

Source parameter estimates for induced earthquakes in western Canada

Yajing Liu¹, Rebecca Harrington², Fiona Clerc³, Kai Deng⁴,

Bei Wang^{1,2}, Ge Li¹

1. Department of Earth and Planetary Sciences, McGill University

2. Institute of Geology, Mineralogy and Geophysics, Ruhr-Universität at Bochum

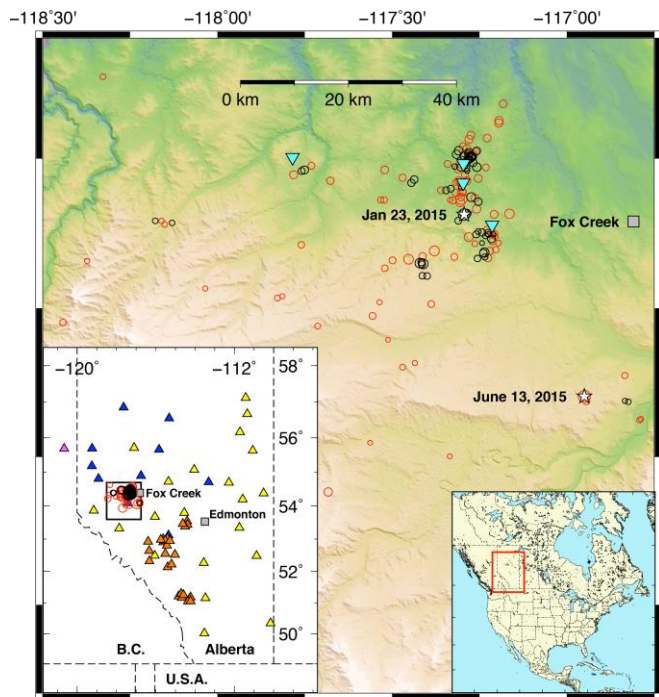
3. Joint Program in Oceanography, MIT/WHOI

