Isotropic FWI

NZ 3D Processing

28 October 2020

INSTITUTE FOR GEOPHYSICS

cgg.com

Passion for Geoscience

Outline

- **Objective:**

  To QC isotropic (ISO) FWI result.

- **Procedure:**

  Isotropic FWI was run with both streamer and OBS data from 2.5 Hz to 7Hz. Only refraction energy is used in the velocity inversion. For OBS data, a mute is applied to exclude the data that is affected by the recording issue.
  To evaluate the result, a depth migration volume was generated using data after low cut filter.

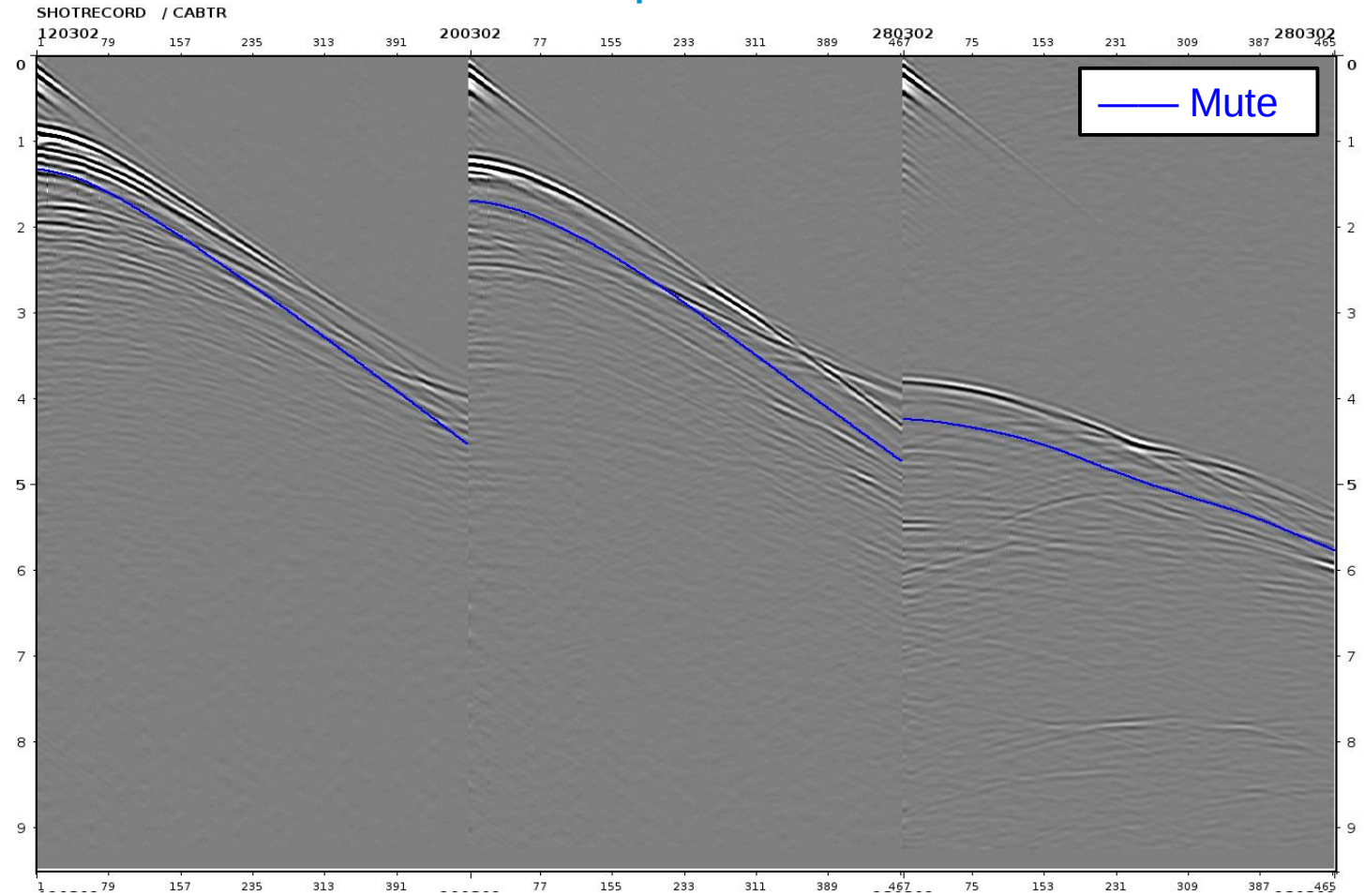
- **Display:**

  Velocity and FWI synthetic.

- **Observation and Recommendation:**

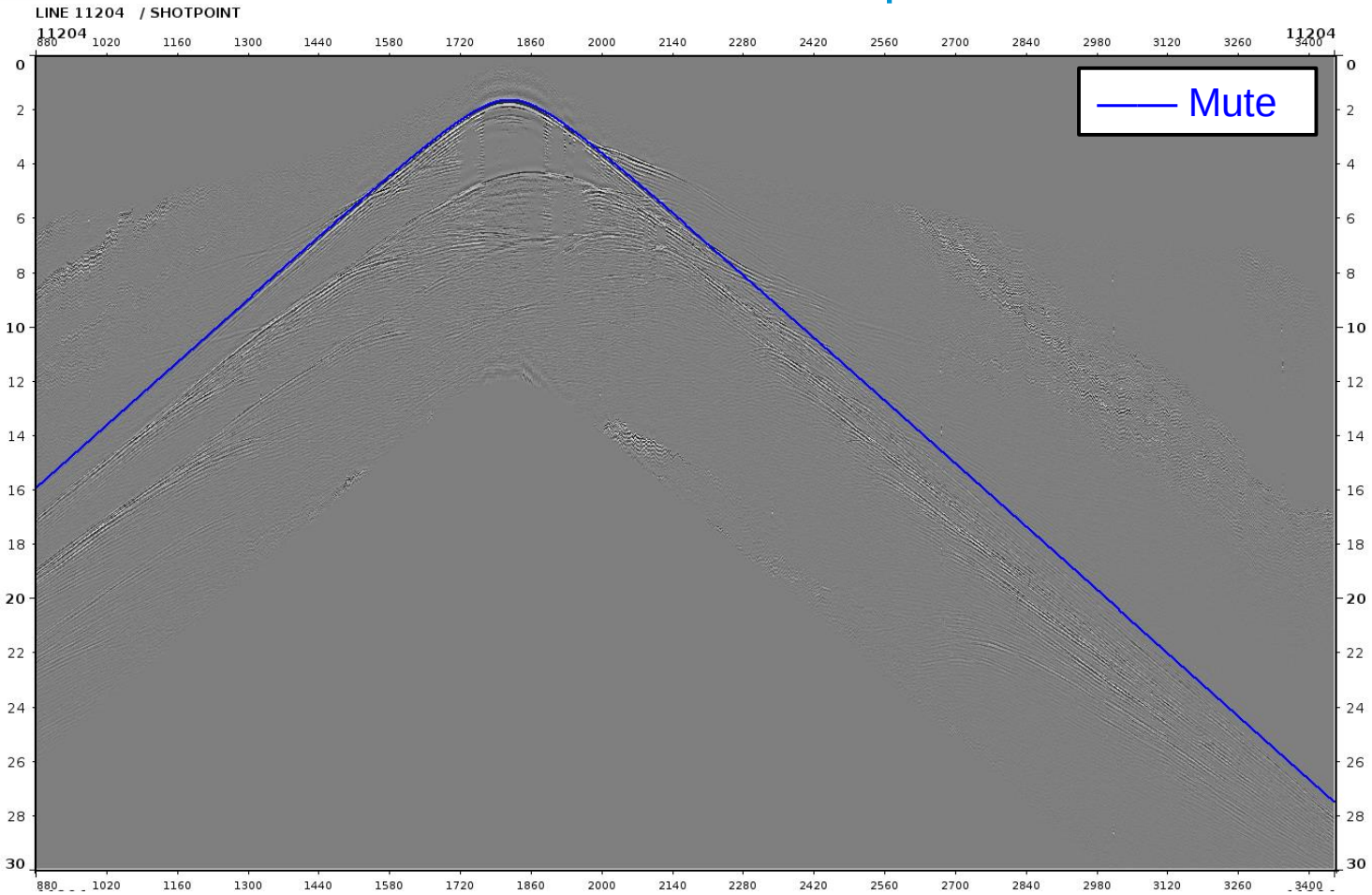
  Current ISO FWI gives reasonable update down to ~2km beneath Water Bottom (WB). Velocity updated deeper than this depth is hard to be evaluated at the moment, due to interference of multiples. We're working on a VMB depth migration volume with major preprocessing steps applied (de-ghost and de-multiple), so we can evaluate the ISO fwi model and proceed to ISO tomography before building TTI model and TTI FWI.

Streamer 001: FWI Input



- The reflection energy (below the blue line) is muted.

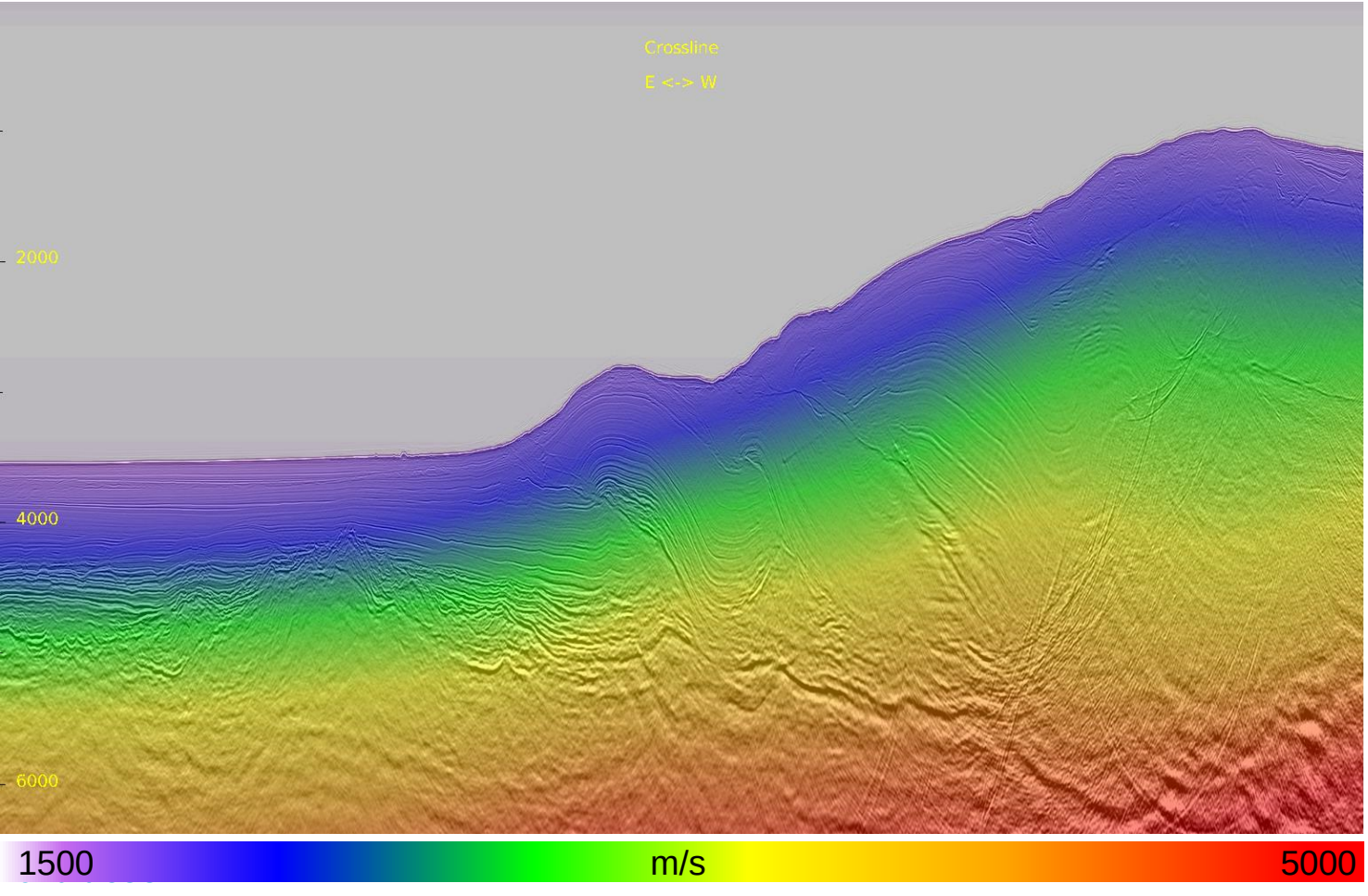
OBS Node 058: Mute on FWI Input



- The reflection energy (below the blue line) is muted, where recording issue happens when amplitudes are high.

