Advanced Multicomponent Seismic Software

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

Report AQ-2026-02-IM

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Contents

1. Station performance

Station performance for February 2026 is summarized in Figure 1, and state-of-health parameters are shown in Figure 2. On several occasions and particularly between February 16-22, battery voltage reduced to near-critical levels (Figure 2), but all stations continued operating.

As shown in the next sections, on February 27-28, the sensor or sensor cable failed at station SV5S. Channel HHE at this station had not been working for at least two years, but since February 28, all three of its channels appear dead.

From reviewing the data records (next sections), it appears that the vertical-component channels at stations SV3S and SV4S are often contaminated with series of strong spikes. The spikes may be correlated with time intervals of low battery power. This issue need to be investigated and addressed by improving the de-spiking software or by trying replacing the sensor cables.

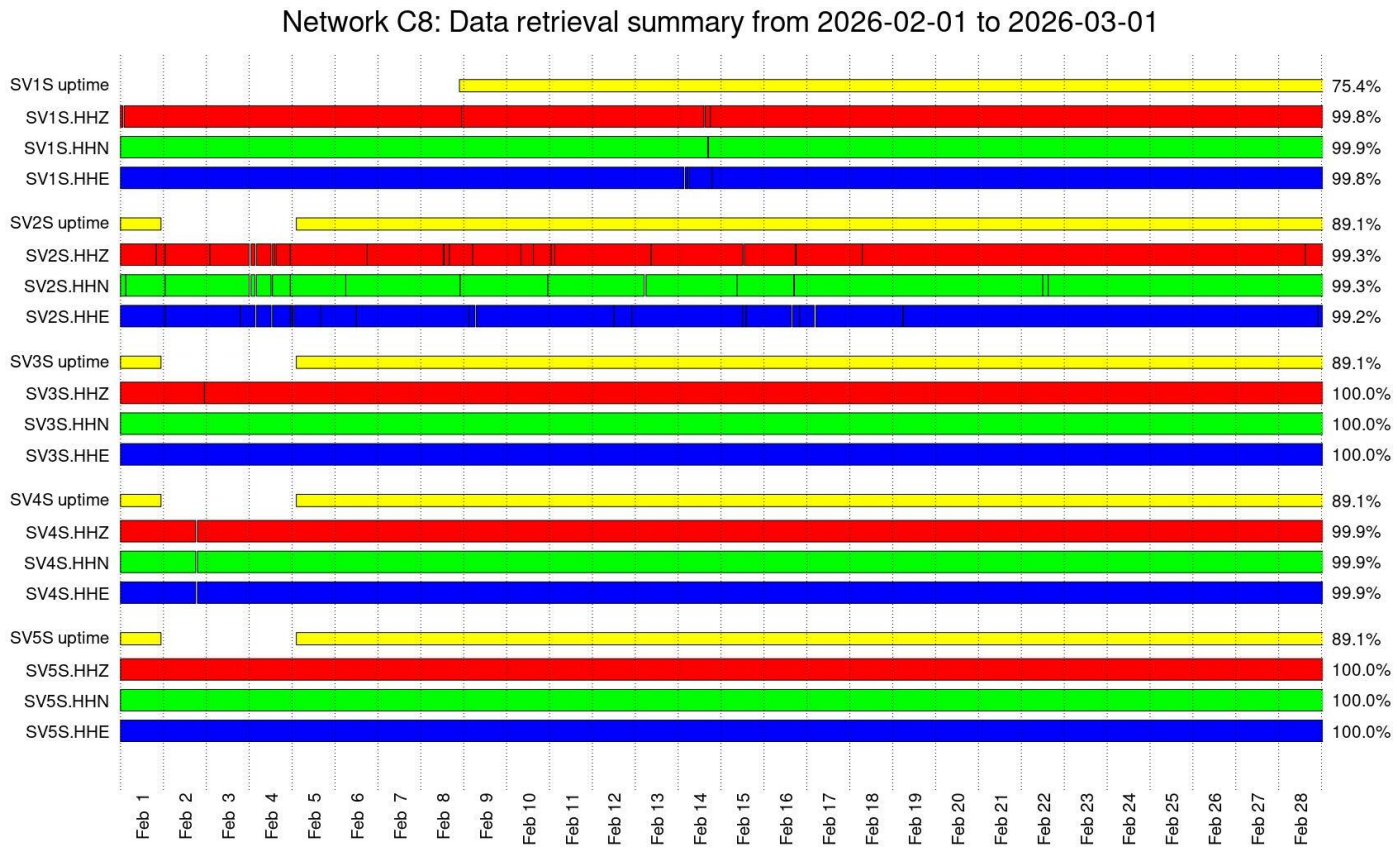


Figure 1. Retrieved data intervals for all channels (red, green, and blue bars) and uptimes (yellow). Total percentages of measured uptime and data retrieval are shown on the right. Gaps in yellow bars are insignificant and only show lapses in probing procedures.

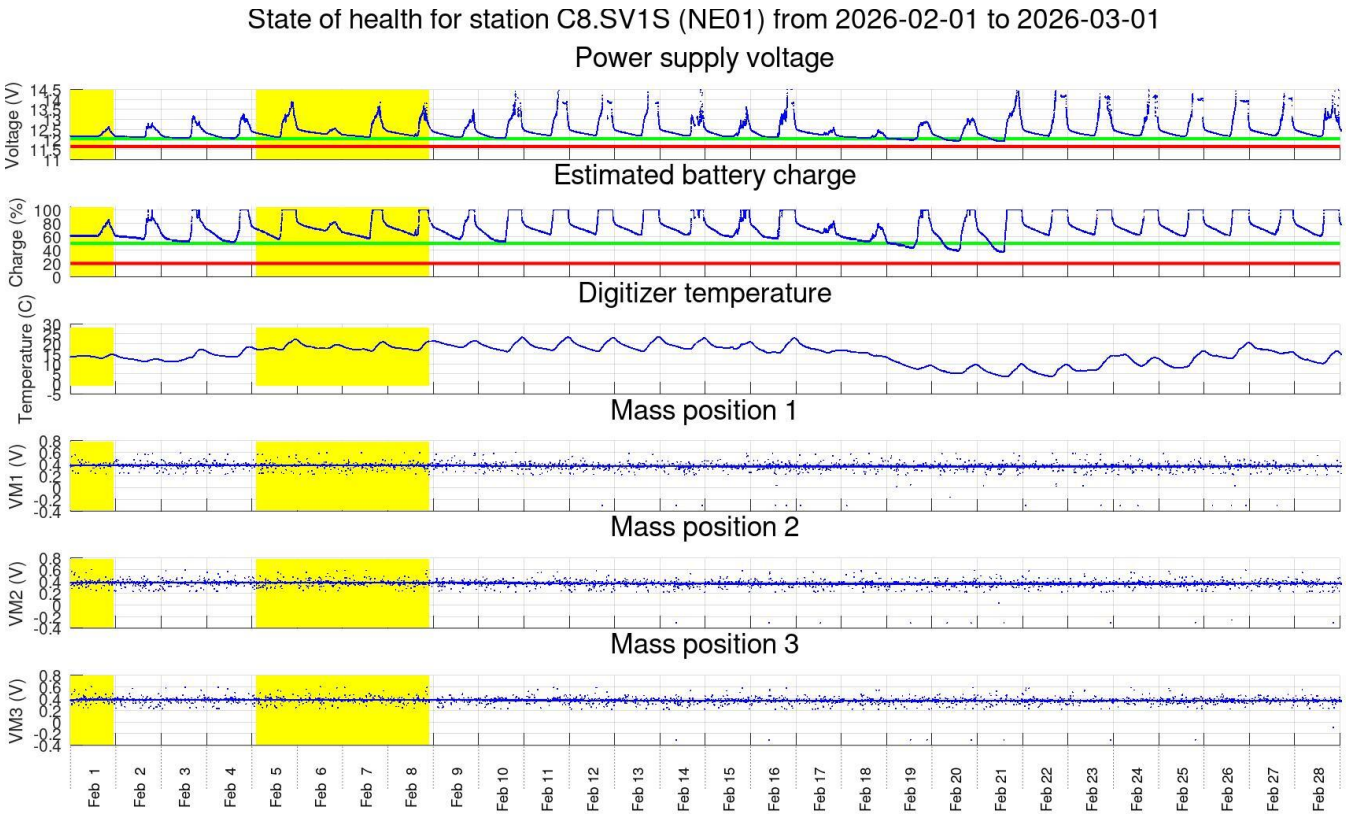


Figure 2. State of health parameters for each station (SV1S here). Image headings: power supply voltage, estimated battery charge levels, temperature on board, voltages measuring mass positions. Yellow intervals indicate lapses in station probing.

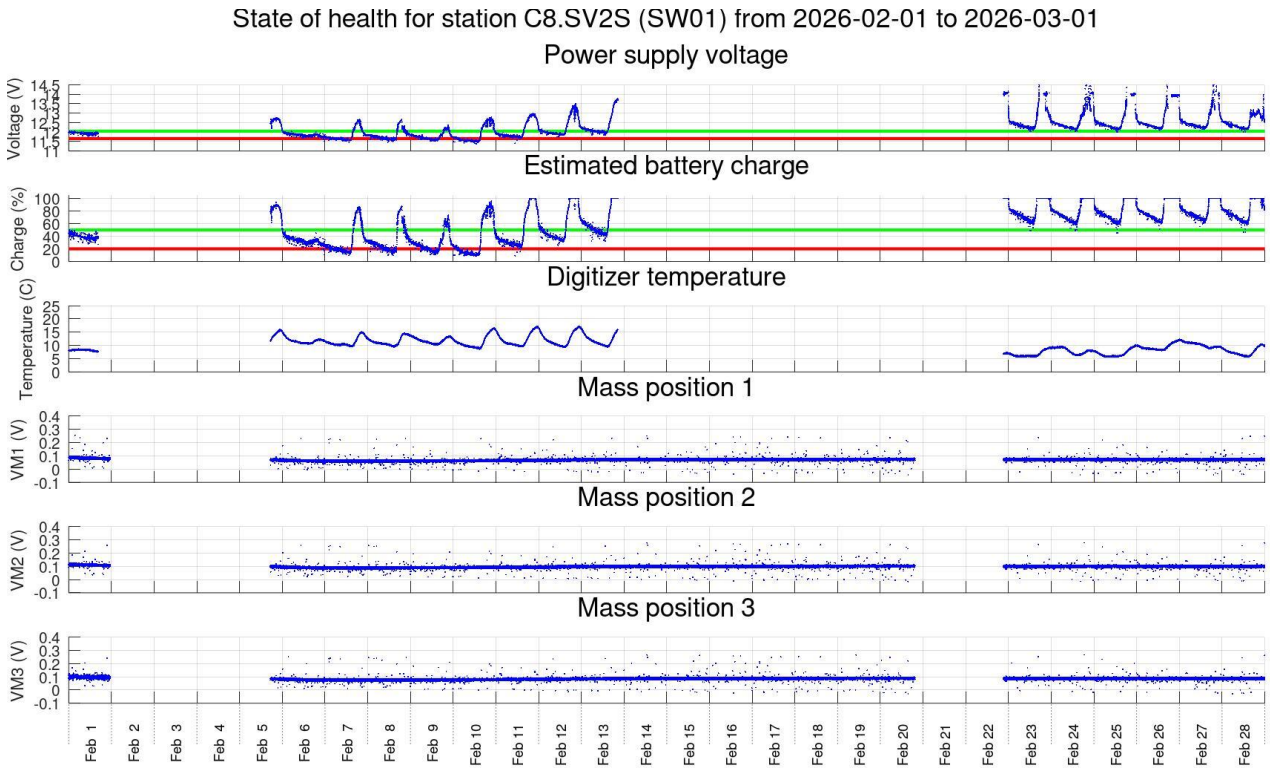


Figure 2, continued, station SV2S. Gaps in the graphs are due to lapses in manual downloading of state-of-health data from Taurus seismometer

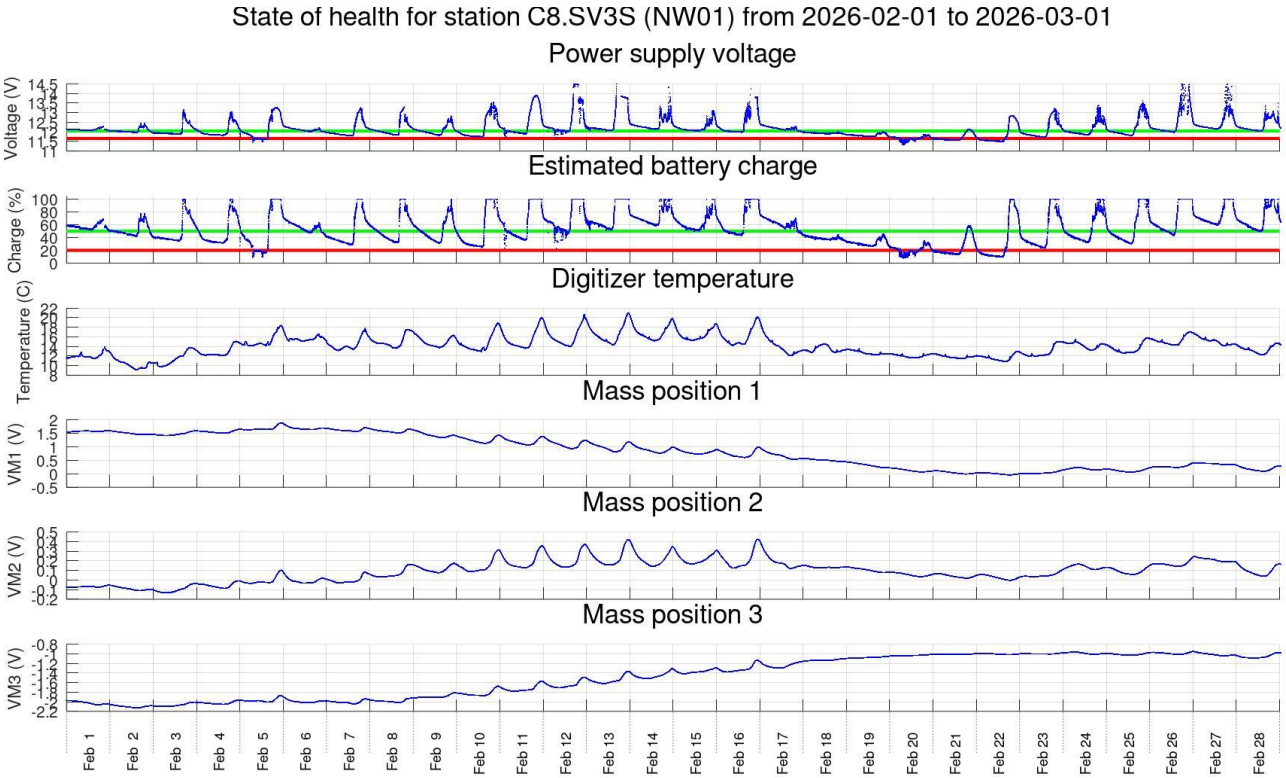


Figure 2, continued, station SV3S.

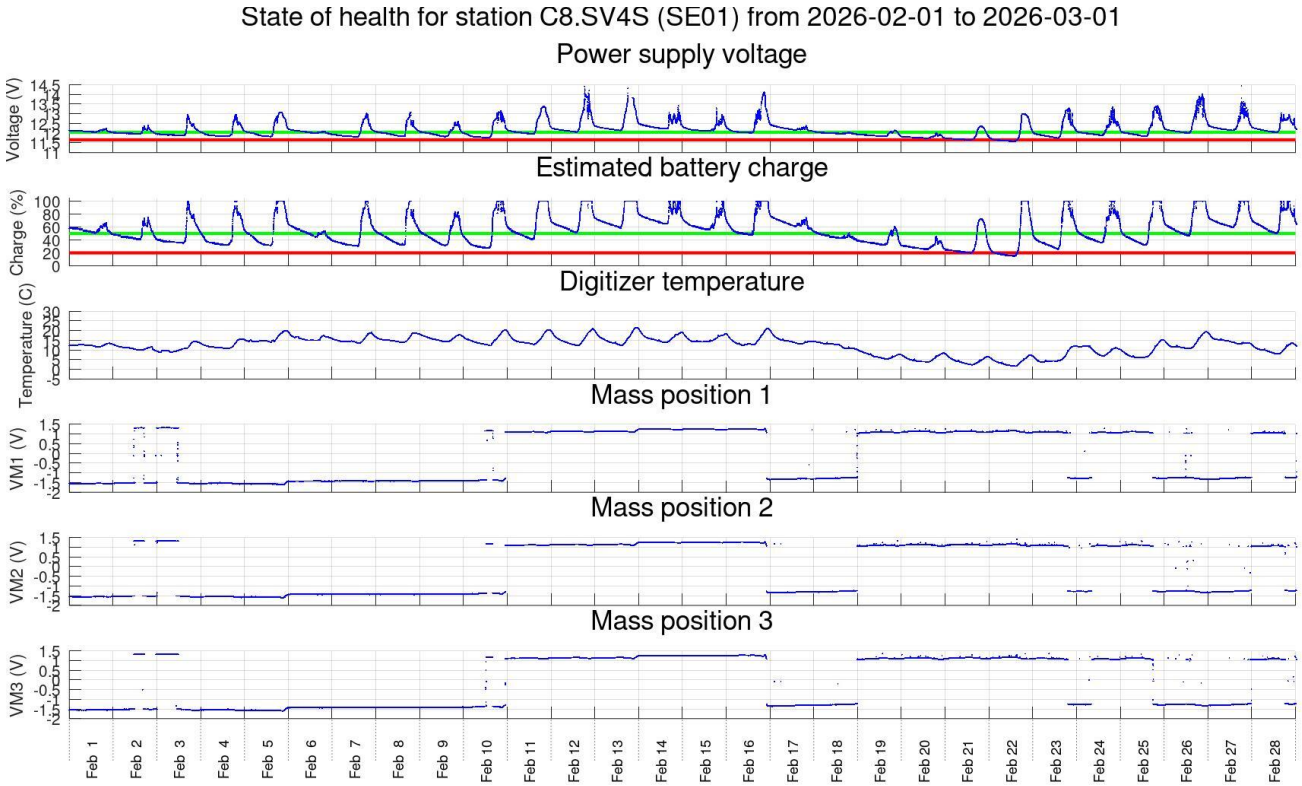


Figure 2, continued, station SV4S.

