

Shale Oil & Gas Production – Seismic Activity



Summary: Federal officials and geologists agree that noticeable earthquake activity from hydraulic fracturing is very rare. Some studies, however, suggest a possible link to the injection of wastewater from drilling. Wastewater injection wells have been around since the 1930s and are used to dispose of wastes from a multitude of sources, including municipal wastewater. Deep-well wastewater injection has been regulated for many years, including wells used for wastewater from hydraulic fracturing. The injection of wastewater from drilling poses no increased risk to seismic activity than does other sources of wastewater underground injection; however, as with all injections, it must be appropriately managed and monitored.

Background: Seismic activity occurs as waves (like a ripple on the water) or vibrations (like a bell), and is much more frequent than people realize. There are many causes of seismic activity, both natural and manmade. Often, non-scientists use the term “earthquake” to represent any seismic event. This can be misleading, however, as most seismic activity is undetectable and not at all linked to a catastrophic earthquake. The vast majority of seismic activity is not noticed by people. The waves or vibrations, if felt at all, feel like events that happen every day.

The chart below, obtained from the U.S. Geological Survey (USGS), puts seismic activity into perspective. Until a seismic event reaches a magnitude of 3.0 on the Richter scale, it is very likely not to be noticed by humans. Events recorded between 3.0 and 3.9 feel like a truck rolling by a house. Even those that occur up to 5.0 on the Richter scale only produce some minor shaking, but nothing destructive.

Richter Magnitudes	Description	Seismic Activity Effects	Worldwide Annual Frequency 2000 - 2012	United States Annual Frequency 2000 - 2012
Less than 2.0	Micro	Micro earthquakes, not felt.	3 million (est.)	unknown
2.0 - 2.9	Minor	Generally not felt, but recorded.	1.3 million	1,685
3.0 - 3.9	Minor	Often felt, but rarely causes damage. A Magnitude 3 earthquake is described by the USGS as causing “vibrations similar to the passing of a truck.”	130,000	1,494
4.0 - 4.9	Light	Noticeable shaking of indoor items, rattling noises. Significant damage unlikely.	13,000	381
5.0 - 5.9	Moderate	Can cause major damage to poorly constructed buildings over small regions. At most slight damage to well-designed buildings.	1,319	56
6.0 - 6.9	Strong	Can be destructive in areas up to about 100 miles across in populated areas.	134	6
7.0 - 7.9	Major	Can cause serious damage over larger areas.	15	1
8.0 - 8.9	Great	Can cause serious damage in areas several hundred miles across.	1	0
9.0 - 9.9	Great	Devastating in areas several thousand miles across.	0	0
10.0+	Epic	Never recorded.	0	0

A review of published research shows no cases of injuries or damage as a result of the very low level of seismicity possibly related to hydraulic fracturing, which has been used in more than one million applications.

USGS has been studying hydraulic fracturing and its impact on seismic activity for several years. William Leith, senior science adviser for earthquake and geologic hazards at the USGS, told National Public Radio, “Fracking itself probably does not put enough energy into the ground to trigger an earthquake. That’s really not something that we should be concerned about.” According to USGS, worldwide there are approximately 1.5 million earthquakes each year. Ninety-nine percent of these earthquakes are of magnitude 3.9 and lower on the Richter scale, imposing nearly zero property damage and going largely unnoticed.

Class II Disposal Wells: Much of the wastewater produced in oil and gas extraction is collected and disposed of by injection into underground geological formations. Fluids associated with oil and natural gas production are injected into Class II disposal wells. According to the U.S. Environmental Protection Agency (EPA), the oil and gas industry began injecting wastewater into underground formations in the 1930s. Wastewater also is injected underground by municipal wastewater entities, industrial producers, agriculture and the U.S. government. It has been widely understood that injections of water into underground formations can cause seismic activity such as recent activity in Oklahoma. The USGS has been studying hydraulic fracturing and its potential for causing earthquakes for several years and a number of studies on the subject have been undertaken by the USGS.

According to the USGS' geophysicist William Ellsworth, “it has long been understood that earthquakes can be induced by impoundment of water in reservoirs, surface and underground mining, withdrawal of fluids and gas from the subsurface, and injection of fluids into underground formations.” This is not a new phenomenon caused by hydraulic fracturing. In other words, the cause of seismic activity appears to have less to do with hydraulic fracturing itself and more to do with the wastewater which needs to be disposed of after the hydraulic fracturing process, according to the USGS. Options to reduce seismic activity from underground injection include reducing the volume of water injected or the depth of wastewater injection wells, and avoiding earthquake-prone areas, to minimize the risk of inducing tremors, however small.

Moving Forward: Today, seismic activity is scrutinized by government officials and research universities in regions where hydraulic fracturing and deep-well wastewater injection occur. That is one of the reasons there has been a significant increase in reported seismic activity: there are many more monitors than ever before, and the newer monitoring technology is more sensitive than older technologies. In cases of recordable seismic activity due to drilling or wastewater injection, regulatory officials require activities to stop until a thorough investigation can be performed. Not surprisingly, these types of seismic events have been confined to small areas and are easily identified through the added monitoring equipment, long before any damage can occur.

While wastewater injection is not unique to oil and gas production, it is certainly appropriate to continue evaluating the issue and exploring ways to reduce any potential disruption to the environment or surrounding population. The industry takes the issue very seriously, and the oil and natural gas industry remains dedicated to the continued safe development of America’s vast shale resources.

Overall, the injection of wastewater from hydraulic fracturing poses no increased risk of seismic activity than does other sources of wastewater underground injection. In other words, disposal wells have been safely used by numerous industries, including the oil and gas industry, for decades.

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