4. College of Geophysics, Chengdu University of Technology

With support from

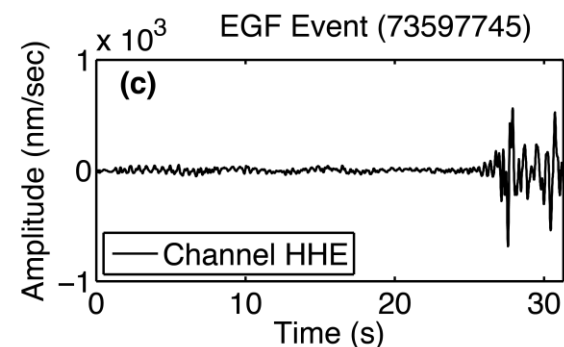
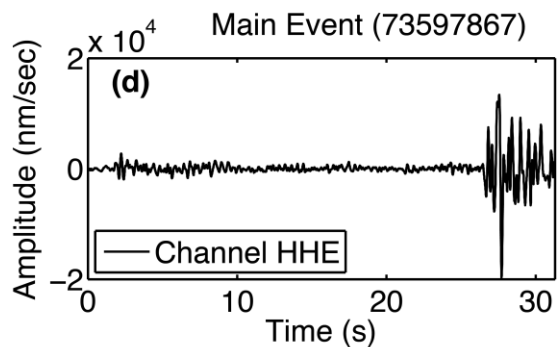
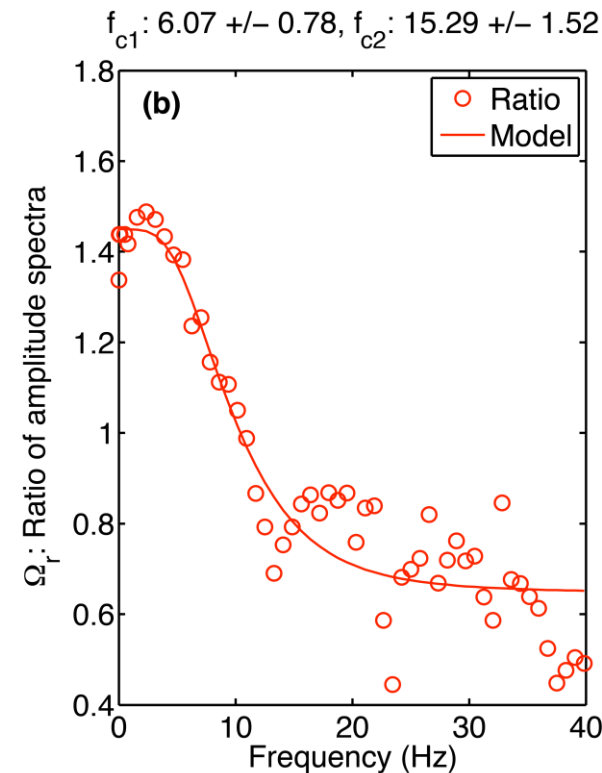
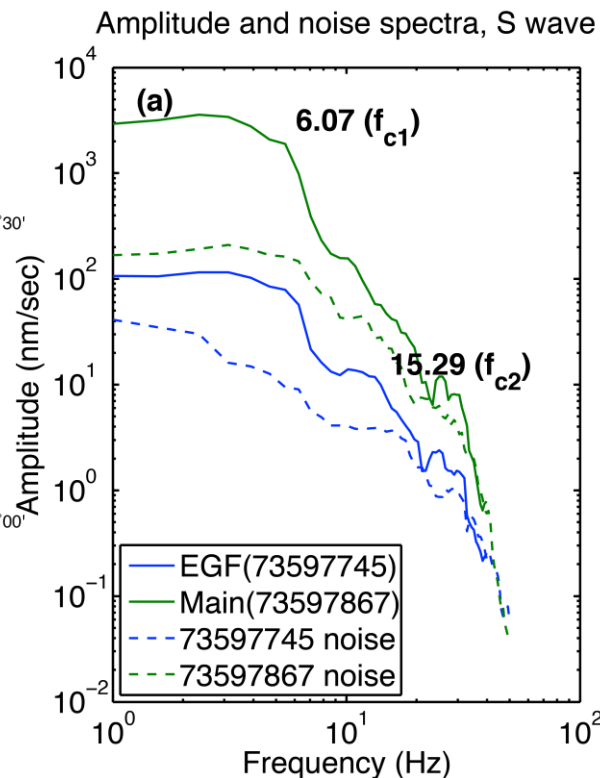
Geological Survey of Canada, BC Oil and Gas Commission and local operators

