Advanced Multicomponent
Seismic Software

Analysis of seismic data recorded in May 2026 by network C8 (stations SV1S-SV5S) at Aquistore test site

Report AQ-2026-05-IM

July 1, 2026

Igor Morozov

igor.morozov@usask.ca

Contents

1. Station performance

Station performance for May 2026 is summarized in Figure 1, and their state-of-health parameters are shown in Figure 2. Only stations SV1S to SV4S were online in May. Station SV5S had a failed sensor and was taken offline, and its SIM card was used for testing different cell modems. At the end of June, we put the SIM card back into SV5S and retrieved its data for May (Figure 1).

Power-supply voltages looked generally good and station operation was practically uninterrupted. However, as in the preceding reports, some issues may require further monitoring:

- Station SV3S has the weakest power-voltage profile frequently dropping below the optimal level (Figure 2). SV2S appears to be the second weakest.
- Sensor "mass position" voltage at station SV3S varies and occasionally reaches the critical levels of ±2.5. In such cases, the station reports "Status Error" in the web user interface. These variations may be related to variation of soil moisture and temperature. Adjustment of sensor mass position or (preferably) replacement to a self-levelling sensor may be needed.
- As noted in previous reports, stations SV3S and SV4S continue showing time intervals contaminated with spikes.

<u>On the positive side</u>, surprisingly, t<u>he sensor at station SV5S started operating correctly</u> during the period the station was offline. All three channels work now, including channel HHE which appeared to be failed since I started monitoring this station (February 2024). This behaviour suggests that the Trillium sensor has been functioning correctly but the sensor cable may have been affected by seasonal and weather-related fluctuations. Hypothetically, the recovery of the sensor (or sensor cable connection) could be related to significantly improved quality of power supply at the station, with its cell modem (the largest consumer of power) being off.

To be prepared to check and repair similar problems in the future, it should be advisable to obtain a spare sensor cable.

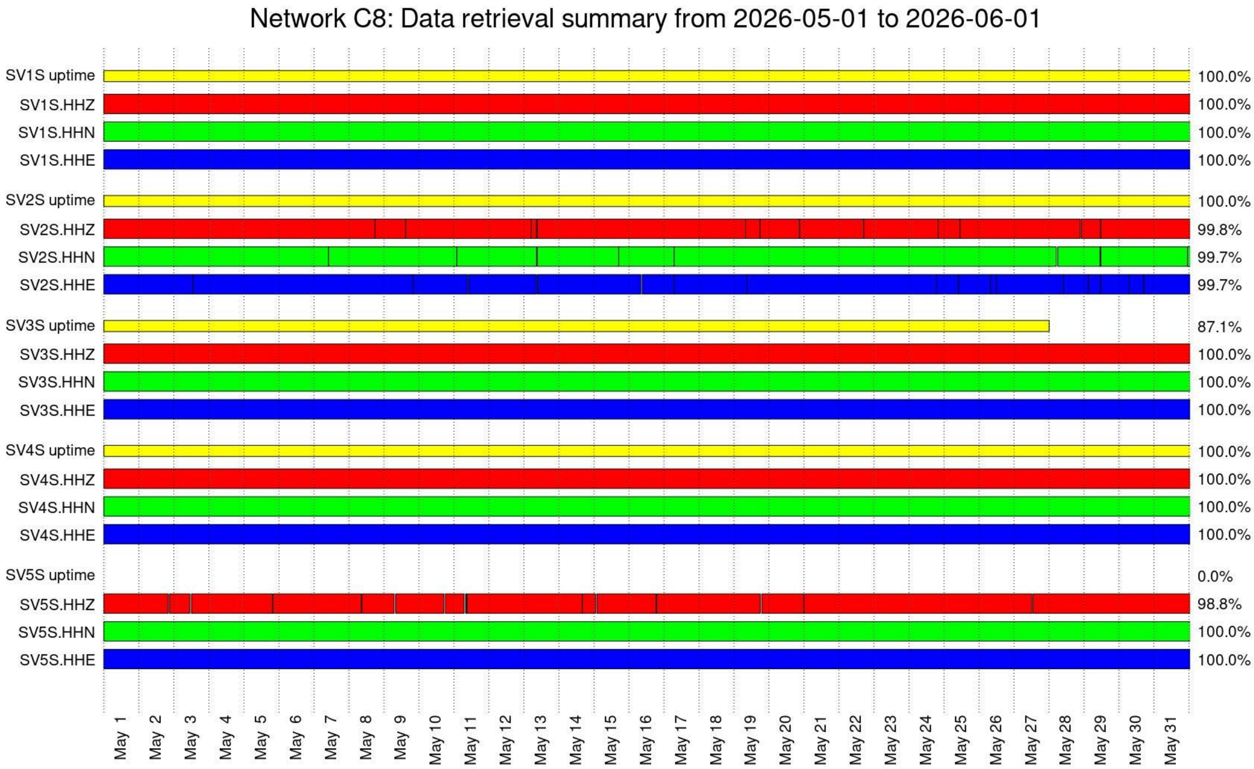

Figure 1. Retrieved data intervals for all channels (red, green, and blue bars) and uptimes (yellow). Total percentages of measured uptime and data retrieval are shown on the right. Station SV5S was offline in May 2026 (no yellow bar) but the seismic records were retrieved at the end of June.

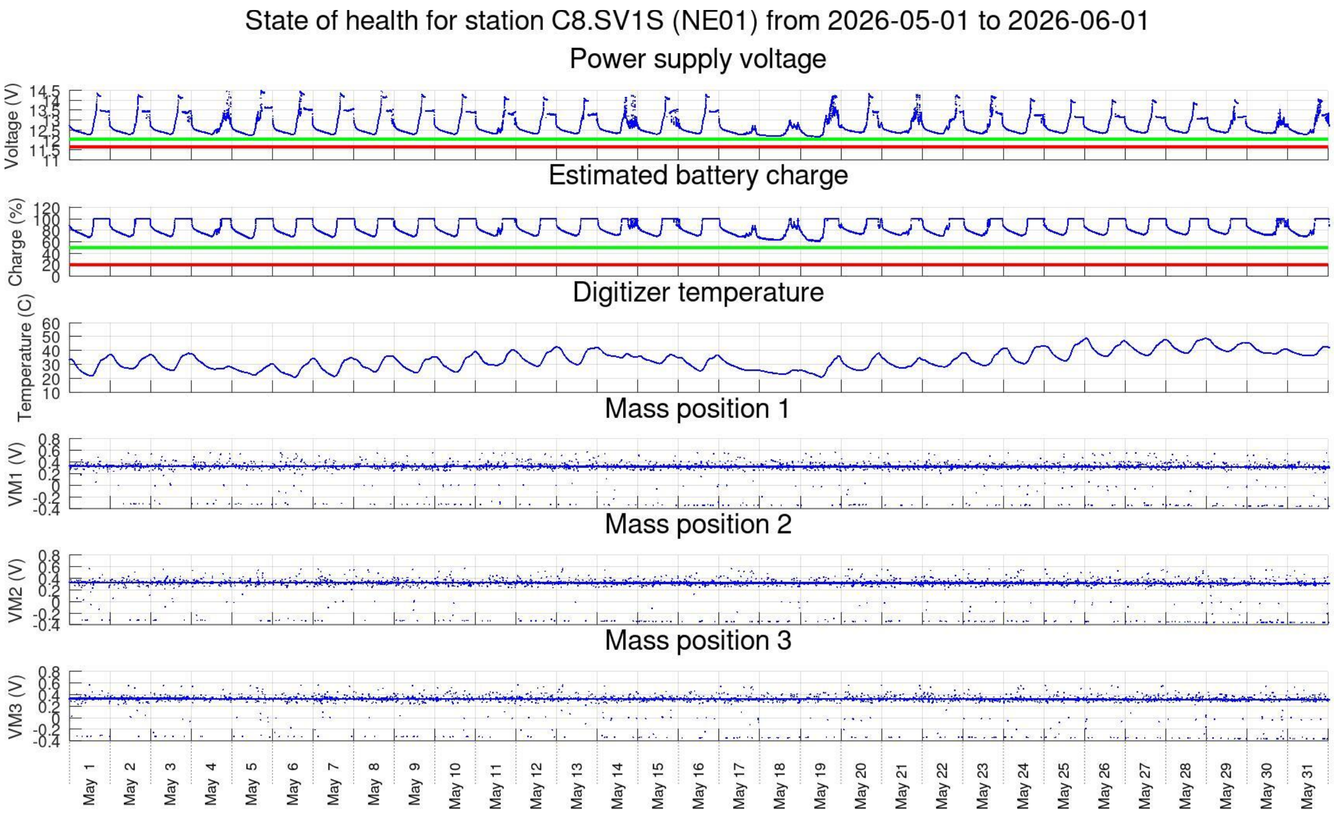

Figure 2. State of health parameters for each station (SV1S here). Image headings: power supply voltage, estimated battery charge levels, temperature on board, voltages measuring mass positions.

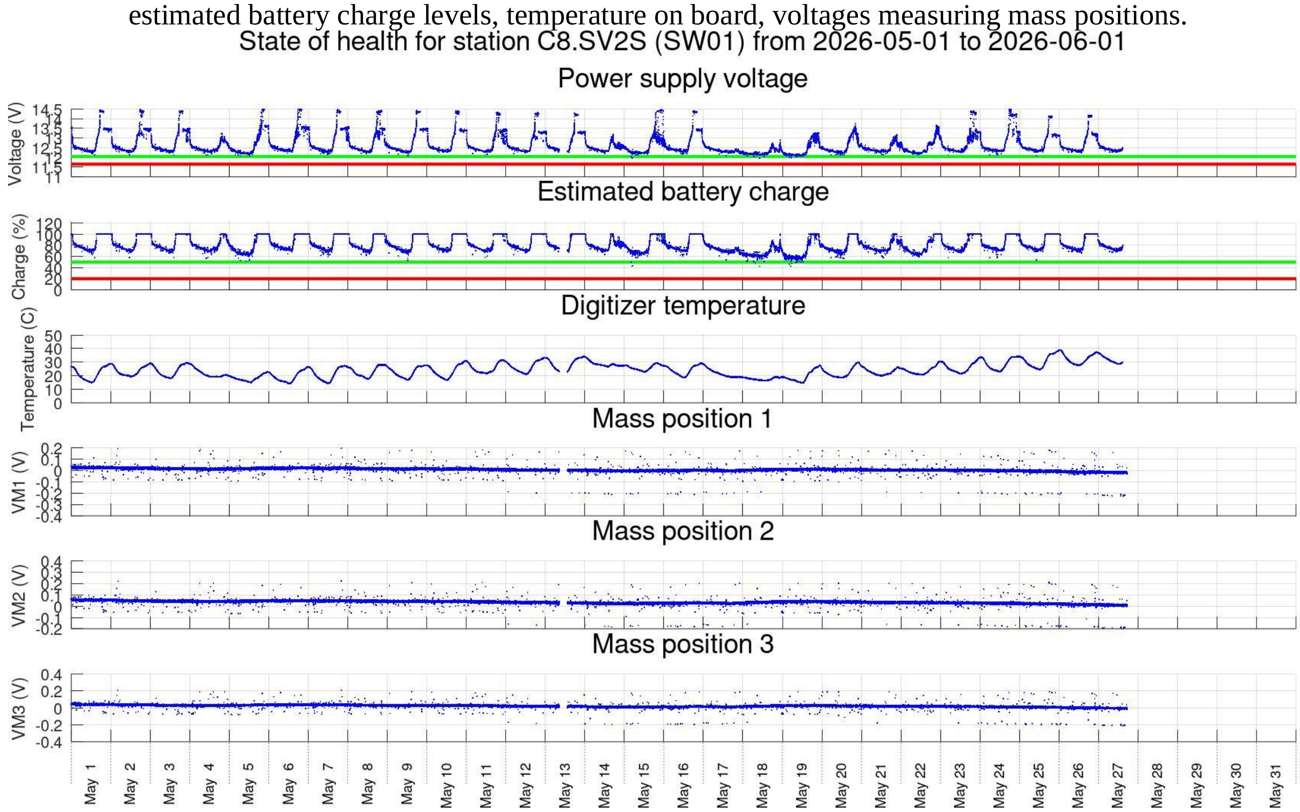

Figure 2, continued, station SV2S.

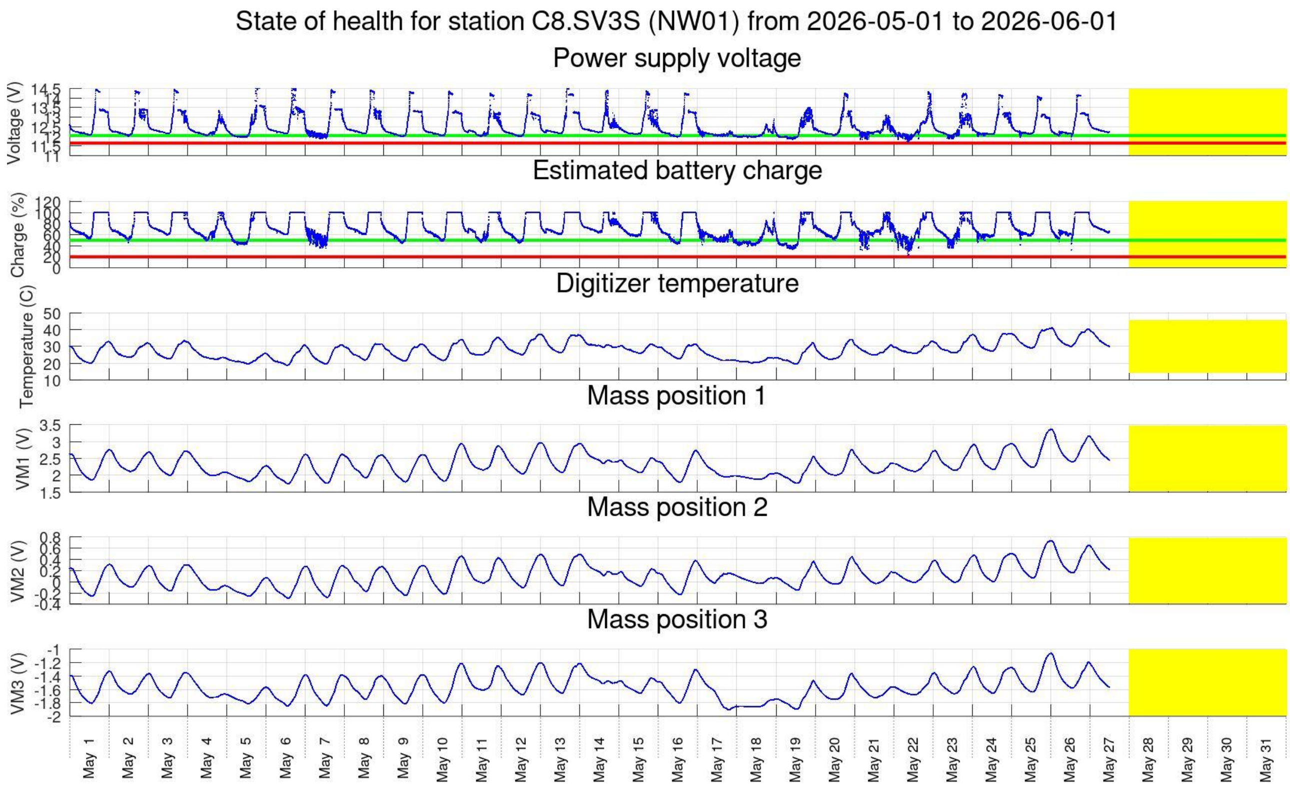

Figure 2, continued, station SV3S.

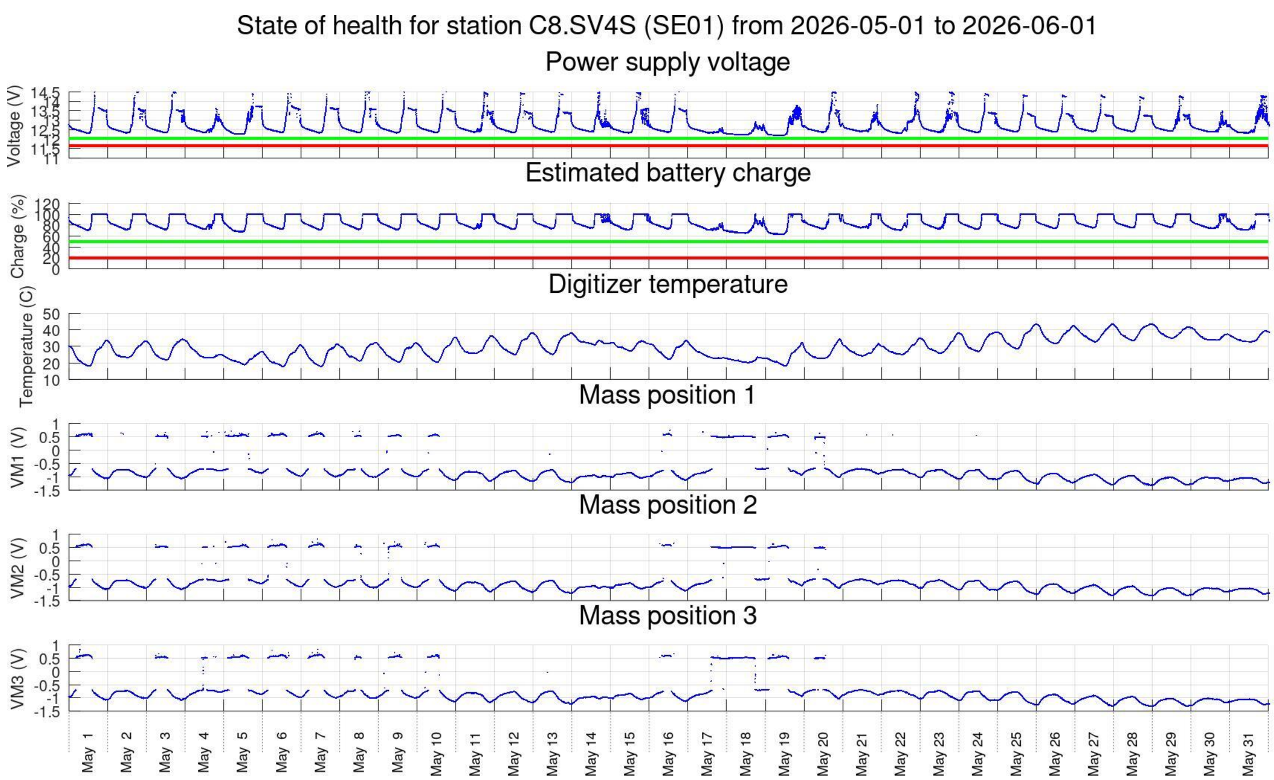

Figure 2, continued, station SV4S.

Figure 2, continued, station SV5S.

Data recovery

Data recovery from all stations was nearly 100% (Figures 1 and 2). The data from station SV5S were retrieved at the end of June.

2. Data quality

Figure 3 shows two measures of data quality evaluated for each channel:

1) Numbers of spikes and tears (sharp changes of DC level) within 1-hour time intervals;
2) 1-hour interval root-mean square (RMS) average amplitudes in each channel.

