Hurrah for Hussar! Comparisons of stacked data

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CREWES

Outline

- Data acquisition and processing
- Comparisons of stacked data spectra
- Phase coherence analysis of stacked data
- Post-stack migrations
- Summary

Data acquisition

Sources

INOVA 364 vibroseis	custom low-dwell sweep: 1 to 100 Hz	20 m
INOVA 364 vibroseis	linear sweep: 1 to 100 Hz	20 m
Eagle Failing vibroseis	custom low-dwell sweep: 1 to 100 Hz	20 m
Dynamite	2 kg at 15 m depth	20 m

Receivers

448 ARAM SM7	10 Hz 3C geophones	10 m
224 Sunfull	4.5 Hz 1C geophones	20 m
448 Vectorseis	3C accelerometers	10 m

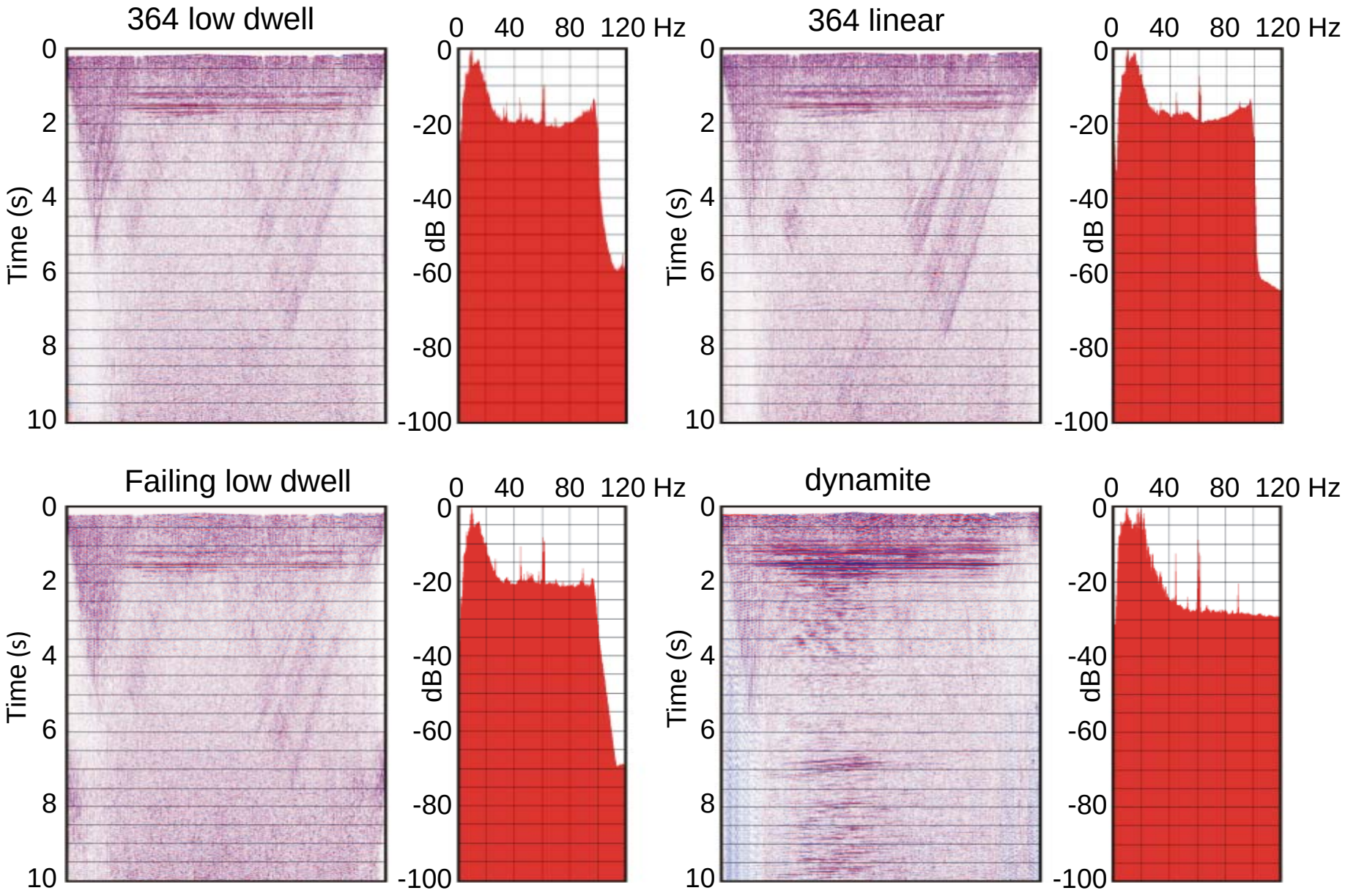
Data processing and analysis

- Elevation and refraction statics
  - separate refraction statics for vibroseis and dynamite
- Attenuation of surface waves and data enhancement
  - surface wave noise attenuation
  - radial filter
  - predictive deconvolution
  - spiking deconvolution
  - Gabor deconvolution
- Velocity analysis, NMO correction, stack, residual statics
- Spectral analysis of stacked data
- Post-stack time migration

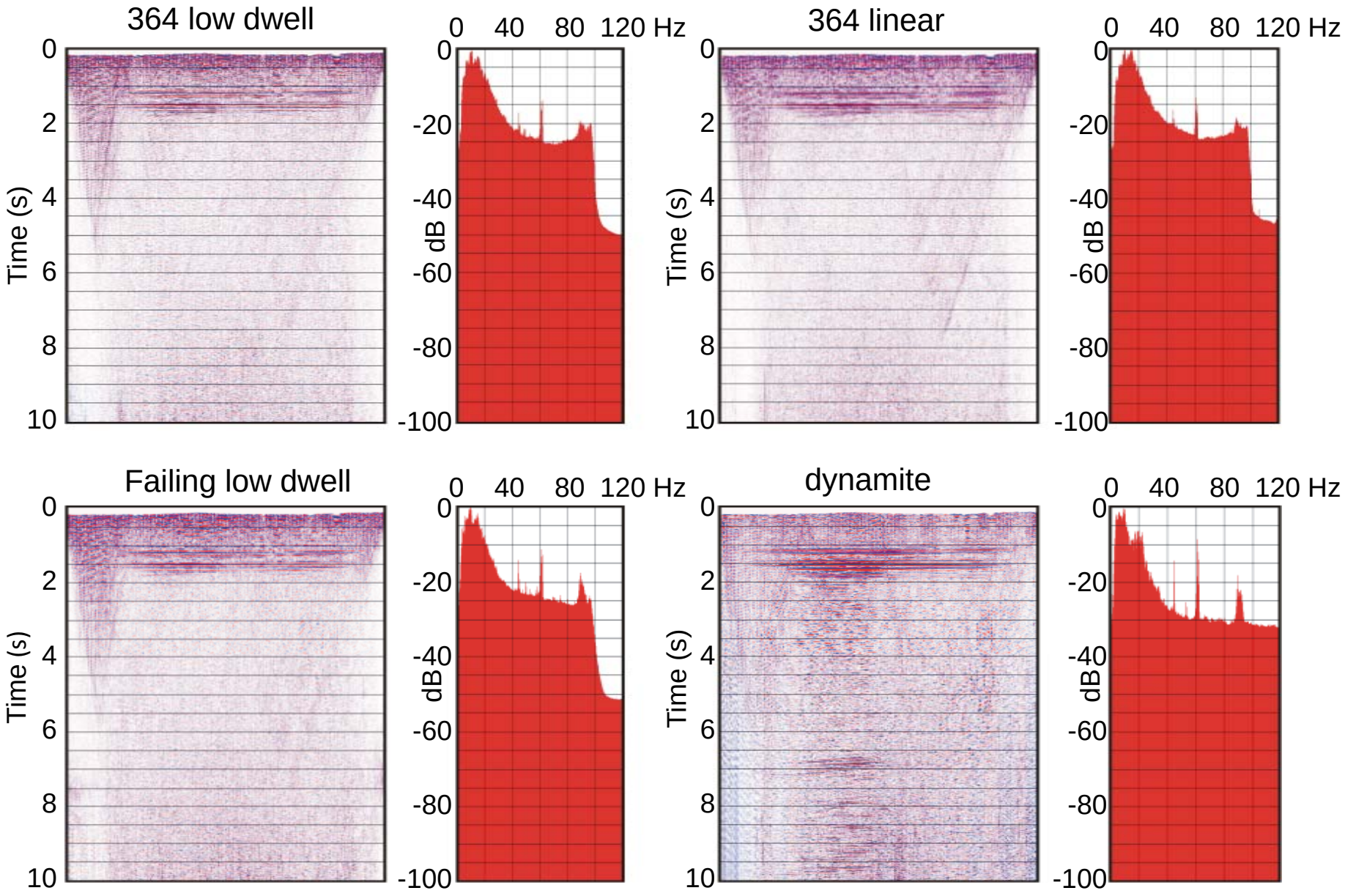
Data processing and analysis

- Oops, go back and don’t attenuate those low frequencies
- Apply statics and amplitude scaling only
- NMO and stack again
- Analyse data again
- Re-do paper

