

Project Profile

Project Name:	Comprehensive Investigation of Earthquake Magnitude-Frequency Relationship Due to Fluid Injections
Project Number:	ER-Seismic-2022-02
Proponent:	University of Victoria (Dr. Kao)
Funding Envelope:	Environmental Research—Induced Seismicity
Timeframe:	October 1, 2021 to September 30, 2023

Project description

The project aims to further understand the magnitude-frequency distributions of induced seismicity and how it can be used to mitigate the associated seismic risk. The project will analyze the most complete earthquake catalogue ever compiled to systematically investigate the seismic pattern in the context of Gutenberg-Richter distribution and seismogenic index as a function of time, geographic location, geological and hydrological setting, tectonic and geomechanical characteristics, and injection parameters. The results will be used to establish a statistical model to constrain the maximum magnitude of injection-induced earthquakes (IIE) in BC and to estimate their occurrence probability.

A comprehensive investigation of the magnitude-frequency relationship with the enhanced dataset, including possible effects from different geological/stratigraphic settings and/or seismotectonic characteristics, is expected to offer new insights into the prediction of maximum magnitude of IIE at unprecedented resolution.

Project objectives

The objectives of this project are to:

1. Delineate the spatial variation of the earthquake magnitude-frequency relationship for areas affected by injection-induced earthquakes in northeastern BC (e.g., Kiskatinaw and Northern Montney seismic monitoring and mitigation areas);
2. Determine the spatiotemporal variation of seismogenic index based on the most updated earthquake catalogue and injection database;
3. Characterize the possible effects from geological, hydrological, and tectonic settings; and
4. Obtain analytical/statistical models to quantitatively estimate the maximum magnitude of IIE and its occurrence probability.

Project approach

The project will consist of the following five tasks:

1. Collection and compilation of injection information—creating an injection parameter database suitable for the proposed analysis.
2. Earthquake data collection and literature review—resulting in an earthquake database containing source parameters suitable for the proposed analysis and a compilation of references relevant to the proposed research.
3. Seismic and injection data analysis—generating a technical/internal summary of the analysis.
4. Additional analysis and result interpretation—generating a technical/internal report of preliminary results.
5. Knowledge presentation and transfer—documenting results including summaries of the key findings and implications of the maximum magnitude and b-value mapping through the Montney Trend.

Project deliverables

The deliverables from this project include the following:

1. Final report.