Independent vs. simultaneous time-lapse processing

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Outline

- TL processing
  - Independent
  - Simultaneous
- Examples
  - Synthetic data
  - Real data
- Summary
- Acknowledgments

Independent processing

Baseline

- Geometry assignment
- Ground roll attenuation
- Trace edits + mute
- Amplitude recovery
- Surf.-consis. Amp. Corr.
- Surf.-consis. spiking decon.
- Velocity analysis
- Surf.- consis. residual statics
- Stacking
- Migration

Monitor

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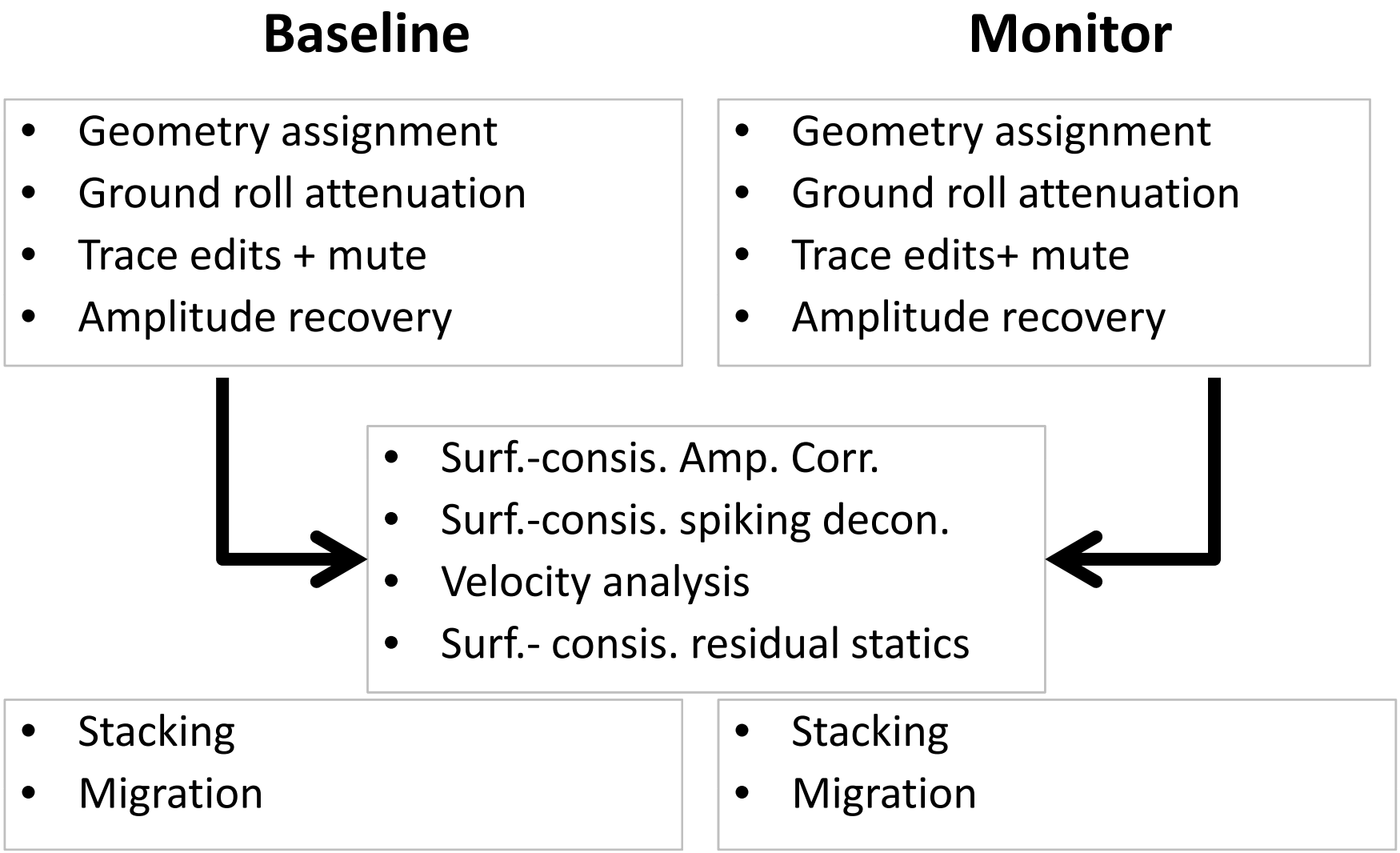
Independent processing

Baseline	Monitor
• Geometry assignment	• Geometry assignment
• Ground roll attenuation	• Ground roll attenuation
• Trace edits + mute	• Trace edits+ mute
• Amplitude recovery	• Amplitude recovery
• Surf.-consis. Amp. Corr.	• Surf.-consis. Amp. Corr.
• Surf.-consis. spiking decon.	• Surf.-consis. spiking decon.
• Velocity analysis	• Velocity analysis
• Surf.- consis. residual statics	• Surf.- consis. residual statics
• Stacking	• Stacking
• Migration	• Migration

Simultaneous processing



Surface-consistent equations

Surface-consistent matching filters:

$$\frac{T_2}{T_1}(ij, f) \approx \frac{S_2}{S_1}(i, f)\frac{R_2}{R_1}(j, f)\frac{O_2}{O_1}(k, f)\frac{M_2}{M_1}(l, f)$$

Surface-consistent amplitude correction:

$$T_{amp} \approx S_{amp}(i)R_{amp}(j)O_{amp}(k)M_{amp}(l)$$

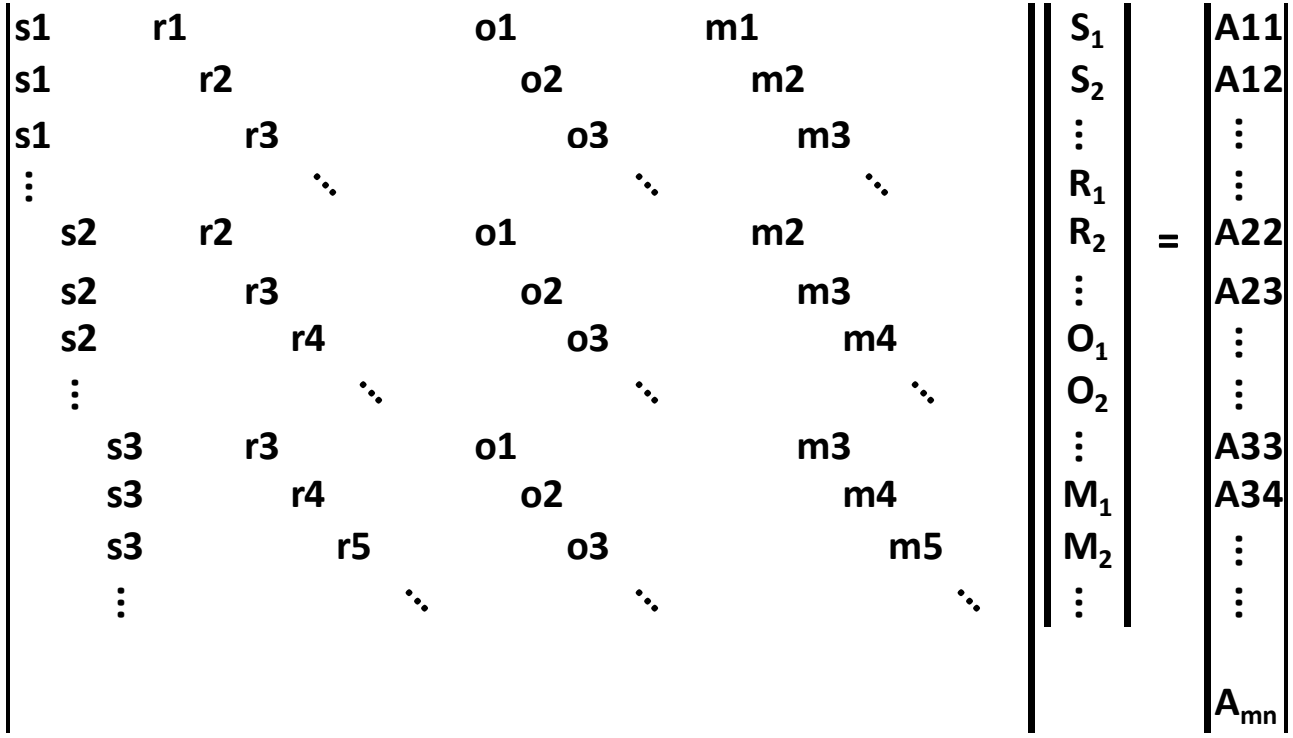
Surface-consistent deconvolution:

$$T_{dec}(f) \approx S_{dec}(i, f)R_{dec}(j, f)O_{dec}(k, f)M_{dec}(l, f)$$

Surface-consistent statics correction:

$$T_{ij} \approx S_i + R_j + M_l + D_{(NMO)l}X_l^2$$

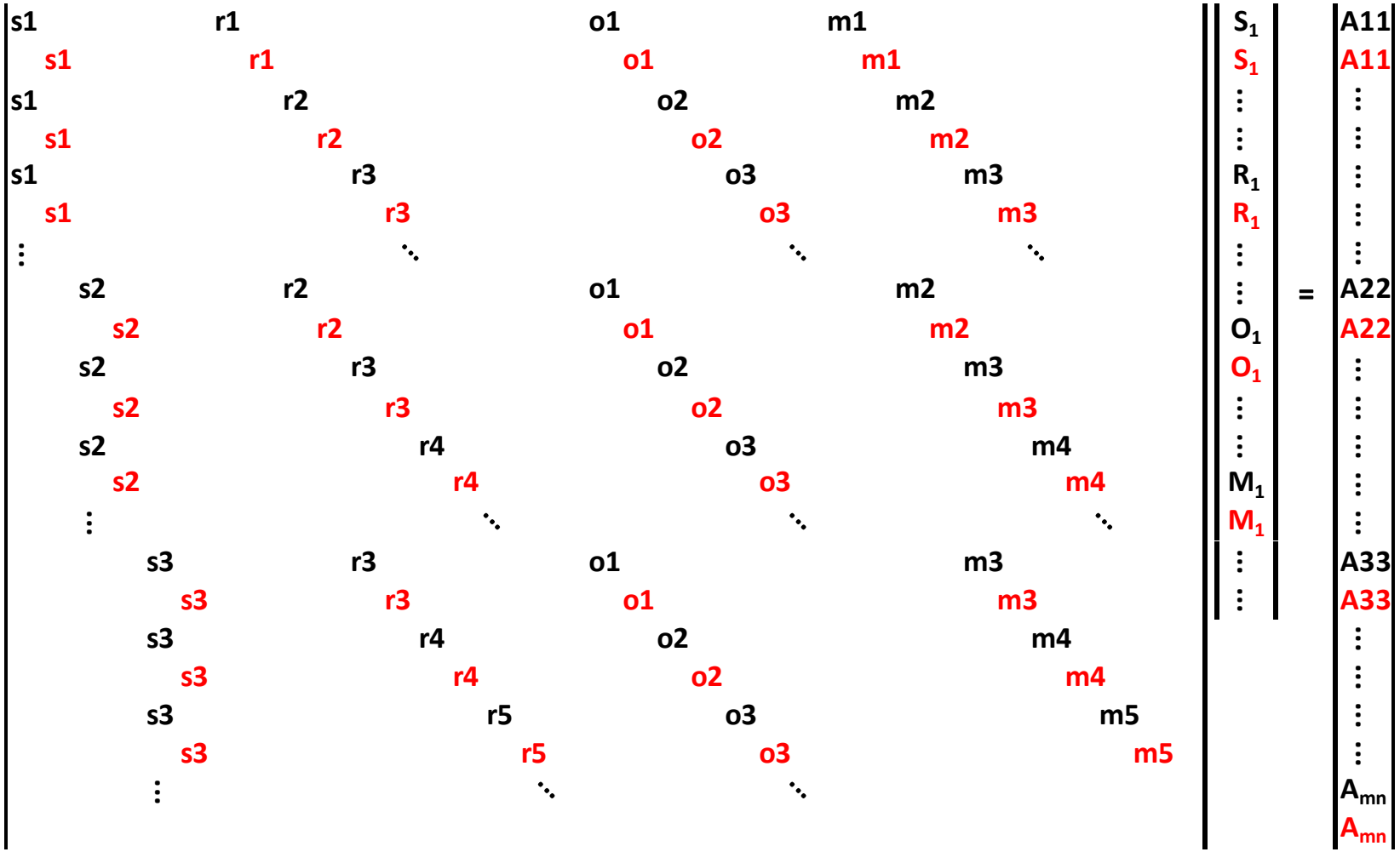
A single dataset



Independent processing:

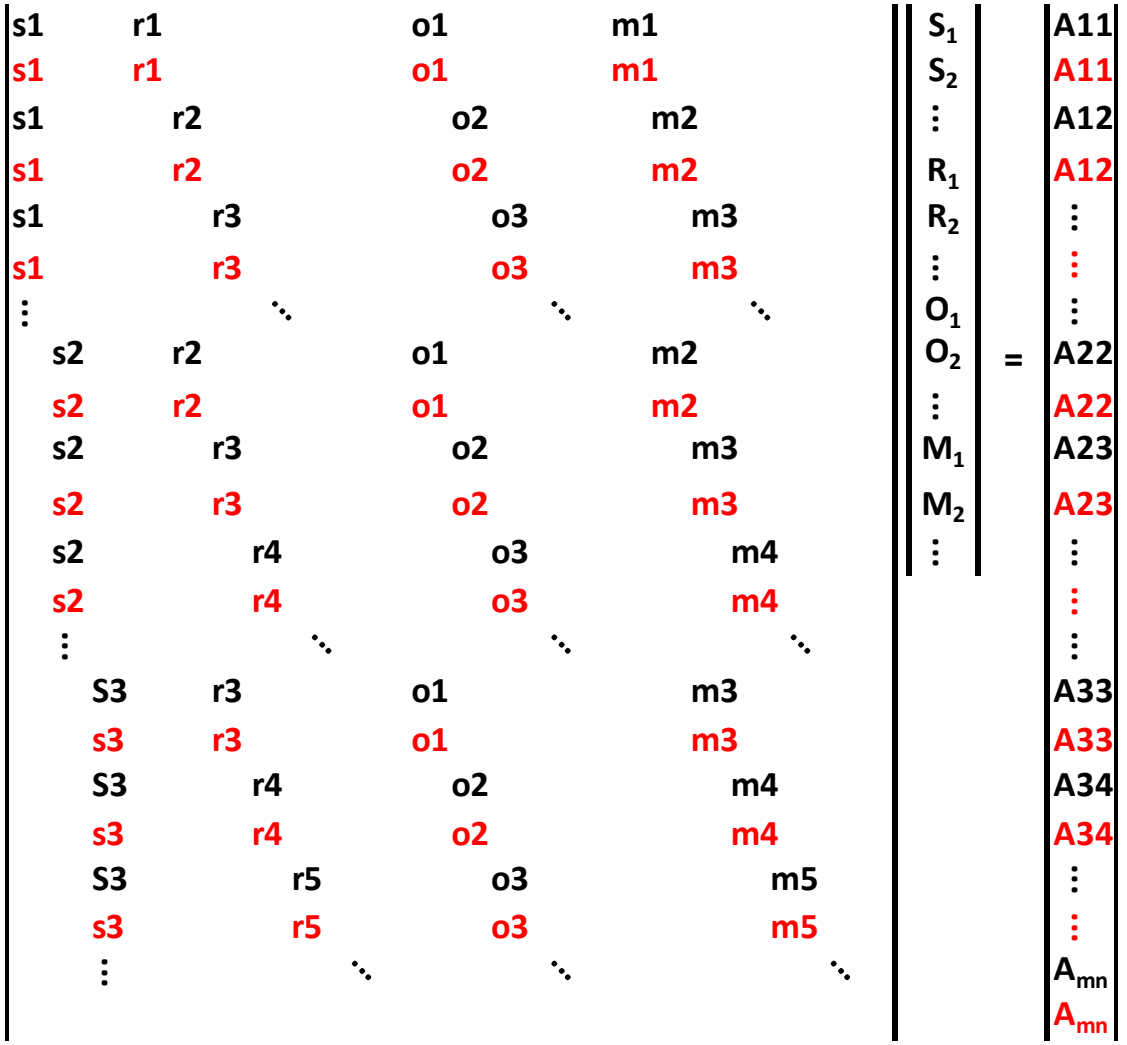
- Independent estimation of Src and Rec wavelets
- Different statics solutions
- Noise will cause a problem in the estimation of the above

Merging two or more datasets



Simultaneously solving the merged system ... however, each survey will have unique S_i, R_j, O_k, M_l operators.

Another type of merging



Simultaneous processing and common S_i, R_j, O_k, M_l operators

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  - Real data
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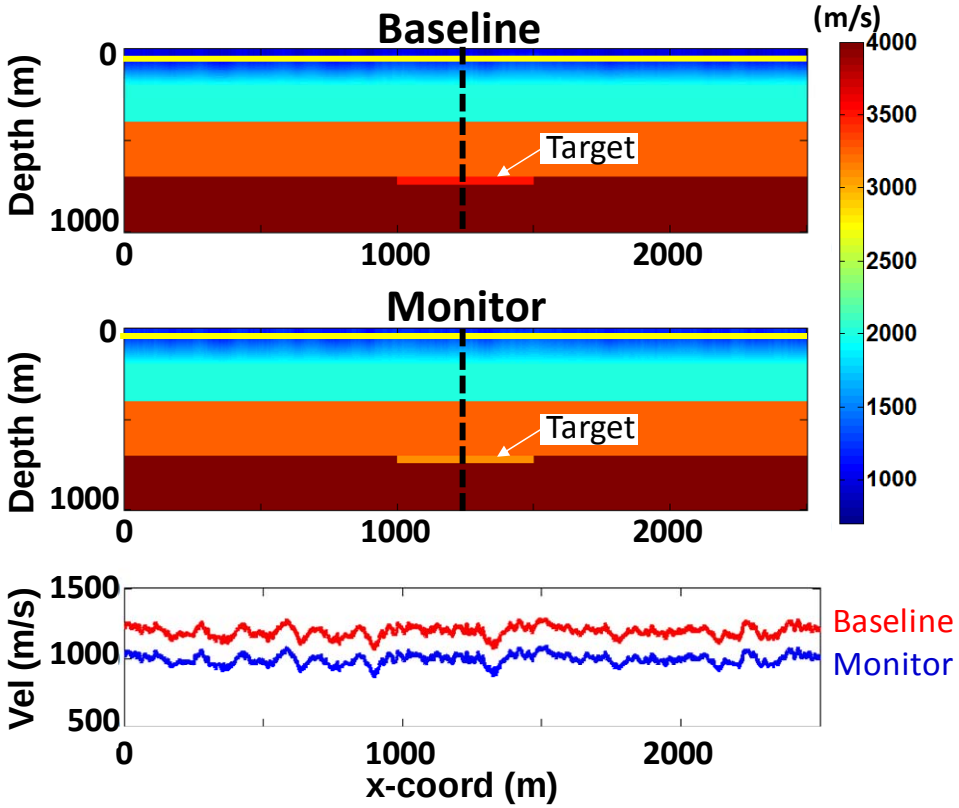
1st example: Synthetic models



Differences:

- near surface velocity
- attenuation
- changes in target layer
- strengths and couplings

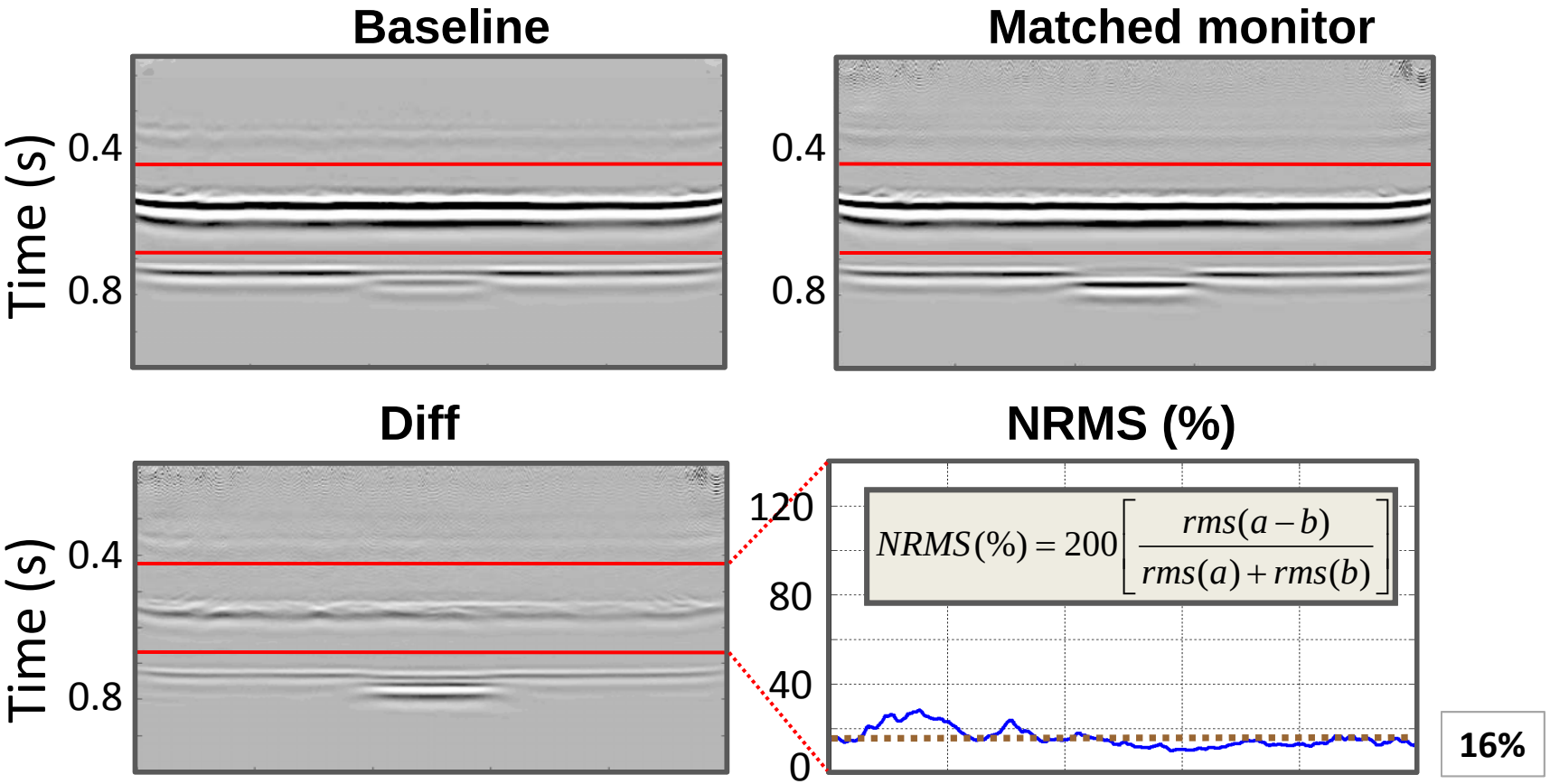
Acquisition:

- exact geometry

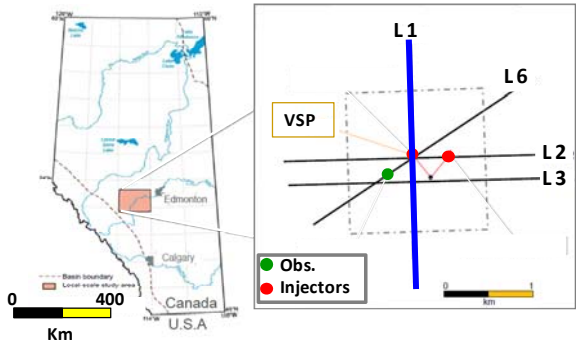
Processing:

- SCMF
- Simultaneous processing
  - SC resid. Statics
  - Velocity
- Post-stack migration

