



# Debubble Test

## NZ 3D Processing

16 September 2020

[cgg.com](http://cgg.com)



INSTITUTE FOR GEOPHYSICS



Passion for Geoscience

1. Convert to CGG internal format
2. Nav merge / trace edit
3. Low cut filter
4. Time Variant Scaling (TVS) & Resample to 4ms
5. Swell noise attenuation (SNA)
6. Debubble

- **Objective:**

To attenuate bubble energy.

- **Procedure:**

A predictive/gap deconvolution filter is designed on source signature with source and receiver ghost. This filter is then applied on the seismic data to attenuate the bubble energy.

The following two source signatures are used for testing:

- **Modelled Signature (MS)** obtained from Nucleus based on acquisition gun array layout and volume.
- **Statistical Signature (SS)** obtained from aligning and stacking water bottom below 1 sec.

- **Display:**

Test line: Seq 018 (Gun 1 Cable 2); Sequence 039 (Gun 2 Cable 1).

Display: Selected shot gathers, stacks, and amplitude spectrum.

- **Observation and Recommendation:**

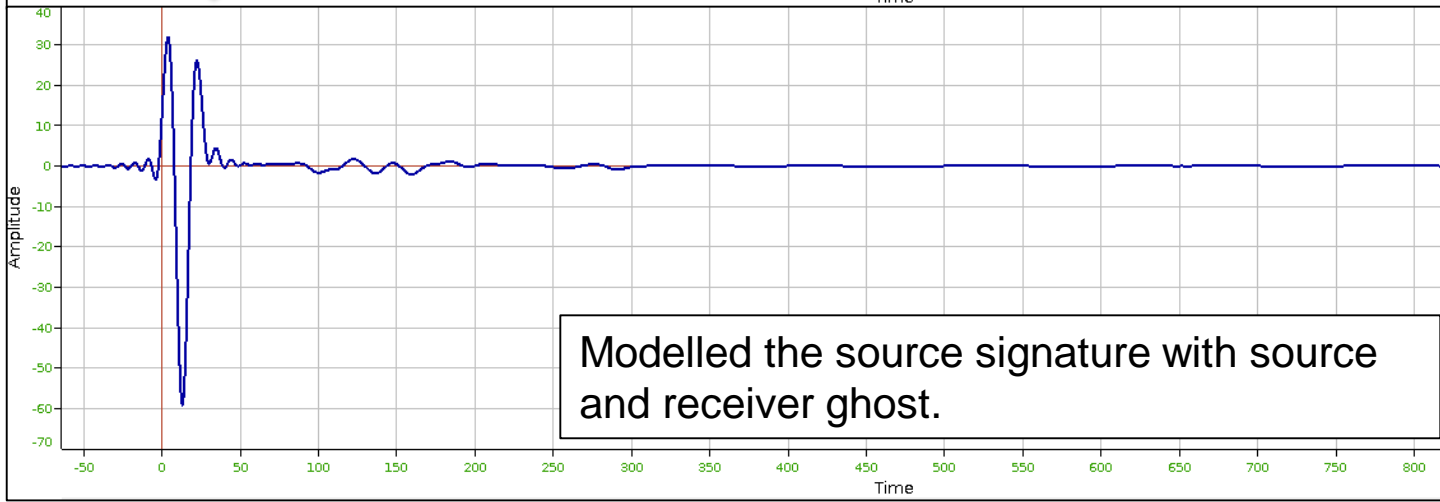
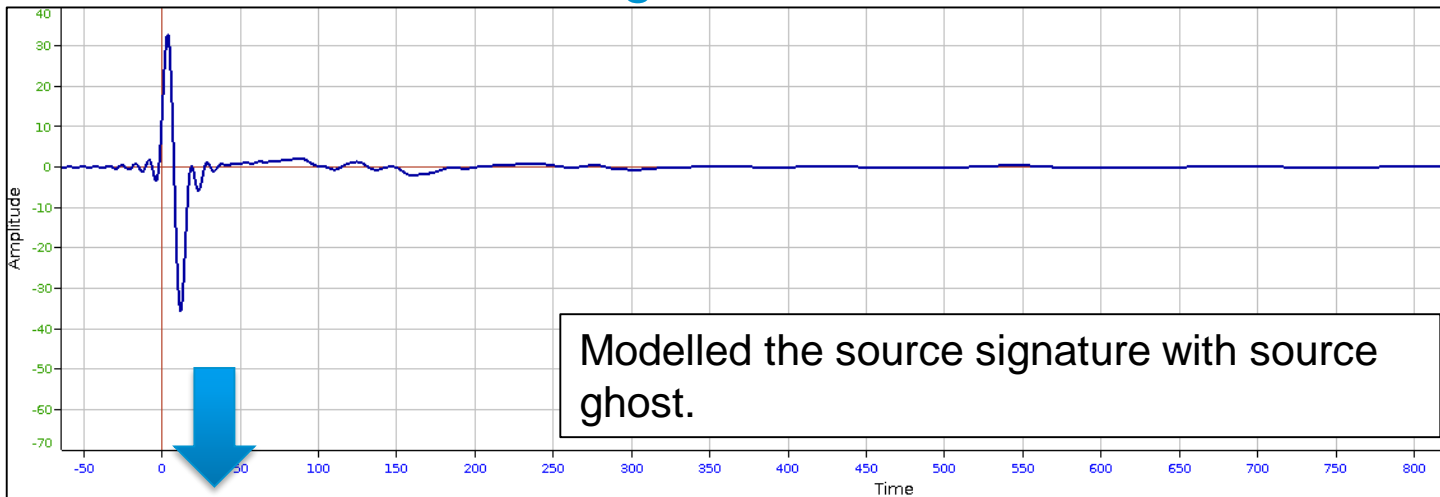
Debubble filter from statistical signature reasonably removes bubble energy without creating artifact compared to the one from modelled signature. We recommend to use statistical signature to generate debubble filter and apply it in production.

# Source Signatures





# Modelled Source Signature

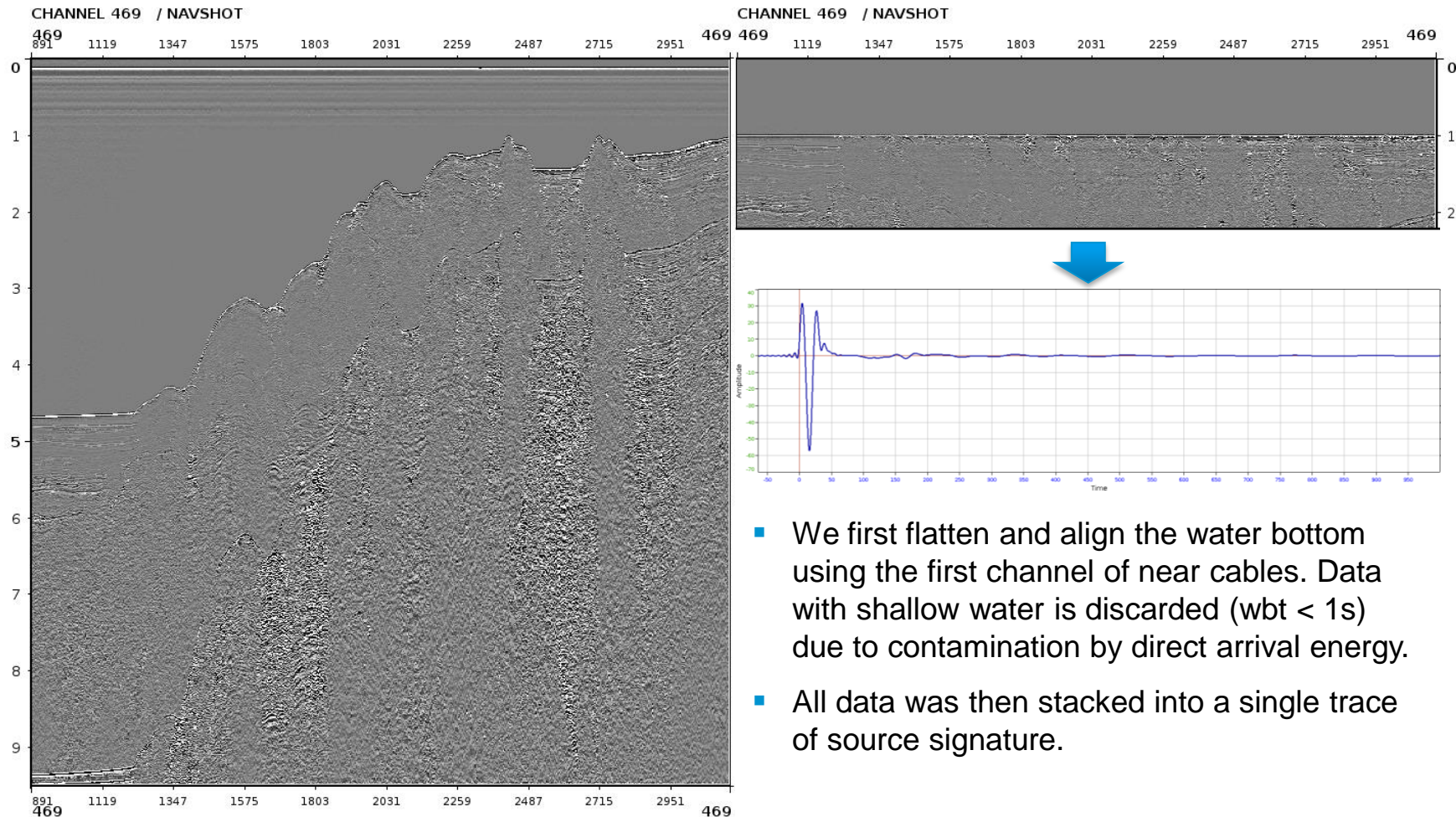


- The signature was resampled to 4ms in the same way as production was.
- Receiver ghost was added based on 8m receiver depth and water velocity of 1520m/s.



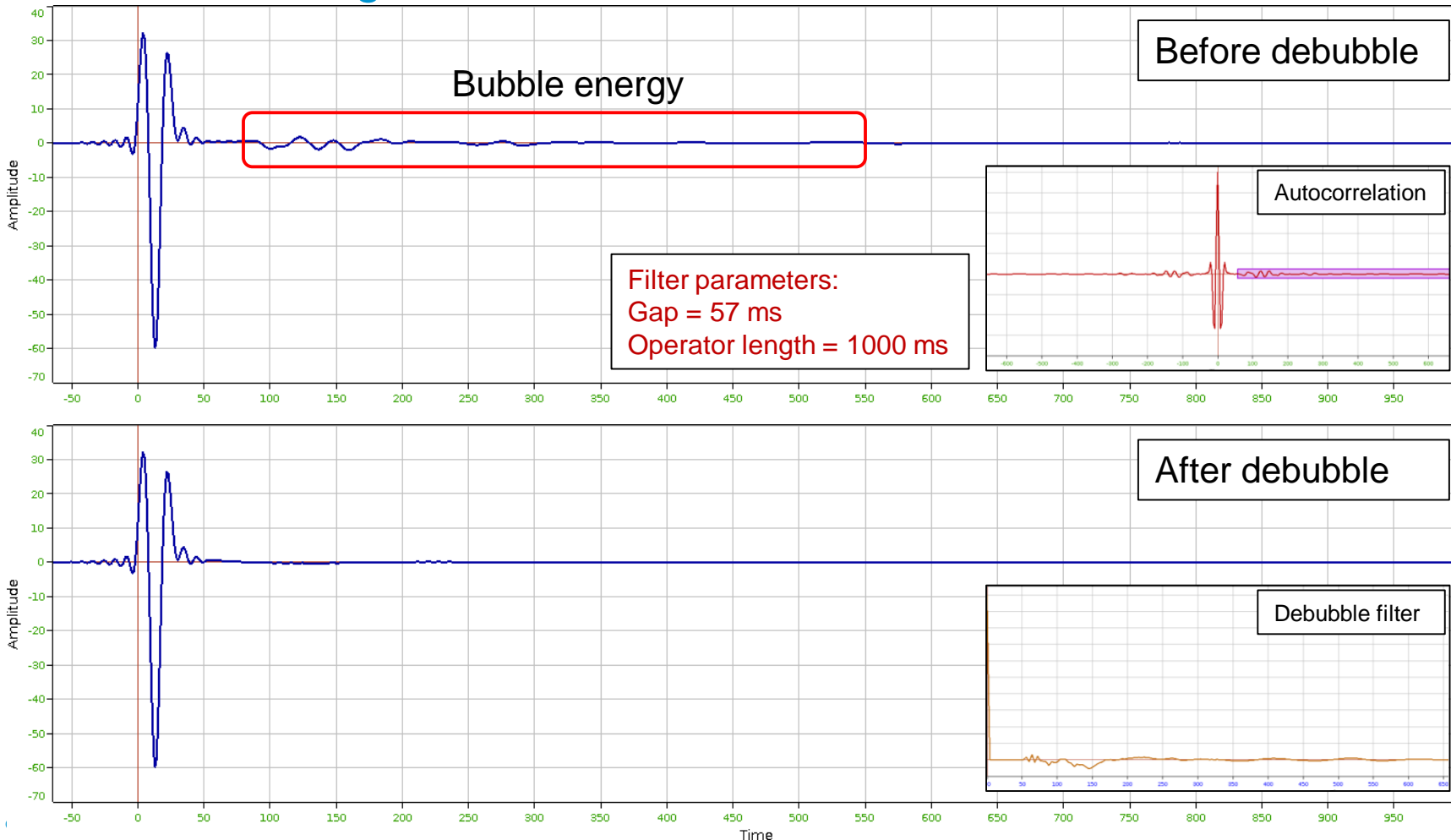
# Statistical Source Signature from Water Bottom Stacking

6

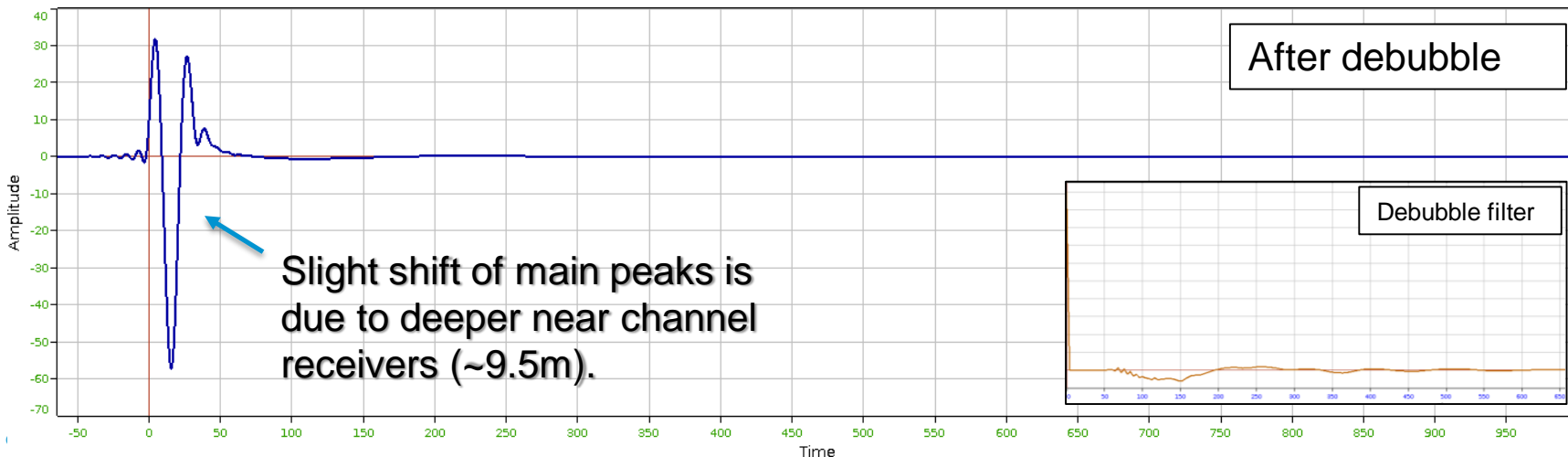
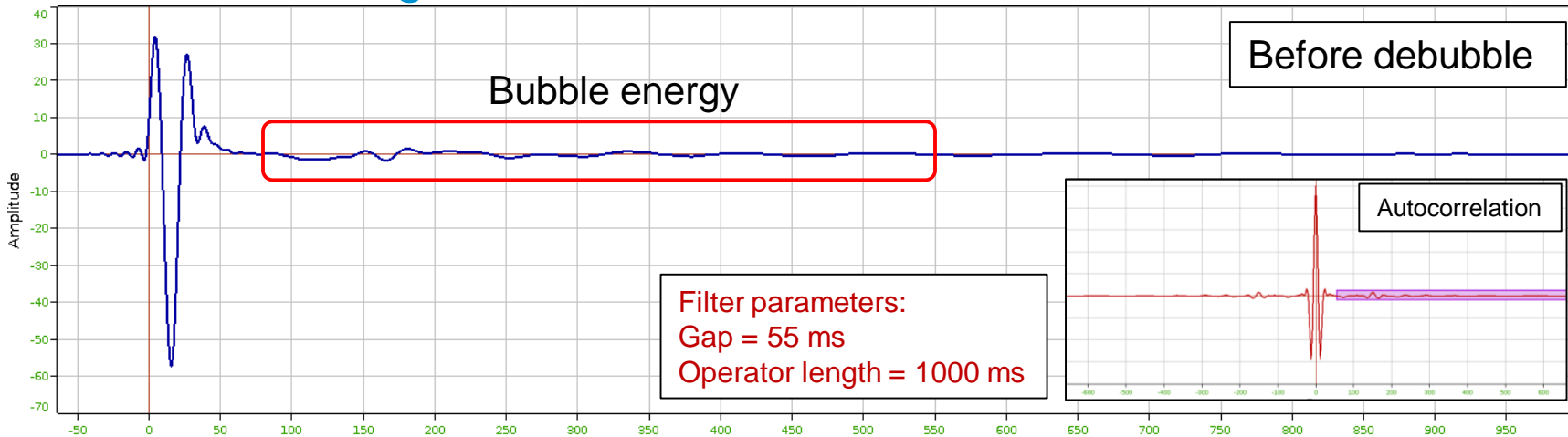


- We first flatten and align the water bottom using the first channel of near cables. Data with shallow water is discarded ( $wbt < 1s$ ) due to contamination by direct arrival energy.
- All data was then stacked into a single trace of source signature.