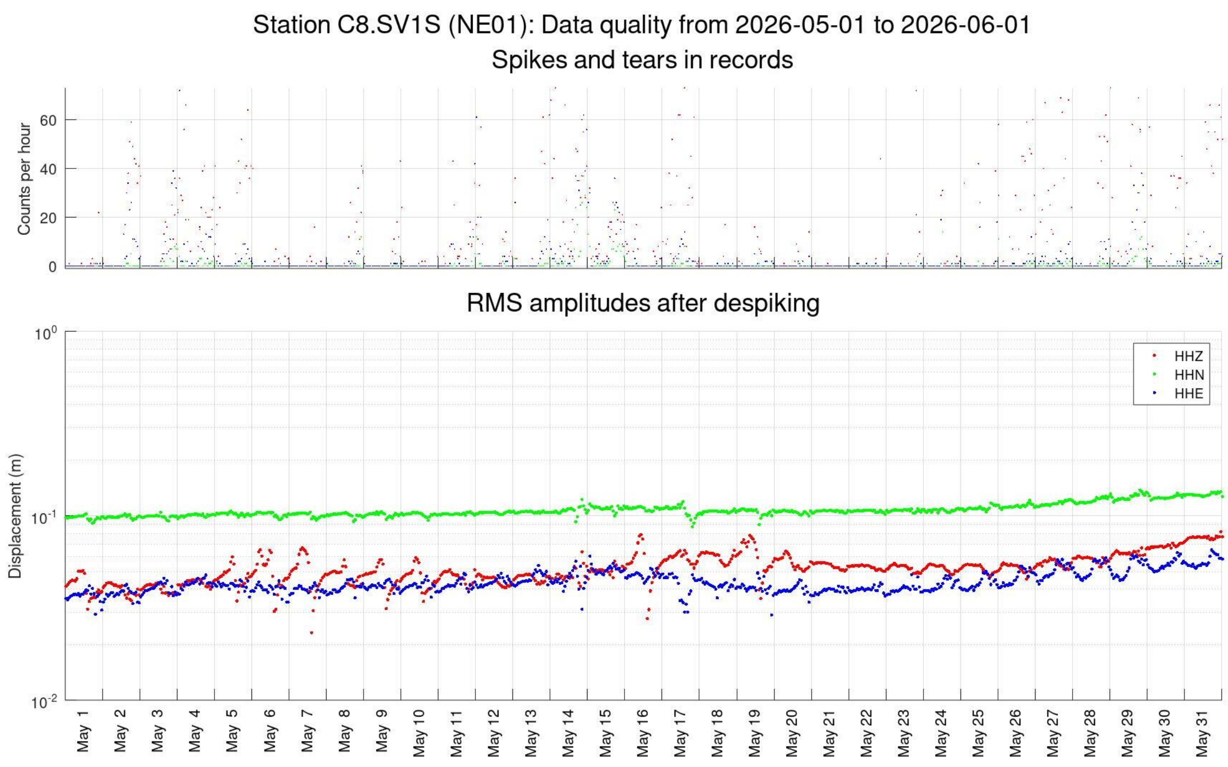

Figure 3. Measures of data quality in hour-long intervals. Station names and time intervals are indicated in plot headings (SV1S in this plot). Red, green, and blue colours correspond to channels HHZ, HHN, and HHE, respectively (as in Figure 1).

Top panels: Numbers of spikes and tears per hour auto-detected in data records.

Bottom panels: RMS ground displacements (meters).

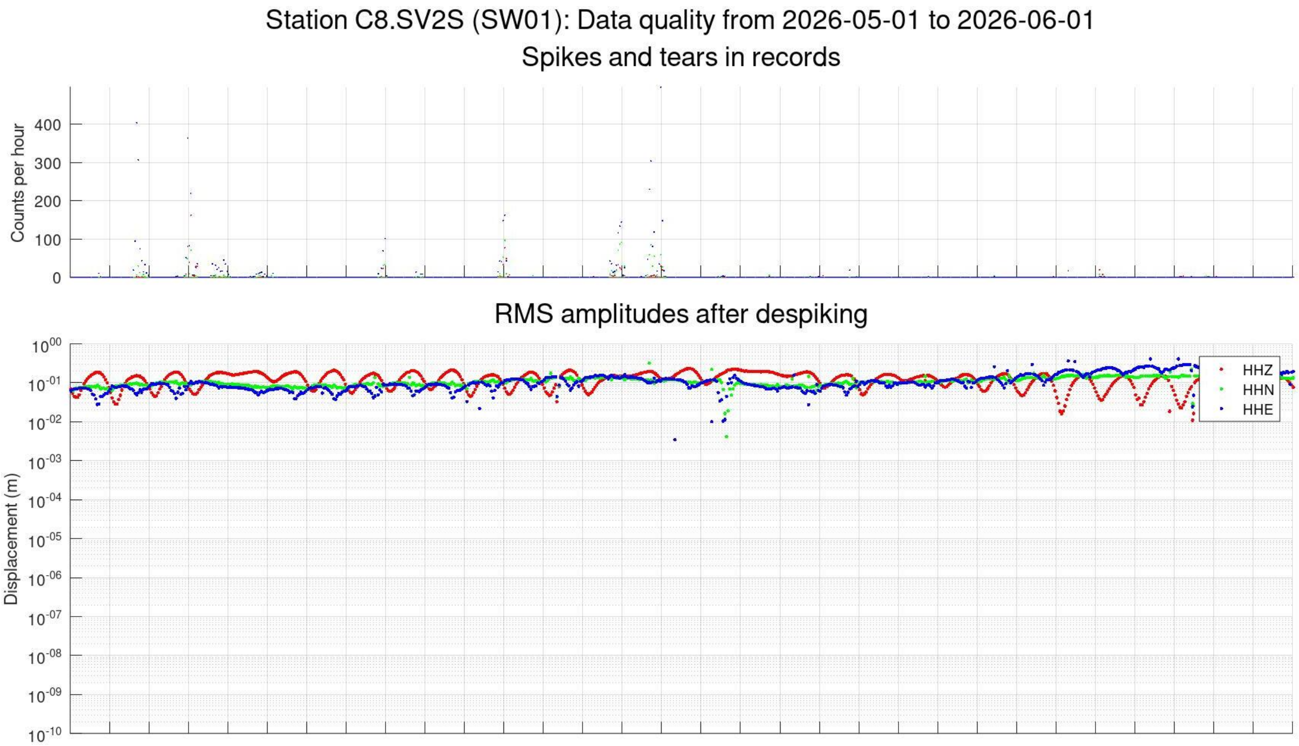

Figure 3, continued. Station SV2S.

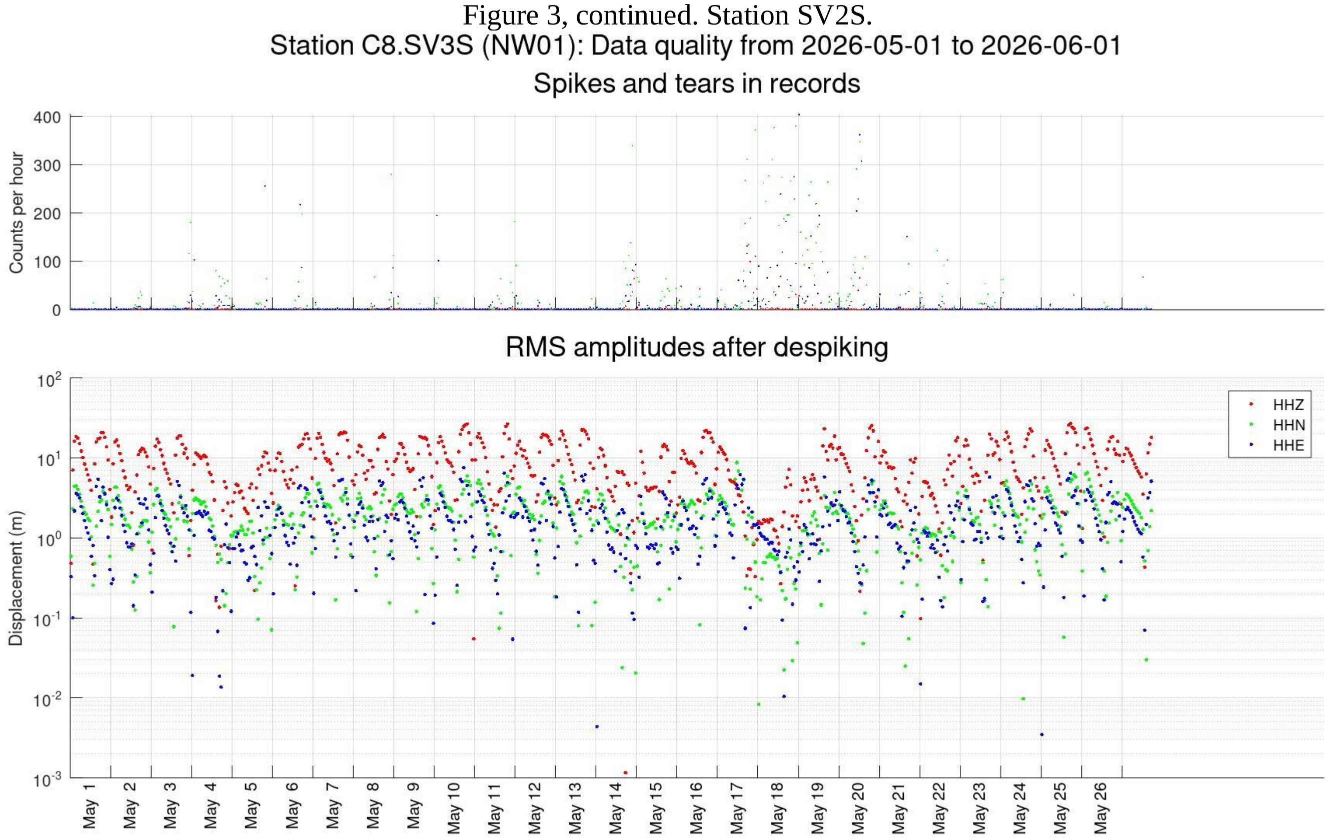

Figure 3, continued. Station SV3S.

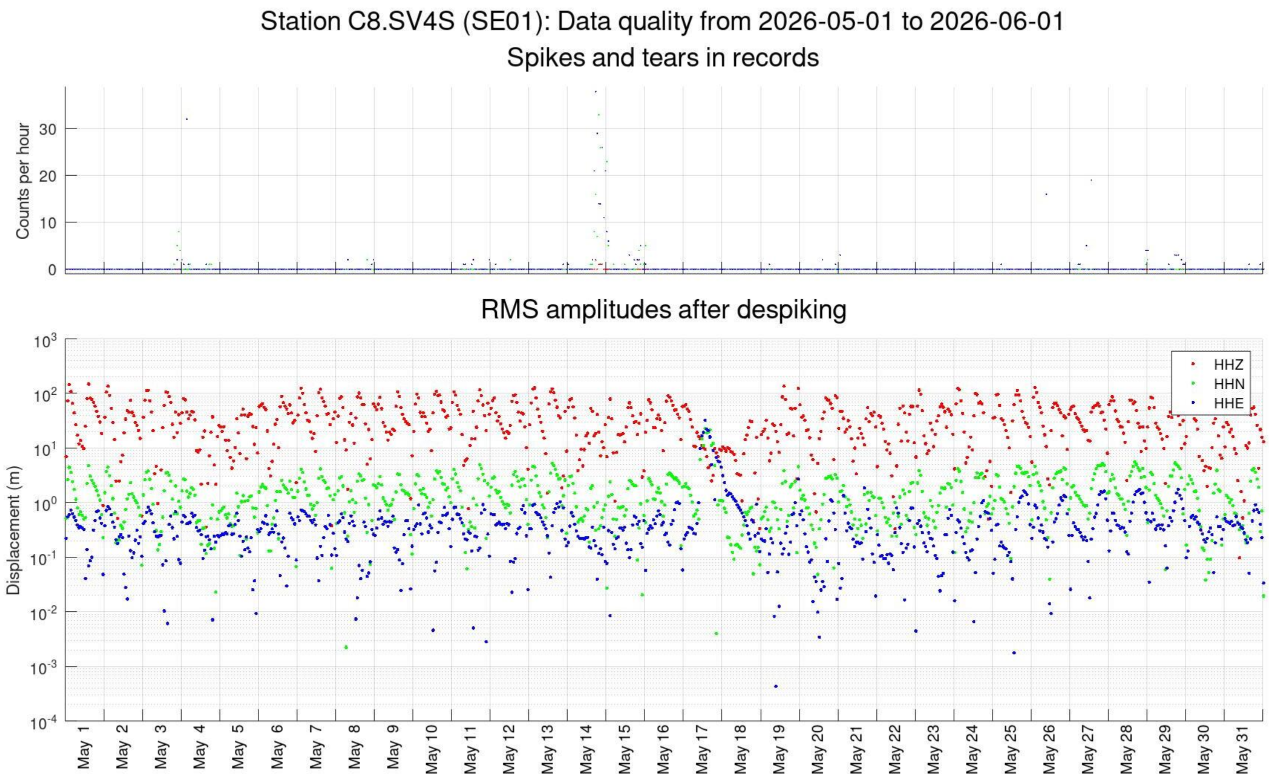

Figure 3, continued. Station SV4S.

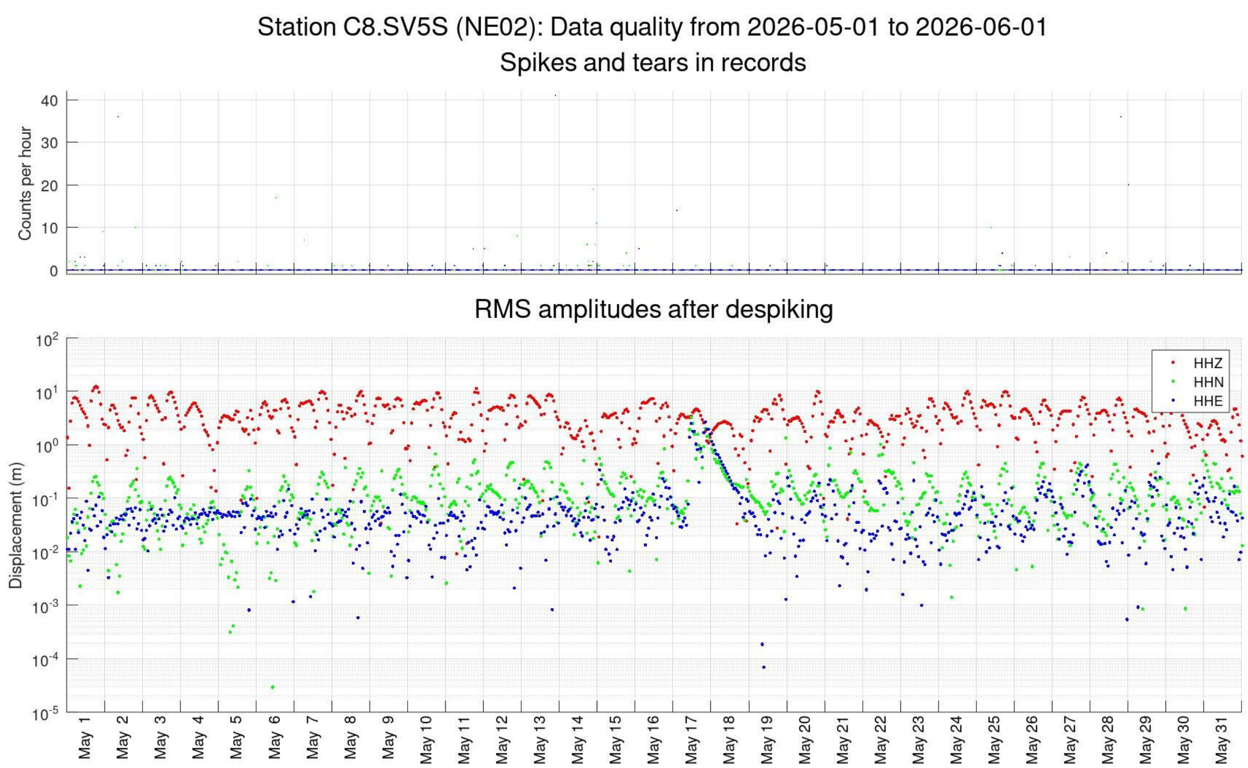

Figure 3, continued. Station SV5S.

3. Processing procedure and parameters

Processing procedure and parameters were the same as in previous reports.

4. Seismic event detection

The classification of seismic events used in these reports and numbers of events detected in May 2026 are shown in Table 2.

Table 2. Classification of seismic events and numbers of detections at Aquistore broadband seismic array

Event class code	Class name	Identification criteria	Number of detections in this report
1	Teleseismic	Hypocentral distance *D* > 1000 km, presence in catalogues	21
2	Regional	100 < *D* < 1000 km, presence in catalogues	0
3	Local	Approx. 4 < *D* < 100 km	------------
3a	Possible mine blasts	Characteristic waveforms, amplitudes, back-azimuths east of Aquistore, *D* about 12-15 km	9
3b	Mining-related	Low frequencies, extended repeated wavetrains low arrival velocities related to surface waves	4 (selected from numerous occurrences)
4	Proximity (close local)	D < 3-4 km, deviation of array moveouts from plane-wave patterns, high frequency	------------
4a	Surface sources near array	Large travel-time moveouts, variable back-azimuths	1
4b	Target zone	Source at recognizable nonzero depth, small travel-time moveouts, high frequency	0

Automatic detections

The procedure of multichannel automatic detections is being revised and not shown in the present report.

Event bulletins

Earthquake data bulletins for the period of this report were obtained from NEIC (USGS) and NRCan web services (Figure e). Events larger than magnitude 2.5 were taken from USGS, and all available events were retrieved from NRCan. Events with magnitudes above the selected $magnitude \propto distance^{1.5}$ threshold (dashed green line in Figure e) were reviewed interactively (next section).

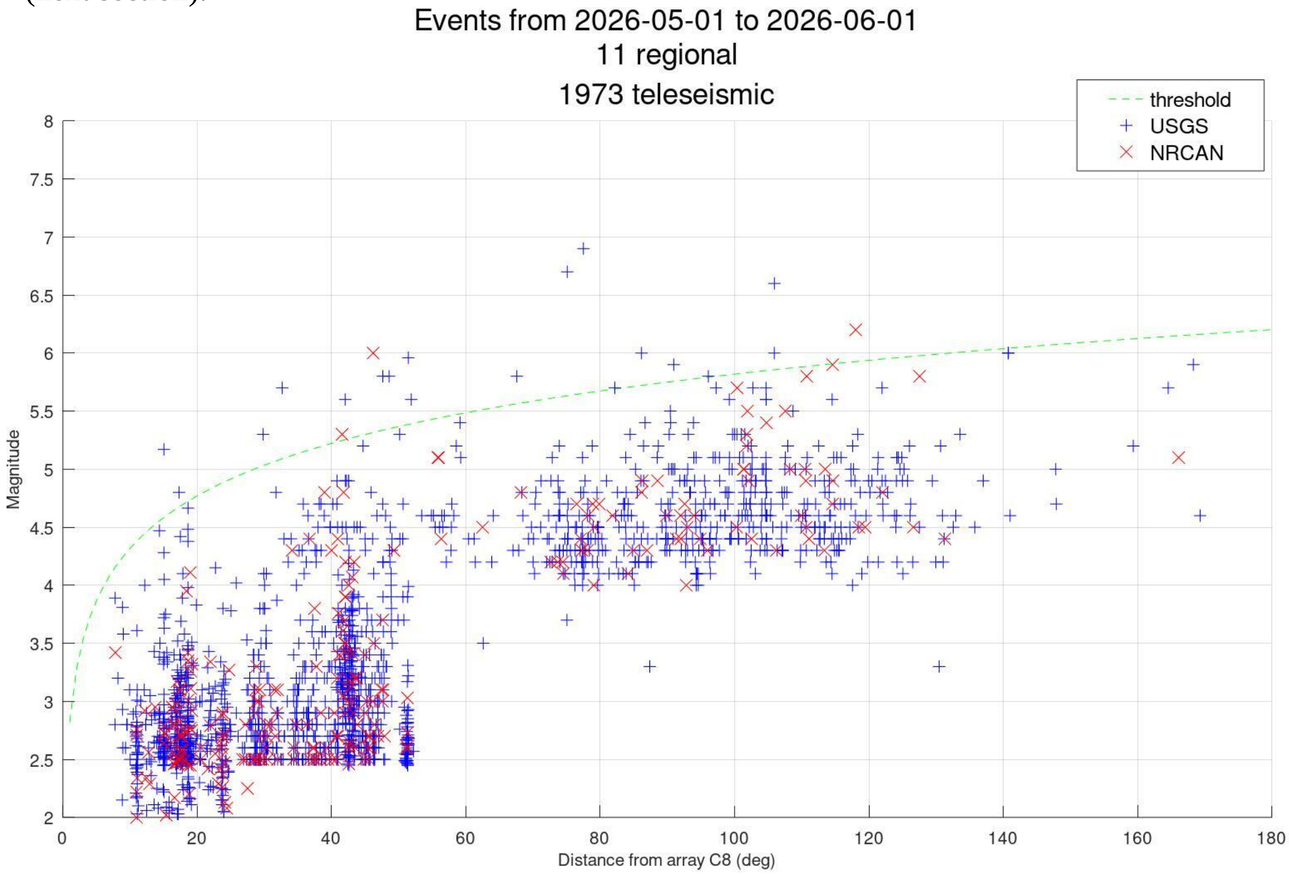

Figure 5. Magnitudes and distances from Aquistore for earthquake parameters downloaded from USGS and NRCan databases (legend). Dashed green line shows the detection threshold above which a manual review of events was performed.

