Earthquake on the Hussar low-frequency experiment

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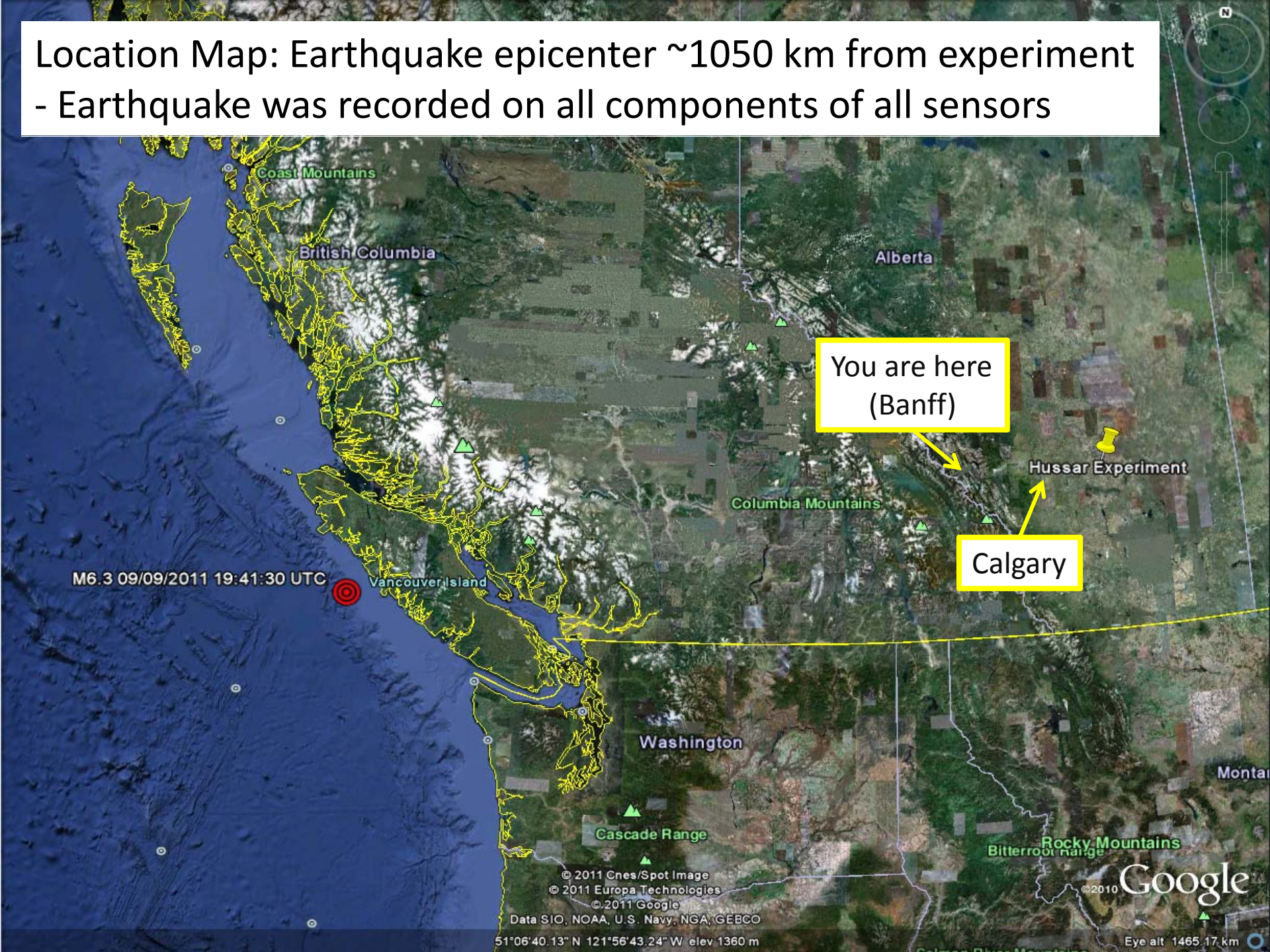
Location Map: Earthquake epicenter ~1050 km from experiment
- Earthquake was recorded on all components of all sensors
Coast Mountains
British Columbia
Alberta
You are here
(Banff)
Hussar Experiment
Columbia Mountains
Calgary
M6.3 09/09/2011 19:41:30 UTC
Vancouver Island
Washington
Cascade Range
Rocky Mountains
© 2011 Cnes/Spot Image
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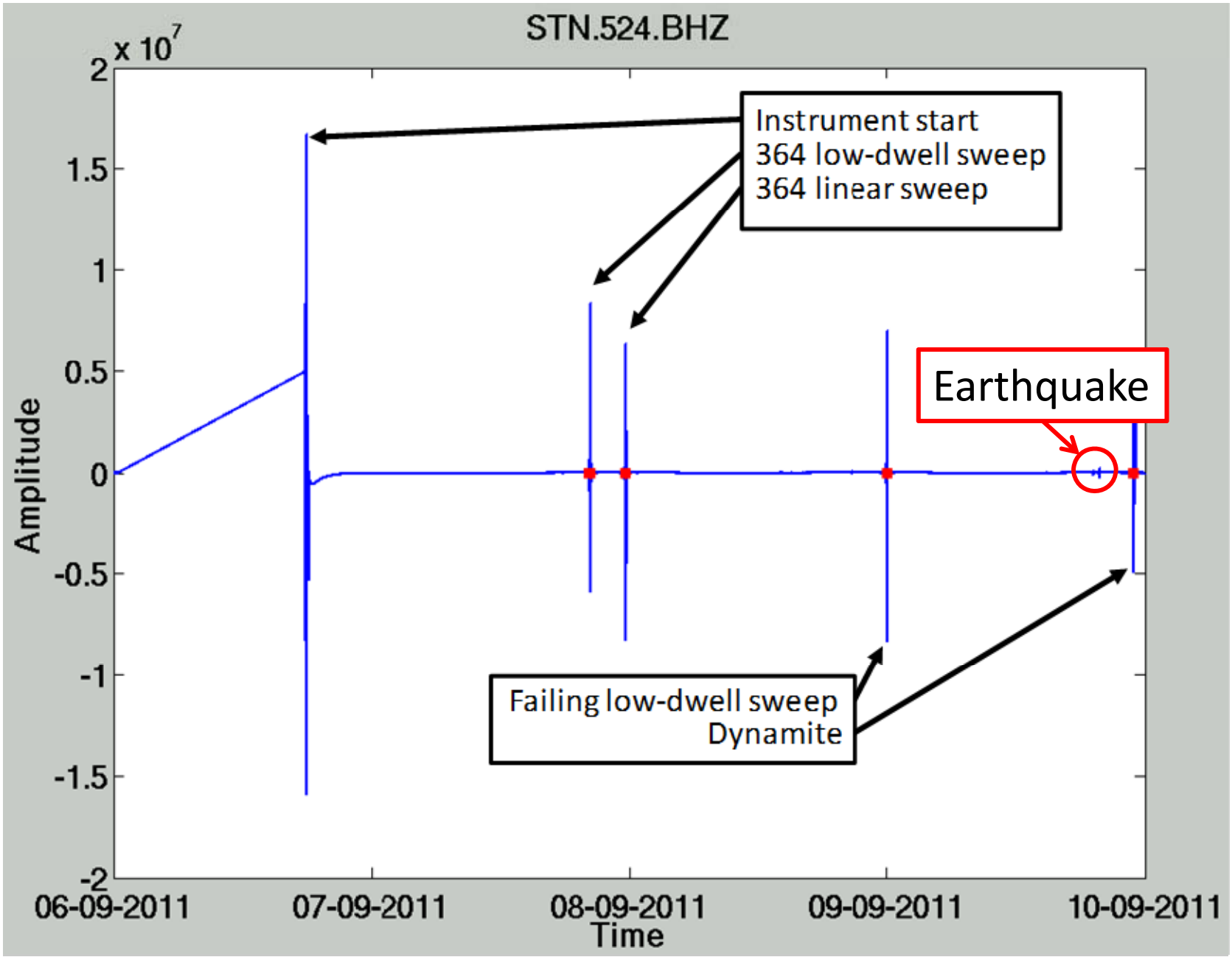
©2011 Google
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
51°06'40.13" N 121°56'43.24" W elev 1360 m
©2010 Google
Eye alt 1465.17 km

