

Advanced Multicomponent Seismic Software

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

Report AQ-2026-07-IM

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Contents

1. Station performance....3
Data recovery....6
2. Data quality....6
3. Processing procedure and parameters....9
4. Seismic event detection....9
Automatic detections....10
Event bulletins....10
Teleseismic events (class 1)....12
Regional events (class 2)....29
Local events (classes 3 and 4)....31
Possible mine blasts at the Estevan mine (class 3a)....31
Events related to mining operations (class 3b)....34
Events in array proximity (classes 4a and 4b)....37
5. SEGY files....40
6. Conclusions and recommendations....40

1. Station performance

Station performance for July 2026 is summarized in Figure 1, and their state-of-health parameters are shown in Figure 2. Power-supply voltages looked generally good and station operation was practically uninterrupted.

The sensor “mass position” (or “sensor SOH”) voltage for station SV3S, which was a concern in last month’s report, fluctuates and currently has returned into the allowed interval [-2.5, +2.5] V (Figure 2). Thus, no manual adjustment of the sensor appears to be needed at this time. However, if working on this station (for example, to upgrade the cellular communications network), it could be advisable to adjust the mass position W (channel VM1 in Figure 2) by about -2.2 V, so that the mean level of longer-term fluctuations is around zero.

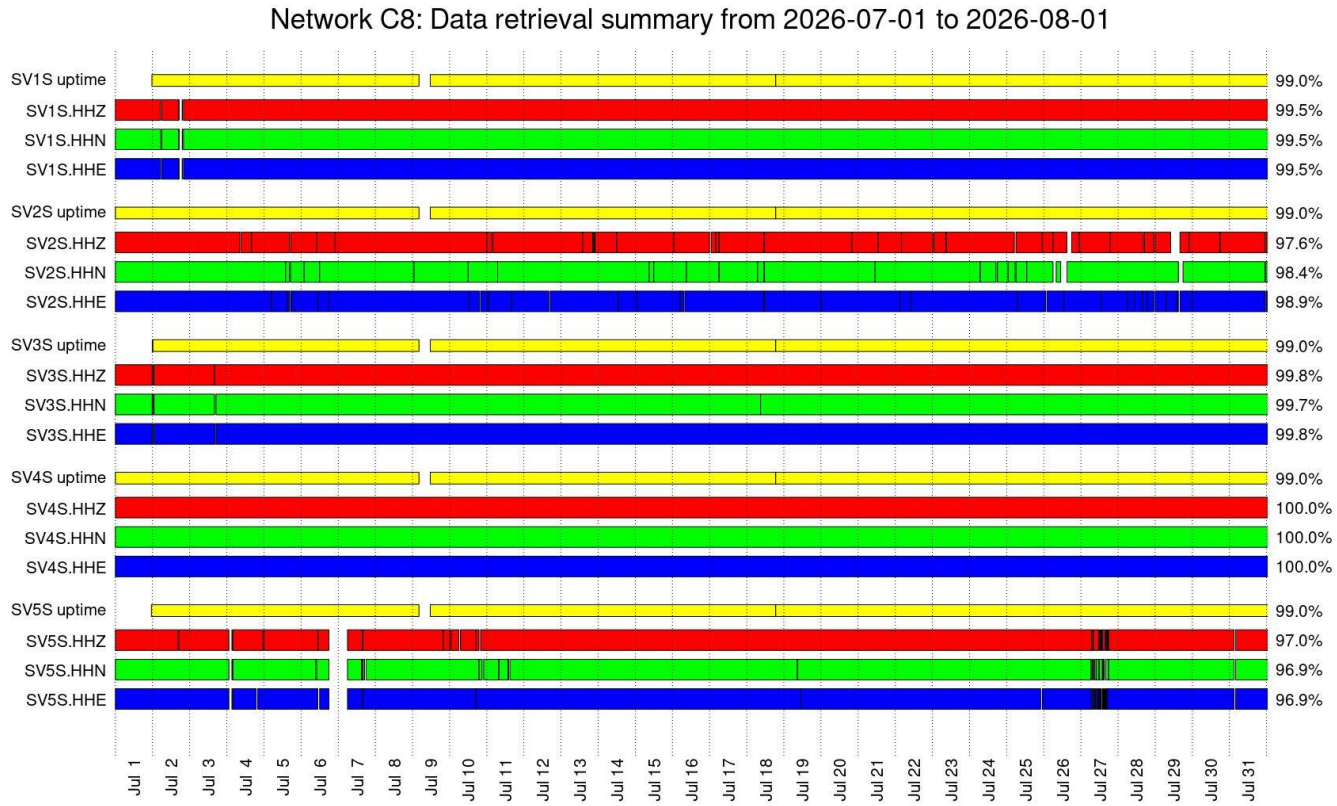


Figure 1. Retrieved data intervals for all channels (red, green, and blue bars) and uptimes (yellow). Total percentages of measured uptime and data retrieval are shown on the right.

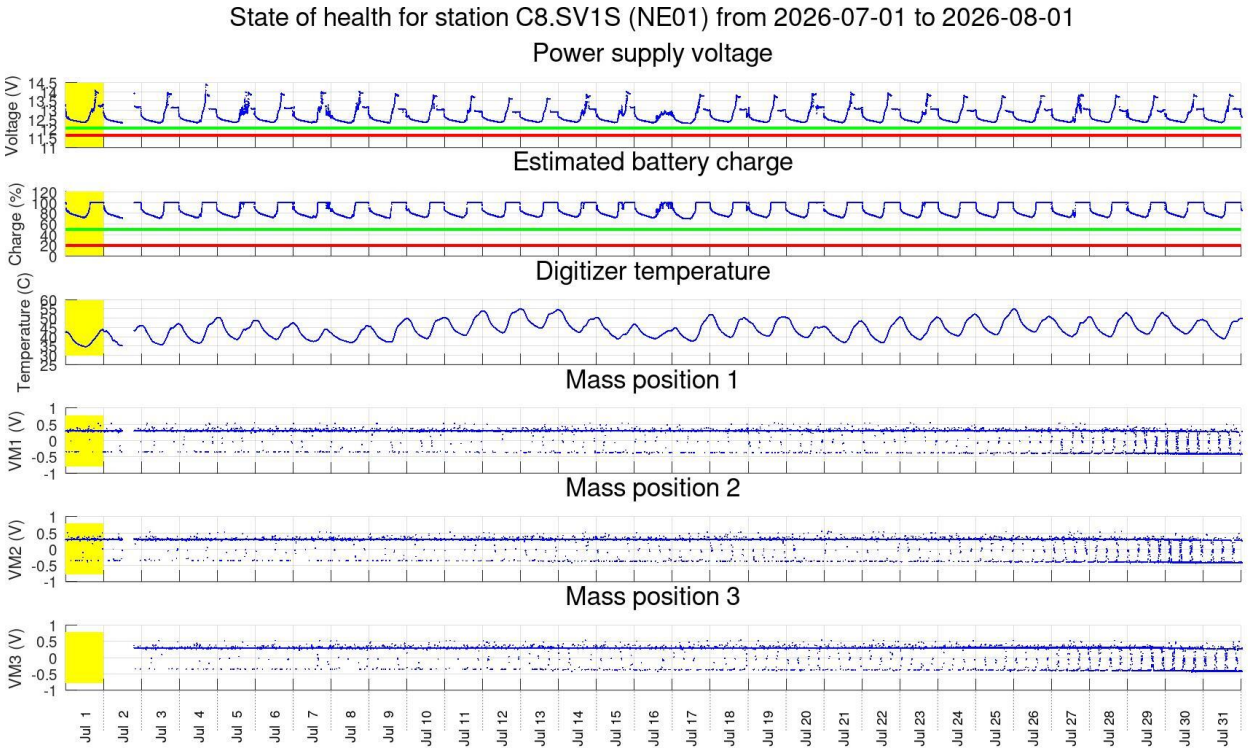


Figure 2. State of health parameters for each station (SV1S here). Image headings: power supply voltage, estimated battery charge levels, temperature on board, voltages measuring mass positions.

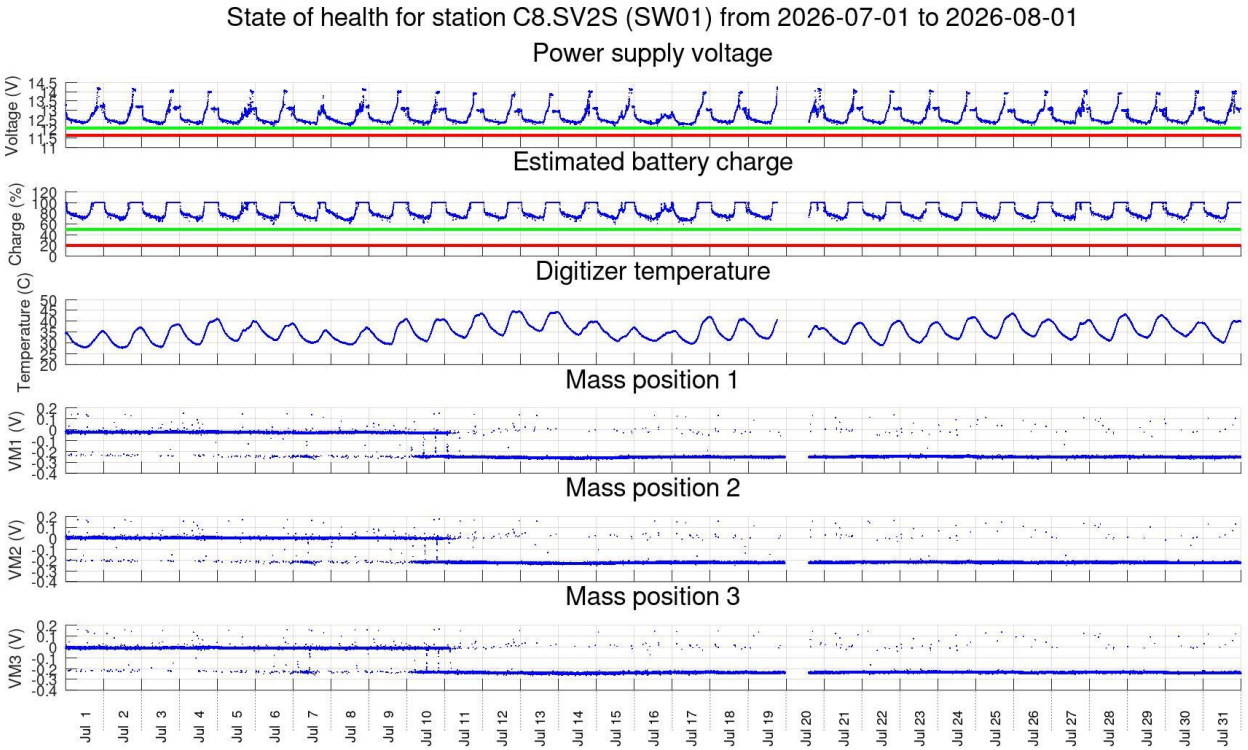


Figure 2, continued, station SV2S.

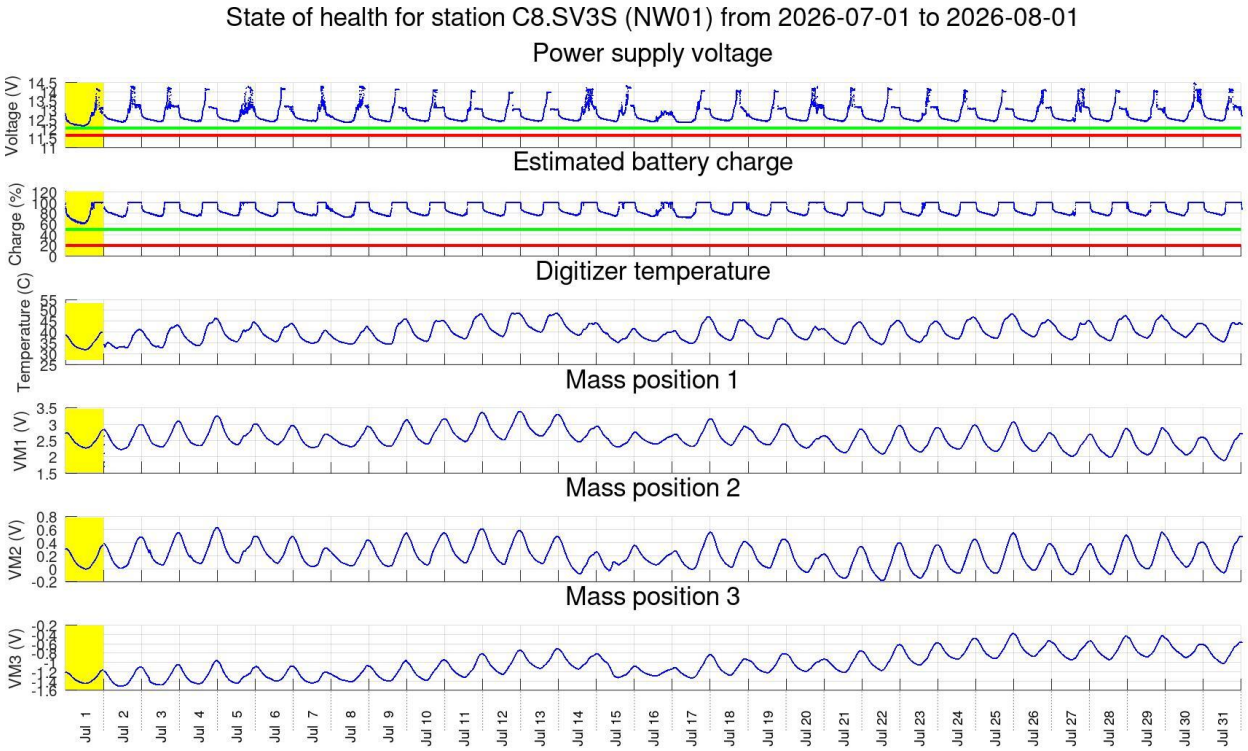


Figure 2, continued, station SV3S.

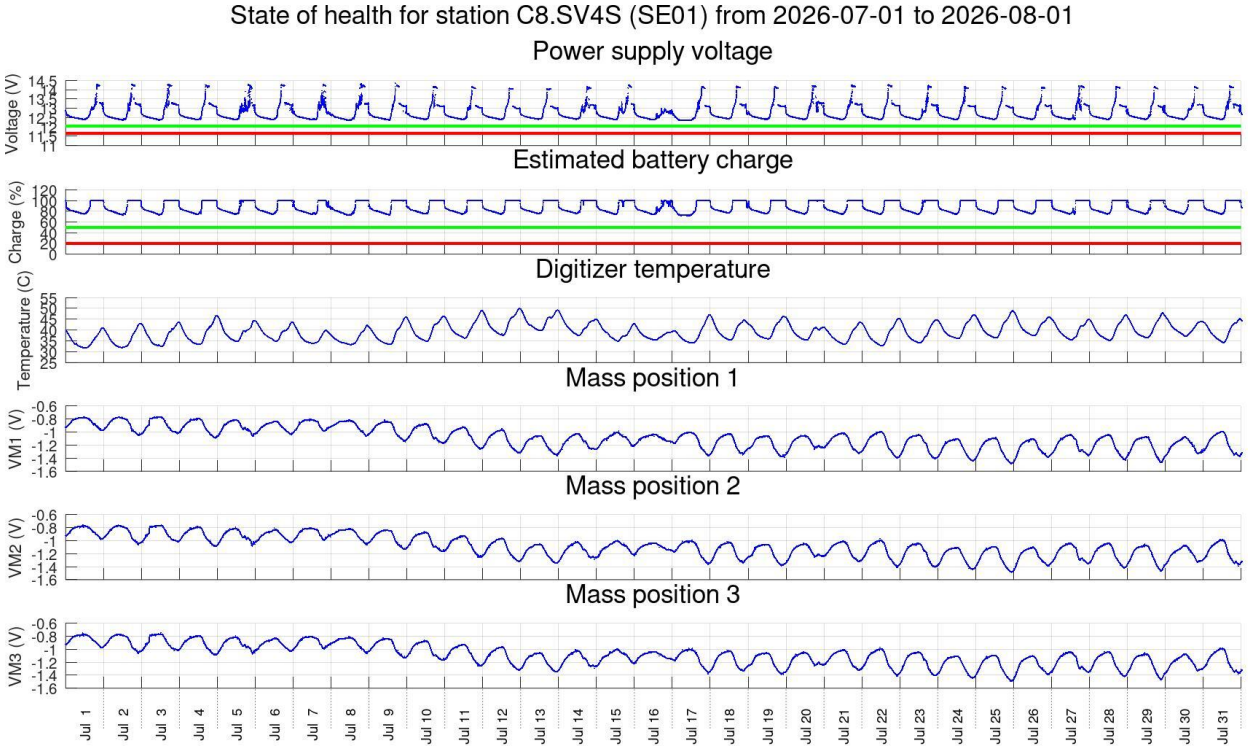


Figure 2, continued, station SV4S.

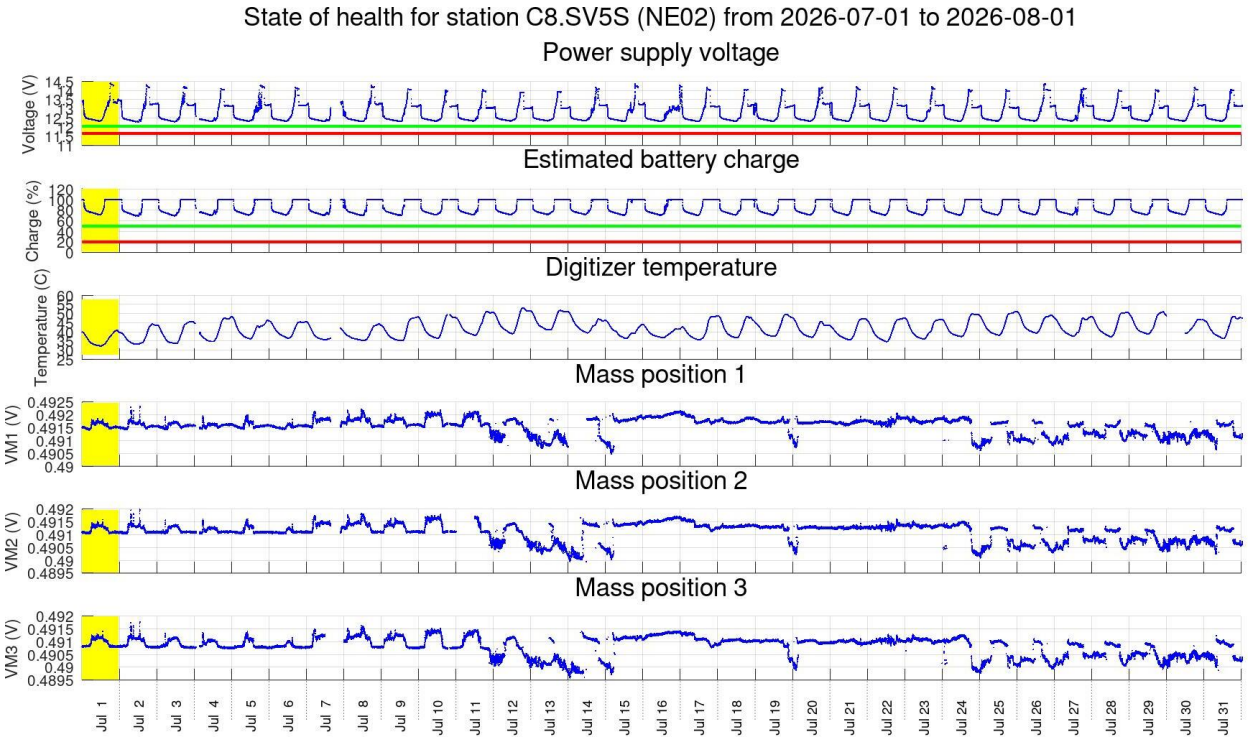


Figure 2, continued, station SV5S.