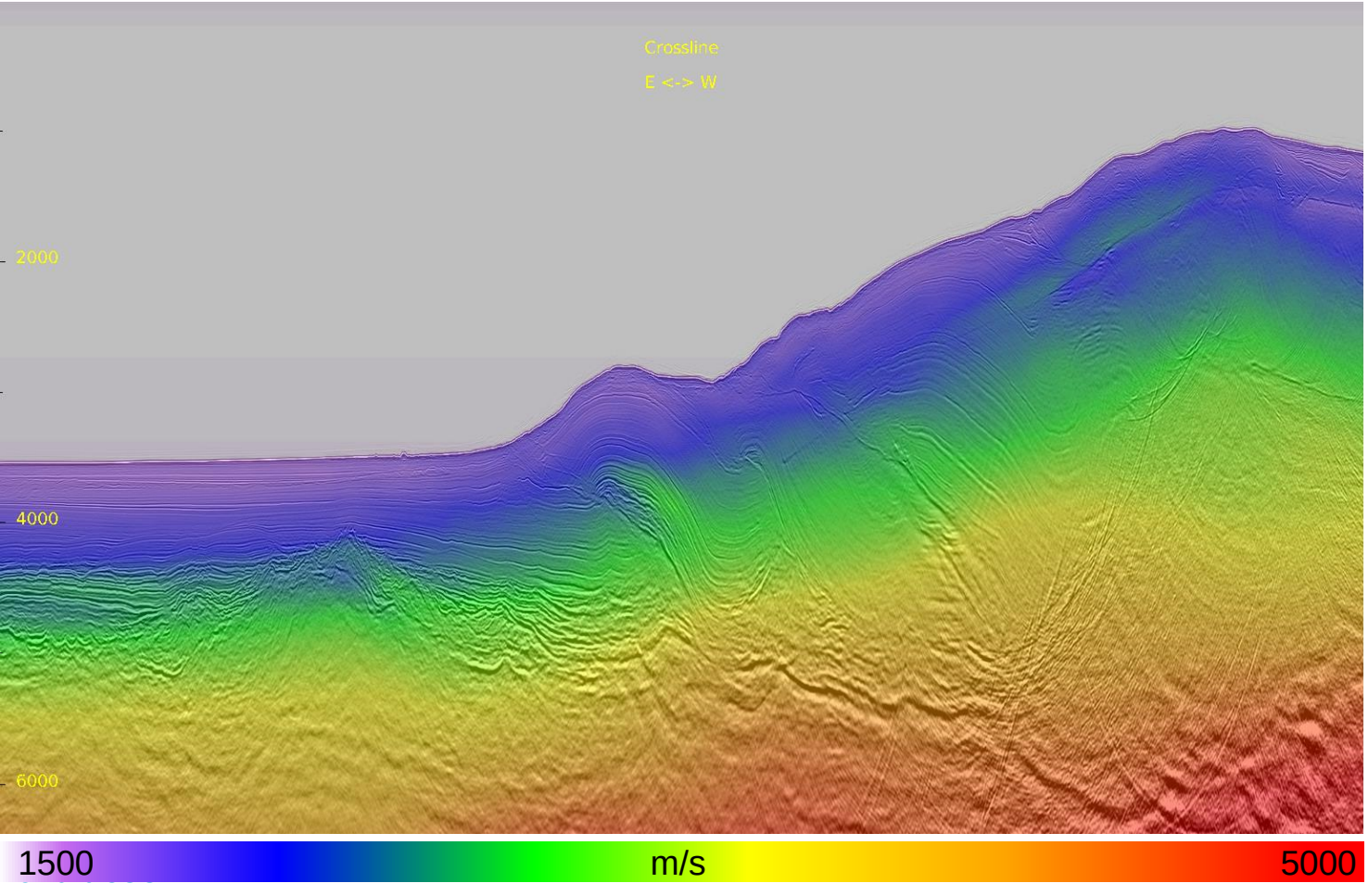
Velocity Model

Inline 436 East: Initial Velocity



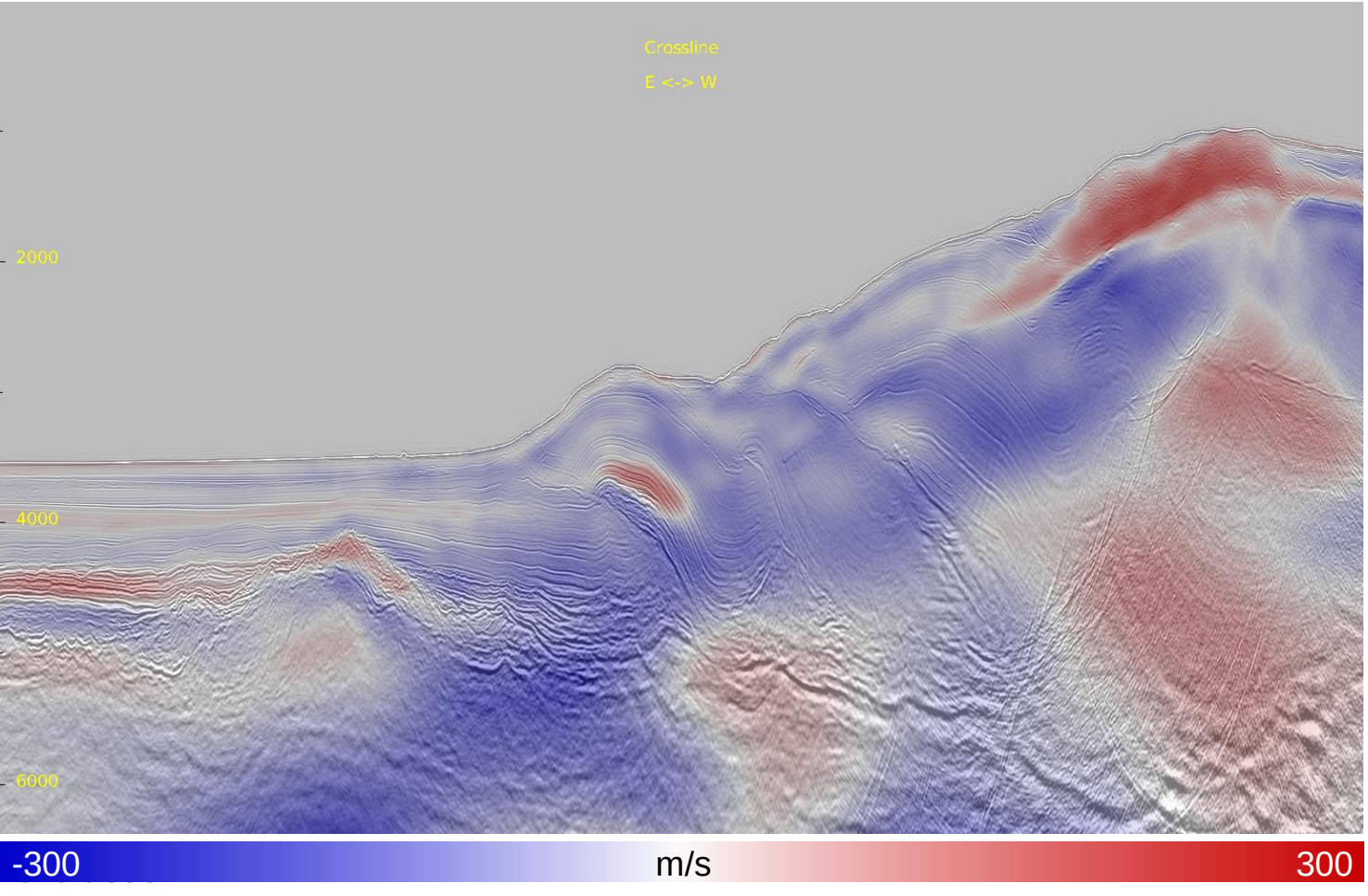
- Initial velocity is smooth.