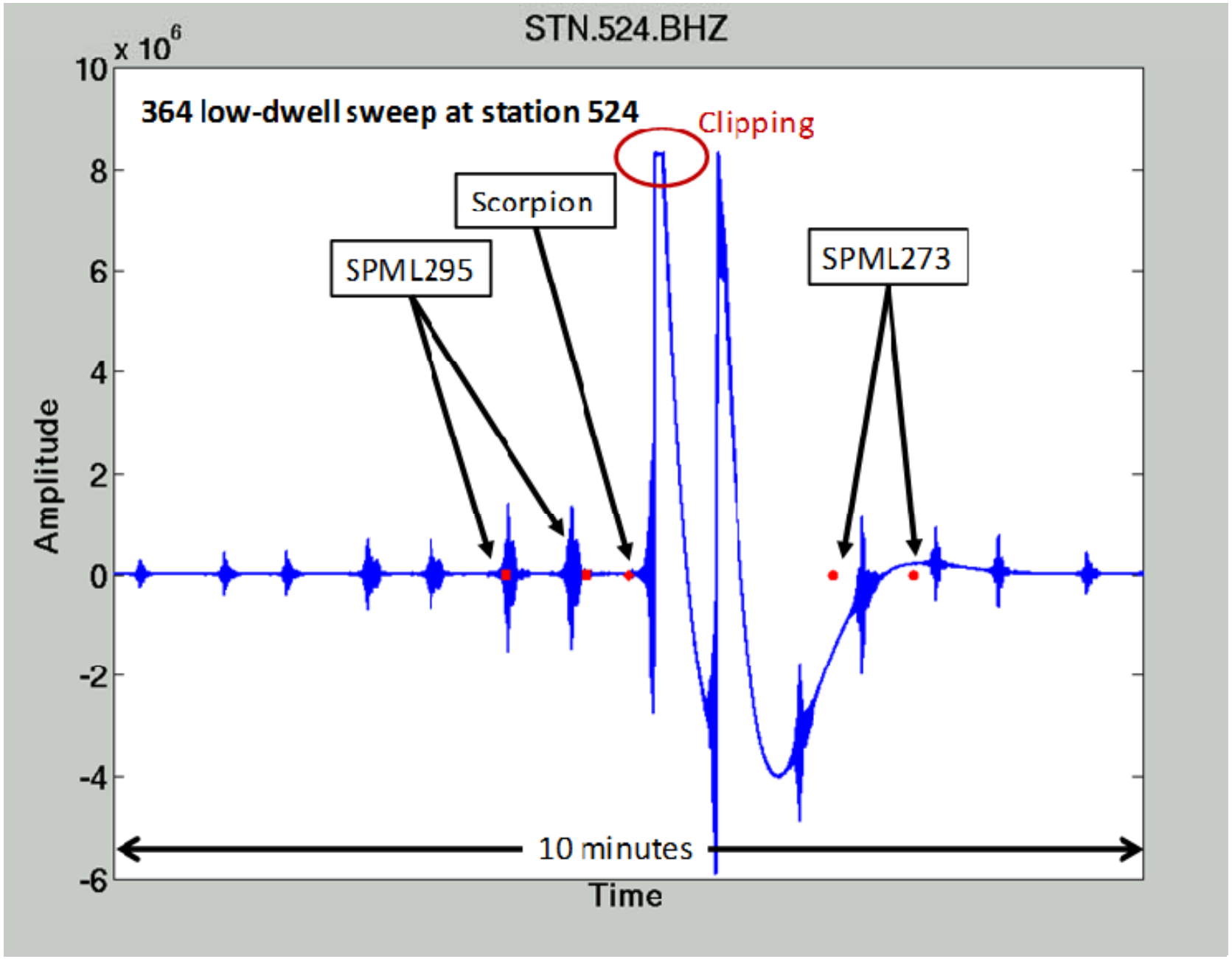
Nanometrics seismometer

Nanometrics seismometer in the field

Nanometrics seismometer data. Trace length = 4 days



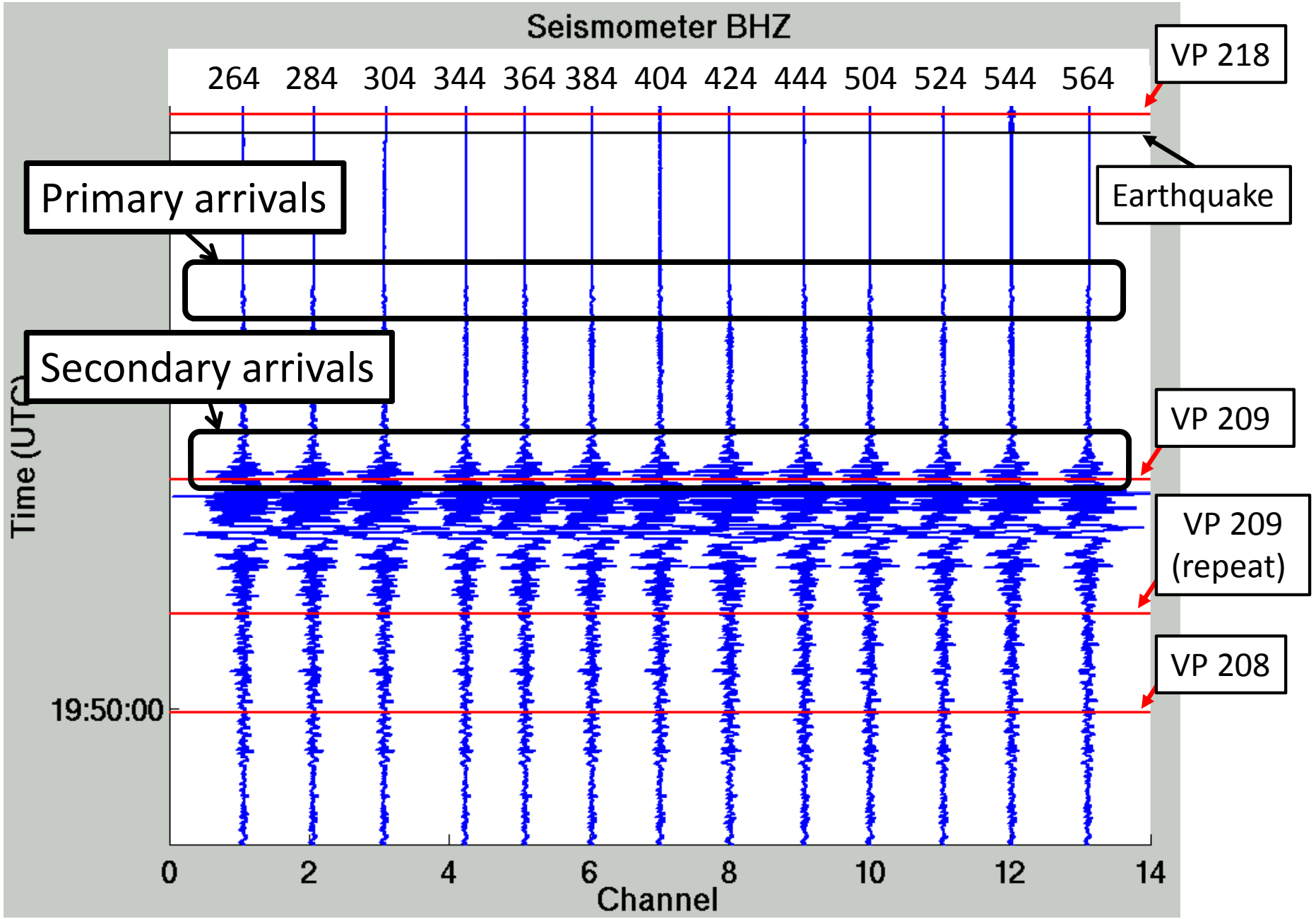
Nanometrics seismometer data, Trace length = 10 minutes



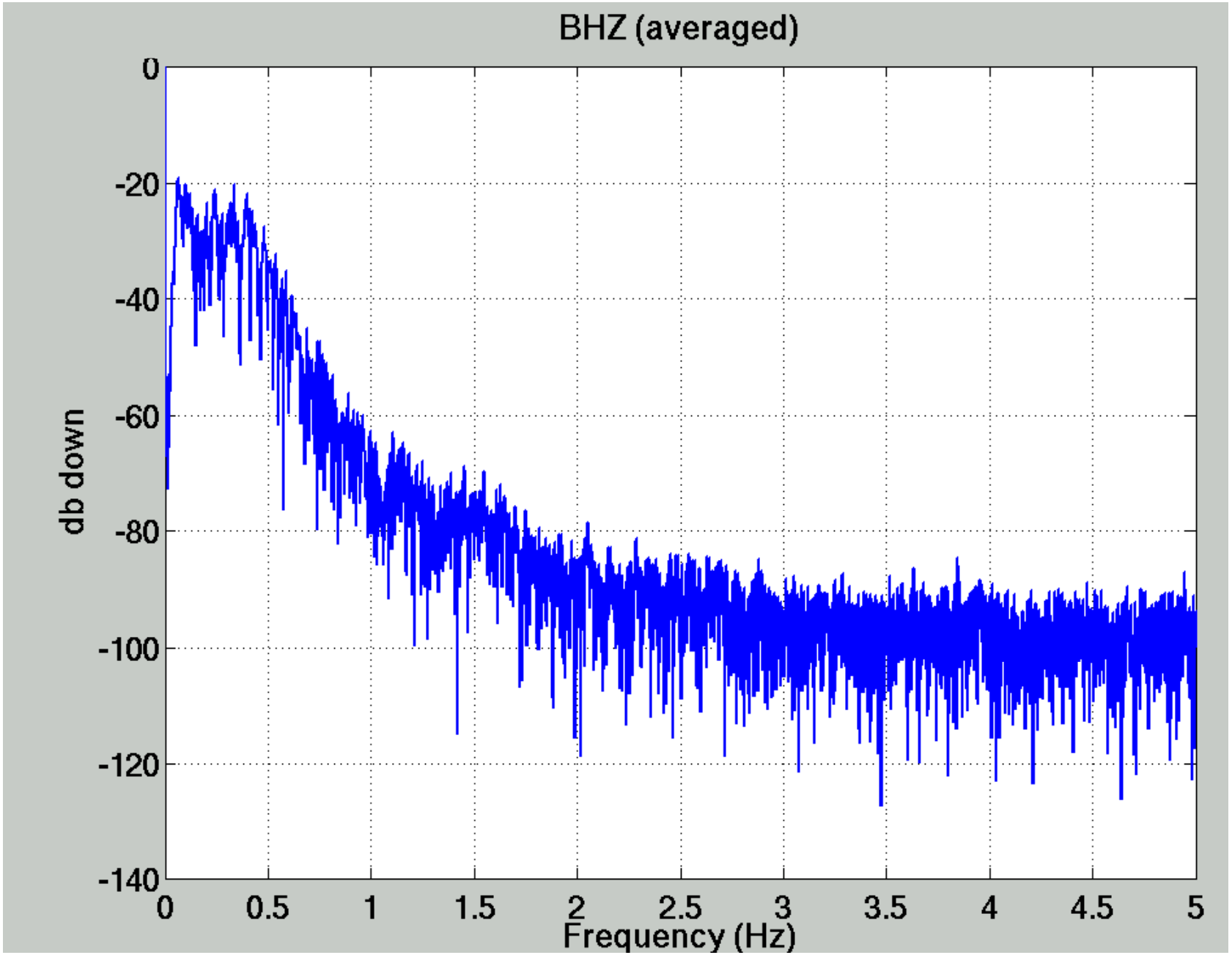
Observers Notes

SPML 273 Flag	SPML 273 File	SPML 295 File	Scorpion SHOT ID	Scorpion TIME (UTC)	Scorpion COMMENTS
Flag	File	File	SHOT ID	TIME	COMMENTS
218	2142	2230	1315593673	9/9/2011 19:41:14	35M S.E.
218	2143	2231			
209	2145	2233	1315593998	9/9/2011 19:46:43	Void File Earthquake
209	2146	2234			
209			1315594116	9/9/2011 19:48:38	
208	2148	2236	1315594204	9/9/2011 19:50:05	
208	2149	2237			

