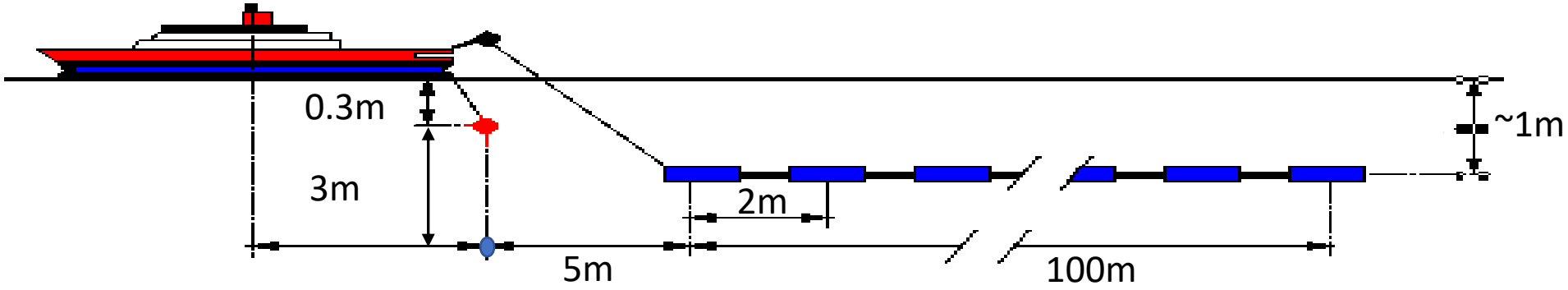
GEO PROVIDER

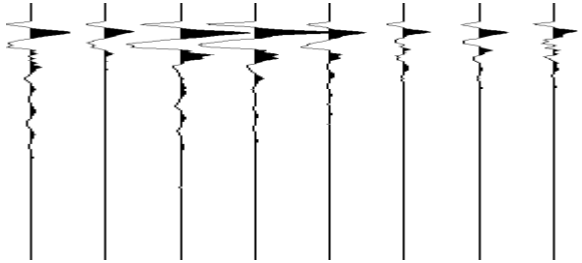
A Case Study Of Ultra High Resolution Broadband Re-processing For Wind Turbine Placement

Grog Fookes, Sarah Furbank

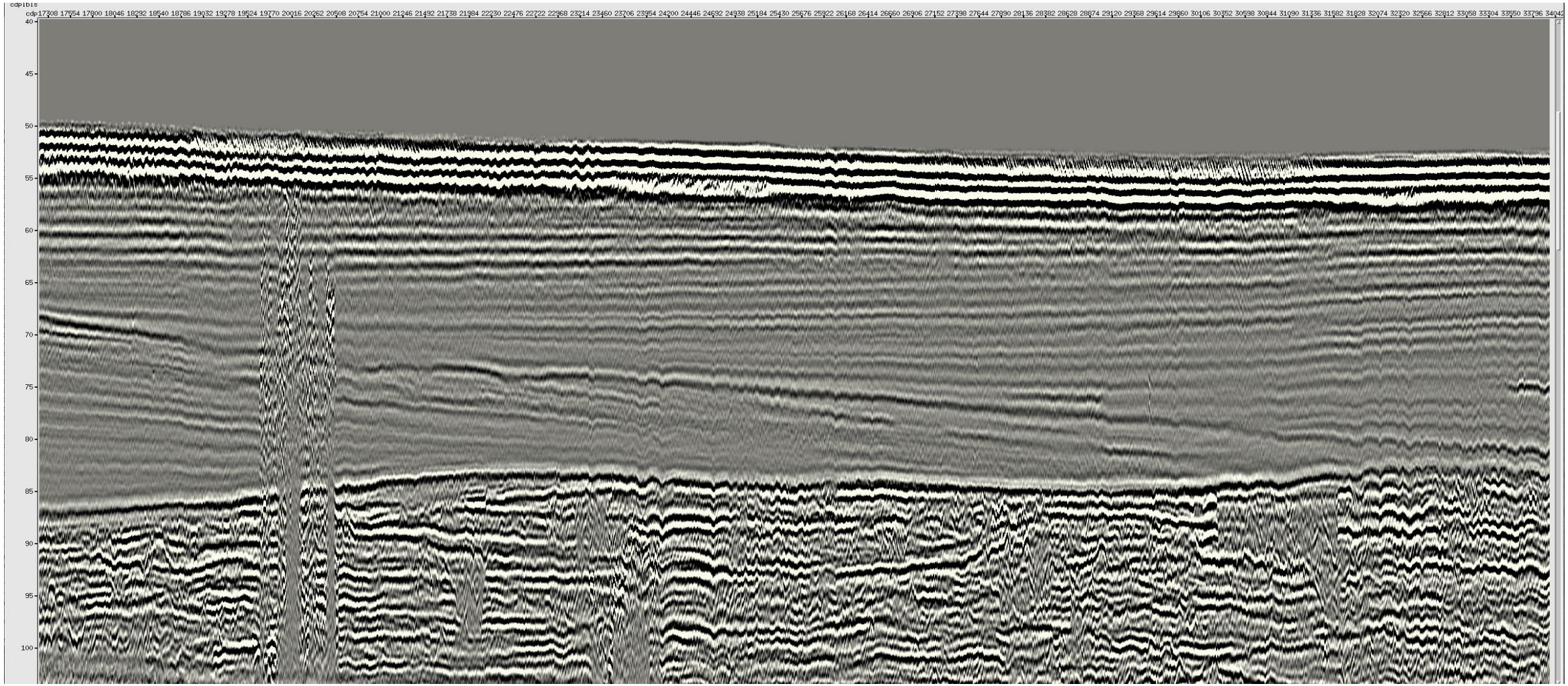
Acquisition



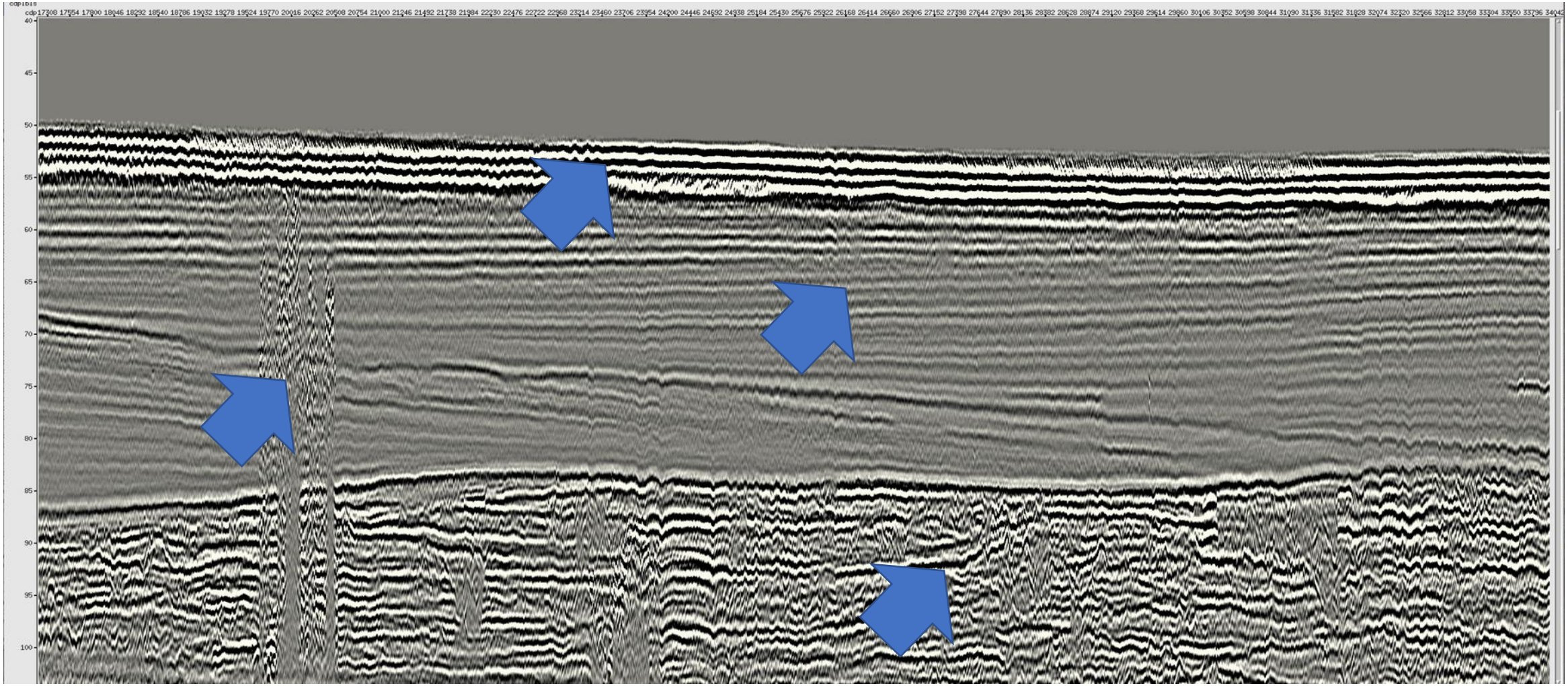
Shot interval	1m	Reference hydrophone	3.3m
Group interval	2m	Bandwidth	5000Hz
Number of channels	48	Sparker source	
Sample rate	0.1ms		
Record length	300ms		



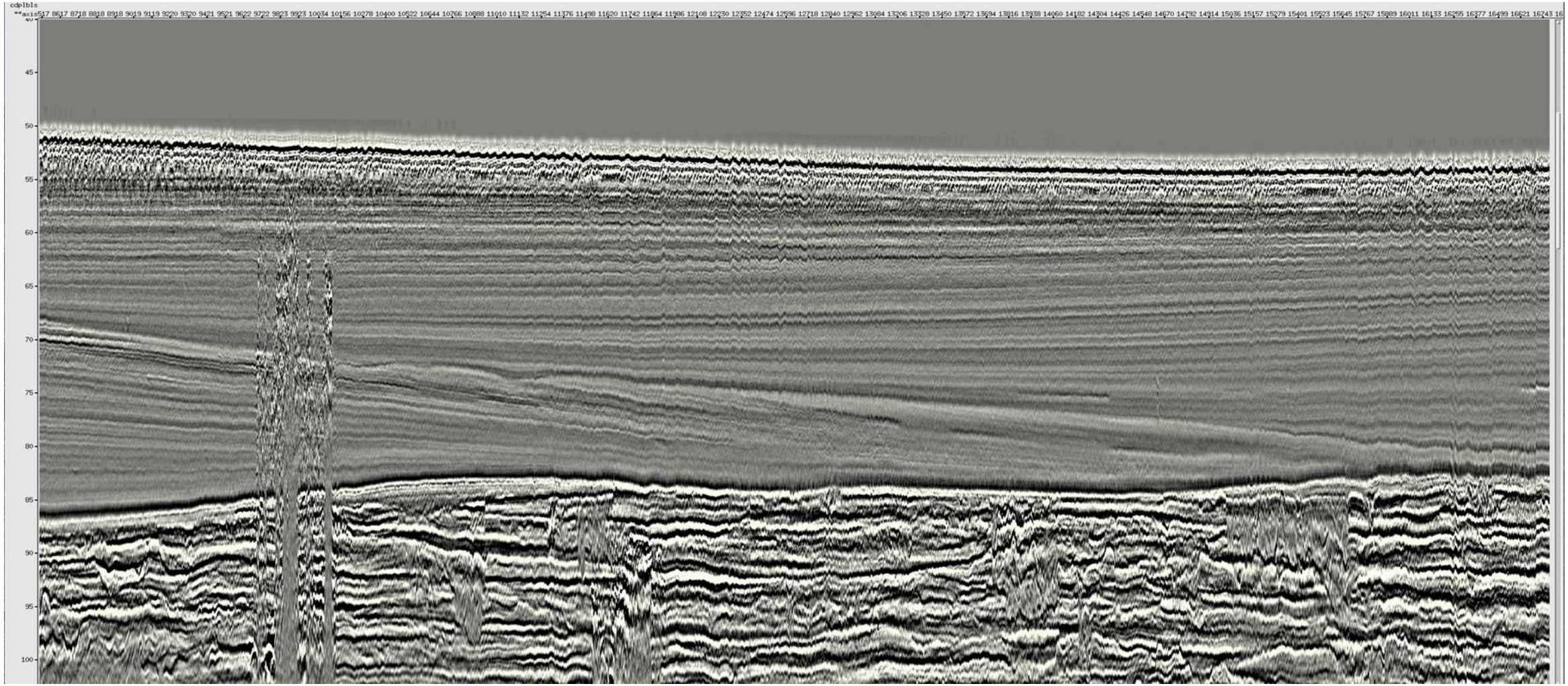
Original Processing – 2017



So, what are the objectives ?... Boulders, gas, imaging



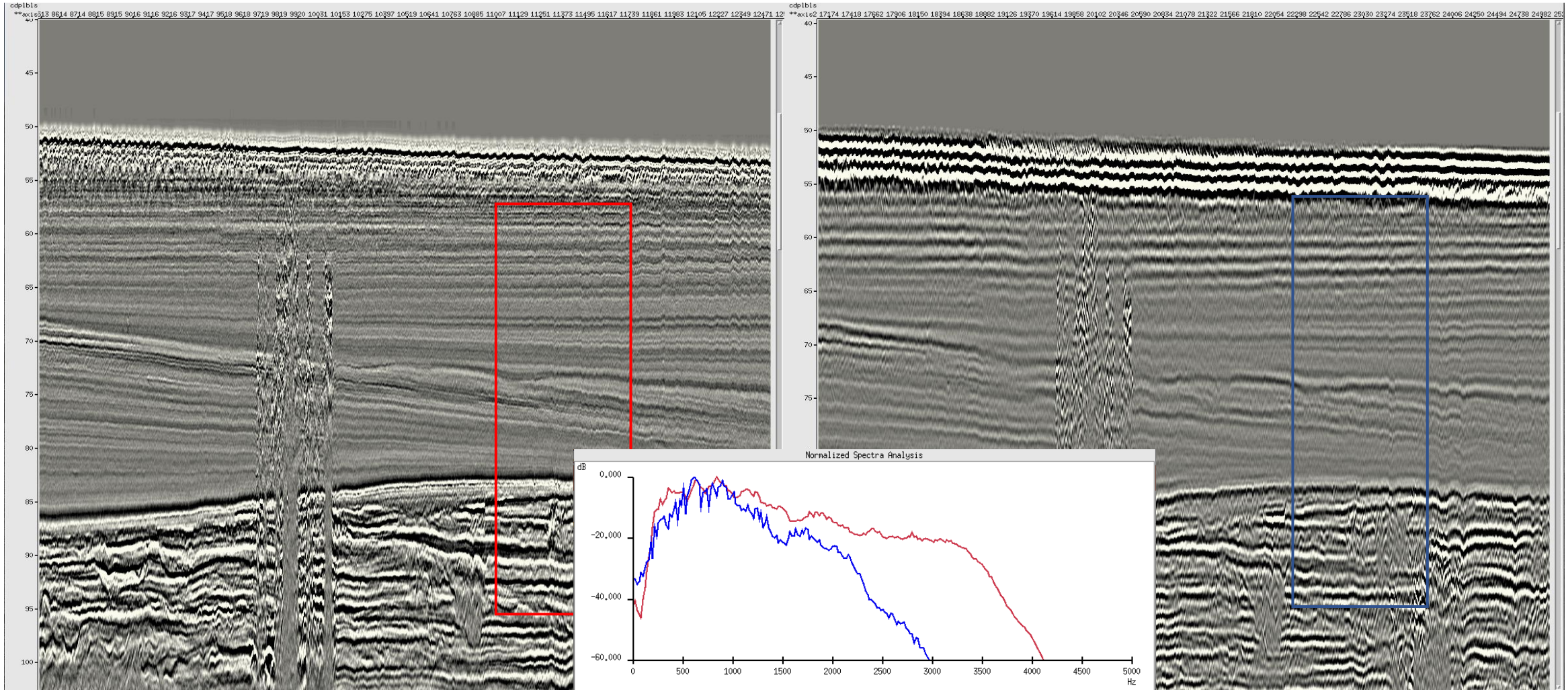
Geoprovider Re-processing - 2021



Spectral comparison

New

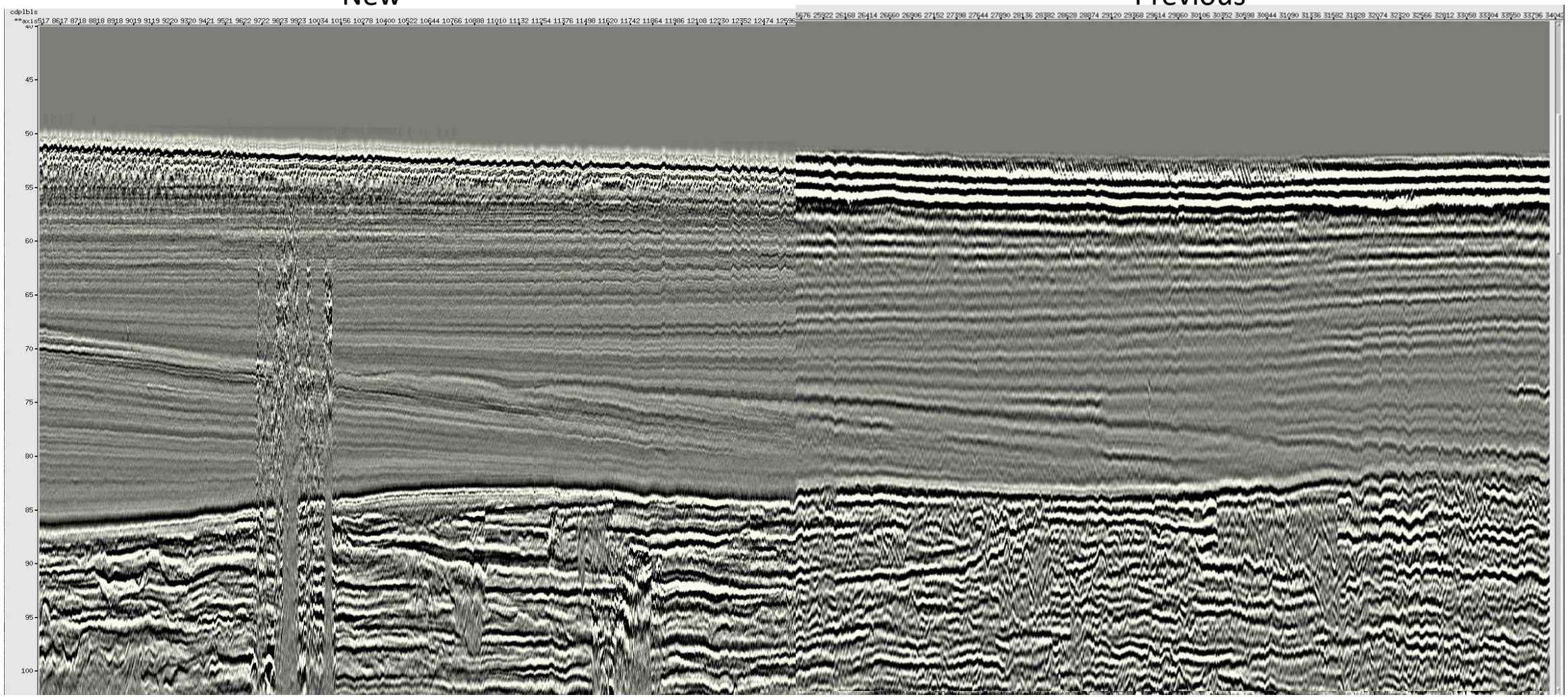
Previous



Composite plot

New

Previous



So how did we get there ?

