Appendix D Geophysical survey

D1 2026 RDCL Downhole Seismic Testing

D2 2026 RDCL Surface Geophysical Survey

REPORT ON:

DOWNHOLE SEISMIC TESTING

PROJECT:

PORT VILLA VANUATU

DOWNHOLE SEISMIC

CLIENT:

TONKIN + TAYLOR INTERNATIONAL
161 VICTORIA STREET
TE ARO
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NEW ZEALAND

RDCL®

CONTENTS

1 INTRODUCTION 3
1.1 Background Information 3
1.2 Objectives 5
2 SCOPE OF WORK 5
2.1 Deliverables 6
2.2 Terms of Reference 6
3 METHODOLOGY 6
4 RESULTS 7
4.1 BH02 – Vs Profile 7
4.2 BH03 – Vs Profile 7
4.3 BH06 – Vs Profile 8
4.4 BH07 – Vs Profile 9
4.5 BH09 – Vs Profile 9
4.6 BH12 – Vs Profile 10
5 LIMITATIONS 11
6 CLOSURE 12

TABLES

Table 1: Summary of Geotechnical Log for BH02. 4
Table 2: Summary of Geotechnical Log for BH03. 4
Table 3: Summary of Geotechnical Log for BH06. 4
Table 4: Summary of Geotechnical Log for BH07. 4
Table 5: Summary of Geotechnical Log for BH09. 5
Table 6: Summary of Geotechnical Log of BH12. 5
Table 7: BH02 Seismic Velocity Profile. 7
Table 8: BH03 Seismic Velocity Profile. 8
Table 9: BH06 Seismic Velocity Profile. 8
Table 10: BH07 Seismic Velocity Profile. 9
Table 11: BH09 Seismic Velocity Profile. 10
Table 12: BH12 Seismic Velocity Profile. 10

FIGURES

Figure 01 – Test Location Map
Figure 02 – BH02 Shear Wave Tx Curve- First Break
Figure 03 – BH02 Shear Wave Tx Curve- First Peak
Figure 04 – BH02 Shear Wave Tx Curve- Max Peak
Figure 05 – BH02 Shear Wave Layer Velocities
Figure 06 – BH02 Shear Wave Interval Velocities
Figure 07 – BH02 Shear Wave Trace Gather
Figure 08 – BH03 Shear Wave Tx Curve- First Break

FIGURE 09 – BH03 SHEAR WAVE TX CURVE- FIRST PEAK
FIGURE 10 – BH03 SHEAR WAVE TX CURVE- MAX PEAK
FIGURE 11 – BH03 SHEAR WAVE LAYER VELOCITIES
FIGURE 12 – BH03 SHEAR WAVE INTERVAL VELOCITIES
FIGURE 13 – BH03 SHEAR WAVE TRACE GATHER
FIGURE 14 – BH06 SHEAR WAVE TX CURVE- FIRST BREAK
FIGURE 15 – BH06 SHEAR WAVE TX CURVE- FIRST PEAK
FIGURE 16 – BH06 SHEAR WAVE LAYER VELOCITIES
FIGURE 17 – BH06SHEAR WAVE INTERVAL VELOCITIES
FIGURE 18 – BH06 SHEAR WAVE TRACE GATHER
FIGURE 19 – BH07 SHEAR WAVE TX CURVE- FIRST BREAK
FIGURE 20 – BH07 SHEAR WAVE TX CURVE- FIRST PEAK
FIGURE 21 – BH07 SHEAR WAVE LAYER VELOCITIES
FIGURE 22 – BH07 SHEAR WAVE INTERVAL VELOCITIES
FIGURE 23 – BH07 SHEAR WAVE TRACE GATHER
FIGURE 24 – BH09 SHEAR WAVE TX CURVE- FIRST BREAK
FIGURE 25 – BH09 SHEAR WAVE TX CURVE- FIRST PEAK
FIGURE 26 – BH09 SHEAR WAVE TX CURVE- MAX PEAK
FIGURE 27 – BH09 SHEAR WAVE LAYER VELOCITIES
FIGURE 28 – BH09 SHEAR WAVE INTERVAL VELOCITIES
FIGURE 29 – BH09 SHEAR WAVE TRACE GATHER
FIGURE 30 – BH12 SHEAR WAVE TX CURVE- FIRST BREAK
FIGURE 31 – BH12 SHEAR WAVE TX CURVE- FIRST PEAK
FIGURE 32 – BH12 SHEAR WAVE LAYER VELOCITIES
FIGURE 33 – BH12 SHEAR WAVE INTERVAL VELOCITIES
FIGURE 34 – BH12 SHEAR WAVE TRACE GATHER

APPENDICES

APPENDIX A – ACQUISITION AND PROCESSING METHODOLOGY

1 INTRODUCTION

Tonkin + Taylor International (T+TI, the client) engaged Resource Development Ltd. (RDCL) to undertake geophysical testing at Port Villa, Efate Island, Vanuatu.

The investigation included Downhole Seismic (DHS) testing, Multi-channel Analysis of Surface Waves (MASW), Seismic Refraction Tomography (SRT) and Horizontal to Vertical Spectral Ratio (HVSR) testing.

This report is only concerned with the downhole seismic testing. The locations of all downhole seismic surveys are displayed in Figure 1.

1.1 BACKGROUND INFORMATION

RDCL understands that the client is undertaking ground investigations as part of the Port Villa redevelopment project. As part of the investigation, the following testing was agreed upon:

- Six (6) Downhole Seismic (DHS) tests to 30 m below ground level (bgl).
- Ten (10) night shifts of Multi-channel Analysis of Surface Waves (MASW) testing along roads.
- Two (2) night shifts of Seismic Refraction Tomography (SRT).
- Four (4) night shifts of Horizontal to Vertical Spectral Ratio (HVSR) tests.

This is a report on the downhole seismic testing in six (6) drillholes: BH02, BH03, BH06, BH07, BH09, BH12. The location of each drillhole is shown in Figure 1.

RDCL received T+TI's logs for all six boreholes. A geological summary of each log is presented in Tables 1 through 6. These summaries were used to partially inform the geophysical models.

TABLE 1: SUMMARY OF GEOTECHNICAL LOG FOR BH02.

From (m)	To (m)	Material
0.0	2.05	Fill, LIMESTONE, SAND
2.05	6.1	Very weak LIMESTONE
6.1	9	Sandy GRAVEL
9	16.5	Weak LIMESTONE
16.5	20.5	Weak LIMESTONE
20.5	29.5	Weak LIMESTONE

TABLE 2: SUMMARY OF GEOTECHNICAL LOG FOR BH03.

From (m)	To (m)	Material
0.0	5.5	GRAVEL/SAND
5.5	10.5	GRAVEL/SAND
10.5	13.5	LIMESTONE
13.5	23.5	LIMESTONE
23.5	29.5	LIMESTONE

TABLE 3: SUMMARY OF GEOTECHNICAL LOG FOR BH06.

From (m)	To (m)	Material
0.0	4.5	LIMESTONE
4.5	10.5	LIMESTONE
10.5	15.5	LIMESTONE
15.5	22.5	LIMESTONE
22.5	25.5	LIMESTONE
25.5	28.5	LIMESTONE

TABLE 4: SUMMARY OF GEOTECHNICAL LOG FOR BH07.

From (m)	To (m)	Material
0.0	3.5	LIMESTONE
3.5	7.5	LIMESTONE
7.5	14.5	LIMESTONE

TABLE 5: SUMMARY OF GEOTECHNICAL LOG FOR BH09.

From (m)	To (m)	Material
0.0	4.5	GRAVEL
4.5	8.5	GRAVEL/SANDS
8.5	13.5	GRAVELS
13.5	19.5	GRAVEL/SANDS
19.5	23.5	LIMESTONE
23.5	29.5	LIMESTONE

TABLE 6: SUMMARY OF GEOTECHNICAL LOG OF BH12.

From (m)	To (m)	Material
0.0	4	GRAVEL
4	6	TUFF
6	11.5	TUFF
11.5	16.5	TUFF
16.5	23.5	TUFF
23.5	26.5	TUFF
26.5	29.5	TUFF

1.2 OBJECTIVES

The survey objectives were as follows:

- Acquire Downhole Seismic data in six drillholes
- Produce a 1D shear wave velocity (Vs) profile for each drillhole.

2 SCOPE OF WORK

The scope of downhole seismic work included:

- Six shear wave velocity profiles in each borehole.
  - Vs profile to at least 30 m bgl.
- Delivery of a technical report summarising site activities, processing and results.

2.1 DELIVERABLES

Deliverables for the project include:

- Raw seismic data (.sg2).
- 1D Vs profiles.
- Technical report.

2.2 TERMS OF REFERENCE

This investigation employed geophysical methods and therefore the findings presented here are the result of the measurement and interpretation of seismic (acoustic) signals. As such any results derived from the geophysical investigation should be taken in the context of and in reference to the complete ground investigation. Reasonable skill and care were taken to ensure that the results are accurate and reliable, including reference where appropriate to published date from this and/or other sites. However, as with other indirect methods there is a possibility of localised inconsistencies and inaccuracies within the results.

3 METHODOLOGY

Field acquisition and processing methodology are described in Appendix A.

4 RESULTS

4.1 BH02 – Vs Profile

Signal to noise ratios (SNR) in BH02 were generally good. Data was clearly polarised and the shear wave was identifiable.

Shear wave velocities were recorded in the range of 150 – 1630 m/s (Figures 02 – 05). Data are summarised in Table 7.

Velocities calculated from the three picking methods were in close agreement. The range of values for each velocity layer may be treated as an uncertainty range.

TABLE 7: BH02 SEISMIC VELOCITY PROFILE.

From	To	Vs First Break	Vs First Peak	Vs Max Peak	Vs Average
m	m	m/s	m/s	m/s	m/s
0	2.05	170	150		**160**
2.05	6.1	240	272	168	**227**
6.1	9	309	248	162	**240**
9	16.5	373	355	329	**352**
16.5	20.5	1630	1512	948	**1363**
20.5	29.5	514	548	569	**544**

4.2 BH03 – Vs Profile

Signal to noise ratios (SNR) in BH03 were generally good. Data was clearly polarised and the shear wave was identifiable.

Shear wave velocities were recorded in the range of 169 – 1109 m/s (Figures 08 – 10). Data are summarised in Table 8.

Velocities calculated from the three picking methods were in close agreement. The range of values for each velocity layer may be treated as an uncertainty range.

TABLE 8: BH03 SEISMIC VELOCITY PROFILE

From	To	Vs First Break	Vs First Peak	Vs Max Peak	Vs Average
m	m	m/s	m/s	m/s	m/s
0	5.5	182	177	169	**176**
5.5	10.5	318	302	309	**310**
10.5	13.5	906	728	738	**791**
13.5	23.5	1109	1084	792	**995**
23.5	29.5	818	754	736	**769**

4.3 BH06 – VS PROFILE

Signal to noise ratios (SNR) in BH06 were generally good. Data was clearly polarised and the shear wave was identifiable. The max peak was not consistently identifiable and has therefore not been picked.

Shear wave velocities were recorded in the range of 530 – 1103 m/s (Figures 14 – 15). Data are summarised in Table 9.

Velocities calculated from the three picking methods were in close agreement. The range of values for each velocity layer may be treated as an uncertainty range.

TABLE 9: BH06 SEISMIC VELOCITY PROFILE.

From	To	Vs First Break	Vs First Peak	Vs Average
m	m	m/s	m/s	m/s
0	4.5	584	530	**557**
4.5	10.5	1096	989	**1043**
10.5	15.5	727	736	**732**
15.5	22.5	1103	1024	**1064**
22.5	25.5	721	861	**791**
25.5	28.5	608	644	**626**

4.4 BH07 – Vs Profile

An obstruction in drillhole BH07 caused a foreshortened end to the survey. The survey was terminated at 13.9 m below ground level.

Signal to noise ratios (SNR) in BH07 were generally good. Data was clearly polarised and the shear wave was identifiable. The max peak was not consistently identifiable and has therefore not been picked.

Shear wave velocities were recorded in the range of 280 – 648 m/s (Figures 19 – 20). Data are summarised in Table 10.

Velocities calculated from the three picking methods were in close agreement. The range of values for each velocity layer may be treated as an uncertainty range.

TABLE 10: BH07 SEISMIC VELOCITY PROFILE.

From	To	Vs First Break	Vs First Peak	Vs Average
m	m	m/s	m/s	m/s
0	3.5	331	280	**305.5**
3.5	7.5	558	648	**603**
7.5	14.5	406	398	**402**

4.5 BH09 – Vs Profile

Signal to noise ratios (SNR) in BH09 were generally good. Data was clearly polarised and the shear wave was identifiable.

Shear wave velocities were recorded in the range of 113 – 1037 m/s (Figures 24 – 26). Data are summarised in Table 11.

Velocities calculated from the three picking methods were in close agreement. The range of values for each velocity layer may be treated as an uncertainty range.

TABLE 11: BH09 SEISMIC VELOCITY PROFILE.

From	To	Vs First Break	Vs First Peak	Vs Max Peak	Vs Average
m	m	m/s	m/s	m/s	m/s
0	4.5	149	125	113	**129**
4.5	8.5	204	237	273	**238**
8.5	13.5	362	389	318	**356**
13.5	19.5	521	510	439	**490**
19.5	23.5	350	427	440	**406**
23.5	29.5	1037	631	623	**764**

4.6 BH12 – VS PROFILE

Signal to noise ratios (SNR) in BH12 were generally good. Data was clearly polarised and the shear wave was identifiable. The max peak was not consistently identifiable and has therefore not been picked.

Shear wave velocities were recorded in the range of 157 – 688 m/s (Figures 30 – 31). Data are summarised in Table 12.

Velocities calculated from the three picking methods were in close agreement. The range of values for each velocity layer may be treated as an uncertainty range.

TABLE 12: BH12 SEISMIC VELOCITY PROFILE.

From	To	Vs First Break	Vs First Peak	Vs Average
m	m	m/s	m/s	m/s
0	4	157	164	**160.5**
4	6	267	230	**249**
6	11.5	253	239	**246**
11.5	16.5	571	504	**538**
16.5	23.5	599	543	**571**
23.5	26.5	292	230	**261**
26.5	29.5	455	688	**572**

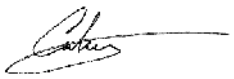
5 LIMITATIONS

- This report has been prepared for the particular purpose outlined in the project brief and no responsibility is accepted for the use of any part in other contexts or for any other purpose.
- This investigation employed geophysical methods and therefore the majority of the findings presented here are the result of the measurement and interpretation of seismic (acoustic) signals. As such any results derived from the geophysical investigation should be taken in the context of and in reference to the complete ground investigation. Reasonable skill and care was taken to ensure that the results are accurate and reliable, including reference where appropriate to published data from this and/or other sites. However, as with other indirect methods there is a possibility of localised inconsistencies and inaccuracies within the results.
- Ground conditions assessed in this report are inferred from data provided by the Client, published sources, site inspection and the investigations described. Variations from the interpreted conditions may occur, and special conditions relating to the site may not have been revealed by this investigation, and which are therefore not taken into account. No warranty is included either expressed or implied that the actual conditions will conform to the interpretation contained in this report.
- No responsibility is accepted by Resource Development Consultants Ltd for inaccuracies in data supplied by others. Where data has been supplied by others, it has been assumed that this information is correct.
- This report is provided for sole use by the Client and is confidential to the Client and their professional advisors. No responsibility whatsoever for the contents of this report shall be accepted for any person other than the Client.

6 CLOSURE

We trust this meets your current needs. Should you wish to discuss any aspect of the contents of this document please contact Oliver Gibson at ogibson@rdcl.co.nz.

Prepared by:





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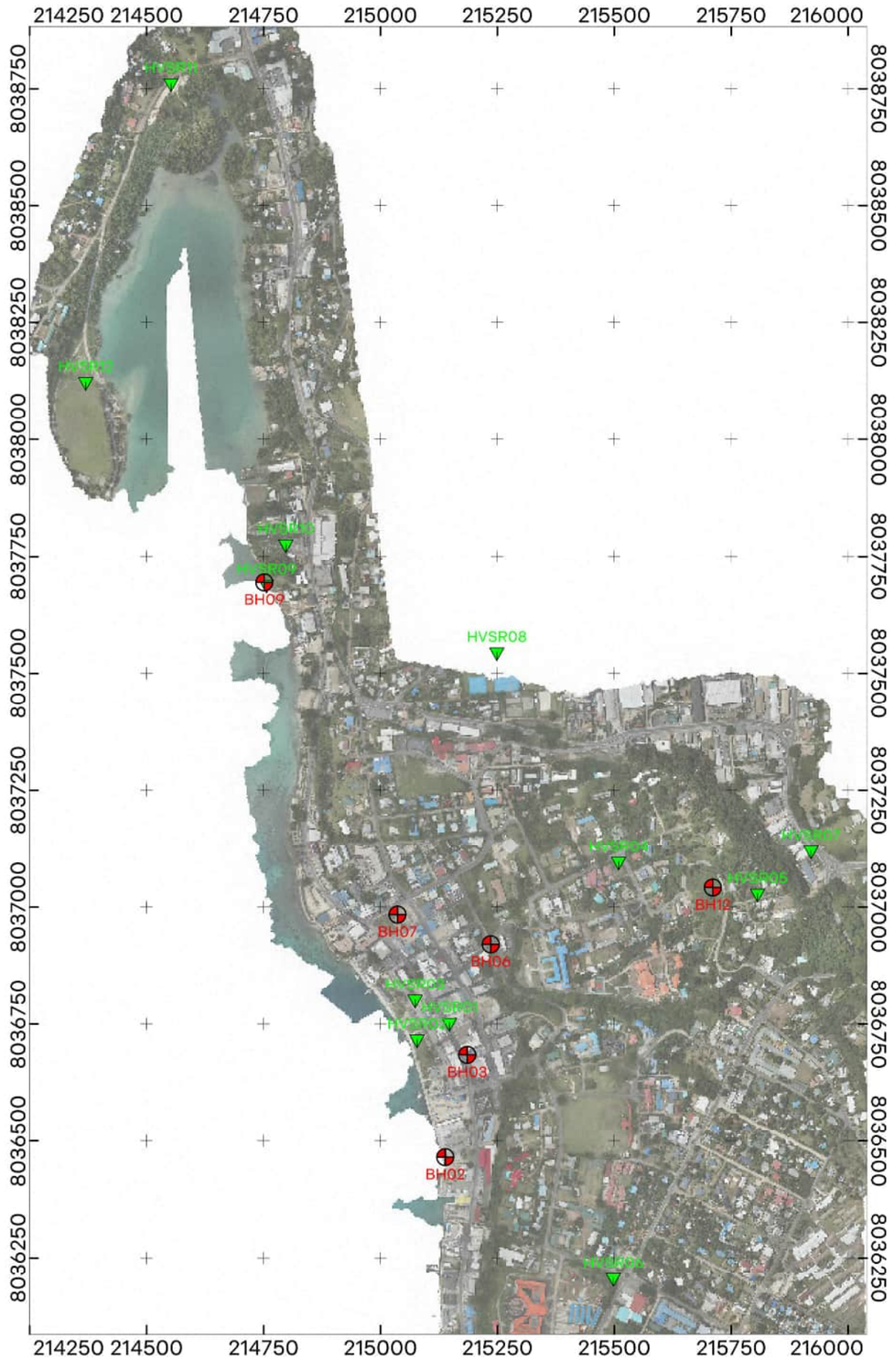
Graduate Geophysicist	Principal Geophysicist

Attached:

Figures 1 – 34

Appendix A

FIGURES



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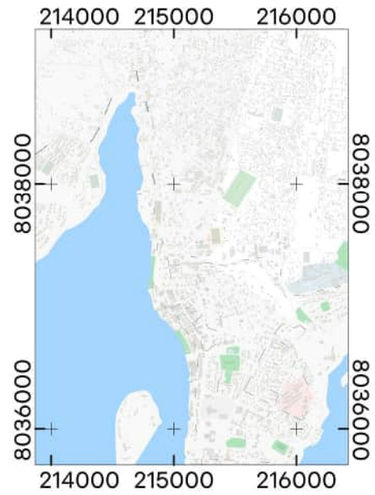

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1000 0 1000 2000

metres

WGS 84 / UTM zone 59S

SCALE: Scale 1:12000

250 0 250 500

metres

WGS 84 / UTM zone 59S

LEGEND:

- Downhole Seismic Test Location
- HVSR Test Location

NOTES:

1. Imagery data provided to RDCL by the client.
2. Absolute accuracy of test location ±3 m.

CLIENT: T+T

PROJECT: PORT VILA, VANUATU GEOPHYSICS

TITLE: HVSR & DOWNHOLE SEISMIC TEST LOCATIONS

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CHECKED BY: SJ	DATE: 01/04/2026	APPROVED BY: SJ	DATE: 01/04/2026

CONTRACT No.: 250306 FIGURE 01

FILE NAME: 250306.gpf
PLOTTED DRAWING SIZE: A3 (420 x 297)

RDCL
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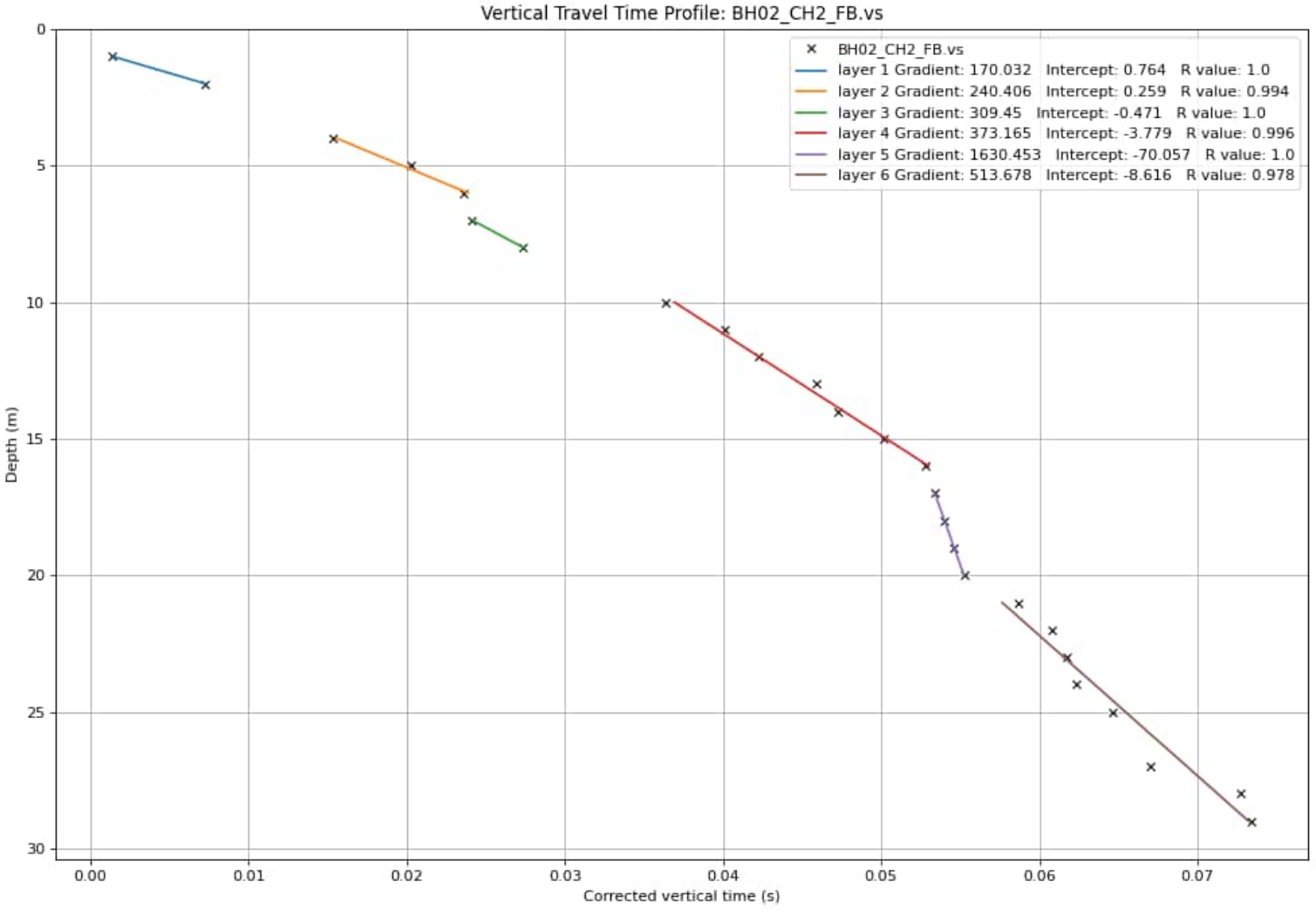
RDCL



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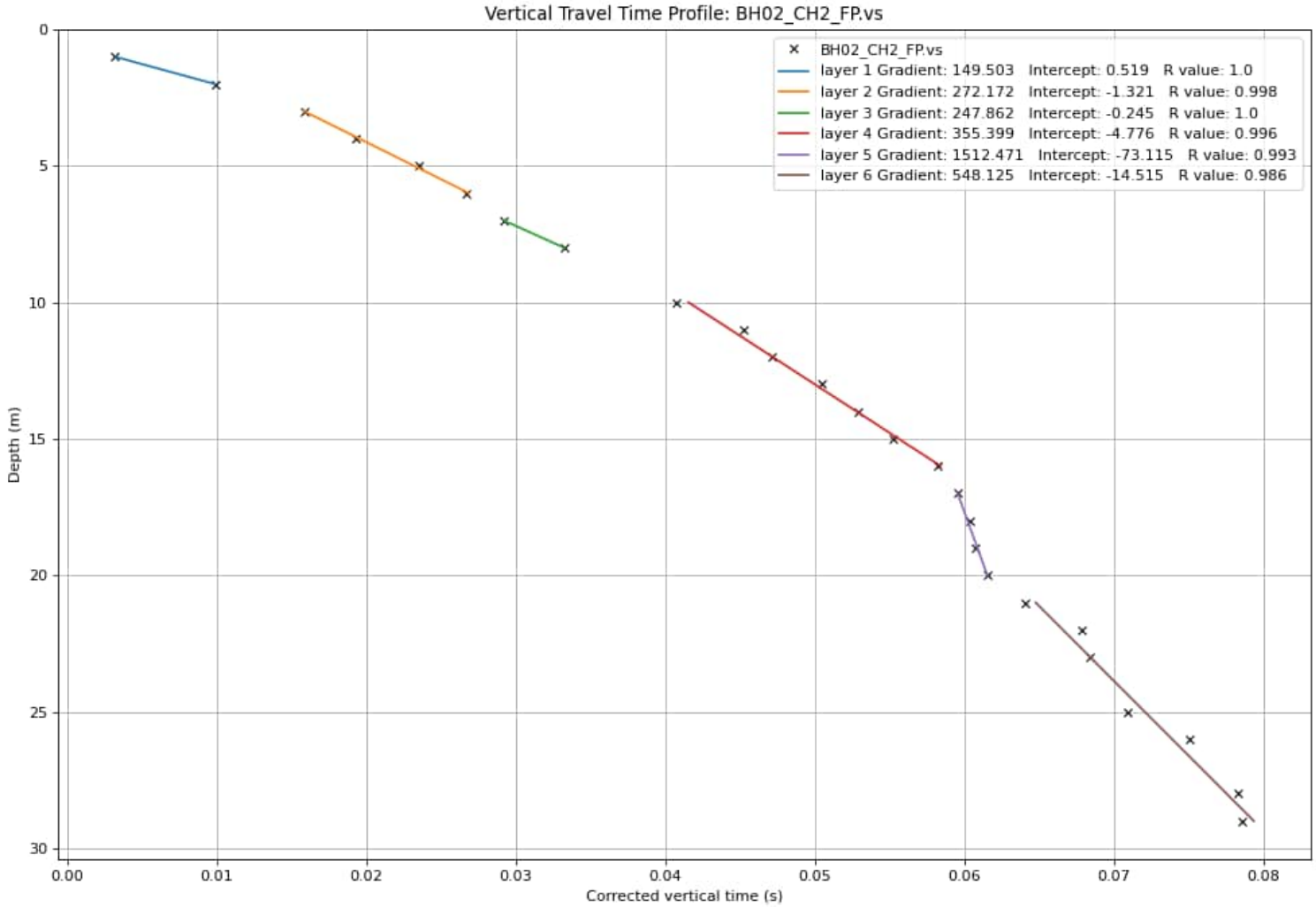

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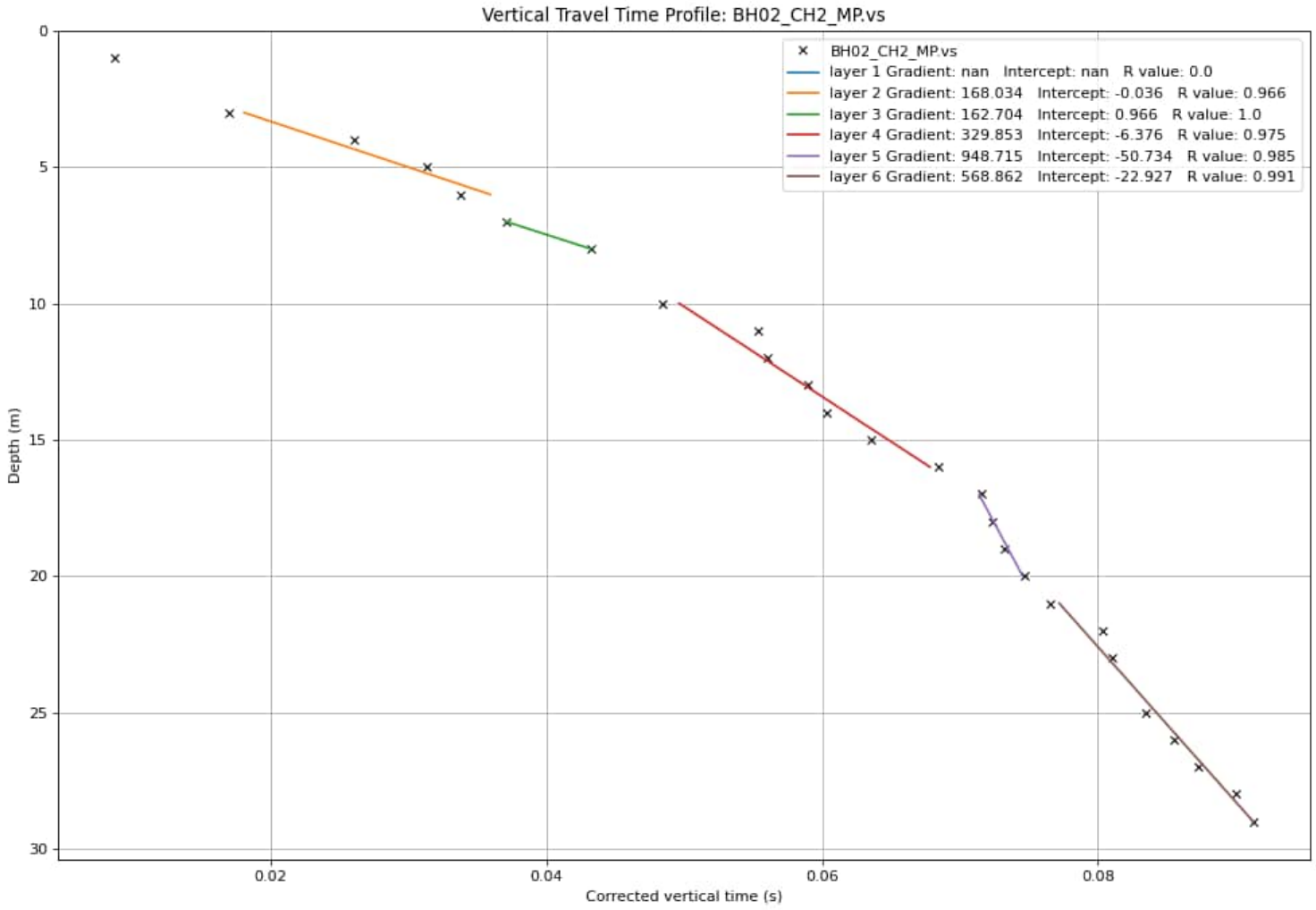

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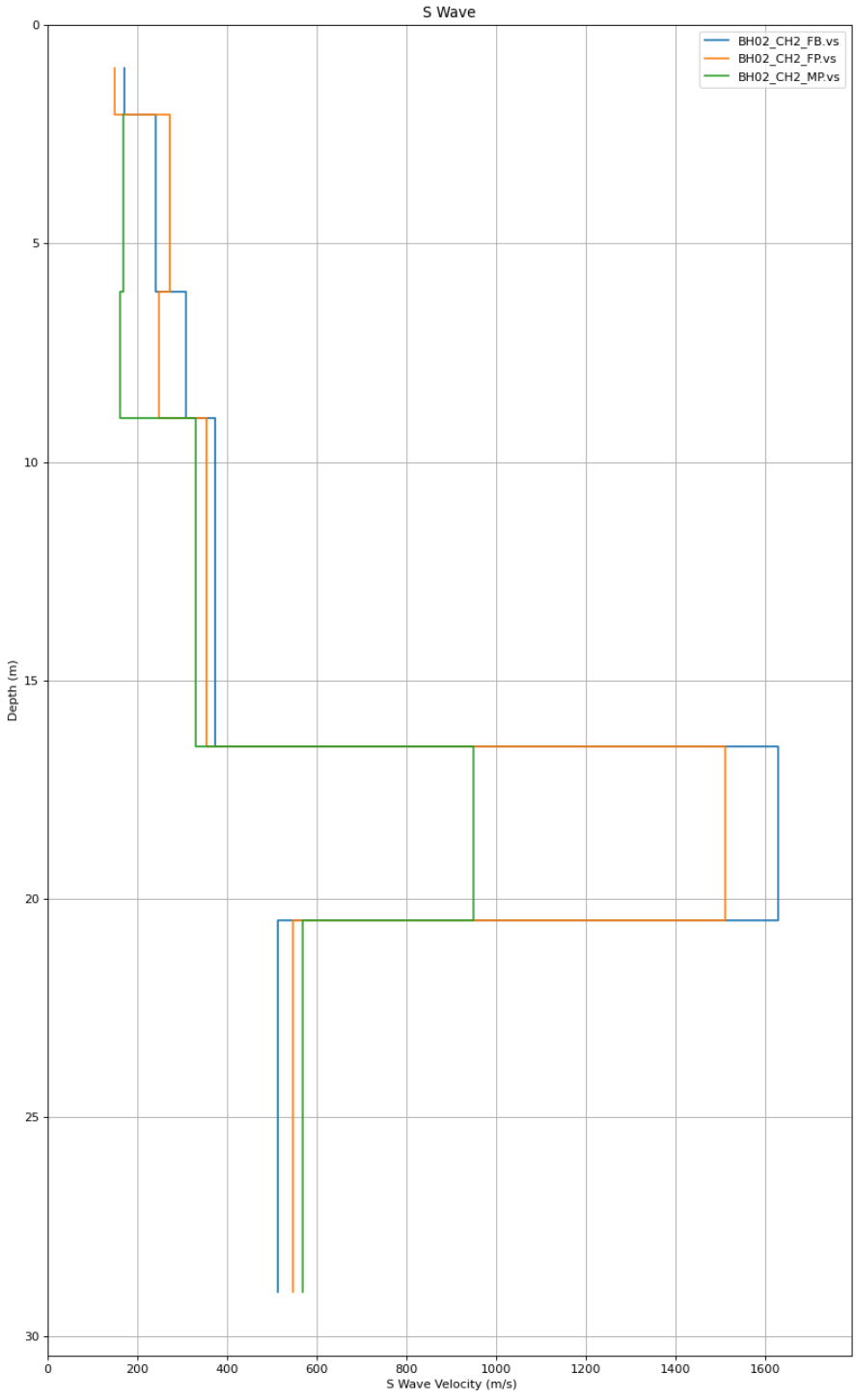

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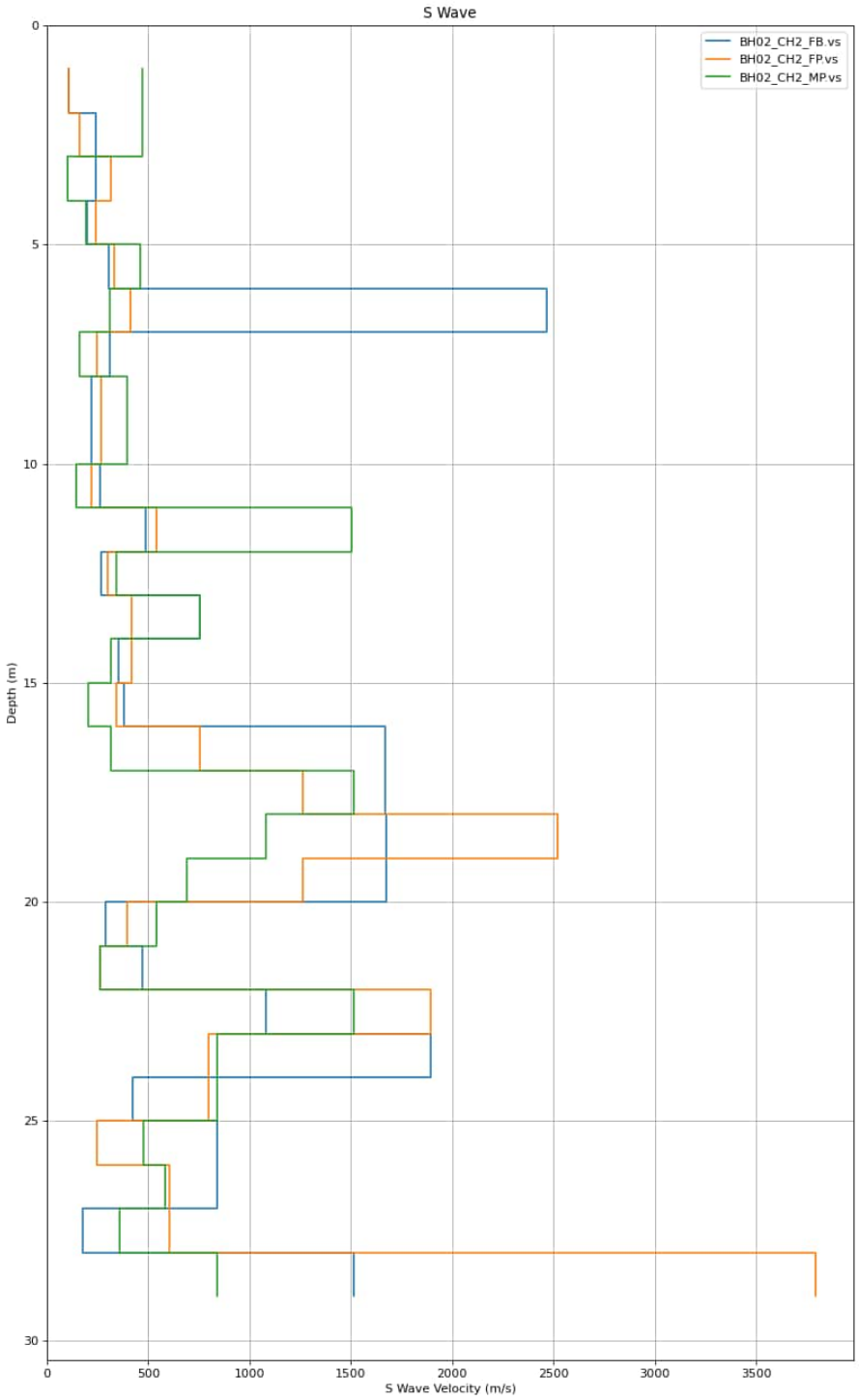

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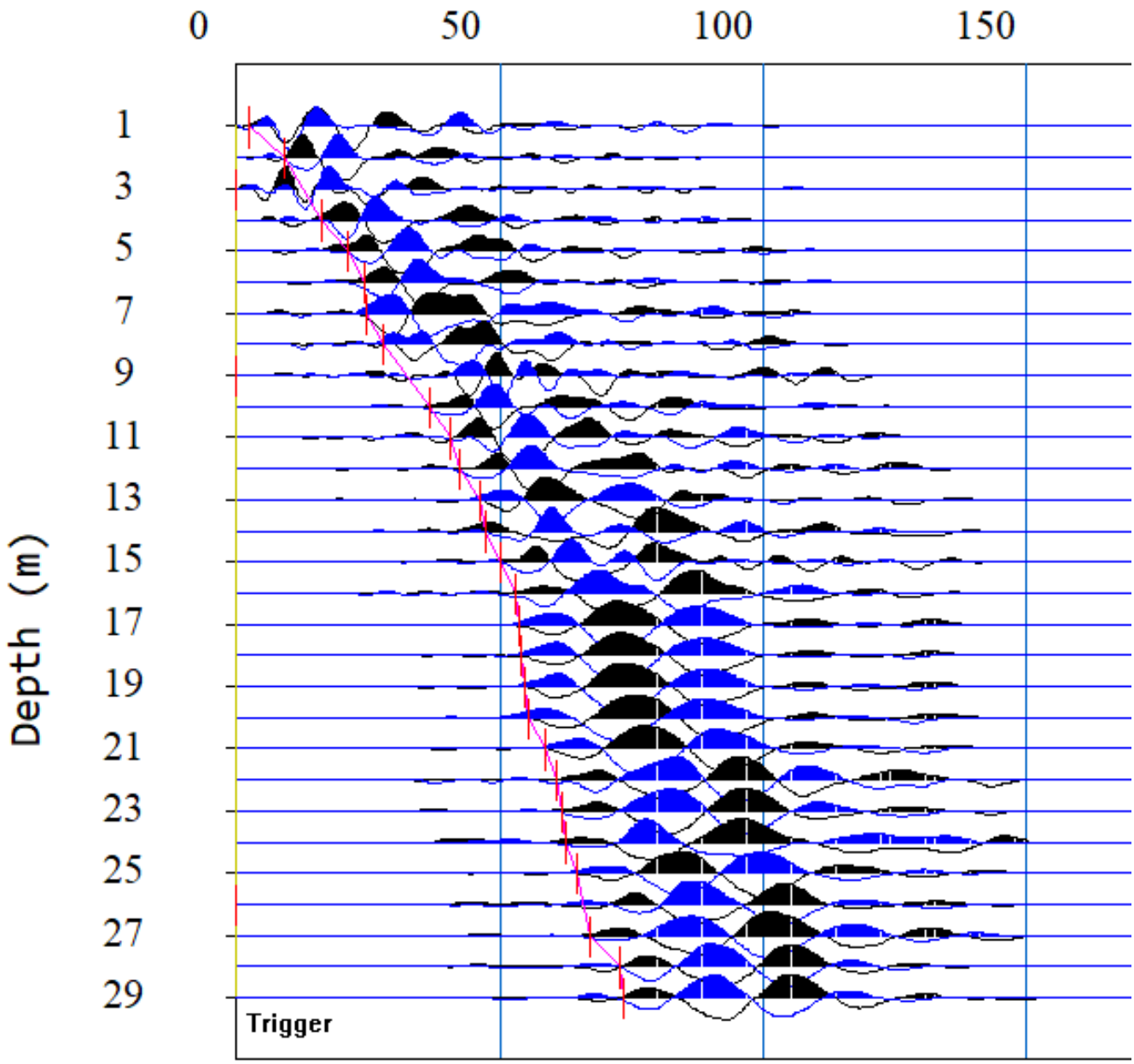

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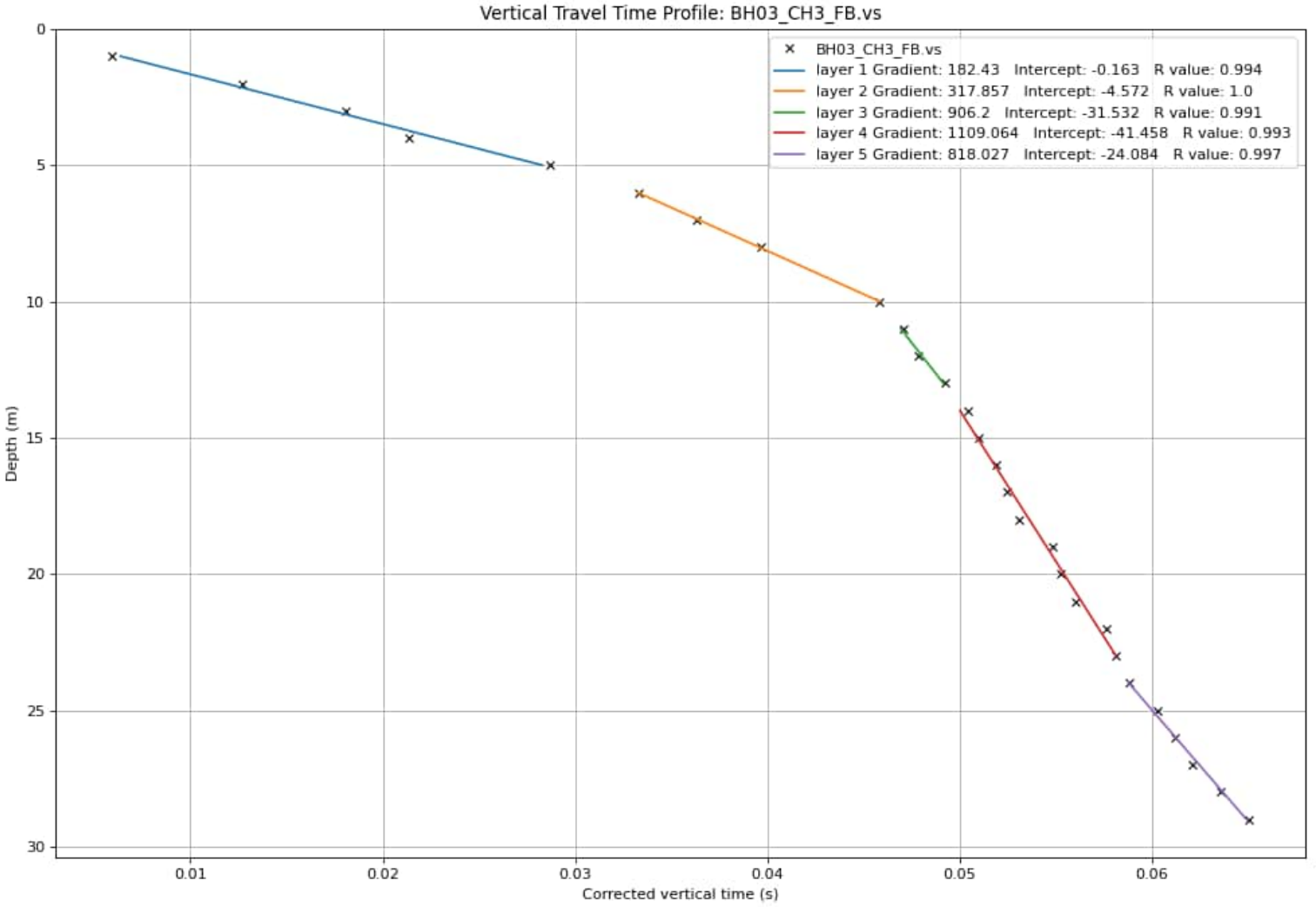

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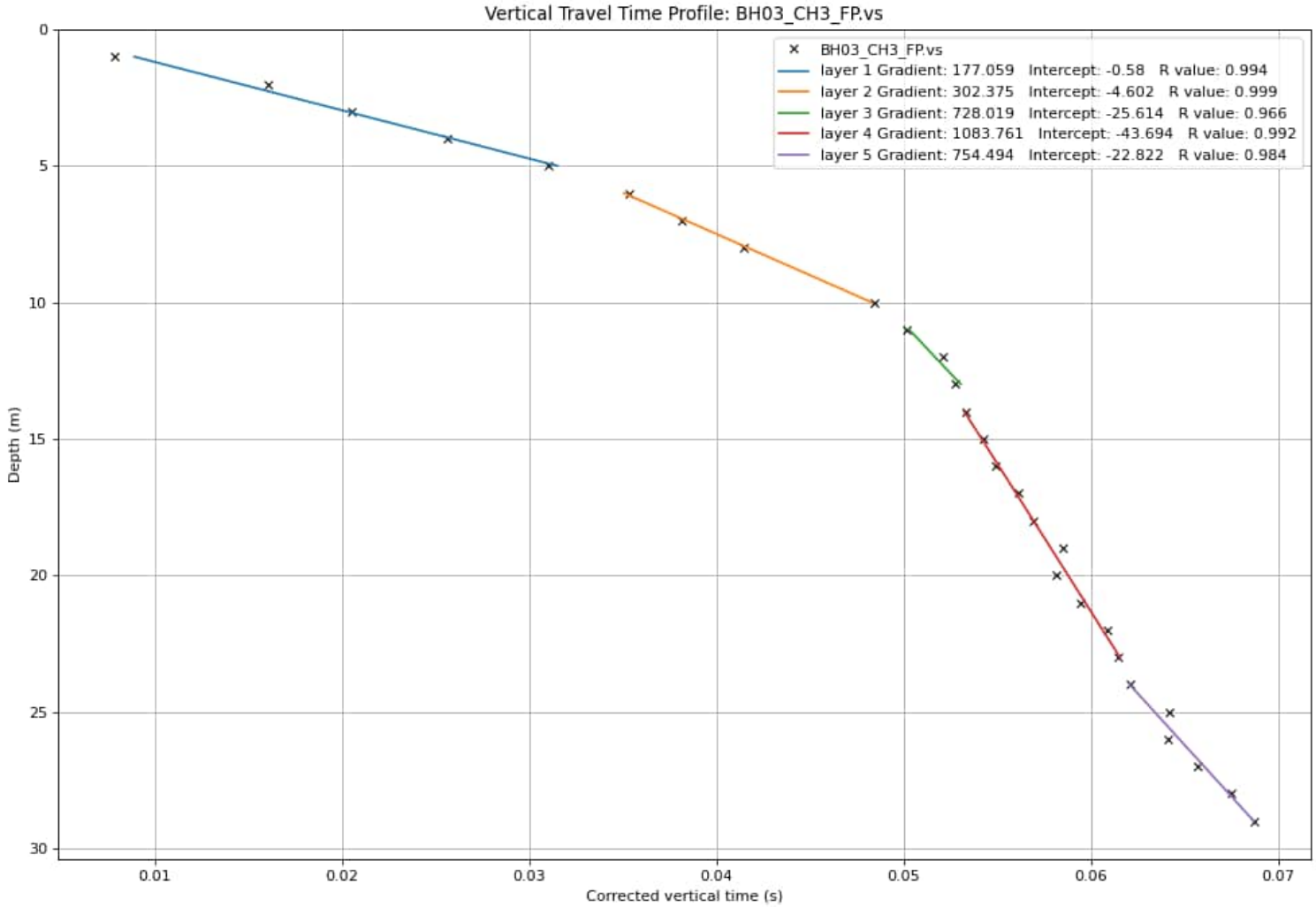

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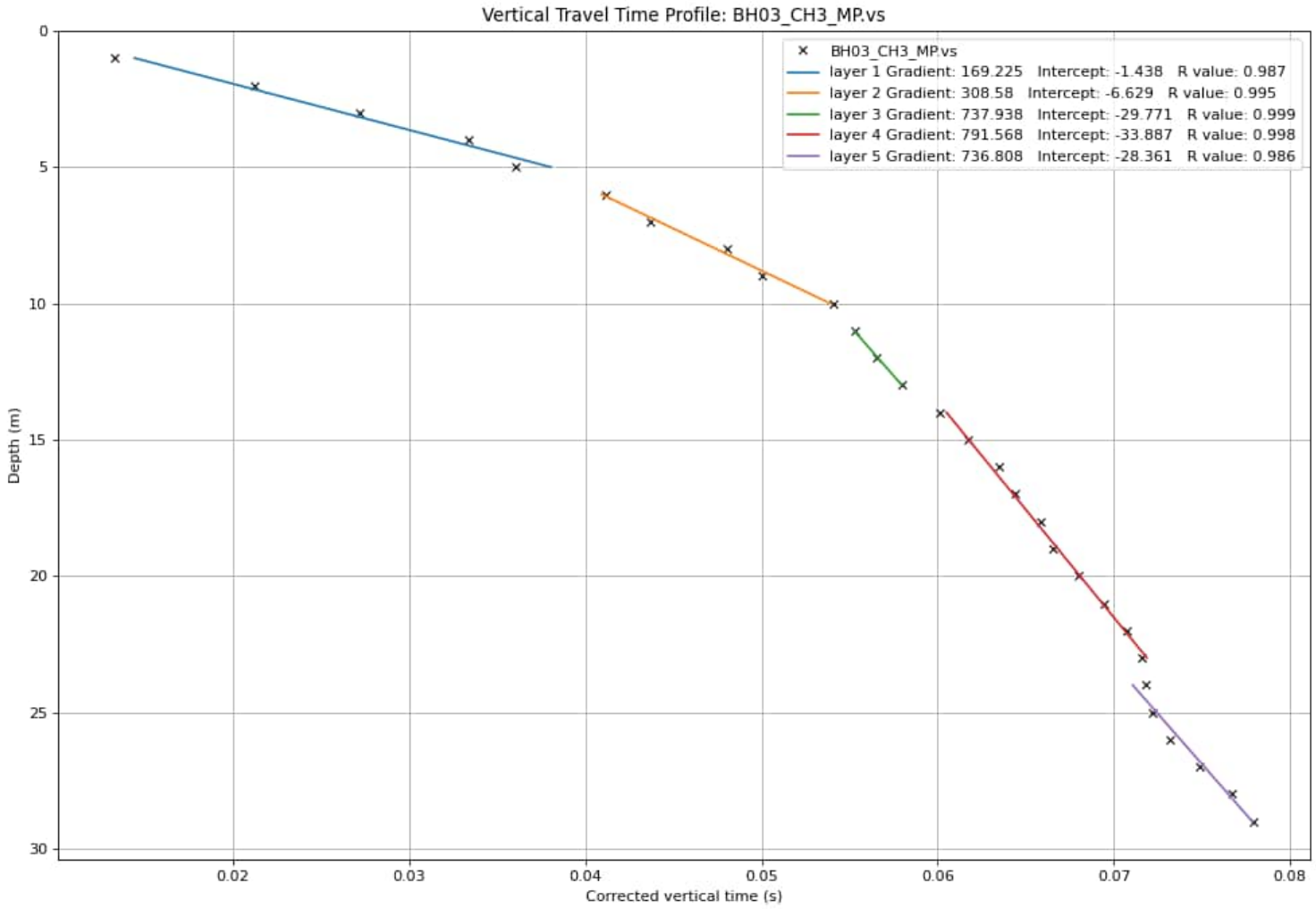

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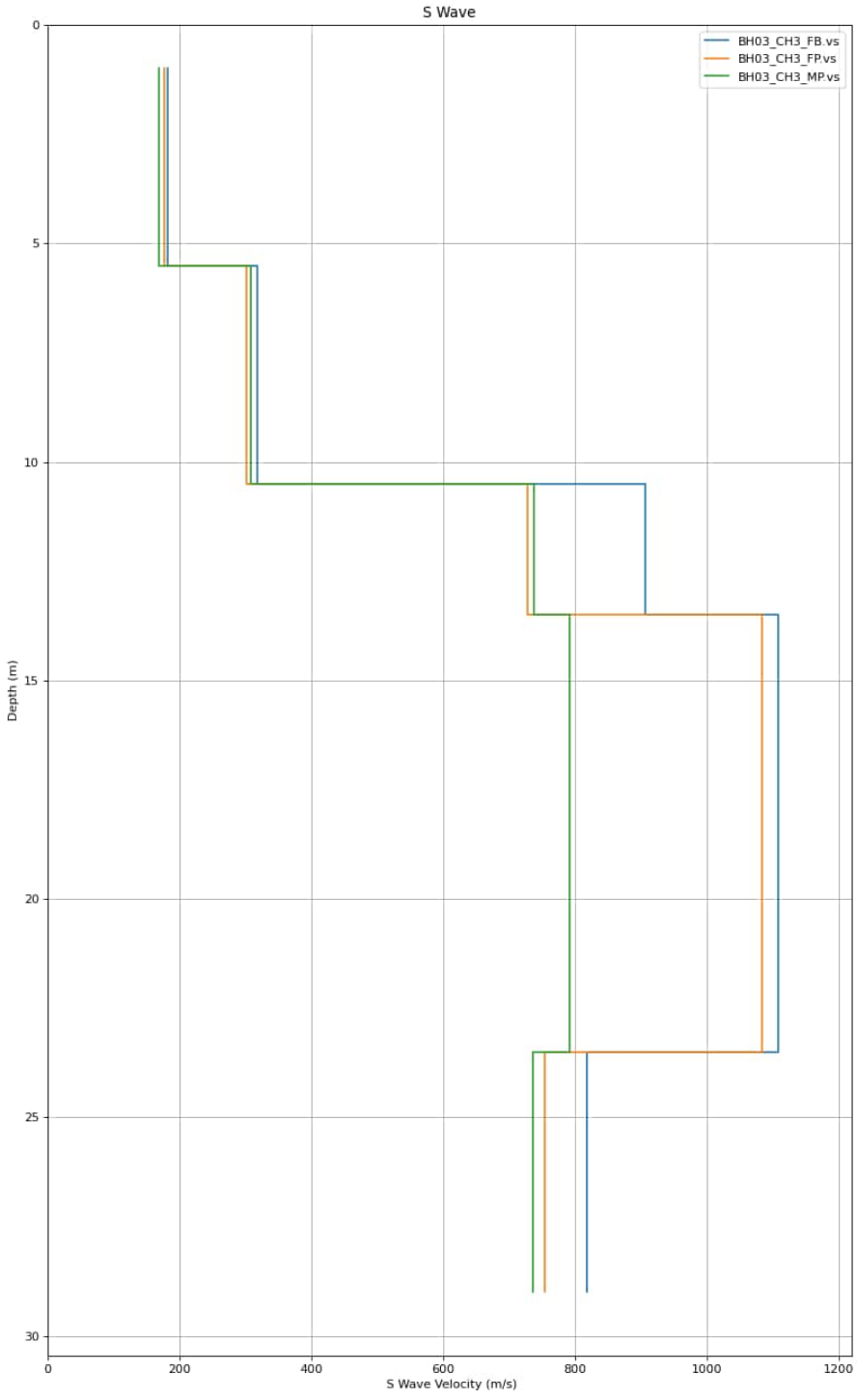

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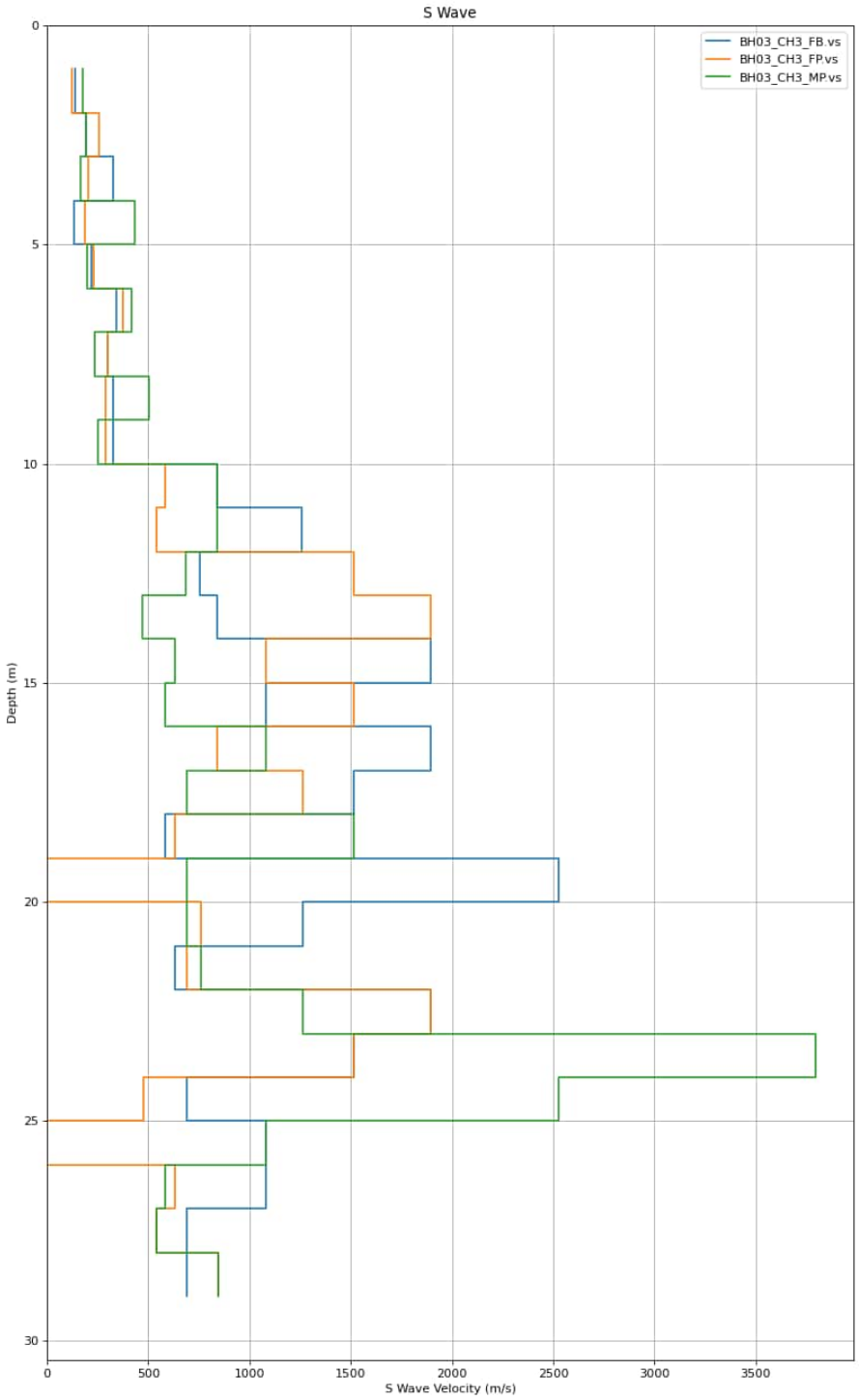

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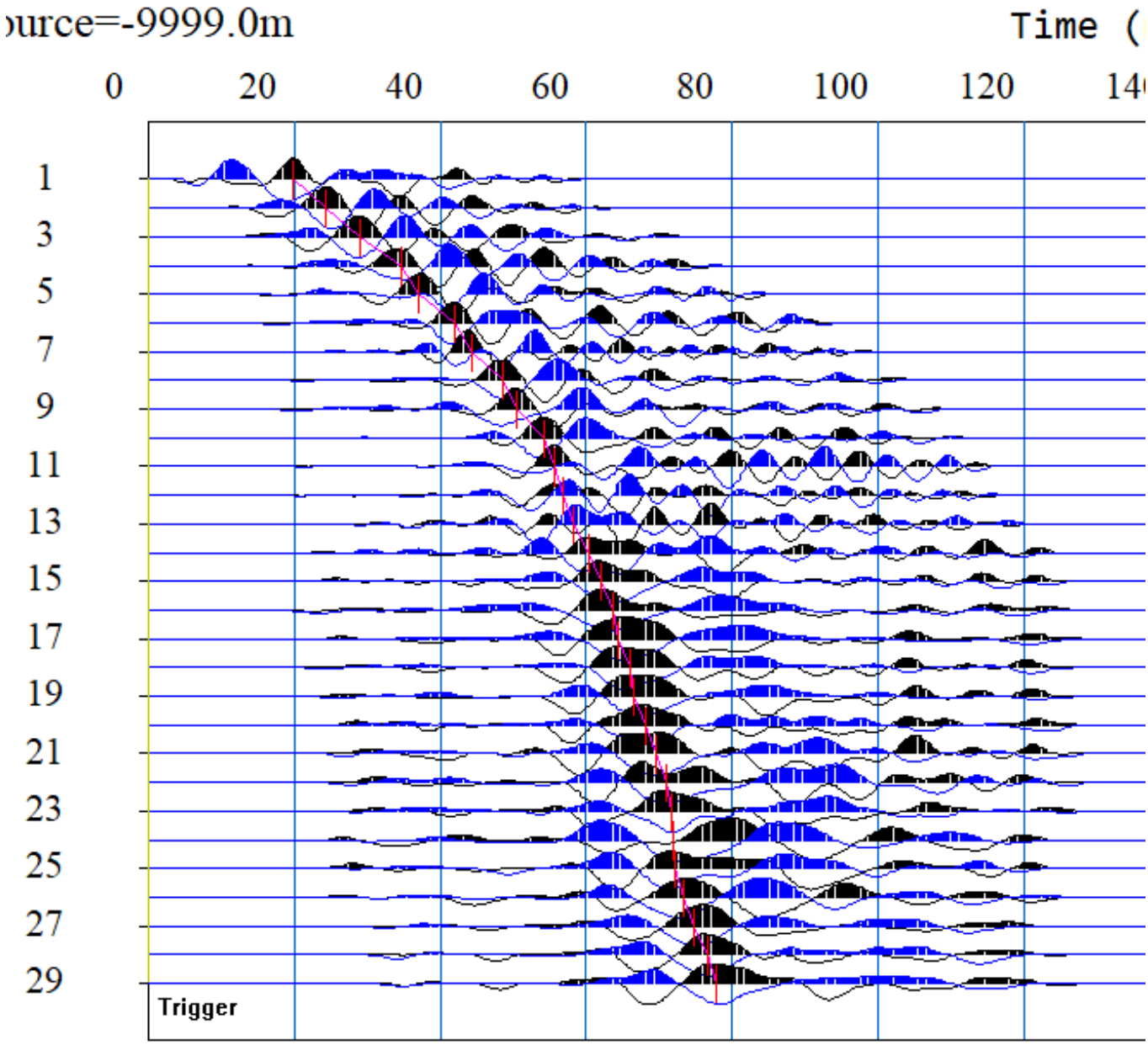

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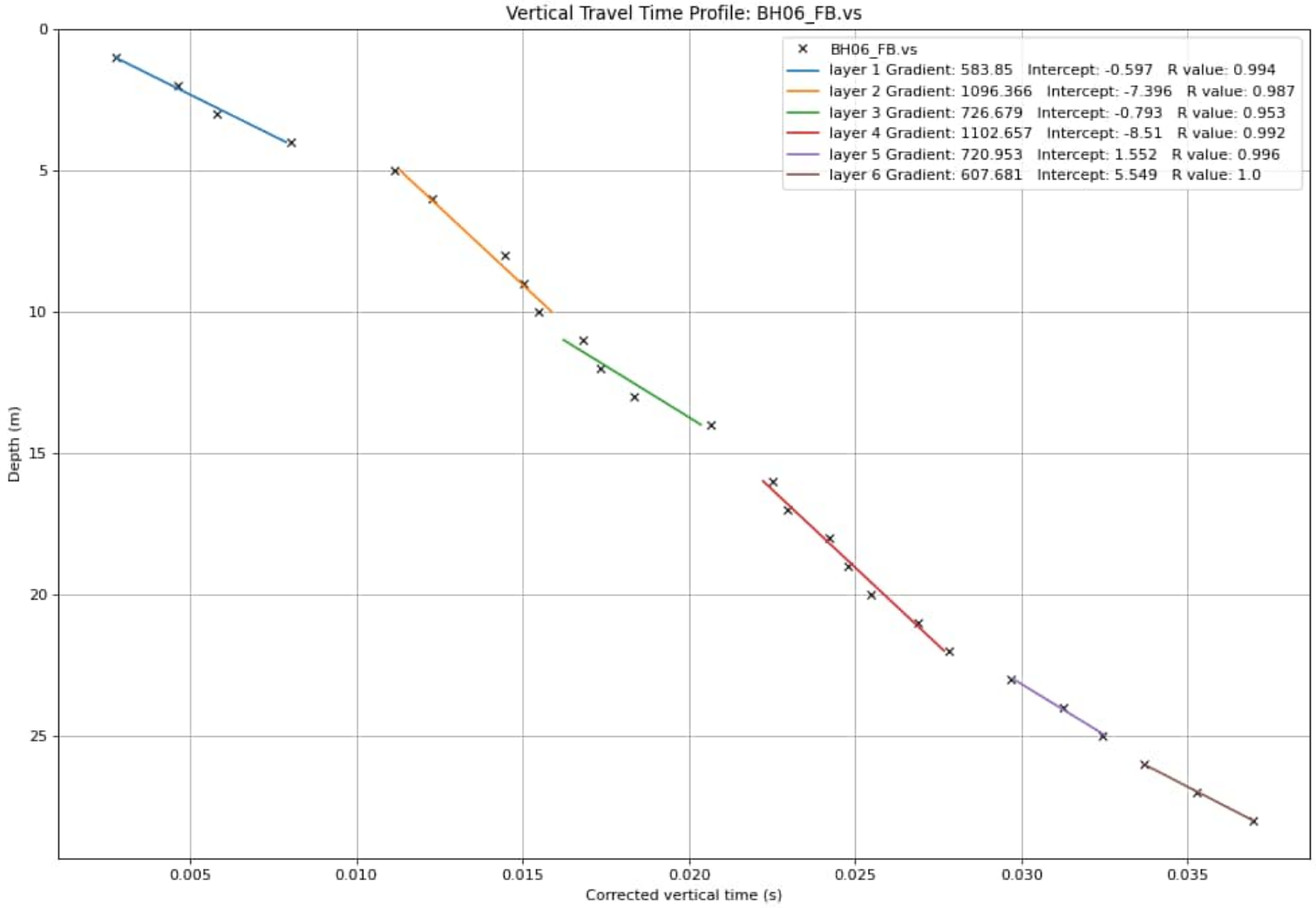

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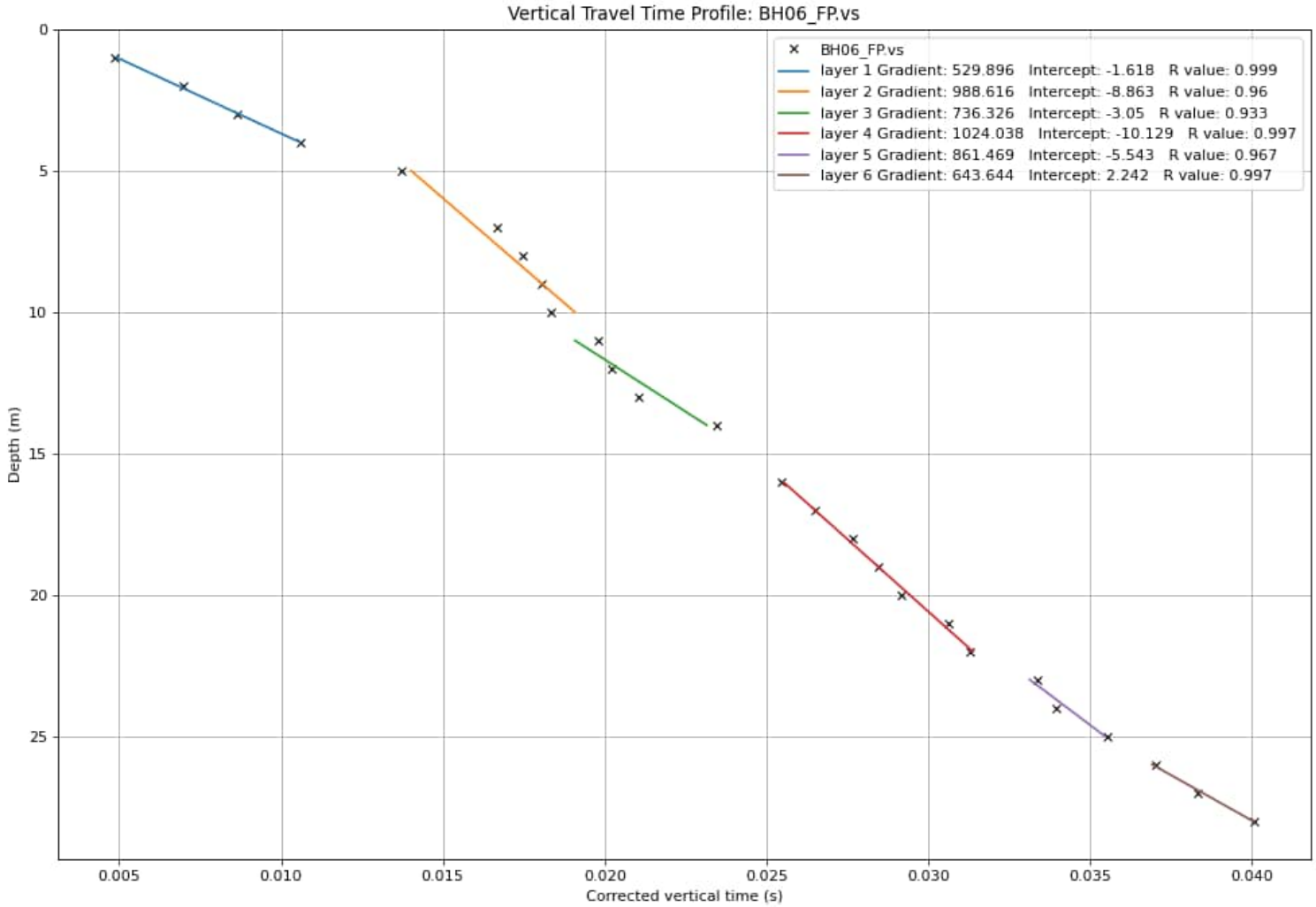

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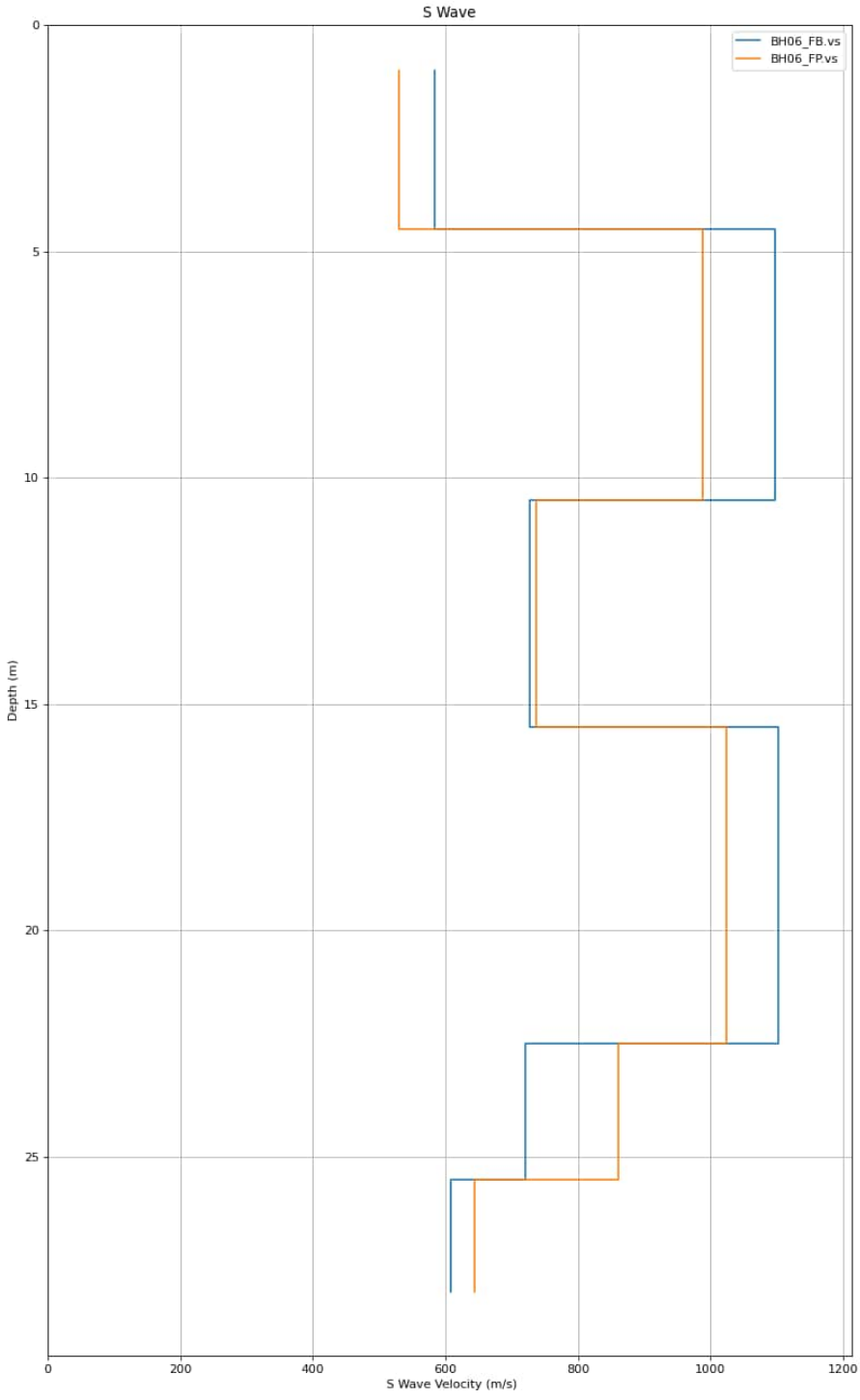

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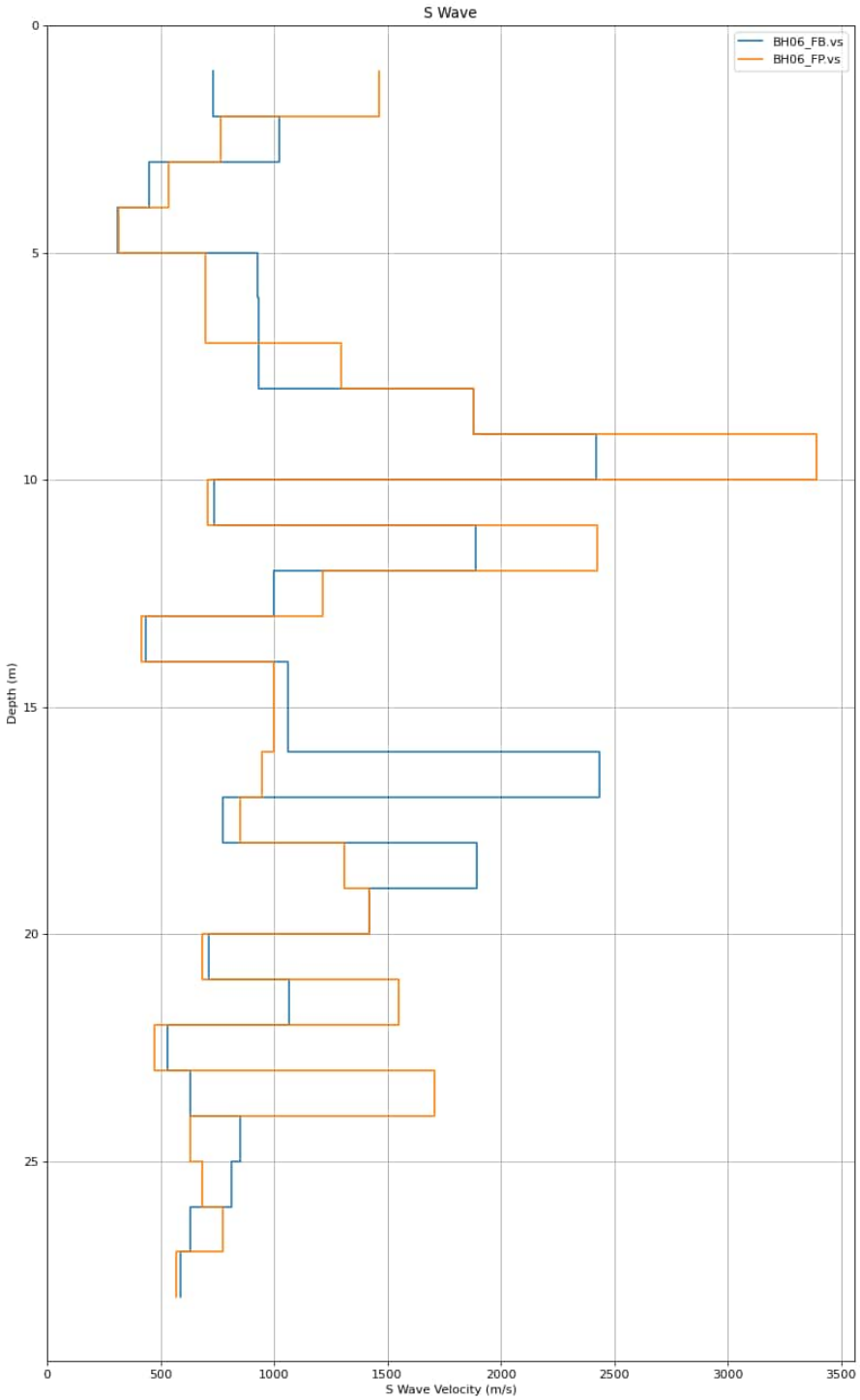

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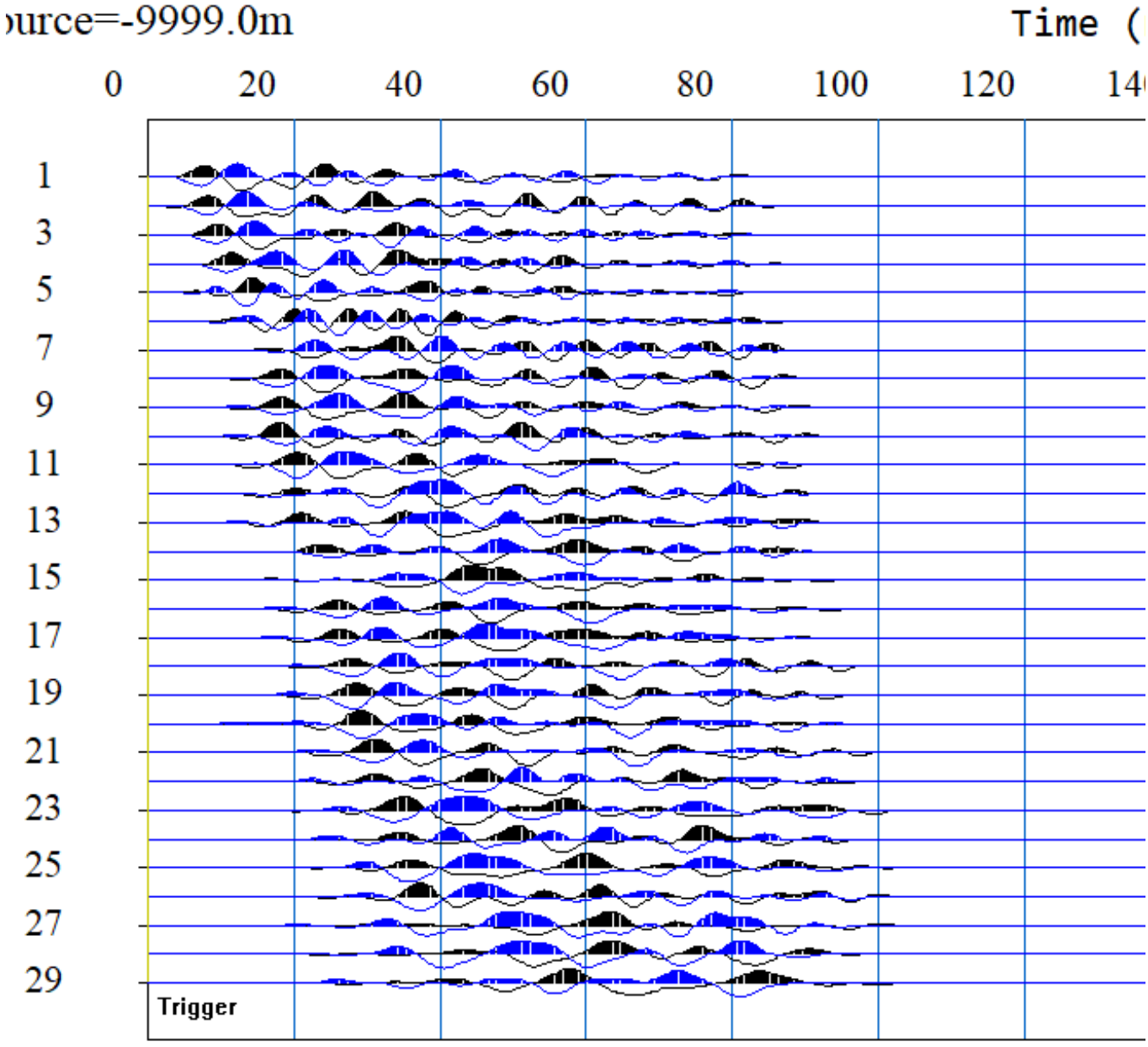

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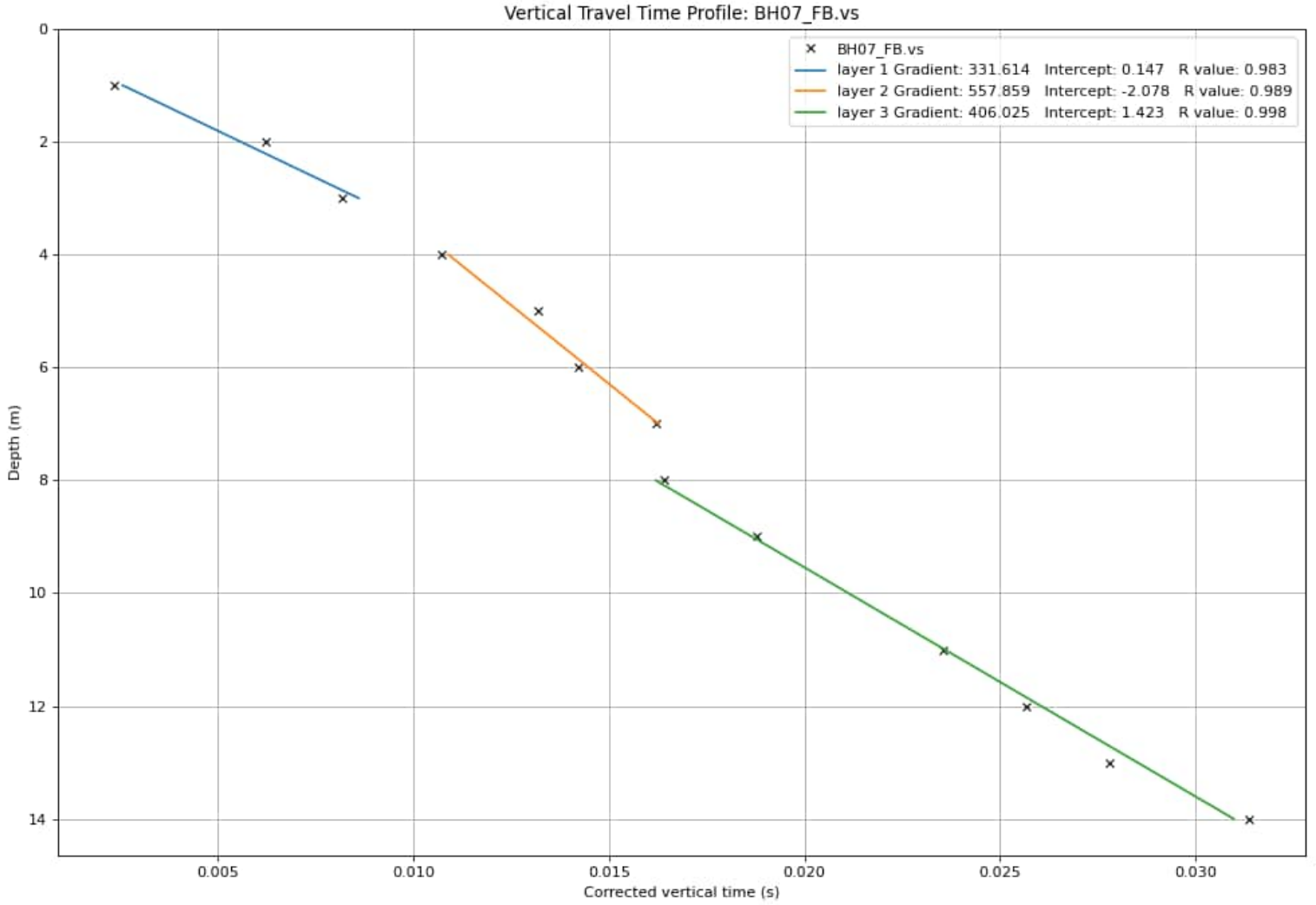

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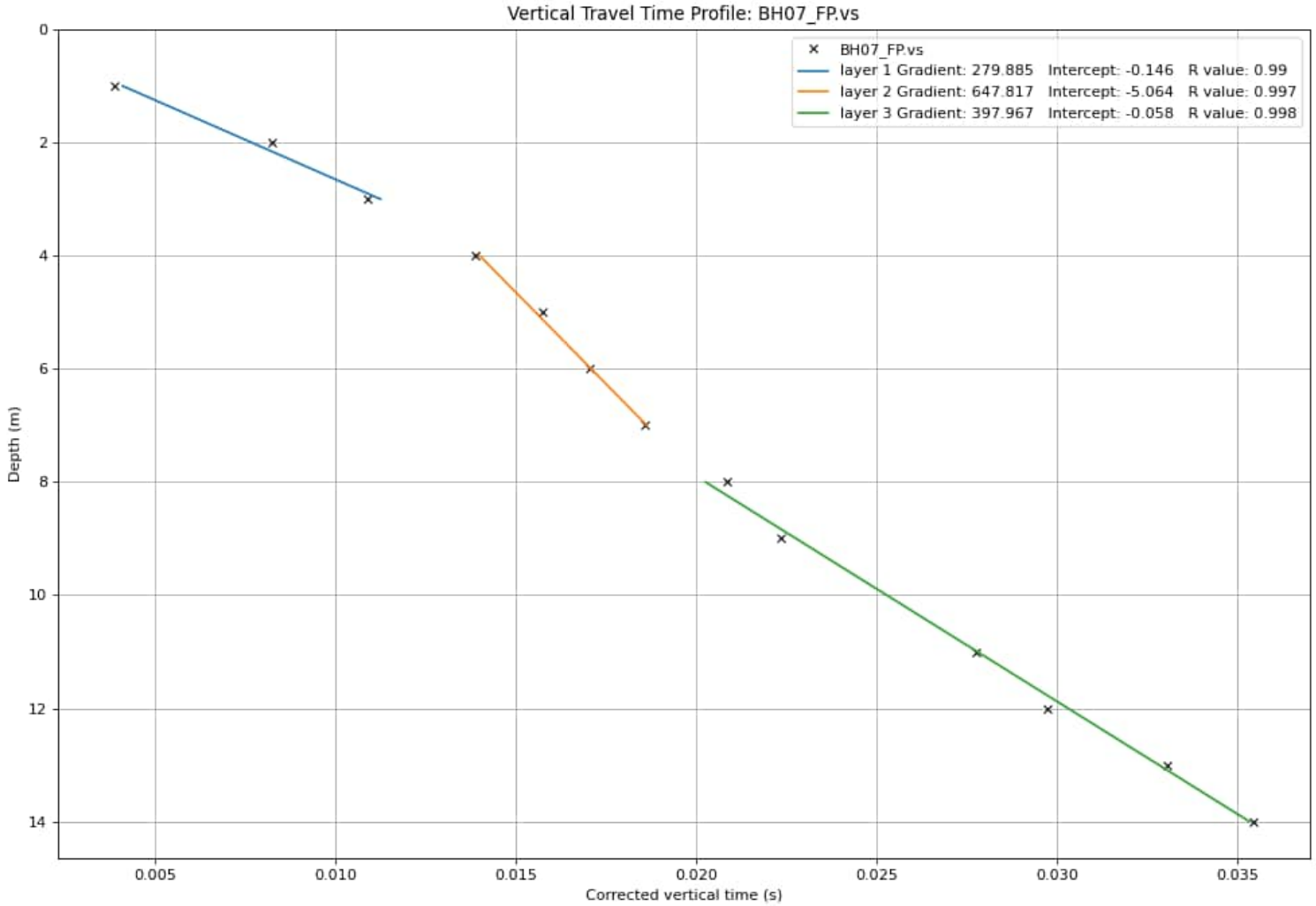

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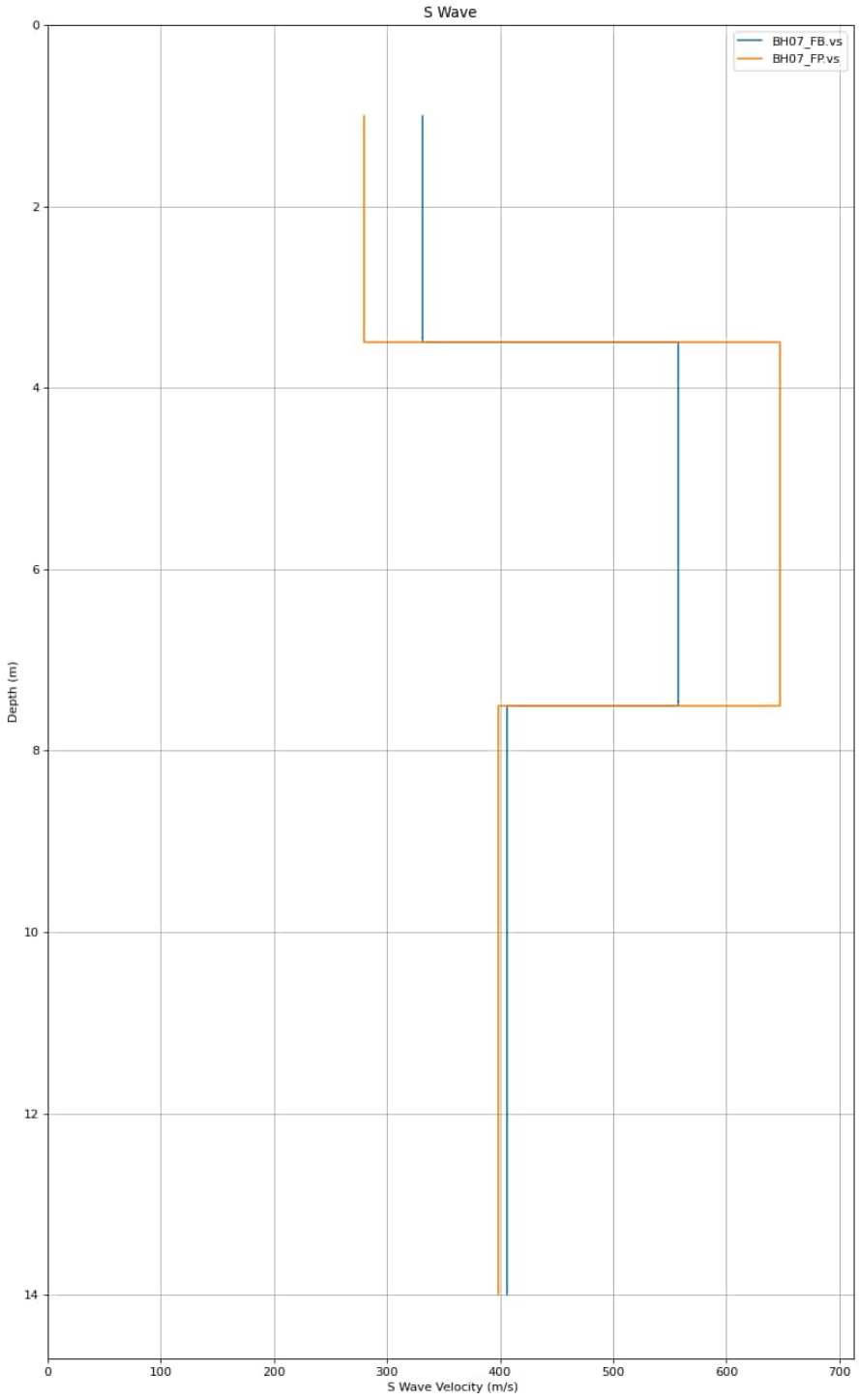

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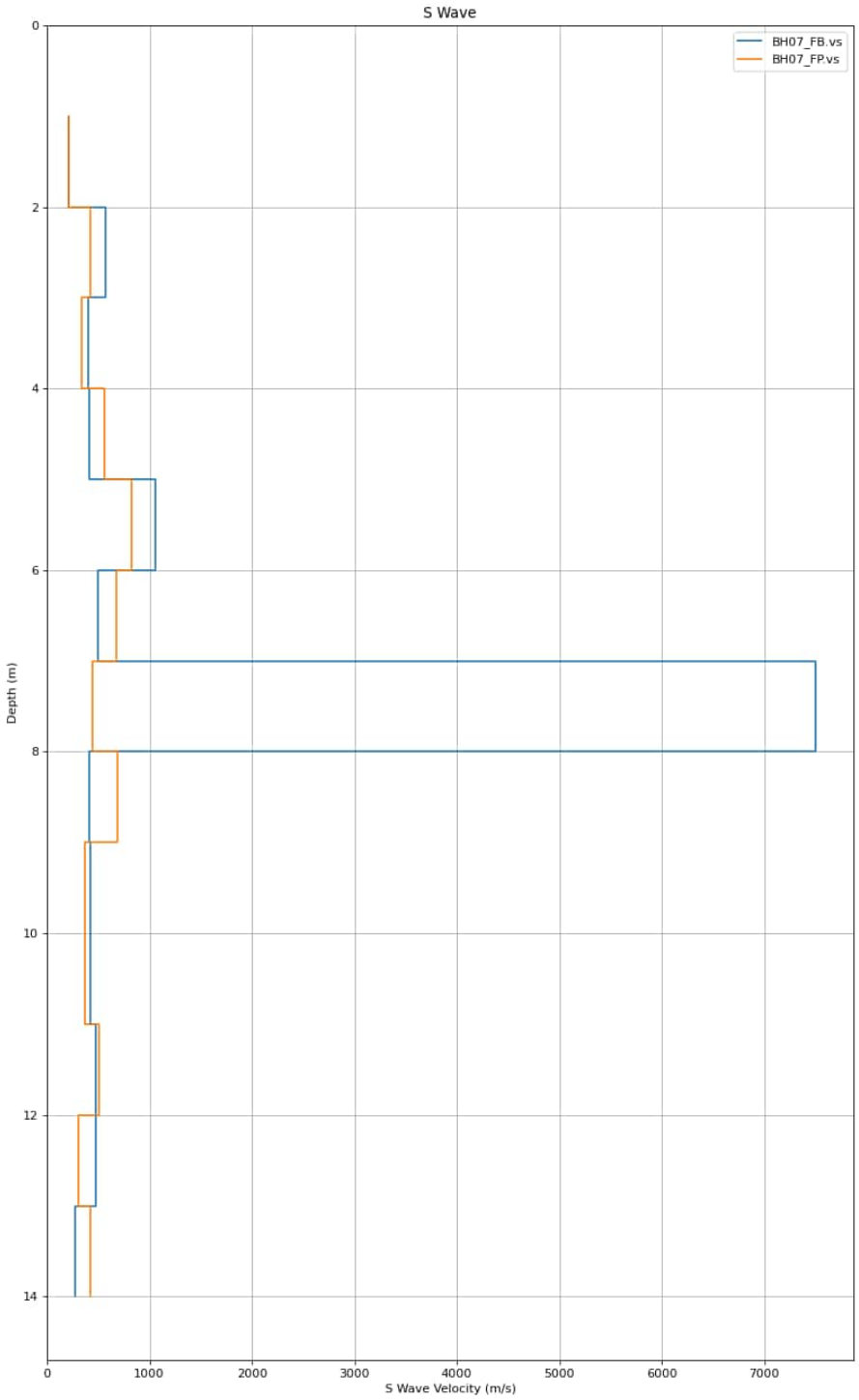

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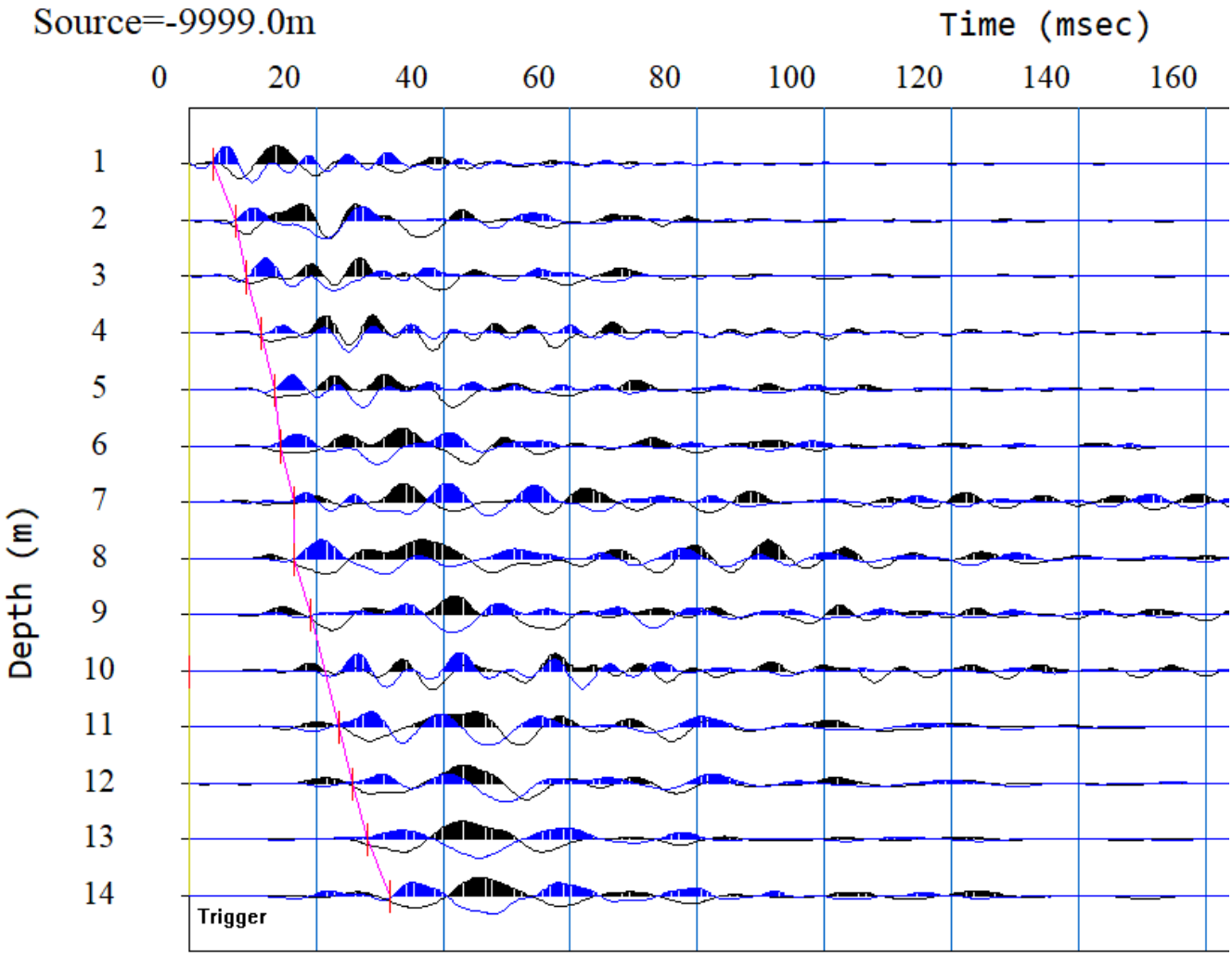

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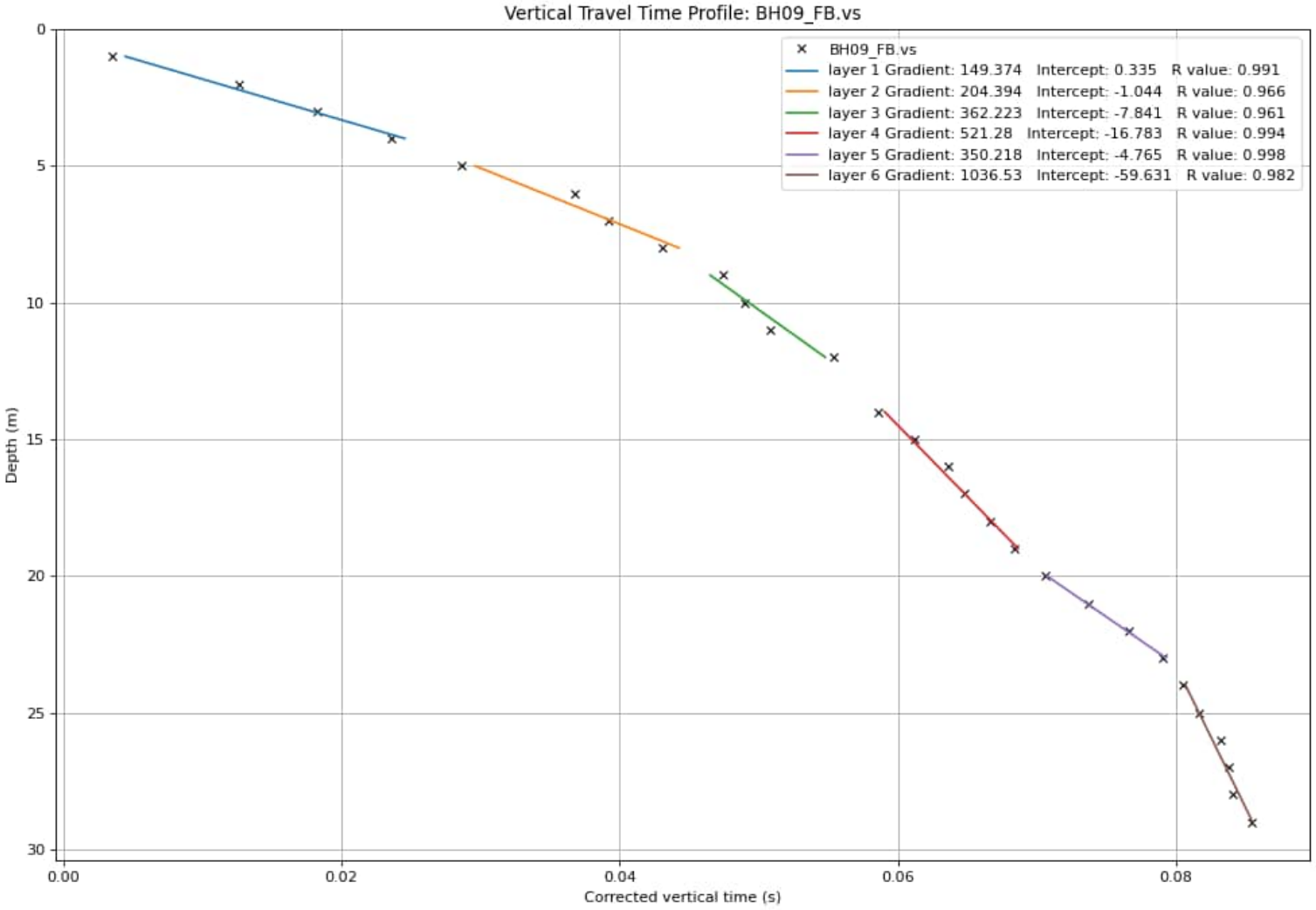

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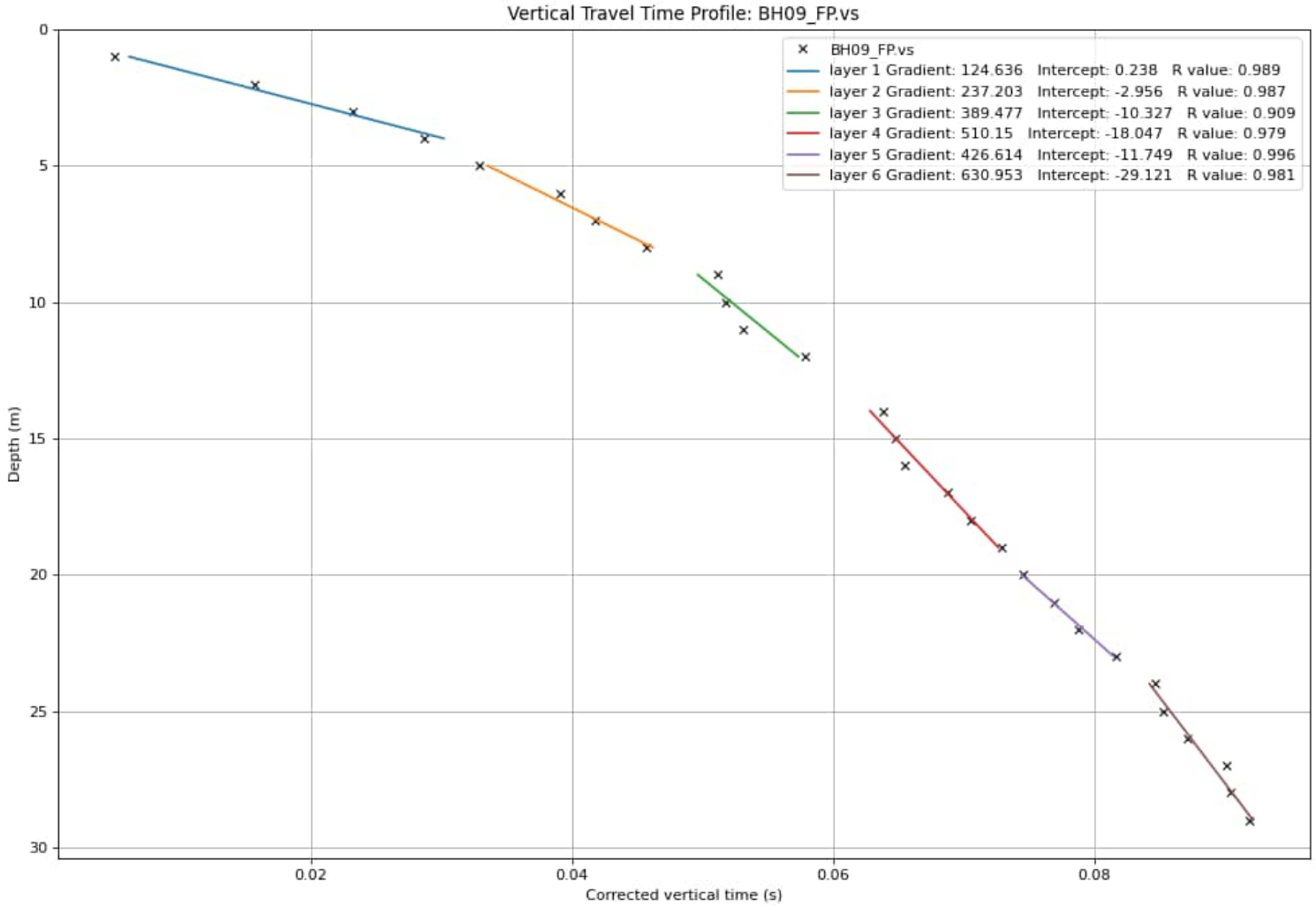

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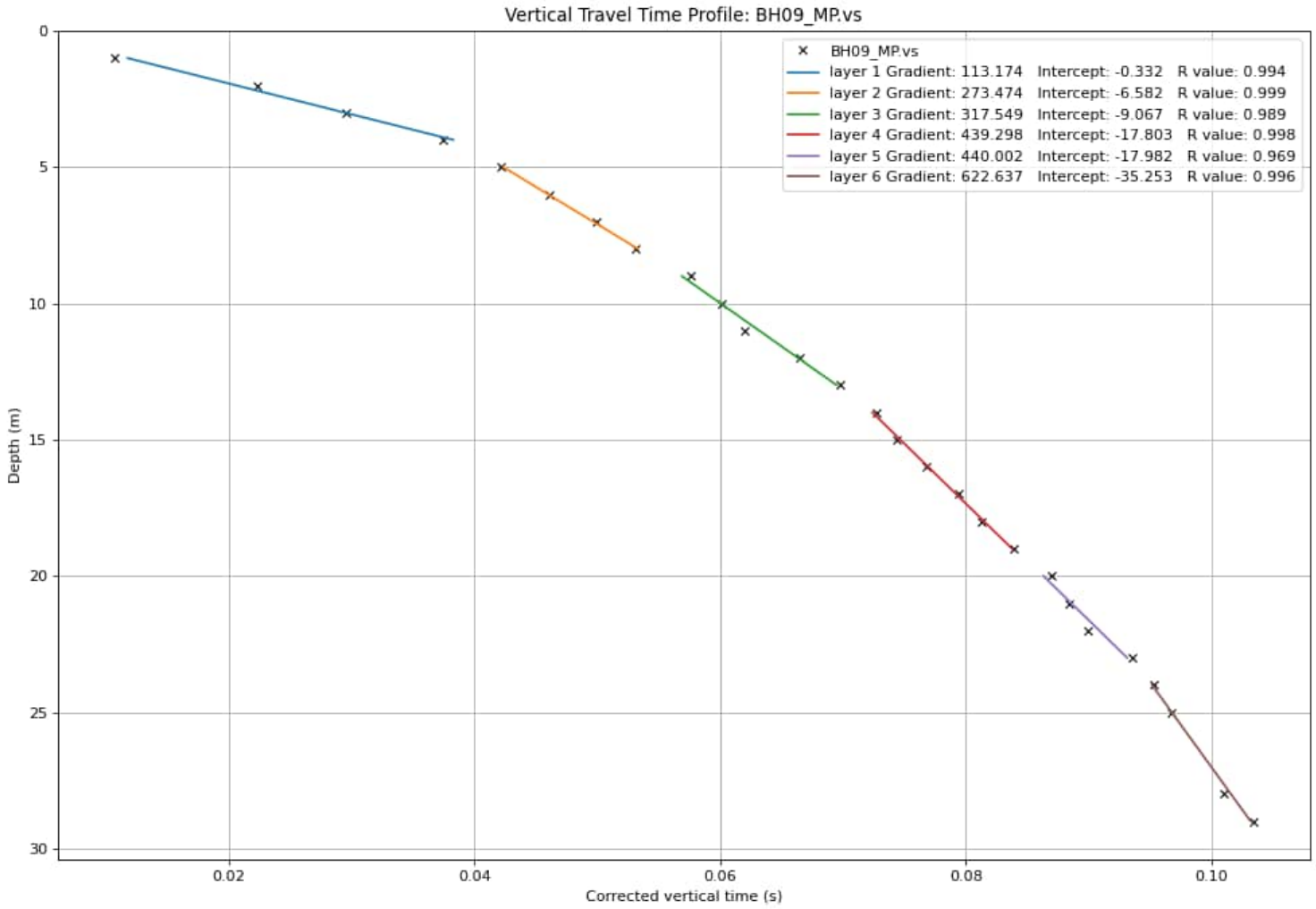

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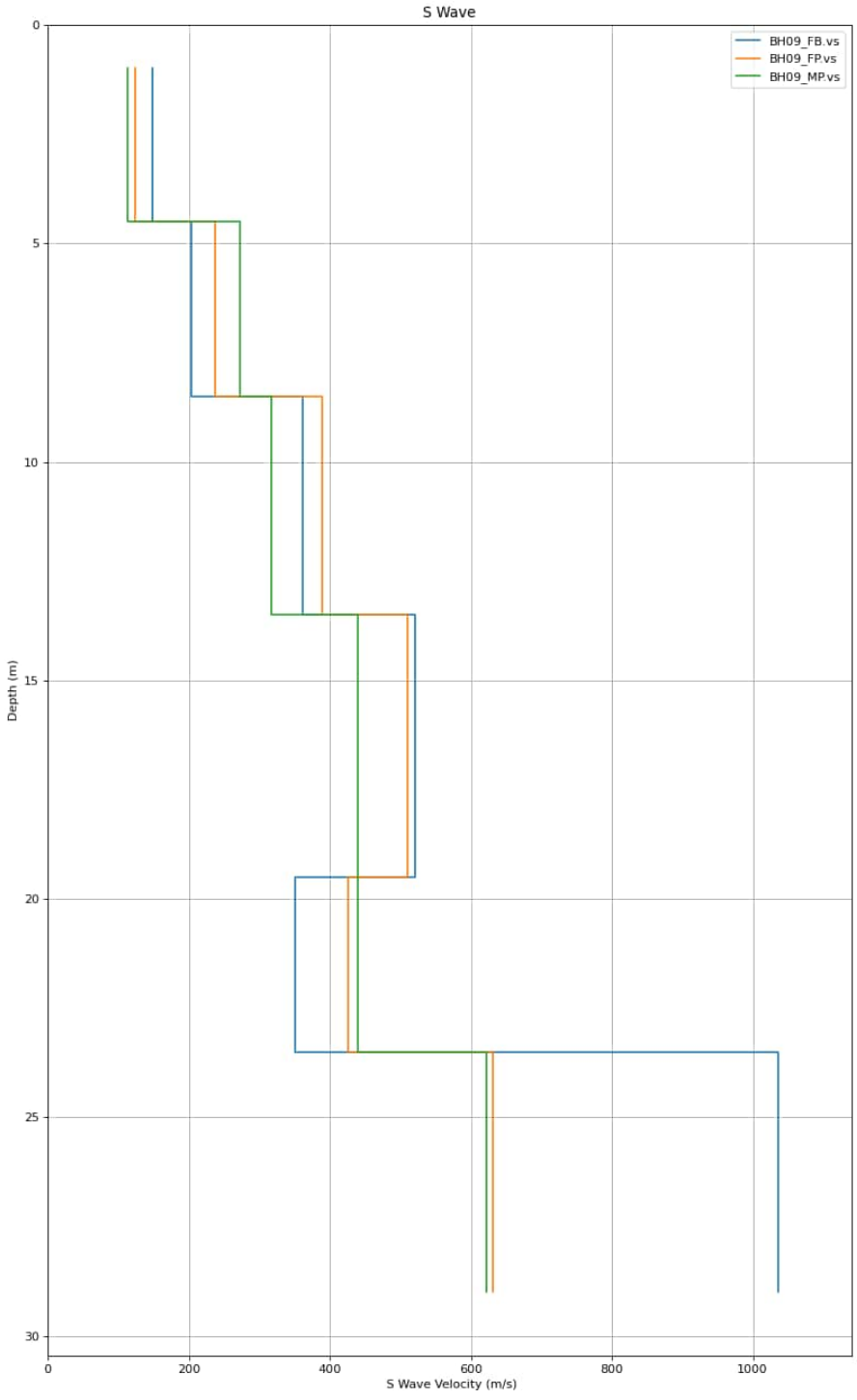

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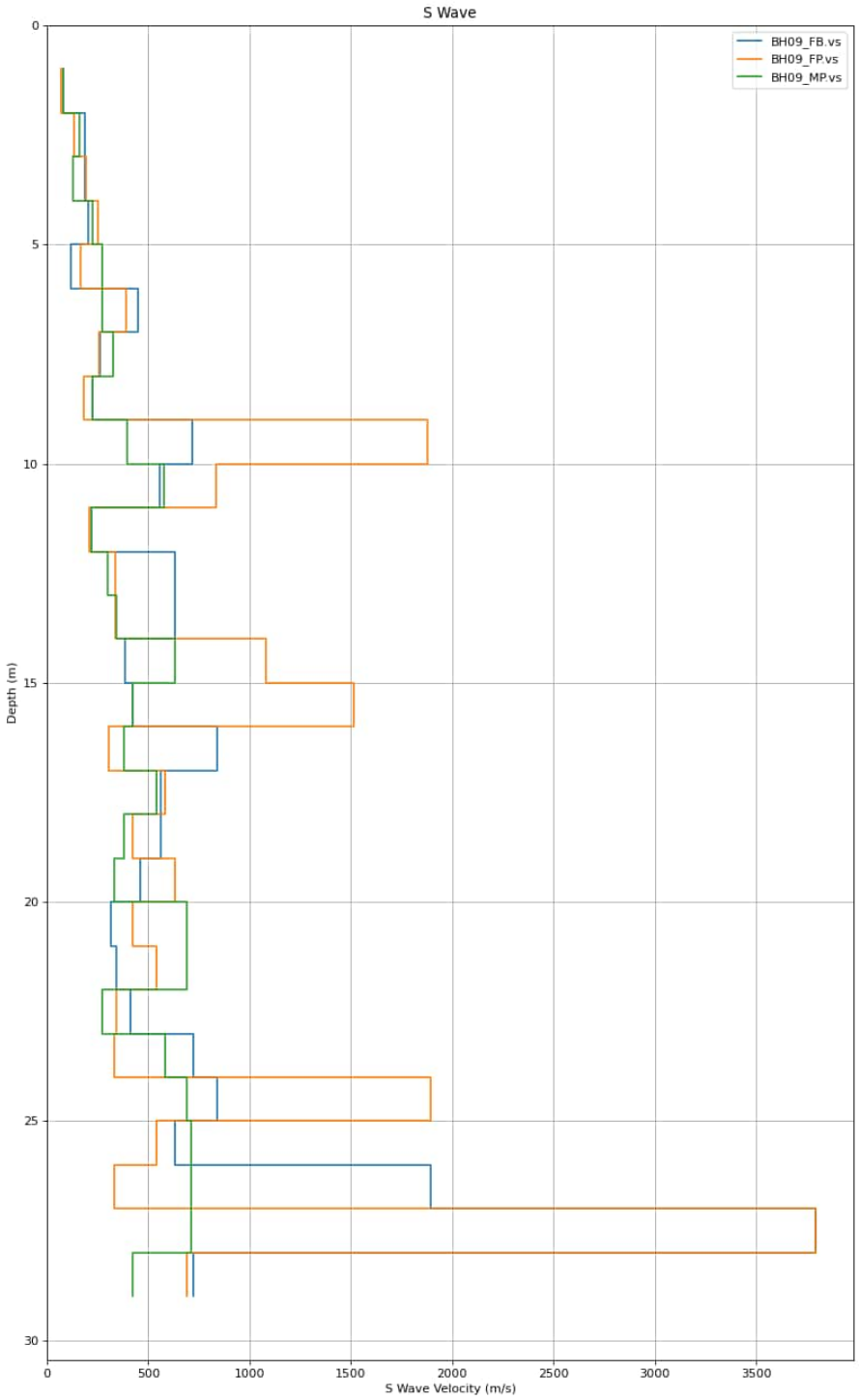

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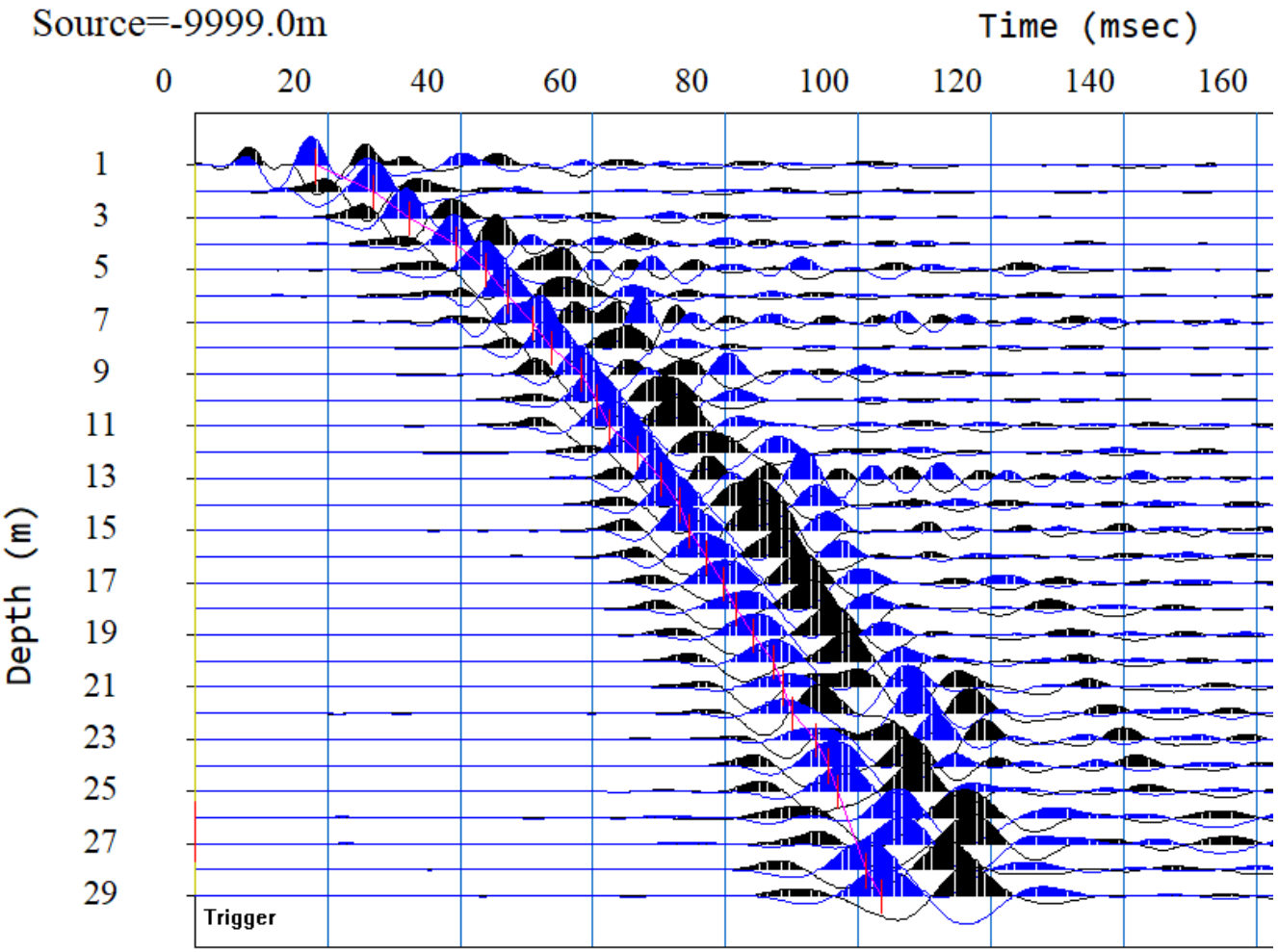

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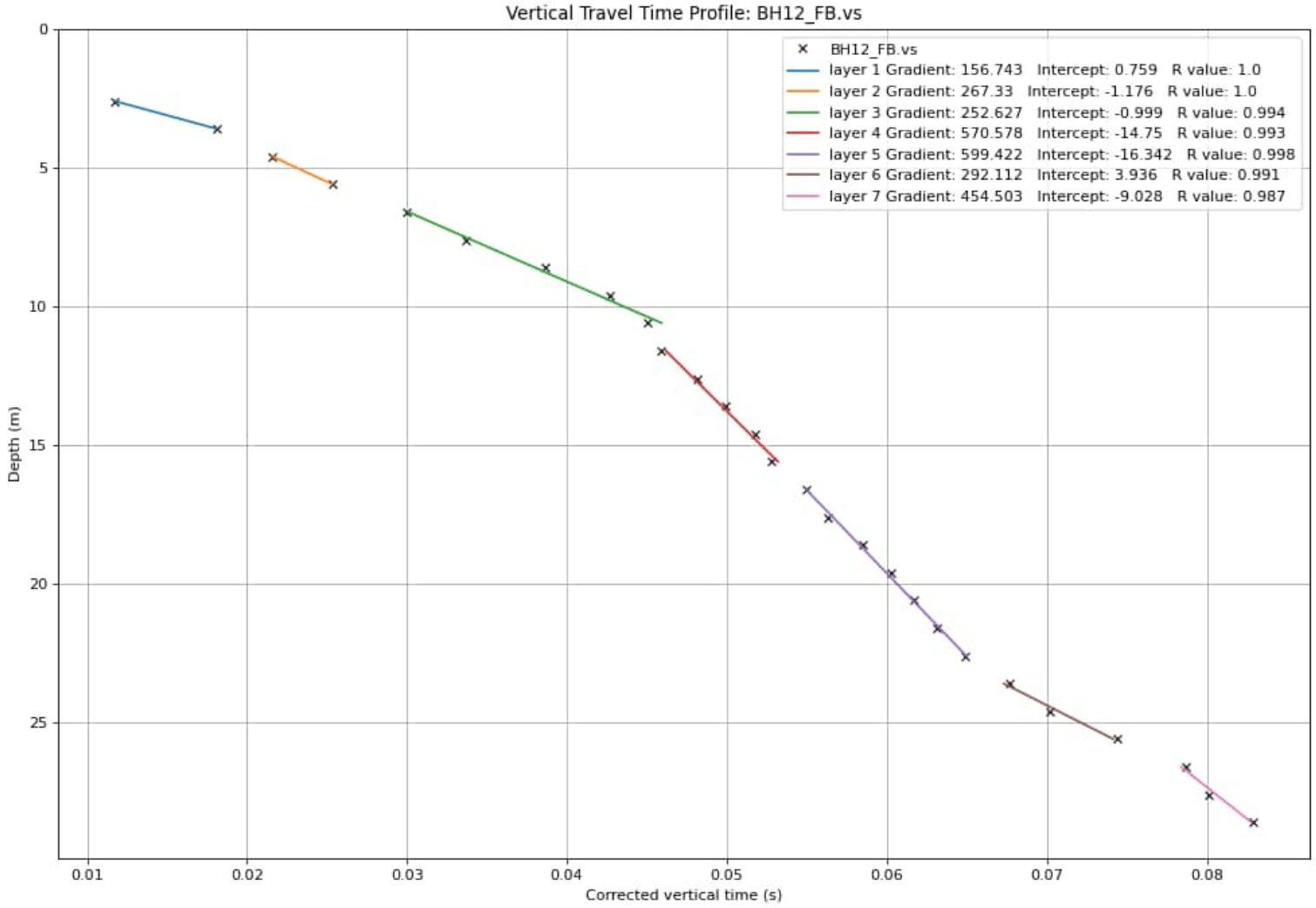

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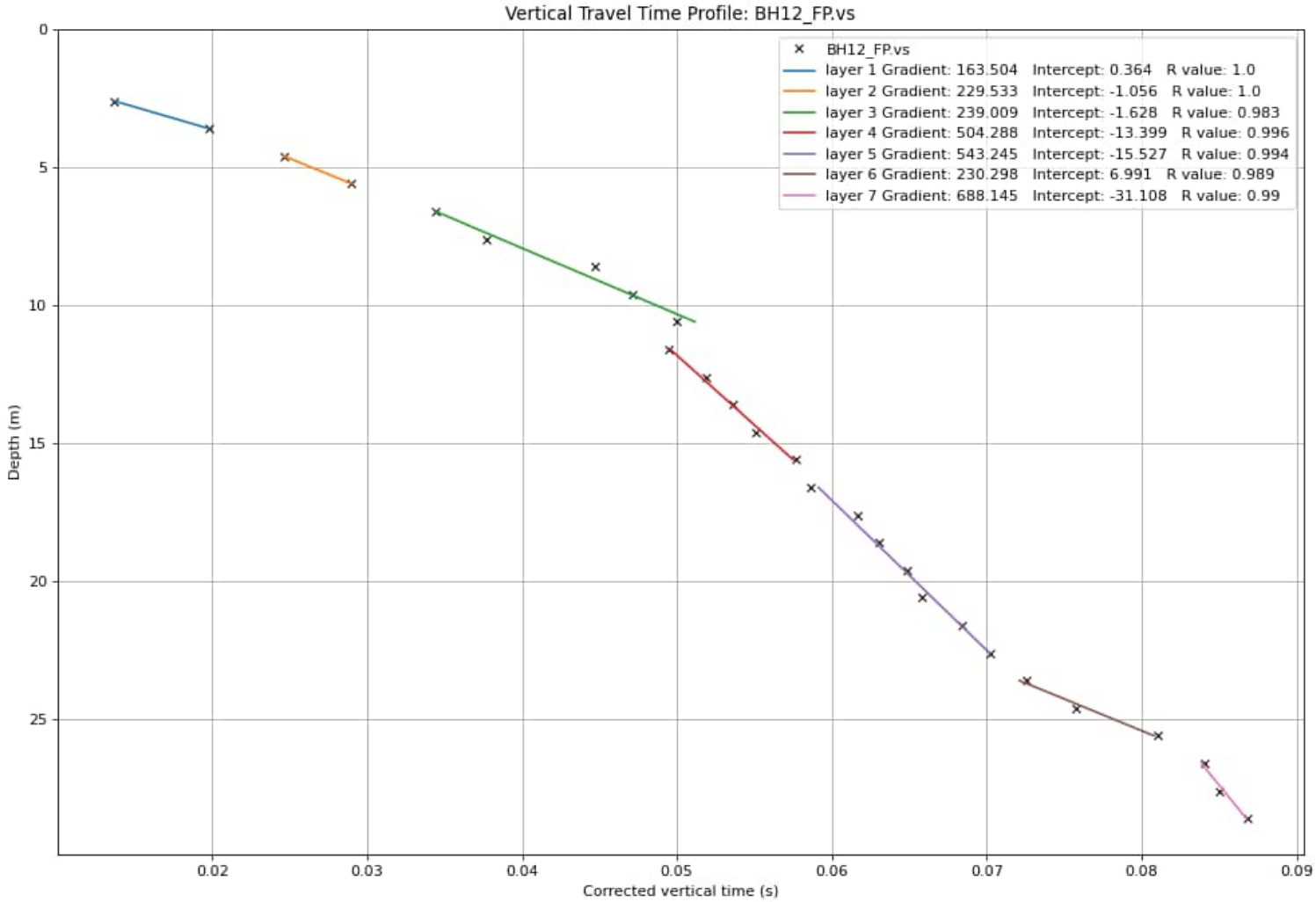

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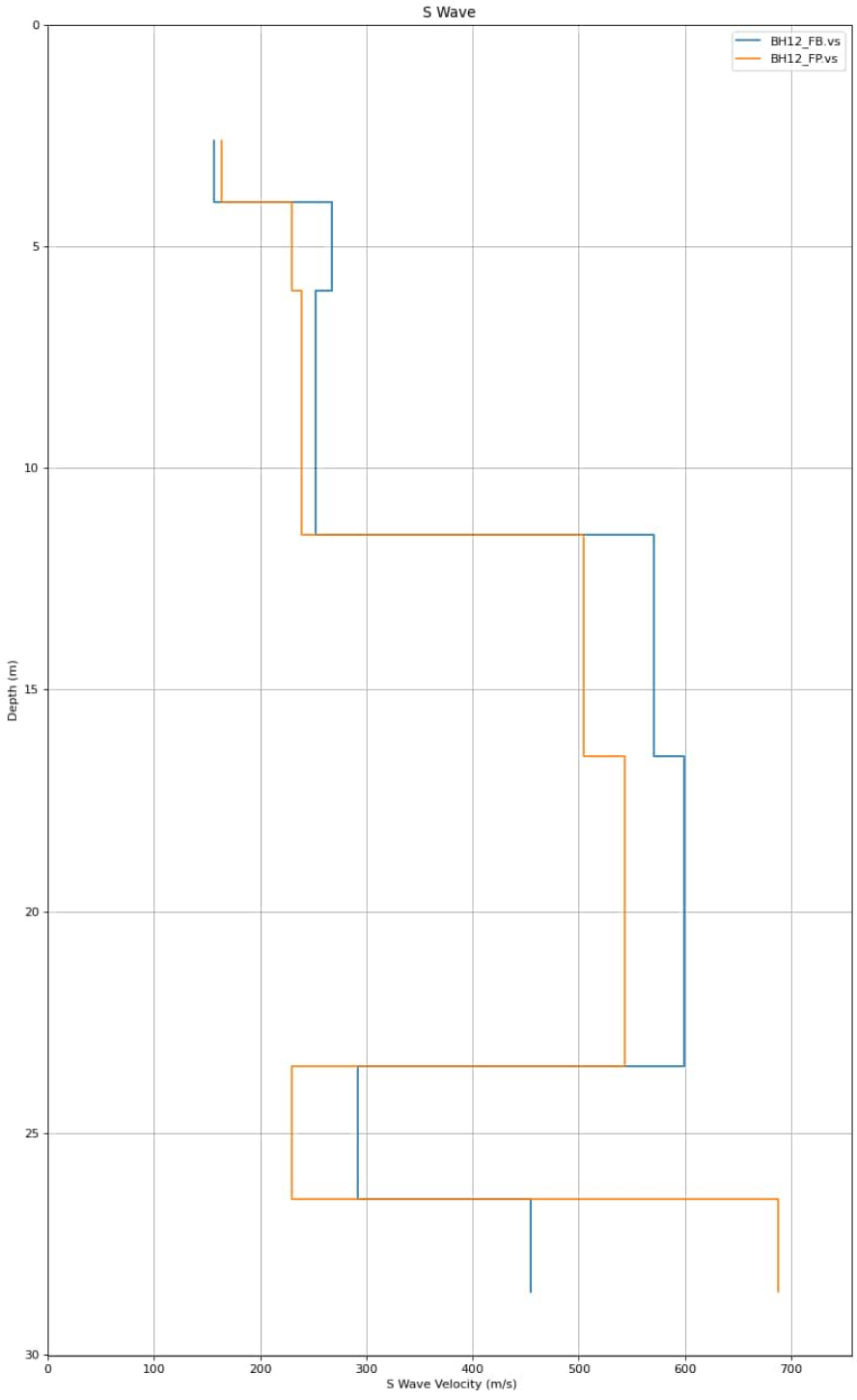

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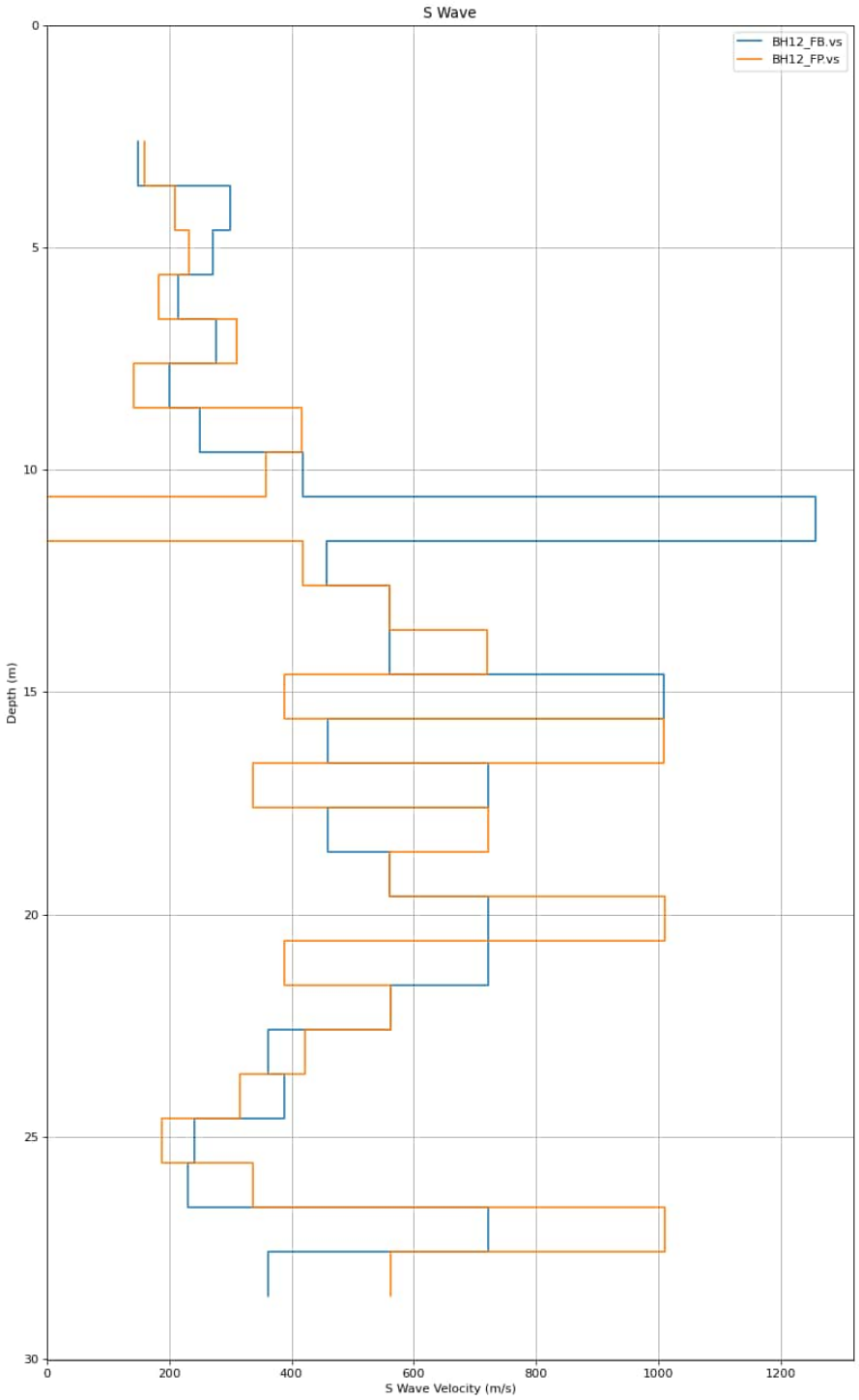

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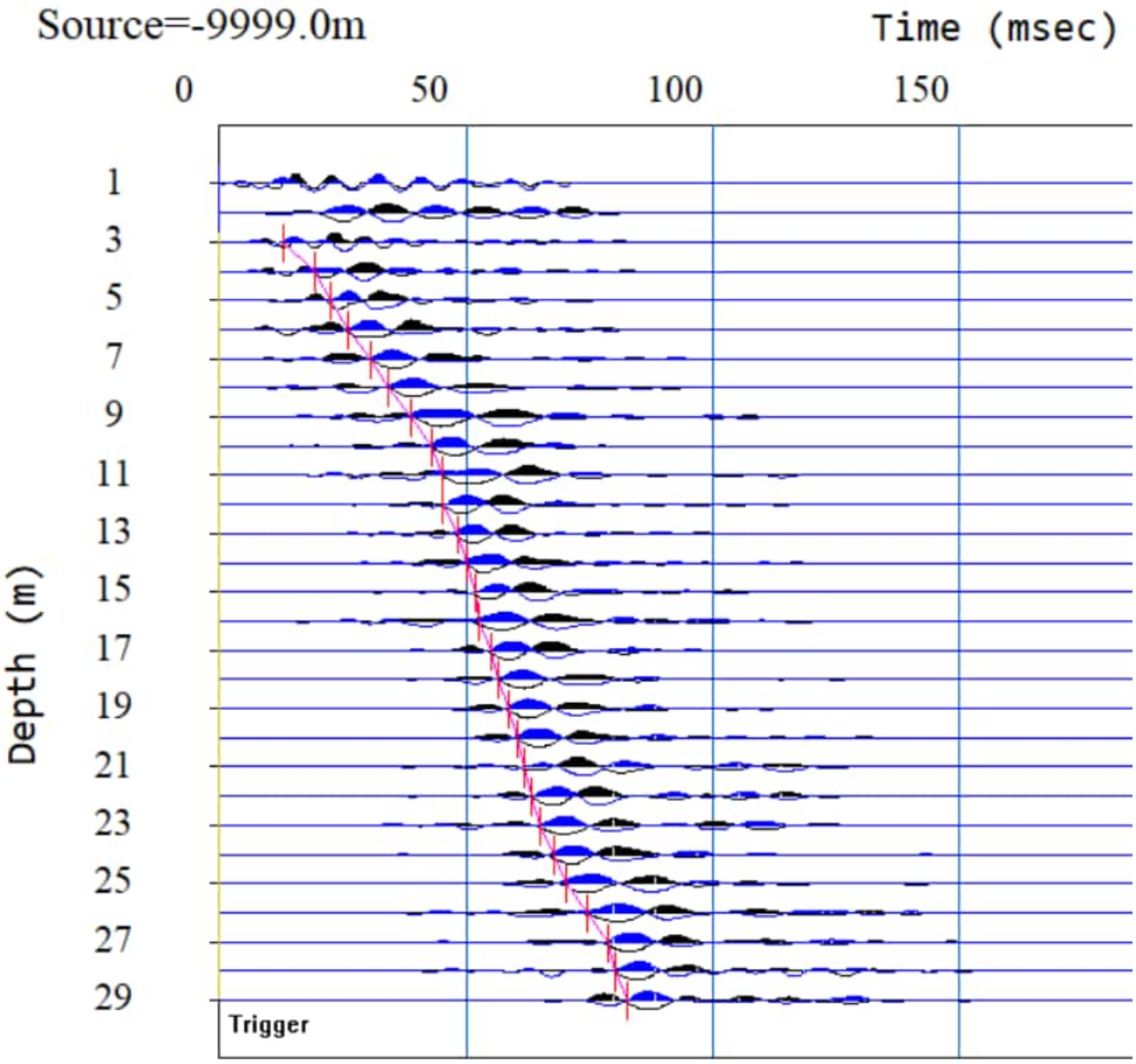

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APPENDIX A – ACQUISITION & PROCESSING METHODS

APPENDIX A CONTENTS

A1 DOWNHOLE SEISMIC SURVEY (DHS) 1

A1.1 DOWNHOLE SEISMIC ACQUISITION METHOD 1
A1.1.1 ACQUISITION SYSTEM 1
A1.1.2 SEISMIC SOURCE 2
A1.1.3 ACQUISITION PARAMETERS 2
A1.1.4 POSITIONAL CONTROL 3
A1.1.5 VERTICALITY 3
A1.1.6 QUALITY ASSURANCE 3
A1.1.7 RESOLUTION LIMITATIONS 4
A1.2 DOWNHOLE SEISMIC PROCESSING 4
A1.2.1 PHASE 1 – INITIAL PROCESSING 4
A1.2.2 PHASE 2 – ARRIVAL TIME 'PICKS' 5
A1.2.3 PHASE 3 – VELOCITY CALCULATIONS 6

A2 REFERENCES 6

A1 DOWNHOLE SEISMIC SURVEY (DHS)

Downhole seismic testing was used to provide a measurement of variations in shear wave velocity (Vs). By measuring the difference in arrival times of the waves at known depths, the seismic wave velocities can be calculated.

Identification of shear waves was achieved by using the fact that shear waves can be polarised. By striking a shear beam in opposing directions, polarised shear waves are created. Seismic traces can then be superimposed allowing the polarisation to be observed, and shear waves to be therefore distinguished from the coda ("tail") of the earlier arriving P-waves.

A1.1 DOWNHOLE SEISMIC ACQUISITION METHOD

A1.1.1 ACQUISITION SYSTEM

Acquisition of downhole seismic data was conducted using a tri-axial Geostuff BHG-5 downhole clamping geophone.

Test intervals were spaced at 1 metre intervals from surface to the bottom of the hole.

A1.1.2 Seismic Source

Shots were:

- Produced by a sledgehammer for seismic signal generation ("shots").
- Stacked (three to seven shots) to improve signal to noise ratio.
- Horizontally polarised "shear" wave shots were acquired in opposite directions by striking a shear beam weighted by a vehicle (to improve coupling). The shear beam was orientated to align with the orientation of one of the transverse components of the tri-axial geophone sensor.

A1.1.3 Acquisition Parameters

Acquisition parameters were:

- Record Length - 250 ms
- Delay - 0 ms
- Sample Interval - 0.25 ms
- Acquisition Filters - OUT
- Source Offsets - BH02: 1.42 m
  BH03: 1.1 m
  BH06: 1.2 m
  BH07: 1.2 m
  BH09: 1.35 m
  BH12: 1.35 m
- Drillhole Stickup - BH02: 0.1 m
  BH03: 0 m
  BH06: 0 m
  BH07: 0.1 m
  BH09: 0 m
  BH12: 0.4 m

A1.1.4 Positional Control

Positional control downhole was obtained using 1 m interval marks on the geophone cable. Downhole measurements were made relative to the top of the stickup during acquisition.

- Therefore, downhole positional accuracy is likely to be of the order of ±0.05 m.

Horizontal offsets to the shear beam were measured using a tape measure.

- Therefore, positional accuracy is likely to be of the order of ±0.05 m.

A1.1.5 Verticality

Drill hole verticality was assumed. A direct ray path method is used, and no travel time corrections are applied associated with variations in verticality.

A1.1.6 Quality Assurance

There are three main field-testing QC steps.

- Before data acquisition seismic channels are checked for signal to noise interference. This is used to assess poor drill hole wall coupling or external noise on site (unwanted sound). This is commonly referred to as a noise shot.
    - A noise shot is recorded at surface, to assess signal to noise ratio and to confirm electronic systems are functioning and correct timing and trigger errors.
    - A noise shot is also recorded at depth, typically at a mid-point in the drill hole. This confirms in-hole signal to noise ratio and to ensure the tool is functioning after deployment.
- Every shot interval has stacked signal shots of three to five shots per test depth. Each shot is checked for timing errors and poor coupling before being saved to the data sets. Shots were stacked in field to improve signal to noise ratios.

- Shear wave seismic shots are recorded in opposing directions to establish a polarised shear wave. Polarised shear waves reduce the chances of tube waves being confused with shear wave arrivals.

A1.1.7 Resolution Limitations

Layer velocities were defined based on changes in arrival time slopes and geological intervals detailed in drill hole logs provided to RDCL. Velocities are calculated from calculating the slope from the Tx curves (time depth). It is usually not appropriate to calculate interval velocities using just two points (over successive measurements) as large errors in velocity are likely (ASTM – D7400-08).

A1.2 Downhole Seismic Processing

Data processing consisted of:

- Phase 1 – Initial processing and data filtering.
- Phase 2 – First break picking and wave amplitude picking.
- Phase 3 – Data presentation and calculation of interval velocities.

A1.2.1 Phase 1 – Initial Processing

Raw data files were imported into an RDCL proprietary Python script. The script undertook the following generalised processes:

- Split of channels 1, 2 and 3 (data orientated in the vertical, north and east components).
- Sort into left, right and vertically polarised shots.
- Deletion of unrequired traces.
- Correct assignment of depth geometry from header.
- Merge of traces into separate gathers for left, right and vertical polarised shots.
- Bandpass filtering.

- Visual assessment of traces.

A1.2.2 Phase 2 – Arrival Time 'Picks'

Gathers were subsequently imported into the Seisimager Pickwin module software for picking.

Shear wave arrival times were manually picked by identifying waves that were polarised.

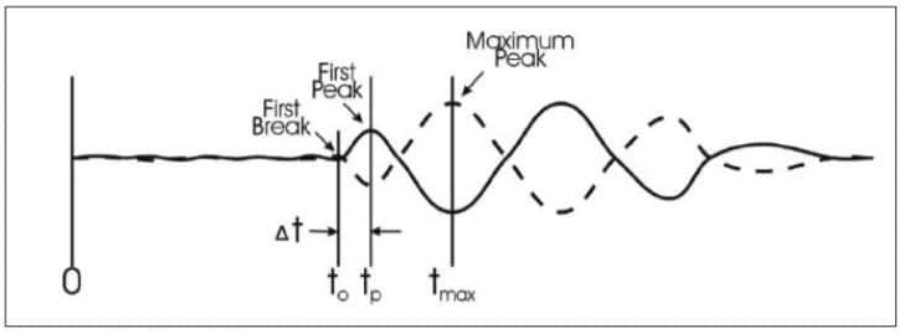
Where waves could not be reliably identified, a gap was left, and that data was not picked.

Shear wave identification may be affected by:

- Decreases in signal to noise ratio.
- Interference from tube waves.
- Disturbance by the coda of the P-wave arrivals.

In processing downhole seismic surveys RDCL usually makes picks at three separate locations on each trace (Schematic 1) and interval/layer velocities are calculated using each of these picking methods.

Schematic 1 - Shear Wave Velocity Picking



The three methods are called:

- First Break (FB)
- First Peak (FP).
- Maximum Peak (MP).

Three methods of shear wave picking are used to reduce and assess the uncertainty in the shear wave velocity interval/layer calculations.

P-wave arrivals were picked using only the "First Break" method, as there is usually minimal ambiguity when picking P-waves.

Arrival times were exported from Pickwin into Python code to create a velocity model.

A1.2.3 Phase 3 – Velocity Calculations

Arrival times were imported into an RDCL proprietary Python script for presentation and calculation of interval velocities and layer velocities. Intervals were defined from changes in slope in the arrival time data and the drill hole log provided to RDCL.

Geometric corrections were made to the travel times for shot/collar horizontal offsets and casing stick up.

A2 REFERENCES

Dunkin, J. W. (1965). Computation of modal solutions in layered, elastic media at high frequencies. Bulletin of the Seismological Society of America, 55(2), 335-358.

REPORT ON:
SURFACE GEOPHYSICAL SURVEY

PROJECT:
PORT VILA, VANUATU
GEOPHYSICS
MASW, SRT & HVSR SURVEY

CLIENT:

TONKIN + TAYLOR INTERNATIONAL

161 VICTORIA STREET
TE ARO WELLINGTON 6011,
NEW ZEALAND

250306

RDCL®

CONTENTS

EXECUTIVE SUMMARY 1

1 INTRODUCTION 2

1.1 GENERAL 2
1.2 OBJECTIVES 2
1.3 SITE WORK 2
1.4 REPORT SCOPE 3
1.5 TERMS OF REFERENCE 3

2 SURVEY PARAMETERS 4

2.1 MULTI-CHANNEL ANALYSIS OF SURFACE WAVES (MASW) 4
2.2 SURVEY RATIONALE - MASW 5
2.3 SEISMIC REFRACTION TOMOGRAPHY (SRT) 5
2.4 SURVEY RATIONALE - SRT 6
2.5 HORIZONTAL TO VERTICAL SPECTRAL RATIOS (HVSR) 6
2.6 SURVEY RATIONALE - HVSR 7

3 SURVEY METHODOLOGIES 8

4 MASW RESULTS 9

4.1 DATA PRESENTATION 9
4.2 PROFILE PARAMETERS 9

5 SRT RESULTS 10

5.1 DATA PRESENTATION 10
5.2 PROFILE PARAMETERS 10

6 HVSR RESULTS 11

6.1 DATA PRESENTATION 11
6.2 HVSR RESULTS 11

7 OBSERVATIONS AND INTERPRETATIONS 12

7.1 MASW LINE 01A 12
7.2 MASW LINE 01B 12
7.3 MASW LINE 01C 13
7.4 MASW LINE 02 13
7.5 MASW LINE 03 14
7.6 MASW LINE 04 14
7.7 MASW LINE 05A 15
7.8 MASW LINE 05B 15
7.9 MASW LINE 05C 16
7.10 MASW LINE 06A 16
7.11 MASW LINE 06B 17
7.12 MASW LINE 06C 17
7.13 MASW LINE 07A 17
7.14 MASW LINE 07B 18
7.15 MASW LINE 08 18
7.16 MASW LINE 09 19
7.17 MASW LINE 10A 19
7.18 MASW LINE 10B 20

7.19 MASW Line 11A 20
7.20 MASW Line 11B 21
7.21 MASW Line 11C 21
7.22 MASW Line 12 21
7.23 MASW Line 13 22
7.24 MASW Line 14 22
7.25 MASW Line 15 23
7.26 MASW Line 16 23
7.27 MASW Line 17 24
7.28 MASW Line 18A 24
7.29 MASW Line 18B 25
7.30 SRT Line 01A 25
7.31 SRT Line 01B 26
7.32 SRT Line 02 26
7.33 SRT Line 03 27
7.34 3D Representations 27
7.35 Raw Data 27
7.36 Vs sounding outputs 27
8 REFERENCES 27
9 LIMITATIONS 28
10 CLOSURE 29

TABLES

Table 1 - MASW Line Parameters 4
Table 2 - SRT Line Parameters 6
Table 3 - HVSR test locations 7
Table 4 - Quasi-2D MASW profile parameters 9
Table 5 - SRT profile parameters 10
Table 6 - HVSR results 11

FIGURES

Figure 01 - HVSR & DHS Test locations
Figure 02 - MASW CBD Test locations
Figure 03 - MASW CBD North Test locations
Figure 04 - MASW East Line Locations
Figure 05 - MASW Line 15 Location
Figure 06 - SRT Locations
Figure 07 - MASW Line 01A
Figure 08 - MASW Line 01B
Figure 09 - MASW Line 01C

FIGURE 10 - MASW LINE 02
FIGURE 11 - MASW LINE 03
FIGURE 12 - MASW LINE 04
FIGURE 13 - MASW LINE 05A
FIGURE 14 - MASW LINE 05B
FIGURE 15 - MASW LINE 05C
FIGURE 16 - MASW LINE 06A
FIGURE 17 - MASW LINE 06B
FIGURE 18 - MASW LINE 06C
FIGURE 19 - MASW LINE 07A
FIGURE 20 - MASW LINE 07B
FIGURE 21 - MASW LINE 08
FIGURE 22 - MASW LINE 09
FIGURE 23 - MASW LINE 10A
FIGURE 24 - MASW LINE 10B
FIGURE 25 - MASW LINE 11A
FIGURE 26 - MASW LINE 11B
FIGURE 27 - MASW LINE 11C
FIGURE 28 - MASW LINE 12
FIGURE 29 - MASW LINE 13
FIGURE 30 - MASW LINE 14
FIGURE 31 - MASW LINE 15
FIGURE 32 - MASW LINE 16
FIGURE 33 - MASW LINE 17
FIGURE 34 - MASW LINE 18A
FIGURE 35 - MASW LINE 18B
FIGURE 36 - SRT LINE 01A
FIGURE 37 - SRT LINE 01B
FIGURE 38 - SRT LINE 02
FIGURE 39 - SRT LINE 03
FIGURE 40 - HVSR01
FIGURE 41 - HVSR02
FIGURE 42 - HVSR03
FIGURE 43 - HVSR04
FIGURE 44 - HVSR05
FIGURE 45 - HVSR06
FIGURE 46 - HVSR07
FIGURE 47 - HVSR08
FIGURE 48 - HVSR09
FIGURE 49 - HVSR10
FIGURE 50 - HVSR11
FIGURE 51 - HVSR12

APPENDICES

APPENDIX A – METHODOLOGIES
APPENDIX B – DISPERSION CURVES
APPENDIX C– LEAPFROG OUTPUTS
APPENDIX D – RAW DATA
APPENDIX E – VS SOUNDING OUTPUTS

EXECUTIVE SUMMARY

Tonkin + Taylor International (the Client) engaged Resource Development Consultants Ltd (RDCL) to undertake a surface geophysical investigation in Port Vila, Efate Island, Vanuatu, to support a broader ground investigation programme associated with redevelopment works.

The survey comprised Multi-channel Analysis of Surface Waves (MASW), Seismic Refraction Tomography (SRT), and Horizontal-to-Vertical Spectral Ratio (HVSR) testing, undertaken between 10 February and 5 March 2026.

A total of 29 MASW lines and soundings, four SRT lines, and twelve HVSR soundings were acquired. MASW results indicate near-surface shear wave velocities typically ranging between approximately 200 m/s and 600 m/s, with higher velocities (>800–1000 m/s) encountered at depth and in elevated inland areas. Lower velocities are generally associated with coastal and low-lying areas, suggesting softer or more unconsolidated materials.

SRT results show compressional wave velocities ranging from approximately 800 m/s near surface to greater than 4000–5000 m/s at depth, generally increasing with depth. Some SRT profiles display relatively homogeneous velocity distributions, which are locally inconsistent with MASW results and may reflect limitations in data quality or method sensitivity.

HVSR testing identified fundamental site frequencies (f_0) ranging from approximately 3.98 Hz to over 30 Hz, indicating variable subsurface conditions and suggesting spatial variability in sediment thickness and stiffness across the site.

Overall, the results indicate a heterogeneous subsurface, with softer near-surface materials in coastal and low-lying areas transitioning to stiffer materials or rock at depth and at higher elevations. These findings provide a valuable geophysical framework to support geotechnical interpretation; however, results should be considered alongside intrusive investigations due to the inherent limitations and non-uniqueness of geophysical methods.

1 INTRODUCTION

1.1 GENERAL

Tonkin + Taylor International (T+TI , the Client) engaged Resource Development Consultants Ltd (RDCL) to undertake a geophysical investigation in Port Vila, Efate Island, Vanuatu. The purpose of the survey was to support T+TI's ground investigation that was part of the Port Vila redevelopment project.

1.2 OBJECTIVES

The objectives of this survey were to acquire:

- 6 (six) Downhole Seismic (DHS) test to 30 m bgl (reported separately).
- Undertake 10 (ten) night shifts of Multi-channel Analysis of Surface Waves (MASW) testing along roads. The tests would use a 46 m (2 m spaced) landstreamer with a theoretical survey depth of ~23 m.
- Undertake 2 (two) night shifts of Seismic Refraction Tomography (SRT).
- Undertake (four) night shifts of Horizontal to Vertical Spectral Ration (HVSR) tests.

These overall objectives translate into the following specific survey objectives:

- Produce in hole shear wave velocity (Vs) measurements from the downhole seismic measurements.
- Produce 2D sections and 1D soundings (depending on line length) of unconstrained shear wave velocity (Vs) models from the MASW testing.
- Produce 2D sections of compressional wave velocity (Vp) models from the SRT testing.
- Produce H/V plots and calculate f_0 from the HVSR testing.

1.3 SITE WORK

The geophysical surveys were carried out between the 10th of February and the 5th of March 2026 (excluding mobilisation and demobilisation).

1.4 Report Scope

This geophysical report details the MASW, SRT and HVSR surveys undertaken as part of this survey. The downhole seismic survey has been reported separately.

1.5 Terms of Reference

This investigation employed seismic geophysical methods. Most of the findings presented here are the result of the measurement and interpretation of electrical signals. As such any results derived from the geophysical investigation should be taken in the context of and in reference to the complete ground investigation. Reasonable skill and care were taken to ensure that the results are accurate and reliable, including reference where appropriate to published data from this and/or other sites. As with other indirect methods there is a possibility of localised inconsistencies and inaccuracies within the results.

2 SURVEY PARAMETERS

2.1 MULTI-CHANNEL ANALYSIS OF SURFACE WAVES (MASW)

The MASW survey consisted of 29 lines or soundings and was acquired with a towed landstreamer with twenty-four geophones spaced at 2 m.

Where lines were not long enough to generate a quasi-2D Vs section soundings were undertaken. This was due to obstructions (such as roads) or extreme bends in the road where the array could not be positioned in a straight line.

MASW Line locations are plotted on Figures 02, 03, 04 & 05. Parameters are given in Table 1 below.

TABLE 1 - MASW LINE PARAMETERS

			Start Location		End Location		
Line ID	Length (m)	Approx. Orientation	Easting (m)	Northing (m)	Easting (m)	Northing (m)	Type
01a	380	SE-NW	215107.1	8036526	214939.8	8036880	Quasi-2D
01b	48	SE-NW	214889	8036912	214870.3	8036959	Sounding
01c	48	SE-NW	214851.3	8036978	214841.8	8037001	Sounding
2	270	SE-NW	215155.5	8036619	215020.5	8036857	Quasi-2D
3	680	NW-SE	214860.3	8037051	215200.7	8036477	Quasi-2D
4	470	SE-NW	215243.5	8036642	215015	8037080	Quasi-2D
05a	48	W-E	215020.1	8036765	215061	8036793	Sounding
05b	48	W-E	215088.1	8036834	215133.2	8036856	Sounding
05c	48	W-E	215152.8	8036863	215186.4	8036900	Sounding
06a	48	W-E	215060.7	8036699	215102.8	8036726	Sounding
06b	48	W-E	215194.9	8036773	215147.7	8036756	Sounding
06c	48	W-E	215246.8	8036789	215223.3	8036780	Sounding
07a	48	W-E	215085	8036599	215135.9	8036614	Sounding
07b	90	W-E	215148.7	8036601	215268.7	8036631	Quasi-2D
8	48	W-E	215132.8	8036480	215197.8	8036497	Sounding
9	510	N-S	215188.2	8036518	215178.9	8036001	Quasi-2D
10a	48	W-E	214924.2	8036890	214979.6	8036941	Sounding
10b	48	W-E	215011.7	8036941	215056.3	8036963	Sounding
11a	60	E-W	215855	8036839	215791.1	8036879	Quasi-2D
11b	210	S-N	215714.9	8036896	215687.8	8037100	Quasi-2D
11c	50	E-W	215633.8	8037039	215578.2	8036989	Quasi-2D
12	430	N-S	214874.5	8037561	214850.1	8037068	Quasi-2D
13	330	N-S	214851.8	8037971	214870.6	8037626	Quasi-2D
14	48	W-E	214752	8037707	214813.7	8037690	Sounding
15	830	S-N	214398.3	8038130	214700.4	8038819	Quasi-2D

			Start Location		End Location		
Line ID	Length (m)	Approx. Orientation	Easting (m)	Northing (m)	Easting (m)	Northing (m)	Type
16	90	E-W	215270.8	8037531	215182.3	8037578	Sounding
17	430	W-E	215004.1	8037434	215444.2	8037346	Quasi-2D
18a	48	W-E	214981.8	8036854	215024.8	8036880	Sounding
18b	48	W-E	215046.9	8036888	215088.9	8036915	Sounding

2.2 Survey Rationale - MASW

MASW is an active source seismic technique which uses analysis of surface waves to measure shear wave velocity in the subsurface. For the purposes of this survey the technique involves the deployment of a 24-channel geophone array mounted on a landstreamer at 2 m spacings.

The depth of investigation of the MASW technique is equal to roughly half the array length, while maximum vertical resolution at the surface is equal to roughly the geophone spacing. Vertical resolution decreases with depth. A 2 m spaced array will be 46 m long and have a maximum depth of investigation of ~23 m.

Seismic shots were made using a sledgehammer. Shot offset distances were located at an optimum separation for the site conditions, considering the required depth of investigation and site restrictions. Each shot was stacked 3 – 5 times to improve signal-to-noise ratio.

For this survey the results produced were unconstrained by the geology or other a priori data except the dispersion curves and should be considered as such.

The 2D outputs should be considered quasi-2D as they are made up of a series of 1D soundings and interpolated between. Generally, soundings were recorded every 20 m along the lines. Full acquisition and processing methods are detailed in Appendix A.

2.3 Seismic Refraction Tomography (SRT)

The SRT survey consisted of three (3) lines and was acquired with a towed landstreamer with twenty-four geophones spaced at 2 m.

SRT Line locations are plotted on Figure 06. Parameters are given in Table 2 below.

TABLE 2 - SRT LINE PARAMETERS

			Start Location		End Location		
Line ID	Length (m)	Approx. Orientation	Easting (m)	Northing (m)	Easting (m)	Northing (m)	Type
SRT01a	197	S-N	215113.1	8036533	215061.5	8036726	SRT
SRT01b	197	SE-NW	215060	8036725	214935	8036885	SRT
SRT02	289	N-S	215022.5	8036909	215181.2	8036644	SRT
SRT03	289	S-N	215235.7	8036642	215117.5	8036918	SRT

2.4 SURVEY RATIONALE - SRT

SRT is an active source seismic technique that measures the compressional wave velocity of the Earth's subsurface. For the purposes of this survey the technique involves the deployment of a 24-channel geophone array mounted on a landstreamer at 2 m spacings.

The depth of investigation of the SRT is equal to between a quarter and a fifth of the array length. In this case the theoretical depth of investigation was between 12 and 9.6 m bgl.

Seismic shots were made using a sledgehammer. Shots were recorded offend and at regular intervals along the array. Each shot was stacked 3 – 5 times to improve signal-to-noise ratio.

Full acquisition and processing methods are detailed in Appendix A.

2.5 HORIZONTAL TO VERTICAL SPECTRAL RATIOS (HVSR)

The HVSR survey consisted of twelve (12) soundings. Data was recorded using a Geometrics ATOM seismograph coupled to a 2 Hz tri-axial geophone.

Typically, soundings were recorded for of the order of an hour.

HVSR locations are plotted on Figures 01. Parameters are given in Table 3 below.

2.6 SURVEY RATIONALE - HVSR

SRT is an active

The Horizontal-to-Vertical Spectral Ratio (HVSR) technique is a passive seismic method used to estimate site resonance characteristics and infer subsurface stratigraphy, particularly the depth to impedance contrasts such as bedrock. The method utilises ambient seismic noise, recording three-component ground motion and analysing the ratio of horizontal to vertical spectral amplitudes. A fundamental resonance frequency (f_0) is identified, which is primarily controlled by the shear wave velocity and thickness of overlying materials. HVSR is well suited to urban and constrained environments due to its non-invasive nature, rapid deployment, and minimal logistical requirements. It provides a cost-effective means of deriving first-order estimates of sediment thickness and dynamic site response, supporting seismic hazard assessments and geotechnical investigations.

TABLE 3 - HVSR TEST LOCATIONS

Line ID	Easting (m)	Northing (m)
HVSR01	215147.6	8036752
HVSR02	215078.3	8036717
HVSR03	215074.2	8036802
HVSR04	215509.2	8037097
HVSR05	215806.6	8037029
HVSR06	215498.1	8036207
HVSR07	215920.7	8037121
HVSR08	215248.9	8037545
HVSR09	214756.5	8037689
HVSR10	214797.7	8037776
HVSR11	214552.1	8038762
HVSR12	214369.9	8038123

3 SURVEY METHODOLOGIES

The survey and processing methodologies for the MASW, SRT and HVSR surveys are described in Appendix A.

4 MASW RESULTS

4.1 DATA PRESENTATION

Data was presented using Geosoft's Oasis Montaj for the quasi-2D outputs and from Geogiga's Surface Plus module for the 1D soundings.

Shear wave velocity (Vs) values were measured in the range of 198 m/s to 1414 m/s across the entire dataset. Gridding was undertaken using a kriging algorithm.

The same standard linear colour scale (350–700 m/s) was applied to all quasi-2D sections to maintain consistency and show the maximum change over the largest range possible without being affected by outliers.

Contours were plotted at 50 m/s intervals using a Hanning filter.

Figures 07 – 35 detail the MASW results.

4.2 PROFILE PARAMETERS

MASW quasi-2D profile parameters are detailed in Table 4 below.

TABLE 4 - QUASI-2D MASW PROFILE PARAMETERS

Line ID	Min Vs (m/s)	Max Vs (m/s)
01a	215	523
2	234	662
3	232	951
4	327	714
07b	308	515
9	295	1341
11a	404	847
11b	241	796
11c	456	1080
12	223	609
13	306	1346
15	198	1229
17	201	1414

5 SRT RESULTS

5.1 DATA PRESENTATION

Data was presented using Geosoft's Oasis Montaj for the SRT 2D outputs.

Compressional wave velocity (Vp) values were measured in the range of 828 m/s to 5952 m/s across the entire dataset. Gridding was undertaken using a kriging algorithm.

The same standard linear colour scale (1500–5000 m/s) was applied to sections 01a and 01b to show the maximum change over the largest range possible.

The same standard linear colour scale (1000–2500 m/s) was applied to sections 02 and 03 to show the maximum change over the largest range possible

Contours were plotted at 500 m/s intervals using a Hanning filter.

Figures 36 – 39 detail the SRT results.

5.2 PROFILE PARAMETERS

SRT 2D profile parameters are detailed in Table 5 below.

TABLE 5 - SRT PROFILE PARAMETERS

Line ID	Min Vp (m/s)	Max Vp (m/s)
SRT01a	1094	4749
SRT01b	1177	5952
SRT02	828	2560
SRT03	828	2682

6 HVSR RESULTS

6.1 DATA PRESENTATION

Data was presented and processed using Geophysical Signal Database for Noise Array Processing (GEOPSY) for the HVSR outputs.

Processing is described in more detail in Appendix A but typically HVSR results were plotted using a 0.5 -45 Hz range and 60 second time windows.

Figures 40 – 51 detail the HVSR results.

6.2 HVSR RESULTS

HVSR results are detailed in Table 6 below.

TABLE 6 - HVSR RESULTS

HVSR#	f_0	f_{min}	f_{max}	A_0	A_{min}	A_{max}	T_0	T_{min}	T_{max}
Unit	Hz	Hz	Hz				s	s	s
1	3.98	3.41	4.64	2.00	1.78	2.24	0.25	0.29	0.22
2	2.52	2.15	2.96	2.06	1.86	2.29	0.40	0.47	0.34
3	3.23	2.73	3.84	1.33	1.13	1.55	0.31	0.37	0.26
4	7.99	6.97	9.17	2.41	2.04	2.85	0.13	0.14	0.11
5	15.50	15.12	15.90	1.65	1.34	2.04	0.06	0.07	0.06
6	30.49	28.32	32.83	3.40	2.95	3.92	0.03	0.04	0.03
7	5.10	4.58	5.68	1.32	1.20	1.46	0.20	0.22	0.18
8	12.81	10.28	15.96	2.13	1.93	2.36	0.08	0.10	0.06
9	4.55	4.02	5.14	2.30	2.03	2.60	0.22	0.25	0.19
10	3.58	3.03	4.23	1.77	1.56	2.01	0.28	0.33	0.24
11	30.66	30.25	31.08	4.42	3.44	5.69	0.03	0.03	0.03
12	26.61	24.55	28.86	1.50	1.20	1.88	0.04	0.04	0.03

7 OBSERVATIONS AND INTERPRETATIONS

7.1 MASW LINE 01A

MASW Line 1a was deployed in a SE-NW direction (Figure 07). The total line was 380 m long (not including shot offsets).

The MASW profile can be divided into two broad sections:

- Chainage 0 – 260 m. This section exhibited slow (<400 m/s) shear wave velocities to ~20 m bgl (blue colours). Below 20 m bgl velocities increase to 400 m/s (greens). The velocities in this area are typically slower than the rest of the survey area, which is indicative of the line's coastal location.
- Chainage 260 m - EOL. This section exhibited slow (<400 m/s) shear wave velocities to ~10 m bgl. Below 10 m bgl velocities increase to 400 m/s. The velocities in this area are typically slower than the rest of the survey area, which is indicative of the line's coastal location.

The MASW profiles was aborted at 380 m as the width of the pathway didn't allow the vehicle and landstreamer to progress further.

7.2 MASW LINE 01B

MASW Line 1b was deployed in a SE-NW direction (Figure 08). The total line was 48 m long (not including shot offsets) and can be considered a sounding.

The following observations can be made about the sounding:

- Modelled shear wave velocities range between 239 and 392 m/s not including the half-space (bottom layer).
- The model is similar to nearby 2D model (MASW line 01a).
- There is good agreement between the experimental (recorded) and model data.
- Model misfits are low at 2.28 %.

7.3 MASW Line 01c

MASW Line 1c was deployed in a SE-NW direction (Figure 09). The total line was 48 m long (not including shot offsets) and can be considered a sounding.

The following observations can be made about the sounding:

- Modelled shear wave velocities range between 282 and 585 m/s not including the half-space (bottom layer).
- A Vs velocity inversion is observed below 12 m bgl (fast over slow). This can indicate a poor model fit; however, the model appears to match the experimental (recorded) dispersion curve.
- The model is similar to nearby 2D model (MASW line 03).
- There is reasonable agreement between the experimental (recorded) and model data.
- Model misfits are acceptable at 3.09 %.

7.4 MASW Line 02

MASW Line 2 was deployed in a SE-NW direction (Figure 10). The total line was 270 m long (not including shot offsets).

The MASW profile can be divided into three broad sections:

- Chainage 0 – 150 m. This section exhibited slow (<400 m/s) shear wave velocities to ~10 m bgl (blue colours). Below 10 m bgl velocities increase to 400 m/s (greens). The velocities in this area are typically slower than the rest of the survey area which is indicative of the low-lying coastal location.
- Chainage 150 m – 220 m. This section exhibited faster (400 m/s) shear wave velocities to ~5 m bgl. Below 5 m bgl there appears to be a subtle velocity inversion to ~10 m bgl. Below 10 m bgl velocities increase again in a similar manner to chainages 0 – 150 m.
- Chainage 220 m – EOL. This section exhibited slow (<400 m/s) shear wave velocities to ~10 m bgl (blue colours). Below 10 m bgl velocities increase to 400 m/s (greens). The velocities in this area are typically

slower than the rest of the survey area which is indicative of the low-lying coastal location.

7.5 MASW Line 03

MASW Line 3 was deployed in a NW-SE direction (Figure 11). The total line was 680 m long (not including shot offsets).

The MASW profile can be divided into four broad sections:

- Chainage 0 – 220 m. This section exhibited relative fast and variable (400 – 600 m/s) shear wave velocities to ~10 m bgl. Below 10 m bgl velocities increase from 500 m/s (yellows to pinks). The velocities in this area are typically faster than the rest of the line.
- Chainage 220 m – 320 m. This section exhibited slow (<400 m/s) shear wave velocities to ~5 m bgl (blue colours). Below 5 m bgl velocities increase significantly from 400 to 900 m/s.
- Chainage 320 m – 390 m. This section exhibited relative fast and variable (400 – 550 m/s) shear wave velocities to ~10 m bgl. Below 10 m bgl velocities increase from 500 m/s (yellows to pinks). The velocities in this area are typically faster than the rest of the line.
- Chainage 390 m – 680 m. This section exhibited slow (<400 m/s) shear wave velocities to ~15 m bgl (blue colours). Below 15 m bgl velocities increase to 400 m/s (greens). The velocities in this area are typically slower than the rest of the survey area which is indicative of the low-lying coastal location.

7.6 MASW Line 04

MASW Line 4 was deployed in a SE-NW direction (Figure 12). The total line was 470 m long (not including shot offsets).

The MASW profile can be divided into two broad sections:

- Chainage 0 – 210 m. This section exhibited relatively slow and homogenous (~400 – 500 m/s) shear wave velocities to the bottom of the model.

- Chainage 210 m – EOL m. This section exhibited relatively fast (>400 m/s) shear wave velocities to ~11 m bgl (greens and yellow colours). Below 11 m bgl velocities typically increase significantly to 600 m/s.

Velocities are generally higher than parallel lines 01, 02 and 03 due to this lines greater distance from the coast and higher elevation.

7.7 MASW Line 05a

MASW Line 5a was deployed in a W-E direction (Figure 13). The total line was 48 m long (not including shot offsets) and can be considered a sounding.

The following observations can be made about the sounding:

- Modelled shear wave velocities range between 255 and 422 m/s not including the half-space (bottom layer).
- A Vs velocity inversion is observed below 11 m bgl (fast over slow). This can be an indication of a poor model fit, but the model seems to match the experimental (recorded data) in the dispersion curve.
- The model is similar to the nearby 2D model (MASW line 02) which it intersects.
- Frequencies greater than 25 Hz were not recorded so resolution in the near surface may be constrained.
- There is good agreement between the experimental (recorded) and model data.
- Model misfits are good at 1.08 %.

7.8 MASW Line 05b

MASW Line 5b was deployed in a W-E direction (Figure 14). The total line was 48 m long (not including shot offsets) and can be considered a sounding.

The following observations can be made about the sounding:

- Modelled shear wave velocities range between 310 and 433 m/s not including the half-space (bottom layer).

- The model is similar to the nearby 2D model (MASW line 02) which it intersects.
- Frequencies greater than 25 Hz were not recorded so resolution in the near surface may be constrained.
- There is good agreement between the experimental (recorded) and model data.
- Model misfits are good at 2.35 %.

7.9 MASW Line 05C

MASW Line 5c was deployed in a W-E direction (Figure 15). The total line was 48 m long (not including shot offsets) and can be considered a sounding.

The following observations can be made about the sounding:

- Modelled shear wave velocities range between 322 and 481 m/s not including the half-space (bottom layer).
- The model is similar to the nearby 2D model (MASW line 03) which it intersects.
- There is reasonable agreement between the experimental (recorded) and model data.
- Model misfits are acceptable at 3.00 % after 15 iterations.

7.10 MASW Line 06a

MASW Line 6a was deployed in a W-E direction (Figure 16). The total line was 48 m long (not including shot offsets) and can be considered a sounding.

The following observations can be made about the sounding:

- Modelled shear wave velocities range between 226 and 383 m/s not including the half-space (bottom layer).
- The model is similar to the nearby 2D model (MASW line 01) which it intersects.
- There is good agreement between the experimental (recorded) and model data.

- Model misfits are good at 0.74 % after 15 iterations.

7.11 MASW Line 06B

MASW Line 6b was deployed in a W-E direction (Figure 17). The total line was 48 m long (not including shot offsets) and can be considered a sounding.

The following observations can be made about the sounding:

- Modelled shear wave velocities range between 263 and 447 m/s not including the half-space (bottom layer).
- The model is similar to the nearby 2D model (MASW line 03) which it which it intersects or is near.
- There is good agreement between the experimental (recorded) and model data.
- Model misfits are good at 0.86 % after 15 iterations.

7.12 MASW Line 06C

MASW Line 6c was deployed in a W-E direction (Figure 18). The total line was 48 m long (not including shot offsets) and can be considered a sounding.

The following observations can be made about the sounding:

- Modelled shear wave velocities range between 404 and 586 m/s not including the half-space (bottom layer).
- The model is similar to the nearby 2D model (MASW line 04) which it which it intersects or is near.
- There is reasonable agreement between the experimental (recorded) and model data.
- Model misfits are acceptable at 4.01 % after 15 iterations.

7.13 MASW Line 07A

MASW Line 7a was deployed in a W-E direction (Figure 19). The total line was 48 m long (not including shot offsets) and can be considered a sounding.

The following observations can be made about the sounding:

- Modelled shear wave velocities range between 223 and 548 m/s not including the half-space (bottom layer).
- The model is similar to the nearby 2D model (MASW line 01) which it which it intersects or is near.
- There is good agreement between the experimental (recorded) and model data.
- Model misfits are good at 2.01 % after 15 iterations.

7.14 MASW Line 07b

MASW Line 07b was deployed in a W-E direction (Figure 20). The total line was 90 m long (not including shot offsets).

The MASW profile can be described as such:

- From 0 – 10 m bgl velocities generally increase from around 350 m/s to 450 m/s from the start of the line (20 m) to the end of the line (90 m).
- Below 10 m bgl velocities are relatively homogenous (>400 m/s).

The shear wave velocity increases as the testing moves away from the coast as might be expected as bedrock/less weathered rock is encountered.

7.15 MASW Line 08

MASW Line 8 was deployed in a W-E direction (Figure 21). The total line was 48 m long (not including shot offsets) and can be considered a sounding.

The following observations can be made about the sounding:

- Modelled shear wave velocities range between 279 and 521 m/s not including the half-space (bottom layer).
- The model is similar to the nearby 2D model (MASW line 03) which it which it intersects or is near. Note it differs from MASW line 09 due to issues with the data at the start of this model (see next section).
- There is good agreement between the experimental (recorded) and model data.
- Model misfits are good at 2.49 % after 15 iterations.

7.16 MASW Line 09

MASW Line 9 was deployed in a NW-SE direction (Figure 22). The total line was 510 m long (not including shot offsets).

The MASW profile can be divided into five broad sections:

- Chainage 0 – 100 m. Data in this section was poor and should be discounted from any analysis. It does not match other lines that intersected it. Poor data may have been the result of a large underlying service or similar.
- Chainage 100 m – 190 m. This section exhibited slow (<400 m/s) shear wave velocities to ~7 m bgl (blue colours). Below 7 m bgl velocities are still relatively low and are generally above or near 400 m/s.
- Chainage 190 m – 270 m. This section exhibited homogenous (~400 m/s) shear wave velocities to ~7 m bgl. Below 7 m bgl velocities decrease below 400 m/s (blues). In MASW modelling velocity inversion like this (fast over soft) can be indicative of modelling/data issues. In this case dispersion curves indicate that the observed model is likely to be realistic.
- Chainage 270 m – 370 m. This section exhibited homogenous (~400 m/s) shear wave velocities to ~7 m bgl (green colours). Below 7 m bgl velocities increase to 700 m/s.
- Chainage 370 m – EOL. This section exhibited slower (<400 m/s) shear wave velocities to ~7 m bgl (blue colours) just before the test line starts to go up the hill. Below 7 m bgl velocities increase to 700 m/s.

7.17 MASW Line 10a

MASW Line 10a was deployed in a W-E direction (Figure 23). The total line was 48 m long (not including shot offsets) and can be considered a sounding.

The following observations can be made about the sounding:

- Modelled shear wave velocities range between 287 and 448 m/s not including the half-space (bottom layer).
- The model is similar to the nearby 2D model (MASW line 03) which it which it intersects or is near.

- There is acceptable agreement between the experimental (recorded) and model data.
- Model misfits are average at 9.31 % after 15 iterations.

7.18 MASW Line 10b

MASW Line 10b was deployed in a W-E direction (Figure 24). The total line was 48 m long (not including shot offsets) and can be considered a sounding.

The following observations can be made about the sounding:

- Modelled shear wave velocities range between 316 and 585 m/s not including the half-space (bottom layer).
- The model exhibits a velocity inversion (fast over soft) below 5.35 m bgl. This can indicate model instability, but the observation matches the input experimental data (dispersion curve). As such there can be some confidence in the output Vs model.
- There is acceptable agreement between the experimental (recorded) and model data.
- Model misfits are average at 4.59 % after 15 iterations.

7.19 MASW Line 11a

MASW Line 11a was deployed in a E_W direction (Figure 25). The total line was 60 m long (not including shot offsets).

The MASW profile can be described as such:

- From 0 – 7 m bgl velocities are generally homogenous around 500 m/s from the start of the line (20 m) to the end of the line (60 m).
- Below 7 m bgl velocities increase gradually to around 800 m/s.

This quasi-2D section was made up of only three soundings due to space available onsite.

7.20 MASW Line 11b

MASW Line 11b was deployed in a S-N direction (Figure 26). The total line was 210 m long (not including shot offsets).

The MASW profile can be divided into three broad sections:

- Chainage 0 – 90 m. This section exhibited relatively homogenous shear wave velocities from surface to TD (400 – 500 m/s).
- Chainage 90 m – 160 m. This section exhibited slow (<400 m/s) shear wave velocities to ~15 m bgl (blue colours). Below 15 m bgl velocities are still relatively low and are generally above or near 400 m/s.
- Chainage 160 m – EOL. This section exhibited slow (<400 m/s) shear wave velocities to ~10 m bgl (blue colours). Below 10 m bgl velocities increase to up to 700 m/s.

This MASW model is interesting because (relatively) low shear wave velocities are observed at what are relatively high elevations. This could be due to variations in geology or weathering conditions.

7.21 MASW Line 11c

MASW Line 11c was deployed in a E_W direction (Figure 27). The total line was 50 m long (not including shot offsets).

The MASW profile can be described as such:

- From 0 – 9 m bgl velocities are generally homogenous around 500 m/s from the start of the line (20 m) to the end of the line (50 m).
- Below 9 m bgl velocities increase gradually to around 1000 m/s.

This quasi-2D section was made up of only three soundings due to space available onsite.

7.22 MASW Line 12

MASW Line 12 was deployed in a NW-SE direction (Figure 28). The total line was 430 m long (not including shot offsets).

The MASW profile can be divided into three broad sections:

- Chainage 0 – 100 m. This section exhibited relatively homogenous low shear wave velocities from surface to TD (~400 m/s).
- Chainage 100 m – 220 m. This section exhibited moderate (~400 m/s) shear wave velocities to TD.
- Chainage 220 m – EOL. This section exhibited slow (<400 m/s) shear wave velocities to ~10 m bgl (blue colours). Below 10 m bgl velocities increase to up to 500 m/s.

Data recorded along this line was relatively noisy due to the higher traffic volumes along this road.

7.23 MASW Line 13

MASW Line 13 was deployed in a NW-SE direction (Figure 29). The total line was 330 m long (not including shot offsets).

The MASW profile can be divided into three broad sections:

- Chainage 0 – 90 m. This section exhibited a gradual increase in shear wave velocity with depth. The model appears to represent a dipping structure that pinches out at ~90 m.
- Chainage 90 m – 200 m. This section exhibited low and reasonably homogenous (~400 m/s) shear wave velocities to TD.
- Chainage 200 m – EOL. This section exhibited slow (<400 m/s) shear wave velocities to ~5 m bgl (blue colours). Below 5 m bgl velocities increase gradually to up to 600 m/s.

Data recorded along this line was relatively noisy due very heavy rain experienced onsite.

7.24 MASW Line 14

MASW Line 14 was deployed in a W-E direction (Figure 30). The total line was 48 m long (not including shot offsets) and can be considered a sounding.

The following observations can be made about the sounding:

- Modelled shear wave velocities range between 325 and 525 m/s not including the half-space (bottom layer).

- The model exhibits a velocity inversion (fast over soft) below 4.88 m bgl. This can indicate model instability, but the observation matches the input experimental data (dispersion curve). As such there can be some confidence in the output Vs model.
- There is acceptable agreement between the experimental (recorded) and model data.
- Model misfits are average at 3.03 % after 15 iterations.

7.25 MASW Line 15

MASW Line 15 was deployed in a S-N direction (Figure 31). The total line was 830 m long (not including shot offsets).

The MASW profile can be divided into four broad sections:

- Chainage 0 – 160 m. This section exhibited relatively low shear wave velocities (~400 m/s) to around 7 m bgl. Below 7 m bgl velocities increase rapidly to ~1000 m/s. This model was indicative of the softer materials in the near surface associated with the coastline.
- Chainage 160 m – 340 m. This section exhibited relatively moderate shear wave velocities (<600 m/s) to around 7 m bgl. Below 7 m bgl velocities increase rapidly to ~1000 m/s. This model was observed as the line went up the hill.
- Chainage 340 m – 640 m. This section exhibited high (~1000 m/s) shear wave velocities to TD (pink colours). Such fast shear wave velocities are not ideal for surface wave testing like MASW that relies on dispersion. Relative shear wave velocities are indicative.
- Chainage 640 m – EOL. This section exhibited relatively moderate shear wave velocities (<600 m/s) to around 7 – 10 m bgl. Below 7 – 10 m bgl velocities generally increase rapidly to ~1000 m/s. This model was observed as the line went down the hill.

7.26 MASW Line 16

MASW Line 11c was deployed in a E_W direction (Figure 32). The total line was 90 m long (not including shot offsets).

The MASW profile can be described as such:

- Generally, the overall model was homogenous along its entire length with Vs values increase gradually from around 300 m/s in the near surface to 1000 m at depth.
- The slowest shear wave velocities pinch out at higher chainages as the line went up the hill.

This quasi-2D section was made up of only four soundings due to space available onsite.

7.27 MASW Line 17

MASW Line 17 was deployed in a W-E direction (Figure 33). The total line was 430 m long (not including shot offsets).

The MASW profile can be divided into four broad sections:

- Chainage 0 – 60 m. This section exhibited relatively low shear wave velocities (~500 m/s) to around 7 m bgl. Below 7 m bgl velocities increase gradually to ~1000 m/s.
- Chainage 60 m – 210 m. This section exhibited relatively low shear wave velocities (<400 m/s) to around 7 m bgl. Below 7 m bgl velocities increase rapidly to ~1000 m/s.
- Chainage 210 m – 340 m. This section exhibited lower shear wave velocities with the maximum shear wave velocity observed being ~600 m/s.
- Chainage 340 m – EOL. This section exhibited lower shear wave velocities (<400 m/s) to around 7 – 10 m bgl. Below 7 – 10 m bgl velocities generally increase to ~1000 m/s in contrast to chainages 210 – 340 m. This model was observed as the line went up the hill.

7.28 MASW Line 18a

MASW Line 18a was deployed in a W-E direction (Figure 34). The total line was 48 m long (not including shot offsets) and can be considered a sounding.

The following observations can be made about the sounding:

- Modelled shear wave velocities range between 228 and 337 m/s not including the half-space (bottom layer).
- The model exhibits reasonable agreement with the end of MASW line 2 that it intersects/is near.
- There is acceptable agreement between the experimental (recorded) and model data.
- Model misfits are average at 3.00 % after 15 iterations.

7.29 MASW Line 18b

MASW Line 18b was deployed in a W-E direction (Figure 35). The total line was 48 m long (not including shot offsets) and can be considered a sounding.

The following observations can be made about the sounding:

- Modelled shear wave velocities range between 299 and 449 m/s not including the half-space (bottom layer).
- The model exhibits reasonable agreement with MASW line 3 that it which it intersects or is near.
- There is acceptable agreement between the experimental (recorded) and model data.
- Model misfits are average at 4.13 % after 15 iterations.
- Model misfits are average at 4.13 % after 15 iterations.

7.30 SRT Line 01a

SRT Line 01a was deployed in a S-N direction (Figure 36). The total line was 197 m long (not including off-end shots).

The SRT profile can be described generally as:

- Compressional wave velocities are generally laterally homogeneous. Vp values appear to increase consistently with depth from just under 1500 m/s to ~4500 m/s.
- This model is unexpected considering the expected geological model and the coincident MASW data.

- Faster materials (>4500 m/s) are observed slightly more shallowly between chainages -10 m – 10 m and 100 – 140 m.
- Signal to noise ratios were relatively low for this SRT line.

7.31 SRT Line 01b

SRT Line 01b was deployed in a SE-NW direction (Figure 37). The total line was 197 m long (not including off-end shots).

The SRT profile can be described generally as:

- Compressional wave velocities are generally laterally homogeneous. Vp values appear to increase consistently with depth from just under 1500 m/s to ~5000 m/s.
- This model is unexpected considering the expected geological model and the coincident MASW data.
- Faster materials (>4500 m/s) are observed at shallower depths between chainages 130 m – 197 m.
- Signal to noise ratios were relatively low for this SRT line.

7.32 SRT Line 02

SRT Line 02 was deployed in a N-S direction (Figure 38). The total line was 289 m long (not including off-end shots).

The SRT profile can be divided into three broad sections:

- Chainage 0 – 110 m. This section exhibited compressional wave velocities increasing gradually from just under 1000 m/s in the near surface to ~2200 m/s at TD.
- Chainage 110 m – 150 m. This section exhibited compressional wave velocities increasing gradually from just under 1000 m/s in the near surface to ~2500 m/s at TD. The higher Vp values were coincident with a topographic high along the profile.
- Chainage 150 m – EOL. This section exhibited generally lower compressional wave velocities increasing gradually from just under 1000 m/s in the near surface to ~1500 m/s at 7 m bgl.

7.33 SRT Line 03

SRT Line 03 was deployed in a S-N direction (Figure 39). The total line was 289 m long (not including off-end shots).

The SRT profile can be divided into three broad sections:

- Chainage 0 – 50 m. This section exhibited compressional wave velocities increasing gradually from just under 1000 m/s in the near surface to ~2500 m/s at TD.
- Chainage 50 m – 140 m. This section exhibited generally lower compressional wave velocities increasing gradually from just under 1000 m/s in the near surface to ~1500 m/s at 10 m bgl.
- Chainage 140 m – EOL. This section exhibited compressional wave velocities increasing gradually from just under 1000 m/s in the near surface to ~2000 m/s at TD.

7.34 3D Representations

Appendix C (digital data only) consists of 3D Leapfrog enabled outputs.

7.35 Raw Data

Appendix D (digital data only) consists of raw seismic data.

7.36 Vs sounding outputs

Appendix E consists of Vs Sounding outputs.

8 REFERENCES

- Reynolds, J. M. (2011). An introduction to applied and environmental geophysics. John Wiley & Sons.

9 LIMITATIONS

- This report has been prepared for the particular purpose outlined in the project brief and no responsibility is accepted for the use of any part in other contexts or for any other purpose.
- Ground conditions assessed in this report are inferred from published sources, site inspection and the investigations described. Variations from the interpreted conditions may occur, and special conditions relating to the site may not have been revealed by this investigation, and which are therefore not taken into account. No warranty is included either expressed or implied that the actual conditions will conform to the interpretation contained in this report.
- No responsibility is accepted by Resource Development Consultants Ltd for inaccuracies in data supplied by others. Where data has been supplied by others, it has been assumed that this information is correct.
- Groundwater conditions can vary with season or due to other events. Any comments on groundwater conditions are based on observations at the time.
- This report is provided for sole use by the client and is confidential to the client and their professional advisors. No responsibility whatsoever for the contents of this report shall be accepted for any person other than the client.

10 CLOSURE

We trust this meets your current needs. Should you wish to discuss any aspect of the contents of this document please contact Siru Jylhänkangas (sjylhankangas@rdcl.co.nz, 04 282 1564).