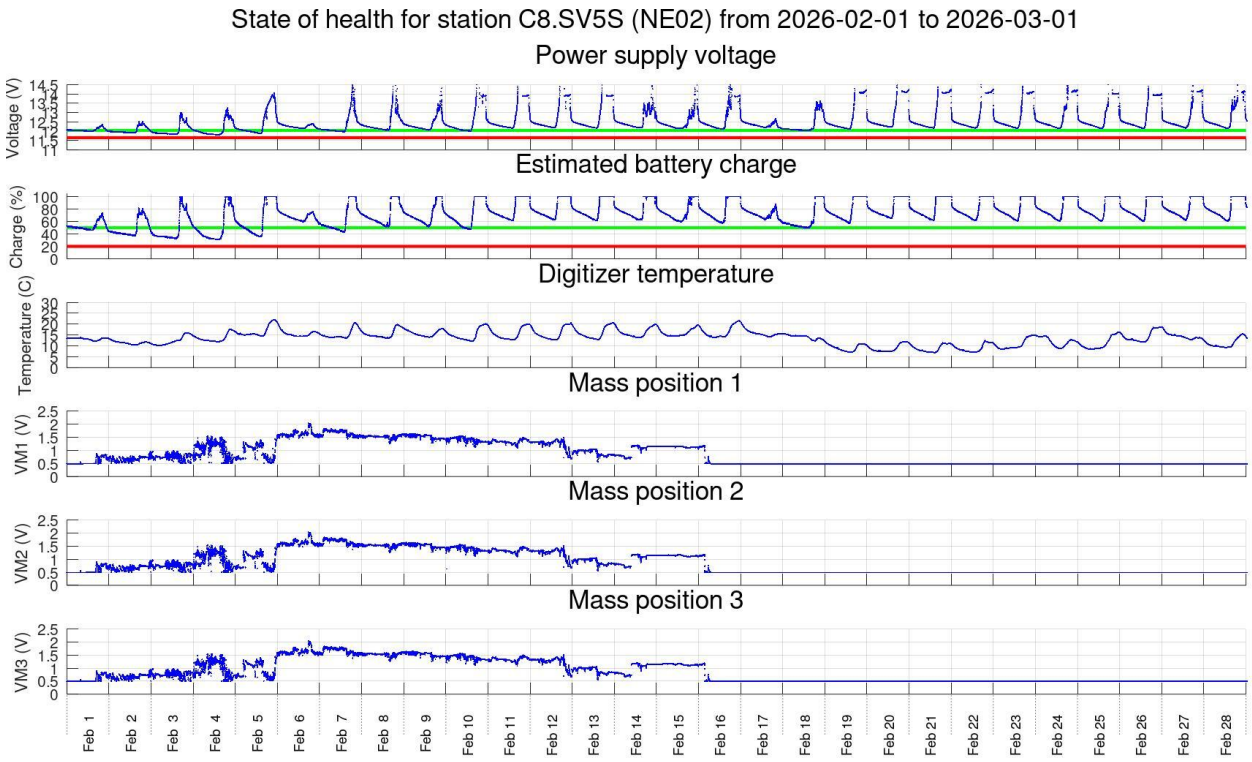


Figure 2, continued, station SV5S.

Data recovery

Data recovery was at nearly 100% from all Aquistore stations (Figures 1 and 2).

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 root-mean square (RMS) average amplitudes in each channel.

Note the change in the amplitude patterns for station SV5S in the second half of the day February 27. This change may indicate a failure of the sensor or sensor cable. All three channels of this station no longer contain valid data.

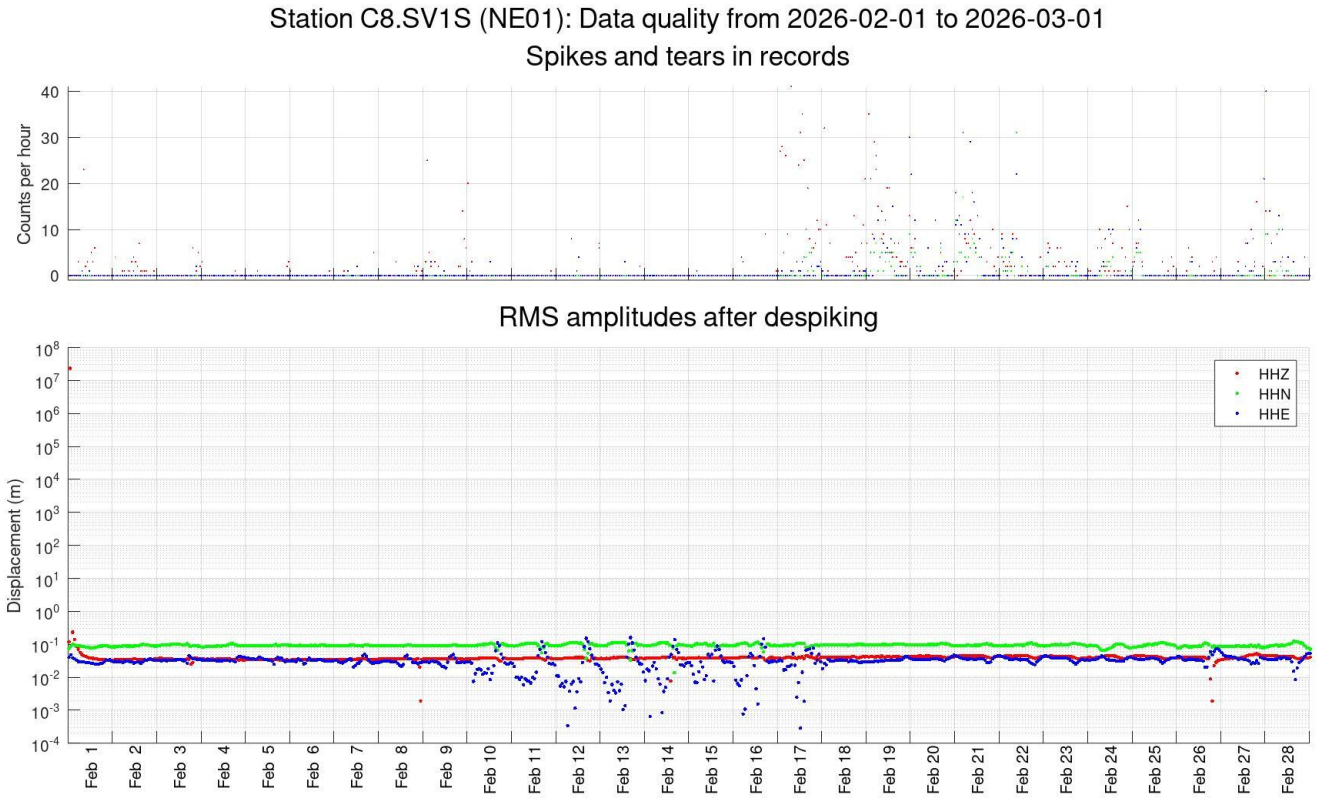


Figure 3. Measures of data quality in hour-long intervals. Station names and time intervals are indicated in plot headings (SV1S in this plot). Red, green, and blue colours correspond to channels HHZ, HHN, and HHE, respectively (as in Figure 1).

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

Bottom panels: RMS ground displacements (meters).

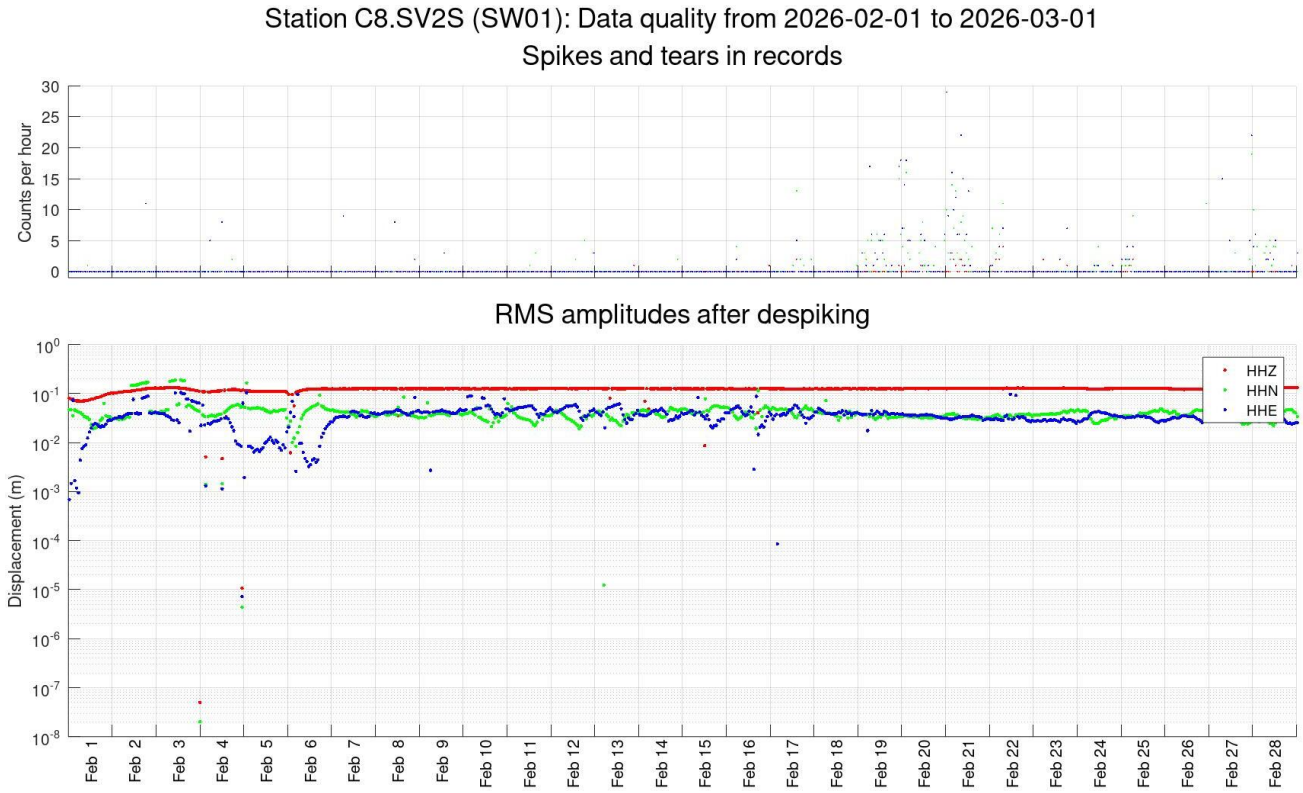


Figure 3, continued. Station SV2S.

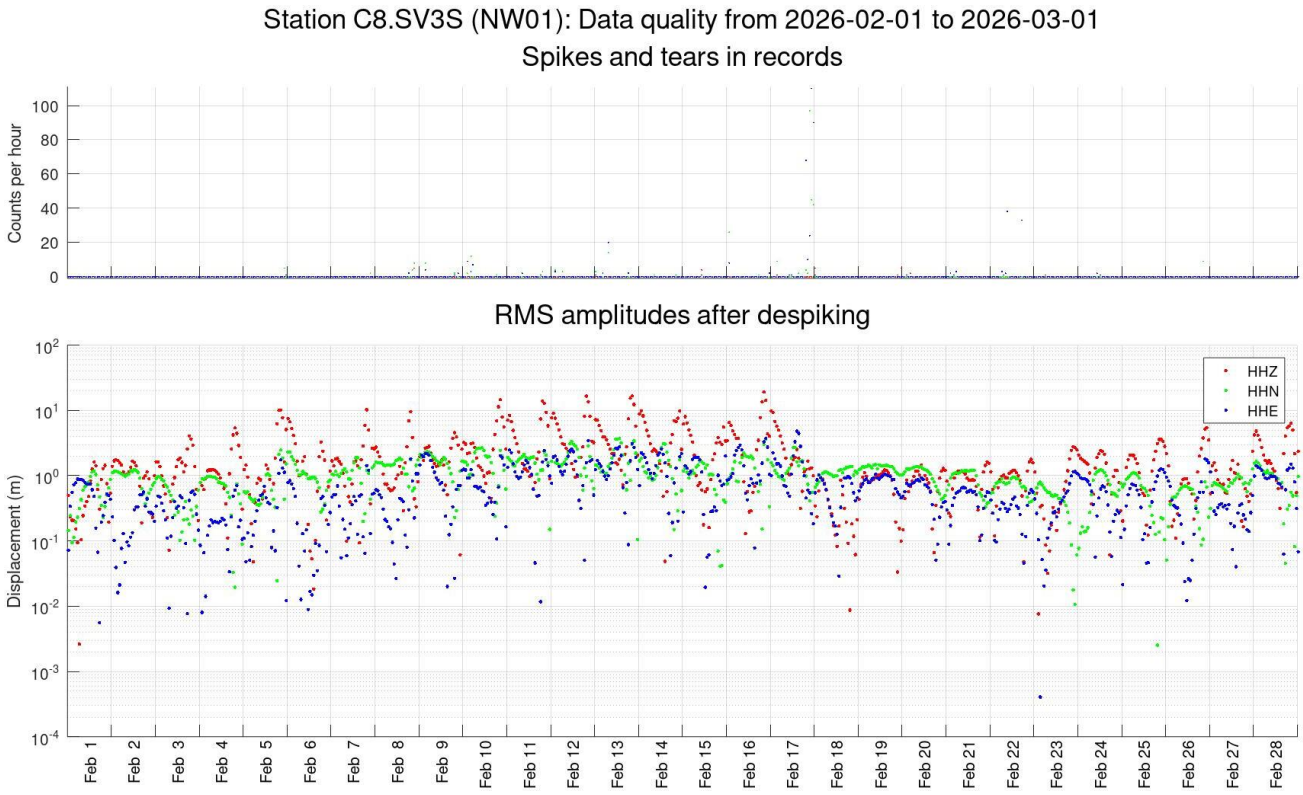


Figure 3, continued. Station SV3S.

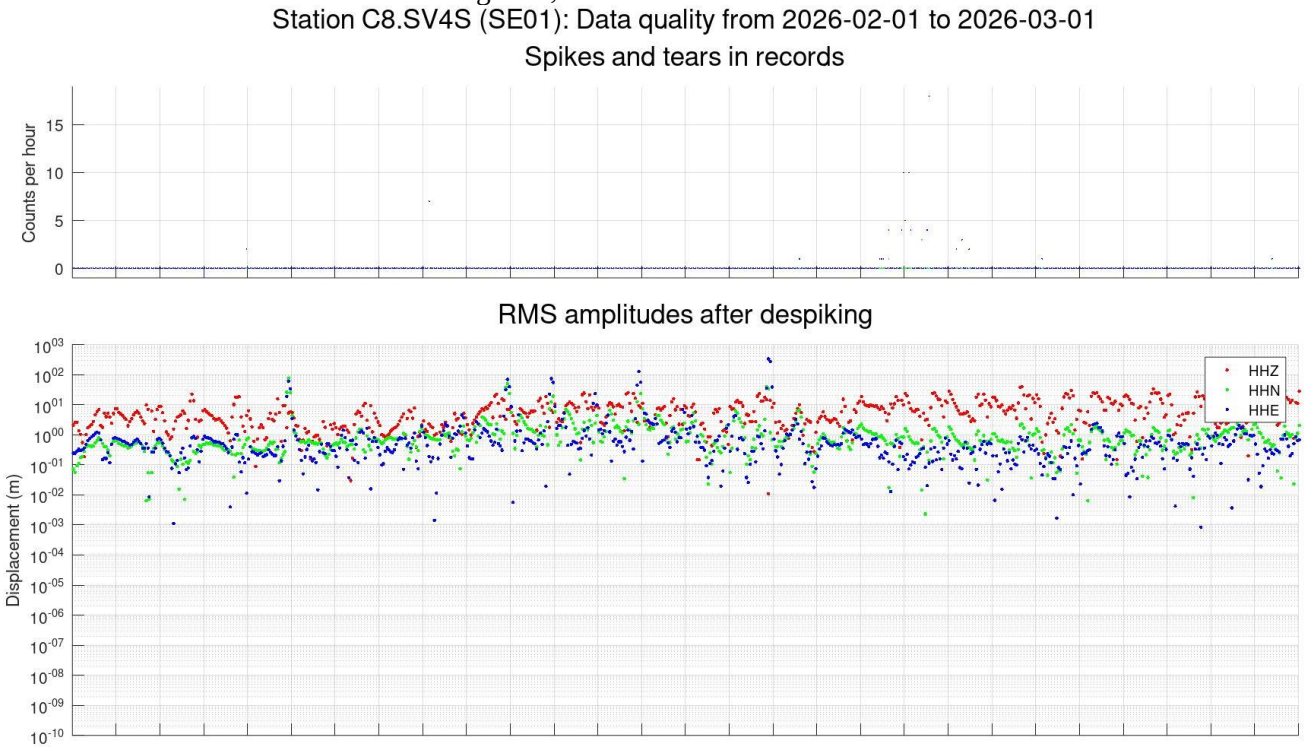


Figure 3, continued. Station SV4S.