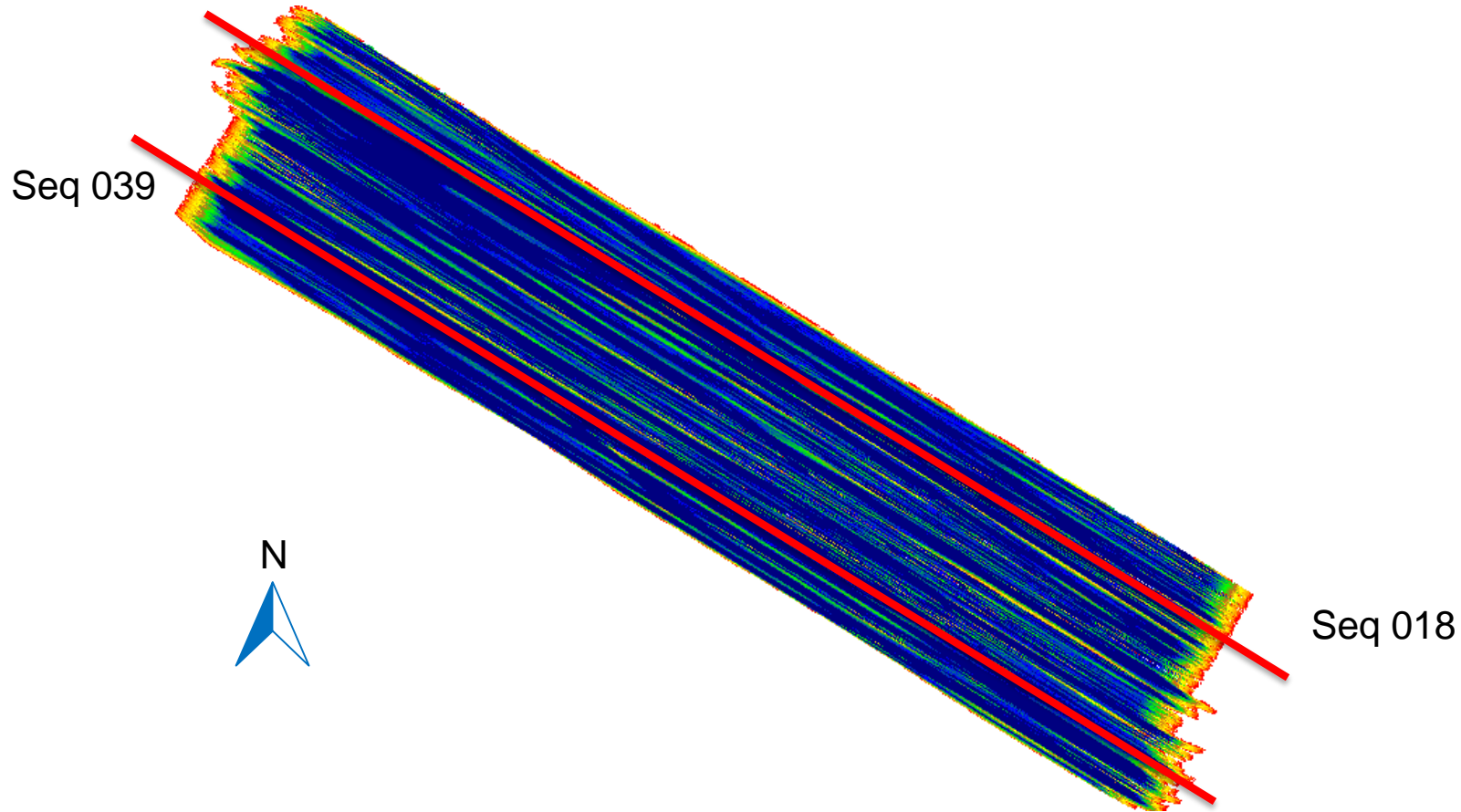
# Modelled Signature & Debubble Filter



# Statistical Signature & Debubble Filter



# Debubble result

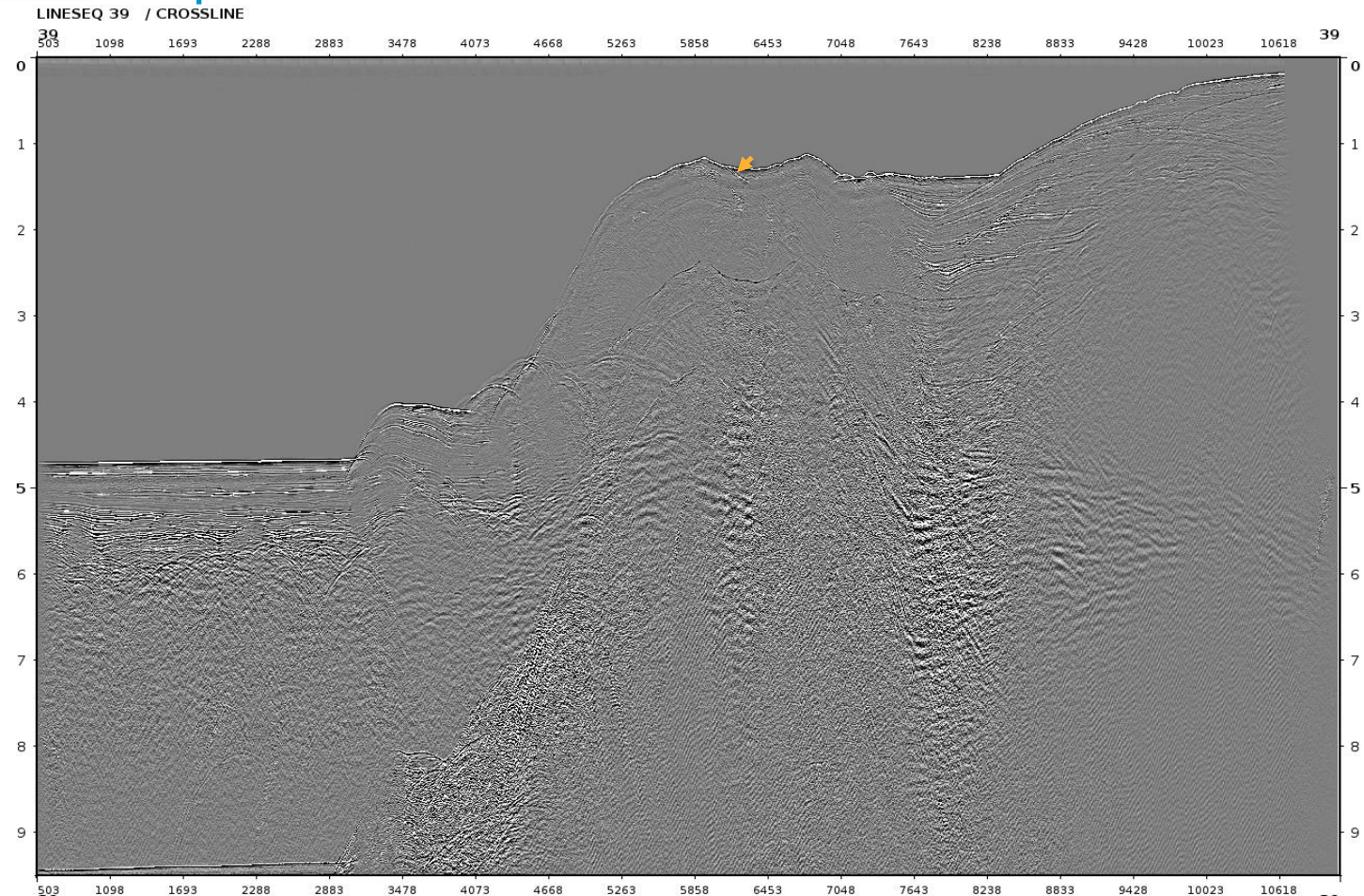


# Seq 039



# Seq039: 2D Stack before Debubble

12

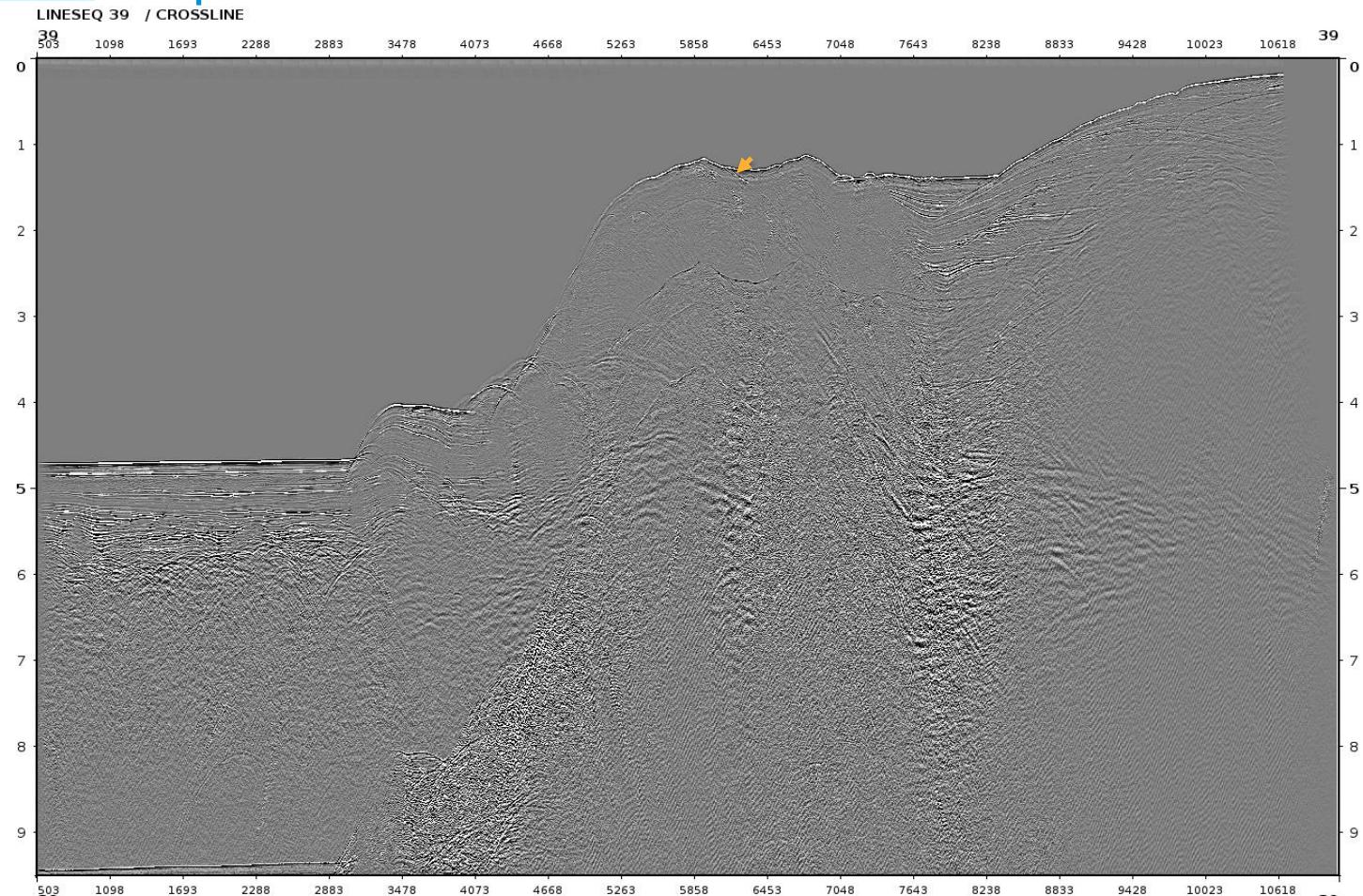


- Low frequency bubble energy consistently follows water bottom.



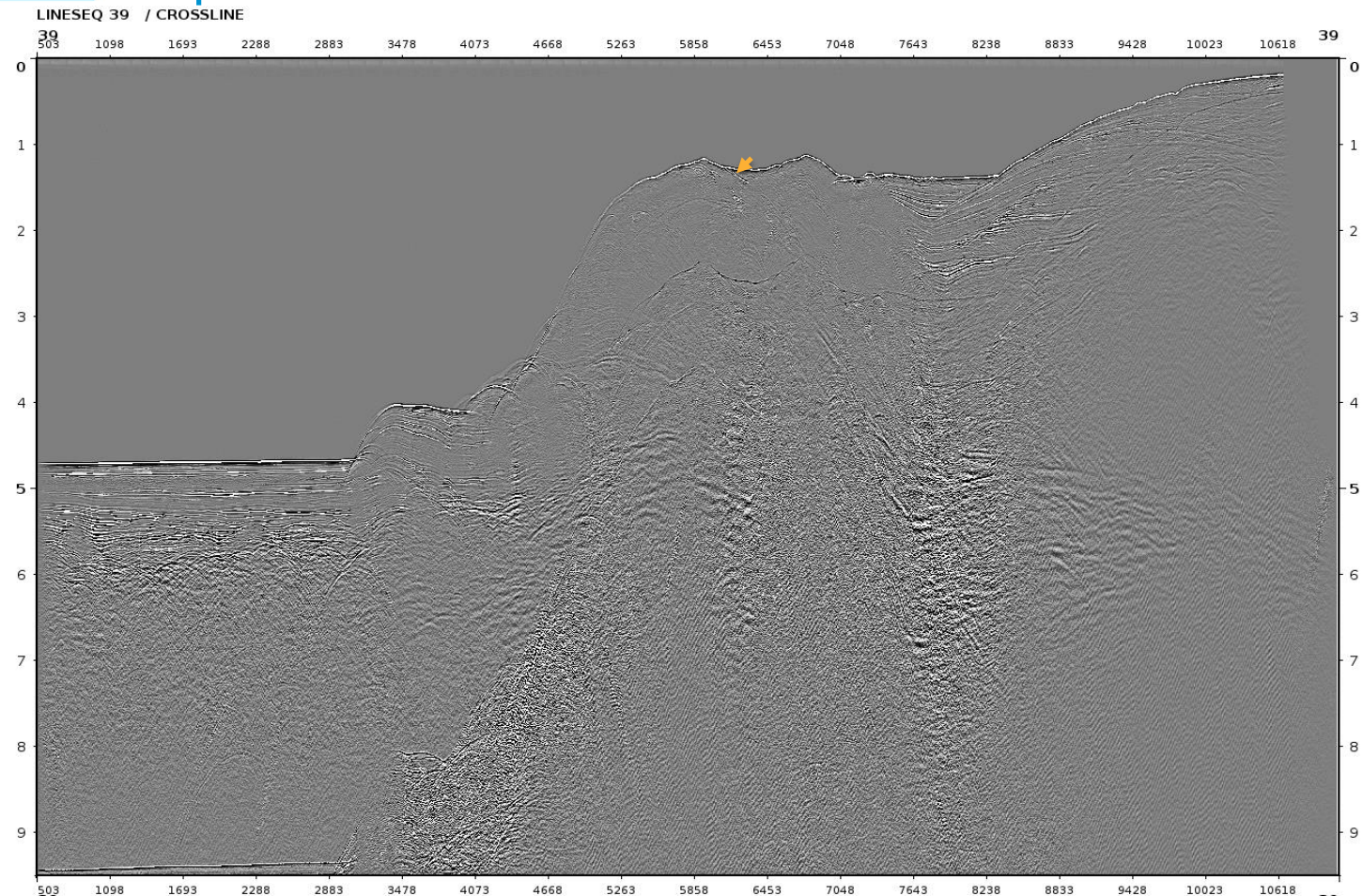
# Seq039: 2D Stack after MS Debubble

13



- Bubble shadow following water bottom is removed while artifact is also generated due to inaccurate bubble in the modelled signature.



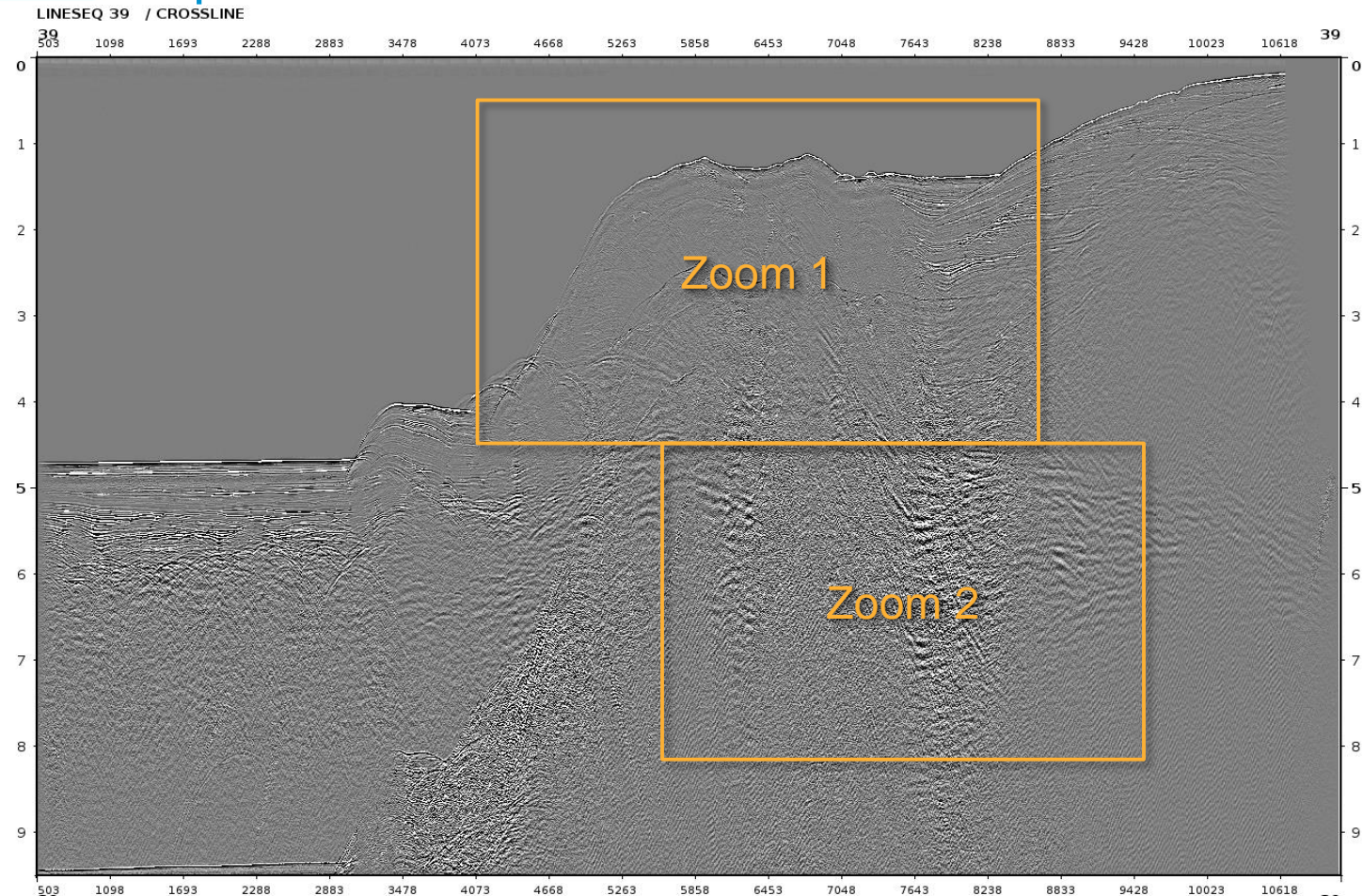


- Bubble filter from statistical signature successfully removes the bubble energy without generating artifact.