Faithfully,

Prepared by:



O Gibson

BSc, MRes

Principal Geophysicist

Reviewed by:

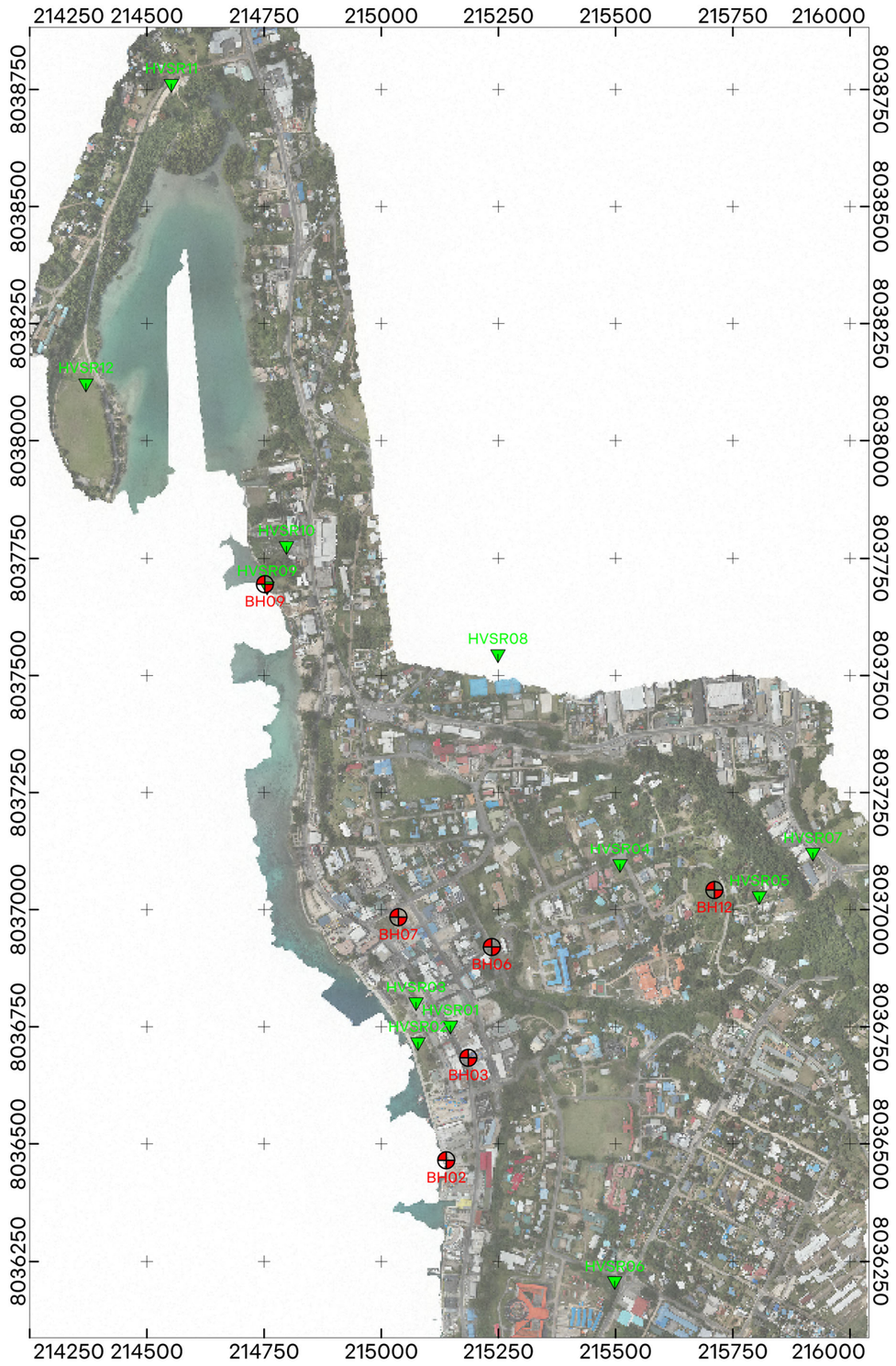


S Jylhänkangas

BSc Geol GPHS, MSc GPHS

Geophysicist

FIGURES



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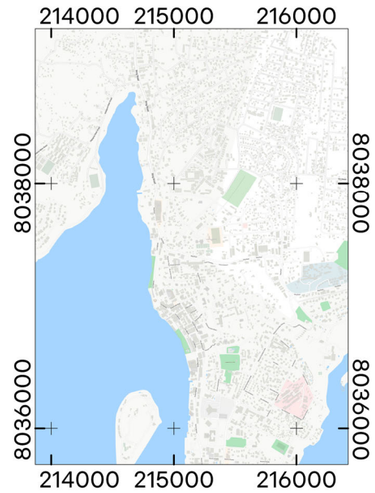

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Scale 1:50000

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metres

WGS 84 / UTM zone 59S

SCALE:

Scale 1:12000

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metres

WGS 84 / UTM zone 59S

LEGEND:

- Downhole Seismic Test Location
- HVSR Test Location

NOTES:

1. Imagery data provided to RDCL by the client.
2. Absolute accuracy of test location ±3 m.

CLIENT: T+T

PROJECT: PORT VILA, VANUATU GEOPHYSICS

TITLE: HVSR & DOWNHOLE SEISMIC TEST LOCATIONS

INTERP. BY: OG	DATE: 01/04/2026	DRAWN BY: OG	DATE: 01/04/2026
CHECKED BY: SJ	DATE: 01/04/2026	APPROVED BY: SJ	DATE: 01/04/2026

CONTRACT No.: 250306 FIGURE 01

FILE NAME: 250306.gpf
PLOTTED DRAWING SIZE: A3 (420 x 297)

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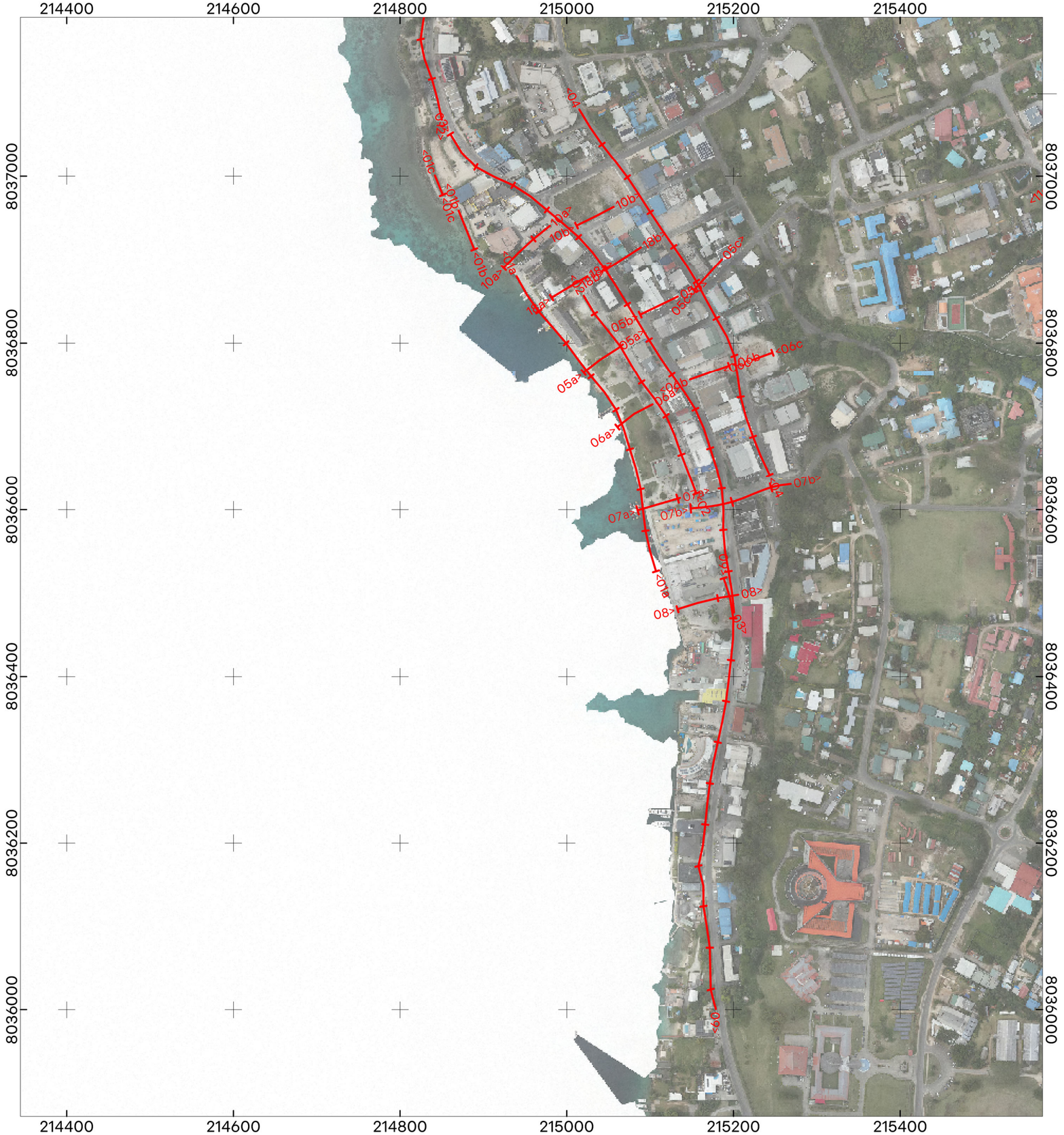

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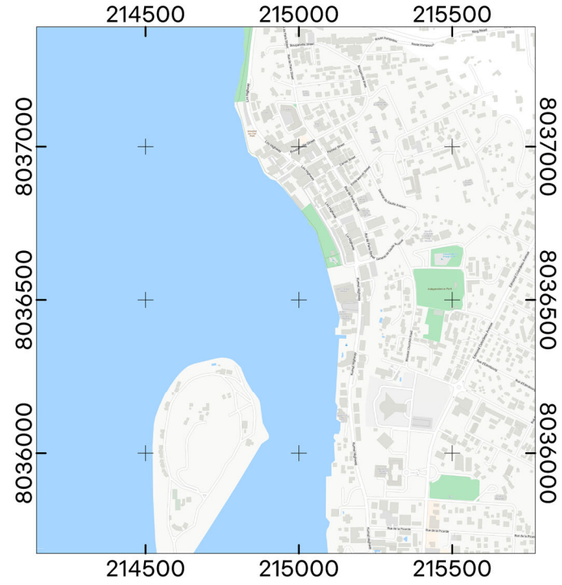

GENERAL LOCATION PLAN SCALE: Scale 1:20000

500 0 500 1000

metres

WGS 84 / UTM zone 59S

SCALE: Scale 1:5000

100 0 100 200

metres

WGS 84 / UTM zone 59S

LEGEND:

MASW Line

NOTES:

1. Imagery data provided to RDCL by the client.
2. Absolute accuracy of test location ±3 m.

CLIENT: T+T

PROJECT: PORT VILA, VANUATU
GEOPHYSICS

TITLE: MASW CBD
TEST LOCATIONS

INTERP. BY: OG	DATE: 02/04/2026	DRAWN BY: OG	DATE: 02/04/2026
CHECKED BY: SJ	DATE: 02/04/2026	APPROVED BY: SJ	DATE: 02/04/2026

CONTRACT No.: 250306 FIGURE 02

FILE NAME: 250306.gpf
PLOTTED DRAWING SIZE: A3 (420 x 297)

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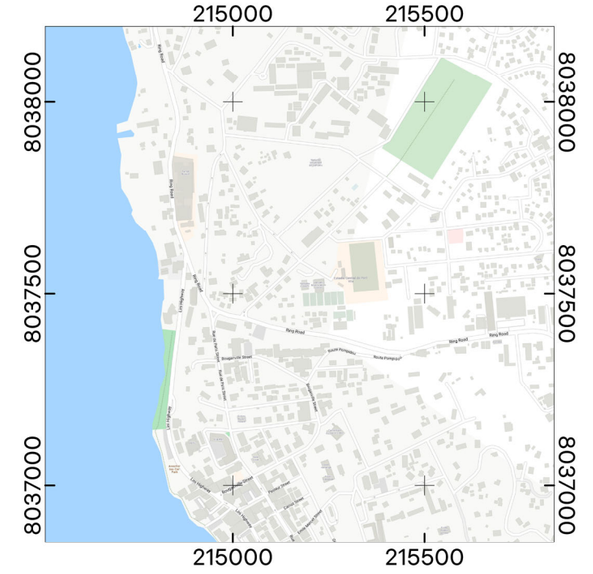
GENERAL LOCATION PLAN:



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metres

WGS 84 / UTM zone 59S

SCALE: Scale 1:4000

100 0 100 200

metres

WGS 84 / UTM zone 59S

LEGEND:

MASW Line

NOTES:

1. Imagery data provided to RDCL by the client.
2. Absolute accuracy of test location ±3 m.

CLIENT: T+T

PROJECT: PORT VILA, VANUATU GEOPHYSICS

TITLE: MASW NORTH CBD TEST LOCATIONS

INTERP. BY: OG	DATE: 02/04/2026	DRAWN BY: OG	DATE: 02/04/2026
CHECKED BY: SJ	DATE: 02/04/2026	APPROVED BY: SJ	DATE: 02/04/2026

CONTRACT No.: 250306 FIGURE 03

FILE NAME: 250306.gpf
PLOTTED DRAWING SIZE: A3 (420 x 297)

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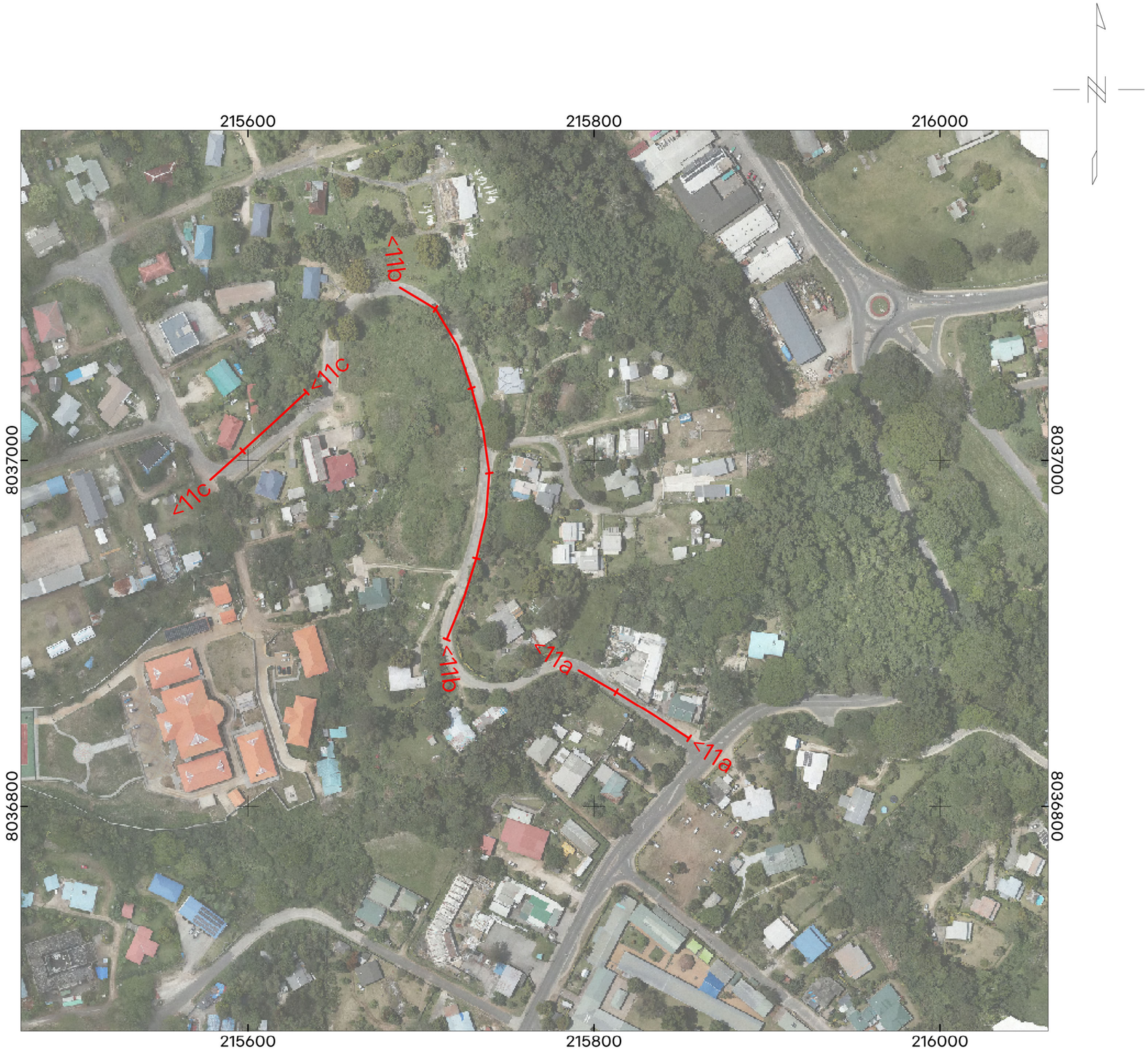

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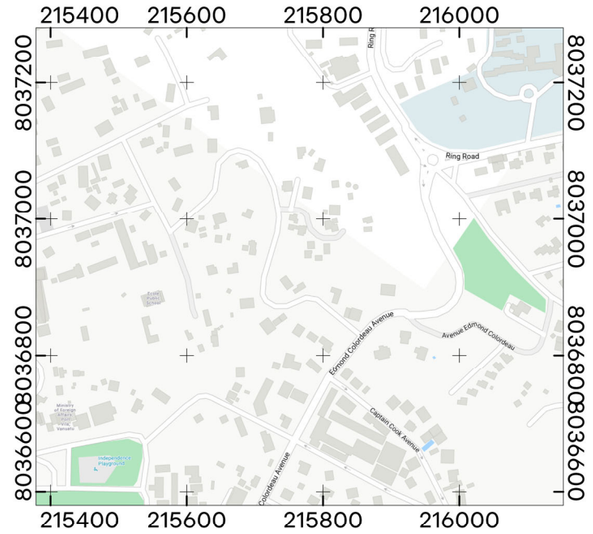

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metres

WGS 84 / UTM zone 59S

SCALE: Scale 1:2500

50 0 50 100

metres

WGS 84 / UTM zone 59S

LEGEND:

MASW Line

NOTES:

1. Imagery data provided to RDCL by the client.
2. Absolute accuracy of test location ±3 m.

CLIENT: T+T

PROJECT: PORT VILA, VANUATU
GEOPHYSICS

TITLE: MASW EAST
TEST LOCATIONS

INTERP. BY: OG	DATE: 02/04/2026	DRAWN BY: OG	DATE: 02/04/2026
CHECKED BY: SJ	DATE: 02/04/2026	APPROVED BY: SJ	DATE: 02/04/2026

CONTRACT No.: 250306 FIGURE 04

FILE NAME: 250306.gpf
PLOTTED DRAWING SIZE: A3 (420 x 297)

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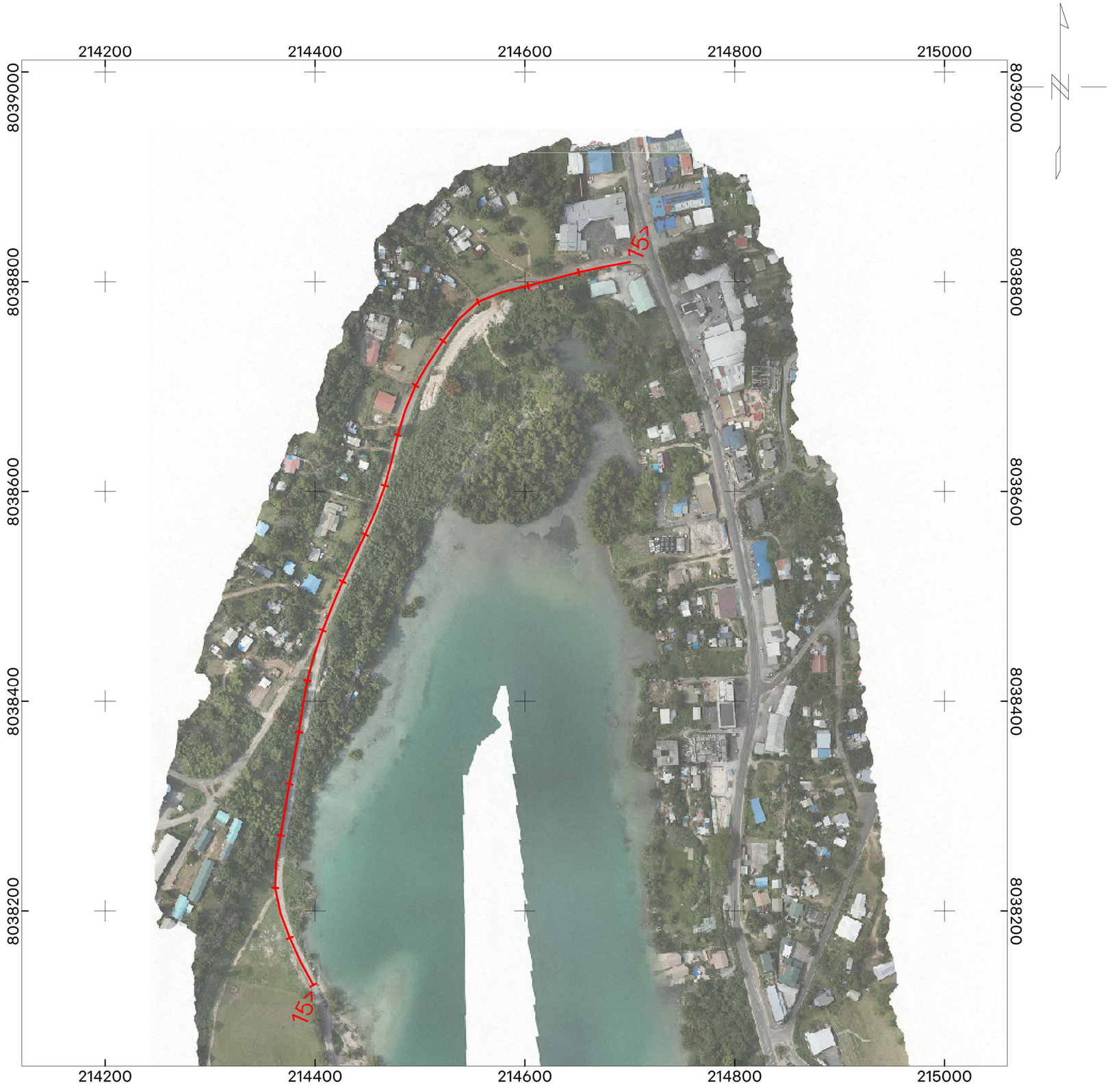

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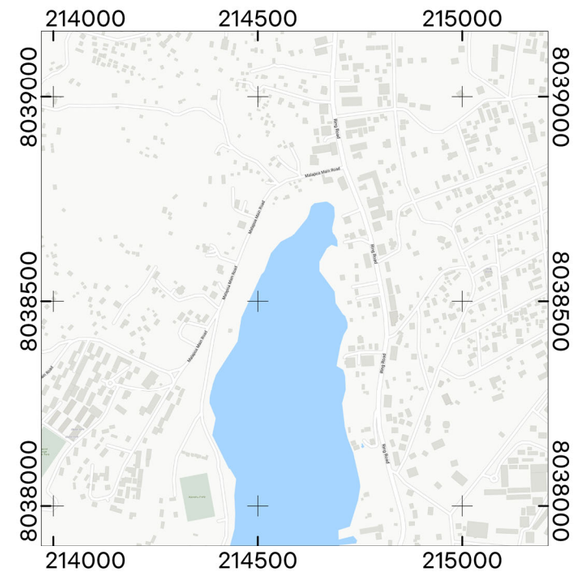

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metres

WGS 84 / UTM zone 59S

SCALE: Scale 1:4000

100 0 100 200

metres

WGS 84 / UTM zone 59S

LEGEND:

MASW Line

NOTES:

1. Imagery data provided to RDCL by the client.
2. Absolute accuracy of test location ±3 m.

CLIENT: T+T

PROJECT: PORT VILA, VANUATU
GEOPHYSICS

TITLE: MASW LINE 15
TEST LOCATIONS

INTERP. BY: OG	DATE: 02/04/2026	DRAWN BY: OG	DATE: 02/04/2026
CHECKED BY: SJ	DATE: 02/04/2026	APPROVED BY: SJ	DATE: 02/04/2026

CONTRACT No.: 250306 FIGURE 05

FILE NAME: 250306.gpf
PLOTTED DRAWING SIZE: A3 (420 x 297)

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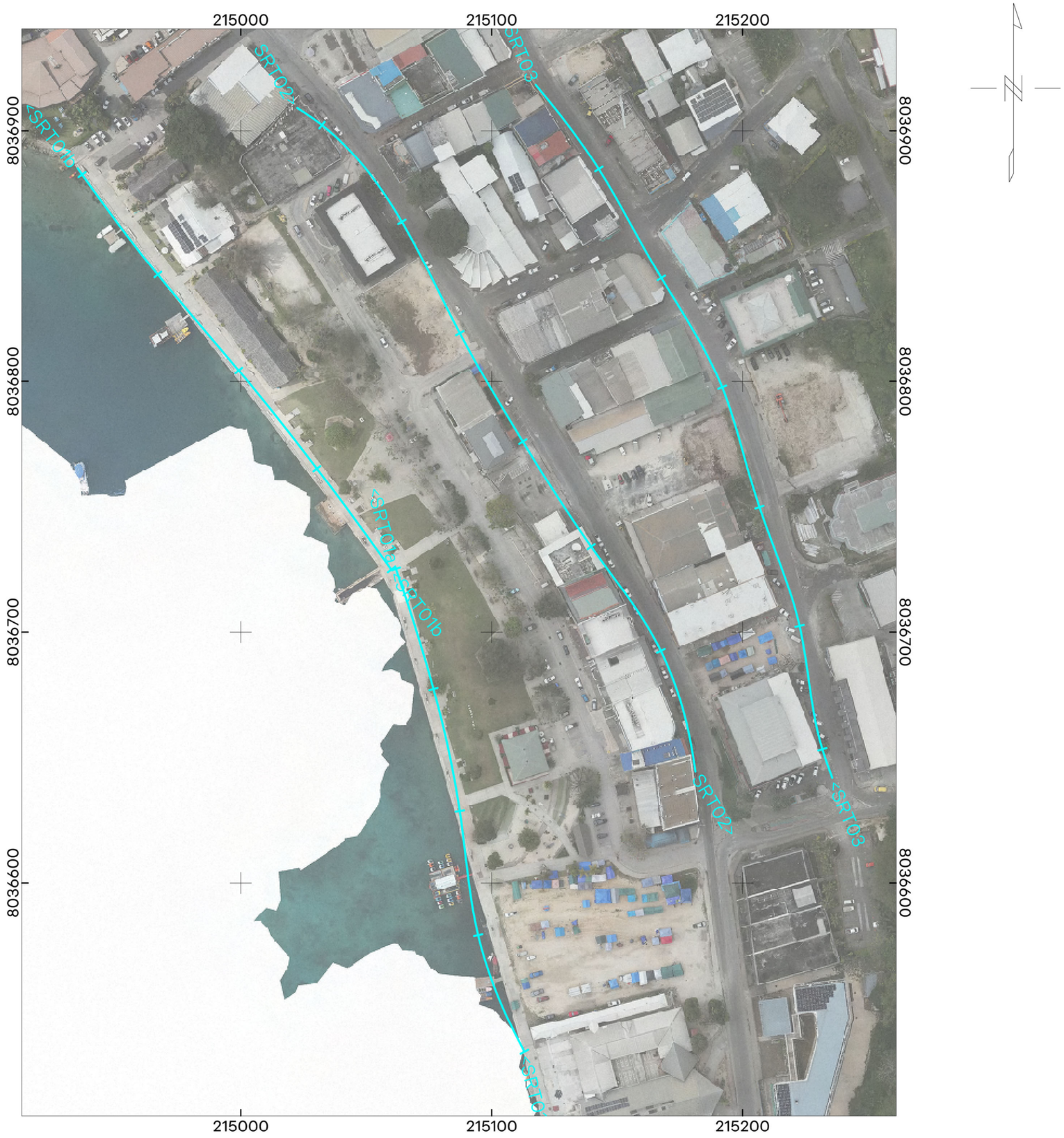

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GENERAL LOCATION PLAN SCALE: Scale 1:6000

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metres

WGS 84 / UTM zone 59S

SCALE: Scale 1:1700

25 0 25 50 75 100

metres

WGS 84 / UTM zone 59S

LEGEND:

SRT Line

NOTES:

1. Imagery data provided to RDCL by the client.
2. Absolute accuracy of test location ±3 m.

CLIENT: T+T

PROJECT: PORT VILA, VANUATU
GEOPHYSICS

TITLE: SRT
TEST LOCATIONS

INTERP. BY: OG	DATE: 03/04/2026	DRAWN BY: OG	DATE: 03/04/2026
CHECKED BY: SJ	DATE: 03/04/2026	APPROVED BY: SJ	DATE: 03/04/2026

CONTRACT No.: 250306 FIGURE 06

FILE NAME: 250306.gpf
PLOTTED DRAWING SIZE: A3 (420 x 297)

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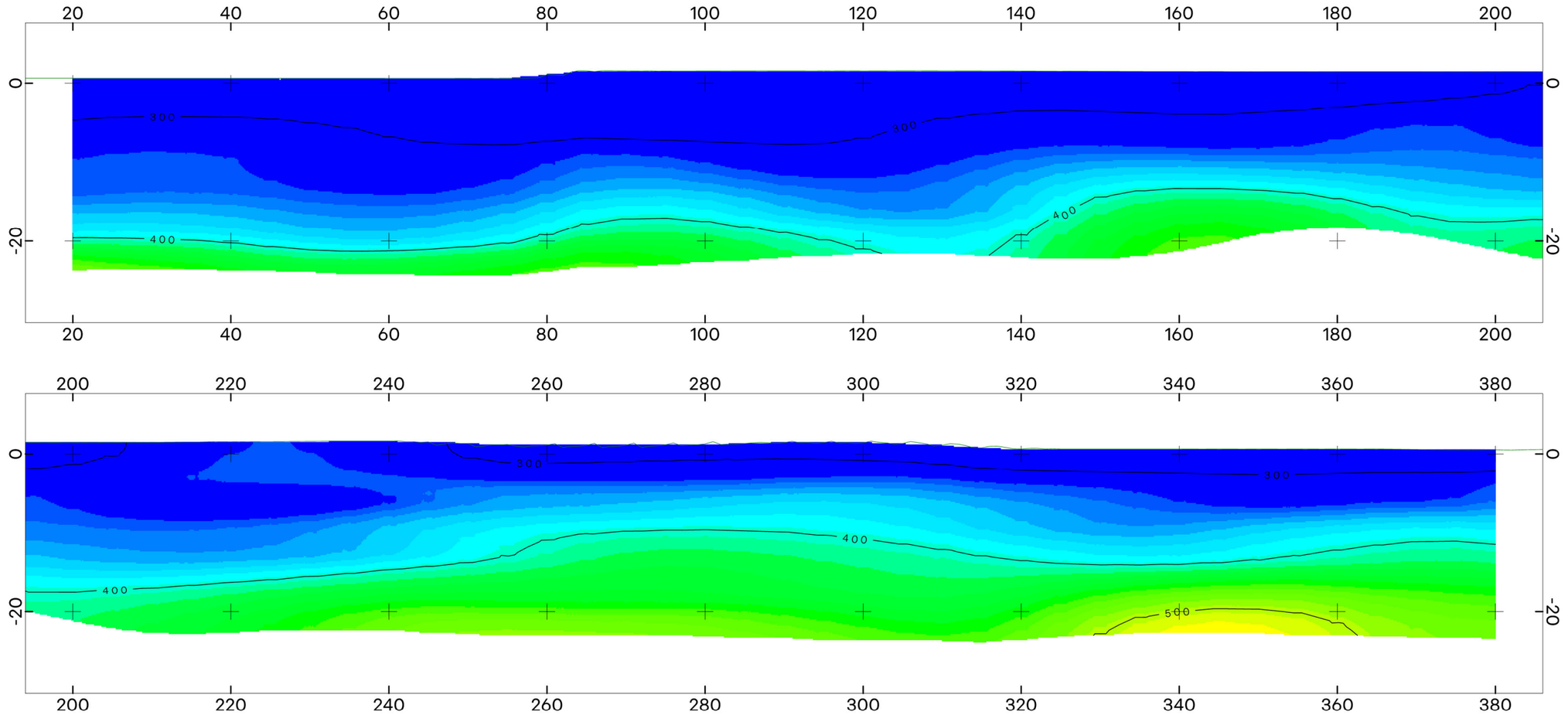
SOUTH EAST

NORTH WEST



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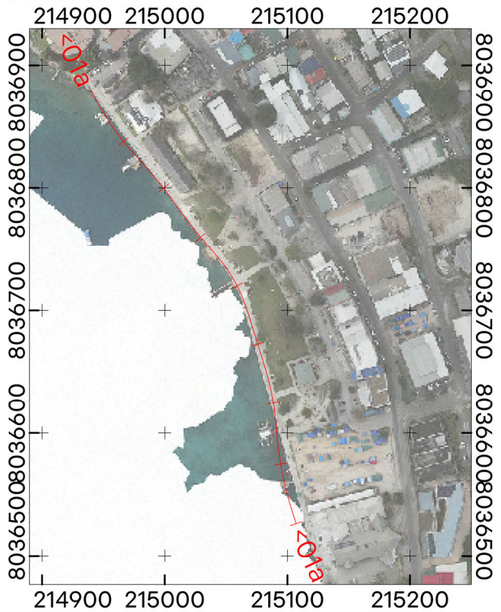

SCALE:

Scale 1:600

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metres

GENERAL LOCATION PLAN SCALE:

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metres

WGS 84 / UTM zone 59S

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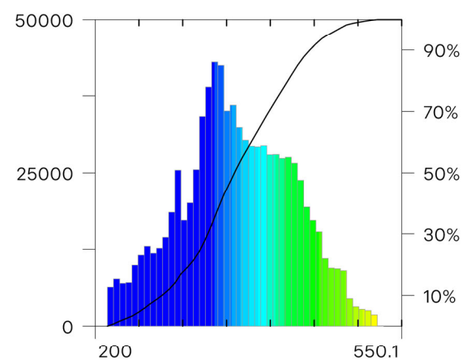

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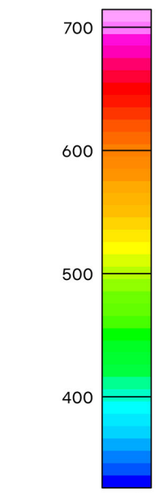

Model Vs (m/s)

NOTES:

1. Imagery data provided to RDCL by the client.

CLIENT: T+T

PROJECT: PORT VILA, VANUATU GEOPHYSICS

TITLE: MASW LINE 01a PSEUDO Vs SECTION

INTERP. BY: OG	DATE: 08/04/2026	DRAWN BY: OG	DATE: 08/04/2026
CHECKED BY: SL	DATE: 08/04/2026	APPROVED BY: SJ	DATE: 08/04/2026

CONTRACT No.: 250306 FIGURE 07

FILE NAME: 250306.gpf

PLOTTED DRAWING SIZE: A3 (420 x 297)

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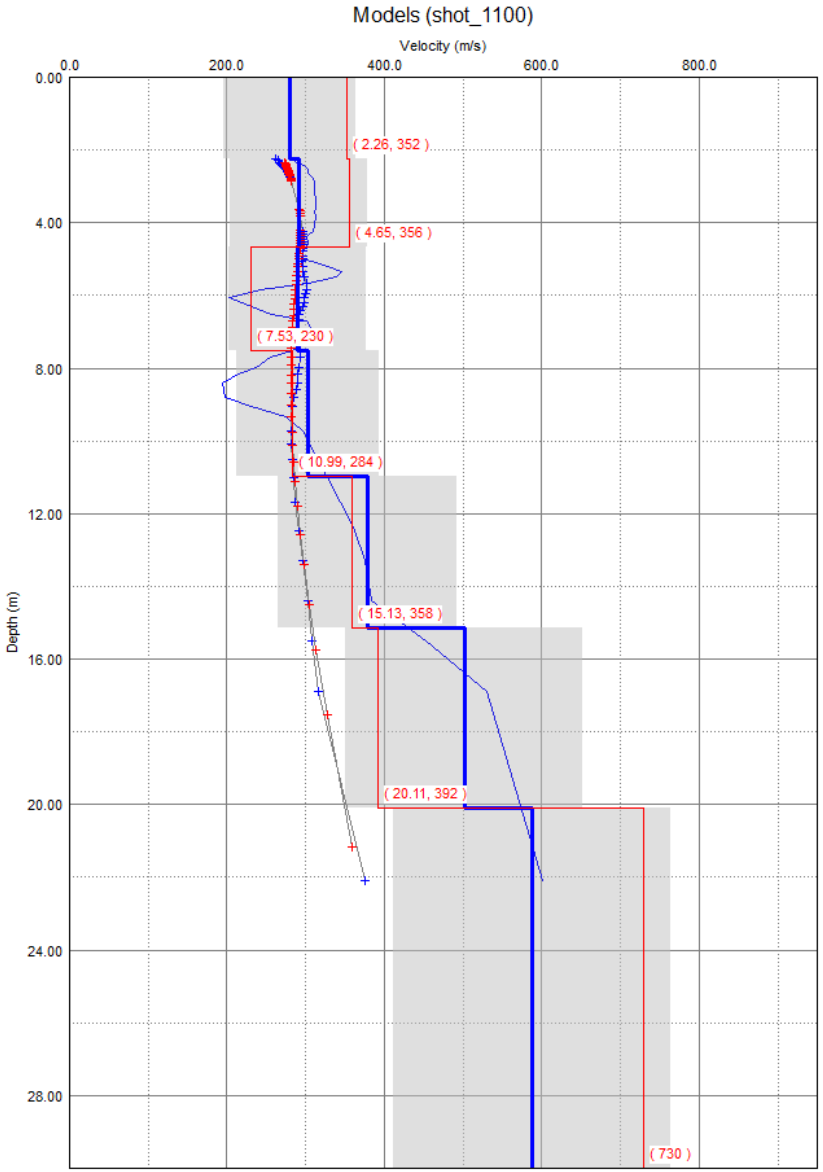
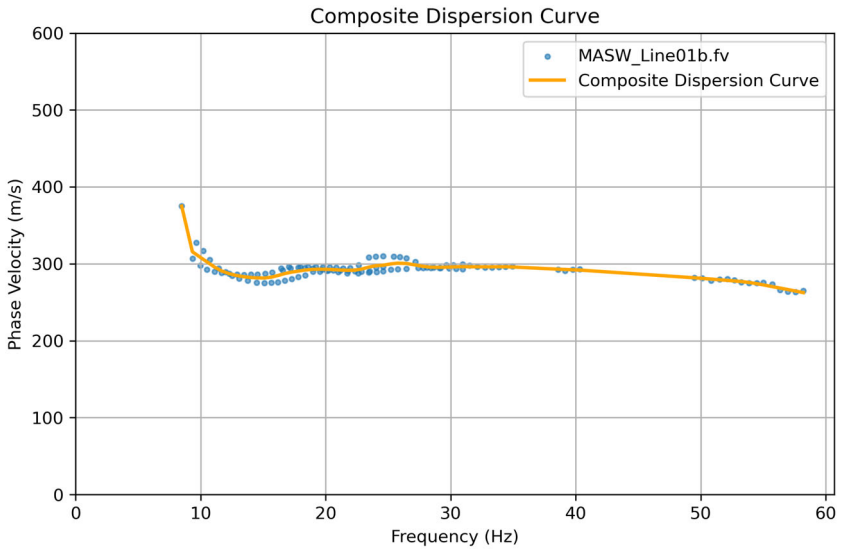
Ground Model

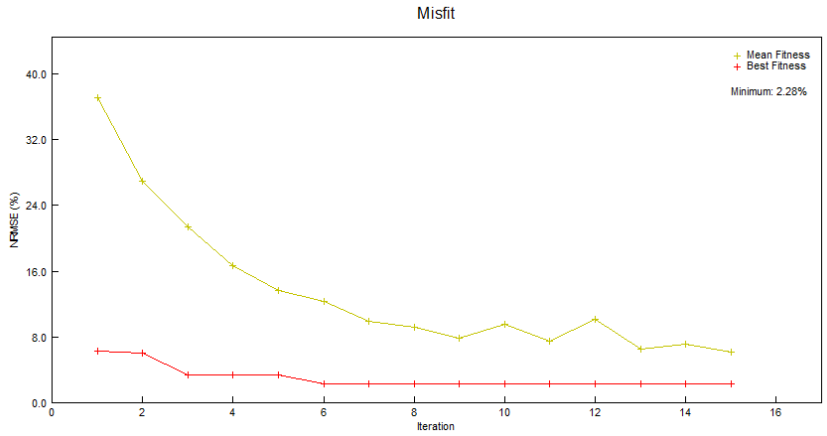


Final Model

Composite Dispersion Curve

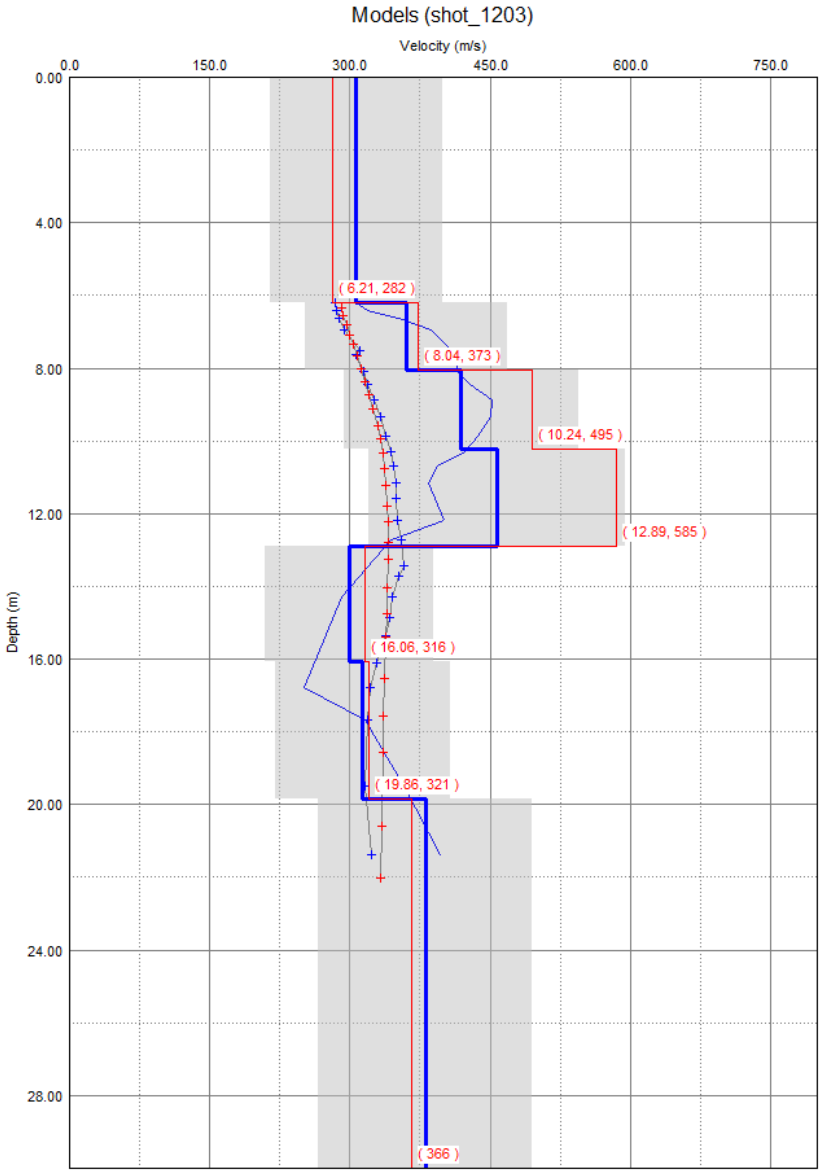


Plot of Misfit



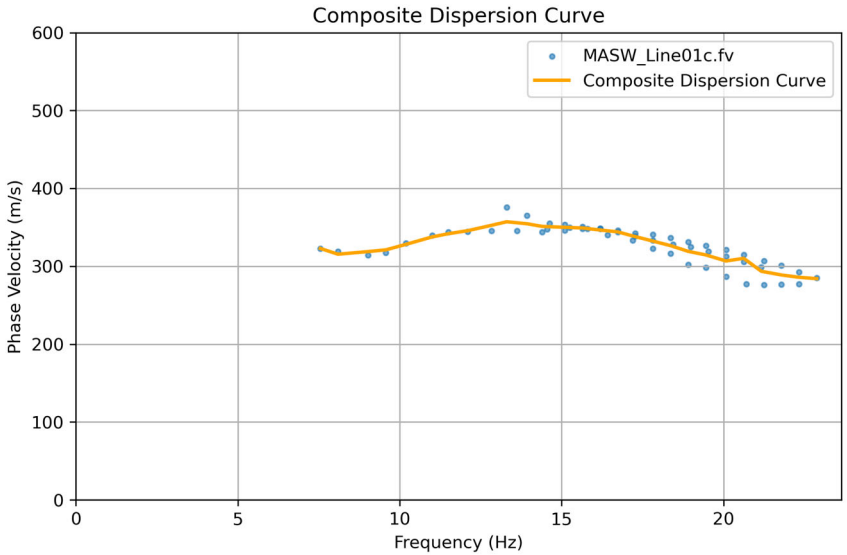
TITLE	MASW Line 01b Sounding	PROJECT				
PROJECT	Port Vila, Vanuatu Geophysics	DRAWN BY	OG	DATE	13/04/26	FIG
CLIENT	T+T	CHECKED BY	SL	DATE	13/04/26	08

Ground Model

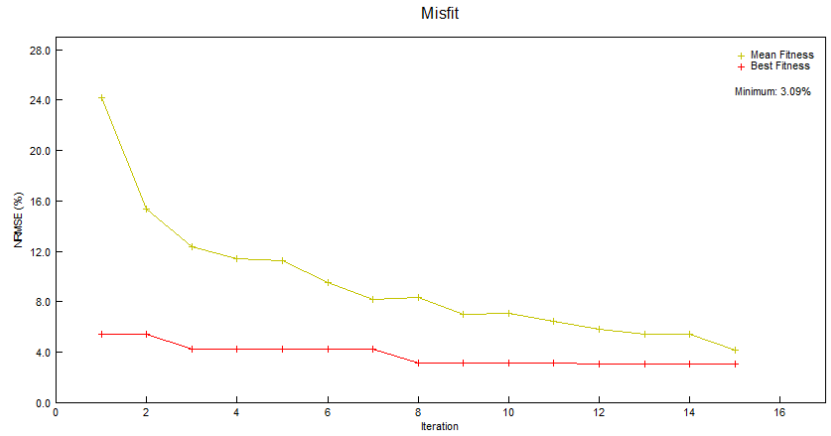


Final Model

Composite Dispersion Curve



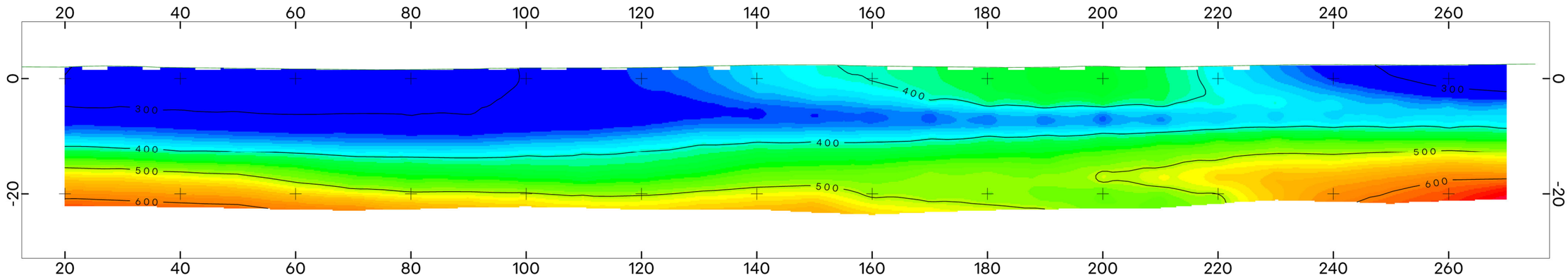
Plot of Misfit



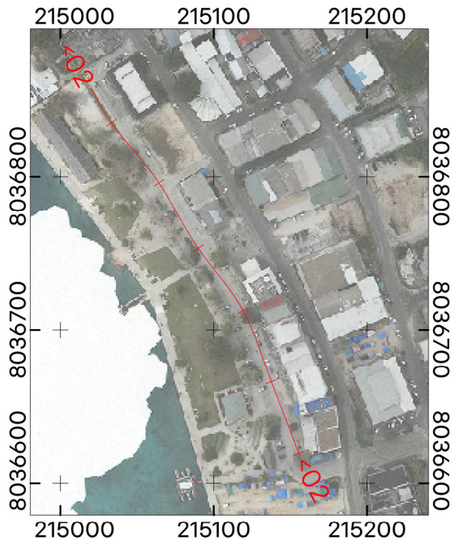
RDCL®	TITLE	MASW Line 01c Sounding	PROJECT	250306		
	PROJECT	Port Vila, Vanuatu Geophysics	DRAWN BY	OG	DATE	13/04/26	FIG
	CLIENT	T+T	CHECKED BY	SL	DATE	13/04/26	09

SOUTH EAST

NORTH WEST



GENERAL LOCATION PLAN:



SCALE:

Scale 1:750

10 0 10 20 30 40

metres

GENERAL LOCATION PLAN SCALE:

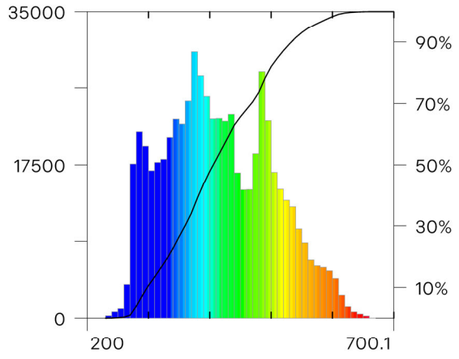
Scale 1:4000

100 0 100 200

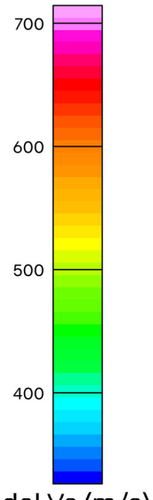
metres

WGS 84 / UTM zone 59S

GRID HISTOGRAM:



LEGEND:



Model Vs (m/s)

NOTES:

1. Imagery data provided to RDCL by the client.

CLIENT:

T+T

PROJECT:

PORT VILA, VANUATU
GEOPHYSICS

TITLE:

MASW LINE 02
PSEUDO Vs SECTION

INTERP. BY: OG	DATE: 08/04/2026	DRAWN BY: OG	DATE: 08/04/2026
CHECKED BY: SL	DATE: 08/04/2026	APPROVED BY: SJ	DATE: 08/04/2026

CONTRACT No.: 250306 FIGURE 10

FILE NAME: 250306.gpf
PLOTTED DRAWING SIZE: A3 (420 x 297)

RDCL
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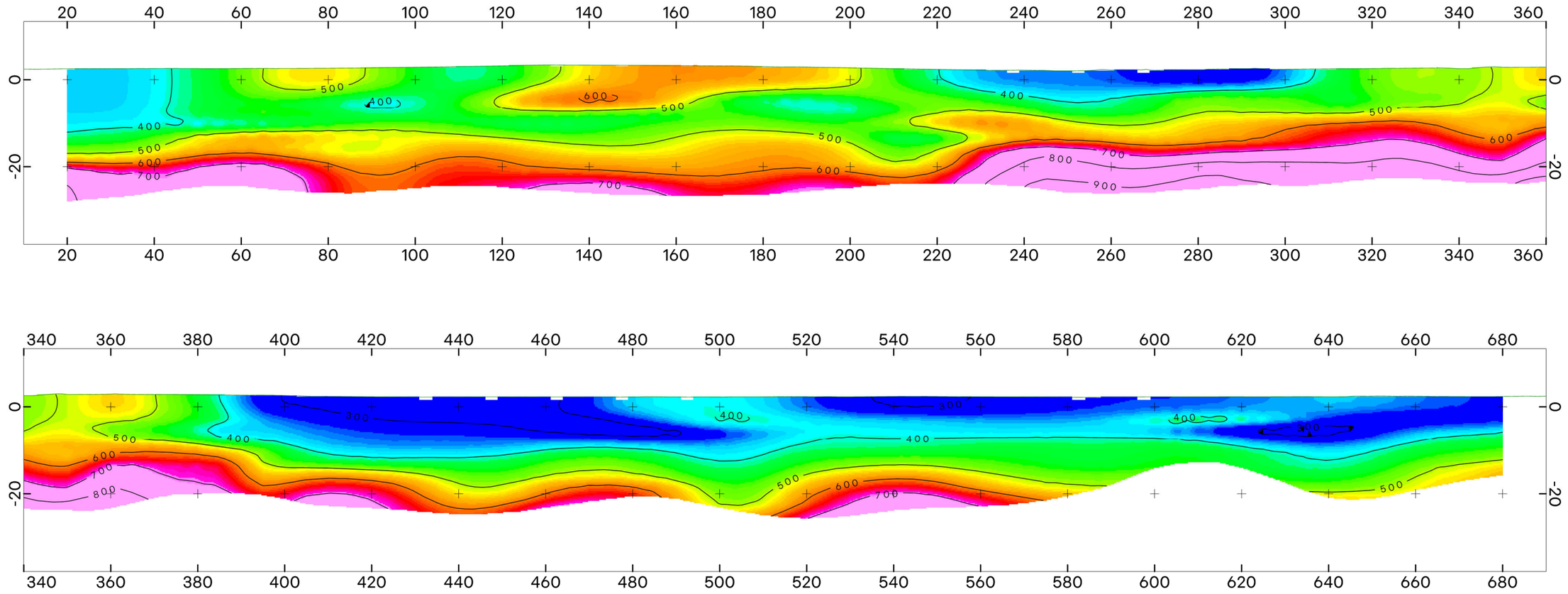
RDCL

NORTH WEST

SOUTH EAST



GENERAL LOCATION PLAN:



SCALE:

Scale 1:1000

20 0 20 40

metres

GENERAL LOCATION PLAN SCALE:

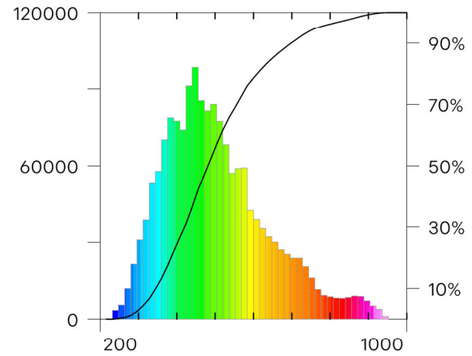
Scale 1:10000

200 0 200 400

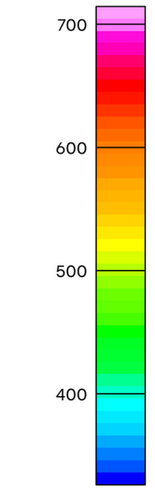
metres

WGS 84 / UTM zone 59S

GRID HISTOGRAM:



LEGEND:



Model Vs (m/s)

NOTES:

1. Imagery data provided to RDCL by the client.

CLIENT:

T+T

PROJECT:

PORT VILA, VANUATU
GEOPHYSICS

TITLE:

MASW LINE 03
PSEUDO Vs SECTION

INTERP. BY: OG	DATE: 07/04/2026	DRAWN BY: OG	DATE: 07/04/2026
CHECKED BY: SL	DATE: 07/04/2026	APPROVED BY: SJ	DATE: 07/04/2026

CONTRACT No.: 250306

FIGURE 11

FILE NAME: 2XXXXXXXXXX

PLOTTED DRAWING SIZE: A3 (420 x 297)

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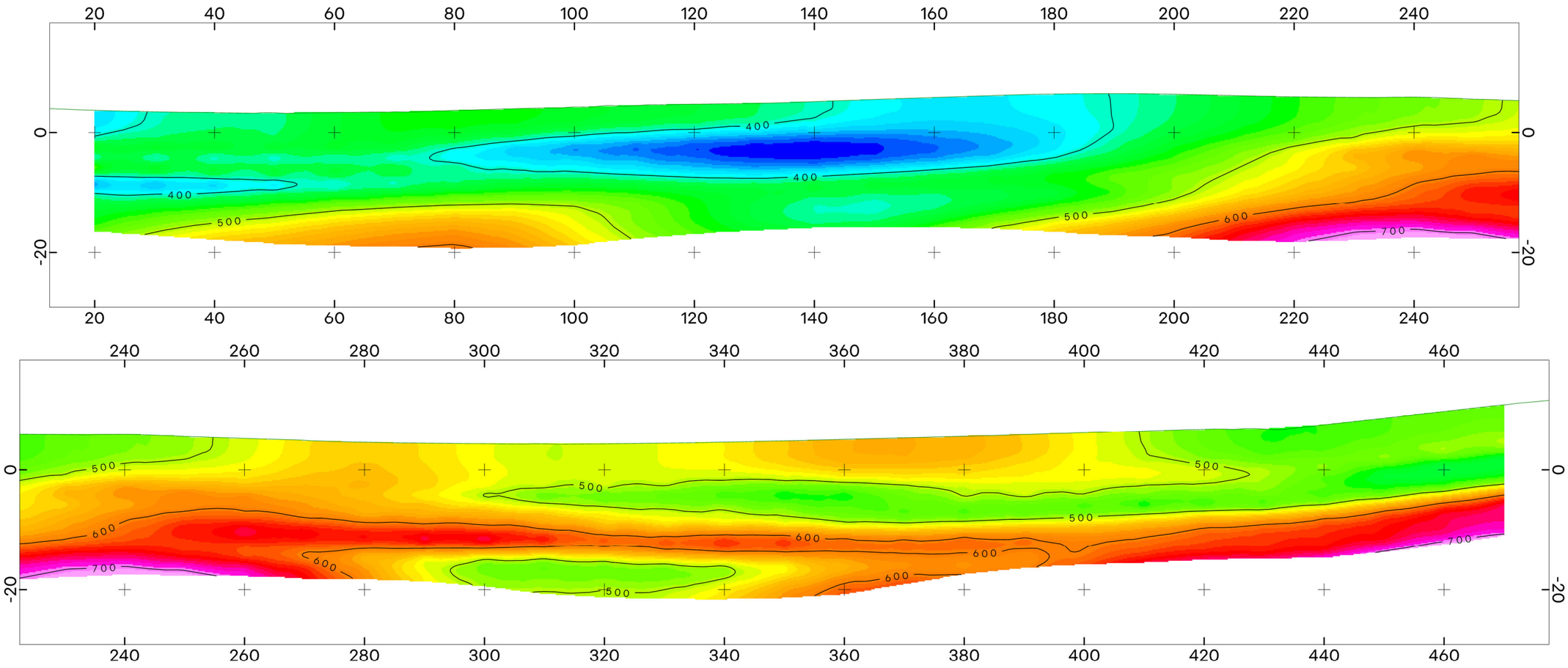
RDCL

SOUTH EAST

NORTH WEST



GENERAL LOCATION PLAN:



SCALE:

Scale 1:750

10 0 10 20 30 40

metres

GENERAL LOCATION PLAN SCALE:

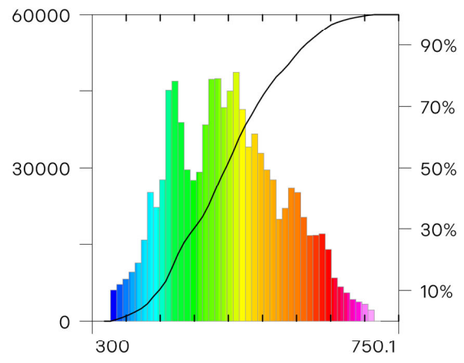
Scale 1:7500

100 0 100 200 300 400

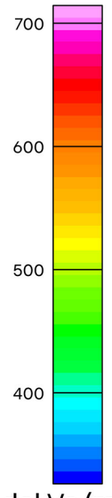
metres

WGS 84 / UTM zone 59S

GRID HISTOGRAM:



LEGEND:



Model Vs (m/s)

NOTES:

1. Imagery data provided to RDCL by the client.

CLIENT: T+T

PROJECT: PORT VILA, VANUATU GEOPHYSICS

TITLE: MASW LINE 04 PSEUDO Vs SECTION

INTERP. BY: OG	DATE: 08/04/2026	DRAWN BY: OG	DATE: 08/04/2026
CHECKED BY: SL	DATE: 08/04/2026	APPROVED BY: SJ	DATE: 08/04/2026

CONTRACT No.: 250306 FIGURE 12

FILE NAME: 250306.gpf

PLOTTED DRAWING SIZE: A3 (420 x 297)

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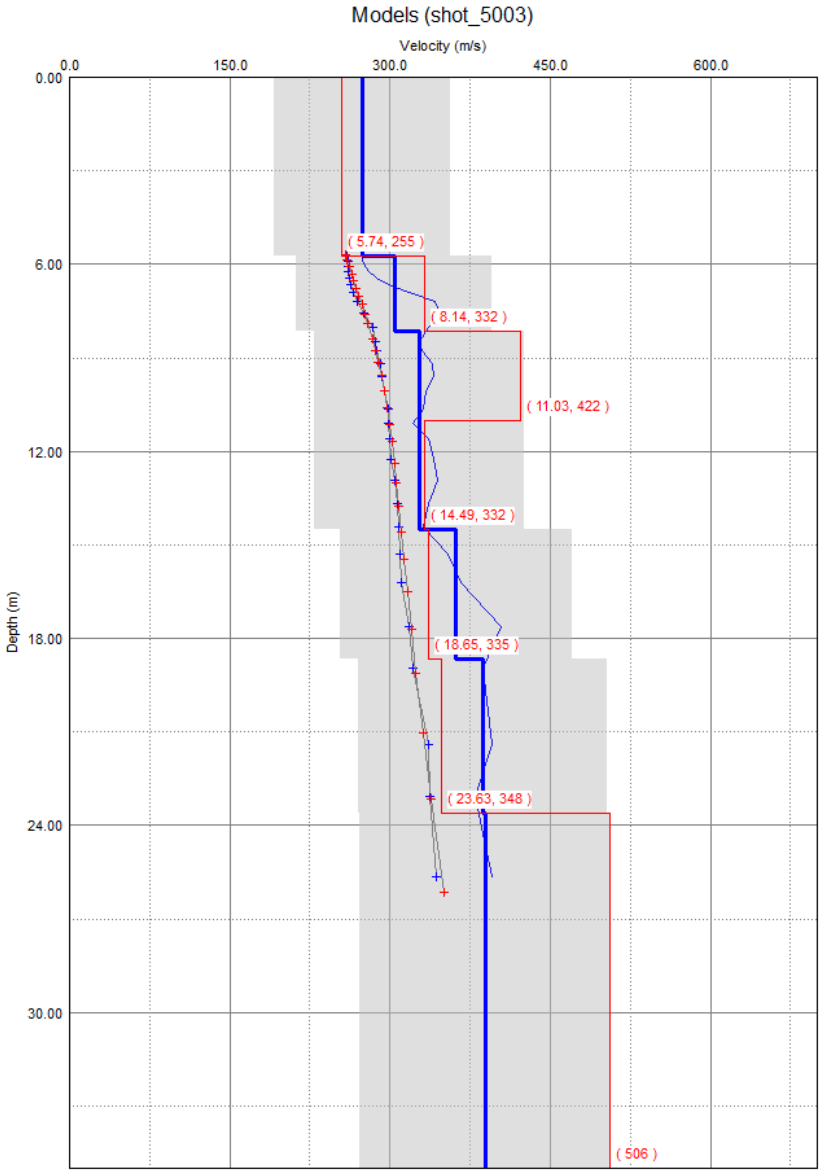
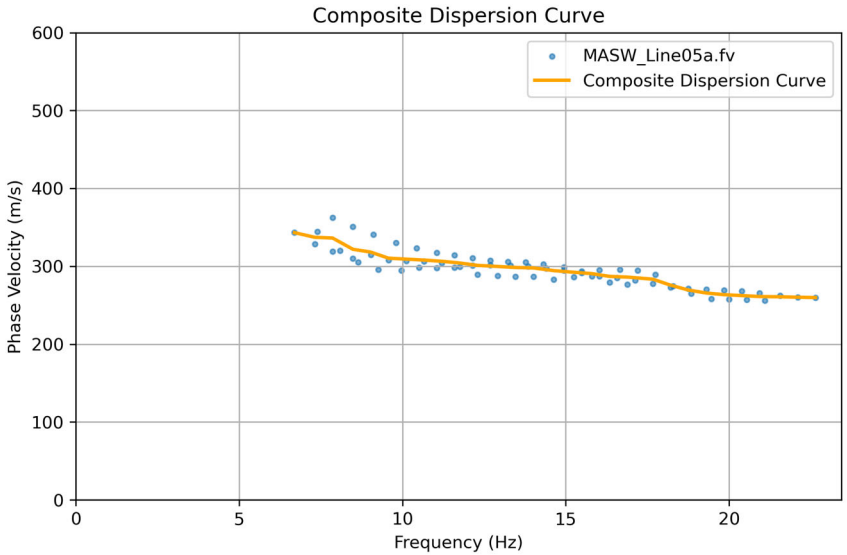
RDCL

Ground Model

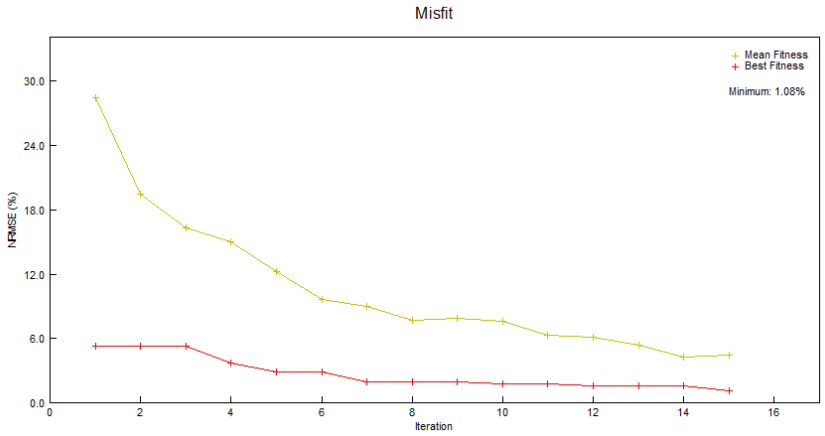


Final Model

Composite Dispersion Curve



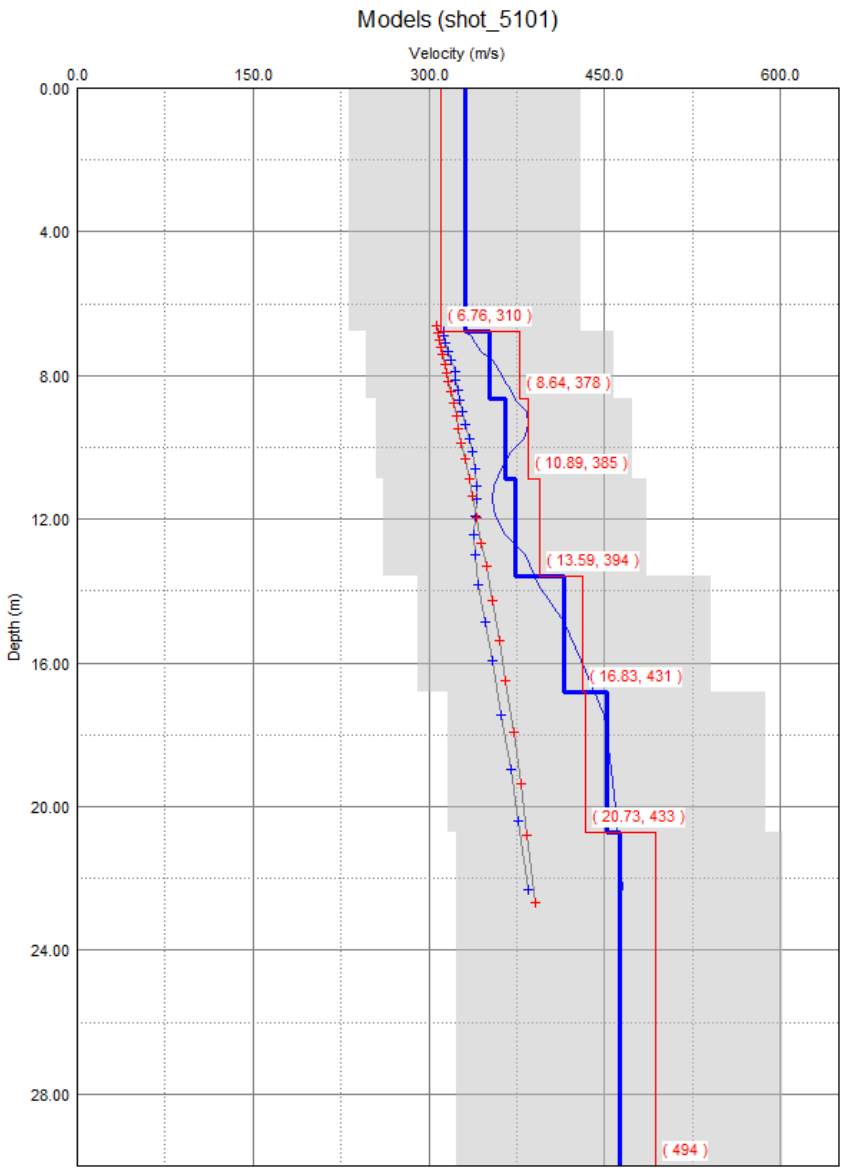
Plot of Misfit



RDCL®

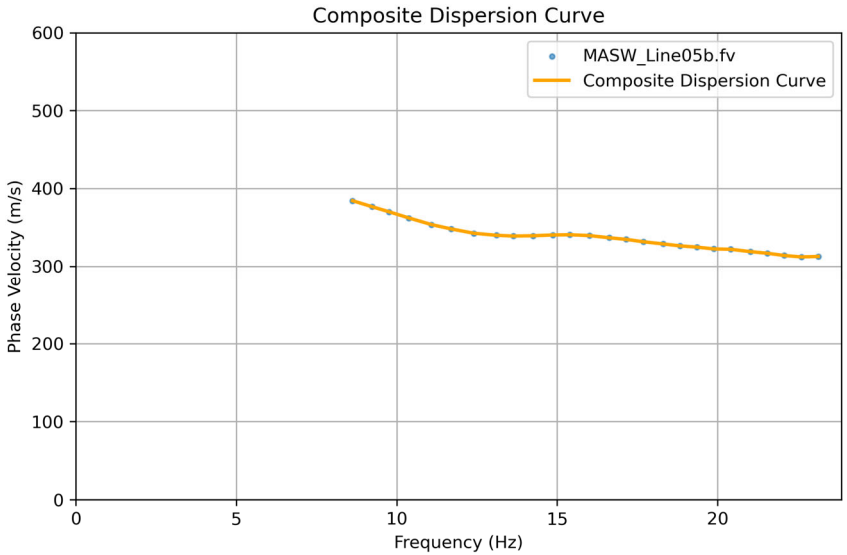
TITLE	MASW Line 05a Sounding	PROJECT	250306			
PROJECT	Port Vila, Vanuatu Geophysics	DRAWN BY	OG	DATE	13/04/26	FIG
CLIENT	T+T	CHECKED BY	SL	DATE	13/04/26	13

Ground Model

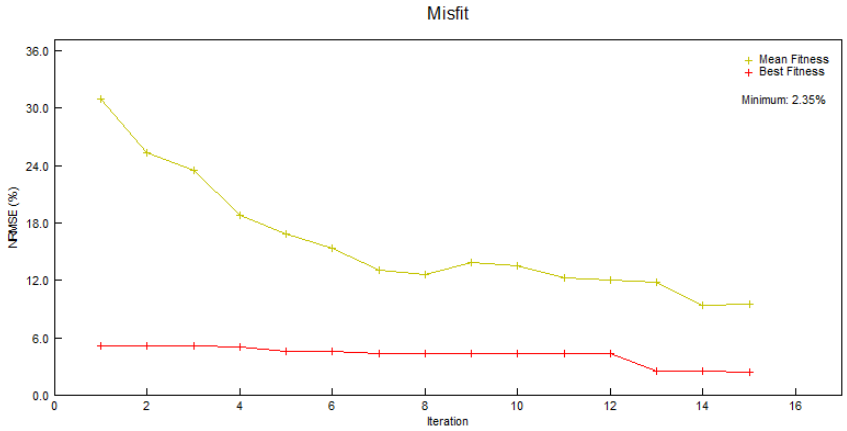


Final Model

Composite Dispersion Curve

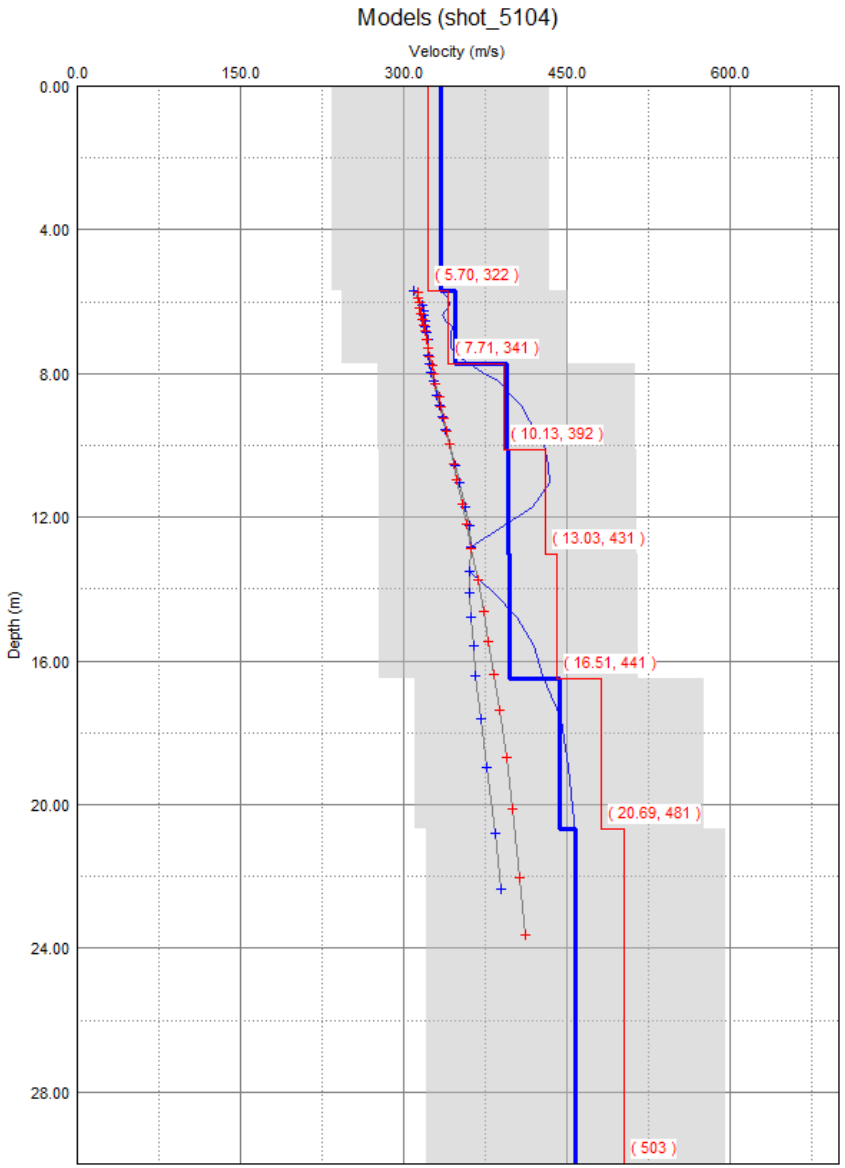


Plot of Misfit



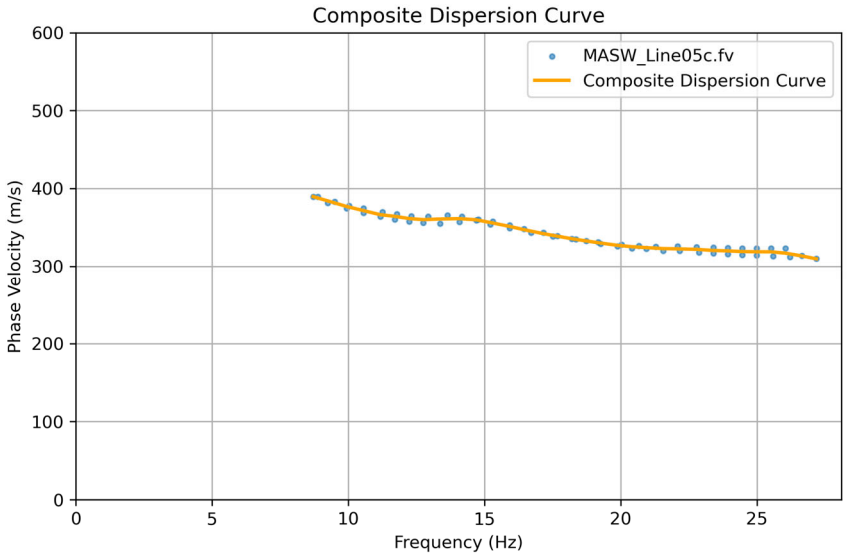
RDCL®	TITLE	MASW Line 05b Sounding	PROJECT	250306		
	PROJECT	Port Vila, Vanuatu Geophysics	DRAWN BY	OG	DATE	13/04/26	FIG
	CLIENT	T+T	CHECKED BY	SL	DATE	13/04/26	14

Ground Model

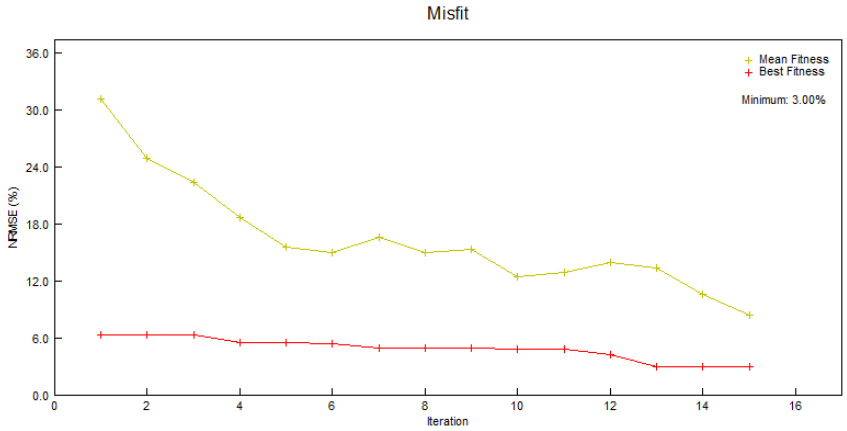


Final Model

Composite Dispersion Curve

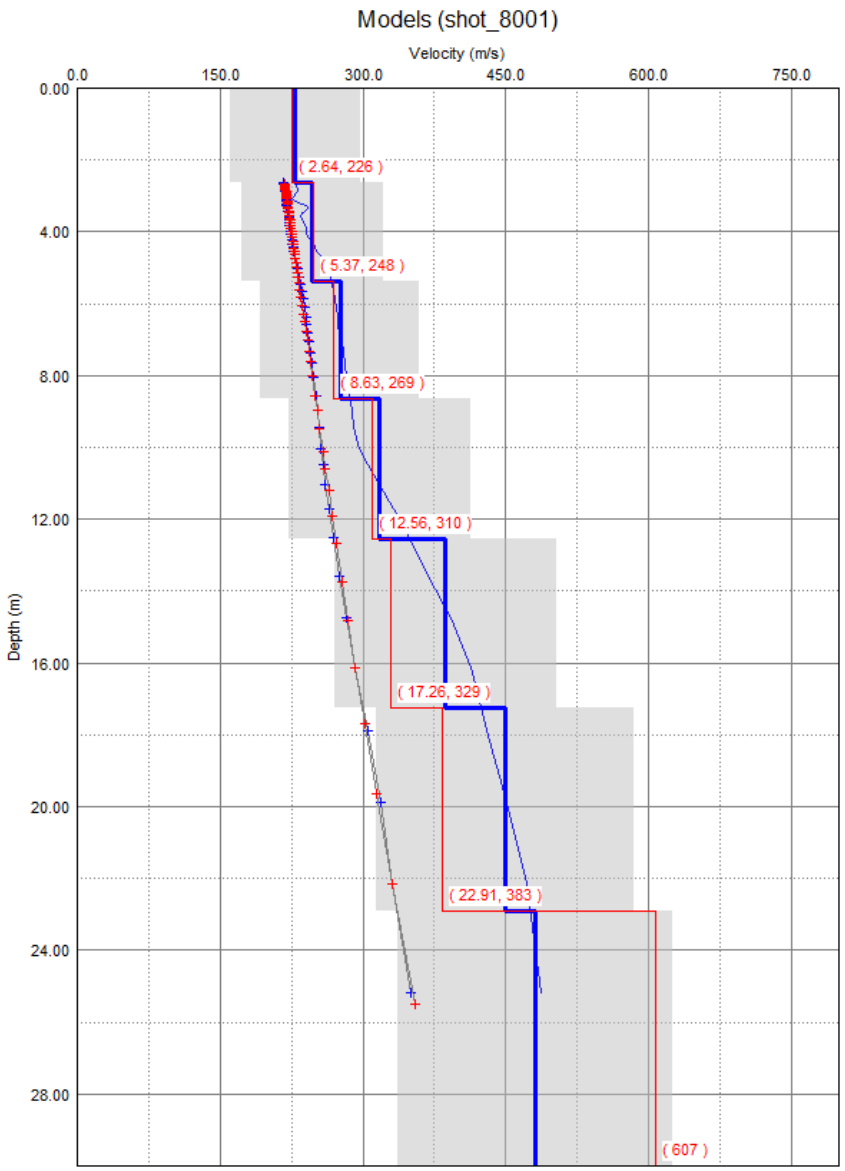


Plot of Misfit



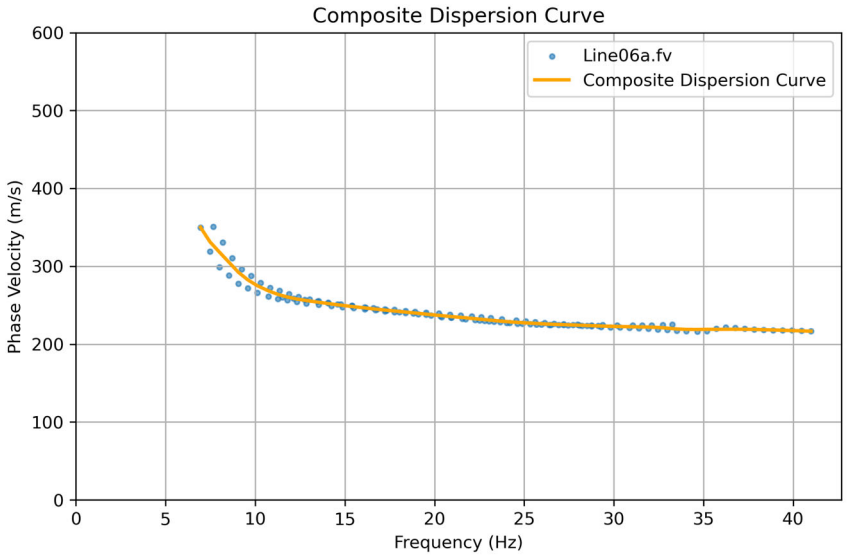
RDCL®	TITLE	MASW Line 05c Sounding	PROJECT	250306		
	PROJECT	Port Vila, Vanuatu Geophysics	DRAWN BY	OG	DATE	13/04/26	FIG
	CLIENT	T+T	CHECKED BY	SL	DATE	13/04/26	15

Ground Model

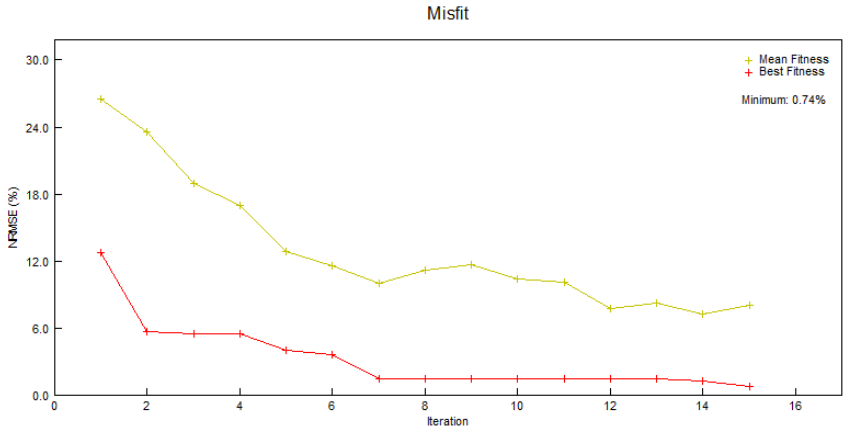


Final Model

Composite Dispersion Curve

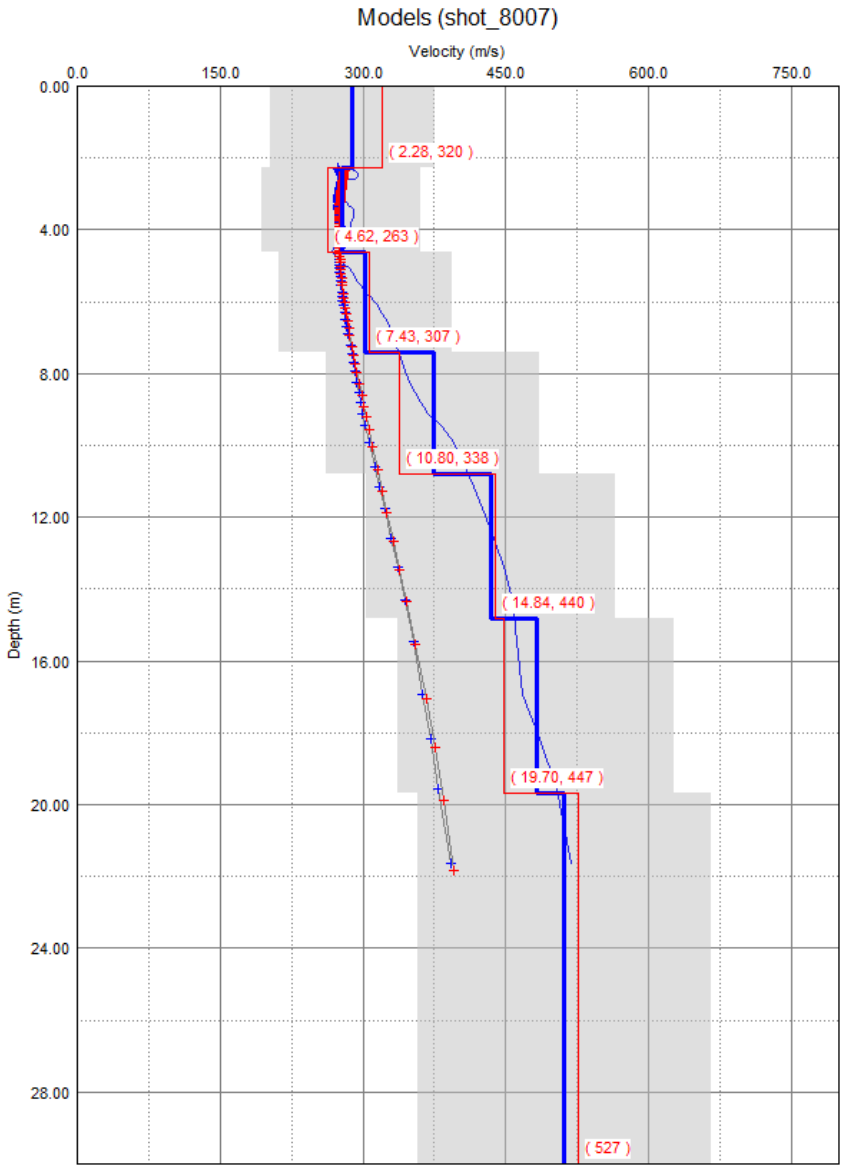


Plot of Misfit



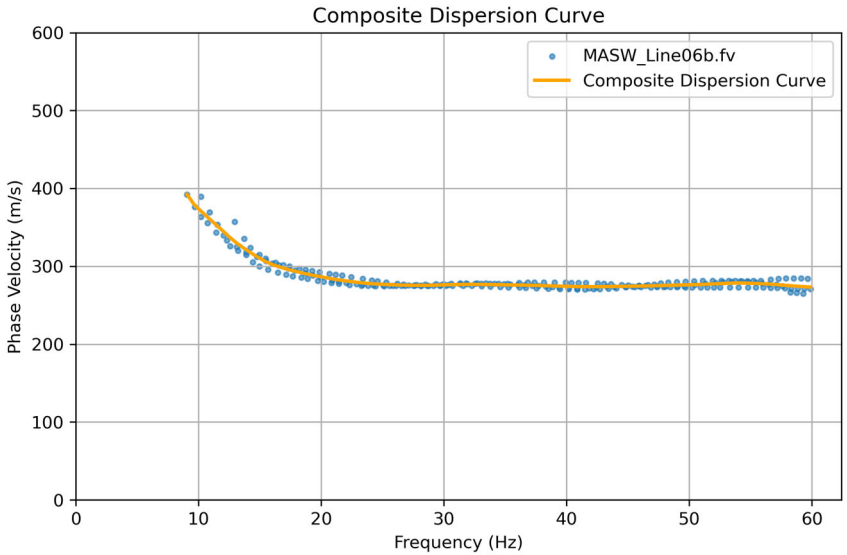
RDCL®	TITLE	MASW Line 06a Sounding	PROJECT	250306		
	PROJECT	Port Vila, Vanuatu Geophysics	DRAWN BY	OG	DATE	13/04/26	FIG
	CLIENT	T+T	CHECKED BY	SL	DATE	13/04/26	16

Ground Model

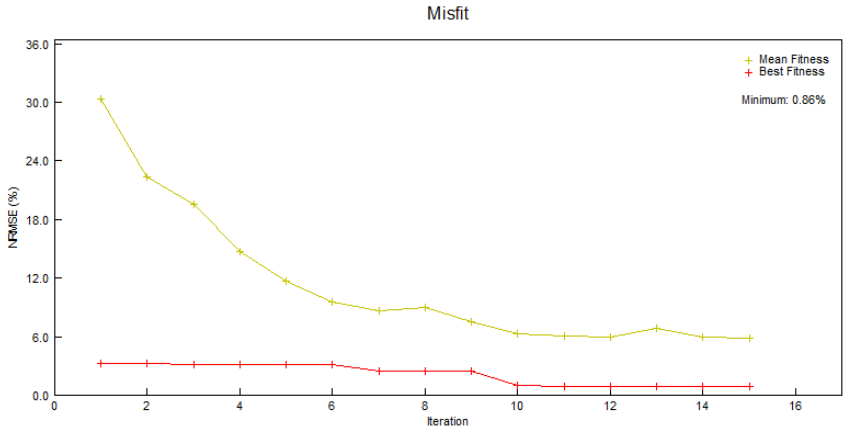


Final Model

Composite Dispersion Curve

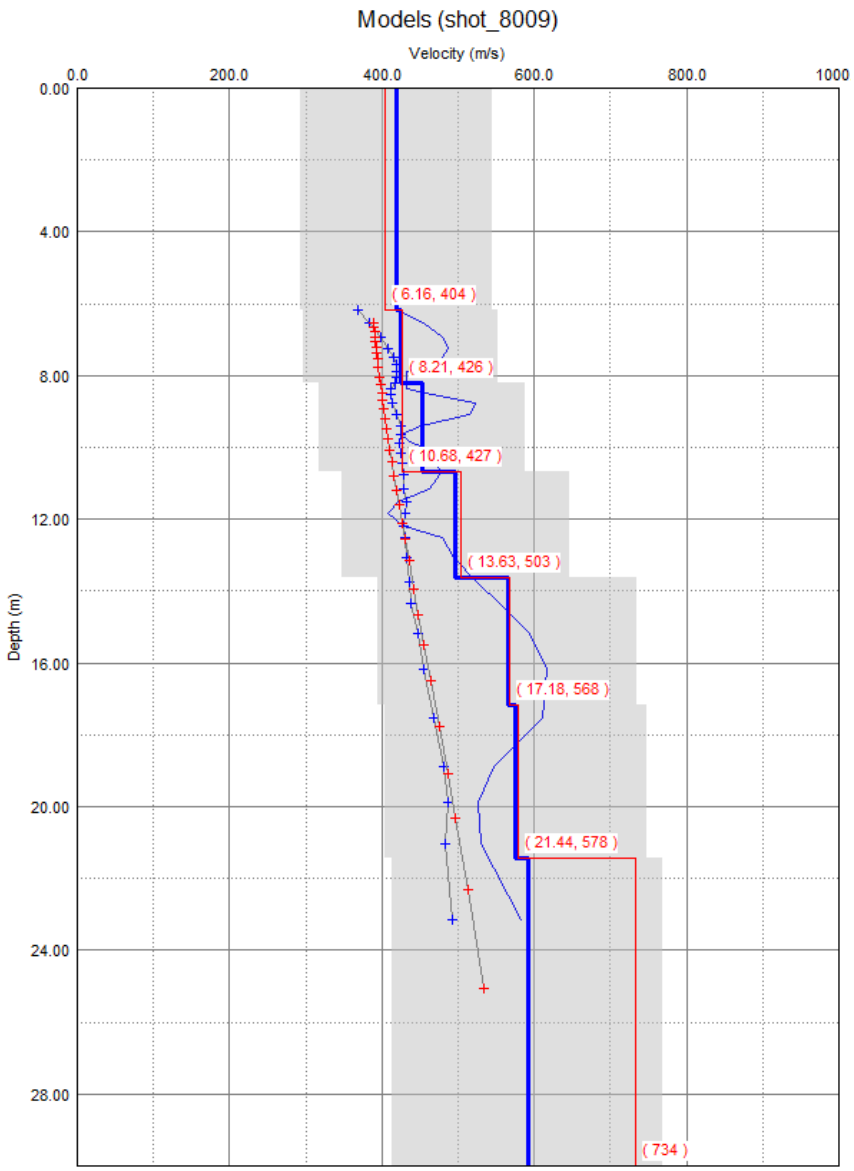


Plot of Misfit



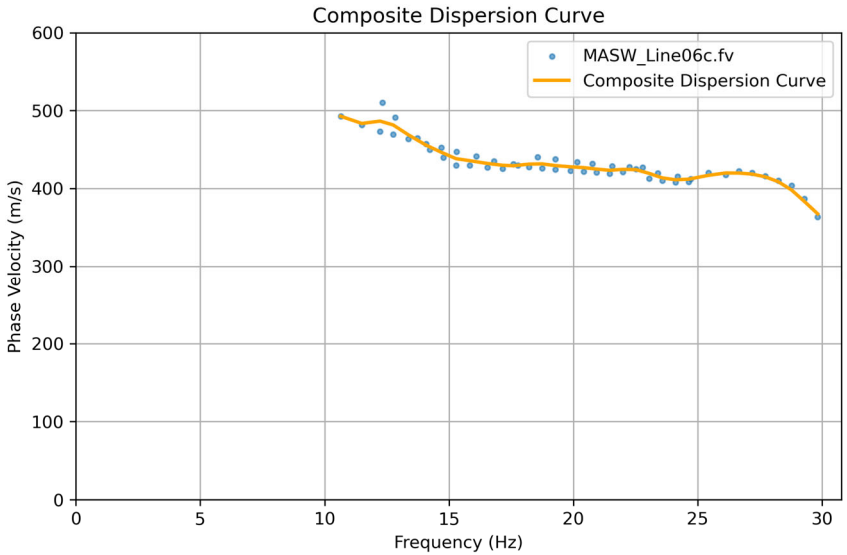
RDCL®	TITLE	MASW Line 06b Sounding	PROJECT	250306		
	PROJECT	Port Vila, Vanuatu Geophysics	DRAWN BY	OG	DATE	13/04/26	FIG
	CLIENT	T+T	CHECKED BY	SL	DATE	13/04/26	17

Ground Model

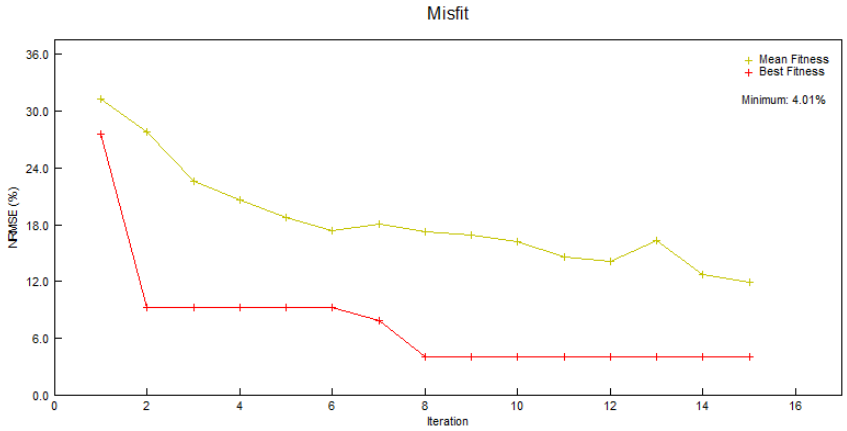


Final Model

Composite Dispersion Curve



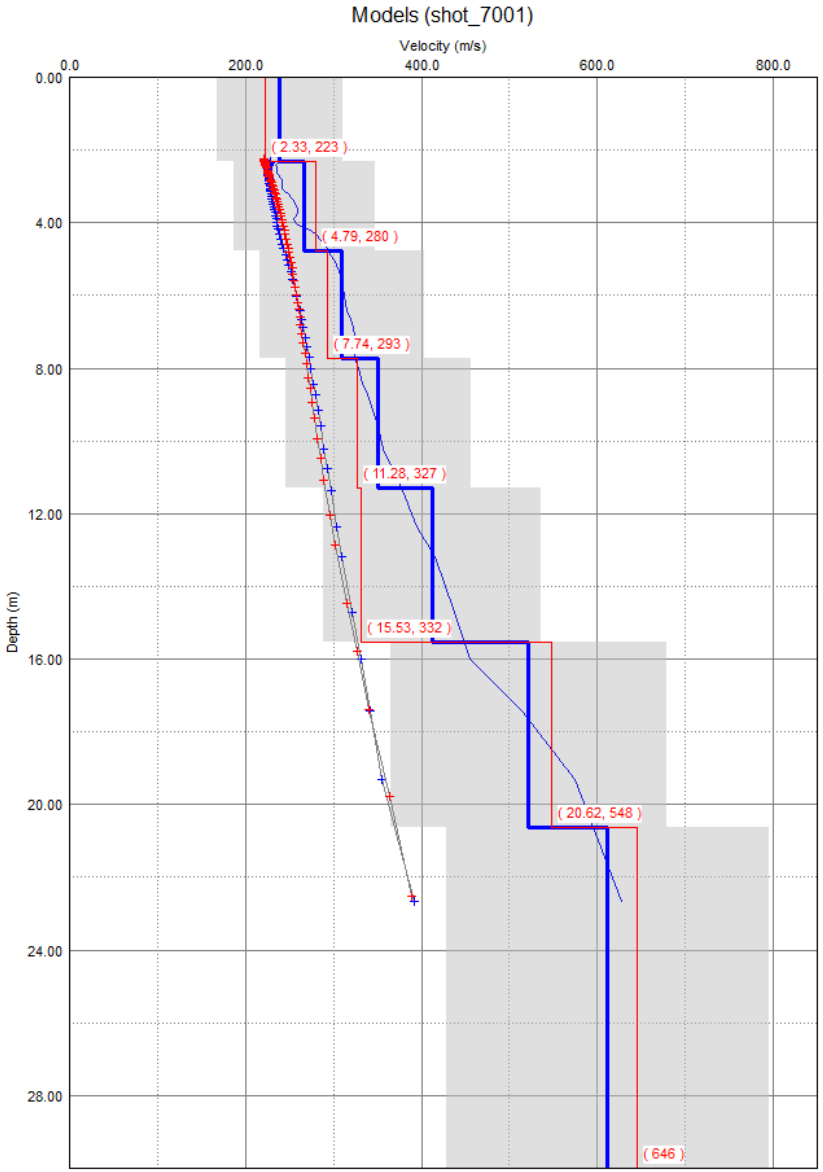
Plot of Misfit



RDCL®

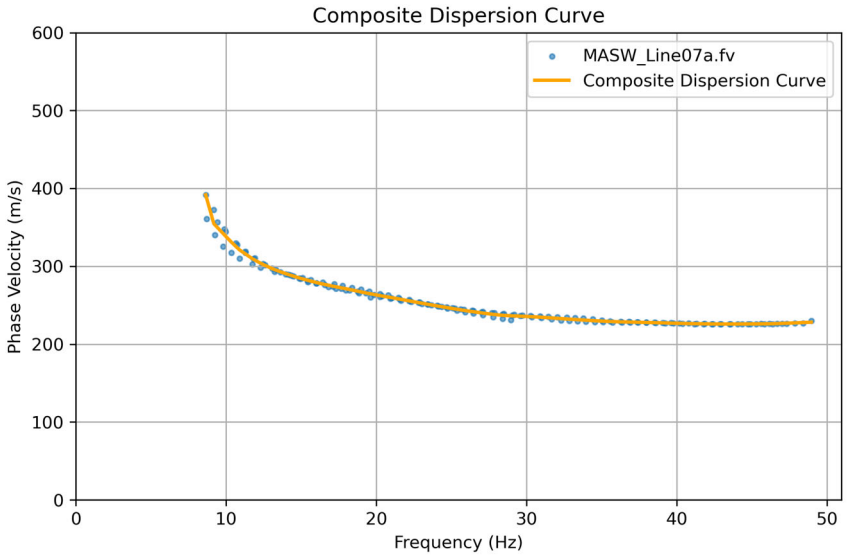
TITLE	MASW Line 06c Sounding	PROJECT	250306			
PROJECT	Port Vila, Vanuatu Geophysics	DRAWN BY	OG	DATE	13/04/26	FIG
CLIENT	T+T	CHECKED BY	SL	DATE	13/04/26	18

Ground Model

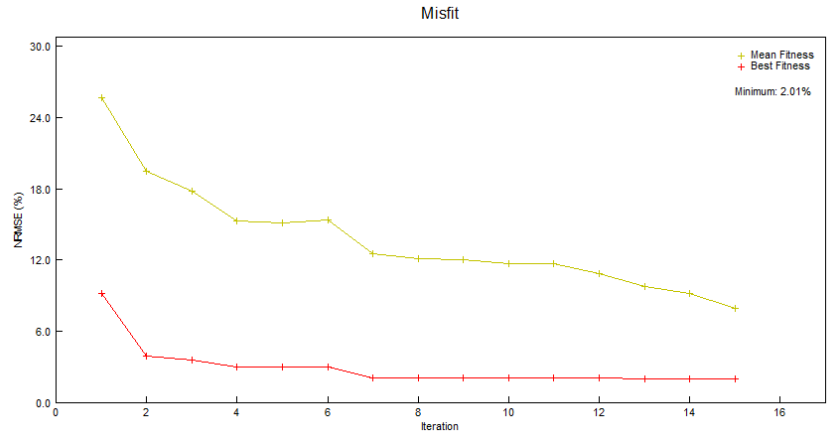


Final Model

Composite Dispersion Curve



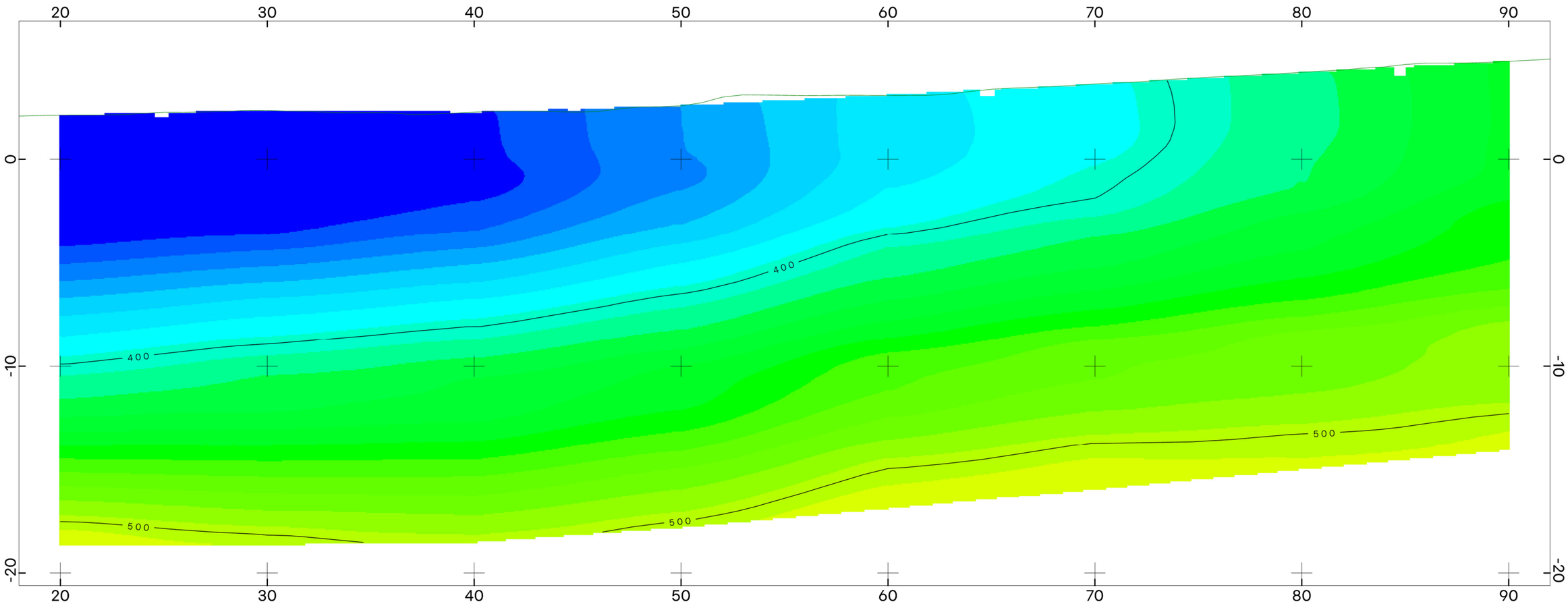
Plot of Misfit



RDCL®	TITLE	MASW Line 07a Sounding	PROJECT	250306		
	PROJECT	Port Vila, Vanuatu Geophysics	DRAWN BY	OG	DATE	13/04/26	FIG
	CLIENT	T+T	CHECKED BY	SL	DATE	13/04/26	19

WEST

EAST



GENERAL LOCATION PLAN:



SCALE:

Scale 1:200

5 0 5 10

metres

GENERAL LOCATION PLAN SCALE:

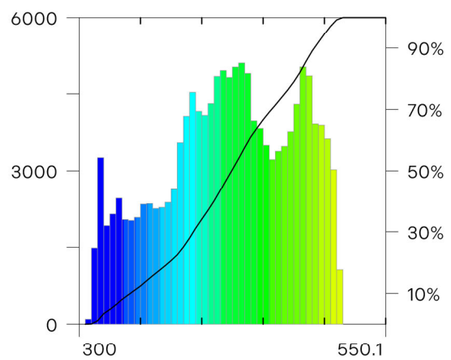
Scale 1:1500

25 0 25 50 75

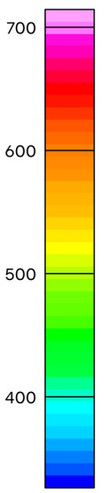
metres

WGS 84 / UTM zone 59S

GRID HISTOGRAM:



LEGEND:



Model Vs (m/s)

NOTES:

1. Imagery data provided to RDCL by the client.

CLIENT: T+T

PROJECT: PORT VILA, VANUATU
GEOPHYSICS

TITLE: MASW LINE 07b
PSEUDO Vs SECTION

INTERP. BY: OG	DATE: 12/04/2026	DRAWN BY: OG	DATE: 12/04/2026
CHECKED BY: SL	DATE: 12/04/2026	APPROVED BY: SJ	DATE: 12/04/2026

CONTRACT No.: 250306 FIGURE 20

FILE NAME: 250306.gpf
PLOTTED DRAWING SIZE: A3 (420 x 297)

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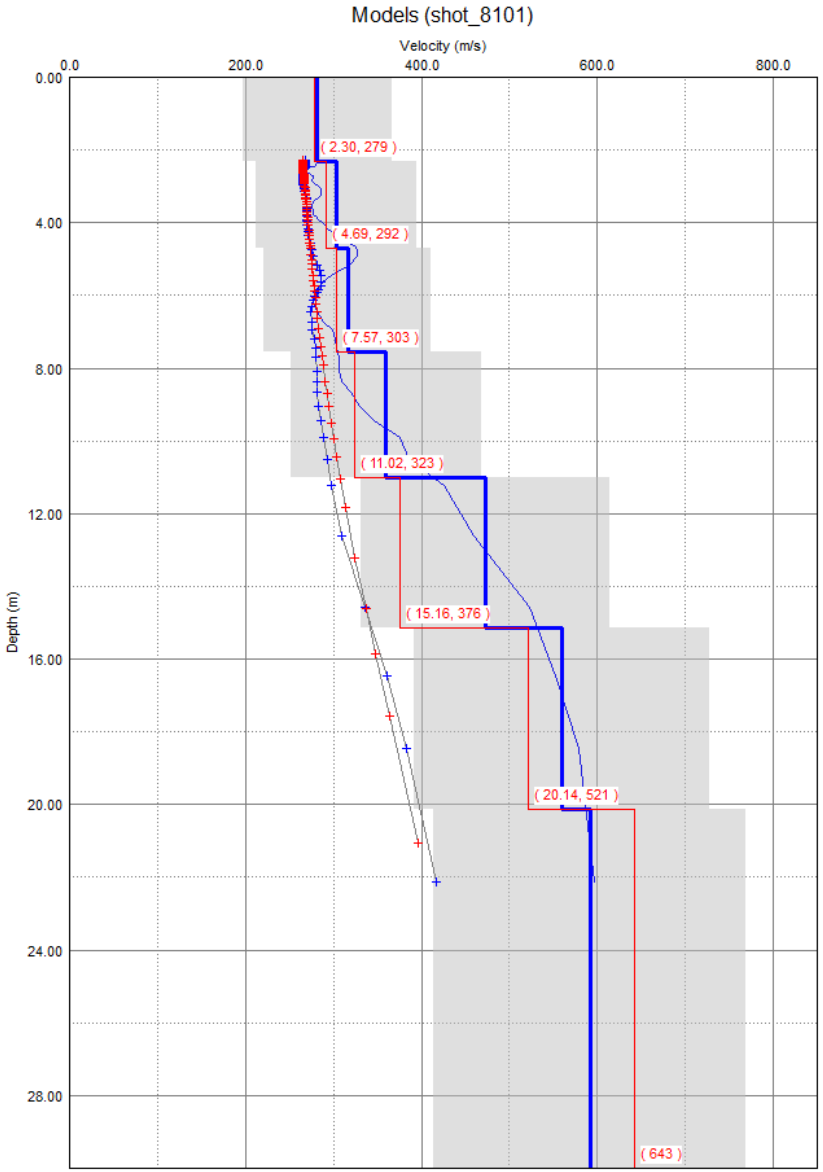
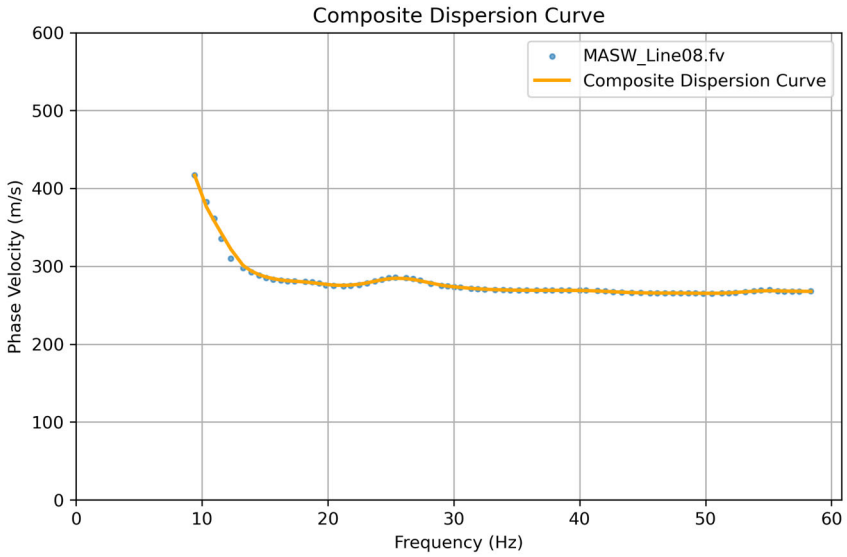
RDCL

Ground Model

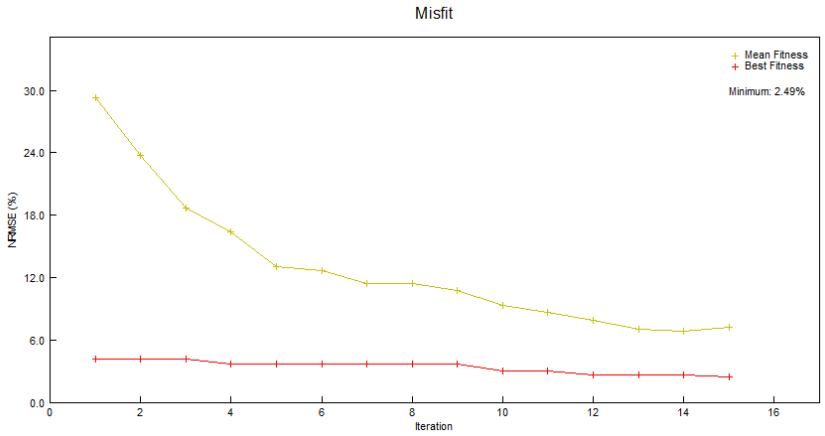


Final Model

Composite Dispersion Curve



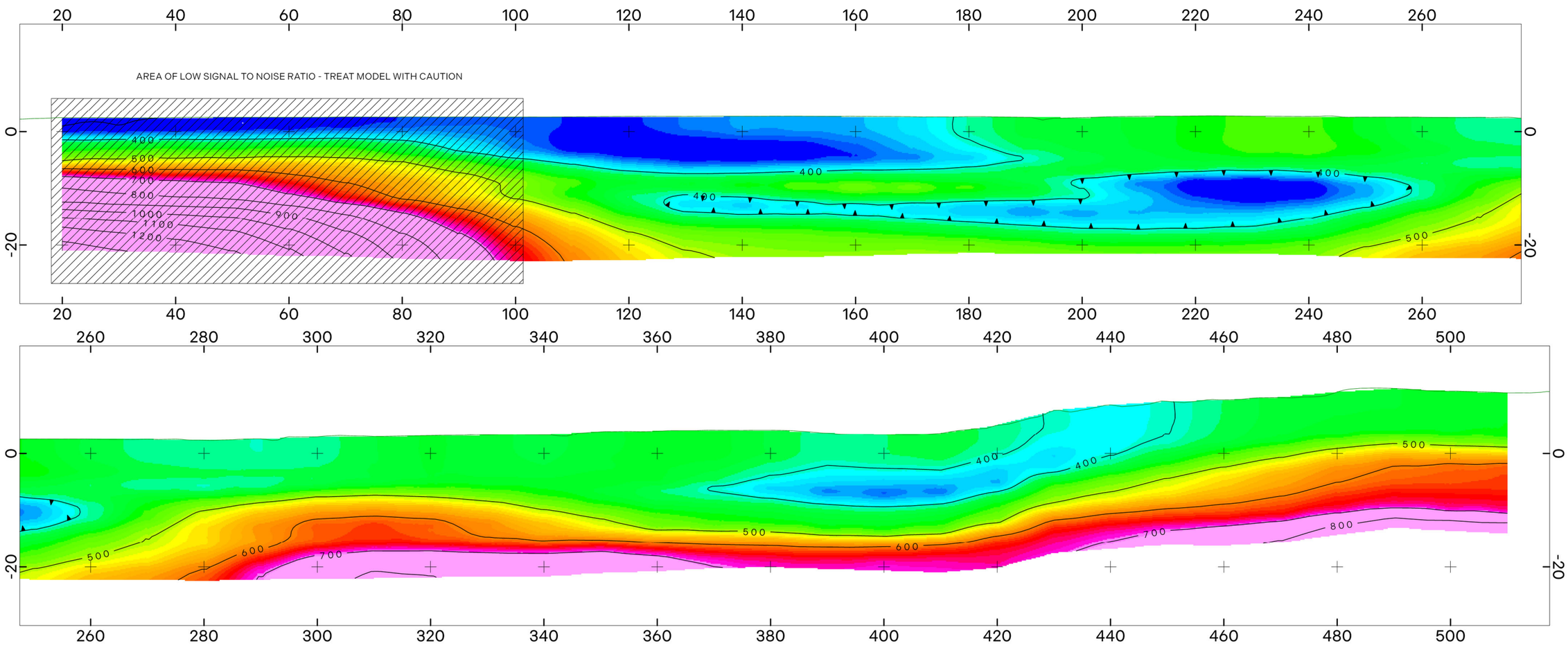
Plot of Misfit



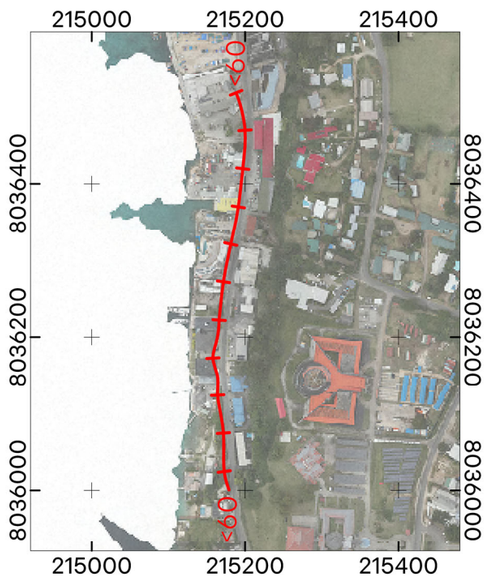
TITLE	MASW Line 08 Sounding	PROJECT	250306			
PROJECT	Port Vila, Vanuatu Geophysics	DRAWN BY	OG	DATE	13/04/26	FIG
CLIENT	T+T	CHECKED BY	SL	DATE	13/04/26	21

NORTH WEST

SOUTH EAST



GENERAL LOCATION PLAN:



SCALE:

Scale 1:750

10 0 10 20 30 40

metres

GENERAL LOCATION PLAN SCALE:

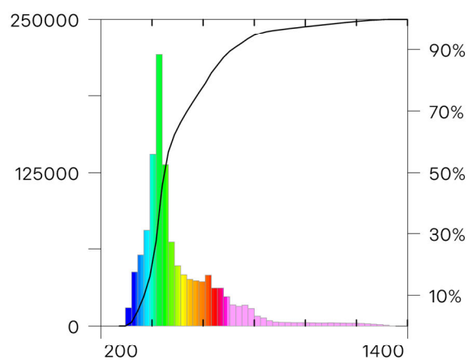
Scale 1:8000

200 0 200 400

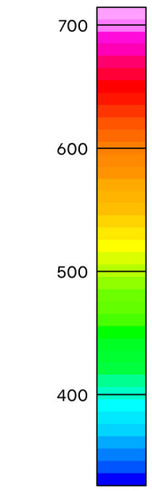
metres

WGS 84 / UTM zone 59S

GRID HISTOGRAM:



LEGEND:



Model Vs (m/s)

NOTES:

1. Imagery data provided to RDCL by the client.

CLIENT: T+T

PROJECT: PORT VILA, VANUATU GEOPHYSICS

TITLE: MASW LINE 09 PSEUDO Vs SECTION

INTERP. BY: OG	DATE: 09/04/2026	DRAWN BY: OG	DATE: 09/04/2026
CHECKED BY: SL	DATE: 09/04/2026	APPROVED BY: SJ	DATE: 09/04/2026

CONTRACT No.: 250306 FIGURE 22

FILE NAME: 250306.gpf

PLOTTED DRAWING SIZE: A3 (420 x 297)

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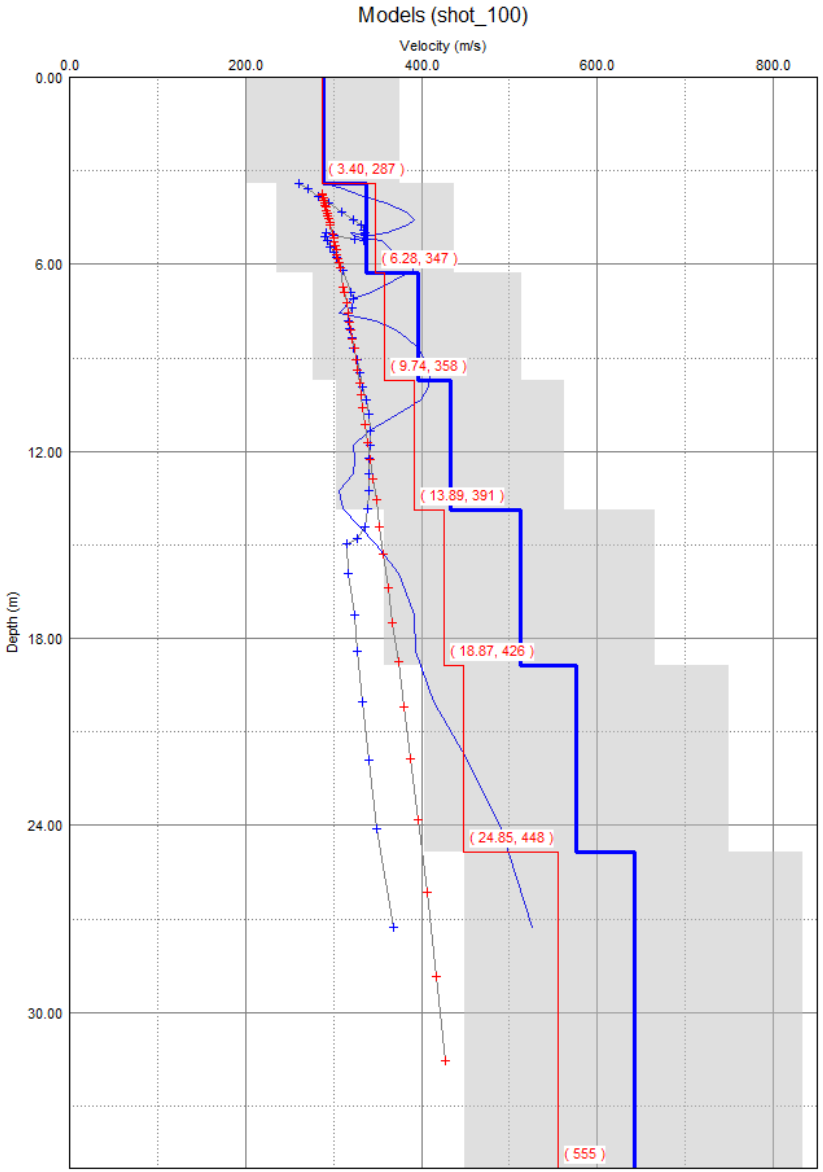
Email: info@rdcl.co.nz www.rdcl.co.nz

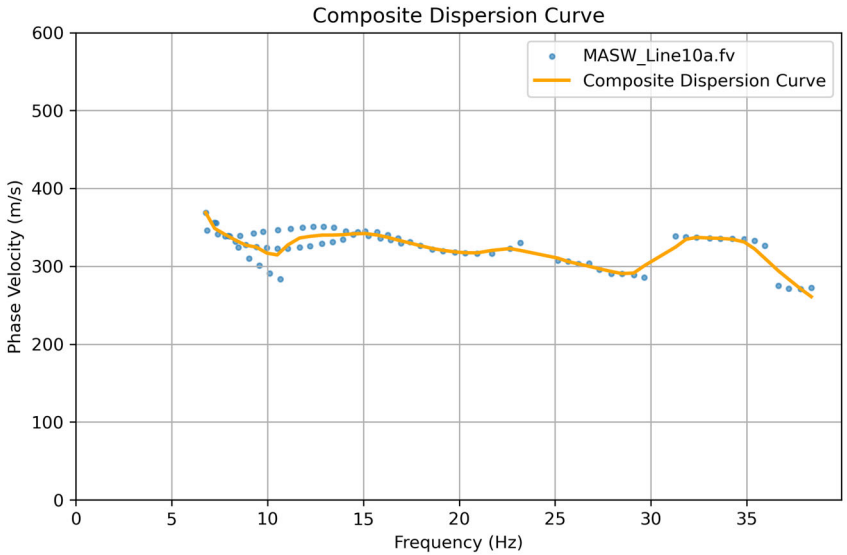
RDCL

Ground Model

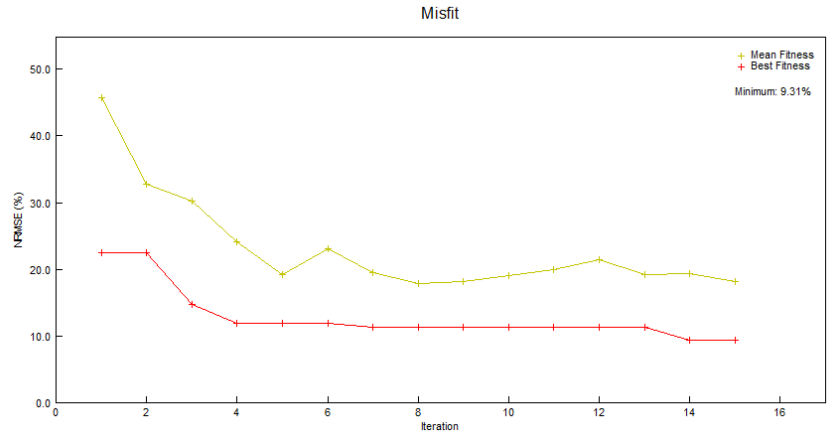


Final Model

Composite Dispersion Curve

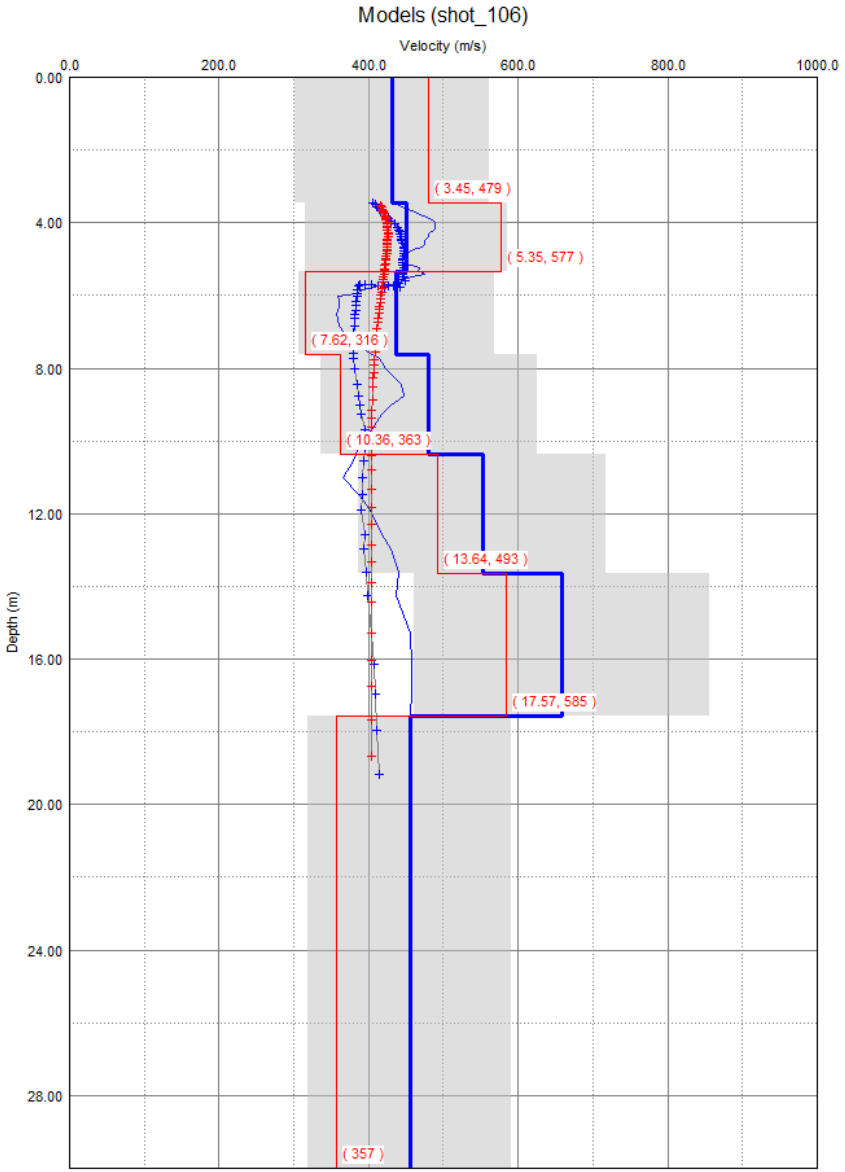


Plot of Misfit



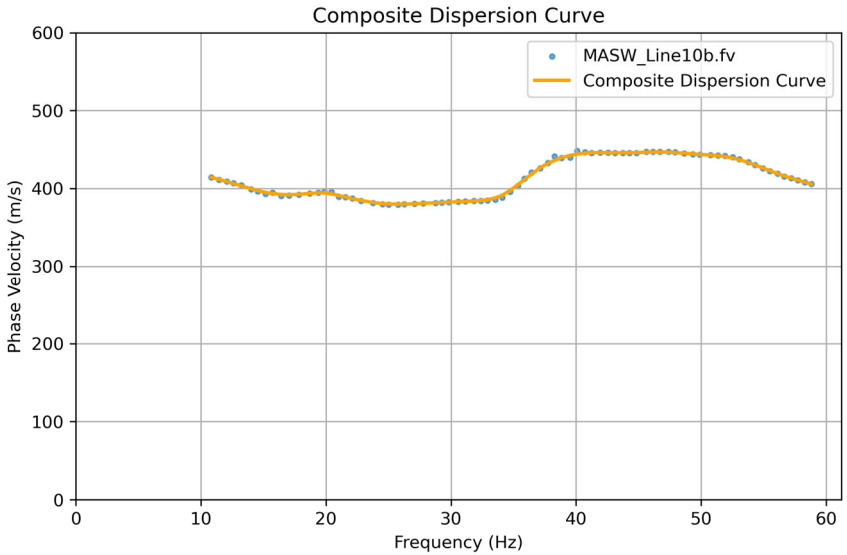
RDCL®	TITLE	MASW Line 10a Sounding	PROJECT	250306		
	PROJECT	Port Vila, Vanuatu Geophysics	DRAWN BY	OG	DATE	13/04/26	FIG
	CLIENT	T+T	CHECKED BY	SL	DATE	13/04/26	23

Ground Model

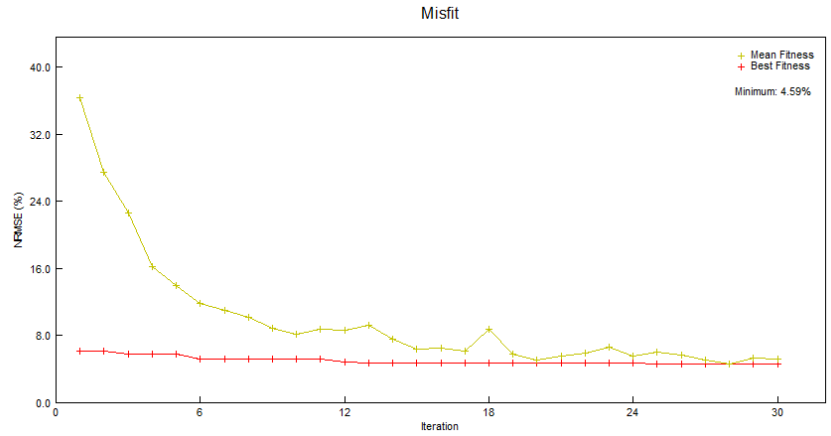


Final Model

Composite Dispersion Curve



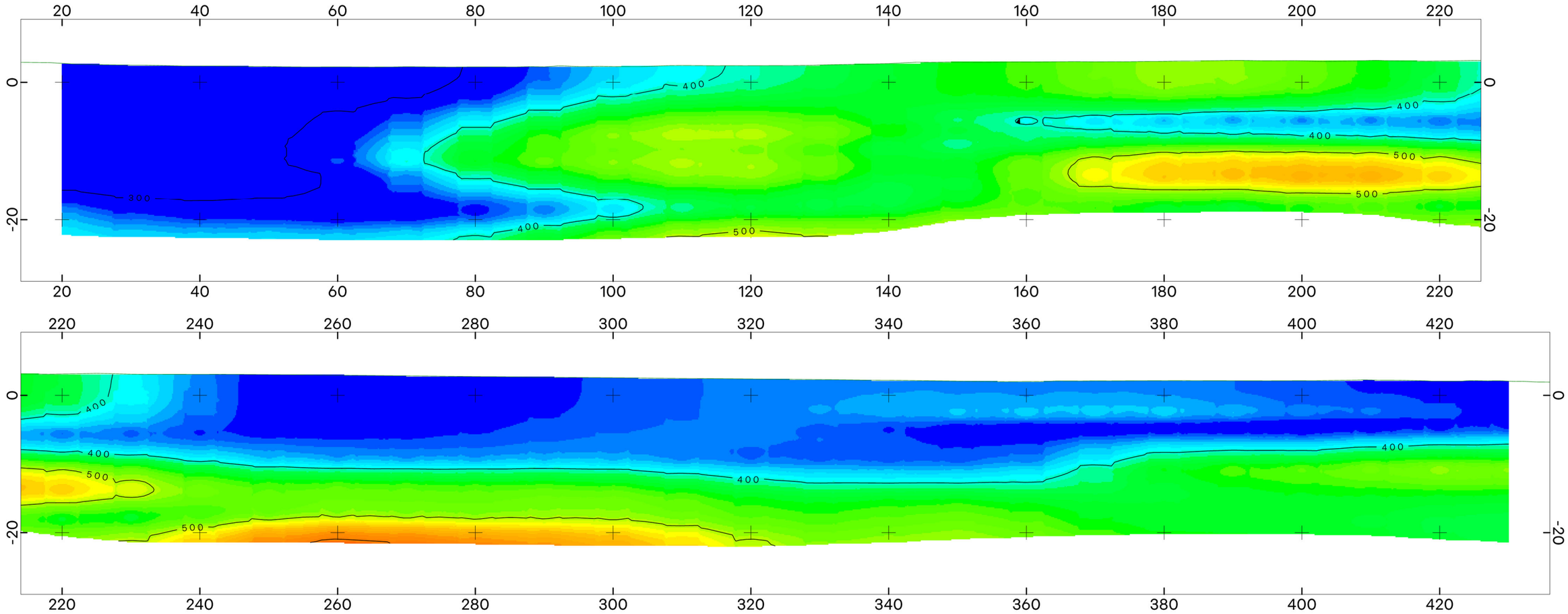
Plot of Misfit



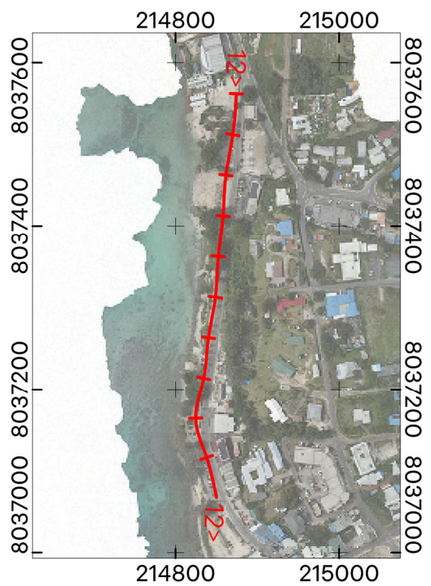
RDCL®	TITLE	MASW Line 10b Sounding	PROJECT	250306		
	PROJECT	Port Vila, Vanuatu Geophysics	DRAWN BY	OG	DATE	13/04/26	FIG
	CLIENT	T+T	CHECKED BY	SL	DATE	13/04/26	24

NORTH WEST

SOUTH EAST



GENERAL LOCATION PLAN:



SCALE:

Scale 1:600

10 0 10 20 30

metres

GENERAL LOCATION PLAN SCALE:

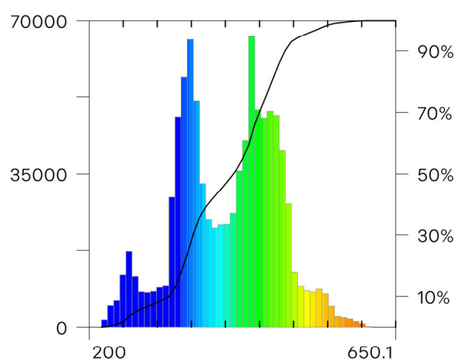
Scale 1:7500

100 0 100 200 300 400

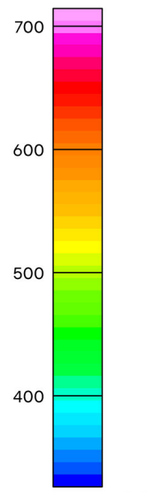
metres

WGS 84 / UTM zone 59S

GRID HISTOGRAM:



LEGEND:



NOTES:

1. Imagery data provided to RDCL by the client.

CLIENT: T+T

PROJECT: PORT VILA, VANUATU GEOPHYSICS

TITLE: MASW LINE 12 PSEUDO Vs SECTION

INTERP. BY: OG	DATE: 10/04/2026	DRAWN BY: OG	DATE: 10/04/2026
CHECKED BY: SL	DATE: 10/04/2026	APPROVED BY: SJ	DATE: 10/04/2026

CONTRACT No.: 250306 FIGURE 24

FILE NAME: 250306.gpf

PLOTTED DRAWING SIZE: A3 (420 x 297)

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Porirua, Wellington, New Zealand
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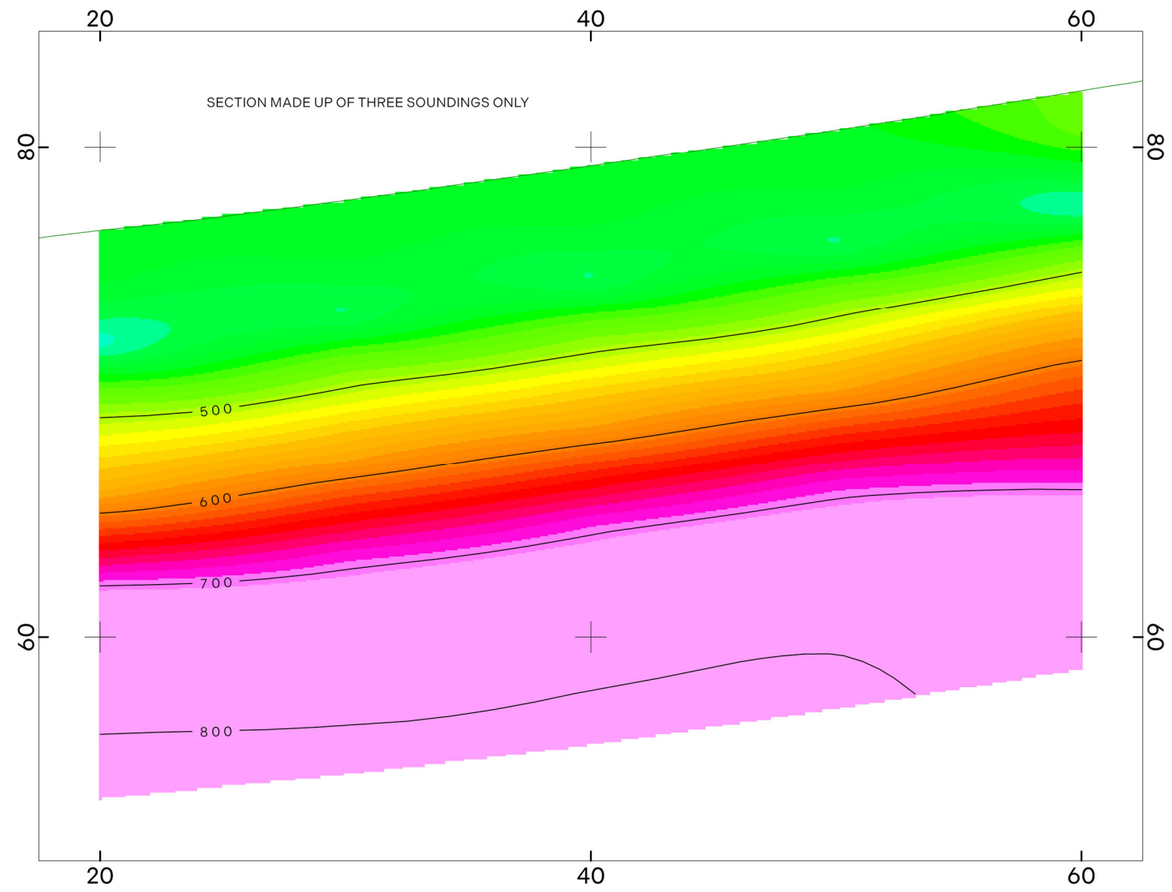
RDCL

EAST

WEST



GENERAL LOCATION PLAN:



SCALE:

Scale 1:250

5 0 5 10

metres

GENERAL LOCATION PLAN SCALE:

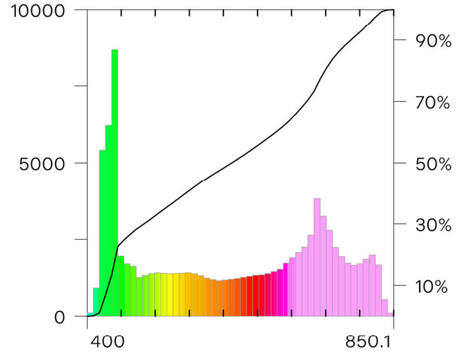
Scale 1:1000

20 0 20 40

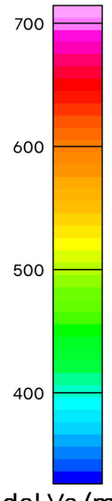
metres

WGS 84 / UTM zone 59S

GRID HISTOGRAM:



LEGEND:



Model Vs (m/s)

NOTES:

1. Imagery data provided to RDCL by the client.

CLIENT: T+T

PROJECT: PORT VILA, VANUATU
GEOPHYSICS

TITLE: MASW LINE 11a
PSEUDO Vs SECTION

INTERP. BY: OG	DATE: 11/04/2026	DRAWN BY: OG	DATE: 11/04/2026
CHECKED BY: SL	DATE: 11/04/2026	APPROVED BY: SJ	DATE: 11/04/2026

CONTRACT No.: 250306 FIGURE 25

FILE NAME: 250306.gpf
PLOTTED DRAWING SIZE: A3 (420 x 297)

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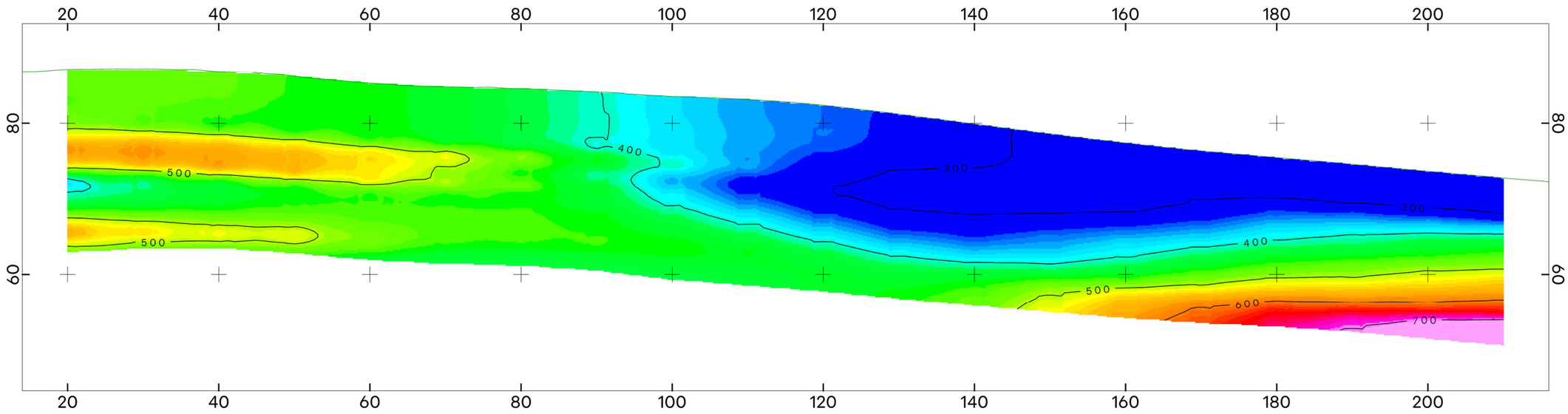
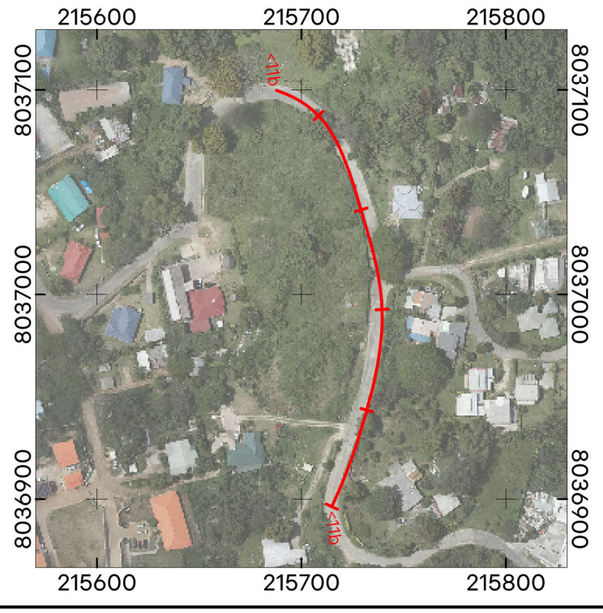
RDCL

SOUTH

NORTH



GENERAL LOCATION PLAN:



SCALE:

Scale 1:600

10 0 10 20 30

metres

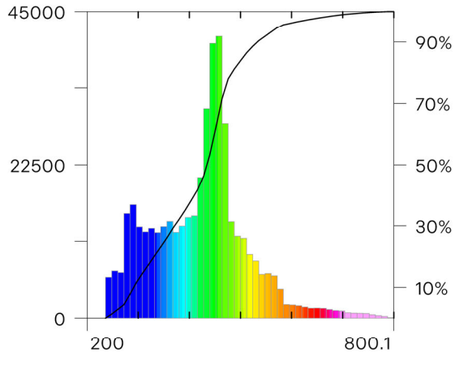
GENERAL LOCATION PLAN SCALE: Scale 1:3000

50 0 50 100 150

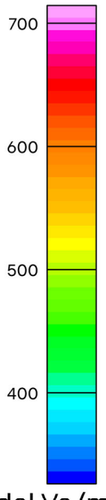
metres

WGS 84 / UTM zone 59S

GRID HISTOGRAM:



LEGEND:



Model Vs (m/s)

NOTES:

1. Imagery data provided to RDCL by the client.

CLIENT: T+T

PROJECT: PORT VILA, VANUATU
GEOPHYSICS

TITLE: MASW LINE 11b
PSEUDO Vs SECTION

INTERP. BY: OG	DATE: 11/04/2026	DRAWN BY: OG	DATE: 11/04/2026
CHECKED BY: SL	DATE: 11/04/2026	APPROVED BY: SJ	DATE: 11/04/2026

CONTRACT No.: 250306 FIGURE 26

FILE NAME: 250306.gpf
PLOTTED DRAWING SIZE: A3 (420 x 297)

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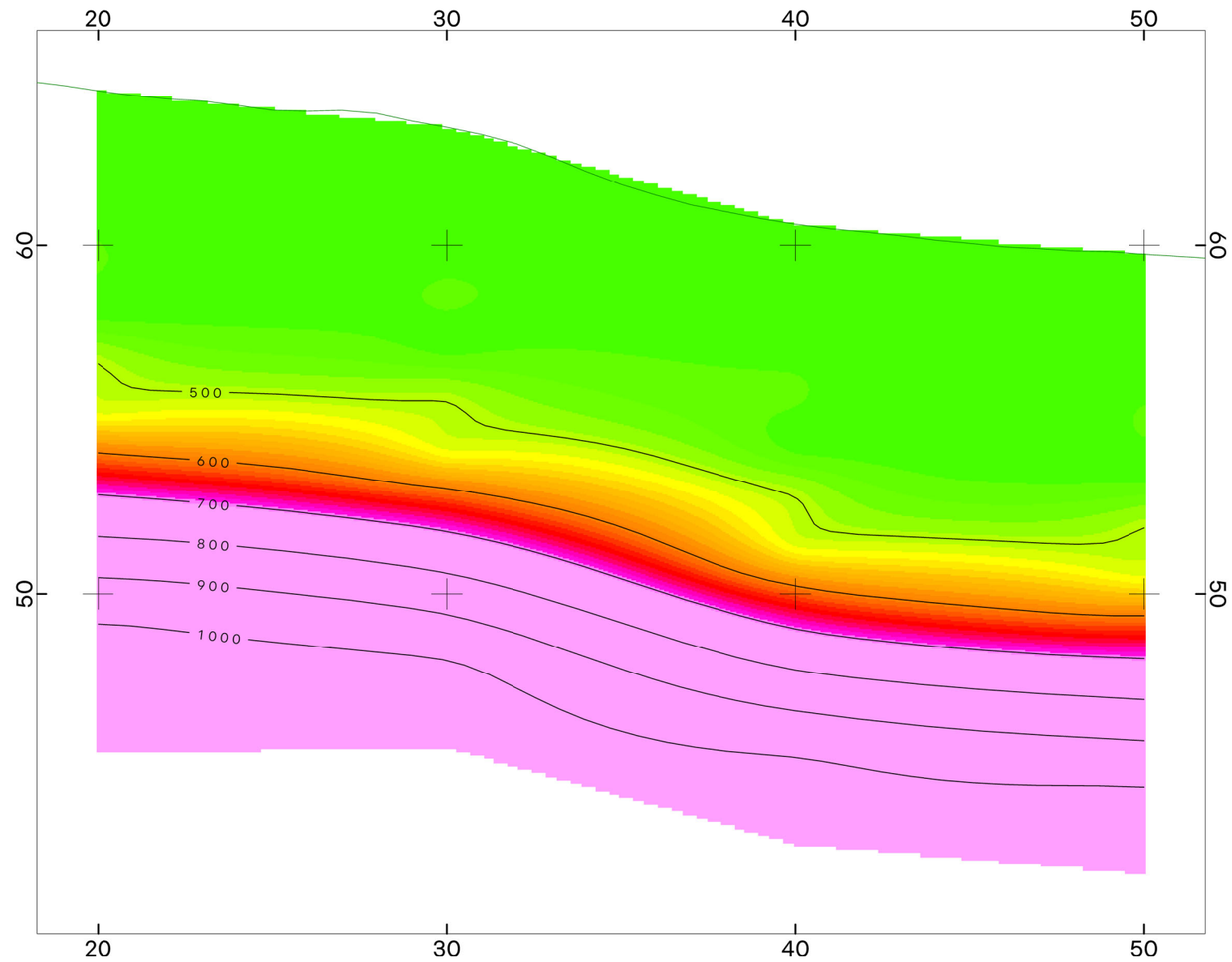
RDCL

EAST

WEST



GENERAL LOCATION PLAN:



SCALE:

Scale 1:175

2.5 0 2.5 5 7.5 10

metres

GENERAL LOCATION PLAN SCALE:

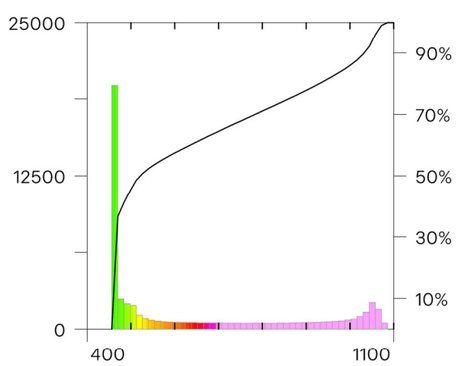
Scale 1:800

20 0 20 40

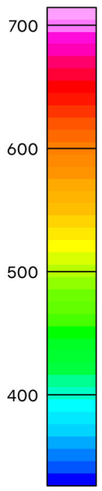
metres

WGS 84 / UTM zone 59S

GRID HISTOGRAM:



LEGEND:



Model Vs (m/s)

NOTES:

1. Imagery data provided to RDCL by the client.

CLIENT: T+T

PROJECT: PORT VILA, VANUATU
GEOPHYSICS

TITLE: MASW LINE 11c
PSEUDO Vs SECTION

INTERP. BY: OG	DATE: 12/04/2026	DRAWN BY: OG	DATE: 12/04/2026
CHECKED BY: SL	DATE: 12/04/2026	APPROVED BY: SJ	DATE: 12/04/2026
CONTRACT No.: 250306		FIGURE 27	
FILE NAME: 250306.gpf PLOTTED DRAWING SIZE: A3 (420 x 297)			

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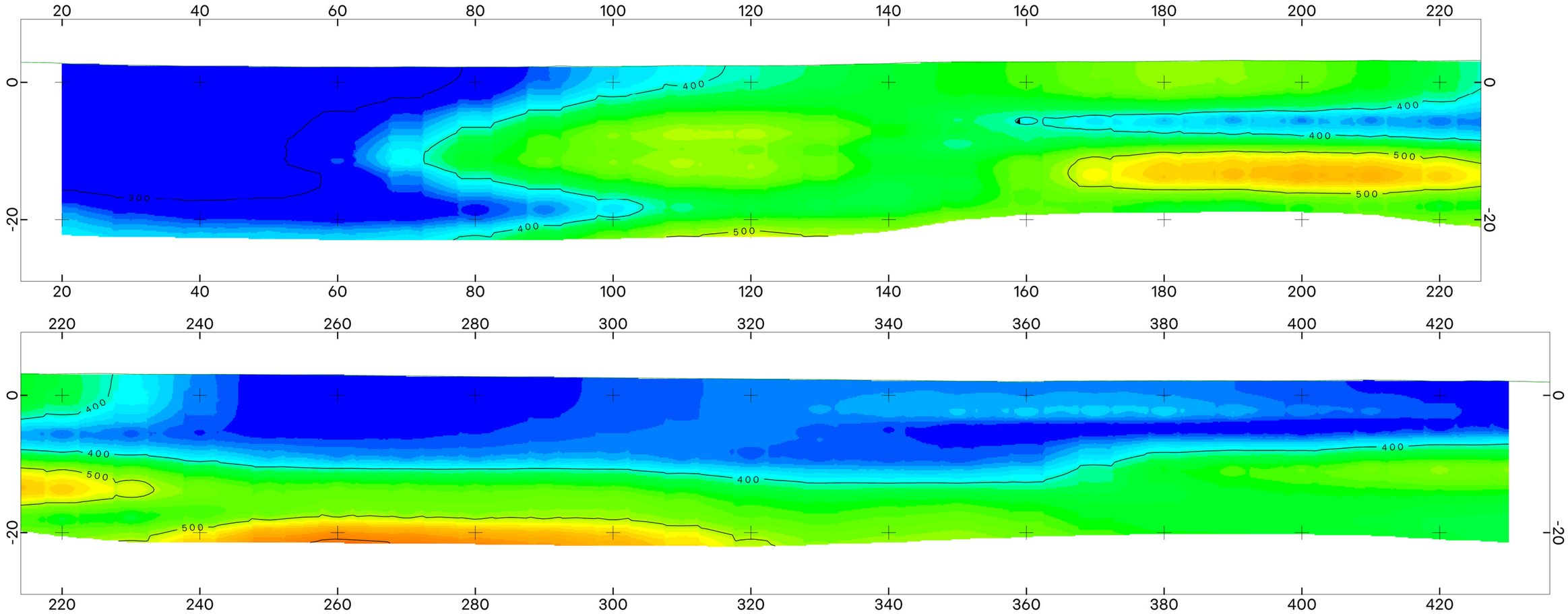
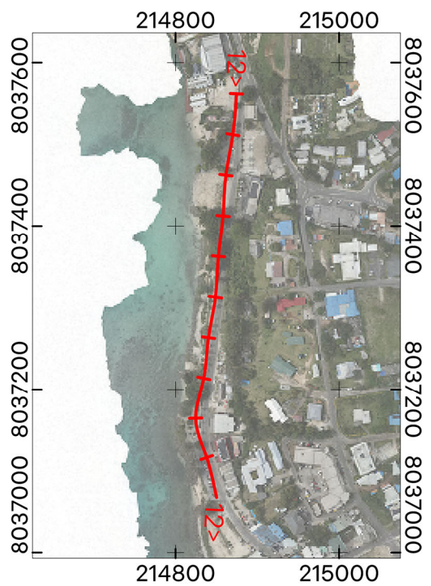
NORTH WEST

SOUTH EAST



GENERAL LOCATION PLAN:



SCALE:

Scale 1:600

10 0 10 20 30

metres

GENERAL LOCATION PLAN SCALE:

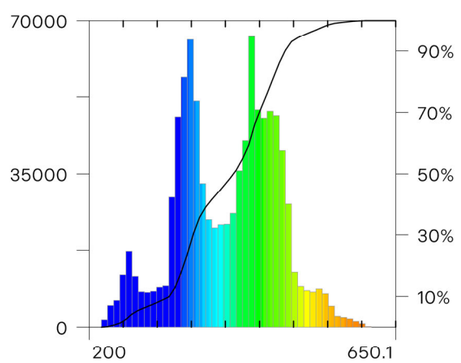
Scale 1:7500

100 0 100 200 300 400

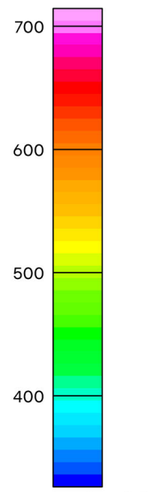
metres

WGS 84 / UTM zone 59S

GRID HISTOGRAM:



LEGEND:



NOTES:

1. Imagery data provided to RDCL by the client.

CLIENT: T+T

PROJECT: PORT VILA, VANUATU
GEOPHYSICS

TITLE: MASW LINE 12
PSEUDO Vs SECTION

INTERP. BY: OG	DATE: 10/04/2026	DRAWN BY: OG	DATE: 10/04/2026
CHECKED BY: SL	DATE: 10/04/2026	APPROVED BY: SJ	DATE: 10/04/2026
CONTRACT No.: 250306		FIGURE 28	
FILE NAME: 250306.gpf PLOTTED DRAWING SIZE: A3 (420 x 297)			

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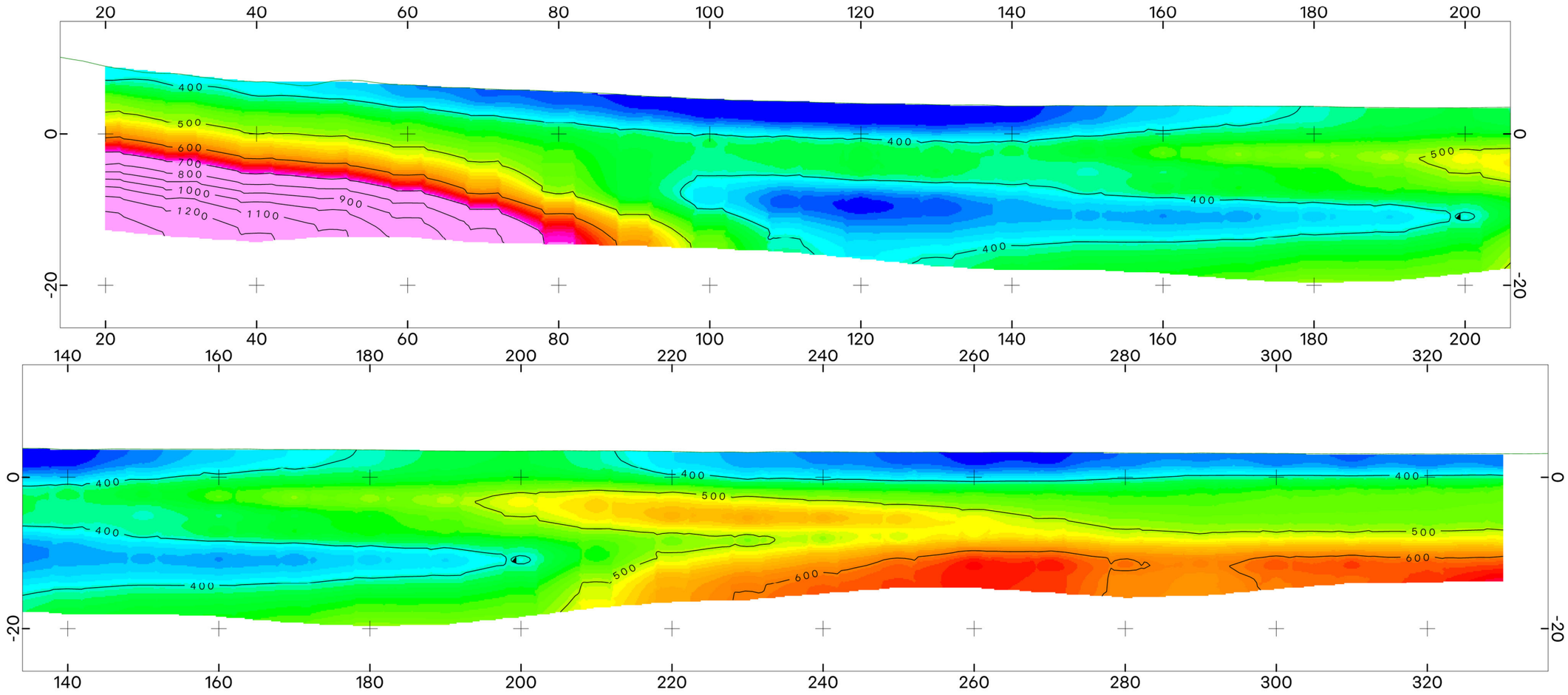
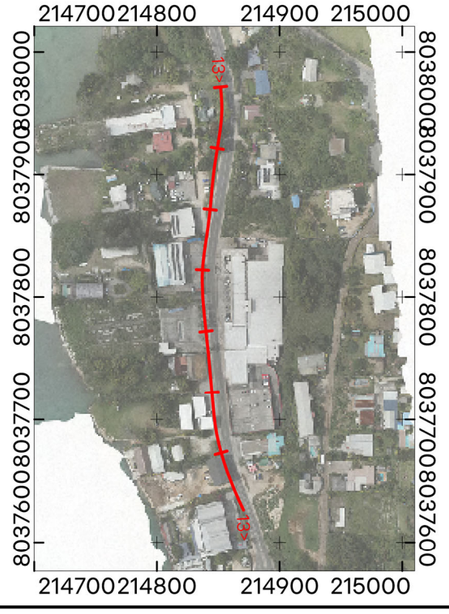
NORTH WEST

SOUTH EAST



GENERAL LOCATION PLAN:



SCALE:

Scale 1:600

10 0 10 20 30

metres

GENERAL LOCATION PLAN SCALE:

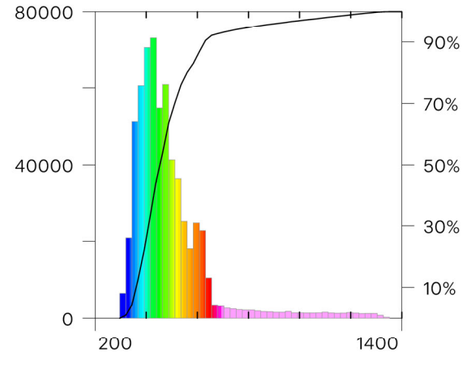
Scale 1:5000

100 0 100 200

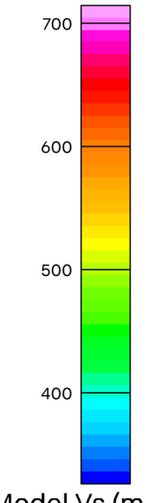
metres

WGS 84 / UTM zone 59S

GRID HISTOGRAM:



LEGEND:



Model Vs (m/s)

NOTES:

1. Imagery data provided to RDCL by the client.

CLIENT: T+T

PROJECT: PORT VILA, VANUATU
GEOPHYSICS

TITLE: MASW LINE 13
PSEUDO Vs SECTION

INTERP. BY: OG	DATE: 11/04/2026	DRAWN BY: OG	DATE: 11/04/2026
CHECKED BY: SL	DATE: 11/04/2026	APPROVED BY: SJ	DATE: 11/04/2026

CONTRACT No.: 250306 FIGURE 29

FILE NAME: 250306.gpf
PLOTTED DRAWING SIZE: A3 (420 x 297)

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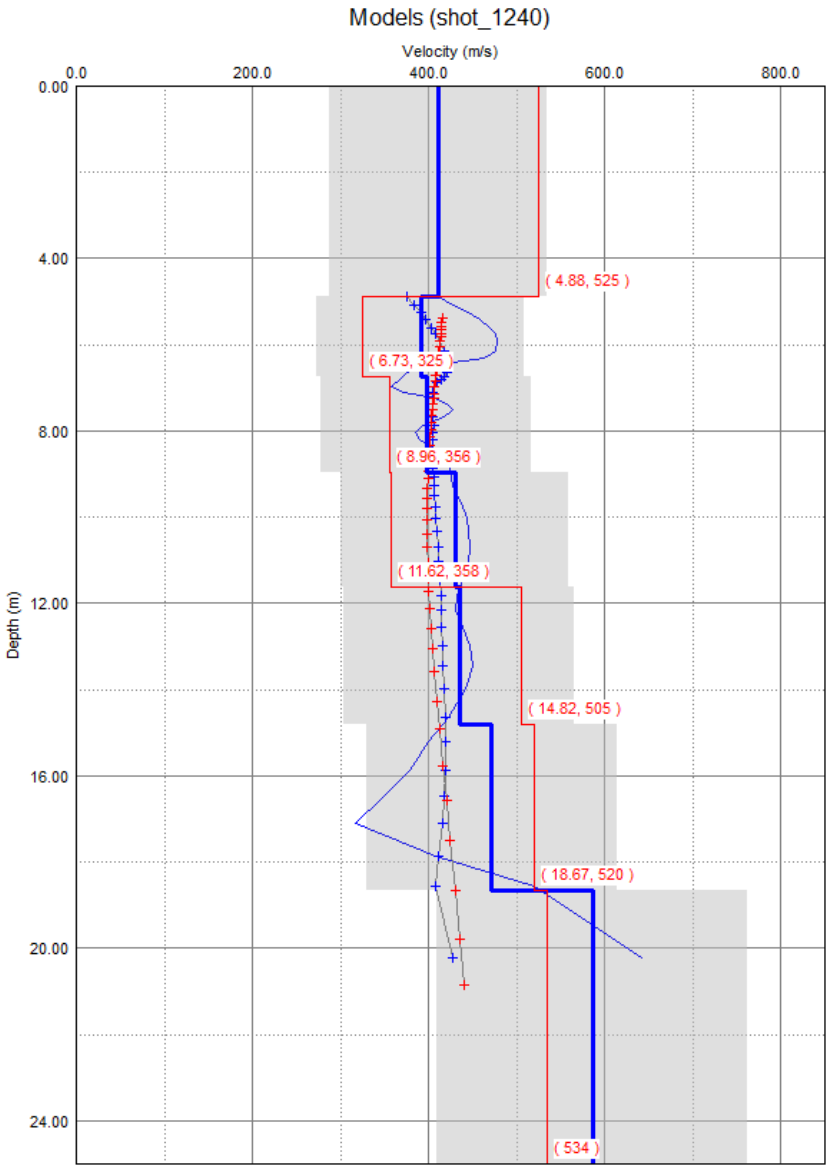
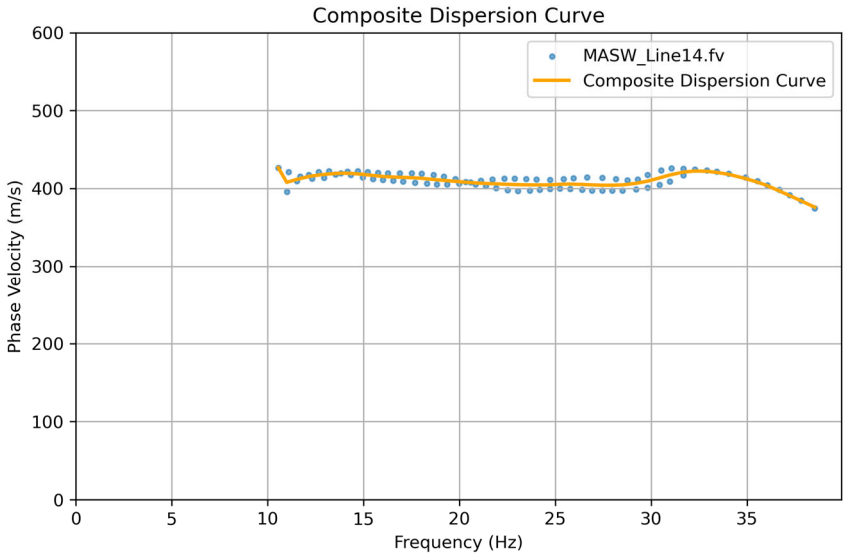
Ground Model

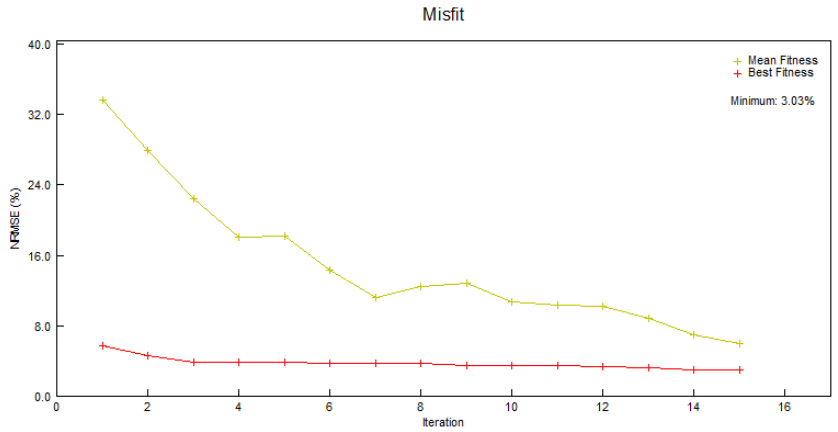


Final Model

Composite Dispersion Curve



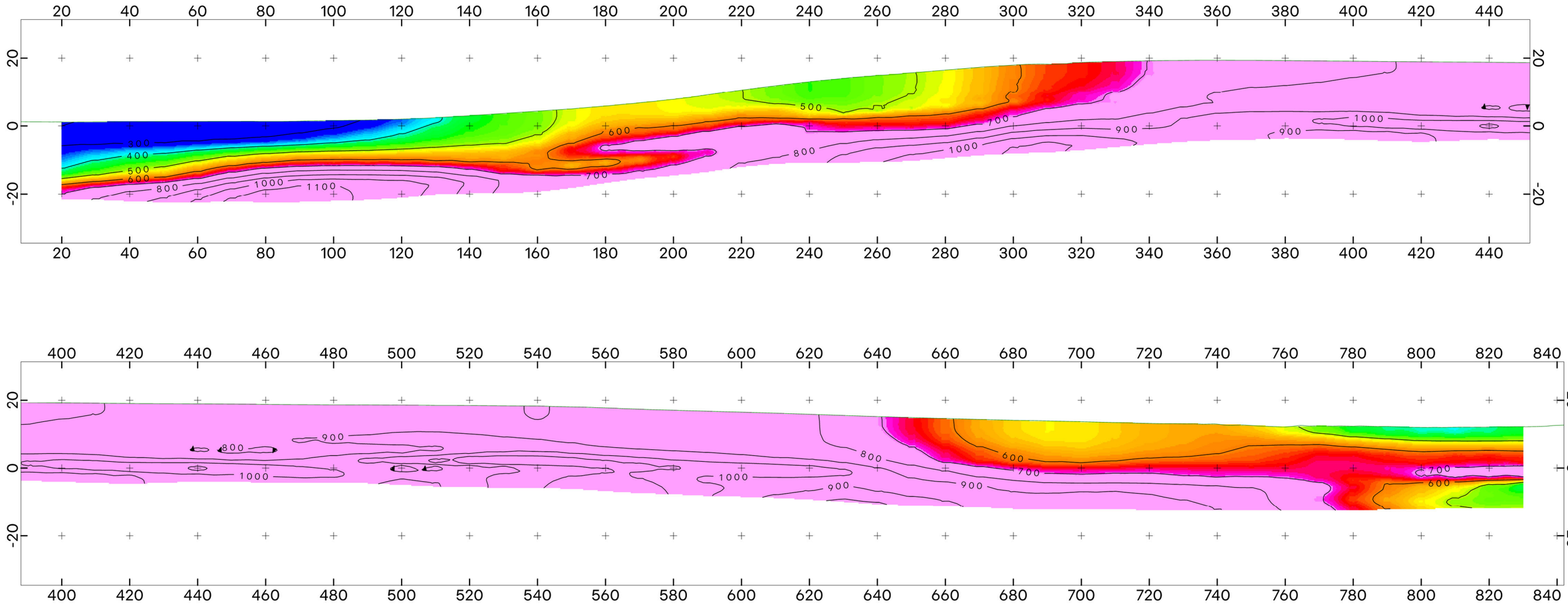
Plot of Misfit



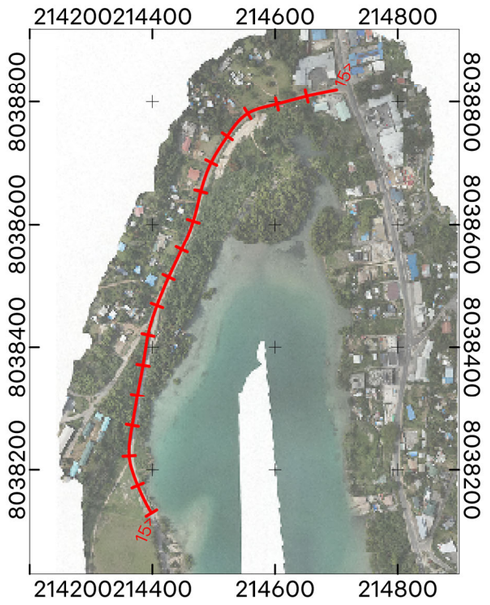
RDCL®	TITLE	MASW Line 14 Sounding	PROJECT	250306		
	PROJECT	Port Vila, Vanuatu Geophysics	DRAWN BY	OG	DATE	13/04/26	FIG
	CLIENT	T+T	CHECKED BY	SL	DATE	13/04/26	30

SOUTH

NORTH



GENERAL LOCATION PLAN:



SCALE:

Scale 1:1200

25 0 25 50

metres

GENERAL LOCATION PLAN SCALE:

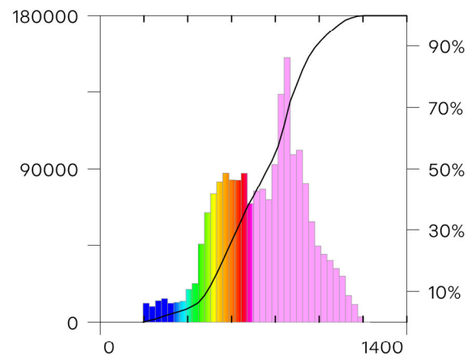
Scale 1:10000

200 0 200 400

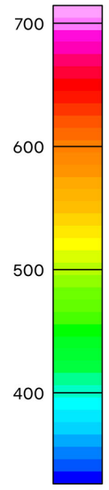
metres

WGS 84 / UTM zone 59S

GRID HISTOGRAM:



LEGEND:



Model Vs (m/s)

NOTES:

1. Imagery data provided to RDCL by the client.

CLIENT: T+T

PROJECT: PORT VILA, VANUATU GEOPHYSICS

TITLE: MASW LINE 15 PSEUDO Vs SECTION

INTERP. BY: OG	DATE: 11/04/2026	DRAWN BY: OG	DATE: 11/04/2026
CHECKED BY: SL	DATE: 11/04/2026	APPROVED BY: SJ	DATE: 11/04/2026

CONTRACT No.: 250306 FIGURE 31

FILE NAME: 250306.gpf

PLOTTED DRAWING SIZE: A3 (420 x 297)

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Tel: +64 4 282 1564
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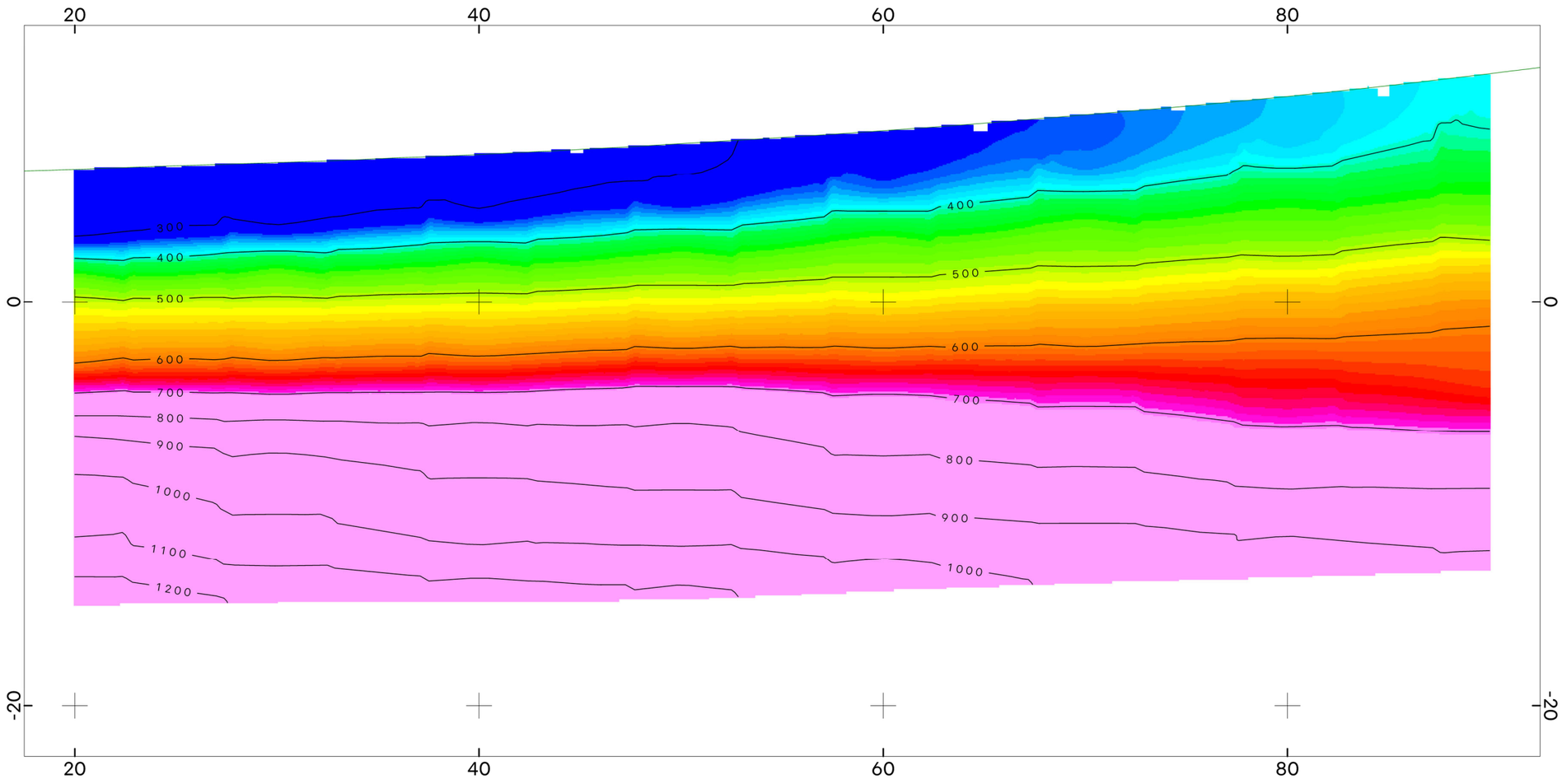
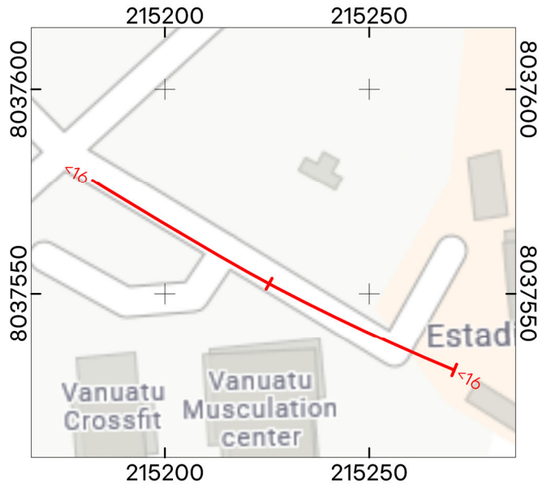
RDCL

EAST

WEST



GENERAL LOCATION PLAN:



SCALE:

Scale 1:250

5 0 5 10

metres

GENERAL LOCATION PLAN SCALE:

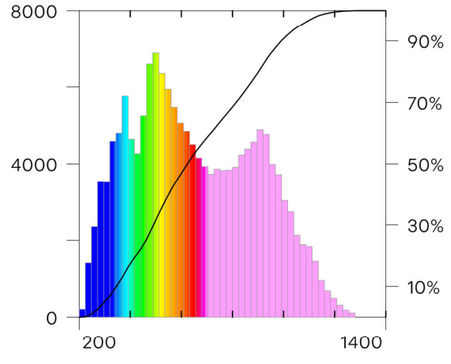
Scale 1:1500

25 0 25 50 75

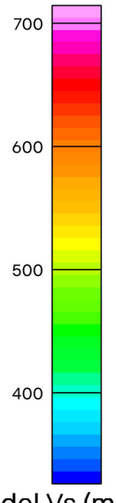
metres

WGS 84 / UTM zone 59S

GRID HISTOGRAM:



LEGEND:



Model Vs (m/s)

NOTES:

CLIENT: T+T

PROJECT: PORT VILA, VANUATU GEOPHYSICS

TITLE: MASV LINE 16 PSEUDO Vs SECTION

INTERP. BY: OG	DATE: 11/04/2026	DRAWN BY: OG	DATE: 11/04/2026
CHECKED BY: SL	DATE: 11/04/2026	APPROVED BY: SJ	DATE: 11/04/2026

CONTRACT No.: 250306 FIGURE 32

FILE NAME: 250306.gpf

PLOTTED DRAWING SIZE: A3 (420 x 297)

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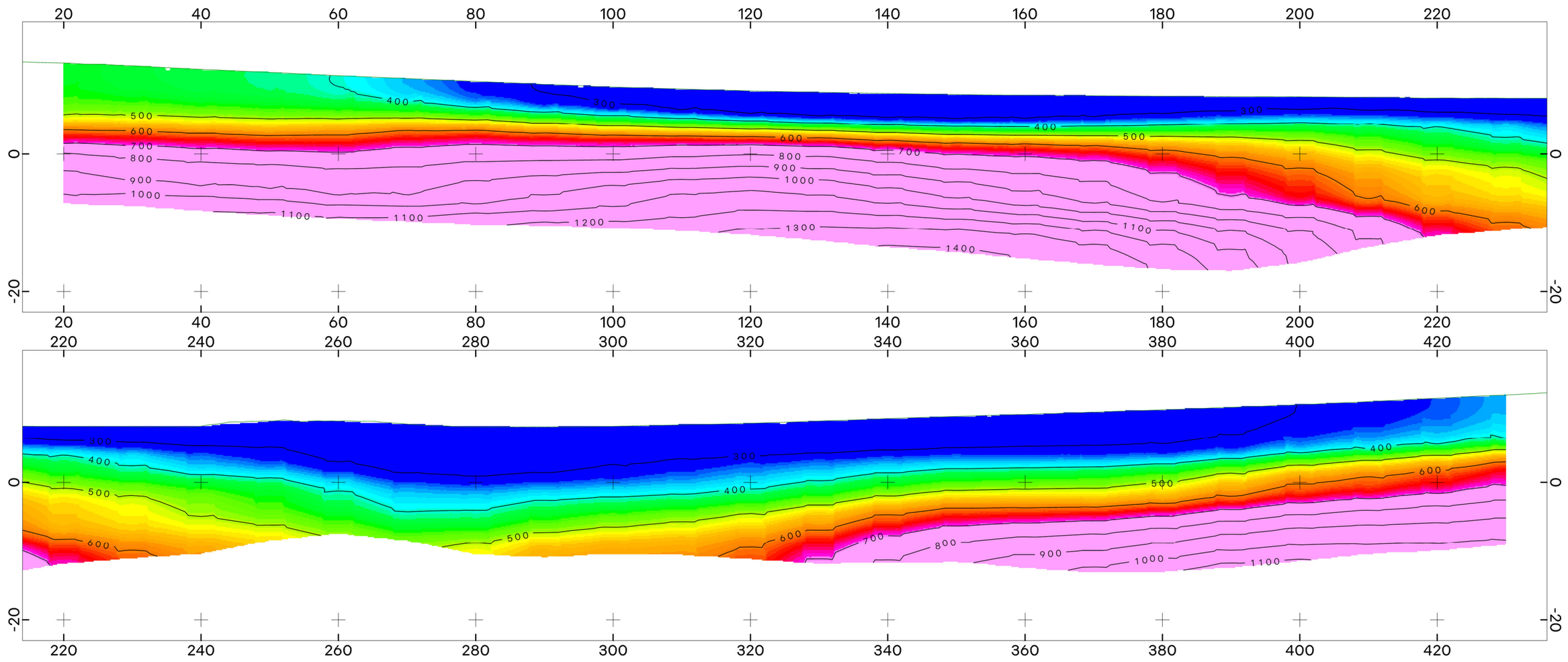
RDCL

WEST

EAST



GENERAL LOCATION PLAN:



SCALE:

Scale 1:600

10 0 10 20 30

metres

GENERAL LOCATION PLAN SCALE:

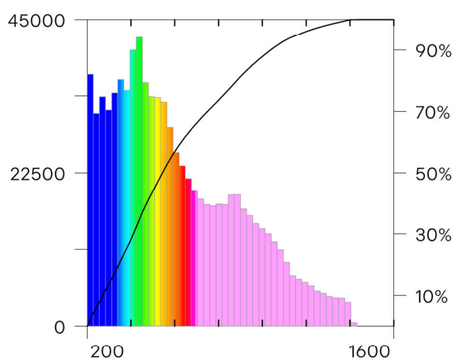
Scale 1:6000

100 0 100 200 300

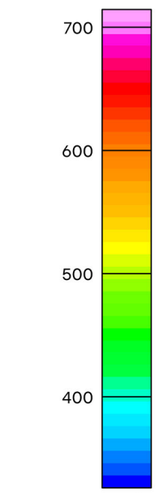
metres

WGS 84 / UTM zone 59S

GRID HISTOGRAM:



LEGEND:



Model Vs (m/s)

NOTES:

1. Imagery data provided to RDCL by the client.

CLIENT: T+T

PROJECT: PORT VILA, VANUATU
GEOPHYSICS

TITLE: MASW LINE 17
PSEUDO Vs SECTION

INTERP. BY: OG	DATE: 11/04/2026	DRAWN BY: OG	DATE: 11/04/2026
CHECKED BY: SL	DATE: 11/04/2026	APPROVED BY: SJ	DATE: 11/04/2026

CONTRACT No.: 250306 FIGURE 33

FILE NAME: 250306.gpf
PLOTTED DRAWING SIZE: A3 (420 x 297)

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Porirua, Wellington, New Zealand
Tel: +64 4 282 1564
Email: info@rdcl.co.nz www.rdcl.co.nz

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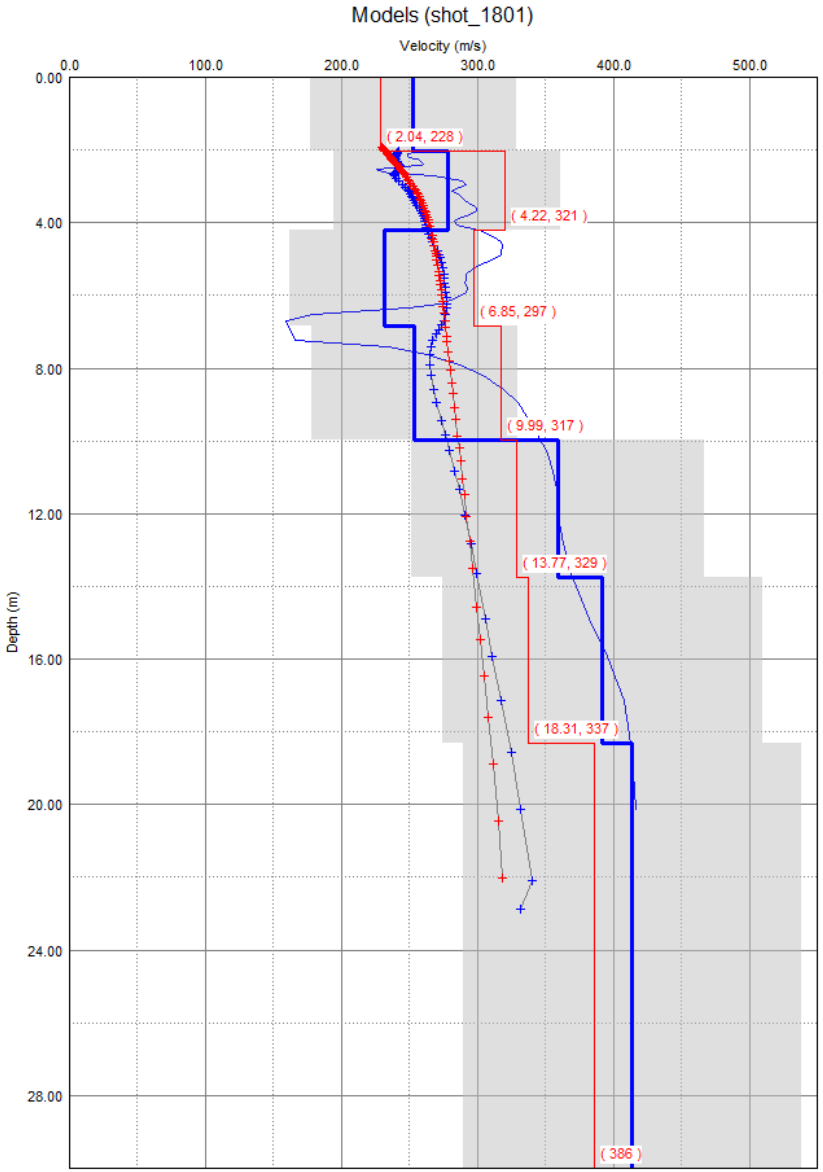
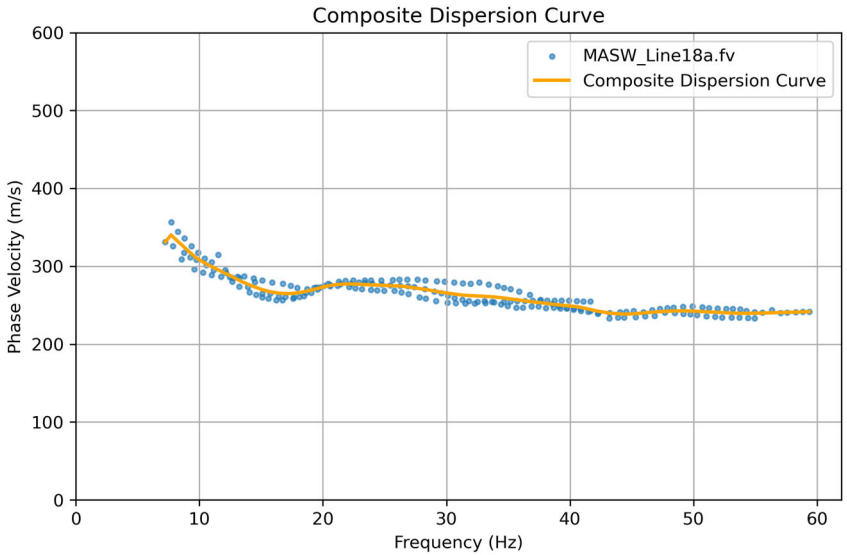
Ground Model

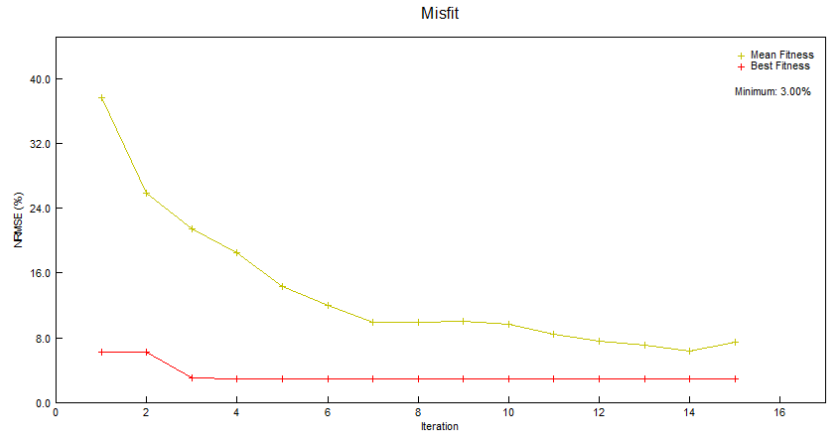


Final Model

Composite Dispersion Curve



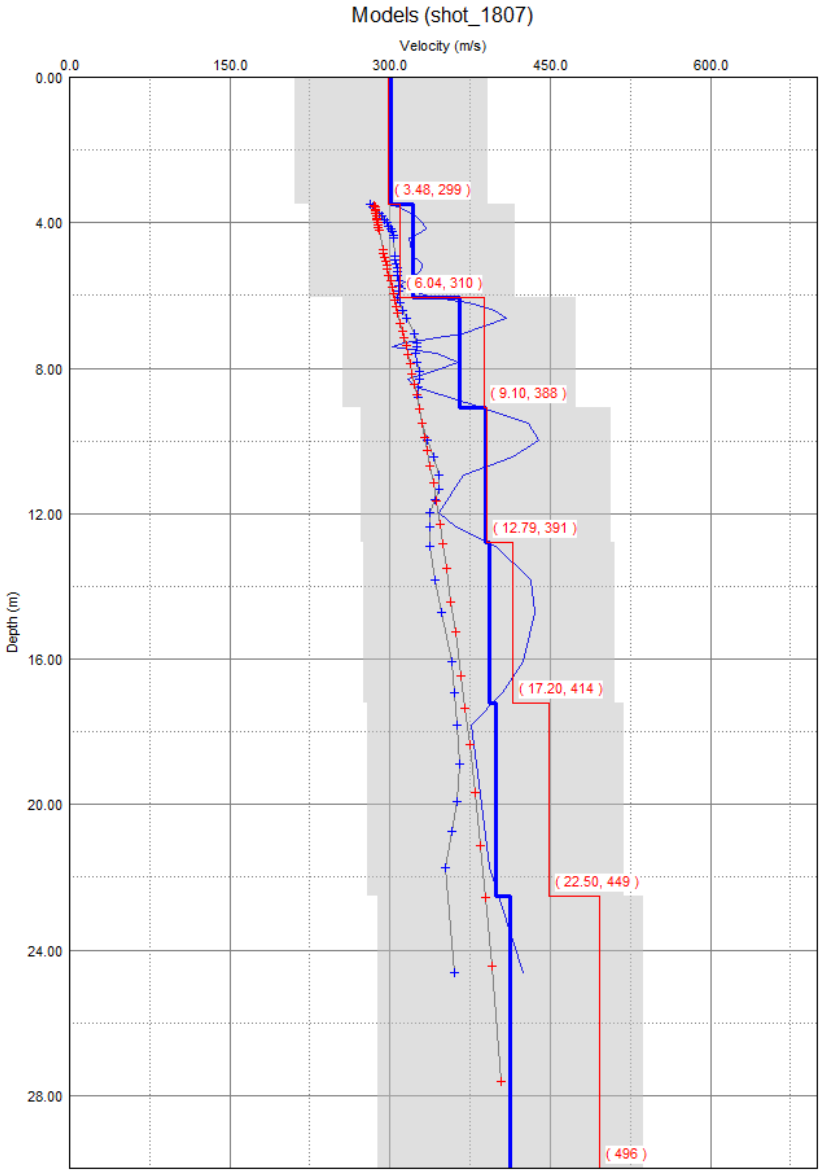
Plot of Misfit



RDCL®

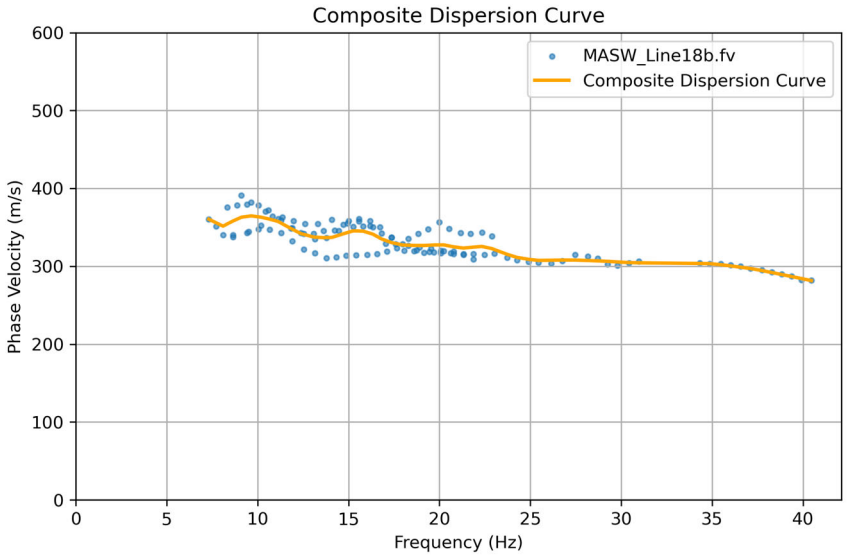
TITLE	MASW Line 18a Sounding	PROJECT	250306			
PROJECT	Port Vila, Vanuatu Geophysics	DRAWN BY	OG	DATE	13/04/26	FIG
CLIENT	T+T	CHECKED BY	SL	DATE	13/04/26	34

Ground Model

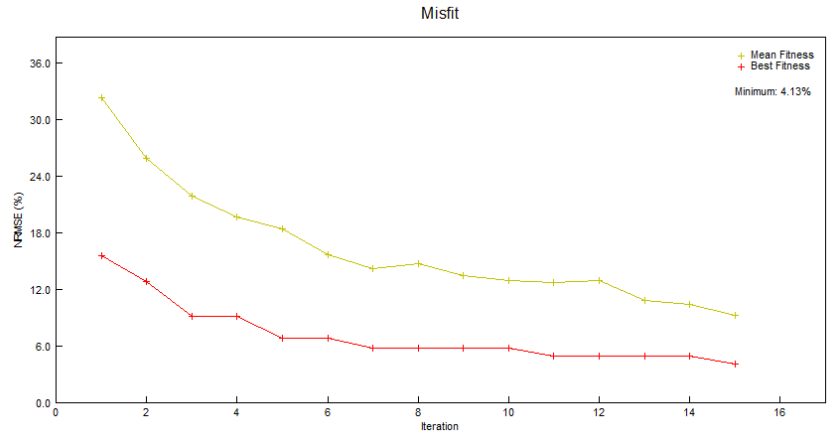


Final Model

Composite Dispersion Curve



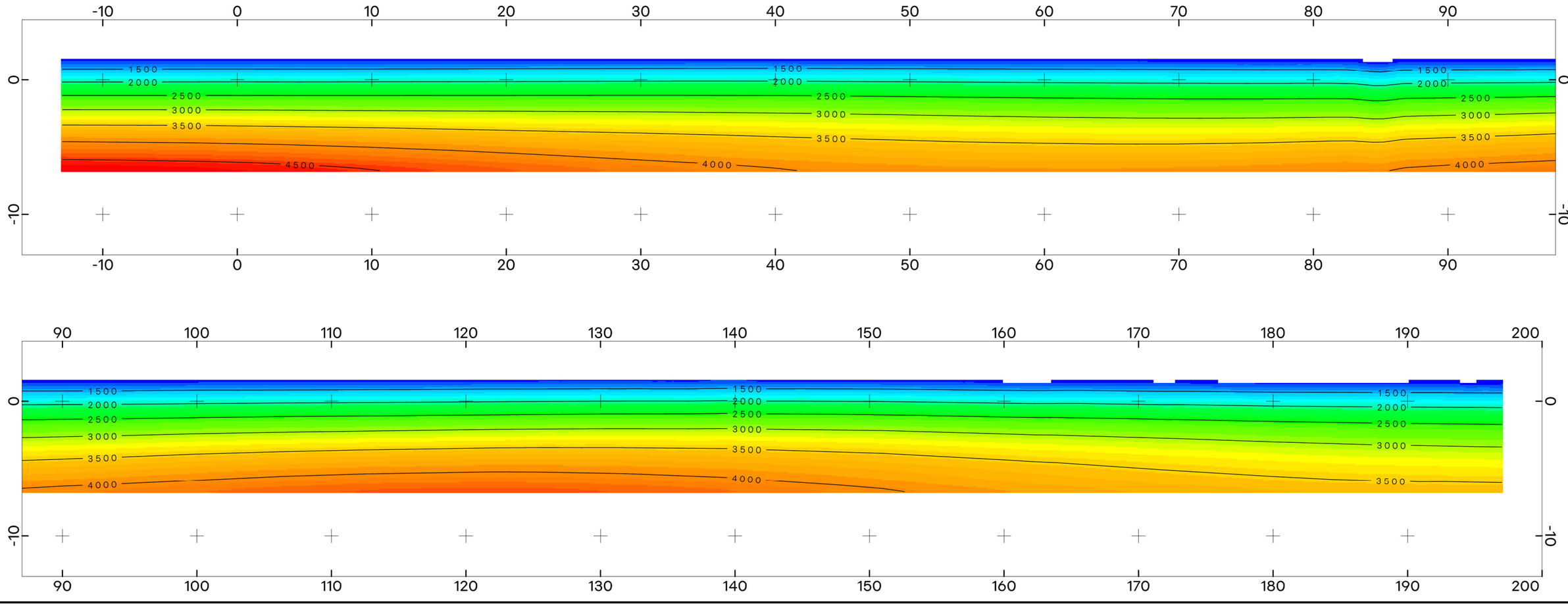
Plot of Misfit



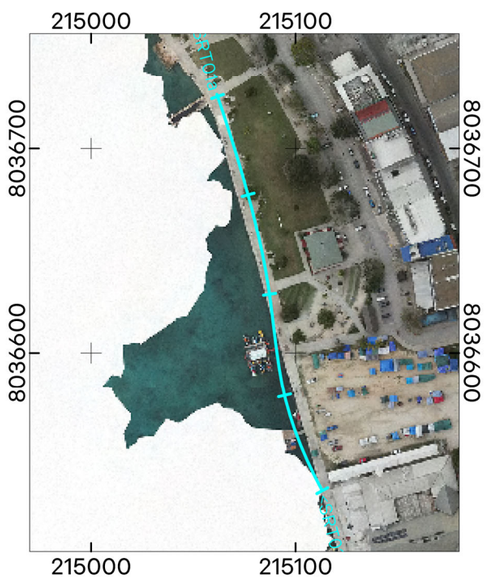
RDCL®	TITLE	MASW Line 18b Sounding	PROJECT	250306		
	PROJECT	Port Vila, Vanuatu Geophysics	DRAWN BY	OG	DATE	13/04/26	FIG
	CLIENT	T+T	CHECKED BY	SL	DATE	13/04/26	35

SOUTH

NORTH



GENERAL LOCATION PLAN:



SCALE:

Scale 1:300

5 0 5 10 15

metres

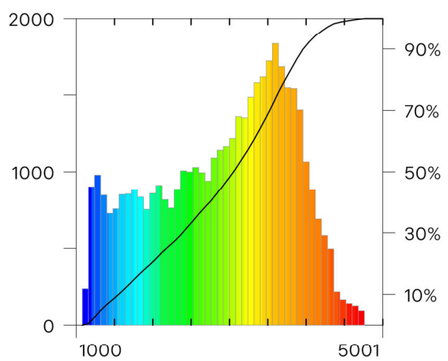
GENERAL LOCATION PLAN SCALE: Scale 1:3000

50 0 50 100 150

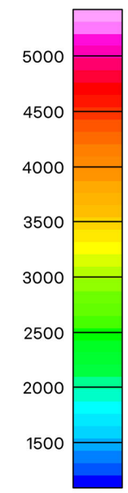
metres

WGS 84 / UTM zone 59S

GRID HISTOGRAM:



LEGEND:



Model Vp (m/s)

NOTES:

1. Imagery data provided to RDCL by the client.

CLIENT: T+T

PROJECT: PORT VILA, VANUATU GEOPHYSICS

TITLE: SRT LINE 01a Vp SECTION

INTERP. BY: OG	DATE: 15/04/2026	DRAWN BY: OG	DATE: 15/04/2026
CHECKED BY: SL	DATE: 15/04/2026	APPROVED BY: SJ	DATE: 15/04/2026

CONTRACT No.: 250306 FIGURE 36

FILE NAME: 250306.gpf

PLOTTED DRAWING SIZE: A3 (420 x 297)

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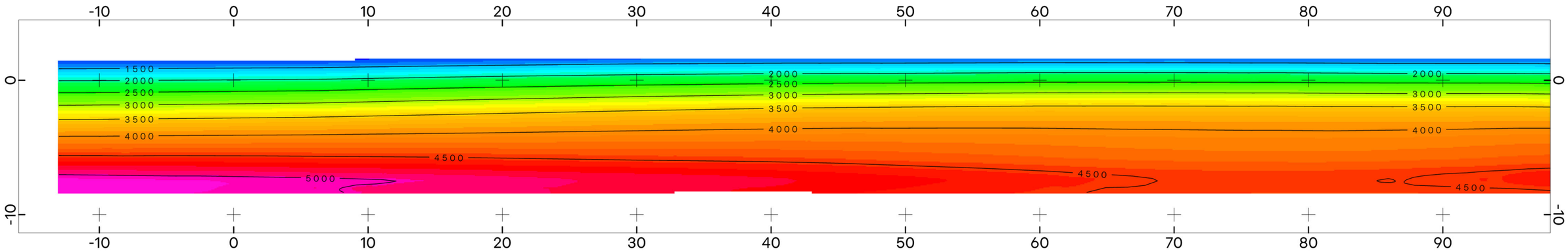
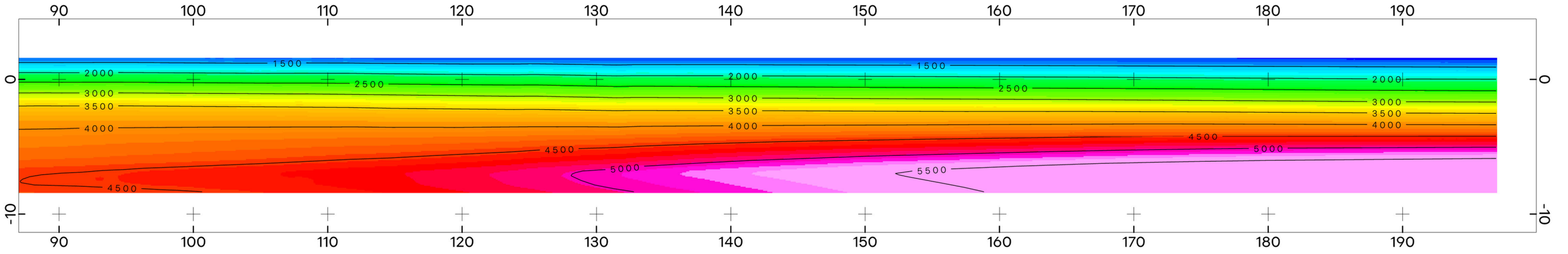
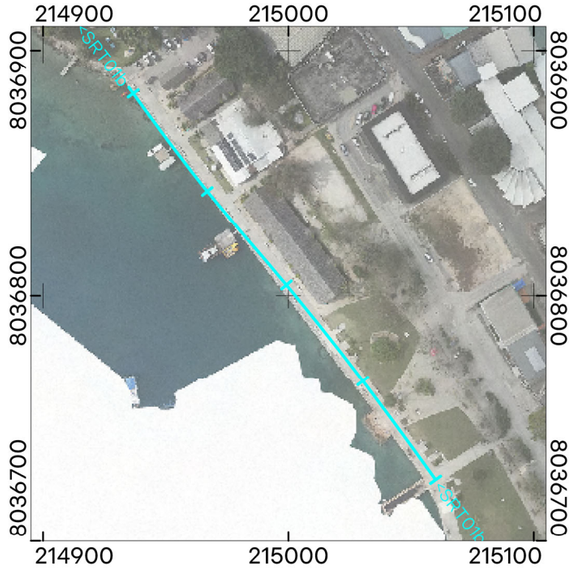
SOUTHEAST

NORTHWEST





GENERAL LOCATION PLAN:



SCALE:

Scale 1:300

5 0 5 10 15

metres

GENERAL LOCATION PLAN SCALE:

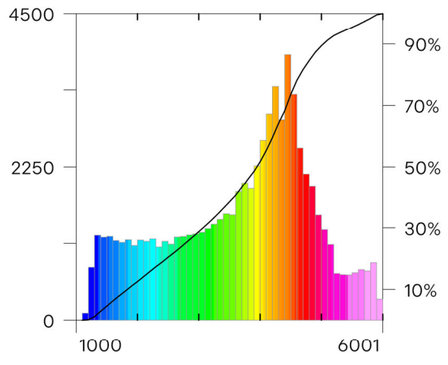
Scale 1:2500

50 0 50 100

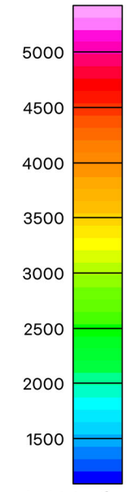
metres

WGS 84 / UTM zone 59S

GRID HISTOGRAM:



LEGEND:



Model Vp (m/s)

NOTES:

1. Imagery data provided to RDCL by the client.

CLIENT:

T+T

PROJECT:

PORT VILA, VANUATU
GEOPHYSICS

TITLE:

SRT LINE 01b
Vp SECTION

INTERP. BY: OG	DATE: 15/04/2026	DRAWN BY: OG	DATE: 15/04/2026
CHECKED BY: SL	DATE: 15/04/2026	APPROVED BY: SJ	DATE: 15/04/2026

CONTRACT No.: 250306 FIGURE 37

FILE NAME: 250306.gpf
PLOTTED DRAWING SIZE: A3 (420 x 297)

RDCL
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Tel: +64 4 282 1564
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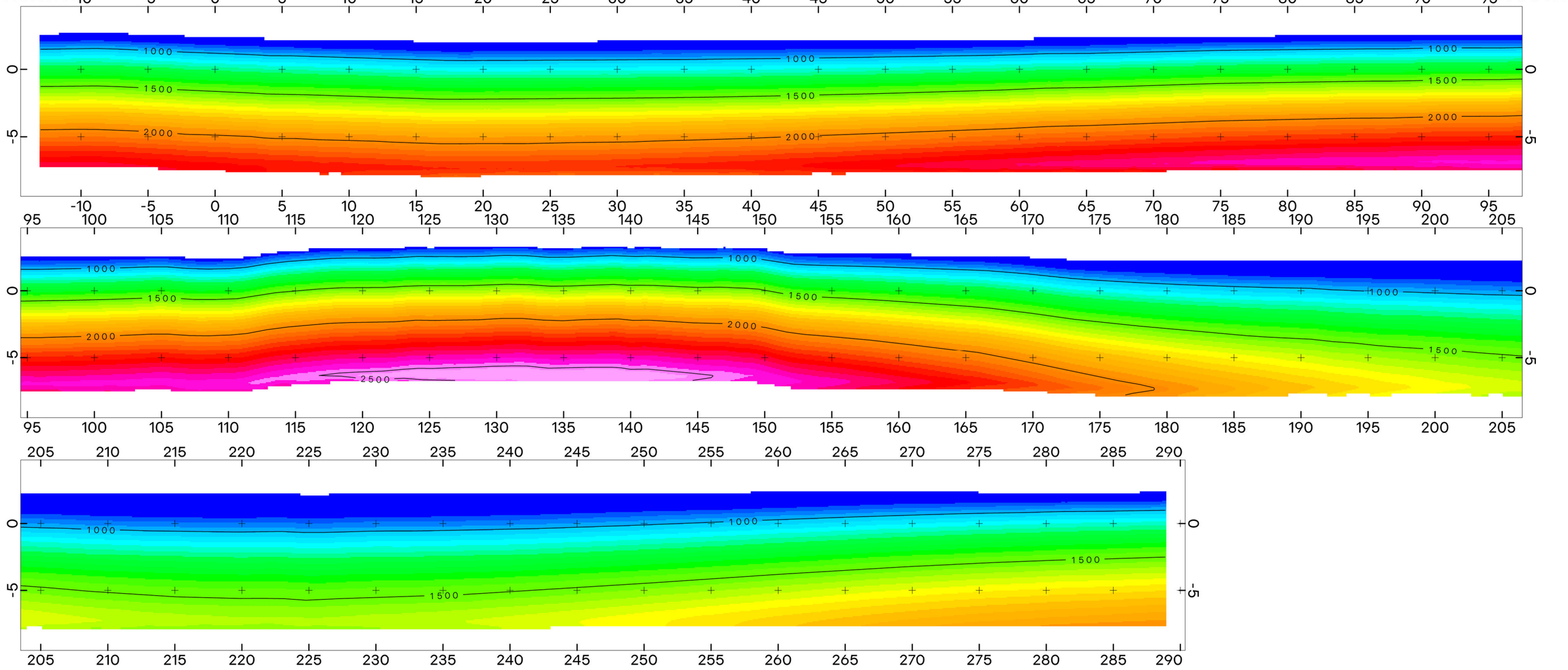
NORTH



SOUTH

GENERAL LOCATION PLAN:



SCALE:

Scale 1:300

5 0 5 10 15

metres

GENERAL LOCATION PLAN SCALE:

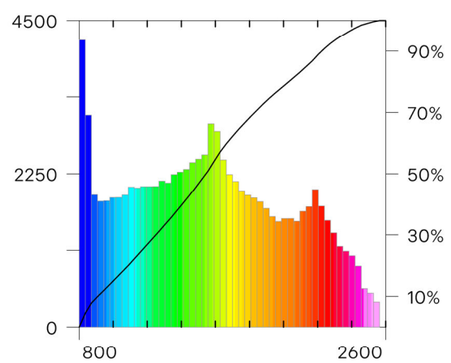
Scale 1:4000

100 0 100 200

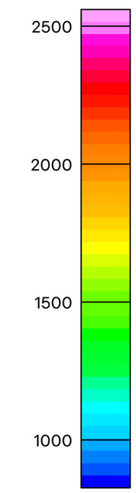
metres

WGS 84 / UTM zone 59S

GRID HISTOGRAM:



LEGEND:



Model Vp (m/s)

NOTES:

1. Imagery data provided to RDCL by the client.

CLIENT: T+T

PROJECT: PORT VILA, VANUATU GEOPHYSICS

TITLE: SRT LINE 02 Vp SECTION

INTERP. BY: OG	DATE: 15/04/2026	DRAWN BY: OG	DATE: 15/04/2026
CHECKED BY: SL	DATE: 15/04/2026	APPROVED BY: SJ	DATE: 15/04/2026

CONTRACT No.: 250306 FIGURE 38

FILE NAME: 250306.gpf

PLOTTED DRAWING SIZE: A3 (420 x 297)

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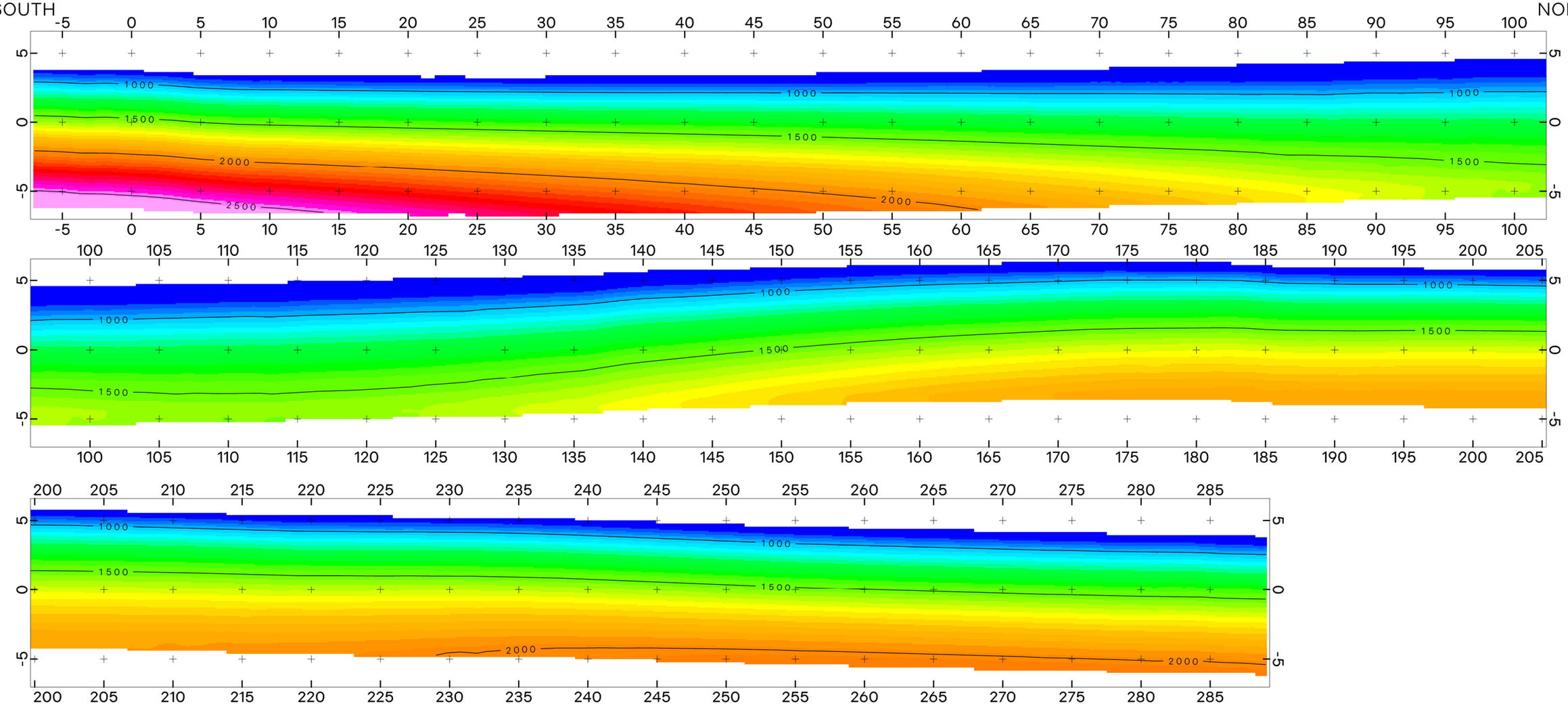
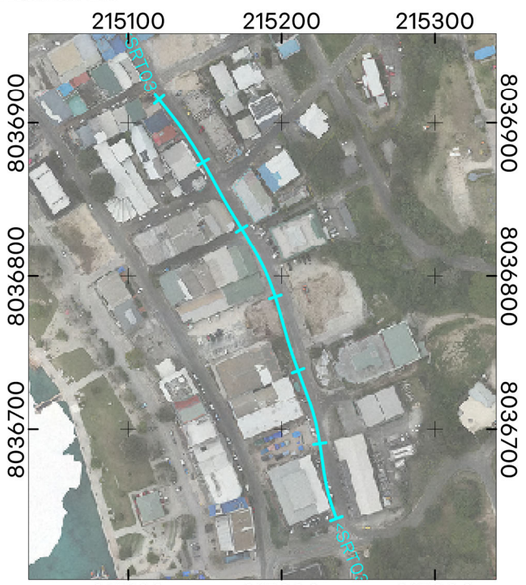
RDCL

SOUTH

NORTH



GENERAL LOCATION PLAN:



SCALE:

Scale 1:300

5 0 5 10 15

metres

GENERAL LOCATION PLAN SCALE:

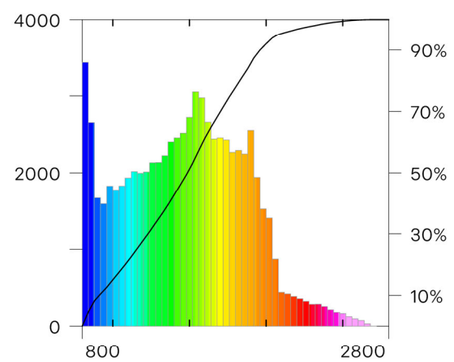
Scale 1:4000

100 0 100 200

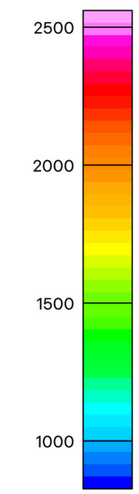
metres

WGS 84 / UTM zone 59S

GRID HISTOGRAM:



LEGEND:



Model Vp (m/s)

NOTES:

1. Imagery data provided to RDCL by the client.

CLIENT: T+T

PROJECT: PORT VILA, VANUATU
GEOPHYSICS

TITLE: SRT LINE 03
Vp SECTION

INTERP. BY: OG	DATE: 16/04/2026	DRAWN BY: OG	DATE: 16/04/2026
CHECKED BY: SL	DATE: 16/04/2026	APPROVED BY: SJ	DATE: 16/04/2026

CONTRACT No.: 250306 FIGURE 39

FILE NAME: 250306.gpf
PLOTTED DRAWING SIZE: A3 (420 x 297)

RDCL
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Porirua, Wellington, New Zealand
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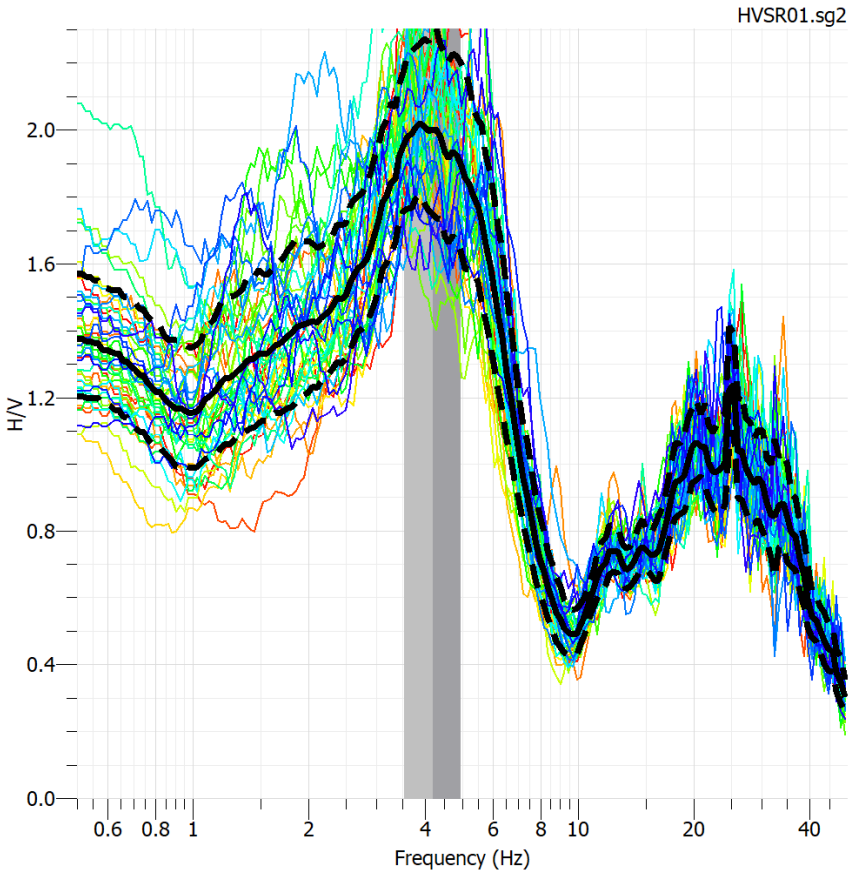
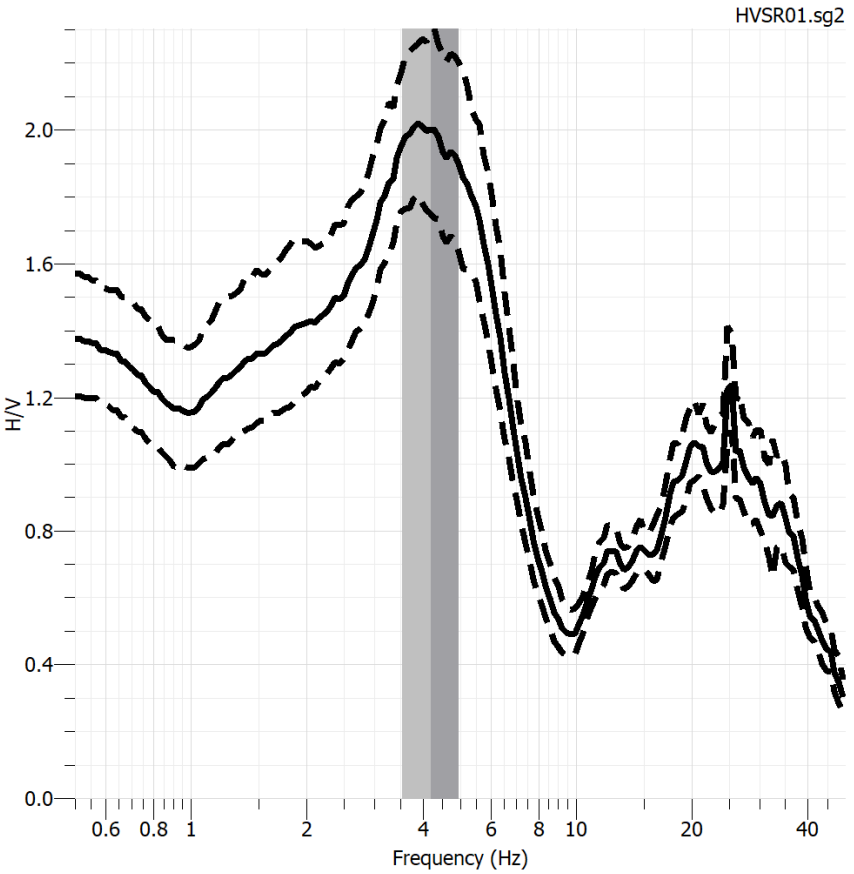
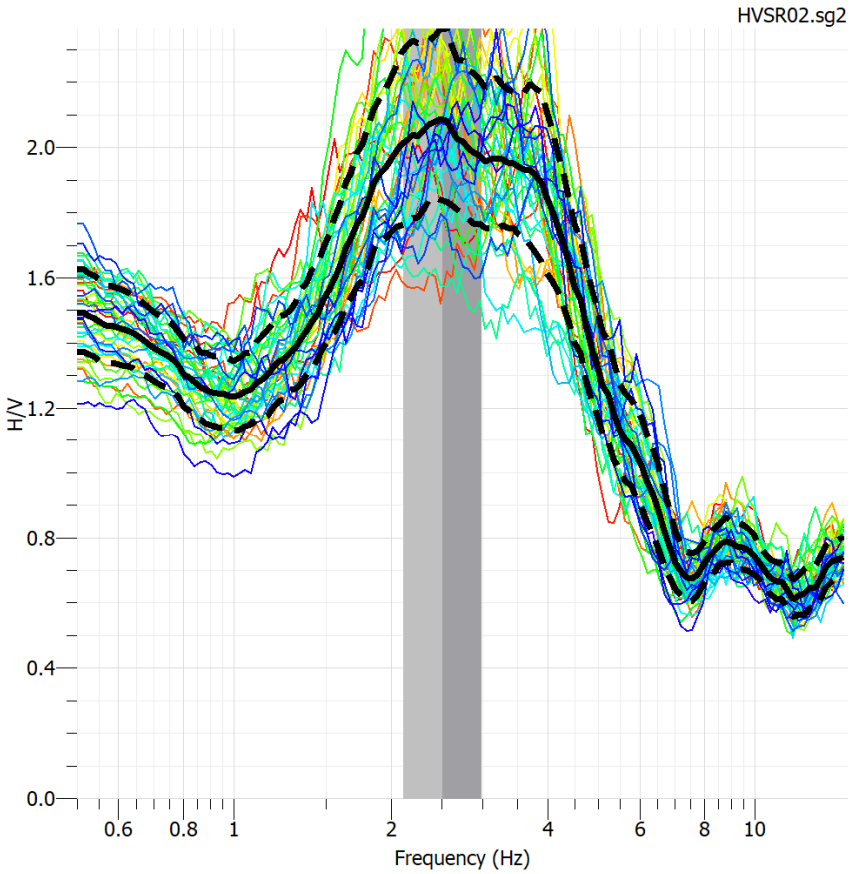


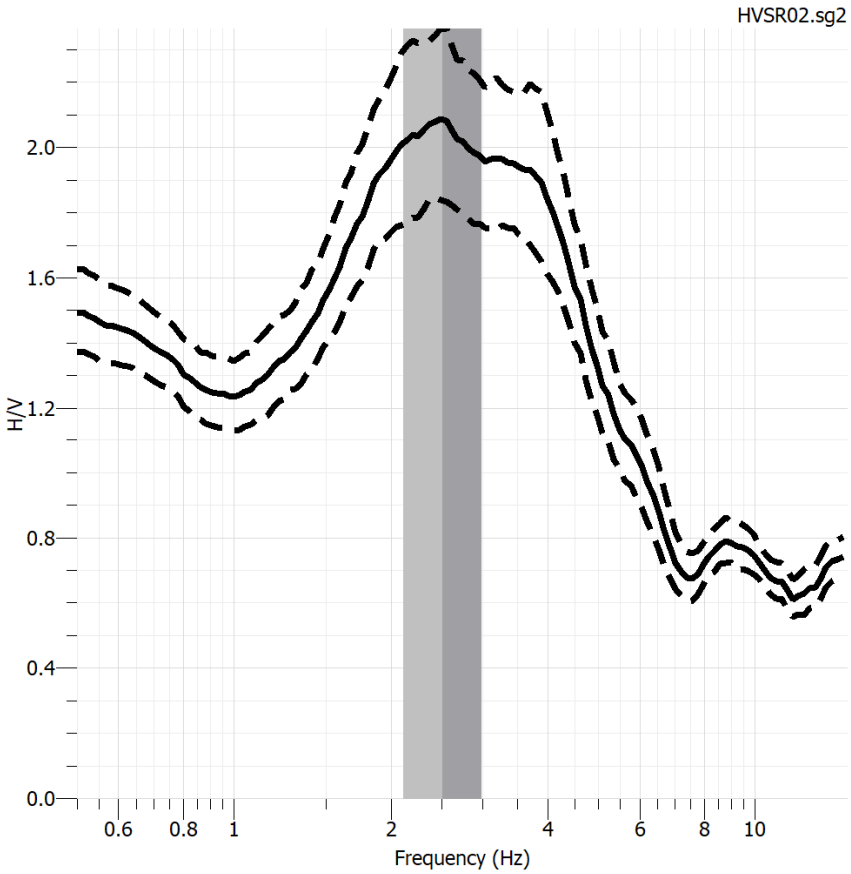


HVSR#	f0	fmin	fmax	A0	Amin	Amax	T0	Tmin	Tmax
	Hz	Hz	Hz				s	s	s
1	3.98	3.41	4.64	2.00	1.78	2.24	0.25	0.29	0.22

RDCL®

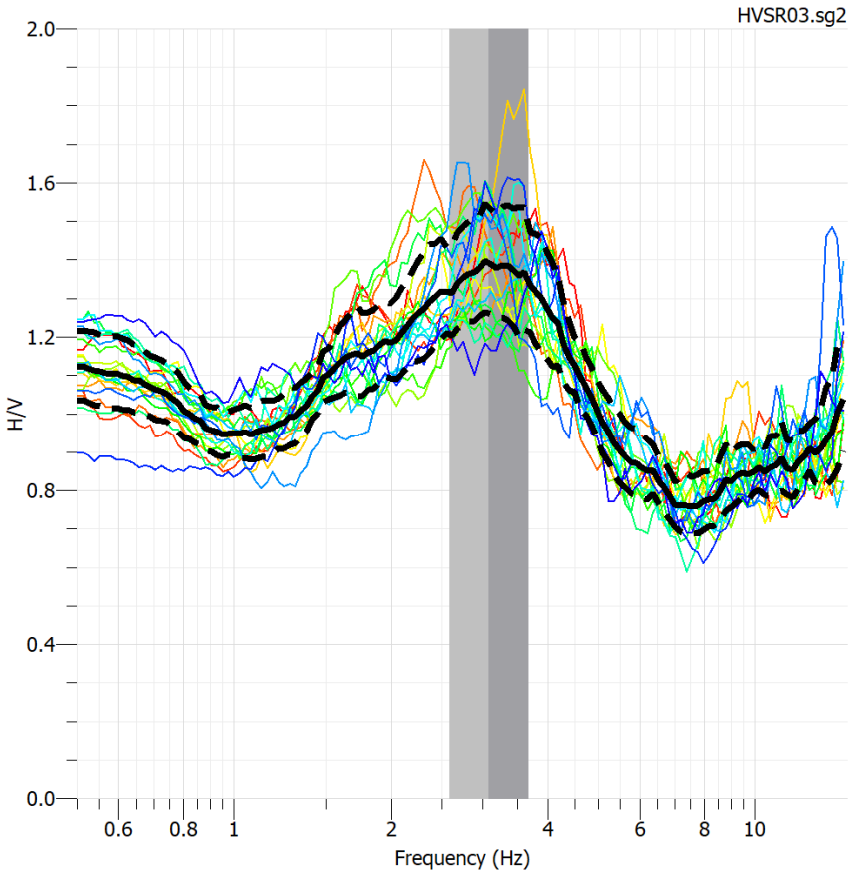
TITLE	HVSR01	PROJECT	250306			
PROJECT	Port Vila, Vanuatu Geophysics	DRAWN BY	OG	DATE	13/04/26	FIG
CLIENT	T+T	CHECKED BY	SL	DATE	13/04/26	40

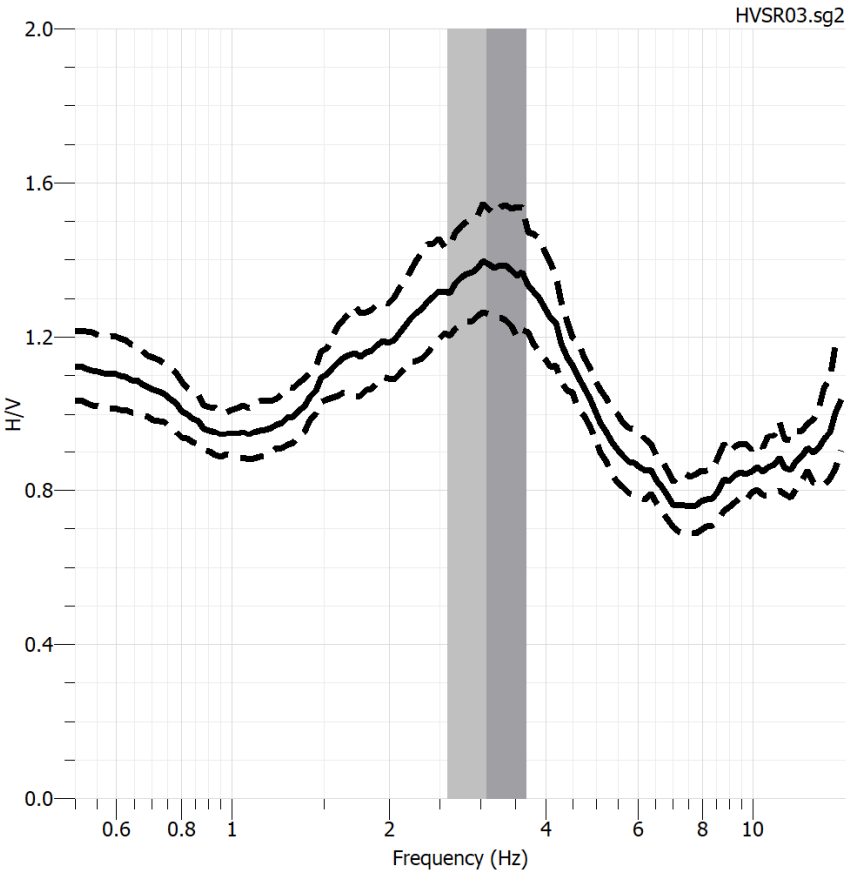




HVSR#	f0	fmin	fmax	A0	Amin	Amax	T0	Tmin	Tmax
	Hz	Hz	Hz				s	s	s
2	2.52	2.15	2.96	2.06	1.86	2.29	0.40	0.47	0.34

RDCL®	TITLE	HVSR02	PROJECT	250306			
	PROJECT	Port Vila, Vanuatu Geophysics	DRAWN BY	OG	DATE	13/04/26	FIG
	CLIENT	T+T	CHECKED BY	SL	DATE	13/04/26	41

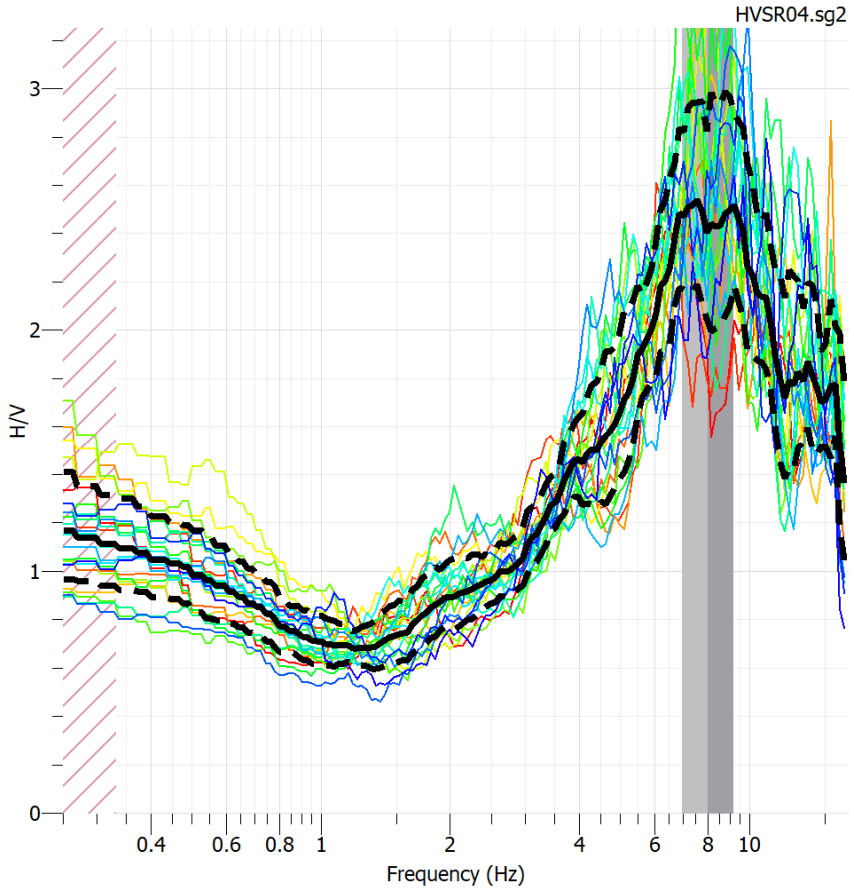


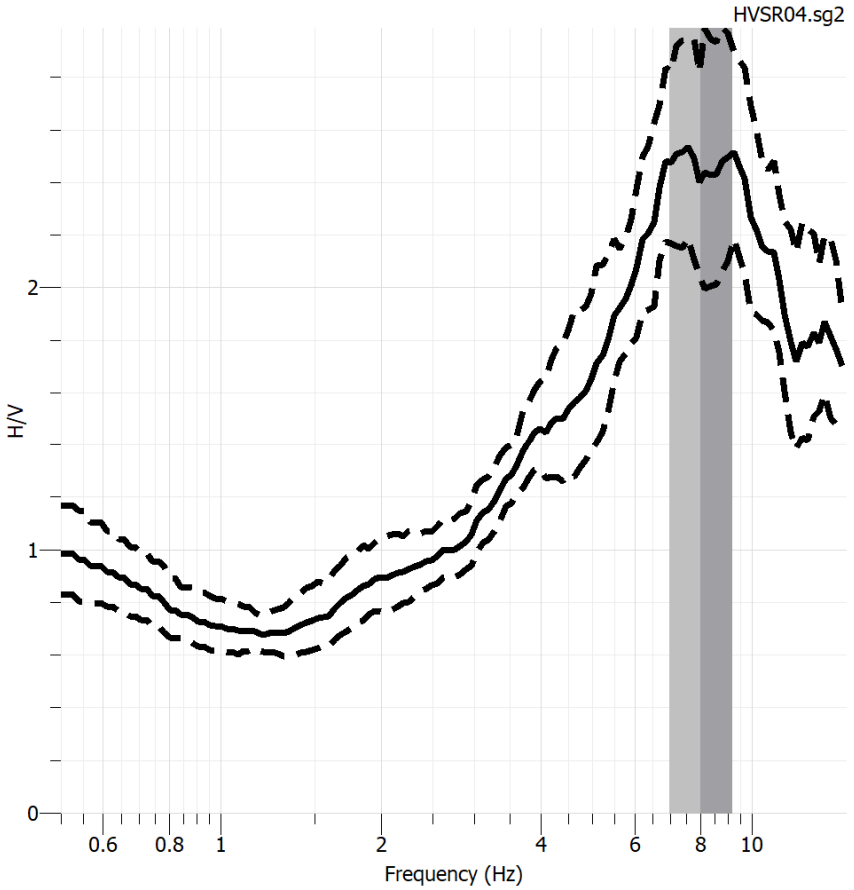


HVSR#	f0	fmin	fmax	A0	Amin	Amax	T0	Tmin	Tmax
	Hz	Hz	Hz				s	s	s
3	3.23	2.73	3.84	1.33	1.13	1.55	0.31	0.37	0.26

RDCL®

TITLE	HVSR03	PROJECT	250306				
PROJECT	Port Vila, Vanuatu Geophysics	DRAWN BY	OG	DATE	13/04/26	FIG	
CLIENT	T+T	CHECKED BY	SL	DATE	13/04/26	42	

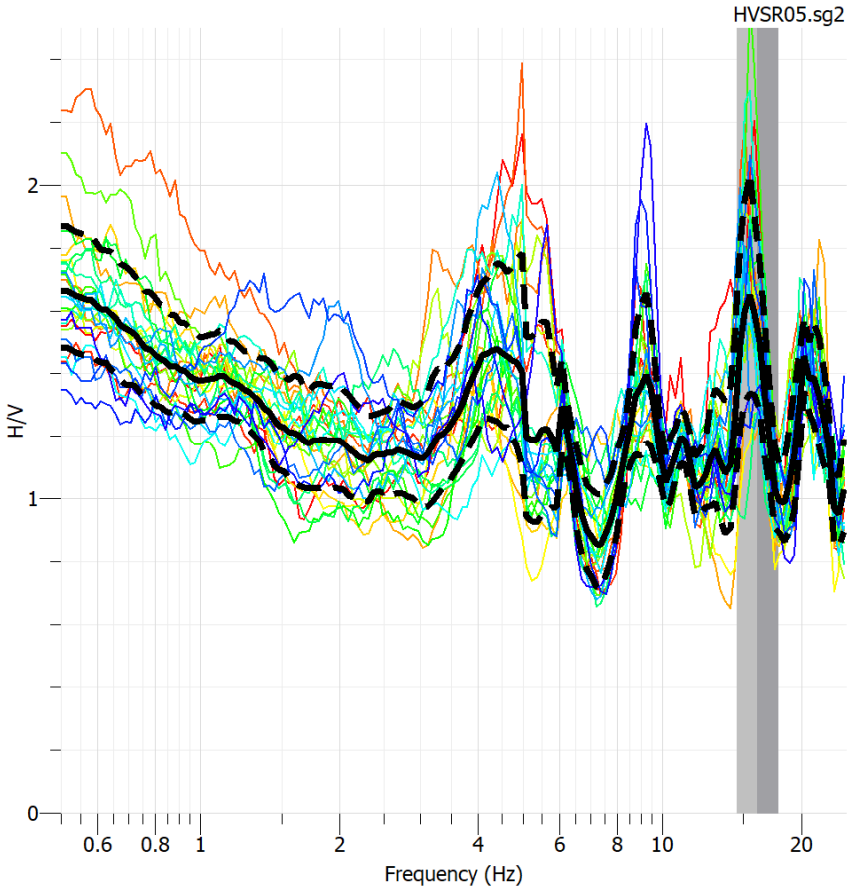


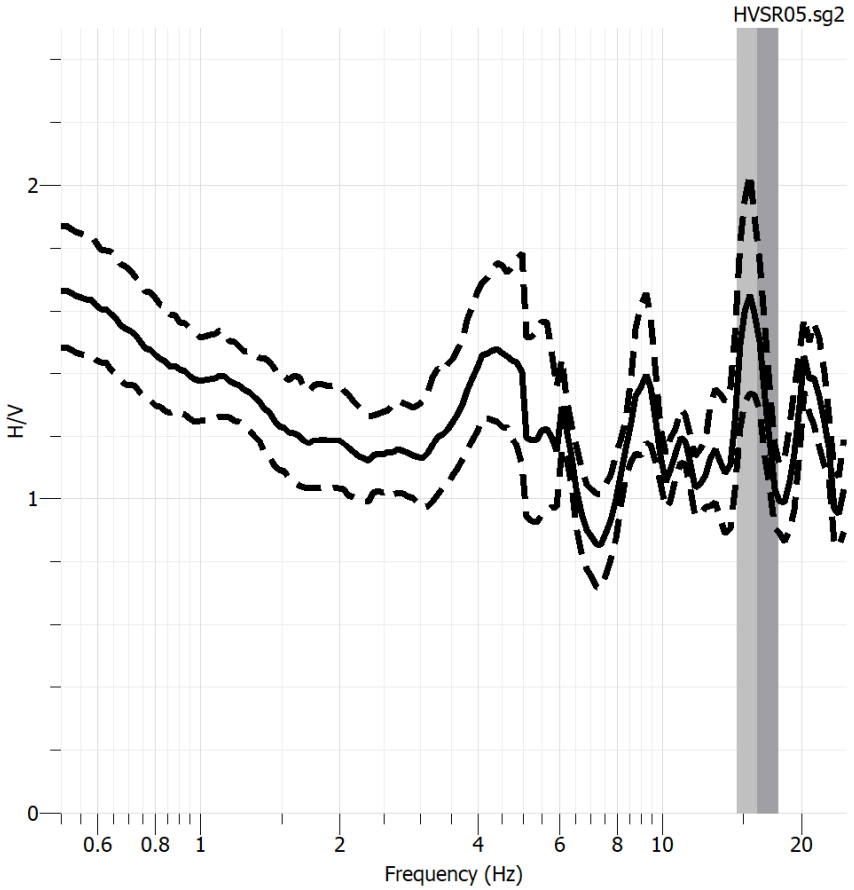


HVSR#	f0	fmin	fmax	A0	Amin	Amax	T0	Tmin	Tmax
	Hz	Hz	Hz				s	s	s
4	7.99	6.97	9.17	2.41	2.04	2.85	0.13	0.14	0.11

