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Induced Seismicity & Injection Wells in Kansas

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Kansas is an area that has been seismically active over millennia. Seismic activity varies over time in an unpredictable manner. Because oil and gas are produced in 90 of Kansas' 105 counties, any seismic activity within the state is likely to occur near oil and gas production.

While hydraulic fracturing is an unlikely source of discernible seismic activity, considerable attention is being focused on injection wells. Given the long history of successful injection well operations across the nation, the likelihood that induced seismic events will occur in properly permitted and operated injection wells is very small. Too often, the mere presence of nearby oil, gas, or injection wells results in allegations that they are the source.

Kansas Geological Survey (KGS) research geophysicist Shelby Peterie and her colleagues published a research letter in the *American Geophysical Union* in 2018 that examined the increase in wastewater injection in southern Kansas and correlating rise in seismic activity in Kansas. Peterie suggested seismic activity has migrated as far as 60 miles from disposal wells. The research letter claims that injection of Mississippian water into the Arbuckle in northern Oklahoma and southern Kansas has increased pressure in the Arbuckle that migrated north and caused seismic activity near Hutchinson. The magnitude of pressure increase is quite small, especially far from the sources of injection. However, it is claimed that even very small pressure increases could cause seismic activity. The research letter does note the presence of Class I injection wells close to the seismic events epicenters, but dismisses any effect of the nearby high-volume Class I injection wells by stating they have been injecting about the same volume for years without prior seismic activity. This conclusion ignores the possibility that a cumulative injection volume/pressure threshold was reached by Class I injection wells near Hutchinson which then caused seismic activity. And, of course there may be other mechanisms which have nothing to do with Class II injection wells 50-100 miles away.

Some scientists and engineers in Oklahoma are not sure Peterie's research is conclusive and suggest much more research is needed. Kim Hatfield, a petroleum engineer and industry liaison with the Oklahoma Governor's seismic task force said Peterie and the KGS over-simplified the system to make a scientific assumption. Hatfield said scientists and industry are just beginning to understand the Arbuckle rock layer's complexities.

Kyle Murray, hydrogeologist with the Oklahoma Geological Survey, said much more research is needed. Murray said Peterie's work essentially compares the Arbuckle rock layer to a bathtub; adding to the tub makes the water level change uniformly. But the Arbuckle is more like an egg crate. The different compartments are bound by rock faults and making changes to one compartment doesn't necessarily change the level in the entire crate.

"It's a complex system, and it should be broken up and examined in sub-regions," said Murray. "That is the direction everyone should go."

It appears Peterie and the KGS over-simplified the Arbuckle rock system and failed to account for the many varying rock dynamics associated with the Arbuckle. Murray pointed to the U.S. Geological Survey description of the Ogallala Aquifer, which spans eight states, as an apt metaphor. The Ogallala Aquifer contains rock faults, joints and other rock dynamic features that isolate compartments within the rock layer.

Peterie's research needs more detailed charts and graphs to verify her conclusions with each well and how the pressure changed before and after quakes. "If you're going to say it's unprecedented, you need to back it up with supporting illustrations and details," said Murray.

The KGS conclusion uses a very limited data set and relies on conjecture to advance, what appear to be, misguided notions.

Although scientists agree wastewater injection from day-to-day oil/gas production can under very specific circumstances cause induced seismicity, much more research is needed before a conclusion can be reached. Fact-challenged and sometimes sensational media coverage adds to the sea of misinformation.

Effectively addressing induced seismicity from injection wells must take into account the fact that geological conditions are not uniform and similar wells in different areas may or may not have any nearby seismicity. A blanket one-size-fits-all approach is not an appropriate solution since every well is operating in different geologies and conditions.

Kansas oil and gas companies have taken the issue of induced seismicity very seriously. Industry has been actively working with state regulators since 2014 helping to secure funds for additional seismic monitoring stations and sharing proprietary data with scientists and regulators in efforts to reduce induced seismicity.

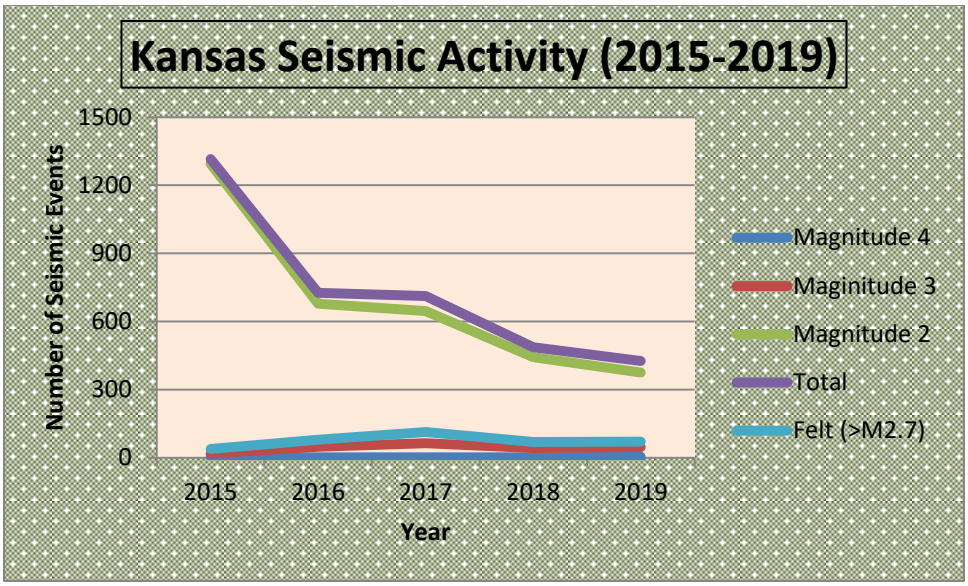
The efforts are producing results. The latest data shows a **67%** decline in seismic activity in Kansas from 2015-2019. That includes a **38%** decrease in felt seismic activity (M>2.7) in Kansas from 2017-2019.

