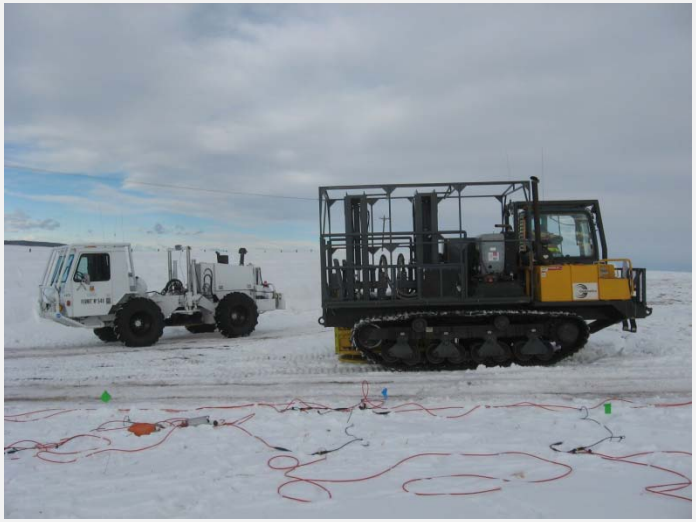
Source and receiver comparisons from Priddis and Hussar

Malcolm B. Bertram, J. Helen Isaac, Kevin W. Hall, Kevin L. Bertram and Gary F. Margrave



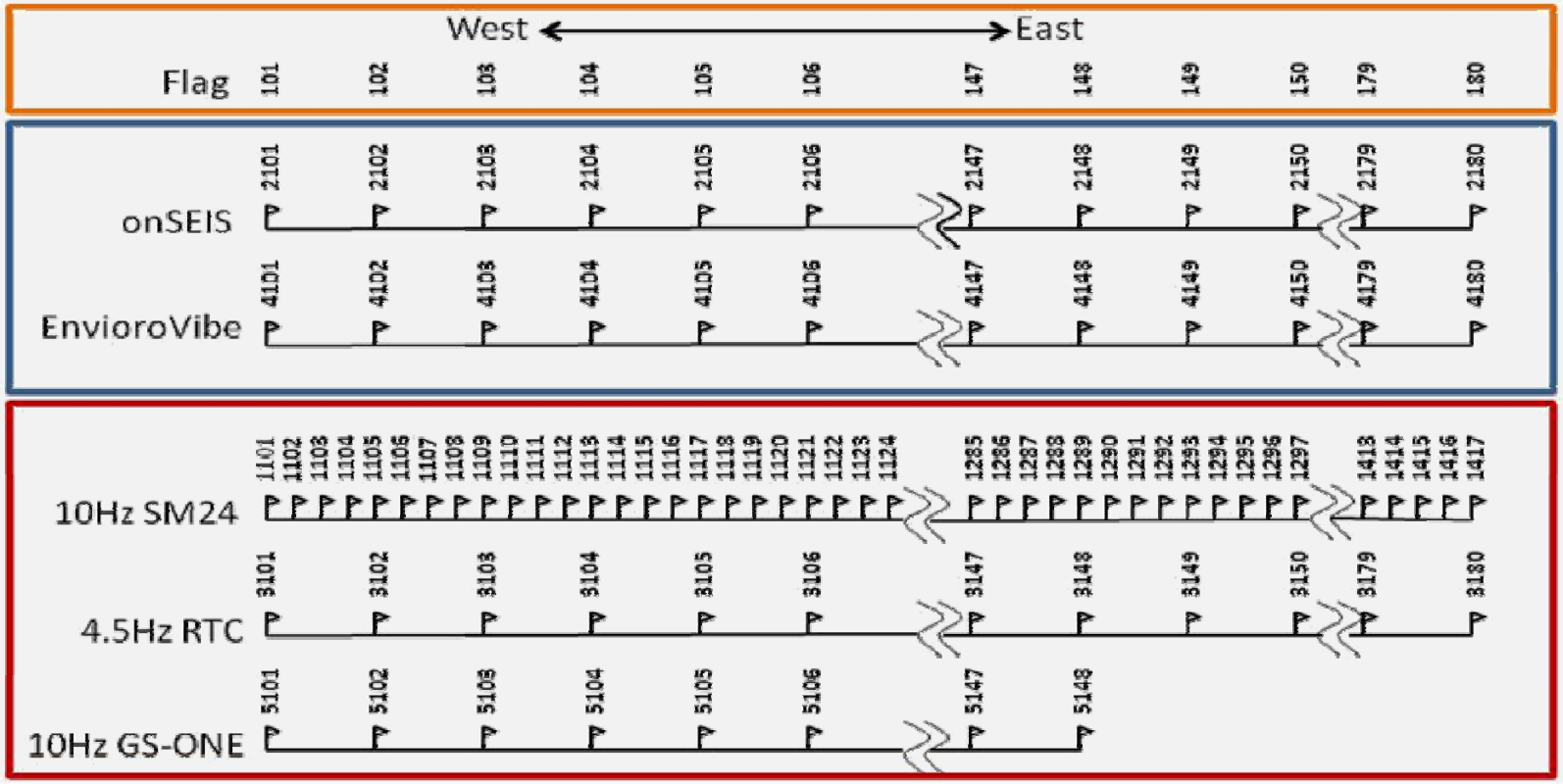
CREWES

Guaranteed 100% real data. No artificial additives. No math.

UNIVERSITY OF CALGARY

The Priddis survey

- Date: 7-10 December 2010
- Sources comparison: onSEIS and EnviroVibe
- Geophone comparison: Sensor SM24, RTC4.5, Oyo-Geospace GS-One
- Recording system: U of C Aries SPMLite



CREWES

Priddis source comparison:

EnviroVibe

Hold down: 15,000 lb
Sweeps per vibe point: 4
Length of sweep: 20 seconds
Sweep: Linear 10-200 Hz
Shot spacing: 10m

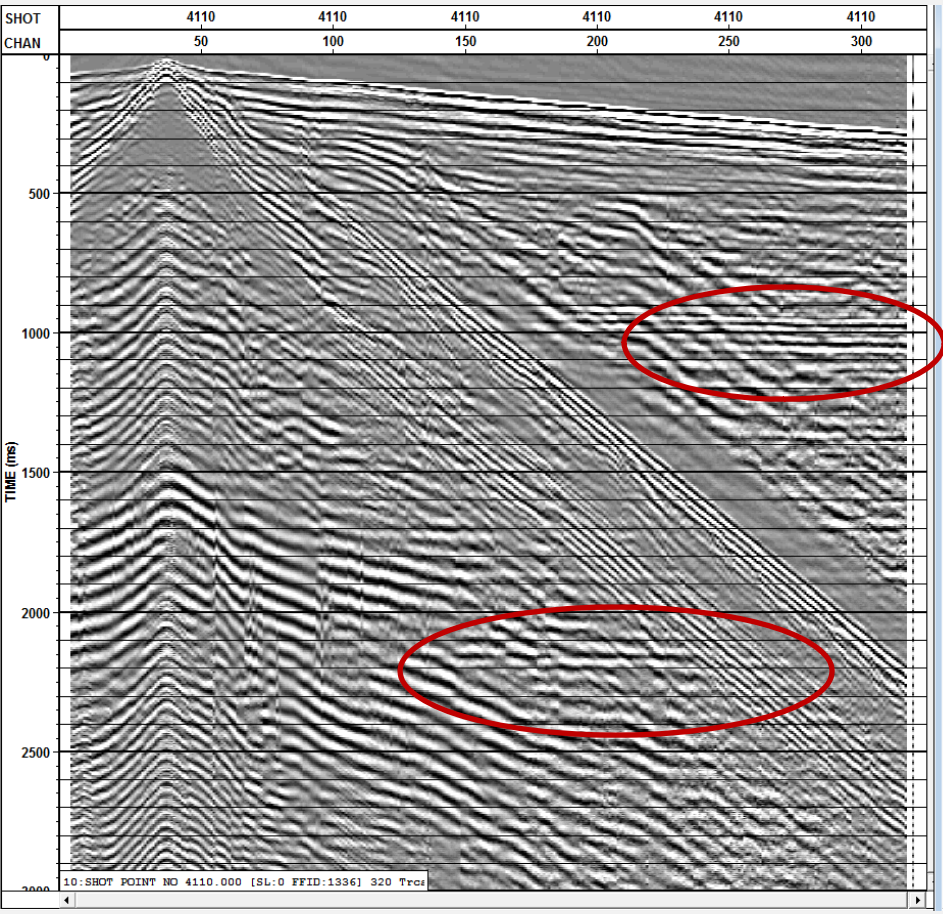
Industrial Vehicles International, Inc

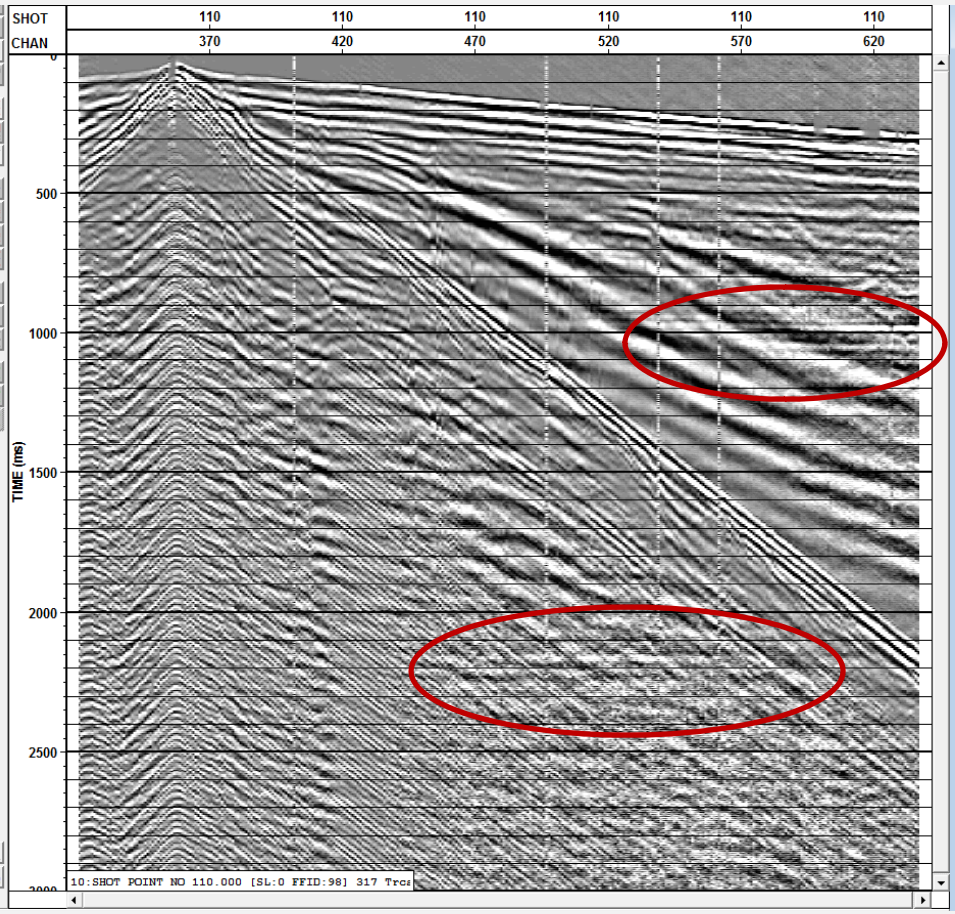
onSEIS

Dual electro-magnetic impact units
Impacts per shot point: 16
Shot spacing: 10m

Yeniseigeofizika OJSC

Shot gathers at flag 110 (SM-24 geophones @ 2.5m)