RDCL®

TITLE	HVSR04	PROJECT	250306			
PROJECT	Port Vila, Vanuatu Geophysics	DRAWN BY	OG	DATE	13/04/26	FIG
CLIENT	T+T	CHECKED BY	SL	DATE	13/04/26	43

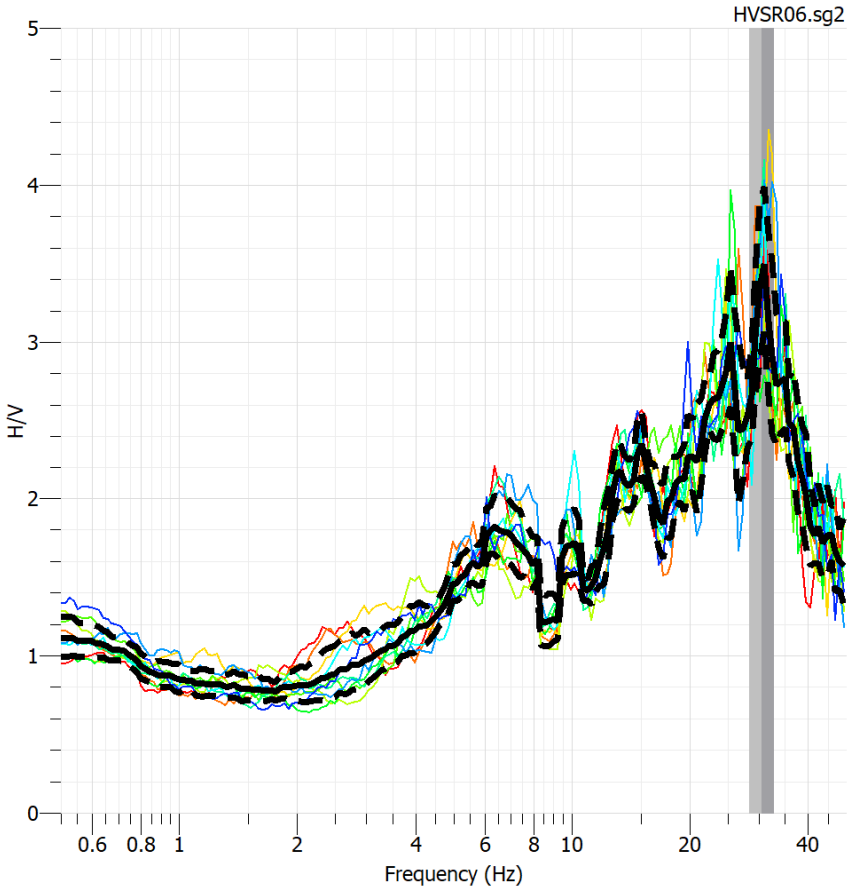


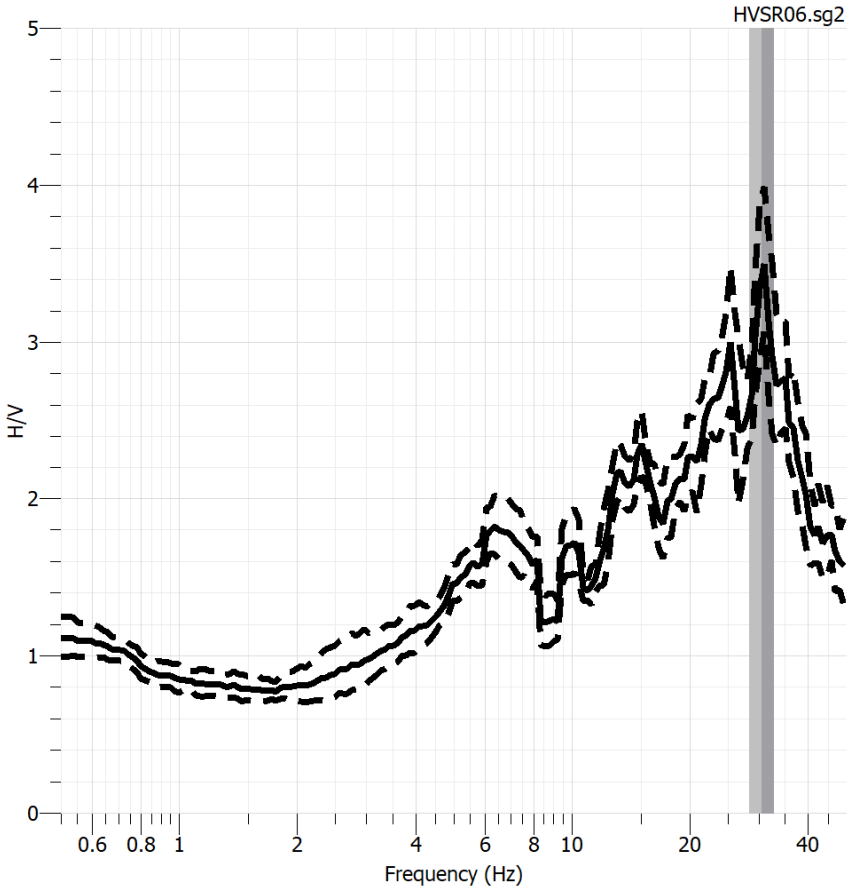


HVSR#	f0	fmin	fmax	A0	Amin	Amax	T0	Tmin	Tmax
	Hz	Hz	Hz				s	s	s
5	15.50	15.12	15.90	1.65	1.34	2.04	0.06	0.07	0.06

RDCL®

TITLE	HVSR05	PROJECT	250306				
PROJECT	Port Vila, Vanuatu Geophysics	DRAWN BY	OG	DATE	13/04/26	FIG	
CLIENT	T+T	CHECKED BY	SL	DATE	13/04/26	44	

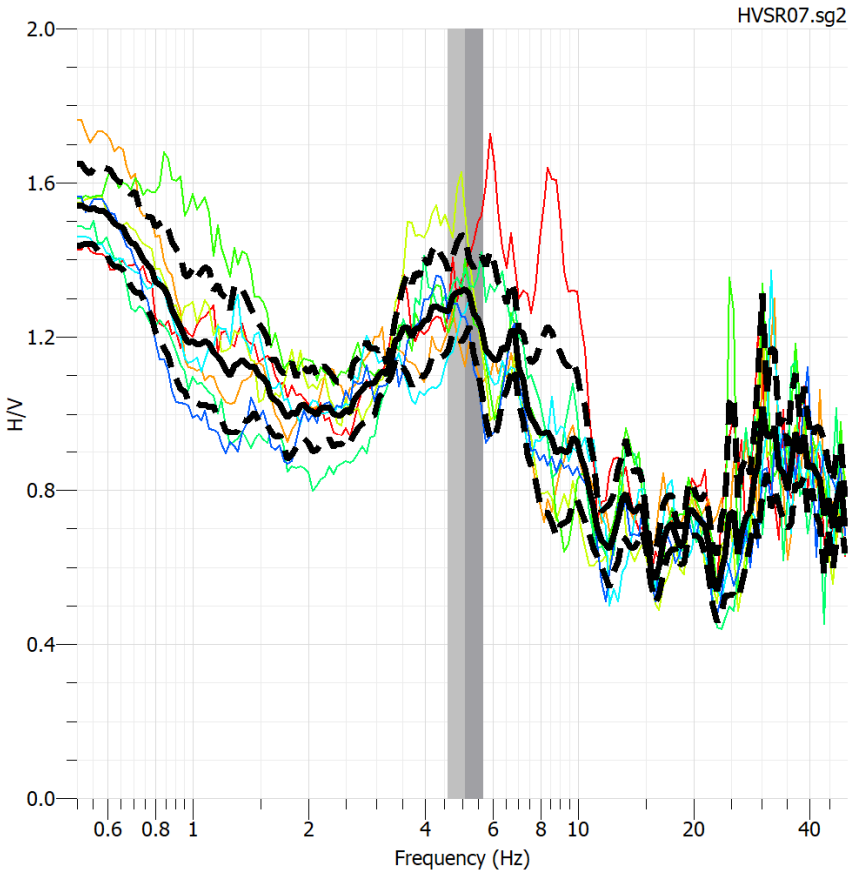


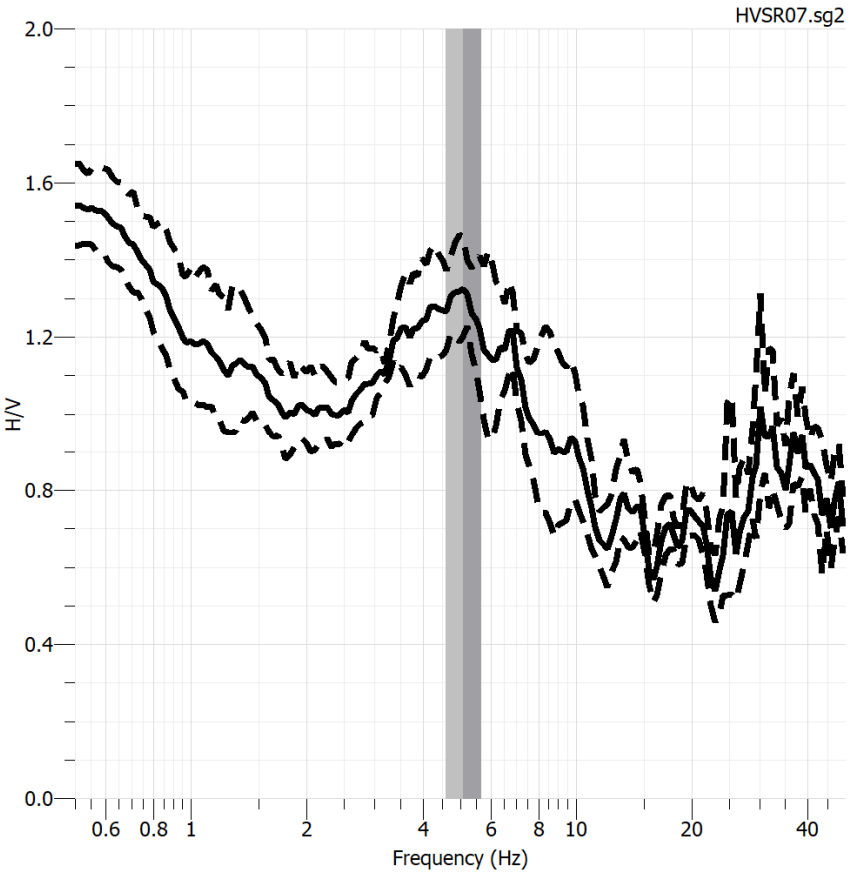


HVSR#	f0	fmin	fmax	A0	Amin	Amax	T0	Tmin	Tmax
	Hz	Hz	Hz				s	s	s
6	30.49	28.32	32.83	3.40	2.95	3.92	0.03	0.04	0.03

RDCL®

TITLE	HVSR06	PROJECT	250306			
PROJECT	Port Vila, Vanuatu Geophysics	DRAWN BY	OG	DATE	13/04/26	FIG
CLIENT	T+T	CHECKED BY	SL	DATE	13/04/26	45

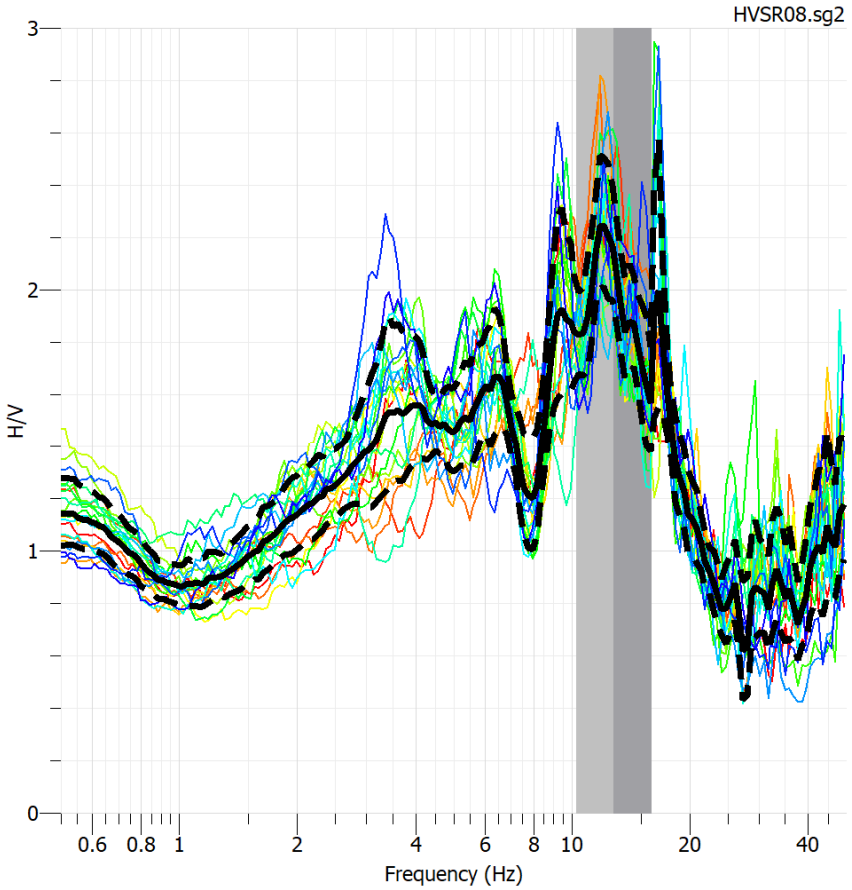


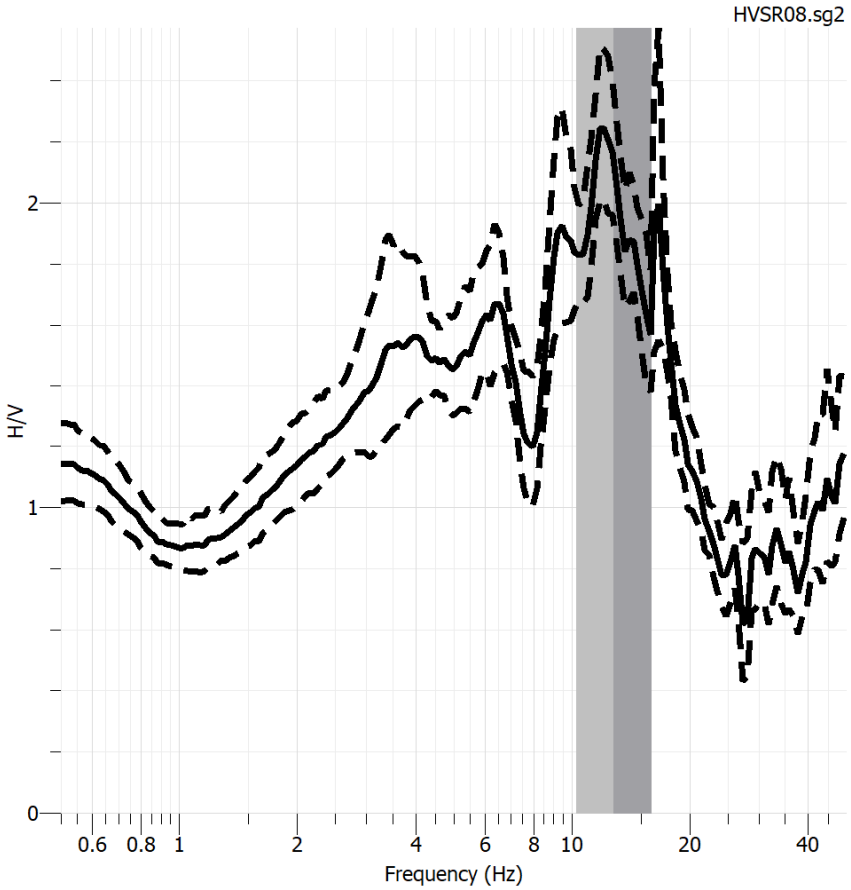


HVSR#	f0	fmin	fmax	A0	Amin	Amax	T0	Tmin	Tmax
	Hz	Hz	Hz				s	s	s
7	5.10	4.58	5.68	1.32	1.20	1.46	0.20	0.22	0.18

RDCL®

TITLE	HVSR07	PROJECT	250306			
PROJECT	Port Vila, Vanuatu Geophysics	DRAWN BY	OG	DATE	13/04/26	FIG
CLIENT	T+T	CHECKED BY	SL	DATE	13/04/26	46

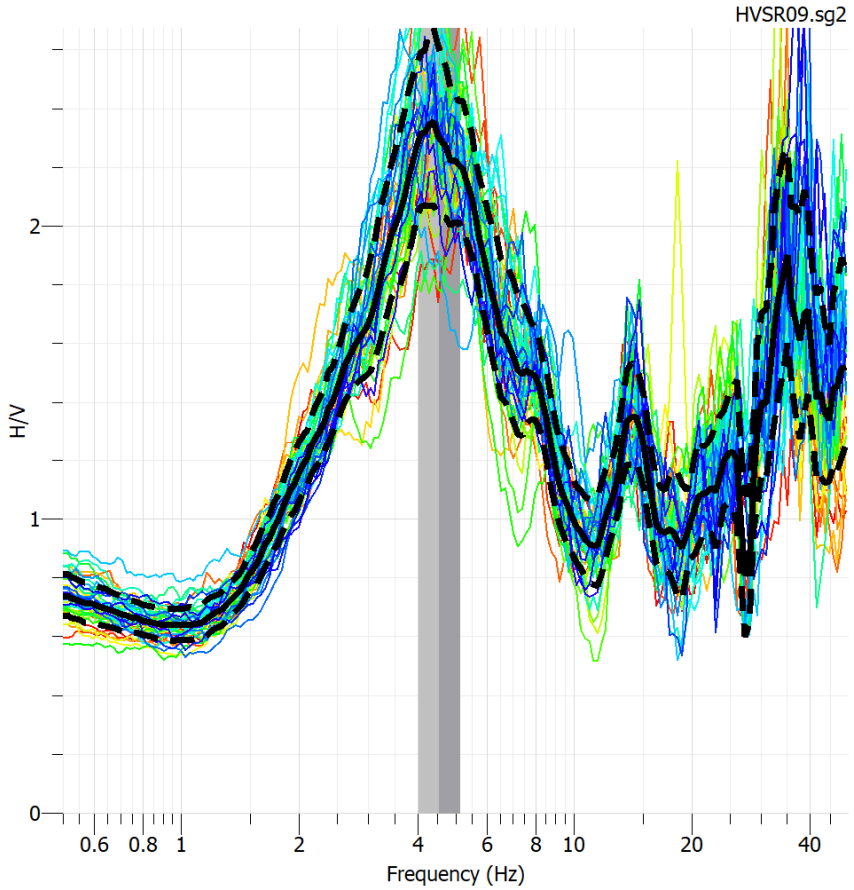


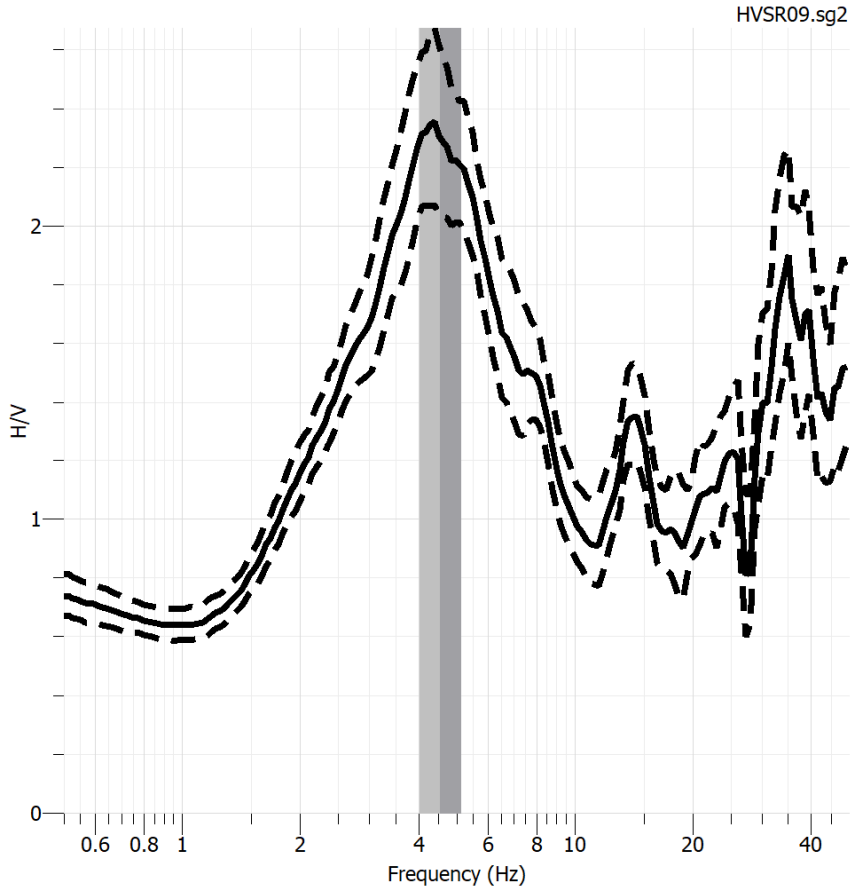


HVSR#	f0	fmin	fmax	A0	Amin	Amax	T0	Tmin	Tmax
	Hz	Hz	Hz				s	s	s
8	12.81	10.28	15.96	2.13	1.93	2.36	0.08	0.10	0.06

RDCL®

TITLE	HVSR08	PROJECT	250306			
PROJECT	Port Vila, Vanuatu Geophysics	DRAWN BY	OG	DATE	13/04/26	FIG
CLIENT	T+T	CHECKED BY	SL	DATE	13/04/26	47

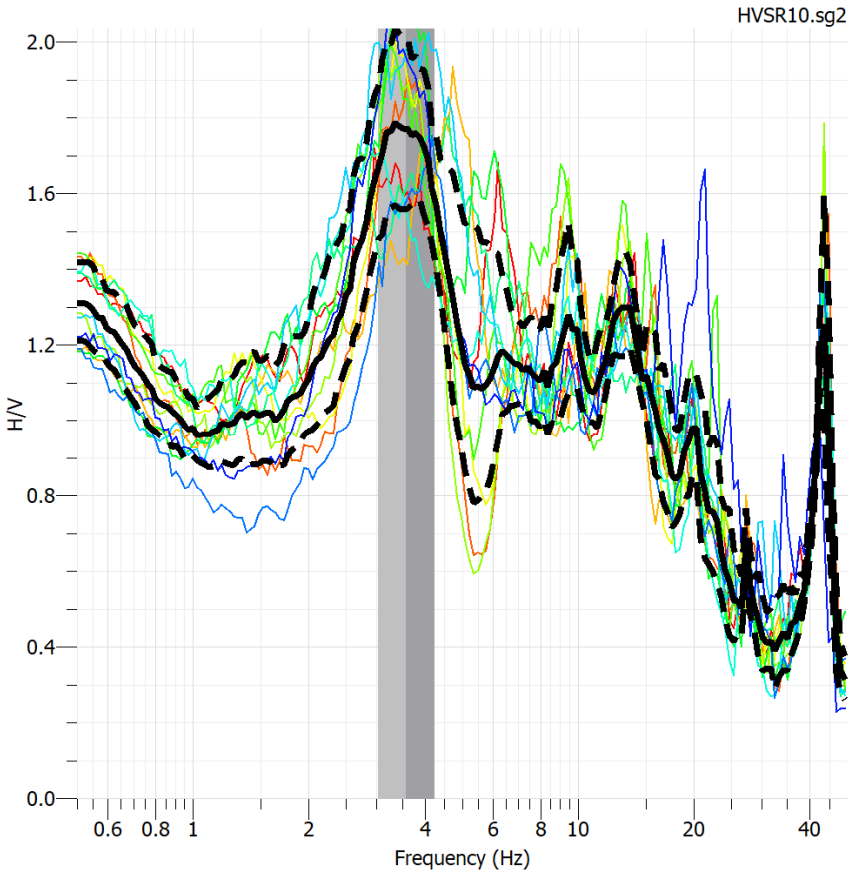


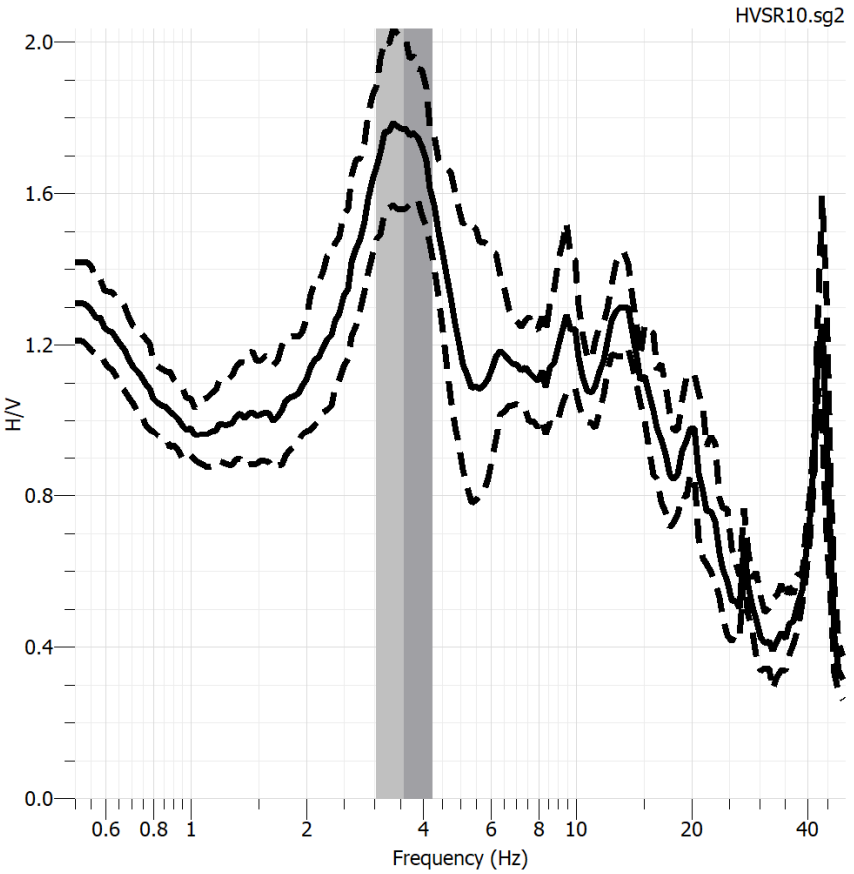


HVSR#	f0	fmin	fmax	A0	Amin	Amax	T0	Tmin	Tmax
	Hz	Hz	Hz				s	s	s
9	4.55	4.02	5.14	2.30	2.03	2.60	0.22	0.25	0.19

RDCL®

TITLE	HVSR09	PROJECT	250306			
PROJECT	Port Vila, Vanuatu Geophysics	DRAWN BY	OG	DATE	13/04/26	FIG
CLIENT	T+T	CHECKED BY	SL	DATE	13/04/26	48

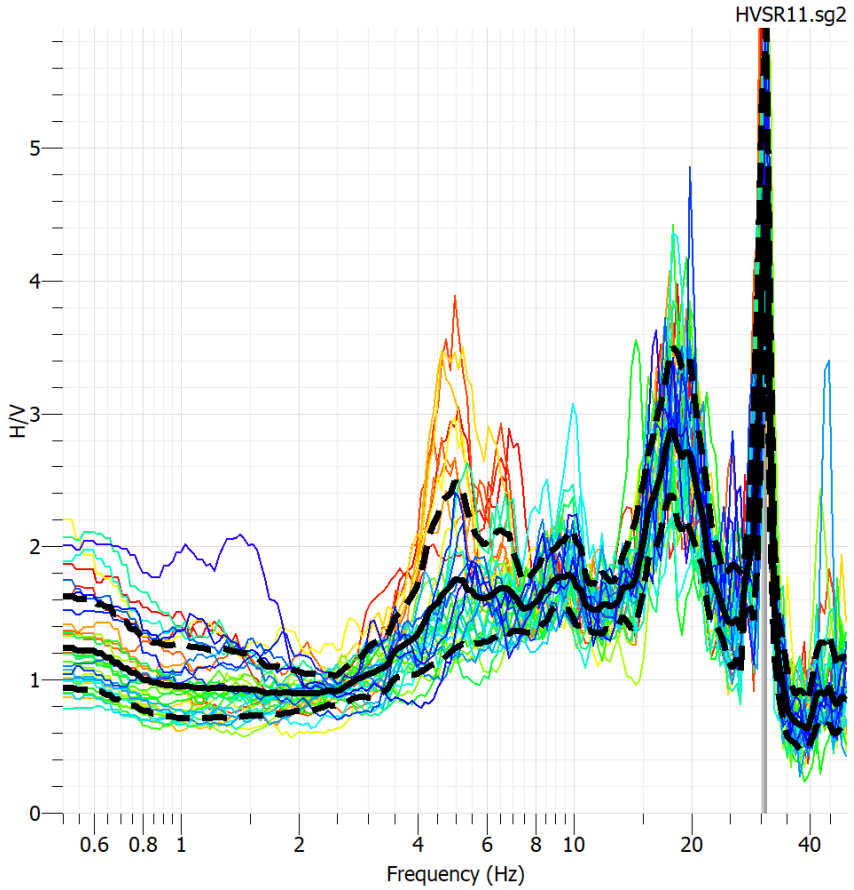


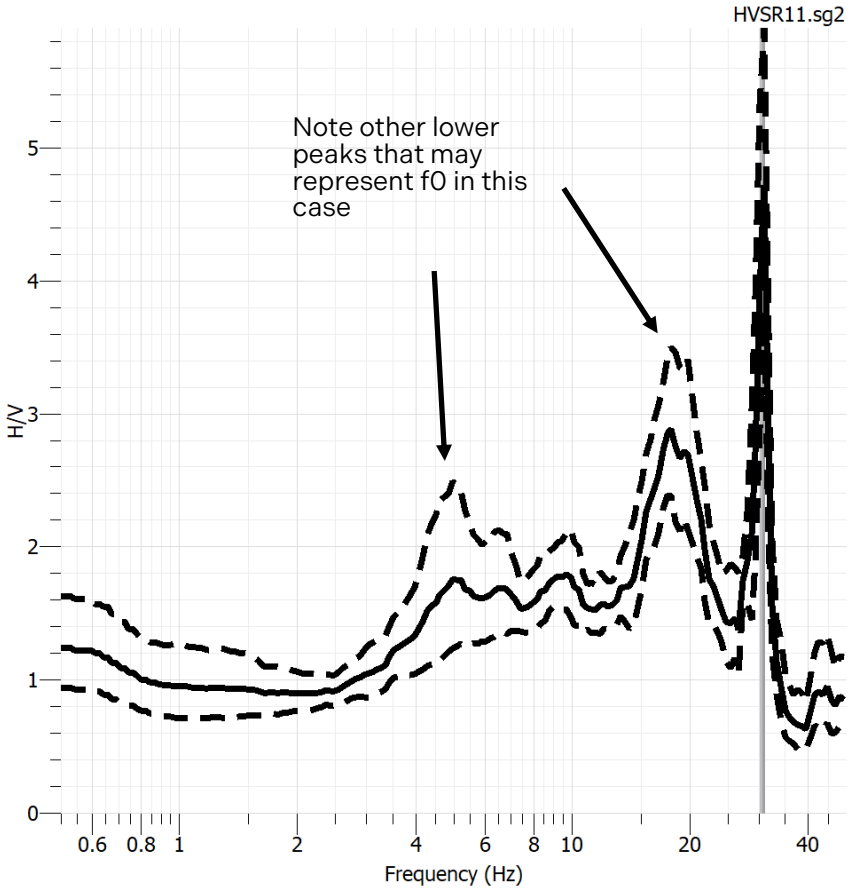


HVSR#	f0	fmin	fmax	A0	Amin	Amax	T0	Tmin	Tmax
	Hz	Hz	Hz				s	s	s
10	3.58	3.03	4.23	1.77	1.56	2.01	0.28	0.33	0.24

RDCL®

TITLE	HVSR10	PROJECT	250306			
PROJECT	Port Vila, Vanuatu Geophysics	DRAWN BY	OG	DATE	13/04/26	FIG
CLIENT	T+T	CHECKED BY	SL	DATE	13/04/26	49

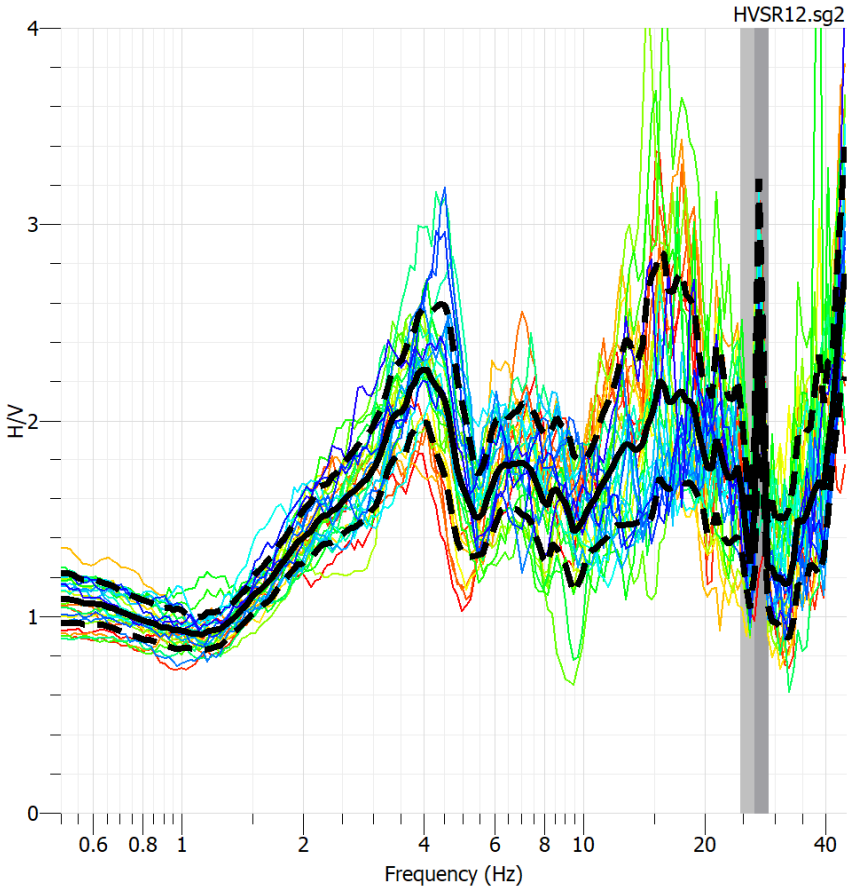


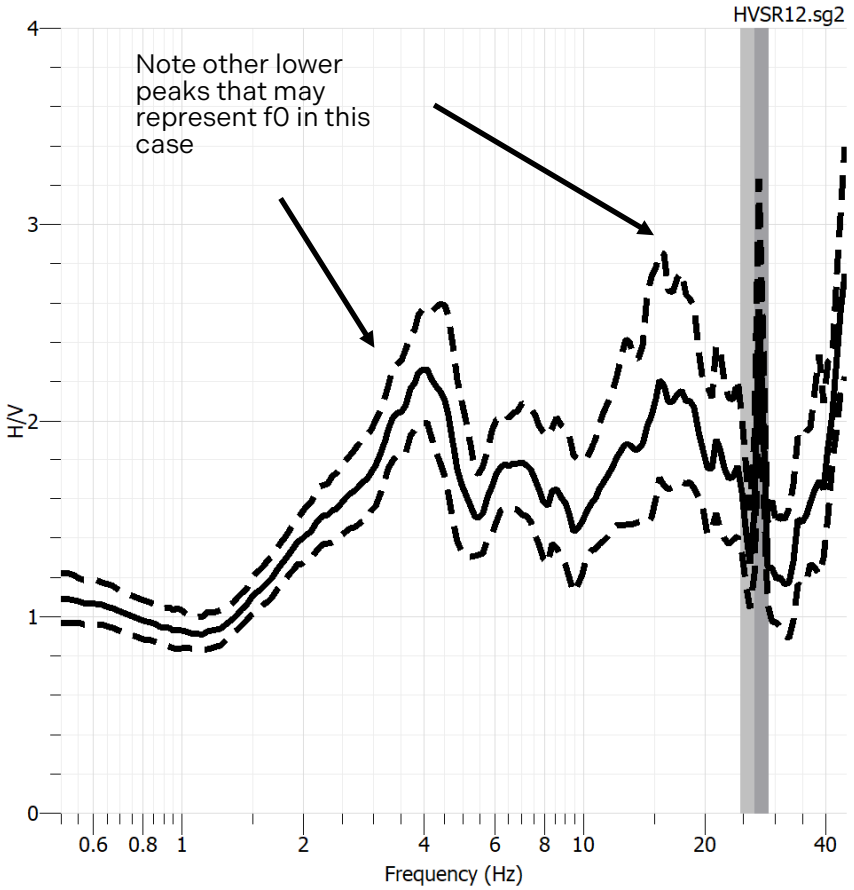


HVSR#	f0	fmin	fmax	A0	Amin	Amax	T0	Tmin	Tmax
	Hz	Hz	Hz				s	s	s
11	30.66	30.25	31.08	4.42	3.44	5.69	0.03	0.03	0.03

RDCL®

TITLE	HVSR11	PROJECT	250306			
PROJECT	Port Vila, Vanuatu Geophysics	DRAWN BY	OG	DATE	13/04/26	FIG
CLIENT	T+T	CHECKED BY	SL	DATE	13/04/26	50





HVSR#	f0	fmin	fmax	A0	Amin	Amax	T0	Tmin	Tmax
	Hz	Hz	Hz				s	s	s
12	26.61	24.55	28.86	1.50	1.20	1.88	0.04	0.04	0.03

RDCL®

TITLE	HVSR12	PROJECT	250306				
PROJECT	Port Vila, Vanuatu Geophysics	DRAWN BY	OG	DATE	13/04/26	FIG	
CLIENT	T+T	CHECKED BY	SL	DATE	13/04/26	51	

APPENDIX A

METHODOLOGIES

APPENDIX A CONTENTS

A1 MULTI-CHANNEL ANALYSIS OF SURFACE WAVES (MASW) 2

A1.1 MASW Acquisition Method 2
A1.1.1 Equipment 2
A1.1.2 Rolling MASW Array Deployments 2
A1.1.3 Field Quality Assurance 2
A1.1.4 Acquisition Parameters 2
A1.1.5 Positional control 3
A1.2 MASW DATA Processing 3
A1.2.1 Phase 1 3
A1.2.2 Phase 2 4
A1.2.3 Phase 3 4
A1.2.4 Phase 4 5

A2 SEISMIC REFRACTION TOMOGRAPHY (SRT) 7

A2.1 Equipment 7
A2.2 SRT Array Deployments 7
A2.2.1 Field Quality Assurance 7
A2.2.2 Acquisition Parameters 8
A2.2.3 Positional Control 8
A2.3 SRT Data Processing 8
A2.3.1 Phase 1 8
A2.3.2 Phase 2 9
A2.3.3 Phase 3 9
A2.3.4 Phase 4 9

A3 HORIZONTAL TO VERTICAL SPECTRAL RATIO (HVSR) 10

A3.1 HVSR Acquisition 10
A3.1.1 Field Quality Assurance 10
A3.1.2 Acquisition Parameters 10
A3.2 HVSR Data Processing 11
A3.2.1 Phase 1 11
A3.2.2 Phase 2 11
A3.2.3 Phase 3 11

A4 REFERENCES 11

A1 MULTI-CHANNEL ANALYSIS OF SURFACE WAVES (MASW)

A1.1 MASW Acquisition Method

A1.1.1 Equipment

RDCL deployed the following equipment:

- One twenty-four channel Geometrics Geode exploration seismograph.
- One 2 m spaced Geomatrix landstreamer with twenty-four 4.5 Hz geophones.
- Instrumented sledgehammer as a seismic source.
- Logging computer and ancillary equipment.

A1.1.2 Rolling MASW Array Deployments

The 2D MASW surveys comprised a 24-channel geophone array mounted at 2 m spacings on a landstreamer for a total array length of 46 m. The landstreamer was advanced by 20 m for every shot. A walkaway test was conducted at the start of the first line to assess the optimum offset from shot to geophone array.

Each shot consisted of 3 – 7 stacked blows of the sledgehammer.

A1.1.3 Field Quality Assurance

Onsite quality control was undertaken during the survey. QC was limited to qualitative assessments of:

- Signal to noise ratios.
- Trigger errors.
- Geophone coupling.

A1.1.4 Acquisition Parameters

Acquisition parameters for the active source acquisition were:

- Record Length 0.6 s

- Delay 0 s
- Sample interval 62.5 µs
- Acquisition filters OUT

A1.1.5 POSITIONAL CONTROL

The start and end points of the MASW lines and every 50 m were picked up with the mobile phone GPS.

Relative positional control on the MASW lines was provided by a tape measure. Relative lateral accuracy was therefore likely to be on the order of ± 0.3 m.

A1.2 MASW DATA PROCESSING

Data processing consisted of four phases.

- Phase 1: Initial processing and data filtering of the data.
- Phase 2: Generation of overtone images from the data and picking of dispersion curves.
- Phase 3: Developing appropriate starting models to match the dispersion curves.
- Phase 4: Inversion of the data within the Surface Plus module of Geogiga.

A1.2.1 PHASE 1

The purpose of Phase 1 was to check raw seismic traces were ready to import into software and were free of unwanted seismic noise.

Raw active source data files were imported into Geogiga Seismic Pro 10.0 software for initial qualitative quality assessments. Anthropogenic noise (human-made unwanted seismic waves) generated nearby can make this stage critical.

Processing which can be applied to data files during this phase includes:

- Data import of .sg2.
- Visual inspection of seismic traces.

- Generation of frequency spectrum (pre-filter).
- Appropriate lowpass or Butterworth bandpass filtering (noise removal).
- Generation of frequency spectrum (post-filter).
- Visual inspection of seismic traces.
- .sg2 file export.

A1.2.2 PHASE 2

The purpose of Phase 2 was to convert time domain seismic data into frequency domain and develop a dispersion curve for further processing in Phase 3.

Overtone images (Appendix B) were developed from each MASW shot. An overtone image is a representation in the frequency domain of phase velocity versus the frequency of the surface waves recorded.

A dispersion curve was picked from each overtone image. A dispersion curve is a plot of phase velocity versus frequency and indicates how fast surface waves of different frequencies (wavelengths) travel through the near surface.

To pick the dispersion curve the maxima of the fundamental mode was selected by the processing geophysicist. To improve the accuracy of the picking the Geogiga software automatically selects the maxima nearest to where the processing geophysicist placed their pick.

A1.2.3 PHASE 3

The purpose of Phase 3 was to develop an initial starting model from each dispersion curve. The starting model was used to constrain the Vs models generated during the inversion process.

The first step is to examine the dispersion curves generated for the site (Appendix B). As a rule of thumb, the resolvable thickness of the surface layers is equal to half the shortest wavelength picked (highest frequency).

Converting from the frequency domain into the wavelength domain:

$$Min\ layer\ thickness\ (approximate\ average) = \frac{c/f}{2} = \frac{300/56}{2} = \sim 2.7\ m$$

Similarly, the maximum depth layers can be resolved at is half the average maximum wavelength (lowest frequency):

$$Max\ depth\ resolved\ (approximate\ average) = \frac{c/f}{2} = \frac{530/12.2}{2} = \sim 21.8\ m$$

Where:

c = velocity

f = frequency

The values calculated above help define the bounds of the starting model developed within Geogiga Surface Plus. Each shot has a unique starting model, positioned at the centre of the array.

Shear wave velocities for each layer were automatically assigned by Geogiga such that the calculated dispersion curve was a reasonable fit to the observed dispersion curve. These were tweaked manually during the modelling process.

A constant density of 2000 kg/m^3 was assumed for all layers. Note the density estimation has a minor effect on calculated velocities.

A1.2.4 Phase 4

The purpose of Phase 4 was to invert the observed dispersion curves from Phase 3 and develop an unconstrained pseudo-2D site-specific shear wave velocity profile model for each MASW line.

Phase 4 comprised running the inversion process within Geogiga Surface Plus. Each dispersion curve was inverted independently. The velocity of each layer was usually allowed to vary by 30% from the starting model.

During inversions the rate of improvement of Normalised Root-Mean-Squared (NRMS) error, a measure of model fit, with iteration was observed. Models were usually run for 15 iterations. In some cases, the starting model or number of iterations were tweaked to improve the output model fit.

Vs model for the line was then gridded, resulting in a pseudo - 2D profiles.

Where lines were not long enough to create a 2D pseudo profile 1D soundings were generated. Here composite dispersion curves were developed from multiple offset shots.

A2 SEISMIC REFRACTION TOMOGRAPHY (SRT)

A2.1 EQUIPMENT

RDCL deployed the following equipment:

- One twenty-four channel Geometrics Geode exploration seismograph.
- One 2 m spaced Geomatrix landstreamer with twenty-four 4.5 Hz geophones.
- Instrumented sledgehammer as a seismic source.
- Logging computer and ancillary equipment.

A2.2 SRT ARRAY DEPLOYMENTS

Four SRT lines were deployed. The lines were placed along the length of the profile. Shots were undertaken at:

- Every 9 m along the array.
- At 6 and 12 m offset at the end of each array.

Once these shots were recorded the array was dragged so that the first geophone was in the same location as the last geophone. The shots were then repeated.

Each shot was repeated and stacked between 3-5 times.

A2.2.1 FIELD QUALITY ASSURANCE

Onsite quality control was undertaken during each survey. QC was limited to qualitative assessments of:

- Signal to noise ratios.
- Trigger errors.
- Geophone coupling.

A2.2.2 Acquisition Parameters

Generic acquisition parameters for the active source acquisition were:

- Delay 0 s
- Sample interval 62.5 µs
- Acquisition filters OUT
- Record length 0.2 seconds

A2.2.3Positional Control

Geophones were placed on the ground using a 100 m tape measure. Relative positional accuracy was therefore likely to be on the order of ± 0.1 m.

A2.3 SRT Data Processing

Data processing consisted of four phases.

- Phase 1: Initial processing and data filtering of the SRT data.
- Phase 2: Picking of first arrivals of the compressional waves for each shot location.
- Phase 3: Undertaking a tomographic inversion to produce 2D profiles showing compressional wave velocities.
- Phase 4: Presentation of 2D profiles and interpretation.

A2.3.1 Phase 1

The purpose of Phase 1 was to check raw SRT seismic traces were ready to import into software and were free of unwanted seismic noise.

Raw active source data files were imported into Geogiga Seismic Pro 7.1 software for initial qualitative quality assessments. Anthropogenic noise (human-made unwanted seismic waves) generated nearby can make this stage critical.

Processing which can be applied to data files during this phase includes:

- Data import of .sg2.

- Visual inspection of seismic traces.
- Generation of frequency spectrum (pre-filter).
- Appropriate lowpass or Butterworth bandpass filtering (noise removal).
- Generation of frequency spectrum (post-filter).
- Visual inspection of seismic traces.
- .sg2 file export.

A2.3.2 PHASE 2

Phase 2 comprised importing the .sg2 files into the DW Tomo module of Geogiga's Seismic Pro software package.

Seismic data files were read into the software and first breaks (refracted compressional waves) identified and picked. Each seismic file was read and the refracted waves picked with reference to the previous picks.

Finally, the ray trace diagram (Appendix B) was examined for anomalous picks and appropriate corrections made.

A2.3.3 PHASE 3

Phase 3 first involved importing elevation data into DW Tomo to make a topographic related static correction. Subsequently data was assessed for reciprocity and corrections made where appropriate.

An initial starting velocity model was developed from the arrival time picks and seismic refraction tomography modelling was undertaken. Raypaths, velocities and fit were all monitored during the inversion process.

The resulting 2D Vp profile grid was trimmed according to raypaths and geophone positions and exported as a text file.

A2.3.4 PHASE 4

Phase 4 involved import of the 2D Vp profile section to Geosoft's Oasis Montaj software. The sections are presented in Figures 36 - 39.

A3 HORIZONTAL TO VERTICAL SPECTRAL RATIO (HVSR)

A3.1 HVSR Acquisition

Data was acquired with reference to the SESAME 2004 guidelines. The following process was followed:

- The spikes of the triaxial geophone were inserted into the ground and a sandbag placed on top.
- Firm coupling was checked.
- Verticality was checked.
- The site was assessed for controllable and unwanted transients (temporary noise sources) for example overhead trees, nearby excavating, idling vehicles etc. The test was relocated as required.
- GPS lock was confirmed.
- Data was recorded for 1 hour.

A3.1.1 Field Quality Assurance

During acquisition the Geophysicist recorded:

- Start and End times.
- Location.
- Weather.
- Coupling.
- The timing of any noise transients.

A3.1.2 Acquisition Parameters

The HVSR survey was configured to acquisition parameters:

- Record length 1 hour
- Delay 0 ms
- Sample interval 2 ms
- Acquisition filters OUT

A3.2 HVSR Data Processing

A3.2.1 Phase 1

The purpose of Phase 1 was to import the seismic data and convert into common time blocks (CTB's). This process included:

- Download of H/V data from the ATOM digitiser using Geometrics ATOM downloader.
- Conversion of .atm data to SEG2 format.
- Division of data in CTB's for each test location

A3.2.2Phase 2

The purpose of Phase 2 was to generate frequency/amplitude plots. The process involved:

- Import of SEG2 data into Geopsy software.
- Visual inspection of seismic traces.
- Semi-automatic assessment of non-transient trace periods into 60 second time windows (typically).
- Generation of frequency/amplitude plots.

A3.2.3 Phase 3

The purpose of Phase 3 was to assess the frequency/amplitude plot. The process involved:

- Assessing the "peakiness" of the H/V peak frequency (f_0).
- Recording the amplitude and frequency of the peak.
- Assessing the error.
- Converting the Peak Frequency to a Period.

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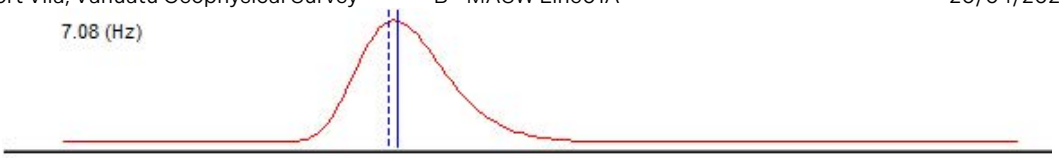
APPENDIX B

DISPERSION CURVES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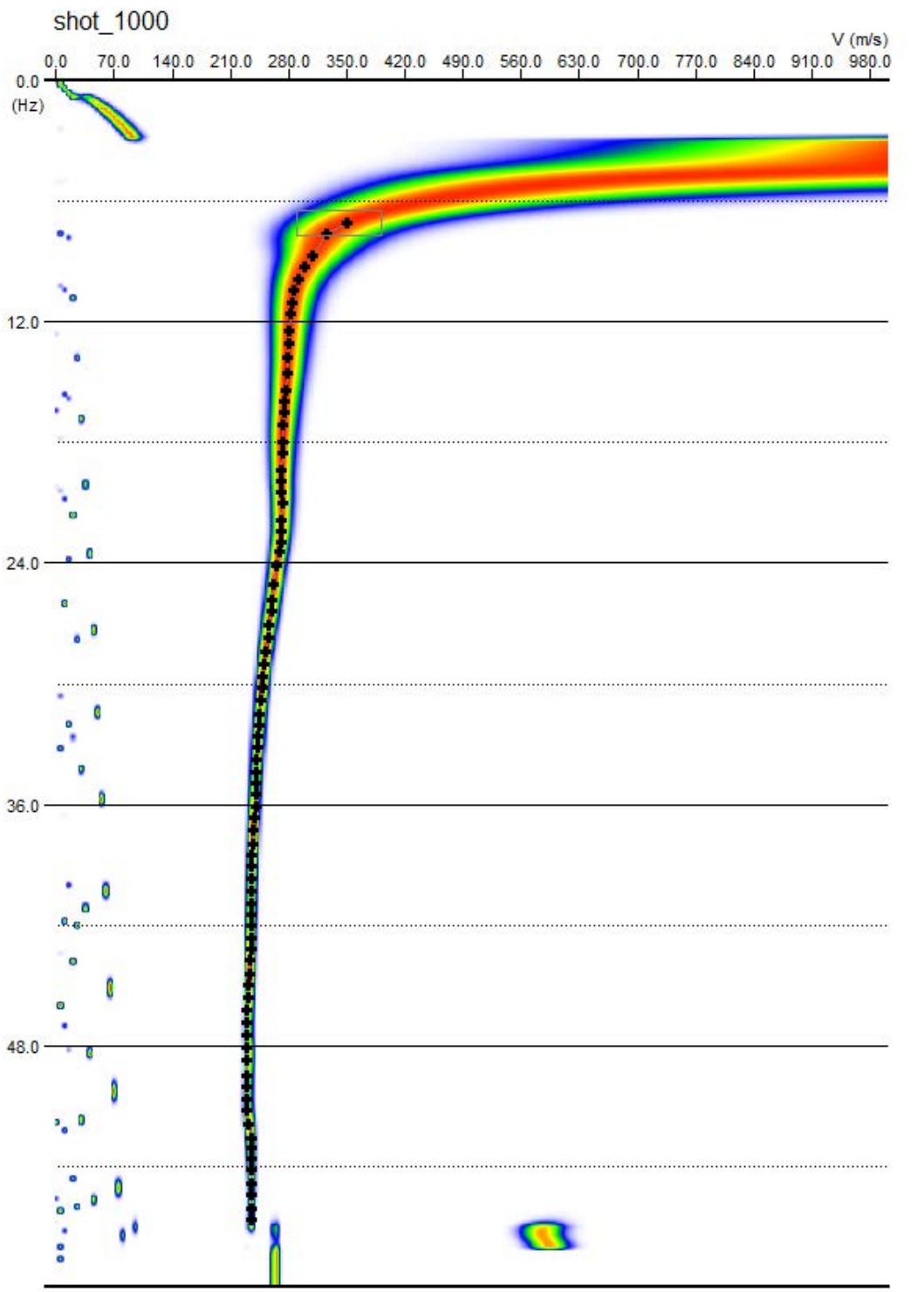
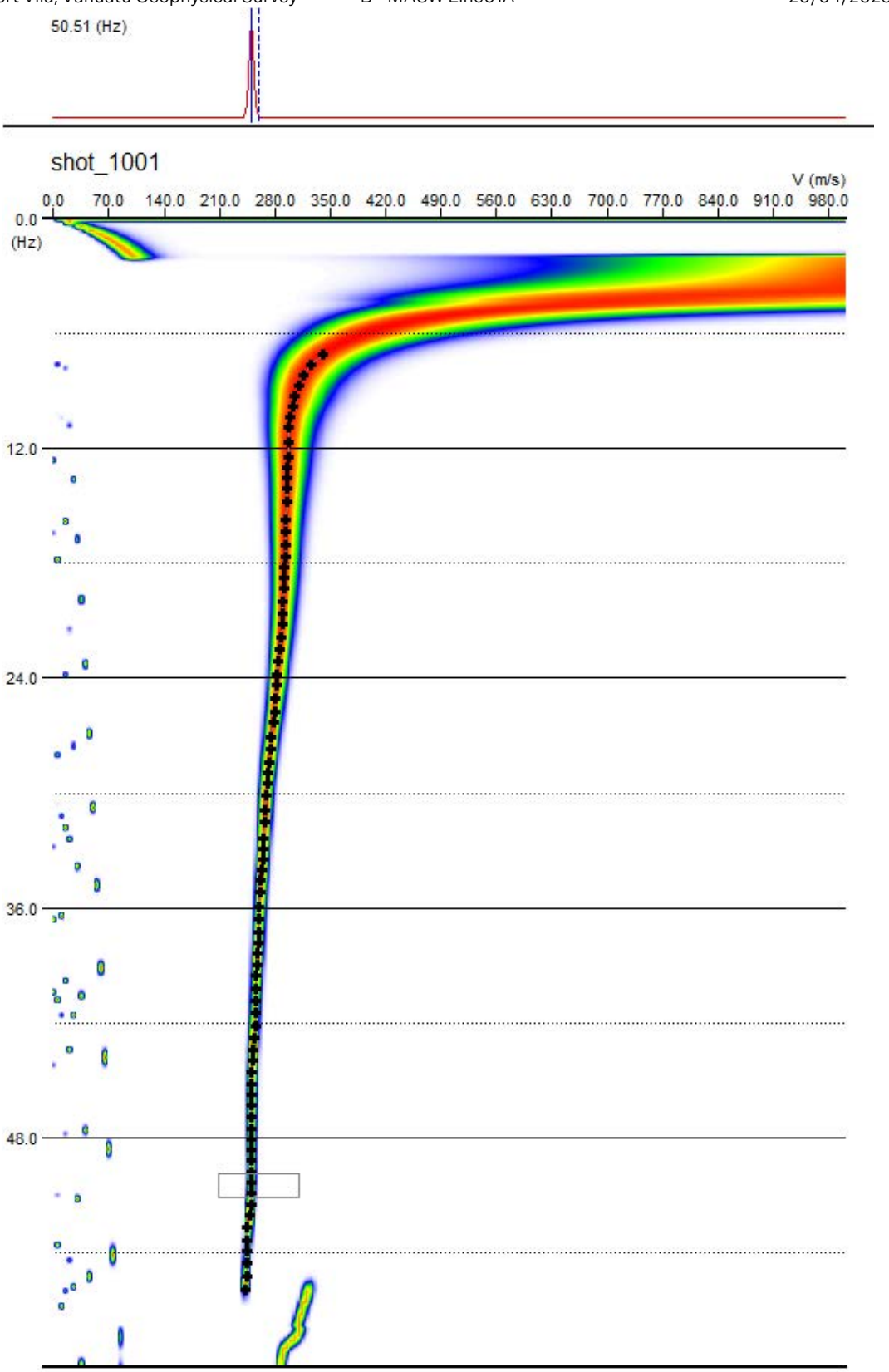
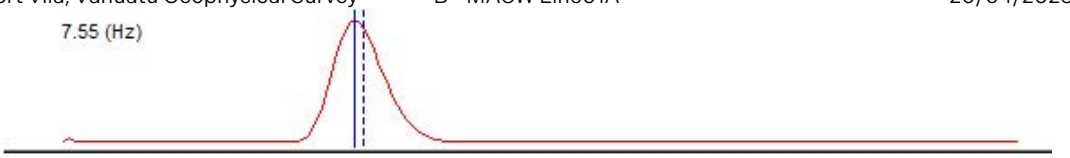

shot_1000
V (m/s)
0.0 70.0 140.0 210.0 280.0 350.0 420.0 490.0 560.0 630.0 700.0 770.0 840.0 910.0 980.0
0.0
(Hz)
12.0
24.0
36.0
48.0


50.51 (Hz)
shot_1001
V (m/s)
0.0 70.0 140.0 210.0 280.0 350.0 420.0 490.0 560.0 630.0 700.0 770.0 840.0 910.0 980.0
0.0
(Hz)
12.0
24.0
36.0
48.0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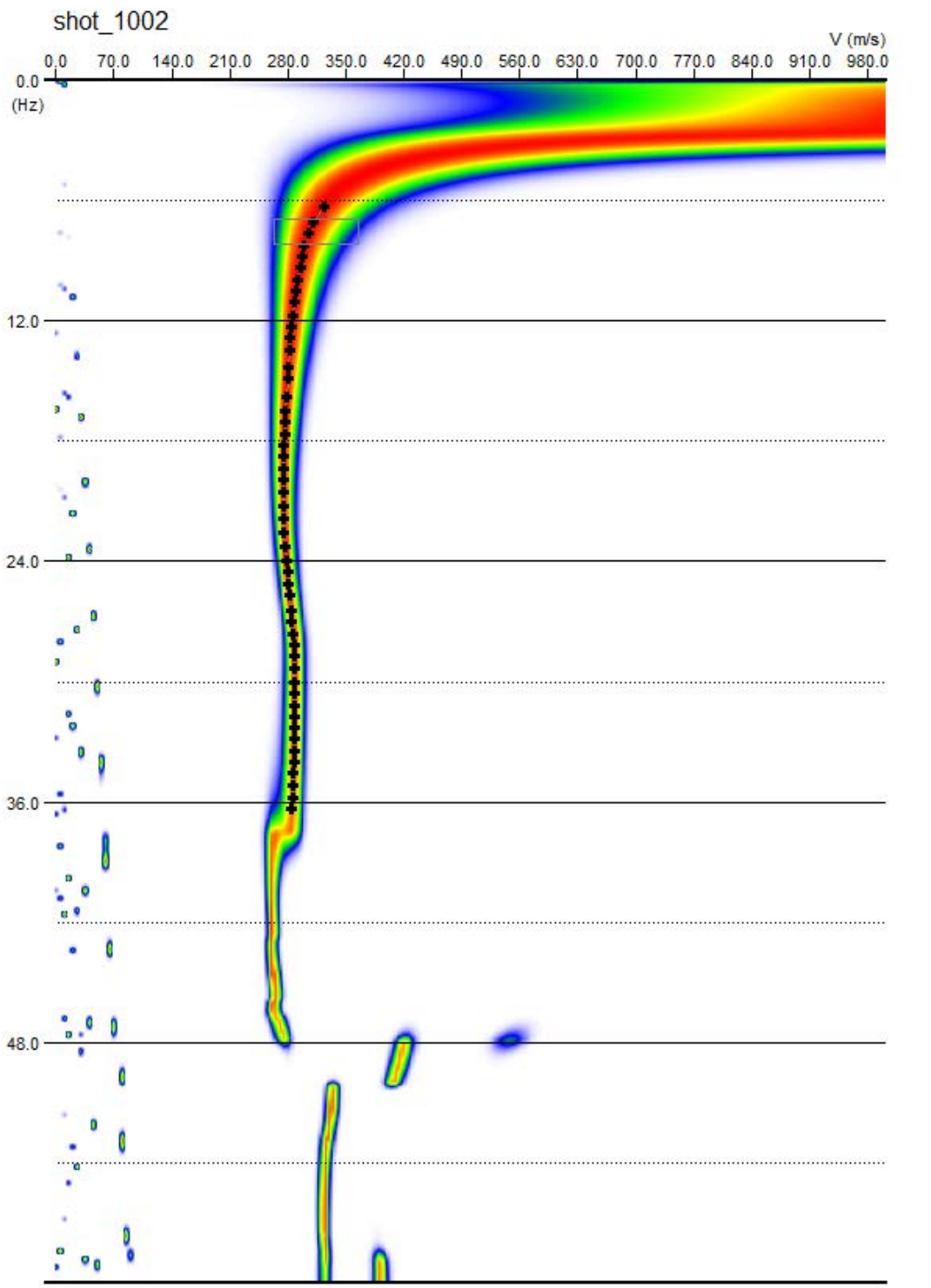
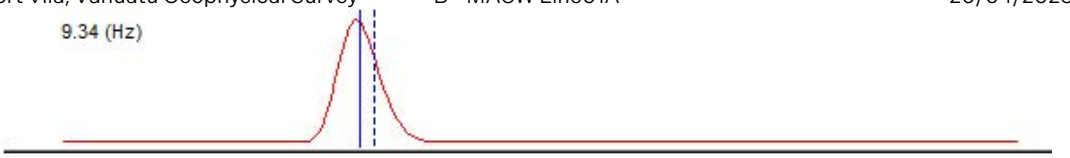
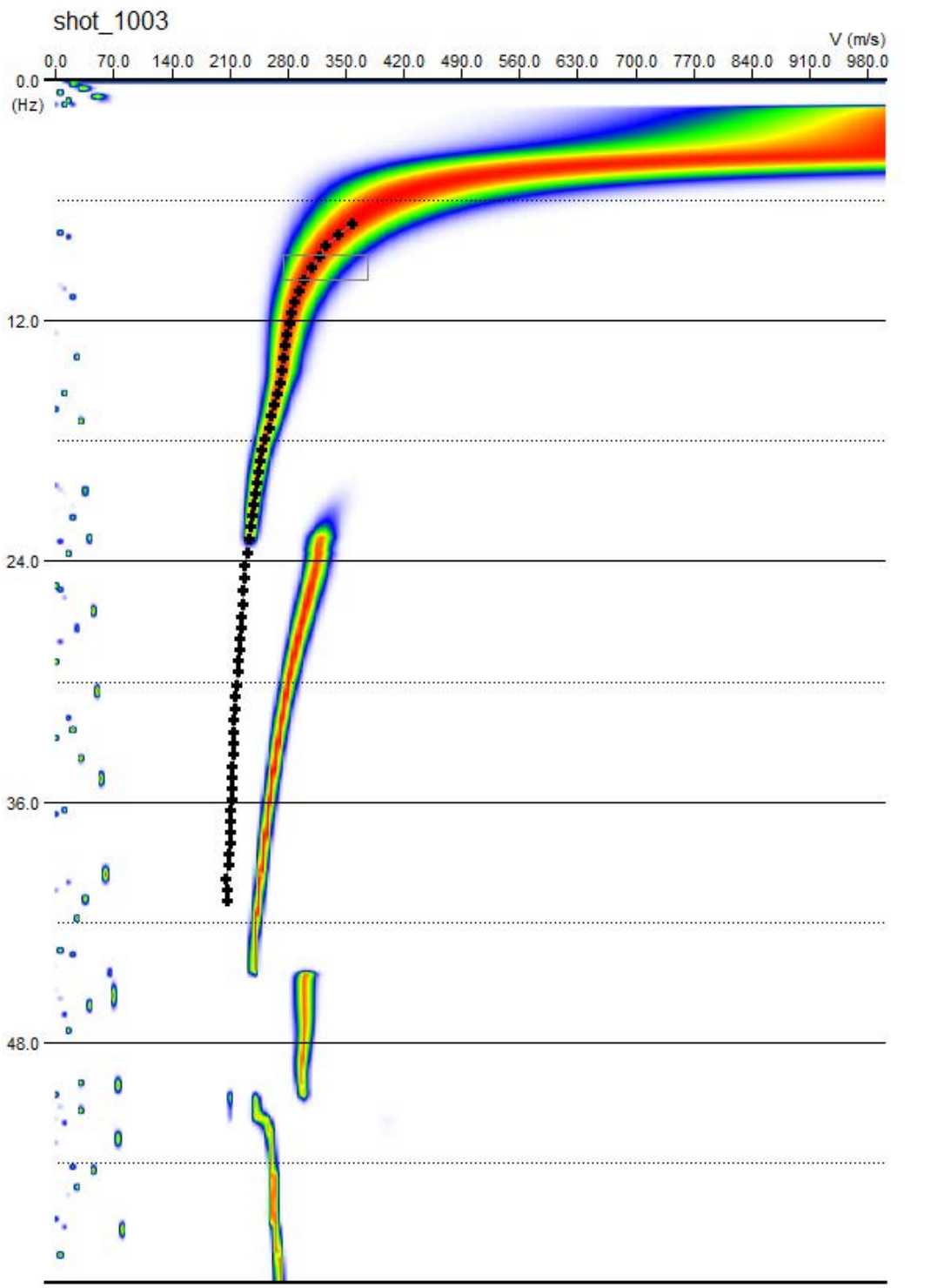

shot_1002
V (m/s)
0.0
70.0
140.0
210.0
280.0
350.0
420.0
490.0
560.0
630.0
700.0
770.0
840.0
910.0
980.0
0.0
(Hz)
12.0
24.0
36.0
48.0


9.34 (Hz)


shot_1003
V (m/s)
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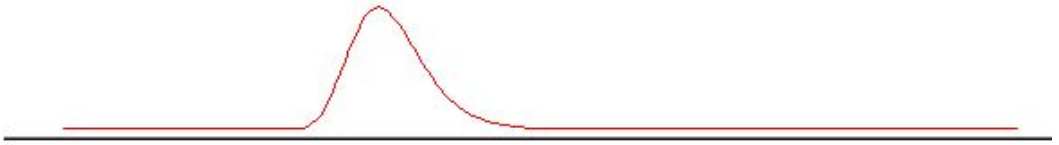
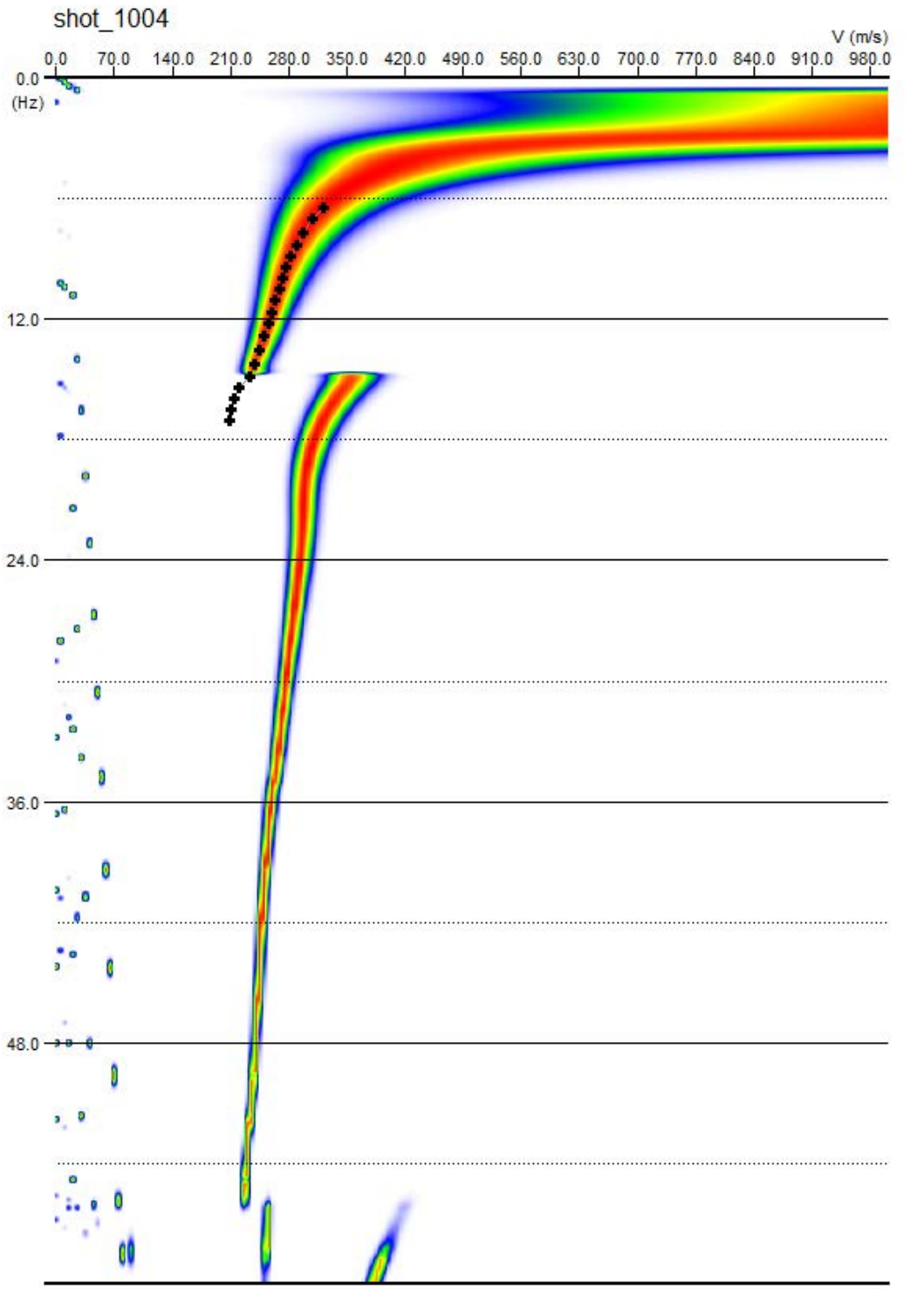
70.0
140.0
210.0
280.0
350.0
420.0
490.0
560.0
630.0
700.0
770.0
840.0
910.0
980.0
0.0
(Hz)
12.0
24.0
36.0
48.0

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V (m/s)
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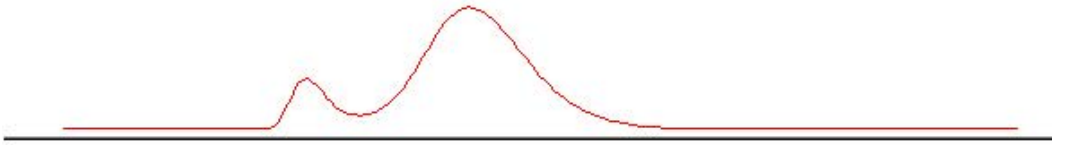
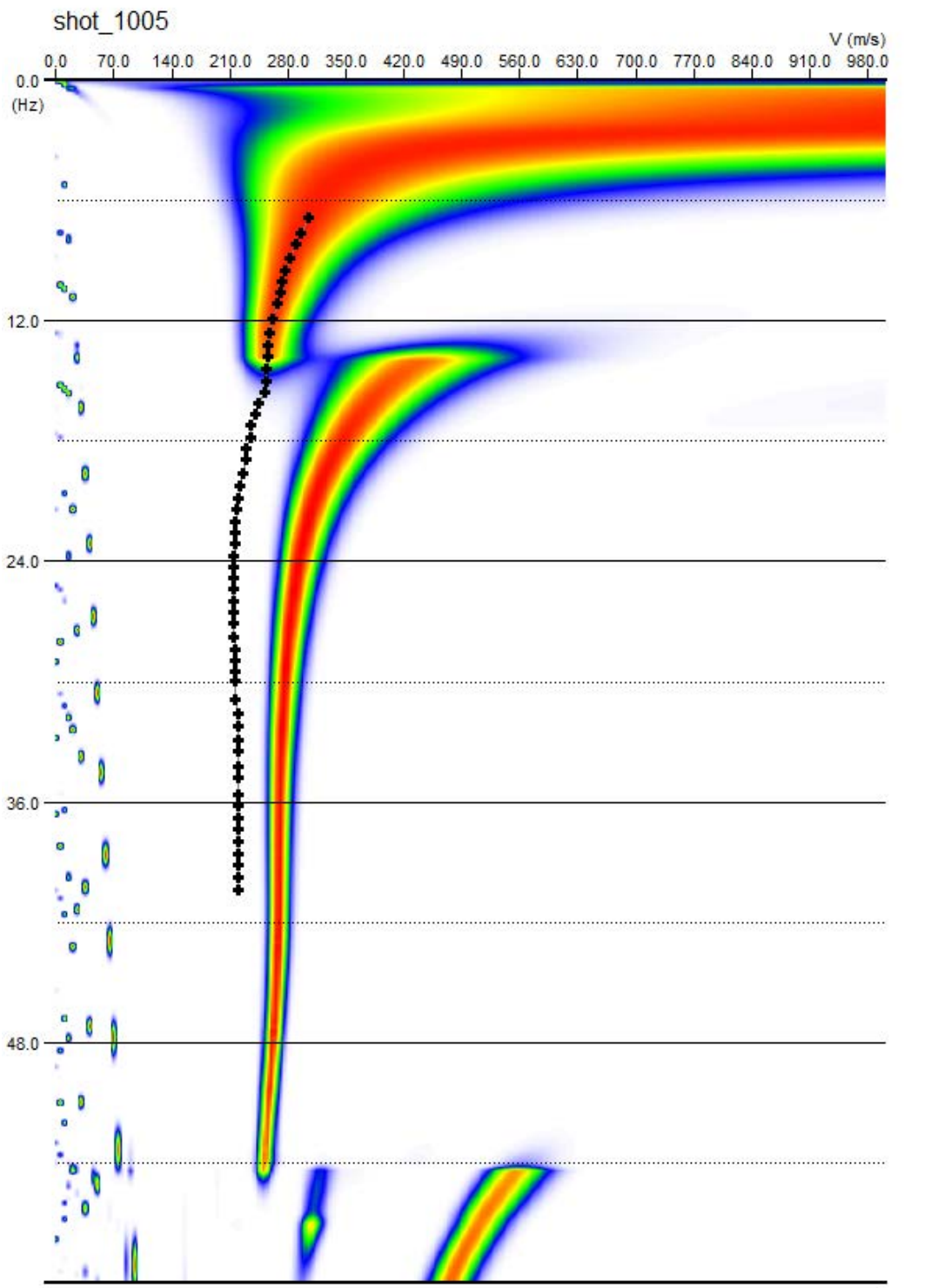
350.0
420.0
490.0
560.0
630.0
700.0
770.0
840.0
910.0
980.0
0.0
(Hz)
12.0
24.0
36.0
48.0




shot_1005
V (m/s)
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140.0
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280.0
350.0
420.0
490.0
560.0
630.0
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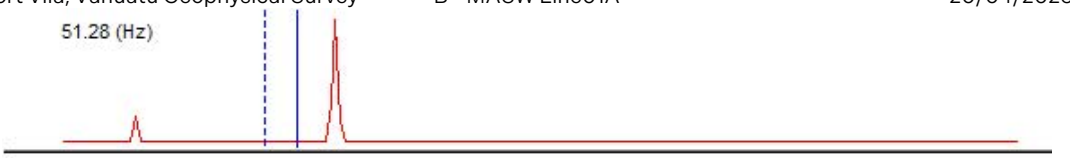
770.0
840.0
910.0
980.0
0.0
(Hz)
12.0
24.0
36.0
48.0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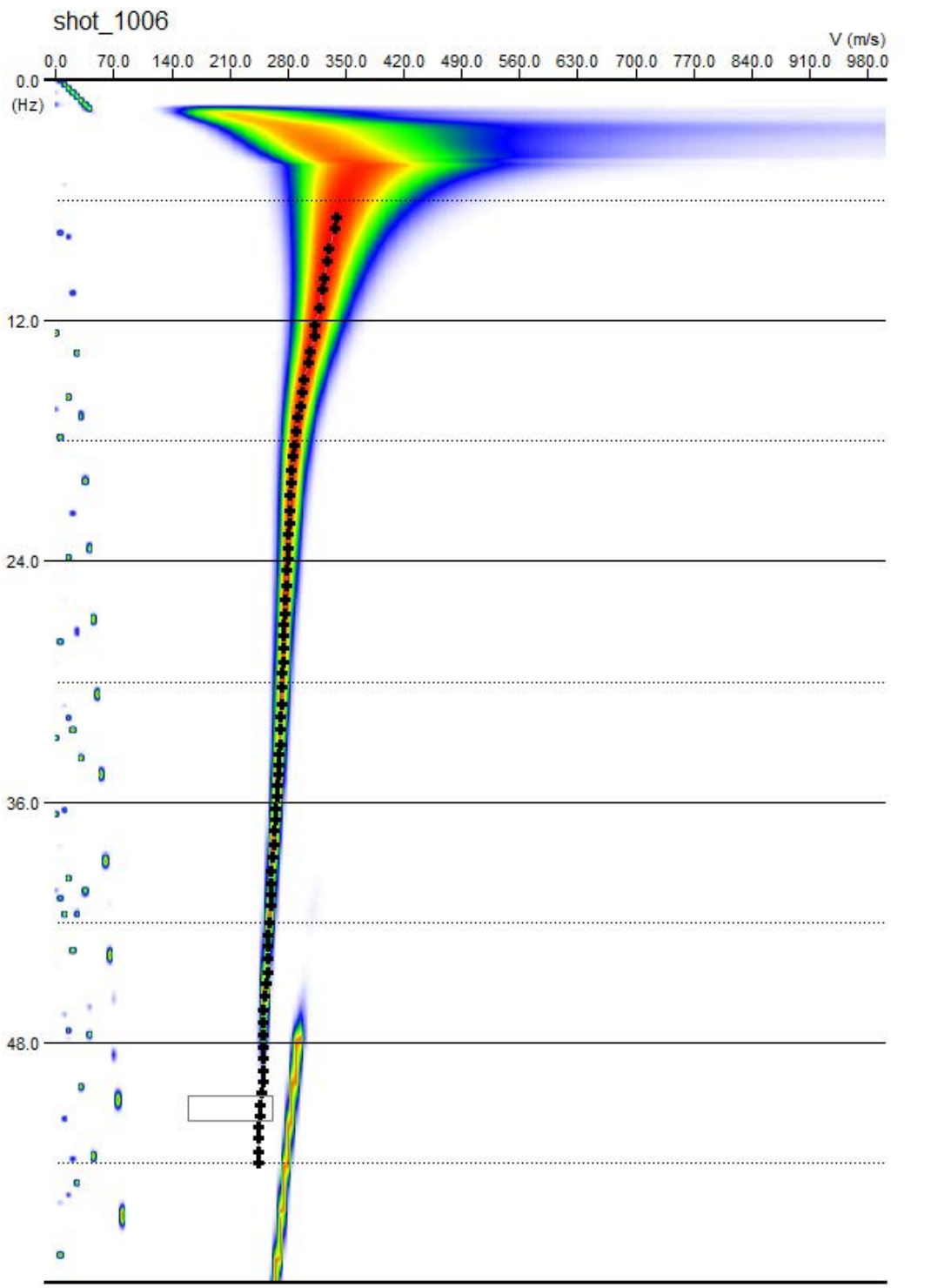
shot_1006
V (m/s)
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70.0
140.0
210.0
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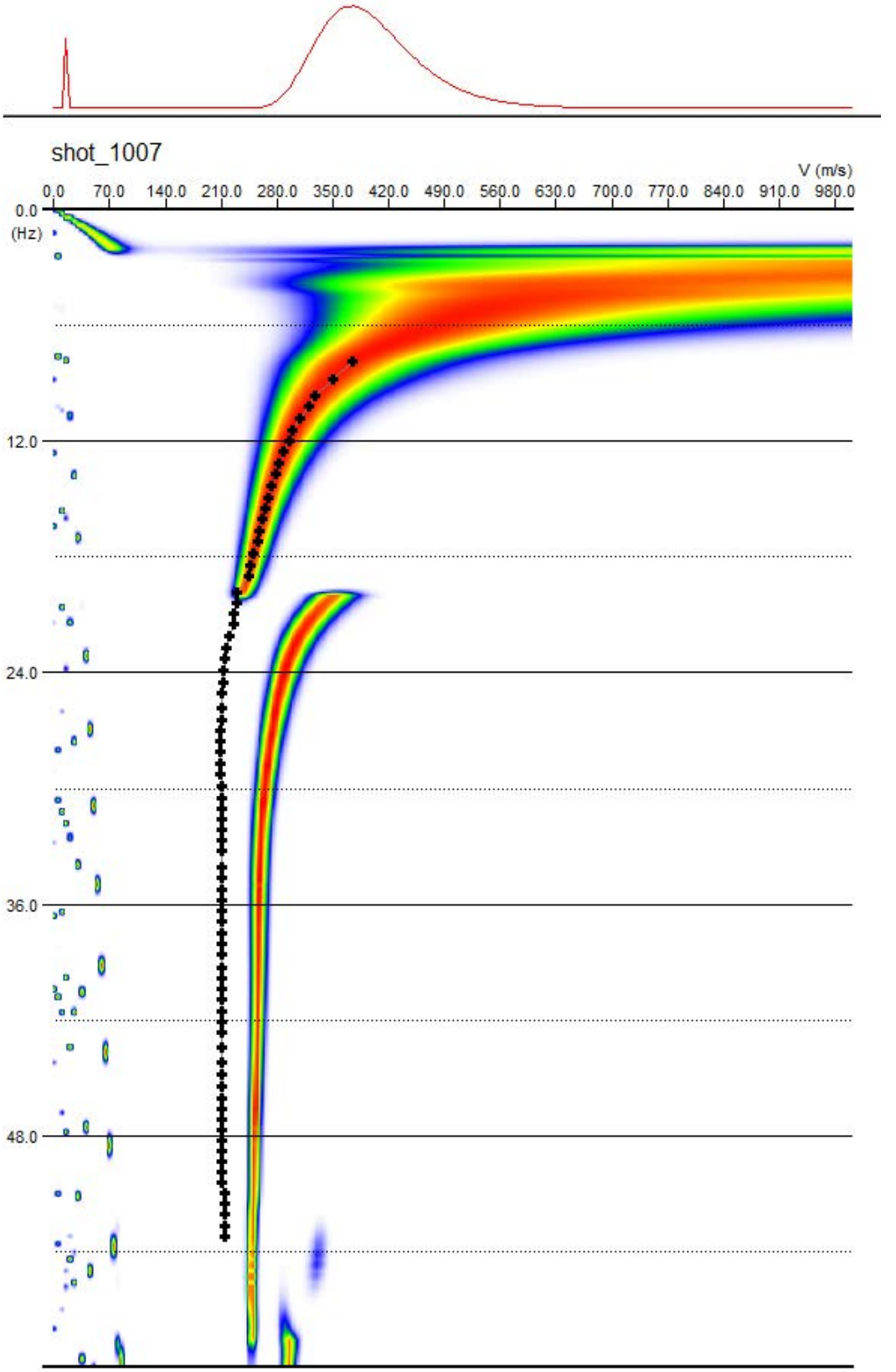
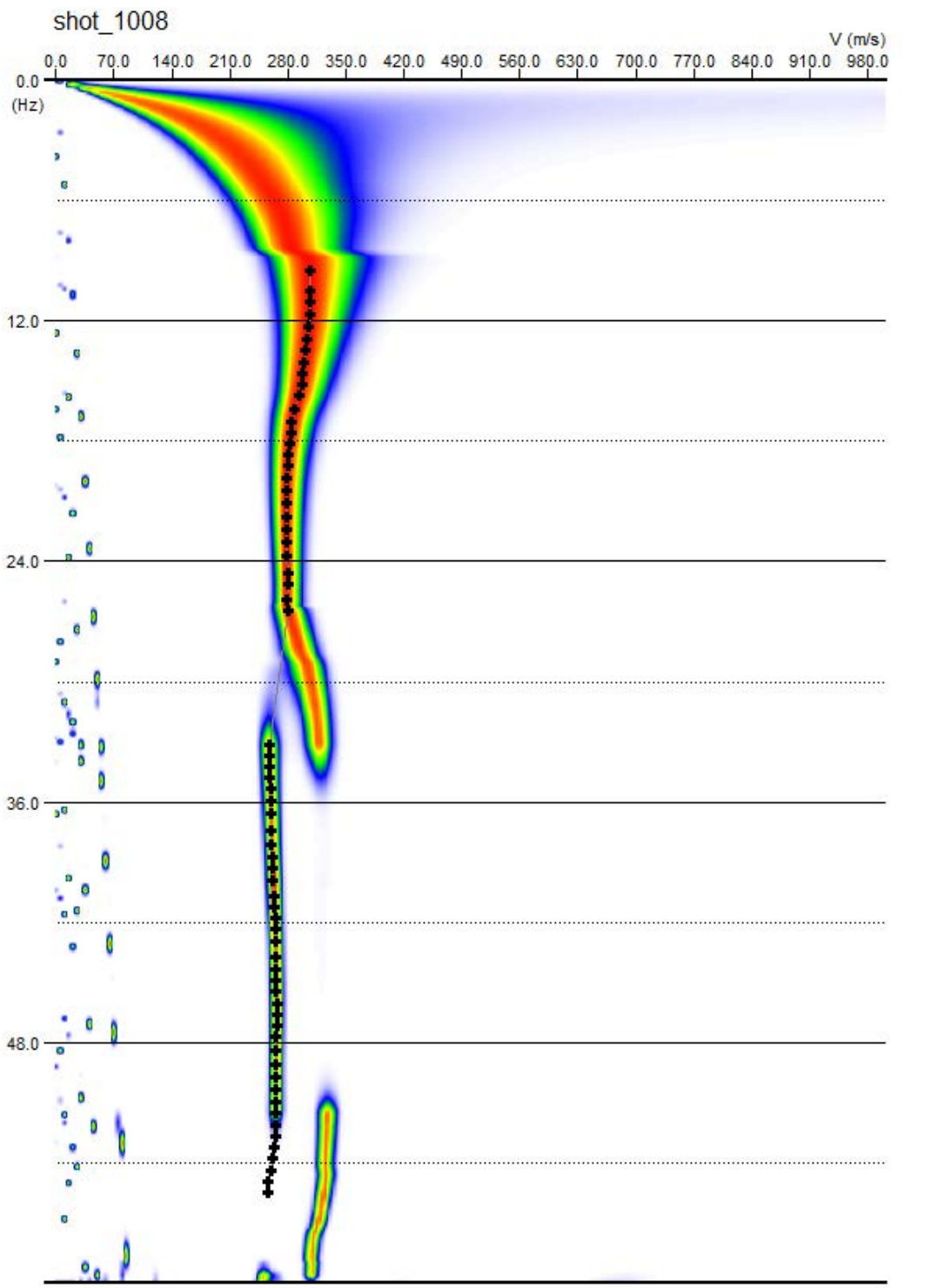
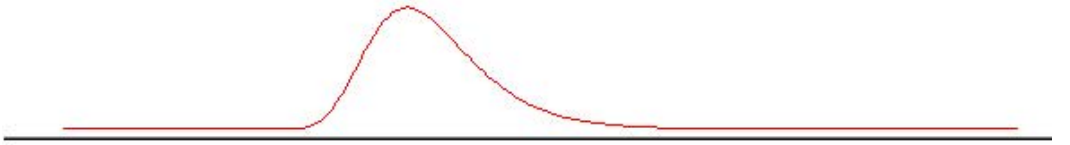
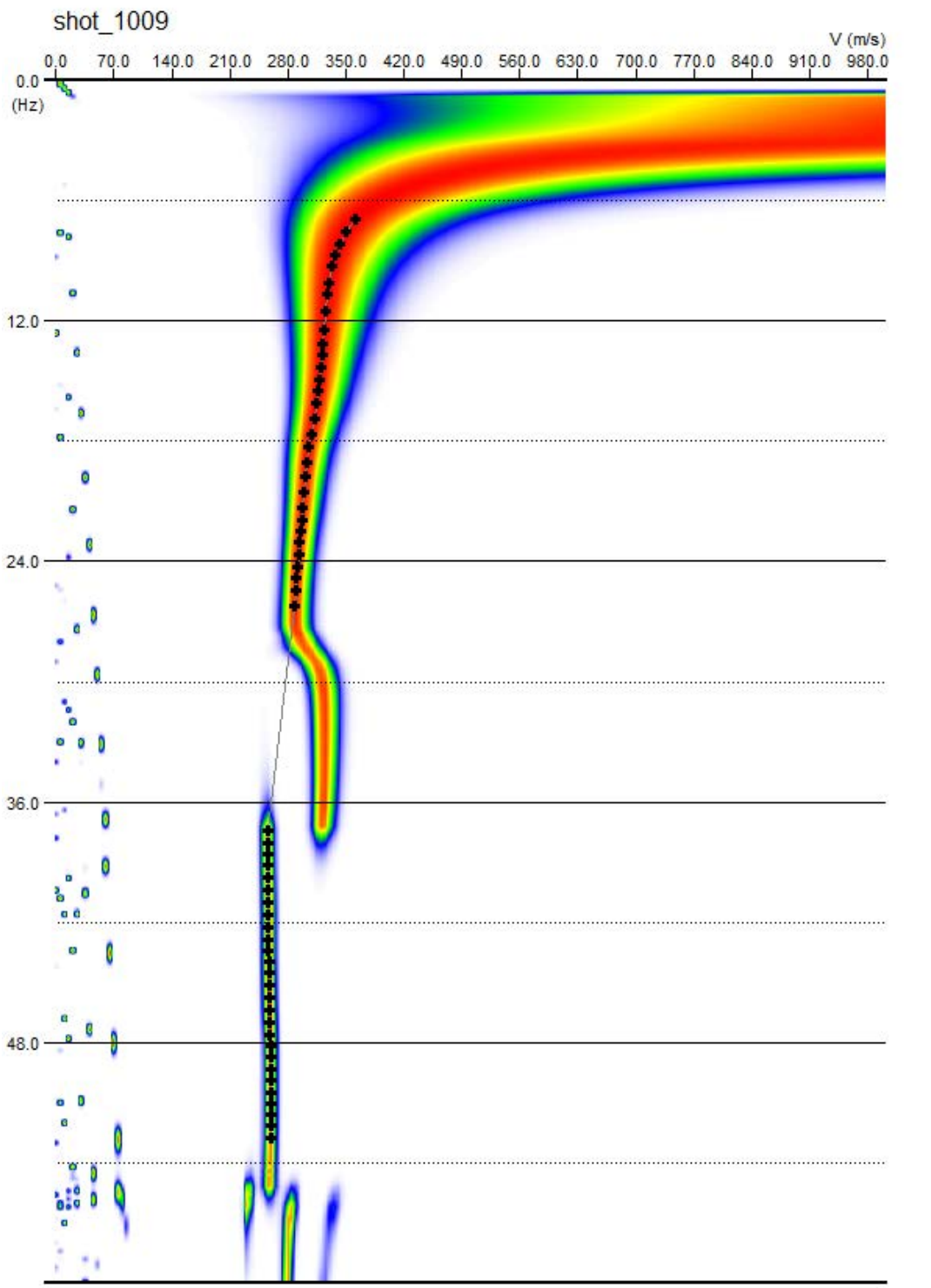
350.0
420.0
490.0
560.0
630.0
700.0
770.0
840.0
910.0
980.0
0.0
(Hz)
12.0
24.0
36.0
48.0

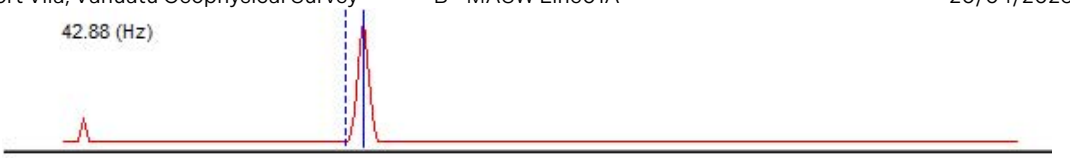

shot_1007
V (m/s)
0.0
70.0
140.0
210.0
280.0
350.0
420.0
490.0
560.0
630.0
700.0
770.0
840.0
910.0
980.0
0.0
(Hz)
12.0
24.0
36.0
48.0

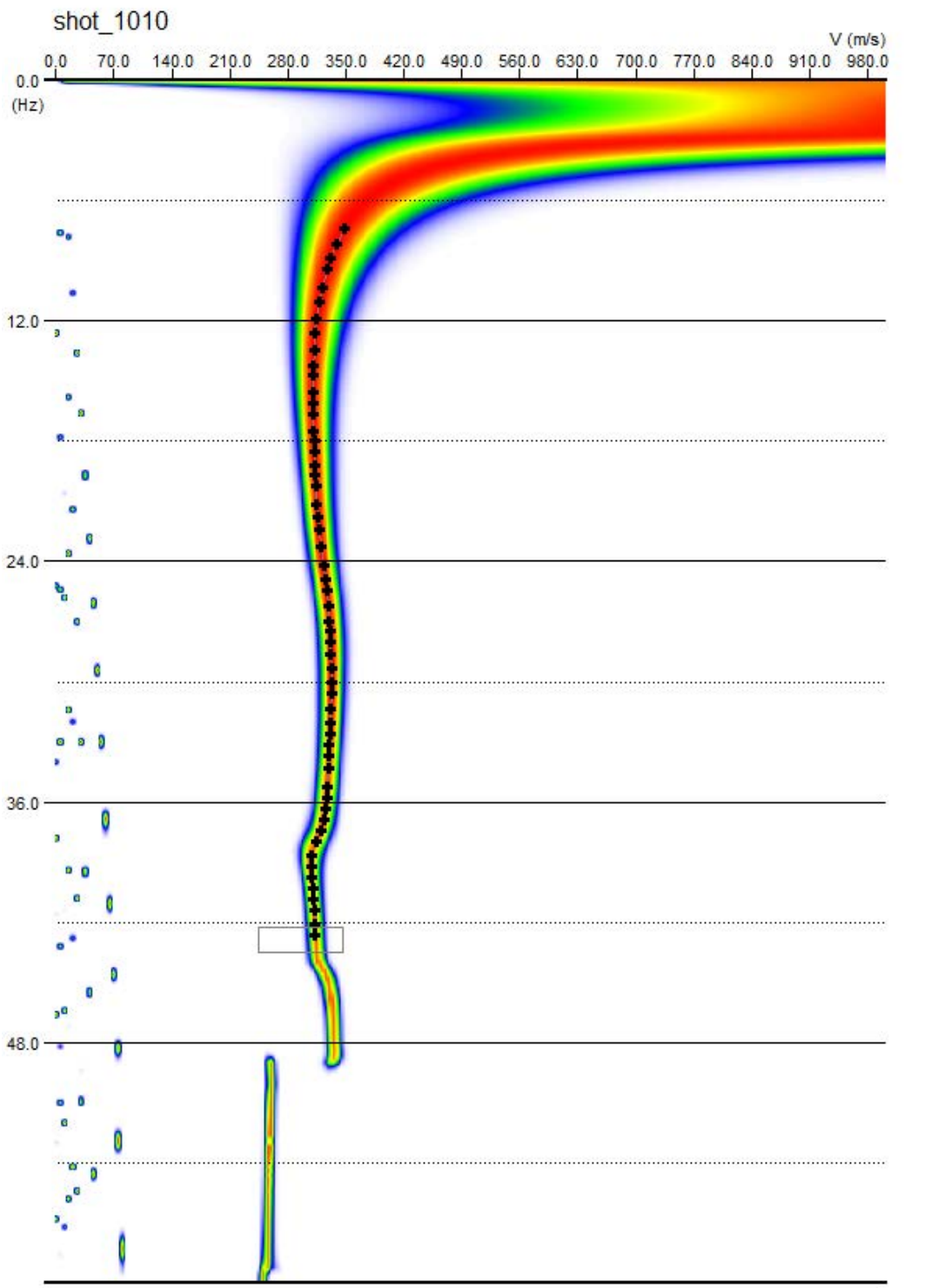


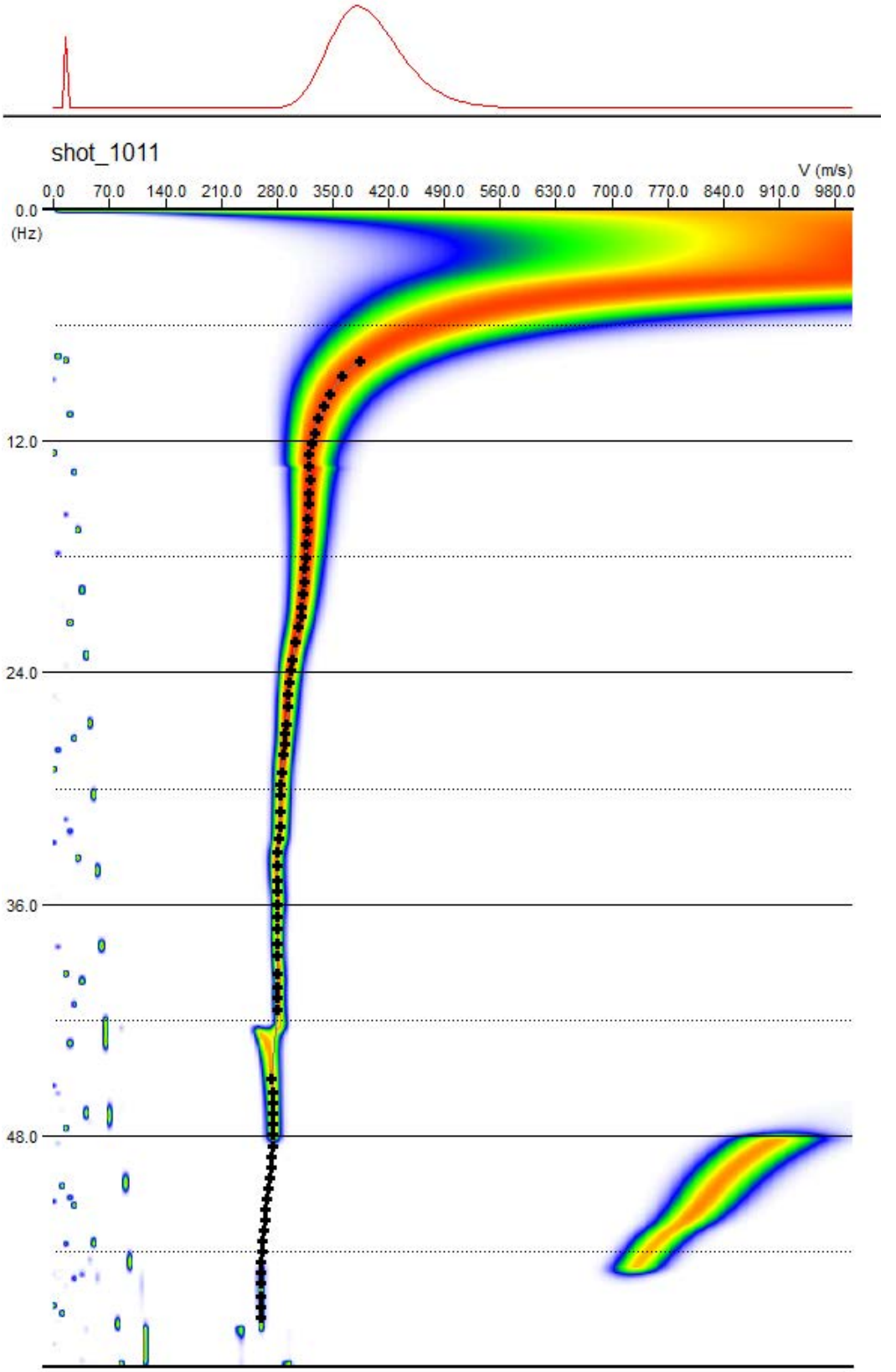

shot_1008
V (m/s)
0.0
70.0
140.0
210.0
280.0
350.0
420.0
490.0
560.0
630.0
700.0
770.0
840.0
910.0
980.0
0.0
(Hz)
12.0
24.0
36.0
48.0



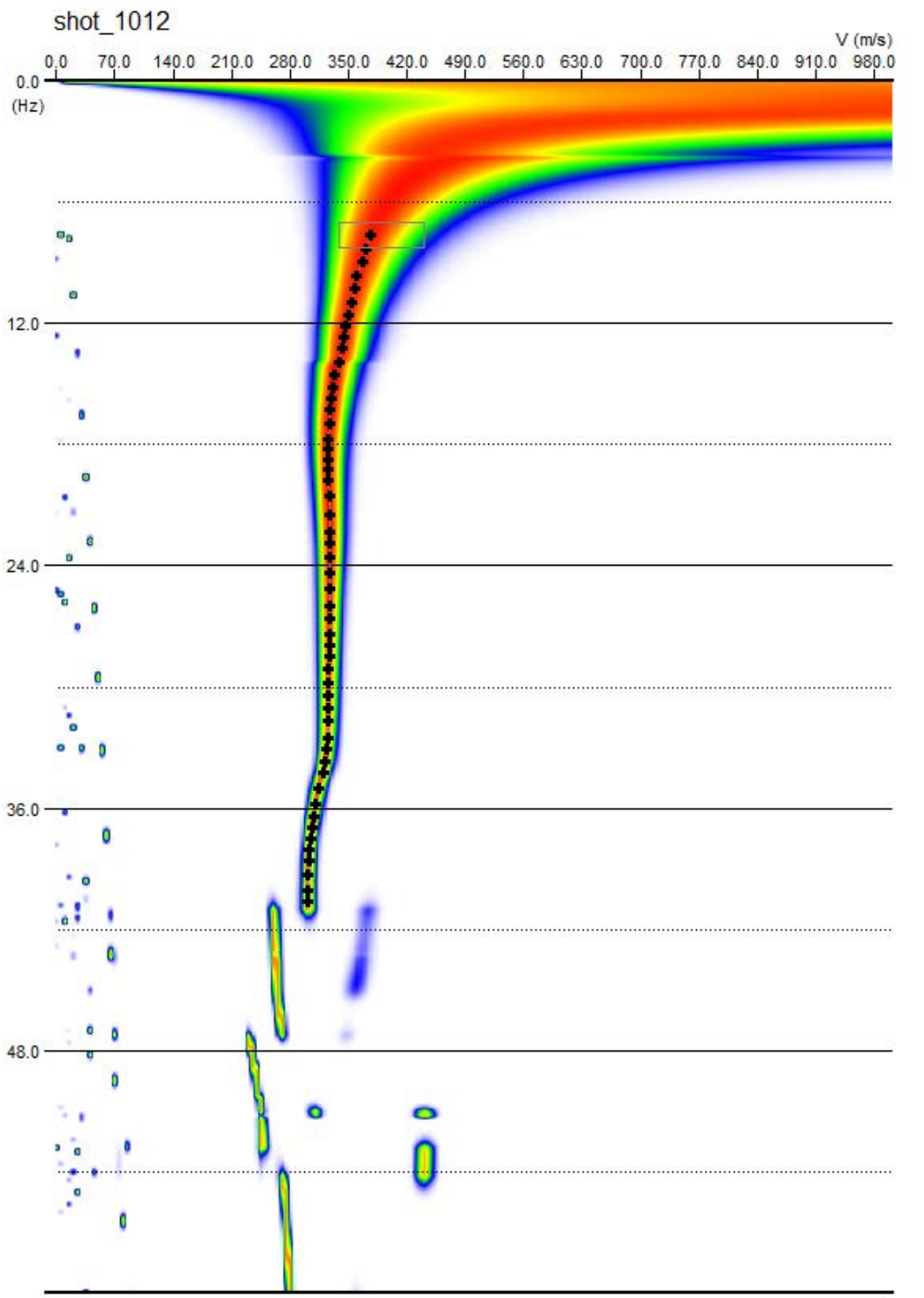

shot_1009
V (m/s)
0.0
70.0
140.0
210.0
280.0
350.0
420.0
490.0
560.0
630.0
700.0
770.0
840.0
910.0
980.0
0.0
(Hz)
12.0
24.0
36.0
48.0

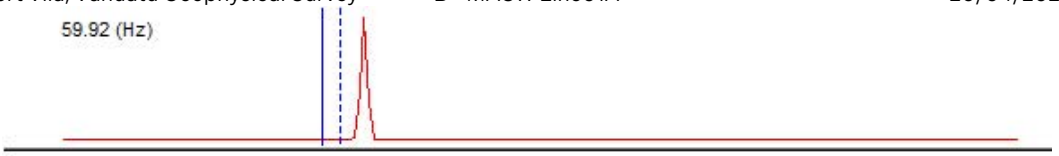

42.88 (Hz)

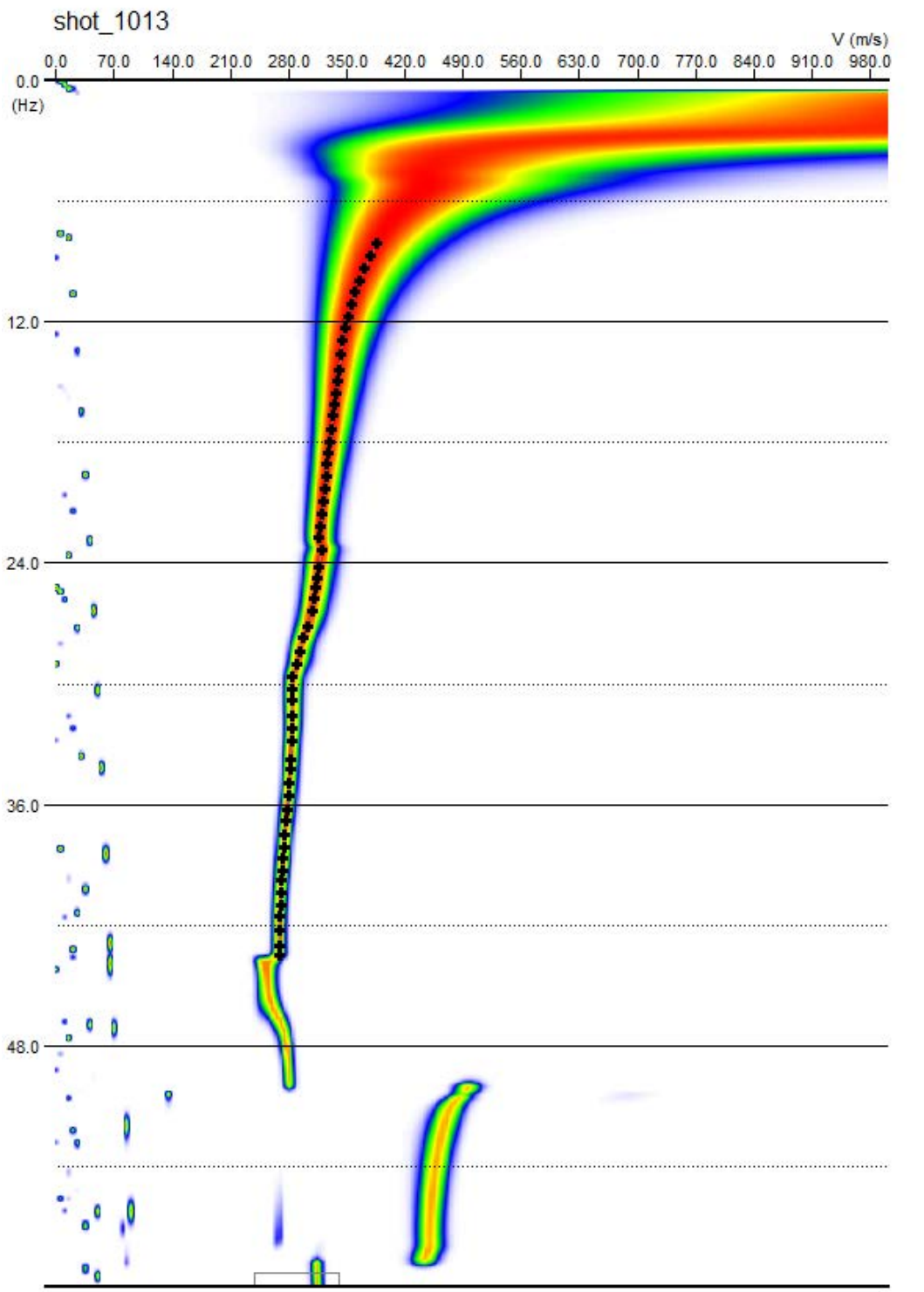

shot_1010
V (m/s)
0.0
70.0
140.0
210.0
280.0
350.0
420.0
490.0
560.0
630.0
700.0
770.0
840.0
910.0
980.0
0.0
(Hz)
12.0
24.0
36.0
48.0


shot_1011
V (m/s)
0.0 70.0 140.0 210.0 280.0 350.0 420.0 490.0 560.0 630.0 700.0 770.0 840.0 910.0 980.0
0.0
(Hz)
12.0
24.0
36.0
48.0

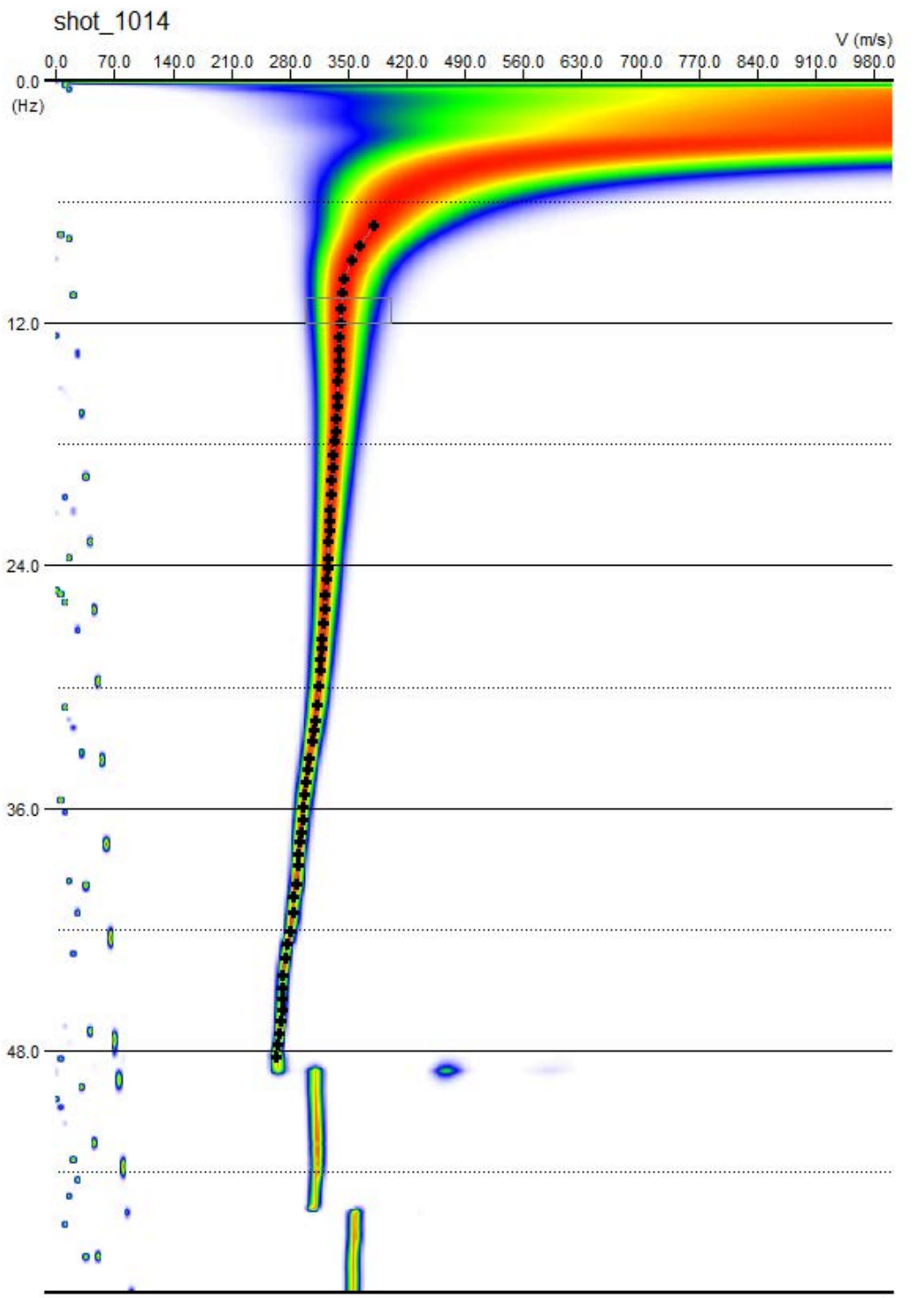

7.63 (Hz)


shot_1012
V (m/s)
0.0
70.0
140.0
210.0
280.0
350.0
420.0
490.0
560.0
630.0
700.0
770.0
840.0
910.0
980.0
0.0
(Hz)
12.0
24.0
36.0
48.0

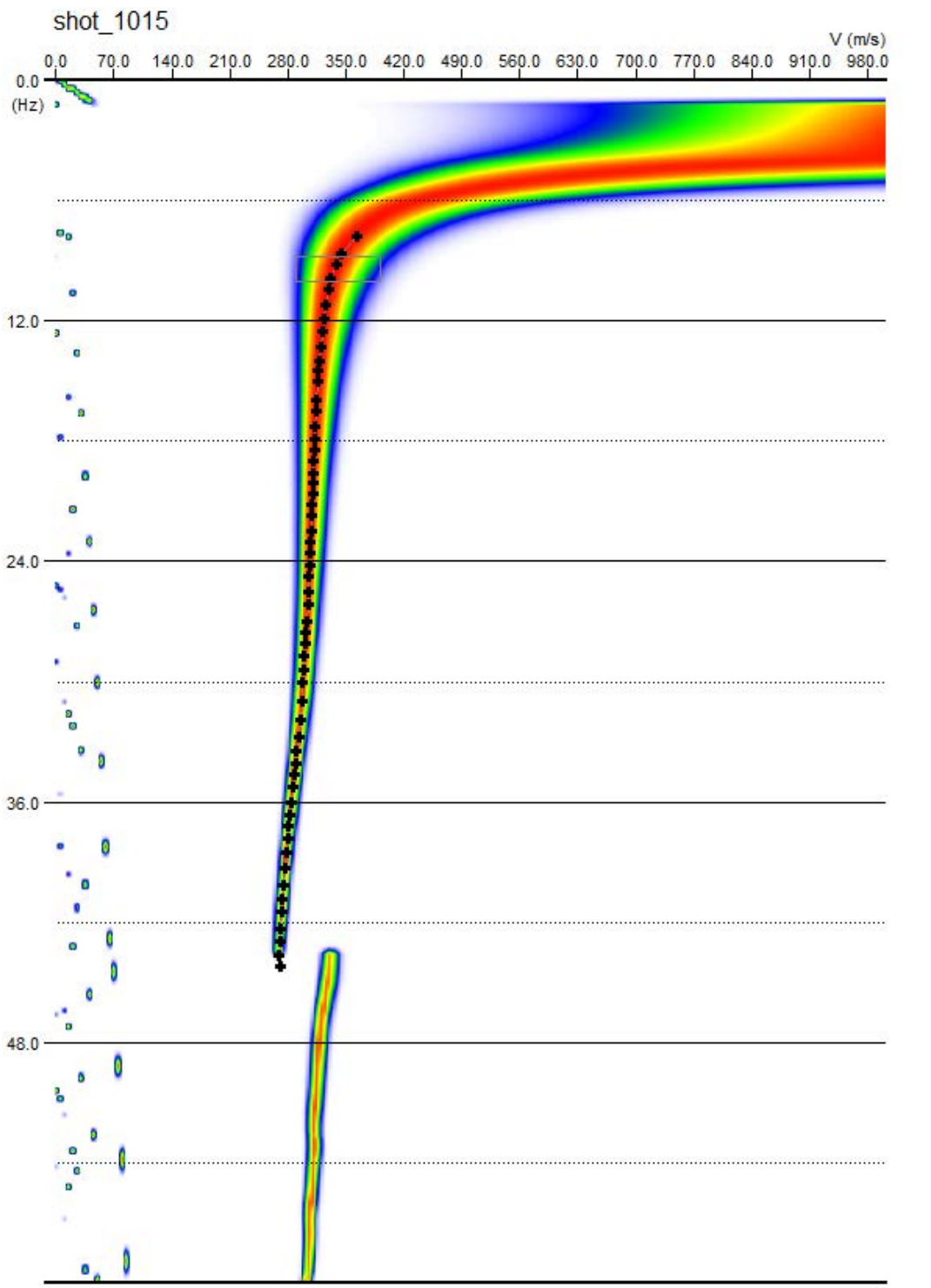

59.92 (Hz)

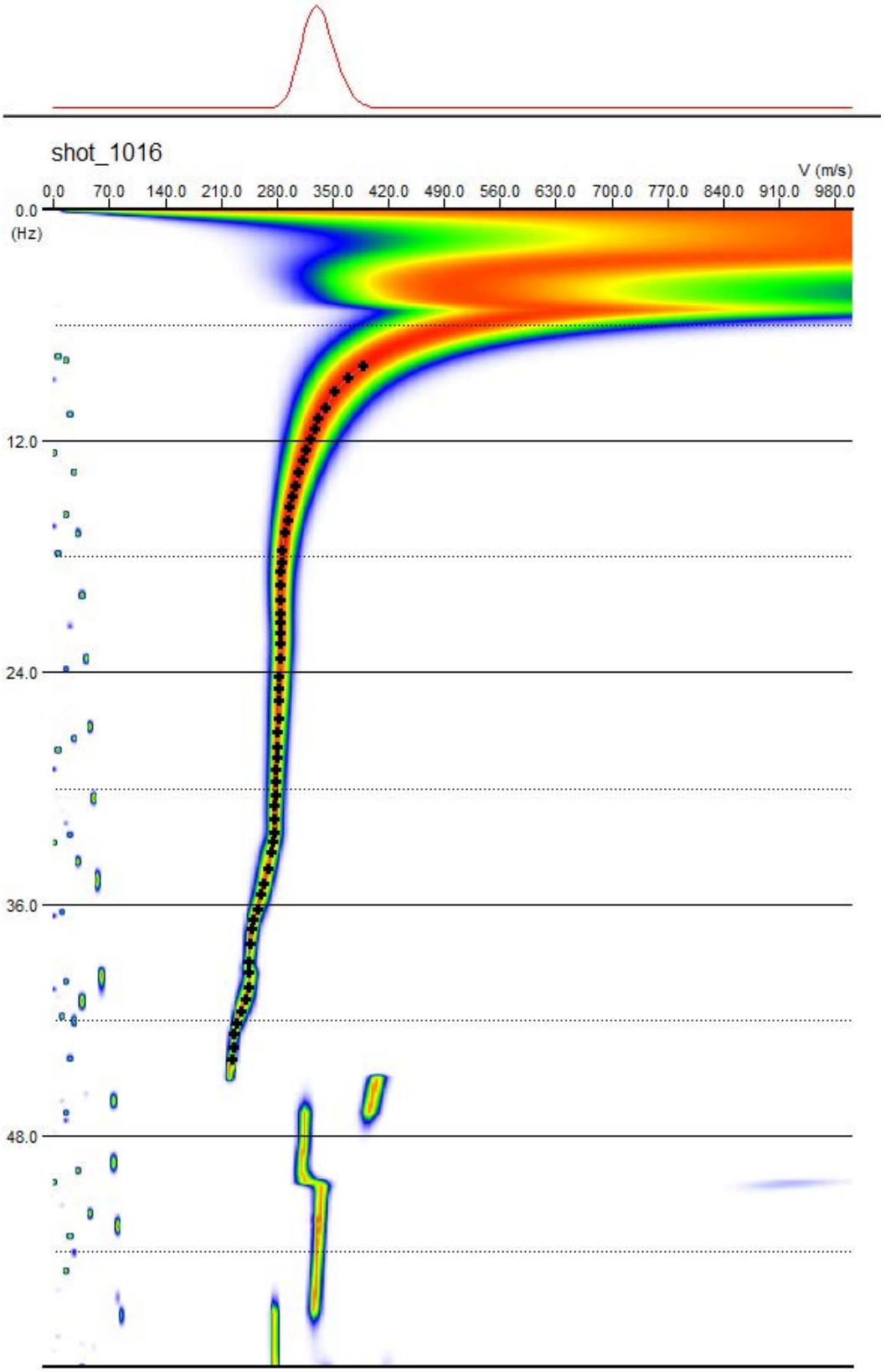

shot_1013
V (m/s)
0.0
70.0
140.0
210.0
280.0
350.0
420.0
490.0
560.0
630.0
700.0
770.0
840.0
910.0
980.0
0.0
(Hz)
12.0
24.0
36.0
48.0


11.36 (Hz)

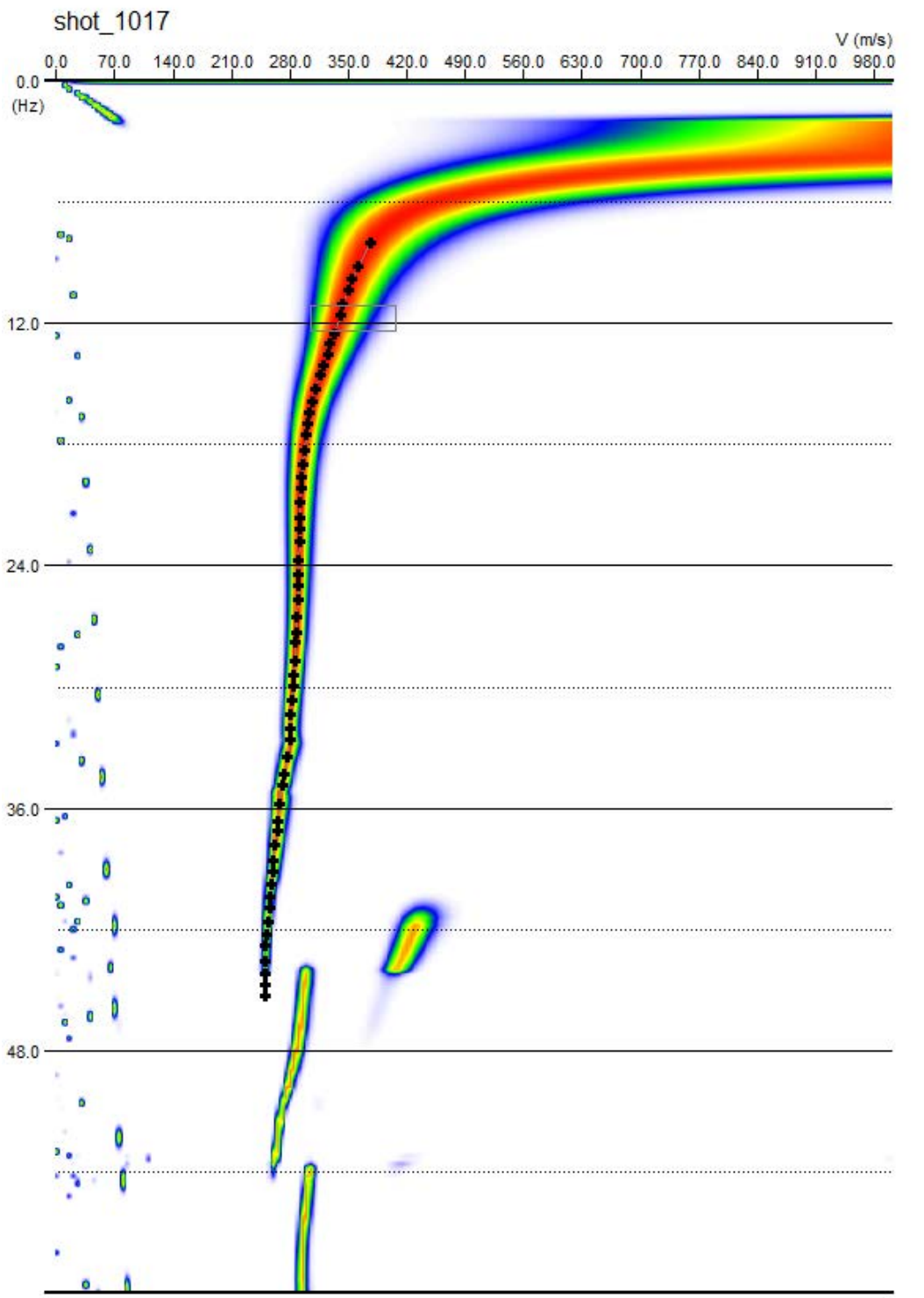

shot_1014
V (m/s)
0.0
70.0
140.0
210.0
280.0
350.0
420.0
490.0
560.0
630.0
700.0
770.0
840.0
910.0
980.0
0.0
(Hz)
12.0
24.0
36.0
48.0

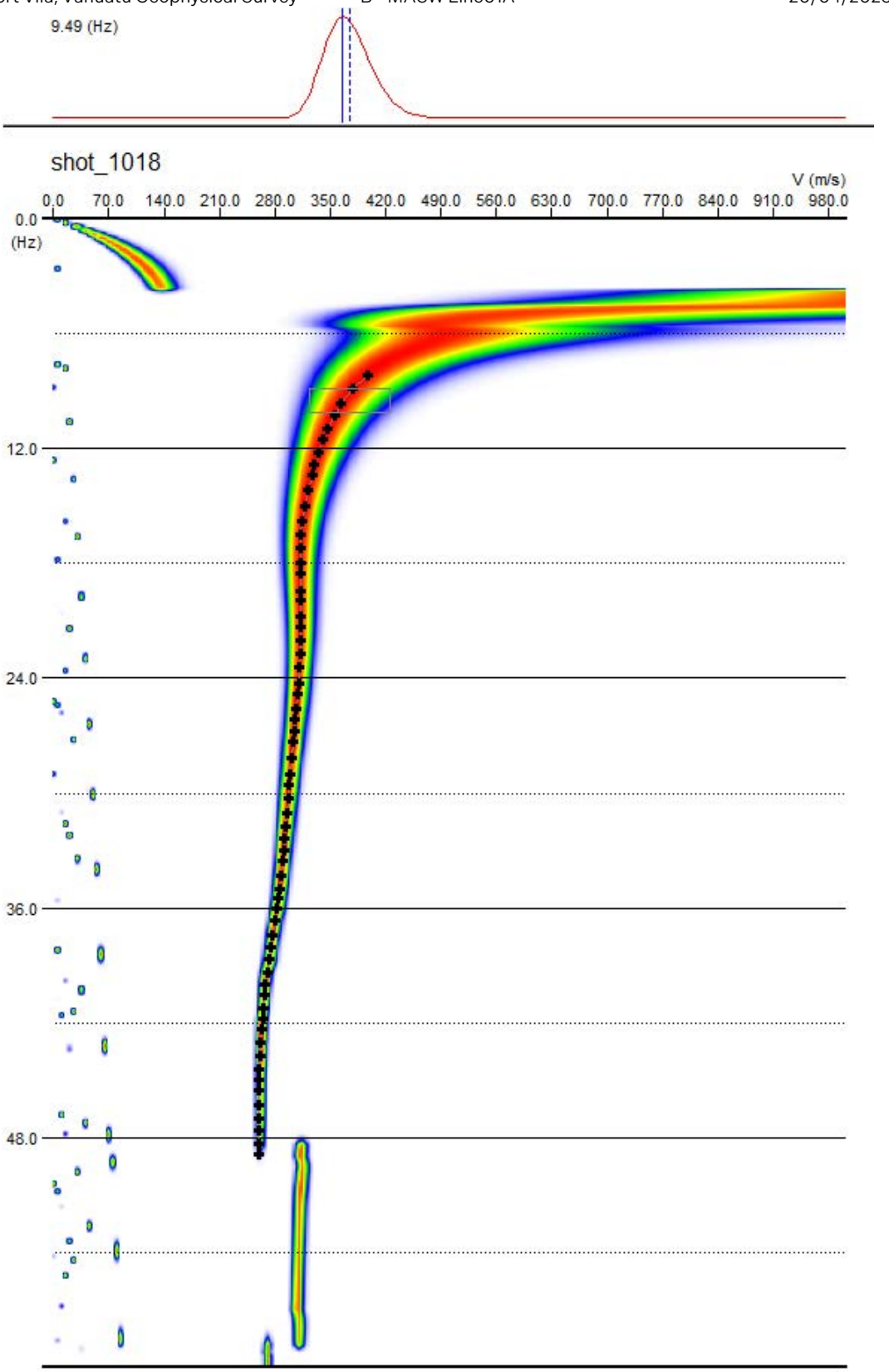

9.42 (Hz)

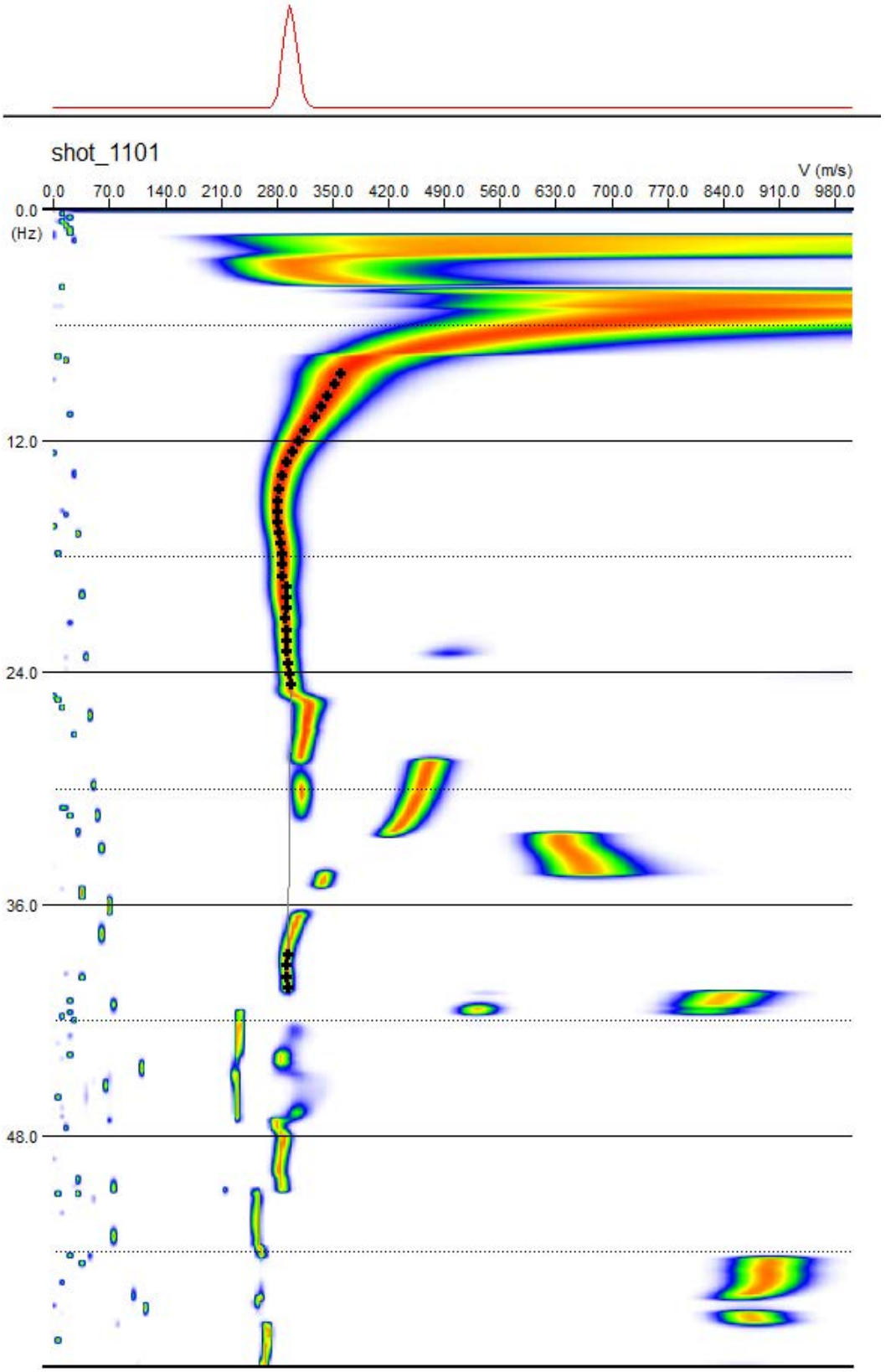

shot_1015
V (m/s)
0.0
70.0
140.0
210.0
280.0
350.0
420.0
490.0
560.0
630.0
700.0
770.0
840.0
910.0
980.0
0.0
(Hz)
12.0
24.0
36.0
48.0

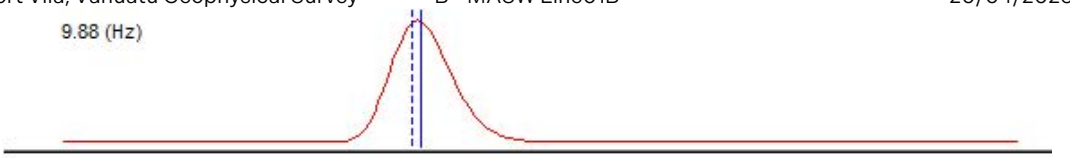

shot_1016
V (m/s)
0.0
70.0
140.0
210.0
280.0
350.0
420.0
490.0
560.0
630.0
700.0
770.0
840.0
910.0
980.0
0.0
(Hz)
12.0
24.0
36.0
48.0

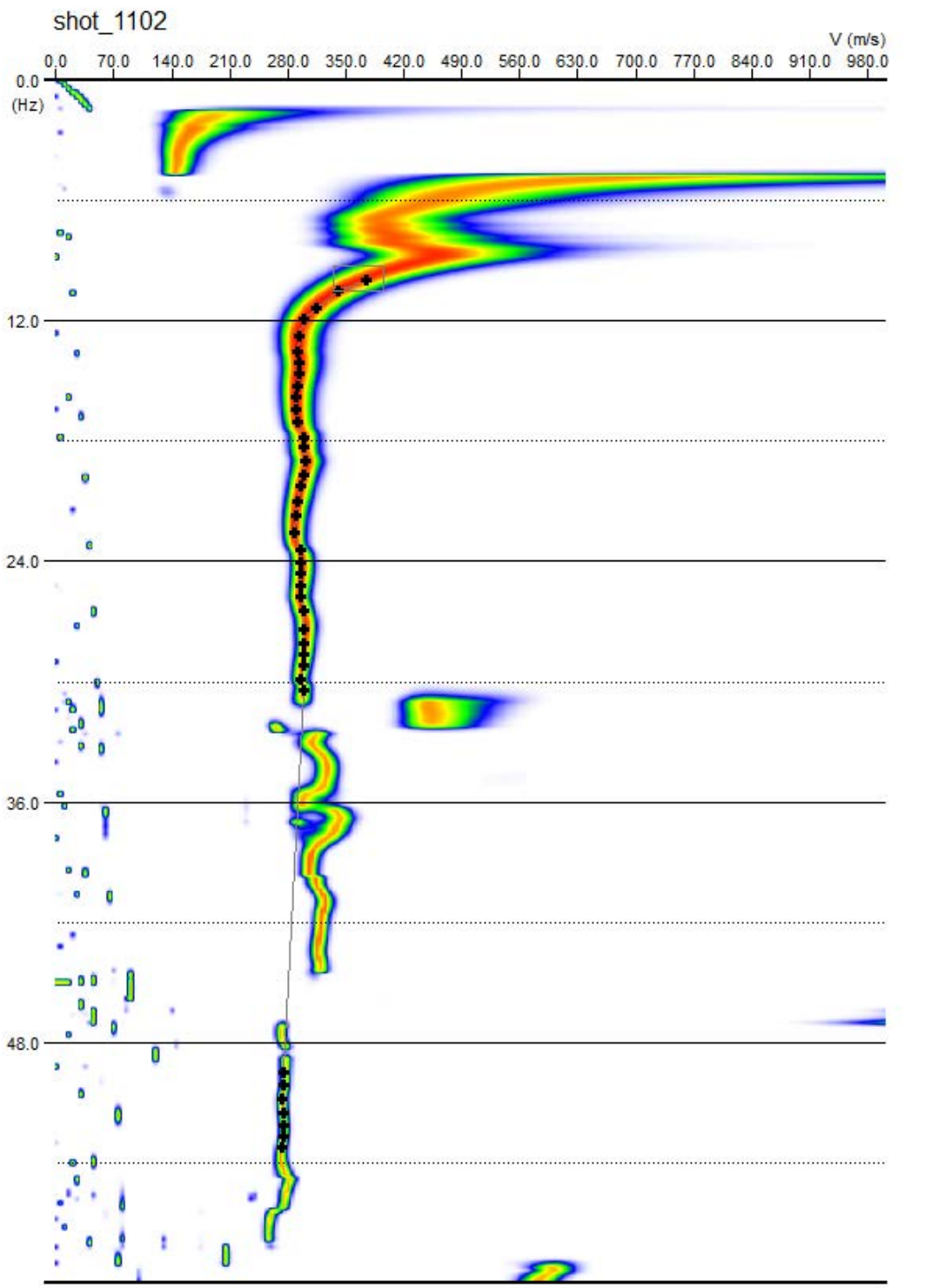

11.75 (Hz)

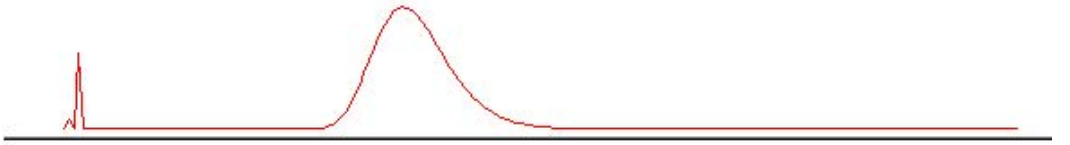

shot_1017
V (m/s)
0.0 70.0 140.0 210.0 280.0 350.0 420.0 490.0 560.0 630.0 700.0 770.0 840.0 910.0 980.0
0.0
(Hz)
12.0
24.0
36.0
48.0

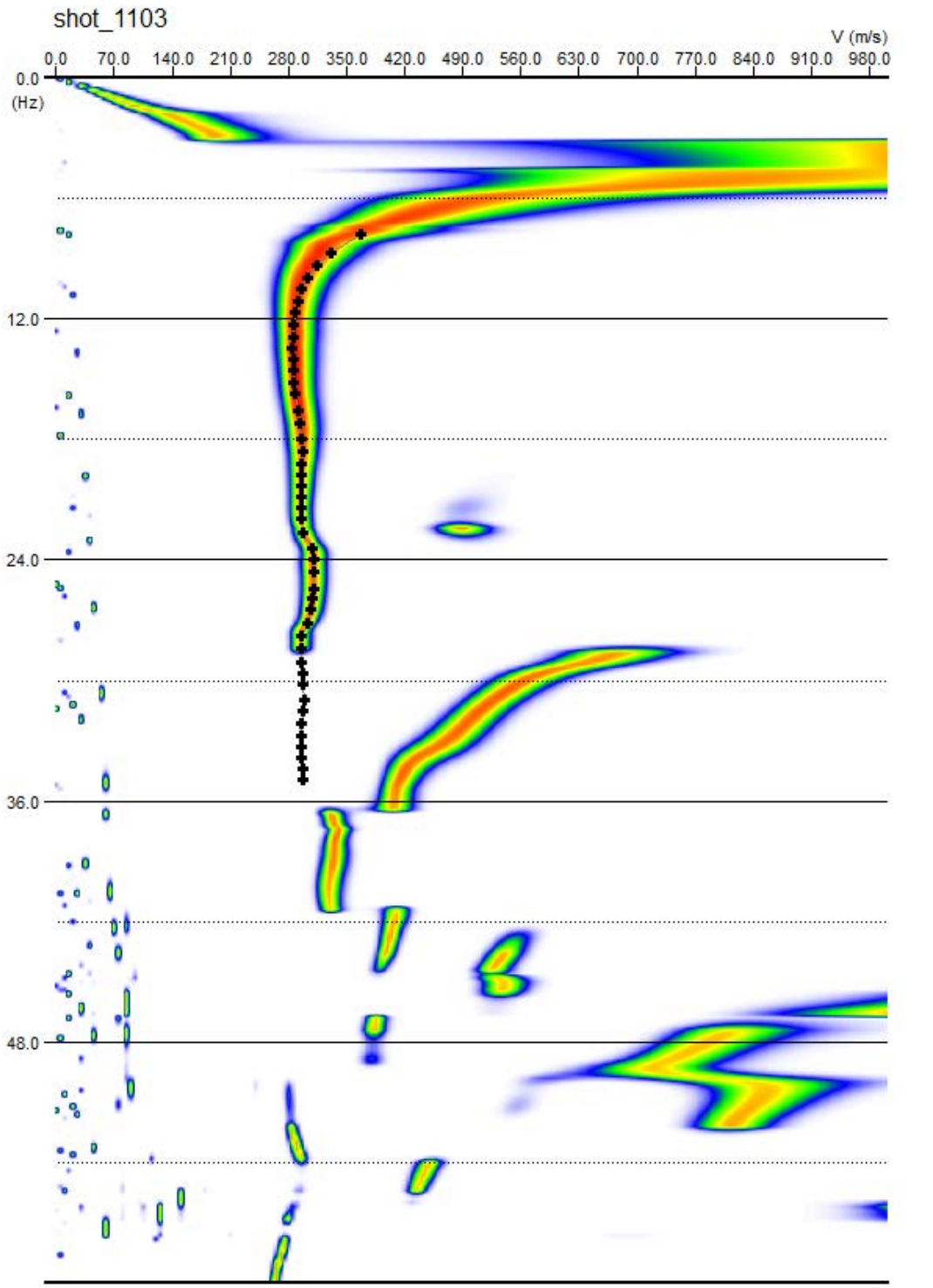

9.49 (Hz)
shot_1018
V (m/s)
0.0
70.0
140.0
210.0
280.0
350.0
420.0
490.0
560.0
630.0
700.0
770.0
840.0
910.0
980.0
0.0
(Hz)
12.0
24.0
36.0
48.0

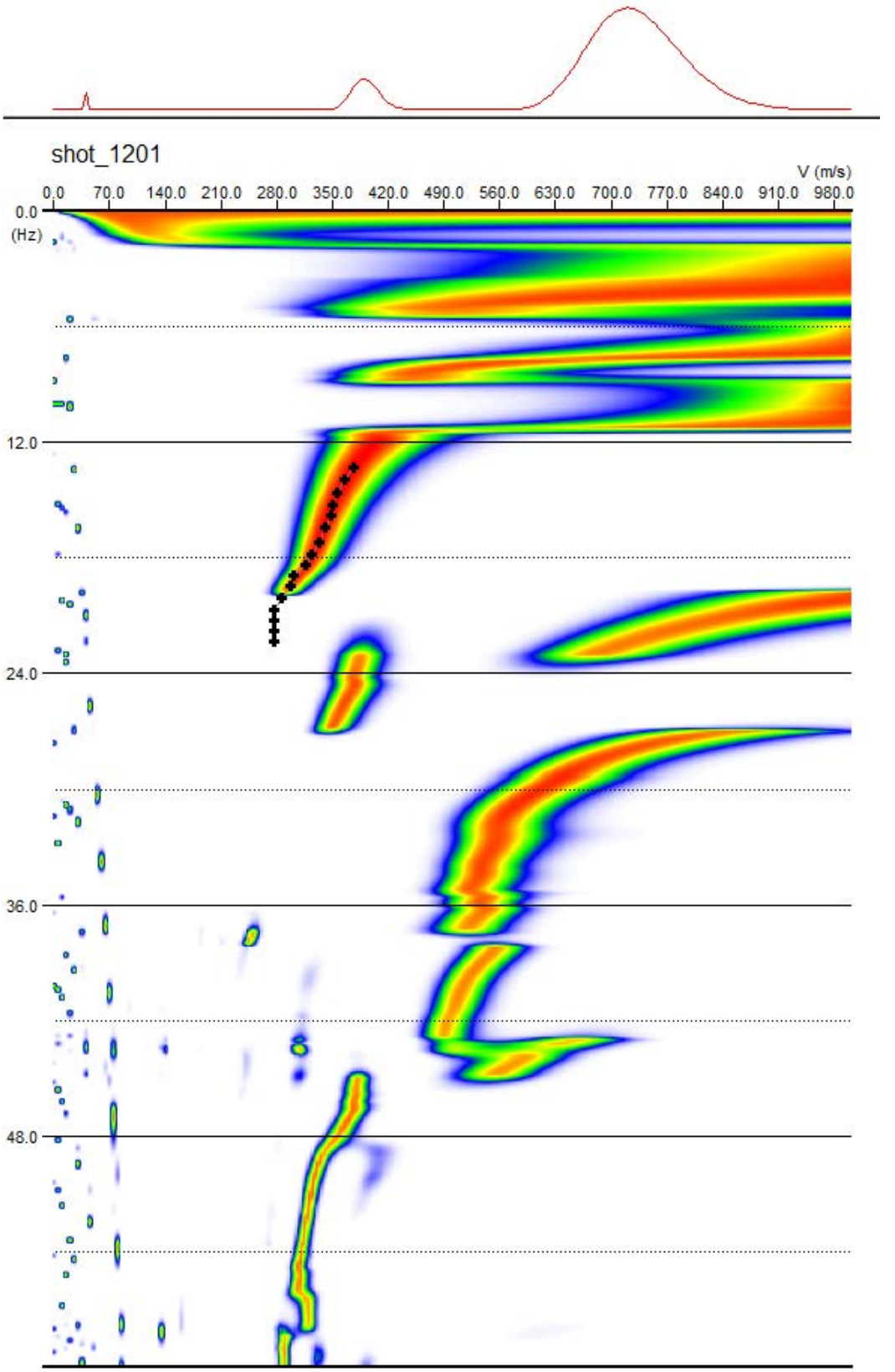

shot_1101
V (m/s)
0.0
70.0
140.0
210.0
280.0
350.0
420.0
490.0
560.0
630.0
700.0
770.0
840.0
910.0
980.0
0.0
(Hz)
12.0
24.0
36.0
48.0

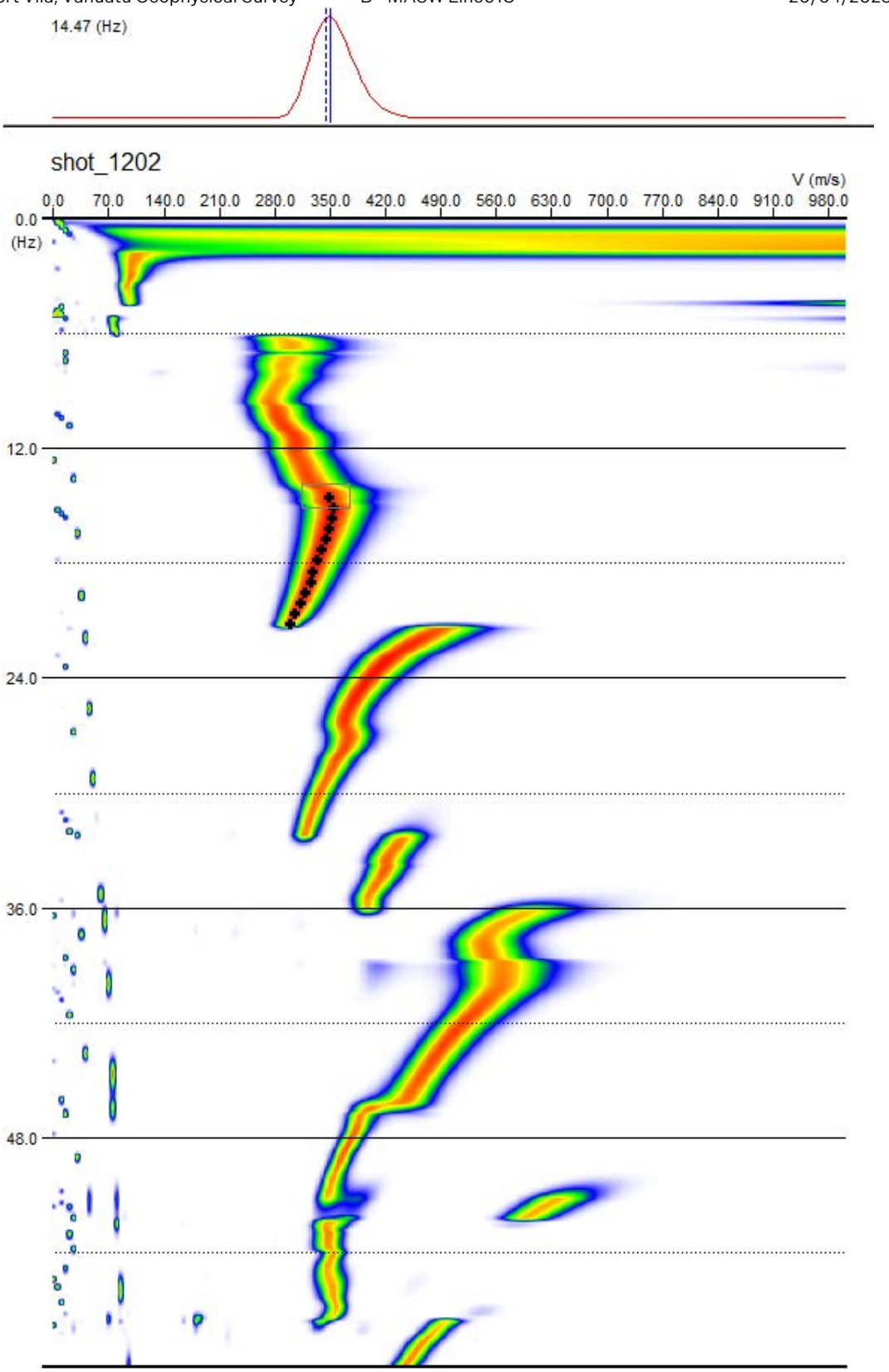

9.88 (Hz)

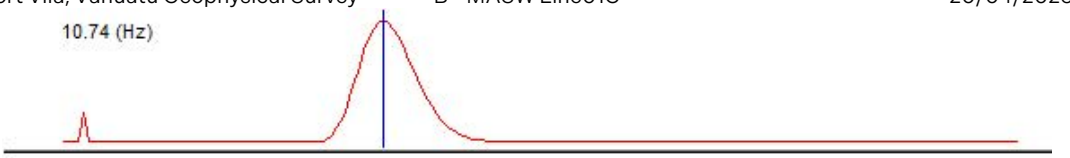

shot_1102
V (m/s)
0.0
70.0
140.0
210.0
280.0
350.0
420.0
490.0
560.0
630.0
700.0
770.0
840.0
910.0
980.0
0.0
(Hz)
12.0
24.0
36.0
48.0

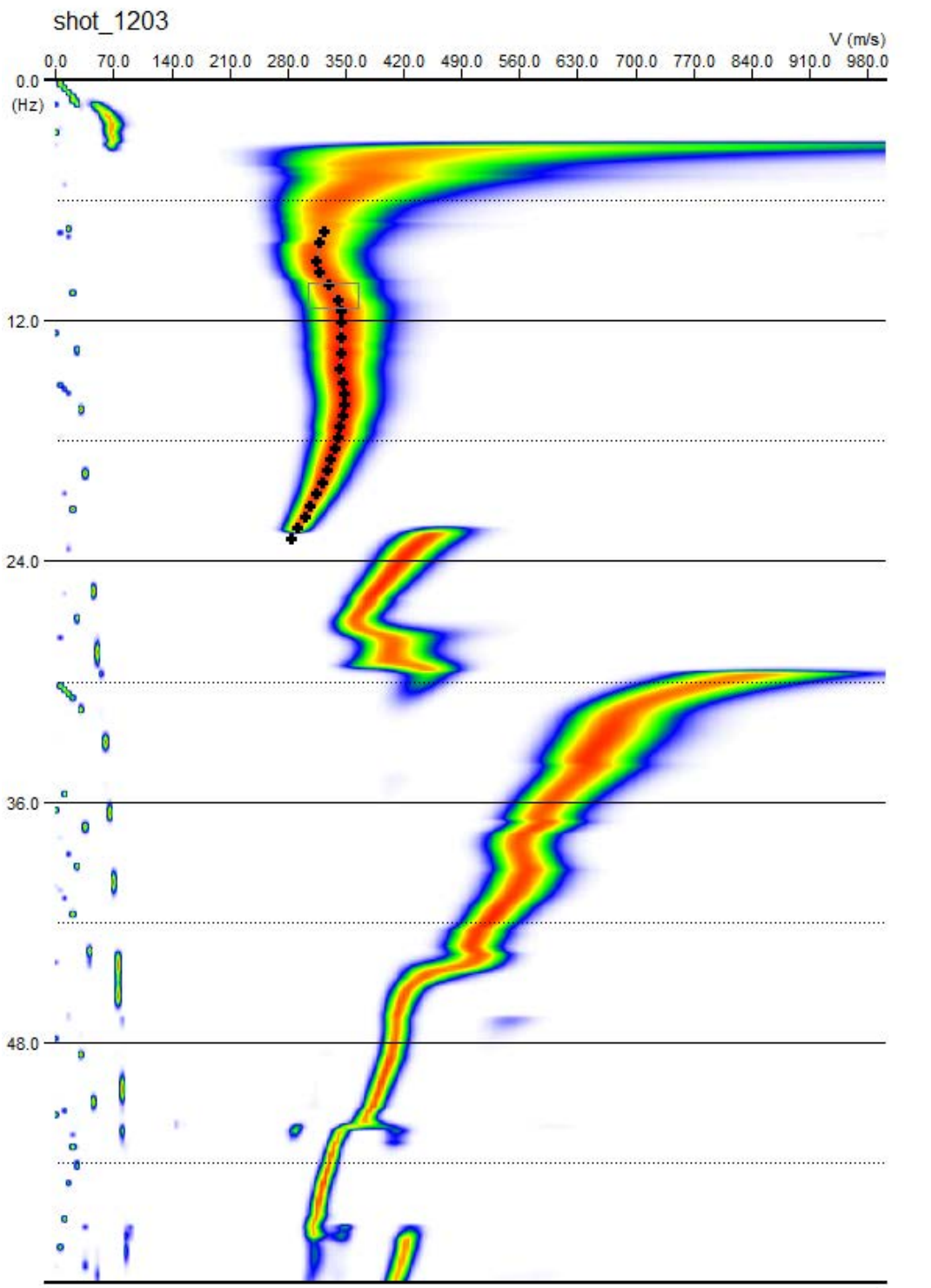


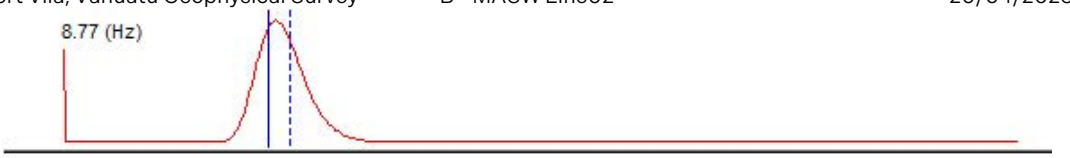

shot_1103
V (m/s)
0.0
70.0
140.0
210.0
280.0
350.0
420.0
490.0
560.0
630.0
700.0
770.0
840.0
910.0
980.0
0.0
(Hz)
12.0
24.0
36.0
48.0

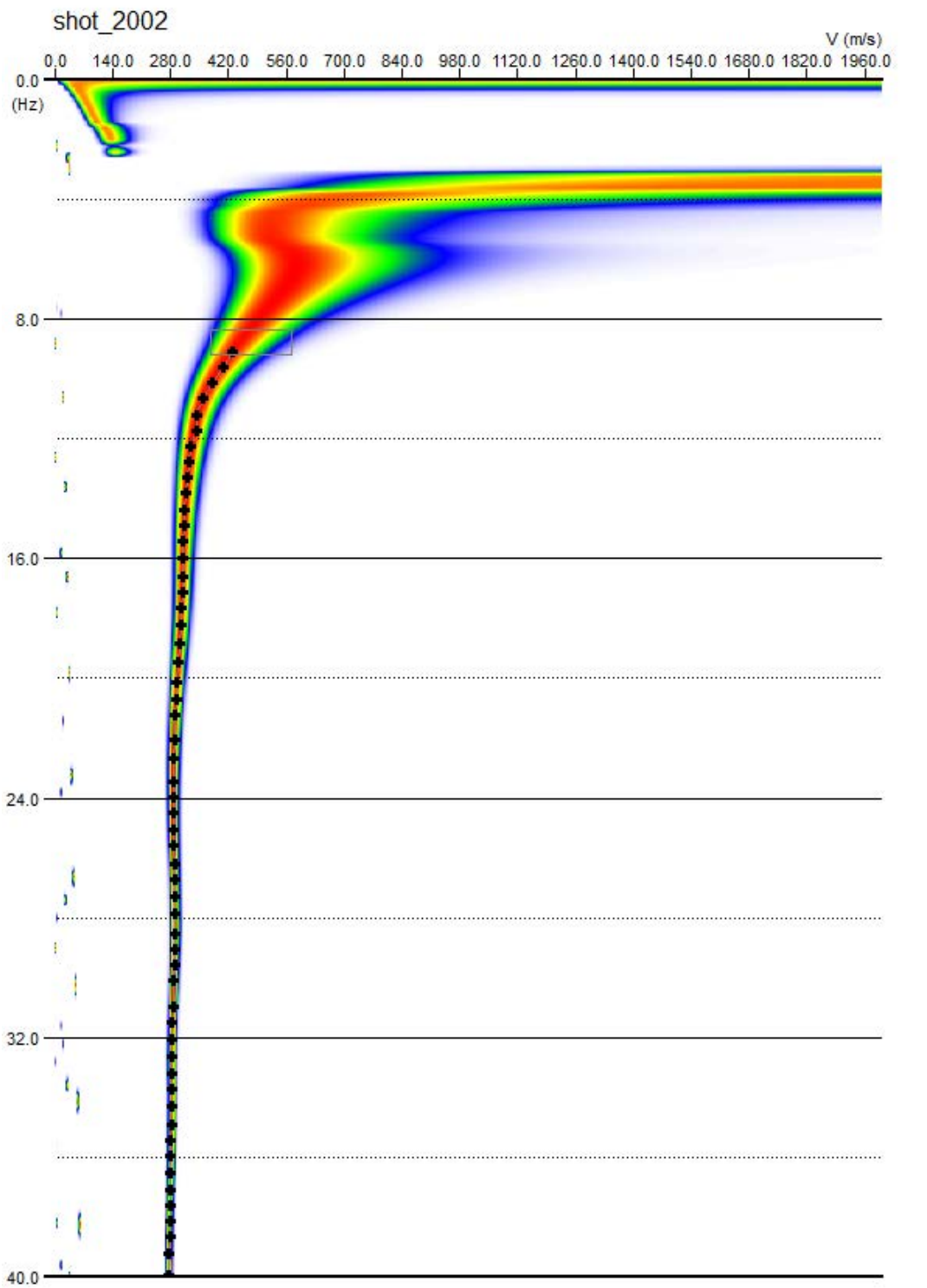

shot_1201
V (m/s)
0.0
70.0
140.0
210.0
280.0
350.0
420.0
490.0
560.0
630.0
700.0
770.0
840.0
910.0
980.0
0.0
(Hz)
12.0
24.0
36.0
48.0

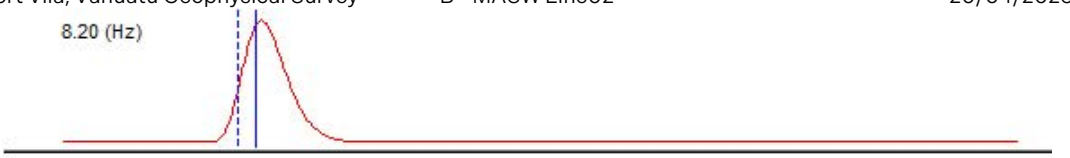

14.47 (Hz)
shot_1202
V (m/s)
0.0
70.0
140.0
210.0
280.0
350.0
420.0
490.0
560.0
630.0
700.0
770.0
840.0
910.0
980.0
0.0
(Hz)
12.0
24.0
36.0
48.0

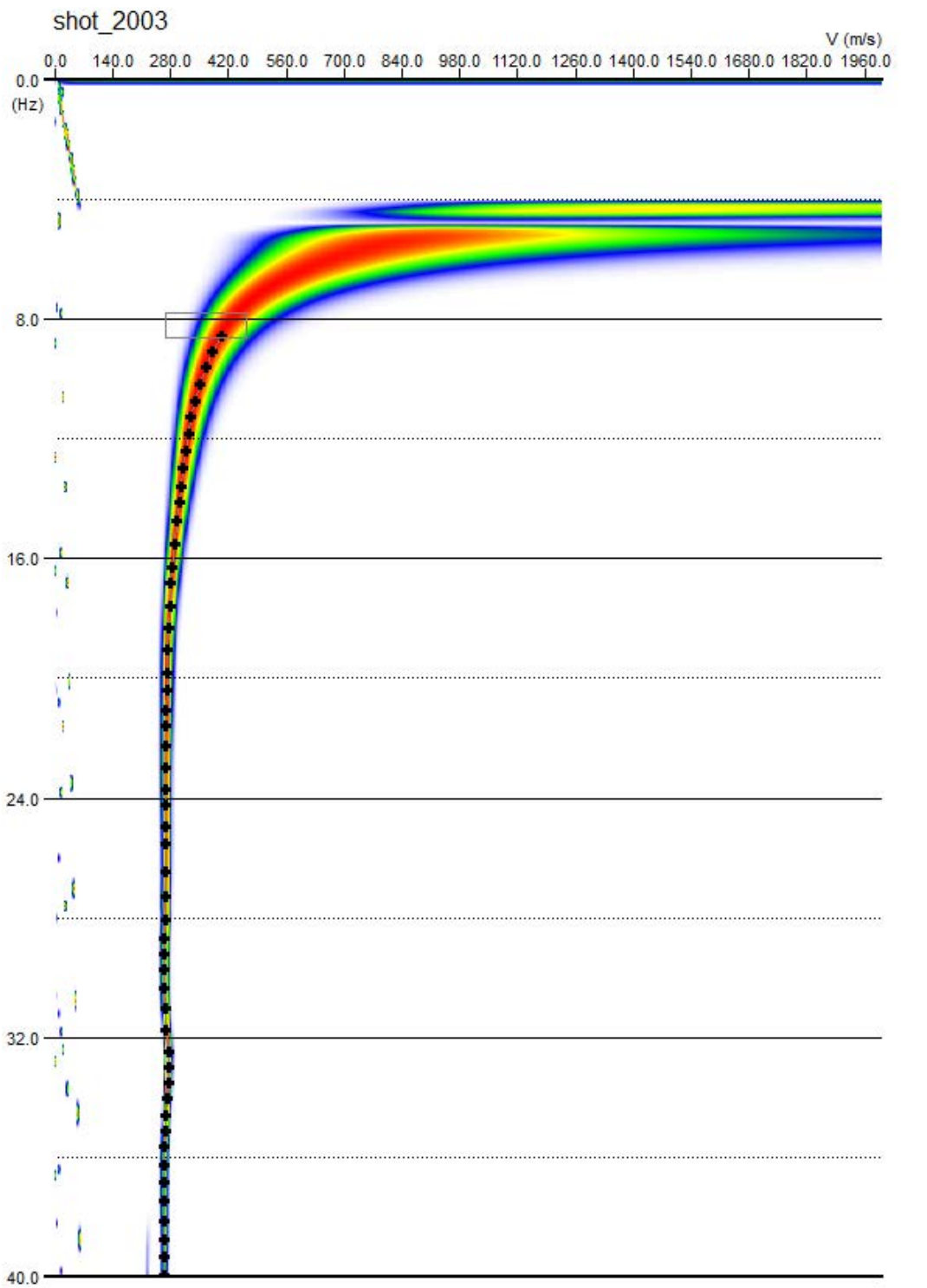

10.74 (Hz)

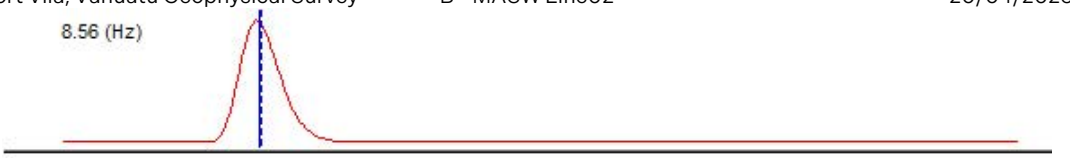

shot_1203
V (m/s)
0.0
70.0
140.0
210.0
280.0
350.0
420.0
490.0
560.0
630.0
700.0
770.0
840.0
910.0
980.0
0.0
(Hz)
12.0
24.0
36.0
48.0

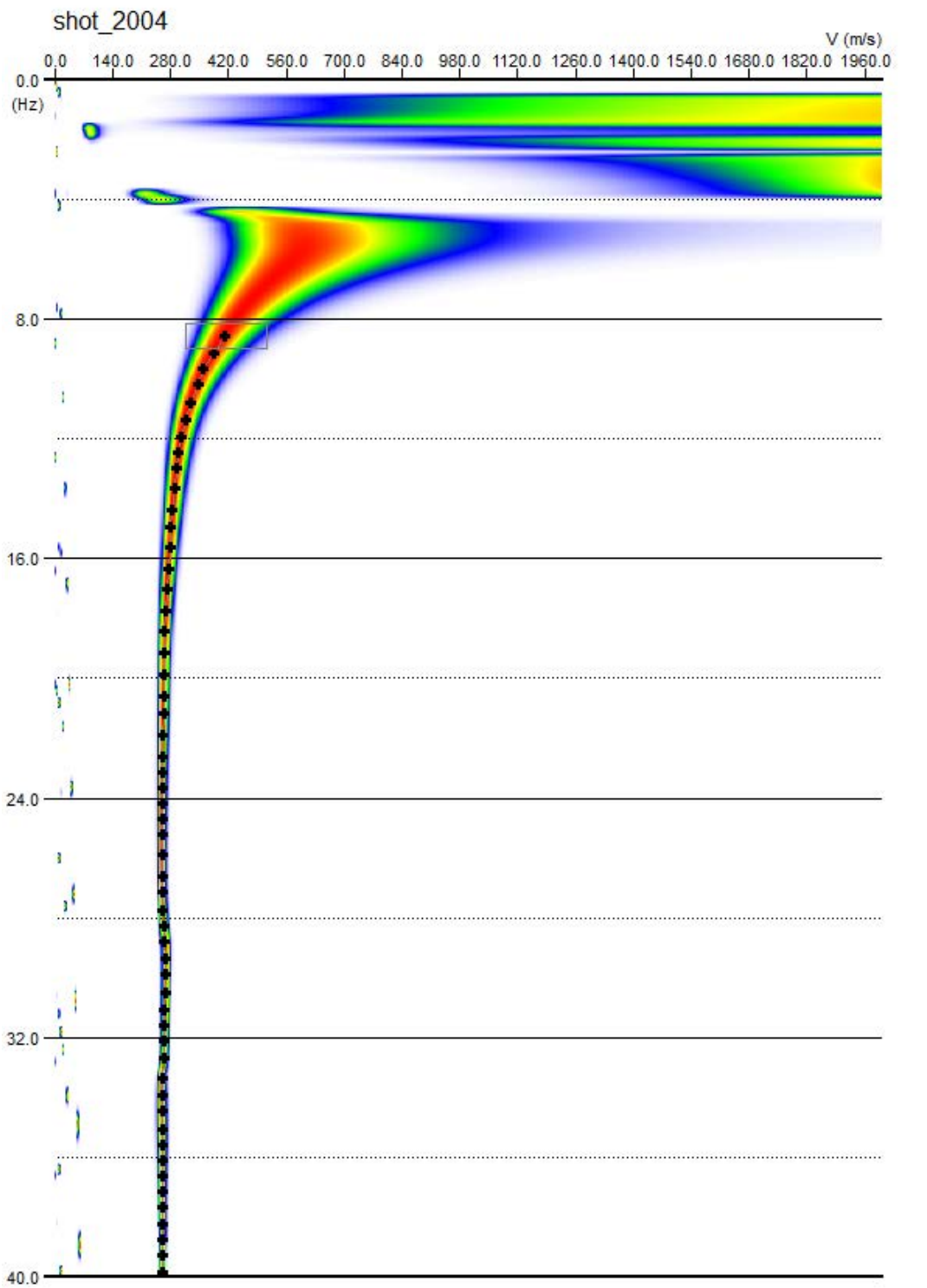

8.77 (Hz)

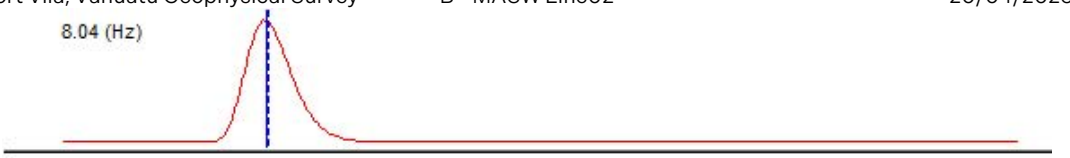

shot_2002
V (m/s)
0.0 140.0 280.0 420.0 560.0 700.0 840.0 980.0 1120.0 1260.0 1400.0 1540.0 1680.0 1820.0 1960.0
0.0
(Hz)
8.0
16.0
24.0
32.0
40.0

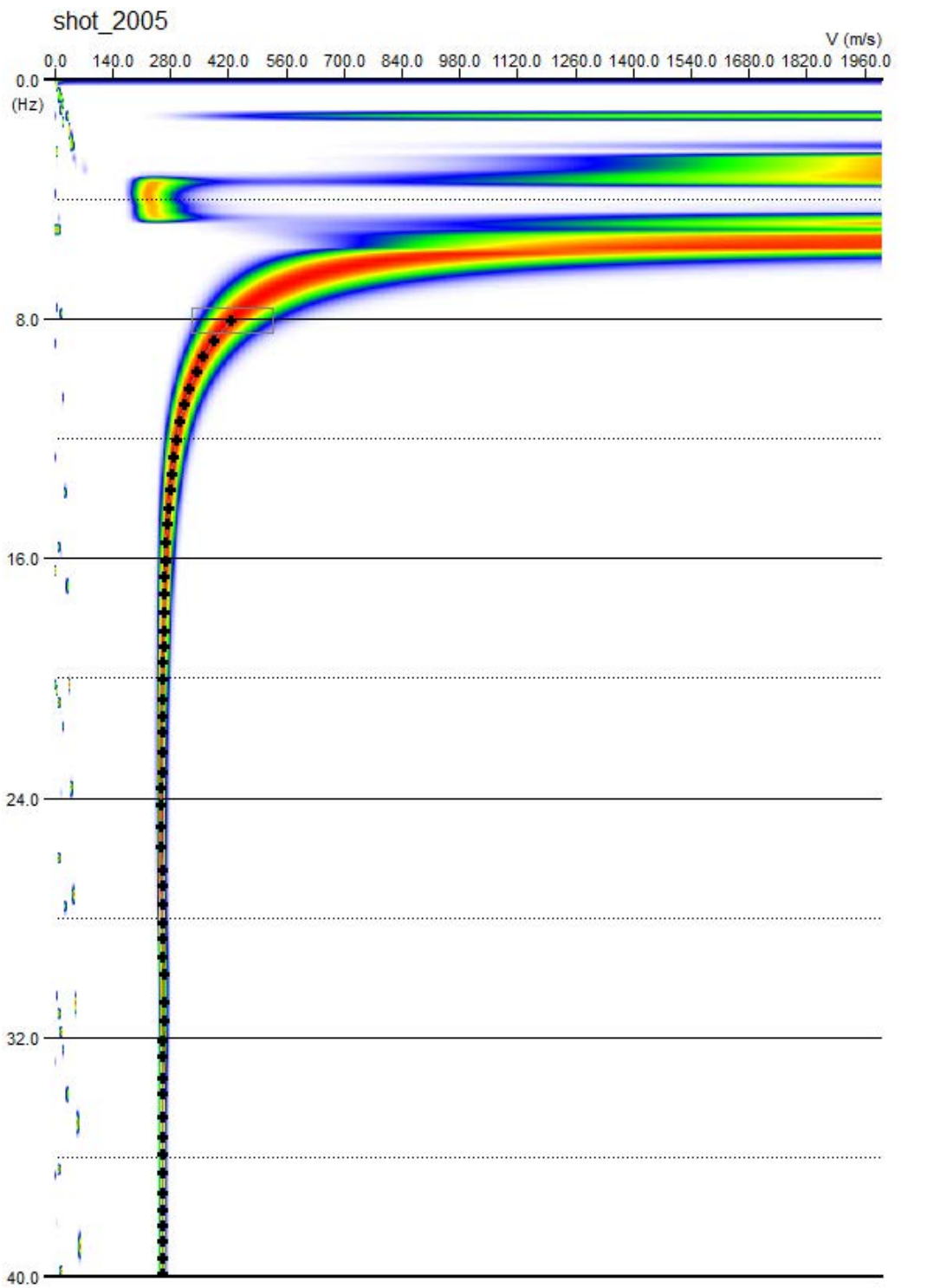

8.20 (Hz)

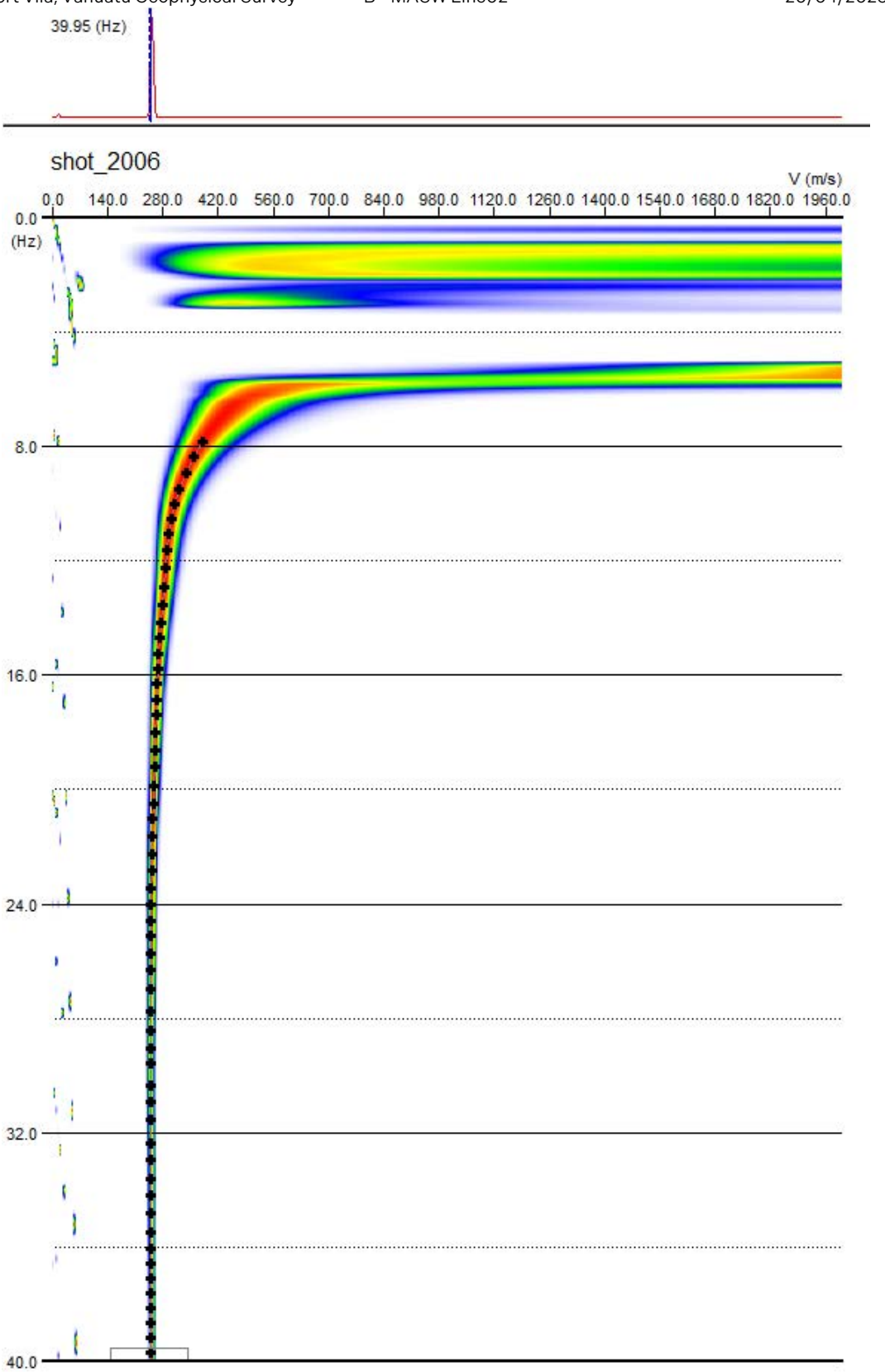

shot_2003
V (m/s)
0.0
140.0
280.0
420.0
560.0
700.0
840.0
980.0
1120.0
1260.0
1400.0
1540.0
1680.0
1820.0
1960.0
0.0
(Hz)
8.0
16.0
24.0
32.0
40.0

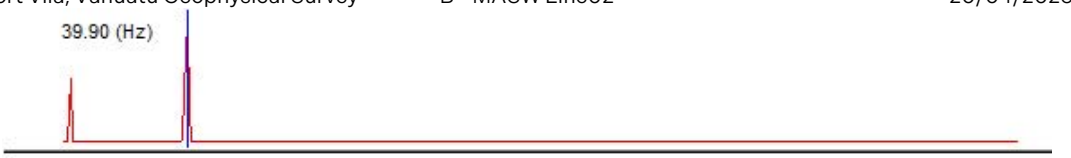

8.56 (Hz)

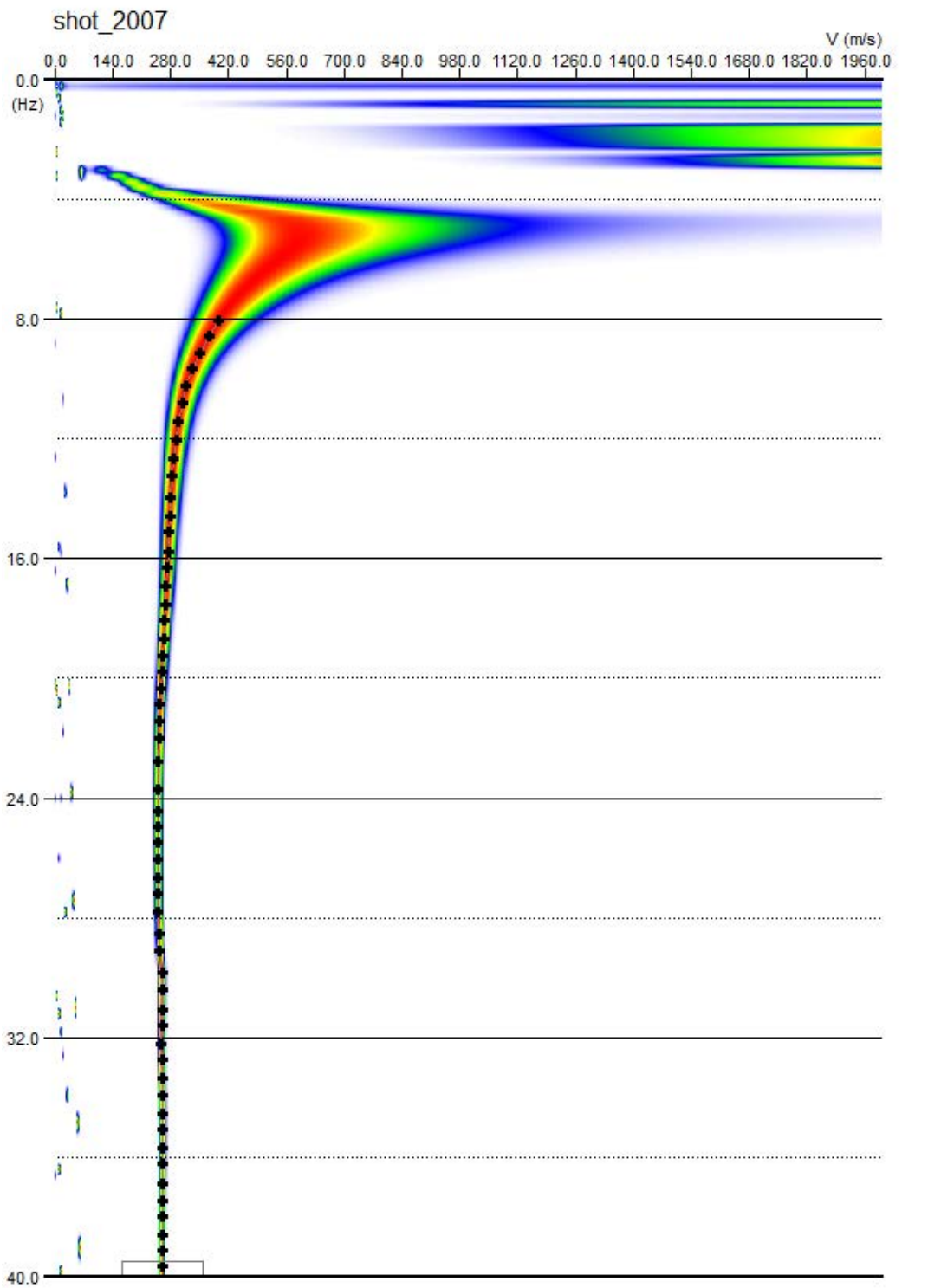

shot_2004
V (m/s)
0.0 140.0 280.0 420.0 560.0 700.0 840.0 980.0 1120.0 1260.0 1400.0 1540.0 1680.0 1820.0 1960.0
0.0
(Hz)
8.0
16.0
24.0
32.0
40.0


8.04 (Hz)

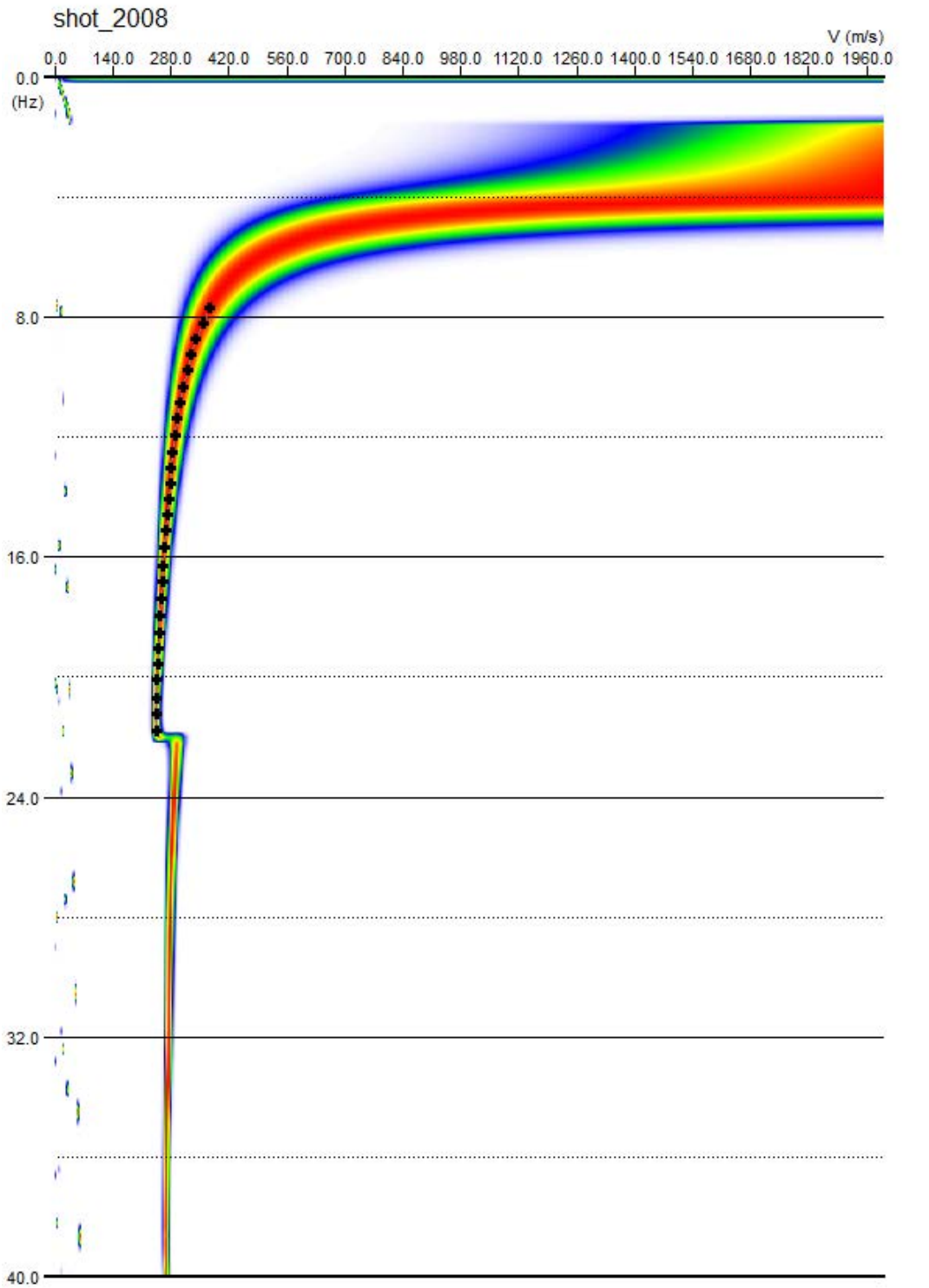

shot_2005
V (m/s)
0.0
140.0
280.0
420.0
560.0
700.0
840.0
980.0
1120.0
1260.0
1400.0
1540.0
1680.0
1820.0
1960.0
0.0
(Hz)
8.0
16.0
24.0
32.0
40.0


39.95 (Hz)
shot_2006
V (m/s)
0.0 140.0 280.0 420.0 560.0 700.0 840.0 980.0 1120.0 1260.0 1400.0 1540.0 1680.0 1820.0 1960.0
0.0
(Hz)
8.0
16.0
24.0
32.0
40.0

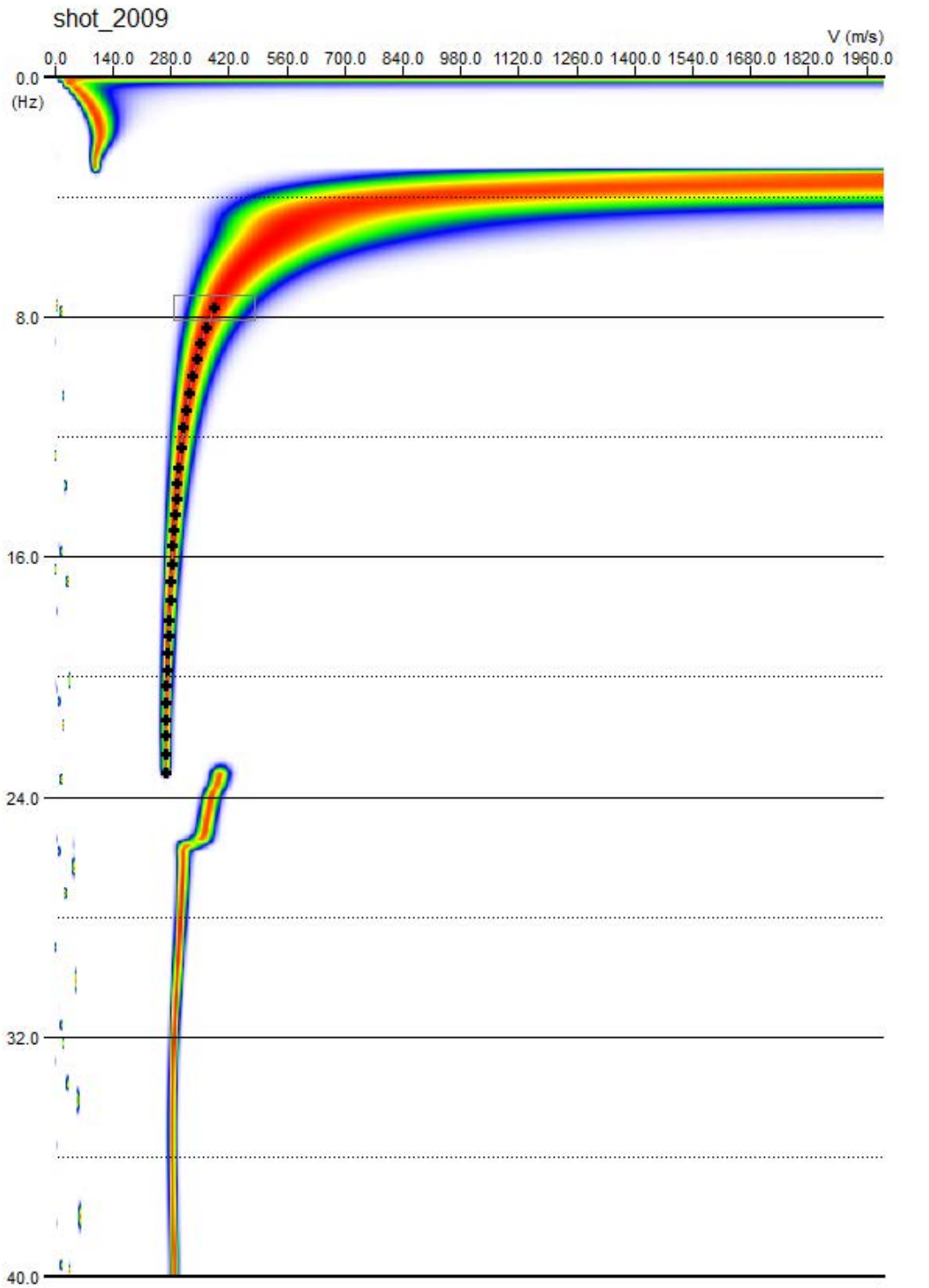

39.90 (Hz)


shot_2007
V (m/s)
0.0 140.0 280.0 420.0 560.0 700.0 840.0 980.0 1120.0 1260.0 1400.0 1540.0 1680.0 1820.0 1960.0
0.0
(Hz)
8.0
16.0
24.0
32.0
40.0

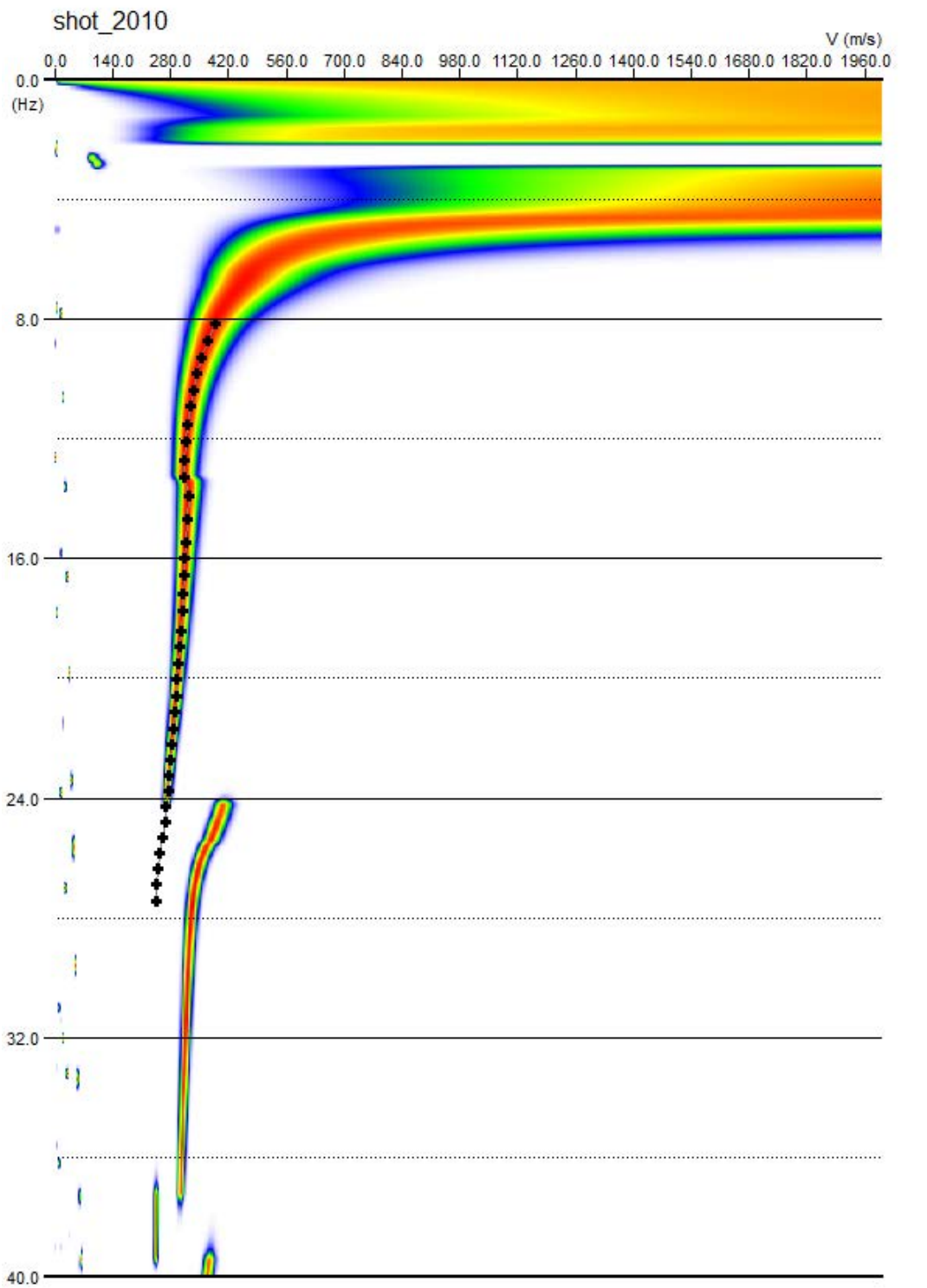


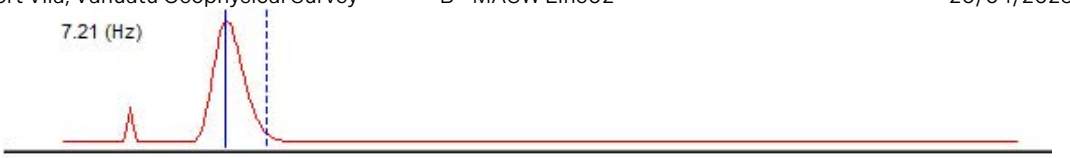

shot_2008
V (m/s)
0.0 140.0 280.0 420.0 560.0 700.0 840.0 980.0 1120.0 1260.0 1400.0 1540.0 1680.0 1820.0 1960.0
0.0
(Hz)
8.0
16.0
24.0
32.0
40.0

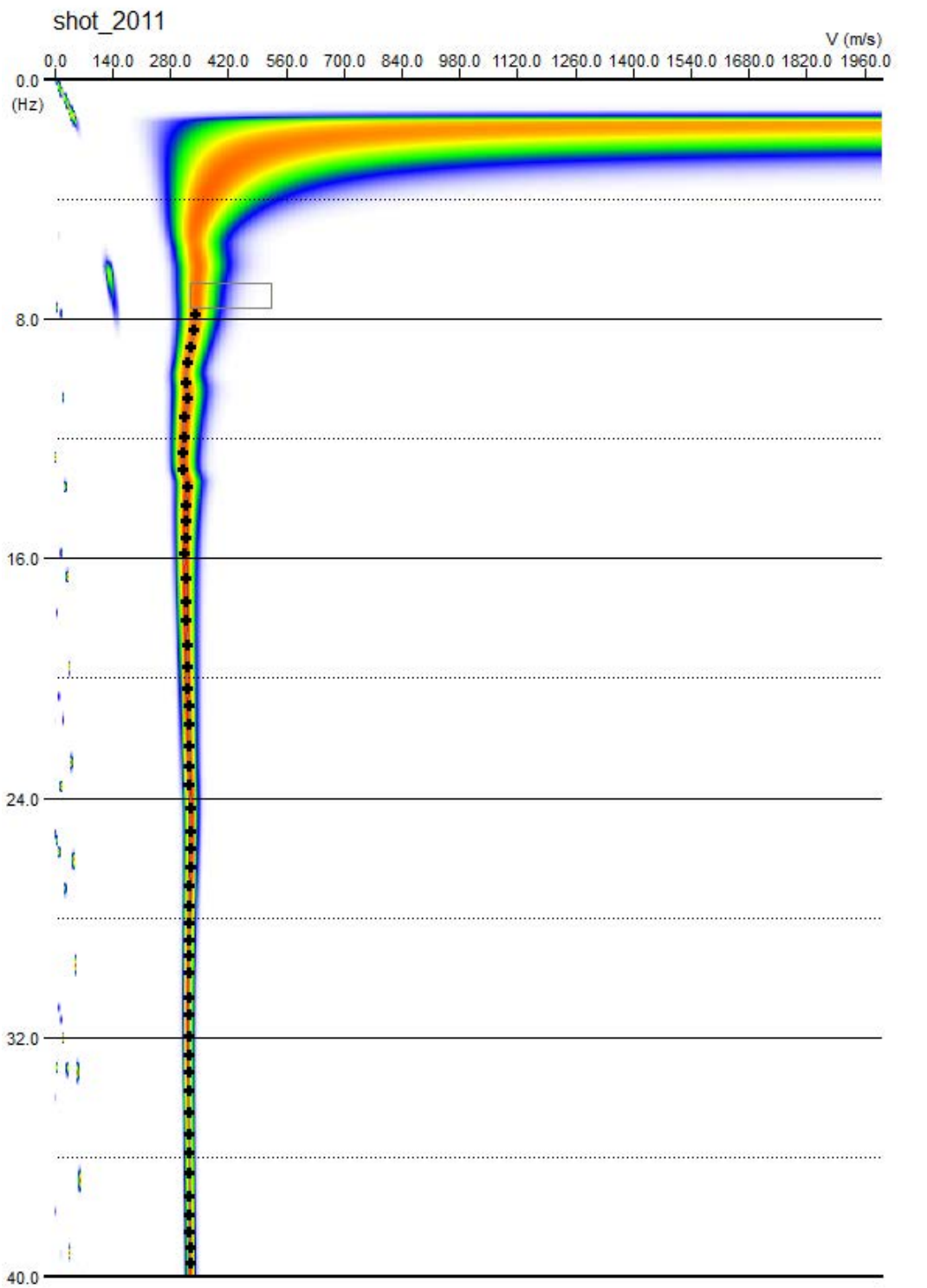

7.68 (Hz)

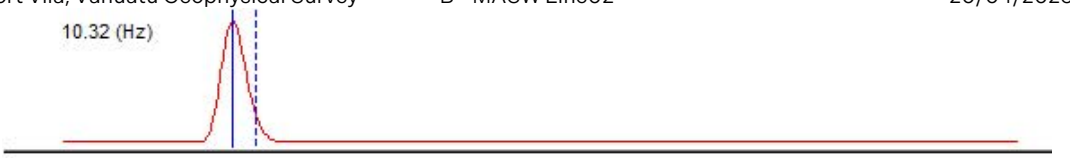

shot_2009
V (m/s)
0.0 140.0 280.0 420.0 560.0 700.0 840.0 980.0 1120.0 1260.0 1400.0 1540.0 1680.0 1820.0 1960.0
0.0
(Hz)
8.0
16.0
24.0
32.0
40.0

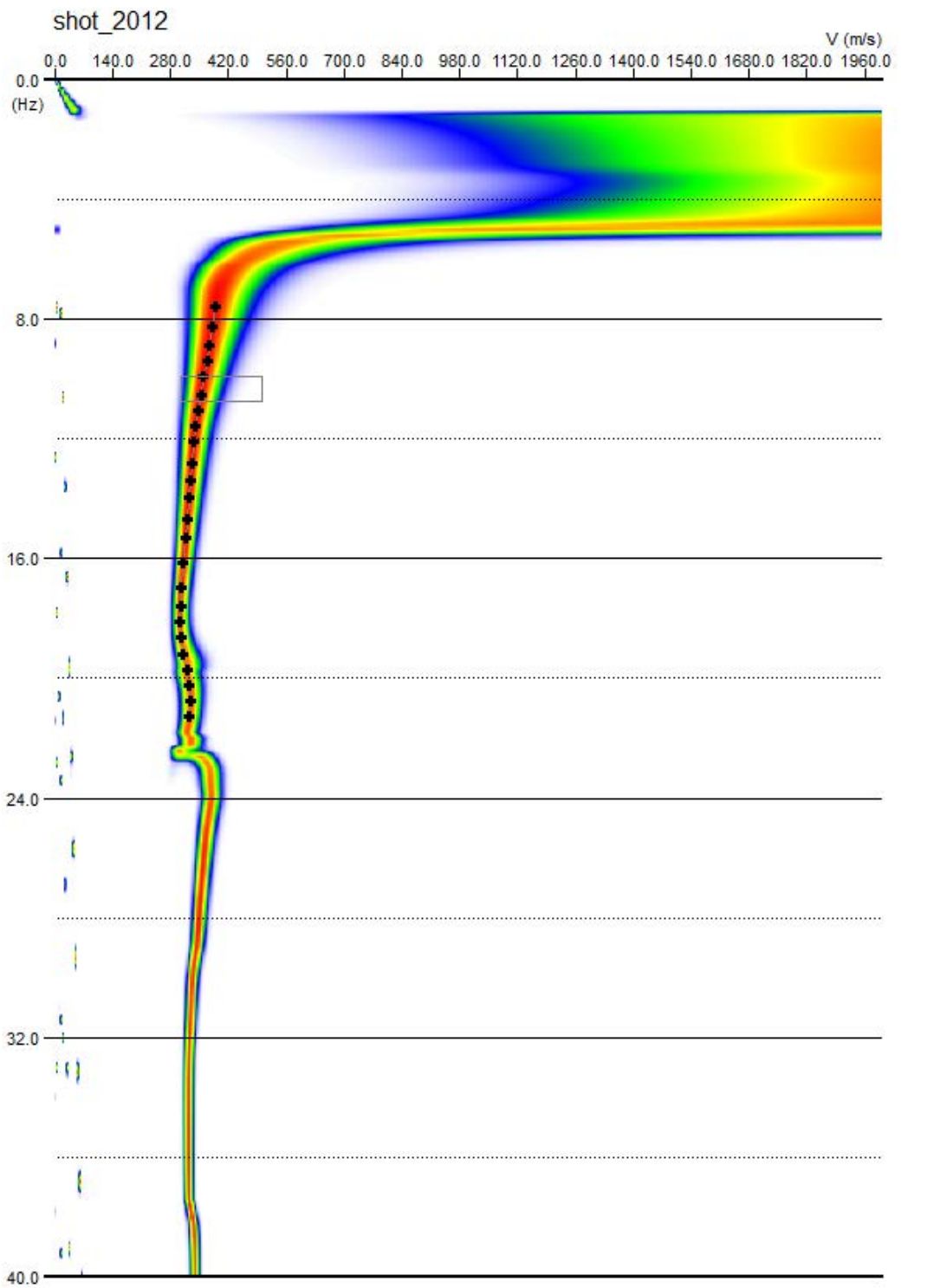


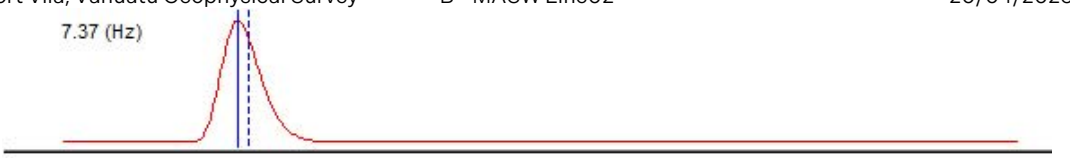

shot_2010
V (m/s)
0.0 140.0 280.0 420.0 560.0 700.0 840.0 980.0 1120.0 1260.0 1400.0 1540.0 1680.0 1820.0 1960.0
0.0
(Hz)
8.0
16.0
24.0
32.0
40.0

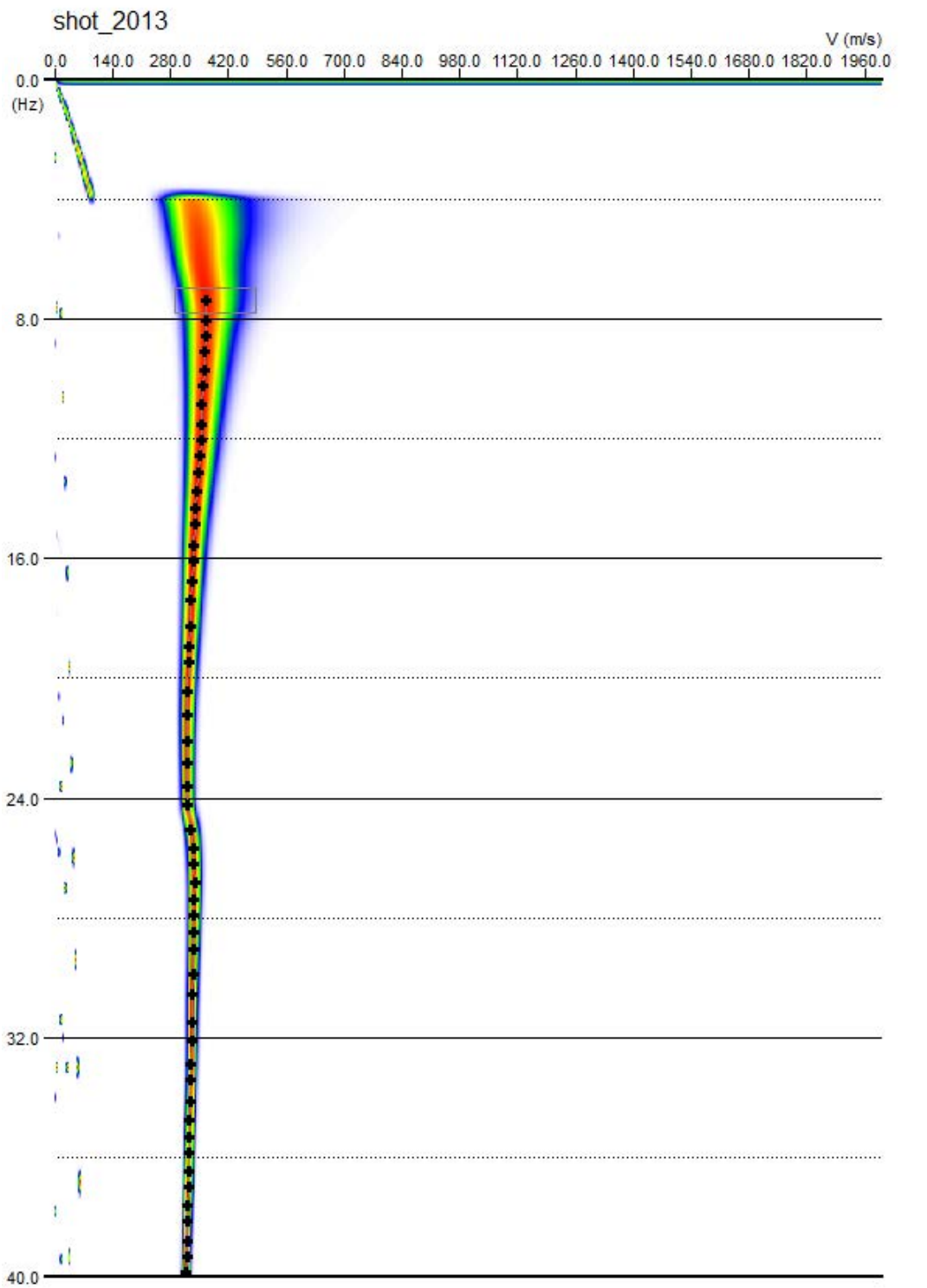

7.21 (Hz)

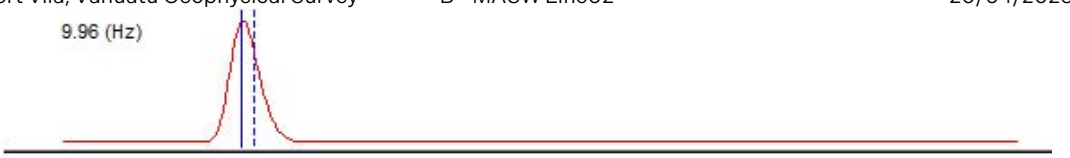

shot_2011
V (m/s)
0.0
140.0
280.0
420.0
560.0
700.0
840.0
980.0
1120.0
1260.0
1400.0
1540.0
1680.0
1820.0
1960.0
0.0
(Hz)
8.0
16.0
24.0
32.0
40.0

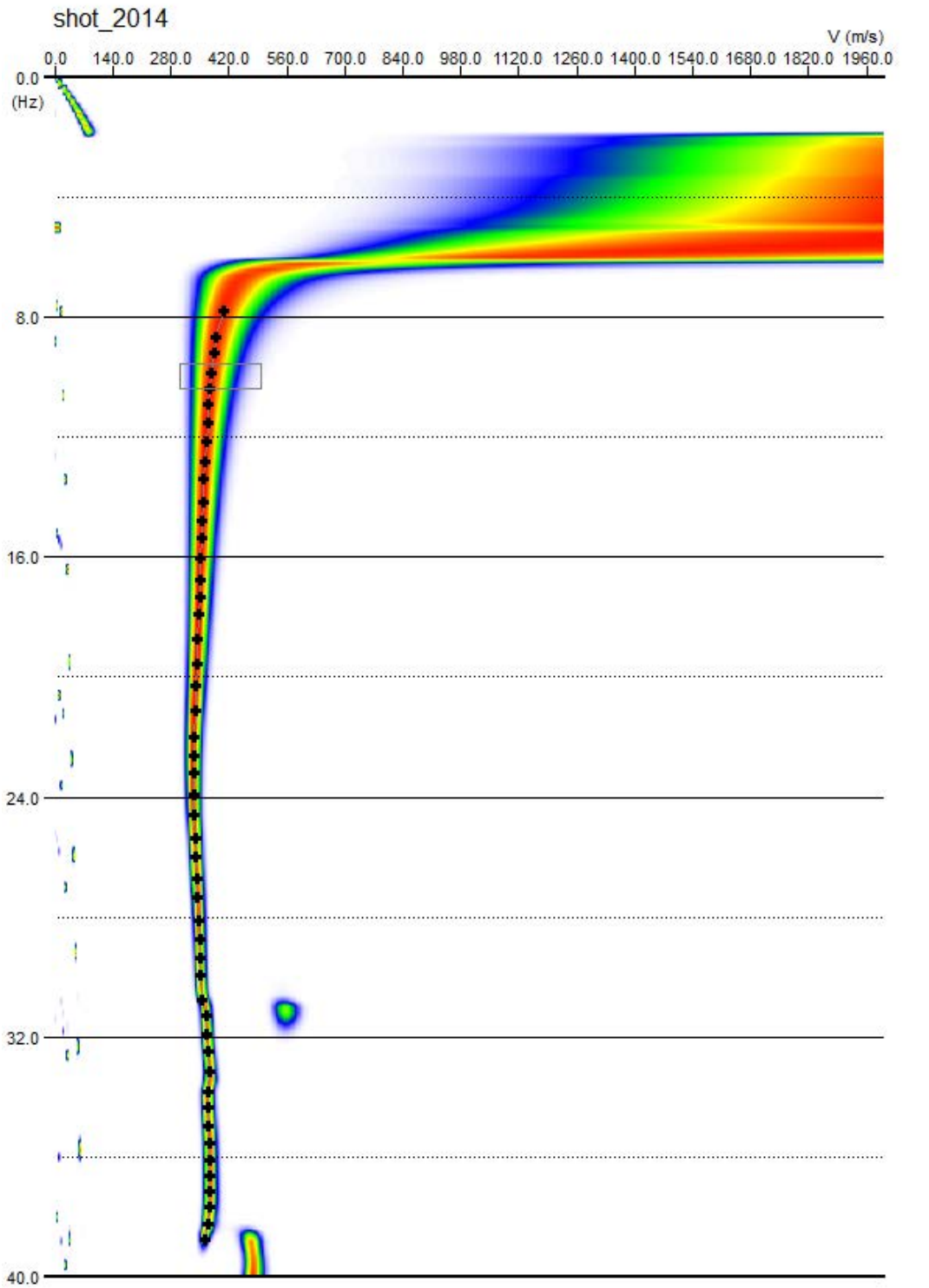

10.32 (Hz)

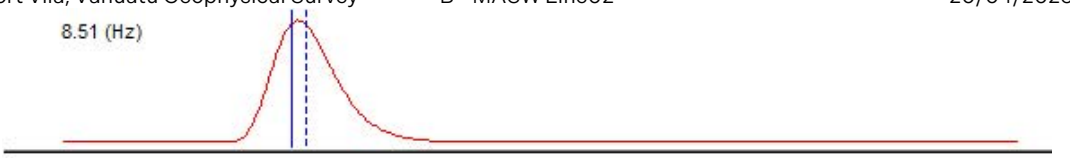

shot_2012
V (m/s)
0.0
140.0
280.0
420.0
560.0
700.0
840.0
980.0
1120.0
1260.0
1400.0
1540.0
1680.0
1820.0
1960.0
0.0
(Hz)
8.0
16.0
24.0
32.0
40.0

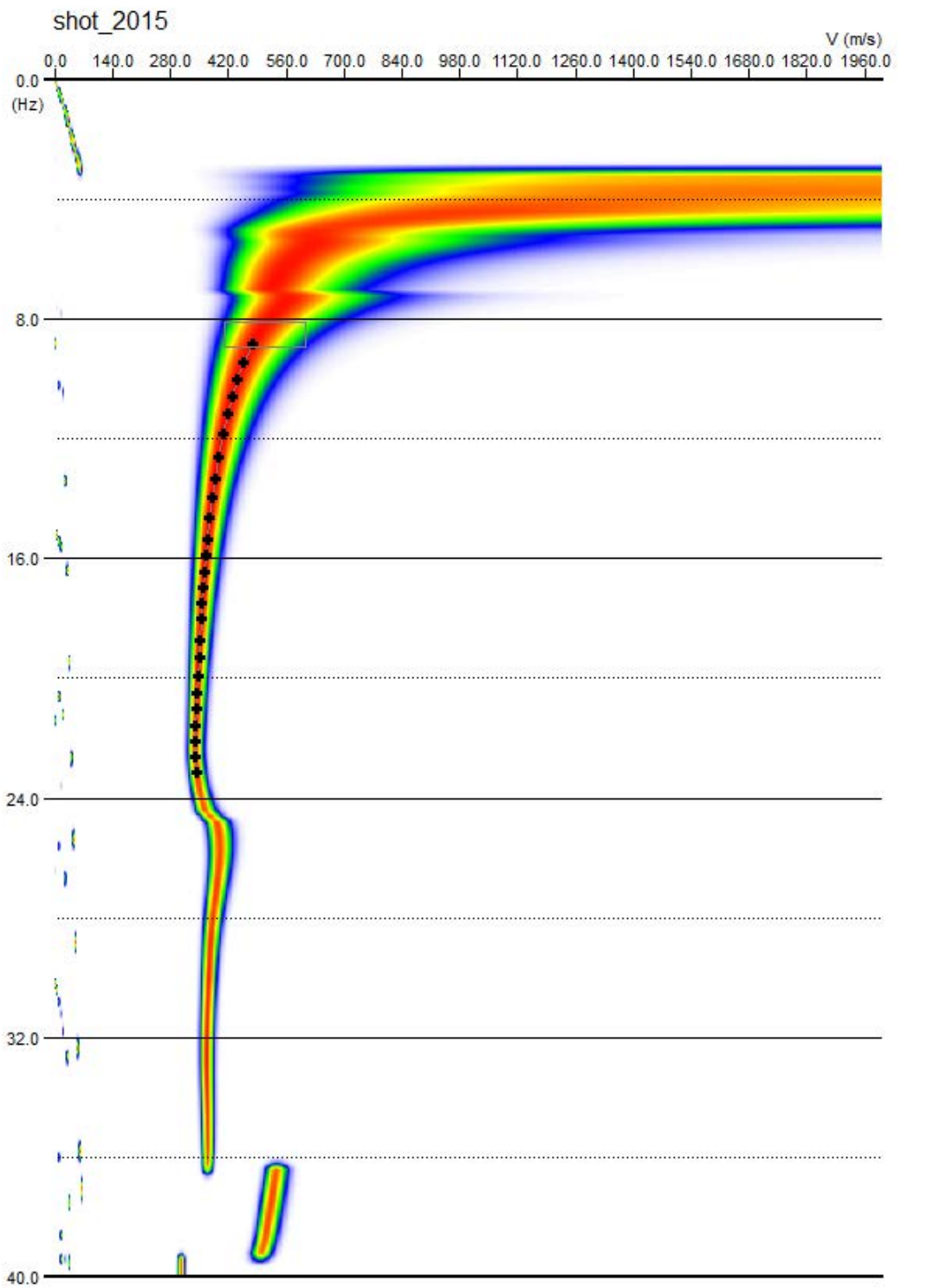

7.37 (Hz)