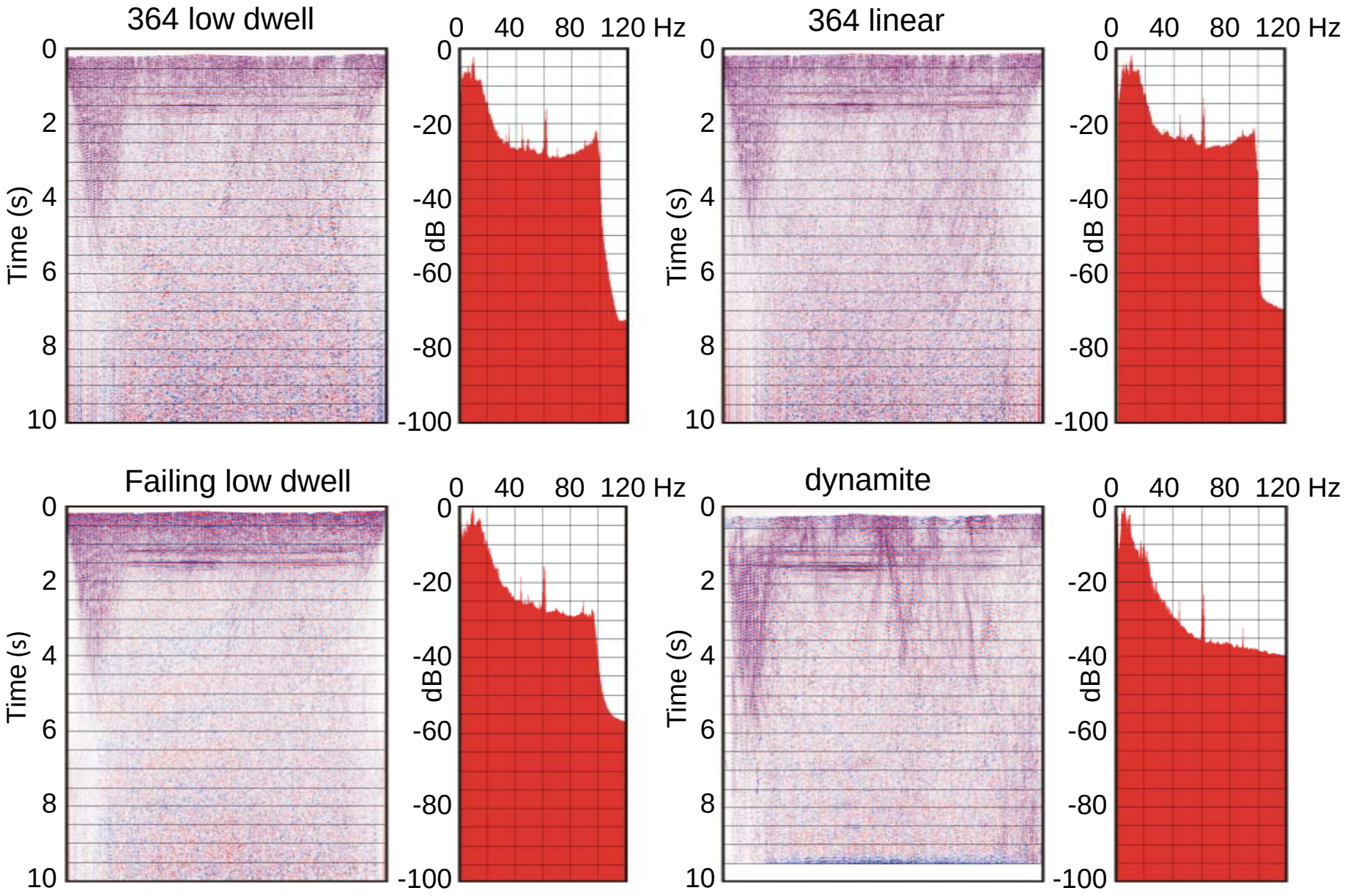
10 Hz geophones – unfiltered data

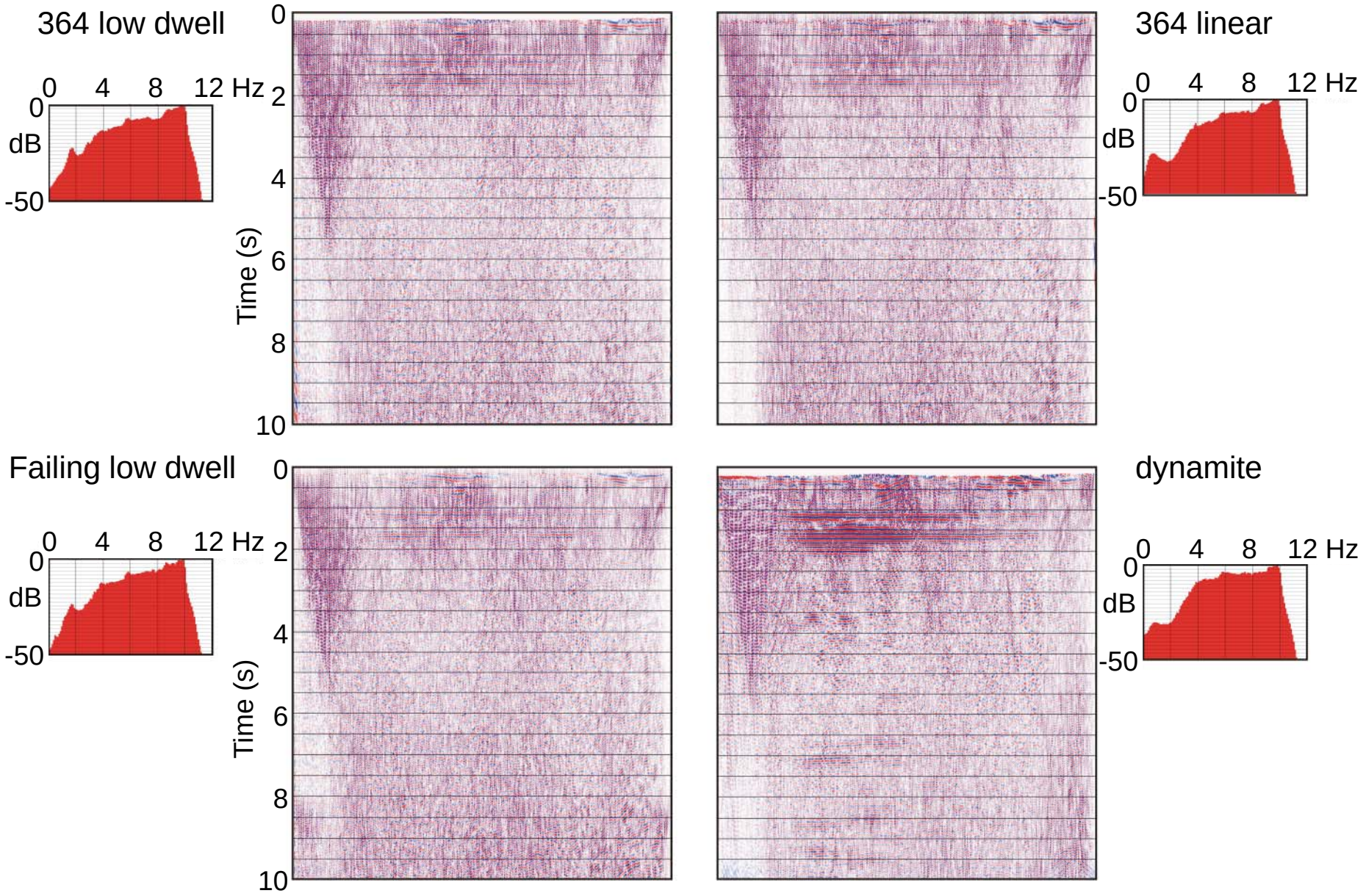


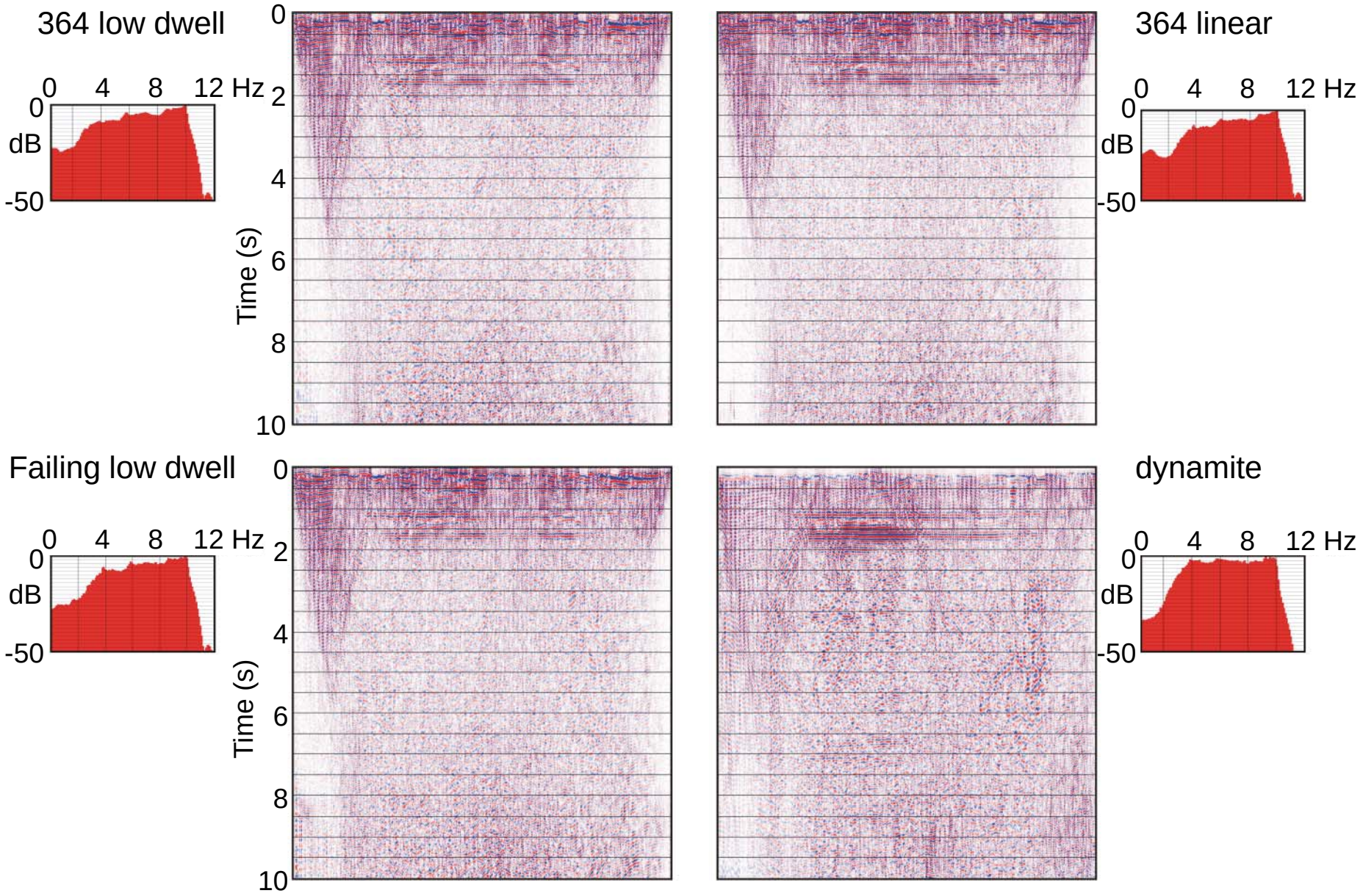
4.5 Hz geophones – unfiltered data



Vectorseis – unfiltered data




10 Hz geophones
0-1-10-10 Hz post-stack filter
364 low dwell
364 linear
Failing low dwell
dynamite
0 4 8 12 Hz
0
dB
-50
Time (s)
0
2
4
6
8
10


