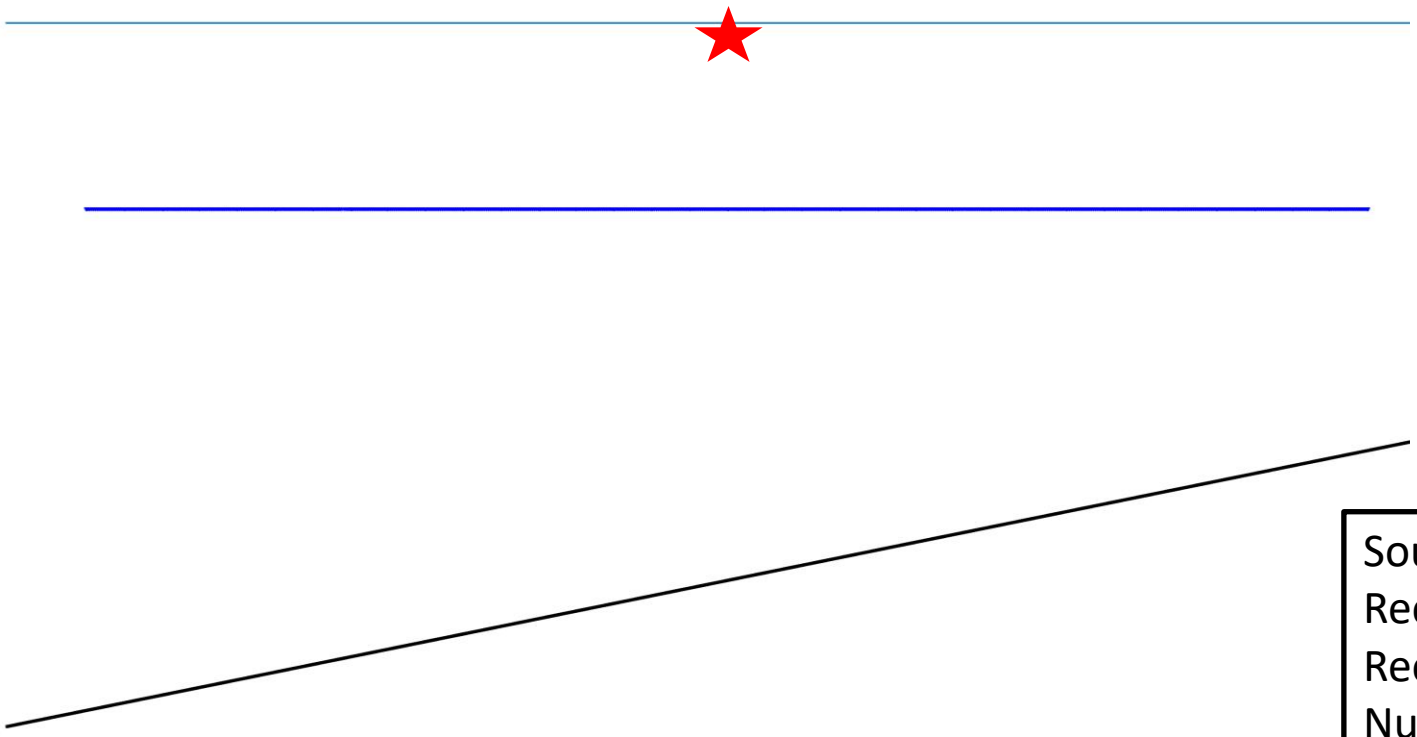
Seismic Acquisition Without Active Sources

Stian Hegna

Outline

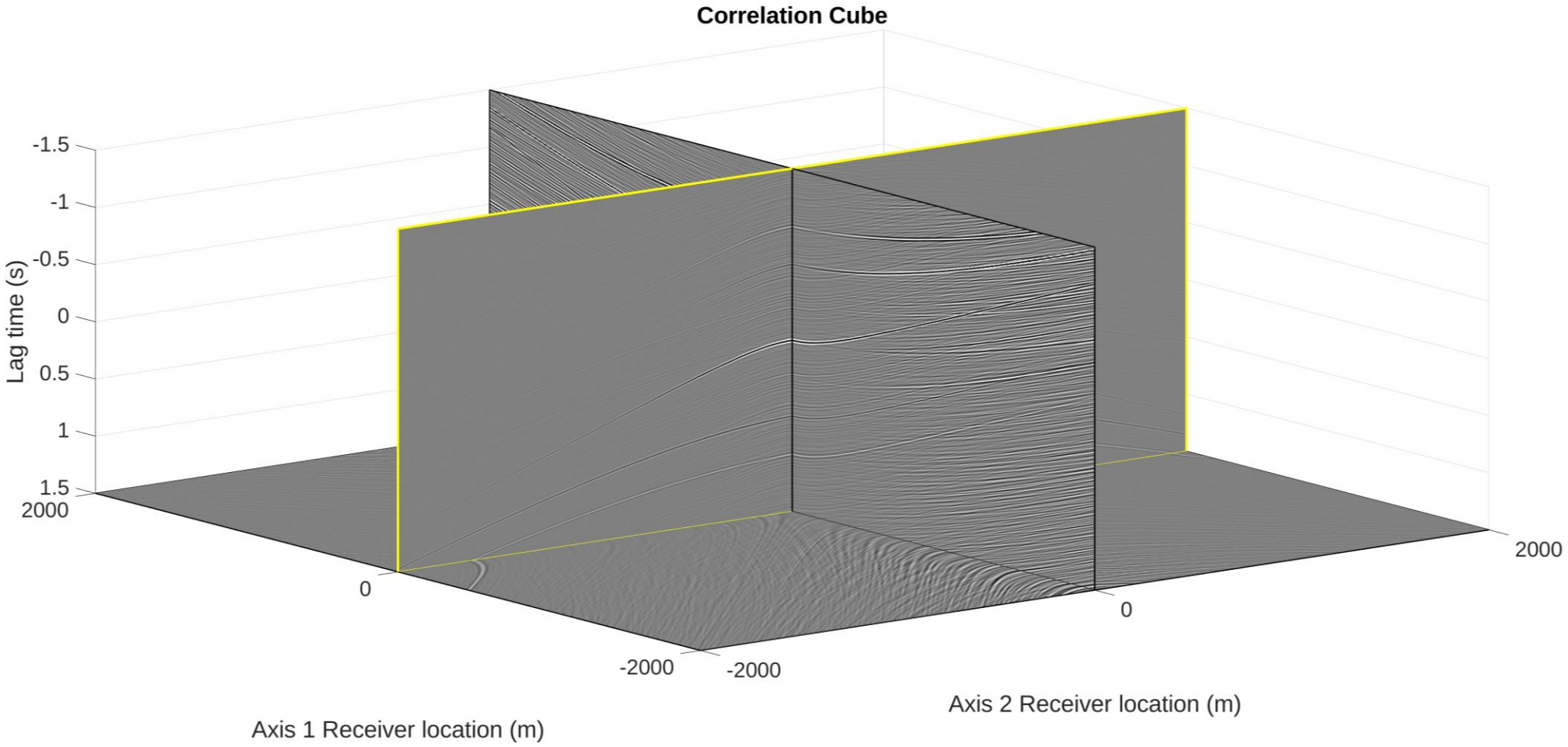
- Introduction
- Method
- Data Examples
- What Next?

Interferometry Approach

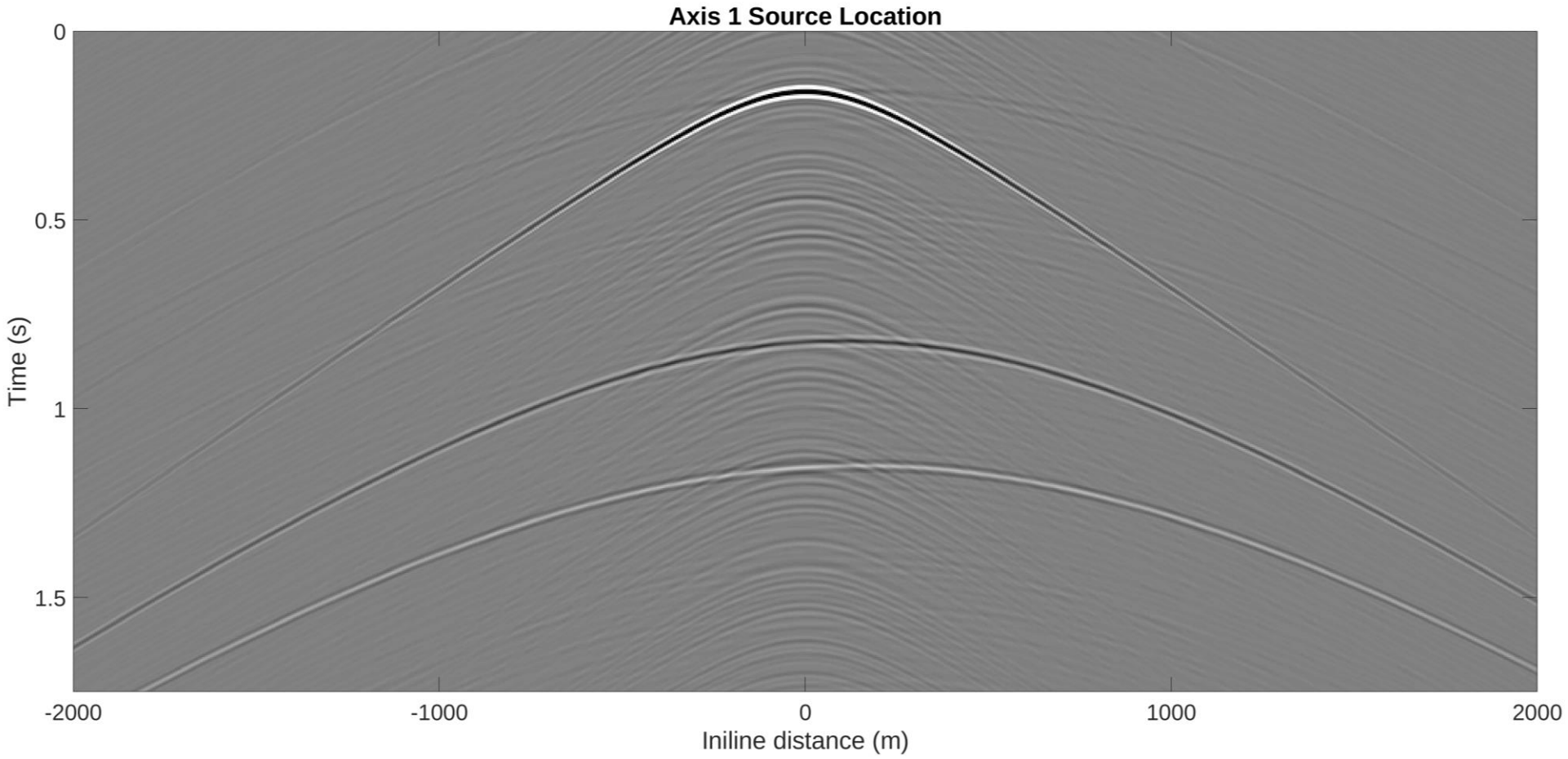


Source Depth:	10m
Receiver Depth:	250m
Receiver Spacing:	6.25m
Number of Receivers:	641 (4,000 m)
Reflector Depth @ Source:	750m
Reflector Dip:	5°
Reflection Coefficient:	1
Velocity:	1,500m/s