Migrated stacks

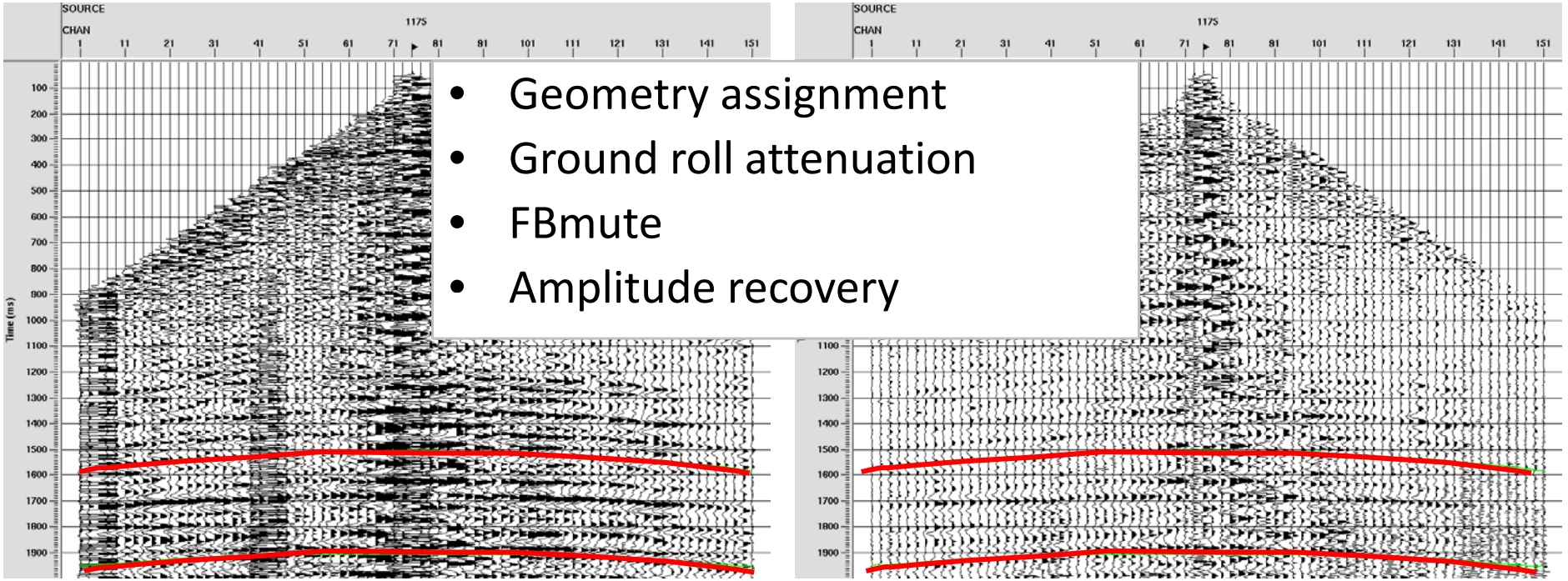


2nd example: Violet Grove TL



Baseline

Monitor

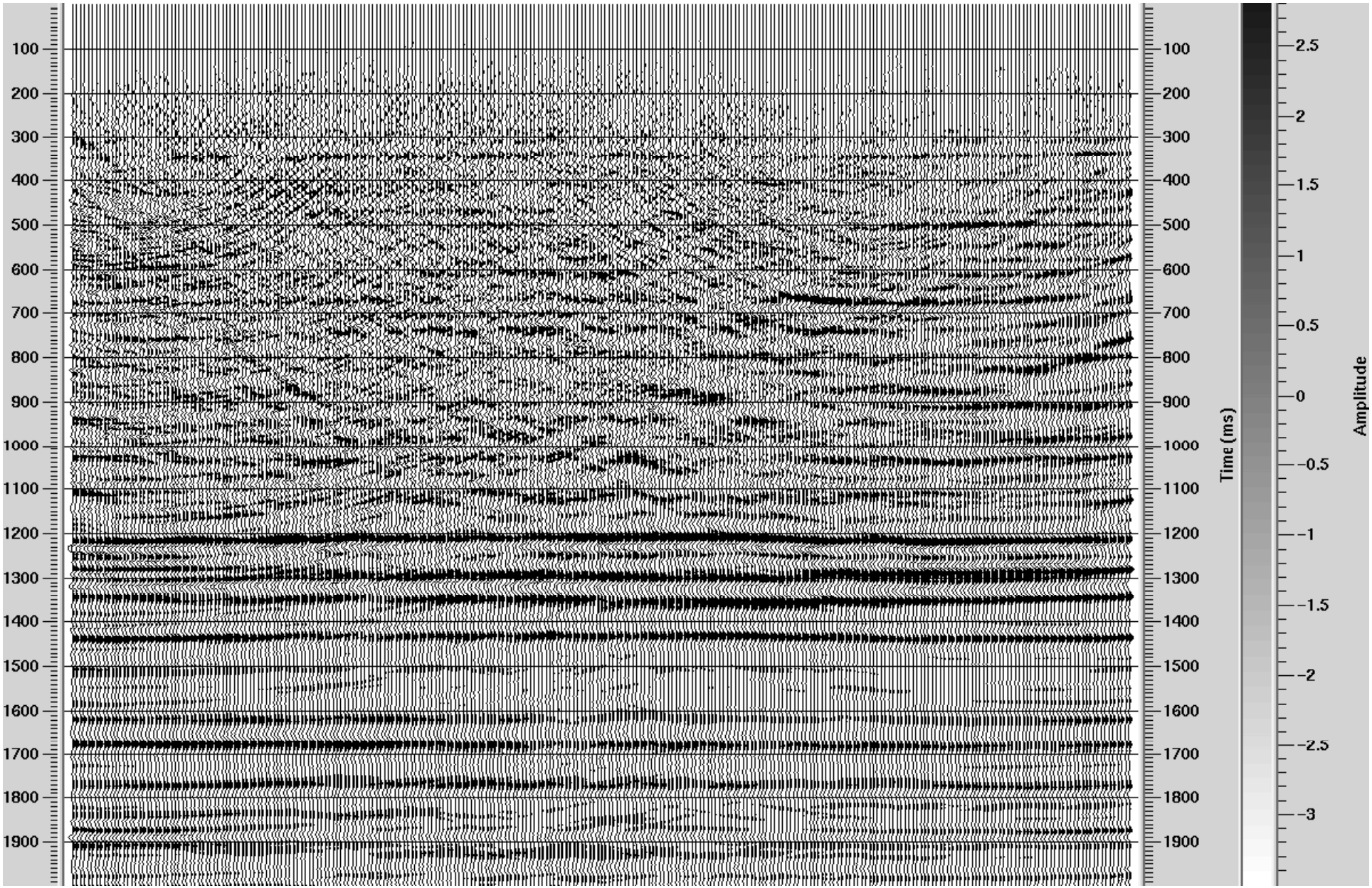


- Geometry assignment
- Ground roll attenuation
- FBmute
- Amplitude recovery

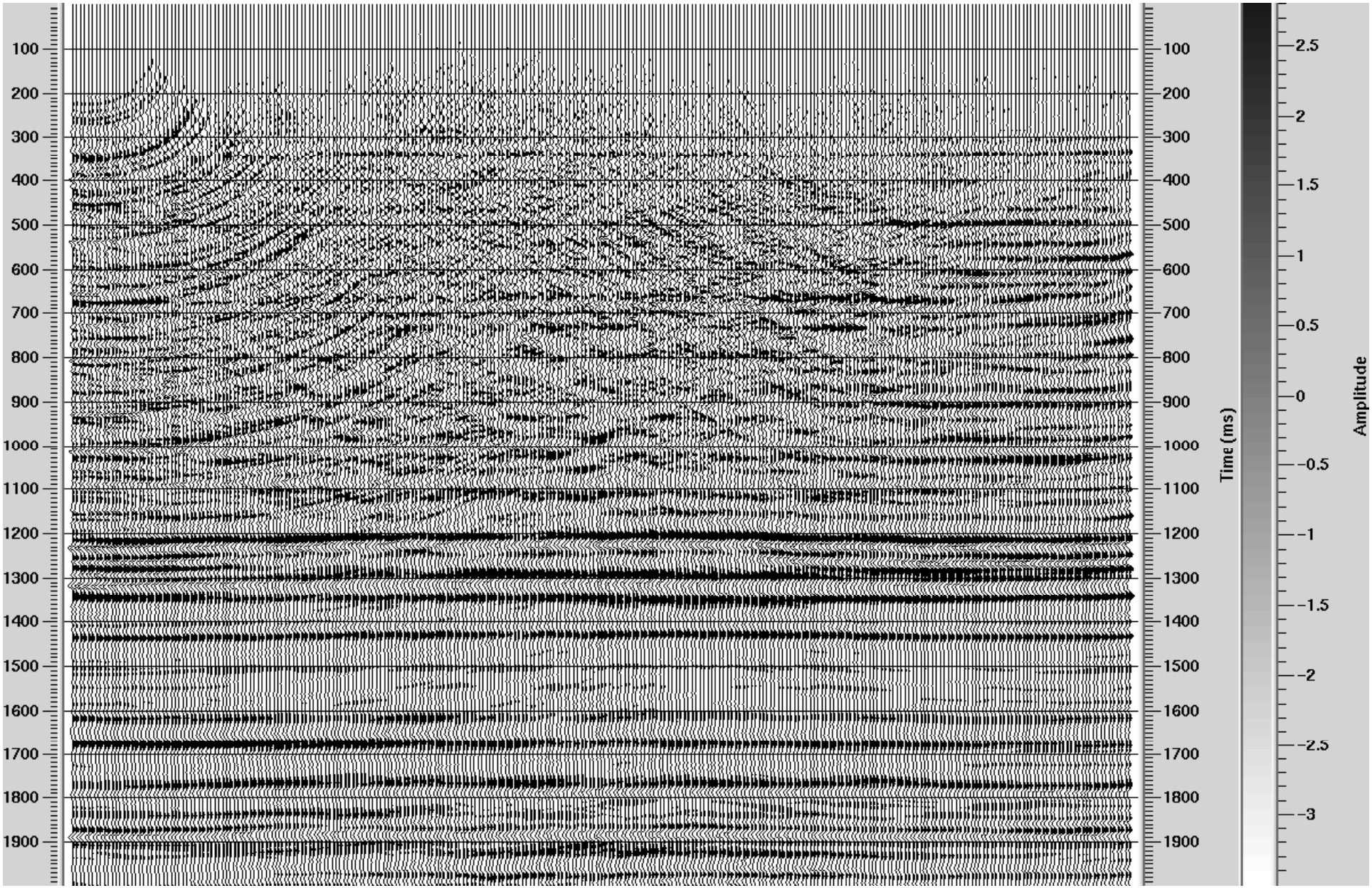
Independent processing

- Geometry assignment
- Ground roll attenuation
- Trace edits + mute
- Amplitude recovery
- Surf.-consis. Amp. Corr.
- Surf.-consis. spiking decon.
- Velocity analysis
- Surf.- consis. residual statics
- Stacking
- **Migration**