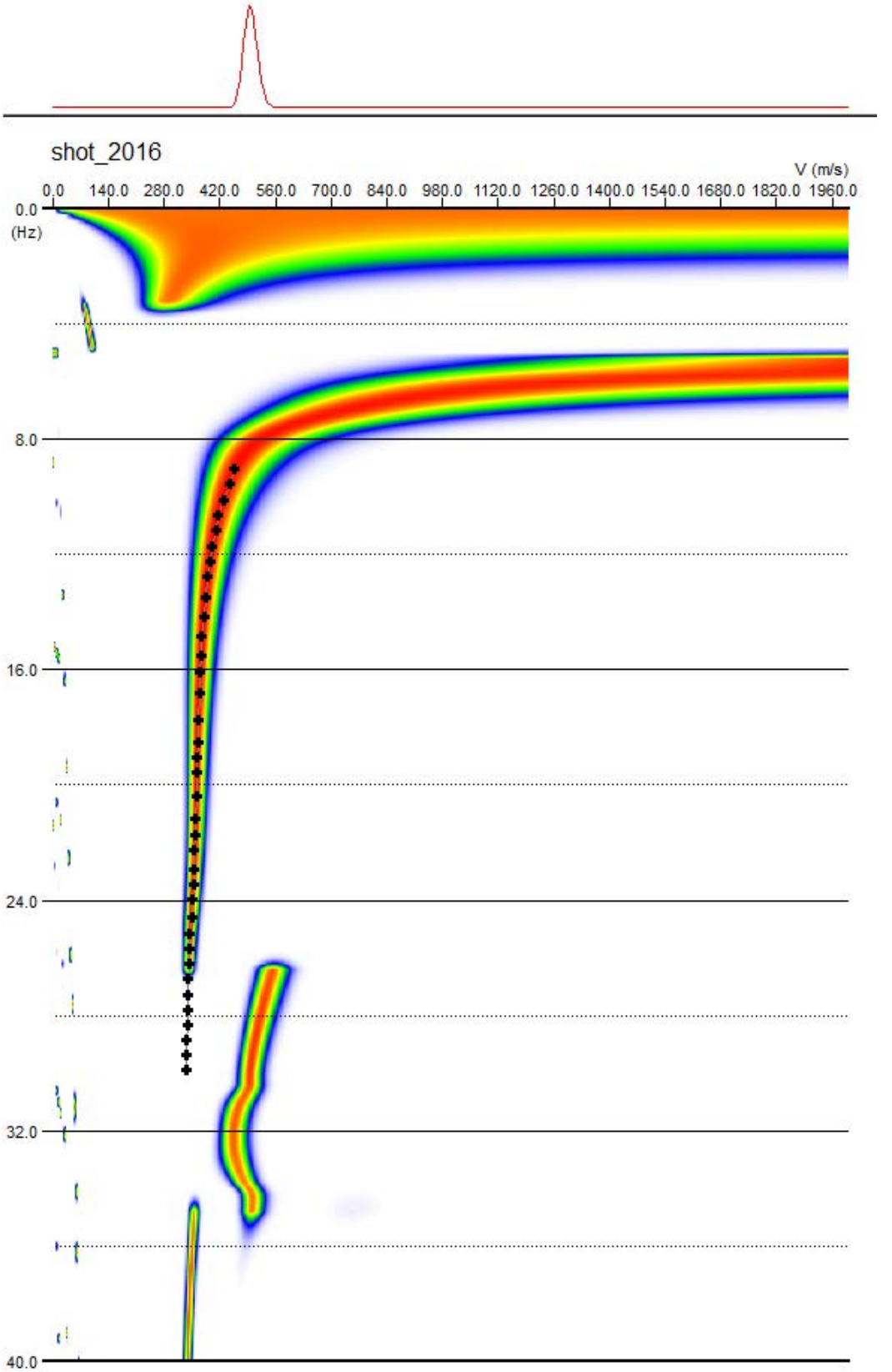

shot_2013
V (m/s)
0.0 140.0 280.0 420.0 560.0 700.0 840.0 980.0 1120.0 1260.0 1400.0 1540.0 1680.0 1820.0 1960.0
0.0
(Hz)
8.0
16.0
24.0
32.0
40.0

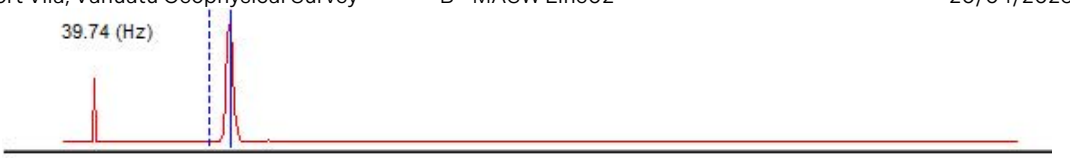

9.96 (Hz)

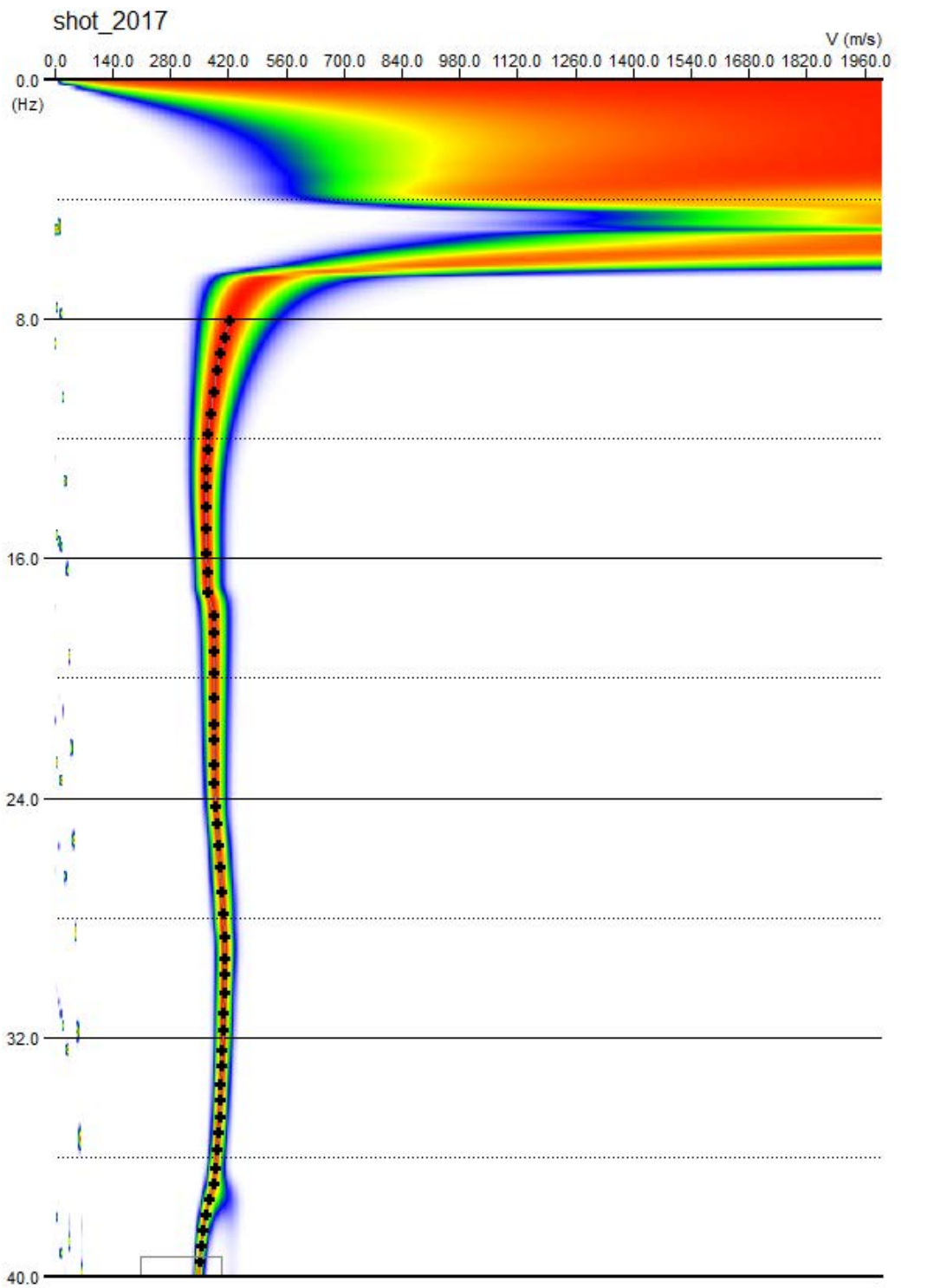

shot_2014
V (m/s)
0.0
140.0
280.0
420.0
560.0
700.0
840.0
980.0
1120.0
1260.0
1400.0
1540.0
1680.0
1820.0
1960.0
0.0
(Hz)
8.0
16.0
24.0
32.0
40.0

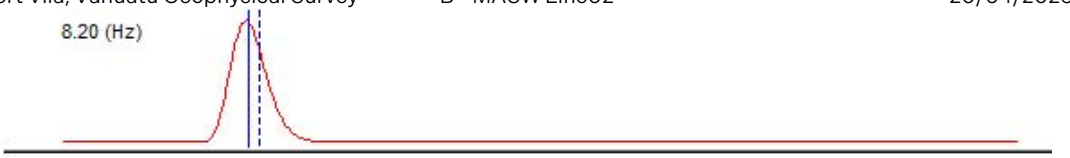

8.51 (Hz)

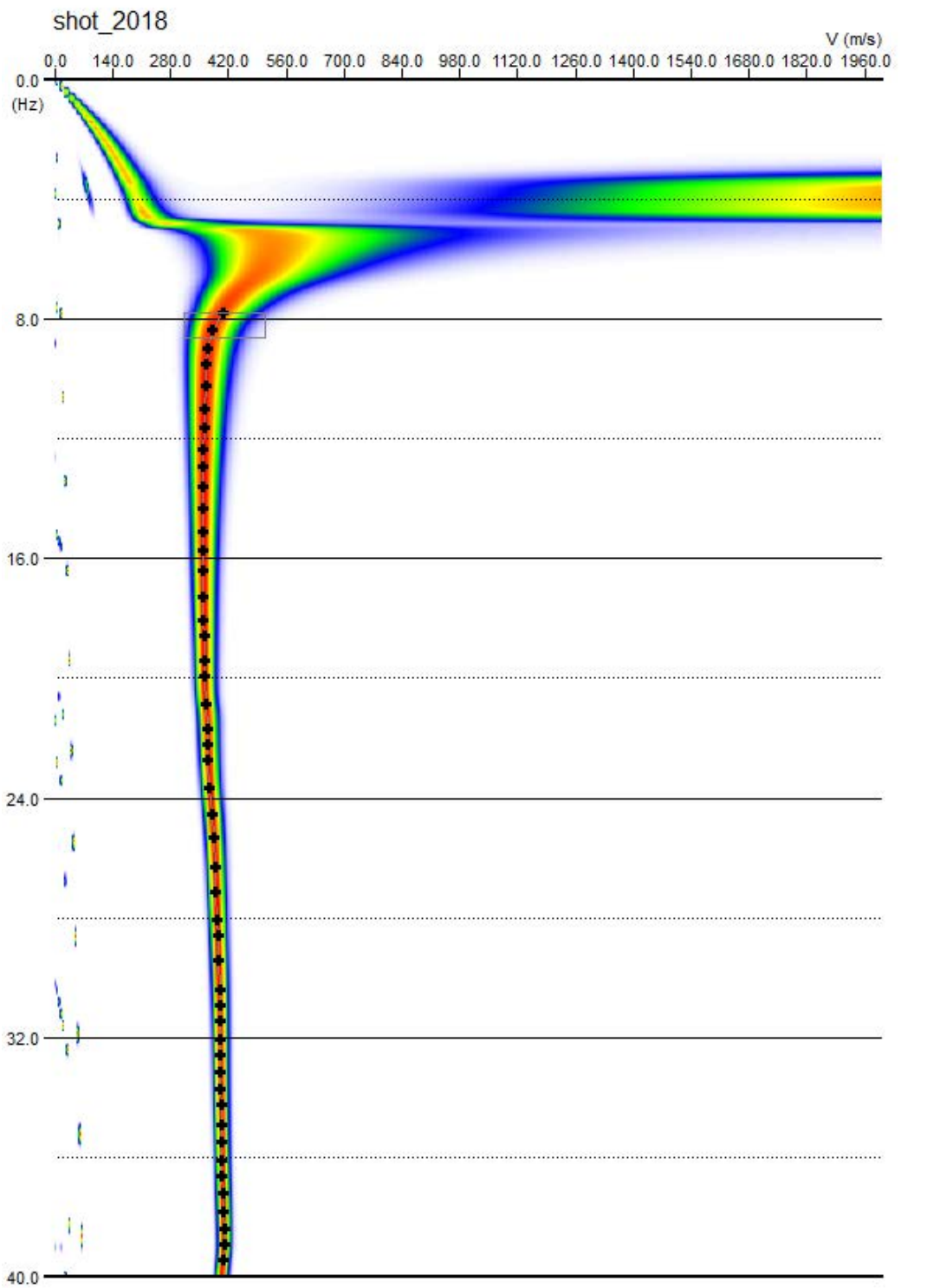

shot_2015
V (m/s)
0.0
140.0
280.0
420.0
560.0
700.0
840.0
980.0
1120.0
1260.0
1400.0
1540.0
1680.0
1820.0
1960.0
0.0
(Hz)
8.0
16.0
24.0
32.0
40.0

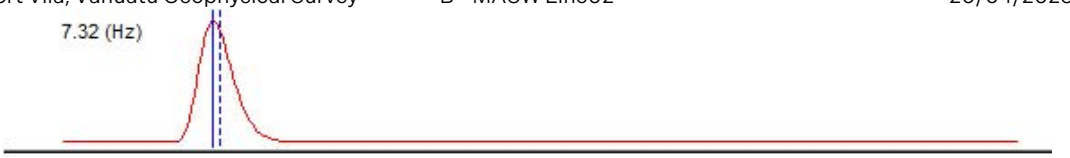

shot_2016
V (m/s)
0.0 140.0 280.0 420.0 560.0 700.0 840.0 980.0 1120.0 1260.0 1400.0 1540.0 1680.0 1820.0 1960.0
0.0
(Hz)
8.0
16.0
24.0
32.0
40.0

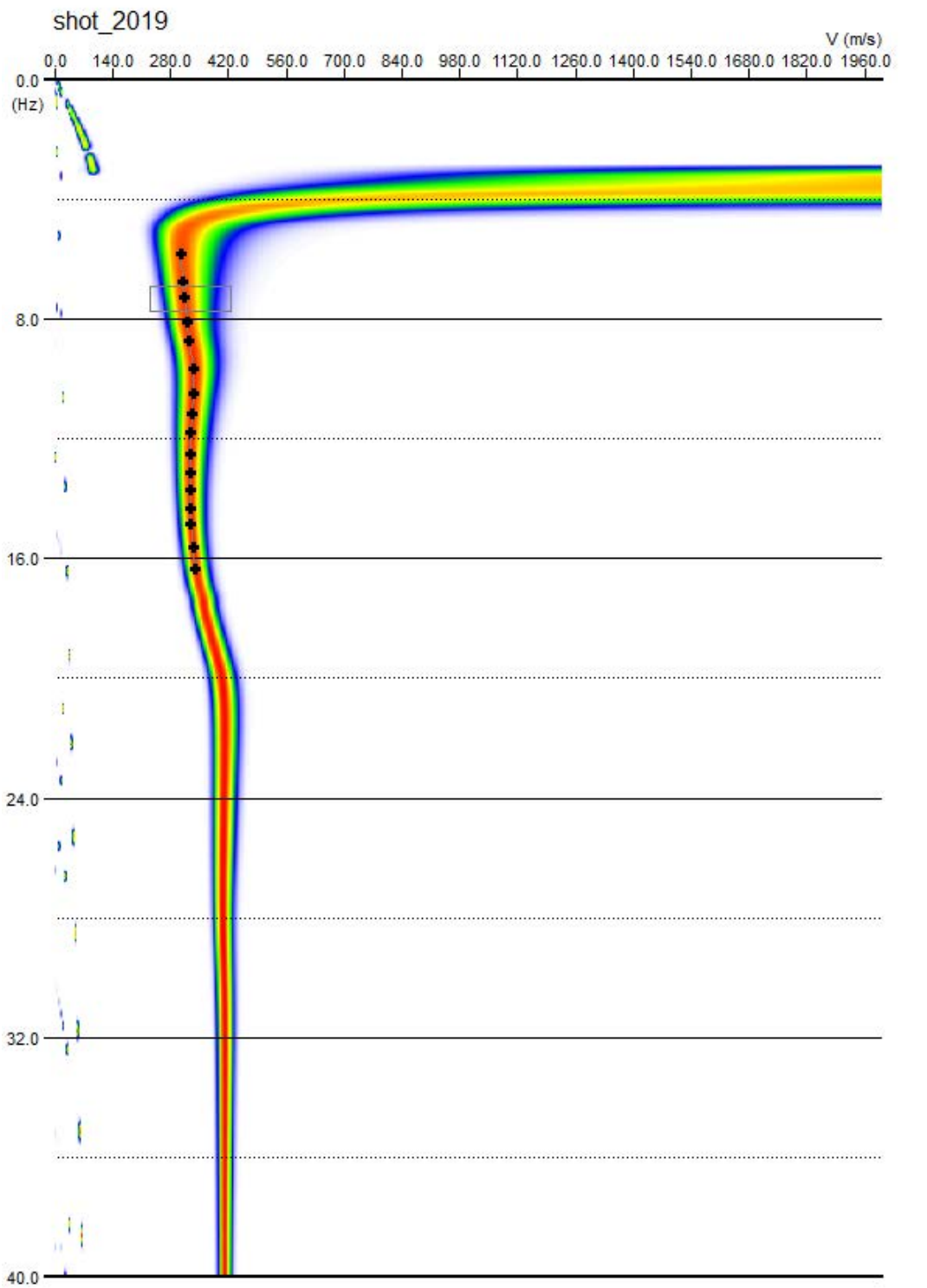

39.74 (Hz)

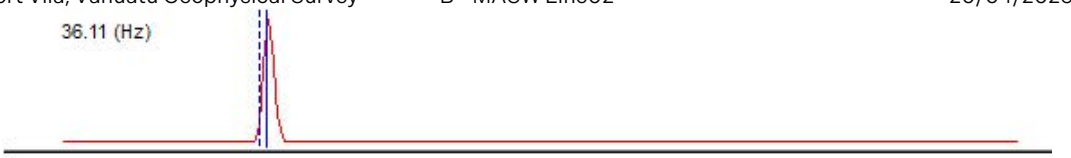

shot_2017
V (m/s)
0.0 140.0 280.0 420.0 560.0 700.0 840.0 980.0 1120.0 1260.0 1400.0 1540.0 1680.0 1820.0 1960.0
0.0
(Hz)
8.0
16.0
24.0
32.0
40.0

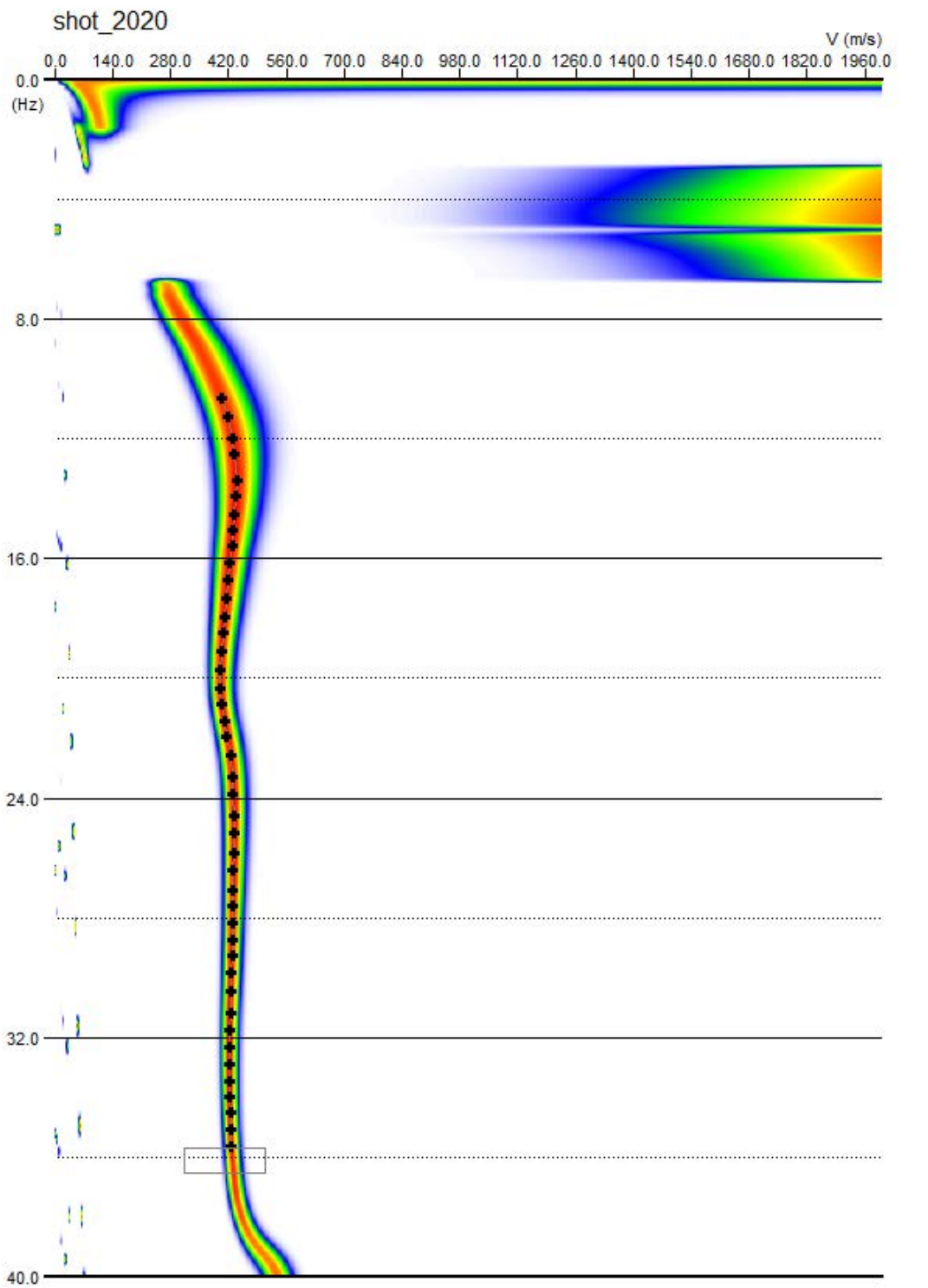

8.20 (Hz)

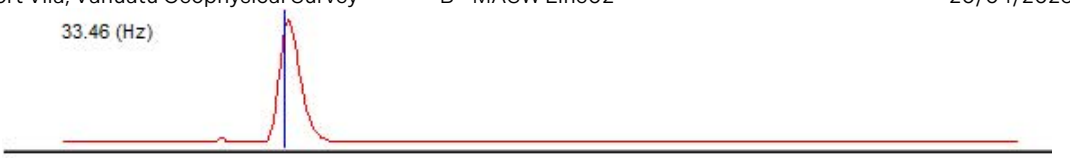

shot_2018
V (m/s)
0.0
140.0
280.0
420.0
560.0
700.0
840.0
980.0
1120.0
1260.0
1400.0
1540.0
1680.0
1820.0
1960.0
0.0
(Hz)
8.0
16.0
24.0
32.0
40.0

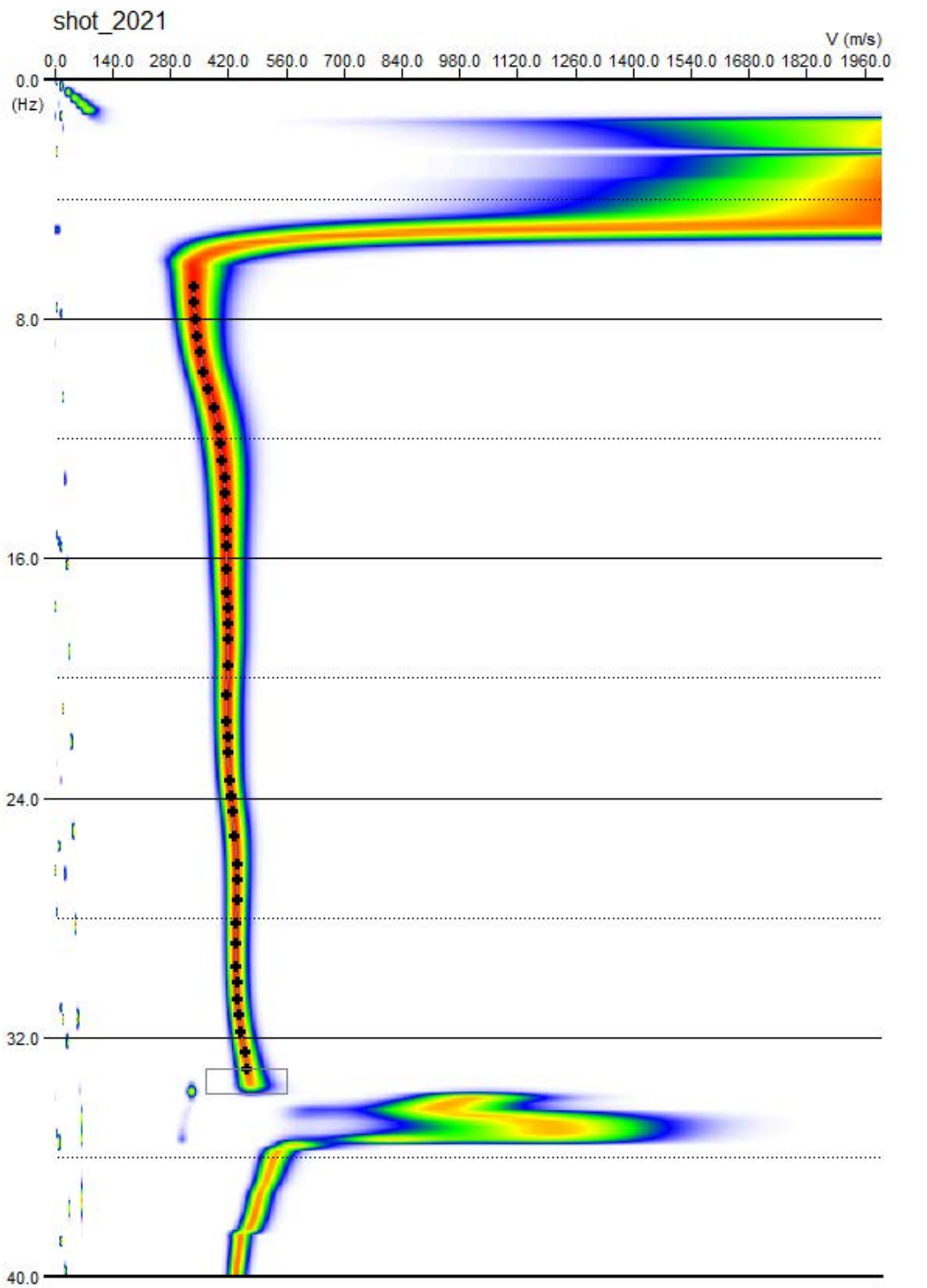

7.32 (Hz)

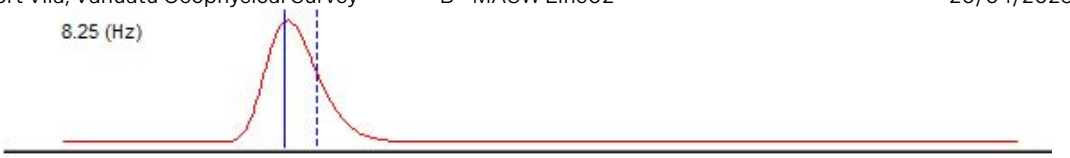

shot_2019
V (m/s)
0.0
140.0
280.0
420.0
560.0
700.0
840.0
980.0
1120.0
1260.0
1400.0
1540.0
1680.0
1820.0
1960.0
0.0
(Hz)
8.0
16.0
24.0
32.0
40.0

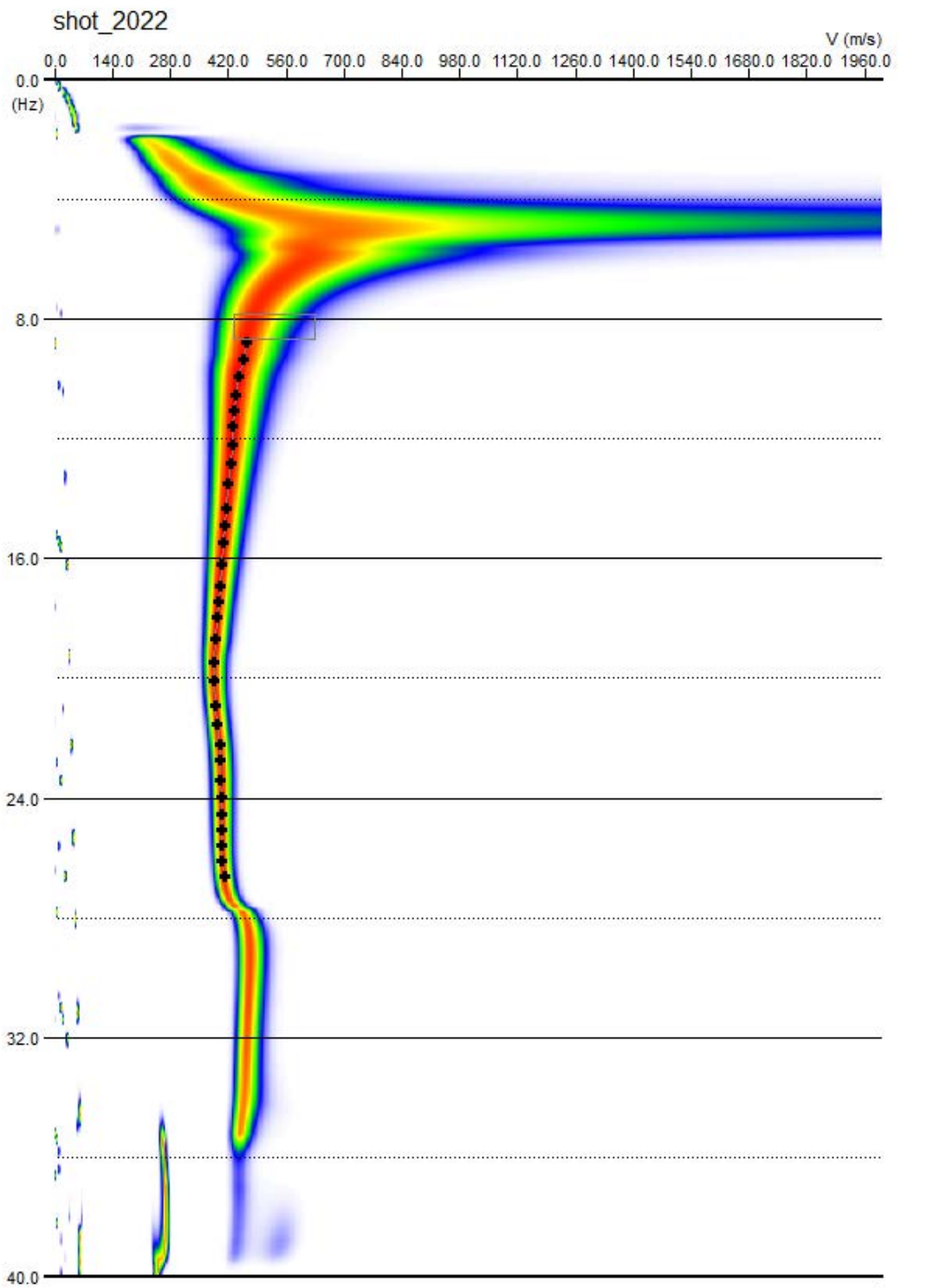

36.11 (Hz)

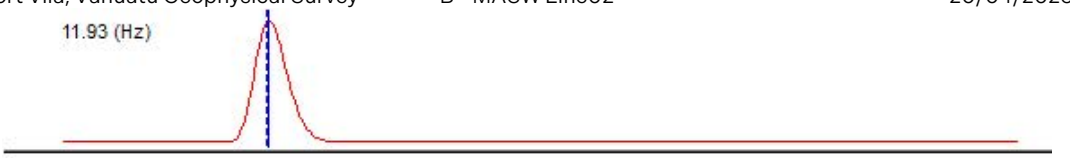

shot_2020
V (m/s)
0.0 140.0 280.0 420.0 560.0 700.0 840.0 980.0 1120.0 1260.0 1400.0 1540.0 1680.0 1820.0 1960.0
0.0
(Hz)
8.0
16.0
24.0
32.0
40.0

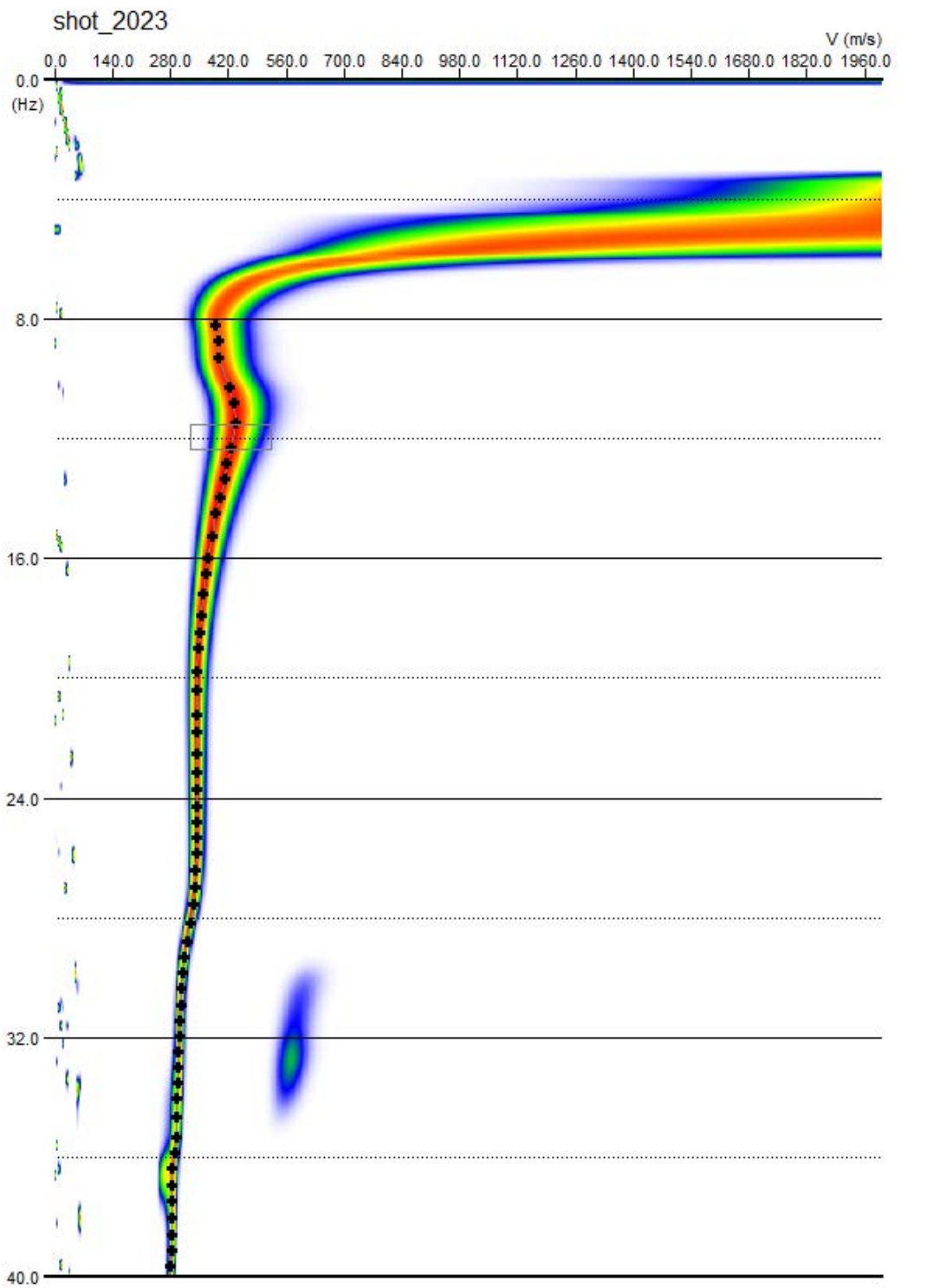

33.46 (Hz)

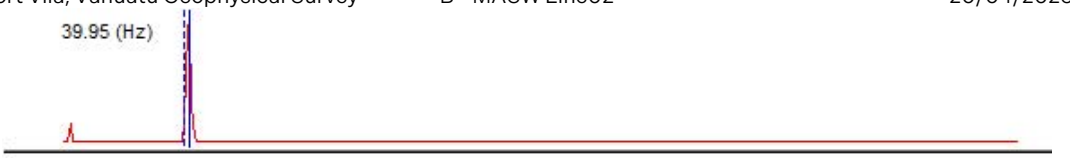

shot_2021
V (m/s)
0.0
140.0
280.0
420.0
560.0
700.0
840.0
980.0
1120.0
1260.0
1400.0
1540.0
1680.0
1820.0
1960.0
0.0
(Hz)
8.0
16.0
24.0
32.0
40.0

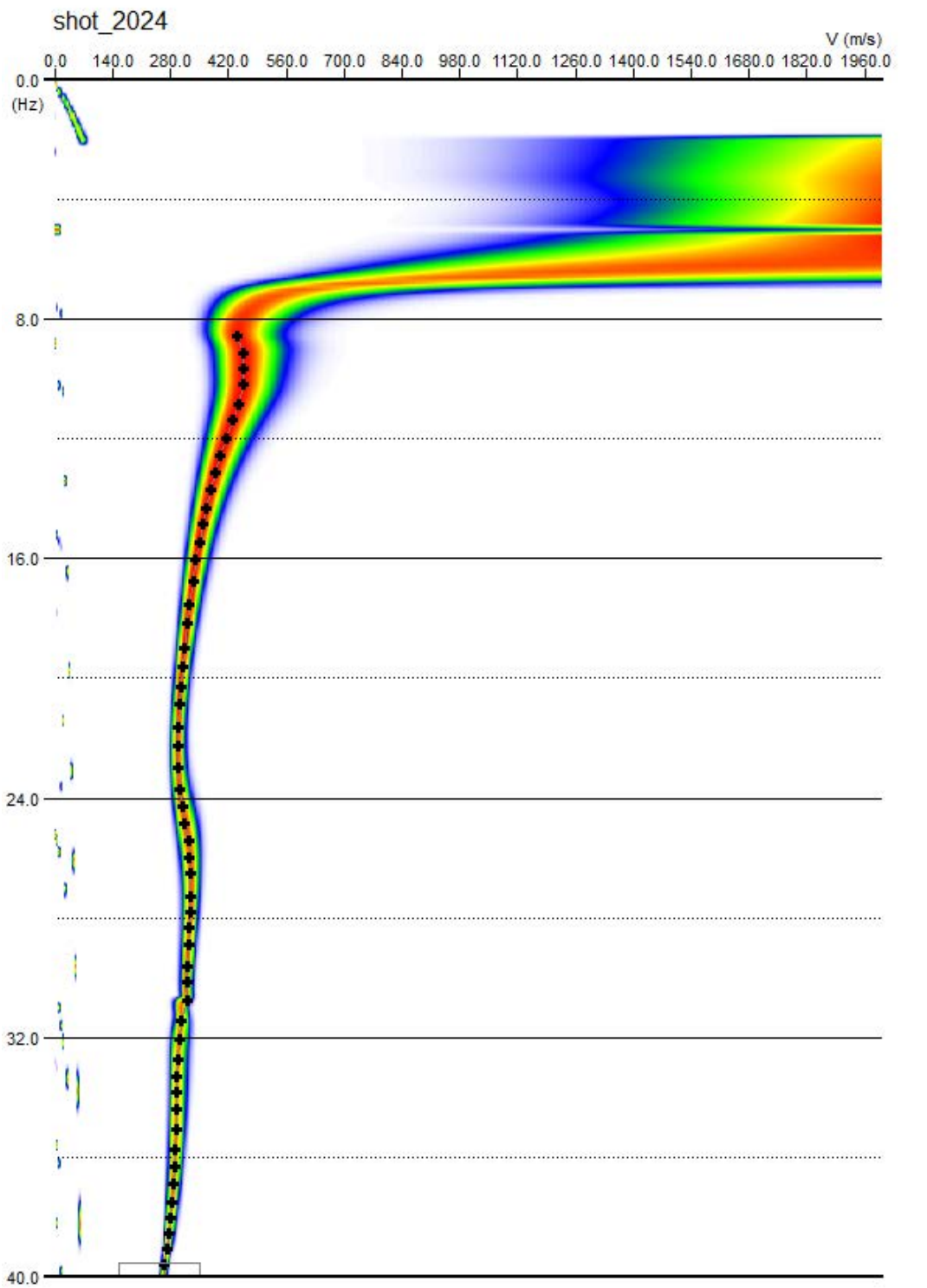

8.25 (Hz)


shot_2022
V (m/s)
0.0 140.0 280.0 420.0 560.0 700.0 840.0 980.0 1120.0 1260.0 1400.0 1540.0 1680.0 1820.0 1960.0
0.0
(Hz)
8.0
16.0
24.0
32.0
40.0

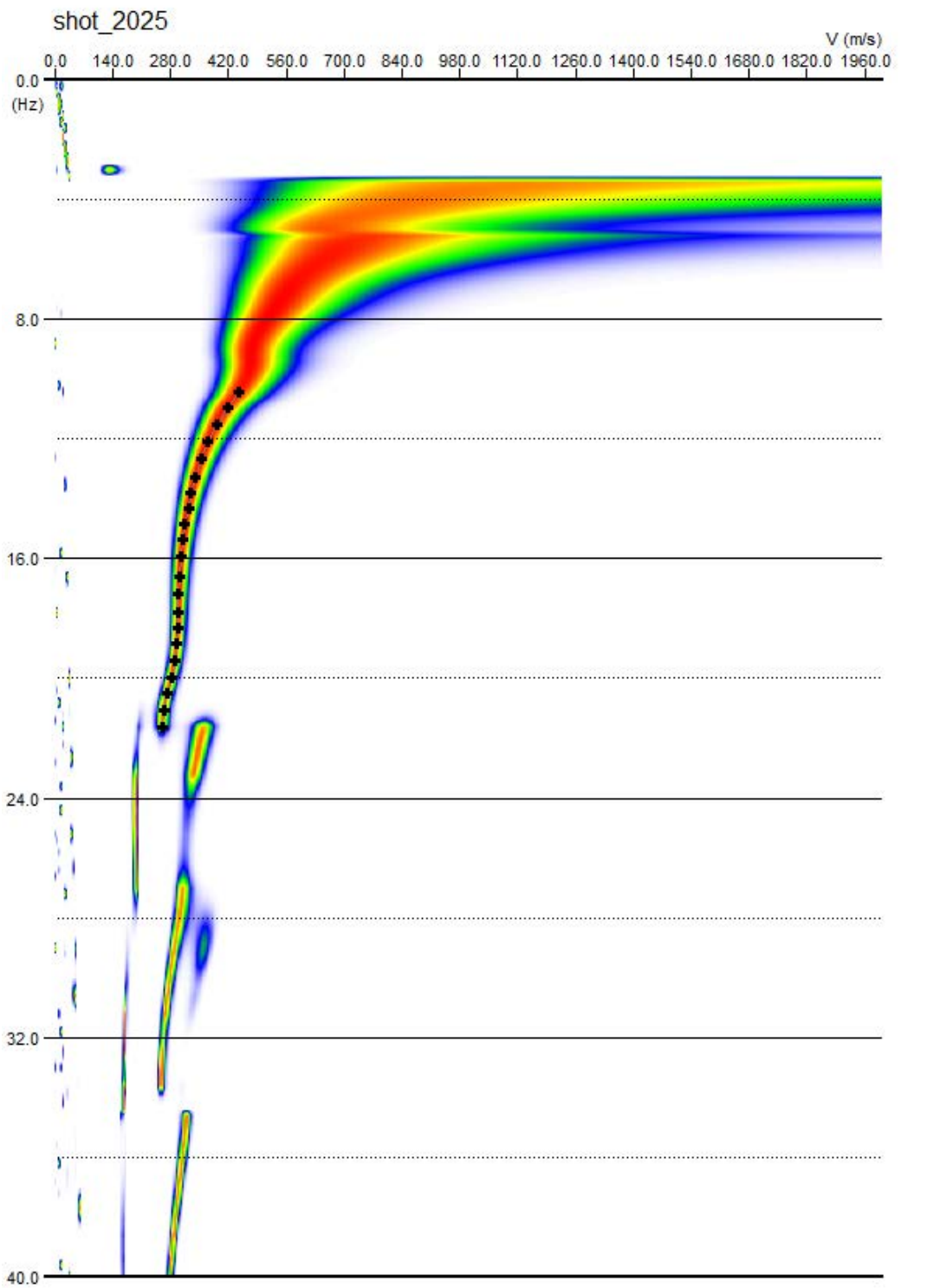

11.93 (Hz)

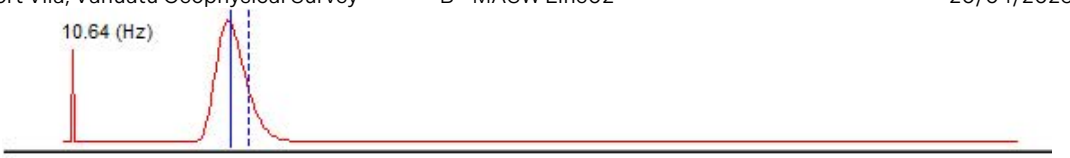

shot_2023
V (m/s)
0.0
140.0
280.0
420.0
560.0
700.0
840.0
980.0
1120.0
1260.0
1400.0
1540.0
1680.0
1820.0
1960.0
0.0
(Hz)
8.0
16.0
24.0
32.0
40.0

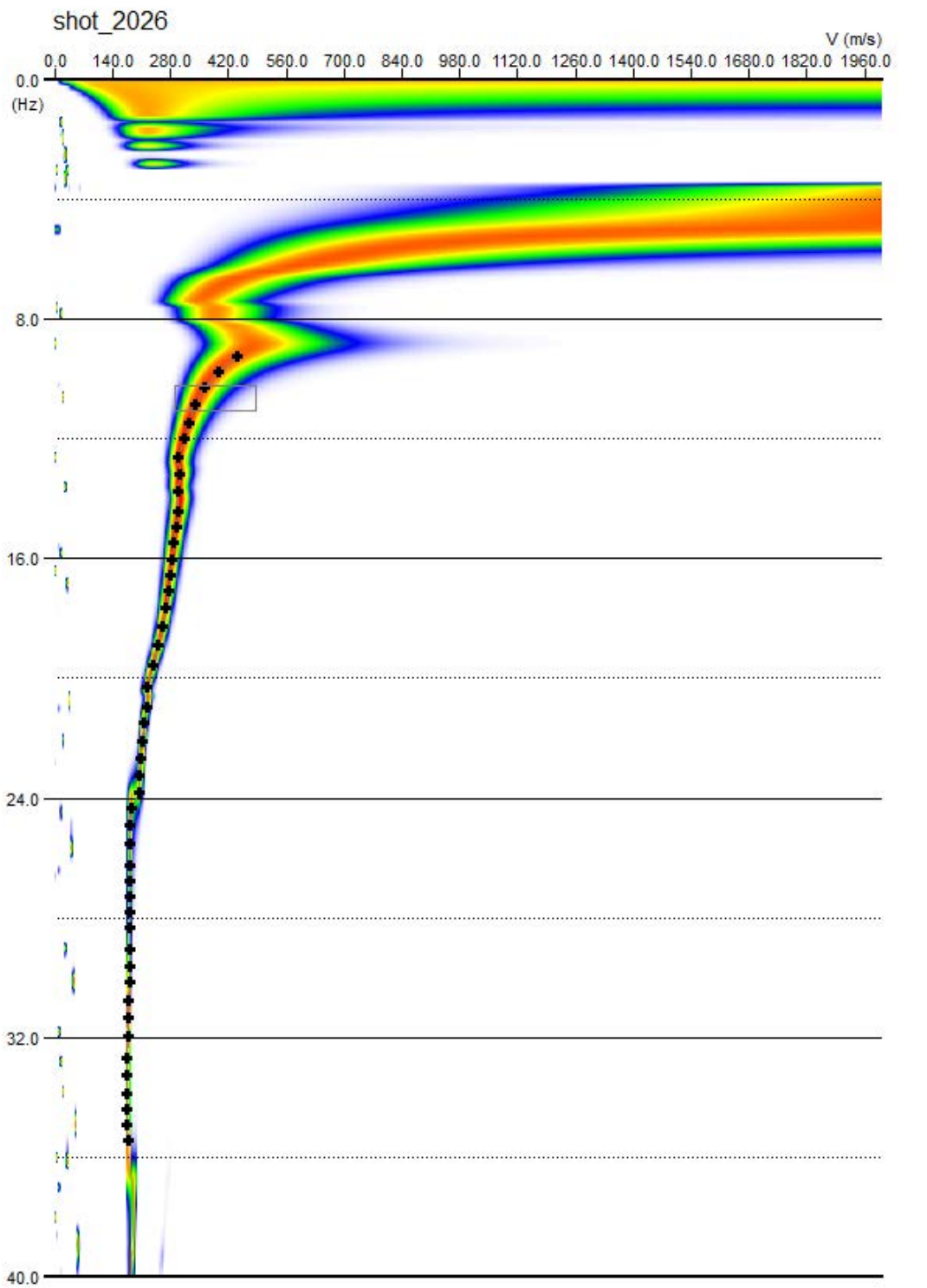

39.95 (Hz)

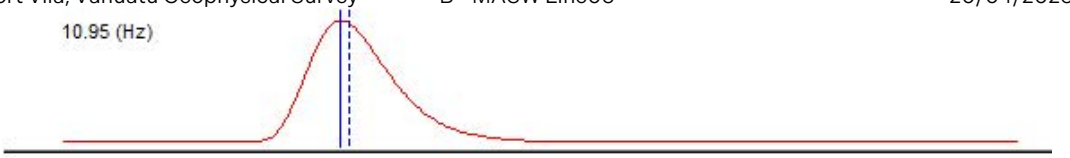

shot_2024
V (m/s)
0.0 140.0 280.0 420.0 560.0 700.0 840.0 980.0 1120.0 1260.0 1400.0 1540.0 1680.0 1820.0 1960.0
0.0
(Hz)
8.0
16.0
24.0
32.0
40.0

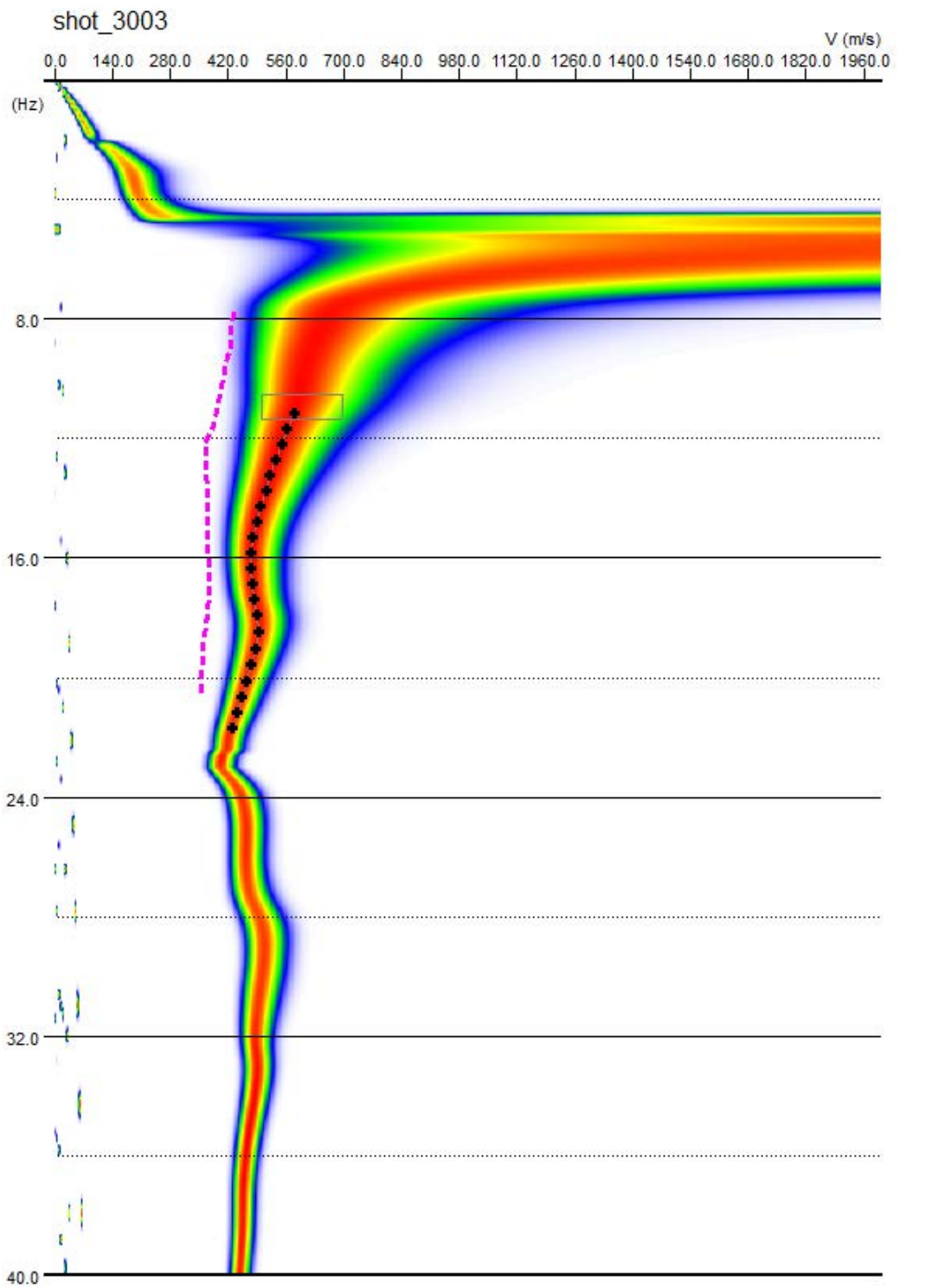


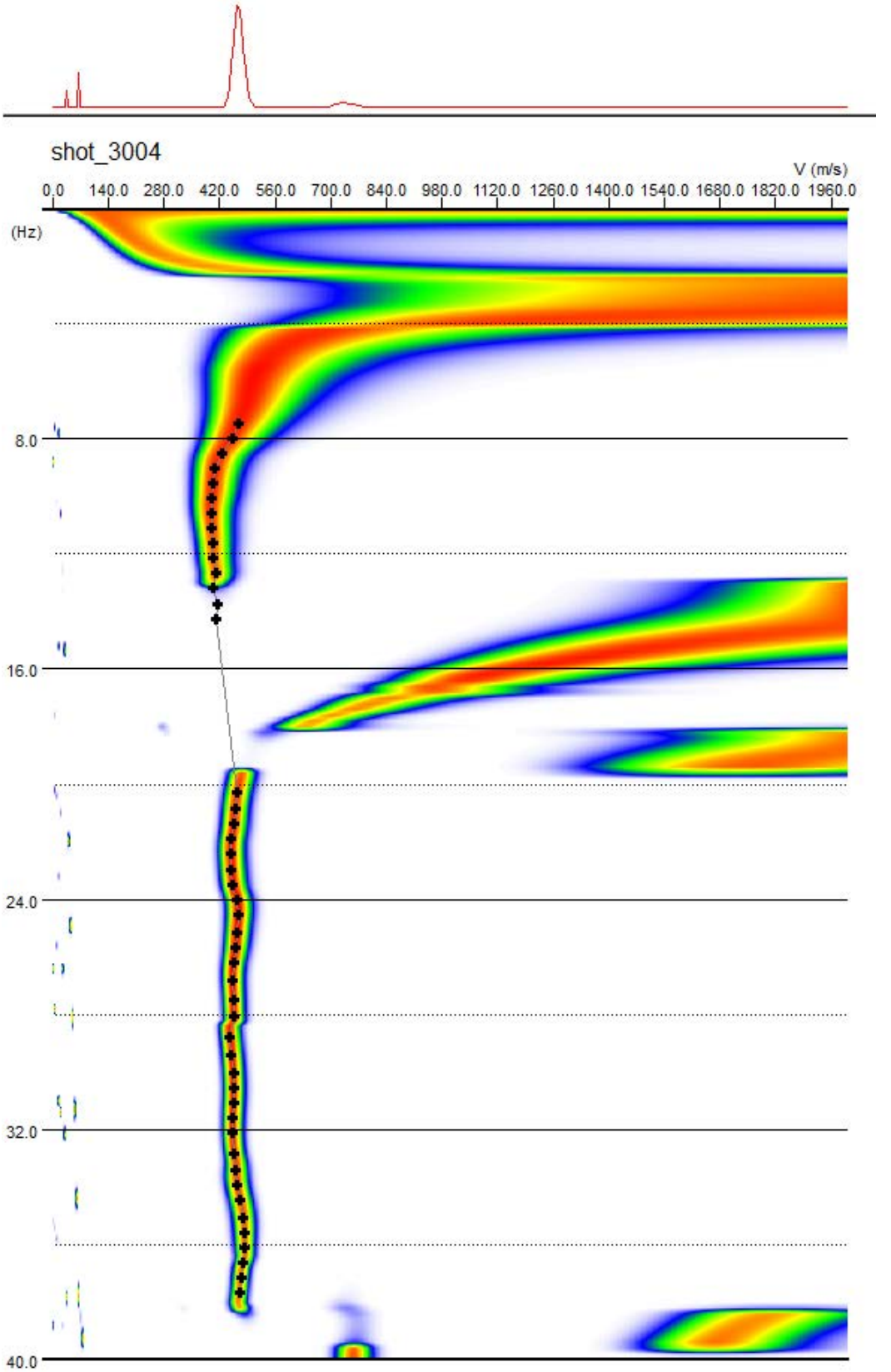

shot_2025
V (m/s)
0.0
140.0
280.0
420.0
560.0
700.0
840.0
980.0
1120.0
1260.0
1400.0
1540.0
1680.0
1820.0
1960.0
0.0
(Hz)
8.0
16.0
24.0
32.0
40.0


10.64 (Hz)

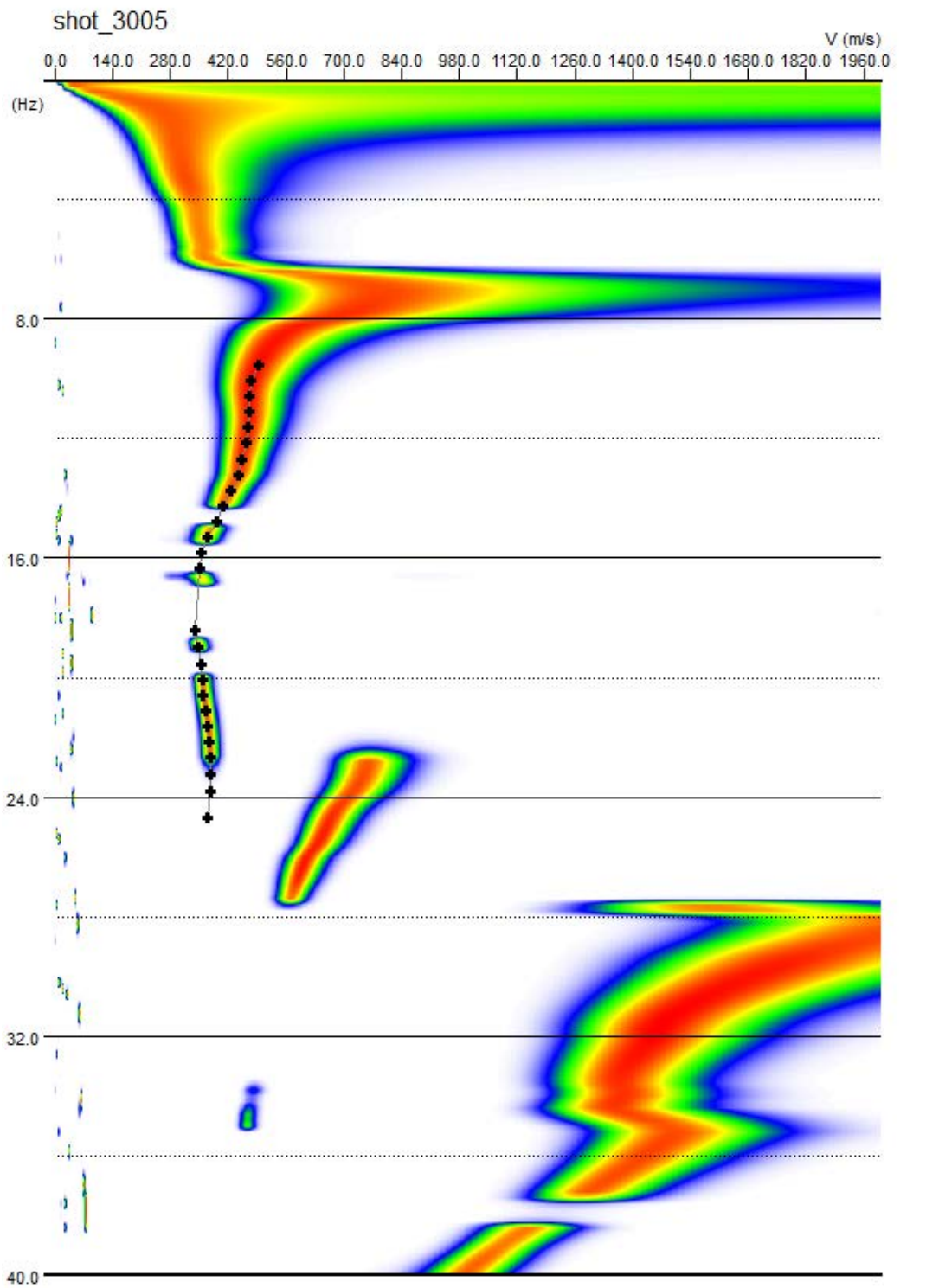

shot_2026
V (m/s)
0.0
140.0
280.0
420.0
560.0
700.0
840.0
980.0
1120.0
1260.0
1400.0
1540.0
1680.0
1820.0
1960.0
0.0
(Hz)
8.0
16.0
24.0
32.0
40.0


10.95 (Hz)

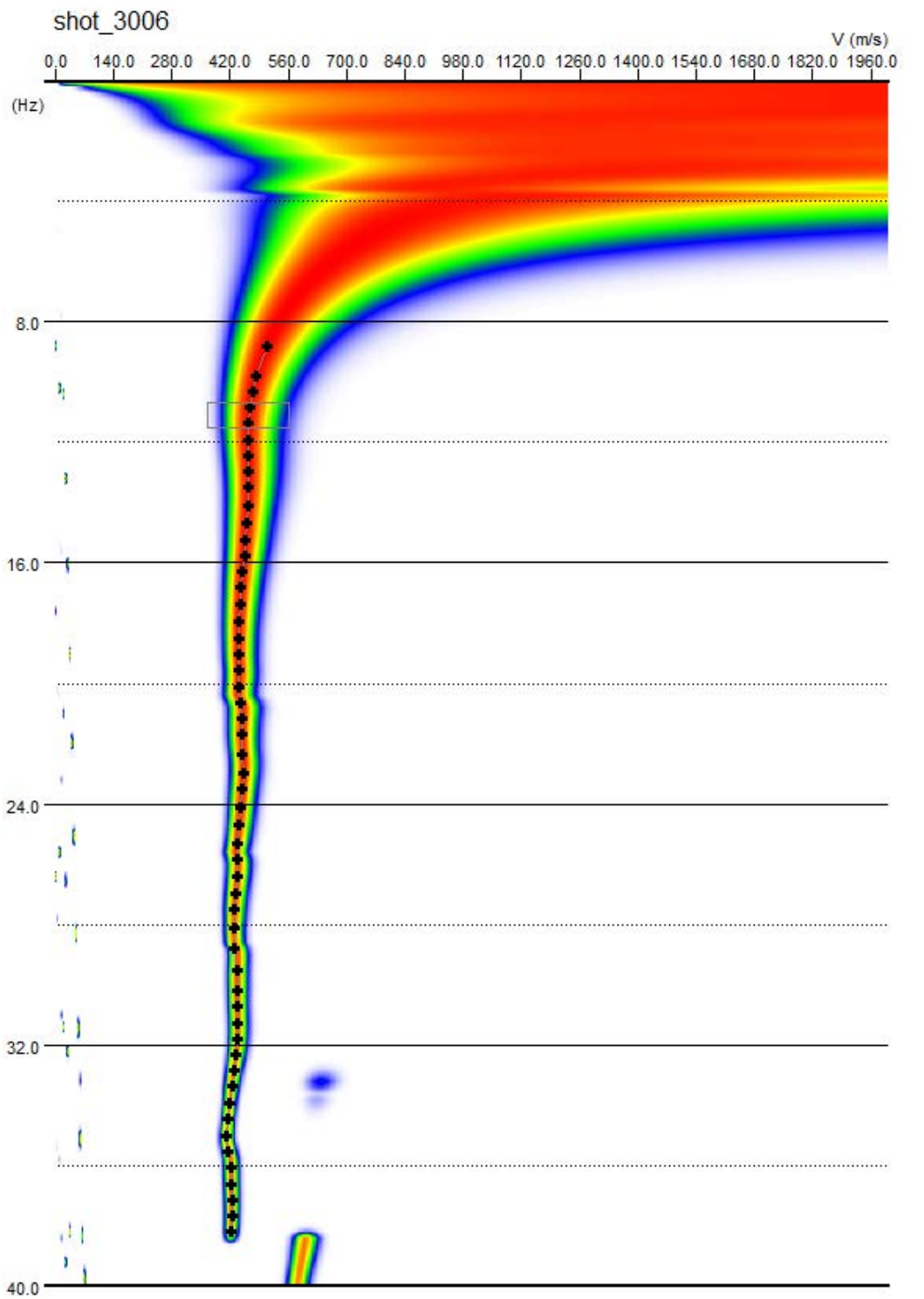

shot_3003
V (m/s)
0.0 140.0 280.0 420.0 560.0 700.0 840.0 980.0 1120.0 1260.0 1400.0 1540.0 1680.0 1820.0 1960.0
(Hz)
8.0
16.0
24.0
32.0
40.0


shot_3004
V (m/s)
0.0 140.0 280.0 420.0 560.0 700.0 840.0 980.0 1120.0 1260.0 1400.0 1540.0 1680.0 1820.0 1960.0
(Hz)
8.0
16.0
24.0
32.0
40.0

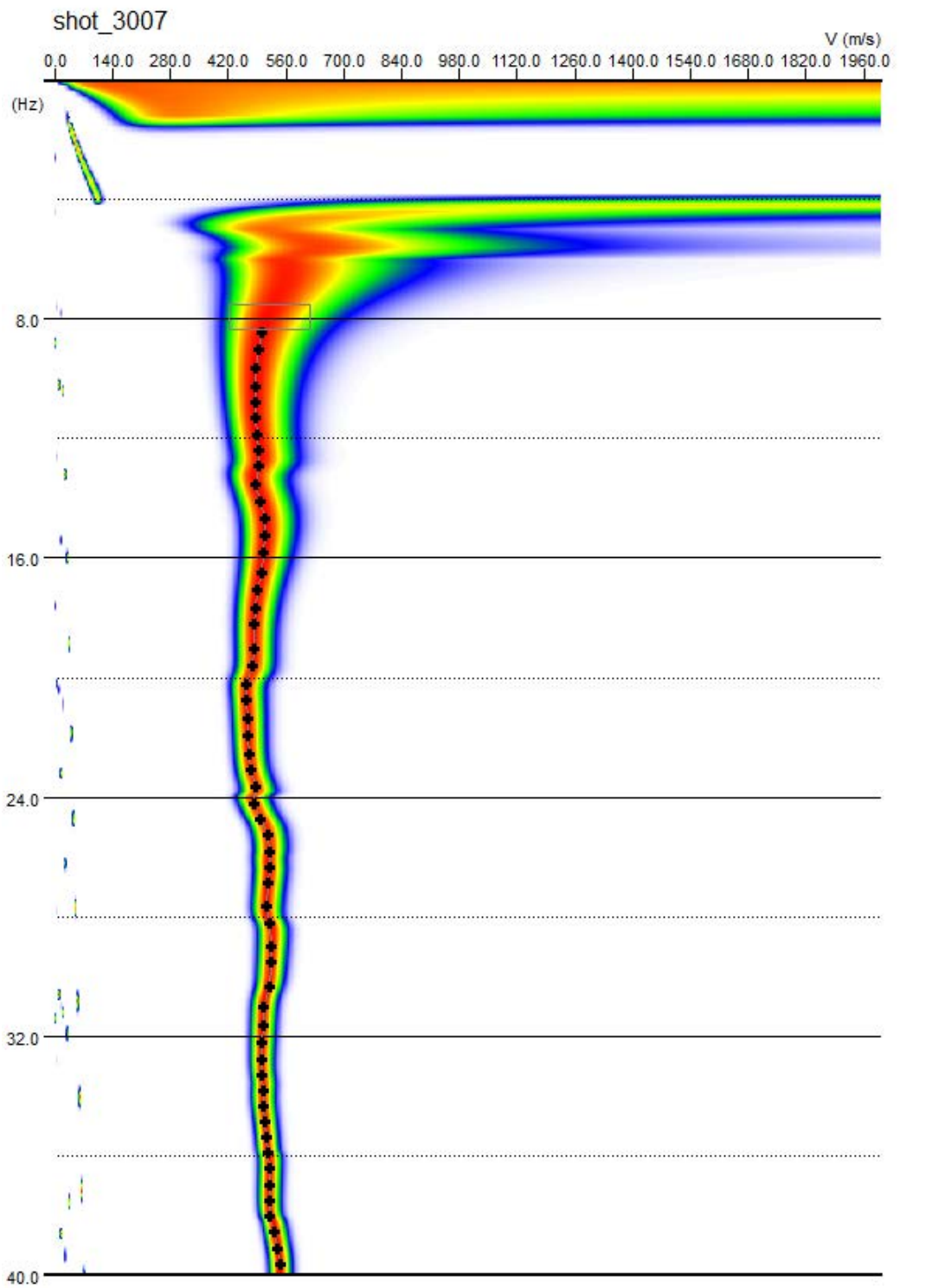


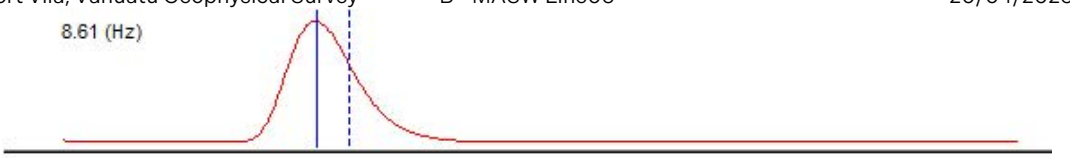

shot_3005
V (m/s)
0.0 140.0 280.0 420.0 560.0 700.0 840.0 980.0 1120.0 1260.0 1400.0 1540.0 1680.0 1820.0 1960.0
(Hz)
8.0
16.0
24.0
32.0
40.0

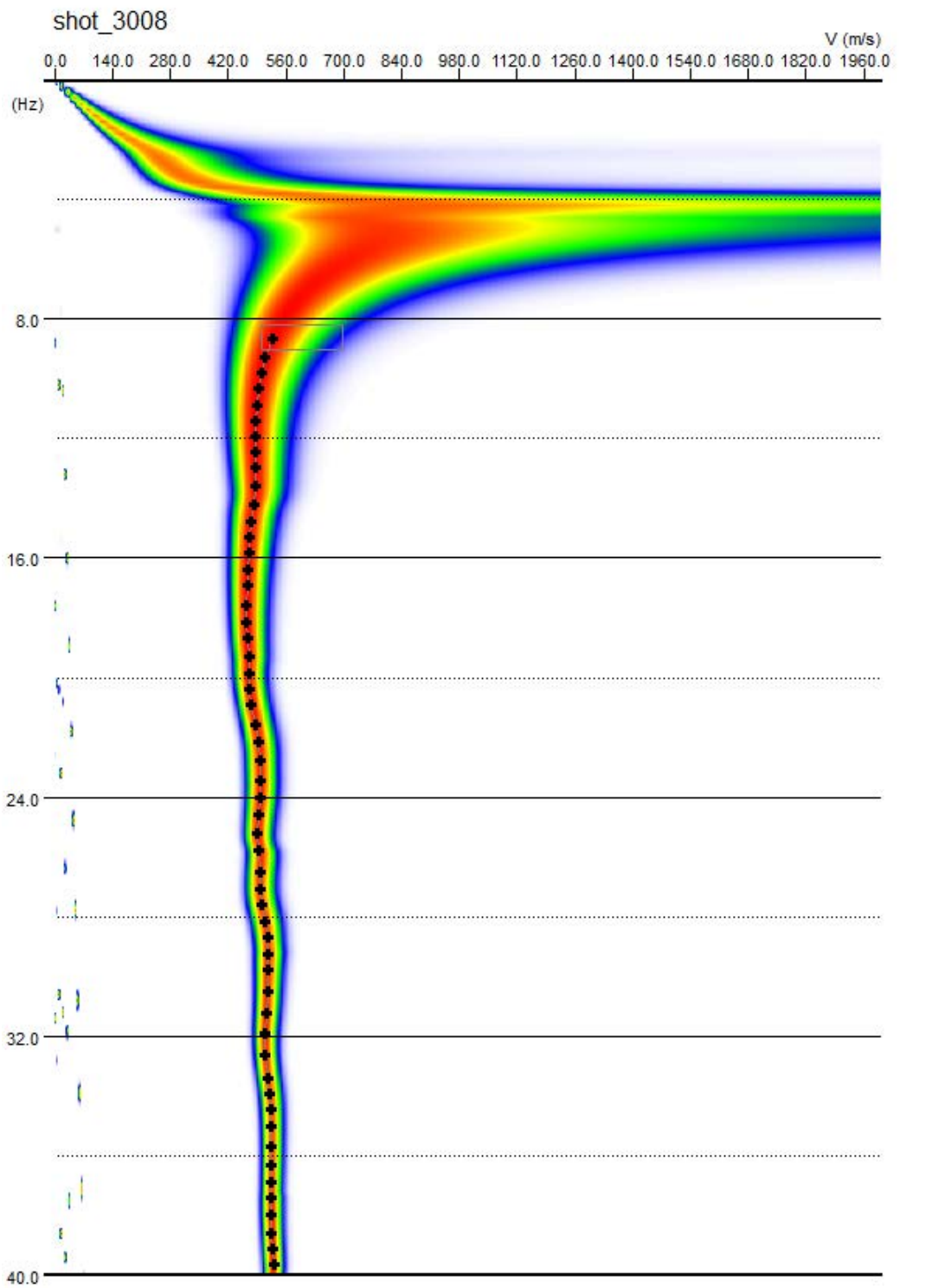

11.10 (Hz)

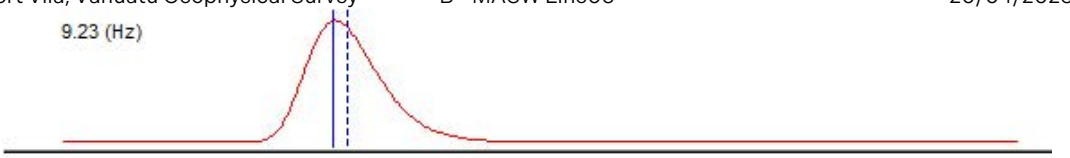

shot_3006
V (m/s)
0.0 140.0 280.0 420.0 560.0 700.0 840.0 980.0 1120.0 1260.0 1400.0 1540.0 1680.0 1820.0 1960.0
(Hz)
8.0
16.0
24.0
32.0
40.0

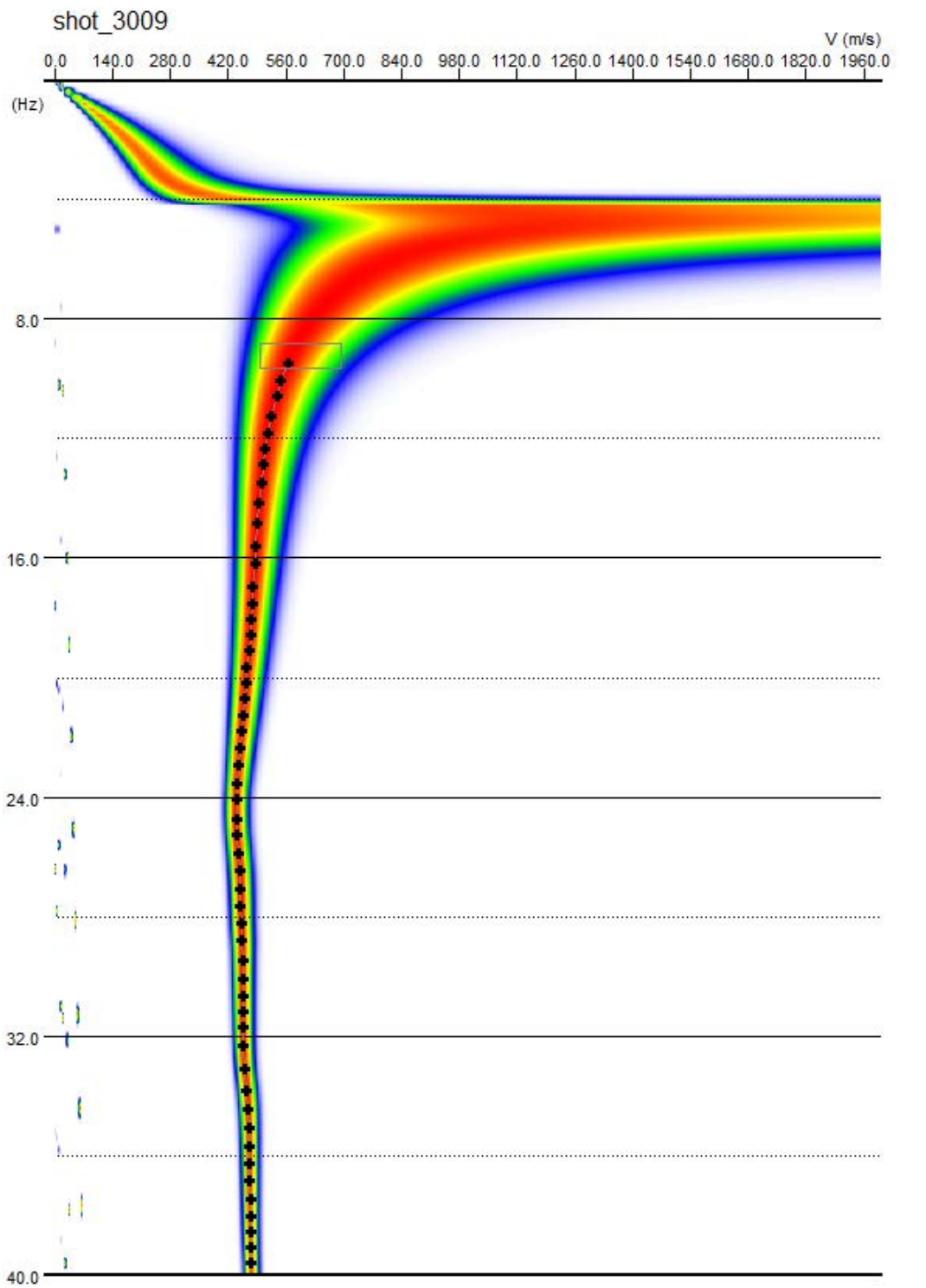

7.94 (Hz)

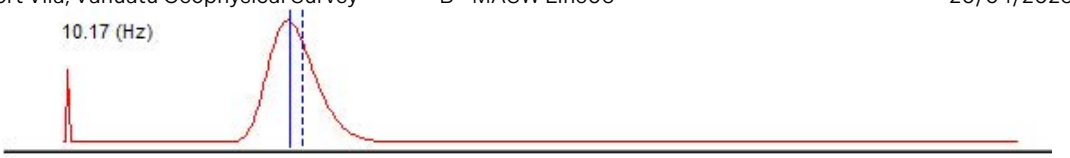

shot_3007
V (m/s)
0.0 140.0 280.0 420.0 560.0 700.0 840.0 980.0 1120.0 1260.0 1400.0 1540.0 1680.0 1820.0 1960.0
(Hz)
8.0
16.0
24.0
32.0
40.0

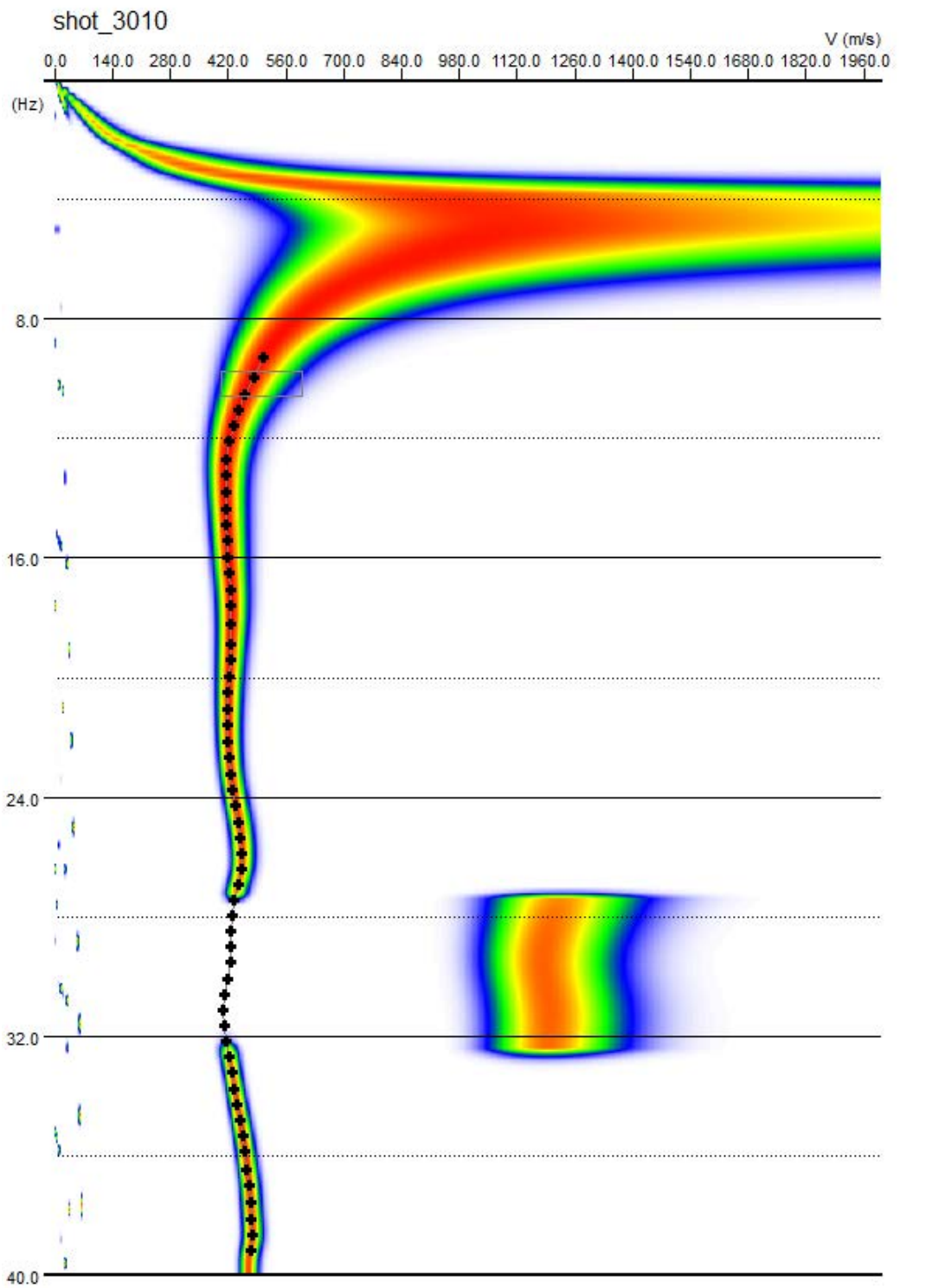

8.61 (Hz)

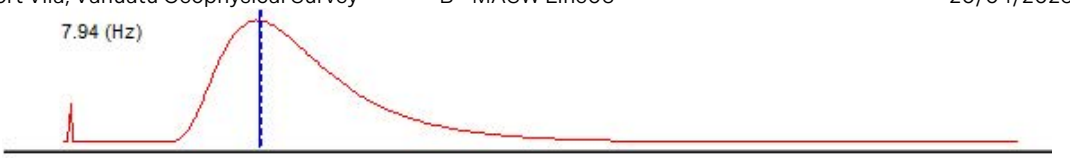

shot_3008
V (m/s)
0.0 140.0 280.0 420.0 560.0 700.0 840.0 980.0 1120.0 1260.0 1400.0 1540.0 1680.0 1820.0 1960.0
(Hz)
8.0
16.0
24.0
32.0
40.0

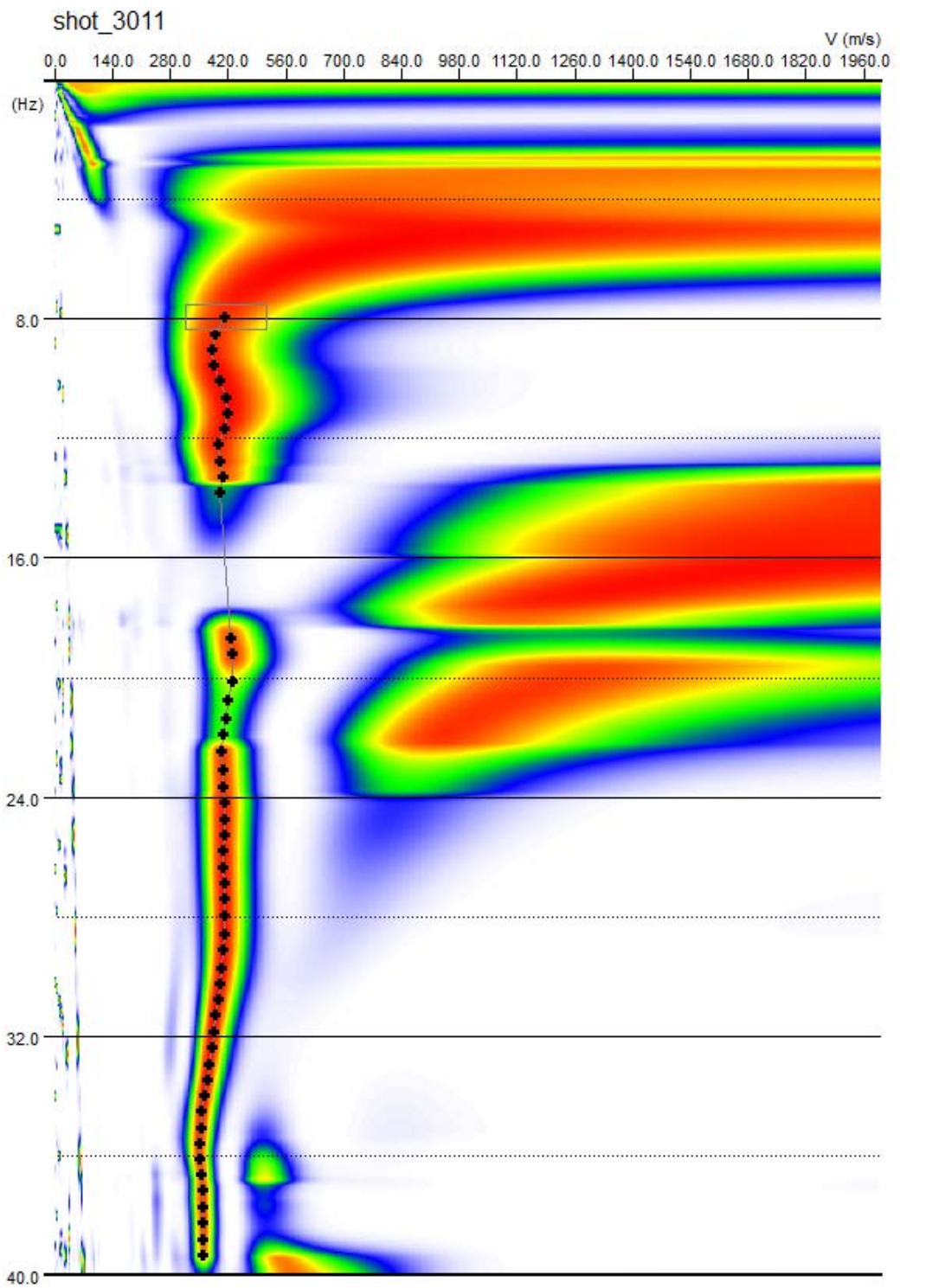

9.23 (Hz)


shot_3009
V (m/s)
0.0 140.0 280.0 420.0 560.0 700.0 840.0 980.0 1120.0 1260.0 1400.0 1540.0 1680.0 1820.0 1960.0
(Hz)
8.0
16.0
24.0
32.0
40.0

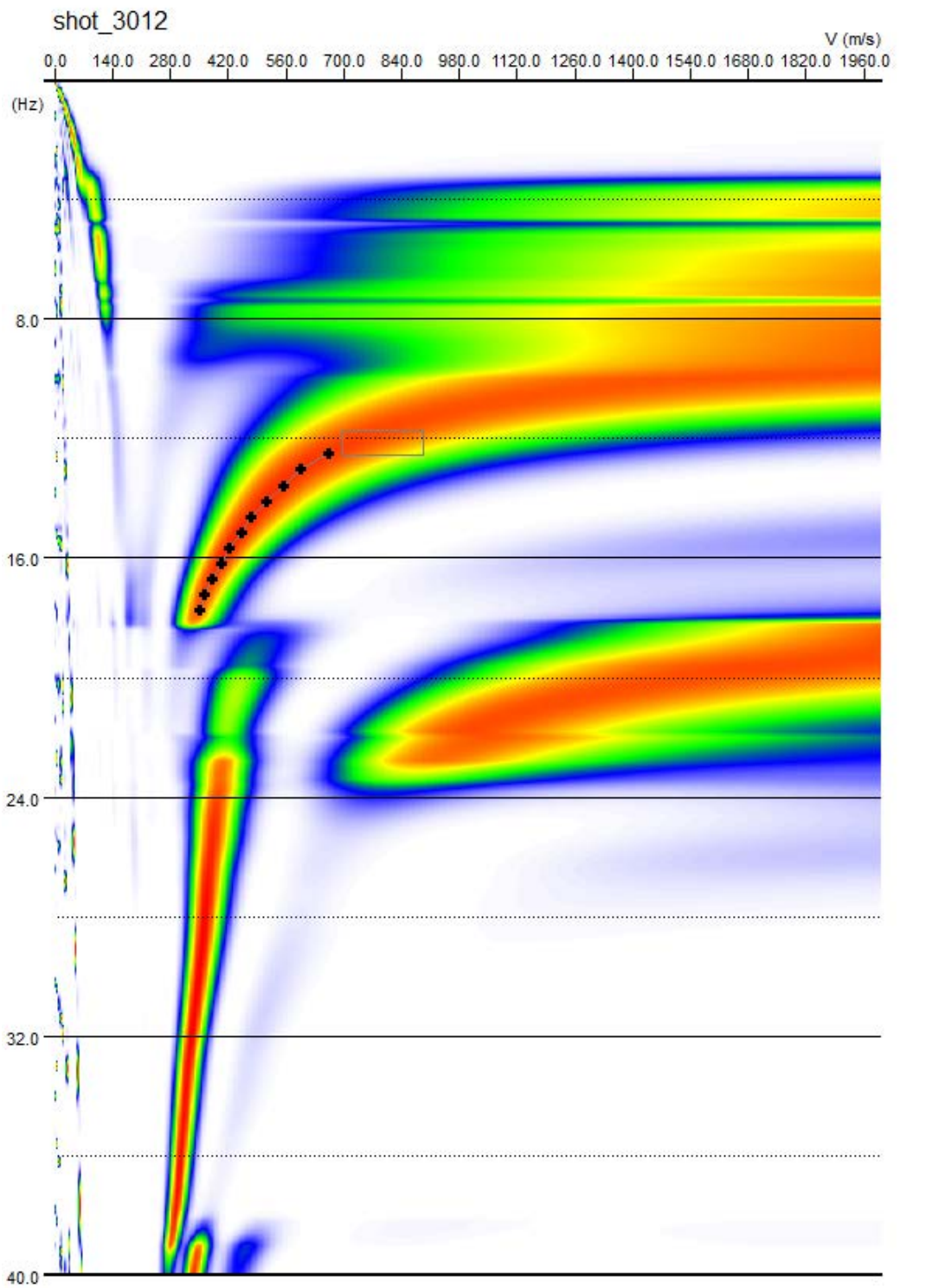

10.17 (Hz)

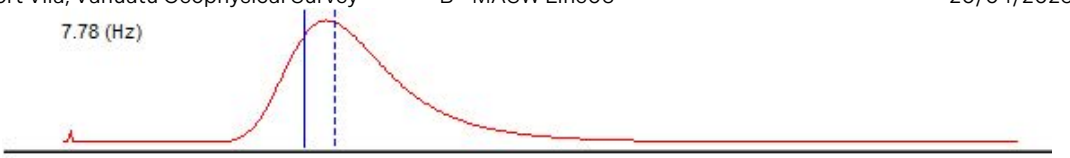

shot_3010
V (m/s)
0.0 140.0 280.0 420.0 560.0 700.0 840.0 980.0 1120.0 1260.0 1400.0 1540.0 1680.0 1820.0 1960.0
(Hz)
8.0
16.0
24.0
32.0
40.0

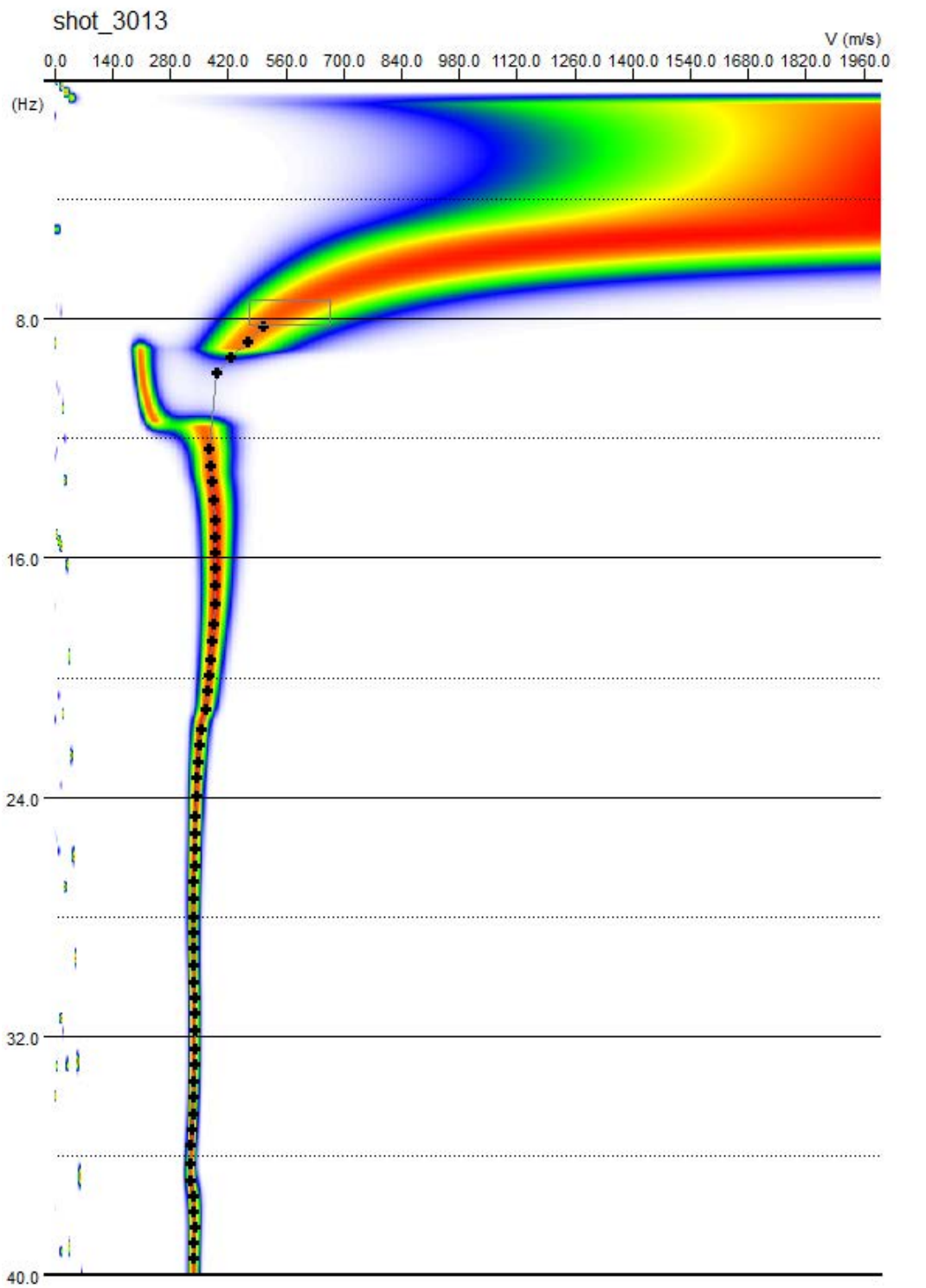

7.94 (Hz)

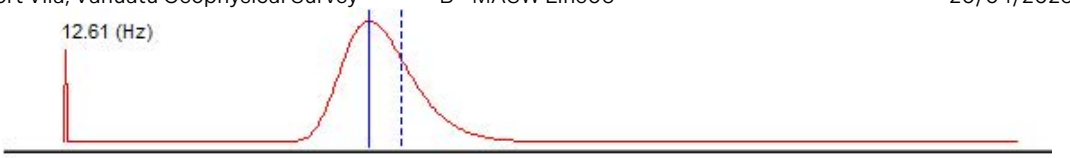

shot_3011
V (m/s)
0.0 140.0 280.0 420.0 560.0 700.0 840.0 980.0 1120.0 1260.0 1400.0 1540.0 1680.0 1820.0 1960.0
(Hz)
8.0
16.0
24.0
32.0
40.0

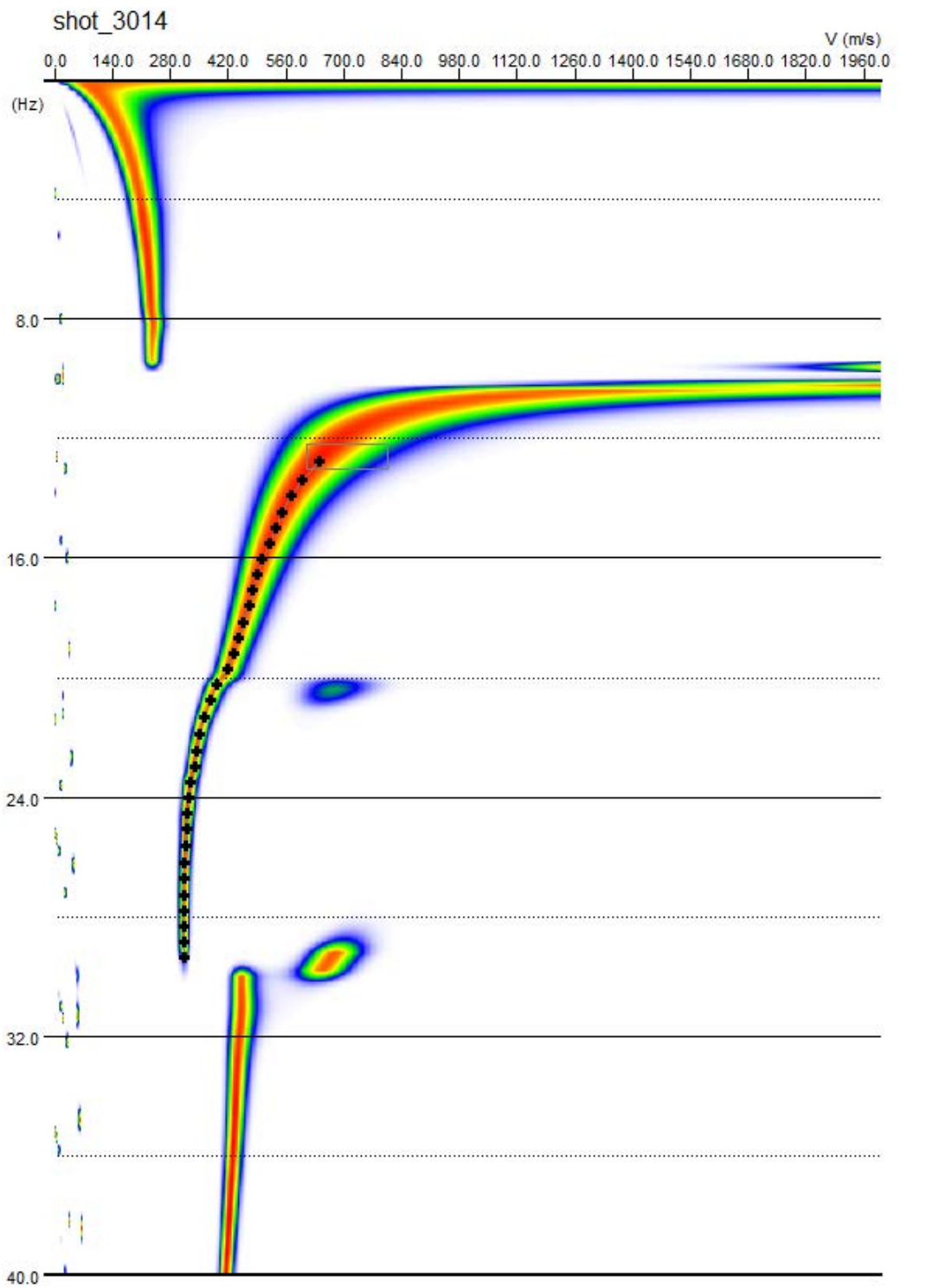

12.14 (Hz)


shot_3012
V (m/s)
0.0 140.0 280.0 420.0 560.0 700.0 840.0 980.0 1120.0 1260.0 1400.0 1540.0 1680.0 1820.0 1960.0
(Hz)
8.0
16.0
24.0
32.0
40.0

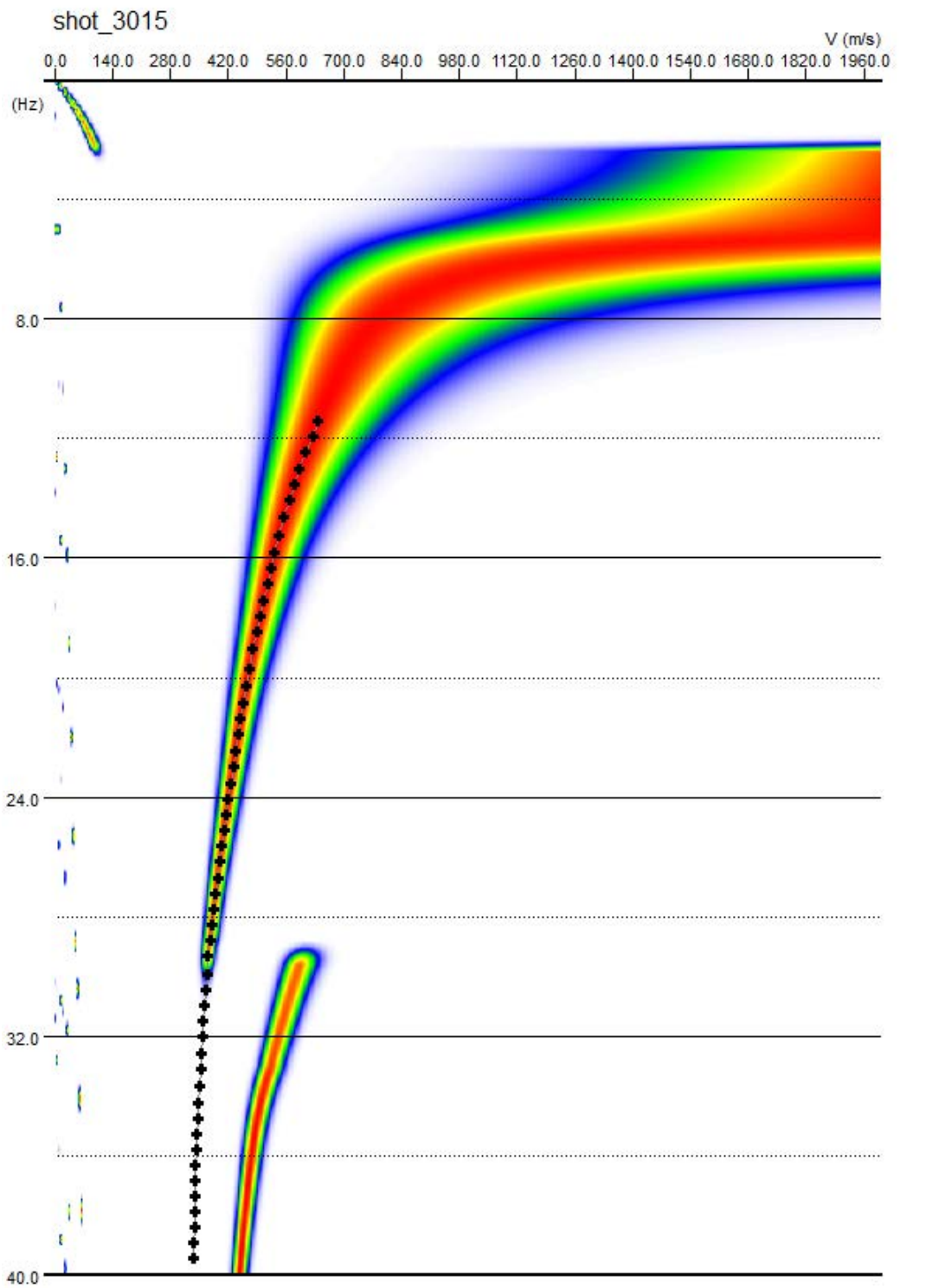

7.78 (Hz)

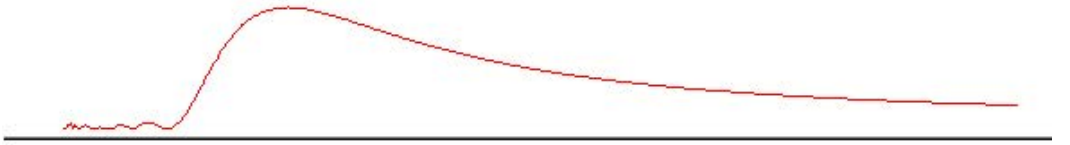

shot_3013
V (m/s)
0.0 140.0 280.0 420.0 560.0 700.0 840.0 980.0 1120.0 1260.0 1400.0 1540.0 1680.0 1820.0 1960.0
(Hz)
8.0
16.0
24.0
32.0
40.0

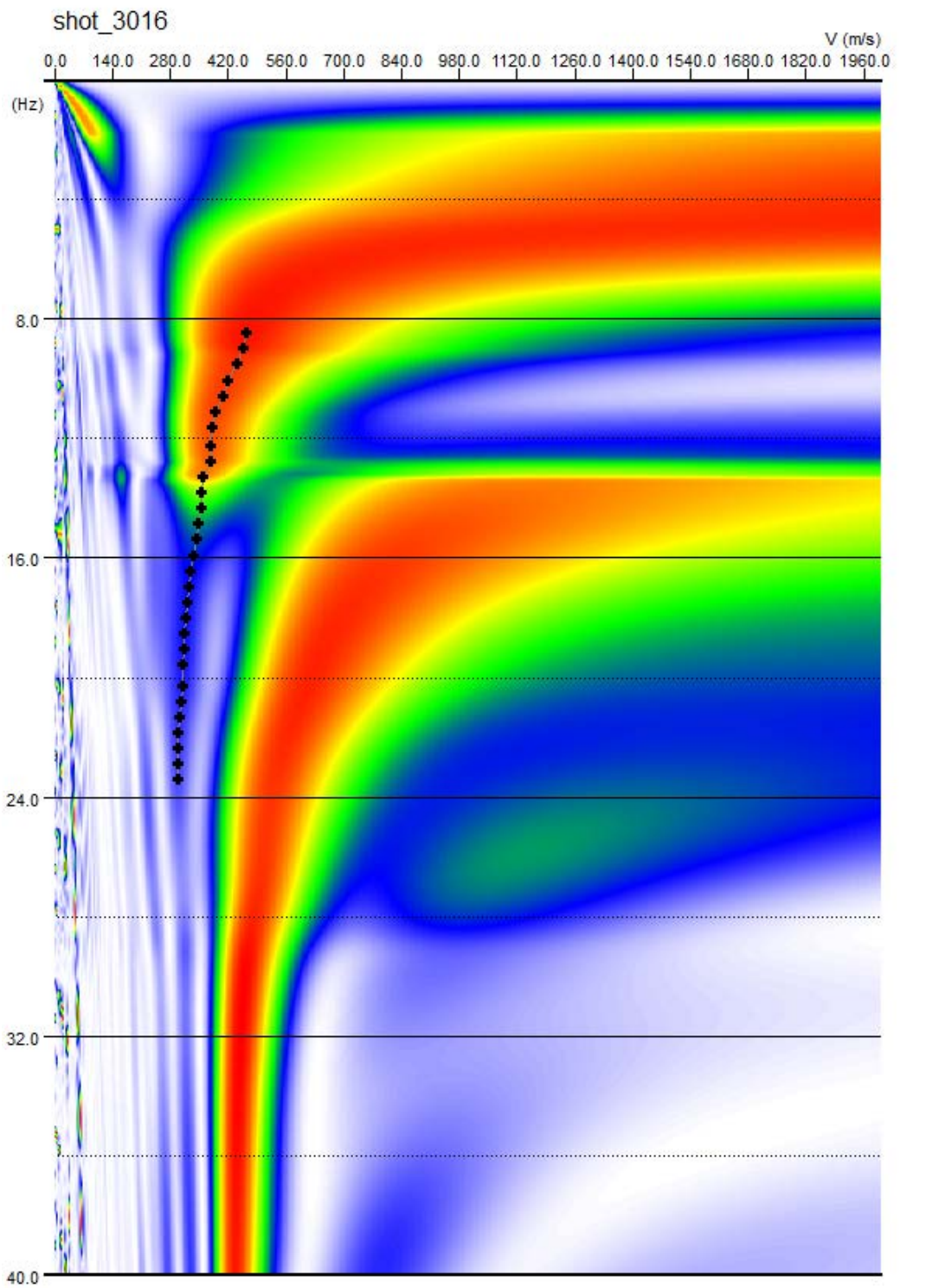

12.61 (Hz)

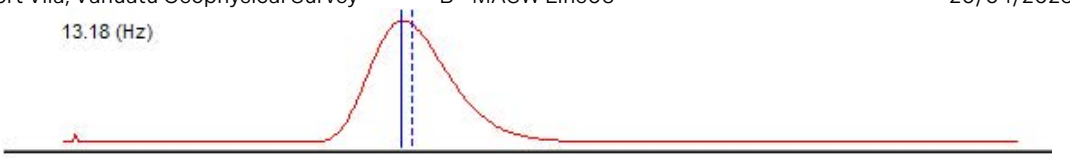

shot_3014
V (m/s)
0.0 140.0 280.0 420.0 560.0 700.0 840.0 980.0 1120.0 1260.0 1400.0 1540.0 1680.0 1820.0 1960.0
(Hz)
8.0
16.0
24.0
32.0
40.0

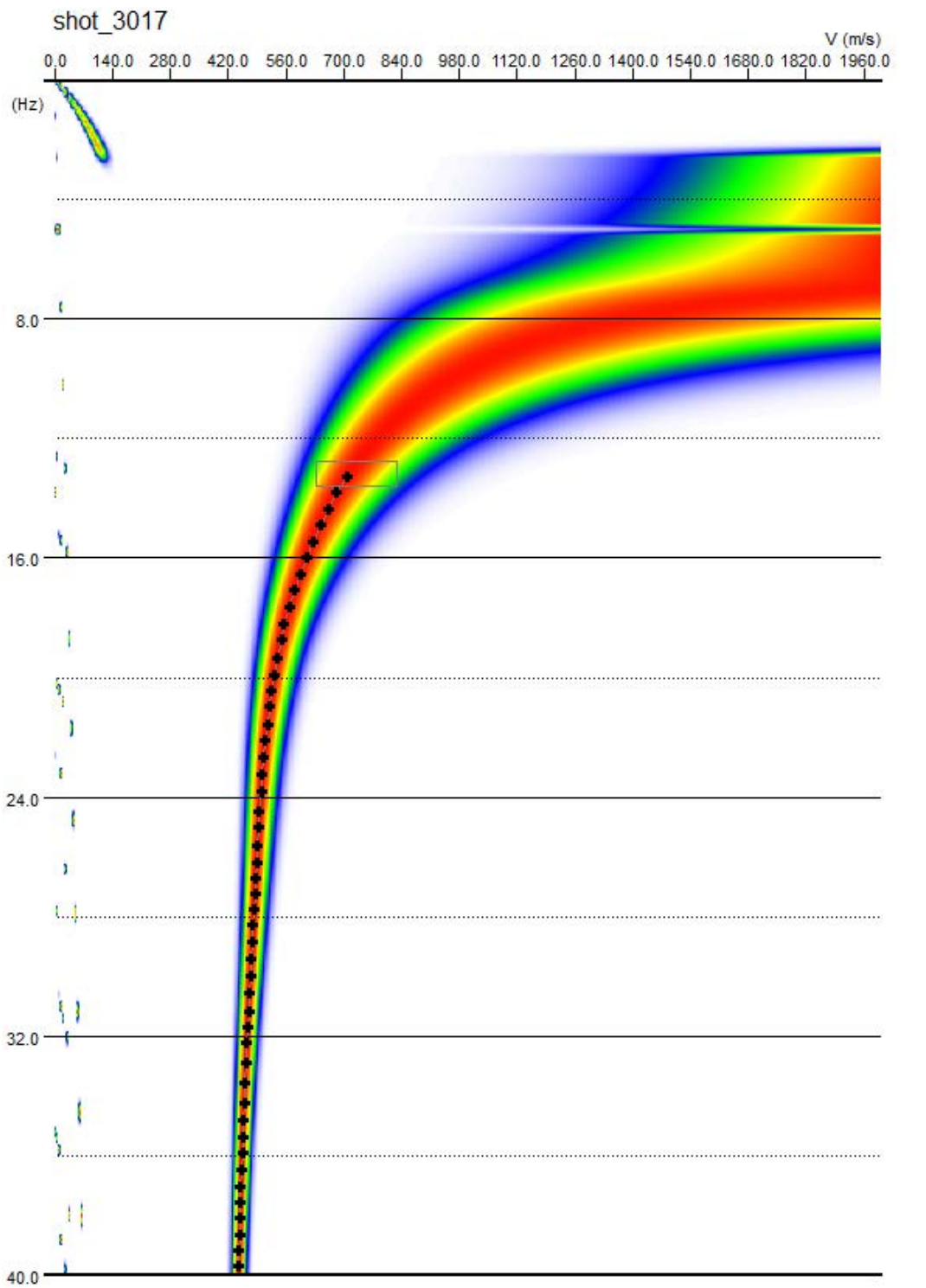


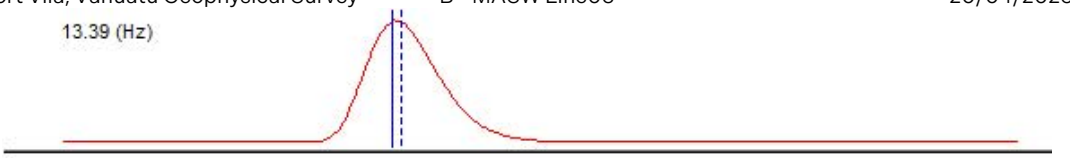

shot_3015
V (m/s)
0.0 140.0 280.0 420.0 560.0 700.0 840.0 980.0 1120.0 1260.0 1400.0 1540.0 1680.0 1820.0 1960.0
(Hz)
8.0
16.0
24.0
32.0
40.0

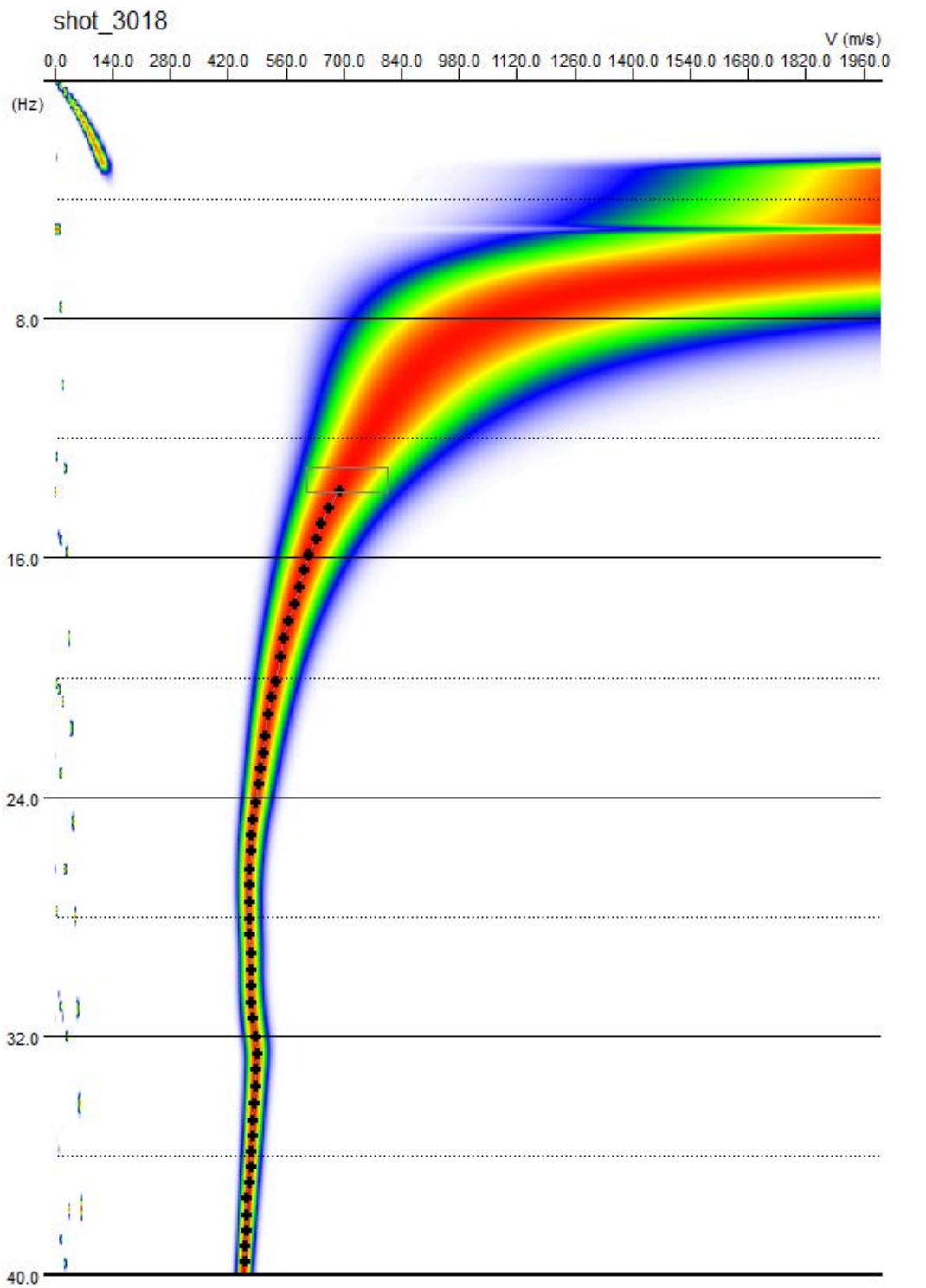



shot_3016
V (m/s)
0.0
140.0
280.0
420.0
560.0
700.0
840.0
980.0
1120.0
1260.0
1400.0
1540.0
1680.0
1820.0
1960.0
(Hz)
8.0
16.0
24.0
32.0
40.0

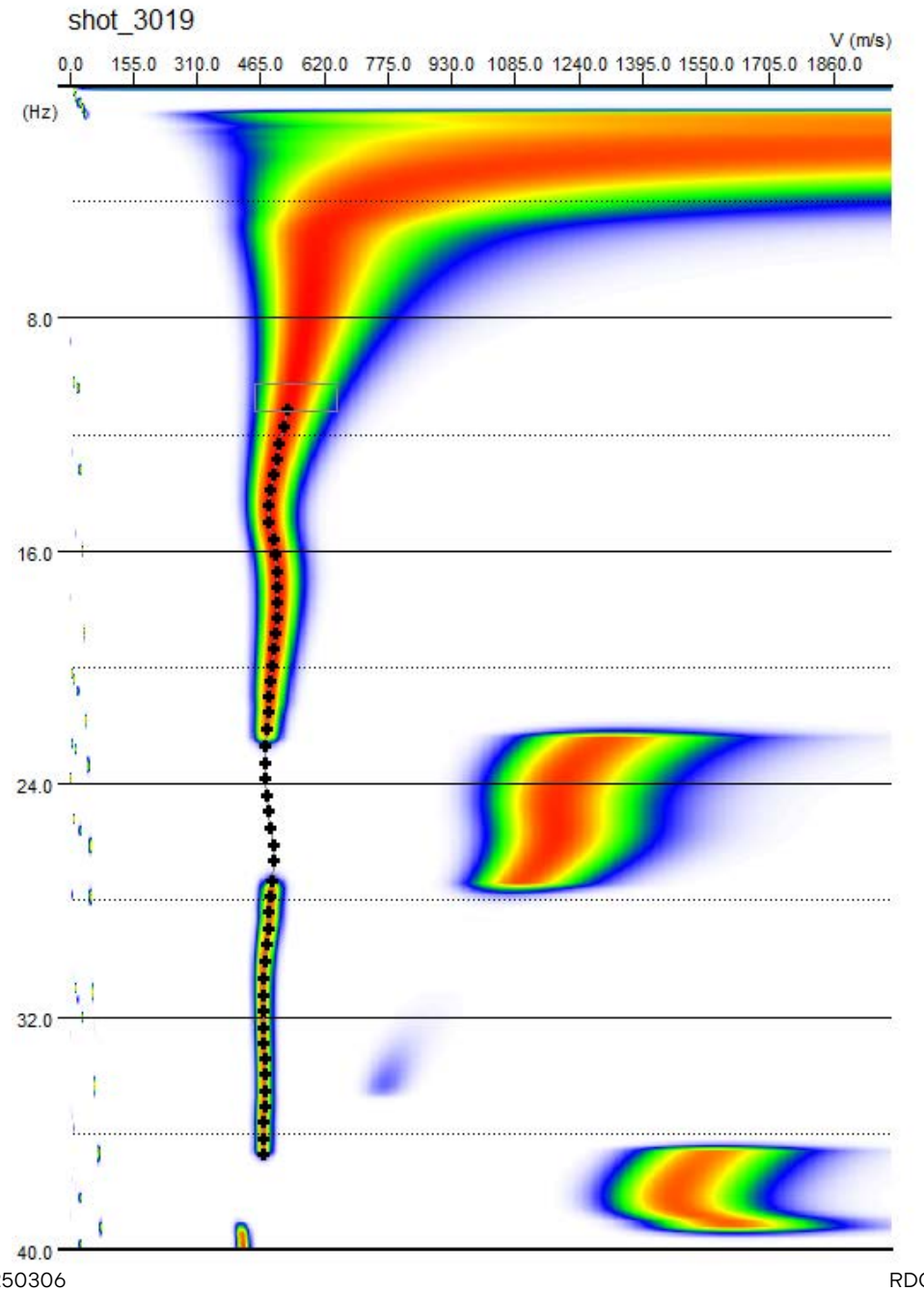

13.18 (Hz)

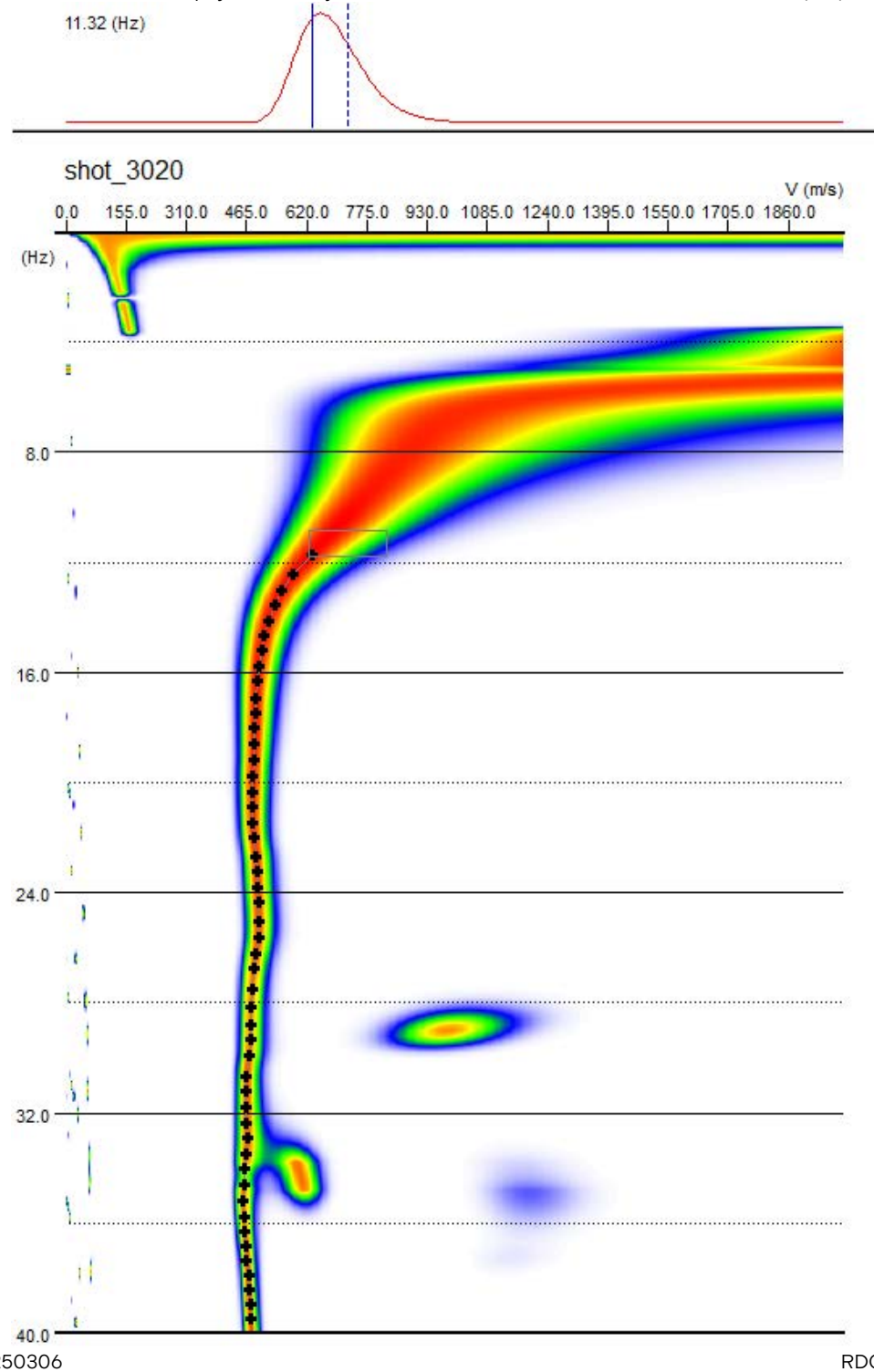

shot_3017
V (m/s)
0.0 140.0 280.0 420.0 560.0 700.0 840.0 980.0 1120.0 1260.0 1400.0 1540.0 1680.0 1820.0 1960.0
(Hz)
8.0
16.0
24.0
32.0
40.0

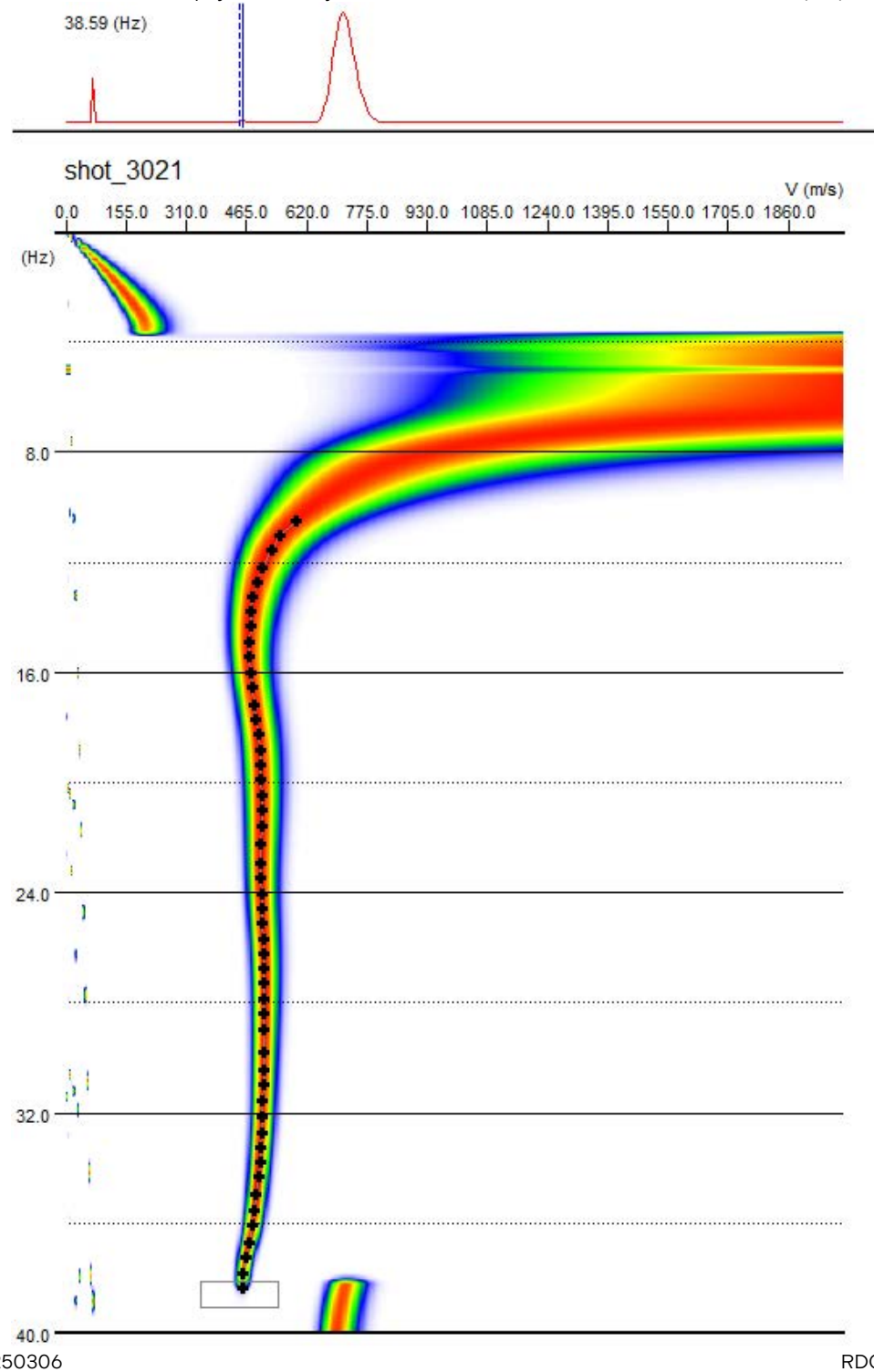

13.39 (Hz)

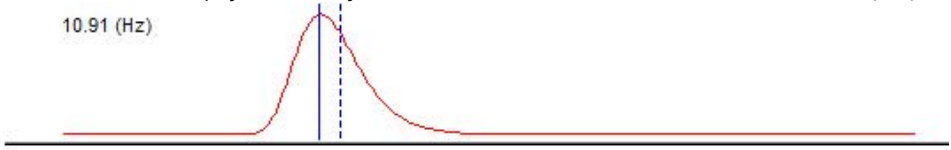

shot_3018
V (m/s)
0.0 140.0 280.0 420.0 560.0 700.0 840.0 980.0 1120.0 1260.0 1400.0 1540.0 1680.0 1820.0 1960.0
(Hz)
8.0
16.0
24.0
32.0
40.0

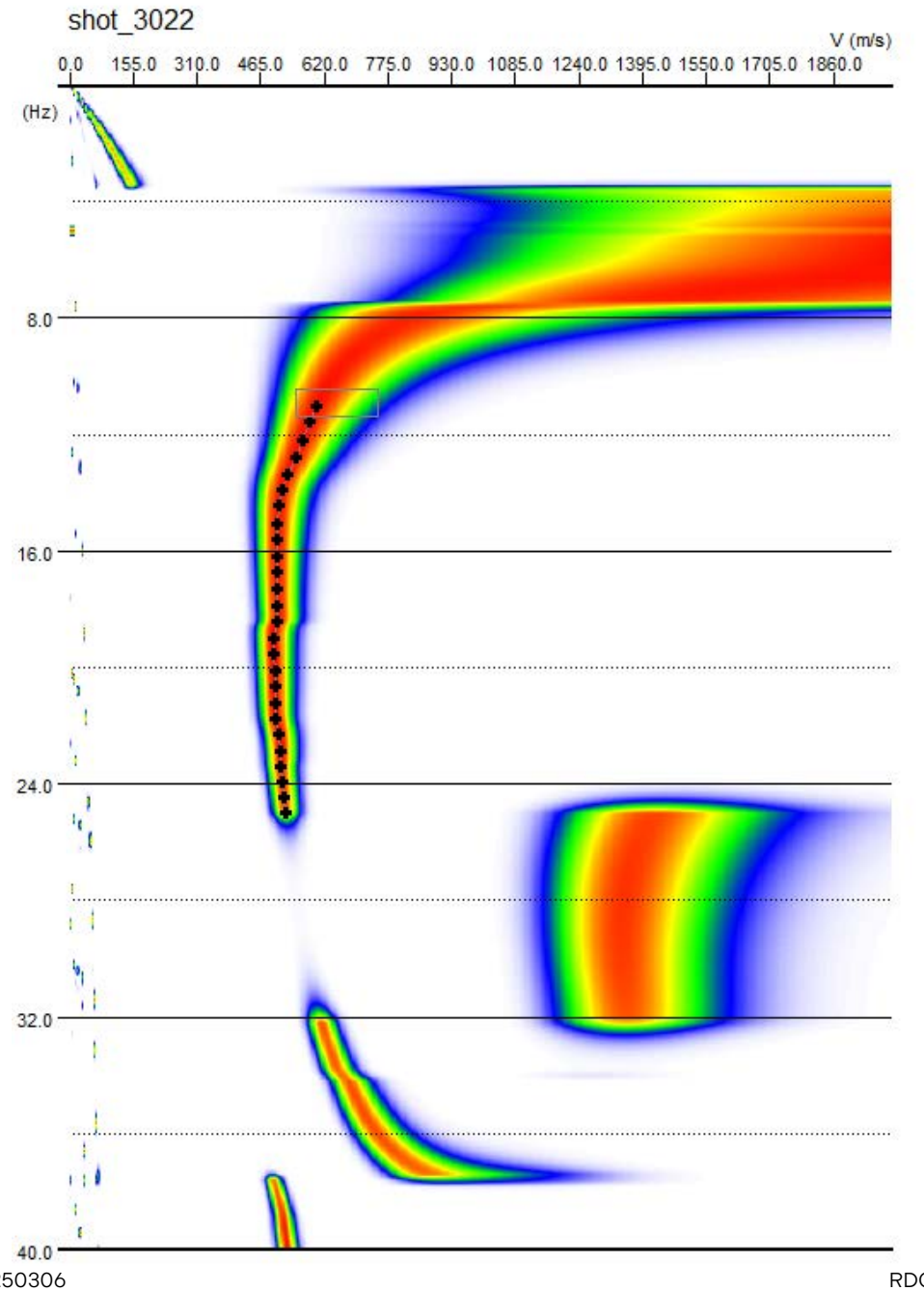

10.73 (Hz)

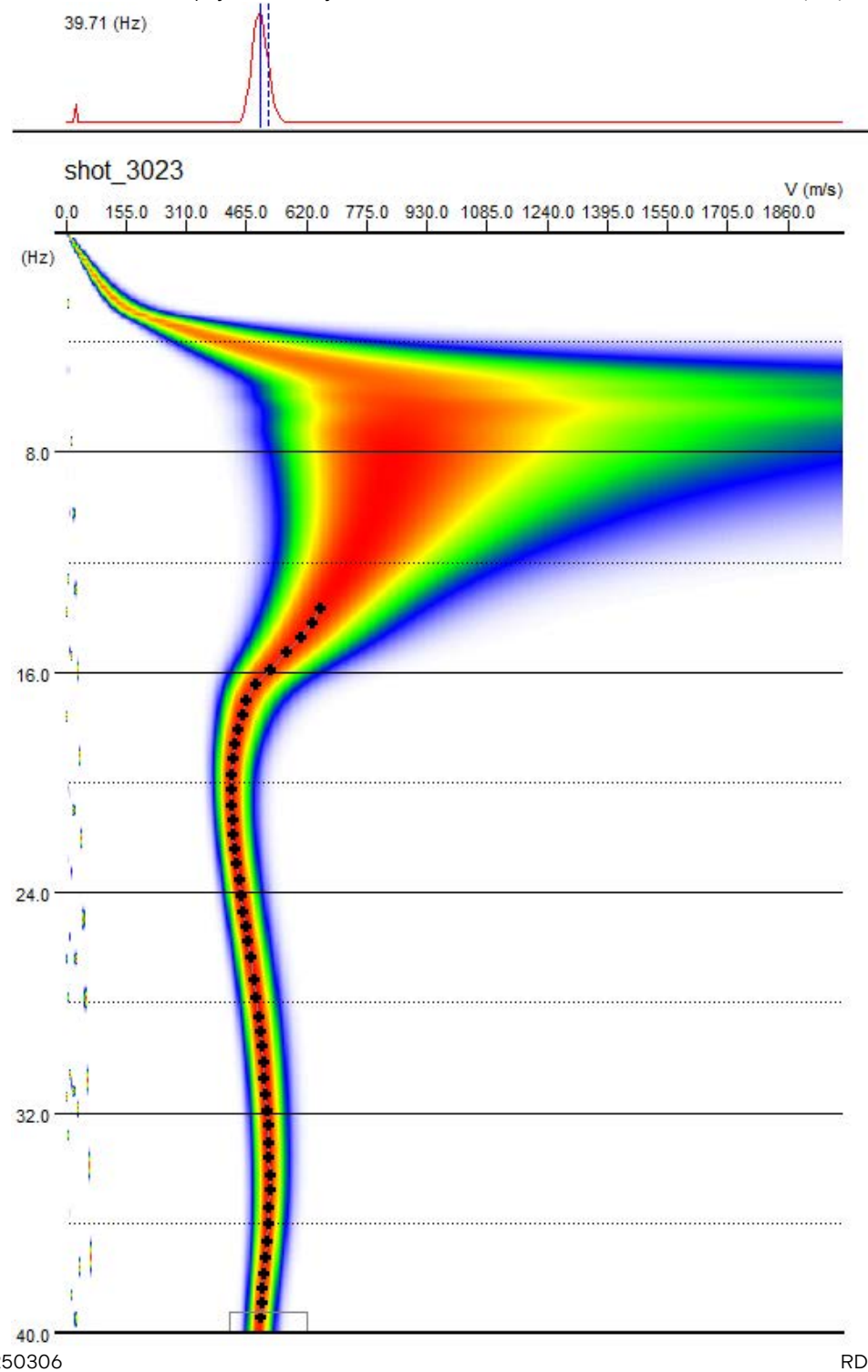

shot_3019
V (m/s)
0.0
155.0
310.0
465.0
620.0
775.0
930.0
1085.0
1240.0
1395.0
1550.0
1705.0
1860.0
(Hz)
8.0
16.0
24.0
32.0
40.0


11.32 (Hz)
shot_3020
V (m/s)
0.0 155.0 310.0 465.0 620.0 775.0 930.0 1085.0 1240.0 1395.0 1550.0 1705.0 1860.0
(Hz)
8.0
16.0
24.0
32.0
40.0

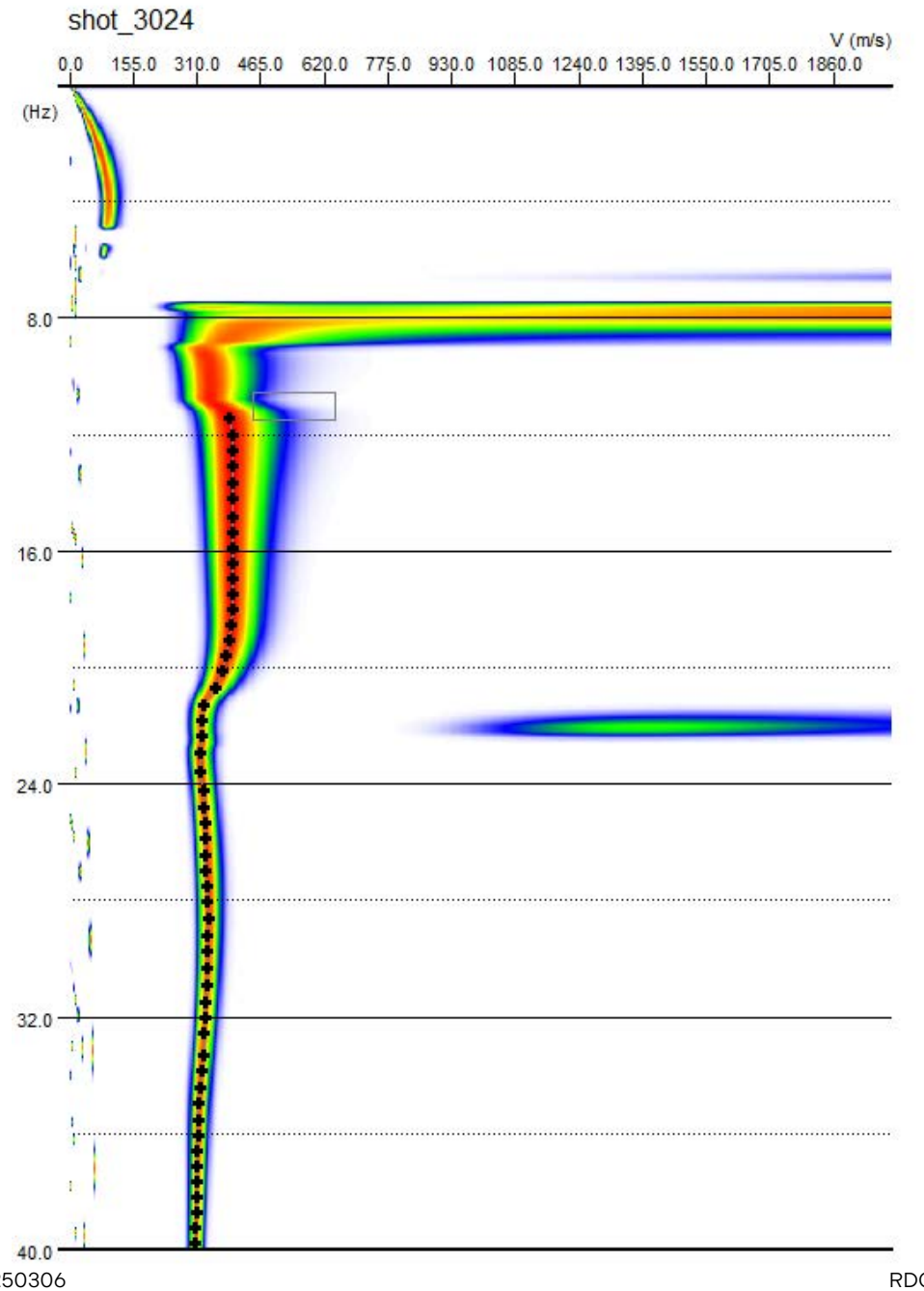

38.59 (Hz)
shot_3021
V (m/s)
0.0 155.0 310.0 465.0 620.0 775.0 930.0 1085.0 1240.0 1395.0 1550.0 1705.0 1860.0
(Hz)
8.0
16.0
24.0
32.0
40.0

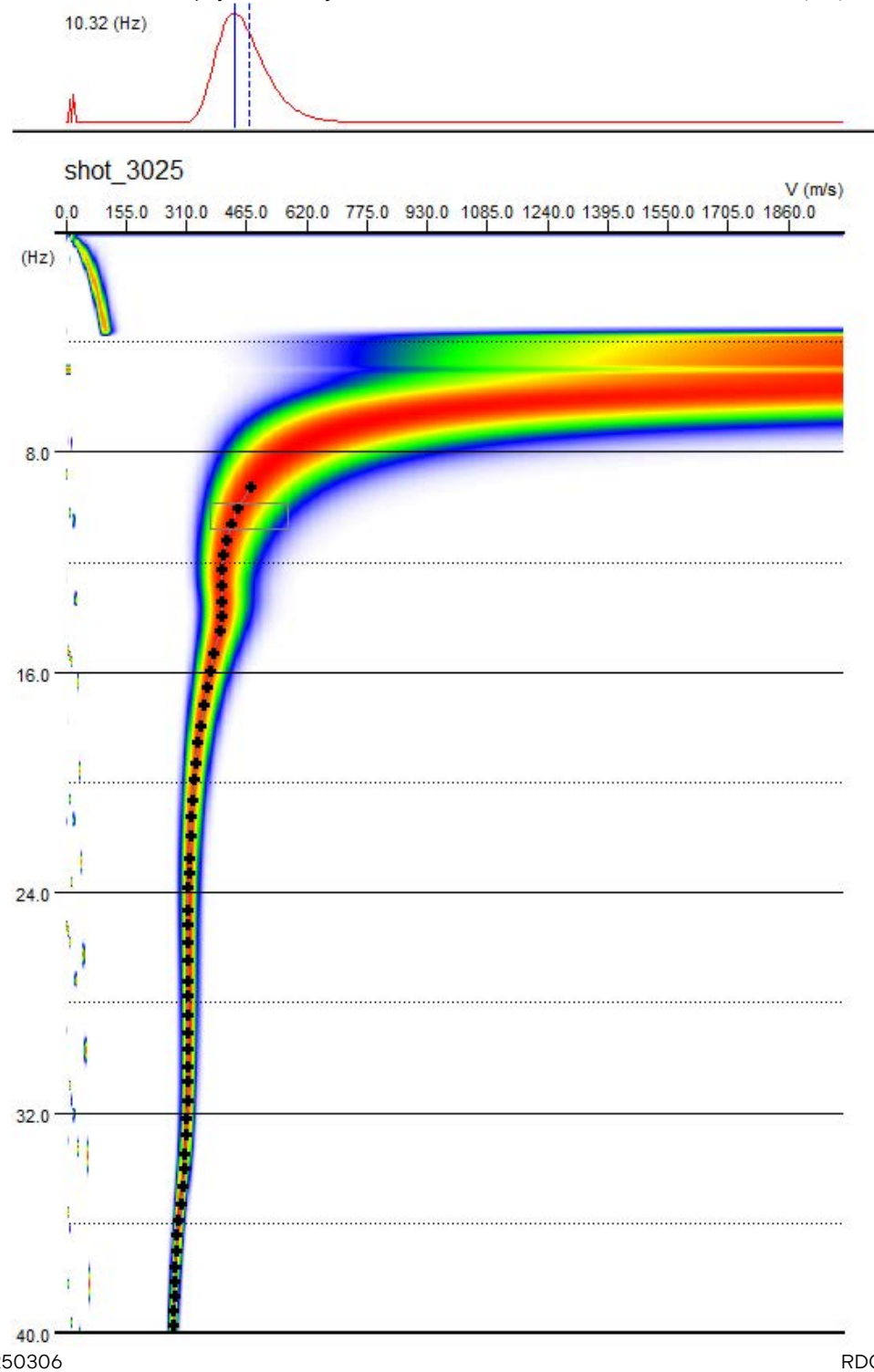

10.91 (Hz)


shot_3022
V (m/s)
0.0 155.0 310.0 465.0 620.0 775.0 930.0 1085.0 1240.0 1395.0 1550.0 1705.0 1860.0
(Hz)
8.0
16.0
24.0
32.0
40.0

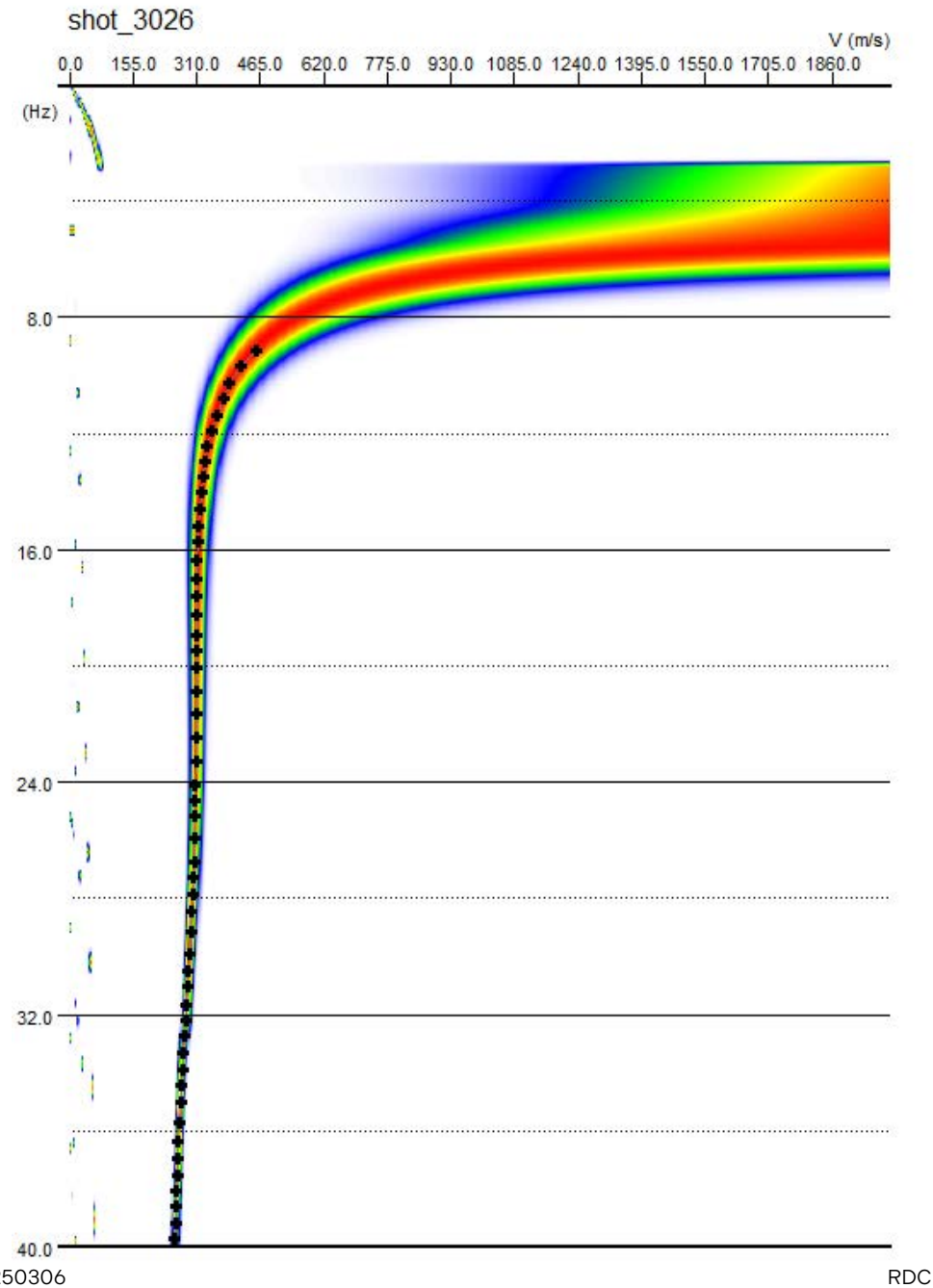

39.71 (Hz)
shot_3023
V (m/s)
0.0 155.0 310.0 465.0 620.0 775.0 930.0 1085.0 1240.0 1395.0 1550.0 1705.0 1860.0
(Hz)
8.0
16.0
24.0
32.0
40.0

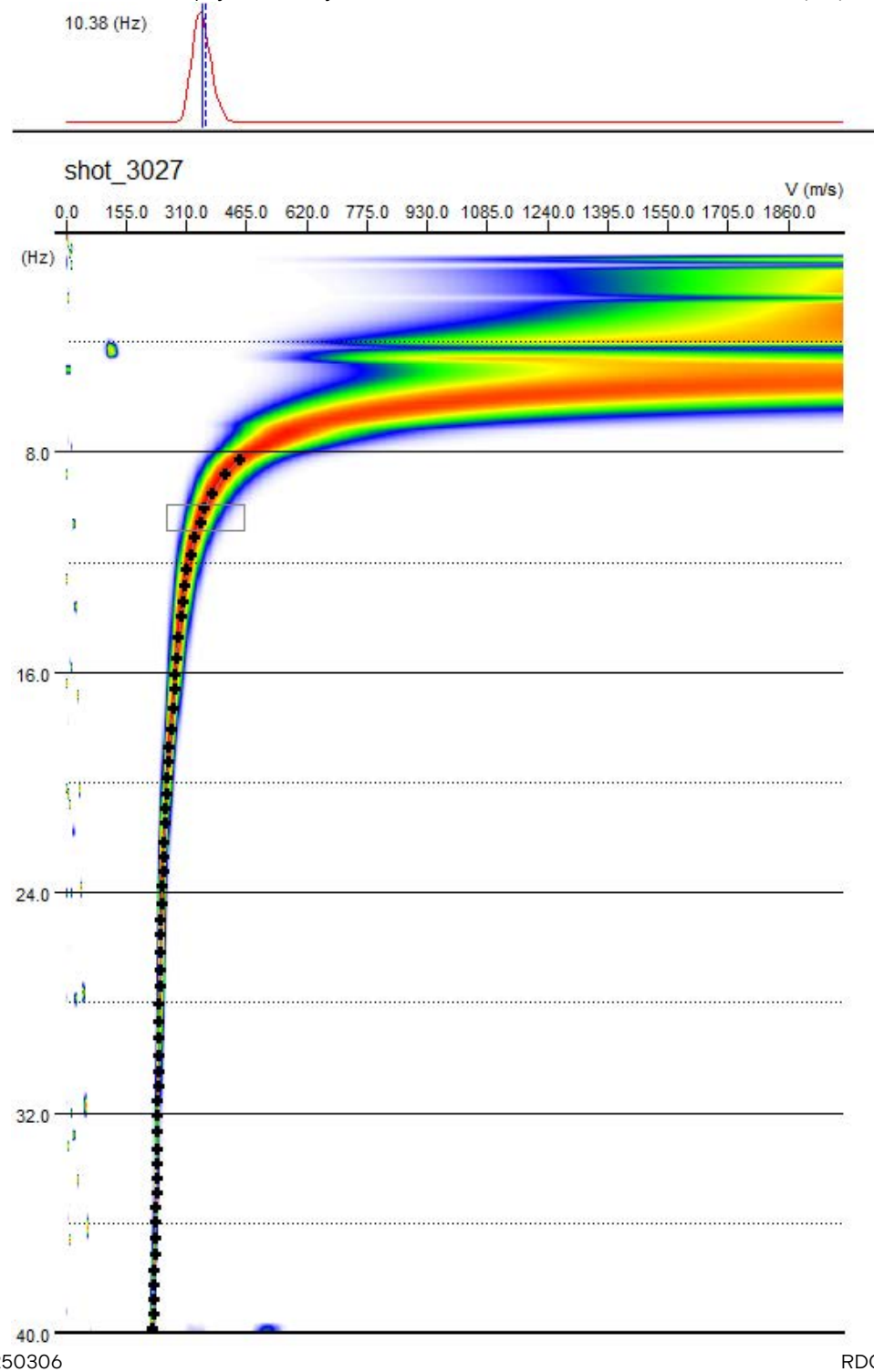

11.03 (Hz)


shot_3024
V (m/s)
0.0 155.0 310.0 465.0 620.0 775.0 930.0 1085.0 1240.0 1395.0 1550.0 1705.0 1860.0
(Hz)
8.0
16.0
24.0
32.0
40.0

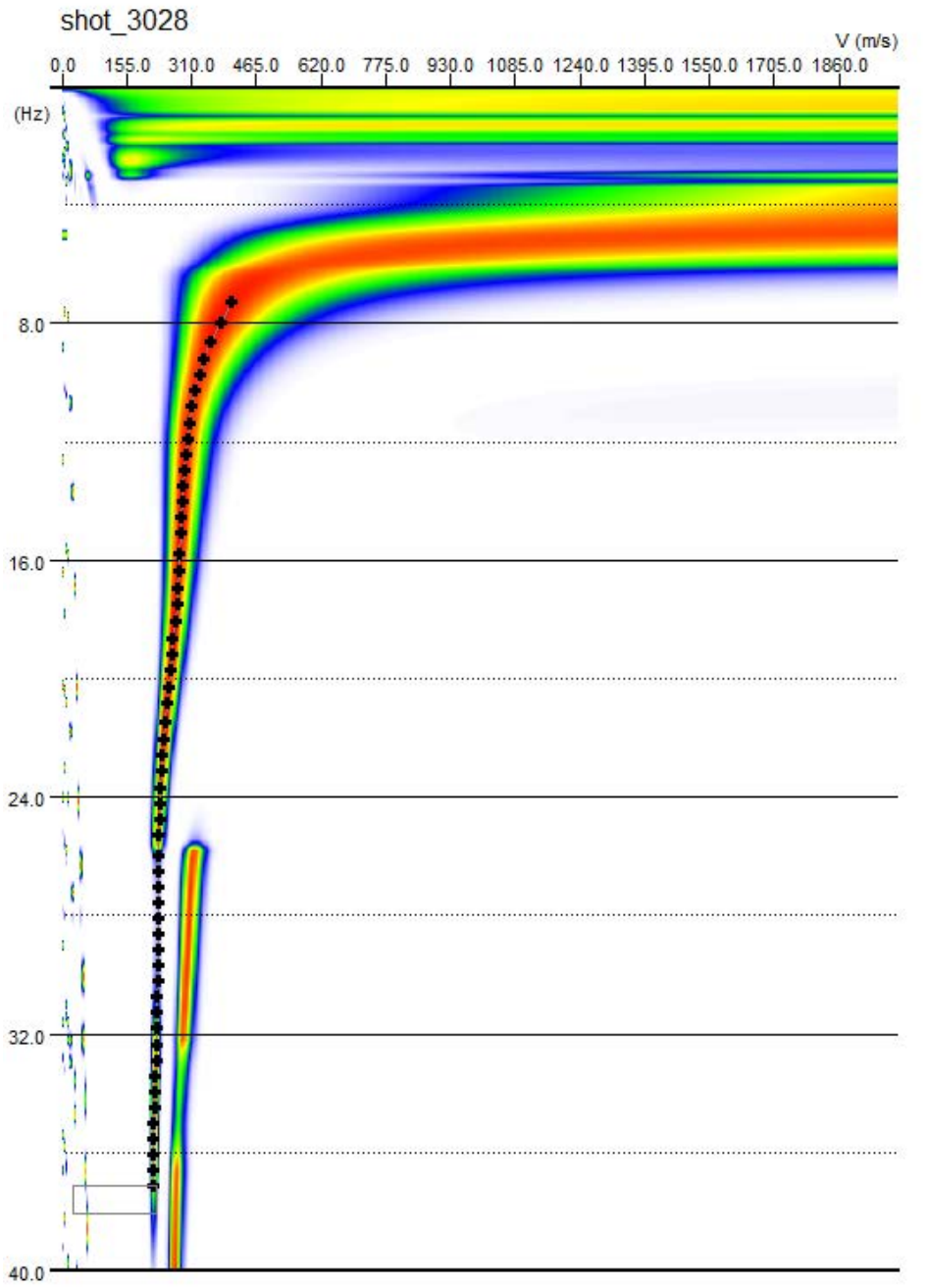

10.32 (Hz)
shot_3025
V (m/s)
0.0 155.0 310.0 465.0 620.0 775.0 930.0 1085.0 1240.0 1395.0 1550.0 1705.0 1860.0
(Hz)
8.0
16.0
24.0
32.0
40.0



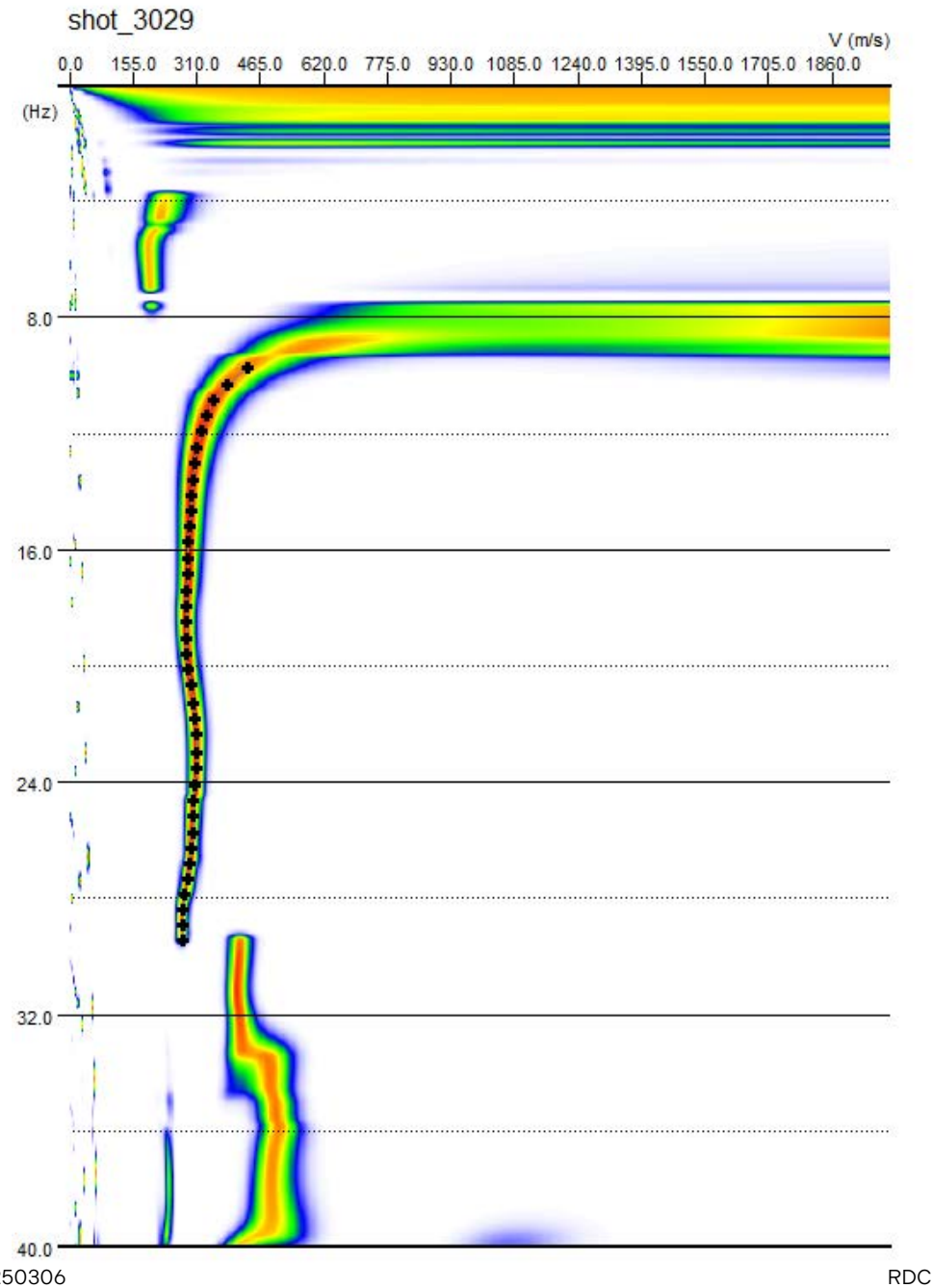

shot_3026
V (m/s)
0.0
155.0
310.0
465.0
620.0
775.0
930.0
1085.0
1240.0
1395.0
1550.0
1705.0
1860.0
(Hz)
8.0
16.0
24.0
32.0
40.0

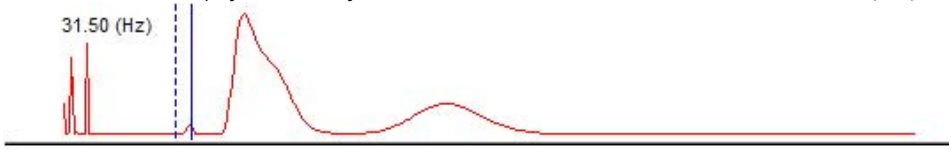

10.38 (Hz)
shot_3027
V (m/s)
0.0 155.0 310.0 465.0 620.0 775.0 930.0 1085.0 1240.0 1395.0 1550.0 1705.0 1860.0
(Hz)
8.0
16.0
24.0
32.0
40.0

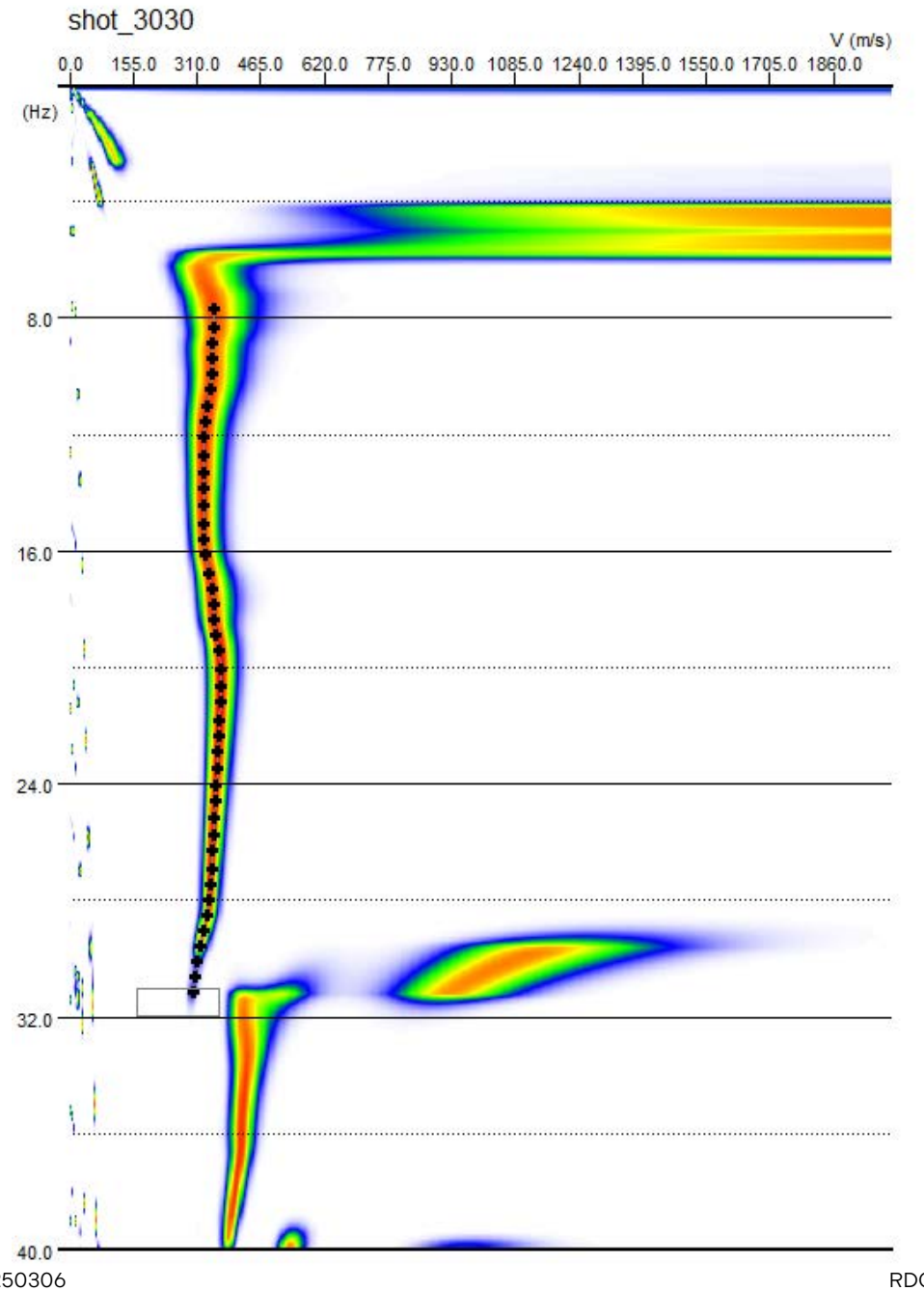

37.60 (Hz)


shot_3028
V (m/s)
0.0
155.0
310.0
465.0
620.0
775.0
930.0
1085.0
1240.0
1395.0
1550.0
1705.0
1860.0
(Hz)
8.0
16.0
24.0
32.0
40.0

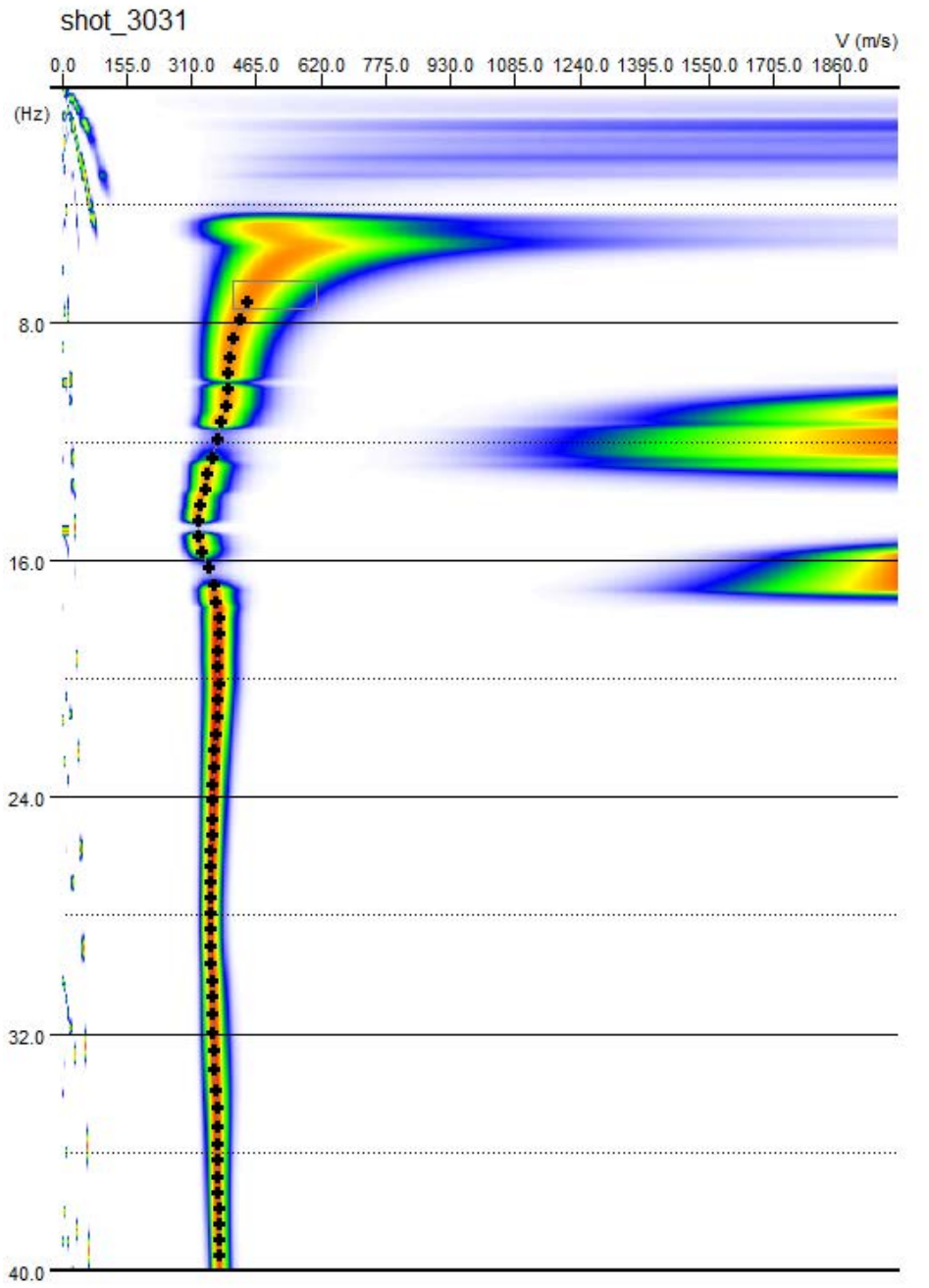



shot_3029
V (m/s)
0.0 155.0 310.0 465.0 620.0 775.0 930.0 1085.0 1240.0 1395.0 1550.0 1705.0 1860.0
(Hz)
8.0
16.0
24.0
32.0
40.0

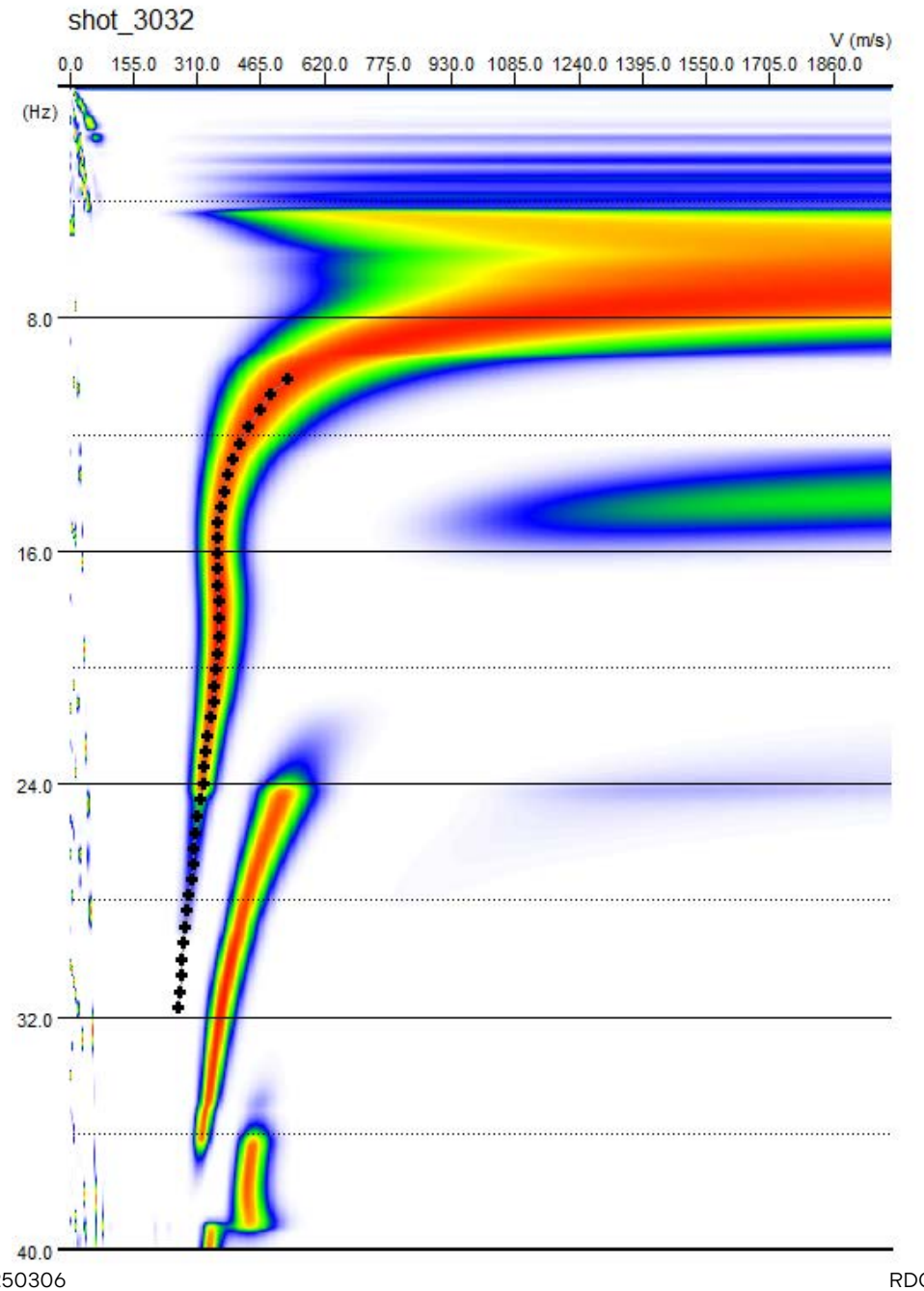

31.50 (Hz)


shot_3030
V (m/s)
0.0 155.0 310.0 465.0 620.0 775.0 930.0 1085.0 1240.0 1395.0 1550.0 1705.0 1860.0
(Hz)
8.0
16.0
24.0
32.0
40.0

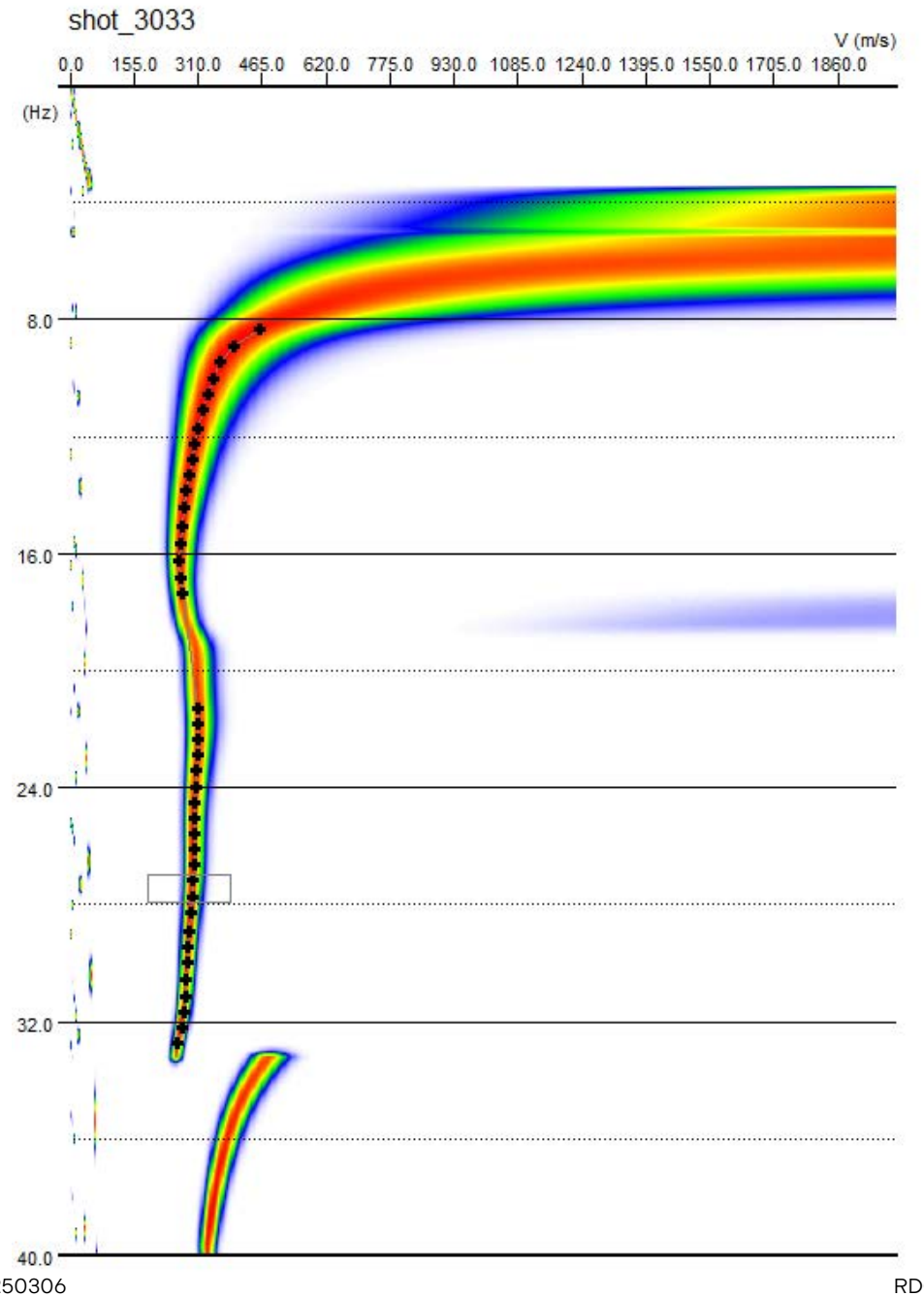

7.04 (Hz)


shot_3031
V (m/s)
0.0
155.0
310.0
465.0
620.0
775.0
930.0
1085.0
1240.0
1395.0
1550.0
1705.0
1860.0
(Hz)
8.0
16.0
24.0
32.0
40.0

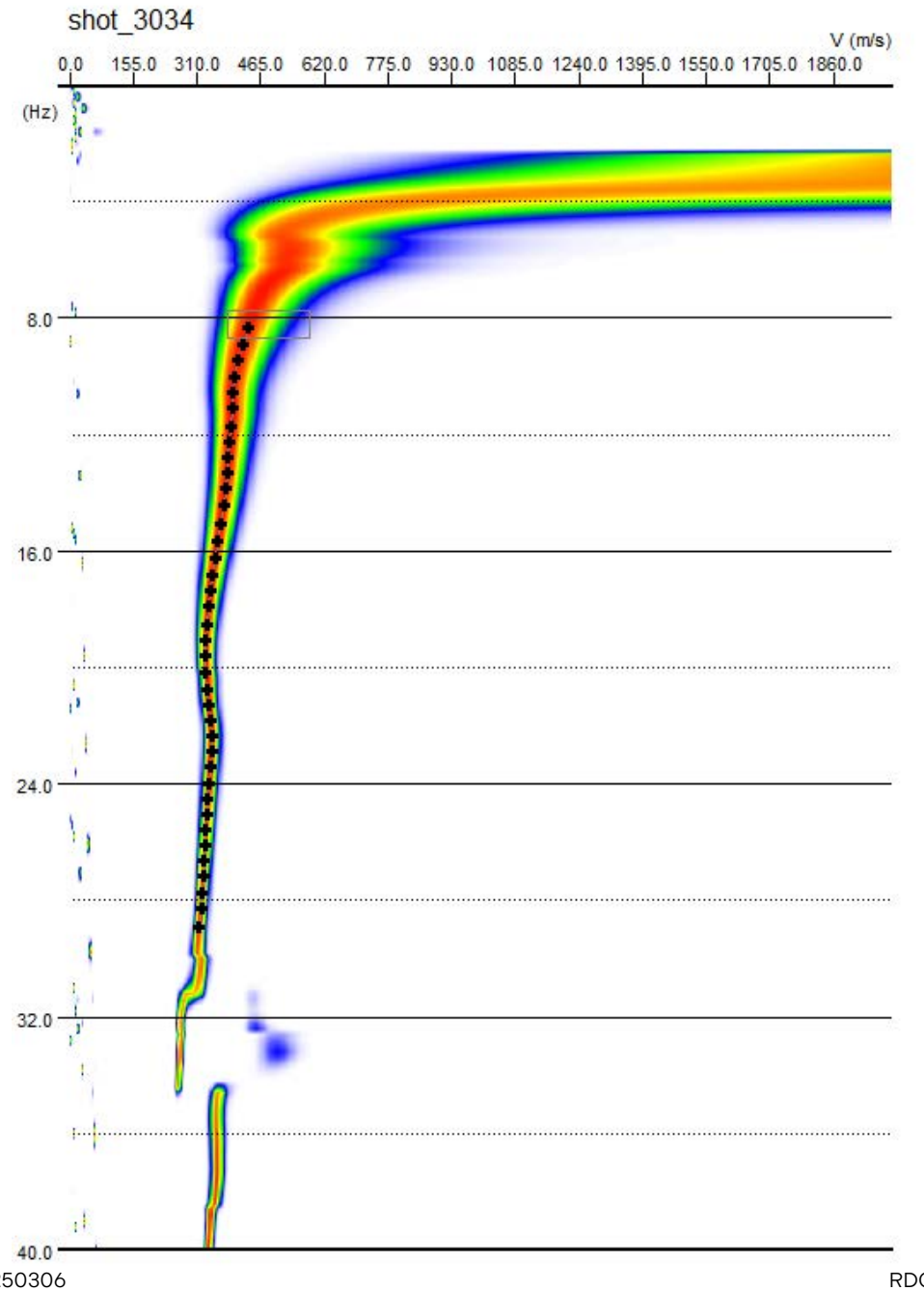


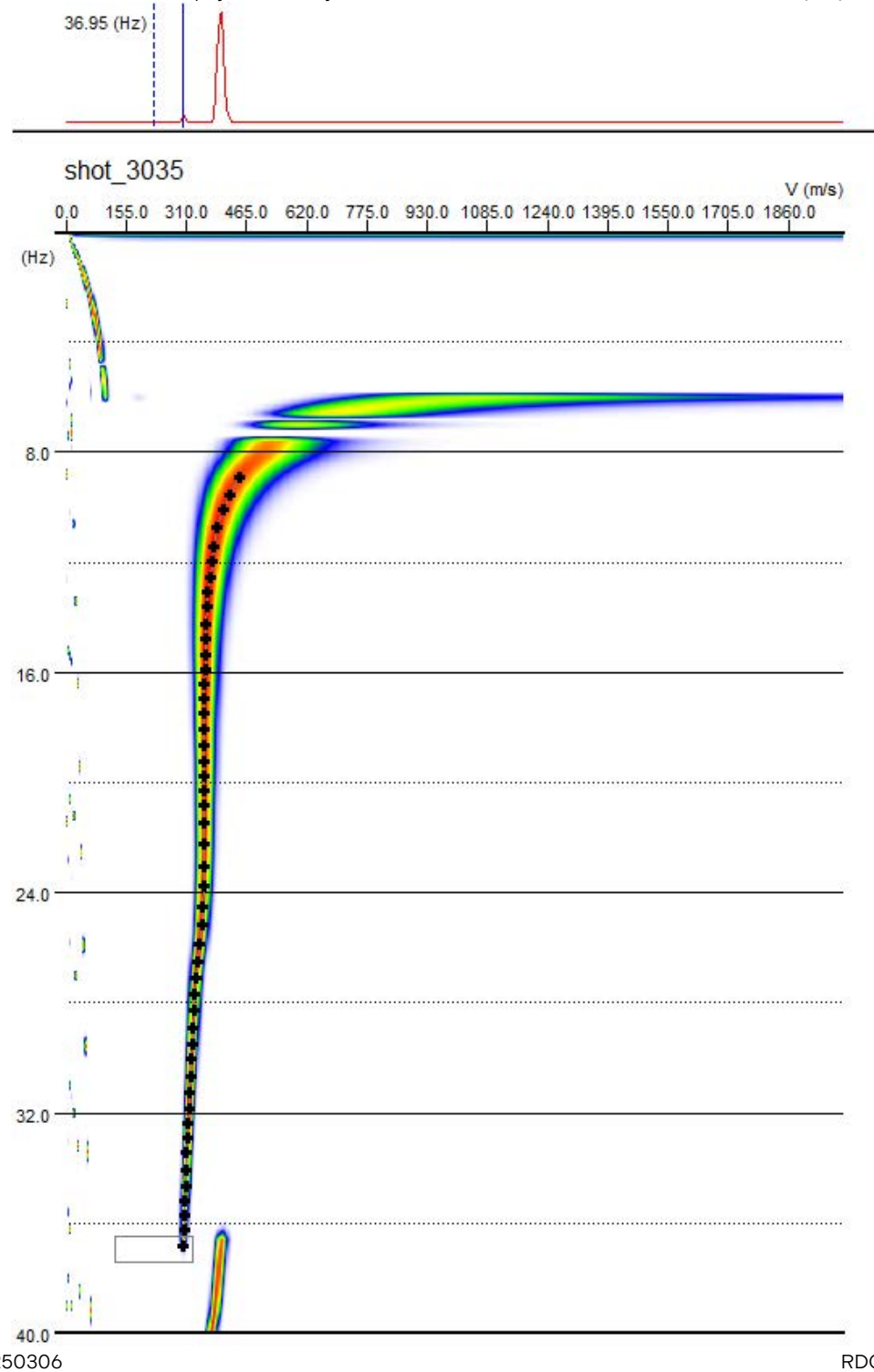

shot_3032
V (m/s)
0.0
155.0
310.0
465.0
620.0
775.0
930.0
1085.0
1240.0
1395.0
1550.0
1705.0
1860.0
(Hz)
8.0
16.0
24.0
32.0
40.0


27.45 (Hz)

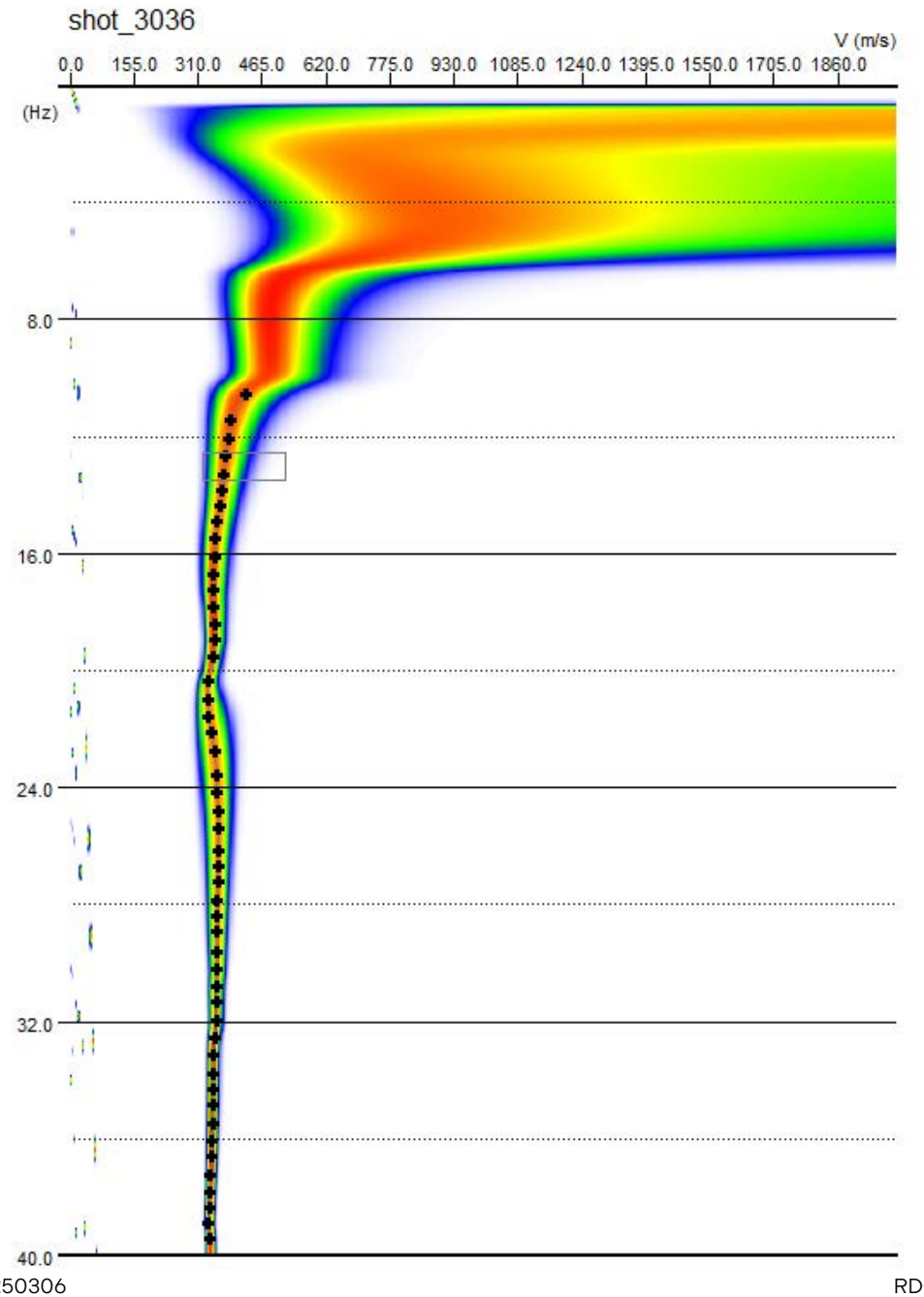

shot_3033
V (m/s)
0.0 155.0 310.0 465.0 620.0 775.0 930.0 1085.0 1240.0 1395.0 1550.0 1705.0 1860.0
(Hz)
8.0
16.0
24.0
32.0
40.0

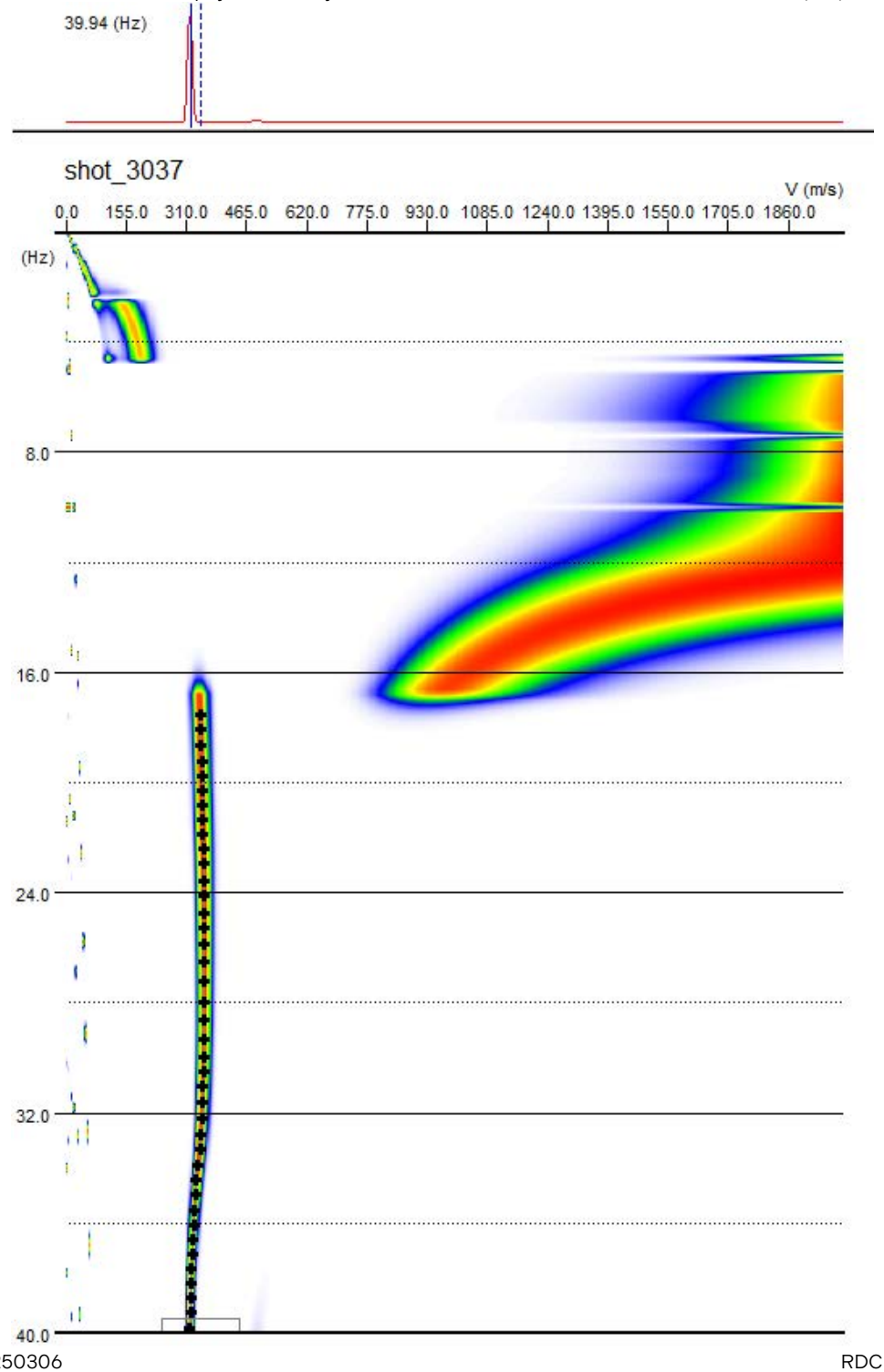

8.21 (Hz)


shot_3034
V (m/s)
0.0 155.0 310.0 465.0 620.0 775.0 930.0 1085.0 1240.0 1395.0 1550.0 1705.0 1860.0
(Hz)
8.0
16.0
24.0
32.0
40.0

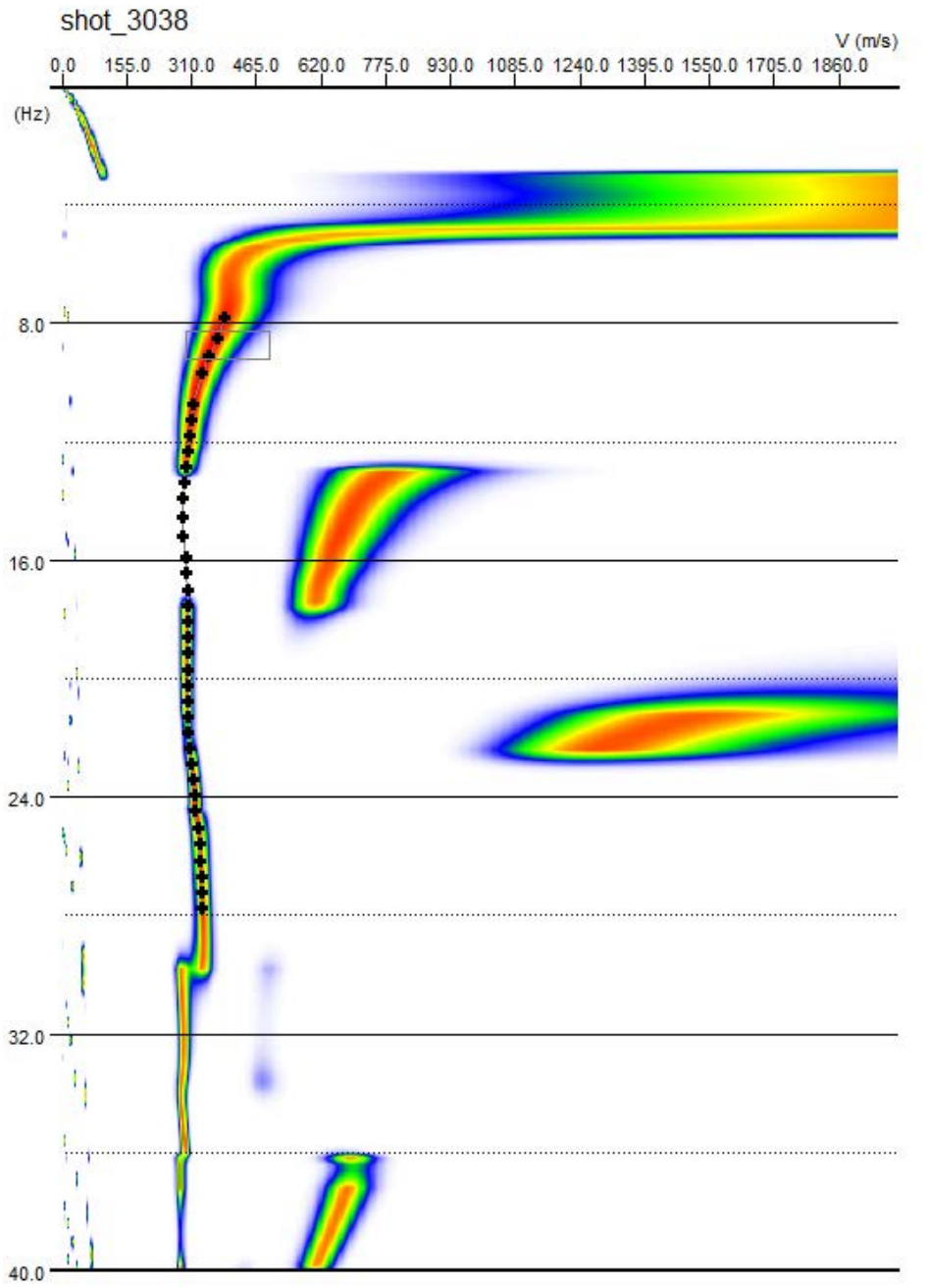

36.95 (Hz)
shot_3035
V (m/s)
0.0 155.0 310.0 465.0 620.0 775.0 930.0 1085.0 1240.0 1395.0 1550.0 1705.0 1860.0
(Hz)
8.0
16.0
24.0
32.0
40.0

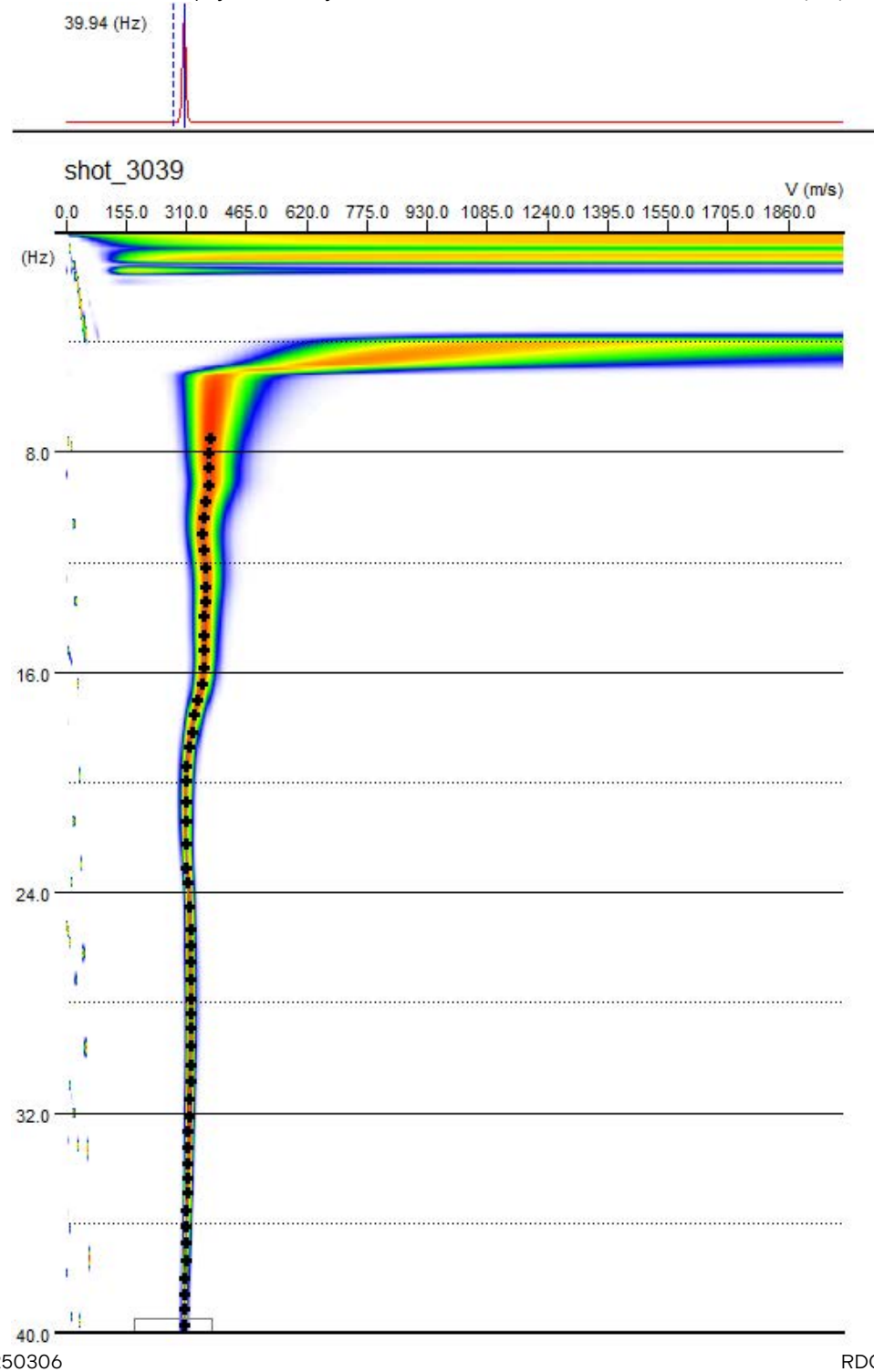

13.02 (Hz)

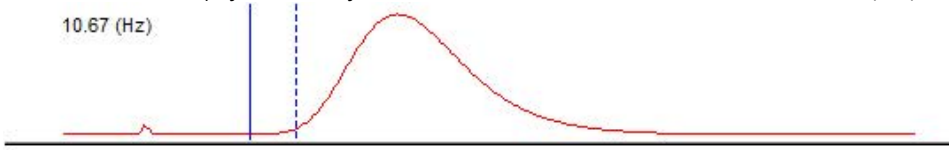

shot_3036
V (m/s)
0.0 155.0 310.0 465.0 620.0 775.0 930.0 1085.0 1240.0 1395.0 1550.0 1705.0 1860.0
(Hz)
8.0
16.0
24.0
32.0
40.0

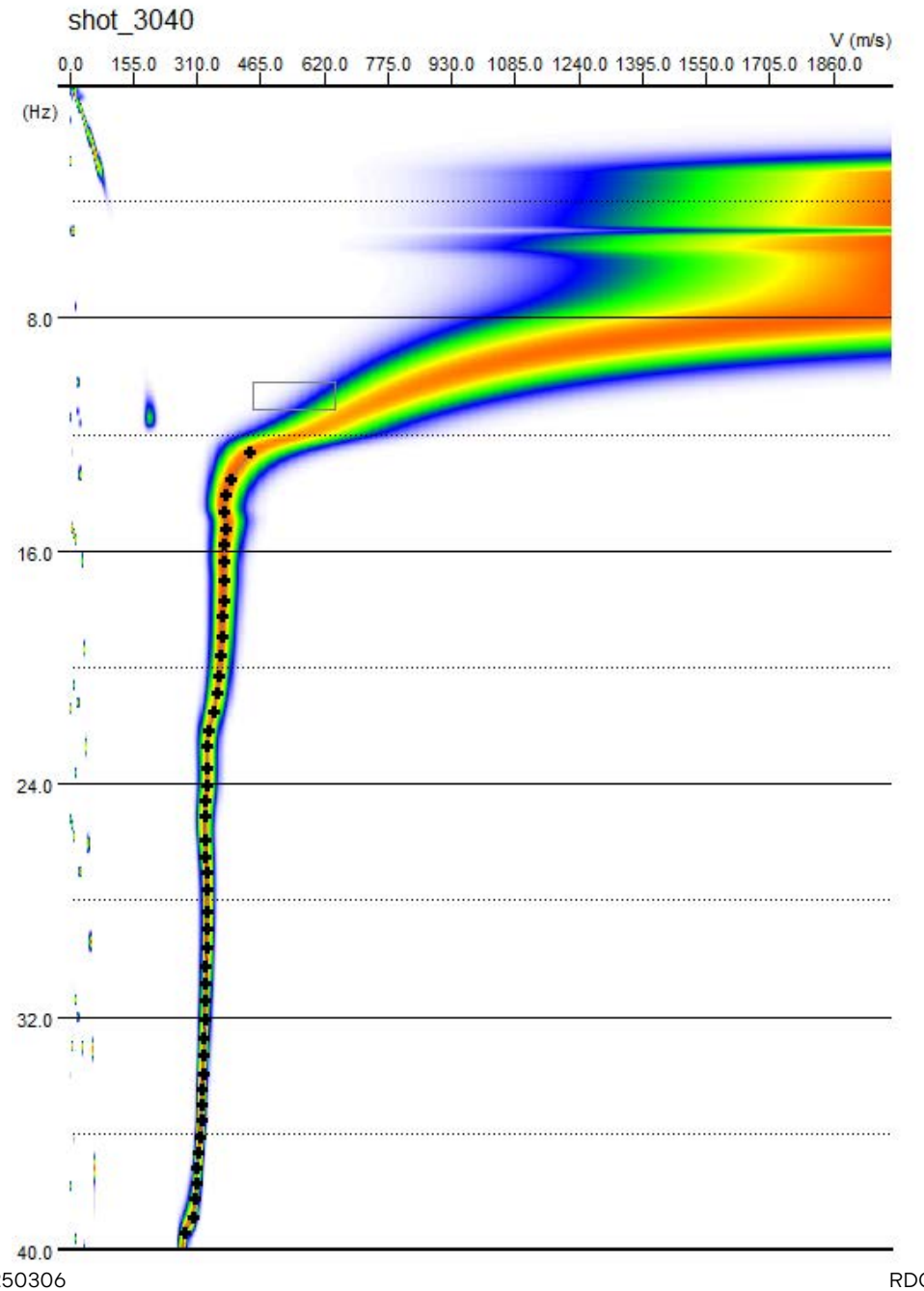

39.94 (Hz)
shot_3037
V (m/s)
0.0 155.0 310.0 465.0 620.0 775.0 930.0 1085.0 1240.0 1395.0 1550.0 1705.0 1860.0
(Hz)
8.0
16.0
24.0
32.0
40.0

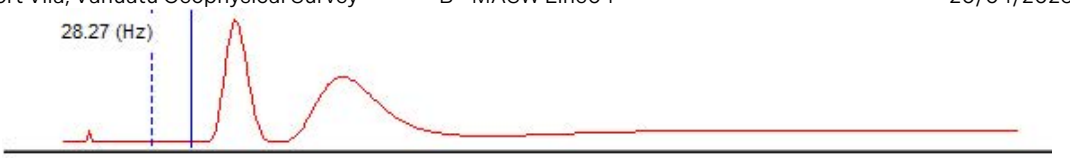

8.74 (Hz)

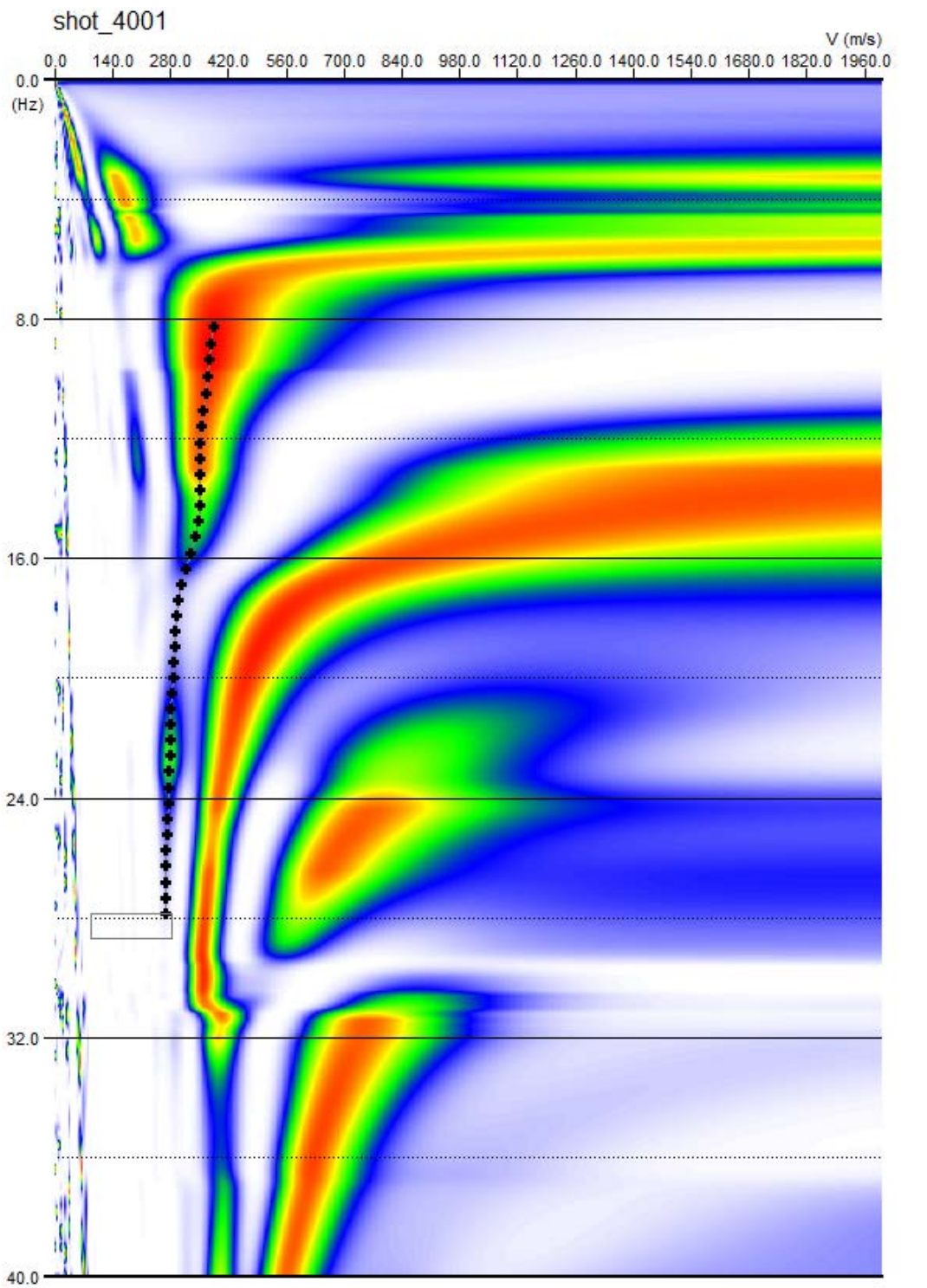

shot_3038
V (m/s)
0.0
155.0
310.0
465.0
620.0
775.0
930.0
1085.0
1240.0
1395.0
1550.0
1705.0
1860.0
(Hz)
8.0
16.0
24.0
32.0
40.0

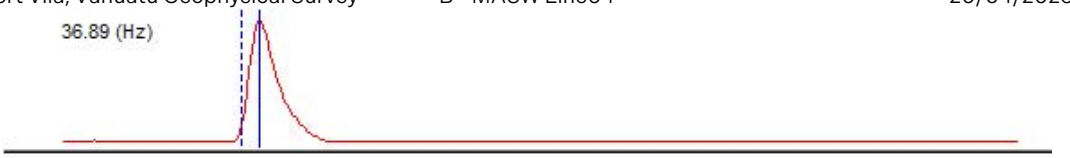

39.94 (Hz)
shot_3039
V (m/s)
0.0 155.0 310.0 465.0 620.0 775.0 930.0 1085.0 1240.0 1395.0 1550.0 1705.0 1860.0
(Hz)
8.0
16.0
24.0
32.0
40.0

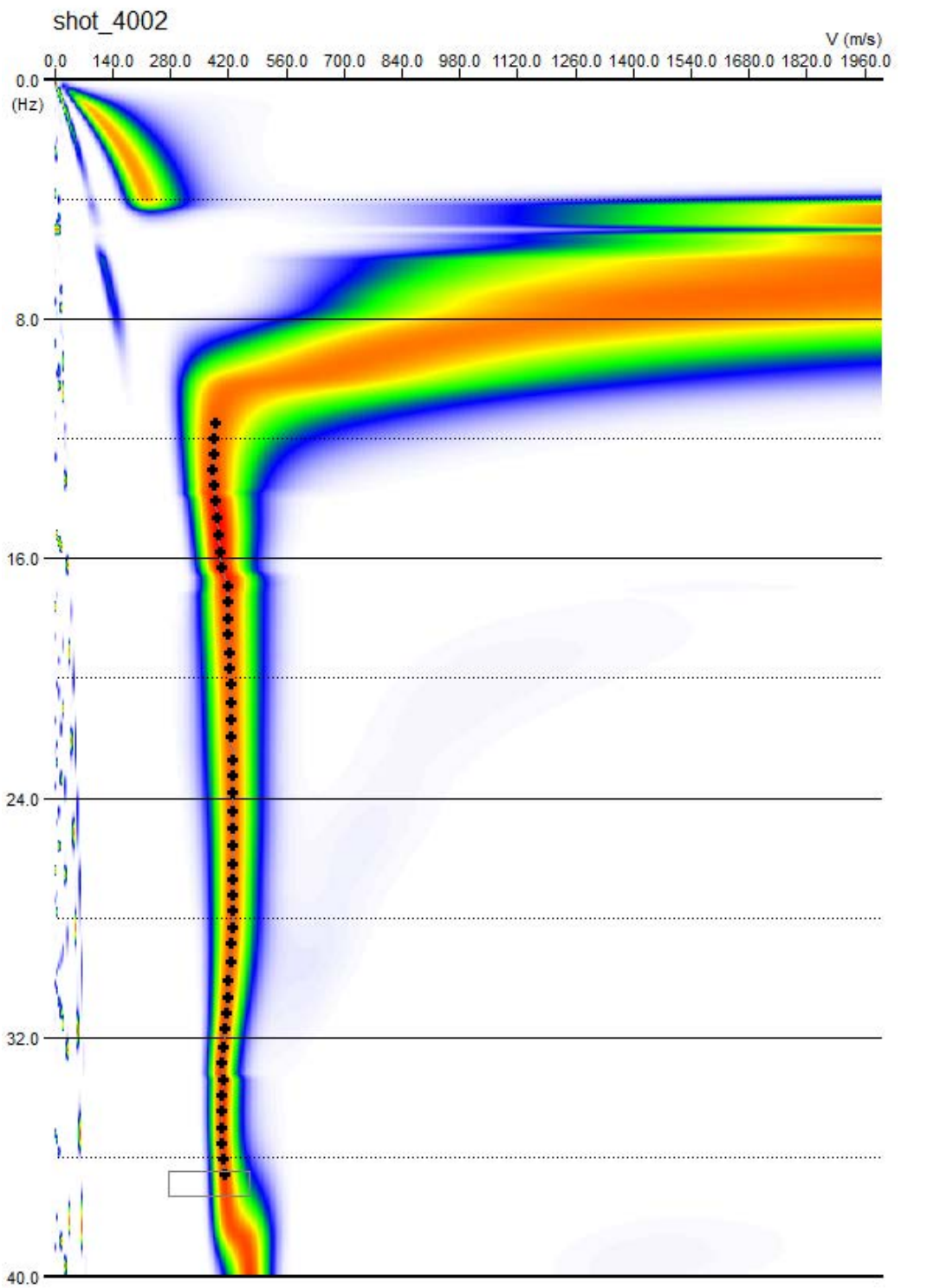

10.67 (Hz)

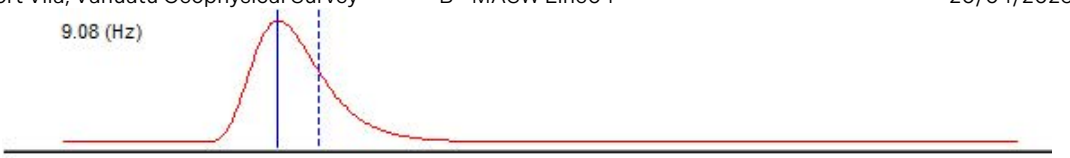

shot_3040
V (m/s)
0.0 155.0 310.0 465.0 620.0 775.0 930.0 1085.0 1240.0 1395.0 1550.0 1705.0 1860.0
(Hz)
8.0
16.0
24.0
32.0
40.0

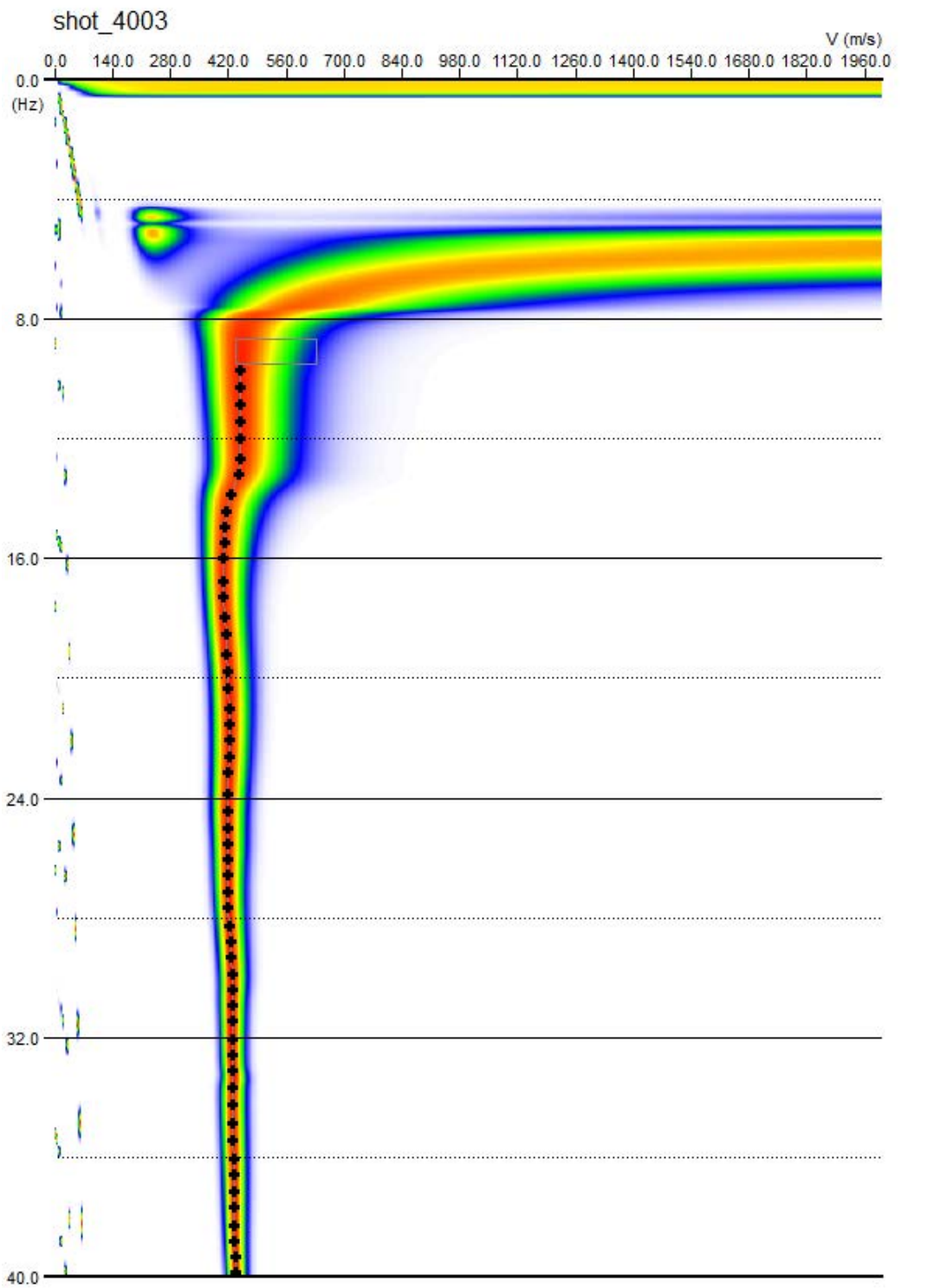

28.27 (Hz)

