MICROSEISMIC MONITORING PROJECT, IGNACE AREA

Annual Event Summary Report (January 1, 2023 - December 31, 2023)

APM-REP-01332-0459 **April 2024**

Nanometrics

nwmo
NUCLEAR WASTE MANAGEMENT ORGANIZATION
SOCIÉTÉ DE GESTION DES DÉCHETS NUCLÉAIRES

This report has been prepared under contract to NWMO. The report has been reviewed by NWMO, but the views and conclusions are those of the authors and do not necessarily represent those of the NWMO.

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Revision Summary

Rev	Date	Authors	Comments
R1.1	2024-04-08	Nate Hermawan	Resolved minor corrections provided by NWMO
R1.0	2024-02-28	Nate Hermawan	Resolved comments provided by NWMO; updated waveforms with offline stations; appended November and December event data
R0.0	2023-11-21	Nate Hermawan	Initial draft

ATTENTION: PLEASE READ CAREFULLY.

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Abbreviations

AOI: Area of interest for the Microseismic Monitoring Program to detect and quantify microseismicity approximately 50 km around the Revell Site

APM: Adaptive Phased Management

CF: Characteristic function for trigger detection algorithm

CHIS: Canadian Hazard Information Service

IRIS: Incorporated Research Institutions for Seismology

Mc: Magnitude of completeness for the monitoring network

ML: Local magnitude scale

MSL: Mean sea level datum

NWMO: Nuclear Waste Management Organization

Program: Microseismic monitoring program for the Revell Site

SNR: Signal to noise ratio

STA/LTA: Short-time average through long-time average trigger detection algorithm

Vp: Seismic propagation velocity of P-waves

Vs: Seismic propagation velocity of S-waves

WGS84: World Geodetic System (1984)

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1. Introduction

The Nuclear Waste Management Organization ("NWMO") is responsible for implementing Adaptive Phased Management ("APM"), Canada's plan for the long-term management of used nuclear fuel. The ultimate objective of APM is the centralized containment and isolation of used nuclear fuel in a deep geological repository located at a safe site in an informed and willing host community.

The Microseismic Monitoring Program ("Program") at the Revell Site is part of Phase 2 Geoscientific Preliminary Field Investigations of the NWMO's APM Site Selection phase. The objective of the Program is to install a network of nine seismic stations (broadband seismometers) and provide continuous monitoring and reporting of earthquake activity for an Area of Interest ("AOI") around the potential repository area (i.e., Revell Site) located in the northwestern portion of the Revell batholith (Figure 1). The Program seeks to develop the ability to detect and quantify microseismicity within a predefined region approximately 50 km around the Revell Site (Figure 2).

Nanometrics was contracted by NWMO for the implementation of the Program. Work activities that have been included in the Program are:

- Design of seismic monitoring network,
- Initial field assessments of station locations,
- Installation and maintenance of stations,
- Data acquisition, archiving and processing, and
- Annual cataloging of data and seismic events detected in the AOI.

This report is prepared by Nanometrics. It includes an annual summary of the Program for activities performed in 2023 regarding network operations, seismic data processing and event detection. An overview of work done for the derivation of a velocity model as well as the assessment of event location accuracy and network magnitude of completeness are also presented in this report.

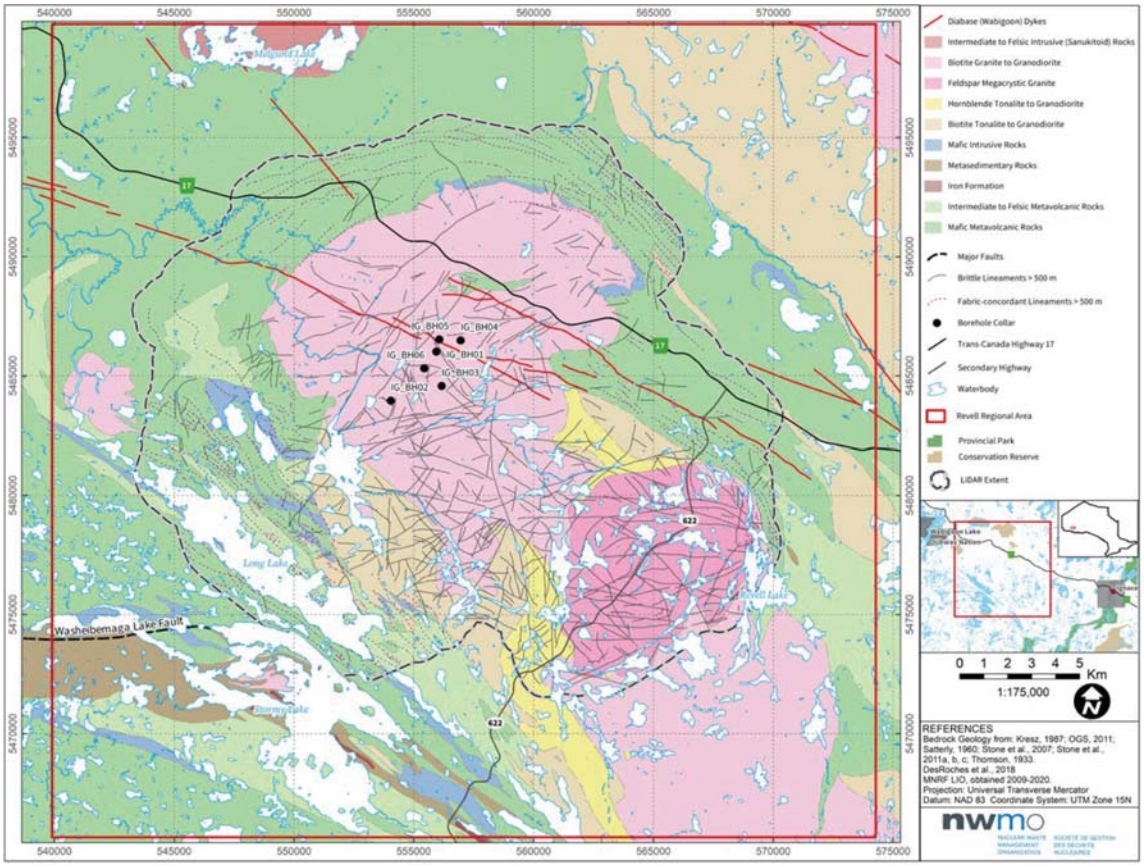

Figure 1. Bedrock map of the Revell Site. Black circles show the surface collar locations of drilled NWMO boreholes (Parmenter et al., 2020)

2. Network Operations

A summary of operational activities, including the installation and maintenance of the monitoring network as well as the statistics on the station state of health and data completeness are presented in this section.

2.1. Seismic Monitoring Network

NWMO seismic monitoring network consists of nine stations (broadband seismometers), all located inside the AOI. Seven of these stations stream data in real-time. Two stations (IG.SEI04 and IG.SEI08) record data in offline mode (i.e., no data transmission) due to lack of

cellular connectivity in the area. Waveform data recorded at these two offline stations are collected with quarterly site visits and are incorporated into the data processing for detection of any additional earthquakes. The station locations are shown in Figure 2.

There are four additional stations from public seismic monitoring networks in the area:

- CN.ATKO, CN.EPLO, CN.SOLO from the Canadian National Seismograph Network, and
- US.EYMN from the United States National Seismic Network

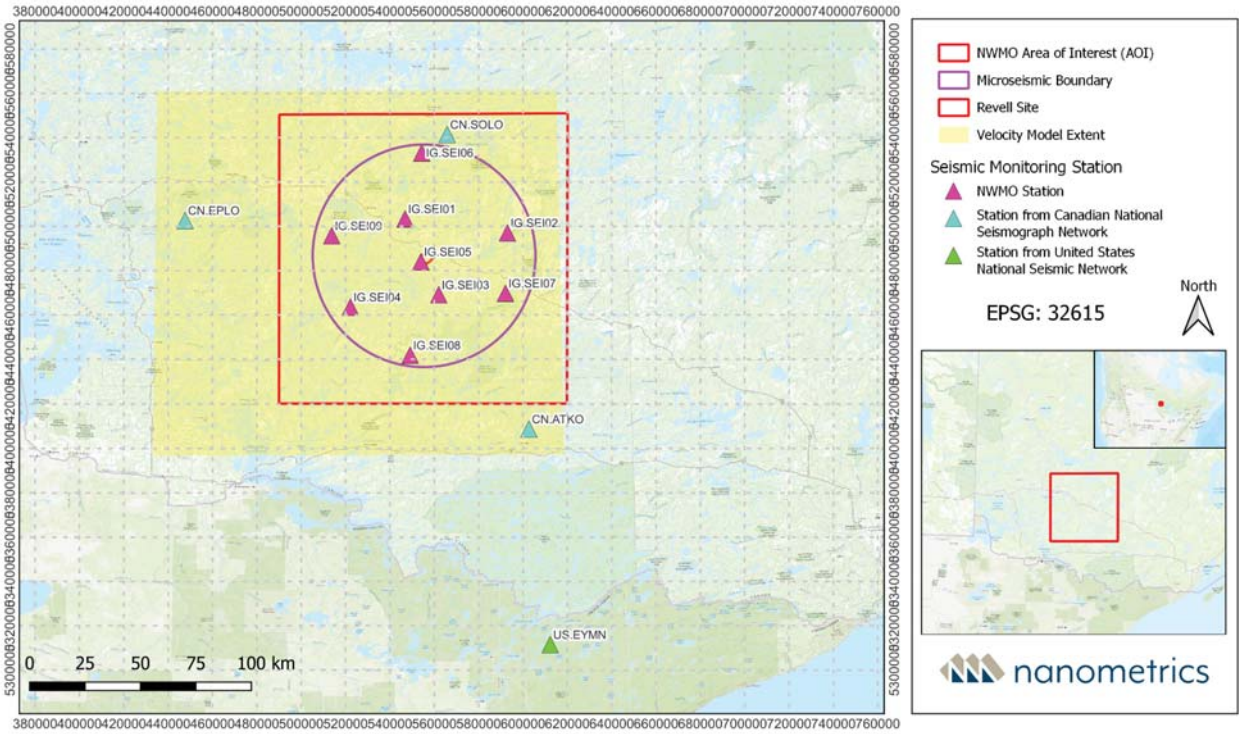

Figure 2. Locations of NWMO stations within the AOI. Public stations from national seismic networks incorporated into the Program are also shown. Microseismic Boundary represents the 50 km area around the Revell Site for microseismic monitoring. NWMO Area of Interest (AOI) represents the area defined by NWMO for detection, manual review and reporting of seismic activity.

These four public stations are also included in the Program. Their waveform data are

streamed from the Incorporated Research Institutions for Seismology ("IRIS") and included in the data processing for event detection.

2.2. Operational Statistics and Maintenance Records

The first NWMO station (IG.SEI05) was installed close to one of the drilled boreholes, near the center of the network, on November 3rd, 2020. The site surveys for the remaining eight stations were completed in November 2020. They were installed in July 2021. The monitoring network consisted of one NWMO station (IG.SEI05) and four public stations until then. Table 1 shows the installation dates for NWMO stations.

Table 1. Installation dates of NWMO stations

Station	Installation Date
IG.SEI05	2020-11-03
IG.SEI07	2021-07-05
IG.SEI02	2021-07-06
IG.SEI03	2021-07-07
IG.SEI08	2021-07-08
IG.SEI01	2021-07-09
IG.SEI06	2021-07-10
IG.SEI09	2021-07-11
IG.SEI04	2021-07-12

Tables 2 and 3 show a summary of station maintenance activities performed in 2023 by either Nanometrics and NWMO teams. Detailed station maintenance records were delivered to NWMO as they occurred. NWMO has taken the ownership of maintenance visits to replace drained batteries due to winter conditions.

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Table 2. NWMO Station Maintenance Visits performed by the Nanometrics Team

Date	Station	Notes
2022-11-16	IG.SEI02	The last maintenance visit performed by the Nanometrics Team was in November of 2022. No visits were needed in 2023.

Table 3. NWMO Station Maintenance Visits performed by the NWMO Team

Date	Station	Changes Made
2021-12-01	IG_SEI03	Cleared snow off panel.
2021-12-01	IG_SEI08	Cleared snow off panel, inspected broken guy wires.
2021-12-01	IG_SEI02	Cleared snow off panel.
2021-12-14	IG_SEI02	Cleared snow off panel, adjusted solar panel to maximum slope angle, fixed broken guy wires, replaced batteries with new charged ones, and disconnected cellular booster.
2021-12-14	IG_SEI08	Cleared snow off solar panel, downloaded data from SD card.
2021-12-15	IG_SEI09	Cleared snow off solar panel, removed damaged / bent cellar antenna, fixed broken guy wires and tighten loose ones, replaced batteries with charged ones, disconnected cellular booster.
2021-12-17	IG_SEI05	Cleared snow off the solar panel.
2021-12-17	IG_SEI01	Cleared snow off solar panel, replaced batteries with charged ones, disconnected cellular booster.
2021-12-20	IG_SEI03	Cleared snow off solar panel, replaced batteries with charged ones, disconnected cellular booster.
2021-12-22	IG_SEI07	Replaced Batteries, Cleared snow off panels, Adjusted solar panel angle from 45 degrees to 19.7 degrees.

2021-12-23	IG_SEI06	Replaced Batteries, disconnected cellular booster, cleared snow off panels, adjusted solar panel angle from 46 degrees to 27.1 degrees (maximum slope possible with the current bracket).
2022-01-05	IG_SEI05	Cleared snow off of the solar panel.
2022-01-05	IG_SEI02	Cleared snow off of the solar panel.
2022-01-09	IG_SEI02	Cleared snow off of the solar panel.
2022-01-12	IG_SEI03	Cleared snow off of solar panel, replaced batteries.
2022-01-13	IG_SEI01	Cleared snow off of solar panel, replaced batteries.
2022-01-18	IG_SEI08	Cleared snow off of solar panel, retrieved data, adjusted panel from 45 degrees to 28.2 degrees.
2022-01-25	IG_SEI09	Cleared snow off of the solar panel, checked battery level and data transmission status, adjusted panel from 45.5 degrees to 27.8 degrees.
2022-01-27	IG_SEI04	Cleared snow off of solar panel, adjusted panel from 45 degrees to 25 degrees, retrieved media from centaur and replaced with empty media card
2022-02-06	IG_SEI02	Cleared snow off of the solar panel.
2022-02-10	IG_SEI06	Replaced batteries with charged ones and cleaned snow off of solar panels.
2022-02-16	IG_SEI03	Cleared snow off of the solar panel, replaced batteries, adjusted solar panel from 45.6 degrees to 23.7 degrees.
2022-02-21	IG_SEI03	Cleared snow off of the solar panel, adjusted the solar panel from 50.4 degrees to 28.8 degrees, placed cable clamps on 3 guy wires for Yagi antenna.
2022-03-06	IG_SEI03	Checked solar panel for snow. No snow observed on panel.
2022-03-11	IG_SEI08	Changed SD card for a new one.
2022-03-11	IG_SEI03	Changed two batteries with charged ones. Breaker for the solar panel was "Off". Turned breaker back "On".

2022-03-30	IG_SEI04	Retrieved data.
2022-04-07	IG_SEI08	Retrieved data.
2022-05-03	IG_SEI08	Retrieved data.
2022-05-05	IG_SEI04	Retrieved data.
2022-07-04	IG_SEI04	Retrieved data.
2022-07-11	IG_SEI08	Retrieved data.
2022-08-06	IG_SEI08	Retrieved data.
2022-08-07	IG_SEI04	Retrieved data.
2022-09-24	IG_SEI02	Added rigid insulation under batteries, checked functionality of unit, pruning as viable.
2022-09-25	IG_SEI07	Added rigid insulation on sides base and front of batteries, checked functionality, pruned as viable.
2022-09-26	IG_SEI04	Added rigid insulation on the sides base and front of batteries. Excavated a larger post hole and added two bags of mixed concrete. Checked functionality, CHARGER error. Unit was throwing an error code (one flashing red) and battery status indicators were flashing Green and Red then yellow. After resetting the breaker, the charger still showed an error code but battery status was solid Green. Passed information along to PM.
2022-09-26	IG_SEI09	Added rigid insulation on sides, base and front of batteries. Checked functionality, no issues
2022-09-27	IG_SEI03	Added insulation on sides, base and front of batteries. Checked functionality, no issues.
2022-09-27	IG_SEI09	Added insulation on sides, base and front of batteries. Checked functionality, no issues.
2022-09-27	IG_SEI06	Added insulation on sides, base and front of batteries. Changed out GPS antenna, no issues with change, unit operational and confirmed by Nanometrics. Checked functionality, no issues. Pruned as viable.

2022-09-28	IG_SEI01	Added insulation on sides, base and front and top of batteries. Checked functionality, no issues. Pruned area as viable.
2022-09-28	IG_SEI05	Added insulation on sides, base and front and top of batteries. Checked functionality, no issues. Pruned area as viable.
2022-10-04	IG_SEI08	Retrieved data
2022-10-05	IG_SEI04	Retrieved data
2022-11-03	IG_SEI08	Retrieved data
2022-11-04	IG_SEI04	Retrieved data
2022-11-15	IG_SEI01	Visited the station with Nanometrics. They installed 6 additional 12v batteries in a battery box on the ground at the base of the post.
2022-11-15	IG_SEI04	Visited the station with Nanometrics. They replaced the charging module and downloaded data.
2022-11-16	IG_SEI01	Visited the station with Nanometrics. They installed 6 additional 12v batteries in a battery box on the ground at the base of the post. Added side insulation to the post box.
2022-11-30	IG_SEI08	Downloaded and transmitted data.
2022-12-01	IG_SEI04	Downloaded and transmitted data.
2022-12-14	IG_SEI07	Replaced batteries with charged ones. Cleaned minor snow off the panels, but it was shedding snow well on its own. The station has had lower charge rates than other stations. This may be due to its installation in the shadow area of the forest, or due to the new antenna that was installed.
2023-01-10	IG_SEI07	Replaced batteries with charged ones and downloaded data. The panel was clear of snow. Cut down several saplings that may have blocked out the sun from hitting the solar panel.

2023-02-05	IG_SEI04	Downloaded and transmitted data.
2023-02-06	IG_SEI08	Downloaded and transmitted data.
2023-03-01	IG_SEI03	Station not communicating with the network or uploading data. Upon inspection it was observed that the antennae buckled and fell over. Several guy wires were damaged as well from the antennae falling over. One wire was snapped, and another was missing the yellow plastic guard. Guy wires appeared to still be attached to the ground anchors. Upon inspection of the control box, all lights were green and batteries were charged.
2023-03-02	IG_SEI03	Retrieved data.
2023-03-03	IG_SEI03	Reattached antenna to mast of seismic station. The Antenna is now lower than previously. Removed the buckled mast with a hacksaw and took offsite. Station still not communicating on its own.
2023-03-10	IG_SEI03	Further troubleshooting connectivity issues, it was observed that the fuse that connects the motherboard to the Centaur unit had been switched to the off position. Power was restored to the modem and connectivity issues were resolved.
2023-04-11	IG_SEI08	Retrieved data.
2023-06-01	IG_SEI04	Downloaded and transmitted data.
2023-06-04	IG_SEI08	Downloaded and transmitted data.
2023-07-24	IG_SEI08	Downloaded and transmitted data.
2023-07-27	IG_SEI04	Downloaded and transmitted data.
2023-10-04	IG_SEI04	Downloaded and transmitted data.
2023-10-06	IG_SEI08	Downloaded and transmitted data.
2023-11-03	IG_SEI06	Replace antenna due to GPS failure at the request of Nanometrics. Functionality was restored after new antenna connected.

2023-11-07	All	Annual inspection all sites
2023-11-20	IG_SEI04	Downloaded and transmitted data.
2023-11-21	IG_SEI08	Downloaded and transmitted data.

2.3. Station State of Health Summary

Nanometrics actively monitors the state of health for streaming stations. If cellular connection to a station is lost temporarily (i.e., no data transmission), the station will continue recording data, as long as it maintains battery life. When the connection is restored, data transfer continues and the incomplete data is automatically filled, typically allowing for the continuation of 100% data collection. Stations were installed in remote areas and are working on batteries with the help of solar panels. No data can be recorded and transmitted when a station goes down due to low or no power. This is generally experienced in winter months when solar panels are covered with snow and batteries are not recharged. Table 4 shows the station data availability (in percent) from January 1 - December 31, 2023, on a monthly basis. Tables provided in Appendix A show data availability on a daily basis.

Table 4. Station data availability (in percent) from January 1 - December 31, 2023.

Station	Jan-2023	Feb-2023	Mar-2023	Apr-2023	May-2023	Jun-2023
IG.SEI01	100	100	100	100	100	100
IG.SEI02	100	100	100	100	100	100
IG.SEI03	100	54	100	100	100	100
IG.SEI04	100	100	100	100	100	100
IG.SEI05	100	100	100	100	100	100
IG.SEI06	100	100	100	100	100	100
IG.SEI07	100	100	100	100	100	100
IG.SEI08	100	100	100	100	100	100
IG.SEI09	100	100	100	100	100	100
Station	**Jul-2023**	**Aug-2023**	**Sep-2023**	**Oct-2023**	**Nov-2023**	**Dec-2023**

IG.SEI01	100	100	100	100	100	100
IG.SEI02	100	100	100	100	100	100
IG.SEI03	100	100	100	100	100	100
IG.SEI04	100	100	100	100	100	100
IG.SEI05	100	100	100	100	100	100
IG.SEI06	100	100	100	100	100	100
IG.SEI07	100	100	100	100	100	100
IG.SEI08	100	100	100	100	100	100
IG.SEI09	100	100	100	100	100	100

3. Seismic Data Processing

An overview of seismic data processing workflow for the detection and characterization of seismic events is presented in this section.

3.1. Automatic Event Detection

Seismic monitoring stations continuously record ground vibrations generated by anthropogenic activities (e.g., mining/quarry blasts - discussed in Section 6) and natural phenomena, including earthquakes. The NWMO stations are equipped with highly sensitive seismometers that can detect vibrations well-below human perception. The recorded data are streamed to the Nanometrics Cloud Data Center in near real-time, for data processing.

The continuous waveform data acquired from each station is processed through a short-time-average through long-time-average ("STA/LTA") trigger detection algorithm. The algorithm predicts a characteristic function ("CF") of the signal based on continuously-moving short-time and long-time windows and declares a trigger when the CF exceeds a pre-set threshold. The automatic processing system declares an event when a minimum of four time-correlated seismic phase arrivals are picked at a minimum of four stations.

3.2. Manual Review

Not every automatic event detection would necessarily be associated with an earthquake. Event waveforms are reviewed by experienced analysts on a next day basis, in order to confirm if they are seismic activities. Seismic events detected within the AOI are posted to Nanometrics Athena seismicity web portal for NWMO to review. False positives (incorrect classification of random noise) and non-seismic event detections due to anthropogenic activities (discussed in Section 6) are removed. For confirmed seismic events, the review process also involves adjustment of automatic picks for seismic phase arrivals and peak amplitudes, if deemed necessary, in order to ensure the quality of event solution (origin time, hypocenter location and magnitude). Following the manual adjustment of phase and amplitude picks, seismic events are re-processed to determine the final event solutions.

Earthquake hypocenter locations are determined based on an 1D velocity model, which was derived from 3D velocity data provided by NWMO (reader is referred to Section 5 for details about velocity models).

Seismic events that fall outside of the AOI after manual review are not included in the Program. For example, Figure 3 shows waveforms obtained from an earthquake that occurred on June 22nd, 2022, located approximately 11km outside of the AOI. In comparison, Figure 4 shows waveforms obtained from an earthquake that occurred on April 21st, 2022, located inside the AOI.

Event magnitudes are determined in terms of Richter local magnitude (“ML”) based on a model proposed by Hutton and Boore (1987).

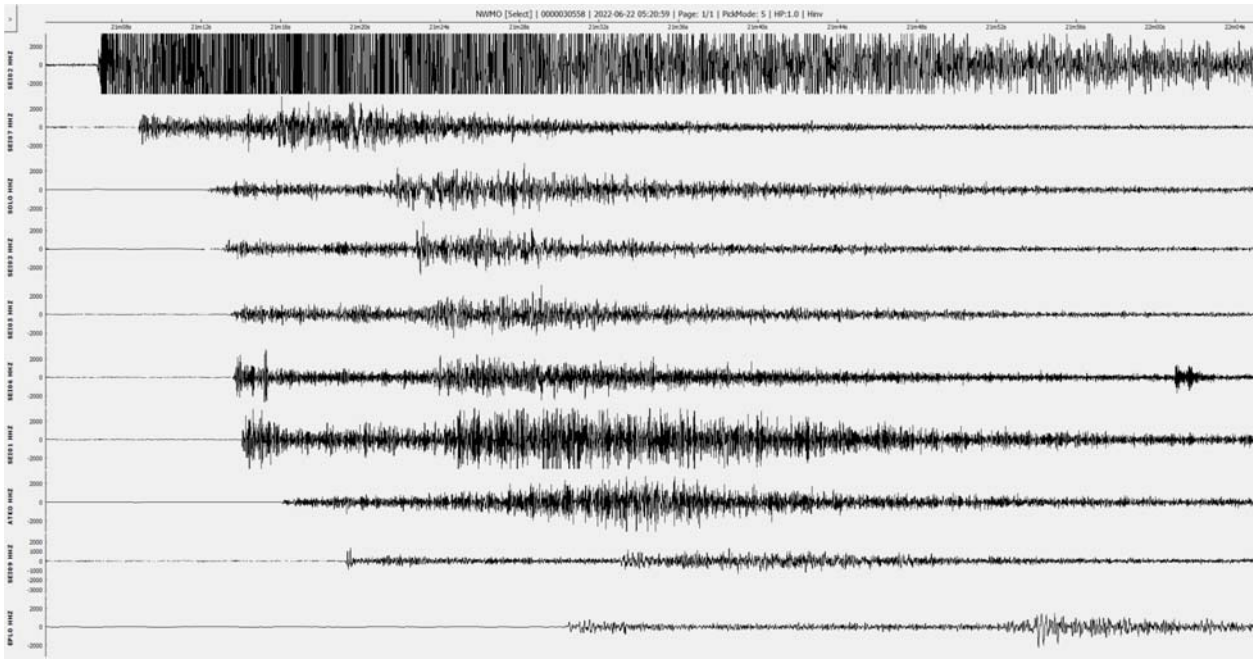

Figure 3. A seismic event detected on June 22nd, 2022 was located ~19 km outside of the AOI and was not included in the Program.

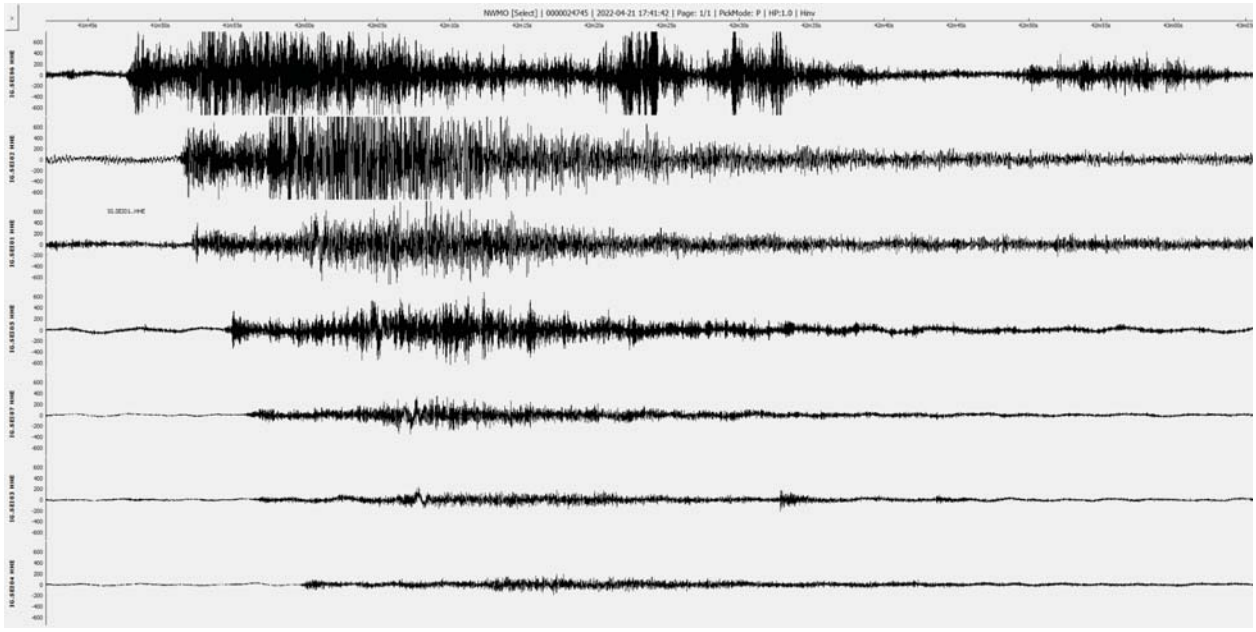

Figure 4. A seismic event detected on April 21st, 2022 that was located inside the AOI - included in the Program.

4. Network Performance

A summary of the network performance based on automatic event detections is provided in this section.

Automatic event detection is not bounded by the AOI to ensure no seismic events are missed due to automatic event location quality. This results in a large number of automatic event detections, with an average of ~1276 events per month. A total of 15311 automatic events were detected across the region from January 1 - December 31, 2023. Figure 5 shows the distribution of automatic event detections on a monthly basis.

The vast majority of these events were either false positives (incorrect detection of random noise) or anthropogenic activities (e.g., mining/quarry blasts - discussed Section 6). An uptick in detections occurred starting in April following a low period of detections in January, February, and March. Common causes for such influxes of automatic detections are high wind patterns that cause increased vibrations at stations due to the shaking of trees and poles nearby.

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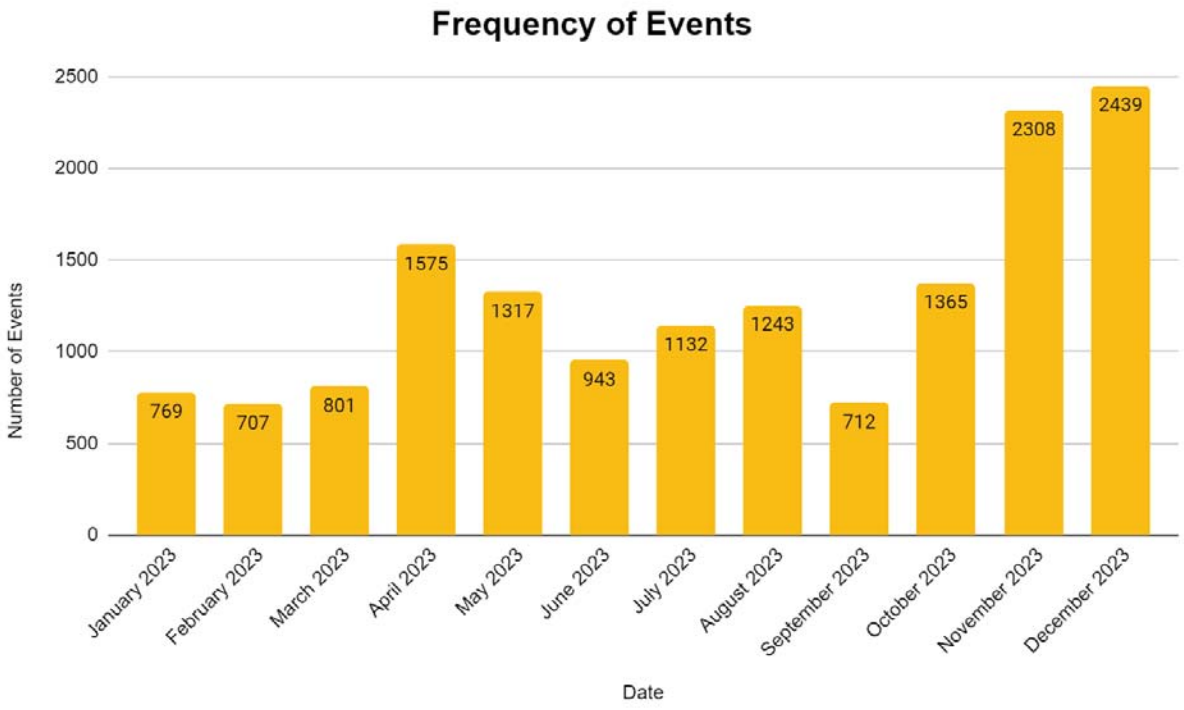

Figure 5. Rates of automatic event detections on a monthly basis

5. Seismic Velocity Model

A velocity model provides information on the seismic velocities present in the underlying geologic structure in an area (i.e. the speed with which seismic waves travel through the subsurface). Seismic velocity information allows for an estimation of distance between an event hypocenter and a recording station. Utilizing this information from several stations allows for the triangulation of earthquake hypocenters.

5.1. 3D Velocity Model

NWMO has provided a grid of P-wave velocity ("Vp") data for development of a 3D seismic velocity model for the AOI. The key steps involved in model building are as follows:

i. The provided velocity data is subsampled and smoothed

ii. 2D velocity layers are generated by interpolating the available data
   - S-wave velocities ("Vs") are estimated based on a constant Vp/Vs ratio of 1.75

- The model is extended to a depth of 15 km assuming a constant velocity beyond the maximum depth of available velocity data (~4 km)

iii. Velocity layers are then merged and blended vertically

iv. Cross-validation is applied to remove outlier velocity data points

v. A 3D smoothing algorithm is applied to remove any sharp velocity contrasts

Figure 6 shows the area covered by the velocity model related to the AOI and Figure 7 shows Vp and Vs cross sections of the 3D velocity model along AA' line on Figure 6.

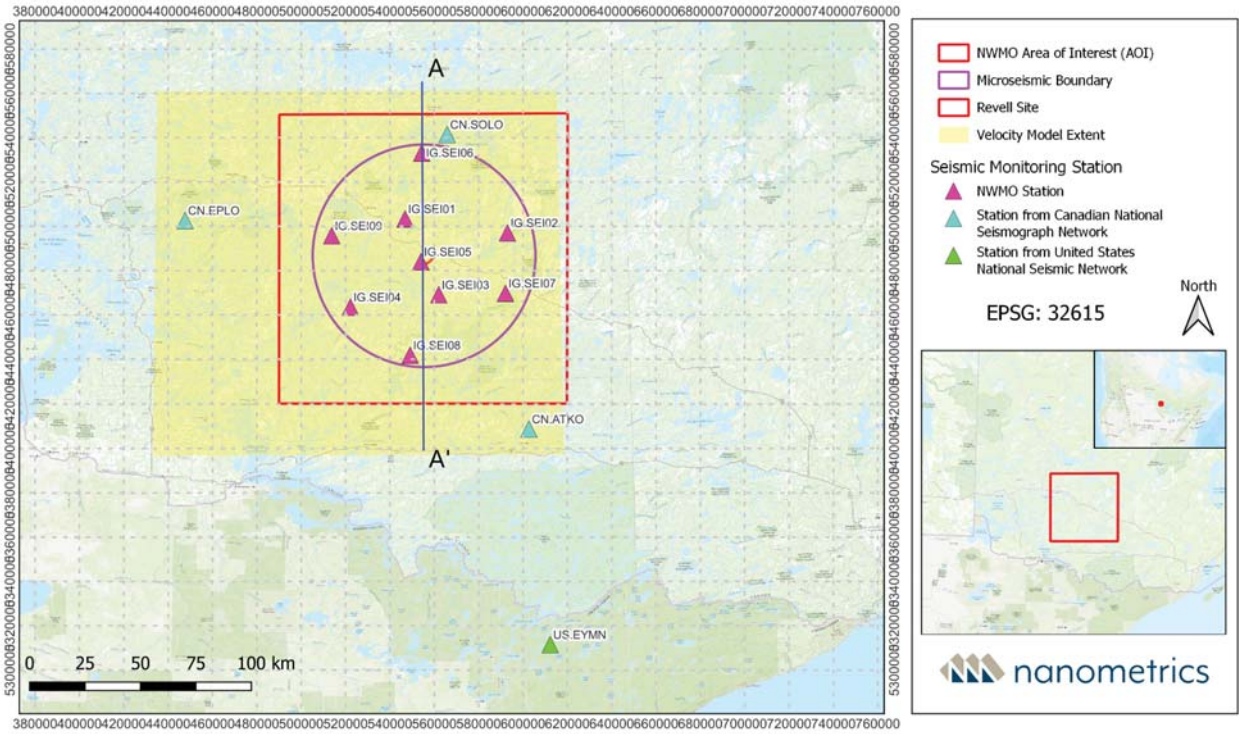

Figure 6. Velocity model extent displayed as yellow box and cross-section highlighted by navy AA' line. Red square shows the AOI and the purple circle represents the microseismic boundary.

The 3D velocity model is tested against seismic events detected within the AOI. It is observed that some events are unrealistically trapped in a medium above the surface due to some incompatibilities of the velocity model with observed seismic travel times. This suggests that the 3D velocity model requires some refinements before its integration with event processing and solution workflows. Therefore, it was agreed to use an average 1D velocity model until the re-assessment of the 3D velocity model with a larger earthquake dataset (minimum of 100 events within the AOI). The event locations will be re-calculated based on the 3D velocity model when it is finalized.

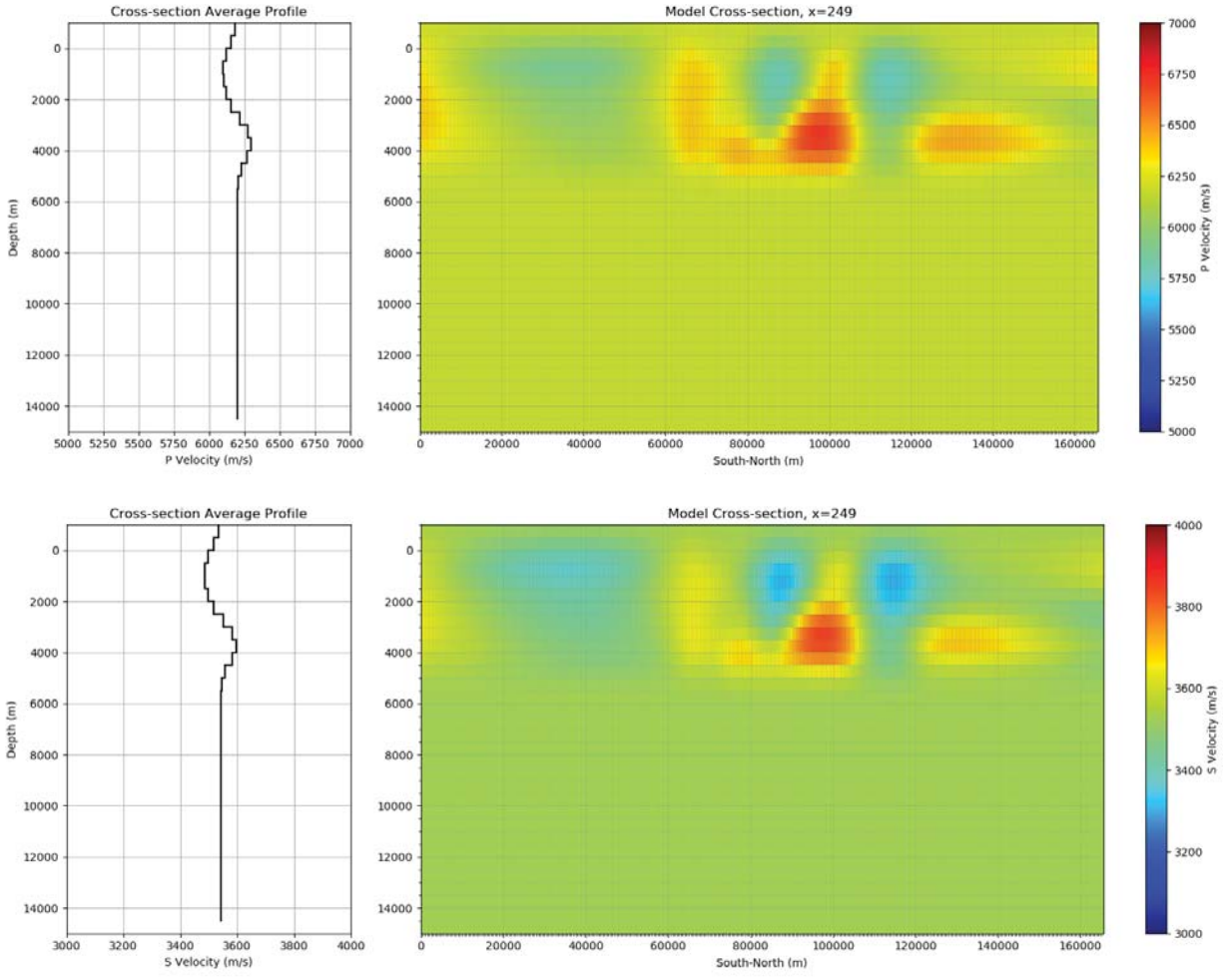

Figure 7. Top: Vp cross-section and **Bottom:** Vs cross-section of the 3D velocity model. The left panels display a cross-section average profile, the right panels display cross-section velocity.