Teleseismic events (class 1)

Above the threshold line in Figure 5, 21 teleseismic events (class 1 in Table 2) were identified in May 2026 (Figure 6). Some of the events are clear and spectacular and for other, only the S-wave (red marks in Figure 5) and surface waves (low-frequency arrivals after the S waves) can be recognized.

Time zeros in Figure 6 plots are located at the times of P-wave arrivals at the Aquistore array predicted in the reference model IASP91 and corrected interactively. Blue bars near *time* = 0 are interactive picks of P-wave arrival times.

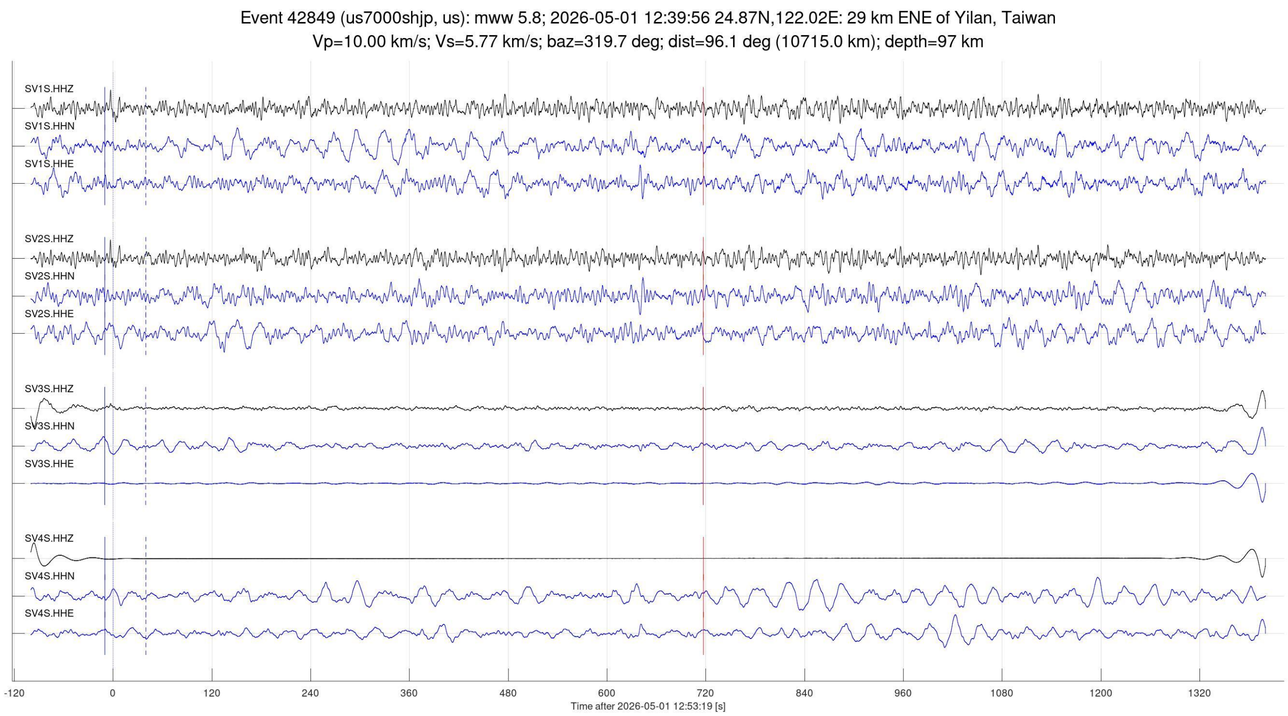

Figure 6. Teleseismic events detected at Aquistore in May 2026. Plot headings show catalogue IDs, magnitudes, times, distances in degrees, source coordinates and localities, back-azimuths (‘baz=’), distances (‘dist=’) and source depths. Vertical-component records are shown in black, and horizontal components in blue. Blue and red bars indicate the P-wave and S-wave picks, respectively. Ignore the (experimental) cyan and dashed bars.

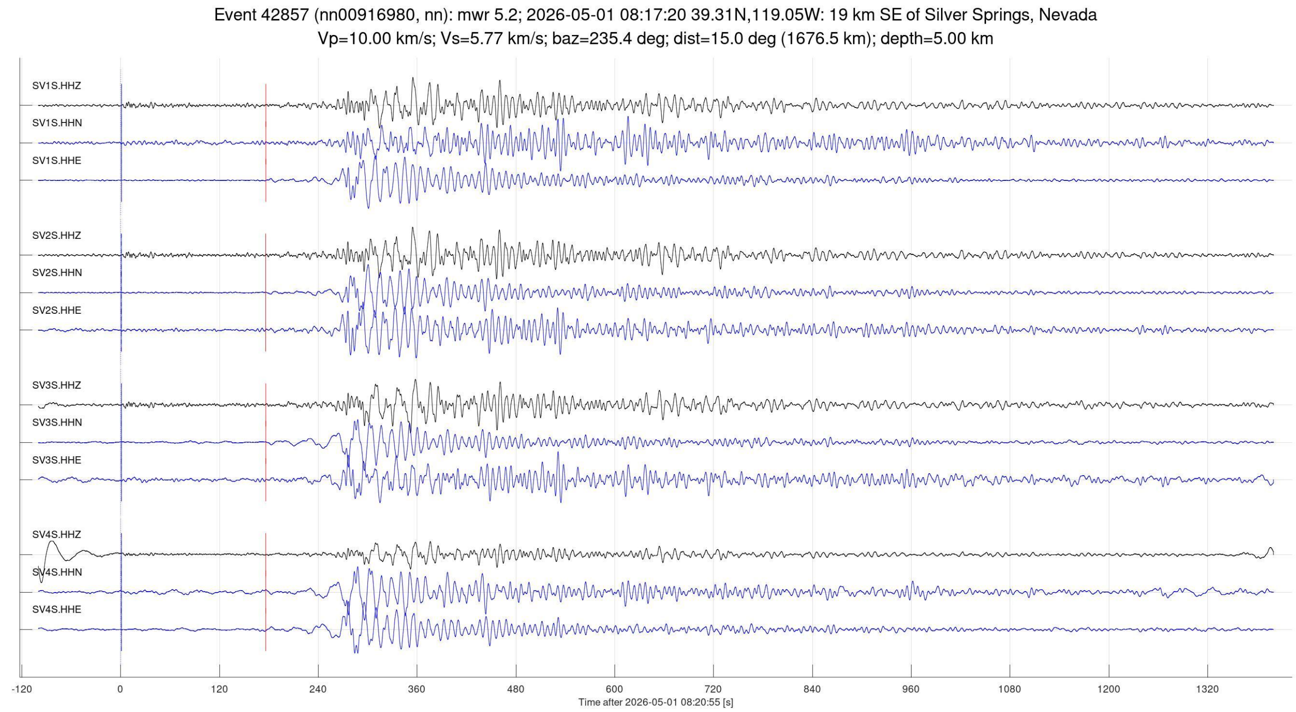

Figure 6, continued.

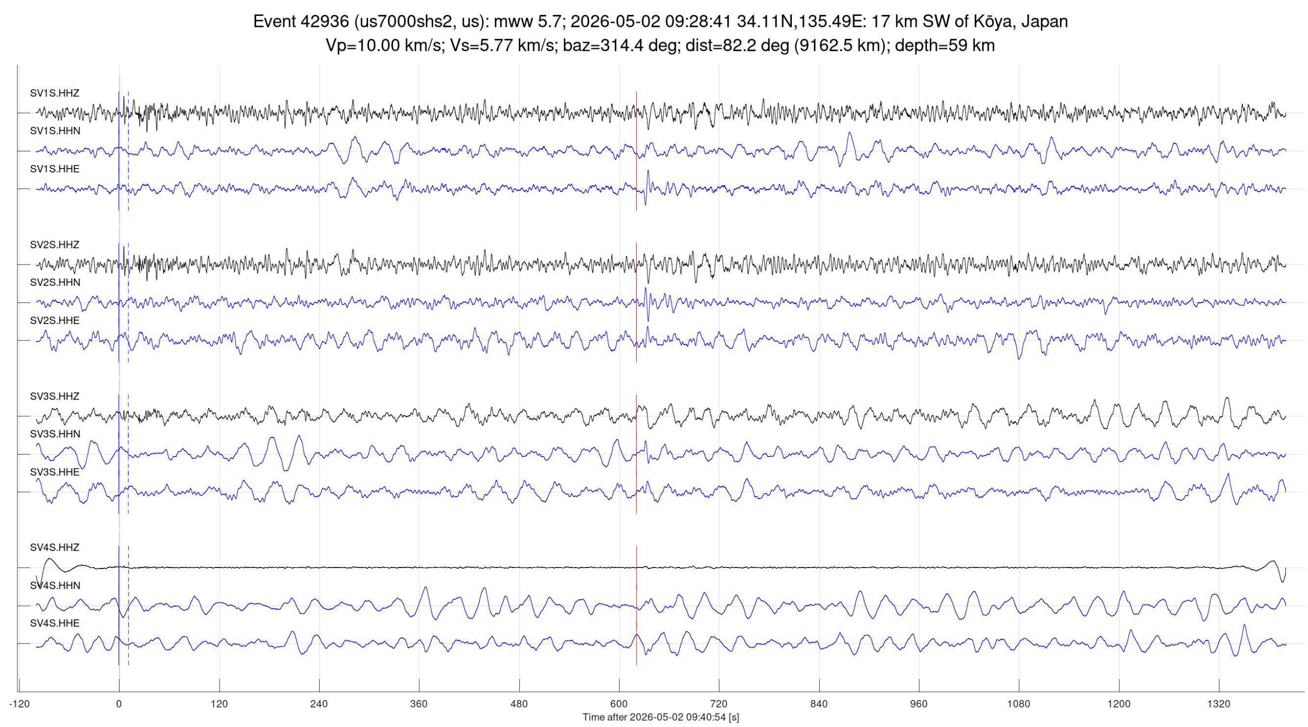

Figure 6, continued.

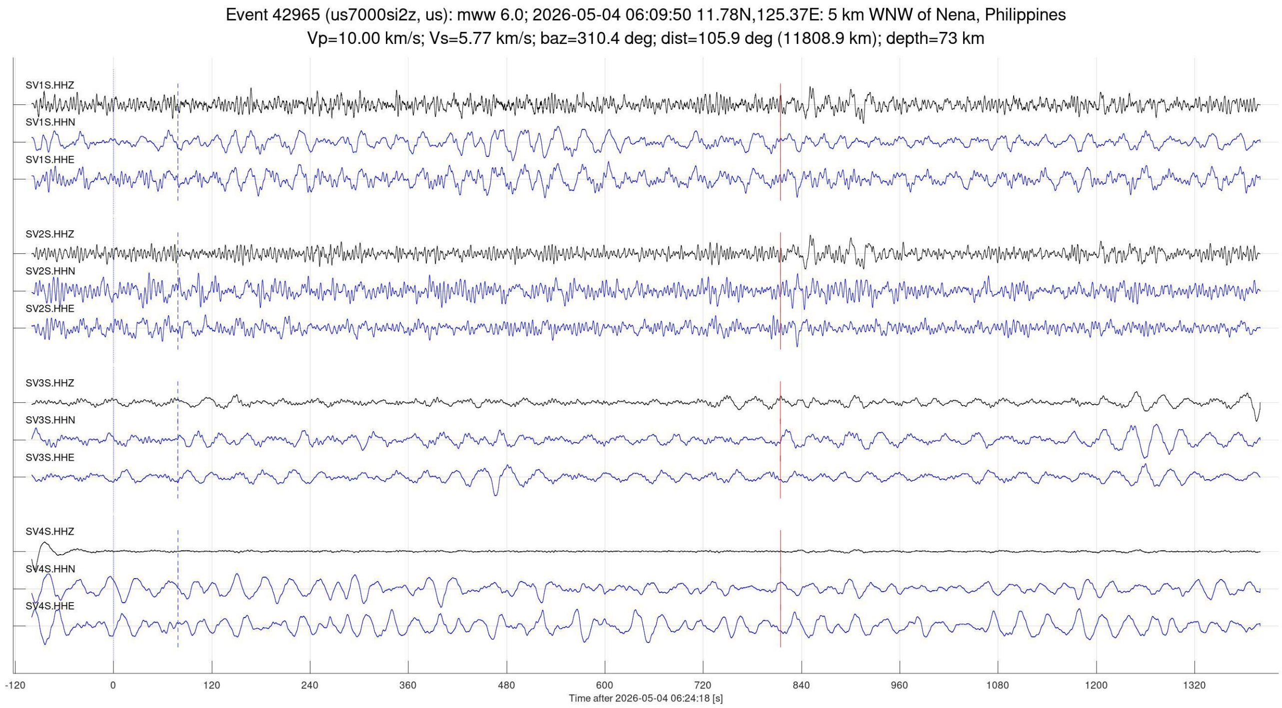

Figure 6, continued.

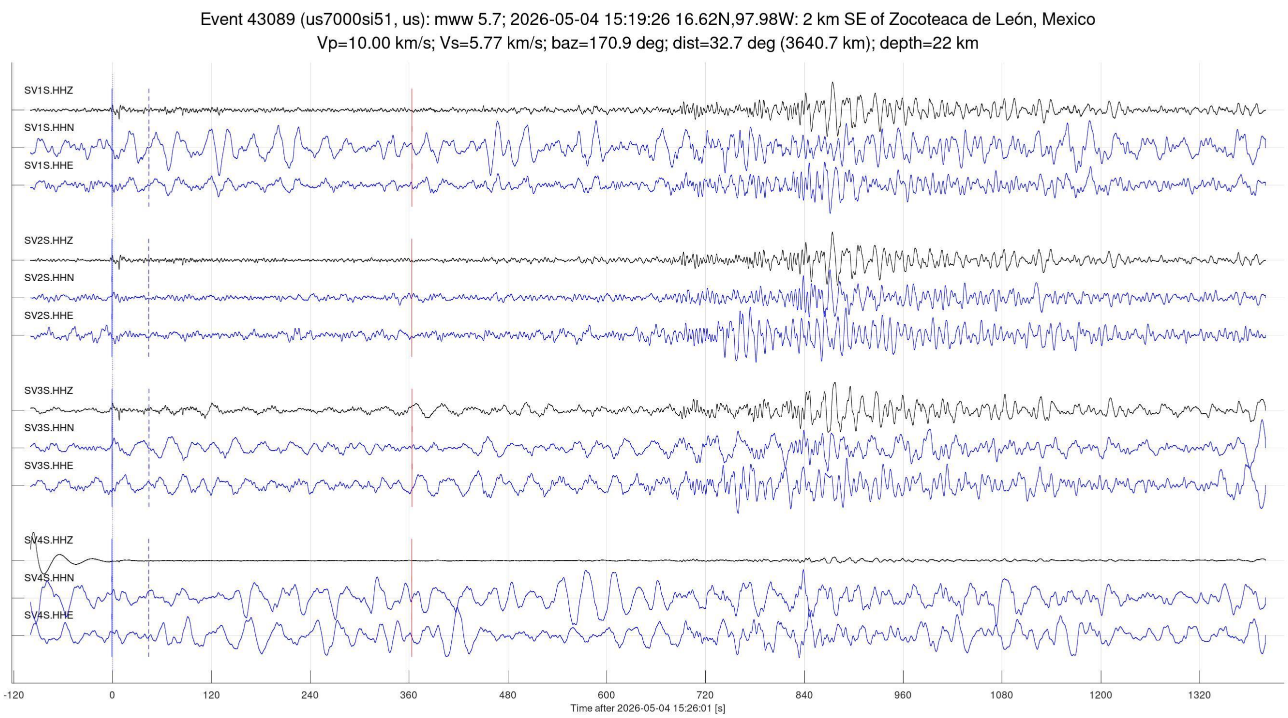

Figure 6, continued.

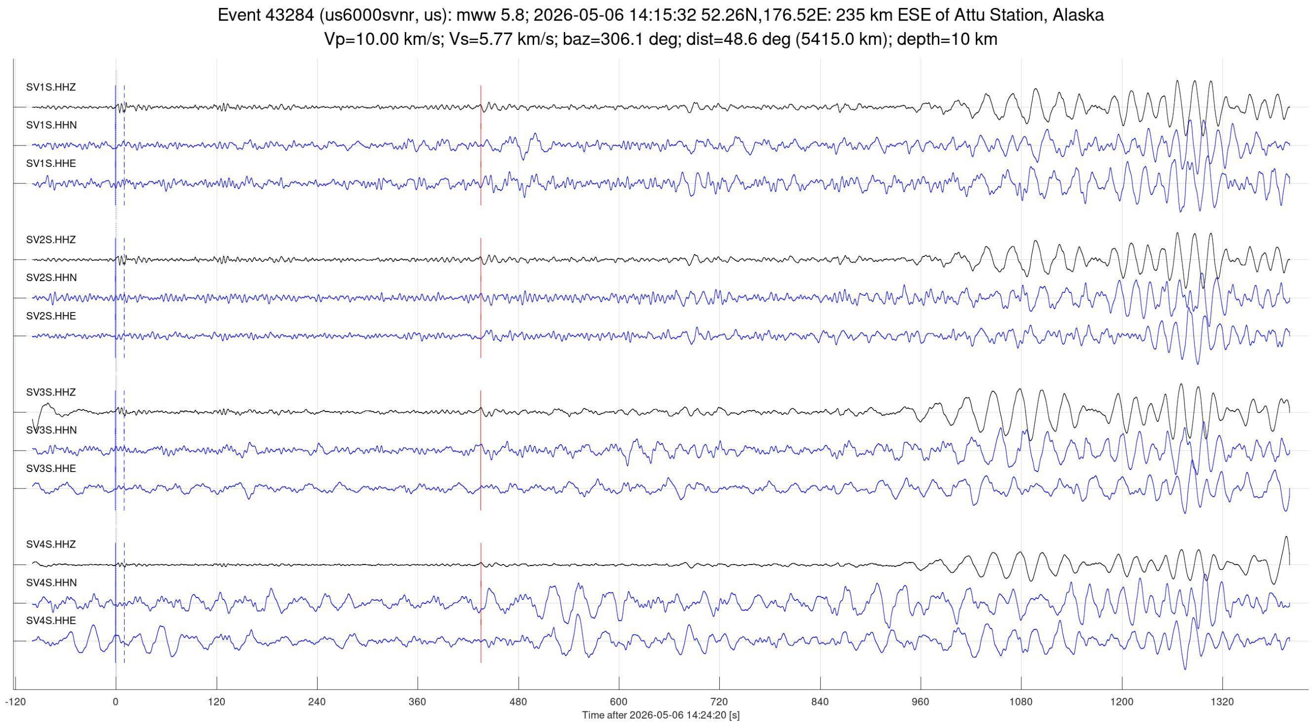

Figure 6, continued.