Data recovery

Data recovery from all stations was near 100% (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 interval root-mean square (RMS) average amplitudes in each channel.

Records from station SV1S are contaminated with spikes occurring roughly every 2 – 10 seconds, synchronously in two or all three channels. Such spikes may be caused by a faulty sensor cable. The spikes are relatively weak and allow recording mine blasts and some teleseismic earthquakes. However, in this persistent spike background, it appears unfeasible to recognize any potential microseisms from the target zone.

As in previous reporting periods, station SV3S and occasionally SV4S also show intervals of spikes in the records.

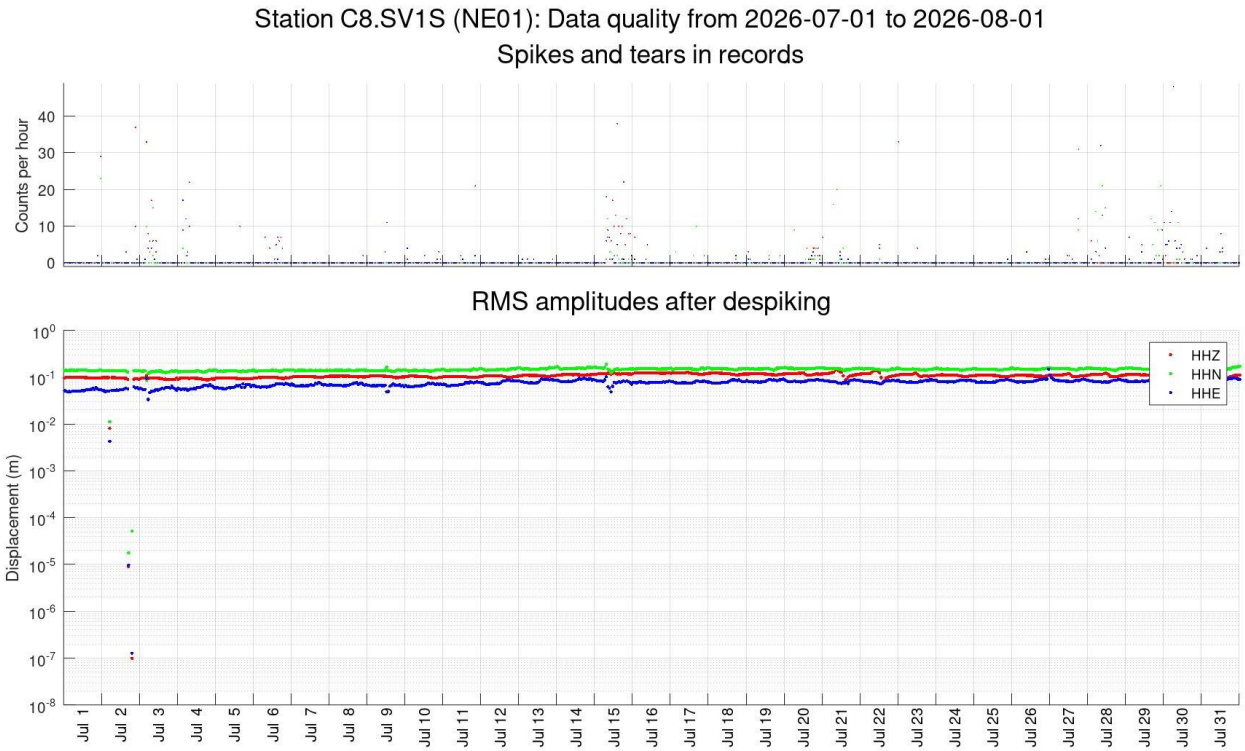


Figure 3. Measures of data quality in hour-long intervals. Station names and time intervals are indicated in plot headings (SV1S in this plot). Red, green, and blue colours correspond to channels HHZ, HHN, and HHE, respectively (as in Figure 1).

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

Bottom panels: RMS ground displacements (meters).

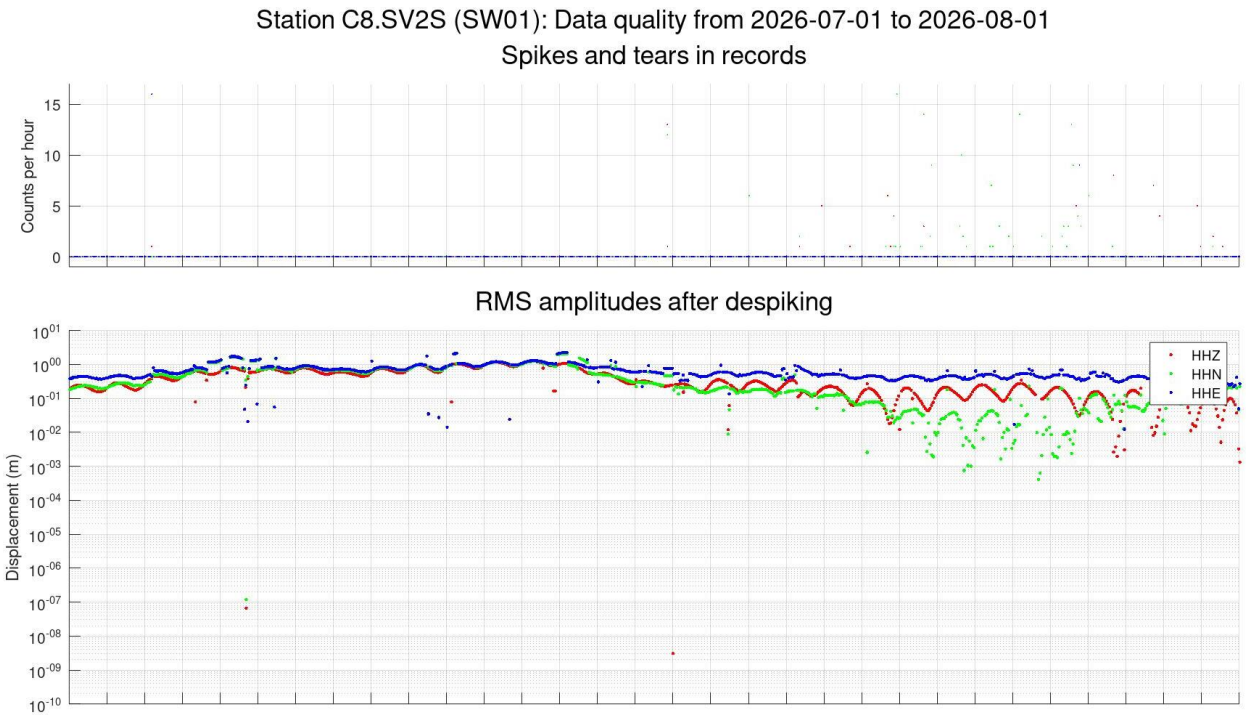


Figure 3, continued. Station SV2S.

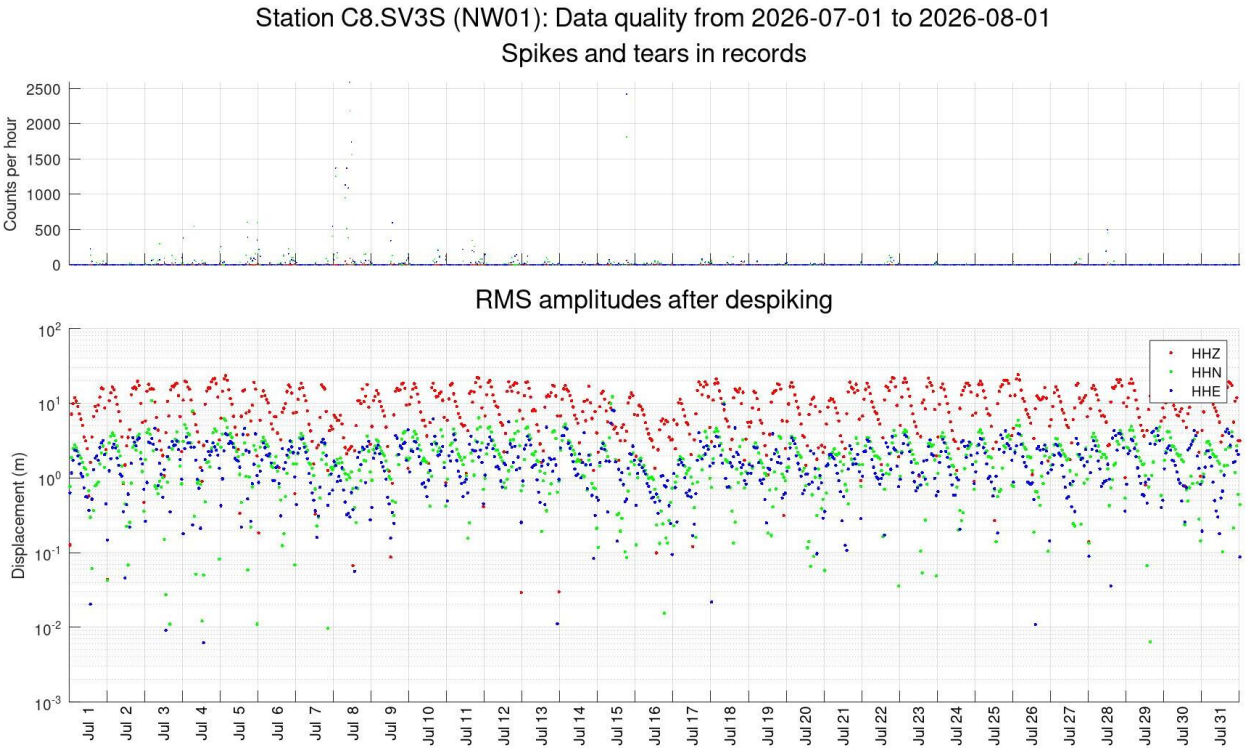


Figure 3, continued. Station SV3S. Note the large numbers of spikes, also seen in some waveform records below in this report.

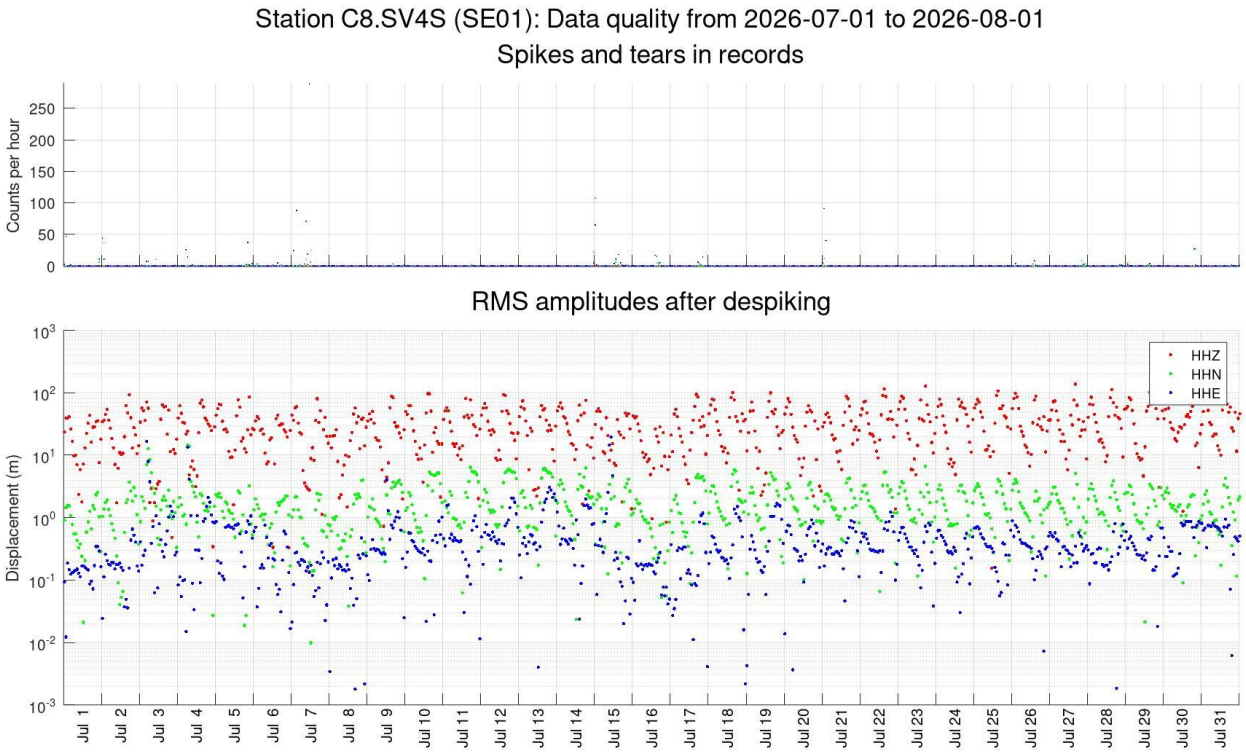


Figure 3, continued. Station SV4S. Also note significant numbers of spikes.

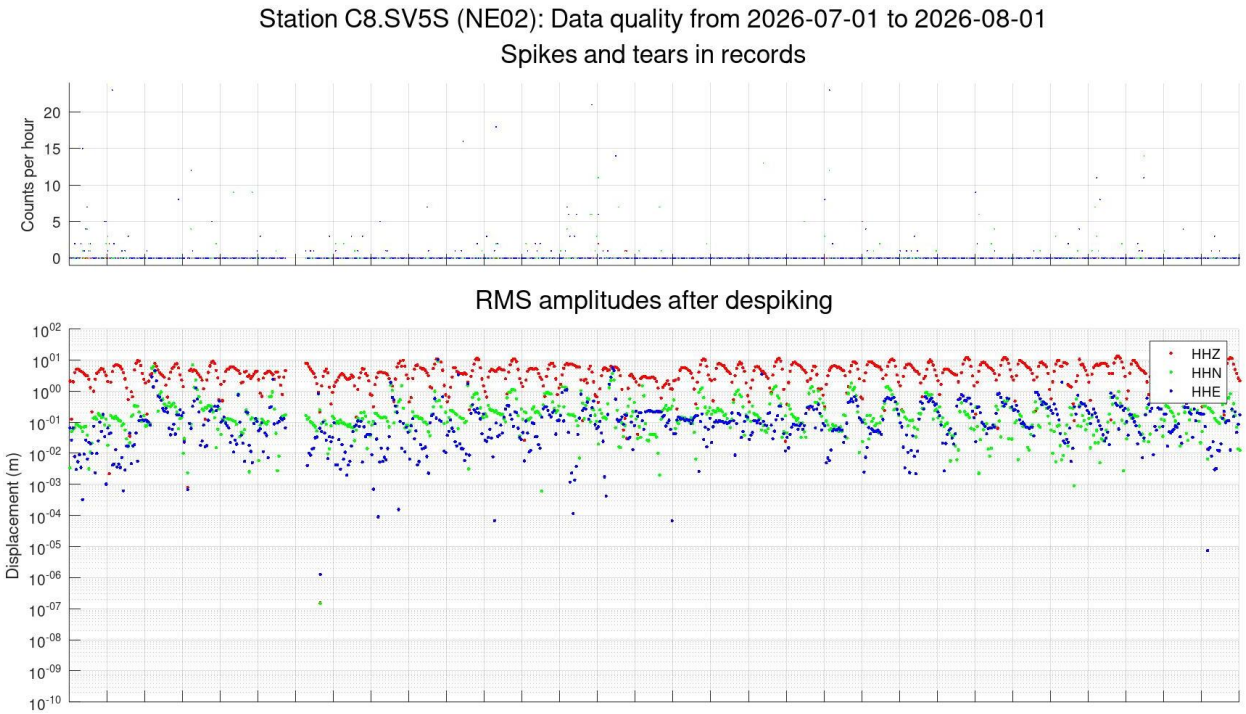


Figure 3, continued. Station SV5S.

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 July 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	25
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	11
3b	Mining-related	Low frequencies, extended repeated wavetrains low arrival velocities related to surface waves	1 (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). Events larger than magnitude 2.5 were taken from USGS, and all available events were retrieved from NRCan. Events located at regional distances or with magnitudes above the selected $magnitude \propto distance^{1.5}$ threshold (dashed green line in Figure) were reviewed interactively (next section).

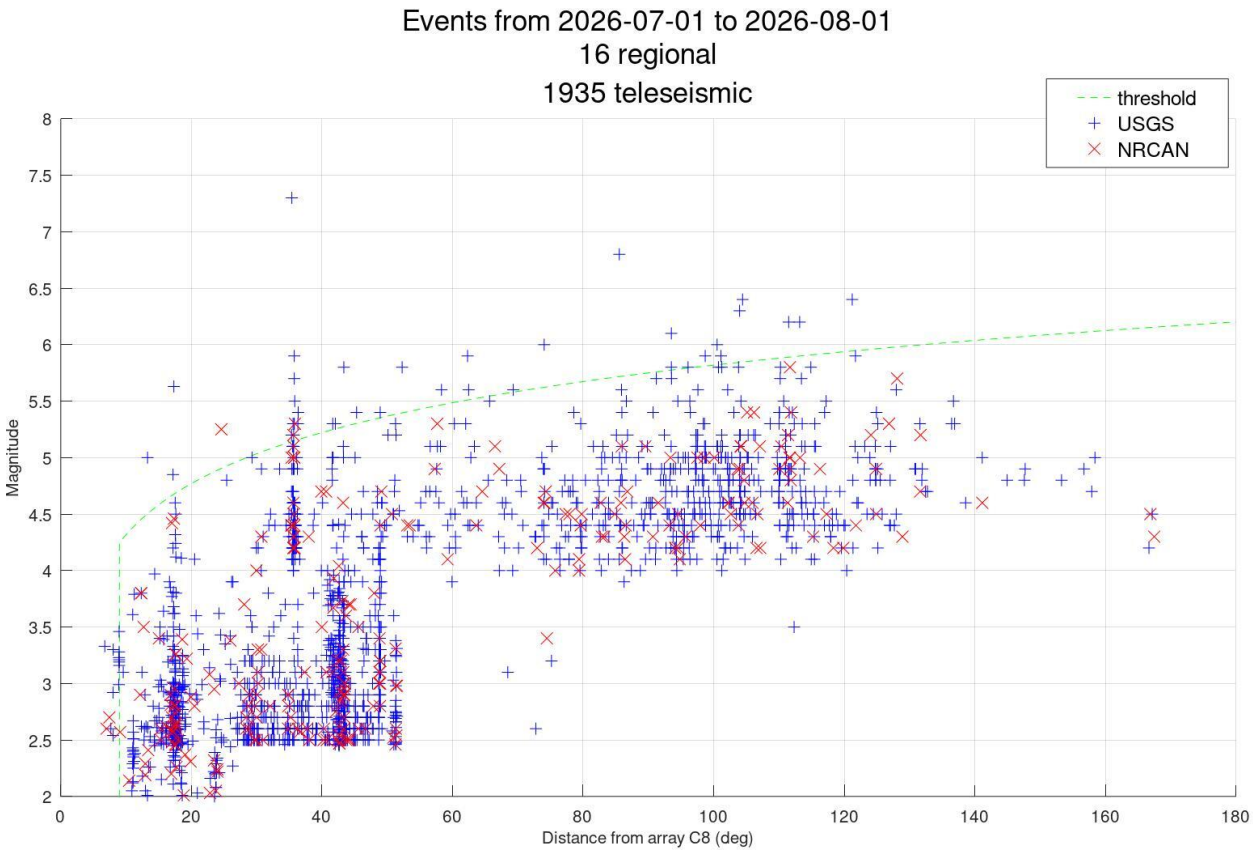


Figure 5. Magnitudes and distances from Aquistore for earthquake parameters downloaded from USGS and NRCan databases (legend). Dashed green line shows the detection threshold above which a manual review of events was performed.