4.5 Hz geophones 0-1-10-10 Hz post-stack filter
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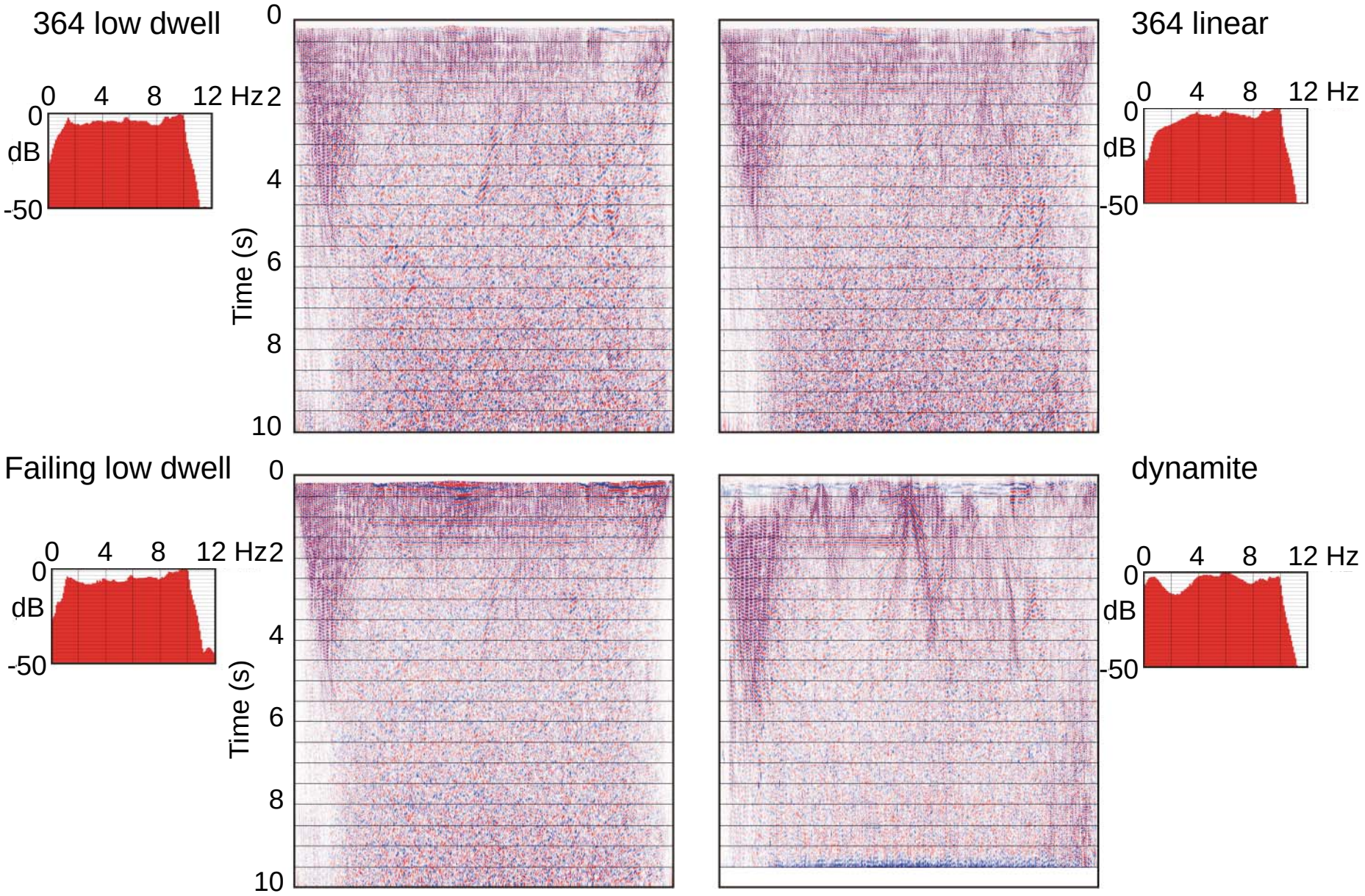
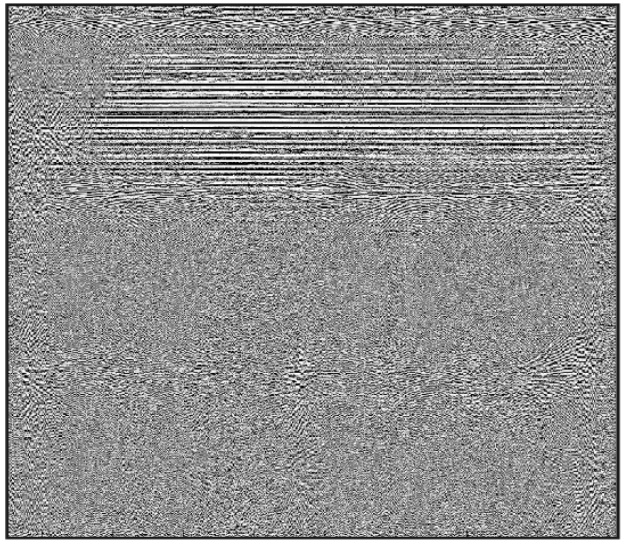
Vectorseis 0-1-10-10 Hz post-stack filter

