

# High Resolution Seismic Renaissance

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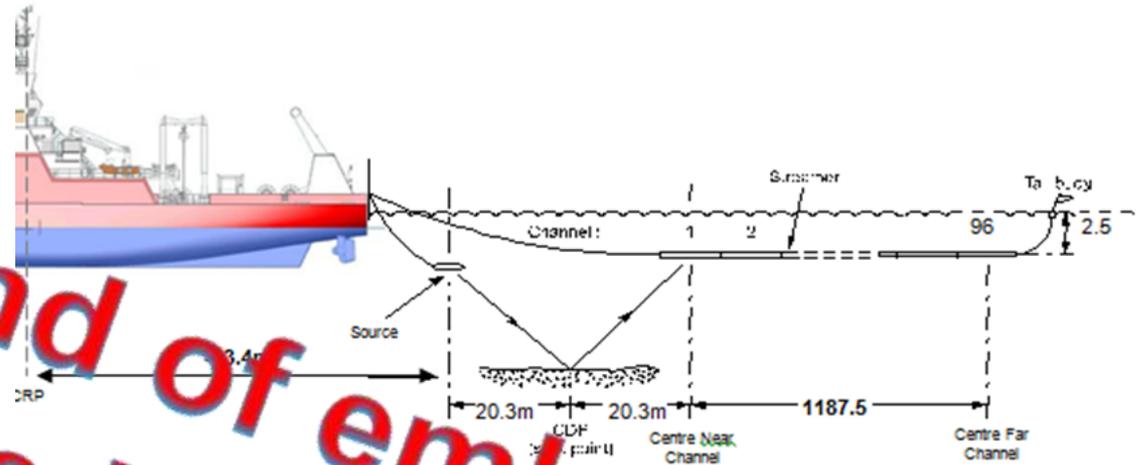
### 2D and 3D High Resolution Seismic:

- small airgun source(s), typically between 100 and 400 cu.in.
- 600-1200m long multi channel streamer(s)
- Short offset (down to 0m)
- Recording frequencies typically from 3 to 1000Hz (0.5ms sample rate)

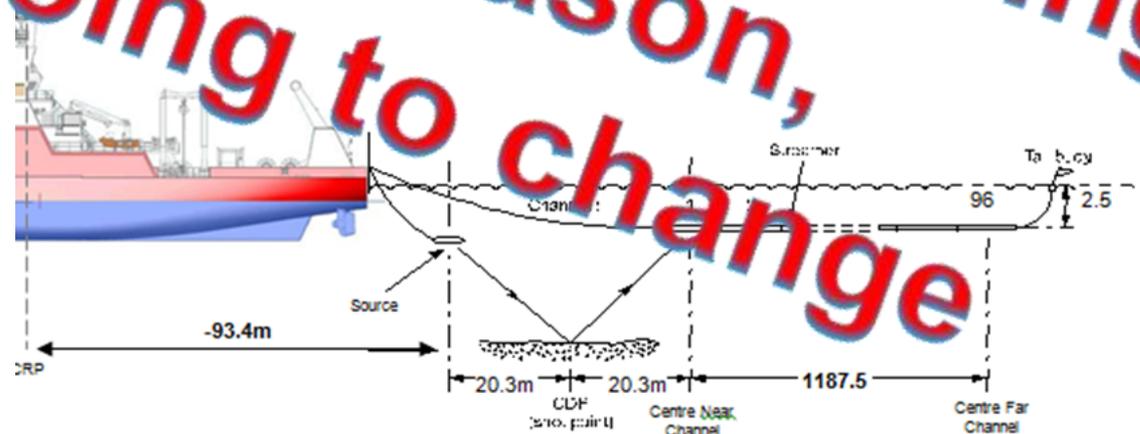
# Standard 2D High Resolution Seismic configuration

**It is a kind of embarrassing  
There is a reason,  
and it's going to change**

1987

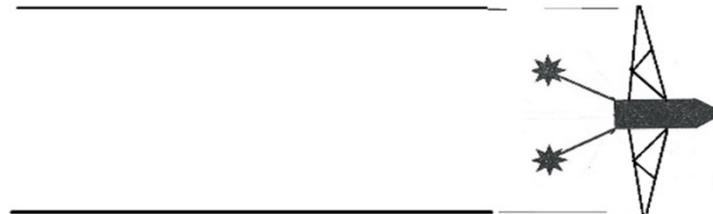


**Today**



- Was considered: not required set of data
  - For Site Survey purpose only - mapping Drilling Hazards / Shallow Gas
  - Some O&G companies view - just generating cost and no value
  - Only to comply with OGP standard and legislation
  - 3D seismic contractors claim their exploration data is of such high resolution that 2D/3D High Res is not required.
- This is also a reason for no technology/methodology improvements
- Now considered: “highly” valuable data