5.2. 1D Velocity Model

A simple 1D velocity model that captures the major velocity contrasts in the AOI is developed based on an averaging of the 3D velocity model. The 1D velocity model is temporarily used for locating seismic events until the 3D velocity model is finalized. Figures 8 and 9 show the 1D velocity model for Vp and Vs, respectively.

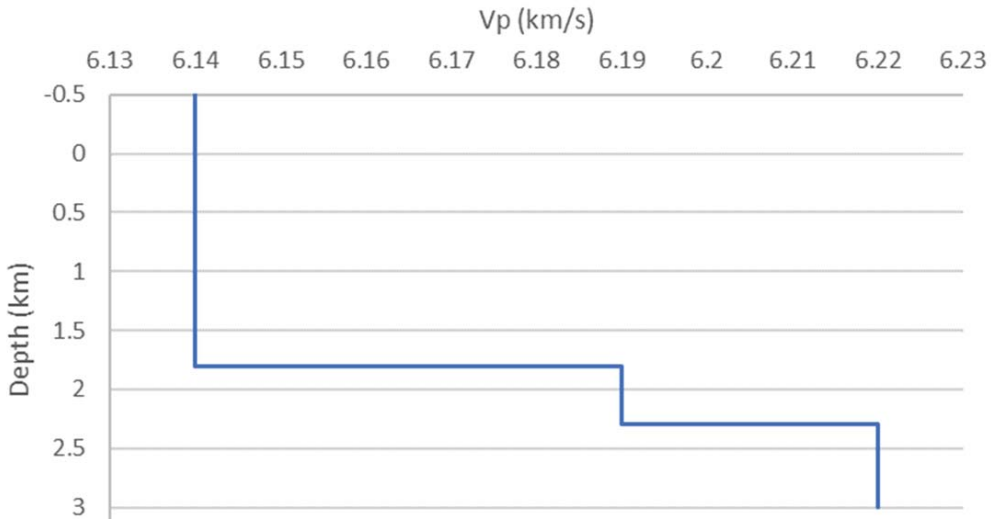

Figure 8. 1D velocity model for P waves. Top 3 km of the velocity model is shown for clarity. Vp attains a constant value of 6.22 km/s for depths greater than 3 km.

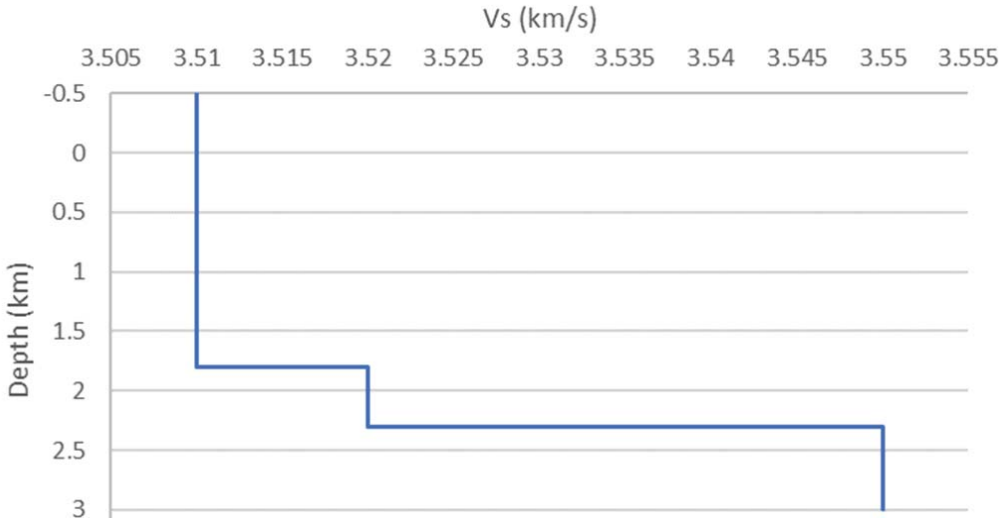

Figure 9. 1D velocity model for S waves. Top 3 km of the velocity model is shown for clarity. Vp attains a constant value of 3.55 km/s for depths greater than 3 km.

6. Seismic Activity within the AOI

This section provides a summary of earthquakes observed within the AOI from January 1 - December 31, 2023.

A total of 55 seismic events were observed within the AOI, with local magnitudes ranging from -0.22ML to 2.11ML. The largest event occurred on July 9th, 2023. Figure 10 shows locations of seismic events observed within the AOI relative to the monitoring network and Table 4 provides a list of these events with their key seismological attributes. Earthquakes within the AOI attain depths ranging from 0.17 km to 11.63 km (relative to Mean Sea Level), with an average value of 4.1 km. The event depths were calculated based on the 1D velocity model and will be reprocessed using a 3D velocity model when the model development is completed (discussed in Section 5). Waveforms obtained from these events are included in Appendix B.

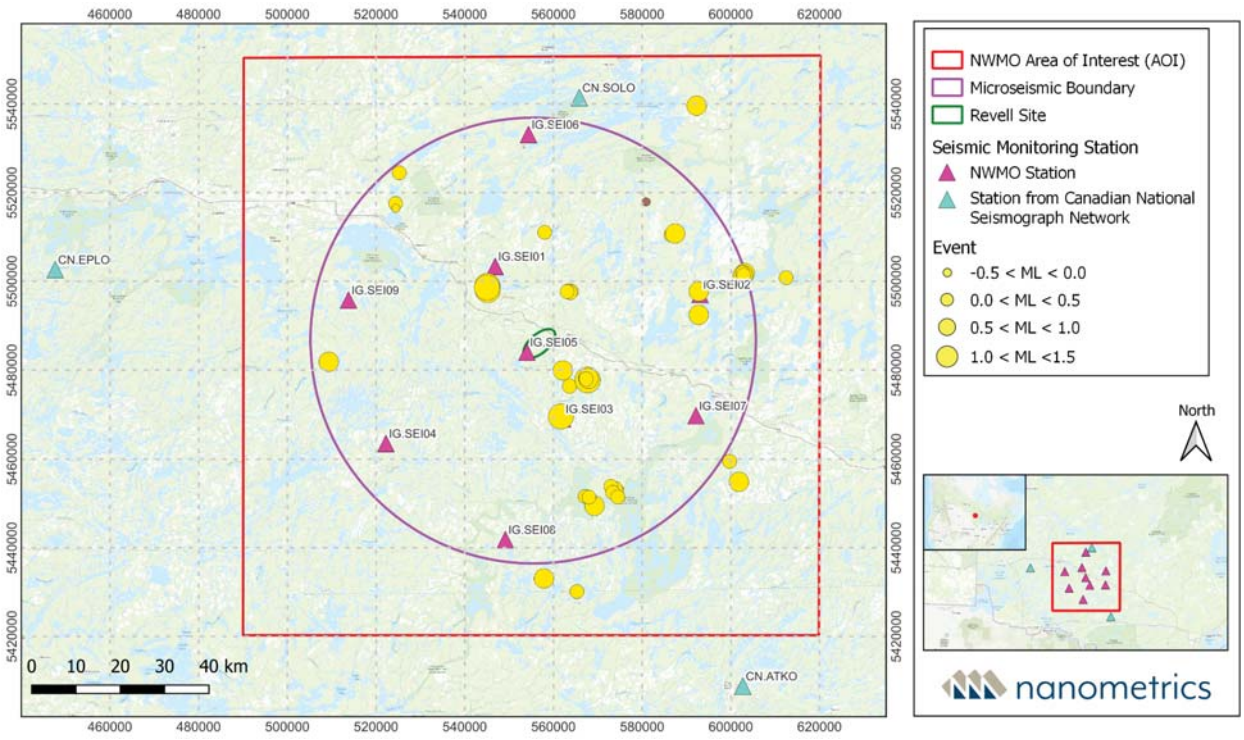

Figure 10. Seismic events observed within the AOI from January 1 - December 31, 2023.

Table 4. Earthquakes detected within the AOI from January 1 - December 31, 2023. Depths are measured relative to Mean Sea Level

Origin Date and Time (UTC)	Latitude (WGS84)	Longitude (WGS84)	Depth (km)	Local Magnitude (ML)	Number of Stations with Phase Picks	Number of Phase Picks	Source Type
2023-12-15T19:07:10Z	49.6600	-91.5708	4.17	0.64	10	19	
2023-12-11T04:42:30Z	49.6587	-91.5685	4.52	0.18	7	13	
2023-12-02T05:33:22Z	49.4475	-92.0683	3.41	0.41	11	22	
2023-12-01T15:04:01Z	49.4483	-92.0688	3.20	0.86	10	20	
2023-12-01T13:56:42Z	49.4368	-92.1223	6.28	0.04	4	7	

Origin Date and Time (UTC)	Latitude (WGS84)	Longitude (WGS84)	Depth (km)	Local Magnitude (ML)	Number of Stations with Phase Picks	Number of Phase Picks	Source Type
2023-12-01T13:55:33Z	49.4478	-92.0640	1.41	0.68	11	21	
2023-11-30T10:10:47Z	49.4463	-92.0665	3.32	0.61	10	18	
2023-11-30T10:03:50Z	49.4440	-92.0740	6.20	-0.09	5	8	
2023-11-30T06:54:36Z	49.4498	-92.0662	4.10	0.04	5	8	
2023-11-29T07:44:04Z	49.4518	-92.0632	0.64	0.00	5	10	
2023-11-29T01:29:23Z	49.4485	-92.0678	3.55	0.13	6	10	
2023-11-28T13:18:57Z	49.3762	-92.1500	7.03	1.36	7	11	
2023-11-28T13:18:28Z	49.4488	-92.0658	2.84	1.23	11	21	
2023-11-20T19:33:45Z	49.6560	-91.5763	4.79	0.99	9	16	
2023-11-19T16:30:21Z	49.6613	-91.5777	4.32	0.30	6	12	
2023-11-16T05:07:17Z	49.6523	-91.5762	5.59	1.80	12	23	
2023-11-15T06:00:03Z	49.4518	-92.0632	2.47	0.57	10	17	
2023-11-15T05:38:01Z	49.4508	-92.0702	1.70	0.08	5	9	
2023-11-13T19:55:22Z	49.6560	-91.5743	5.23	0.45	5	10	
2023-11-12T23:27:11Z	49.6535	-91.5718	4.76	1.63	12	23	
2023-11-11T12:34:25Z	49.6293	-92.1205	7.19	0.13	8	16	
2023-11-09T21:03:49Z	49.6302	-92.1187	5.45	0.28	7	14	
2023-11-09T19:31:06Z	49.6285	-92.1128	1.01	0.33	7	14	
2023-11-09T11:35:10Z	49.6257	-92.1163	3.88	0.29	8	16	
2023-11-07T14:57:14Z	49.6247	-91.7152	1.26	0.59	6	12	

Origin Date and Time (UTC)	Latitude (WGS84)	Longitude (WGS84)	Depth (km)	Local Magnitude (ML)	Number of Stations with Phase Picks	Number of Phase Picks	Source Type
2023-09-21T19:41:57Z	49.6328	-92.3742	6.44	1.36	9	17	quarry_blast
2023-09-12T12:44:14Z	49.4888	-92.8712	6.74	0.94	8	14	
2023-09-11T23:17:30Z	49.6280	-92.1263	6.76	0.30	7	13	
2023-08-29T23:17:04Z	49.6400	-92.3718	1.75	1.58	10	10	quarry_blast
2023-08-24T01:10:43Z	50.0017	-91.7117	5.16	0.74	8	11	
2023-08-21T17:35:58Z	49.6397	-92.3768	0.17	0.95	9	9	quarry_blast
2023-08-07T13:33:54Z	49.8097	-92.6608	1.69	0.31	7	12	
2023-07-13T20:29:26Z	49.6413	-92.3752	5.71	1.43	7	14	quarry_blast
2023-07-09T06:30:14Z	49.8065	-91.8798	3.00	2.11	10	20	
2023-06-12T18:45:13Z	49.6378	-92.3763	1.43	1.42	10	10	quarry_blast
2023-05-21T10:54:17Z	49.5772	-91.7165	2.00	0.60	9	17	
2023-05-19T11:18:33Z	49.2380	-91.6007	7.76	0.63	10	18	
2023-05-12T11:53:12Z	49.7488	-92.1943	4.05	0.11	8	16	
2023-05-09T14:34:12Z	49.7402	-91.7990	3.37	0.39	7	13	
2023-05-07T23:41:37Z	49.7428	-91.7860	2.04	0.53	6	12	
2023-05-06T01:58:40Z	49.8720	-92.6485	2.33	0.40	9	16	
2023-05-03T15:08:03Z	49.2132	-92.0782	5.94	0.48	8	15	
2023-04-30T19:12:03Z	49.1937	-92.0493	4.19	1.00	7	14	
2023-04-26T14:33:14Z	49.2115	-92.0658	4.81	0.47	7	14	
2023-03-25T19:01:31Z	49.8002	-92.6602	1.18	-0.22	4	8	

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Origin Date and Time (UTC)	Latitude (WGS84)	Longitude (WGS84)	Depth (km)	Local Magnitude (ML)	Number of Stations with Phase Picks	Number of Phase Picks	Source Type
2023-03-07T19:19:19Z	49.0475	-92.2080	11.63	0.52	9	13	
2023-02-08T22:21:20Z	49.2242	-91.9797	2.35	0.10	9	15	
2023-02-05T02:35:00Z	49.2282	-91.9832	3.23	0.45	9	17	
2023-01-30T13:24:17Z	49.2328	-91.9977	2.34	0.02	6	11	
2023-01-30T09:20:05Z	49.2207	-91.9922	6.60	0.02	5	10	
2023-01-22T02:25:04Z	49.4682	-92.1427	1.90	0.62	10	19	
2023-01-18T03:33:54Z	49.6490	-91.4417	7.75	0.36	5	10	
2023-01-14T22:31:14Z	49.2798	-91.6287	2.86	0.34	10	19	
2023-01-11T11:16:40Z	49.0202	-92.1067	7.78	0.46	6	11	
2023-01-03T05:31:19Z	49.2112	-91.9768	2.84	0.01	4	7	

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Figure 11 shows the rate of seismic activity in each month in 2023.

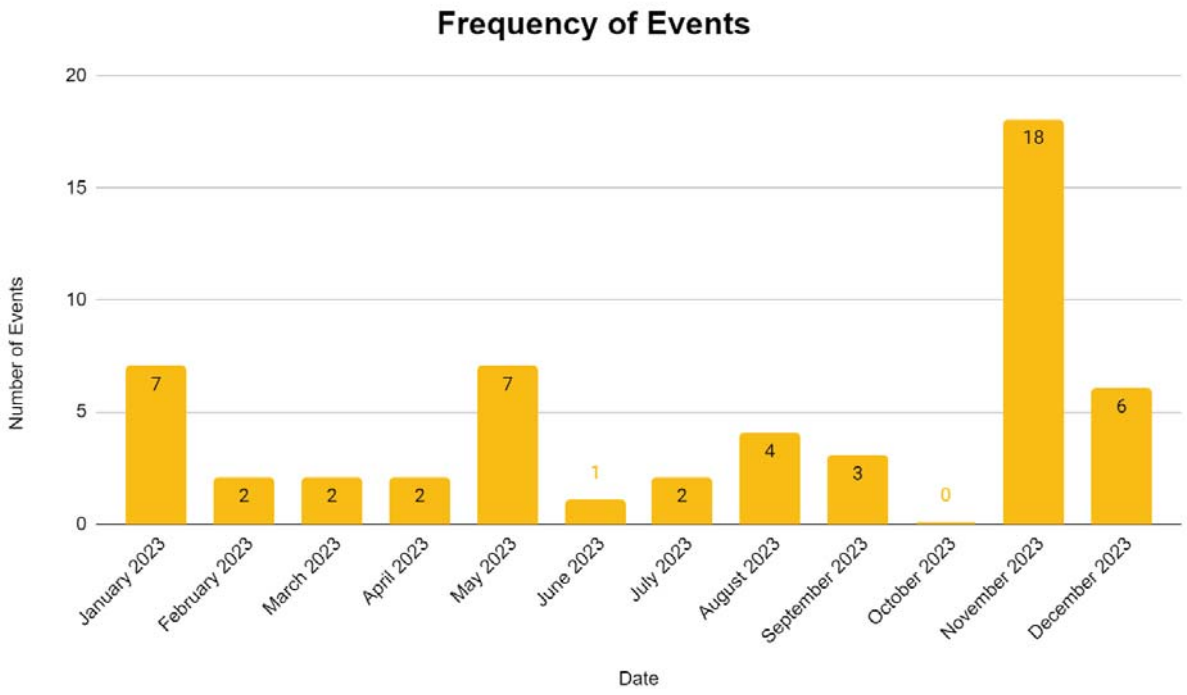

Figure 11. Number of seismic events observed within the AOI on a monthly basis in 2023.

7. Anthropogenic Activity

There are several active mines and quarries located within 150 km of the NWMO network (the maximum distance that an event from a nearby anthropogenic source can be detected). Blasting activities at these mines and quarries are one of the major sources of events detected by the automatic processing system. In the manual review stage, non-seismic events, including mining/quarry blasts, are identified by experienced analysts by visual inspection of recorded waveforms in terms of presence and motion of seismic phases (P and S waves), Wood-Anderson simulated traces, and their correlated timing at multiple stations. Mining/quarry blasts events that occur within 3 km of the Dyment Quarry

(approximately 42 km SE of Dryden) are kept in the catalog. Any other blasts inside the AOI are removed after manual review.

Events detected by the Canadian National Seismograph Network are reviewed and categorized by Canadian Hazards Information Service ("CHIS") depending on their sources. The historical event catalog is accessible from the Earthquakes Canada website (https://chis.nrcan.gc.ca/index-en.php). Figure 12 shows seismic and anthropogenic events identified by CHIS in the region from January 1 - December 31, 2023 (the event list is provided in Appendix C). The events associated with mining activities by CHIS are clustered around

- Rainy River, Red Lake and Lac des Iles mines in Canada, and
- Minntac and Peter Mitchell mines in the United States.

Most of these events are mining/quarry blasts. However, there are a few events that are labeled by CHIS as mining-induced seismic events (i.e., earthquakes occurred on critically stressed faults near mining sites due to stress perturbations of mining/quarrying activities). The mining-induced events are also included in the event list in Appendix C.

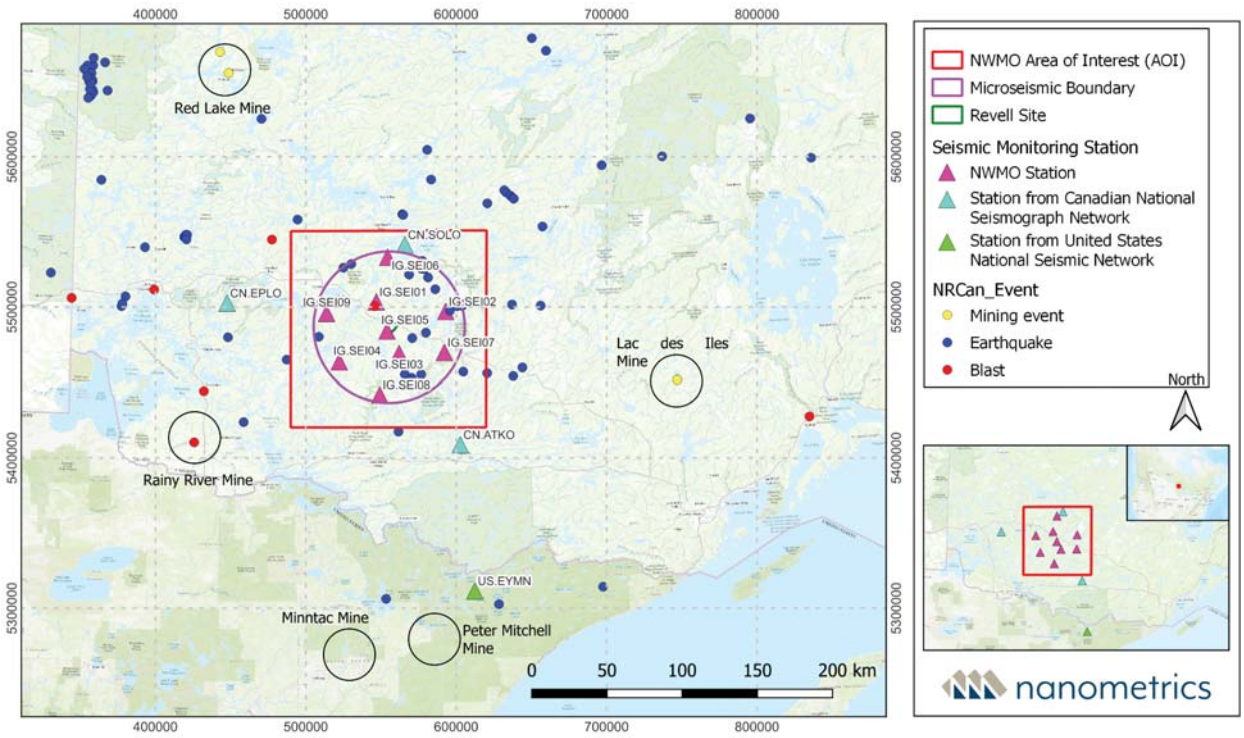

Figure 12. Earthquakes (blue), quarry blasts (red) and mining-induced seismic events (yellow) as defined by CHIS, observed in the In 2023. Mine sites are indicated by black circles.

8. Event Location Accuracy

In this section, the location accuracy of earthquakes within the AOI is investigated using synthetic events, in order to understand the effect of the velocity model complexity and the network density on the event location uncertainty. To this end, a number of distributed synthetic hypocenters with a specified depth and spacing are simulated. Travel time grids are generated for the velocity model using the Eikonal finite-difference method (Podvin et al., 1991). For each simulated event, synthetic P and S first arrivals with Gaussian-distributed timing errors are computed.

Simulated events are then located using a grid search algorithm to determine hypocentral probability density functions and maximum likelihood locations. The probability density function for each event accounts for P and S pick time uncertainties and an overall travel

time uncertainty. Location uncertainty, σ, is calculated as the standard deviation of the hypocenter probability distribution for horizontal and vertical direction.

The 1D velocity model is used to model the location accuracy, considering all 13 stations (9 NWMO stations and 4 public stations). A timing error of 120 ms is assumed in this assessment. Figure 13 shows the modeled horizontal uncertainty of events detected by the monitoring network within the AOI. The minimum horizontal location uncertainty is estimated as 327.8 m, in the center of the NWMO array. This is applicable for events which are well recorded by most stations. Overall, the vertical uncertainty is expected to be higher than the horizontal uncertainty due to its higher sensitivity to the station proximity.

Accuracy event hypocenter locations depends on two key factors:

i. Azimuthal coverage and number of stations at which the timing of phase arrivals are identified accurately, and
ii. The compatibility of the velocity model used for locating events

The incorporation of the 3D velocity model into the event processing and solution workflow is expected to improve the event location accuracies.

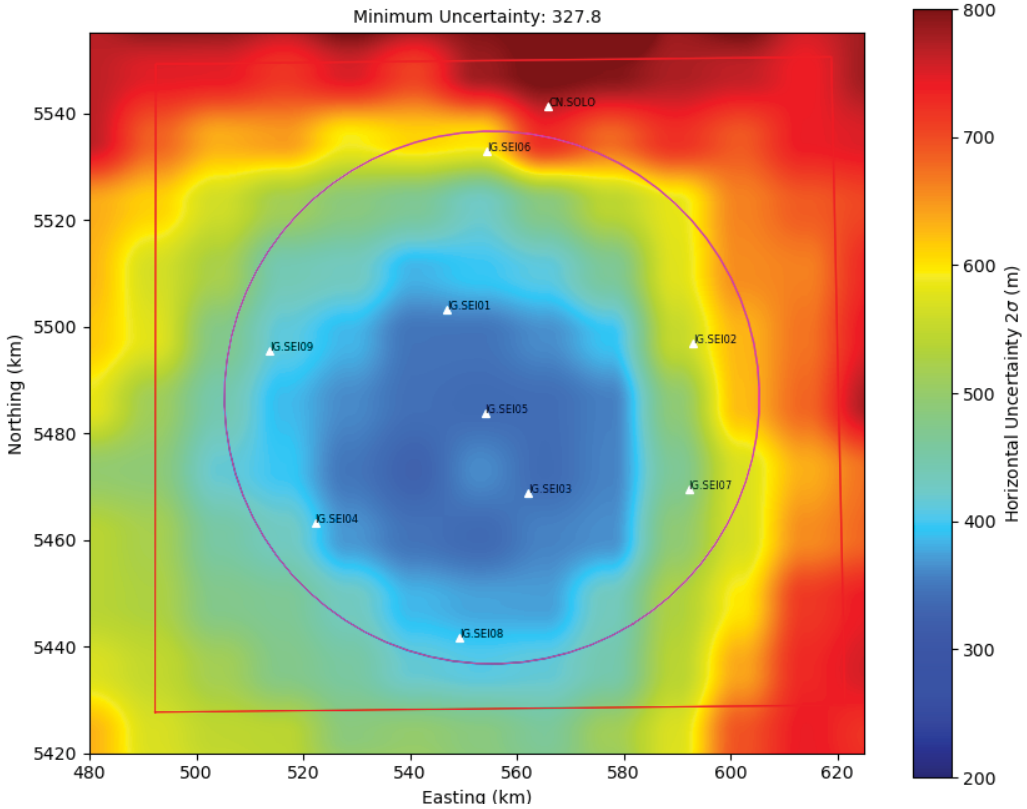

Figure 13. Modeled horizontal location uncertainty of events within the AOI

9. Magnitude of Completeness

Magnitude of completeness ("Mc") within the AOI is modeled for the NWMO network to understand the minimum magnitude above which all seismic events can be detected and located, given the current array geometry and the assumed velocity model, instrument noise floors, background noise model, and attenuation parameters. For an assumed event depth, Mc modeling measures the spectral amplitude levels at different stations following a waveform propagation modeling, taking into account seismic attenuation attributes and assuming a point-source model (Brune, 1970). This is performed for a large number of synthetic events with variable magnitudes across a gridded space. The event signal to noise ratios ("SNR") are measured at monitoring stations for each grid point, considering the mean noise level at each station of the network. The Mc at a grid point is determined as the minimum magnitude at which the estimated SNR on at least four stations satisfies a pre-set

detectability threshold. Figure 14 shows the spatial variation of Mc within the AOI for the NWMO network. All seismic events down to magnitude of ~M1.0, on average, are expected to be detected by the array. Smaller earthquakes may still be detected and located but with a lower accuracy and completeness.

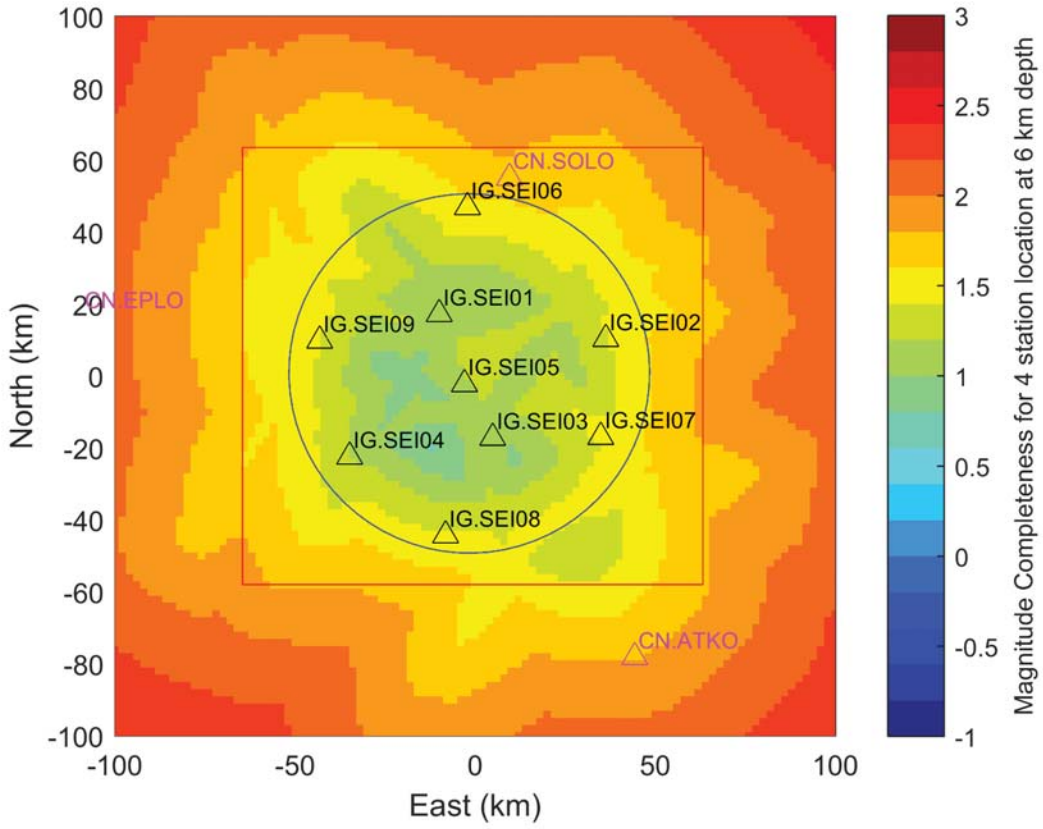

Figure 14. Magnitude of completeness (Mc) model of the NWMO network for events at a depth of 6 km. Blue circle represents the microseismic monitoring boundary (50 km radius around the Revell site) and the red square shows NWMO AOI. Black triangles represent locations of NWMO stations and pink triangles indicate the locations of public stations included in the Program.

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10. Data Delivery

Nanometrics has delivered the monitoring data obtained from January 1 - December 31, 2023. The data has been uploaded to an SFTP server along with metadata, a data transmittal letter and the Annual Seismic Monitoring Report. The delivered data includes:

1. A catalog of earthquakes detected within the AOI (event origin date and time, hypocenter location, magnitude, location error ellipses etc.)
2. Seismic phase pick information in JSON-formatted files
3. Earthquake waveform data in miniSEED formatted files
4. Continuous raw waveforms delivered in form of 1-hour long miniSEED files for each station and channel

11. Summary

Nanometrics operates a seismic monitoring network at the Revell Site on behalf of NWMO, as part of the Microseismic Monitoring Program ("Program"). An annual overview of network operation activities and observed seismic activities are presented in this report.

The monitoring network consists of nine broadband seismograph stations within the AOI. The first station was installed on November 3rd, 2020 and the remaining eight stations were installed in July 2021. Four additional public stations located around the AOI are also incorporated into the Program.

Two stations (IG.SEI04 and IG.SEI08) record data in offline mode (i.e., no data transmission) due to lack of cellular connectivity in the area. All other stations stream data to the Nanometrics Data Center in the cloud in near real time. Waveform data recorded at offline stations are collected with periodic site visits and are incorporated into the data processing workflows. The acquired data are processed using an automatic event detection algorithm. The automatic processing system declares an event when a minimum of four time-correlated seismic phase arrivals are picked at a minimum of four stations. Event waveforms are reviewed by experienced analysts to identify those associated with seismic activities. A 1D velocity model was used for locating events. A modeling of event location accuracy indicated that the earthquakes detected within the AOI are estimated to have a

minimum horizontal location uncertainty of ~330 m, considering the adopted 1D velocity model. The vertical uncertainty is expected to be higher than the horizontal uncertainty due to its higher sensitivity to the station proximity. A 3D velocity model is currently under development and event locations will be recalculated when it is completed.

From January 1 - December 31, 2023, a total of 15311 automatic events were detected by the monitoring networks. The vast majority of these events were either false positives (incorrect classification of random noise) or anthropogenic activities (e.g., mining/quarry blasts). As a result of manual reviews, 55 earthquakes with local magnitudes ranging from -0.22ML to 2.11ML were identified within the AOI. These events attained depths (relative to Mean Sea Level) ranging from 0.17 km to 11.63 km, with an average value of 4.1 km.

Magnitude of completeness (Mc) within the AOI is modeled for the NWMO network to understand the minimum magnitude above which all seismic events can be detected. This assessment suggests that earthquakes of magnitude M >1.0 within the AOI are expected to be detected by the array. Smaller earthquakes may still be detected and located but with a lower accuracy and completeness.

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Appendix A: Daily Station Data Availability

January 2023

Network	Station	2023-01-01	2023-01-02	2023-01-03	2023-01-04	2023-01-05	2023-01-06	2023-01-07
IG	SEI01	100	100	100	100	100	100	100
IG	SEI02	100	100	100	100	100	100	100
IG	SEI03	100	100	100	100	100	100	100
IG	SEI04	100	100	100	100	100	100	100
IG	SEI05	100	100	100	100	100	100	100
IG	SEI06	100	100	100	100	100	100	100
IG	SEI07	100	100	100	100	100	100	100
IG	SEI08	100	100	100	100	100	100	100
IG	SEI09	100	100	100	100	100	100	100
Network	**Station**	**2023-01-08**	**2023-01-09**	**2023-01-10**	**2023-01-11**	**2023-01-12**	**2023-01-13**	**2023-01-14**
IG	SEI01	100	100	100	100	100	100	100
IG	SEI02	100	100	100	100	100	100	100
IG	SEI03	100	100	100	100	100	100	100
IG	SEI04	100	100	100	100	100	100	100
IG	SEI05	100	100	100	100	100	100	100
IG	SEI06	100	100	100	100	100	100	100
IG	SEI07	100	100	100	99.3	100	100	100
IG	SEI08	100	100	100	100	100	100	100
IG	SEI09	100	100	100	100	100	100	100
Network	**Station**	**2023-01-15**	**2023-01-16**	**2023-01-17**	**2023-01-18**	**2023-01-19**	**2023-01-20**	**2023-01-21**
IG	SEI01	100	100	100	100	100	100	100
IG	SEI02	100	100	100	100	100	100	100
IG	SEI03	100	100	100	100	100	100	100
IG	SEI04	100	100	100	100	100	100	100
IG	SEI05	100	100	100	100	100	100	100
IG	SEI06	100	100	100	100	100	100	100
IG	SEI07	100	100	100	100	100	100	100
IG	SEI08	100	100	100	100	100	100	100
IG	SEI09	100	100	100	100	100	100	100

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Network	Station	2023-01-22	2023-01-23	2023-01-24	2023-01-25	2023-01-26	2023-01-27	2023-01-28
IG	SEI01	100	100	100	100	100	100	100
IG	SEI02	100	100	100	100	100	100	100
IG	SEI03	100	100	100	100	100	100	100
IG	SEI04	100	100	100	100	100	100	100
IG	SEI05	100	100	100	100	100	100	100
IG	SEI06	100	100	100	100	100	100	100
IG	SEI07	100	100	100	100	100	100	100
IG	SEI08	100	100	100	100	100	100	100
IG	SEI09	100	100	100	100	100	100	100

Network	Station	2023-01-29	2023-01-30	2023-01-31
IG	SEI01	100	100	100
IG	SEI02	100	100	100
IG	SEI03	100	100	100
IG	SEI04	100	100	100
IG	SEI05	100	100	100
IG	SEI06	100	100	100
IG	SEI07	100	100	100
IG	SEI08	100	100	100
IG	SEI09	100	100	100

February 2023

Network	Station	2023-02-01	2023-02-02	2023-02-03	2023-02-04	2023-02-05	2023-02-06	2023-02-07
IG	SEI01	100	100	100	100	100	100	100
IG	SEI02	100	100	100	100	100	100	100
IG	SEI03	100	100	100	100	100	100	100
IG	SEI04	100	100	100	100	100	100	100
IG	SEI05	100	100	100	100	100	100	100
IG	SEI06	100	100	100	100	100	100	100
IG	SEI07	100	100	100	100	100	100	100
IG	SEI08	100	100	100	100	100	100	100
IG	SEI09	100	100	100	100	100	100	100

Network	Station	2023-02-08	2023-02-09	2023-02-10	2023-02-11	2023-02-12	2023-02-13	2023-02-14
IG	SEI01	100	100	100	100	100	100	100
IG	SEI02	100	100	100	100	100	100	100
IG	SEI03	100	100	100	100	100	72.6	2.7
IG	SEI04	100	100	100	100	100	100	100
IG	SEI05	100	100	100	100	100	100	100
IG	SEI06	100	100	100	100	100	100	100
IG	SEI07	100	100	100	100	100	100	100
IG	SEI08	100	100	100	100	100	100	100
IG	SEI09	100	100	100	100	100	100	100
Network	**Station**	**2023-02-15**	**2023-02-16**	**2023-02-17**	**2023-02-18**	**2023-02-19**	**2023-02-20**	**2023-02-21**
IG	SEI01	100	100	100	100	100	100	100
IG	SEI02	100	100	100	100	100	100	100
IG	SEI03	13	77	41.2	5.6	7.9	12.2	17.9
IG	SEI04	100	100	100	100	100	100	100
IG	SEI05	100	100	100	100	100	100	100
IG	SEI06	100	100	100	100	100	100	100
IG	SEI07	100	100	100	100	100	100	100
IG	SEI08	100	100	100	100	100	100	100
IG	SEI09	100	100	100	100	100	100	100
Network	**Station**	**2023-02-22**	**2023-02-23**	**2023-02-24**	**2023-02-25**	**2023-02-26**	**2023-02-27**	**2023-02-28**
IG	SEI01	100	100	100	100	100	100	100
IG	SEI02	100	100	100	100	100	100	100
IG	SEI03	25.1	5.7	8.8	4.7	7.5	0.8	2.8
IG	SEI04	100	100	100	100	100	100	100
IG	SEI05	100	100	100	100	100	100	100
IG	SEI06	100	100	100	100	100	100	100
IG	SEI07	100	100	100	100	100	100	100
IG	SEI08	100	100	100	100	100	100	100
IG	SEI09	100	100	100	100	100	100	100

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March 2023

Network	Station	2023-03-01	2023-03-02	2023-03-03	2023-03-04	2023-03-05	2023-03-06	2023-03-07
IG	SEI01	100	100	100	100	100	100	100
IG	SEI02	100	100	100	100	100	100	100
IG	SEI03	100	100	100	100	99.8	100	100
IG	SEI04	100	100	100	100	100	100	100
IG	SEI05	100	100	100	100	100	100	100
IG	SEI06	100	100	100	100	100	100	100
IG	SEI07	100	100	100	100	100	100	100
IG	SEI08	100	100	100	100	100	100	100
IG	SEI09	100	100	100	100	100	100	100
Network	**Station**	**2023-03-08**	**2023-03-09**	**2023-03-10**	**2023-03-11**	**2023-03-12**	**2023-03-13**	**2023-03-14**
IG	SEI01	100	100	100	100	100	100	100
IG	SEI02	100	100	100	100	100	100	100
IG	SEI03	100	100	100	100	100	100	100
IG	SEI04	100	100	100	100	100	100	100
IG	SEI05	100	100	100	100	100	100	100
IG	SEI06	100	100	100	100	100	100	100
IG	SEI07	100	100	100	100	100	100	100
IG	SEI08	100	100	100	100	100	100	100
IG	SEI09	100	100	100	100	100	100	100
Network	**Station**	**2023-03-15**	**2023-03-16**	**2023-03-17**	**2023-03-18**	**2023-03-19**	**2023-03-20**	**2023-03-21**
IG	SEI01	100	100	100	100	100	100	100
IG	SEI02	100	100	100	100	100	100	100
IG	SEI03	100	100	100	100	100	100	100
IG	SEI04	100	100	100	100	100	100	100
IG	SEI05	100	100	100	100	100	100	100
IG	SEI06	100	100	100	100	100	100	100
IG	SEI07	100	100	100	100	100	100	100
IG	SEI08	100	100	100	100	100	100	100
IG	SEI09	100	100	100	100	100	100	100
Network	**Station**	**2023-03-22**	**2023-03-23**	**2023-03-24**	**2023-03-25**	**2023-03-26**	**2023-03-27**	**2023-03-28**
IG	SEI01	100	100	100	100	100	100	100

