Processing seismic data for high resolution

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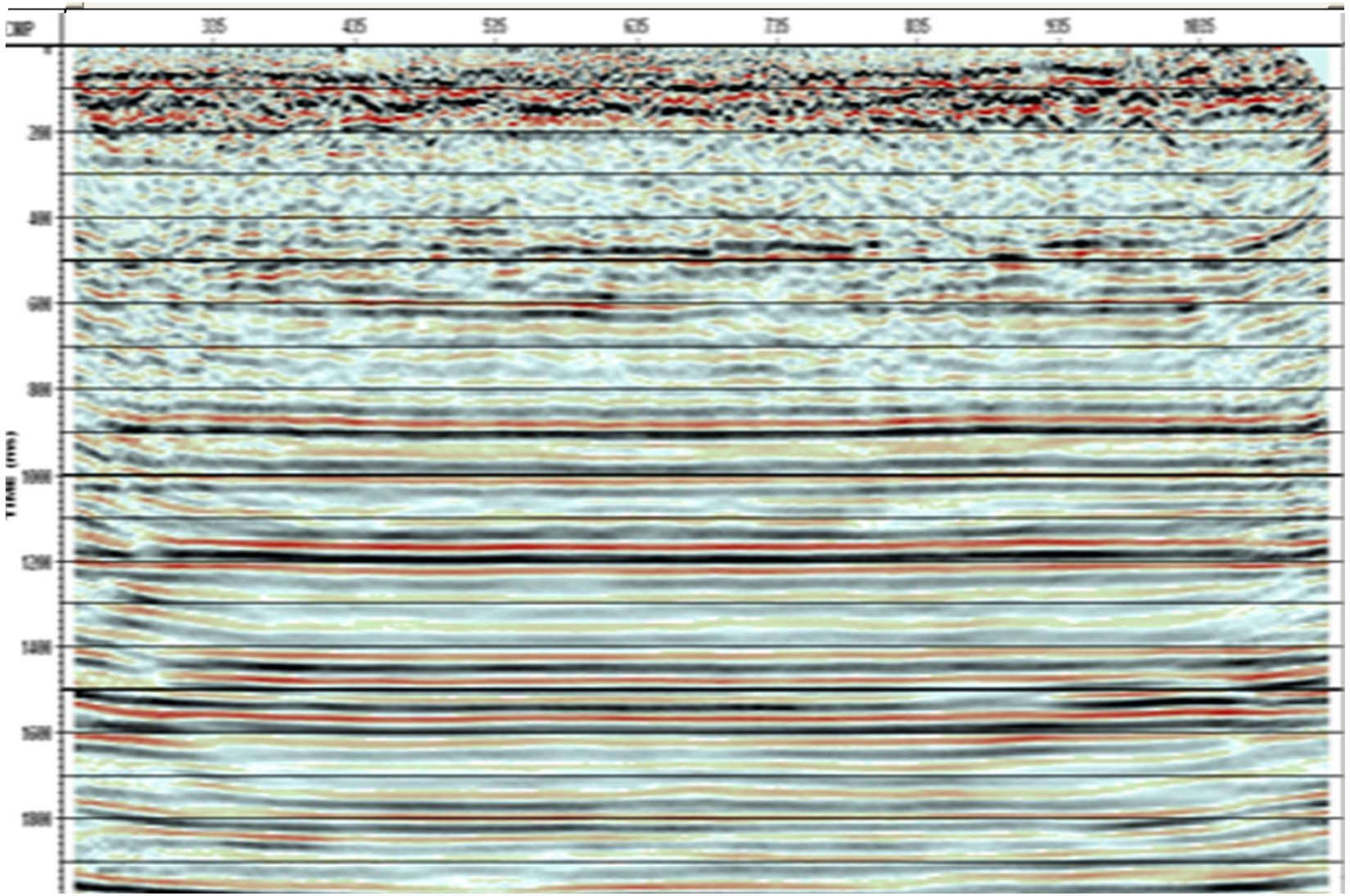
CREWES 2014