Teleseismic events (class 1)

Above the threshold line in Figure 5, 25 teleseismic events (class 1 in Table 2) were identified in July 2026 (Figure 6). Most teleseismic events can be recognized by the onsets of S waves (red marks in Figure 6) and surface waves (low-frequency arrivals after the S waves). Some of the events also show strong P-wave (blue bars near time zero in Figure 6), and several events show strong and P/S or S/P mode conversions (between the P-wave and S-wave times).

For three events (number 48179, 47857, and 48356 in Figure 6), I corrected the origin times as shown in the titles of plots in Figure 6. For these events, S-wave arrivals appear to have been misinterpreted as P-wave onsets by networks “CN”, “CN”, and “TX” respectively. This error led to about 150 – 240-s late origin times reported in the USGS bulletin published in the end of July.

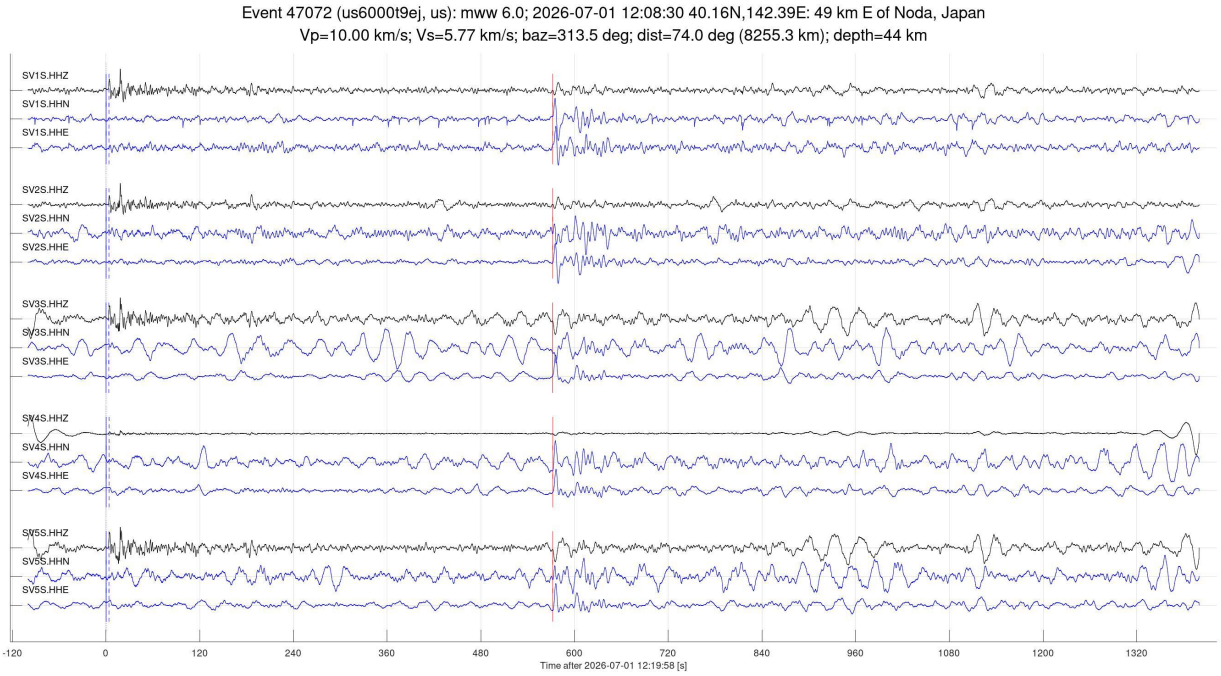


Figure 6. Teleseismic events detected at Aquistore in July 2026. Plot headings show catalogue IDs, magnitudes, times, distances in degrees, source coordinates and localities, back-azimuths (‘baz=’), distances (‘dist=’) and source depths. Vertical-component records are shown in black, and horizontal components in blue. Time zeros are located at the times of P-wave arrivals at the Aquistore array predicted in the reference model IASP91 and corrected interactively. Blue and red bars indicate the P-wave and S-wave picks, respectively. Ignore the (technical) cyan and dashed bars.

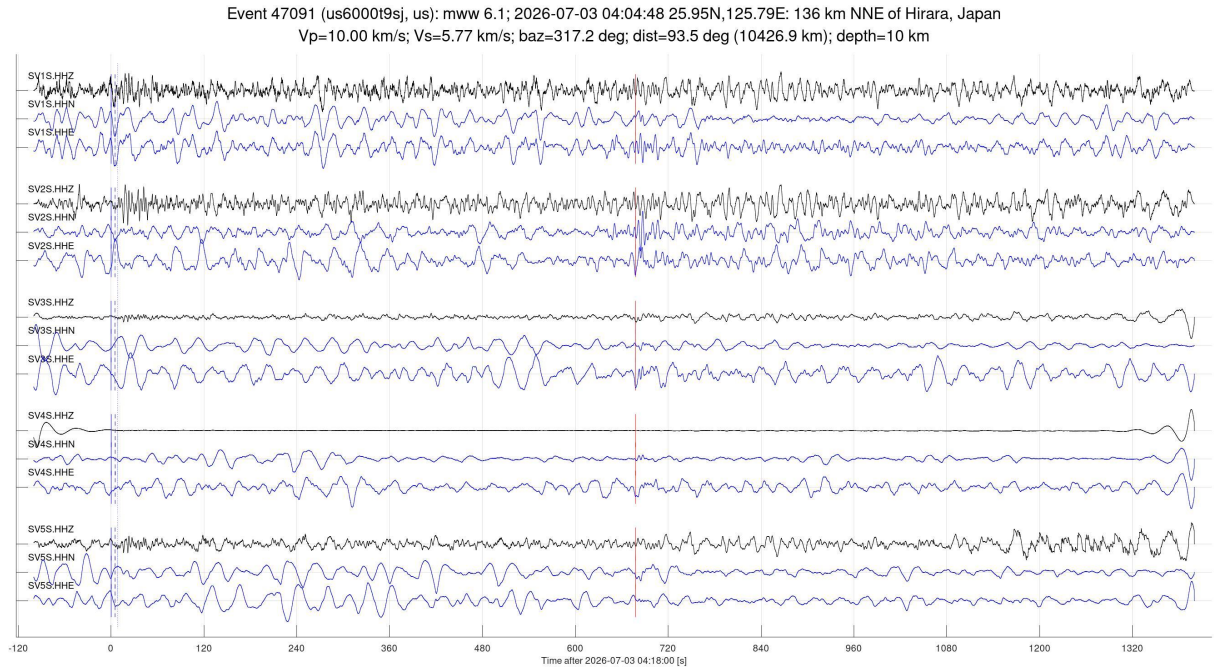


Figure 6, continued.

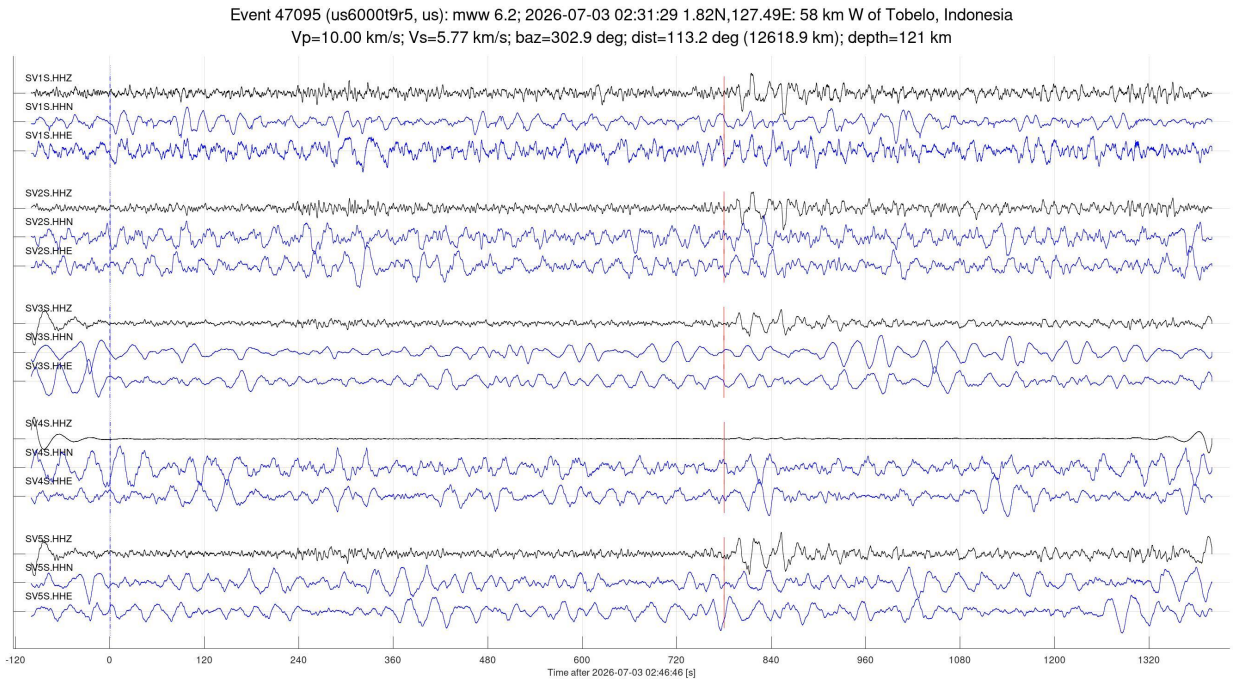


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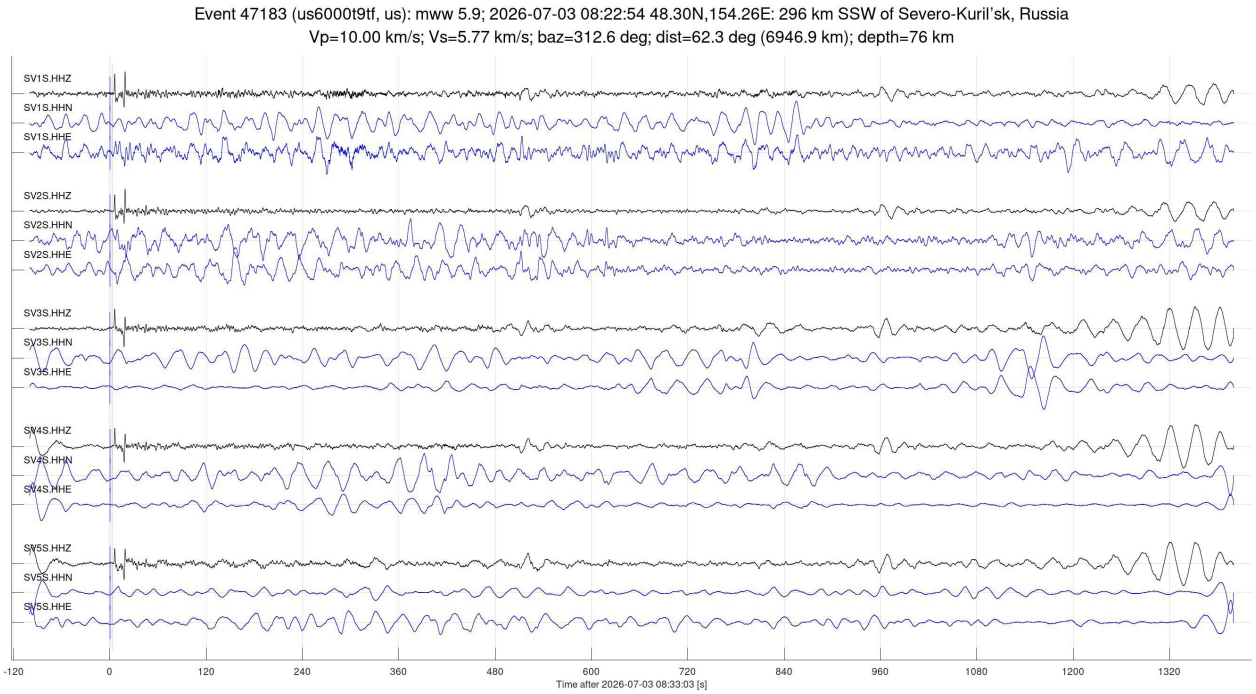


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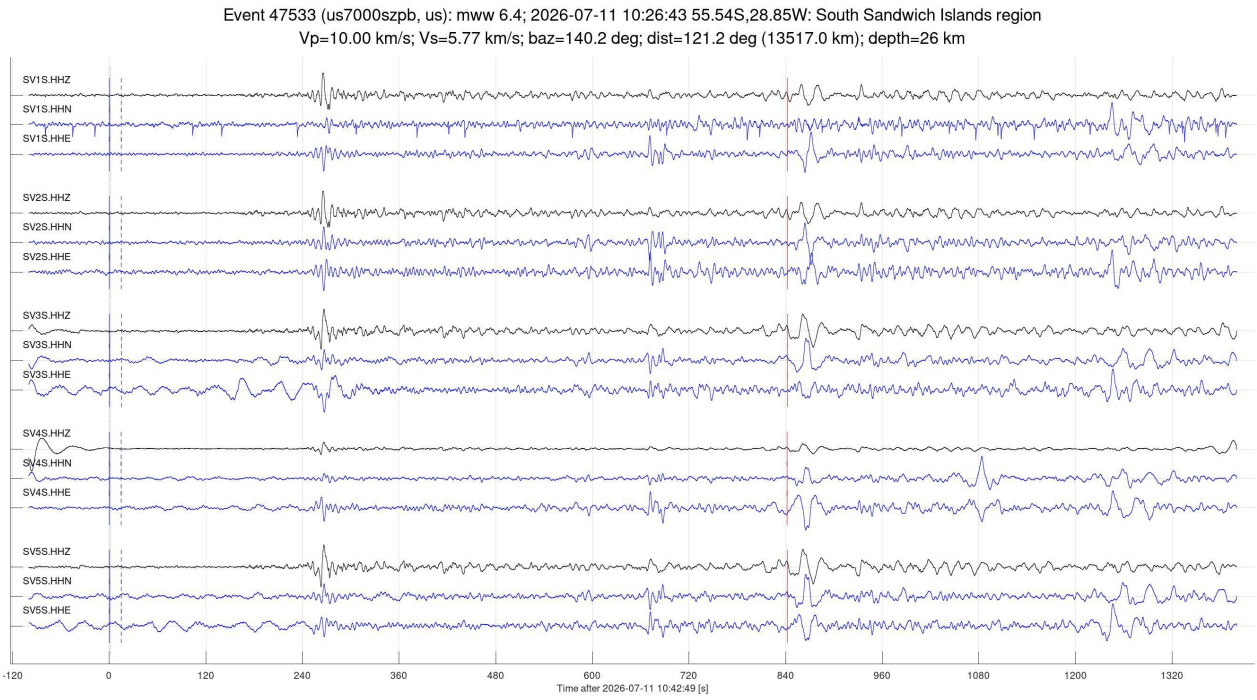


Figure 6, continued.

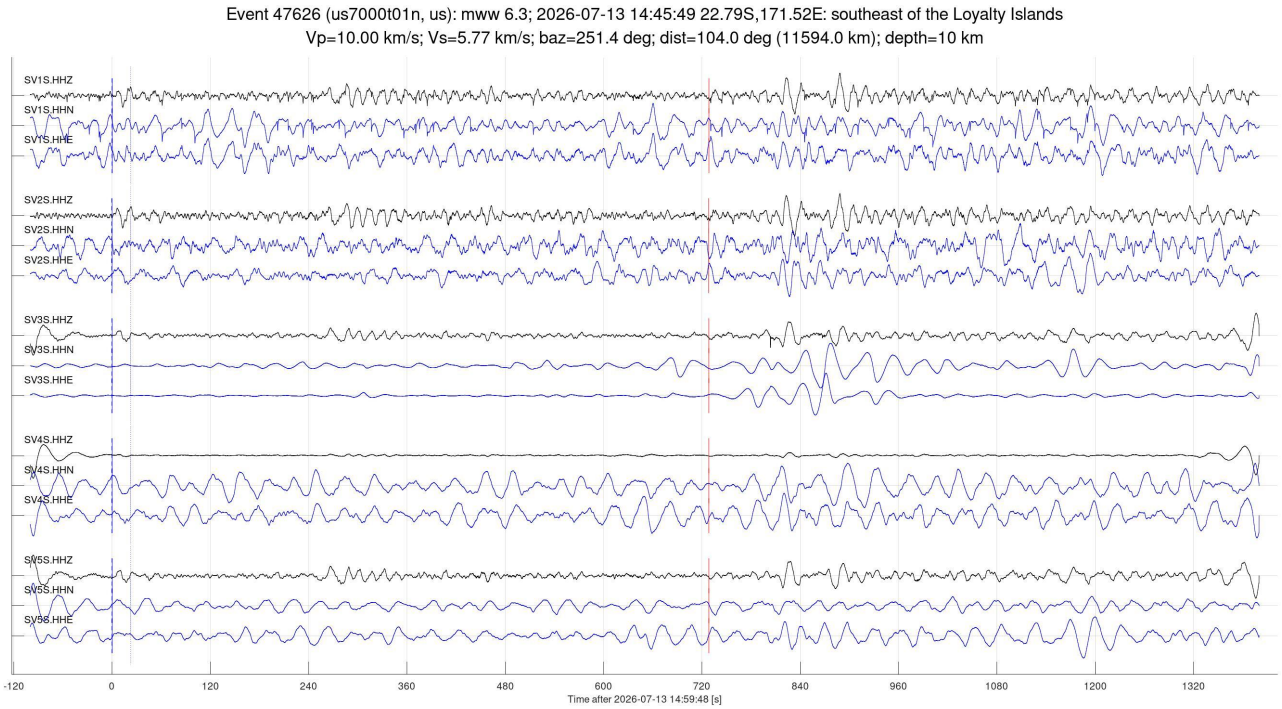


Figure 6, continued.