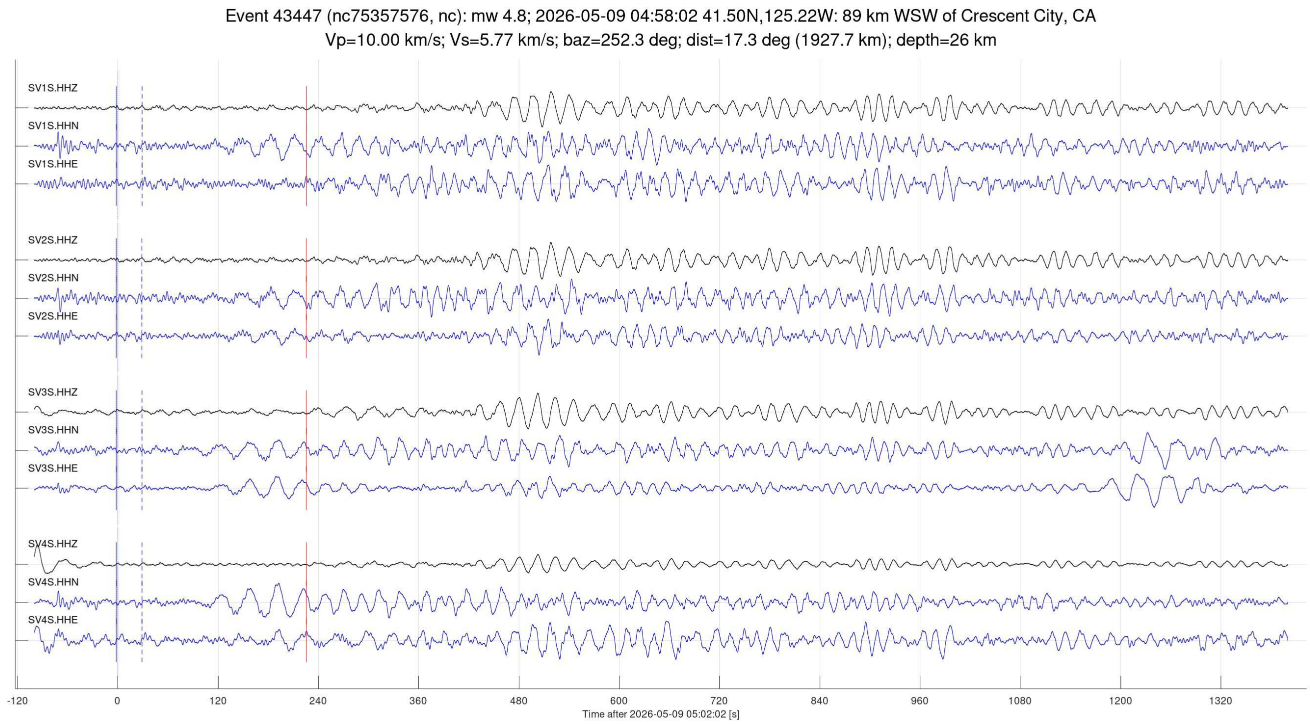

Figure 6, continued.

Event 43448 (us6000swf4, us): mww 5.8; 2026-05-09 04:42:23 51.08N,179.35E: 292 km WSW of Adak, Alaska
Vp=10.00 km/s; Vs=5.77 km/s; baz=303.5 deg; dist=47.6 deg (5310.2 km); depth=26 km

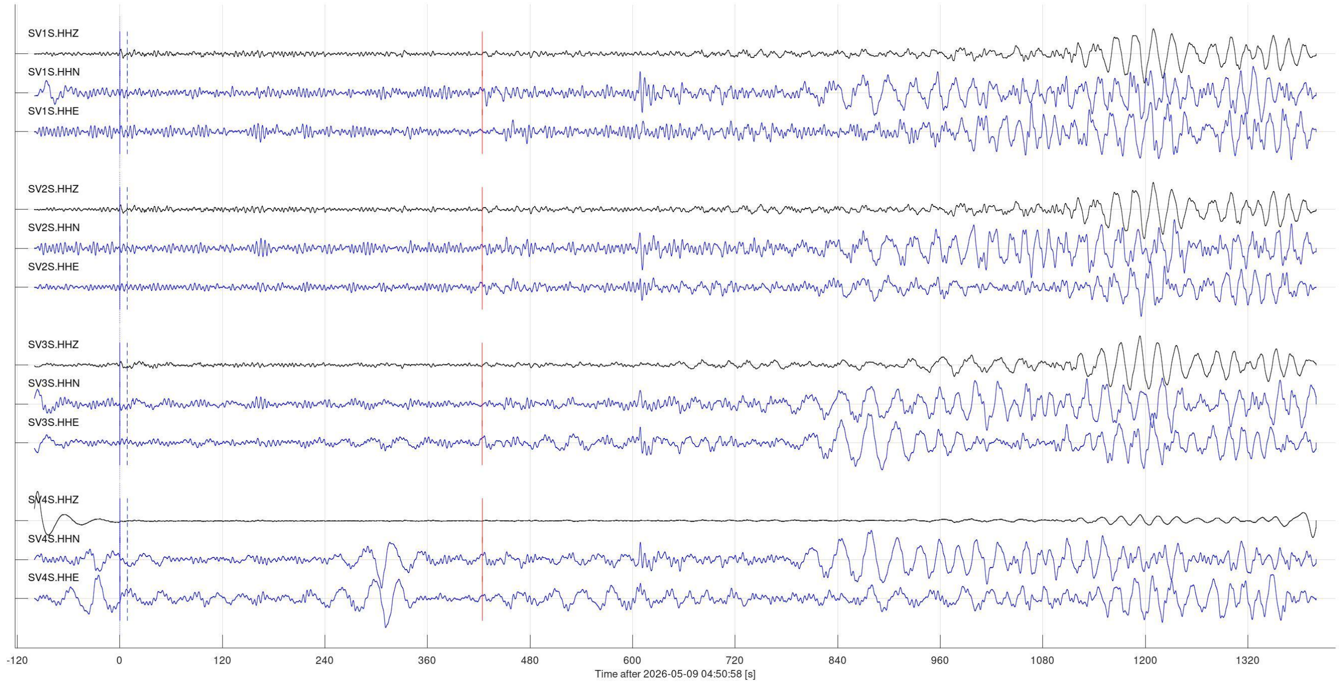

Figure 6, continued.

Event 43911 (us6000sxqf, us): mww 6.2; 2026-05-14 17:53:15 6.20S,130.37E: 271 km WSW of Tual, Indonesia
Vp=10.00 km/s; Vs=5.77 km/s; baz=295.2 deg; dist=118.0 deg (13161.2 km); depth=146 km

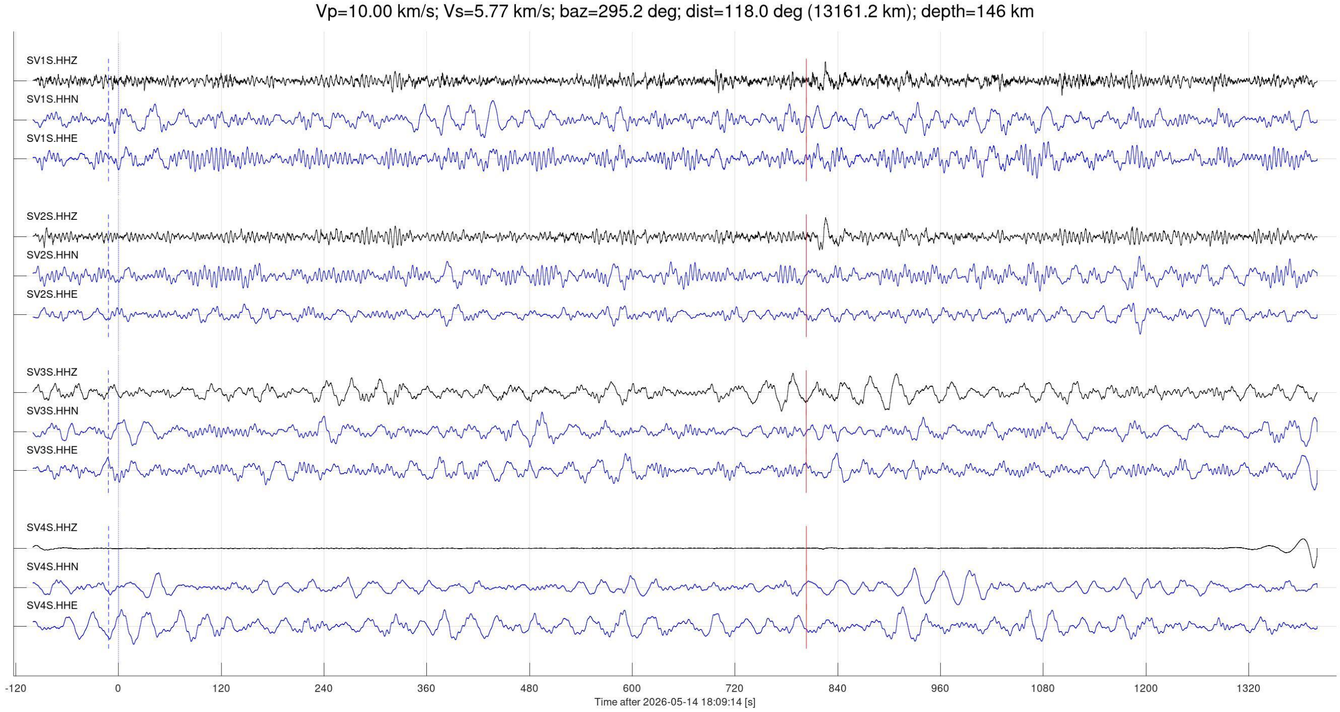

Figure 6, continued.

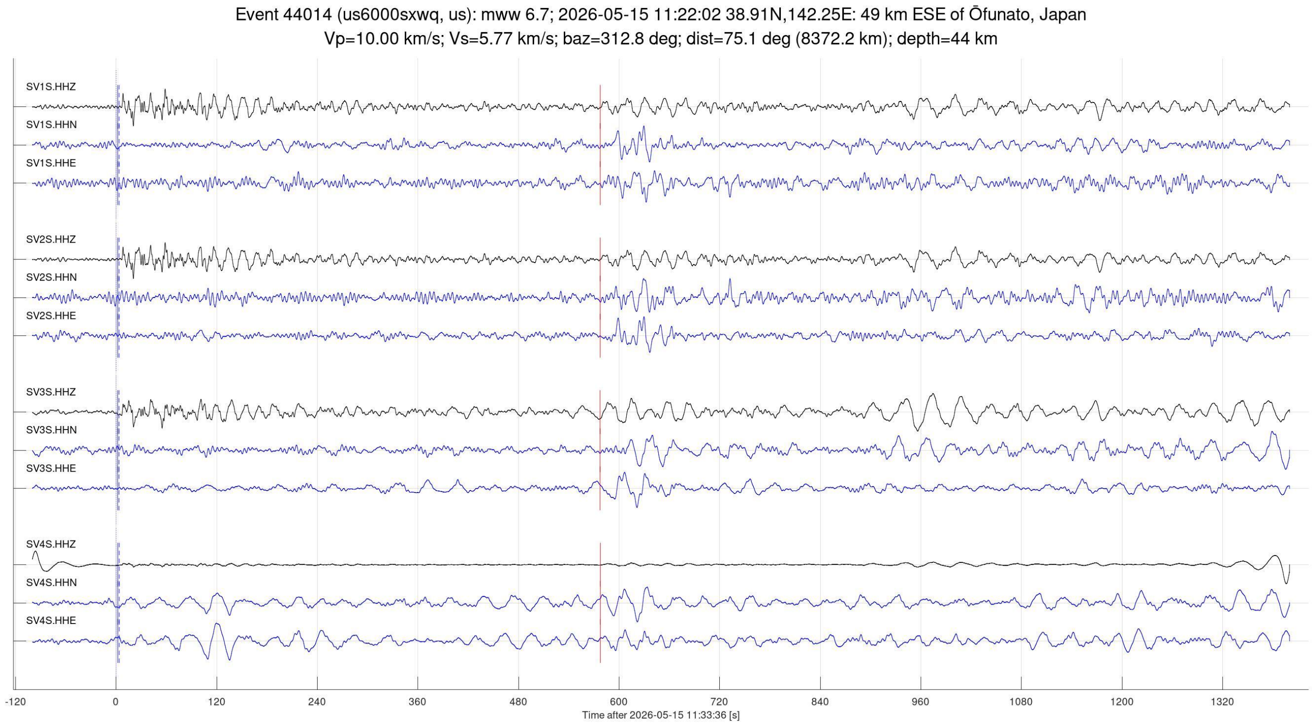

Figure 6, continued.

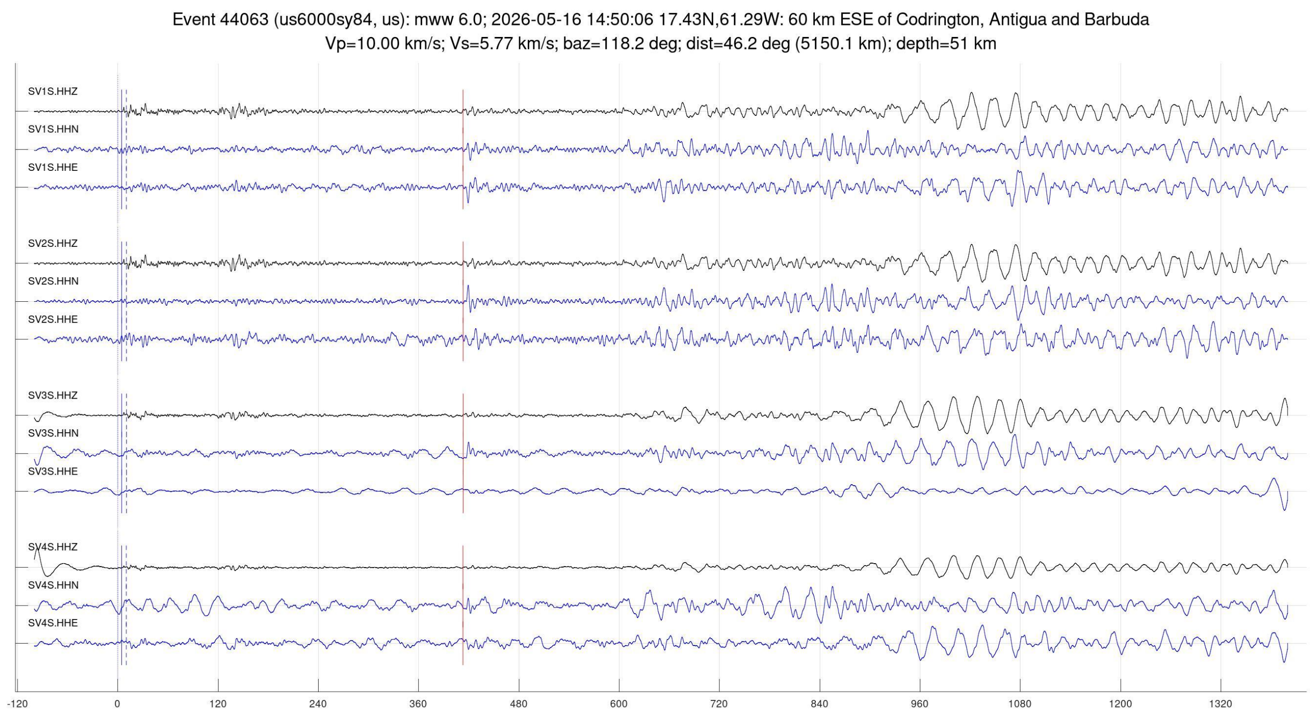

Figure 6, continued.

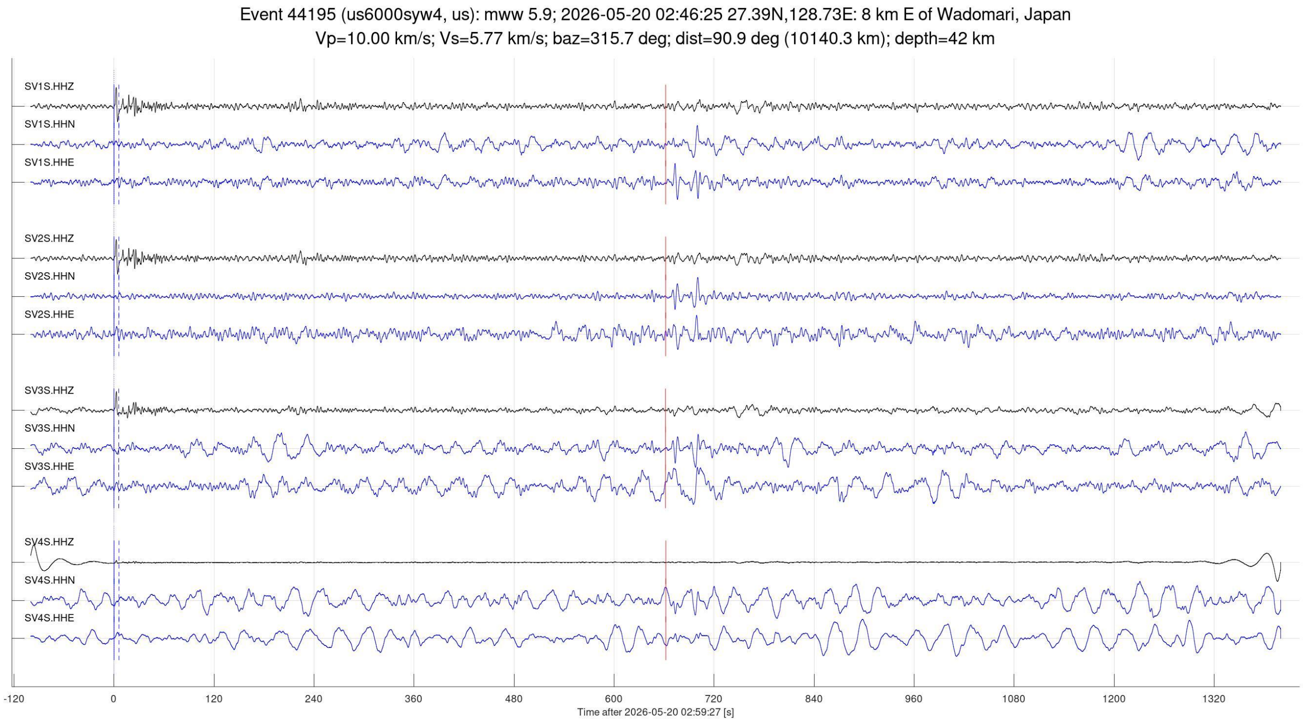

Figure 6, continued.