- 20 years ago Fugro offered a 3D High Res spread ( 2/3 streamers and 2 sources)
  - We expected (hoped) that Clients wanted better imaging of drilling hazards
  - No interest – service withdrawn
- The last two/three years the same type of spread is used for acquiring data considered valuable



## Why the change from «not wanted» to «highly valuable»

- Large 3D exploration spread lack resolution in the top even if using broadband technology,
  - due to near offsets being from around 300m for the outer streamers
  - Seismic. The 3D wide tow (8x100m cables) using flip flop provide fundamental constraints of ~9-16 deg near angles and 6-8 nominal stacking fold at target.
  - There are some **shallow reservoirs** that are better mapped and visualised with High Resolution Seismic (shallower than 1000m)
- Some areas require **monitoring of the overburden** (what is above the reservoirs). Reservoirs, especially those put under pressure by injection, can start leaking. There are examples where leakages are not detected before reaching the seafloor. 3D High Resolution Seismic is considered a good tool for such monitoring – detecting leakages before it becomes an environmental incident is of **high value**

## High Resolution Seismic Renaissance

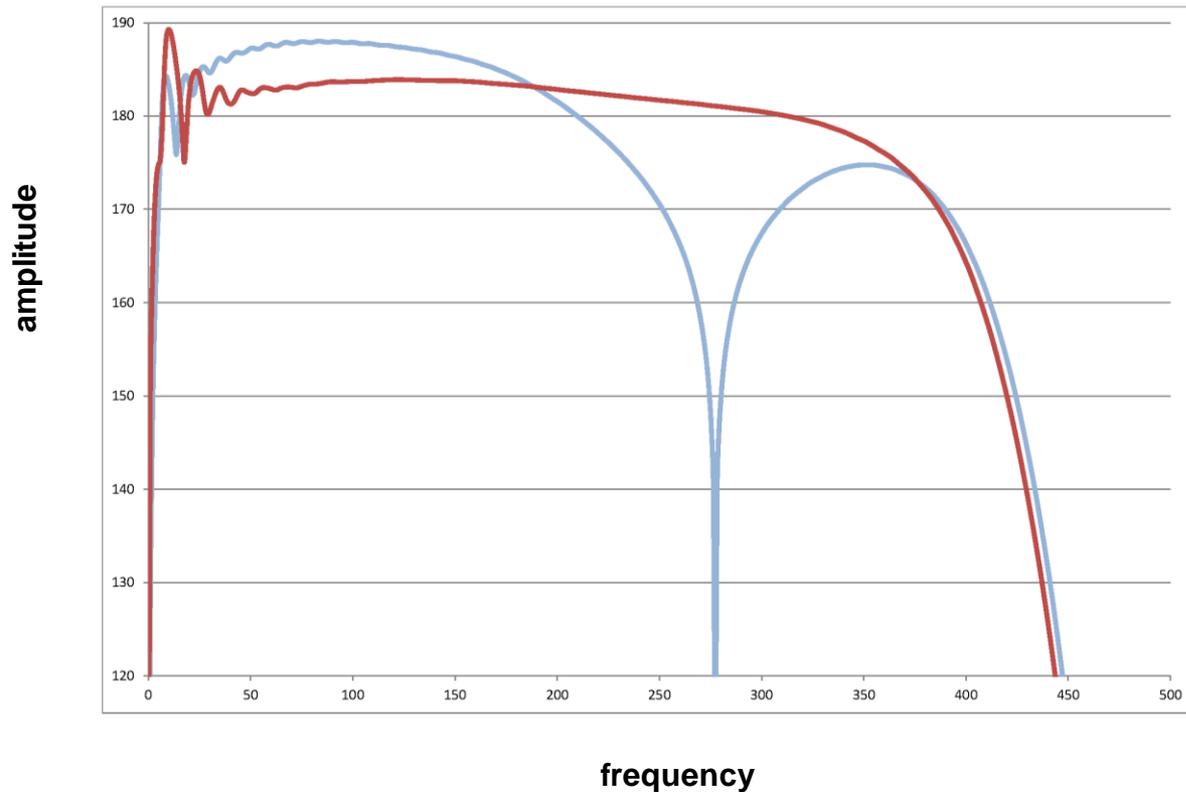
- The change in the value of High Resolution Seismic data creates innovations and justifies investments in improvements
- Fugro will not just copy what we offered 20 years ago, we will do better and be best:
  - Utilise existing technology to improve data quality and operational efficiency
  - Implement new proprietary developments for further improvements
  - The process has started and we expect to soon offer second to none 2D and 3D High Resolution Seismic data

A second to none 2D/3D High Resolution Seismic solution:

- The source
- Streamer and recording
- Seismic Processing with deghosting/broadbanding
- Operational efficiency / towing configuration

