

More Ohio Earthquakes Linked to Fracking

EarthScope data suggests connection to fault orientation

Hydraulic fracturing, also known as fracking, has been linked to earthquakes in parts of the US, Canada, and the UK. EarthScope data has documented several such connections related to wastewater injection, but three recent tremors in eastern Ohio reveal how the natural-gas-extracting process may trigger earthquakes as well.

Paul Friberg, CEO of Instrumental Software Technologies, Inc., a software company specializing in seismology and geophysics, will present this research at the Fall Meeting of the American Geophysical Union in San Francisco on December 14.

In October 2014, a pair of earthquakes, of magnitudes 1.9 and 1.7, struck Ohio's Harrison County within hours of each other. In a place where earthquakes hardly ever happen, they were cause for suspicion.

In fact, there had been no earthquakes until 2013, when several 2.0-magnitude quakes hit. Friberg led a study that linked those quakes to fracking wells. The hypothesis was that fracking also caused the 2014 quakes.

During fracking, bursts of high-pressure water are pumped into the ground to create small cracks that facilitate the extraction of natural gas. That's different from the wastewater injection wells that have spawned a huge uptick in earthquakes across the central and eastern U.S. in recent years. Those wells dispose of the wastewater resulting from what is called "enhanced oil recovery." When the wastewater is pumped into the ground, the pressure on a fault decreases, resulting in earthquakes.

Although the fracking process itself uses much less water, it can also generate earthquakes by reducing the stress on a fault, triggering it to slip. But most of these earthquakes are tiny and harmless, hardly detectable disturbances that typically have magnitudes below zero. Occasionally, though, they've caused bigger quakes—such as a 4.6-magnitude tremor near the town of Fox Creek in Alberta, Canada, last summer and the latest ones in Ohio.

The question is why. "We're trying to understand what's going on," Friberg says. "Why are we seeing bigger quakes in this particular series of fracks when there are several thousand fracks in Ohio that don't produce any activity?"

To find out, and to determine whether the 2014 Ohio quakes were due to fracking, Friberg used data from an EarthScope seismic sensor located a few kilometers from the epicenter. The sensor was part of EarthScope's Transportable Array of 400 such devices distributed across the contiguous US.

Normally, hundreds of tiny seismic disturbances accompany every earthquake. The researchers analyzed the two 2014 quakes to determining the kind of disturbances the quakes would've caused. After searching for these signature events in the EarthScope data, they found more than a thousand matching signals from September 26 to October 17, all coinciding with fracking operations.



Location of the Transportable Array O53A.
Source: anf.ucsd.edu/stations/TA/O53A

Most recently, another earthquake in fall of 2015 less than a mile eastward—this time with a magnitude of 2.8—also points to fracking as the culprit.

The small seismic events all occurred along a line running east to west, suggesting the presence of an east-west fault network. Perhaps, Friberg explains, this east-west direction is what makes this particular area of Ohio vulnerable to fracking-caused earthquakes.

While the eastern U.S. lacks active plate boundaries, the basement rocks in the northeast are oriented northeast to southwest, recording ancient stresses. If a fault line were perpendicular to the direction of this stress—if the fault went from the northwest to the southeast—then quakes would be less likely because local stresses would squeeze the fault, preventing it from slipping. But if a strike-slip fault were aligned in another direction—like east to west—then earthquakes may be more likely.

These conclusions are preliminary, and other factors may be at play. "There haven't been enough of these cases to nail down what exactly is going on," Friberg says.

To date, fracking-caused earthquakes haven't been big enough to cause significant damage, he says. But fracking could potentially produce a quake that damages property or the fracking infrastructure itself. At the very least, fracking-induced earthquakes would be a nuisance to the local community.

If researchers can determine how fracking generates these earthquakes, then the industry can try to prevent them, for example by building wells in less quake-prone areas or changing how fracking is done.

Friberg will present his findings on Monday, December 14th at 8:30 AM local time in Moscone South, Room 305. This talk is part of session S11C, "Induced and Triggered Earthquakes: Theory, Observations, Impact."

For further information on the study, please contact Paul Friberg, paulfriberg@isti.com

The EarthScope National Office seeks to disseminate EarthScope scientific findings, and is housed at the University of Alaska Fairbanks Geophysical Institute. On the web: www.earthscope.org