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IG	SEI02	100	100	100	100	100	100	100
IG	SEI03	100	100	100	100	100	100	100
IG	SEI04	100	100	100	100	100	100	100
IG	SEI05	100	100	100	100	100	100	100
IG	SEI06	100	100	100	100	100	100	100
IG	SEI07	100	100	100	100	100	100	100
IG	SEI08	100	100	100	100	100	100	100
IG	SEI09	100	100	100	100	100	100	100
Network	**Station**	**2023-03-29**	**2023-03-30**	**2023-03-31**				
IG	SEI01	100	100	100				
IG	SEI02	100	100	100				
IG	SEI03	100	100	100				
IG	SEI04	100	100	100				
IG	SEI05	100	100	100				
IG	SEI06	100	100	100				
IG	SEI07	100	100	100				
IG	SEI08	100	100	100				
IG	SEI09	100	100	100				

April 2023

Network	**Station**	**2023-04-01**	**2023-04-02**	**2023-04-03**	**2023-04-04**	**2023-04-05**	**2023-04-06**	**2023-04-07**
IG	SEI01	100	100	100	100	100	100	100
IG	SEI02	100	100	100	100	100	100	100
IG	SEI03	100	100	100	100	100	100	100
IG	SEI04	100	100	100	100	100	100	100
IG	SEI05	100	100	100	100	100	100	100
IG	SEI06	100	100	100	100	100	100	100
IG	SEI07	100	100	100	100	100	100	100
IG	SEI08	100	100	100	100	100	100	100
IG	SEI09	100	100	100	100	100	100	100
Network	**Station**	**2023-04-08**	**2023-04-09**	**2023-04-10**	**2023-04-11**	**2023-04-12**	**2023-04-13**	**2023-04-14**
IG	SEI01	100	100	100	100	100	100	100

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IG	SEI02	100	100	100	100	100	100	100
IG	SEI03	100	100	100	100	100	100	100
IG	SEI04	100	100	100	100	100	100	100
IG	SEI05	100	100	100	100	100	100	100
IG	SEI06	100	100	100	100	100	100	100
IG	SEI07	100	100	100	100	100	100	100
IG	SEI08	100	100	100	100	100	100	100
IG	SEI09	100	100	100	100	100	100	100
Network	**Station**	**2023-04-15**	**2023-04-16**	**2023-04-17**	**2023-04-18**	**2023-04-19**	**2023-04-20**	**2023-04-21**
IG	SEI01	100	100	100	100	100	100	100
IG	SEI02	100	100	100	100	100	100	100
IG	SEI03	100	100	100	100	100	100	100
IG	SEI04	100	100	100	100	100	100	100
IG	SEI05	100	100	100	100	100	100	100
IG	SEI06	100	100	100	100	100	100	100
IG	SEI07	100	100	100	100	100	100	100
IG	SEI08	100	100	100	100	100	100	100
IG	SEI09	100	100	100	100	100	100	100
Network	**Station**	**2023-04-22**	**2023-04-23**	**2023-04-24**	**2023-04-25**	**2023-04-26**	**2023-04-27**	**2023-04-28**
IG	SEI01	100	100	100	100	100	100	100
IG	SEI02	100	100	100	100	100	100	100
IG	SEI03	100	100	100	100	100	100	100
IG	SEI04	100	100	100	100	100	100	100
IG	SEI05	100	100	100	100	100	100	100
IG	SEI06	100	100	100	100	100	100	100
IG	SEI07	100	100	100	100	100	100	100
IG	SEI08	100	100	100	100	100	100	100
IG	SEI09	100	100	100	100	100	100	100
Network	**Station**	**2023-04-29**	**2023-04-30**					
IG	SEI01	100	100					
IG	SEI02	100	100					
IG	SEI03	100	100					
IG	SEI04	100	100					

IG	SEI05	100	100
IG	SEI06	100	100
IG	SEI07	100	100
IG	SEI08	100	100
IG	SEI09	100	100

May 2023

Network	Station	2023-05-01	2023-05-02	2023-05-03	2023-05-04	2023-05-05	2023-05-06	2023-05-07
IG	SEI01	100	100	100	100	100	100	100
IG	SEI02	100	100	100	100	100	100	100
IG	SEI03	100	100	100	100	100	100	100
IG	SEI04	100	100	100	100	100	100	100
IG	SEI05	100	100	100	100	100	100	100
IG	SEI06	100	100	100	100	100	100	100
IG	SEI07	100	100	100	100	100	100	100
IG	SEI08	100	100	100	100	100	100	100
IG	SEI09	100	100	100	100	100	100	100
Network	**Station**	**2023-05-08**	**2023-05-09**	**2023-05-10**	**2023-05-11**	**2023-05-12**	**2023-05-13**	**2023-05-14**
IG	SEI01	100	100	100	100	100	100	100
IG	SEI02	100	100	100	100	100	100	100
IG	SEI03	100	100	100	100	100	100	100
IG	SEI04	100	100	100	100	100	100	100
IG	SEI05	100	100	100	100	100	100	100
IG	SEI06	100	100	100	100	100	100	100
IG	SEI07	100	100	100	100	100	100	100
IG	SEI08	100	100	100	100	100	100	100
IG	SEI09	100	100	100	100	100	100	100
Network	**Station**	**2023-05-15**	**2023-05-16**	**2023-05-17**	**2023-05-18**	**2023-05-19**	**2023-05-20**	**2023-05-21**
IG	SEI01	100	100	100	100	100	100	100
IG	SEI02	100	100	100	100	100	100	100
IG	SEI03	100	100	100	100	100	100	100
IG	SEI04	100	100	100	100	100	100	100

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IG	SEI05	100	100	100	100	100	100	100
IG	SEI06	100	100	100	100	100	100	100
IG	SEI07	100	100	100	100	100	100	100
IG	SEI08	100	100	100	100	100	100	100
IG	SEI09	100	100	100	100	100	100	100
Network	**Station**	**2023-05-22**	**2023-05-23**	**2023-05-24**	**2023-05-25**	**2023-05-26**	**2023-05-27**	**2023-05-28**
IG	SEI01	100	100	100	100	100	100	100
IG	SEI02	100	100	100	100	100	100	100
IG	SEI03	100	100	100	100	100	100	100
IG	SEI04	100	100	100	100	100	100	100
IG	SEI05	100	100	100	100	100	100	100
IG	SEI06	100	100	100	100	100	100	100
IG	SEI07	100	100	100	100	100	100	100
IG	SEI08	100	100	100	100	100	100	100
IG	SEI09	100	100	100	100	100	100	100
Network	**Station**	**2023-05-29**	**2023-05-30**	**2023-05-31**				
IG	SEI01	100	100	100				
IG	SEI02	100	100	100				
IG	SEI03	100	100	100				
IG	SEI04	100	100	100				
IG	SEI05	100	100	100				
IG	SEI06	100	100	100				
IG	SEI07	100	100	100				
IG	SEI08	100	100	100				
IG	SEI09	100	100	100				

June 2023

Network	**Station**	**2023-06-01**	**2023-06-02**	**2023-06-03**	**2023-06-04**	**2023-06-05**	**2023-06-06**	**2023-06-07**
IG	SEI01	100	100	100	100	100	100	100
IG	SEI02	100	100	100	100	100	100	100
IG	SEI03	100	100	100	100	100	100	100
IG	SEI04	100	100	100	100	100	100	100

IG	SEI05	100	100	100	100	100	100	100
IG	SEI06	99.9	100	100	100	100	100	100
IG	SEI07	100	100	100	100	100	100	100
IG	SEI08	100	100	100	100	100	100	100
IG	SEI09	100	100	100	100	100	100	100
Network	**Station**	**2023-06-08**	**2023-06-09**	**2023-06-10**	**2023-06-11**	**2023-06-12**	**2023-06-13**	**2023-06-14**
IG	SEI01	100	100	100	100	100	100	100
IG	SEI02	100	100	100	100	100	100	100
IG	SEI03	100	100	100	100	100	100	100
IG	SEI04	100	100	100	100	100	100	100
IG	SEI05	100	100	100	100	100	100	100
IG	SEI06	100	100	100	100	100	100	100
IG	SEI07	100	100	100	100	100	100	100
IG	SEI08	100	100	100	100	100	100	100
IG	SEI09	100	100	100	100	100	100	100
Network	**Station**	**2023-06-15**	**2023-06-16**	**2023-06-17**	**2023-06-18**	**2023-06-19**	**2023-06-20**	**2023-06-21**
IG	SEI01	100	100	100	100	100	100	100
IG	SEI02	100	100	100	100	100	100	100
IG	SEI03	100	100	100	100	100	100	100
IG	SEI04	100	100	100	100	100	100	100
IG	SEI05	100	100	100	100	100	100	100
IG	SEI06	100	100	100	100	100	100	100
IG	SEI07	100	100	100	100	100	100	100
IG	SEI08	100	100	100	100	100	100	100
IG	SEI09	100	100	100	100	100	100	100
Network	**Station**	**2023-06-22**	**2023-06-23**	**2023-06-24**	**2023-06-25**	**2023-06-26**	**2023-06-27**	**2023-06-28**
IG	SEI01	100	100	100	100	100	100	100
IG	SEI02	100	100	100	100	100	100	100
IG	SEI03	100	100	100	100	100	100	100
IG	SEI04	100	100	100	100	100	100	100
IG	SEI05	100	100	100	100	100	100	100
IG	SEI06	100	100	100	100	100	100	100
IG	SEI07	100	100	100	100	100	100	100

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IG	SEI08	100	100	100	100	100	100	100
IG	SEI09	100	100	100	100	100	100	100
Network	**Station**	**2023-06-29**	**2023-06-30**					
IG	SEI01	100	100					
IG	SEI02	100	100					
IG	SEI03	100	100					
IG	SEI04	100	100					
IG	SEI05	100	100					
IG	SEI06	100	100					
IG	SEI07	100	100					
IG	SEI08	100	100					
IG	SEI09	100	100					

July 2023

Network	**Station**	**2023-07-01**	**2023-07-02**	**2023-07-03**	**2023-07-04**	**2023-07-05**	**2023-07-06**	**2023-07-07**
IG	SEI01	100	100	100	100	100	100	100
IG	SEI02	100	100	100	100	100	100	100
IG	SEI03	100	100	100	100	100	100	100
IG	SEI04	100	100	100	100	100	100	100
IG	SEI05	100	100	100	100	100	100	100
IG	SEI06	100	100	100	100	100	100	100
IG	SEI07	100	100	100	100	100	100	100
IG	SEI08	100	100	100	100	100	100	100
IG	SEI09	100	100	100	100	100	100	100
Network	**Station**	**2023-07-08**	**2023-07-09**	**2023-07-10**	**2023-07-11**	**2023-07-12**	**2023-07-13**	**2023-07-14**
IG	SEI01	100	100	100	100	100	100	100
IG	SEI02	100	100	100	100	100	100	100
IG	SEI03	100	100	100	100	100	100	100
IG	SEI04	100	100	100	100	100	100	100
IG	SEI05	100	100	100	100	100	100	100
IG	SEI06	100	100	100	100	100	100	100
IG	SEI07	100	100	100	100	100	100	100

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IG	SEI08	100	100	100	100	100	100	100
IG	SEI09	100	100	100	100	100	100	100
Network	**Station**	**2023-07-15**	**2023-07-16**	**2023-07-17**	**2023-07-18**	**2023-07-19**	**2023-07-20**	**2023-07-21**
IG	SEI01	100	100	100	100	100	100	100
IG	SEI02	100	100	100	100	100	100	100
IG	SEI03	100	100	100	100	100	100	100
IG	SEI04	100	100	100	100	100	100	100
IG	SEI05	100	100	100	100	100	100	100
IG	SEI06	100	100	100	100	100	100	100
IG	SEI07	100	100	100	100	100	100	100
IG	SEI08	100	100	100	100	100	100	100
IG	SEI09	100	100	100	100	100	100	100
Network	**Station**	**2023-07-22**	**2023-07-23**	**2023-07-24**	**2023-07-25**	**2023-07-26**	**2023-07-27**	**2023-07-28**
IG	SEI01	100	100	100	100	100	100	100
IG	SEI02	100	100	100	100	100	100	100
IG	SEI03	100	100	100	100	100	100	100
IG	SEI04	100	100	100	100	100	100	100
IG	SEI05	100	100	100	100	100	100	100
IG	SEI06	100	100	100	100	100	100	100
IG	SEI07	100	100	100	100	100	100	100
IG	SEI08	100	100	100	100	100	100	100
IG	SEI09	100	100	100	100	100	100	100
Network	**Station**	**2023-07-29**	**2023-07-30**	**2023-07-31**				
IG	SEI01	100	100	100				
IG	SEI02	100	100	100				
IG	SEI03	100	100	100				
IG	SEI04	100	100	100				
IG	SEI05	100	100	100				
IG	SEI06	100	100	100				
IG	SEI07	100	100	100				
IG	SEI08	100	100	100				
IG	SEI09	100	100	100				

August 2023

Network	Station	2023-08-01	2023-08-02	2023-08-03	2023-08-04	2023-08-05	2023-08-06	2023-08-07
IG	SEI01	100	100	100	100	100	100	100
IG	SEI02	100	100	100	100	100	100	100
IG	SEI03	100	100	100	100	100	100	100
IG	SEI04	100	100	100	100	100	100	100
IG	SEI05	100	100	100	100	100	100	100
IG	SEI06	100	100	100	100	100	100	100
IG	SEI07	100	100	100	100	100	100	100
IG	SEI08	100	100	100	100	100	100	100
IG	SEI09	100	100	100	100	100	100	100
Network	**Station**	**2023-08-08**	**2023-08-09**	**2023-08-10**	**2023-08-11**	**2023-08-12**	**2023-08-13**	**2023-08-14**
IG	SEI01	100	100	100	100	100	100	100
IG	SEI02	100	100	100	100	100	100	100
IG	SEI03	100	100	100	100	100	100	100
IG	SEI04	100	100	100	100	100	100	100
IG	SEI05	100	100	100	100	100	100	100
IG	SEI06	100	100	100	100	100	100	100
IG	SEI07	100	100	100	100	100	100	100
IG	SEI08	100	100	100	100	100	100	100
IG	SEI09	100	100	100	100	100	100	100
Network	**Station**	**2023-08-15**	**2023-08-16**	**2023-08-17**	**2023-08-18**	**2023-08-19**	**2023-08-20**	**2023-08-21**
IG	SEI01	100	100	100	100	100	100	100
IG	SEI02	100	100	100	100	100	100	100
IG	SEI03	100	100	100	100	100	100	100
IG	SEI04	100	100	100	100	100	100	100
IG	SEI05	100	100	100	100	100	100	100
IG	SEI06	100	100	100	100	100	100	100
IG	SEI07	100	100	100	100	100	100	100
IG	SEI08	100	100	100	100	100	100	100
IG	SEI09	100	100	100	100	100	100	100
Network	**Station**	**2023-08-22**	**2023-08-23**	**2023-08-24**	**2023-08-25**	**2023-08-26**	**2023-08-27**	**2023-08-28**

IG	SEI01	100	100	100	100	100	100	100
IG	SEI02	100	100	100	100	100	100	100
IG	SEI03	100	100	100	100	100	100	100
IG	SEI04	100	100	100	100	100	100	100
IG	SEI05	100	100	100	100	100	100	100
IG	SEI06	100	100	100	100	100	100	100
IG	SEI07	100	100	100	100	100	100	100
IG	SEI08	100	100	100	100	100	100	100
IG	SEI09	100	100	100	100	100	100	100
Network	**Station**	**2023-08-29**	**2023-08-30**	**2023-08-31**				
IG	SEI01	100	100	100				
IG	SEI02	100	100	100				
IG	SEI03	100	100	100				
IG	SEI04	100	100	100				
IG	SEI05	100	100	100				
IG	SEI06	100	100	100				
IG	SEI07	100	100	100				
IG	SEI08	100	100	100				
IG	SEI09	100	100	100				

September 2023

Network	**Station**	**2023-09-01**	**2023-09-02**	**2023-09-03**	**2023-09-04**	**2023-09-05**	**2023-09-06**	**2023-09-07**
IG	SEI01	100	100	100	100	100	100	100
IG	SEI02	100	100	100	100	100	100	100
IG	SEI03	100	100	100	100	100	100	100
IG	SEI04	100	100	100	100	100	100	100
IG	SEI05	100	100	100	100	100	100	100
IG	SEI06	100	100	100	100	100	100	100
IG	SEI07	100	100	100	100	100	100	100
IG	SEI08	100	100	100	100	100	100	100
IG	SEI09	100	100	100	100	100	100	100
Network	**Station**	**2023-09-08**	**2023-09-09**	**2023-09-10**	**2023-09-11**	**2023-09-12**	**2023-09-13**	**2023-09-14**

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IG	SEI01	100	100	100	100	100	100	100
IG	SEI02	100	100	100	100	100	100	100
IG	SEI03	100	100	100	100	100	100	100
IG	SEI04	100	100	100	100	100	100	100
IG	SEI05	100	100	100	100	100	100	100
IG	SEI06	100	100	100	100	100	100	100
IG	SEI07	100	100	100	100	100	100	100
IG	SEI08	100	100	100	100	100	100	100
IG	SEI09	100	100	100	100	100	100	100
Network	**Station**	**2023-09-15**	**2023-09-16**	**2023-09-17**	**2023-09-18**	**2023-09-19**	**2023-09-20**	**2023-09-21**
IG	SEI01	100	100	100	100	100	100	100
IG	SEI02	100	100	100	100	100	100	100
IG	SEI03	100	100	100	100	100	100	100
IG	SEI04	100	100	100	100	100	100	100
IG	SEI05	100	100	100	100	100	100	100
IG	SEI06	100	100	100	100	100	100	100
IG	SEI07	100	100	100	100	100	100	100
IG	SEI08	100	100	100	100	100	100	100
IG	SEI09	100	100	100	100	100	100	100
Network	**Station**	**2023-09-22**	**2023-09-23**	**2023-09-24**	**2023-09-25**	**2023-09-26**	**2023-09-27**	**2023-09-28**
IG	SEI01	100	100	100	100	100	100	99.9
IG	SEI02	100	100	100	100	100	100	100
IG	SEI03	100	100	100	100	100	100	100
IG	SEI04	100	100	100	100	100	100	100
IG	SEI05	100	100	100	100	100	100	100
IG	SEI06	100	100	100	100	100	100	100
IG	SEI07	100	100	100	100	100	100	100
IG	SEI08	100	100	100	100	100	100	100
IG	SEI09	100	100	100	100	100	100	100
Network	**Station**	**2023-09-29**	**2023-09-30**					
IG	SEI01	99.9	100					
IG	SEI02	99.8	100					
IG	SEI03	99.9	100					

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IG	SEI04	100	100
IG	SEI05	99.9	100
IG	SEI06	100	100
IG	SEI07	99.9	100
IG	SEI08	100	100
IG	SEI09	99.9	100

October 2023

Network	Station	2023-10-01	2023-10-02	2023-10-03	2023-10-04	2023-10-05	2023-10-06	2023-10-07
IG	SEI01	100	100	100	100	100	100	100
IG	SEI02	100	100	100	100	100	100	100
IG	SEI03	100	100	100	100	100	100	100
IG	SEI04	100	100	100	100	100	100	100
IG	SEI05	100	100	100	100	100	100	100
IG	SEI06	100	100	100	100	100	100	100
IG	SEI07	100	100	100	100	100	100	100
IG	SEI08	100	100	100	100	100	100	100
IG	SEI09	100	100	100	100	100	100	100
Network	**Station**	**2023-10-08**	**2023-10-09**	**2023-10-10**	**2023-10-11**	**2023-10-12**	**2023-10-13**	**2023-10-14**
IG	SEI01	100	100	100	100	100	100	100
IG	SEI02	100	100	100	100	100	100	100
IG	SEI03	100	100	100	100	100	100	100
IG	SEI04	100	100	100	100	100	100	100
IG	SEI05	100	100	100	100	100	100	100
IG	SEI06	100	100	100	100	100	100	100
IG	SEI07	100	100	100	100	100	100	100
IG	SEI08	100	100	100	100	100	100	100
IG	SEI09	100	100	100	100	100	100	100
Network	**Station**	**2023-10-15**	**2023-10-16**	**2023-10-17**	**2023-10-18**	**2023-10-19**	**2023-10-20**	**2023-10-21**
IG	SEI01	100	100	100	100	100	100	100
IG	SEI02	100	100	100	100	100	100	100
IG	SEI03	100	100	100	100	100	100	100
IG	SEI04	100	100	100	100	100	100	100

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IG	SEI05	100	100	100	100	100	100	100
IG	SEI06	100	100	100	100	100	100	100
IG	SEI07	100	100	100	100	100	100	100
IG	SEI08	100	100	100	100	100	100	100
IG	SEI09	100	100	100	100	100	100	100
Network	**Station**	**2023-10-22**	**2023-10-23**	**2023-10-24**	**2023-10-25**	**2023-10-26**	**2023-10-27**	**2023-10-28**
IG	SEI01	100	100	100	100	100	100	100
IG	SEI02	100	100	100	100	100	100	100
IG	SEI03	100	100	100	100	100	100	100
IG	SEI04	100	100	100	100	100	100	100
IG	SEI05	100	100	100	100	100	100	100
IG	SEI06	100	100	100	100	100	100	100
IG	SEI07	100	100	100	100	100	100	100
IG	SEI08	100	100	100	100	100	100	100
IG	SEI09	100	100	100	100	100	100	100
Network	**Station**	**2023-10-29**	**2023-10-30**	**2023-10-31**				
IG	SEI01	100	100	100				
IG	SEI02	100	100	100				
IG	SEI03	100	100	100				
IG	SEI04	100	100	100				
IG	SEI05	100	100	100				
IG	SEI06	100	100	100				
IG	SEI07	100	100	100				
IG	SEI08	100	100	100				
IG	SEI09	100	100	100				

November 2023

Network	**Station**	**2023-11-01**	**2023-11-02**	**2023-11-03**	**2023-11-04**	**2023-11-05**	**2023-11-06**	**2023-11-07**
IG	SEI01	100	100	100	100	100	100	100
IG	SEI02	100	100	100	100	100	100	100
IG	SEI03	100	100	100	100	100	100	100
IG	SEI04	100	100	100	100	100	100	100
IG	SEI05	100	100	100	100	100	100	100

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IG	SEI06	100	100	99.9	100	100	100	100
IG	SEI07	100	100	100	100	100	100	100
IG	SEI08	100	100	100	100	100	100	100
IG	SEI09	100	100	100	100	100	100	100
Network	**Station**	**2023-11-08**	**2023-11-09**	**2023-11-10**	**2023-11-11**	**2023-11-12**	**2023-11-13**	**2023-11-14**
IG	SEI01	100	100	100	100	100	100	100
IG	SEI02	100	100	100	100	100	100	100
IG	SEI03	100	100	100	100	100	100	100
IG	SEI04	100	100	100	100	100	100	100
IG	SEI05	100	100	100	100	100	100	100
IG	SEI06	100	100	100	100	100	100	100
IG	SEI07	100	100	100	100	100	100	100
IG	SEI08	100	100	100	100	100	100	100
IG	SEI09	100	100	100	100	100	100	100
Network	**Station**	**2023-11-15**	**2023-11-16**	**2023-11-17**	**2023-11-18**	**2023-11-19**	**2023-11-20**	**2023-11-21**
IG	SEI01	100	100	100	100	100	100	100
IG	SEI02	100	100	100	100	100	100	100
IG	SEI03	100	100	100	100	100	100	100
IG	SEI04	100	100	100	100	100	100	100
IG	SEI05	100	100	100	100	100	100	100
IG	SEI06	100	100	100	100	100	100	100
IG	SEI07	100	100	100	100	100	100	100
IG	SEI08	100	100	100	100	100	100	100
IG	SEI09	100	100	100	100	100	100	100
Network	**Station**	**2023-11-22**	**2023-11-23**	**2023-11-24**	**2023-11-25**	**2023-11-26**	**2023-11-27**	**2023-11-28**
IG	SEI01	100	100	100	100	100	100	100
IG	SEI02	100	100	100	100	100	100	100
IG	SEI03	100	100	100	100	100	100	100
IG	SEI04	100	100	100	100	100	100	100
IG	SEI05	100	100	100	100	100	100	100
IG	SEI06	100	100	100	100	100	100	100
IG	SEI07	100	100	100	100	100	100	100
IG	SEI08	100	100	100	100	100	100	100

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IG	SEI09	100	100	100	100	100	100	100

Network	Station	2023-11-29	2023-11-30
IG	SEI01	100	100
IG	SEI02	100	100
IG	SEI03	100	100
IG	SEI04	100	100
IG	SEI05	100	100
IG	SEI06	100	100
IG	SEI07	100	100
IG	SEI08	100	100
IG	SEI09	100	100

December 2023

Network	Station	2023-12-01	2023-12-02	2023-12-03	2023-12-04	2023-12-05	2023-12-06	2023-12-07
IG	SEI01	100	100	100	100	100	100	100
IG	SEI02	100	100	100	100	100	100	100
IG	SEI03	100	100	100	100	100	100	100
IG	SEI04	100	100	100	100	100	100	100
IG	SEI05	100	100	100	100	100	100	100
IG	SEI06	100	100	99.9	100	100	100	100
IG	SEI07	100	100	100	100	100	100	100
IG	SEI08	100	100	100	100	100	100	100
IG	SEI09	100	100	100	100	100	100	100

Network	Station	2023-12-08	2023-12-09	2023-12-10	2023-12-11	2023-12-12	2023-12-13	2023-12-14
IG	SEI01	100	100	100	100	100	100	100
IG	SEI02	100	100	100	100	100	100	100
IG	SEI03	100	100	100	100	100	100	100
IG	SEI04	100	100	100	100	100	100	100
IG	SEI05	100	100	100	100	100	100	100
IG	SEI06	100	100	100	100	100	100	100
IG	SEI07	100	100	100	100	100	100	100
IG	SEI08	100	100	100	100	100	100	100
IG	SEI09	100	100	100	100	100	100	100

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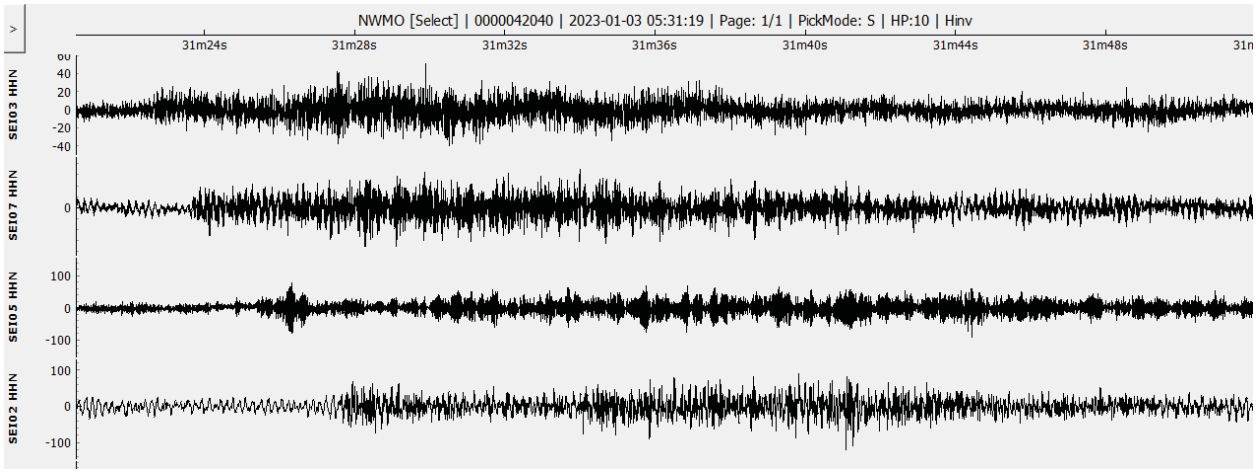
Network	Station	2023-12-15	2023-12-16	2023-12-17	2023-12-18	2023-12-19	2023-12-20	2023-12-21
IG	SEI01	100	100	100	100	100	100	100
IG	SEI02	100	100	100	100	100	100	100
IG	SEI03	100	100	100	100	100	100	100
IG	SEI04	100	100	100	100	100	100	100
IG	SEI05	100	100	100	100	100	100	100
IG	SEI06	100	100	100	100	100	100	100
IG	SEI07	100	100	100	100	100	100	100
IG	SEI08	100	100	100	100	100	100	100
IG	SEI09	100	100	100	100	100	100	100
Network	**Station**	**2023-12-22**	**2023-12-23**	**2023-12-24**	**2023-12-25**	**2023-12-26**	**2023-12-27**	**2023-12-28**
IG	SEI01	100	100	100	100	100	100	100
IG	SEI02	100	100	100	100	100	100	100
IG	SEI03	100	100	100	100	100	100	100
IG	SEI04	100	100	100	100	100	100	100
IG	SEI05	100	100	100	100	100	100	100
IG	SEI06	100	100	100	100	100	100	100
IG	SEI07	100	100	100	100	100	100	100
IG	SEI08	100	100	100	100	100	100	100
IG	SEI09	100	100	100	100	100	100	100
Network	**Station**	**2023-12-29**	**2023-12-30**	**2023-12-31**				
IG	SEI01	100	100	100				
IG	SEI02	100	100	100				
IG	SEI03	100	100	100				
IG	SEI04	100	100	100				
IG	SEI05	100	100	100				
IG	SEI06	100	100	100				
IG	SEI07	100	100	100				
IG	SEI08	100	100	100				
IG	SEI09	100	100	100				

Appendix B: Waveforms of Earthquakes Detected within the AOI

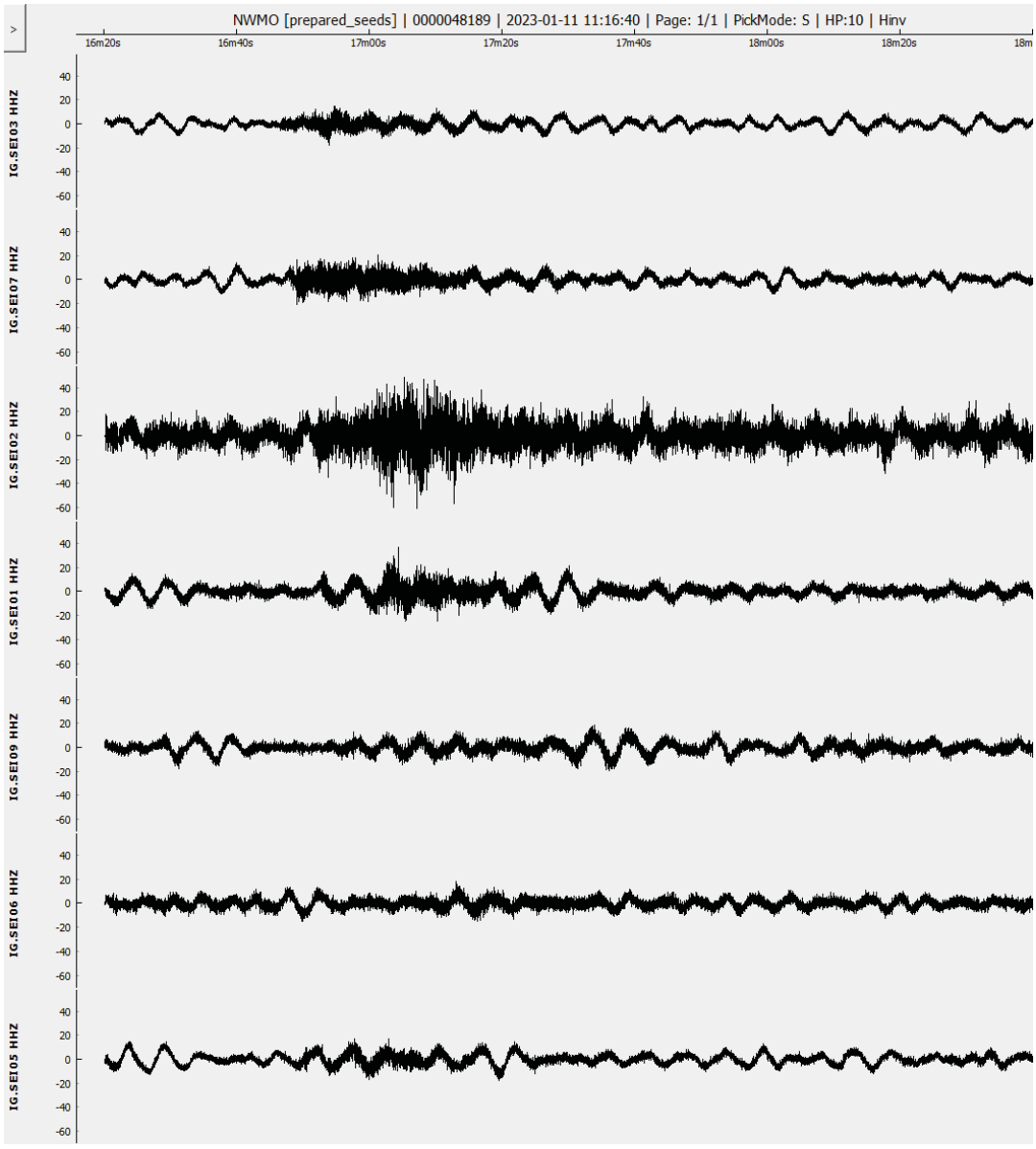
This section displays the waveforms of seismic events detected in 2023 within the AOI by the NWMO monitoring network. Waveforms are filtered with a 10 Hz bandpass unless otherwise specified.