Original flow

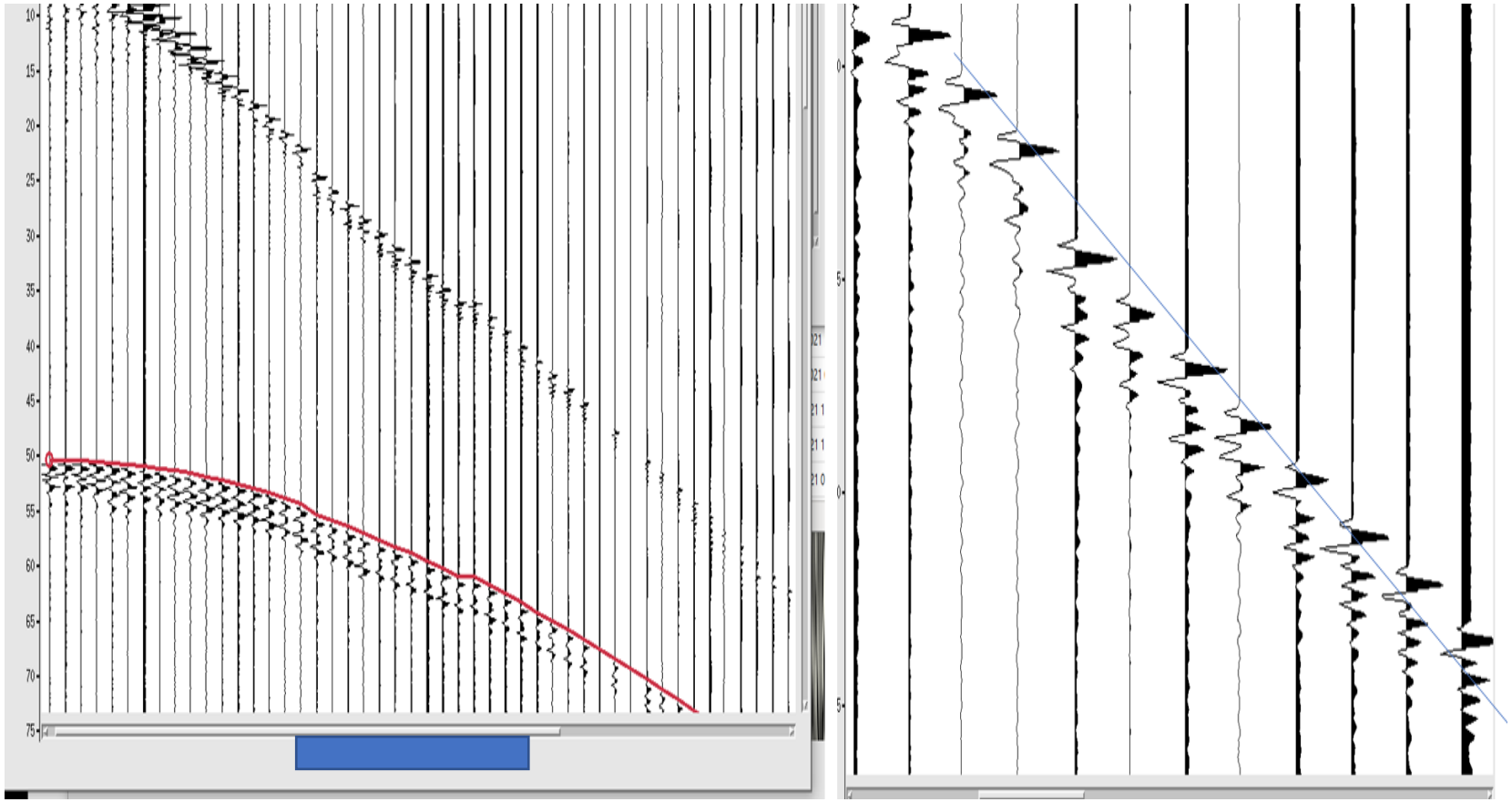
SEGY Input
Bandpass filter (100-250-3000-4000Hz)
Amplitude recovery
Crooked line geometry assignment
Velocity Analysis
NMO
Static correction
Stack
Static Evaluation
Re-stack
Post stack De-multiple
Post stack Kirchhoff migration

Geoprovider flow

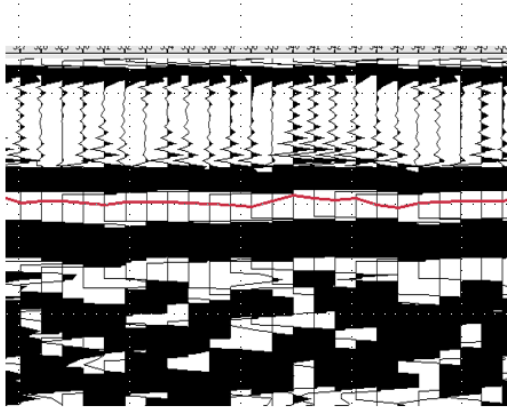
SEGD Input
Geometry assignment
Low cut filter
Amplitude recovery
Trace edits, Interpolation to recover
Interpolation, channels
Crooked line geometry assignment
Ghost free signature inversion, de-bubble
Source notch inversion
Timing correction
2D wave equation pre-stack de-multiple
Preliminary static
Velocity analysis
Residual static
Stack
Residual de-bubble
Targeted residual de-multiple
Receiver ghost attenuation
Post-stack time migration
Gun & cable static

Initial QC

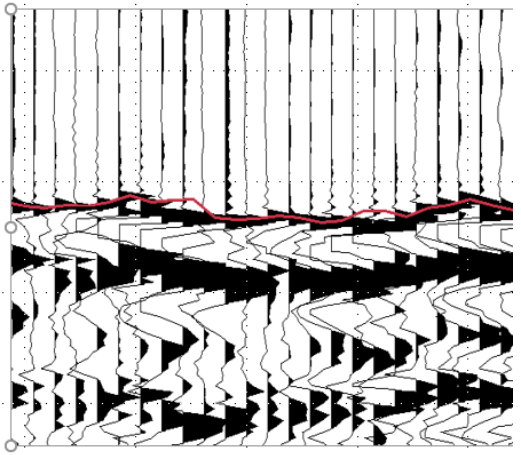
Direct arrival & water bottom times…….gives us the velocity



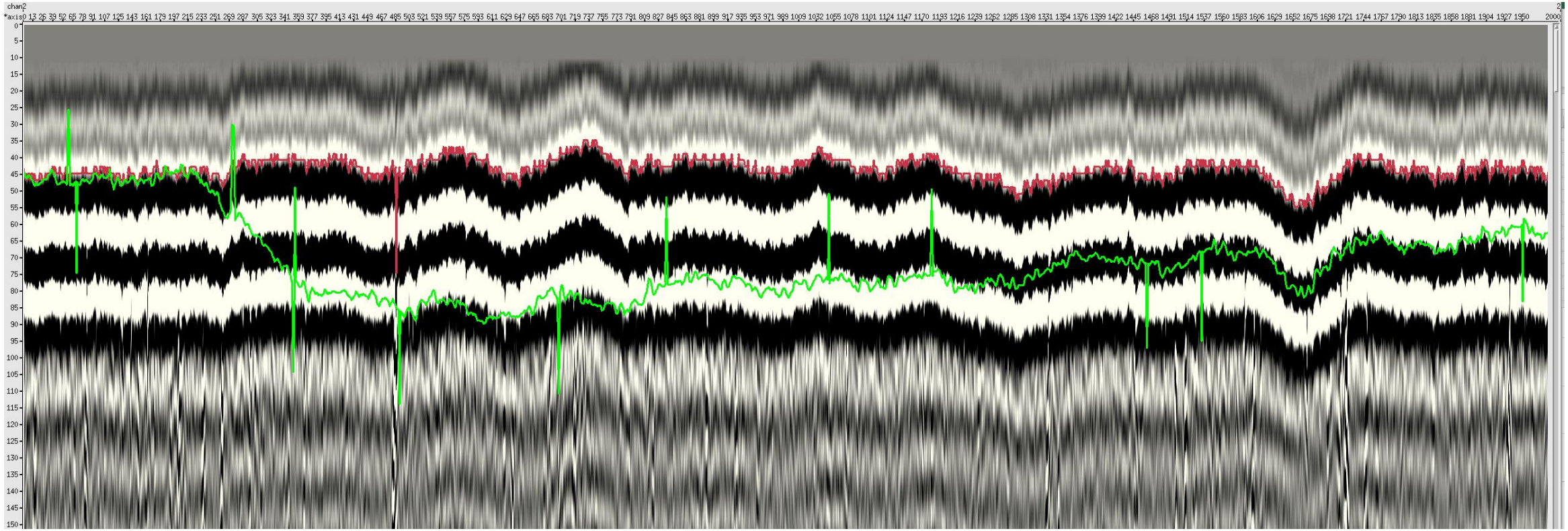
Auxiliary Hydrophone



Near Channel



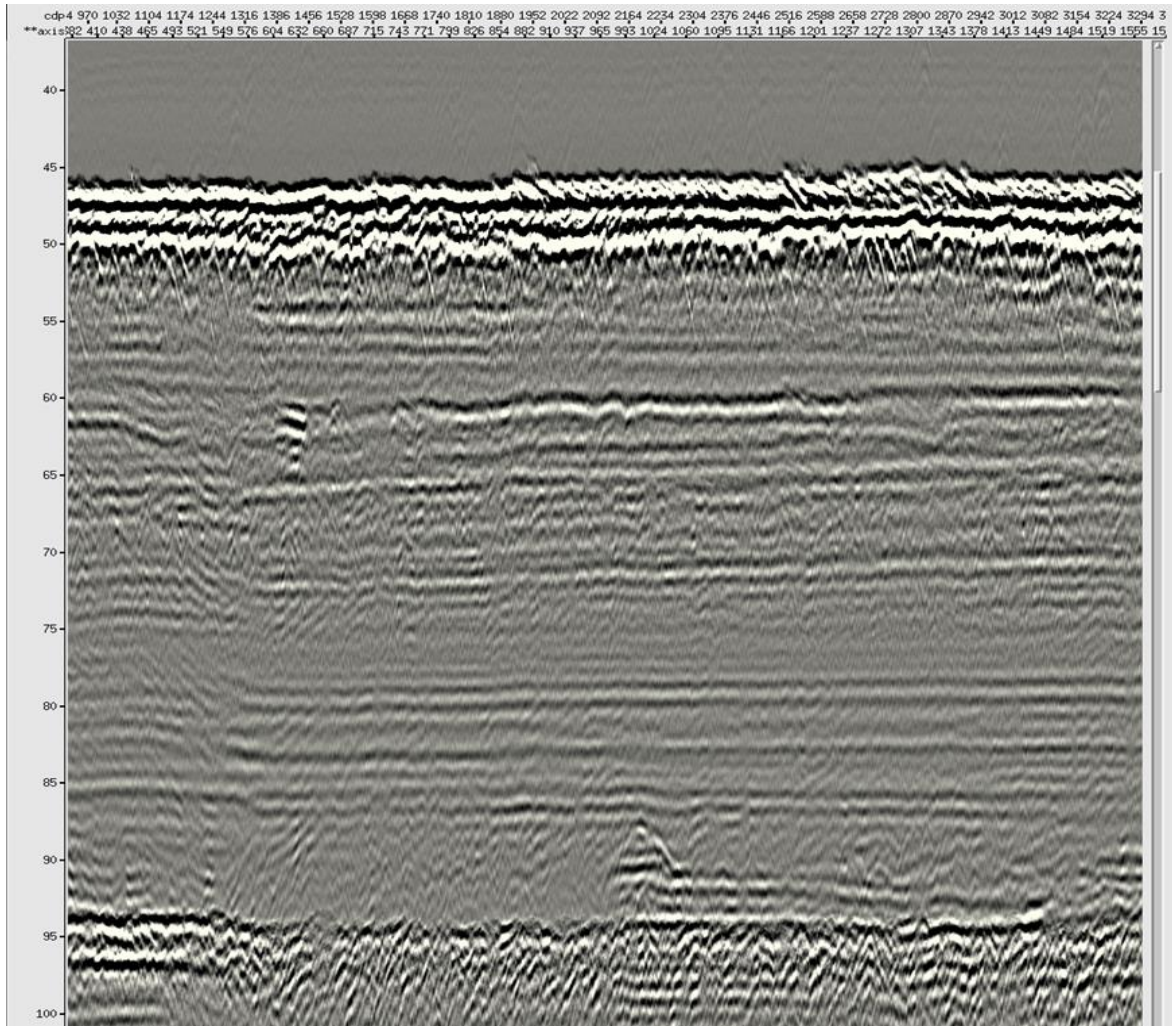
Initial QC: Direct arrival check, near common channel



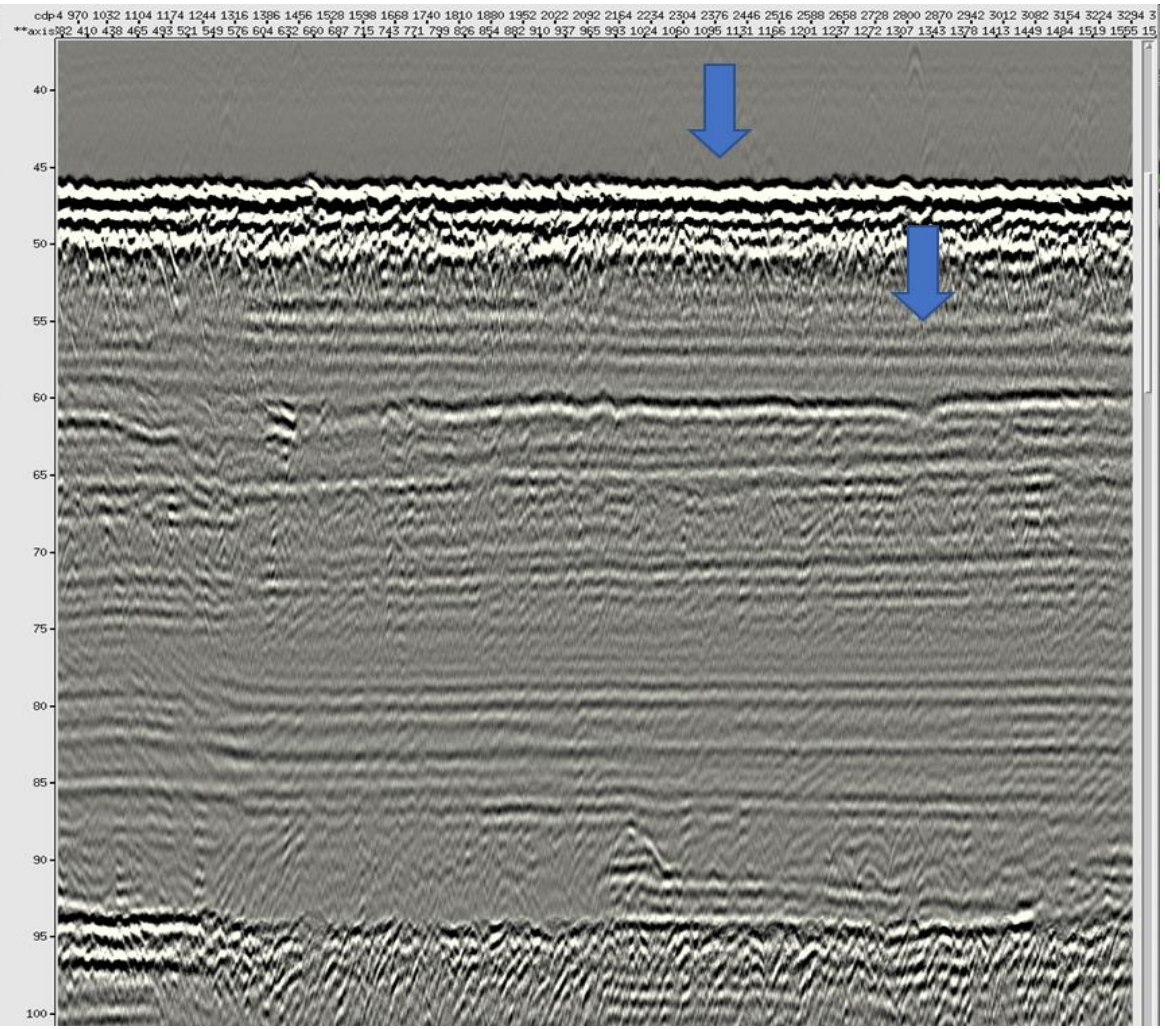
Green horizon is the direct arrival calculated using offset, red is auto-pick arrival