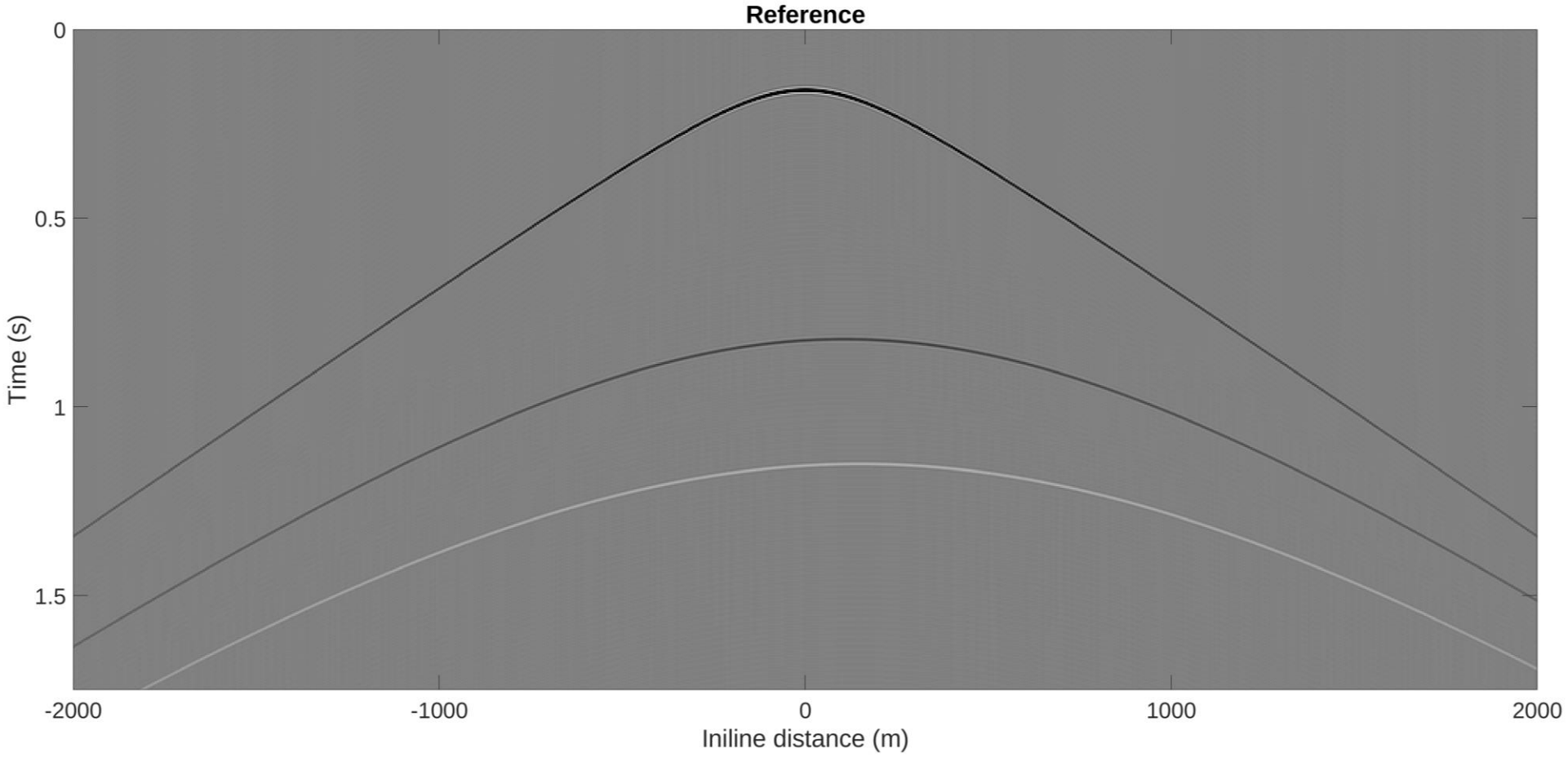
Cross Correlation Cube



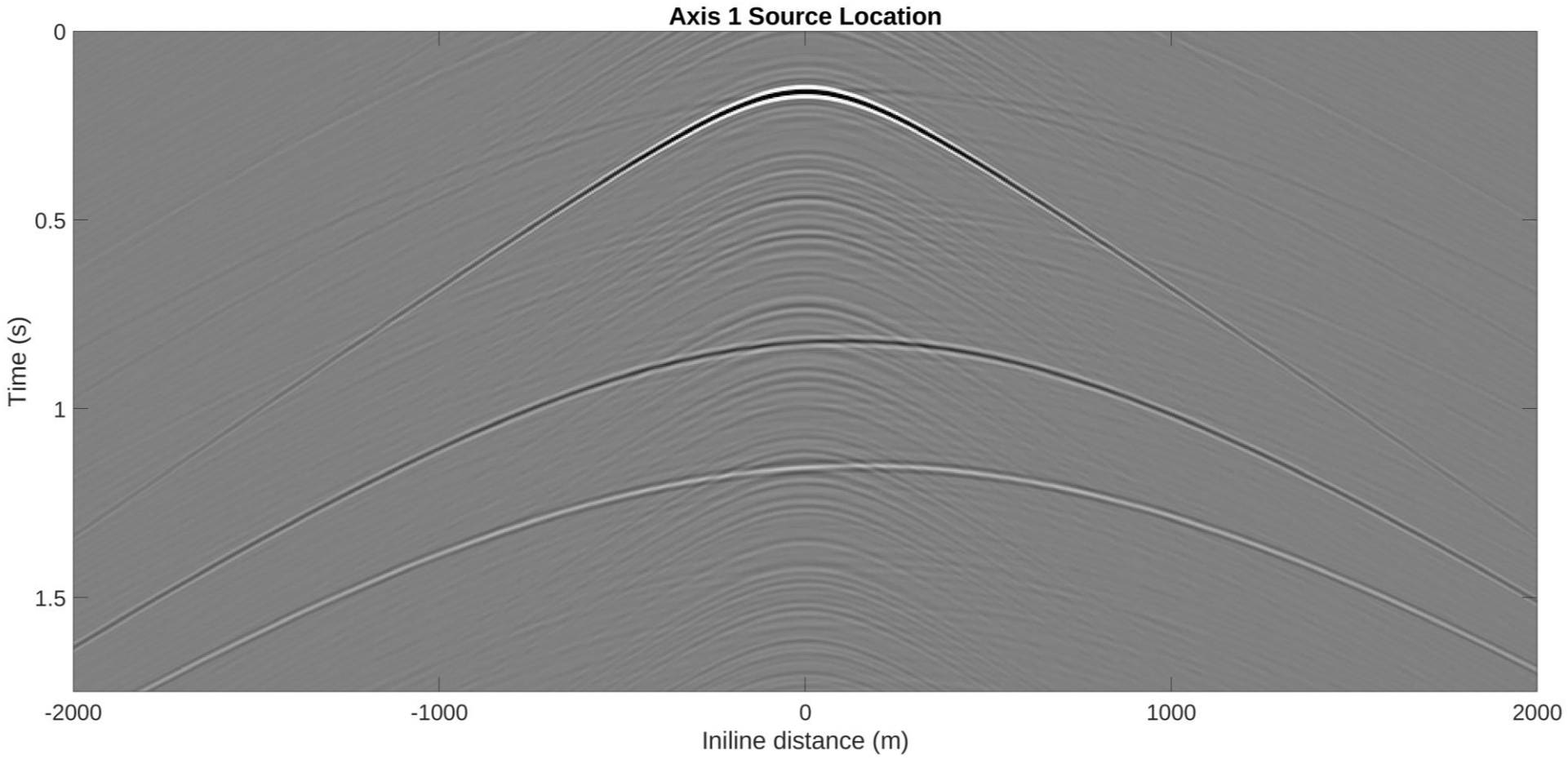
Receiver in Source Location w/ All Receivers



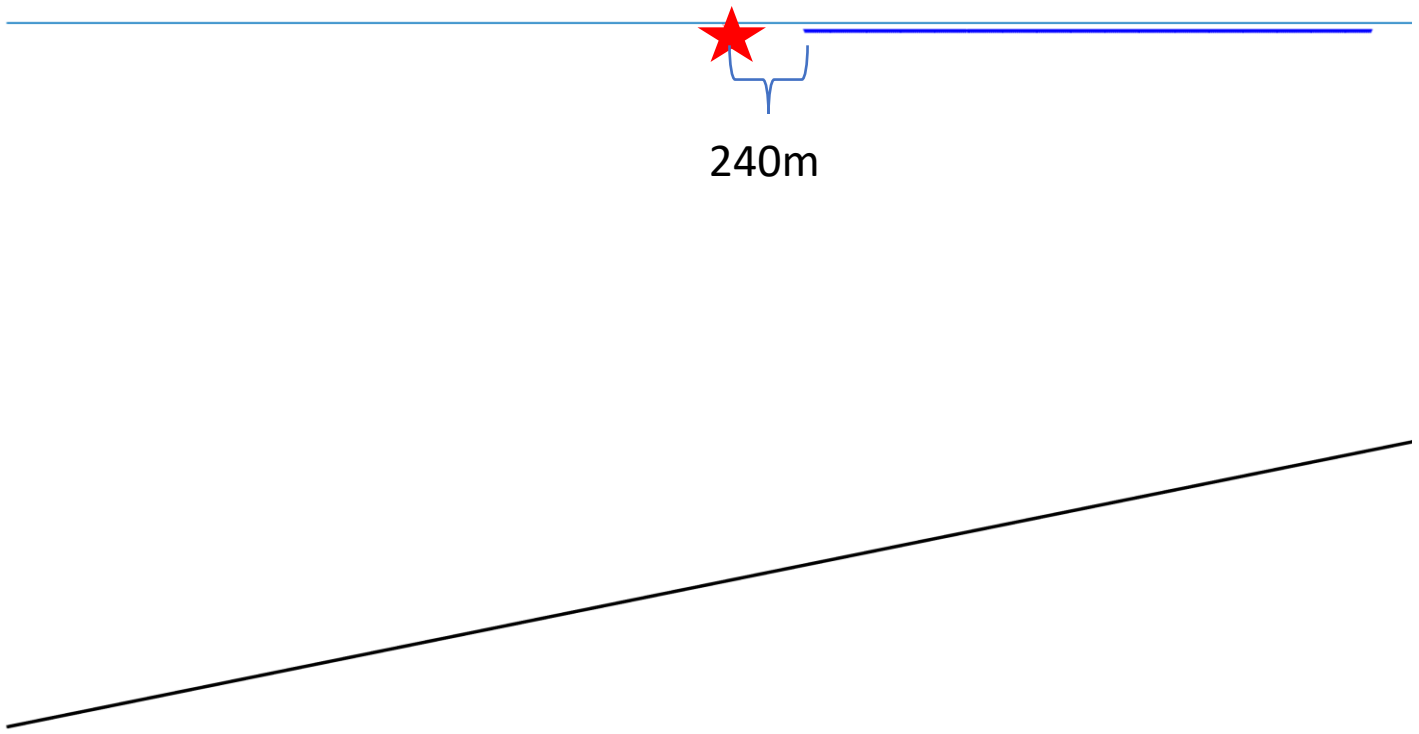
Reference – Earth Model



Receiver in Source Location w/ All Receivers

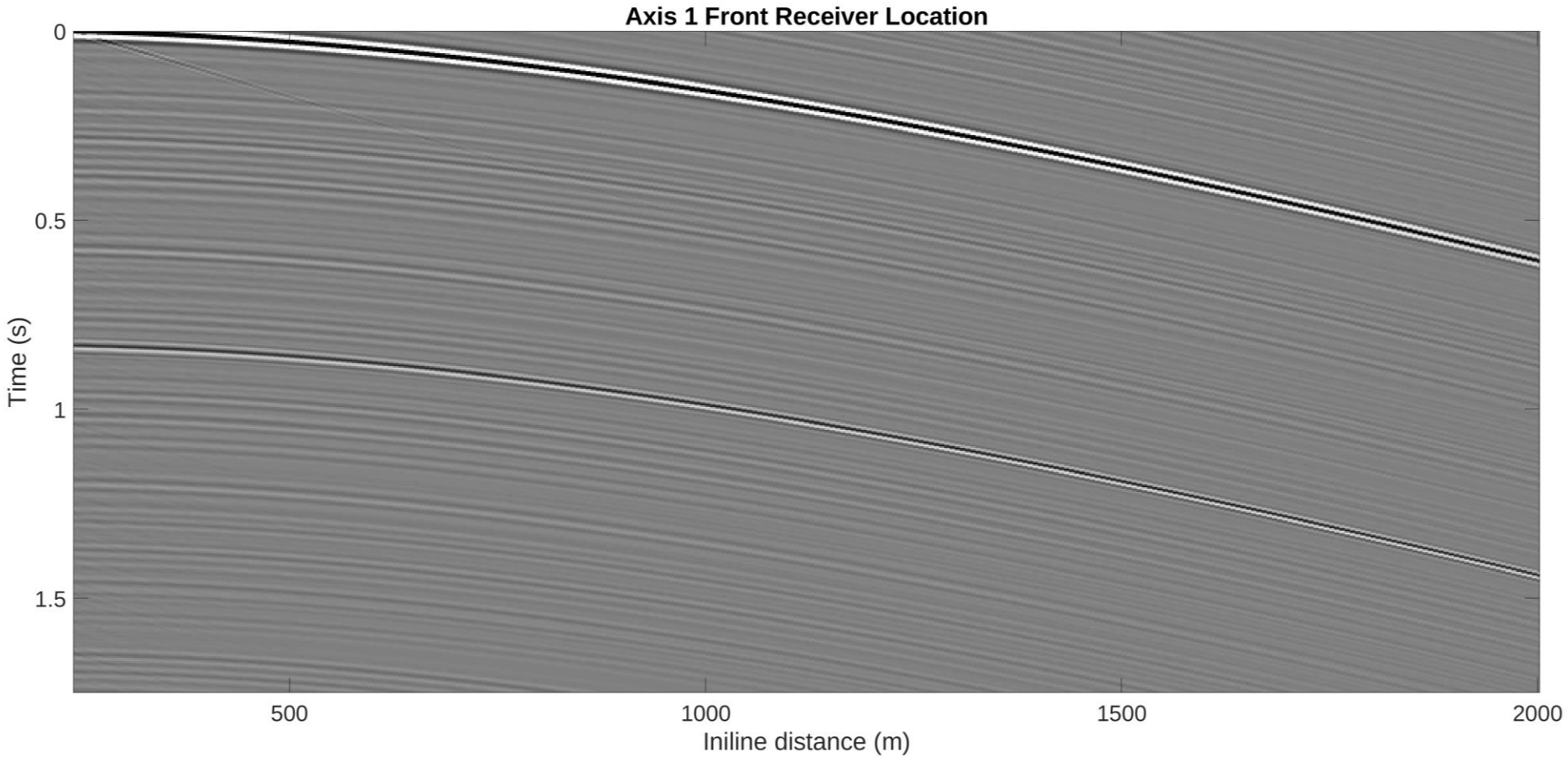


Cross Correlation Approach

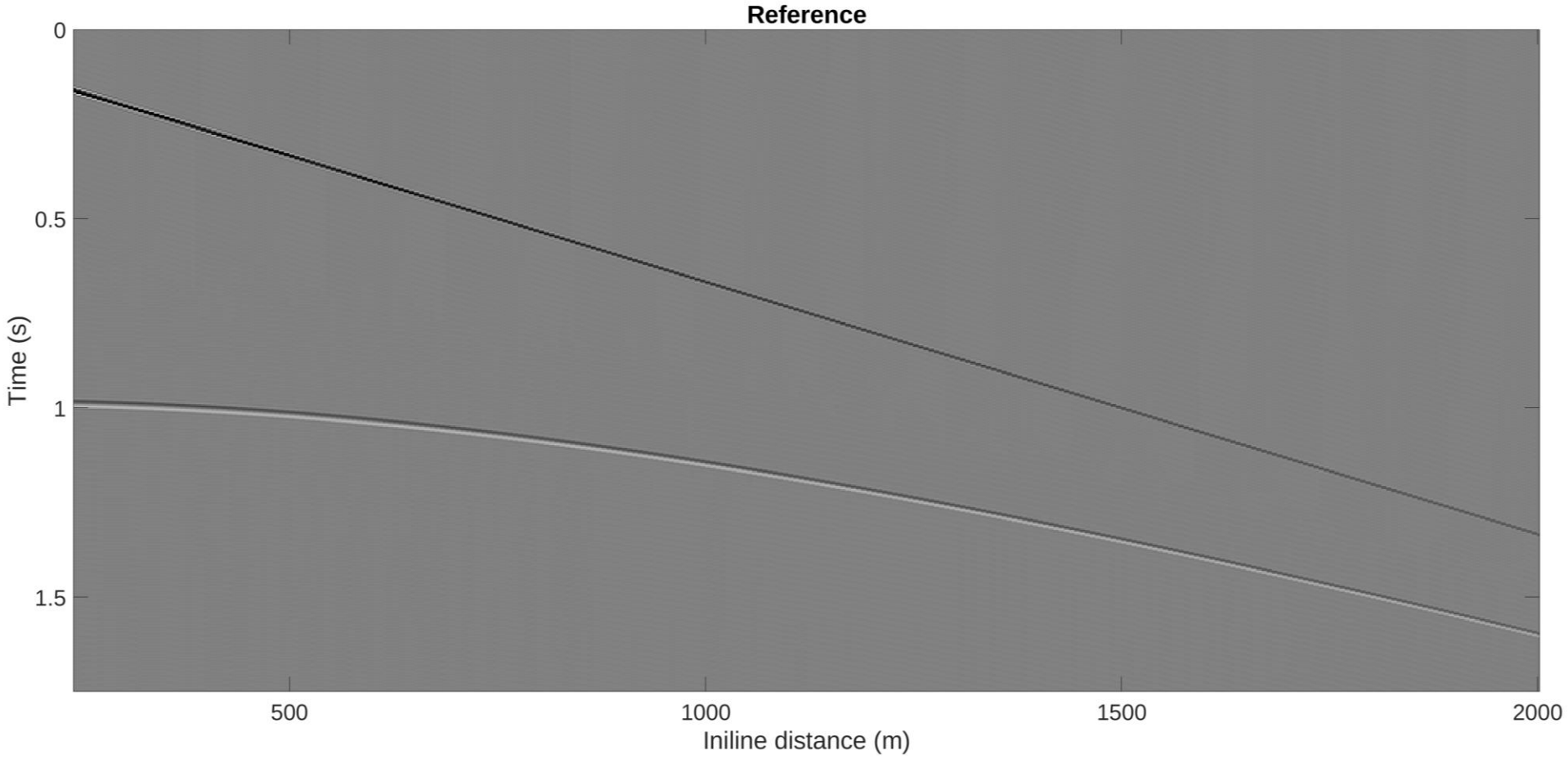


Source Depth:	10m
Receiver Depth:	10m
Near Offset:	240m
Receiver Spacing: 6.25m	
Number of Receivers:	283 (1763 m)
Reflector Depth @ Source:	750m
Reflector Dip:	5°
Reflection Coefficient:	1