Conventional and Deghosted source - available and being used

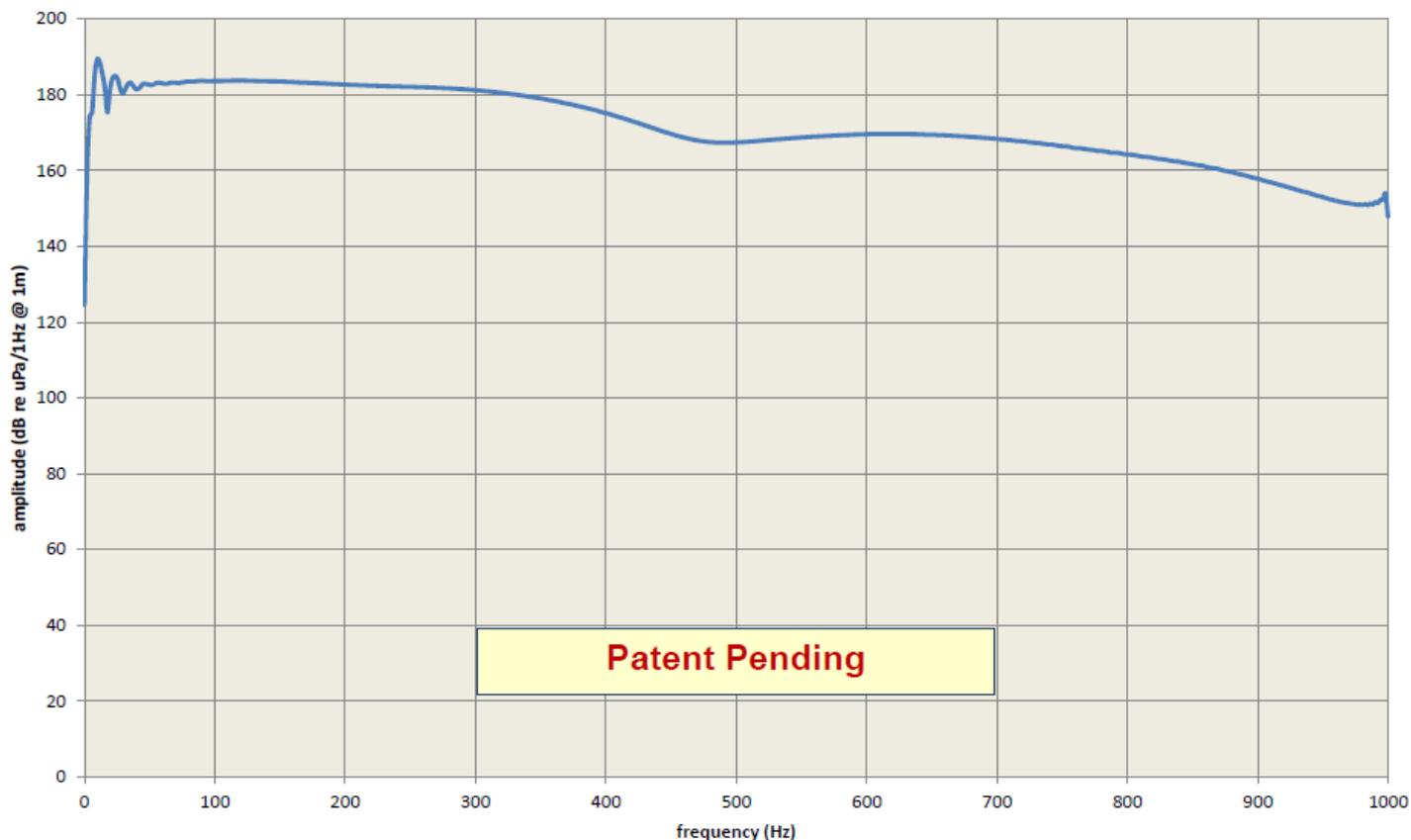
## Frequency Domain



# A further improved High Resolution source

Fugro proprietary ghost free source covering the entire wanted frequency spectre – soon available

Enhanced Marine High-Resolution Seismic Source



- Streamer(s) are towed deeper – lowered from 2,5m down to 15m
  - Constant depth or slanted
  - Less noise
  - Less weather sensitivity
  - Utilise broadband processing
  
- Main advantage is less noise and reduced weather sensitivity (operational efficiency)

