



Nov. 29, 2018 Seismic Event Determination

The BC Oil and Gas Commission has determined the three seismic events which occurred approximately 20 km south of Fort St. John on Nov. 29, 2018 were caused by fluid injection during hydraulic fracturing operations conducted by Canadian Natural Resources Ltd (CNRL).

The events measured 3.4, 4.0 and 4.5 magnitude, with the first event recorded at 18:27 MST followed by two smaller aftershocks ending at 19:15 MST. The Commission received 14 reports of felt events related to this seismicity. CNRL performed well bore integrity assessments, and no problems were reported. As per the Commission's Kiskatinaw Seismic Monitoring and Mitigation Area (KSMMA) [Special Project Order](#) and the [Drilling and Production Regulation](#), CNRL immediately suspended hydraulic fracturing operations.

The investigation included a review of operational and seismological data within a 10 kilometre radius of the epicentres as determined by Natural Resources Canada. The events occurred during hydraulic fracture operations targeting the lower Montney formation. Seven upper Montney wells had been previously drilled and completed at CNRL's well pad (5-22-81-18W6) from May to June 2018 (see attached Map). No events larger than magnitude 2.5 were detected during that period. A pre-assessment report relating to completion operations for two wells ('G' and 'H') targeting the lower Montney was submitted as required by KSMMA and concluded induced seismicity was likely to occur, but events larger than magnitude 3 were not expected.

Factors leading to this determination include:

- The timing of the events coincided with hydraulic fracture operations within the lower Montney zone in the 'G' and 'H' well of the 5-22 pad which were ongoing from Nov. 27, 2018 until the occurrence of the events on Nov. 29, 2018.
- The epicentres of the events were located in close proximity to the 'G' and 'H' wells based on data from both the Canadian National Seismograph Network and a proprietary seismic array deployed to monitor for induced seismicity.
- Water disposal was occurring in the Septimus area but the closest active disposal well was approximately six km from the epicentre of the 4.5 magnitude event. Further, the depth of the events as determined by the proprietary dense array was significantly lower than the formation where water disposal was occurring.
- Based on "felt" reports, ground motion appears to have been strongest in the vicinity of the 'G' and 'H' wellbores.

CNRL has satisfied the pre-operation and active operation requirements as per the KSMMA order. However, all hydraulic fracture operations within the lower Montney formation will remain suspended at the 5-22 well pad pending the results of a detailed technical review. CNRL continues to cooperate fully with the ongoing investigation.

Other companies within the specified area identified in [Industry Bulletin 2018-29](#) and the general KSMMA may resume operations pursuant to the applicable KSMMA requirements. It is the Commission's understanding the first planned operations will begin Jan. 5, 2019. Prior to commencing operations, all permit holders within KSMMA are required to submit revised induced seismicity assessments. Completions targeting the lower Montney formation within KSMMA appear to have increased susceptibility for induced seismic events and operators should be prepared to implement mitigation measures if seismic monitoring indicates an increase in the frequency or magnitude of events.

The Commission is taking the following steps to further understand and mitigate induced seismicity:

- Working with KSMMA area operators to catalogue and characterize known geologic faults.
- Conducting a third party review of geo-mechanical properties, hydraulic fracture design and seismologic data to refine induced seismicity hazard assessments.