# Seq039: 2D Stack Zoomed In Location

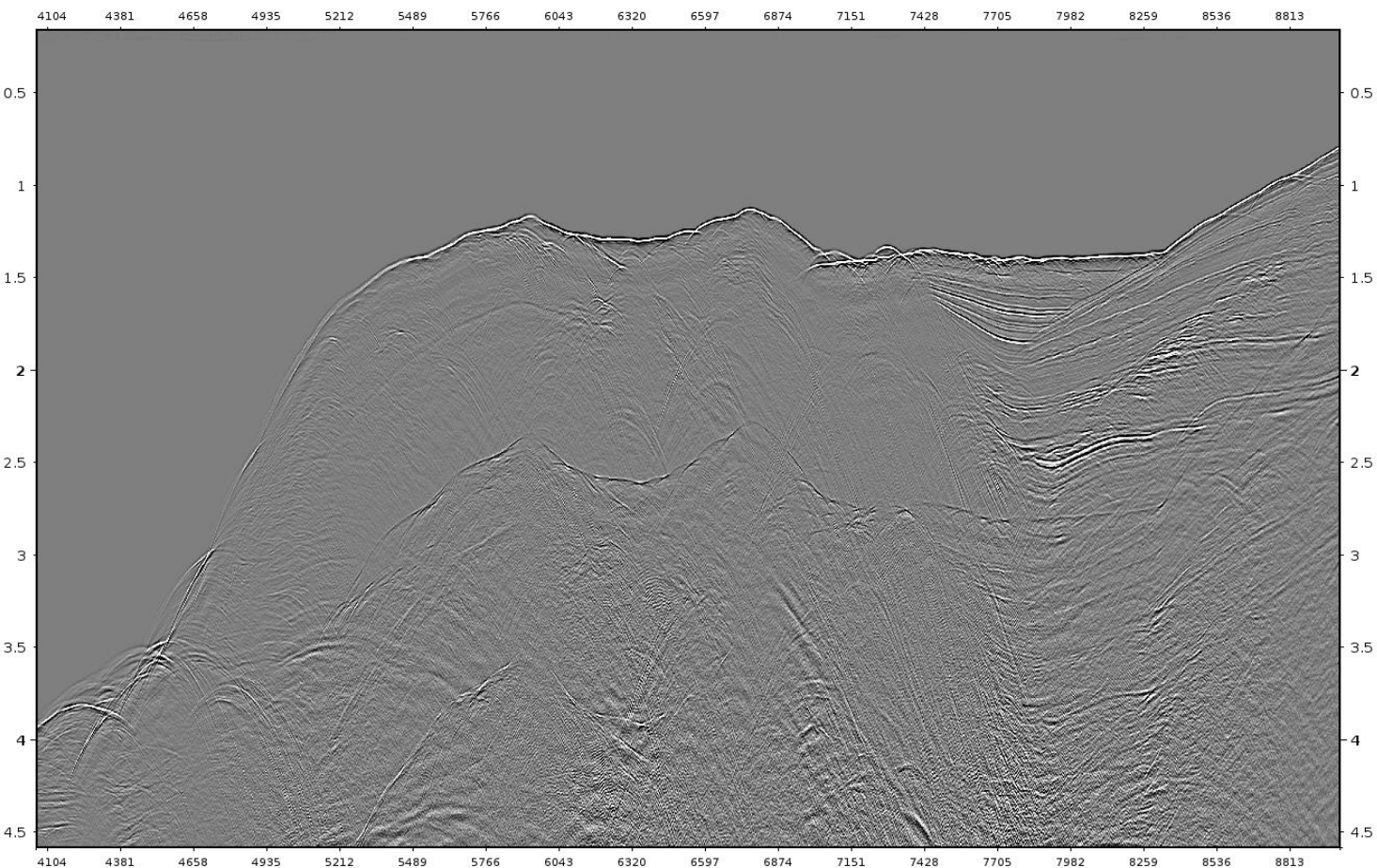
15



# Seq039: Zoomed 2D Stack before Debubble

16

LINESEQ 39 / CROSSLINE



- Low frequency bubble energy consistently follows water bottom.

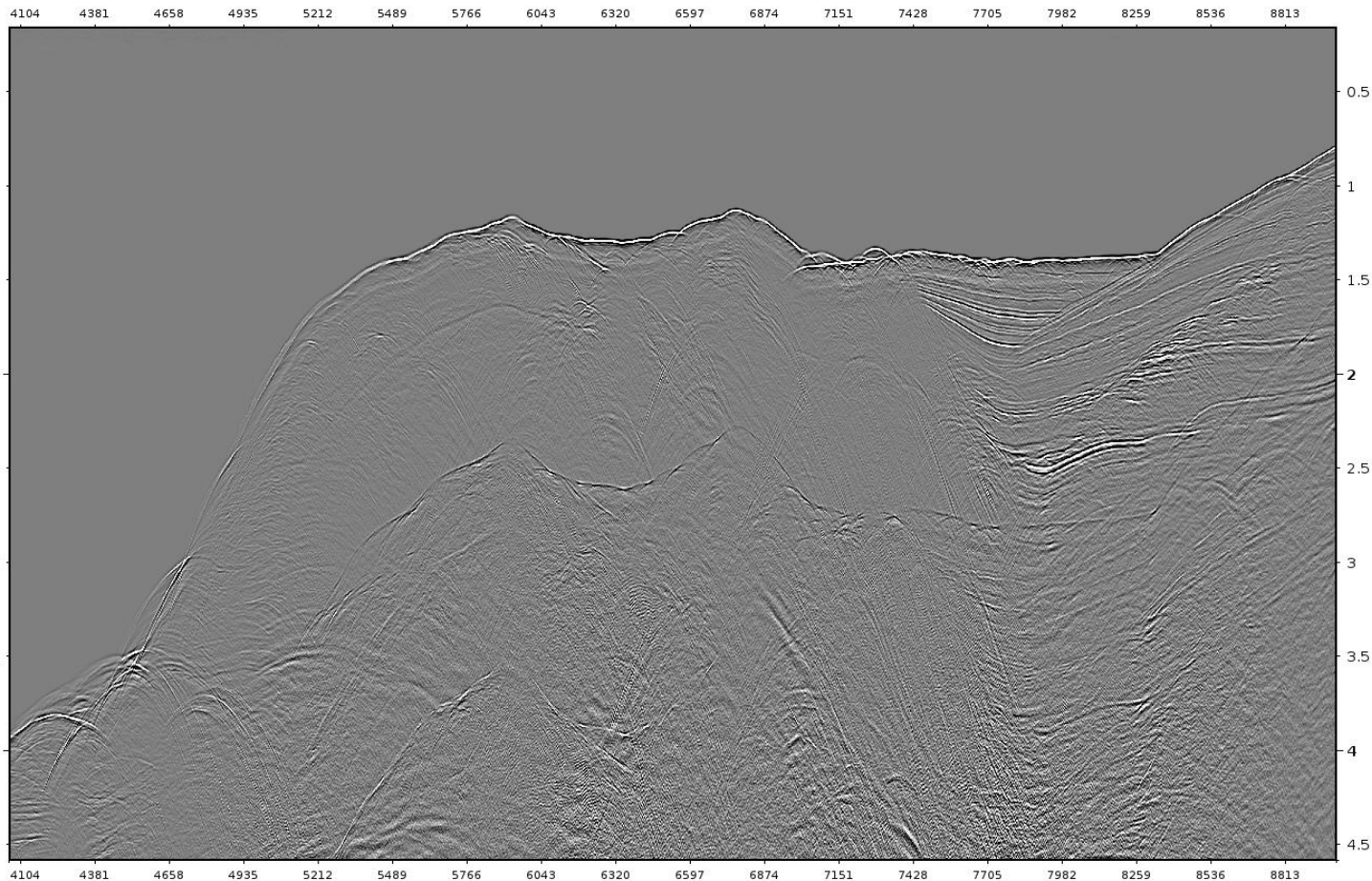




# Seq039: Zoomed 2D Stack after MS Debubble

17

LINESEQ 39 / CROSSLINE



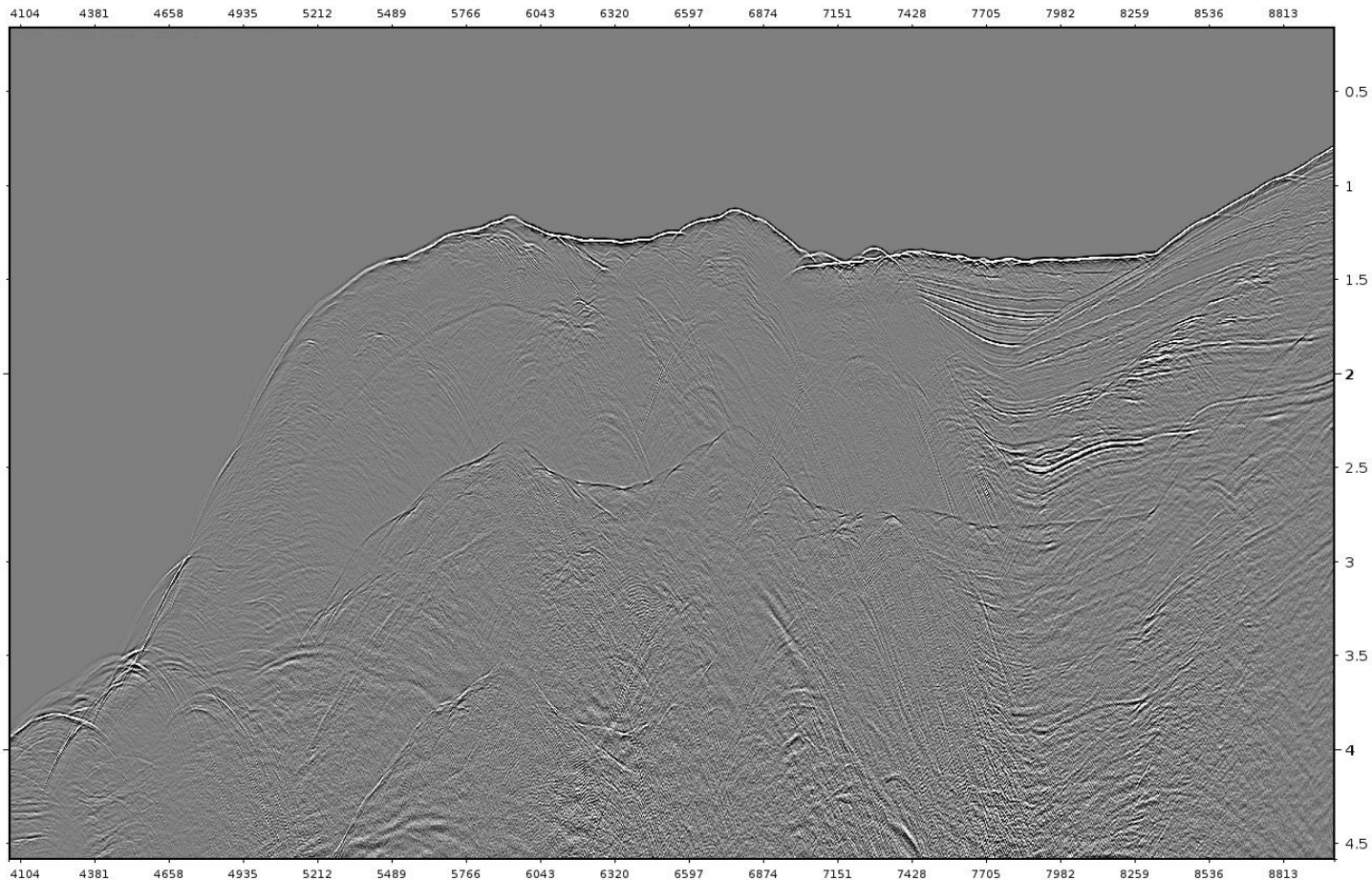
- Bubble shadow following water bottom is removed while artifact is also generated due to inaccurate bubble in the modelled signature.



# Seq039: Zoomed 2D Stack **after** SS Debubble

18

LINESEQ 39 / CROSSLINE



- Bubble filter from statistical signature successfully removes the bubble energy without generating artifact.

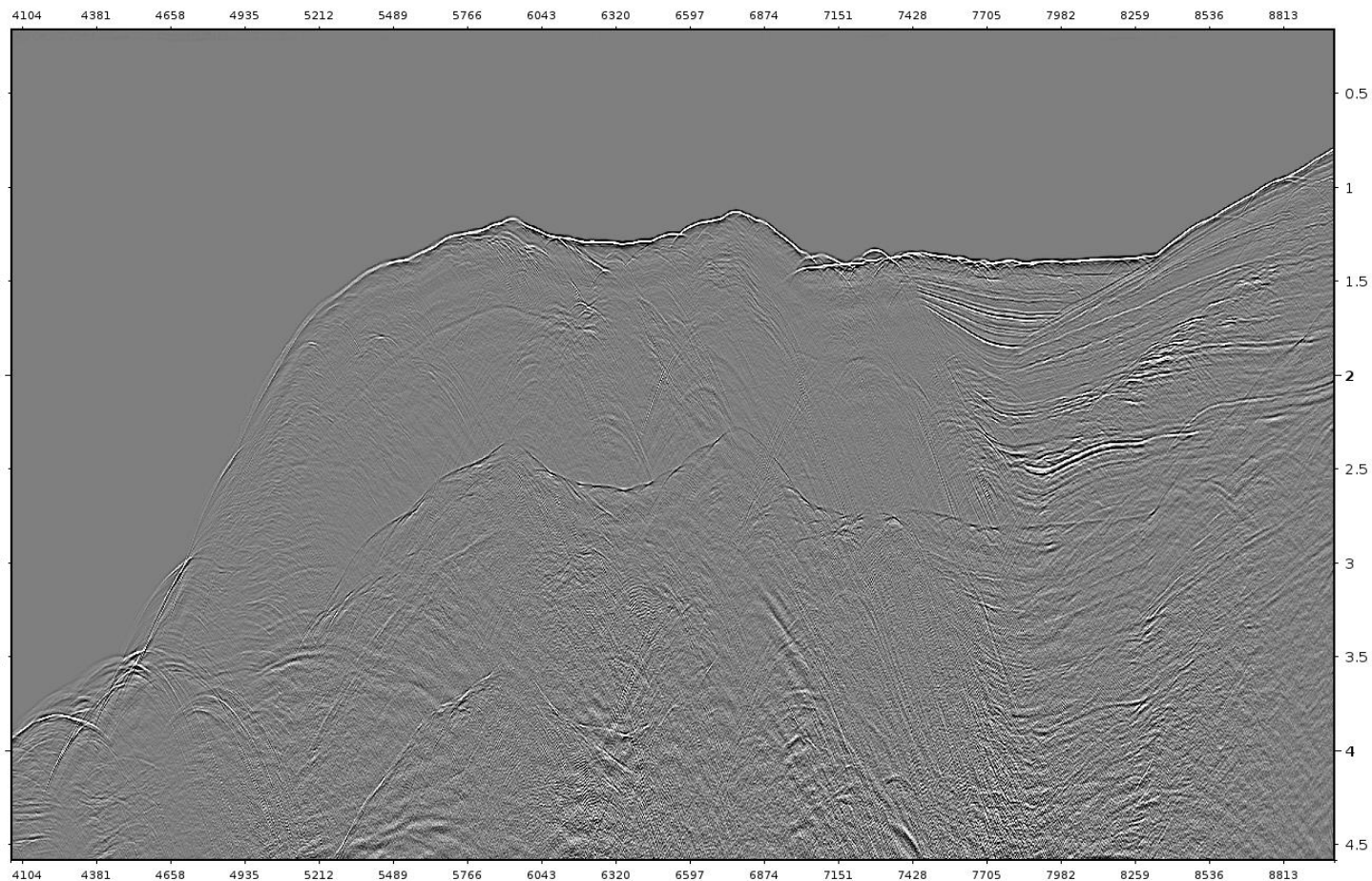




# Seq039: Zoomed 2D Stack before Debubble (Repeat)

19

LINESEQ 39 / CROSSLINE



- Repeat of debubble input.

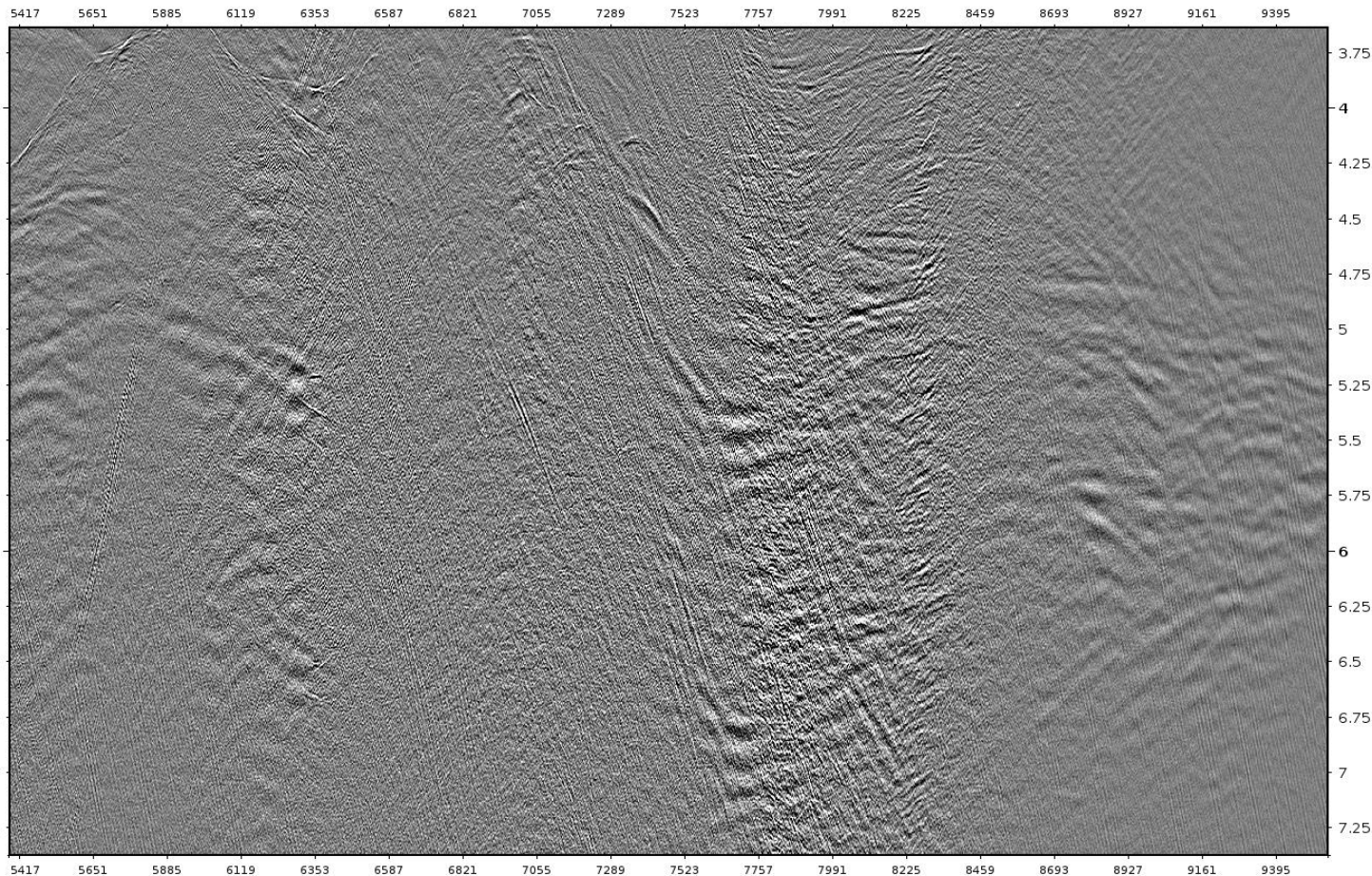




# Seq039: Zoomed 2D Stack before Debubble

20

LINESEQ 39 / CROSSLINE



- In deep section, bubble energy appears as reverberation of primaries.