Date: 2023-01-03
Time: 05:31:19 UTC
Latitude: 49.211167
Longitude: -91.976833
Depth: 2.84 km
Magnitude: 0.01



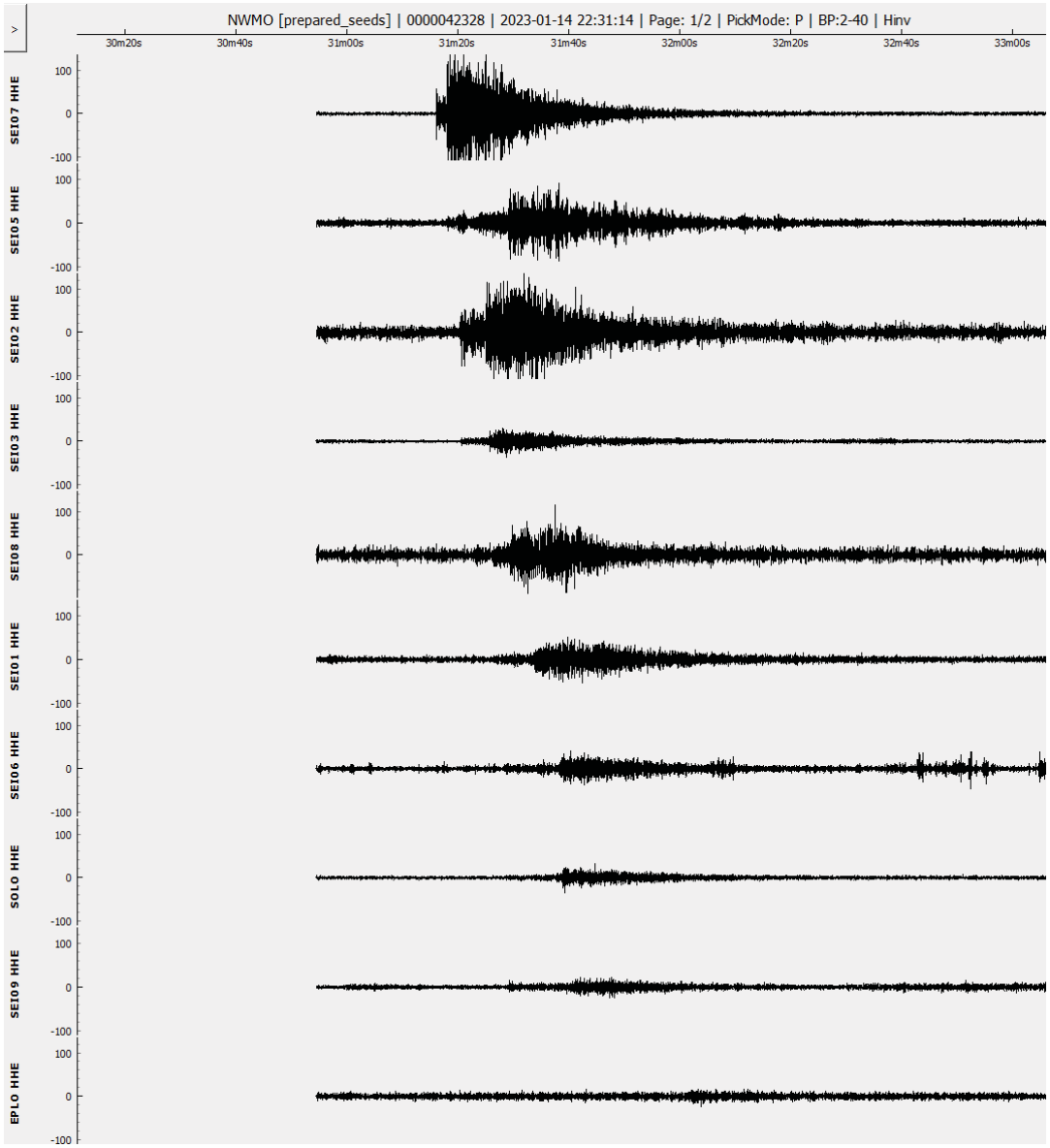
Manual event within NWMO area of interest

Date: 2023-01-11
Time: 11:16:40 UTC
Latitude: 49.020200
Longitude: -92.106700
Depth: 7.78 km
Magnitude: 0.46Ml



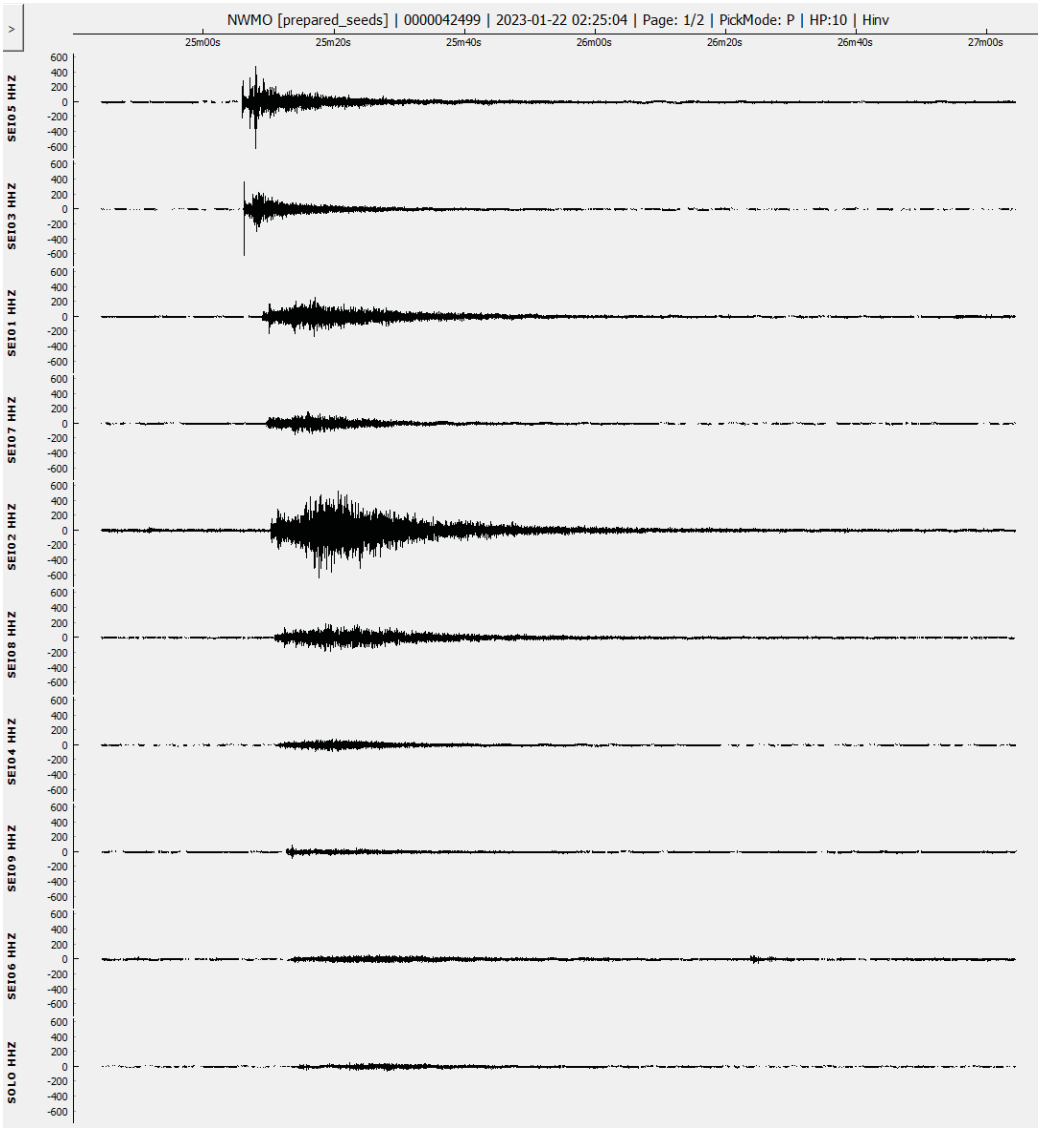
Manual event within NWMO area of interest

Date: 2023-01-14
Time: 22:31:14 UTC
Latitude: 49.279833
Longitude: -91.628667
Depth: 2.86 km
Magnitude: 0.34Ml



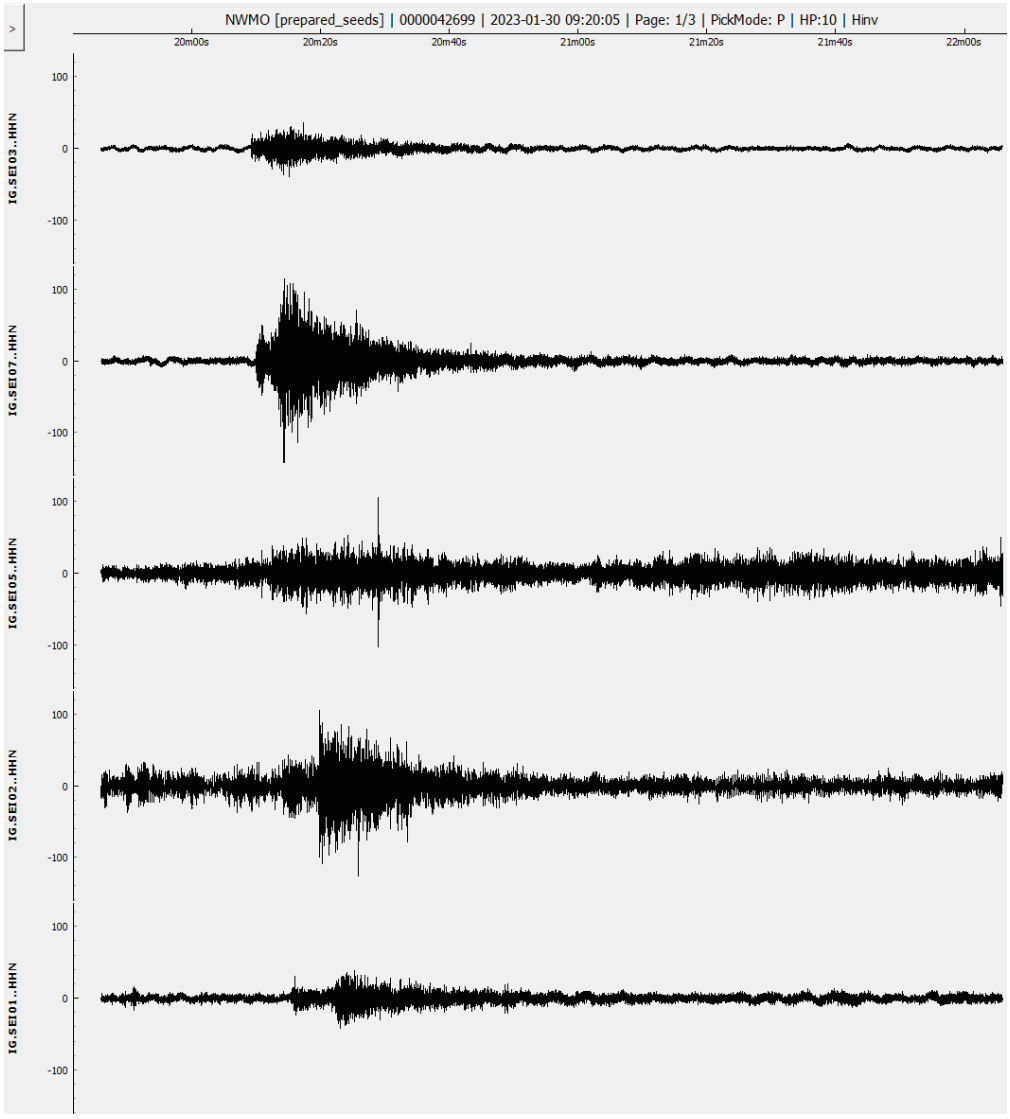
Manual event within NWMO area of interest

Date: 2023-01-22
Time: 02:25:04 UTC
Latitude: 49.468167
Longitude: -92.142667
Depth: 1.90km
Magnitude: 0.62Ml



Manual event within NWMO area of interest

Date: 2023-01-30
Time: 09:20:05 UTC
Latitude: 49.220667
Longitude: -91.992167
Depth: 6.6 km
Magnitude: 0.02 Ml



Manual event within NWMO area of interest

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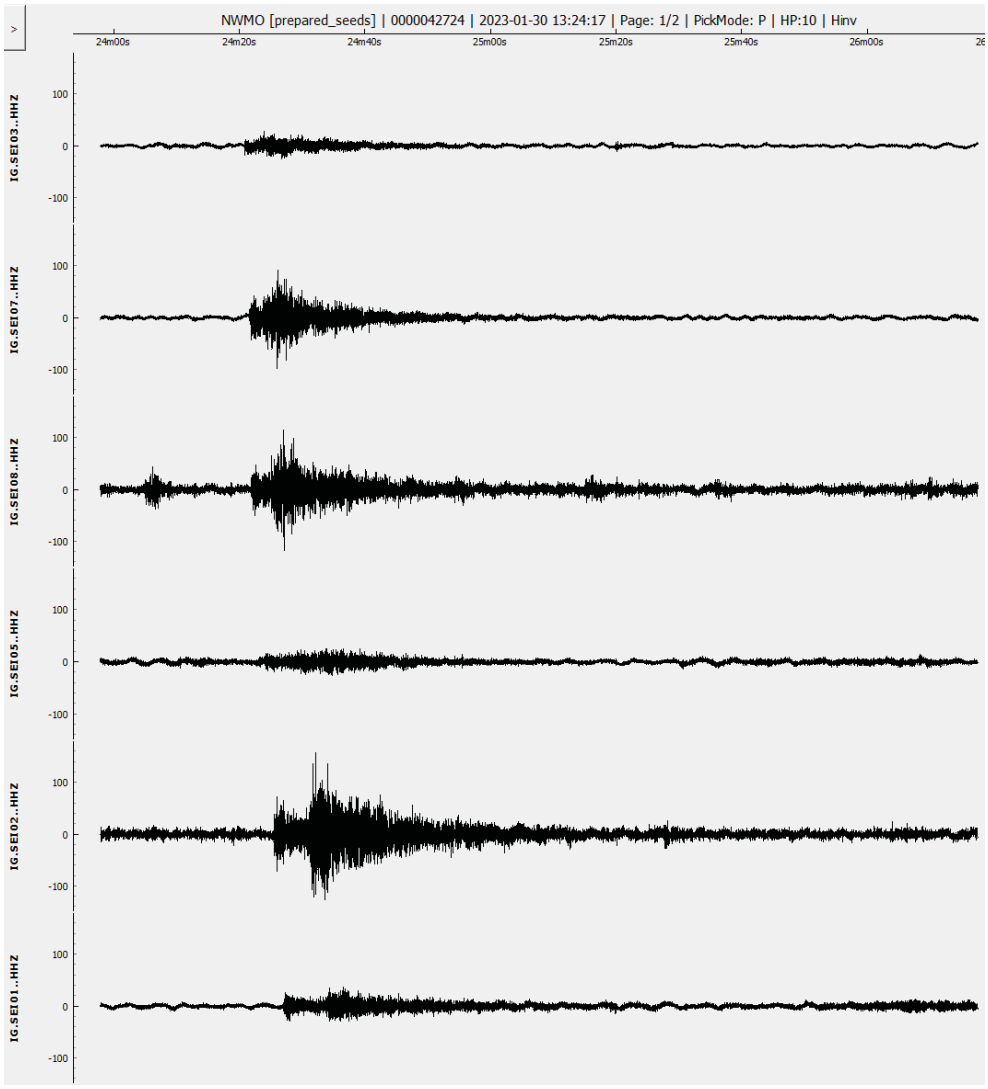
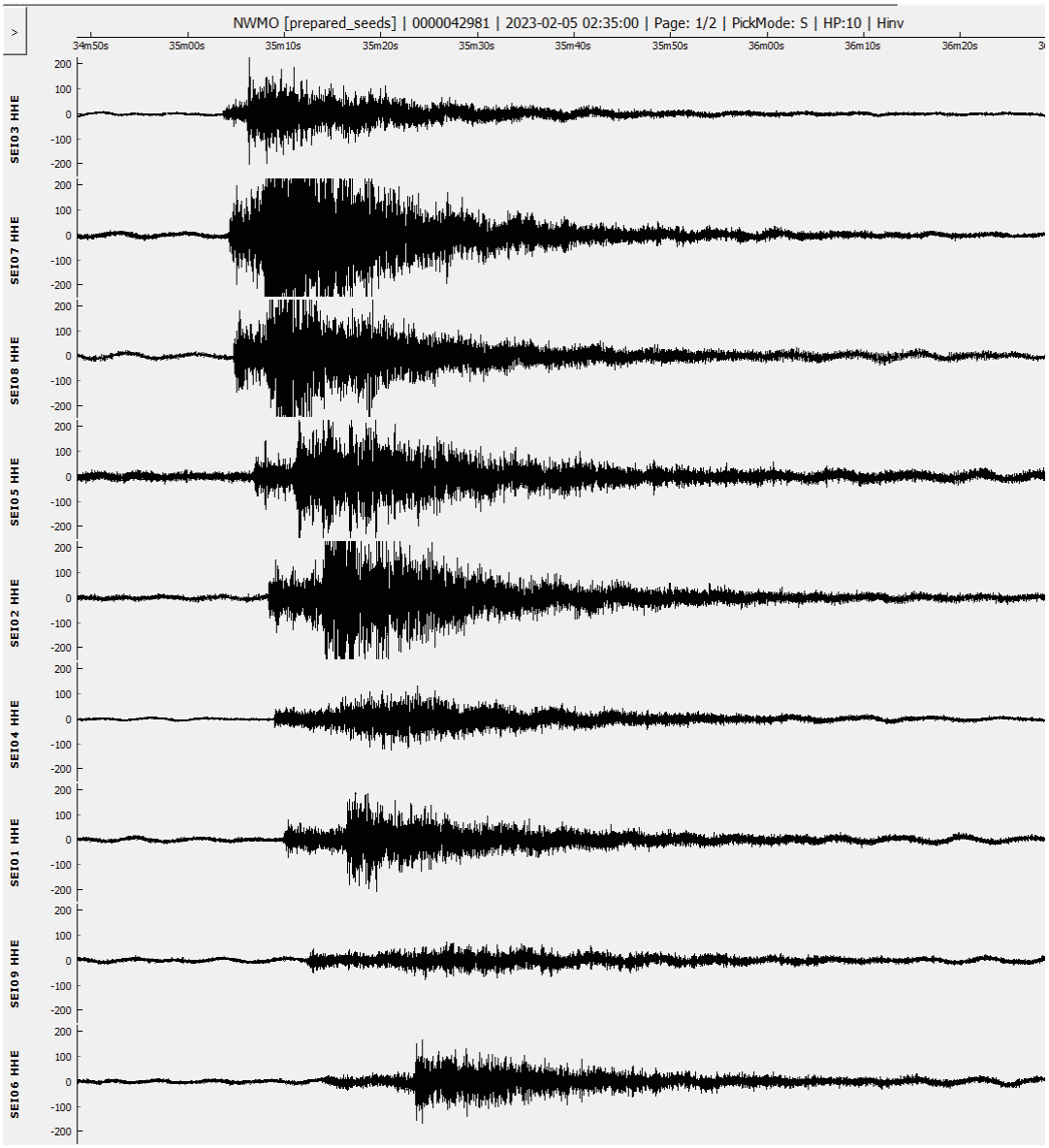
Date:	2023-01-30
Time:	13:24:17 UTC
Latitude:	49.232833
Longitude:	-91.997667
Depth:	2.34 km
Magnitude:	0.02 Ml



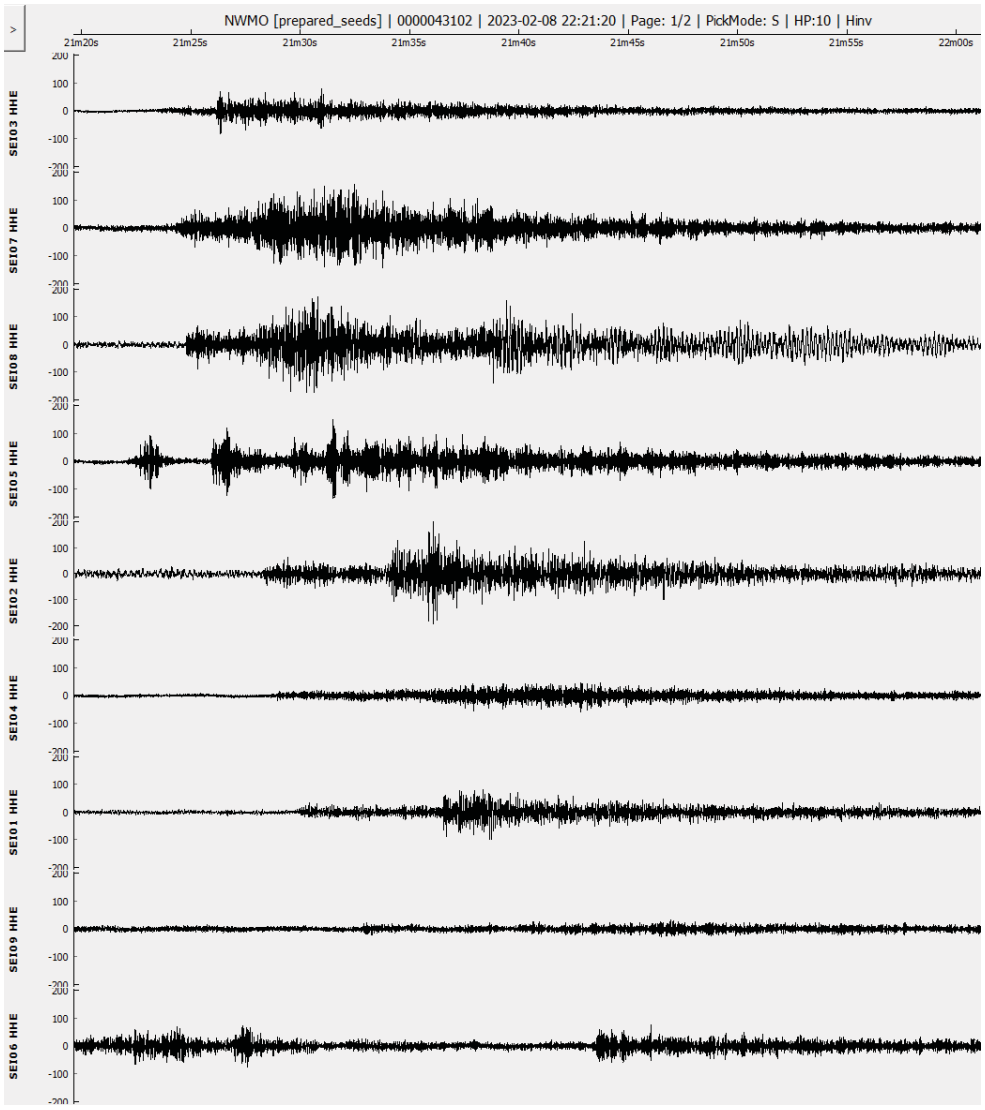
Manual event within NWMO area of interest

Date: 2023-02-05
Time: 02:35:00 UTC
Latitude: 49.228167
Longitude: -91.983167
Depth: 3.23 km
Magnitude: 0.45 Ml



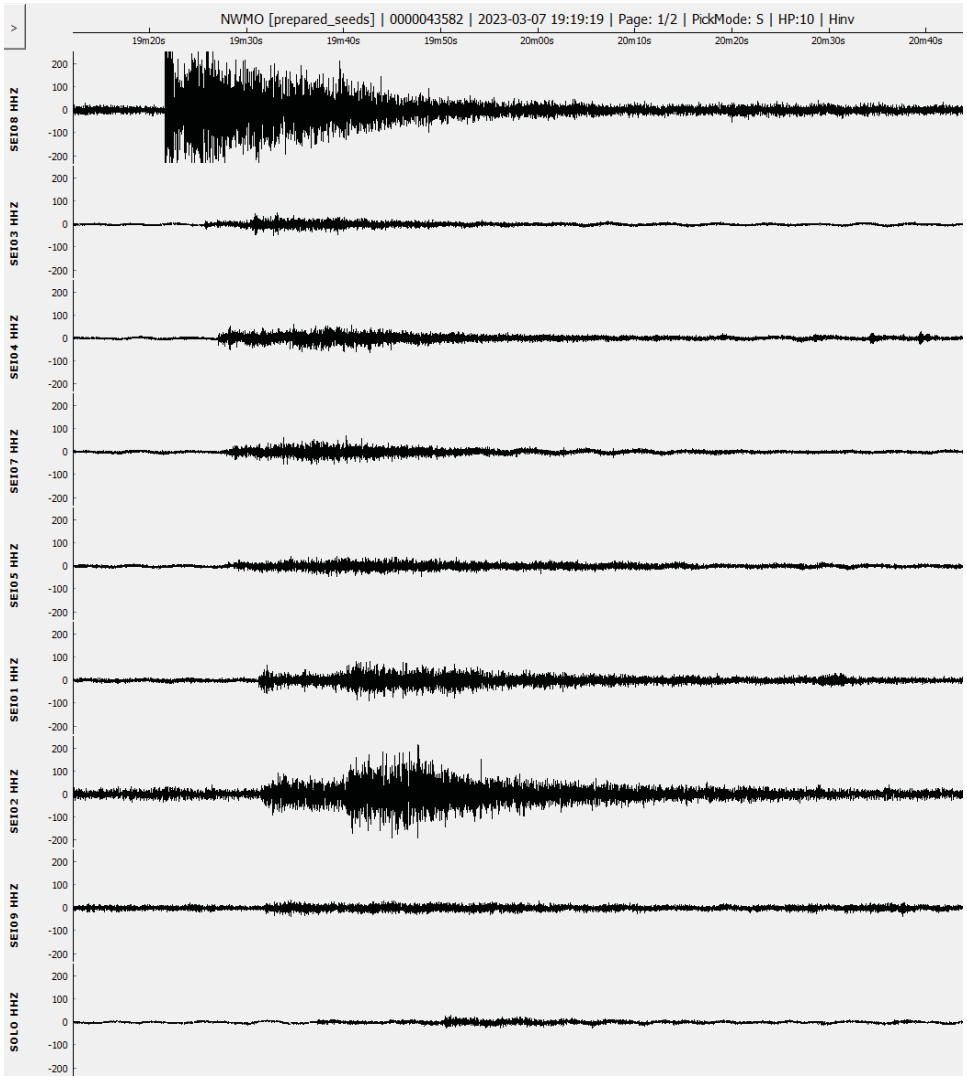
Manual event within NWMO area of interest

Date:	2023-02-08
Time:	22:21:20 UTC
Latitude:	49.224167
Longitude:	-91.979667
Depth:	2.35 km
Magnitude:	0.10 Ml



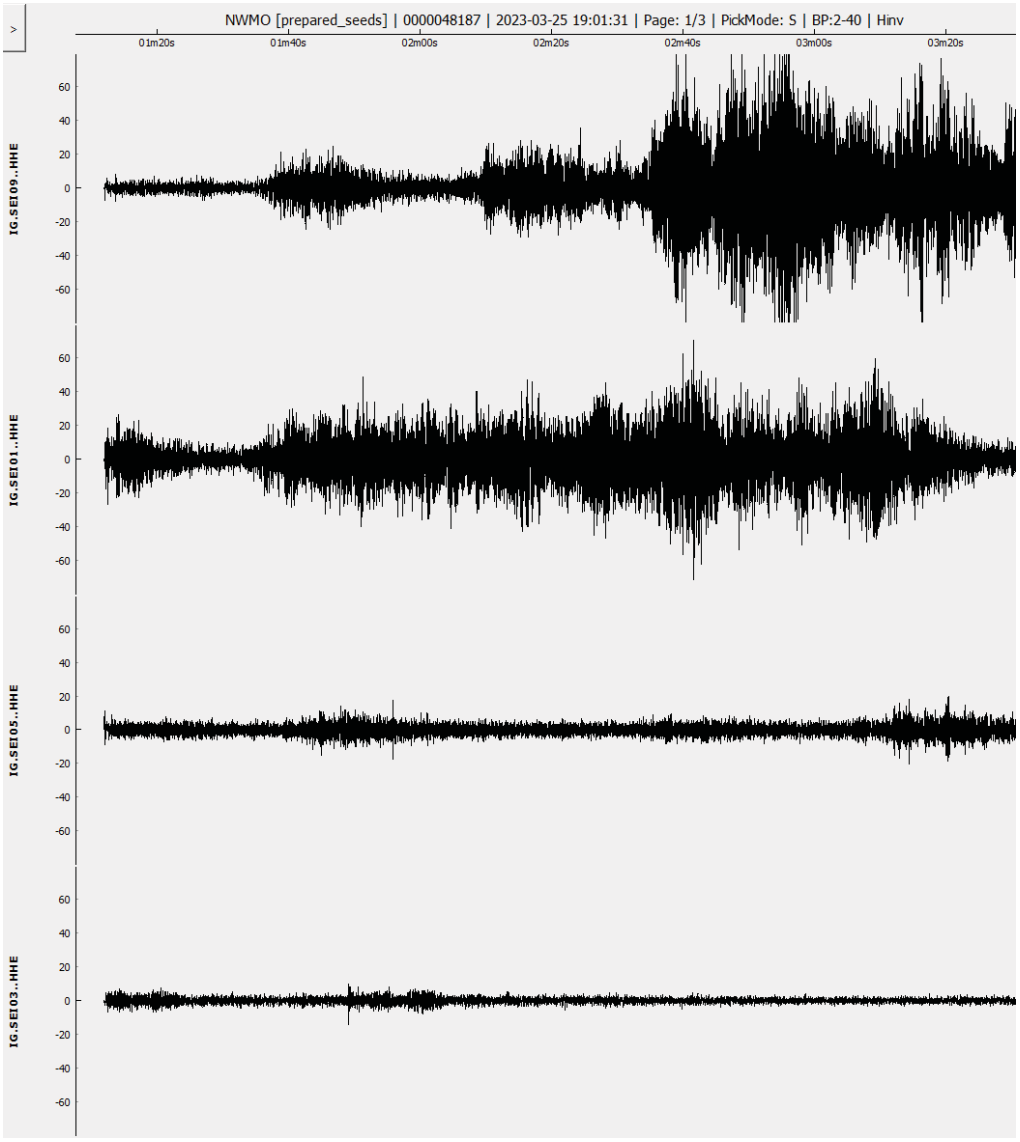
Manual event within NWMO area of interest

Date: 2023-03-07
Time: 19:19:19 UTC
Latitude: 49.0475
Longitude: -92.208
Depth: 11.63 km
Magnitude: 0.52 Ml



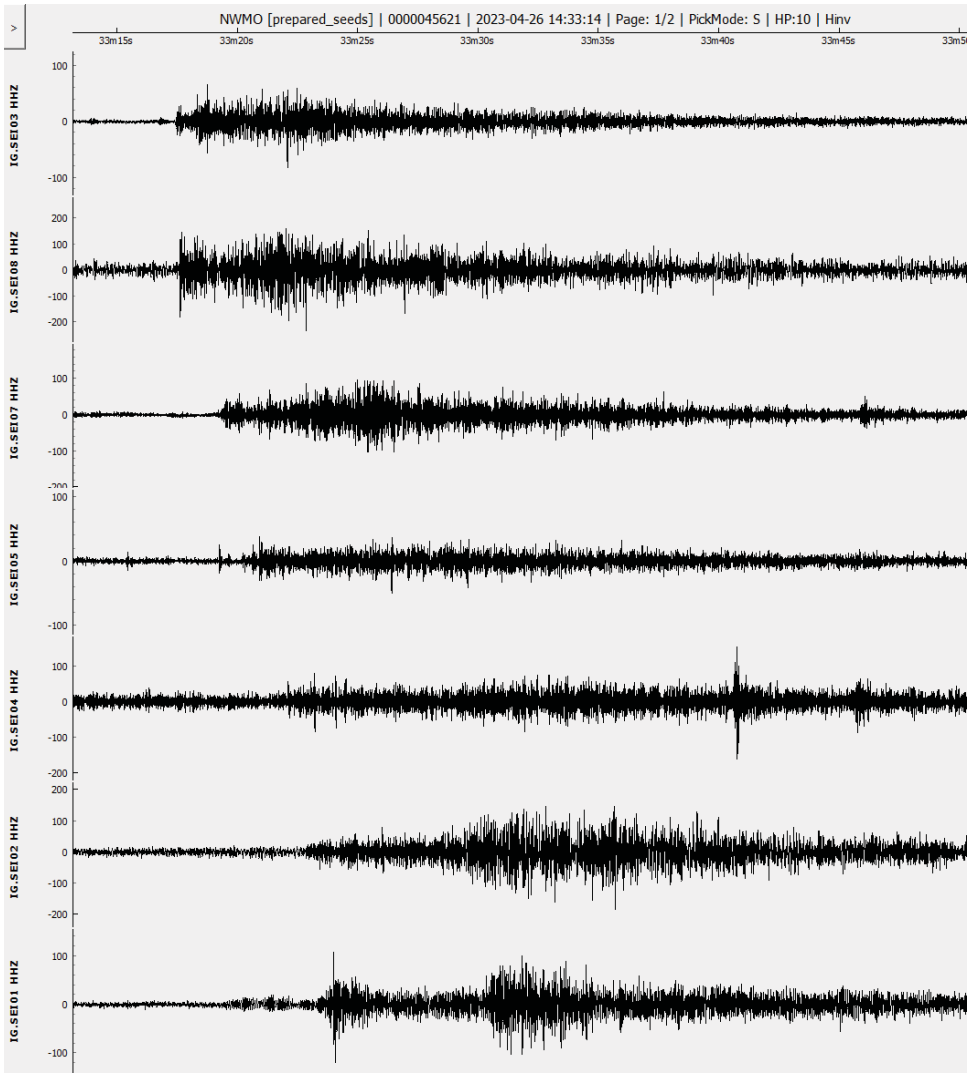
Manual event within NWMO area of interest

Date: 2023-03-25
Time: 19:01:31 UTC
Latitude: 49.8002
Longitude: -92.6602
Depth: 1.18 km
Magnitude: -0.22 Ml



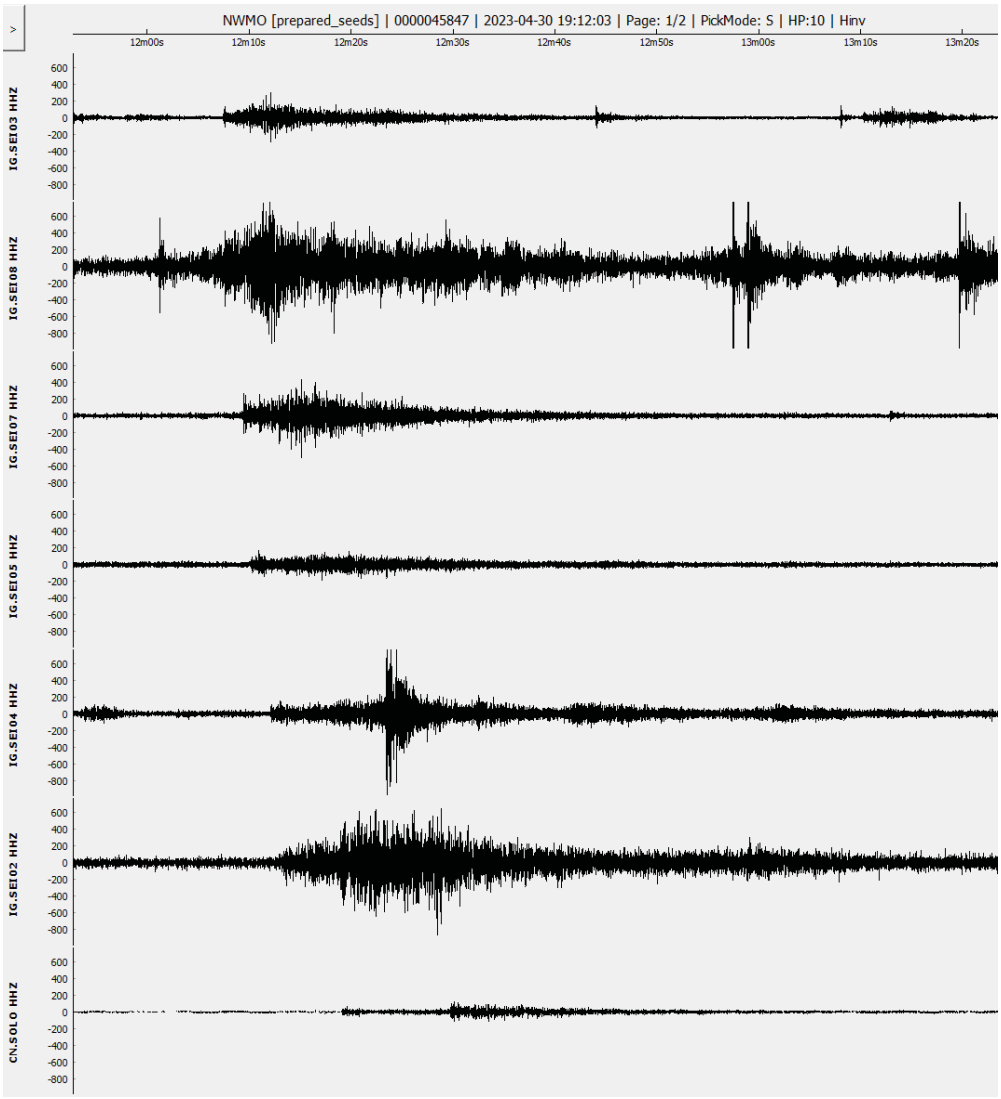
Manual event within NWMO area of interest

Date: 2023-04-26
Time: 14:33:14 UTC
Latitude: 49.2115
Longitude: -92.065833
Depth: 4.81 km
Magnitude: 0.47 Ml



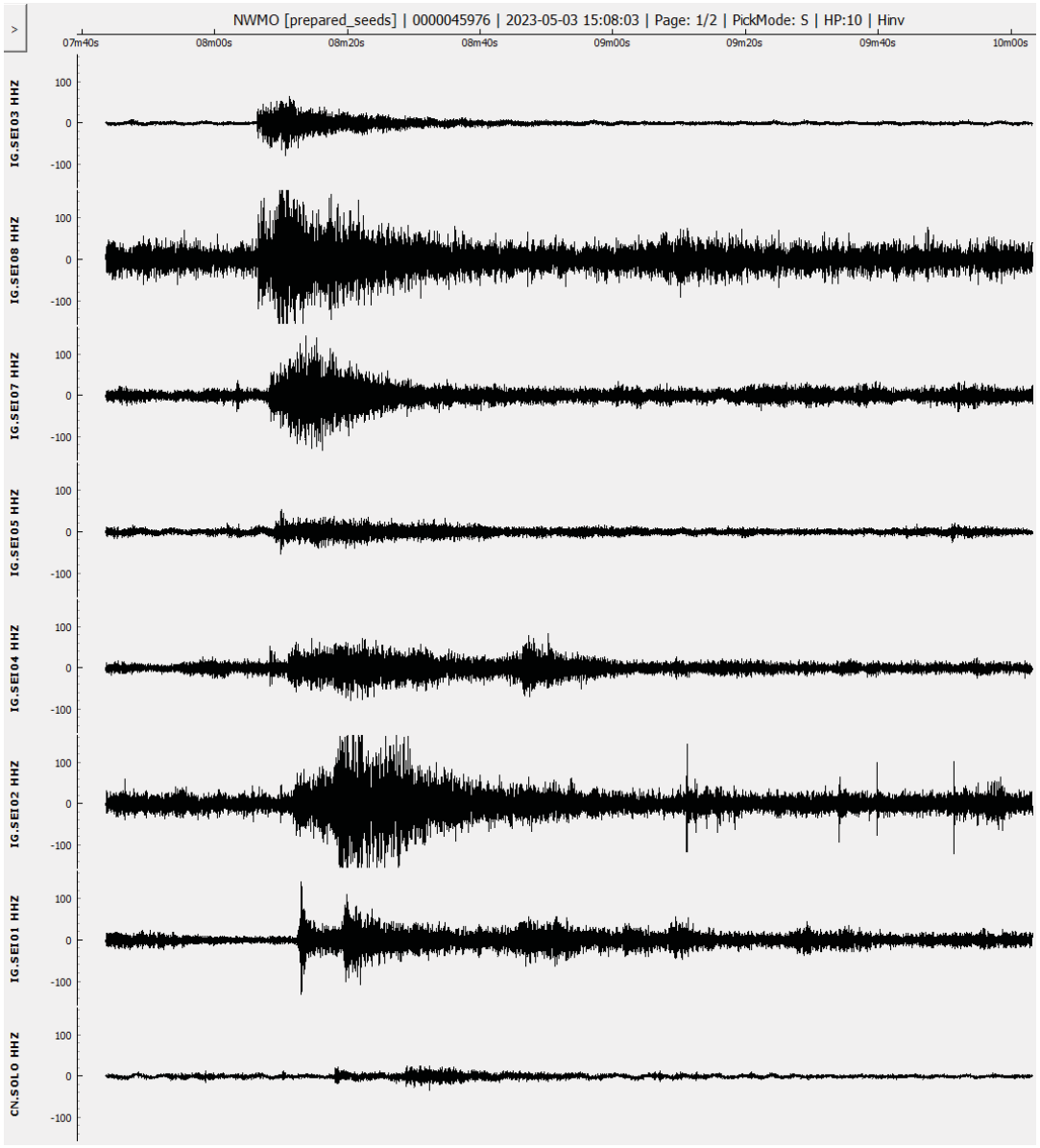
Manual event within NWMO area of interest

Date: 2023-04-30
Time: 19:12:03 UTC
Latitude: 49.193667
Longitude: -92.049333
Depth: 4.19km
Magnitude: 1.00 Ml



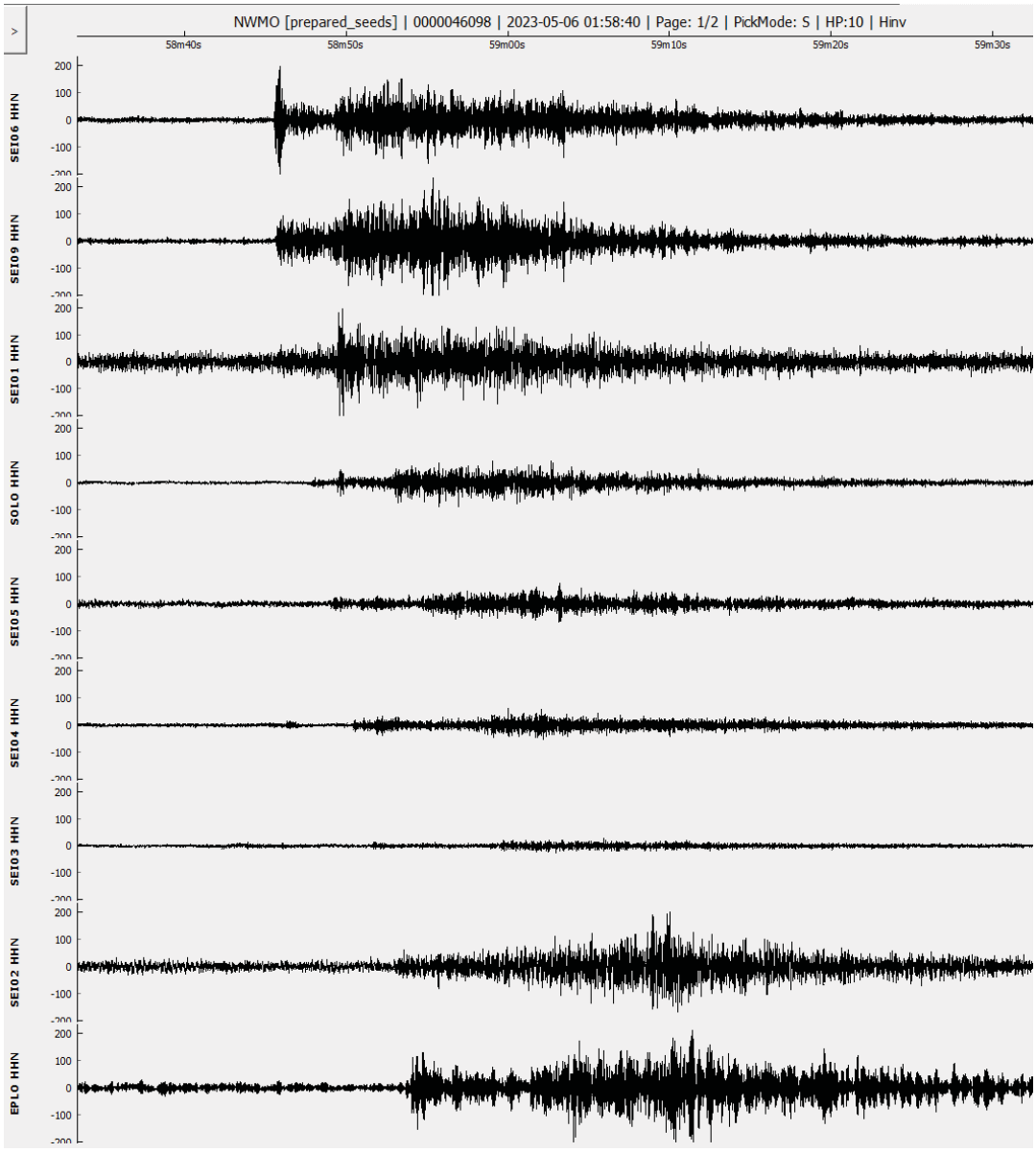
Manual event within NWMO area of interest

Date: 2023-05-03
Time: 15:08:03 UTC
Latitude: 49.213167
Longitude: -92.078167
Depth: 5.94 km
Magnitude: 0.48 Ml