Nanometrics seismometer data. Trace length = 11.5 minutes

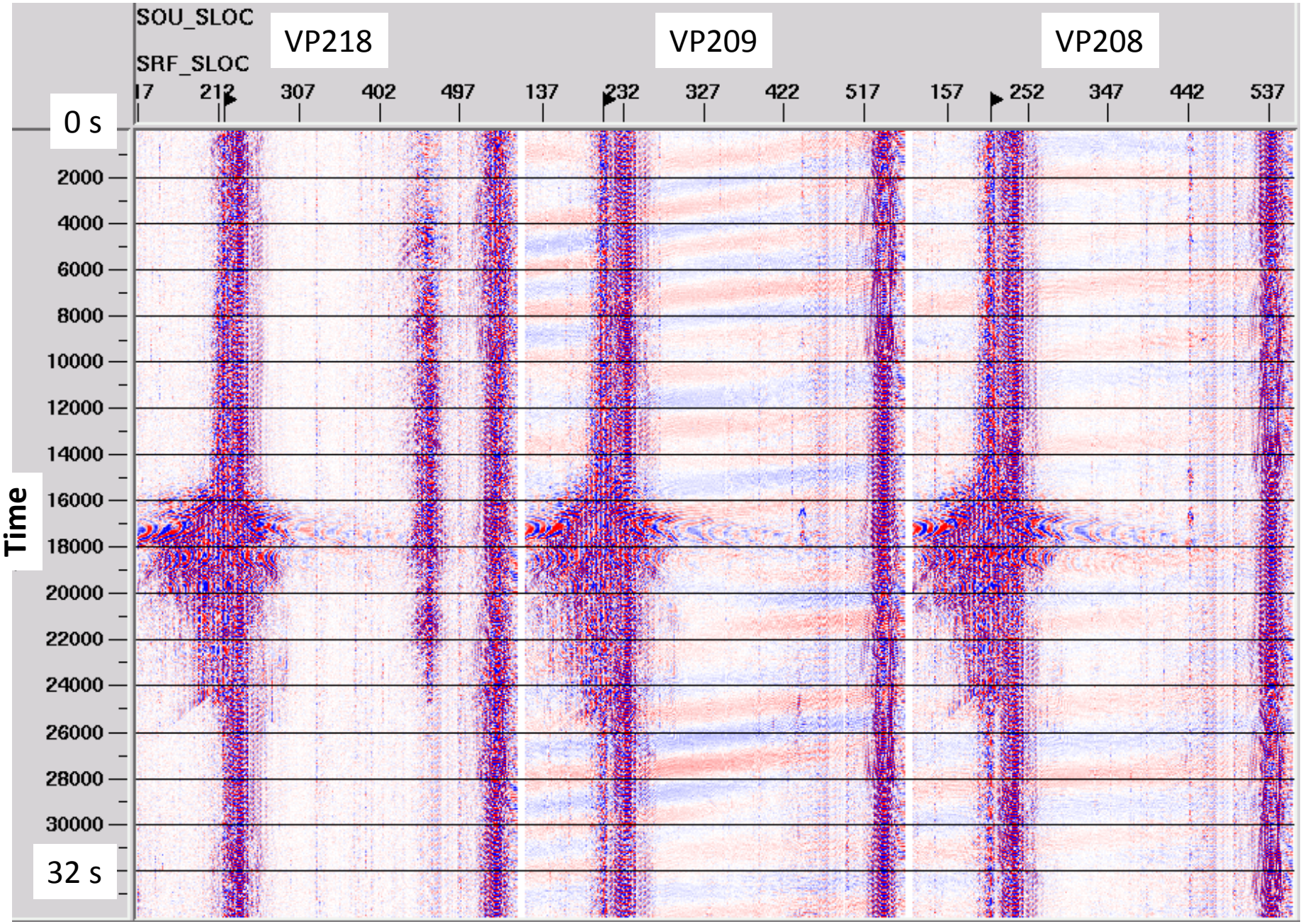


Nanometrics seismometer data. Averaged amplitude spectrum

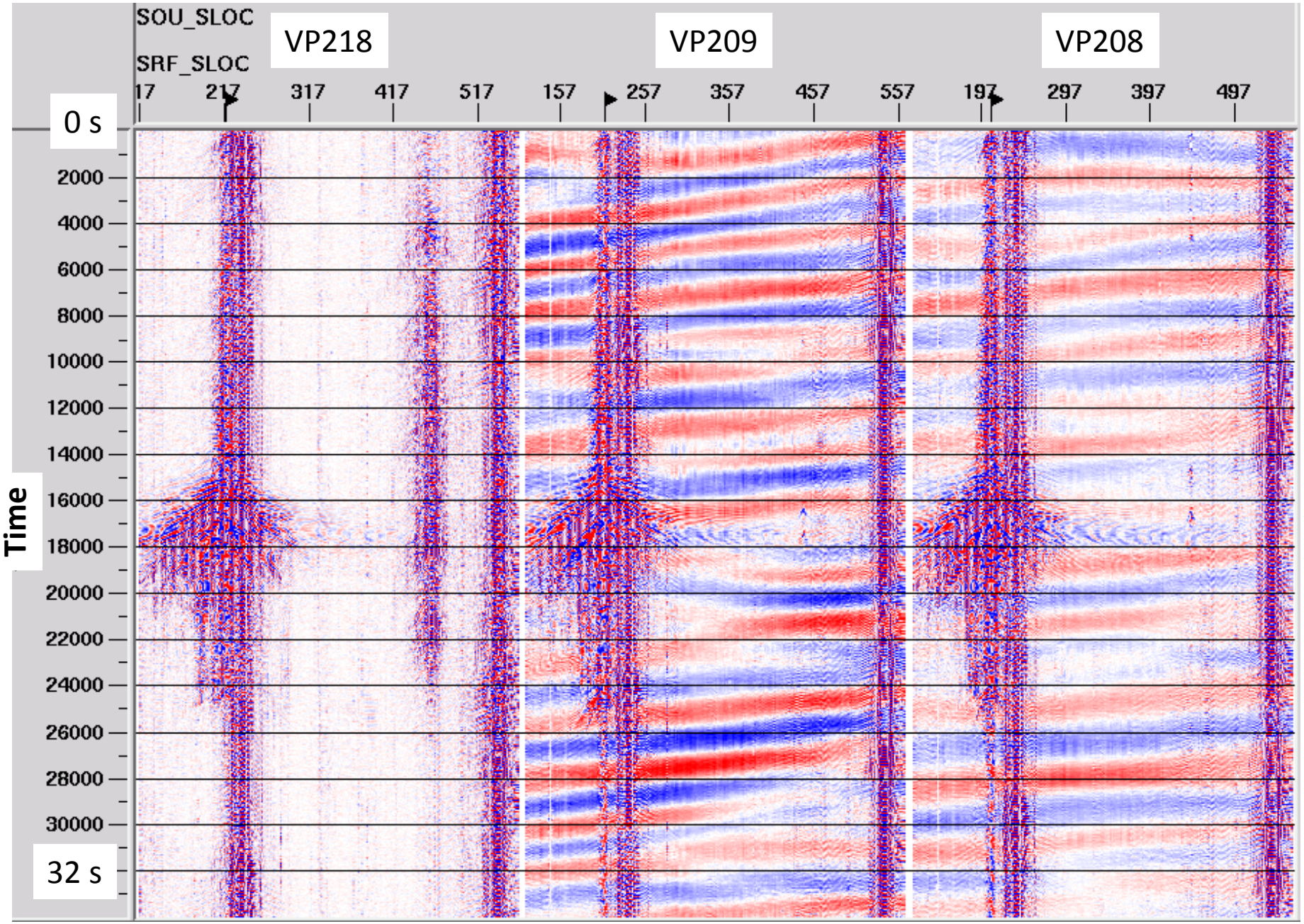


Low-frequency recording limits	
Hardware/Software low-cut filters	Aries recorders: 3 Hz low-cut filter was turned off.
	Scorpion recorder: 1.6 Hz low-cut could not be turned off (??)
	Nanometrics recorders: No low-cut (??)
	low-cut filters in the hardware (??)
Receiver limitations	Geophone response -> correct amplitude/phase
	MEMS instrument noise
Vibroseis Correlation	1-100 Hz sweep -> look at uncorrelated data for earthquake at less than 1 Hz

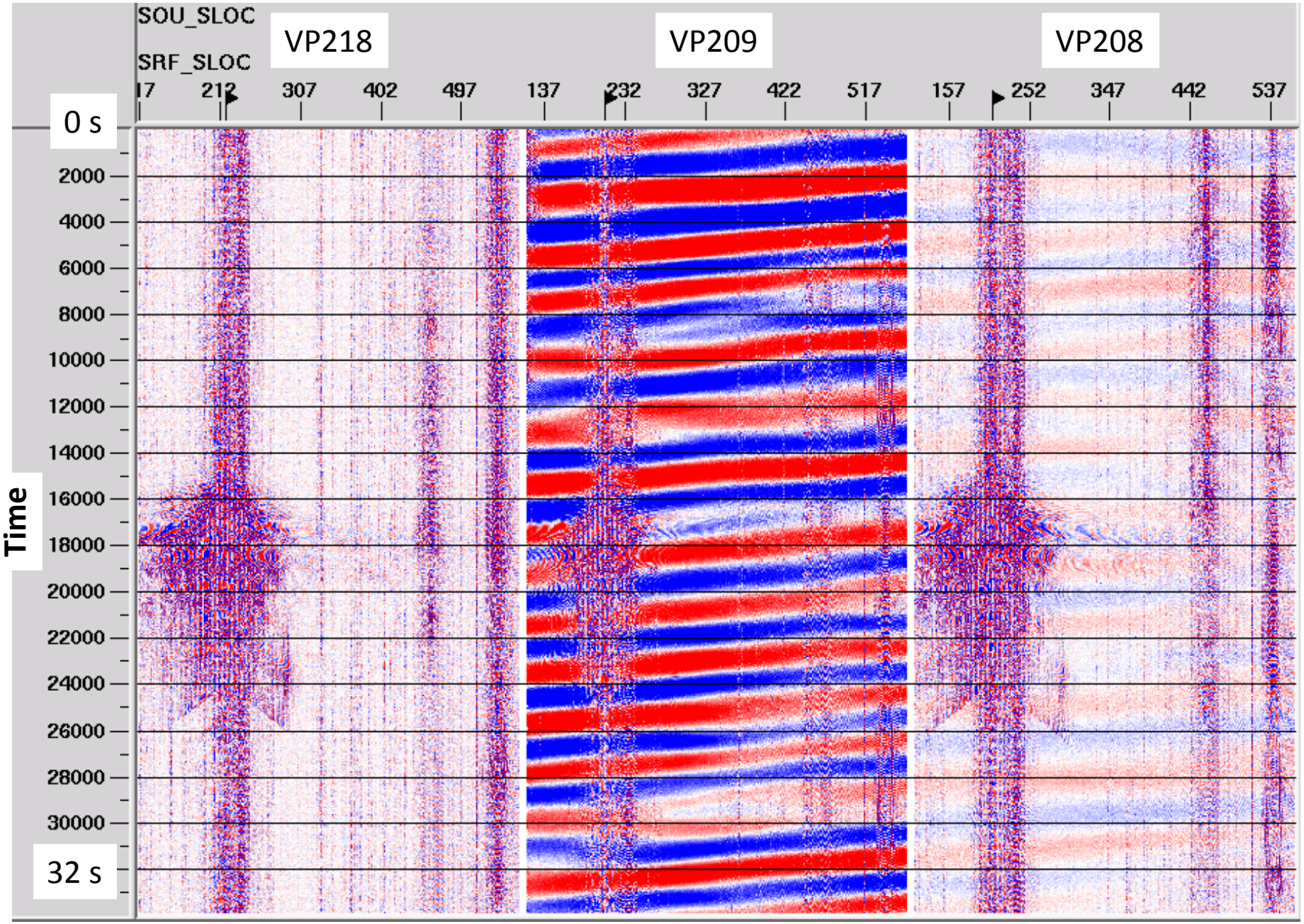
10 Hz 3C geophones, V component. Trace length = 34 seconds



