Induced seismicity by hydrofracking and wastewater disposal: the re/insurance perspective

Sarah Barrett (1), Iain Bailey (1), Simona Esposito (1)
(1) Swiss Re, Zurich, Switzerland (simona_esposito@swissre.com)

Introduction

Induced seismicity from hydrofracking and wastewater disposal presents an emerging risk and brings several concerns for insurers and reinsurers.

Long-term based risk and price models are no longer accurate for many regions, vulnerability of the building stock in these regions is poorly understood, and many affected consumers are unaware that standard insurance policies do not protect against earthquake damage. If an earthquake is deemed to have been induced by human activity, it is not clear as to who will be liable for damages and how that could be proved.

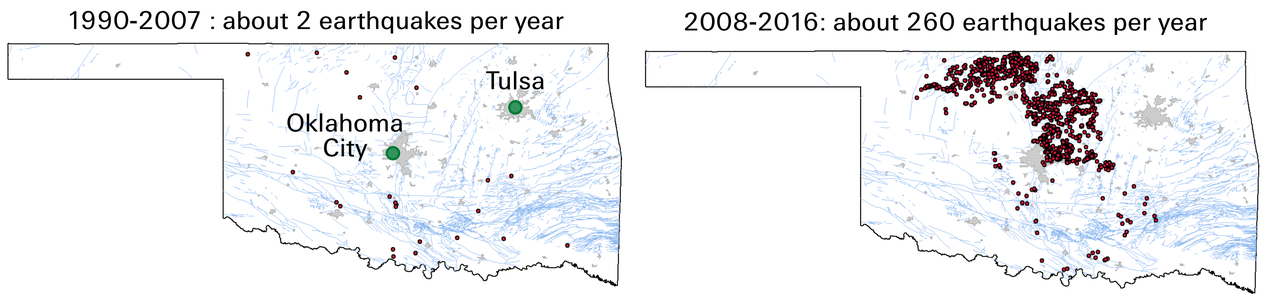


Figure 1. Red shading highlights the location of seismic activity within boundaries of Oklahoma before and after 2008. Faults (light blue lines) are present in throughout Oklahoma. The Meers fault cuts across the southern portion of the state, yet the recently earthquake activity is primarily concentrated in the north-central part of the state and near the Kansas border. The expansion of wastewater injection in the state occurred concurrently with the rise in seismic activity.

1. Induced seismicity

Hydrofracking itself creates very low magnitude events during the process of fracturing the rock. These earthquakes are so small that they are generally not felt at the surface.

The vast majority of the earthquakes in Oklahoma are related to wastewater injection. It involves pumping large volume of fluid at high pressure in a less target manner than hydrofracking process.

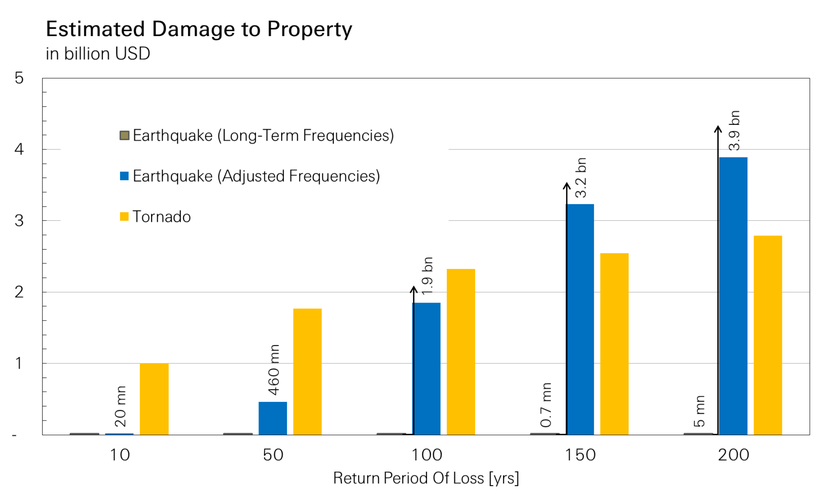
Research shows that some locations may be more prone to induced earthquakes than others. Many factors, such as rock types, pre-existing fault planes and natural seismic hazard may play a role.

So far, there is no definitive method to predict when and where an induced earthquake will occur, and even more difficult to distinguish between naturally occurring earthquake and those induced by human actions.

2. Increased expected losses?

The possible impact of increased earthquake probability on expected loss from property damage in Oklahoma using the Swiss Re earthquake model.

Figure 2. Estimated economic (property) damage for the state of Oklahoma at different return periods for earthquakes and tornadoes. Gray bars (barely visible) show earthquake risk at the seismic hazard levels of ten years ago, while blue bars results for today's seismic hazard. Tornado loss estimates (yellow bars) are shown for comparison.



3. Key issues for insurers and reinsurers

Earthquake protection gaps

There is potential for a large uninsured losses resulting from induced earthquakes in Oklahoma for a variety of reasons:

- Many policies come with high deductibles, designed to protect the consumer from a catastrophic loss of the structure in a large-magnitude earthquake. In Oklahoma, we observe frequent, moderate-size earthquakes that may not reach the level of a typical deductible (~10%).
- Several instances of structural damage are to masonry structures, such as chimneys. Often, an earthquake policy excludes masonry damage.
- Many homeowners may not realize that their existing insurance policy excludes damage caused by earthquakes, or may not know how to obtain earthquake insurance.

The liability landscape

Some homeowners may expect to obtain compensation via the courts in the case of a future damaging earthquake. This presents another source of exposure for the insurance industry, with an accumulation risk that is not commonly accounted for.

However, it is not clear whether we can determine which, if any, well operators are responsible for specific earthquakes. The density of wells in Oklahoma is high. There may be dozens of wells within a 5-10 km radius of an earthquake. Prior and ongoing lawsuits in Oklahoma have not reached consistent outcomes.

Potential impact of regulation & mitigation

Induced earthquakes are particularly difficult to model from an insurance context because the hazard is much more dynamic than for traditional earthquake risks:

- There is some evidence that limiting the rates or volume of fluid injection might restrict the effects of wastewater injection. However, there are several instances of low-volume, low-rate injection wells associated with seismic activity. Limiting injection might not resolve the issue.
- Scientists have offered several mitigation frameworks which may help limit the effects of induced seismicity.
- The price of oil and gas might influence production.

Conclusions

The insurance industry can adapt to this emerging risk by:

- **Considering the possible accumulation of property and casualty lines for an induced earthquake risk**
- **Carefully underwriting for earthquakes in regions with known induced seismicity by acknowledging many earthquake models do not include the recent increase in activity.**
- **Revising existing products to adapt earthquake coverage for low-magnitude, high-frequency earthquake losses.**