Cooperated with several Processing contractors

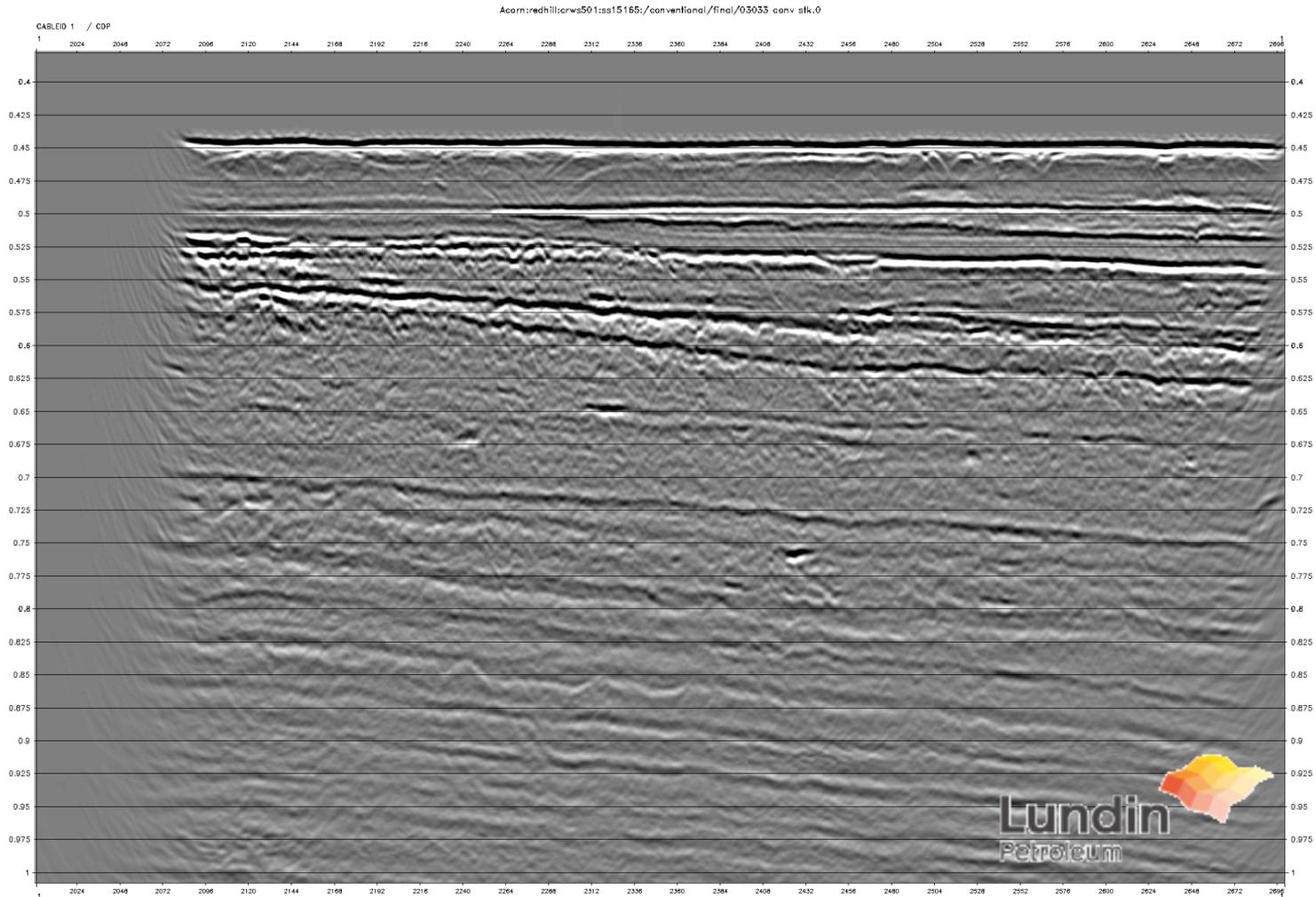
Continuous improvements are being made

Broadband processing of higher frequencies than from exploration seismic (from 2/4ms to 1ms) was a challenge, but resolved