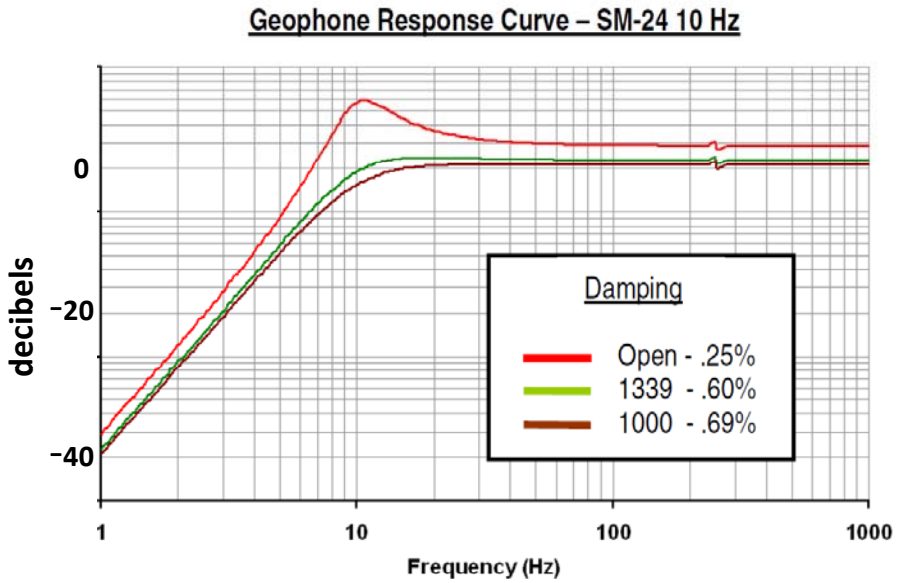
4.5 Hz 1C geophones, V component. Trace length = 34 seconds

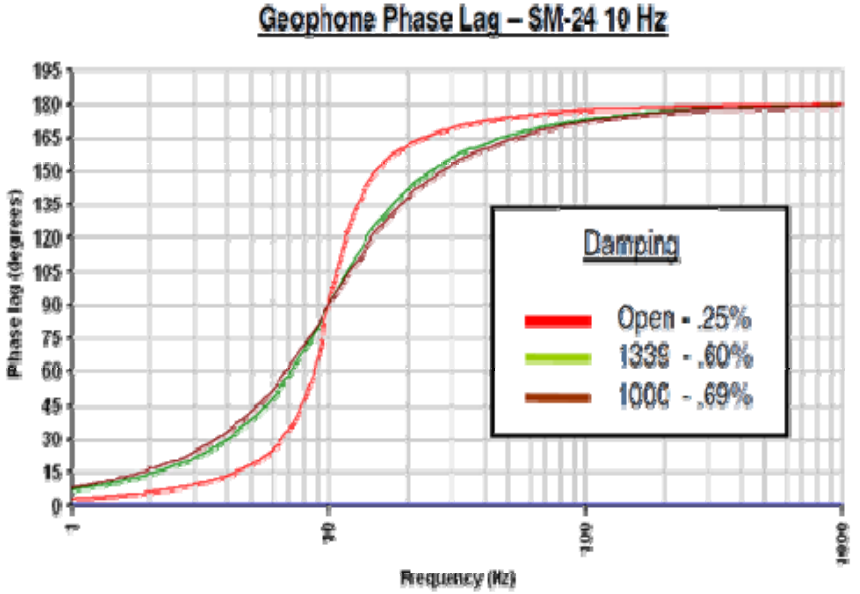


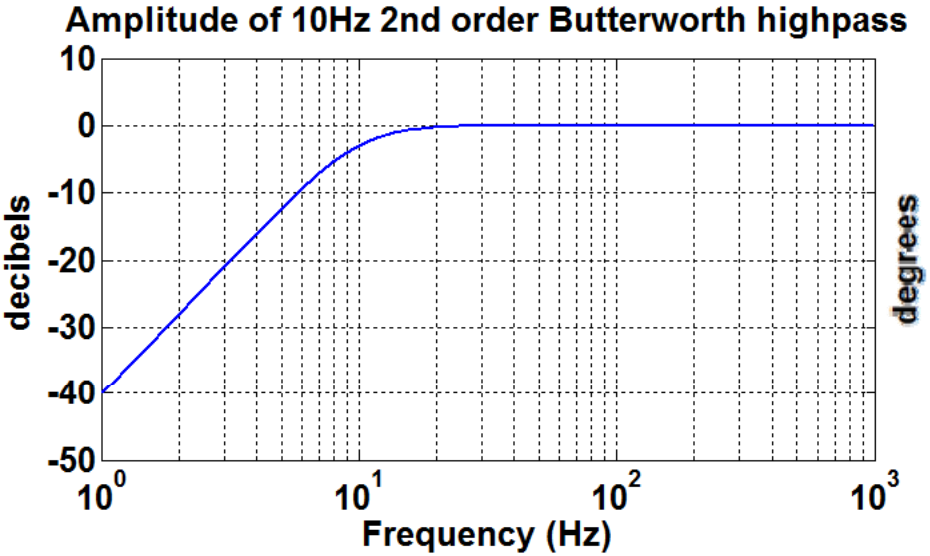
Vectorseis, V component. Trace length = 34 seconds