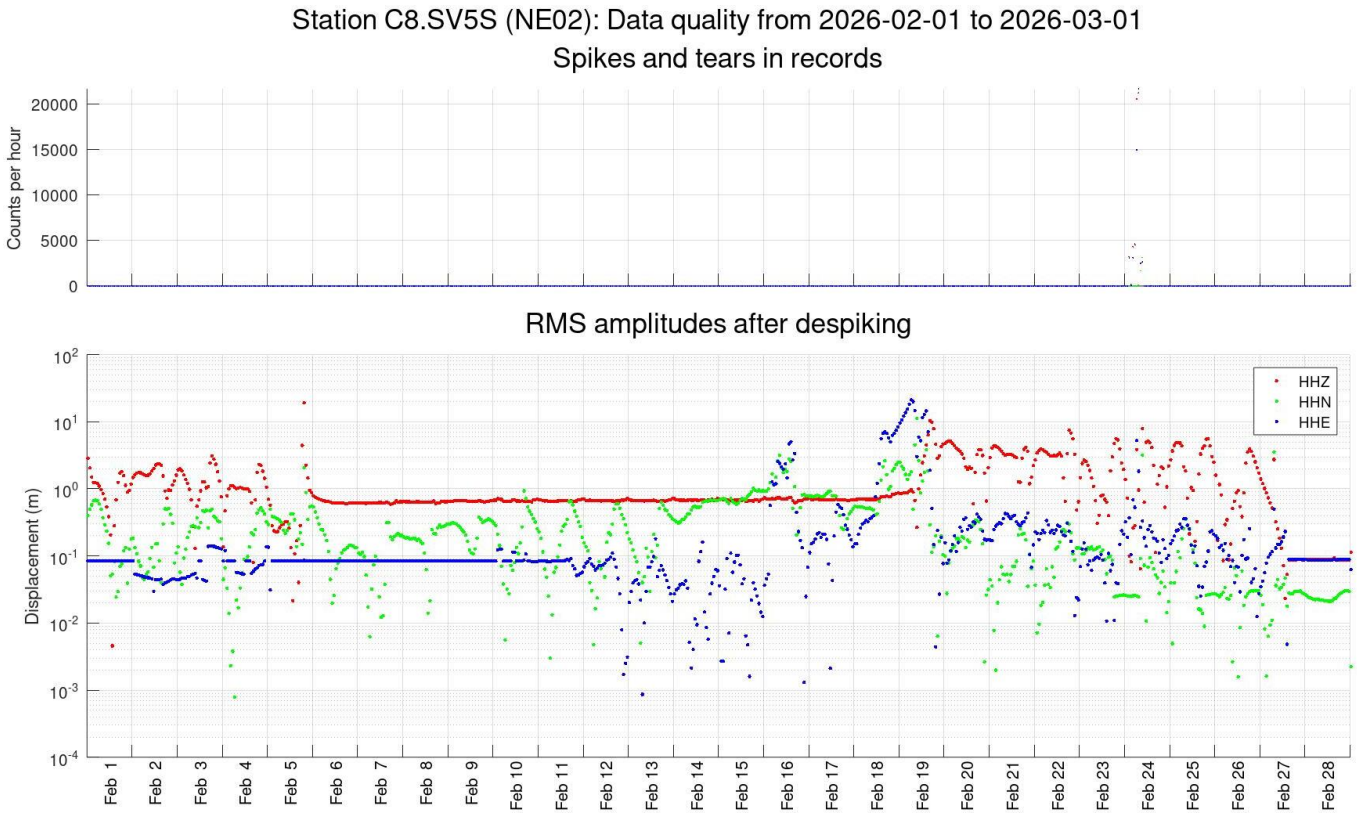


Figure 3, continued. Station SV5S

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 February 2026 are shown in Table 2.

Table 2. Classification of seismic events and numbers of detections at the 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	13
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	13
3b	Mining-related	Low frequencies, extended repeated wavetrains low arrival velocities related to surface waves	2 (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	3
4b	Target zone	Source at recognizable nonzero depth, small travel-time moveouts, high frequency	0

Automatic detections

The procedure of multichannel automatic detections is currently 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). Events larger than magnitude 2.5 were taken from USGS, and all available events obtained from NRCan. Events with magnitudes above the selected $magnitude \propto distance^{1.5}$ threshold (dashed green line in Figure) were reviewed interactively (next section).

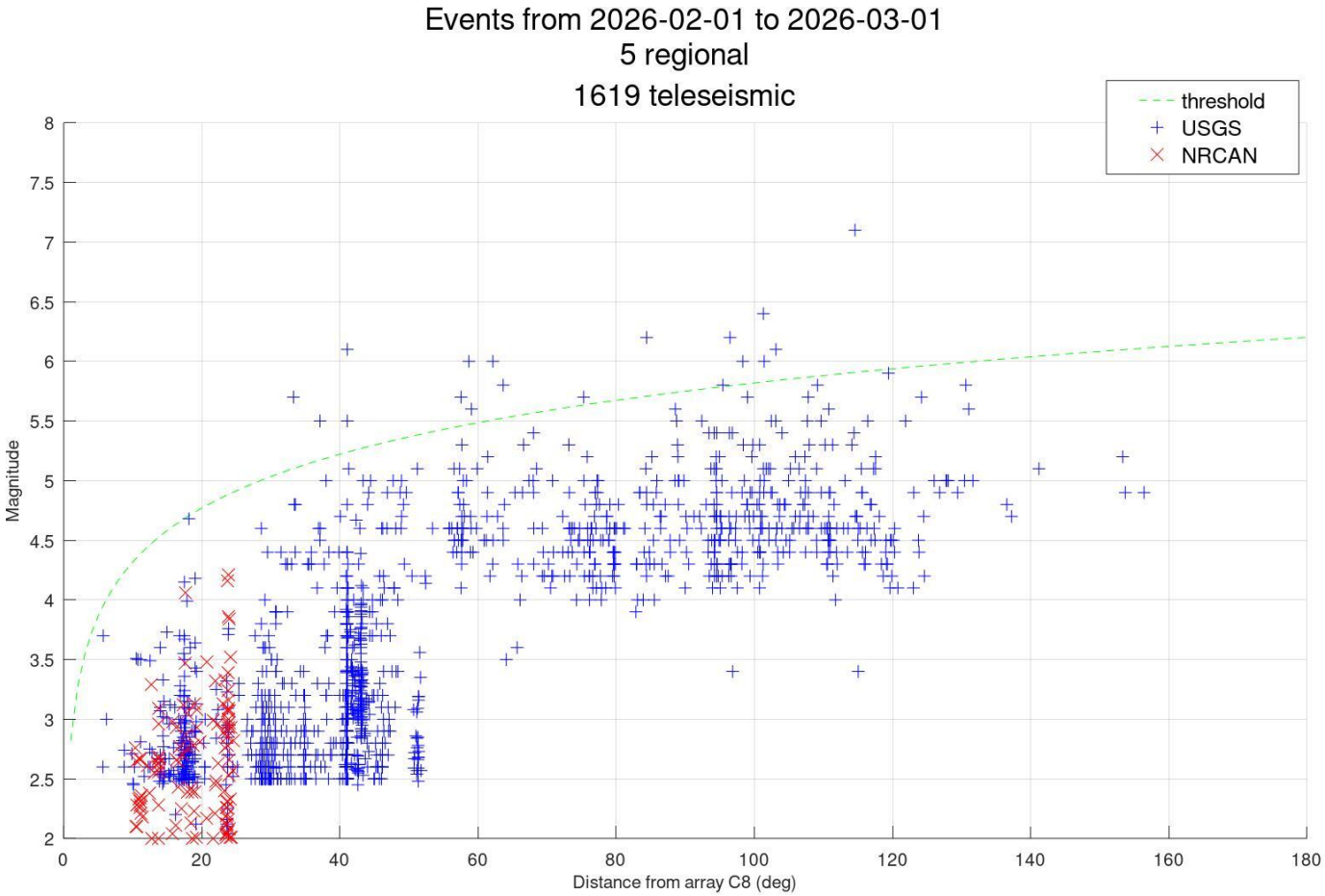


Figure 5. Magnitudes and distances from Aquistore for earthquake parameters downloaded from USGS and NRCan databases (legend). Dashed green line shows the detection threshold above which a manual review of events was performed.

Teleseismic events (class 1)

Above the threshold line in Figure 5, thirteen teleseismic events (class 1 in Table 2) were identified in February 2026 (Figure 6). 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.

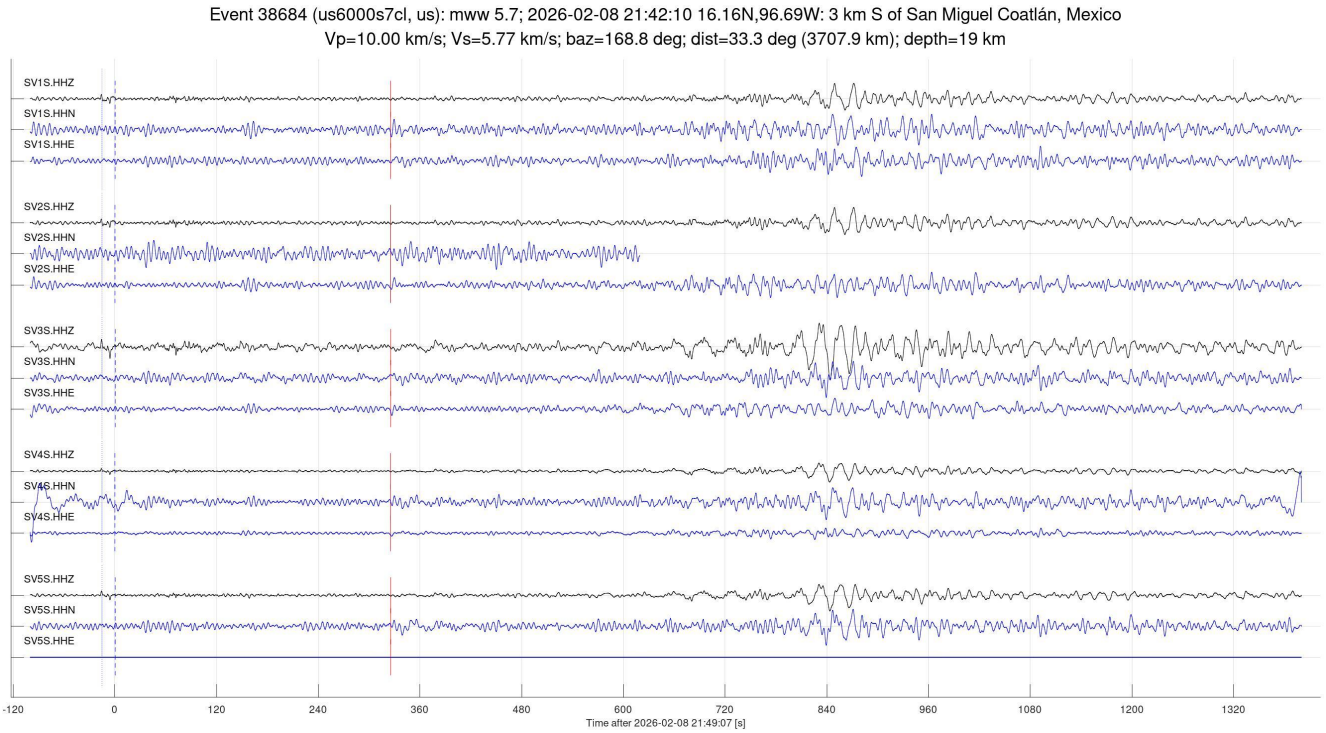


Figure 6. Teleseismic events detected at Aquistore in February 2026. Plot headings show catalogue IDs, times, distances in degrees, source coordinates and localities, back-azimuths ('baz='), distances ('dist=') and source depths. Vertical-component records are shown in black, and horizontal components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

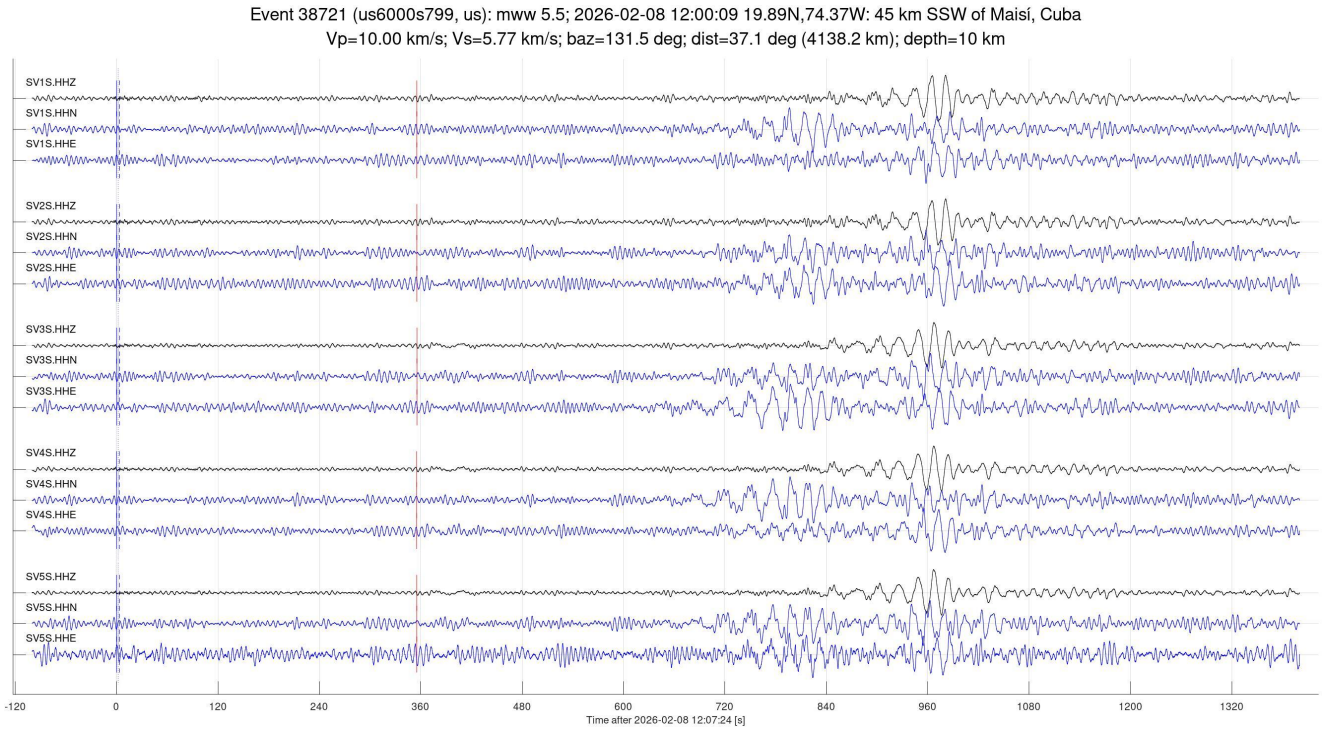


Figure 6, continued.

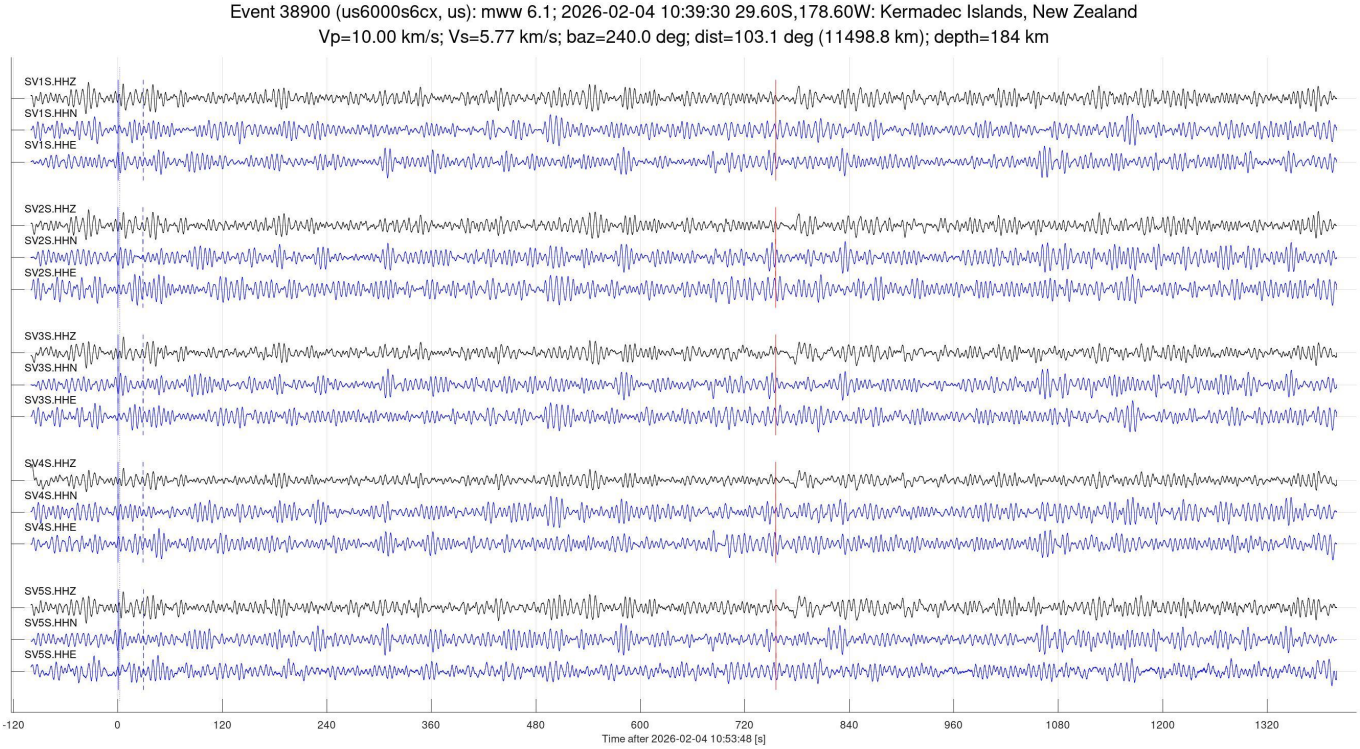
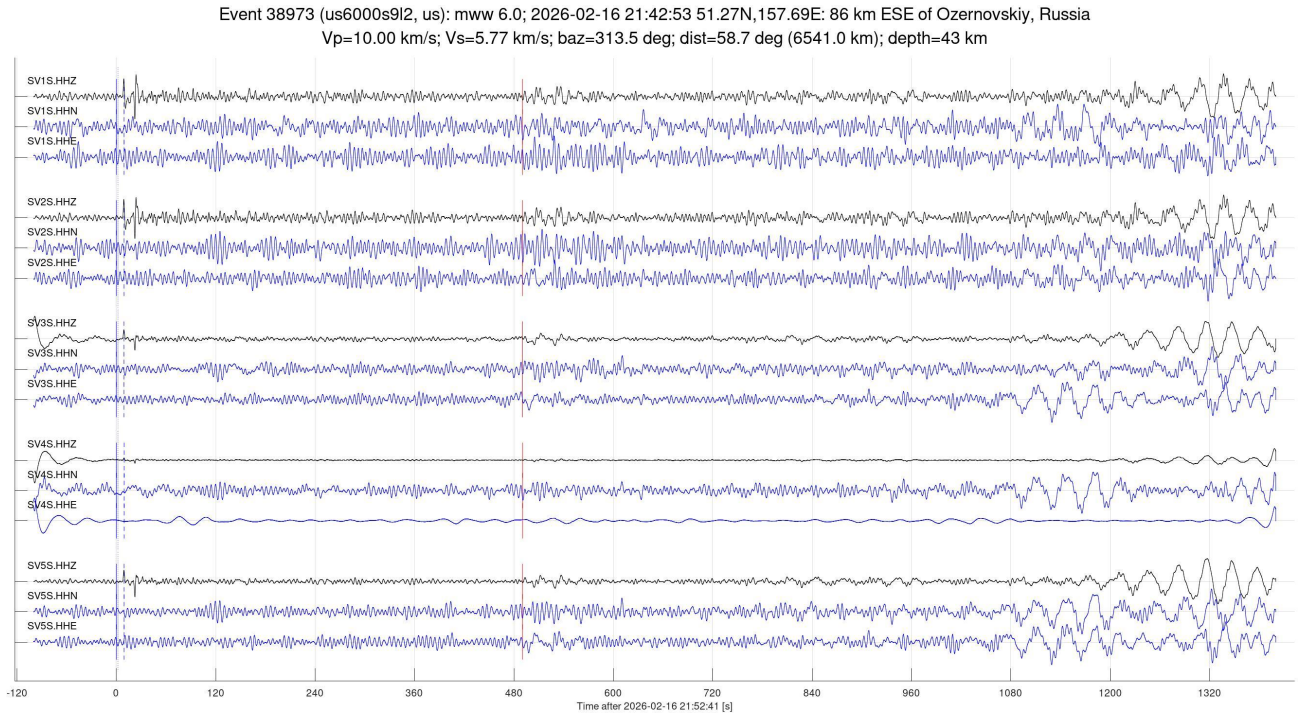


Figure 6, continued.