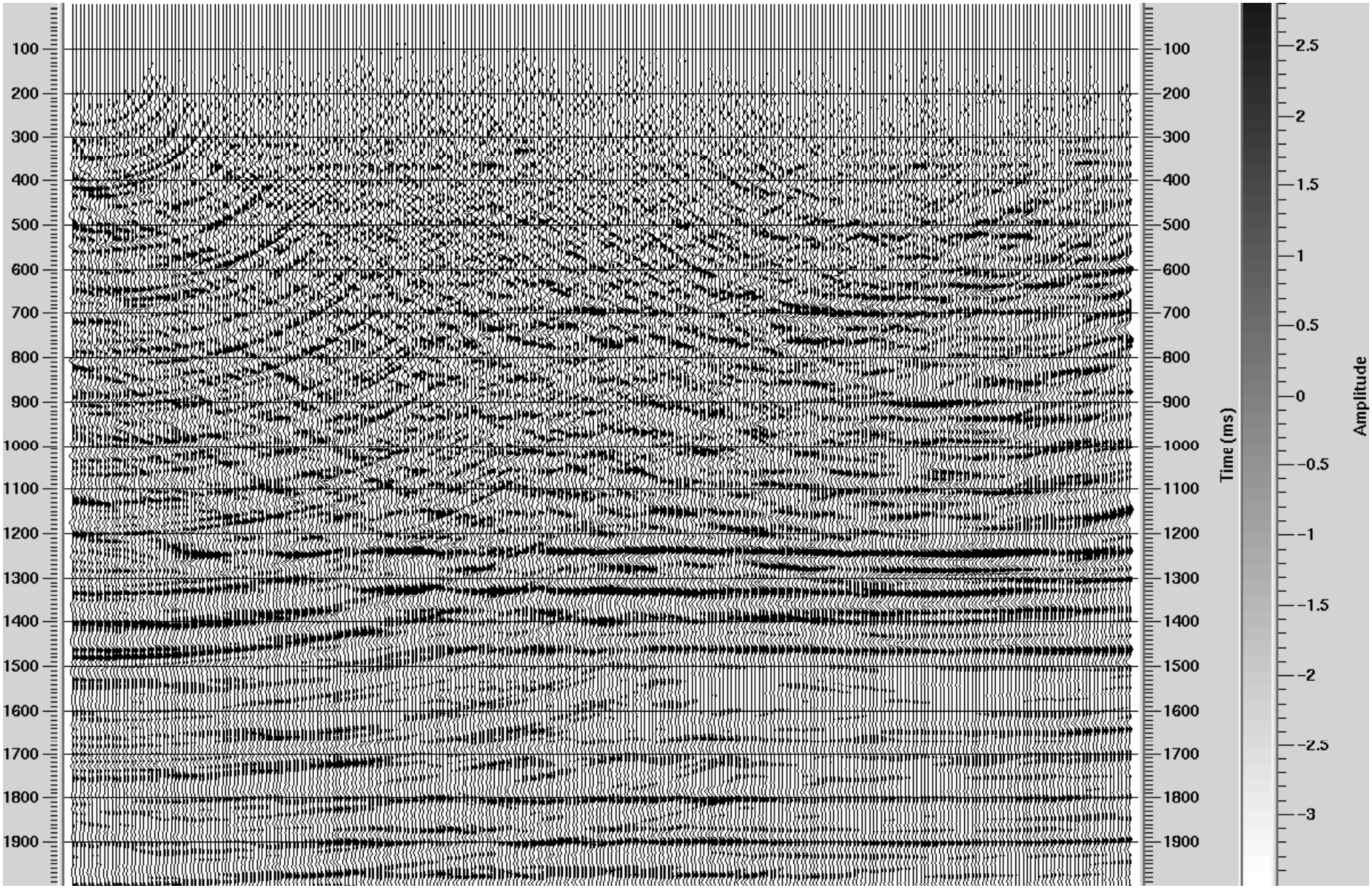
Migrated baseline



Migrated monitor



Difference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Amplitude

Simultaneous but unique

S, R, O, M

- Geometry assignment
- Ground roll attenuation
- Trace edits + mute
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- Geometry assignment
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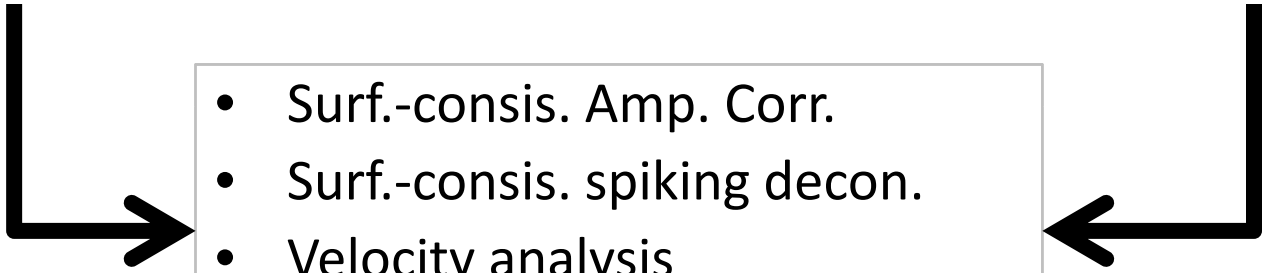
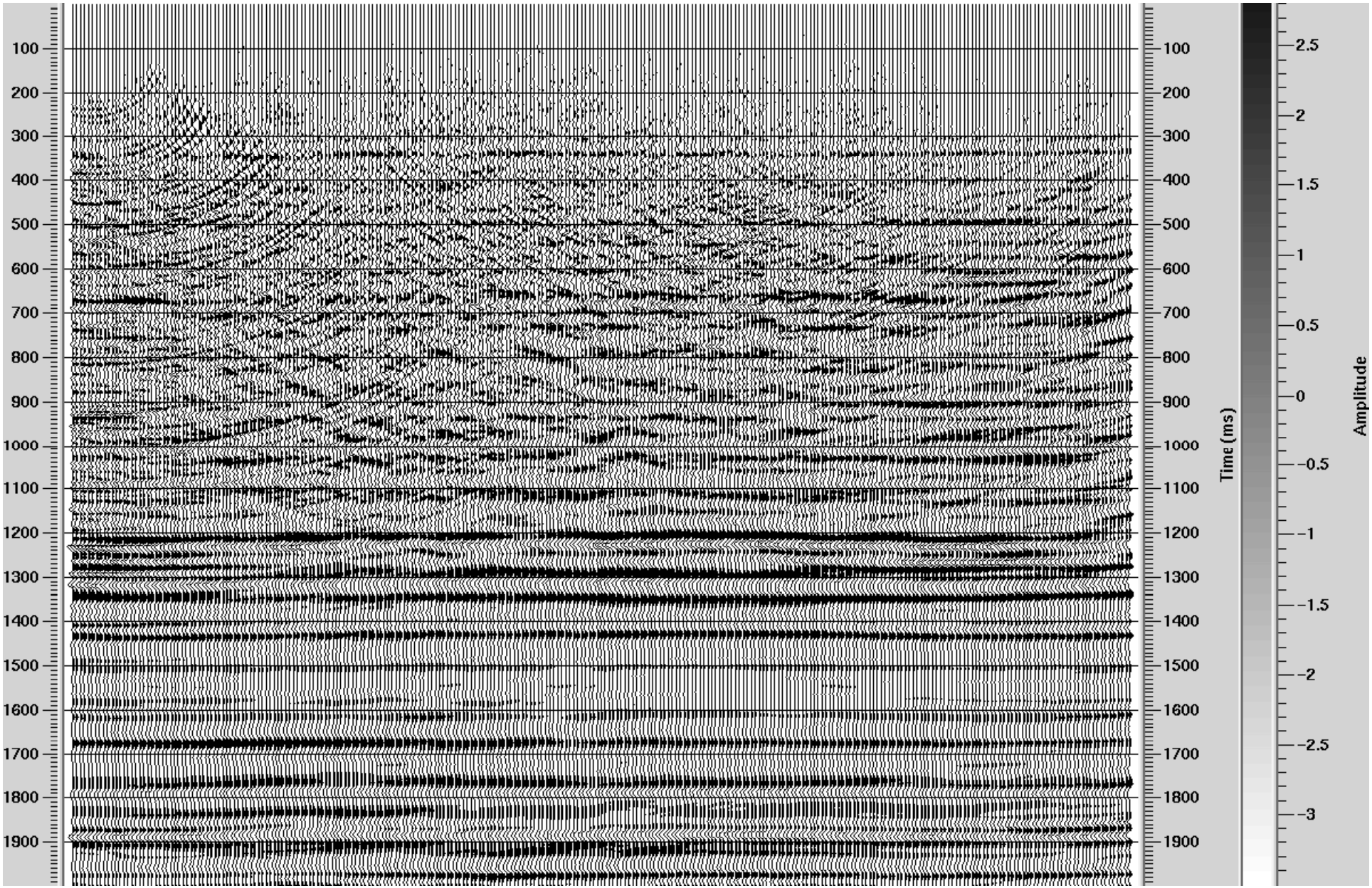


- Surf.-consis. Amp. Corr.
- Surf.-consis. spiking decon.
- Velocity analysis
- Surf.- consis. residual statics