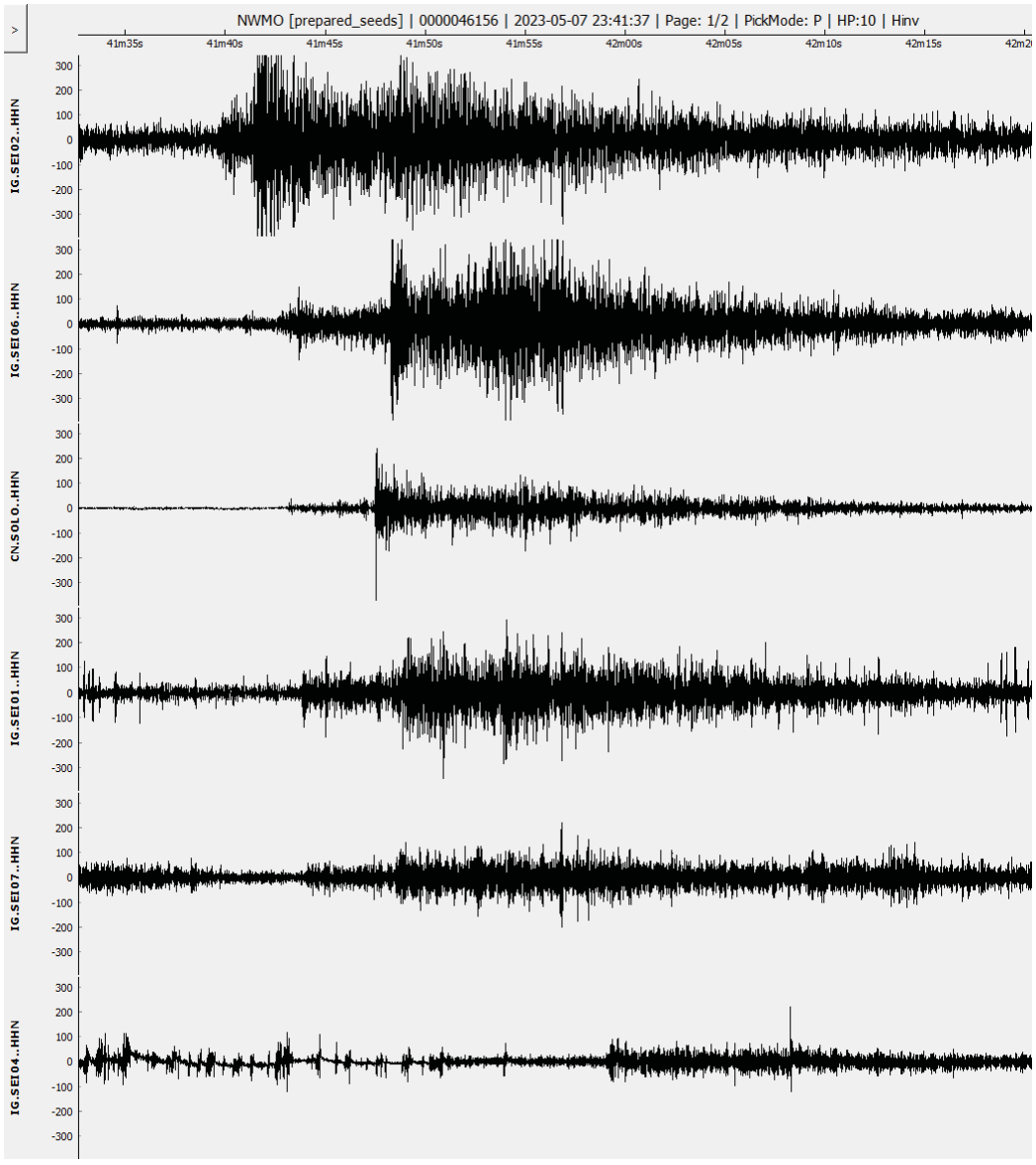
Manual event within NWMO area of interest

Date: 2023-05-06
Time: 01:58:40 UTC
Latitude: 49.872
Longitude: -92.6485
Depth: 2.33 km
Magnitude: 0.40 Ml



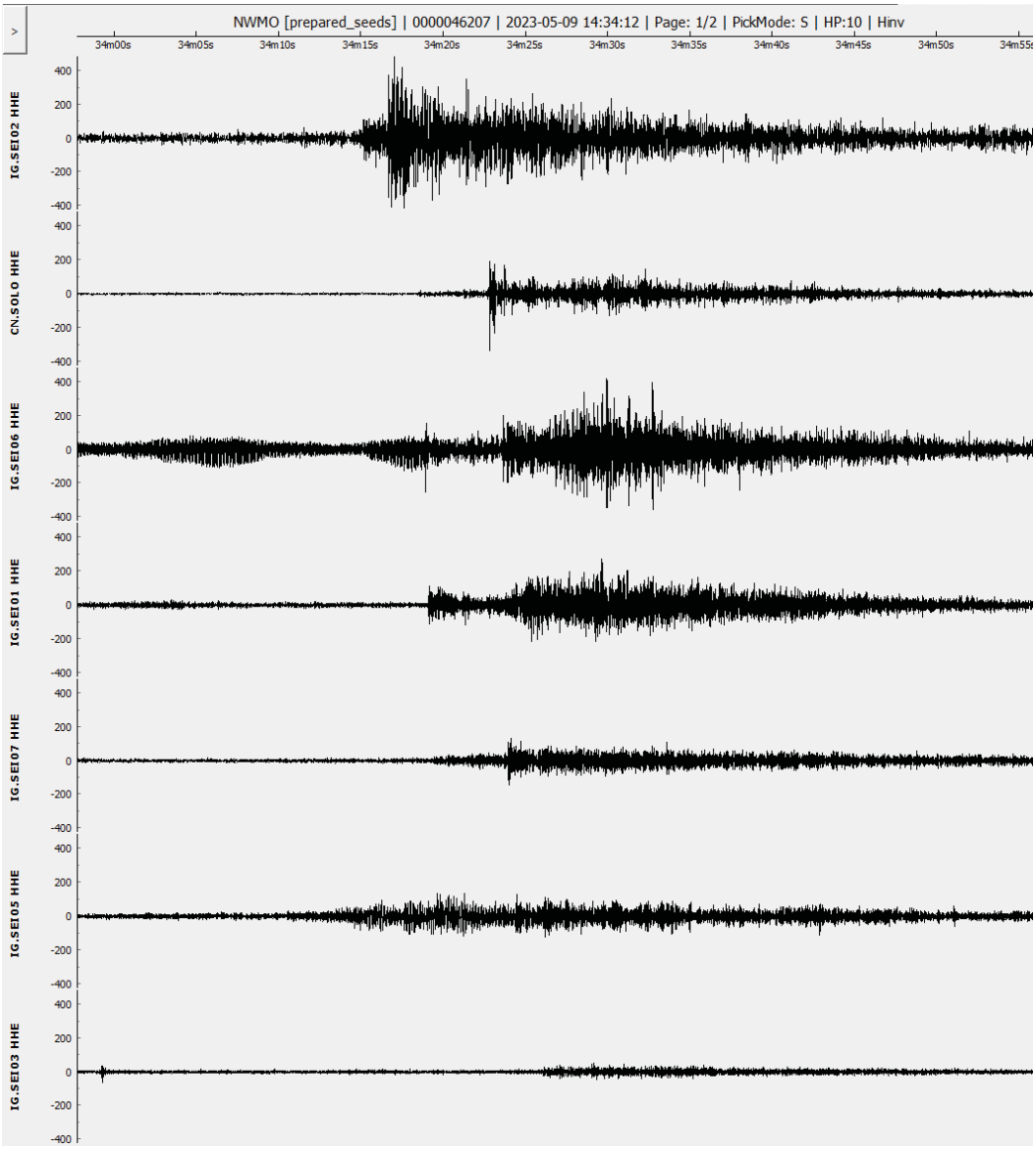
Manual event within NWMO area of interest

Date: 2023-05-07
Time: 23:41:37 UTC
Latitude: 49.742833
Longitude: -91.786
Depth: 2.04 km
Magnitude: 0.53 Ml



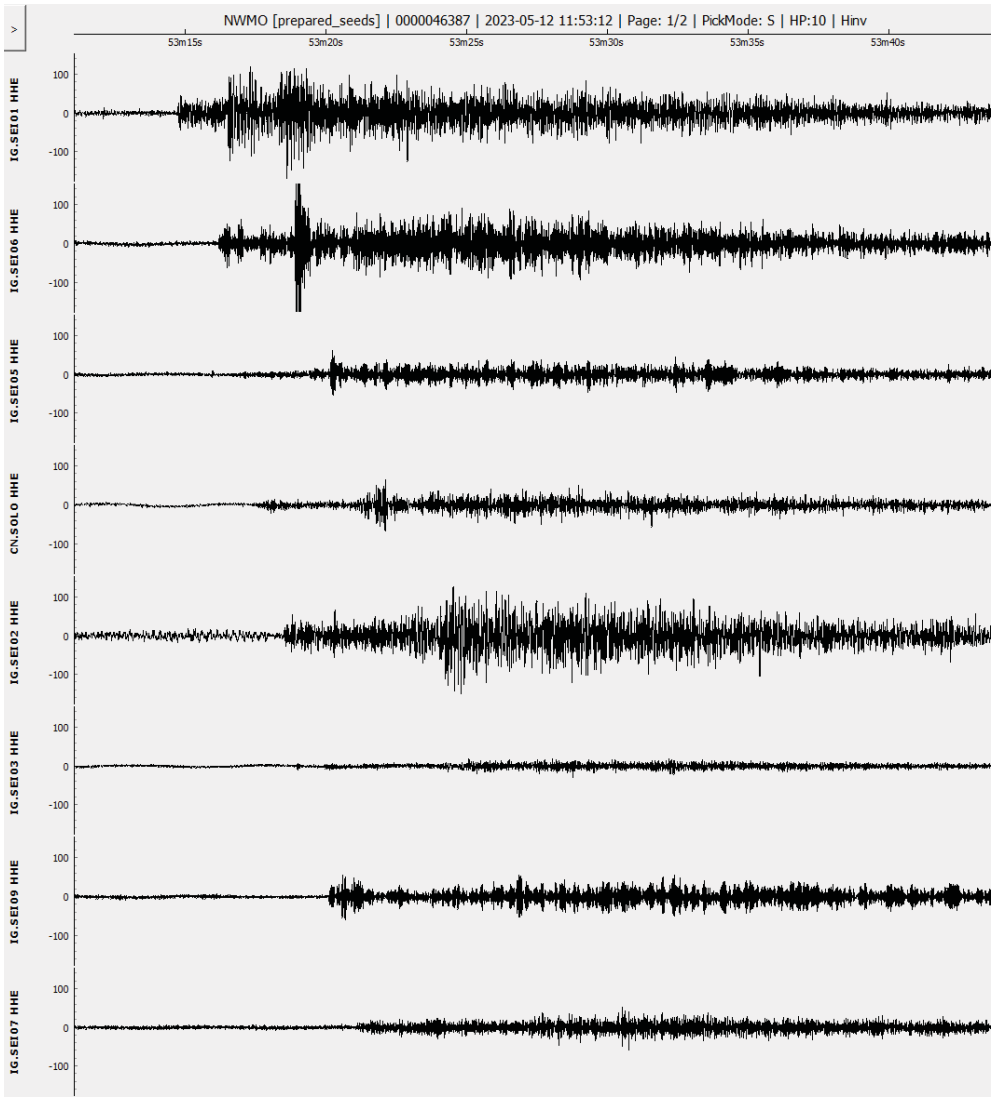
Manual event within NWMO area of interest

Date: 2023-05-09
Time: 14:34:12 UTC
Latitude: 49.740167
Longitude: -91.799
Depth: 3.37 km
Magnitude: 0.39 Ml



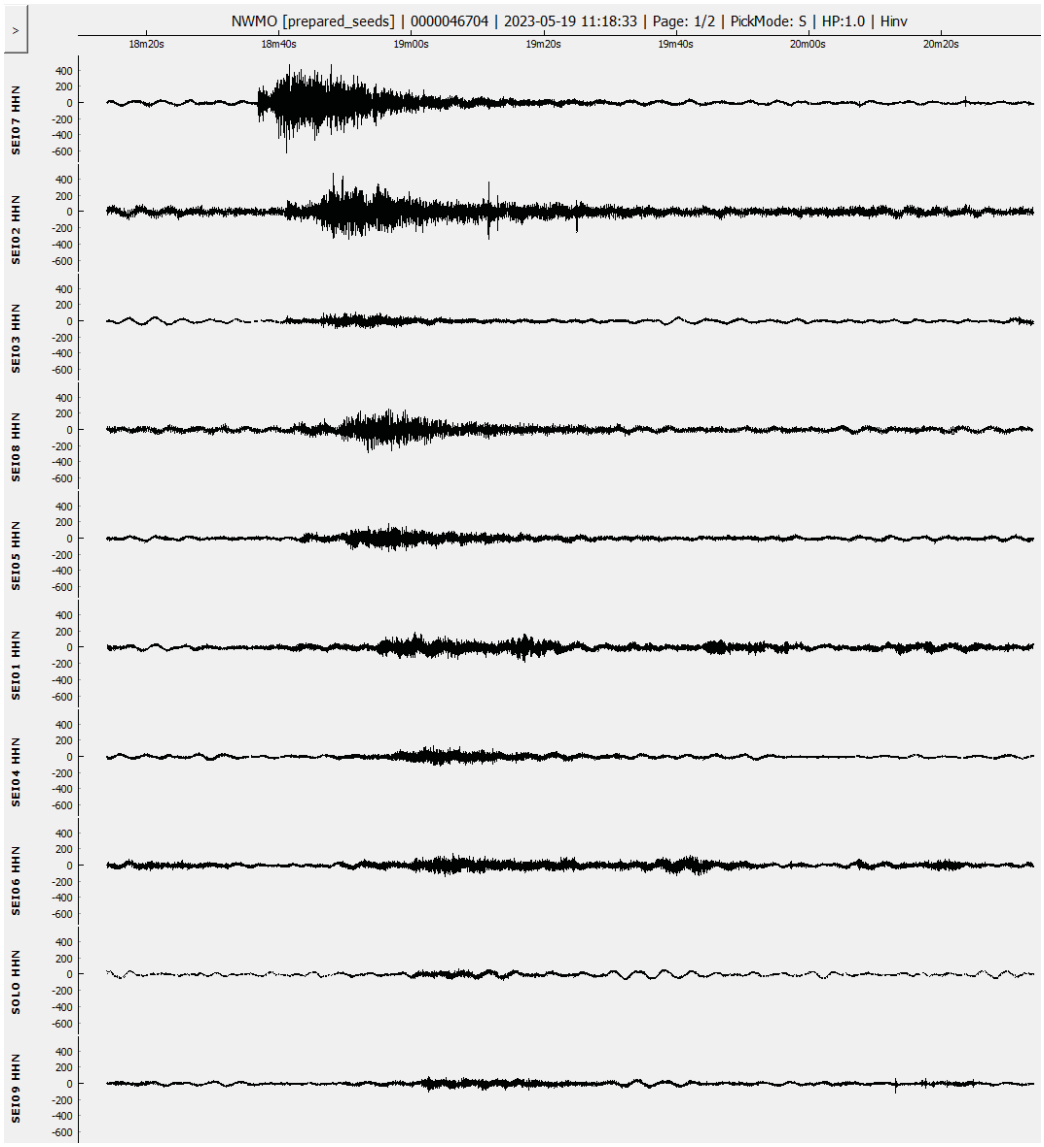
Manual event within NWMO area of interest

Date:	2023-05-12
Time:	11:53:12 UTC
Latitude:	49.748833
Longitude:	-92.194333
Depth:	4.05 km
Magnitude:	0.11 Ml



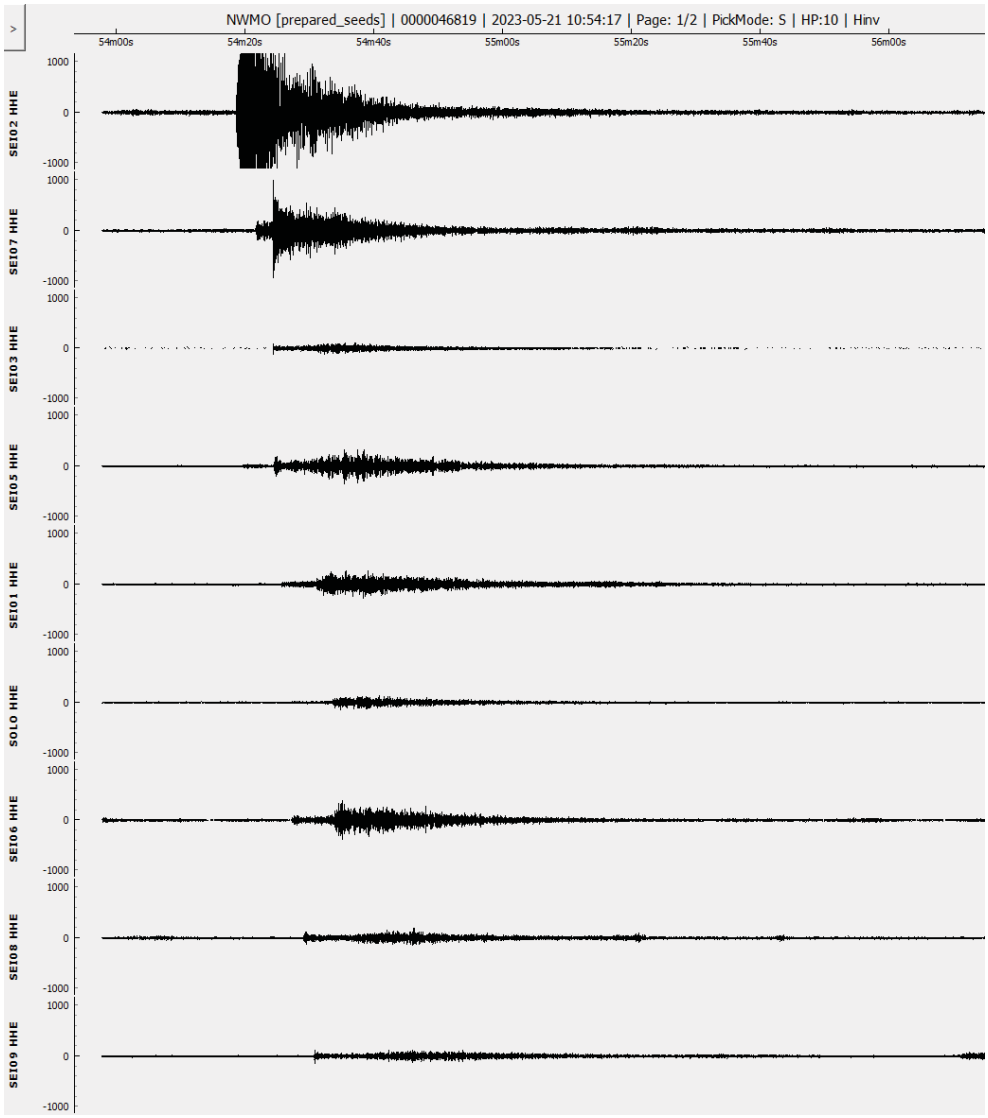
Manual event within NWMO area of interest

Date: 2023-05-19
Time: 11:18:33 UTC
Latitude: 49.238
Longitude: -91.600667
Depth: 7.76 km
Magnitude: 0.63 Ml



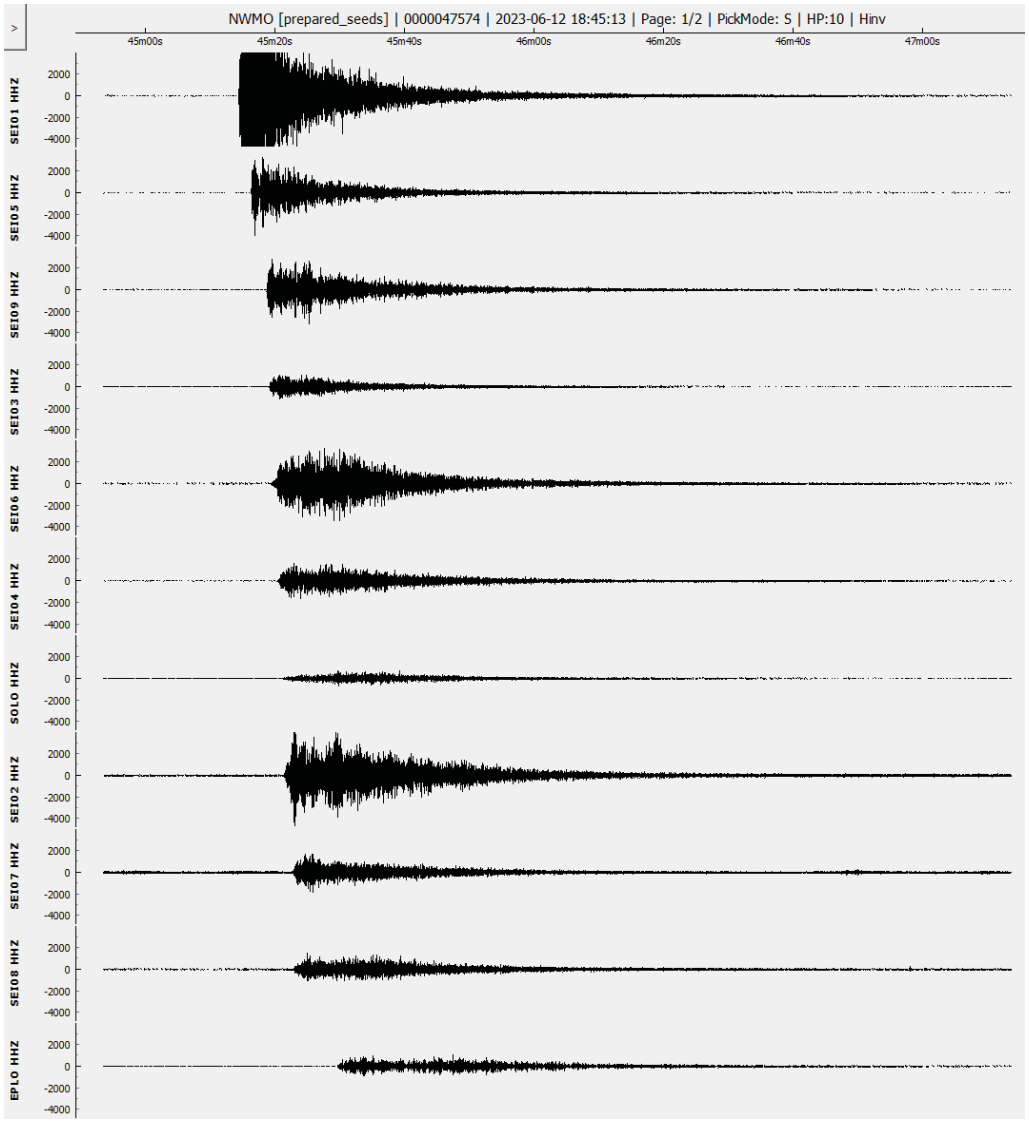
Manual event within NWMO area of interest

Date:	2023-05-21
Time:	10:54:17 UTC
Latitude:	49.577167
Longitude:	-91.7165
Depth:	2.00 km
Magnitude:	0.60 Ml



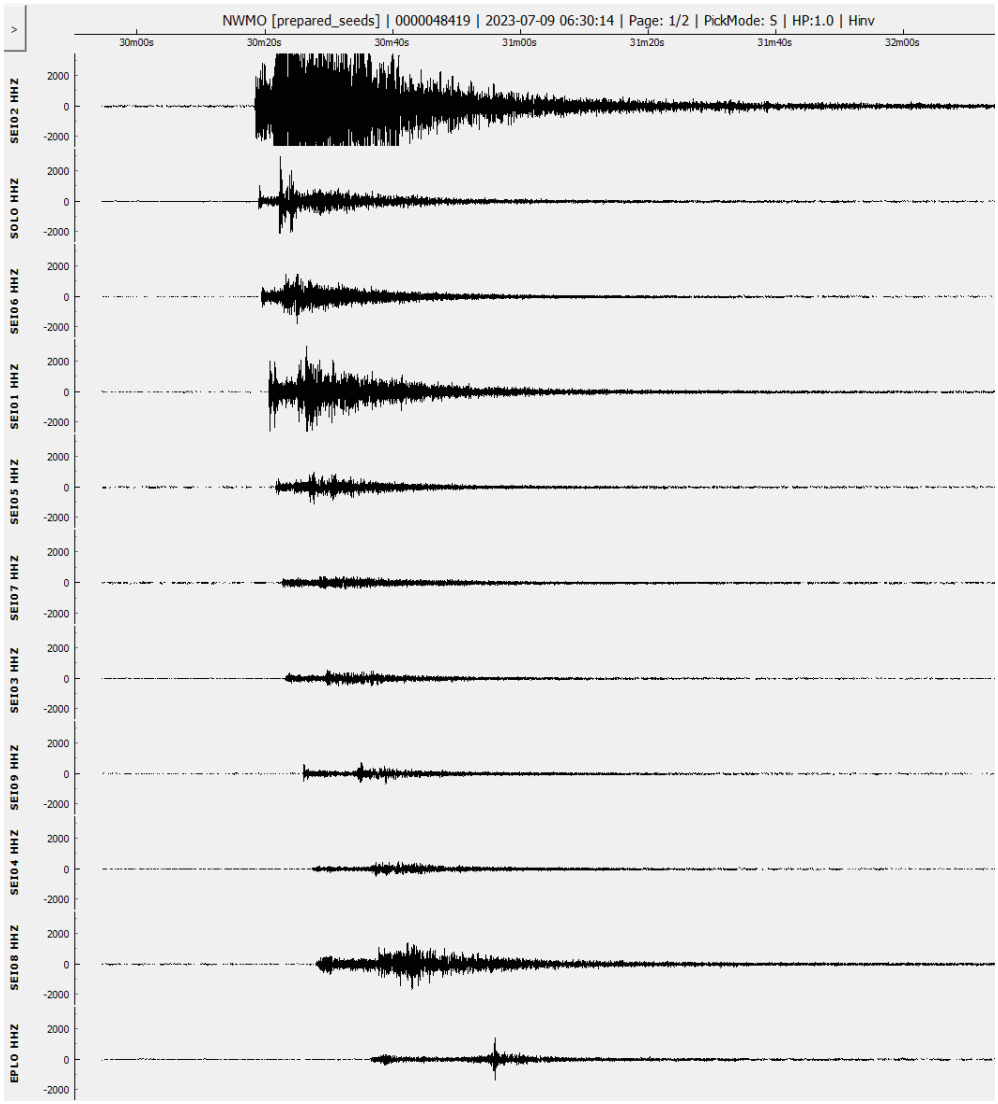
Manual event within NWMO area of interest

Date:	2023-06-12
Time:	18:45:13 UTC
Latitude:	49.6378
Longitude:	-92.3763
Depth:	1.43 km
Magnitude:	1.42 Ml
Source:	Quarry Blast



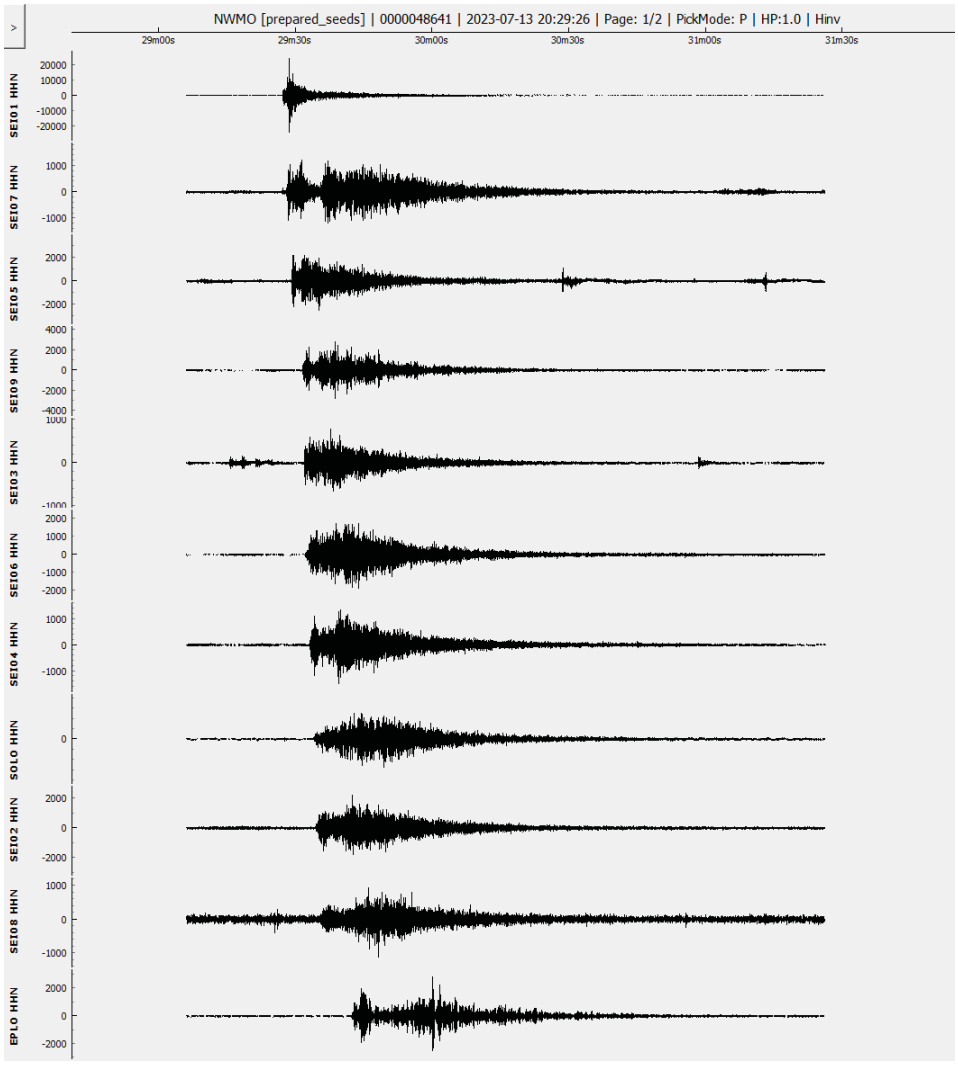
Quarry blast within NWMO area of interest

Date:	2023-07-09
Time:	06:30:14 UTC
Latitude:	49.808
Longitude:	-91.8755
Depth:	2.90 km
Magnitude:	2.14 Ml



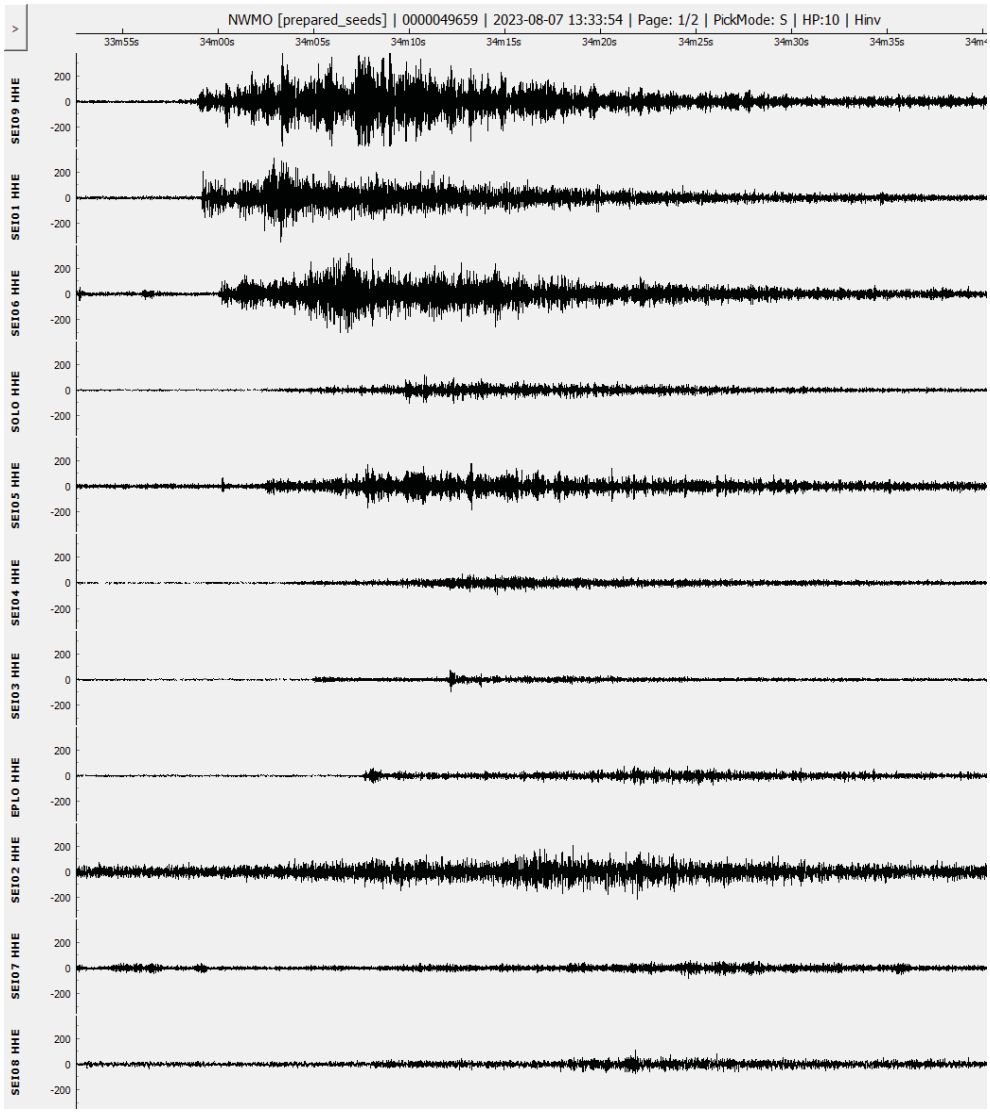
Manual event within NWMO area of interest

Date:	2023-07-13
Time:	20:29:26 UTC
Latitude:	49.641333
Longitude:	-92.375167
Depth:	5.71 km
Magnitude:	1.43 Ml
Source:	Quarry Blast



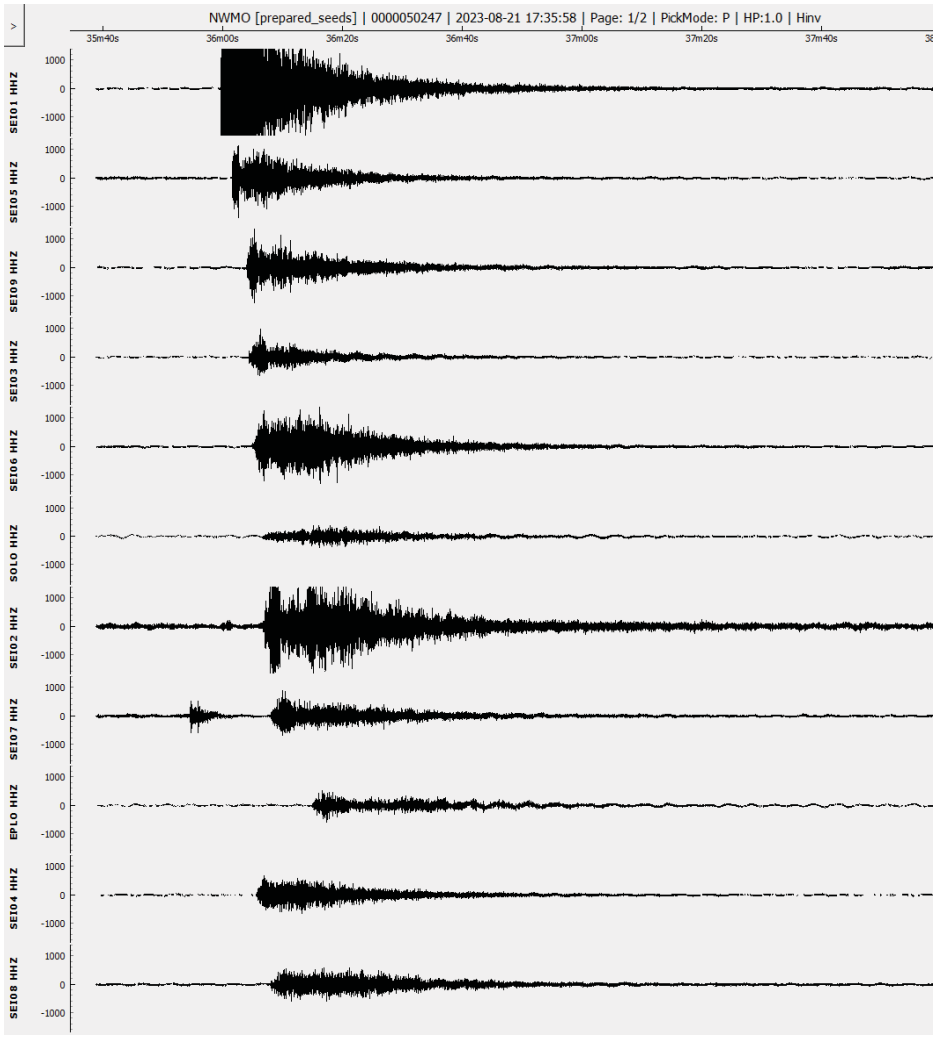
Quarry blast within NWMO area of interest

Date:	2023-08-07
Time:	13:33:54 UTC
Latitude:	49.809667
Longitude:	-92.660833
Depth:	1.69 km
Magnitude:	0.31 Ml



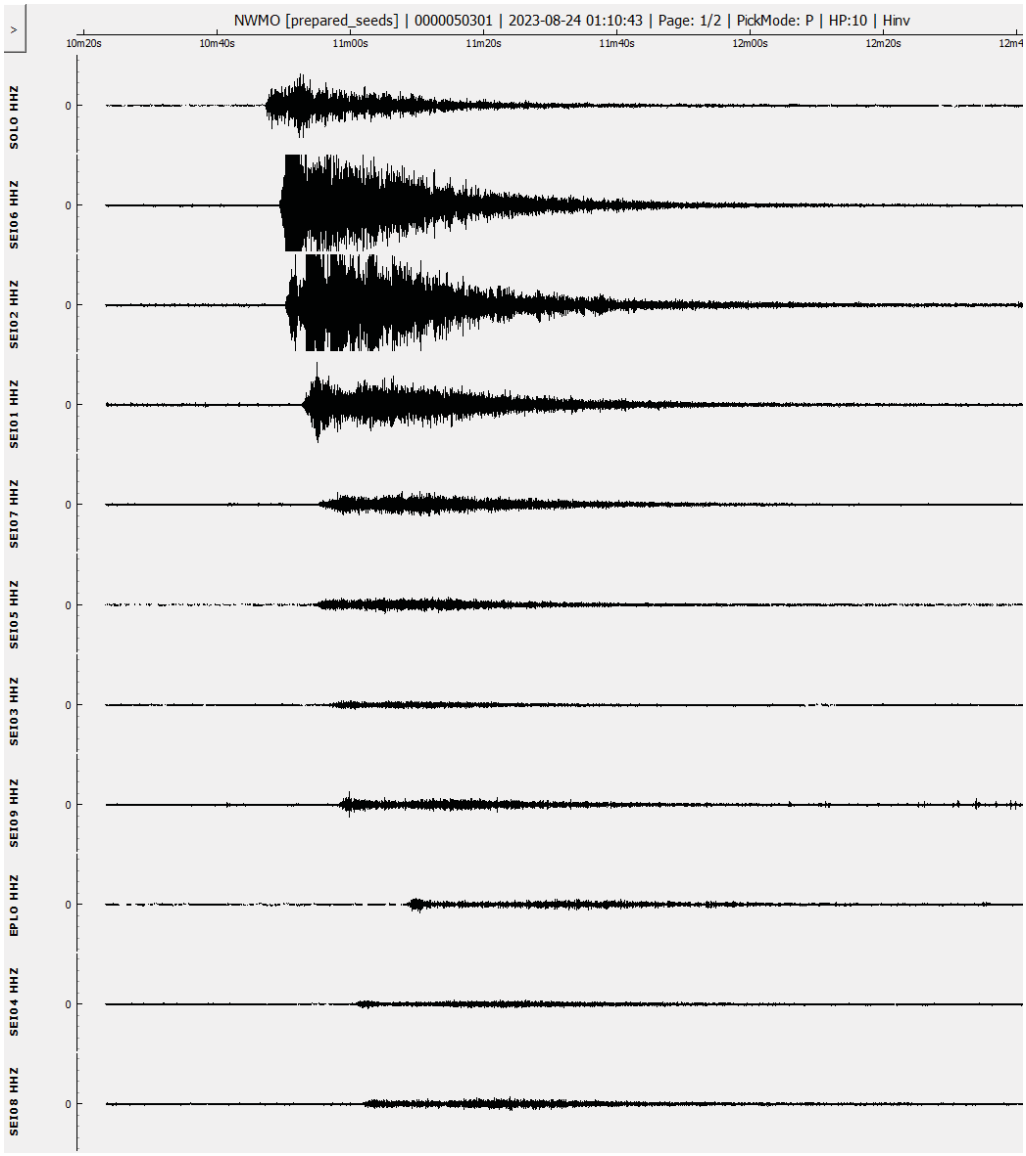
Manual event within NWMO area of interest