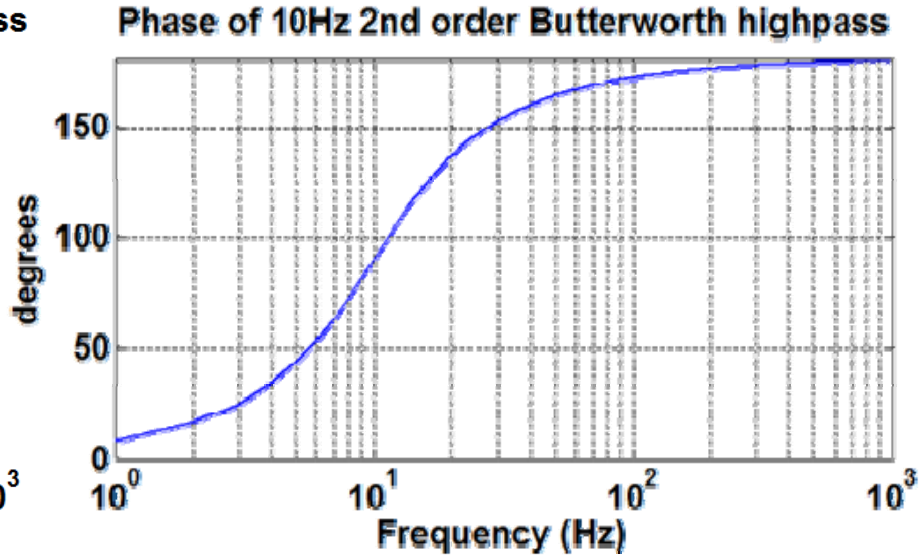


10 Hz Geophone Response correction: Create wavelet, invert, convolve with data

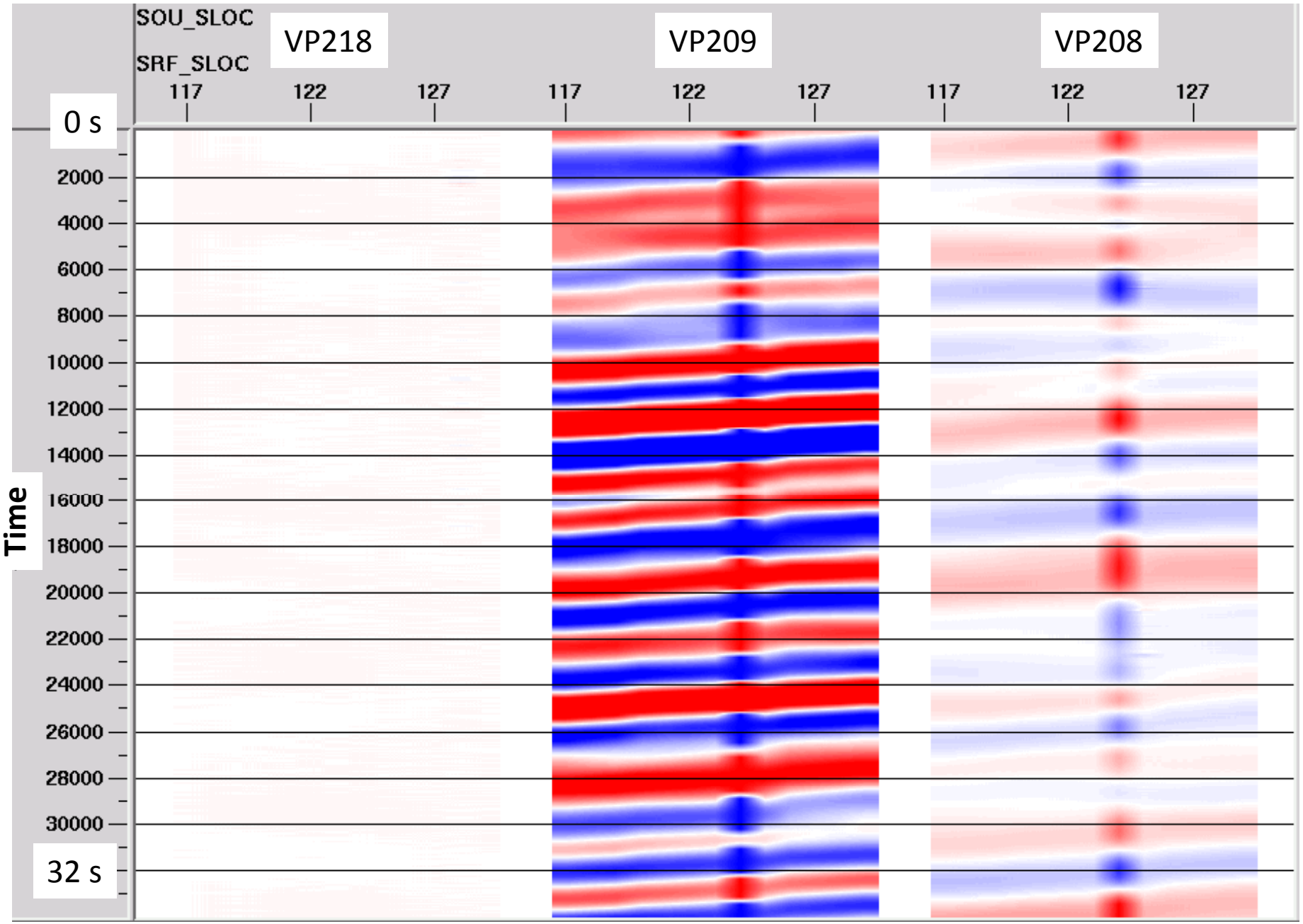




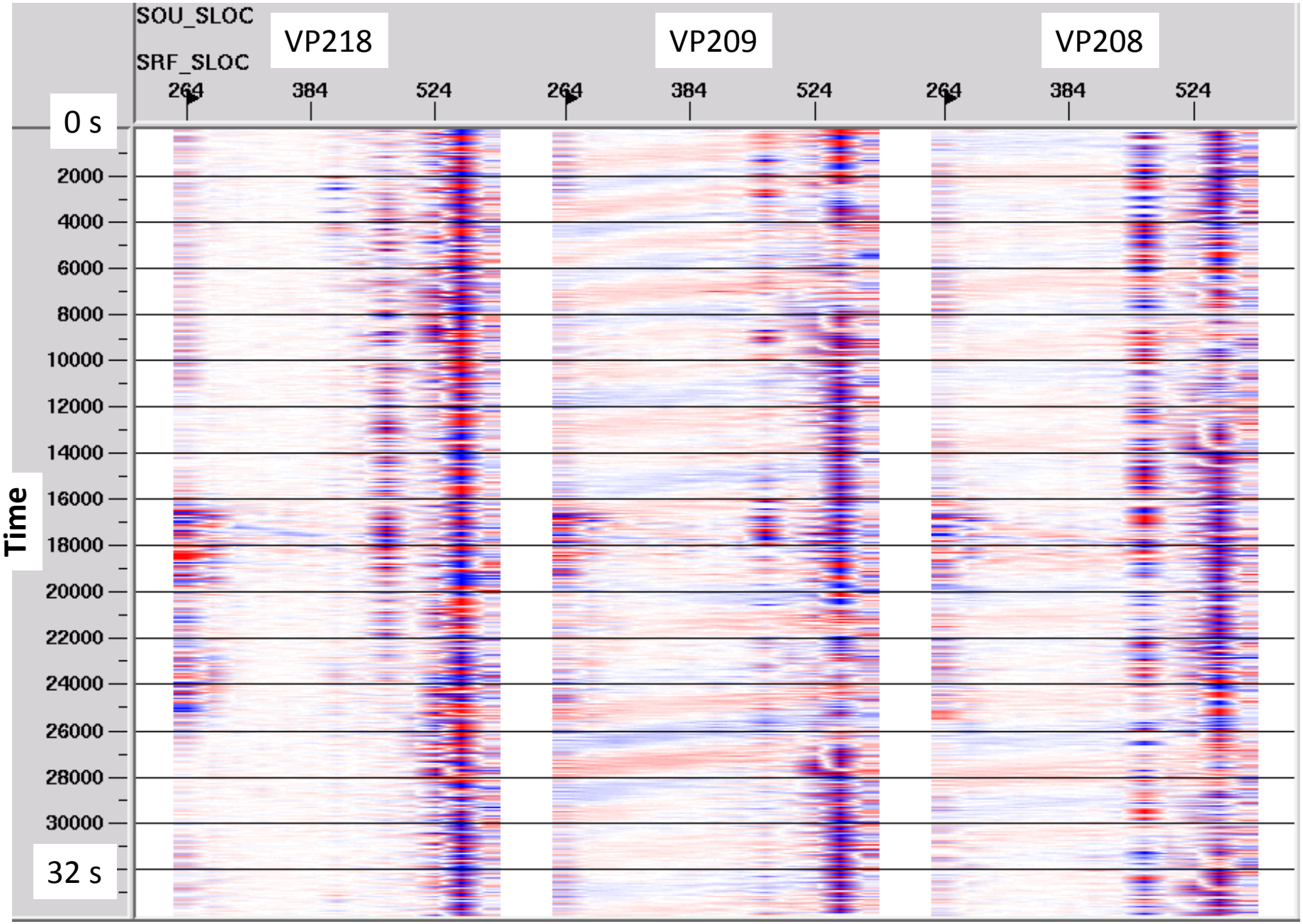




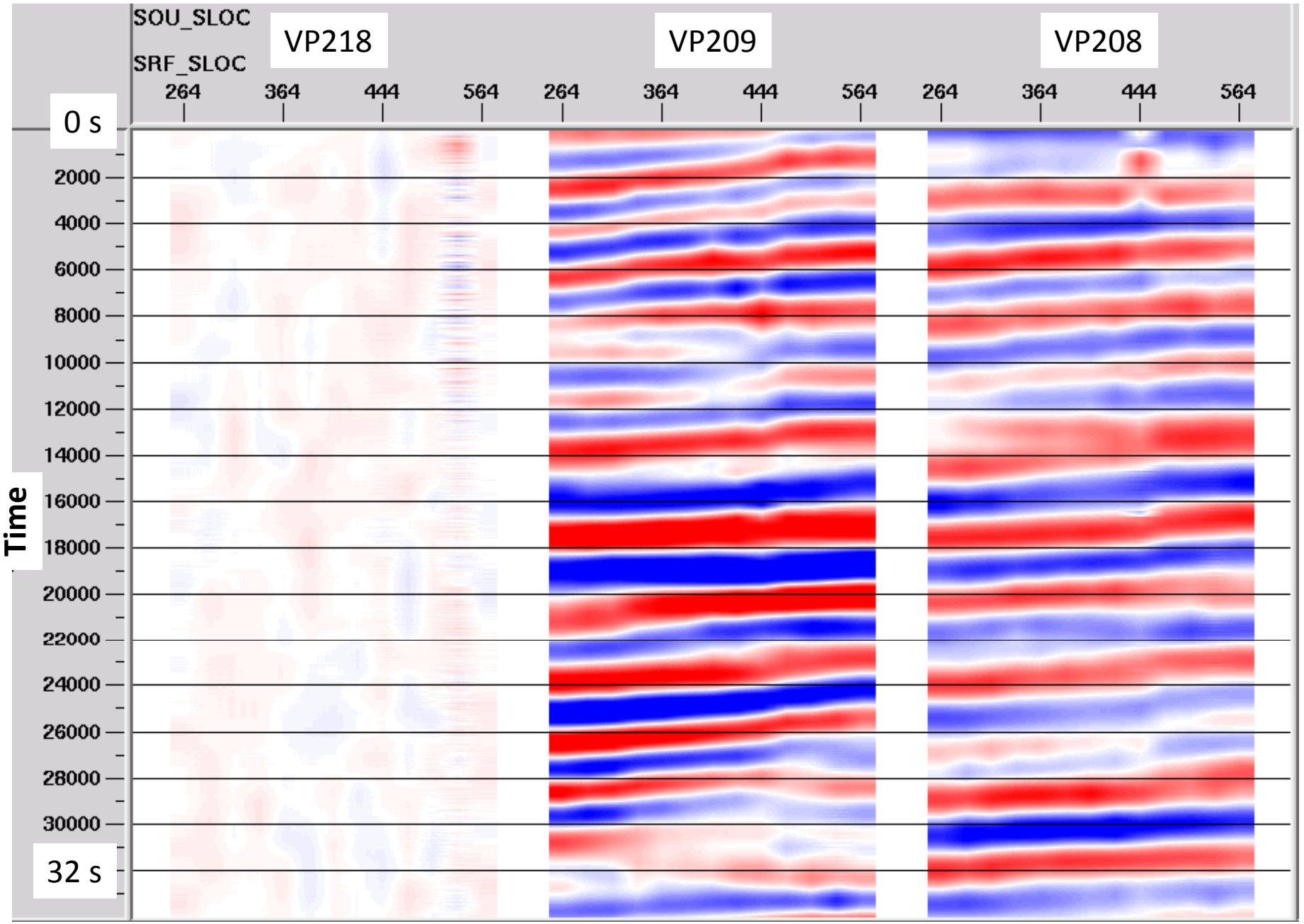
Seismometer, V component. Trace length = 34 s



