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Induced Sesimicity in the Montney – A Case Study

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Introduction

Development of unconventioanal resources in the Montney has resulted in an surge in number of horizontal wells being drilled an completed, and an increase in disposal wells and disposal volumes (BC OGC, 2014). An unintended consequence of this increased activity is the occurrence of induced seismic events – some which are felt locally. In this case study, induced seismicity related to hydraulic fracturing operations in the Montney is investigated.

Theory and/or Method

Seismicity monitoring of a hydraulic fracturing operation was conducted in the Montney play in northeastern British Columbia, Canada. Monitoring was conducted with a permanent array of seven 3-component sondes placed within a 5 km circle, centered on the pad. 820 events were recorded with moment magnitudes greater than 1.0, with a magnitude of completeness of approximately 1.5 Mw. Of the 820 events, only 5 events were recorded by the Canadian National Seismograph Network. The largest event recorded by the local array is 3.4 Mw, which produced weak, but perceptible, shaking. No damage was reported as a result of these events.

Examples

Event locations delineate deep strike-slip faults that are steeply-dipping and trend N 60° E. These faults are optimally oriented within the current-day stress field for strike-slip failure. The regional maximum horizontal stress direction, as measured by borehole breakout data, is N 30° E. These fault reactivation events occur below the stimulated formation and within ~1 km laterally of the well pad. Reactivated fault segments along lineaments that intersect the wellbores (in map view only) spatially and temporally follow the frac stage sequence, which moves sequentially from toe to heel along individual wellbores.

Lineaments that are more distal, and seemingly disconnected from the wells, are reactivated during and after the treatment and are not geometrically aligned with the completions stages. These lineaments may be reactivated fault segments from previous pad completions.

Event frequency dissipates over time, with the most events occurring during completions, moderate activity occurring during flowback operations and minimal activity occurring once all wells are flowing. Activity is observed to return to background rates within weeks of the completion.

Conclusions

This study demonstrates that seismicity can be linked to major reservoir changes caused by hydraulic fracturing and flowback. It also demonstrates that local arrays of sondes can be used to locate seismic events, characterize slip, and quantify ground motion.

Acknowledgements

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References

BC Oil and Gas Commission, December 2014 , Investigation of Observed Seismicity in the Montney Trend.