Initial QC

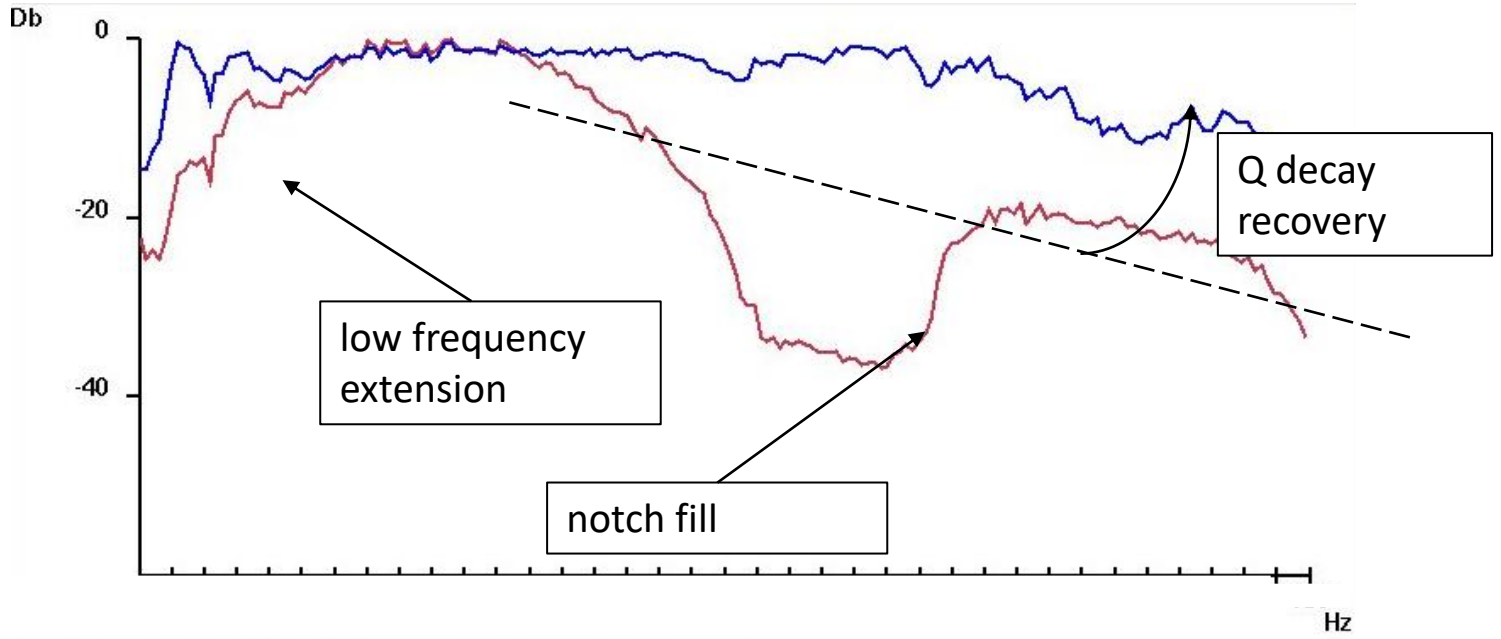
Stack - before



Stack - after



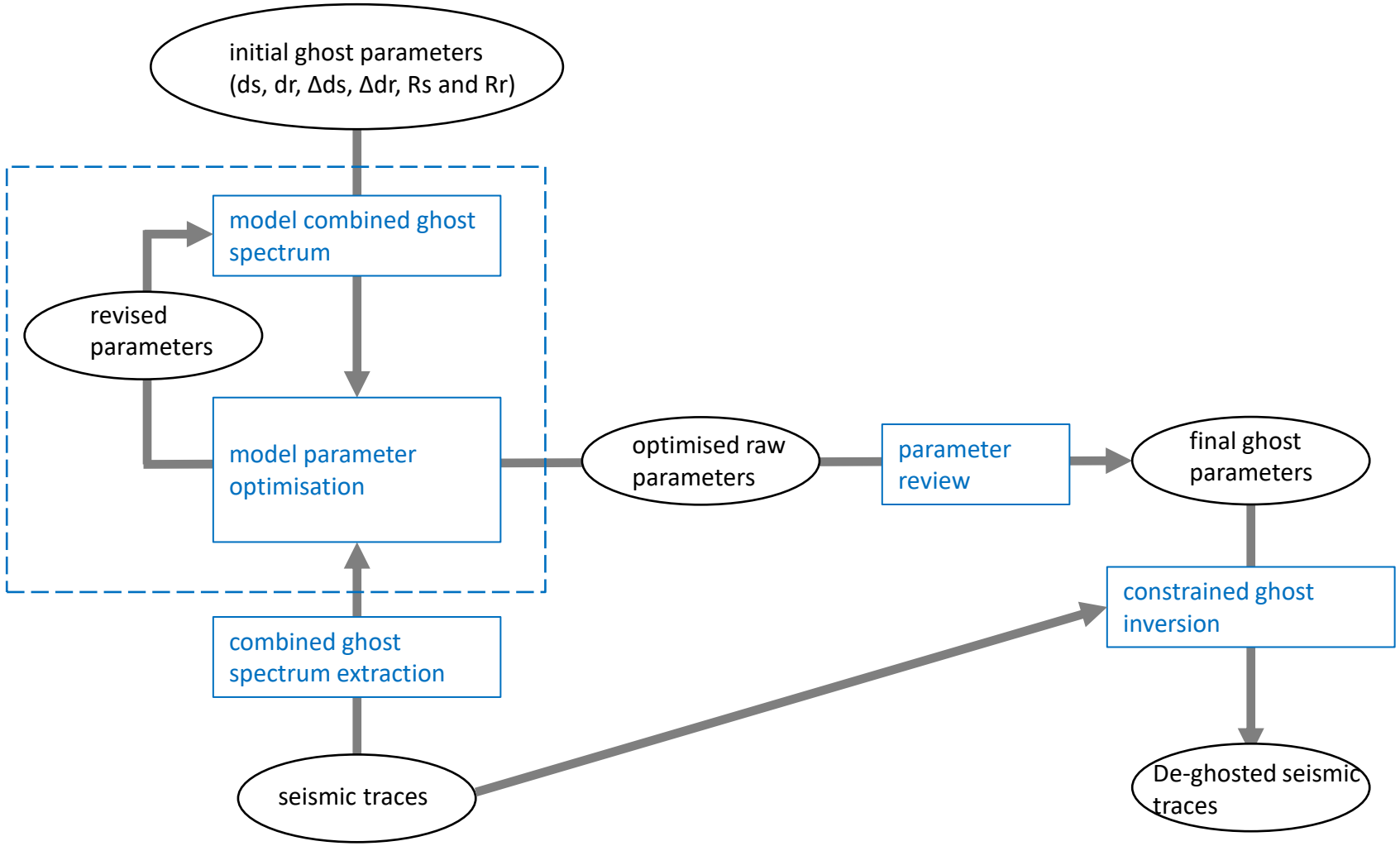
Processing objective: Flat spectrum over large frequency range



for a particular trace window, the embedded seismic wavelet can be expressed in the frequency domain as the product of a ghost-free signature, a source and receiver ghost function, and a Q-based earth filter

$$\boldsymbol{W = SG_sG_rE}$$

Methodology outline
(shot and receiver ghosts)

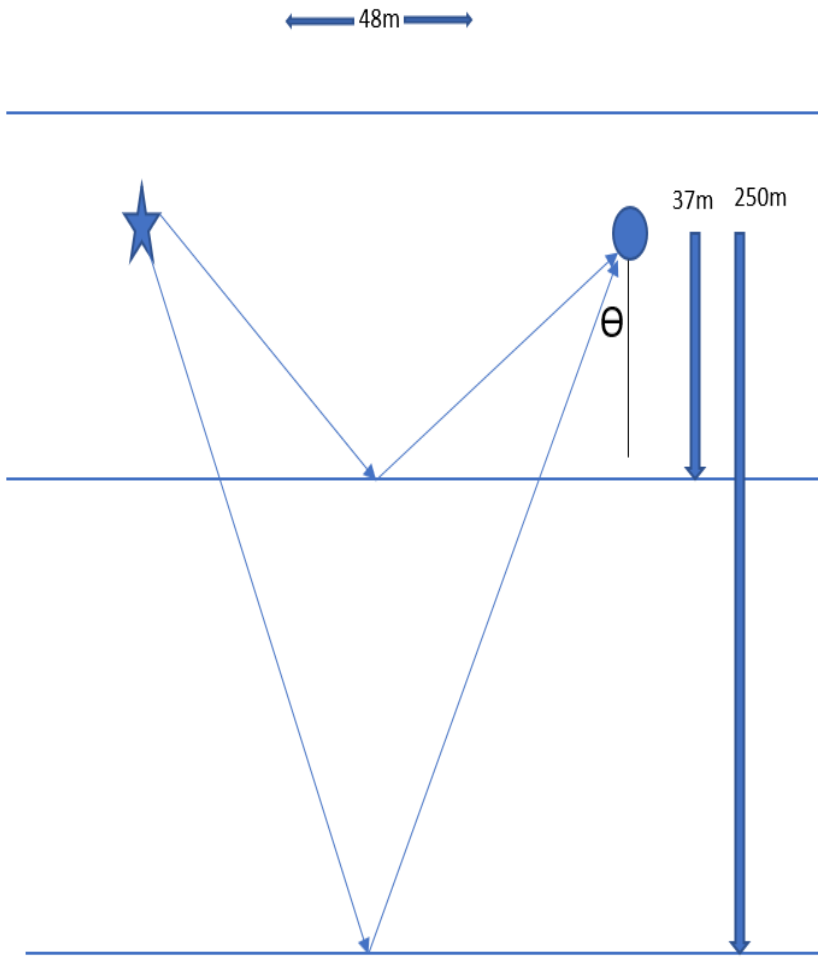


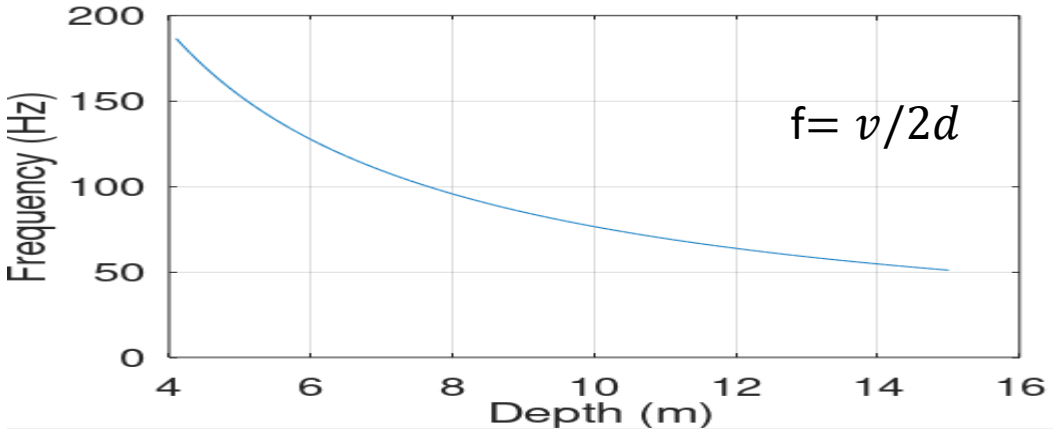
More on ghosts – UHR survey

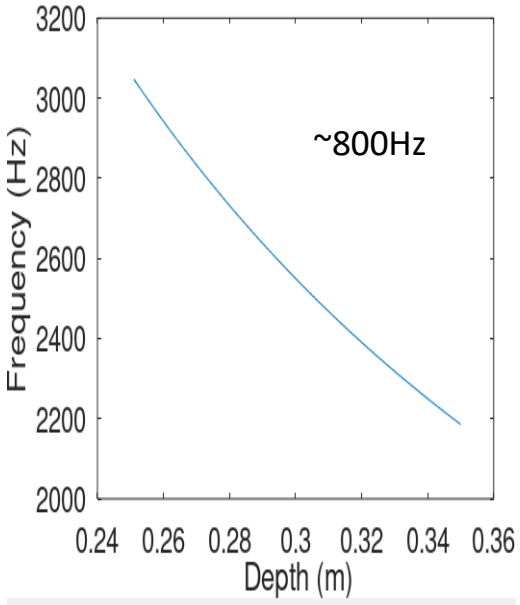
Angles vary here. In the UHR
The small offsets & recording time plays a role.
The ghosts are between ~0° and ~50°, where as in normal seismic with long offset ~0° and 90°