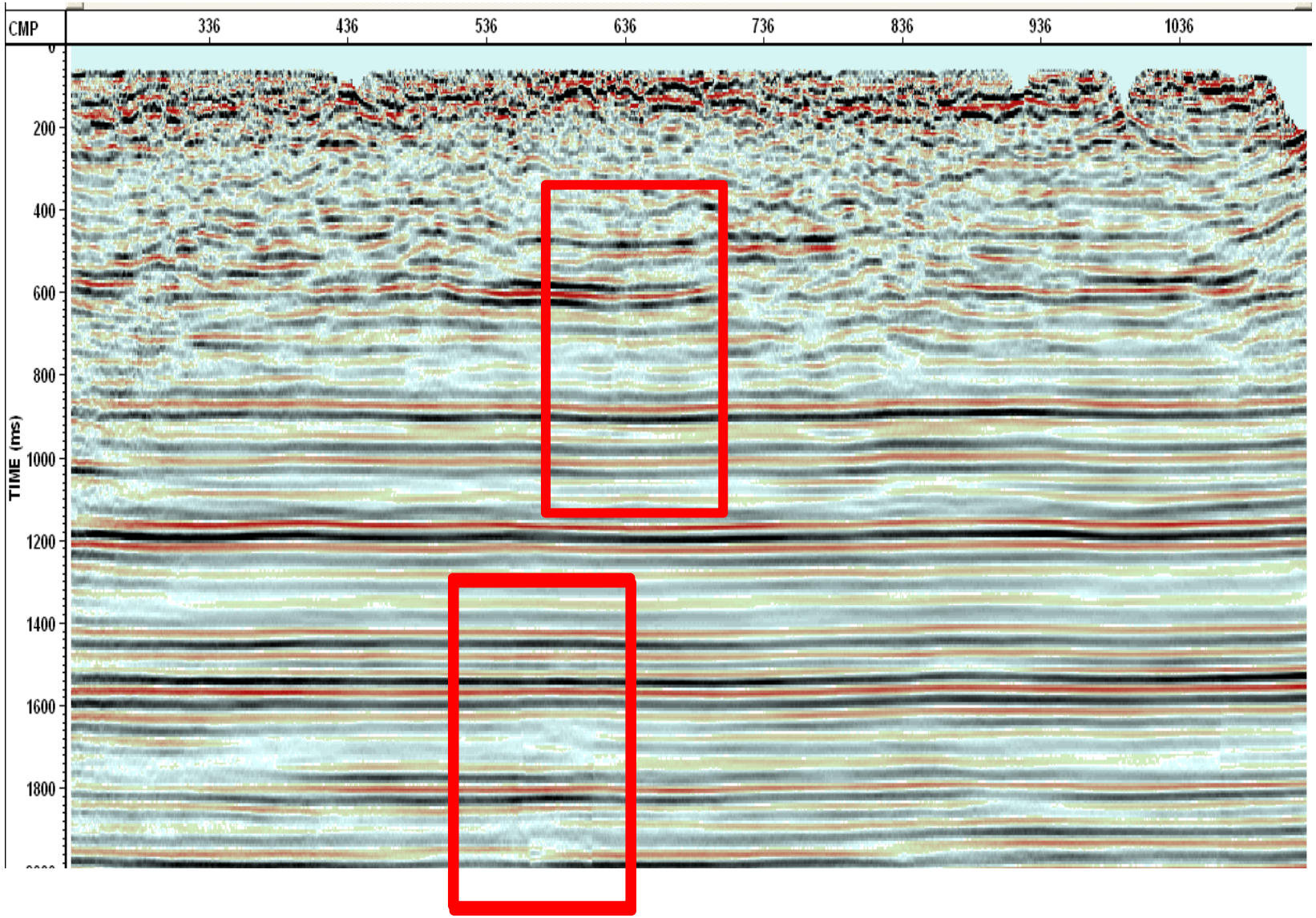

Motivation

Low resolution data

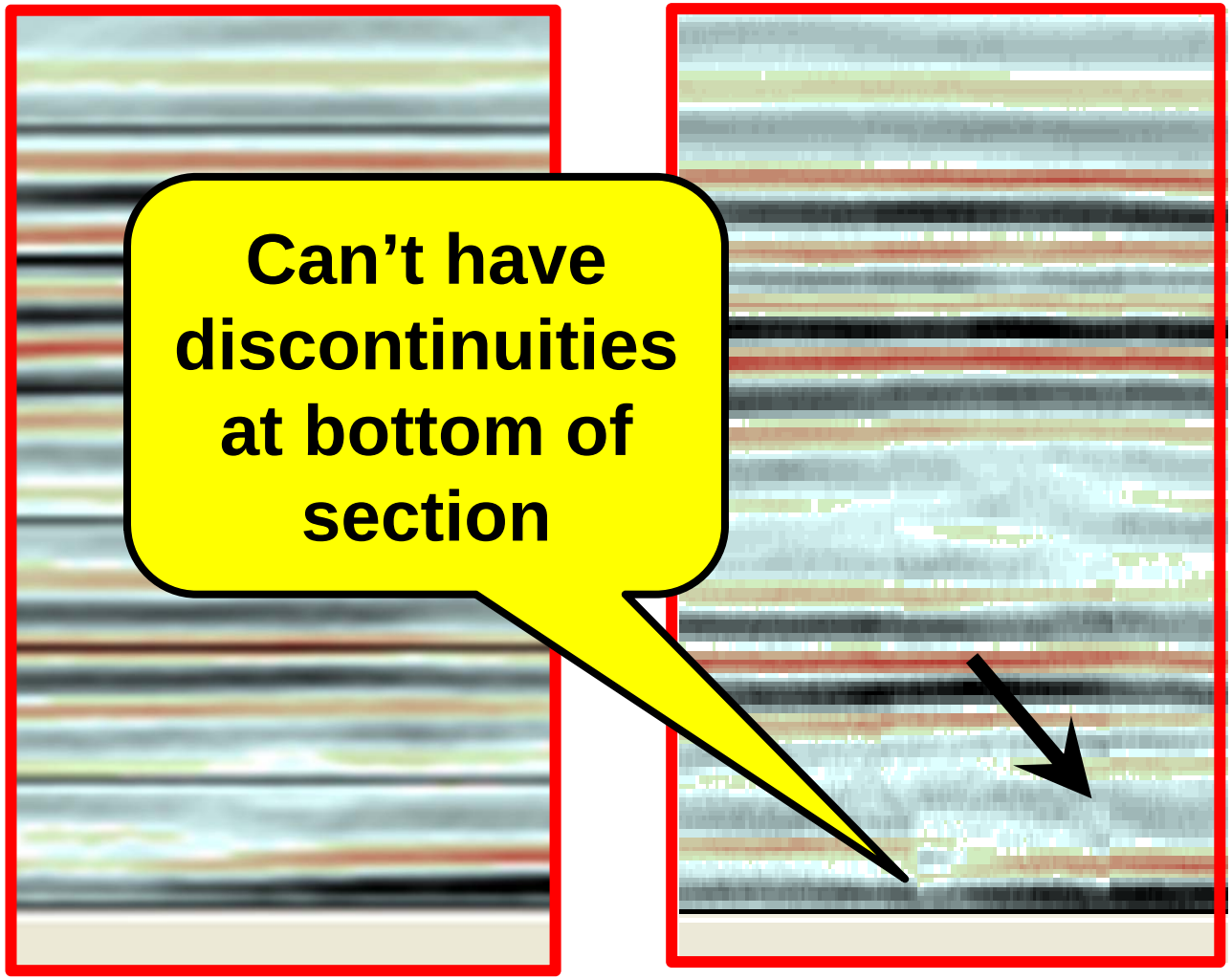



Story

