

INDUCED SEISMIC ACTIVITY IN CANADA



WHAT IS INDUCED SEISMICITY?

Induced seismicity refers to seismicity caused by human activity. Micro-seismicity is generally defined as seismicity of magnitude less than 3, as measured on the Richter scale. Anomalous induced seismicity refers to seismic events caused by human activity that is unusual or inconsistent with what is expected.

Induced seismicity is associated with several industrial processes, including geothermal energy extraction, mining and dam building.

Scientific evidence indicates the risk of damage or injury from induced seismicity caused by hydraulic fracturing is very low.

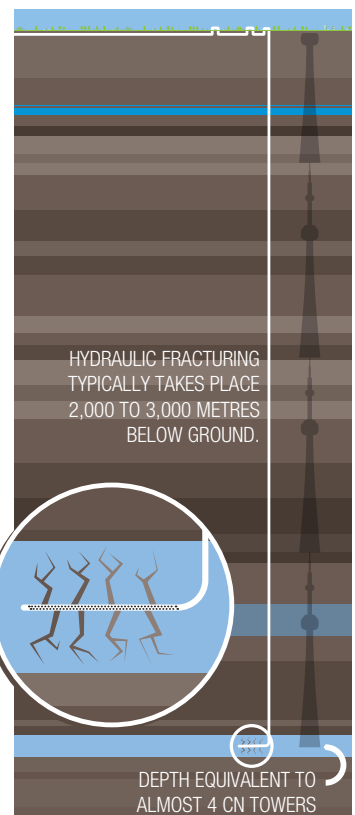
WHAT IS HYDRAULIC FRACTURING?

Hydraulic fracturing is a proven and highly regulated technique that has been used for more than 60 years to recover oil and natural gas from tight rock formations that are typically 2,000 to 3,000 metres below ground. It involves injecting fluids into the deep underground rock at high enough pressures to create fractures in the rock. This opens pathways in the rock to allow oil and natural gas to flow.

HOW CAN HYDRAULIC FRACTURING OR WATER DISPOSAL CAUSE SEISMIC ACTIVITY?

The energy released by hydraulic fracturing or injections into deep disposal wells can trigger movement along existing faults, leading to an anomalous induced seismic event. Most anomalous induced seismicity related to oil and natural gas operations occur at depths of 2,000 to 3,000 metres below ground or deeper. A few events have magnitudes of 4, but most have been much smaller, with magnitudes of 0-3, below the range of magnitudes that are generally felt. The largest events that have been felt at surface are similar to the vibrations of a large truck passing by.

Resource rock is isolated from ground water.



HOW IS INDUCED SEISMICITY REGULATED IN THE OIL AND NATURAL GAS INDUSTRY?

In British Columbia and designated areas in Alberta, oil and natural gas operators are required to assess and monitor for seismic activity on their operating sites. Operators complete detailed risk assessments before commencing hydraulic fracturing activities and must also submit a response plan to the regulator in the event their operations trigger a seismic event. In the rare case an event of magnitude 4 or greater occurs, operations must stop immediately for an investigation to be conducted by the regulator. Operations may not resume until the regulator provides permission.

WHAT IS BEING DONE TO MANAGE INDUCED SEISMICITY FROM OIL AND NATURAL GAS DEVELOPMENT?

Industry takes induced seismicity seriously and understands the public has concerns. Recognizing these concerns is reflected in several regulatory enhancements as well as industry-led initiatives:

- The B.C. regulator (BCOGC) introduced new permit conditions requiring ground motion monitoring and reporting, and amendments to the regulations that require operators to suspend operations if an event of magnitude 4 or greater is triggered.
- In Alberta, the regulator uses a compliance dashboard for seismic monitoring and reporting requirements for hydraulic fracturing operators in the Duvernay region. A “traffic light” system requires operators to report seismic events of magnitudes 2 or greater. Operations must cease if the event measures a magnitude of 4 or greater.
- Oil and natural gas producers developed an operating practice that addresses seismicity caused by hydraulic fracturing to establish monitoring, mitigation and response procedures to avoid or minimize any adverse effects of induced seismicity associated with hydraulic fracturing.
- Industry is also guided by *Industry Shared Practices: Anomalous Induced Seismicity Due to Hydraulic Fracturing*. The shared practices are based on the current level of knowledge and ensure industry has access to the same information so that any potential risks related to induced seismicity caused by hydraulic fracturing is managed using the best available information, technology and science.
- Increased monitoring through the Canadian National Seismograph Network (CNSN) in northeast British Columbia.
- Industry supports independent, science-based research and shares data with academia.

WHAT DOES SCIENTIFIC RESEARCH SAY ABOUT OIL AND NATURAL GAS OPERATIONS AND INDUCED SEISMIC ACTIVITY?

Canadian research on the link between oil and natural gas activity and induced seismicity is growing. This includes three academic studies (see sidebar) and two prepared by the BC Oil and Gas Commission (BCOGC). All studies state that the risk of hydraulic fracturing causing an event that can be felt at the surface is low. They also agree that events of larger magnitudes, 3 or greater, are rare.

CURRENT CANADIAN RESEARCH

FAULT ACTIVATION BY HYDRAULIC FRACTURING IN WESTERN CANADA
(November 2016)

Authors - David Eaton and Xuewei Bao, University of Calgary

HYDRAULIC FRACTURING AND SEISMICITY IN THE WESTERN CANADIAN SEDIMENTARY BASIN
(May 2016)

Authors - A team of researchers led by Western University's Gail Atkinson and University of Calgary's David Eaton.

IMPACT OF INDUCED SEISMICITY ON THE EVALUATION OF SEISMIC HAZARD: SOME PRELIMINARY CONSIDERATIONS
(May 2015)

Authors - A team of Western University researchers led by Gail Atkinson.

BCOGC INVESTIGATION OF OBSERVED SEISMICITY IN THE MONTNEY TREND
(December 2014)

Authors - BC Oil and Gas Commission

BCOGC INVESTIGATION OF OBSERVED SEISMICITY IN THE HORN RIVER BASIN
(August 2012)

Authors - BC Oil and Gas Commission