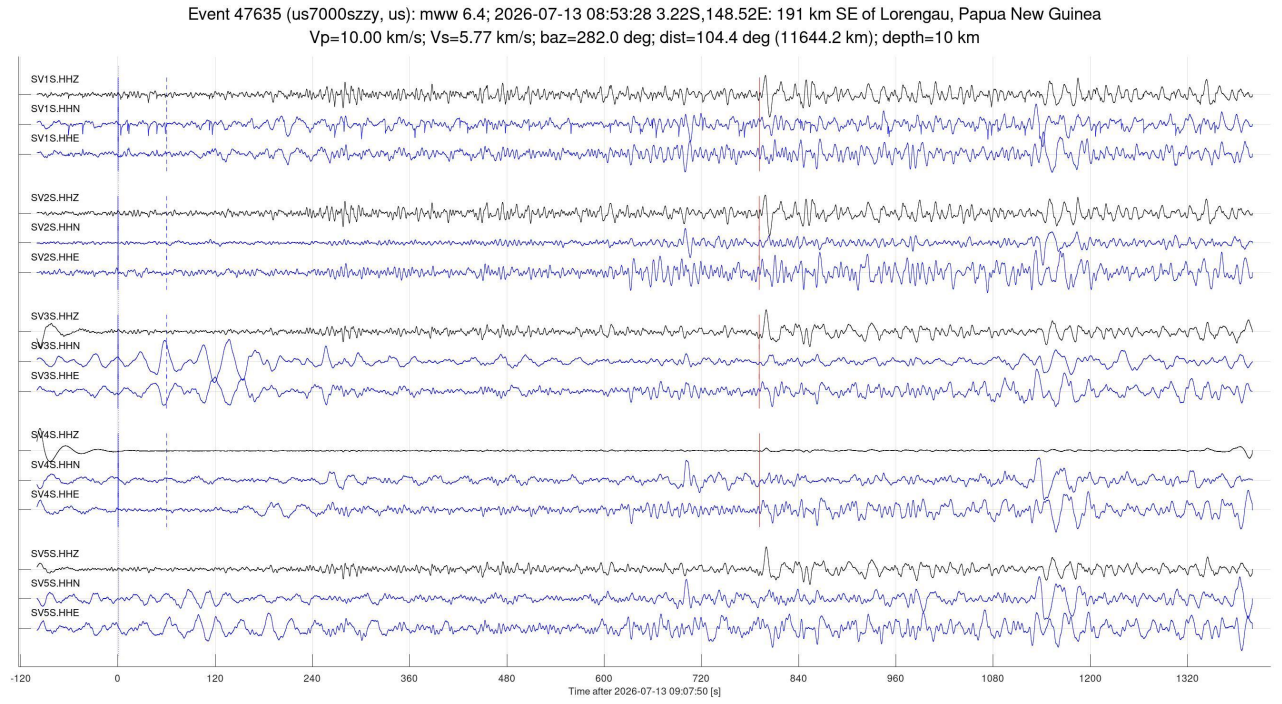


Figure 6, continued.

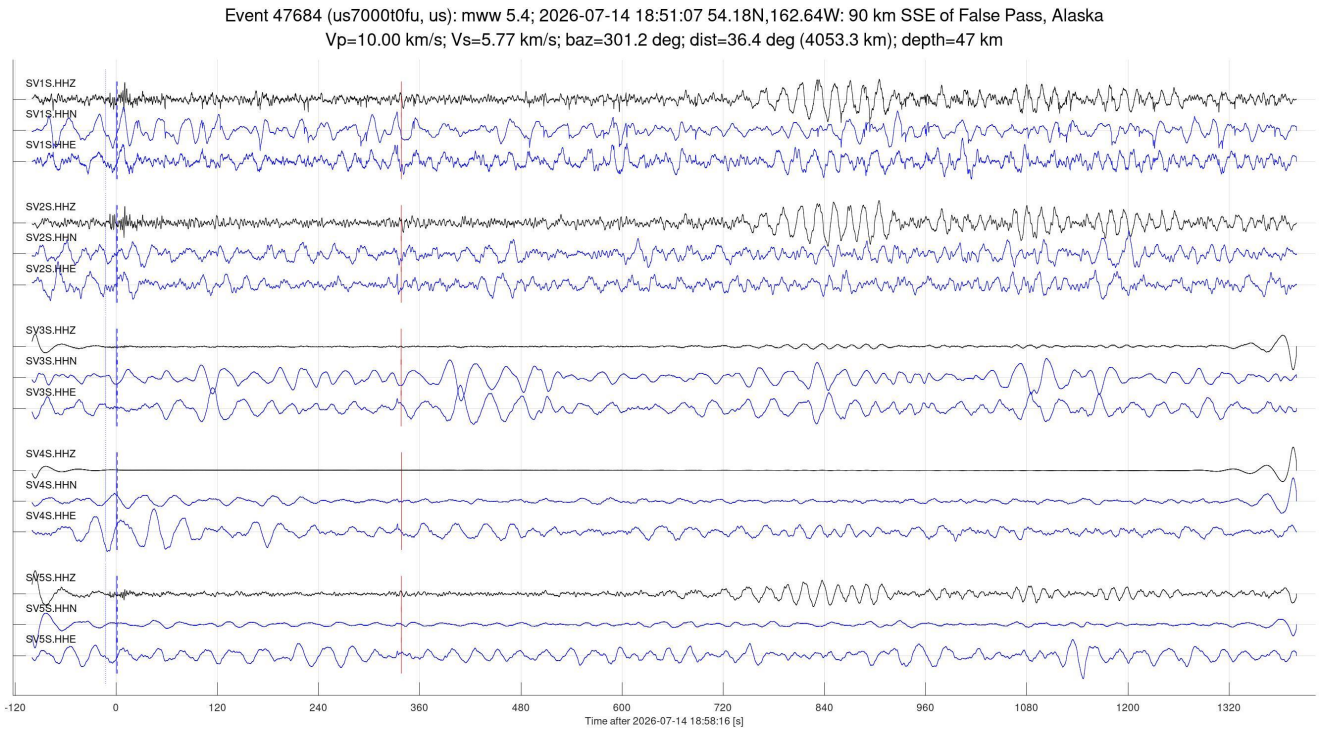


Figure 6, continued.

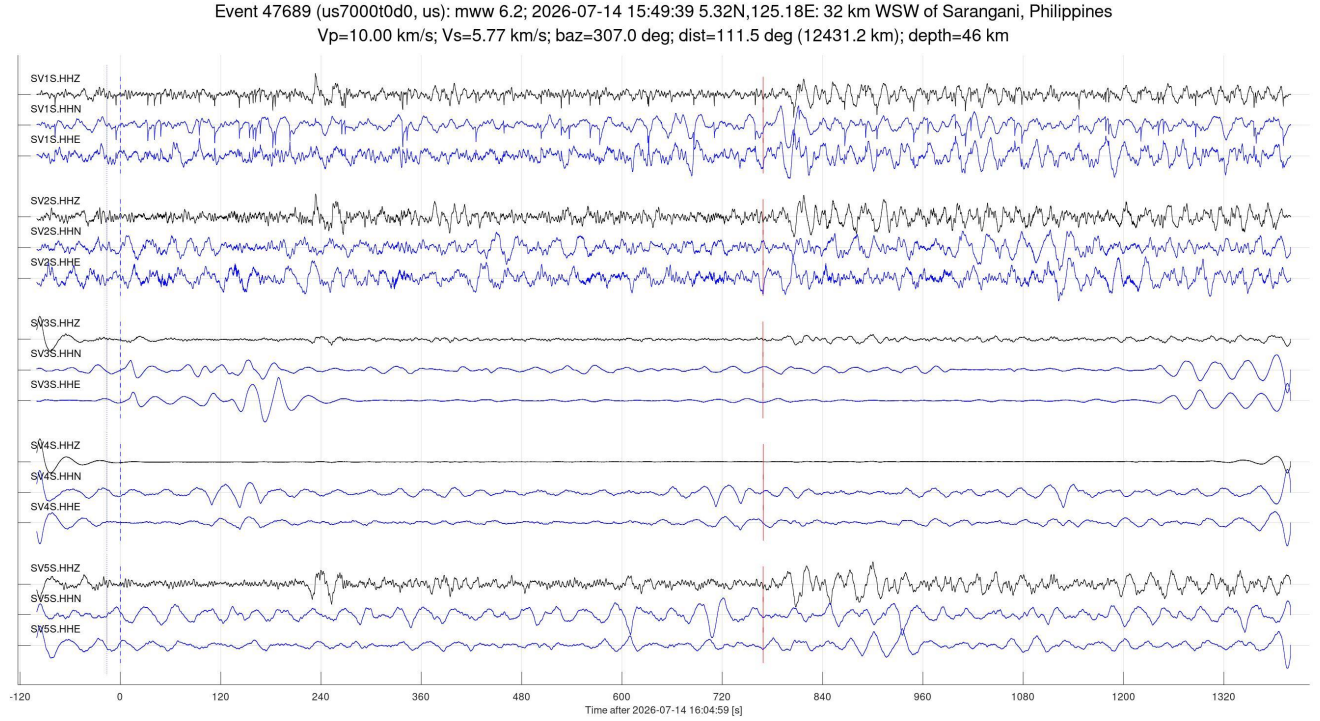


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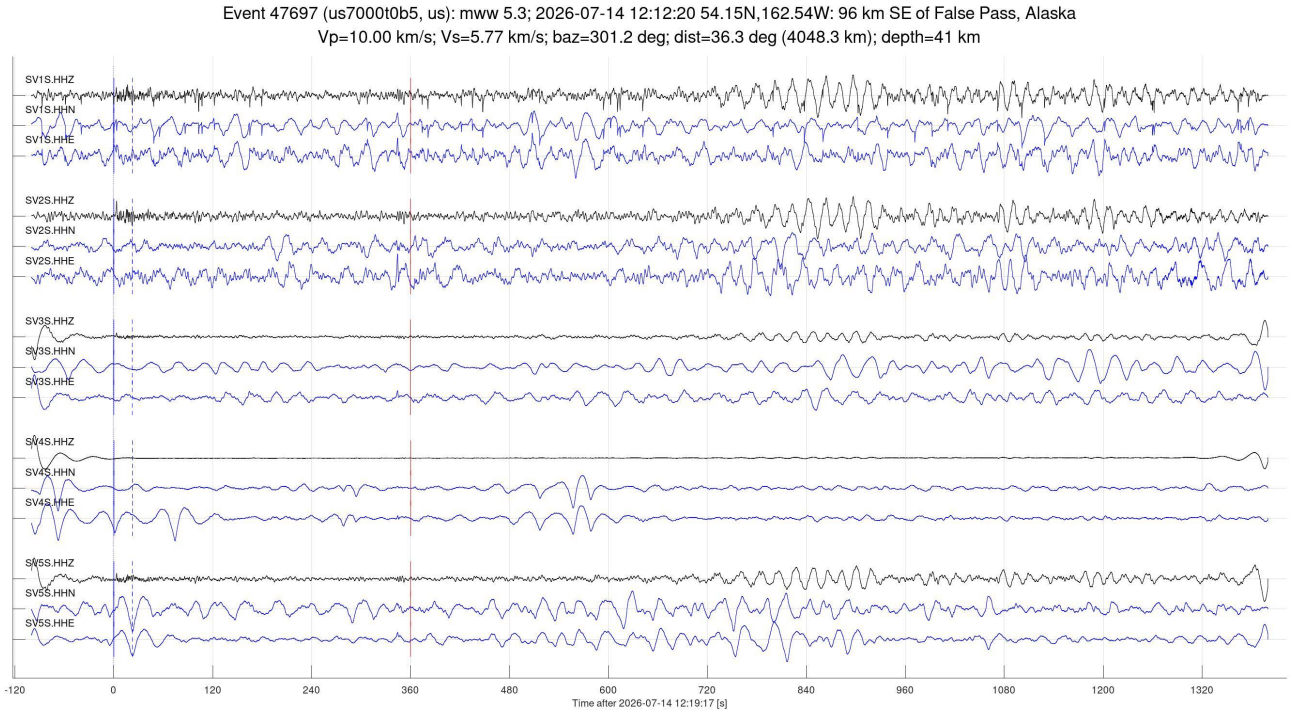


Figure 6, continued.

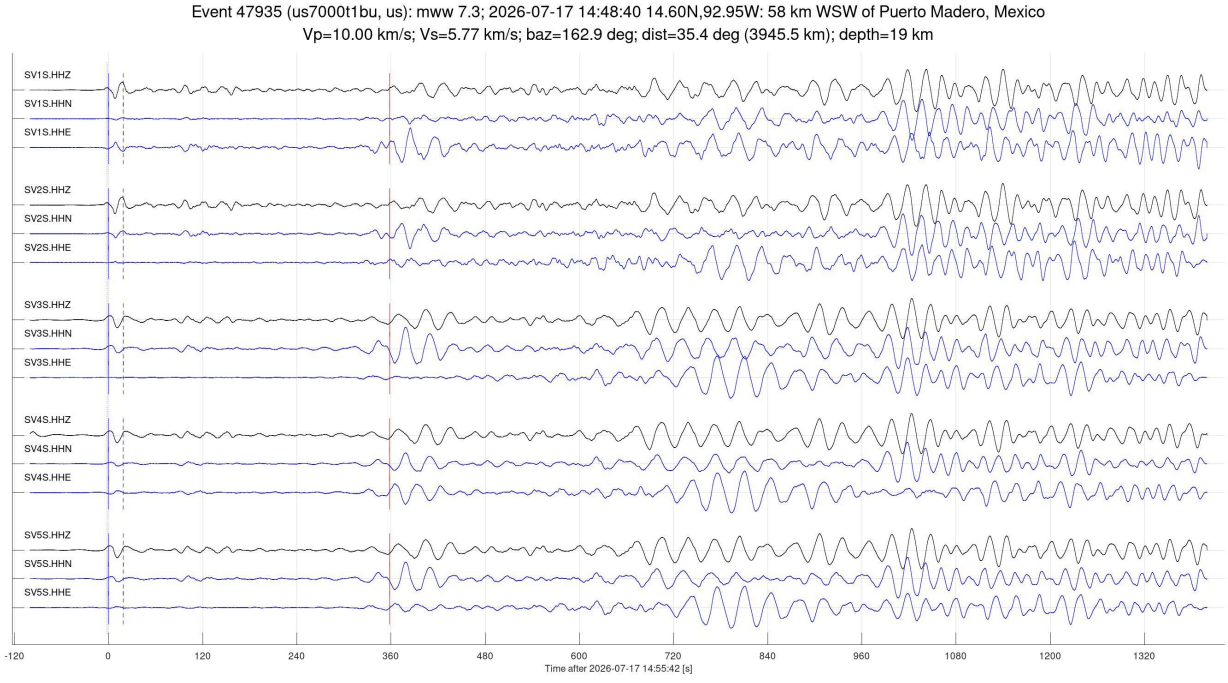


Figure 6, continued. Note that for such low-frequency events, S-wave and surface wave records are difficult to differentiate from local seismic noise near the site.

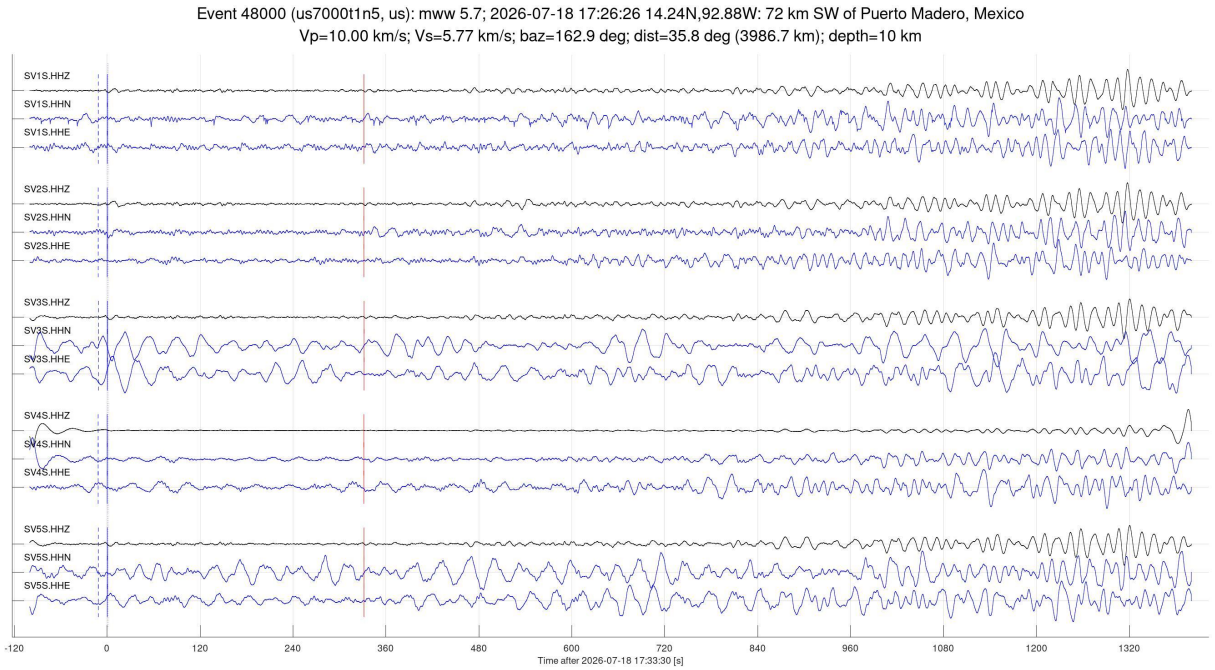


Figure 6, continued.