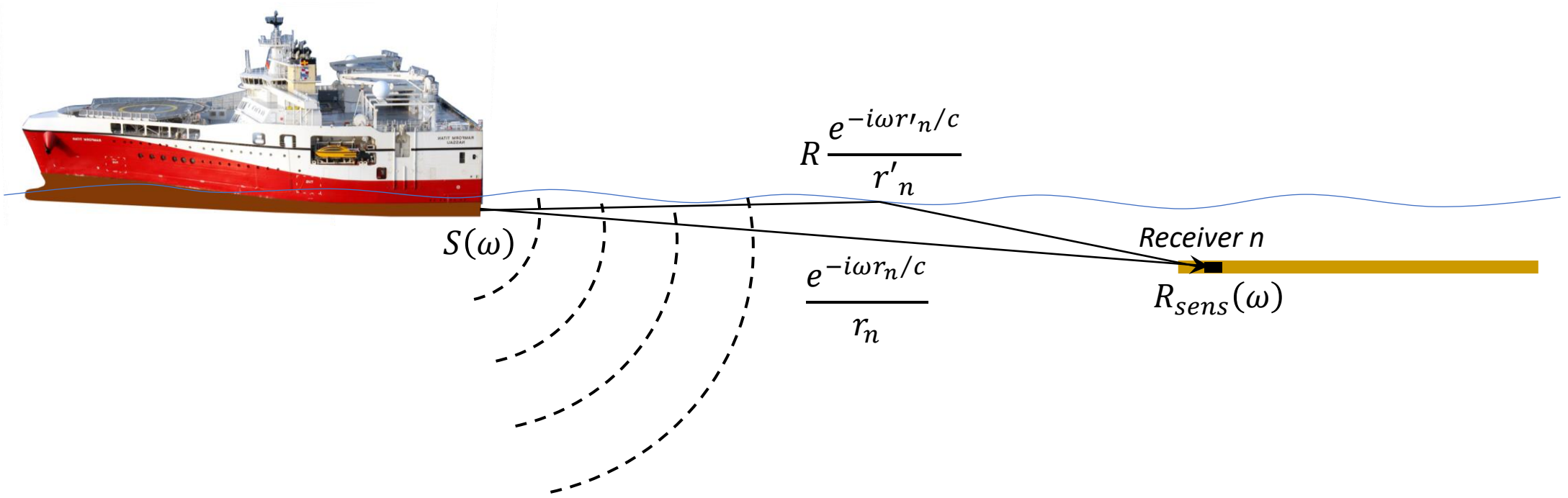
Receiver at Streamer Front w/ All Receivers



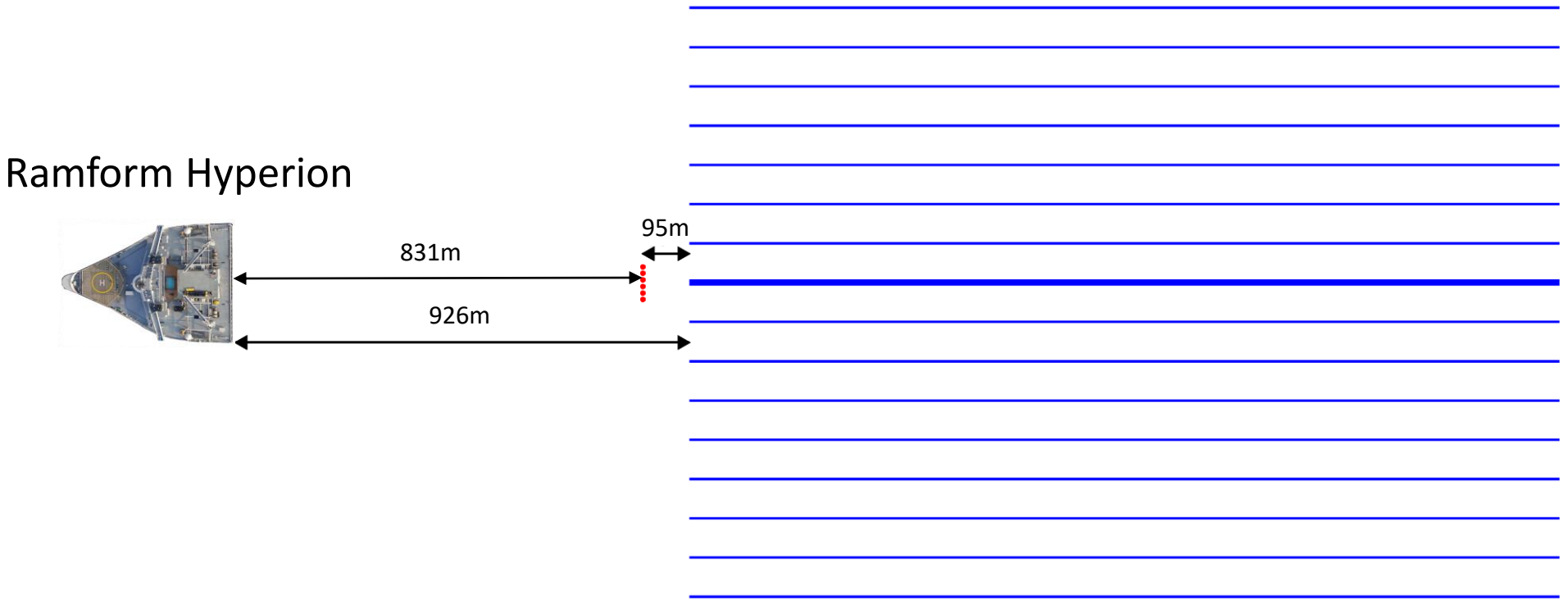
Reference – Earth Model



Acoustic Wavefield Generated by a Vessel

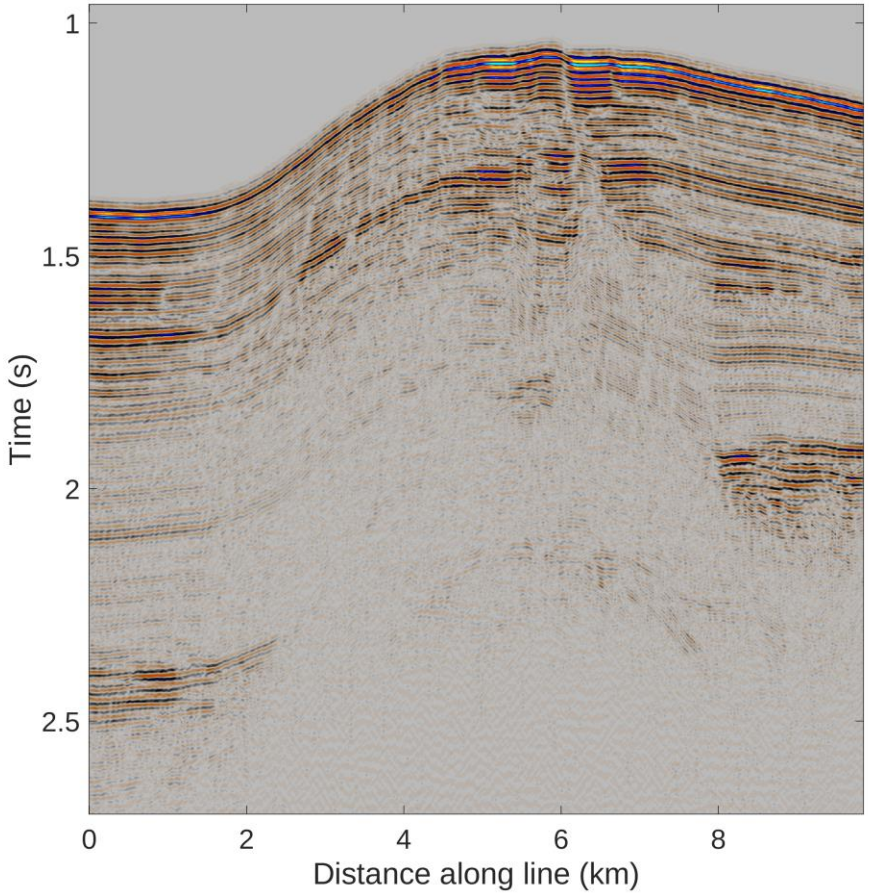


Towed Streamer Configuration 16 x 100m

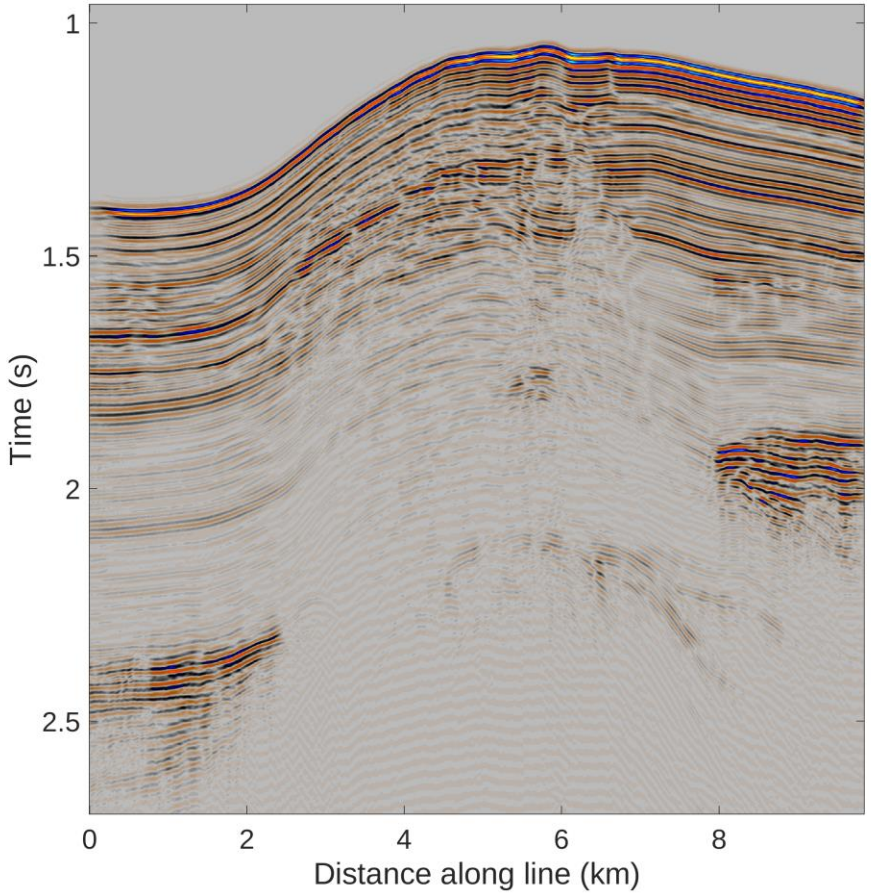


Migrated Stack Comparison

Source: Ramform Hyperion

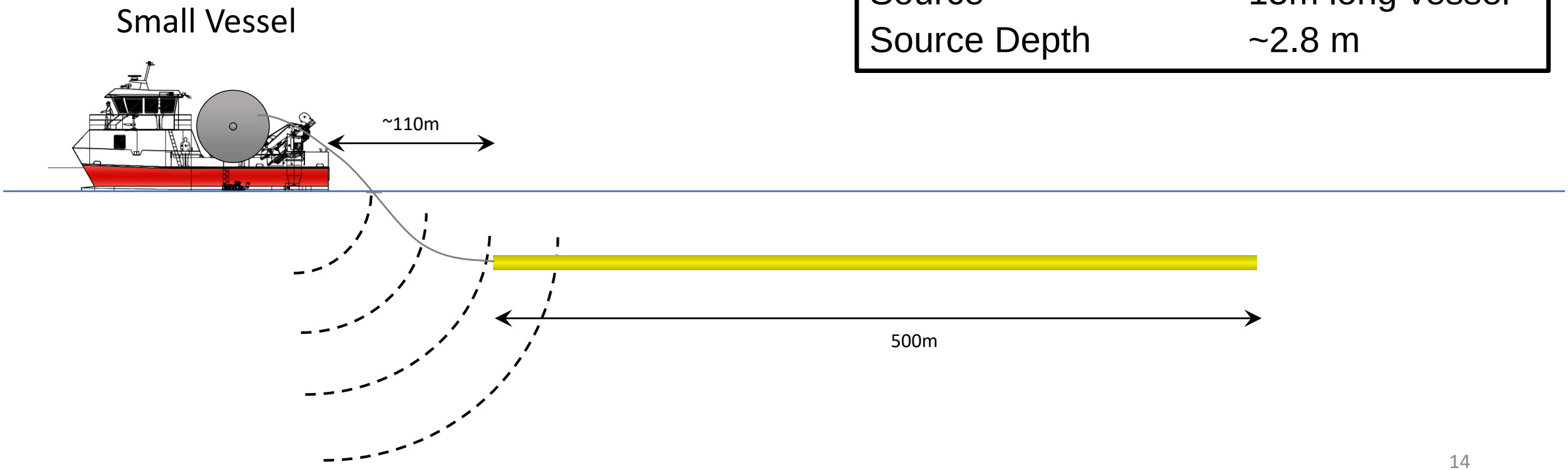


Source: Airguns



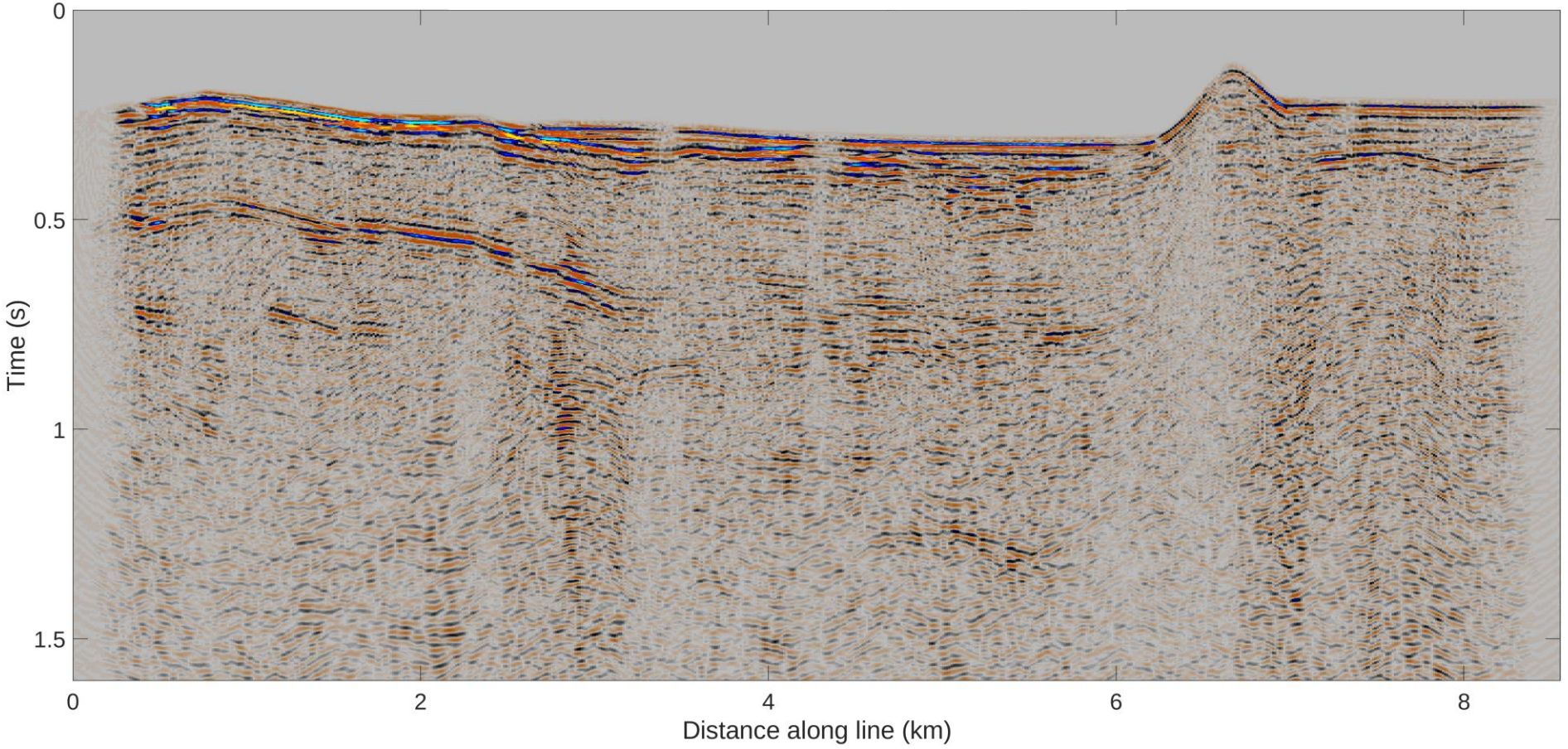
Streamer Test Data

Streamer Length	500 m
No. Channels	40
Streamer Depth	15 m
Near Offset	~110m
Source	15m long vessel
Source Depth	~2.8 m

