OIL

Texas researchers dig into quake data

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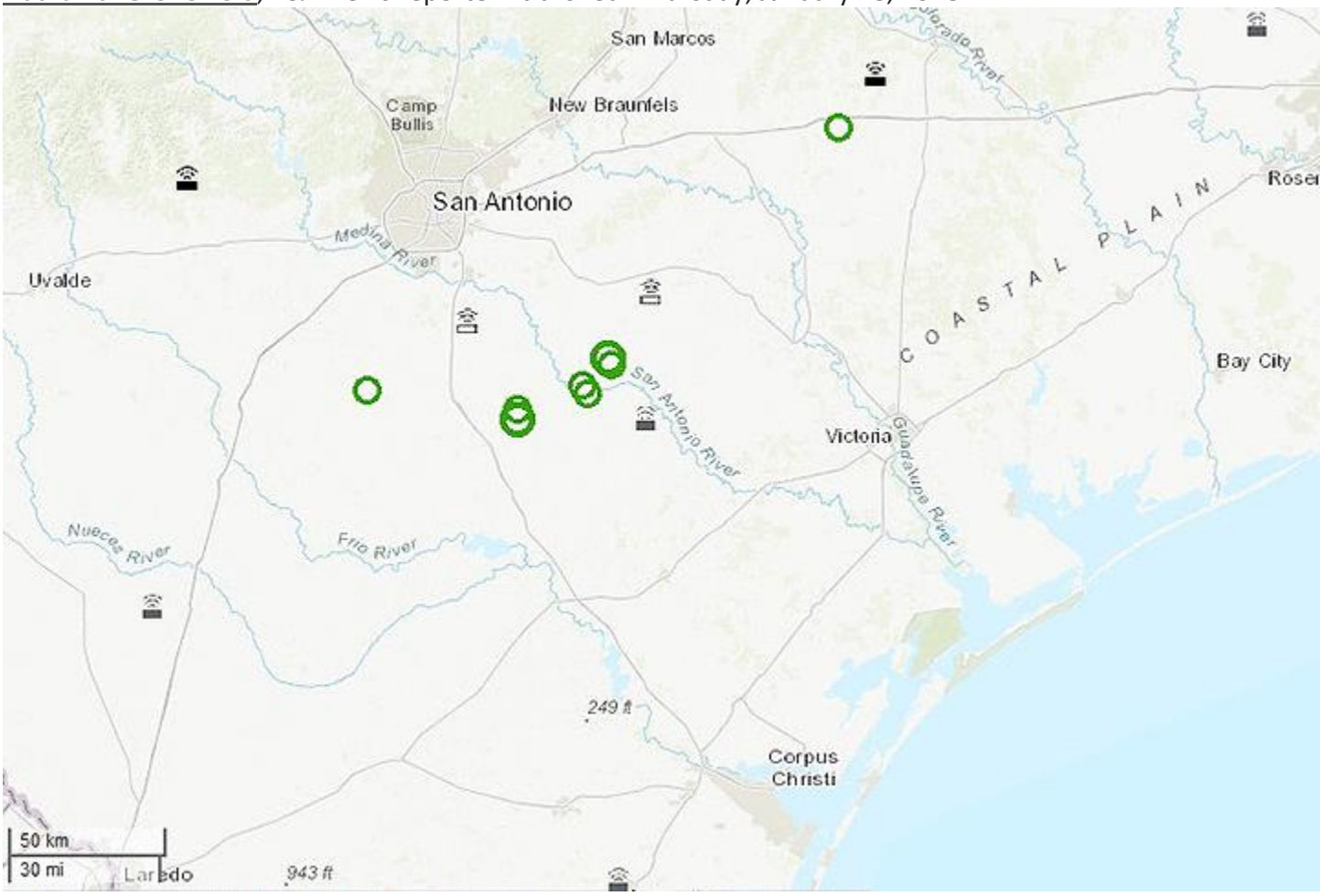

Data published on the Bureau of Economic Geology's public TexNet portal show one year's worth of seismic activity just outside San Antonio detected by sensors. The events are few and weak, detectable only by sensitive instruments, but they show a definite correlation between small earthquakes and oil field activity running along the Eagle Ford Shale. University of Texas' Bureau of Economic Geology

HOUSTON — A statewide effort at monitoring earthquakes in Texas has resulted in at least one broad

conclusion: There is a correlation between oil and gas industry operations and seismic activity.

Once you drill down from that conclusion, it gets a lot more complicated. Correlation is not causation.

Texas has one year's worth of data. The number of seismic events is relatively small, and the vast majority have been minor quakes, undetectable to the average person and harmless to property.