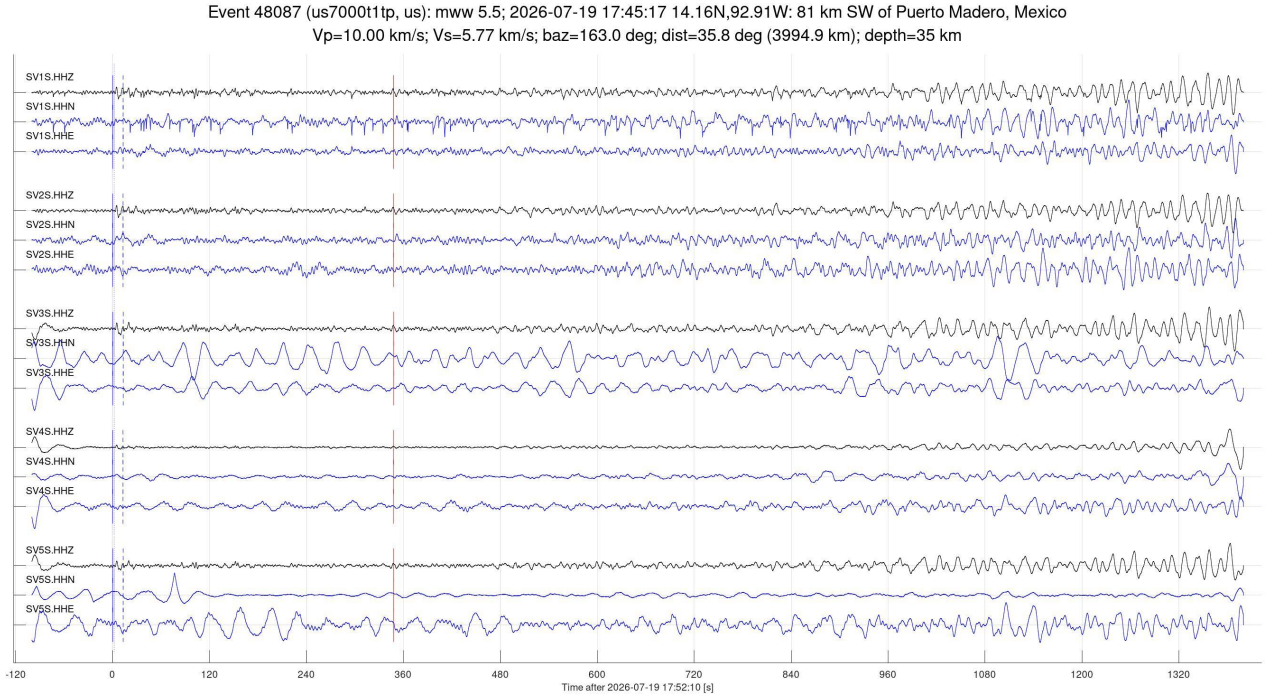


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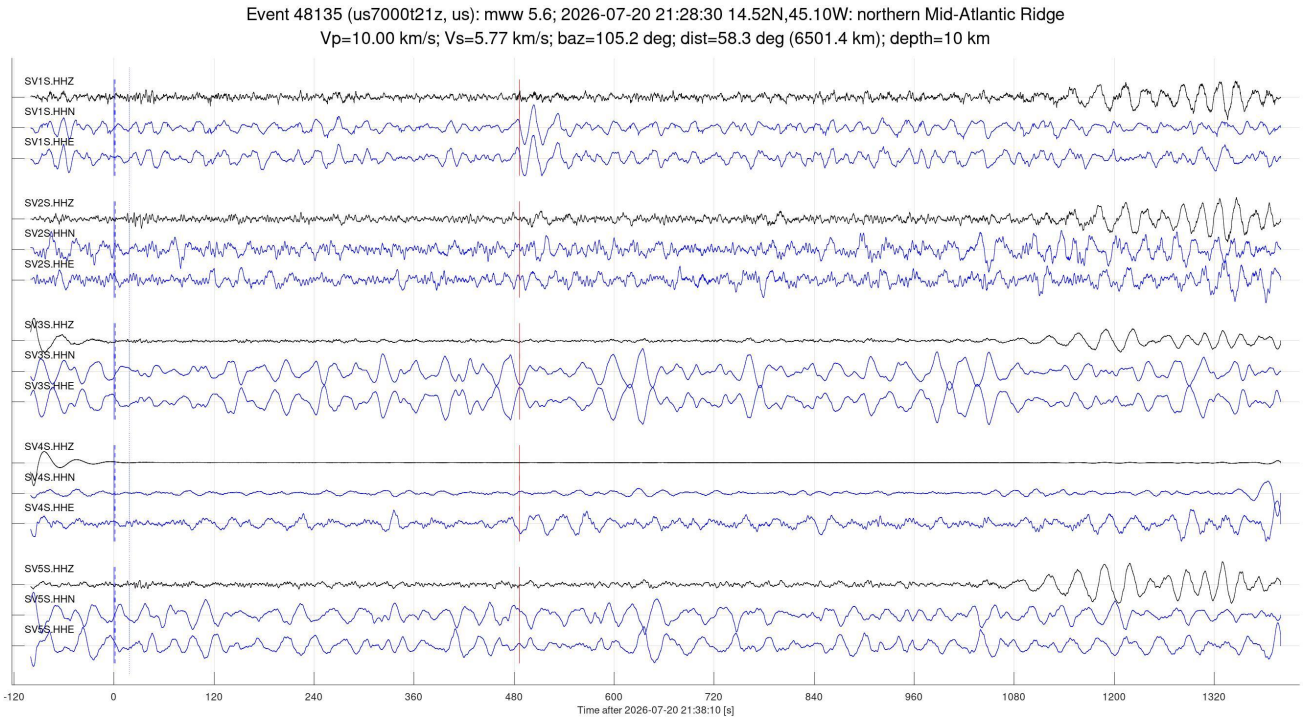


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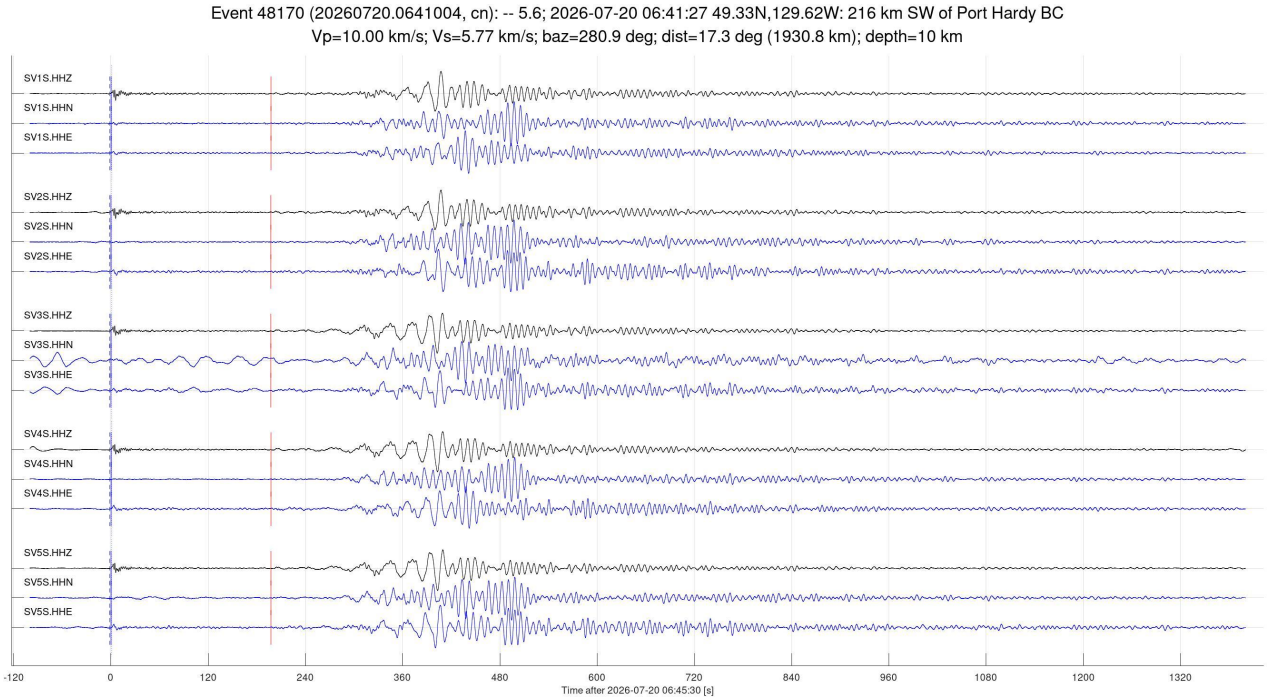


Figure 6, continued. In this and the next plot, note that in contrast to the preceding examples, Port Hardy area earthquakes are high-frequency and show strong P-wave arrivals, and comparatively weak S waves.

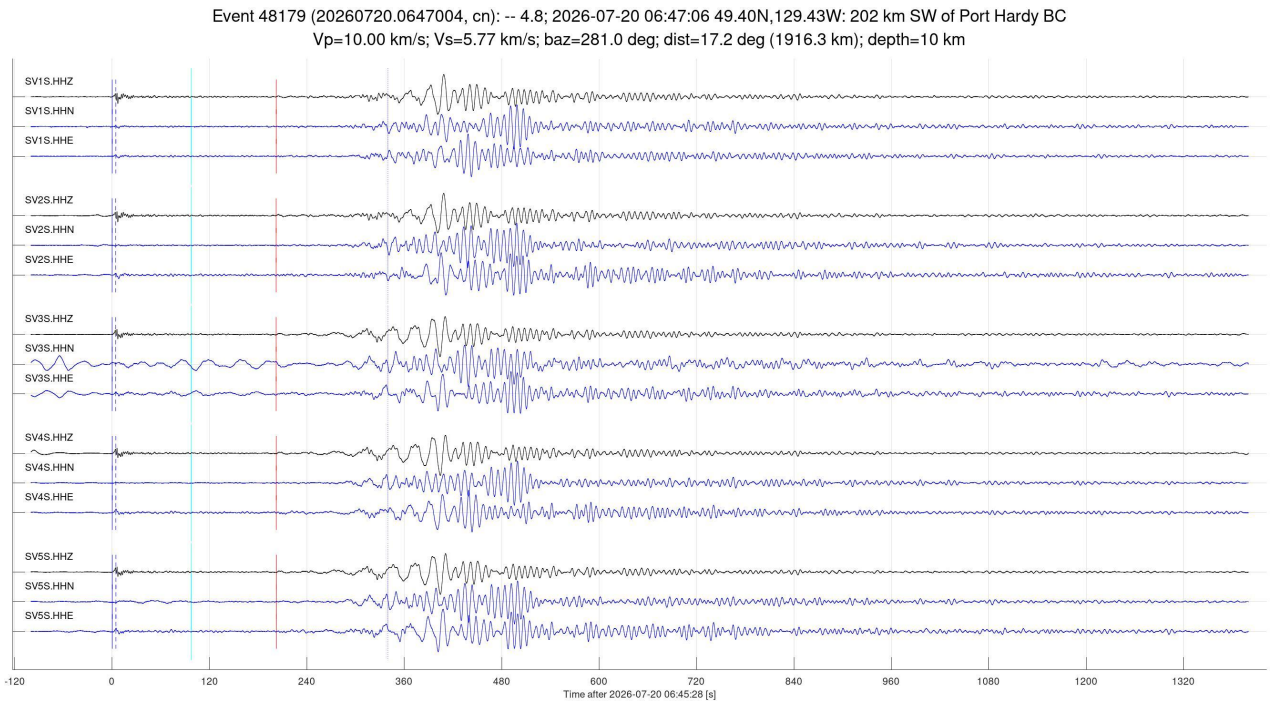


Figure 6, continued. For this event, the P-wave arrivals appear to have been missed and the event time reported about 200 s late in the USGS bulletin.

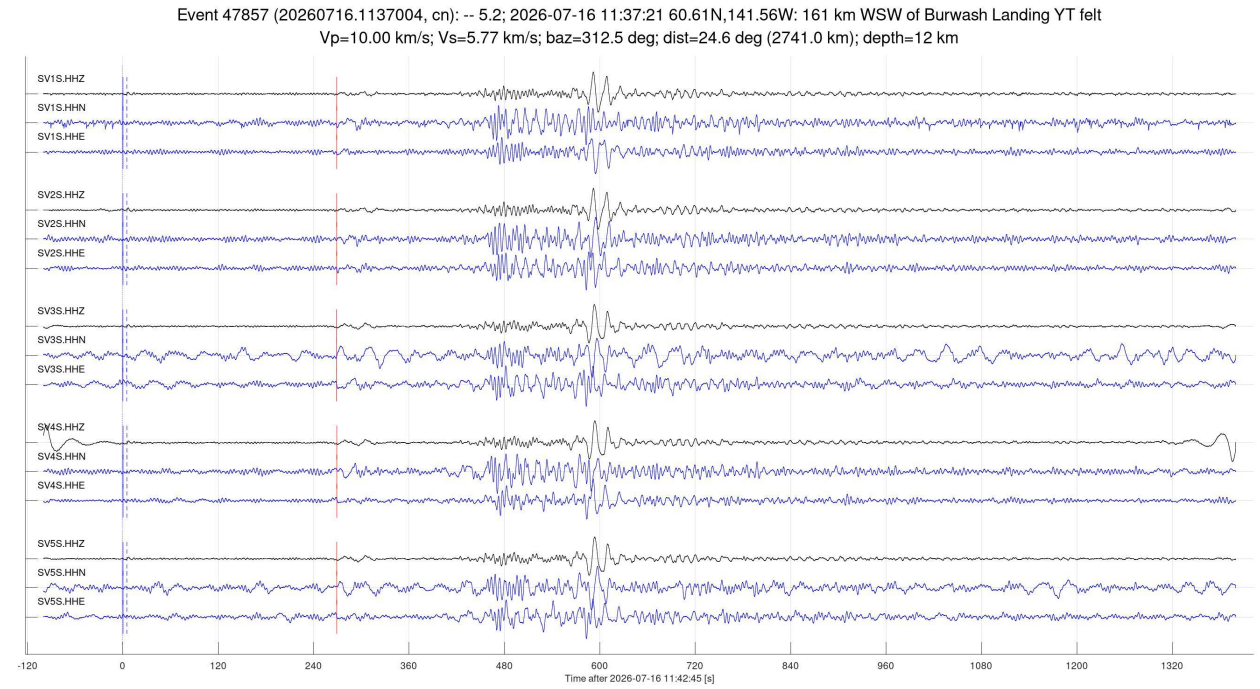


Figure 6, continued. For this event, the weak S-wave arrival was also misidentified as P-wave in the USGS bulletin.

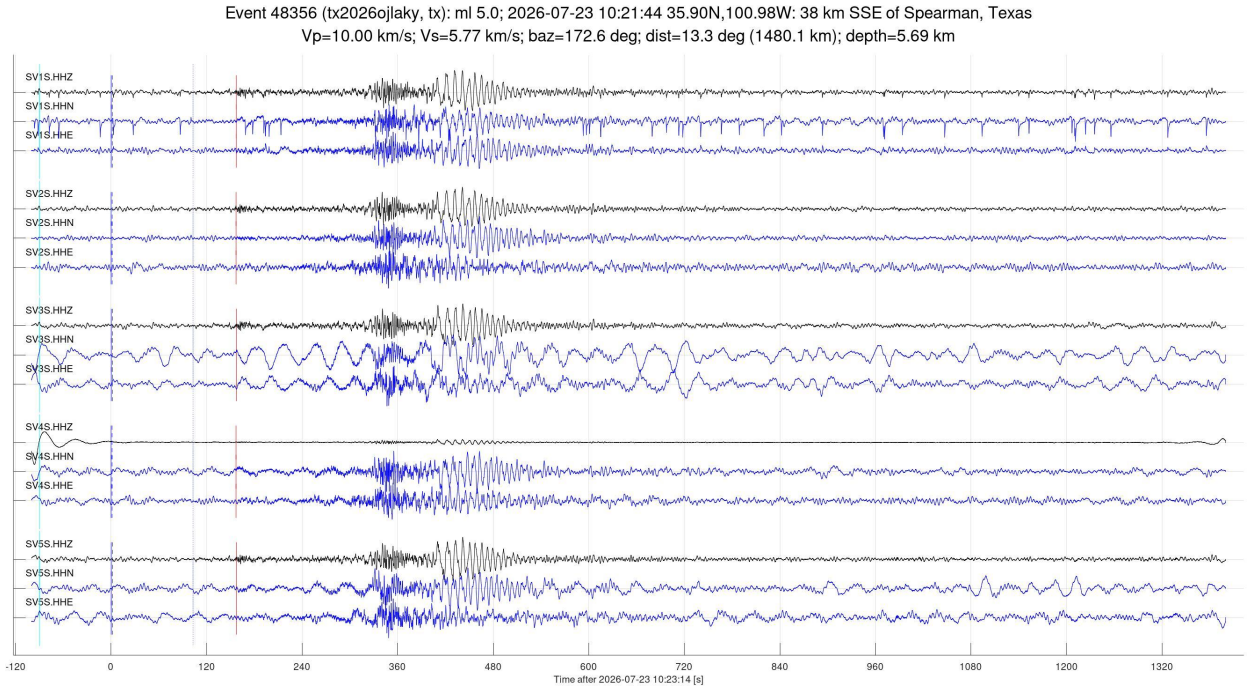


Figure 6, continued. For this event, the S-wave arrival also appears to have been interpreted as P when reporting the origin time in USGS bulletin (corrected in the label shown here).

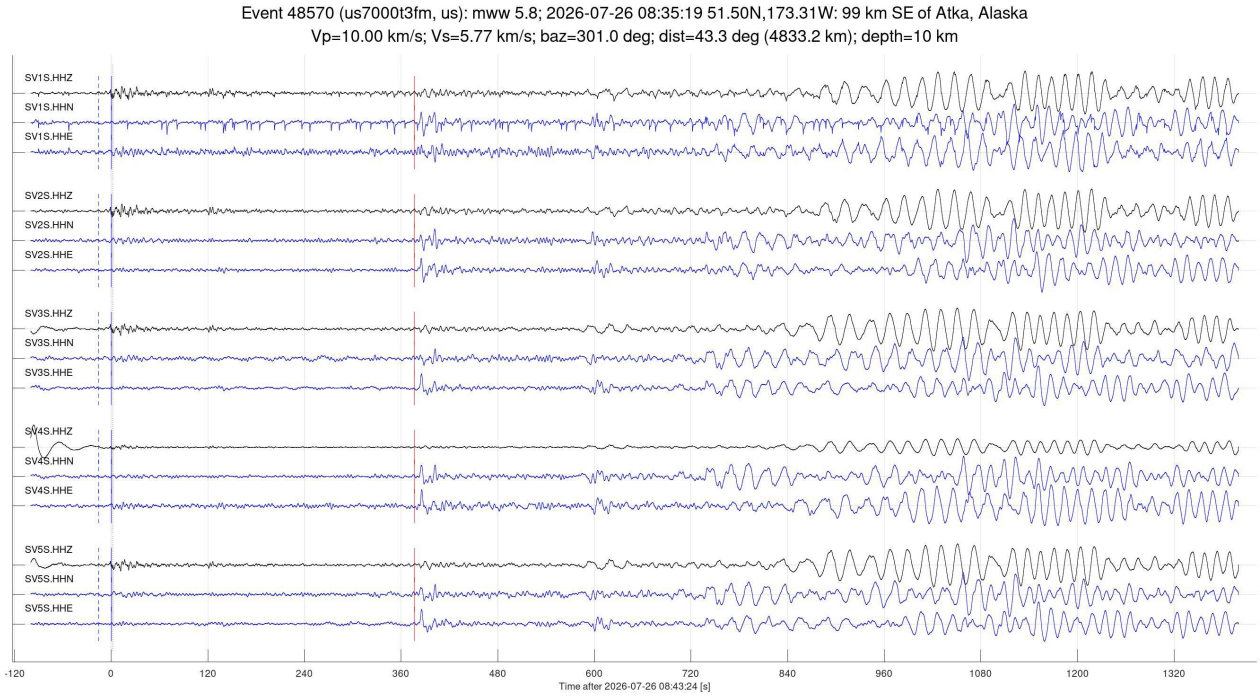


Figure 6, continued.