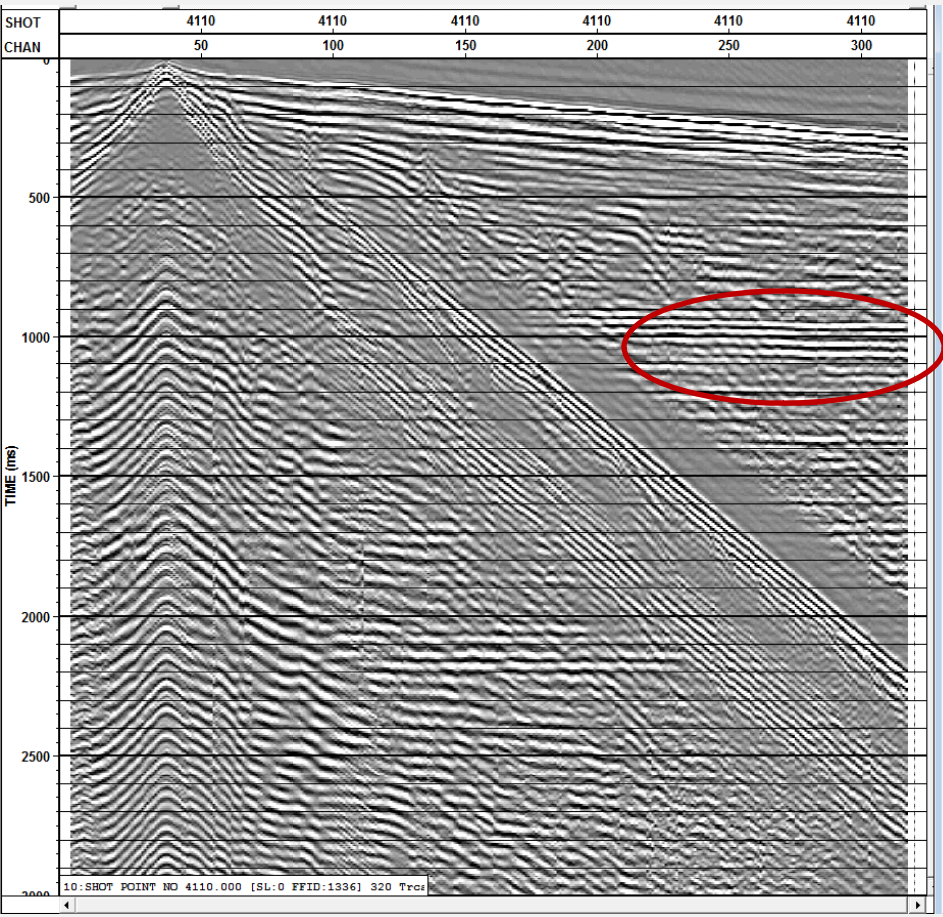


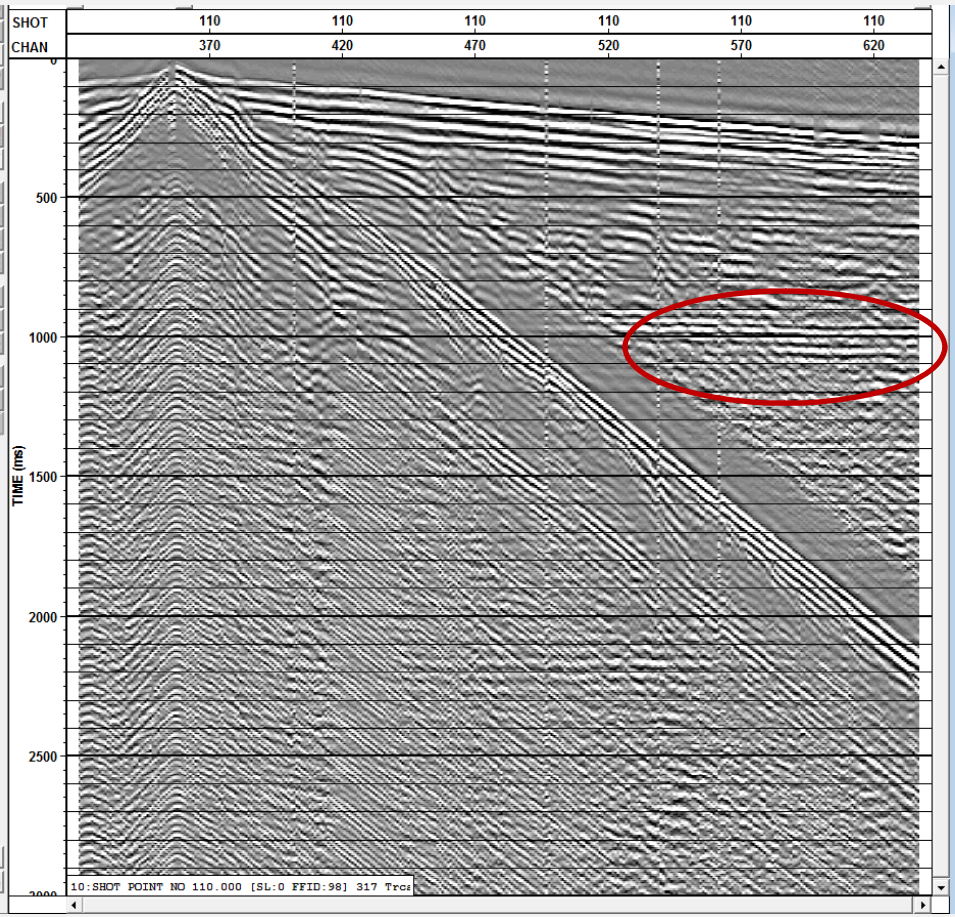
EnviroVibe

onSEIS

CREWES

Shot gathers at flag 110 (SM-24 geophones @ 2.5m)





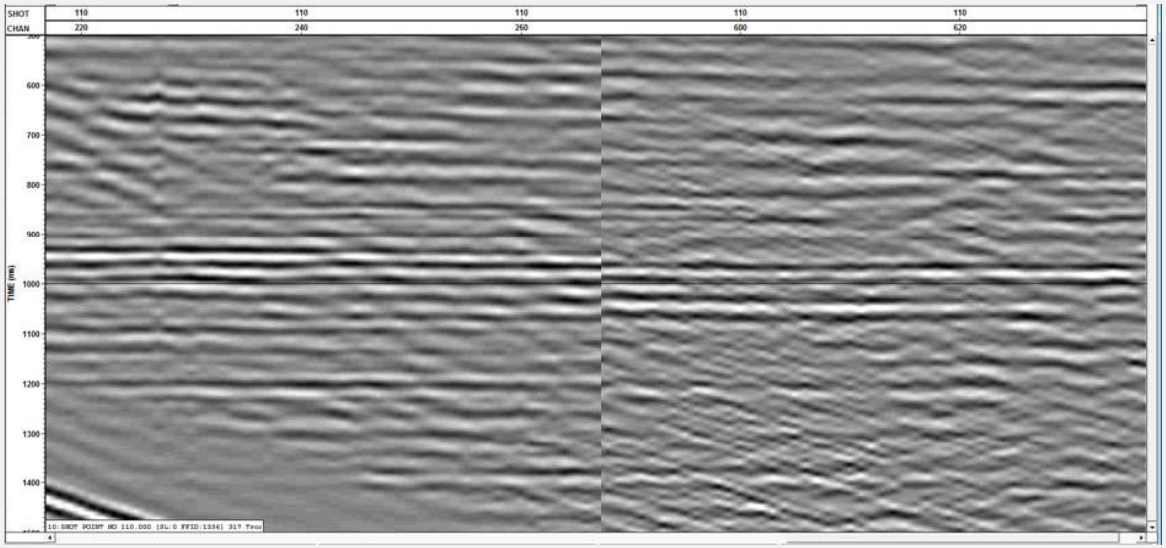
EnviroVibe

onSEIS

Filters: 20-25-60-80

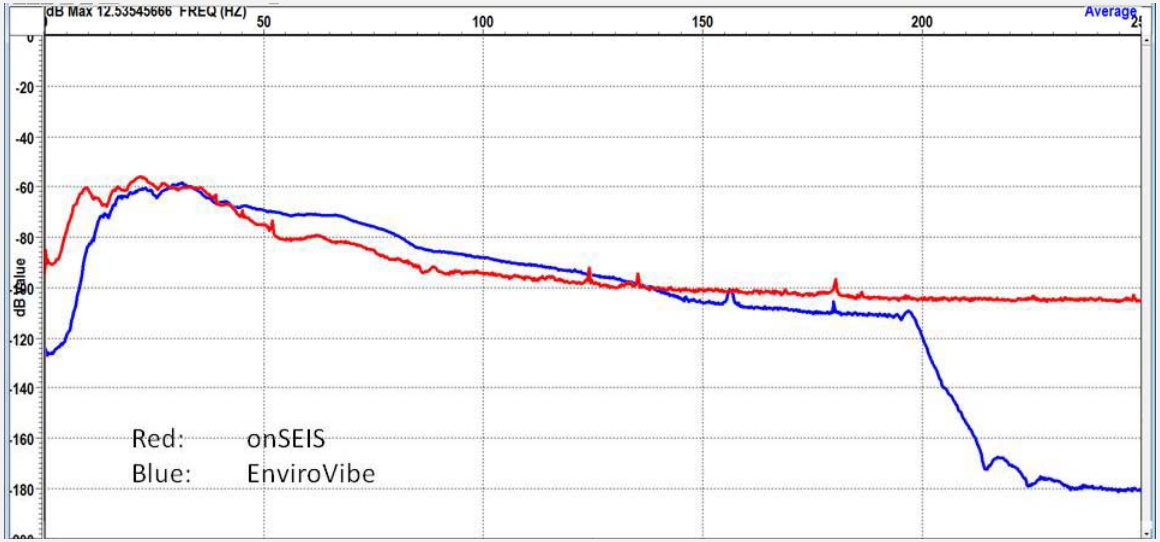
CREWES

The event at 1 second



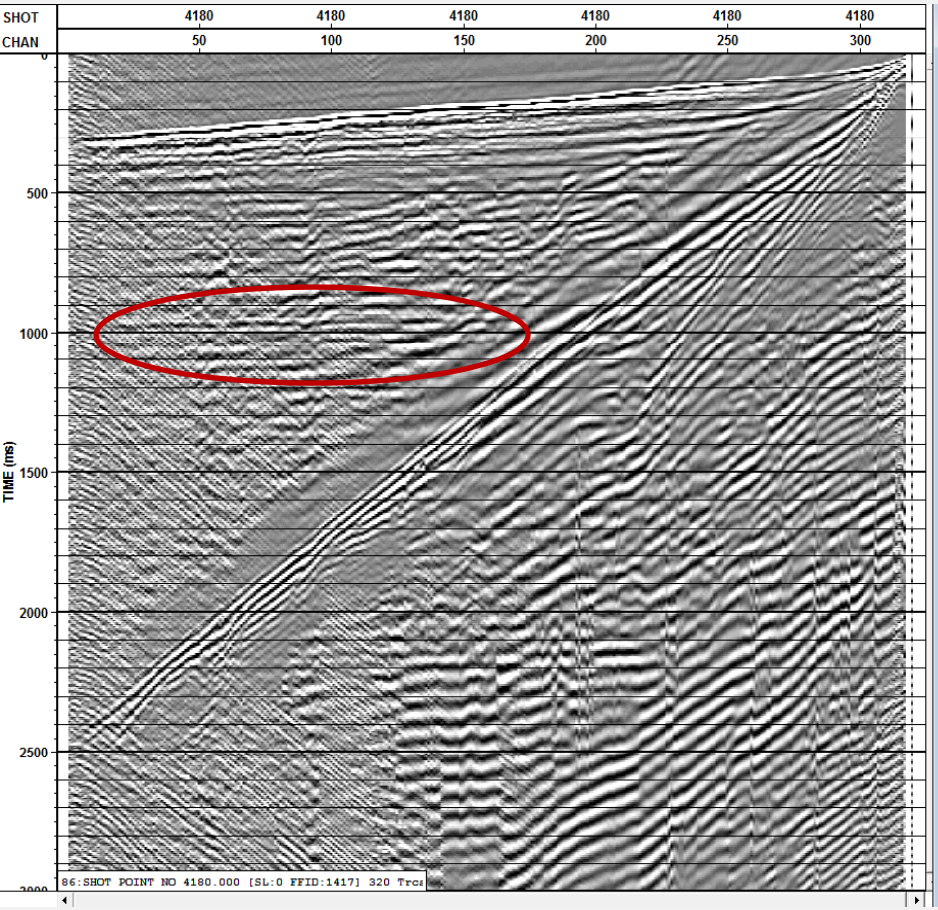
EnviroVibe onSEIS

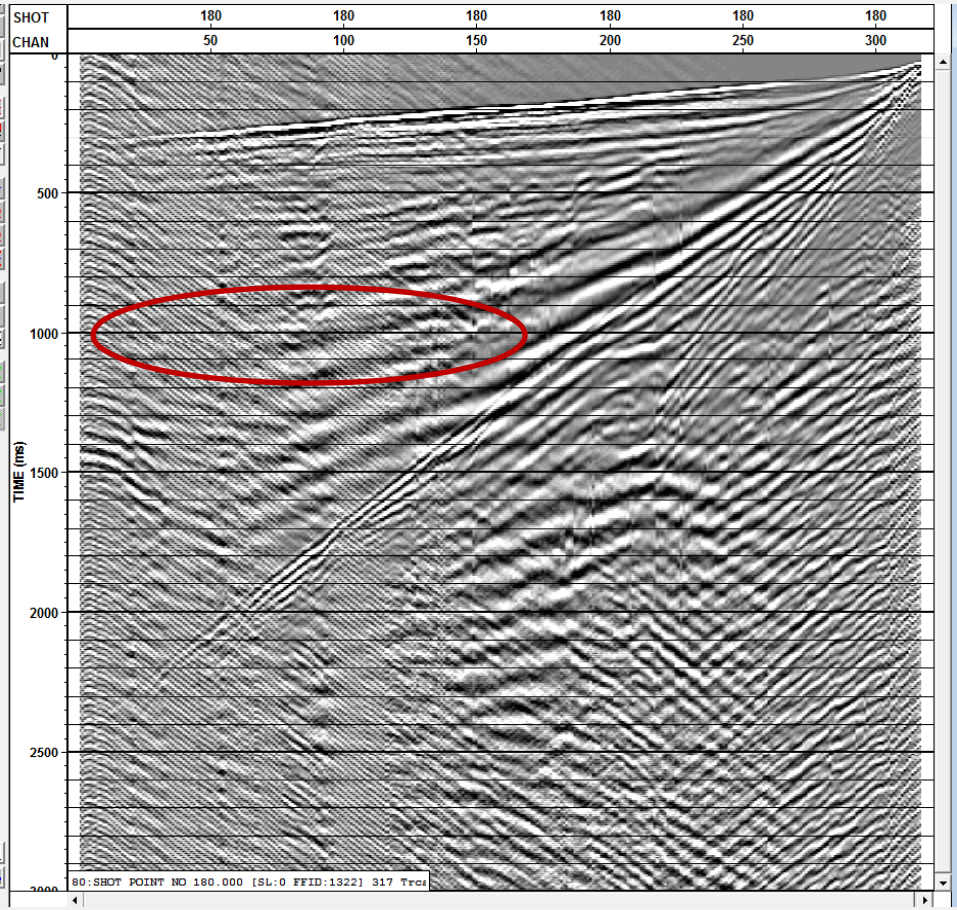
Spectra of the gathers



CREWES

Shot gathers at flag 180 (SM-24 geophones @ 2.5m)