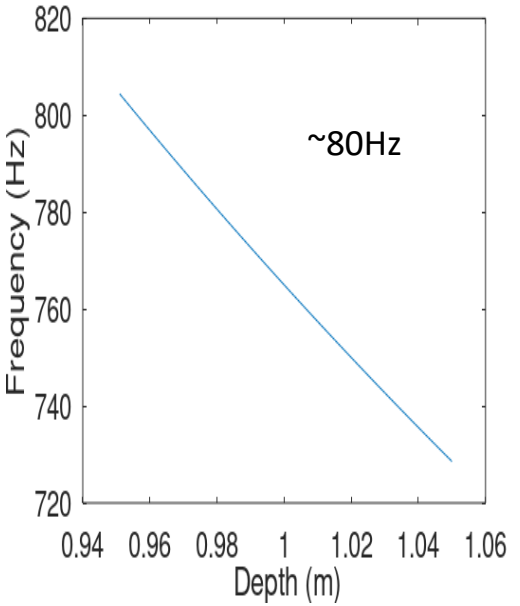
$$t = 2d/v$$

$$t = 2dcos(\theta)/v$$

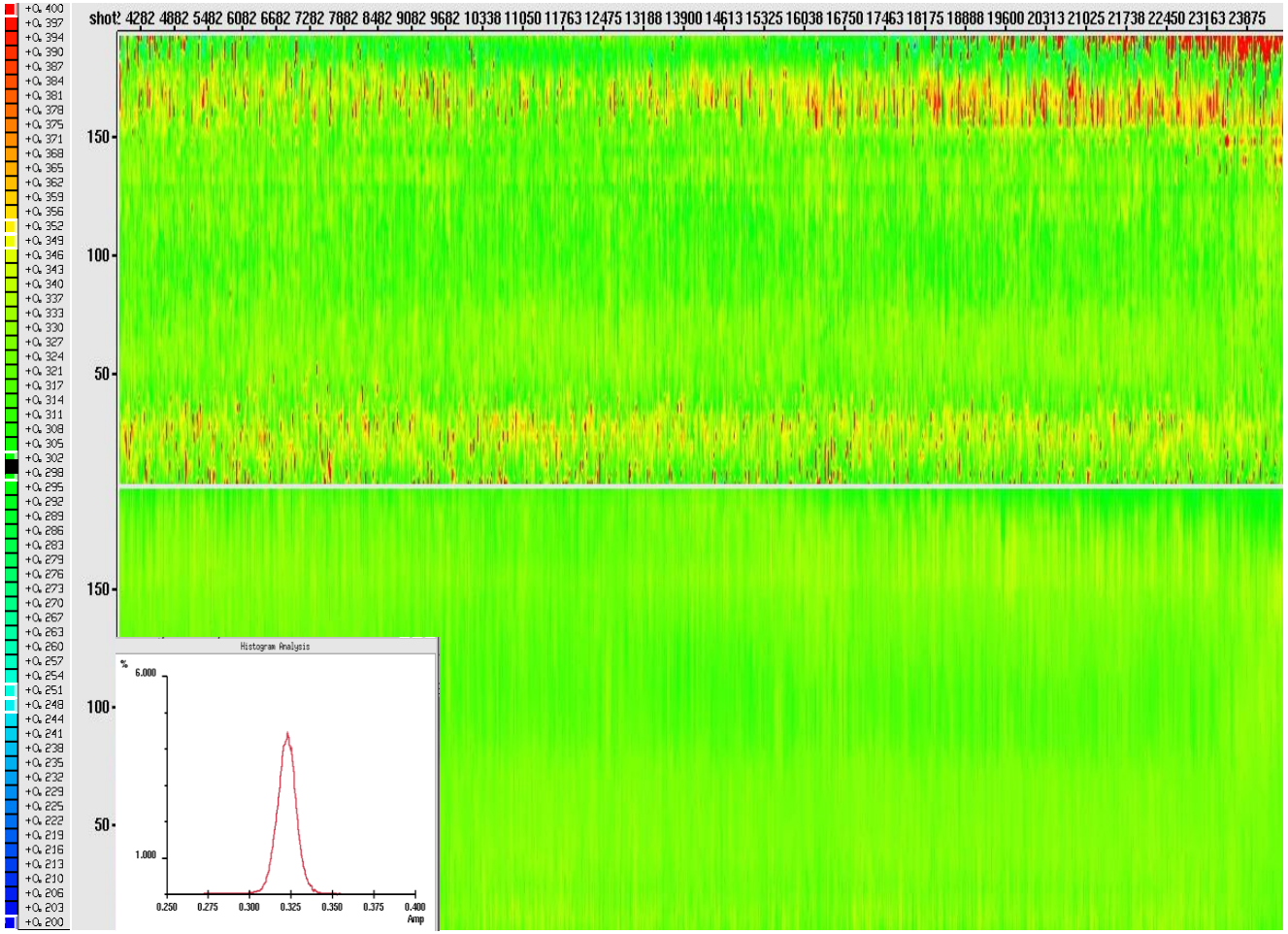






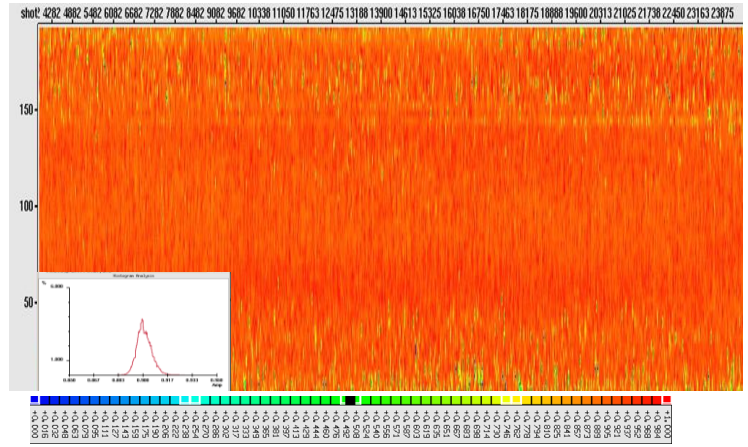


Broadband processing: Source Ghost estimation



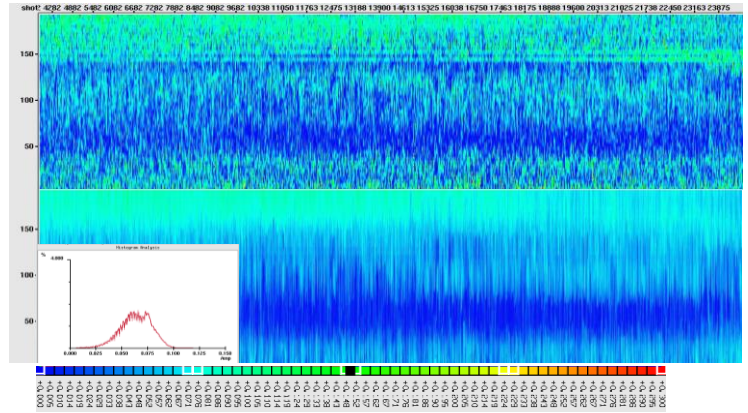
Source Depth

Raw



Reflectivity

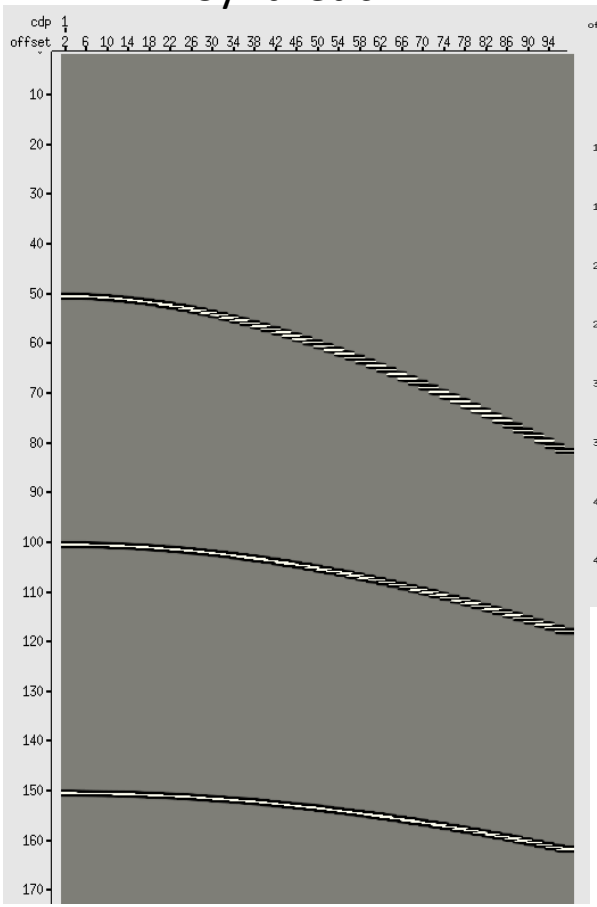
Smoothed



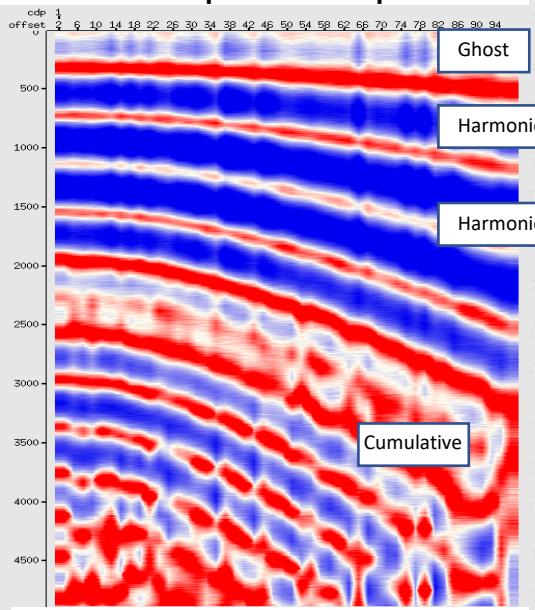
Fluctuation

Broadband processing – Receiver Ghost

Synthetic



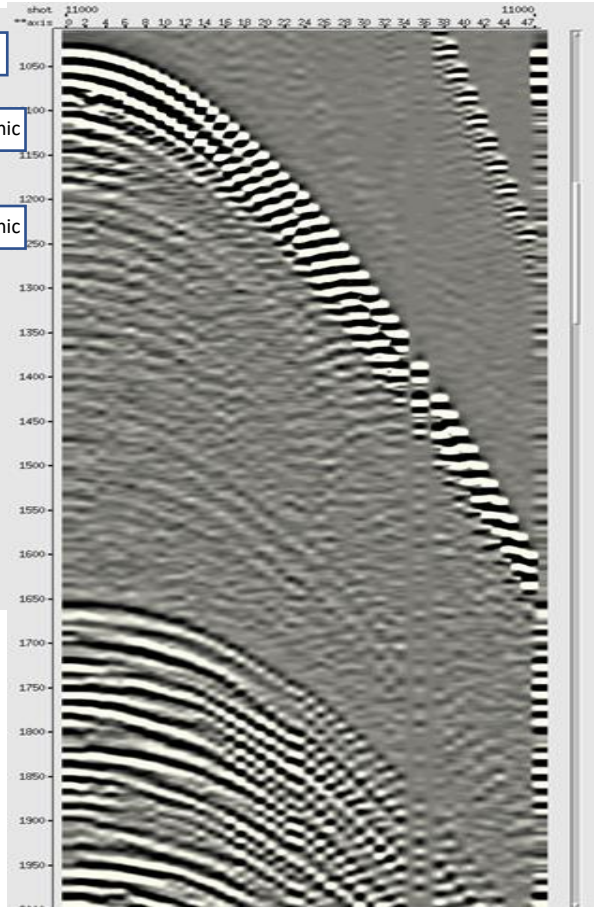
Amplitude Spectra



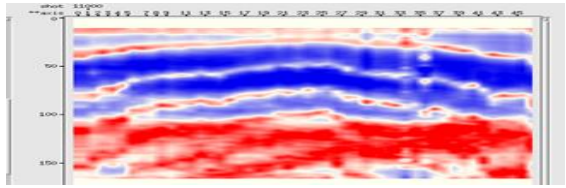
R Depth=2m, 375Hz

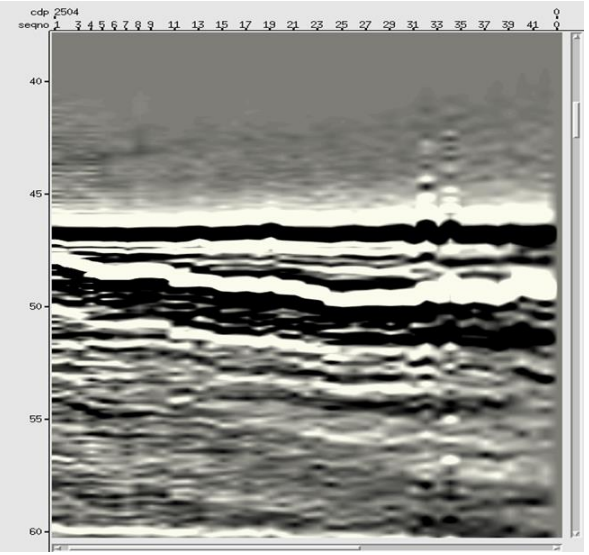
S Depth=.325m, 2142Hz

Real



Amplitude Spectra

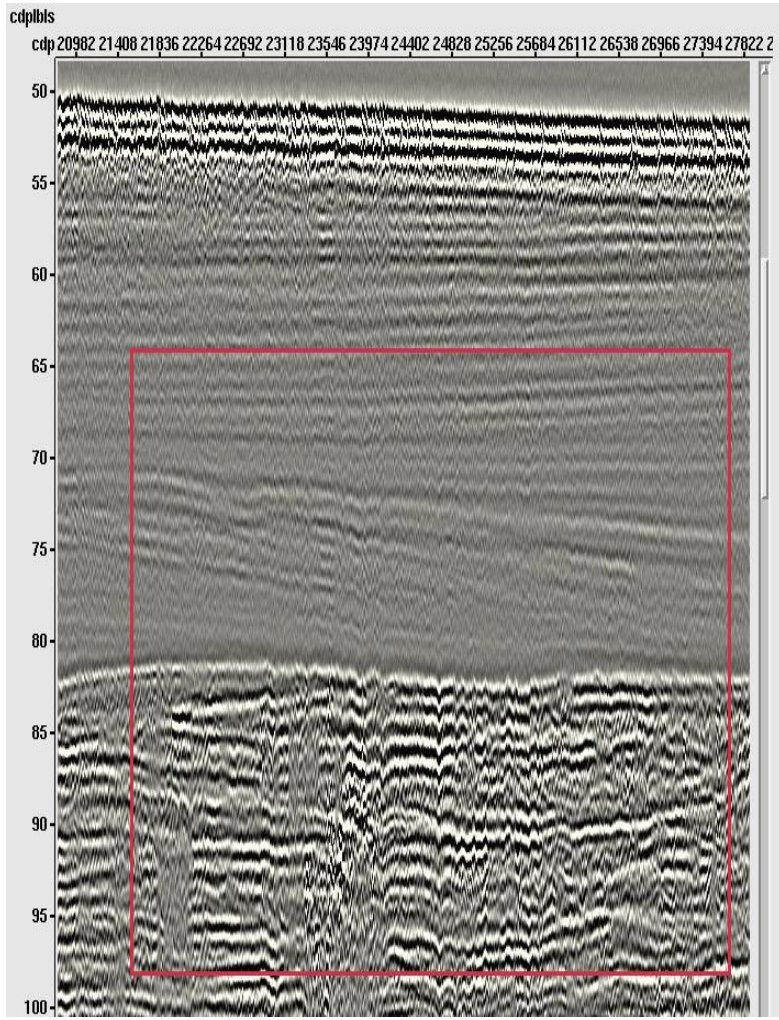




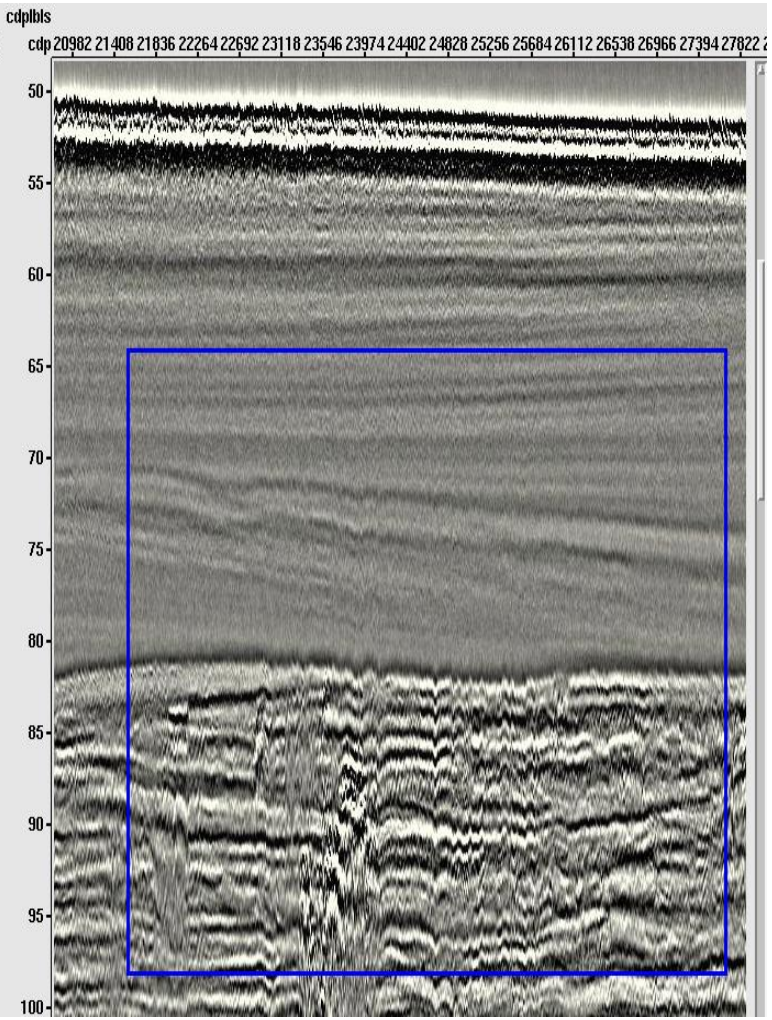
With Source desig/de-ghost

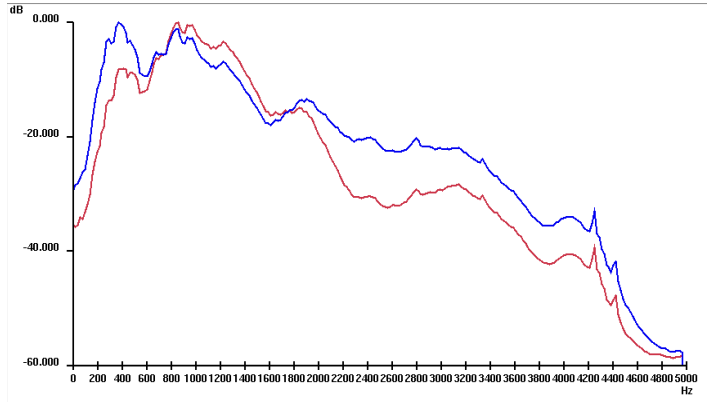
Broadband processing - Preliminary stack

