

January 2023 – Geomechanical Effects of Cumulative Fluid Injection in KSMMA

To kick off the year, the featured speaker for our Technical Webinar Series was Neil Watson, Director – Geology at Enlighten Geoscience Ltd. The subject of his talk was “Geomechanical Effects of Cumulative Fluid Injection through Hydraulic Fracturing in the Kiskatinaw Seismic Monitoring and Mitigation Area (KSMMA), British Columbia”. Also joining in on the call was Amy Fox, Geomechanics Specialist at Enlighten Geoscience Ltd.

Prior to the keynote presentation, Dr. Brad Hayes, CSEE’s Outreach Chair, provided a brief update of his speaking engagements in Q1 2023. The schedule includes visits / presentations at various academic institutions, technical associations and conferences. In addition to his historical presentations on Unconventional Oil & Gas Developments in Canada, Dr. Hayes has been instrumental in both structuring and then communicating & delivering the concepts within CSEE’s Massive Open Online Course (MOOC), which delves into the complex topic of “The 21st Century Energy Transition”.

To commence his presentation, Neil acknowledged the various individuals and organizations that have been involved in different aspects of this work over the past number of years, including the previous iterations of the KSMMA studies. The original work was started in 2019, with the subject project being the 4th in the series. The primary focus of this study was to investigate the effects of fluid injection into the Triassic Montney play on induced seismicity in the KSMMA (established in 2018). The identified four subdivisions (stratigraphic intervals) of the Montney formation are Upper Montney (most intensely drilled), Upper Middle Montney, Lower Middle Montney (most associated seismicity), and Lower Montney.

After providing the geological setting and a structural summary of the area (including the mapping of publicly available 3D seismic data), the speaker provided various fluid injection summaries for the period 2008 to 2020. It was noted that during the indicated time period, almost 20 million m³ of liquids had been injected into the KSMMA Montney play via hydraulic fracturing operations. Although the fluid injection volume appears relatively high, it represents approximately only 0.003% of the estimated total pore volume of the Montney play in the area. In addition, it was noted that there has also been a significant volume of fluid removal (via production) and potential fluid retention in the formation due to sub-irreducible saturation conditions. Therefore, although some investigators have suggested the high fluid volumes as the reason for induced seismic events, the speaker indicated that additional work is necessary to determine the exact cause(s) and condition(s) that lead to seismic occurrences.

Some of the other work / studies that are underway and / or are being suggested to further the overall understanding, including possible mechanisms to mitigate induced seismicity, include the following:

1. Continued statistical investigation of geological factors & geomechanical knowledge, in conjunction with well parameters (i.e depth to top of Montney, distance to normal & listric faults, etc.), to determine the onset or occurrence of seismic events
2. Pore Pressure Mapping & Stress Distribution – initial work suggests that neither of these are uniform nor static in the KSMMA; there are areas of high overpressure to indicate compartmentalization

3. Montney Gas Dryness Mapping – trends of increased gas dryness likely correspond to pressure discontinuities within migration fairways
4. Probabilistic & GIS-based Fault Risk Mapping
5. Monitoring falloff pressures in the vicinity of existing / known faults as a mitigation technique
6. Falloff pressure monitoring in combination with a detailed structural model to enhance mitigation efforts