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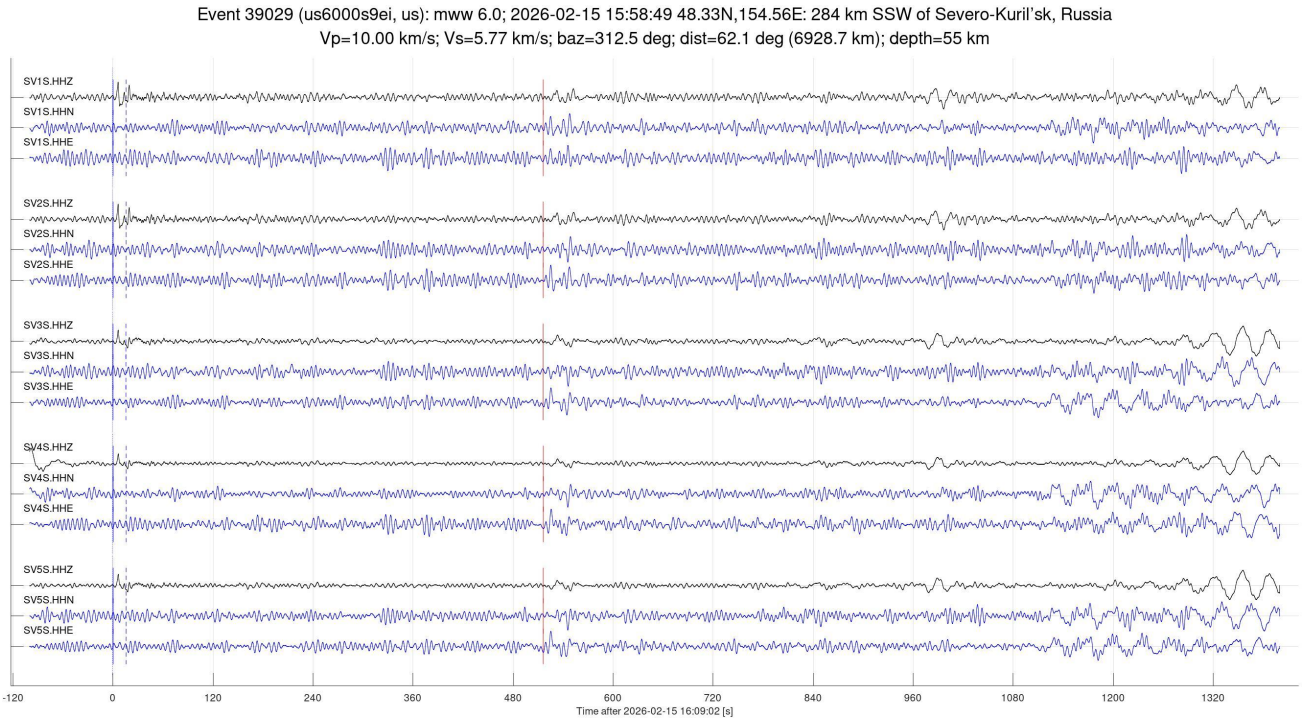
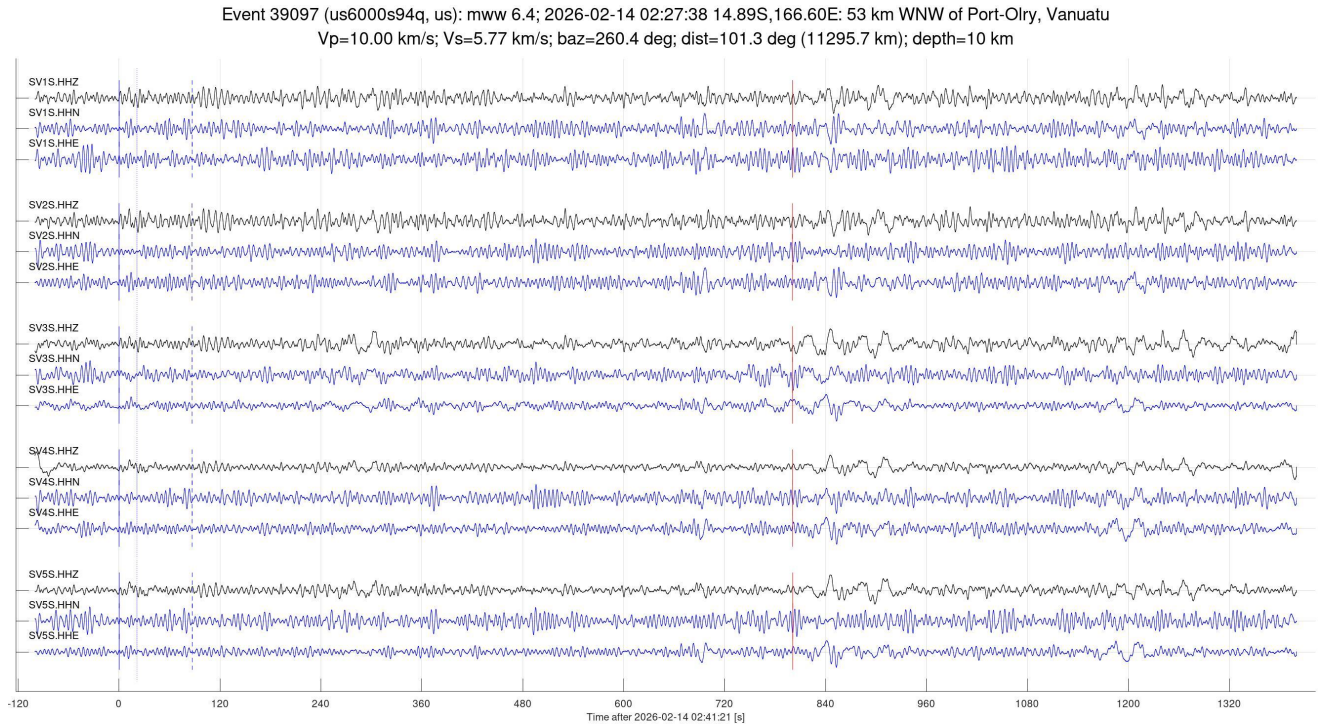


Figure 6, continued.



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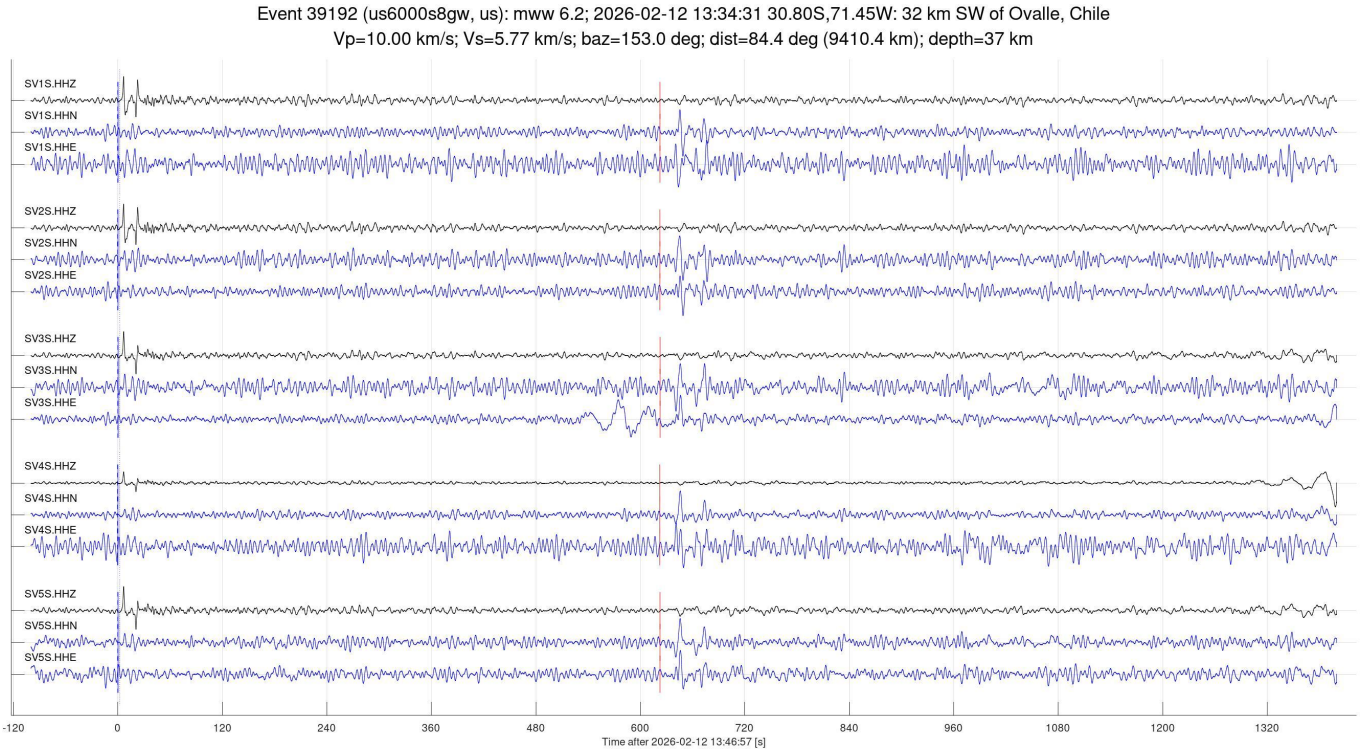

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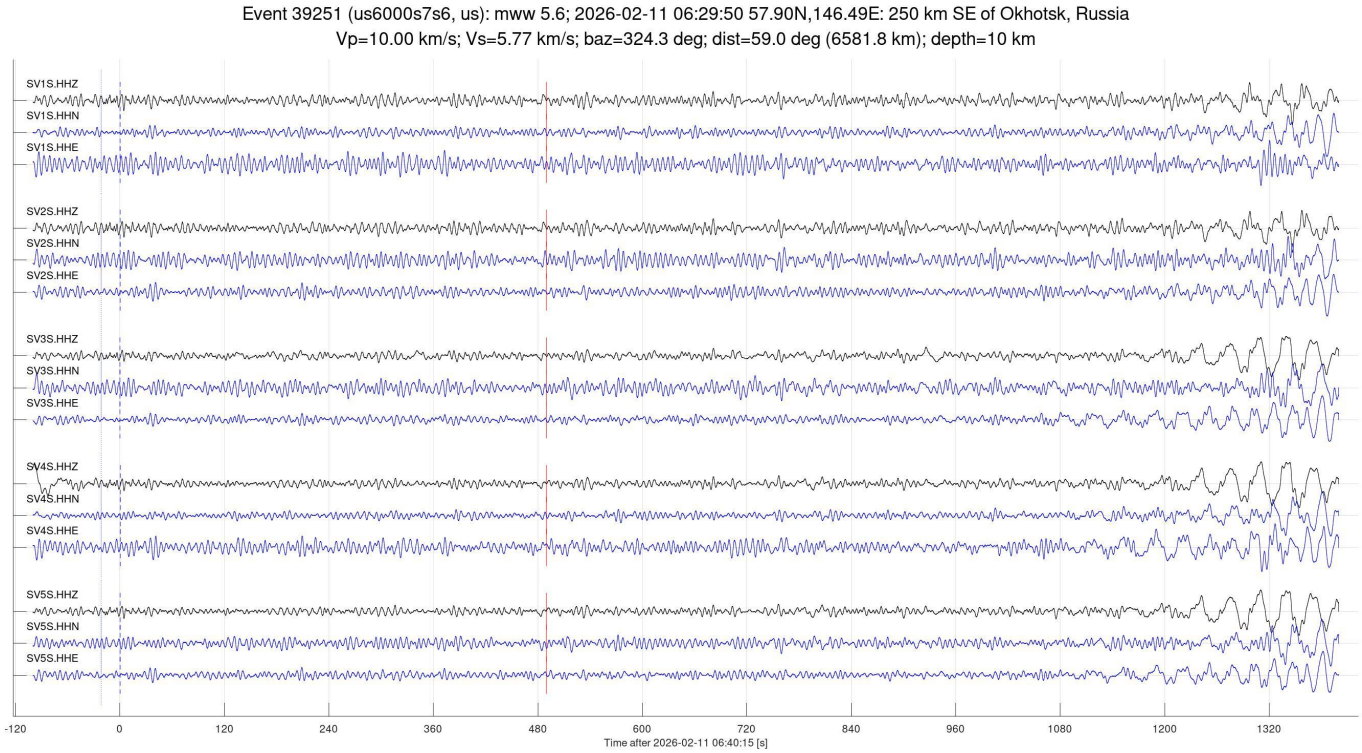

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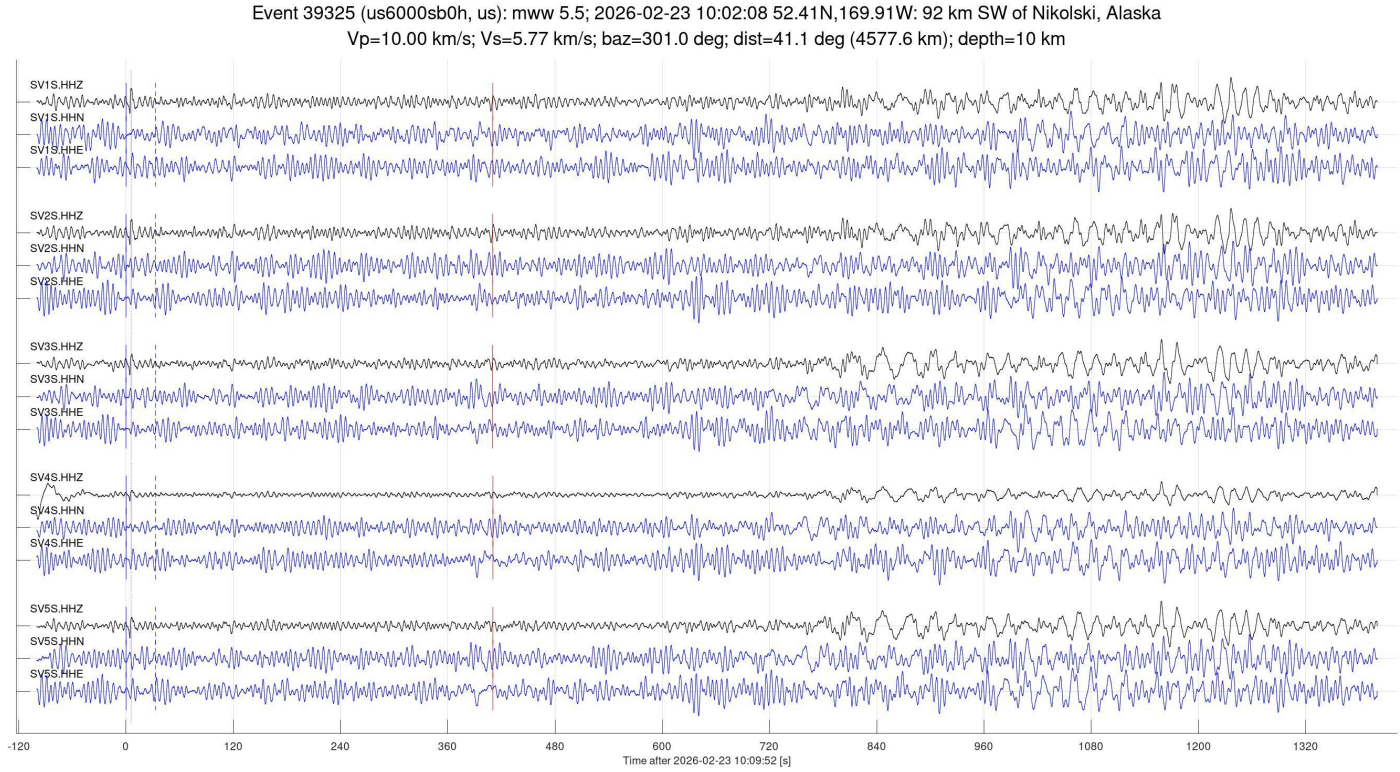