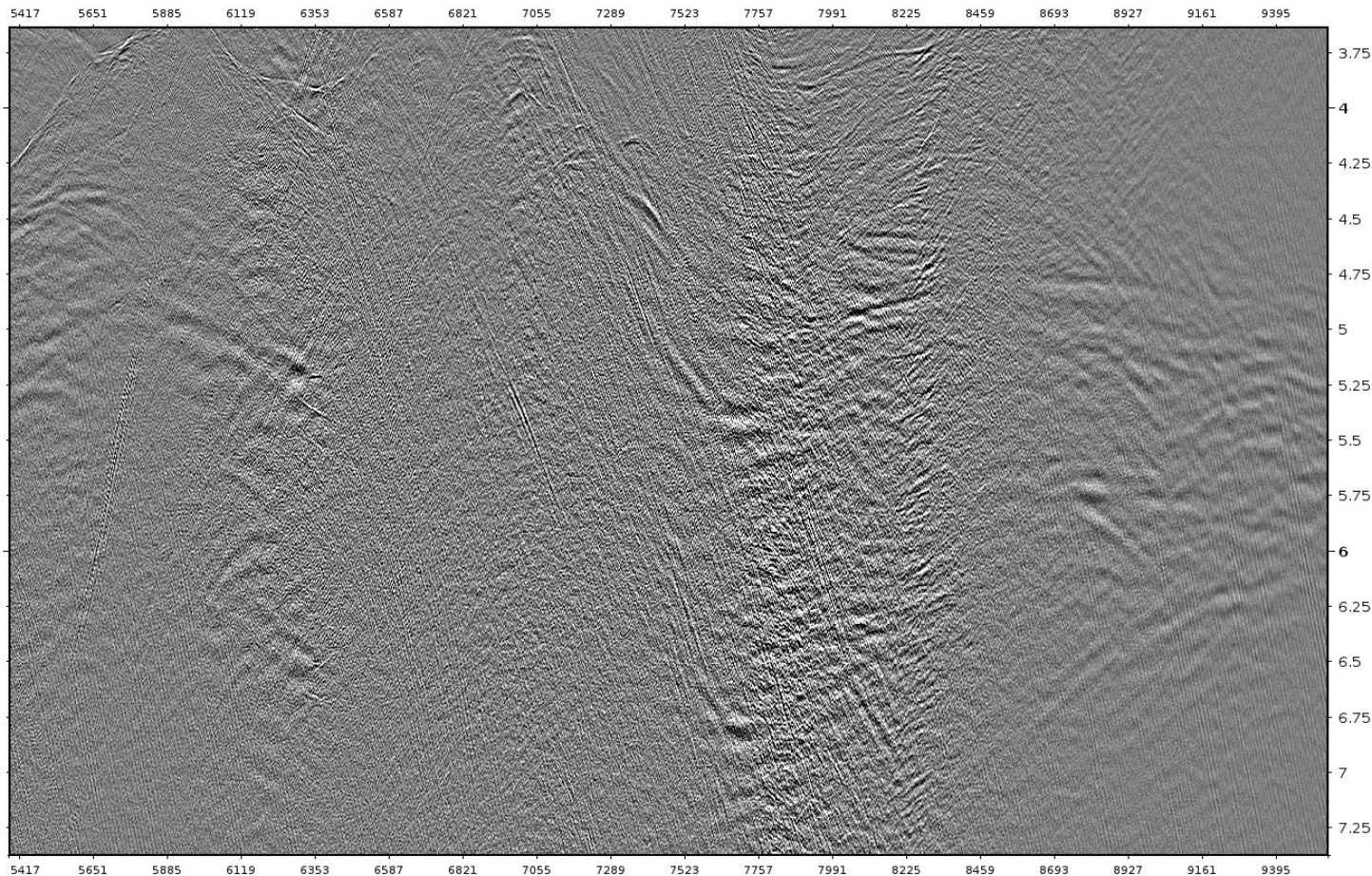




# Seq039: Zoomed 2D Stack **after** MS Debubble

21

LINESEQ 39 / CROSSLINE

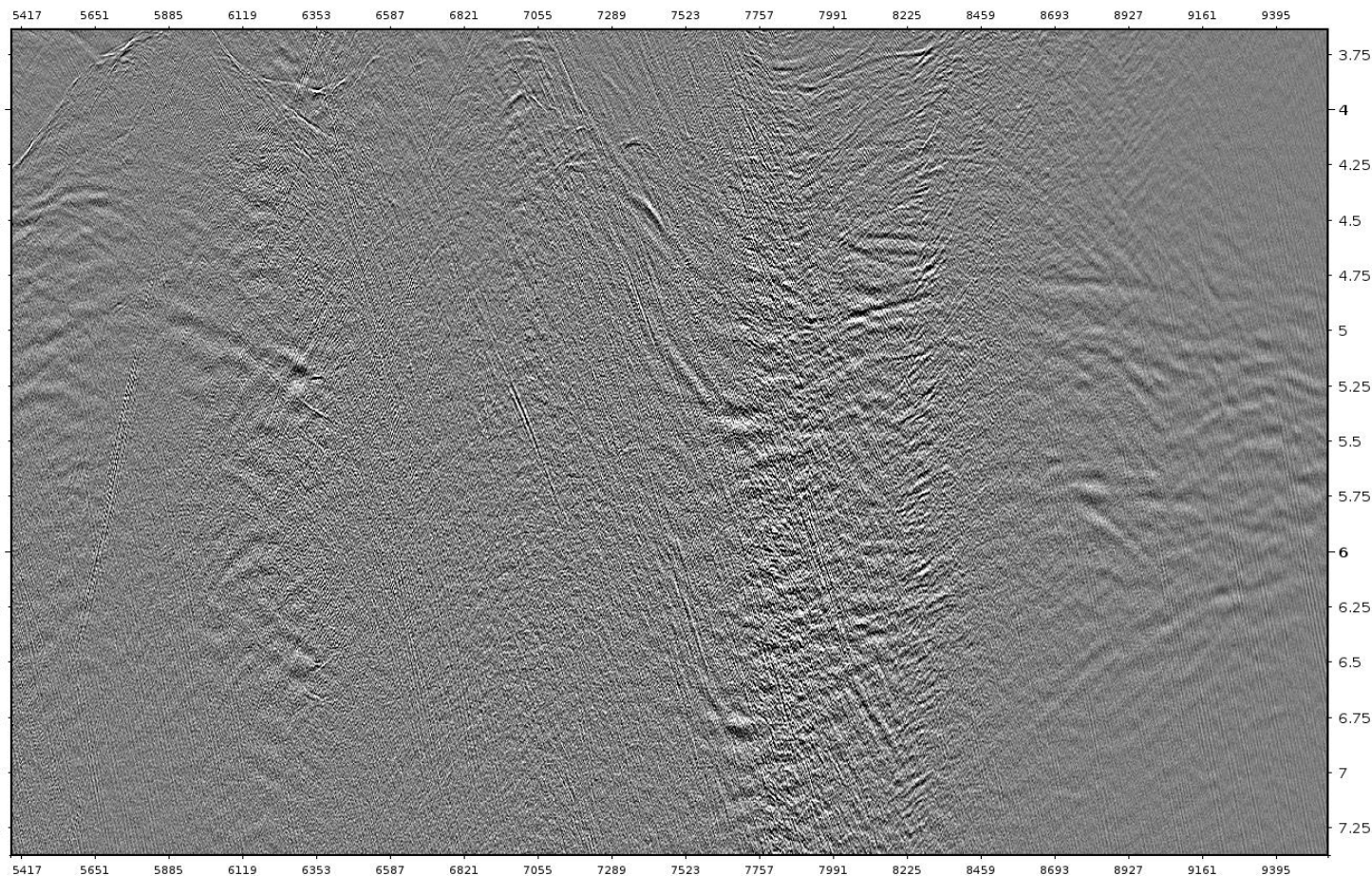


- MS Debubble removes majority of the bubble with some residual.





LINESEQ 39 / CROSSLINE



■ SS Debubble gives better result.