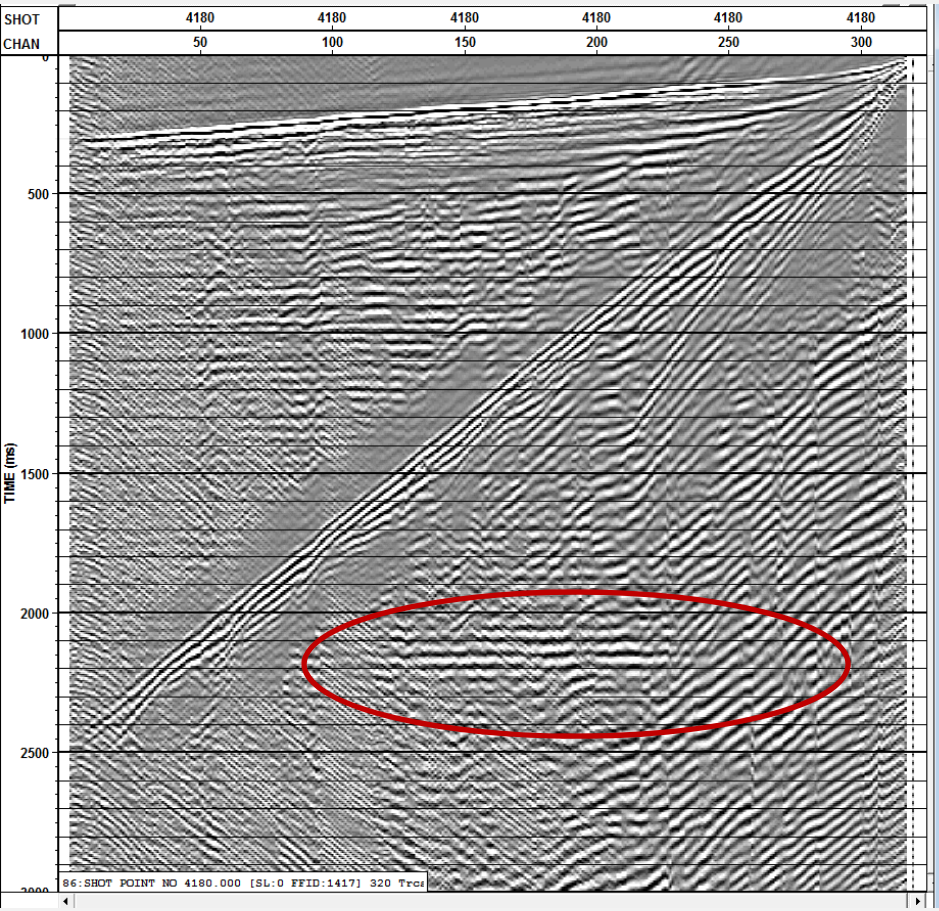


EnviroVibe

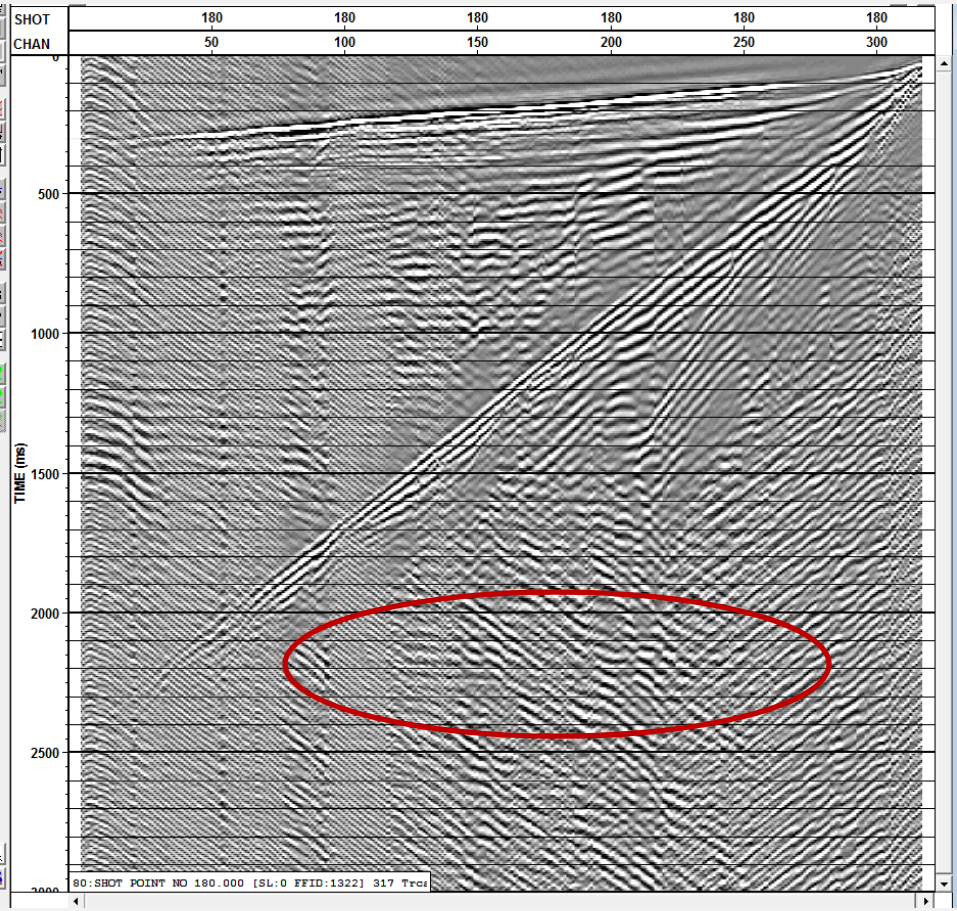
onSEIS

CREWES

Shot gathers at flag 180 (SM-24 geophones @ 2.5m)



EnviroVibe

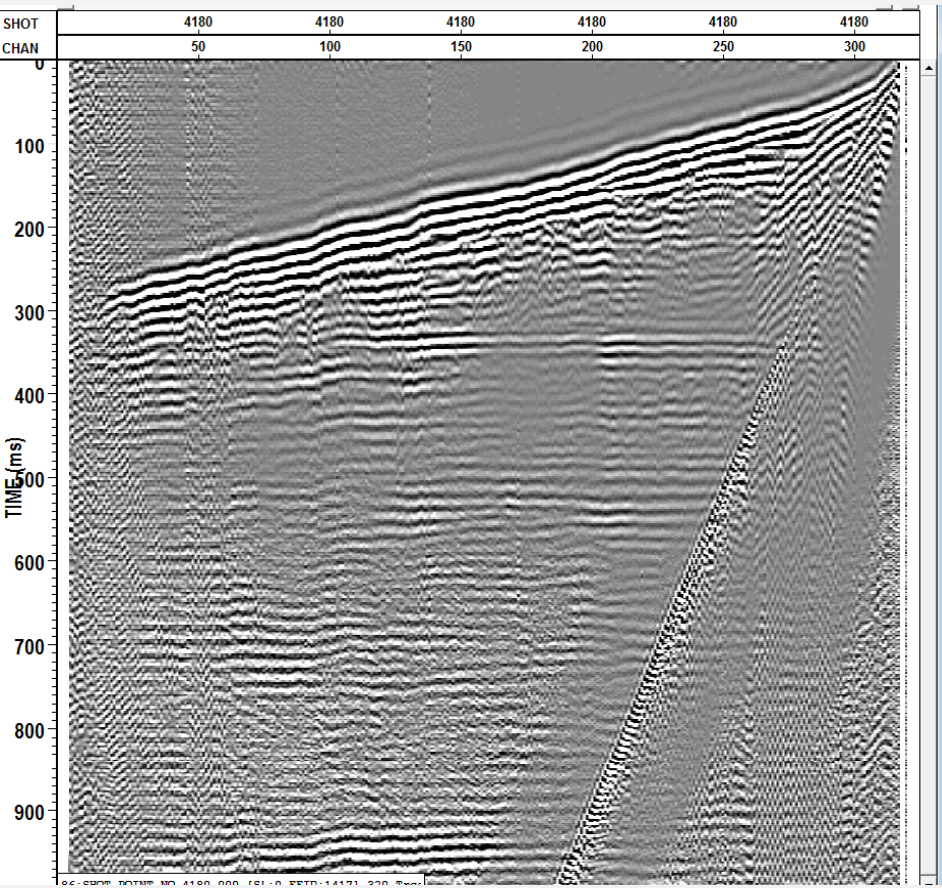


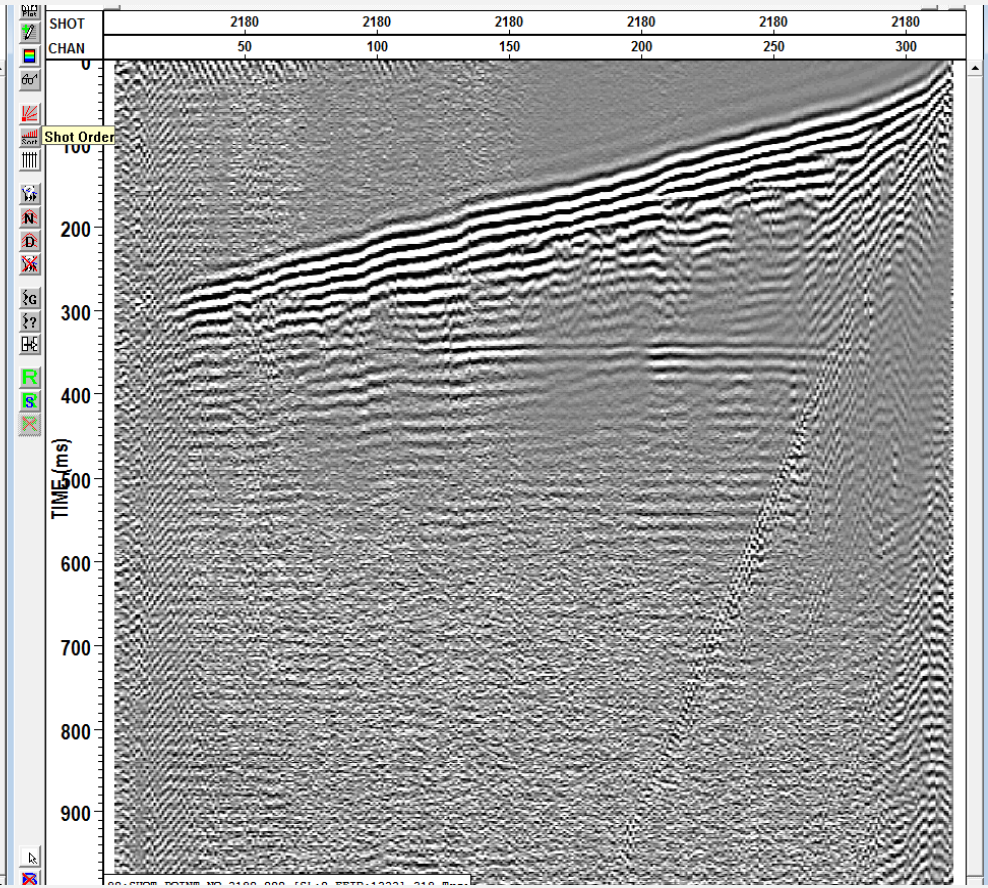
onSEIS

Filters: 20-25-60-80

CREWES

Shot gathers at flag 180 (SM-24 geophones @ 2.5m)