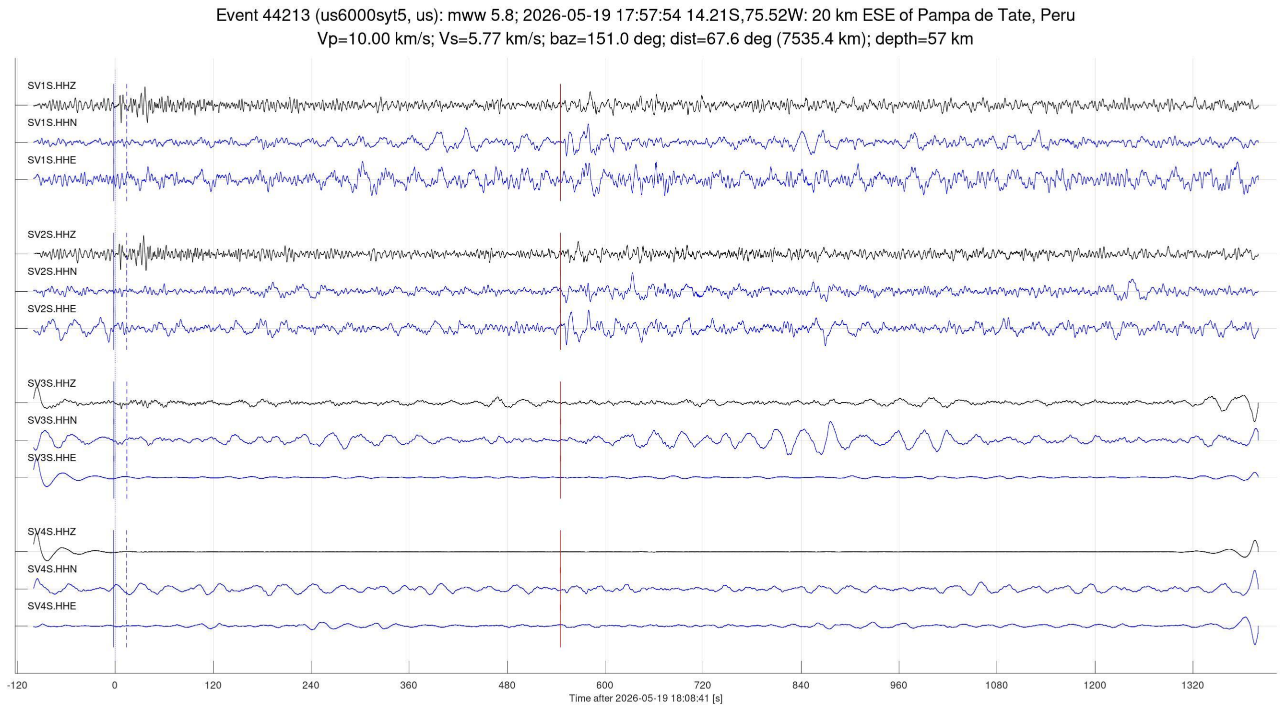

Figure 6, continued.

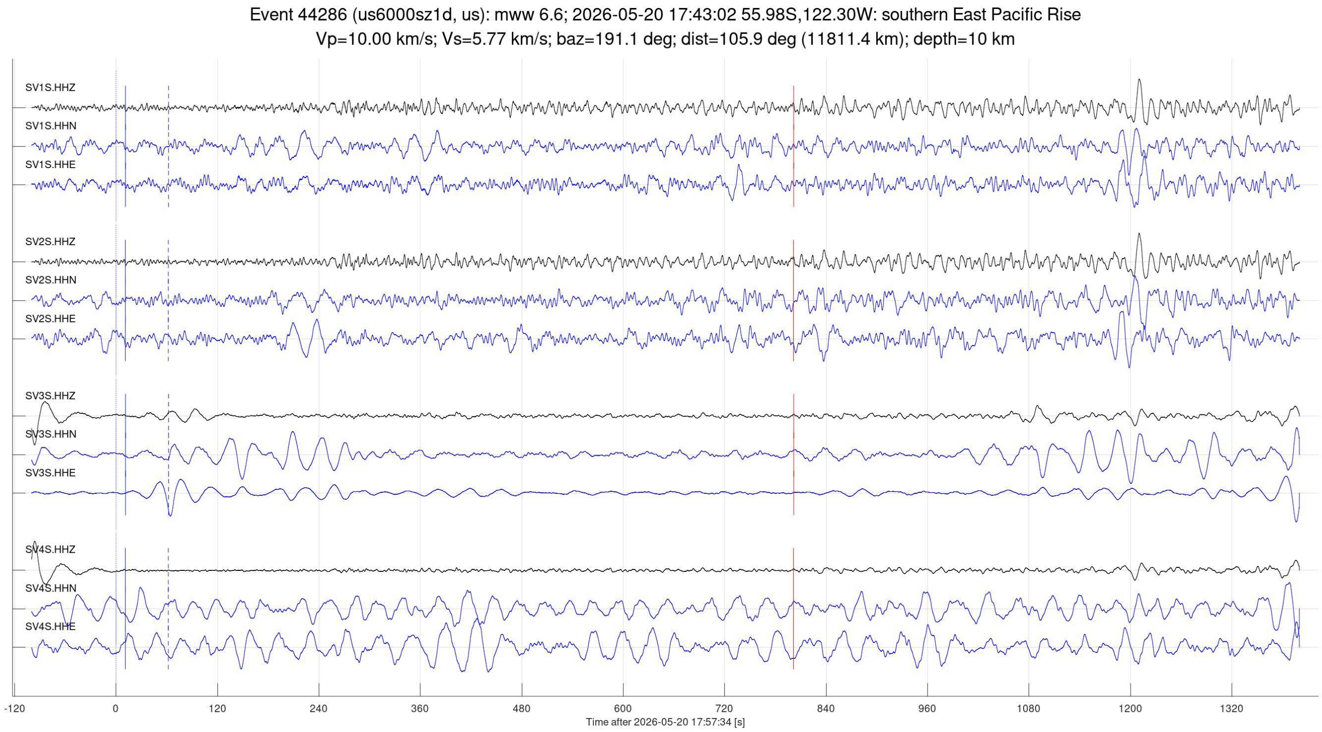

Figure 6, continued.

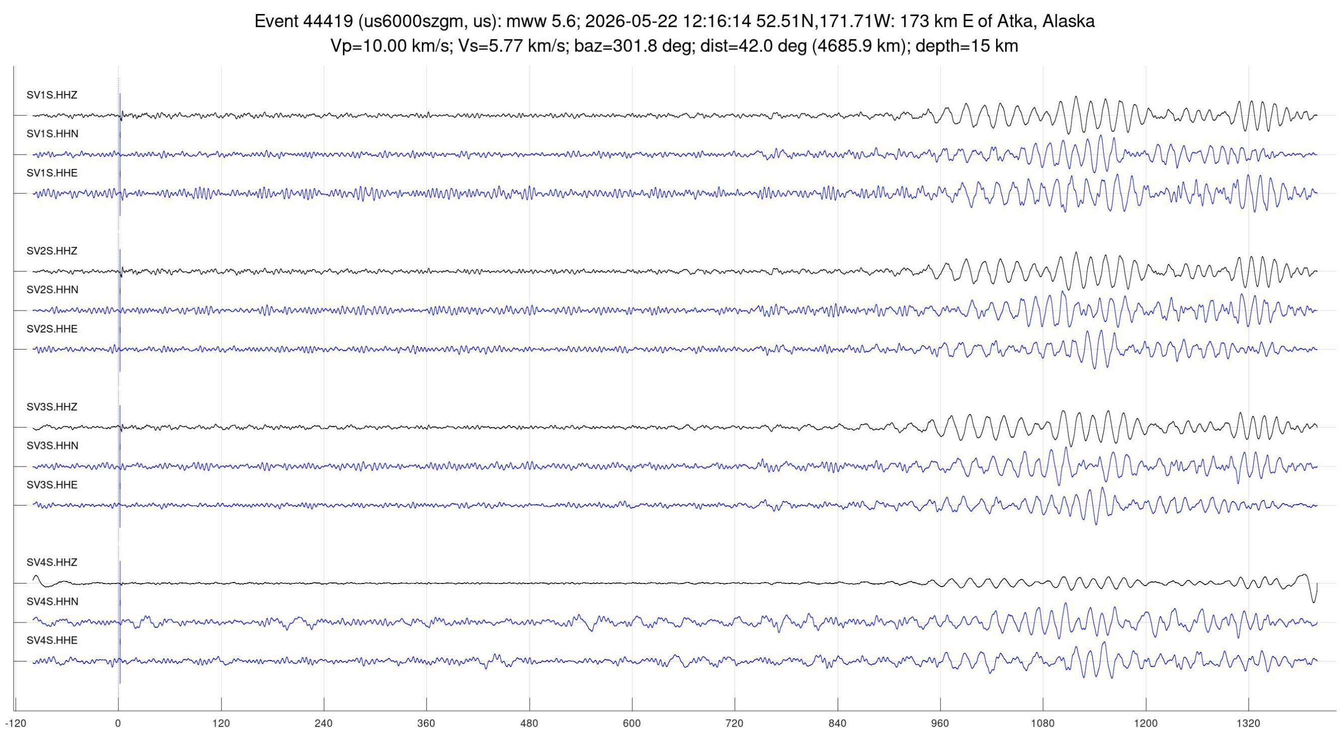

Figure 6, continued.

Event 44465 (us6000szt5, us): mww 5.3; 2026-05-23 21:49:17 51.73N,170.35W: 168 km SW of Nikolski, Alaska
Vp=10.00 km/s; Vs=5.77 km/s; baz=300.2 deg; dist=41.6 deg (4635.7 km); depth=7.15 km

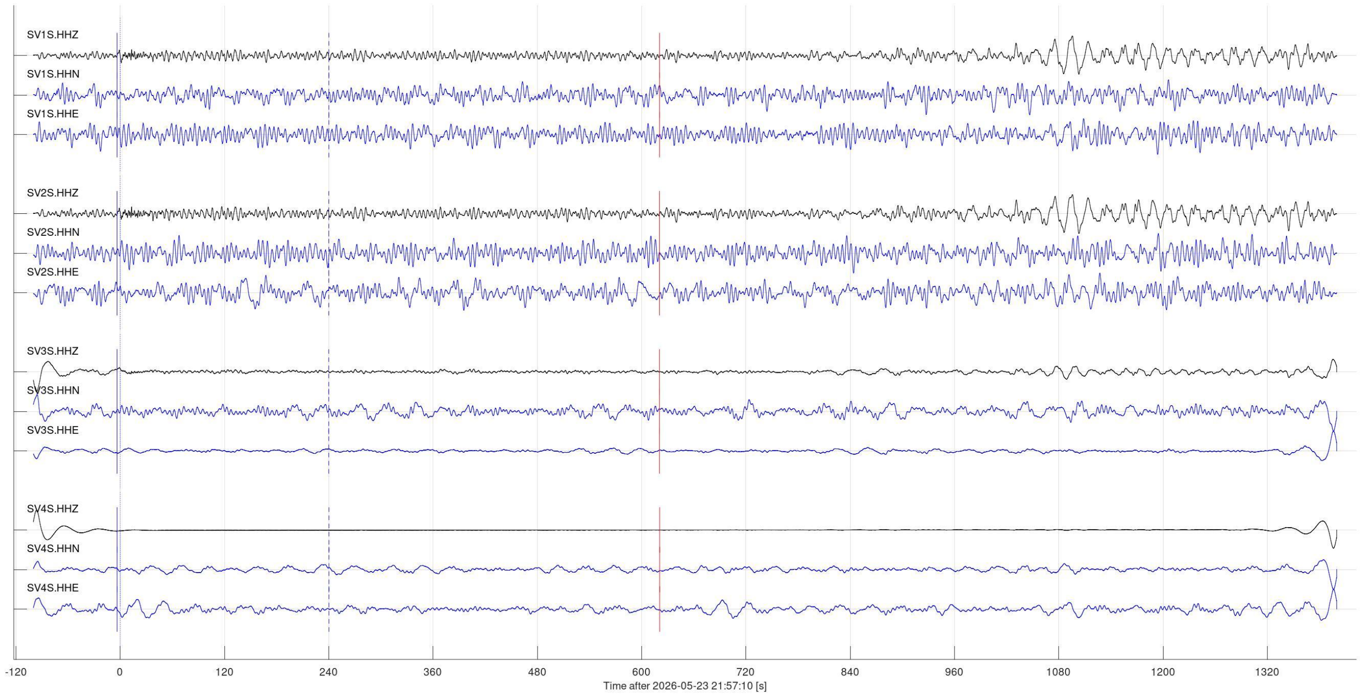

Figure 6, continued.

Event 44495 (hv74966427, hv): ml 6.0; 2026-05-23 07:46:01 19.34N,155.84W: 13 km S of Honaunau-Napoopoo, Hawaii
Vp=10.00 km/s; Vs=5.77 km/s; baz=254.1 deg; dist=51.4 deg (5733.1 km); depth=23 km

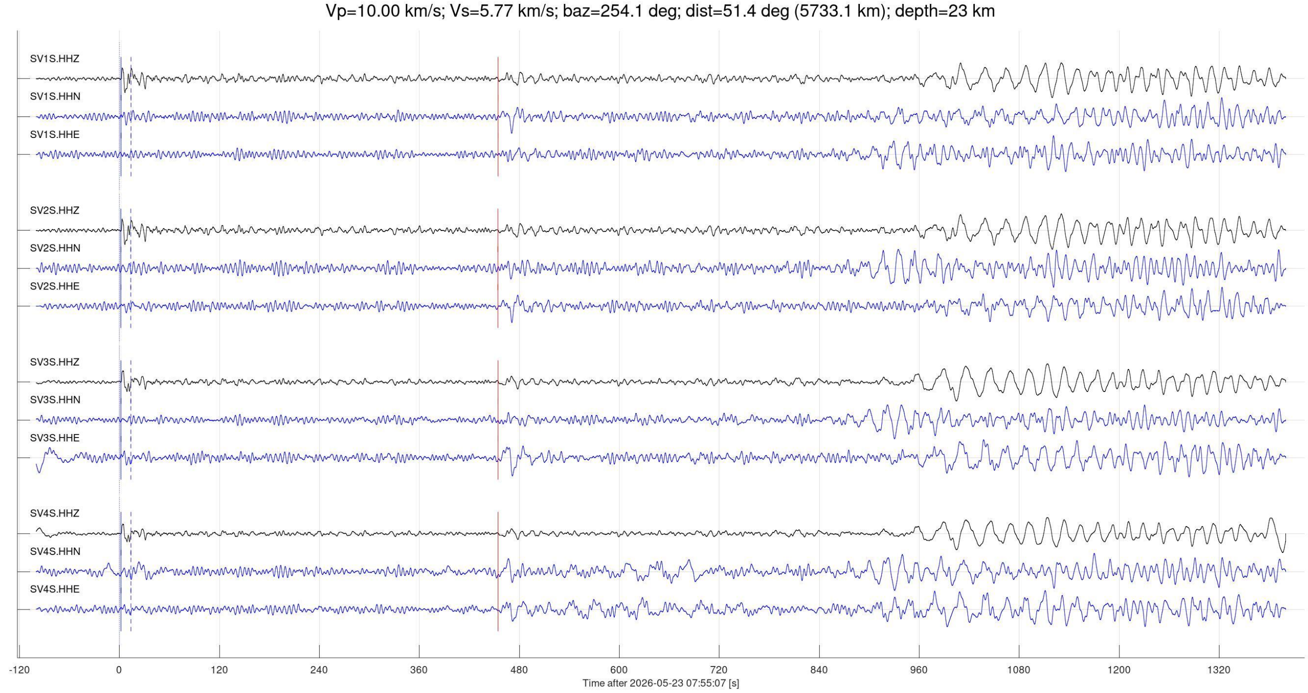

Figure 6, continued.

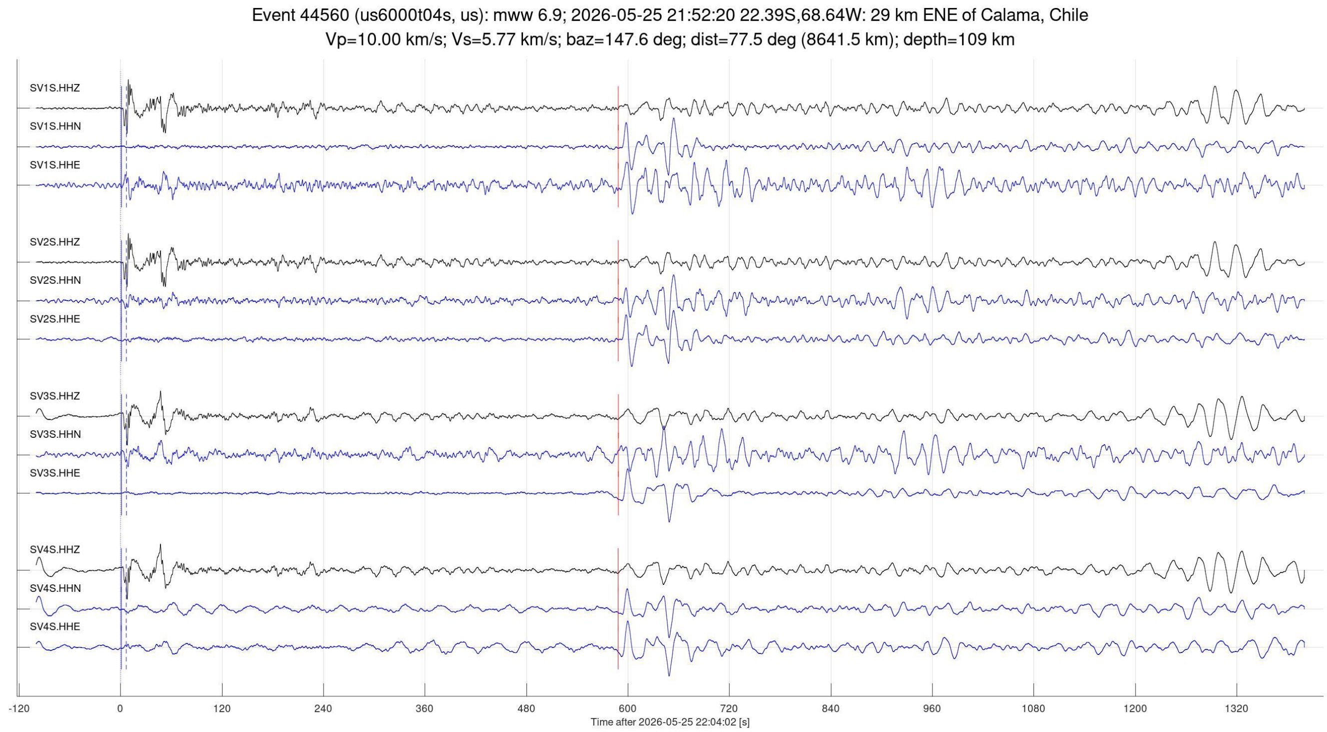

Figure 6, continued.