Static stress drop values

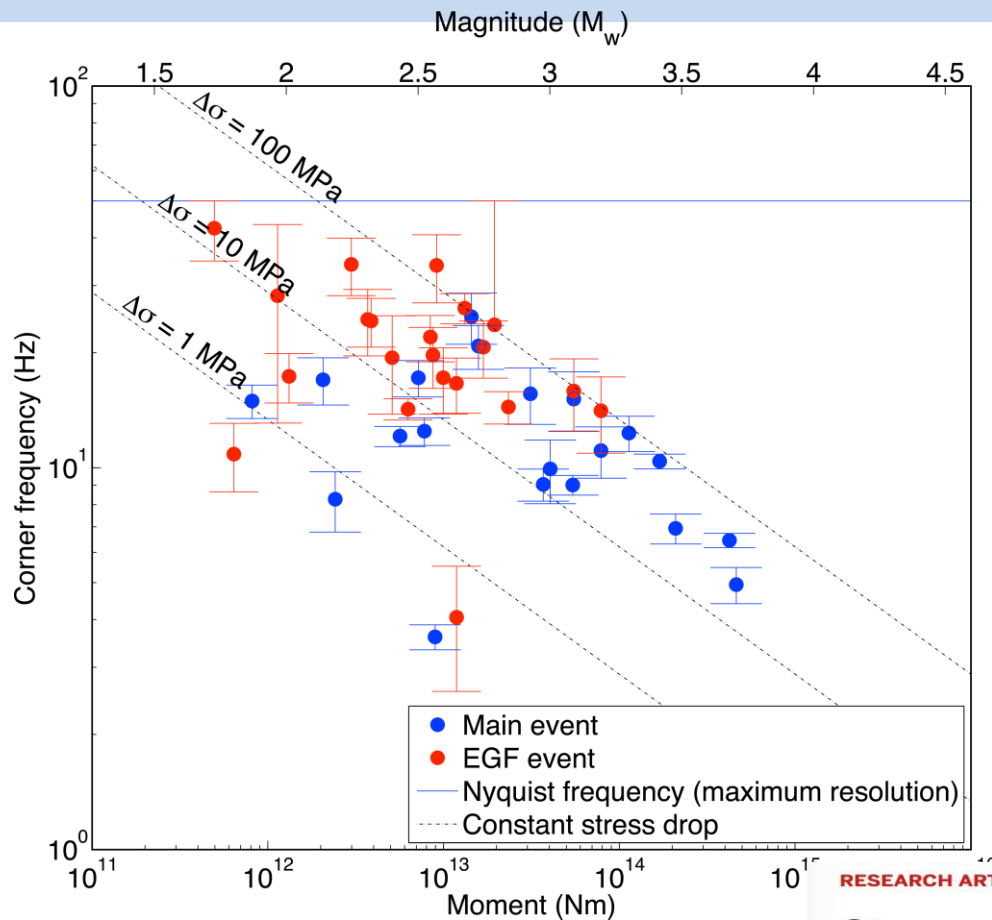


| | | | |
|-----------------------------------|-------------------|-------|-------|
| ▲ CRANE | ▲ RAVEN | ▲ TD | ▲ CN |
| ○ HypoDD relocations (this study) | ○ NRCAN locations | | |
| ○ M 1 | ○ M 2 | ○ M 3 | ○ M 4 |
| ▽ Hydraulic fracturing wells | ■ Municipalities | | |

[Clerc et al., 2016]



Static stress drop values



- fall within the high side of the typical reported range of tectonic events
- show no correlation with earthquake magnitude, depth, or distance from the well
- appear roughly constant for events with M_w 3 to 4.
- Our findings imply that neither stress drop amplitude nor scaling are reliable metrics in distinguishing induced and tectonic earthquakes, as stress drop range may be greatly affected by the regional setting.

RESEARCH ARTICLE | EARTHQUAKES

Stress drops of induced and tectonic earthquakes in the central United States are indistinguishable

Yihe Huang^{1,*}, William L. Ellsworth² and Gregory C. Beroza²

+ See all authors and affiliations

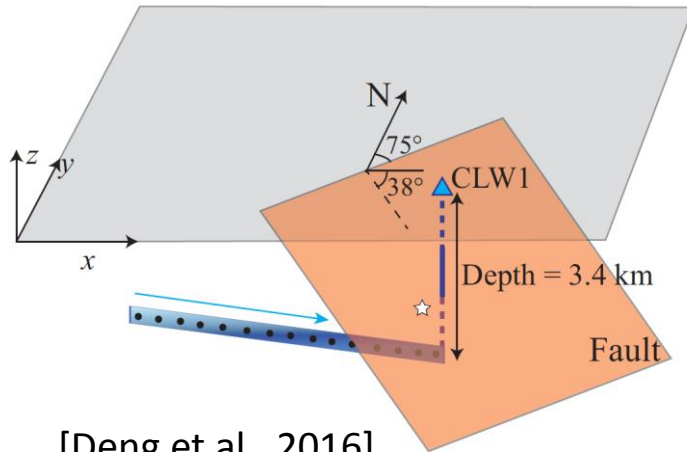
Science Advances 02 Aug 2017:

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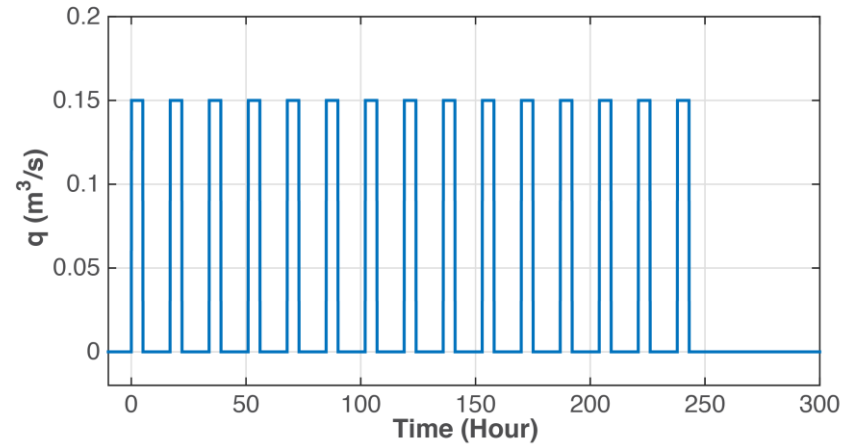
DOI: 10.1126/sciadv.1700772

Poroelastic stress modeling

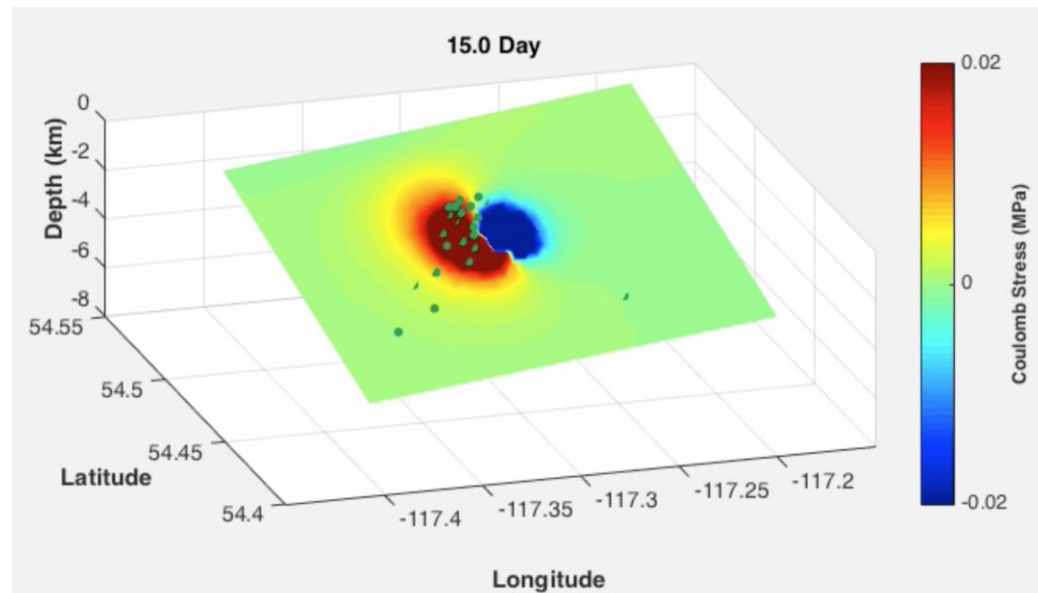
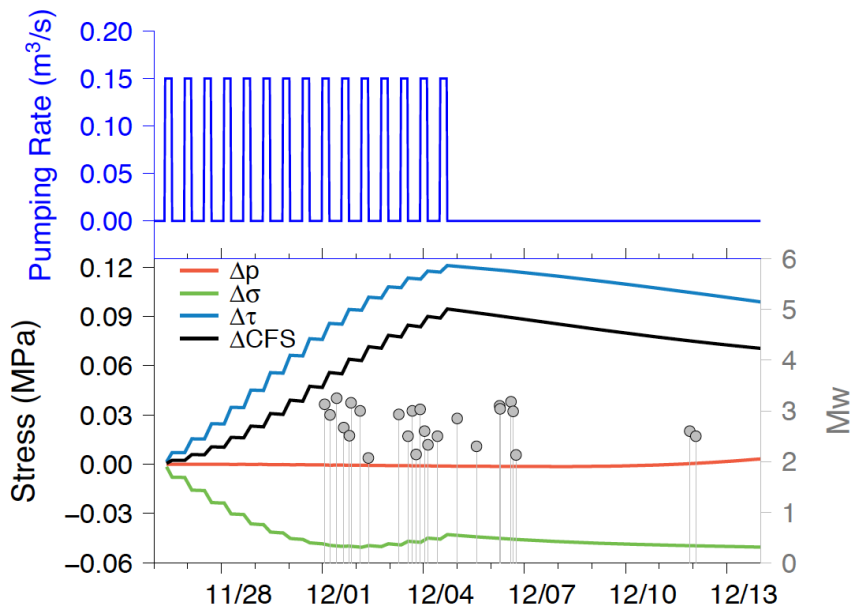
Fitted "fault plane" from relocated seismicity [Schultz et al., 2015]