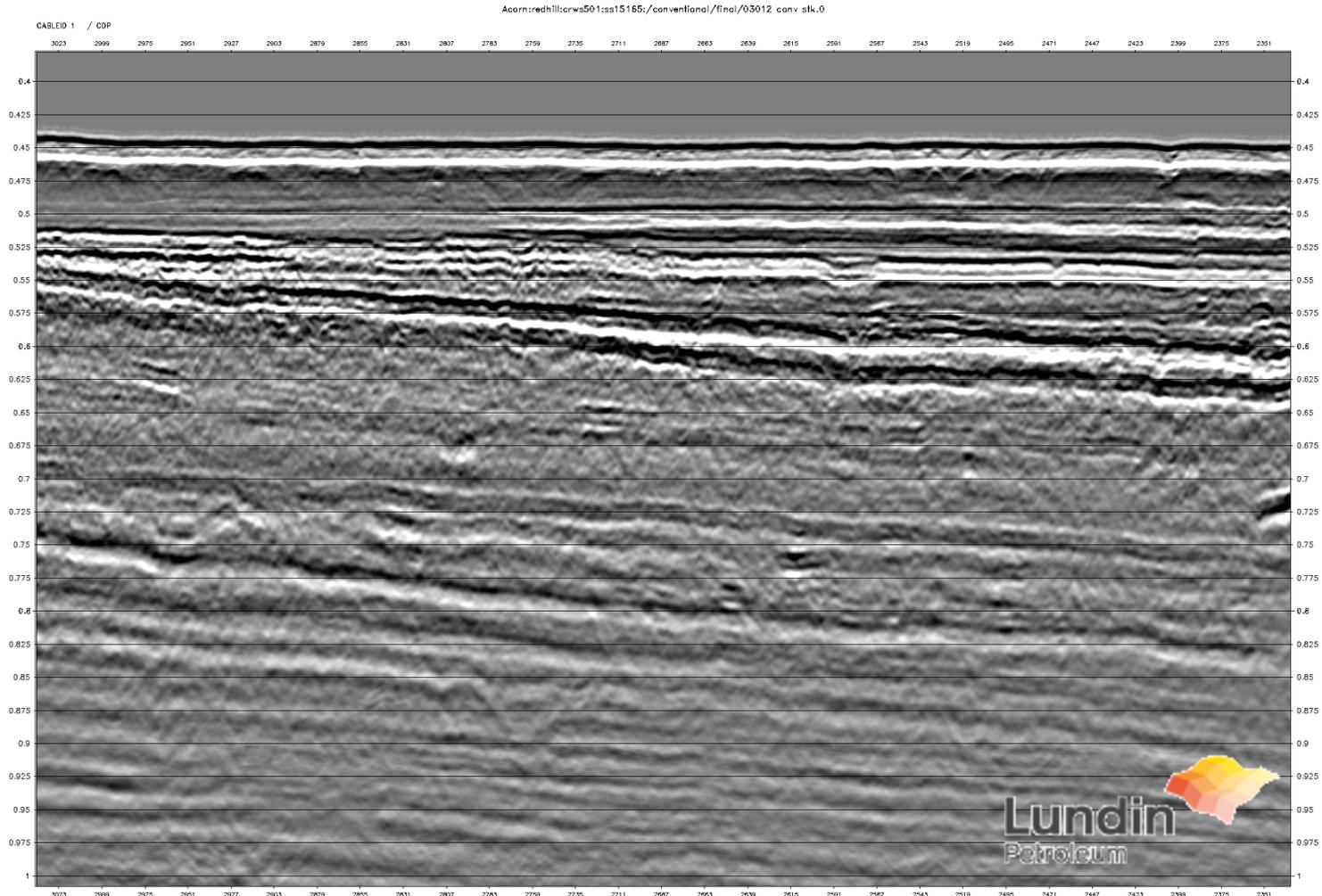
Data examples to follow

- Source: Conventional 140 cu.in. source
- 1,200m streamer / 12,5m group interval
- 1ms sample
- Various towing depth

