

Activation Rate of Seismicity for Hydraulic Fracture Wells in the Western Canada

Sedimentary Basin

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ABSTRACT

The rate of $M \geq 3$ earthquakes associated with hydraulic fracturing in horizontal wells (HF wells) in the Western Canada Sedimentary Basin is estimated for the period from 2009 to 2019. The estimates are based on a statistical discrimination algorithm that uses an objective scoring function deduced from the observed spatiotemporal correlations between wells and earthquakes. A Monte Carlo simulation approach is used to test the efficacy of the scoring function in determining non-coincidental association rates, allowing correction of the observed association rates for the expected number of false positives. The basin-wide average rate of association of $M \geq 3$ earthquakes with HF wells (2009-2019) is $\sim 0.8\%$ on a per well basis. The susceptibility appears to vary by formation by more than an order of magnitude, ranging from $\sim 6\%$ for HF wells in the Duvernay Formation to $\sim 0.07\%$ for HF wells in the Cardium Formation. For some formations there has been no observed association at the $M \geq 3$ level to date, but this does not necessarily imply that such formations are immune to induced seismicity.