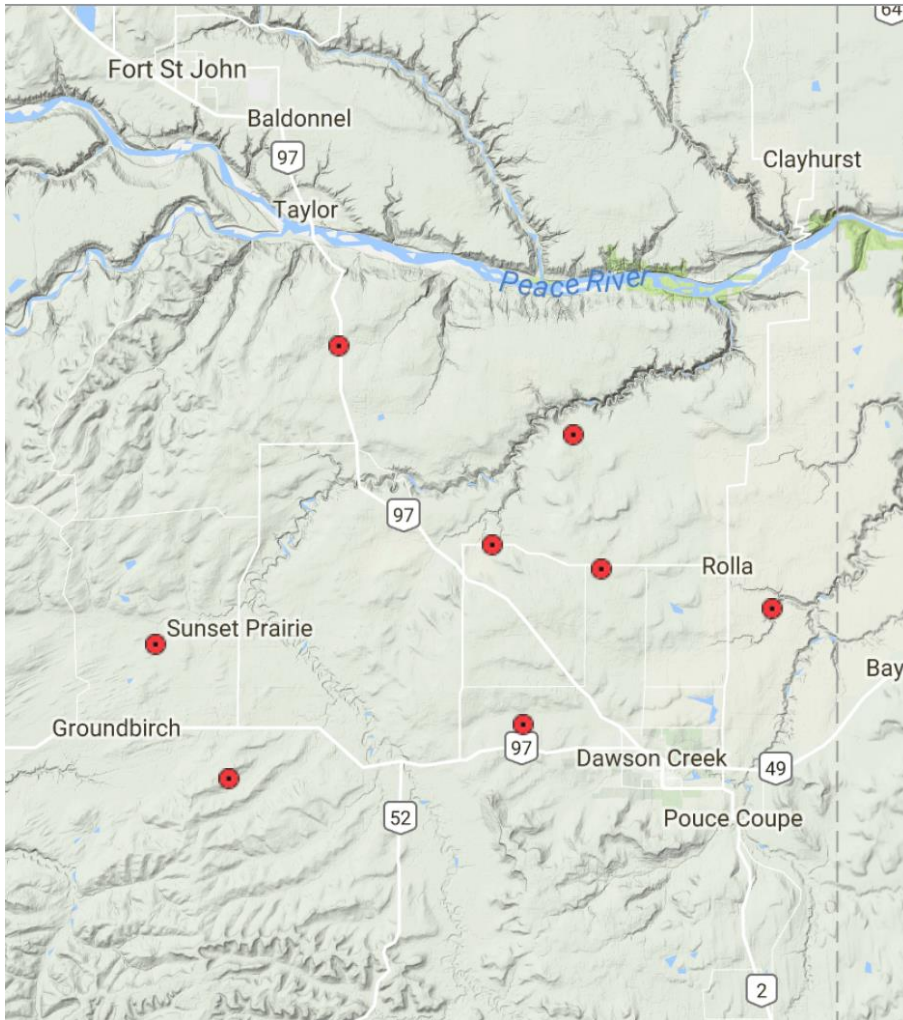
Multi-stage pumping history



Coulomb stress change



Work in progress



A dense array consisting of

- 8 broadband seismometers
- 3 seismogeodetic integrated systems (accelerometer+GNSS)
- Co-located corner reflectors for InSAR imaging
- Groundwater sampling

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<http://ds.iris.edu/gmap/XL>