

# Understanding the link between fracking and earthquakes

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Researchers studying hydraulic fracturing have answered a longstanding question over how the practice can sometimes cause moderate earthquakes and may be able to use their model to forecast when quakes

linked to fracking might occur.

The team of seismologists and geophysicists from Dalhousie University and the University of Calgary conducted a new study aimed at understanding the physical mechanisms of earthquakes "induced" by hydraulic fracturing, a widely used method to stimulate extraction of hydrocarbons from the ground.

They wanted to understand why these events were occurring, in spite of laboratory measurements suggesting they shouldn't happen in the type of shale rock undergoing stimulation.

What they found is that the injection of fracturing fluids can lead to a slow slip on a fault. That can gradually put enough strain on another, distant section of the fault to cause it to slip suddenly and produce an [earthquake](#).

## **Possibilities for new monitoring and mitigation strategies**

Dmitry Garagash, a professor in the Civil and Resource Engineering Department at Dalhousie, co-authored the study that was published in *Science Advances*, a top-tier online journal of the American Association for the Advancement of Science.

"Work like this allows us to understand the phenomenon better and may ultimately lead to improved regulations and practices of hydraulic fracturing," said Dr. Garagash.

"The developed physics-based model of fault slip in response to changes caused by fracking can lead to better prediction of this type of events, but also suggest new field monitoring and mitigation strategies."

The team was led by Dr. Thomas Eyre, a postdoctoral researcher in the Department of Geoscience at the University of Calgary, and looked at so-called "felt events" or earthquakes that are large enough to be felt in nearby communities.

That included a magnitude 4.2 earthquake earlier this year near Red Deer, Alta., and a 4.5 quake last year near Fort St. John, B.C.

The researchers analyzed a set of seismic and geological data, some of which were collected during a magnitude 4.1 hydraulic fracturing-induced earthquake on Jan. 12, 2016, near Fox Creek in northwest Alberta.

## **An important milestone**

Hydraulic fracturing involves pumping a mixture of water, sand and chemicals into a well bore under high pressure to create fractures in reservoir rocks to exploit them for oil and gas.

"This is an important new milestone for understanding earthquakes caused by hydraulic fracturing," says study co-author Dr. David Eaton, a professor in the University of Calgary's Department of Geoscience.

Dr. Eyre said that based on the research team's model, corroborated by field observations and by physics-based mathematical modeling, the earthquake initiates on a distant part of the fault where friction conditions are unstable.

"In the case we studied, the earthquake occurred hundreds of meters above the [hydraulic fracturing](#) zone," Dr. Eyre said.

Previous studies have suggested that fault slip in shale formations targeted by fracking occurs too slowly to produce an earthquake. But the

new research found that this slow slip can alter the conditions on the fault a distance away from the site of fracking and cause a distant quake.

**More information:** Thomas S. Eyre et al. The role of aseismic slip in hydraulic fracturing–induced seismicity, *Science Advances* (2019). [DOI: 10.1126/sciadv.aav7172](https://doi.org/10.1126/sciadv.aav7172)

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