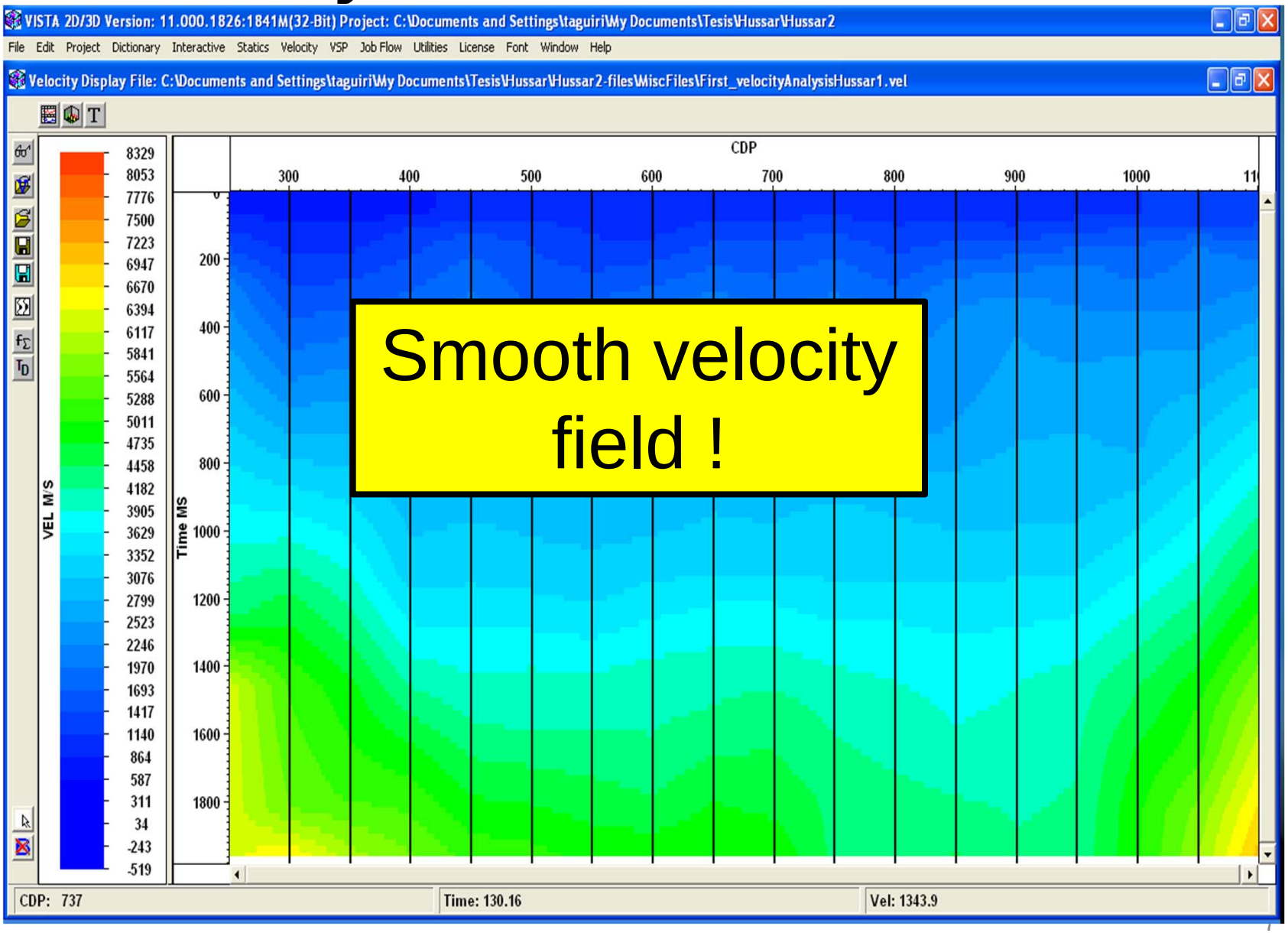
Must be artefacts…



Must be artefacts…



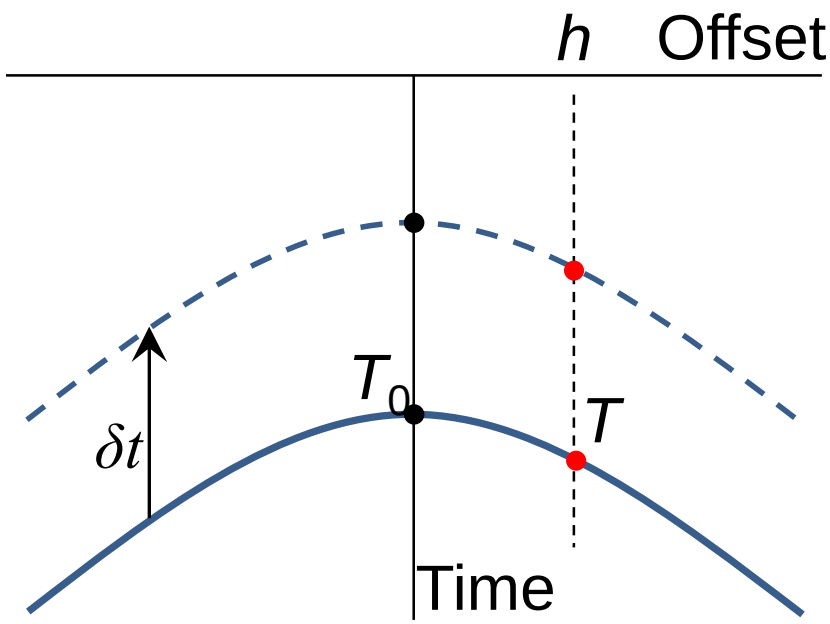
Velocity field too structured..