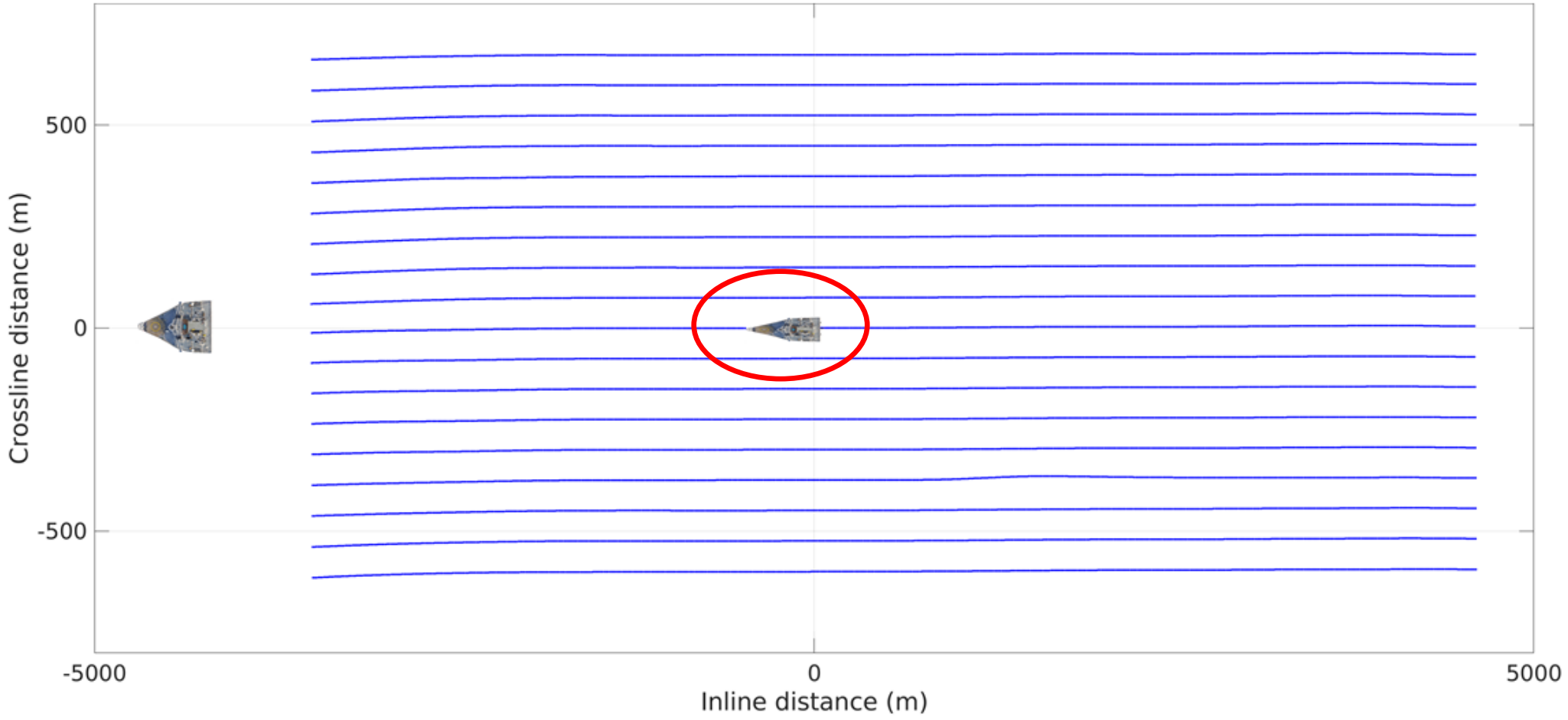


Streamer Test Data – 2D Migrated Stack

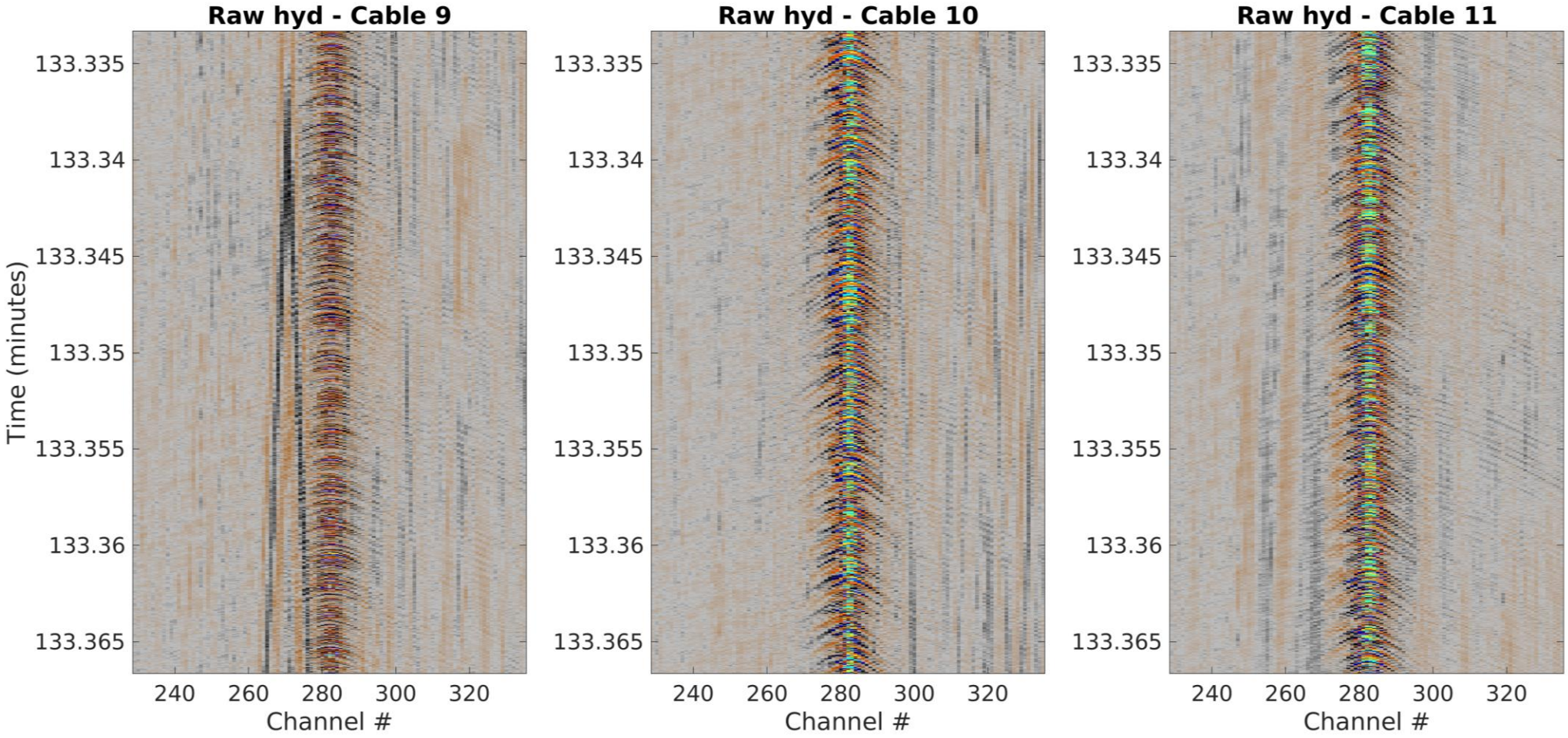
Source: Small Vessel



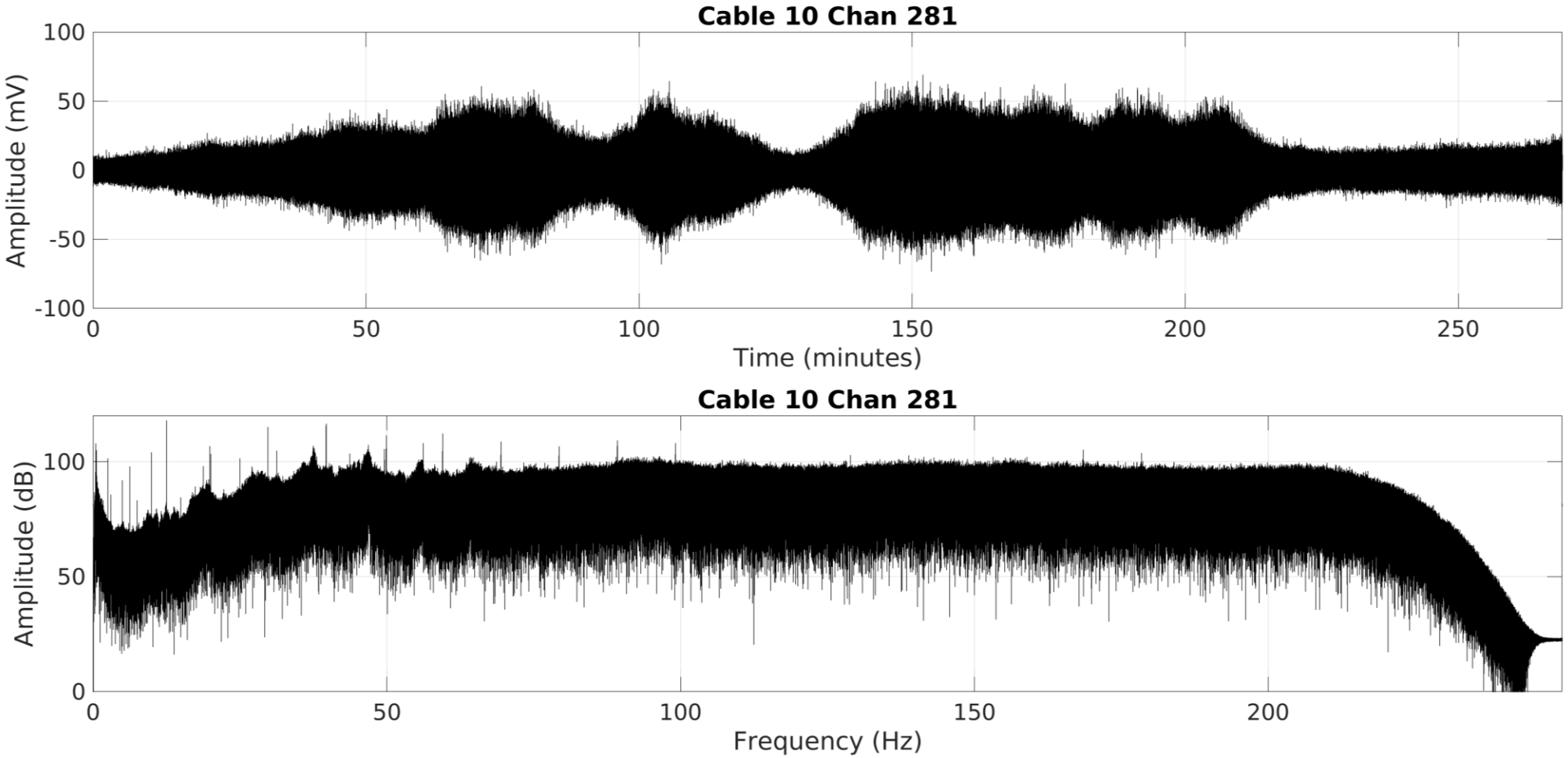
Source-Over-Cable Survey, Barents Sea



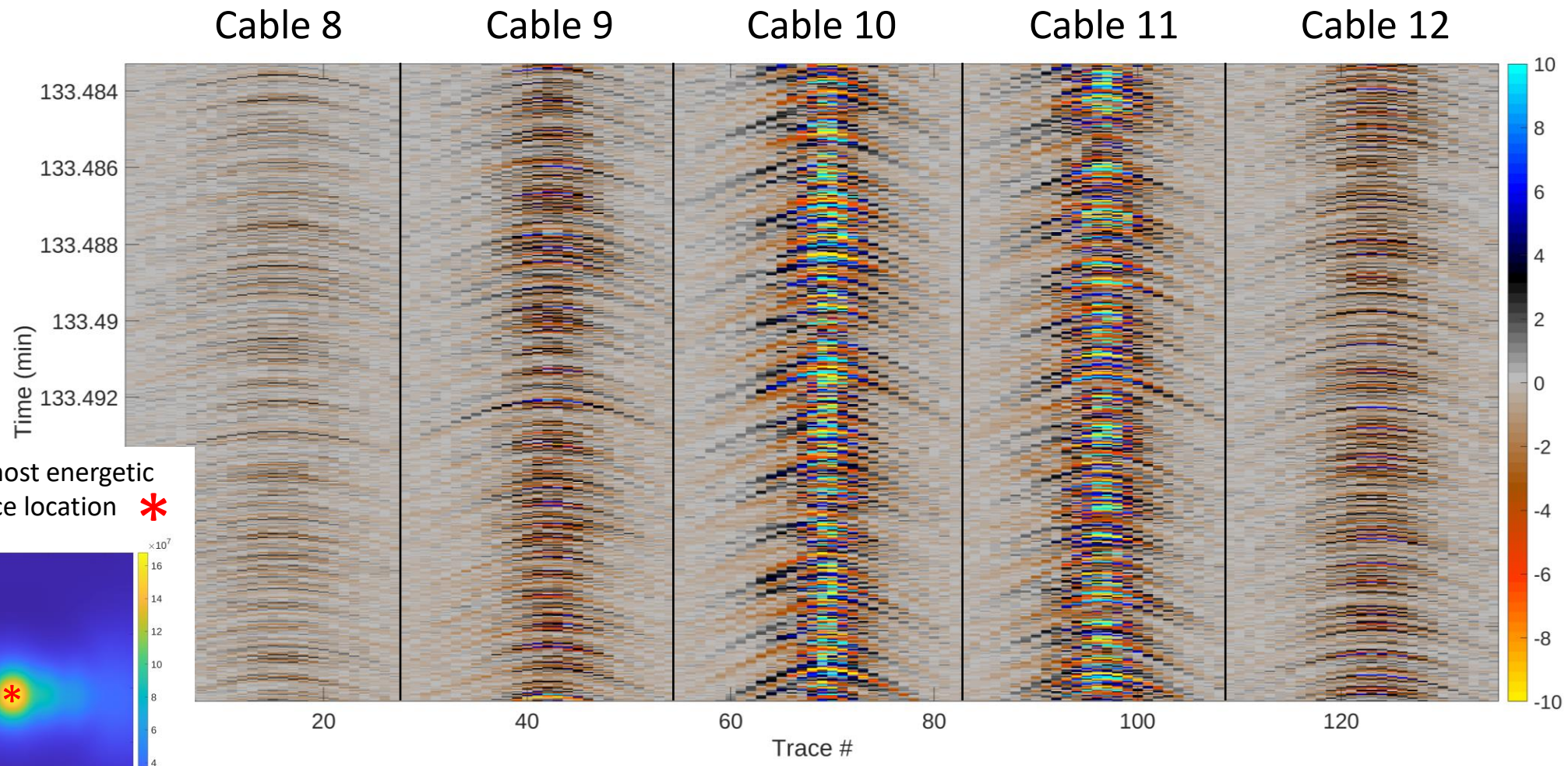
Raw recorded hydrophone data



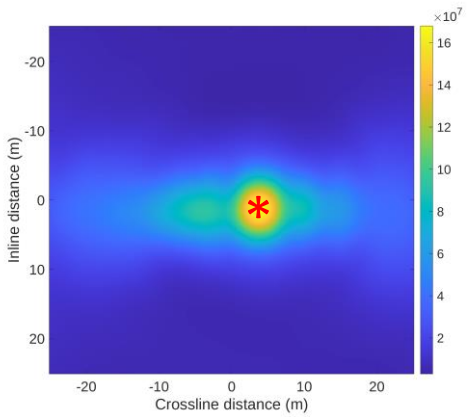
Nearest Hydrophone Channel



Iteration 1

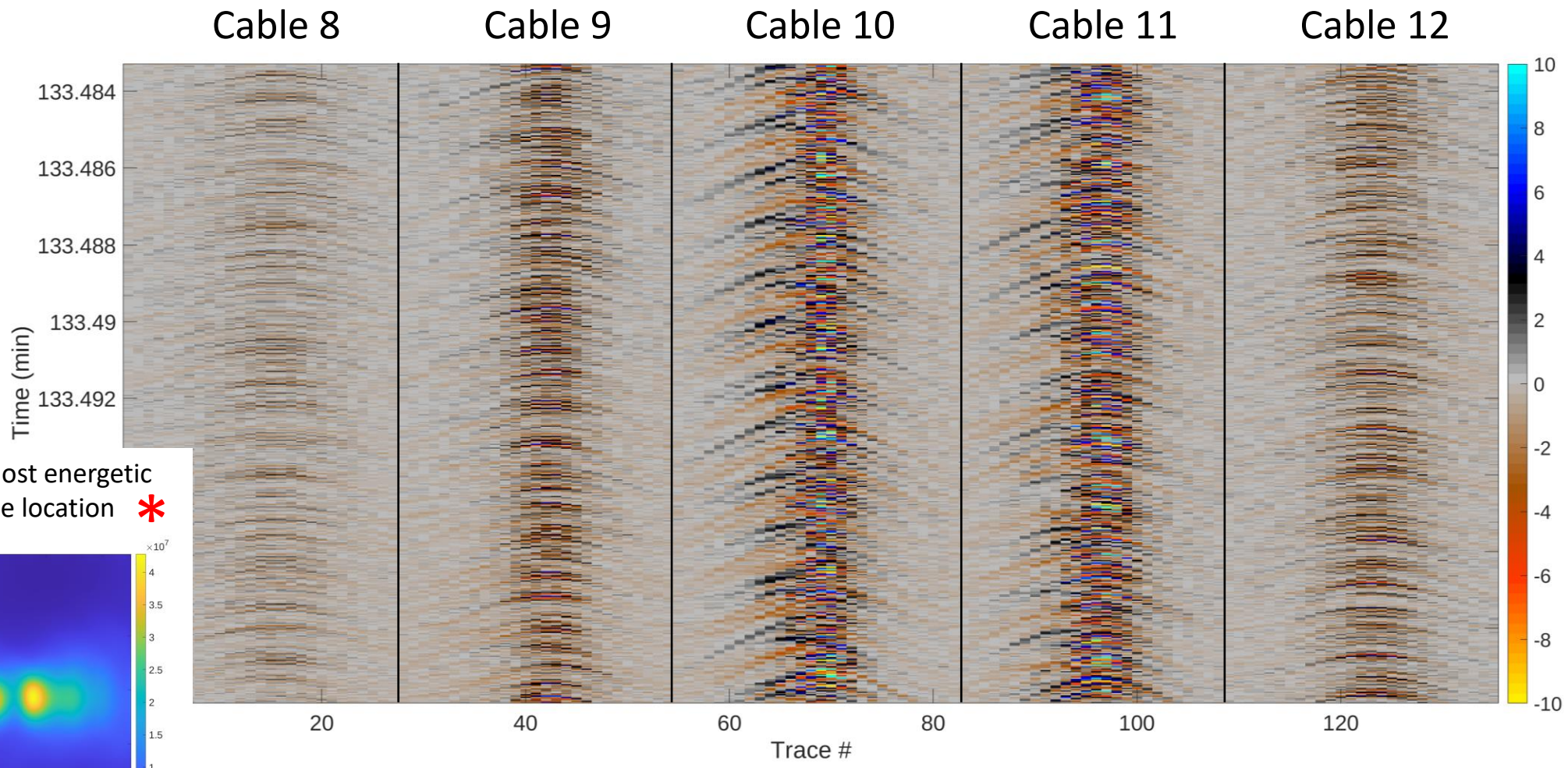


Scan for the most energetic point source location *

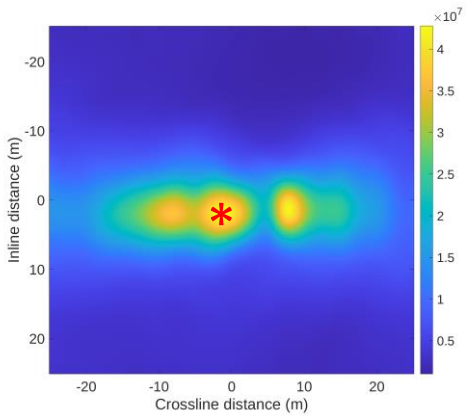


Inline / crossline positions are relative to the stern of the vessel.

Residuals after Iteration 1 – Iteration 2

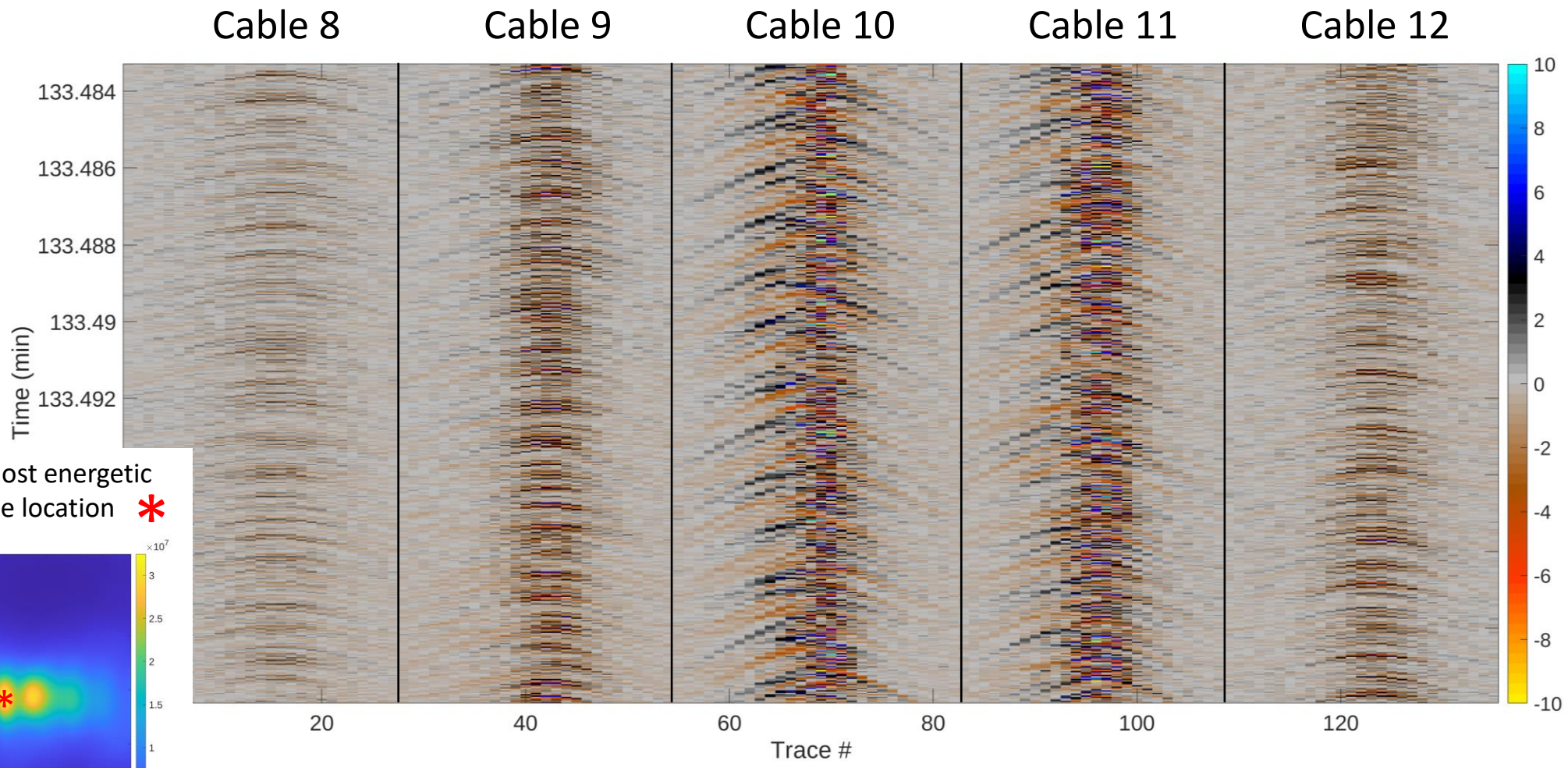


Scan for the most energetic point source location *

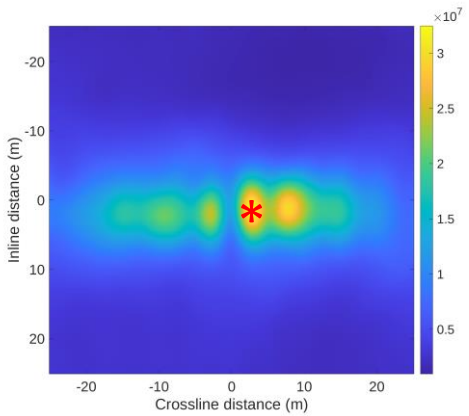


Inline / crossline positions are relative to the stern of the vessel.