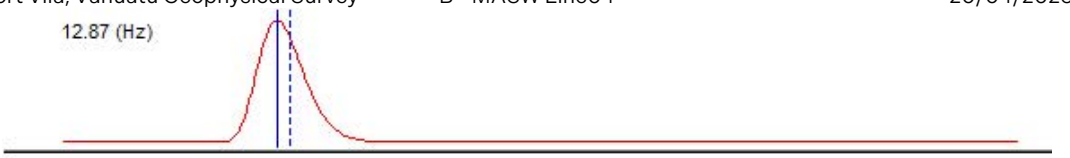

shot_4001
V (m/s)
0.0 140.0 280.0 420.0 560.0 700.0 840.0 980.0 1120.0 1260.0 1400.0 1540.0 1680.0 1820.0 1960.0
0.0
(Hz)
8.0
16.0
24.0
32.0
40.0

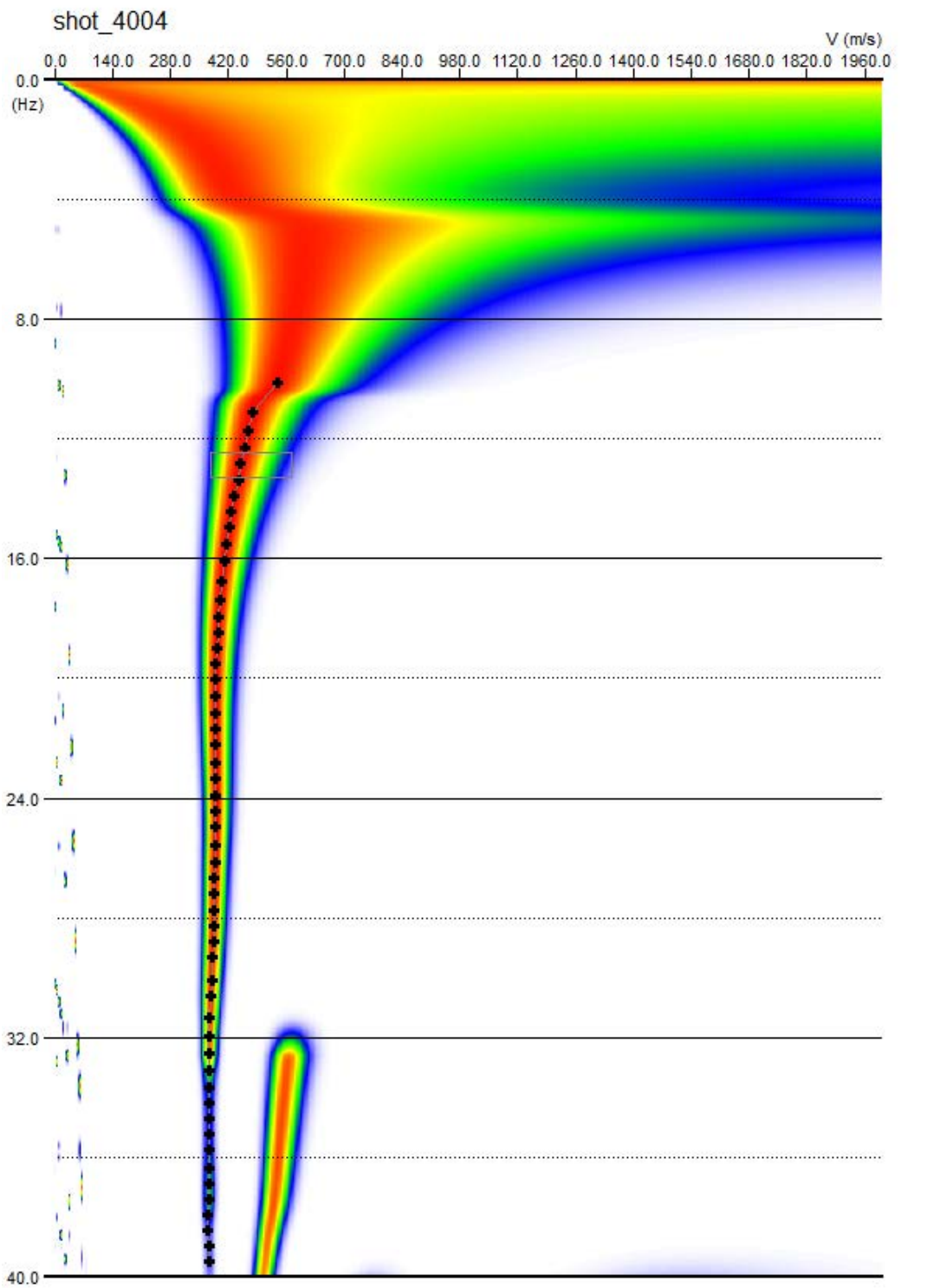

36.89 (Hz)

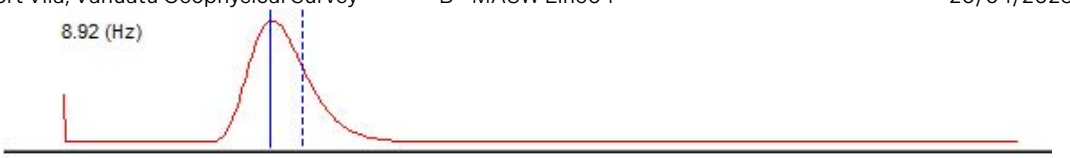

shot_4002
V (m/s)
0.0
140.0
280.0
420.0
560.0
700.0
840.0
980.0
1120.0
1260.0
1400.0
1540.0
1680.0
1820.0
1960.0
0.0
(Hz)
8.0
16.0
24.0
32.0
40.0

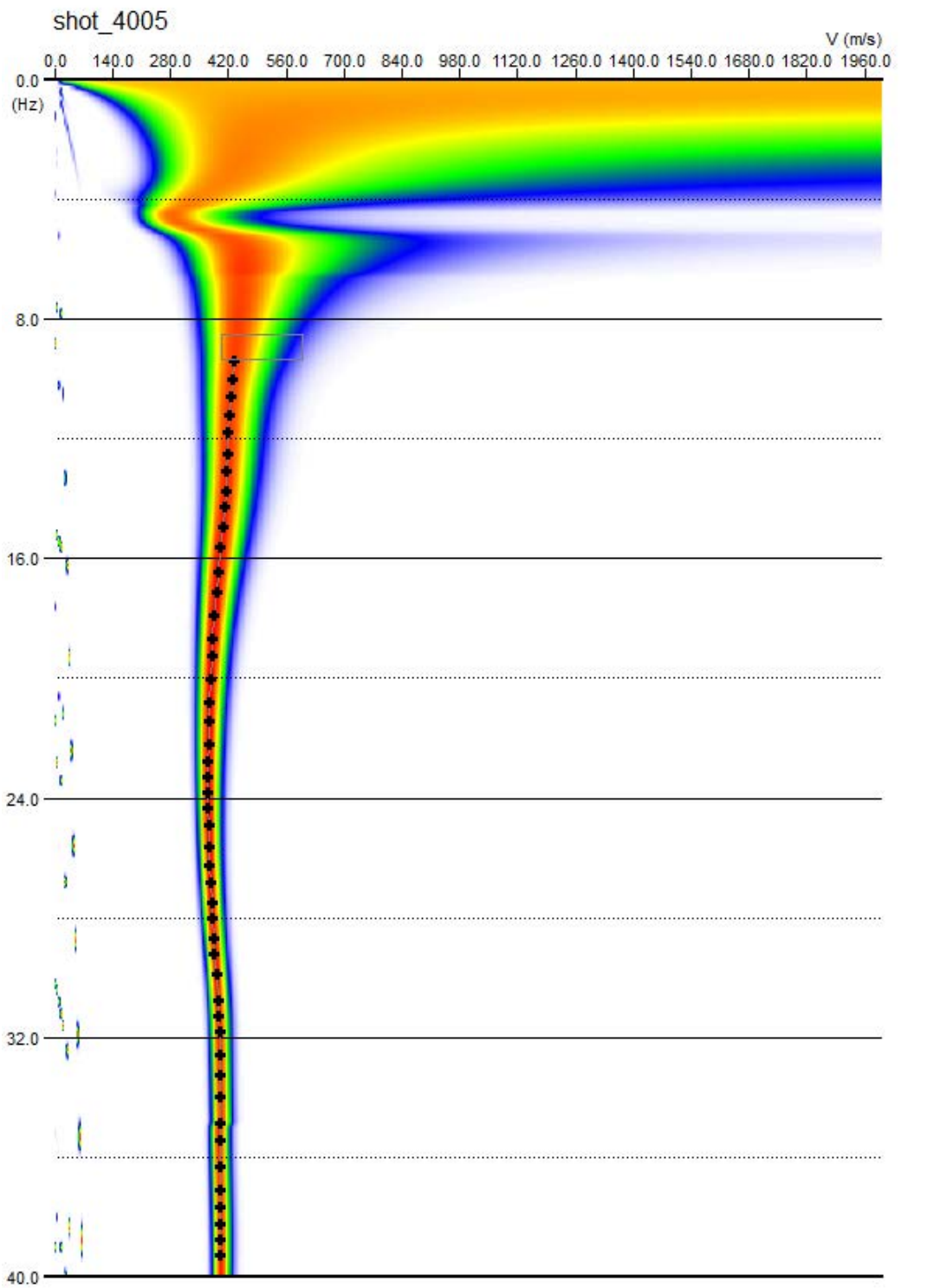

9.08 (Hz)


shot_4003
V (m/s)
0.0 140.0 280.0 420.0 560.0 700.0 840.0 980.0 1120.0 1260.0 1400.0 1540.0 1680.0 1820.0 1960.0
0.0
(Hz)
8.0
16.0
24.0
32.0
40.0

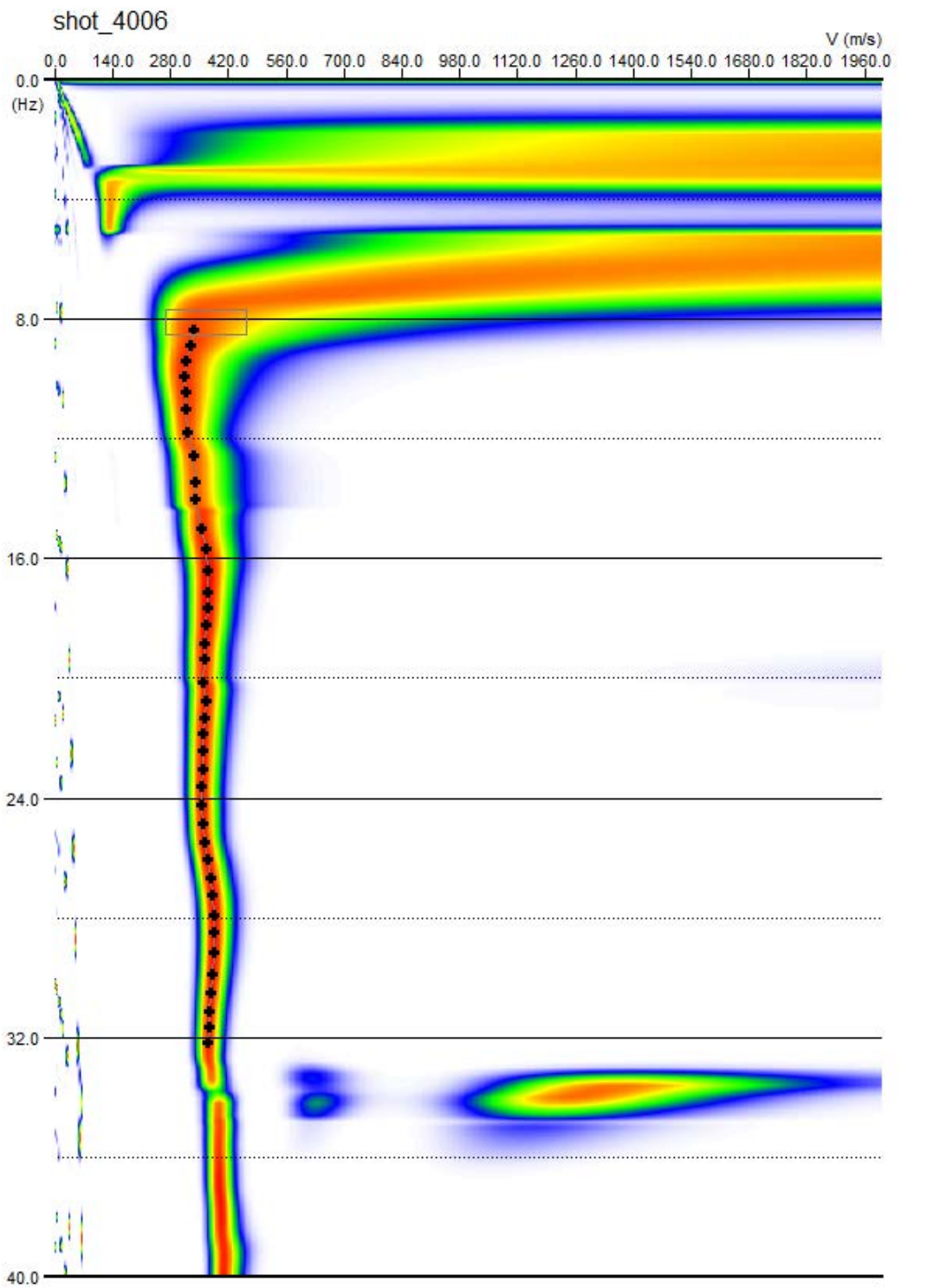

12.87 (Hz)


shot_4004
V (m/s)
0.0
140.0
280.0
420.0
560.0
700.0
840.0
980.0
1120.0
1260.0
1400.0
1540.0
1680.0
1820.0
1960.0
0.0
(Hz)
8.0
16.0
24.0
32.0
40.0

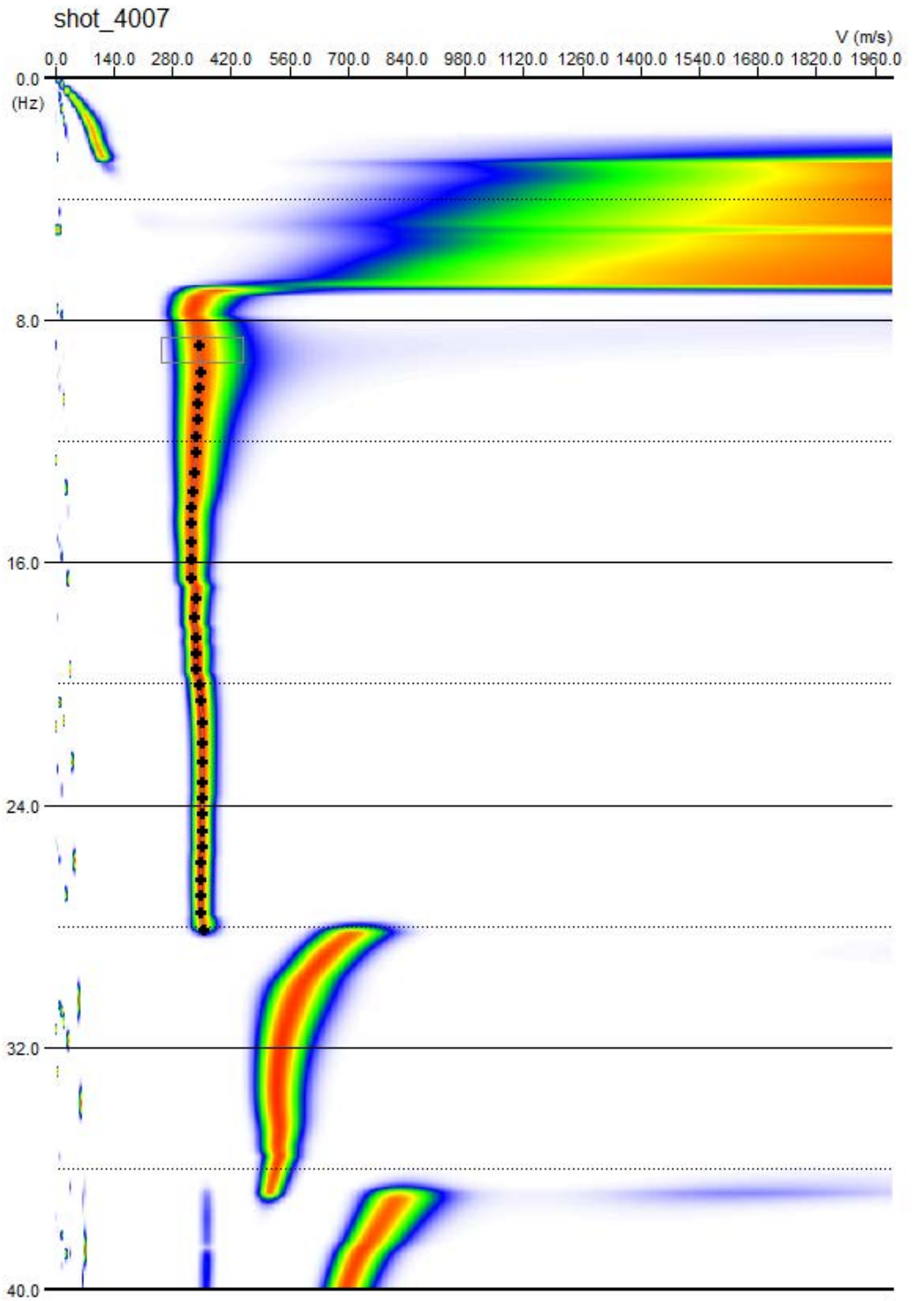

8.92 (Hz)

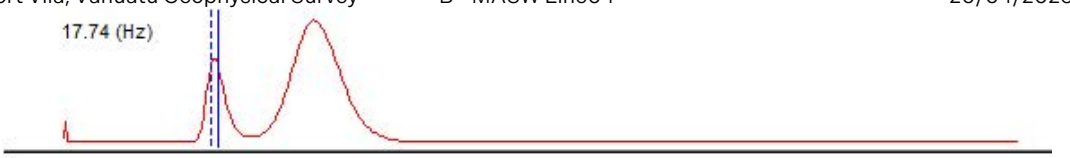

shot_4005
V (m/s)
0.0 140.0 280.0 420.0 560.0 700.0 840.0 980.0 1120.0 1260.0 1400.0 1540.0 1680.0 1820.0 1960.0
0.0
(Hz)
8.0
16.0
24.0
32.0
40.0

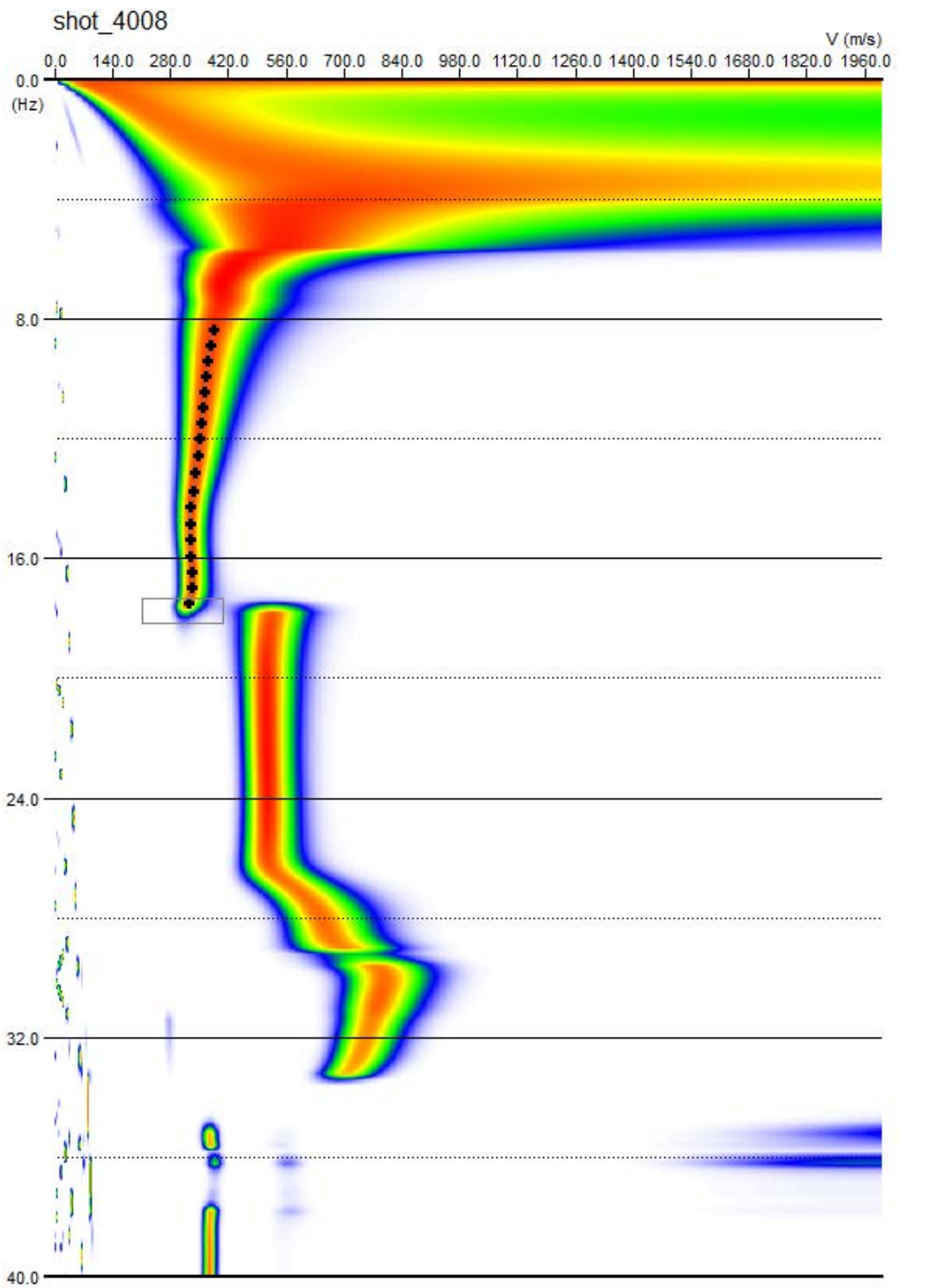

8.09 (Hz)

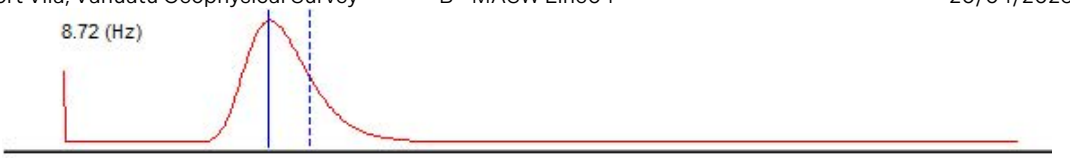

shot_4006
V (m/s)
0.0
140.0
280.0
420.0
560.0
700.0
840.0
980.0
1120.0
1260.0
1400.0
1540.0
1680.0
1820.0
1960.0
0.0
(Hz)
8.0
16.0
24.0
32.0
40.0

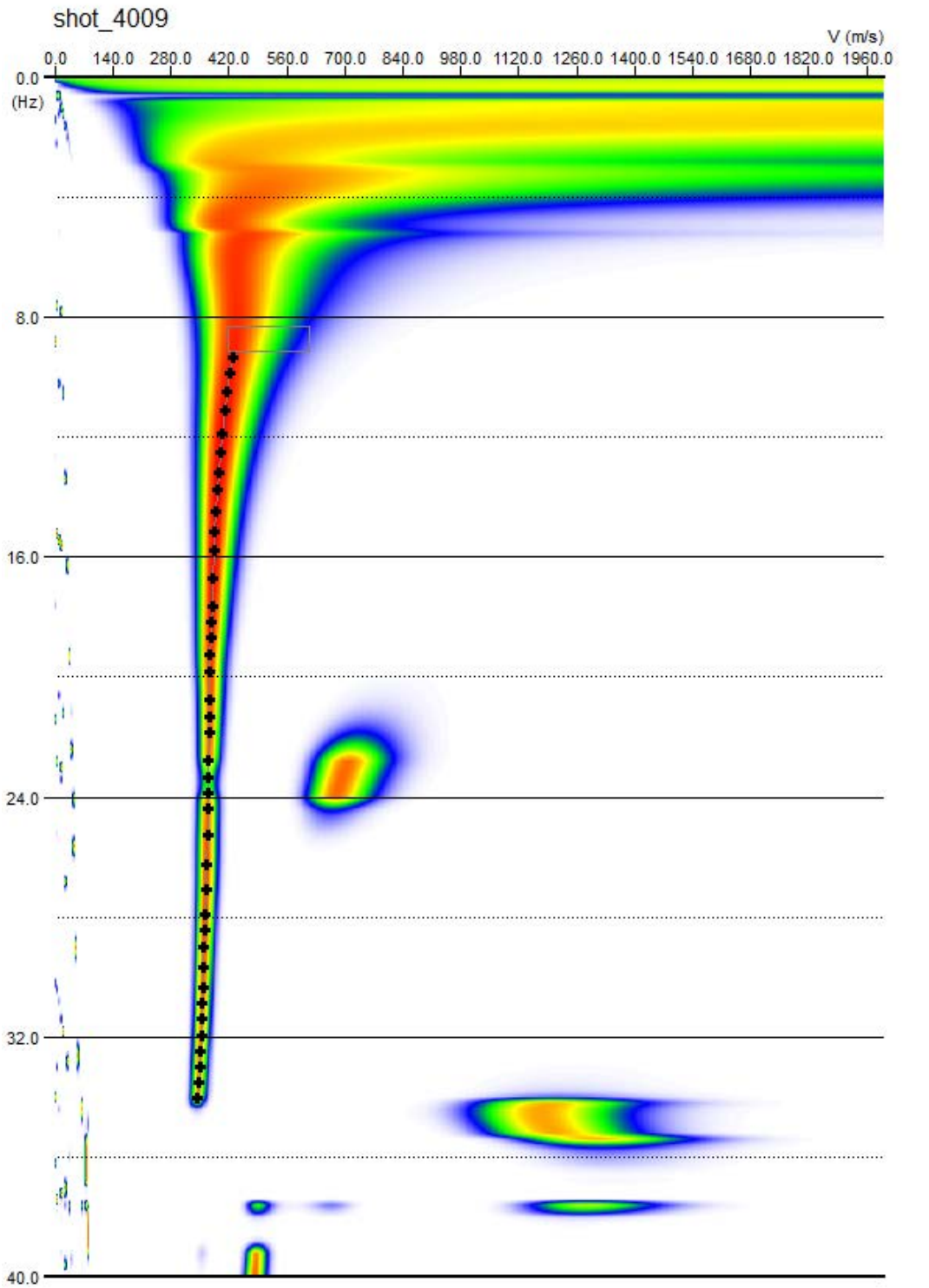

8.98 (Hz)

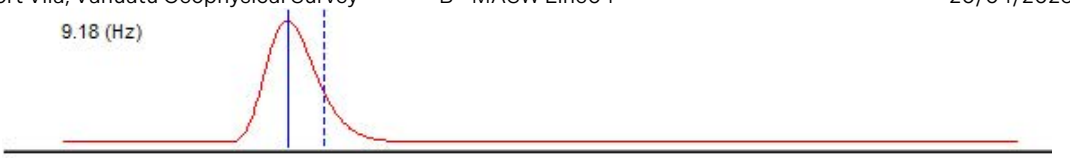

shot_4007
V (m/s)
0.0 140.0 280.0 420.0 560.0 700.0 840.0 980.0 1120.0 1260.0 1400.0 1540.0 1680.0 1820.0 1960.0
0.0
(Hz)
8.0
16.0
24.0
32.0
40.0

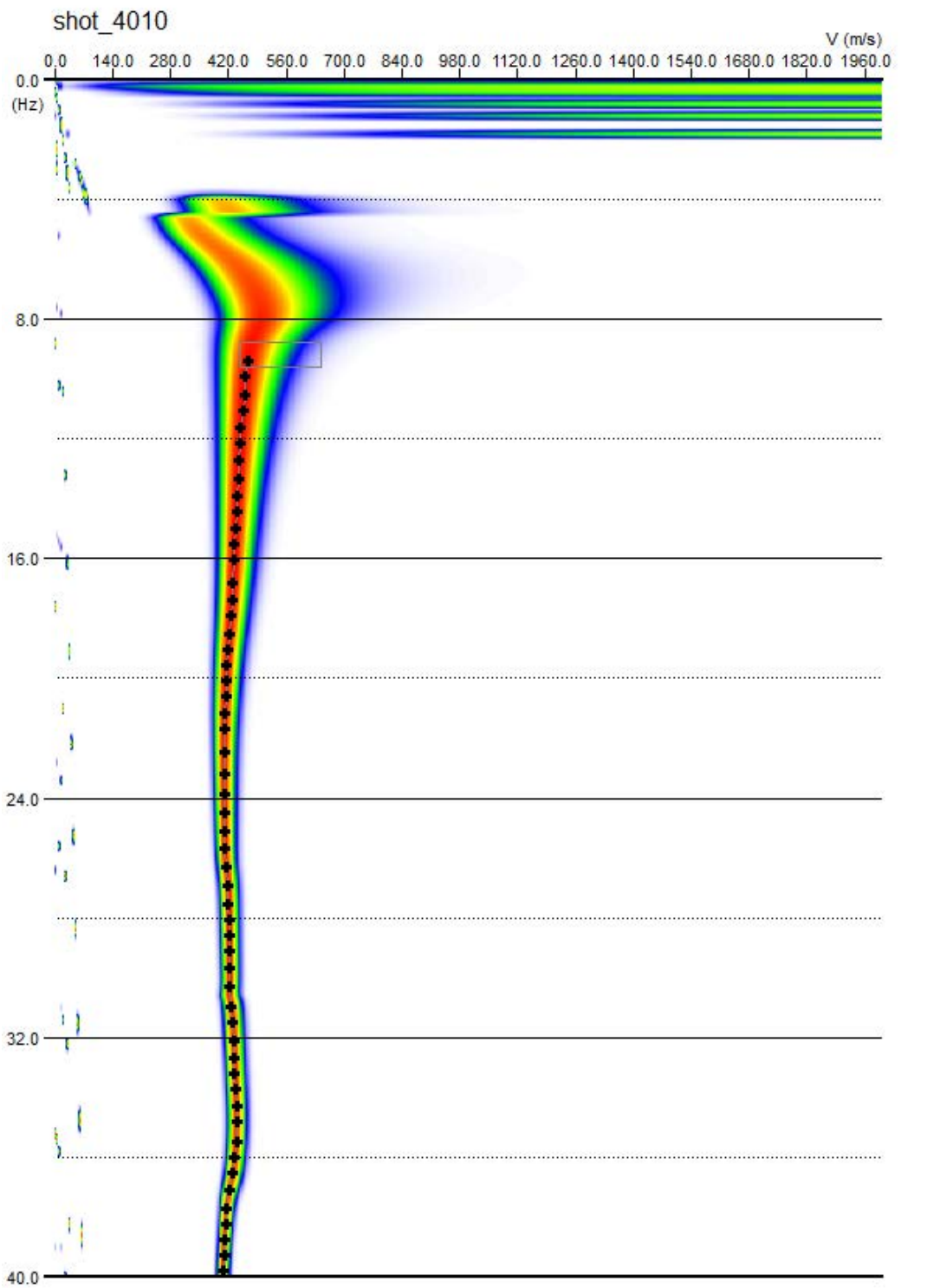

17.74 (Hz)

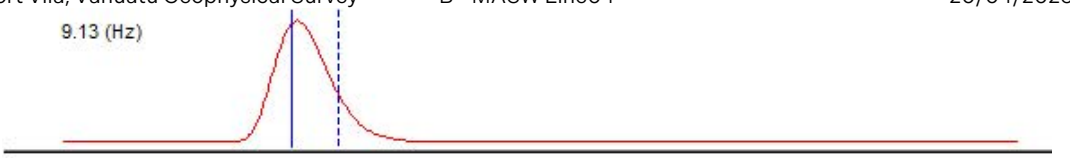

shot_4008
V (m/s)
0.0 140.0 280.0 420.0 560.0 700.0 840.0 980.0 1120.0 1260.0 1400.0 1540.0 1680.0 1820.0 1960.0
0.0
(Hz)
8.0
16.0
24.0
32.0
40.0

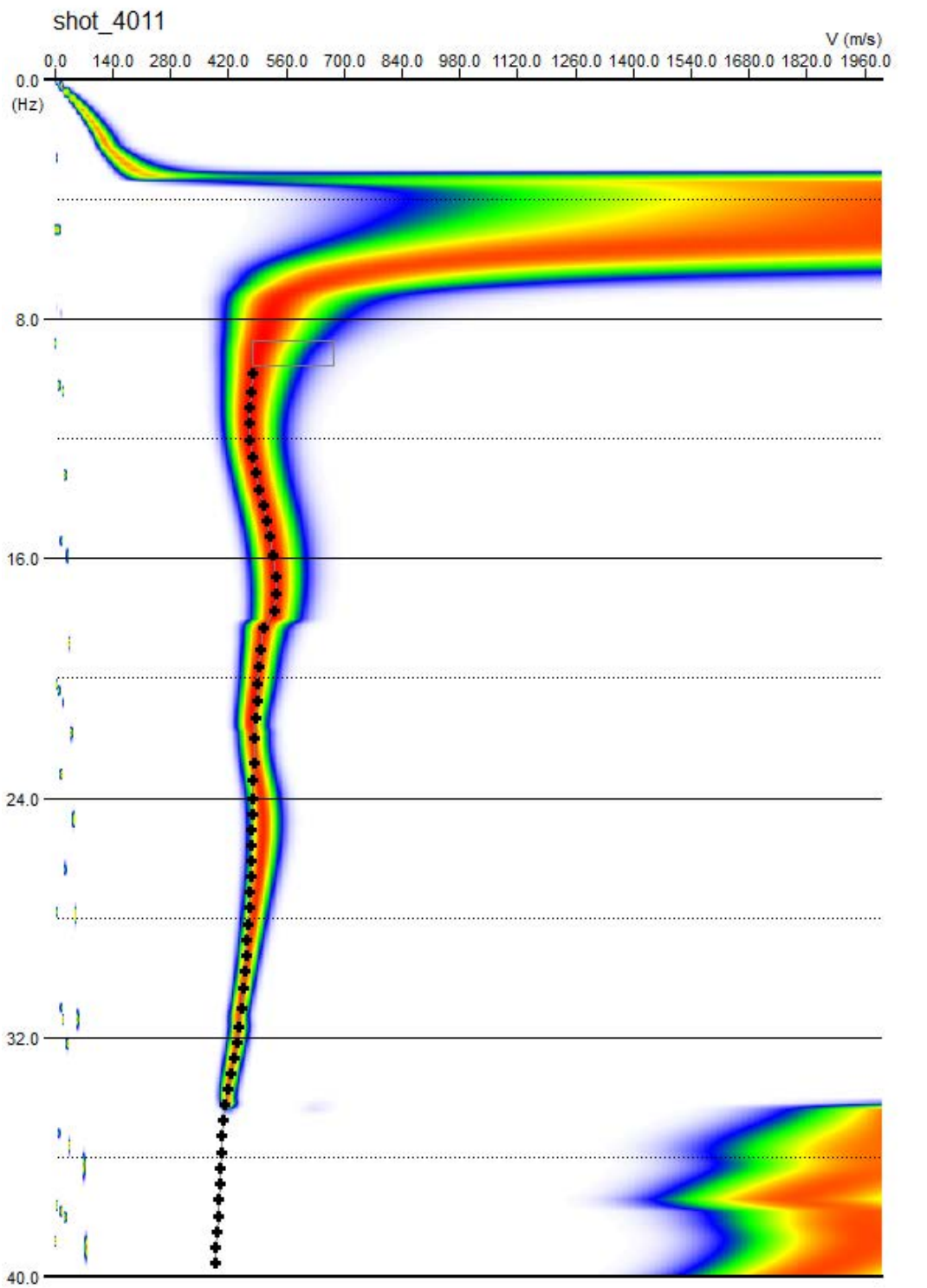

8.72 (Hz)


shot_4009
V (m/s)
0.0
140.0
280.0
420.0
560.0
700.0
840.0
980.0
1120.0
1260.0
1400.0
1540.0
1680.0
1820.0
1960.0
0.0
(Hz)
8.0
16.0
24.0
32.0
40.0

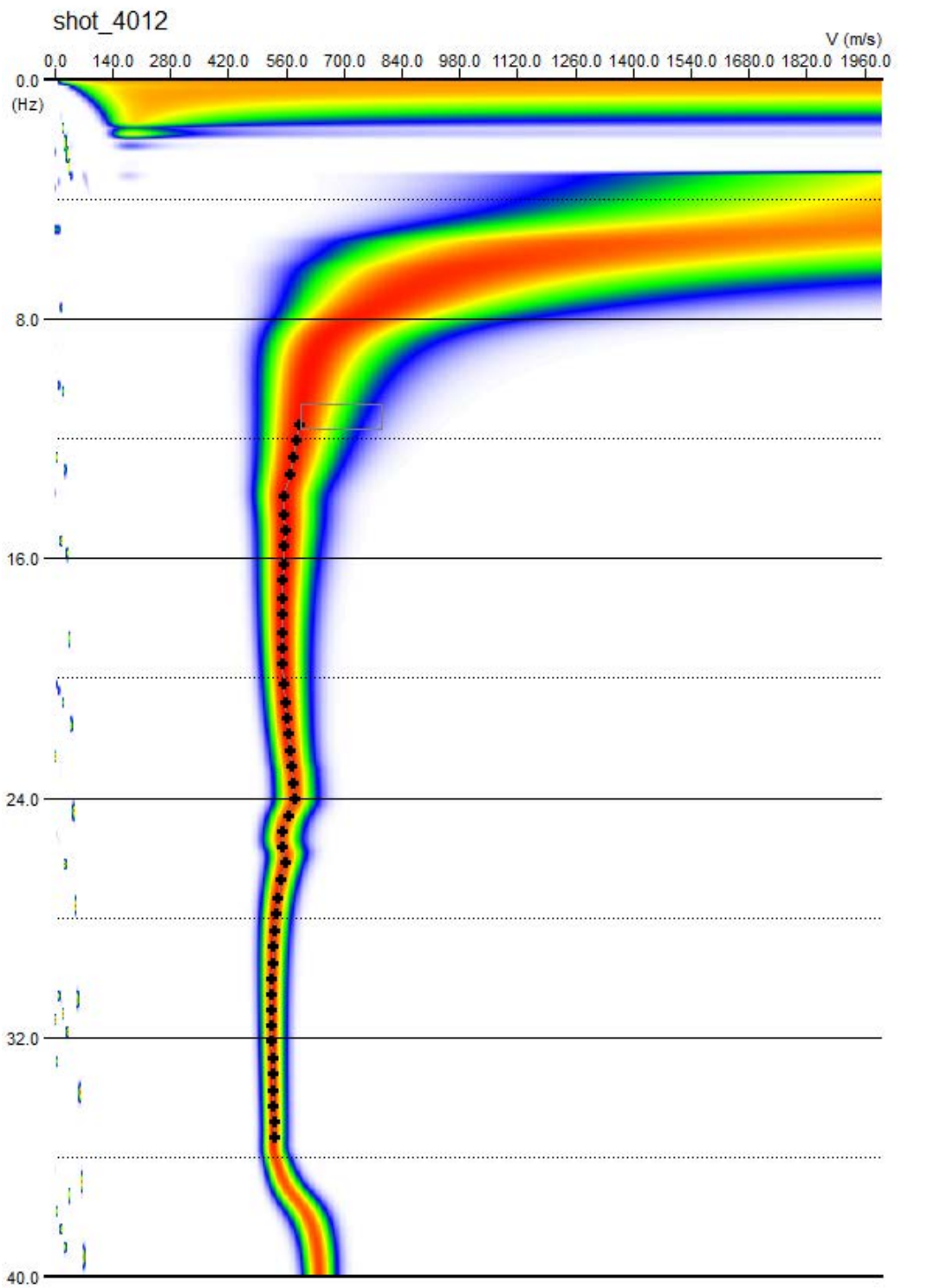

9.18 (Hz)

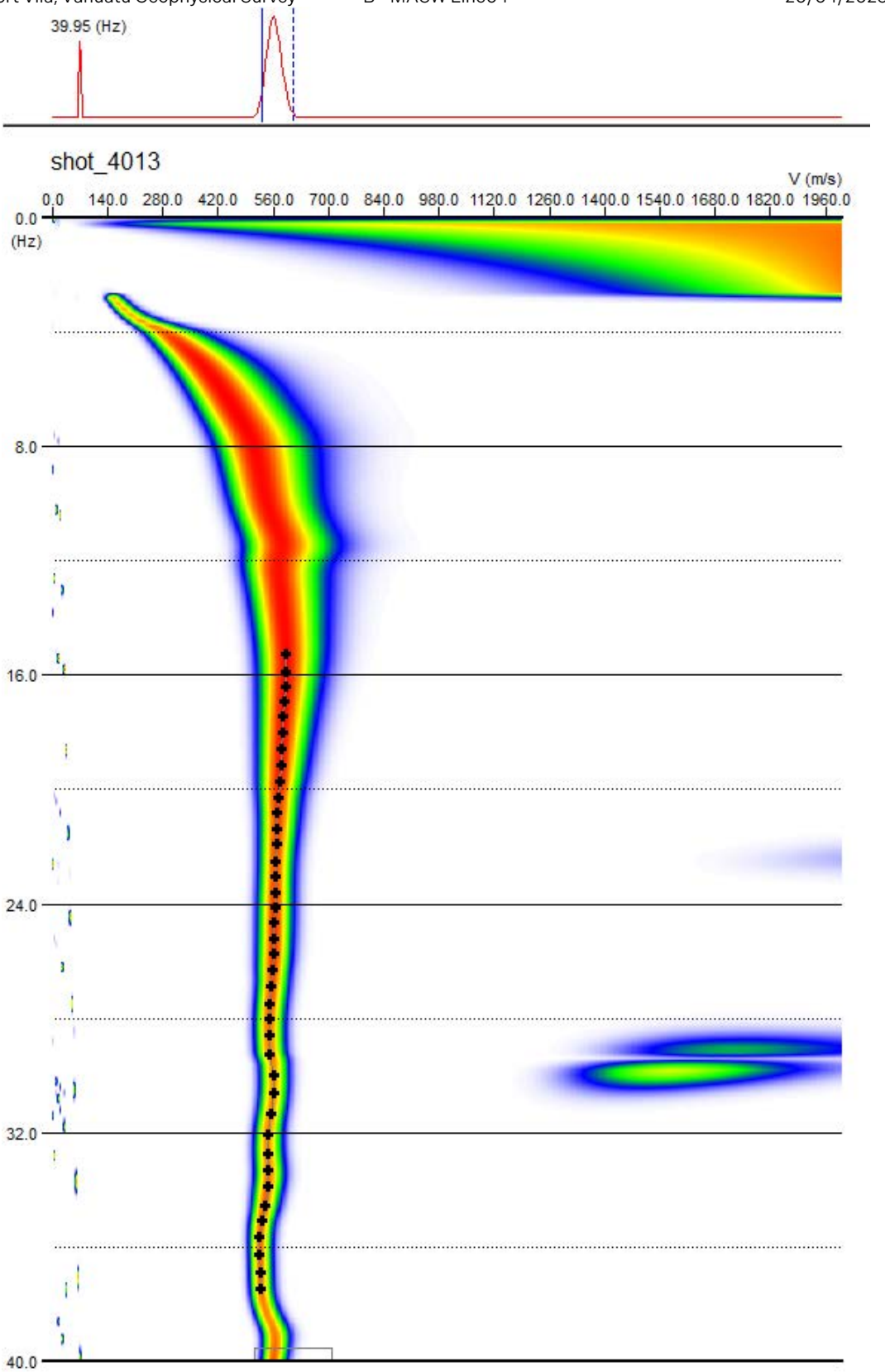

shot_4010
V (m/s)
0.0 140.0 280.0 420.0 560.0 700.0 840.0 980.0 1120.0 1260.0 1400.0 1540.0 1680.0 1820.0 1960.0
0.0
(Hz)
8.0
16.0
24.0
32.0
40.0

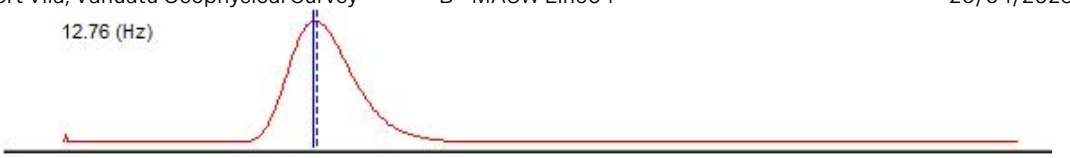

9.13 (Hz)

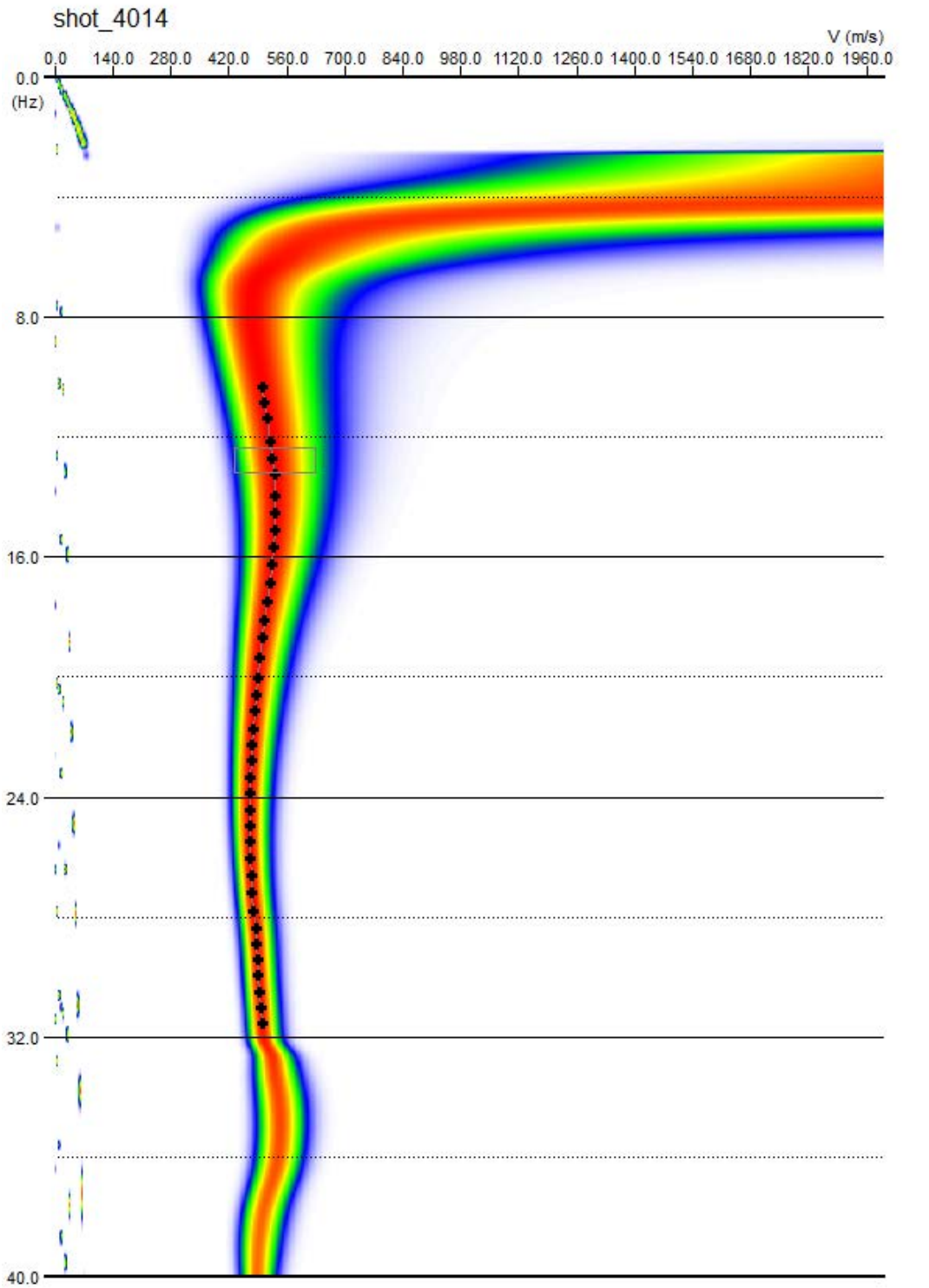

shot_4011
V (m/s)
0.0
140.0
280.0
420.0
560.0
700.0
840.0
980.0
1120.0
1260.0
1400.0
1540.0
1680.0
1820.0
1960.0
0.0
(Hz)
8.0
16.0
24.0
32.0
40.0

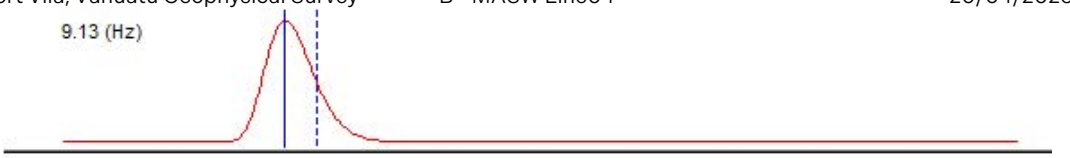

11.26 (Hz)

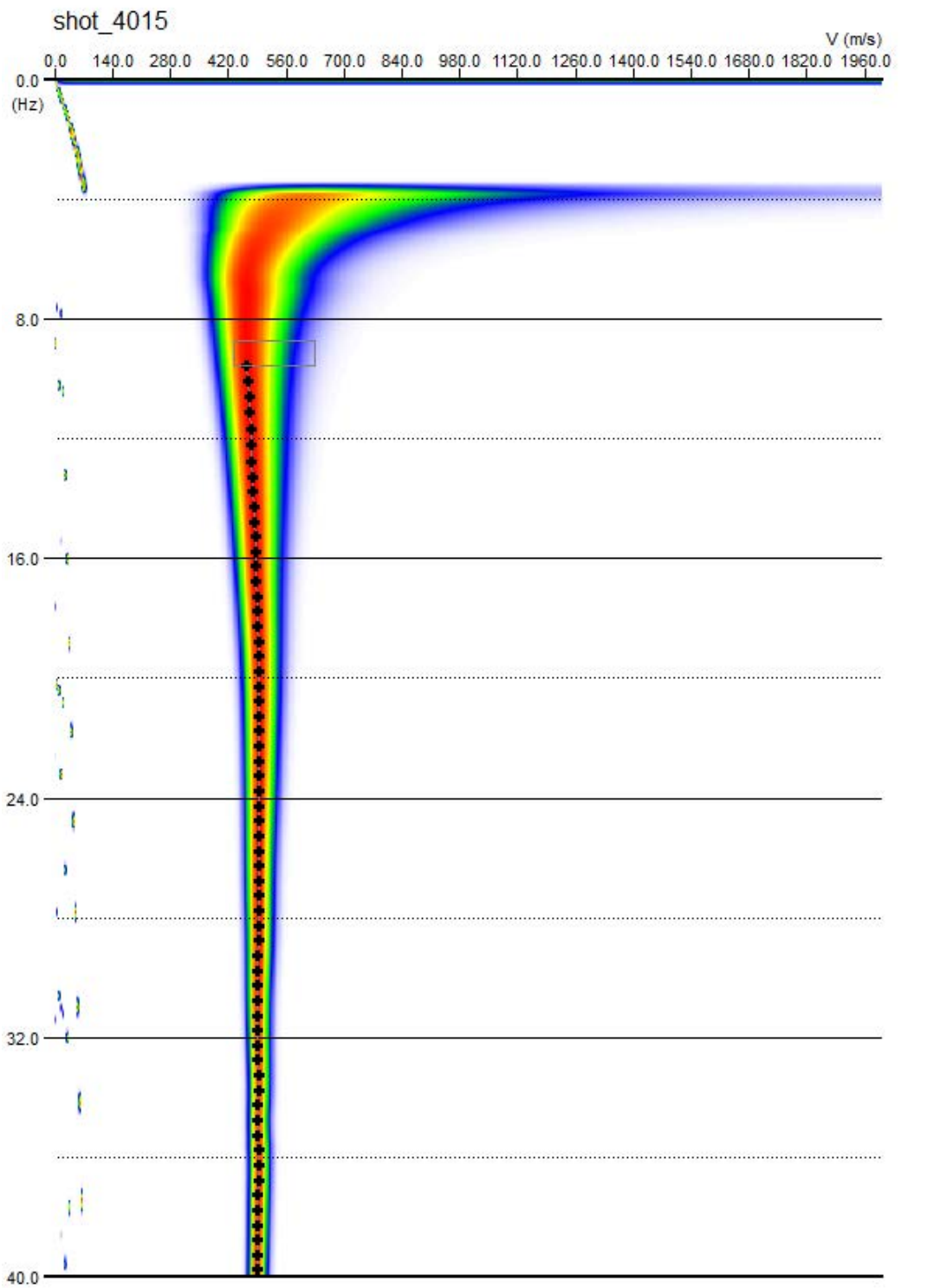

shot_4012
V (m/s)
0.0 140.0 280.0 420.0 560.0 700.0 840.0 980.0 1120.0 1260.0 1400.0 1540.0 1680.0 1820.0 1960.0
0.0
(Hz)
8.0
16.0
24.0
32.0
40.0

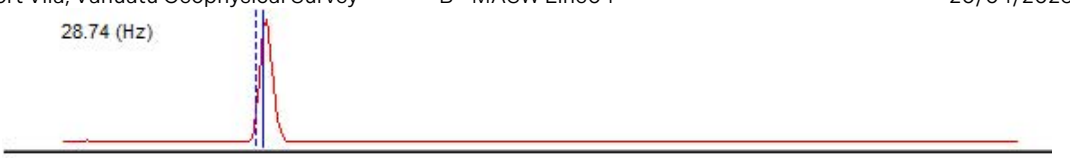

39.95 (Hz)
shot_4013
V (m/s)
0.0 140.0 280.0 420.0 560.0 700.0 840.0 980.0 1120.0 1260.0 1400.0 1540.0 1680.0 1820.0 1960.0
0.0
(Hz)
8.0
16.0
24.0
32.0
40.0

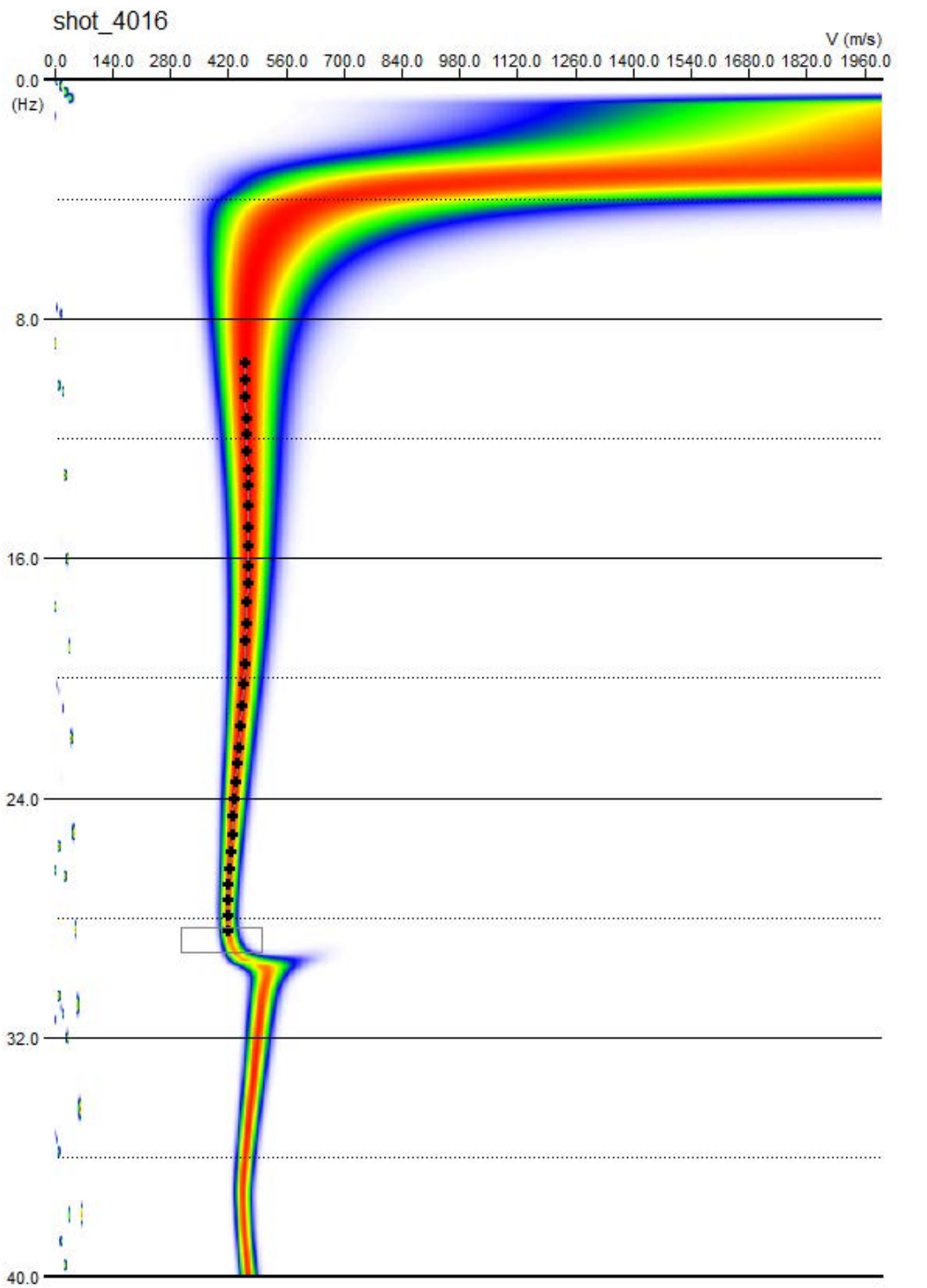

12.76 (Hz)


shot_4014
V (m/s)
0.0 140.0 280.0 420.0 560.0 700.0 840.0 980.0 1120.0 1260.0 1400.0 1540.0 1680.0 1820.0 1960.0
0.0
(Hz)
8.0
16.0
24.0
32.0
40.0

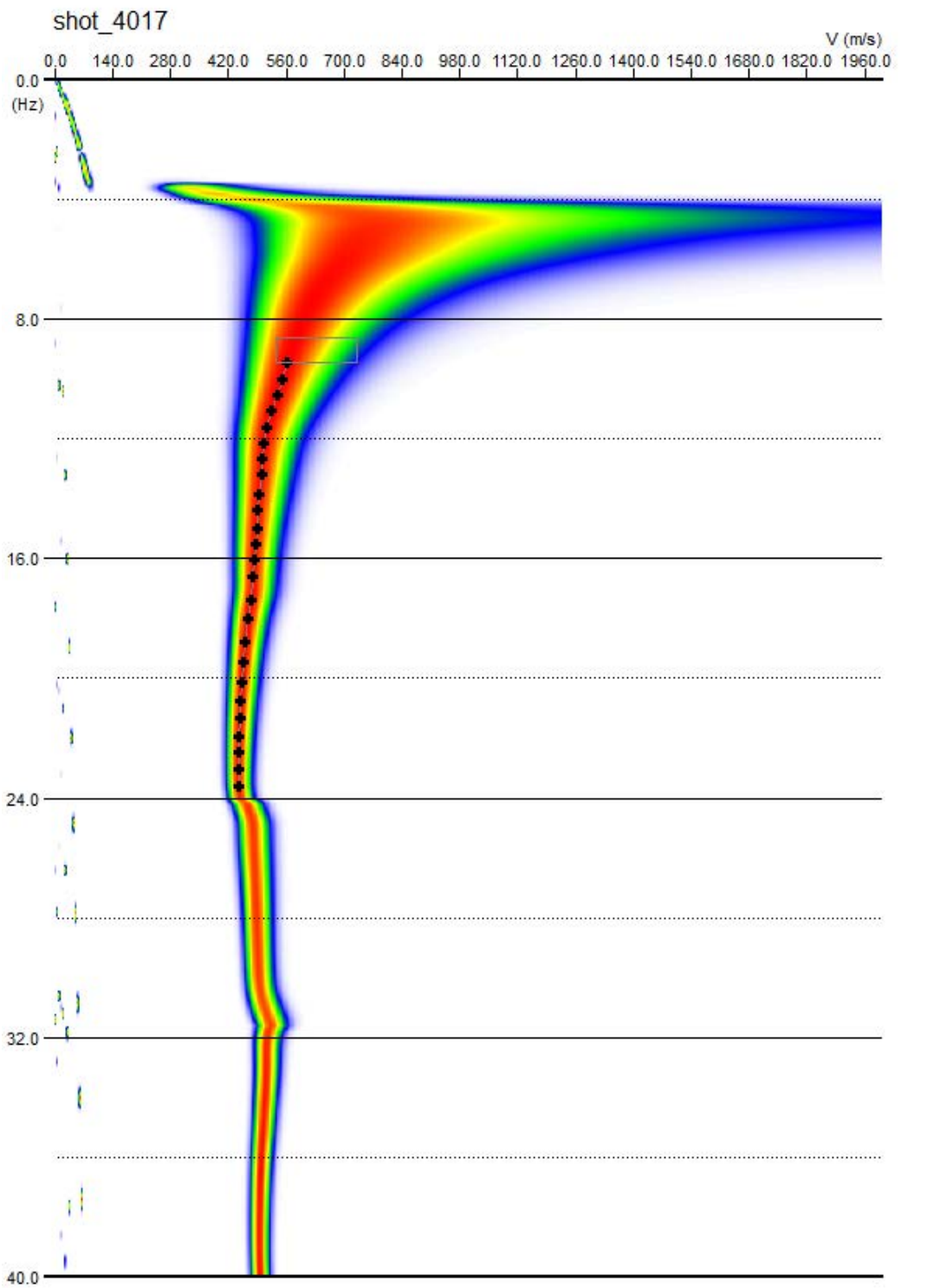

9.13 (Hz)

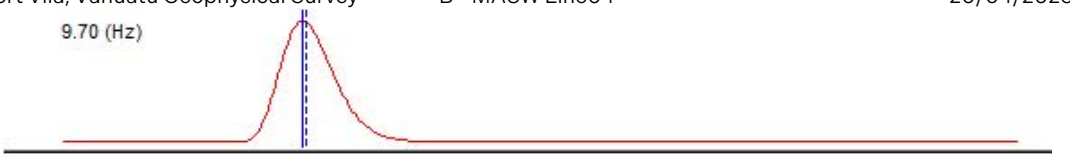

shot_4015
V (m/s)
0.0 140.0 280.0 420.0 560.0 700.0 840.0 980.0 1120.0 1260.0 1400.0 1540.0 1680.0 1820.0 1960.0
0.0
(Hz)
8.0
16.0
24.0
32.0
40.0

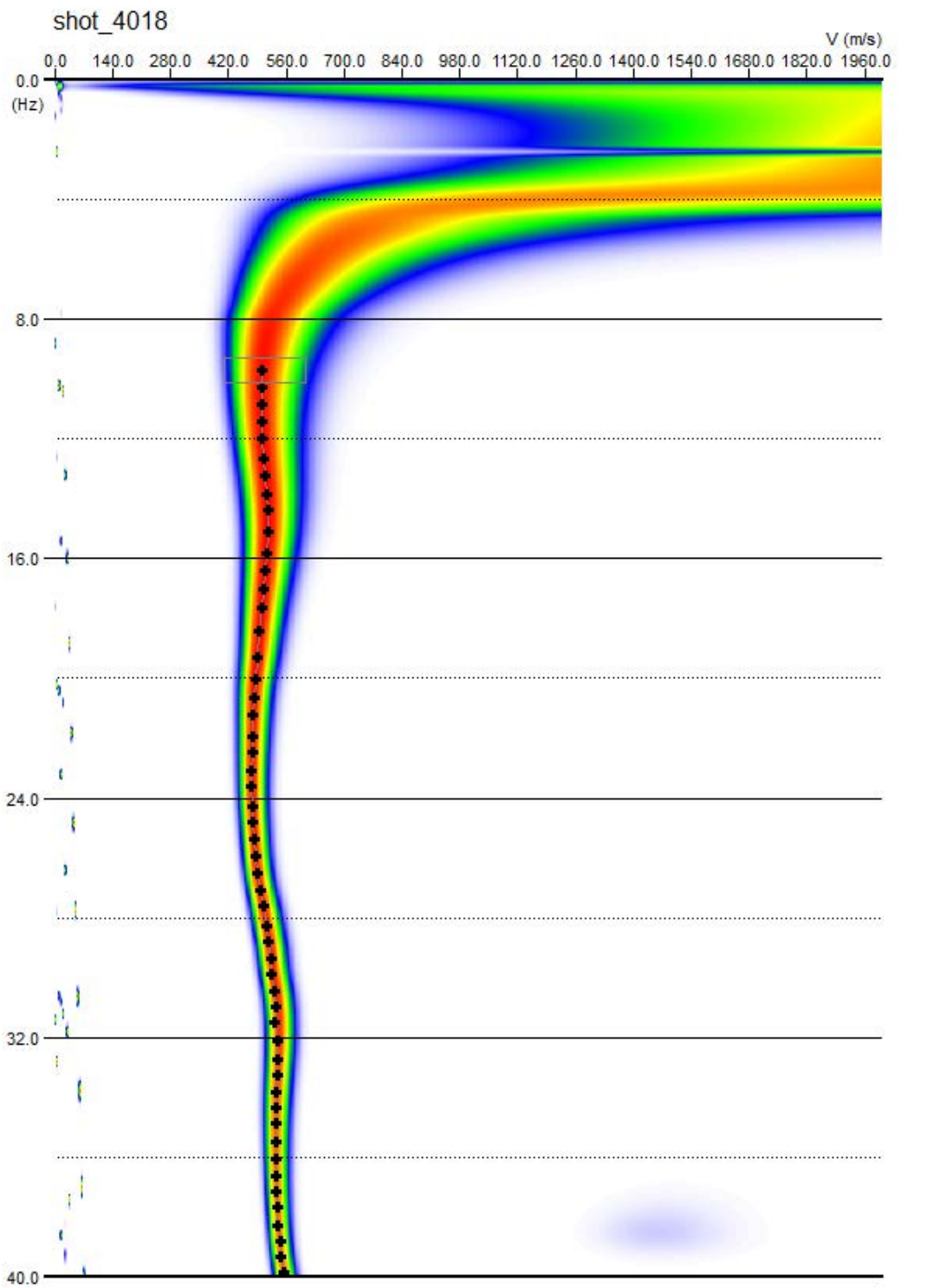

28.74 (Hz)

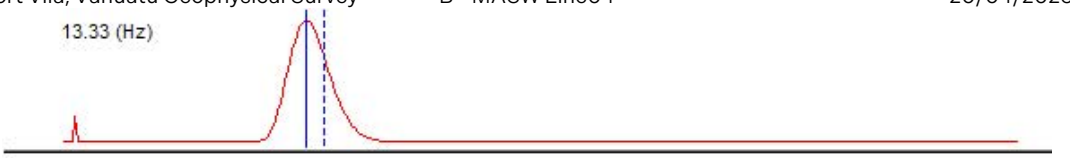

shot_4016
V (m/s)
0.0
140.0
280.0
420.0
560.0
700.0
840.0
980.0
1120.0
1260.0
1400.0
1540.0
1680.0
1820.0
1960.0
0.0
(Hz)
8.0
16.0
24.0
32.0
40.0

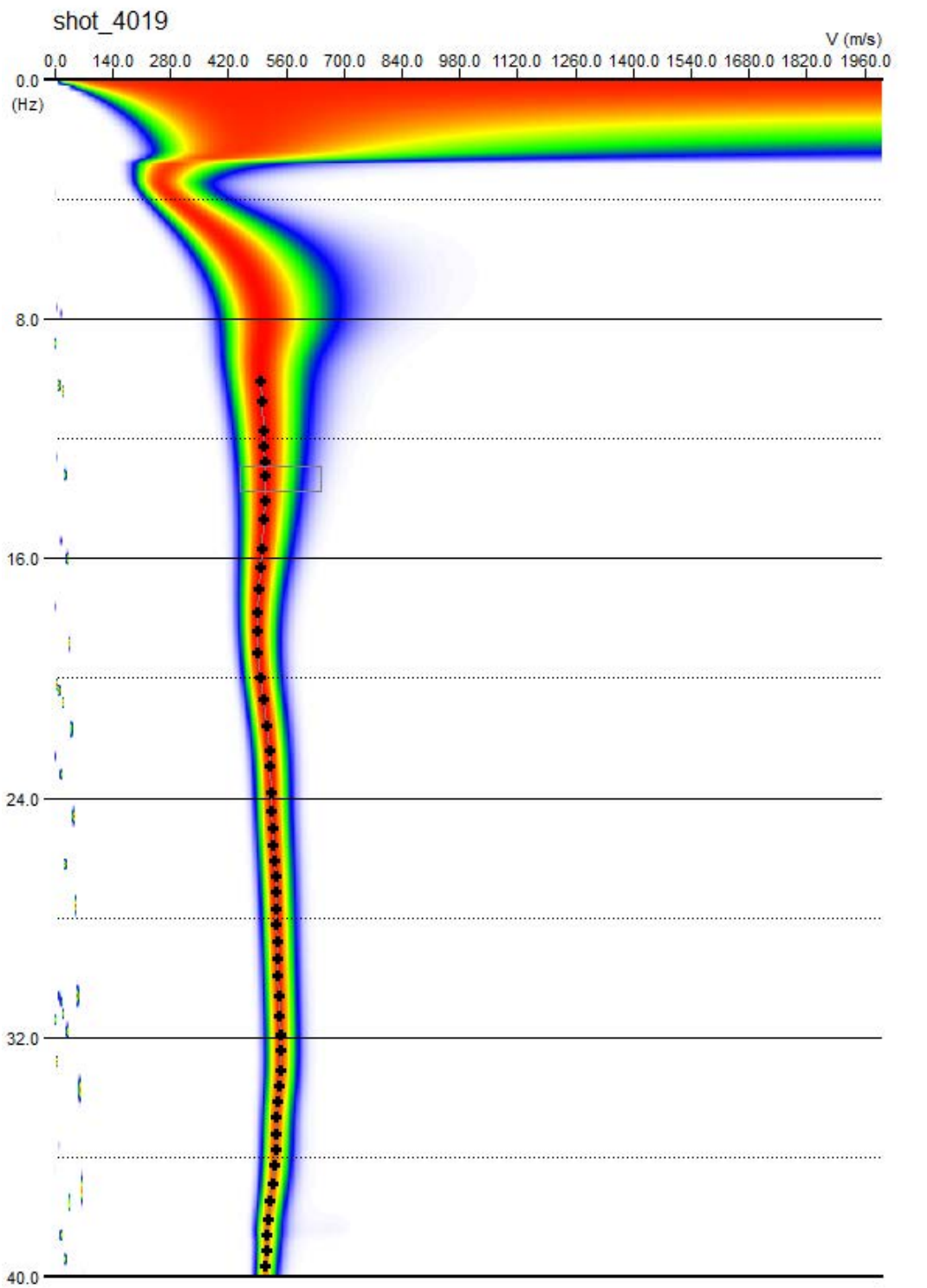

9.03 (Hz)

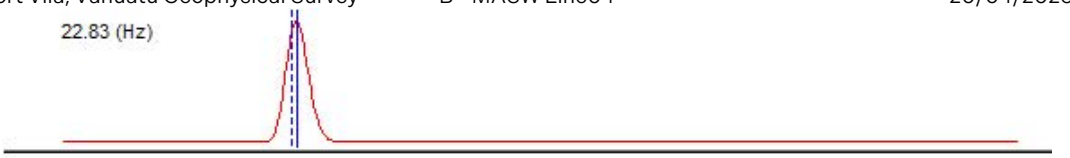

shot_4017
V (m/s)
0.0
140.0
280.0
420.0
560.0
700.0
840.0
980.0
1120.0
1260.0
1400.0
1540.0
1680.0
1820.0
1960.0
0.0
(Hz)
8.0
16.0
24.0
32.0
40.0

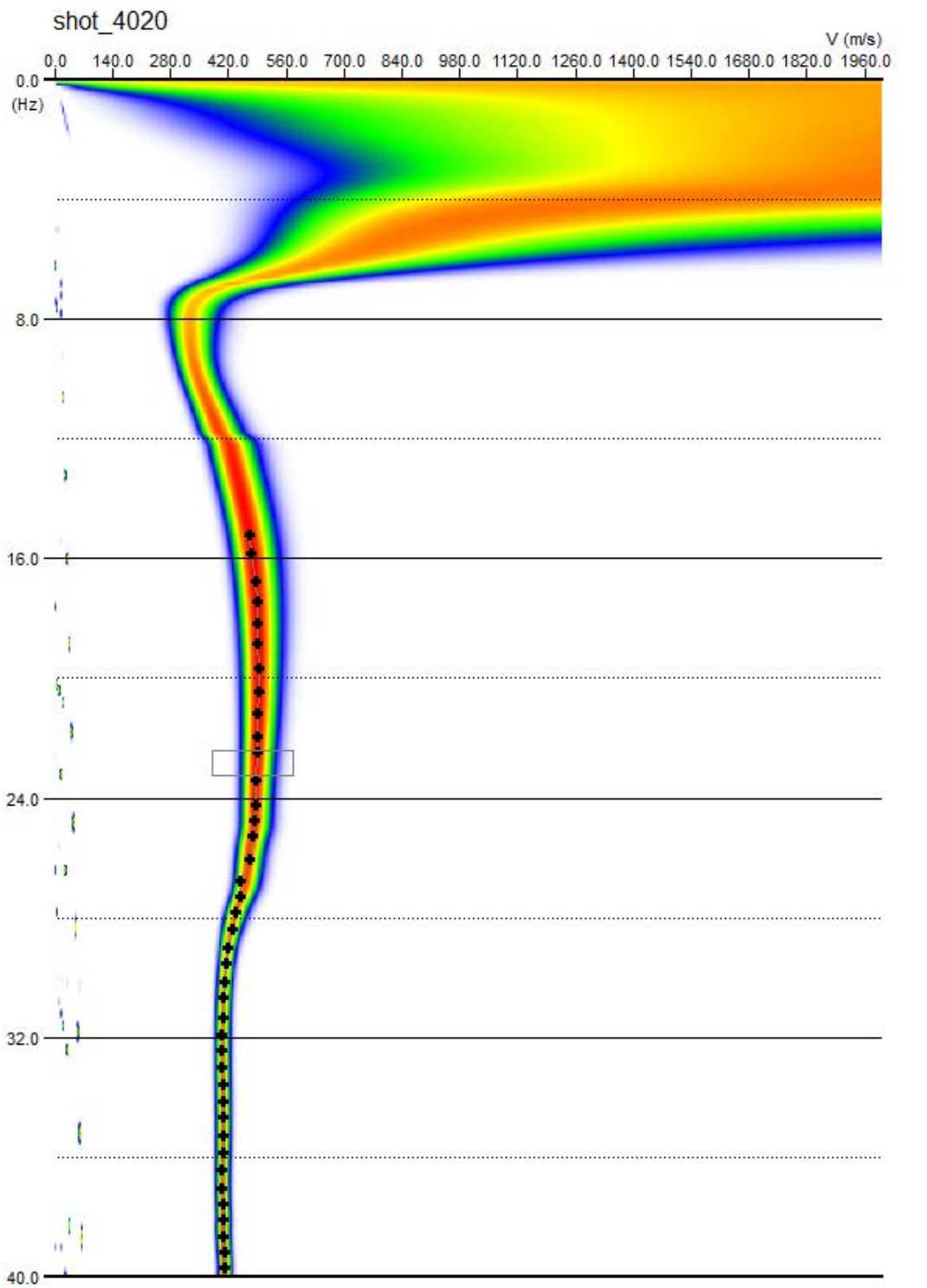

9.70 (Hz)

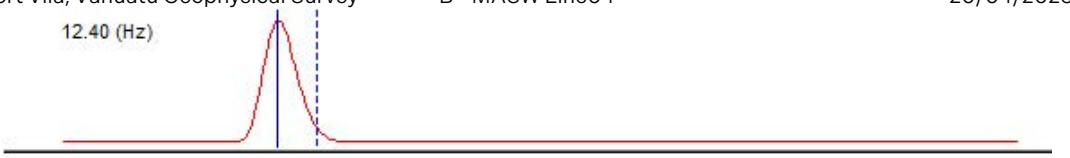

shot_4018
V (m/s)
0.0 140.0 280.0 420.0 560.0 700.0 840.0 980.0 1120.0 1260.0 1400.0 1540.0 1680.0 1820.0 1960.0
0.0
(Hz)
8.0
16.0
24.0
32.0
40.0

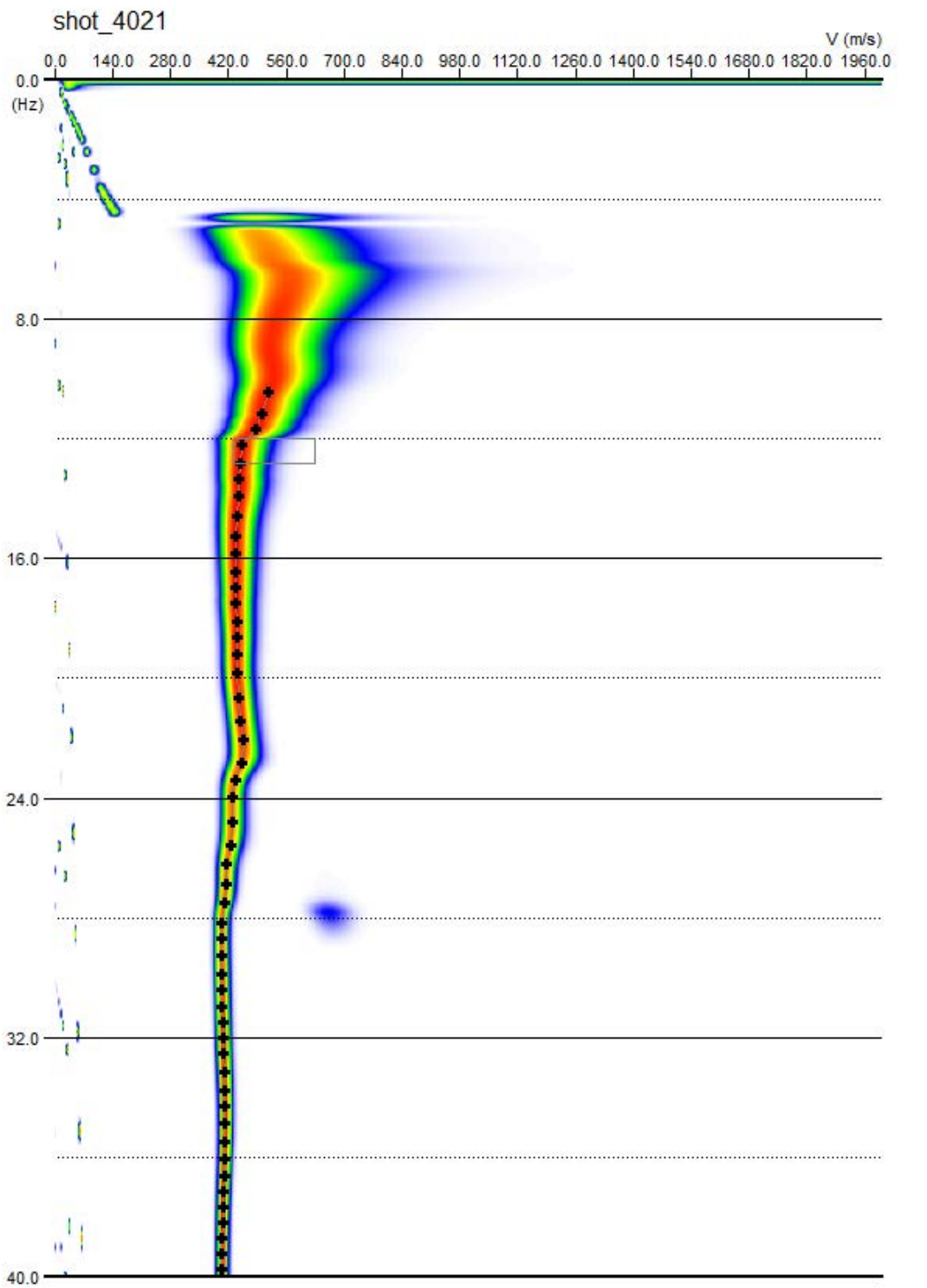

13.33 (Hz)

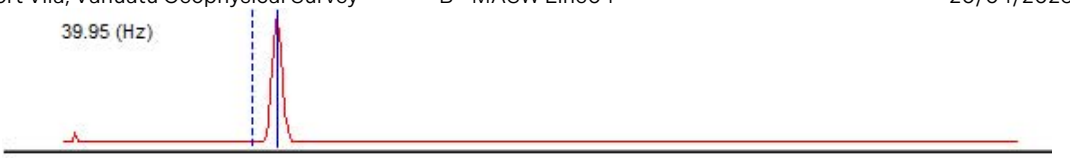

shot_4019
V (m/s)
0.0 140.0 280.0 420.0 560.0 700.0 840.0 980.0 1120.0 1260.0 1400.0 1540.0 1680.0 1820.0 1960.0
0.0
(Hz)
8.0
16.0
24.0
32.0
40.0

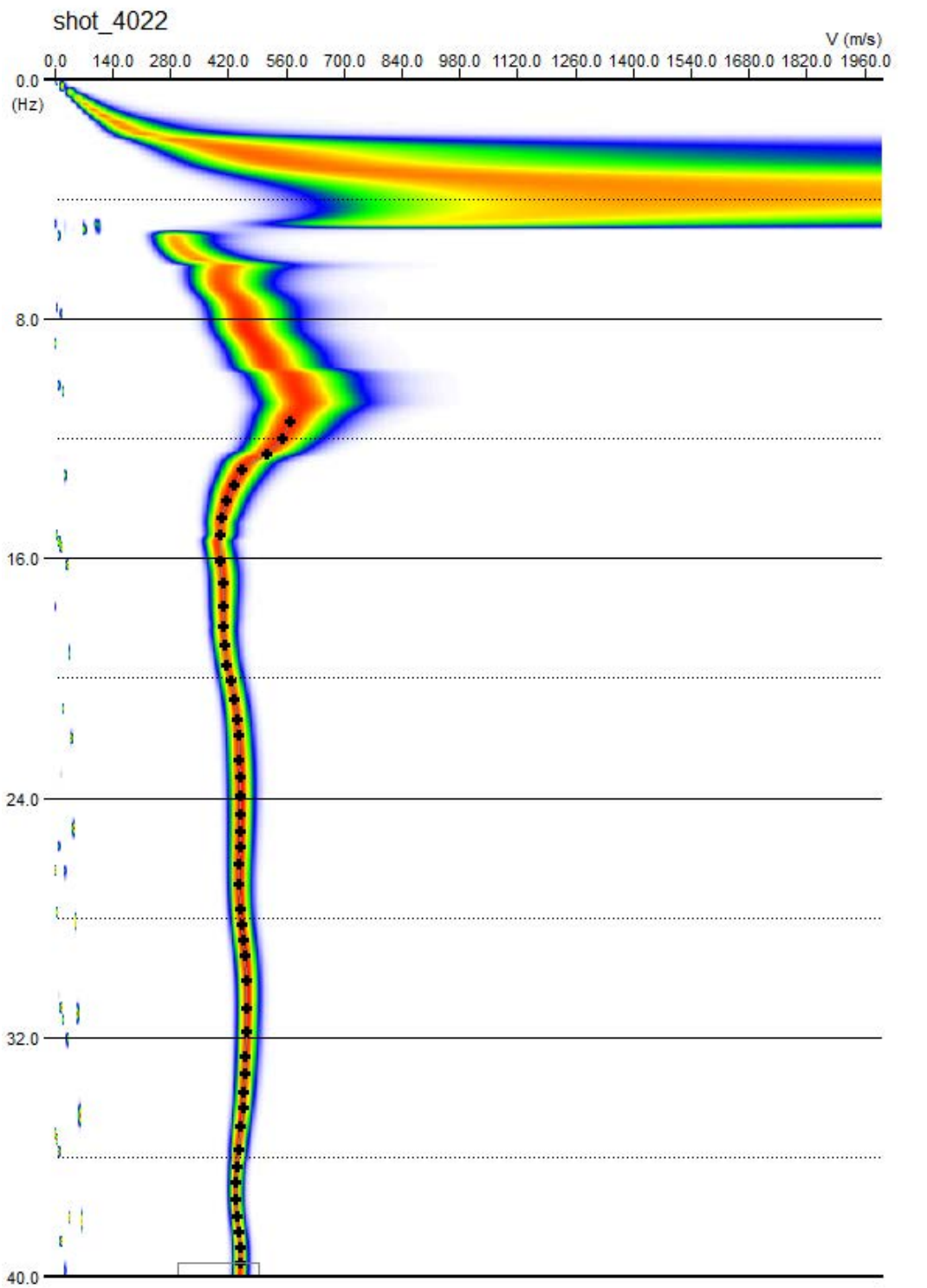

22.83 (Hz)

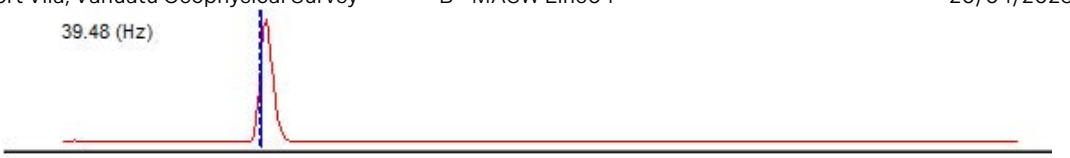

shot_4020
V (m/s)
0.0 140.0 280.0 420.0 560.0 700.0 840.0 980.0 1120.0 1260.0 1400.0 1540.0 1680.0 1820.0 1960.0
0.0
(Hz)
8.0
16.0
24.0
32.0
40.0

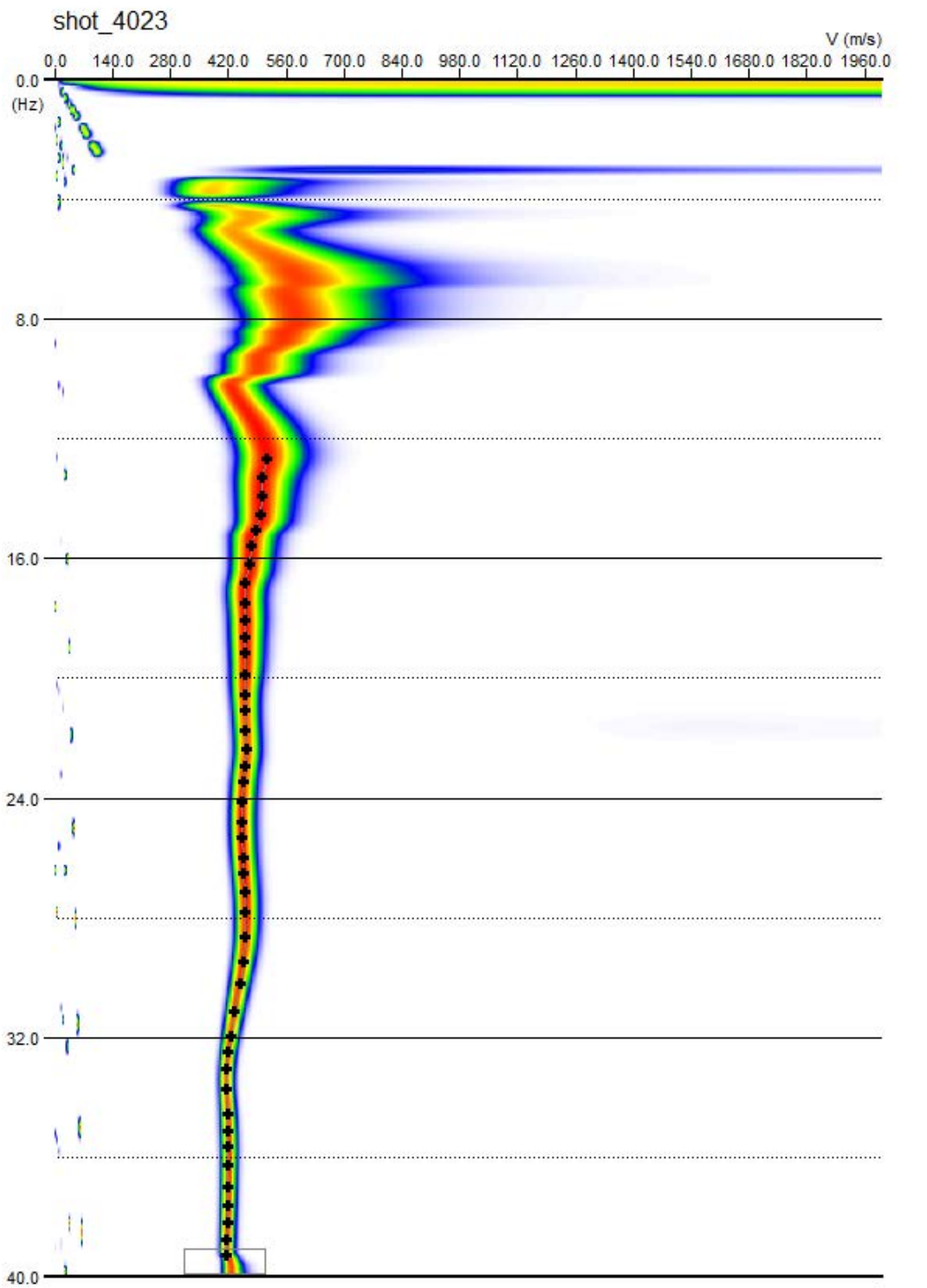

12.40 (Hz)

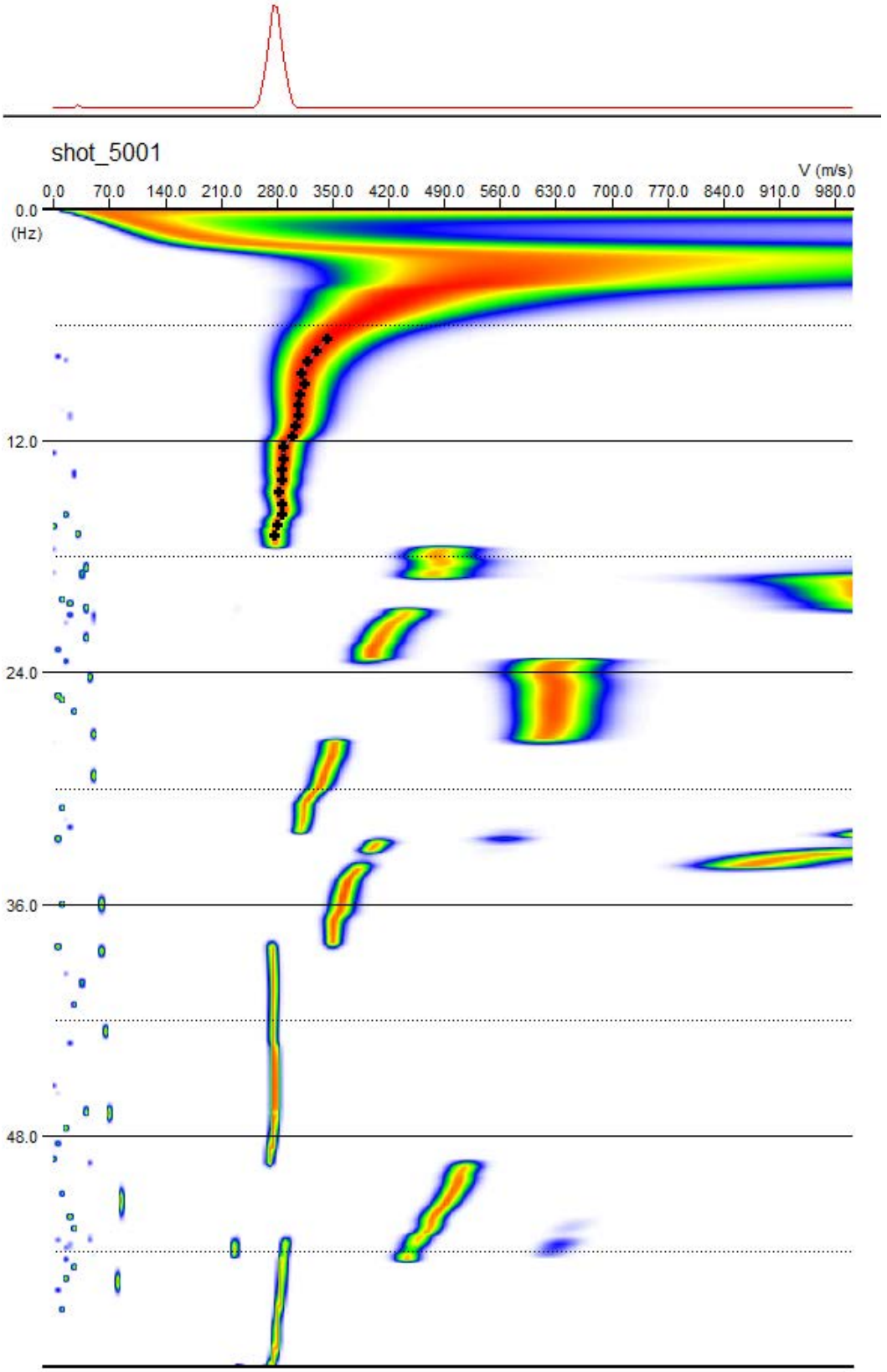

shot_4021
V (m/s)
0.0 140.0 280.0 420.0 560.0 700.0 840.0 980.0 1120.0 1260.0 1400.0 1540.0 1680.0 1820.0 1960.0
0.0
(Hz)
8.0
16.0
24.0
32.0
40.0

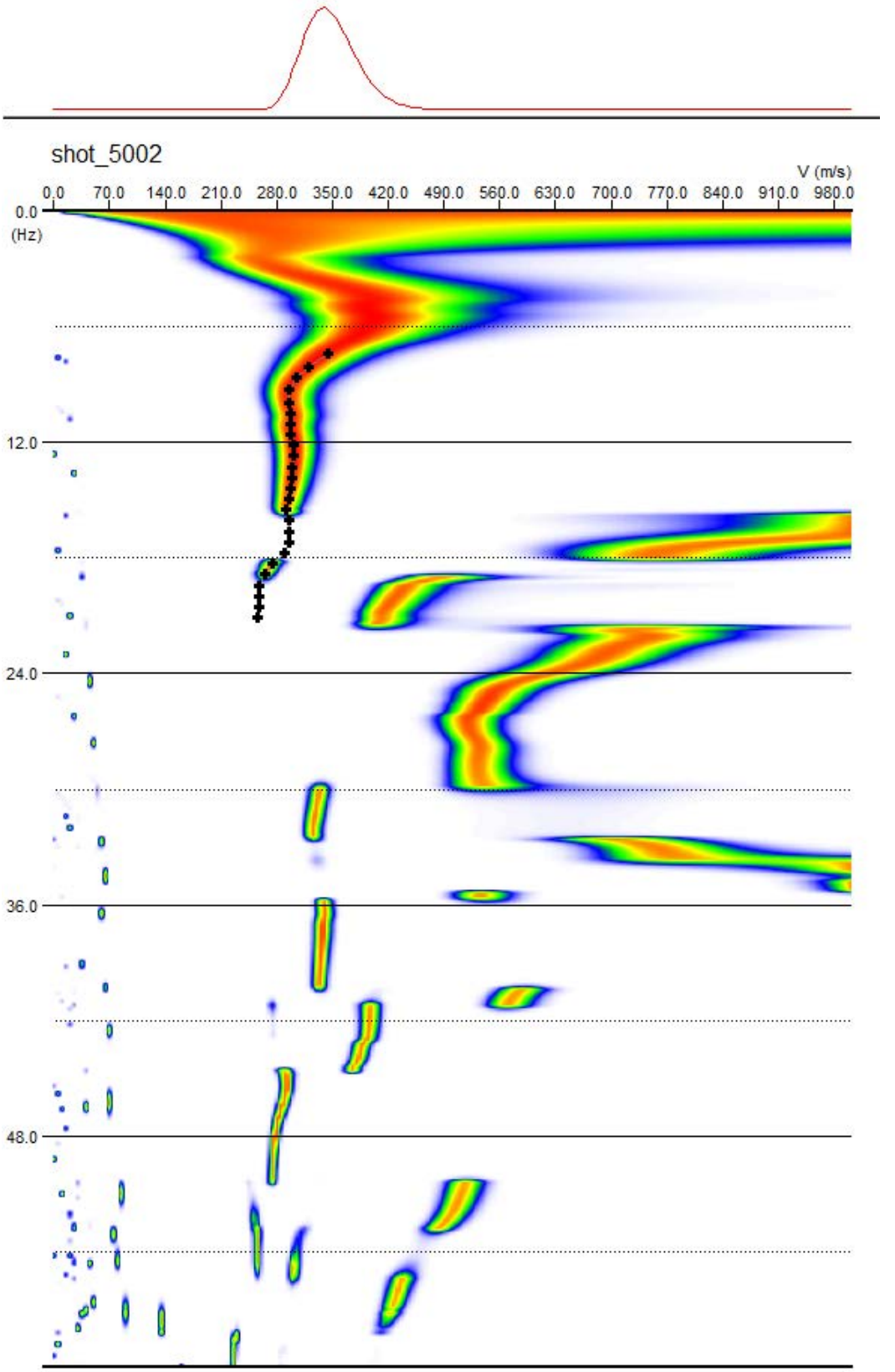

39.95 (Hz)

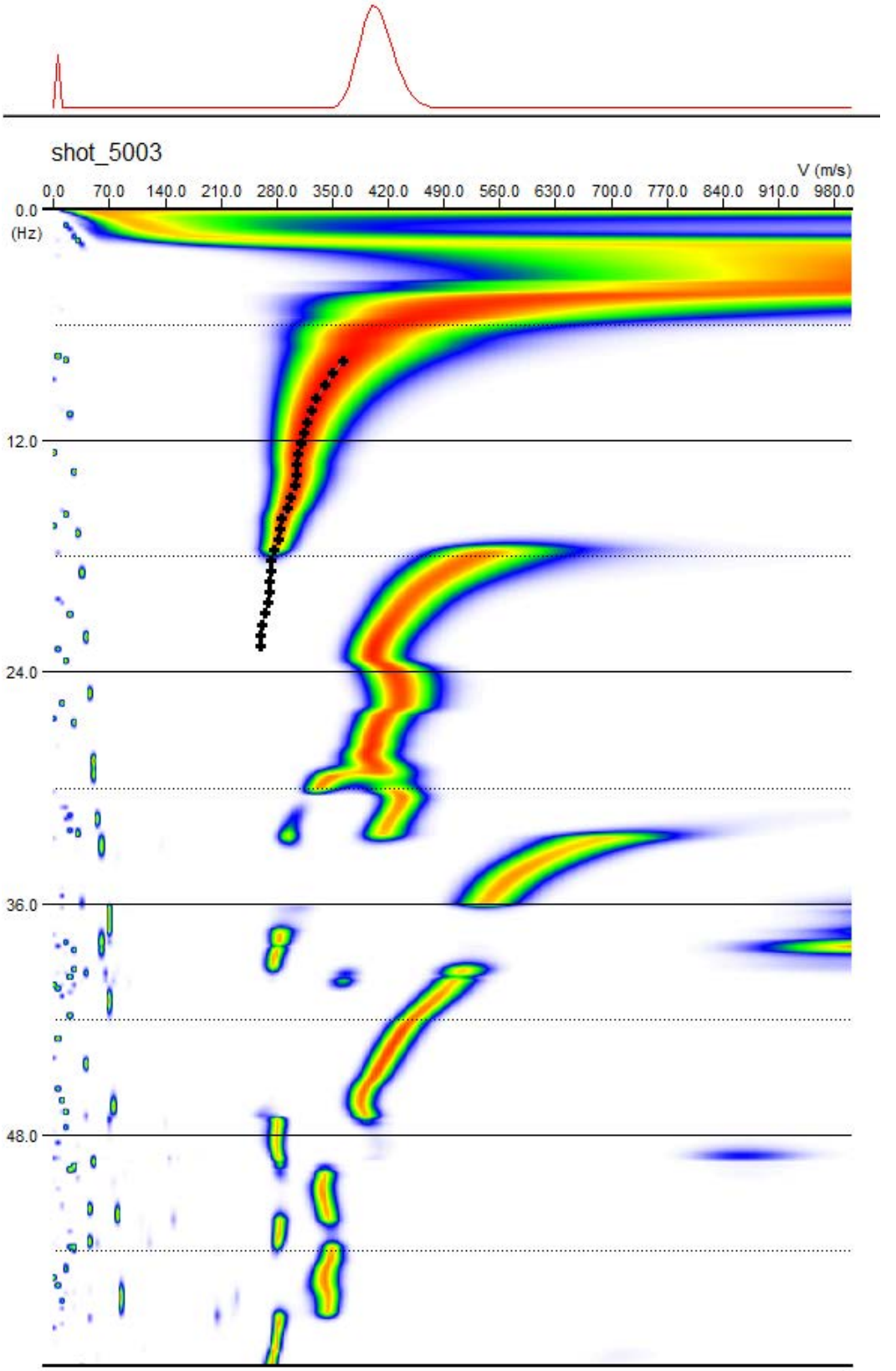

shot_4022
V (m/s)
0.0 140.0 280.0 420.0 560.0 700.0 840.0 980.0 1120.0 1260.0 1400.0 1540.0 1680.0 1820.0 1960.0
0.0
(Hz)
8.0
16.0
24.0
32.0
40.0

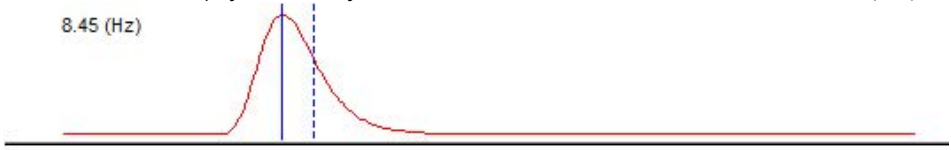

39.48 (Hz)

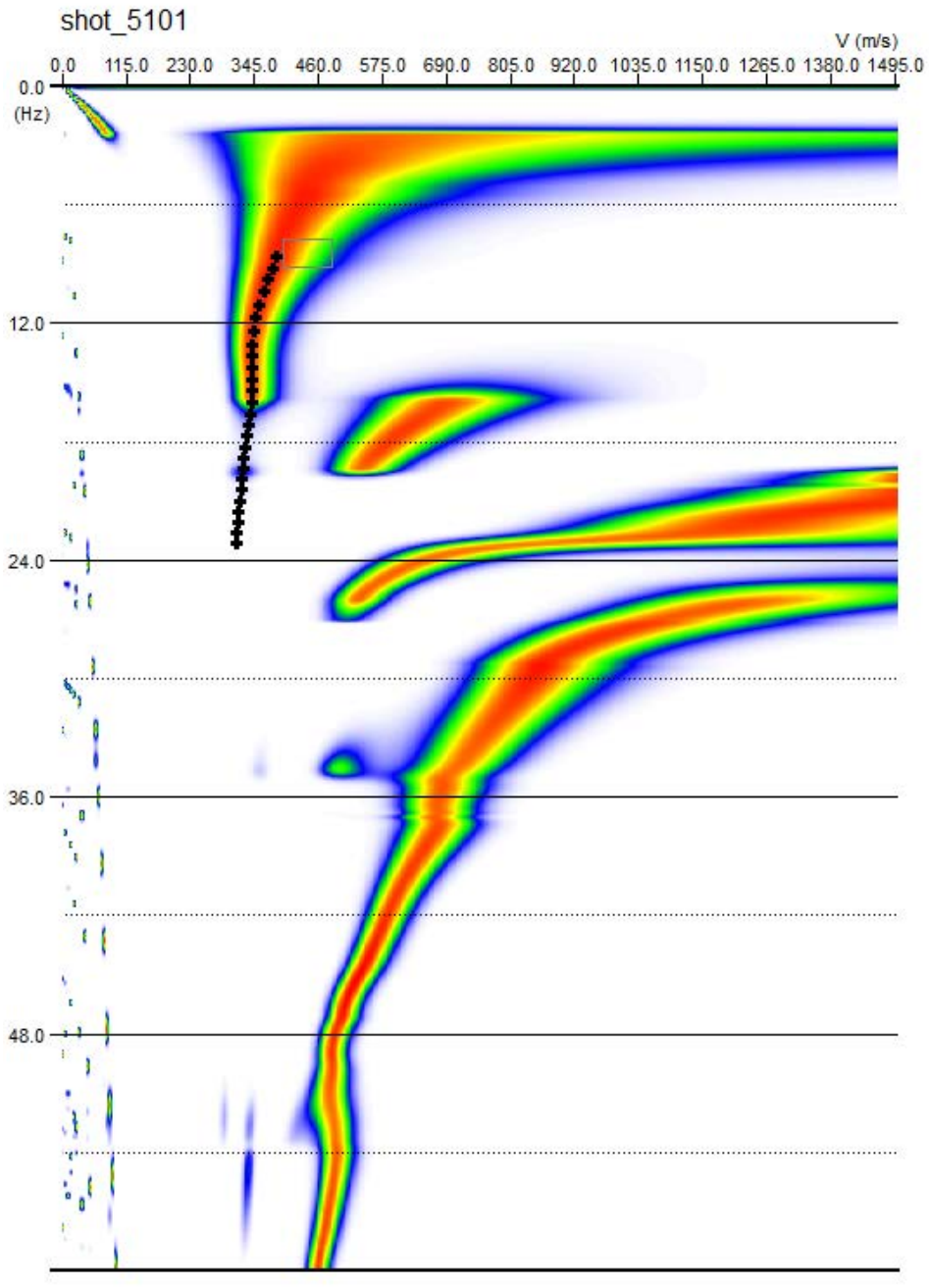

shot_4023
V (m/s)
0.0 140.0 280.0 420.0 560.0 700.0 840.0 980.0 1120.0 1260.0 1400.0 1540.0 1680.0 1820.0 1960.0
0.0
(Hz)
8.0
16.0
24.0
32.0
40.0

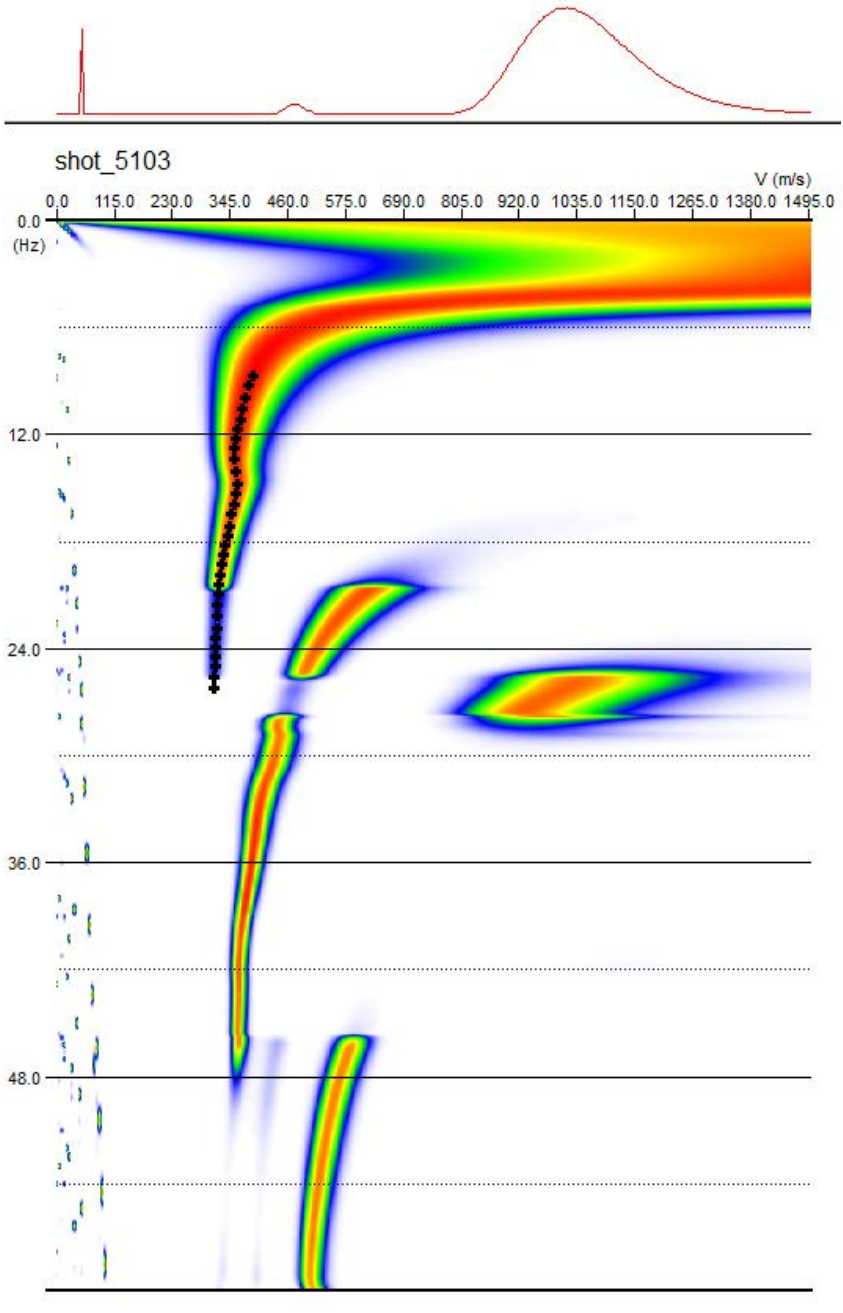

shot_5001
V (m/s)
0.0
70.0
140.0
210.0
280.0
350.0
420.0
490.0
560.0
630.0
700.0
770.0
840.0
910.0
980.0
0.0
(Hz)
12.0
24.0
36.0
48.0

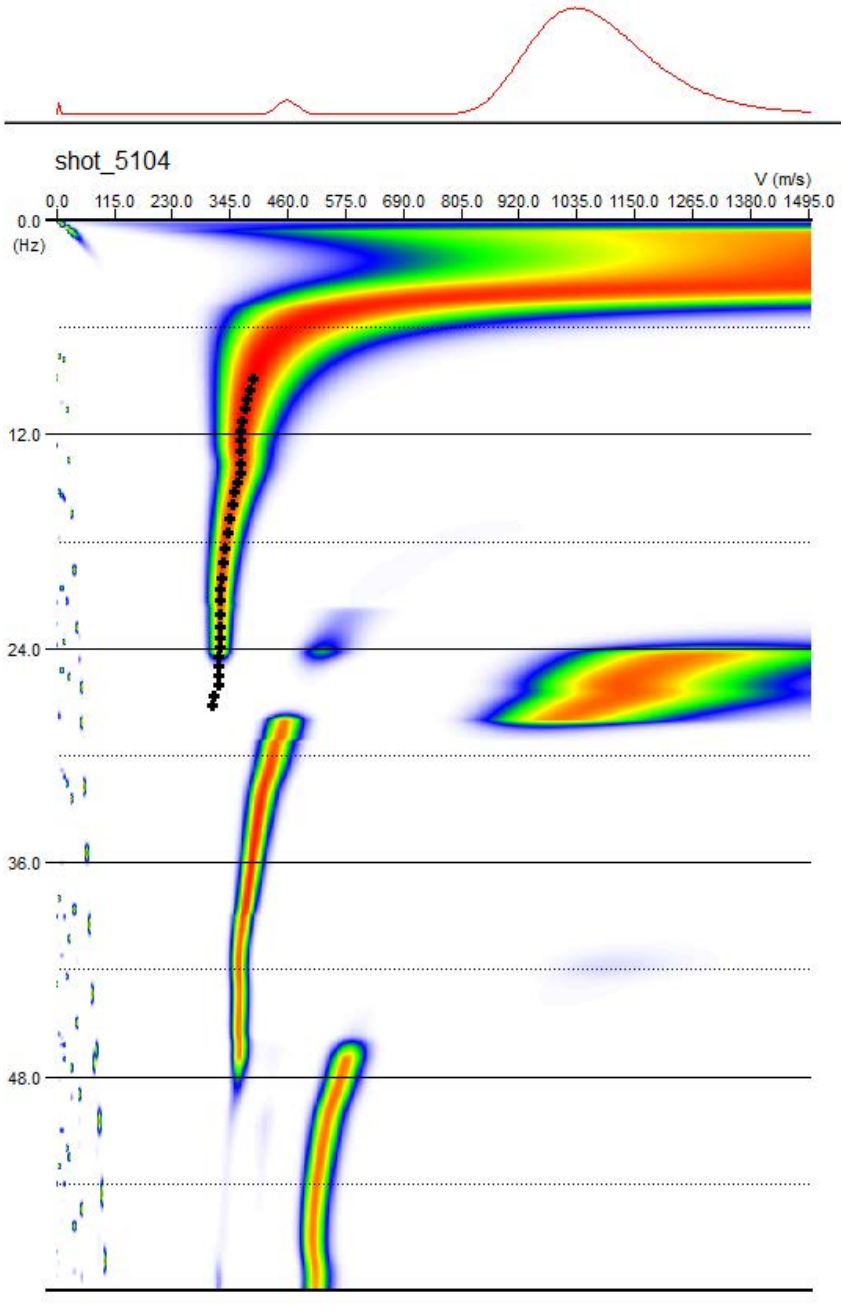

shot_5002
V (m/s)
0.0
70.0
140.0
210.0
280.0
350.0
420.0
490.0
560.0
630.0
700.0
770.0
840.0
910.0
980.0
0.0
(Hz)
12.0
24.0
36.0
48.0


shot_5003
V (m/s)
0.0
70.0
140.0
210.0
280.0
350.0
420.0
490.0
560.0
630.0
700.0
770.0
840.0
910.0
980.0
0.0
(Hz)
12.0
24.0
36.0
48.0

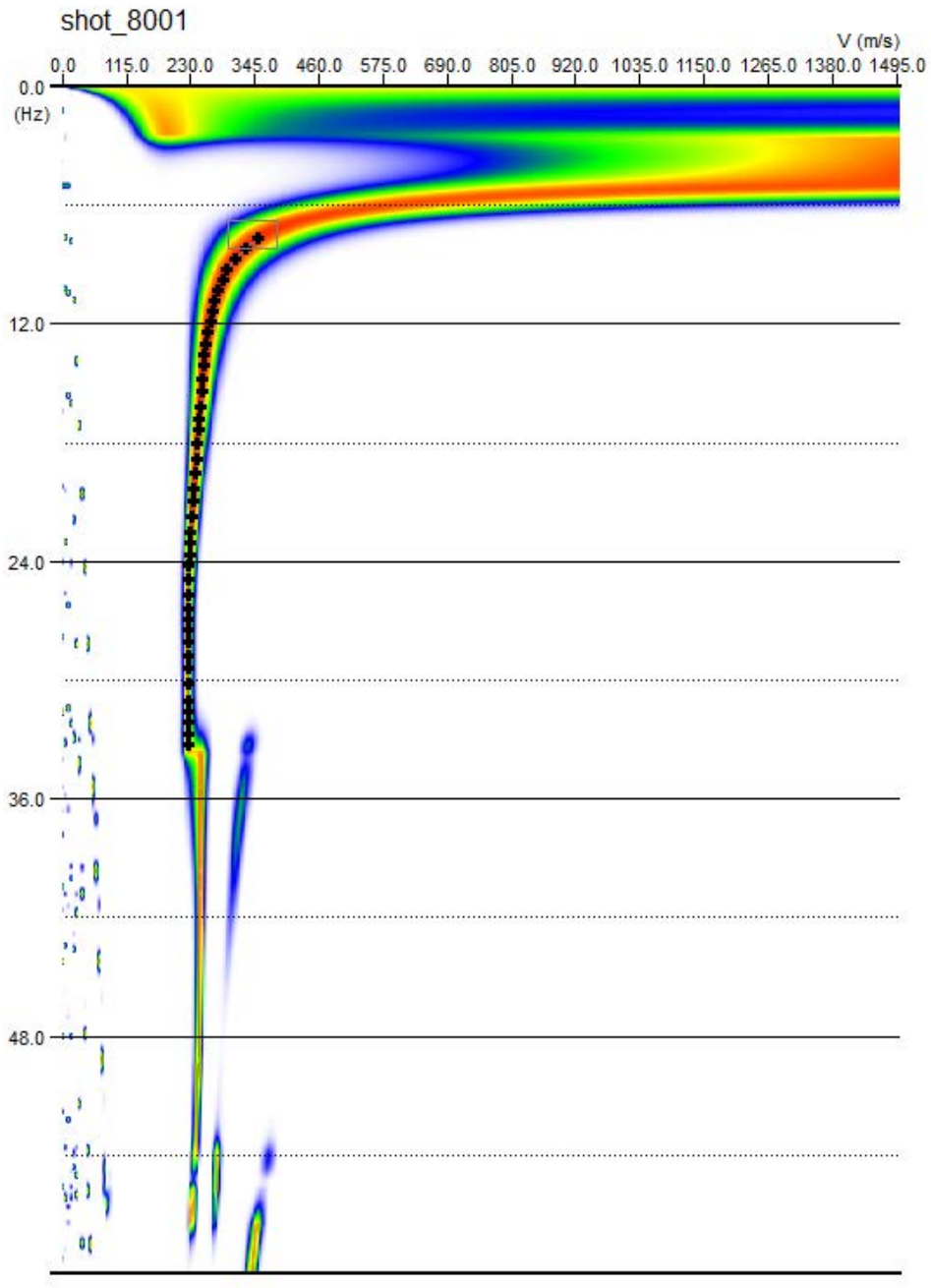

8.45 (Hz)


shot_5101
V (m/s)
0.0 115.0 230.0 345.0 460.0 575.0 690.0 805.0 920.0 1035.0 1150.0 1265.0 1380.0 1495.0
0.0
(Hz)
12.0
24.0
36.0
48.0

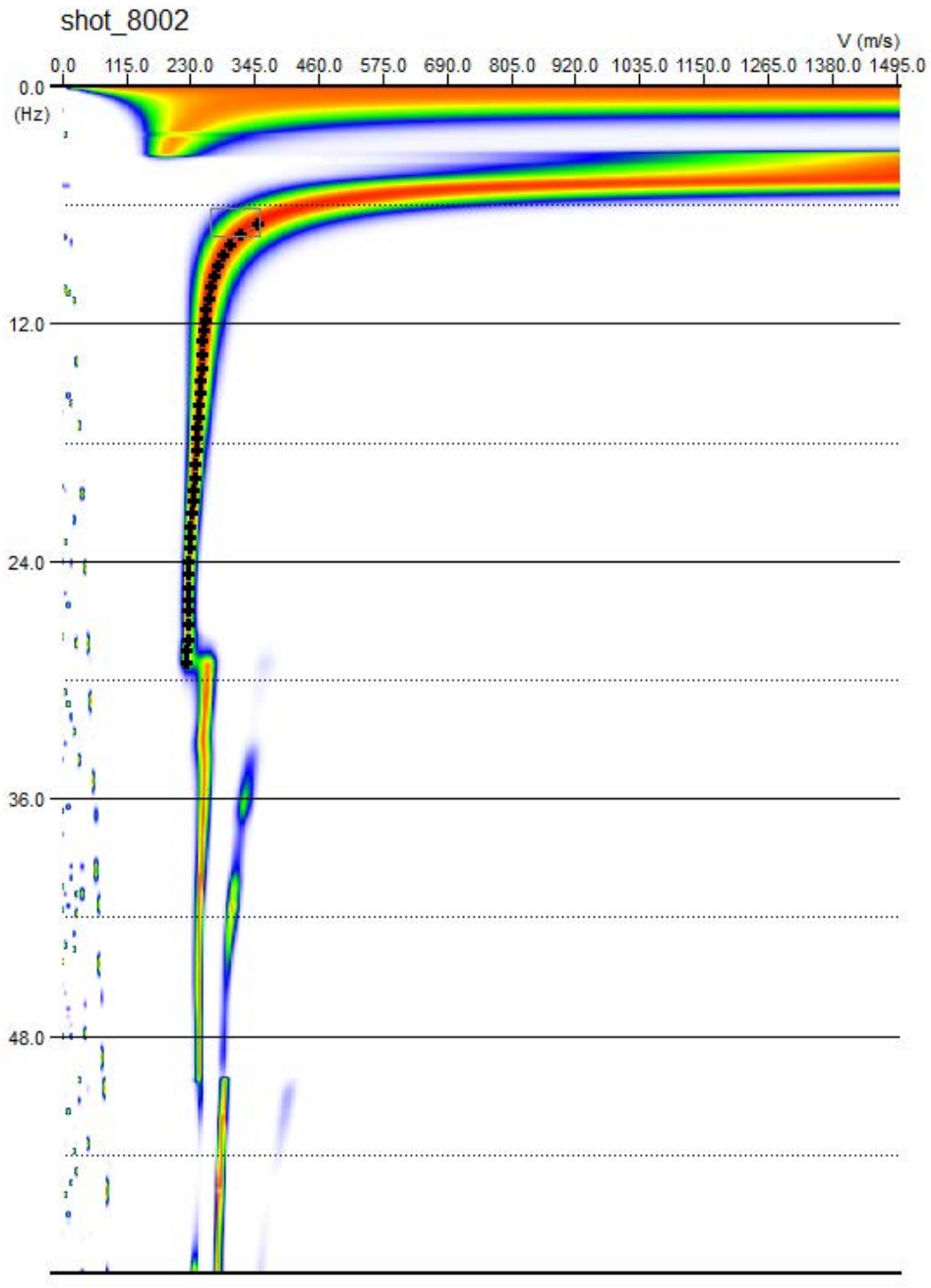

shot_5103
V (m/s)
0.0 115.0 230.0 345.0 460.0 575.0 690.0 805.0 920.0 1035.0 1150.0 1265.0 1380.0 1495.0
0.0
(Hz)
12.0
24.0
36.0
48.0


shot_5104
V (m/s)
0.0 115.0 230.0 345.0 460.0 575.0 690.0 805.0 920.0 1035.0 1150.0 1265.0 1380.0 1495.0
0.0
(Hz)
12.0
24.0
36.0
48.0

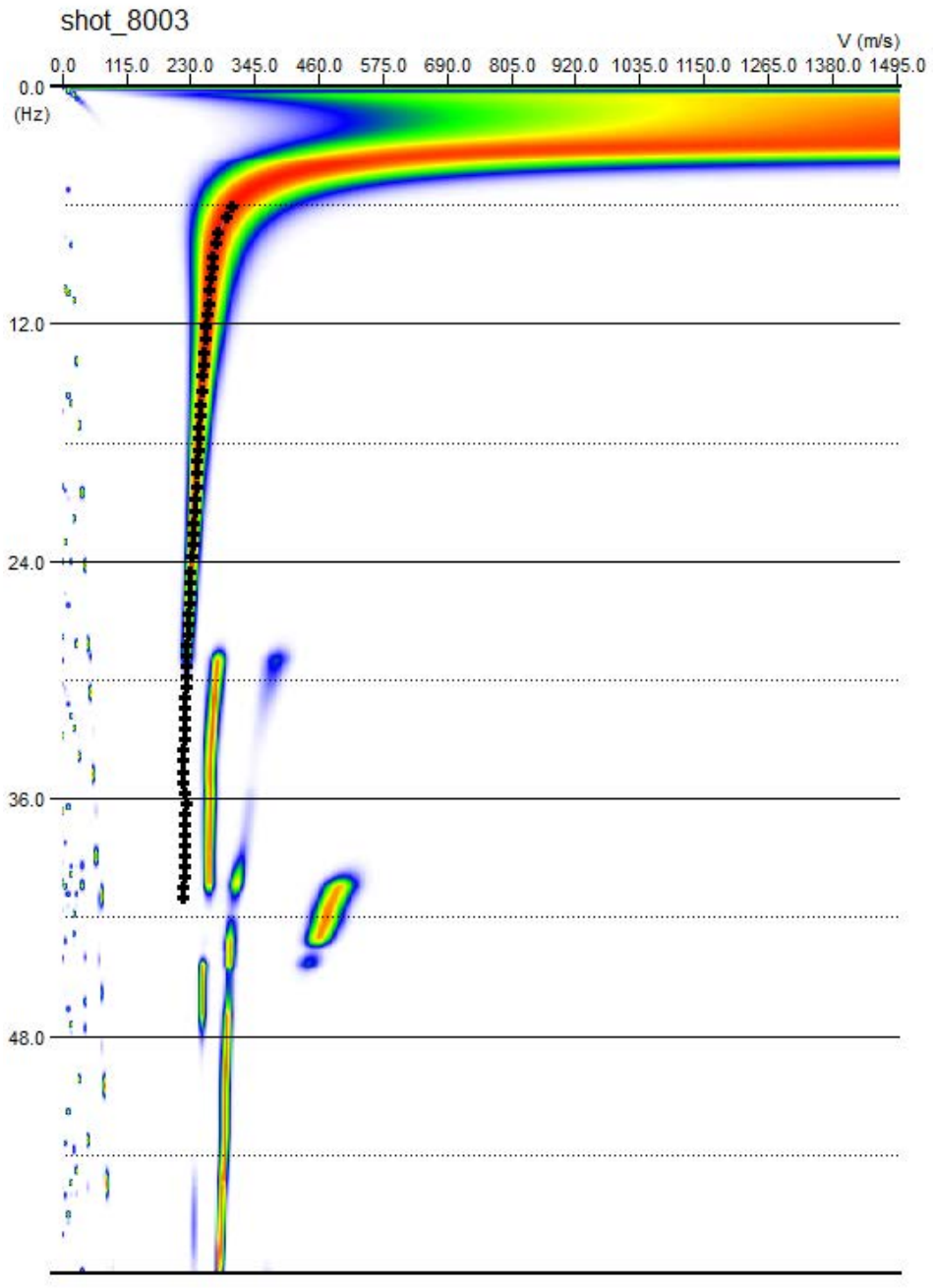

7.48 (Hz)

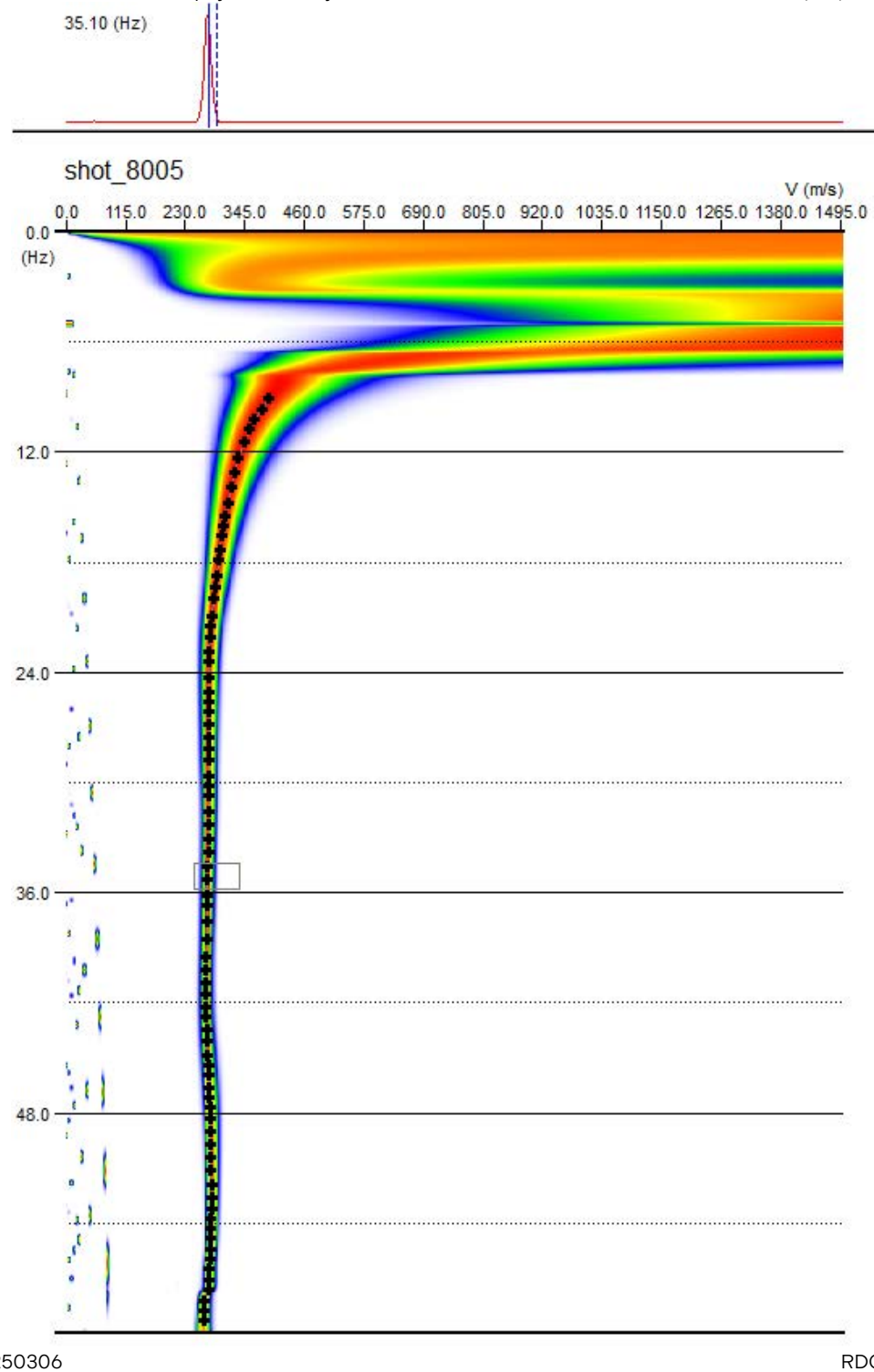

shot_8001
V (m/s)
0.0 115.0 230.0 345.0 460.0 575.0 690.0 805.0 920.0 1035.0 1150.0 1265.0 1380.0 1495.0
0.0
(Hz)
12.0
24.0
36.0
48.0

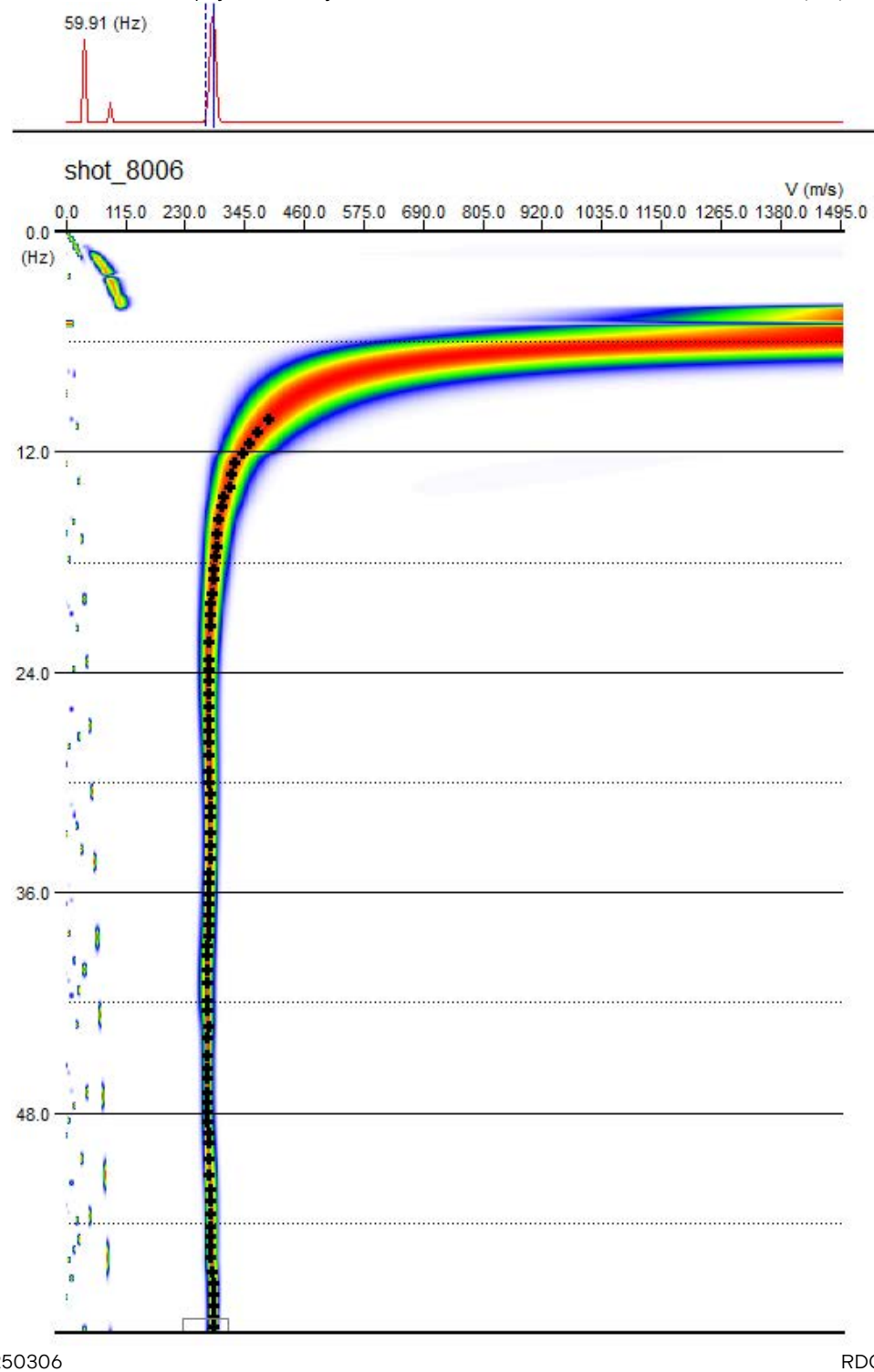

6.86 (Hz)


shot_8002
V (m/s)
0.0 115.0 230.0 345.0 460.0 575.0 690.0 805.0 920.0 1035.0 1150.0 1265.0 1380.0 1495.0
0.0
(Hz)
12.0
24.0
36.0
48.0

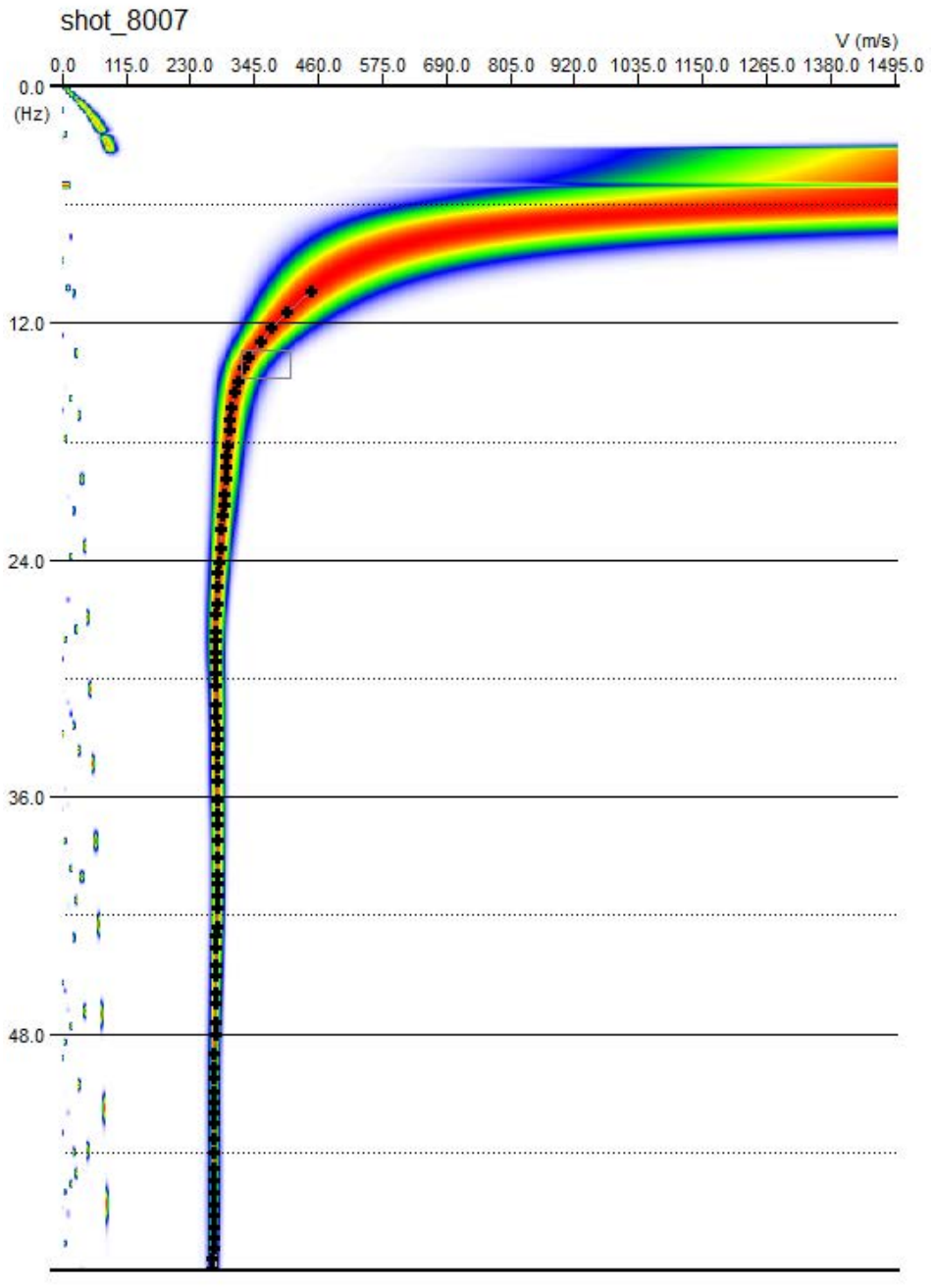



shot_8003
V (m/s)
0.0 115.0 230.0 345.0 460.0 575.0 690.0 805.0 920.0 1035.0 1150.0 1265.0 1380.0 1495.0
0.0
(Hz)
12.0
24.0
36.0
48.0

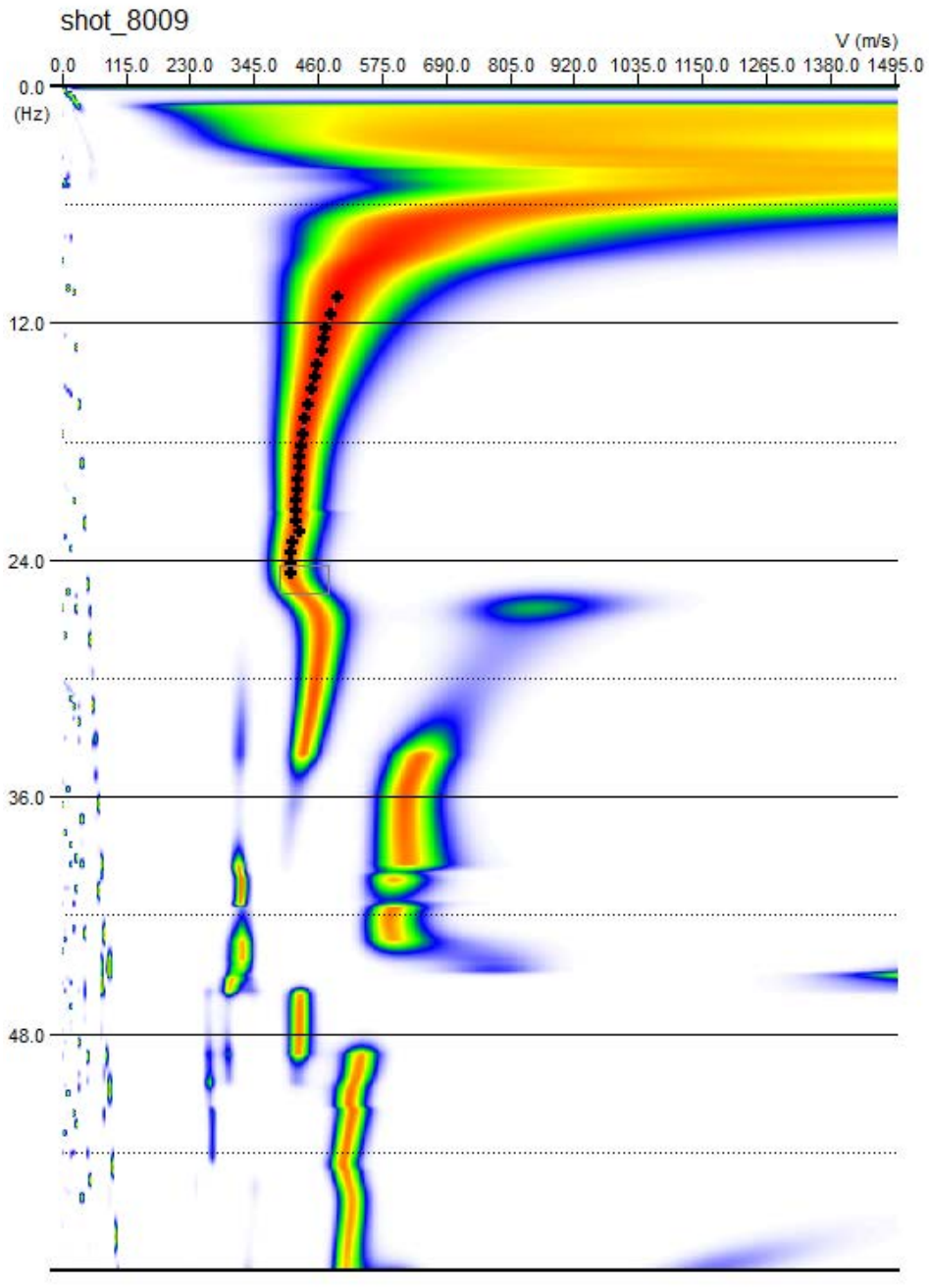

35.10 (Hz)
shot_8005
V (m/s)
0.0 115.0 230.0 345.0 460.0 575.0 690.0 805.0 920.0 1035.0 1150.0 1265.0 1380.0 1495.0
0.0
(Hz)
12.0
24.0
36.0
48.0

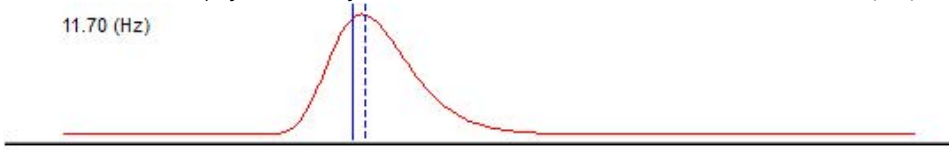

59.91 (Hz)
shot_8006
V (m/s)
0.0 115.0 230.0 345.0 460.0 575.0 690.0 805.0 920.0 1035.0 1150.0 1265.0 1380.0 1495.0
0.0
(Hz)
12.0
24.0
36.0
48.0

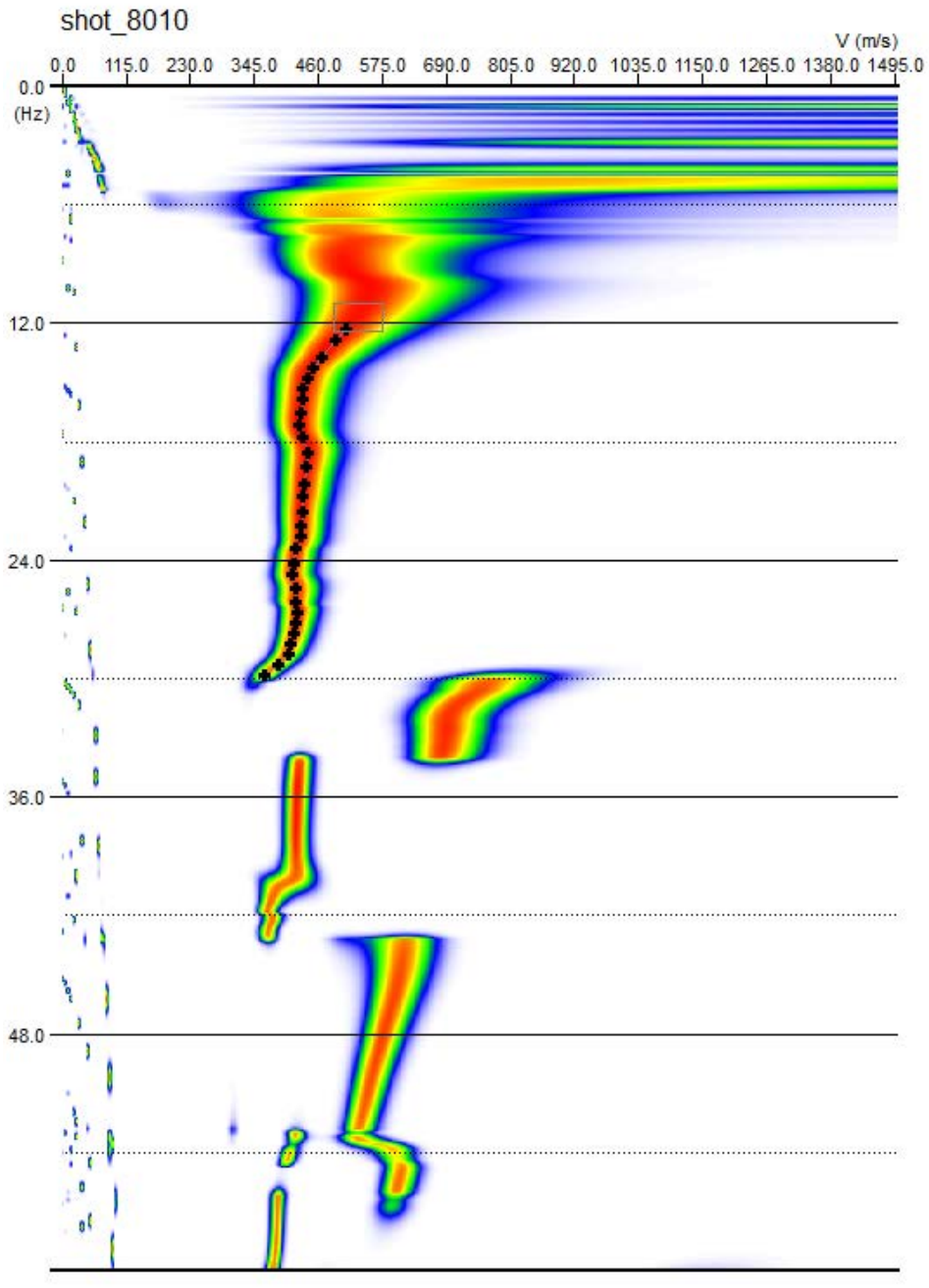

14.08 (Hz)


shot_8007
V (m/s)
0.0 115.0 230.0 345.0 460.0 575.0 690.0 805.0 920.0 1035.0 1150.0 1265.0 1380.0 1495.0
0.0
(Hz)
12.0
24.0
36.0
48.0

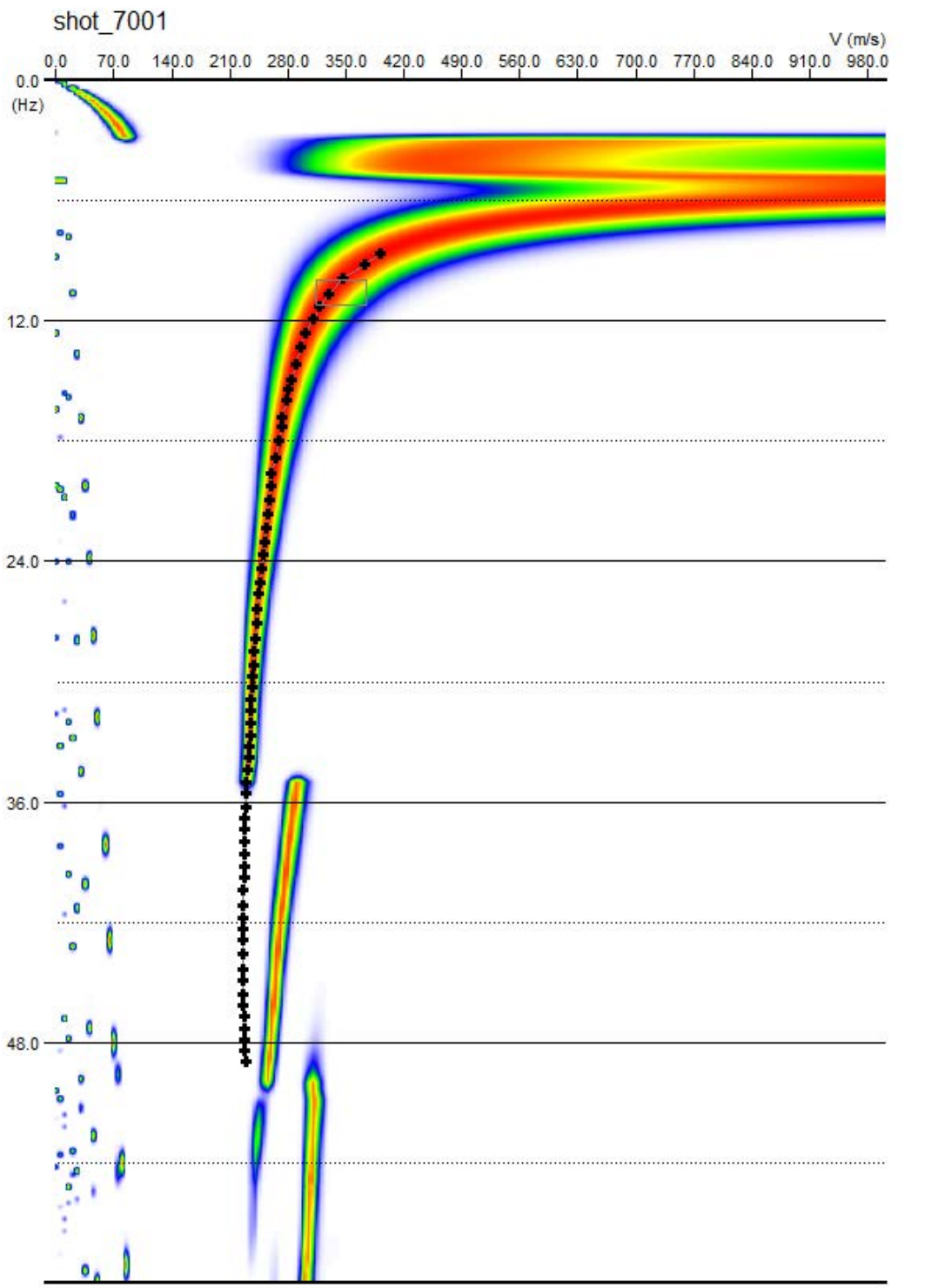

24.99 (Hz)

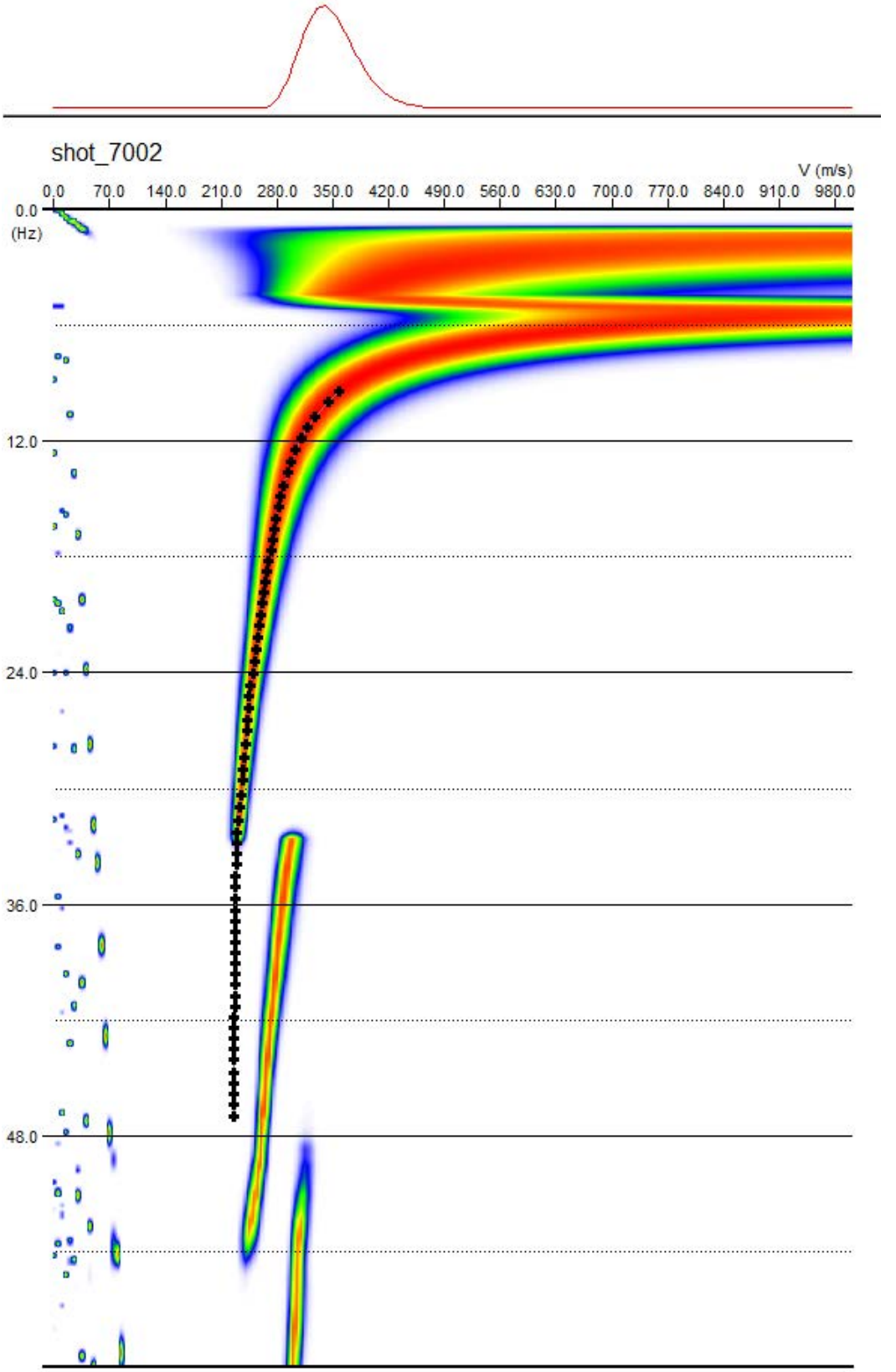

shot_8009
V (m/s)
0.0
115.0
230.0
345.0
460.0
575.0
690.0
805.0
920.0
1035.0
1150.0
1265.0
1380.0
1495.0
0.0
(Hz)
12.0
24.0
36.0
48.0

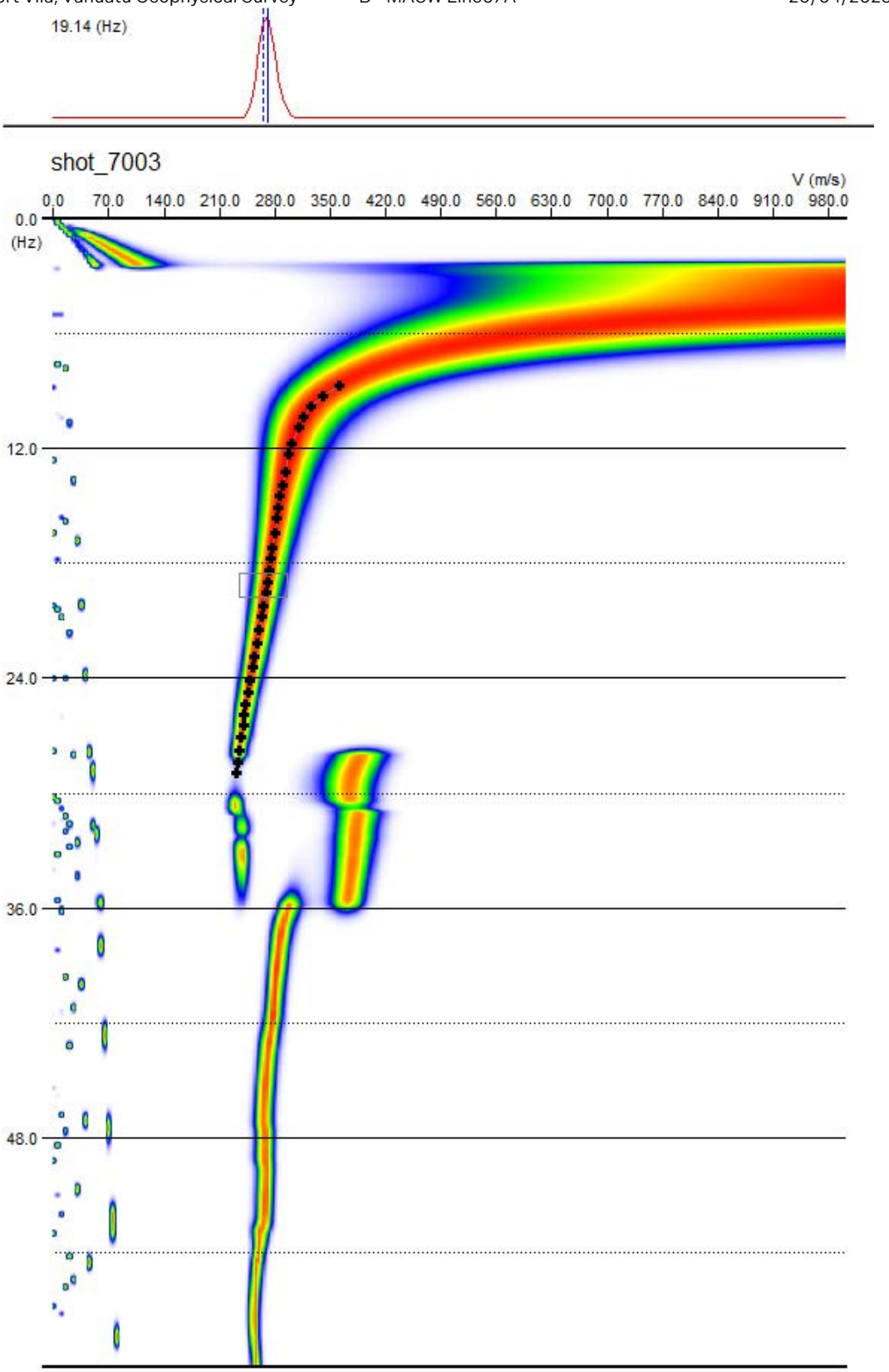

11.70 (Hz)

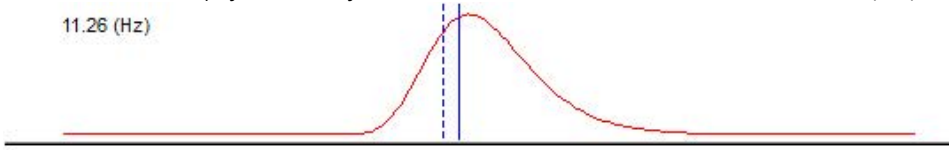

shot_8010
V (m/s)
0.0 115.0 230.0 345.0 460.0 575.0 690.0 805.0 920.0 1035.0 1150.0 1265.0 1380.0 1495.0
0.0
(Hz)
12.0
24.0
36.0
48.0

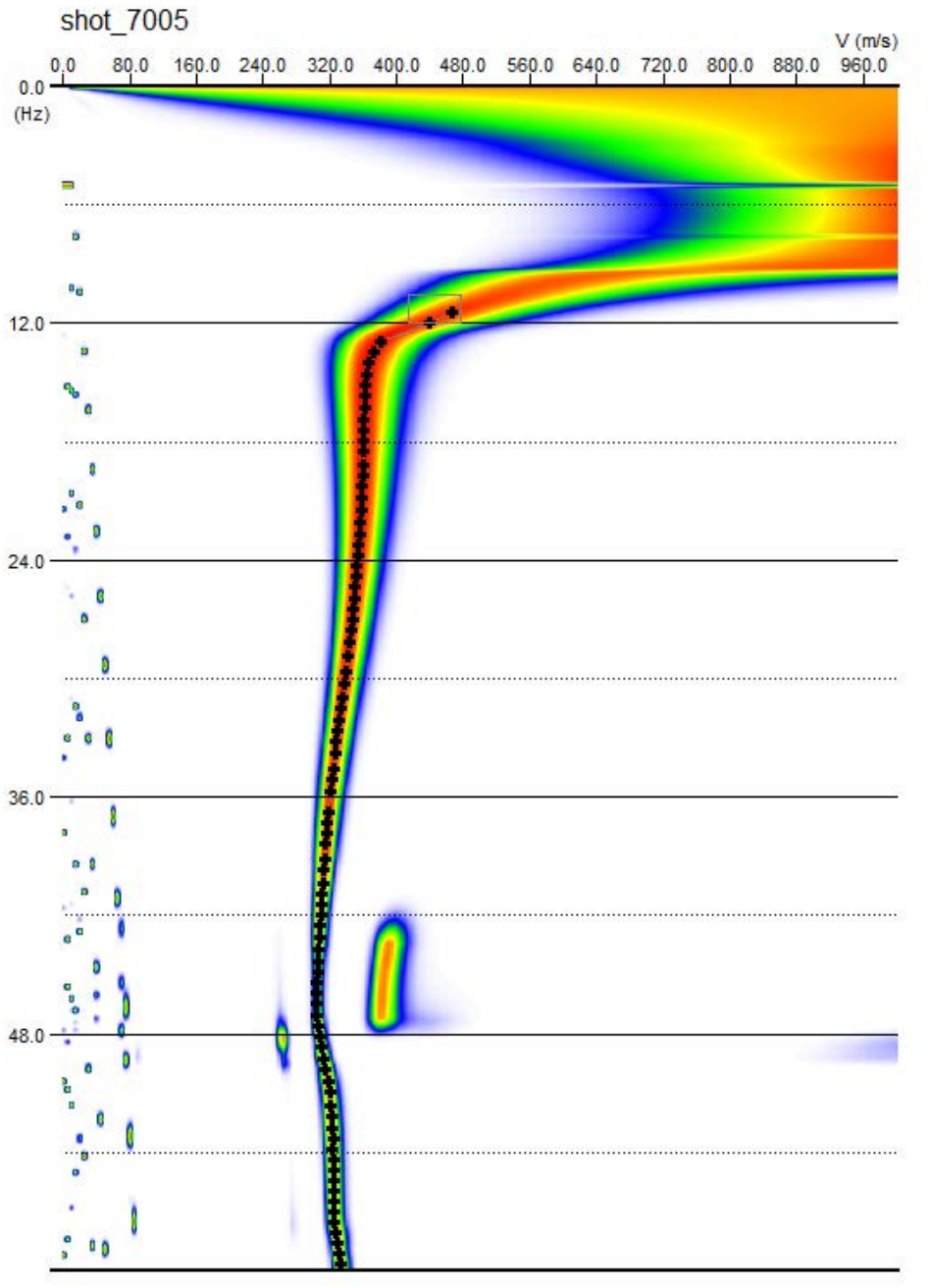

10.58 (Hz)

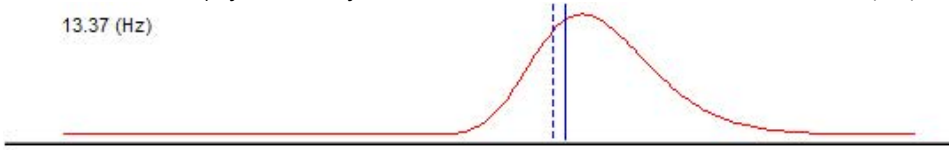

shot_7001
V (m/s)
0.0
70.0
140.0
210.0
280.0
350.0
420.0
490.0
560.0
630.0
700.0
770.0
840.0
910.0
980.0
0.0
(Hz)
12.0
24.0
36.0
48.0

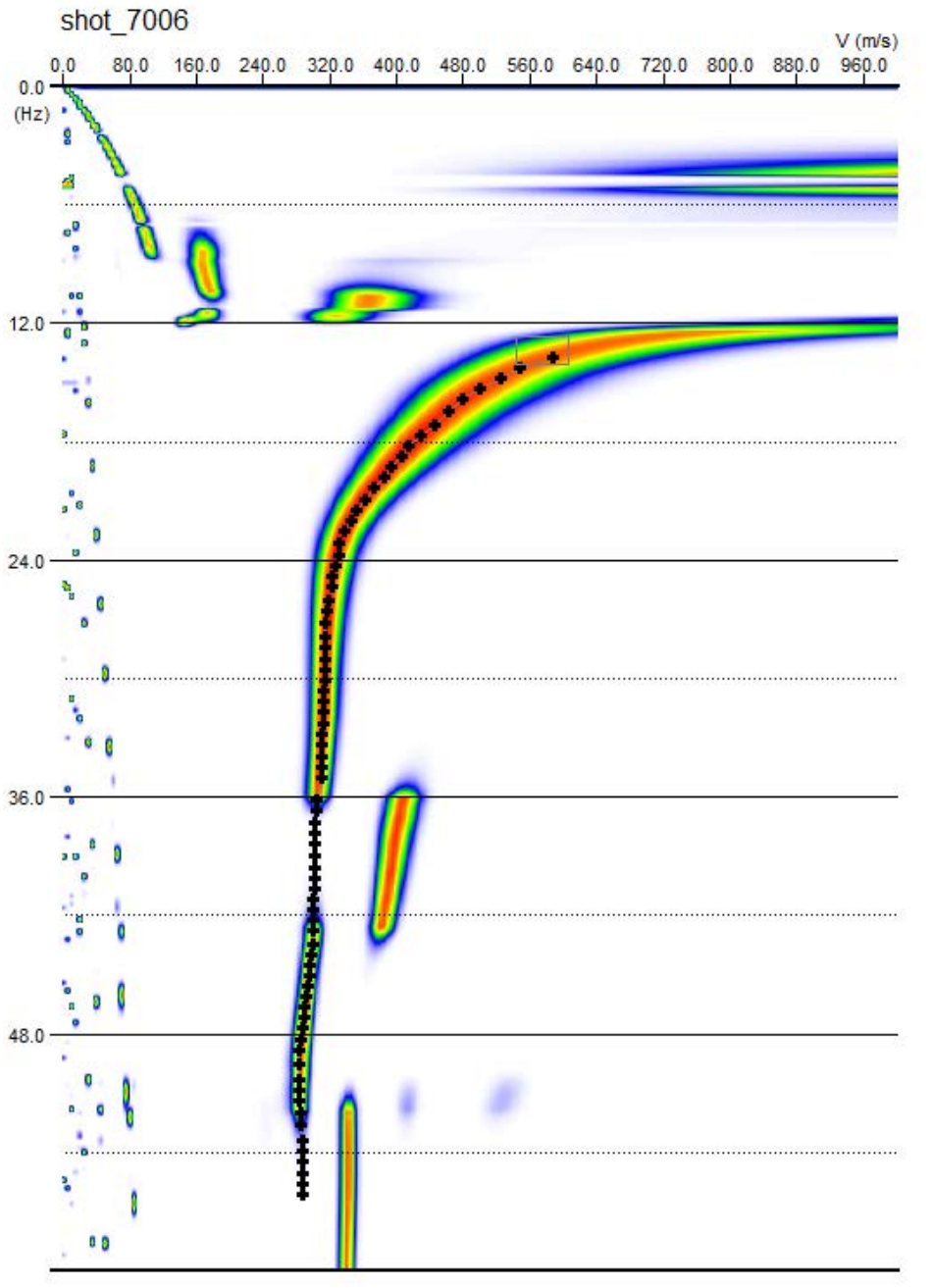

shot_7002
V (m/s)
0.0
70.0
140.0
210.0
280.0
350.0
420.0
490.0
560.0
630.0
700.0
770.0
840.0
910.0
980.0
0.0
(Hz)
12.0
24.0
36.0
48.0


19.14 (Hz)
shot_7003
V (m/s)
0.0 70.0 140.0 210.0 280.0 350.0 420.0 490.0 560.0 630.0 700.0 770.0 840.0 910.0 980.0
0.0
(Hz)
12.0
24.0
36.0
48.0

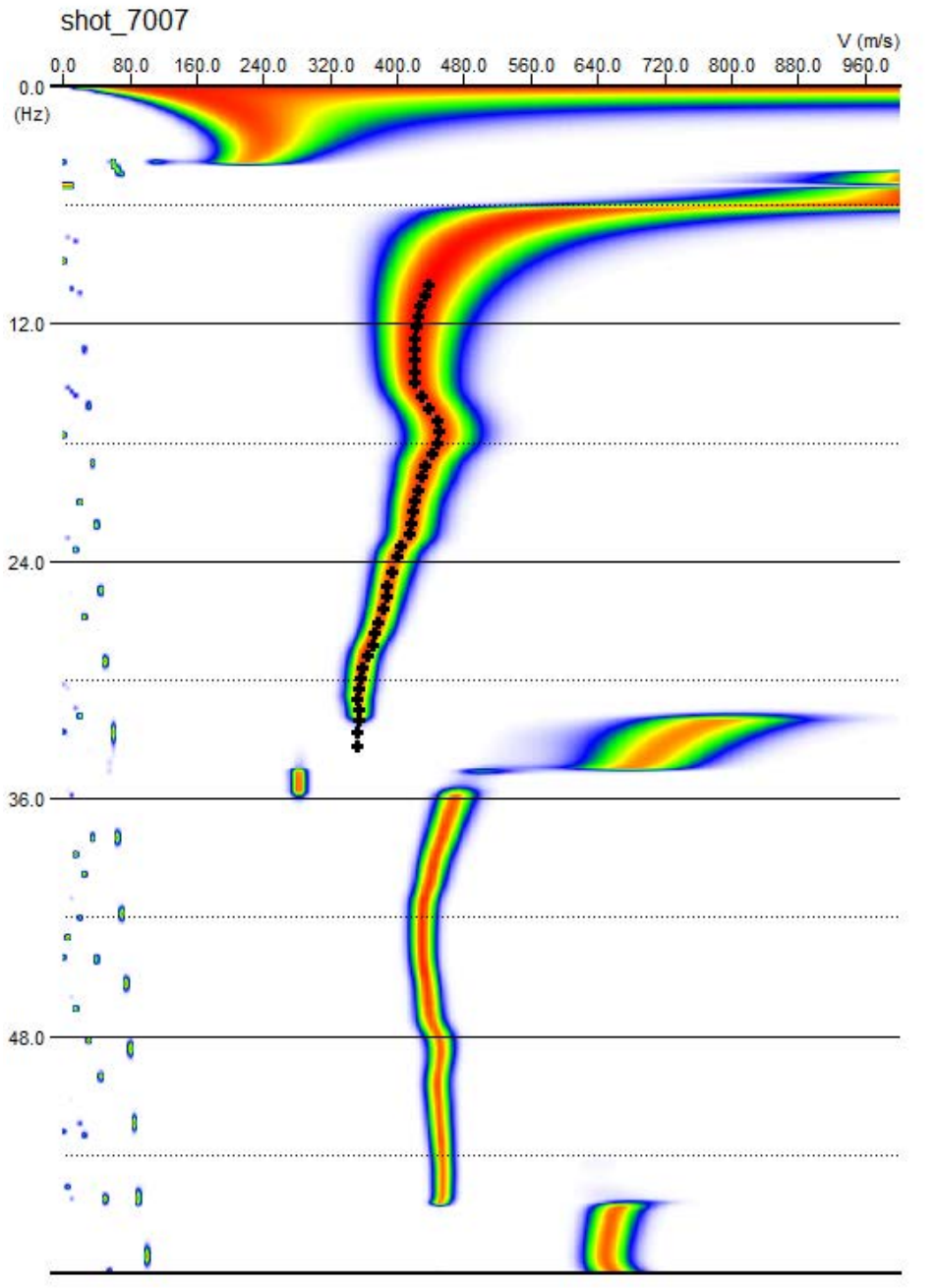

11.26 (Hz)

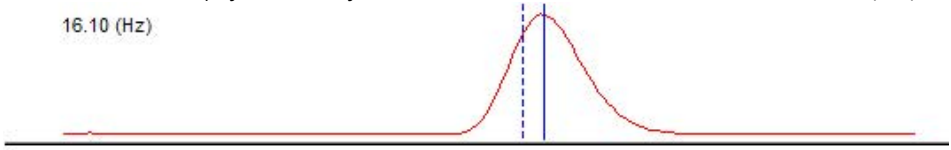

shot_7005
V (m/s)
0.0
80.0
160.0
240.0
320.0
400.0
480.0
560.0
640.0
720.0
800.0
880.0
960.0
0.0
(Hz)
12.0
24.0
36.0
48.0

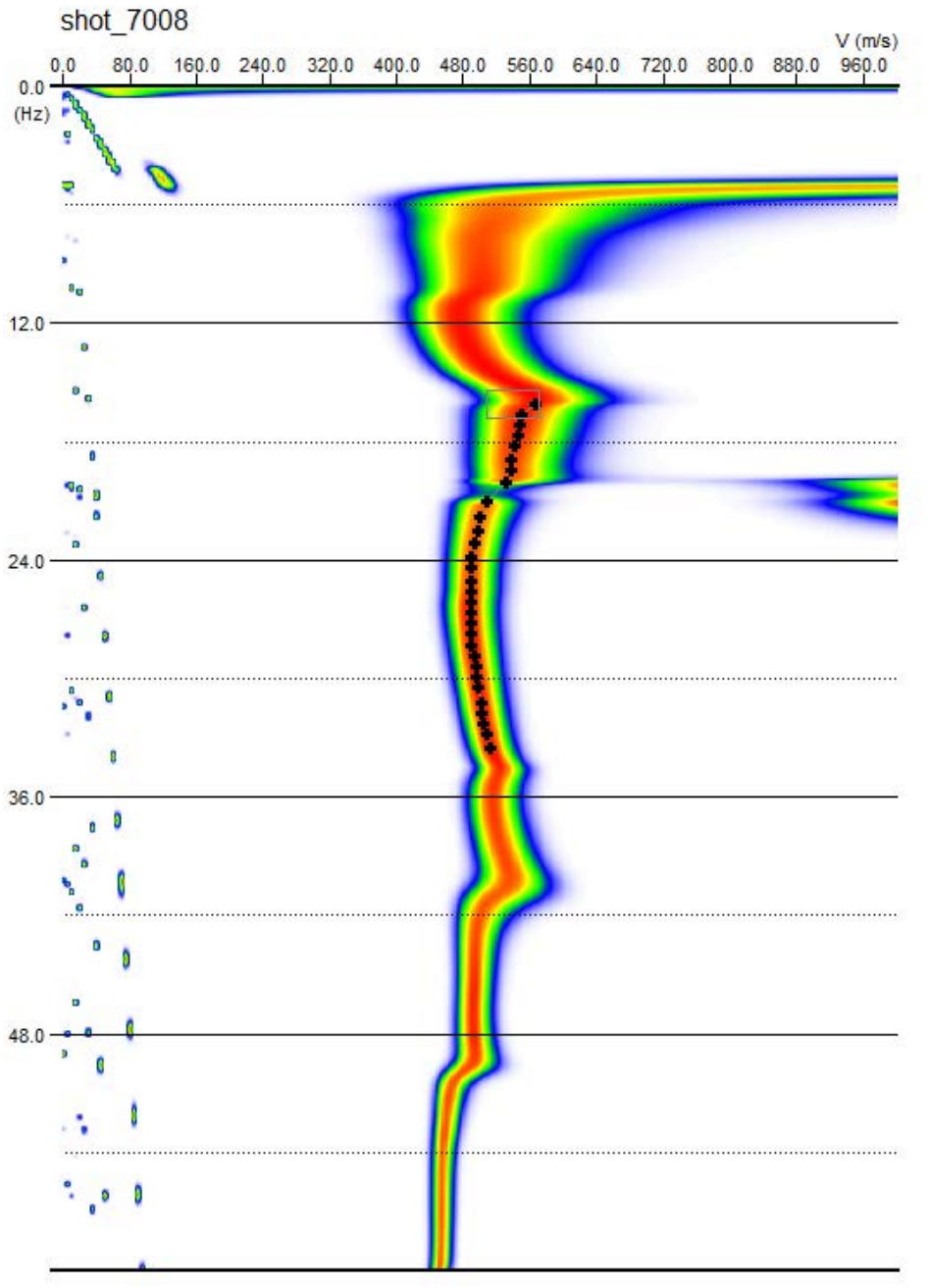

13.37 (Hz)

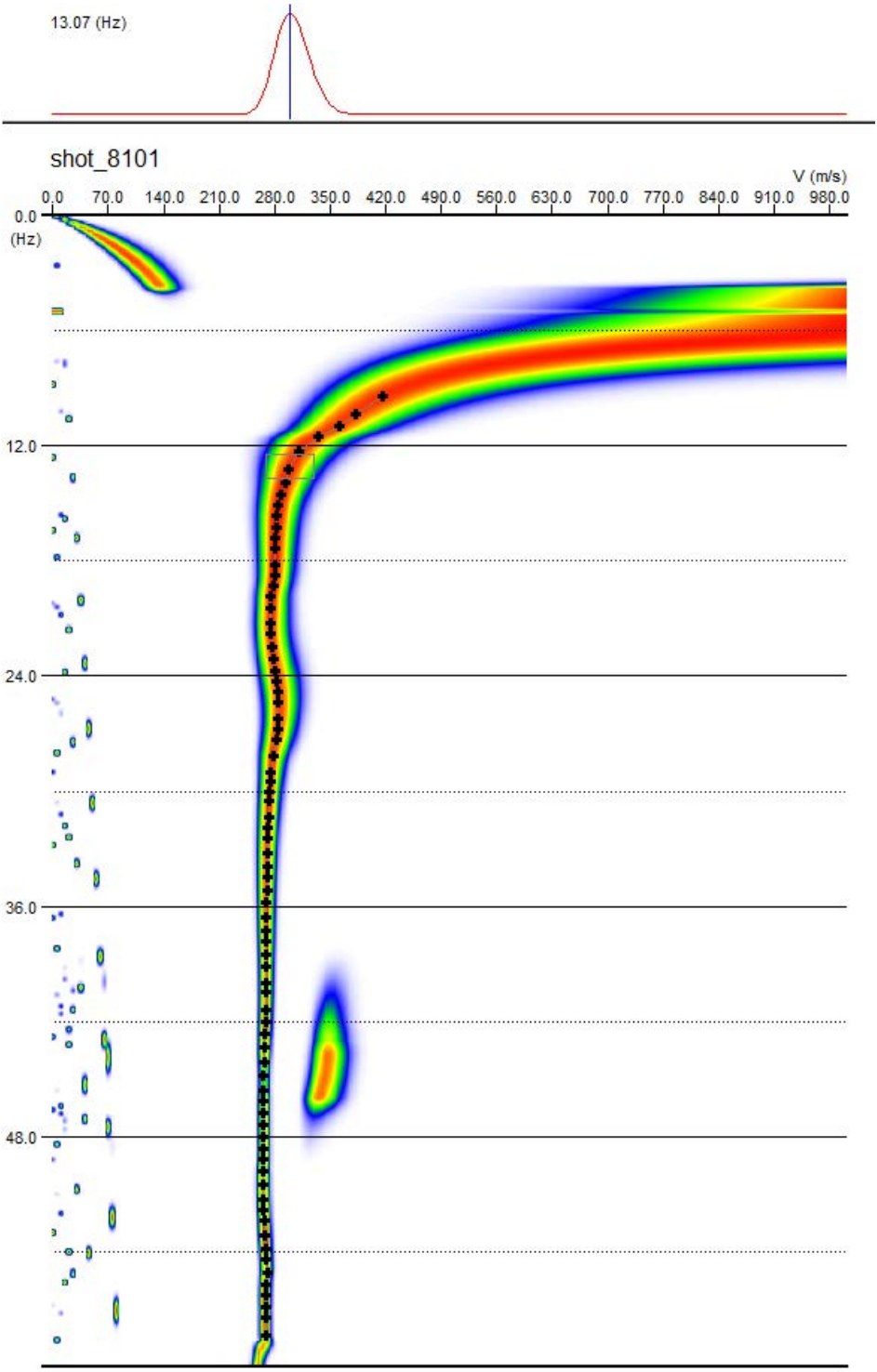

shot_7006
V (m/s)
0.0
80.0
160.0
240.0
320.0
400.0
480.0
560.0
640.0
720.0
800.0
880.0
960.0
0.0
(Hz)
12.0
24.0
36.0
48.0

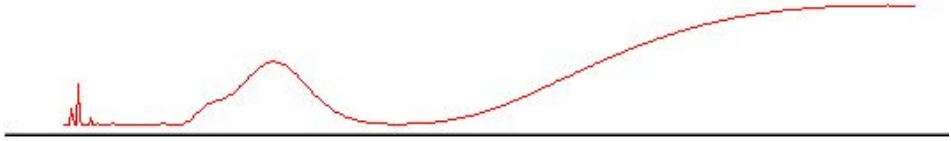


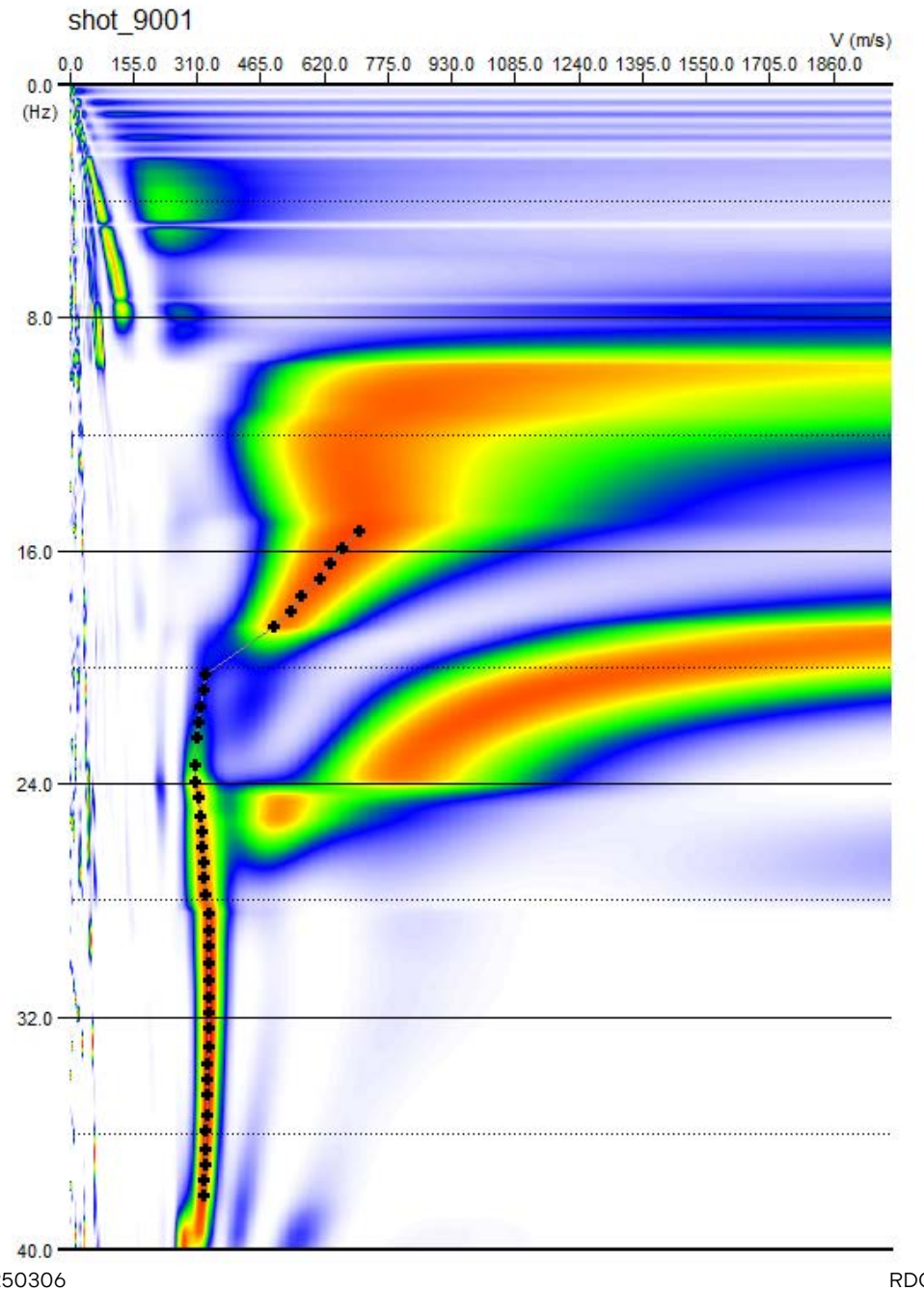

shot_7007
V (m/s)
0.0 80.0 160.0 240.0 320.0 400.0 480.0 560.0 640.0 720.0 800.0 880.0 960.0
0.0
(Hz)
12.0
24.0
36.0
48.0

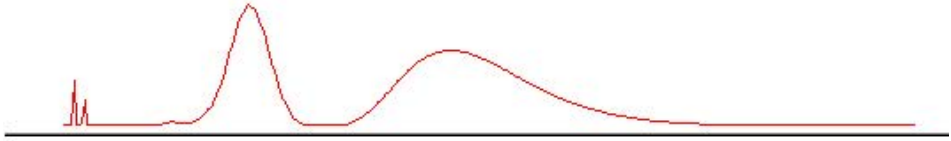

16.10 (Hz)

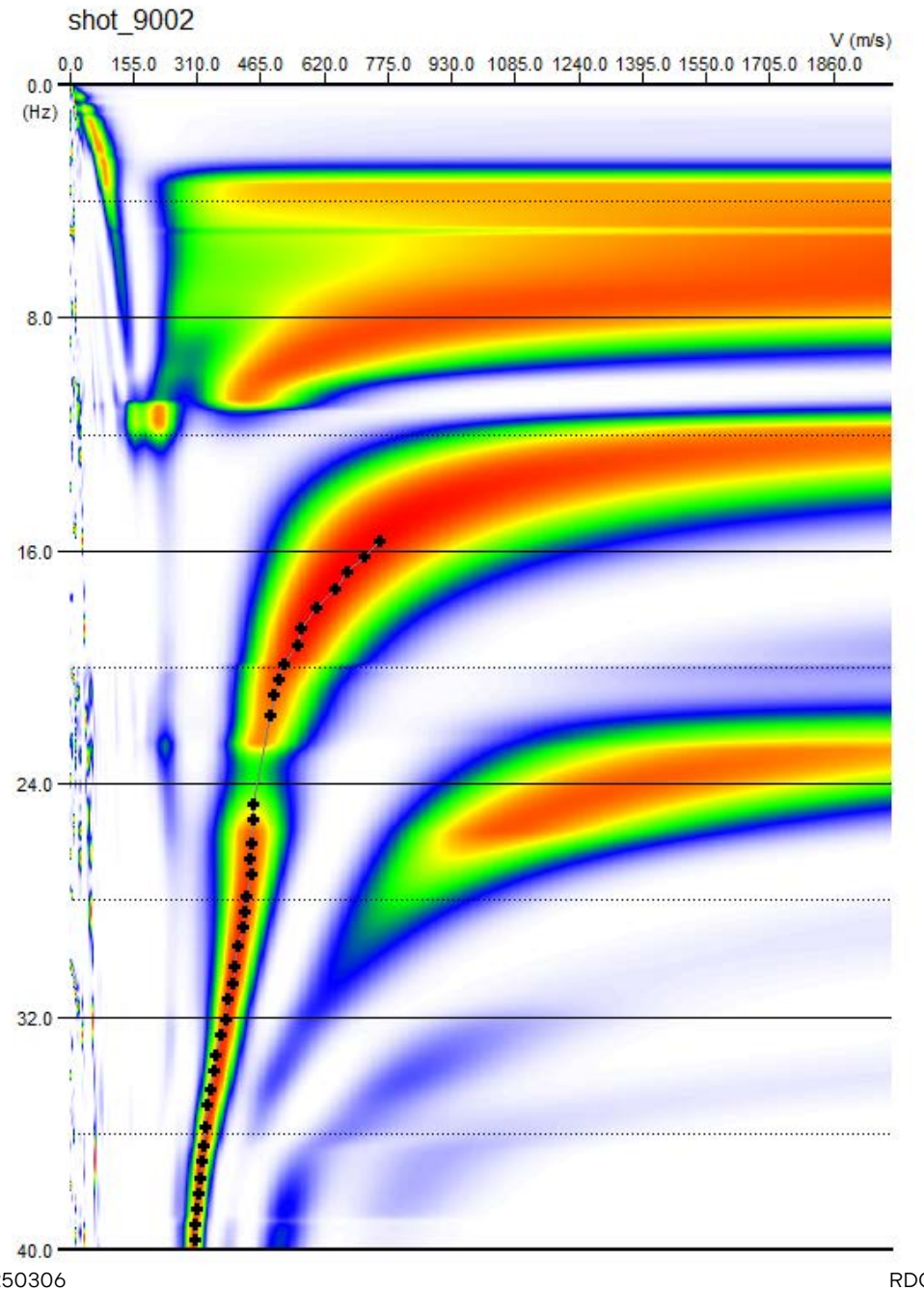

shot_7008
V (m/s)
0.0
80.0
160.0
240.0
320.0
400.0
480.0
560.0
640.0
720.0
800.0
880.0
960.0
0.0
(Hz)
12.0
24.0
36.0
48.0

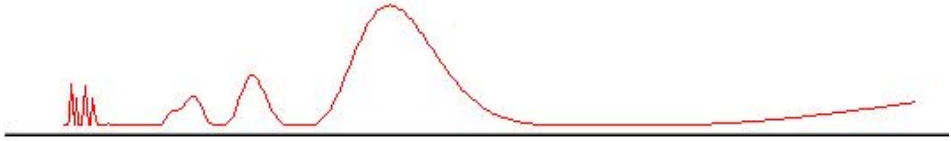

13.07 (Hz)
shot_8101
V (m/s)
0.0 70.0 140.0 210.0 280.0 350.0 420.0 490.0 560.0 630.0 700.0 770.0 840.0 910.0 980.0
0.0
(Hz)
12.0
24.0
36.0
48.0

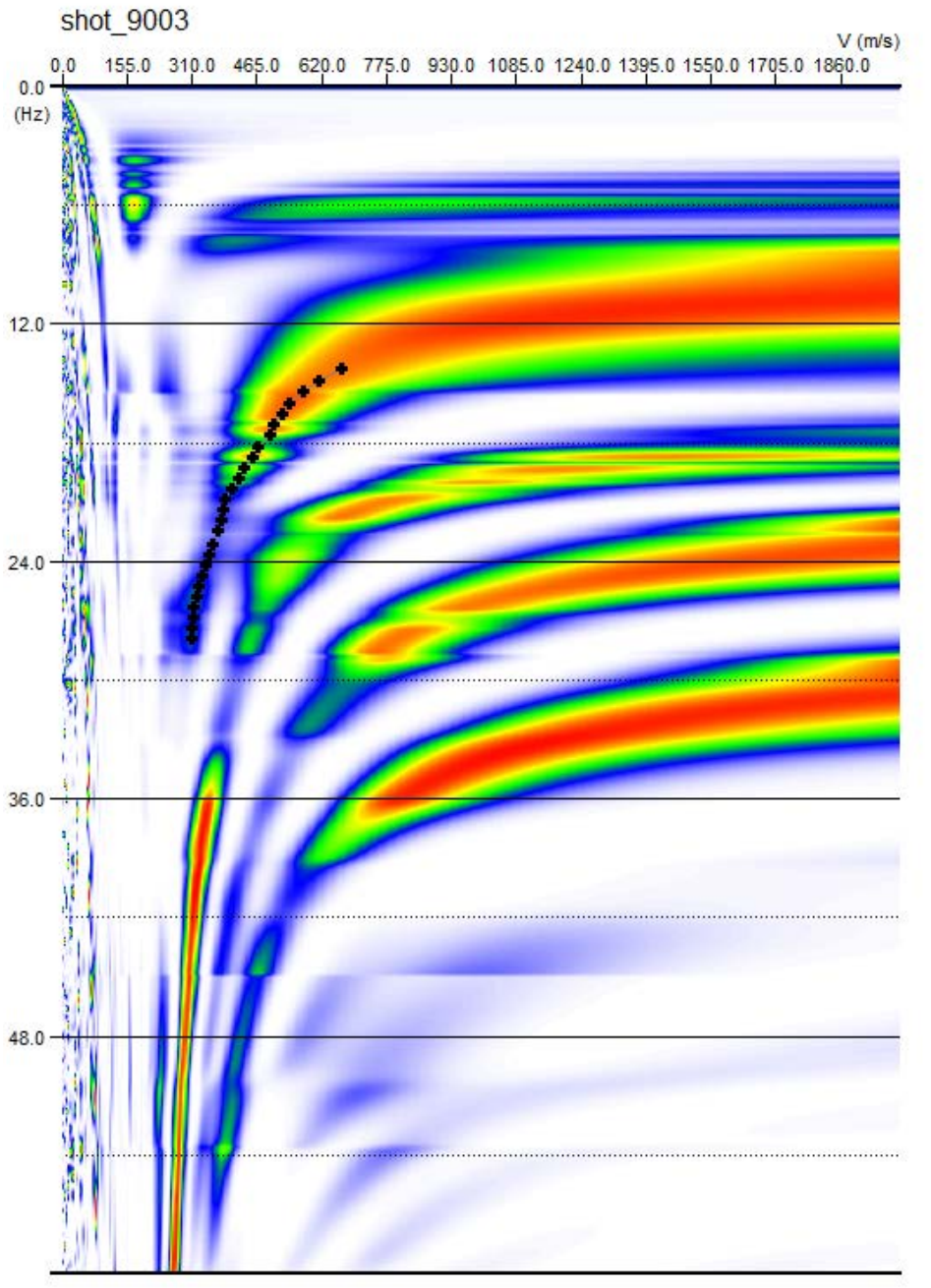



shot_9001
V (m/s)
0.0
155.0
310.0
465.0
620.0
775.0
930.0
1085.0
1240.0
1395.0
1550.0
1705.0
1860.0
0.0
(Hz)
8.0
16.0
24.0
32.0
40.0

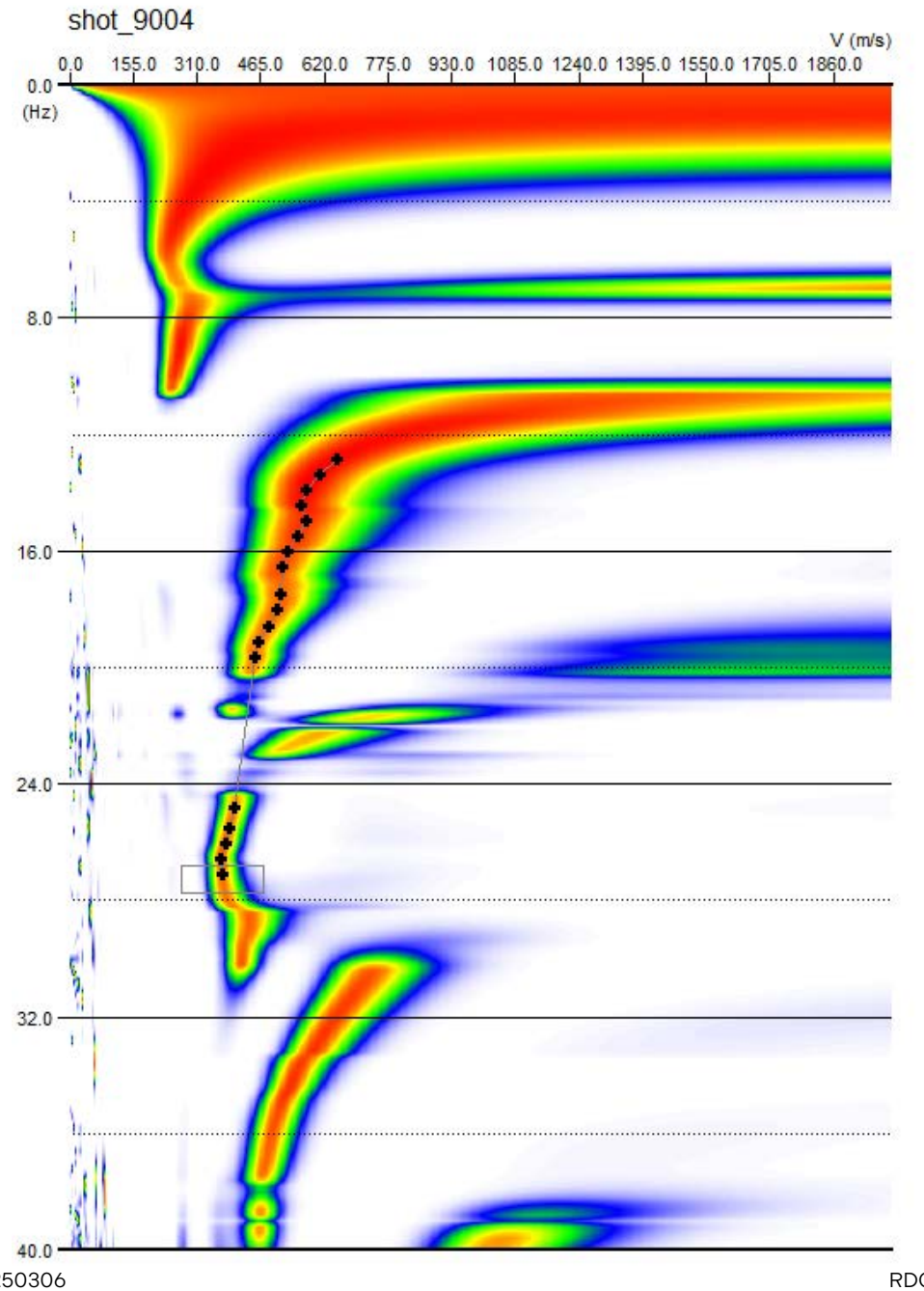


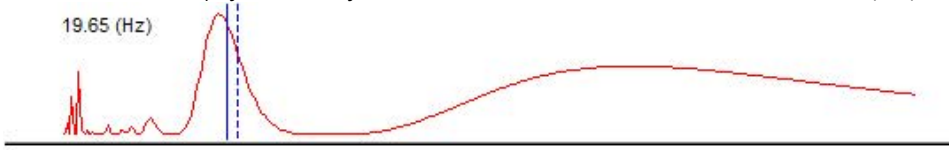

shot_9002
V (m/s)
0.0 155.0 310.0 465.0 620.0 775.0 930.0 1085.0 1240.0 1395.0 1550.0 1705.0 1860.0
0.0
(Hz)
8.0
16.0
24.0
32.0
40.0

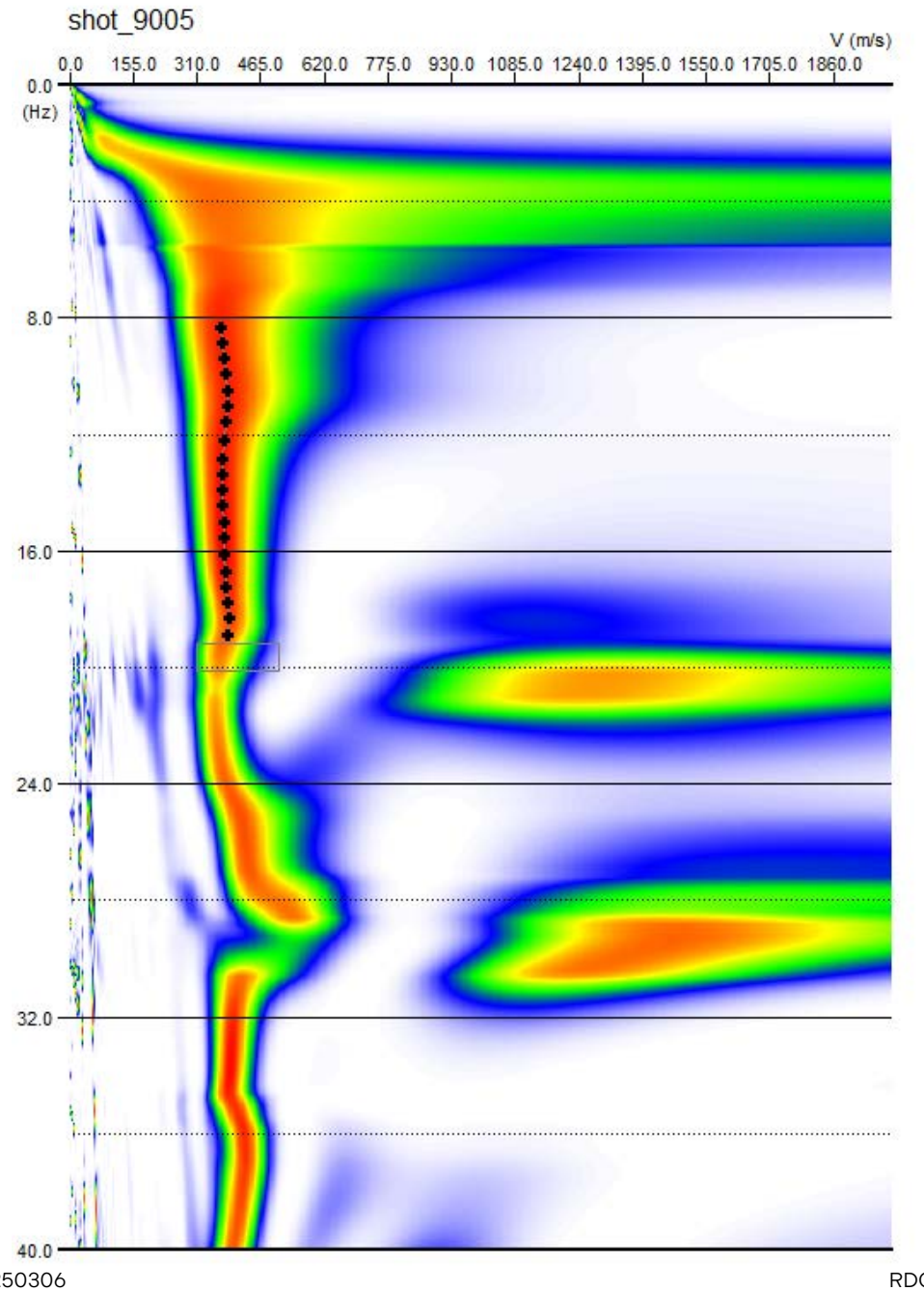


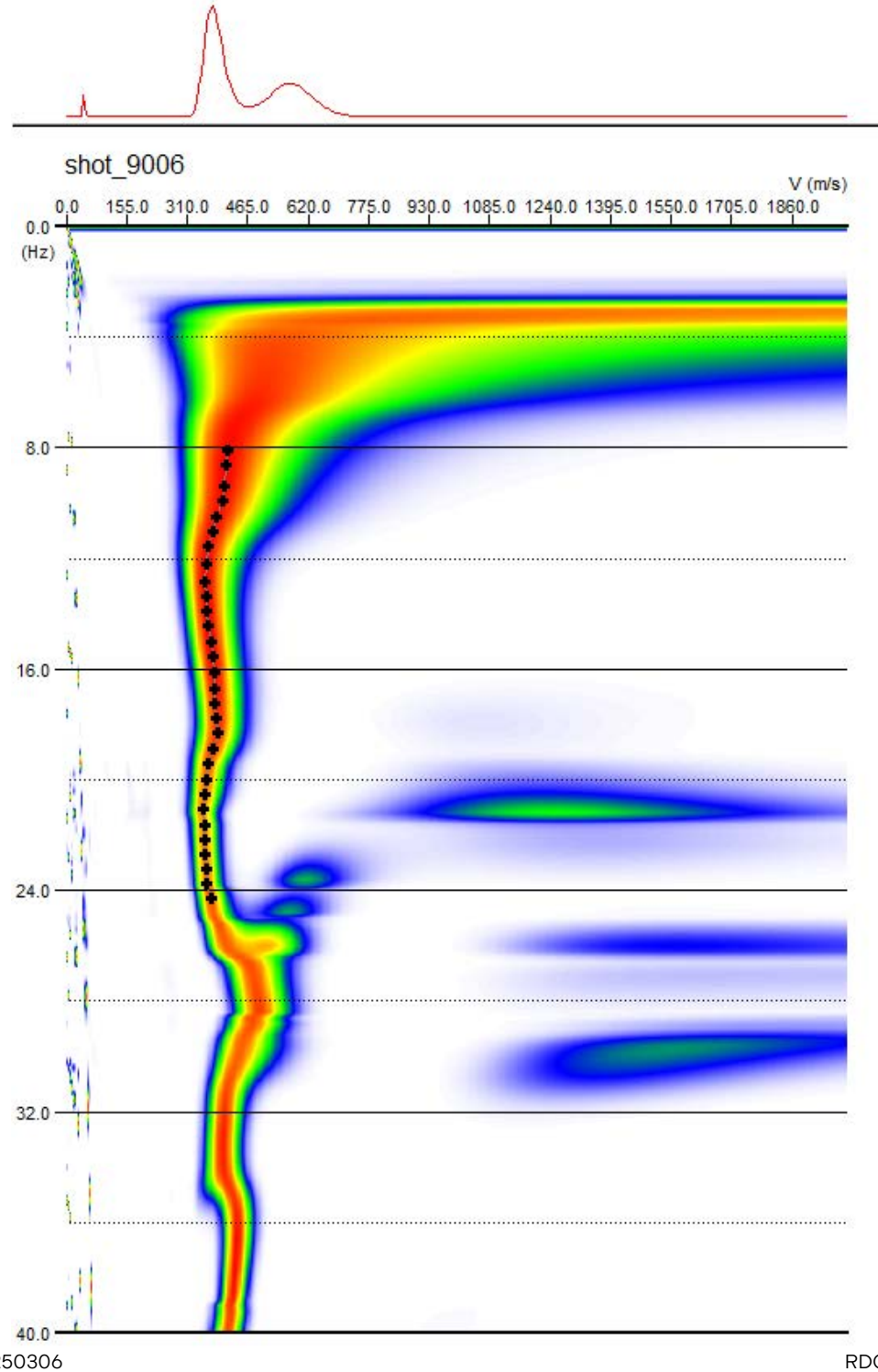

shot_9003
V (m/s)
0.0 155.0 310.0 465.0 620.0 775.0 930.0 1085.0 1240.0 1395.0 1550.0 1705.0 1860.0
0.0
(Hz)
12.0
24.0
36.0
48.0

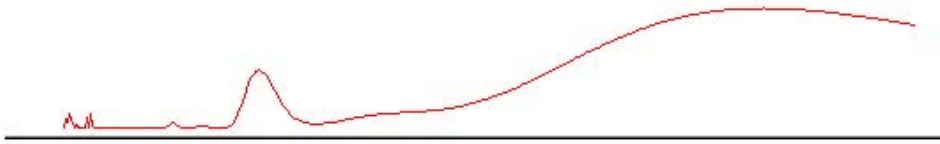

27.27 (Hz)

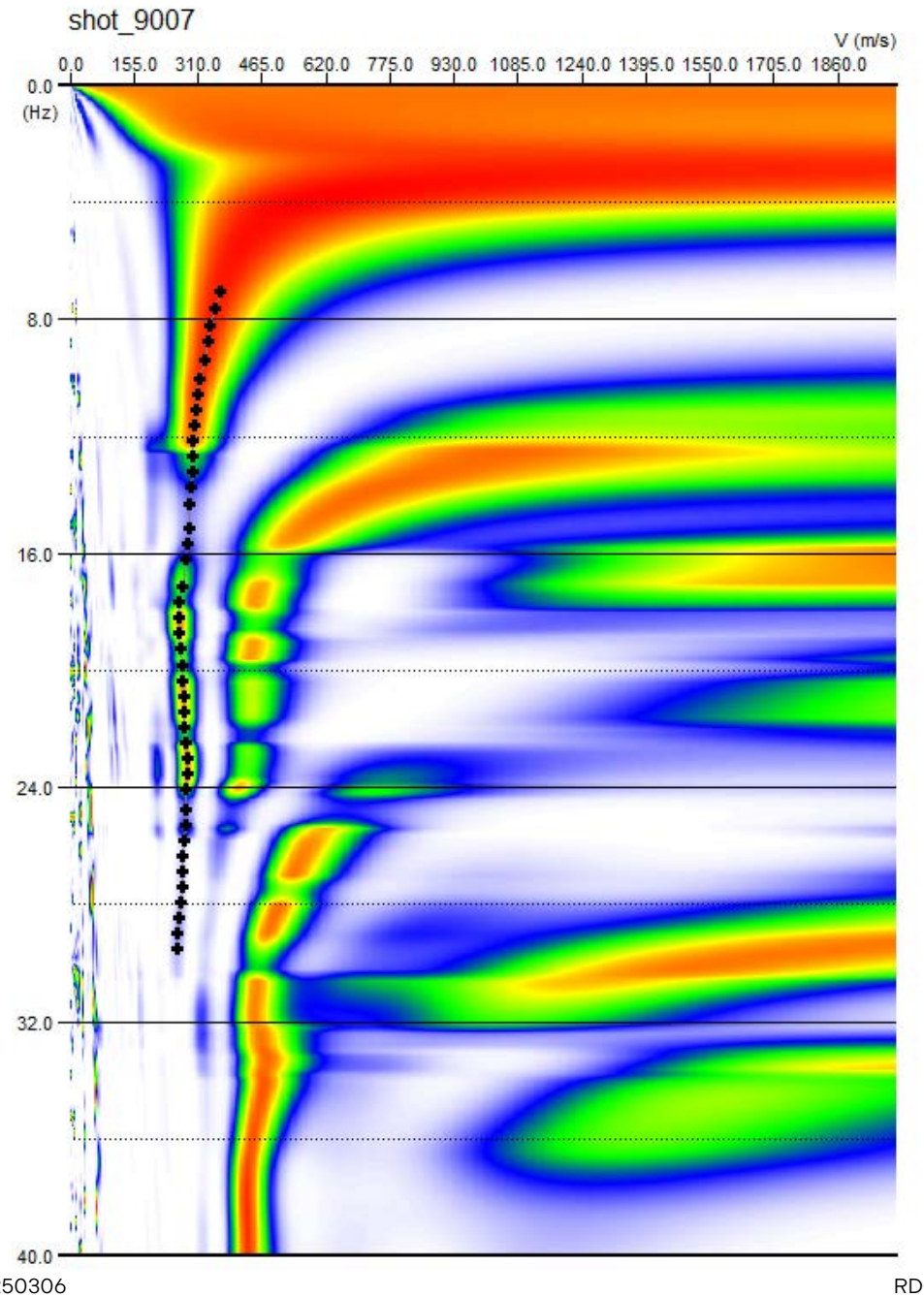

shot_9004
V (m/s)
0.0 155.0 310.0 465.0 620.0 775.0 930.0 1085.0 1240.0 1395.0 1550.0 1705.0 1860.0
0.0
(Hz)
8.0
16.0
24.0
32.0
40.0

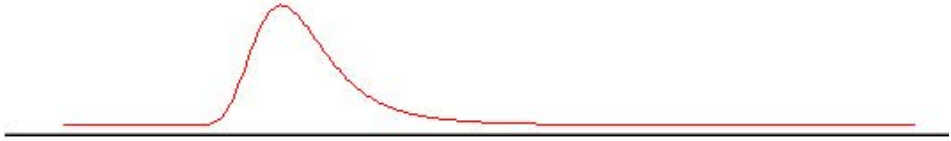

19.65 (Hz)

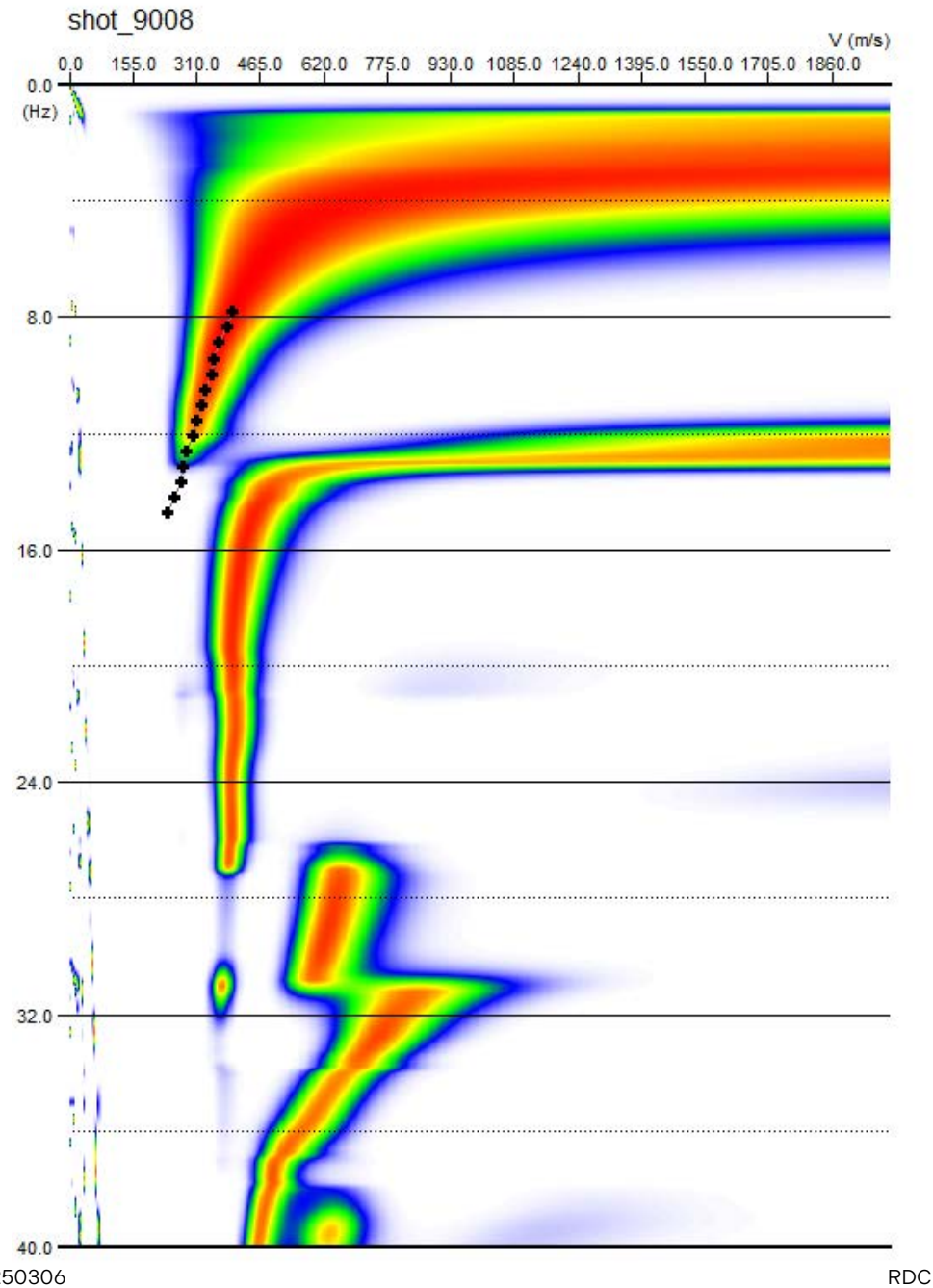

shot_9005
V (m/s)
0.0
155.0
310.0
465.0
620.0
775.0
930.0
1085.0
1240.0
1395.0
1550.0
1705.0
1860.0
0.0
(Hz)
8.0
16.0
24.0
32.0
40.0

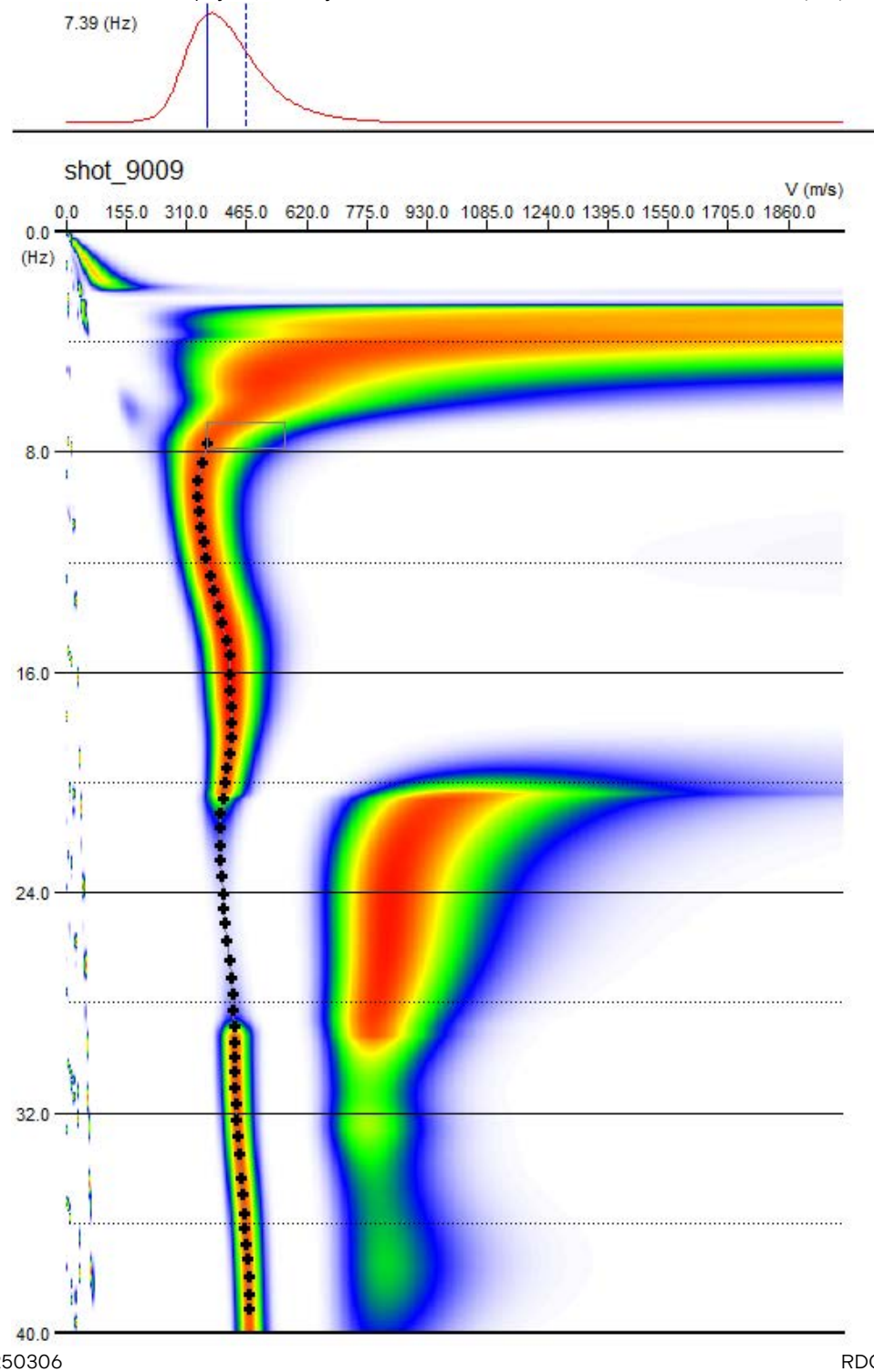

shot_9006
V (m/s)
0.0 155.0 310.0 465.0 620.0 775.0 930.0 1085.0 1240.0 1395.0 1550.0 1705.0 1860.0
0.0
(Hz)
8.0
16.0
24.0
32.0
40.0