Previous



New





Source de-sig, source de-ghost

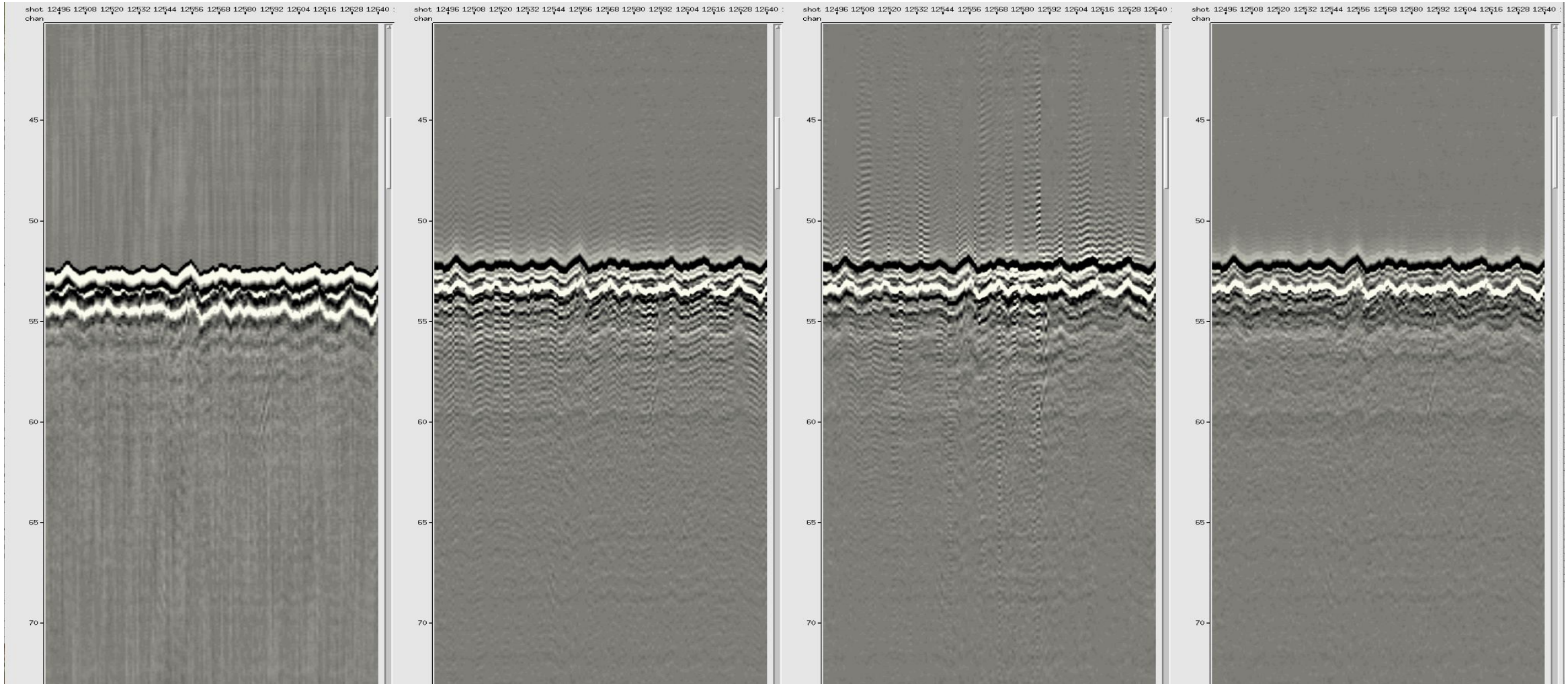
Source Ghost Inversion Tests

Input

Global source ghost inversion designature operator

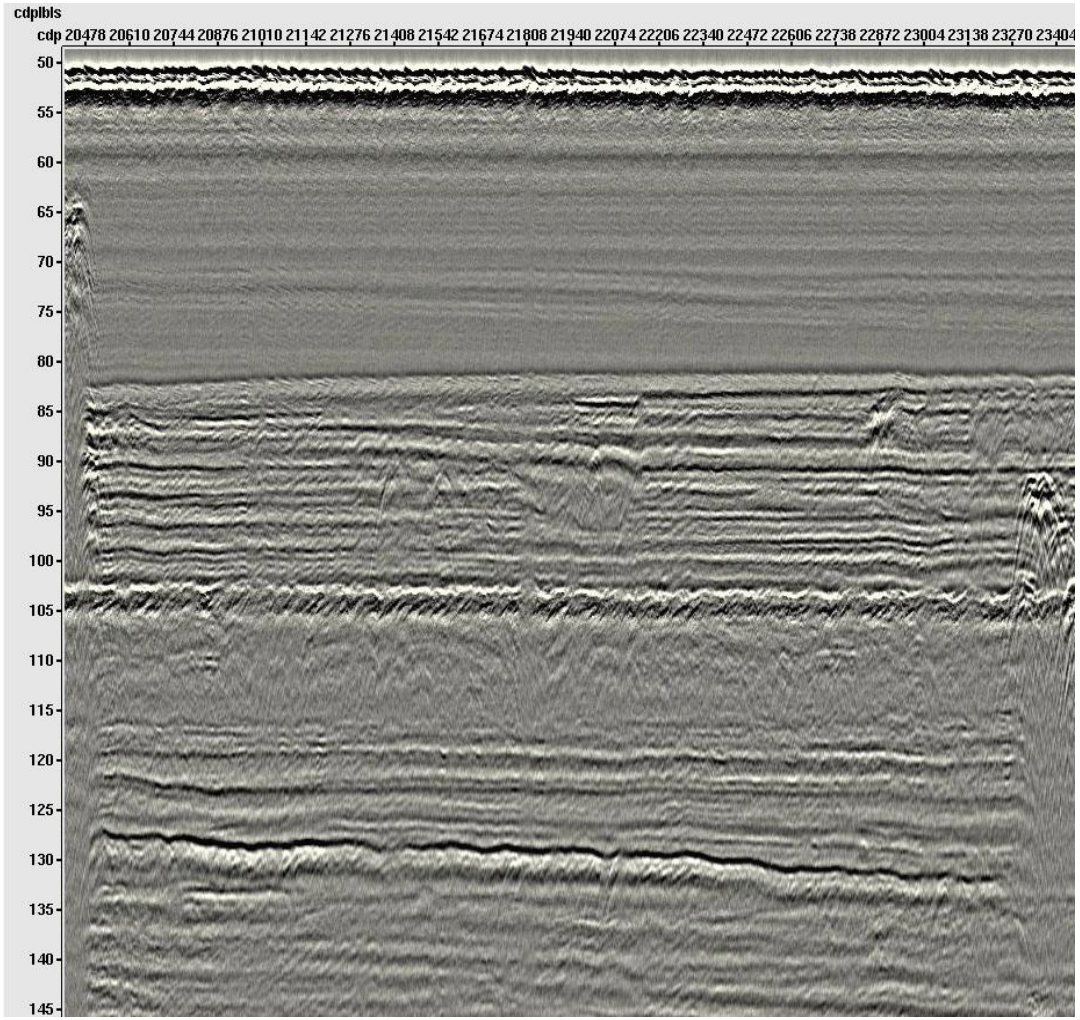
Shot-by-shot source ghost inversion designature operator

Ghost-free designature and data dependent source ghost inversion

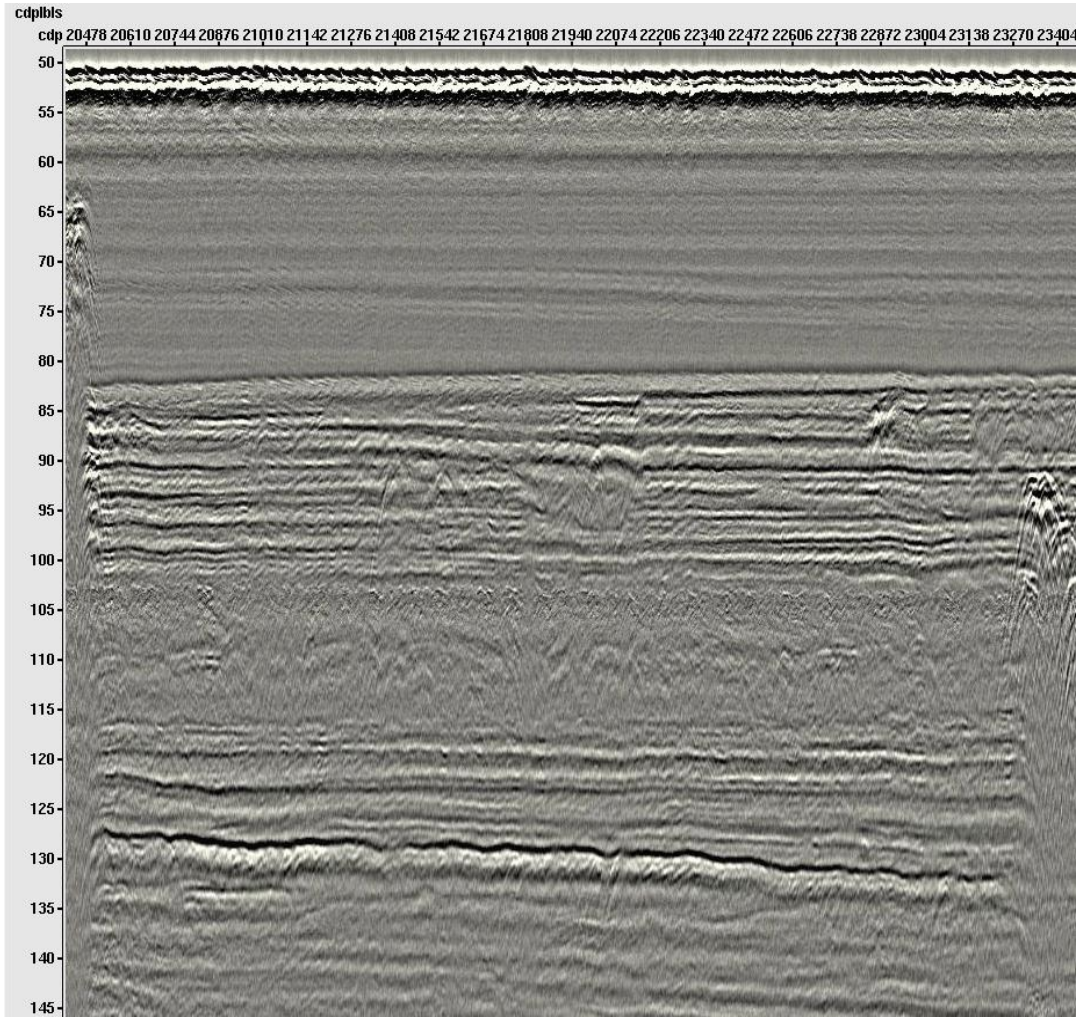


De-multiple, dual model subtraction - dswd & wave equation

Before



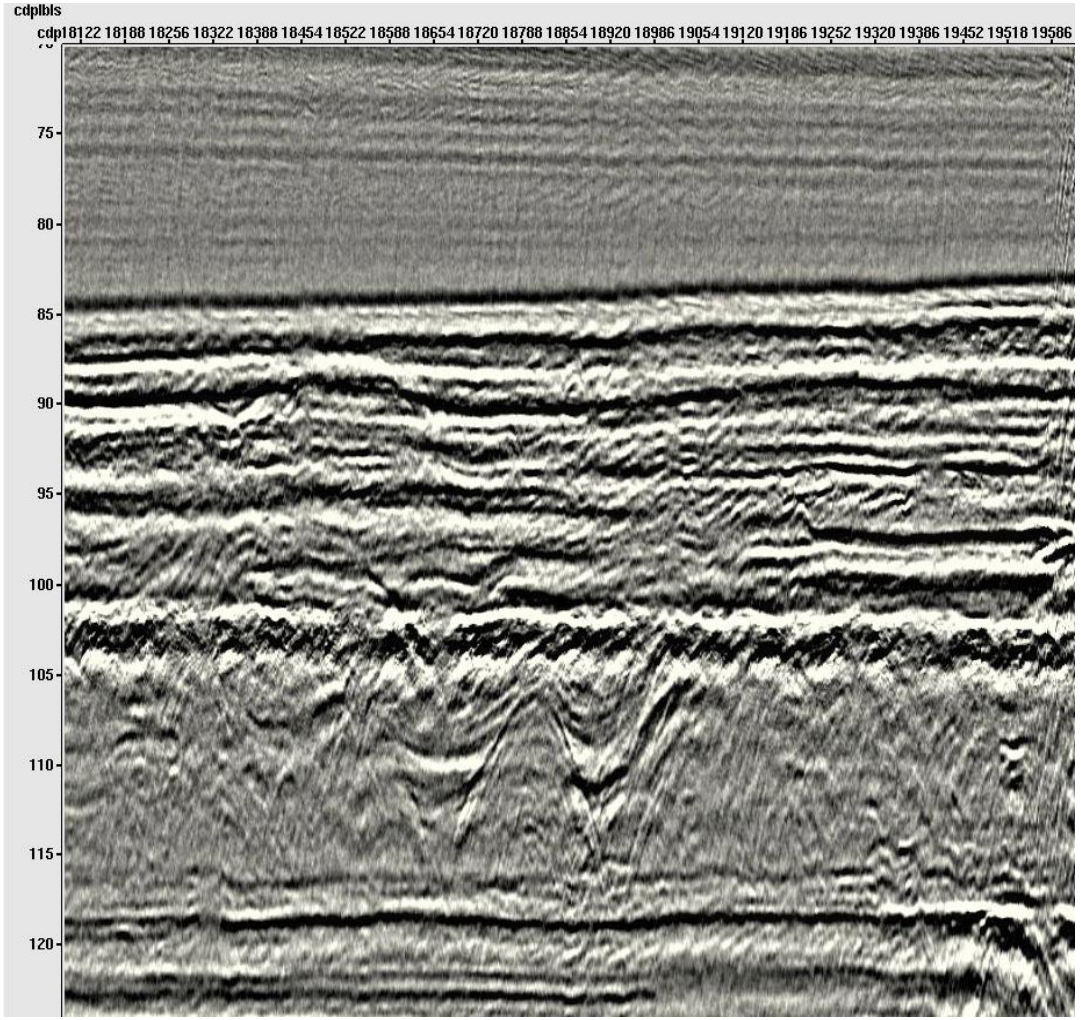
After



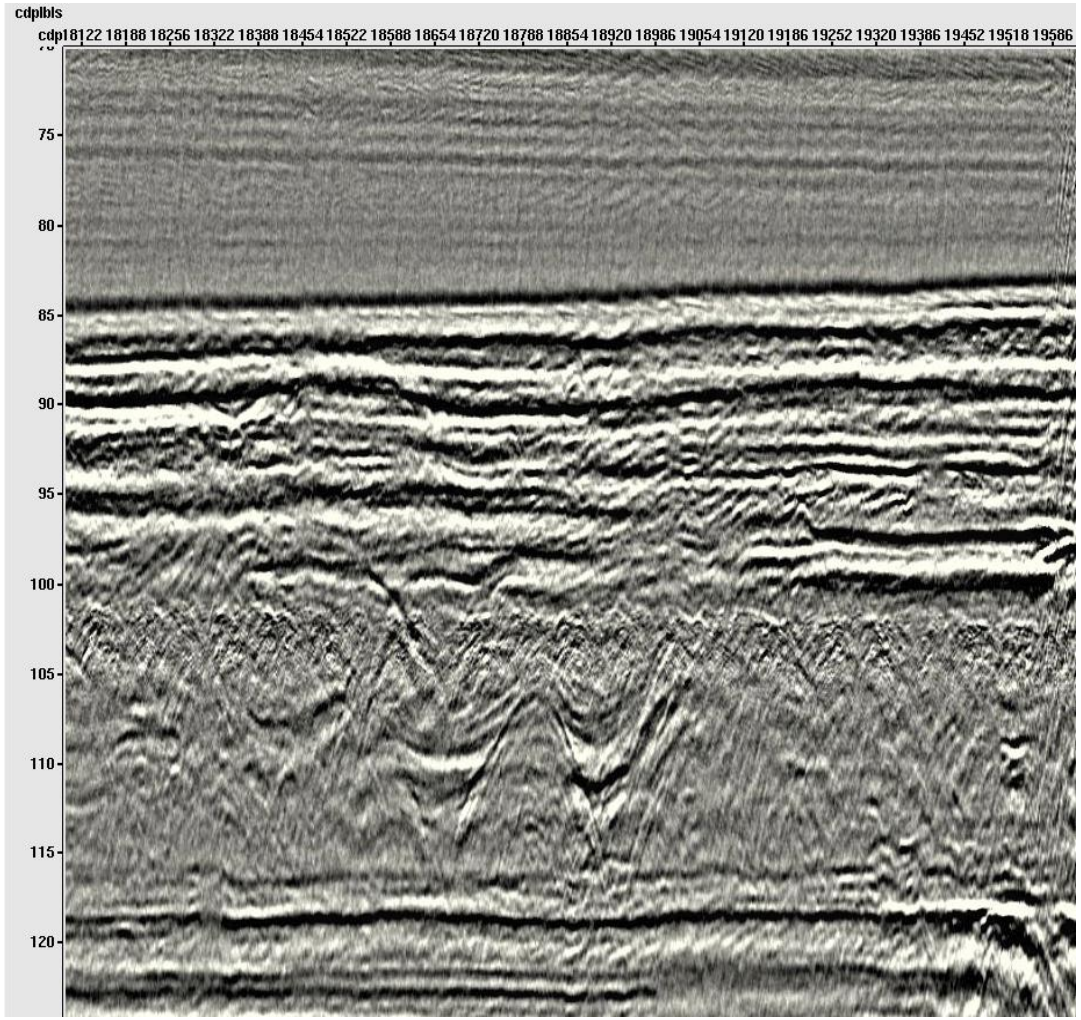
De-multiple, dual model subtraction - dswd & wave equation