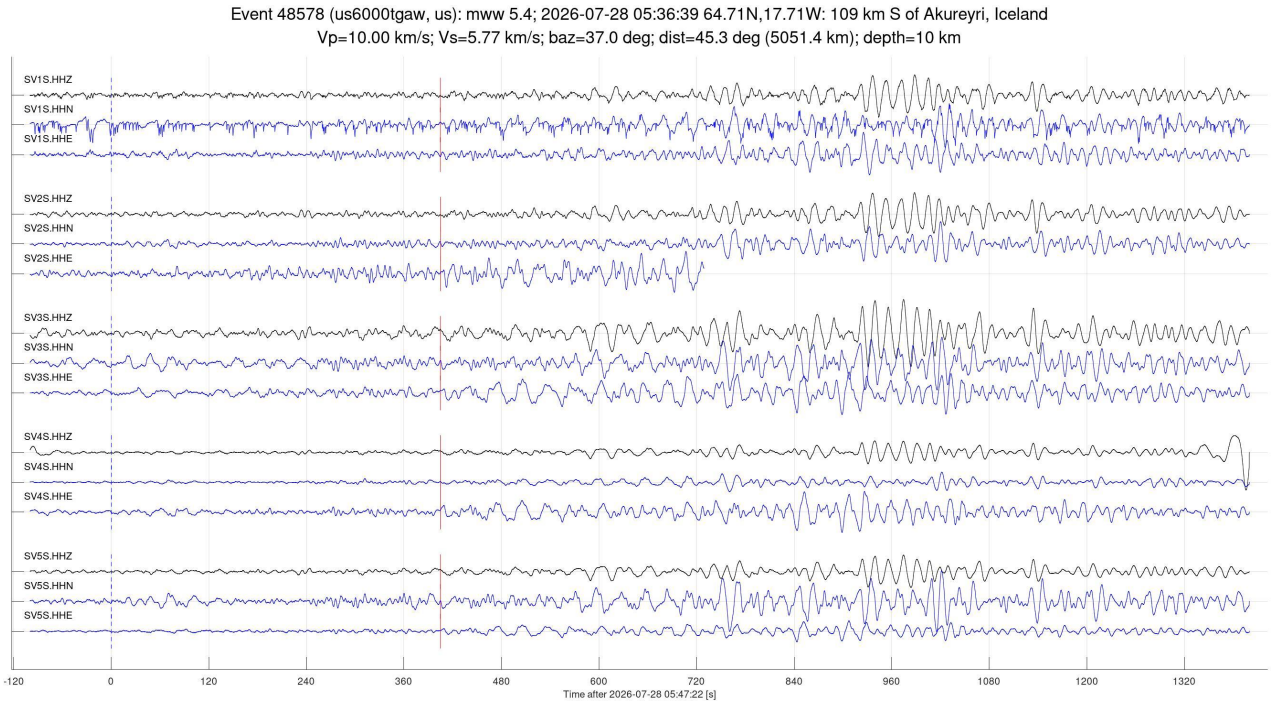


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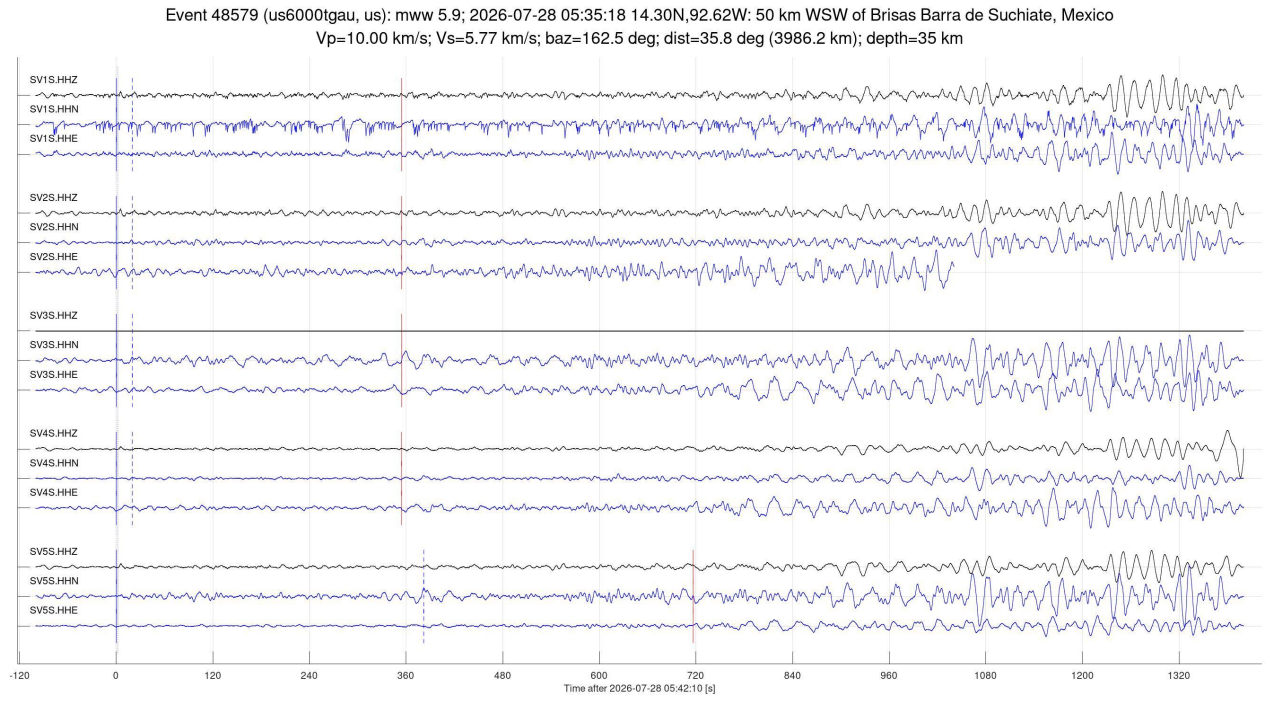


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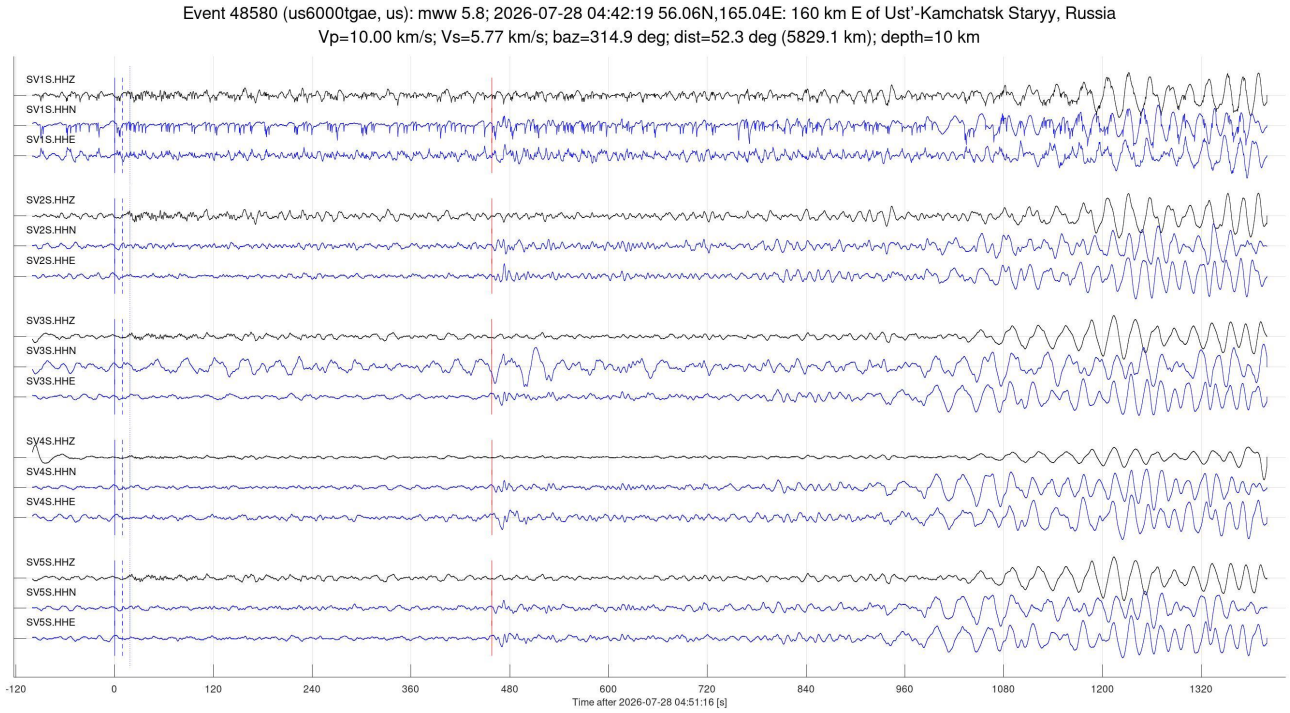


Figure 6, continued.

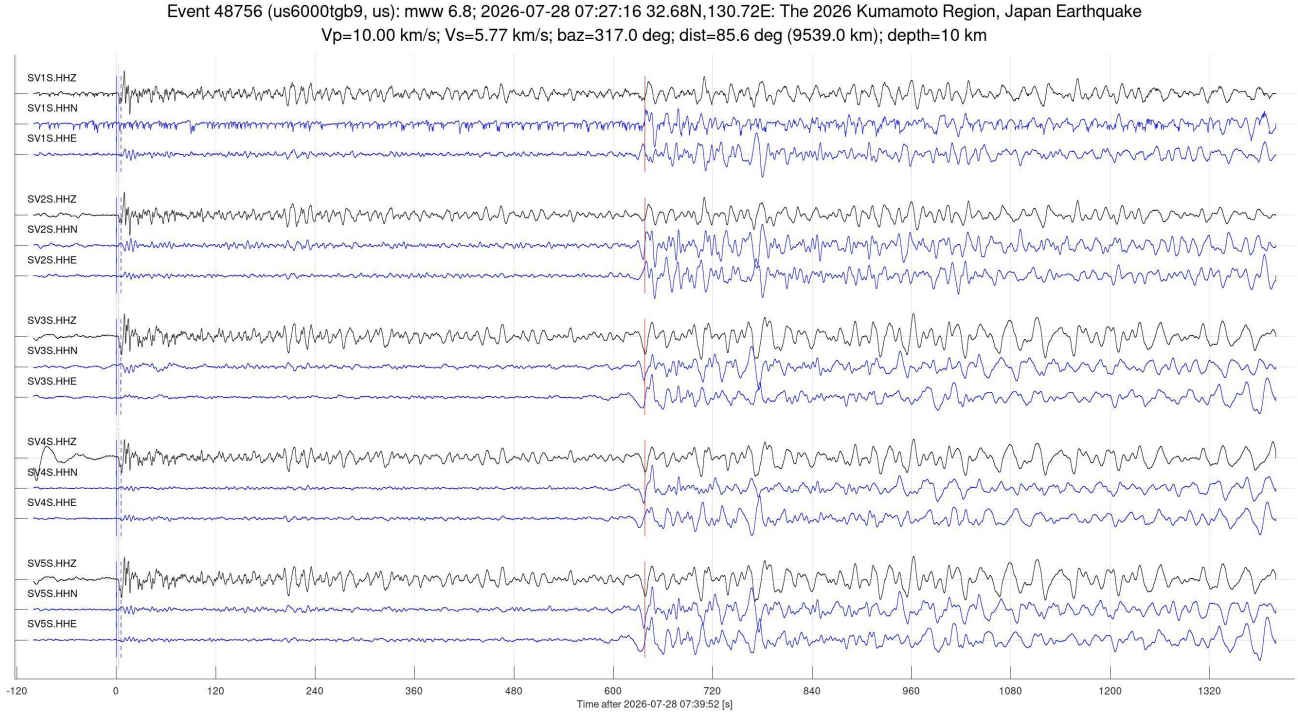


Figure 6, continued.

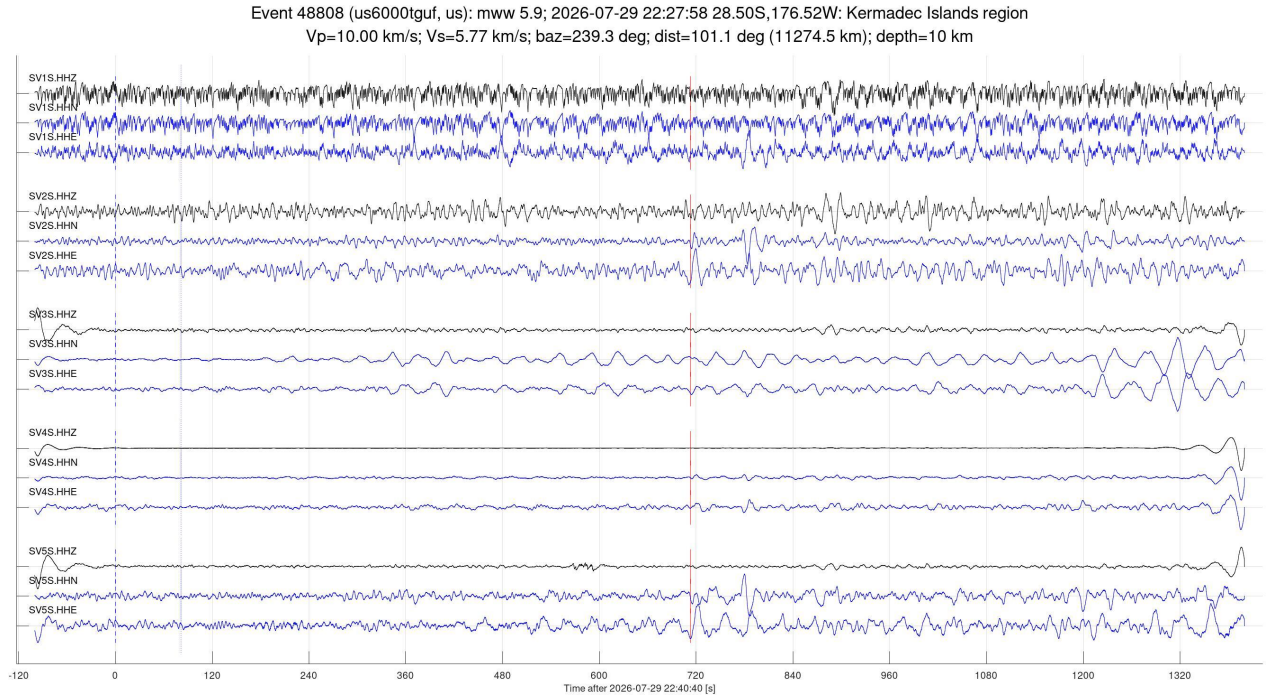


Figure 6, continued.

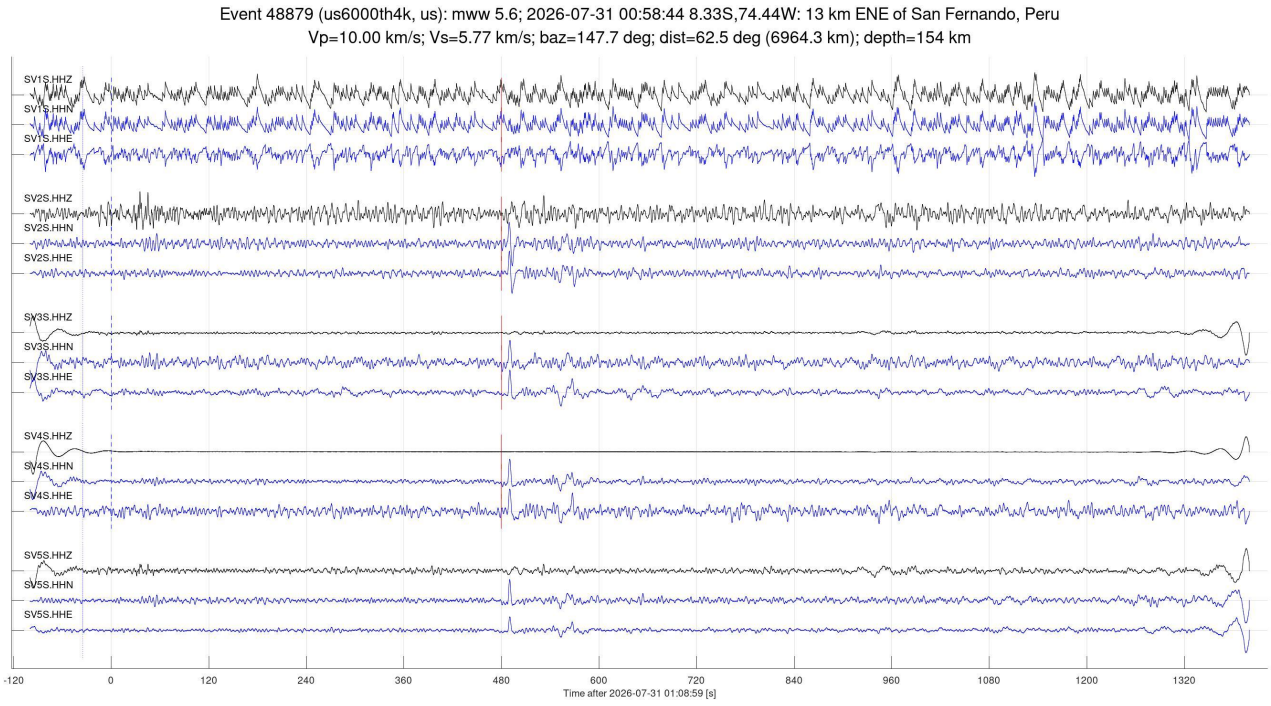


Figure 6, continued.

Regional events (class 2)

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

Eleven events were identified as mine blasts in the area of Estevan coal mining (Figure 8). Similar to recent reports, these blasts appear to be located at distances around 25 km from the Aquistore array. Accurate location was not attempted.

In Figure 8, note the significantly noisier records from station SV1S. These plots show that the spike noise level is below the strong signals from mine blasts. However, it is still prohibitive for detecting weaker teleseismic arrivals and likely the potential events occurring within the target zone.