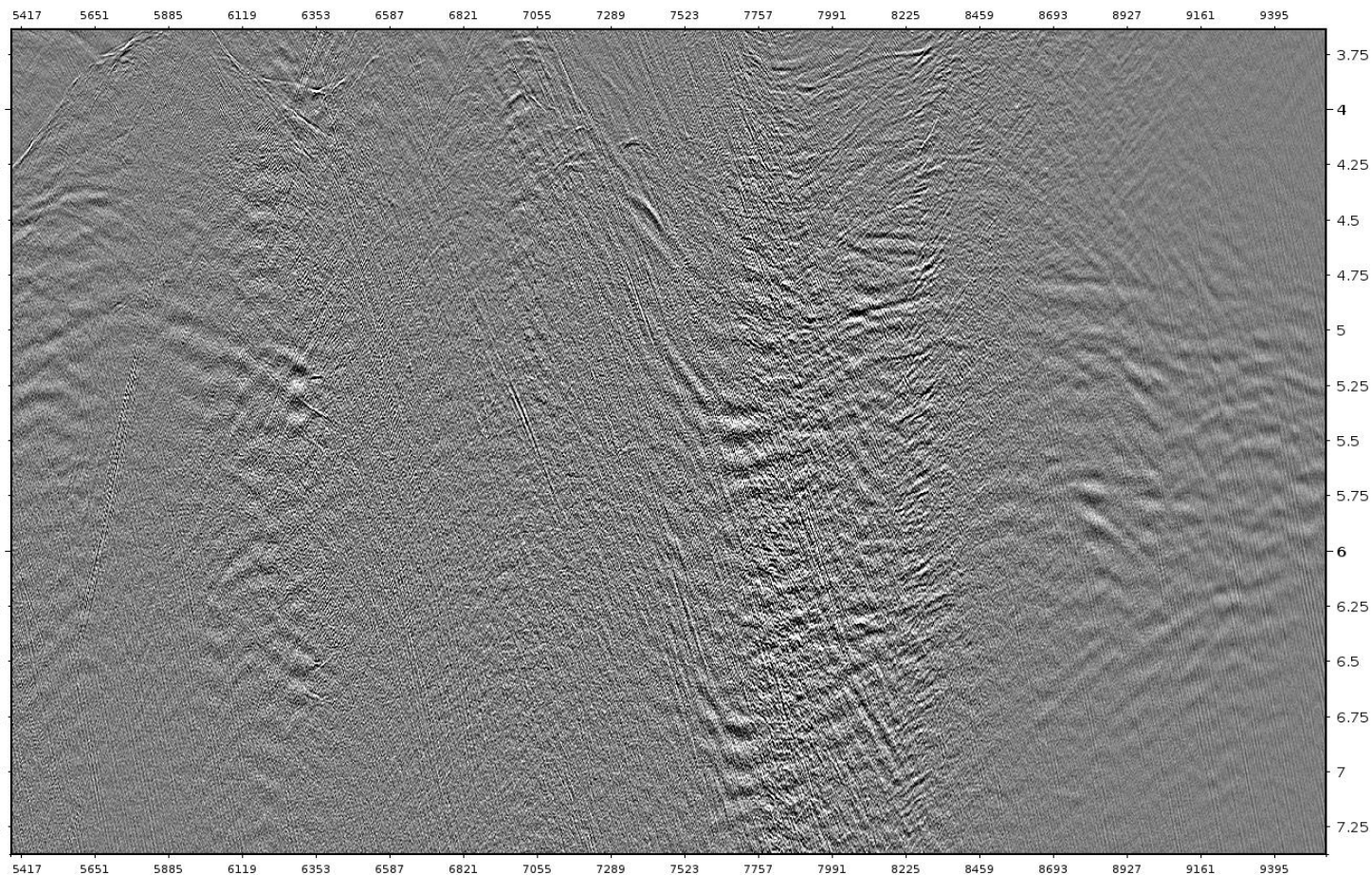




# Seq039: Zoomed 2D Stack before Debubble (Repeat)

23

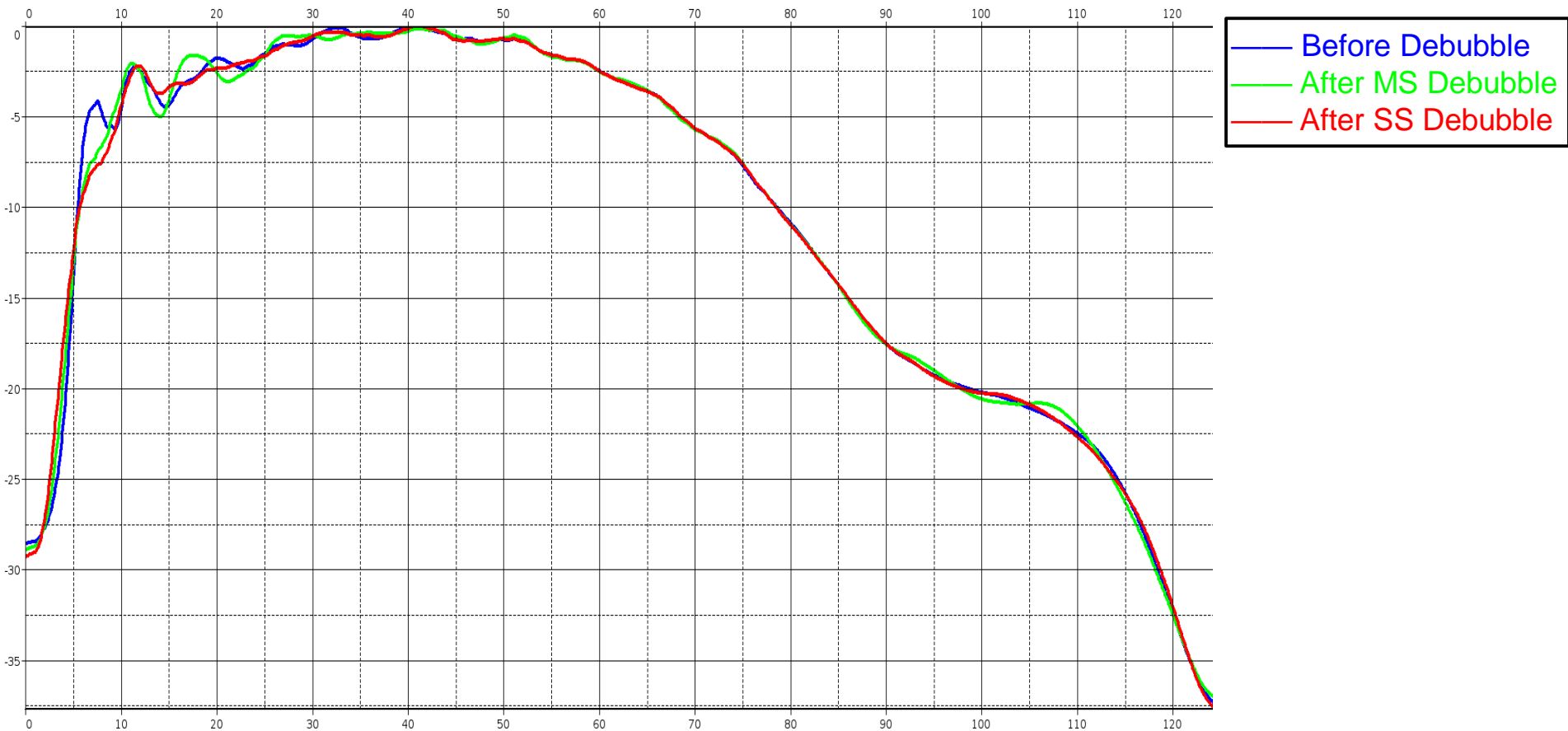
LINESEQ 39 / CROSSLINE





# Seq039: Full Window Amplitude Spectrum of 2D Stack

24

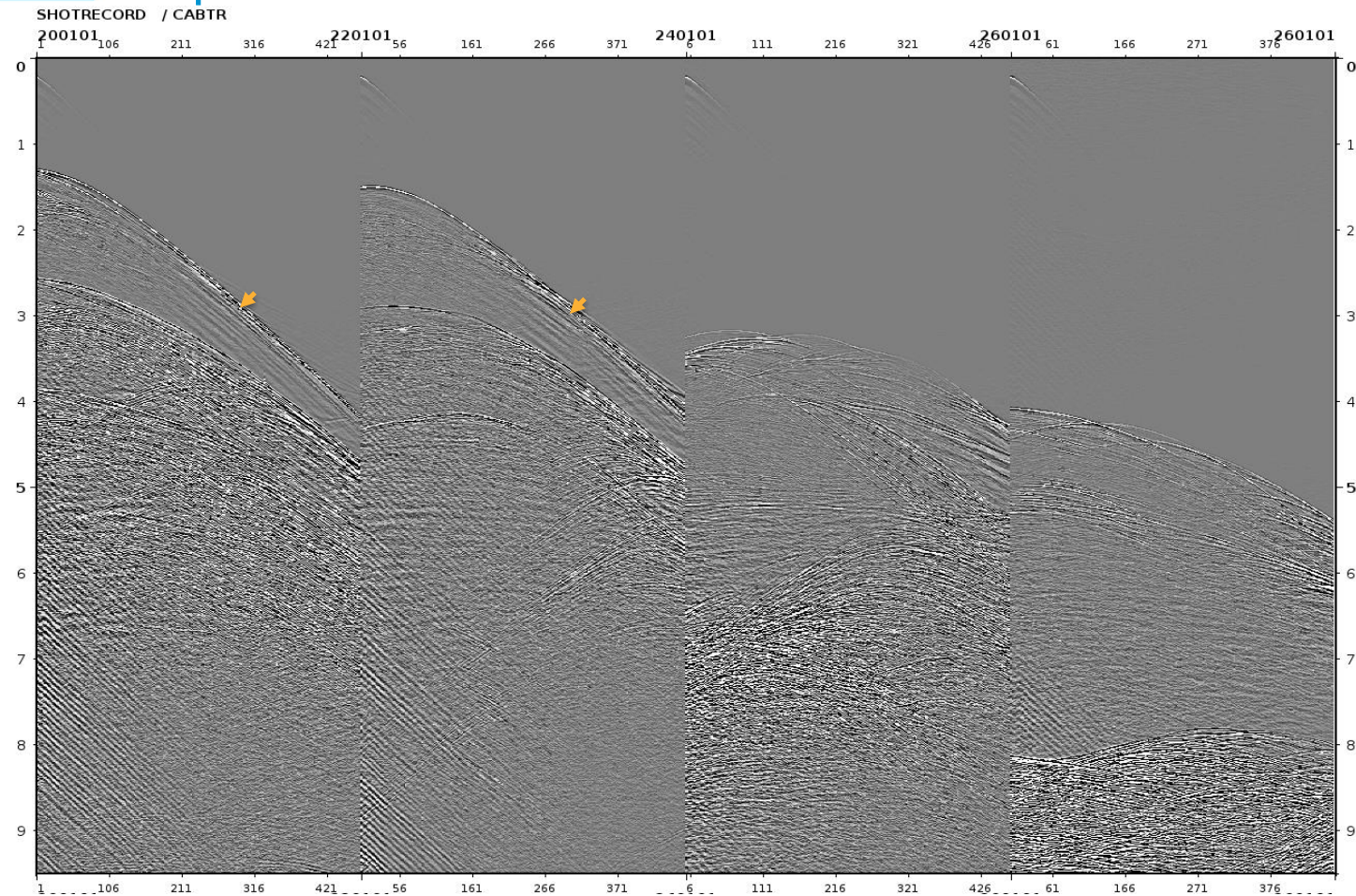






# Seq039: Selected Shot Gathers before Debubble

25

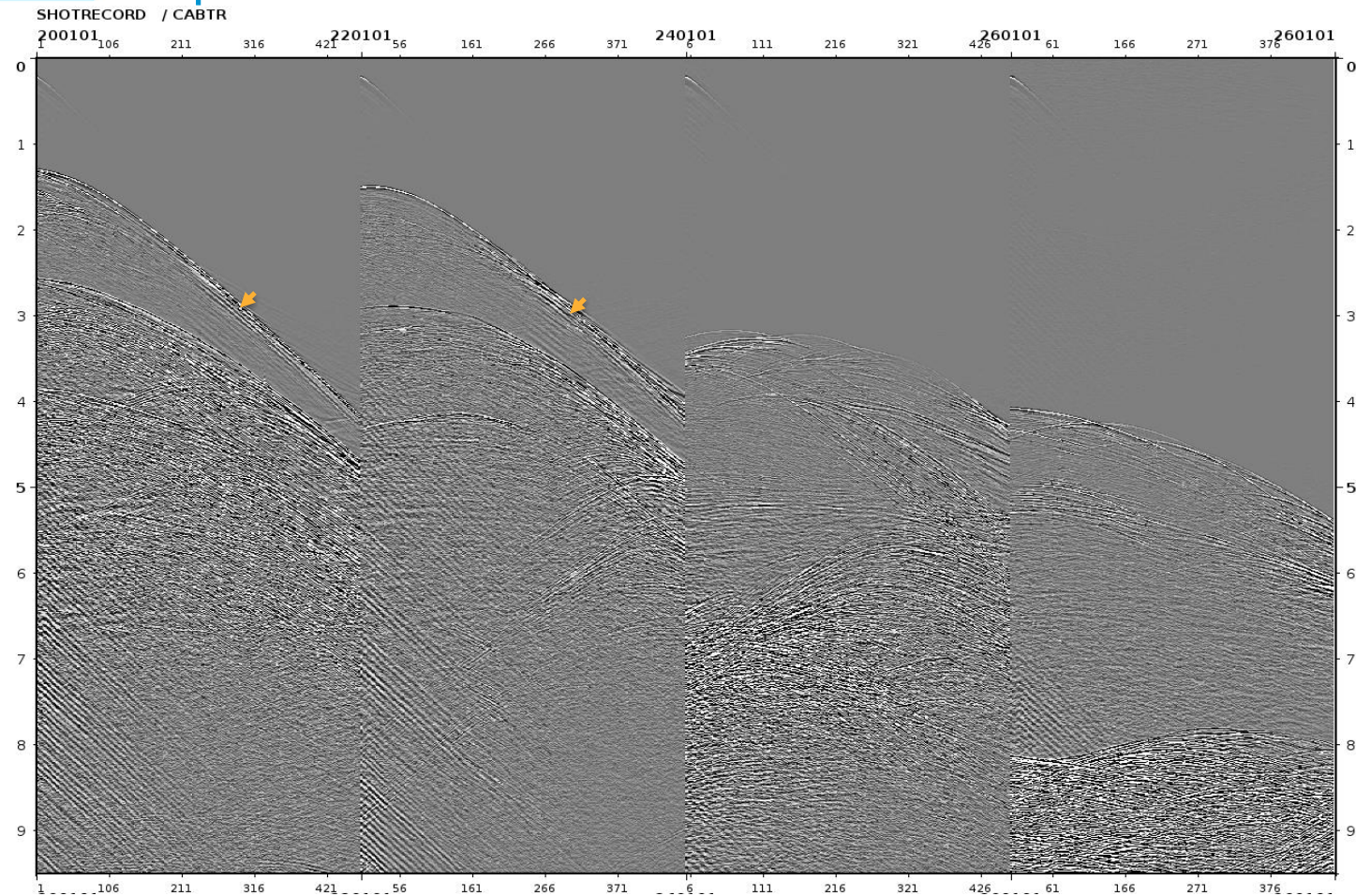


- Bubble energy is more obvious beneath the strong events.



# Seq039: Selected Shot Gathers after MS Debubble

26



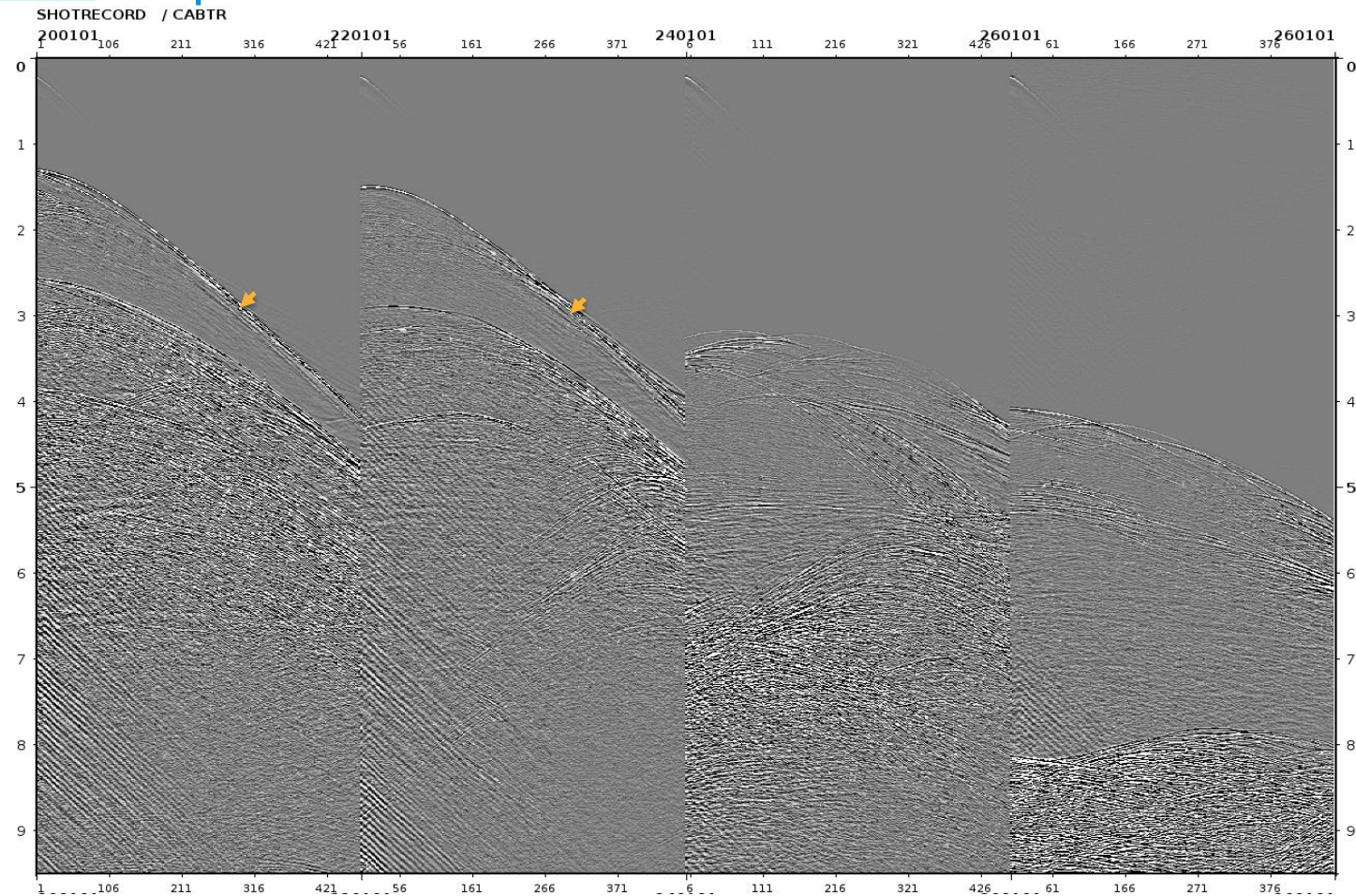
- Bubble energy is more obvious beneath the strong events.





# Seq039: Selected Shot Gathers after SS Debubble

27

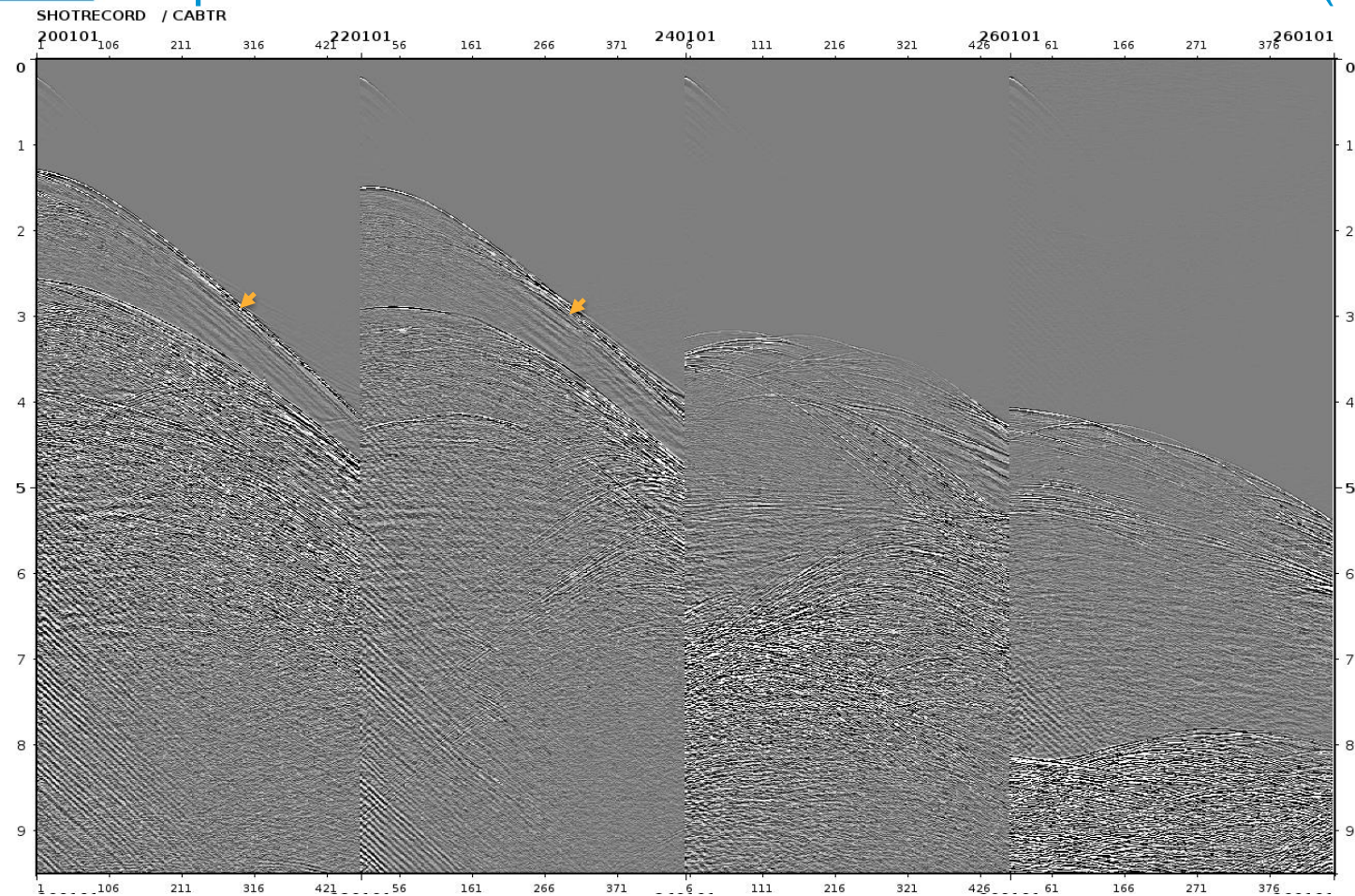


- Bubble energy is more obvious beneath the strong events.



# Seq039: Selected Shot Gathers before Debubble (Repeat)

28



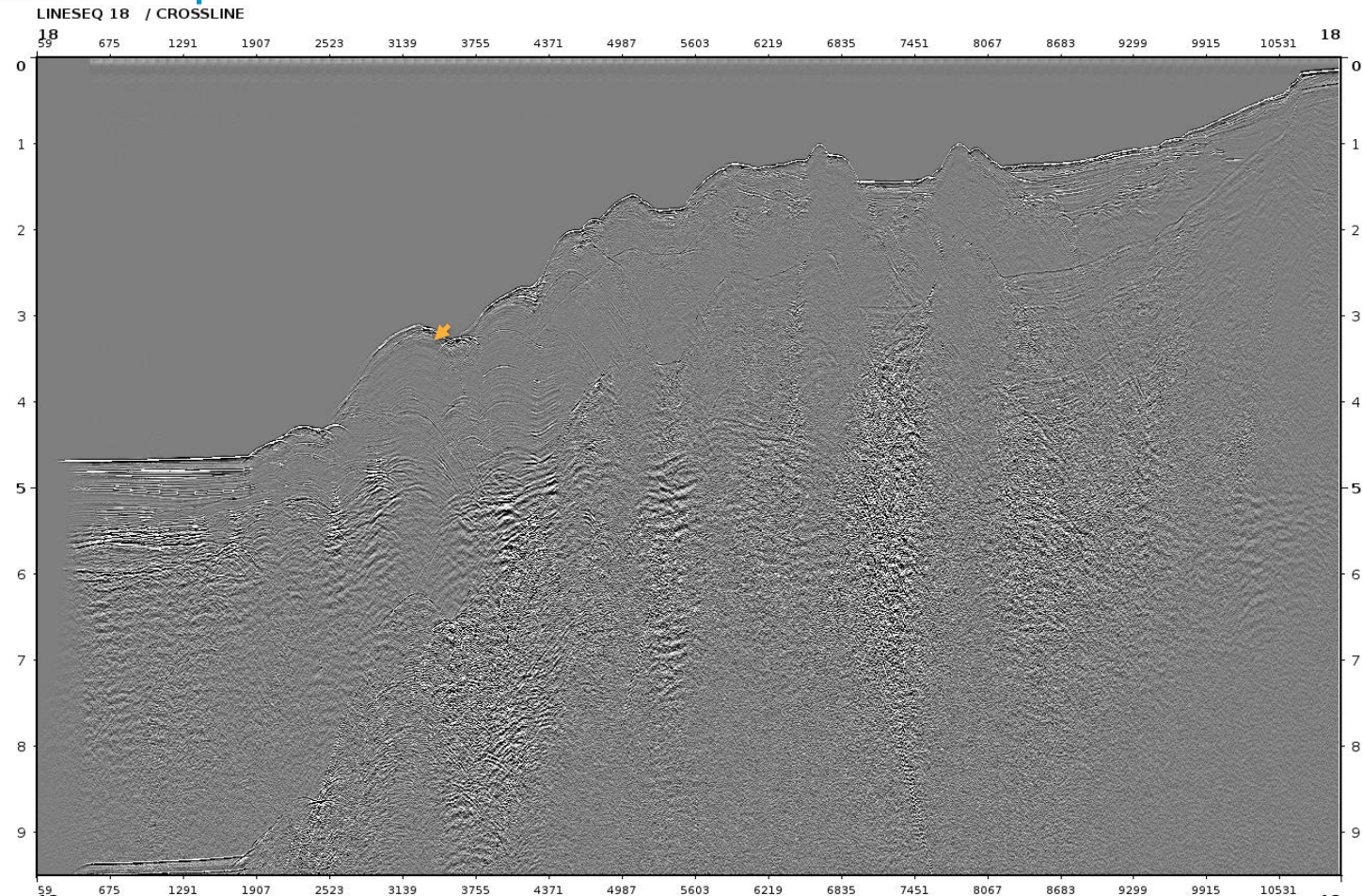
- Repeat of debubble input.



# Seq 018

# Seq018: 2D Stack before Debubble

30

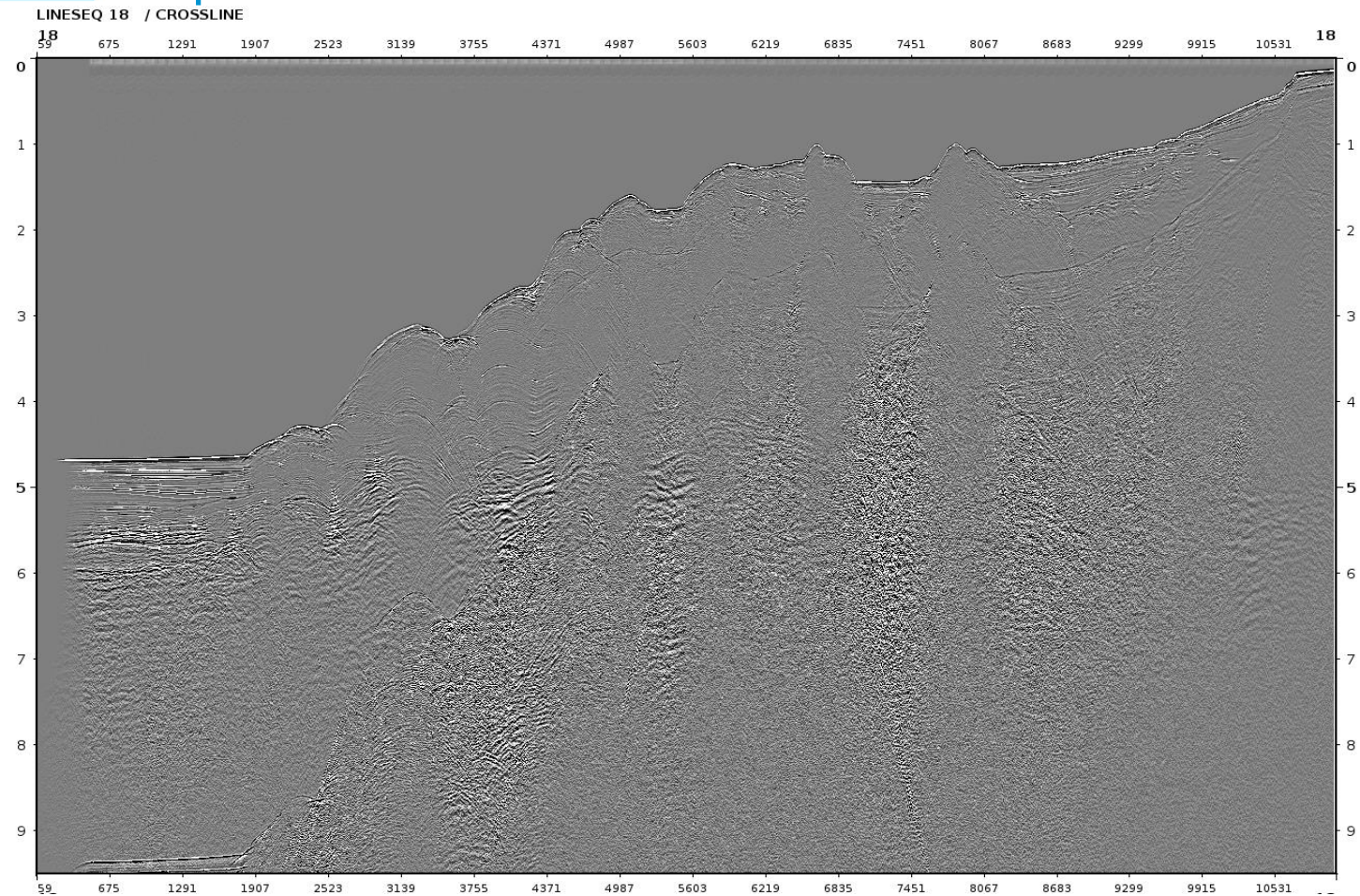


- Low frequency bubble energy consistently follows water bottom.