Zoomed section

Before

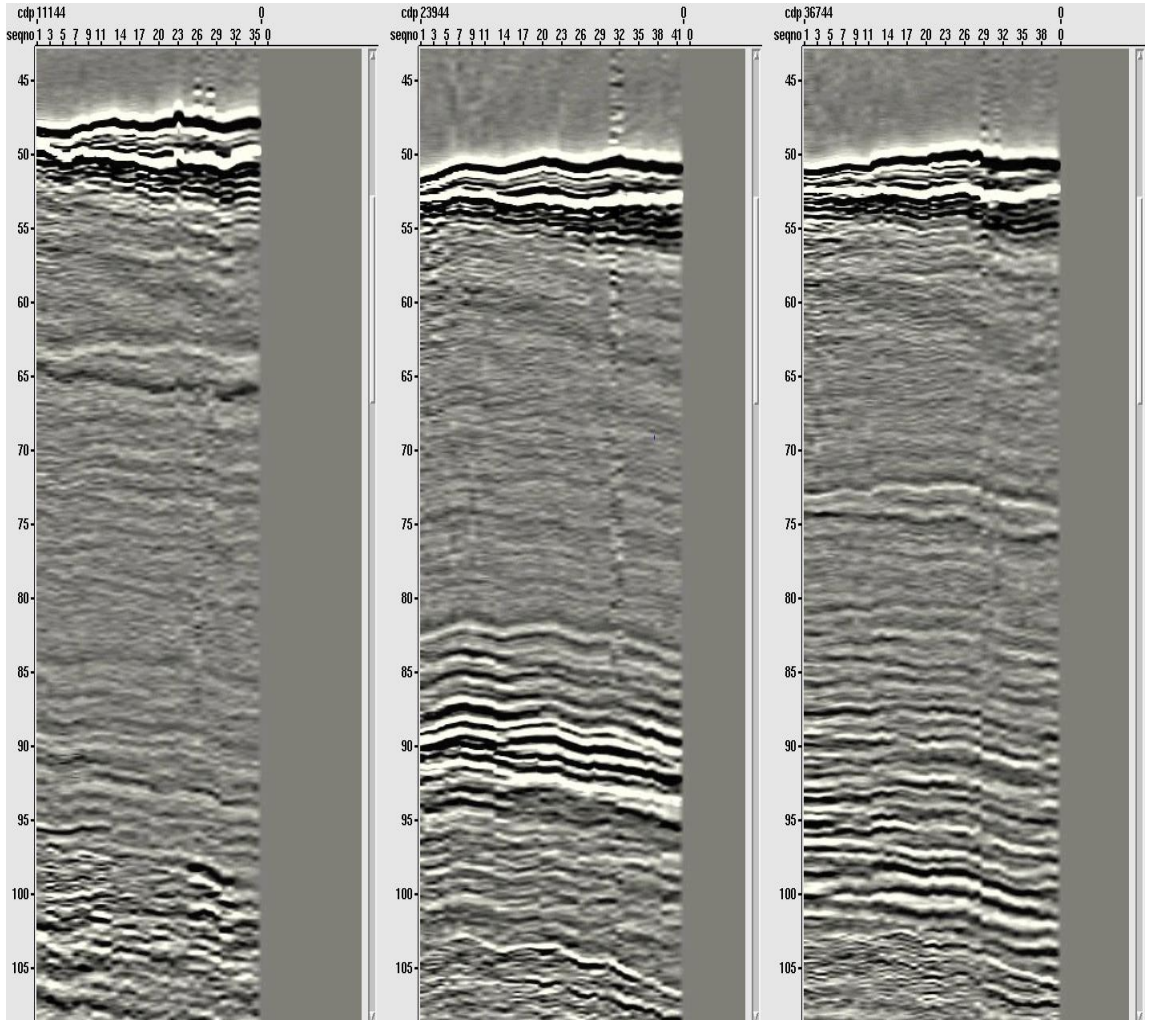


After

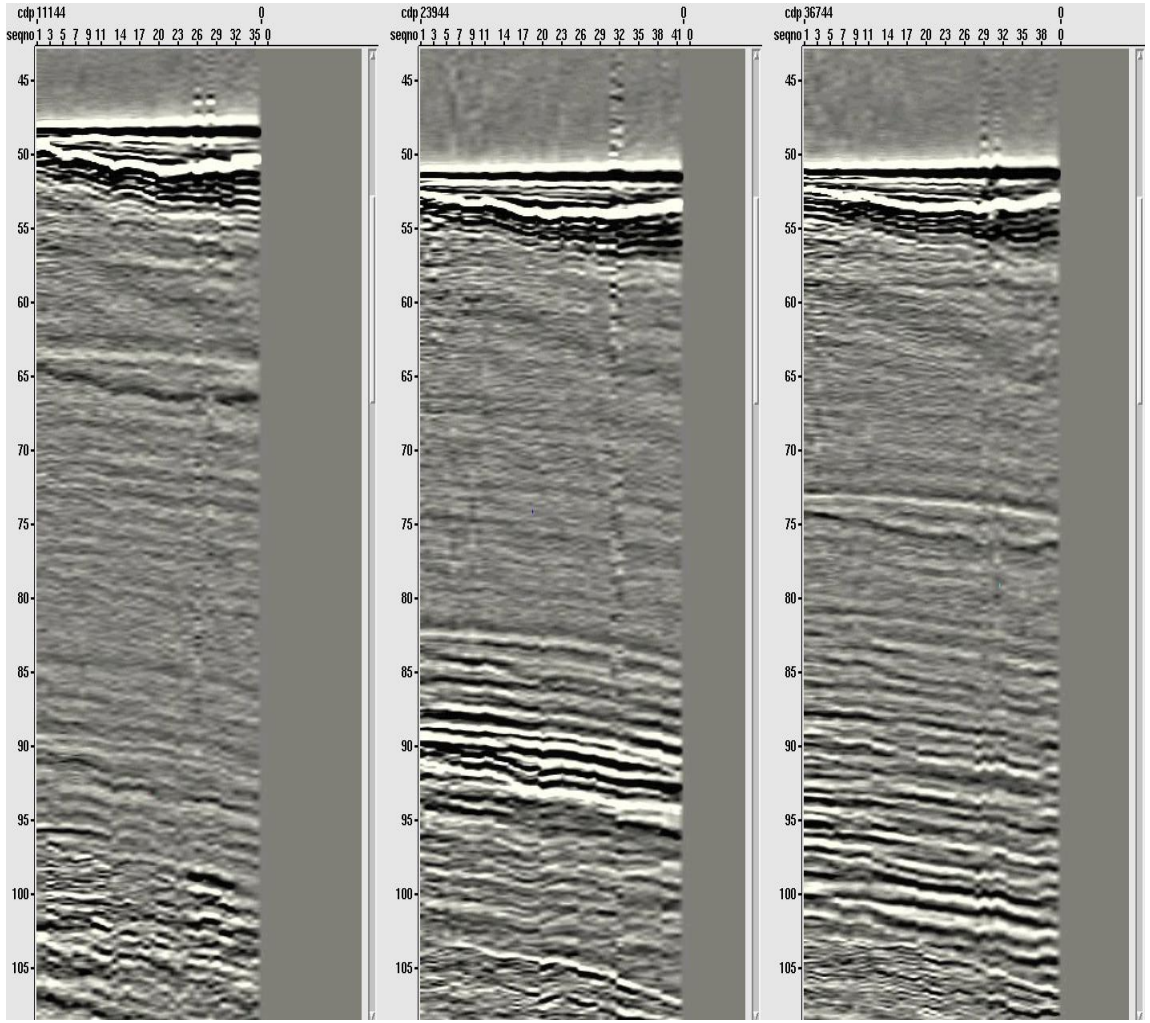


Preliminary statics: Legacy vels

Before

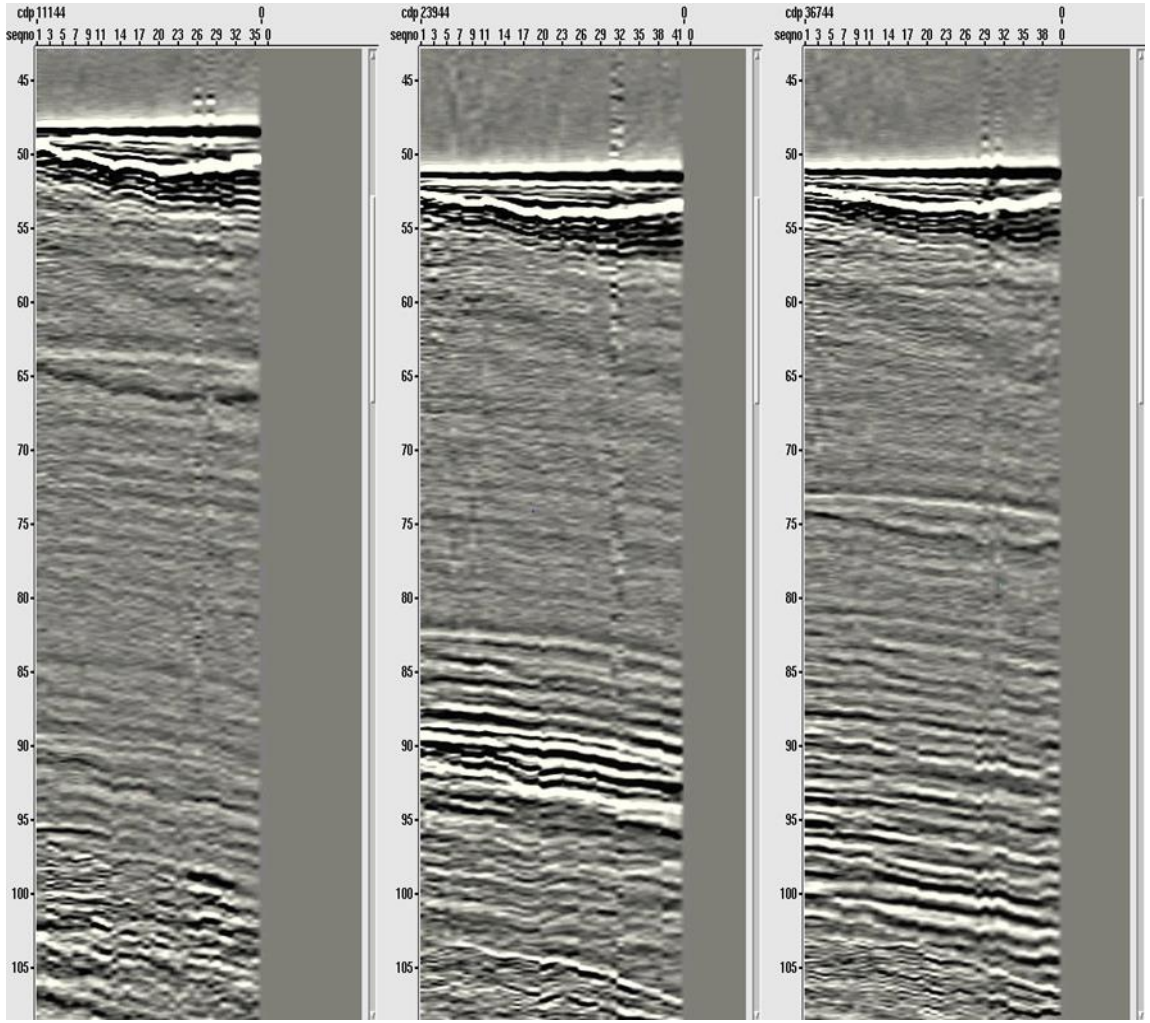


After

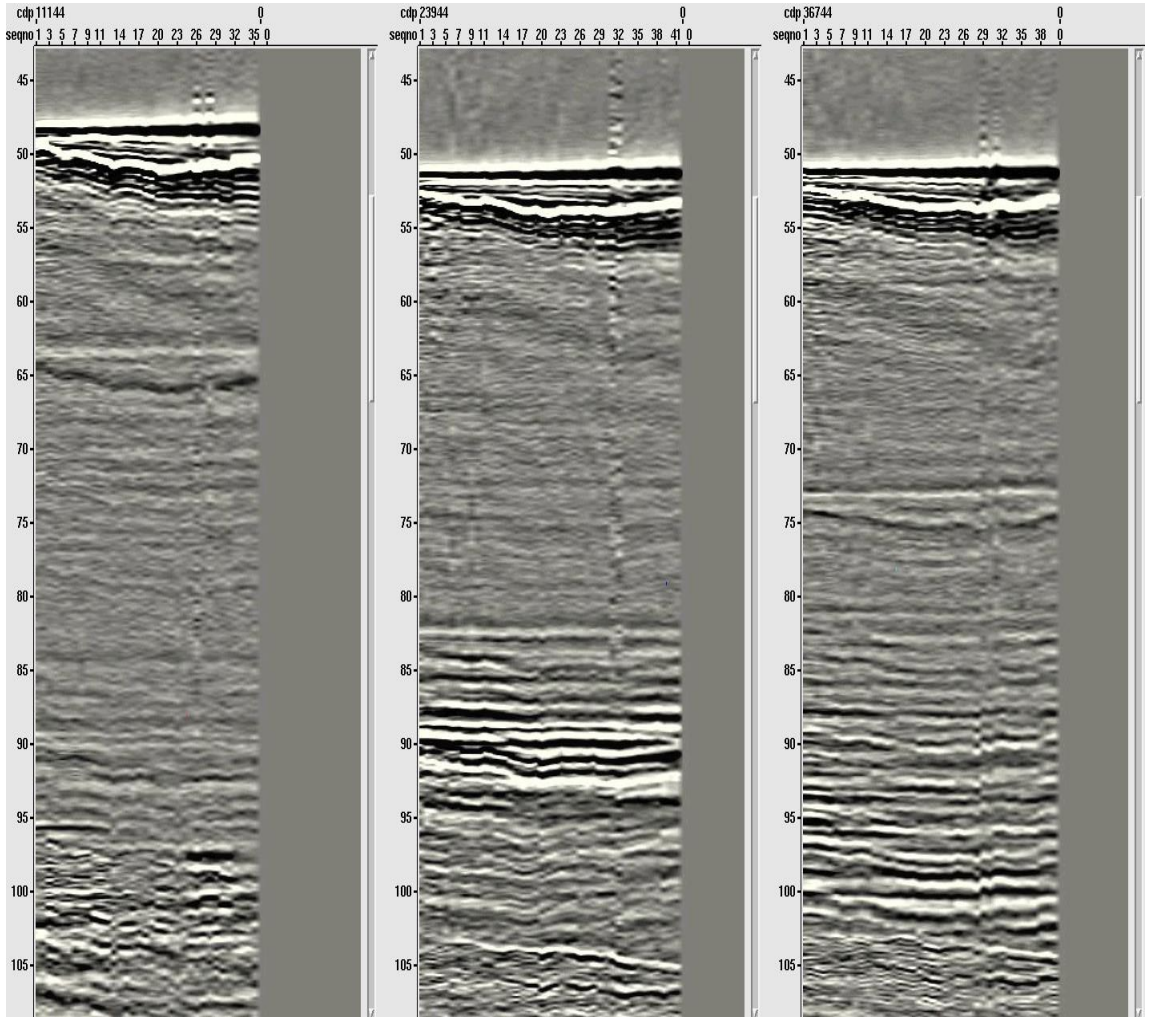


Preliminary statics: Improved vels

Before

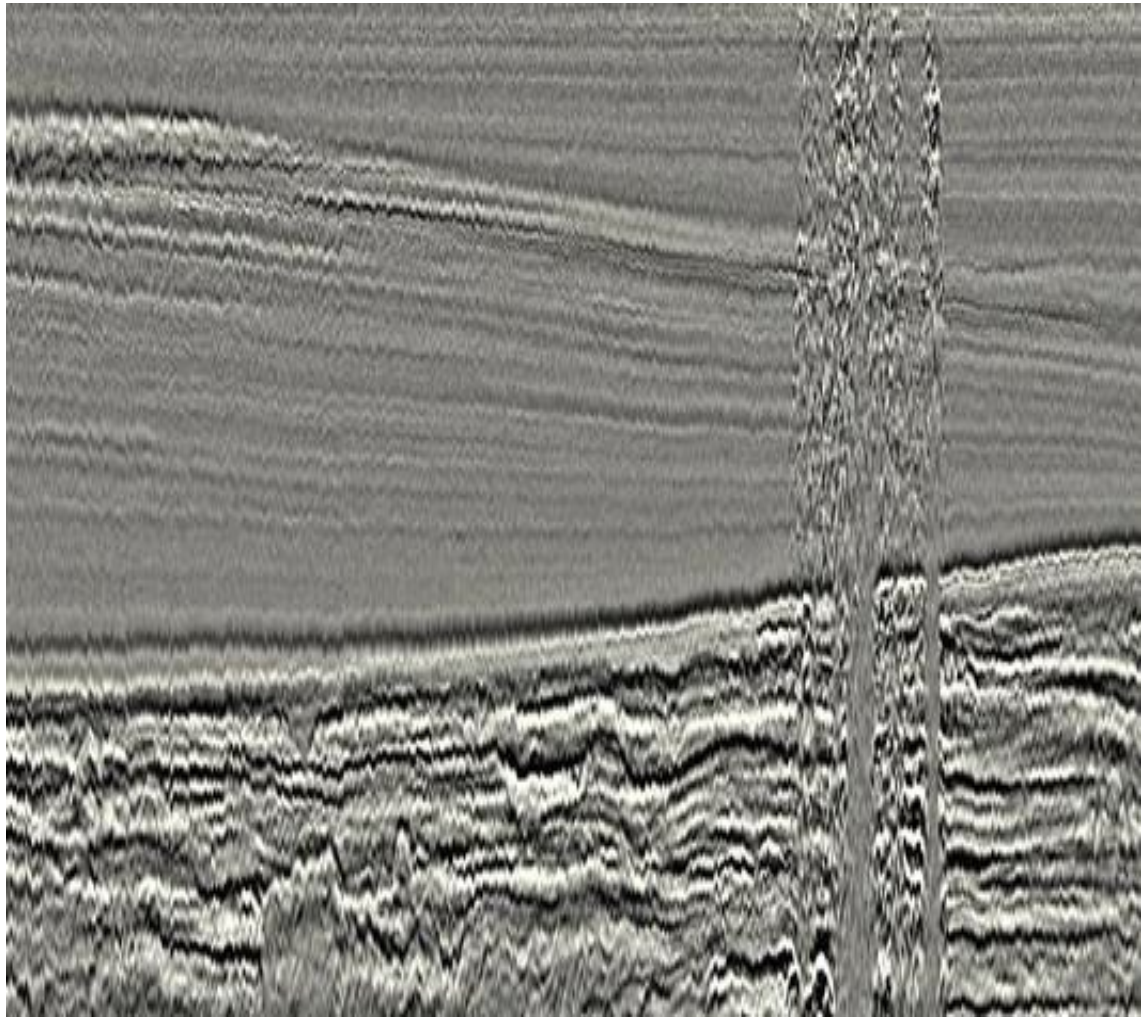


After

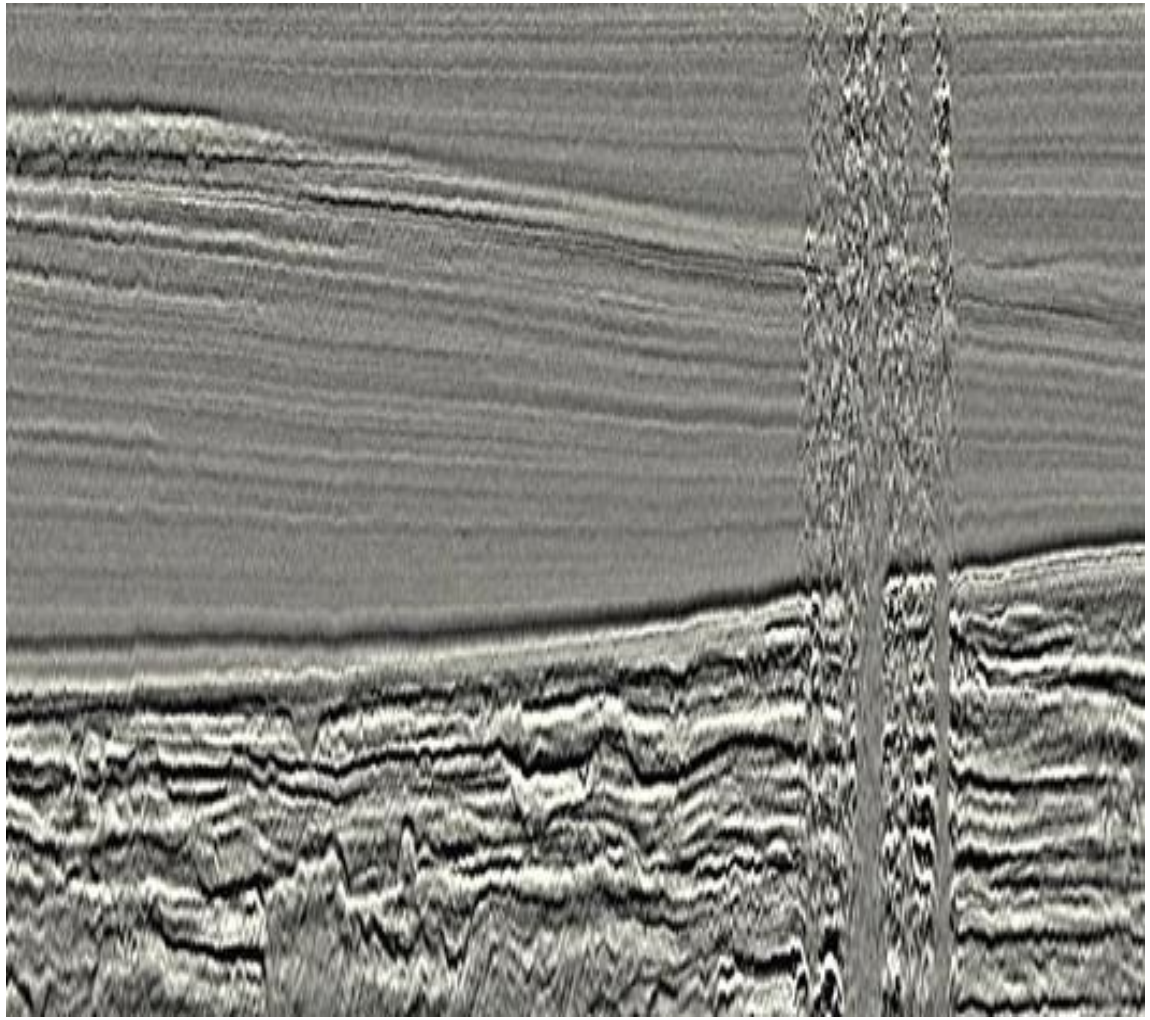


Residual Statics