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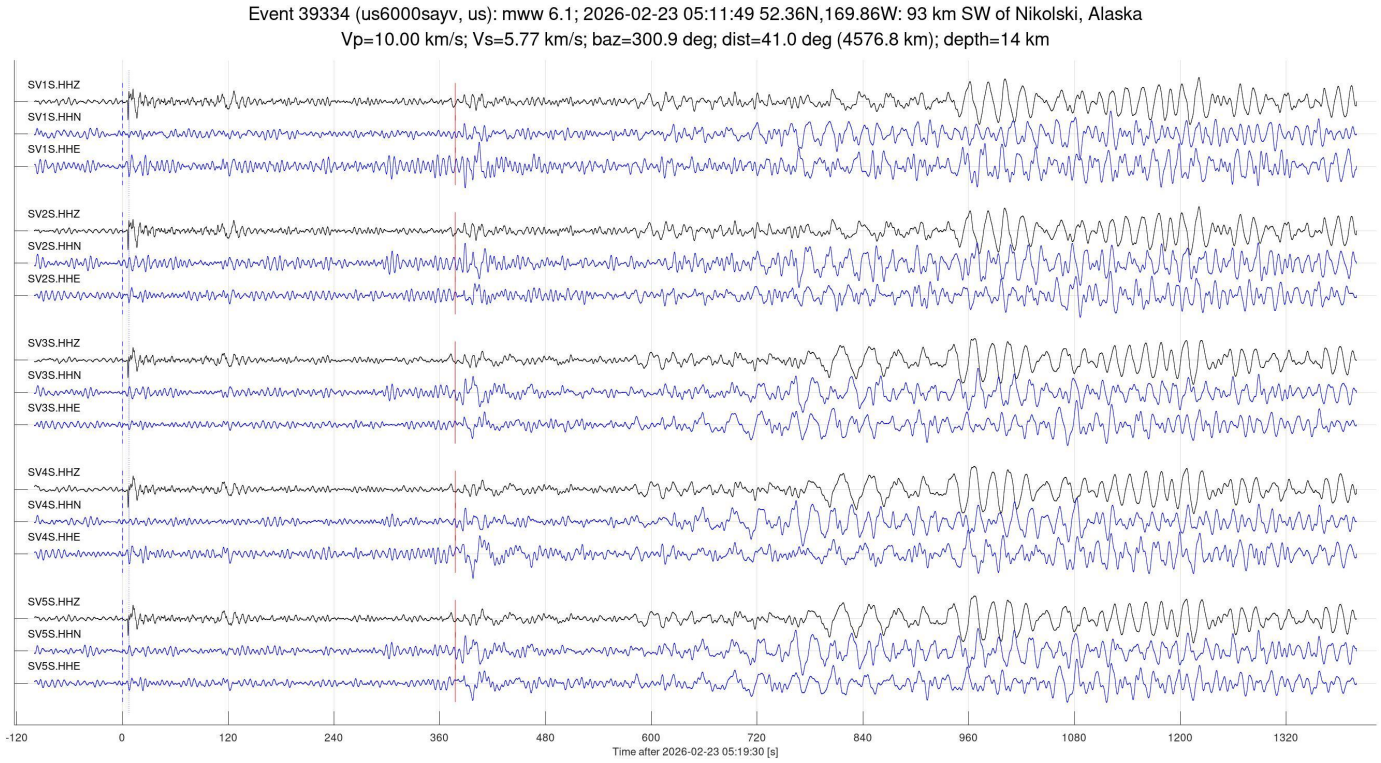

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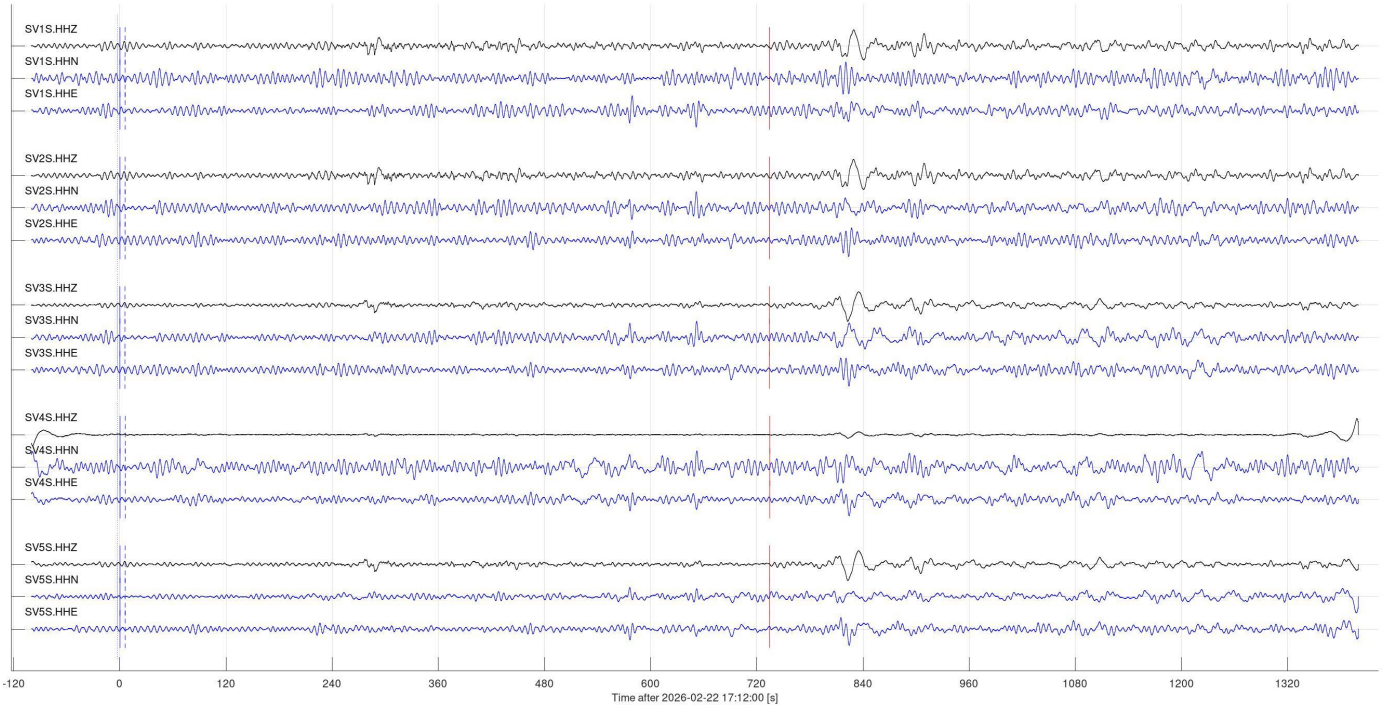


Figure 6, continued.

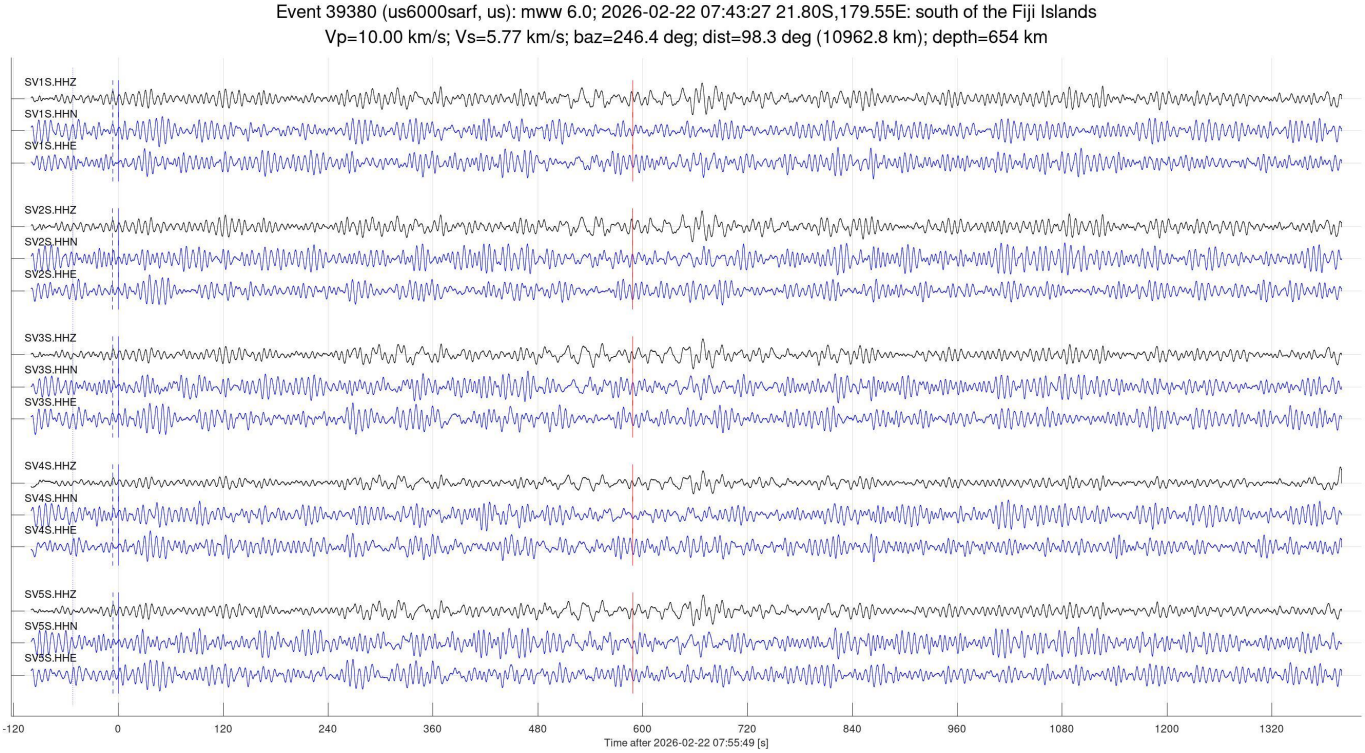


Figure 6, continued.

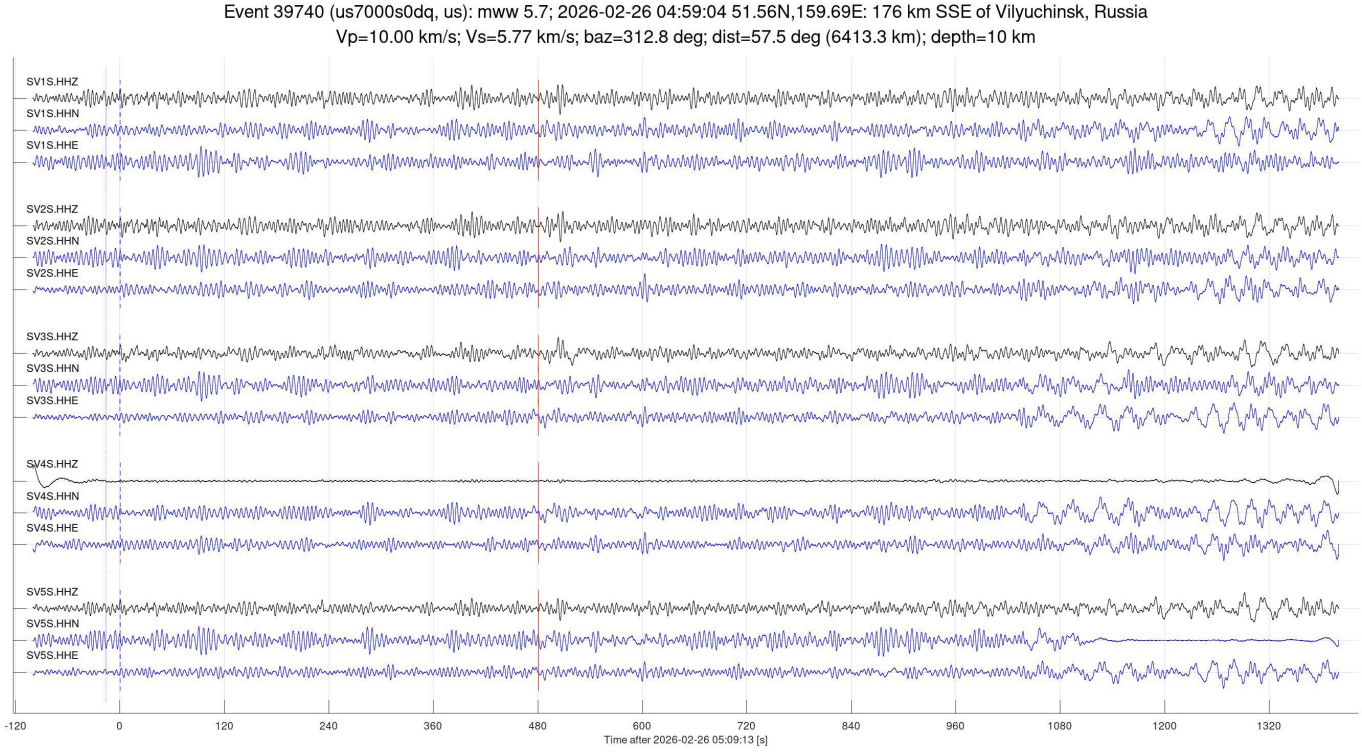


Figure 6, continued.

Regional events (class 2)

No regional seismic events (class 2 in Table 2) were identified at 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)

Thirteen events were identified as mine blasts in the area of Estevan coal mining (Figure 8).

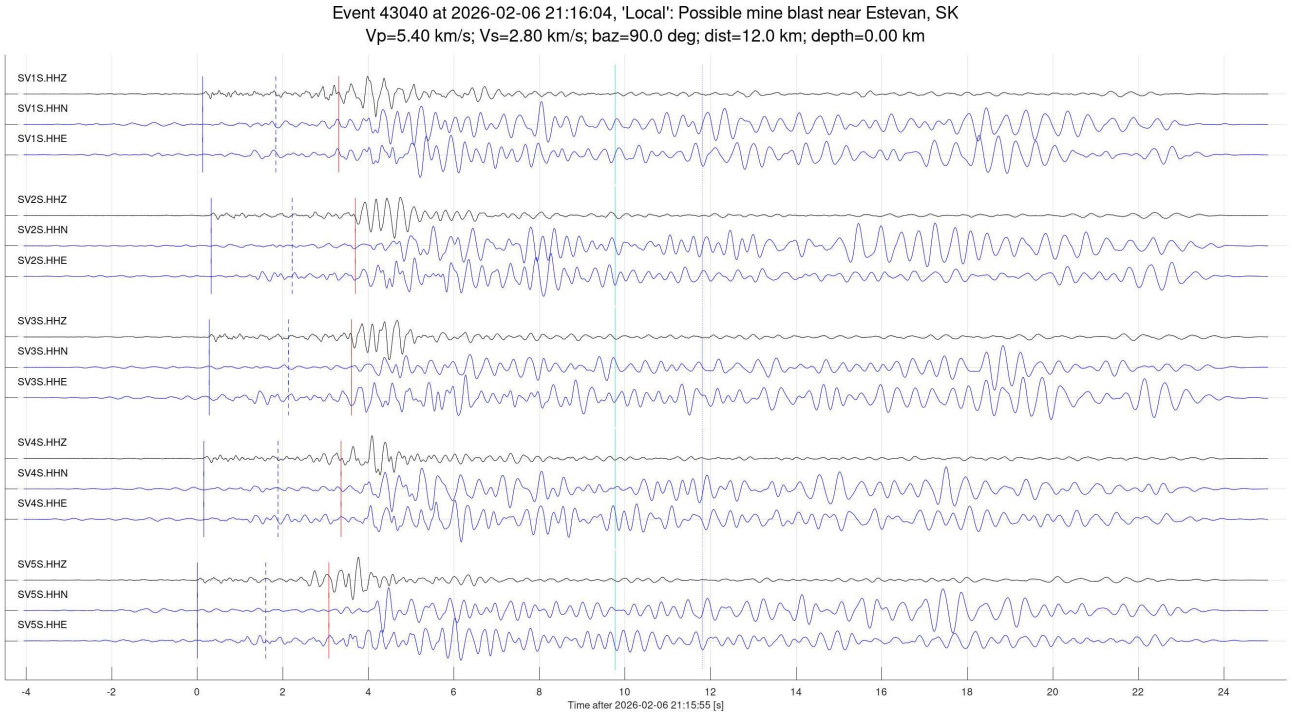


Figure 8. Seismic arrivals produced by mine blasts at the Estevan mine. Colours and labels are as in Figure 6.