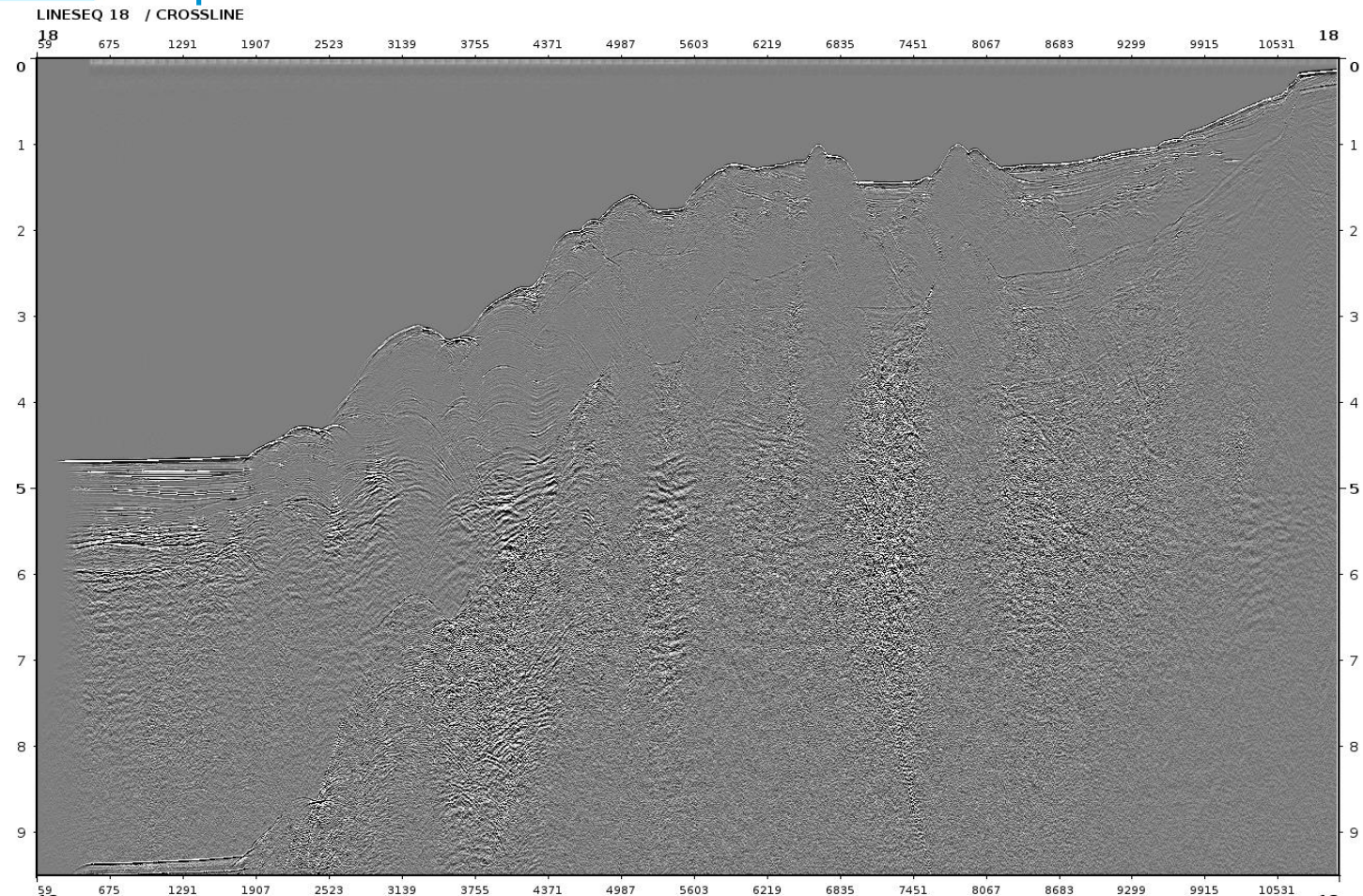
# Seq018: 2D Stack after MS Debubble

31



- Bubble shadow following water bottom is removed while artifact is also generated due to inaccurate bubble in the modelled signature.



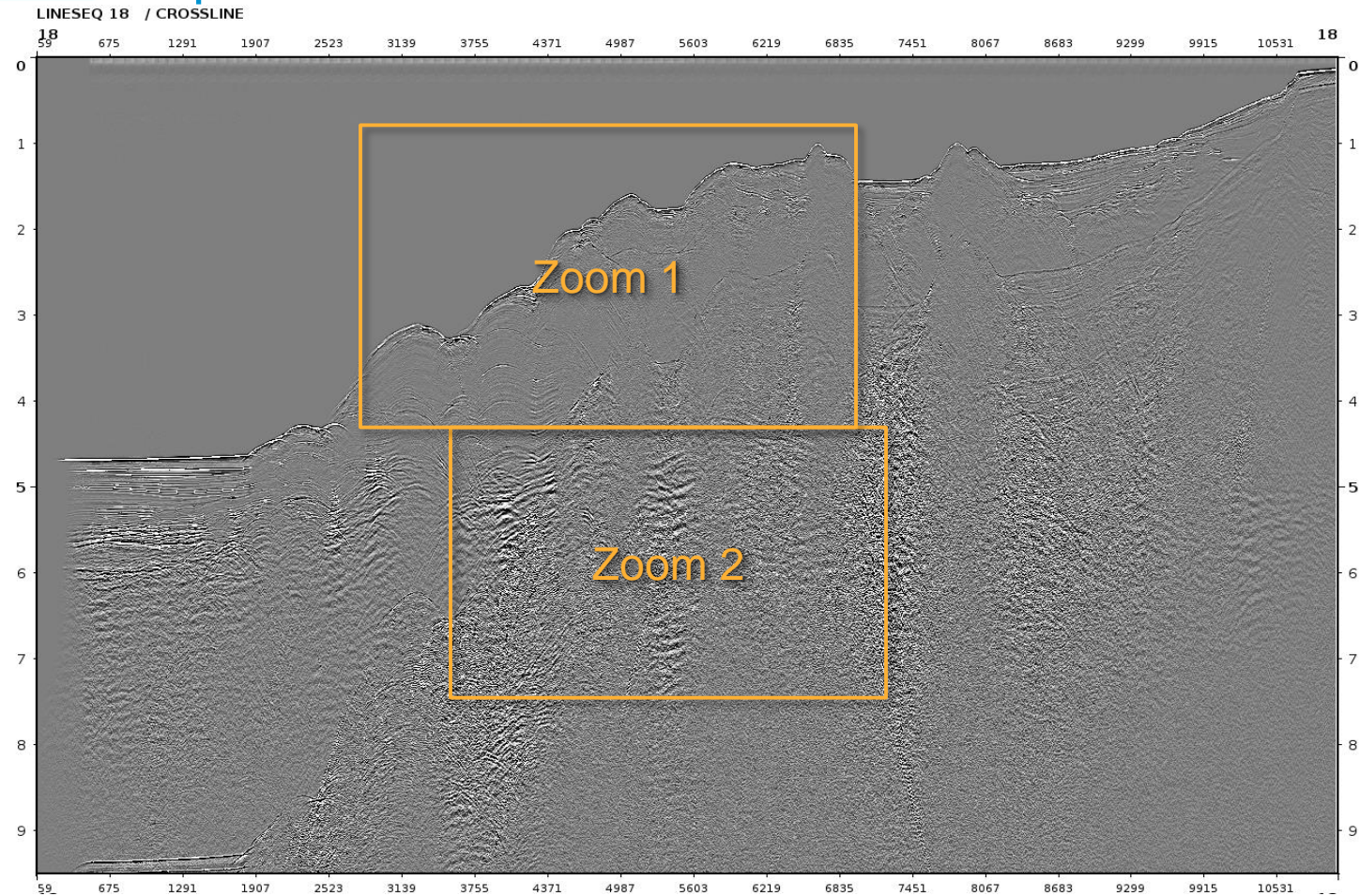


- Bubble filter from statistical signature successfully removes the bubble energy without generating artifact.



# Seq018: 2D Stack Zoomed In Location

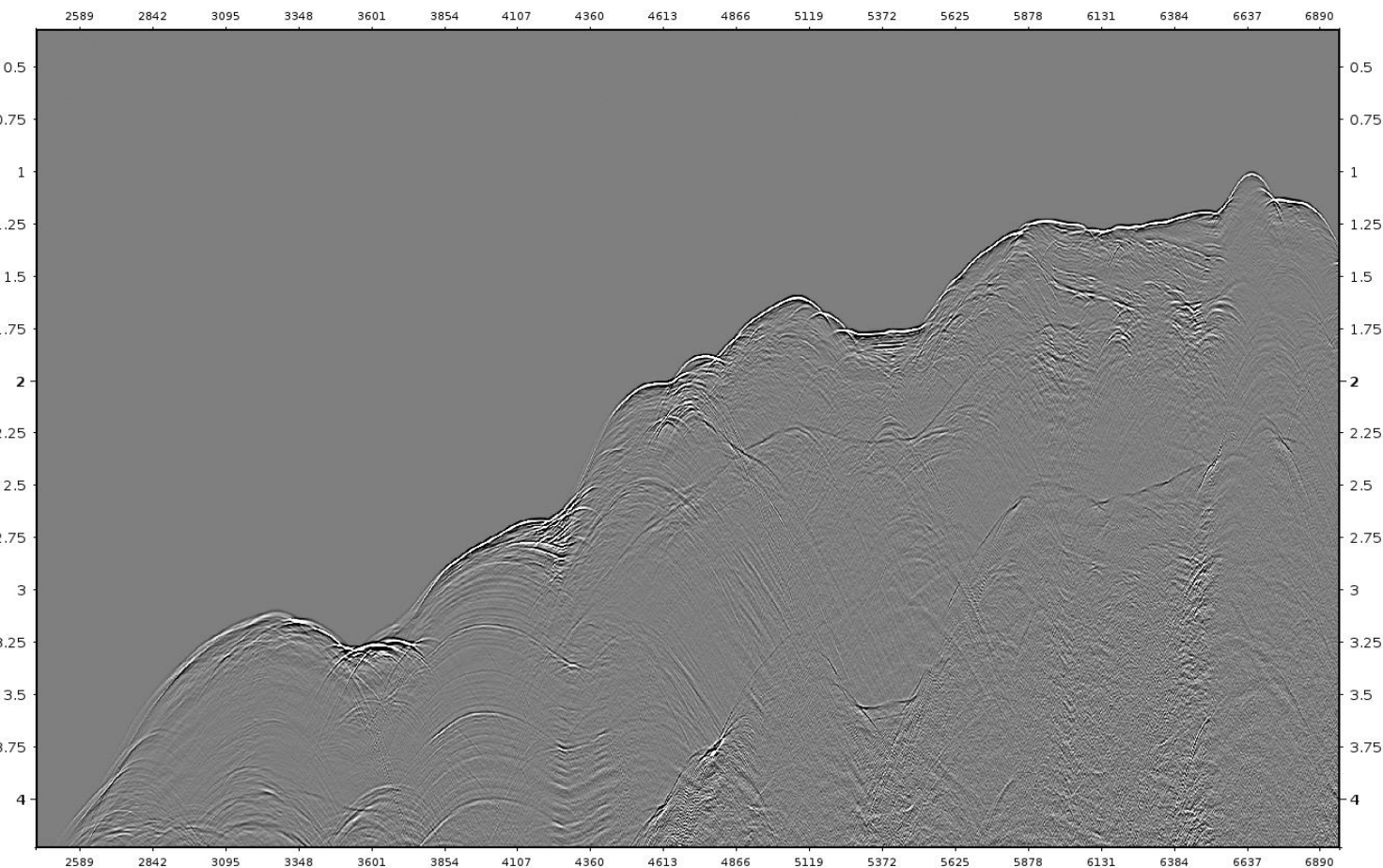
33



# Seq018: Zoomed 2D Stack before Debubble

34

LINESEQ 18 / CROSSLINE



- Low frequency bubble energy consistently follows water bottom.

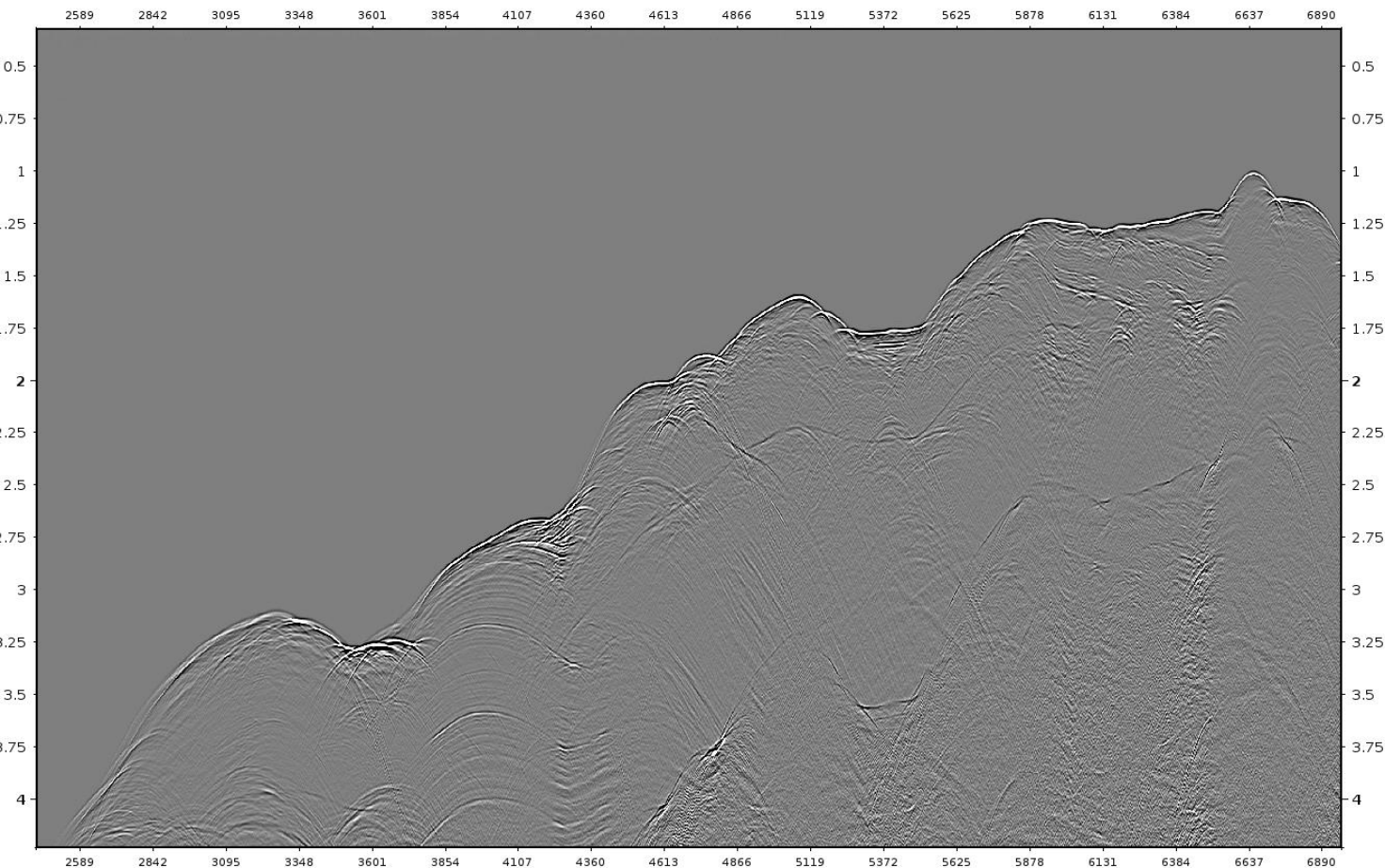




# Seq018: Zoomed 2D Stack after MS Debubble

35

LINESEQ 18 / CROSSLINE



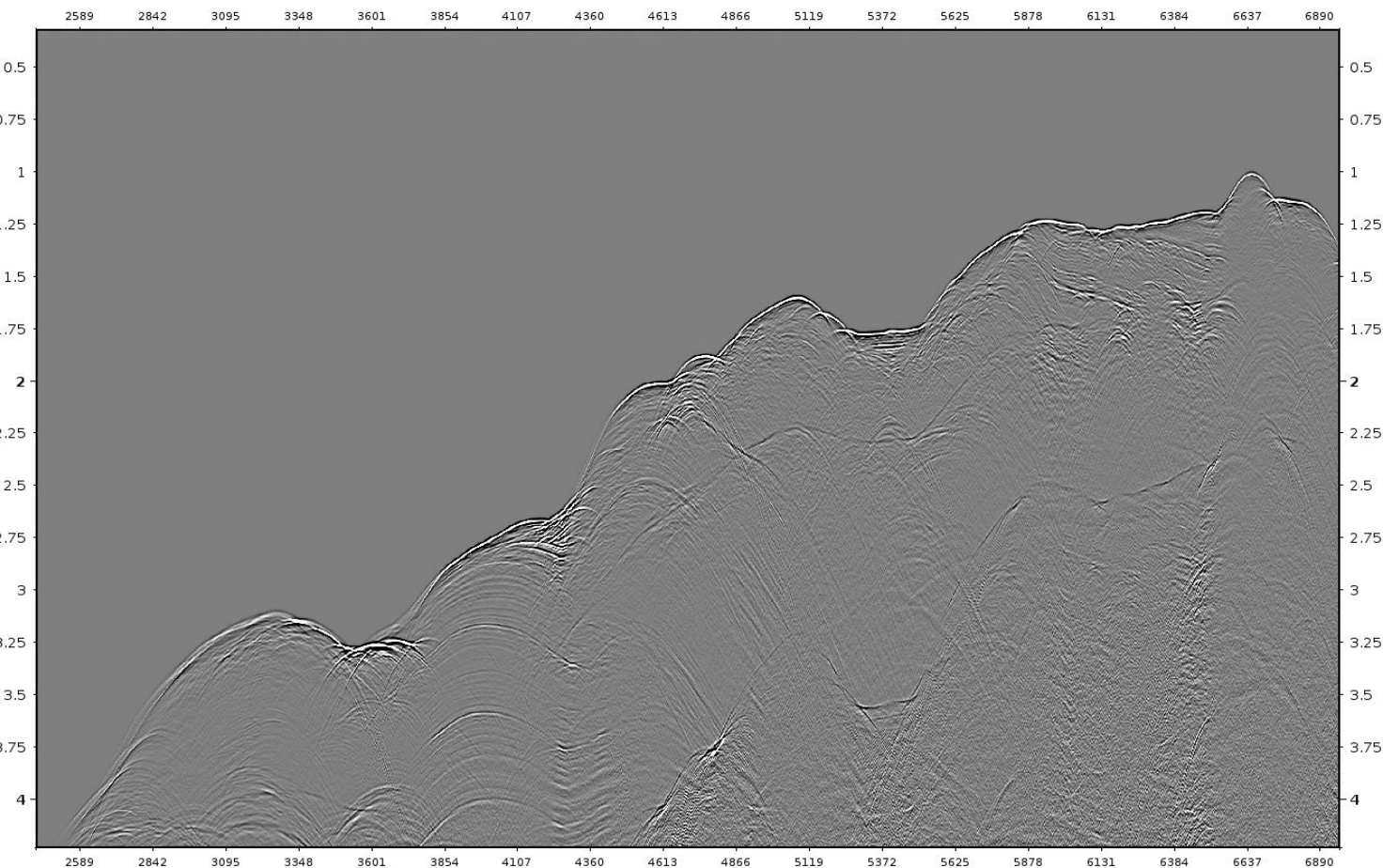
- Bubble shadow following water bottom is removed while artifact is also generated due to inaccurate bubble in the modelled signature.



# Seq018: Zoomed 2D Stack **after** SS Debubble

36

LINESEQ 18 / CROSSLINE



- Bubble filter from statistical signature successfully removes the bubble energy without generating artifact.

