



## Induced Seismicity in Unconventional Resource Development

**Data Types:** Seismic, regulatory

**Challenge Details:** In some areas the development of low-permeability unconventional resources has resulted in anomalous induced seismicity, in the form of small-to-moderate earthquakes triggered by subsurface fluid injection. Although neither injuries nor property damage have yet occurred in Canada, induced seismicity has raised widespread public concerns, including the Alexander First Nations community northwest of Edmonton, and has prompted regulatory measures and even moratoria.

One measure for managing risks has involved the introduction of “traffic-light systems” that require operators to monitor seismic activity in the vicinity of a well completion program, activate a mitigation protocol in response to small induced events (“amber” condition) and to halt operations in response to a larger event (“red” condition).

A number of risk factors for hydraulic-fracturing induced seismicity have been proposed. For example, most unconventional horizontal wells are drilled NW–SE to maximize transverse fracture propagation along the wellbore. Since the land registry system in western Canada is based on a NS–EW grid pattern, this diagonal drilling method impedes use of the remainder of the plot of land and, therefore, is less efficient in terms of resource development. Given the in situ stress conditions, there is evidence that wells drilled NS are more likely to induce an earthquake sequence.

### Questions:

- (1) In what ways do traffic light systems in various jurisdictions differ around the world? How do induced seismicity traffic light systems used for geothermal energy development or carbon capture and storage compare with those used for unconventional oil and gas development?
- (2) What are the currently known risk factors for induced seismicity from hydraulic fracturing? What types of mitigation measures are used?
- (3) What evidence exists to suggest that N-S horizontal drilling in the Duvernay play is more likely to induce an earthquake? What is the underlying physical mechanism?
- (4) Can we quantify the increased drilling cost of diagonal drilling? In other words, what is the resultant economic cost incurred by not drilling N-S or E–W?

THINK  TANK



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