Inline 436 East: ISO FWI Velocity



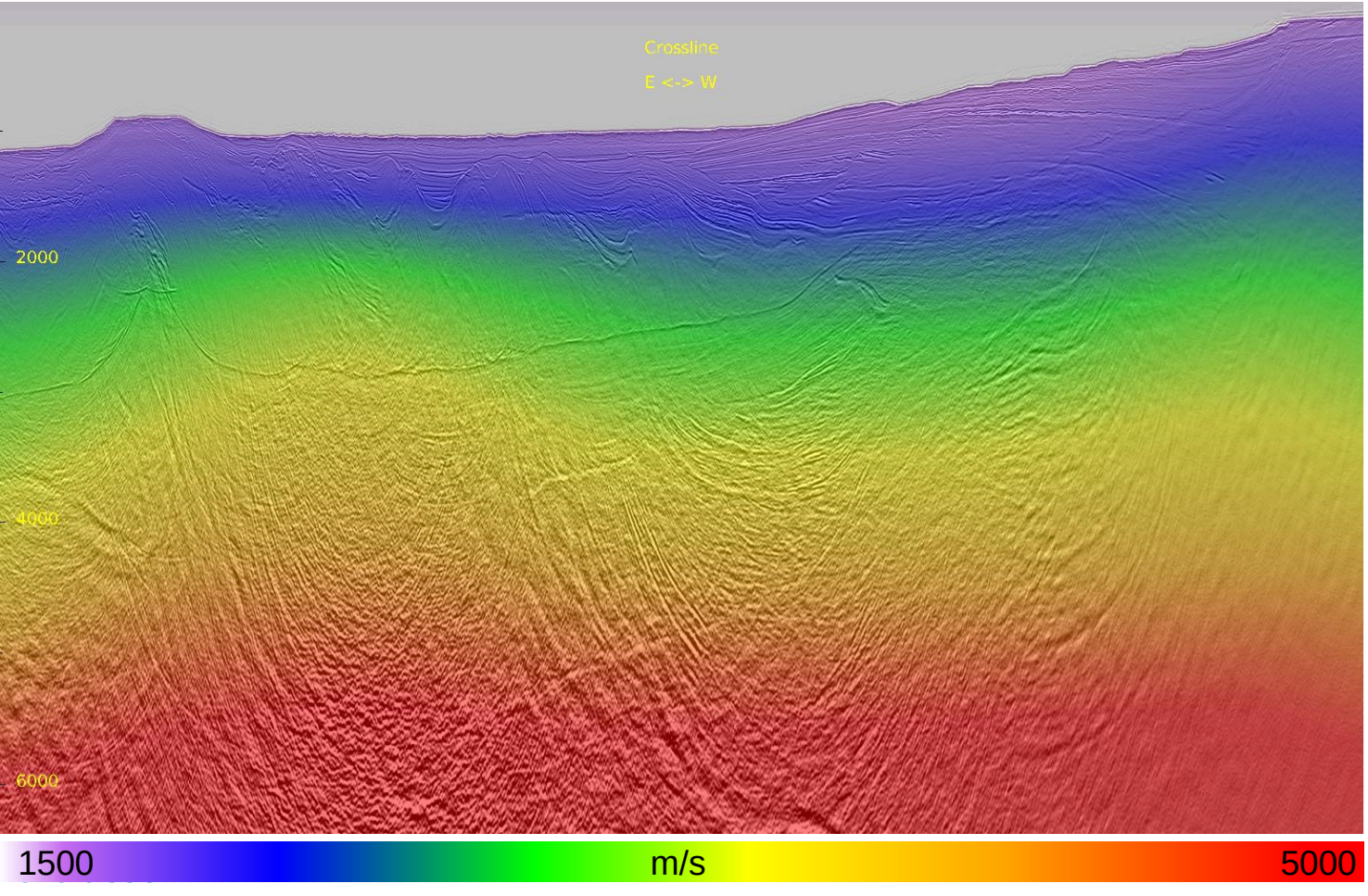
- ISO FWI gives reasonable update that follows geology, down to 2km beneath water bottom.

Inline 436 East: ISO FWI Velocity Perturbation



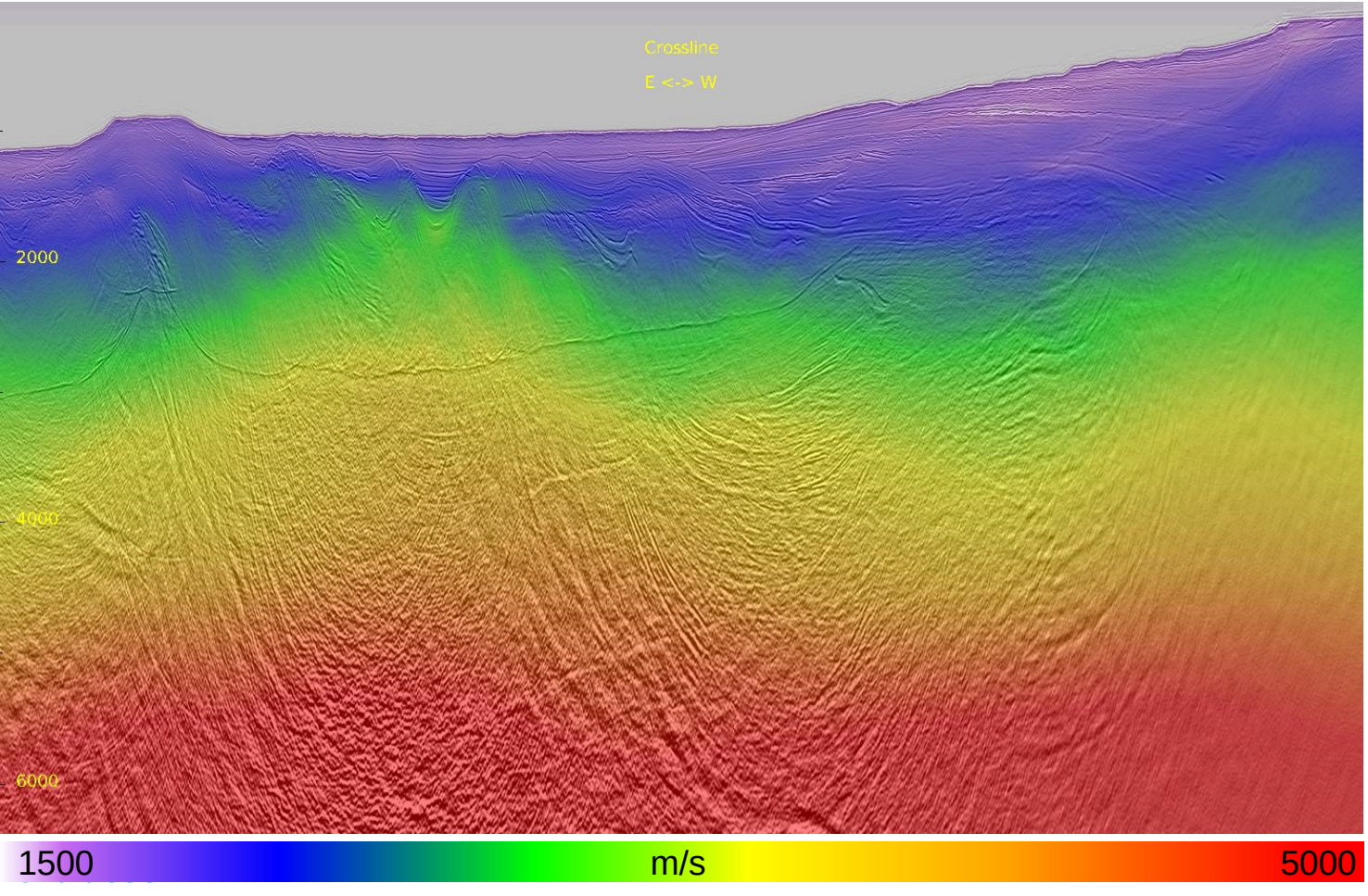
- ISO FWI gives reasonable update that follows geology, down to 2km beneath water bottom.
- The perturbation deeper than 2km beneath water bottom is hard to be assessed, due to interference of multiples on seismic data.

Inline 436 West: Initial Velocity



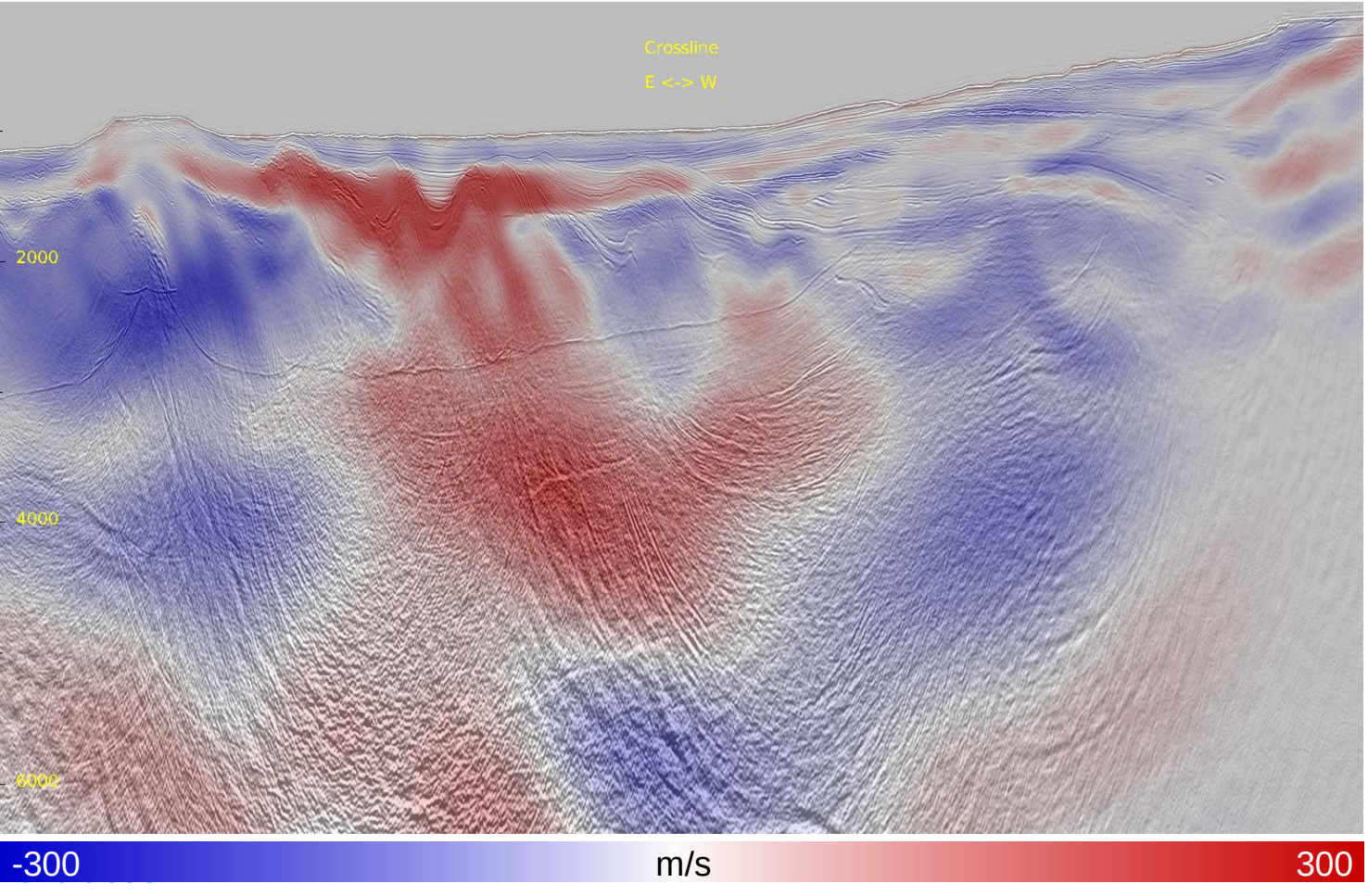
- Initial velocity is smooth.

Inline 436 West: ISO FWI Velocity



- ISO FWI gives reasonable update that follows geology, down to 2km beneath water bottom.