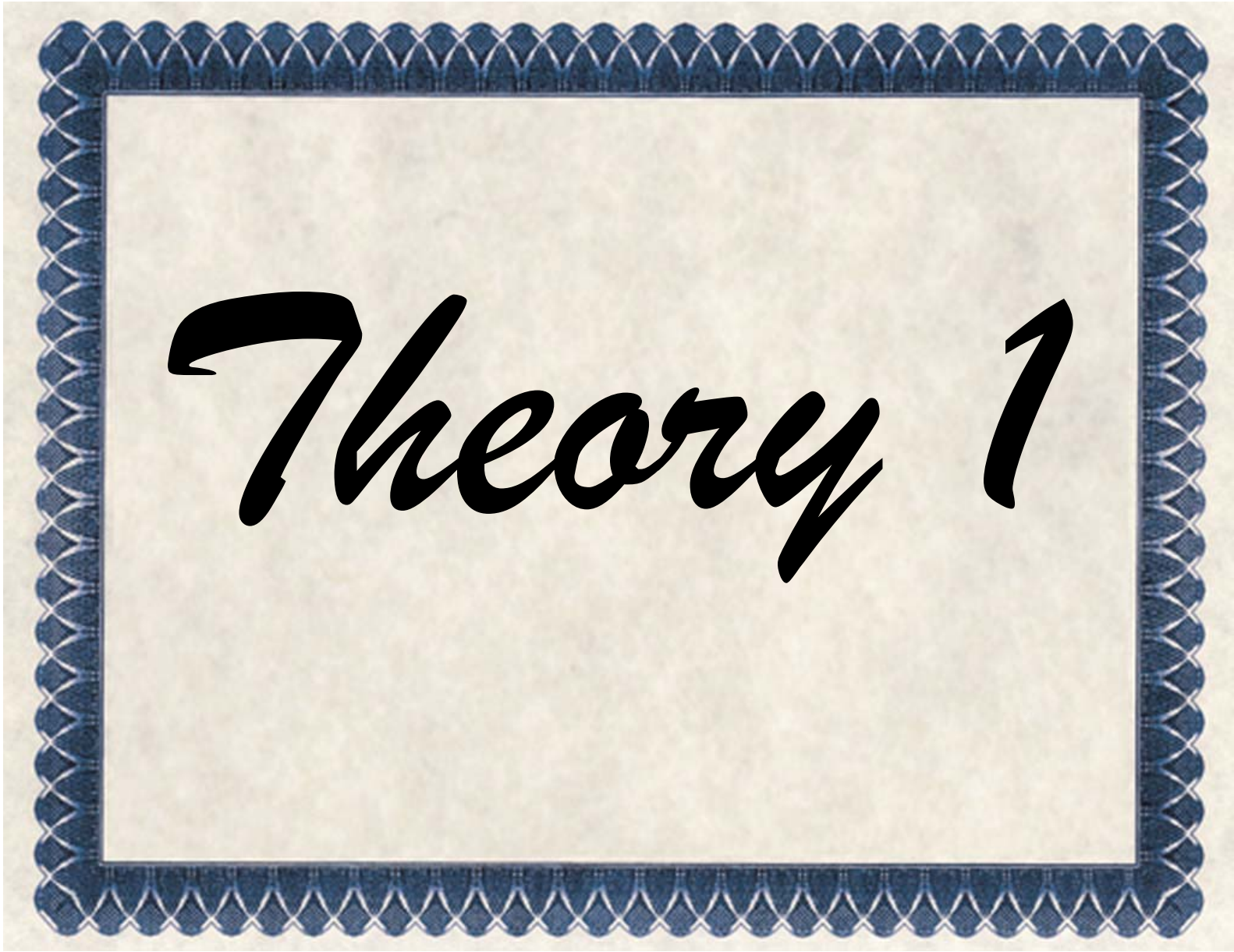


Revisit velocity problem.

Rule of thumb:
If elevation less 3 to 5 trace intervals, elevation statics OK.

If not wave-equation datumming is required.



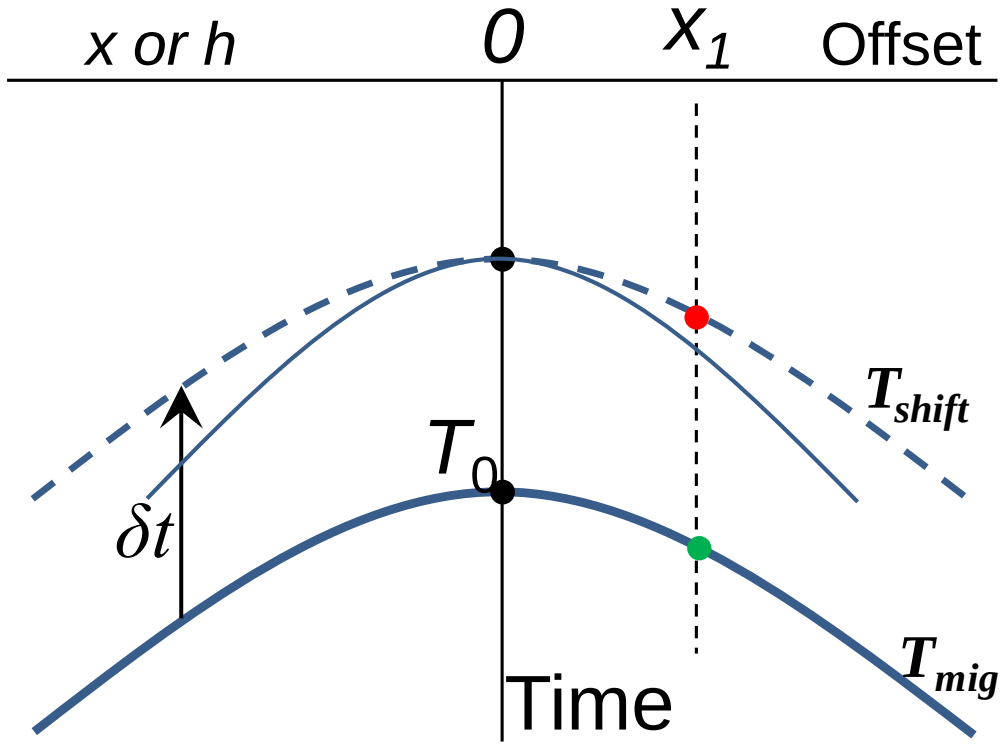

Theory 1

Moveout equation

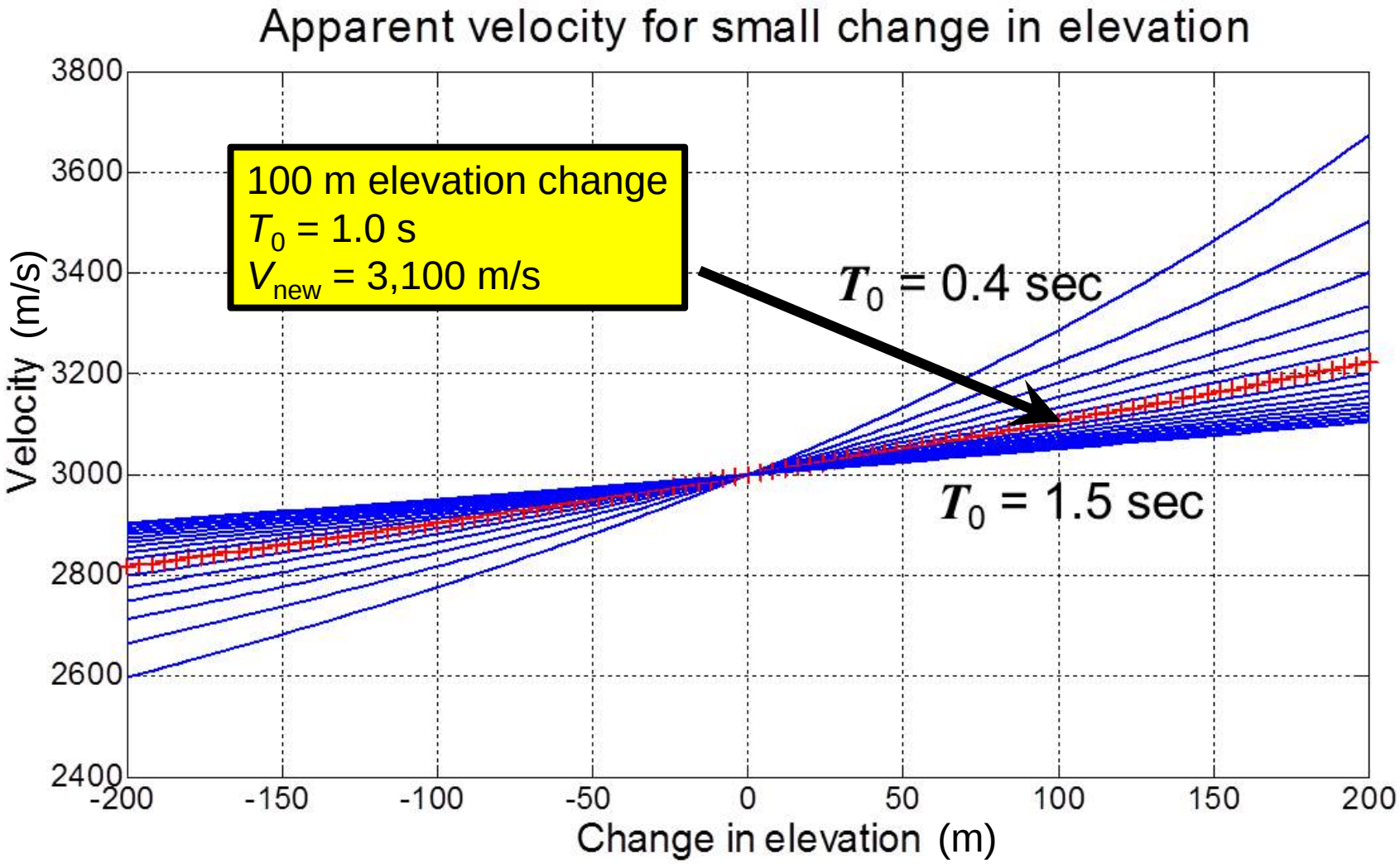
$$T_{Mig}^2 = T_0^2 + \frac{4x^2}{V_{RMS}^2}$$