Date:	2023-08-21
Time:	17:35:58 UTC
Latitude:	49.6397
Longitude:	-92.3768
Depth:	0.17 km
Magnitude:	0.95 Ml
Source:	Quarry Blast



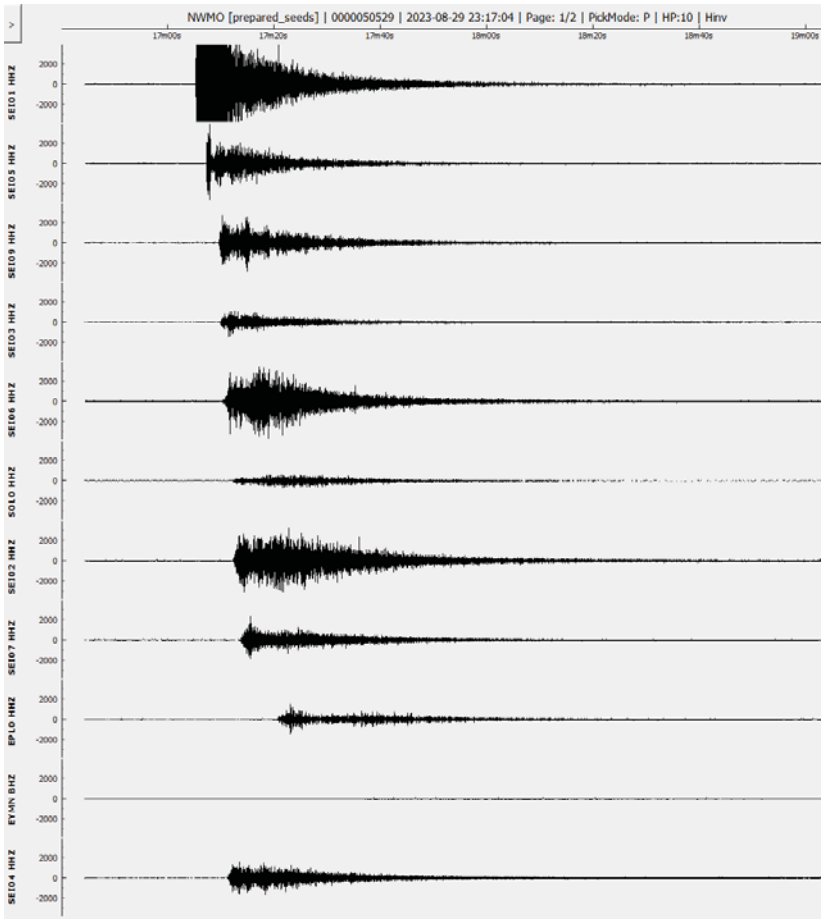
Quarry blast within NWMO area of interest

Date: 2023-08-24
Time: 01:10:43 UTC
Latitude: 50.001667
Longitude: -91.711667
Depth: 5.16 km
Magnitude: 0.74 Ml



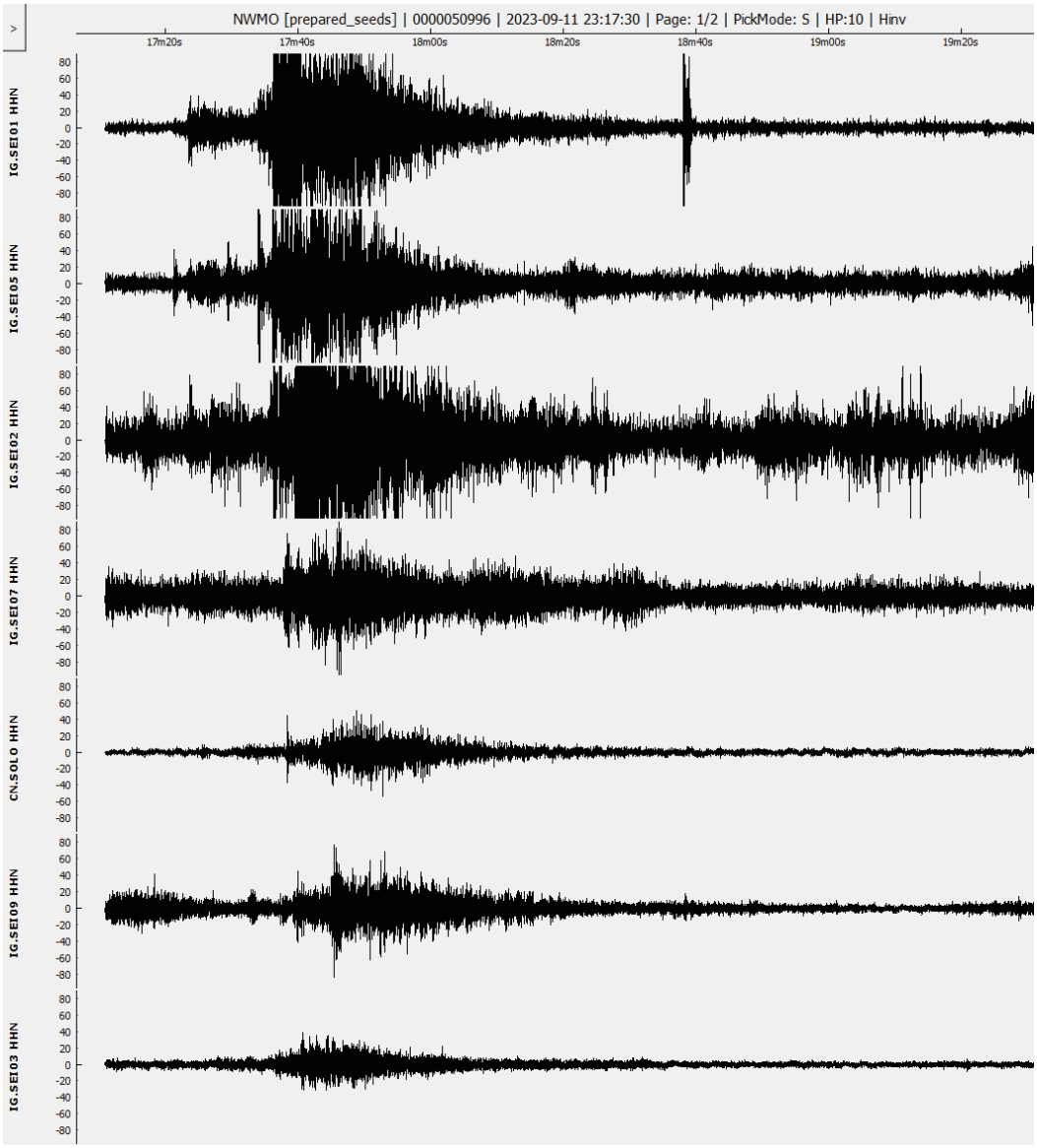
Manual event within NWMO area of interest

Date:	2023-08-29
Time:	23:17:04 UTC
Latitude:	49.6400
Longitude:	-92.3718
Depth:	1.75 km
Magnitude:	1.58 Ml
Source:	Quarry Blast



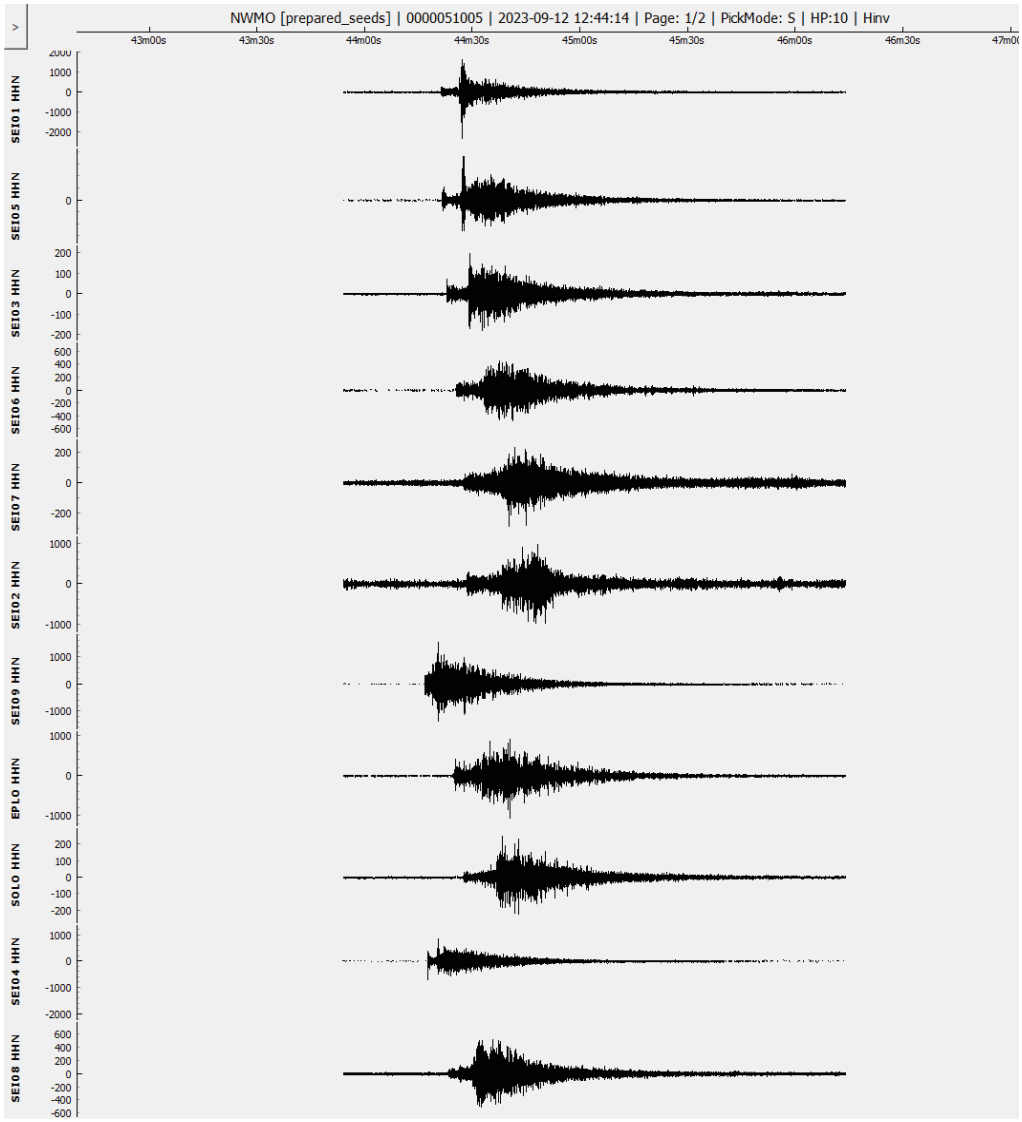
Quarry blast within NWMO area of interest

Date: 2023-09-11
Time: 23:17:30 UTC
Latitude: 49.628
Longitude: -92.126333
Depth: 6.76 km
Magnitude: 0.30 Ml



Manual event within NWMO area of interest

Date:	2023-09-12
Time:	12:44:14 UTC
Latitude:	49.488833
Longitude:	-92.871167
Depth:	6.74 km
Magnitude:	0.94 Ml



Manual event within NWMO area of interest

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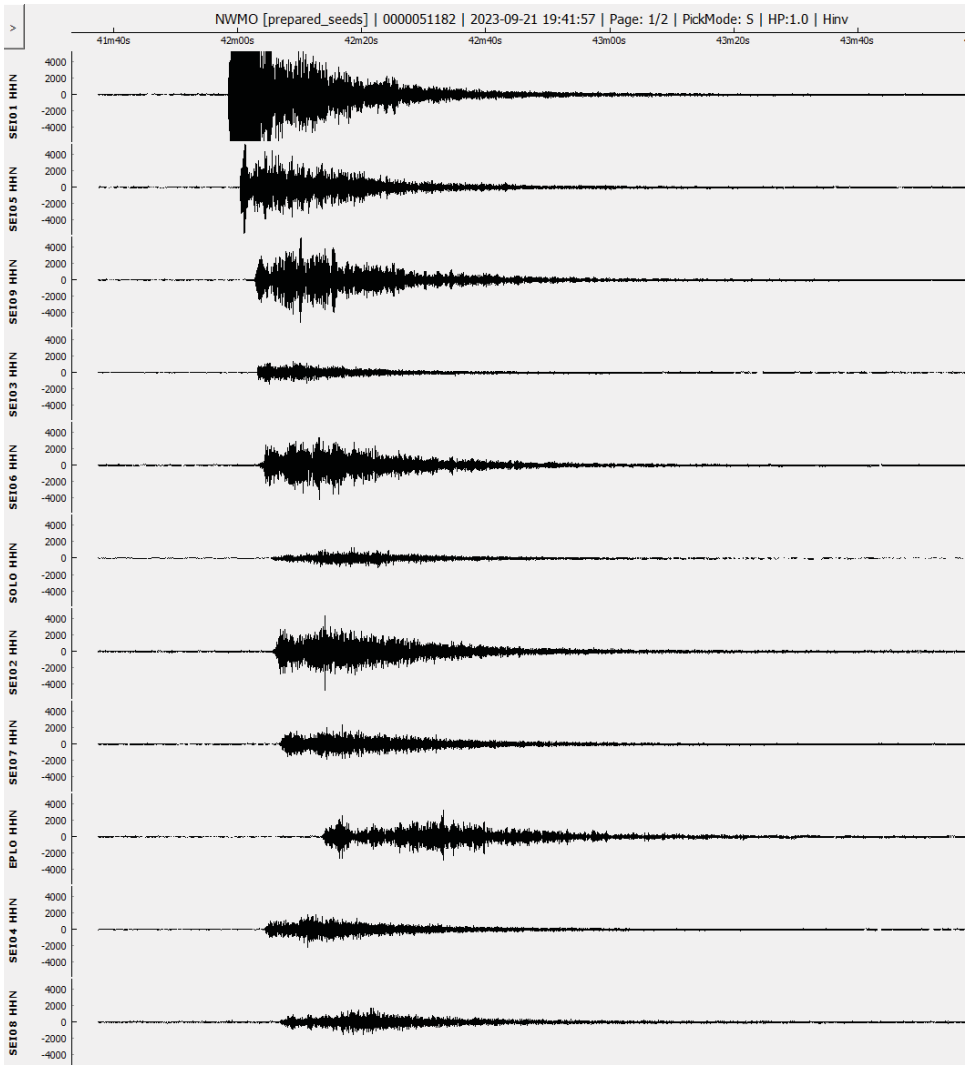
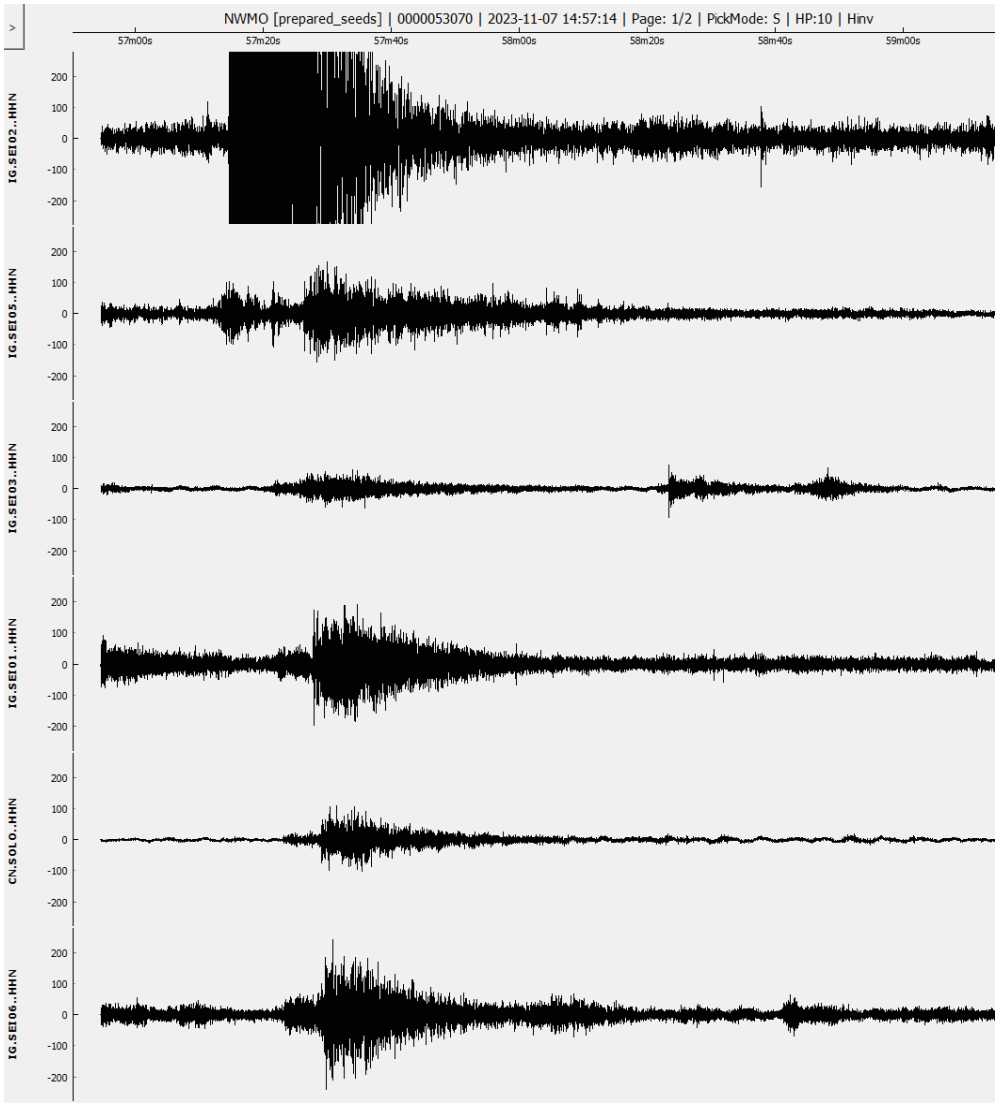
Date:	2023-09-21
Time:	19:41:57 UTC
Latitude:	49.632833
Longitude:	-92.374167
Depth:	6.44 km
Magnitude:	1.36 Ml
Source:	Quarry Blast



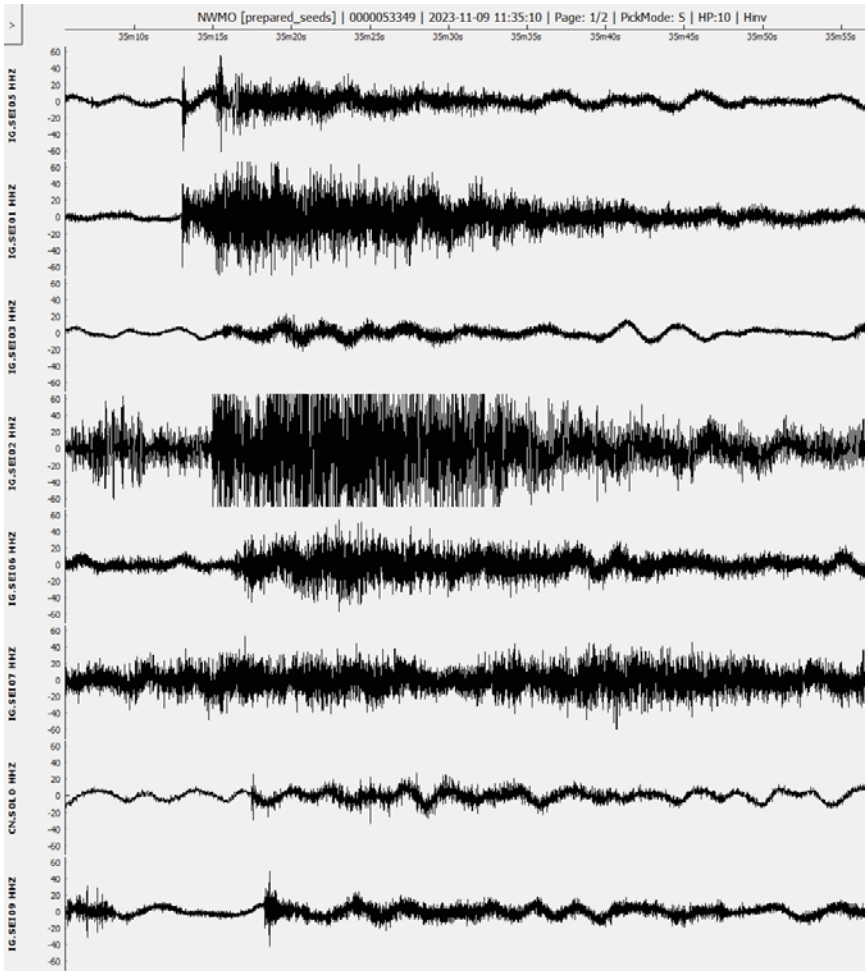
Quarry blast within NWMO area of interest

Date: 2023-11-07
Time: 14:57:14 UTC
Latitude: 49.624667
Longitude: -91.715167
Depth: 1.26km
Magnitude: 0.59Ml



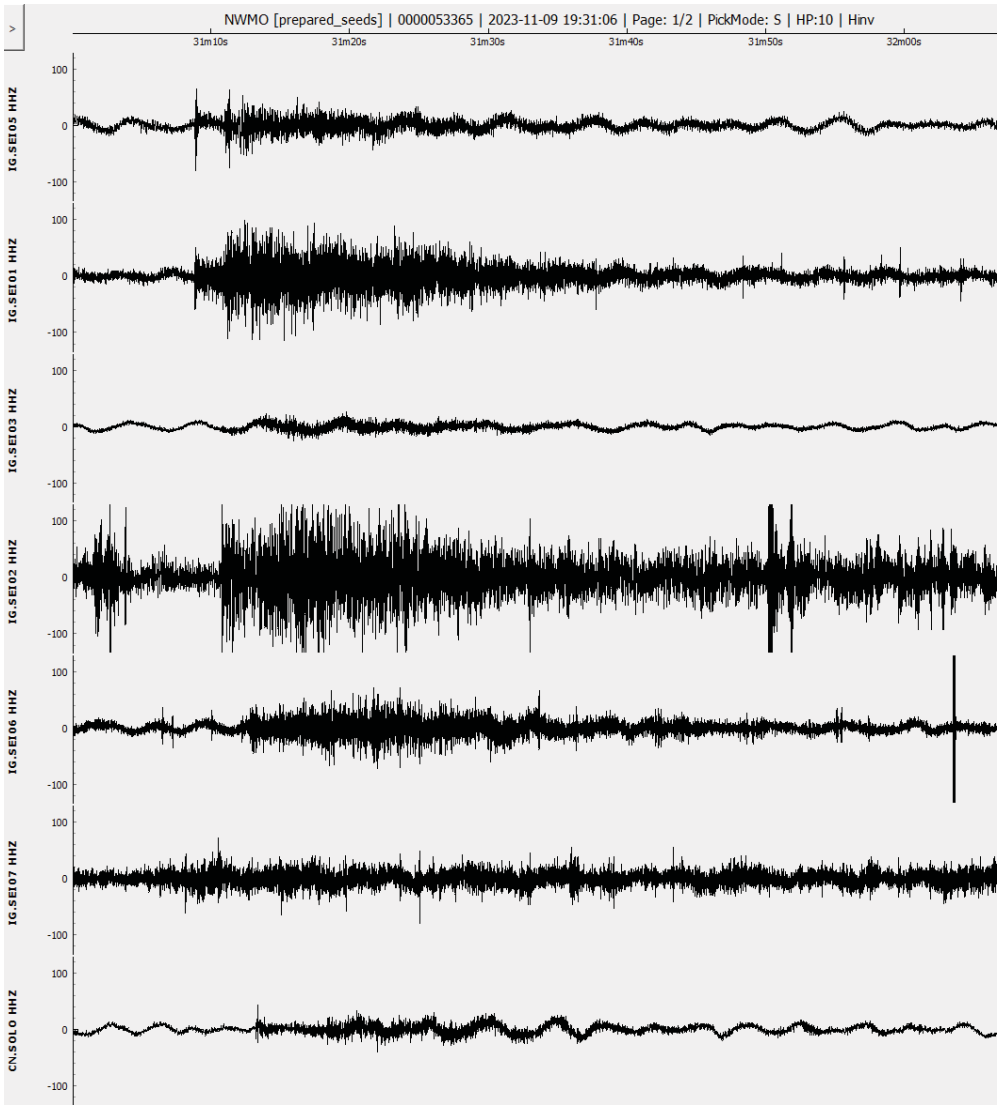
Manual event within NWMO area of interest

Date: 2023-11-09
Time: 11:35:10 UTC
Latitude: 49.625667
Longitude: -92.1175
Depth: 5.08 km
Magnitude: 0.29 Ml



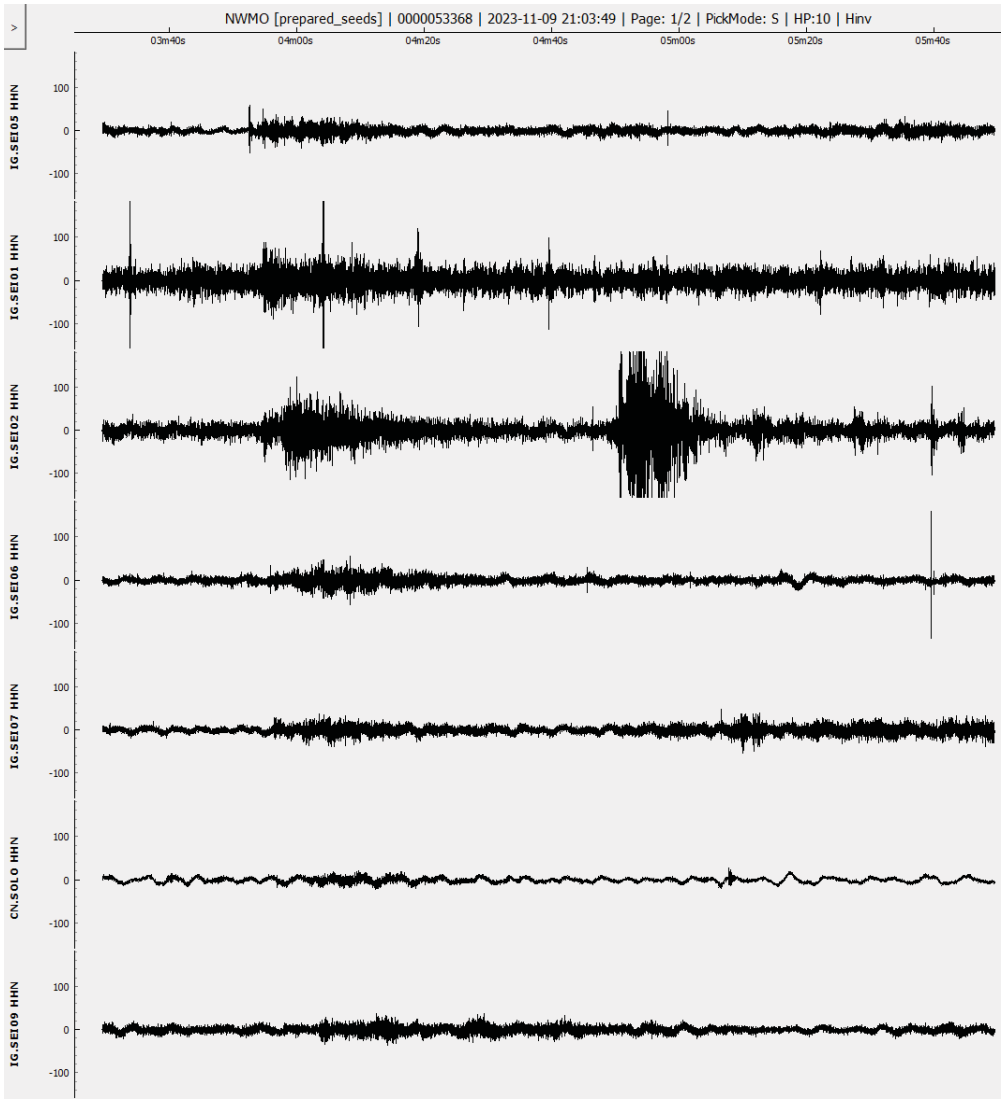
Manual event within NWMO area of interest

Date:	2023-11-09
Time:	19:31:06 UTC
Latitude:	49.6285
Longitude:	-92.112833
Depth:	1.01 km
Magnitude:	0.33 Ml



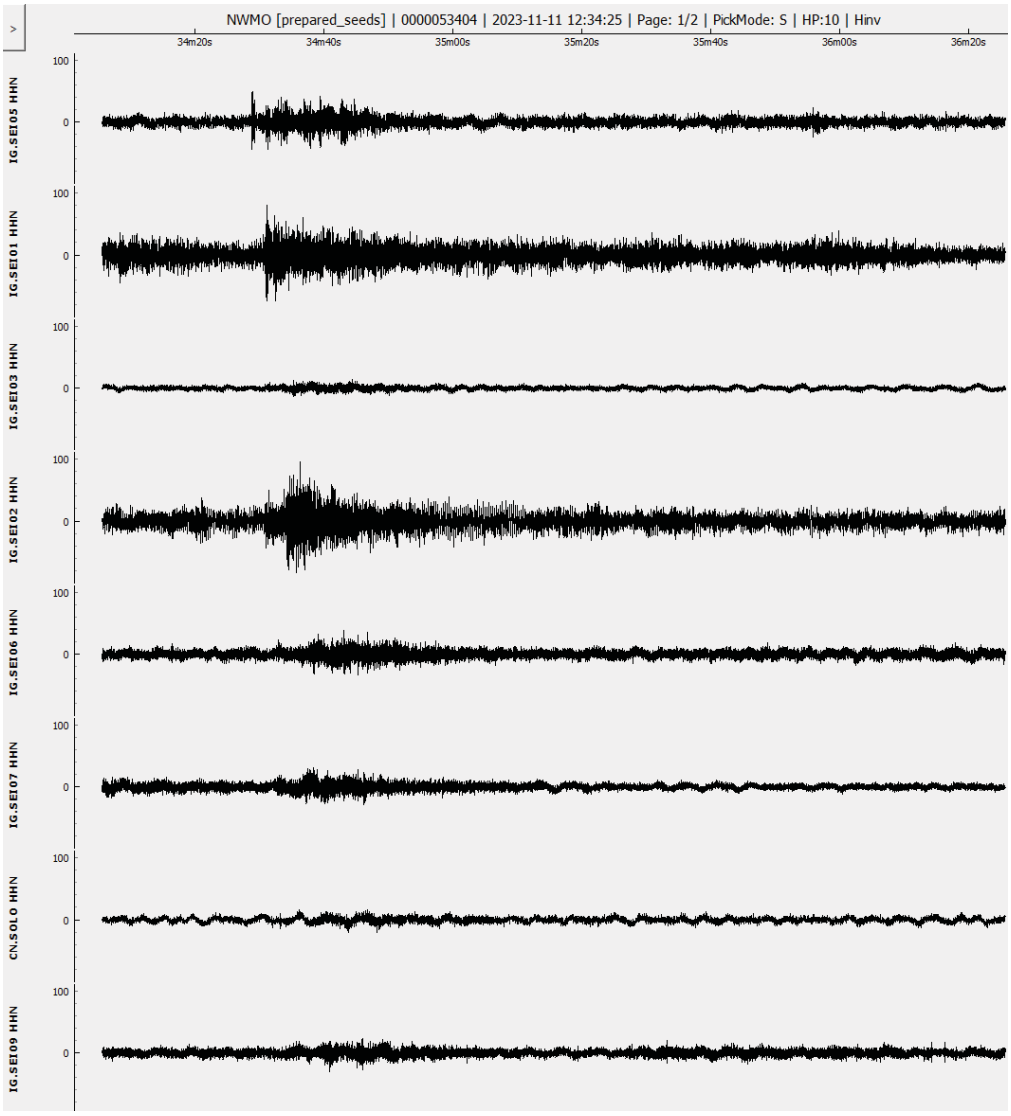
Manual event within NWMO area of interest

Date:	2023-11-09
Time:	21:03:49 UTC
Latitude:	49.628333
Longitude:	-92.118833
Depth:	6.19 km
Magnitude:	0.24 Ml



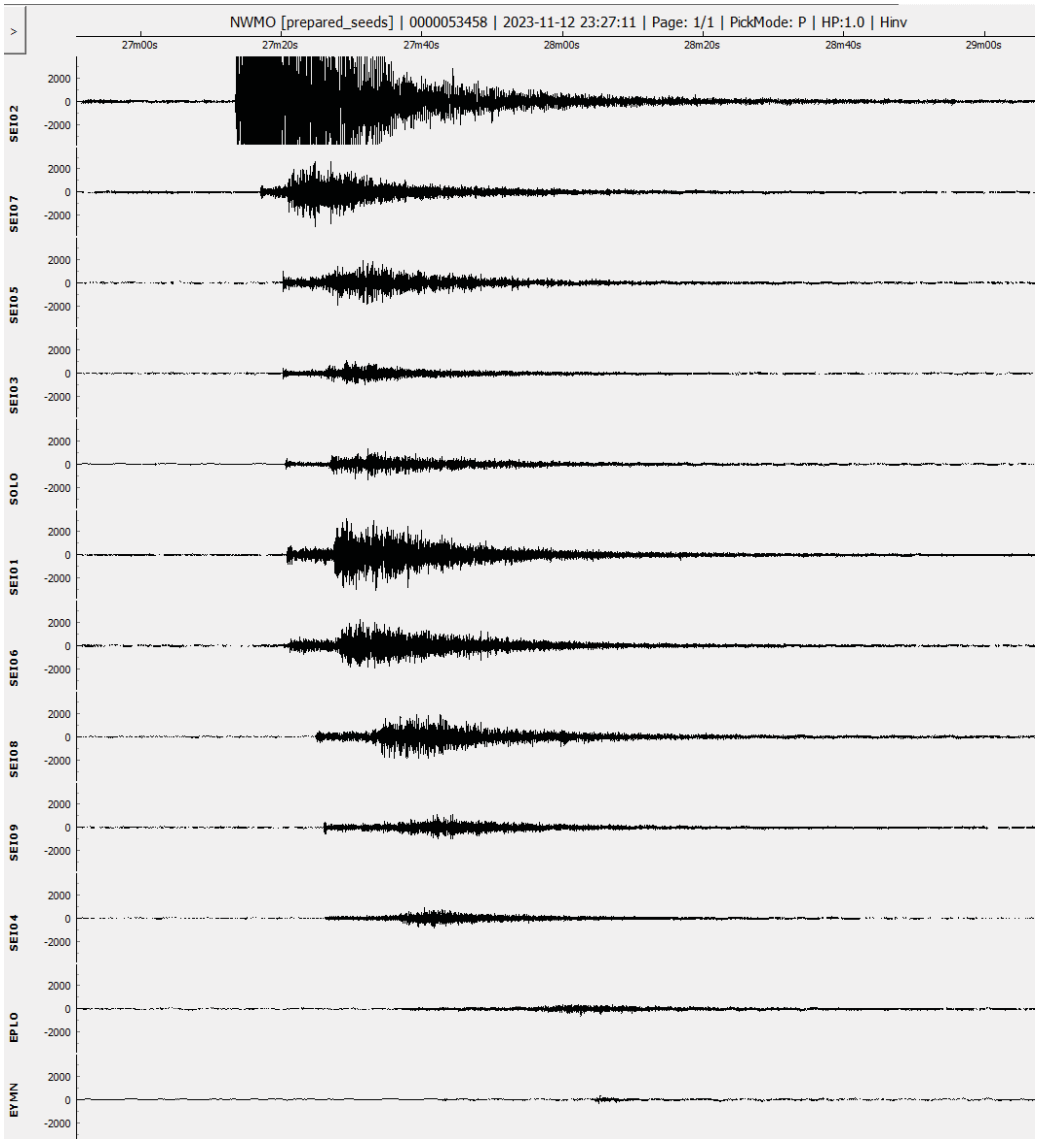
Manual event within NWMO area of interest

Date: 2023-11-11
Time: 12:34:25 UTC
Latitude: 49.633333
Longitude: -92.120667
Depth: 6.86 km
Magnitude: 0.22 Ml



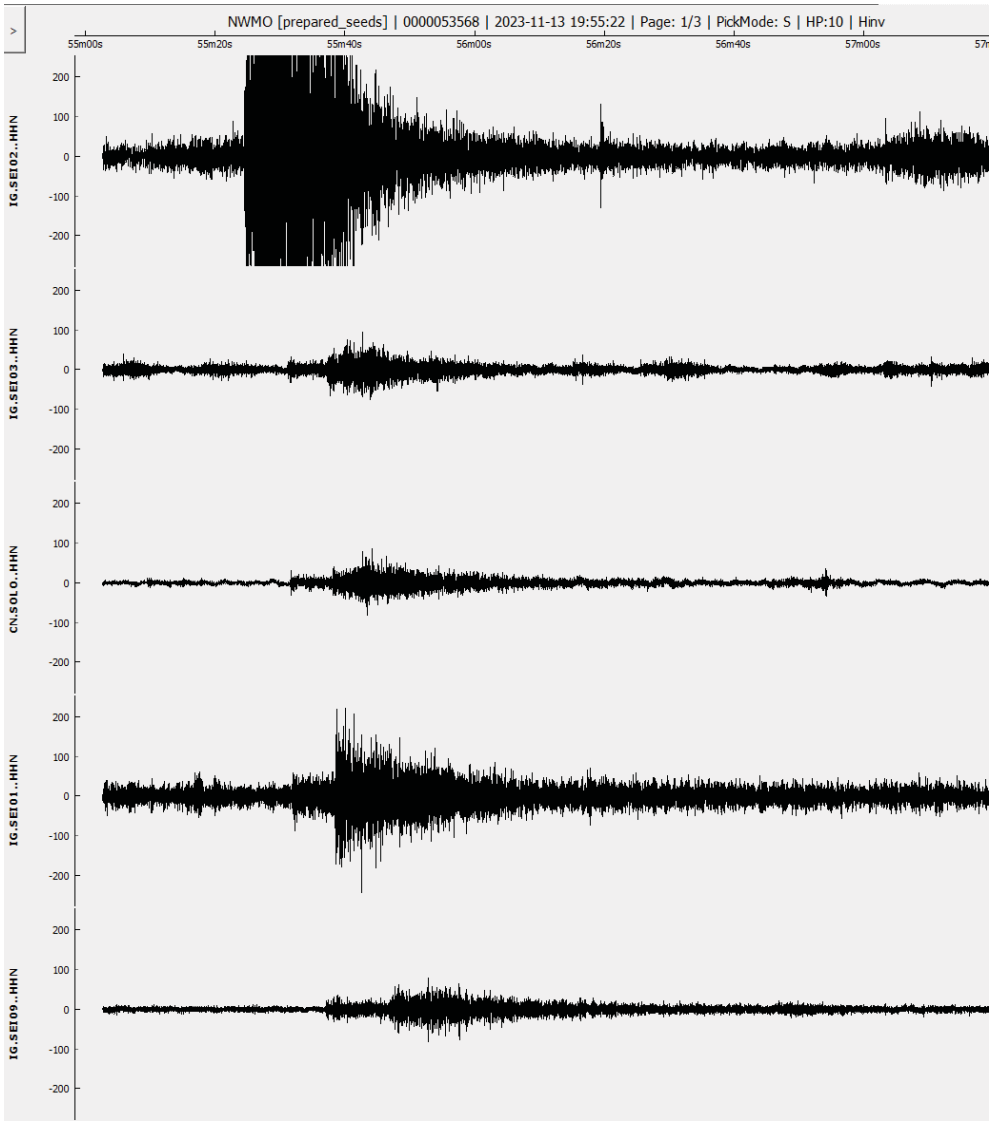
Manual event within NWMO area of interest