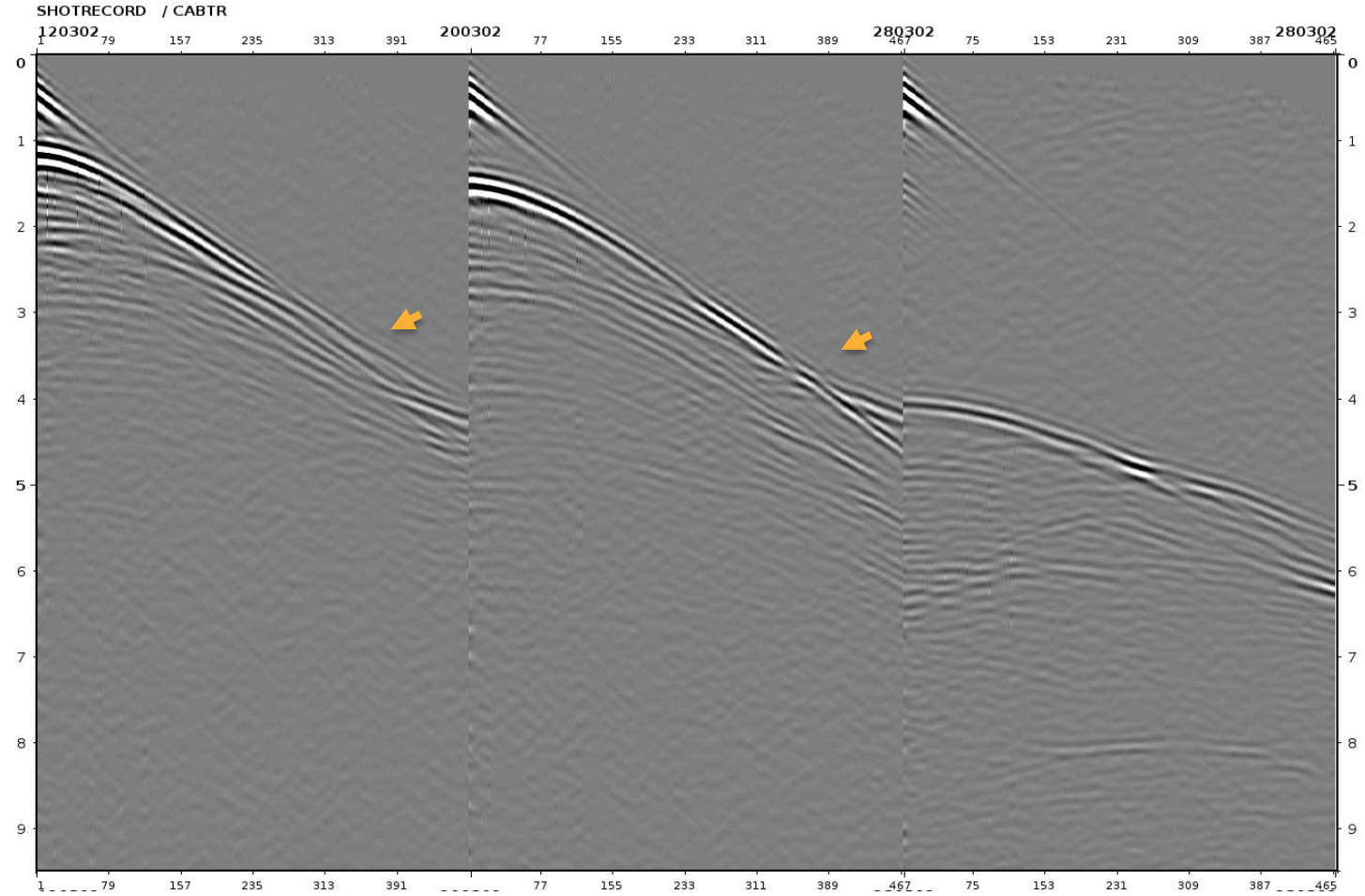
Inline 436 West: ISO FWI Velocity Perturbation



- ISO FWI gives reasonable update that follows geology, down to 2km beneath water bottom.
- The perturbation deeper than 2km beneath water bottom is hard to be assessed, due to interference of multiples on seismic data.

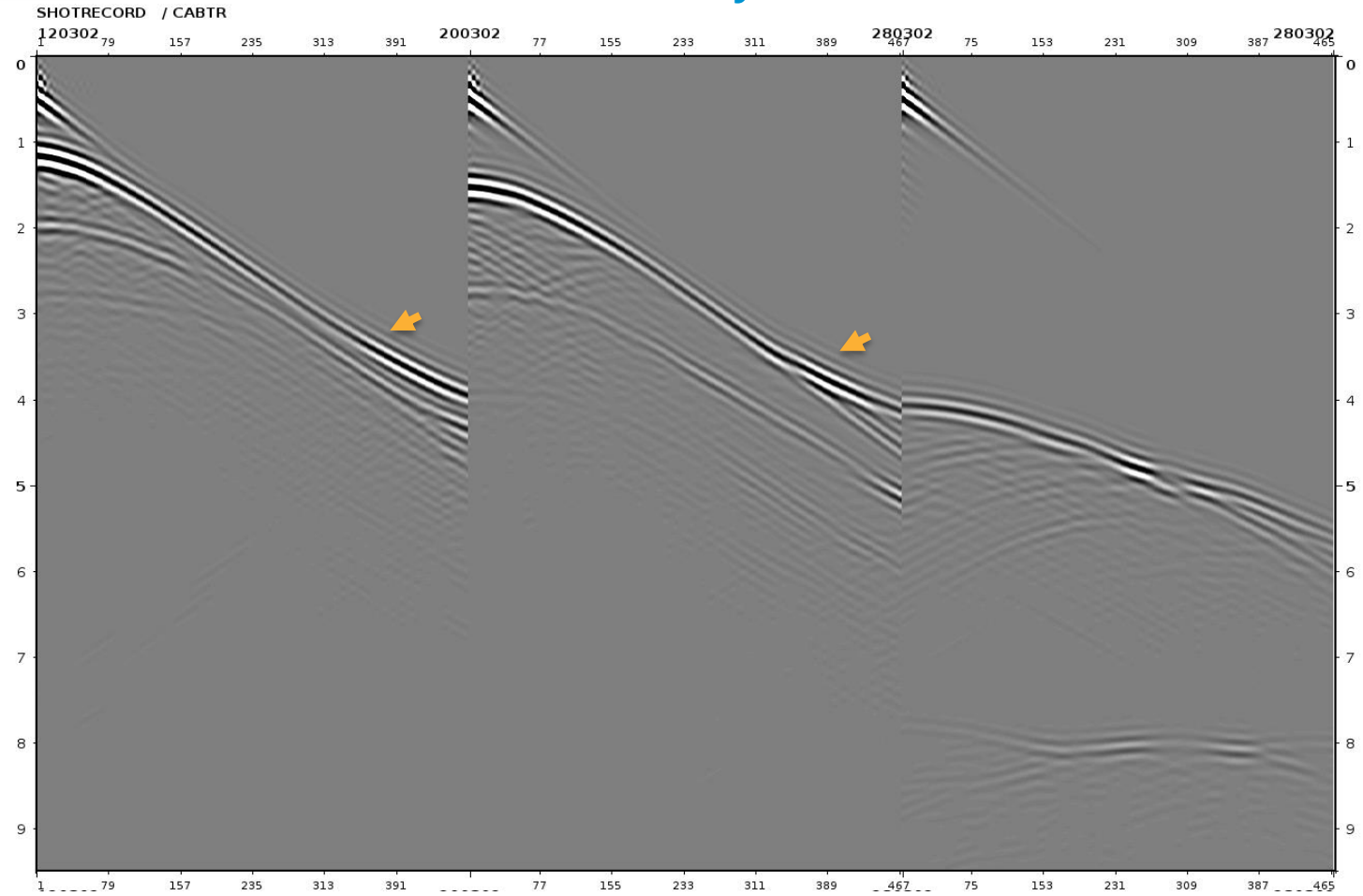
FWI Synthetic VS Real Data Streamer (< 7 Hz)

Streamer 001: Real Shots



- With initial velocity, synthetic shot and real data matches not very well from mid to far channels.

Streamer 001: ISO FWI Synthetic Shots with Initial Velocity



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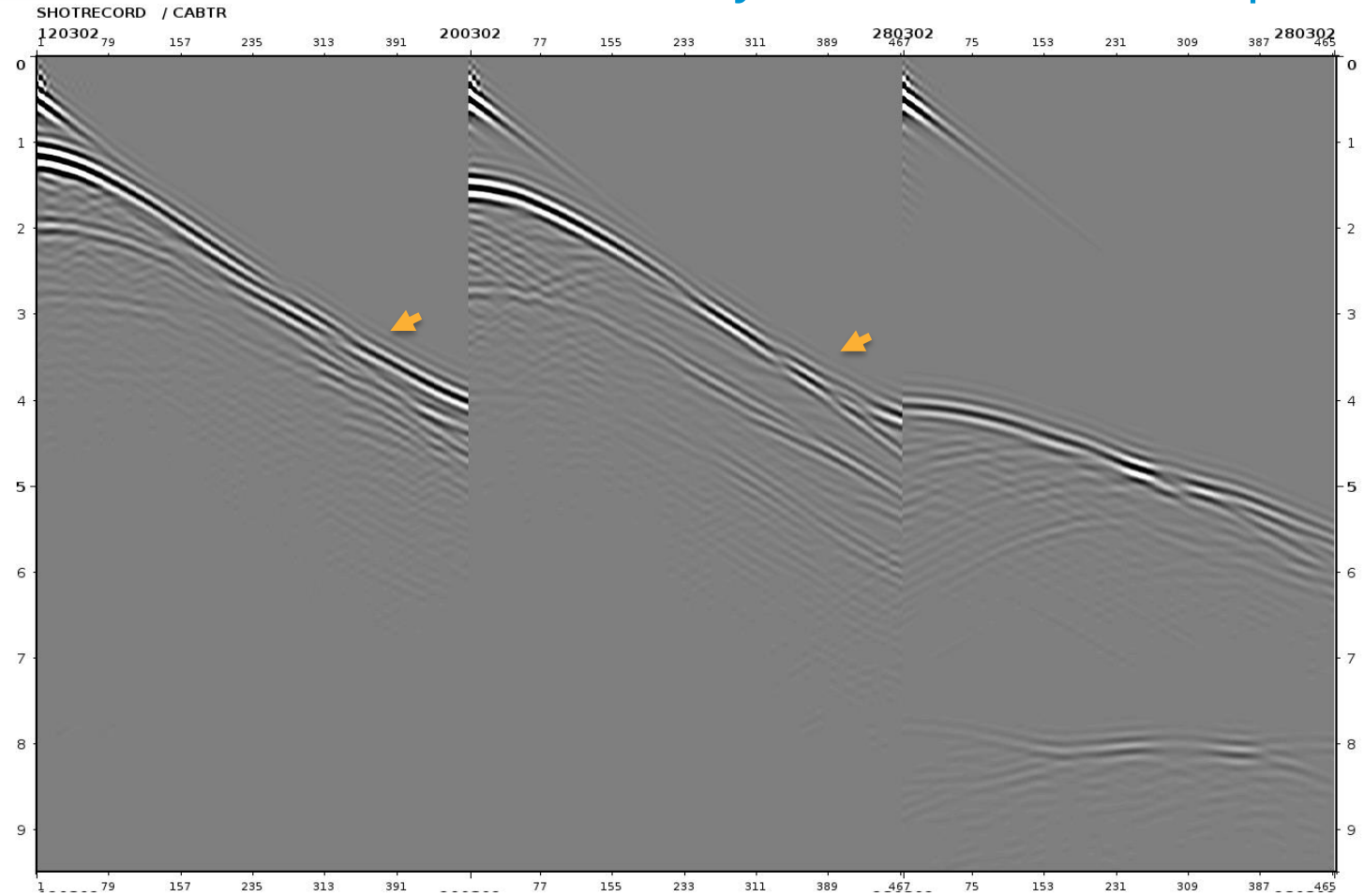
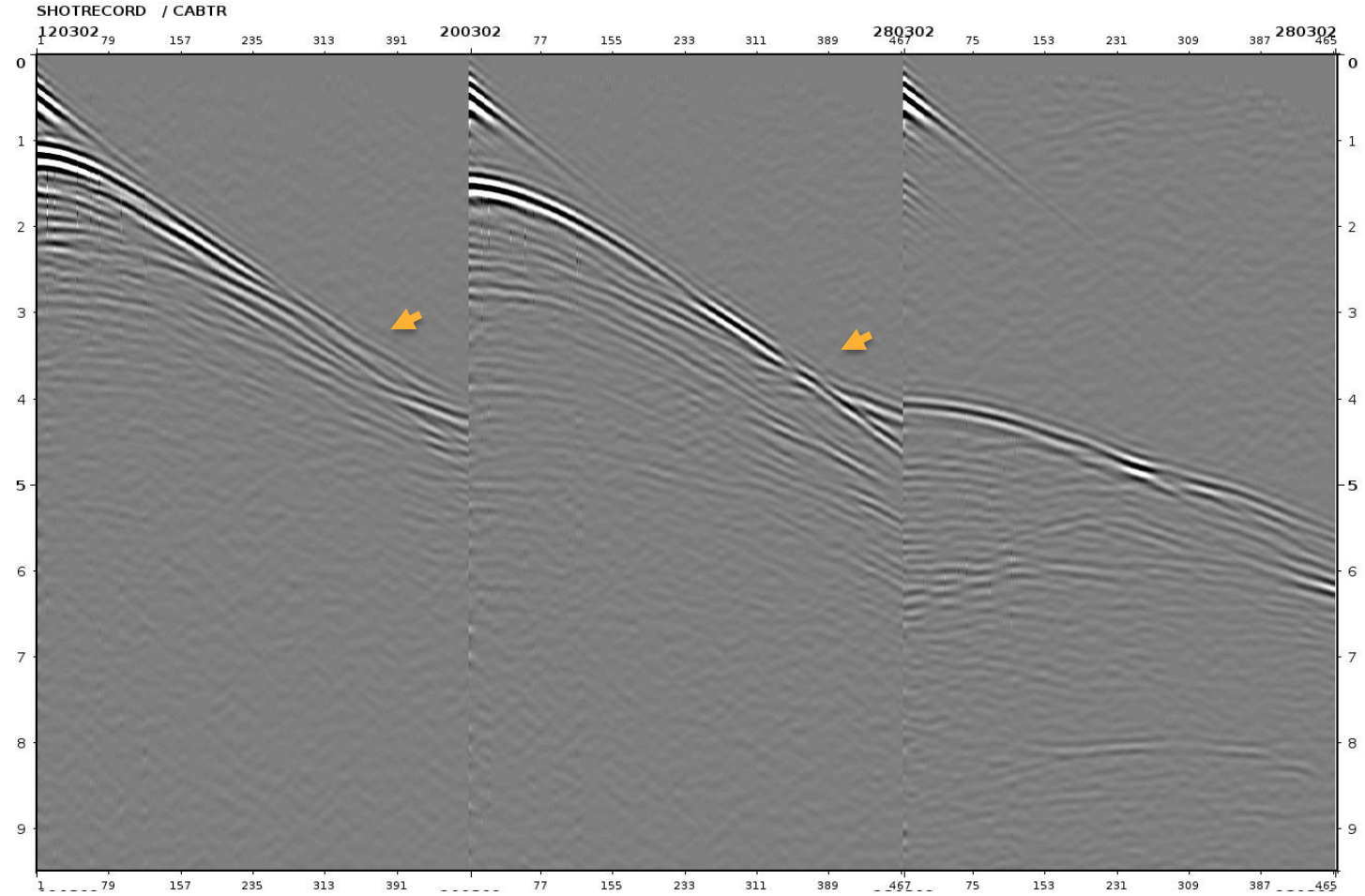
Streamer 001: ISO FWI Synthetic Shots with Updated Velocity