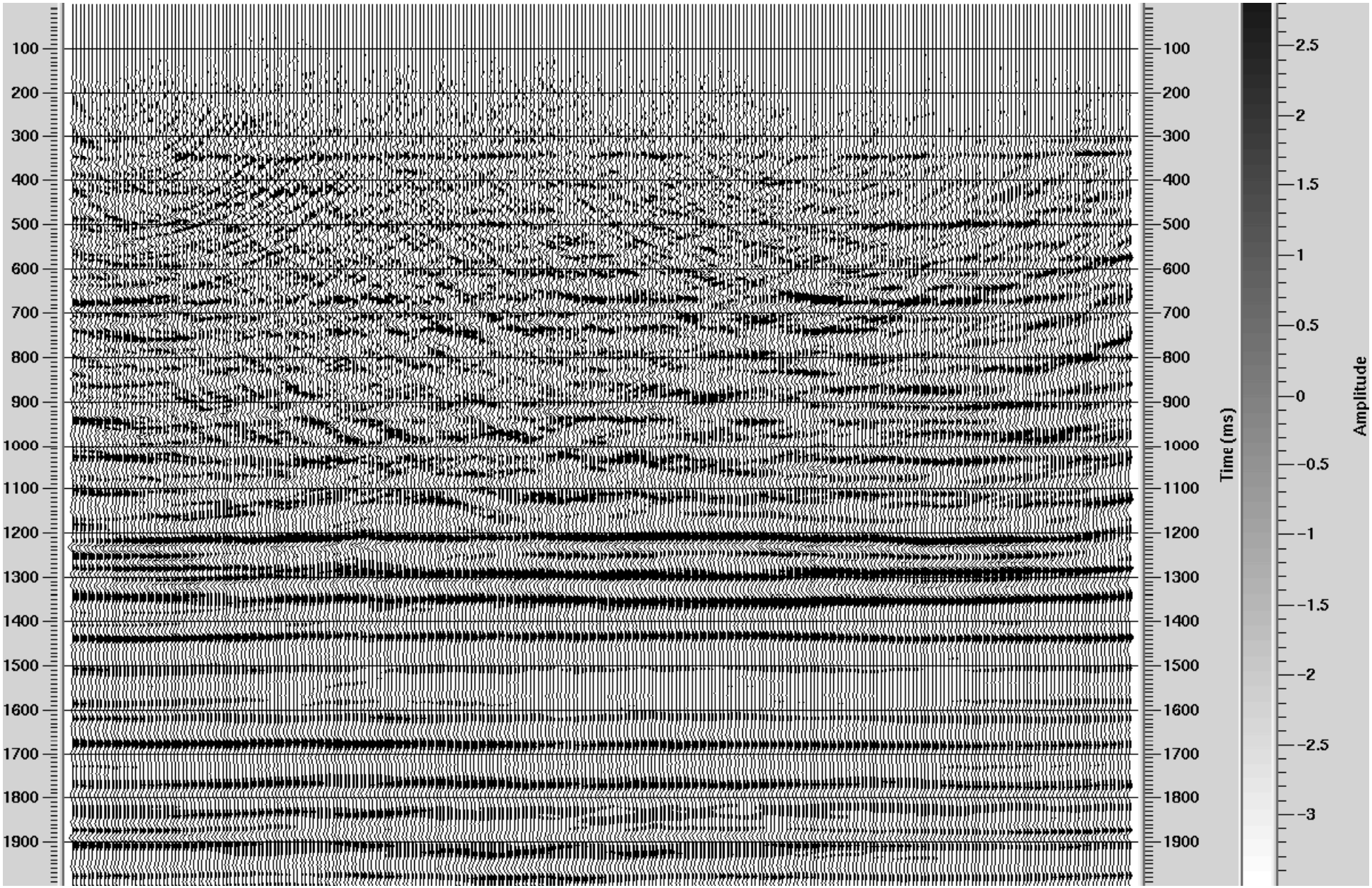
- Stacking
- **Migration**

- Stacking
- **Migration**

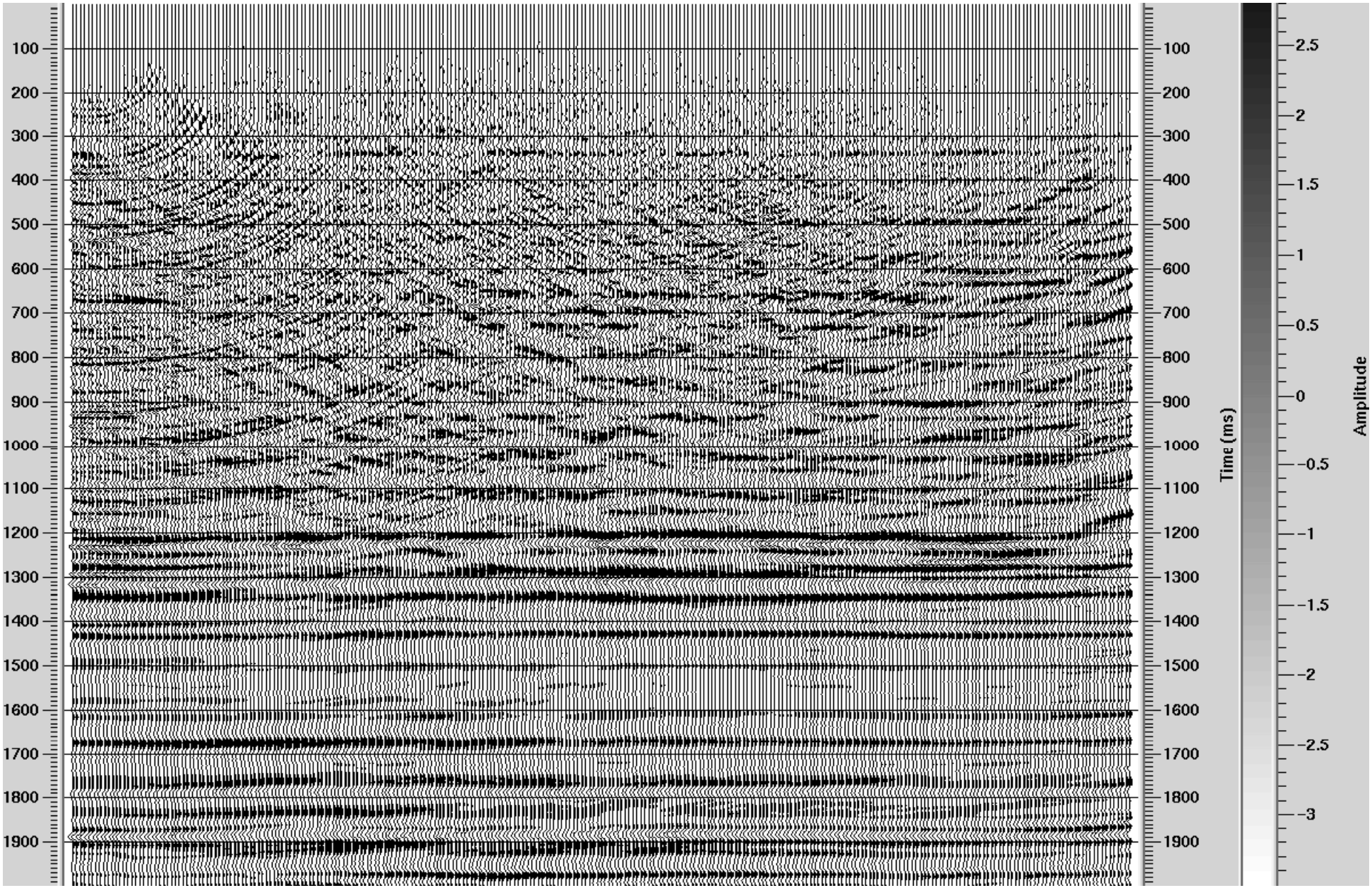
Migrated baseline



Migrated monitor



Difference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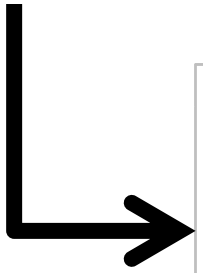
Amplitude

Simultaneous and common

S, R, O, M

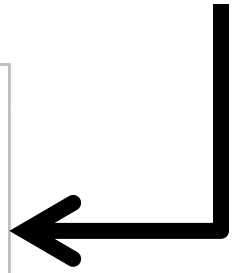
- Geometry assignment
- Ground roll attenuation
- Trace edits + mute
- Amplitude recovery

- Geometry assignment
- Ground roll attenuation
- Trace edits+ mute
- Amplitude recovery



Surface-consistent matching filters

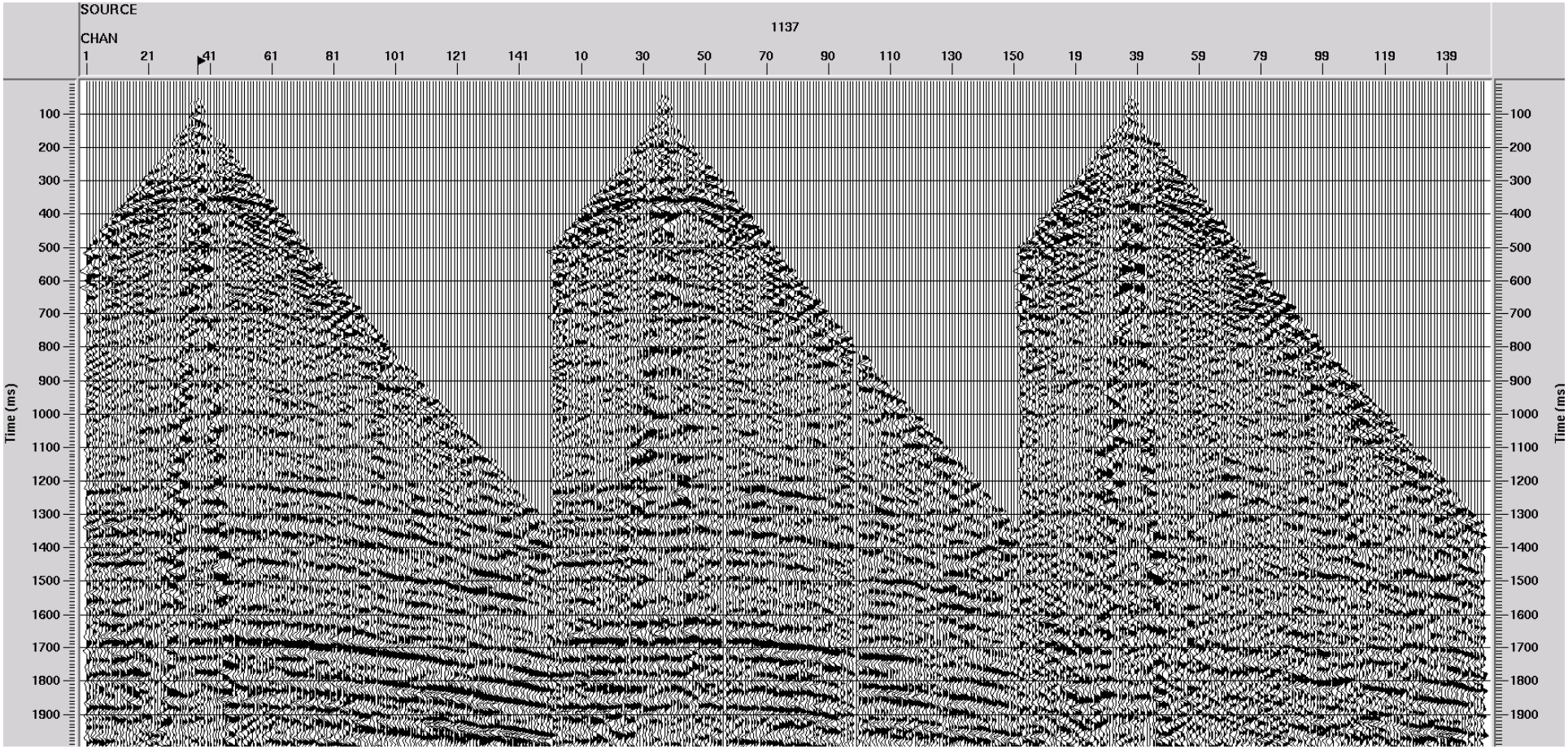
- Surf.-consis. Amp. Corr.
- Surf.-consis. spiking decon.
- Velocity analysis
- Surf.- consis. residual statics