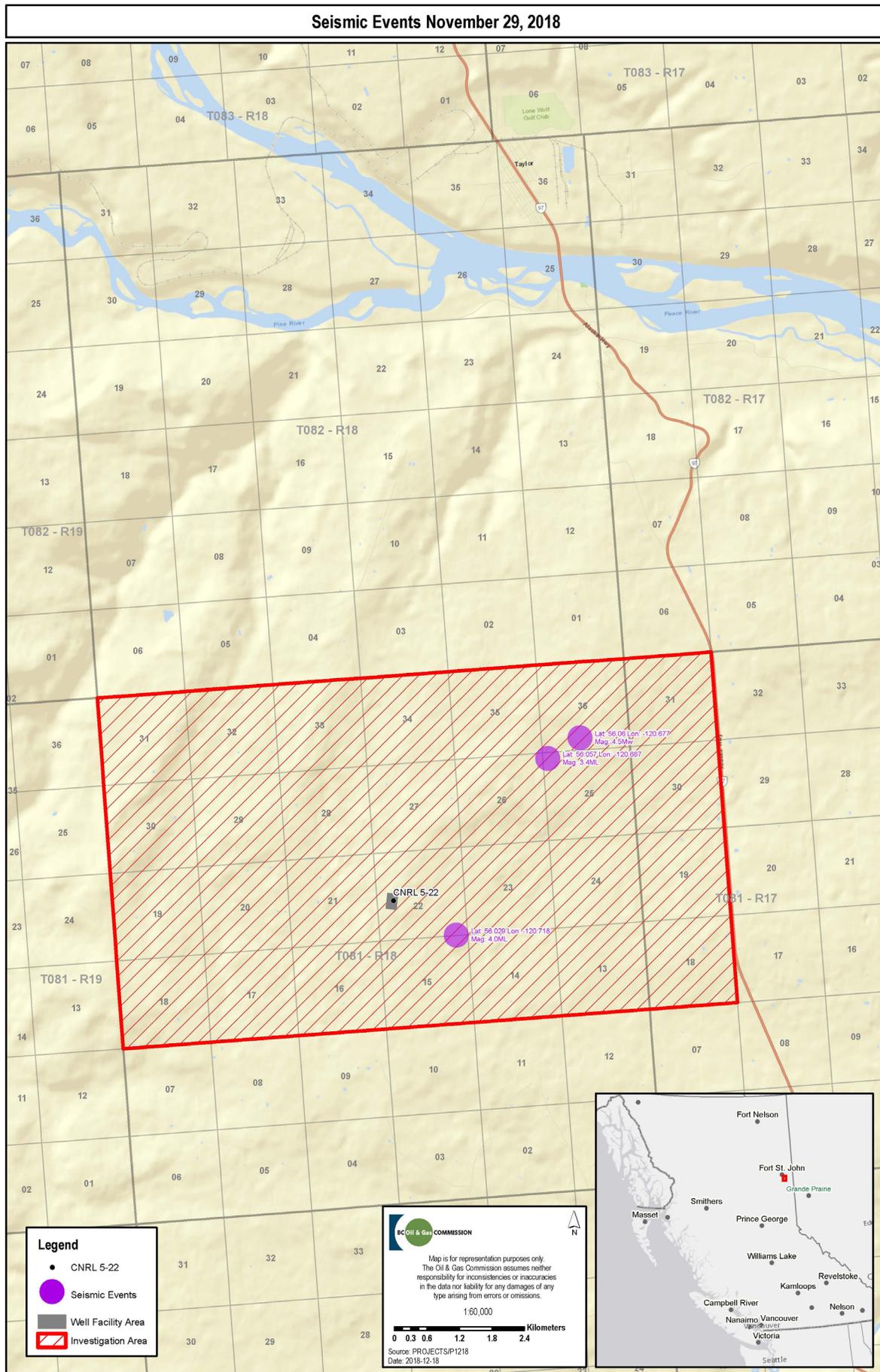
An improved pre-assessment of seismic hazards may allow for more targeted mitigation measures in areas of specific concern.

Background:

Based upon ongoing research and cooperation initiatives, the Commission issued a Special Project Order in May 2018, strengthening the regulation of induced seismicity resulting from hydraulic fracturing operations in the KSMMA. The Order requires the immediate shut down of operations when an induced seismic event reaches or exceeds a 3.0 magnitude within the KSMMA, rather than at 4.0, as specified in section 21.1 of the Drilling and Production Regulation.

More details on these seismic events can be found on the Natural Resources Canada site at: <http://www.earthquakescanada.nrcan.gc.ca/index-en.php>.

Map



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Public enquiries and concerns can be made via the Commission's 24 hour public number: 250-794-5200.
Email inquiries can also be sent to OGCSeismic.Reports@bcogc.ca.

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