- After ISO FWI date, synthetic shots and real data matches better through out all channels.

Streamer 001: Real Shots



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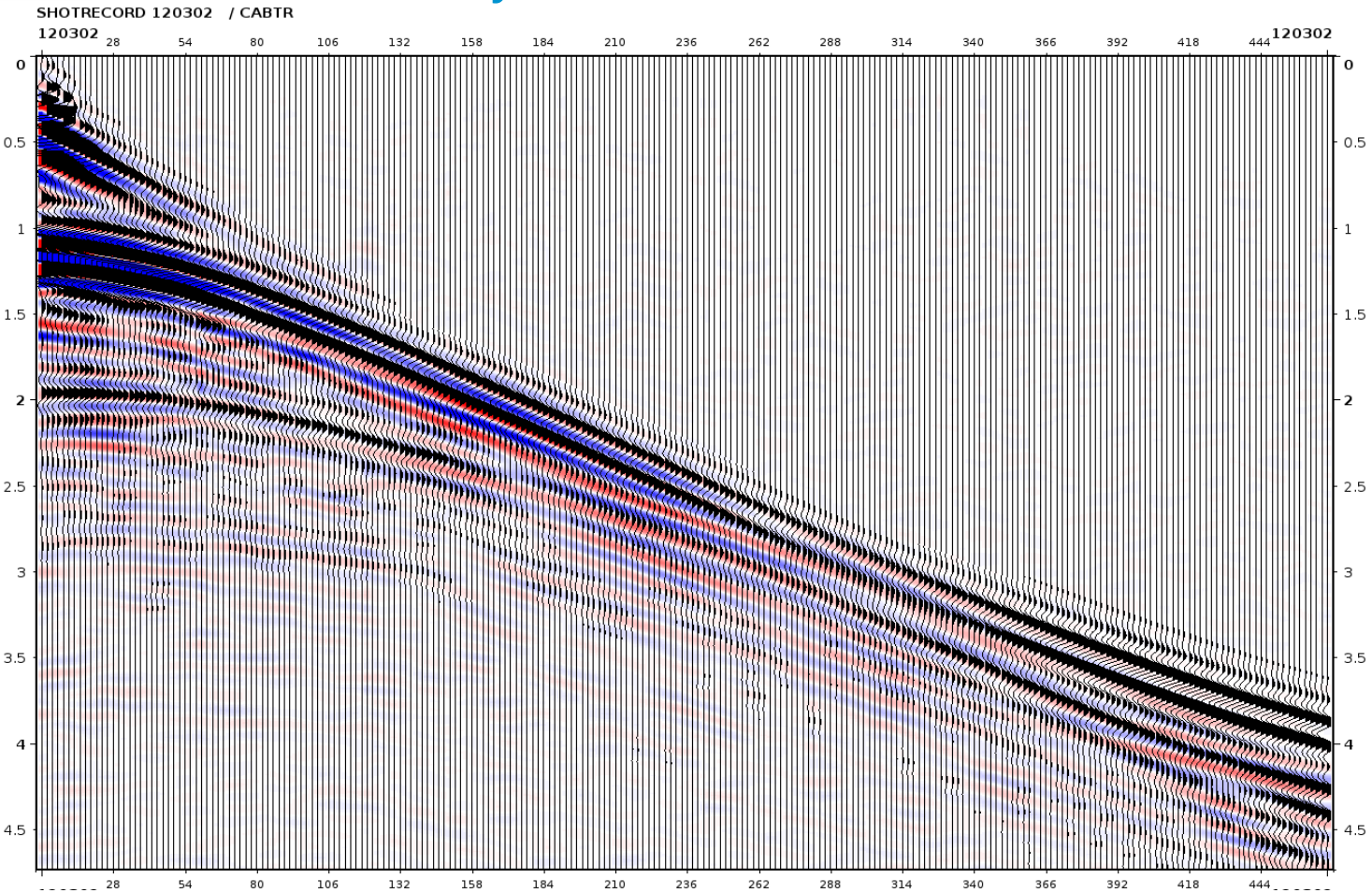
Streamer 001 Synthetic Overlaid on Real: Initial Velocity



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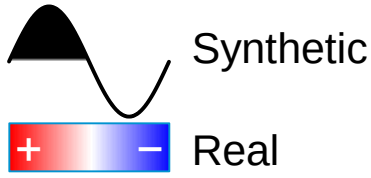
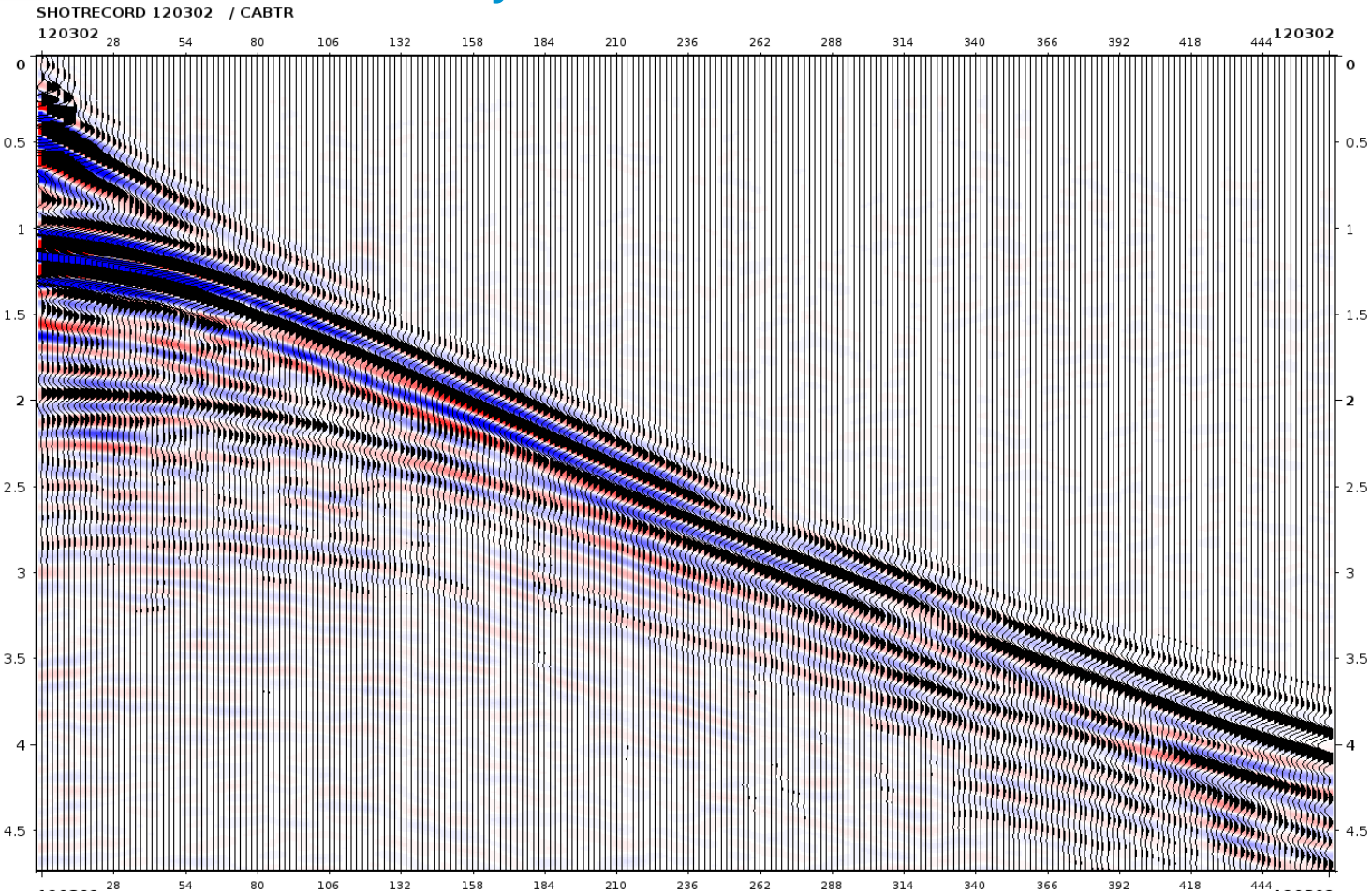