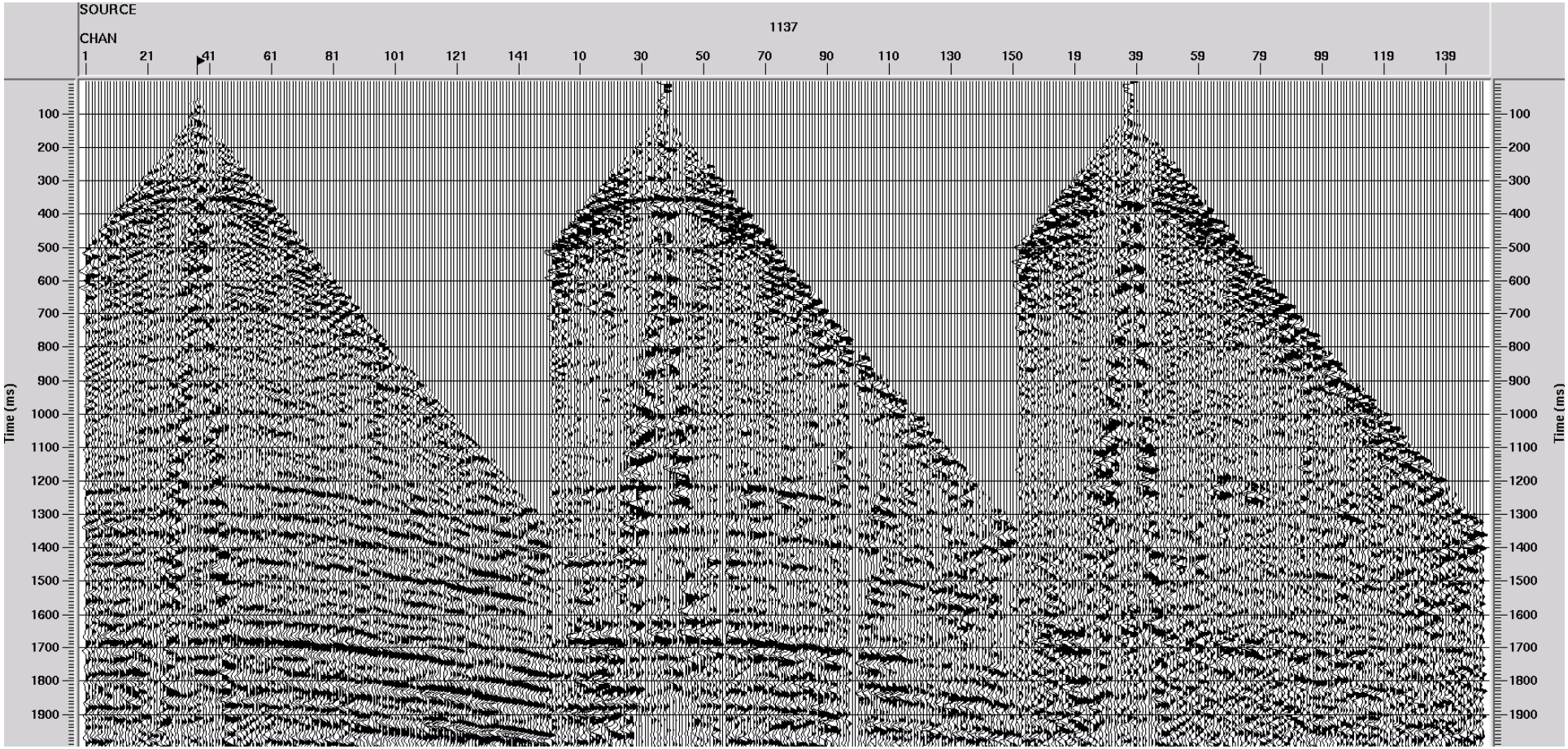
- Stacking
- **Migration**

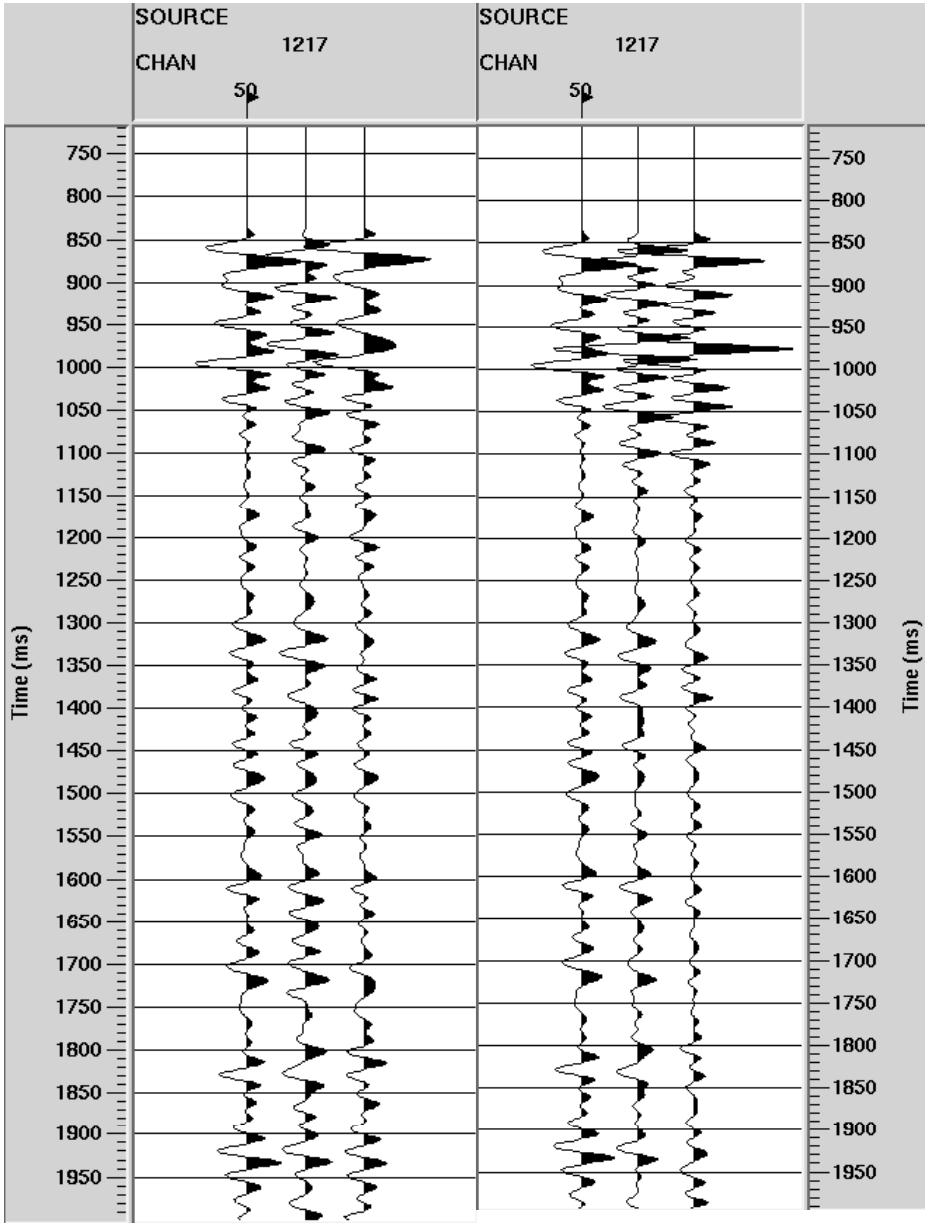
- Stacking
- **Migration**

Difference before SC matching filters



Difference after SC matching filters

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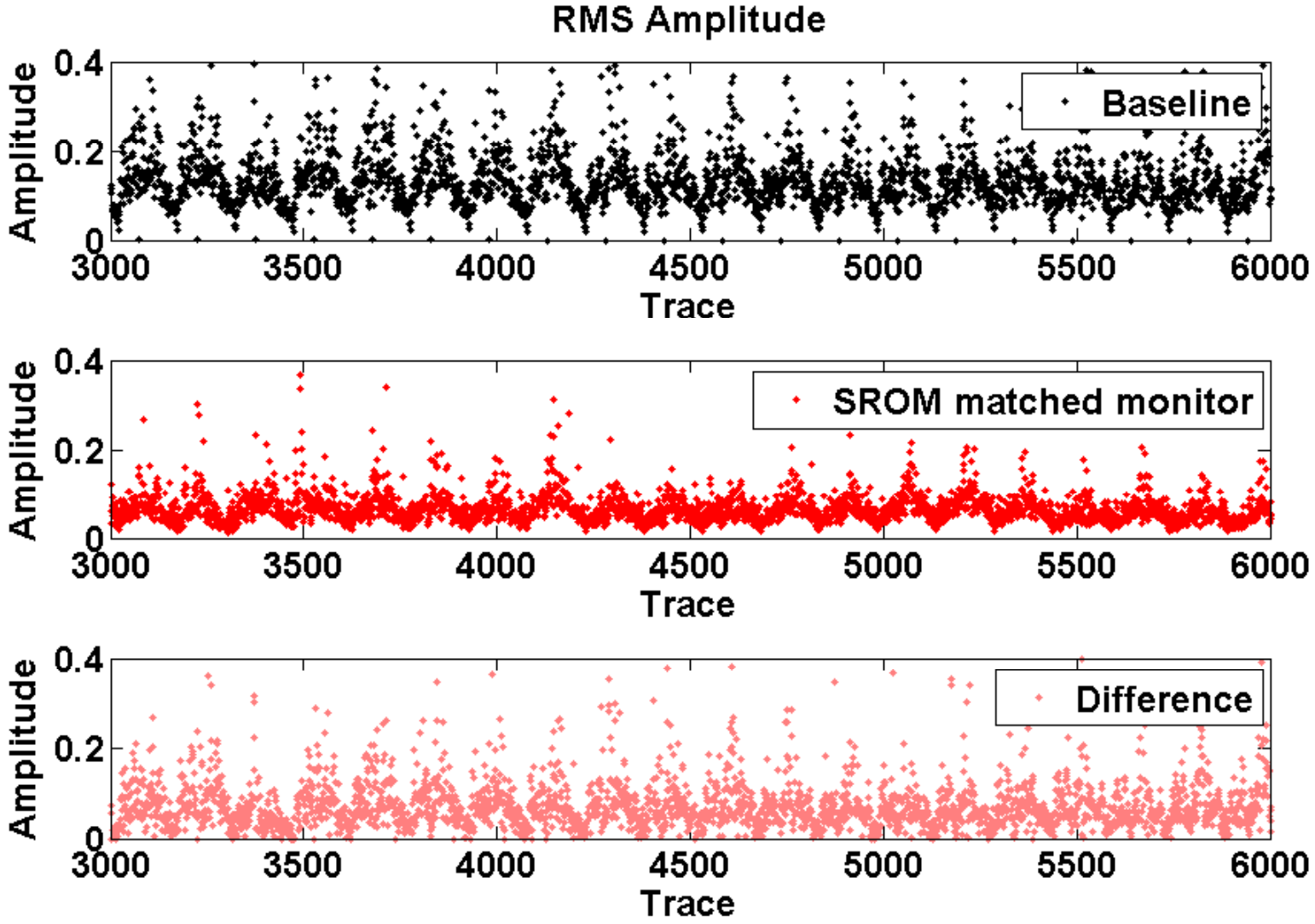
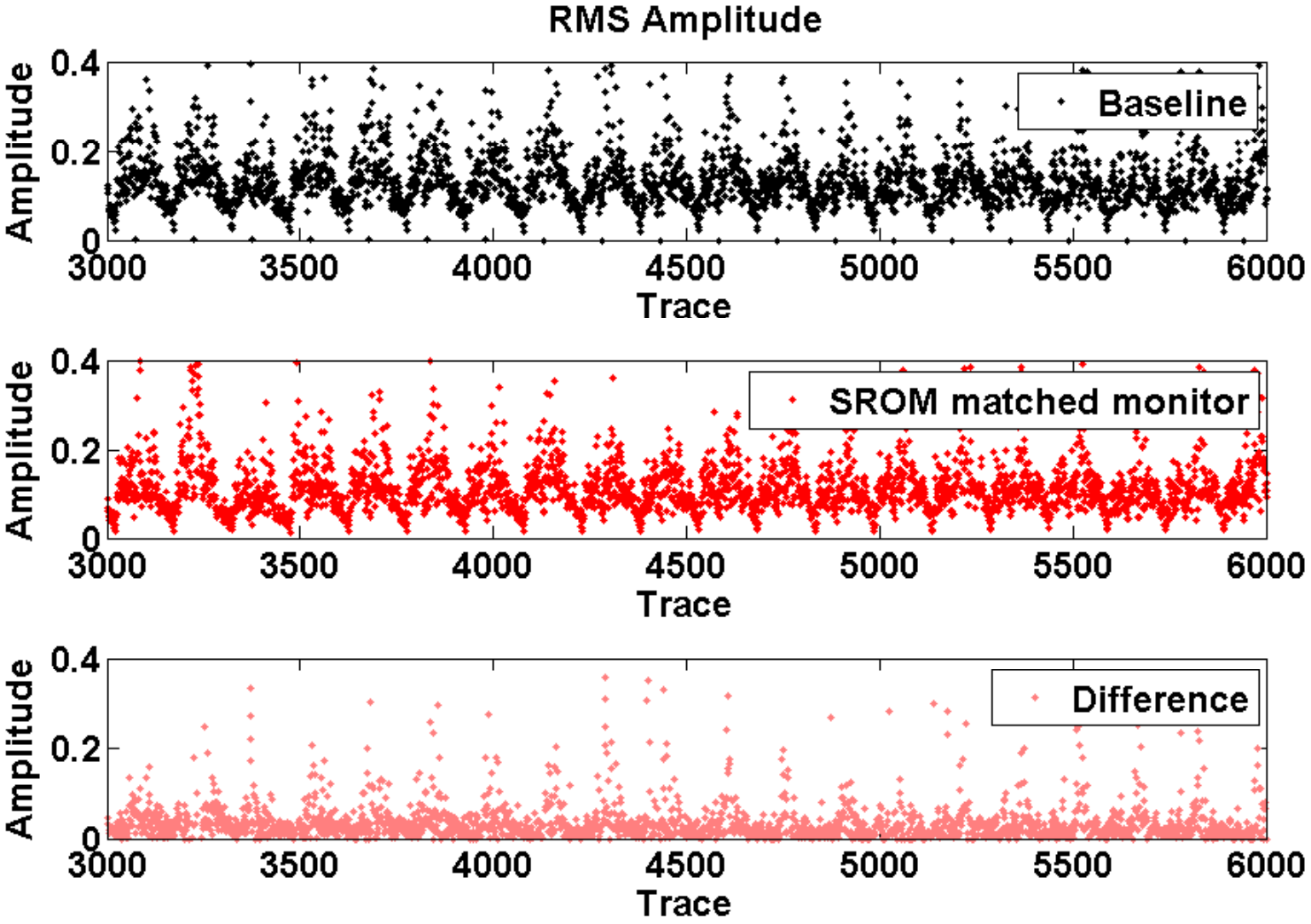
Time (ms)
SCMF window