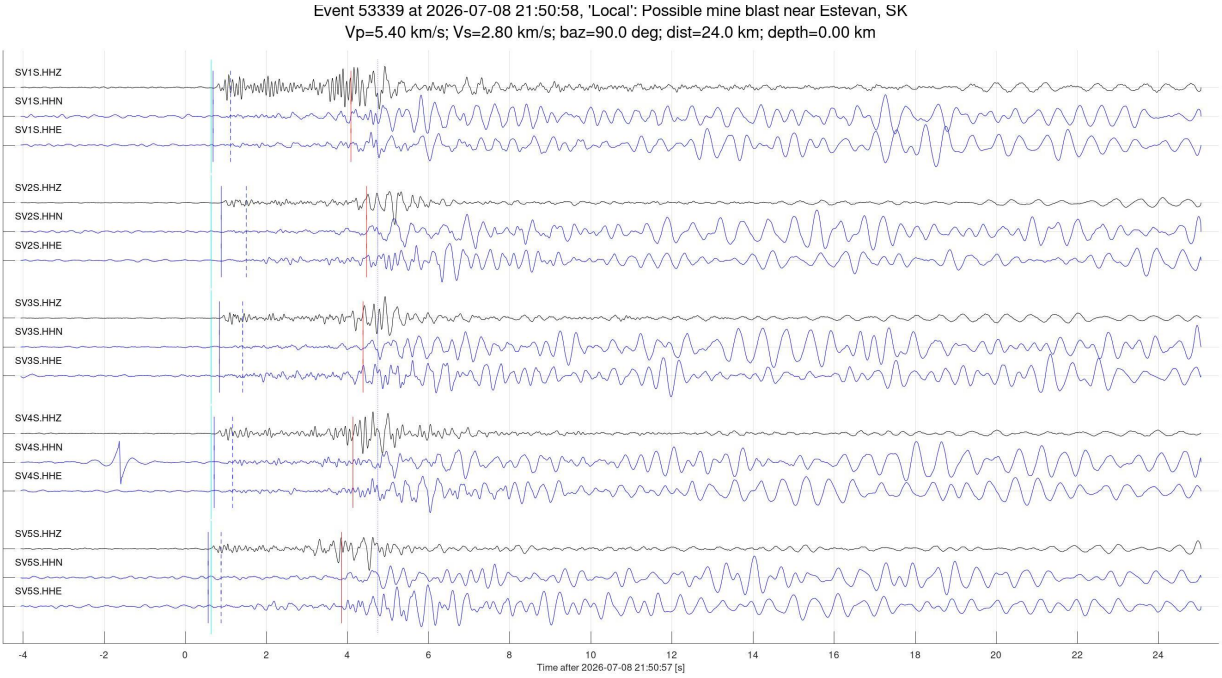


Figure 8. Seismic arrivals produced by mine blasts at the Estevan mine. Colours and labels are as in Figure 6.

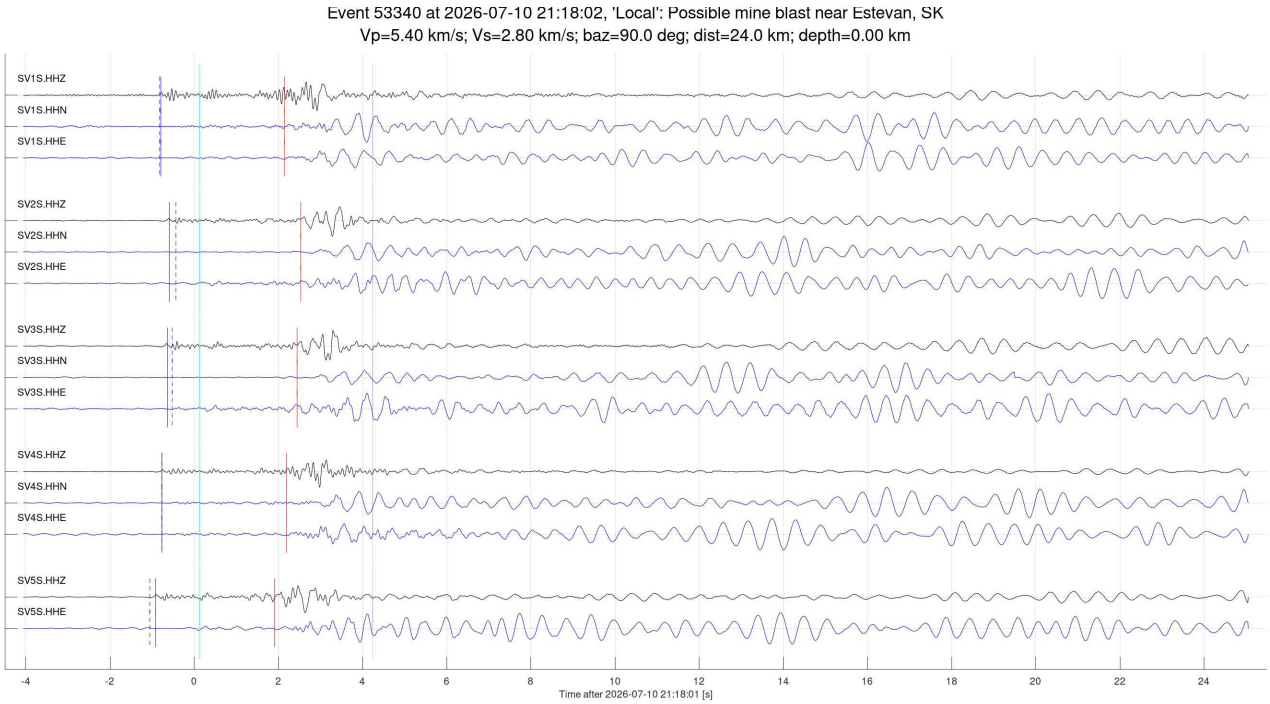


Figure 8, continued.

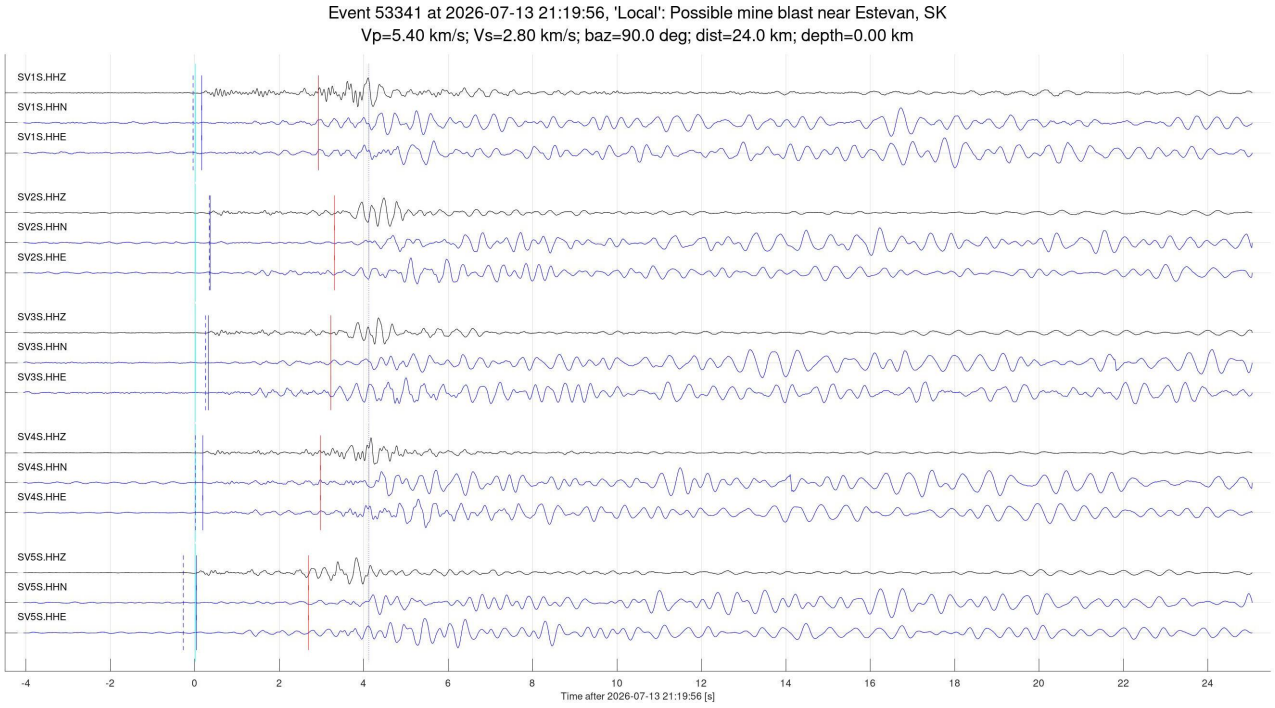


Figure 8, continued.

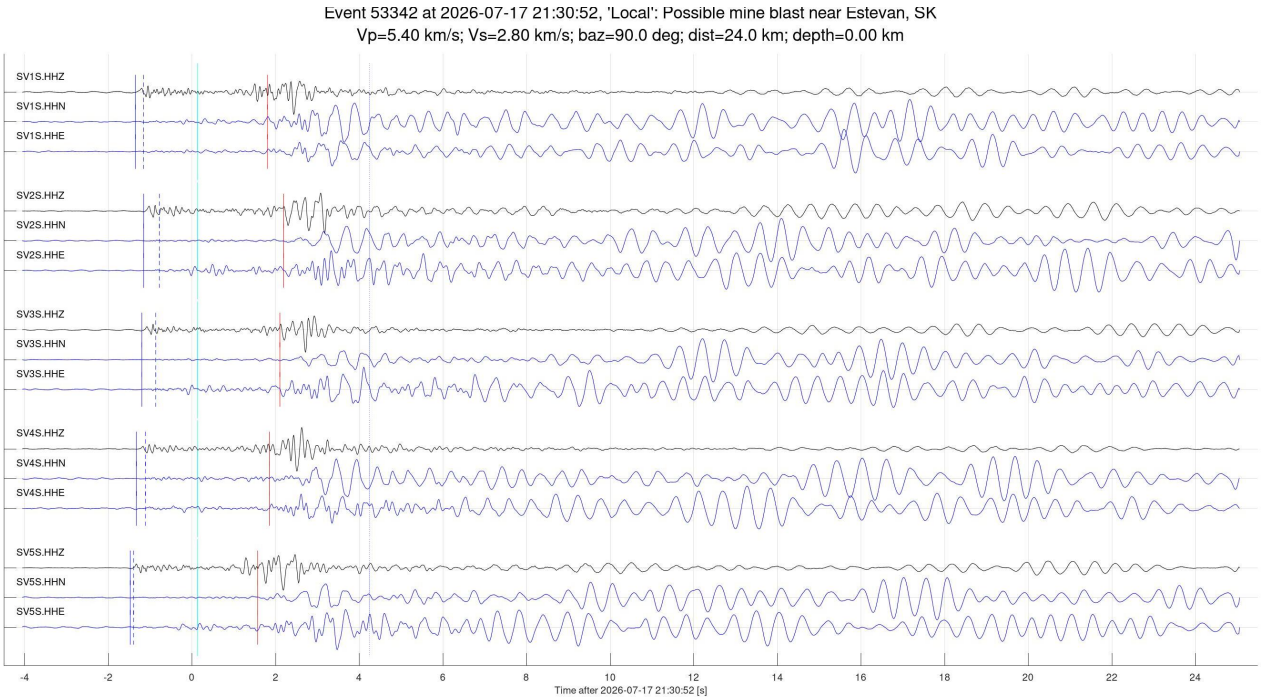


Figure 8, continued.

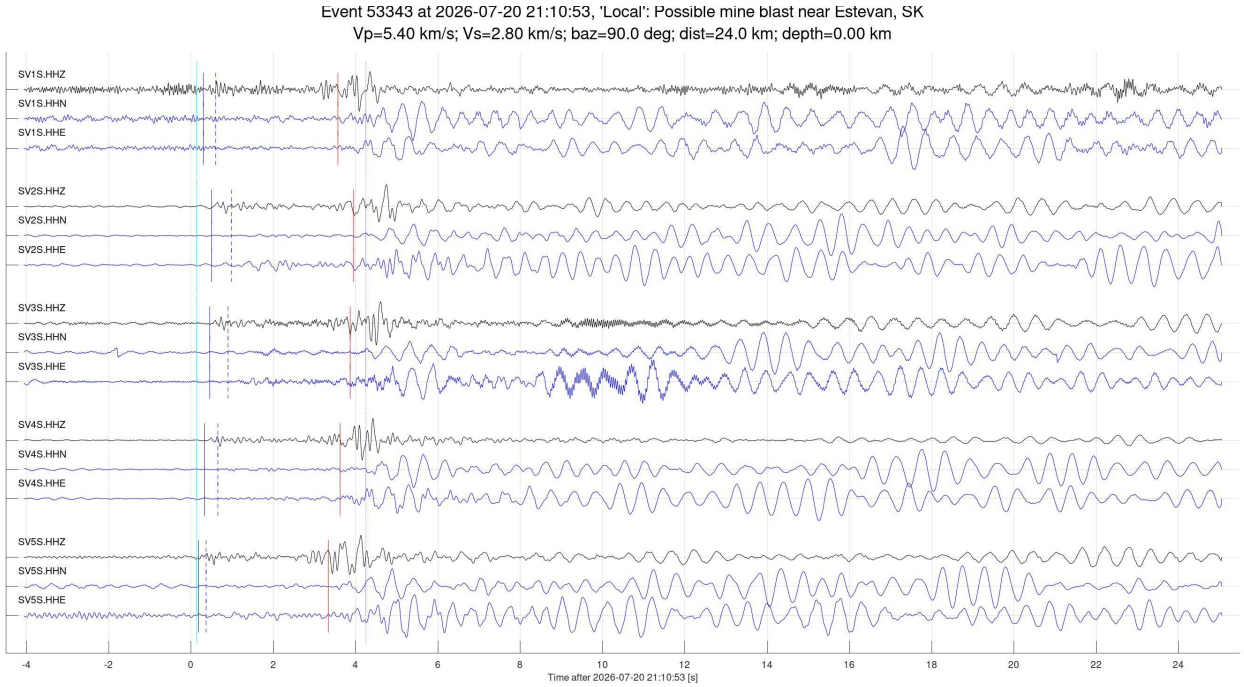


Figure 8, continued.

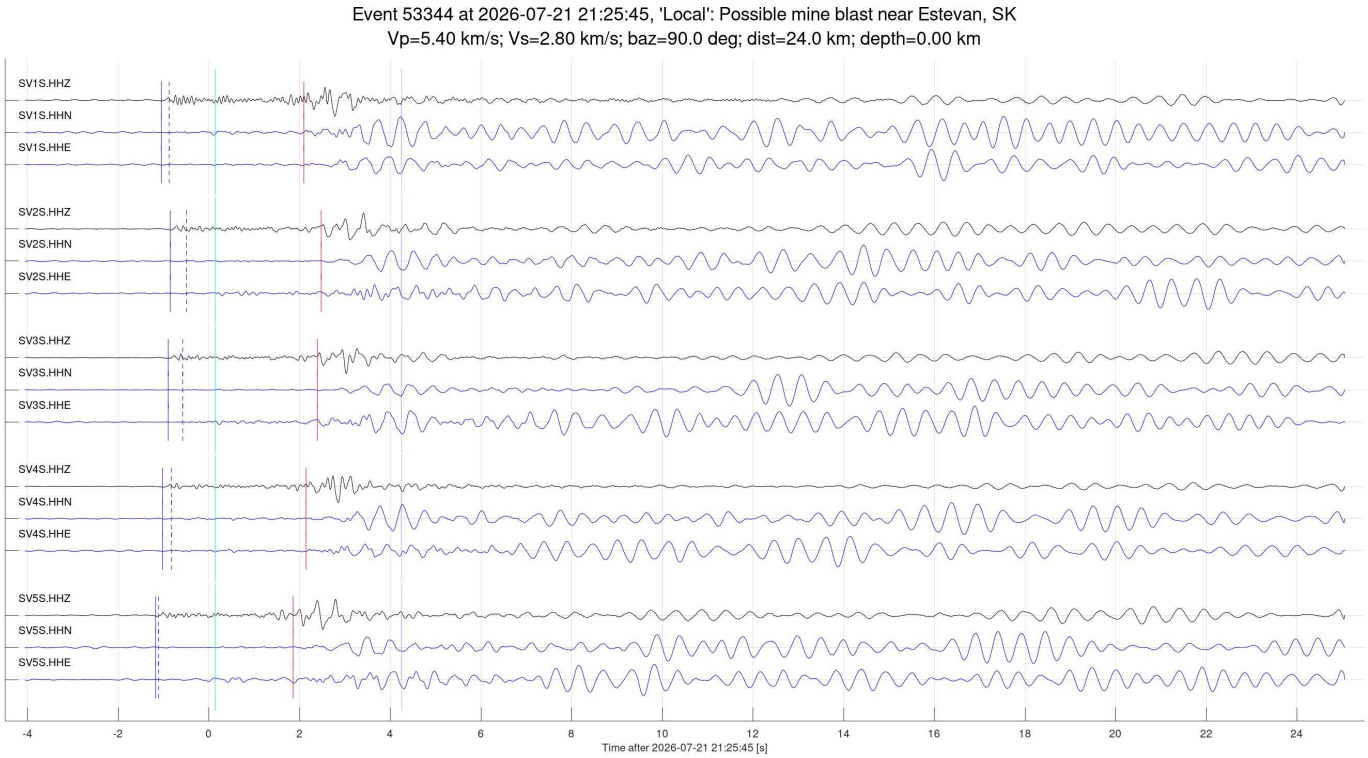


Figure 8, continued.

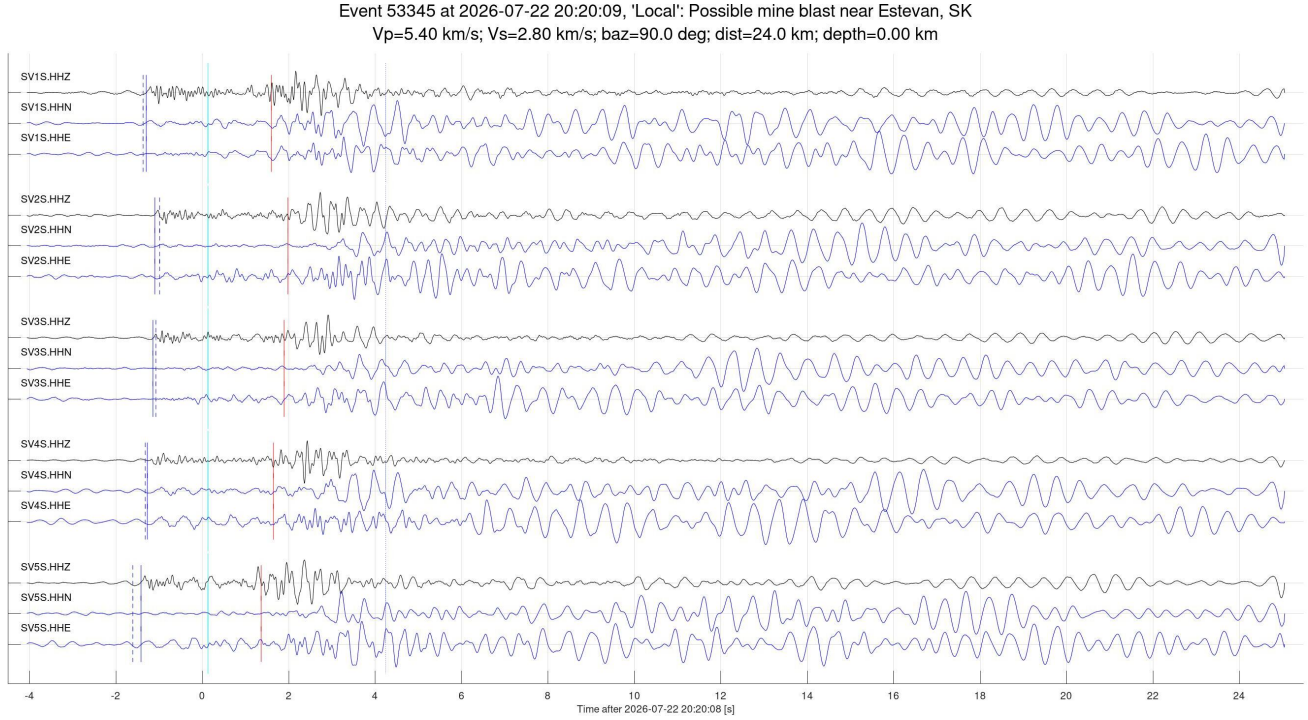


Figure 8, continued.