Curvature at apex same

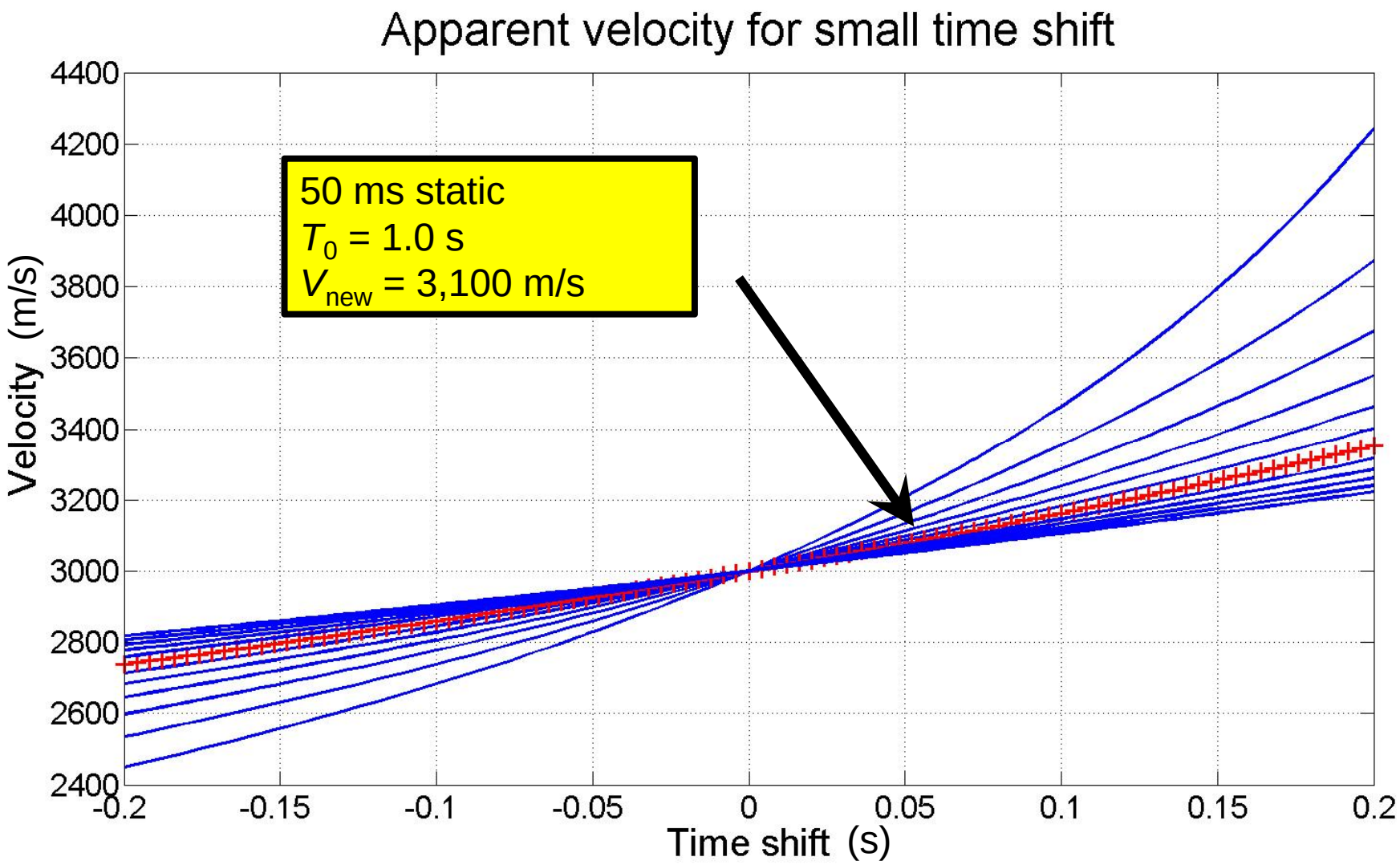
$$V_{New} = V_{RMS}\sqrt{\frac{T_0}{T_0 - \delta t}}$$



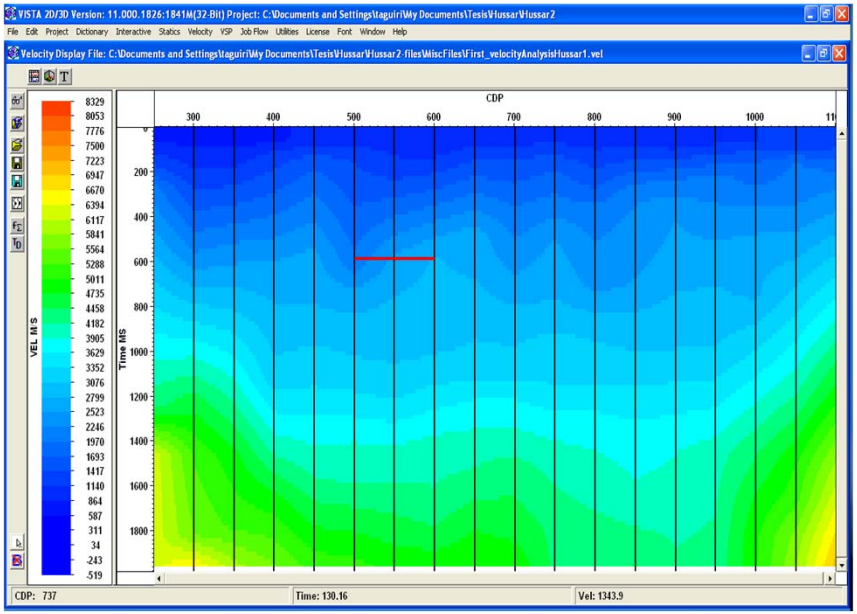
Apparent velocity vs δelev.