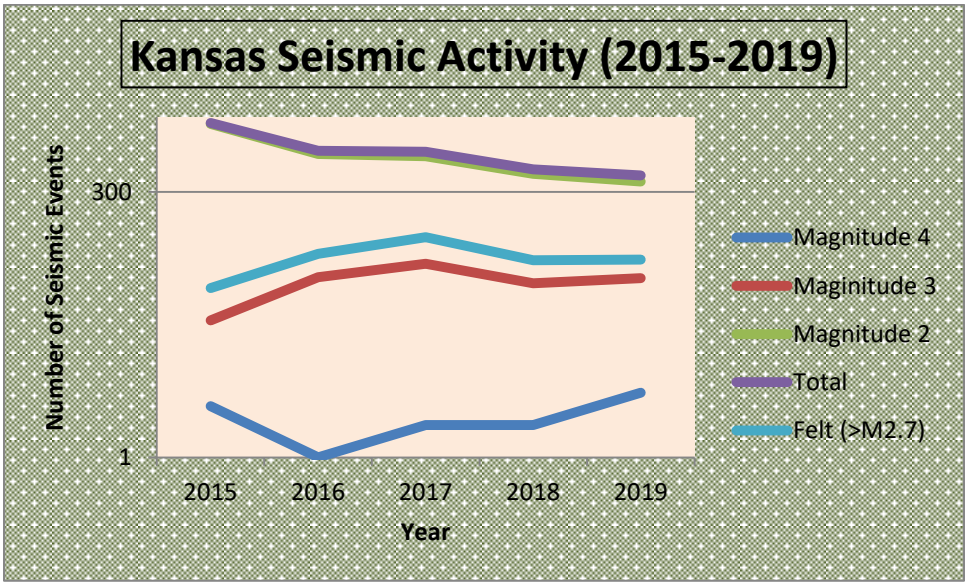
Seismic activity across Kansas in 2019 led to some elected officials and environmental activists to point to Class II injection wells (wells used to inject fluid associated with oil and natural gas production) as the cause. Some have been led to believe that Class I injection wells (wells used to inject hazardous and non-hazardous industrial and municipal wastewater) were not likely contributors to seismic event because Class I injection rates had declined in recent years. The facts revealed that Class I injection rates had declined by only 0.45% over the last year and the Class I injection wells were injecting an order of magnitude or more fluid into the ground than nearby Class II injection wells.

On August 21, 2019, the KCC announced that it would collect data and analyze recent injection activity in areas where seismic events had occurred. The KCC said it is conducting the investigation to evaluate whether additional action is needed to safeguard Kansans. The investigation will involve both Class II and Class I injection wells.

In late 2019, Governor Kelly indicated she would be forming an Arbuckle Study Workgroup to look into the injection well/seismic event issue. The Kansas Independent Oil & Gas Association (KIOGA) encouraged Governor Kelly to make sure any such study is accurate, scientifically-based, and limited in scope to site specific features of areas in question. KIOGA also encouraged the Governor to make sure the workgroup gathers all data and information before drawing conclusions. When asked for perspective, KIOGA offered insights that included our opinion that drilling a well and injecting fluid into the granite wash (basement rock) in high seismic risk areas increases risk for seismic activity. The KCC model of regulatory response offers a proven record of success. The KCC prohibits drilling/injecting into granite wash and limits injection volumes and pressure into the Arbuckle formation in high seismic risk areas. The KCC model should apply to all Arbuckle injection wells, Class I and Class II.

Although seismic activity in Kansas and Oklahoma had been on the increase earlier this decade, a recent study from Stanford University predicts a continuing decline in seismic activity in Kansas and Oklahoma in 2020. The result of the study is definitely good news. The new study shows a 19% probability of seismic activity in Kansas and Oklahoma in 2020. This is down significantly from the 70% probability in 2015 and 2016 and shows that Kansas and Oklahoma regulatory policies are working. Despite all the alarmist propaganda and agenda-driven KGS rhetoric, the risk of induced seismicity is small, rare, and manageable.





Several recent studies and reports have found very few injection wells have been linked to induced seismicity, and the risk from these wells is low.

The most recent comprehensive study based on data from the USGS and peer-reviewed studies, found that less than one percent of injection wells across the nation and in Kansas have been linked to induced seismicity.

The USGS states in its list of myths and misconceptions regarding induced seismicity that "Most injection wells are not associated with felt earthquakes."

A report conducted by StatesFirst, an initiative of the Ground Water Protection Council and Interstate Oil & Gas Compact Commission, takes a comprehensive look at potential induced seismicity associated with injection wells. The report finds that seismicity linked to oil and gas development is rare; that the risk associated with these rare occurrences are minimal; and that understanding of induced seismicity is growing and mitigation techniques are proving effective. The report also notes that a "vast majority of earthquakes are tectonic, or attributable to natural causes."

The bottom line is these studies and more confirm what have long been true - that seismicity induced by injection wells is rare and certainly not a widespread issue. Despite misleading claims exaggerating risks and incorrectly linking seismicity to injection wells, the risk of induced seismicity from injection wells is small, rare, and manageable.