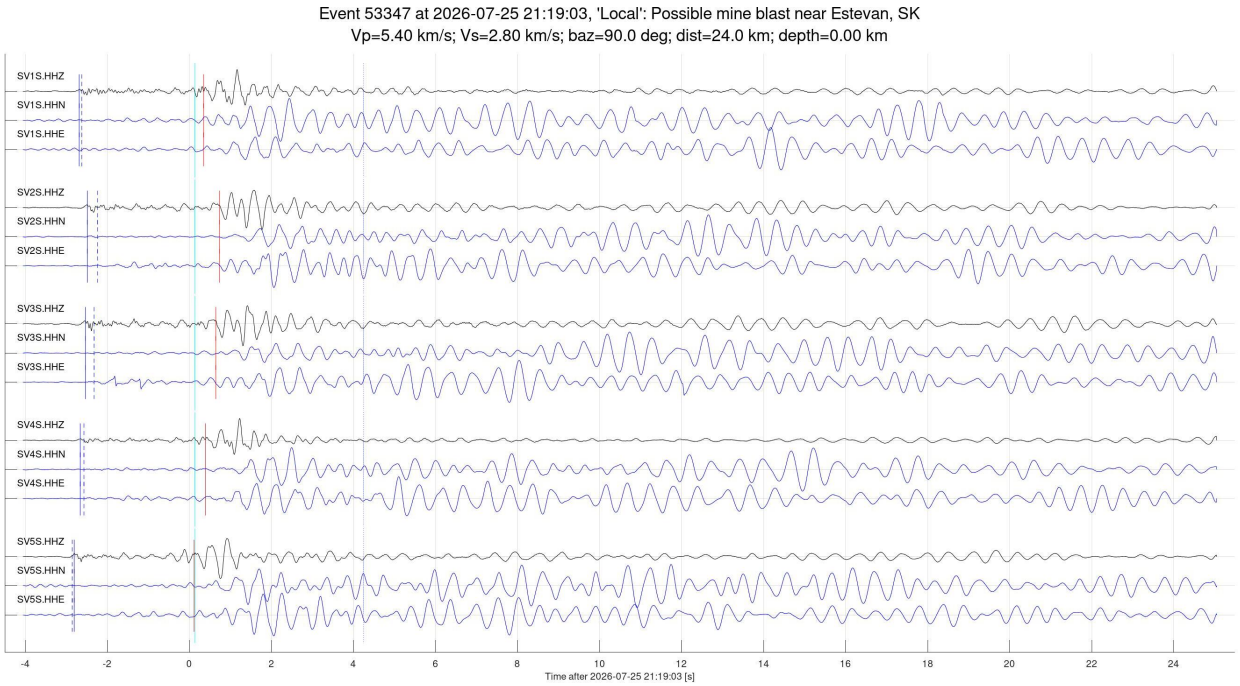


Figure 8, continued.

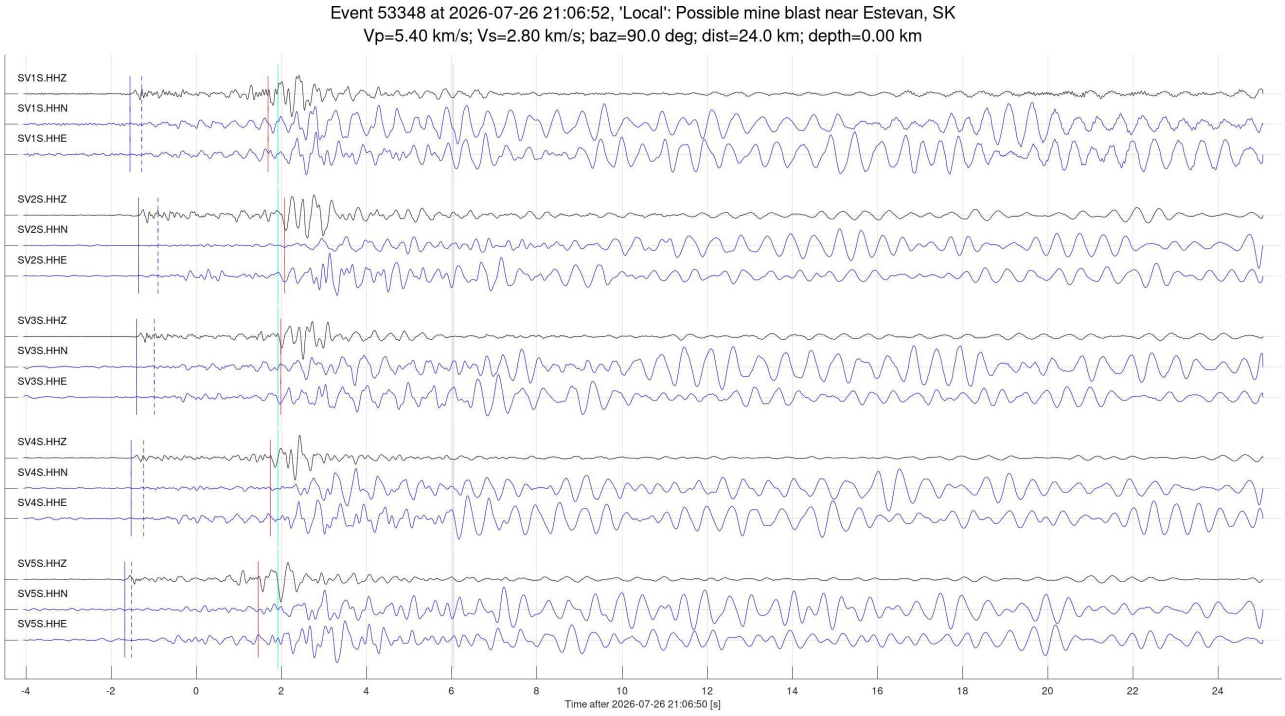


Figure 8, continued.

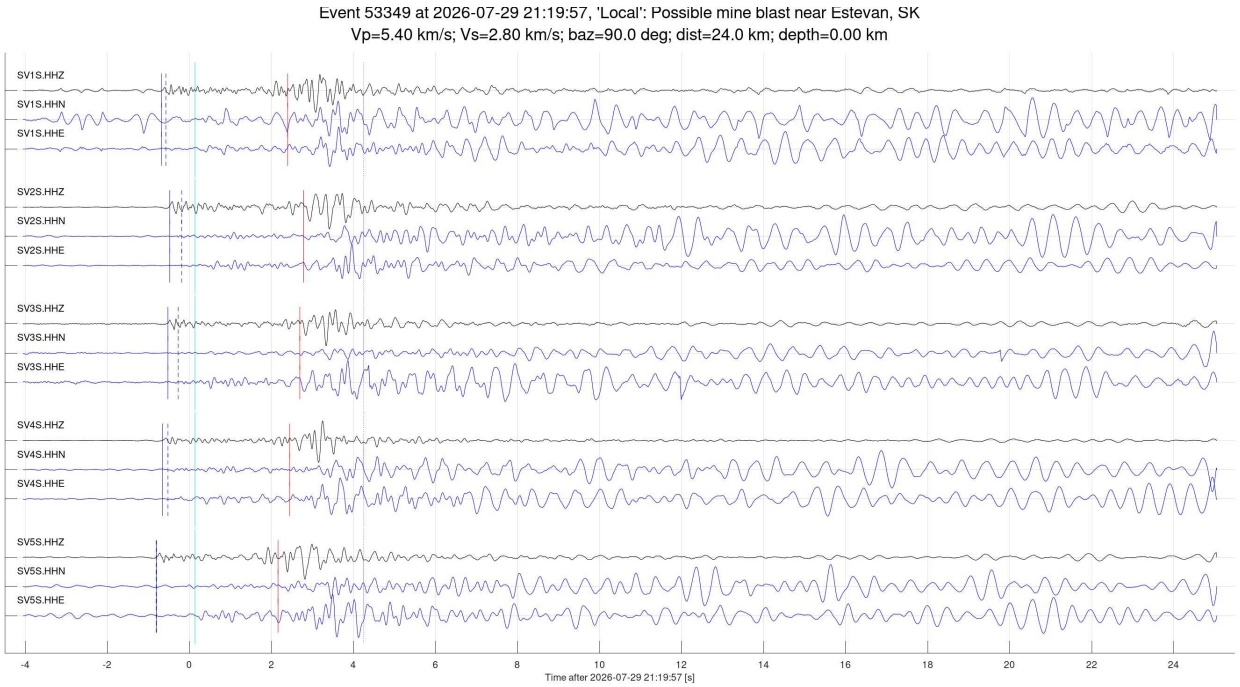


Figure 8, continued.

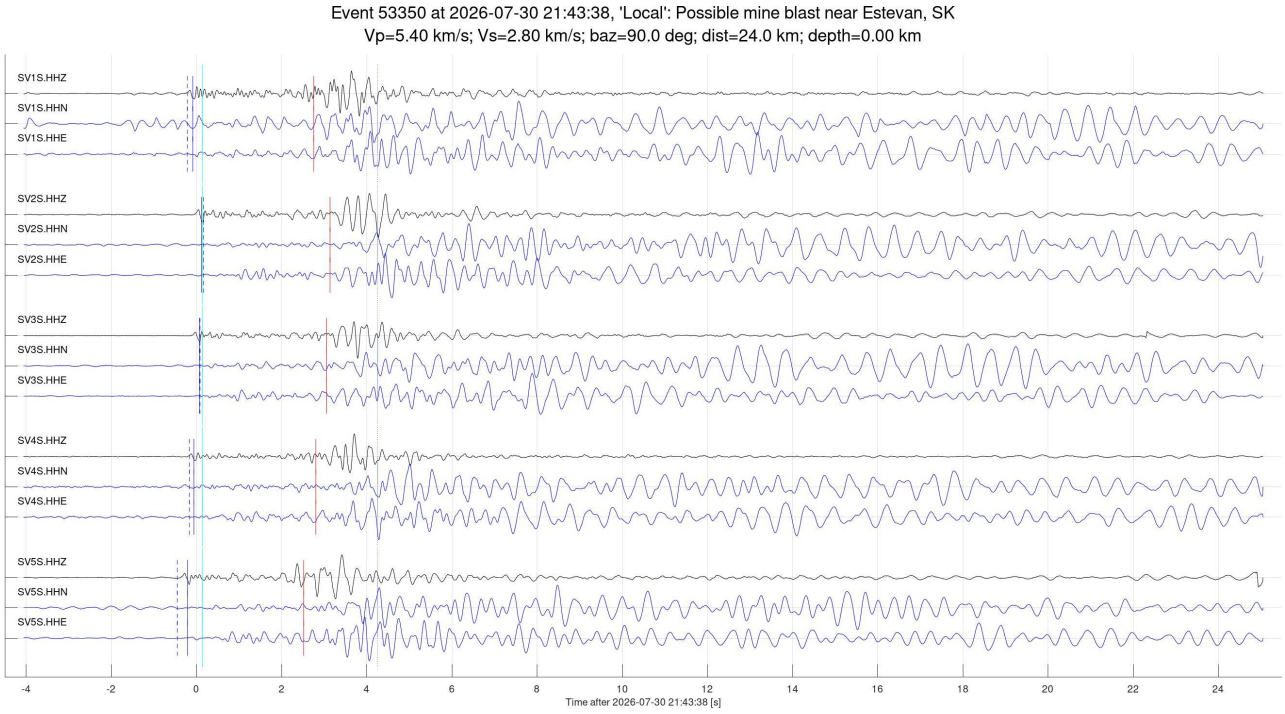


Figure 8, continued.

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 or surface waves from teleseismic and regional events. Figure 9 illustrates one such event.

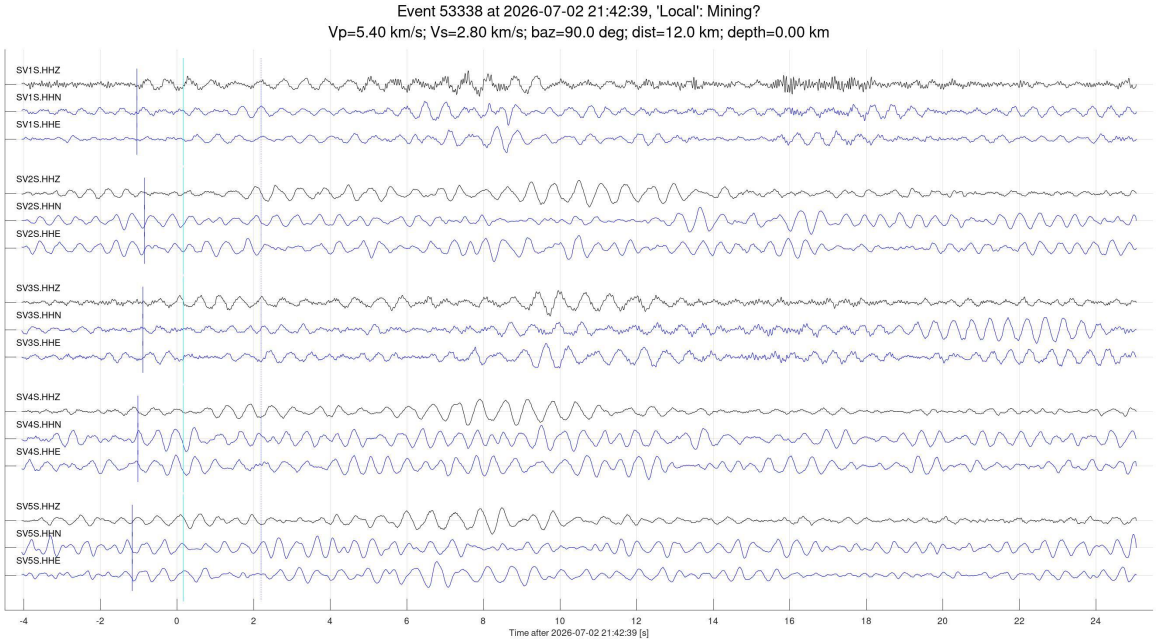


Figure 9. Sample events interpreted as due to mining activity in the area. Lines, colour bars and labels are as in the preceding figures.

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

One seismic event was identified as possibly occurring in the proximity of the array (class 4a) (Figure 10). The waveforms are unclear and inconsistent between stations. These arrivals appear as near-surface scattering and unlikely came from depth.

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

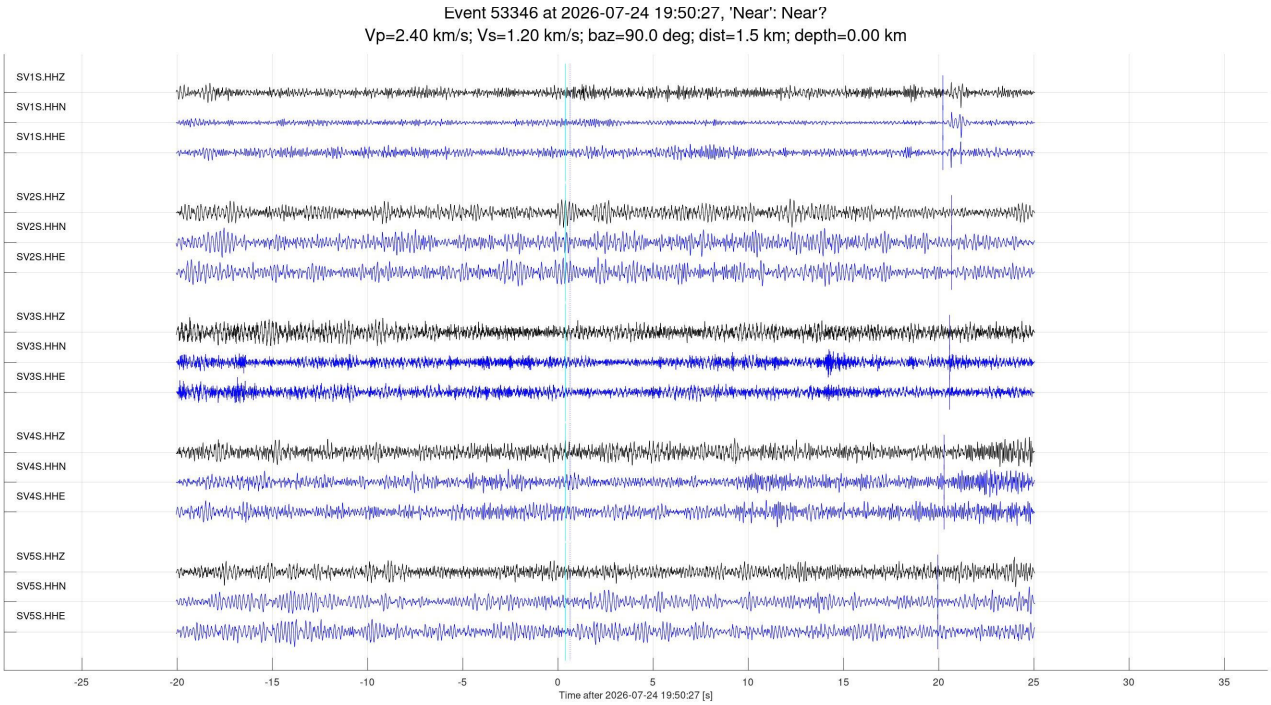


Figure 10. Possible event occurring near surface in the proximity of the array (class 4a in Table 2). Lines, colour bars and labels are as in the preceding figures.

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:

- Seismic data retrieval from all stations was nearly 100%.
- Records from station SV1S are contaminated with persistent spikes. To correct this problem, replacement of the sensor cable is recommended.
- Intermittently, records from stations SV3S and SV4S also contain significant intervals of spikes.

Data and observations:

- 25 teleseismic events and 11 mine blasts were detected in July 2026.
- Numerous local events were observed, likely related to mining operations or freight trains. These events were not catalogued or analyzed in detail.
- Three teleseismic events reported in the USGS bulletin with (likely) misinterpreted origin times were identified.
- No events occurring near the reservoir level were identified.