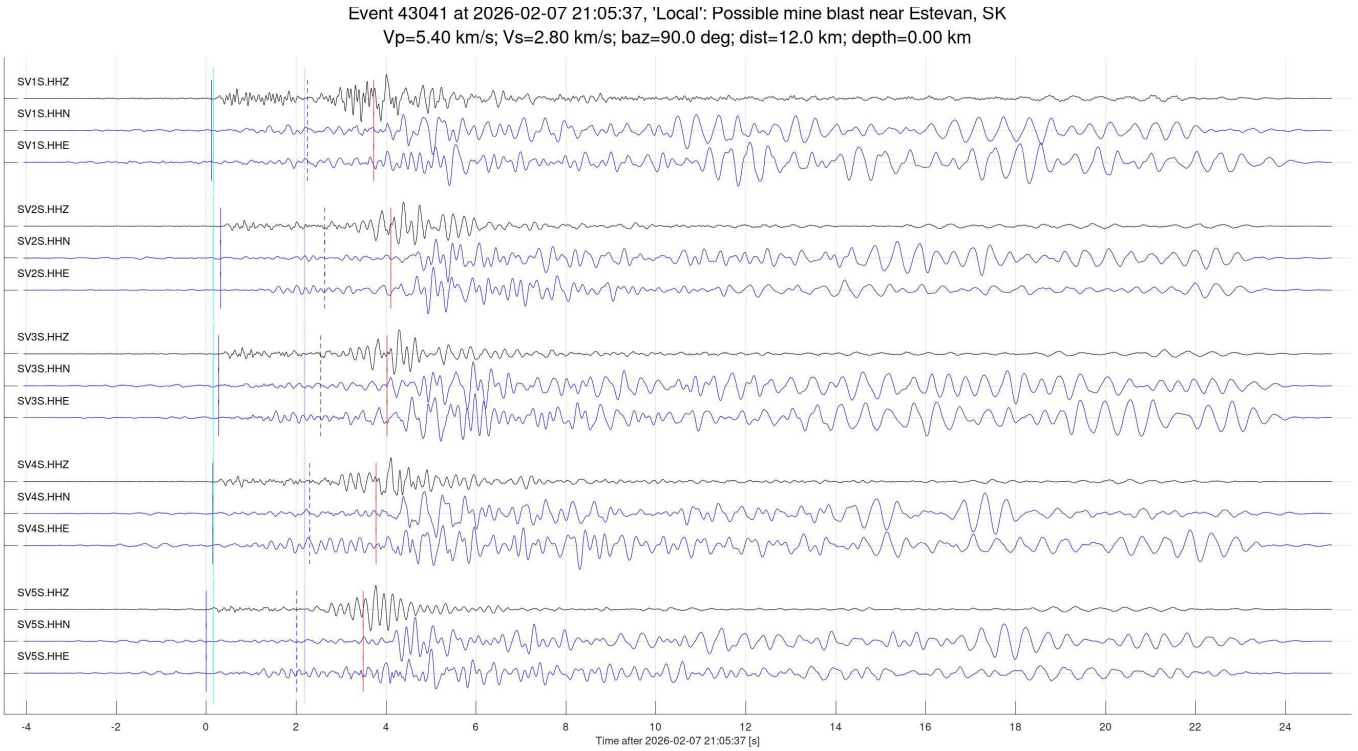
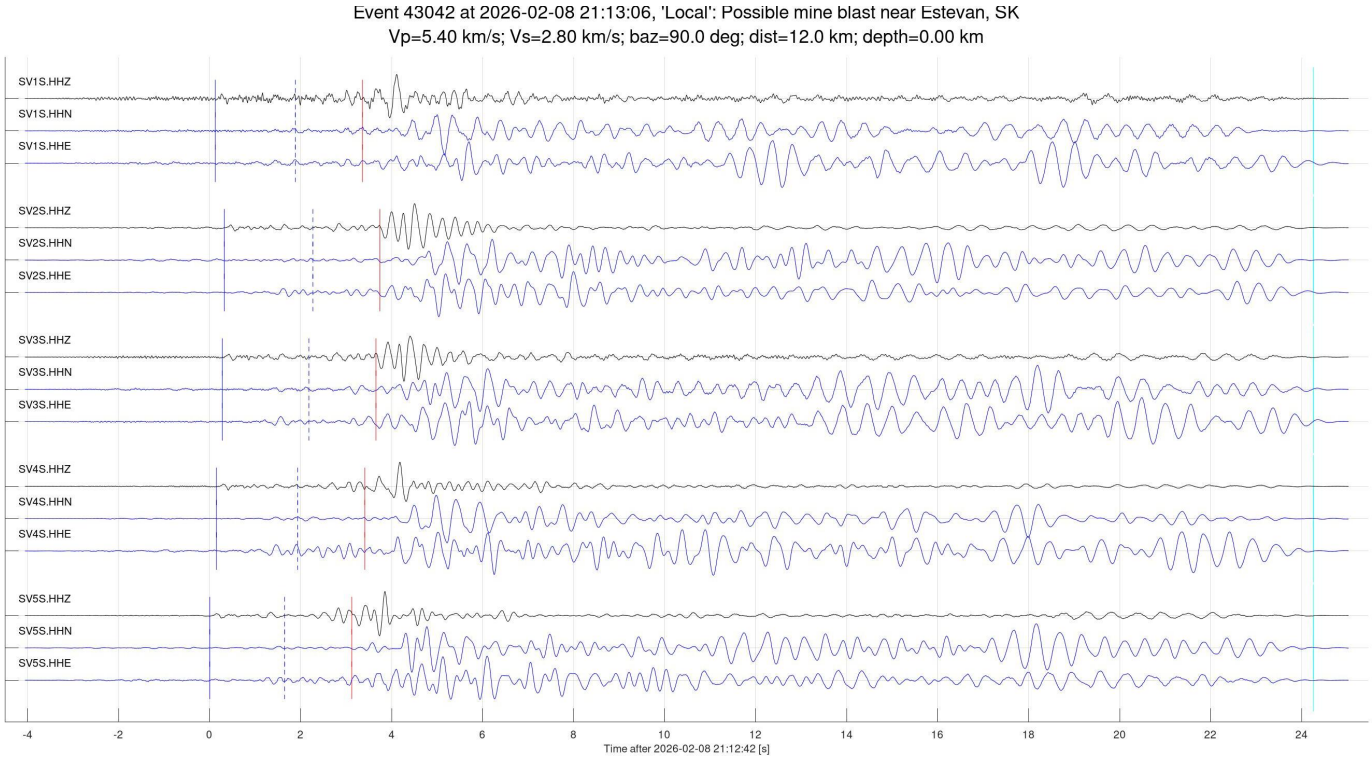


Figure 8, continued.



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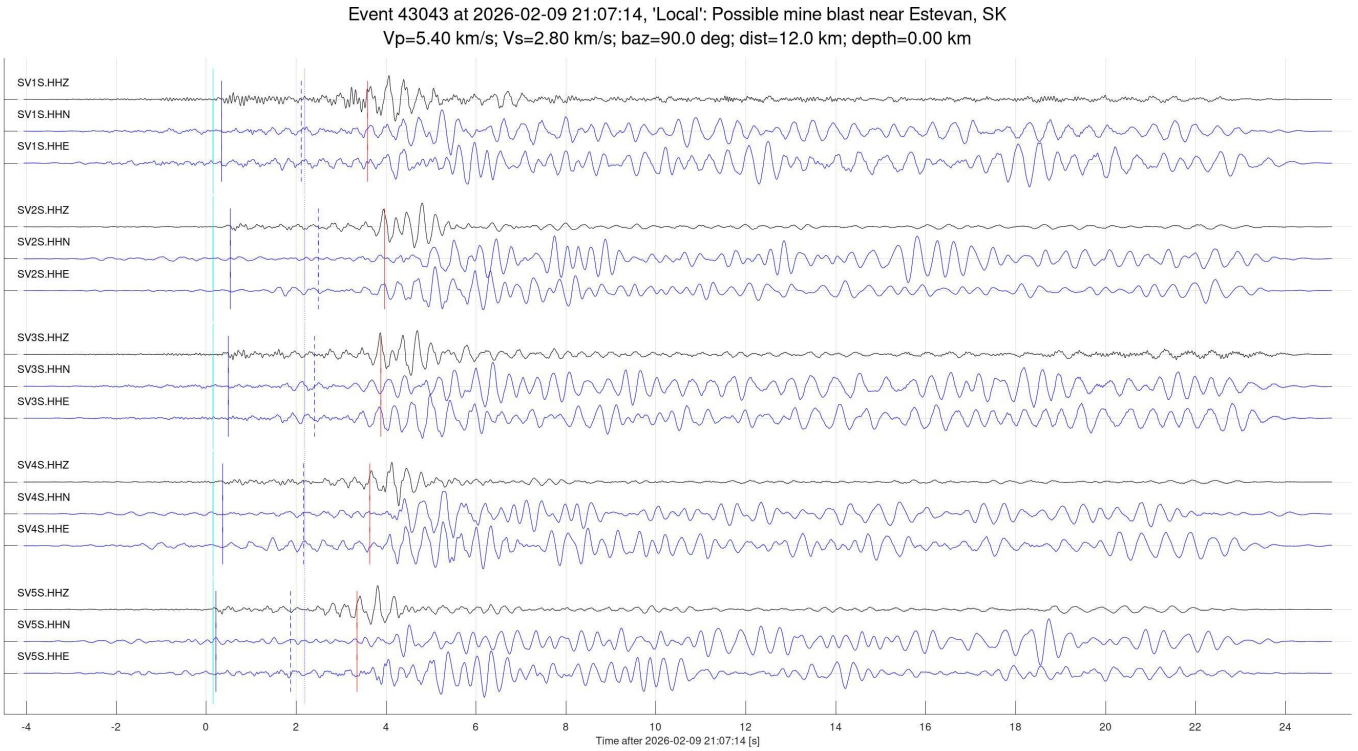

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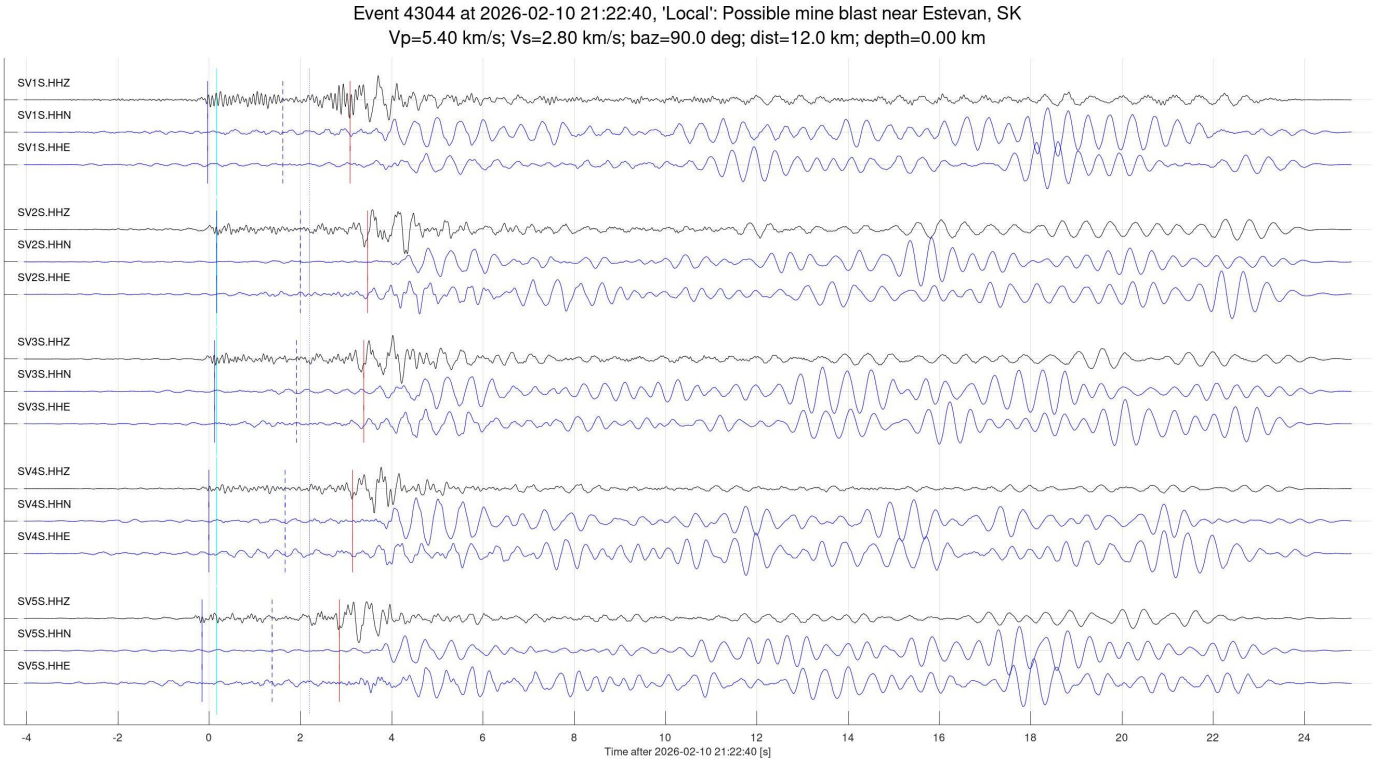

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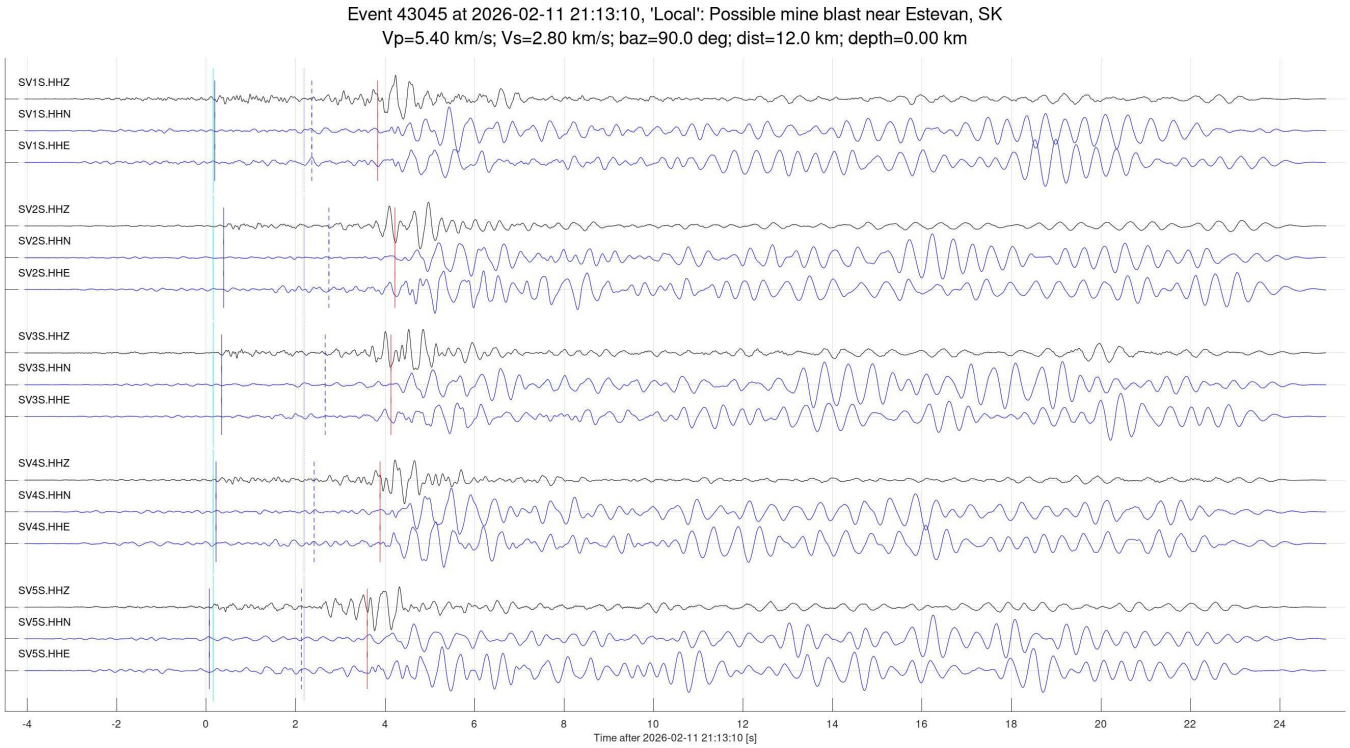

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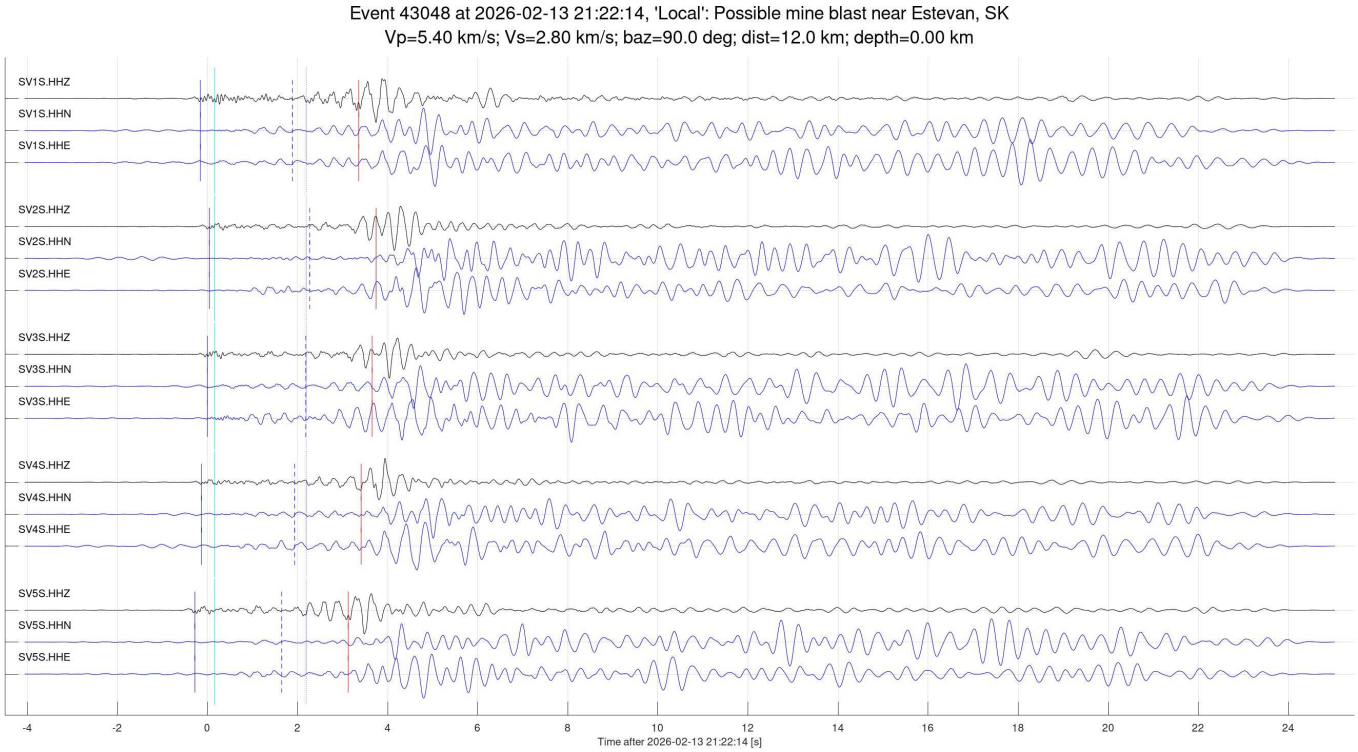