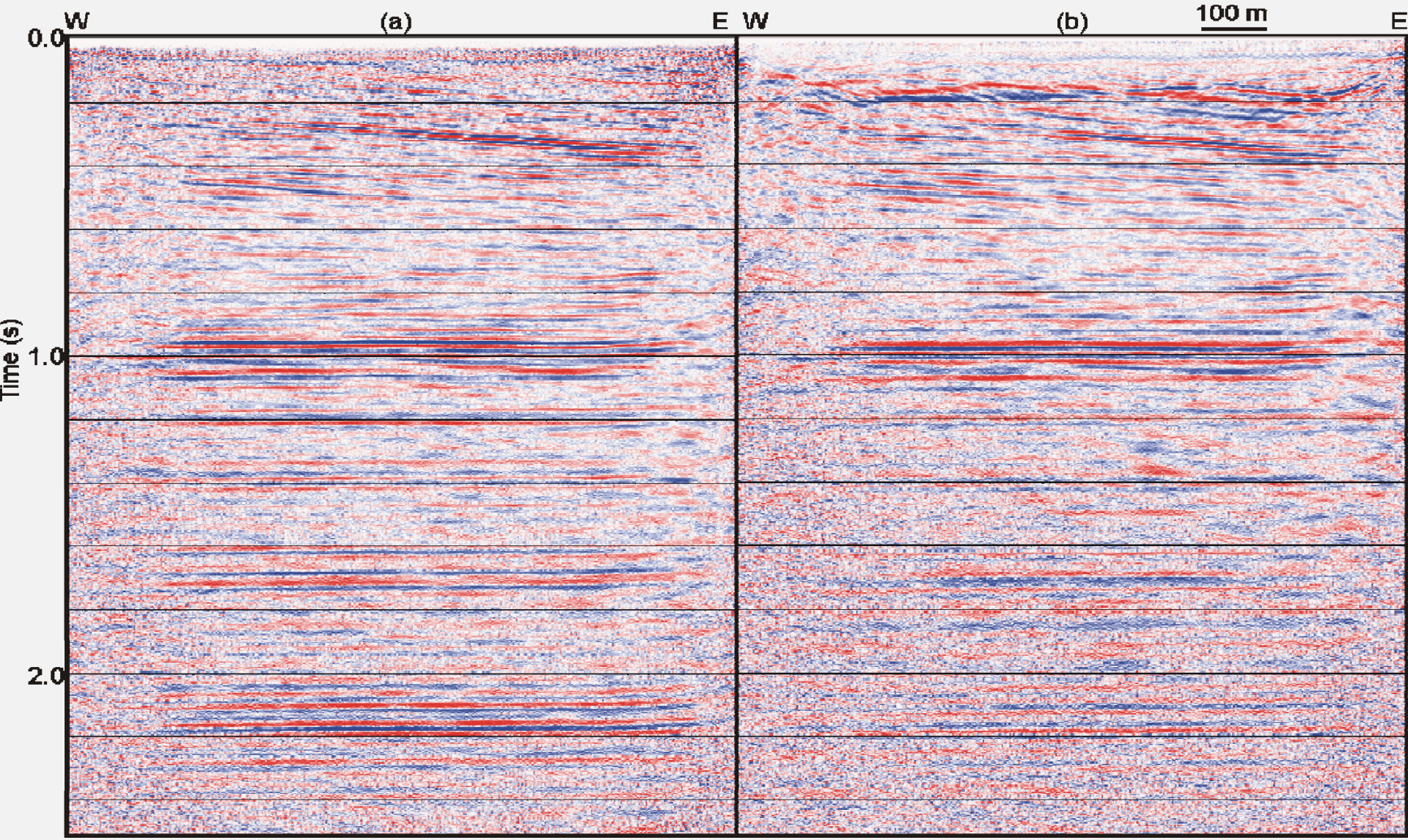
EnviroVibe

onSEIS

First second of gathers with filters: 45-70-250-250

CREWES

Stacked section with no filter applied

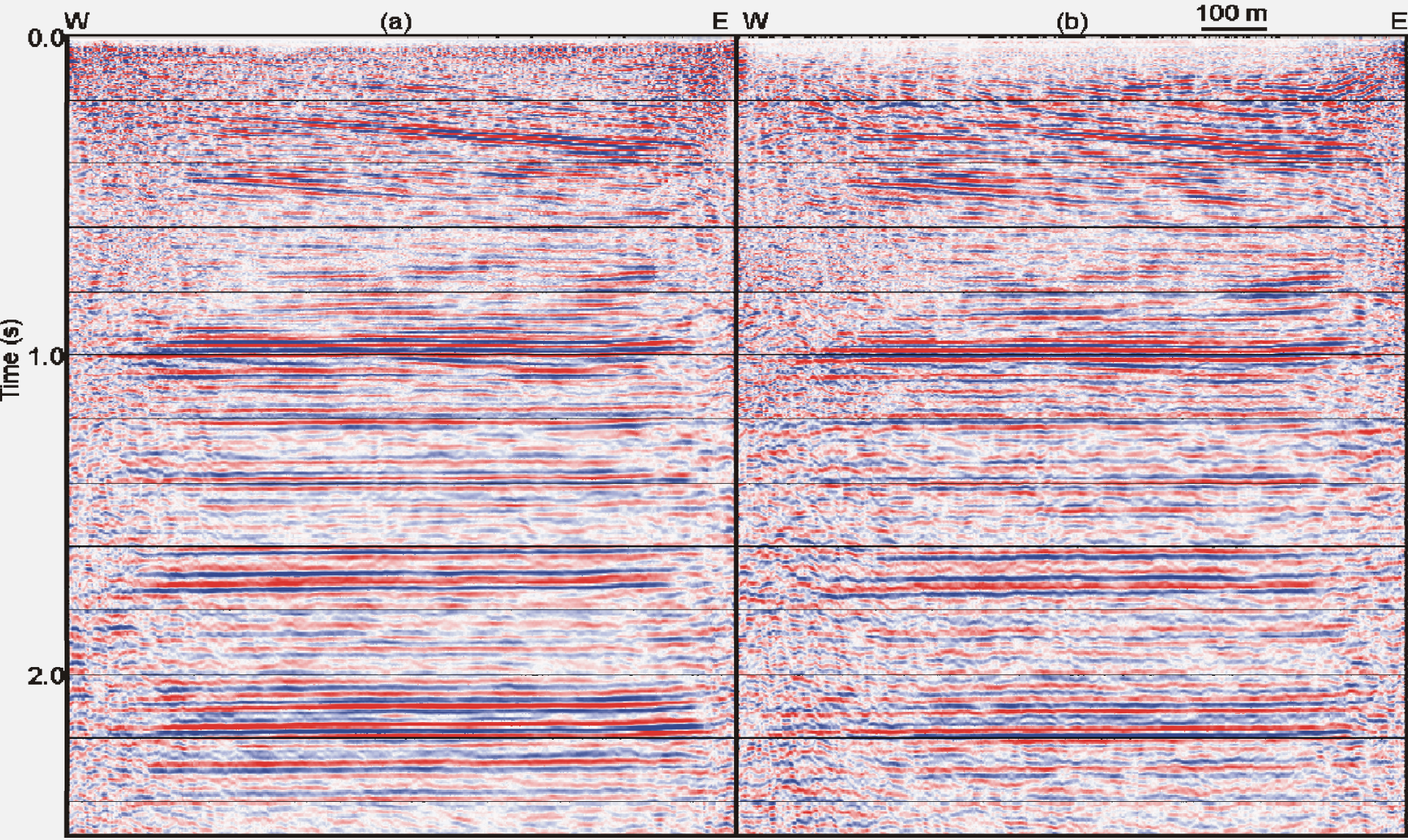


EnviroVibe

onSEIS

CREWES

Stacked section with time variant filter applied



EnviroVibe

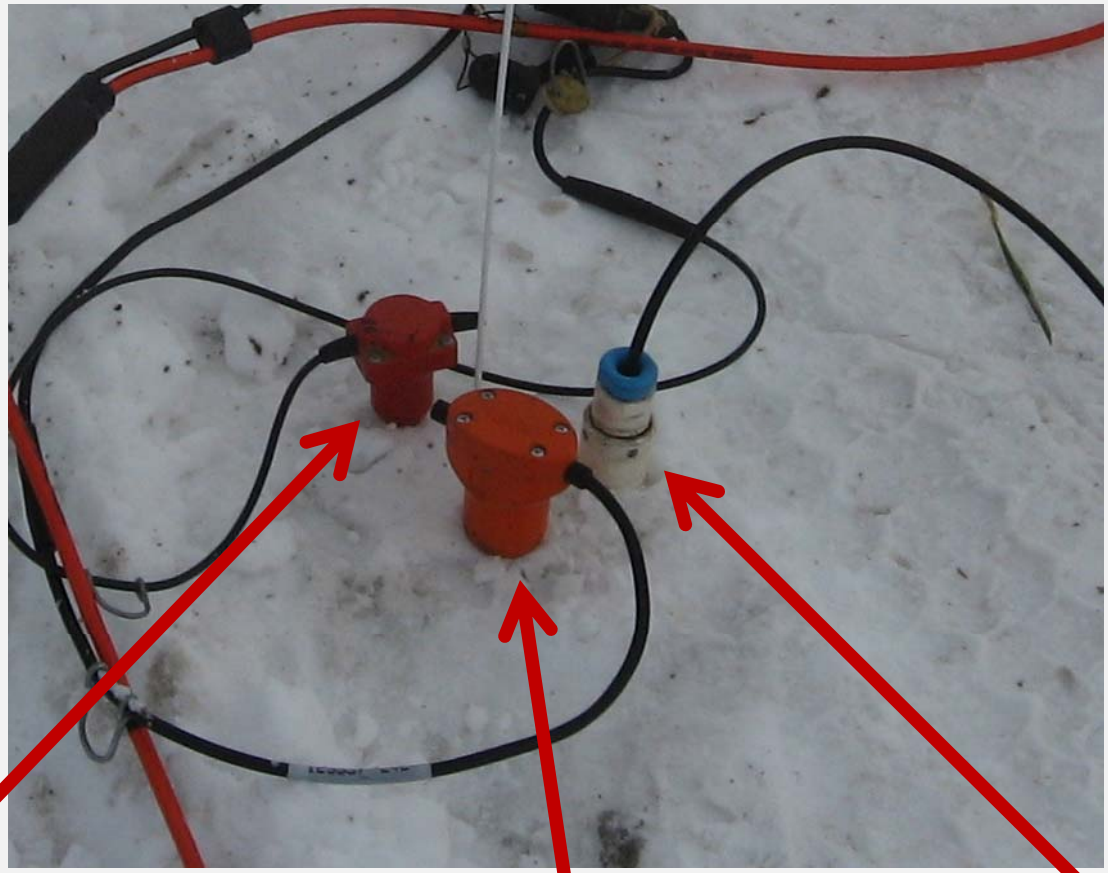
onSEIS

CREWES

Conclusions on the source comparison

- Both sources provide data to better than 2 seconds in this area
- Both sources provide good data for the shallow events
- The onSEIS is a lower frequency source than the EnviroVIbe
- The cycle time of the two sources is about the same for 4 x 20 second sweeps and 16 impacts per shot point

Priddis geophone comparison:



OYO-Geospace GS-One

RTC4.5

Ion-Sensor SM-24

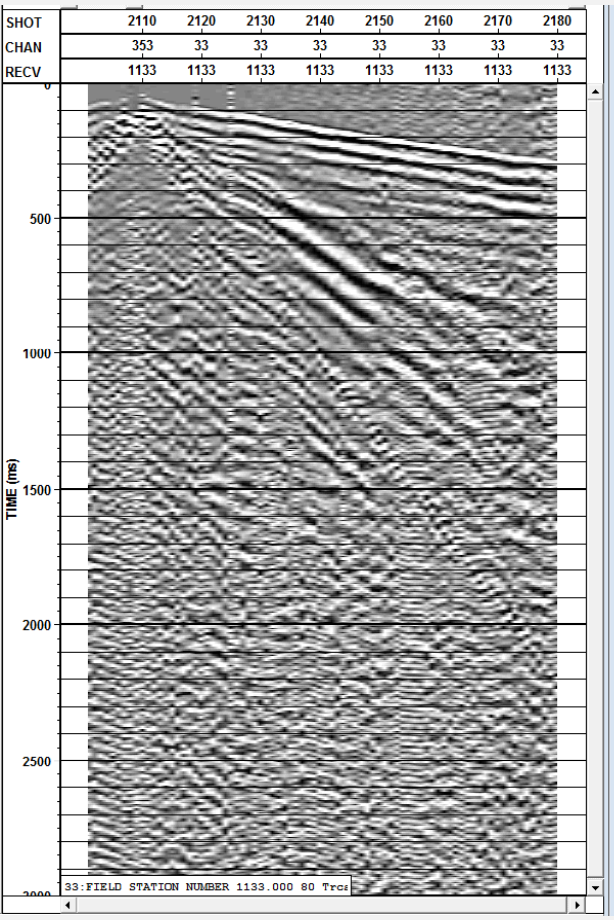
CREWES

The specifications of the geophones

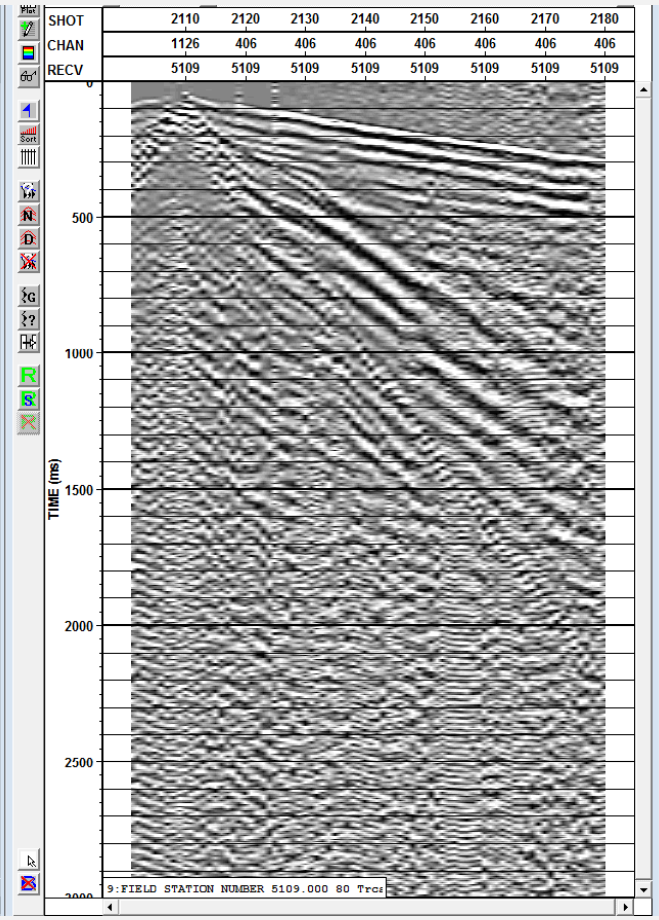
Geophone	Damping	Sensitivity V/m/s	Comparative output (db)
SM-24 (10Hz)	69%	21	0.00
RTC4.5 (4.5Hz)	70%	23.4	0.94
GS-One (10Hz)	70%	78.7	11.48

- The comparisons are made using receiver gathers at different locations
- The onSEIS data is used to make the comparisons

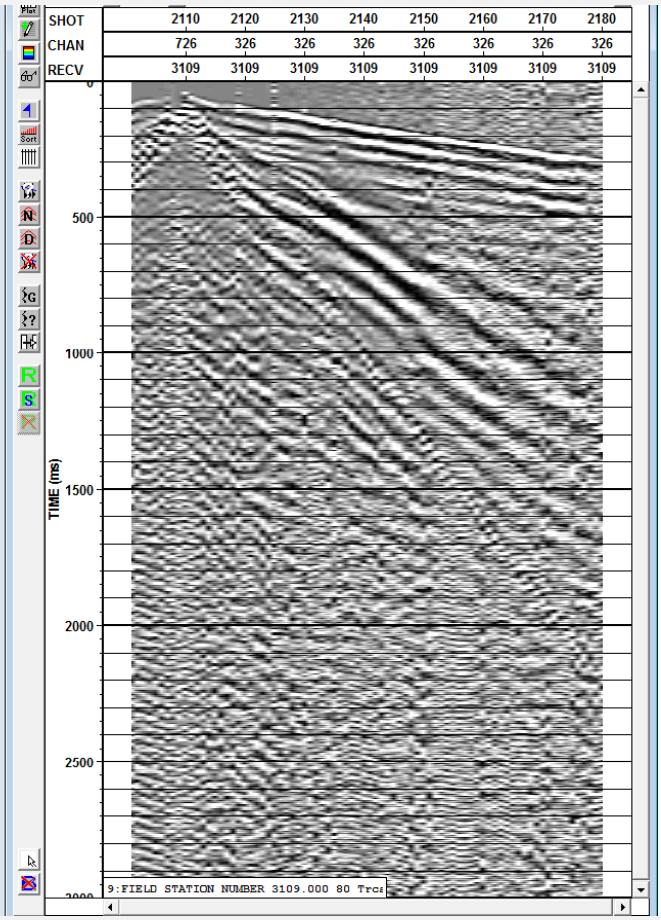
Receiver gather at flag 109 for all onSEIS shots with offsets >30m