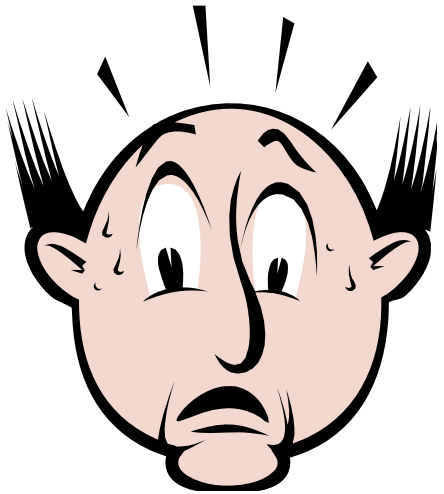


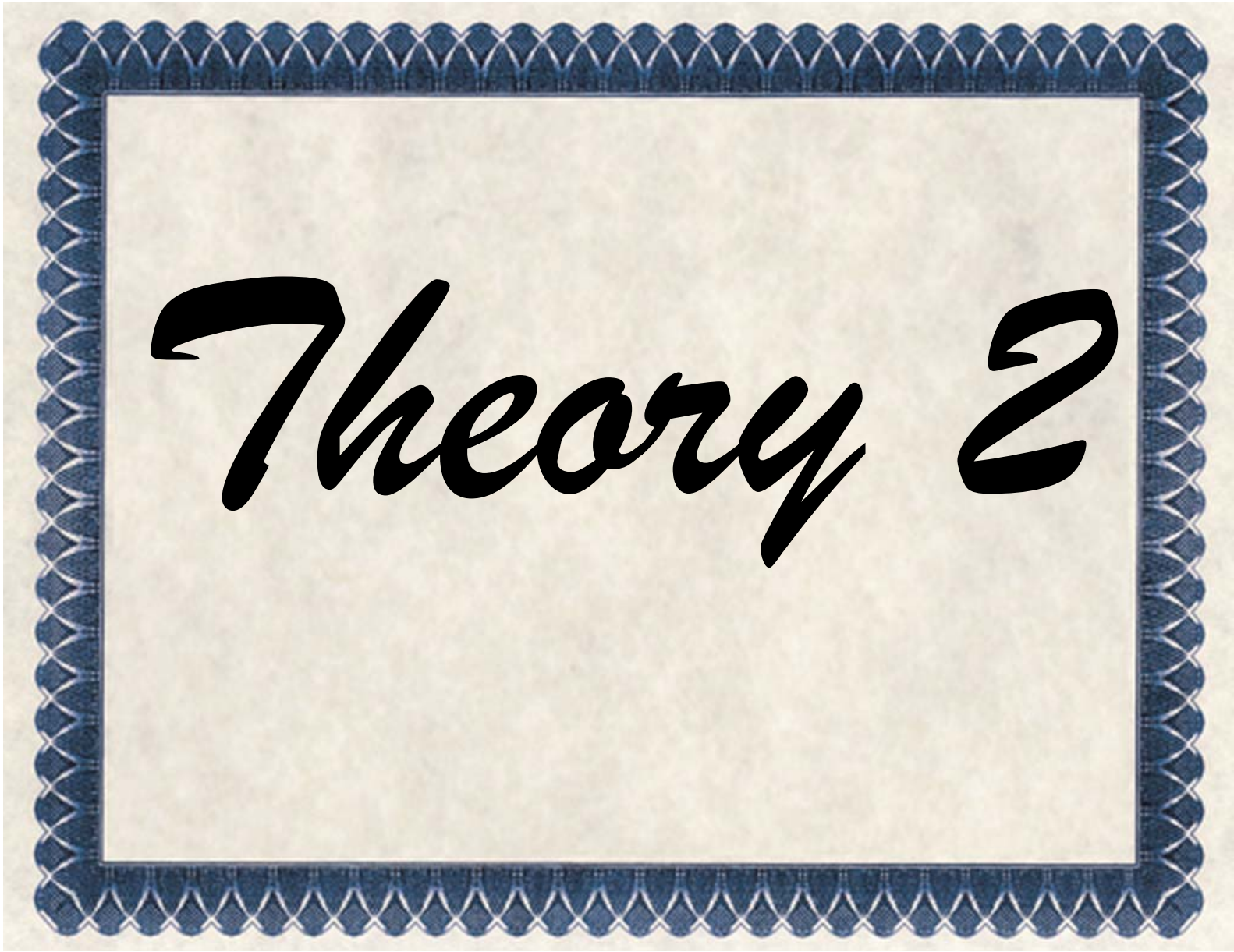
Apparent velocity vs static



Could the picked velocity field for Hussar data be valid?