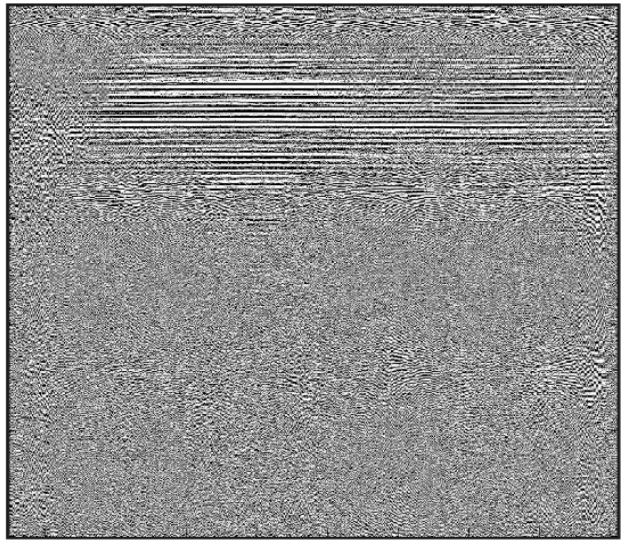


F-x phase coherence (0.5-2.5 s) 10 Hz geophones

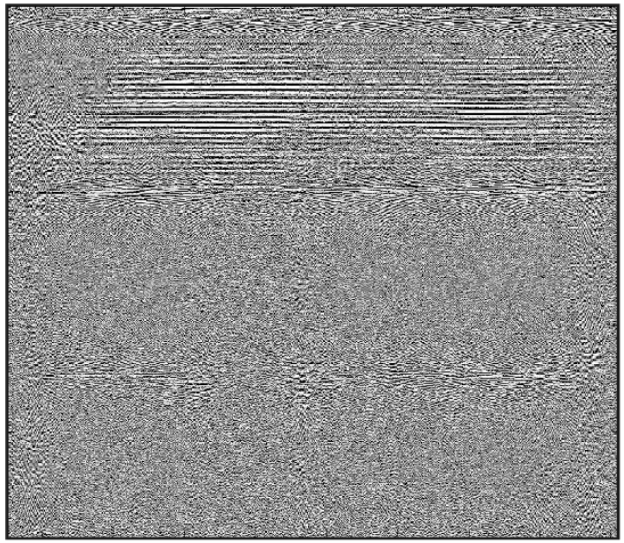
364 low dwell



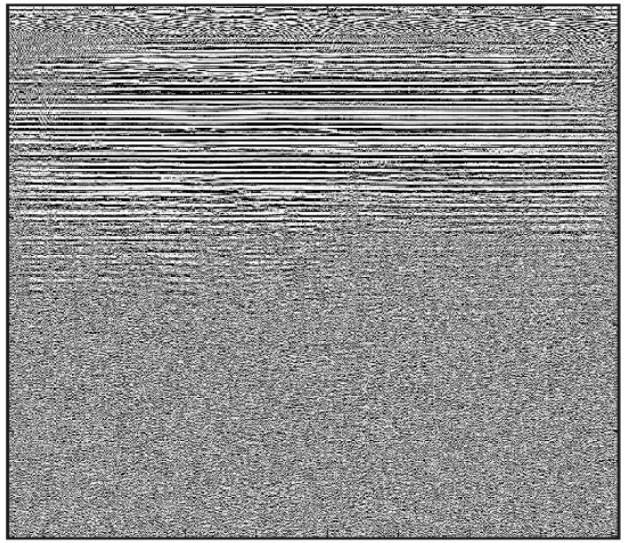
364 linear



Failing low dwell

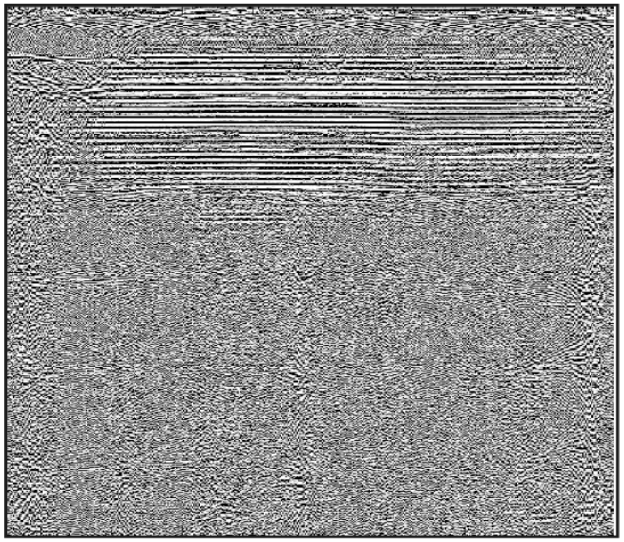


dynamite



F-x phase coherence (0.5-2.5 s) 4.5 Hz geophones

364 low dwell



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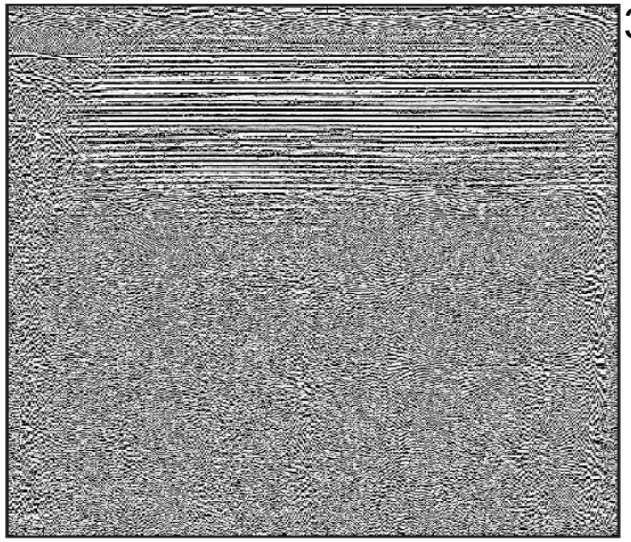
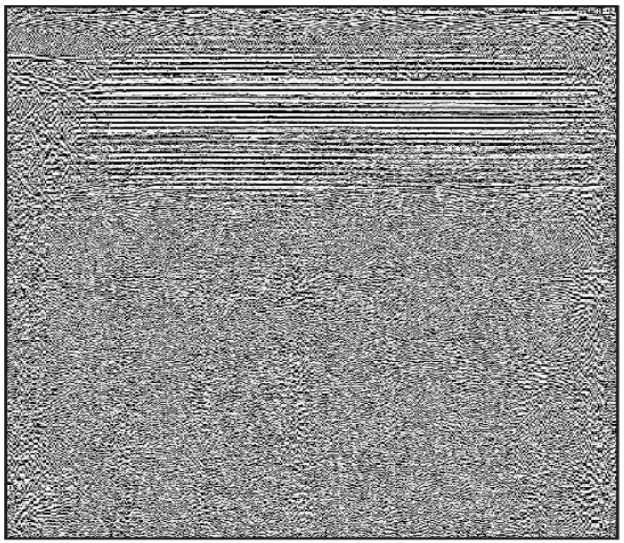
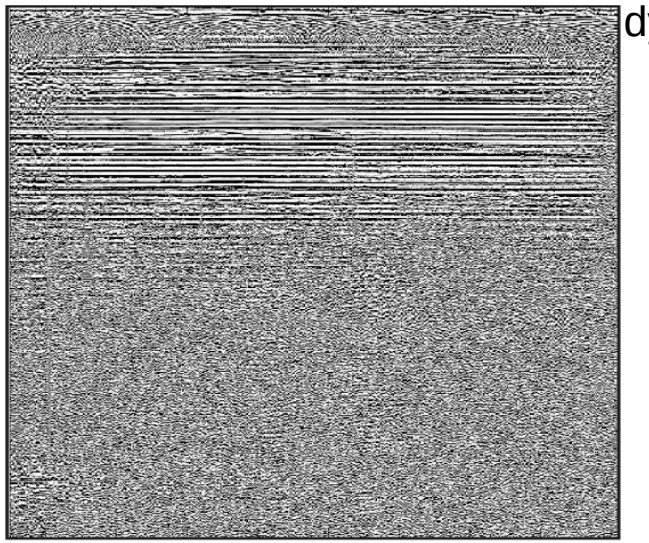