SM24



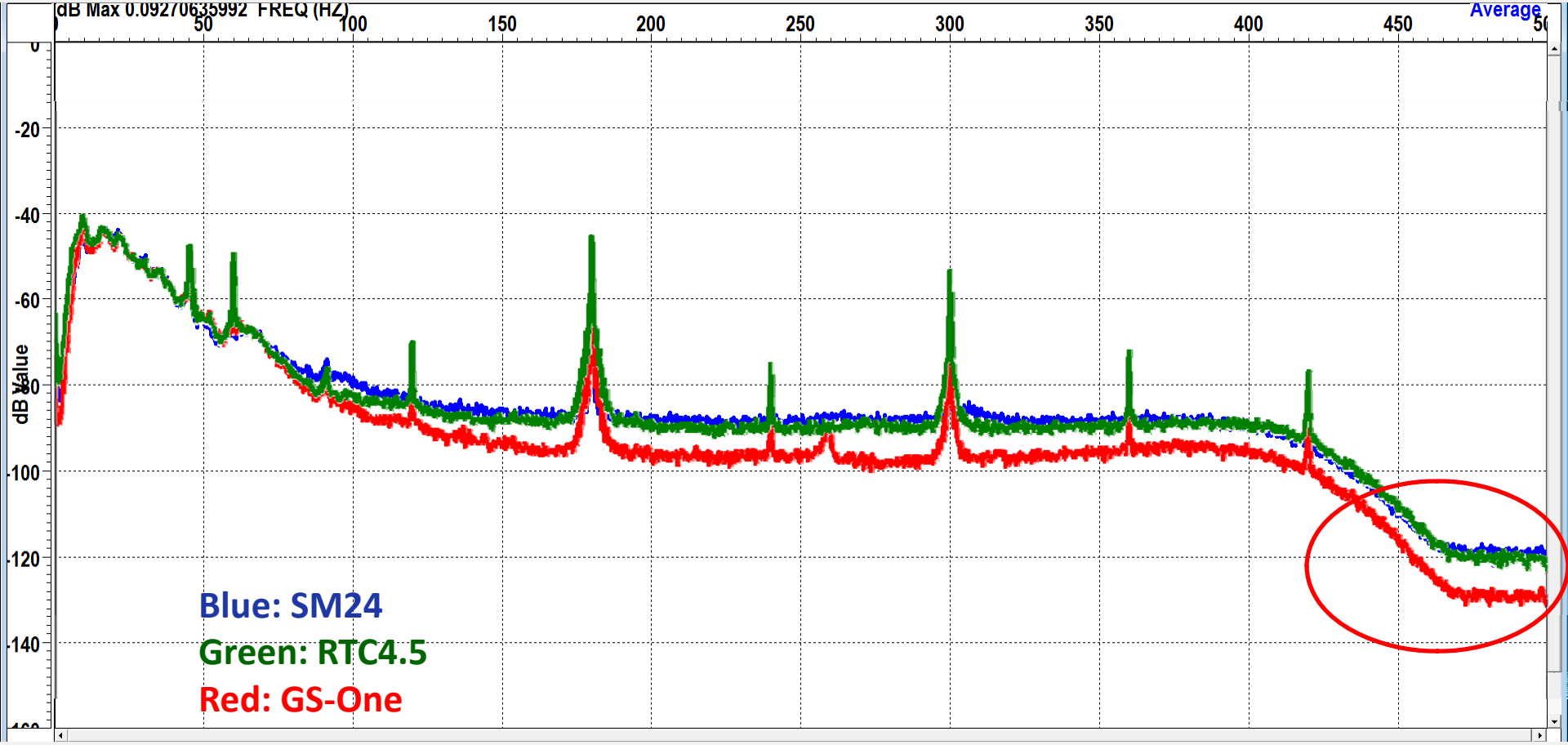
GS-One



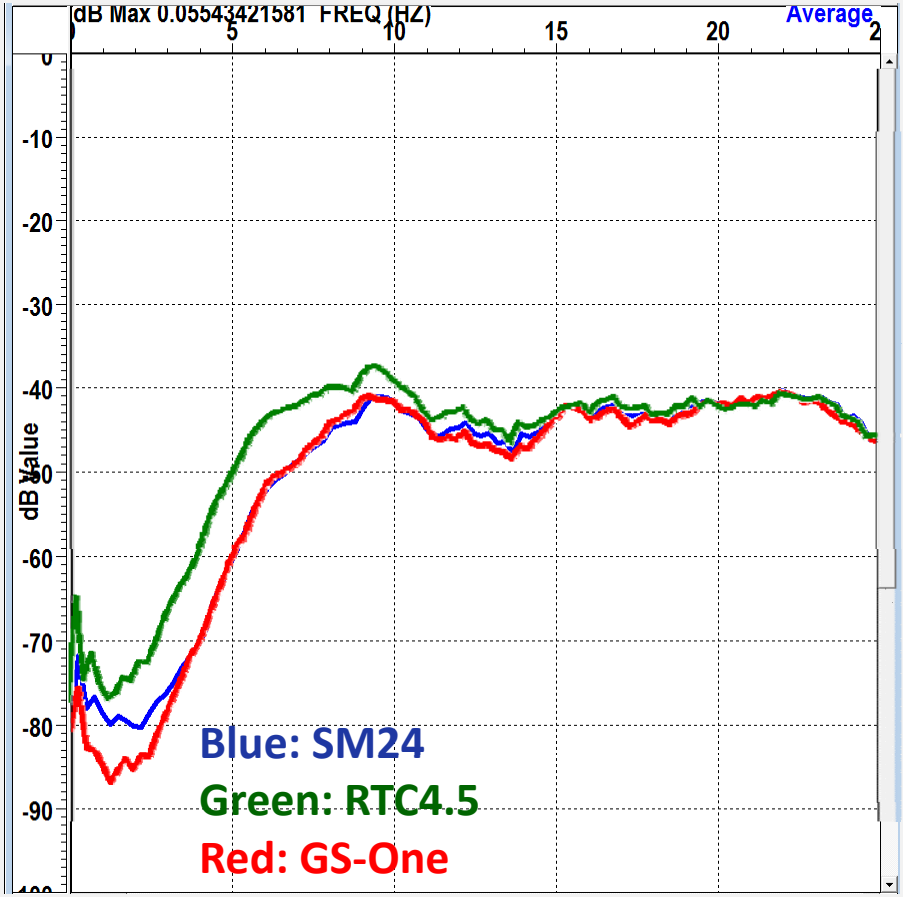
RTC4.5

CREWES

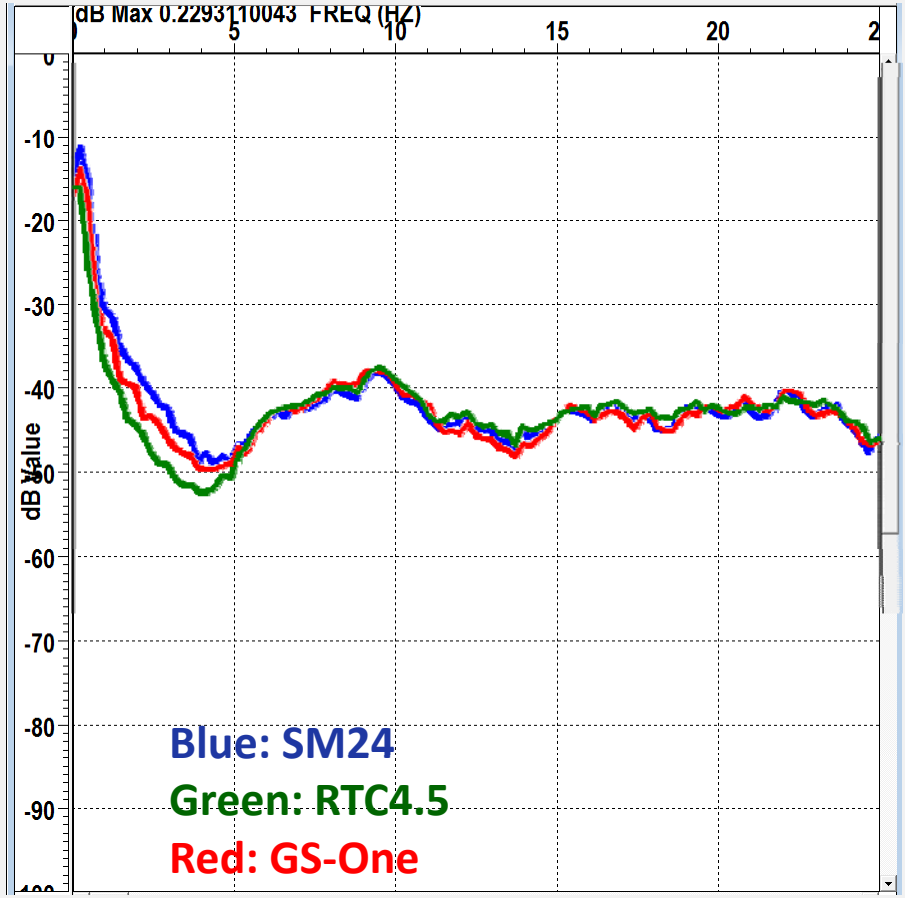
Spectra of the receivers from the gathers at flag 109



Expanded spectra of the receivers from the gathers at flag 109

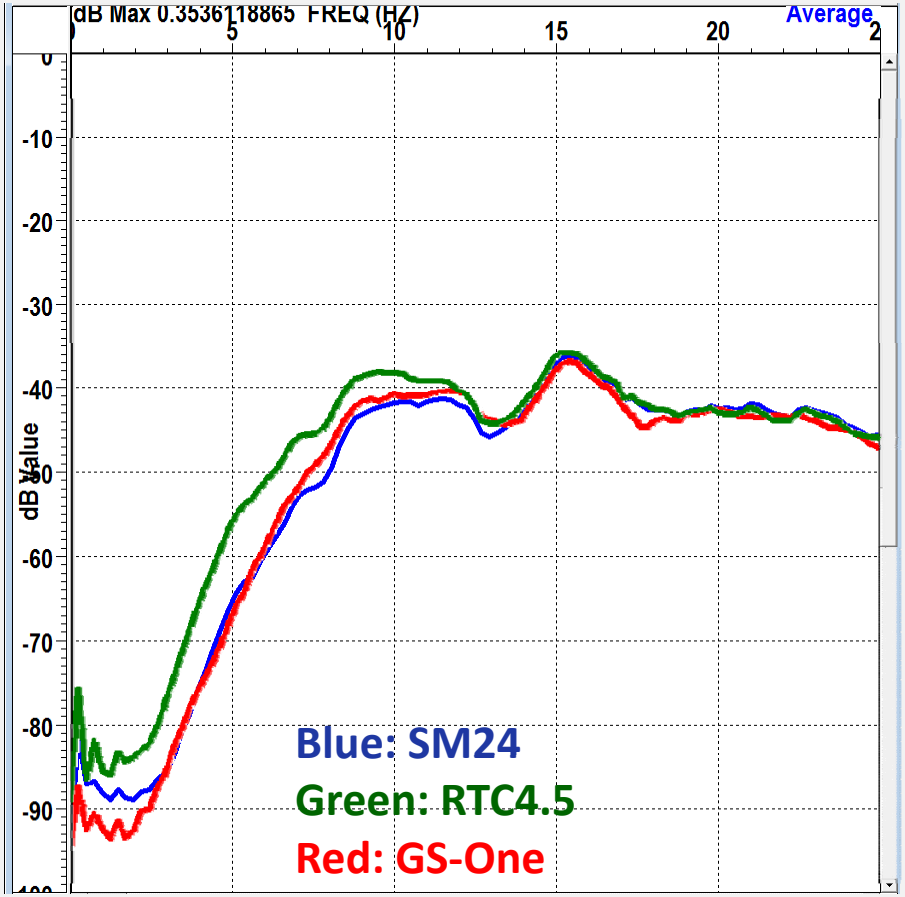


Raw



After low frequency recovery

Spectra of the receivers from the gathers at flag 148



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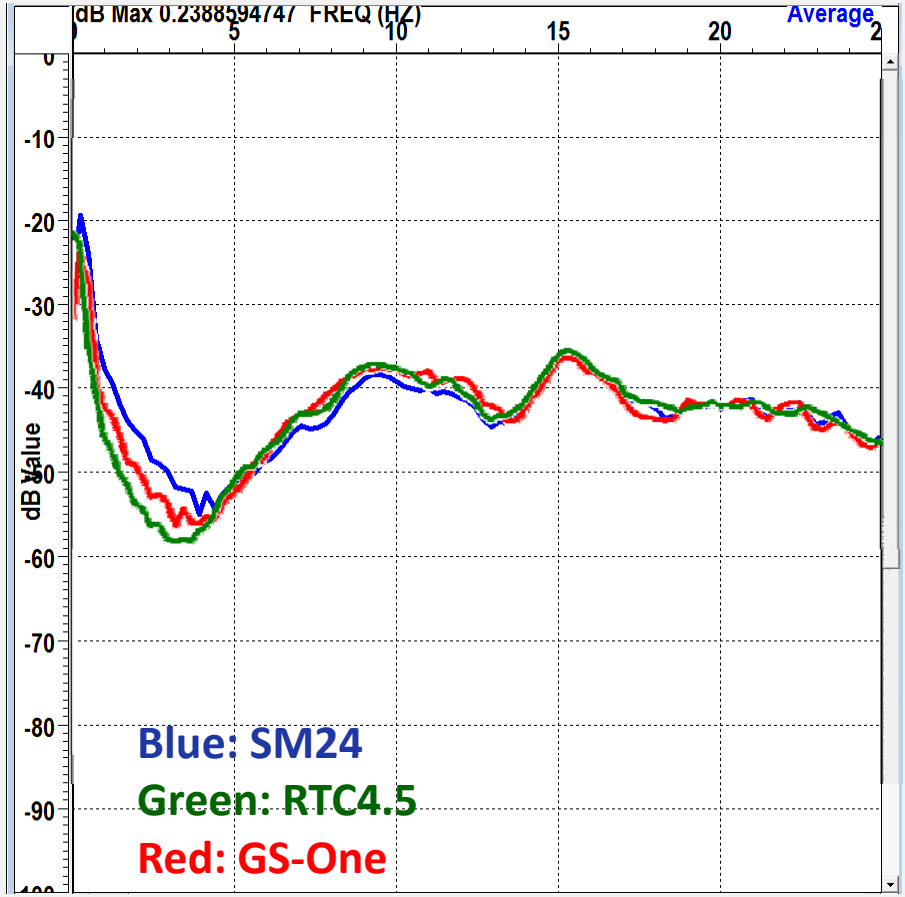