Date: 2023-11-12
Time: 23:27:11 UTC
Latitude: 49.654
Longitude: -91.5721x1
Depth: 4.76 km
Magnitude: 1.63 Ml



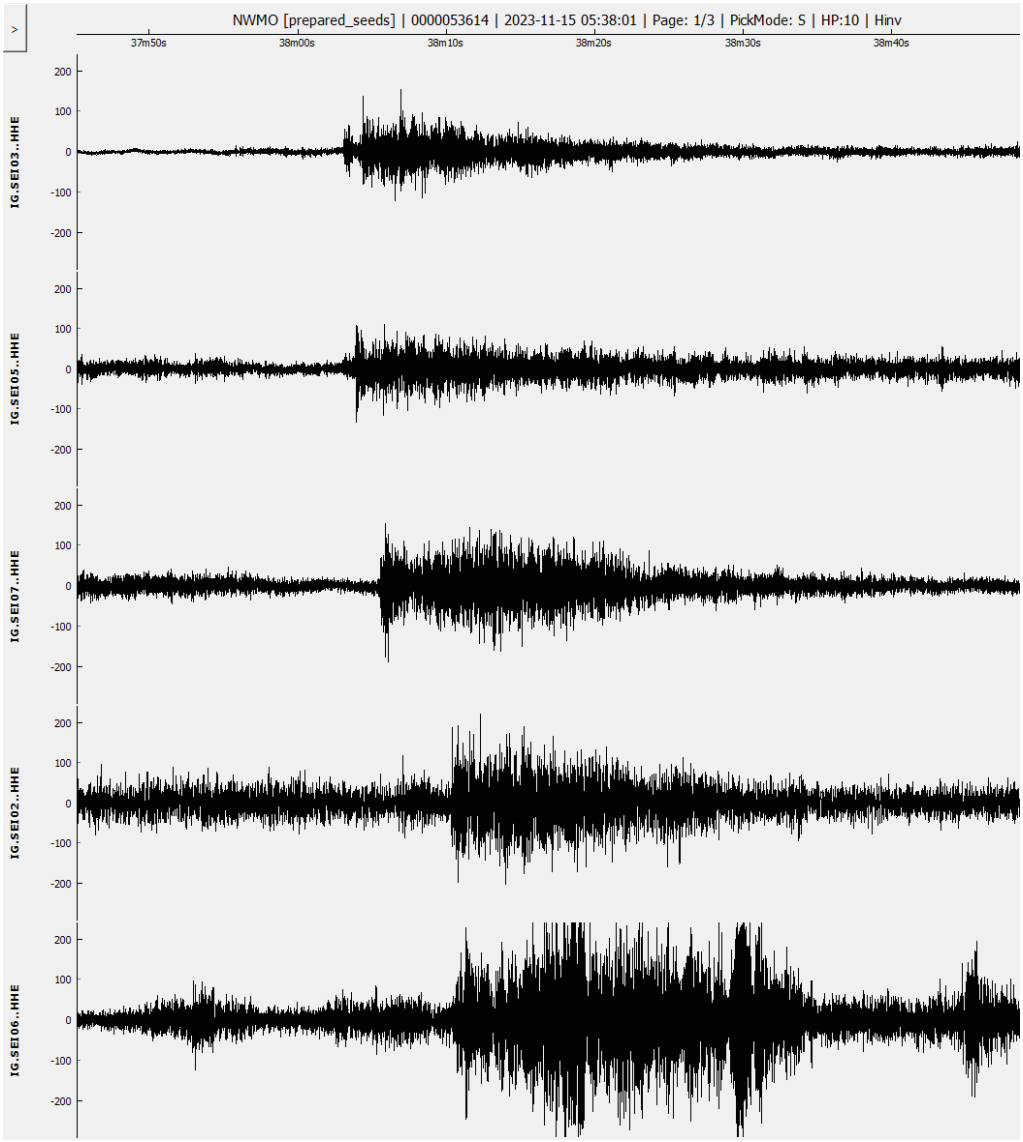
Manual event within NWMO area of interest

Date:	2023-11-13
Time:	19:55:22 UTC
Latitude:	49.656
Longitude:	-91.574333
Depth:	5.23 km
Magnitude:	0.45 Ml



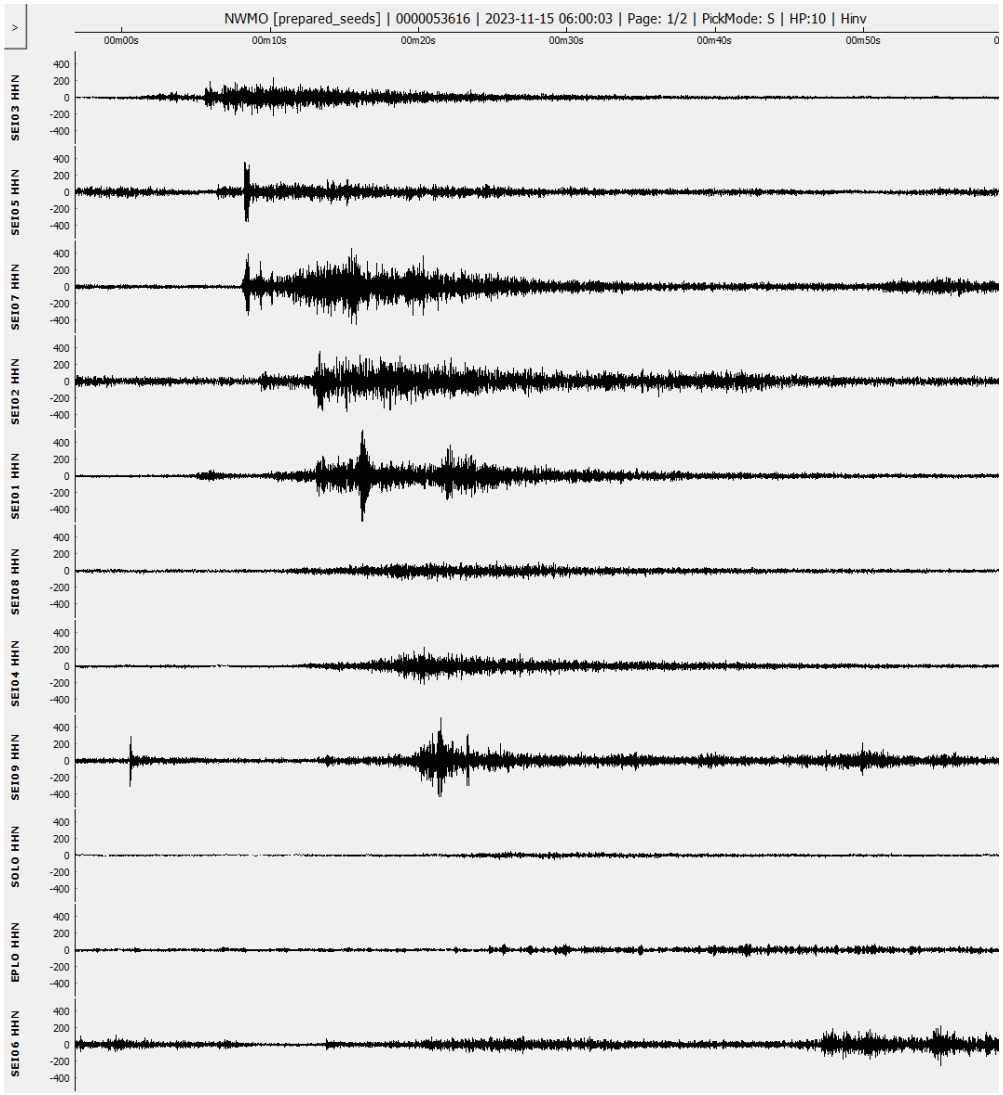
Manual event within NWMO area of interest

Date: 2023-11-15
Time: 05:38:01 UTC
Latitude: 49.446167
Longitude: -92.063667
Depth: 2.55 km
Magnitude: 0.10Ml



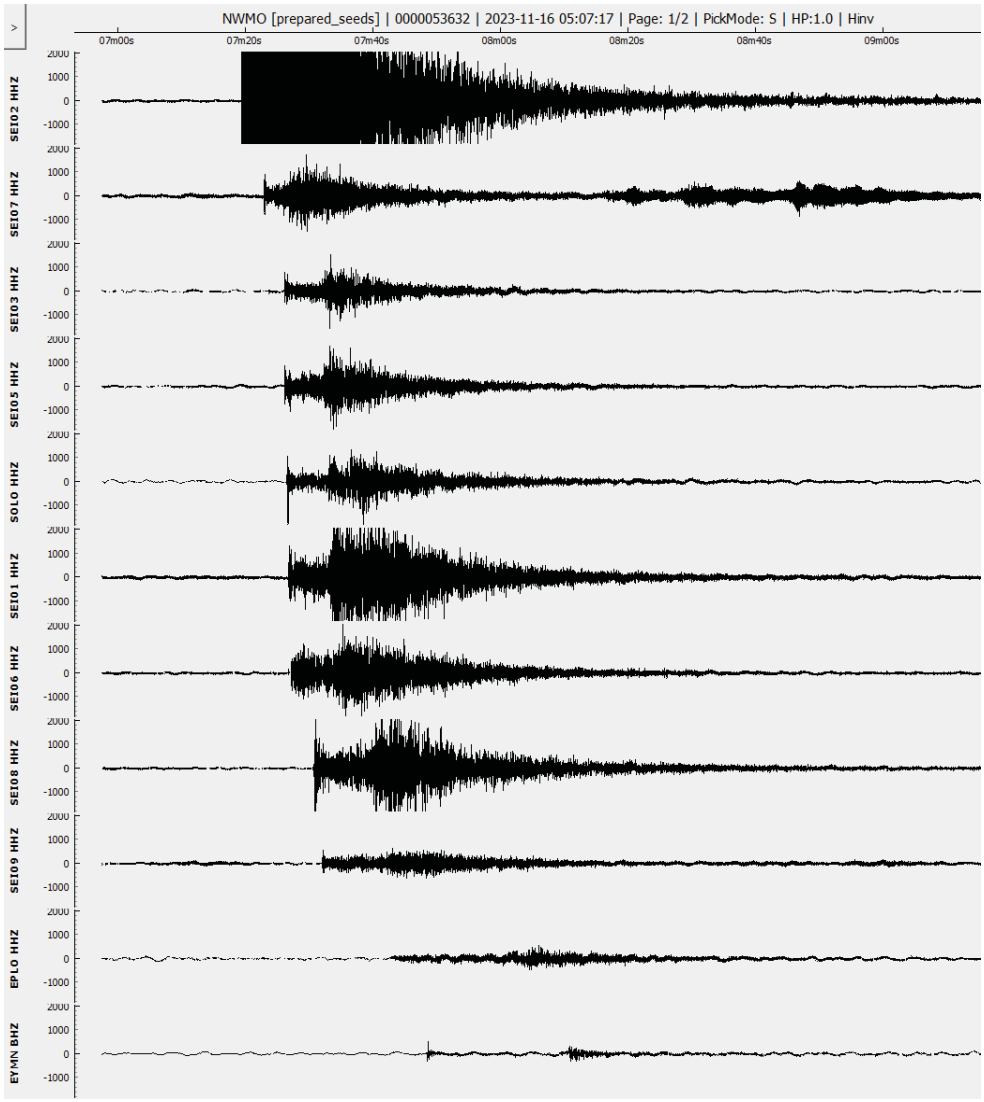
Manual event within NWMO area of interest

Date:	2023-11-15
Time:	06:00:03 UTC
Latitude:	49.4518
Longitude:	-92.0632
Depth:	2.47 km
Magnitude:	0.57 Ml



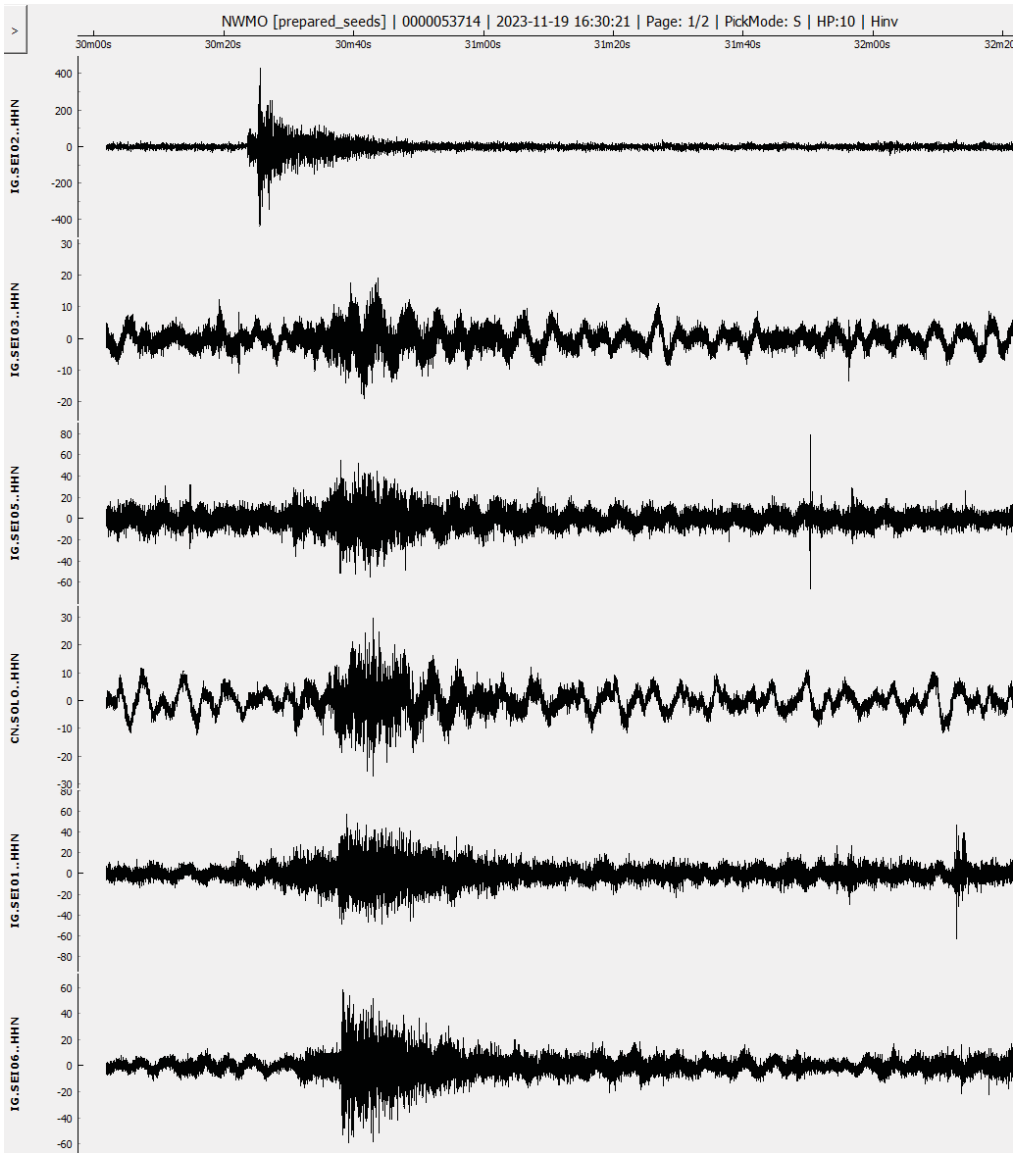
Manual event within NWMO area of interest

Date:	2023-11-16
Time:	05:07:17 UTC
Latitude:	49.652
Longitude:	-91.576
Depth:	5.59 km
Magnitude:	1.80 Ml



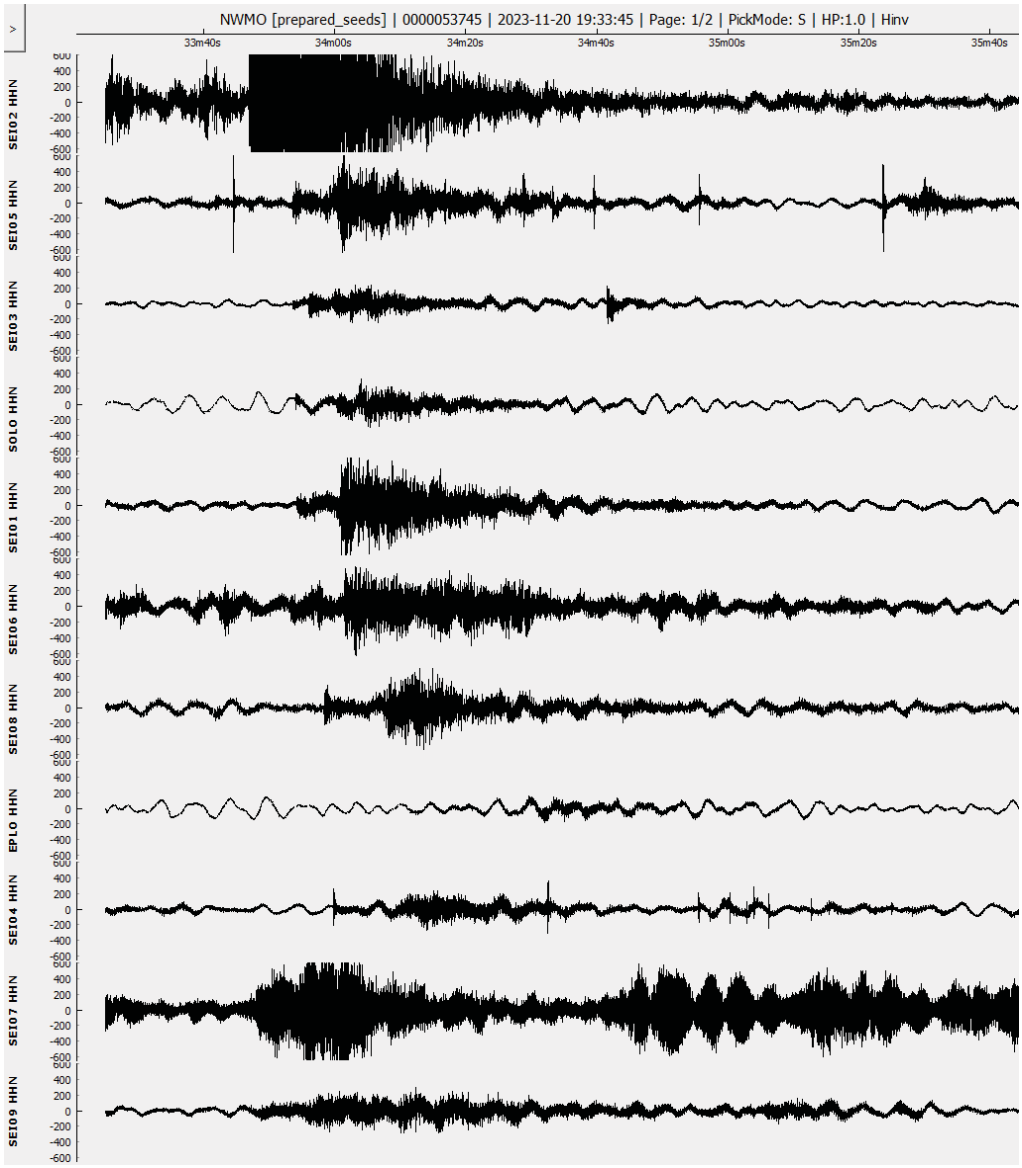
Manual event within NWMO area of interest

Date: 2023-11-19
Time: 16:30:21 UTC
Latitude: 49.6613
Longitude: -91.5777
Depth: 4.32 km
Magnitude: 0.30Ml



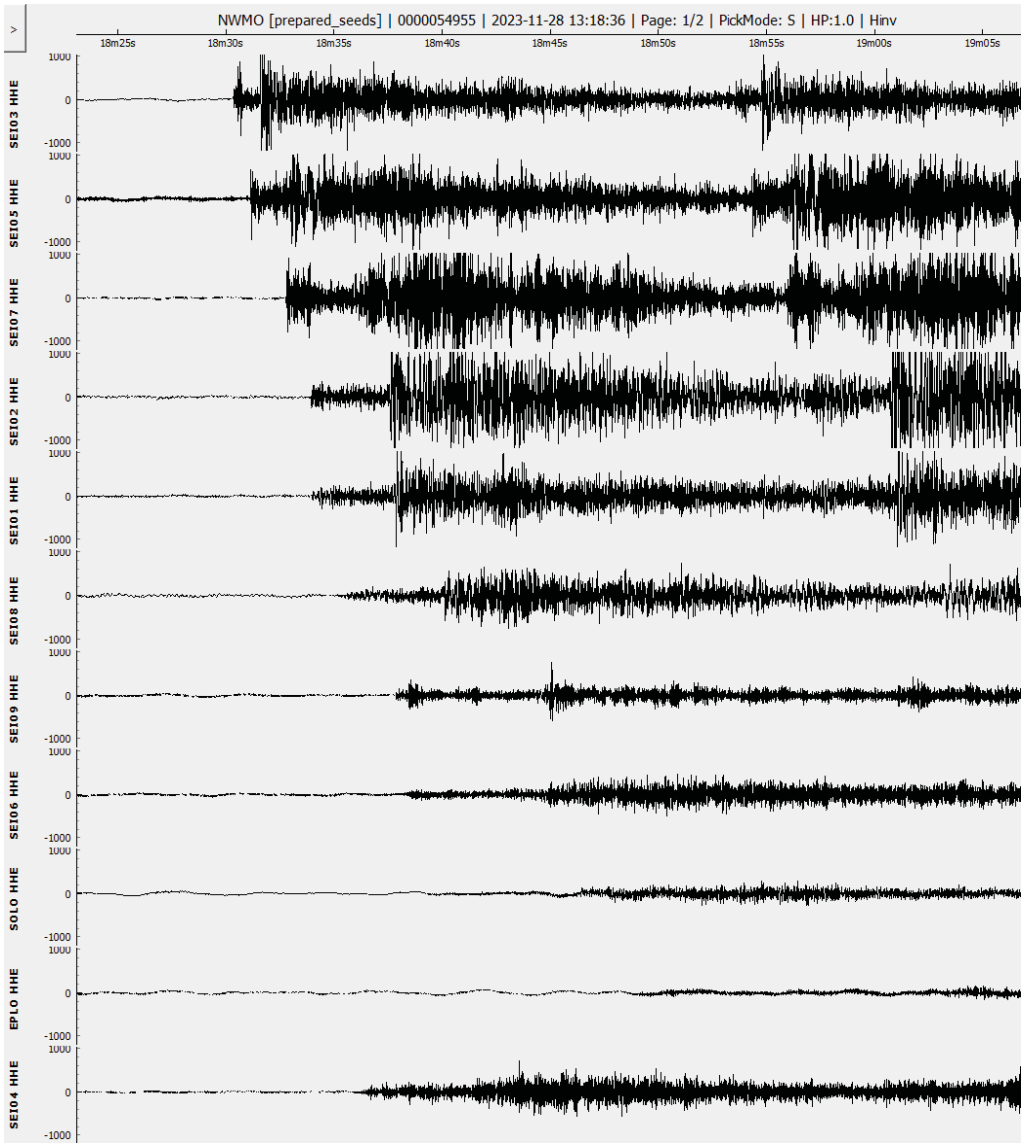
Manual event within NWMO area of interest

Date:	2023-11-20
Time:	19:33:45 UTC
Latitude:	49.6560
Longitude:	-91.5763
Depth:	4.79 km
Magnitude:	0.99 Ml



Manual event within NWMO area of interest

Date: 2023-11-28
Time: 13:18:28 UTC
Latitude: 49.4488
Longitude: -92.0658
Depth: 2.84 km
Magnitude: 1.23 Ml



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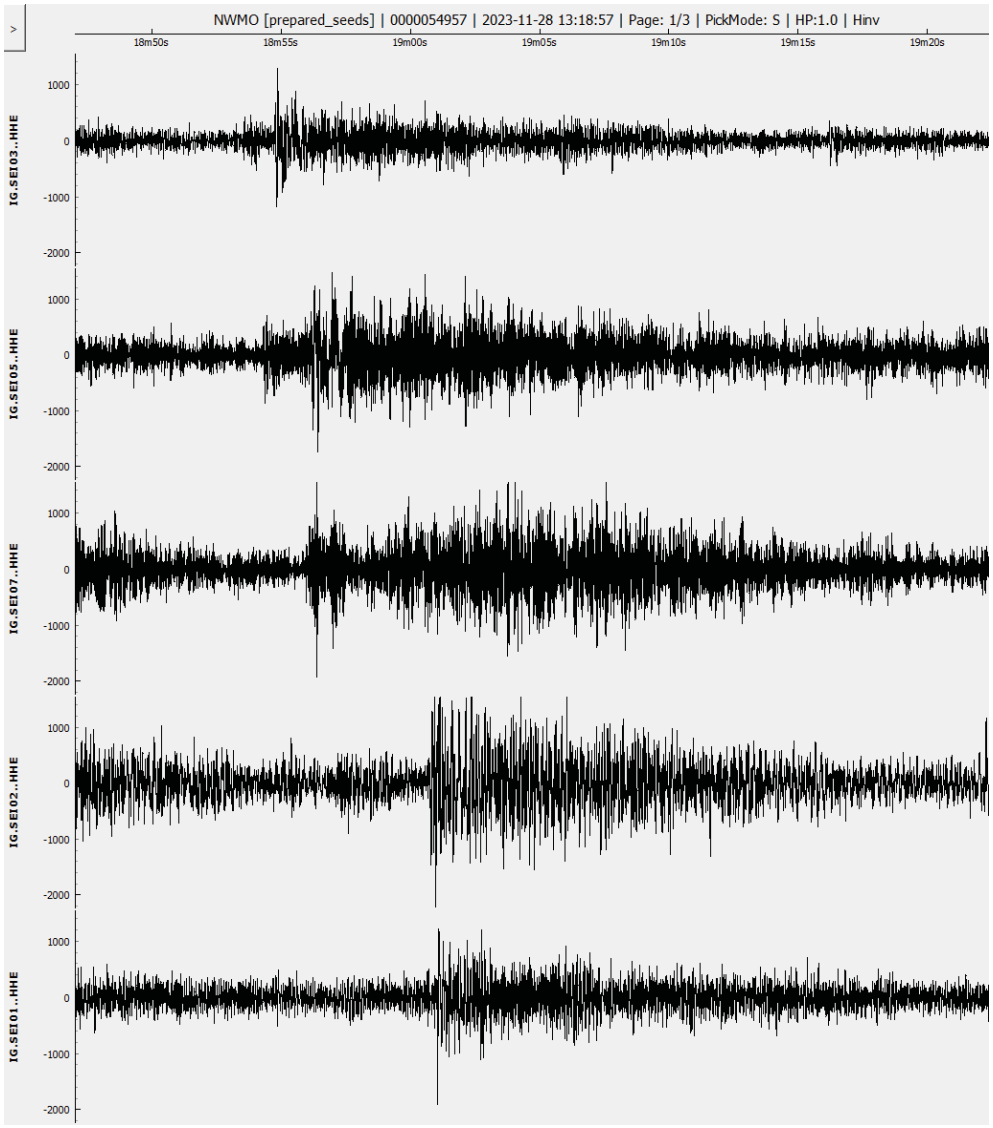
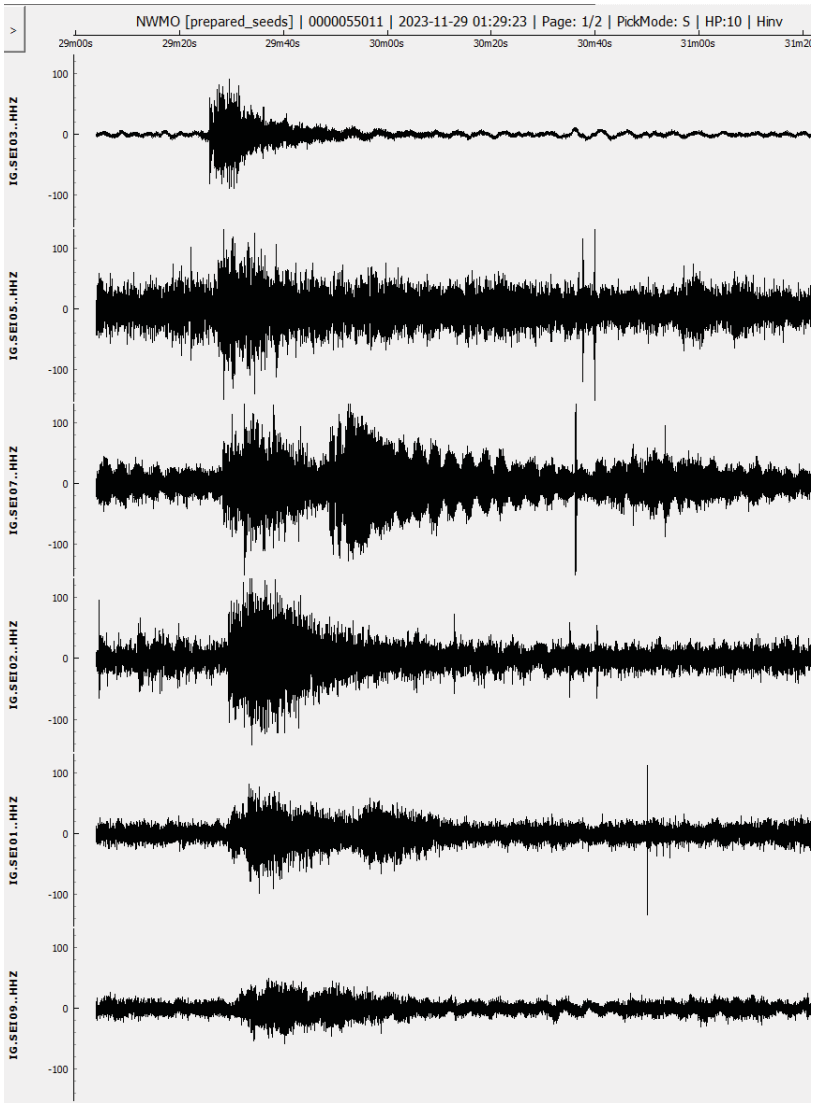
Date: 2023-11-28
Time: 13:18:57 UTC
Latitude: 49.3762
Longitude: -92.1500
Depth: 7.03 km
Magnitude: 1.36 Ml



Manual event within NWMO area of interest

Date:	2023-11-29
Time:	01:29:23 UTC
Latitude:	49.4485
Longitude:	-92.0678
Depth:	3.55 km
Magnitude:	0.13 Ml



Manual event within NWMO area of interest

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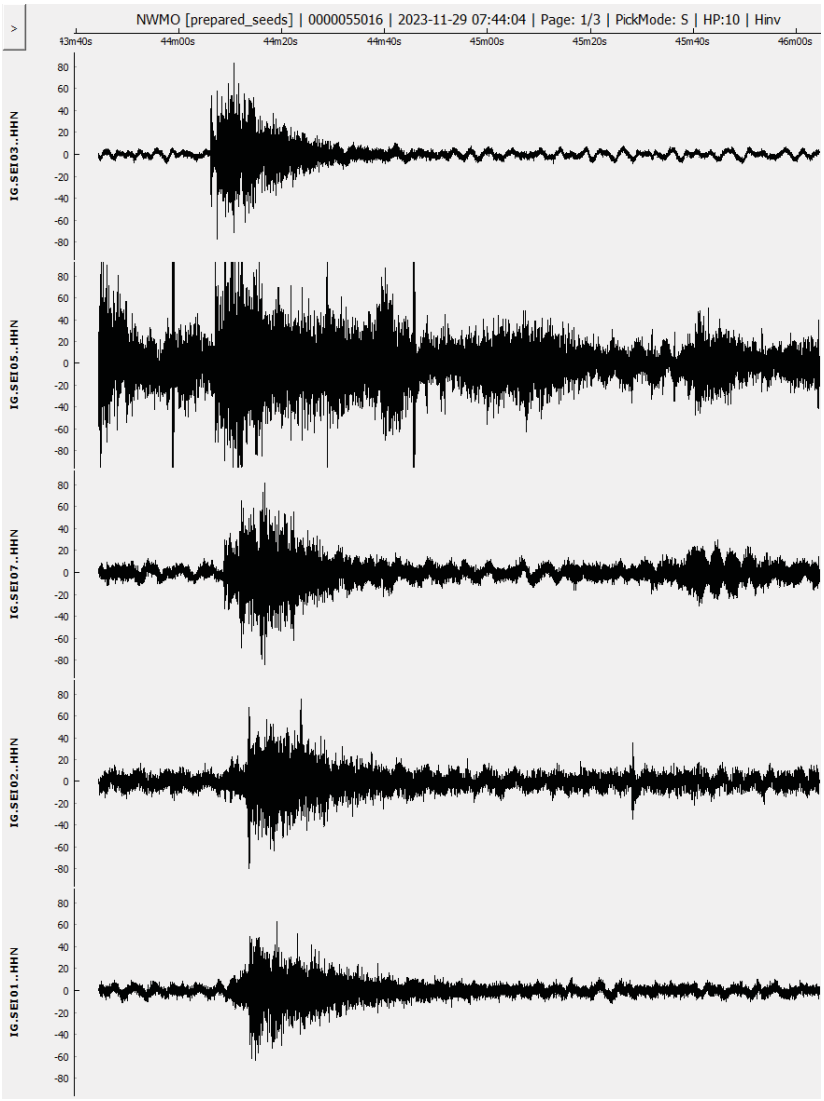
Date:	2023-11-29
Time:	07:44:04 UTC
Latitude:	49.4518
Longitude:	-92.0632
Depth:	0.64 km
Magnitude:	0.00 Ml



Manual event within NWMO area of interest

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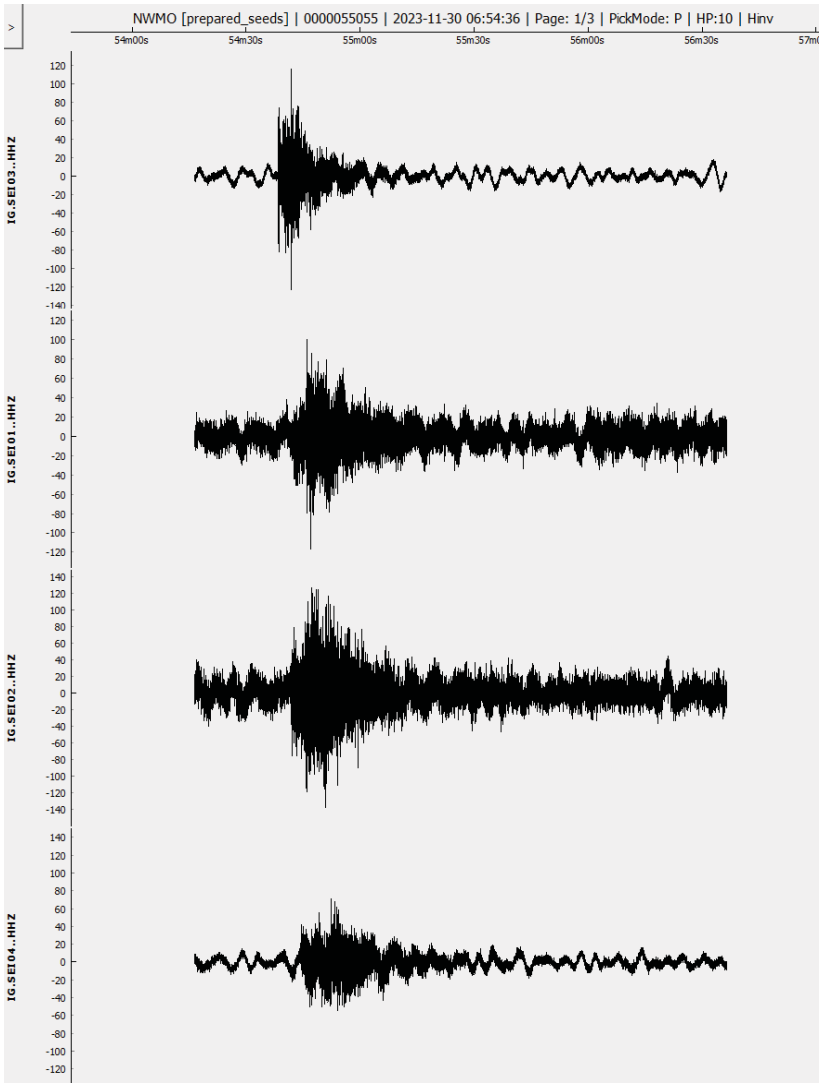
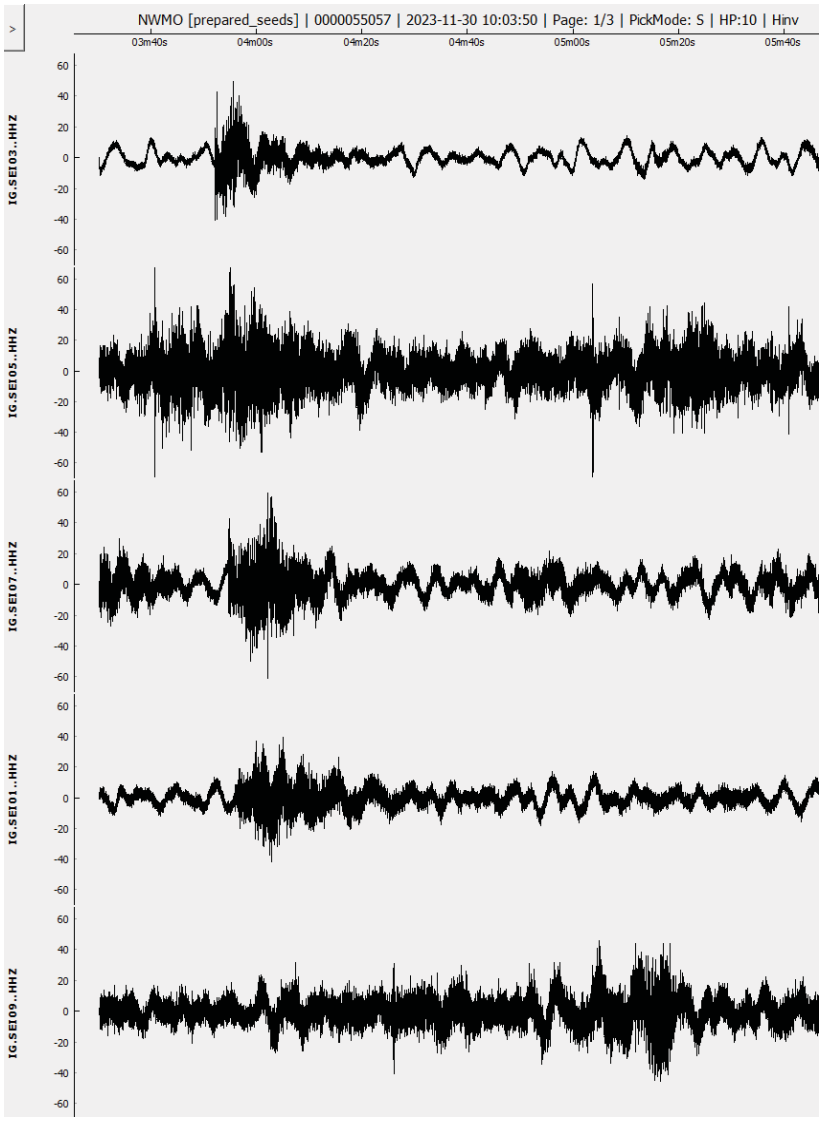
Date:	2023-11-30
Time:	06:54:36 UTC
Latitude:	49.4498
Longitude:	-92.0662
Depth:	4.10 km
Magnitude:	0.04 Ml