Before

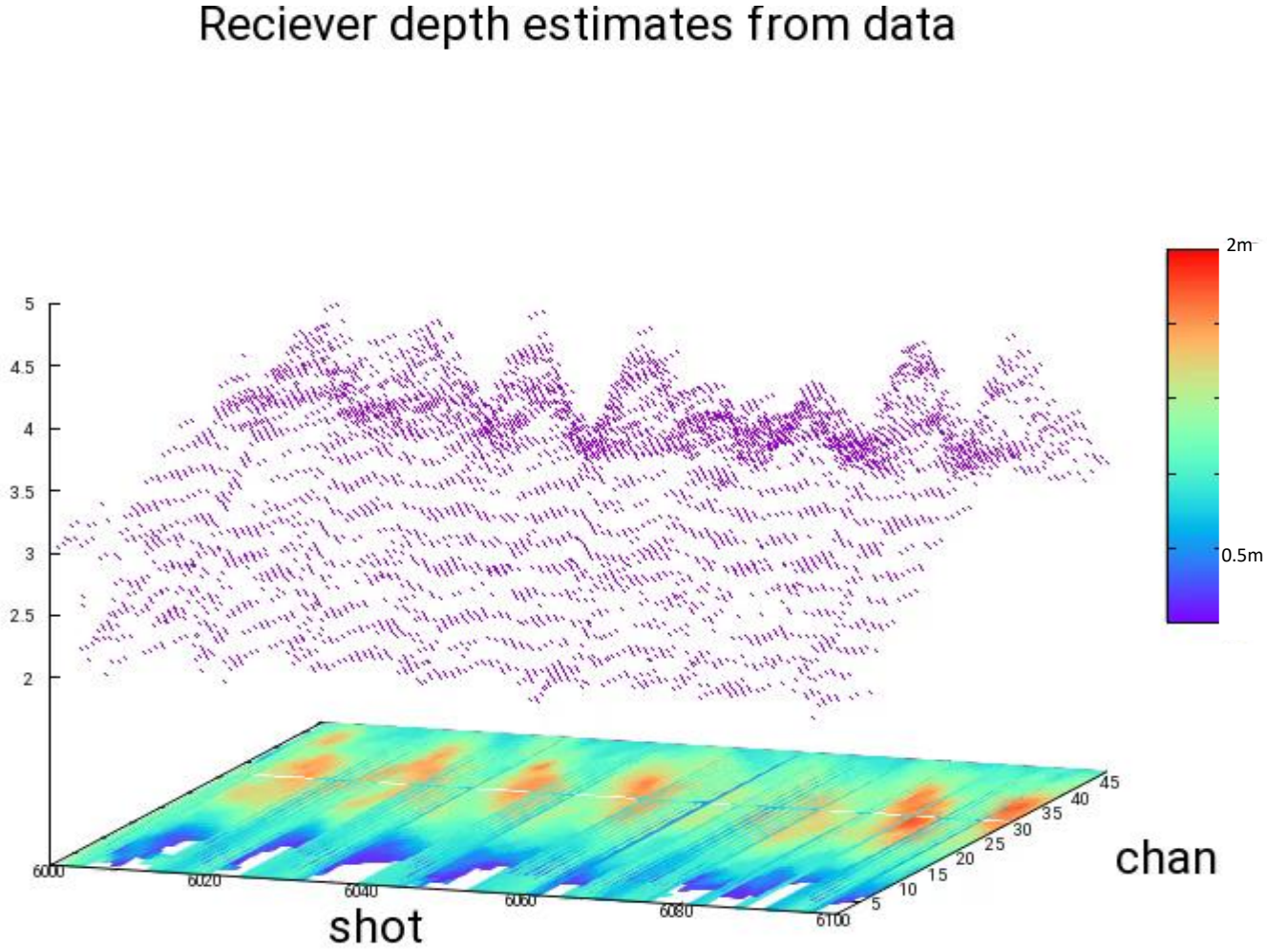


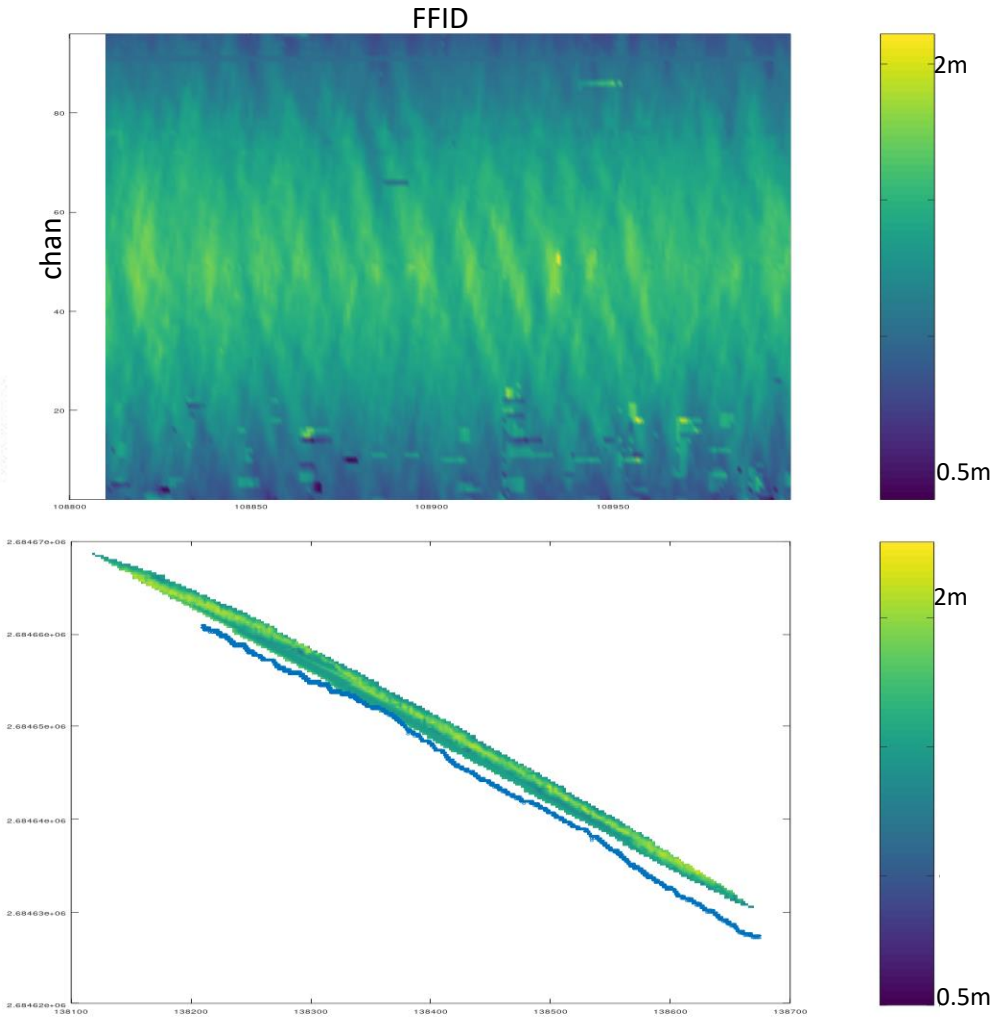
After



Spatial mapping… re-visit receiver ghost

10 mins for this traverse, shot every 0.5 sec





Mapping driven inversion

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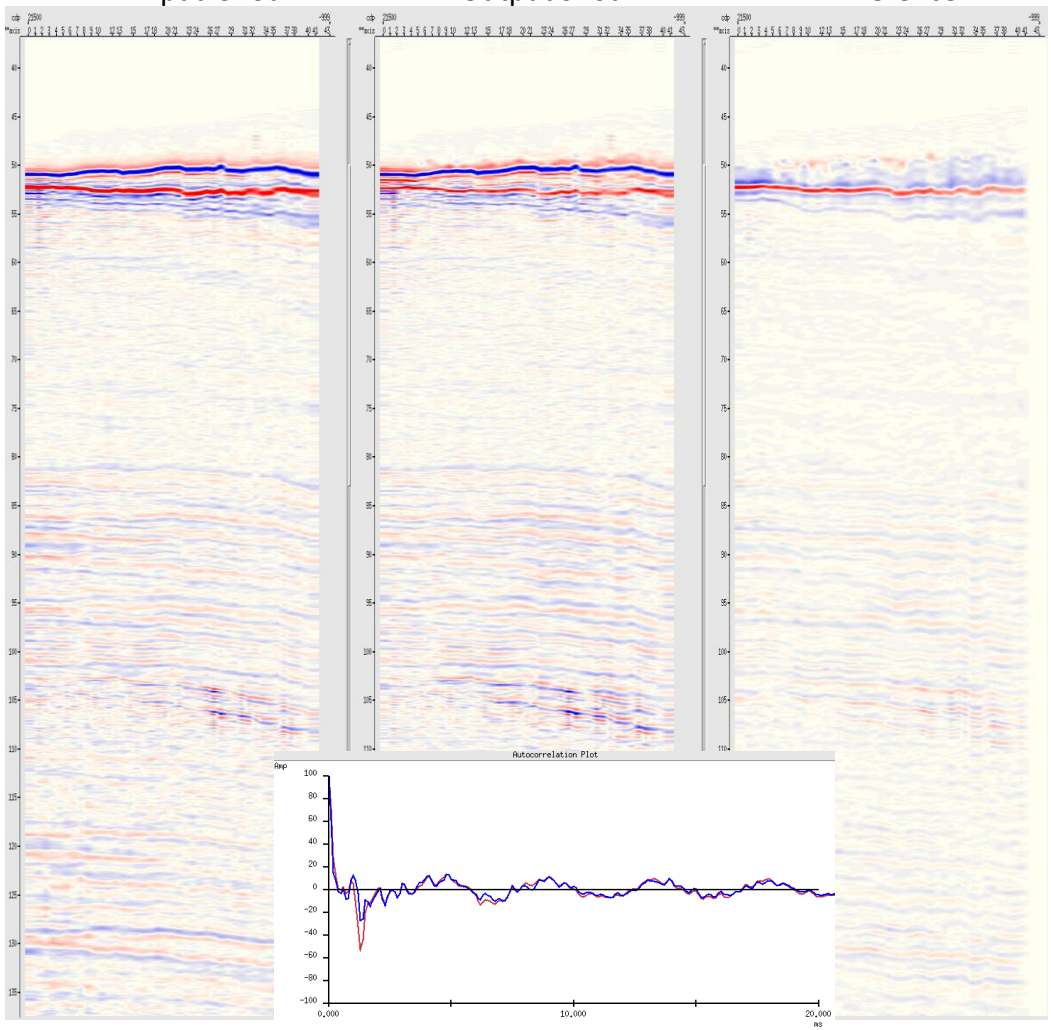
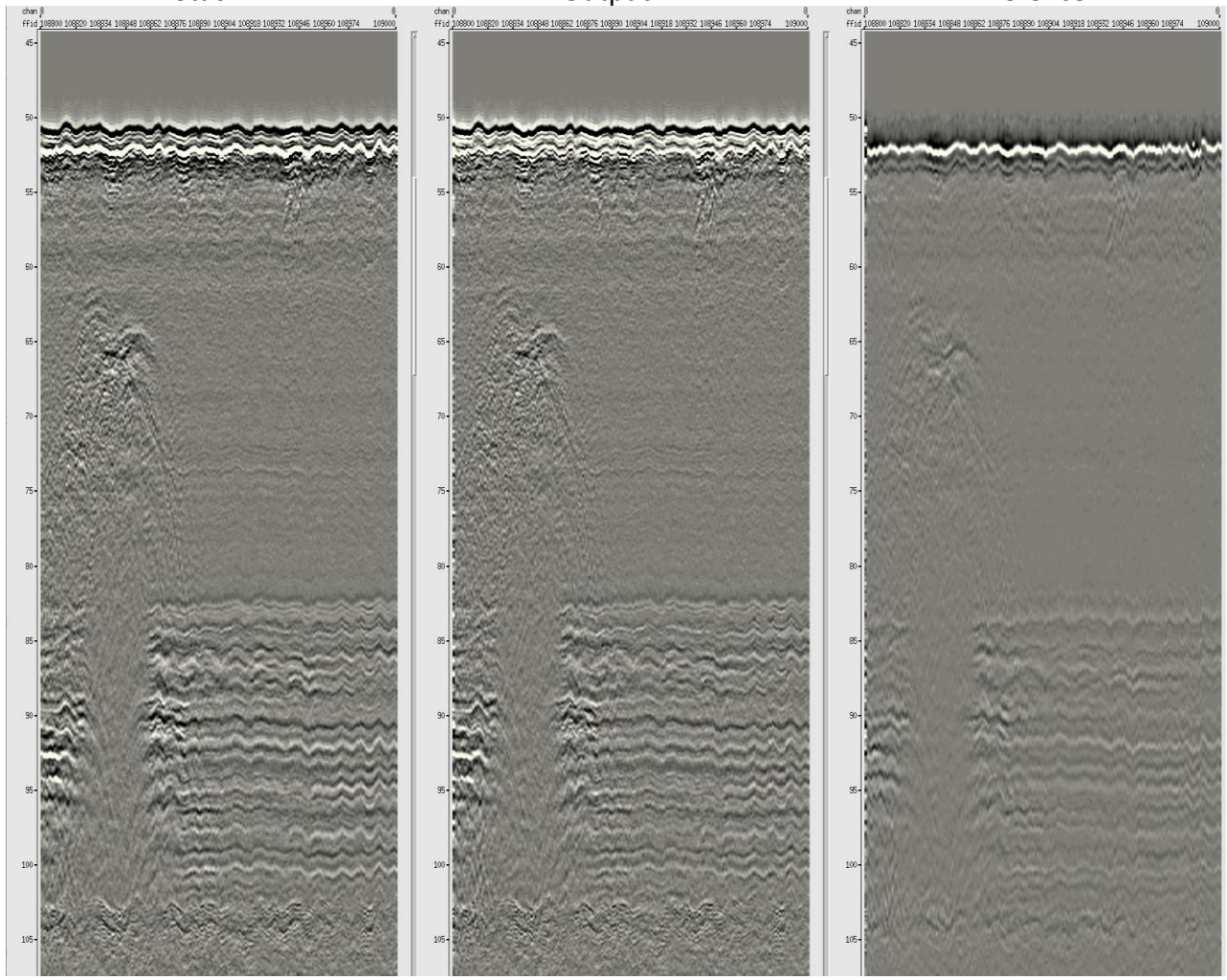
Input Shot | Output Shot | Difference