After low frequency recovery

Conclusions on the geophone comparison

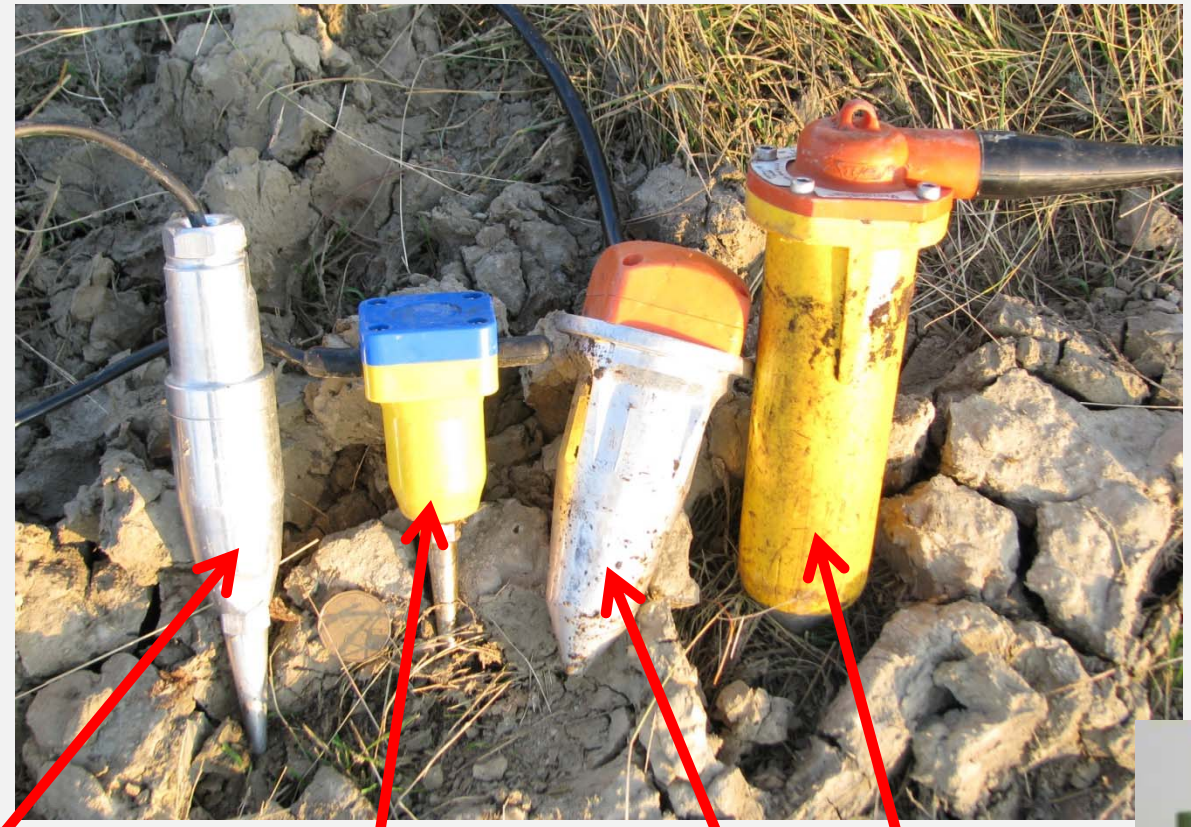
- After low frequency recovery, all geophones track very closely down to 5Hz, below which the RTC4.5 shows a better noise floor

- The three geophones show the expected difference in output levels measured at the noise floor

- The GS-One devolves into noise about 1Hz below the SM24, and the RTC4.5 about 1Hz below that

- For this type of survey, any of the geophones would be adequate, since there is very little data below 5Hz for the onSEIS, 10Hz for the EnviroVibe

Hussar sensor comparison



Ion-Sensor SM-24-1k8

Weihai Sunfull PS-4.5B

Ion-Sensor SM7 3C

Vectorseis 3C

Nanometrics Trillium Compact

CREWES

The specifications of the geophones

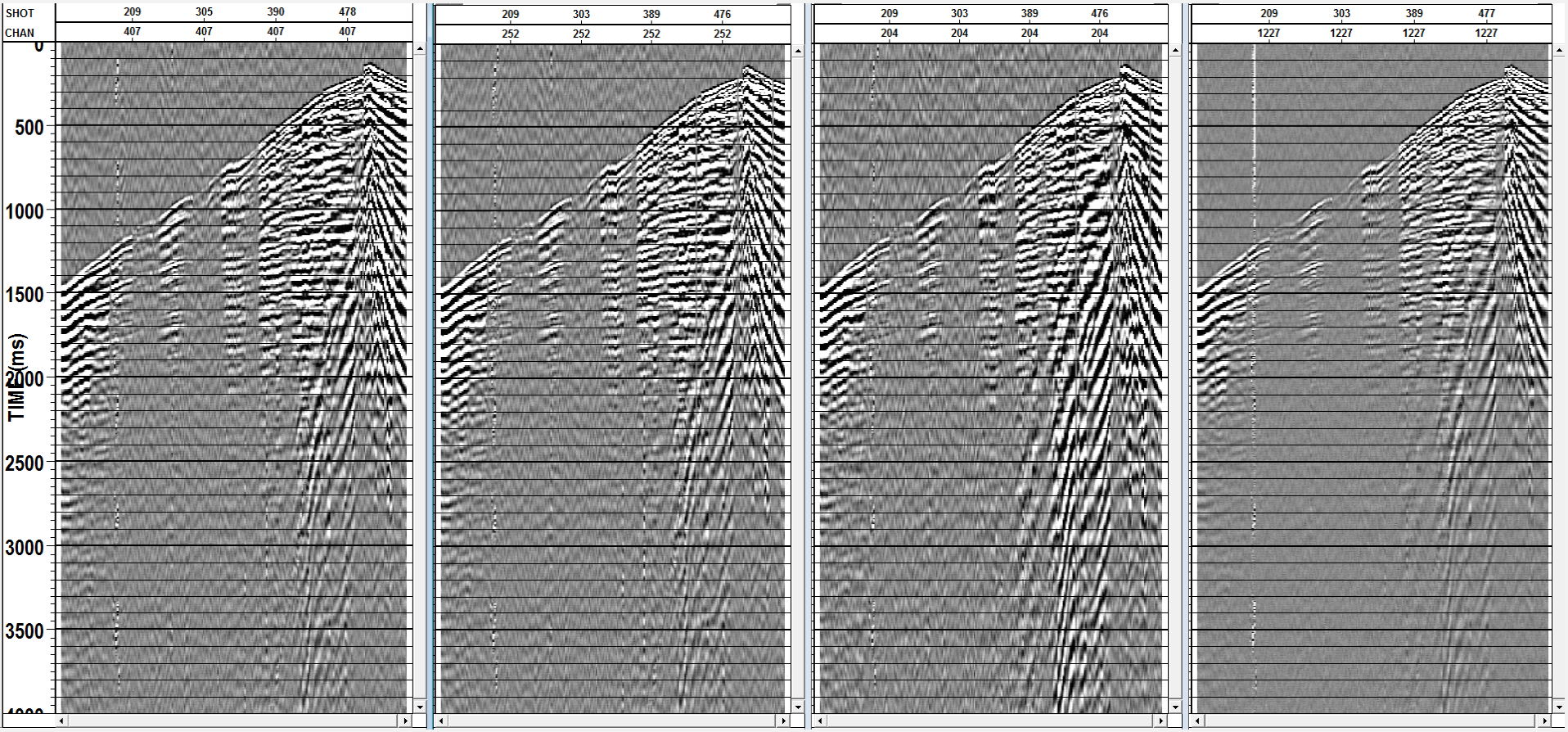
Geophone	Sensitivity v/m/s (open circuit)	Sensitivity v/m/s (damped)	db wrt sm7
SM7	28.8	21	0.00
PS-4.5B	28.8	28.8	2.74
SM24-1k8	82	75.2	11.08
Trillium	750	750	31.06

The spread layout

Line 1: Vectorseis every 10m (flags 117 to 564)
Line 2: Sensor SM7 3C every 10m (flags 117 to 564)
Line 3: PS-4.5B 1C every 20m (flags 117 to 563)
Line 4: Sensor SM124-1k8 1C every 20m (flag 469 to 563)
Line 5: Nanometrics Trillium Compact every 200m (spaced along line)

CREWES

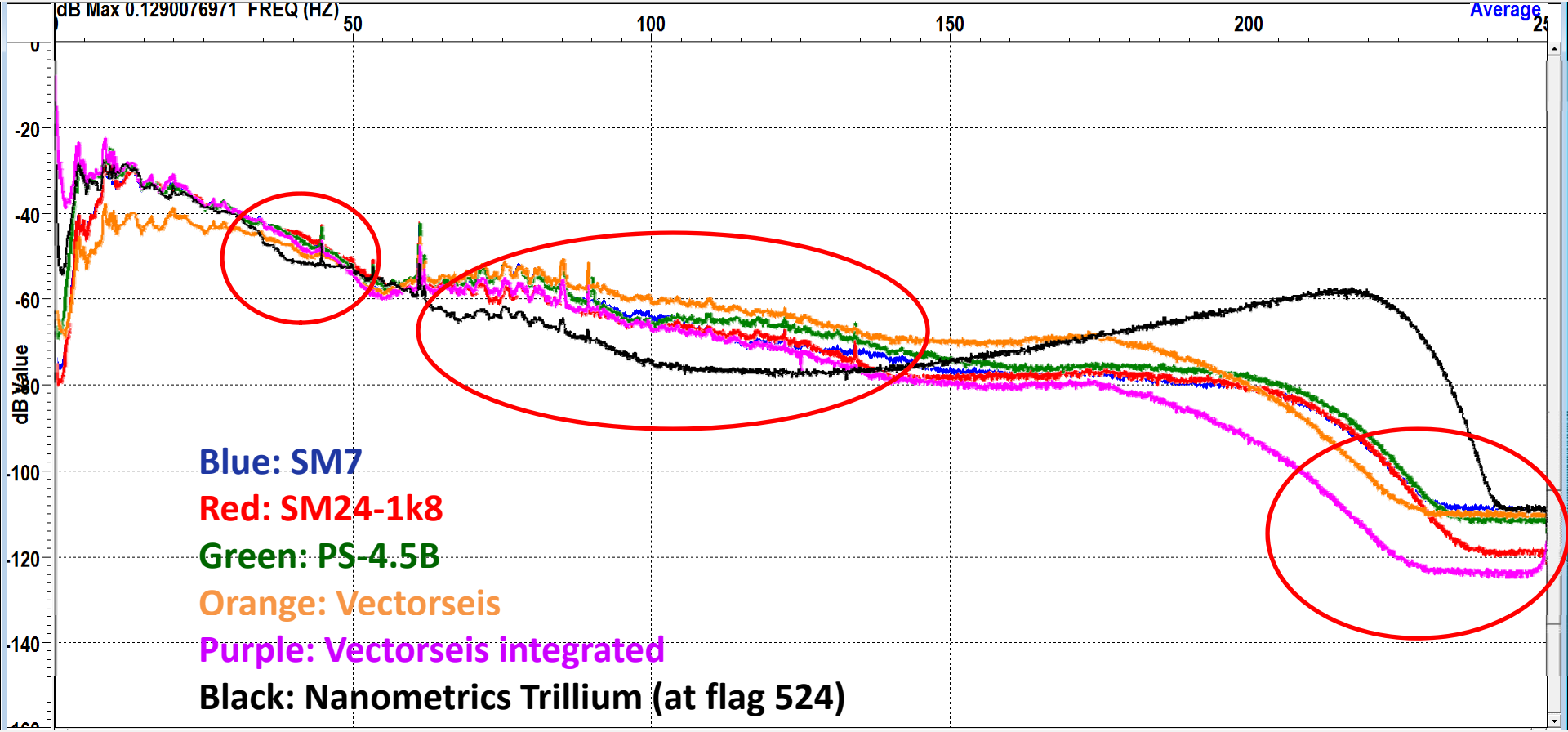
Receiver gathers at flag 523 for dynamite shots with offset >140m