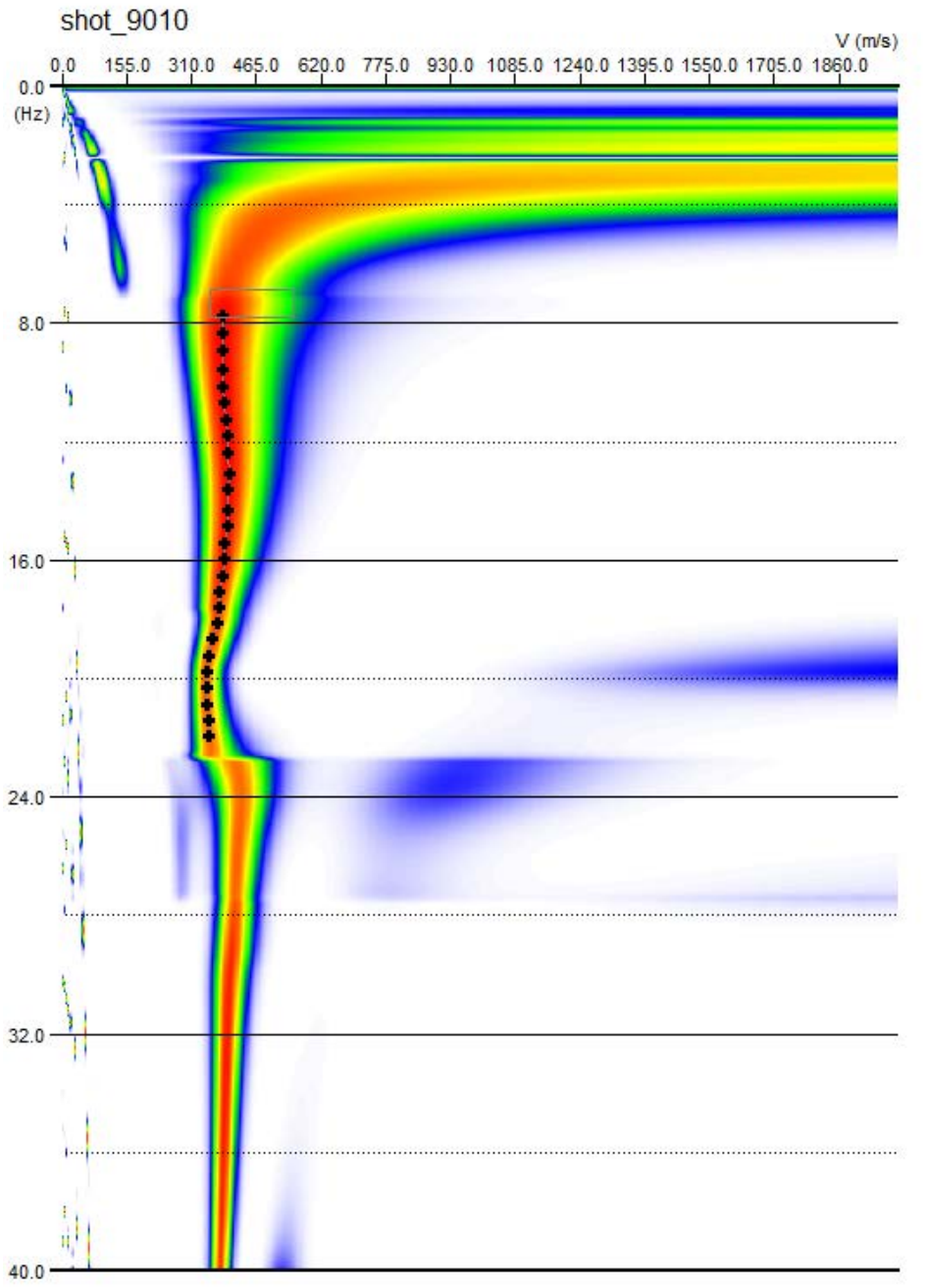

shot_9007
V (m/s)
0.0
155.0
310.0
465.0
620.0
775.0
930.0
1085.0
1240.0
1395.0
1550.0
1705.0
1860.0
0.0
(Hz)
8.0
16.0
24.0
32.0
40.0

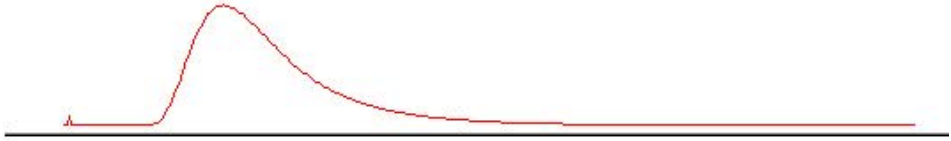


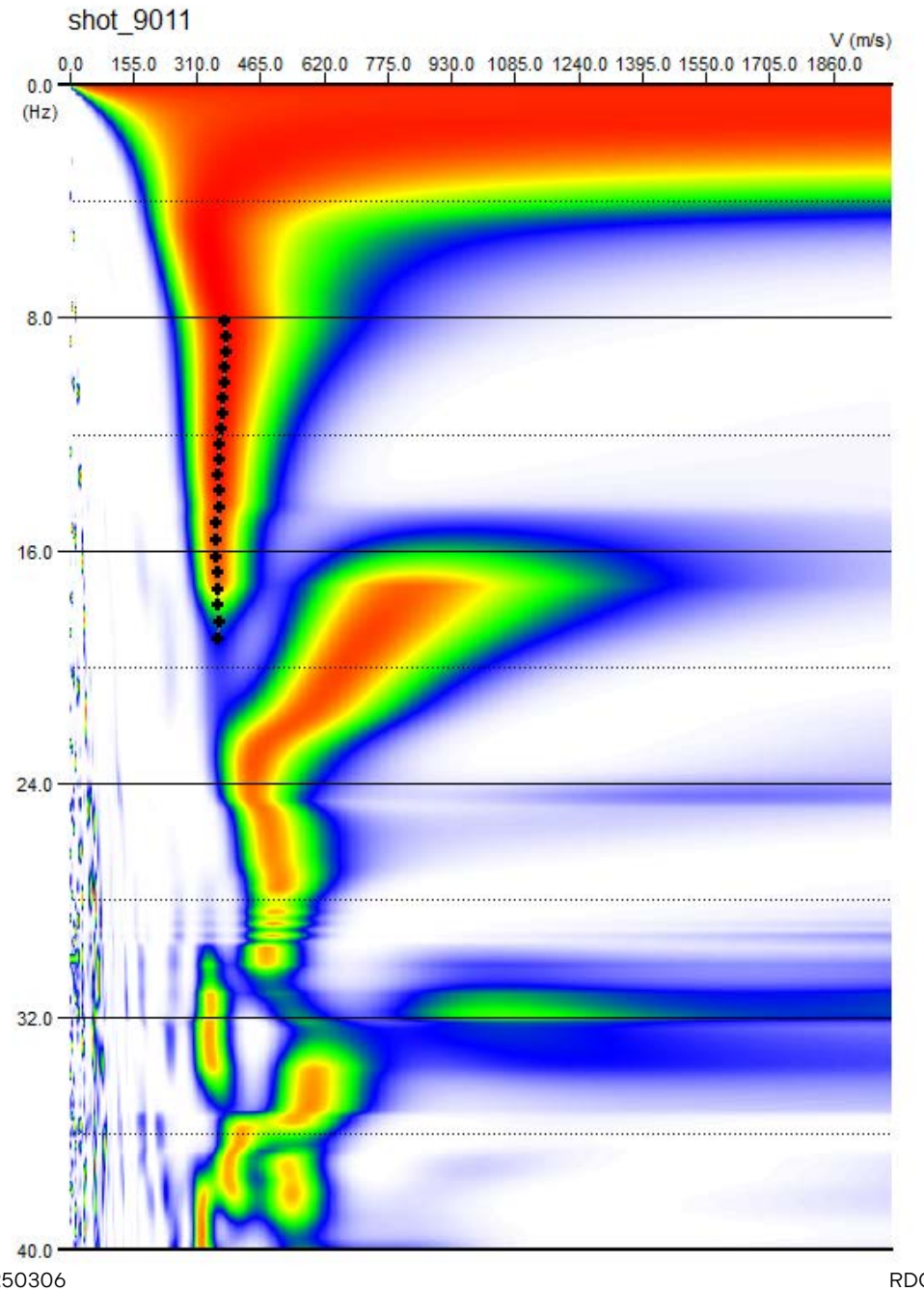

shot_9008
V (m/s)
0.0 155.0 310.0 465.0 620.0 775.0 930.0 1085.0 1240.0 1395.0 1550.0 1705.0 1860.0
0.0
(Hz)
8.0
16.0
24.0
32.0
40.0

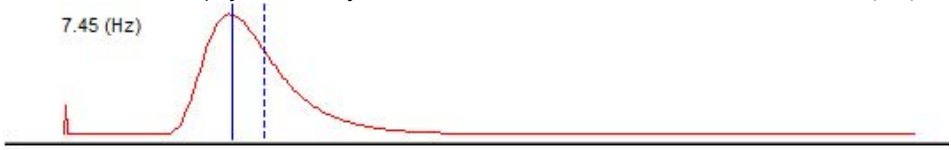

7.39 (Hz)
shot_9009
V (m/s)
0.0 155.0 310.0 465.0 620.0 775.0 930.0 1085.0 1240.0 1395.0 1550.0 1705.0 1860.0
0.0
(Hz)
8.0
16.0
24.0
32.0
40.0

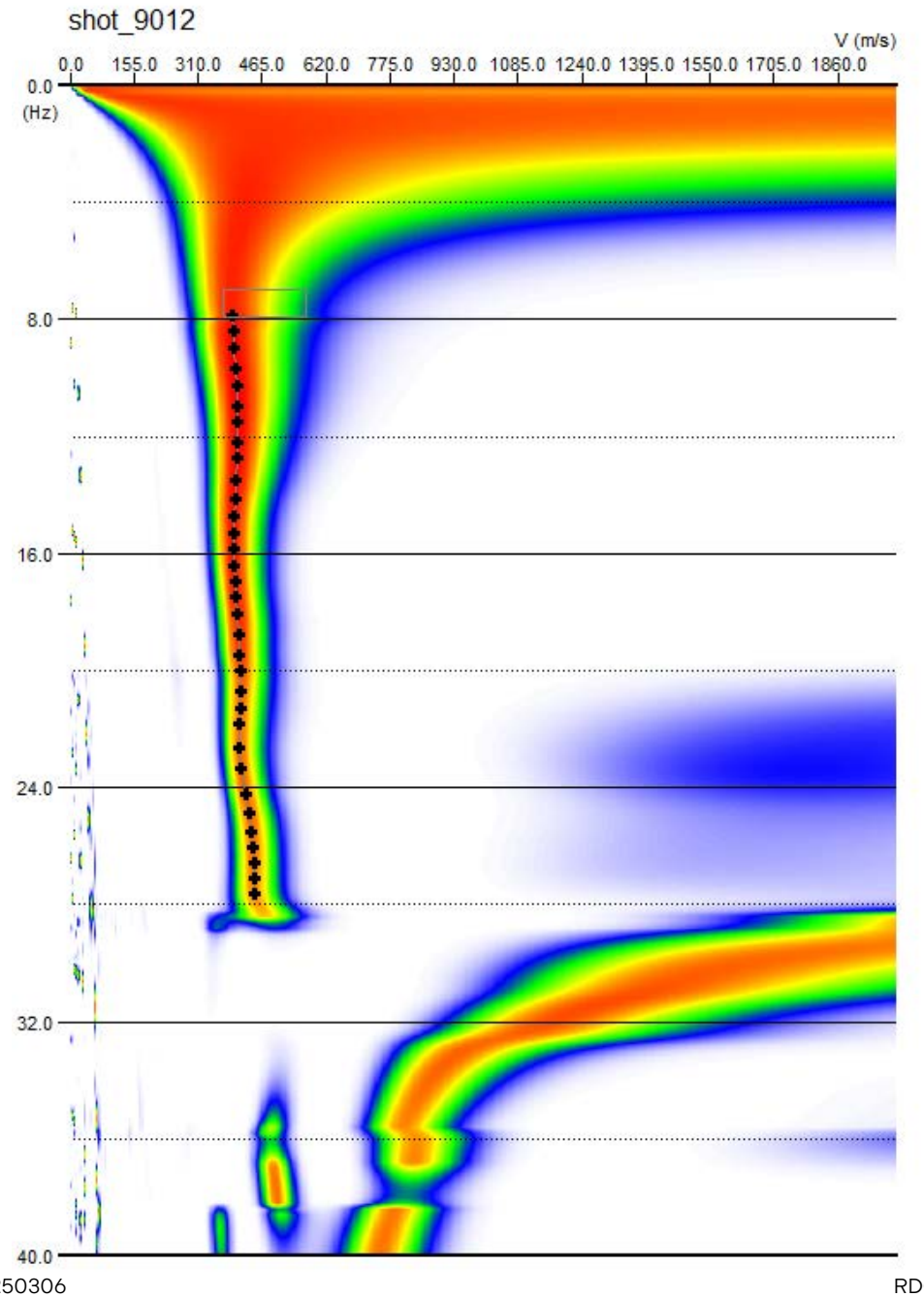

7.33 (Hz)


shot_9010
V (m/s)
0.0
155.0
310.0
465.0
620.0
775.0
930.0
1085.0
1240.0
1395.0
1550.0
1705.0
1860.0
0.0
(Hz)
8.0
16.0
24.0
32.0
40.0

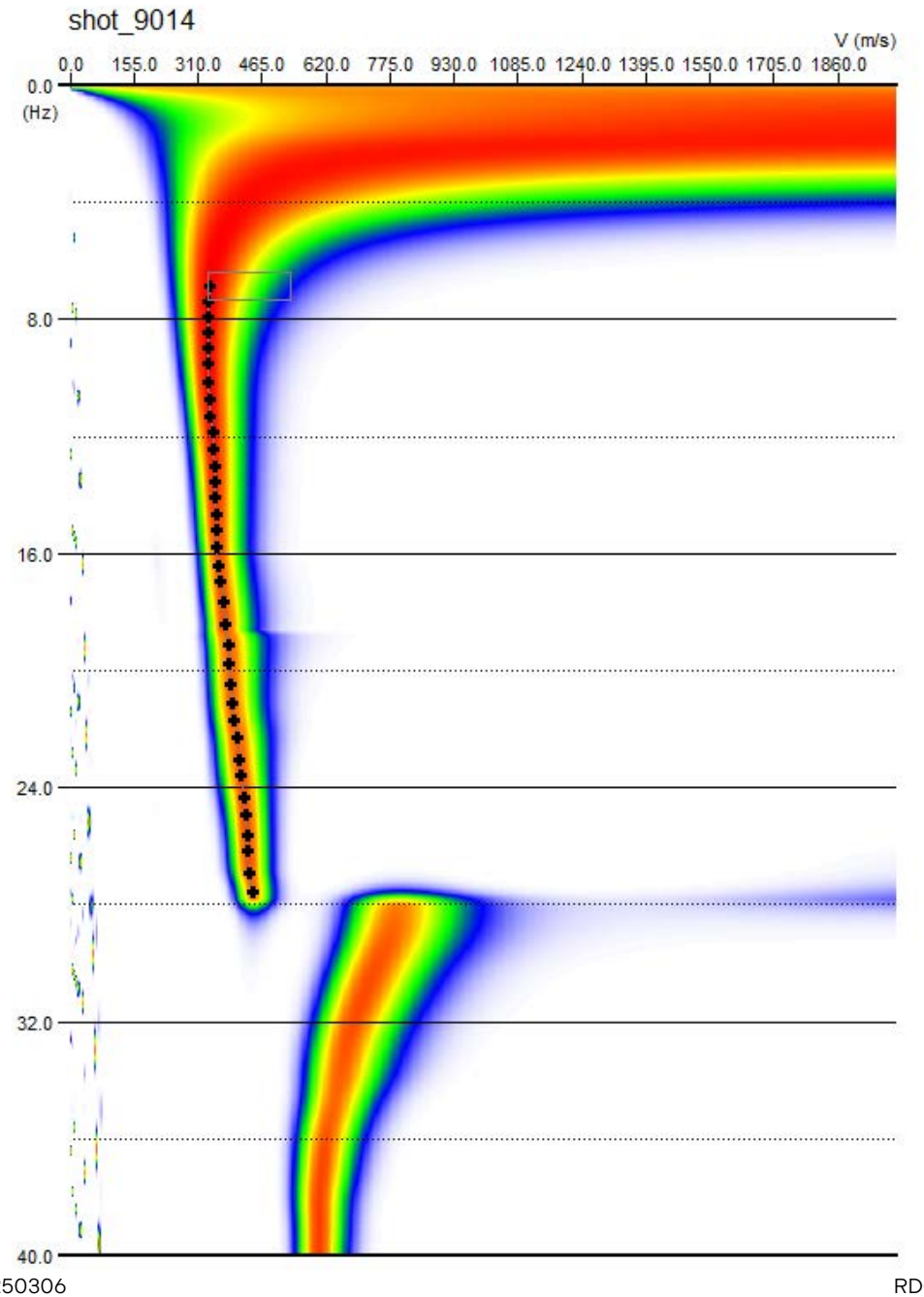


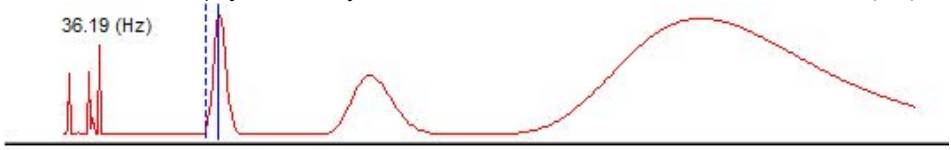

shot_9011
V (m/s)
0.0 155.0 310.0 465.0 620.0 775.0 930.0 1085.0 1240.0 1395.0 1550.0 1705.0 1860.0
0.0
(Hz)
8.0
16.0
24.0
32.0
40.0

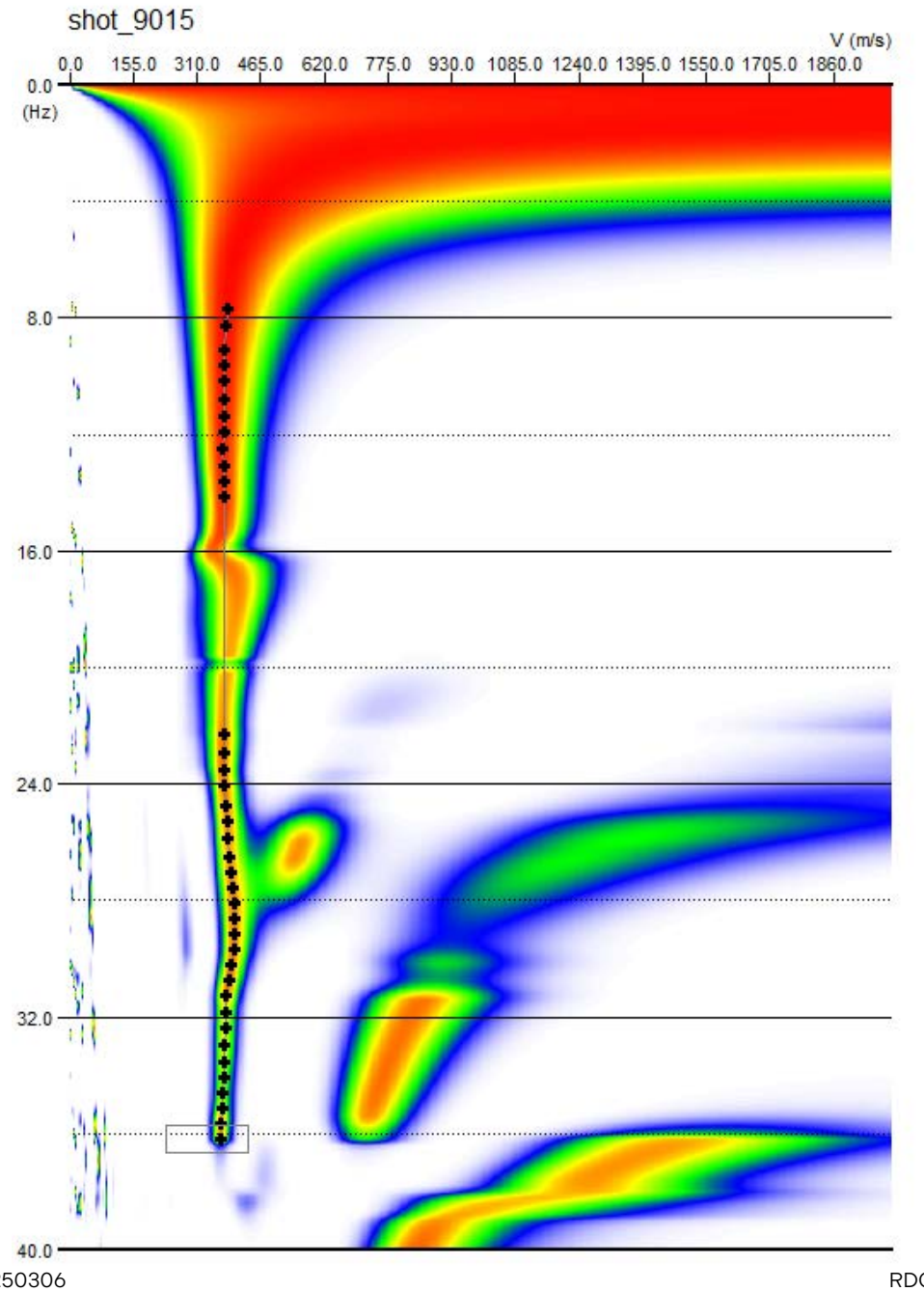

7.45 (Hz)

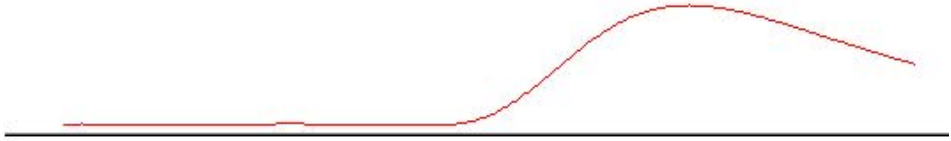

shot_9012
V (m/s)
0.0
155.0
310.0
465.0
620.0
775.0
930.0
1085.0
1240.0
1395.0
1550.0
1705.0
1860.0
0.0
(Hz)
8.0
16.0
24.0
32.0
40.0

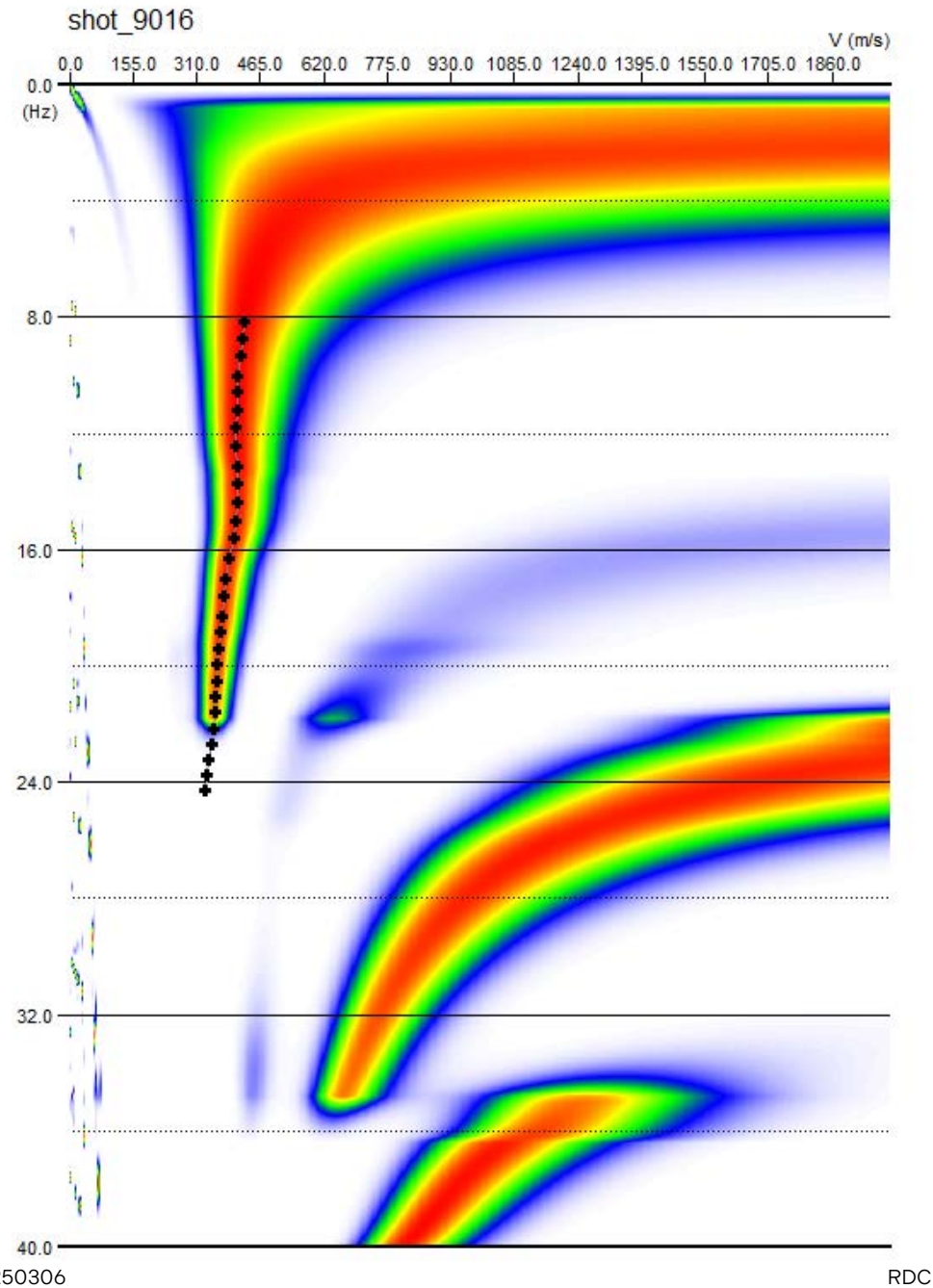

6.86 (Hz)

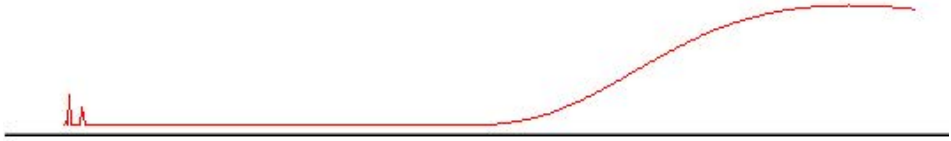

shot_9014
V (m/s)
0.0 155.0 310.0 465.0 620.0 775.0 930.0 1085.0 1240.0 1395.0 1550.0 1705.0 1860.0
0.0
(Hz)
8.0
16.0
24.0
32.0
40.0

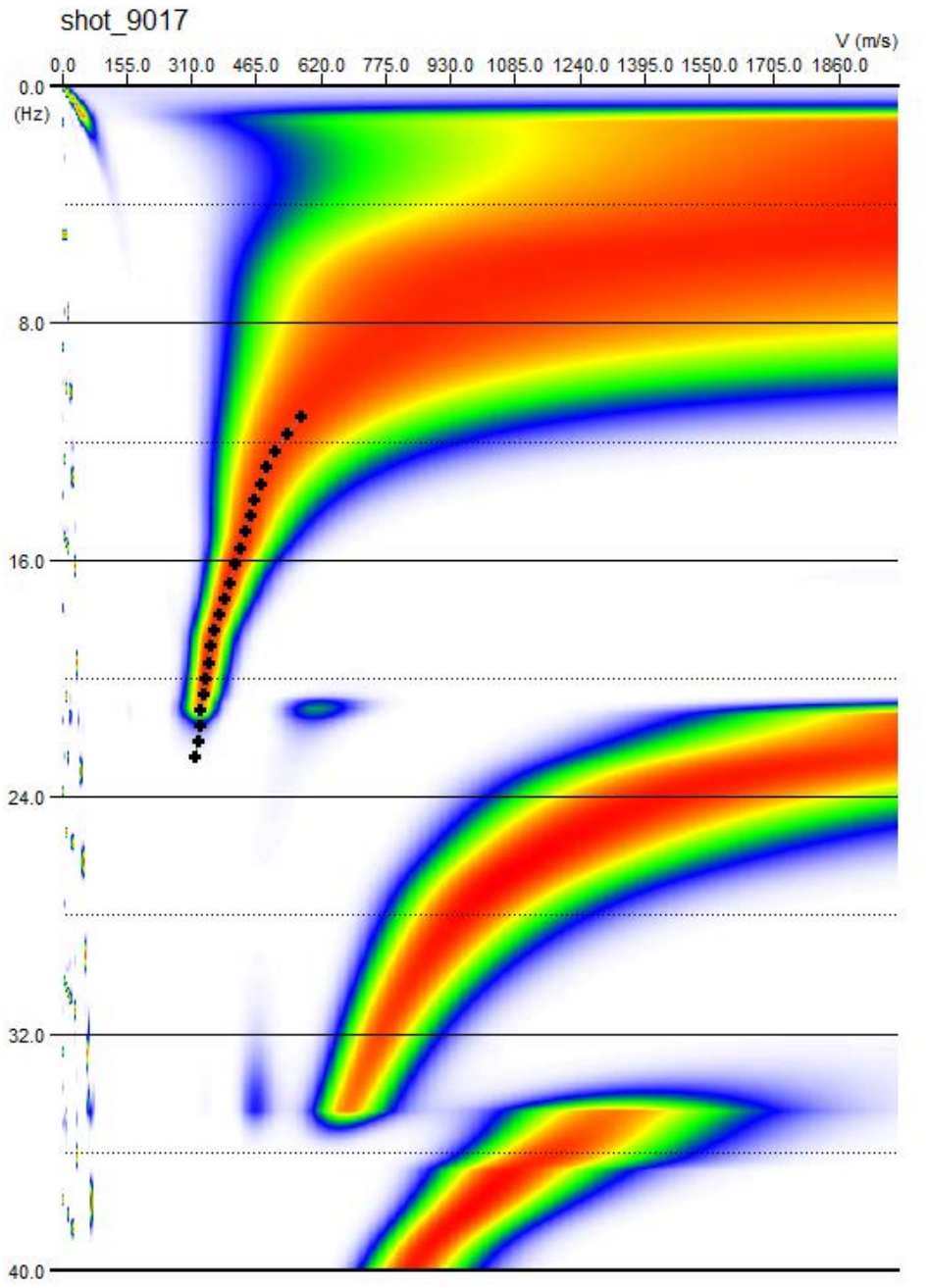

36.19 (Hz)

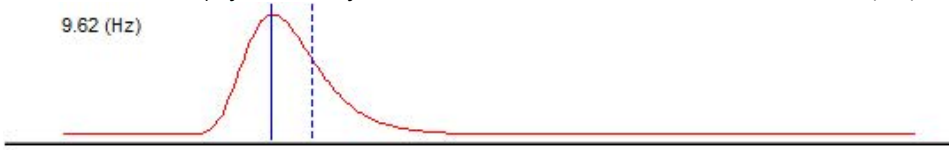

shot_9015
V (m/s)
0.0
155.0
310.0
465.0
620.0
775.0
930.0
1085.0
1240.0
1395.0
1550.0
1705.0
1860.0
0.0
(Hz)
8.0
16.0
24.0
32.0
40.0

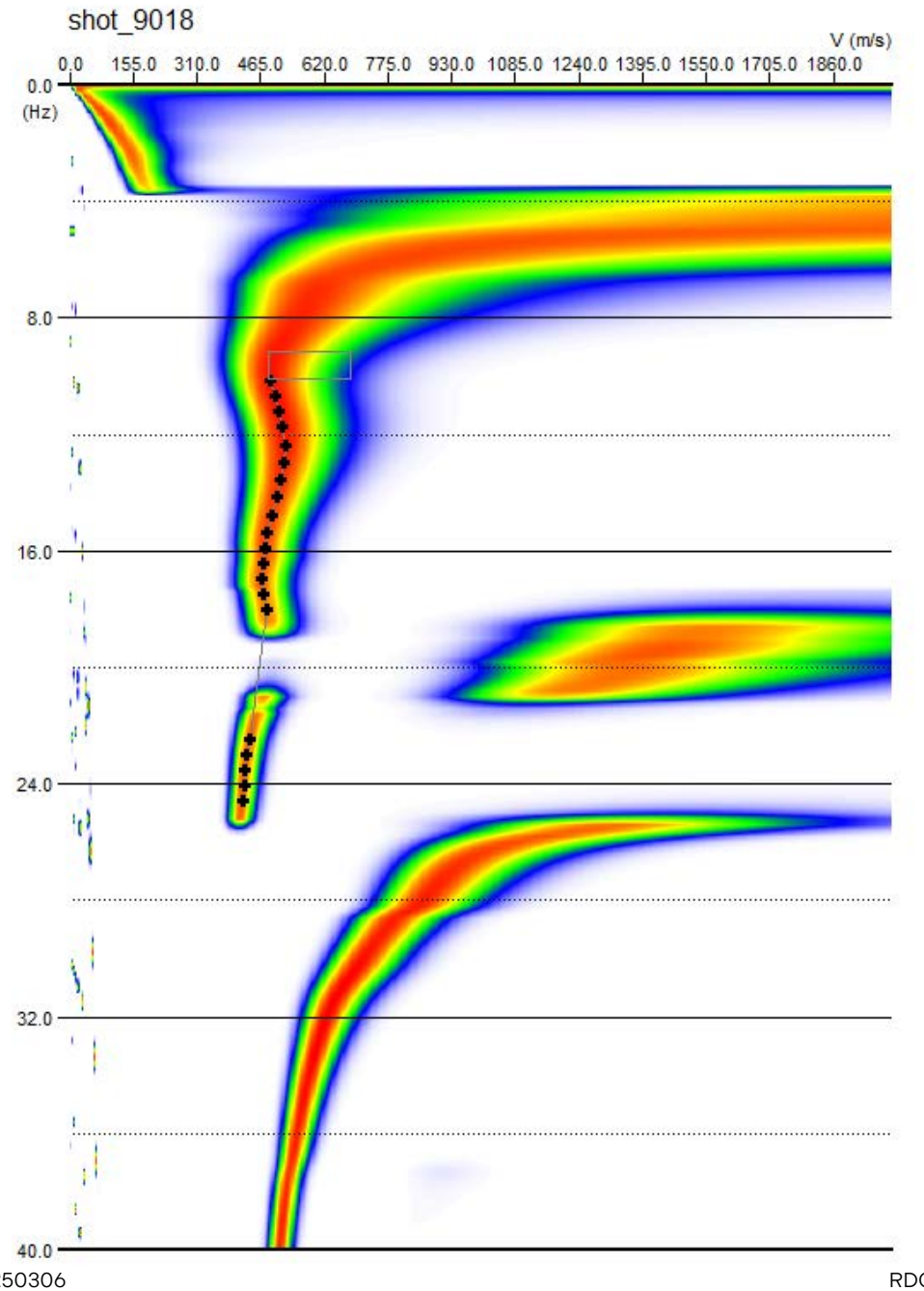



shot_9016
V (m/s)
0.0 155.0 310.0 465.0 620.0 775.0 930.0 1085.0 1240.0 1395.0 1550.0 1705.0 1860.0
0.0
(Hz)
8.0
16.0
24.0
32.0
40.0

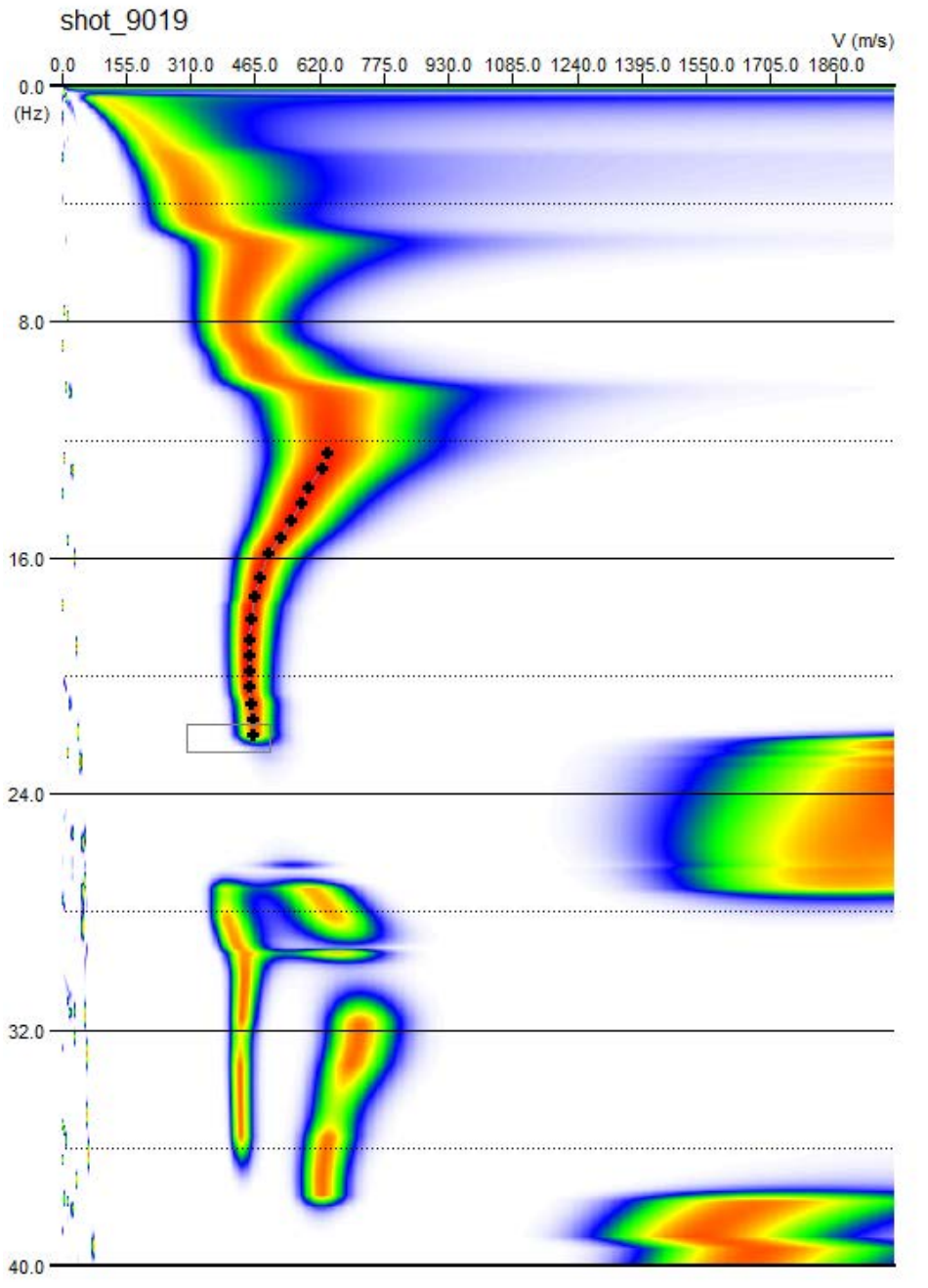



shot_9017
V (m/s)
0.0 155.0 310.0 465.0 620.0 775.0 930.0 1085.0 1240.0 1395.0 1550.0 1705.0 1860.0
0.0
(Hz)
8.0
16.0
24.0
32.0
40.0

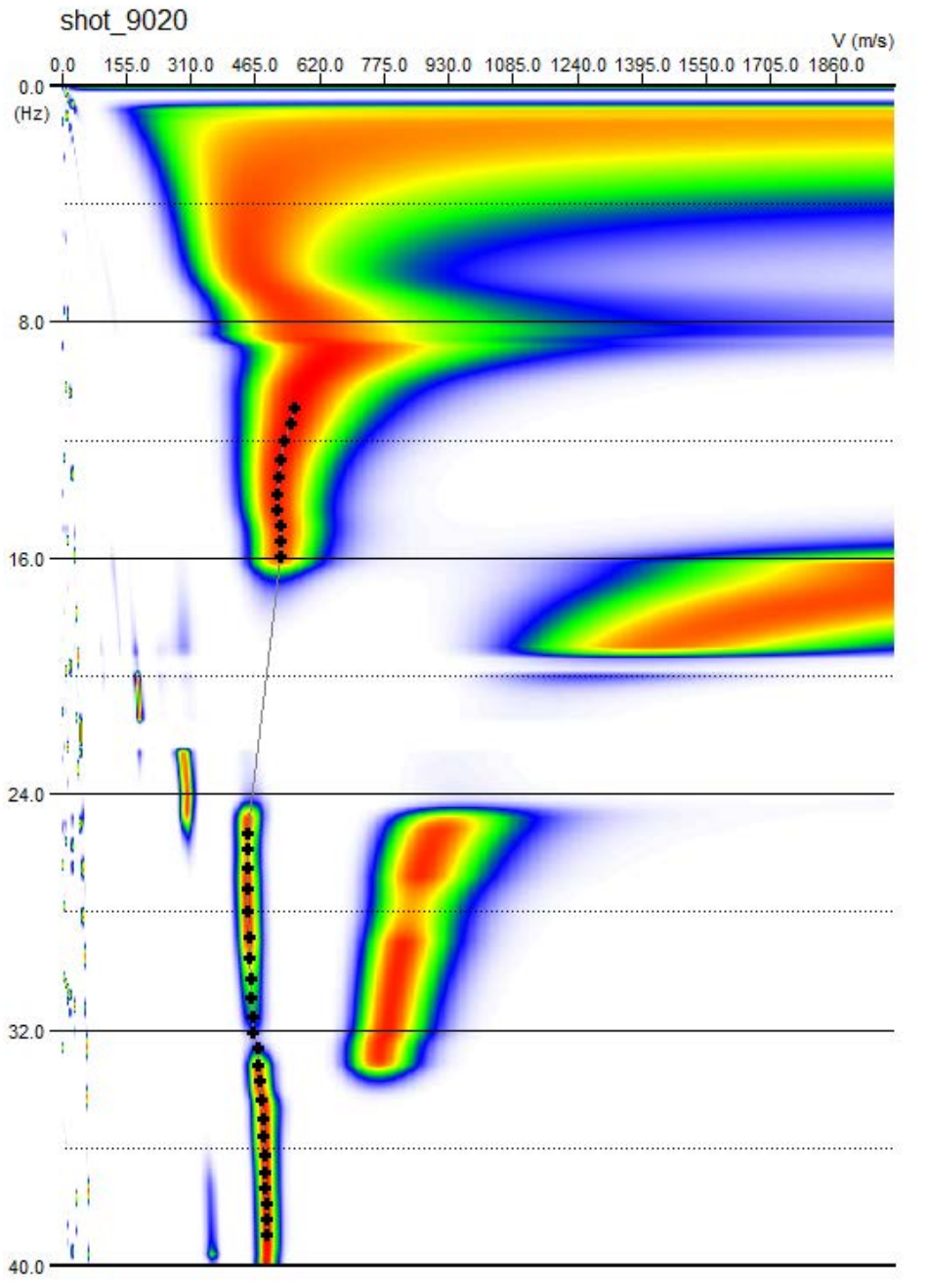

9.62 (Hz)

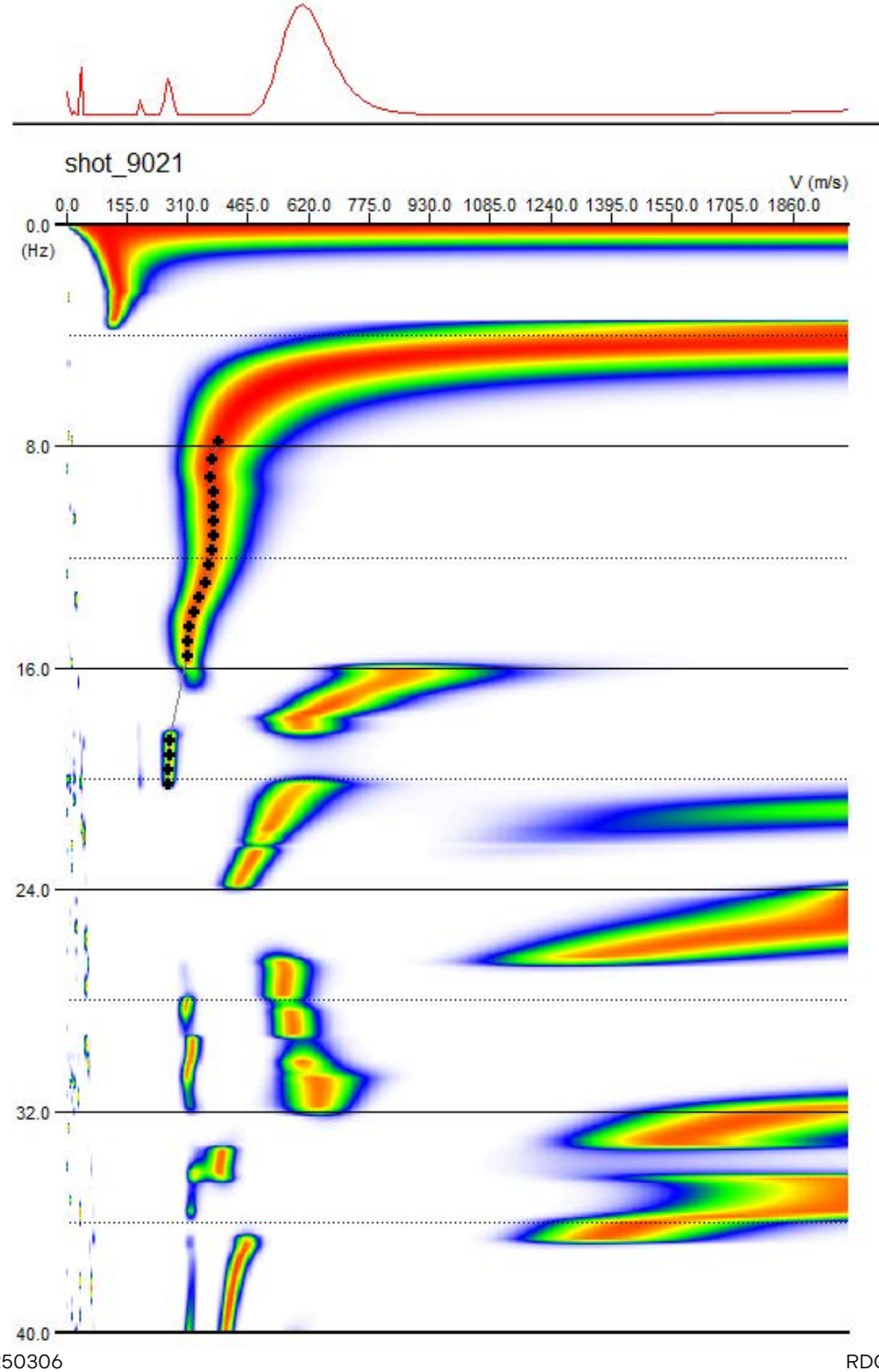

shot_9018
V (m/s)
0.0
155.0
310.0
465.0
620.0
775.0
930.0
1085.0
1240.0
1395.0
1550.0
1705.0
1860.0
0.0
(Hz)
8.0
16.0
24.0
32.0
40.0

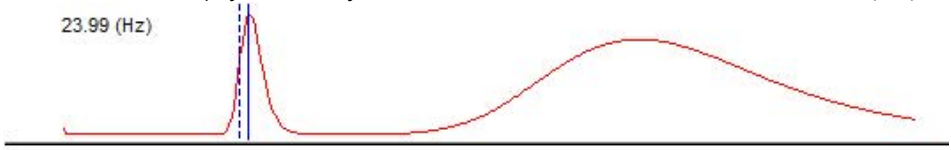

22.11 (Hz)

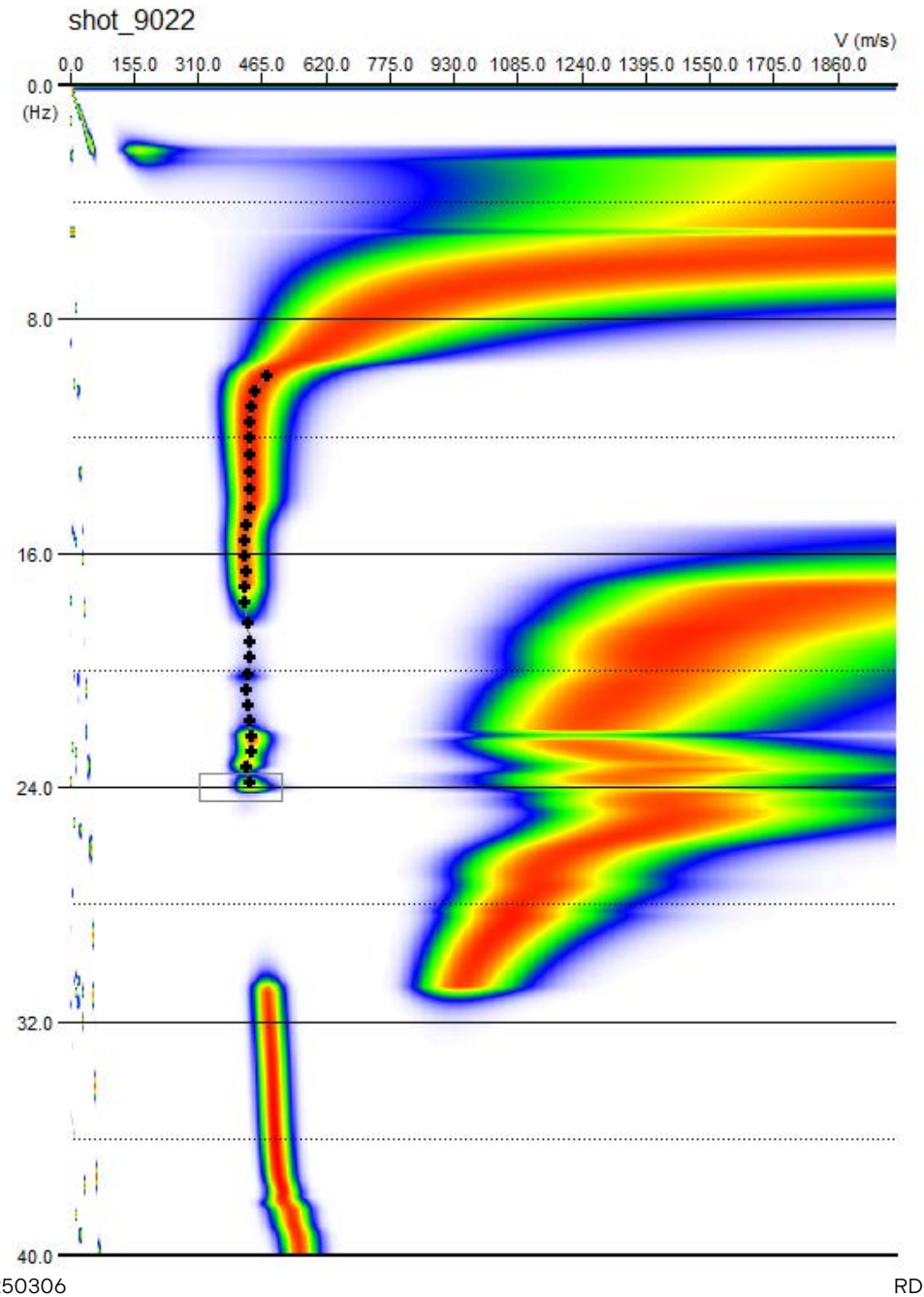

shot_9019
V (m/s)
0.0
155.0
310.0
465.0
620.0
775.0
930.0
1085.0
1240.0
1395.0
1550.0
1705.0
1860.0
0.0
(Hz)
8.0
16.0
24.0
32.0
40.0

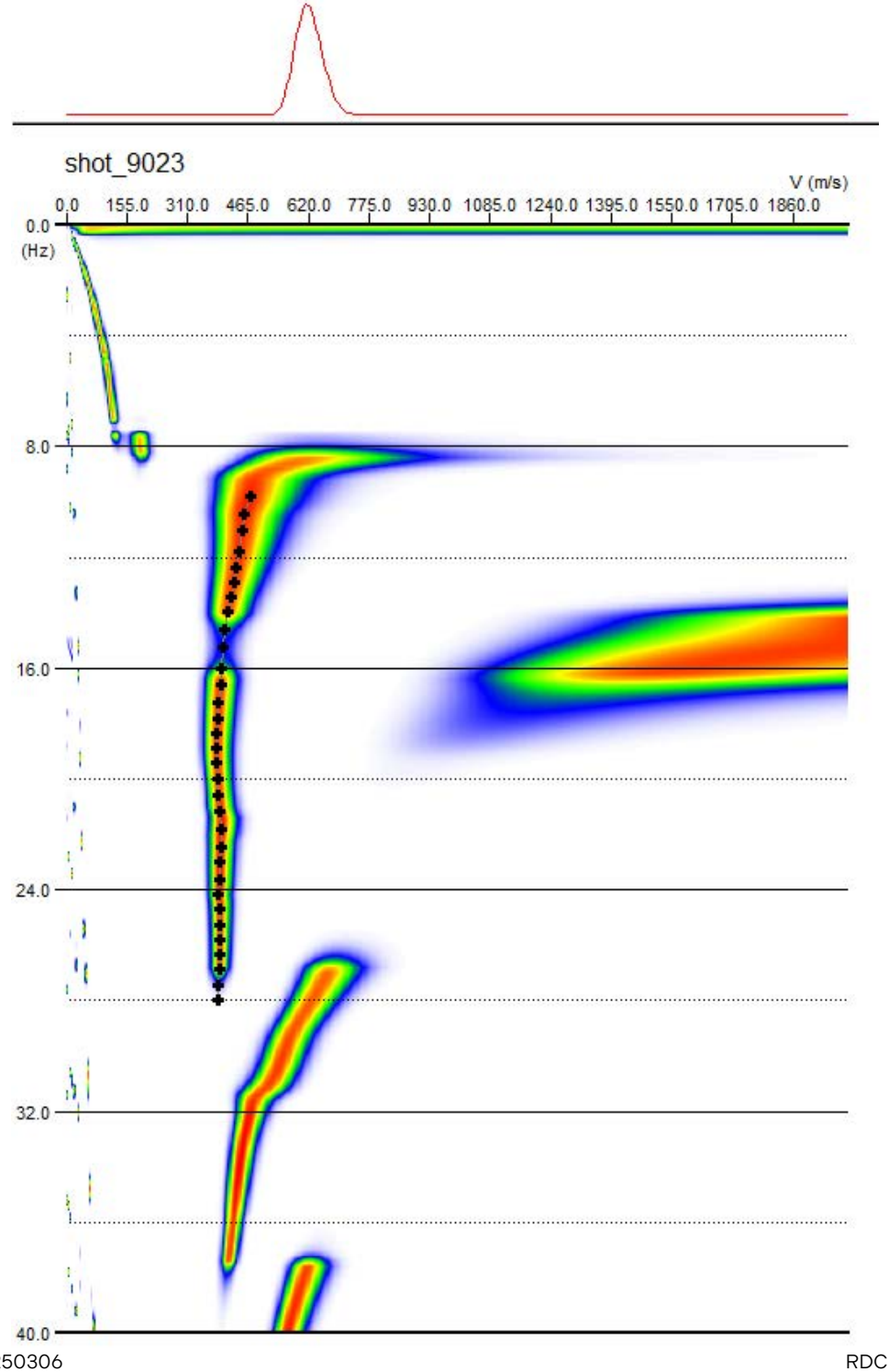


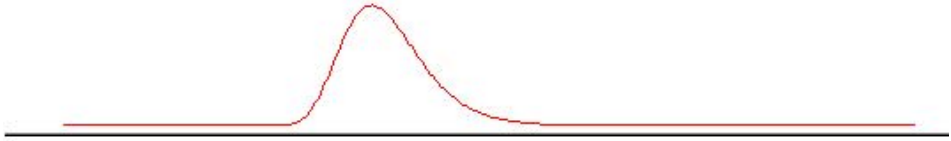

shot_9020
V (m/s)
0.0 155.0 310.0 465.0 620.0 775.0 930.0 1085.0 1240.0 1395.0 1550.0 1705.0 1860.0
0.0
(Hz)
8.0
16.0
24.0
32.0
40.0

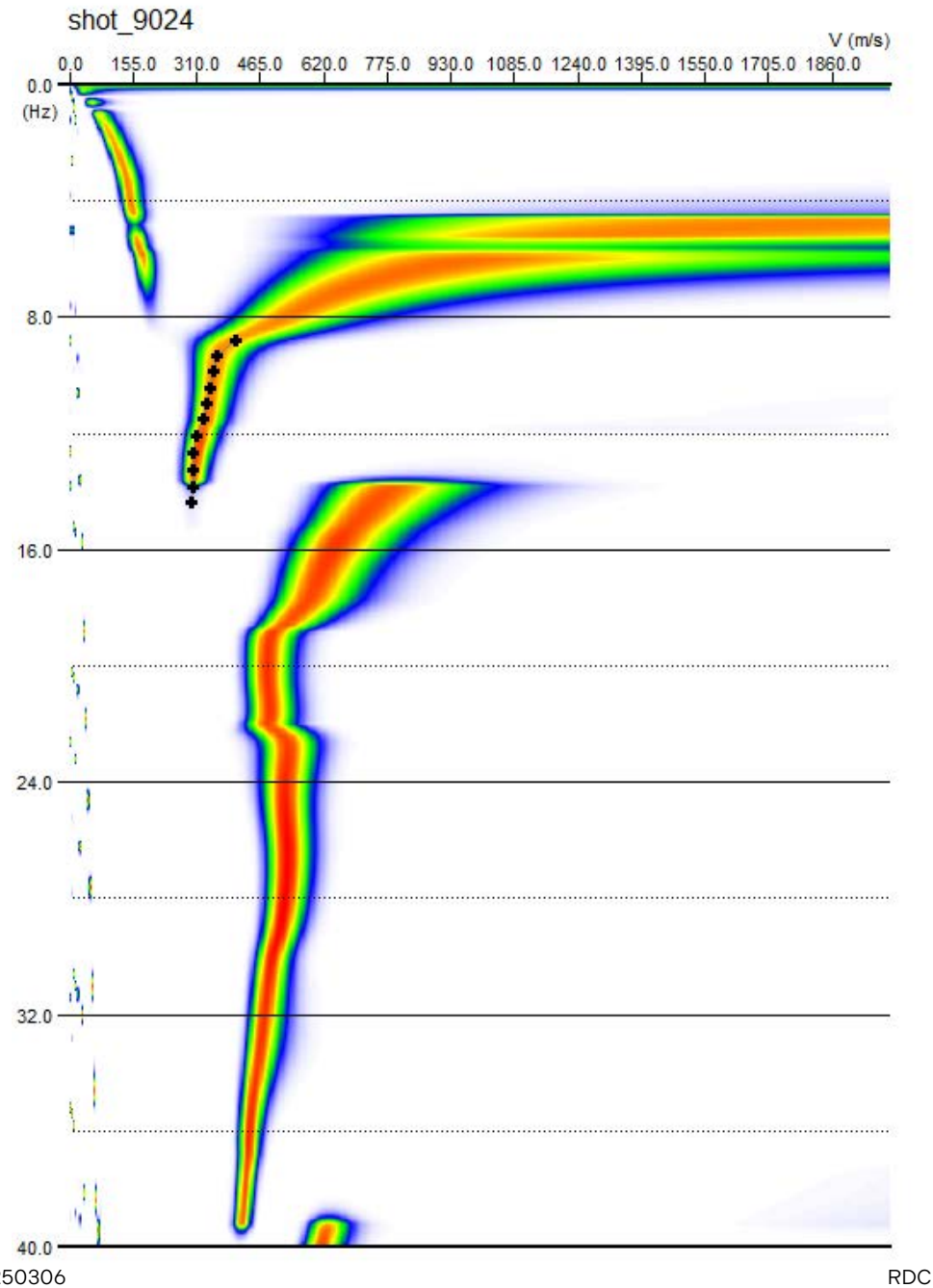

shot_9021
V (m/s)
0.0 155.0 310.0 465.0 620.0 775.0 930.0 1085.0 1240.0 1395.0 1550.0 1705.0 1860.0
0.0
(Hz)
8.0
16.0
24.0
32.0
40.0

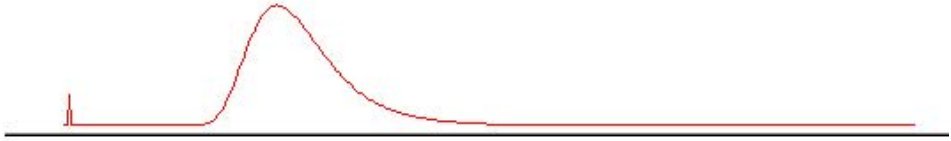

23.99 (Hz)

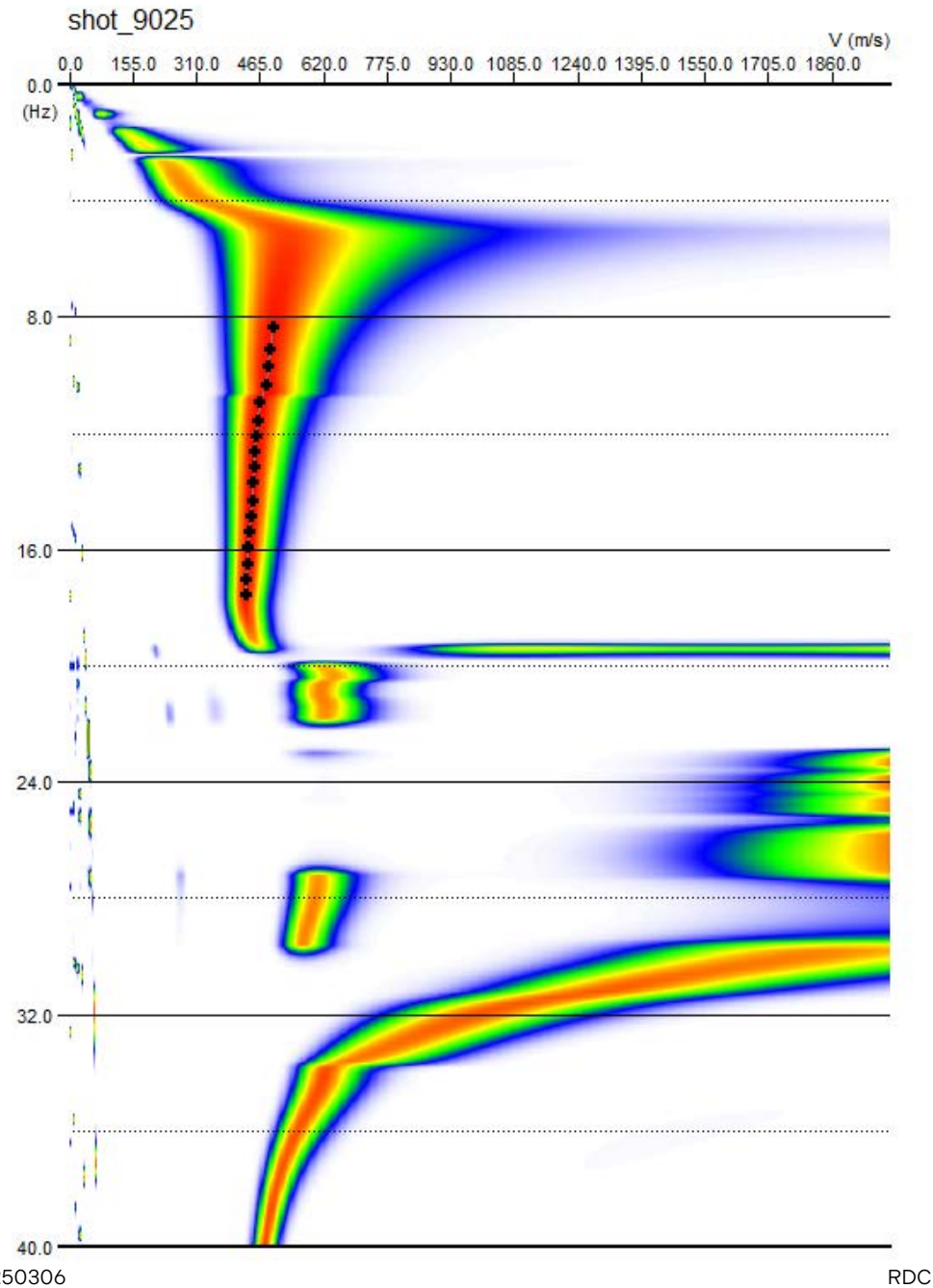

shot_9022
V (m/s)
0.0
155.0
310.0
465.0
620.0
775.0
930.0
1085.0
1240.0
1395.0
1550.0
1705.0
1860.0
0.0
(Hz)
8.0
16.0
24.0
32.0
40.0

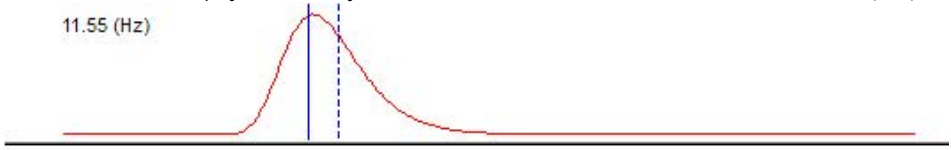

shot_9023
V (m/s)
0.0 155.0 310.0 465.0 620.0 775.0 930.0 1085.0 1240.0 1395.0 1550.0 1705.0 1860.0
0.0
(Hz)
8.0
16.0
24.0
32.0
40.0

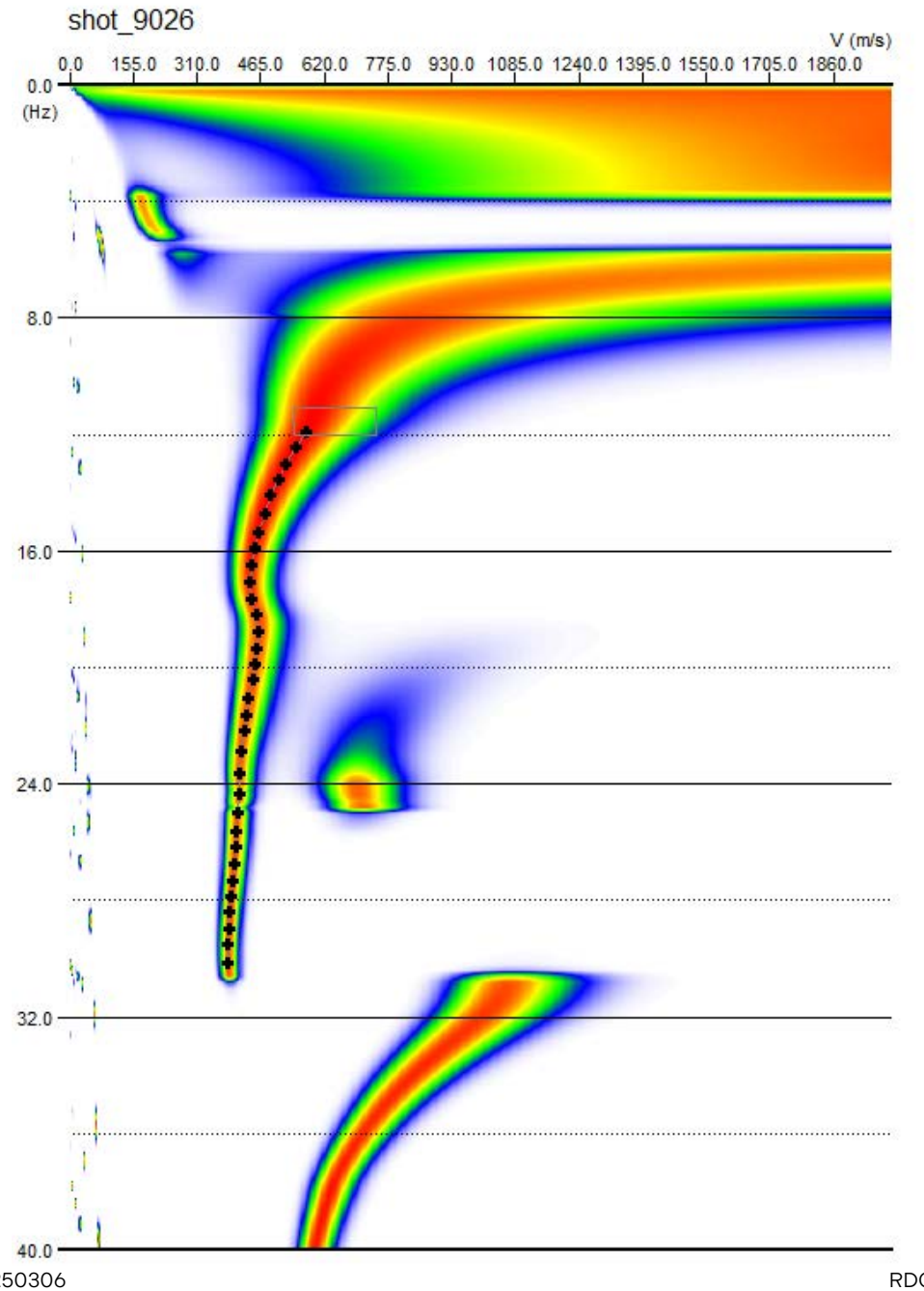


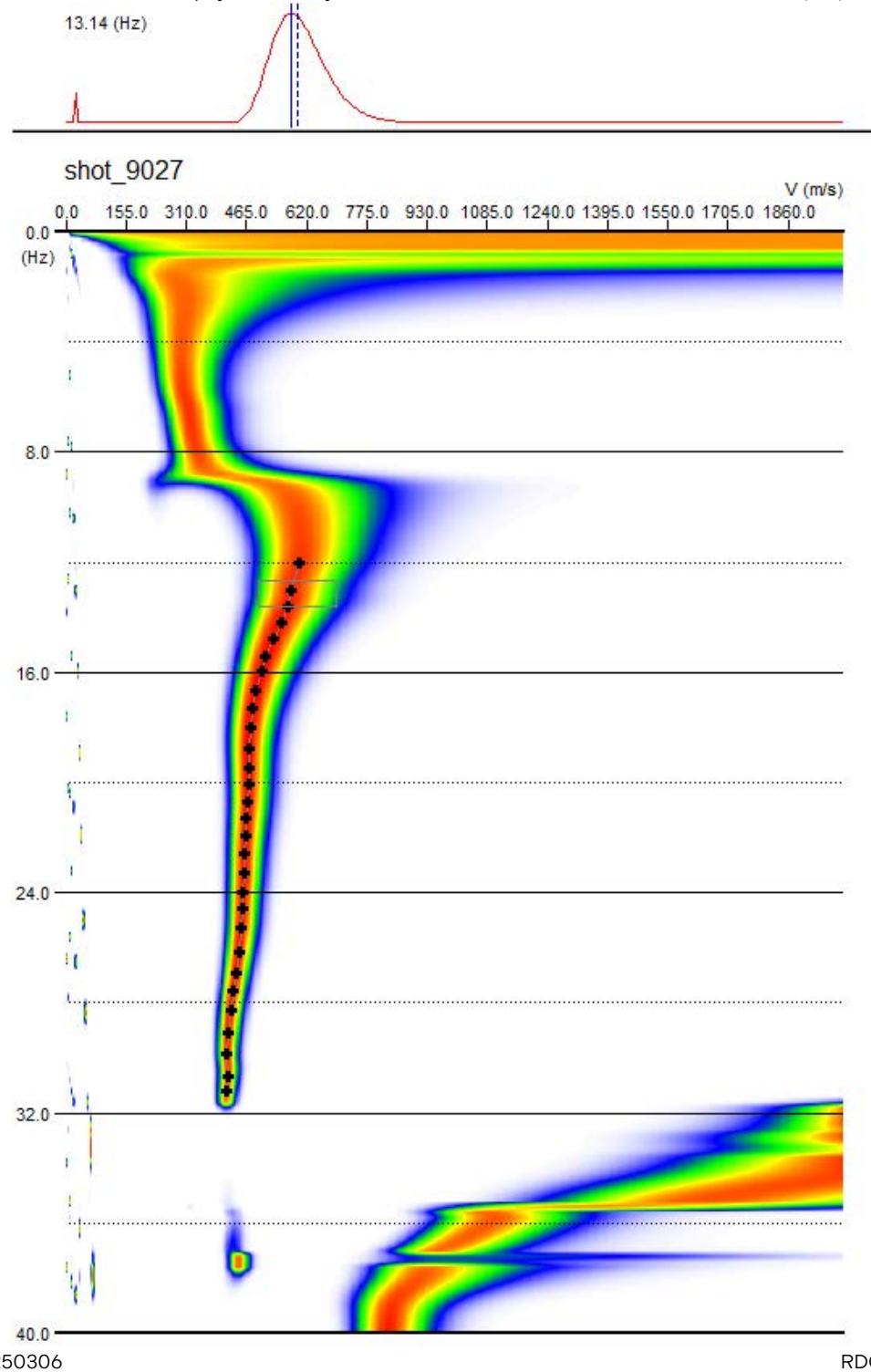

shot_9024
V (m/s)
0.0
155.0
310.0
465.0
620.0
775.0
930.0
1085.0
1240.0
1395.0
1550.0
1705.0
1860.0
0.0
(Hz)
8.0
16.0
24.0
32.0
40.0



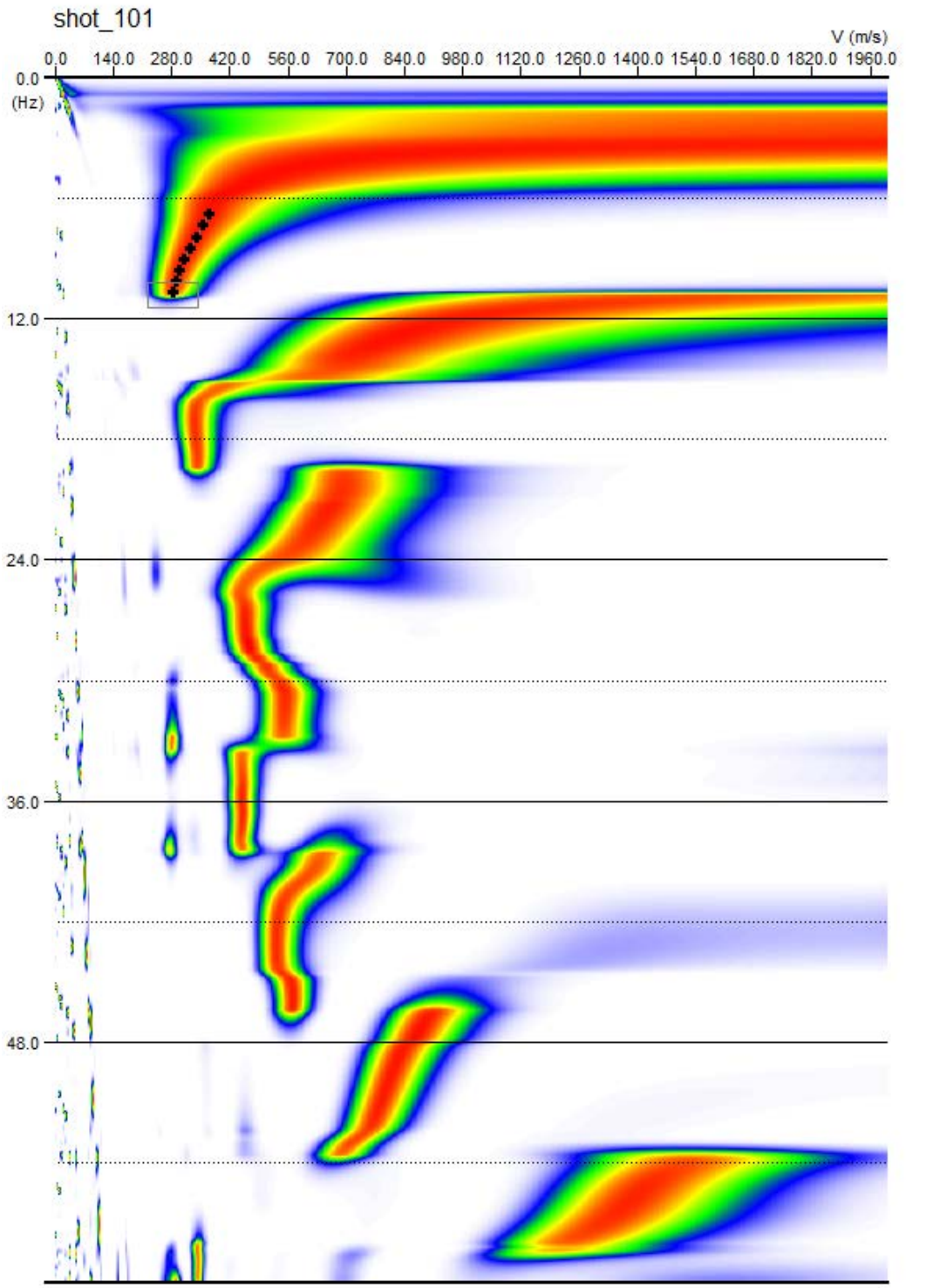

shot_9025
V (m/s)
0.0 155.0 310.0 465.0 620.0 775.0 930.0 1085.0 1240.0 1395.0 1550.0 1705.0 1860.0
0.0
(Hz)
8.0
16.0
24.0
32.0
40.0


11.55 (Hz)

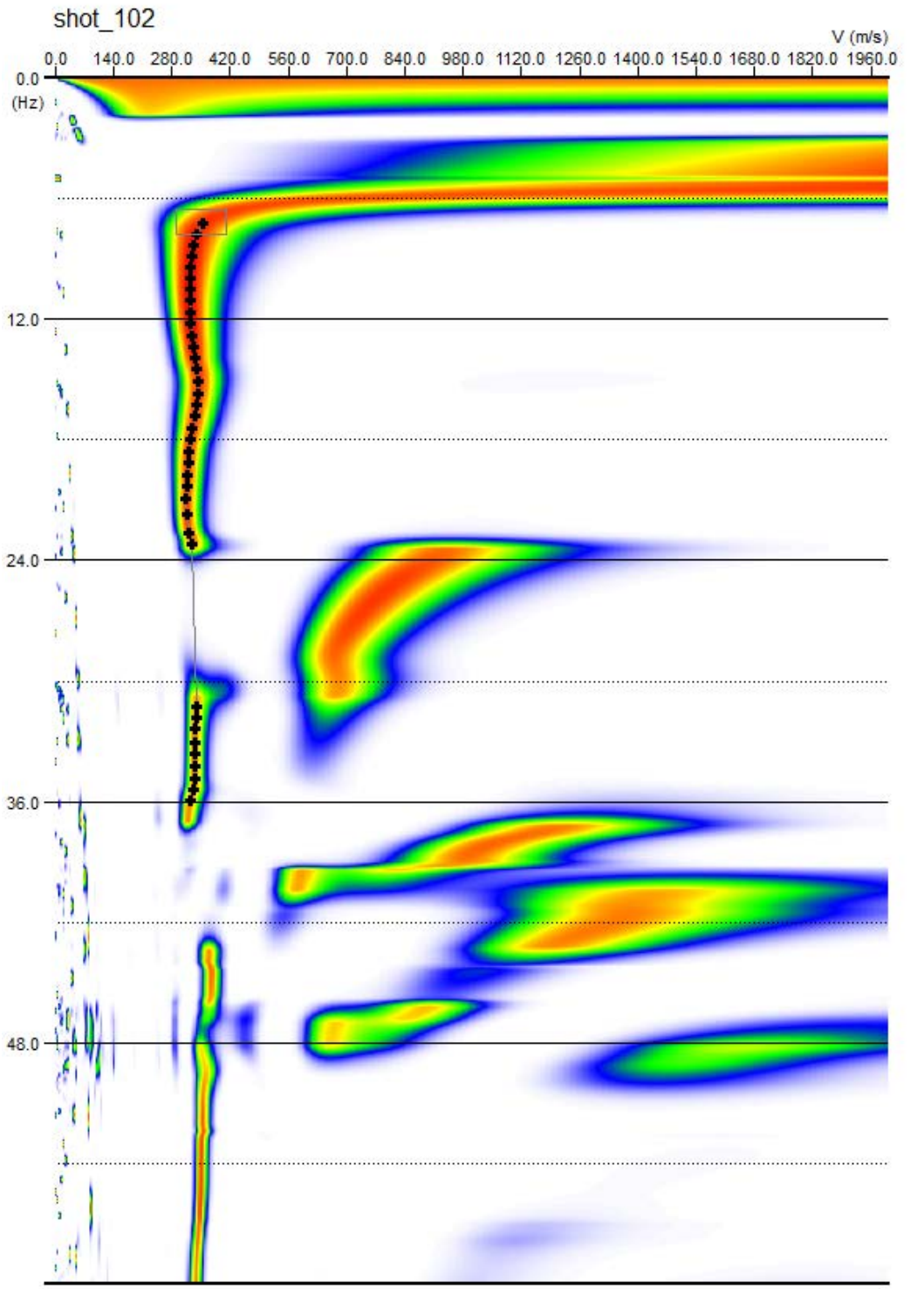

shot_9026
V (m/s)
0.0 155.0 310.0 465.0 620.0 775.0 930.0 1085.0 1240.0 1395.0 1550.0 1705.0 1860.0
0.0
(Hz)
8.0
16.0
24.0
32.0
40.0

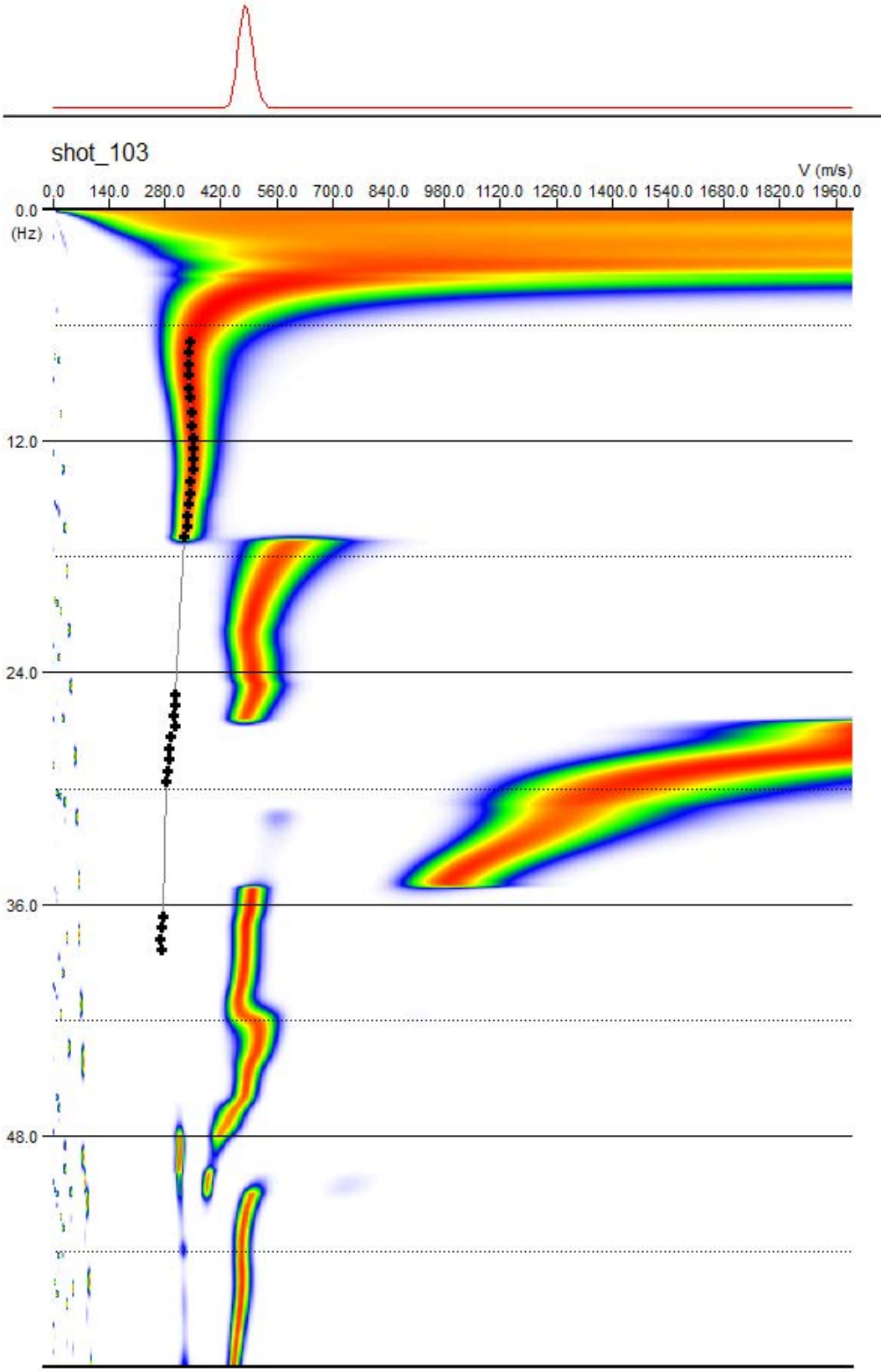

13.14 (Hz)
shot_9027
V (m/s)
0.0 155.0 310.0 465.0 620.0 775.0 930.0 1085.0 1240.0 1395.0 1550.0 1705.0 1860.0
0.0
(Hz)
8.0
16.0
24.0
32.0
40.0

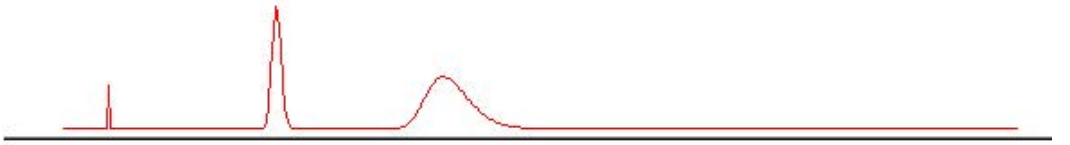

10.82 (Hz)

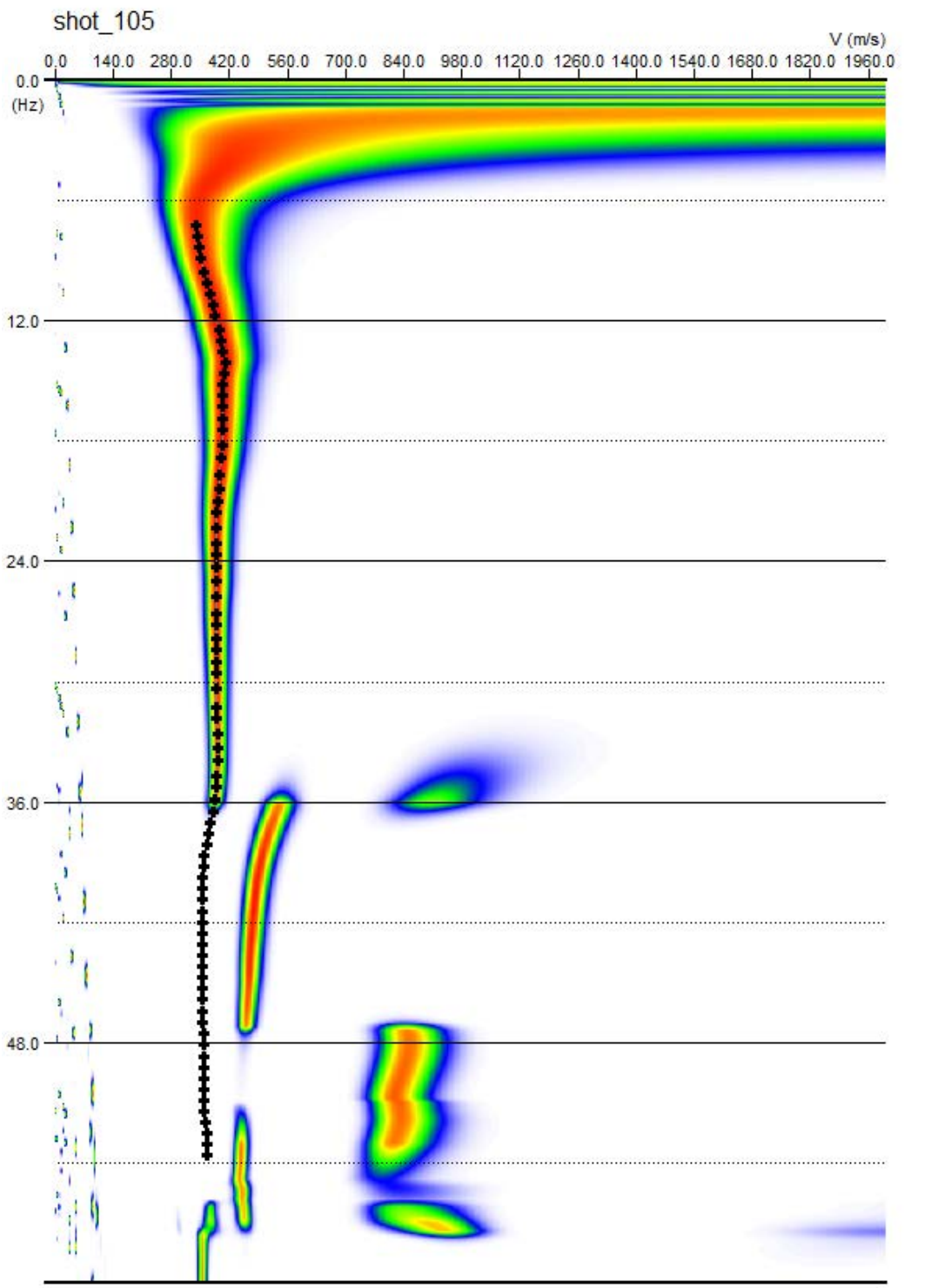

shot_101
V (m/s)
0.0
140.0
280.0
420.0
560.0
700.0
840.0
980.0
1120.0
1260.0
1400.0
1540.0
1680.0
1820.0
1960.0
0.0
(Hz)
12.0
24.0
36.0
48.0

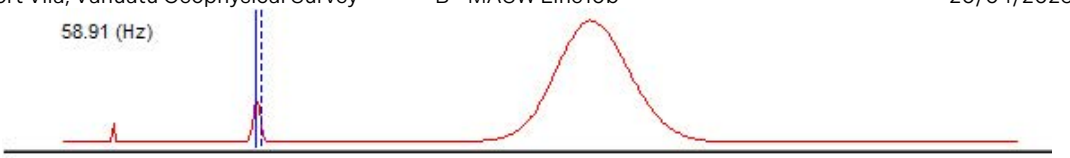

7.16 (Hz)

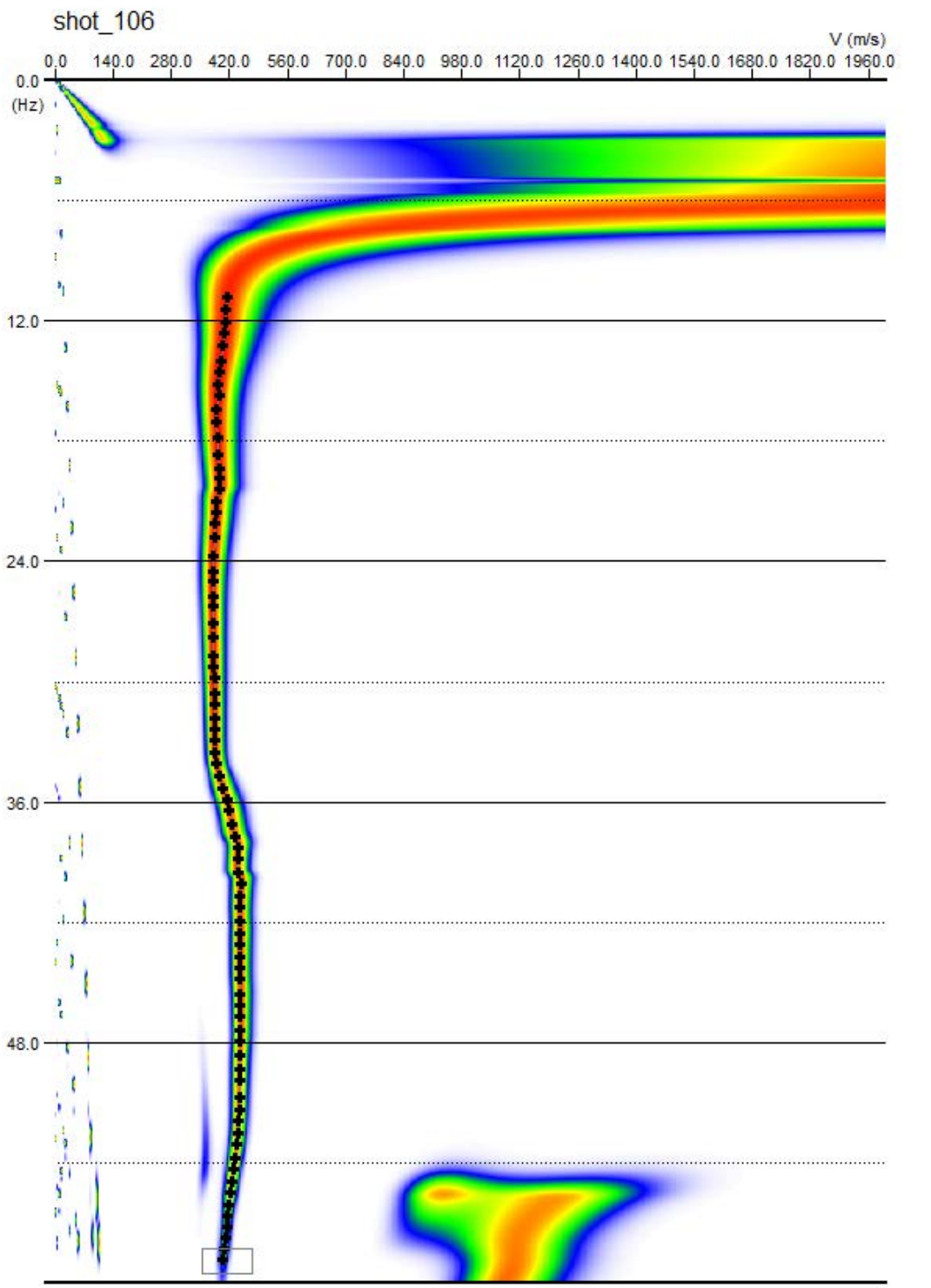

shot_102
V (m/s)
0.0 140.0 280.0 420.0 560.0 700.0 840.0 980.0 1120.0 1260.0 1400.0 1540.0 1680.0 1820.0 1960.0
0.0
(Hz)
12.0
24.0
36.0
48.0

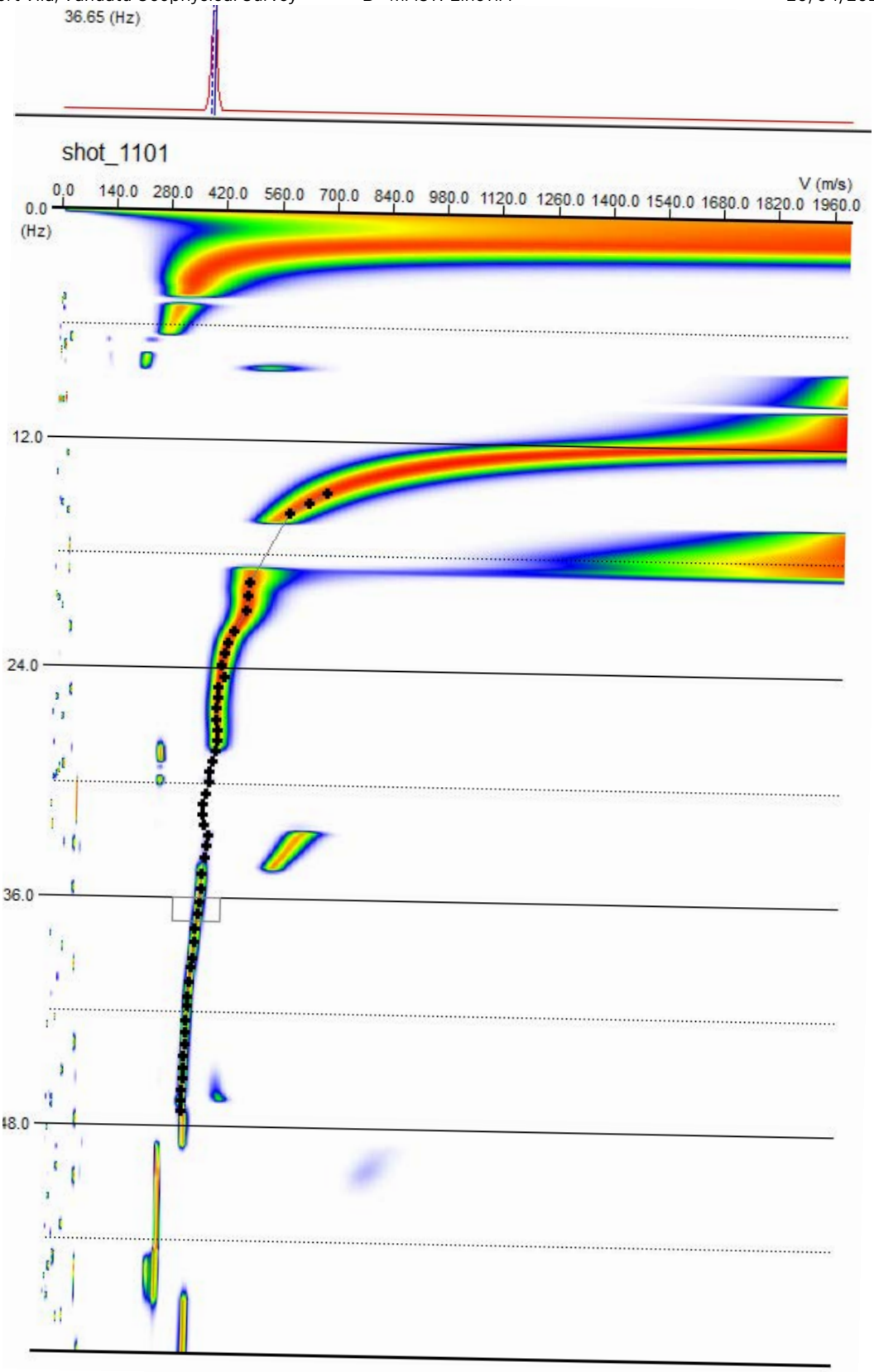

shot_103
V (m/s)
0.0 140.0 280.0 420.0 560.0 700.0 840.0 980.0 1120.0 1260.0 1400.0 1540.0 1680.0 1820.0 1960.0
0.0
(Hz)
12.0
24.0
36.0
48.0

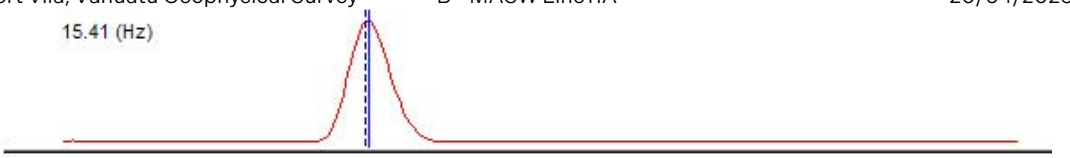


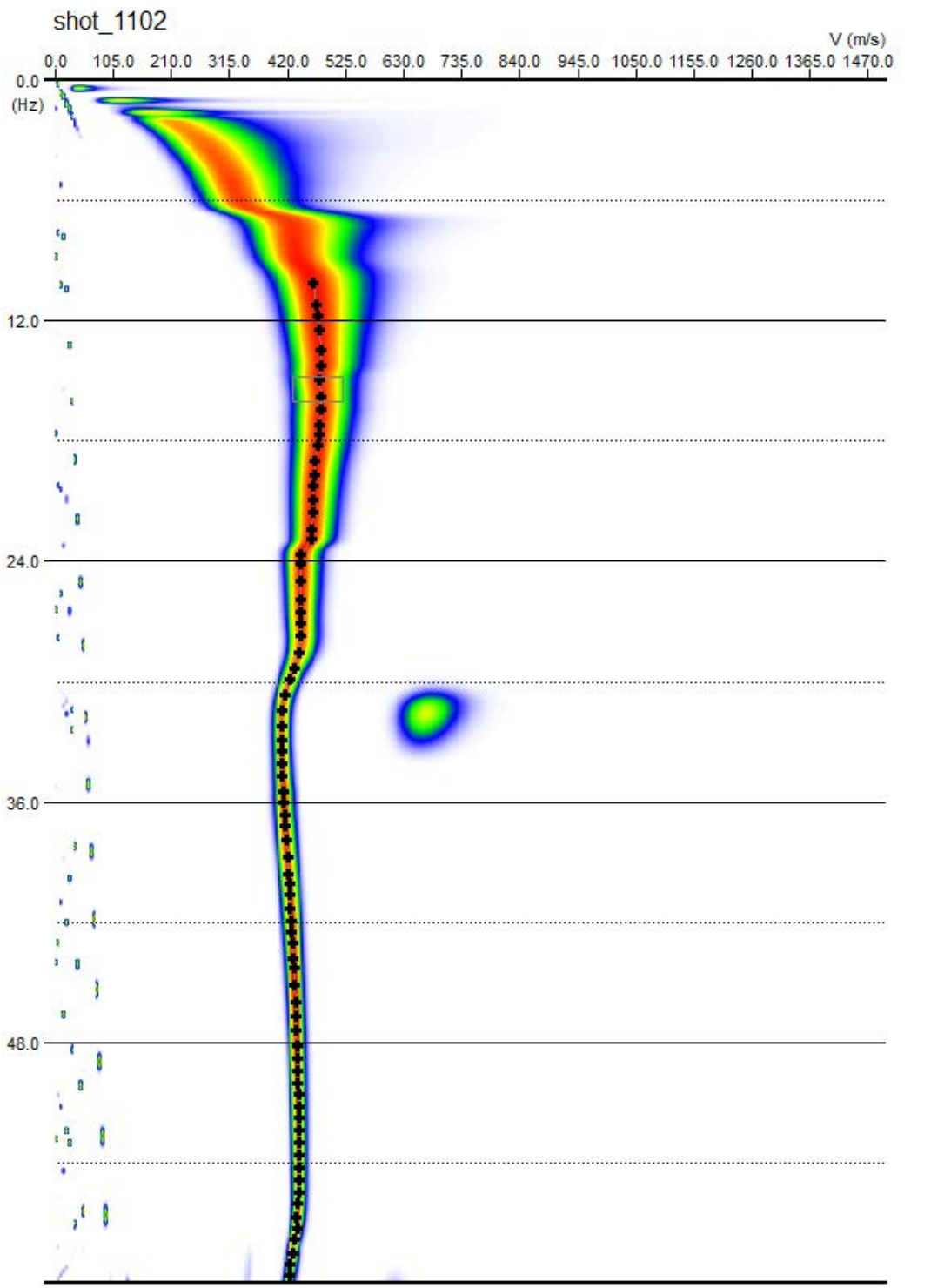

shot_105
V (m/s)
0.0 140.0 280.0 420.0 560.0 700.0 840.0 980.0 1120.0 1260.0 1400.0 1540.0 1680.0 1820.0 1960.0
0.0
(Hz)
12.0
24.0
36.0
48.0


58.91 (Hz)

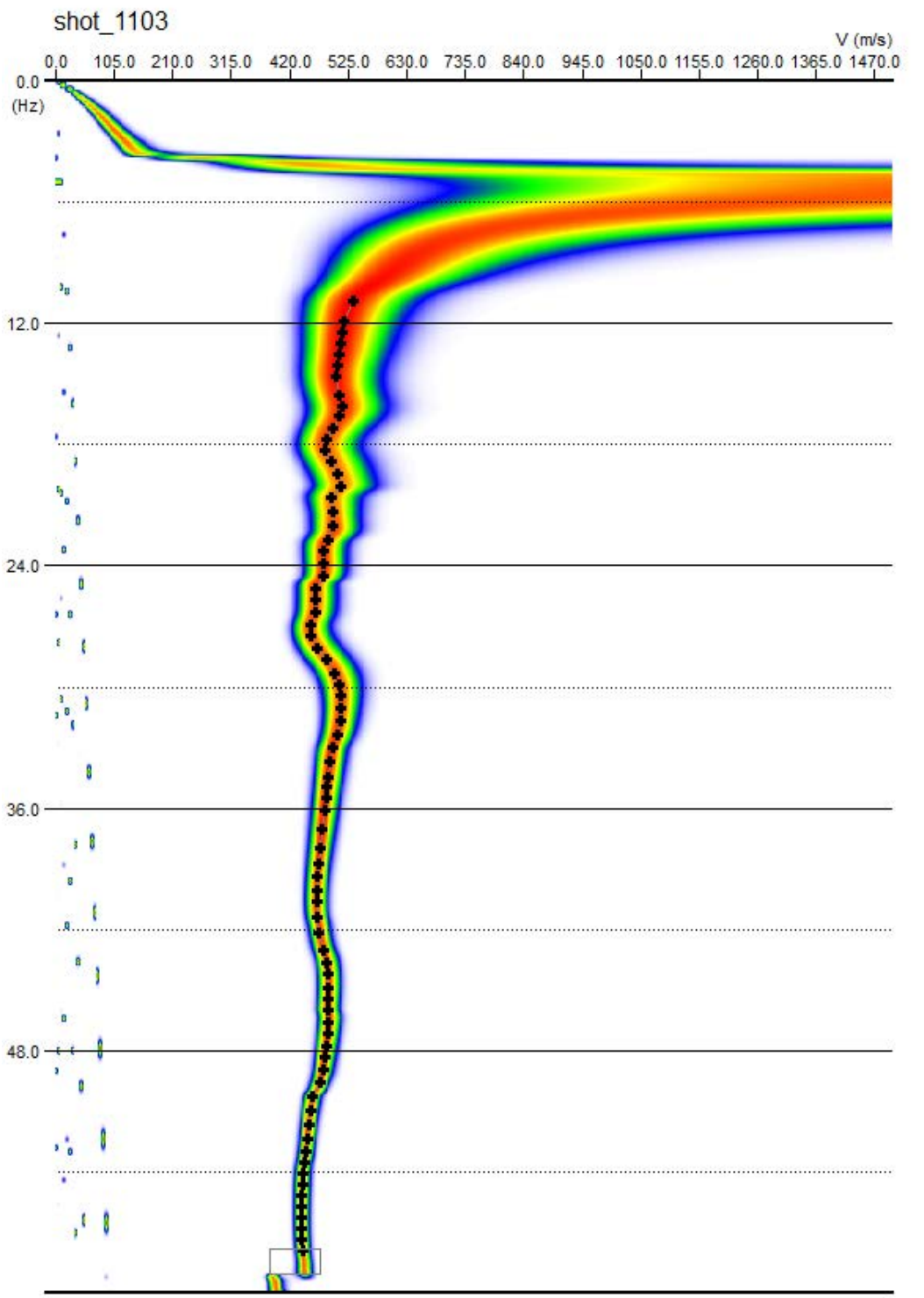

shot_106
V (m/s)
0.0 140.0 280.0 420.0 560.0 700.0 840.0 980.0 1120.0 1260.0 1400.0 1540.0 1680.0 1820.0 1960.0
0.0
(Hz)
12.0
24.0
36.0
48.0

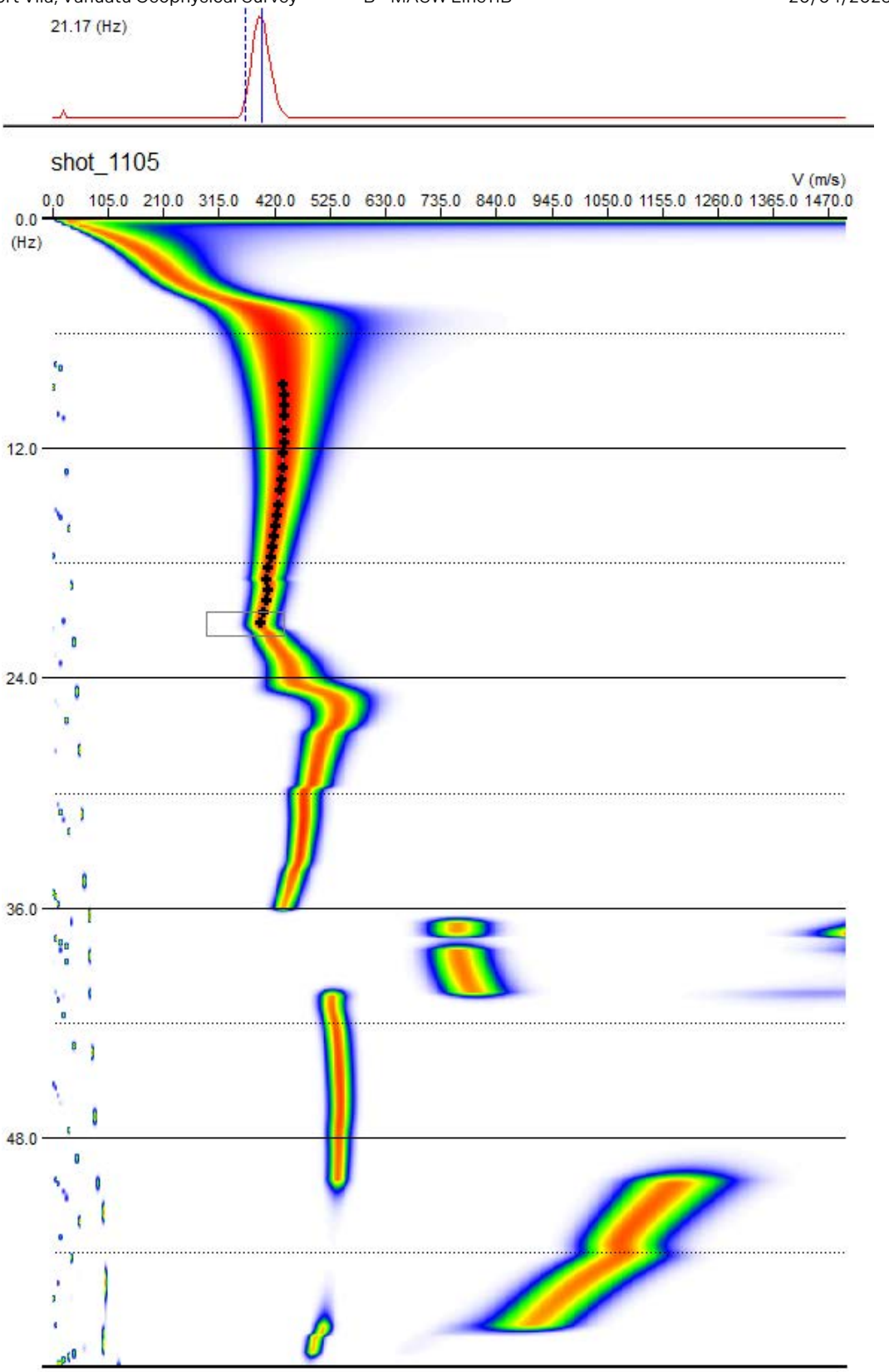

36.65 (Hz)
shot_1101
0.0 140.0 280.0 420.0 560.0 700.0 840.0 980.0 1120.0 1260.0 1400.0 1540.0 1680.0 1820.0 1960.0
V (m/s)
0.0
(Hz)
12.0
24.0
36.0
48.0

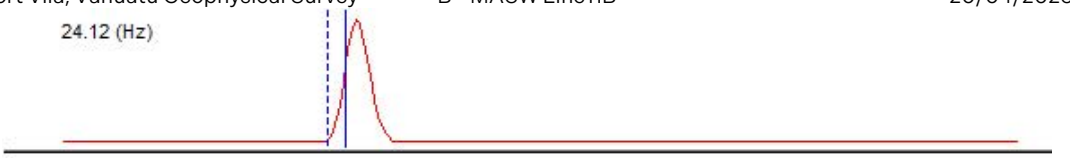

15.41 (Hz)

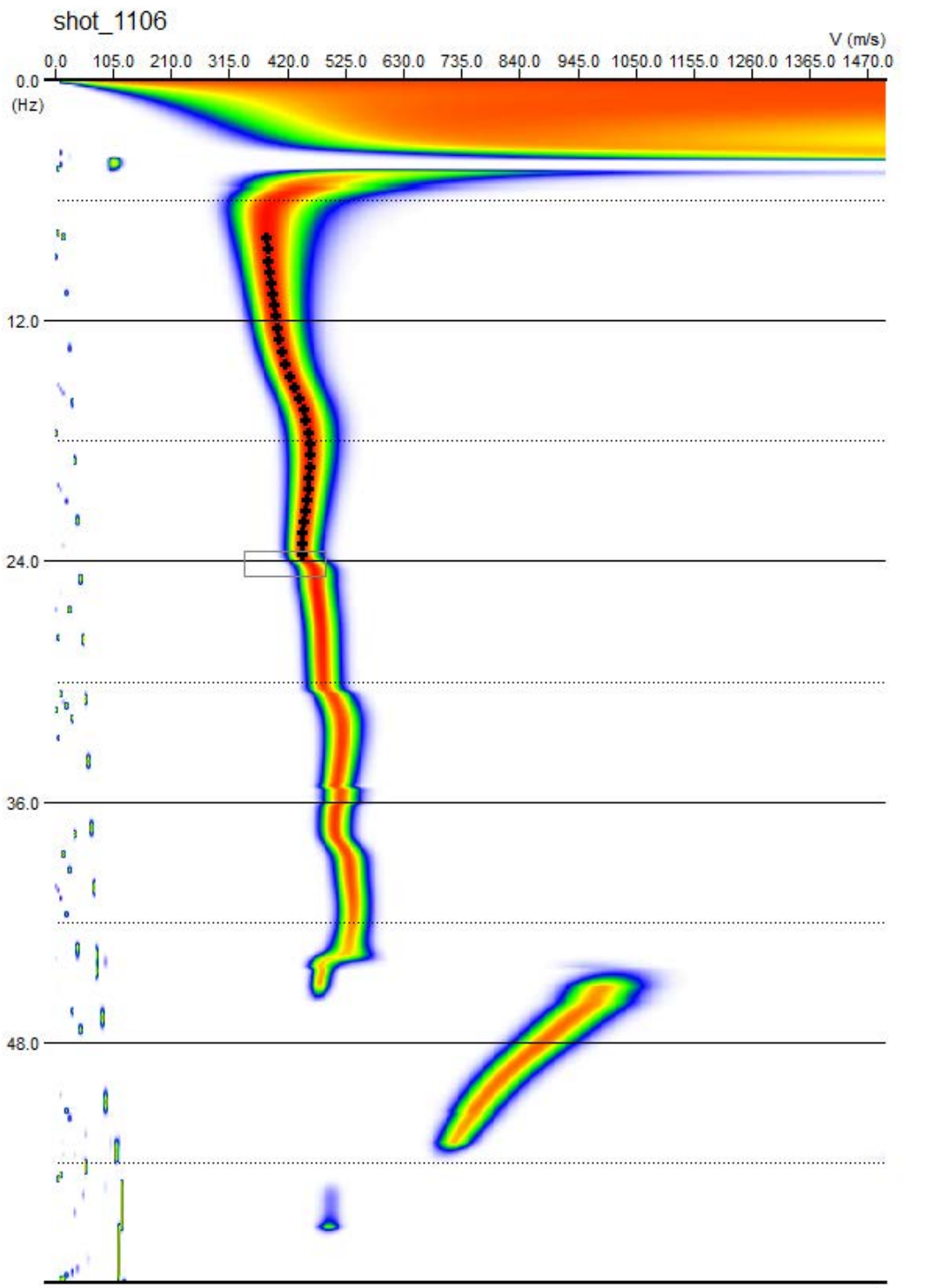

shot_1102
V (m/s)
0.0
105.0
210.0
315.0
420.0
525.0
630.0
735.0
840.0
945.0
1050.0
1155.0
1260.0
1365.0
1470.0
0.0
(Hz)
12.0
24.0
36.0
48.0


58.44 (Hz)

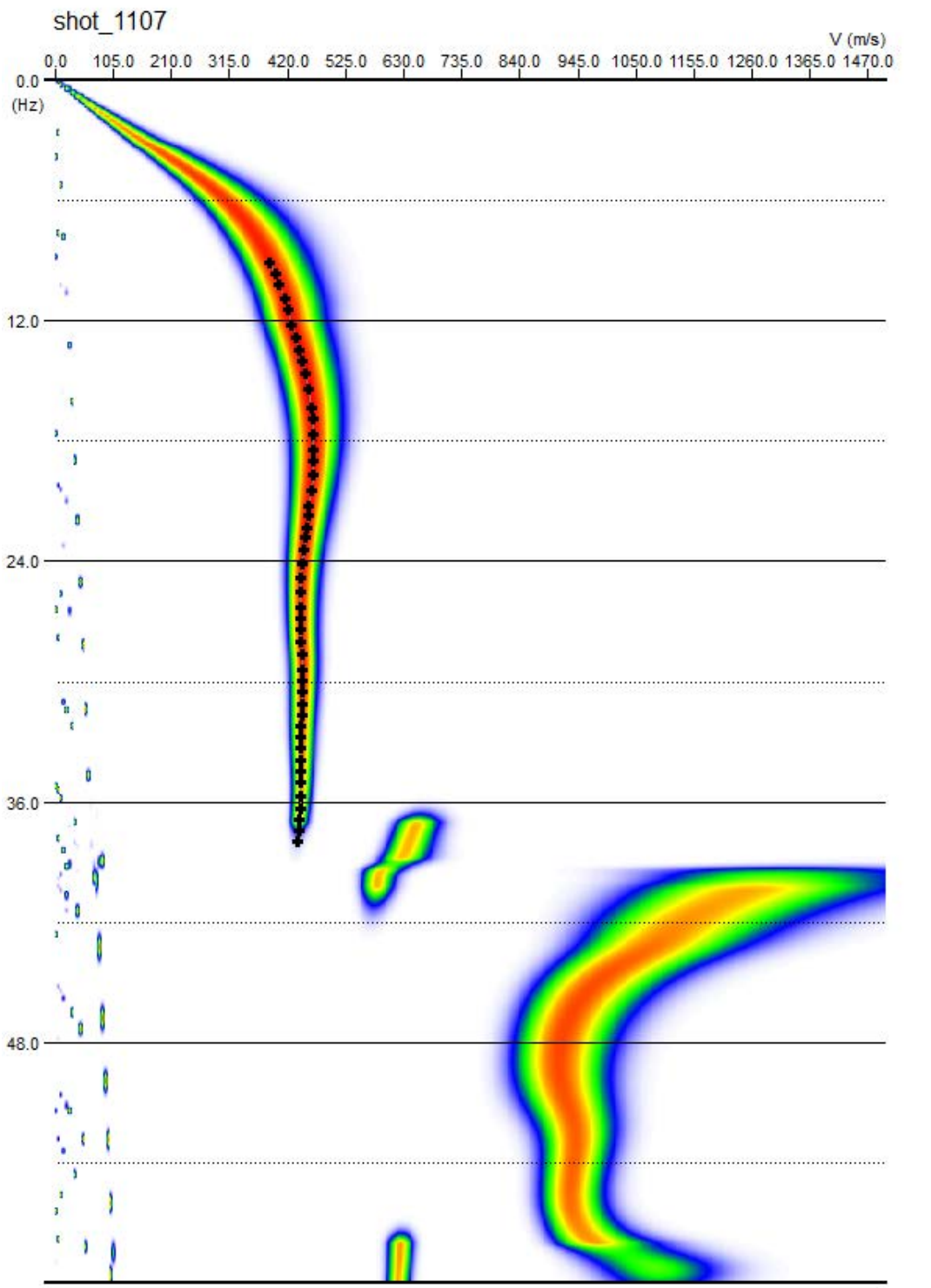

shot_1103
V (m/s)
0.0
105.0
210.0
315.0
420.0
525.0
630.0
735.0
840.0
945.0
1050.0
1155.0
1260.0
1365.0
1470.0
0.0
(Hz)
12.0
24.0
36.0
48.0

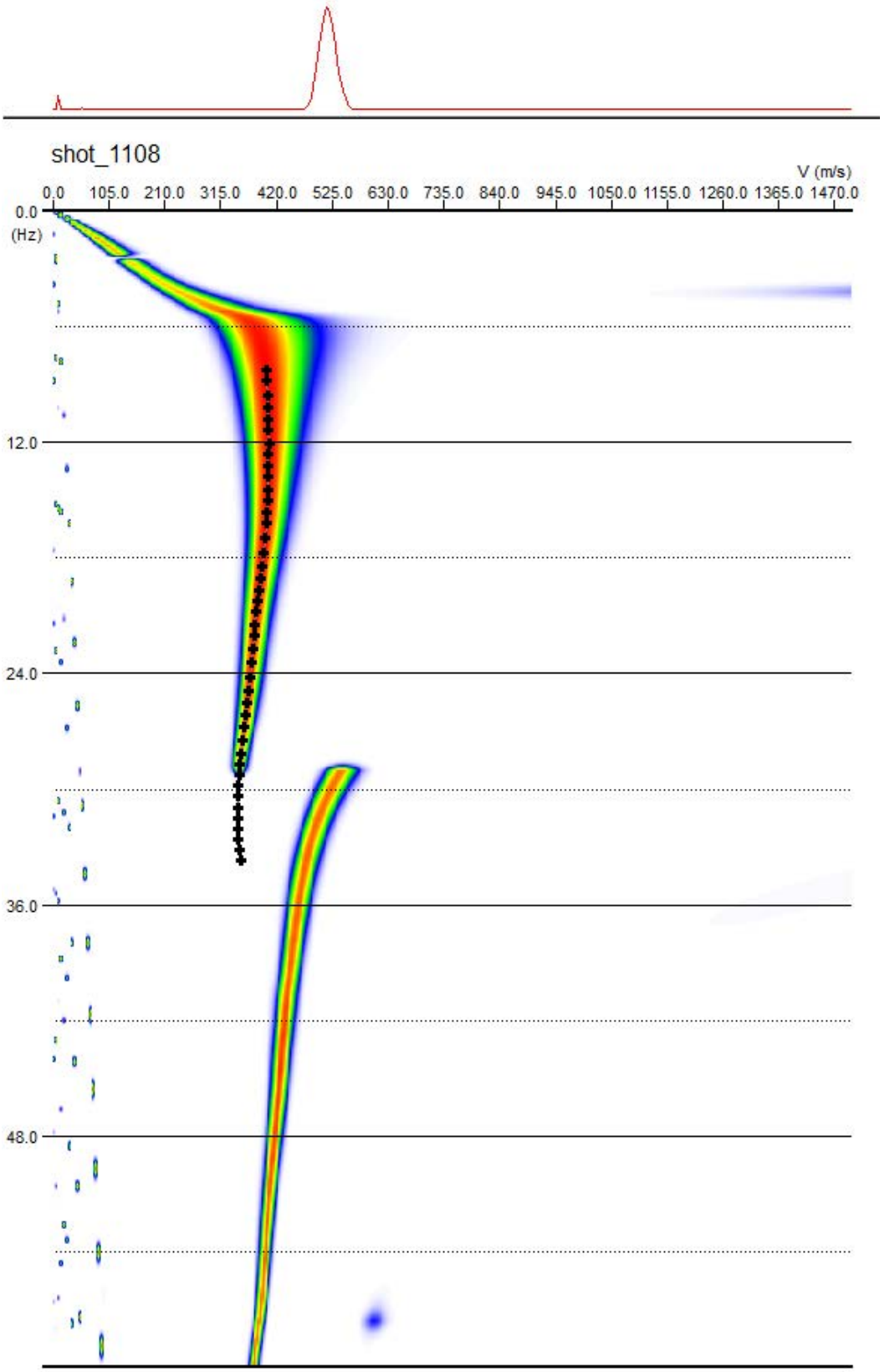

21.17 (Hz)
shot_1105
V (m/s)
0.0 105.0 210.0 315.0 420.0 525.0 630.0 735.0 840.0 945.0 1050.0 1155.0 1260.0 1365.0 1470.0
0.0
(Hz)
12.0
24.0
36.0
48.0

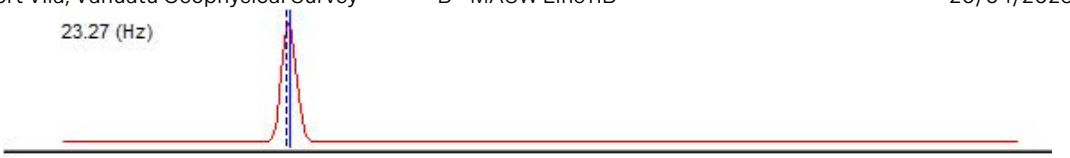

24.12 (Hz)

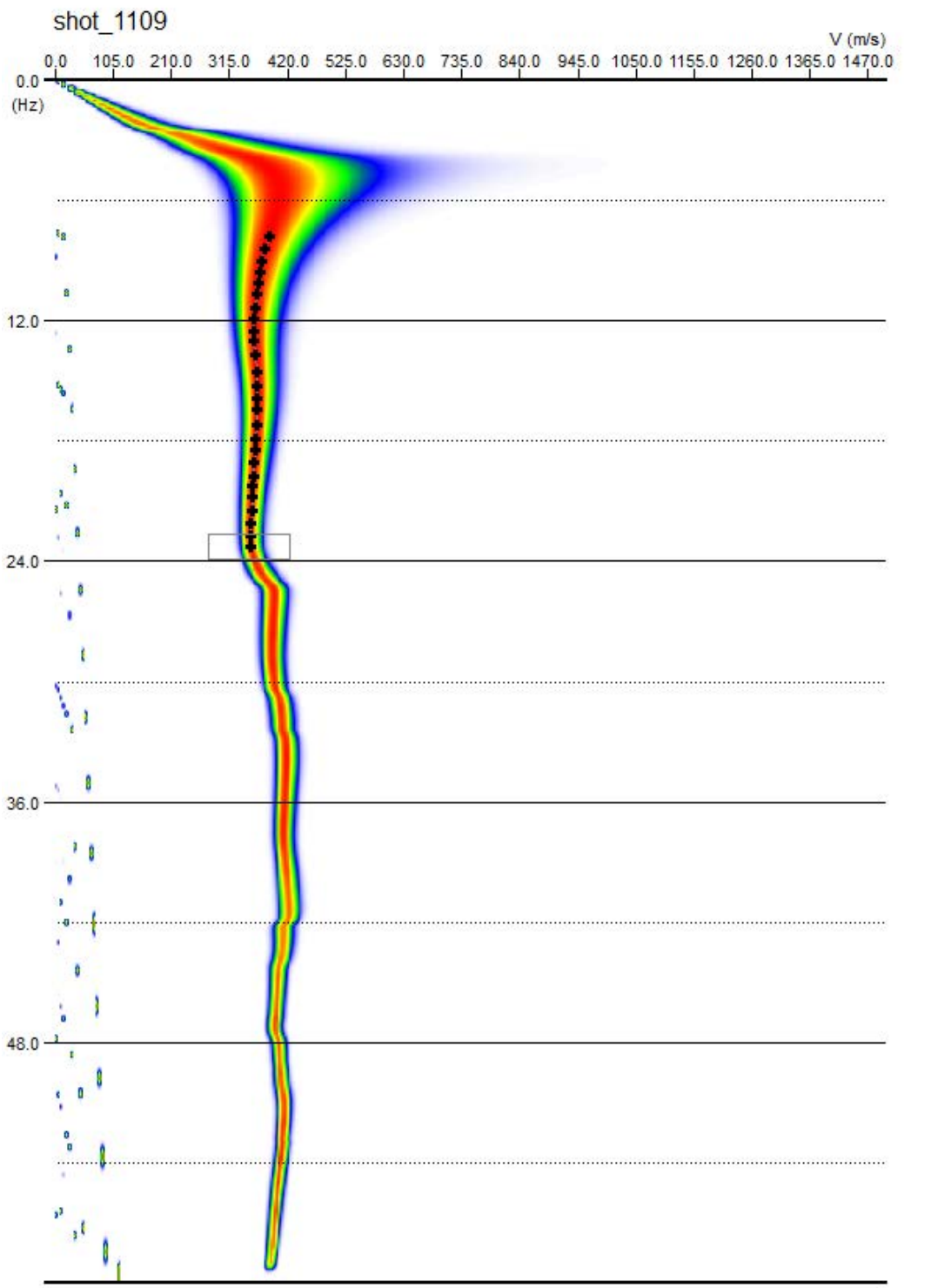

shot_1106
V (m/s)
0.0 105.0 210.0 315.0 420.0 525.0 630.0 735.0 840.0 945.0 1050.0 1155.0 1260.0 1365.0 1470.0
0.0
(Hz)
12.0
24.0
36.0
48.0

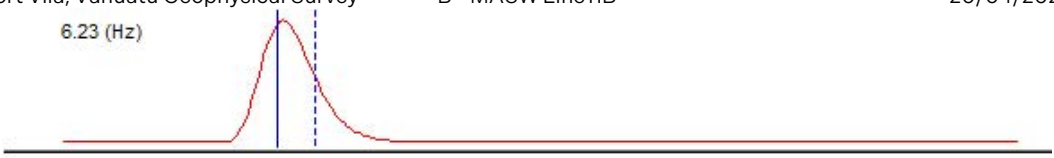


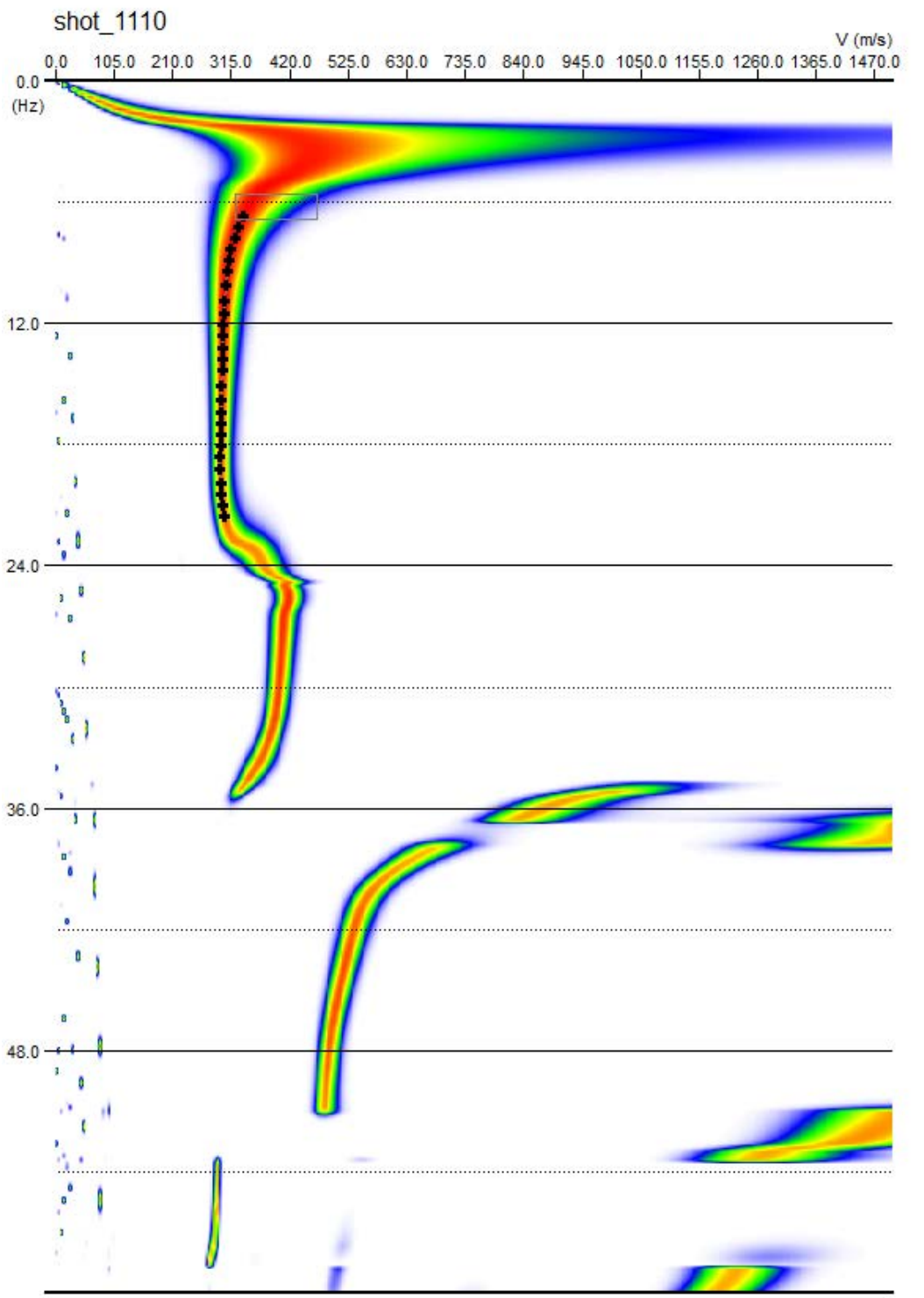

shot_1107
V (m/s)
0.0 105.0 210.0 315.0 420.0 525.0 630.0 735.0 840.0 945.0 1050.0 1155.0 1260.0 1365.0 1470.0
0.0
(Hz)
12.0
24.0
36.0
48.0

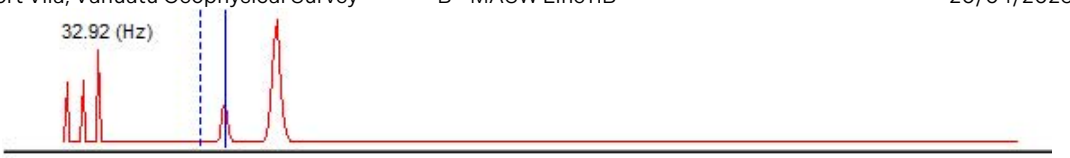

shot_1108
V (m/s)
0.0 105.0 210.0 315.0 420.0 525.0 630.0 735.0 840.0 945.0 1050.0 1155.0 1260.0 1365.0 1470.0
0.0
(Hz)
12.0
24.0
36.0
48.0

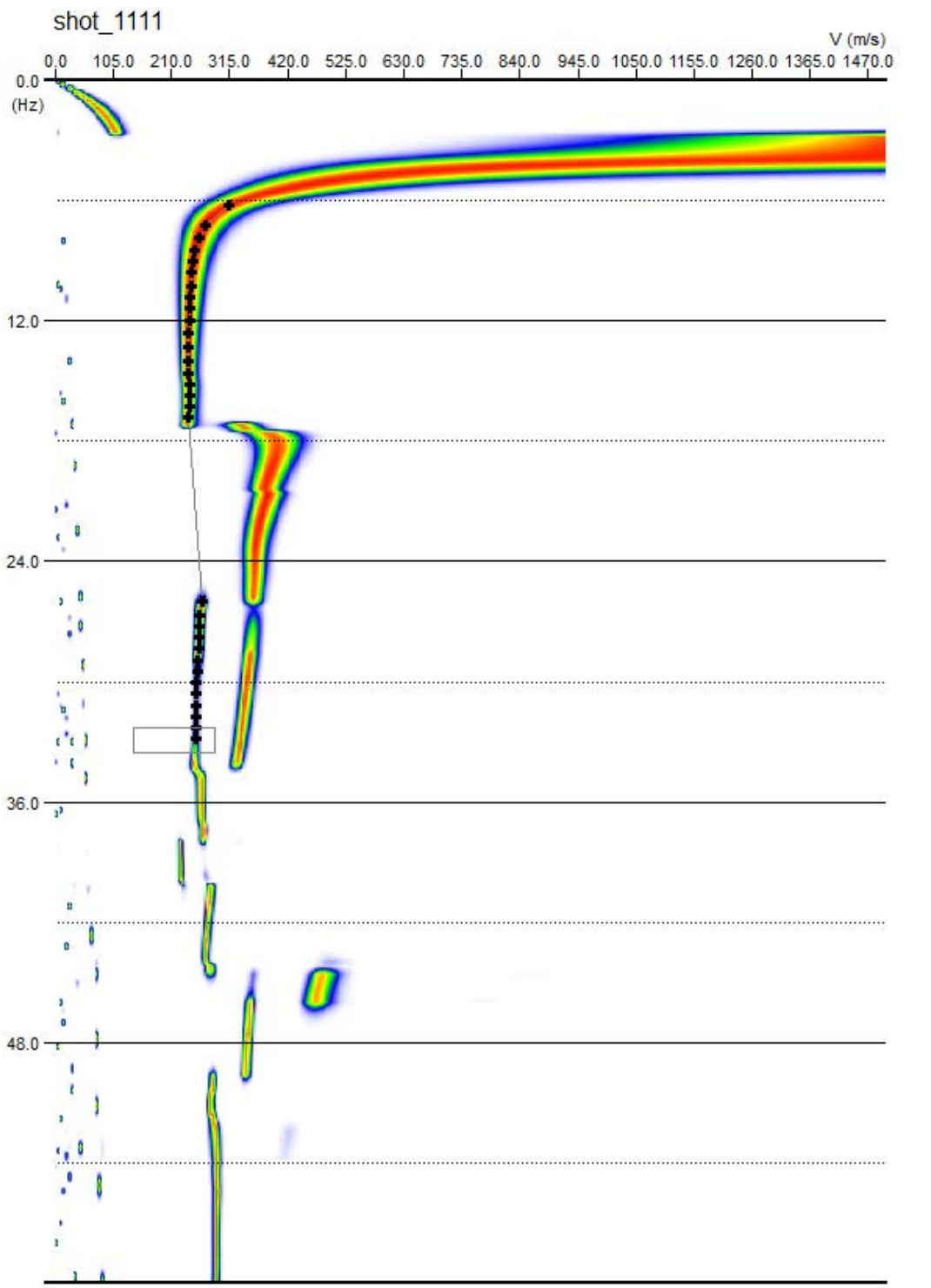

23.27 (Hz)

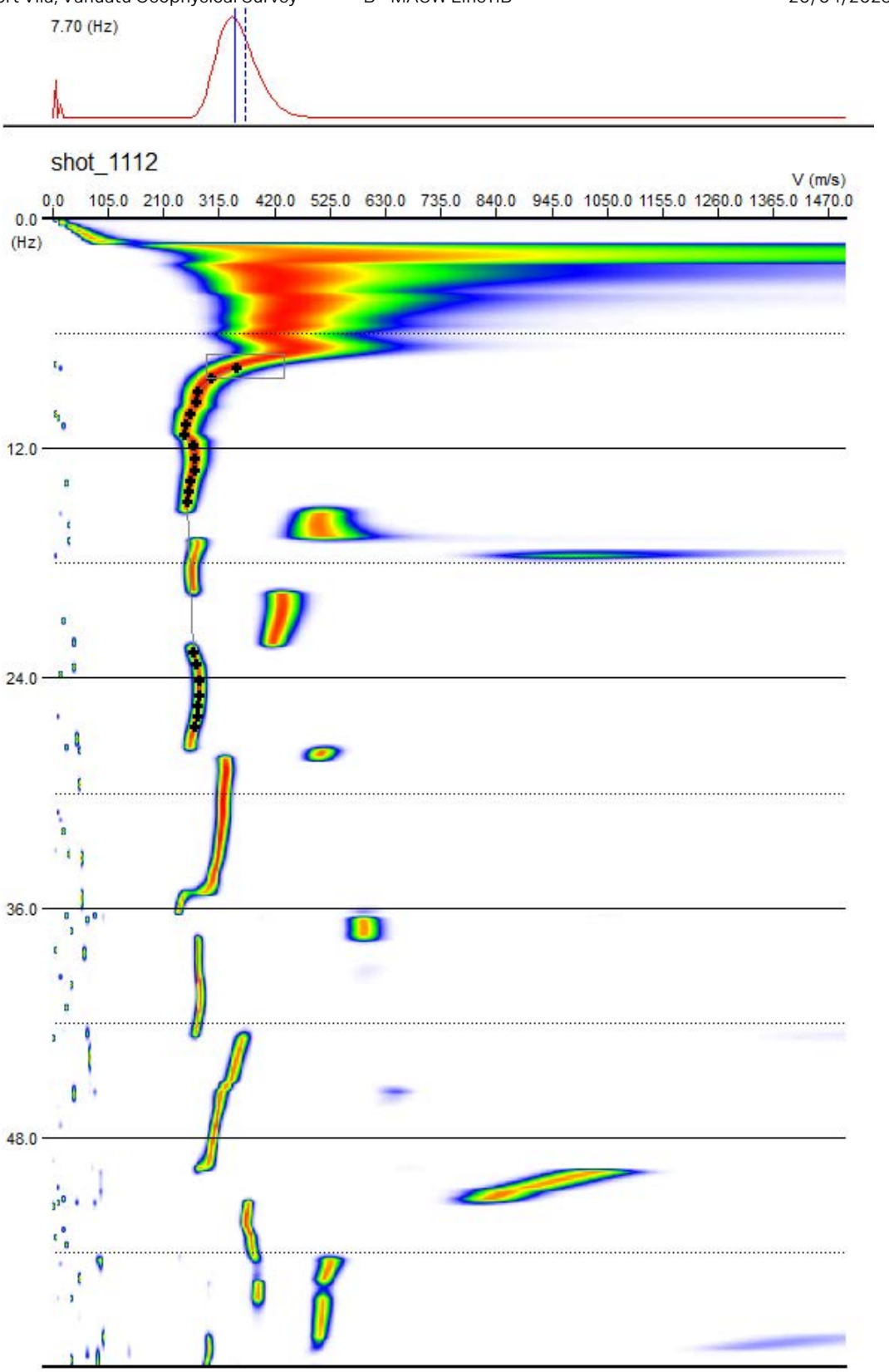

shot_1109
V (m/s)
0.0
105.0
210.0
315.0
420.0
525.0
630.0
735.0
840.0
945.0
1050.0
1155.0
1260.0
1365.0
1470.0
0.0
(Hz)
12.0
24.0
36.0
48.0

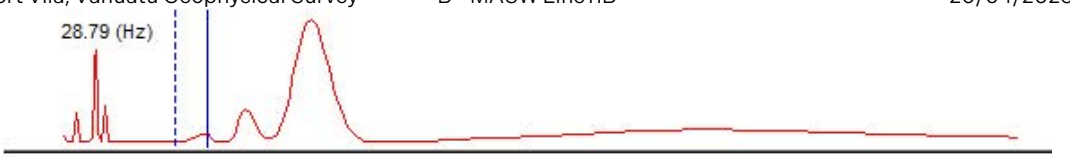

6.23 (Hz)

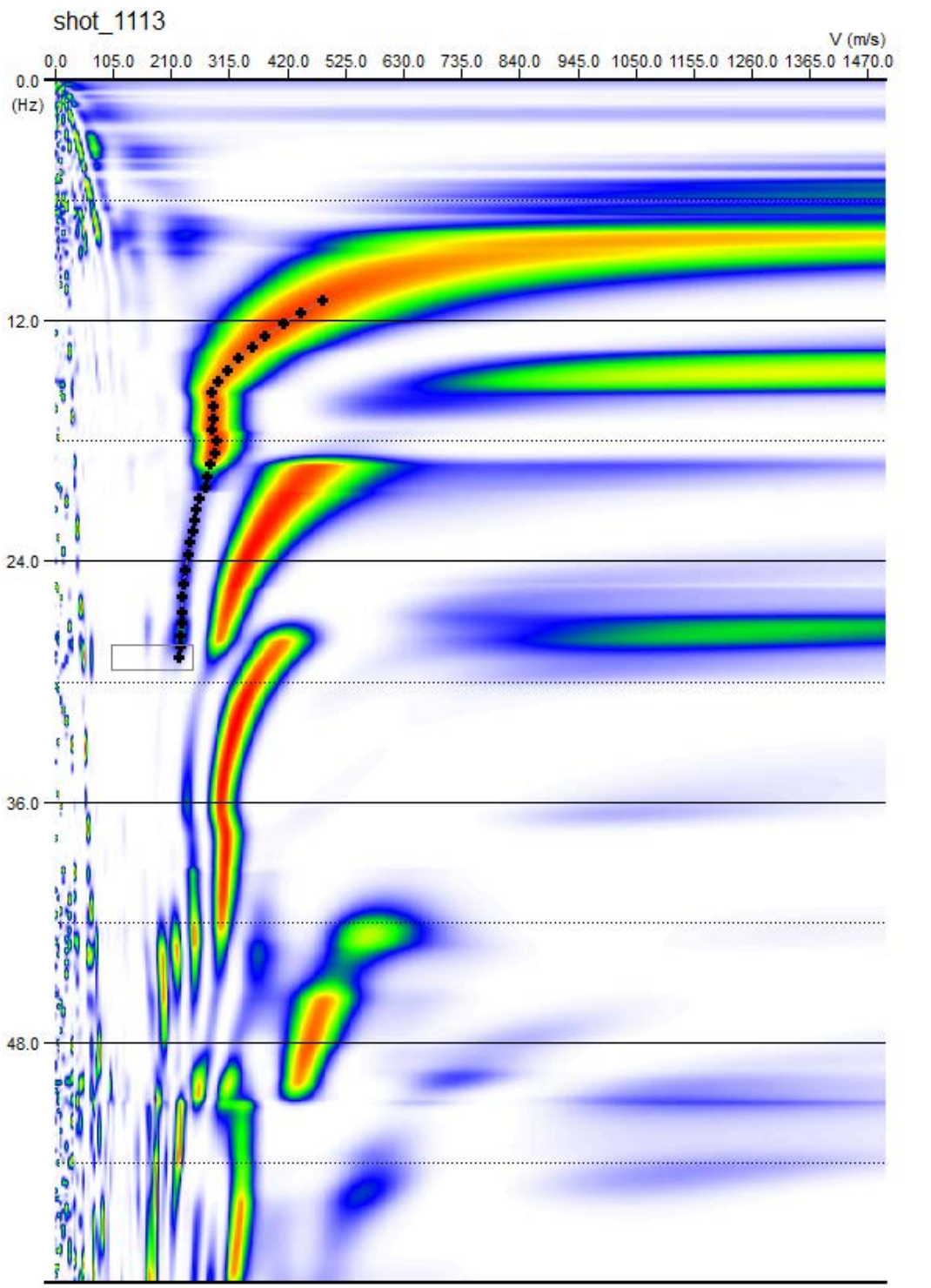

shot_1110
V (m/s)
0.0
105.0
210.0
315.0
420.0
525.0
630.0
735.0
840.0
945.0
1050.0
1155.0
1260.0
1365.0
1470.0
0.0
(Hz)
12.0
24.0
36.0
48.0


32.92 (Hz)

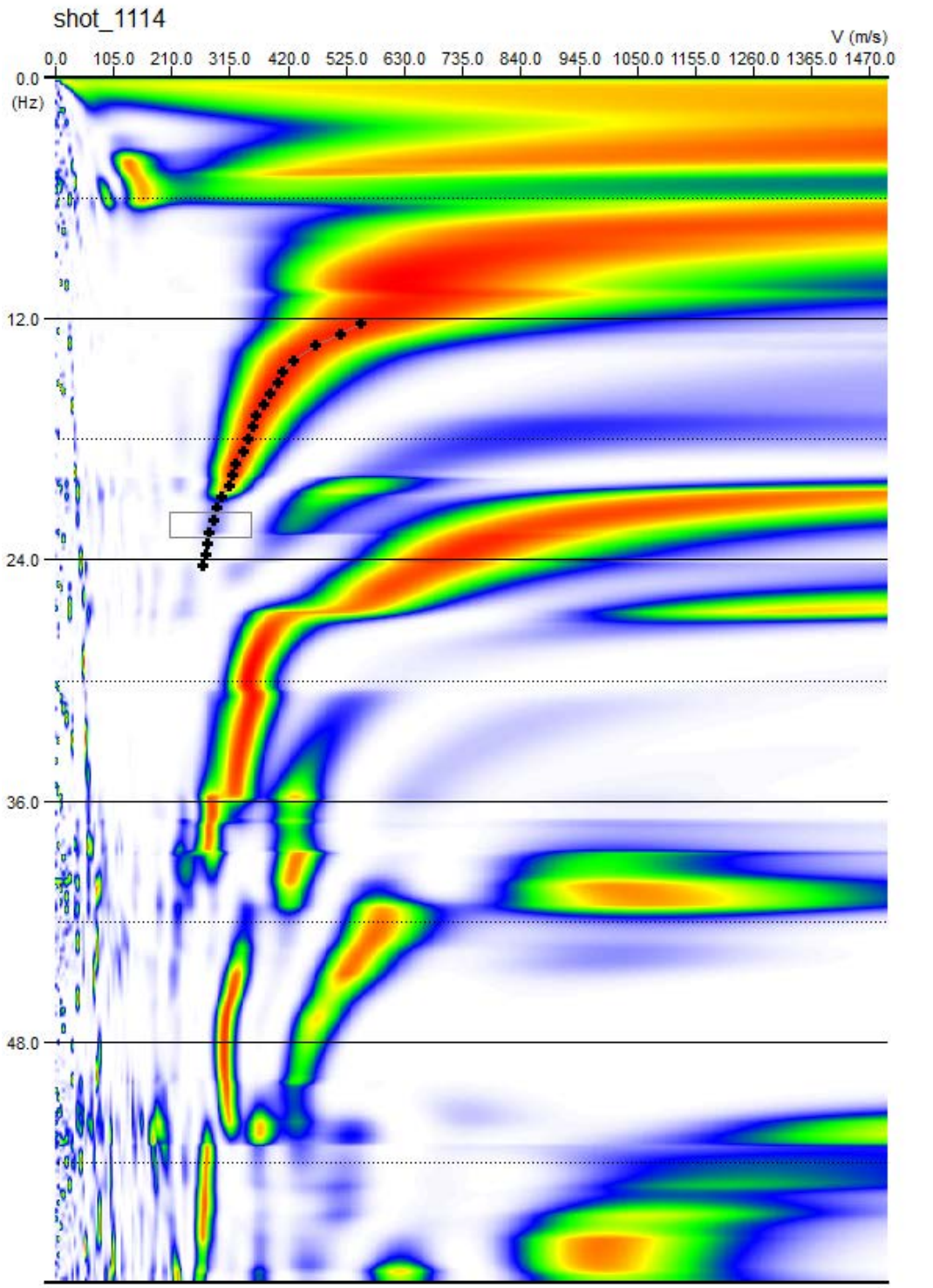

shot_1111
V (m/s)
0.0 105.0 210.0 315.0 420.0 525.0 630.0 735.0 840.0 945.0 1050.0 1155.0 1260.0 1365.0 1470.0
0.0
(Hz)
12.0
24.0
36.0
48.0

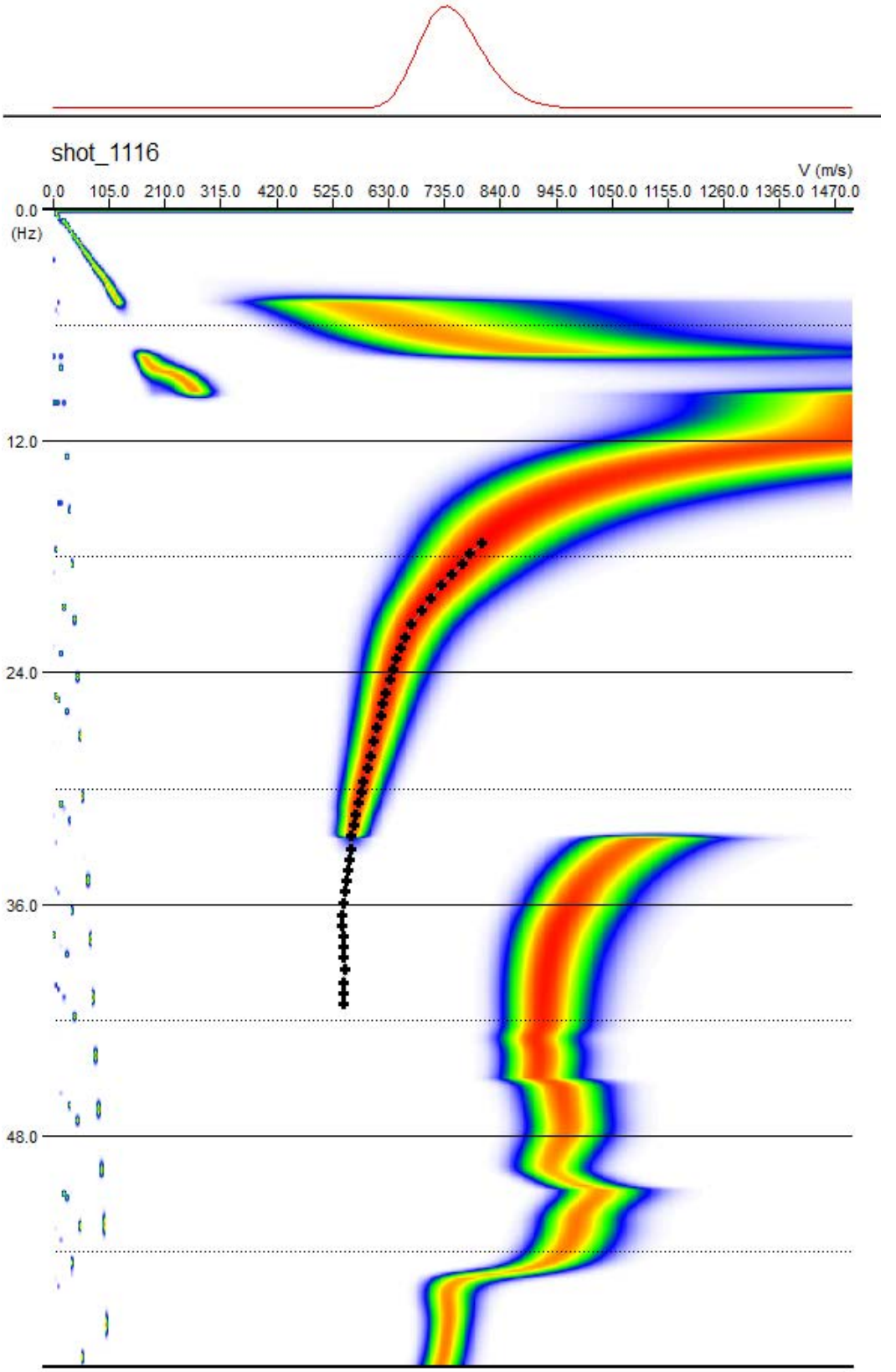

7.70 (Hz)
shot_1112
V (m/s)
0.0 105.0 210.0 315.0 420.0 525.0 630.0 735.0 840.0 945.0 1050.0 1155.0 1260.0 1365.0 1470.0
0.0
(Hz)
12.0
24.0
36.0
48.0

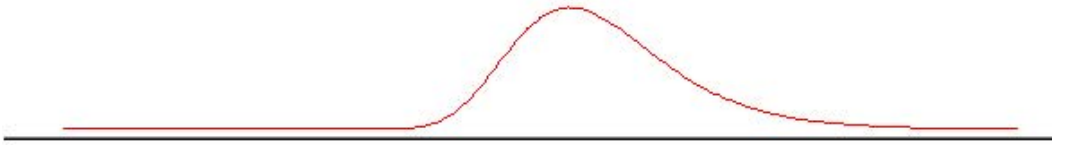

28.79 (Hz)

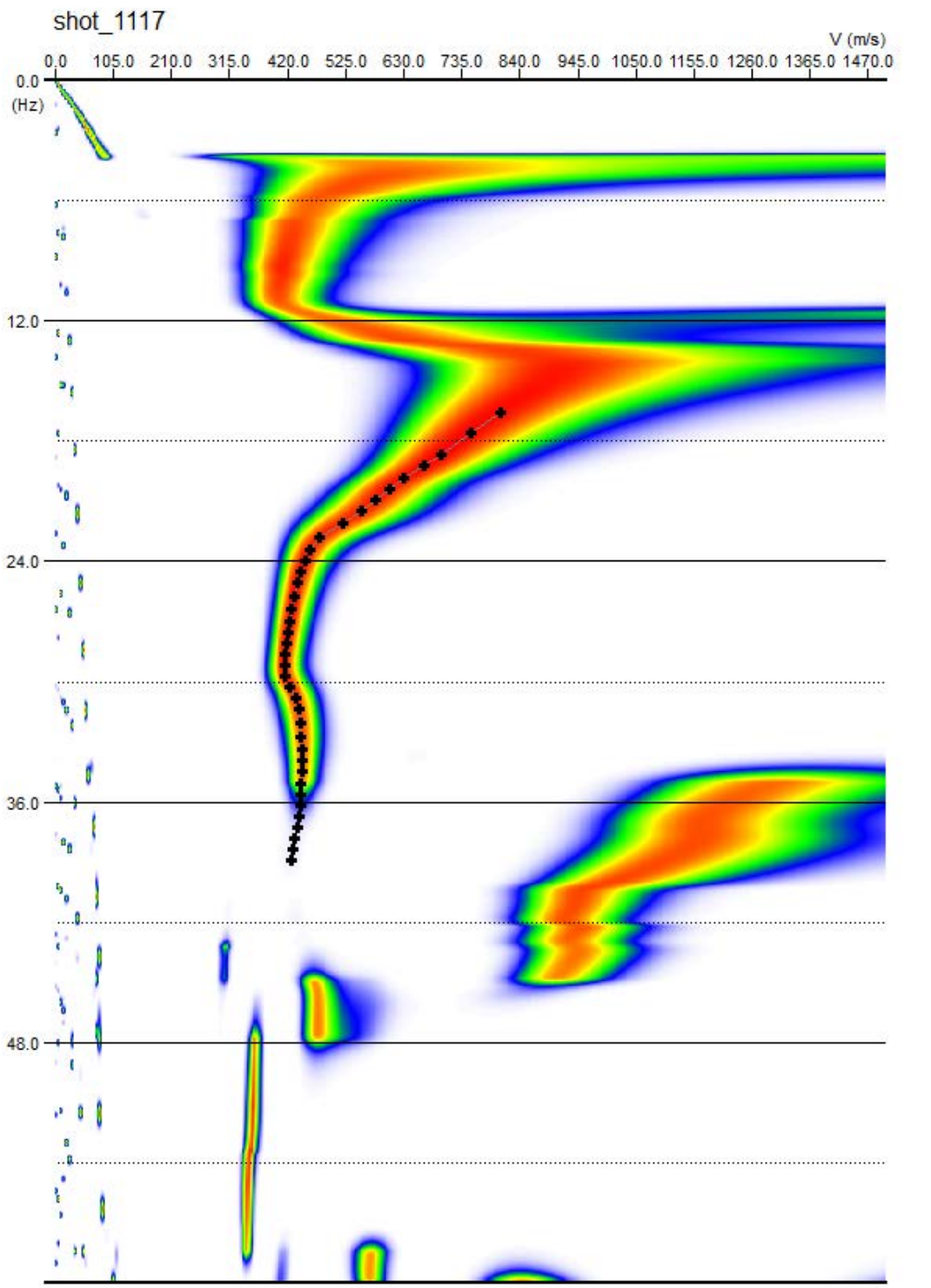

shot_1113
V (m/s)
0.0
105.0
210.0
315.0
420.0
525.0
630.0
735.0
840.0
945.0
1050.0
1155.0
1260.0
1365.0
1470.0
0.0
(Hz)
12.0
24.0
36.0
48.0


22.26 (Hz)

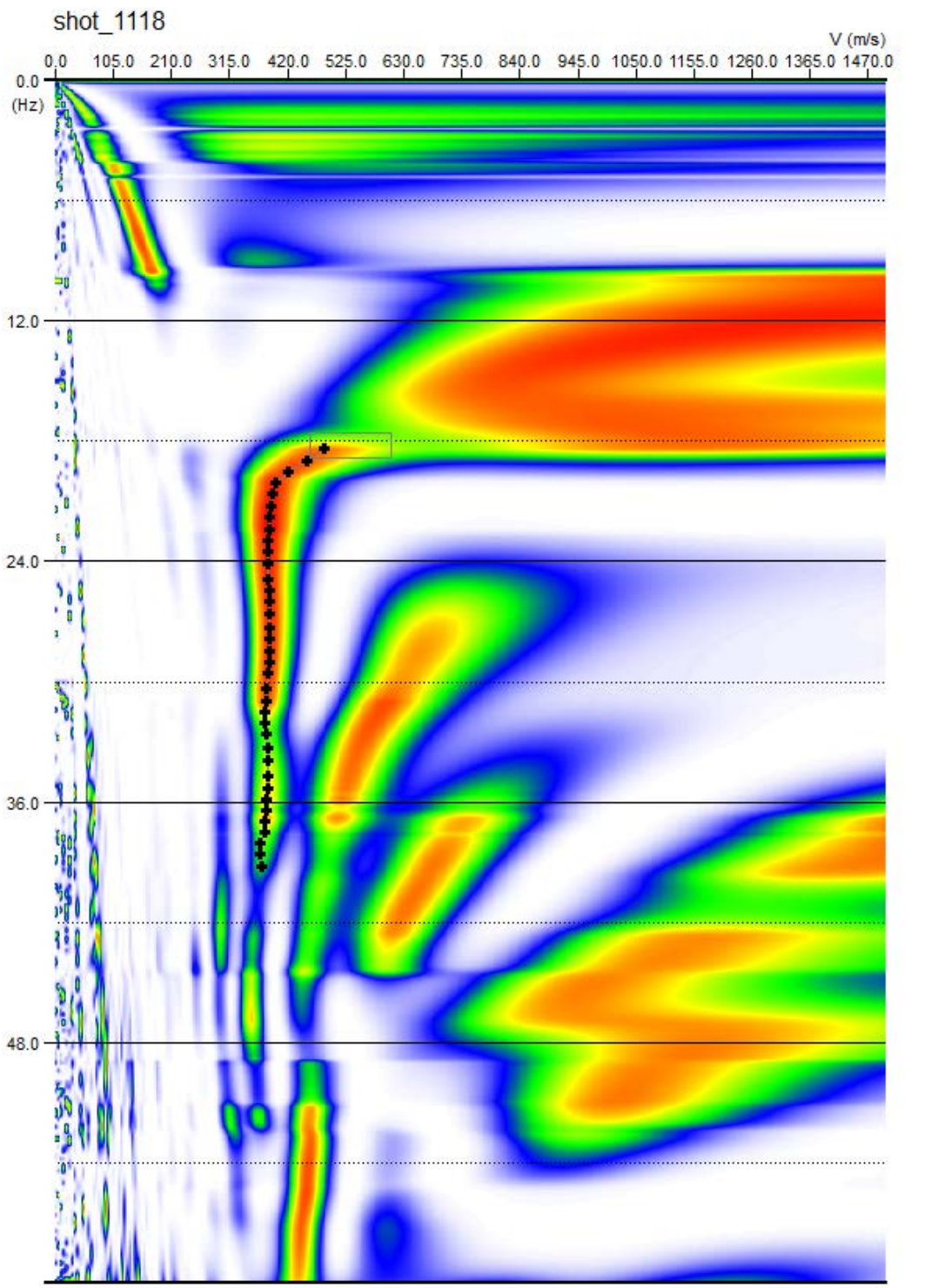

shot_1114
V (m/s)
0.0
105.0
210.0
315.0
420.0
525.0
630.0
735.0
840.0
945.0
1050.0
1155.0
1260.0
1365.0
1470.0
0.0
(Hz)
12.0
24.0
36.0
48.0

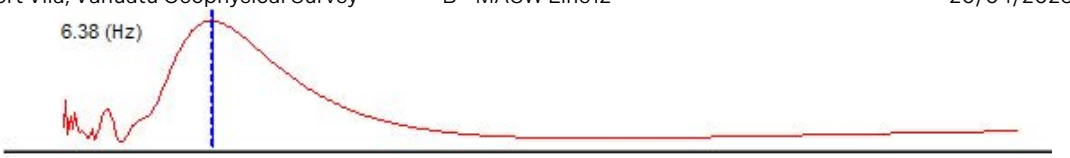

shot_1116
V (m/s)
0.0 105.0 210.0 315.0 420.0 525.0 630.0 735.0 840.0 945.0 1050.0 1155.0 1260.0 1365.0 1470.0
0.0
(Hz)
12.0
24.0
36.0
48.0

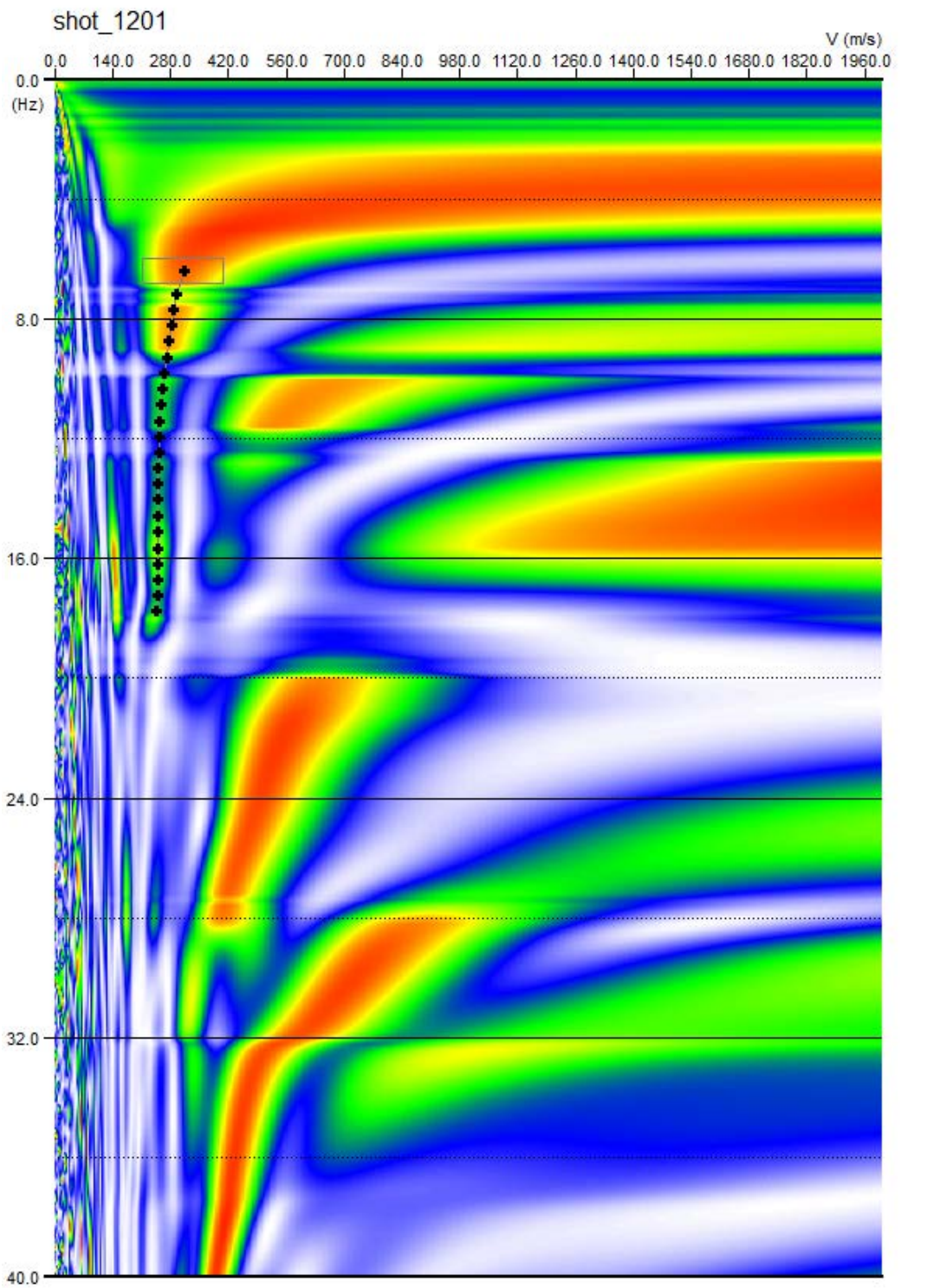


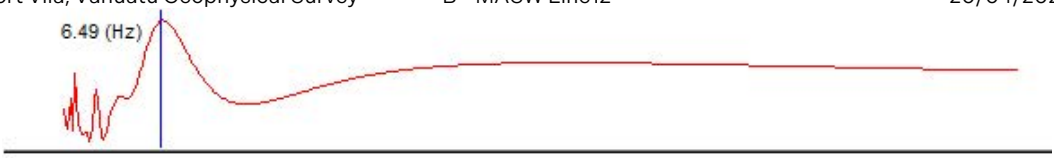

shot_1117
V (m/s)
0.0
105.0
210.0
315.0
420.0
525.0
630.0
735.0
840.0
945.0
1050.0
1155.0
1260.0
1365.0
1470.0
0.0
(Hz)
12.0
24.0
36.0
48.0

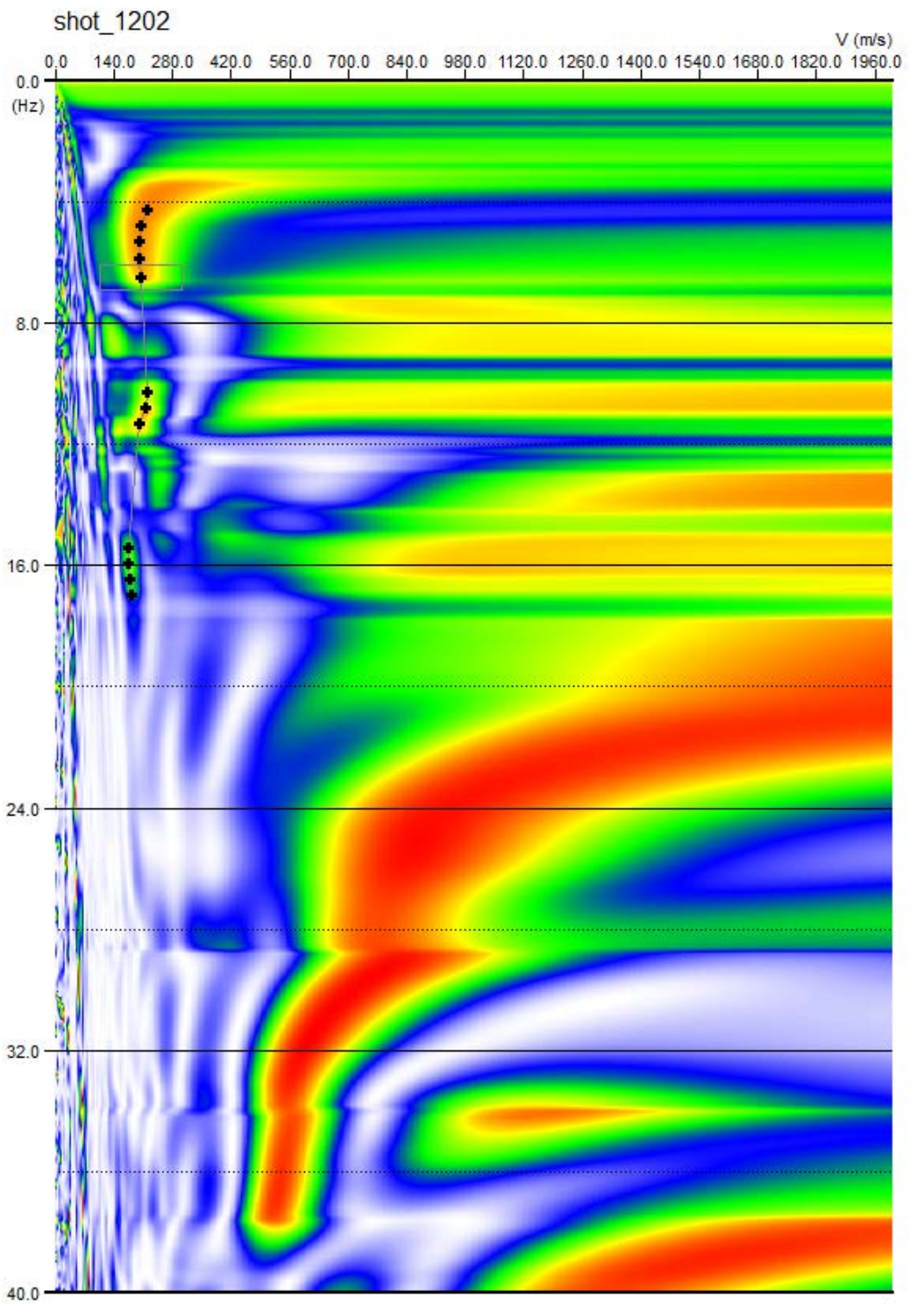

18.21 (Hz)

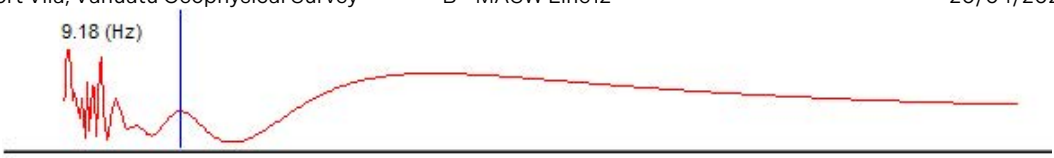

shot_1118
V (m/s)
0.0 105.0 210.0 315.0 420.0 525.0 630.0 735.0 840.0 945.0 1050.0 1155.0 1260.0 1365.0 1470.0
0.0
(Hz)
12.0
24.0
36.0
48.0

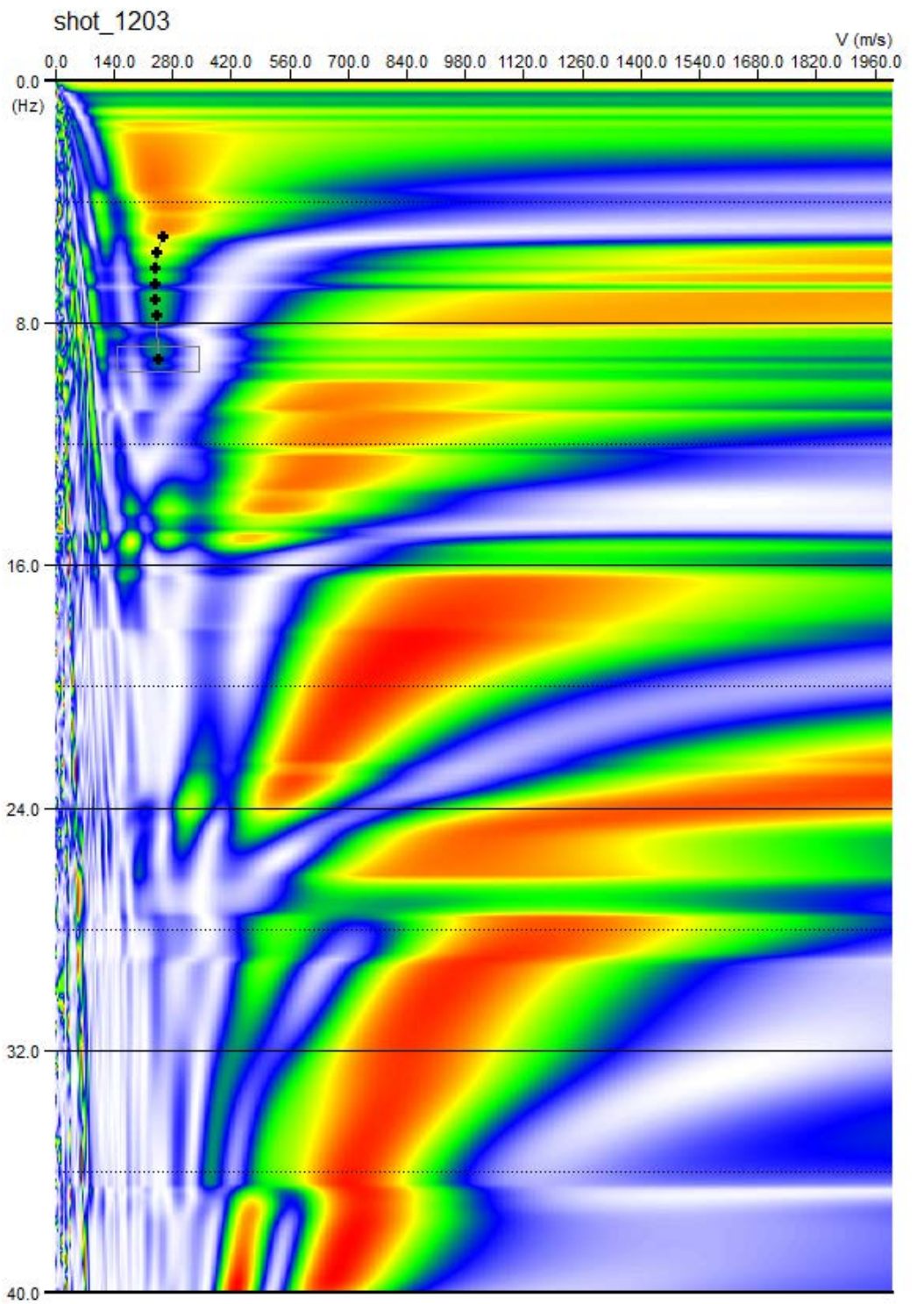

6.38 (Hz)

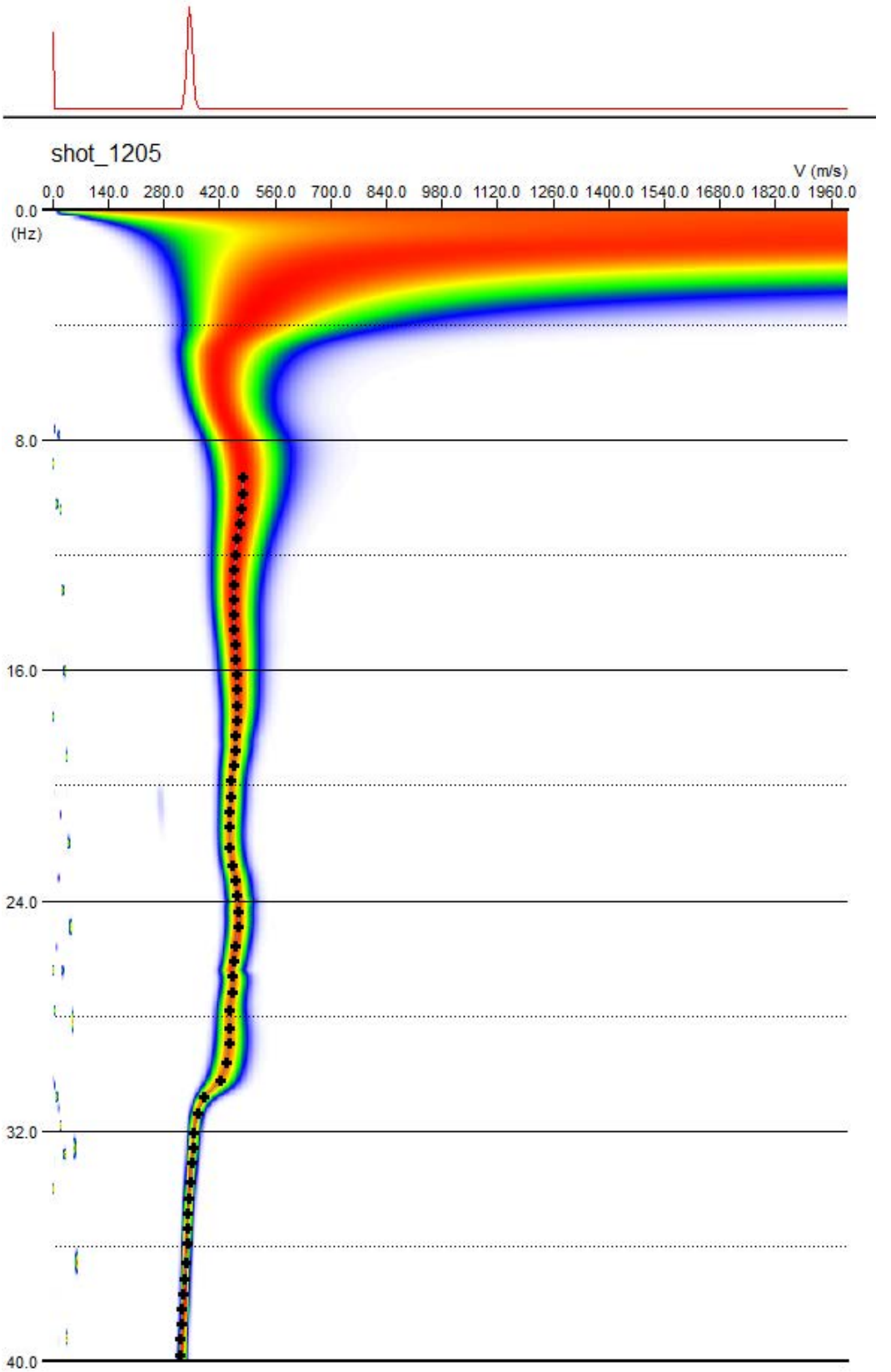

shot_1201
V (m/s)
0.0
140.0
280.0
420.0
560.0
700.0
840.0
980.0
1120.0
1260.0
1400.0
1540.0
1680.0
1820.0
1960.0
0.0
(Hz)
8.0
16.0
24.0
32.0
40.0

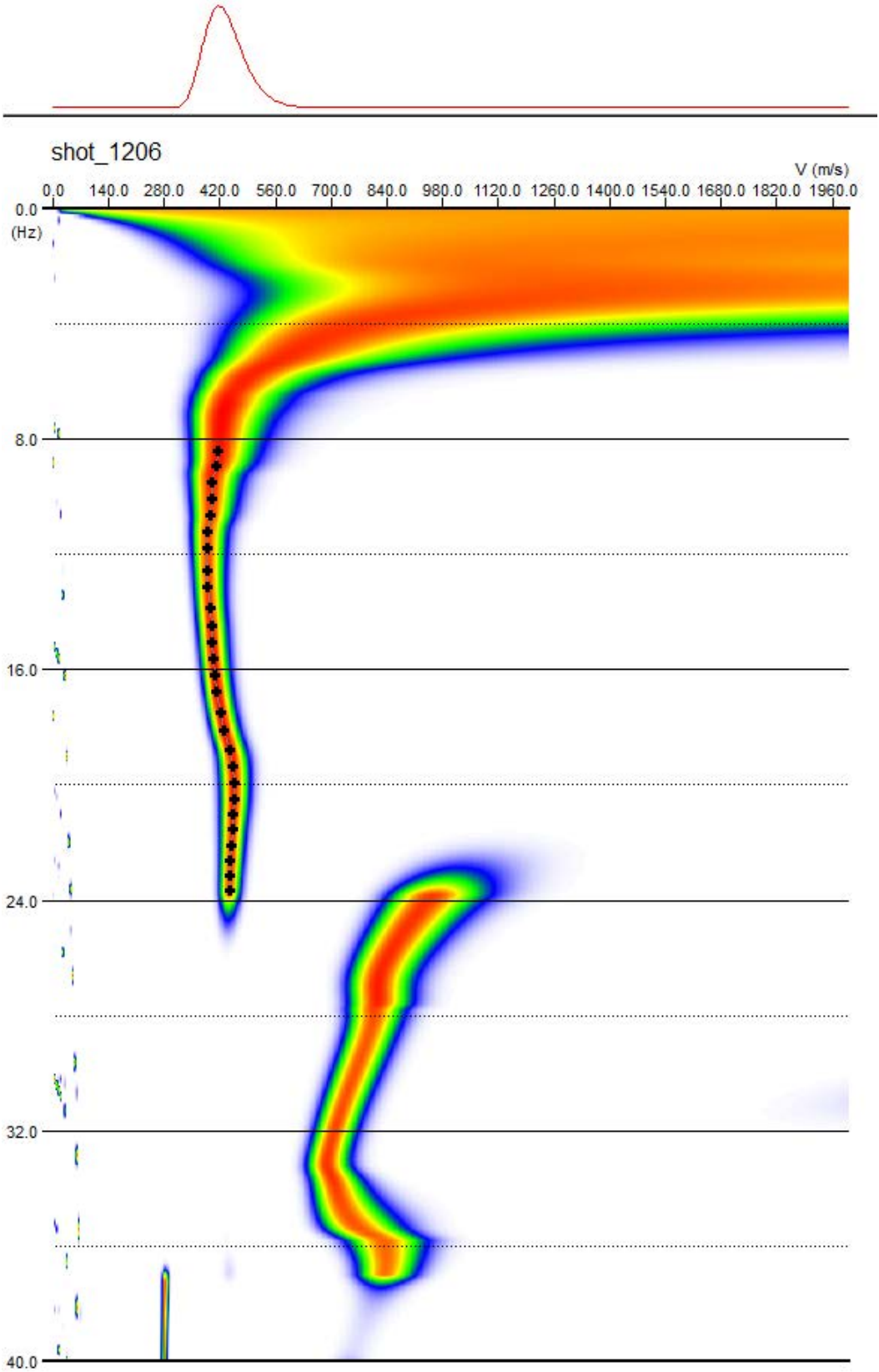

6.49 (Hz)

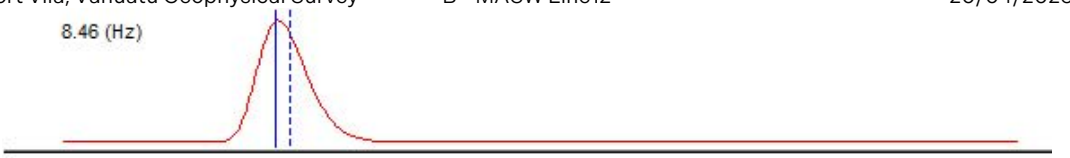

shot_1202
V (m/s)
0.0
140.0
280.0
420.0
560.0
700.0
840.0
980.0
1120.0
1260.0
1400.0
1540.0
1680.0
1820.0
1960.0
0.0
(Hz)
8.0
16.0
24.0
32.0
40.0

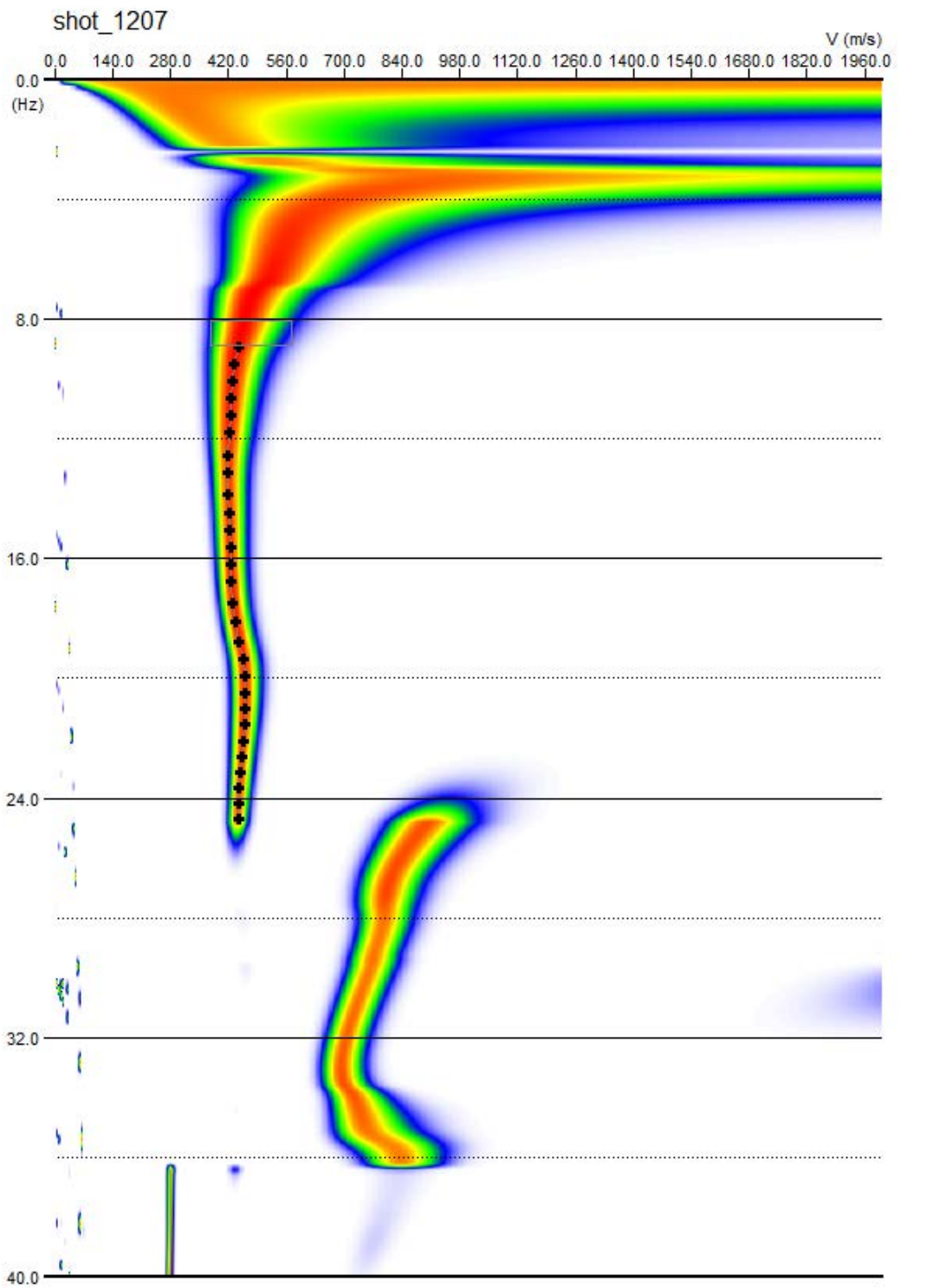

9.18 (Hz)

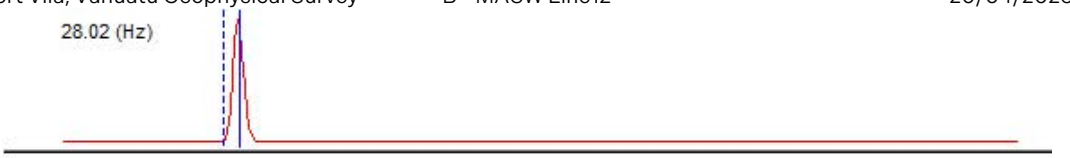

shot_1203
V (m/s)
0.0
140.0
280.0
420.0
560.0
700.0
840.0
980.0
1120.0
1260.0
1400.0
1540.0
1680.0
1820.0
1960.0
0.0
(Hz)
8.0
16.0
24.0
32.0
40.0

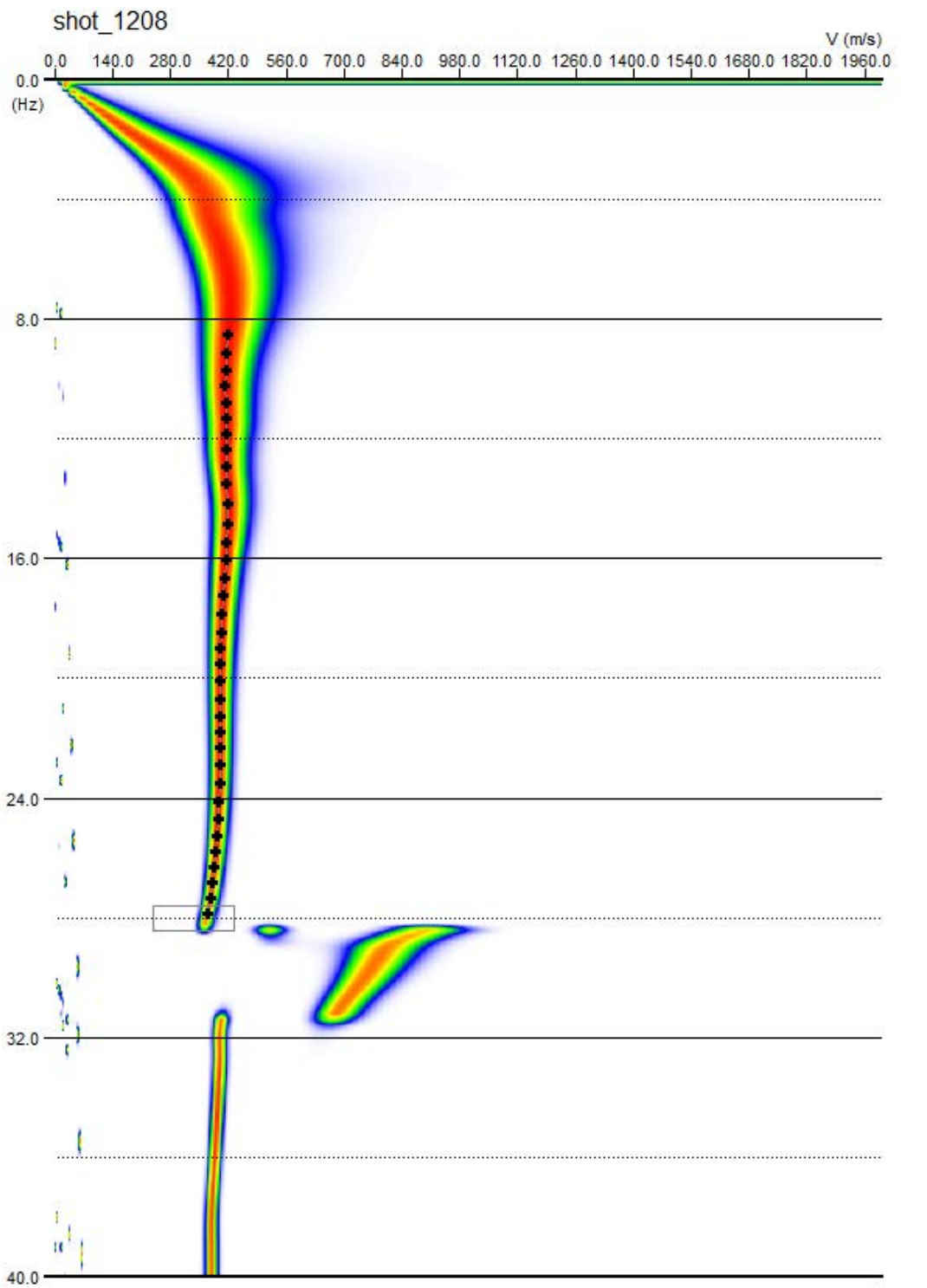

shot_1205
V (m/s)
0.0 140.0 280.0 420.0 560.0 700.0 840.0 980.0 1120.0 1260.0 1400.0 1540.0 1680.0 1820.0 1960.0
0.0
(Hz)
8.0
16.0
24.0
32.0
40.0

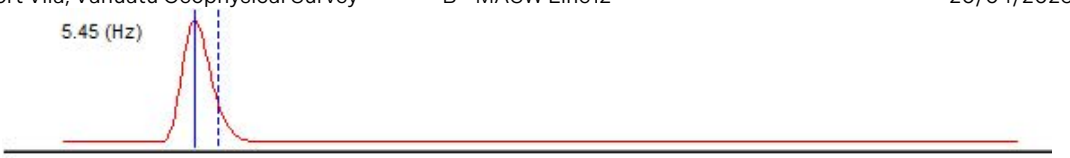

shot_1206
V (m/s)
0.0 140.0 280.0 420.0 560.0 700.0 840.0 980.0 1120.0 1260.0 1400.0 1540.0 1680.0 1820.0 1960.0
0.0
(Hz)
8.0
16.0
24.0
32.0
40.0

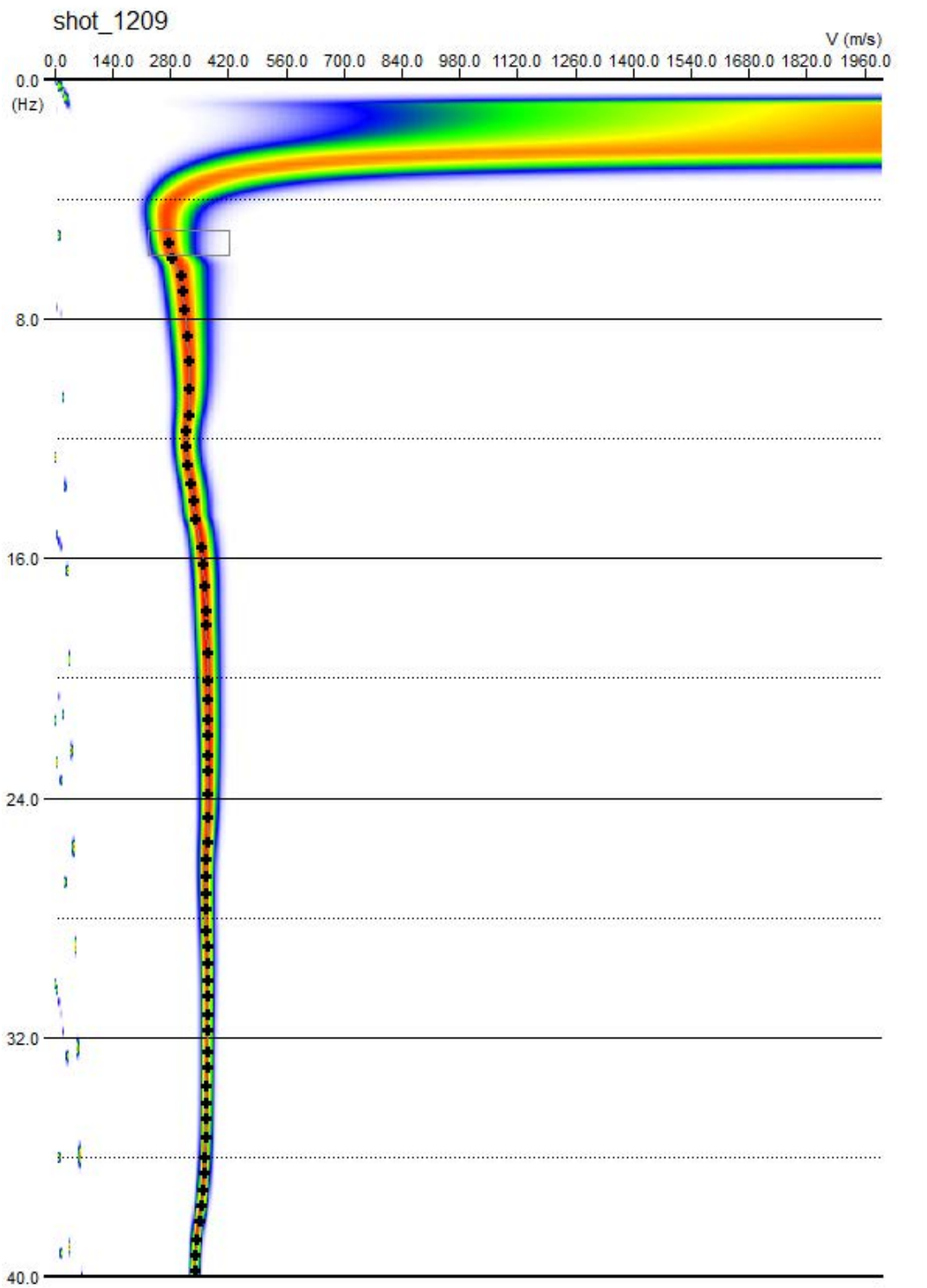

8.46 (Hz)

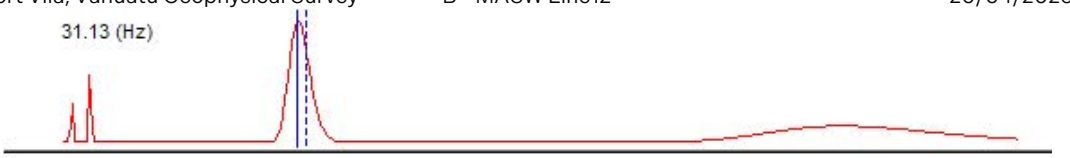

shot_1207
V (m/s)
0.0
140.0
280.0
420.0
560.0
700.0
840.0
980.0
1120.0
1260.0
1400.0
1540.0
1680.0
1820.0
1960.0
0.0
(Hz)
8.0
16.0
24.0
32.0
40.0

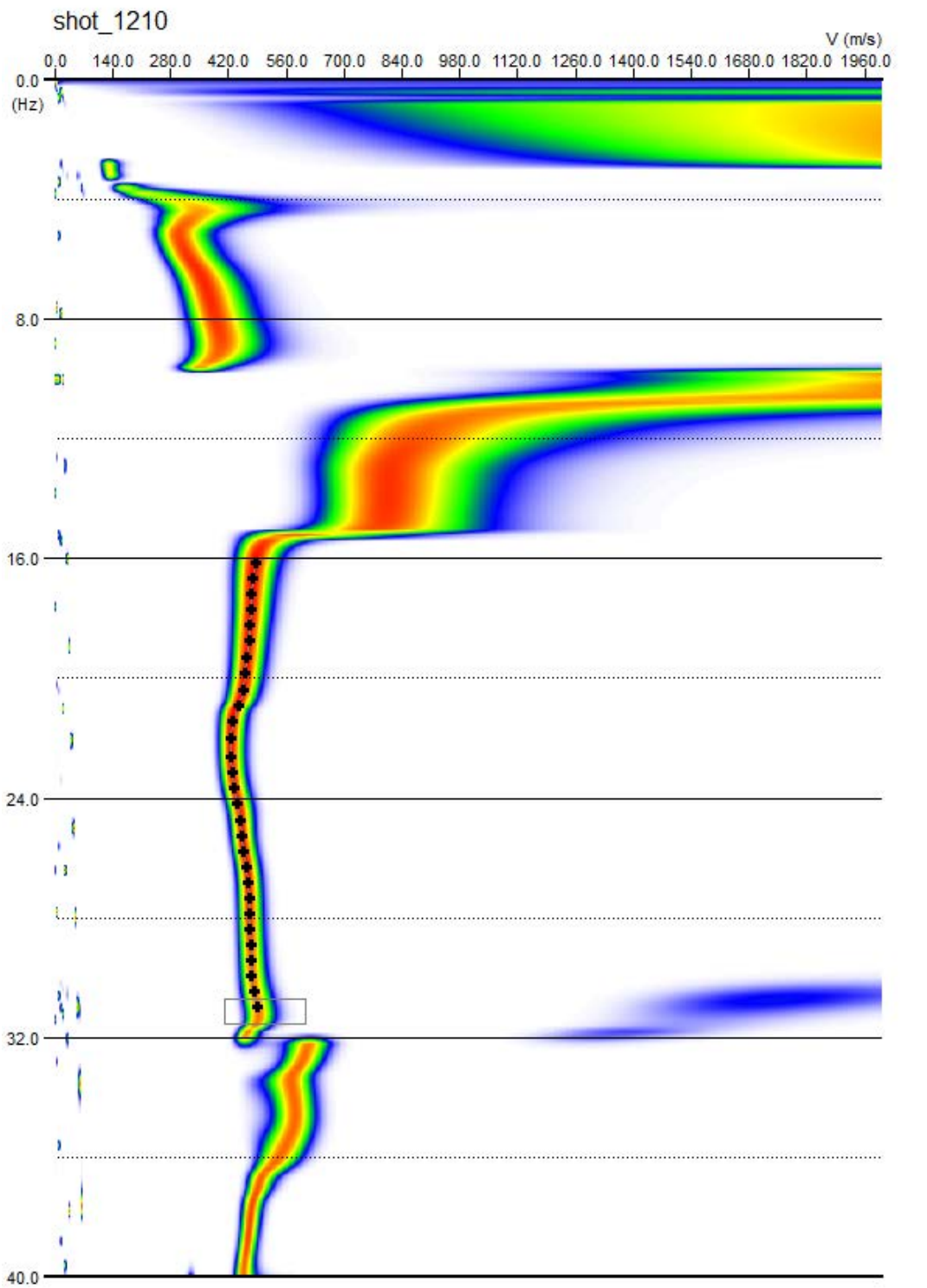

28.02 (Hz)

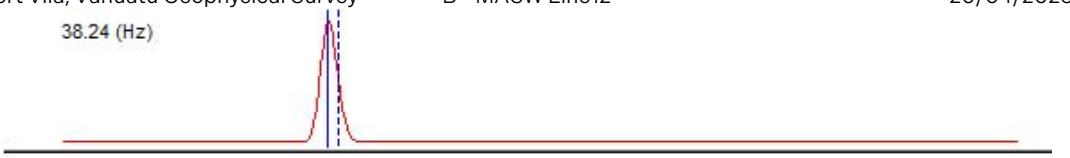

shot_1208
V (m/s)
0.0 140.0 280.0 420.0 560.0 700.0 840.0 980.0 1120.0 1260.0 1400.0 1540.0 1680.0 1820.0 1960.0
0.0
(Hz)
8.0
16.0
24.0
32.0
40.0

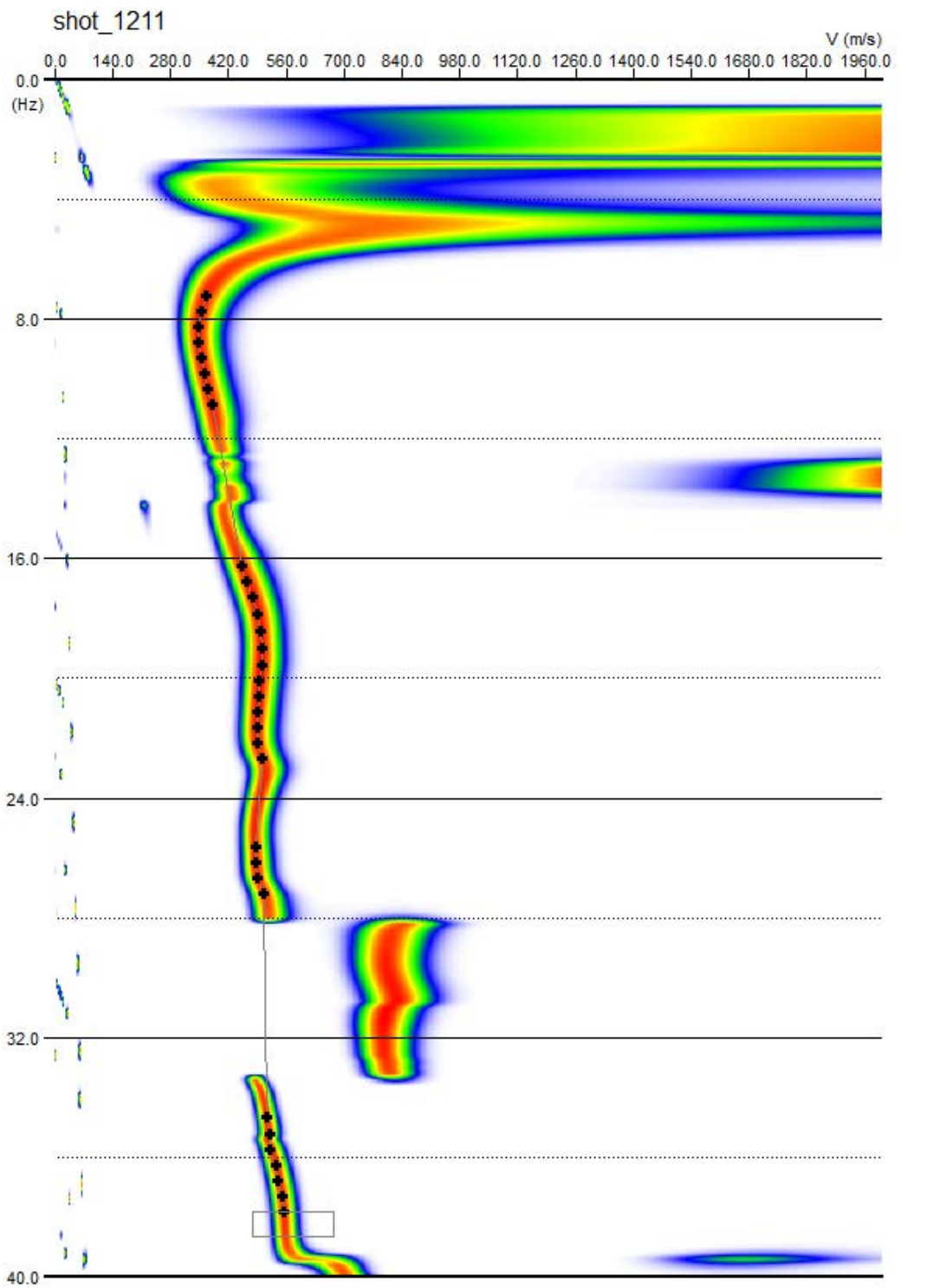

5.45 (Hz)

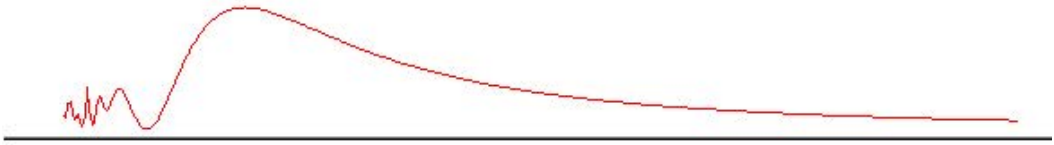

shot_1209
V (m/s)
0.0
140.0
280.0
420.0
560.0
700.0
840.0
980.0
1120.0
1260.0
1400.0
1540.0
1680.0
1820.0
1960.0
0.0
(Hz)
8.0
16.0
24.0
32.0
40.0

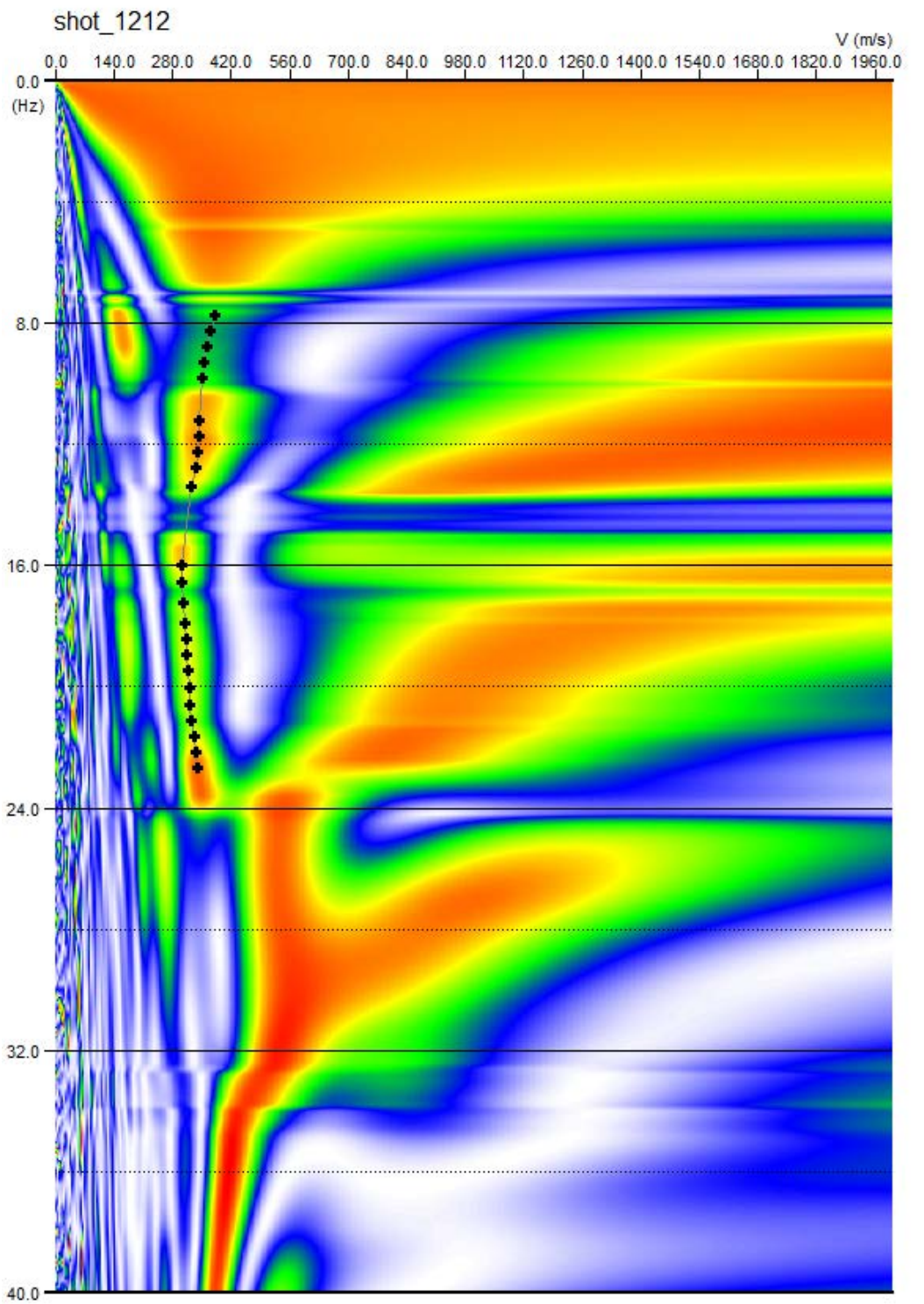

31.13 (Hz)


shot_1210
V (m/s)
0.0
140.0
280.0
420.0
560.0
700.0
840.0
980.0
1120.0
1260.0
1400.0
1540.0
1680.0
1820.0
1960.0
0.0
(Hz)
8.0
16.0
24.0
32.0
40.0

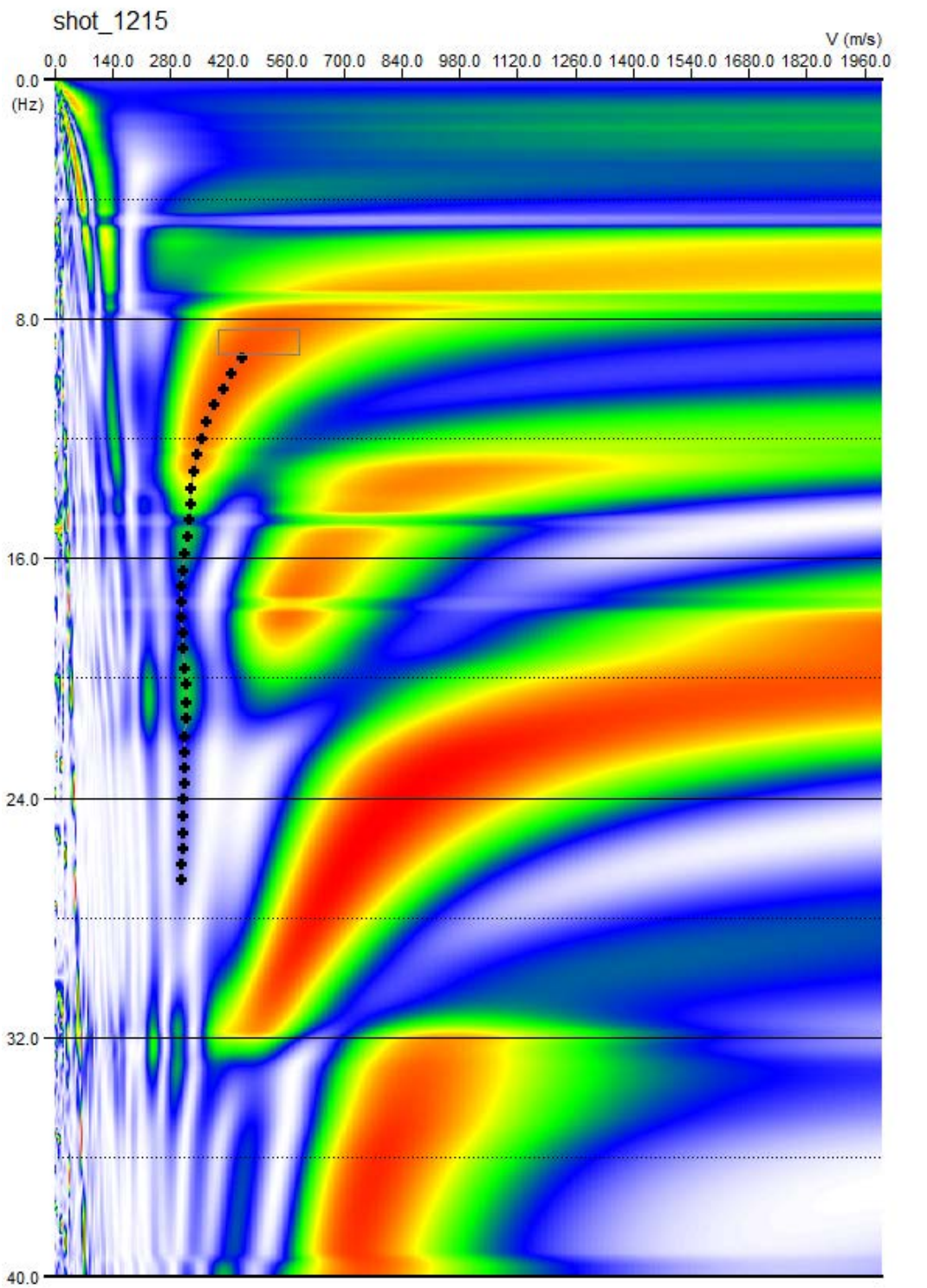

38.24 (Hz)

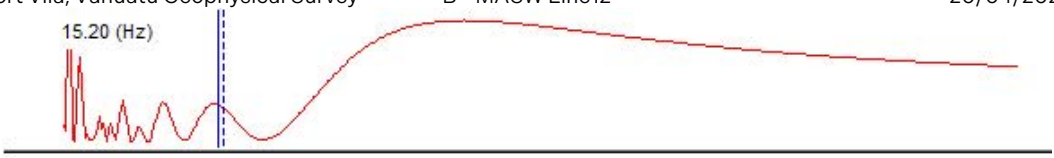

shot_1211
V (m/s)
0.0
140.0
280.0
420.0
560.0
700.0
840.0
980.0
1120.0
1260.0
1400.0
1540.0
1680.0
1820.0
1960.0
0.0
(Hz)
8.0
16.0
24.0
32.0
40.0

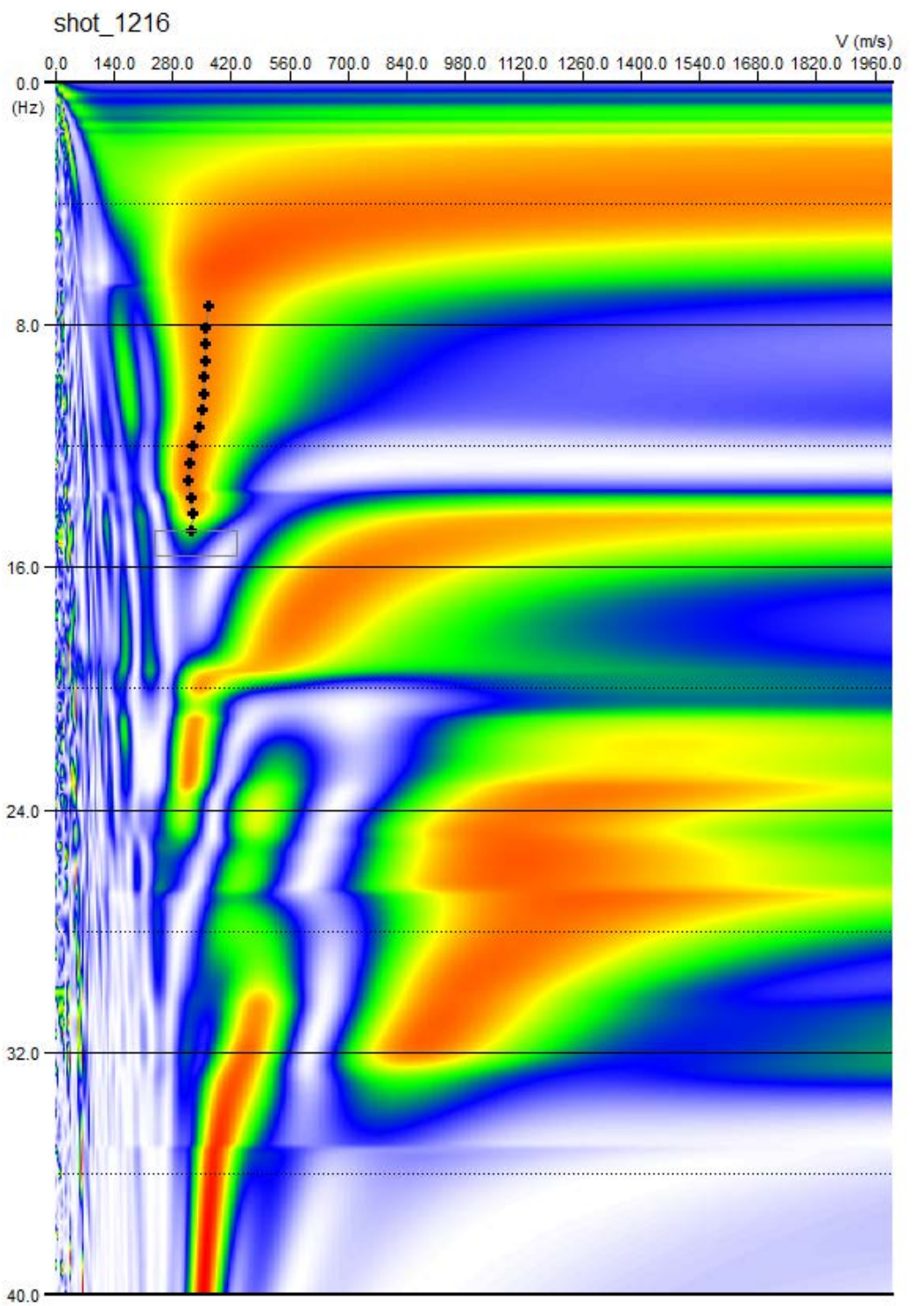



shot_1212
V (m/s)
0.0 140.0 280.0 420.0 560.0 700.0 840.0 980.0 1120.0 1260.0 1400.0 1540.0 1680.0 1820.0 1960.0
0.0
(Hz)
8.0
16.0
24.0
32.0
40.0