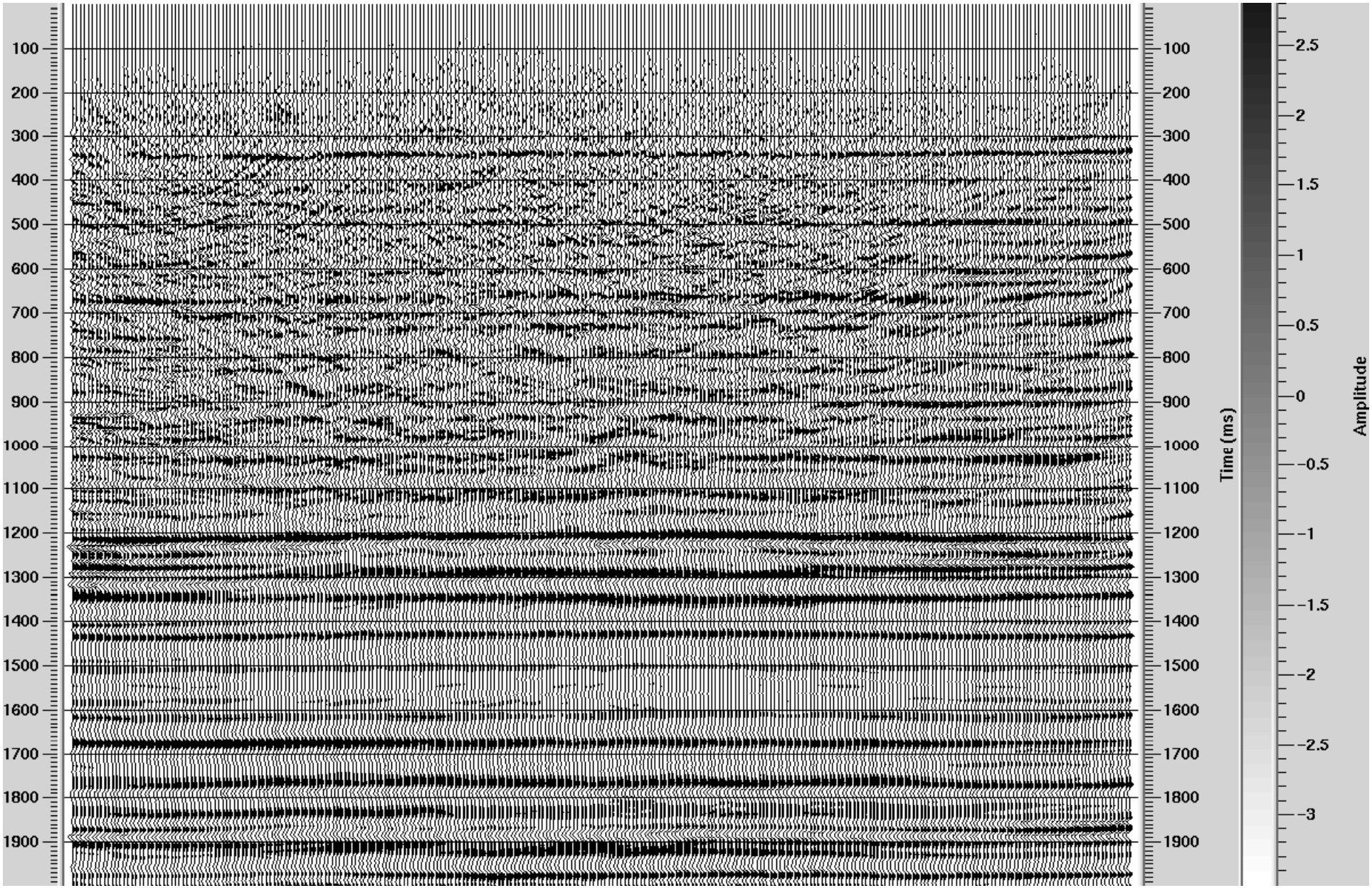
RMS ampl. before SC matching filters



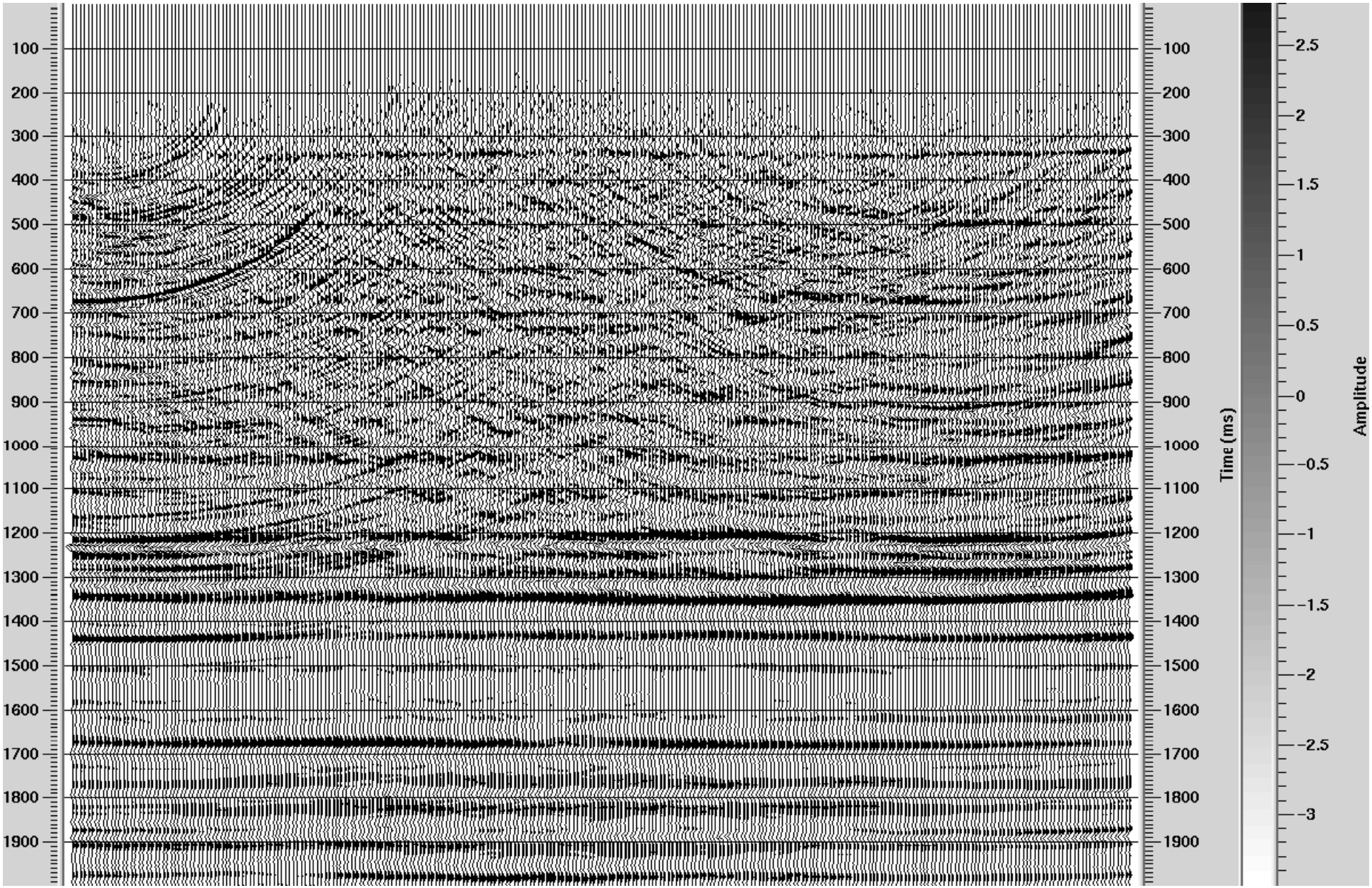
RMS ampl. after SC matching filters



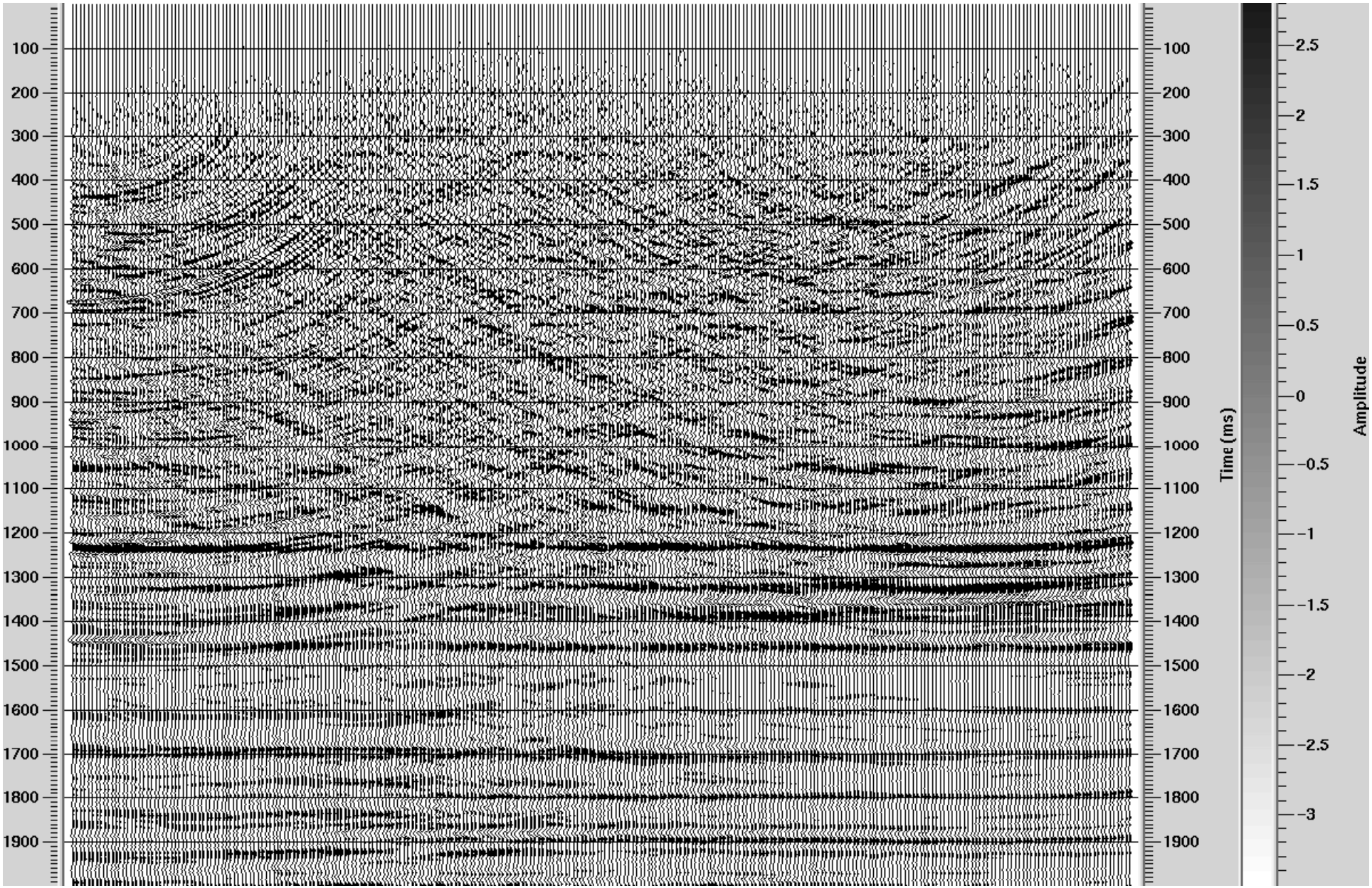
Migrated baseline



Migrated matched monitor



Difference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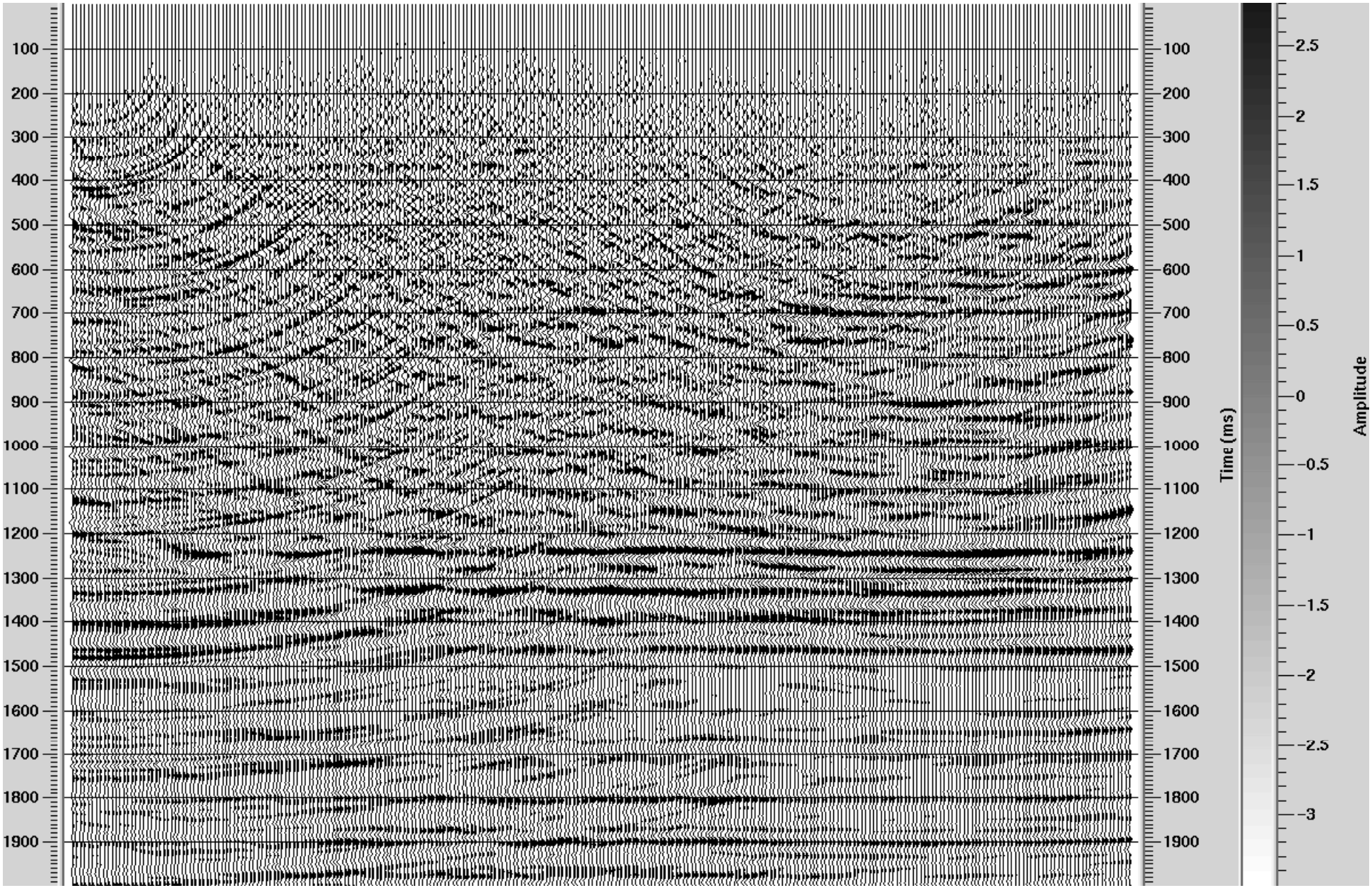
Amplitude