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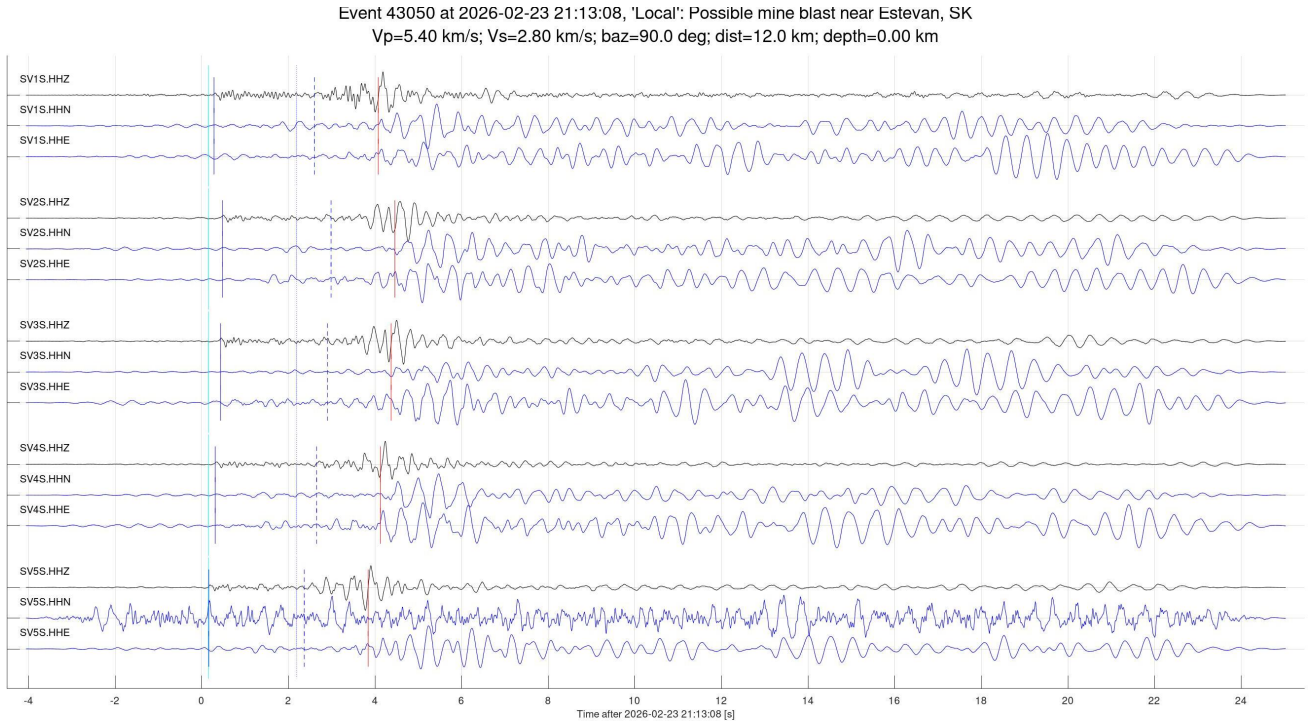

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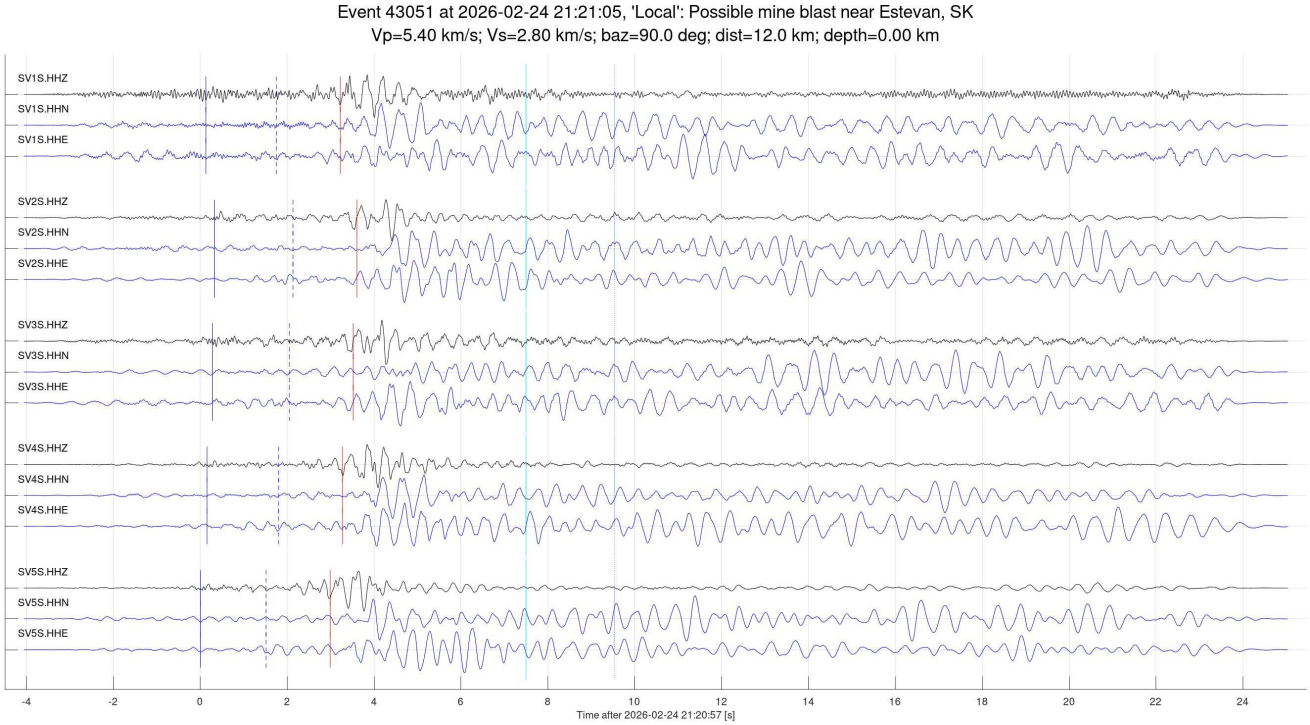

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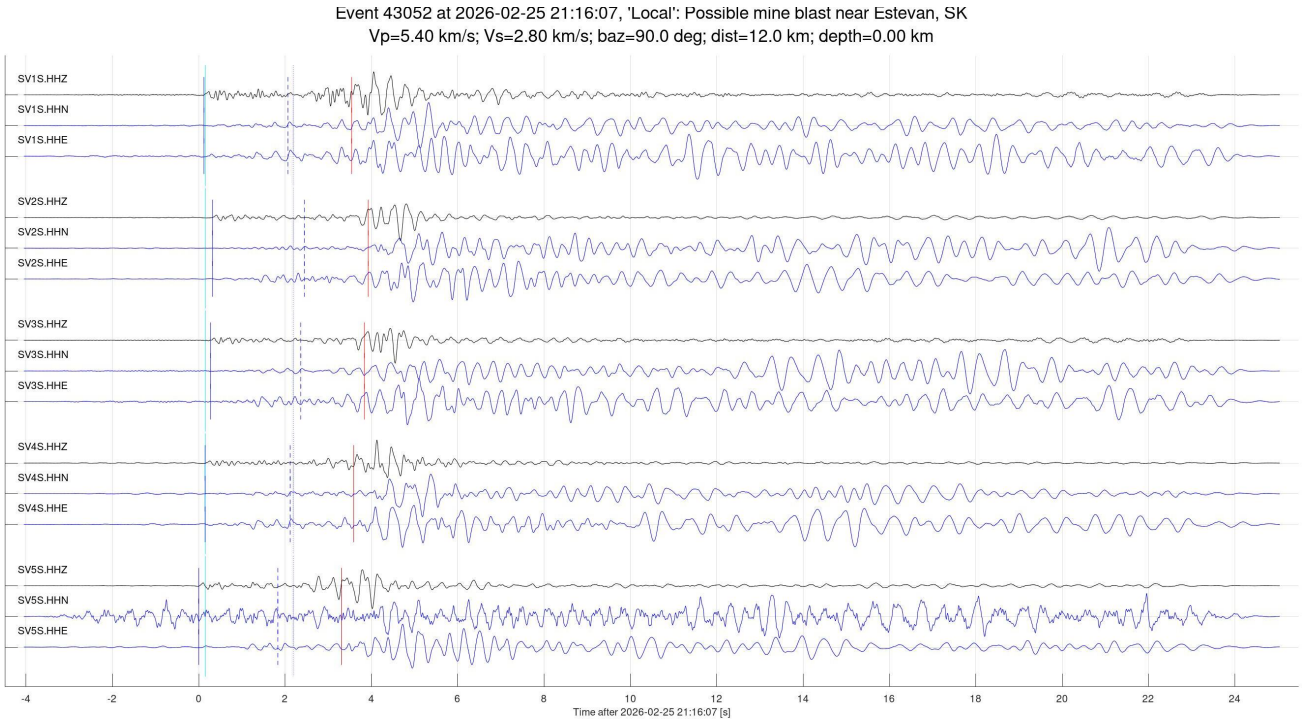

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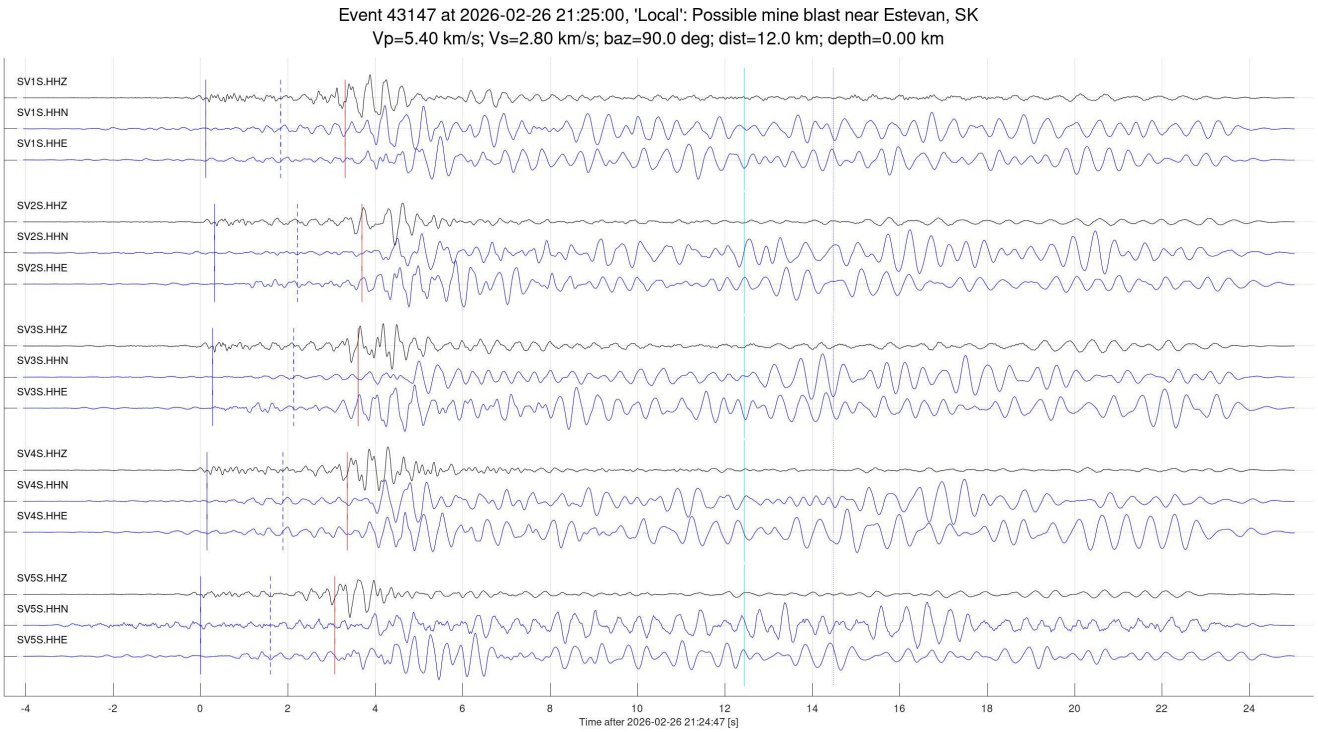

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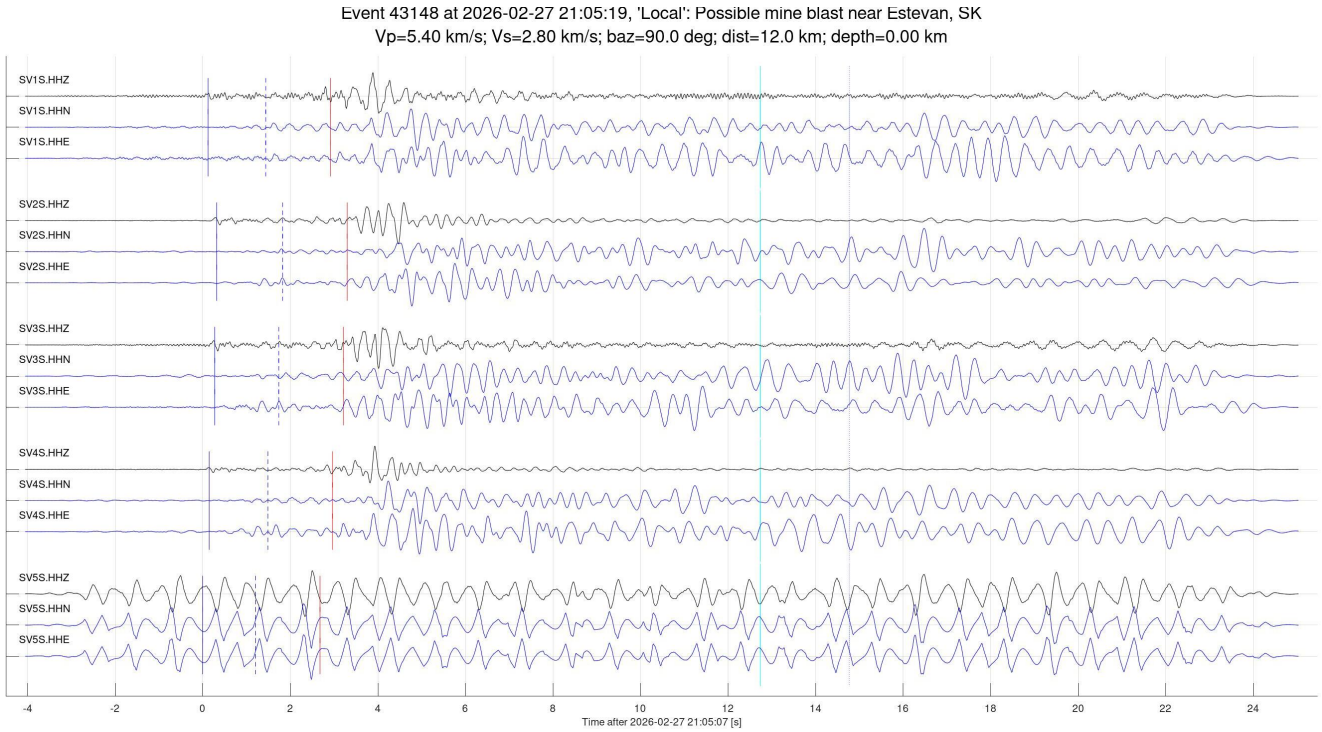

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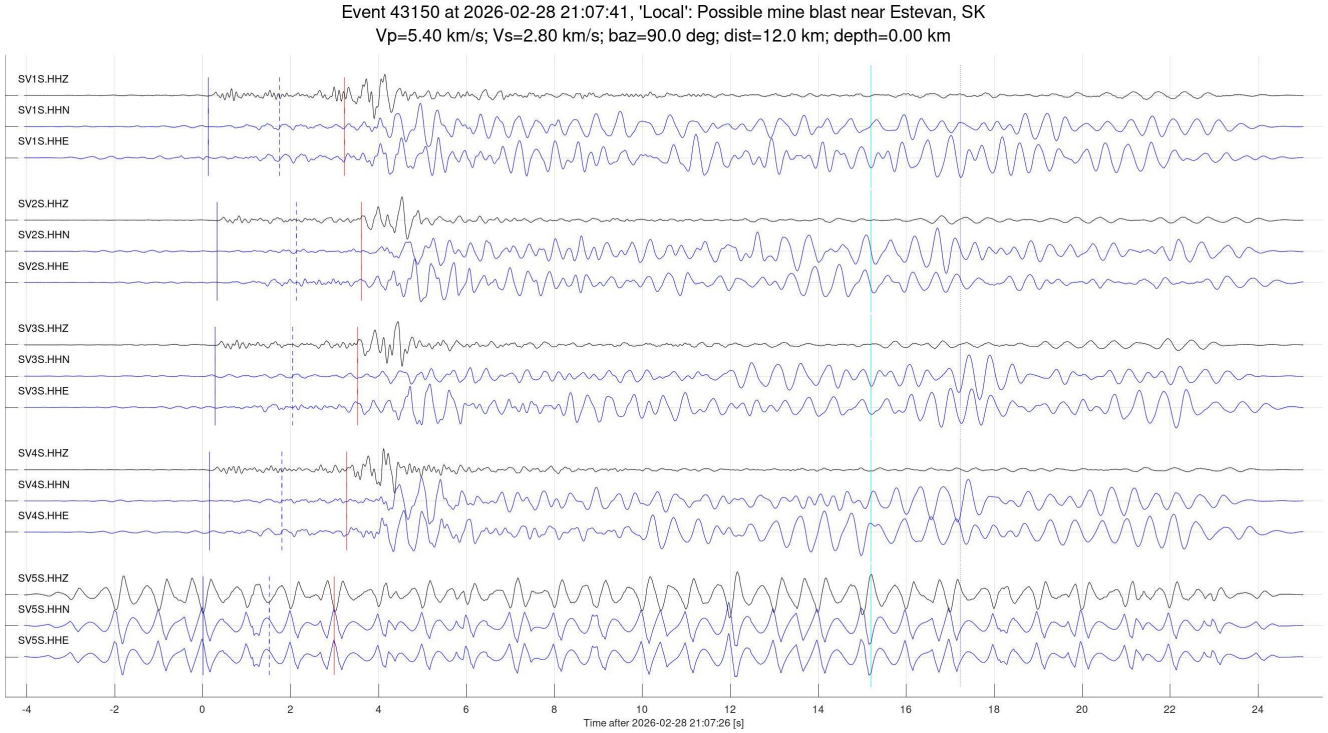

Figure 8, continued.