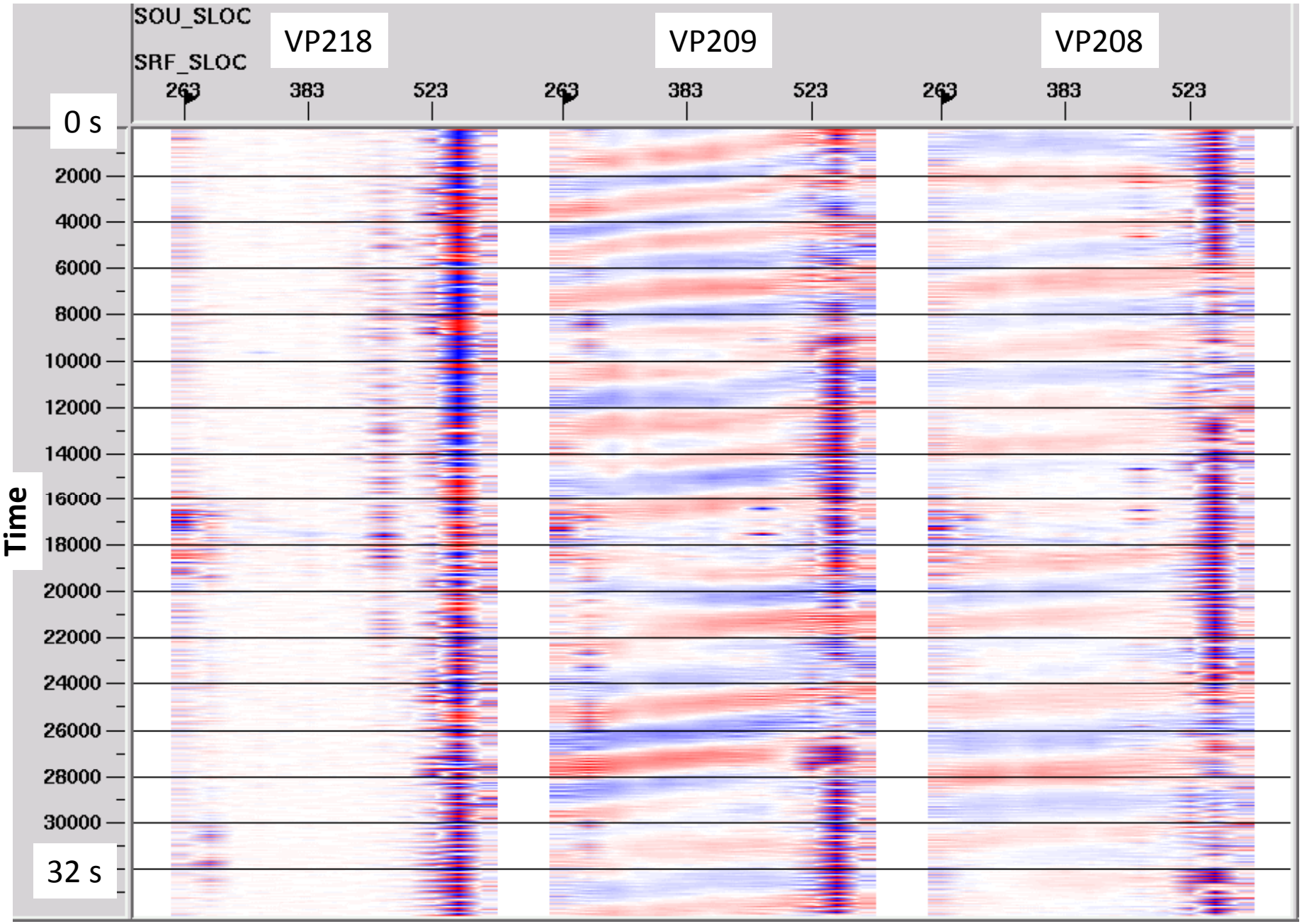
10 Hz 3C geophones, V component. Trace length = 34 s



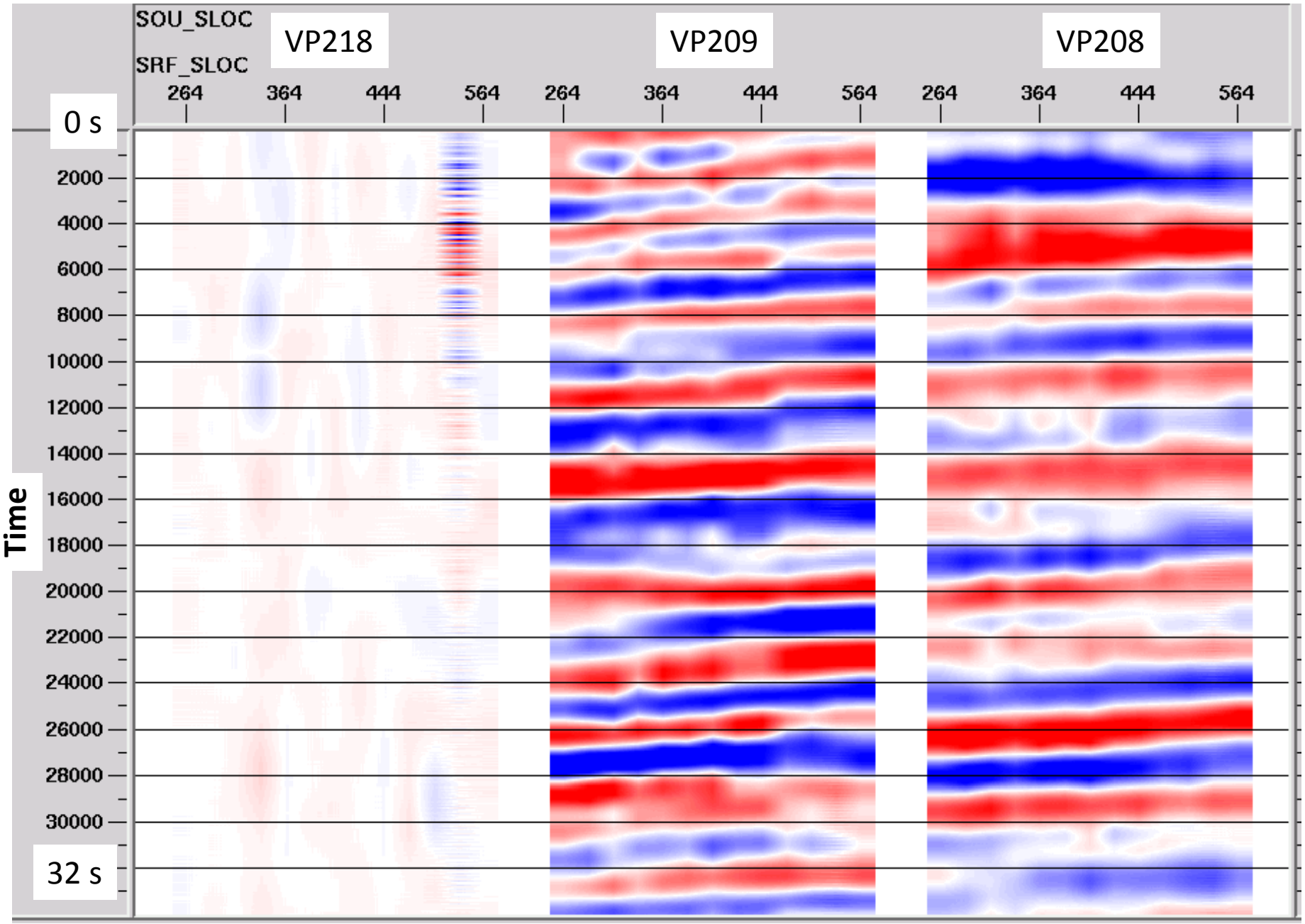
10 Hz 3C geophones, corrected V component. Trace length = 34 s



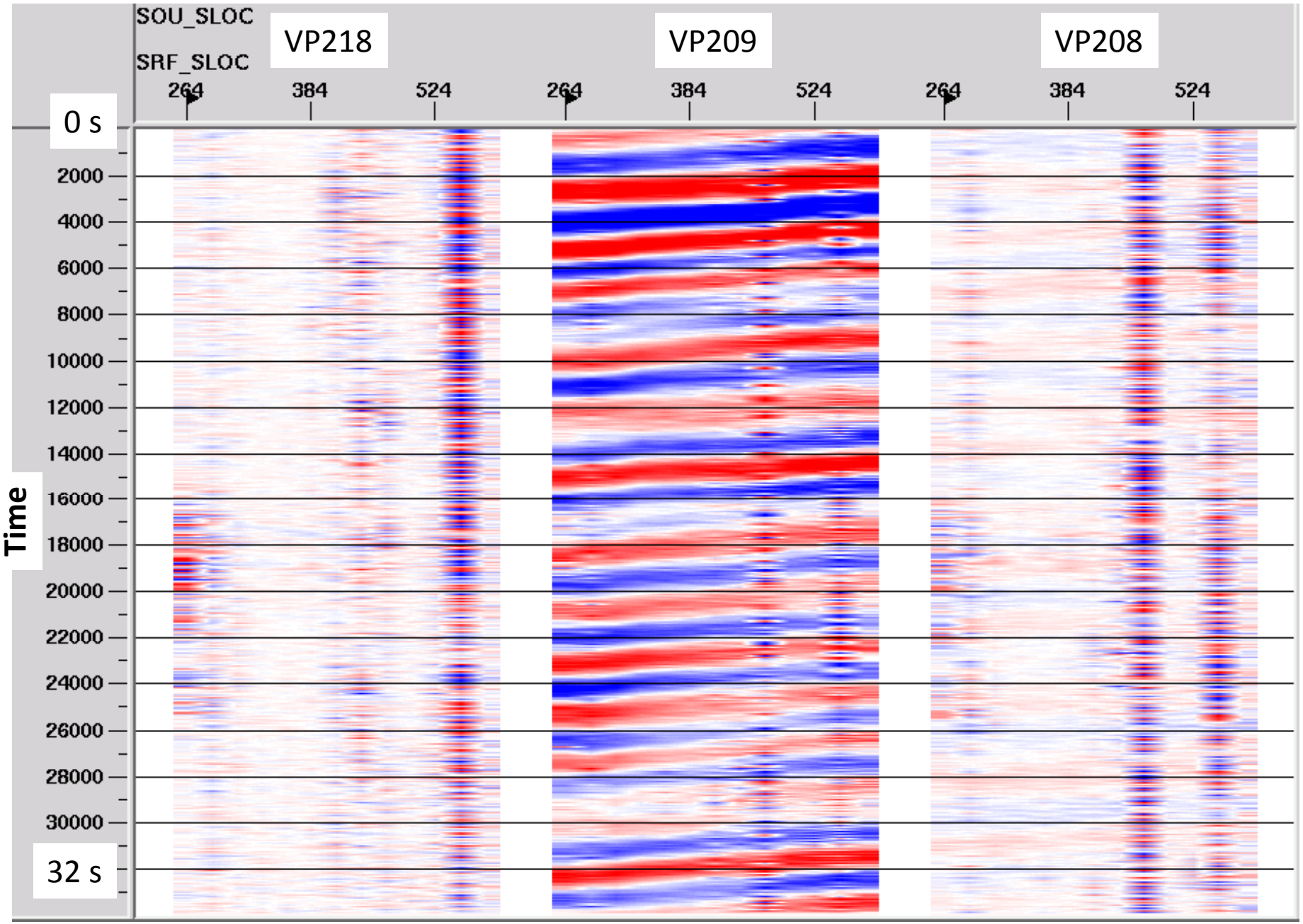
4.5 Hz 1C geophones, V component. Trace length = 34 s