Failing low dwell

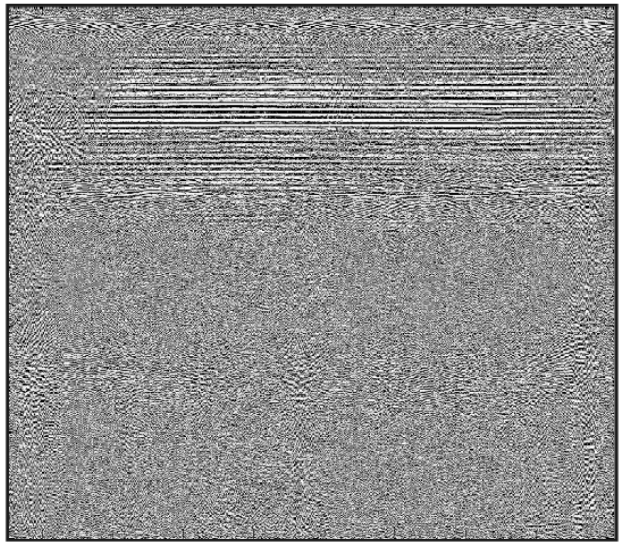


dynamite

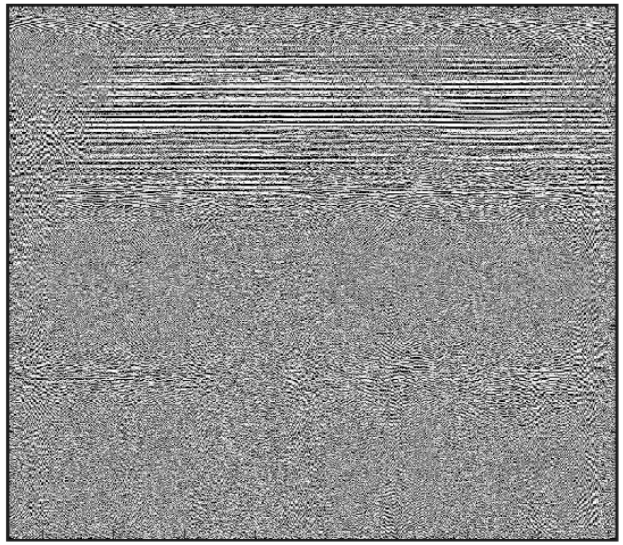


F-x phase coherence (0.5-2.5 s) Vectorseis

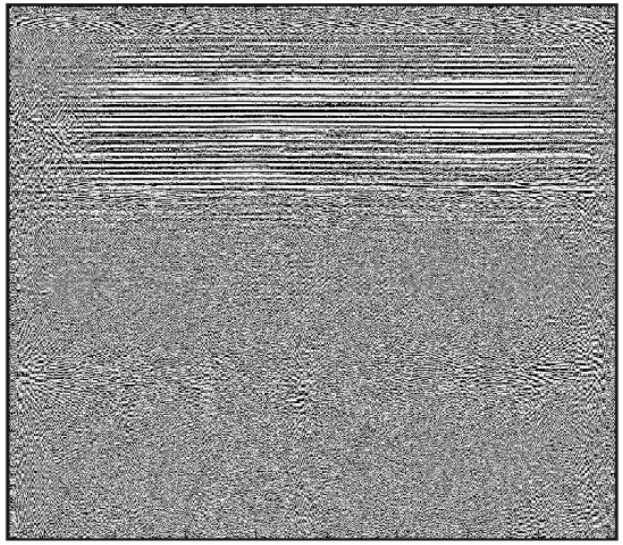
364 low dwell



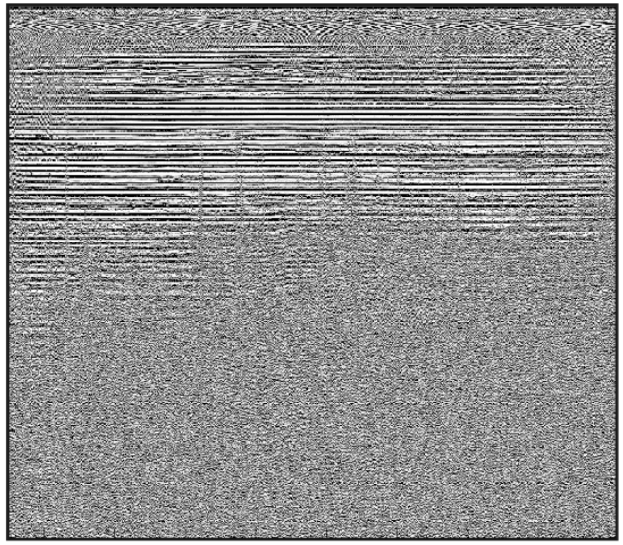
364 linear



Failing low dwell

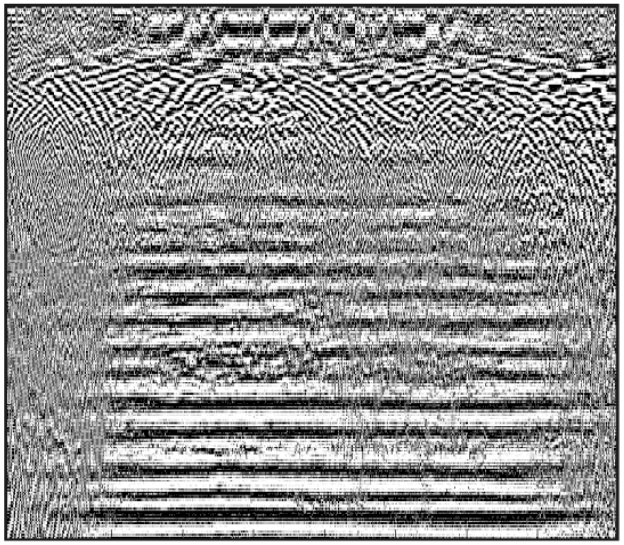


dynamite

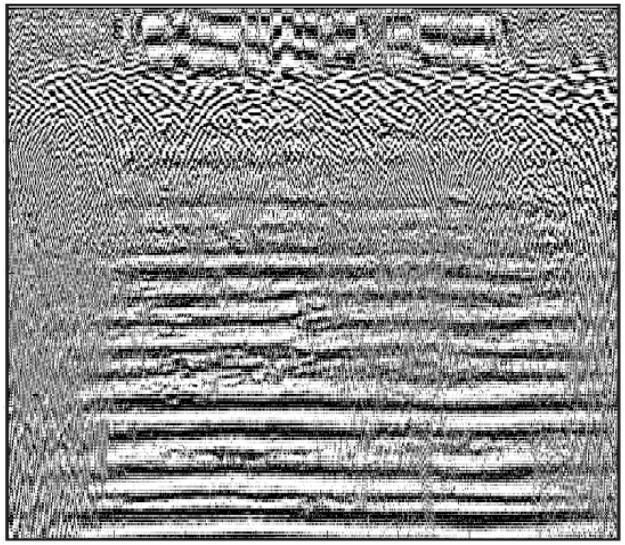


F-x phase coherence (0.5-4.0 s) 10 Hz geophones

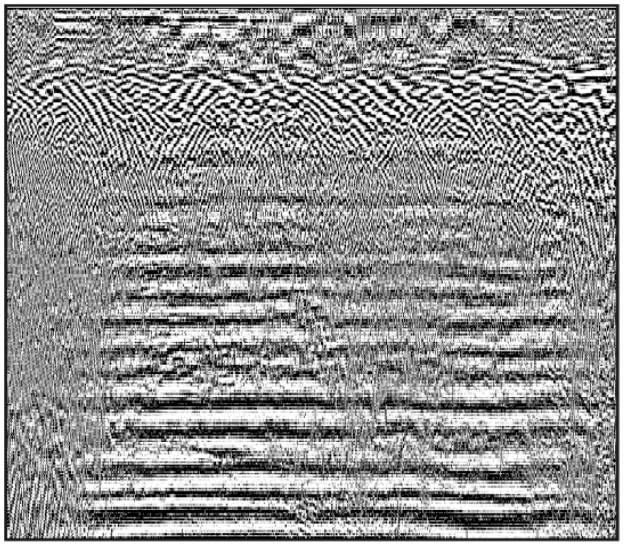
364 low dwell



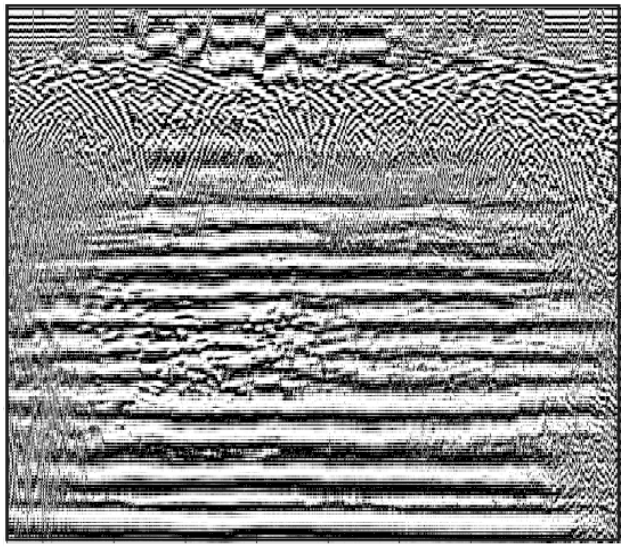
364 linear



Failing low dwell