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 two such events.

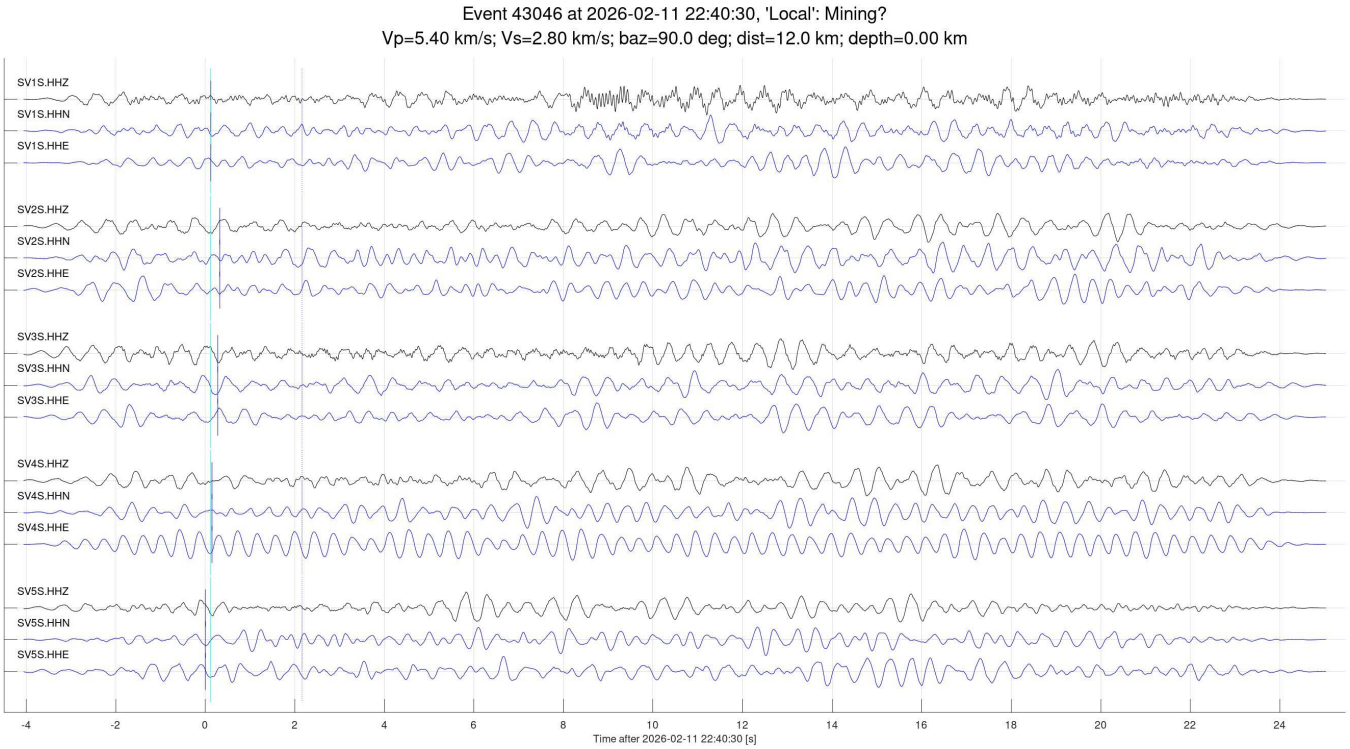

Figure 9. Sample events interpreted as due to mining activity in the area. Lines, colour bars and labels are as in the preceding figures.

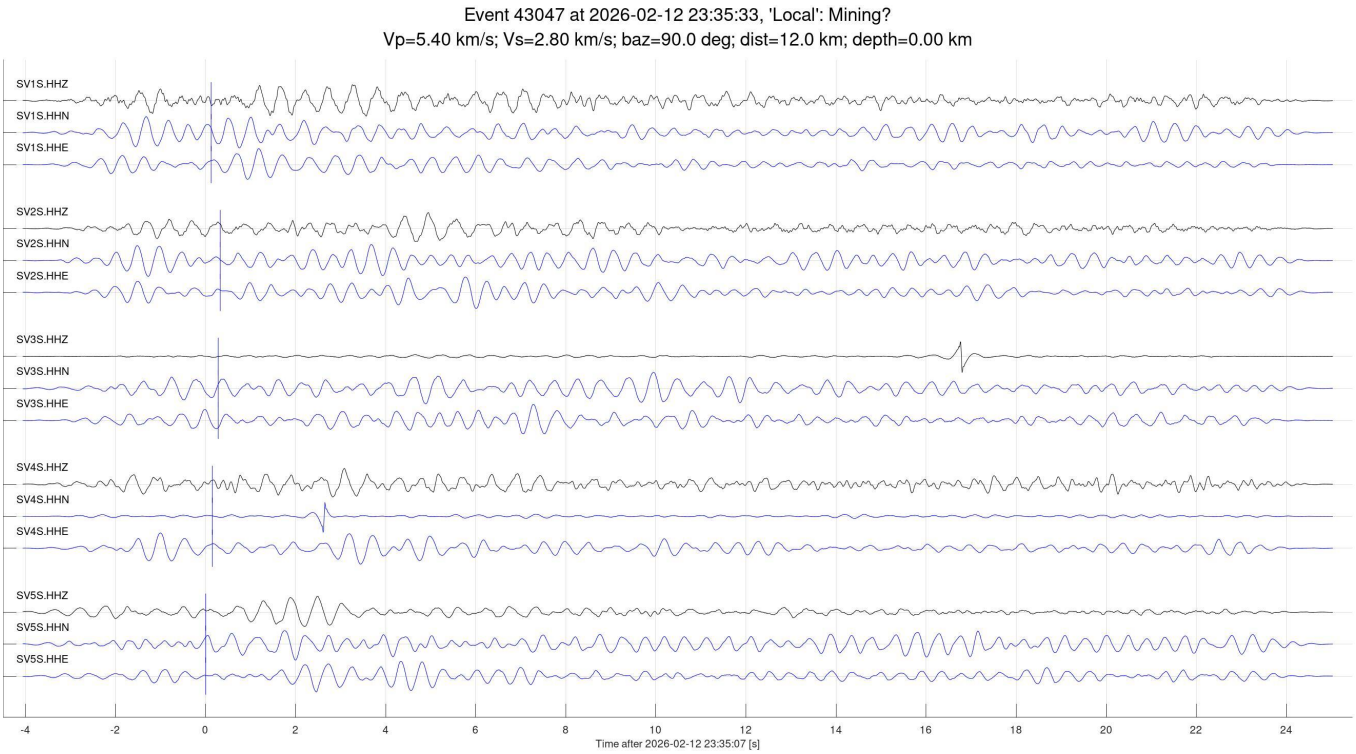

Figure 9, continued.

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

Three 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. However, no events which could be related to fracturing within the target zone (class 4b, impulsive and higher-frequency) were found.

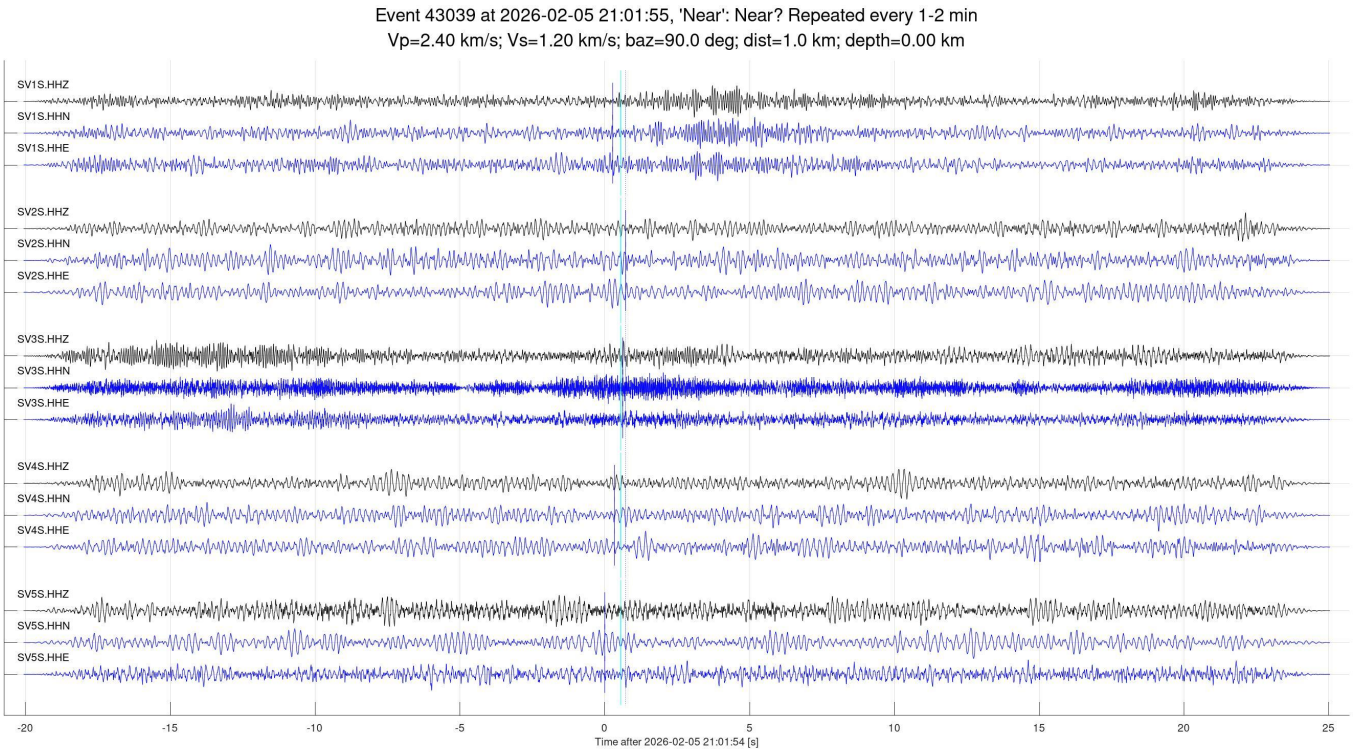

Figure 10. Events interpreted as occurring near surface in the proximity of the array (class 4a in Table 2). Lines, colour bars and labels are as in the preceding figures. Seismic velocity estimates shown in the headers (particularly P-wave) are from an averaged model and require further analysis.

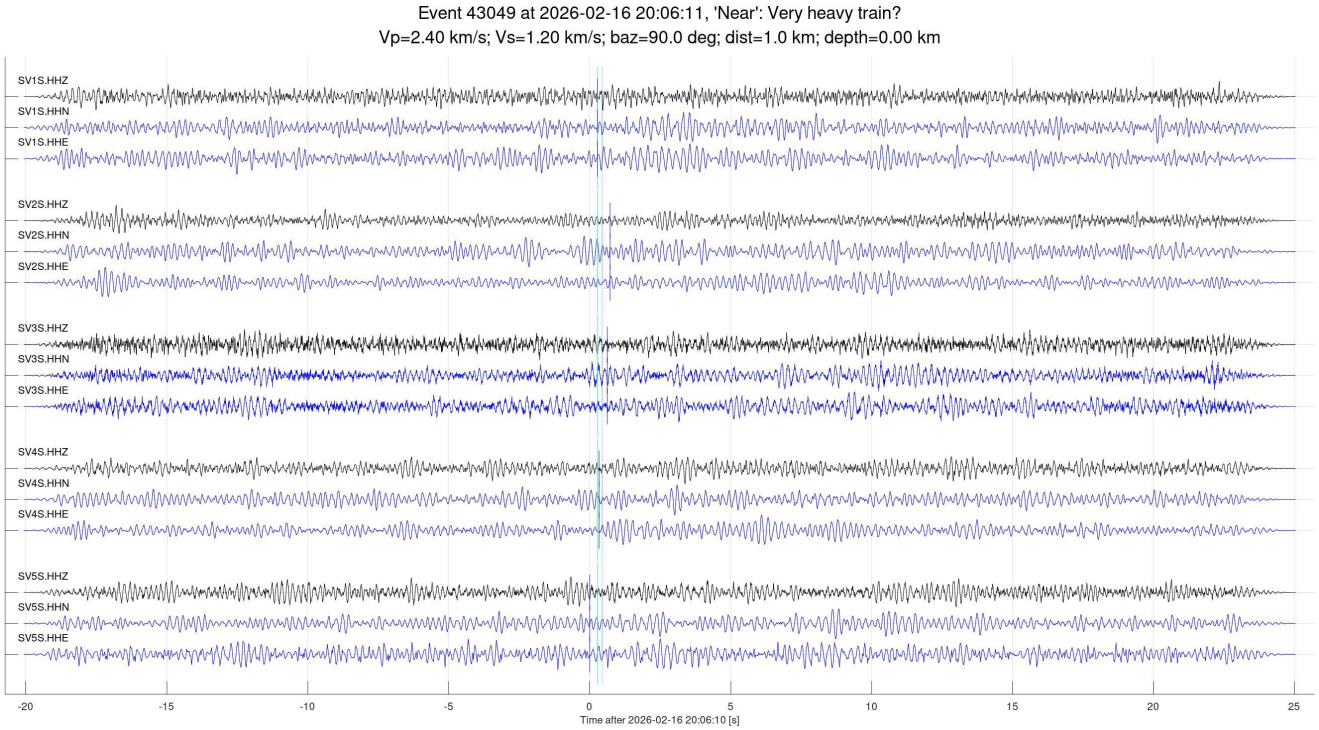

Figure 10, continued

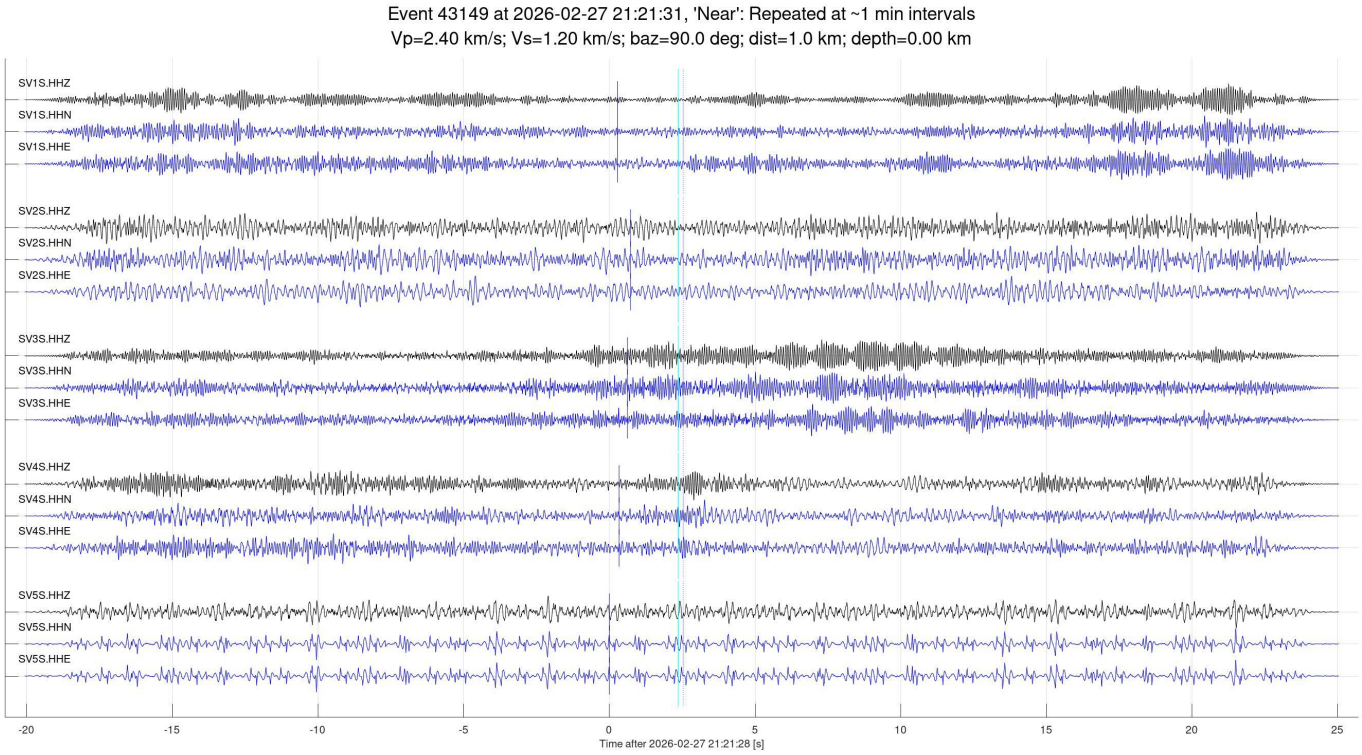

Figure 10, continued

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:

- Station uptime and data retrieval was nearly 100% in February 2026.
- However, because of the high power consumption by the current SaskTel modems, it seems impossible to maintain consistent operation in December-January. It is strongly recommended that the modems are replaced with a much lower-power option. This may require switching to another cellular service

provider (Bell, Rogers, Telus) and purchasing low-power modems like Semtech (Sierra) RV55.

- The Trillium posthole sensor or its sensor cable at station SV5S failed on February 27-28. I recommend purchasing a new sensor cable, and if this does not help, replacing the sensor.
- Vertical-component records at stations SV3S and SV4S frequently contain intervals of spikes and poor record quality. I recommend considering purchasing spare sensor cables (Trillium Posthole for SV4S and Trillium 120P for SV5S) and trying swapping the cables.
- If further maintenance and upgrade of the array is intended, it would be useful to upgrade station SV2S to a Centaur seismometer and station SV3S to a self-levelling Trillium Posthole sensor.

Data and observations:

- 13 teleseismic events, no regional events, and 13 mine blasts were detected in February 2026.
- Numerous local events were also detected, likely related to mining operations or freight trains. These events were not catalogued or analyzed in detail.
- Three events possibly occurring near-surface in the vicinity of the array were noted. However, these events are difficult to identify conclusively.
- No events occurring at the reservoir level were identified.