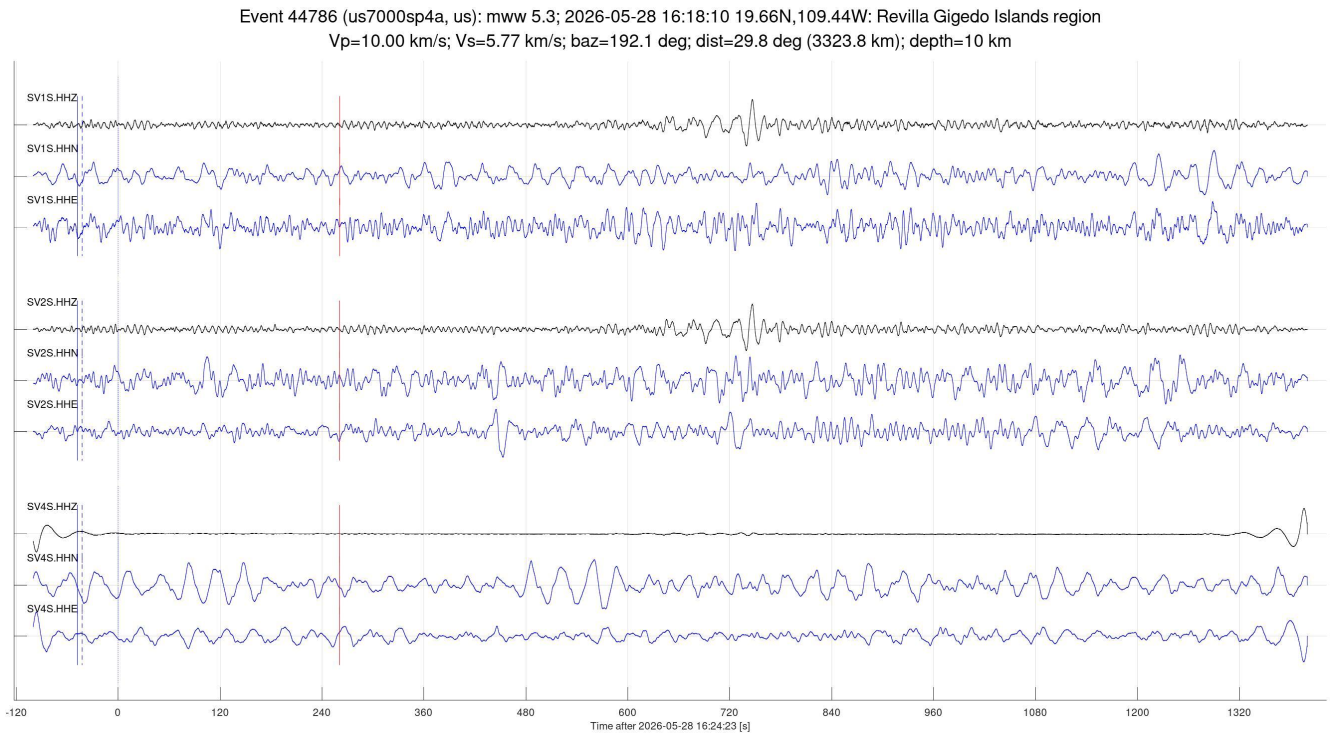

Figure 6, continued.

Event 44902 (us7000spkc, us): mww 5.6; 2026-05-30 21:27:26 11.91N,59.10W: 137 km SSE of Oistins, Barbados
Vp=10.00 km/s; Vs=5.77 km/s; baz=120.2 deg; dist=51.9 deg (5783.0 km); depth=35 km

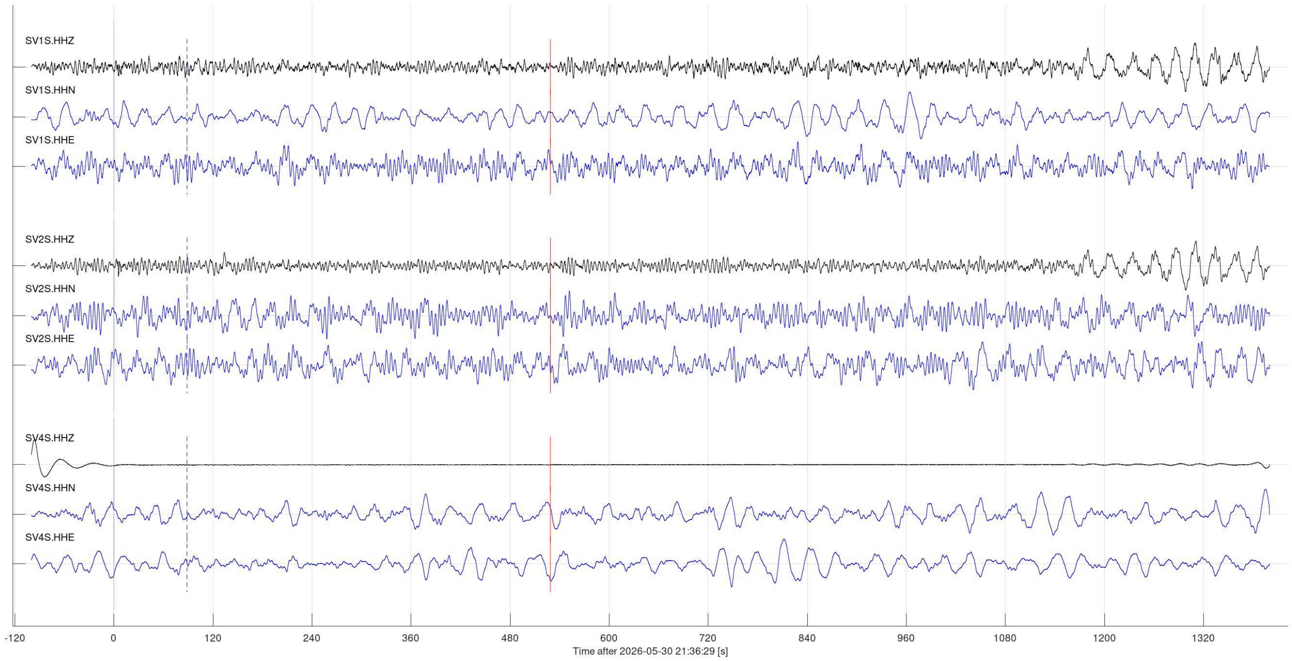

Figure 6, continued.

Event 44943 (us7000spqc, us): mww 6.0; 2026-05-31 21:34:18 32.80S,71.86W: 33 km NW of Valparaíso, Chile
Vp=10.00 km/s; Vs=5.77 km/s; baz=154.1 deg; dist=86.2 deg (9606.0 km); depth=25 km

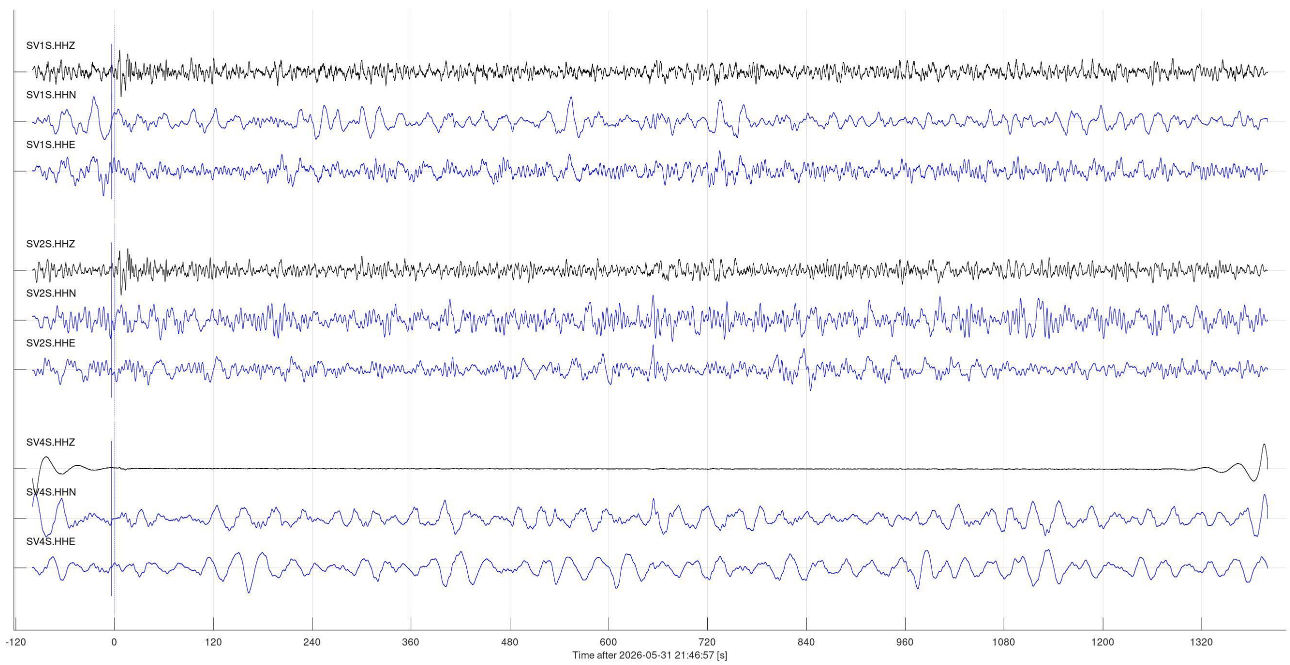

Figure 6, continued.

Regional events (class 2)

No regional seismic events (class 2 in Table 2) were found in bulletins or detected by the Aquistore stations in the reporting period.

Local events (classes 3 and 4)

The following subsections summarize observations of event classes 3 and 4 in Table 2.

Possible mine blasts at the Estevan mine (class 3a)

16 events were identified as mine blasts in the area of Estevan coal mining (Figure 8). It appears that some of these blasts are weaker and located at greater distance from the seismic array than most events recorded in 2025. A more datreiled analyusis locations require an updated

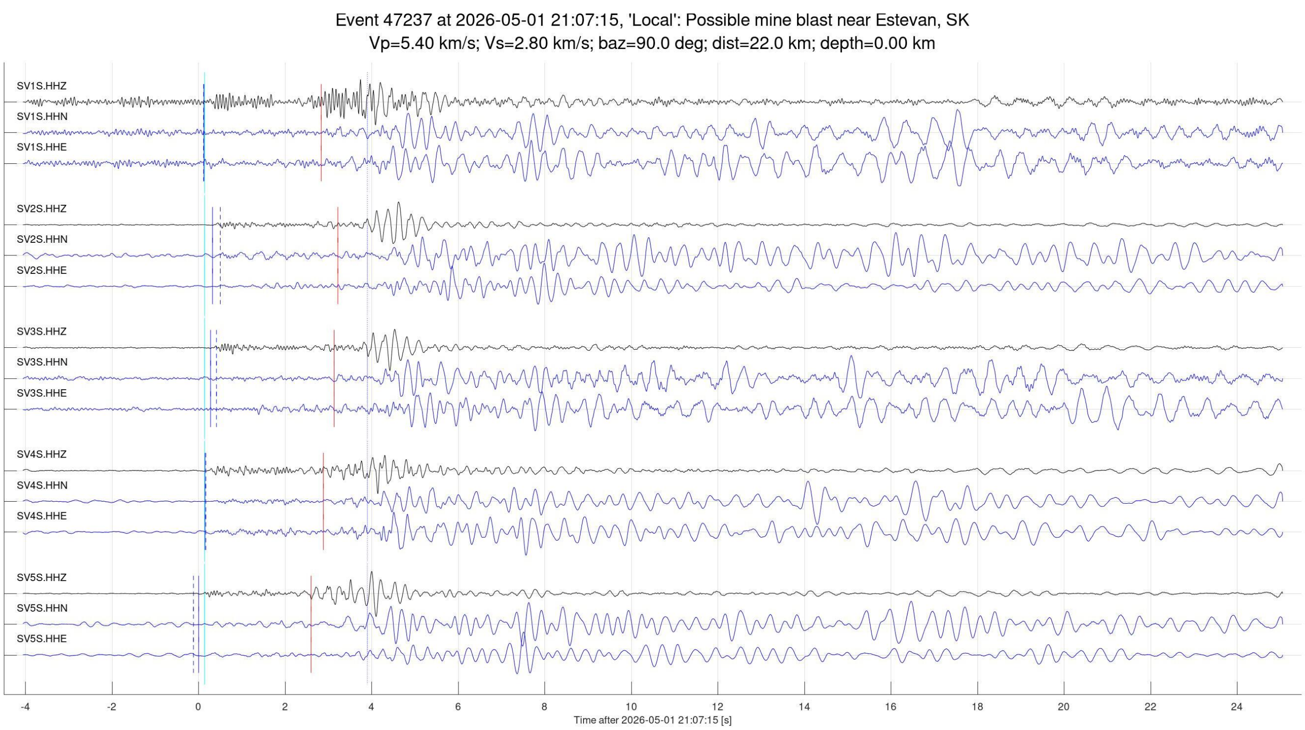

Figure 8. Seismic arrivals produced by mine blasts at the Estevan mine. Colours and labels are as in Figure 6.

Event 47238 at 2026-05-04 21:13:52, 'Local': Possible mine blast near Estevan, SK
Vp=5.40 km/s; Vs=2.80 km/s; baz=90.0 deg; dist=22.0 km; depth=0.00 km

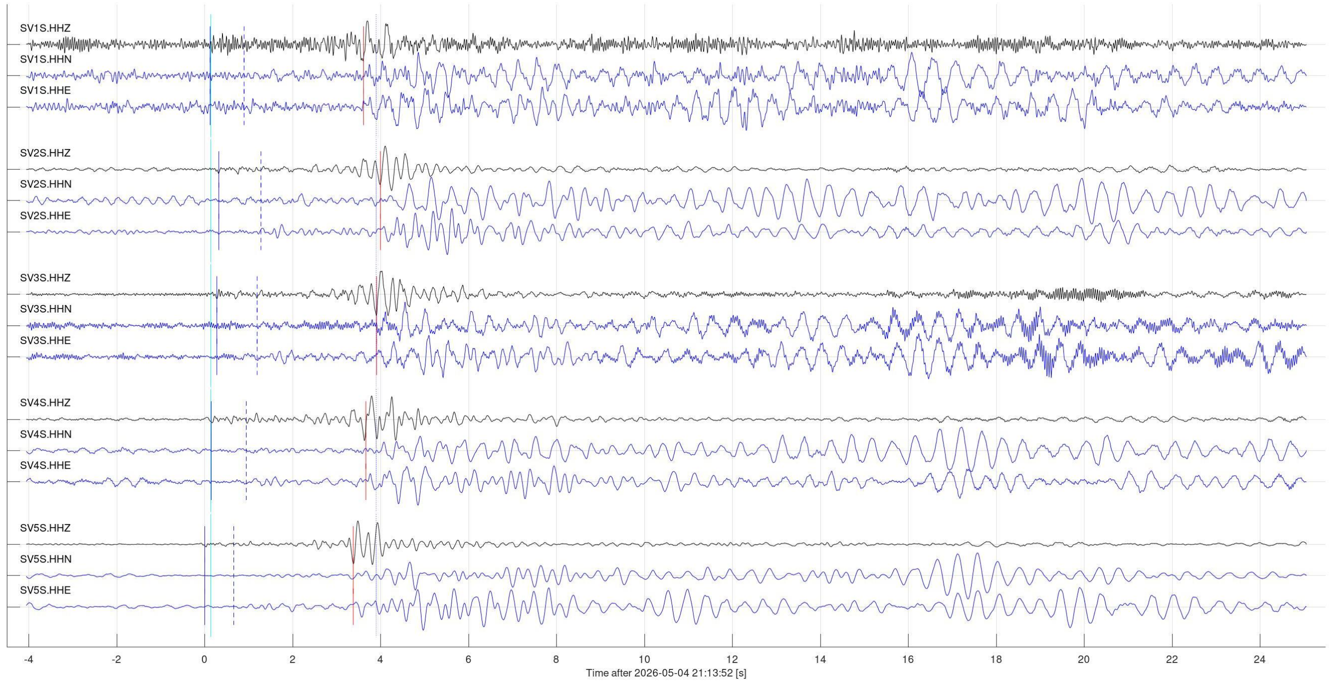

Figure 8, continued.

Event 47239 at 2026-05-05 21:04:00, 'Local': Possible mine blast near Estevan, SK
Vp=5.40 km/s; Vs=2.80 km/s; baz=90.0 deg; dist=22.0 km; depth=0.00 km

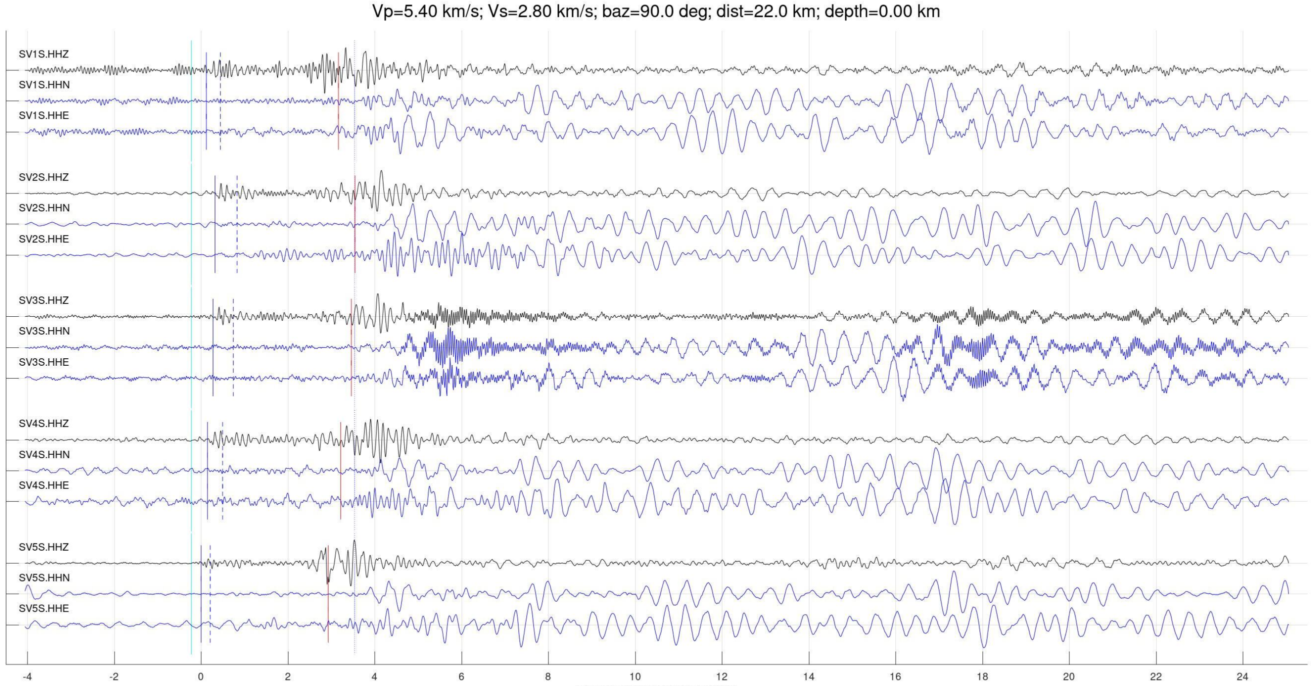

Figure 8, continued.