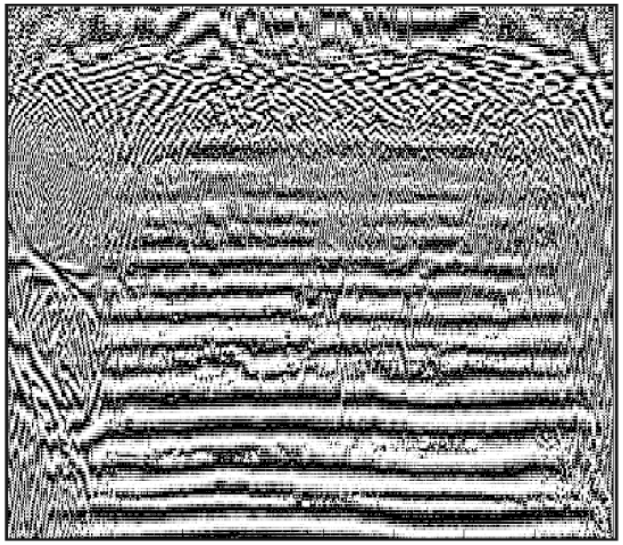


dynamite

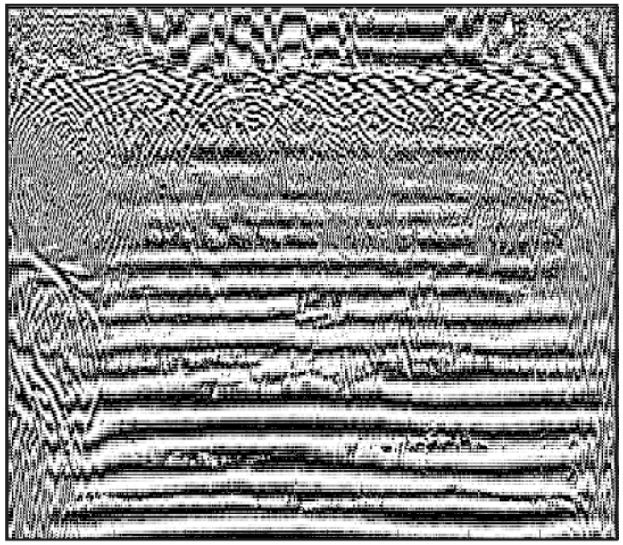


F-x phase coherence (0.5-4.0 s) 4.5 Hz geophones

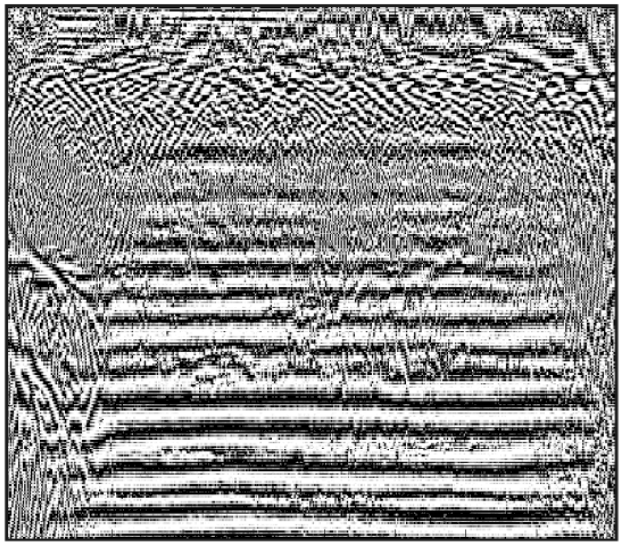
364 low dwell



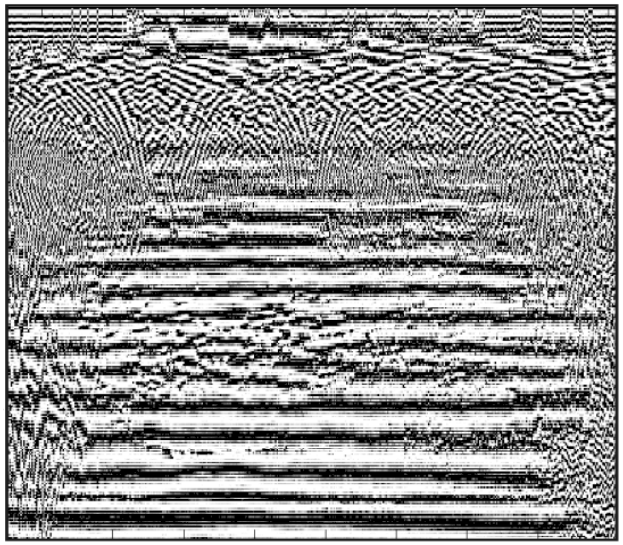
364 linear



Failing low dwell

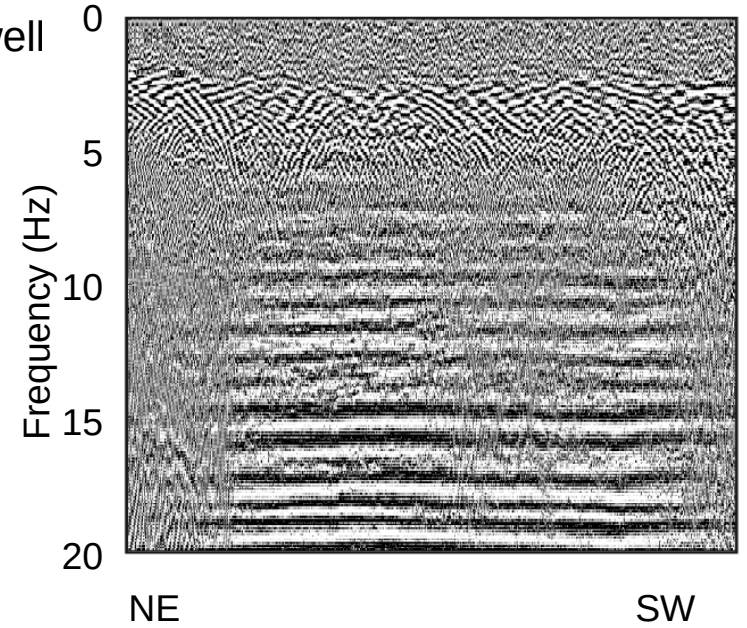


dynamite

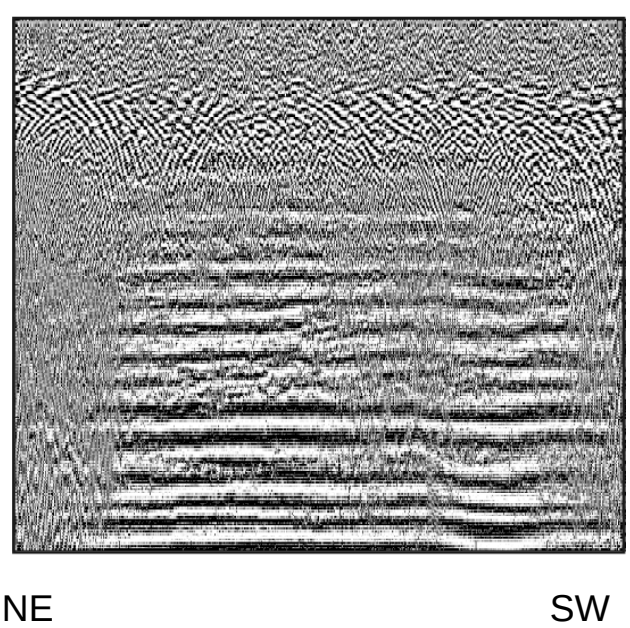


F-x phase coherence (0.5-4.0 s) Vectorseis

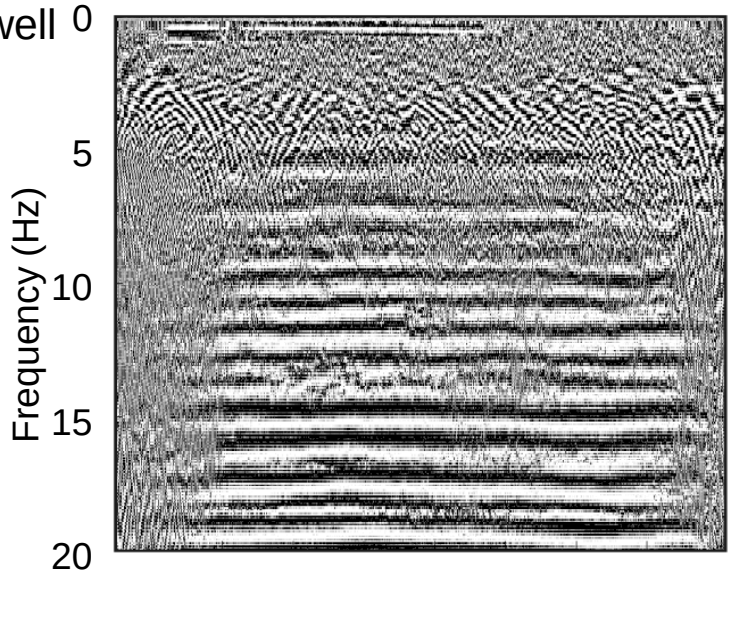
364 low dwell



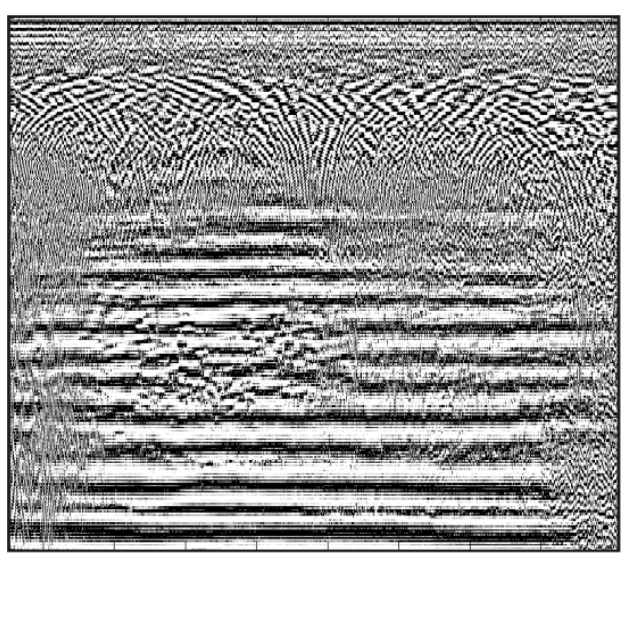
364 linear



Failing low dwell



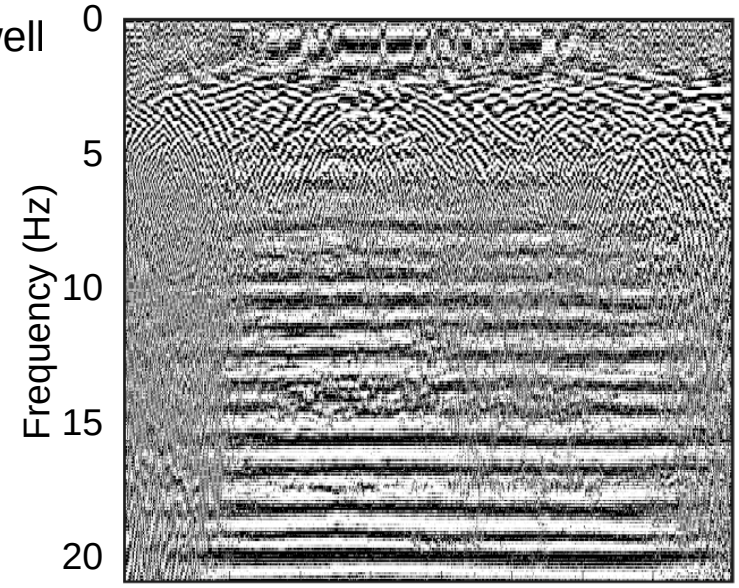