SM7 SM24-1k8 PS-4.5B Vectorseis

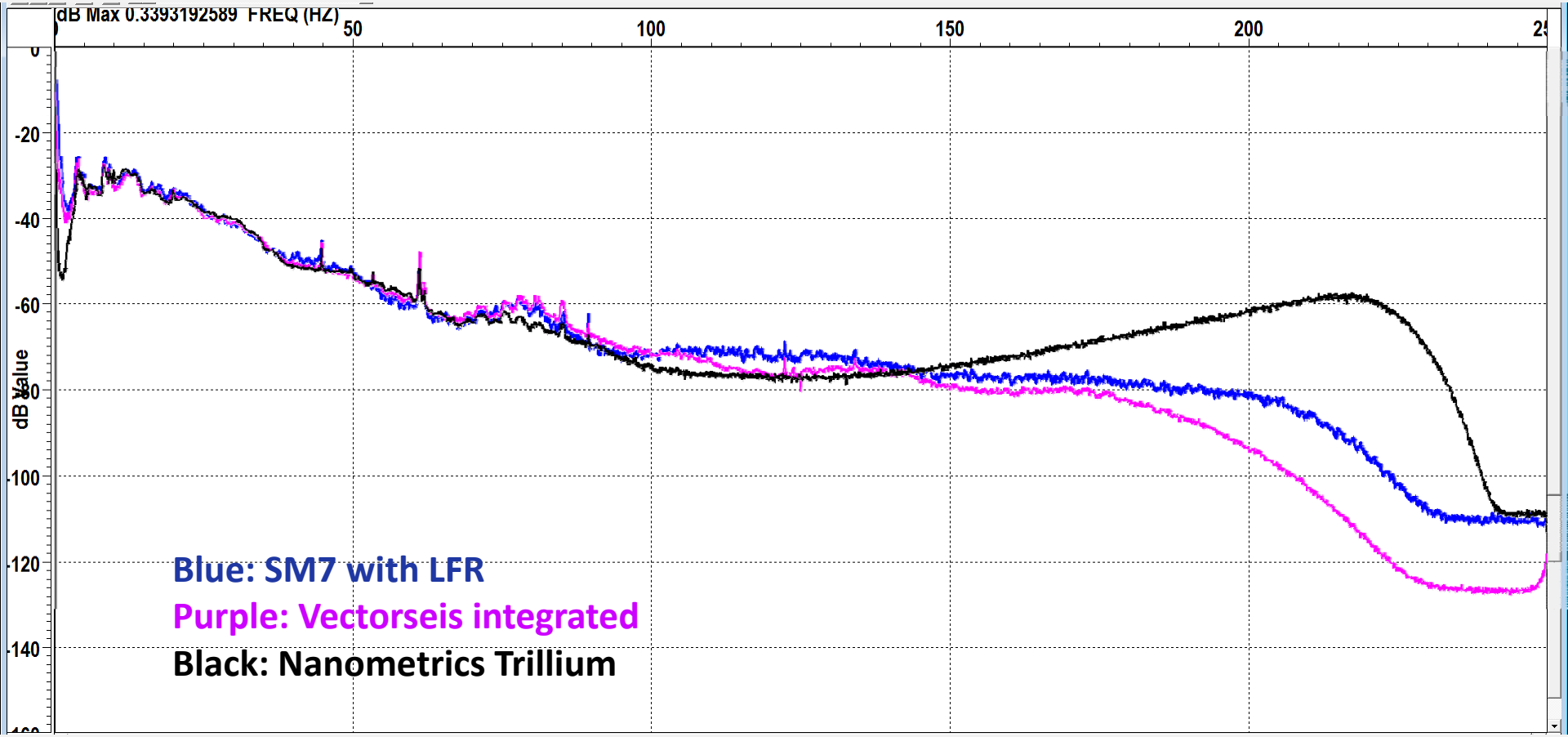
CREWES

Receiver gathers at flag 523 for dynamite shots with offset >140m



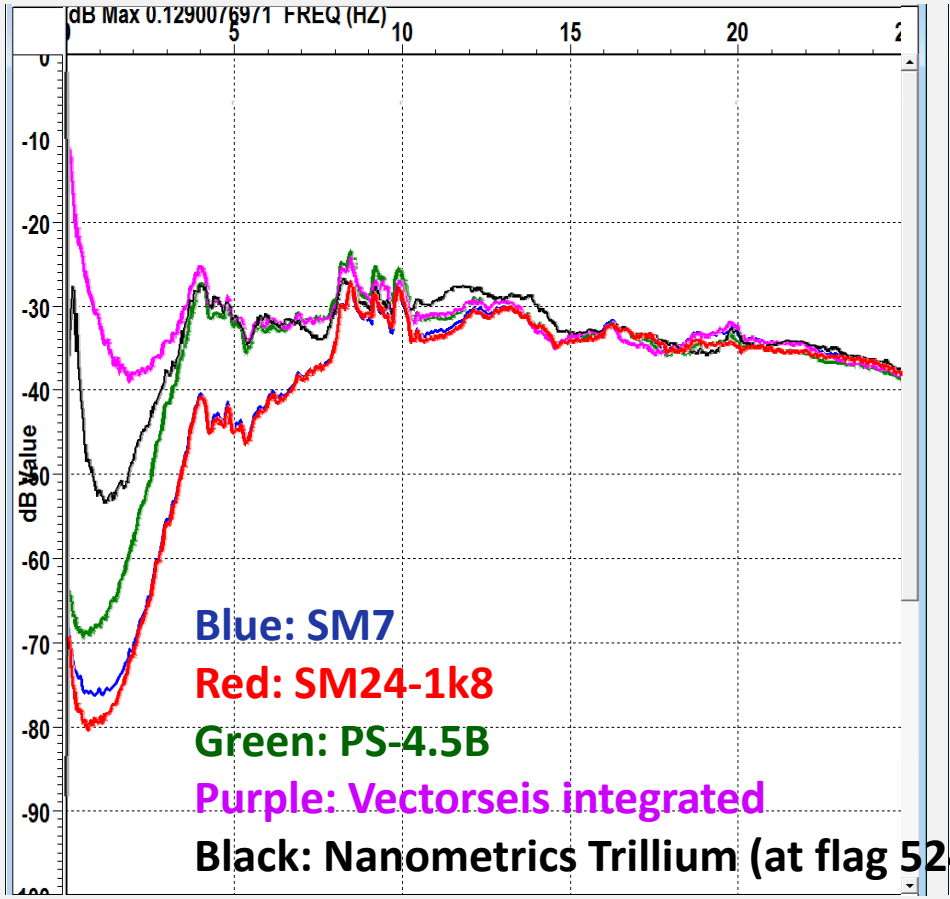
CREWES

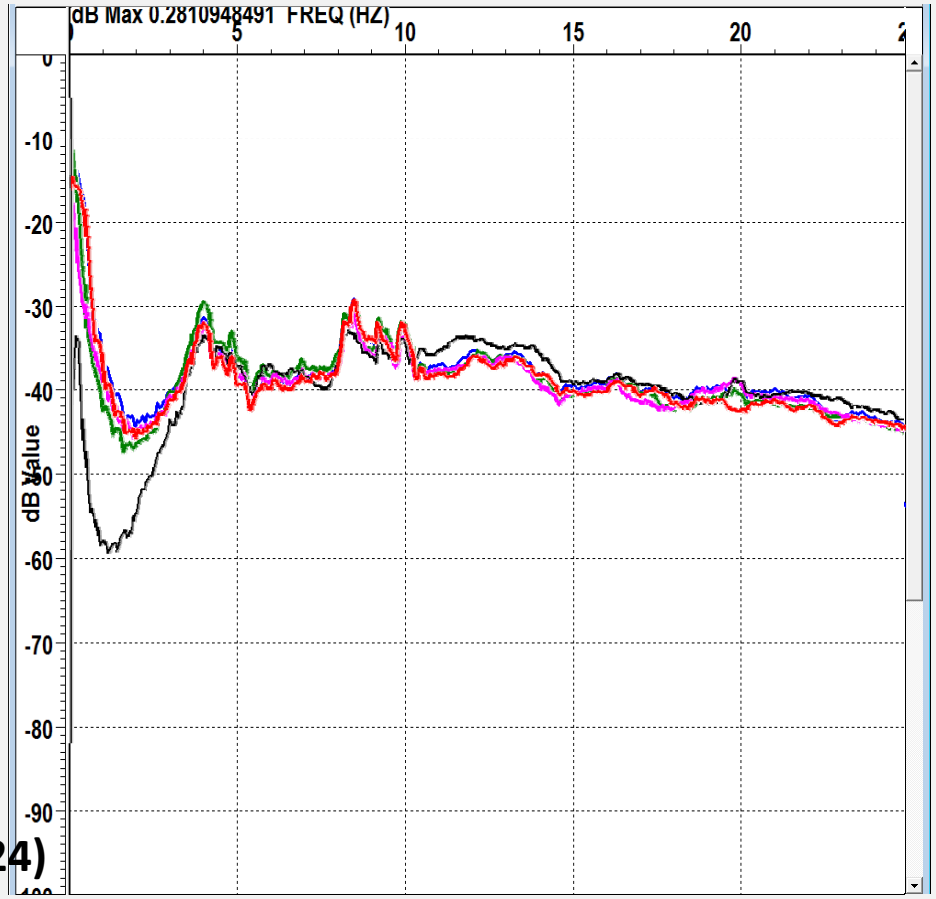
Receiver gathers at flag 524 for dynamite shots with offset >140m



CREWES

Expanded spectra for receiver gathers at flag 523 for dynamite



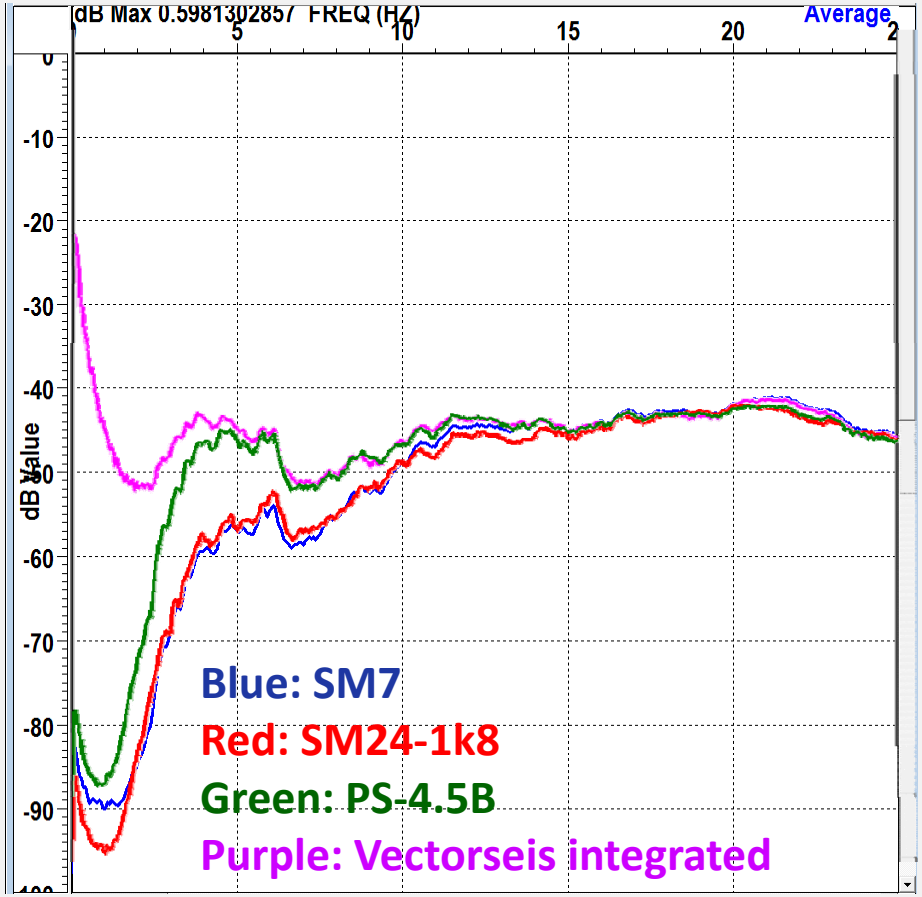


Raw

After low frequency recovery

CREWES

Expanded spectra for receiver gathers at flag 469 for dynamite



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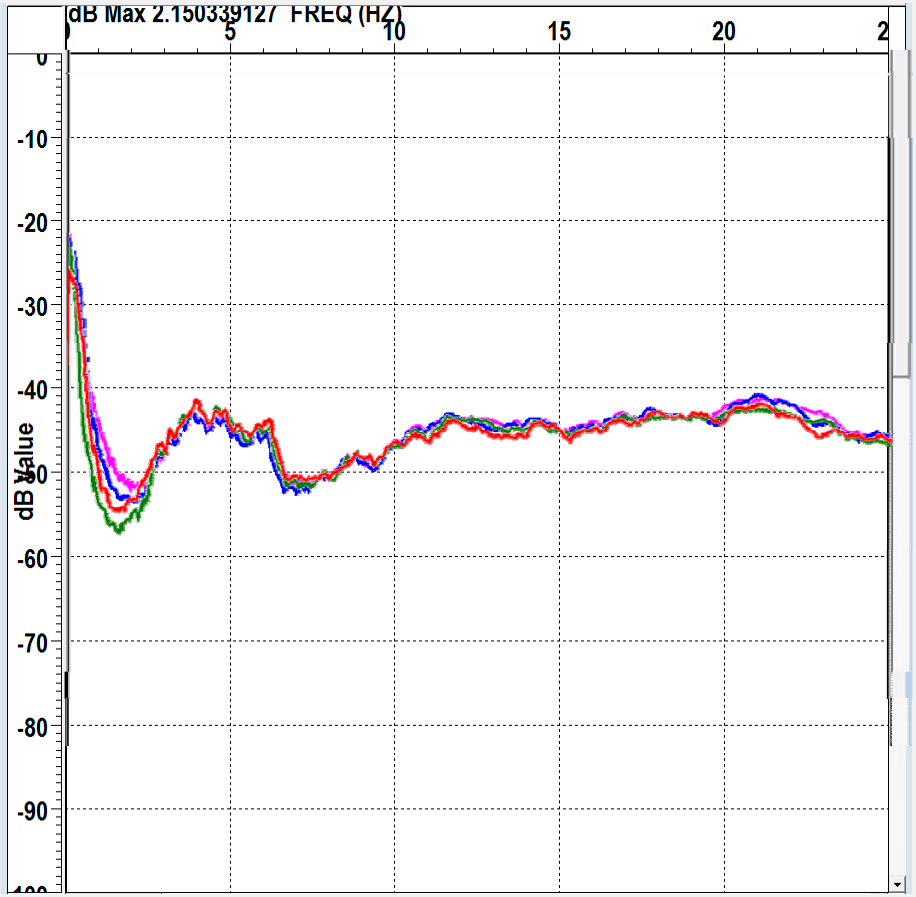
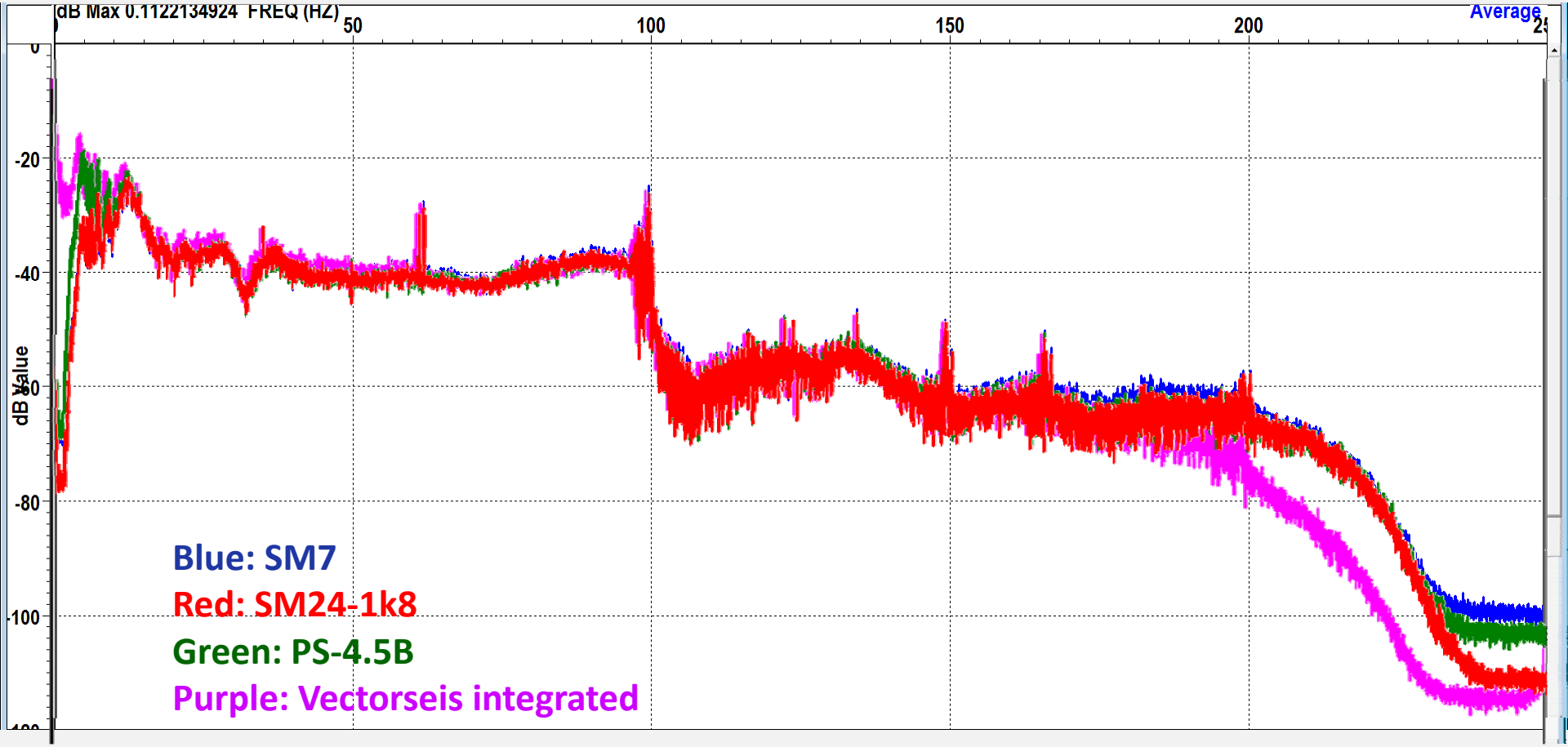


