texas history.

And it may be impossible to predict how long the current rash of quakes will last. The Azle area got 27 quakes over three months. Cleburne was hit by two clusters, in 2009 and 2012.

But without knowing the size of the fault under Irving, scientists have no way to tell whether it might one day produce a devastating quake - something thousands of times more powerful than the 3.6-magnitude earthquake that struck last week. (Scientists say the majority of earthquake swarms do not culminate in large, damaging events.)

To that end, the SMU team is trying to pinpoint each new quake and use the earthquakes' locations to map the Irving fault's size and depth.

The team is also trying to figure out which of several nearby fault systems Irving's fissure belongs to. To the west, a system of small, deep faults has been linked to previous quakes in Azle, Cleburne and Dallas/Fort Worth International Airport. In the east, the large Balcones and Ouachita fault systems wind south to the Gulf of Mexico and beyond.

The U.S. Geological Survey, which monitors and locates earthquakes across the world, places most of Irving's quakes near the former Texas Stadium site. With sparse equipment near the quakes, the agency's estimates can be off by miles. So last week, the SMU team added nearly two dozen seismometers - quake detectors - in and around Irving.

The team has also asked the Texas Railroad Commission and energy

companies to help them gather information.

"Since the oil and gas industry are actively drilling into those rocks, they tend to know more than we do about subsurface fault structure," DeShon said.

But the team has another purpose in investigating nearby gas wells and wastewater wells: to see whether underground pressure changes related to those wells are significant enough to cause quakes.

Almost as soon as earthquakes began rattling North Texas, fingers pointed at the hydraulic fracturing, or fracking, boom that has overtaken the state this past decade.

The Texas Railroad Commission's newly appointed seismologist, Craig Pearson, quickly dismissed any connection to oil and gas drilling. But the SMU team isn't so sure.

"Obviously, we're in the Fort Worth basin. We have to look into production activities and also wastewater injection activities," DeShon said.

For decades, research has linked earthquake activity to underground injection wells, used by oil and gas companies to dispose of the large volumes of brackish water that are a byproduct of oil and gas drilling.

An injection well can reach more than 10,000 feet deep, pumping tens of millions of gallons of untreated water a year into underground rock formations and sometimes the faults that cause earthquakes.

That rush of liquid can stress the faults, setting off a chain reaction that can make buildings shake.

Since 2008, the SMU team has linked the Cleburne and airport quakes to injection-well activity.

But with Irving's quakes, there's some skepticism about whether injection wells are to blame.

Two injection wells lie under the airport, up to 10 miles from the center of the latest quakes. While one study in Oklahoma found that injection wells could cause quakes as far as 21 miles away, most studies link earthquakes to [injection wells](#) no more than six miles away.

"You can never say never, but it doesn't seem like a smoking gun," said Cliff Frohlich, a University of Texas at Austin seismologist and one of the foremost experts on Texas earthquakes.

But that is not the only line of inquiry directed at the oil and gas industry.

Recent research has linked earthquakes to fracking itself - a process where water and chemicals are pumped underground at high pressure to create small fissures in rock that release oil and gas.

Scientists at Miami University in Ohio published a paper tying natural gas wells there to a [quake](#) in a previously unknown underground fault that registered magnitude 3.0.

In North Texas, the closest wells are about two miles northwest of the epicenter of the Irving earthquakes. They are operated by Fort Worth-based Trinity East Energy.

There are nine more within about seven miles of the quakes, according to data from the Texas Railroad Commission.

According to Trinity East President Steve Fort, the two closest wells were last fracked about five years ago.

That would make them an unlikely cause, said Steve Horton, a seismologist at the University of Memphis.

But with many questions and little in the way of explanation, scientists are digging through those and other drilling records and studying fault maps looking for a connection.

They expect solving the riddle to take months - and they're only just getting started.

"It's like cancer," Frohlich said. "You can never really prove someone got lung cancer because they smoked. All you can do is look at the statistics and say you're more likely to get cancer if you smoke."

"In 1902, there was a big earthquake in Austin," he said. "You know that wasn't fracking. But if it happened at D/FW airport tomorrow, you'd wonder if it was."

Besides drilling activity and natural shifts in the bedrock, at least one other theory intrigues some researchers: Could the long Texas drought have sucked enough water from the ground to destabilize the fault?

A gallon of water weighs a bit over 8 pounds - whether it's in a jug or in the ground.

Multiply that by thousands of square miles, years of scorching heat, and millions of thirsty residents. A drought can reduce the force of gravity over a fault zone - potentially causing the Earth's crust to bounce up and trigger earthquakes.

In theory, anyway. And local data appear to pour cold water on that theory.

Much of the state has been in a drought for years, yet only a few places have had earthquakes.

What's more, drought or no drought, groundwater pumping in urban North Texas is minuscule - seemingly not nearly enough to tip the balance toward earthquakes.

The water that comes out of public taps in Dallas-Fort Worth is from reservoirs and rivers, which aren't believed to affect earthquakes.

Local monitoring of groundwater levels is spotty. A state database showed no readings from Irving wells for years. Another well about seven miles southeast of Irving has seen a general decrease in water levels since 2006, but nothing dramatic.

And studies show that people would need to use at least three times as much water from the aquifers below Irving before depletion would become a threat, let alone cause a gravity-induced [earthquake](#).

One final clue: Two NASA satellites called GRACE circle the Earth, taking gravity readings. They show intense groundwater reduction in parts of North Texas in the last few years.

But the deficit is not uniform across the region.

"We have not seen anything in the GRACE records that would relate to the quakes reported in the Dallas-Fort Worth area," Byron D. Tapley, director of the Center for Space Research at the University of Texas and the satellite's chief investigator, said in an email.

Until scientists can explain the quakes, the people living with them can only guess.

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