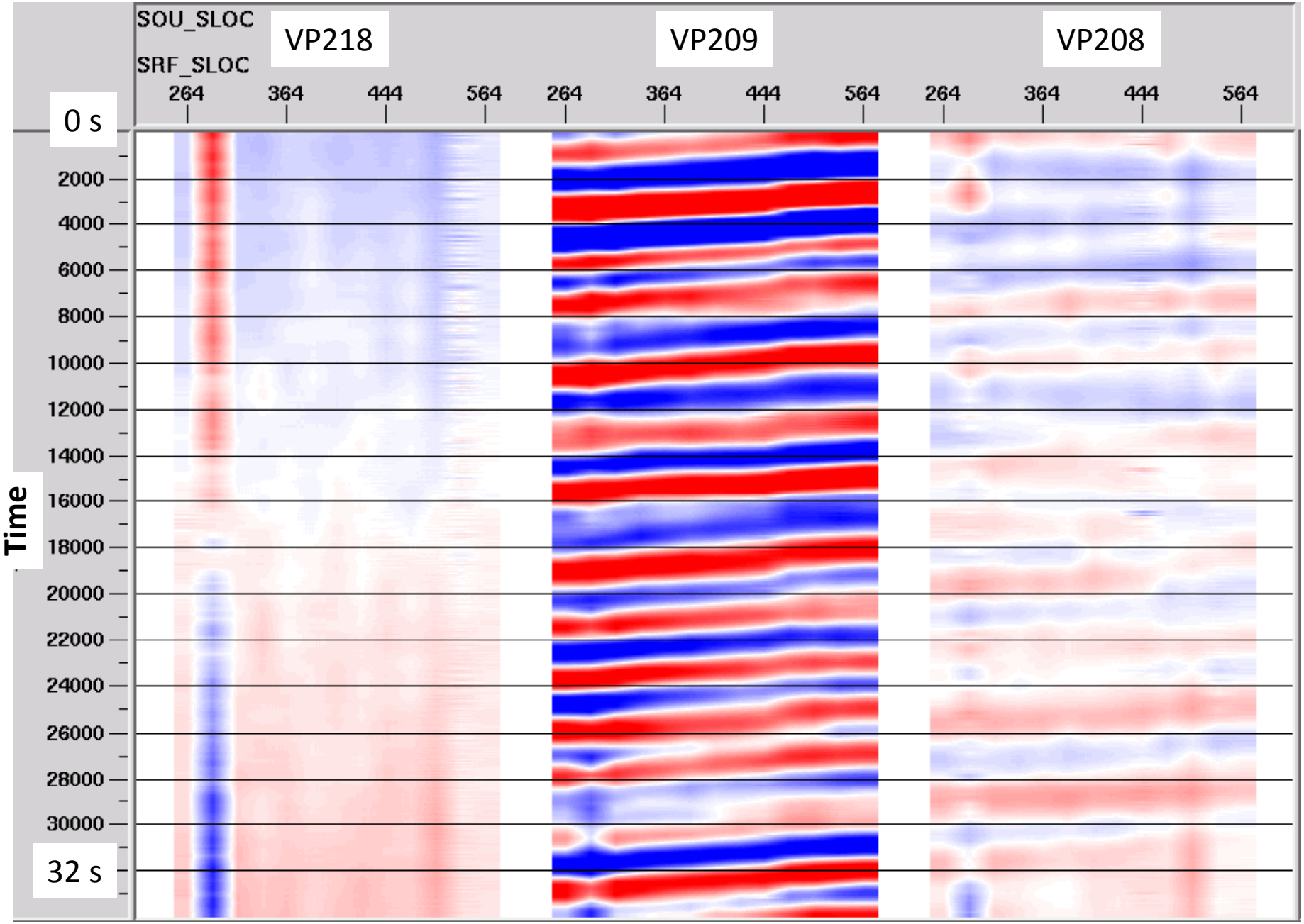
4.5 Hz 1C geophones, corrected V component. Trace length = 34 s



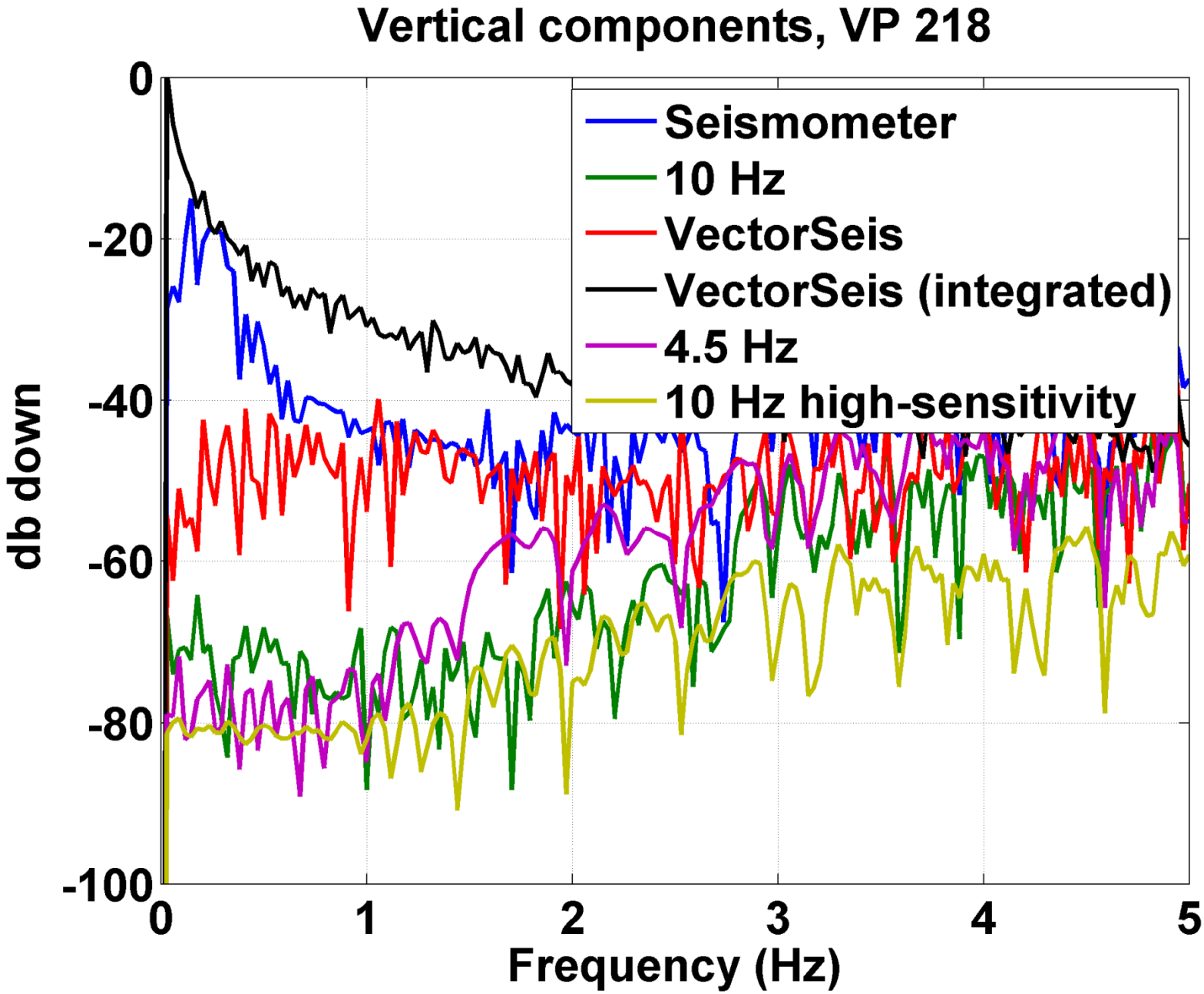
Vectorseis, V component. Trace length = 34 s