Residuals after Iteration 2 – Iteration 3

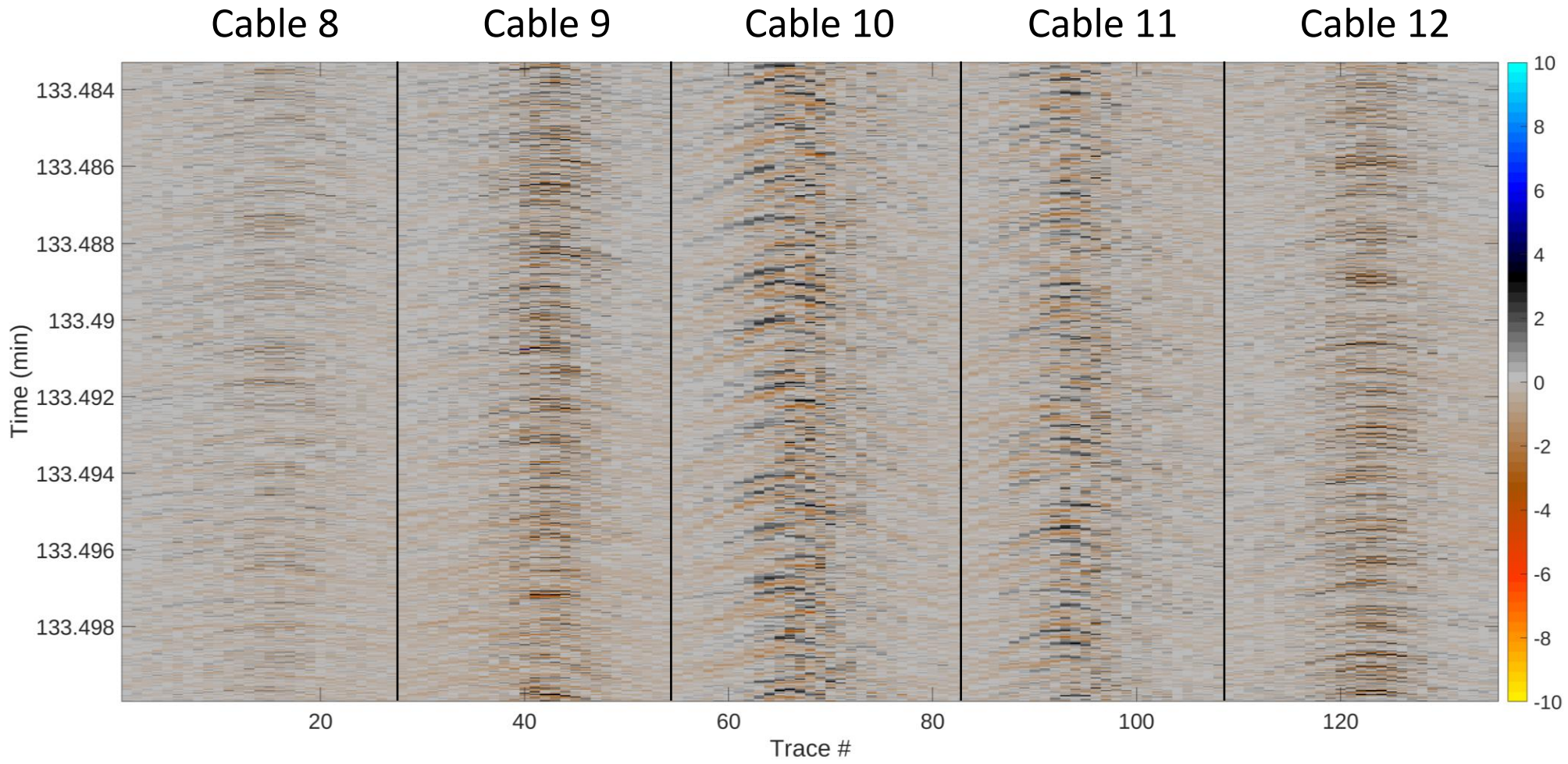


Scan for the most energetic point source location *

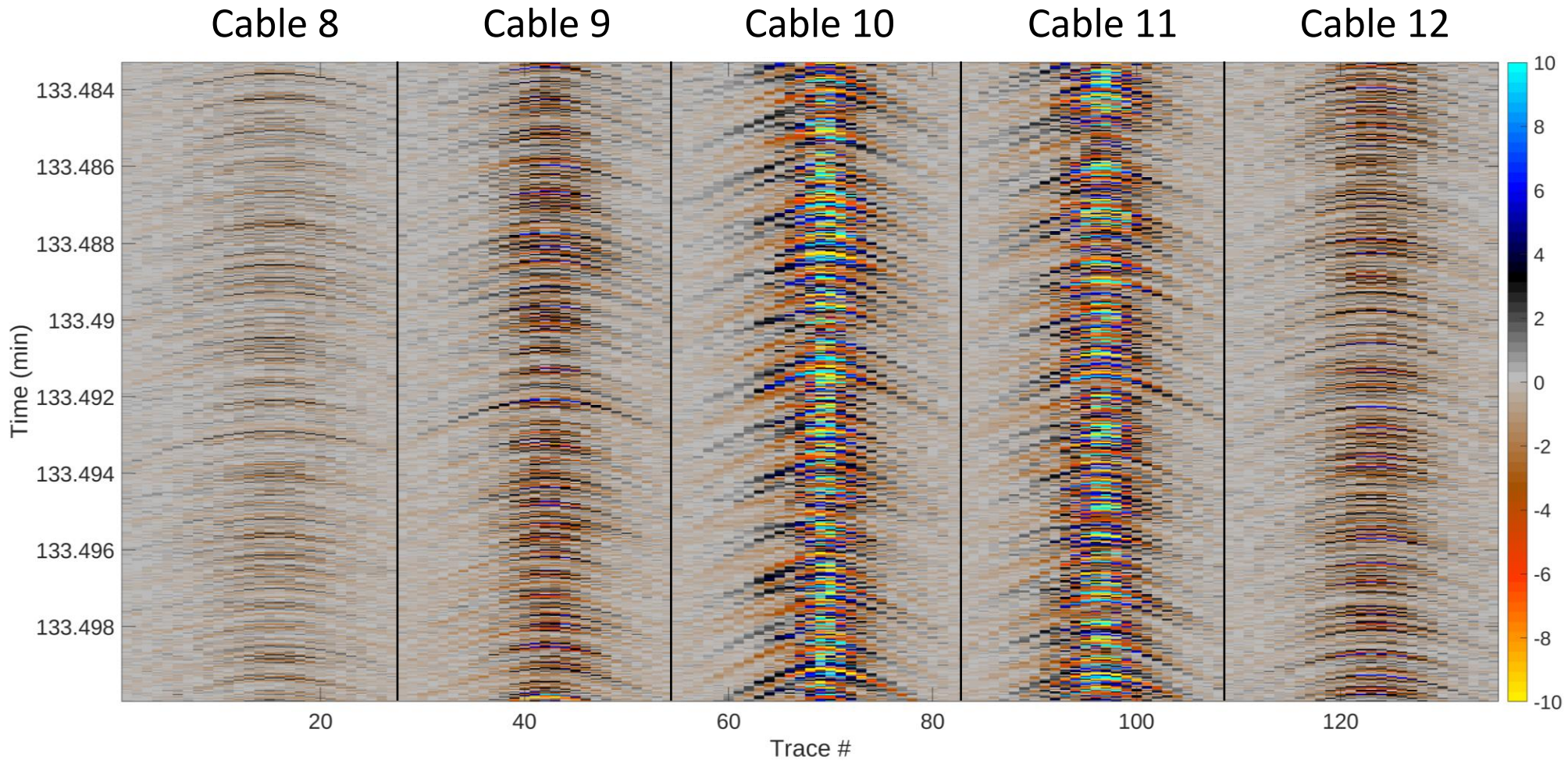


Inline / crossline positions are relative to the stern of the vessel.