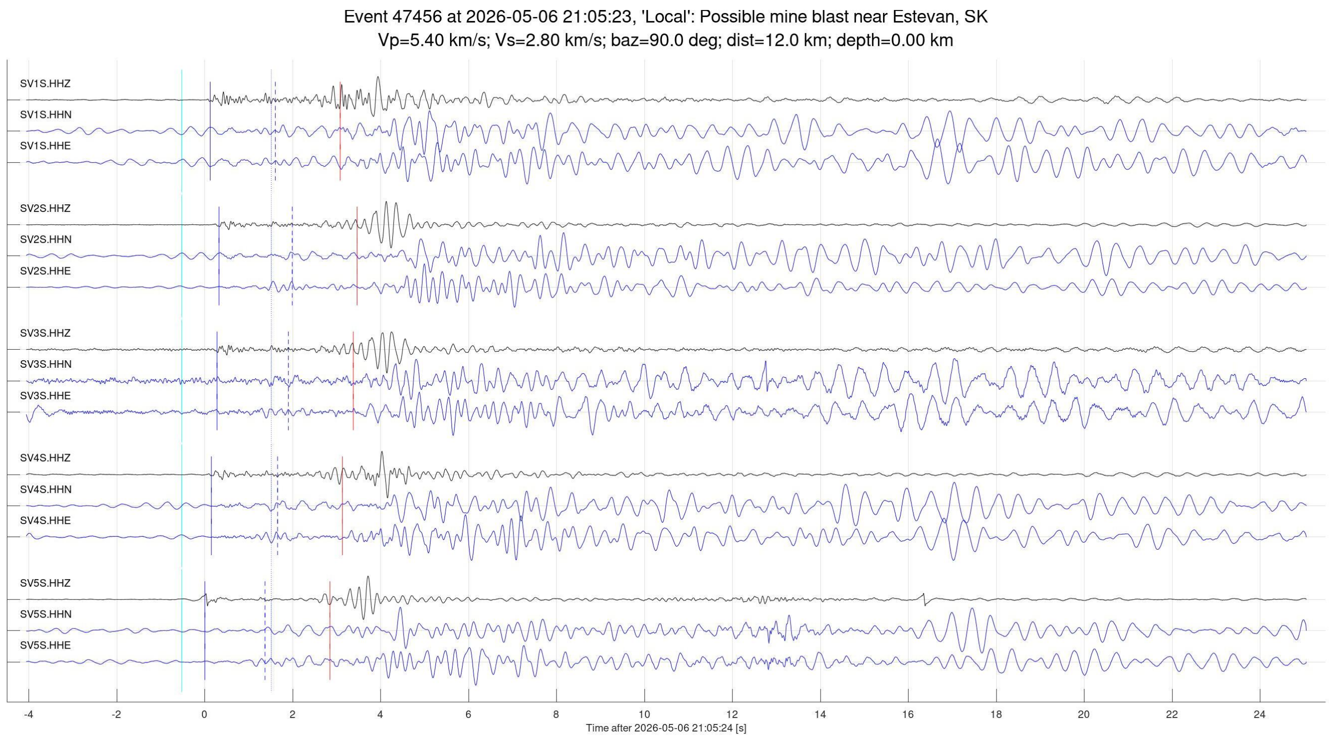

Figure 8, continued.

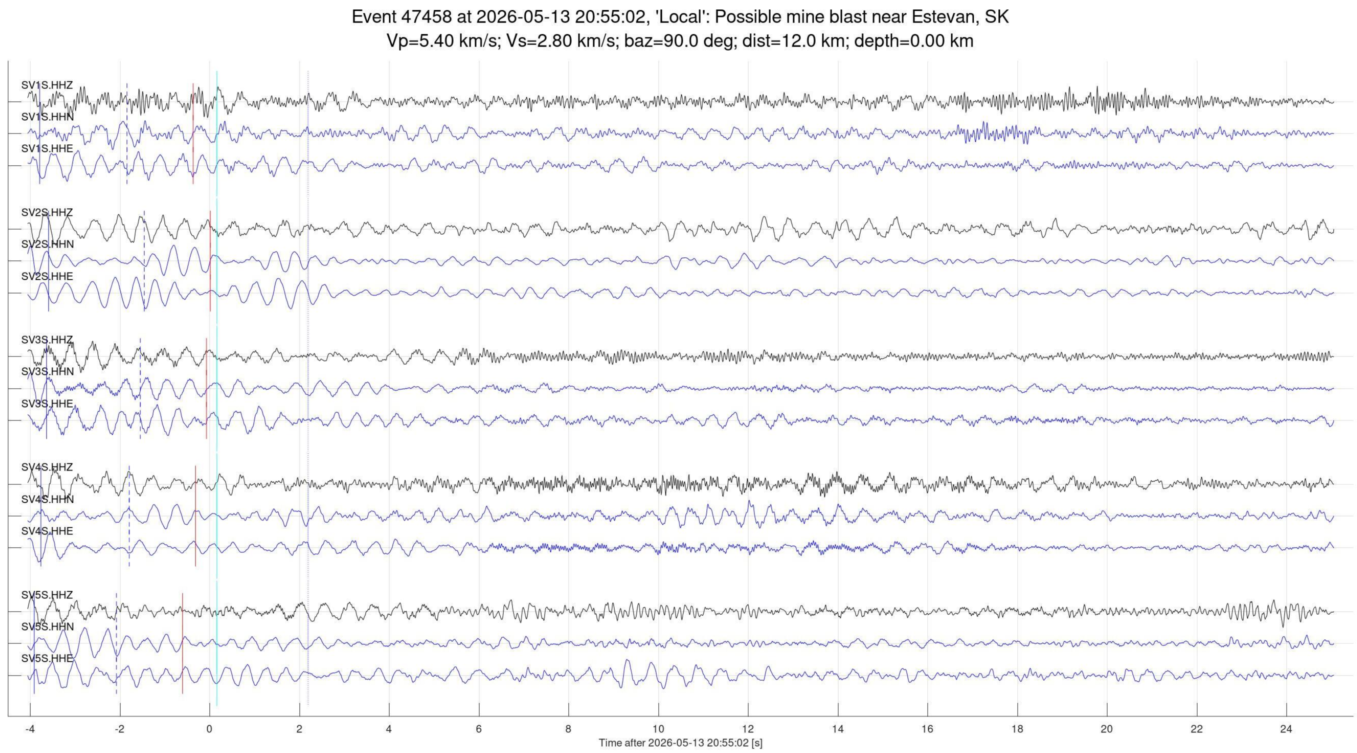

Figure 8, continued.

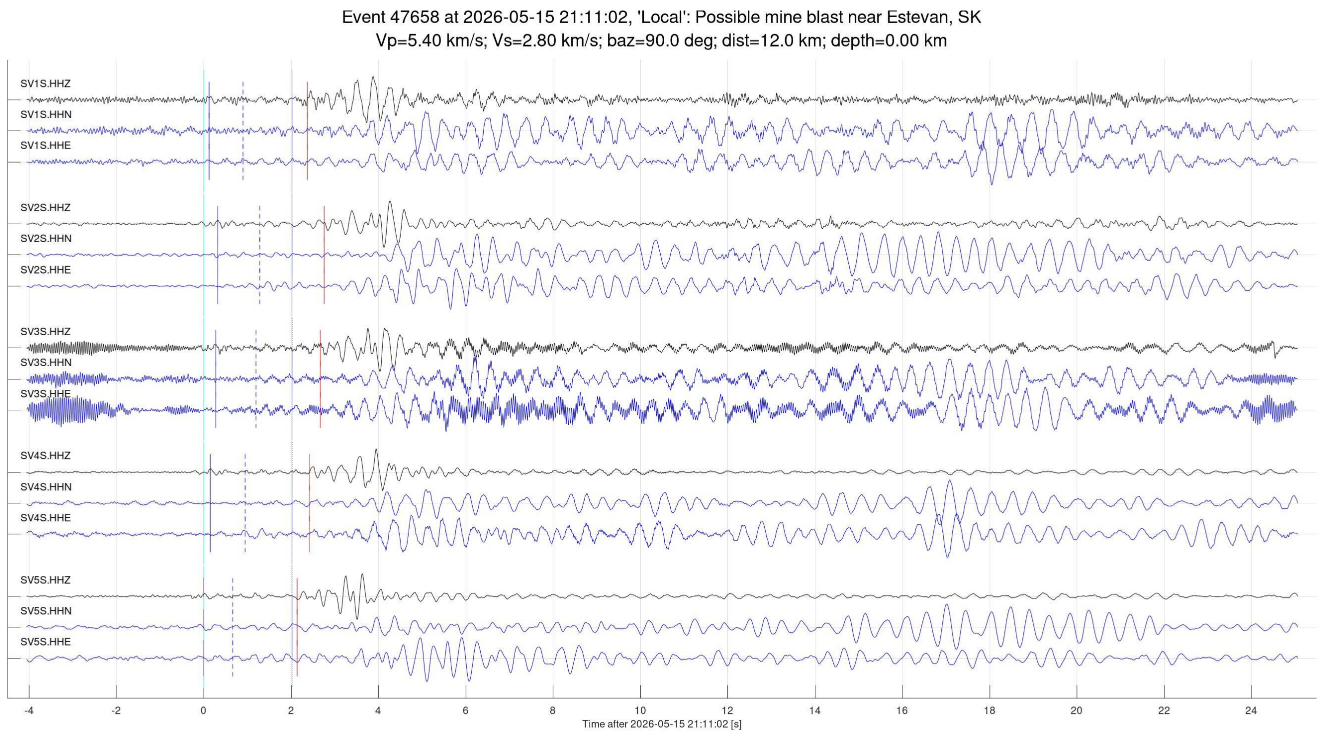

Figure 8, continued.

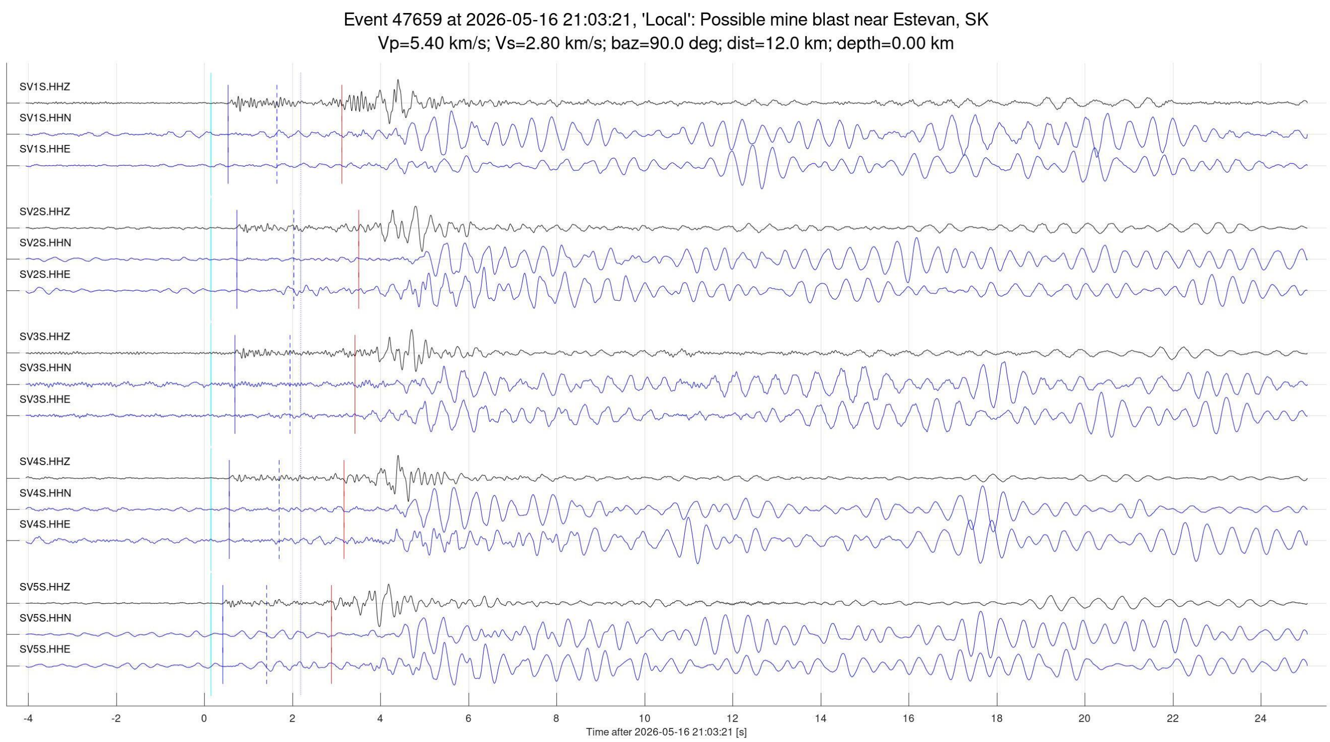

Figure 8, continued.

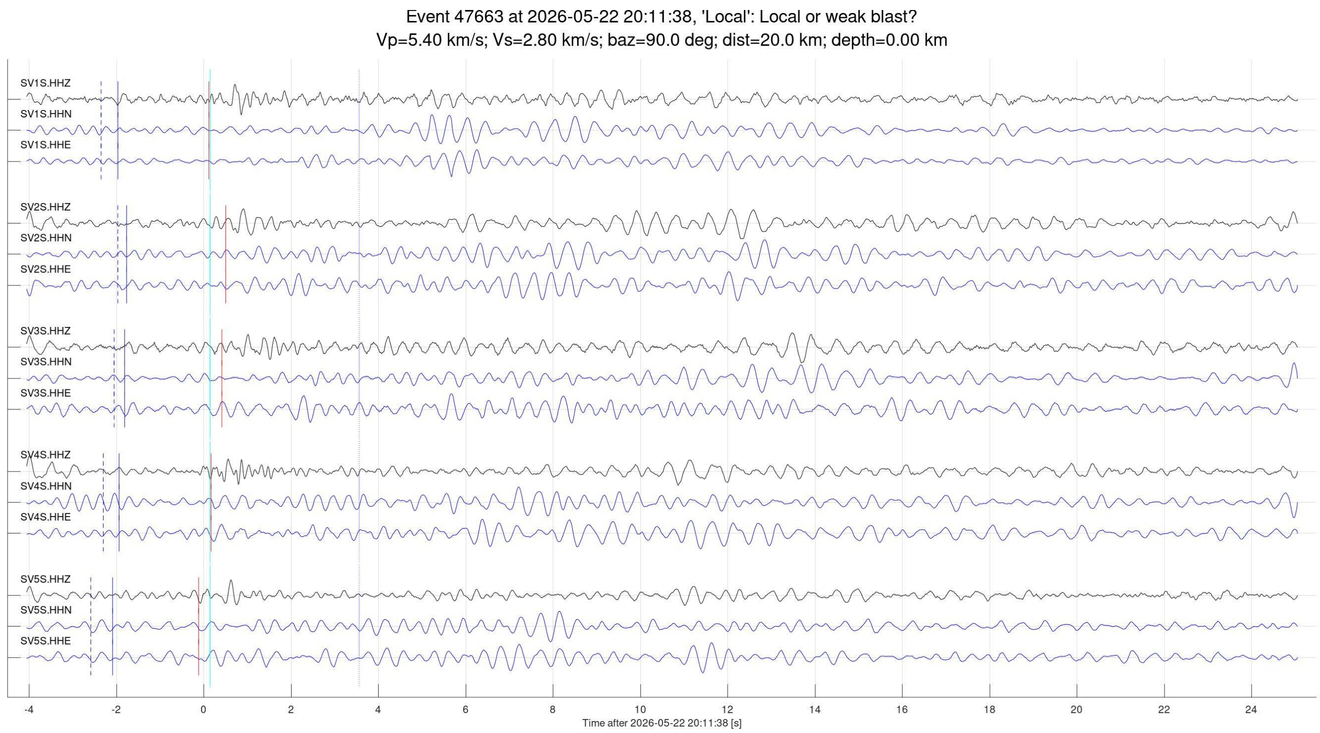

Figure 8, continued.

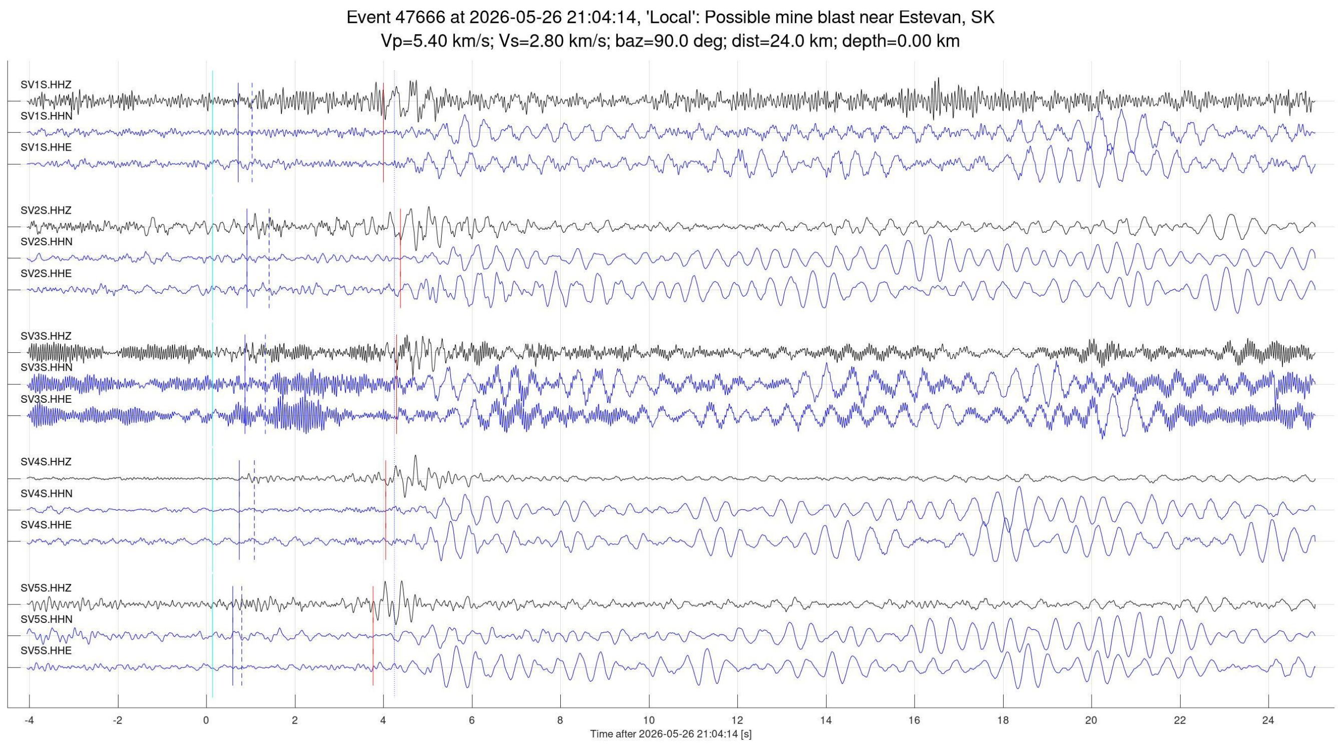

Figure 8, continued.

Events related to mining operations (class 3b)

Numerous mining- and industrial-operations related seismic events were observed in the area. Many such events may be produced by trains. Figure 9 illustrates four such events.