Streamer 001 Synthetic Overlaid on Real: ISO FWI Velocity



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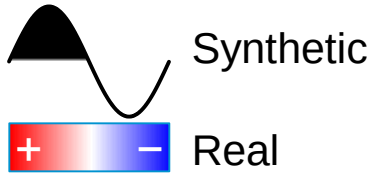

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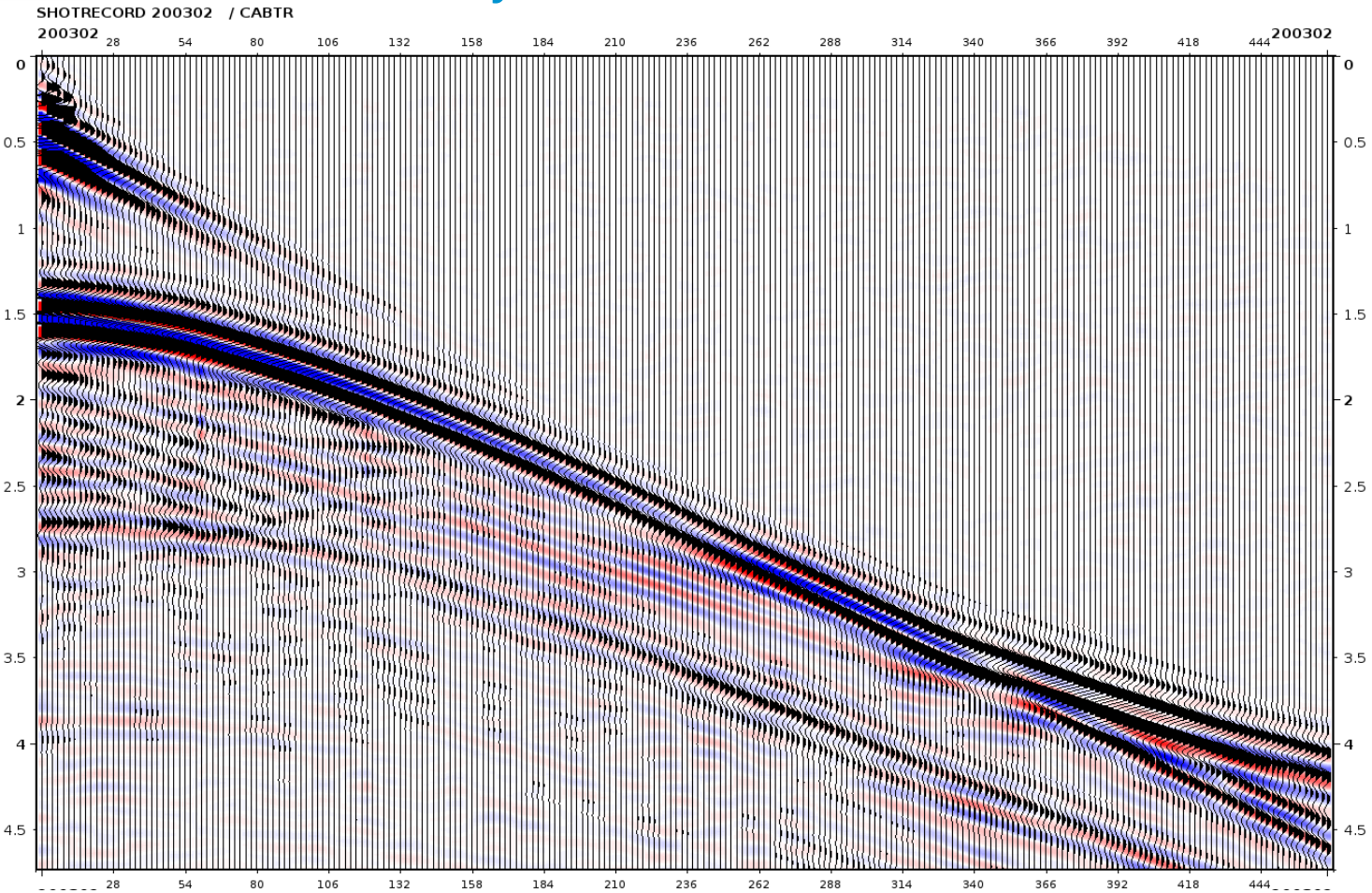

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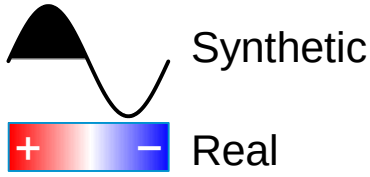
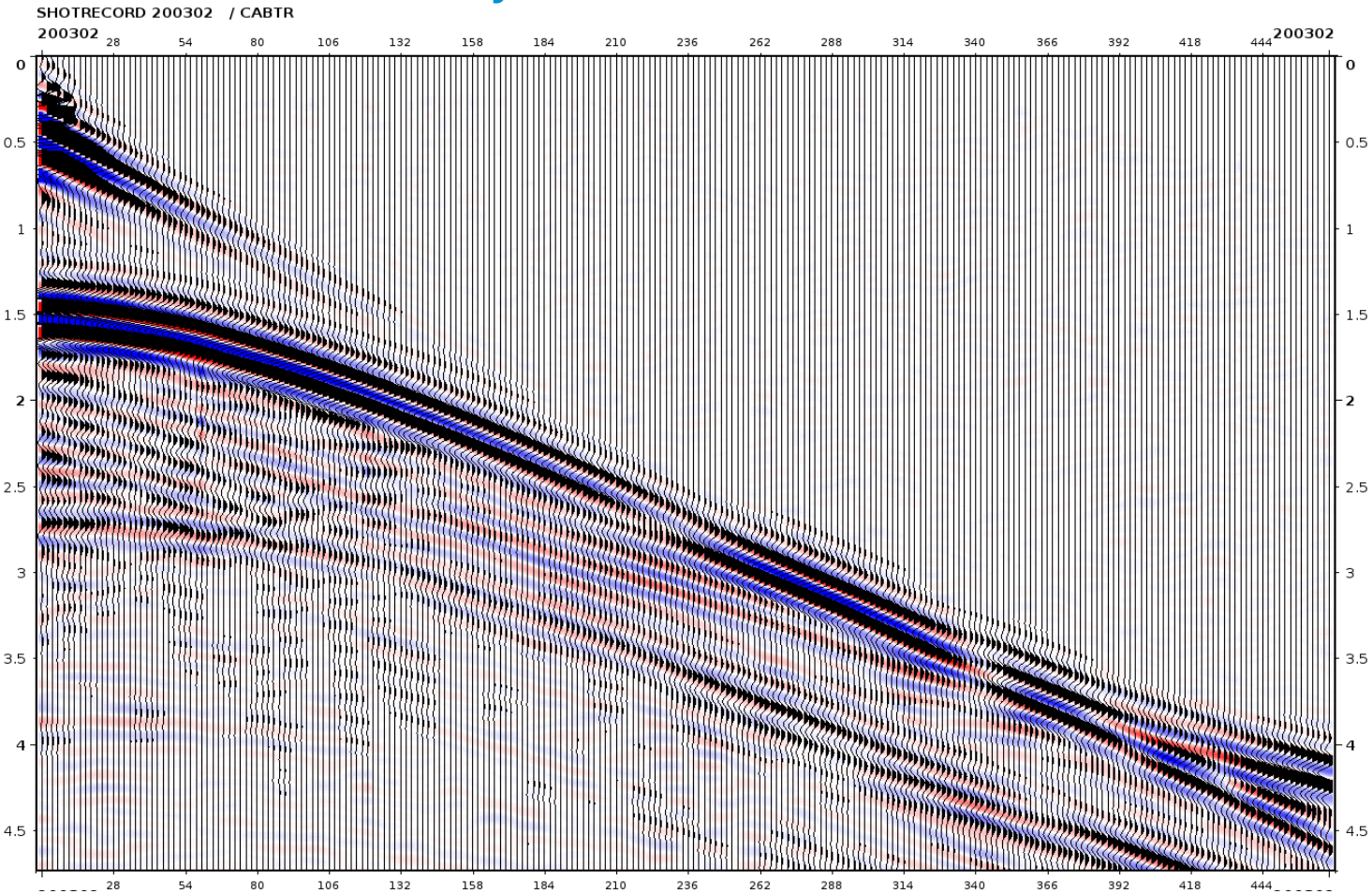


Streamer 001 Synthetic Overlaid on Real: ISO FWI Velocity



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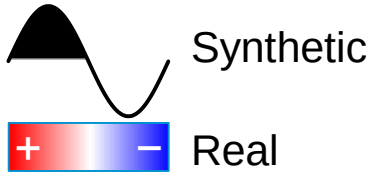
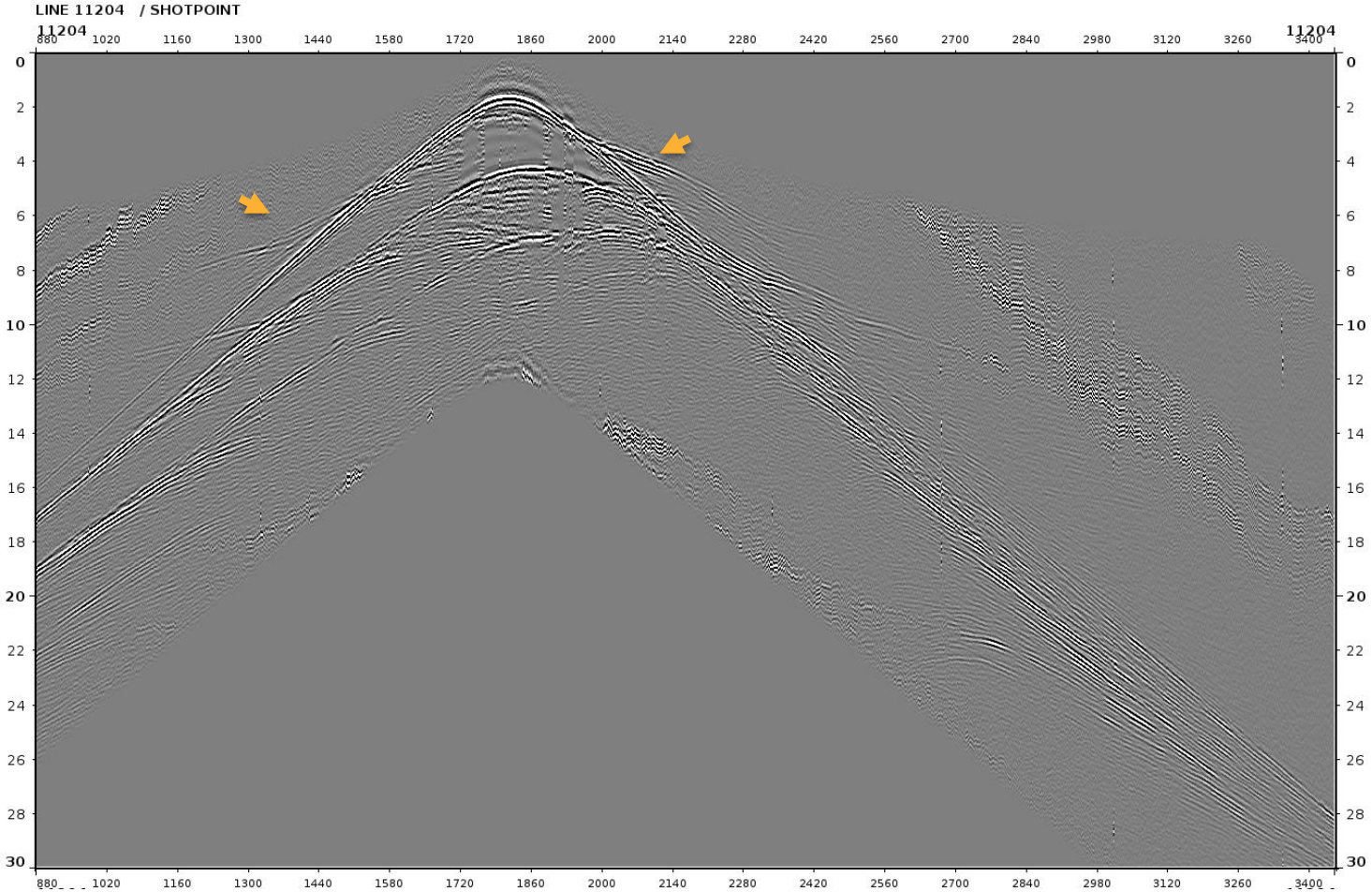