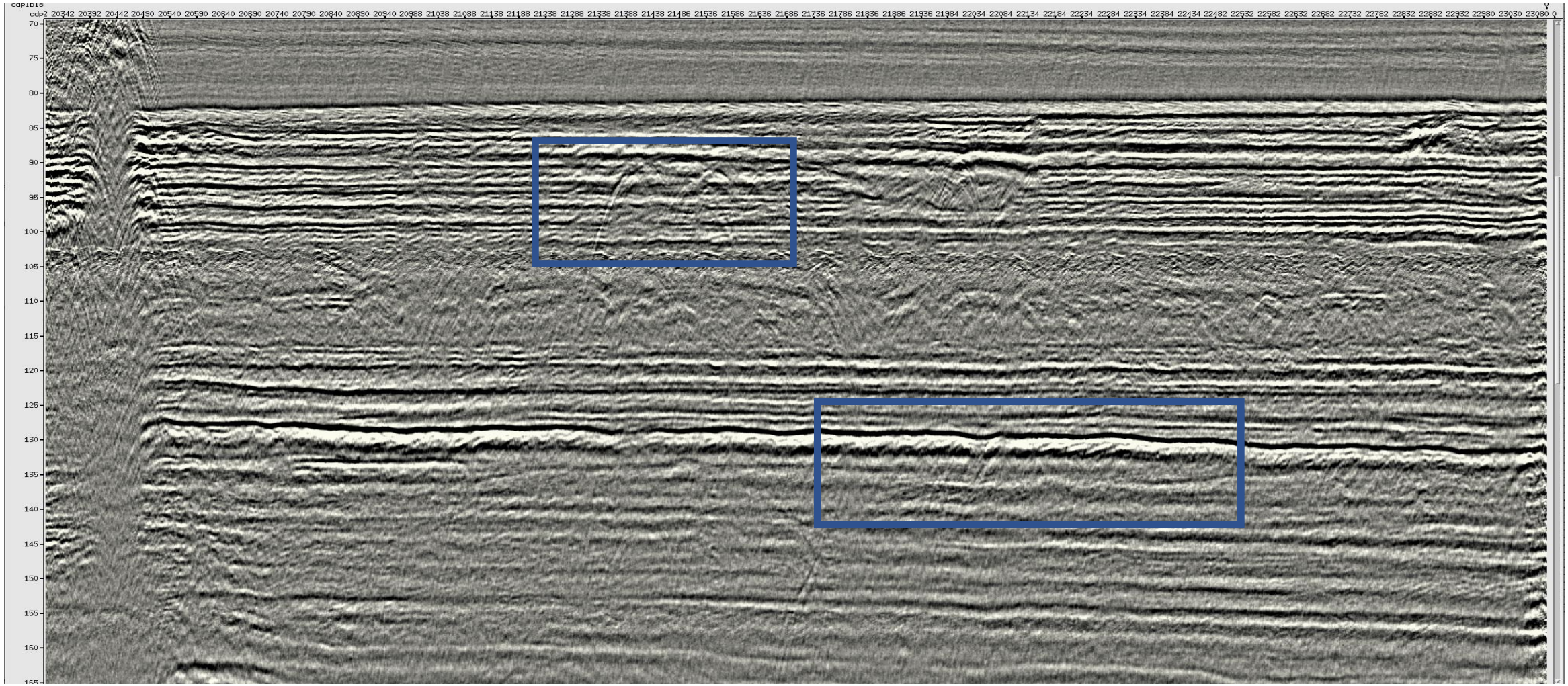


Stack | Output | Difference



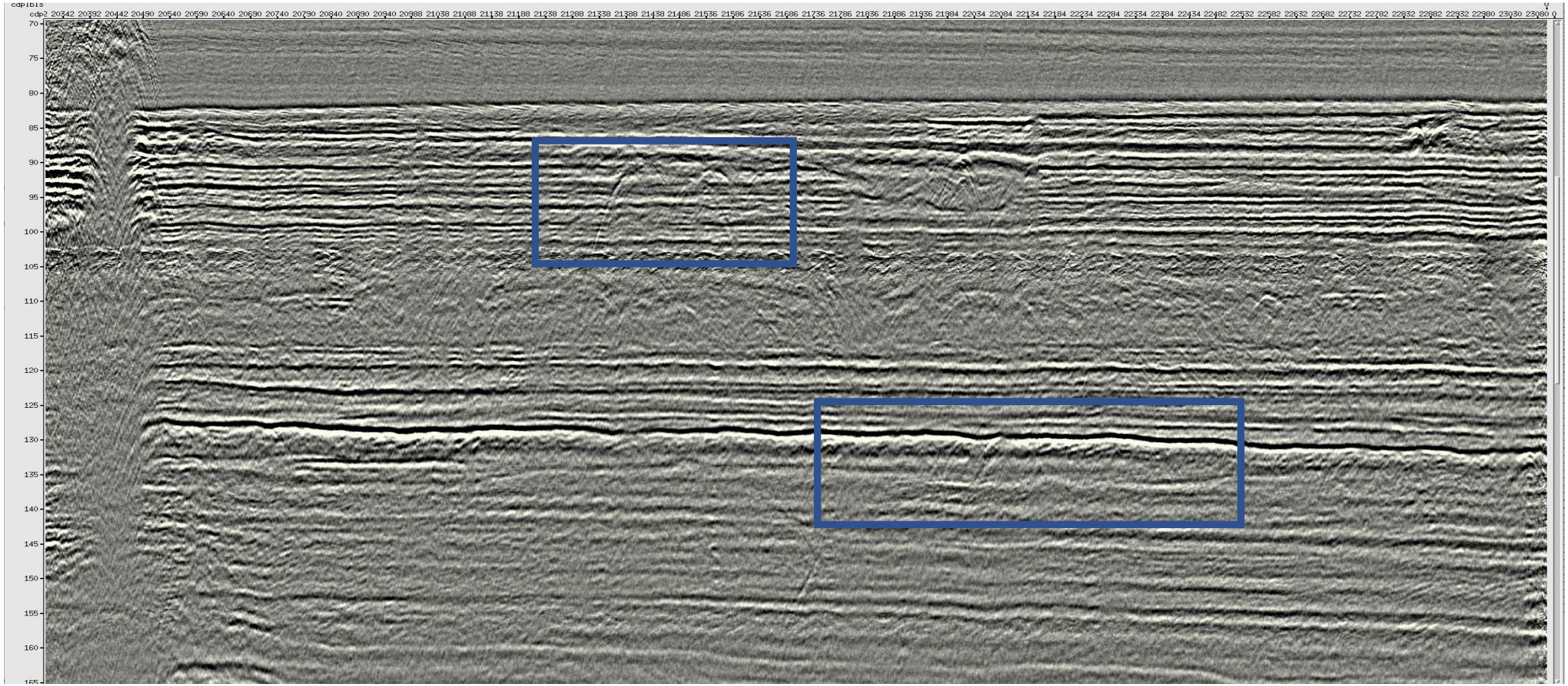
Mapping driven inversion

Stack zoom - before

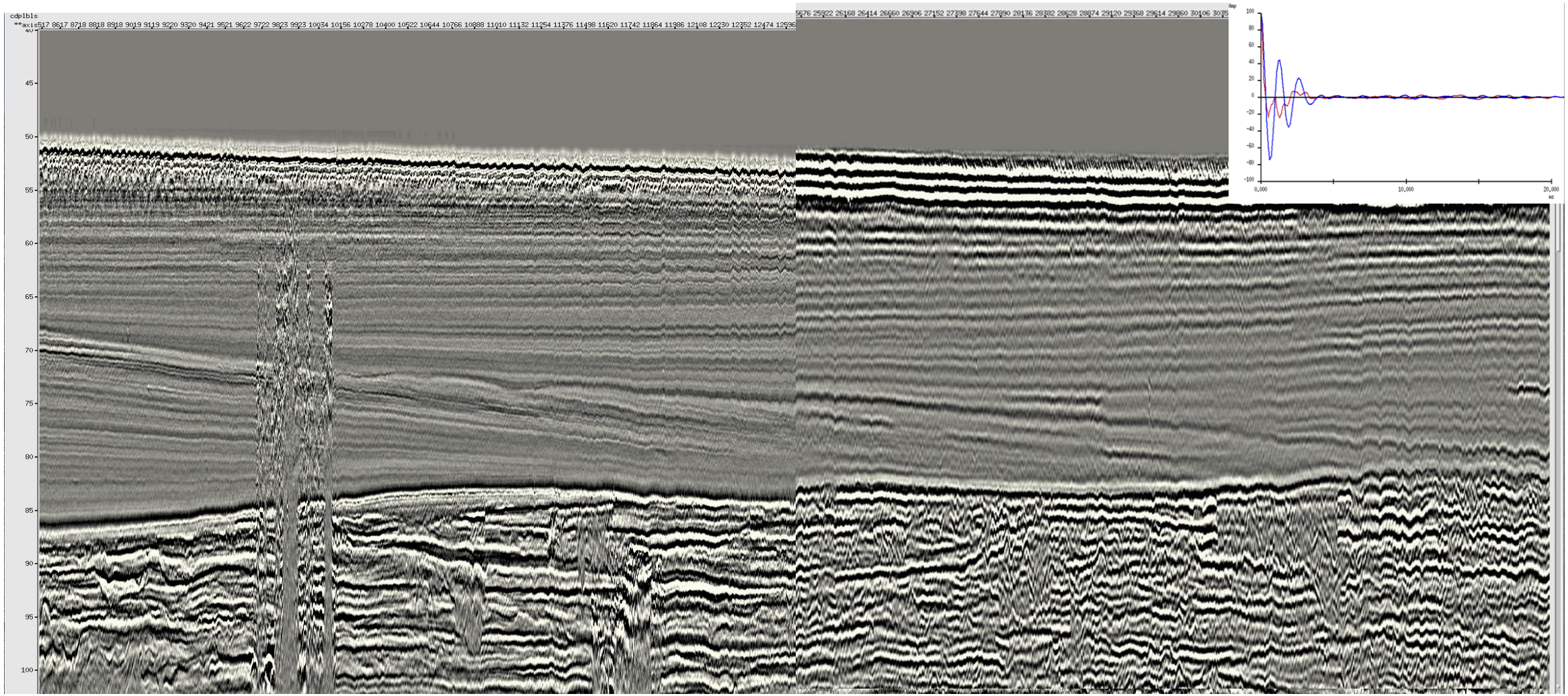


Mapping driven inversion

Stack zoom - after

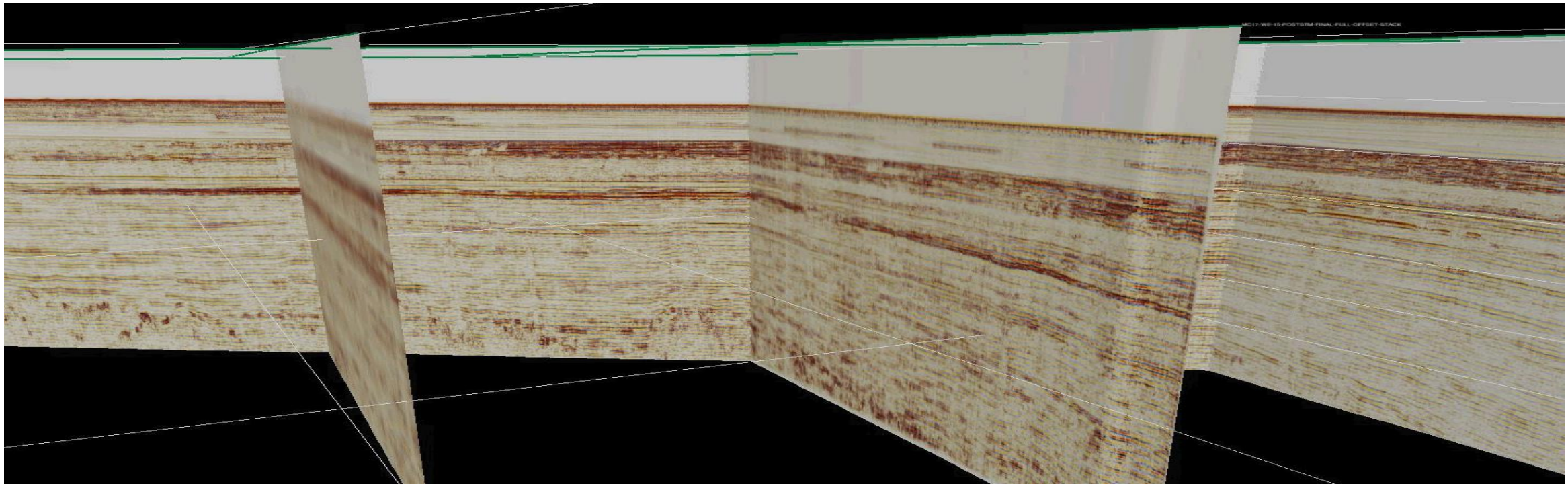


Final result

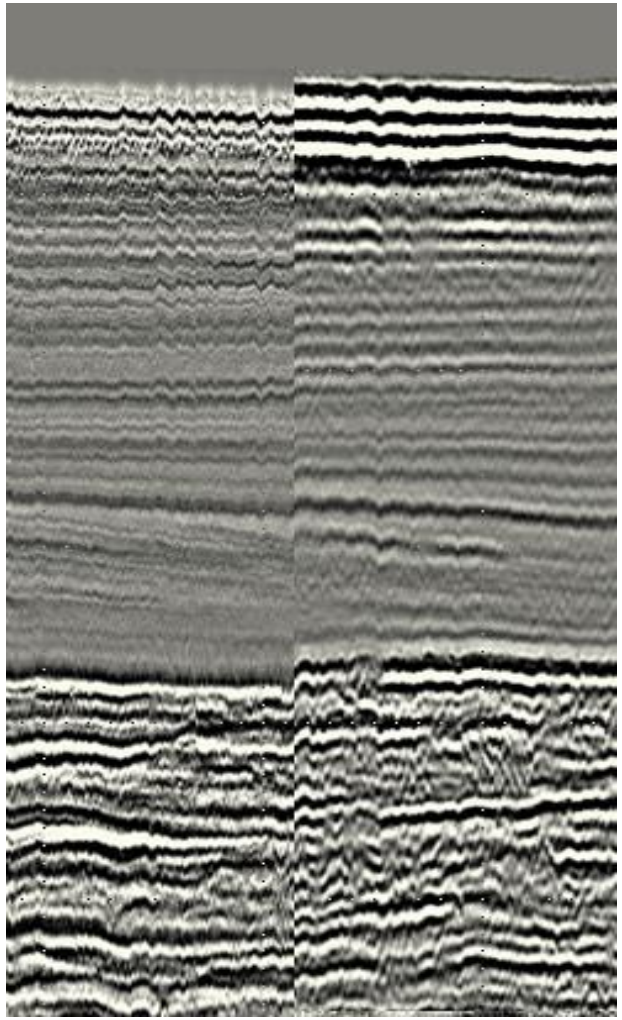


Summary

- Asset relocation, evaluation
- Improved identification of Geo-Hazards
- Update of survey design for future work
- Uplift of legacy data… a key economic driver.. There may be more data in your data
- Don’t trust what you are given…..



Thank You



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