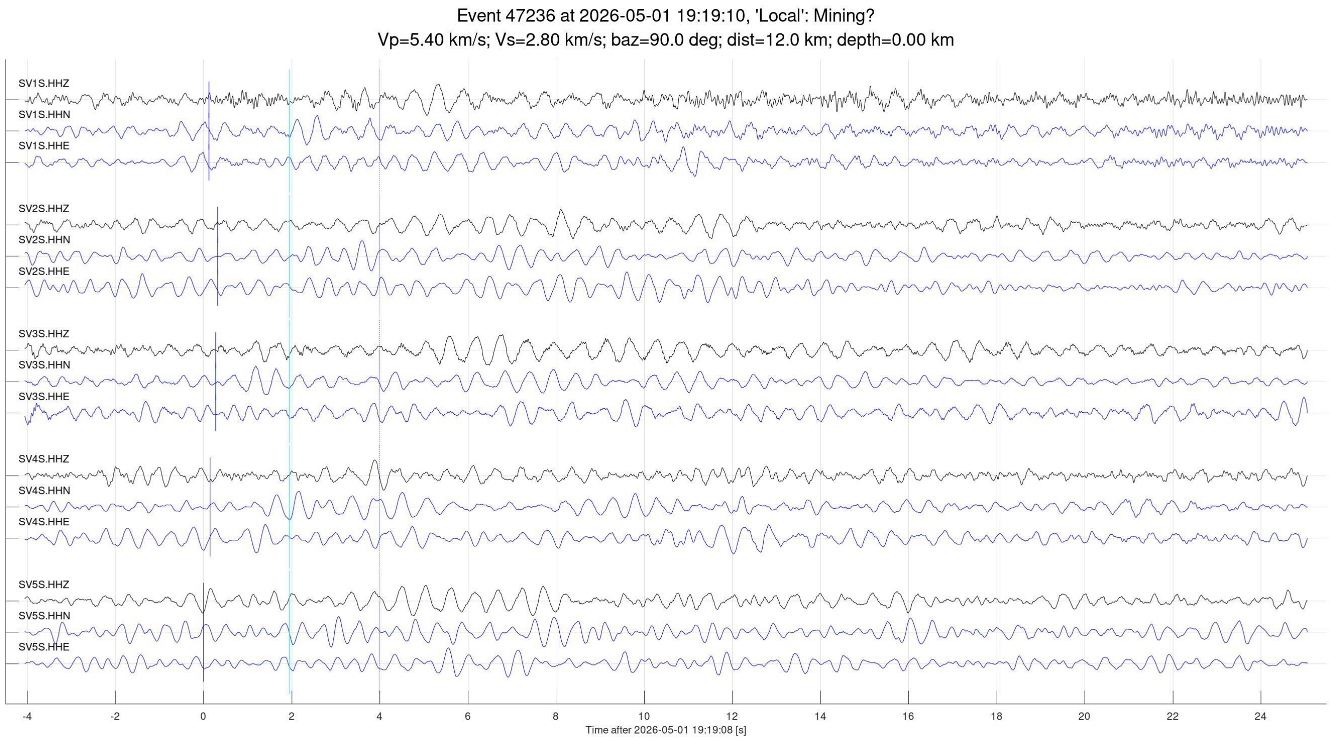

Figure 9. Sample events interpreted as due to mining activity in the area. Lines, colour bars and labels are as in the preceding figures.

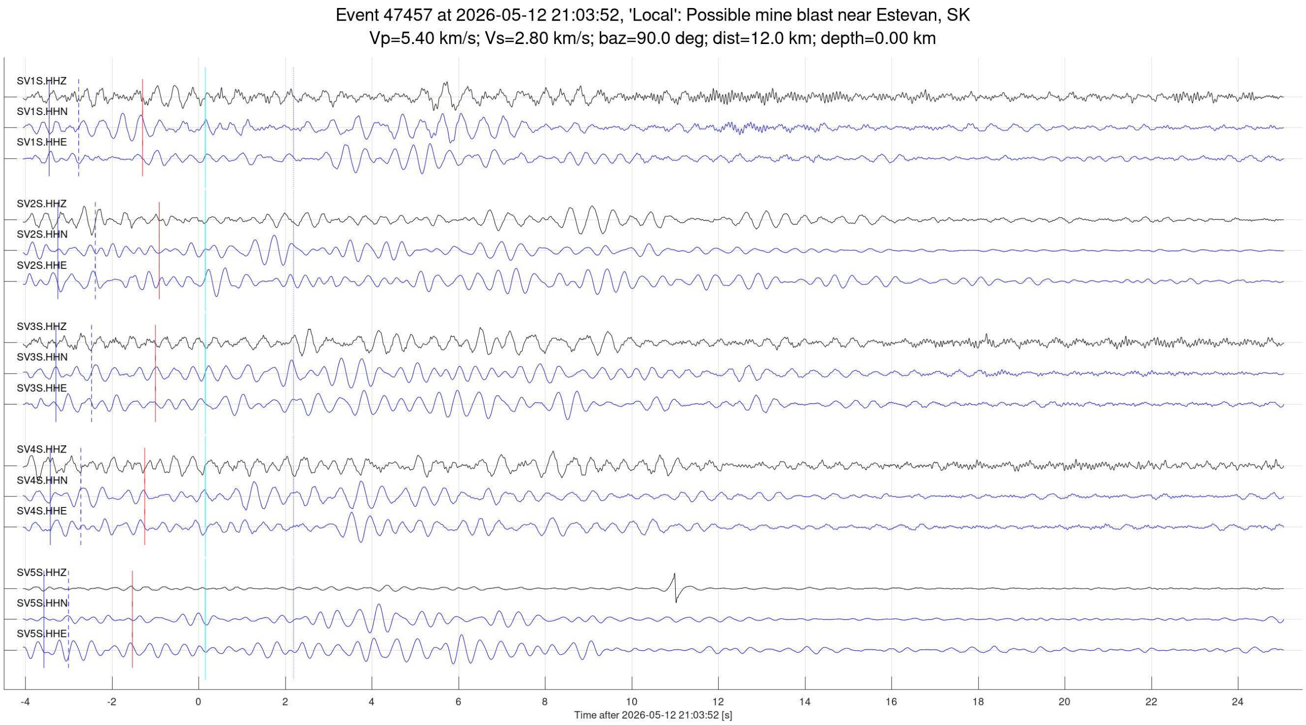

Figure 9, continued.

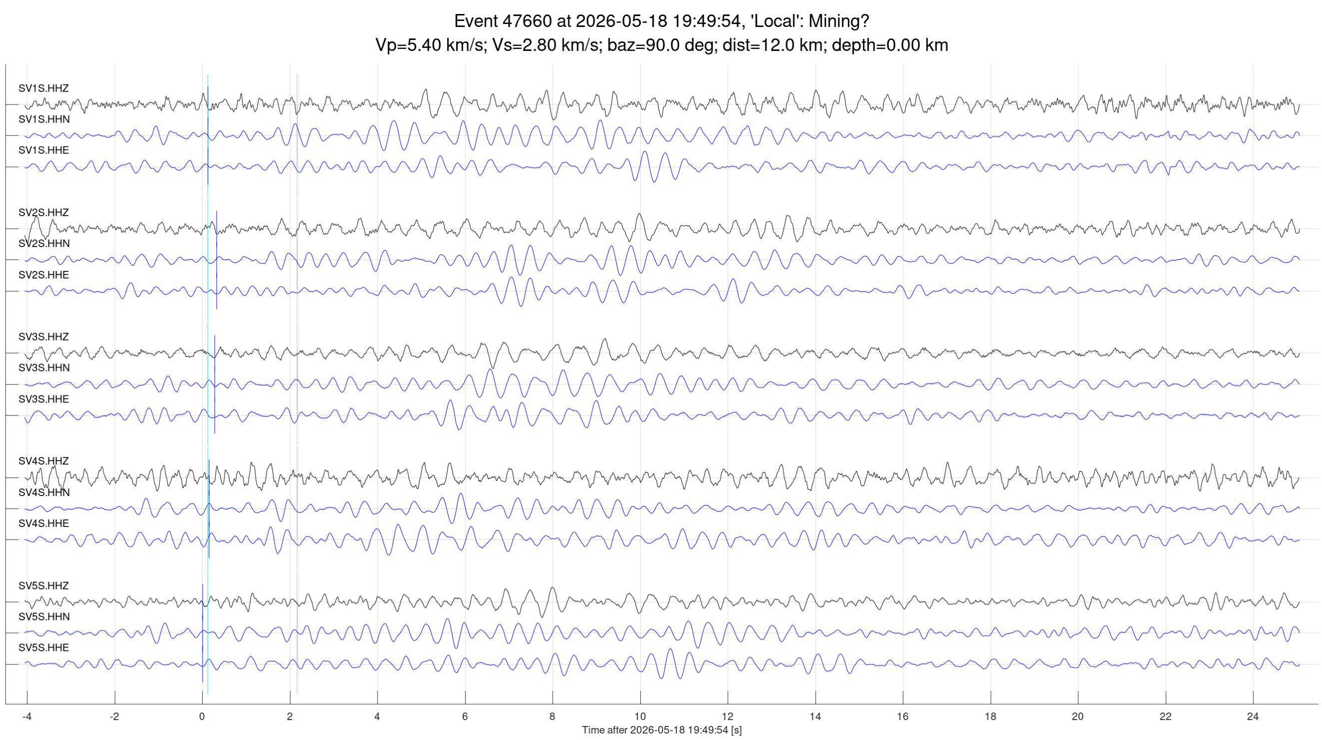

Figure 9, continued.

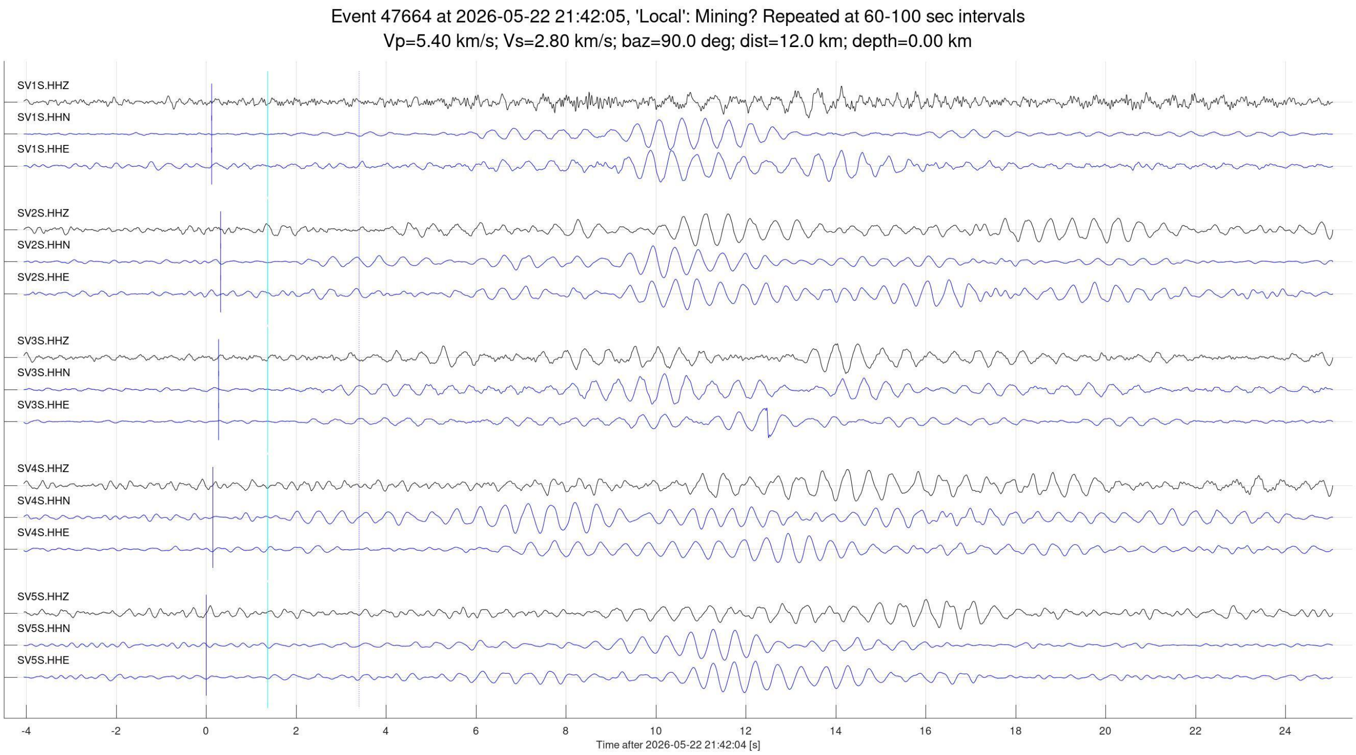

Figure 9, continued.

Events in array proximity (classes 4a and 4b)

Two seismic events were identified as possibly occurring in the proximity of the array (class 4a) (Figure 10). Clear identification of such events and separation from class 3b and recordings of trains is difficult. In particular, the first of the events shown in Figure 10 may be caused by a train or heavy machinery, although the strong wavetrain appears to be too short for trains (~15 sec).

No events which could be related to class 4b (impulsive and higher-frequency) were found.

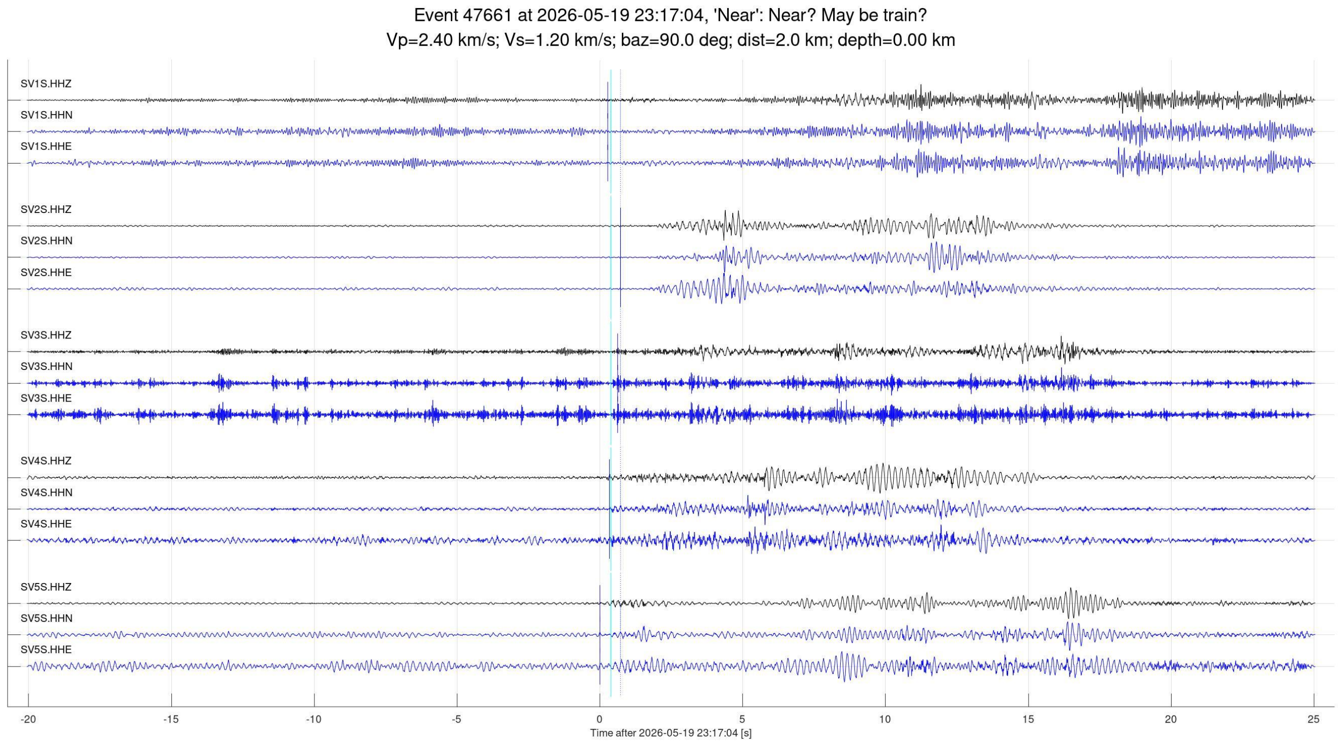

Figure 10. Possible events occurring near surface in the proximity of the array (class 4a in Table 2). Lines, colour bars and labels are as in the preceding figures. Seismic velocity estimates shown in the headers (particularly P-wave) are from an averaged model and require further analysis.

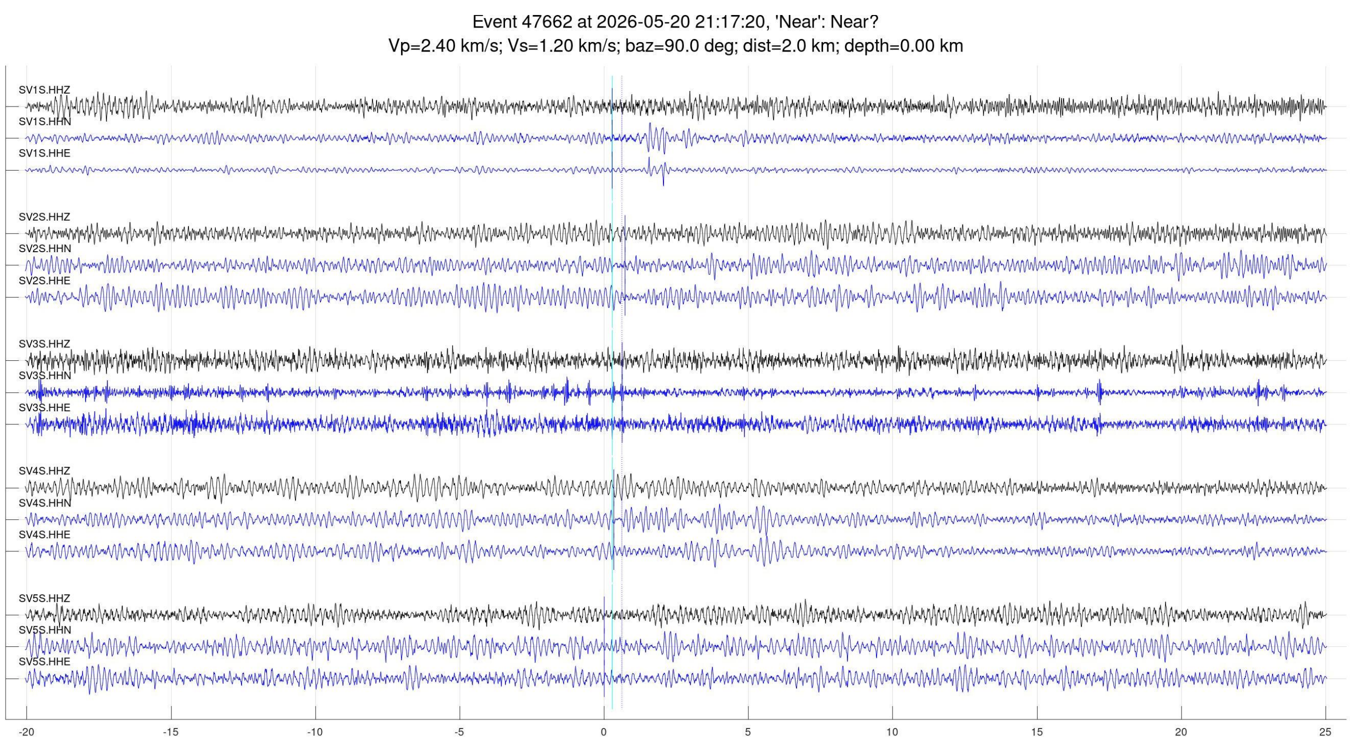

Figure 10, continued.

5. SEGY files

Event time windows are provided in SEGY format in the attached zipped archive, separately for teleseismic and regional event detections. Subdirectory names and file naming convention and header formats are described in our reports for August and October 2024.

6. Conclusions and recommendations

Seismic array operation:

- For stations SV1S to SV4S, station uptime and data retrieval was nearly 100%.
- Station SV5S was offline in May 2026. Nearly 100% of its waveform data were retrieved in June.
- Trillium sensor at station SV5S started working normally, after 2 years of channel HHE and 2 months of all channels being failed.
- The above suggests that sensor cable at SV5S is unstable. A spare sensor cable is recommended.
- An upgrade of cell networking equipment to low-power Sierra (Semtech) modems is urgently needed before winter.

Data and observations:

- 21 teleseismic events and 9 mine blasts were detected in May 2026.
- Numerous local events were observed, likely related to mining operations or freight trains. These events were not catalogued or analyzed in detail.
- Two events possibly (yet inconclusively) occurring near surface in the vicinity of the array were noted.
- No events occurring at the reservoir level were identified.