A slew of quakes possibly associated with oil and gas operations in the Barnett Shale region around Fort Worth prompted the state of Texas to fund the creation of TexNet, a system of permanent and mobile seismometers maintained and operated by the University of Texas, Austin's Bureau of Economic Geology. TexNet has been feeding scientists with real-time data on earthquakes in Texas, a state regarded as having relatively stable geology with no major earthquake issues.

The publicly available online TexNet catalog of quakes shows a pattern: Most events are clustered around active oil patches, in particular the Permian Basin and Eagle Ford Shale.

The quakes are mostly minor, and scientists are still struggling to determine how these swarms of small quakes may be linked to larger events or even what is causing them.

"It's a very complicated pattern," said Bureau of Economic Geology research scientist Peter Hennings. "Most of these earthquakes are tiny, not felt at the surface."

Hennings says the network has revealed a lot about Texas earthquakes, but the information isn't enough to draw definitive conclusions.

Texas is no Oklahoma

Geologists mostly connect oil-field-related seismicity to the deep underground injection of wastewater that is produced from extracting oil and natural gas.

Though the Barnett experienced past earthquake episodes, the problem was most pronounced in Oklahoma. Mirko van der Baan, an exploration seismology expert at the University of Alberta, explained that the sheer volume of wastewater that companies were injecting into disposal wells made Oklahoma the most earthquake-prone state in the nation.

"At the peak, Oklahoma produced something like seven times more water than oil," he said. "They have very large water cuts, and so all that water was disposed of."

The volume of disposal was above and beyond what's been experienced in Texas or other states. At the height of disposal activity, van der Baan estimates that Oklahoma was injected upward of 3 million barrels a day of wastewater into the earth. The water intermingled with Oklahoma's complex underground geology, reactivating long-dormant faults that caused noticeable and damaging quakes, he said.

But in better understanding the problem, regulators in Oklahoma have been able to devise solutions, he noted.

"The good news is now the disposal volumes are coming down and the trend is still downward, and that means the seismicity in Oklahoma is also going down, so that's what everybody wants," said van der Baan.

Quakes and the Barnett

Texas might be on a similar path, or not.

Hennings pointed out how the TexNet data confirm a sharp decrease in seismic events in the Barnett Shale area. But no single factor accounts for the decline, he

cautioned. Regulators stepped in some, but industry interest in the Barnett has also waned, another factor in the decline of quakes there. Still, Hennings drew parallels to Oklahoma's success at tackling quakes and the experience of the Barnett region.

"From 2011 to 2015, the rate was alarmingly high, which is what really resulted in the TexNet funding in the first place," he recalled. "Since then, the industry activity has turned down, the basin is very mature from a development standpoint."

The rate of monthly injection and disposal in the Dallas-Fort Worth area has also declined. And the rate of earthquakes has decreased dramatically. "So that story is just like Oklahoma," Hennings said.

While clusters of seismic events can be detected, Hennings said, no one injection well or disposal event can be linked to any specific quake. And even tying the general vicinity of injection activity to specific seismic events can prove challenging. At best, a regional approach can be taken to monitor events and how they may be correlated to industry activity, he said.

Van der Baan said, from his point of view, he would need to know much more about the underlying geology

to determine how the quakes are caused in any given region.

"There are lots of factors that will determine if you are likely to get any induced seismicity," he said. "It depends on the geology. Some areas, like in North Dakota, chunks of Texas or Pennsylvania, there are no signs of human-induced seismicity, or it's really a cluster."

In a recent academic journal he published with colleague Frank Calixto, van der Baan and his co-author write that outside Oklahoma, studies of seismicity in other active oil and gas regions of North America find "no state/province-wide correlation between increased seismicity and hydrocarbon production, despite 8-16-fold increases in production in some states."

However, the paper acknowledges discovering high increases of rates of local seismic activity.

The paper's conclusions that "seismicity rates have increased locally" with oil field activity alludes to the clear pattern TexNet shows: insignificant seismicity statewide in Texas but an obvious clustering of events in and near the most active drilling and wastewater disposal zones.

Yet, Hennings stressed in an interview that the data uncovered by TexNet is nowhere near complete enough for researchers to begin reaching hard conclusions or drafting recommendations to industry leaders or regulators.

"We're doing a lot of research on these earthquakes, but since we only have about one year's worth of data, we're only now starting to do something with it," he said. "So we're analyzing the timing of the earthquakes, the depth of the earthquakes, are the earthquakes arranging themselves in linear patterns that might represent fault zones in the subsurface. We're going to start comparing these earthquakes to where there have been systems of injection wells to ask the question: How tightly related might they be to injection?"

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