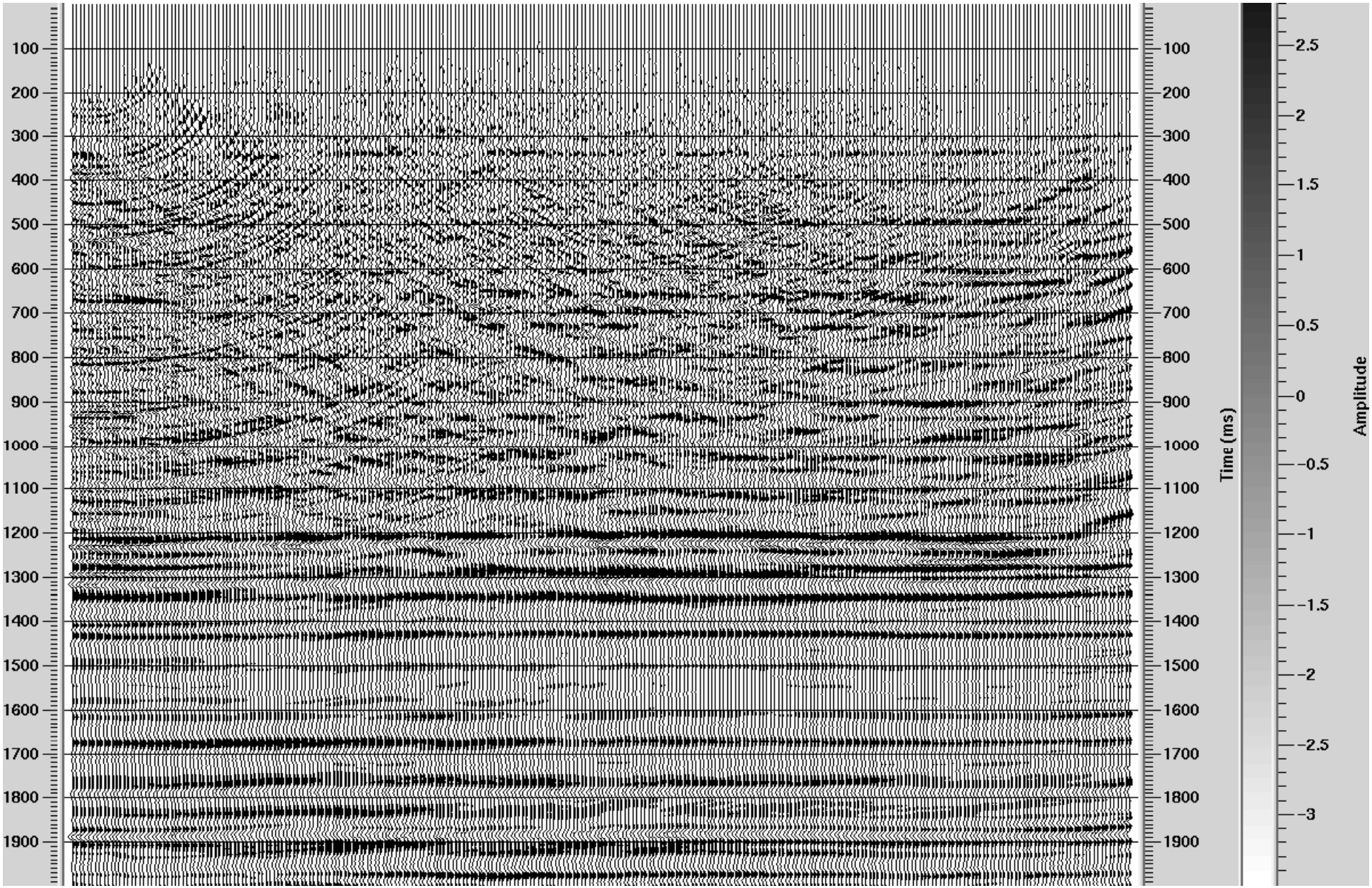
Comparing difference stacks of:

1. Independent processing
2. Simultaneous but unique
3. Simultaneous and common

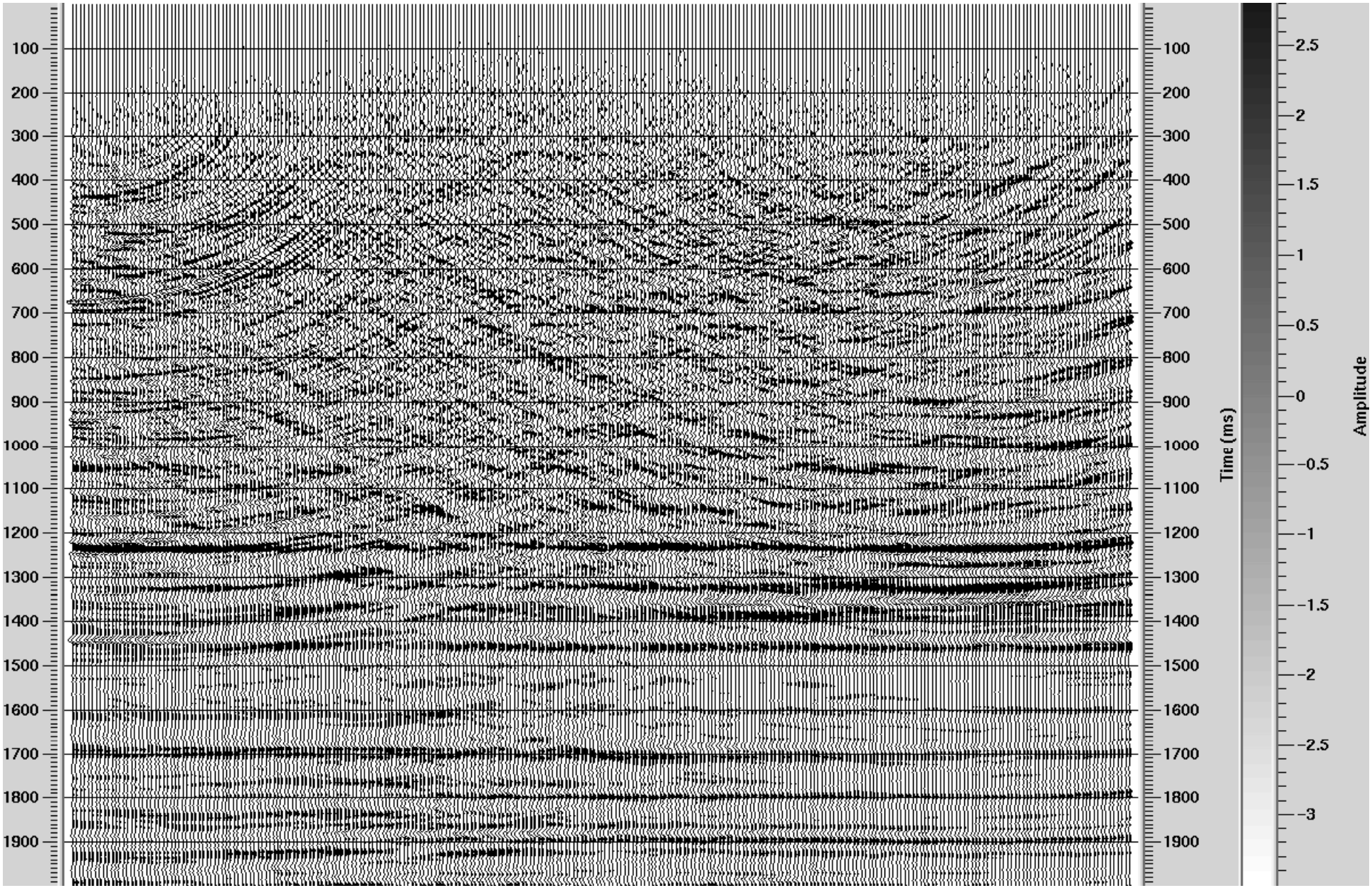
1. Independent processing



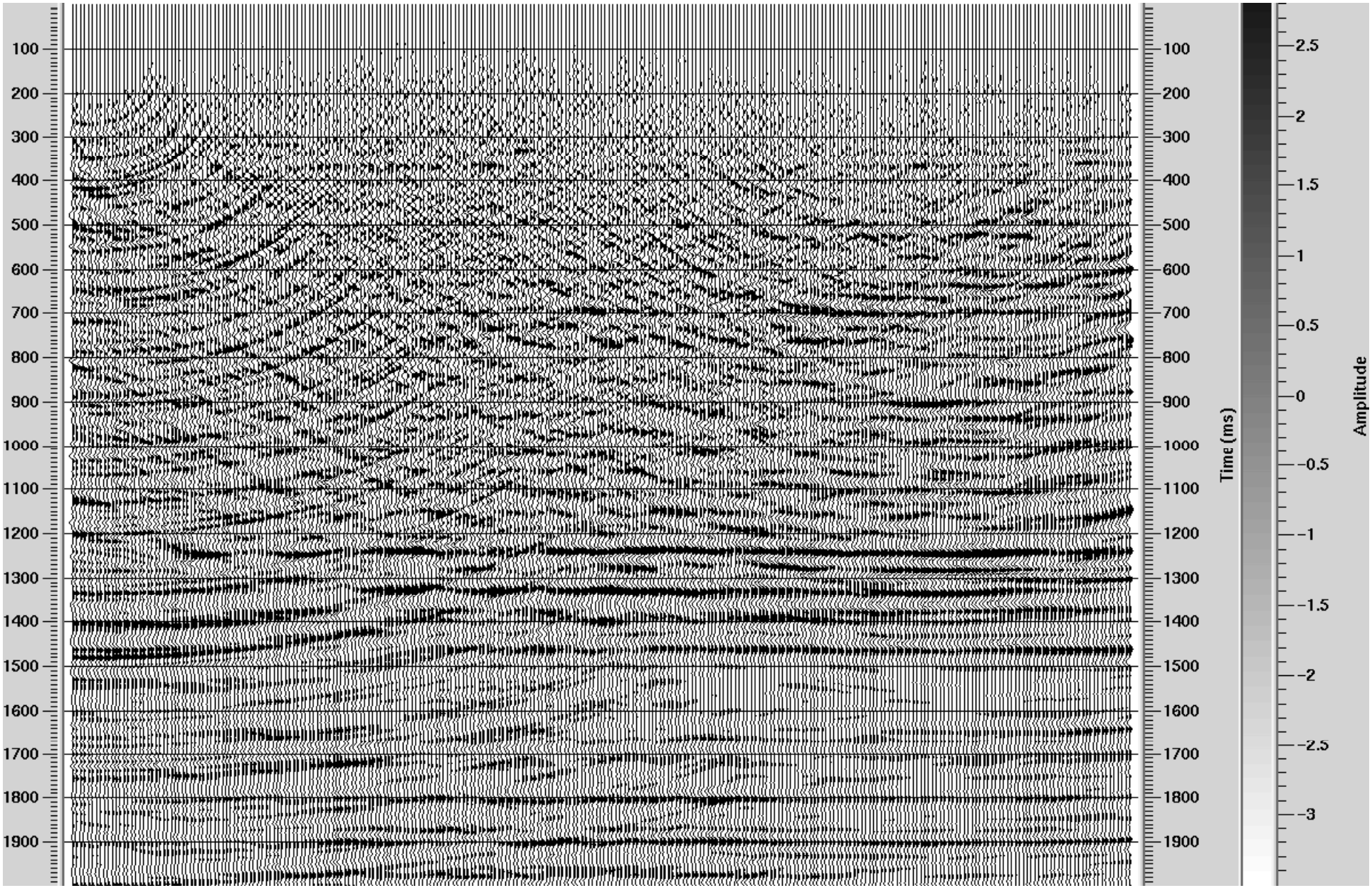
2. Simultaneous but unique



3. Simultaneous and common



1. Independent processing



Summary

- We’ve seen the difference between independent & simultaneous TL processing
- Independent flow: src & rec wavelets & statics are estimated separately. They may not be the same for co-located traces due to noise/seasonal changes
- Simultaneous but unique operators: the merged surveys will have unique operators and merging both data might ONLY help in resolving longwavelength error

Summary (cont.)

- Simultaneous and common operators:
  - Require surface-consistent matching
  - Common filters for the co-located sources, receivers, ...
  - Common statics solution

Acknowledgments

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