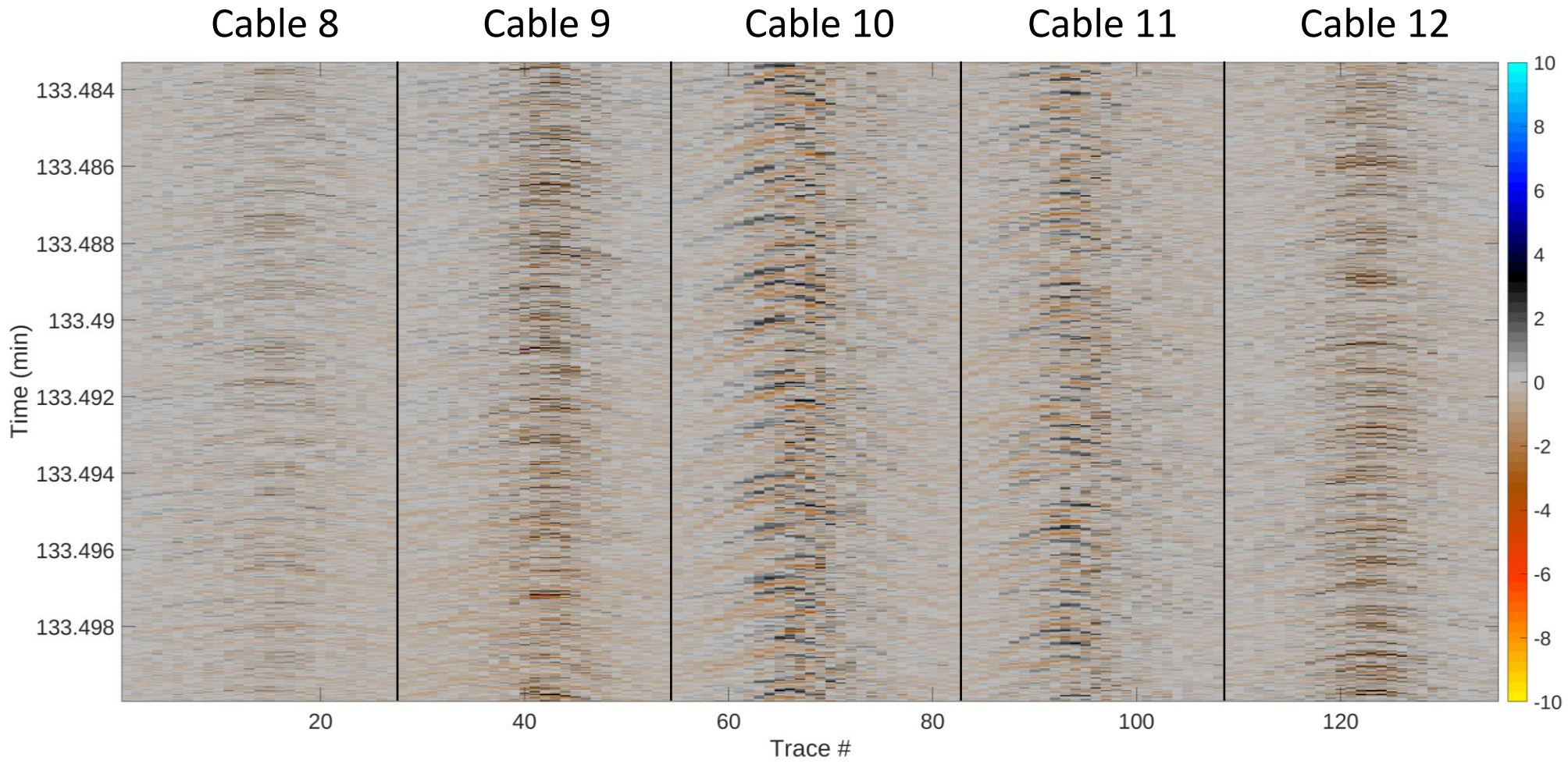
Residuals after Iteration 9



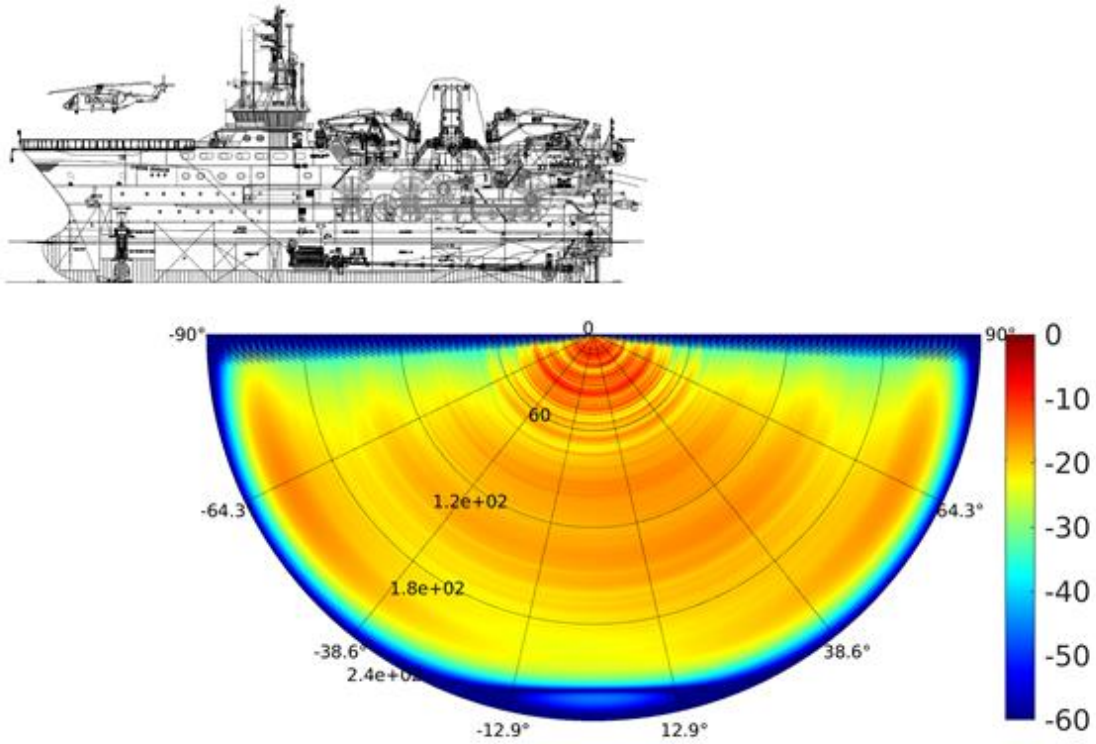
Input Data from Streamers 8 – 12



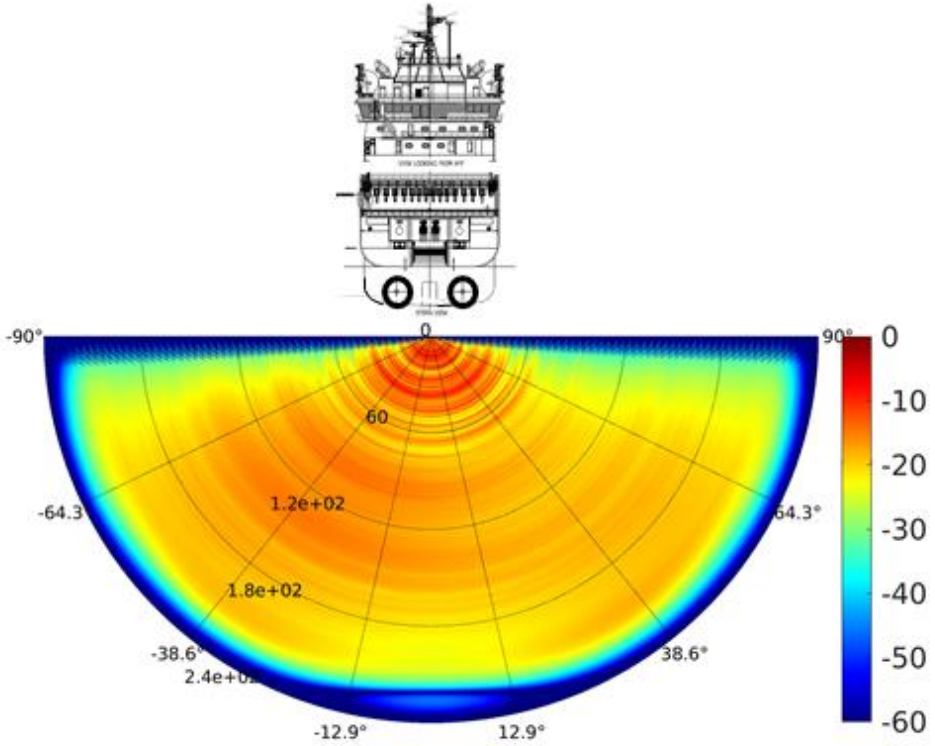
Residuals after Iteration 9



The Sound of Sanco Swift

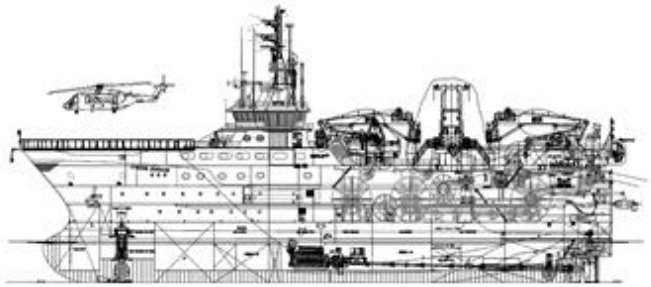


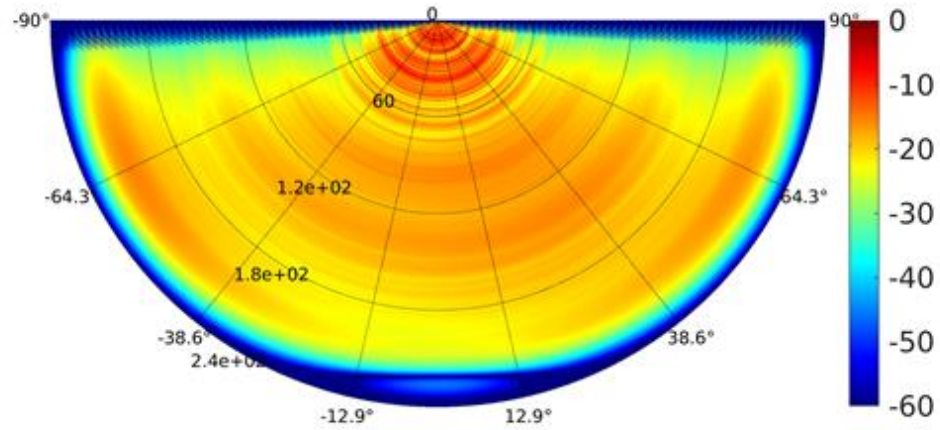
Inline directivity



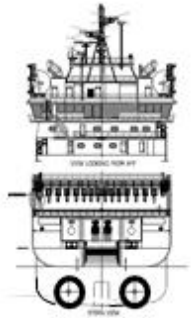
Crossline directivity

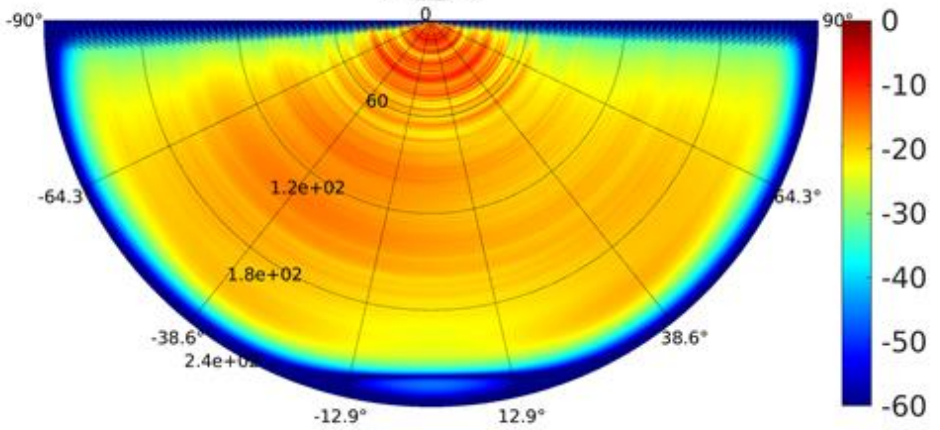
The Sound of Sanco Swift





Inline directivity

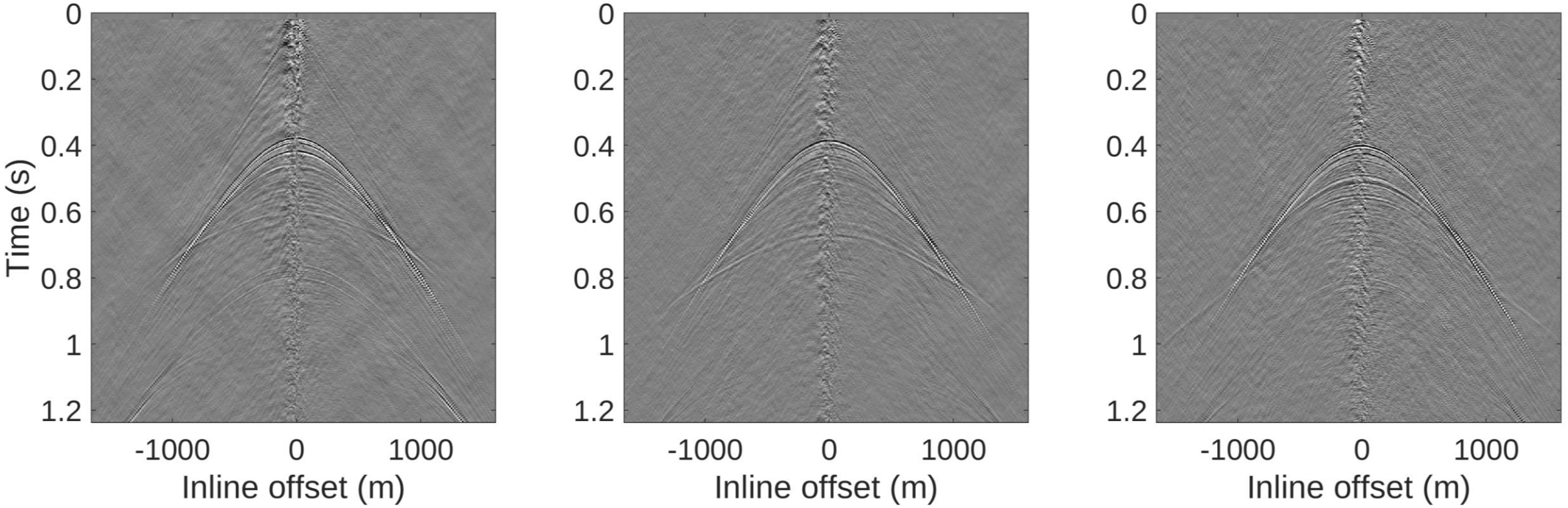




Crossline directivity

CMP gathers – 642 fold