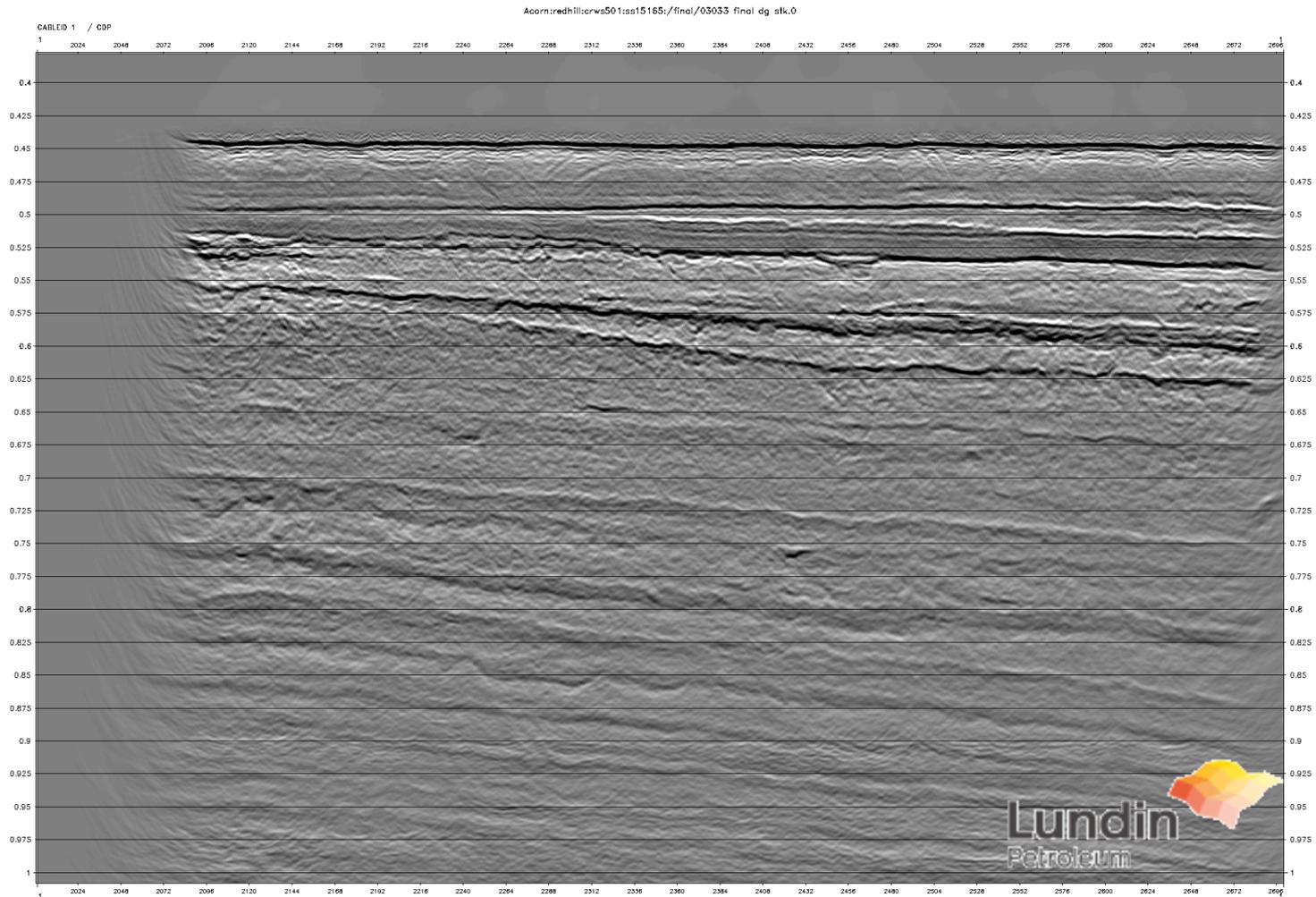
# Conventional Stack (Lined up) 2,5m



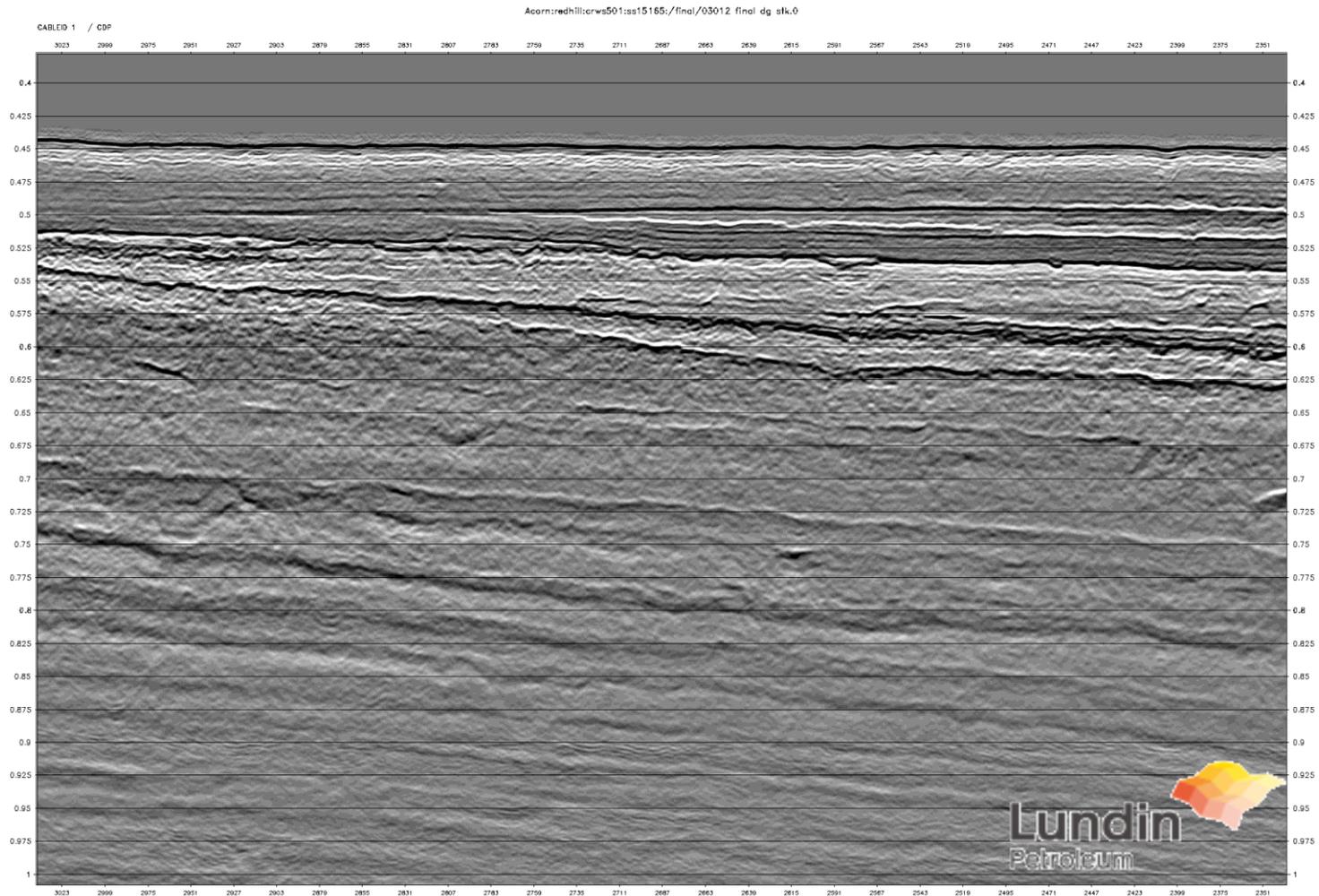
# Conventional Stack (Lined up) 10m



# Final Deghosted broadband Stack (Lined up) 2,5m

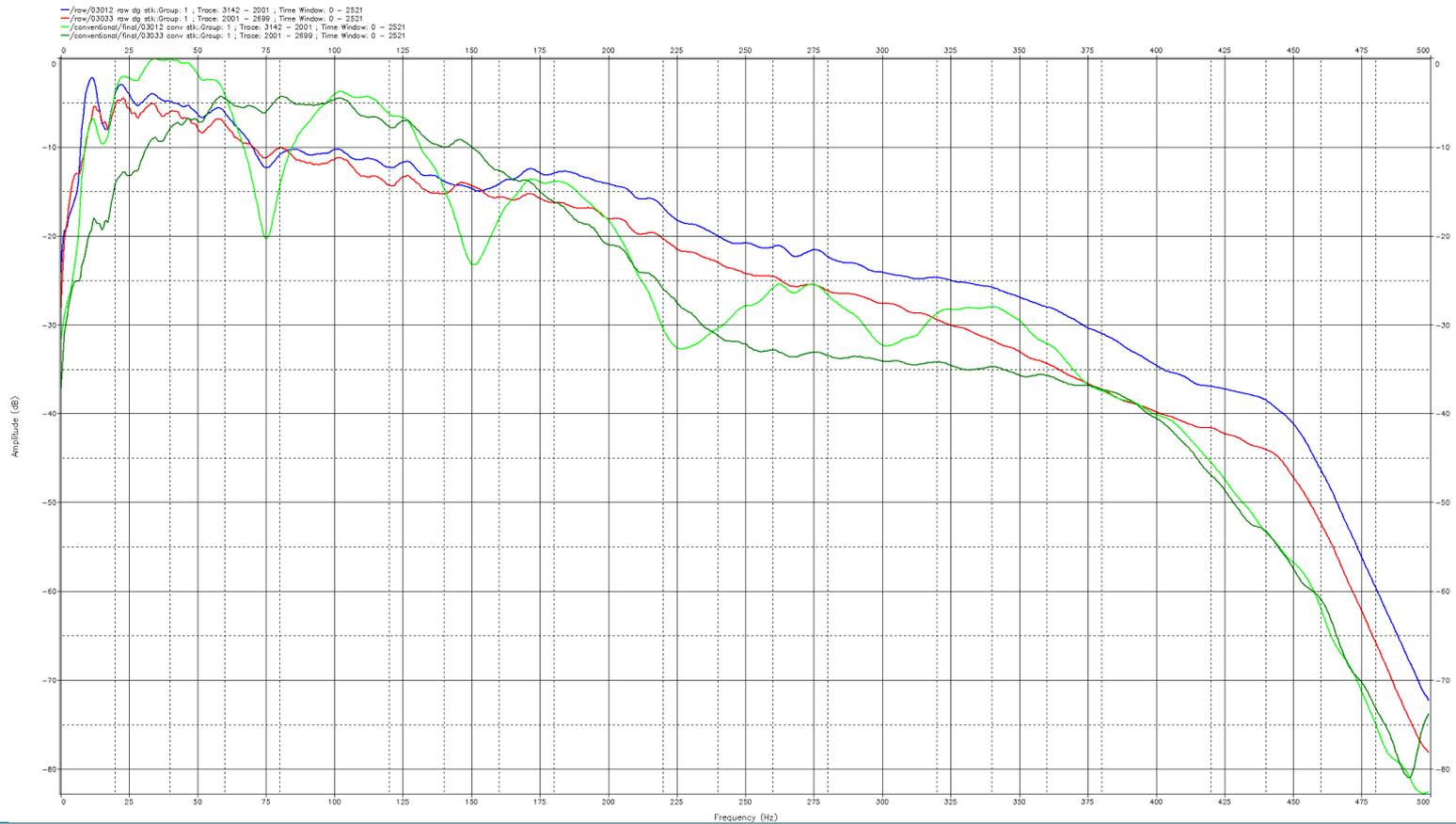


# Final Deghosted broadband Stack (Lined up) 10m



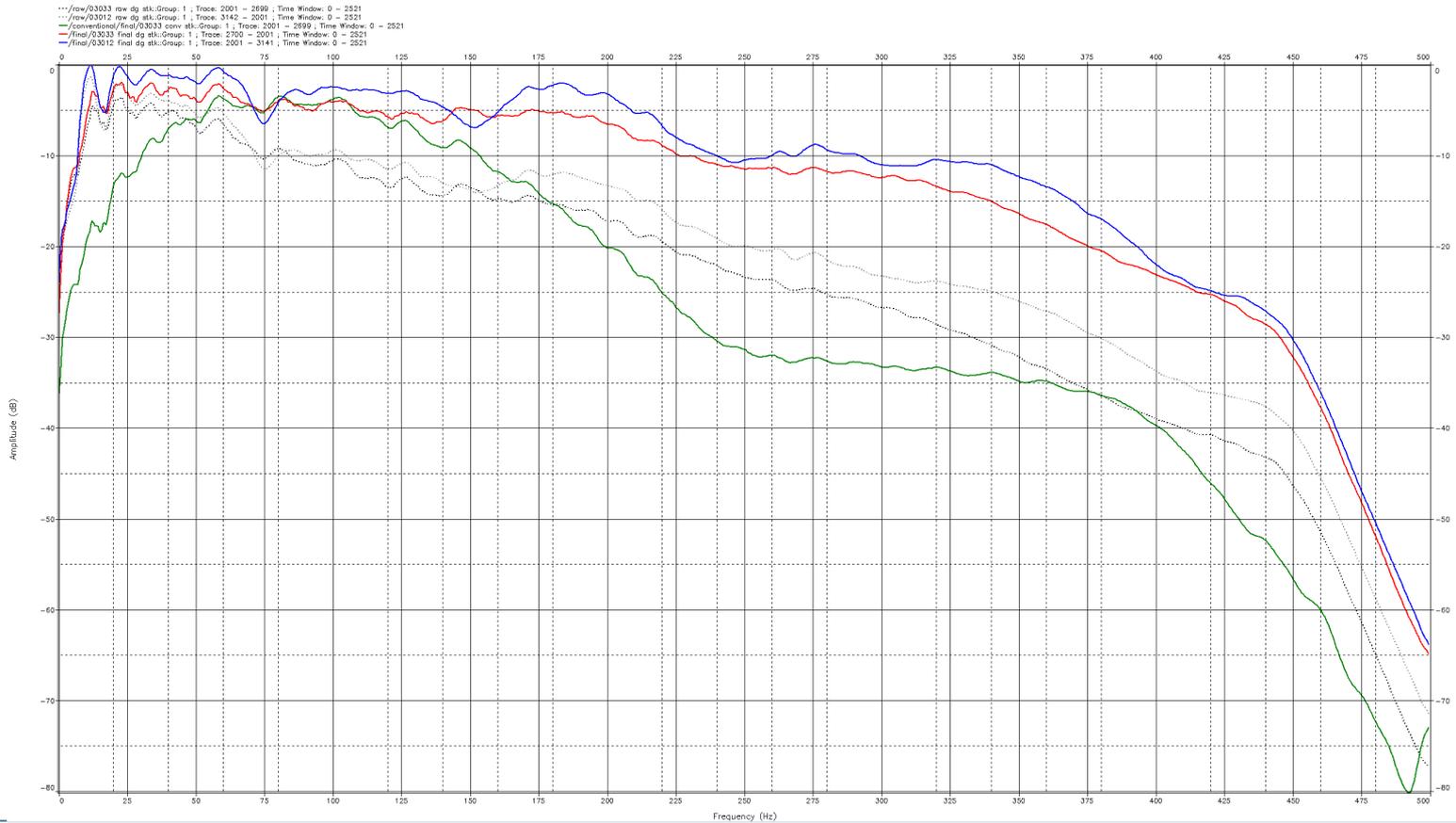
# Amplitude Spectrums Without Shaping

Green = 2.5m conventional  
 Red = 2.5m receiver deghosted  
 Blue = 10m receiver deghosted  
 Bright green = 10 m conventional



# Amplitude Spectrums After Shaping

Green = 2.5m conventional  
 Red = 2.5m receiver deghosted  
 Blue = 10m receiver deghosted  
 Grey = deghosted lines prior to shaping (raw)



## Towing Configuration and equipment handling

A proprietary (IP pending) towing configuration has been designed that will, in both 2D and 3D mode, allow for increased survey speed – operational efficiency.

Equipment handling will be redesigned to allow for launch and recovery in worse weather conditions.

Our main objectives are:

- increased speed and productivity and be less weather sensitive in order to reduce cost
- Improved data quality



## **A revitalised seismic service**

## **Higher quality with reduced cost**

Thanks to Lundin for giving show rights to the data examples

Data shown was processed by CGG

**THANK YOU**