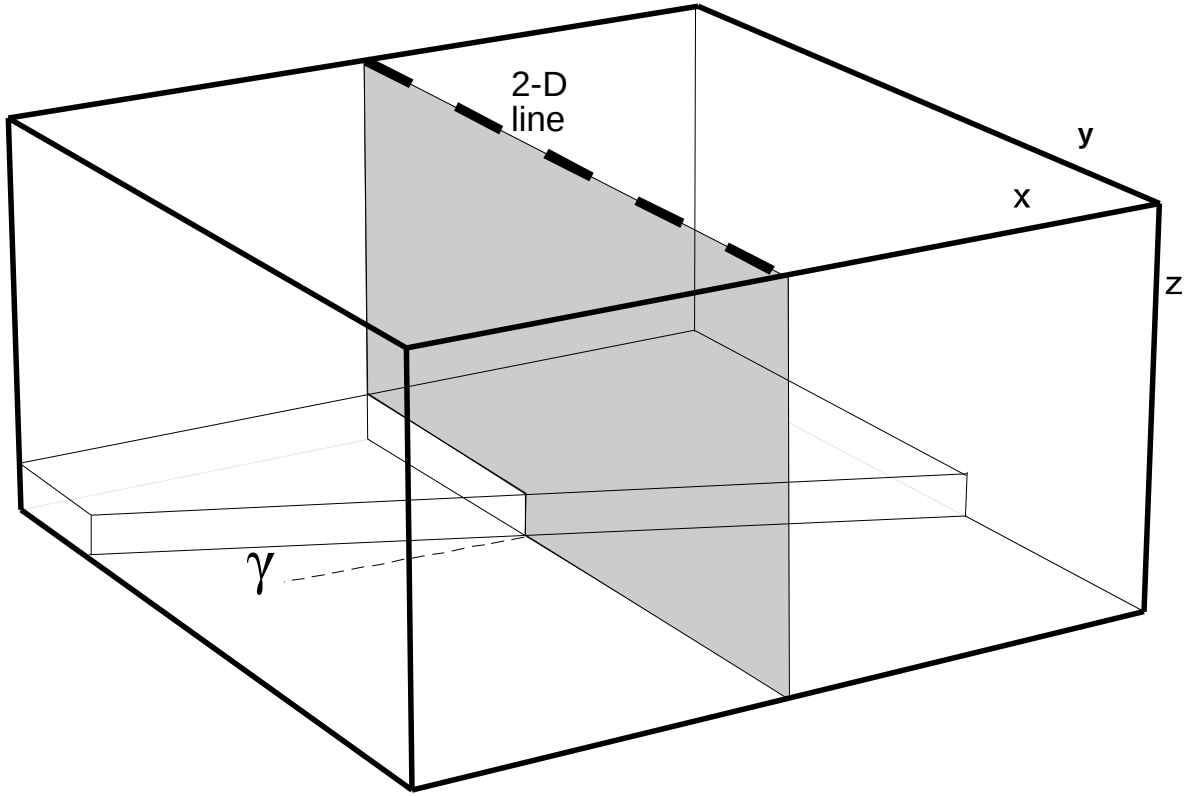





Theory 2

Oblique reflectors

$$V_{mig} = \frac{V_{rms}}{\cos\gamma}$$



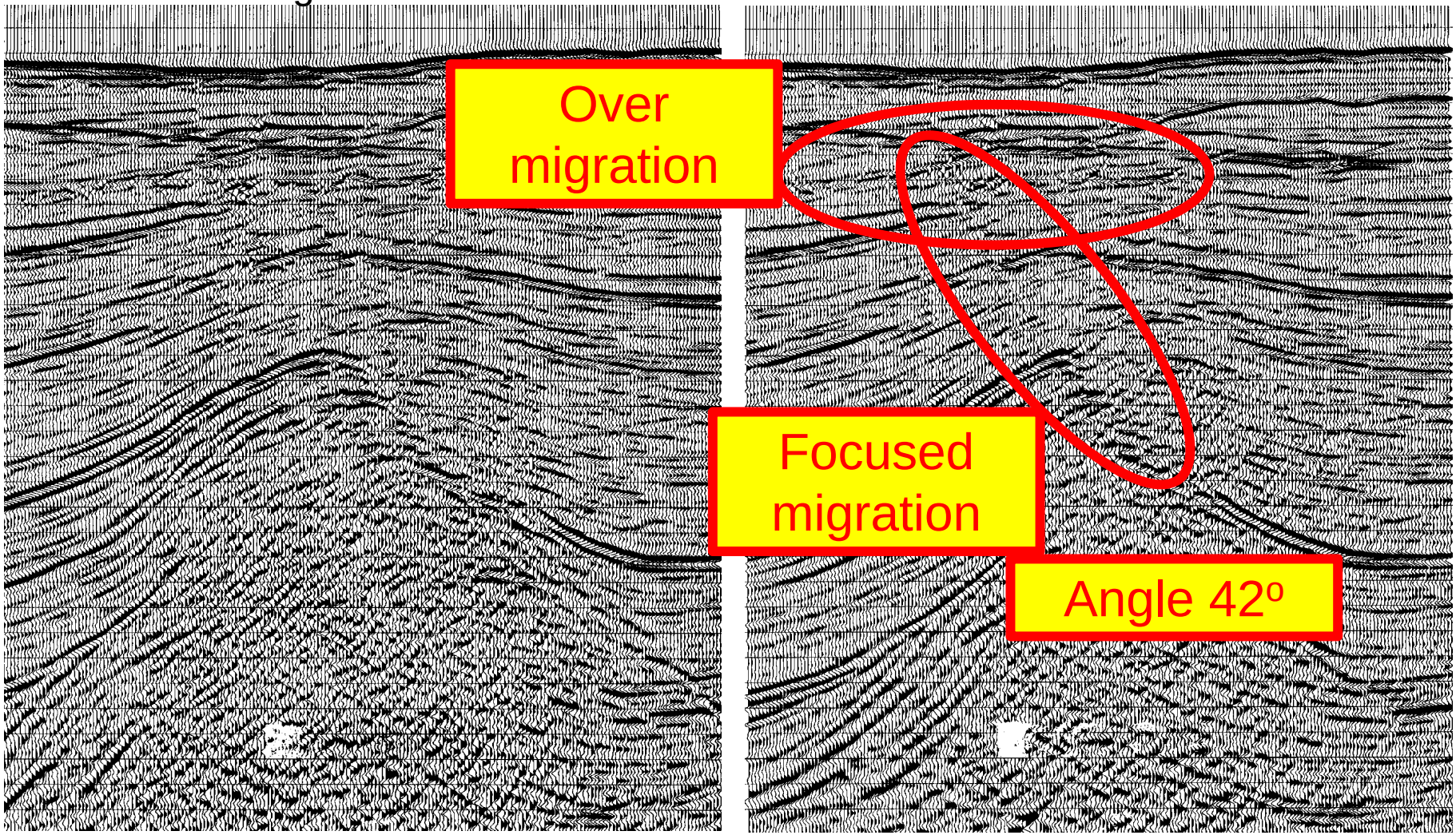
Oblique reflectors

- Only a concern for **2D** data
- Run sweep from **80%** to **200 %** V_{RMS}
- Best focus $\gamma = \cos^{-1} \dfrac{V_{rms}}{V_{mig}}$

