Characteristics of microseismicity in the Kiskatinaw area, northeastern British Columbia, Canada

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INTRODUCTION

METHODS

- Automatic earthquake detection using PALM (Zhou *et al.*, 2022)
 - Arrival-time picking of *P* and *S*-waves on the continuous waveform (Figure 1)
 - > *P*-wave: Short-term-average to the long-term-average ratio (STA/LTA)
 - > S-wave: STA/LTA and kurtosis (if kurtosis variation is 0 or less, use STA/LTA)
- 2. Seismic phase association based on 1) the estimated origin time and 2) the residual between theoretical and observed *P*-wave arrival times (Figure 2)
- 3. Hypocenter determination with HYPOINVERSE (Klein, 2002)
- Refining the phase arrival time and measuring the *P*-wave first motion polarity from visual inspection using the well-located earthquake (FOCMEC; Snoke et al., 2003)
- > Considering well-located if it meets the following criteria: RMS of 0.50 seconds or less, ERH of less than 5.0 km, and is recorded with at least six phases.

RESULTS

- During the analysis period, 1,717 earthquakes were detected, of which 817 were well-located from visual inspection, and their distribution is located around the active fluid injection areas.
- Focal mechanisms were determined for some events in the two areas (Area 1 and Area 2 in Figure 4). They show dominantly strike-slip faulting, consistent with the $_{56.0^{\circ}N}$ – maximum horizontal stress (S_{Hmax}) direction (NE–SW) in northeastern British Columbia.
- In Area 1, where earthquakes occurred throughout the entire period, most earthquakes in Period 1 were distributed within 1 km depth, while earthquakes in Period 3 were mainly distributed within 1–2 km depth (Area 1 in Figure 5).
- In Area 2, where earthquakes mainly occurred in Period 3, most earthquakes were distributed at 1–2 km depth (Area 2 in Figure 5).
- The reason for the lower number of earthquakes in Period 2 compared to other periods is believed to be the lockdown of industrial activities during the COVID-19 pandemic.

SUMMARY

- Many induced earthquakes due to fluid injection have occurred in the KSMMA in northeastern British Columbia, Canada.

- Seismicity is believed to have decreased due to the COVID-19 lockdown during Period 2.

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• Since the early 2000s, in northeastern British Columbia, Canada, many induced earthquakes have occurred due to industrial activities such as unconventional development using fluid injection. • Monitoring microseismicity in fluid injection areas provides the characteristic of fault and movement of fluid, which is essential for mitigating earthquake hazards.





• To analyze the characteristic of microseismicity, earthquakes were analyzed using the seismic observation data from EO and 1E networks and automatic detection methods, including STA/LTA and kurtosis. • Hypocenters are concentrated in locations known to have active fluid injection areas and within 2 km depth. Focal mechanisms are consistent with the direction of this region's principal stress.



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