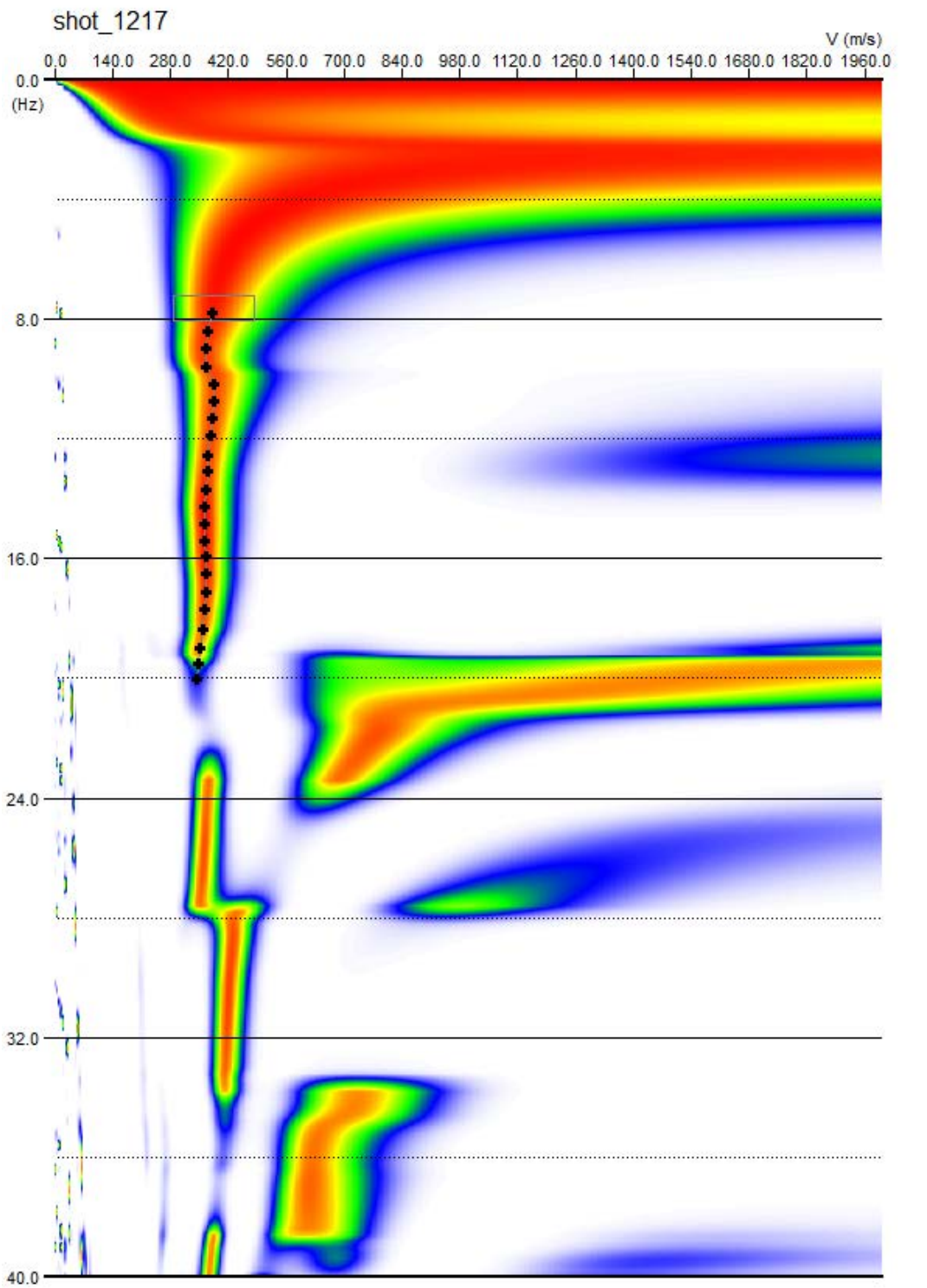

8.77 (Hz)


shot_1215
V (m/s)
0.0 140.0 280.0 420.0 560.0 700.0 840.0 980.0 1120.0 1260.0 1400.0 1540.0 1680.0 1820.0 1960.0
0.0
(Hz)
8.0
16.0
24.0
32.0
40.0

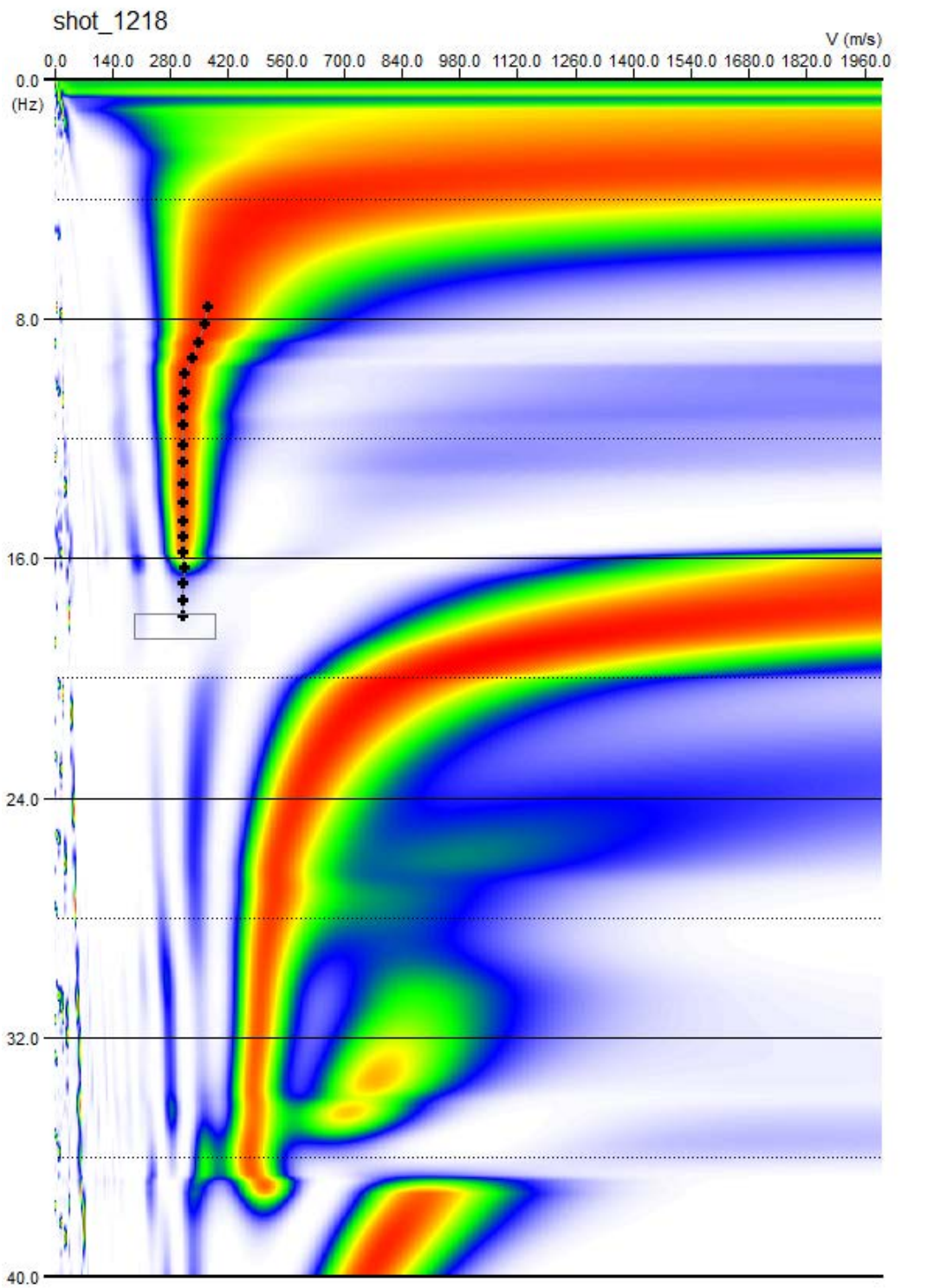

15.20 (Hz)

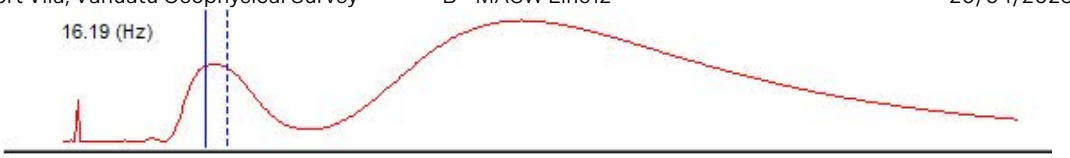

shot_1216
V (m/s)
0.0
140.0
280.0
420.0
560.0
700.0
840.0
980.0
1120.0
1260.0
1400.0
1540.0
1680.0
1820.0
1960.0
0.0
(Hz)
8.0
16.0
24.0
32.0
40.0

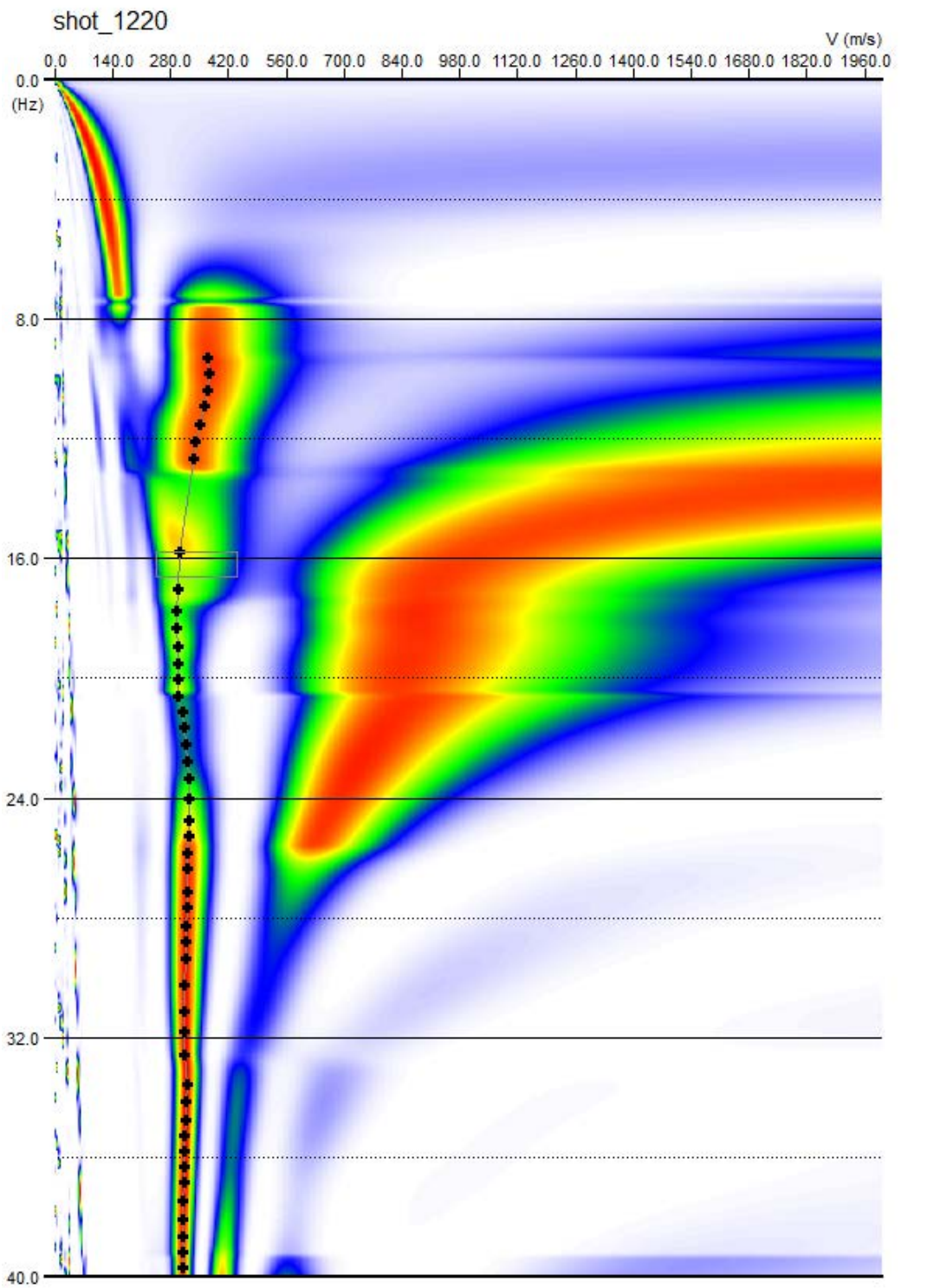

7.63 (Hz)


shot_1217
V (m/s)
0.0
140.0
280.0
420.0
560.0
700.0
840.0
980.0
1120.0
1260.0
1400.0
1540.0
1680.0
1820.0
1960.0
0.0
(Hz)
8.0
16.0
24.0
32.0
40.0

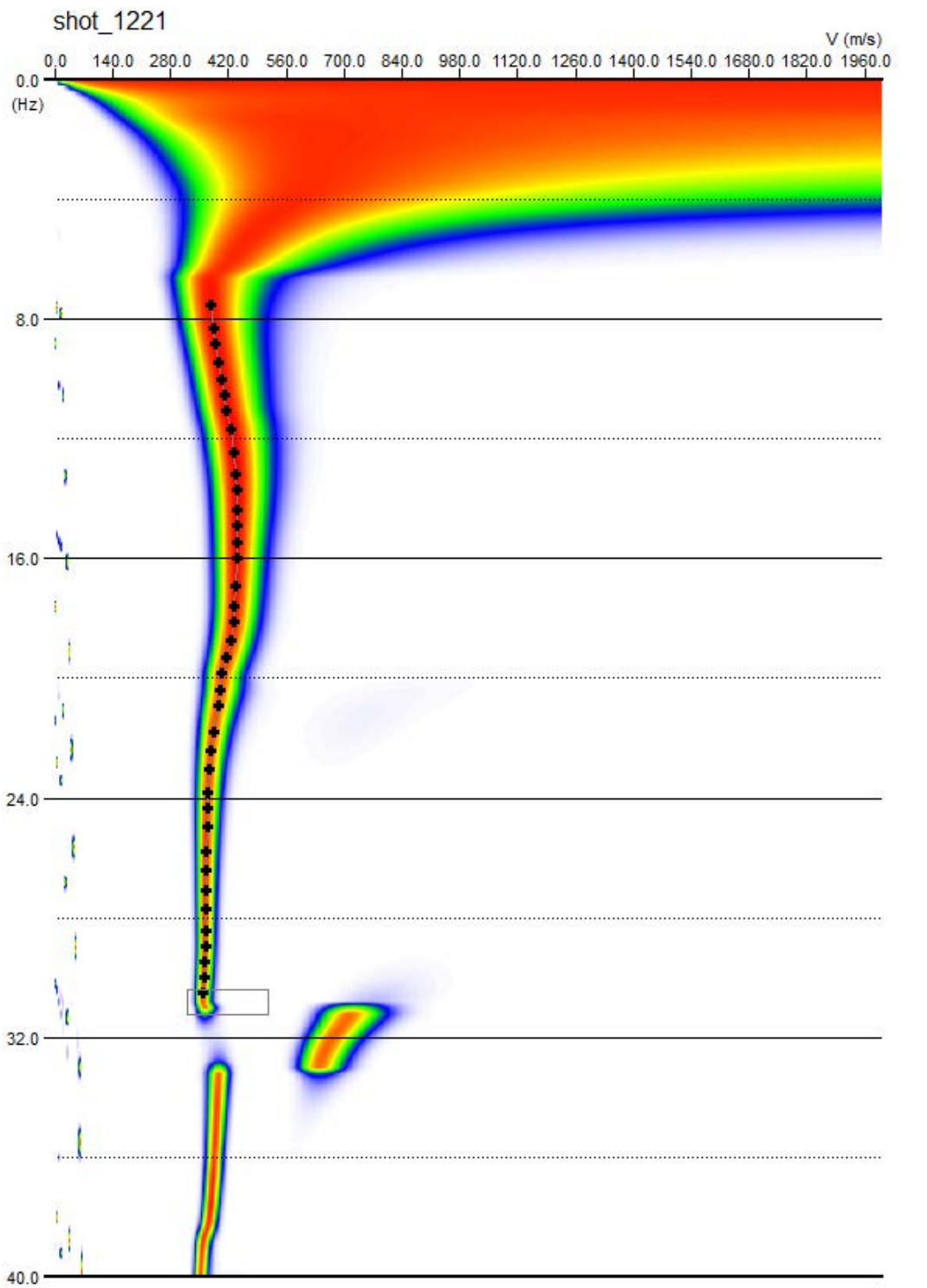

18.26 (Hz)

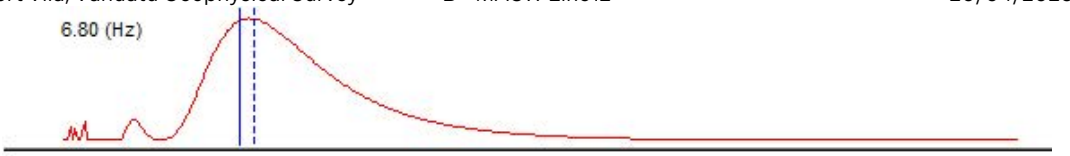

shot_1218
V (m/s)
0.0 140.0 280.0 420.0 560.0 700.0 840.0 980.0 1120.0 1260.0 1400.0 1540.0 1680.0 1820.0 1960.0
0.0
(Hz)
8.0
16.0
24.0
32.0
40.0

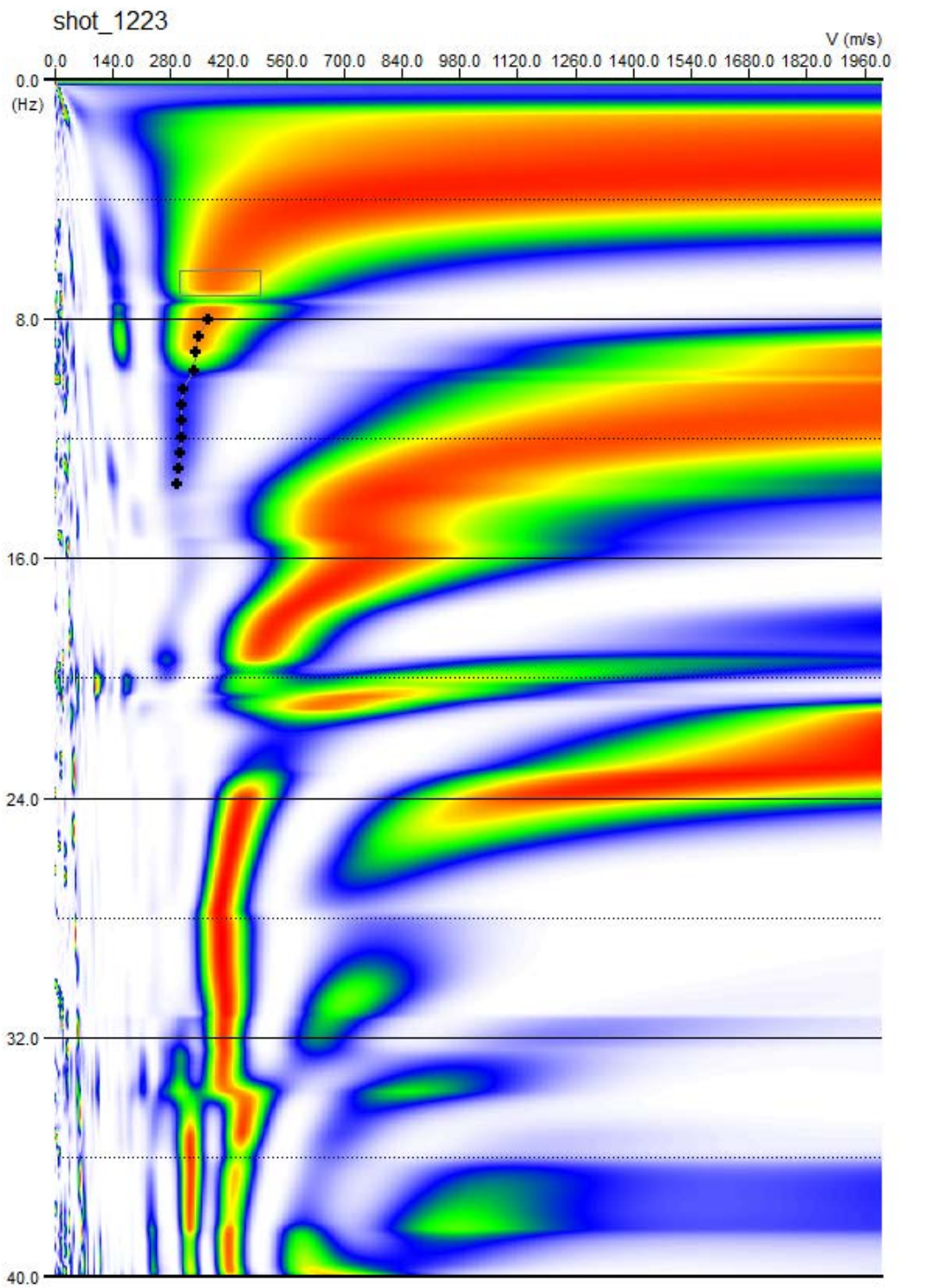

16.19 (Hz)

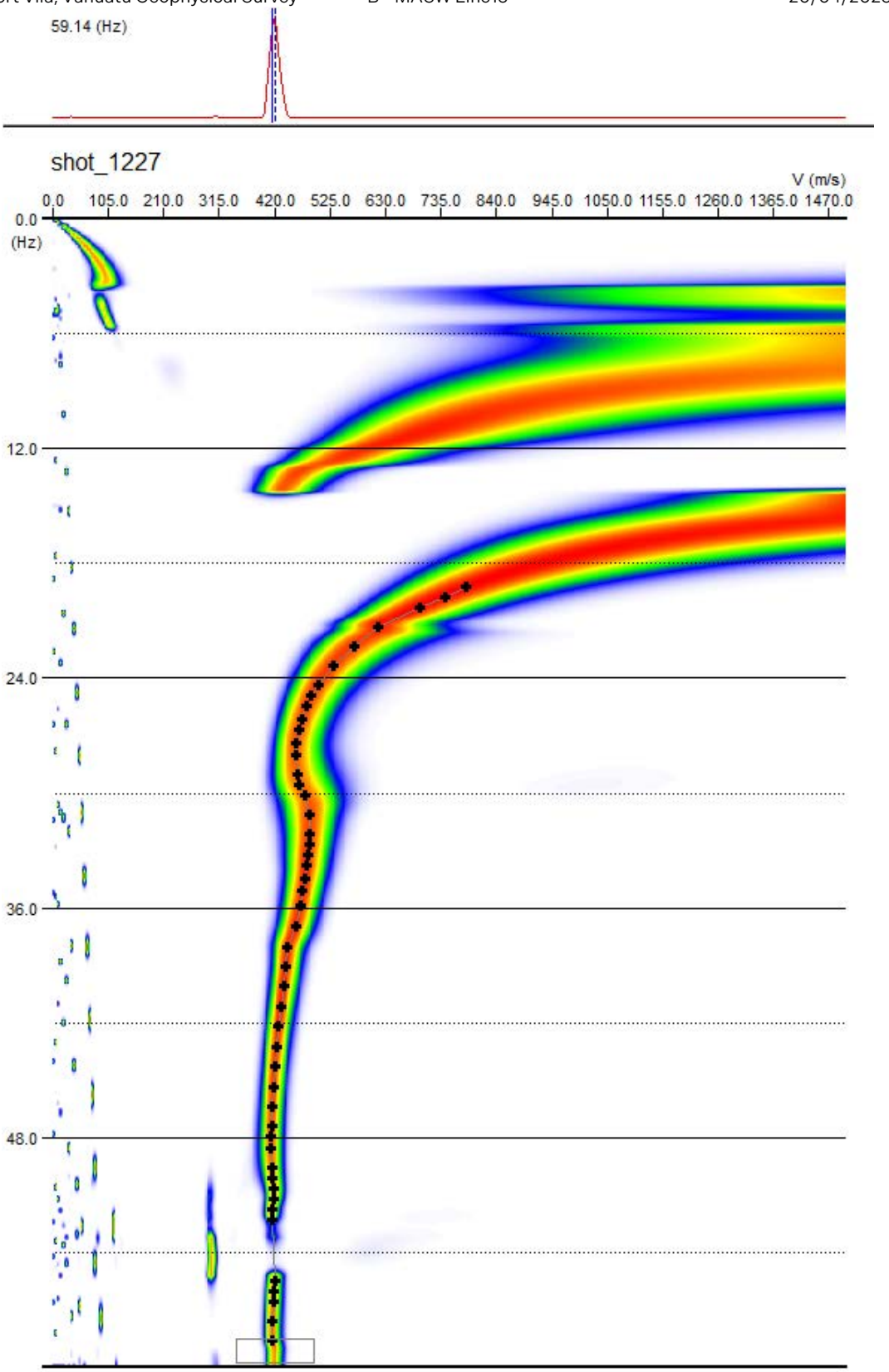

shot_1220
V (m/s)
0.0
140.0
280.0
420.0
560.0
700.0
840.0
980.0
1120.0
1260.0
1400.0
1540.0
1680.0
1820.0
1960.0
0.0
(Hz)
8.0
16.0
24.0
32.0
40.0


30.82 (Hz)

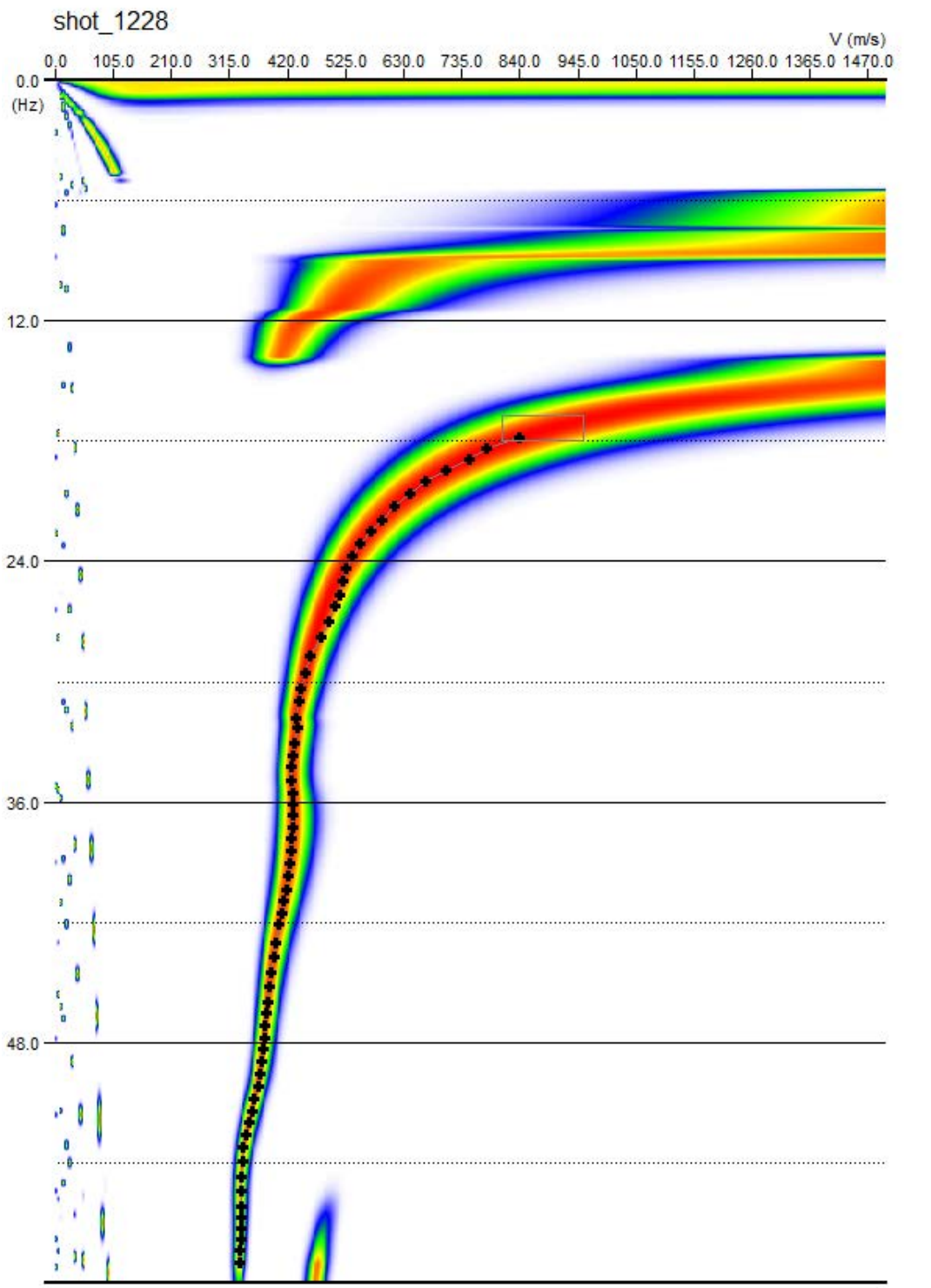

shot_1221
V (m/s)
0.0
140.0
280.0
420.0
560.0
700.0
840.0
980.0
1120.0
1260.0
1400.0
1540.0
1680.0
1820.0
1960.0
0.0
(Hz)
8.0
16.0
24.0
32.0
40.0

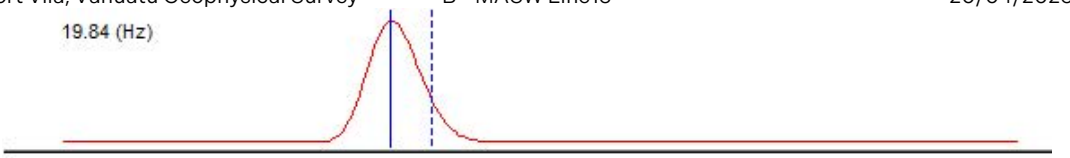

6.80 (Hz)

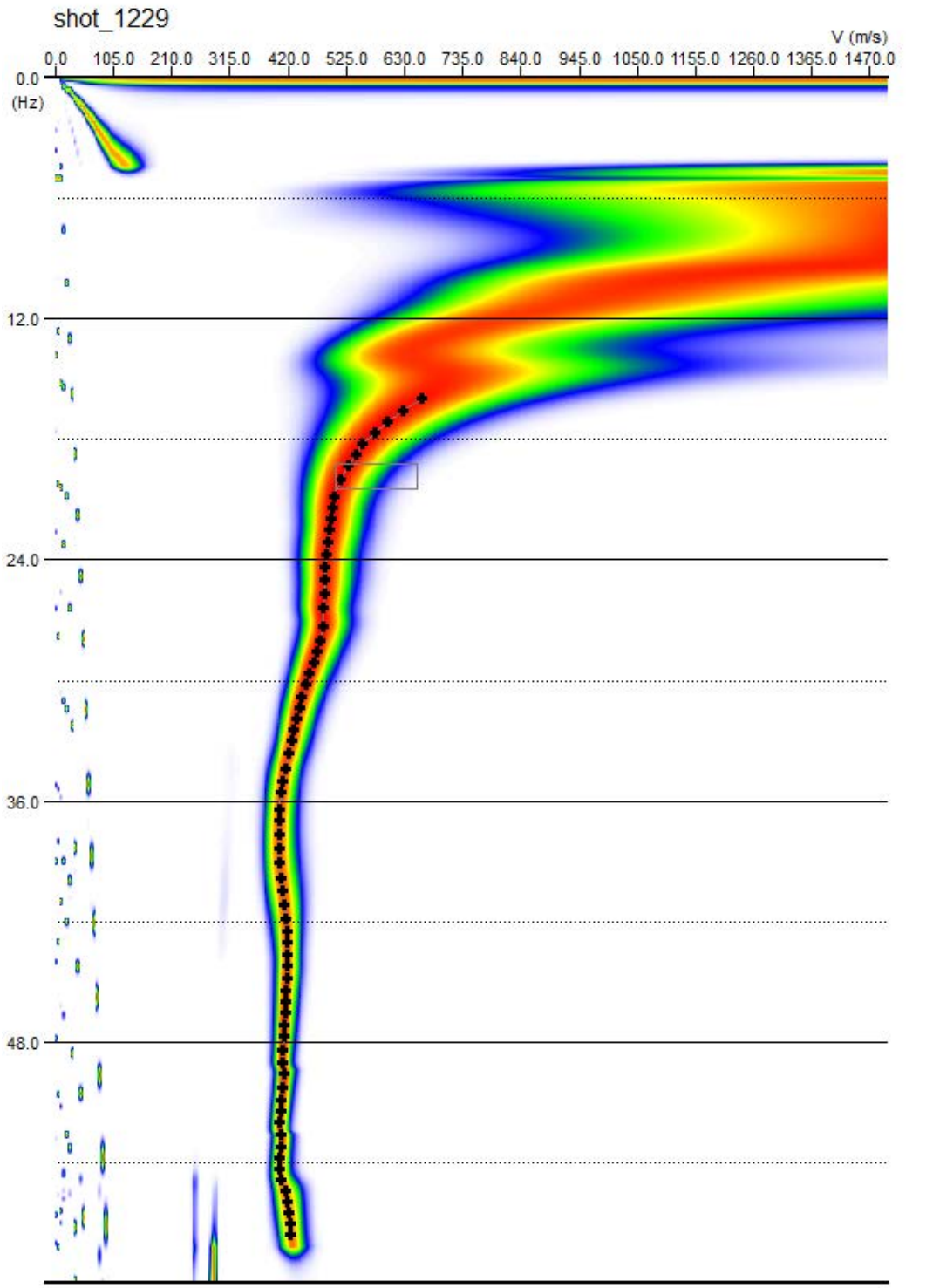

shot_1223
V (m/s)
0.0
140.0
280.0
420.0
560.0
700.0
840.0
980.0
1120.0
1260.0
1400.0
1540.0
1680.0
1820.0
1960.0
0.0
(Hz)
8.0
16.0
24.0
32.0
40.0

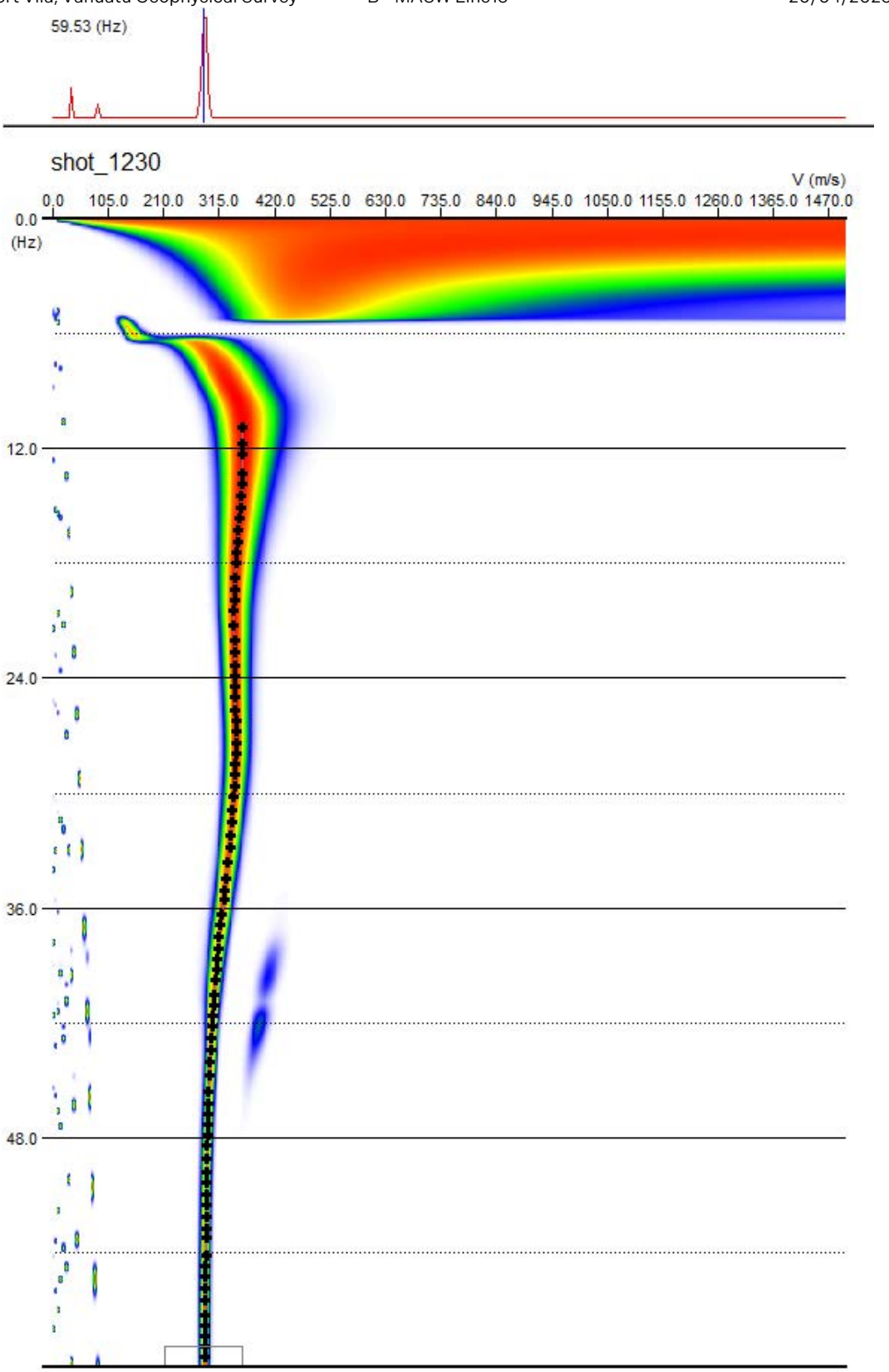

59.14 (Hz)
shot_1227
V (m/s)
0.0 105.0 210.0 315.0 420.0 525.0 630.0 735.0 840.0 945.0 1050.0 1155.0 1260.0 1365.0 1470.0
0.0
(Hz)
12.0
24.0
36.0
48.0

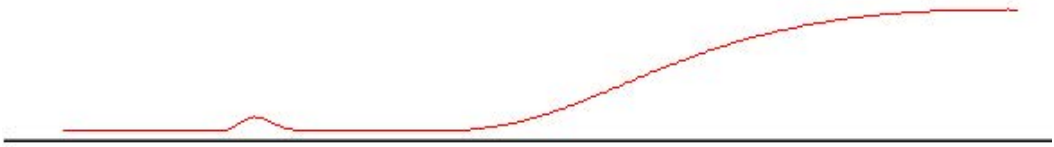

17.35 (Hz)

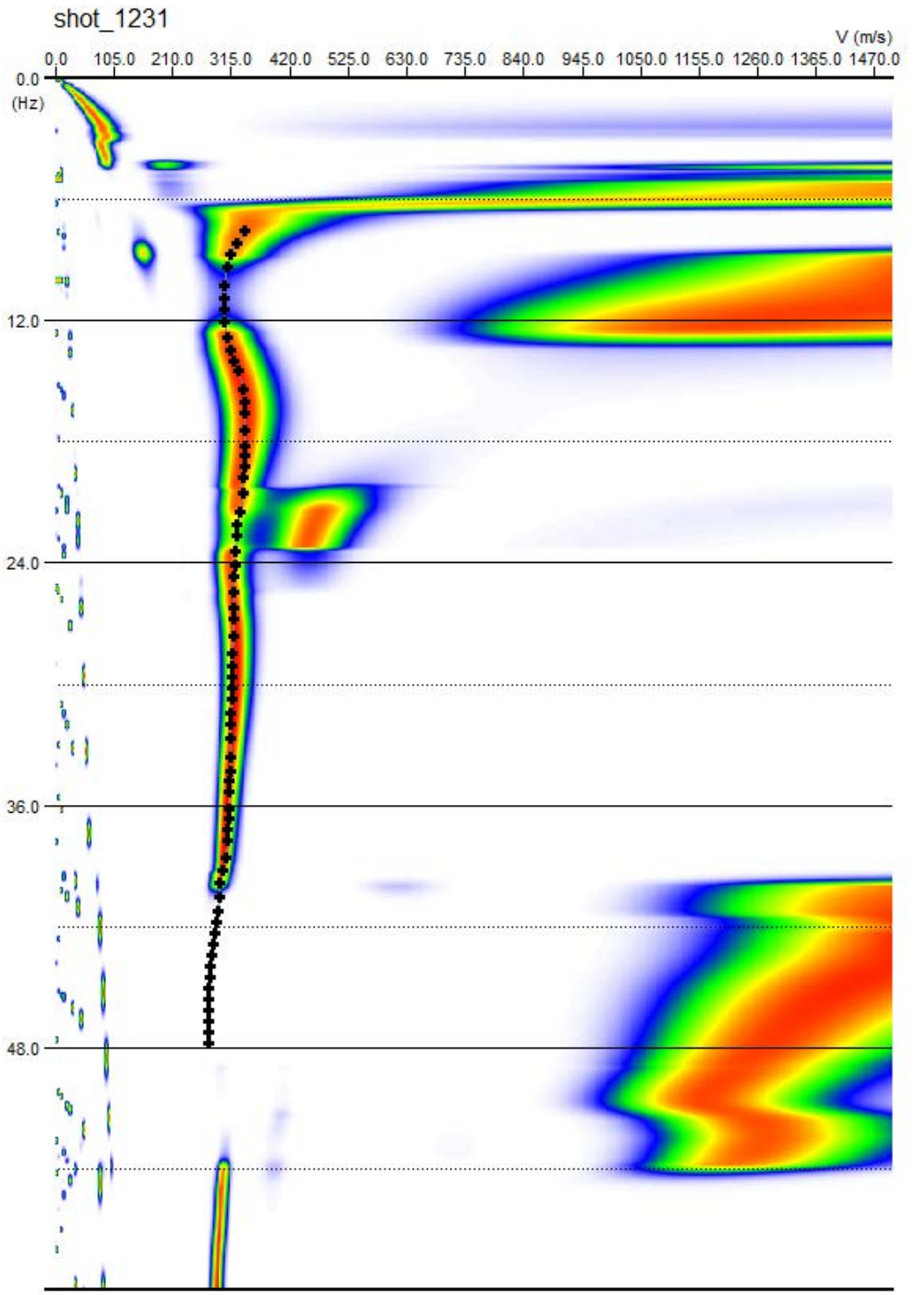

shot_1228
V (m/s)
0.0
105.0
210.0
315.0
420.0
525.0
630.0
735.0
840.0
945.0
1050.0
1155.0
1260.0
1365.0
1470.0
0.0
(Hz)
12.0
24.0
36.0
48.0

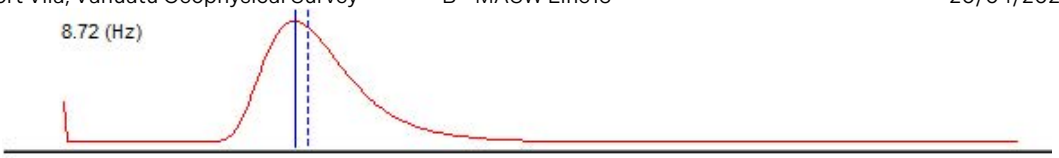

19.84 (Hz)

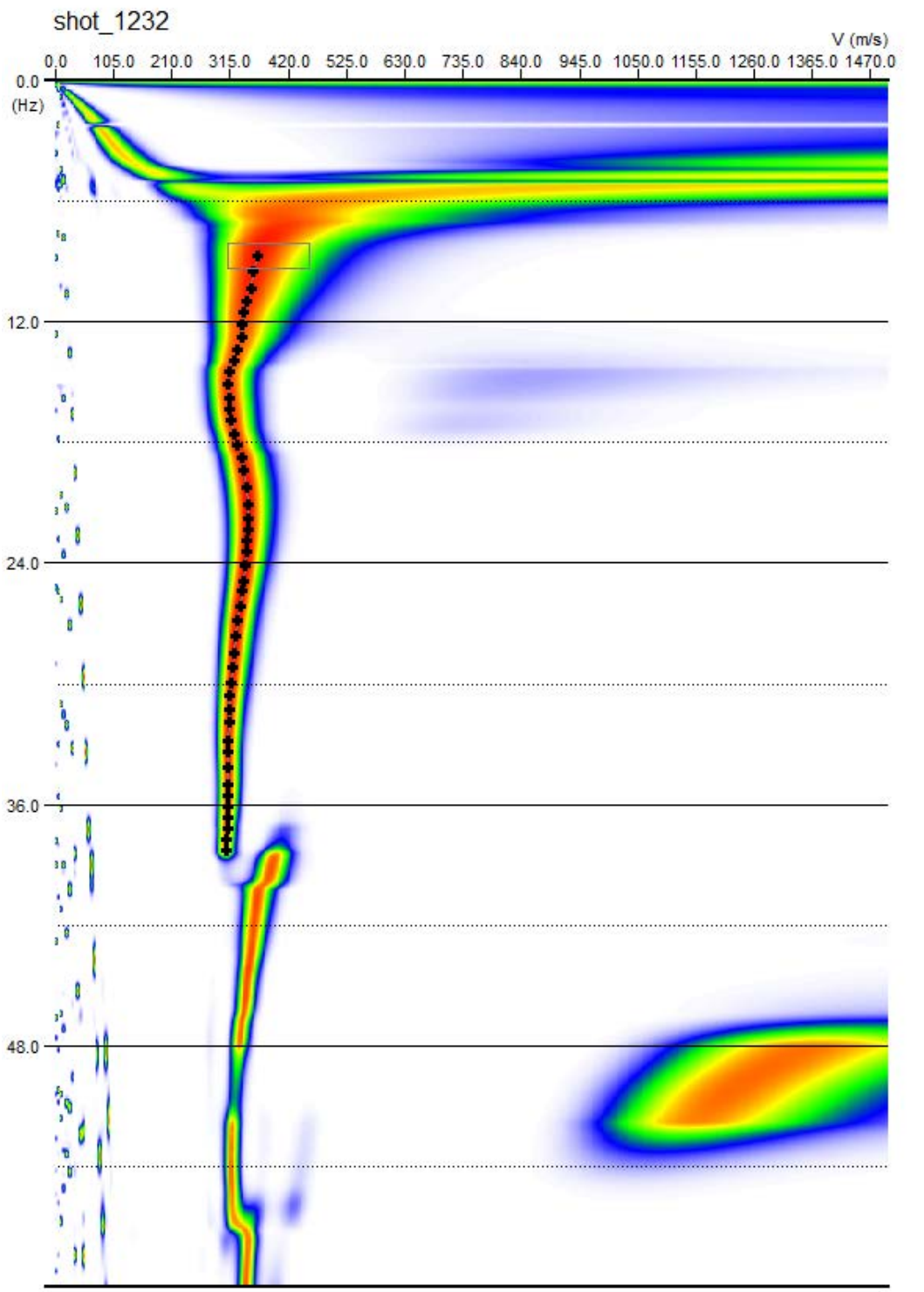

shot_1229
V (m/s)
0.0
105.0
210.0
315.0
420.0
525.0
630.0
735.0
840.0
945.0
1050.0
1155.0
1260.0
1365.0
1470.0
0.0
(Hz)
12.0
24.0
36.0
48.0

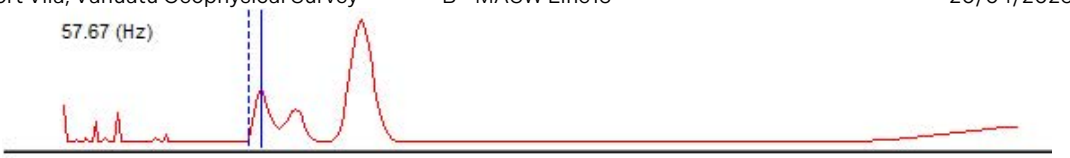

59.53 (Hz)
shot_1230
V (m/s)
0.0 105.0 210.0 315.0 420.0 525.0 630.0 735.0 840.0 945.0 1050.0 1155.0 1260.0 1365.0 1470.0
0.0
(Hz)
12.0
24.0
36.0
48.0

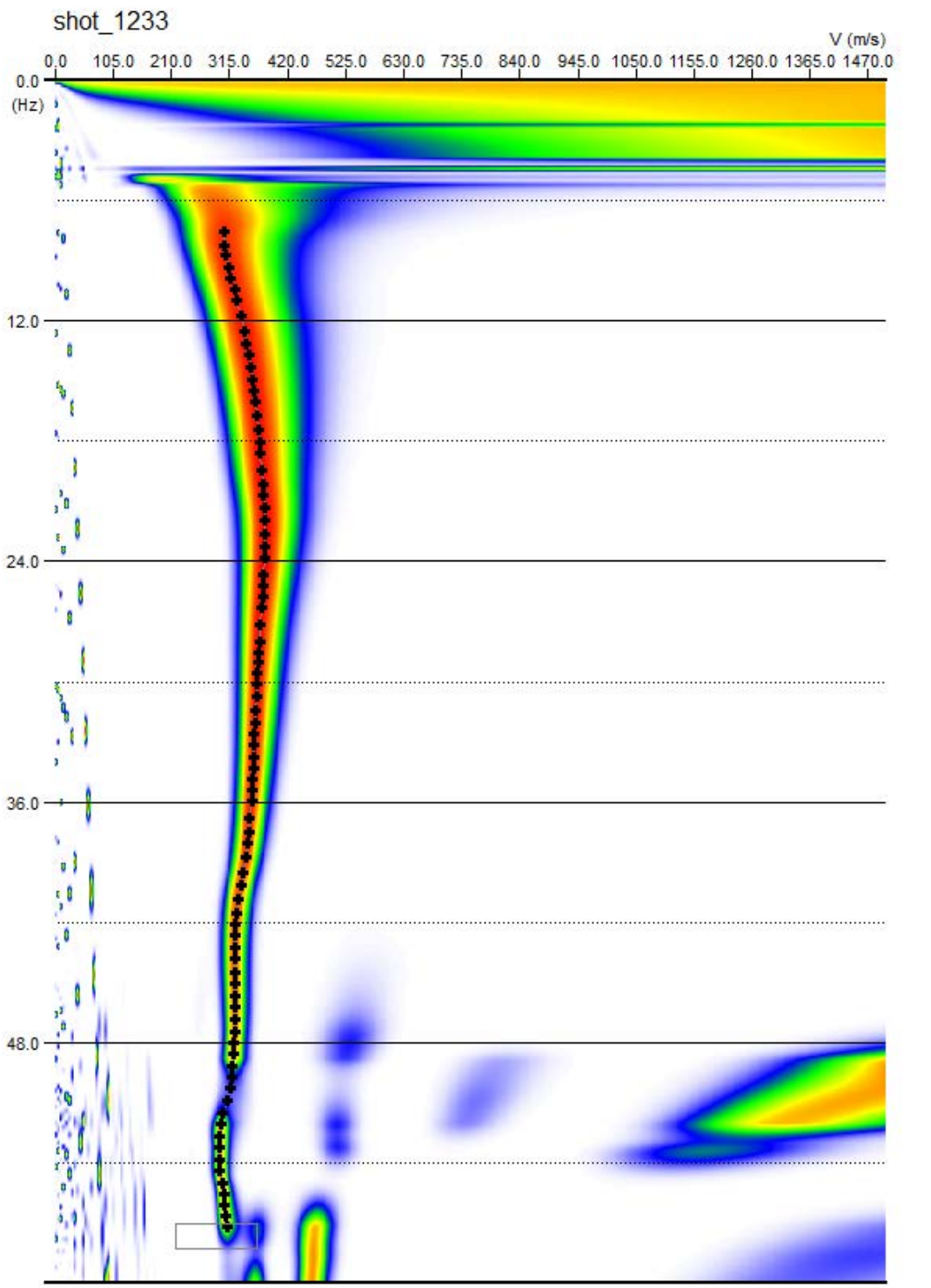


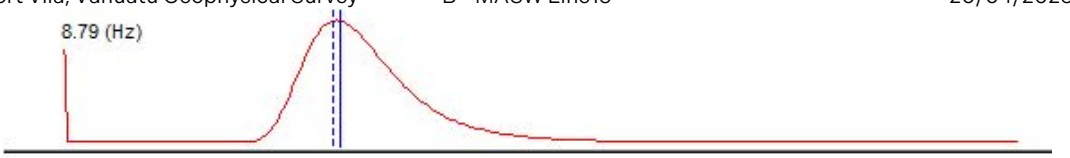

shot_1231
V (m/s)
0.0 105.0 210.0 315.0 420.0 525.0 630.0 735.0 840.0 945.0 1050.0 1155.0 1260.0 1365.0 1470.0
0.0
(Hz)
12.0
24.0
36.0
48.0

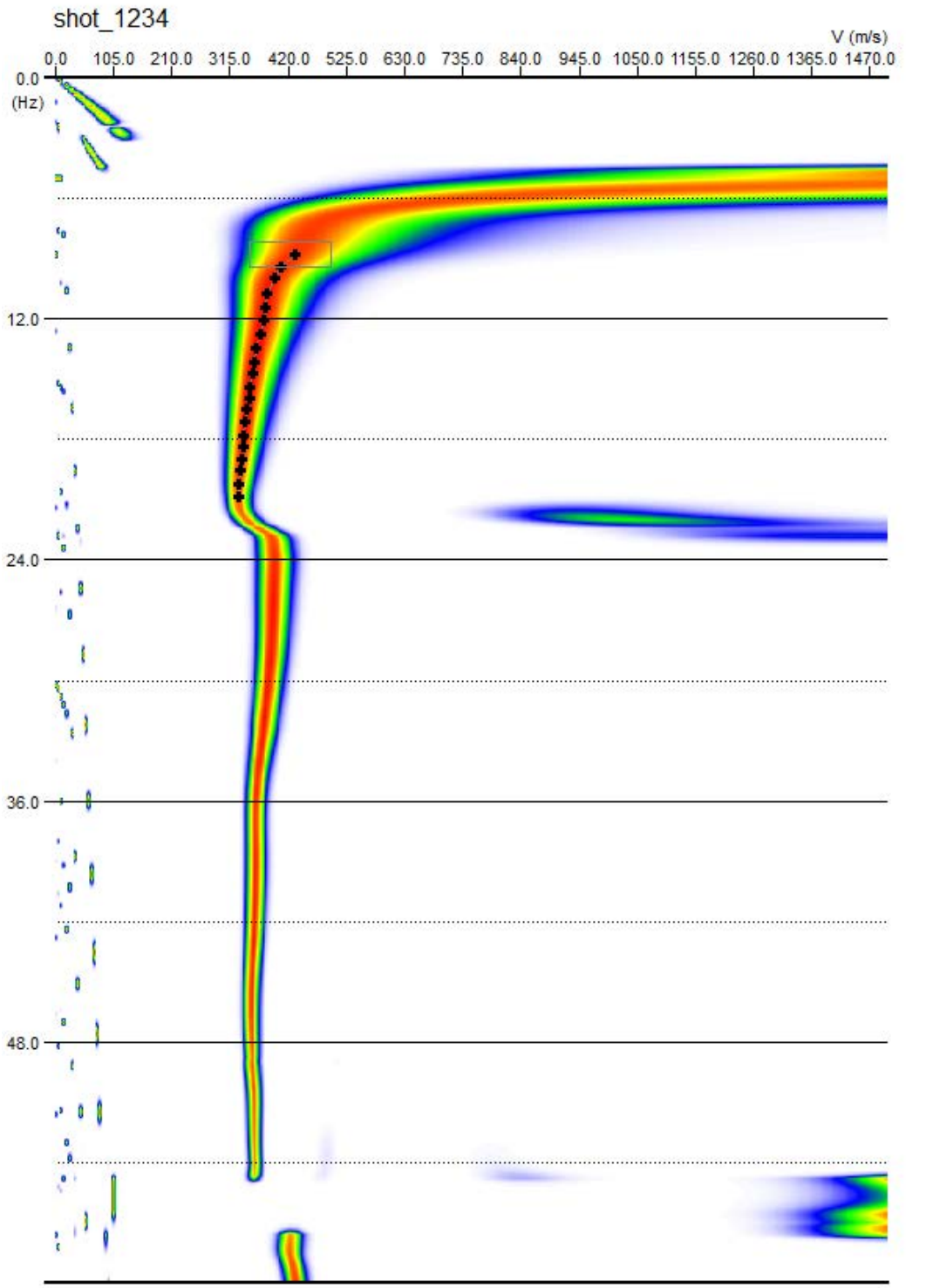

8.72 (Hz)

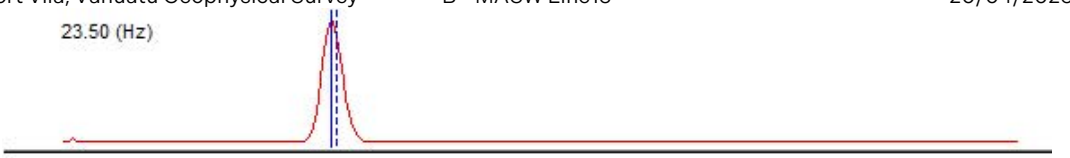

shot_1232
V (m/s)
0.0
105.0
210.0
315.0
420.0
525.0
630.0
735.0
840.0
945.0
1050.0
1155.0
1260.0
1365.0
1470.0
0.0
(Hz)
12.0
24.0
36.0
48.0

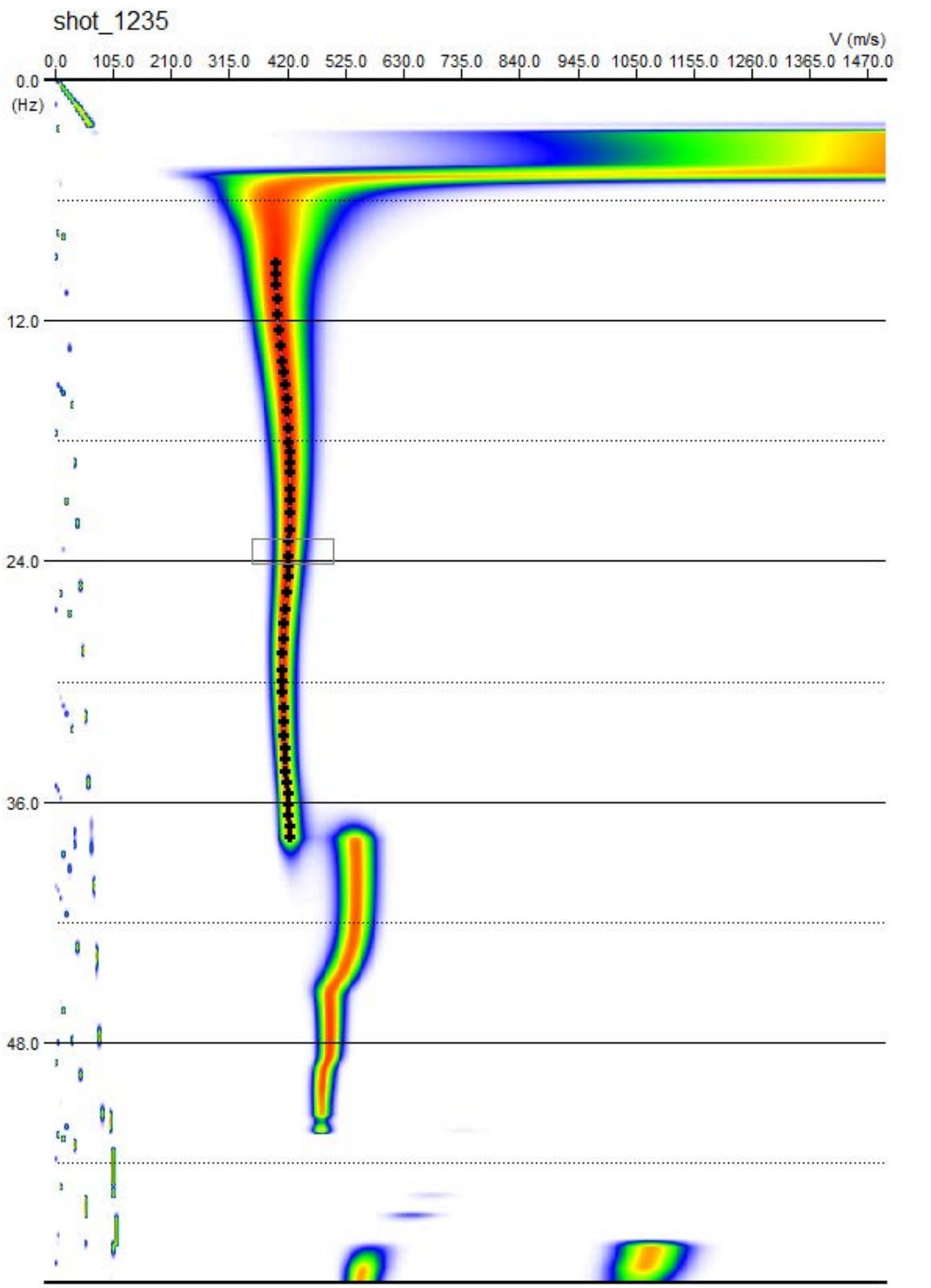

57.67 (Hz)

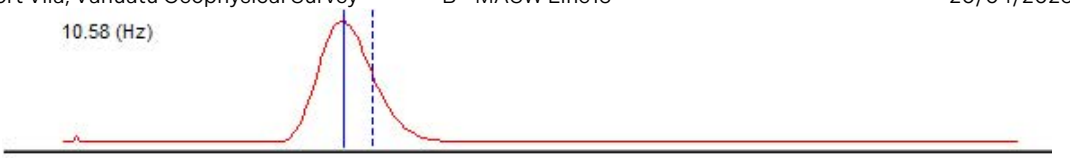

shot_1233
V (m/s)
0.0
105.0
210.0
315.0
420.0
525.0
630.0
735.0
840.0
945.0
1050.0
1155.0
1260.0
1365.0
1470.0
0.0
(Hz)
12.0
24.0
36.0
48.0

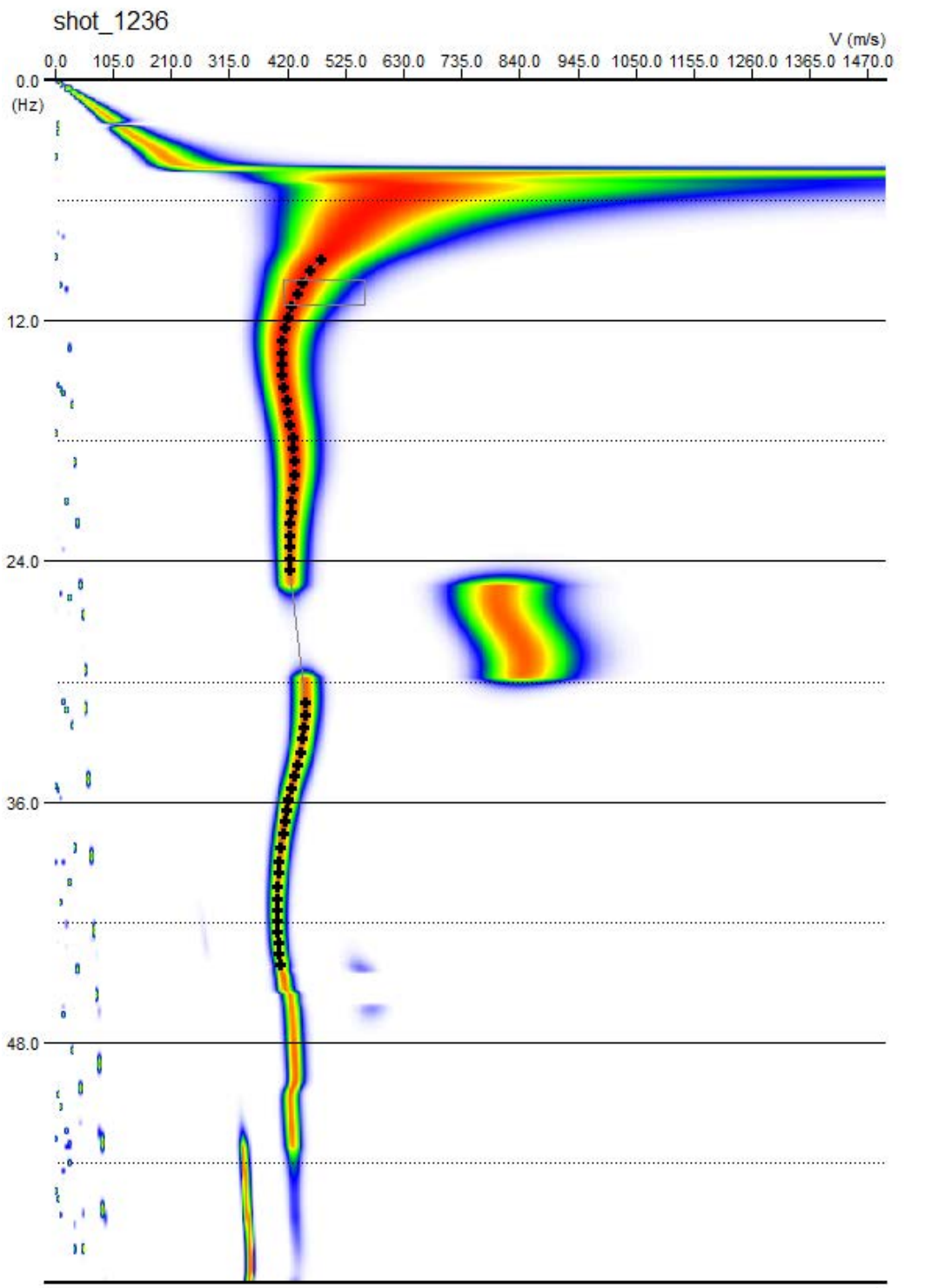

8.79 (Hz)

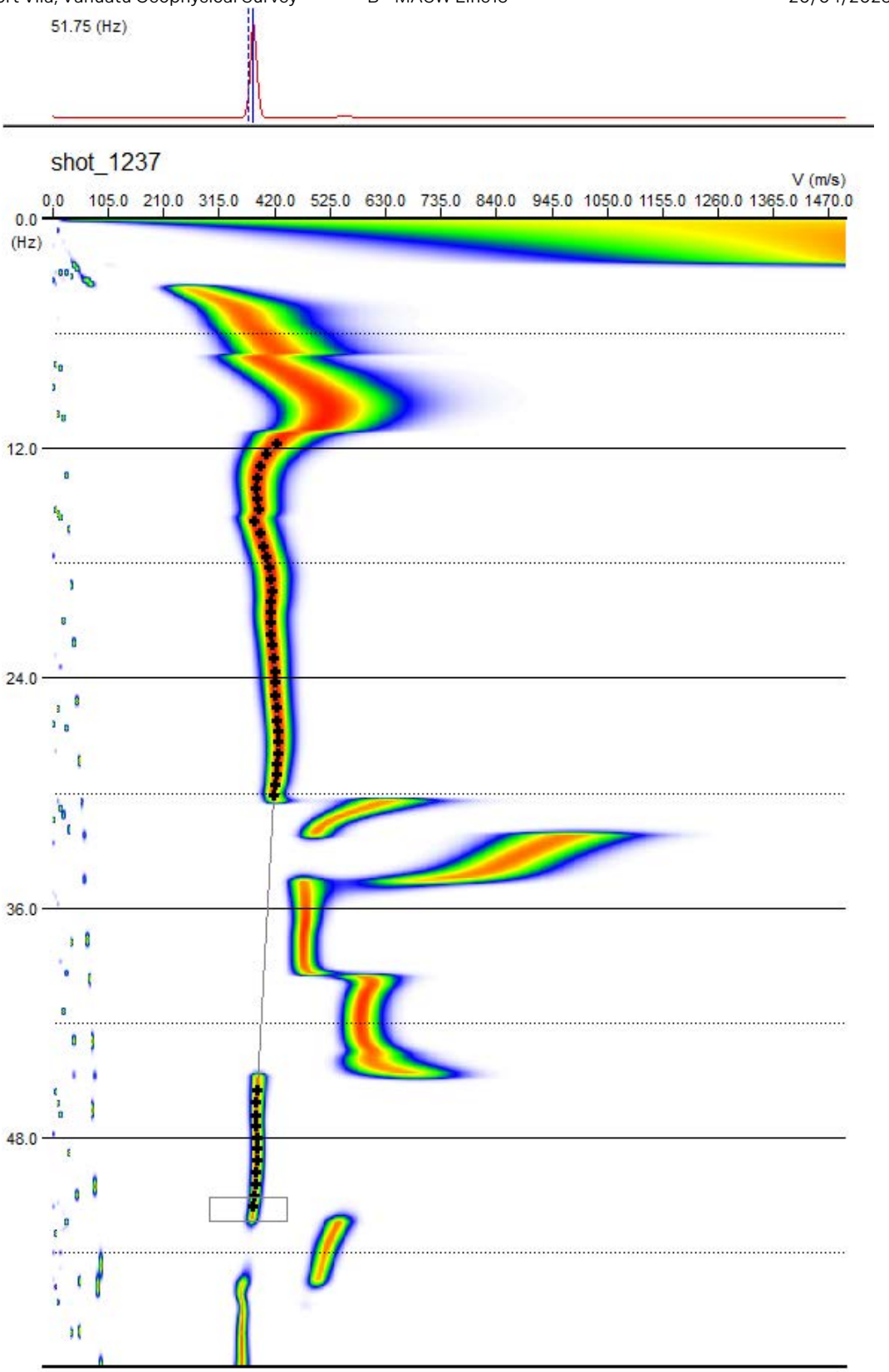

shot_1234
V (m/s)
0.0
105.0
210.0
315.0
420.0
525.0
630.0
735.0
840.0
945.0
1050.0
1155.0
1260.0
1365.0
1470.0
0.0
(Hz)
12.0
24.0
36.0
48.0


23.50 (Hz)

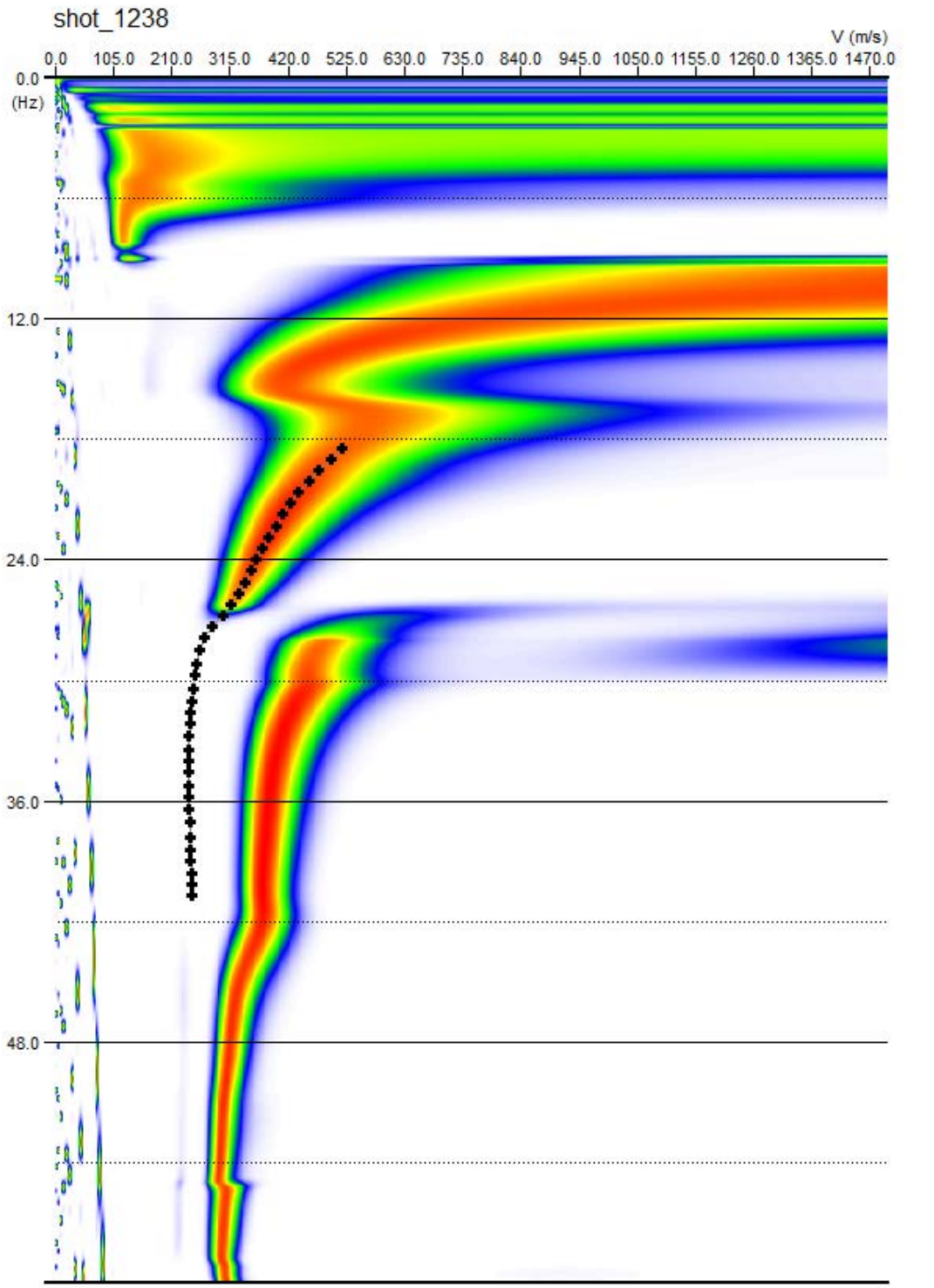

shot_1235
V (m/s)
0.0 105.0 210.0 315.0 420.0 525.0 630.0 735.0 840.0 945.0 1050.0 1155.0 1260.0 1365.0 1470.0
0.0
(Hz)
12.0
24.0
36.0
48.0

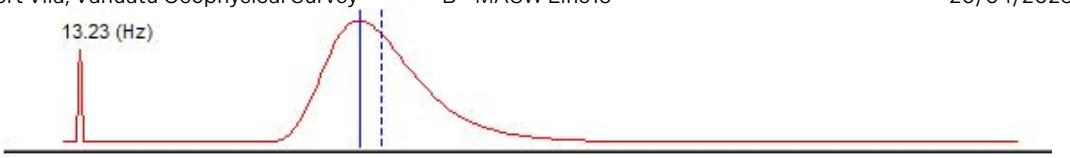

10.58 (Hz)

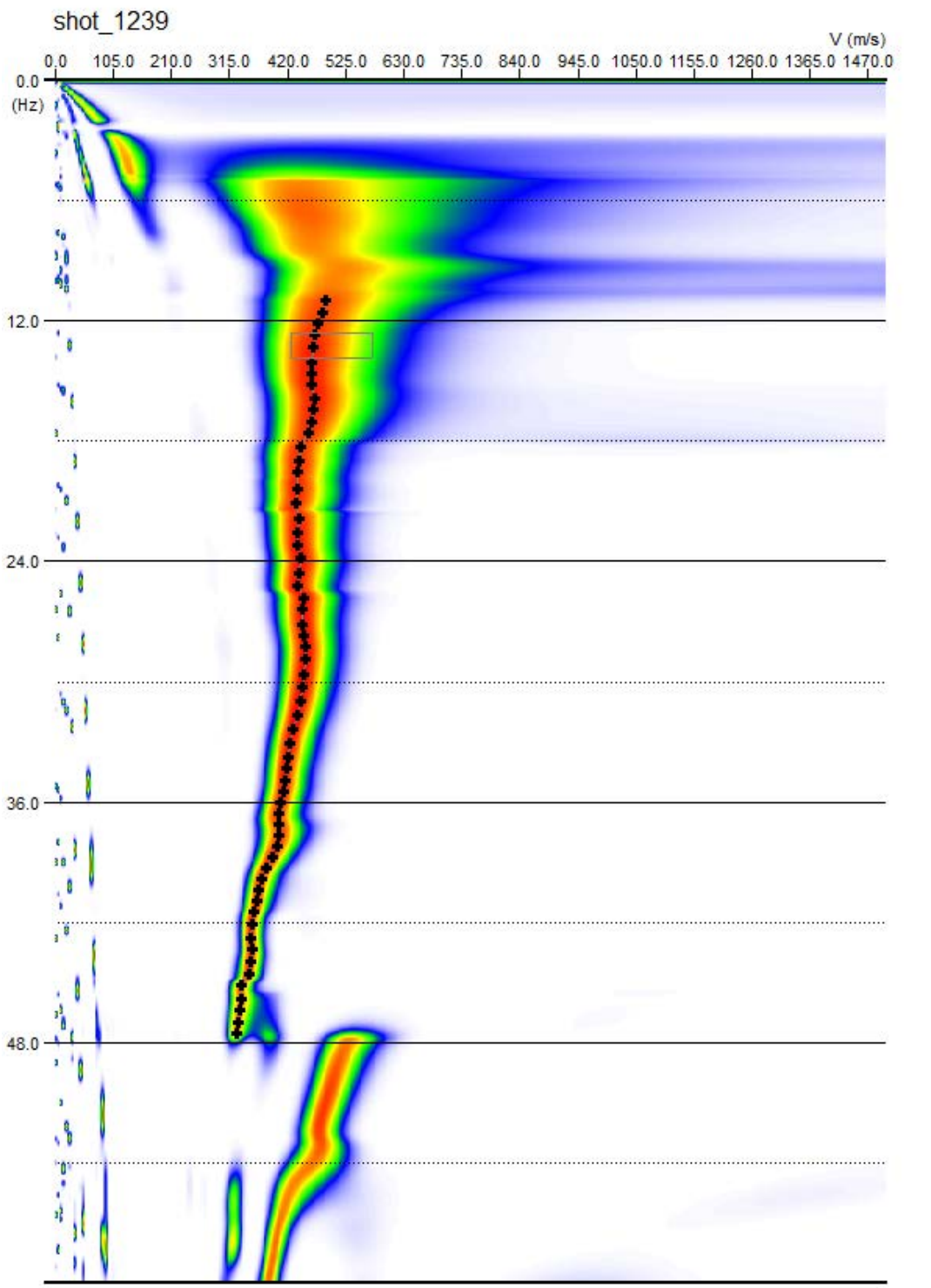

shot_1236
V (m/s)
0.0
105.0
210.0
315.0
420.0
525.0
630.0
735.0
840.0
945.0
1050.0
1155.0
1260.0
1365.0
1470.0
0.0
(Hz)
12.0
24.0
36.0
48.0

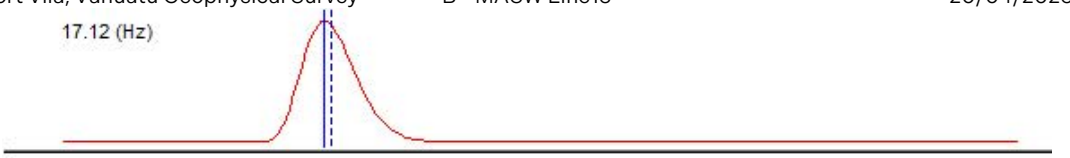

51.75 (Hz)
shot_1237
V (m/s)
0.0 105.0 210.0 315.0 420.0 525.0 630.0 735.0 840.0 945.0 1050.0 1155.0 1260.0 1365.0 1470.0
0.0
(Hz)
12.0
24.0
36.0
48.0

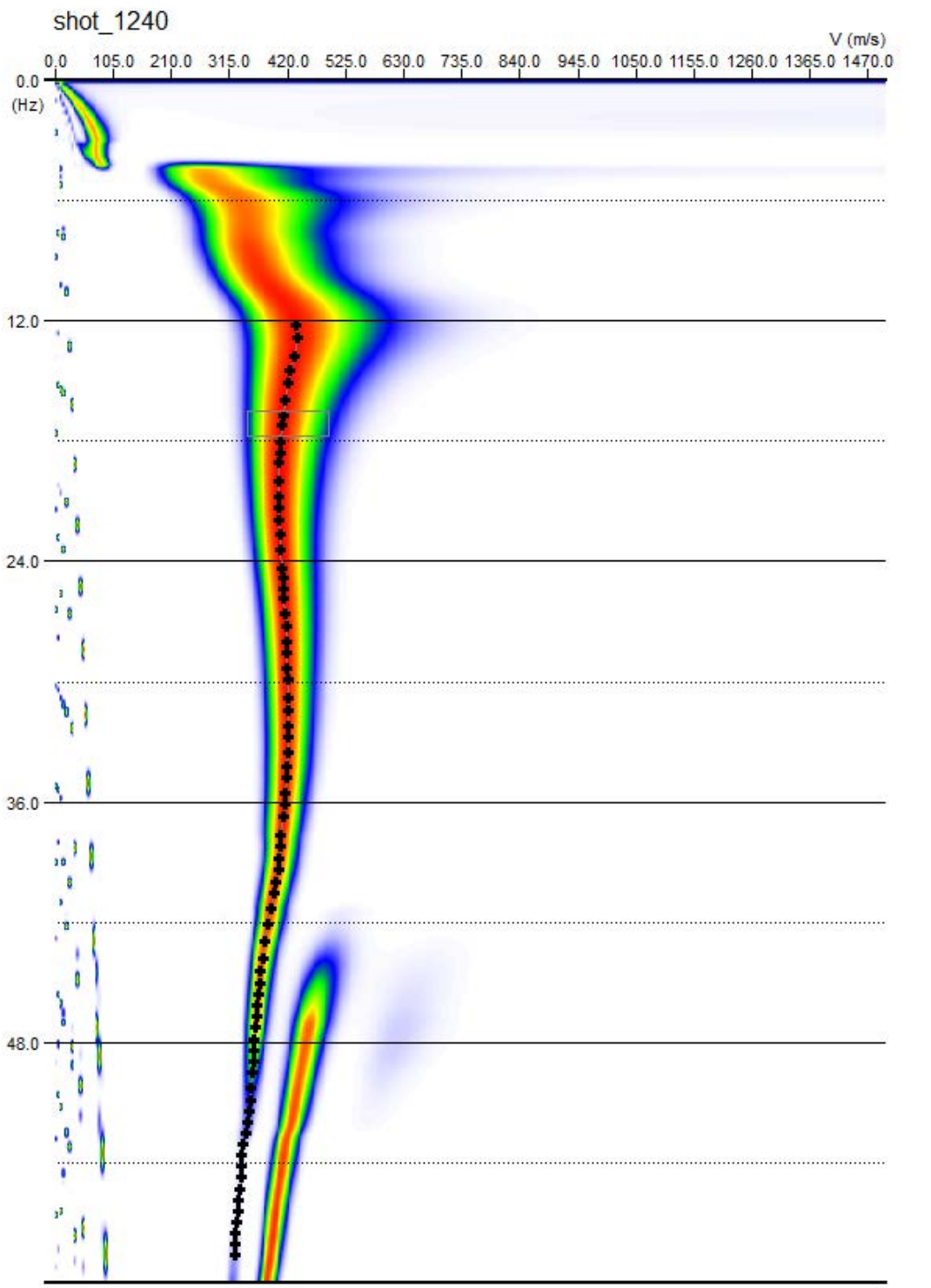


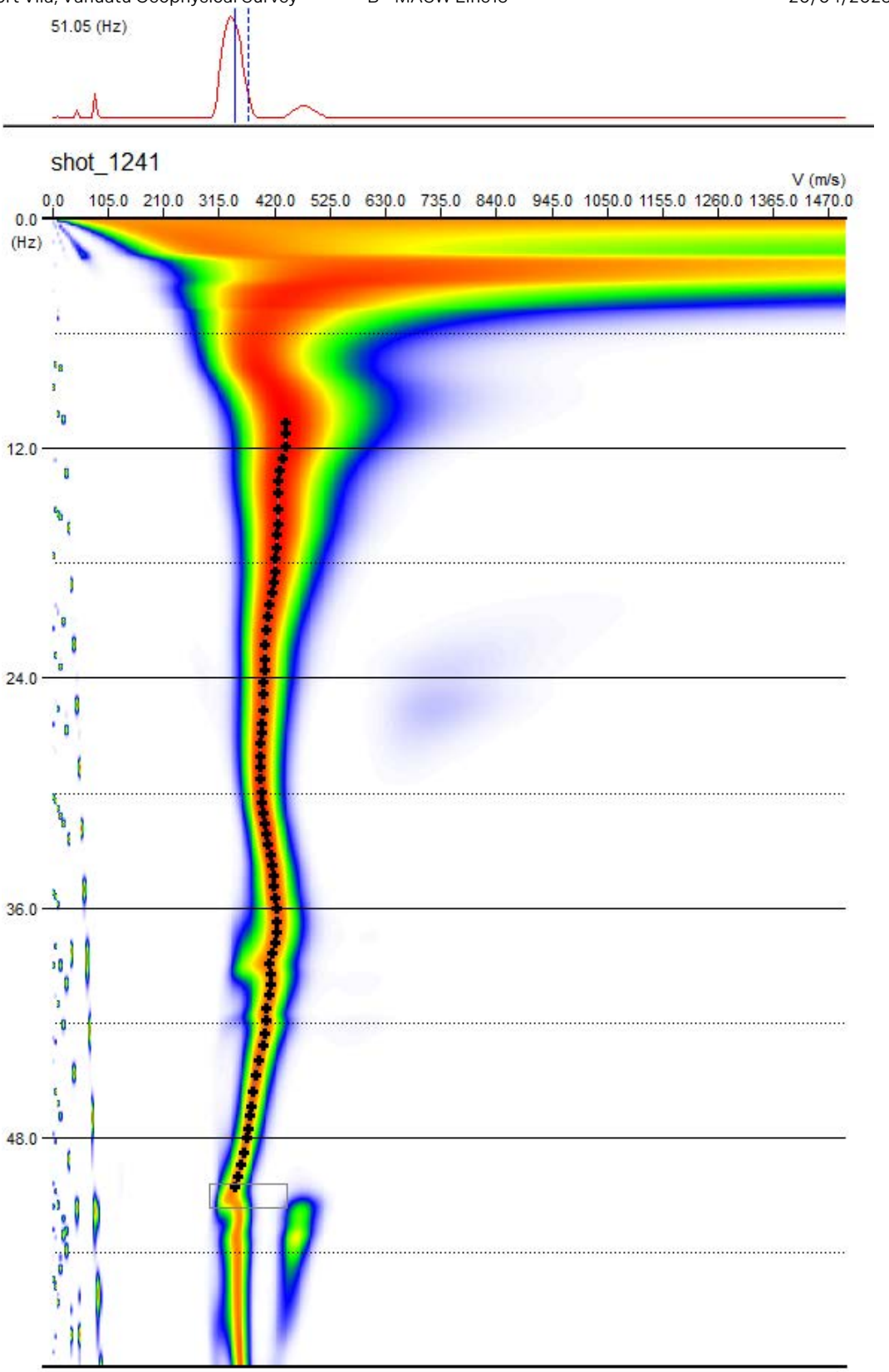

shot_1238
V (m/s)
0.0
105.0
210.0
315.0
420.0
525.0
630.0
735.0
840.0
945.0
1050.0
1155.0
1260.0
1365.0
1470.0
0.0
(Hz)
12.0
24.0
36.0
48.0


13.23 (Hz)

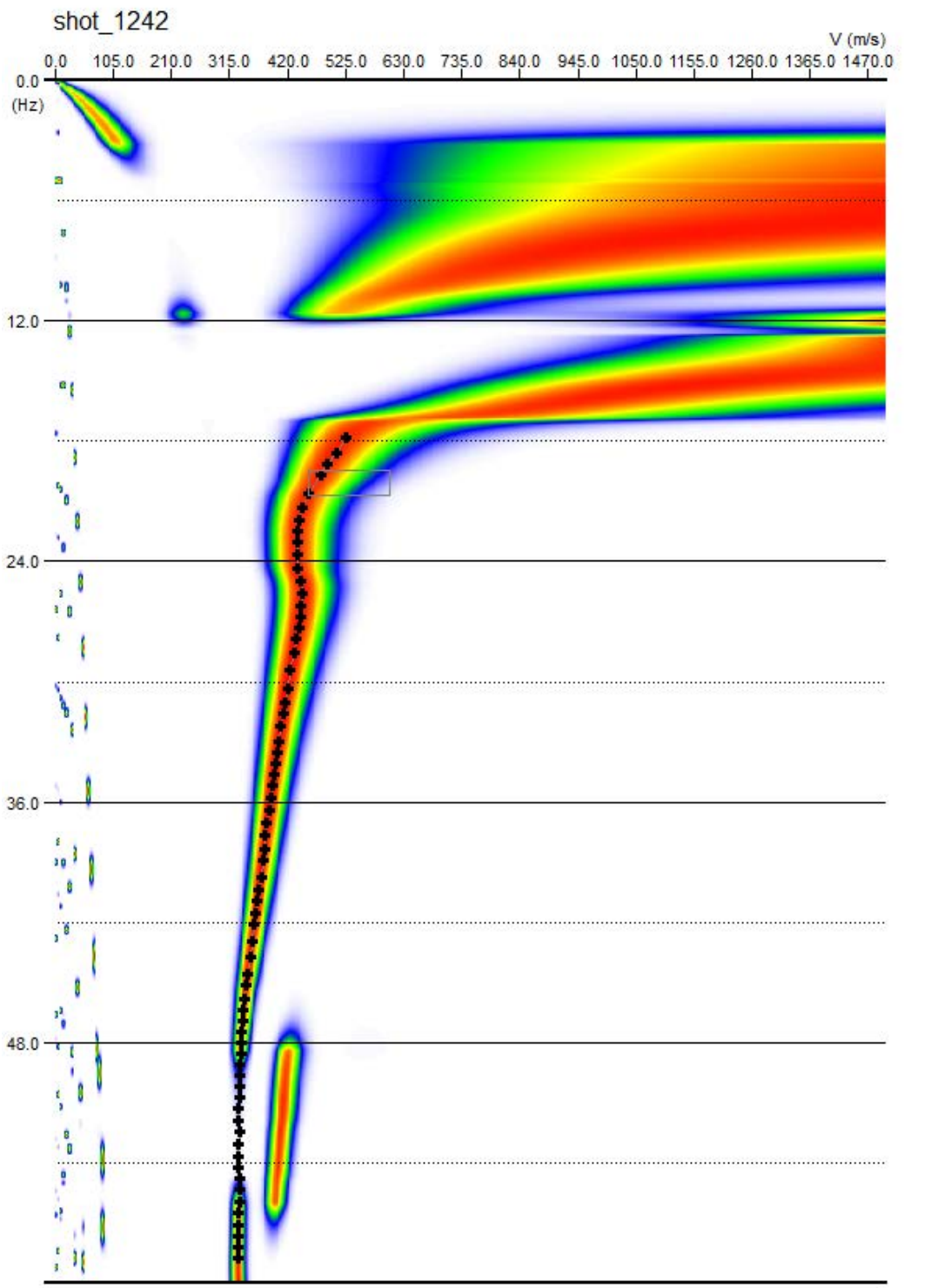

shot_1239
V (m/s)
0.0
105.0
210.0
315.0
420.0
525.0
630.0
735.0
840.0
945.0
1050.0
1155.0
1260.0
1365.0
1470.0
0.0
(Hz)
12.0
24.0
36.0
48.0

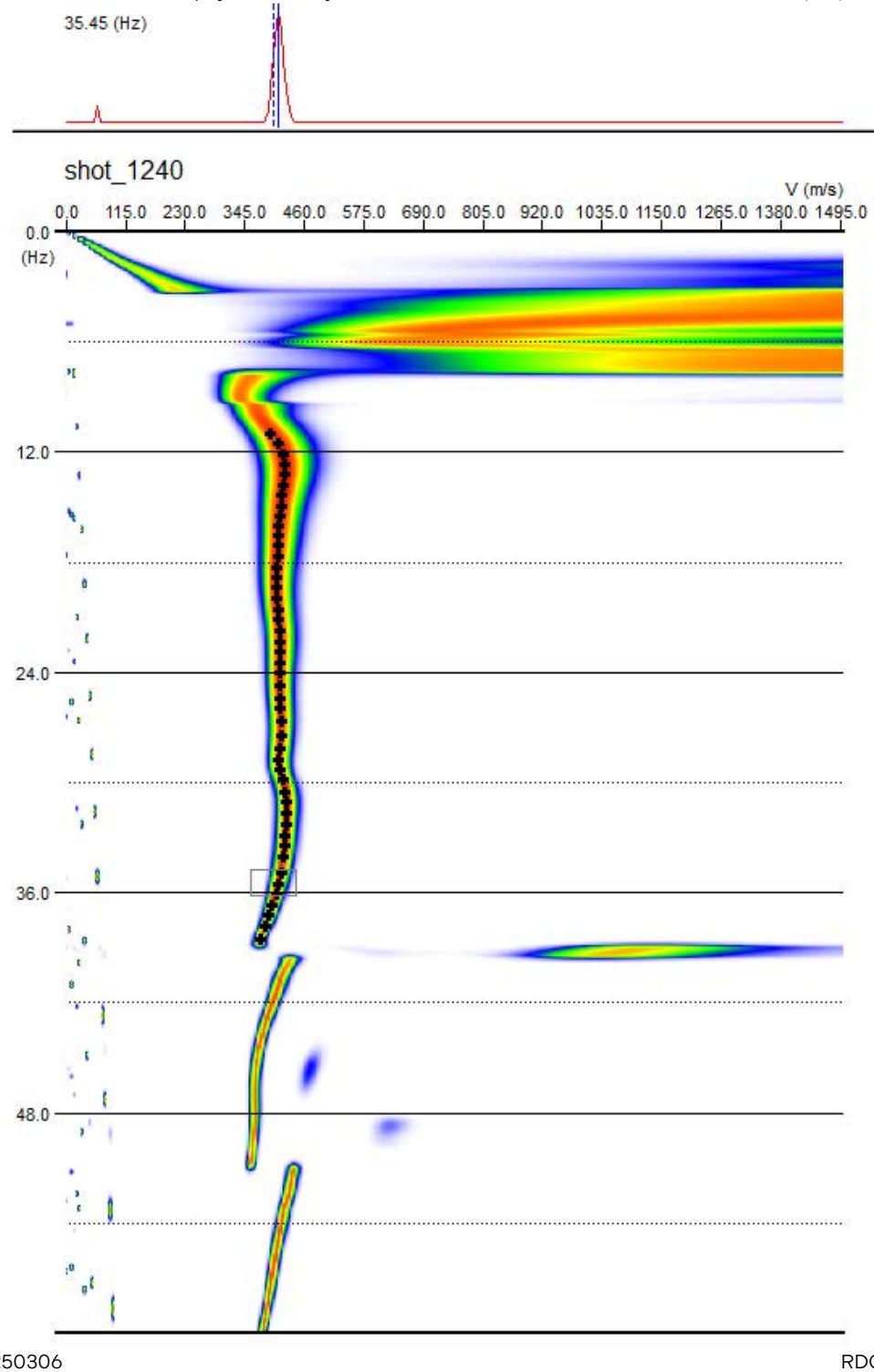

17.12 (Hz)


shot_1240
V (m/s)
0.0
105.0
210.0
315.0
420.0
525.0
630.0
735.0
840.0
945.0
1050.0
1155.0
1260.0
1365.0
1470.0
0.0
(Hz)
12.0
24.0
36.0
48.0

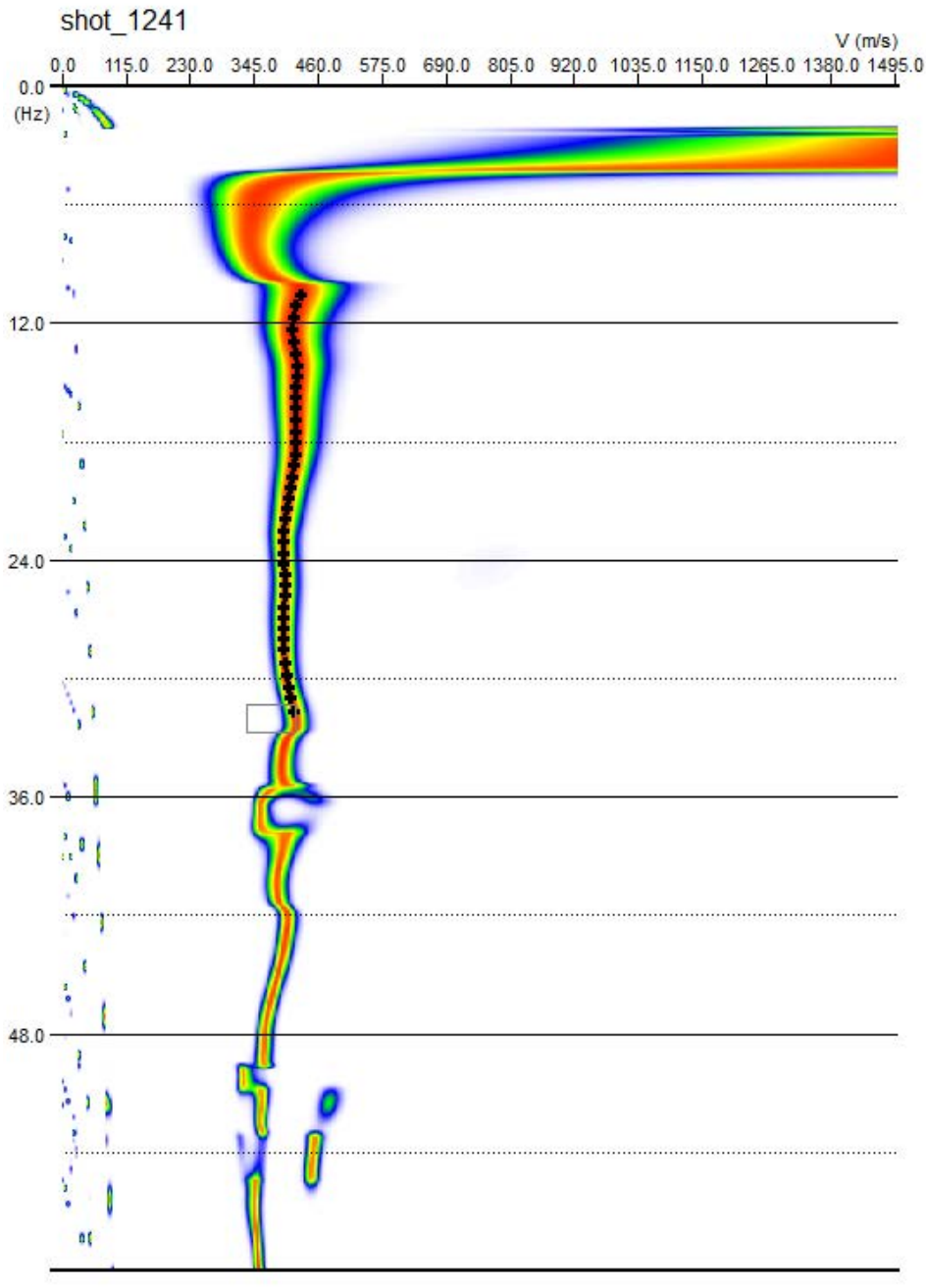

51.05 (Hz)
shot_1241
V (m/s)
0.0 105.0 210.0 315.0 420.0 525.0 630.0 735.0 840.0 945.0 1050.0 1155.0 1260.0 1365.0 1470.0
0.0
(Hz)
12.0
24.0
36.0
48.0

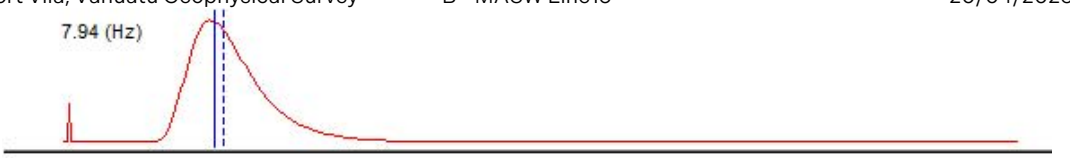

20.08 (Hz)

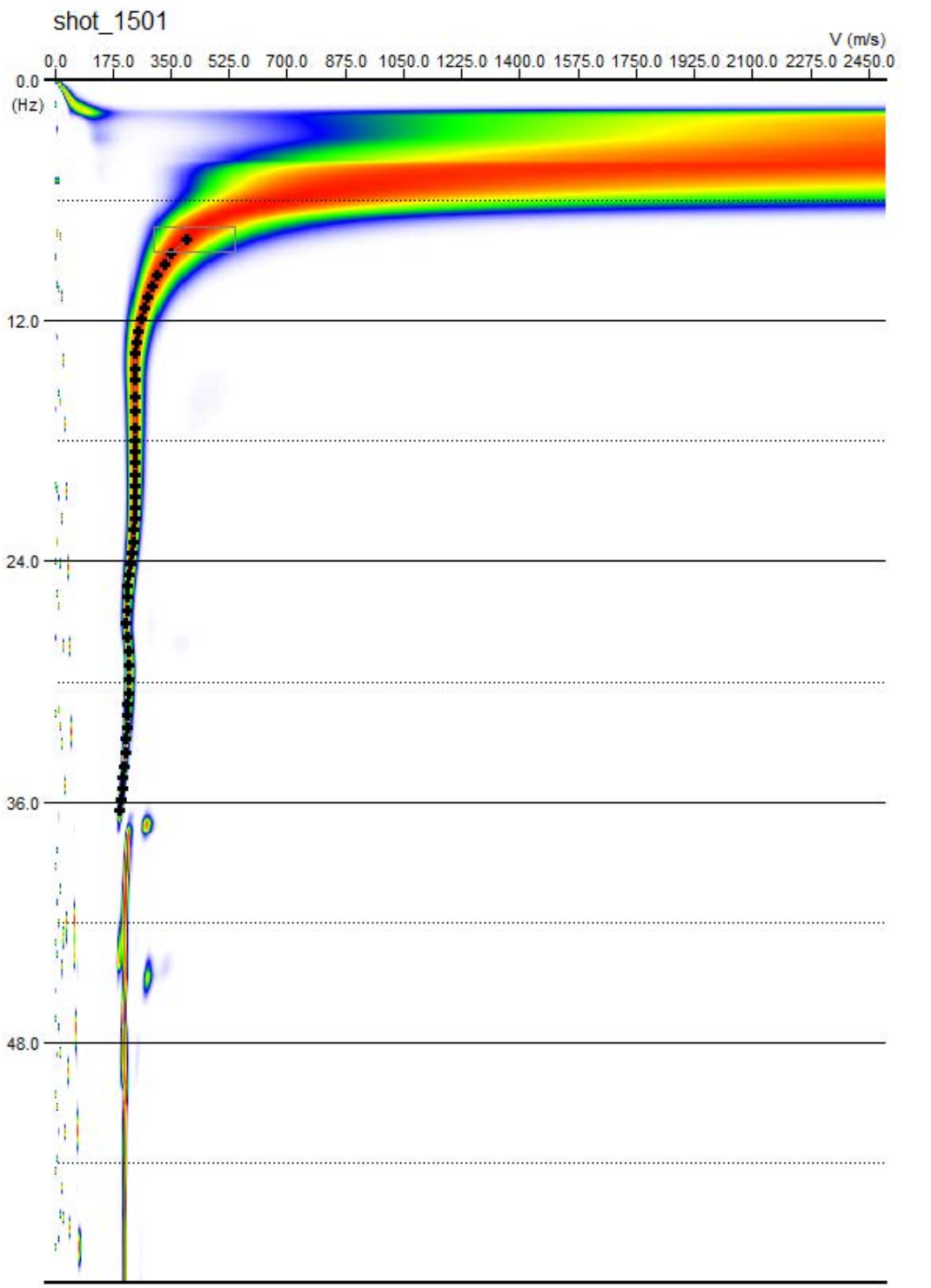

shot_1242
V (m/s)
0.0
105.0
210.0
315.0
420.0
525.0
630.0
735.0
840.0
945.0
1050.0
1155.0
1260.0
1365.0
1470.0
0.0
(Hz)
12.0
24.0
36.0
48.0


35.45 (Hz)
shot_1240
V (m/s)
0.0 115.0 230.0 345.0 460.0 575.0 690.0 805.0 920.0 1035.0 1150.0 1265.0 1380.0 1495.0
0.0
(Hz)
12.0
24.0
36.0
48.0

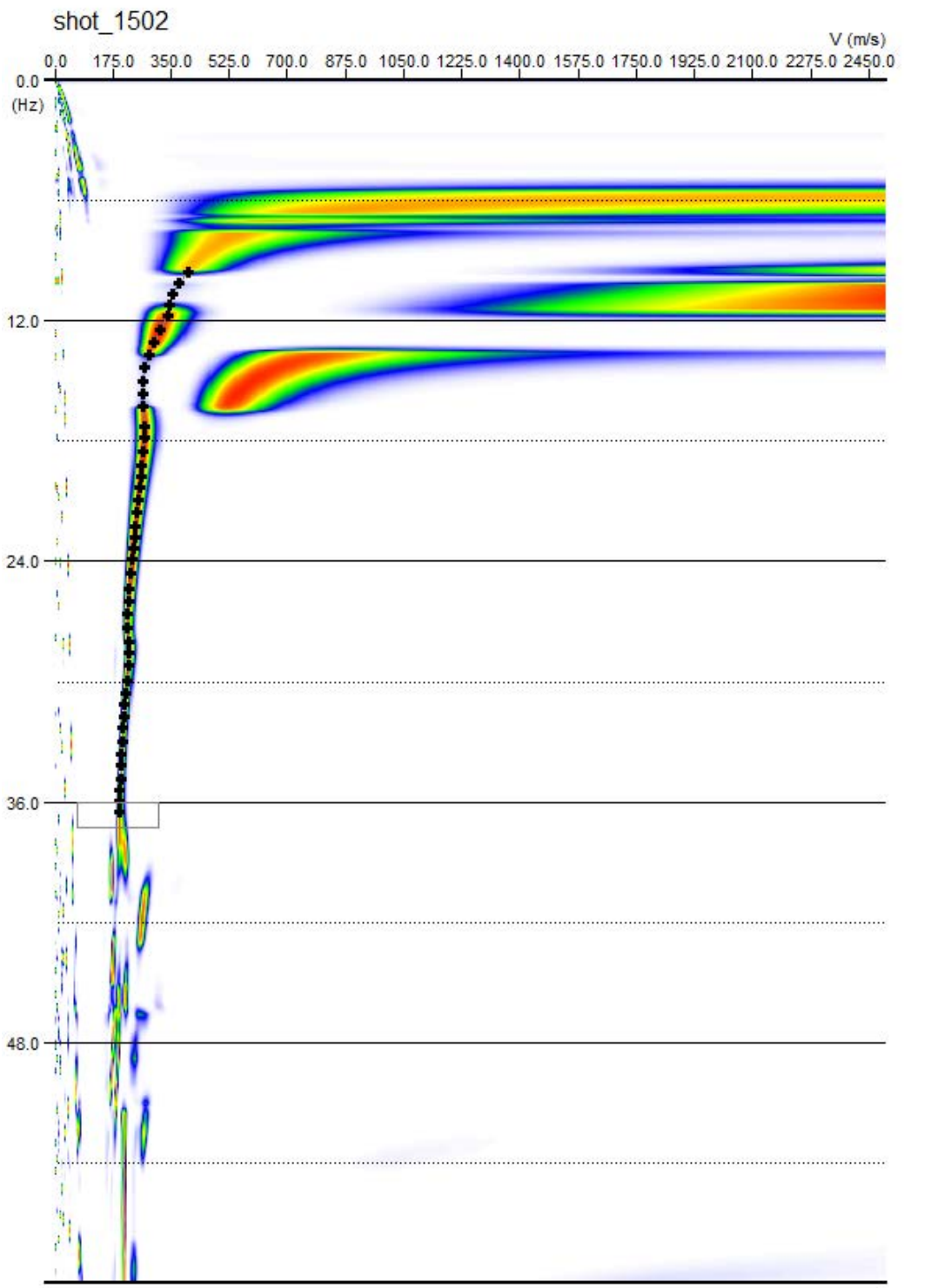

32.02 (Hz)


shot_1241
V (m/s)
0.0 115.0 230.0 345.0 460.0 575.0 690.0 805.0 920.0 1035.0 1150.0 1265.0 1380.0 1495.0
0.0
(Hz)
12.0
24.0
36.0
48.0

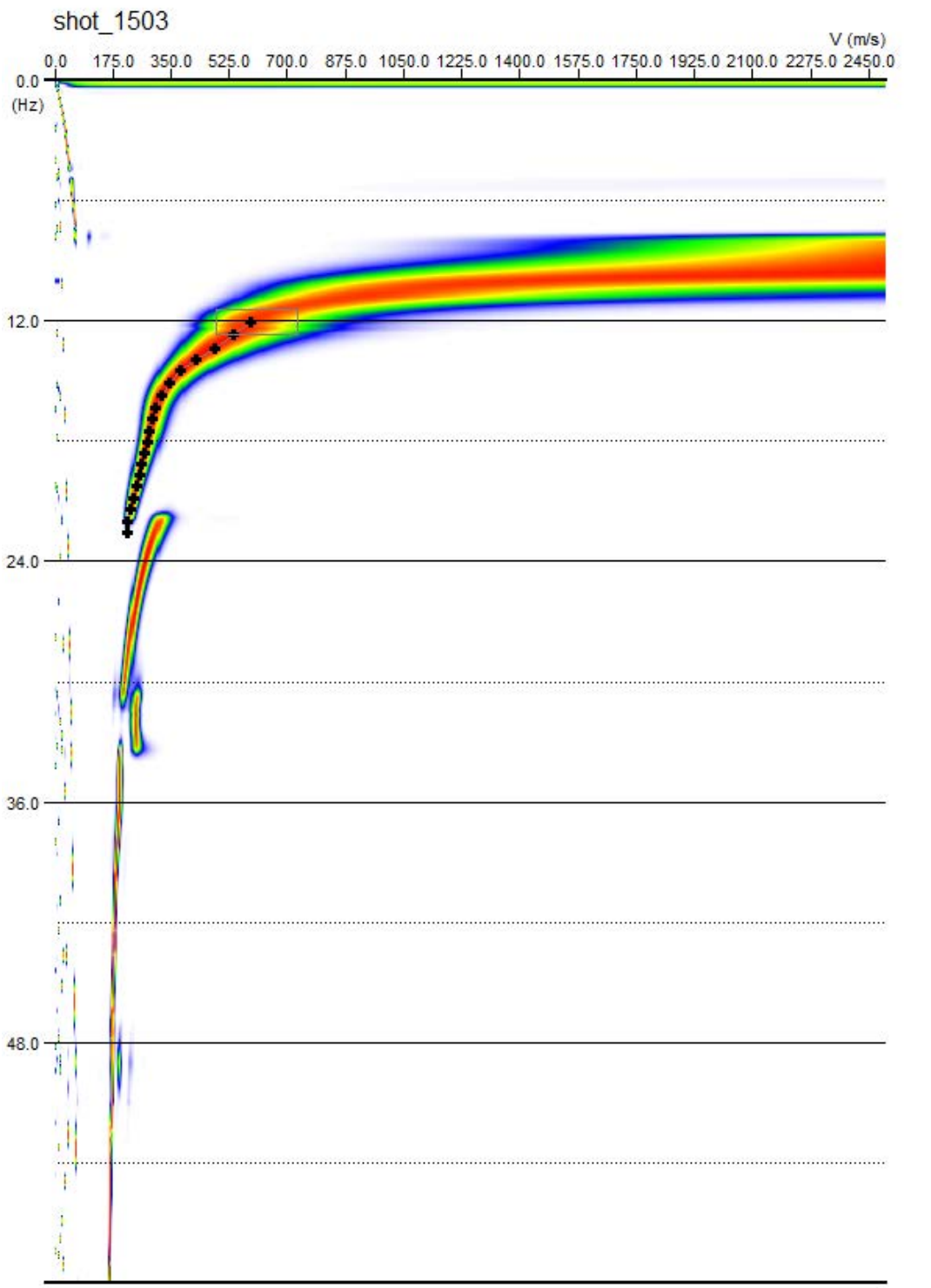

7.94 (Hz)

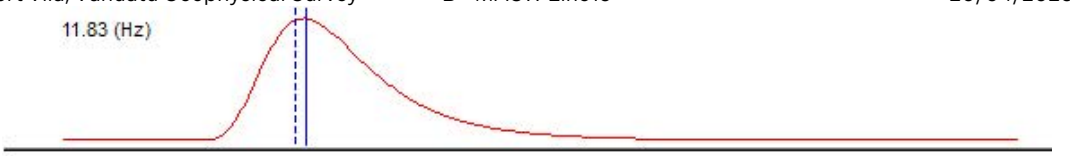

shot_1501
V (m/s)
0.0 175.0 350.0 525.0 700.0 875.0 1050.0 1225.0 1400.0 1575.0 1750.0 1925.0 2100.0 2275.0 2450.0
0.0
(Hz)
12.0
24.0
36.0
48.0

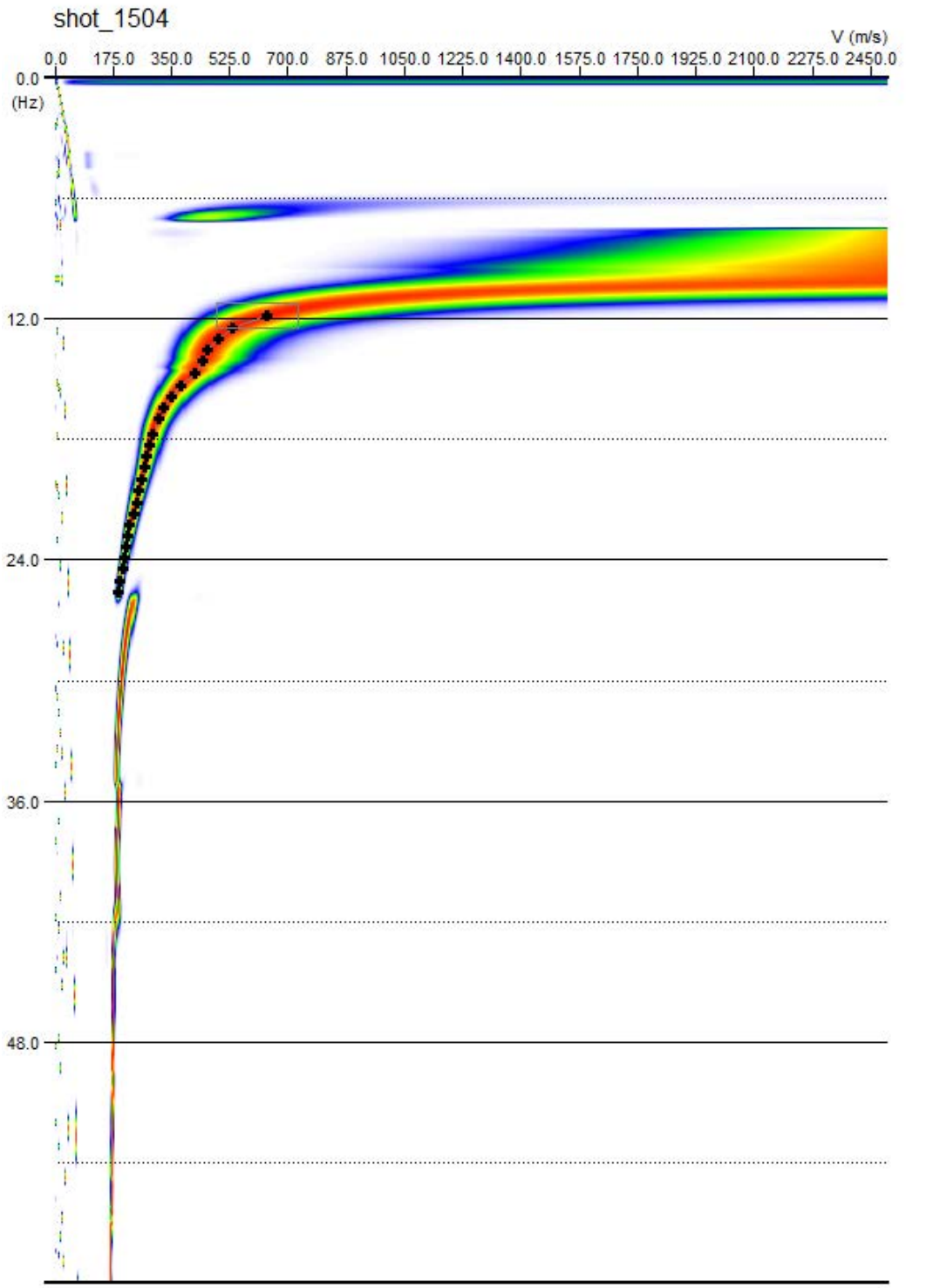

36.65 (Hz)

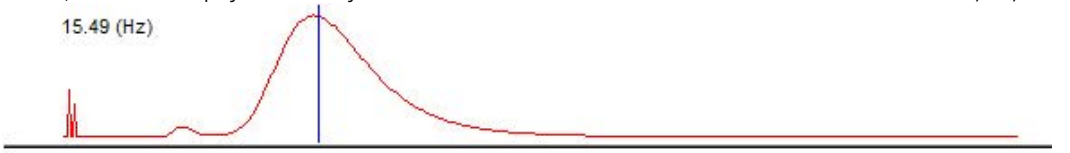

shot_1502
V (m/s)
0.0
175.0
350.0
525.0
700.0
875.0
1050.0
1225.0
1400.0
1575.0
1750.0
1925.0
2100.0
2275.0
2450.0
0.0
(Hz)
12.0
24.0
36.0
48.0

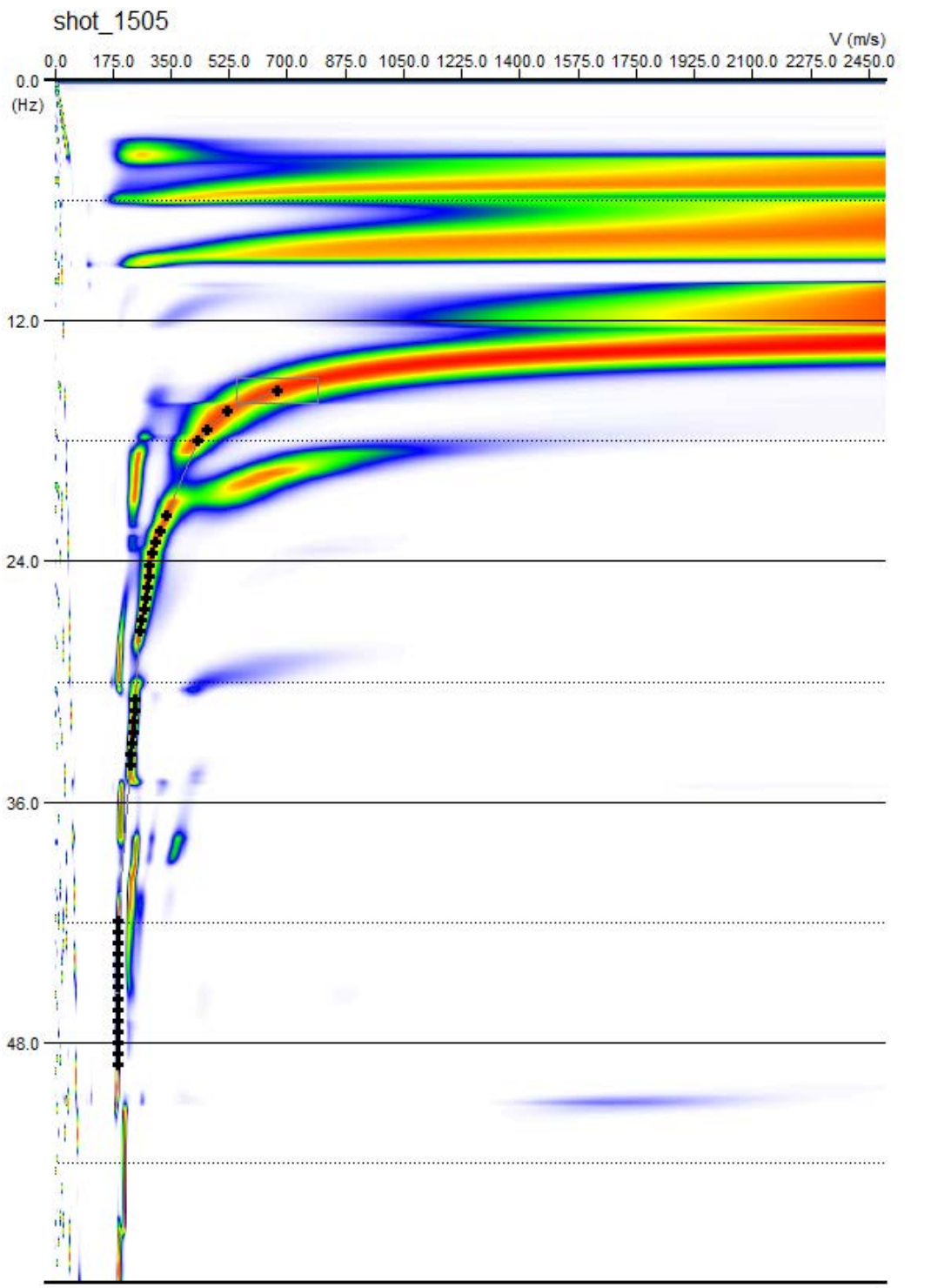

12.06 (Hz)

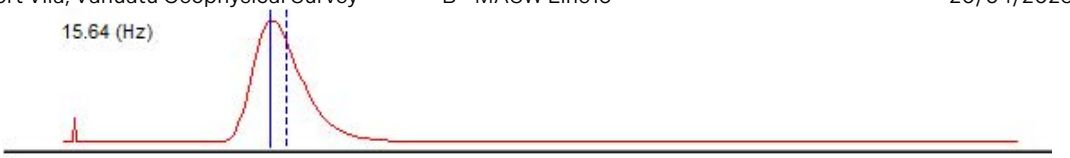

shot_1503
V (m/s)
0.0 175.0 350.0 525.0 700.0 875.0 1050.0 1225.0 1400.0 1575.0 1750.0 1925.0 2100.0 2275.0 2450.0
0.0
(Hz)
12.0
24.0
36.0
48.0

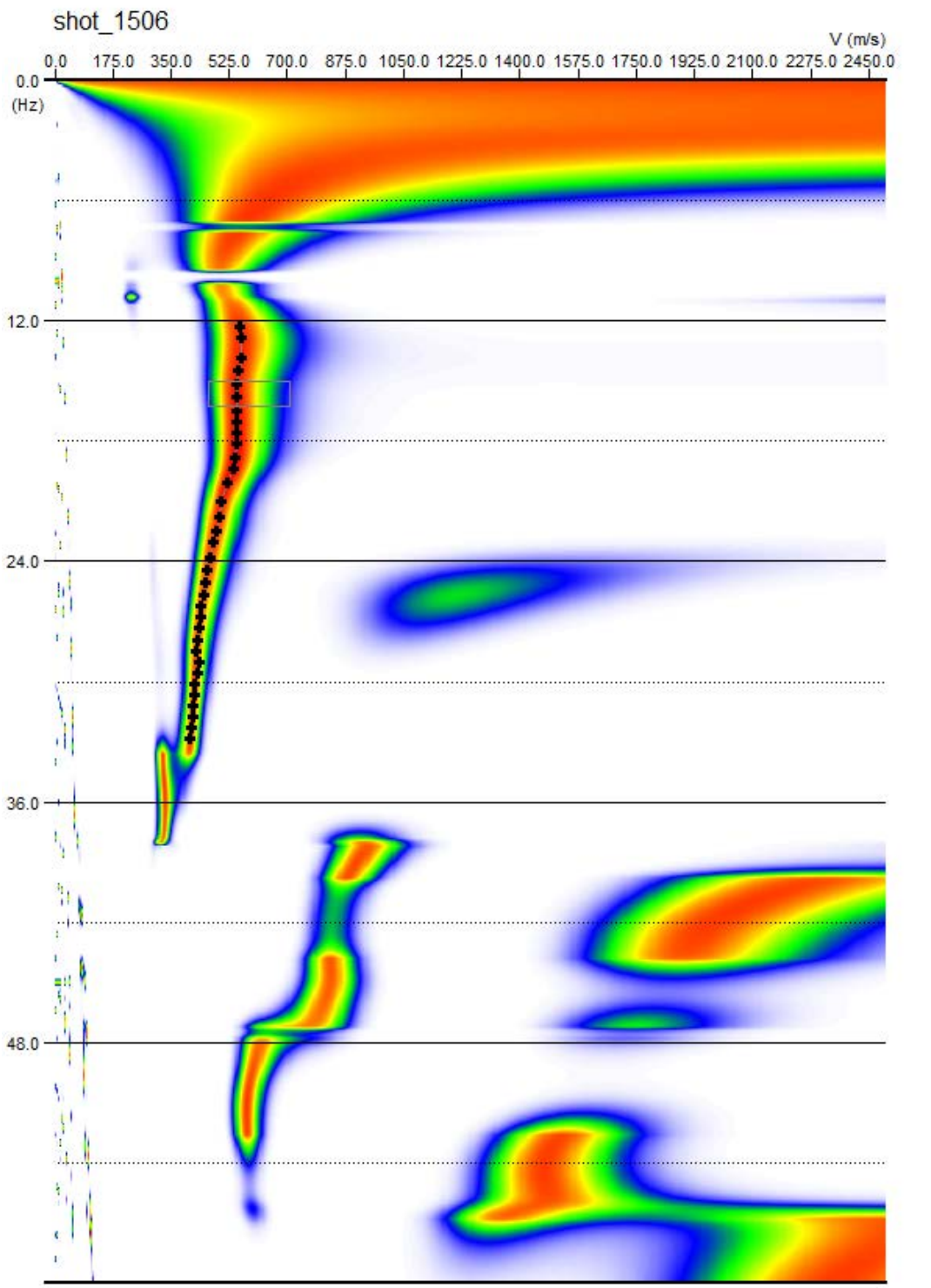

11.83 (Hz)

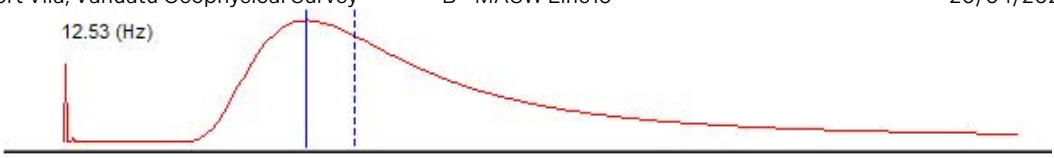

shot_1504
V (m/s)
0.0 175.0 350.0 525.0 700.0 875.0 1050.0 1225.0 1400.0 1575.0 1750.0 1925.0 2100.0 2275.0 2450.0
0.0
(Hz)
12.0
24.0
36.0
48.0

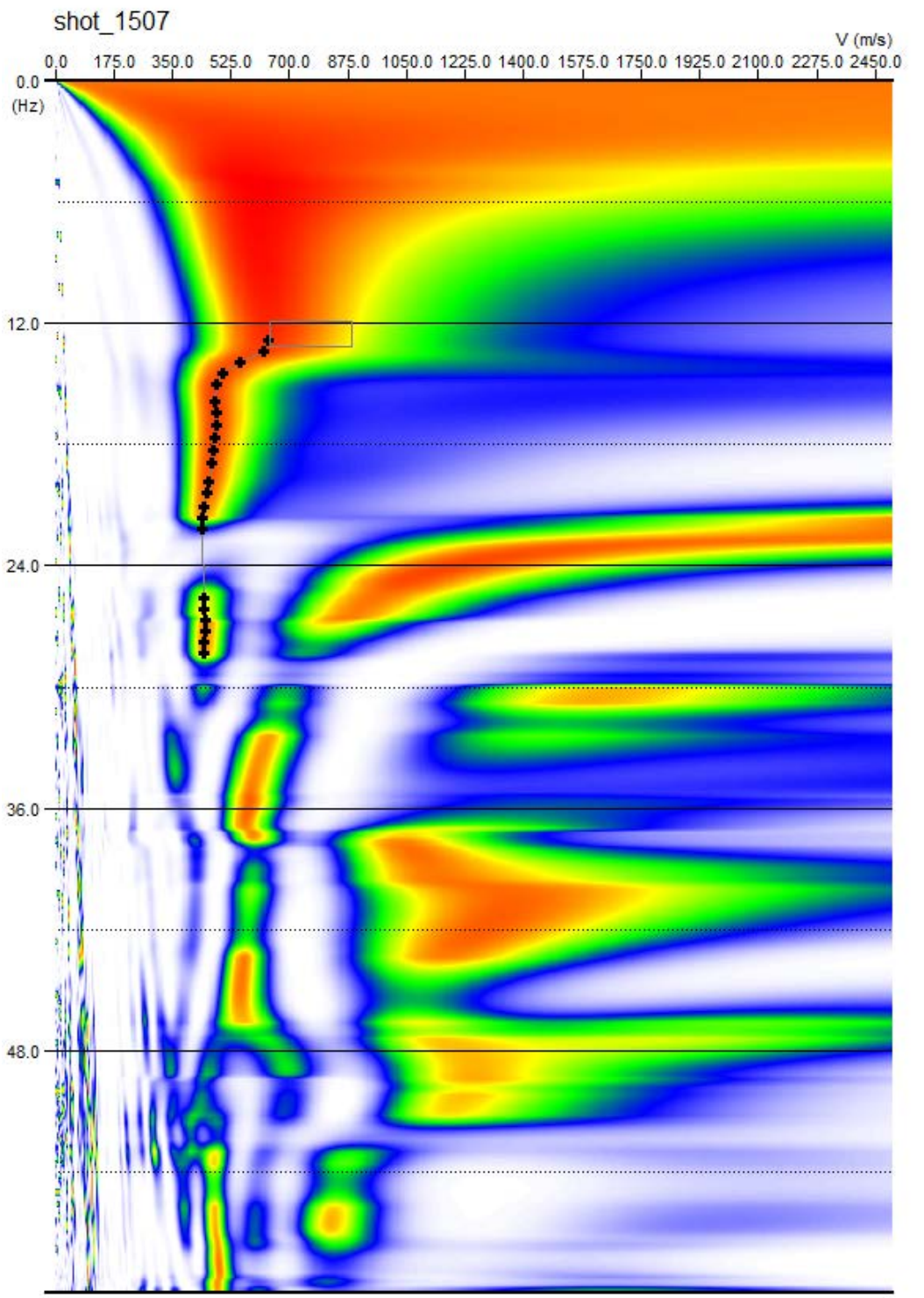

15.49 (Hz)

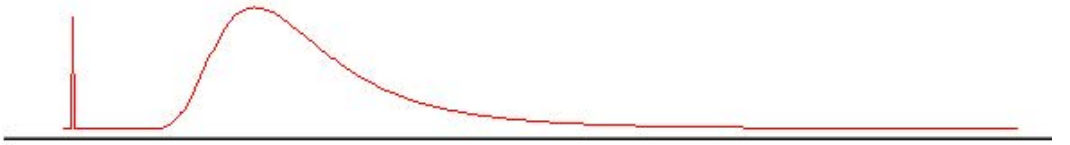

shot_1505
V (m/s)
0.0
175.0
350.0
525.0
700.0
875.0
1050.0
1225.0
1400.0
1575.0
1750.0
1925.0
2100.0
2275.0
2450.0
0.0
(Hz)
12.0
24.0
36.0
48.0

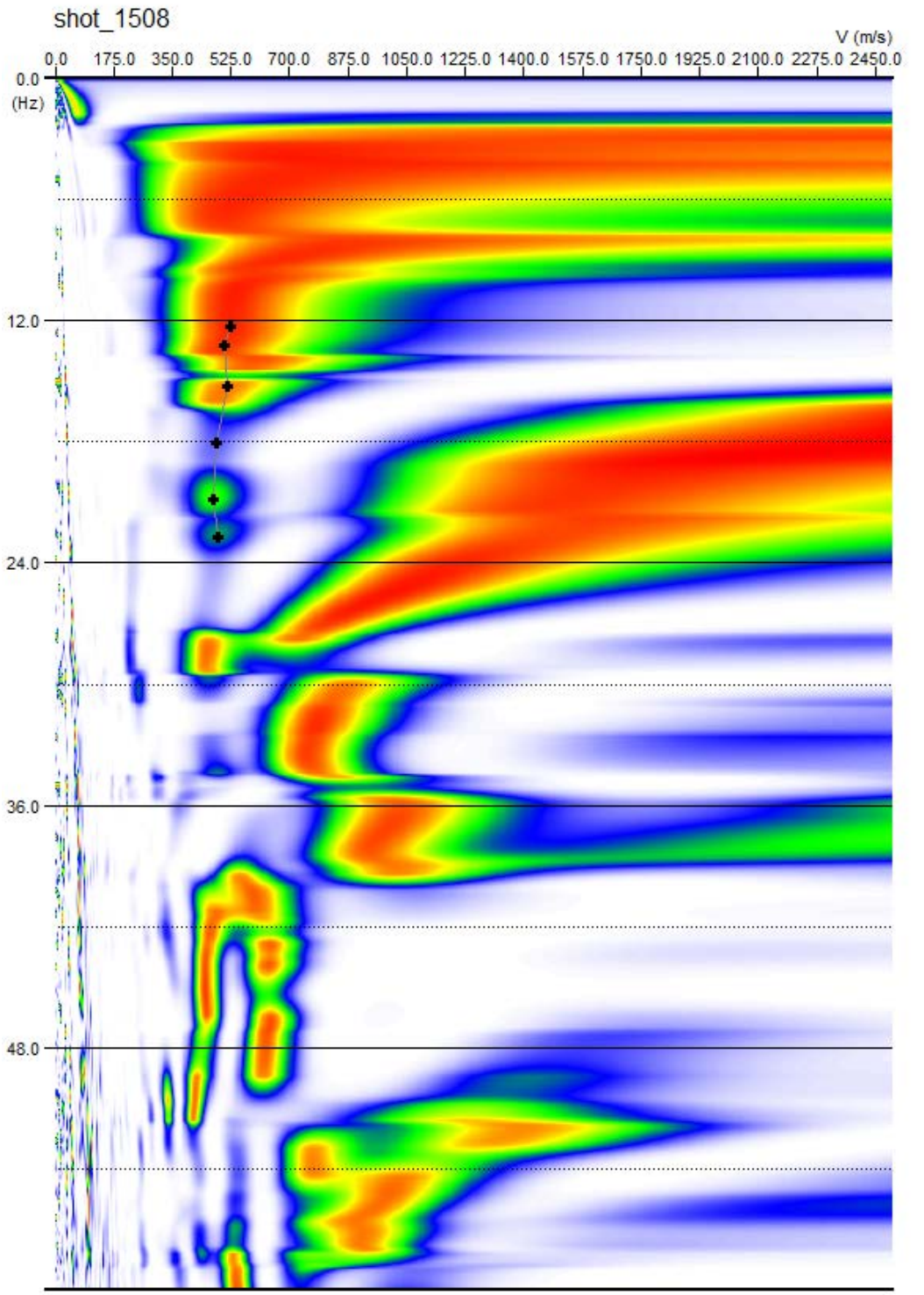

15.64 (Hz)

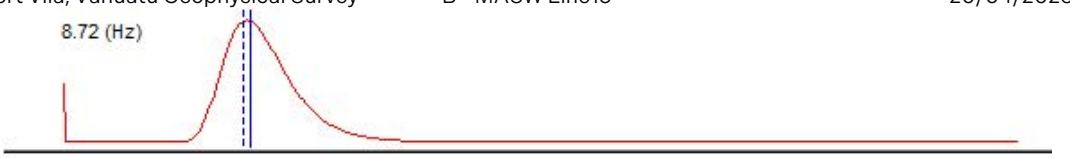

shot_1506
V (m/s)
0.0 175.0 350.0 525.0 700.0 875.0 1050.0 1225.0 1400.0 1575.0 1750.0 1925.0 2100.0 2275.0 2450.0
0.0
(Hz)
12.0
24.0
36.0
48.0

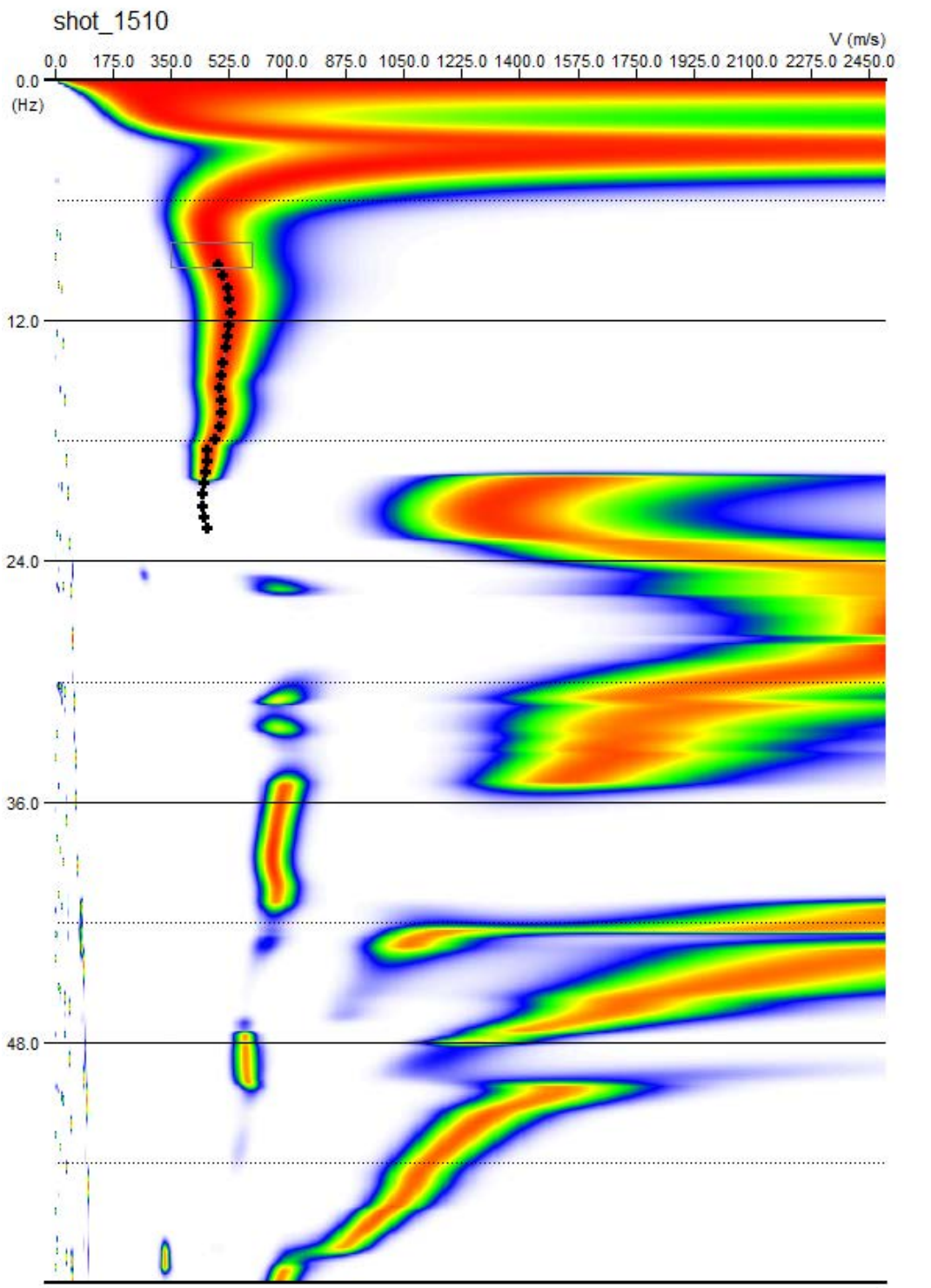

12.53 (Hz)

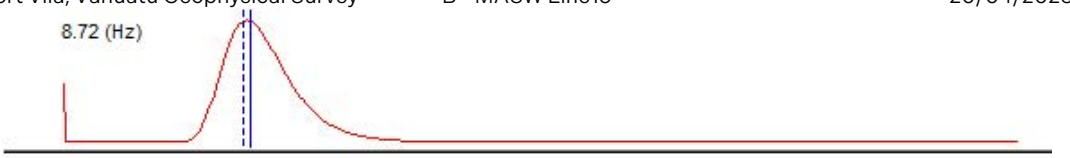

shot_1507
V (m/s)
0.0 175.0 350.0 525.0 700.0 875.0 1050.0 1225.0 1400.0 1575.0 1750.0 1925.0 2100.0 2275.0 2450.0
0.0
(Hz)
12.0
24.0
36.0
48.0

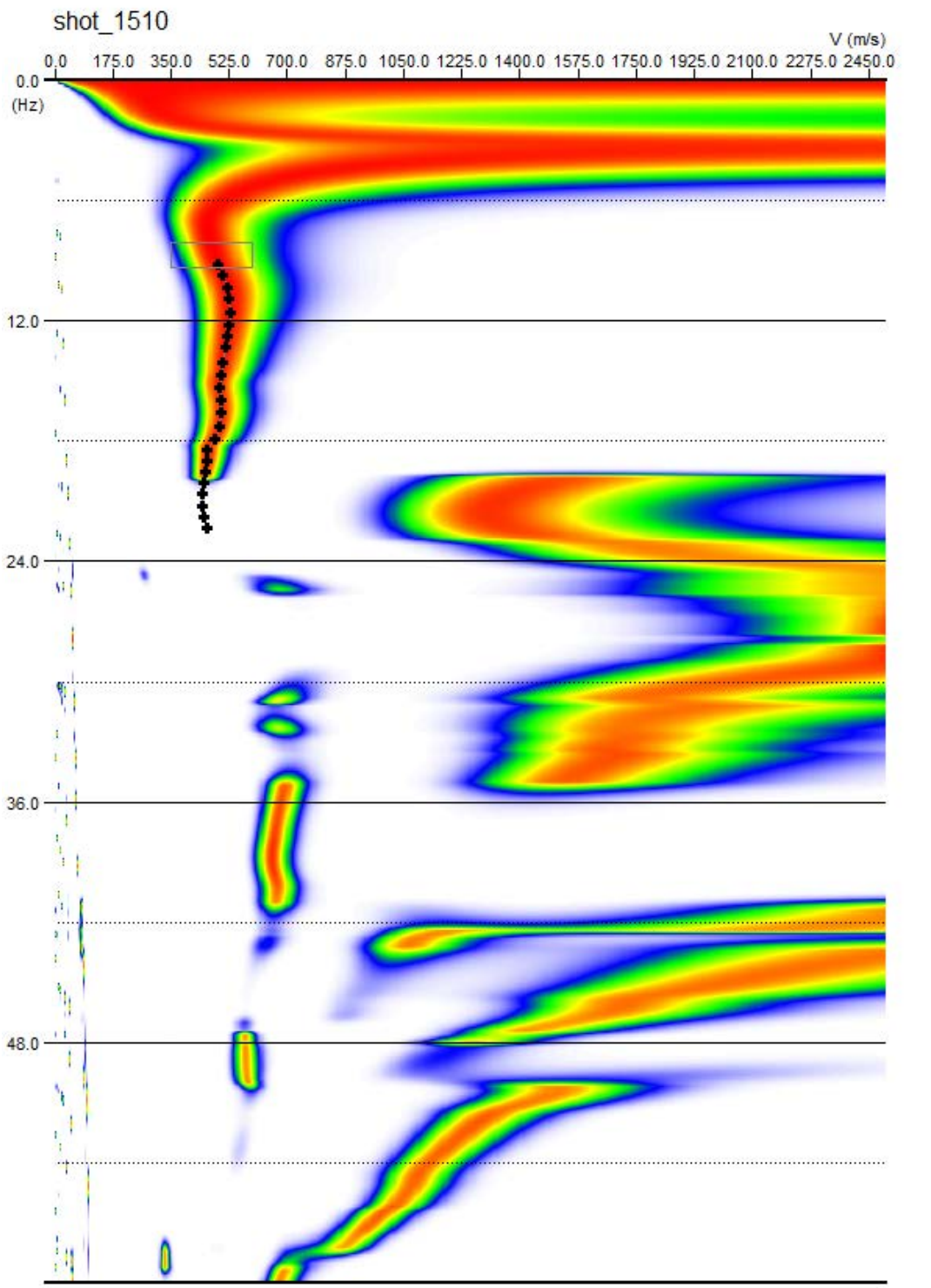


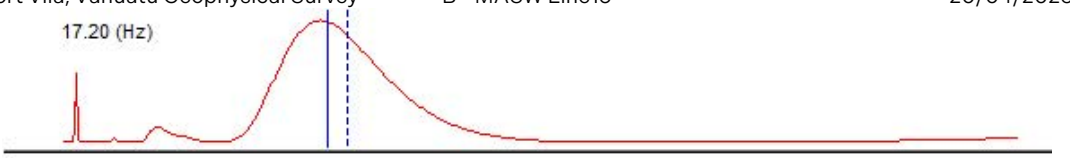

shot_1508
V (m/s)
0.0 175.0 350.0 525.0 700.0 875.0 1050.0 1225.0 1400.0 1575.0 1750.0 1925.0 2100.0 2275.0 2450.0
0.0
(Hz)
12.0
24.0
36.0
48.0

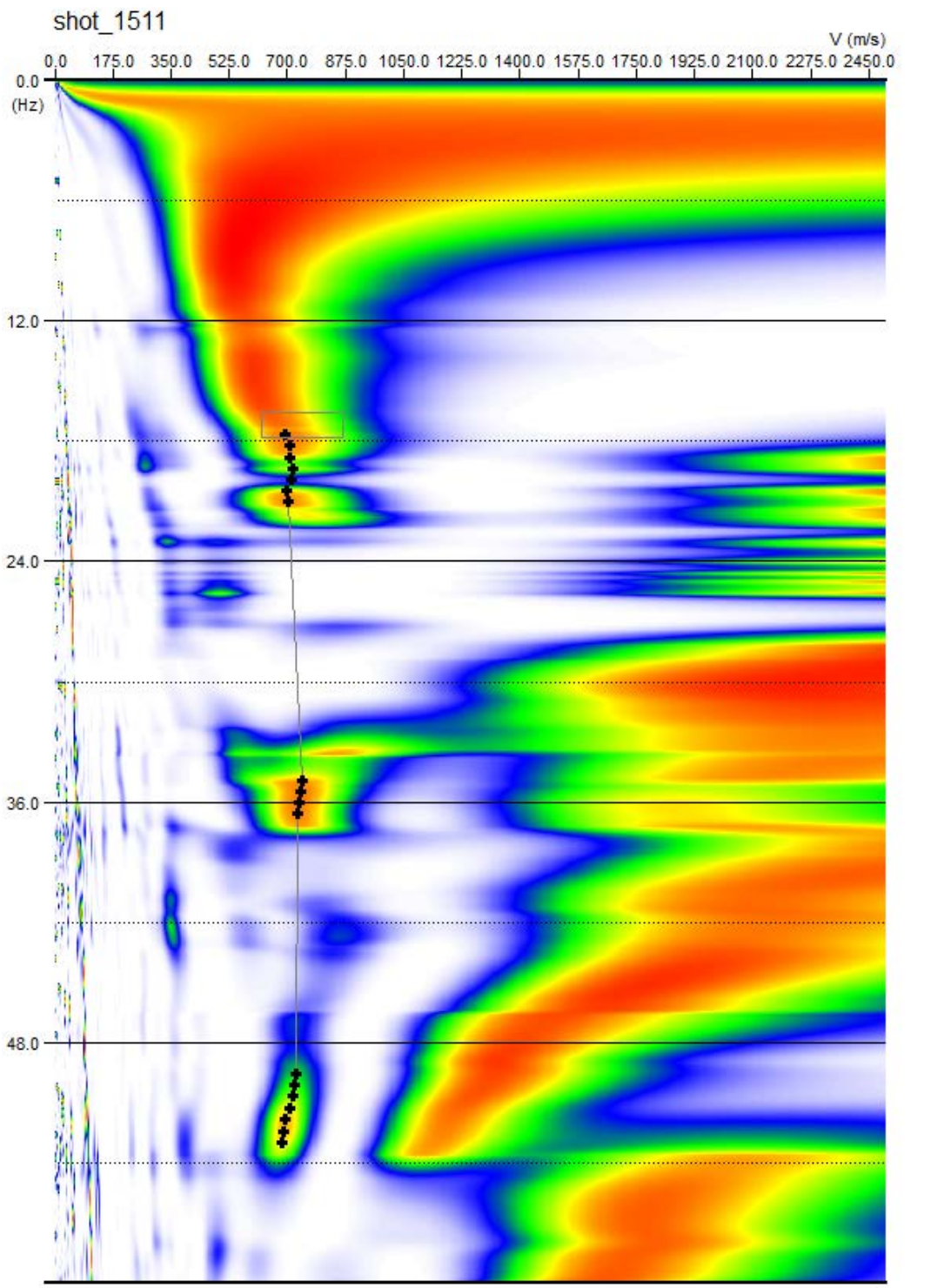

8.72 (Hz)


shot_1510
V (m/s)
0.0
175.0
350.0
525.0
700.0
875.0
1050.0
1225.0
1400.0
1575.0
1750.0
1925.0
2100.0
2275.0
2450.0
0.0
(Hz)
12.0
24.0
36.0
48.0

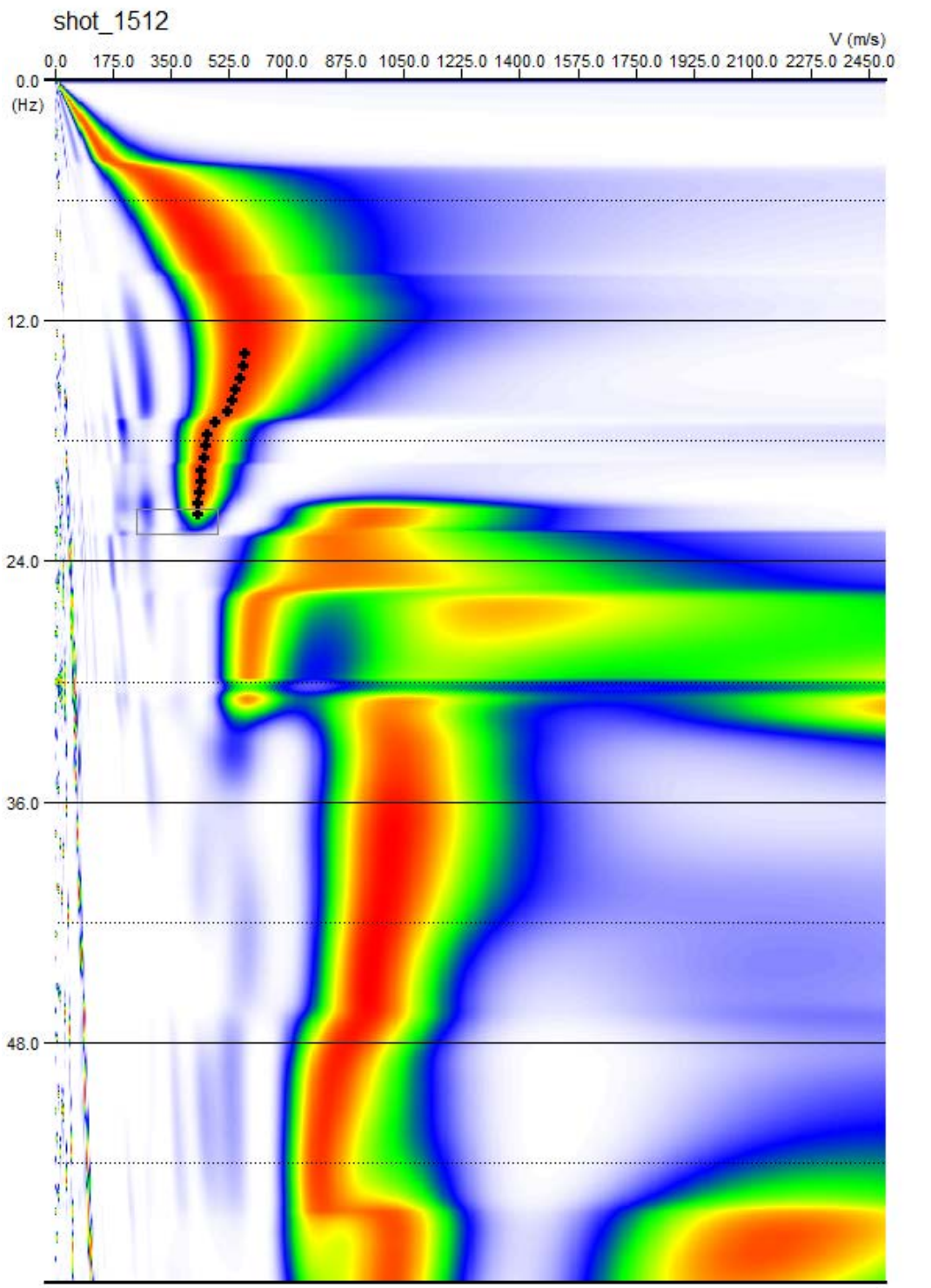

8.72 (Hz)

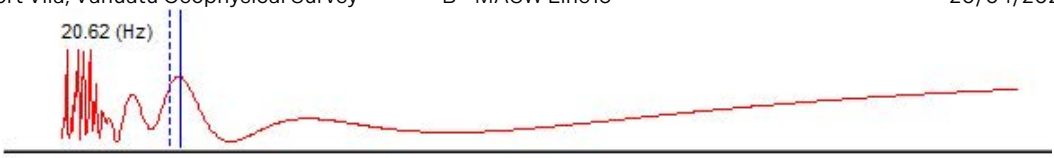

shot_1510
V (m/s)
0.0
175.0
350.0
525.0
700.0
875.0
1050.0
1225.0
1400.0
1575.0
1750.0
1925.0
2100.0
2275.0
2450.0
0.0
(Hz)
12.0
24.0
36.0
48.0

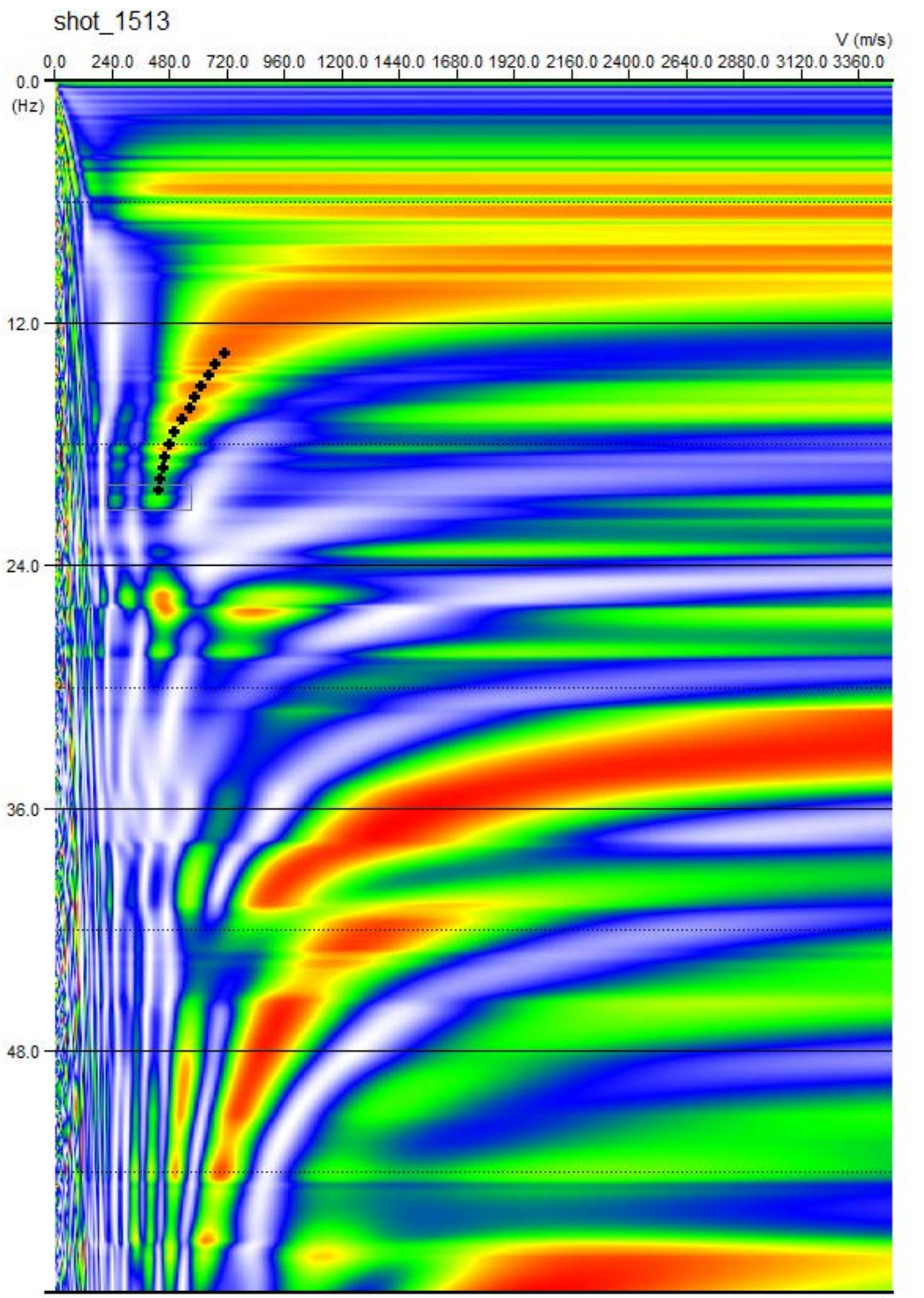

17.20 (Hz)

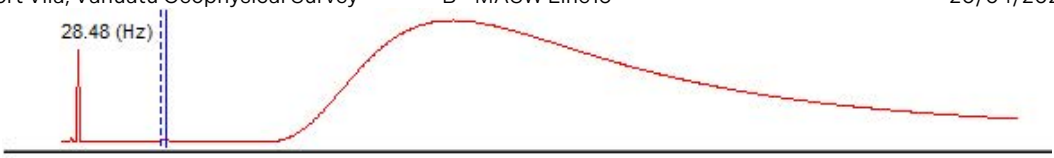

shot_1511
V (m/s)
0.0 175.0 350.0 525.0 700.0 875.0 1050.0 1225.0 1400.0 1575.0 1750.0 1925.0 2100.0 2275.0 2450.0
0.0
(Hz)
12.0
24.0
36.0
48.0

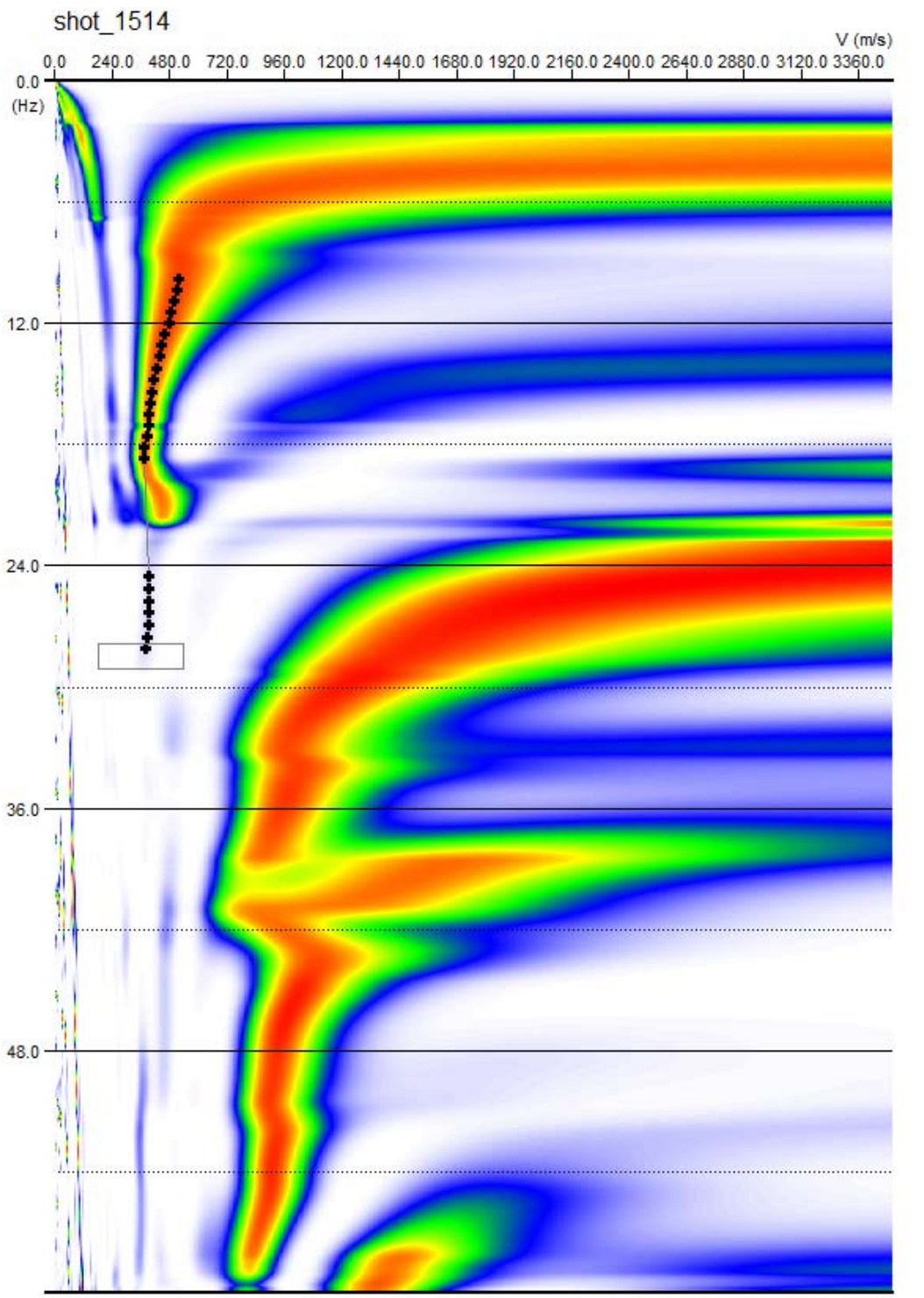

22.02 (Hz)

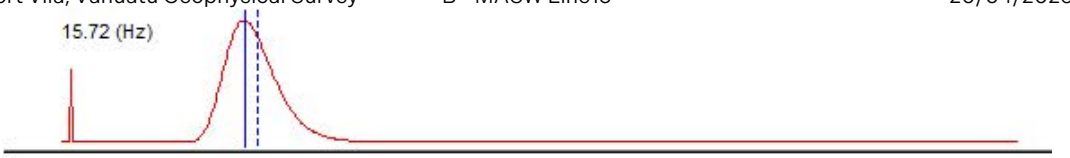

shot_1512
V (m/s)
0.0 175.0 350.0 525.0 700.0 875.0 1050.0 1225.0 1400.0 1575.0 1750.0 1925.0 2100.0 2275.0 2450.0
0.0
(Hz)
12.0
24.0
36.0
48.0

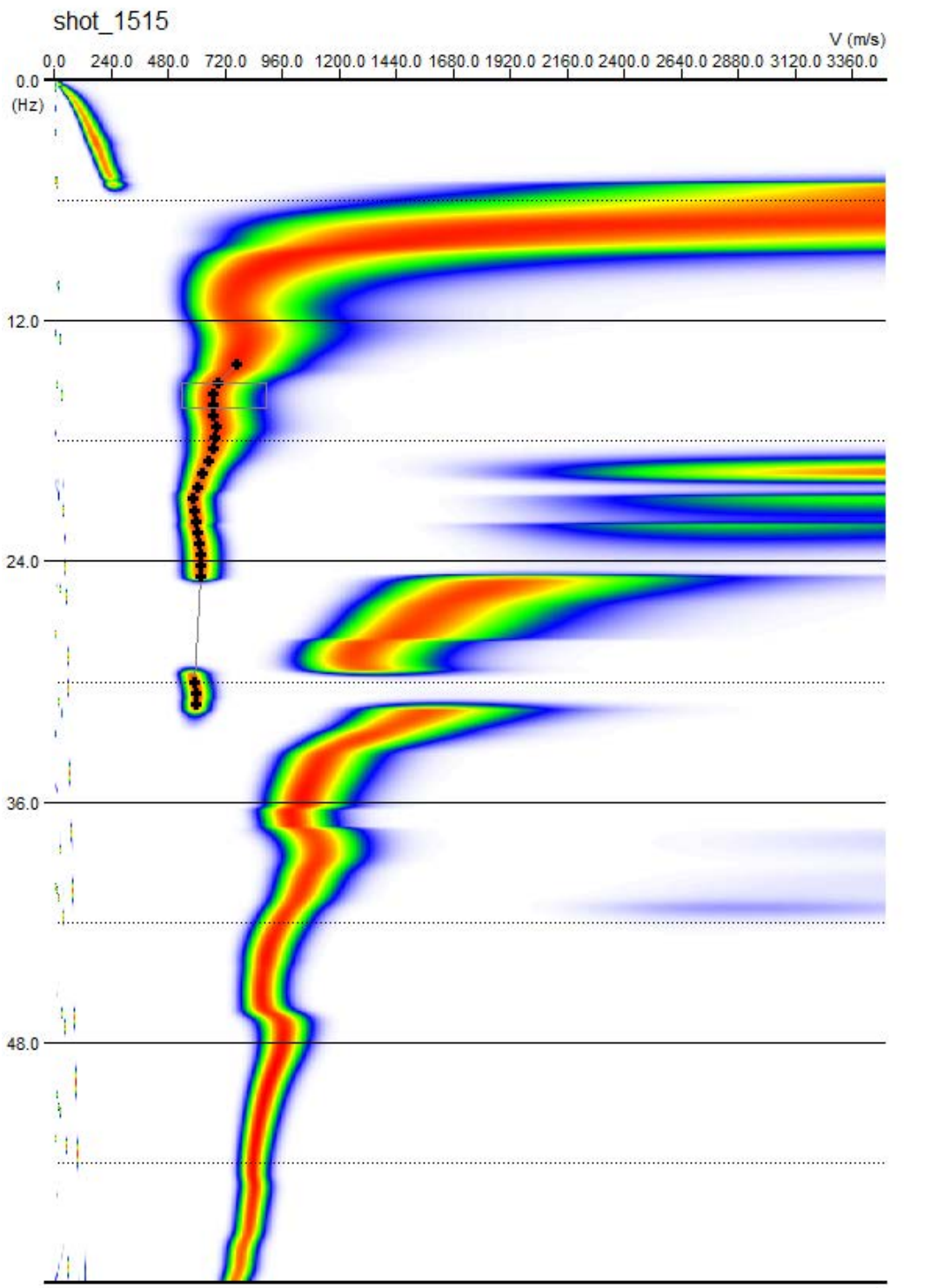

20.62 (Hz)

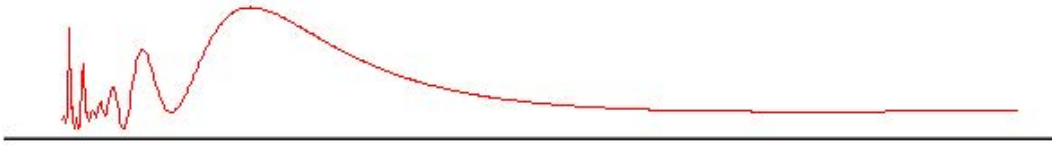

shot_1513
V (m/s)
0.0 240.0 480.0 720.0 960.0 1200.0 1440.0 1680.0 1920.0 2160.0 2400.0 2640.0 2880.0 3120.0 3360.0
0.0
(Hz)
12.0
24.0
36.0
48.0

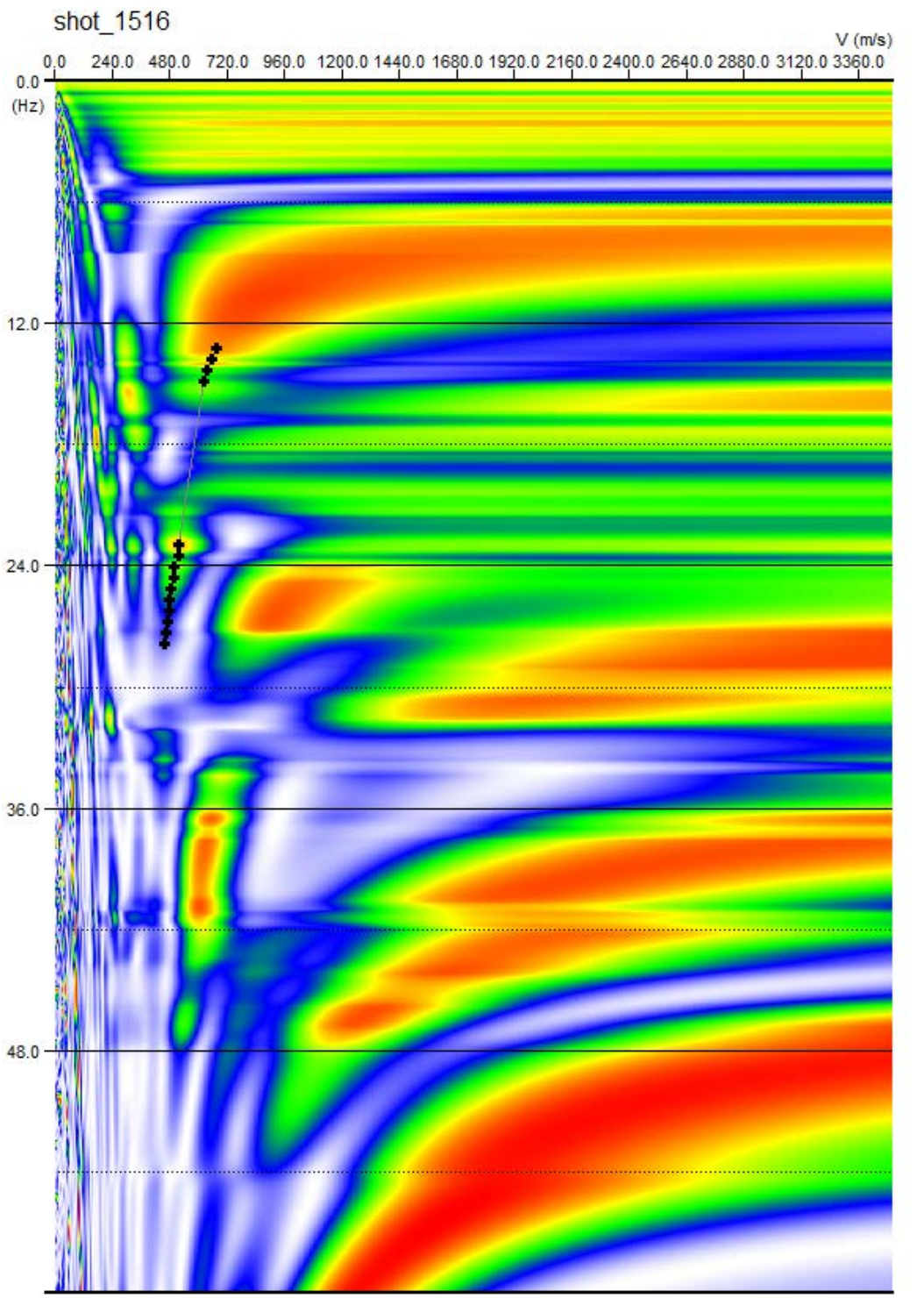

28.48 (Hz)

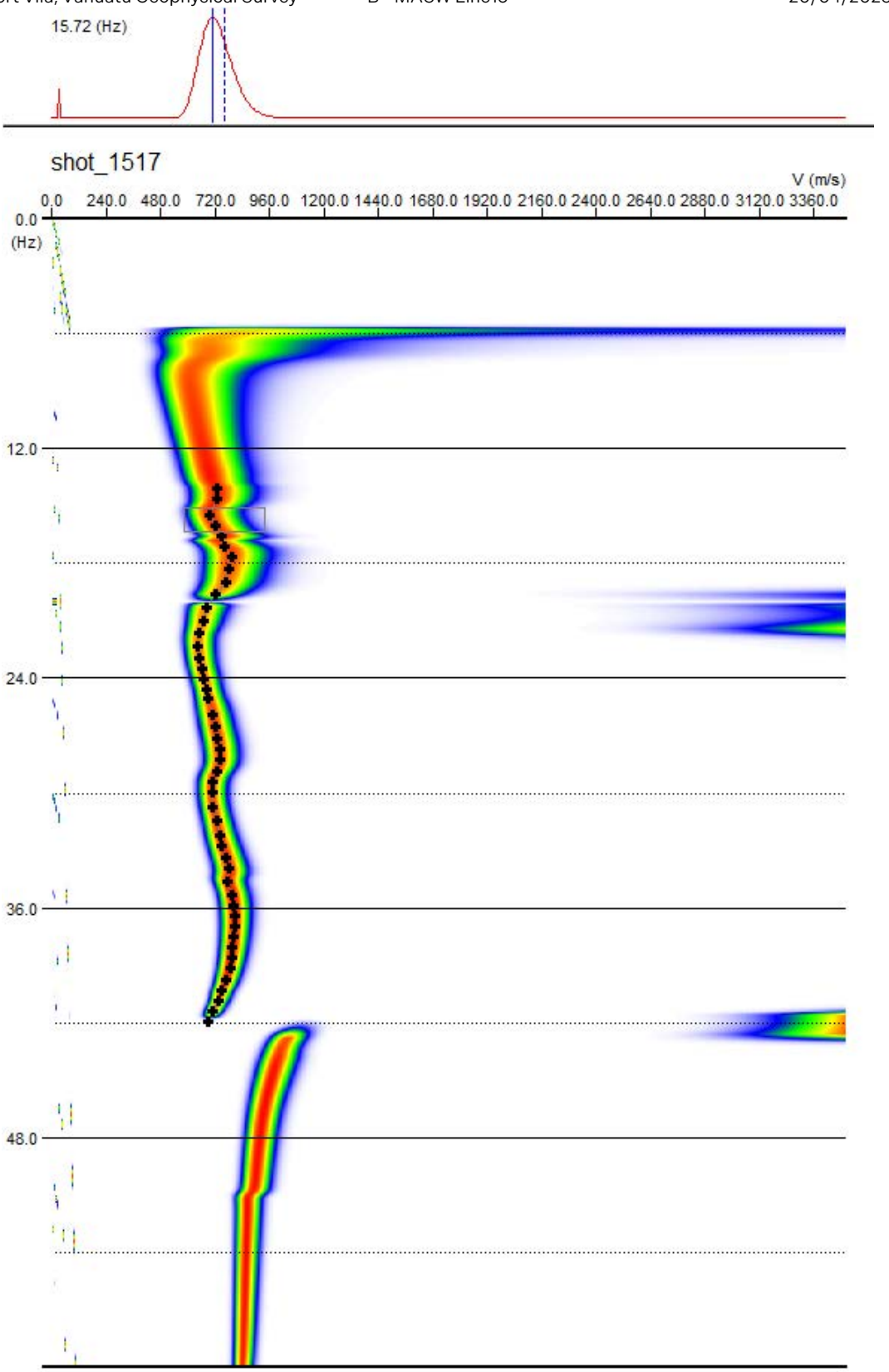

shot_1514
V (m/s)
0.0 240.0 480.0 720.0 960.0 1200.0 1440.0 1680.0 1920.0 2160.0 2400.0 2640.0 2880.0 3120.0 3360.0
0.0
(Hz)
12.0
24.0
36.0
48.0

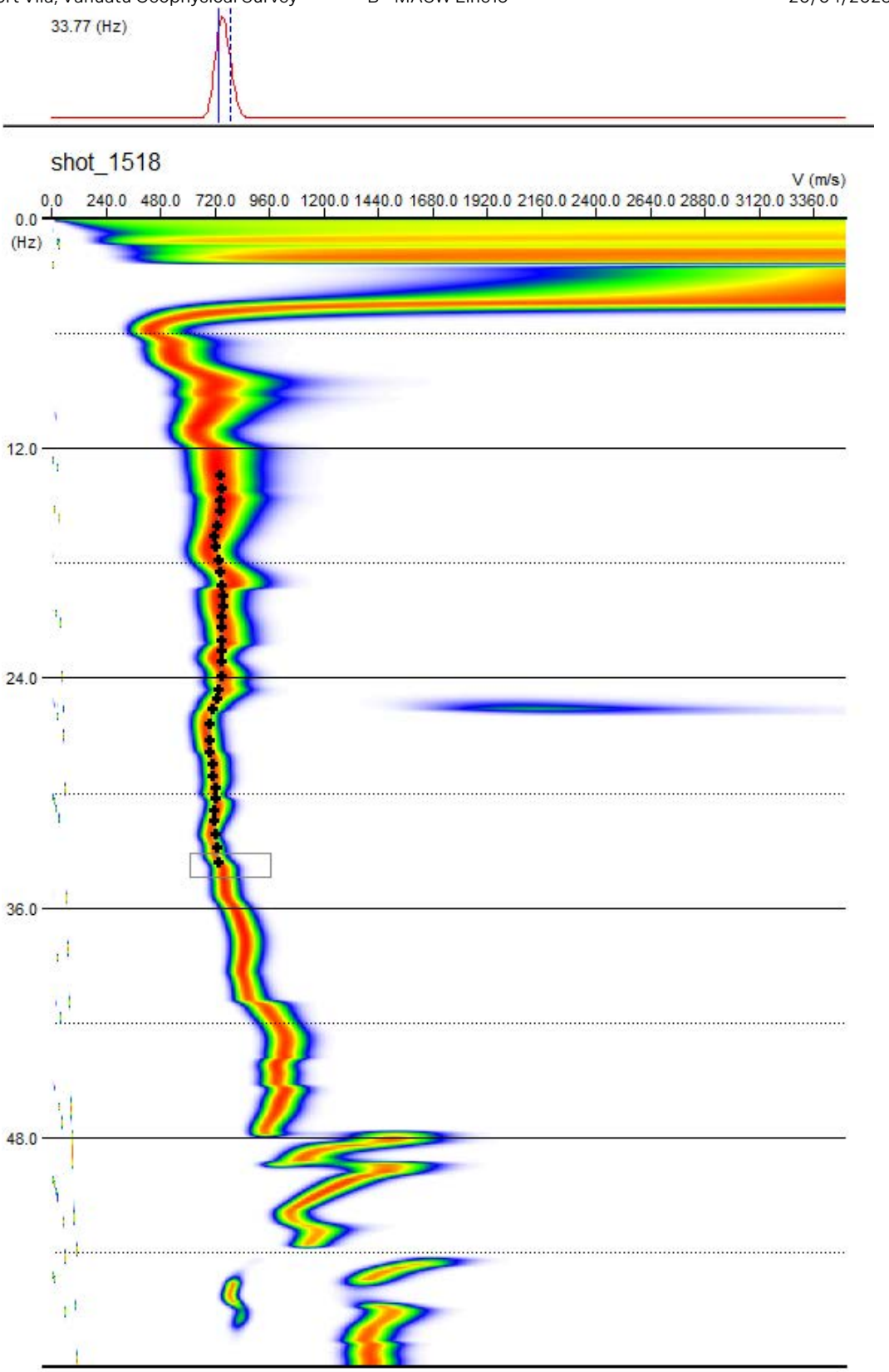

15.72 (Hz)

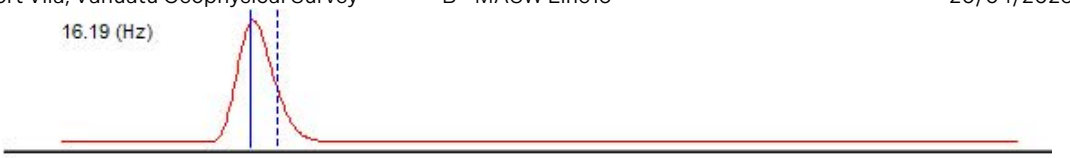

shot_1515
V (m/s)
0.0 240.0 480.0 720.0 960.0 1200.0 1440.0 1680.0 1920.0 2160.0 2400.0 2640.0 2880.0 3120.0 3360.0
0.0
(Hz)
12.0
24.0
36.0
48.0

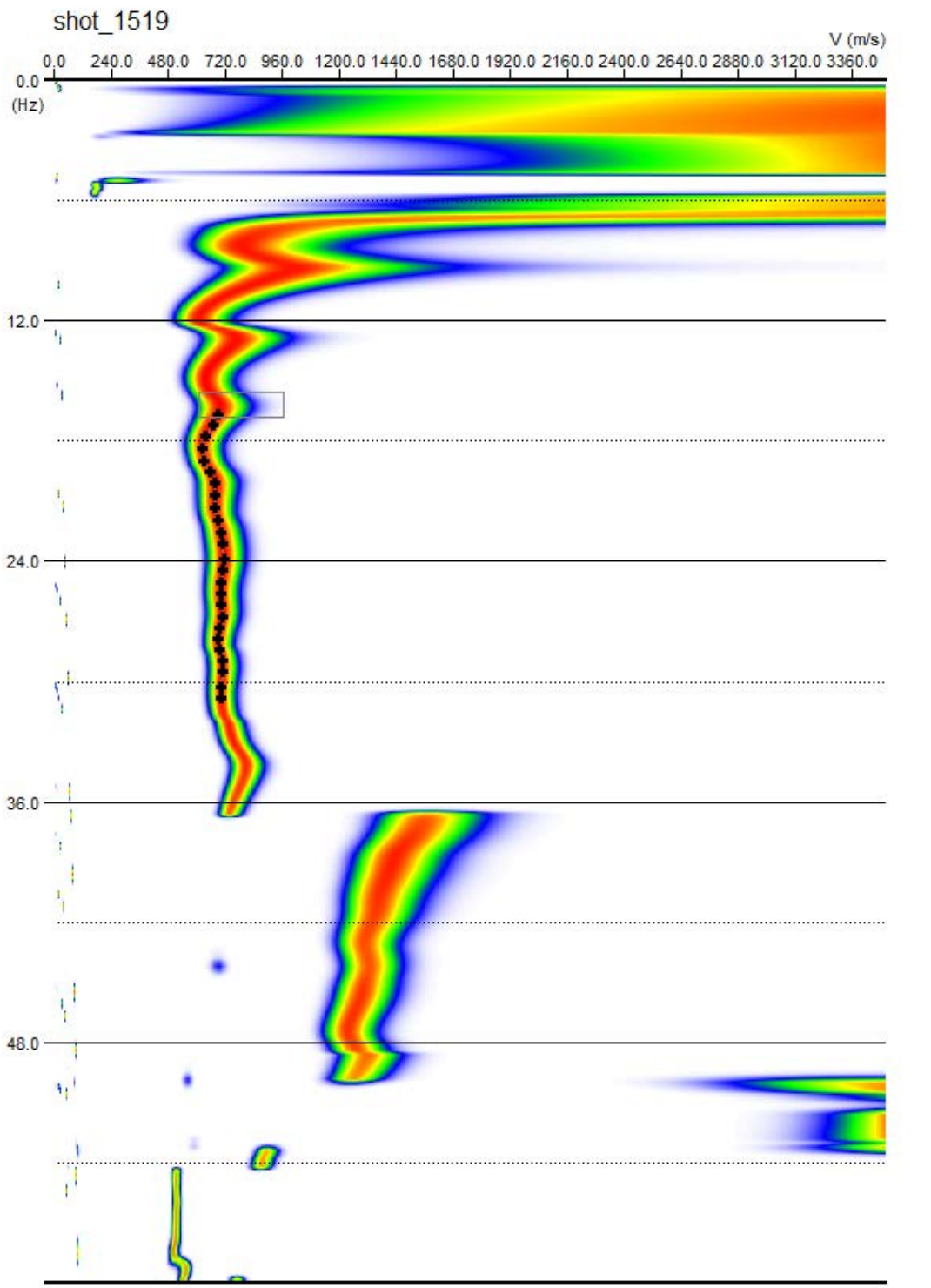


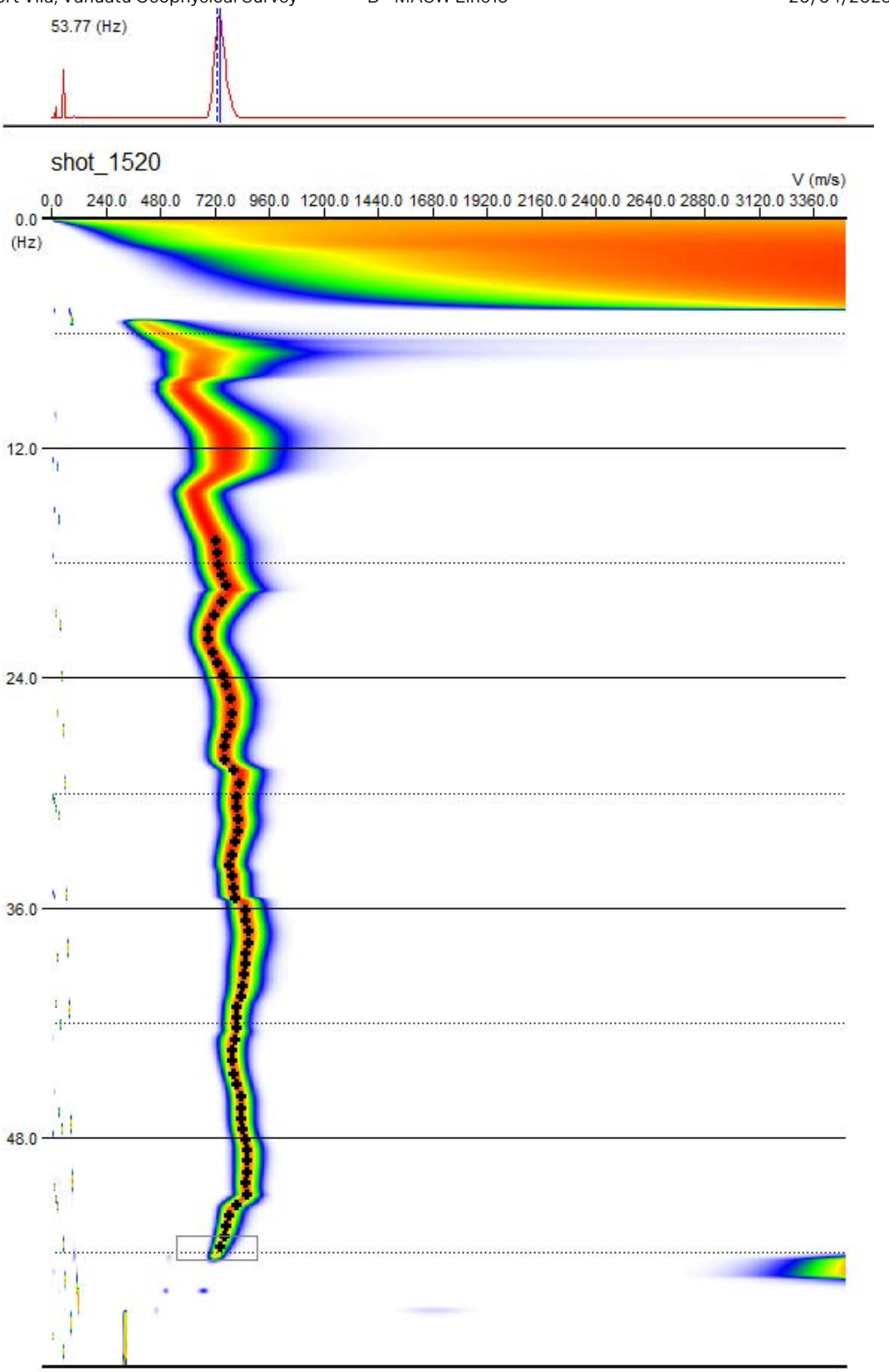

shot_1516
V (m/s)
0.0 240.0 480.0 720.0 960.0 1200.0 1440.0 1680.0 1920.0 2160.0 2400.0 2640.0 2880.0 3120.0 3360.0
0.0
(Hz)
12.0
24.0
36.0
48.0

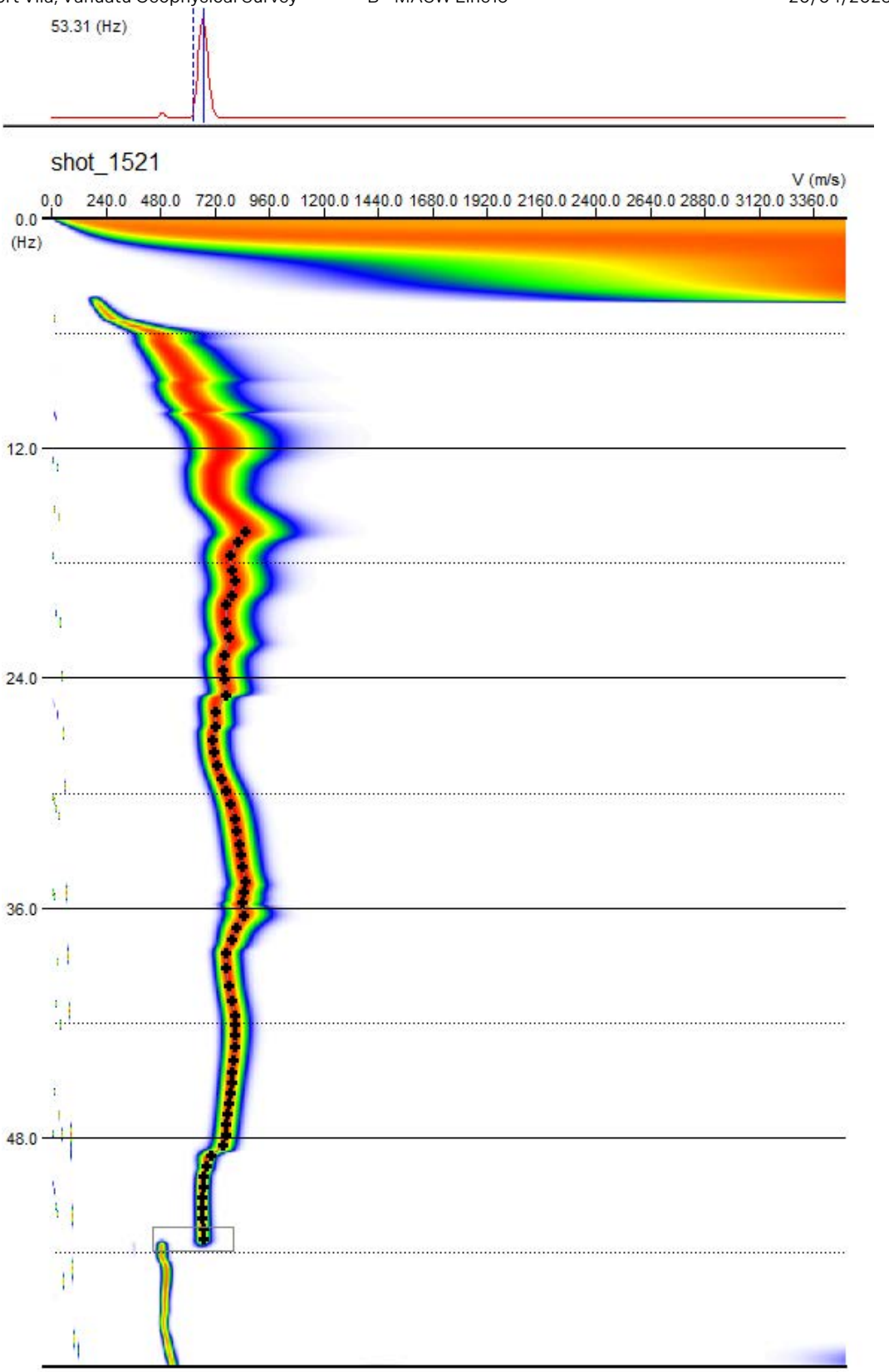

15.72 (Hz)
shot_1517
V (m/s)
0.0 240.0 480.0 720.0 960.0 1200.0 1440.0 1680.0 1920.0 2160.0 2400.0 2640.0 2880.0 3120.0 3360.0
0.0
(Hz)
12.0
24.0
36.0
48.0

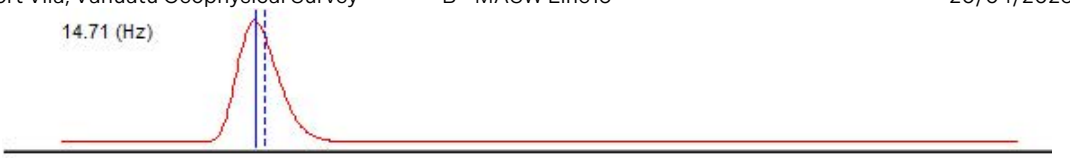

33.77 (Hz)
shot_1518
V (m/s)
0.0 240.0 480.0 720.0 960.0 1200.0 1440.0 1680.0 1920.0 2160.0 2400.0 2640.0 2880.0 3120.0 3360.0
0.0
(Hz)
12.0
24.0
36.0
48.0

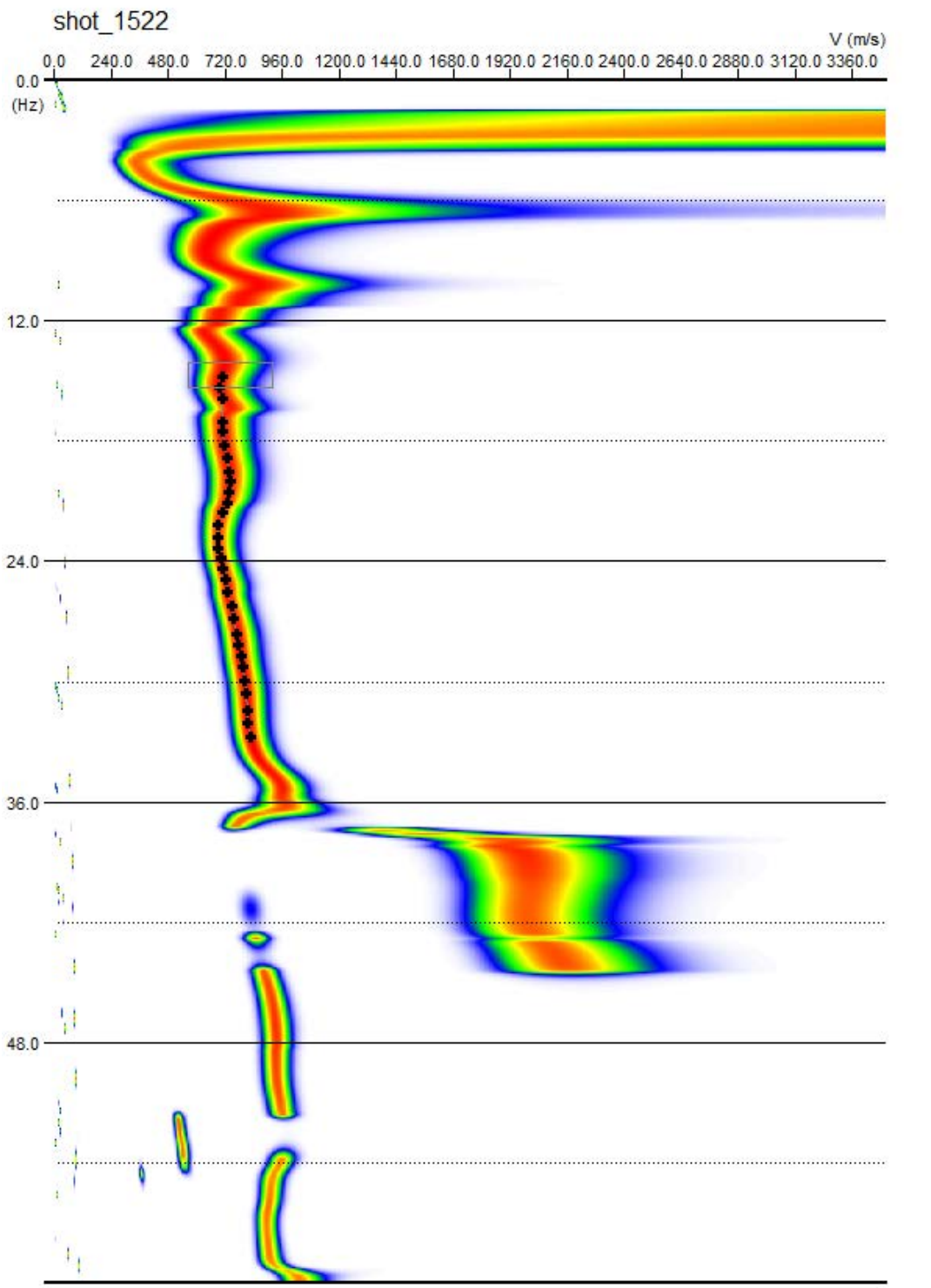

16.19 (Hz)


shot_1519
V (m/s)
0.0 240.0 480.0 720.0 960.0 1200.0 1440.0 1680.0 1920.0 2160.0 2400.0 2640.0 2880.0 3120.0 3360.0
0.0
(Hz)
12.0
24.0
36.0
48.0

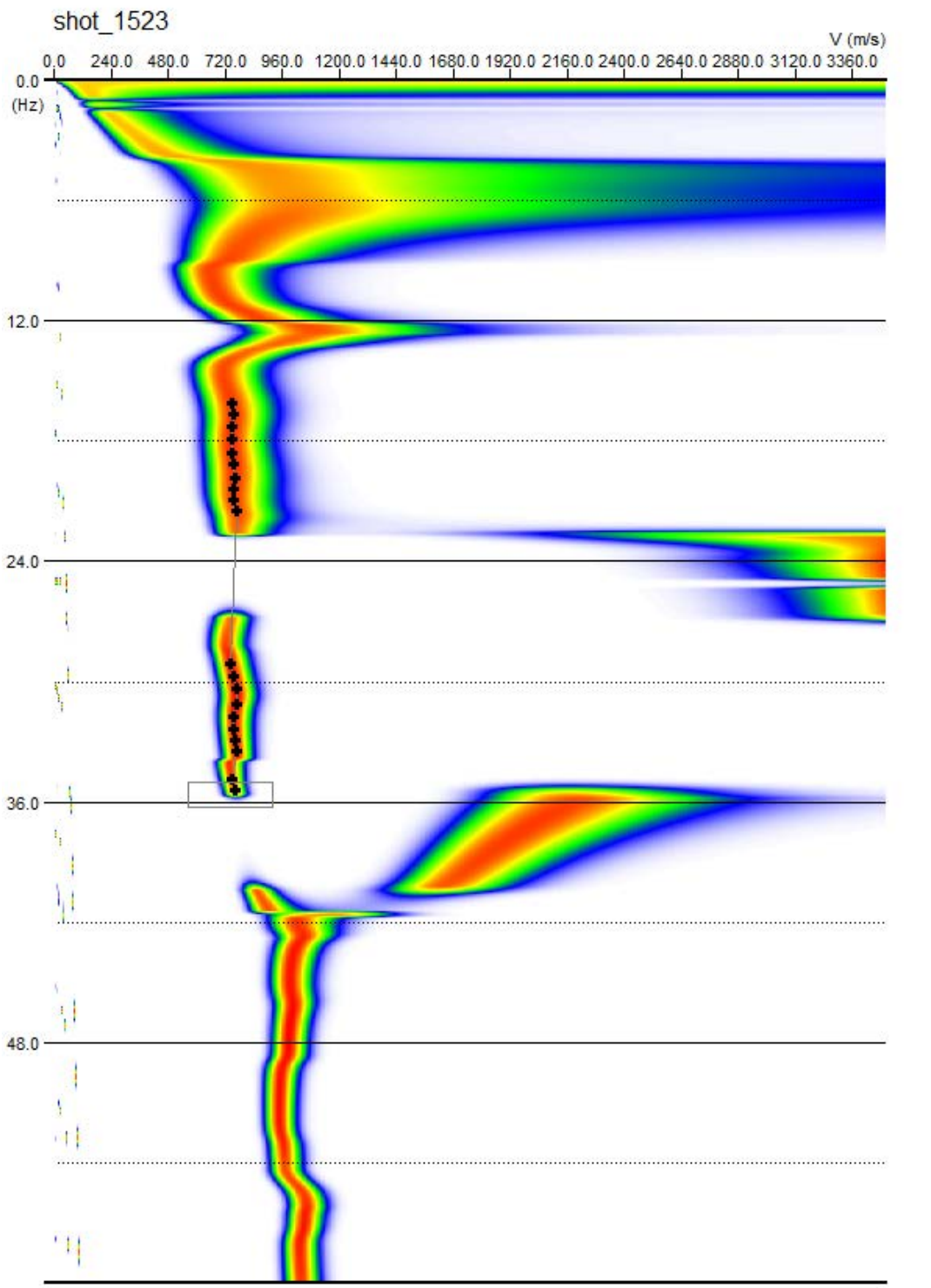

53.77 (Hz)
shot_1520
V (m/s)
0.0 240.0 480.0 720.0 960.0 1200.0 1440.0 1680.0 1920.0 2160.0 2400.0 2640.0 2880.0 3120.0 3360.0
0.0
(Hz)
12.0
24.0
36.0
48.0

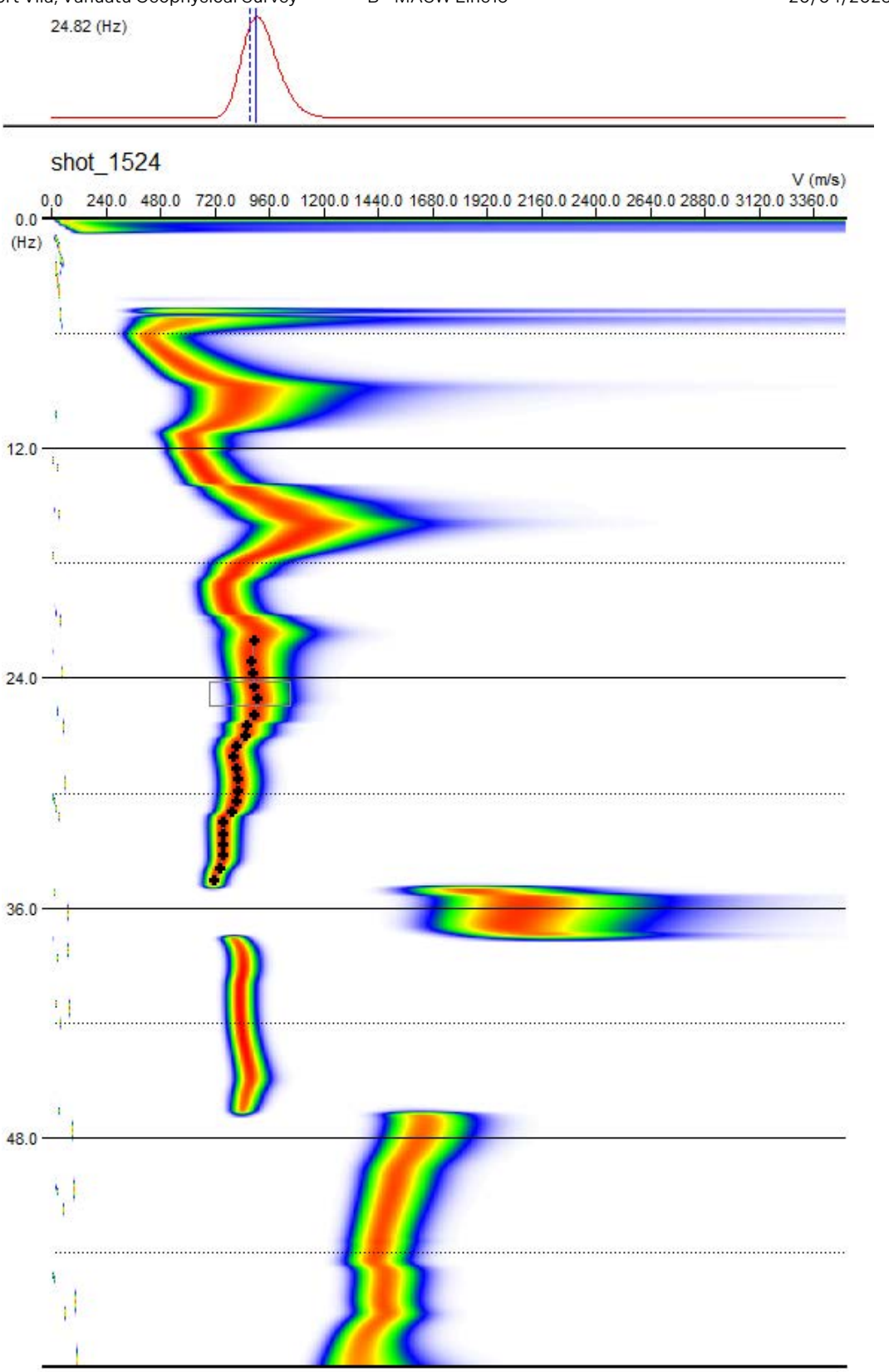

53.31 (Hz)
shot_1521
V (m/s)
0.0 240.0 480.0 720.0 960.0 1200.0 1440.0 1680.0 1920.0 2160.0 2400.0 2640.0 2880.0 3120.0 3360.0
0.0
(Hz)
12.0
24.0
36.0
48.0

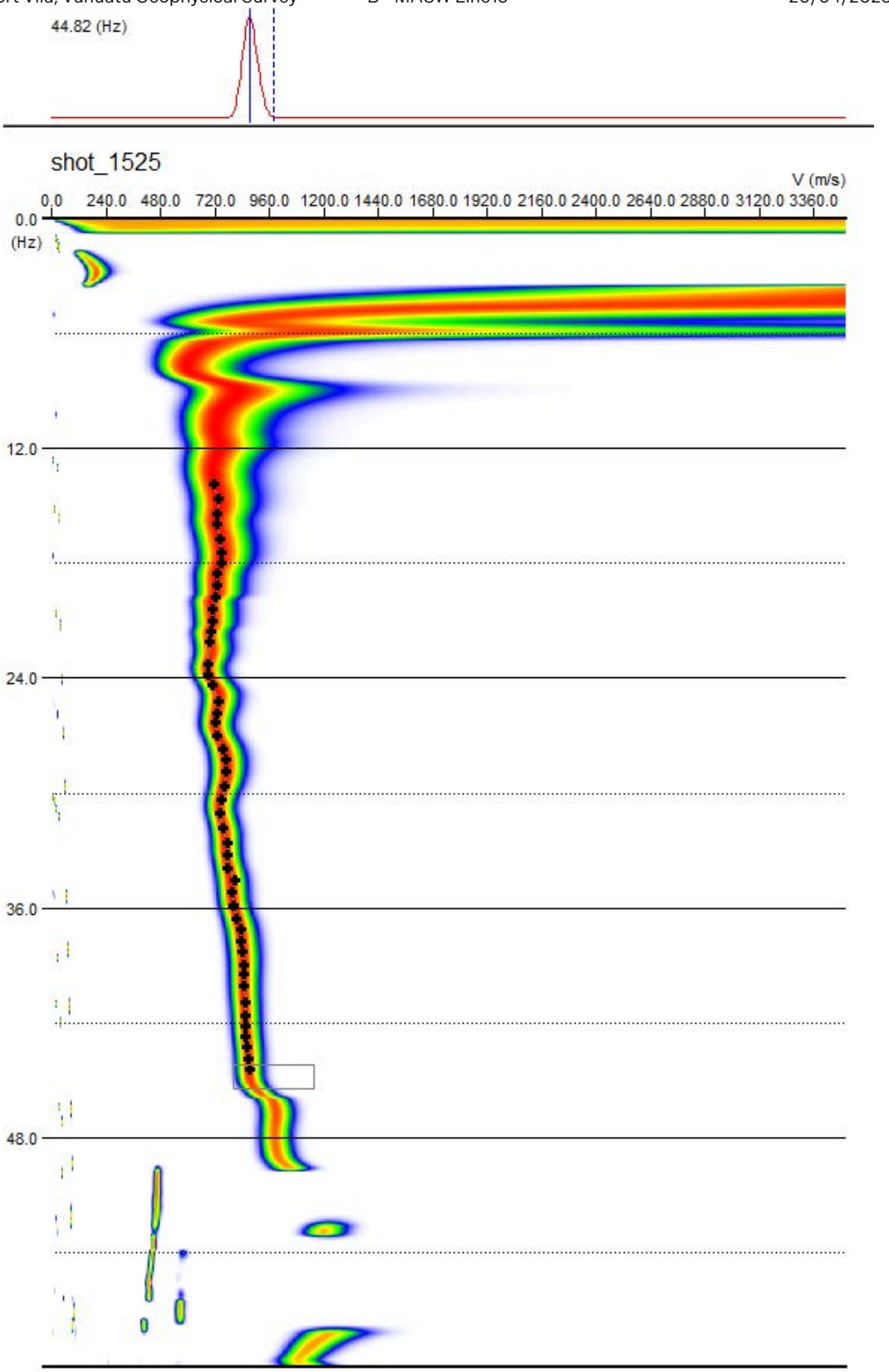

14.71 (Hz)

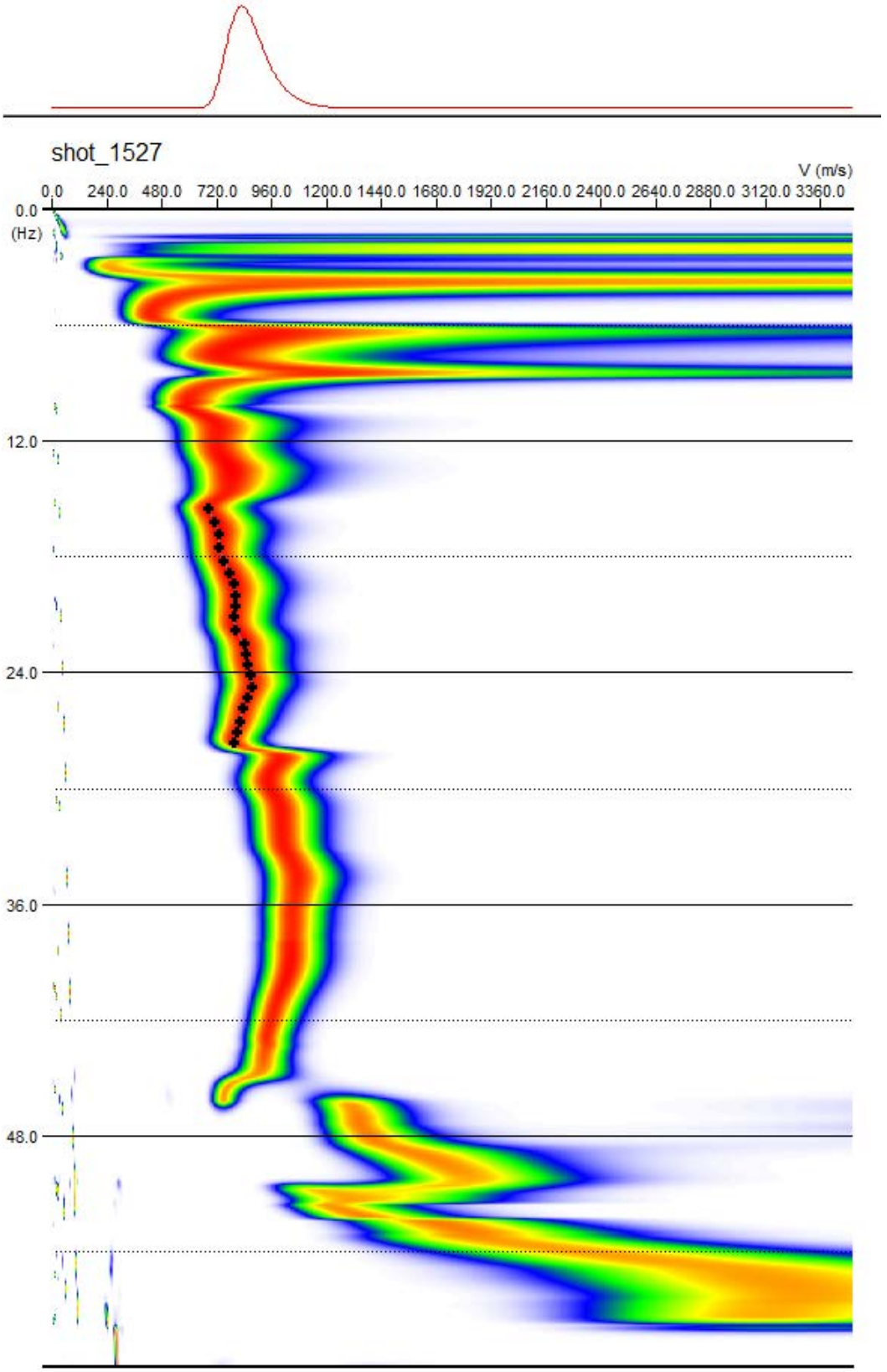

shot_1522
V (m/s)
0.0 240.0 480.0 720.0 960.0 1200.0 1440.0 1680.0 1920.0 2160.0 2400.0 2640.0 2880.0 3120.0 3360.0
0.0
(Hz)
12.0
24.0
36.0
48.0

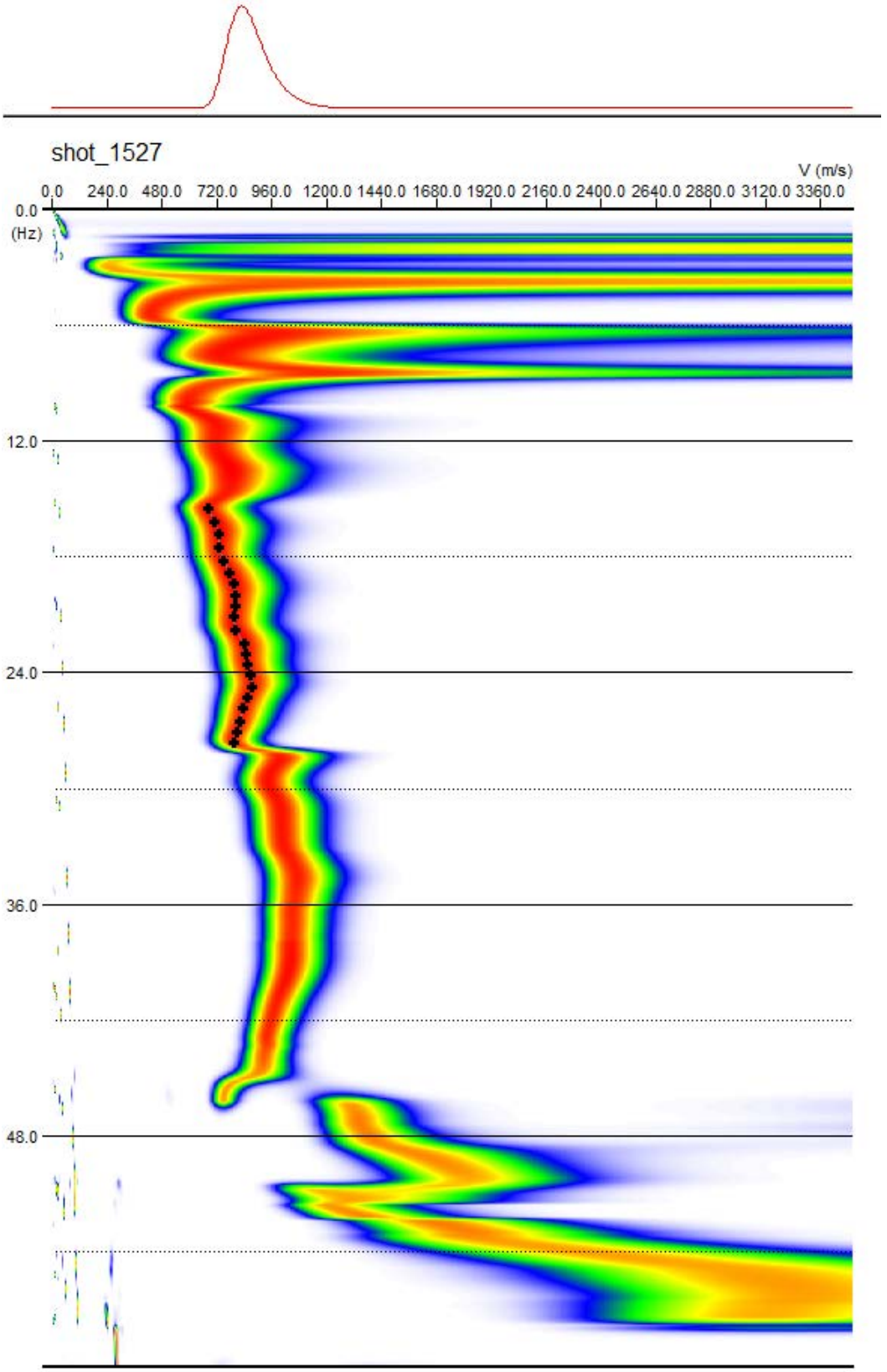

35.64 (Hz)


shot_1523
V (m/s)
0.0 240.0 480.0 720.0 960.0 1200.0 1440.0 1680.0 1920.0 2160.0 2400.0 2640.0 2880.0 3120.0 3360.0
0.0
(Hz)
12.0
24.0
36.0
48.0

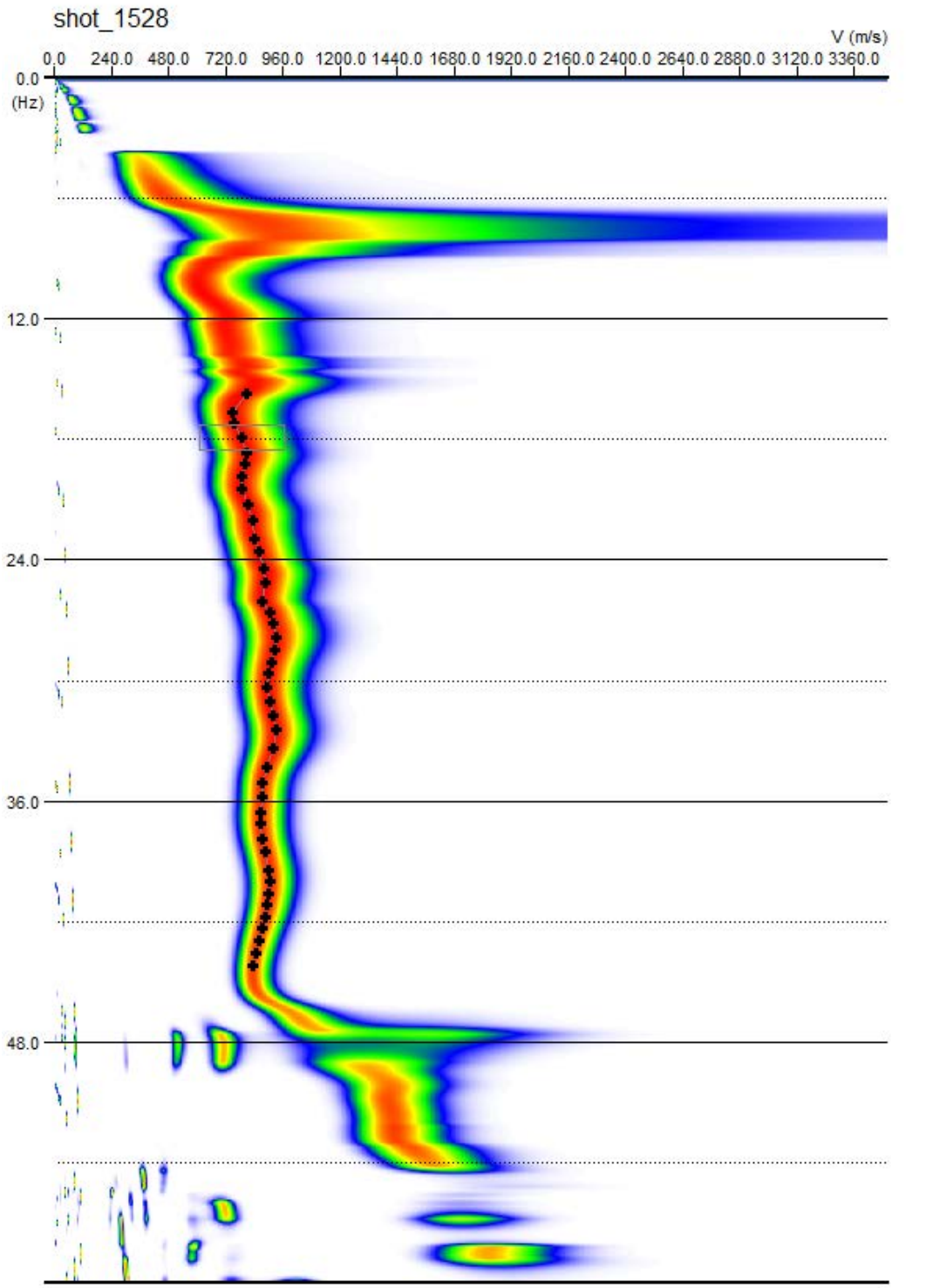

24.82 (Hz)
shot_1524
V (m/s)
0.0 240.0 480.0 720.0 960.0 1200.0 1440.0 1680.0 1920.0 2160.0 2400.0 2640.0 2880.0 3120.0 3360.0
0.0
(Hz)
12.0
24.0
36.0
48.0

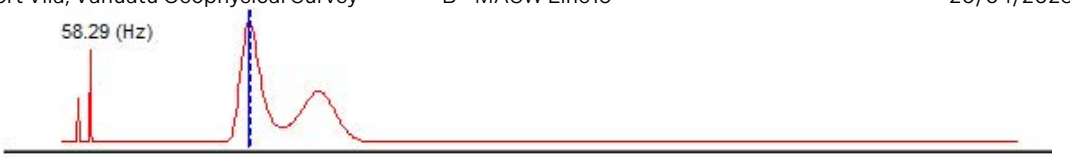

44.82 (Hz)
shot_1525
V (m/s)
0.0 240.0 480.0 720.0 960.0 1200.0 1440.0 1680.0 1920.0 2160.0 2400.0 2640.0 2880.0 3120.0 3360.0
0.0
(Hz)
12.0
24.0
36.0
48.0