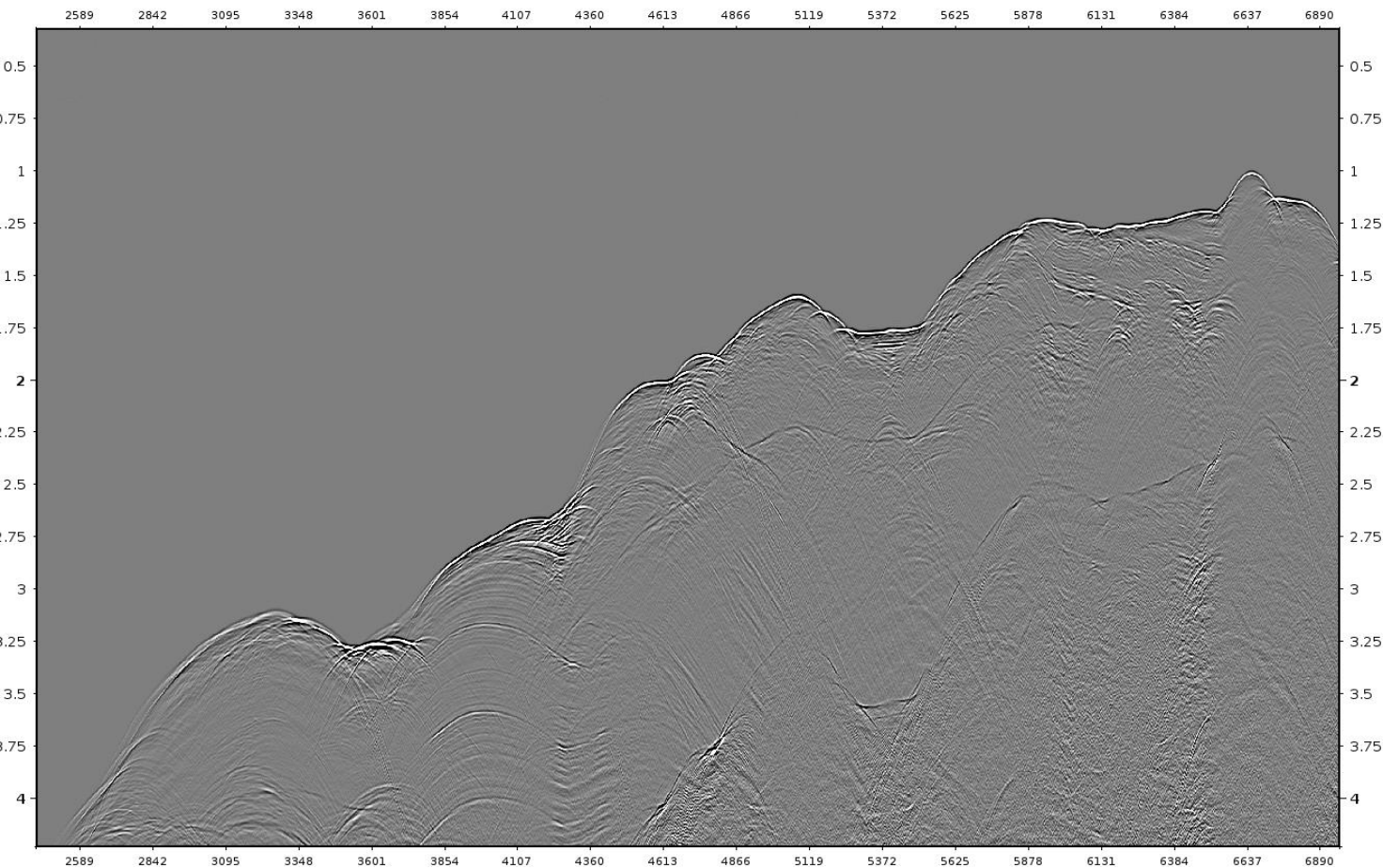




# Seq018: Zoomed 2D Stack before Debubble (Repeat)

37

LINESEQ 18 / CROSSLINE



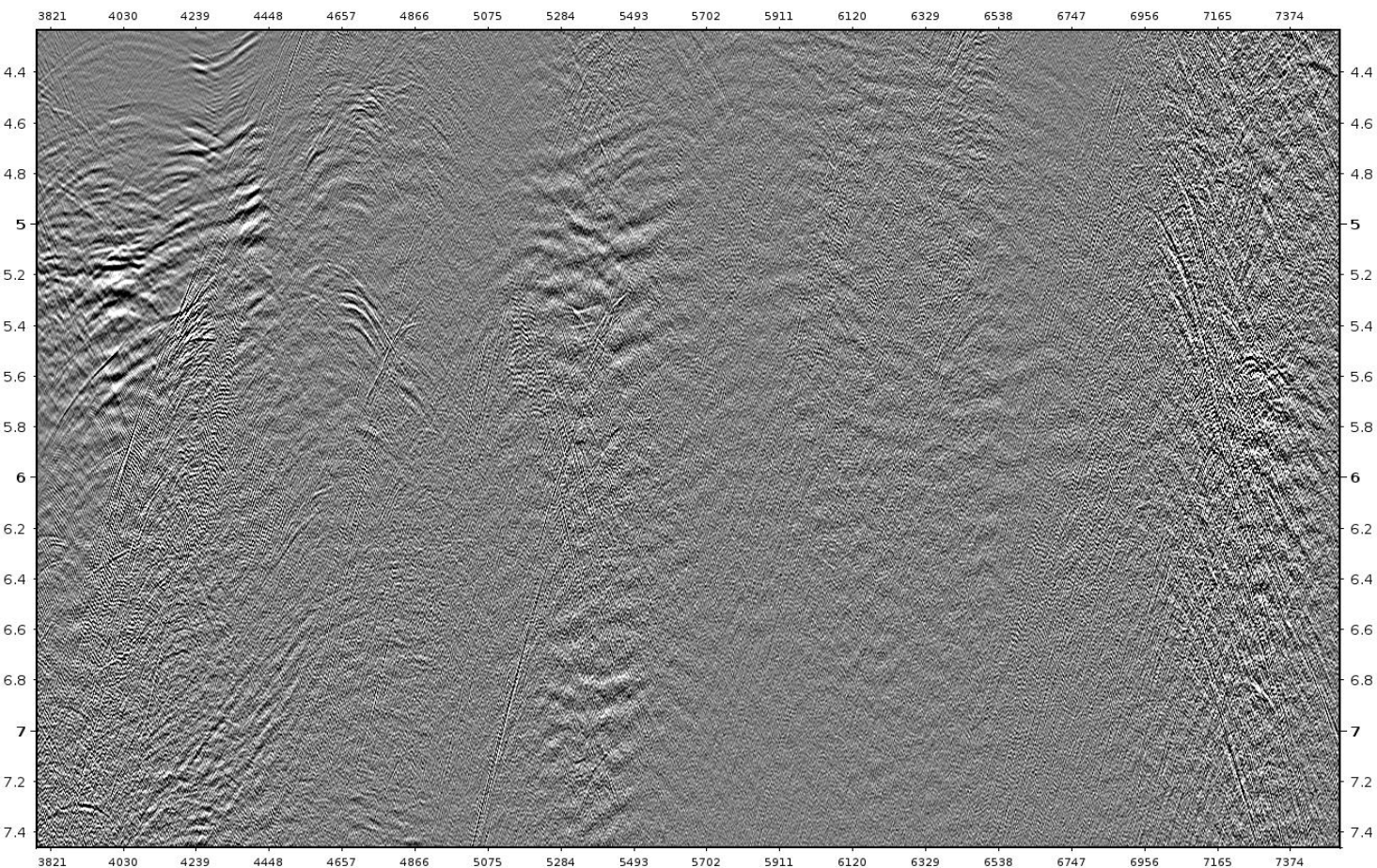
- Repeat of debubble input.



# Seq018: Zoomed 2D Stack before Debubble

38

LINESEQ 18 / CROSSLINE



- In deep section, bubble energy appears as reverberation of primaries.

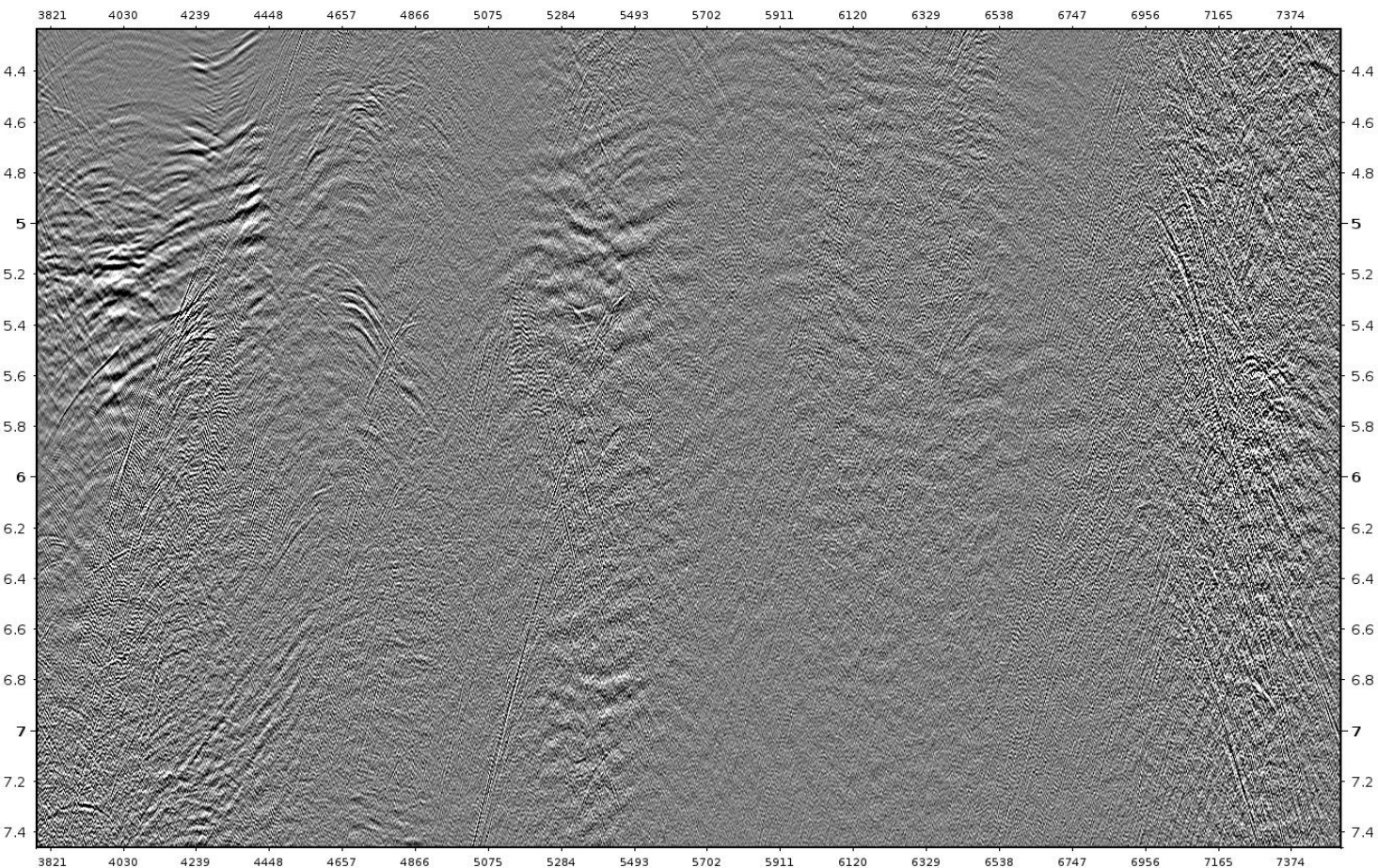




# Seq018: Zoomed 2D Stack **after** MS Debubble

39

LINESEQ 18 / CROSSLINE



- Bubble energy is more obvious beneath the strong events.

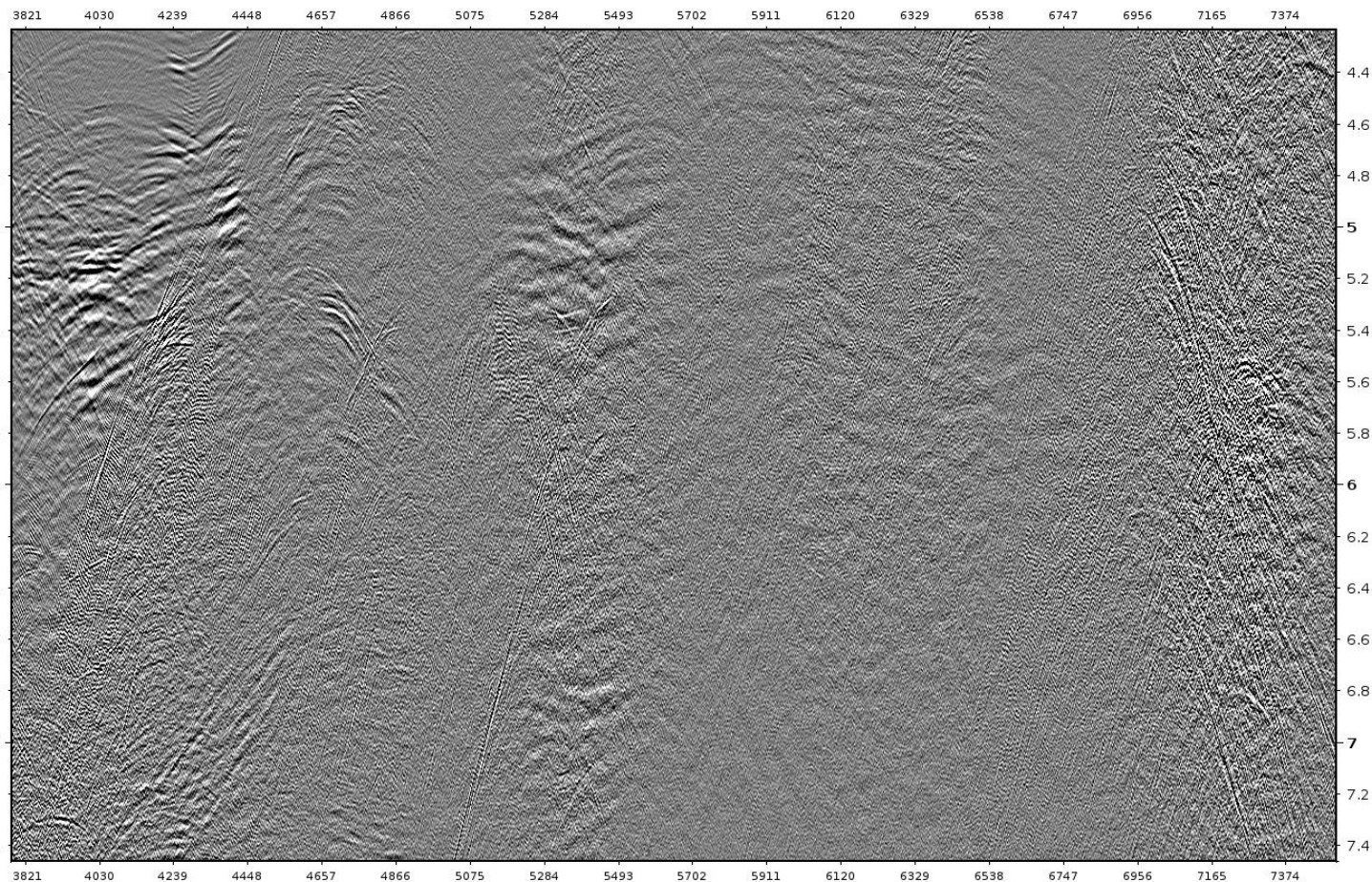




# Seq018: Zoomed 2D Stack **after** SS Debubble

40

LINESEQ 18 / CROSSLINE



- SS Debubble gives better result.