dynamite

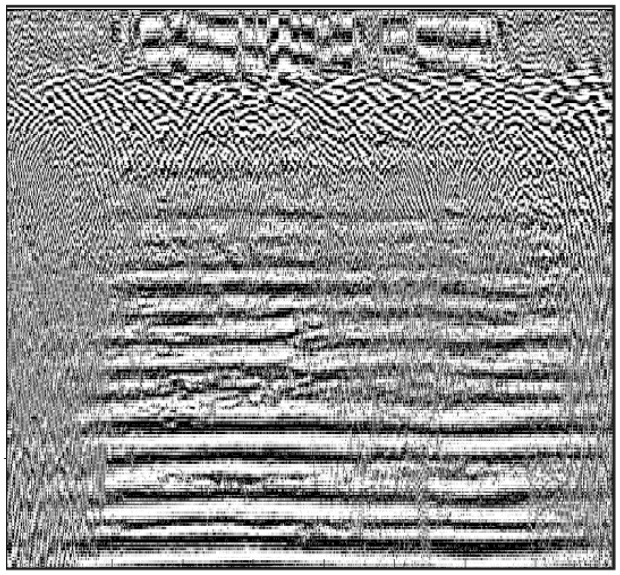


F-x phase coherence 10 Hz geophones

364 low dwell

no filter

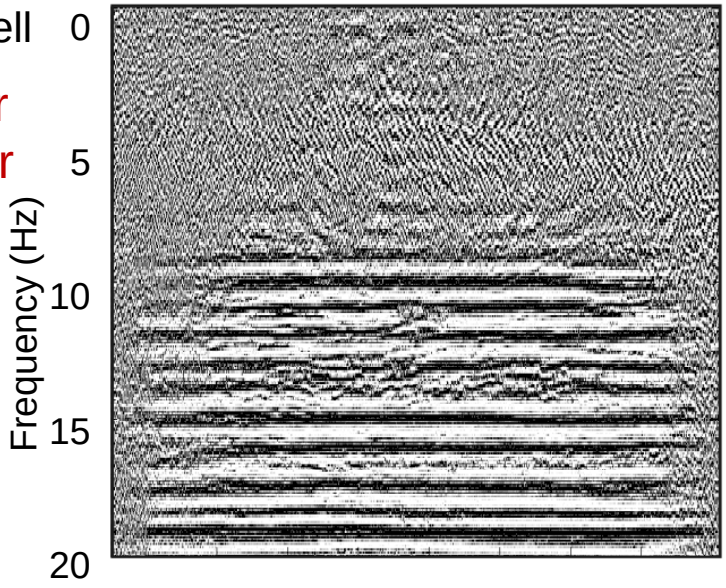


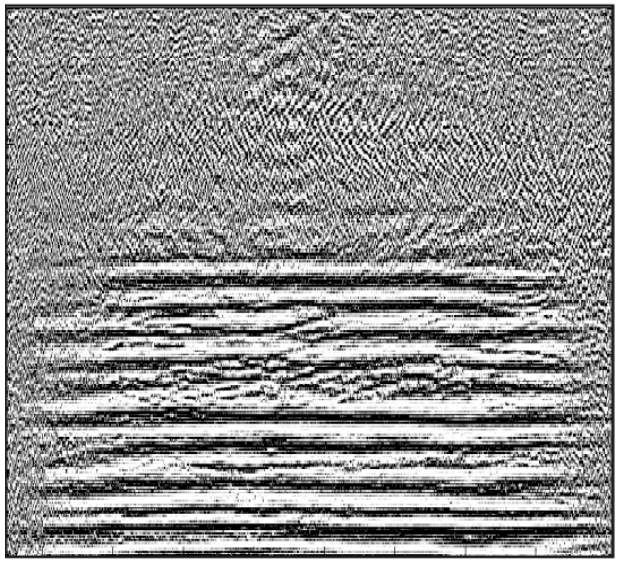


364 linear

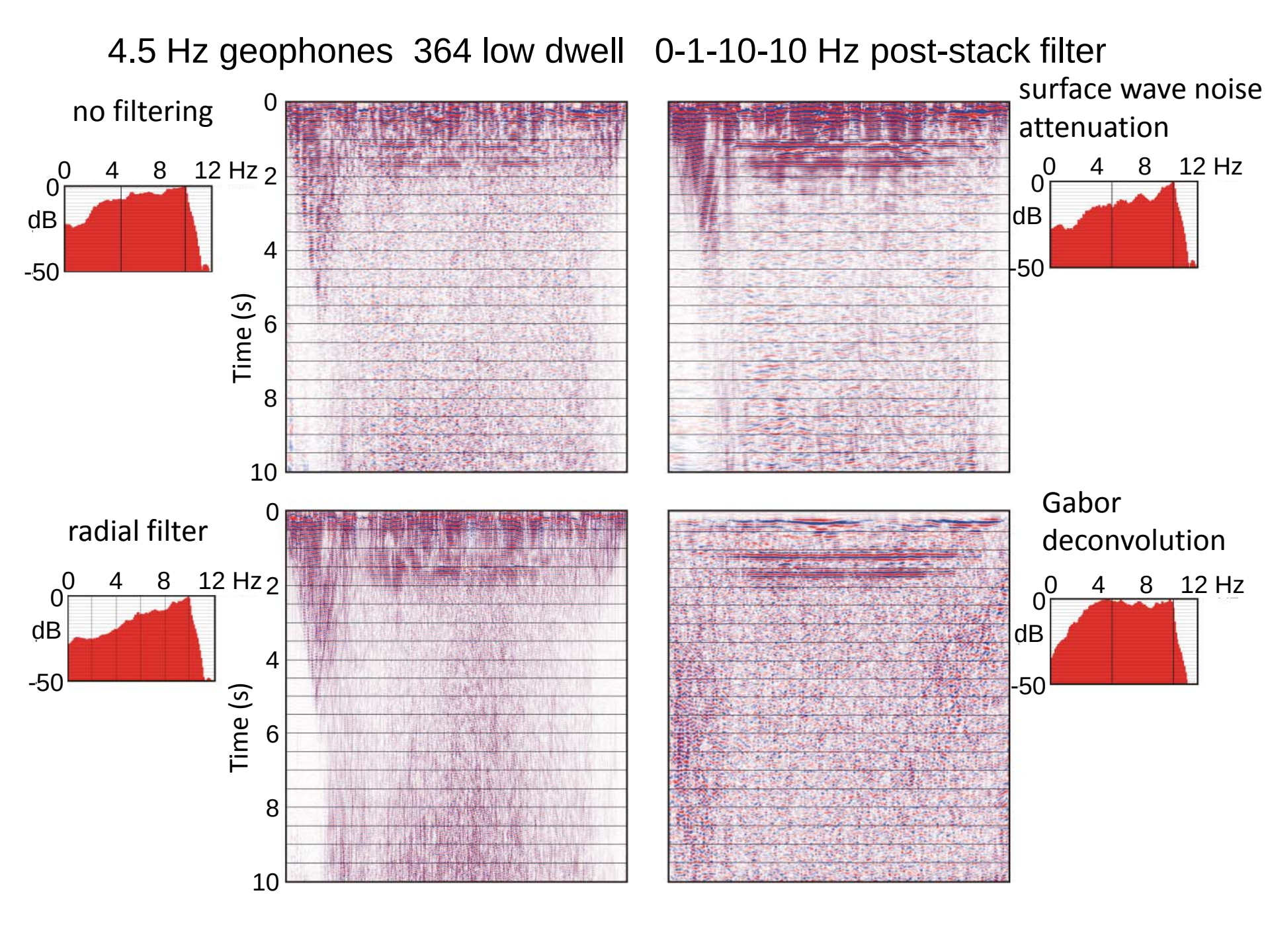
364 low dwell

radial filter and Gabor decon

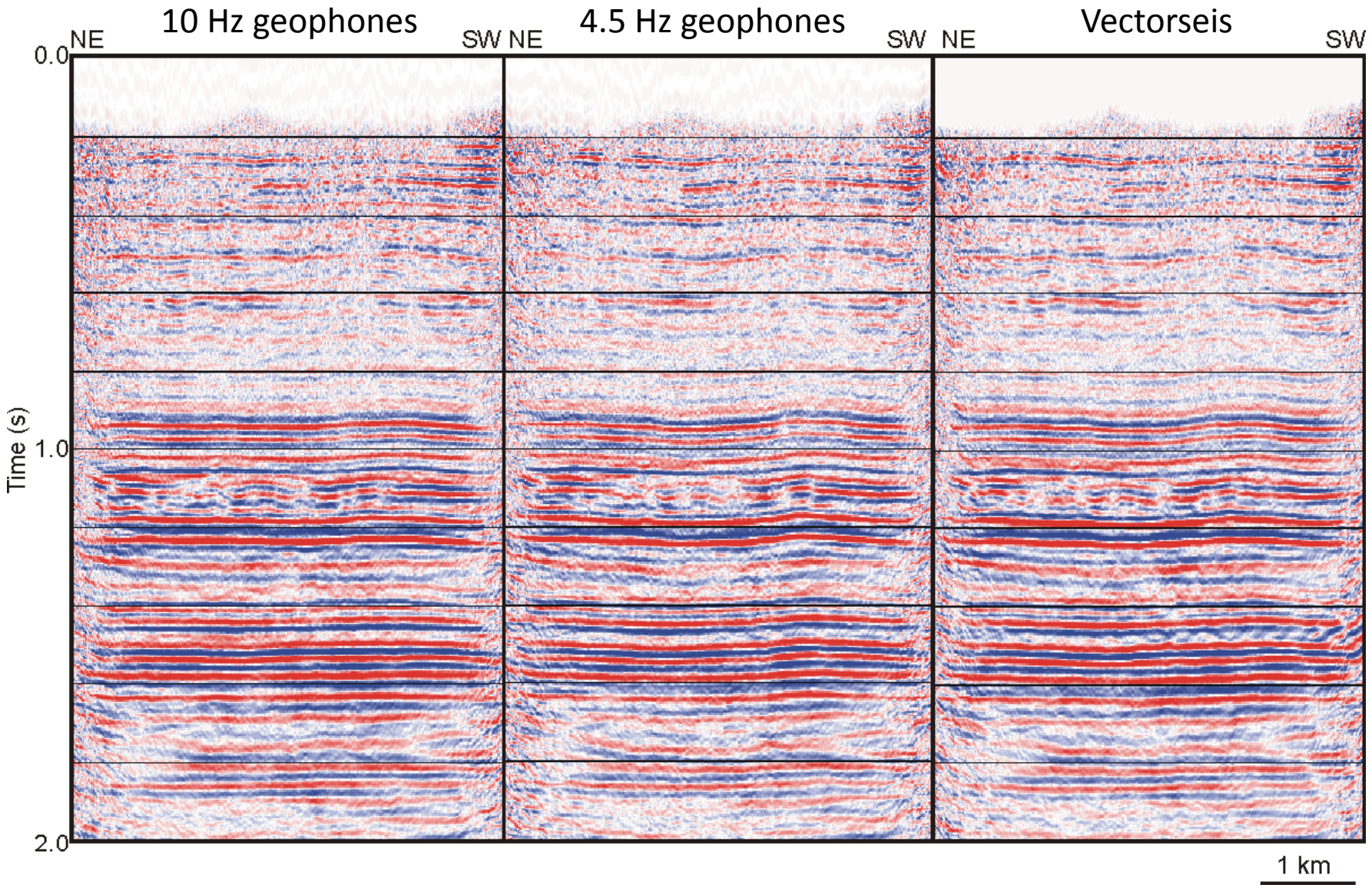




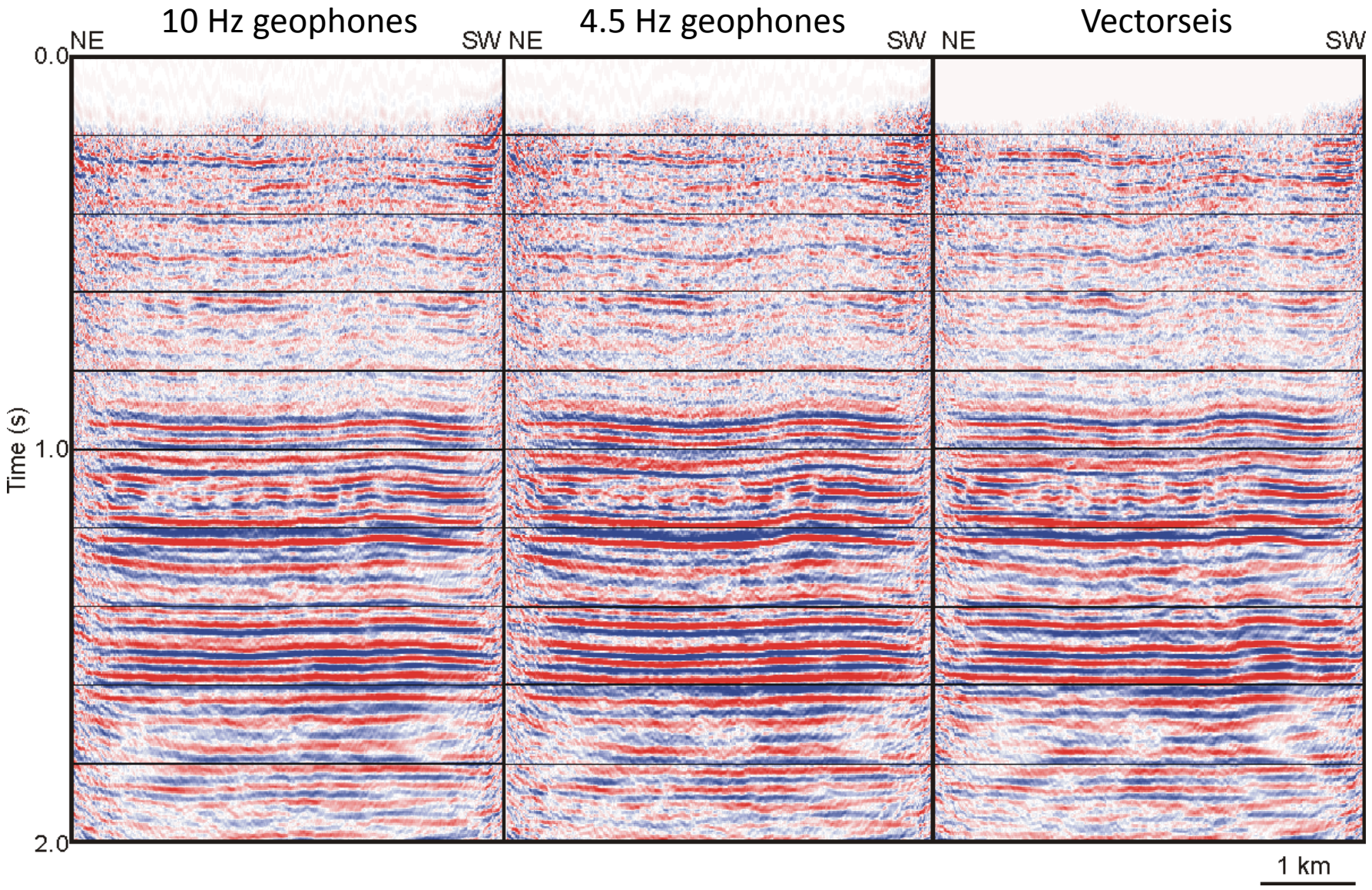
364 linear


4.5 Hz geophones 364 low dwell 0-1-10-10 Hz post-stack filter
no filtering
surface wave noise attenuation
radial filter
Gabor deconvolution
Time (s)
0
2
4
6
8
10
0 4 8 12 Hz
0
dB
-50