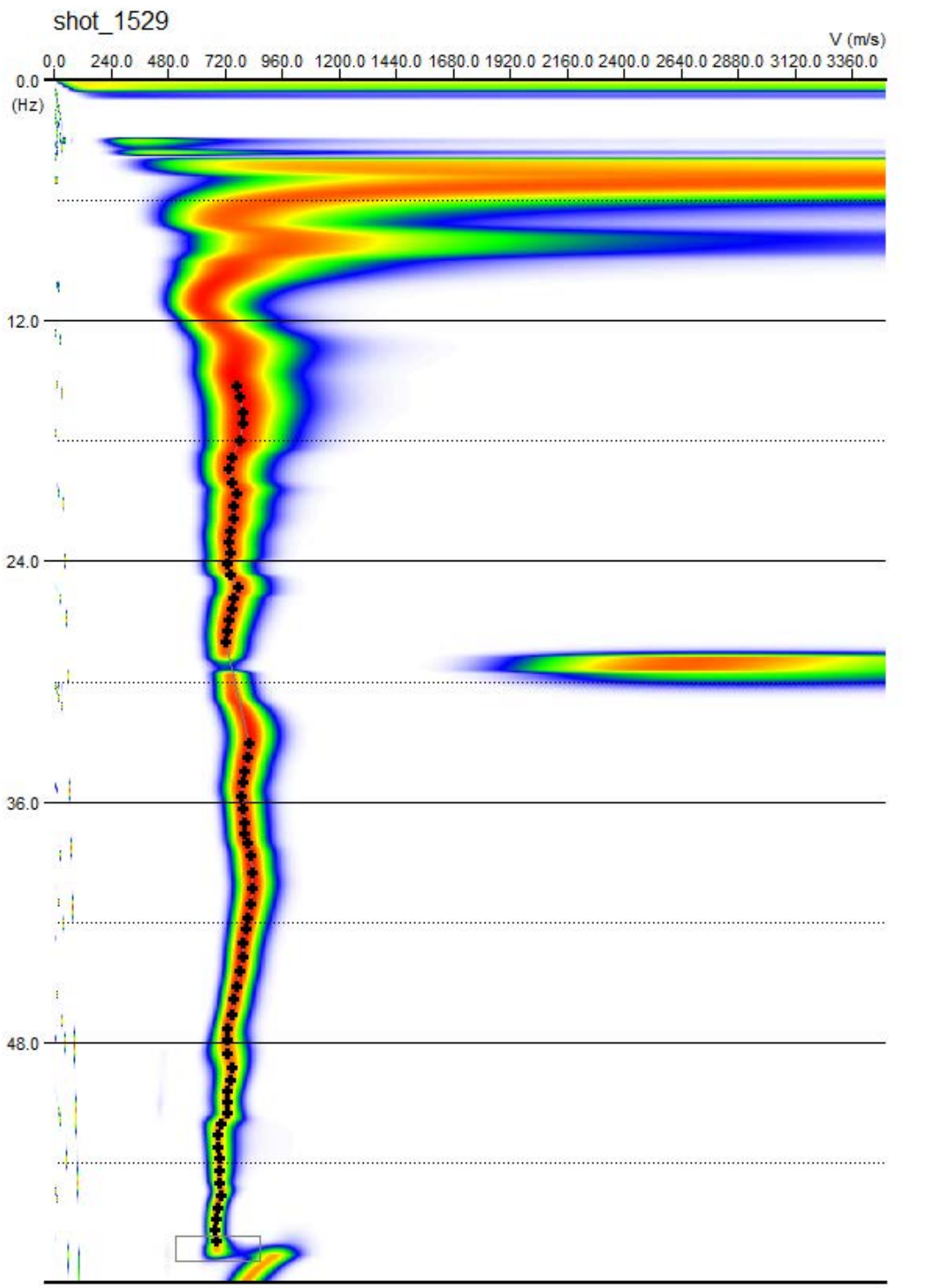

shot_1527
V (m/s)
0.0 240.0 480.0 720.0 960.0 1200.0 1440.0 1680.0 1920.0 2160.0 2400.0 2640.0 2880.0 3120.0 3360.0
0.0
(Hz)
12.0
24.0
36.0
48.0

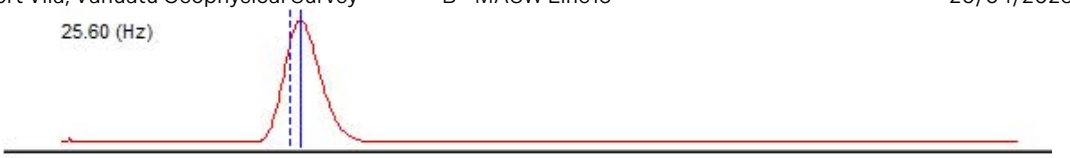

shot_1527
V (m/s)
0.0 240.0 480.0 720.0 960.0 1200.0 1440.0 1680.0 1920.0 2160.0 2400.0 2640.0 2880.0 3120.0 3360.0
0.0
(Hz)
12.0
24.0
36.0
48.0

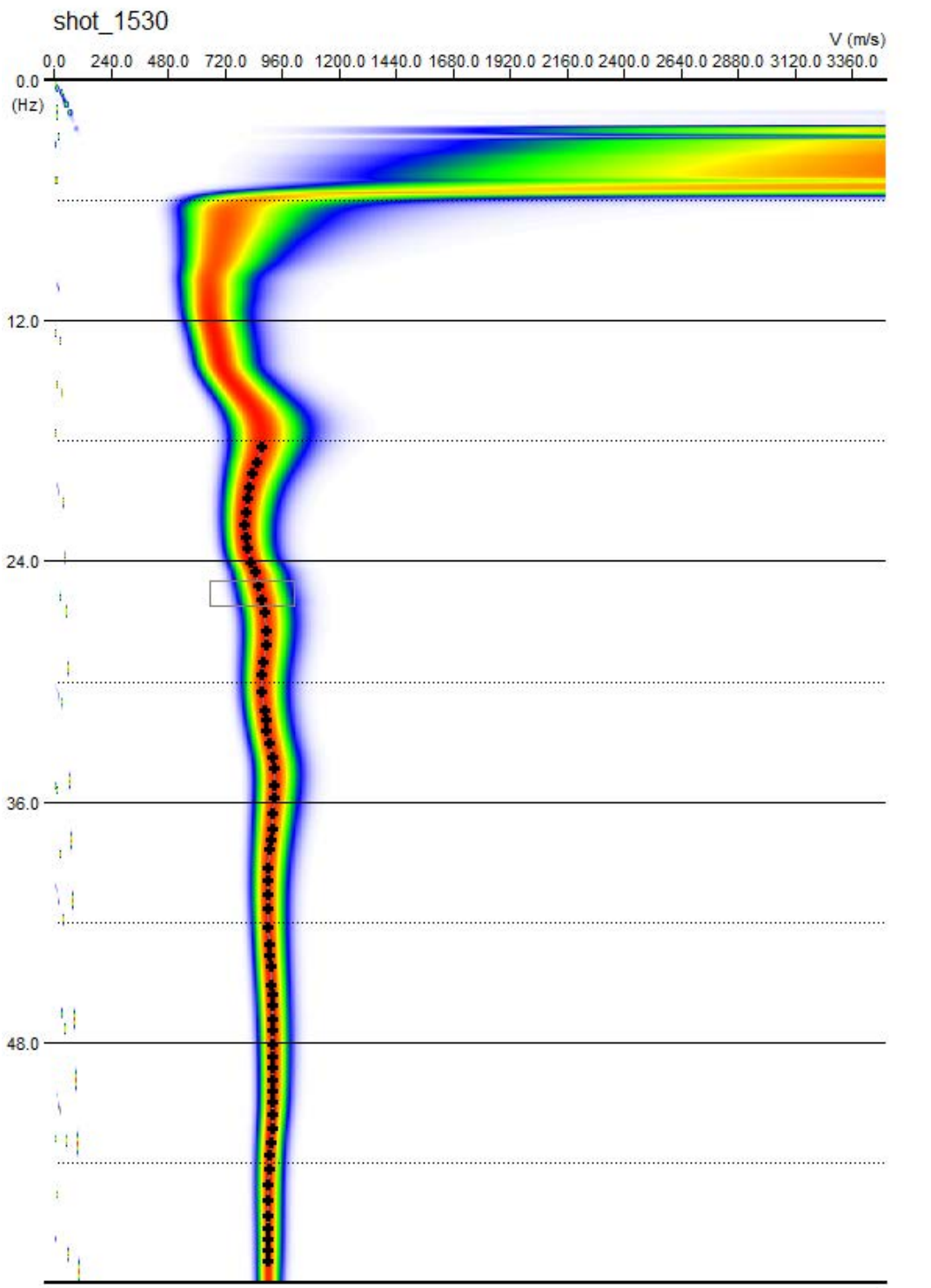

17.90 (Hz)

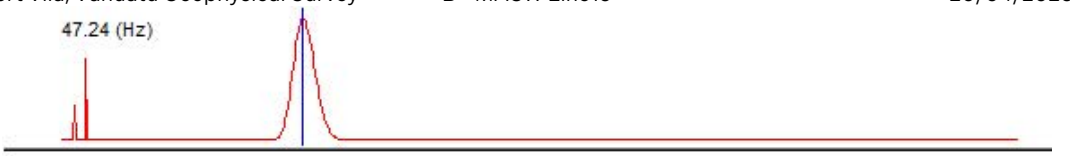

shot_1528
V (m/s)
0.0 240.0 480.0 720.0 960.0 1200.0 1440.0 1680.0 1920.0 2160.0 2400.0 2640.0 2880.0 3120.0 3360.0
0.0
(Hz)
12.0
24.0
36.0
48.0

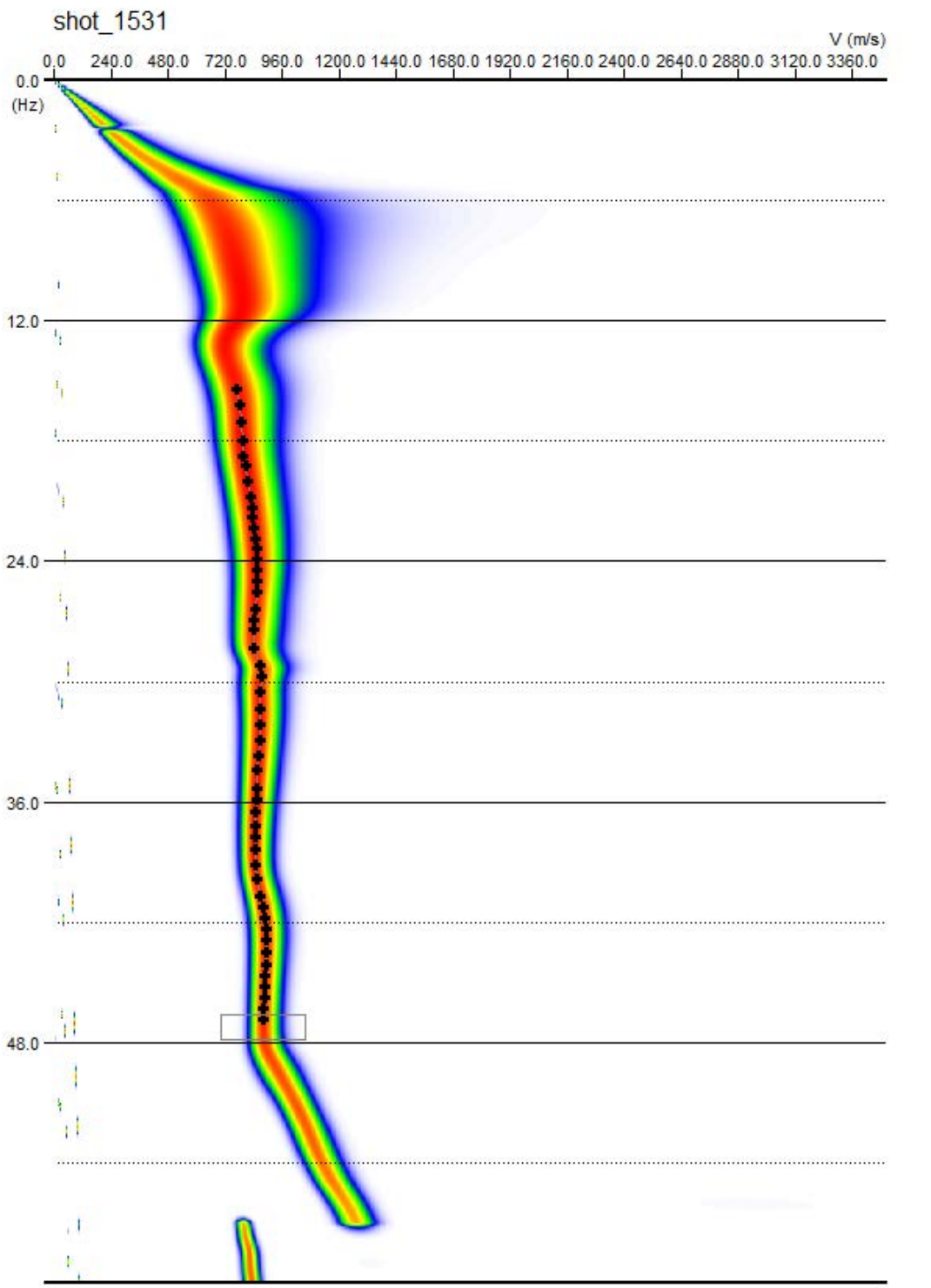

58.29 (Hz)

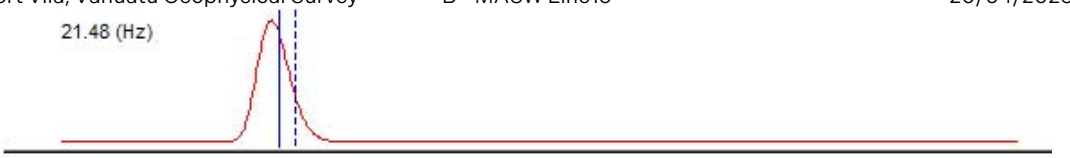

shot_1529
V (m/s)
0.0 240.0 480.0 720.0 960.0 1200.0 1440.0 1680.0 1920.0 2160.0 2400.0 2640.0 2880.0 3120.0 3360.0
0.0
(Hz)
12.0
24.0
36.0
48.0

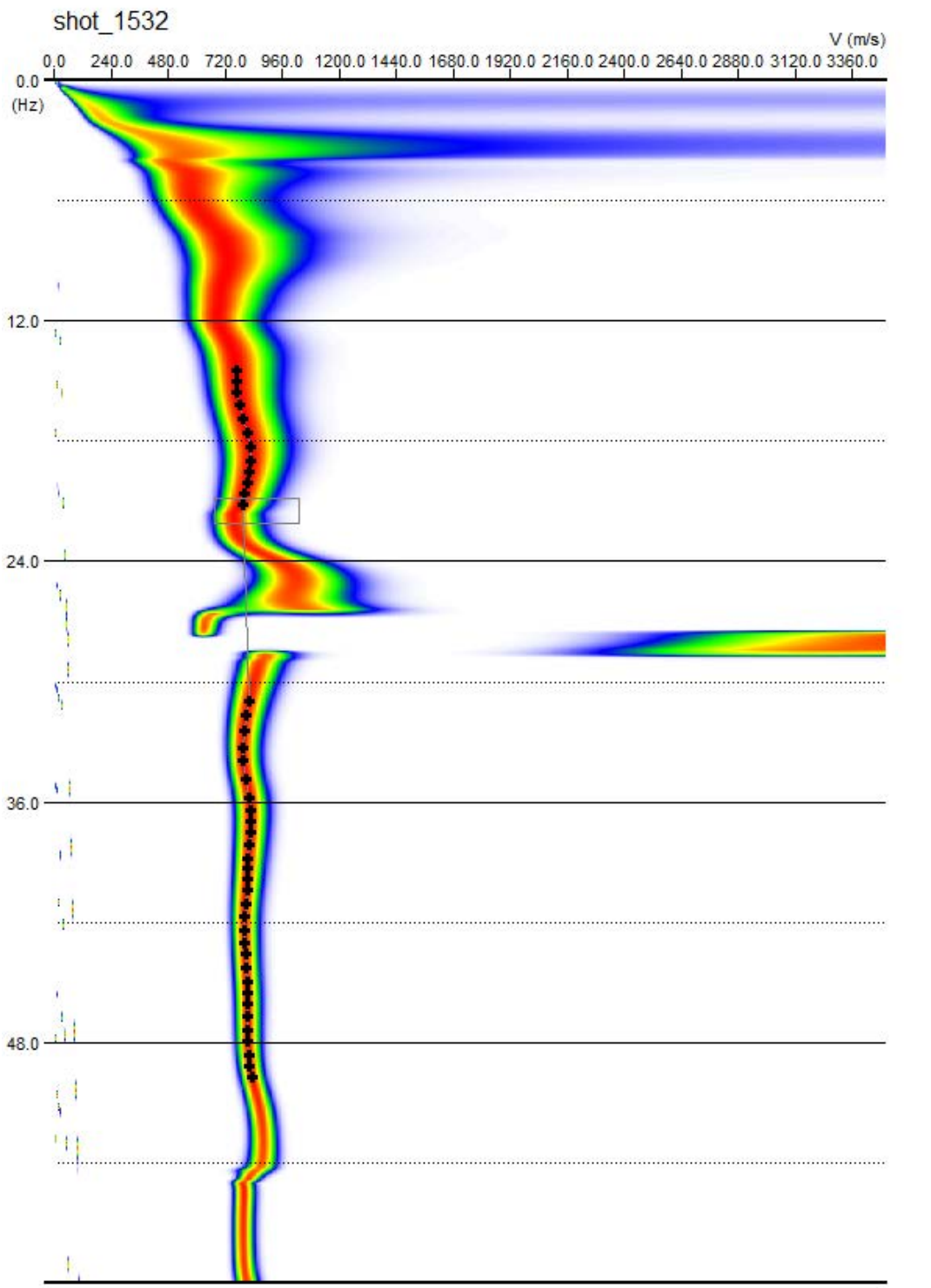

25.60 (Hz)

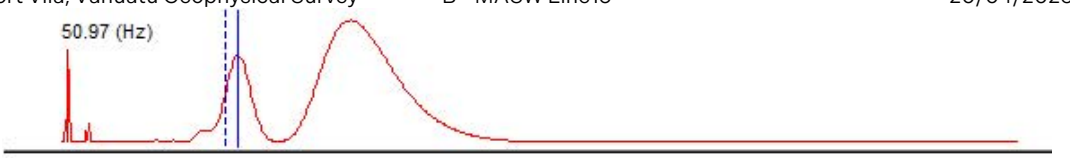

shot_1530
V (m/s)
0.0 240.0 480.0 720.0 960.0 1200.0 1440.0 1680.0 1920.0 2160.0 2400.0 2640.0 2880.0 3120.0 3360.0
0.0
(Hz)
12.0
24.0
36.0
48.0

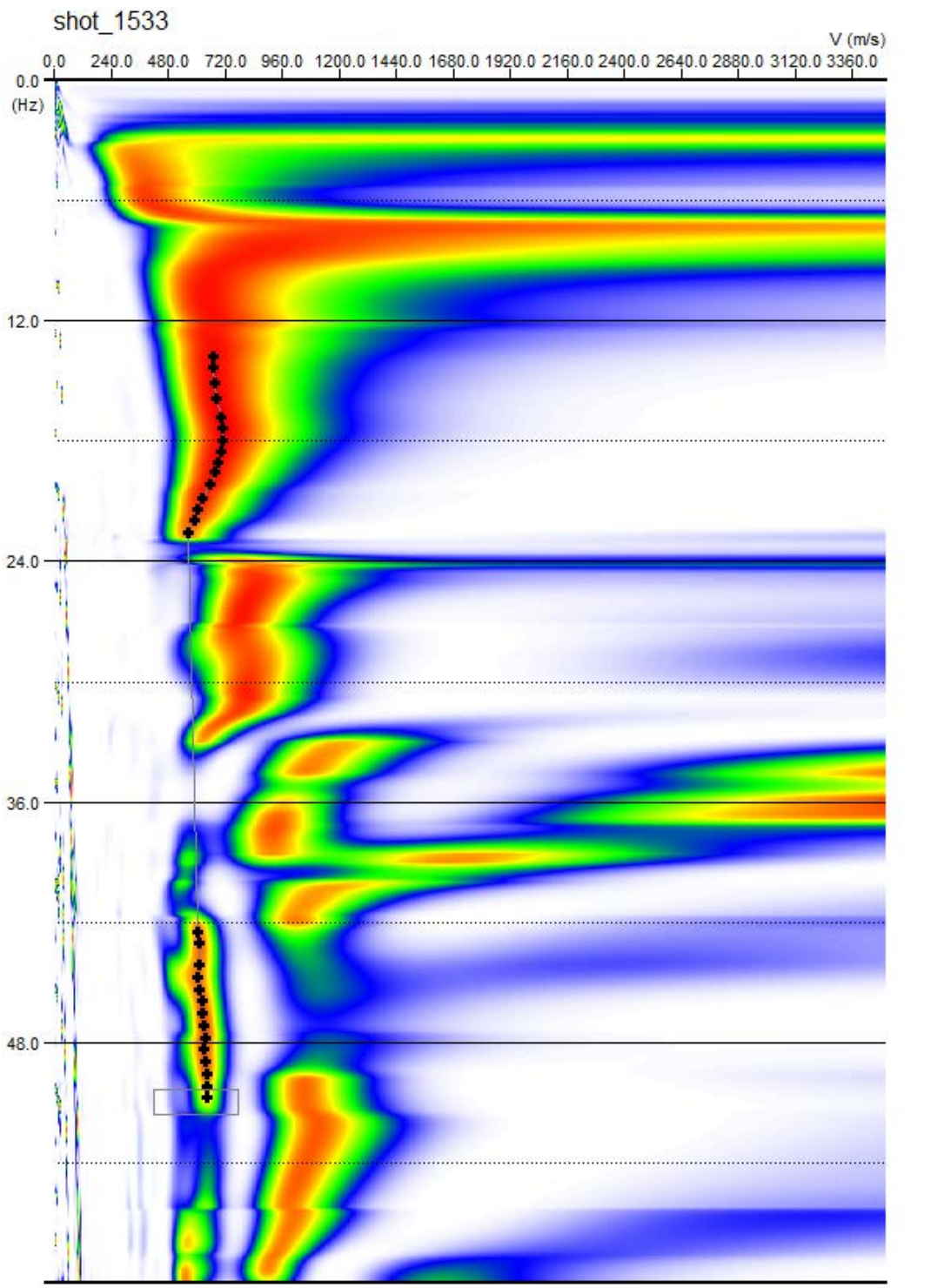

47.24 (Hz)


shot_1531
V (m/s)
0.0 240.0 480.0 720.0 960.0 1200.0 1440.0 1680.0 1920.0 2160.0 2400.0 2640.0 2880.0 3120.0 3360.0
0.0
(Hz)
12.0
24.0
36.0
48.0

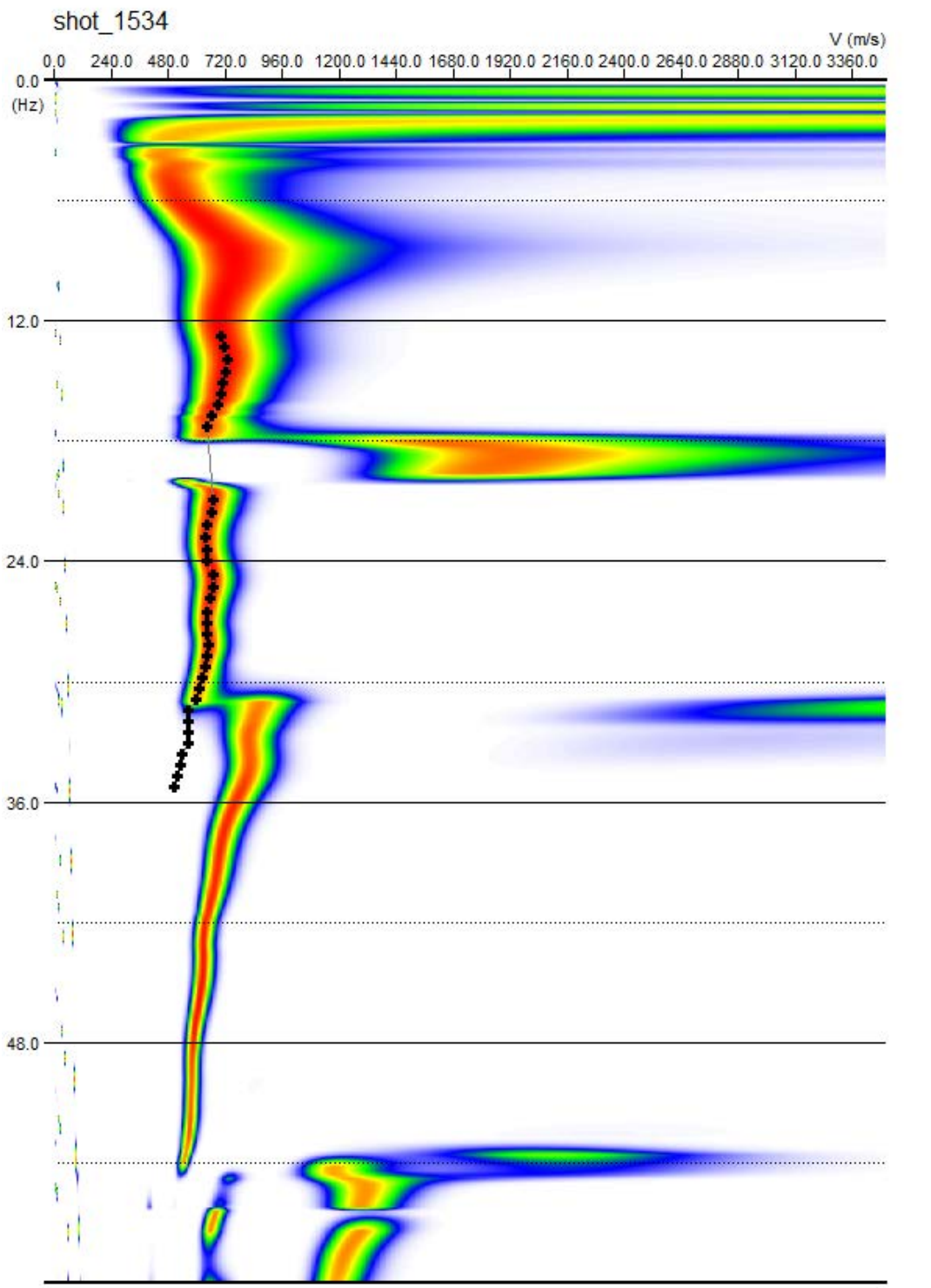

21.48 (Hz)

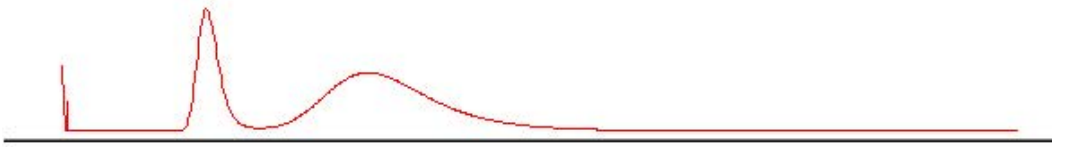

shot_1532
V (m/s)
0.0 240.0 480.0 720.0 960.0 1200.0 1440.0 1680.0 1920.0 2160.0 2400.0 2640.0 2880.0 3120.0 3360.0
0.0
(Hz)
12.0
24.0
36.0
48.0

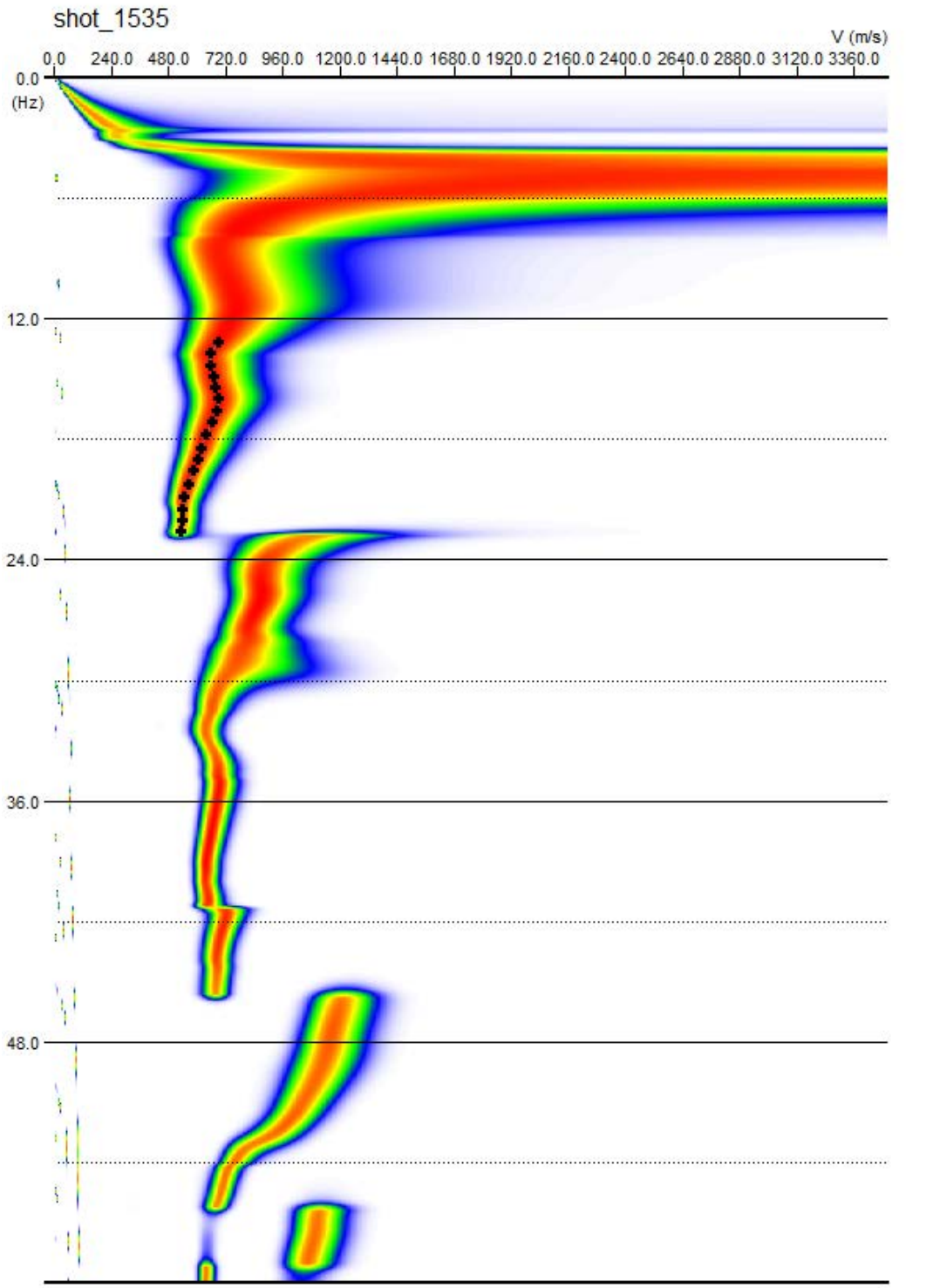

50.97 (Hz)

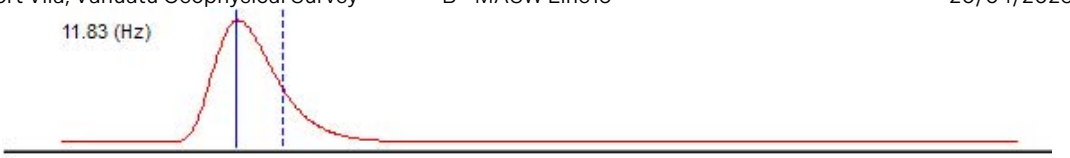

shot_1533
V (m/s)
0.0 240.0 480.0 720.0 960.0 1200.0 1440.0 1680.0 1920.0 2160.0 2400.0 2640.0 2880.0 3120.0 3360.0
0.0
(Hz)
12.0
24.0
36.0
48.0

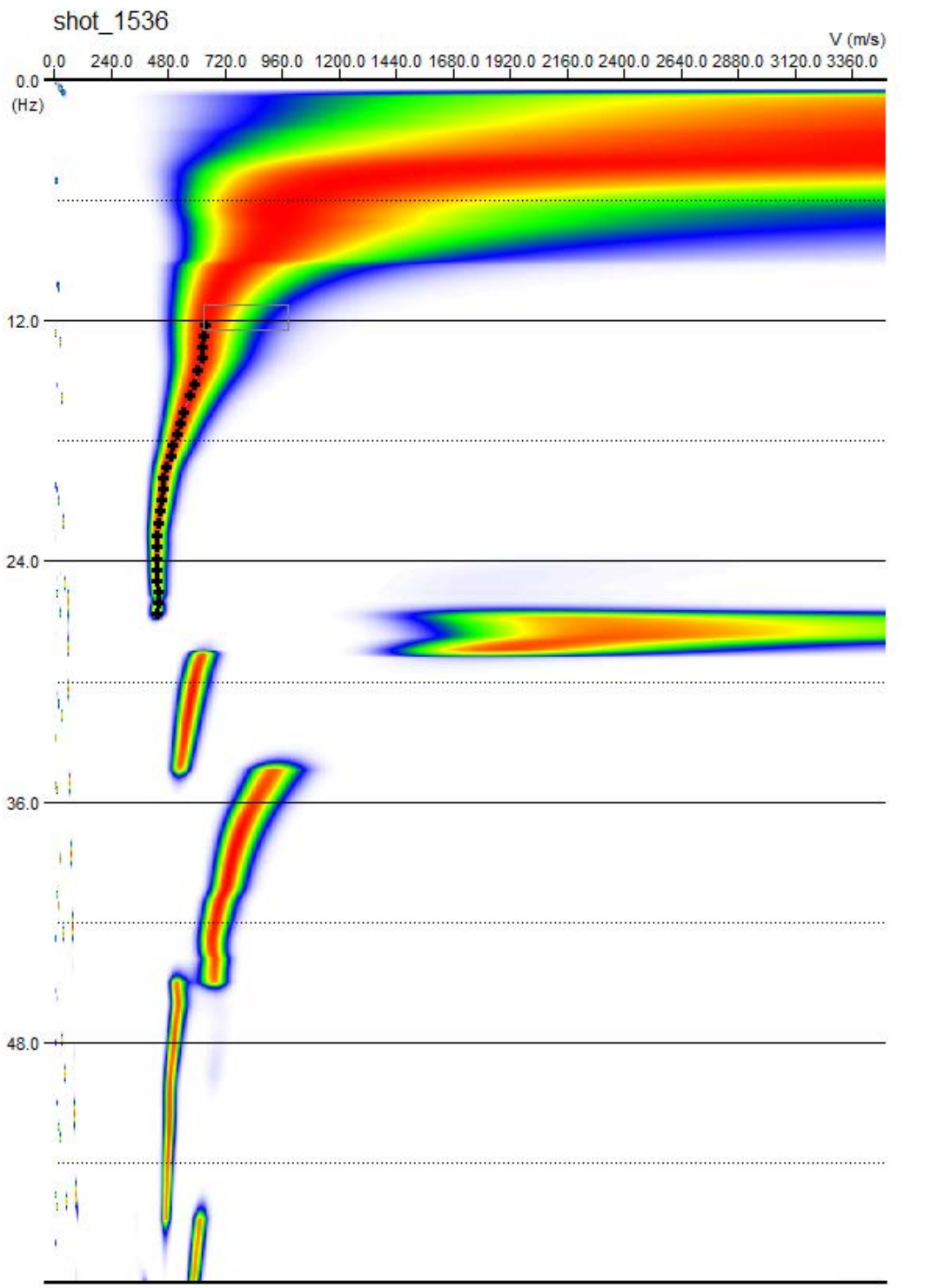


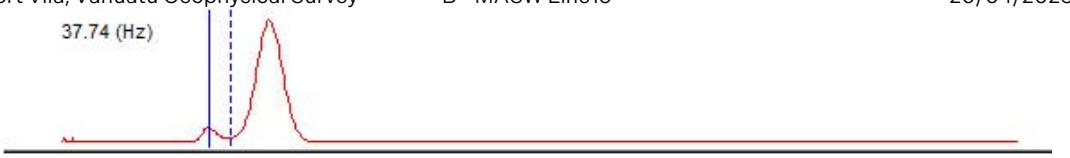

shot_1534
V (m/s)
0.0 240.0 480.0 720.0 960.0 1200.0 1440.0 1680.0 1920.0 2160.0 2400.0 2640.0 2880.0 3120.0 3360.0
0.0
(Hz)
12.0
24.0
36.0
48.0

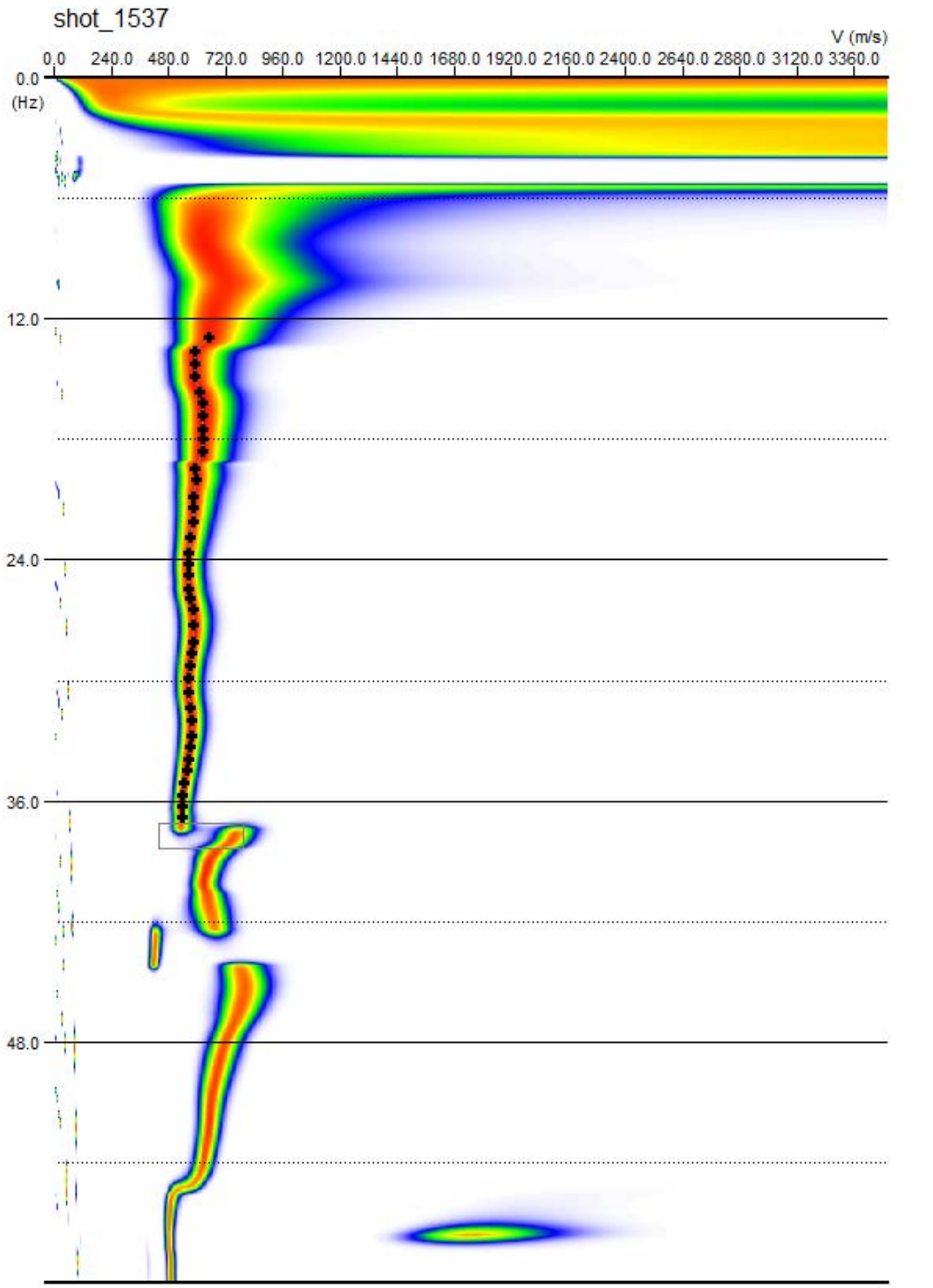


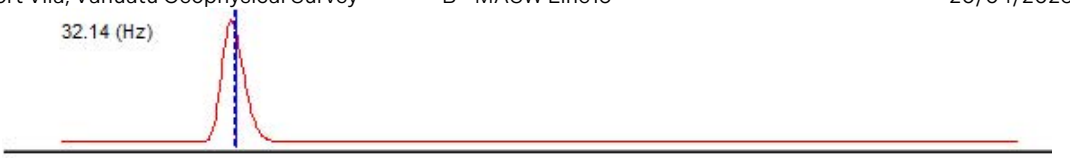

shot_1535
V (m/s)
0.0 240.0 480.0 720.0 960.0 1200.0 1440.0 1680.0 1920.0 2160.0 2400.0 2640.0 2880.0 3120.0 3360.0
0.0
(Hz)
12.0
24.0
36.0
48.0

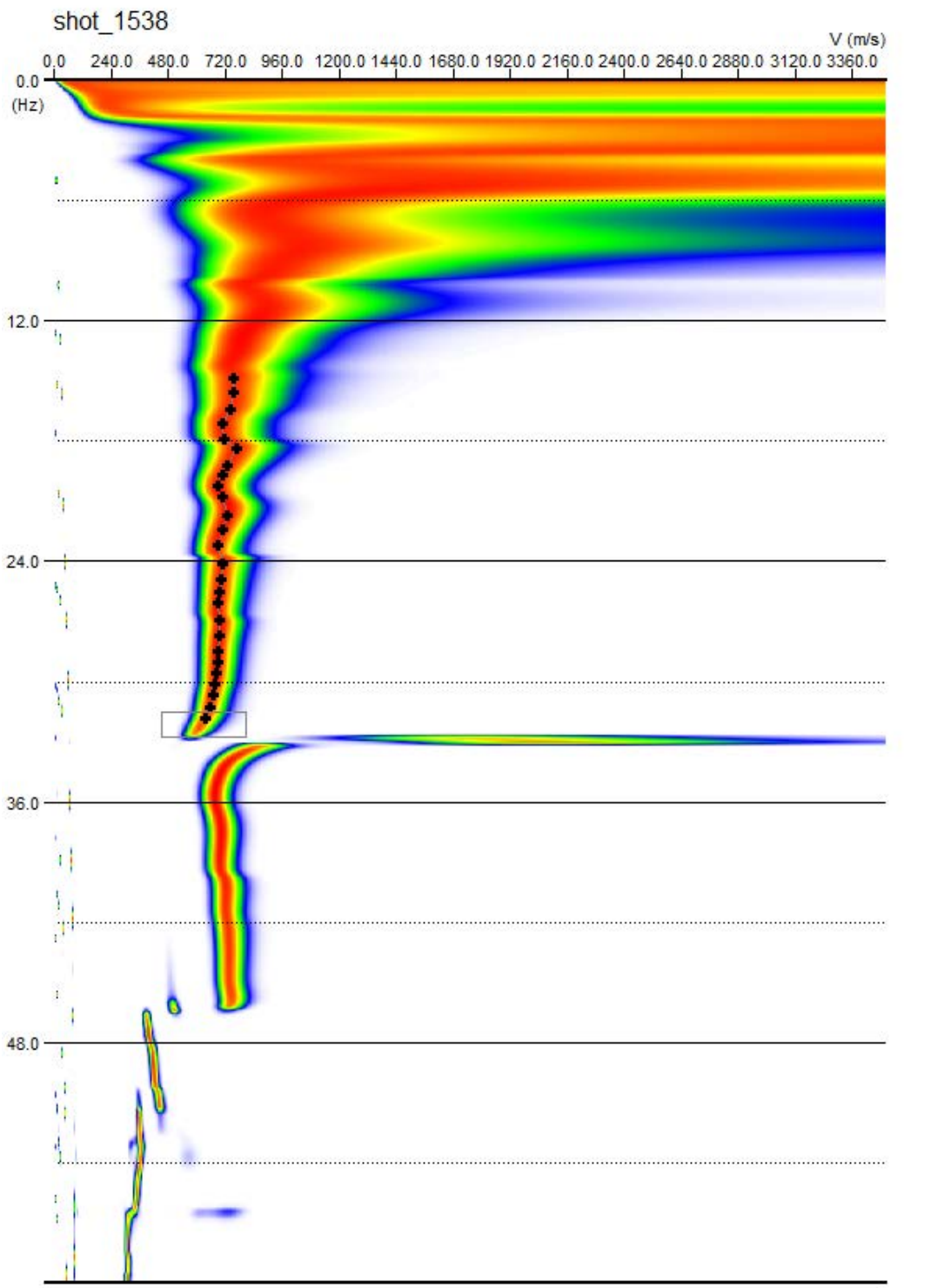

11.83 (Hz)

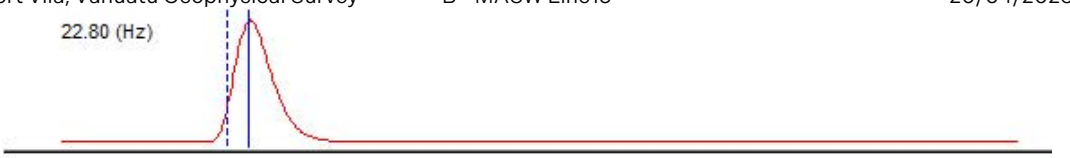

shot_1536
V (m/s)
0.0 240.0 480.0 720.0 960.0 1200.0 1440.0 1680.0 1920.0 2160.0 2400.0 2640.0 2880.0 3120.0 3360.0
0.0
(Hz)
12.0
24.0
36.0
48.0

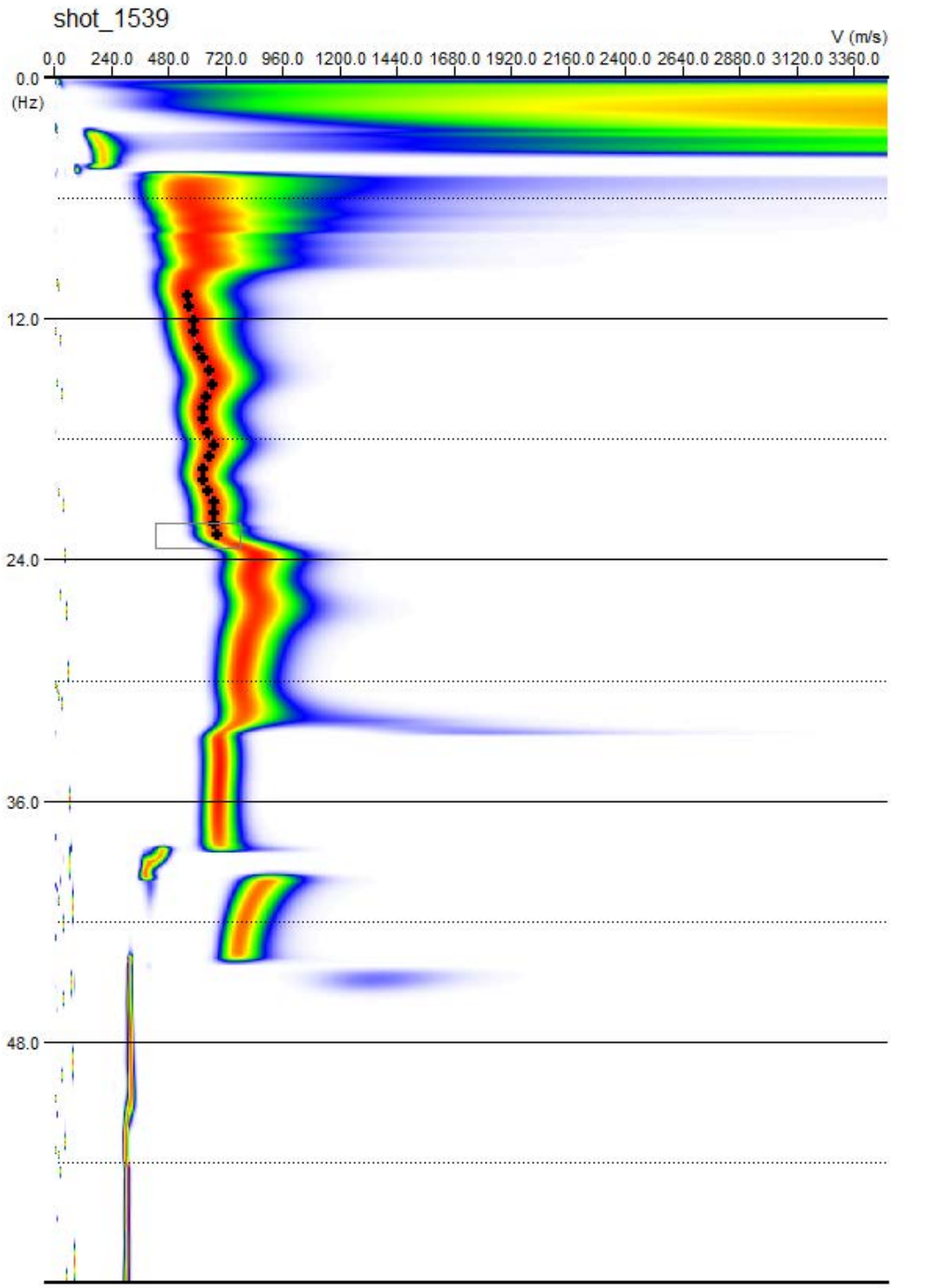

37.74 (Hz)

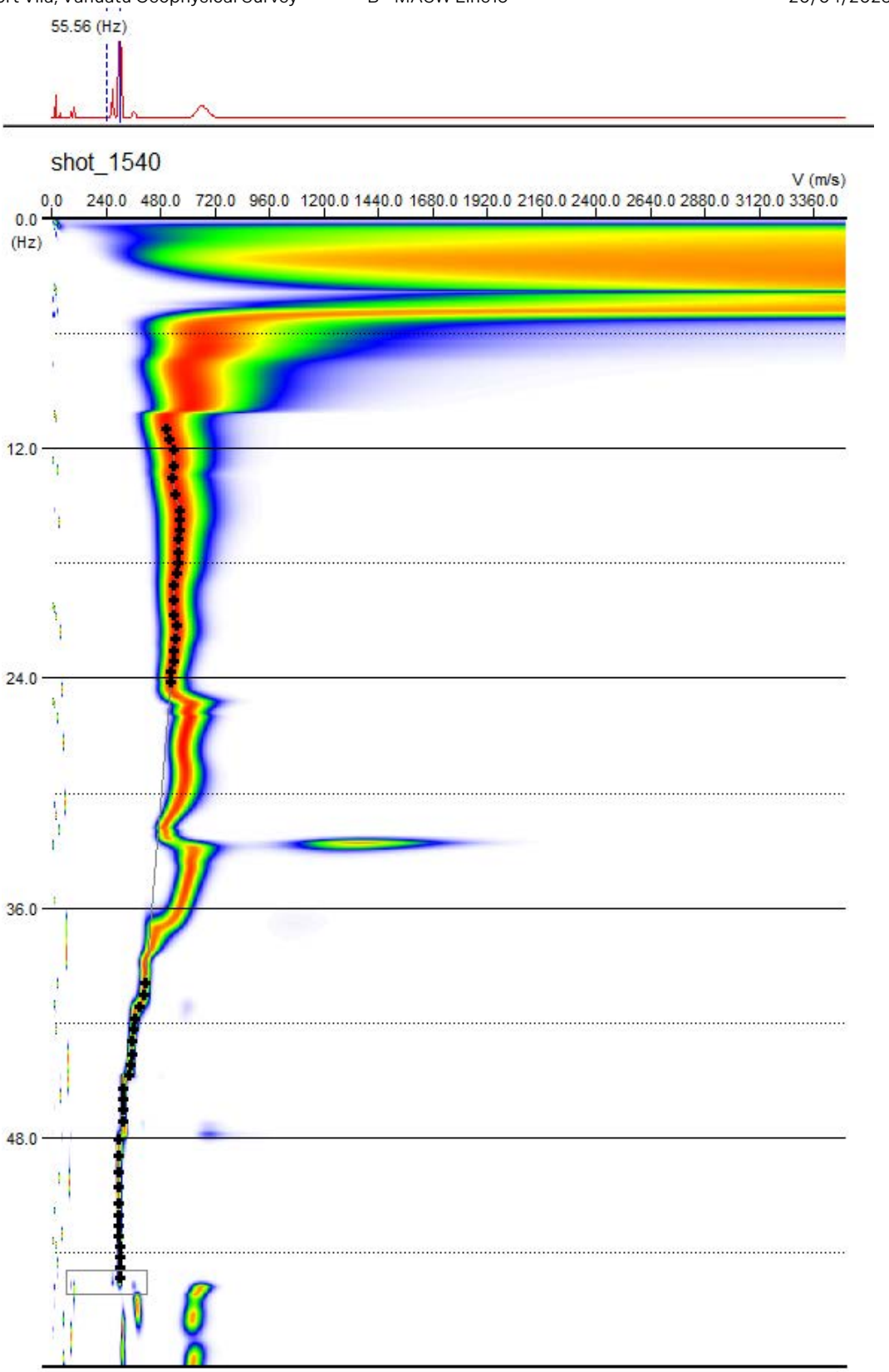

shot_1537
V (m/s)
0.0 240.0 480.0 720.0 960.0 1200.0 1440.0 1680.0 1920.0 2160.0 2400.0 2640.0 2880.0 3120.0 3360.0
0.0
(Hz)
12.0
24.0
36.0
48.0


32.14 (Hz)

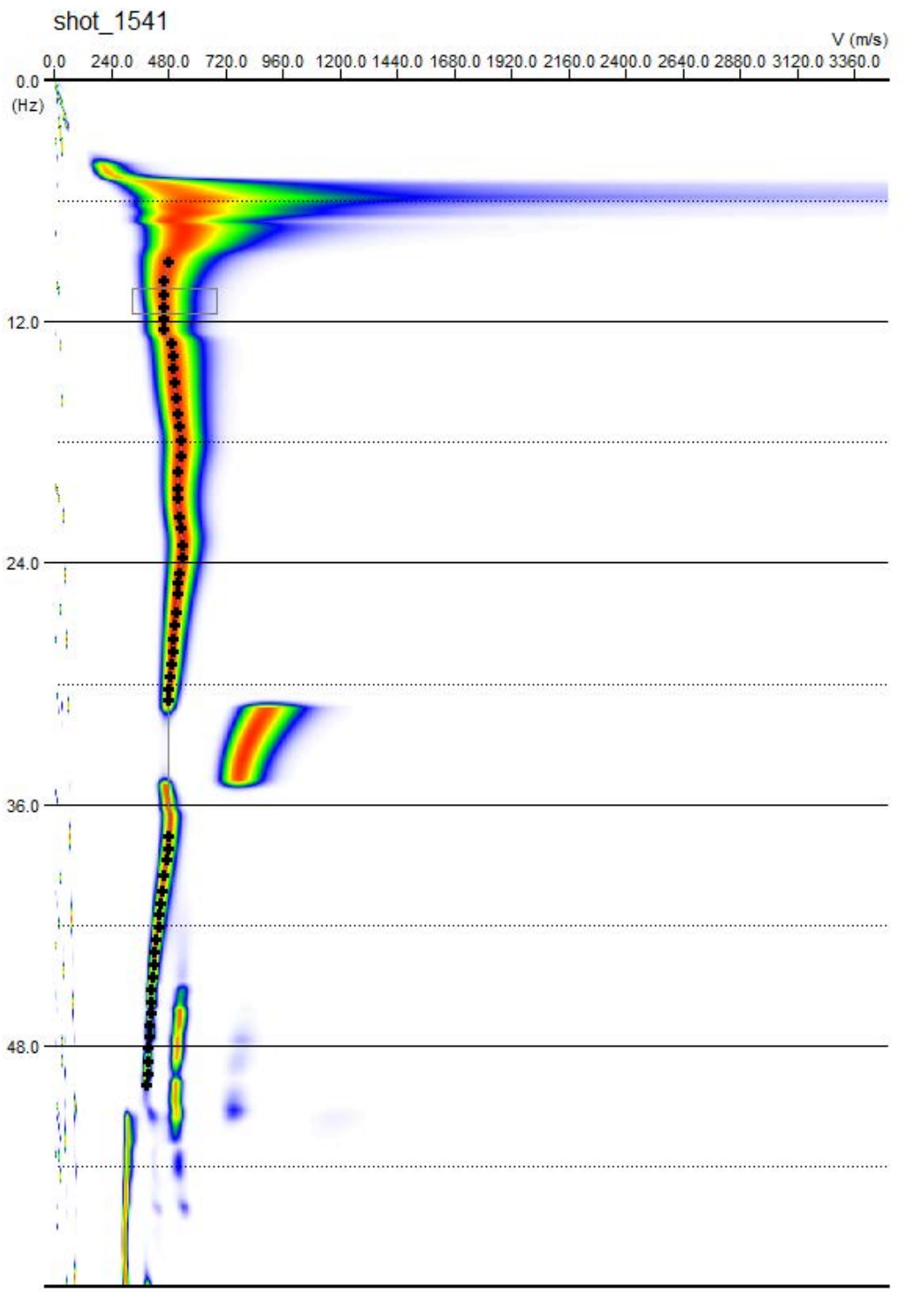

shot_1538
V (m/s)
0.0 240.0 480.0 720.0 960.0 1200.0 1440.0 1680.0 1920.0 2160.0 2400.0 2640.0 2880.0 3120.0 3360.0
0.0
(Hz)
12.0
24.0
36.0
48.0

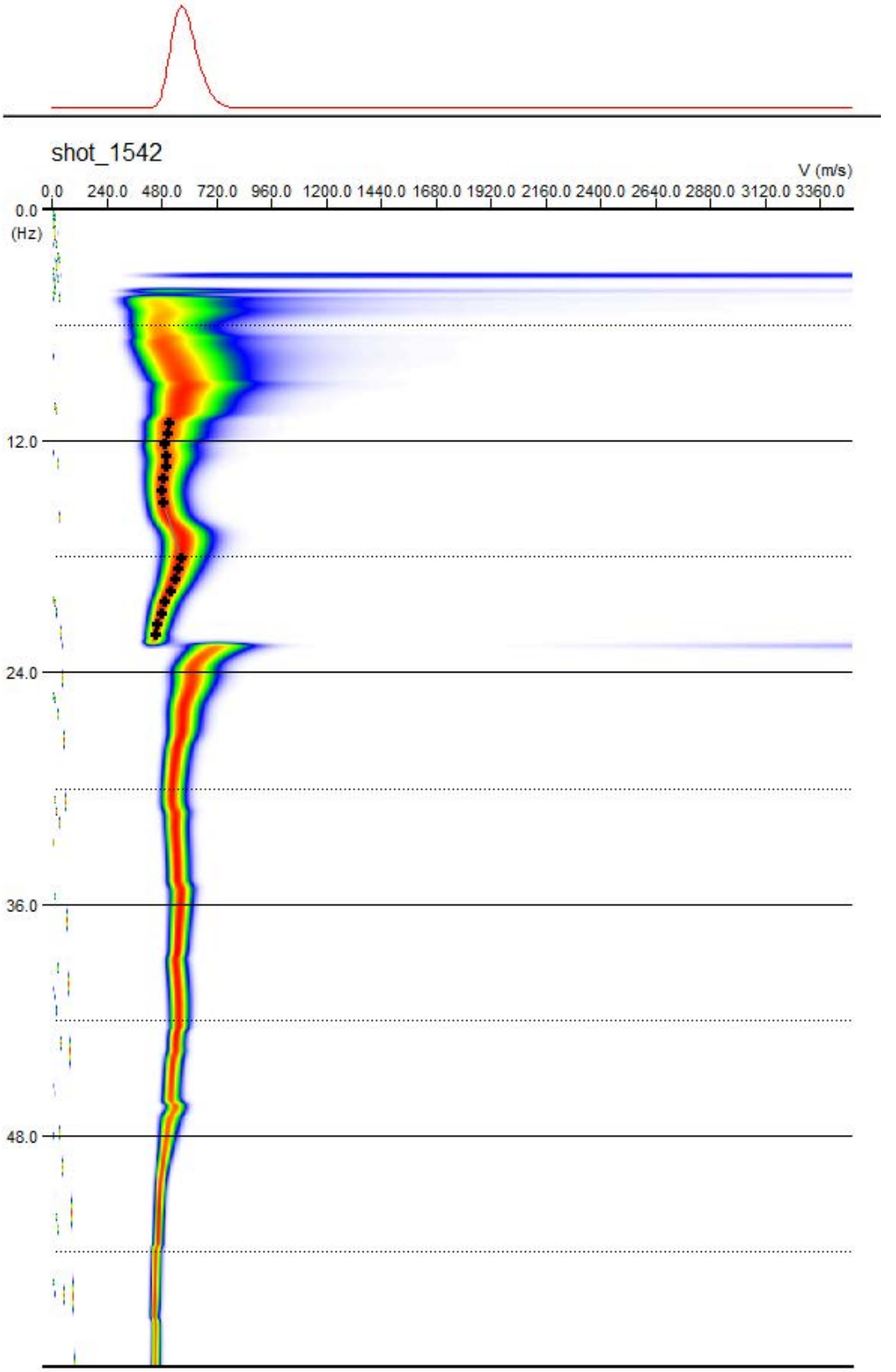

22.80 (Hz)


shot_1539
V (m/s)
0.0 240.0 480.0 720.0 960.0 1200.0 1440.0 1680.0 1920.0 2160.0 2400.0 2640.0 2880.0 3120.0 3360.0
0.0
(Hz)
12.0
24.0
36.0
48.0

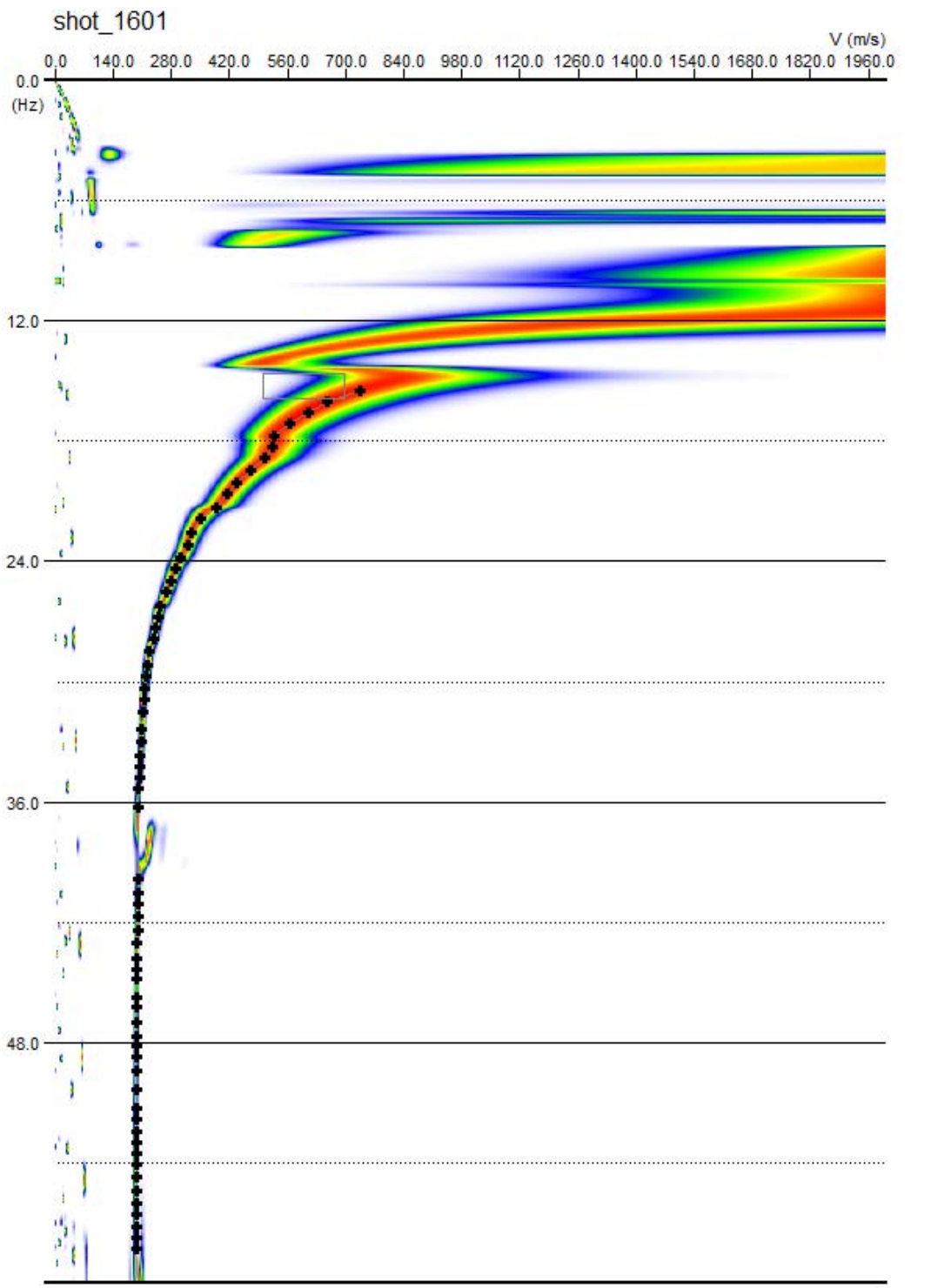

55.56 (Hz)
shot_1540
V (m/s)
0.0 240.0 480.0 720.0 960.0 1200.0 1440.0 1680.0 1920.0 2160.0 2400.0 2640.0 2880.0 3120.0 3360.0
0.0
(Hz)
12.0
24.0
36.0
48.0

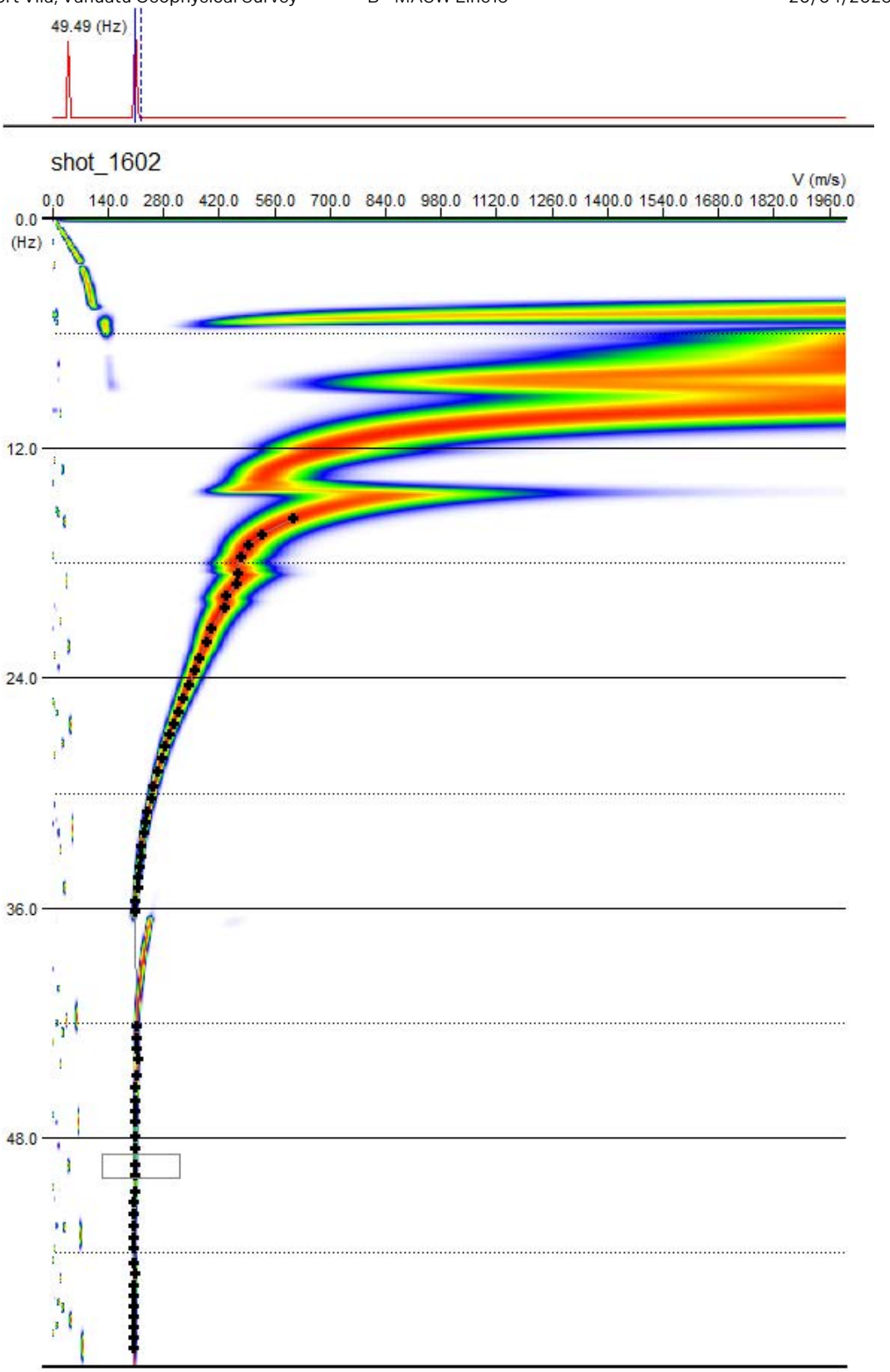

10.97 (Hz)

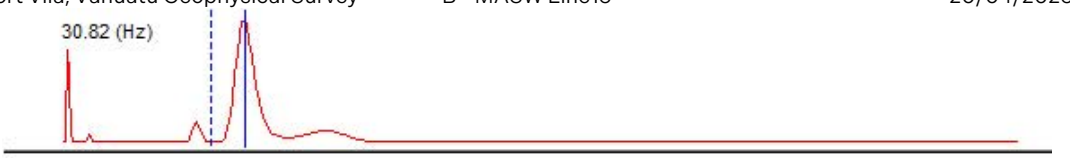

shot_1541
V (m/s)
0.0 240.0 480.0 720.0 960.0 1200.0 1440.0 1680.0 1920.0 2160.0 2400.0 2640.0 2880.0 3120.0 3360.0
0.0
(Hz)
12.0
24.0
36.0
48.0

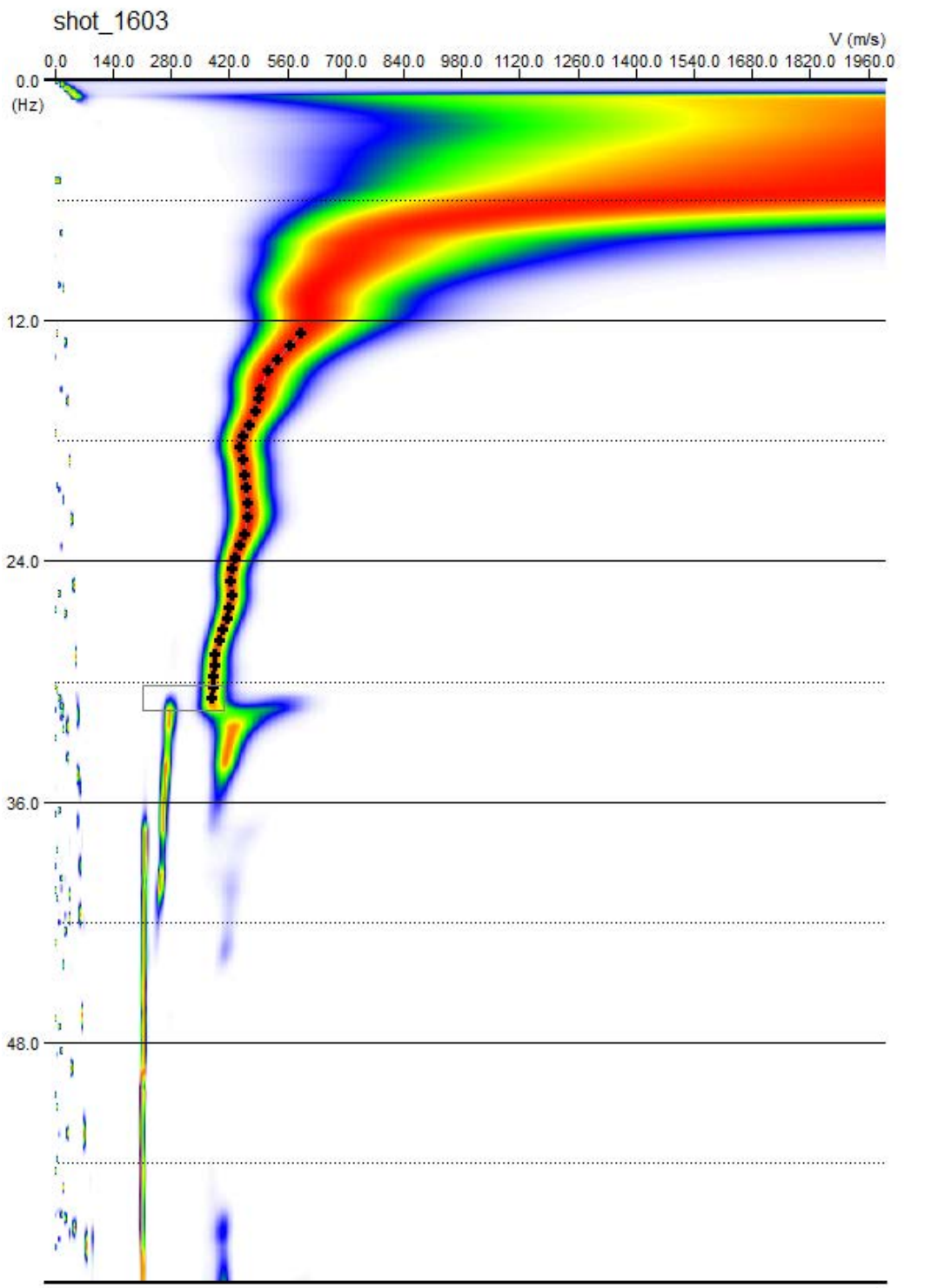

shot_1542
V (m/s)
0.0 240.0 480.0 720.0 960.0 1200.0 1440.0 1680.0 1920.0 2160.0 2400.0 2640.0 2880.0 3120.0 3360.0
0.0
(Hz)
12.0
24.0
36.0
48.0

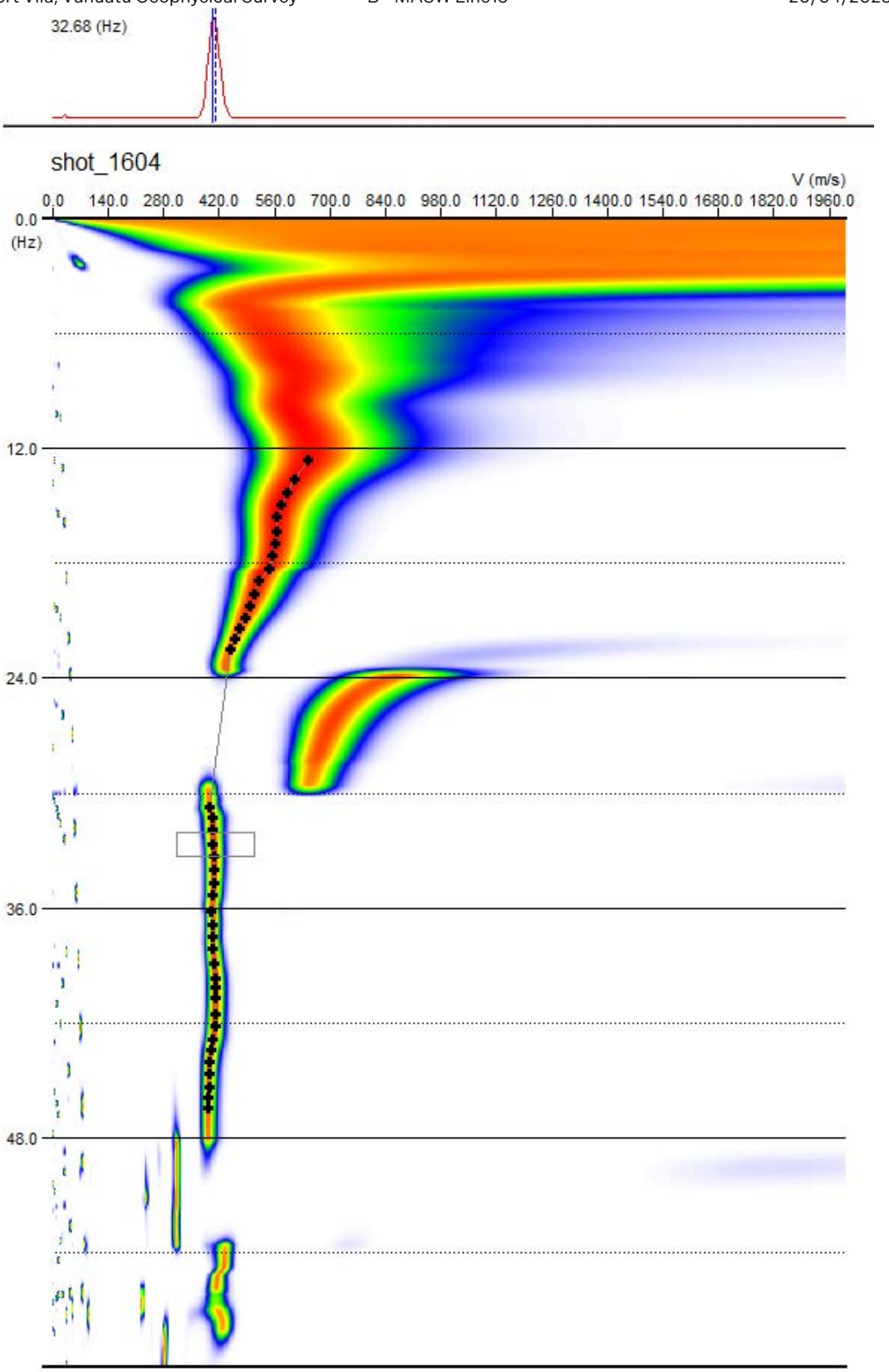

15.25 (Hz)

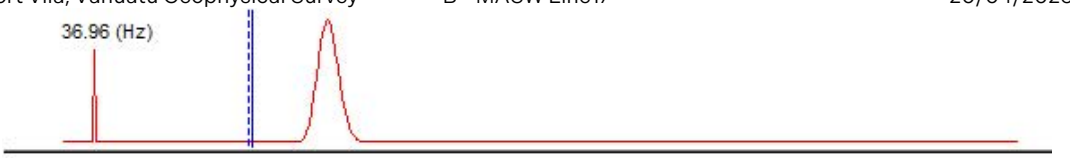

shot_1601
V (m/s)
0.0
140.0
280.0
420.0
560.0
700.0
840.0
980.0
1120.0
1260.0
1400.0
1540.0
1680.0
1820.0
1960.0
0.0
(Hz)
12.0
24.0
36.0
48.0

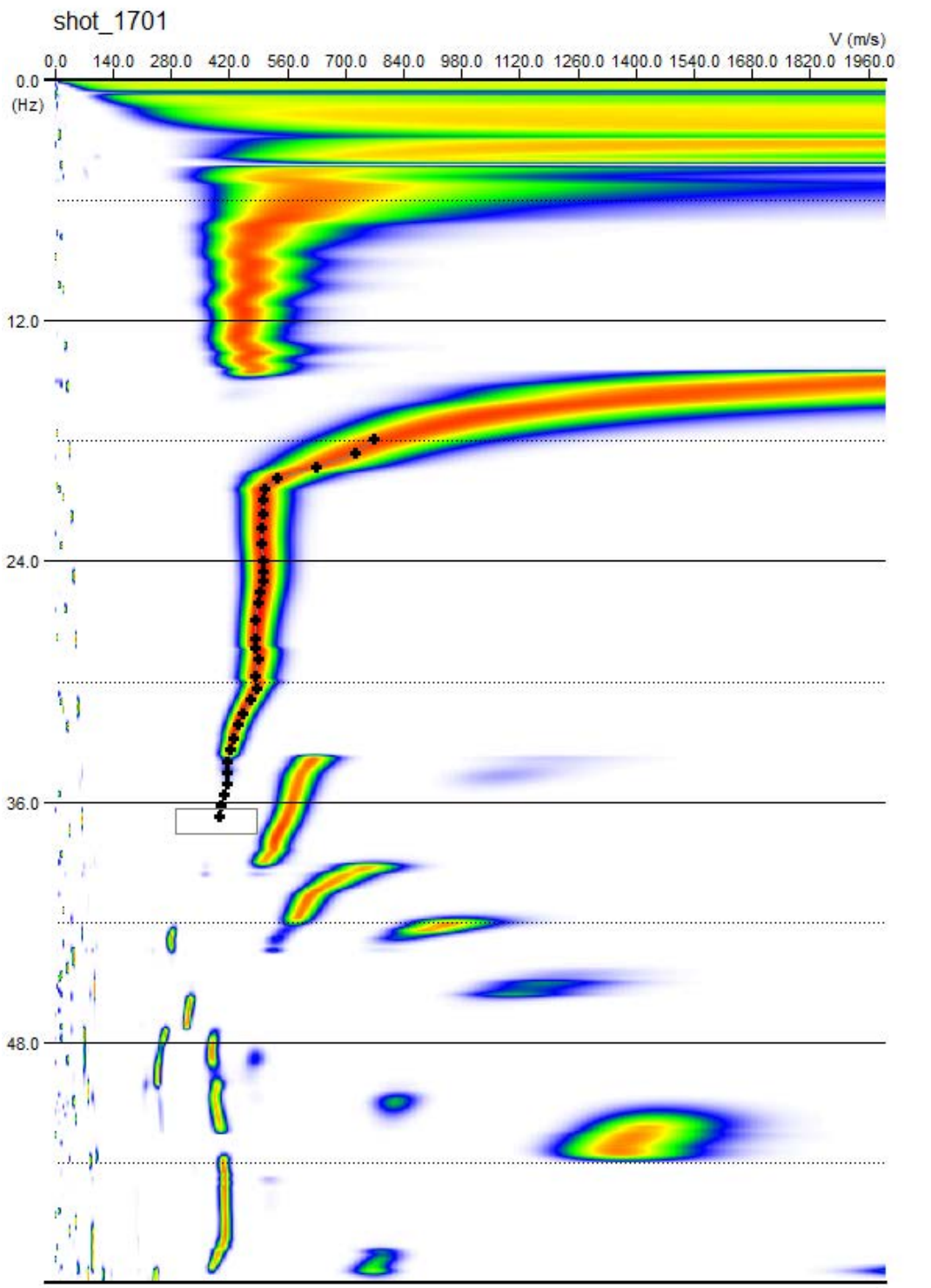

49.49 (Hz)
shot_1602
V (m/s)
0.0 140.0 280.0 420.0 560.0 700.0 840.0 980.0 1120.0 1260.0 1400.0 1540.0 1680.0 1820.0 1960.0
0.0
(Hz)
12.0
24.0
36.0
48.0


30.82 (Hz)

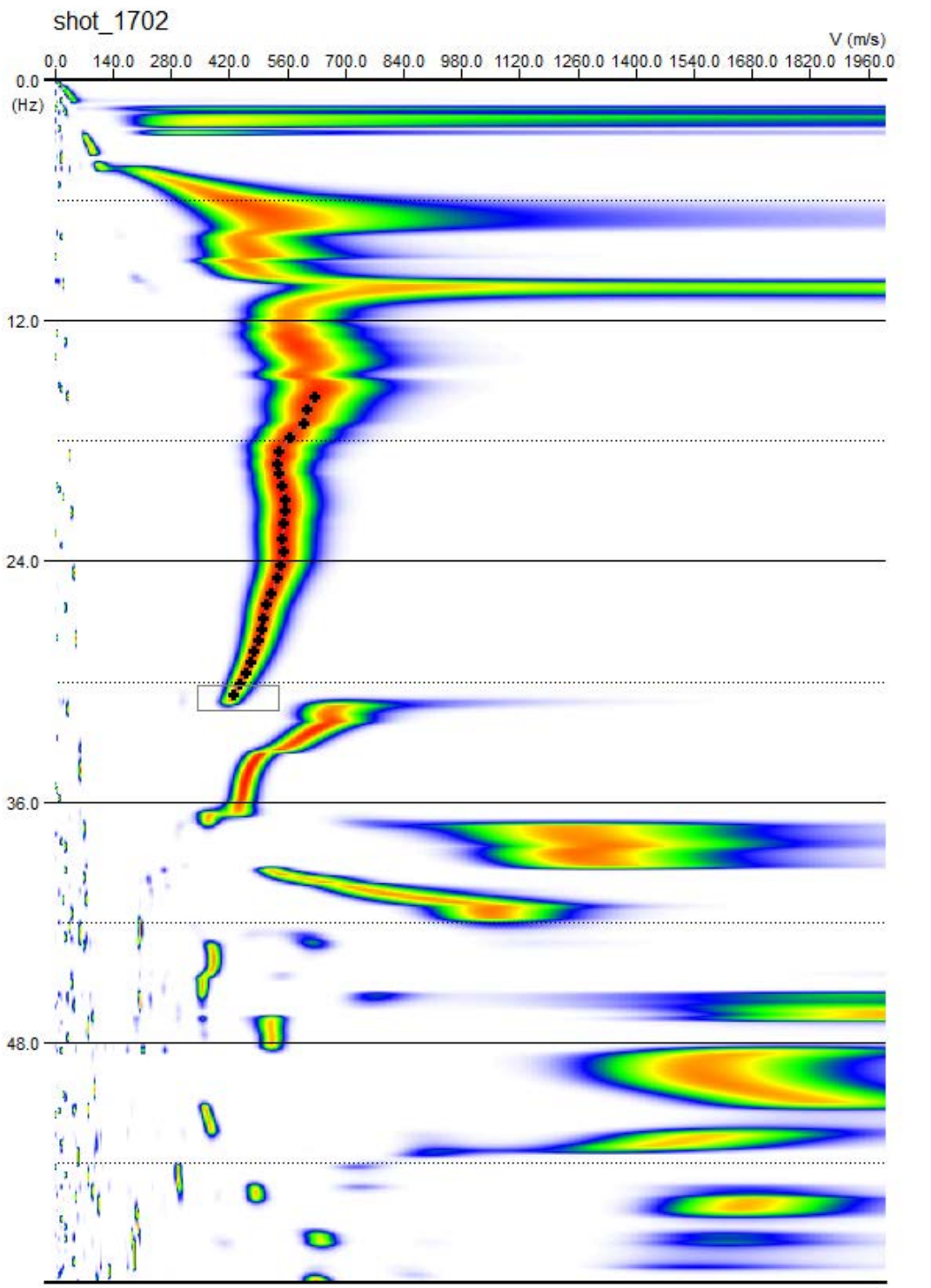

shot_1603
V (m/s)
0.0
140.0
280.0
420.0
560.0
700.0
840.0
980.0
1120.0
1260.0
1400.0
1540.0
1680.0
1820.0
1960.0
0.0
(Hz)
12.0
24.0
36.0
48.0


32.68 (Hz)
shot_1604
V (m/s)
0.0 140.0 280.0 420.0 560.0 700.0 840.0 980.0 1120.0 1260.0 1400.0 1540.0 1680.0 1820.0 1960.0
0.0
(Hz)
12.0
24.0
36.0
48.0

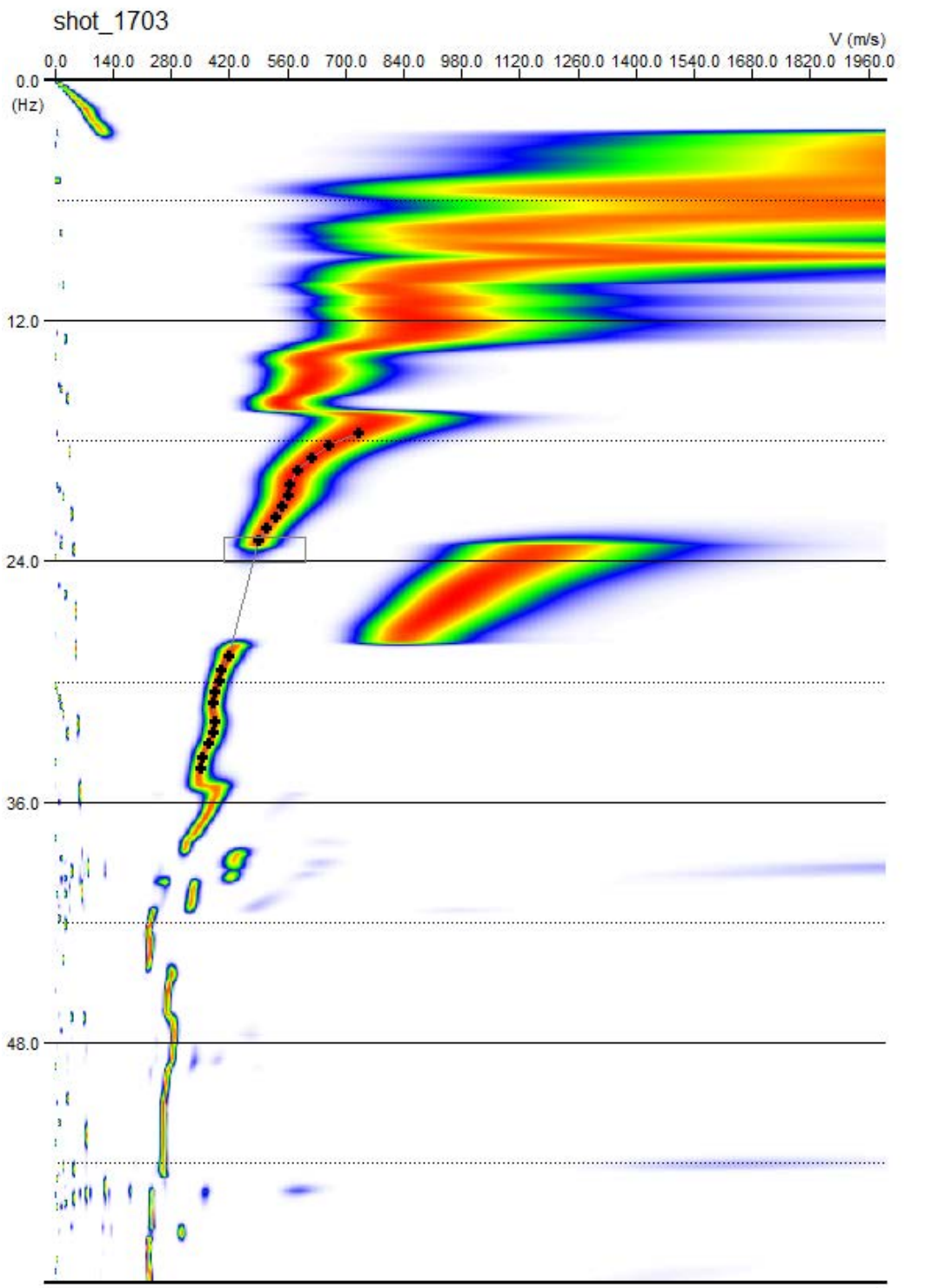

36.96 (Hz)

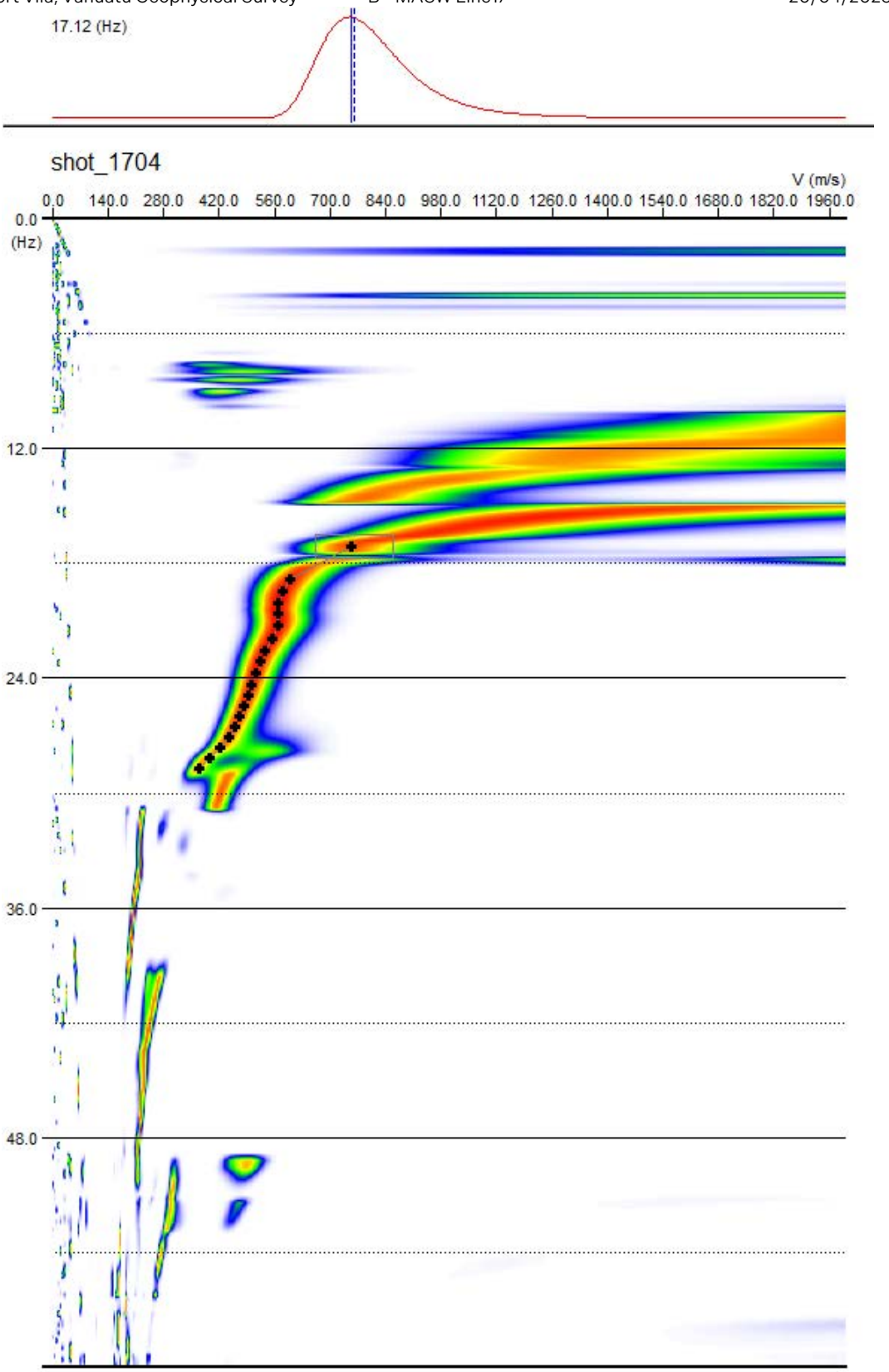

shot_1701
V (m/s)
0.0
140.0
280.0
420.0
560.0
700.0
840.0
980.0
1120.0
1260.0
1400.0
1540.0
1680.0
1820.0
1960.0
0.0
(Hz)
12.0
24.0
36.0
48.0

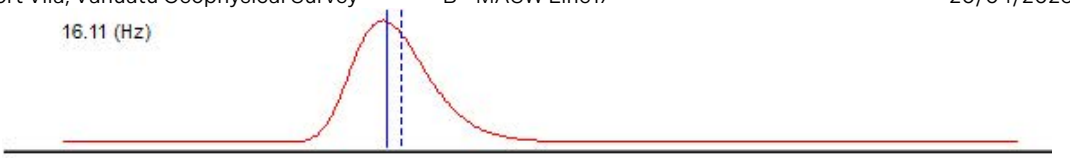

30.82 (Hz)

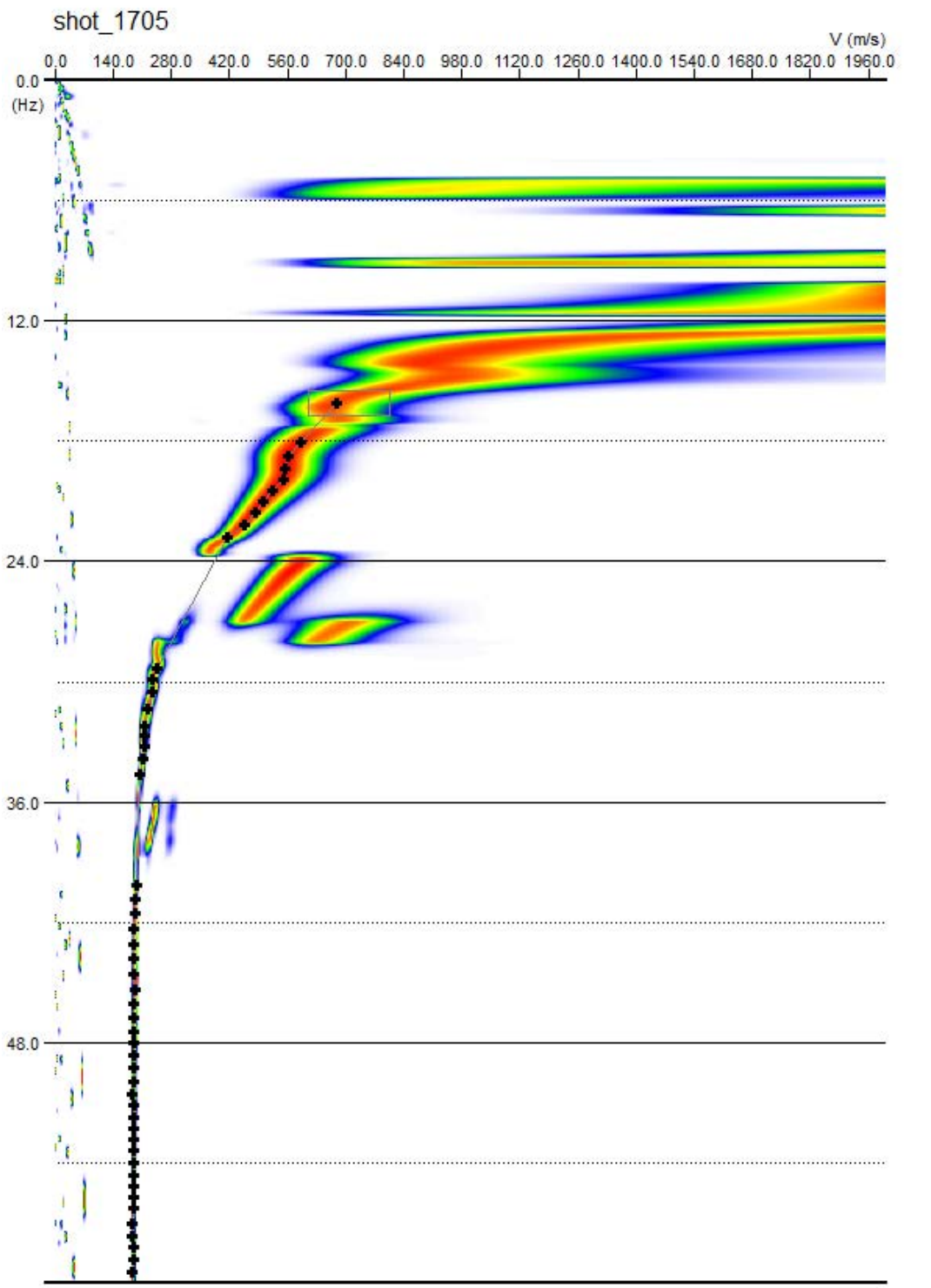

shot_1702
V (m/s)
0.0 140.0 280.0 420.0 560.0 700.0 840.0 980.0 1120.0 1260.0 1400.0 1540.0 1680.0 1820.0 1960.0
0.0
(Hz)
12.0
24.0
36.0
48.0


23.42 (Hz)

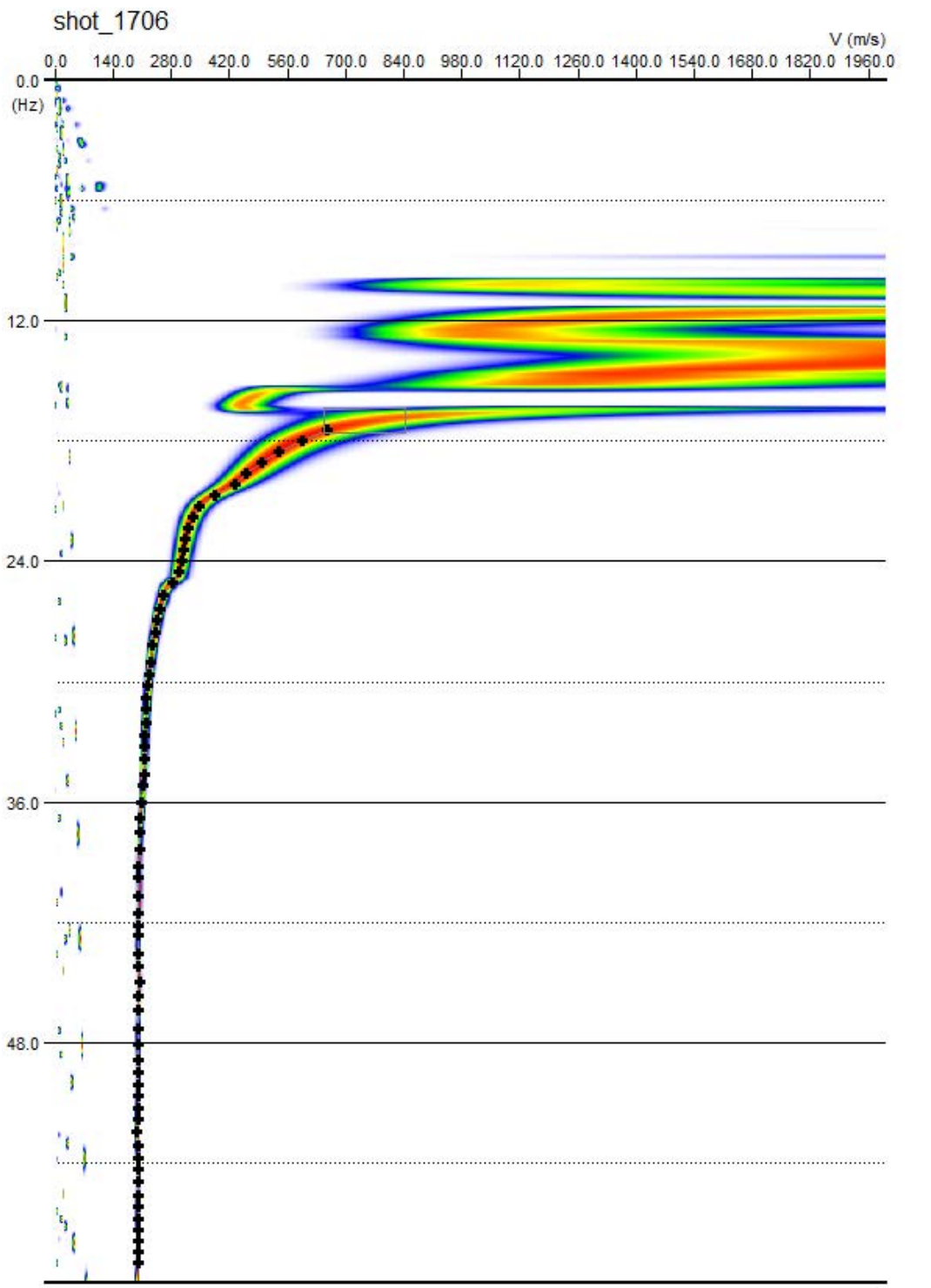

shot_1703
V (m/s)
0.0
140.0
280.0
420.0
560.0
700.0
840.0
980.0
1120.0
1260.0
1400.0
1540.0
1680.0
1820.0
1960.0
0.0
(Hz)
12.0
24.0
36.0
48.0


17.12 (Hz)
shot_1704
V (m/s)
0.0 140.0 280.0 420.0 560.0 700.0 840.0 980.0 1120.0 1260.0 1400.0 1540.0 1680.0 1820.0 1960.0
0.0
(Hz)
12.0
24.0
36.0
48.0

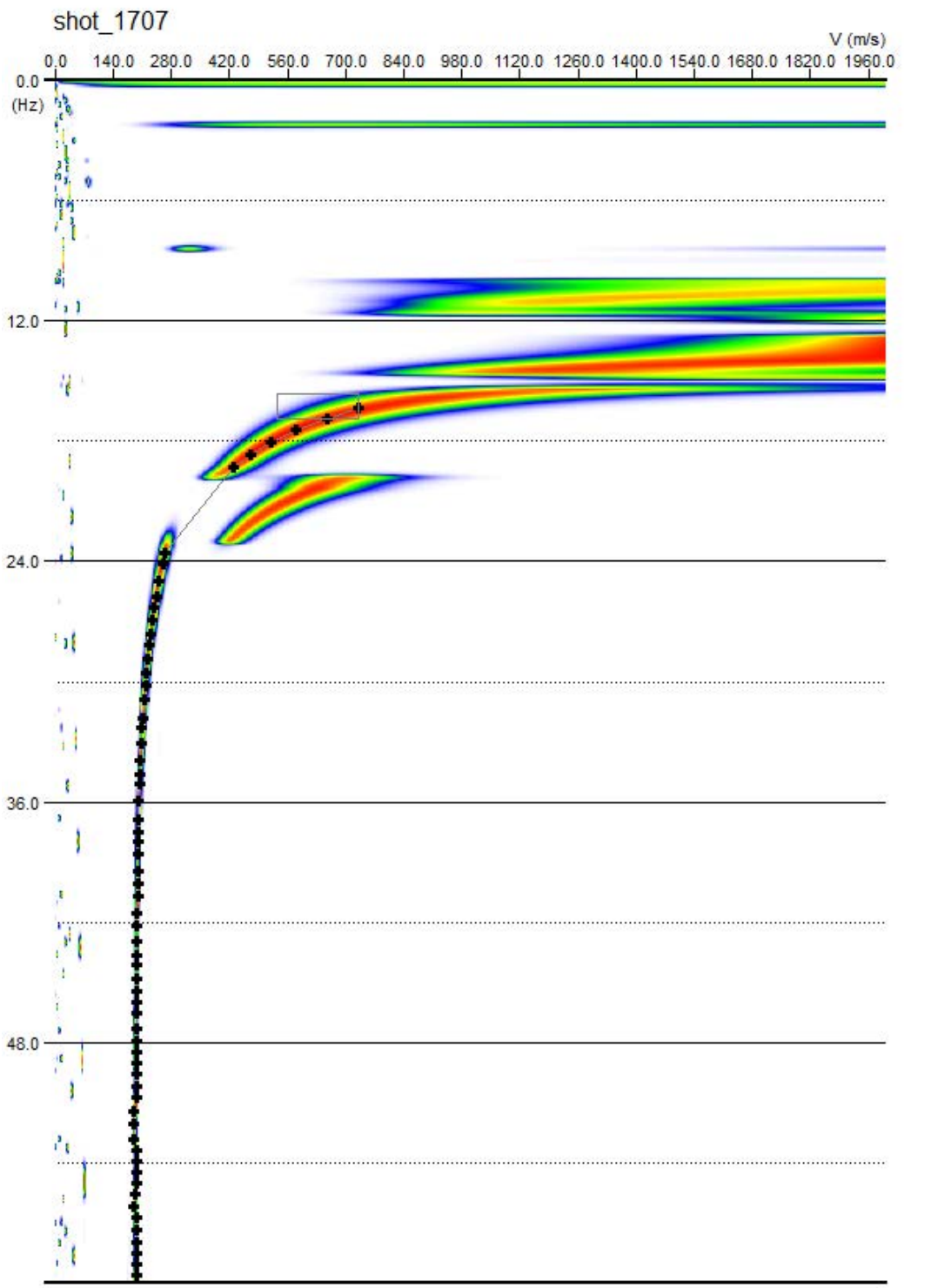

16.11 (Hz)


shot_1705
V (m/s)
0.0
140.0
280.0
420.0
560.0
700.0
840.0
980.0
1120.0
1260.0
1400.0
1540.0
1680.0
1820.0
1960.0
0.0
(Hz)
12.0
24.0
36.0
48.0

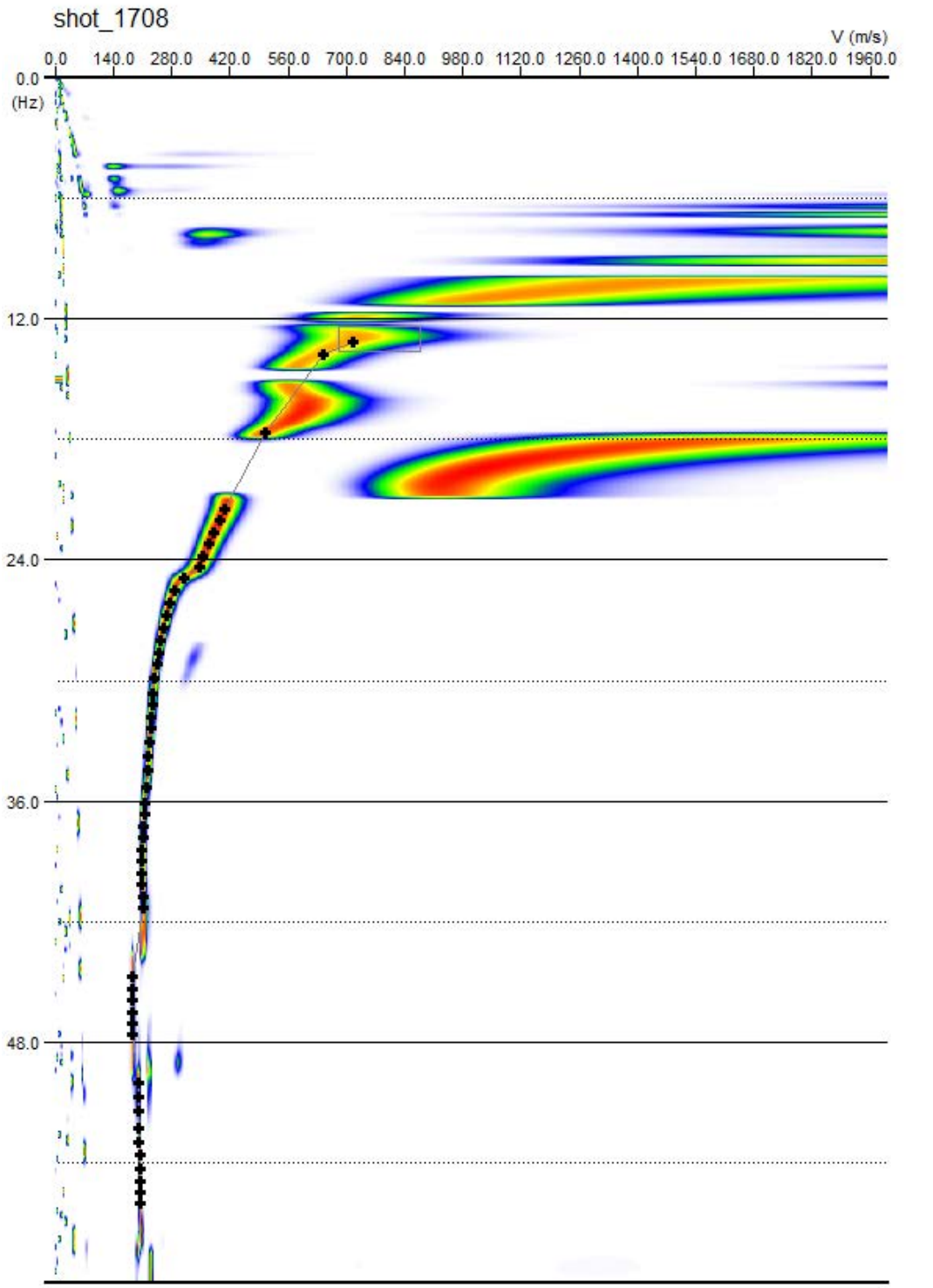

16.96 (Hz)


shot_1706
V (m/s)
0.0
140.0
280.0
420.0
560.0
700.0
840.0
980.0
1120.0
1260.0
1400.0
1540.0
1680.0
1820.0
1960.0
0.0
(Hz)
12.0
24.0
36.0
48.0

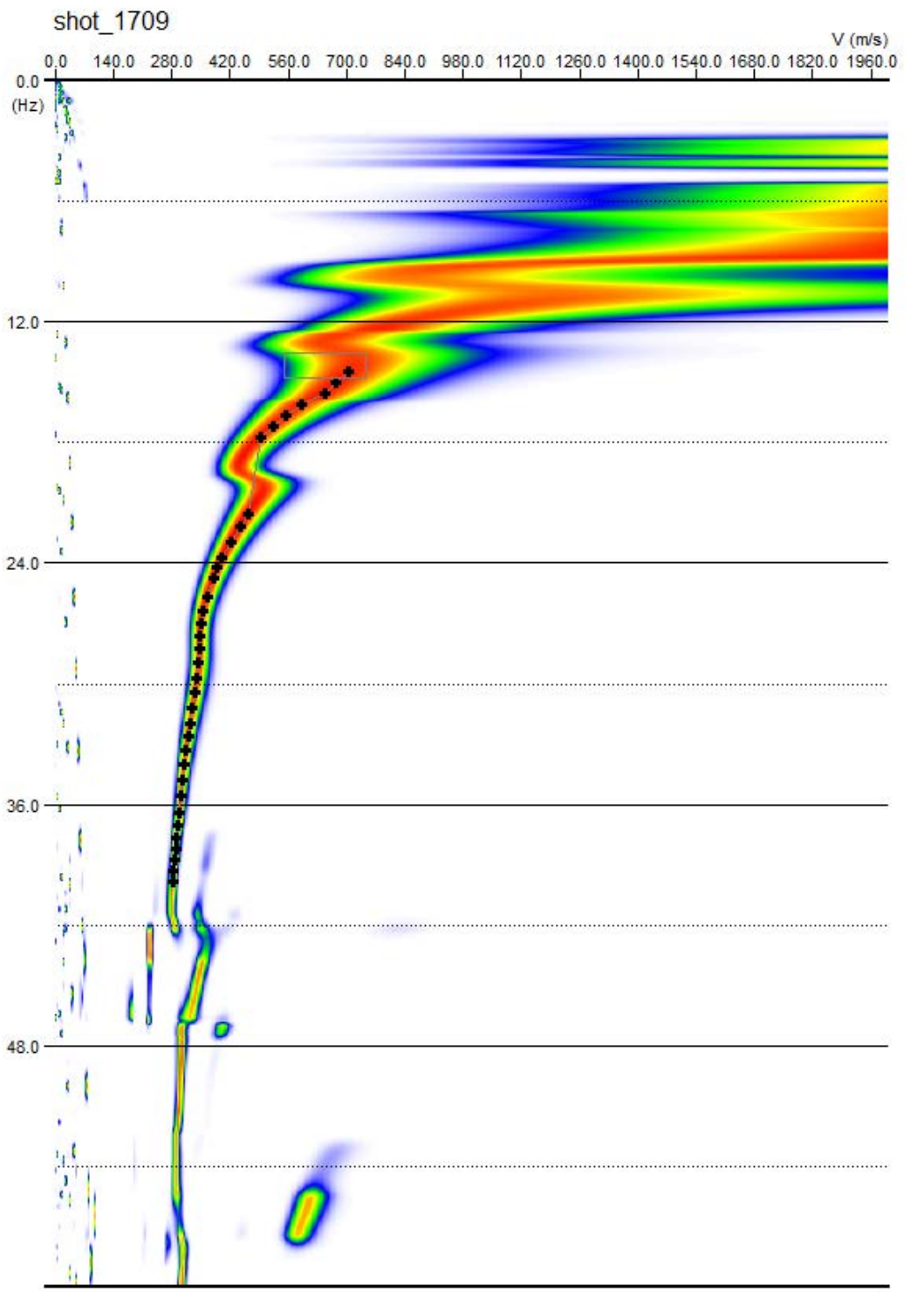

16.26 (Hz)

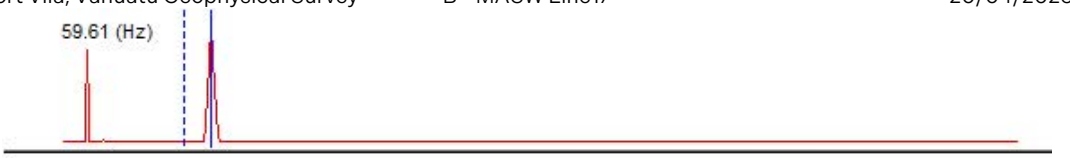

shot_1707
V (m/s)
0.0 140.0 280.0 420.0 560.0 700.0 840.0 980.0 1120.0 1260.0 1400.0 1540.0 1680.0 1820.0 1960.0
0.0
(Hz)
12.0
24.0
36.0
48.0

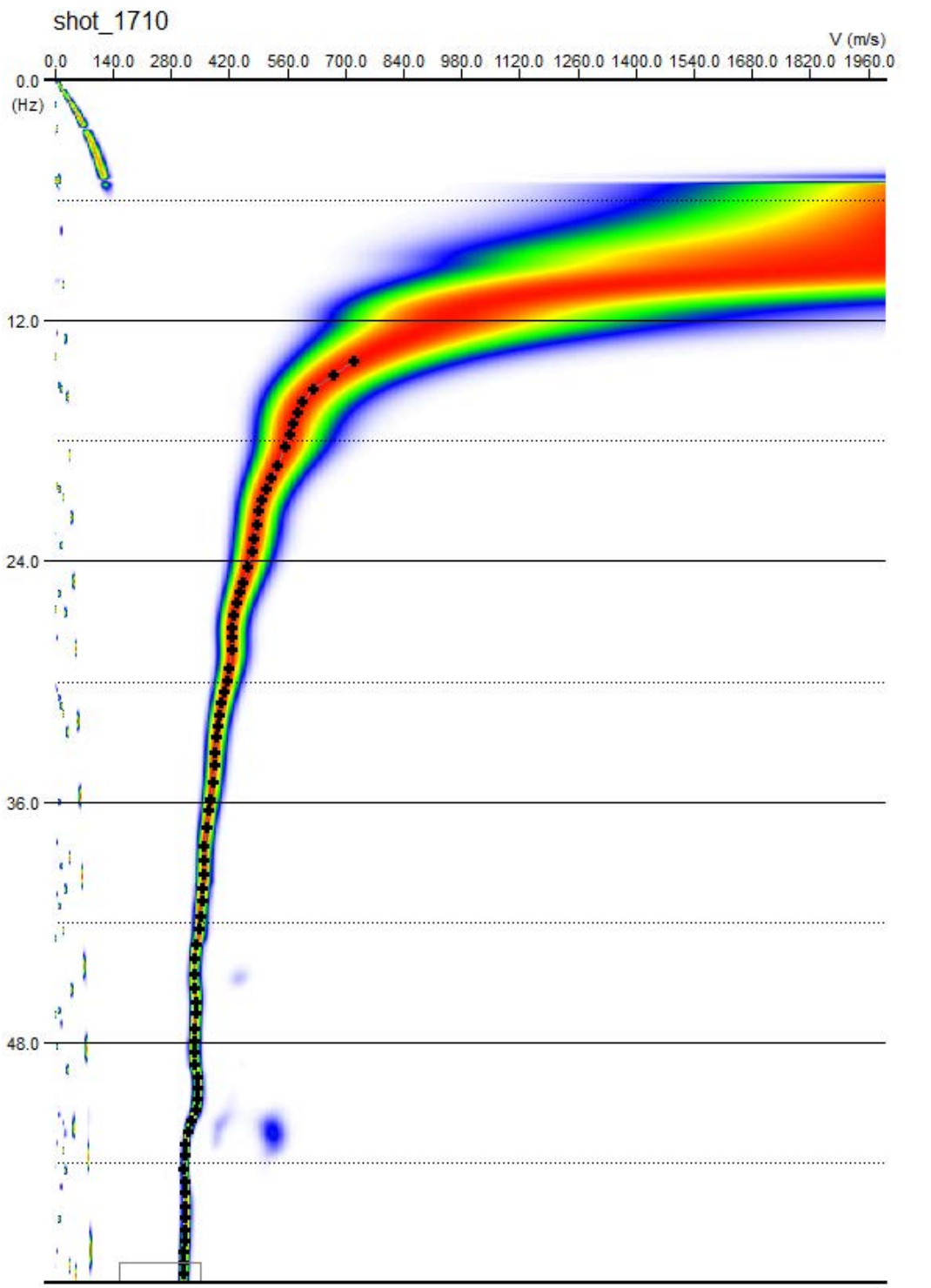

13.00 (Hz)

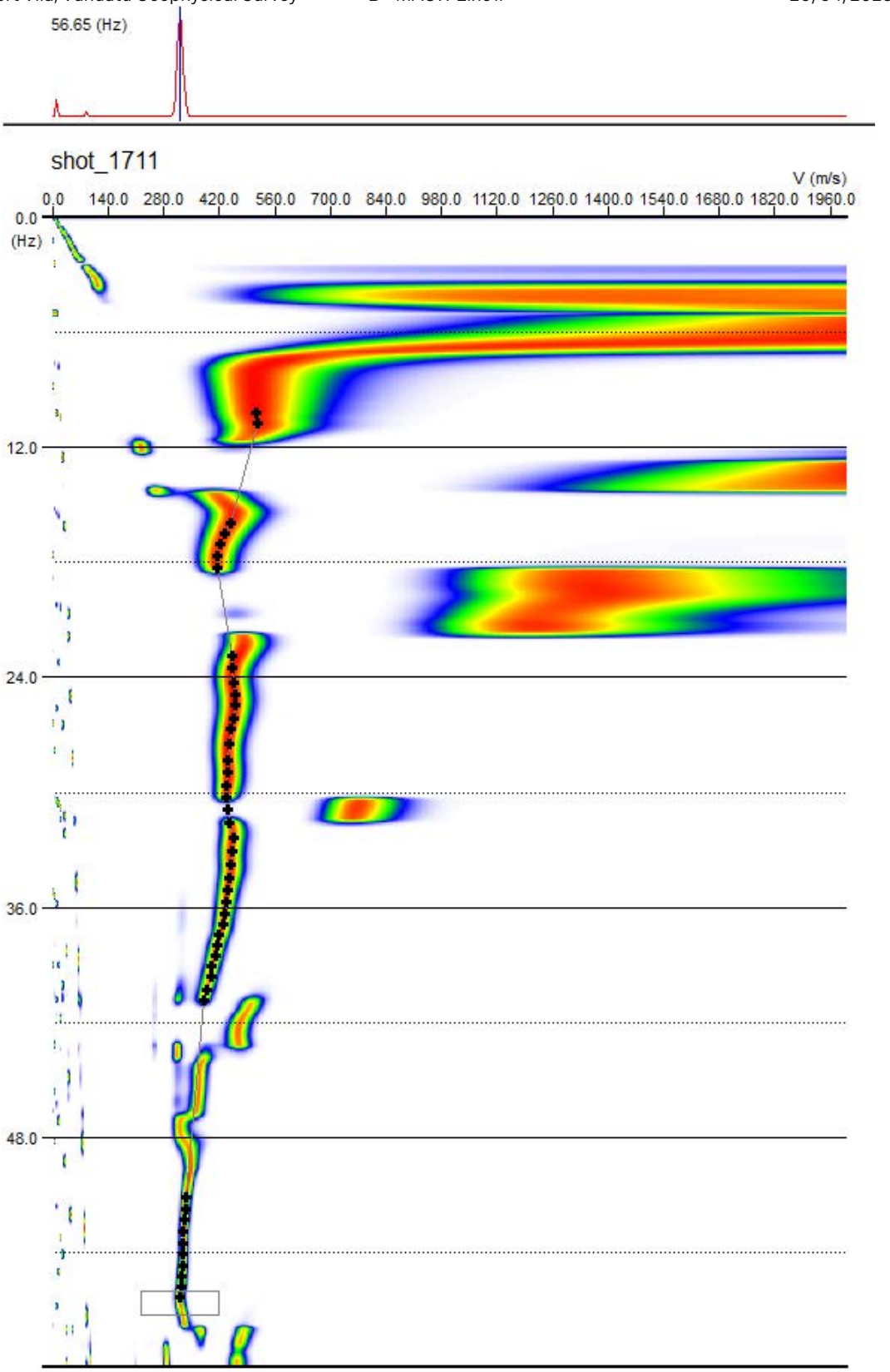

shot_1708
V (m/s)
0.0
140.0
280.0
420.0
560.0
700.0
840.0
980.0
1120.0
1260.0
1400.0
1540.0
1680.0
1820.0
1960.0
0.0
(Hz)
12.0
24.0
36.0
48.0

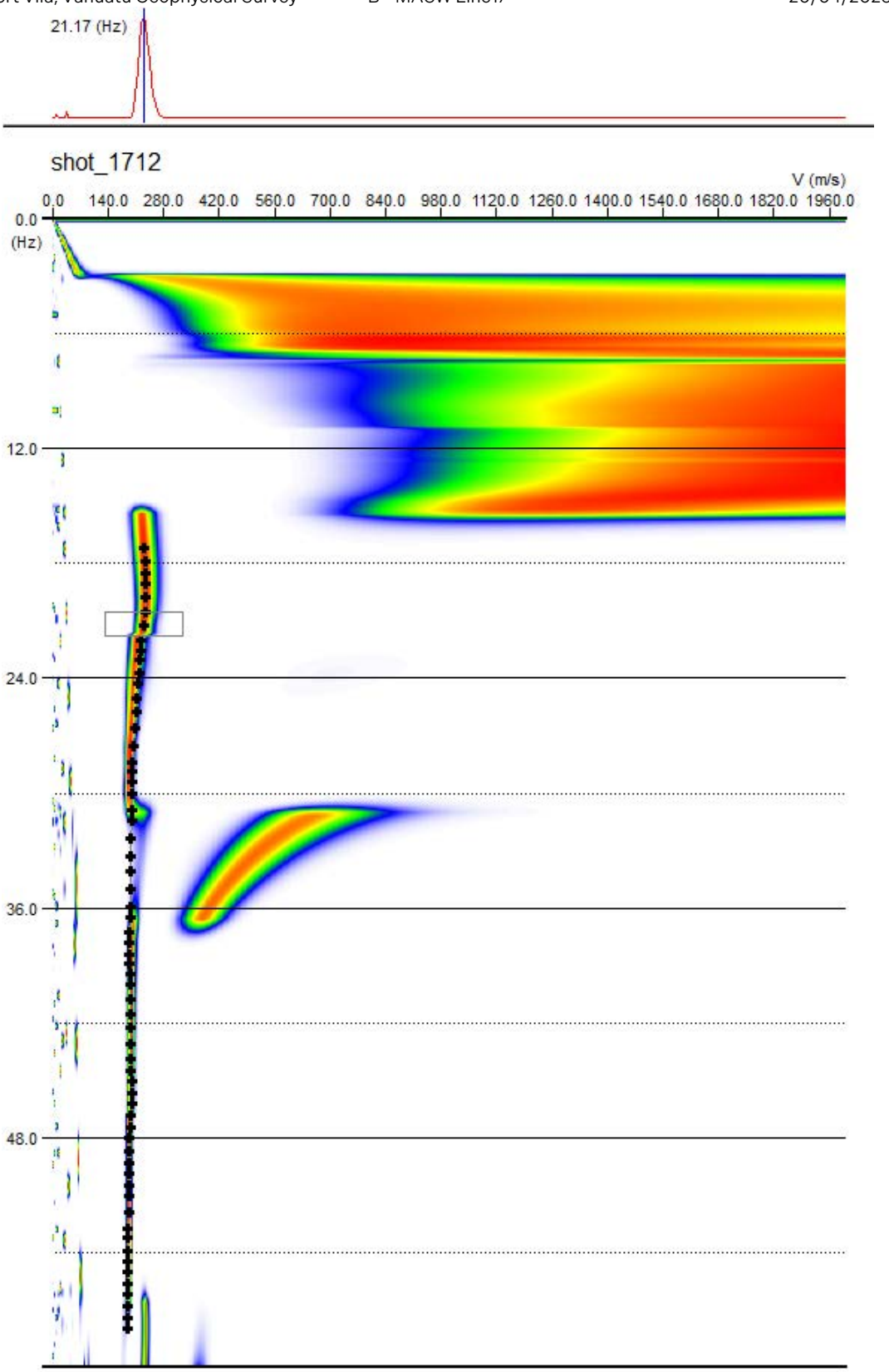

14.16 (Hz)


shot_1709
V (m/s)
0.0
140.0
280.0
420.0
560.0
700.0
840.0
980.0
1120.0
1260.0
1400.0
1540.0
1680.0
1820.0
1960.0
0.0
(Hz)
12.0
24.0
36.0
48.0

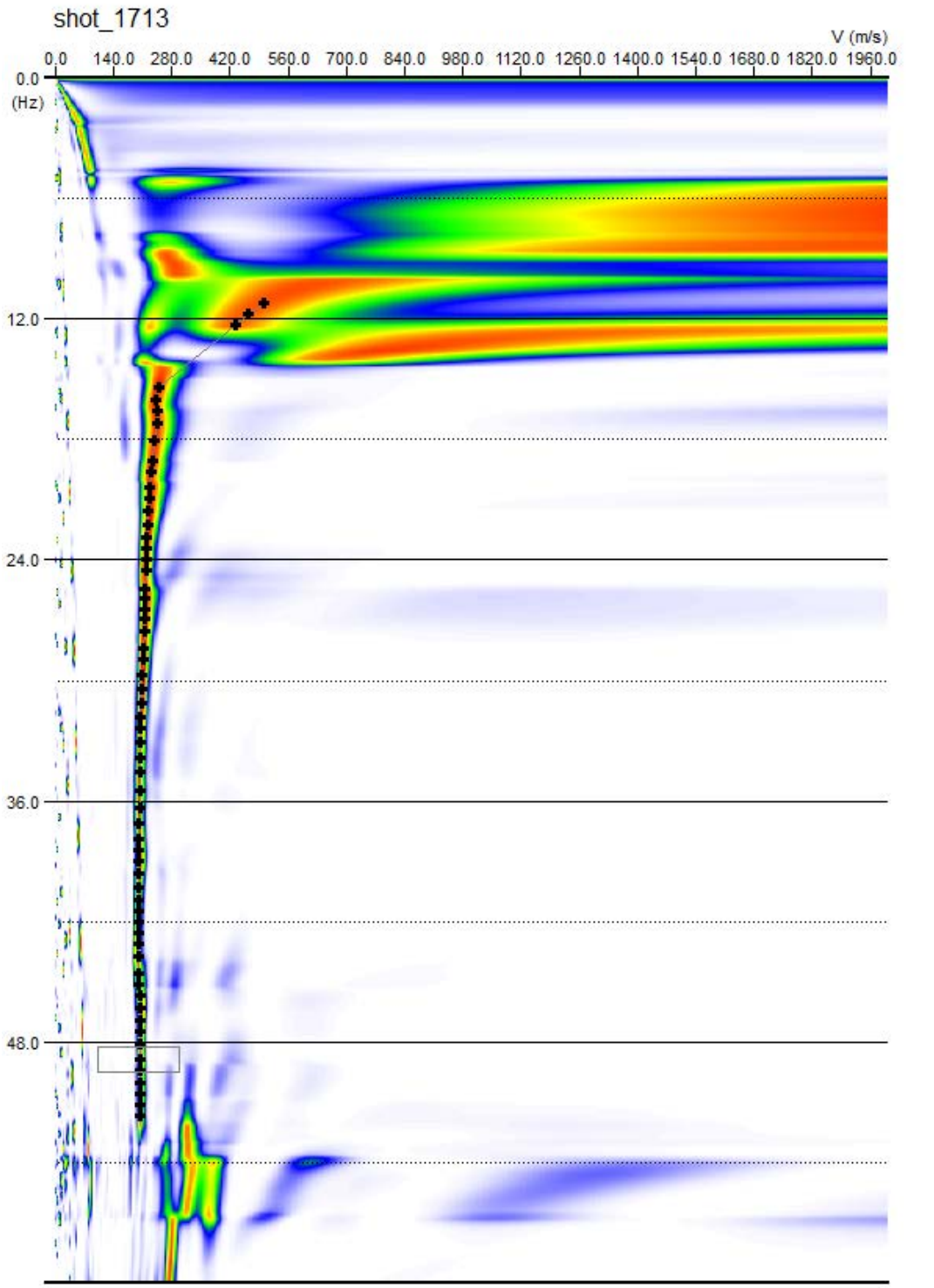

59.61 (Hz)


shot_1710
V (m/s)
0.0
140.0
280.0
420.0
560.0
700.0
840.0
980.0
1120.0
1260.0
1400.0
1540.0
1680.0
1820.0
1960.0
0.0
(Hz)
12.0
24.0
36.0
48.0

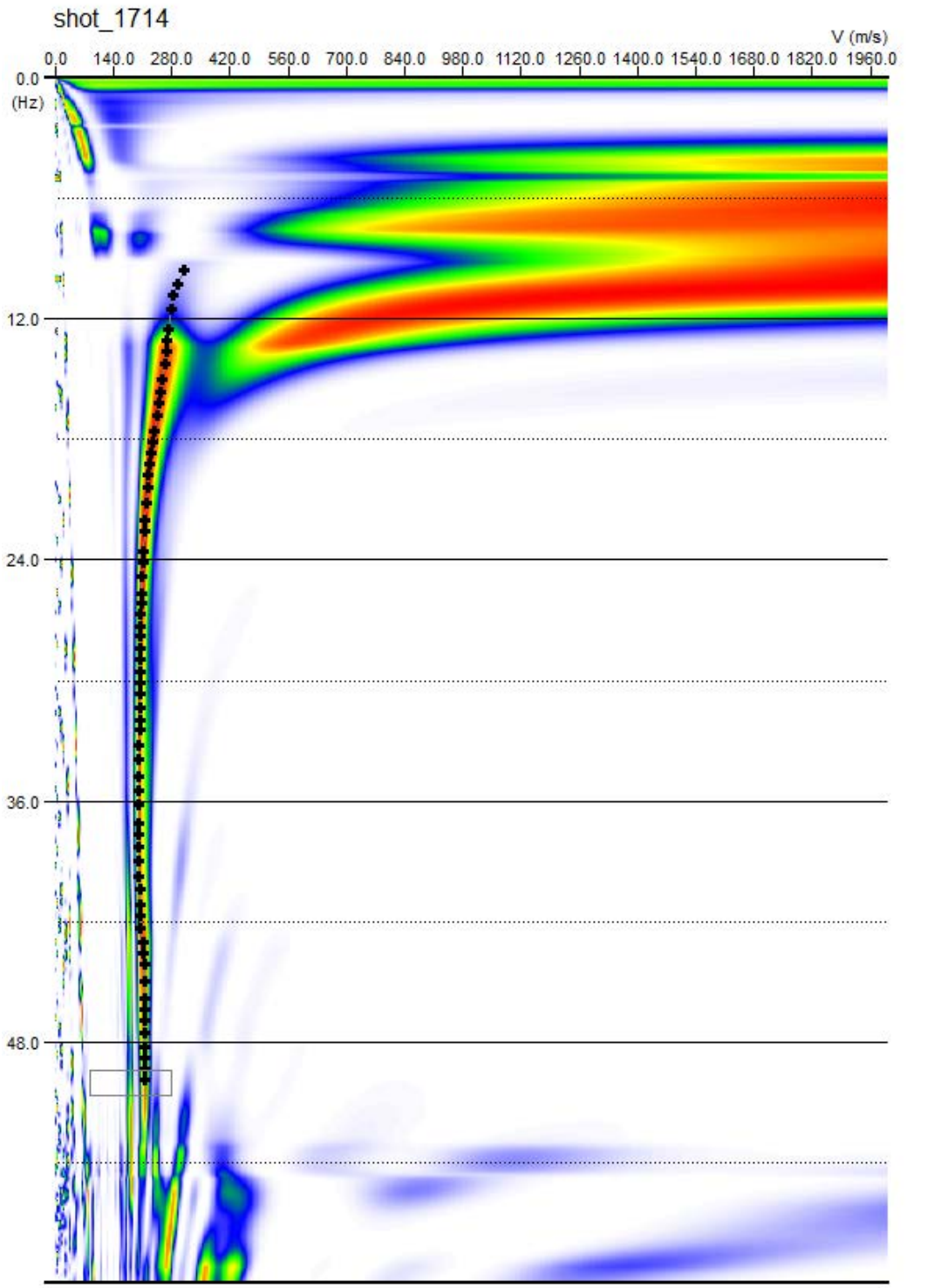

56.65 (Hz)
shot_1711
V (m/s)
0.0 140.0 280.0 420.0 560.0 700.0 840.0 980.0 1120.0 1260.0 1400.0 1540.0 1680.0 1820.0 1960.0
0.0
(Hz)
12.0
24.0
36.0
48.0


21.17 (Hz)
shot_1712
V (m/s)
0.0 140.0 280.0 420.0 560.0 700.0 840.0 980.0 1120.0 1260.0 1400.0 1540.0 1680.0 1820.0 1960.0
0.0
(Hz)
12.0
24.0
36.0
48.0

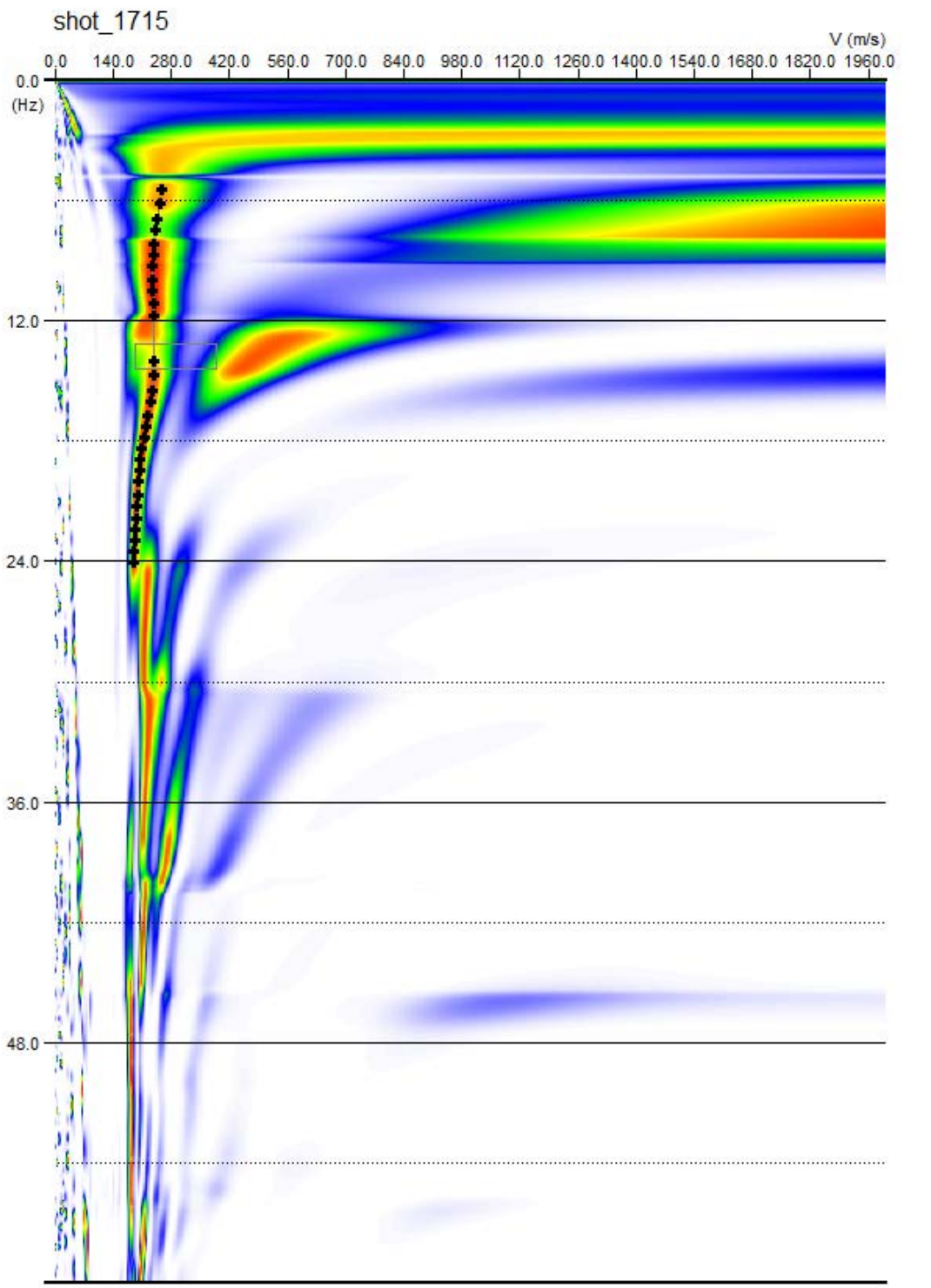

48.87 (Hz)

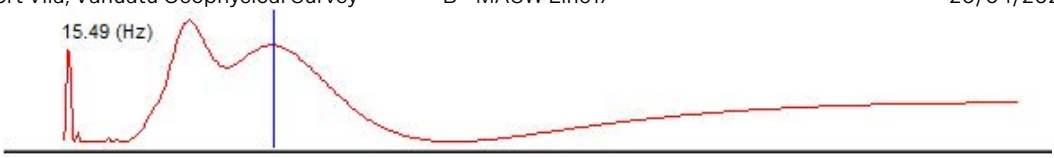

shot_1713
V (m/s)
0.0
140.0
280.0
420.0
560.0
700.0
840.0
980.0
1120.0
1260.0
1400.0
1540.0
1680.0
1820.0
1960.0
0.0
(Hz)
12.0
24.0
36.0
48.0

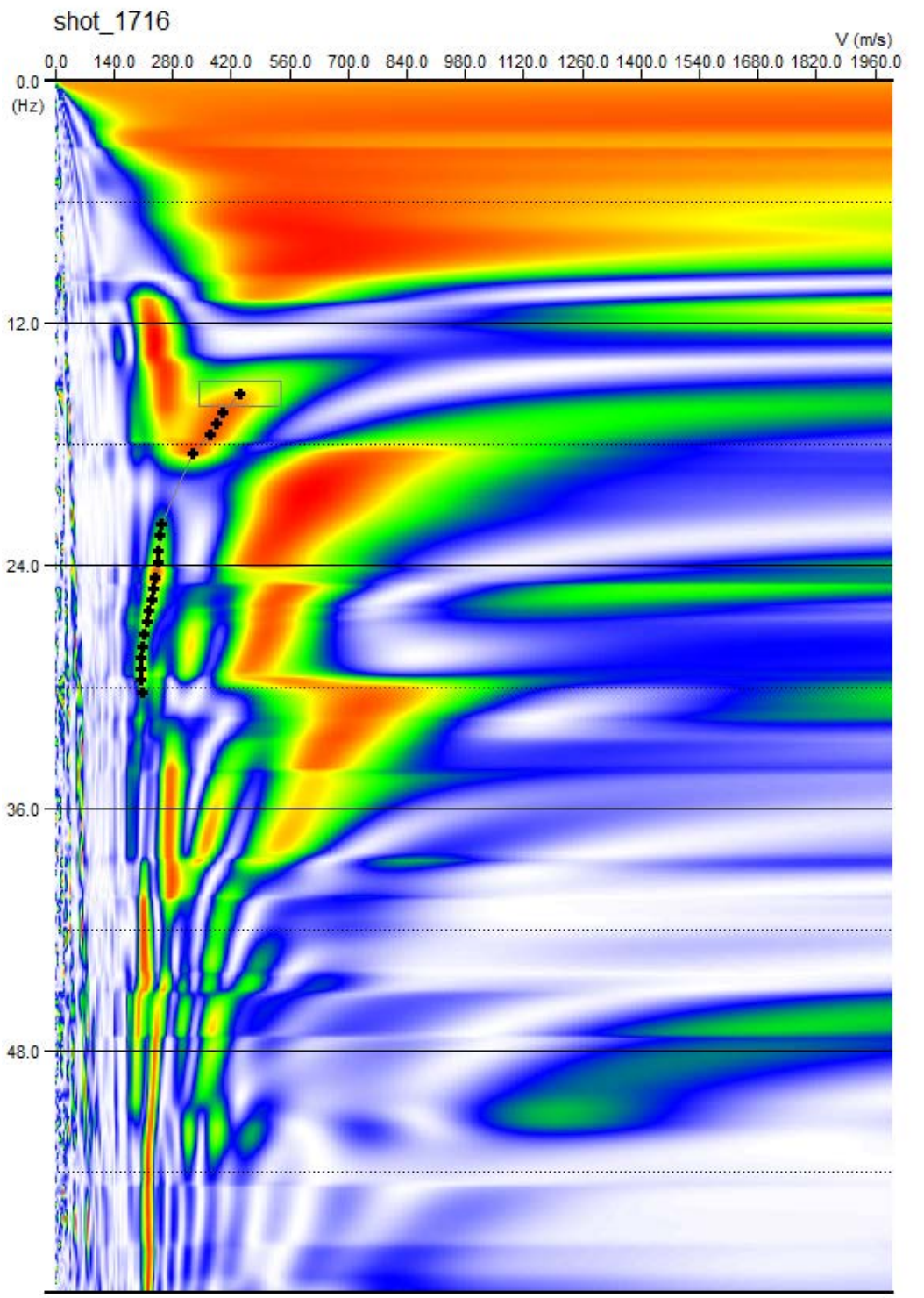

50.04 (Hz)

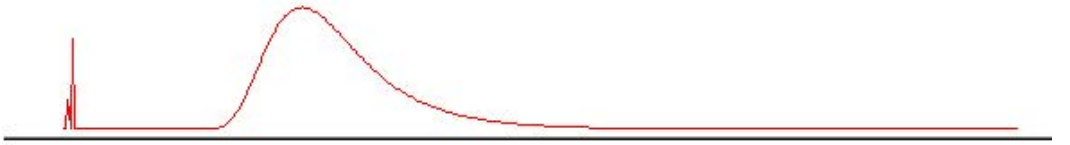

shot_1714
V (m/s)
0.0
140.0
280.0
420.0
560.0
700.0
840.0
980.0
1120.0
1260.0
1400.0
1540.0
1680.0
1820.0
1960.0
0.0
(Hz)
12.0
24.0
36.0
48.0

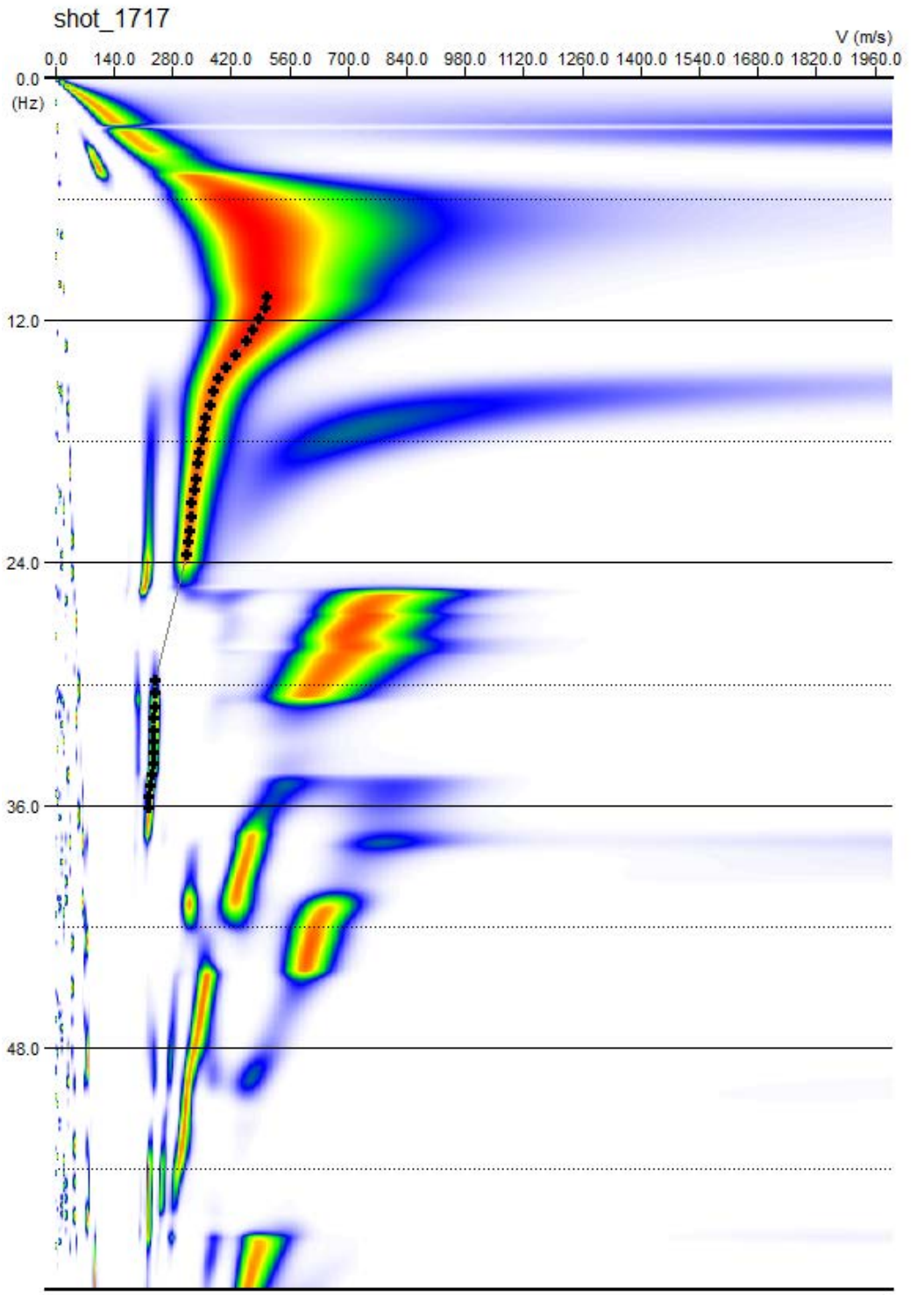

13.77 (Hz)

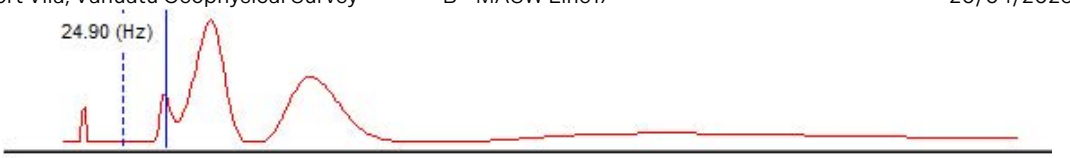

shot_1715
V (m/s)
0.0 140.0 280.0 420.0 560.0 700.0 840.0 980.0 1120.0 1260.0 1400.0 1540.0 1680.0 1820.0 1960.0
0.0
(Hz)
12.0
24.0
36.0
48.0

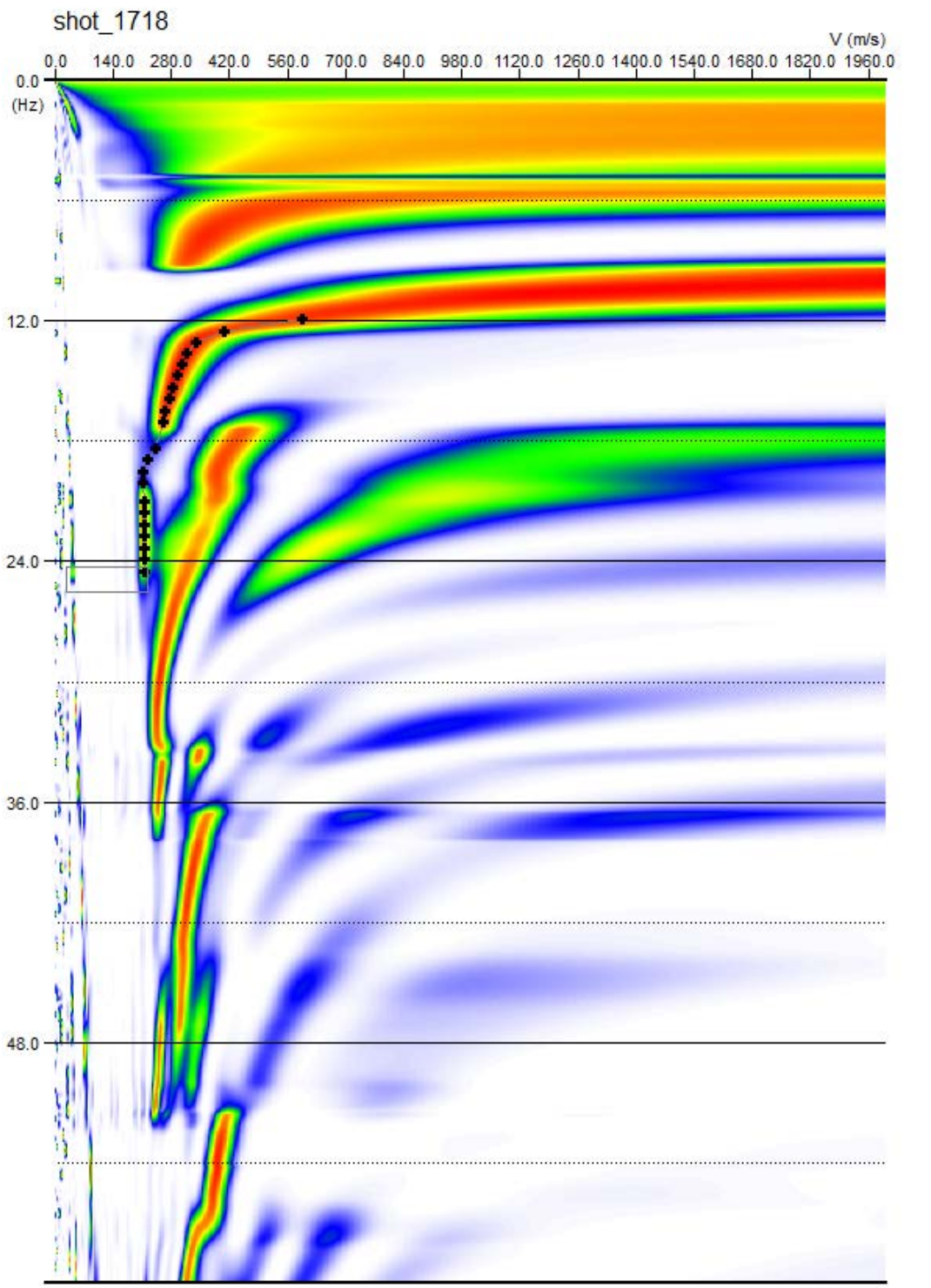

15.49 (Hz)

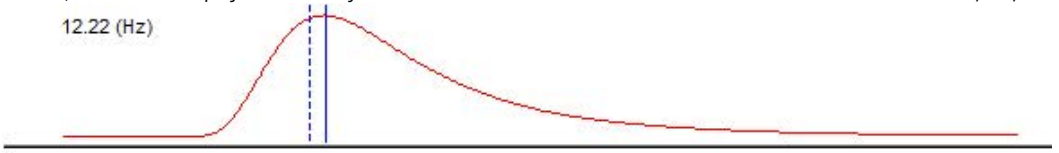

shot_1716
V (m/s)
0.0 140.0 280.0 420.0 560.0 700.0 840.0 980.0 1120.0 1260.0 1400.0 1540.0 1680.0 1820.0 1960.0
0.0
(Hz)
12.0
24.0
36.0
48.0

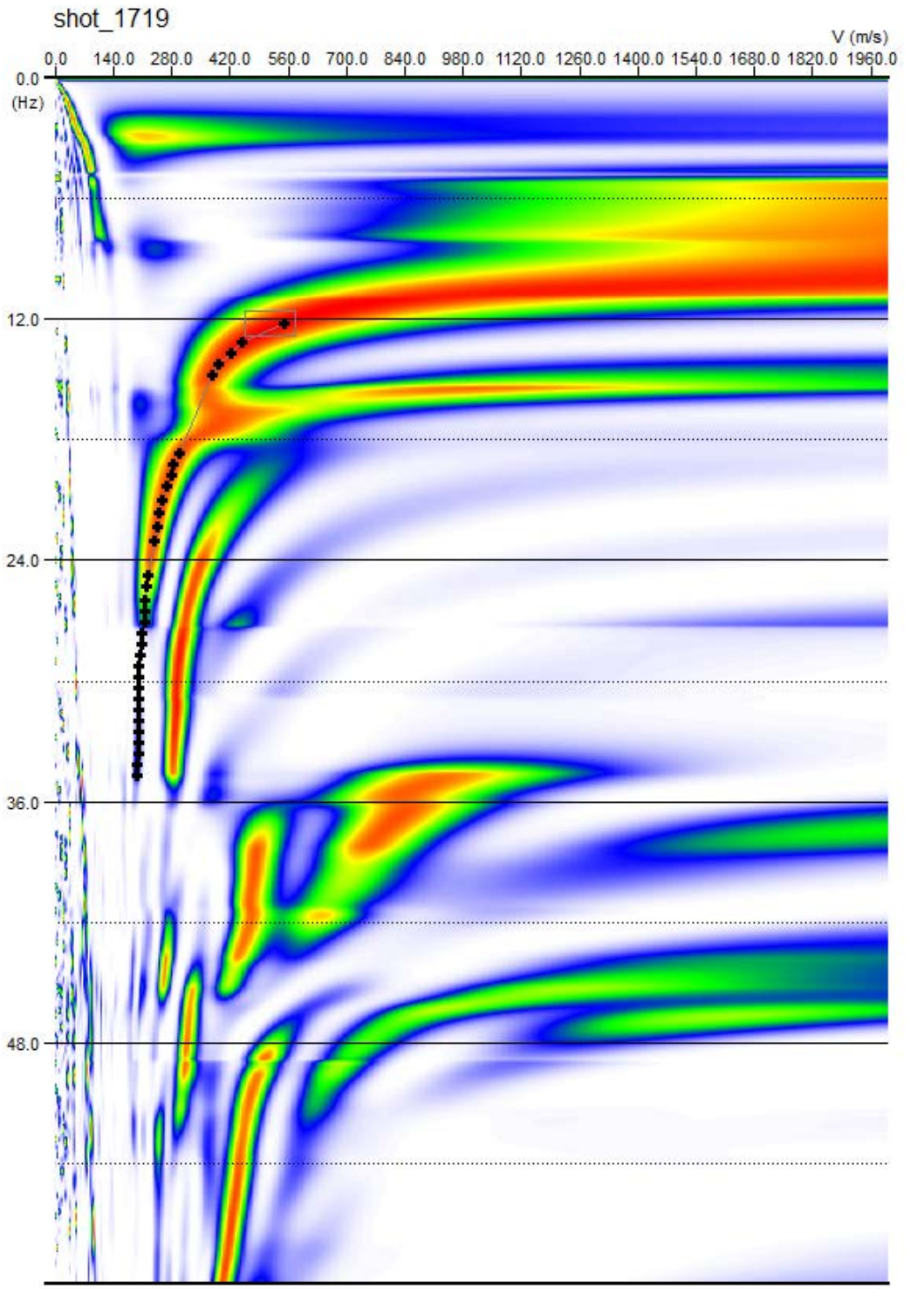


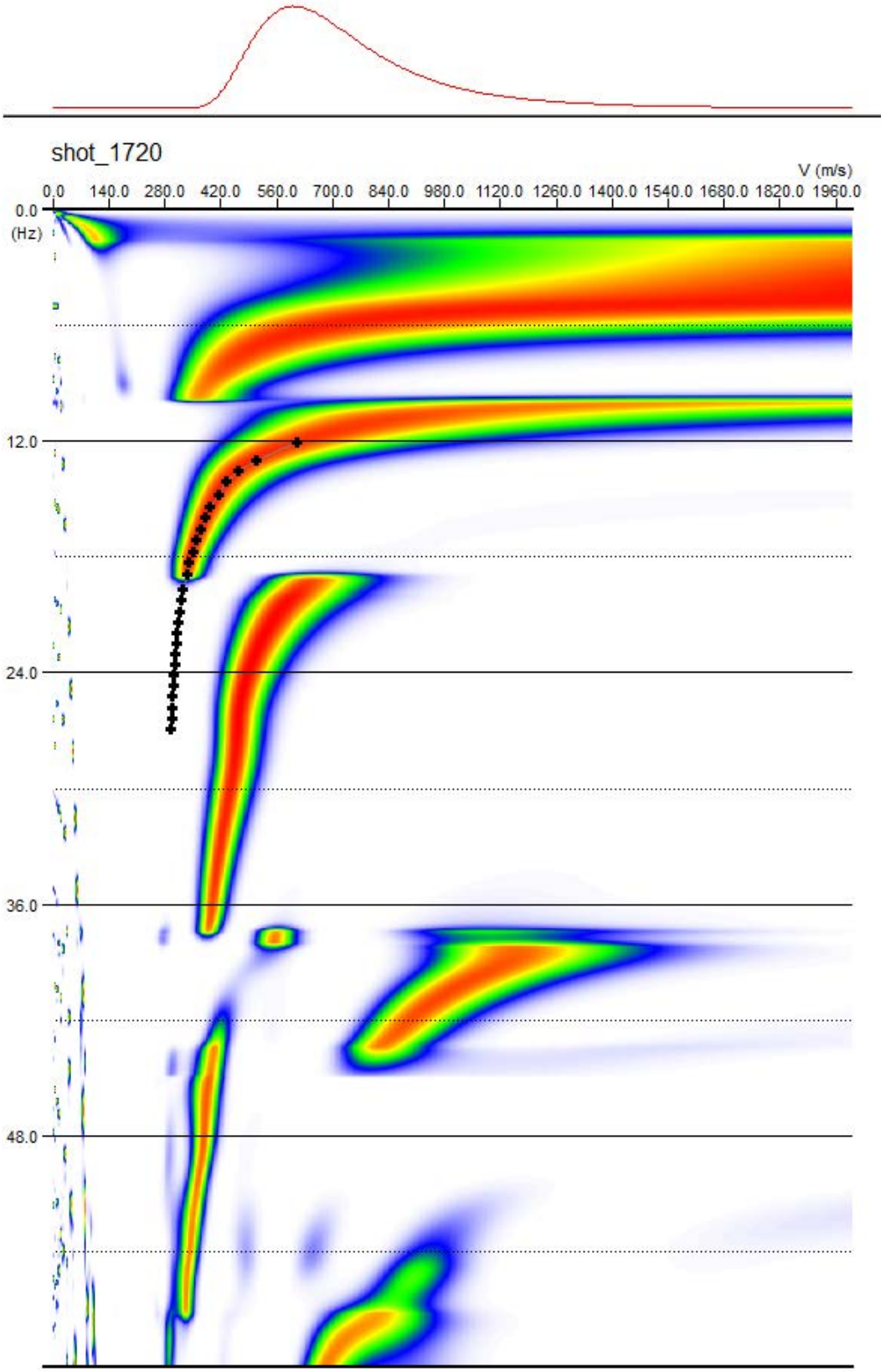

shot_1717
V (m/s)
0.0
140.0
280.0
420.0
560.0
700.0
840.0
980.0
1120.0
1260.0
1400.0
1540.0
1680.0
1820.0
1960.0
0.0
(Hz)
12.0
24.0
36.0
48.0

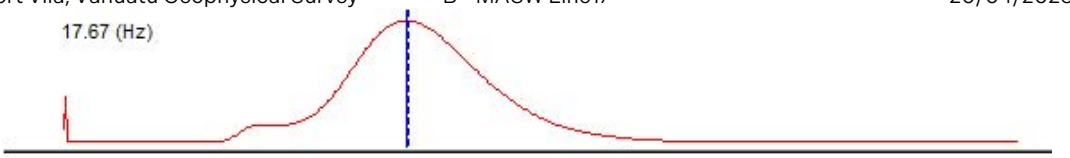

24.90 (Hz)

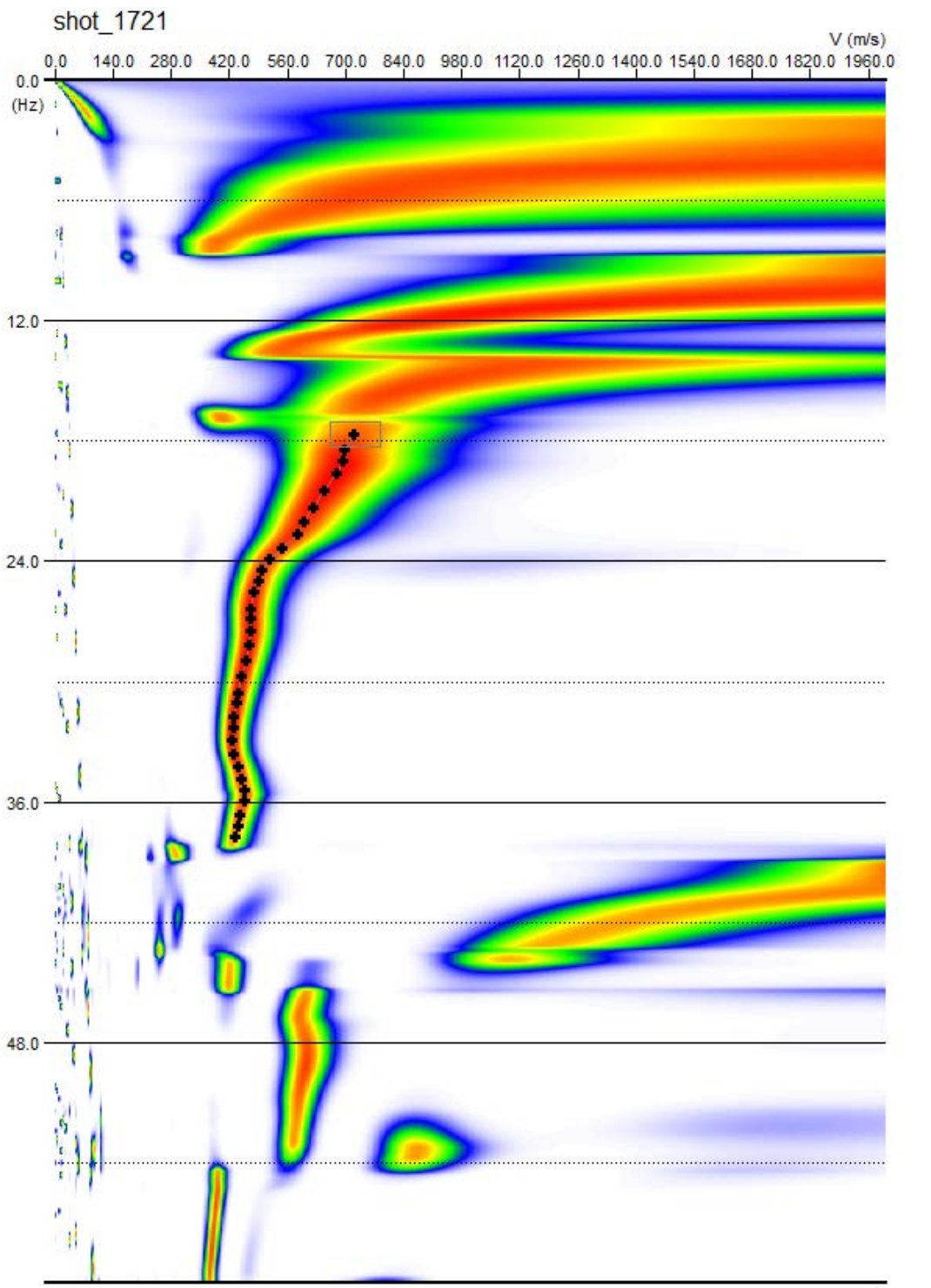

shot_1718
V (m/s)
0.0 140.0 280.0 420.0 560.0 700.0 840.0 980.0 1120.0 1260.0 1400.0 1540.0 1680.0 1820.0 1960.0
0.0
(Hz)
12.0
24.0
36.0
48.0

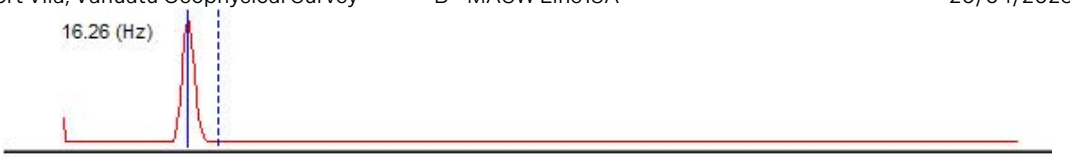

12.22 (Hz)

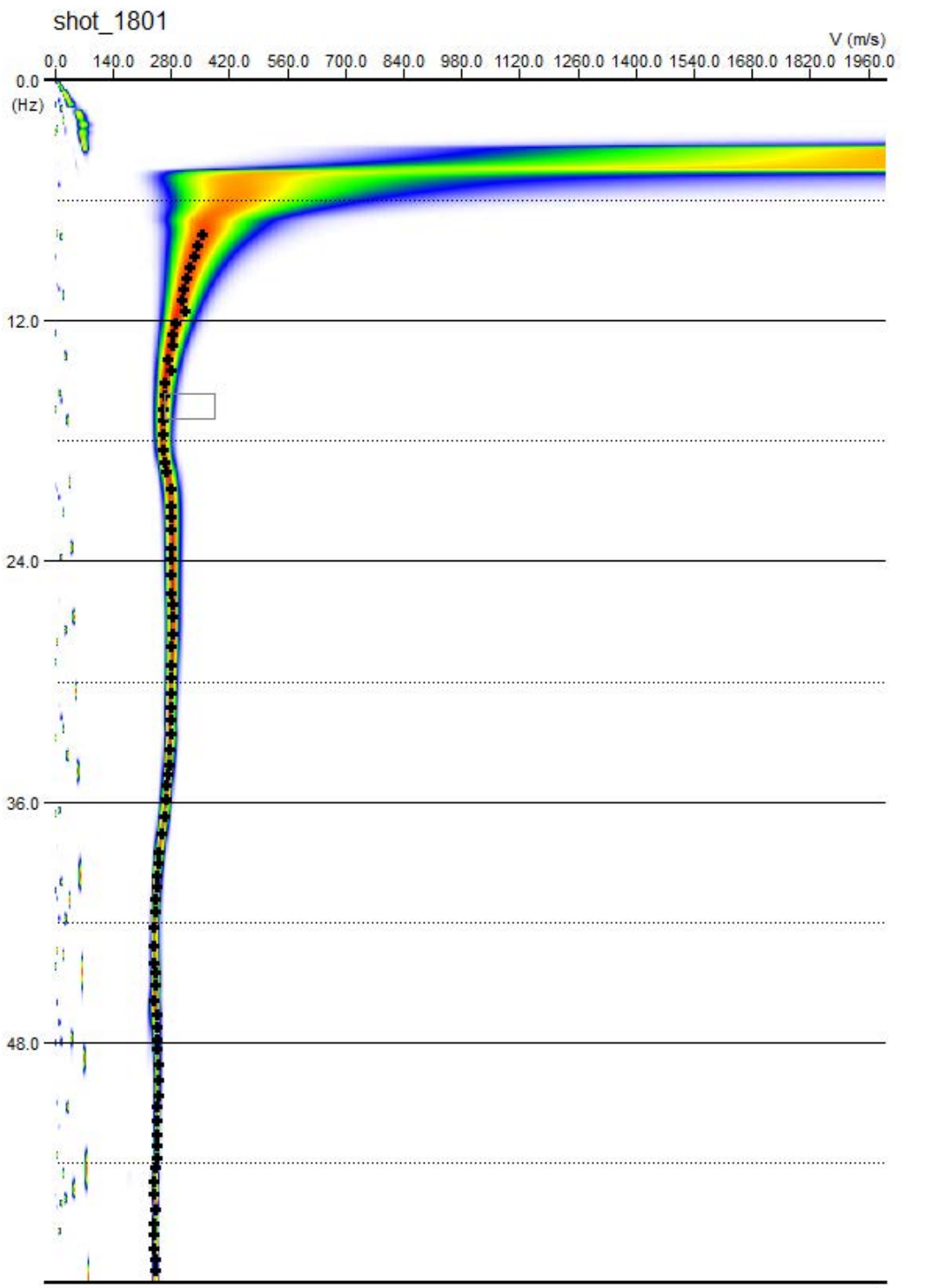

shot_1719
V (m/s)
0.0 140.0 280.0 420.0 560.0 700.0 840.0 980.0 1120.0 1260.0 1400.0 1540.0 1680.0 1820.0 1960.0
0.0
(Hz)
12.0
24.0
36.0
48.0

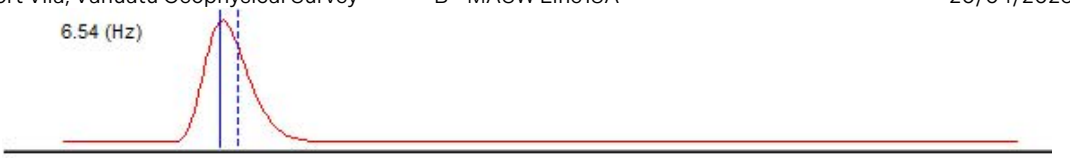

shot_1720
V (m/s)
0.0 140.0 280.0 420.0 560.0 700.0 840.0 980.0 1120.0 1260.0 1400.0 1540.0 1680.0 1820.0 1960.0
0.0
(Hz)
12.0
24.0
36.0
48.0

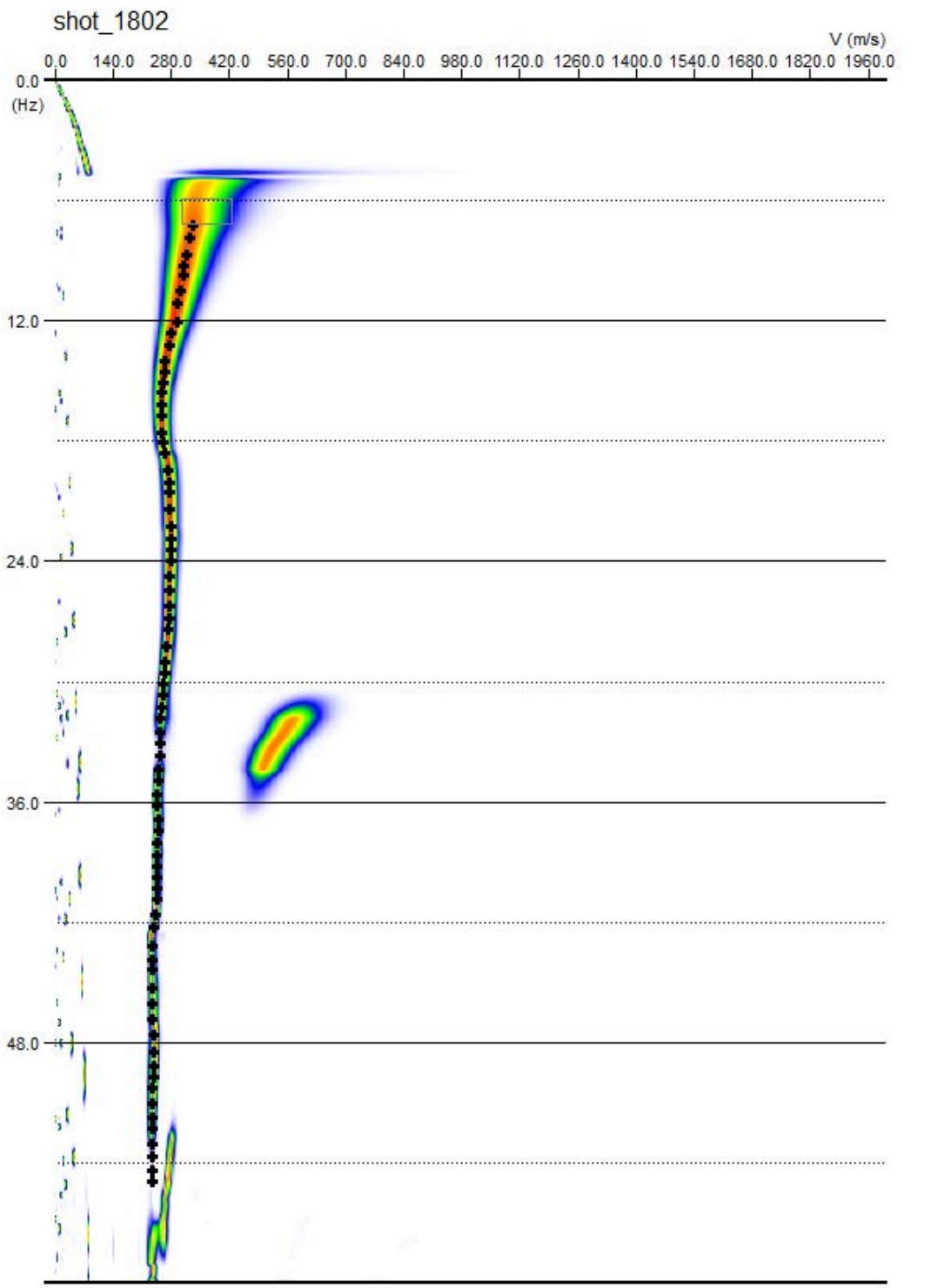

17.67 (Hz)

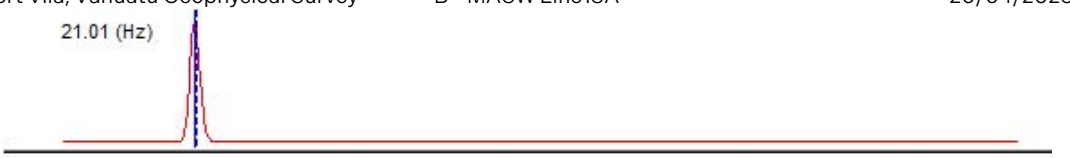

shot_1721
V (m/s)
0.0
140.0
280.0
420.0
560.0
700.0
840.0
980.0
1120.0
1260.0
1400.0
1540.0
1680.0
1820.0
1960.0
0.0
(Hz)
12.0
24.0
36.0
48.0

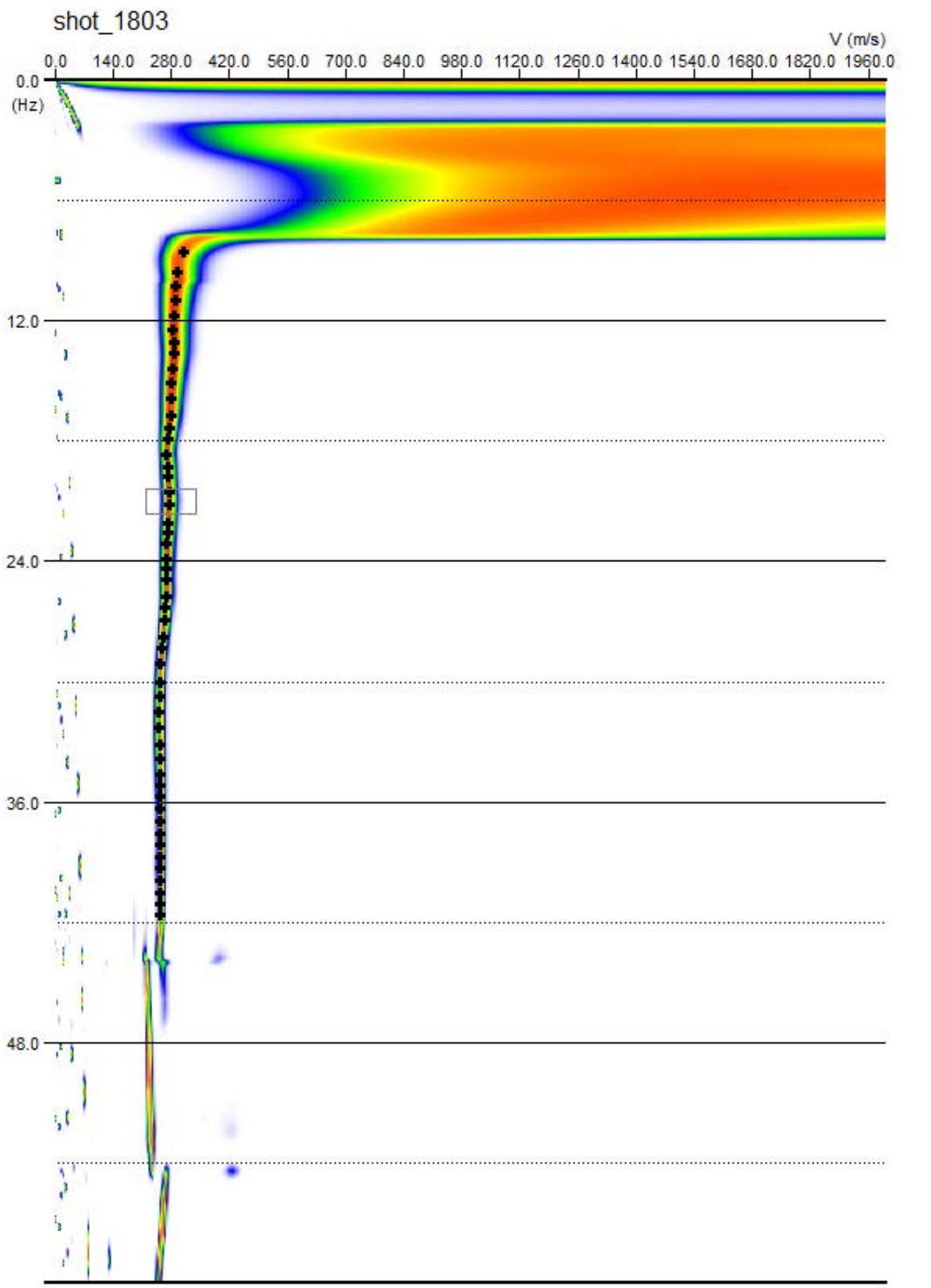

16.26 (Hz)

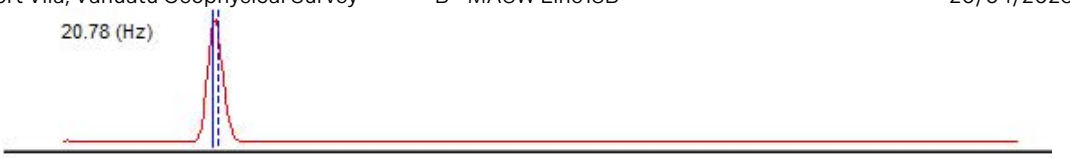

shot_1801
V (m/s)
0.0
140.0
280.0
420.0
560.0
700.0
840.0
980.0
1120.0
1260.0
1400.0
1540.0
1680.0
1820.0
1960.0
0.0
(Hz)
12.0
24.0
36.0
48.0

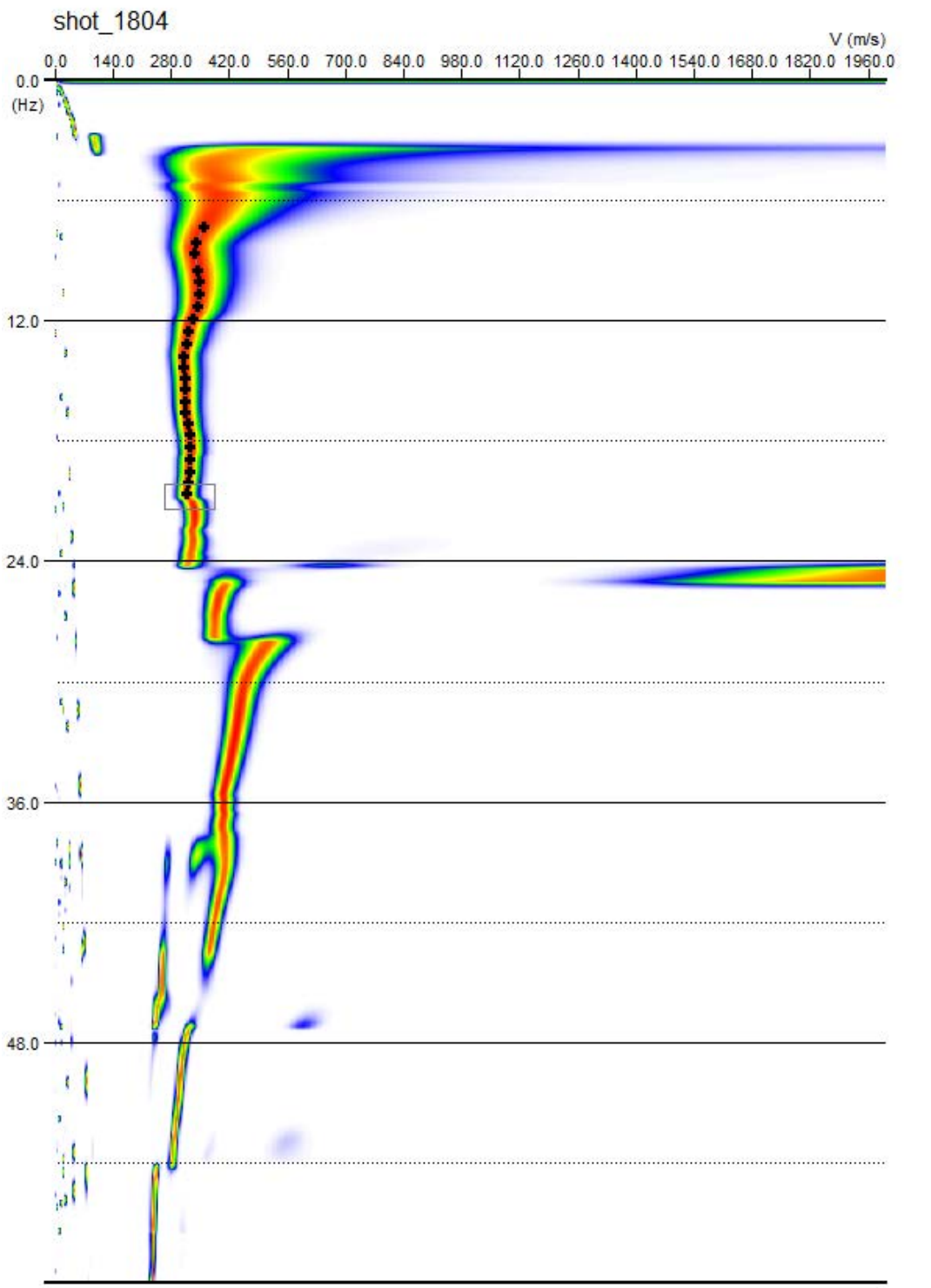

6.54 (Hz)

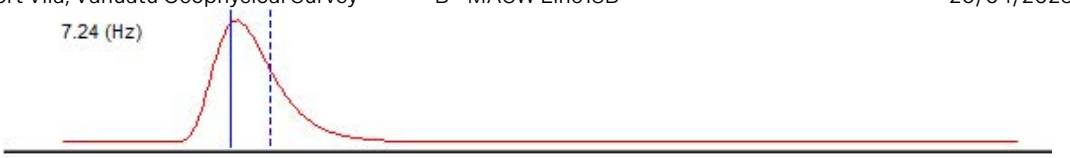

shot_1802
V (m/s)
0.0 140.0 280.0 420.0 560.0 700.0 840.0 980.0 1120.0 1260.0 1400.0 1540.0 1680.0 1820.0 1960.0
0.0
(Hz)
12.0
24.0
36.0
48.0

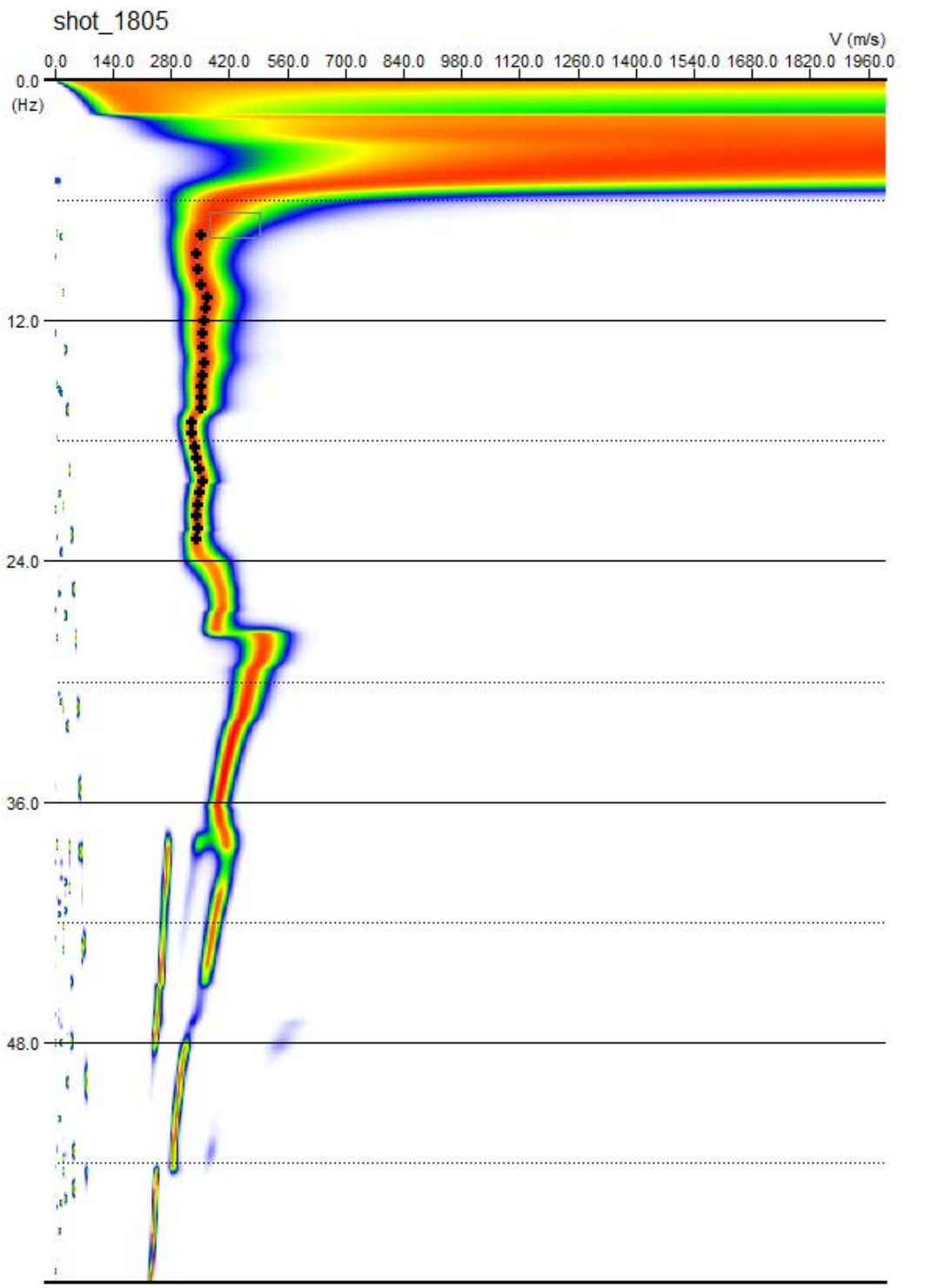

21.01 (Hz)


shot_1803
V (m/s)
0.0 140.0 280.0 420.0 560.0 700.0 840.0 980.0 1120.0 1260.0 1400.0 1540.0 1680.0 1820.0 1960.0
0.0
(Hz)
12.0
24.0
36.0
48.0

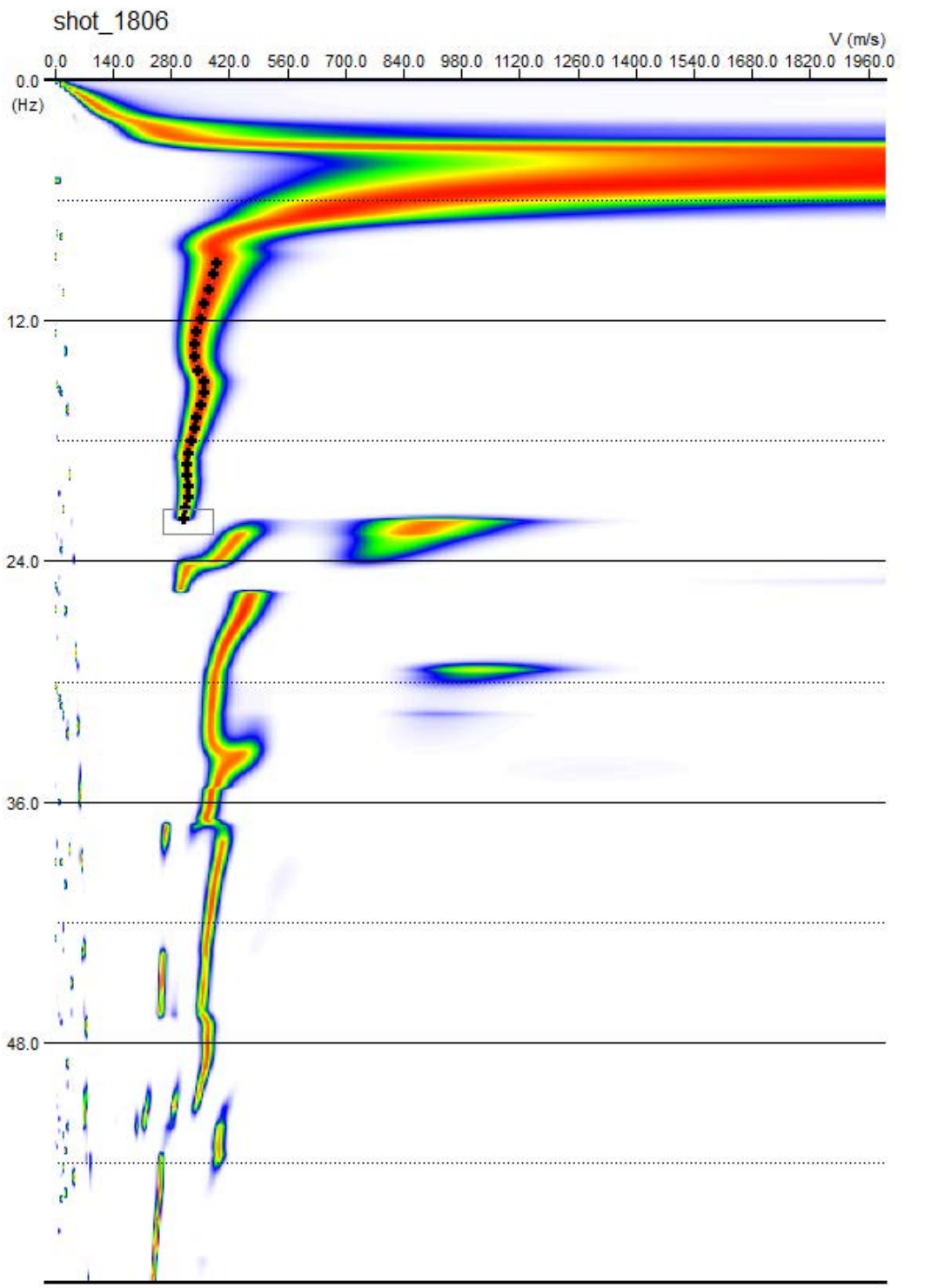

20.78 (Hz)

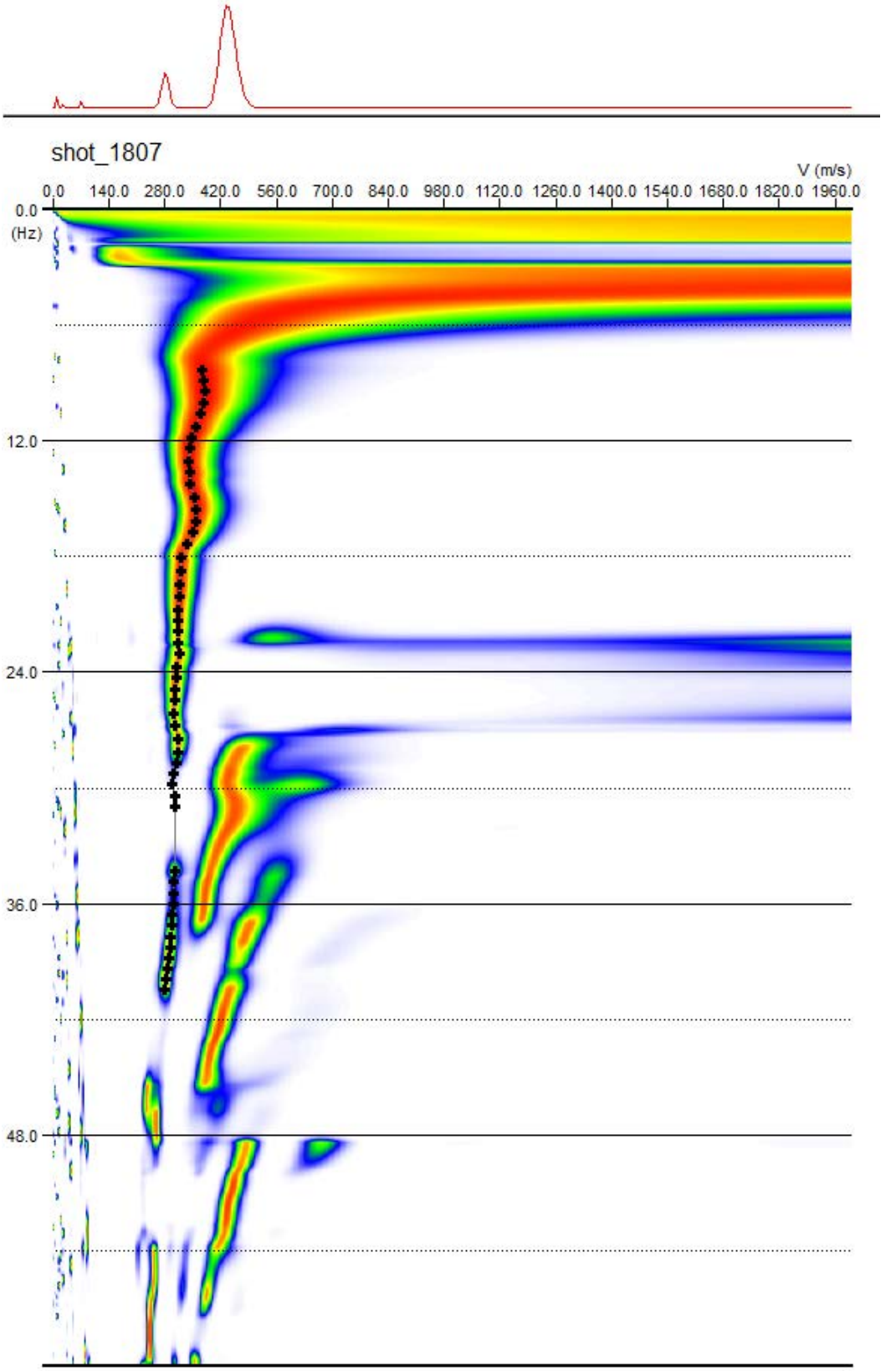

shot_1804
V (m/s)
0.0
140.0
280.0
420.0
560.0
700.0
840.0
980.0
1120.0
1260.0
1400.0
1540.0
1680.0
1820.0
1960.0
0.0
(Hz)
12.0
24.0
36.0
48.0

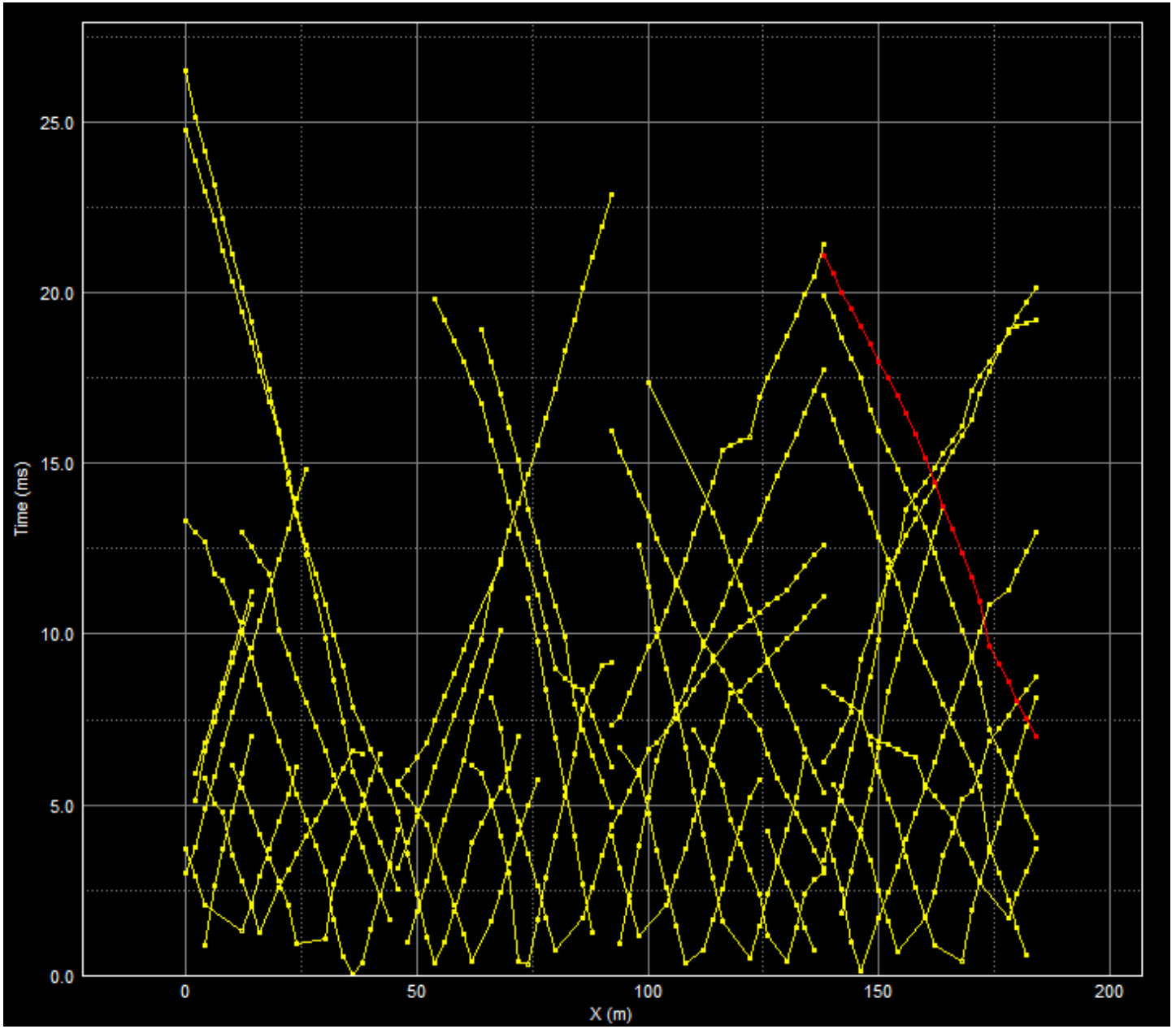

7.24 (Hz)


shot_1805
V (m/s)
0.0
140.0
280.0
420.0
560.0
700.0
840.0
980.0
1120.0
1260.0
1400.0
1540.0
1680.0
1820.0
1960.0
0.0
(Hz)
12.0
24.0
36.0
48.0


22.02 (Hz)

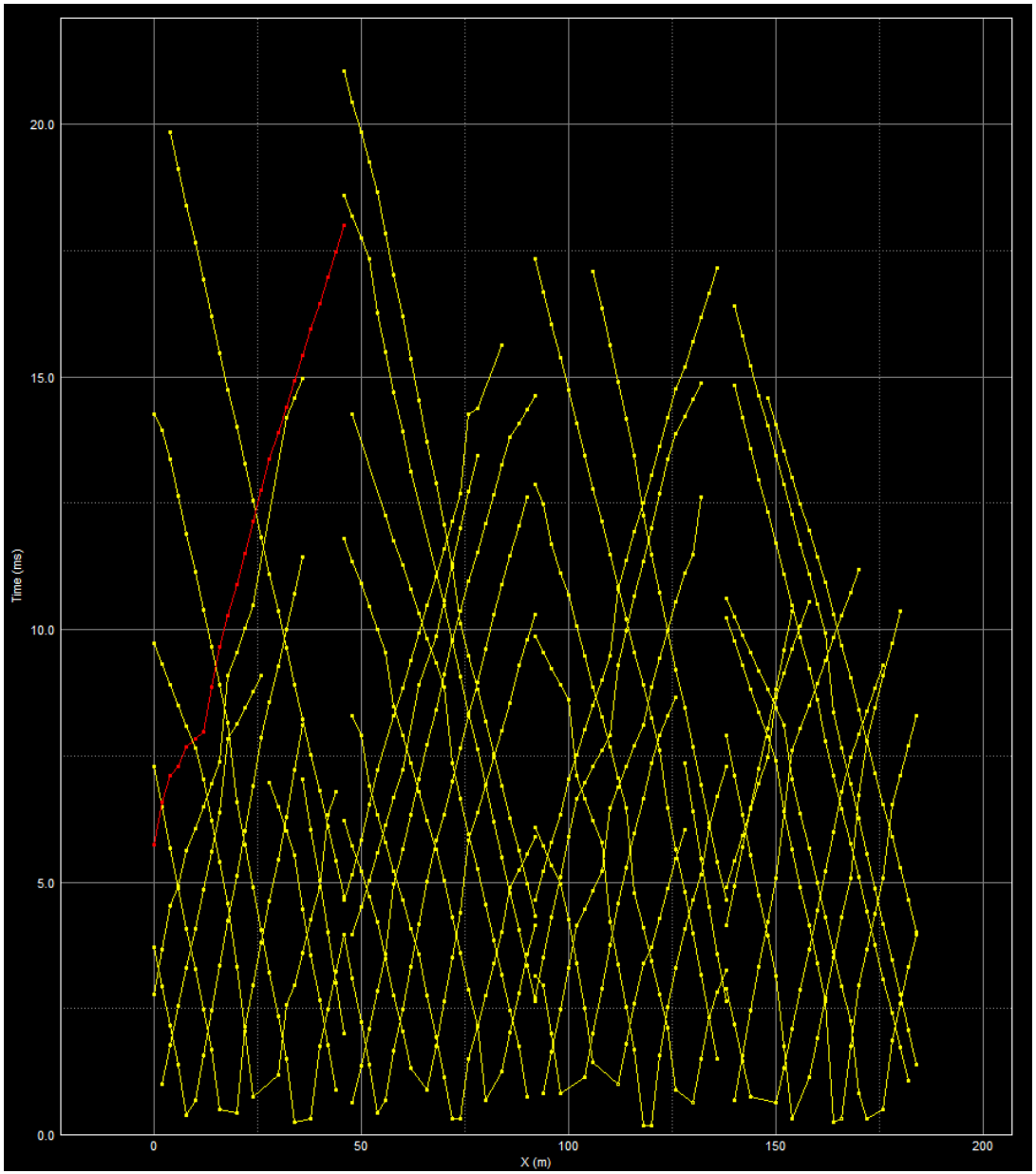

shot_1806
V (m/s)
0.0
140.0
280.0
420.0
560.0
700.0
840.0
980.0
1120.0
1260.0
1400.0
1540.0
1680.0
1820.0
1960.0
0.0
(Hz)
12.0
24.0
36.0
48.0


shot_1807
V (m/s)
0.0
140.0
280.0
420.0
560.0
700.0
840.0
980.0
1120.0
1260.0
1400.0
1540.0
1680.0
1820.0
1960.0
0.0
(Hz)
12.0
24.0
36.0
48.0

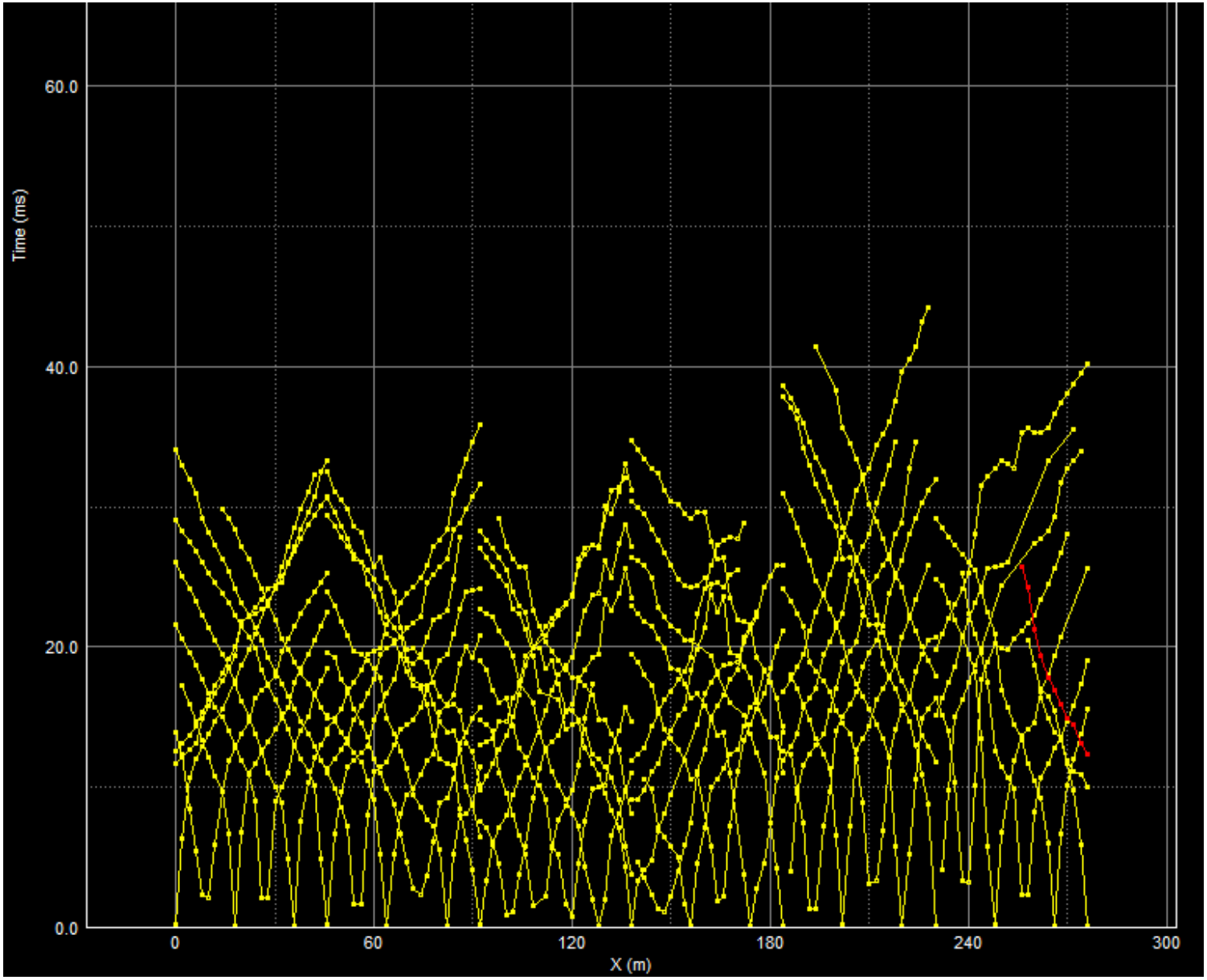


RDCL®

TITLE	SRT Line 01a Travel Time Curve	PROJECT	250306			
PROJECT	Port Vila, Vanuatu Seismic Survey	DRAWN BY	OG	DATE	27/03/26	FIG
CLIENT	T+T	CHECKED BY	SJ	DATE	27/03/26	B01

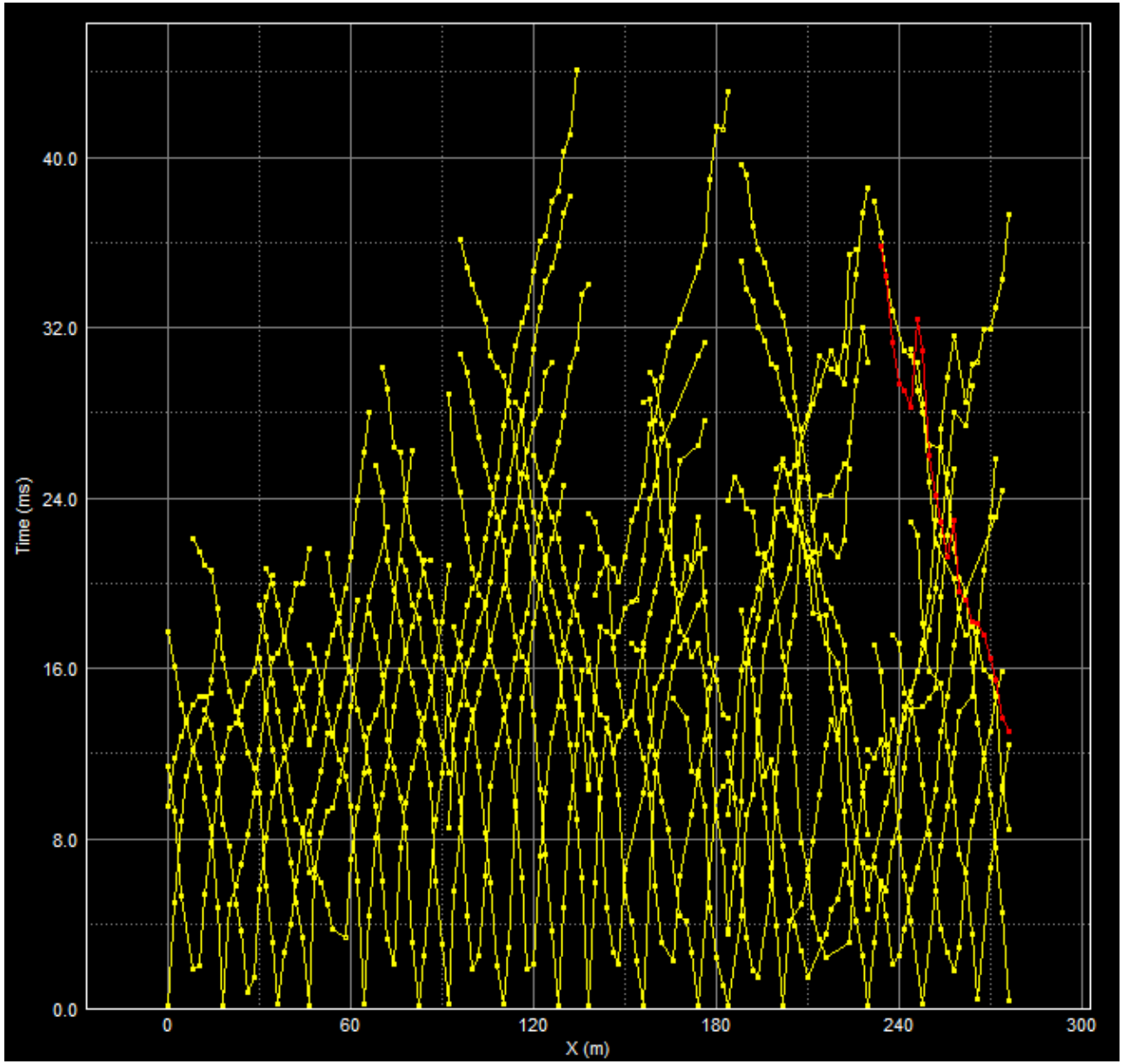


RDCL®	TITLE	SRT Line 01b Travel Time Curve	PROJECT	250306			
	PROJECT	Port Vila, Vanuatu Seismic Survey	DRAWN BY	OG	DATE	27/03/26	FIG
	CLIENT	T+T	CHECKED BY	SJ	DATE	27/03/26	B02



RDCL®

TITLE	SRT Line 02 Travel Time Curve	PROJECT	250306			
PROJECT	Port Vila, Vanuatu Seismic Survey	DRAWN BY	OG	DATE	27/03/26	FIG
CLIENT	T+T	CHECKED BY	SJ	DATE	27/03/26	B03



RDCL®	TITLE	SRT Line 03 Travel Time Curve	PROJECT	250306			
	PROJECT	Port Vila, Vanuatu Seismic Survey	DRAWN BY	OG	DATE	27/03/26	FIG
	CLIENT	T+T	CHECKED BY	SJ	DATE	27/03/26	B04

APPENDIX C

3D LEAPFROG OUTPUTS

APPENDIX D

RAW DATA (DIGITAL ONLY)

APPENDIX E

Vs SOUNDINGS OUTPUTS

TABLES

TABLE E1: SOUNDING 01B. E1
TABLE E2: SOUNDING 01C. E1
TABLE E3: SOUNDING 05A. E2
TABLE E4: SOUNDING 05B. E2
TABLE E5: SOUNDING 05C. E2
TABLE E6: SOUNDING 06A. E3
TABLE E7: SOUNDING 06B. E3
TABLE E8: SOUNDING 06C. E3
TABLE E9: SOUNDING 07A. E4
TABLE E10: SOUNDING 08. E4
TABLE E11: SOUNDING 10A. E4
TABLE E12: SOUNDING 10B. E5
TABLE E13: SOUNDING 14. E5
TABLE E14: SOUNDING 18A. E5
TABLE E15: SOUNDING 18B. E6

TABLE E1: SOUNDING 01B.

From	To	Layer Thickness	Vs
m	m	m	m/s
0	2.26	2.26	352
2.26	4.65	2.39	356
4.65	7.53	2.88	230
7.53	10.99	3.46	284
10.99	15.13	4.14	358
15.13	20.11	4.98	392
20.11	30	9.89	730

TABLE E2: SOUNDING 01C.

From	To	Layer Thickness	Vs
m	m	m	m/s
0	6.21	6.21	282
6.21	8.04	1.83	373
8.04	10.24	2.2	495
10.24	12.89	2.65	585
12.89	16.06	3.17	316
16.06	19.86	3.8	321
19.86	30	10.14	366

TABLE E3: SOUNDING 05A.

From	To	Layer Thickness	Vs
m	m	m	m/s
0	5.74	5.74	255
5.74	8.14	2.4	332
8.14	11.03	2.89	422
11.03	14.49	3.46	332
14.49	18.65	4.16	335
18.65	23.63	4.98	348
23.63	35	11.37	506

TABLE E4: SOUNDING 05B.

From	To	Layer Thickness	Vs
m	m	m	m/s
0	6.76	6.76	309.89
6.76	8.64	1.88	377.78
8.64	10.89	2.25	384.83
10.89	13.59	2.7	394.32
13.59	16.83	3.24	430.74
16.83	20.73	3.9	433.39
20.73	30	9.27	494.05

TABLE E5: SOUNDING 05C.

From	To	Layer Thickness	Vs
m	m	m	m/s
0	5.7	5.7	322.17
5.7	7.71	2.01	341.26
7.71	10.13	2.42	392.2
10.13	13.03	2.9	430.61
13.03	16.51	3.48	441.1
16.51	20.69	4.18	481.05
20.69	30	9.31	502.72

TABLE E6: SOUNDING 06A.

From	To	Layer Thickness	Vs
m	m	m	m/s
0	2.64	2.64	226.3
2.64	5.37	2.73	247.58
5.37	8.63	3.26	268.83
8.63	12.56	3.93	309.74
12.56	17.26	4.7	329.41
17.26	22.91	5.65	382.77
22.91	30	7.09	607.19

TABLE E7: SOUNDING 06B.

From	To	Layer Thickness	Vs
m	m	m	m/s
0	2.28	2.28	319.72
2.28	4.62	2.34	262.9
4.62	7.43	2.81	306.58
7.43	10.8	3.37	337.78
10.8	14.84	4.04	439.61
14.84	19.7	4.86	447.41
19.7	30	10.3	527.06

TABLE E8: SOUNDING 06C.

From	To	Layer Thickness	Vs
m	m	m	m/s
0	6.16	6.16	404.15
6.16	8.21	2.05	426
8.21	10.68	2.47	426.89
10.68	13.63	2.95	503.43
13.63	17.18	3.55	568.32
17.18	21.44	4.26	578.03
21.44	30	8.56	733.91

TABLE E9: SOUNDING 07A.

From	To	Layer Thickness	Vs
m	m	m	m/s
0	2.33	2.33	222.63
2.33	4.79	2.46	280.25
4.79	7.74	2.95	293.16
7.74	11.28	3.54	326.96
11.28	15.53	4.25	332.03
15.53	20.62	5.09	548.41
20.62	30	9.38	645.84

TABLE E10: SOUNDING 08.

From	To	Layer Thickness	Vs
m	m	m	m/s
0	2.3	2.3	278.67
2.3	4.69	2.39	291.79
4.69	7.57	2.88	303.31
7.57	11.02	3.45	323.43
11.02	15.16	4.14	375.62
15.16	20.14	4.98	521.13
20.14	30	9.86	642.84

TABLE E11: SOUNDING 10A.

From	To	Layer Thickness	Vs
m	m	m	m/s
0	3.4	3.4	286.95
3.4	6.28	2.88	347.35
6.28	9.74	3.46	357.65
9.74	13.89	4.15	391.48
13.89	18.87	4.98	425.86
18.87	24.85	5.98	448.12
24.85	35	10.15	554.95

TABLE E12: SOUNDING 10B.

From	To	Layer Thickness	Vs
m	m	m	m/s
0	3.45	3.45	479.27
3.45	5.35	1.9	576.75
5.35	7.62	2.27	316.18
7.62	10.36	2.74	362.63
10.36	13.64	3.28	493.01
13.64	17.57	3.93	584.74
17.57	30	12.43	357.04

TABLE E13: SOUNDING 14.

From	To	Layer Thickness	Vs
m	m	m	m/s
0	4.88	4.88	524.59
4.88	6.73	1.85	325.42
6.73	8.96	2.23	355.69
8.96	11.62	2.66	357.88
11.62	14.82	3.2	505.23
14.82	18.67	3.85	520.31
18.67	25	6.33	534.29

TABLE E14: SOUNDING 18A.

From	To	Layer Thickness	Vs
m	m	m	m/s
0	2.04	2.04	228.5
2.04	4.22	2.18	320.69
4.22	6.85	2.63	297.22
6.85	9.99	3.14	317
9.99	13.77	3.78	329.32
13.77	18.31	4.54	337.37
18.31	30	11.69	385.64

TABLE E15: SOUNDING 18B.

From	To	Layer Thickness	Vs
m	m	m	m/s
0	3.48	3.48	298.87
3.48	6.04	2.56	309.63
6.04	9.1	3.06	388.28
9.1	12.79	3.69	390.92
12.79	17.2	4.41	414.35
17.2	22.5	5.3	448.95
22.5	30	7.5	495.93