After low frequency recovery

CREWES

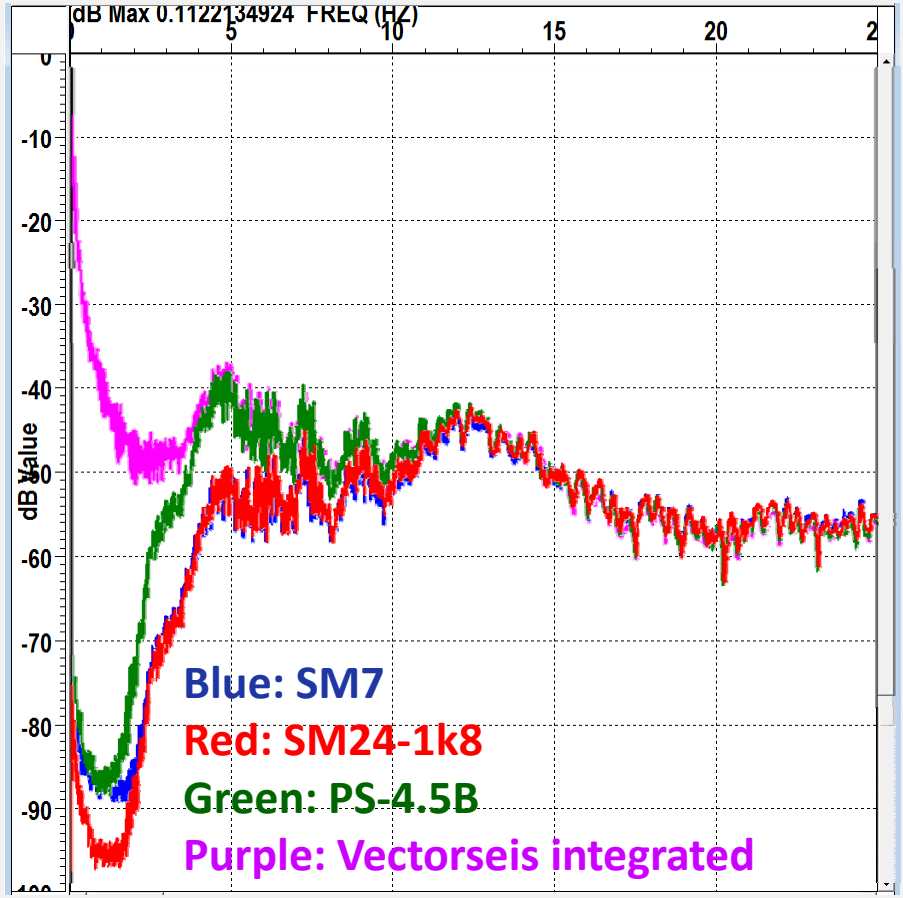
Uncorrelated stacked sweeps for Inova 364 low dwell at VP 449



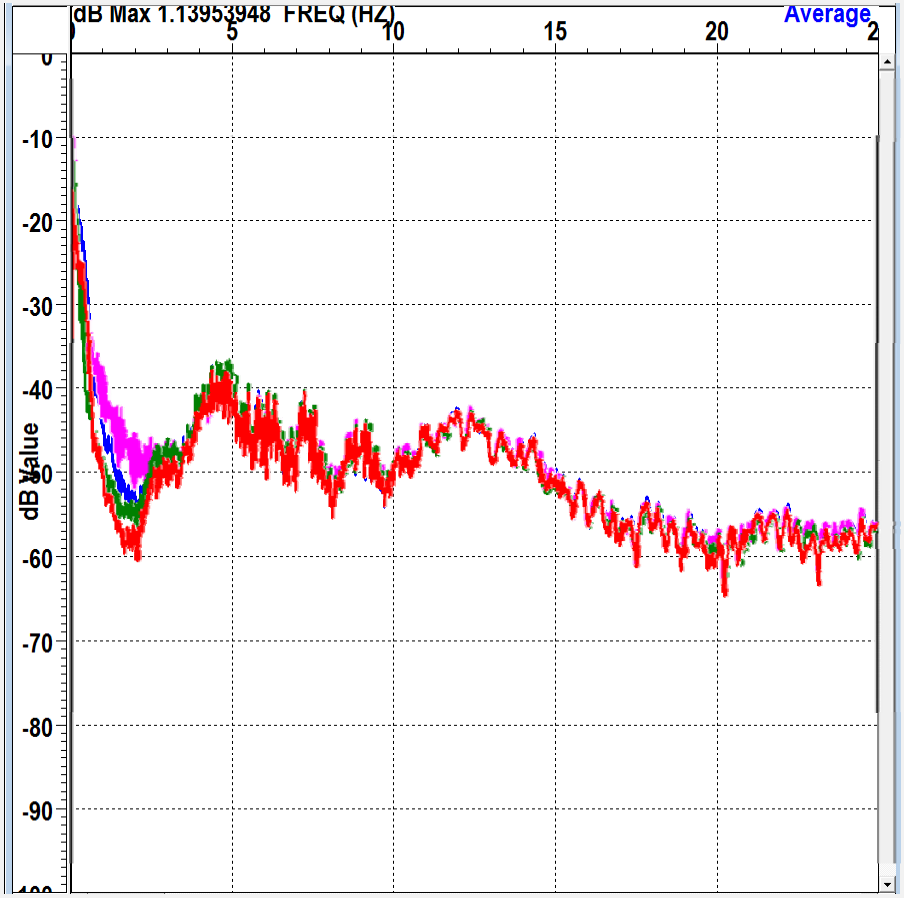
From the sensors at the odd flags between 469 and 563

CREWES

Uncorrelated stacked sweeps for Inova 364 low dwell at VP 449



Raw

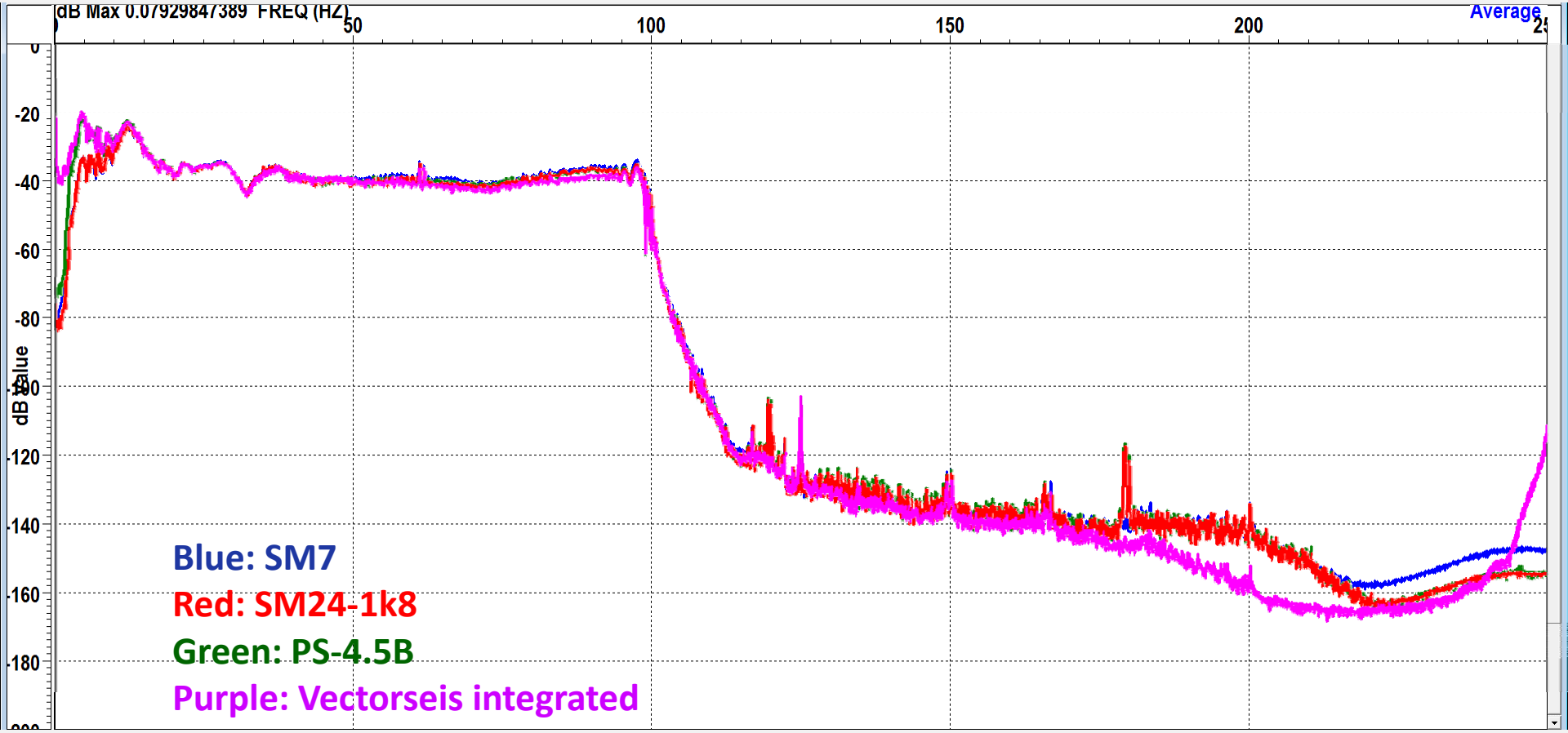


After low frequency recovery

From the sensors at the odd flags between 469 and 563

CREWES

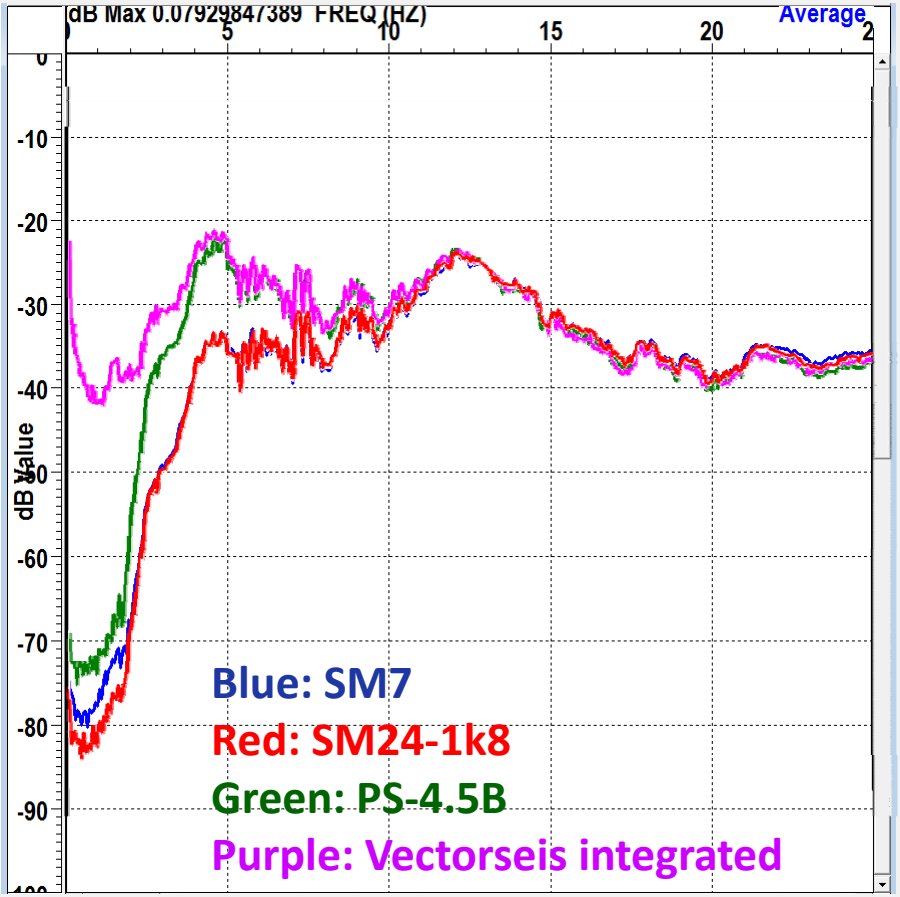
Correlated gather for Inova 364 low dwell at VP 449



From the sensors at the odd flags between 469 and 563

CREWES

Correlated gather for Inova 364 low dwell at VP 449



Raw

After low frequency recovery

From the sensors at the odd flags between 469 and 563

CREWES

Conclusions on the geophone comparison

- All four sensors provide good data down to about 3Hz
- The low frequency recovery is a valid method of improving the bandwidth for all the geophones
- The determination of noise vs signal below 5Hz needs to be better defined
- There is a lot more work required to investigate the very low frequency response of these sensors (1 – 5 Hz)

Acknowledgments

For the Priddis survey:

- Geokinetics for the loan of the onSEIS seismic source and their assistance in the field
- OYO-Geospace for the loan of the GS-One 10Hz geophones

For the Hussar survey:

- Ion-Sensor for the donation of the SM24-1k8 geophones to CREWES
- INOVA for making the INOVA 364 vibrator available for this survey
- Geokinetics for the field work and co-ordination of the project
- Husky for making it possible
- Nanometrics for the loan of the Trillium Compact seismometers as a calibrated sensor for the comparison work

CREWES sponsors and NSERC