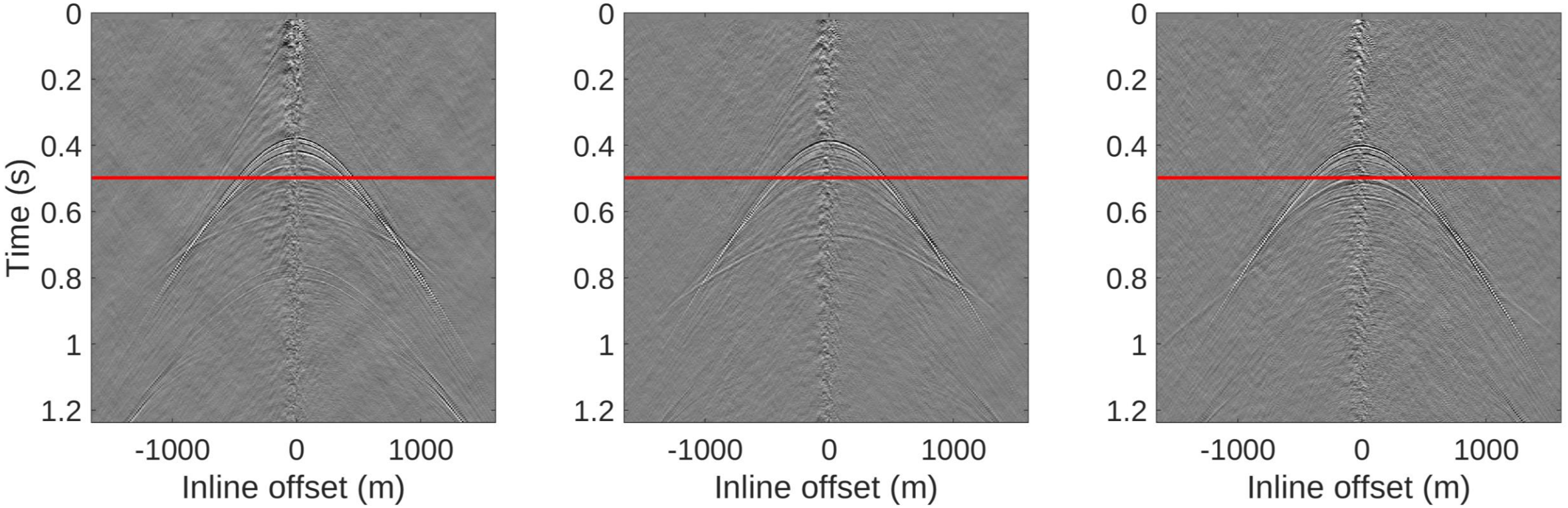
Source: Swift



12.5m trace spacing, 2ms sample rate, 6.25m spacing between CMP gathers

CMP gathers – 642 fold

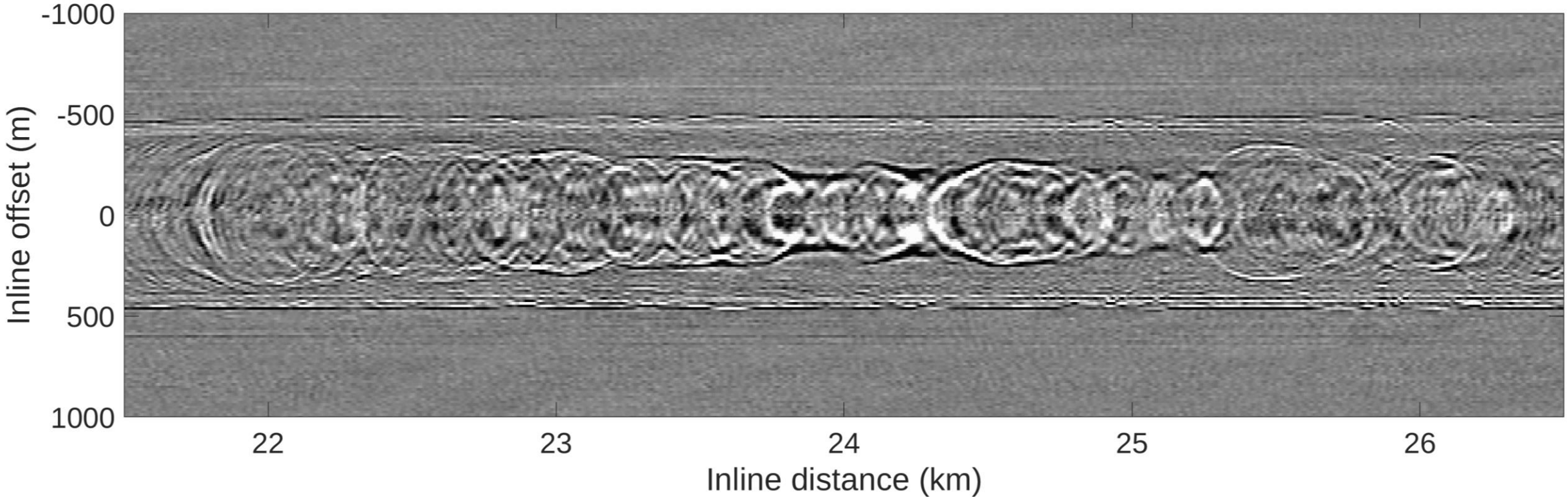
Source: Swift



12.5m trace spacing, 2ms sample rate, 6.25m spacing between CMP gathers

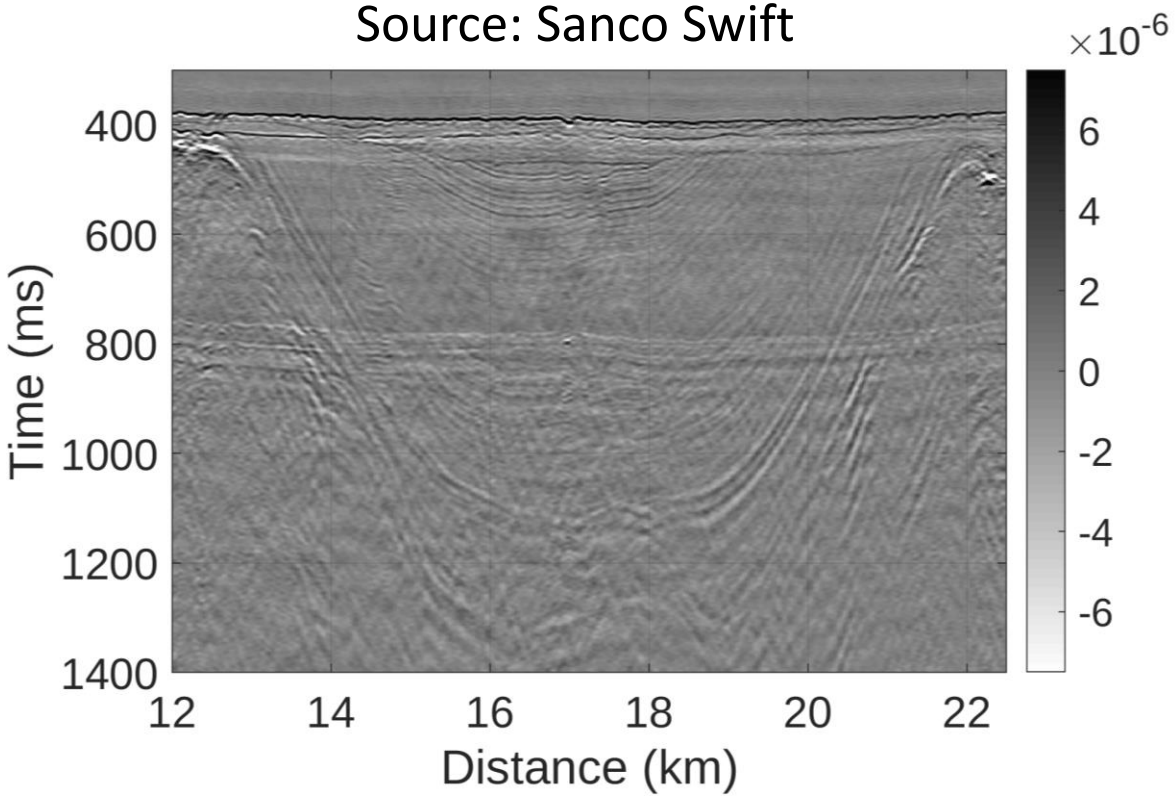
Time-slice through CMP gathers at 0.5 s

Source: Sanco Swift

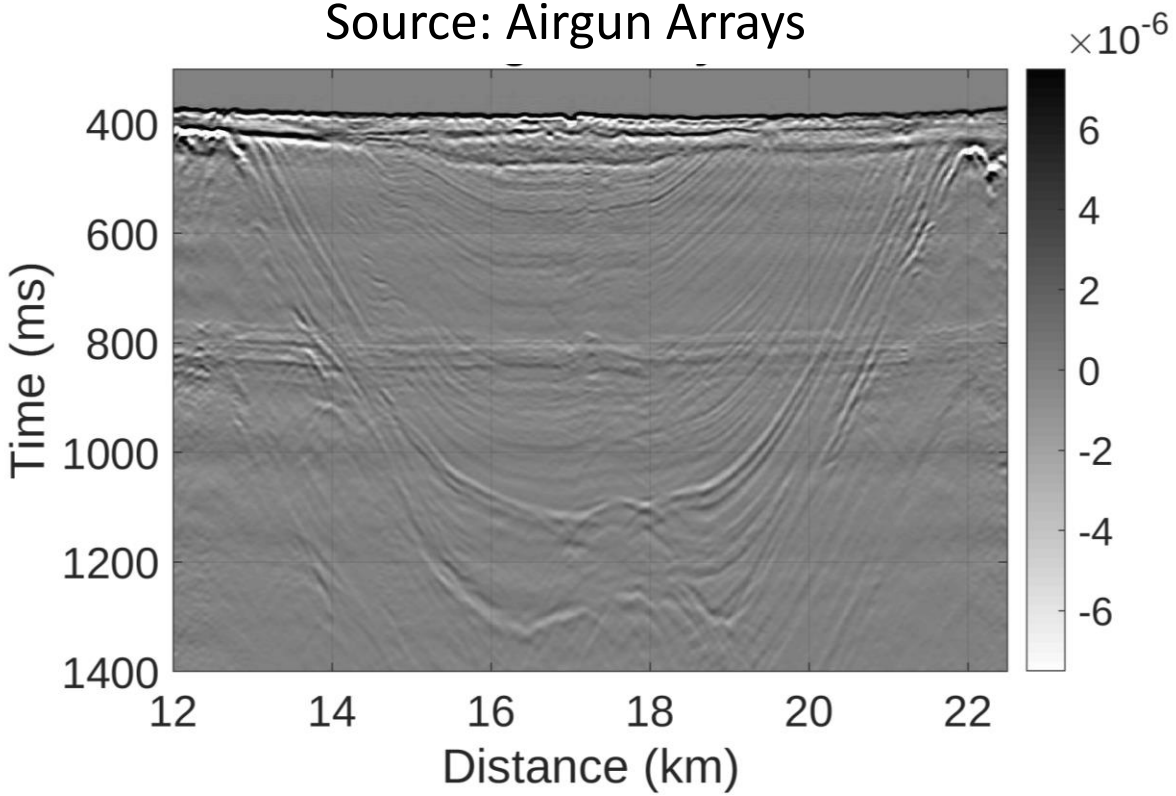


NMO Stack

Source: Sanco Swift

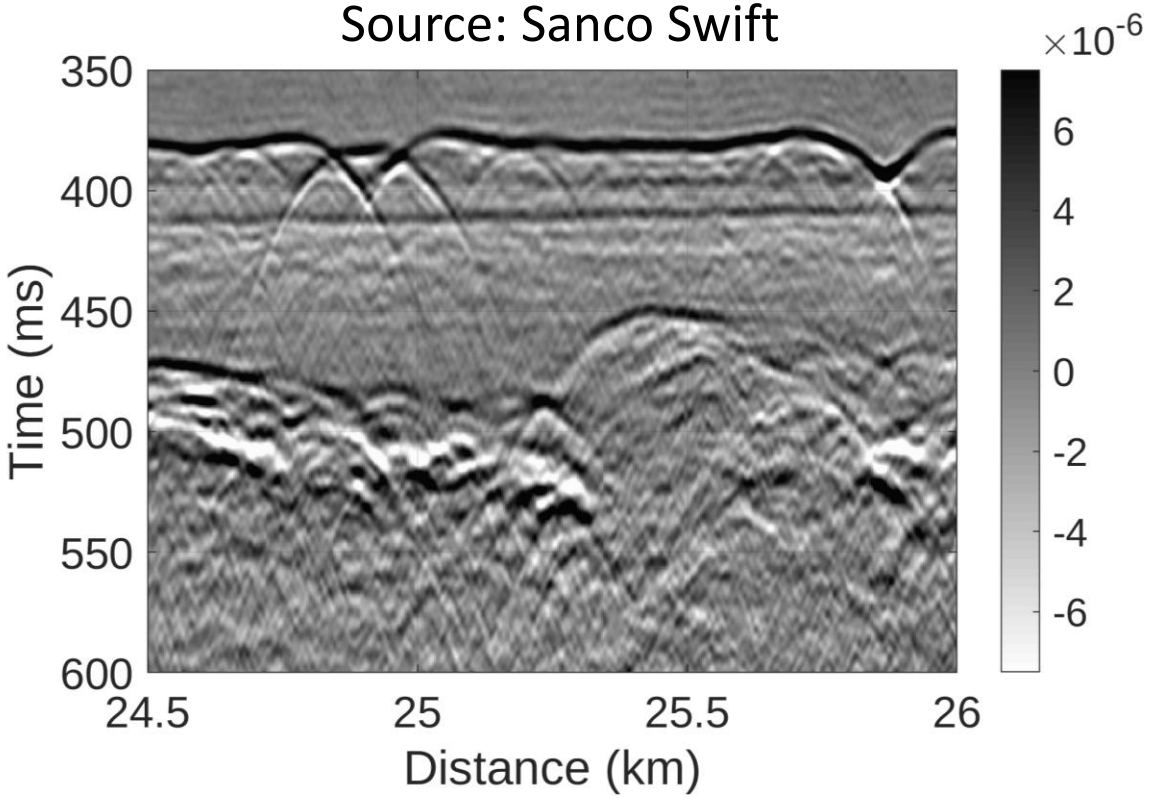


Source: Airgun Arrays

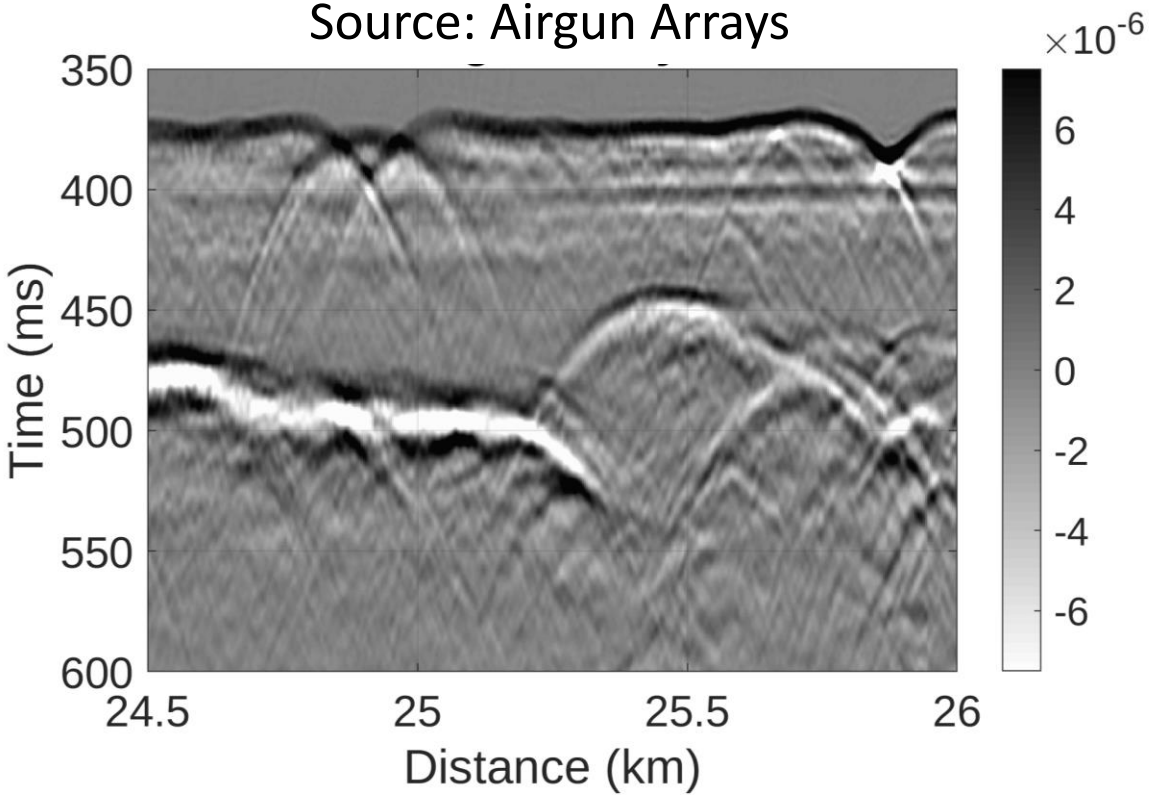


NMO Stack

Source: Sanco Swift