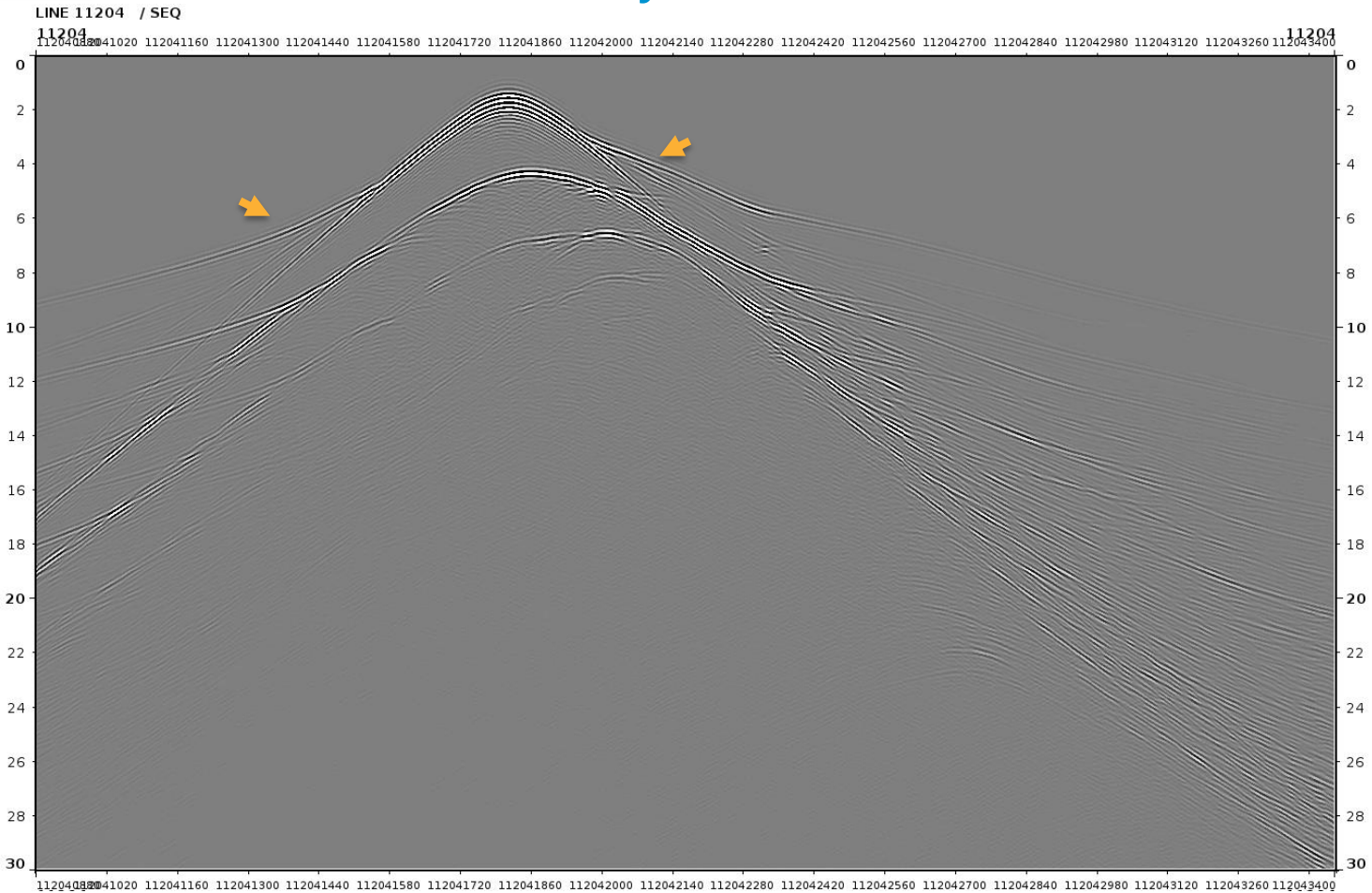
FWI Synthetic VS Real Data OBS

OBS 058 : Real Data



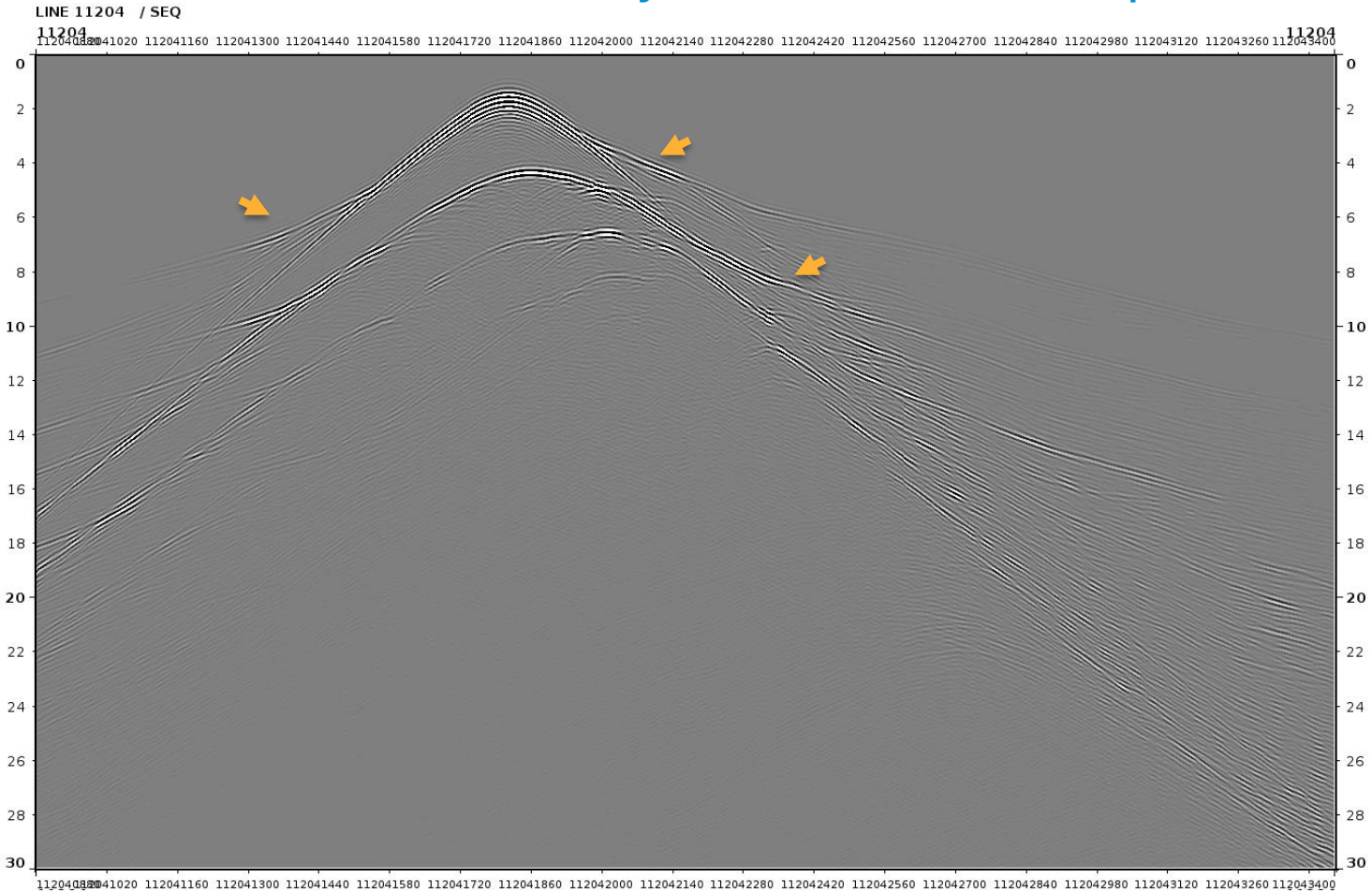
- With initial velocity, synthetic shot and real data matches not very well.

OBS 058 : ISO FWI Synthetic Data with Initial Velocity



- With initial velocity, synthetic shot and real data matches not very well.

OBS 058 : ISO FWI Synthetic Data with Updated Velocity



- After ISO FWI date, synthetic shots and real data matches better.
- Mismatches at far offset remains, where ISO FWI may suffer from cycle skipping due to large velocity error in deep section.