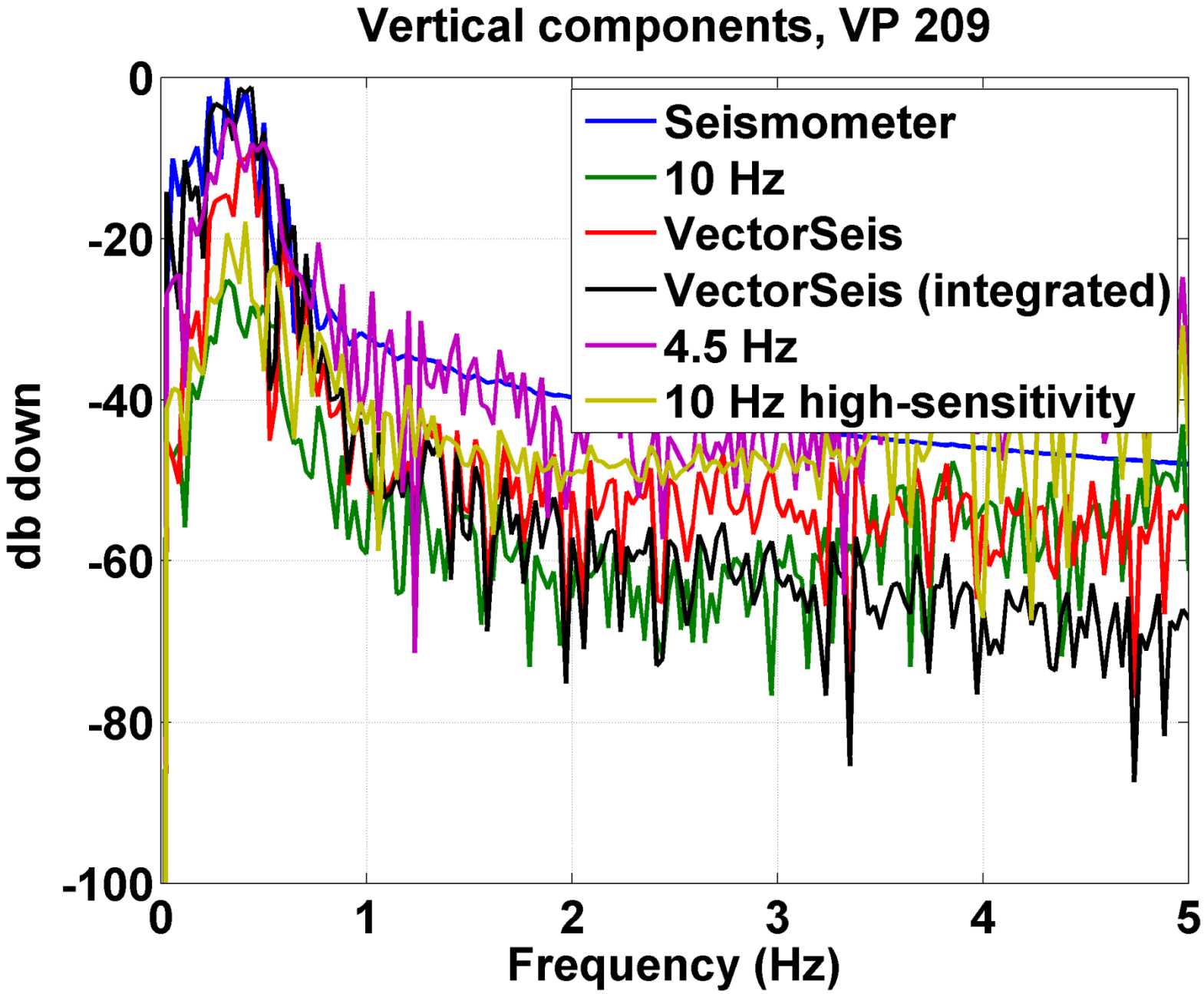
Vectorseis, integrated V component. Trace length = 34 s



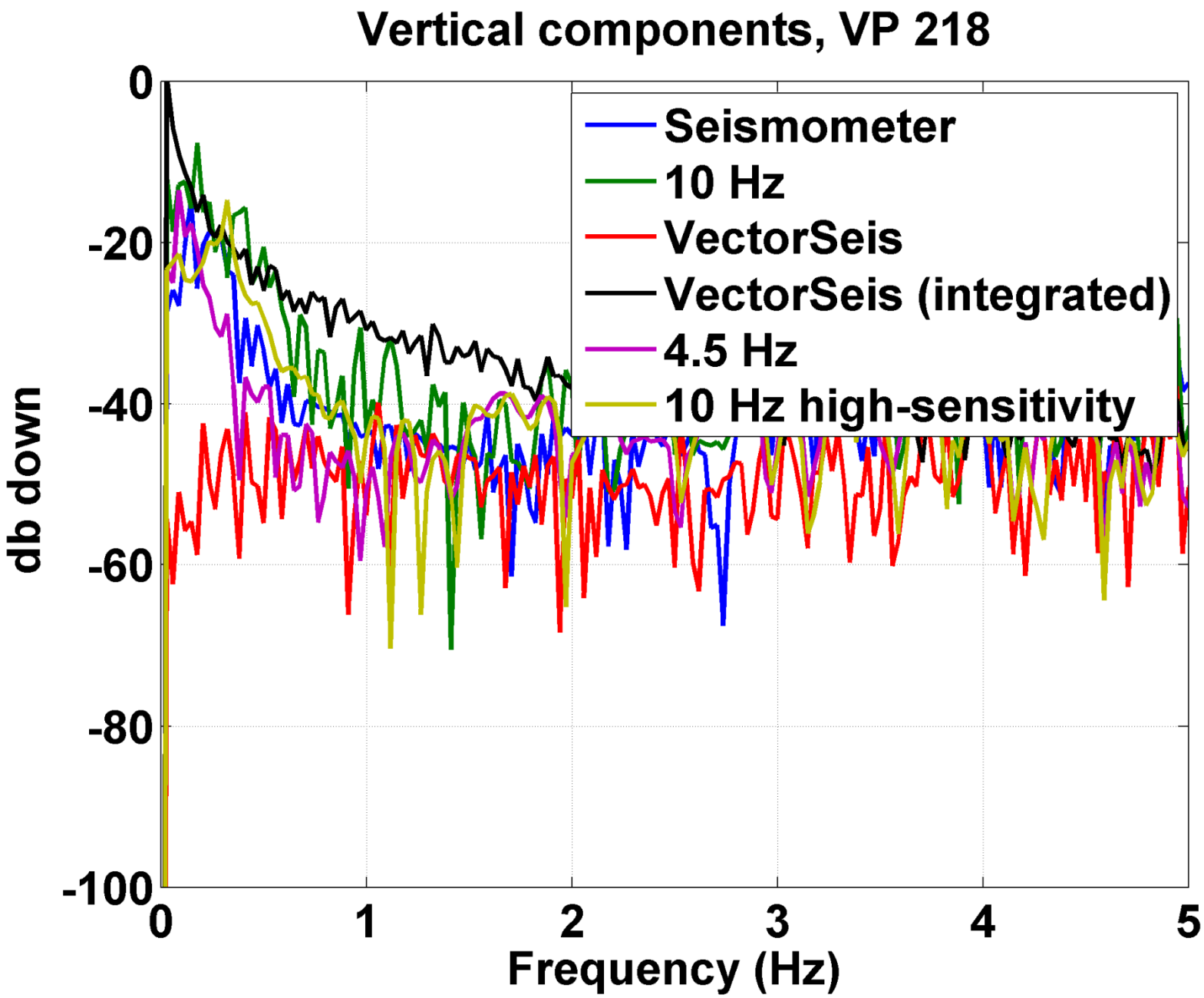
Amplitude spectra, V component, all sensors



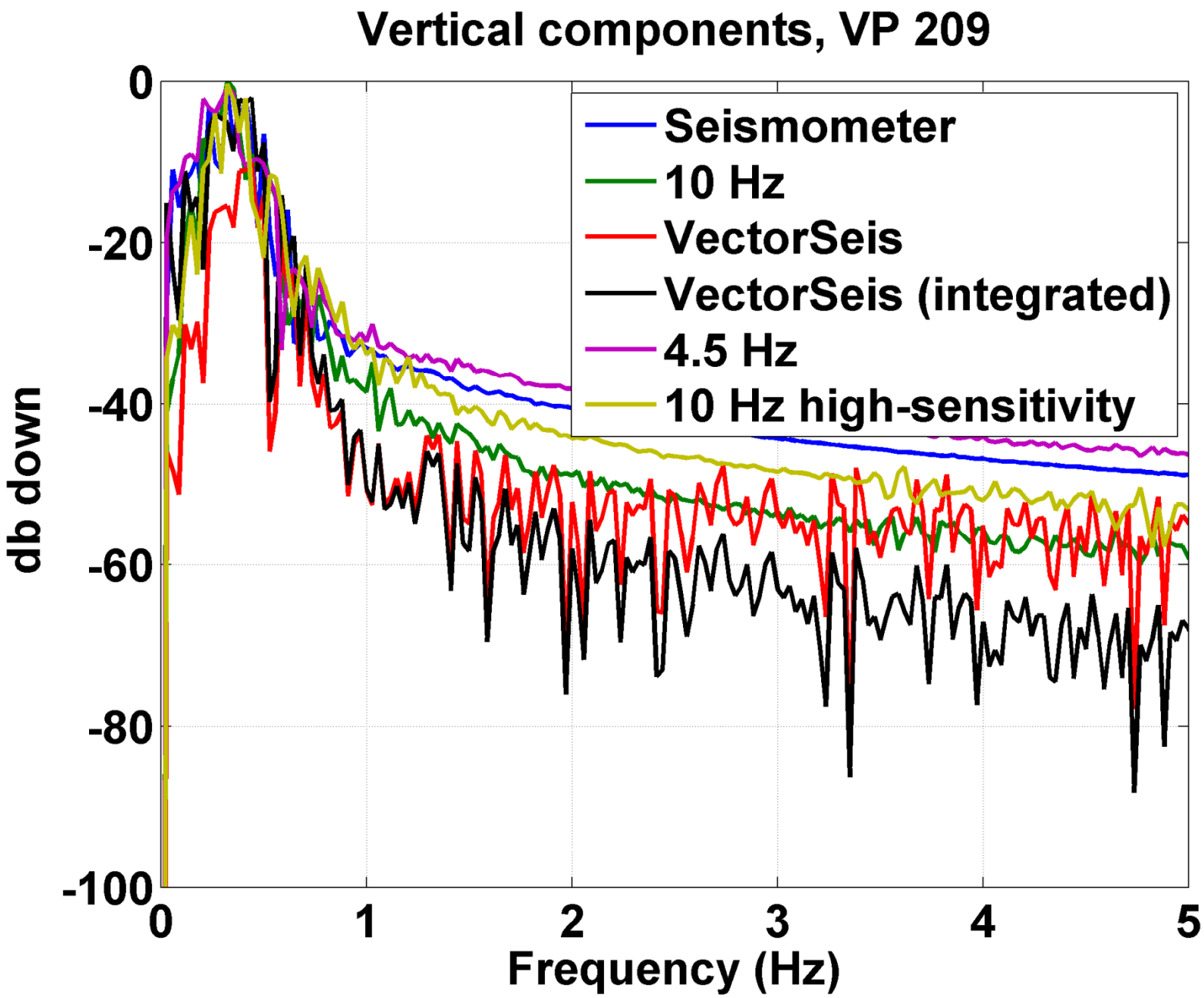
Amplitude spectra, V component, all sensors



Amplitude spectra, corrected V component, all sensors



Amplitude spectra, corrected V component, all sensors



Summary

- The Vancouver Island earthquake was a low-frequency source for the Hussar low-frequency experiment.
- Events with frequencies less than 1 Hz were successfully recorded by all sensors and recording systems that were deployed on the line.
- Correcting geophone data amplitude and phase response improved the low-frequency data for all geophone components.

Acknowledgements

We would like to thank all participants in the low-frequency experiment, including Husky, INOVA, Geokinetics and Nanometrics, as well as Landmark Graphics for the use of donated software.