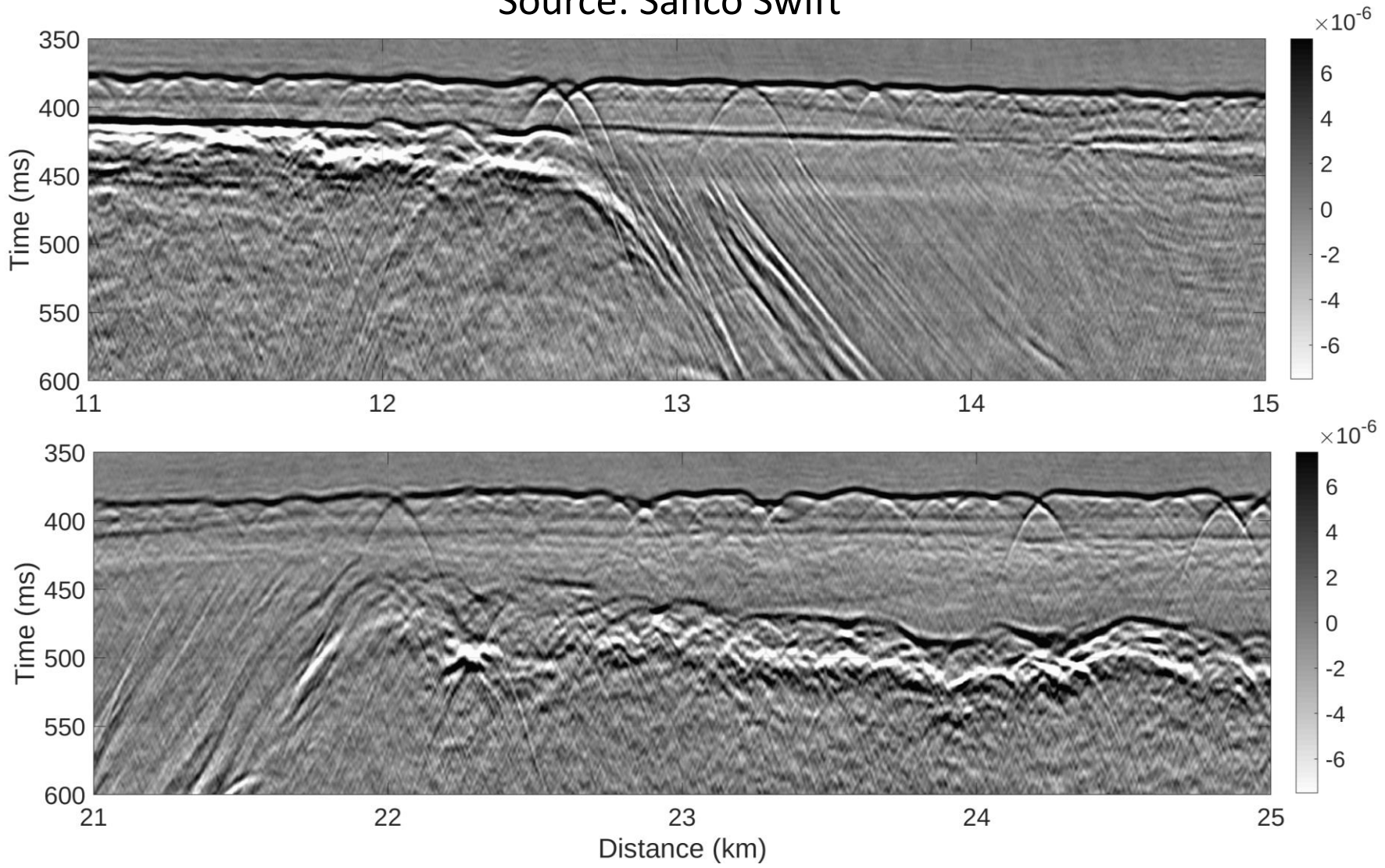


Source: Airgun Arrays



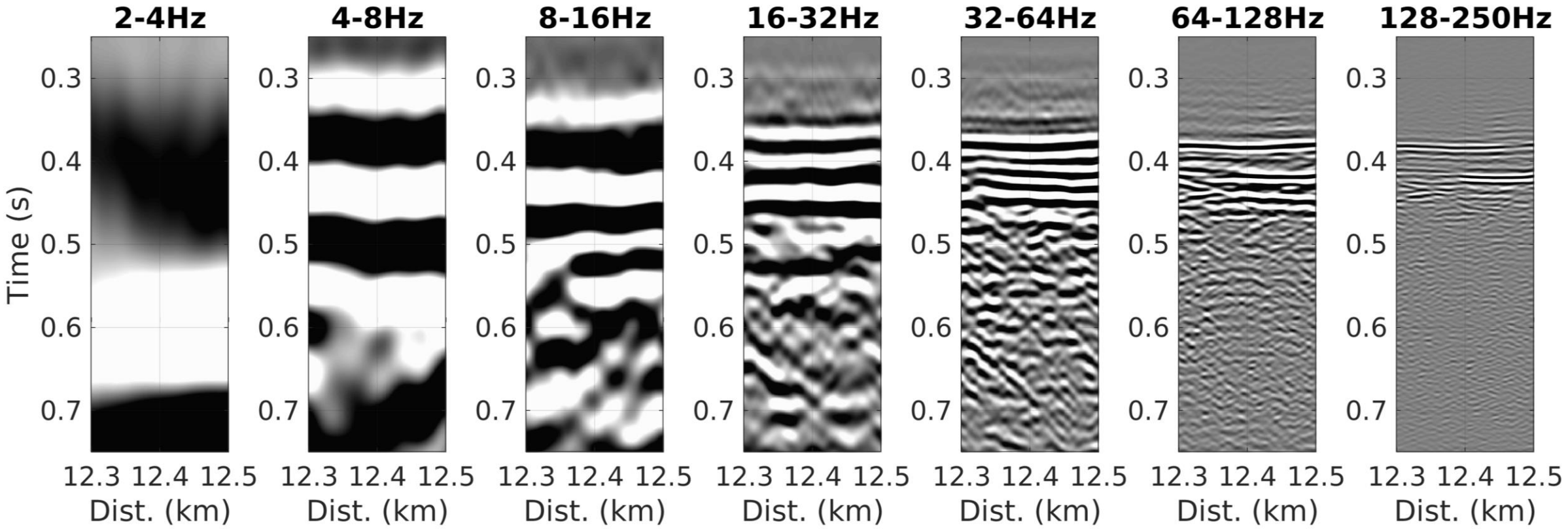
NMO Stack – No Active Source

Source: Sanco Swift



NMO Stack – No Active Source – Octave Panels

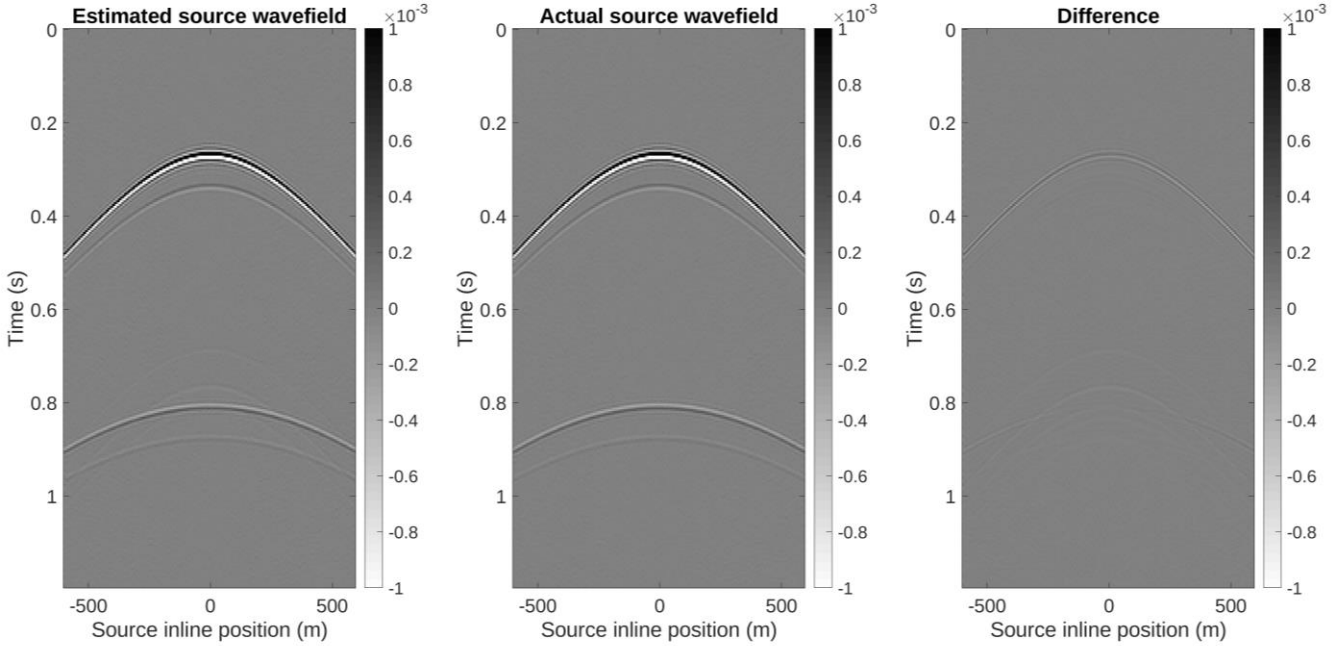
Source: Sanco Swift



What next?

- Ocean bottom cables / nodes?
  - ✓ See presentation in the Seismic Acquisition – OBN session on Thursday June 8th at EAGE 2023
- Utilizing the crossline directivity?
- Applications on conventional data?

Simulated OBC data



Acknowledgements

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Many thanks to PGS for supporting this work