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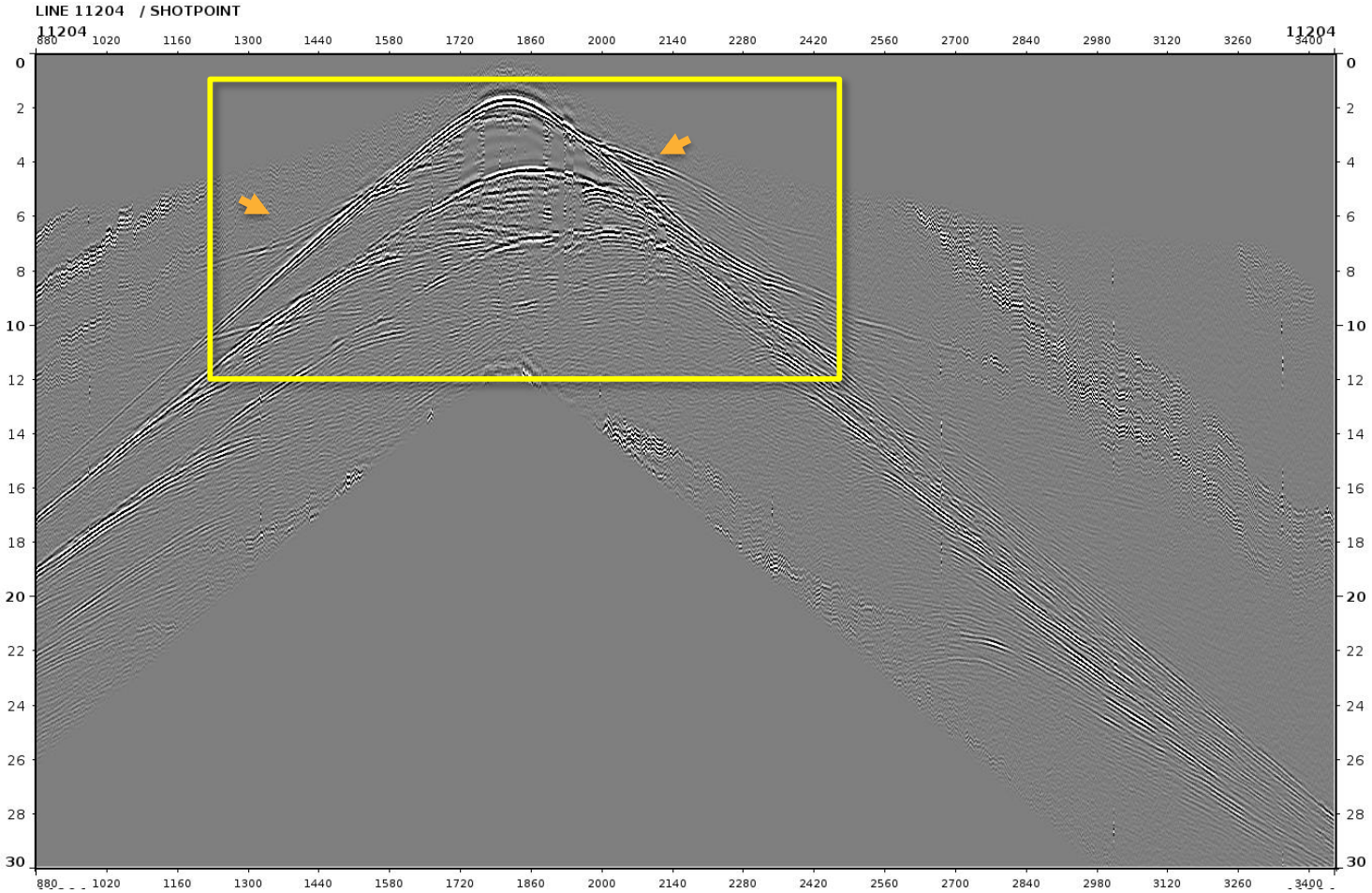

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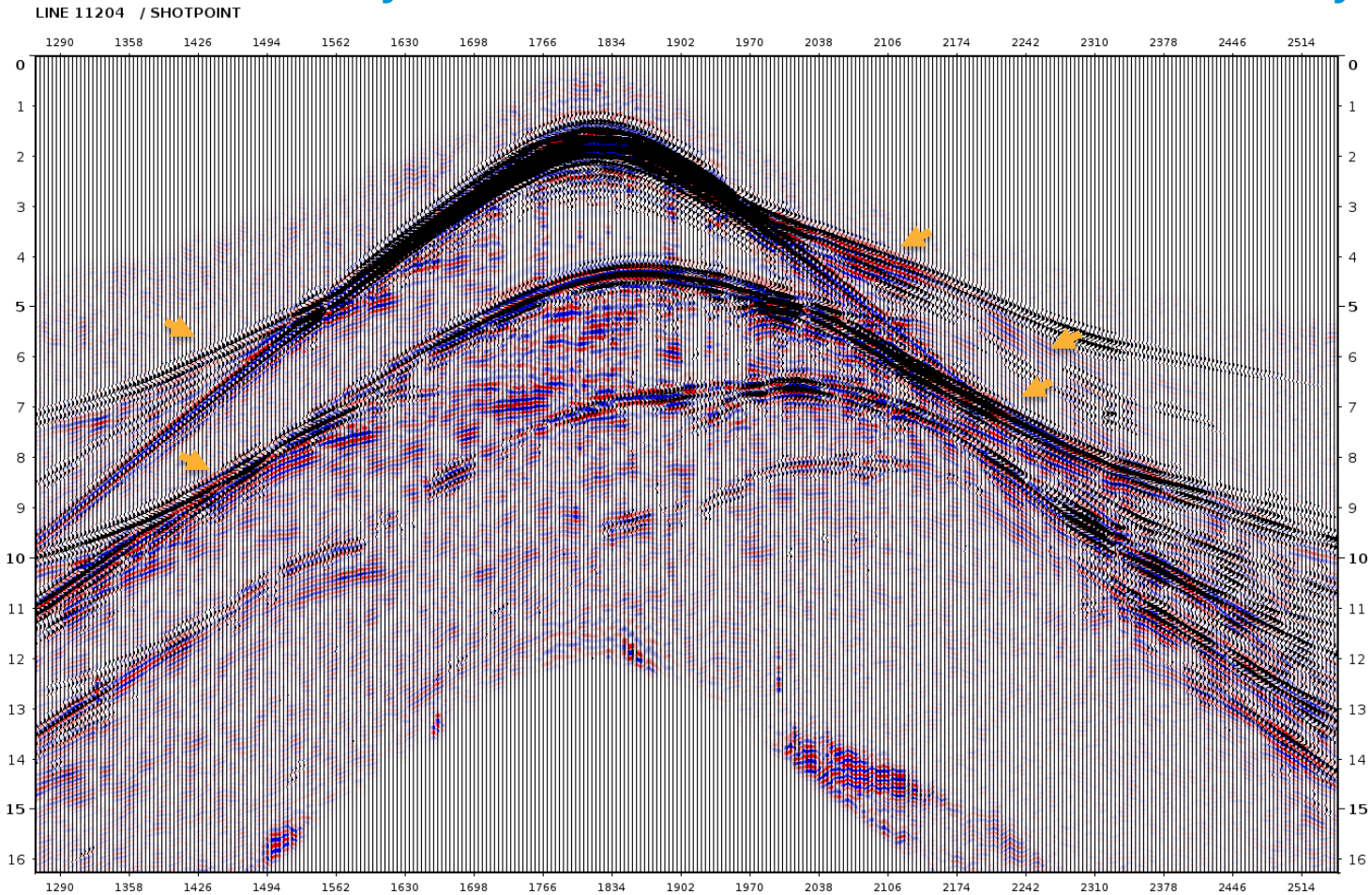
- Mismatches at far offset remains, where ISO FWI may suffer from cycle skipping due to large velocity error in deep section and/or anisotropic effect.

OBS 058 Synthetic Overlaid on Real: Initial Velocity



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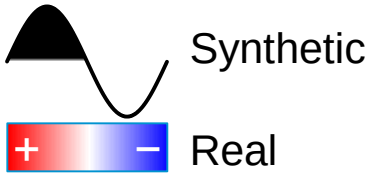
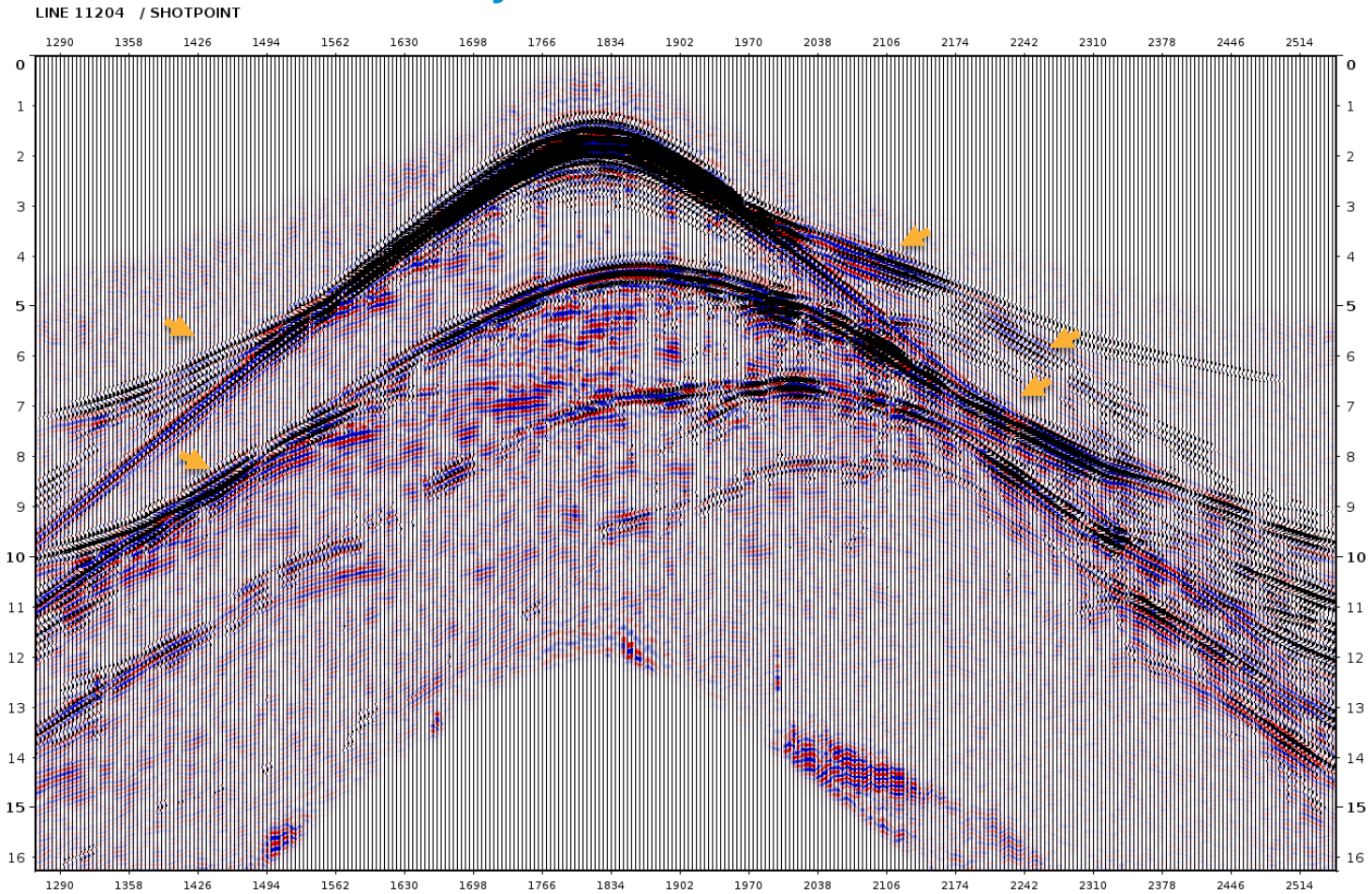


Synthetic

Real

Streamer 001 Synthetic Overlaid on Real: ISO FWI Velocity



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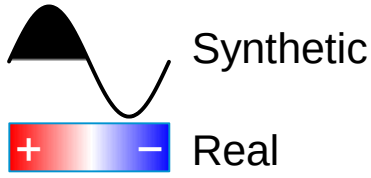

Summary

- ISO FWI gives reasonable update that follows geology down to ~2km beneath water bottom.

- Deeper than 2km beneath water bottom, we have less confidence due to increasing chances of cycle skipping and/or anisotropic effects.

- We plan to use reasonable update to continue with ISO tomography, which may provide better starting model for TTI FWI, especially in the deep section.