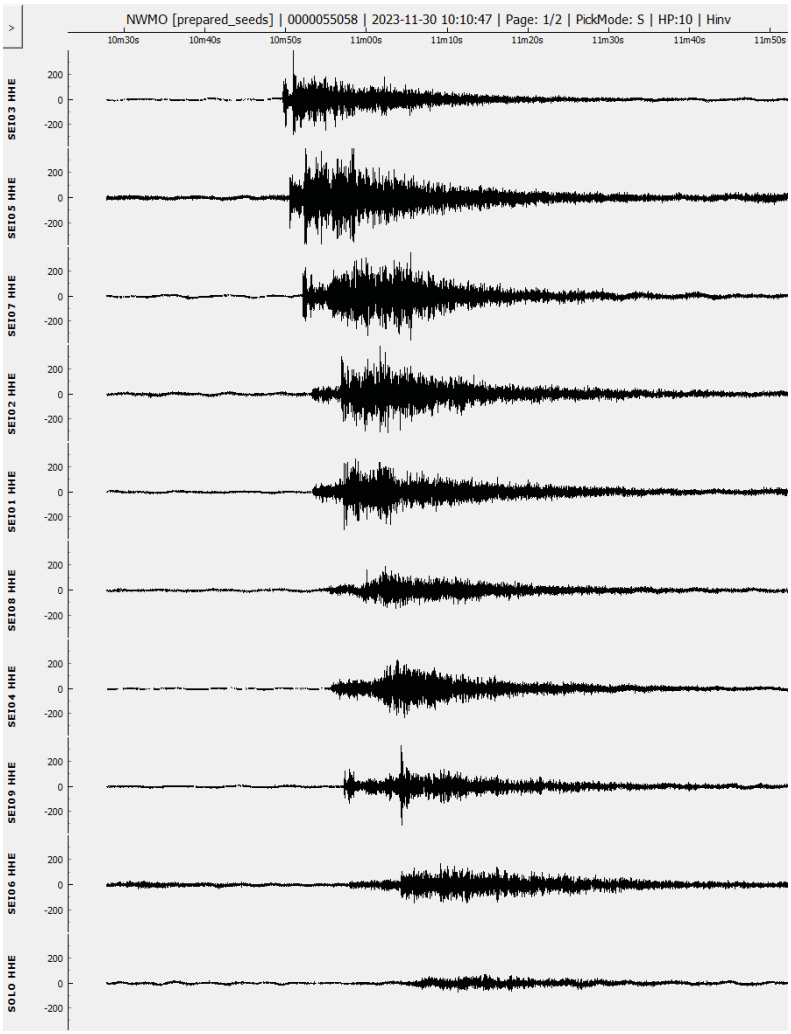
Manual event within NWMO area of interest

Date:	2023-11-30
Time:	10:03:50 UTC
Latitude:	49.4440
Longitude:	-92.0740
Depth:	6.20 km
Magnitude:	-0.09 Ml



Manual event within NWMO area of interest

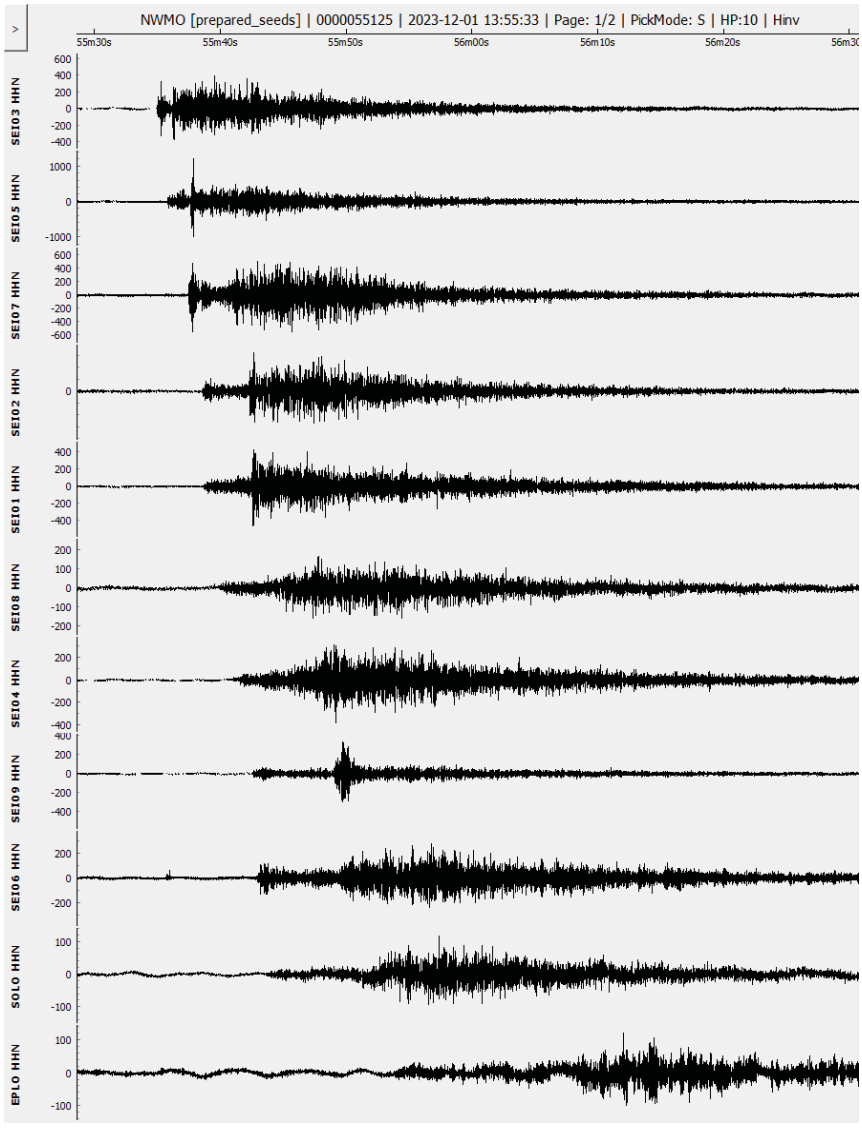
Date: 2023-11-30
Time: 10:10:47 UTC
Latitude: 49.4463
Longitude: -92.0665
Depth: 3.32 km
Magnitude: 0.61 Ml



Manual event within NWMO area of interest

Date: 2023-12-01

Time: 13:55:33 UTC
Latitude: 49.4478
Longitude: -92.0640
Depth: 1.41 km
Magnitude: 0.68 Ml



Manual event within NWMO area of interest

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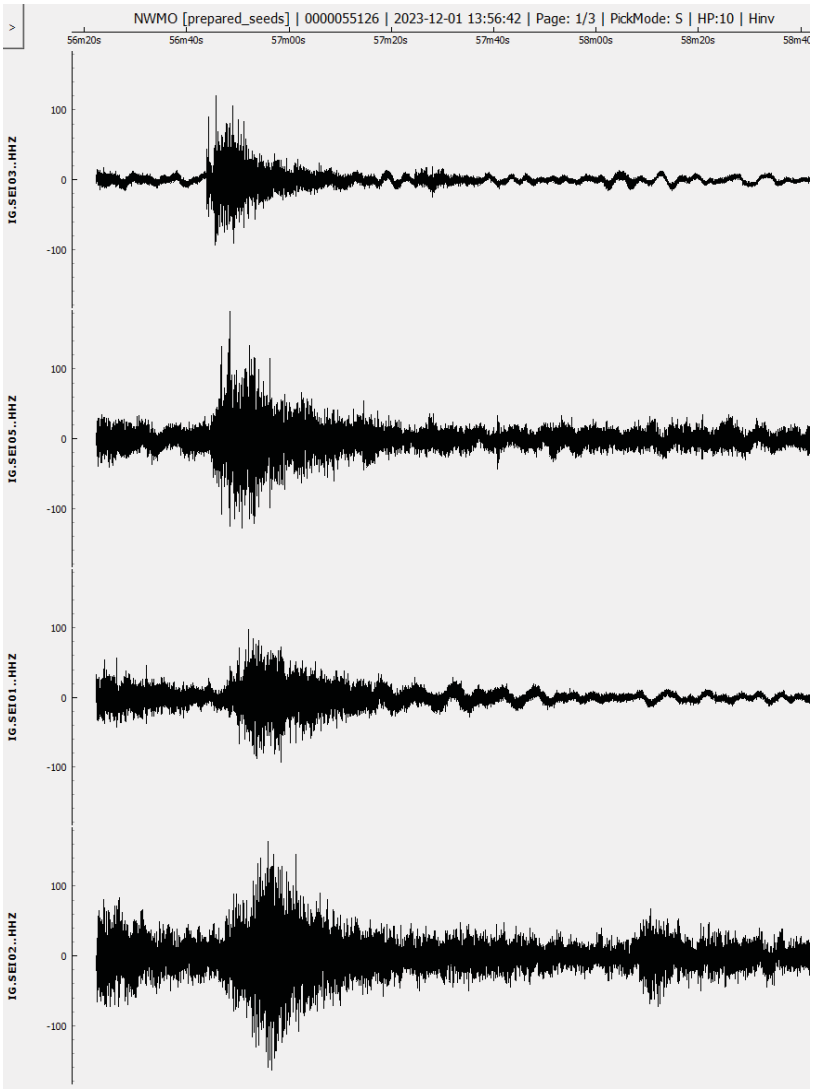
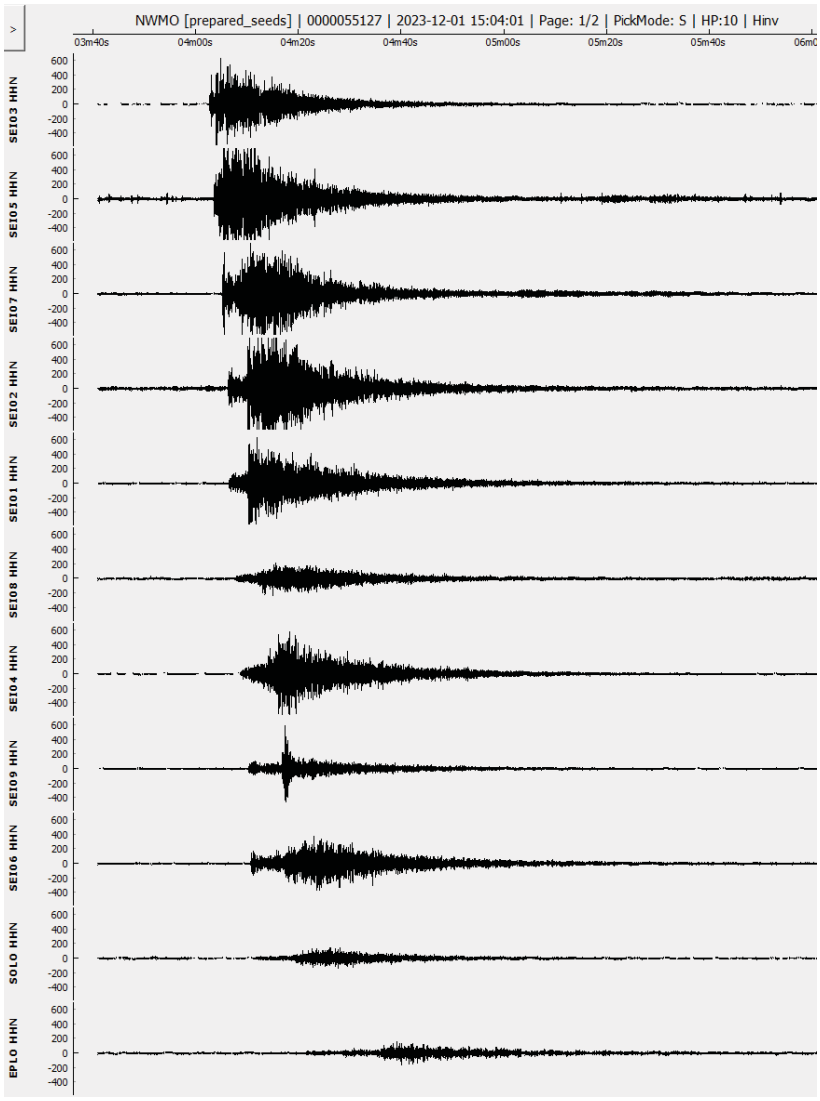
Date:	2023-12-01
Time:	13:56:42 UTC
Latitude:	49.4368
Longitude:	-92.1223
Depth:	6.28 km
Magnitude:	0.04 Ml



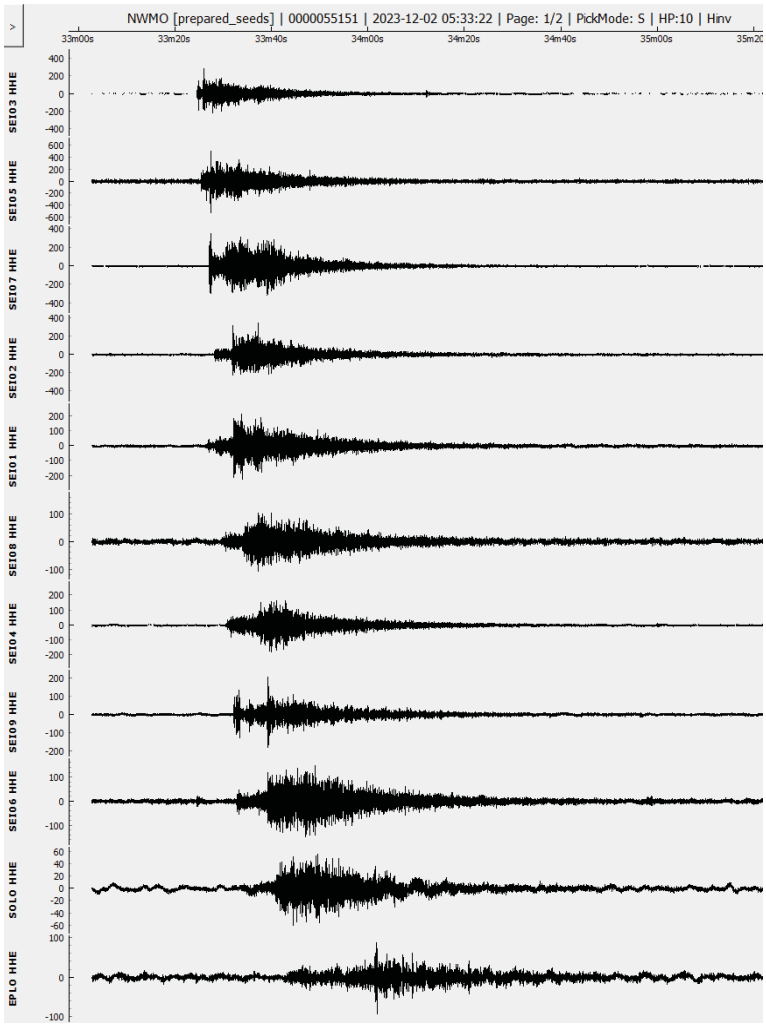
Manual event within NWMO area of interest

Date:	2023-12-01
Time:	15:04:01 UTC
Latitude:	49.4483
Longitude:	-92.0688
Depth:	3.20 km
Magnitude:	0.86 Ml



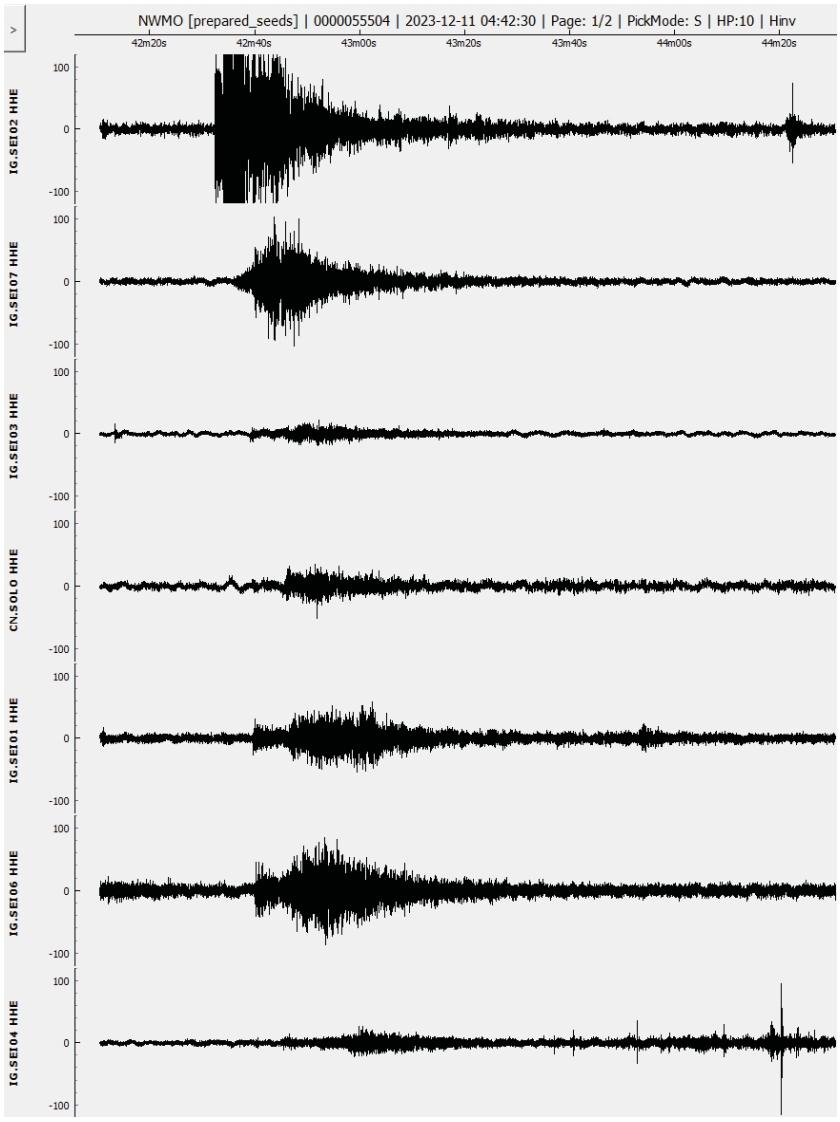
Manual event within NWMO area of interest

Date:	2023-12-02
Time:	05:33:22 UTC
Latitude:	49.4475
Longitude:	-92.0683
Depth:	3.41 km
Magnitude:	0.41 Ml



Manual event within NWMO area of interest

Date:	2023-12-11
Time:	04:42:30 UTC
Latitude:	49.6587
Longitude:	-91.5685
Depth:	4.52 km
Magnitude:	0.18 Ml



Manual event within NWMO area of interest

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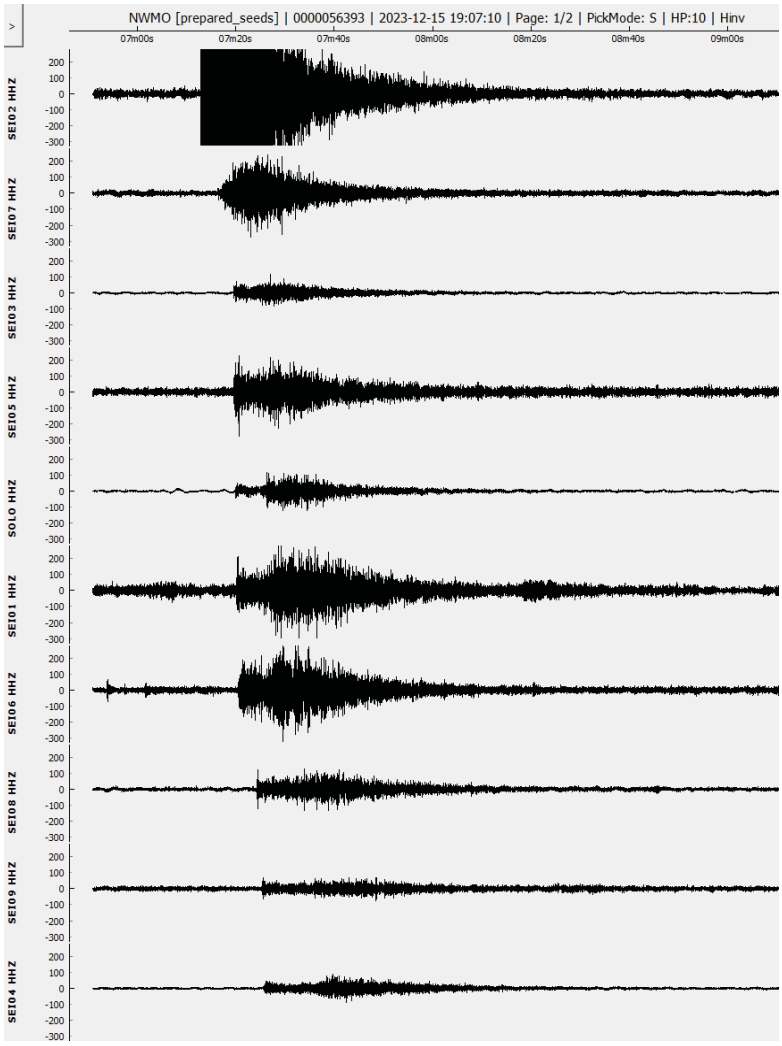
Date:	2023-12-15
Time:	19:07:10 UTC
Latitude:	49.6600
Longitude:	-91.5708
Depth:	4.17 km
Magnitude:	0.64 Ml



Manual event within NWMO area of interest

Appendix C: CHIS Events (January 1, 2023 - December 31, 2023)

Origin Date and Time (UTC)	Latitude (WGS84)	Longitude (WGS84)	Depth (km)	Local Magnitude (ML)	Description	Source Type
2023-12-31 9:19	49.2448	-91.3425	5	1.26	29 km SE of Ignace, ON/29 km SE de Ignace, ON	Earthquake
2023-12-31 1:58	49.6402	-90.8371	2	1.93	64 km ENE of Ignace, ON/64 km ENE de Ignace, ON	Earthquake
2023-12-15 19:07	49.658	-91.6092	2	1.49	28 km N of Ignace, ON/28 km N de Ignace, ON	Earthquake
2023-12-09 14:26	49.8742	-91.9036	5	0.93	25 km S of Sioux Lookout, ON/25 km S de Sioux Lookout, ON	Earthquake
2023-12-09 13:50	49.2738	-91.019	5	1.65	49 km ESE of Ignace, ON/49 km ESE de Ignace, ON	Earthquake
2023-12-08 23:02	50.2037	-92.0995	2	2.33	13 km NE of Lac Seul, ON/13 km NE de Lac Seul, ON	Earthquake
2023-11-24 22:10	49.6678	-91.5802	5	1.48	29 km N of Ignace, ON/29 km N de Ignace, ON	Earthquake
2023-11-23 0:05	50.1755	-93.0767	2	2.17	25 km SSE of Wabauskang, ON/25 km SSE de Wabauskang, ON	Earthquake
2023-11-20 19:33	49.6489	-91.6077	2	1.52	27 km N of Ignace, ON/27 km N de Ignace, ON	Earthquake
2023-11-19 4:26	49.6574	-91.5498	2	2.57	28 km NNE of Ignace, ON/28 km NNE de Ignace, ON	Earthquake

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Origin Date and Time (UTC)	Latitude (WGS84)	Longitude (WGS84)	Depth (km)	Local Magnitude (ML)	Description	Source Type
2023-11-16 5:15	49.6499	-91.5609	5	1.5	27 km NNE of Ignace, ON/27 km NNE de Ignace, ON	Earthquake
2023-11-16 5:07	49.6597	-91.5572	2	2.57	28 km NNE of Ignace, ON/28 km NNE de Ignace, ON	Earthquake
2023-11-15 4:06	49.4618	-92.0233	5	0.99	27 km WNW of Ignace, ON/27 km ONO de Ignace, ON	Earthquake
2023-11-12 23:27	49.6556	-91.5567	2	2.41	28 km NNE of Ignace, ON/28 km NNE de Ignace, ON	Earthquake
2023-11-12 14:34	47.8639	-91.2823	5	2.32	41 km E of Ely, MN/41 km E de Ely, MN	Earthquake
2023-11-11 22:59	51.4806	-93.7165	5	2.49	47 km N of Golden, ON/47 km N de Golden, ON	Earthquake
2023-10-31 22:36	50.2008	-92.0957	2	2.44	13 km NE of Lac Seul, ON/13 km NE de Lac Seul, ON	Earthquake
2023-10-31 1:46	50.2004	-92.0926	2	2.54	13 km NE of Lac Seul, ON/13 km NE de Lac Seul, ON	Earthquake
2023-10-29 22:52	50.2604	-91.3063	2	2.29	47 km ENE of Sioux Lookout, ON/47 km ENE de Sioux Lookout, ON	Earthquake
2023-10-21 1:37	50.0659	-94.1299	2	2.23	13 km SW of English River, ON/13 km SO de English River, ON	Earthquake
2023-10-14 11:30	51.0806	-95.0187	2	2.1	47 km E of Bissett, MB/47 km E de Bissett, MB	Earthquake

Origin Date and Time (UTC)	Latitude (WGS84)	Longitude (WGS84)	Depth (km)	Local Magnitude (ML)	Description	Source Type
2023-10-12 7:15	51.0291	-95.0668	2	1.83	43 km E of Bissett, MB/43 km E de Bissett, MB	Earthquake
2023-10-06 23:09	51.0353	-95.033	2	1.95	45 km E of Bissett, MB/45 km E de Bissett, MB	Earthquake
2023-10-06 22:29	51.1265	-95.016	2	1.87	48 km ENE of Bissett, MB/48 km ENE de Bissett, MB	Earthquake
2023-10-05 21:17	51.0801	-95.0723	2	2.7	43 km E of Bissett, MB/43 km E de Bissett, MB	Earthquake
2023-10-05 16:30	50.925	-95.0329	2	1.89	47 km ESE of Bissett, MB/47 km ESE de Bissett, MB	Earthquake
2023-10-05 16:18	50.9135	-95.0273	2	2.24	47 km ESE of Bissett, MB/47 km ESE de Bissett, MB	Earthquake
2023-10-05 16:05	51.0034	-95.0426	2	2.63	45 km E of Bissett, MB/45 km E de Bissett, MB	Earthquake
2023-10-05 15:47	50.9328	-94.8764	2	1.33	57 km E of Bissett, MB/57 km E de Bissett, MB	Earthquake
2023-10-05 15:41	50.987	-95.021	1.3	2.7	46 km E of Bissett, MB/46 km E de Bissett, MB	Earthquake
2023-10-05 15:30	50.9953	-95.0248	2	2.49	46 km E of Bissett, MB/46 km E de Bissett, MB	Earthquake
2023-10-05 15:00	50.8984	-95.0335	2	1.31	47 km ESE of Bissett, MB/47 km ESE de Bissett, MB	Earthquake

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Origin Date and Time (UTC)	Latitude (WGS84)	Longitude (WGS84)	Depth (km)	Local Magnitude (ML)	Description	Source Type
2023-10-05 14:36	50.9209	-95.0109	2	1.49	48 km ESE of Bissett, MB/48 km ESE de Bissett, MB	Earthquake
2023-10-05 12:00	50.9861	-95.0526	2	2.45	44 km E of Bissett, MB/44 km E de Bissett, MB	Earthquake
2023-10-05 11:03	50.9349	-95.0187	2	1.93	47 km ESE of Bissett, MB/47 km ESE de Bissett, MB	Earthquake
2023-10-05 10:38	50.9395	-95.0445	2	2.03	46 km ESE of Bissett, MB/46 km ESE de Bissett, MB	Earthquake
2023-10-05 10:18	50.9824	-95.0501	2	2.51	44 km E of Bissett, MB/44 km E de Bissett, MB	Earthquake
2023-10-05 8:35	50.8858	-95.0571	2	1.81	46 km ESE of Bissett, MB/46 km ESE de Bissett, MB	Earthquake
2023-10-04 20:35	50.9767	-95.0359	2	2.57	45 km E of Bissett, MB/45 km E de Bissett, MB	Earthquake
2023-10-04 18:10	51.0586	-95.1014	5	2.33	41 km E of Bissett, MB/41 km E de Bissett, MB	Earthquake
2023-10-04 17:27	51.0117	-95.0735	5	2.52	43 km E of Bissett, MB/43 km E de Bissett, MB	Earthquake
2023-09-24 8:59	47.9063	-92.2856	5	1.67	34 km W of Ely, MN/34 km O de Ely, MN	Earthquake
2023-09-23 9:29	51.164	-90.7157	5	1.1	34 km WSW of Osnaburgh 63B, ON/34 km OSO de Osnaburgh 63B, ON	Earthquake

Origin Date and Time (UTC)	Latitude (WGS84)	Longitude (WGS84)	Depth (km)	Local Magnitude (ML)	Description	Source Type
2023-09-19 19:11	51.2416	-90.8468	2	2	43 km W of Osnaburgh 63B, ON/43 km O de Osnaburgh 63B, ON	Earthquake
2023-09-14 5:17	51.0506	-93.7329	1.36	2.73	Mining event, Red Lake Mine, ON	Mining
2023-09-12 12:44	49.4736	-92.881	2	1.88	34 km S of Dryden, ON/34 km S de Dryden, ON	Earthquake
2023-08-31 17:22	49.8419	-92.0445	2	1.01	30 km SSW of Sioux Lookout, ON/30 km SSO de Sioux Lookout, ON	Earthquake
2023-08-31 17:21	49.8774	-91.932	2	1.13	25 km S of Sioux Lookout, ON/25 km S de Sioux Lookout, ON	Earthquake
2023-08-29 23:17	49.6555	-92.3674	0	2.11	Blast, 13 km ENE of Wabigoon Lake, ON/Dynamitage, 13 km ENE de Wabigoon Lake, ON	Blast
2023-08-22 9:21	49.6511	-91.0995	5	1.82	48 km ENE of Ignace, ON/48 km ENE de Ignace, ON	Earthquake
2023-08-07 0:40	50.3024	-91.0886	5	1.88	32 km WSW of Ojibway Nation of Saugeen (Savant Lake), ON/32 km OSO de Ojibway Nation of Saugeen (Savant Lake), ON	Earthquake
2023-08-02 13:36	50.3217	-91.1262	5	1.21	33 km WSW of Ojibway Nation of Saugeen (Savant Lake), ON/33 km OSO de Ojibway Nation of Saugeen (Savant Lake), ON	Earthquake

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Origin Date and Time (UTC)	Latitude (WGS84)	Longitude (WGS84)	Depth (km)	Local Magnitude (ML)	Description	Source Type
2023-08-02 9:40	50.3358	-91.1453	5	1.16	34 km WSW of Ojibway Nation of Saugeen (Savant Lake), ON/34 km OSO de Ojibway Nation of Saugeen (Savant Lake), ON	Earthquake
2023-08-02 9:21	50.2841	-91.0599	5	1.36	31 km SW of Ojibway Nation of Saugeen (Savant Lake), ON/31 km SO de Ojibway Nation of Saugeen (Savant Lake), ON	Earthquake
2023-08-02 6:36	49.246	-92.0952	5	1.45	37 km WSW of Ignace, ON/37 km OSO de Ignace, ON	Earthquake
2023-08-01 12:10	50.1548	-95.8366	2	2.06	3 km ENE of Pinawa, MB/3 km ENE de Pinawa, MB	Earthquake
2023-07-31 0:37	50.2848	-91.059	2	1.45	31 km SW of Ojibway Nation of Saugeen (Savant Lake), ON/31 km SO de Ojibway Nation of Saugeen (Savant Lake), ON	Earthquake
2023-07-27 20:25	49.148	-93.93	0	1.99	Blast, 3 km S of Sabaskong Bay, ON/Dynamitage, 3 km S de Sabaskong Bay, ON	Blast
2023-07-15 3:10	51.5515	-93.6944	2	1.77	55 km N of Golden, ON/55 km N de Golden, ON	Earthquake
2023-07-09 6:30	49.8232	-91.8693	2.5	2.82	31 km S of Sioux Lookout, ON/31 km S de Sioux Lookout, ON	Earthquake

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Origin Date and Time (UTC)	Latitude (WGS84)	Longitude (WGS84)	Depth (km)	Local Magnitude (ML)	Description	Source Type
2023-06-29 15:06	49.4686	-93.7146	2	1.25	19 km ENE of Whitefish Bay 32A, ON/19 km ENE de Whitefish Bay 32A, ON	Earthquake
2023-05-30 10:24	50.0008	-94.4926	5	1.58	8 km WNW of Redditt, ON/8 km ONO de Redditt, ON	Earthquake
2023-05-21 20:00	48.8415	-94.0119	0	2.24	Blast, 1 km N of Rainy River Mine, ON/Dynamitage, 1 km N de la mine Rainy River, ON	Blast
2023-05-21 10:54	49.6217	-91.6738	5	1.41	23 km N of Ignace, ON/23 km N de Ignace, ON	Earthquake
2023-05-19 11:18	49.2565	-91.5608	5	1.53	19 km SSE of Ignace, ON/19 km SSE de Ignace, ON	Earthquake
2023-05-14 19:17	50.0555	-93.3144	0	2.03	Blast, 30 km NNW of Machin, ON/Dynamitage, 30 km NNO de Machin, ON	Blast
2023-05-14 14:25	50.5061	-89.658	2	1.51	48 km WNW of Whitesand, ON/48 km ONO de Whitesand, ON	Earthquake
2023-05-14 14:24	50.468	-90.2276	2	1.25	34 km E of Ojibway Nation of Saugeen (Savant Lake), ON/34 km E de Ojibway Nation of Saugeen (Savant Lake), ON	Earthquake
2023-05-13 7:17	50.7776	-93.4182	5	1.29	20 km NW of Ear Falls, ON/20 km NO de Ear Falls, ON	Earthquake

Origin Date and Time (UTC)	Latitude (WGS84)	Longitude (WGS84)	Depth (km)	Local Magnitude (ML)	Description	Source Type
2023-05-07 23:41	49.7525	-91.8051	5	1.38	39 km SSE of Sioux Lookout, ON/39 km SSE de Sioux Lookout, ON	Earthquake
2023-05-06 1:58	49.887	-92.6519	2	1.61	18 km NE of Dryden, ON/18 km NE de Dryden, ON	Earthquake
2023-05-02 13:47	49.2242	-92.0335	5	1.57	34 km SW of Ignace, ON/34 km SO de Ignace, ON	Earthquake
2023-04-30 19:12	49.2115	-92.0322	5	1.82	35 km SW of Ignace, ON/35 km SO de Ignace, ON	Earthquake
2023-04-30 5:02	51.5067	-92.9086	5	1.86	77 km NE of Golden, ON/77 km NE de Golden, ON	Earthquake
2023-04-27 1:07	49.169	-89.611	0.85	2	Mining event, Lac des Iles Mine, ON/Ã‰vÃ©nement minier, Mine Lac des ÃŽles, ON	Mining
2023-04-27 1:05	49.169	-89.611	0.85	2.37	Mining event, Lac des Iles Mine, ON/Ã‰vÃ©nement minier, Mine Lac des ÃŽles, ON	Mining
2023-04-14 2:16	51.1008	-94.9065	2	1.45	55 km E of Bissett, MB/55 km E de Bissett, MB	Earthquake
2023-04-11 21:30	50.3976	-94.9129	2	1.69	30 km N of Wabaseemoong, ON/30 km N de Wabaseemoong, ON	Earthquake
2023-04-05 2:25	49.8341	-95.3574	2	2.03	17 km N of Falcon Lake, MB/17 km N de Falcon Lake, MB	Earthquake

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Origin Date and Time (UTC)	Latitude (WGS84)	Longitude (WGS84)	Depth (km)	Local Magnitude (ML)	Description	Source Type
2023-03-31 1:29	49.9235	-91.9208	2	2.05	20 km S of Sioux Lookout, ON/20 km S de Sioux Lookout, ON	Earthquake
2023-03-26 4:22	50.7053	-88.8156	2	1.88	47 km NNE of Whitesand, ON/47 km NNE de Whitesand, ON	Earthquake
2023-03-21 0:35	48.9064	-92.1588	5	1.98	29 km NE of Seine River, ON/29 km NE de Seine River, ON	Earthquake
2023-03-14 21:58	50.064	-94.1227	2	2.36	13 km SW of English River, ON/13 km SO de English River, ON	Earthquake
2023-03-07 10:04	50.0784	-94.1168	2.5	2.51	11 km SW of English River, ON/11 km SO de English River, ON	Earthquake
2023-03-05 3:37	50.0796	-94.1036	2	1.7	11 km SW of English River, ON/11 km SO de English River, ON	Earthquake
2023-03-05 3:36	50.0516	-94.1088	2	1.39	13 km SW of English River, ON/13 km SO de English River, ON	Earthquake
2023-03-01 2:44	49.2241	-91.1054	2	1.63	45 km ESE of Ignace, ON/45 km ESE de Ignace, ON	Earthquake
2023-02-25 16:56	48.9102	-88.4281	0	2.16	Blast, 8 km NNE of Hurkett, ON/Dynamitage, 8 km NNE de Hurkett, ON	Blast
2023-02-22 19:35	50.4092	-91.8273	2	1.84	35 km N of Sioux Lookout, ON/35 km N de Sioux Lookout, ON	Earthquake
2023-02-21 17:02	49.7476	-94.4004	0	2.36	Blast, 3 km NNW of Kenora 38B, ON/Dynamitage, 3 km NNO de Kenora 38B, ON	Blast

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Origin Date and Time (UTC)	Latitude (WGS84)	Longitude (WGS84)	Depth (km)	Local Magnitude (ML)	Description	Source Type
2023-02-11 20:24	50.1134	-90.7985	5	2.19	38 km S of Ojibway Nation of Saugeen (Savant Lake), ON/38 km S de Ojibway Nation of Saugeen (Savant Lake), ON	Earthquake
2023-02-09 9:01	47.9508	-90.3518	2	1.82	62 km SW of Gillies, ON/62 km SO de Gillies, ON	Earthquake
2023-02-05 2:35	49.2443	-91.9457	5	2.07	28 km SW of Ignace, ON/28 km SO de Ignace, ON	Earthquake
2023-01-24 20:10	49.6866	-95.1592	0	1.78	Blast, 9 km NNW of Shoal Lake (Part) 39A, ON/Dynamitage, 9 km NNO de Shoal Lake (Part) 39A, ON	Blast
2023-01-24 17:45	49.7033	-94.663	2	1.85	1 km NNW of Rat Portage, ON/1 km NNO de Rat Portage, ON	Earthquake
2023-01-23 5:31	49.9085	-92.579	2	0.78	23 km NE of Dryden, ON/23 km NE de Dryden, ON	Earthquake
2023-01-22 2:25	49.4934	-91.897	2	2.01	20 km WNW of Ignace, ON/20 km ONO de Ignace, ON	Earthquake
2023-01-19 18:37	50.5874	-91.8595	2	2.38	54 km N of Sioux Lookout, ON/54 km N de Sioux Lookout, ON	Earthquake
2023-01-19 16:01	49.6448	-94.6974	2	1.48	6 km SSW of Rat Portage, ON/6 km SSO de Rat Portage, ON	Earthquake
2023-01-17 15:23	49.6603	-94.6905	5	1.34	4 km SSW of Rat Portage, ON/4 km SSO de Rat Portage, ON	Earthquake

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Origin Date and Time (UTC)	Latitude (WGS84)	Longitude (WGS84)	Depth (km)	Local Magnitude (ML)	Description	Source Type
2023-01-12 0:10	51.1764	-93.816	1	1.82	Suspected mining event, 14 km NNW of Golden, ON/Ã‰vÃ©nement minier soupconnÃ©, 14 km NNO de Golden, ON	Mining
2023-01-03 22:54	49.3368	-93.1752	2	2.11	45 km SSW of Eagle Lake, ON/45 km SSO de Eagle Lake, ON	Earthquake
2023-01-01 5:18	50.4492	-88.2657	2	1.77	57 km ENE of Whitesand, ON/57 km ENE de Whitesand, ON	Earthquake
2023-01-01 4:02	48.9651	-93.5646	2	2.19	12 km N of Rainy Lake 17A, ON/12 km N de Rainy Lake 17A, ON	Earthquake

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