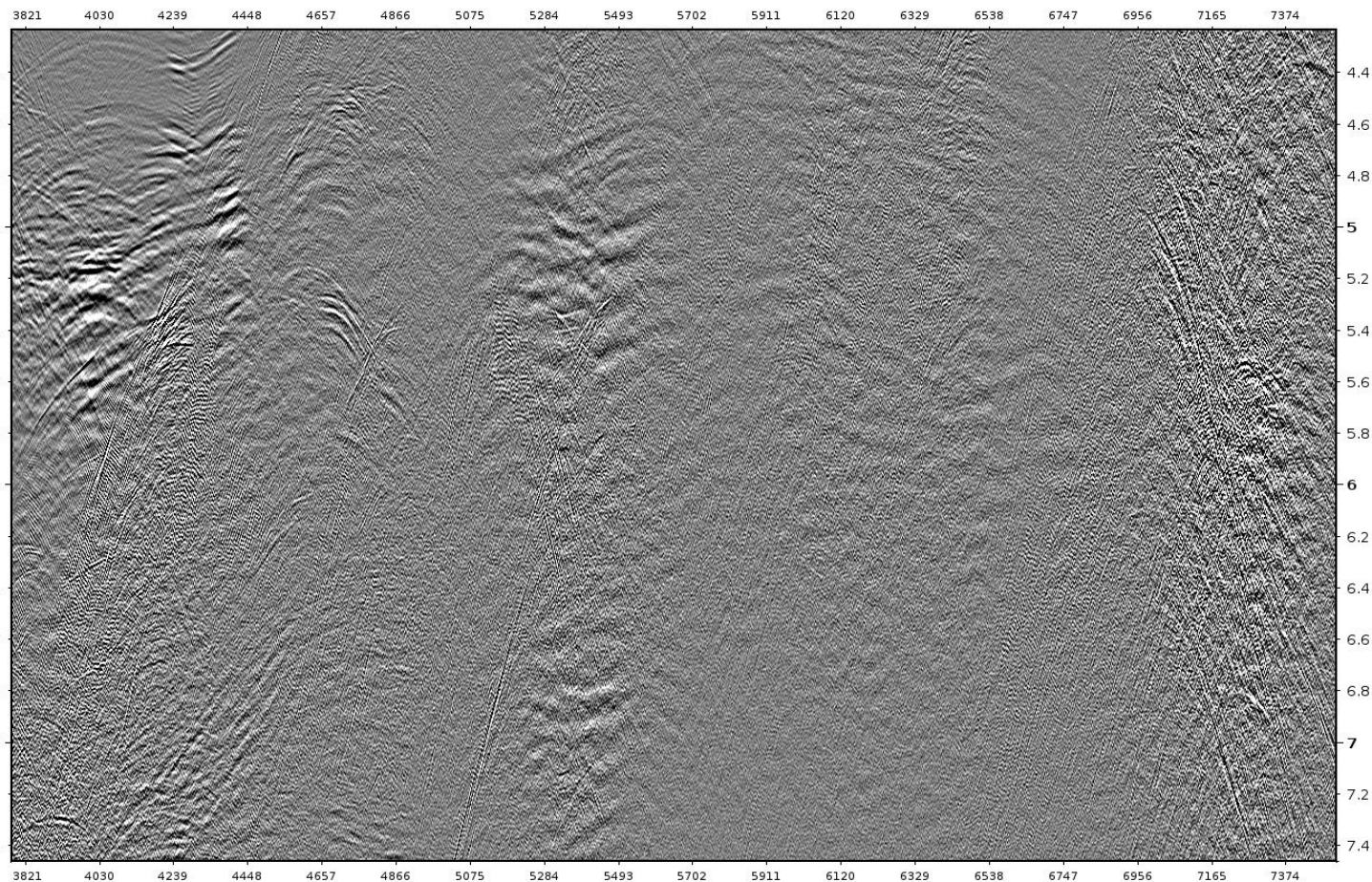




# Seq018: Zoomed 2D Stack before Debubble (Repeat)

41

LINESEQ 18 / CROSSLINE

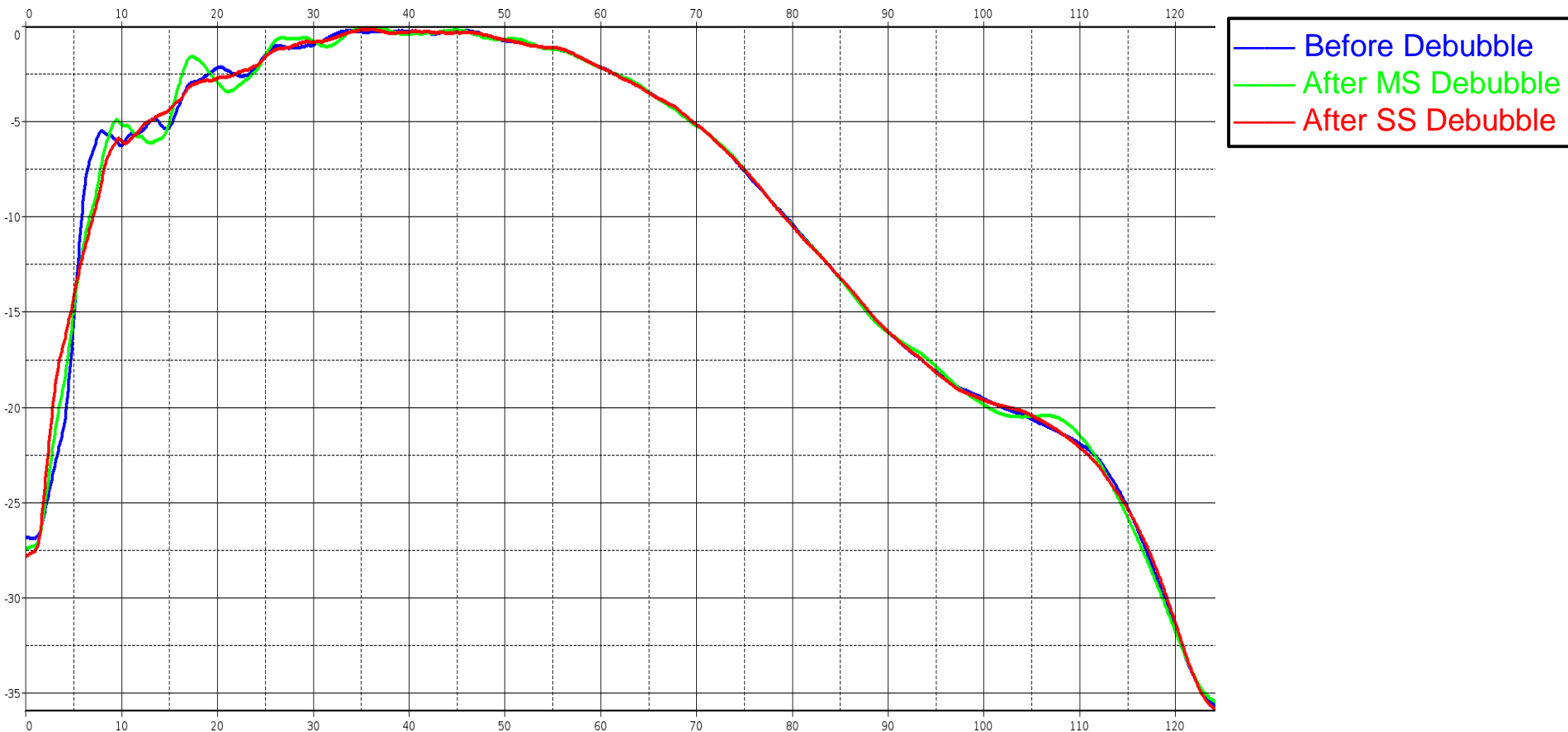


- Repeat of debubble input.



# Seq018: Full Window Amplitude Spectrum of 2D Stack

42

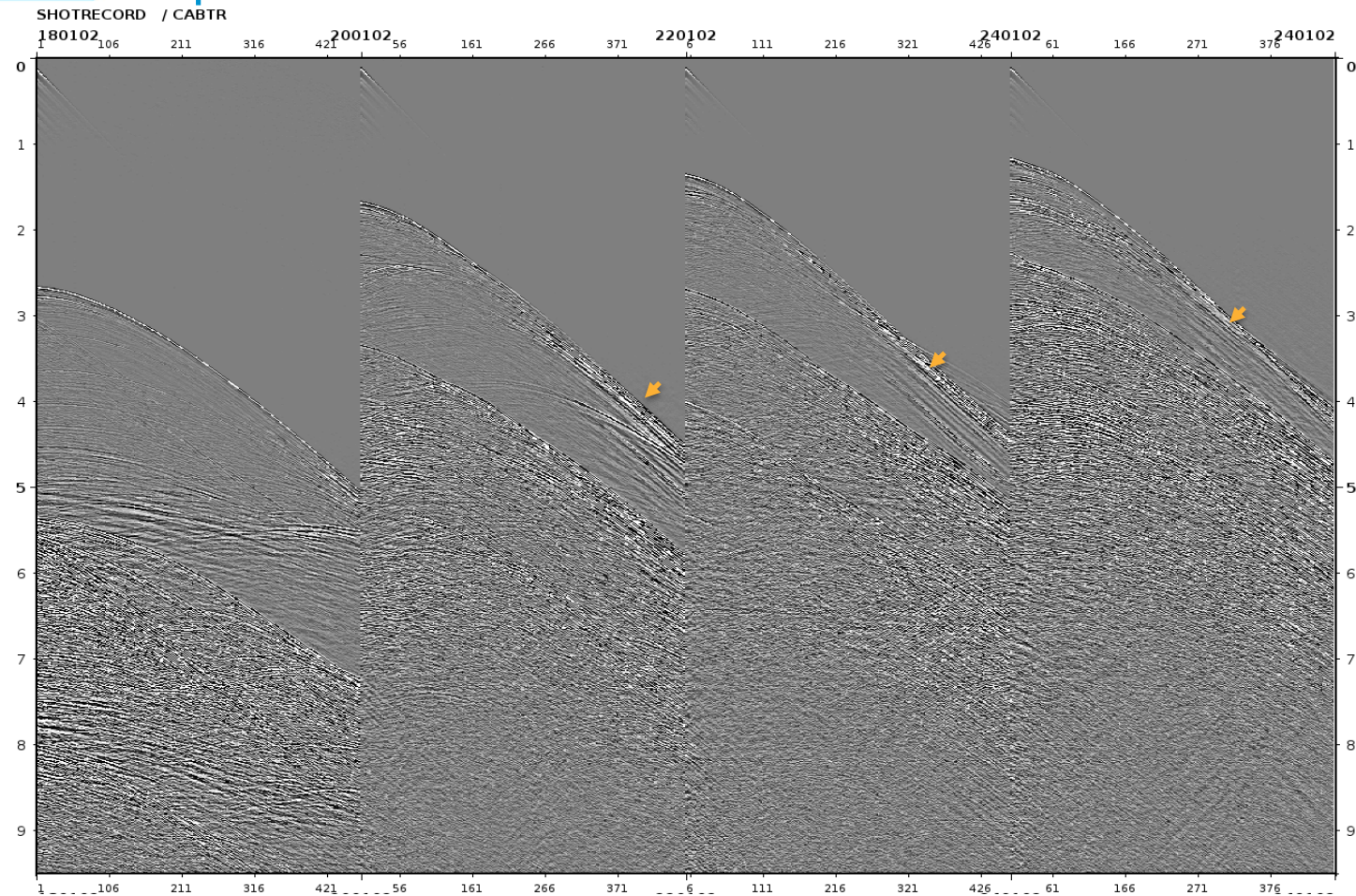






# Seq018: Selected Shot Gathers before Debubble

43



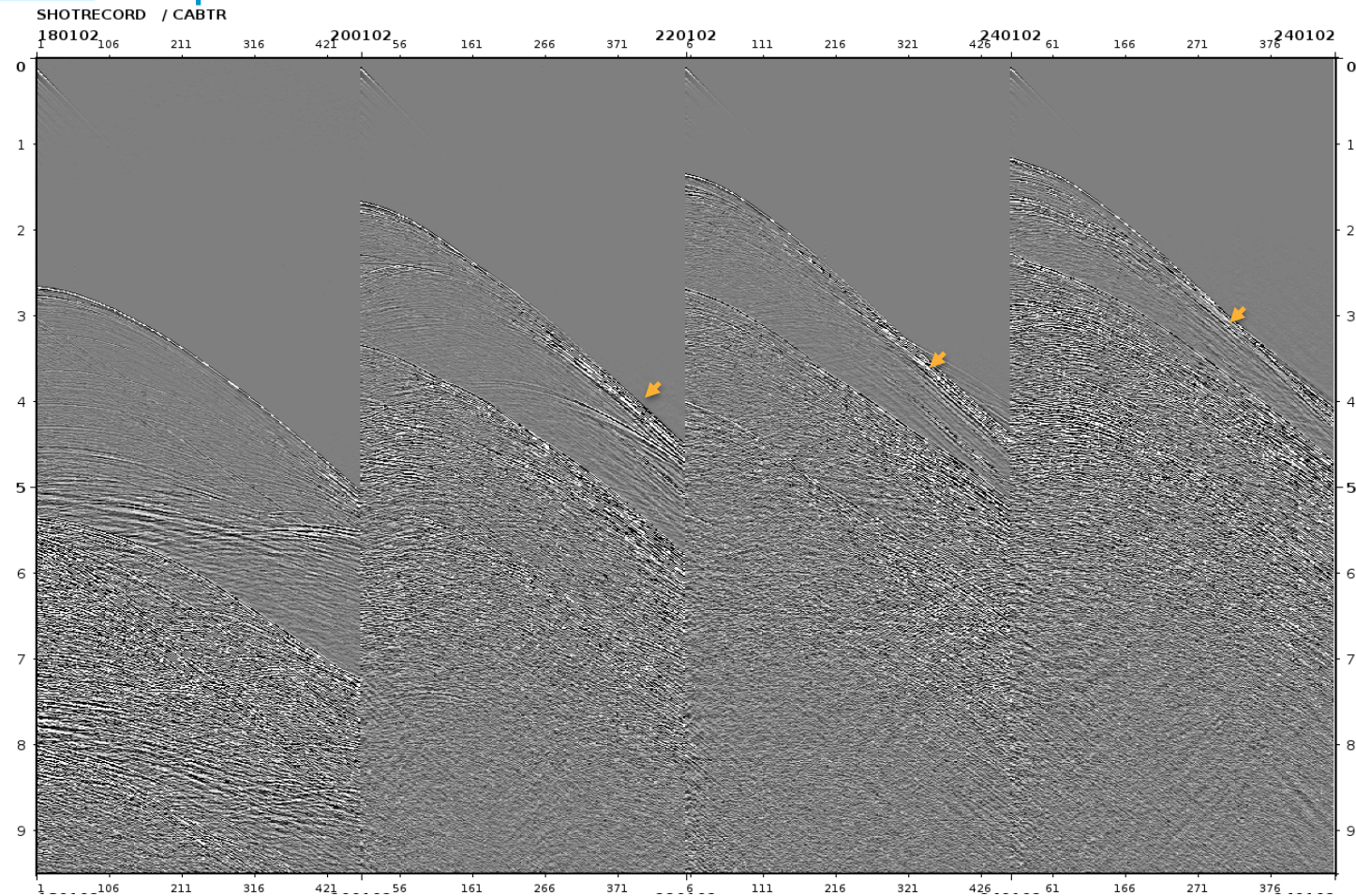
- Bubble energy is more obvious beneath the strong events.





# Seq018: Selected Shot Gathers after MS Debubble

44



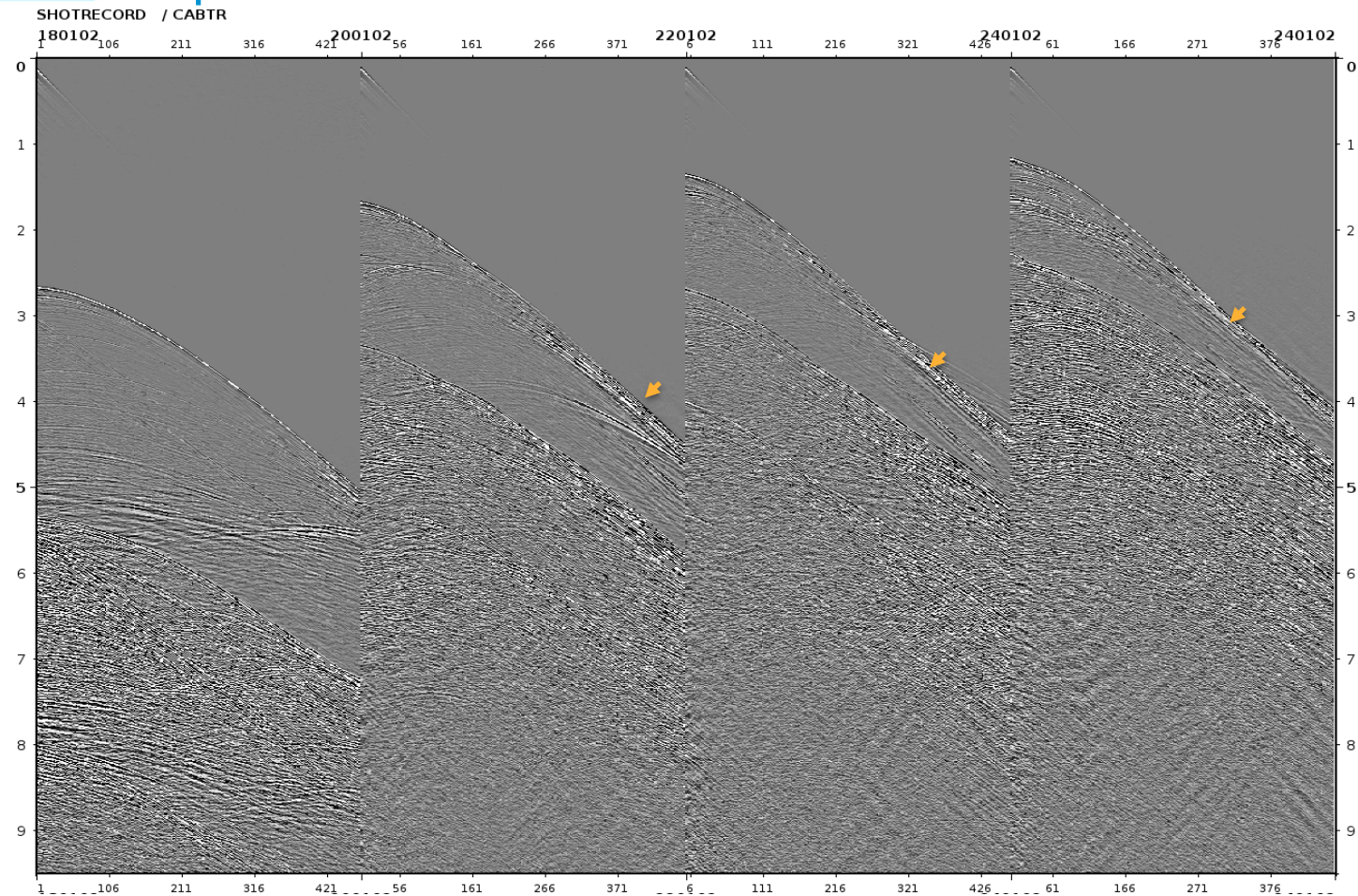
- Bubble energy is more obvious beneath the strong events.





# Seq018: Selected Shot Gathers after SS Debubble

45



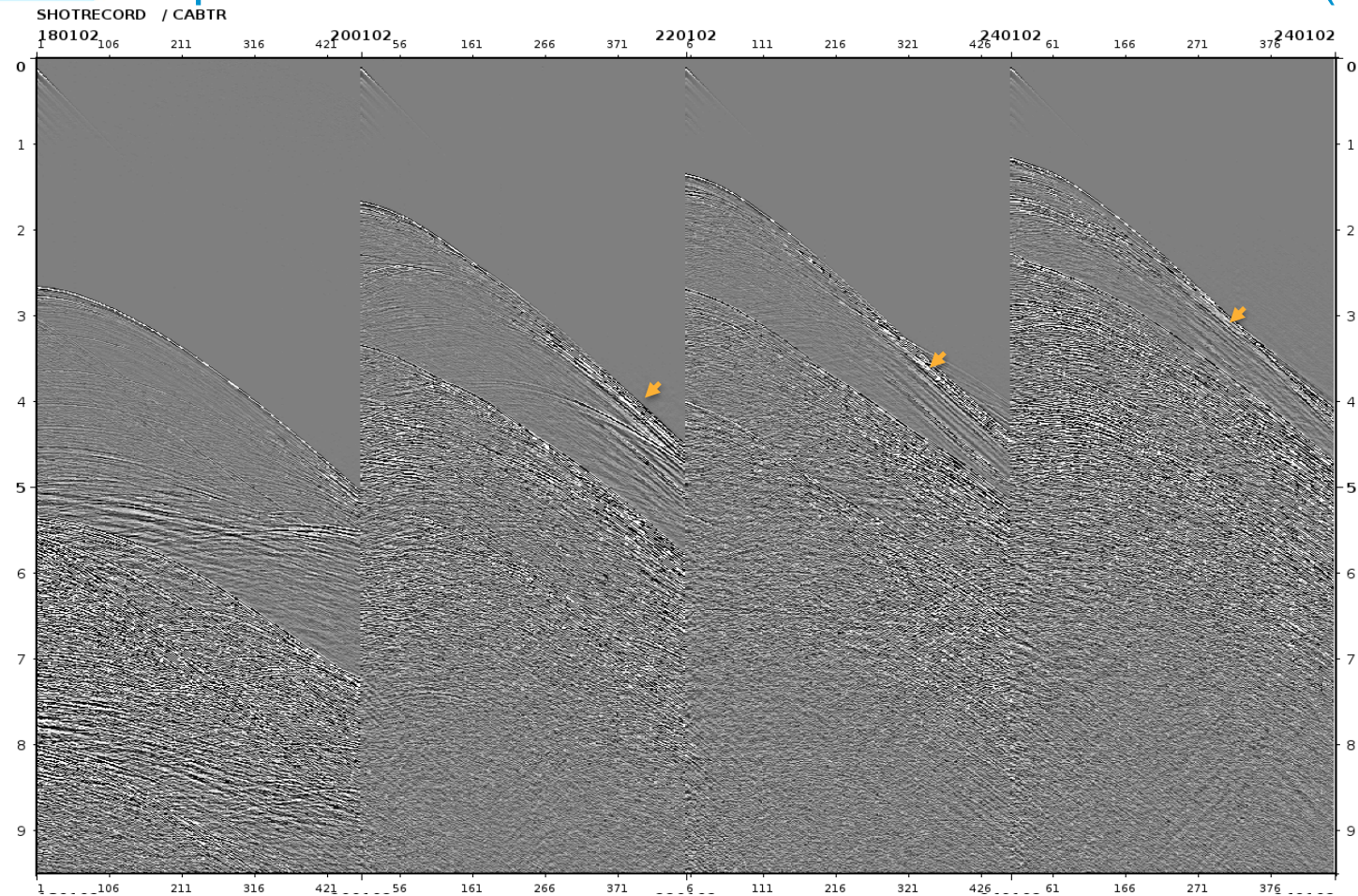
- Bubble energy is more obvious beneath the strong events.





# Seq018: Selected Shot Gathers before Debubble (Repeat)

46



- Repeat of debubble input.