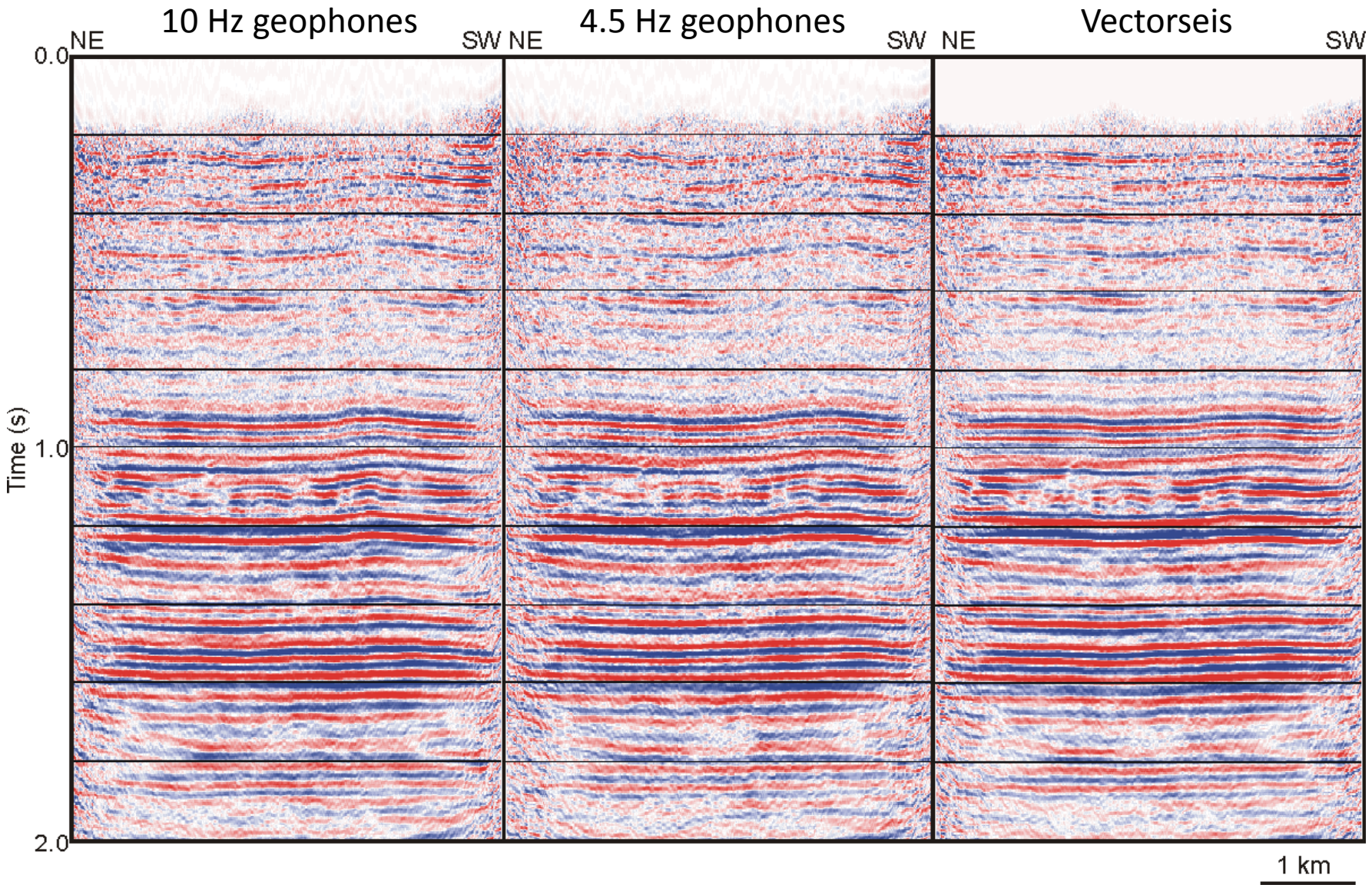
Post-stack time migrations: 364 low dwell sweep



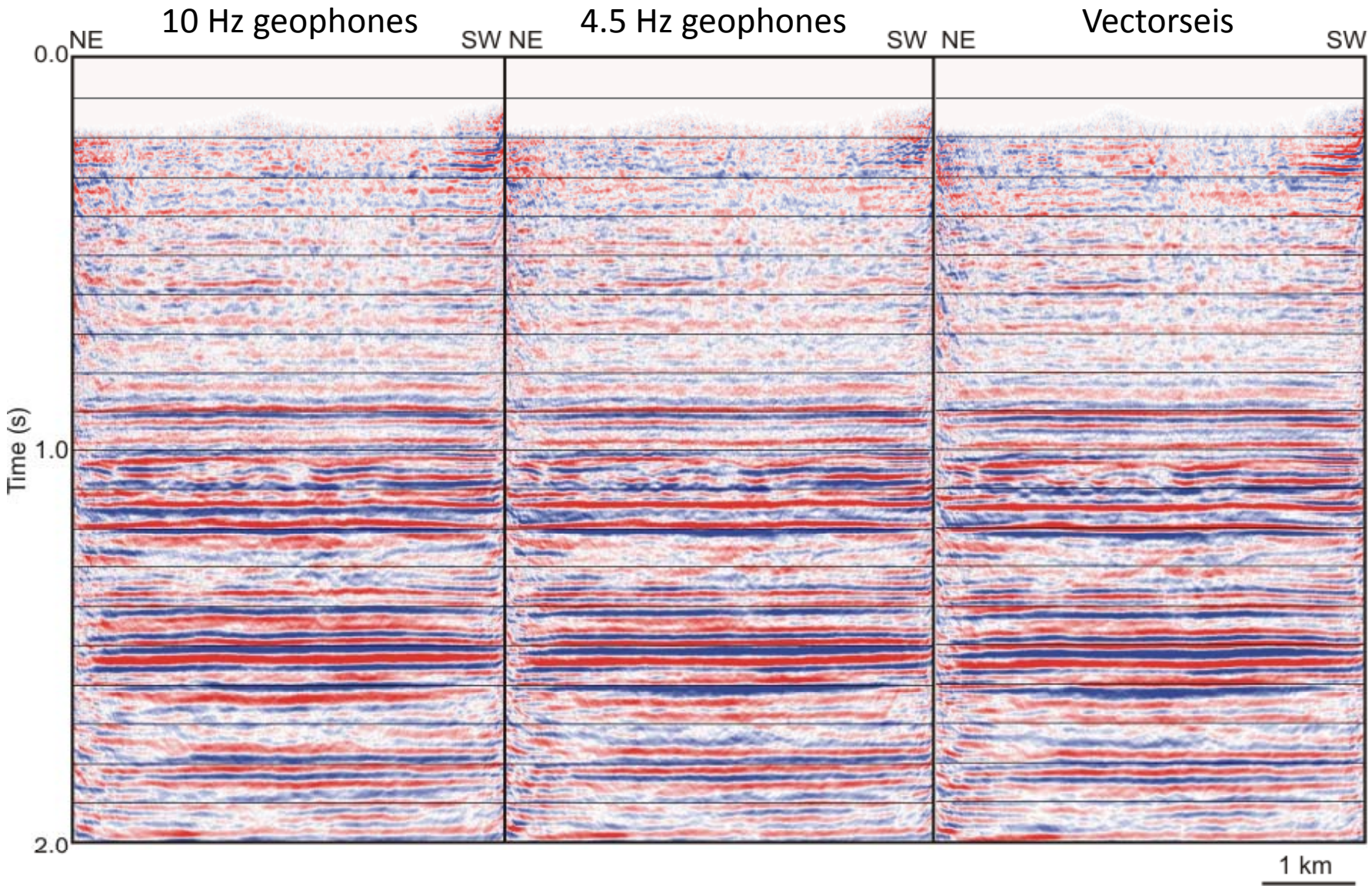
Post-stack time migrations: 364 linear sweep



Post-stack time migrations: Failing low dwell sweep



Post-stack time migrations: Dynamite



Summary

- Dominant signal band 10-40 Hz
- Vectorseis data have flattest spectra below 10 Hz
- 10 Hz geophones show greatest drop in power below 10 Hz
- Dynamite data have greatest dynamic range and lowest power at high frequencies
- Phase coherence plots show frequencies down to 7.5 Hz and (optimistically) to 5 Hz

Summary

- How do we process data to retain low frequency signal?
- How do we know we have low frequency signal and not noise?
- How do we attenuate the low frequency noise without attenuating the signal too?

Acknowledgements

- Husky Energy
  Geokinetics
  INOVA
  ION-Sensor

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  Carbon Management Canada

- Landmark Graphics