# Examining Earthquakes Recorded in Eastern Canadian Areas With Shale Gas Exploration Potential

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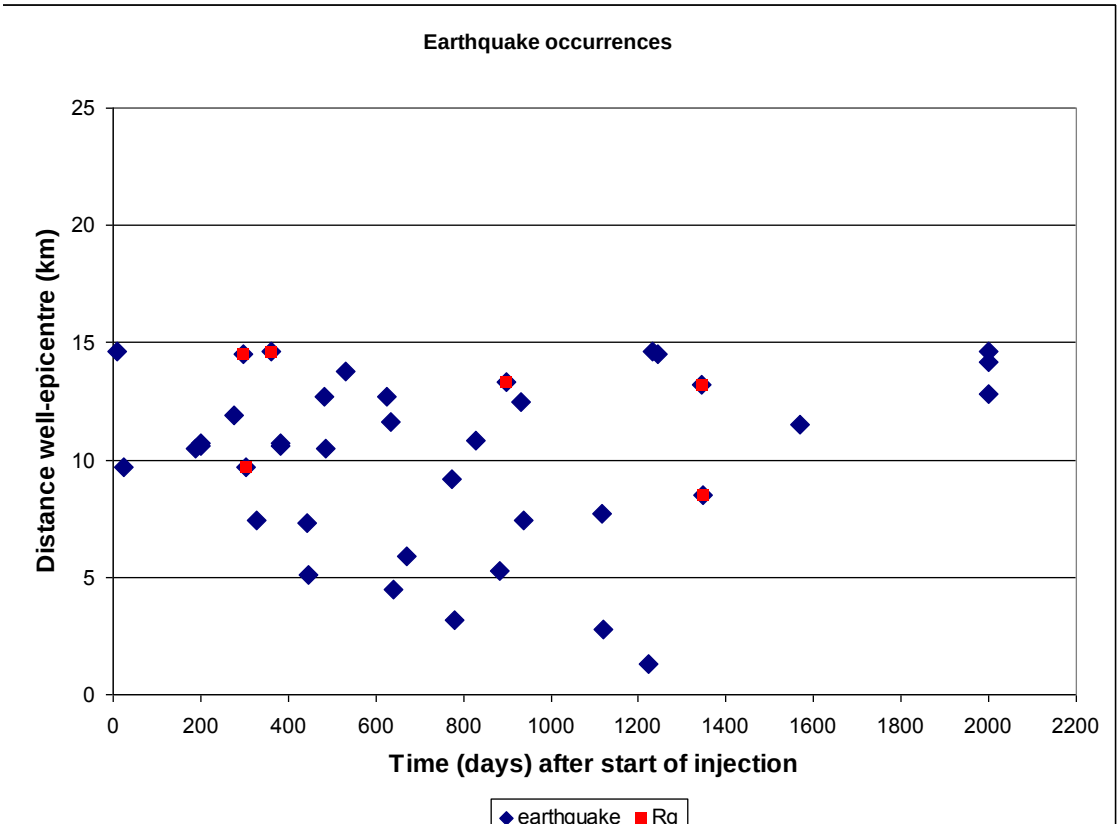
## Summary

Two eastern Canadian areas have had some shale gas exploration activities in recent years: southeastern New Brunswick (NB) and the St. Lawrence Lowlands between Quebec City and Montreal (QC). In these two areas, the regional earthquake activity is routinely monitored by the Canadian National Seismograph Network (CNSN) providing earthquake location completeness slightly better than Nuttli magnitude (mN) 2.0. Earthquake epicentres have a location uncertainty of about 7 km estimated from confirmed quarry blast events. For some areas of QC where temporary portable seismographs are deployed, the completeness level is lowered to Nuttli magnitude (mN) ~1.0 and focal depths can be computed. Both southern QC and NB have a low level of naturally occurring earthquakes. For the St. Lawrence Lowlands, we investigate the possibility that some of the earthquakes could be associated in time and in space with the shale gas exploration work conducted between 2006 and 2010. Specifically, we compare earthquake parameters (locations and origin times) and the basic record of well operations (locations and time periods when hydraulic fracturing was performed). Our search for possible induced events examines a temporal connection (i.e., an event's origin time must be after the start of fluid injection) and relative proximity (i.e., within 10 km of well locations). For the very few earthquakes that satisfy the time and spatial conditions, seismic waveforms at stations within 100 km from the epicentres are systematically examined for a Rayleigh (Rg) phase indicative of a shallow source. We present results for the St. Lawrence Lowlands region in addition to our study of a magnitude mN 4.1 tectonic earthquake that was proven to be mid-crustal and not related to any human activity (which specifically addresses the concern raised by the media and the public). In NB, only one seismic event in the hydraulic fracturing region was found but the long period between its occurrence and hydraulic fracturing makes a connection unlikely.

Figure 1. Plot of the earthquakes detected in the St. Lawrence valley by the Canadian Seismograph Network between January 2005 and October 2012. The plotted earthquakes had their epicentres within 15 km of a well where hydraulic fracturing had occurred. The time axis represents the time interval between the injection date and the earthquake occurrence. One must note that the epicentre precision is about 7 km in the area. The events shown in red are those for which a Rg phase was seen on the seismic traces which suggest a shallow depth (less than 5 km). The analysis suggests that none of these events were likely caused by the hydraulic fracturing because of the large distances and the long time interval between the injection and the earthquake occurrence.




**References**

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