Arctic data

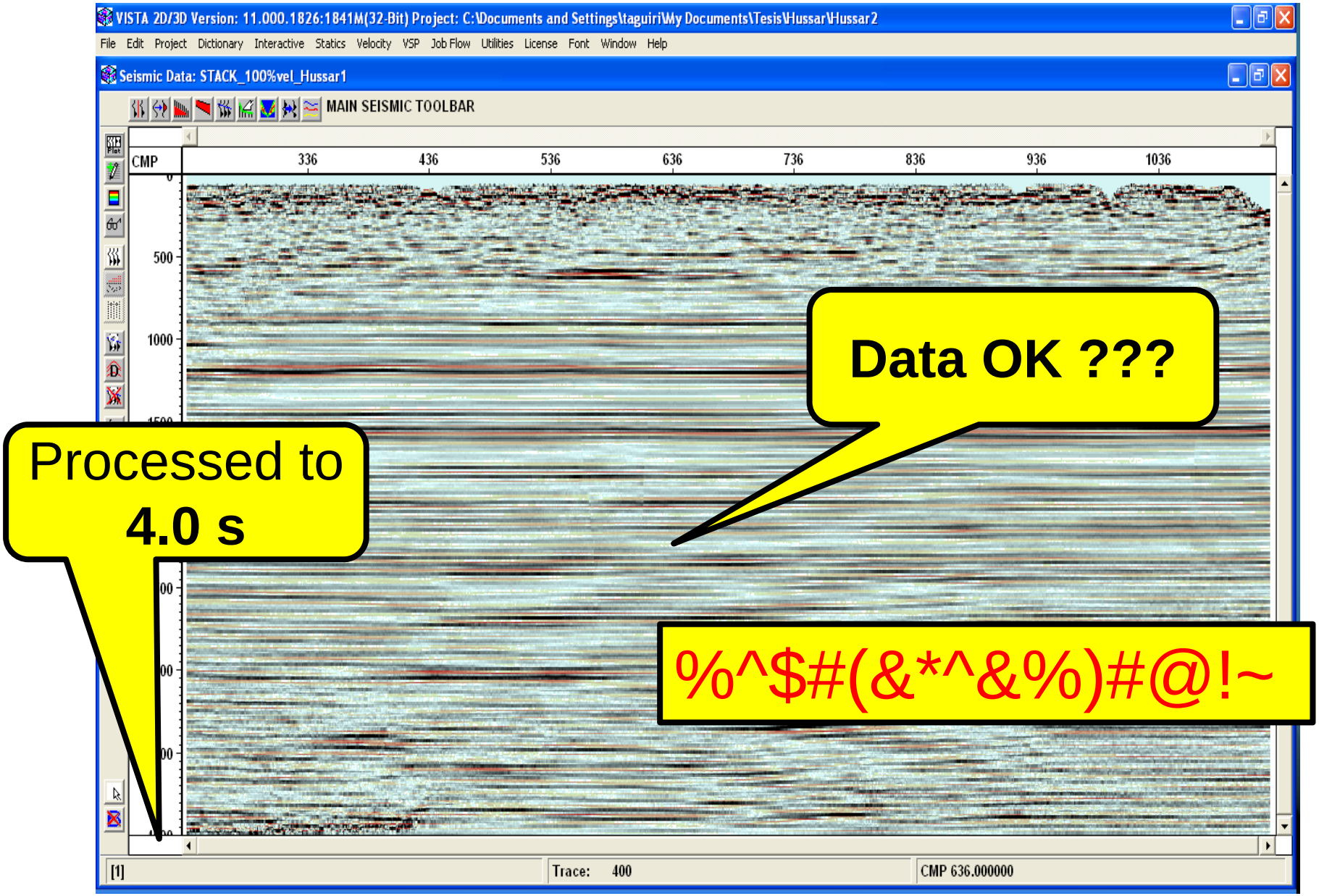
V_{mig} = 100%

V_{mig} = 135%

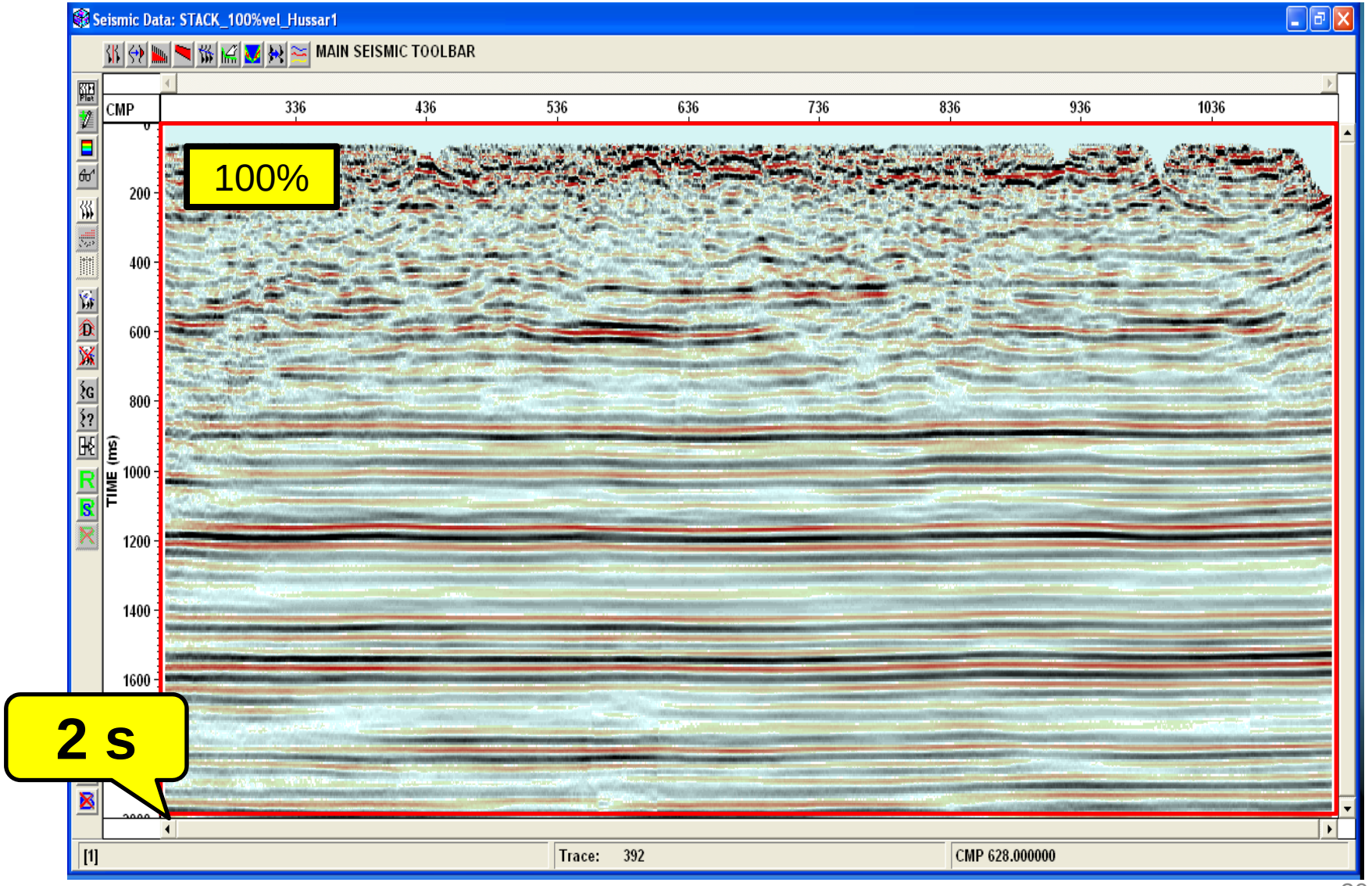



Data

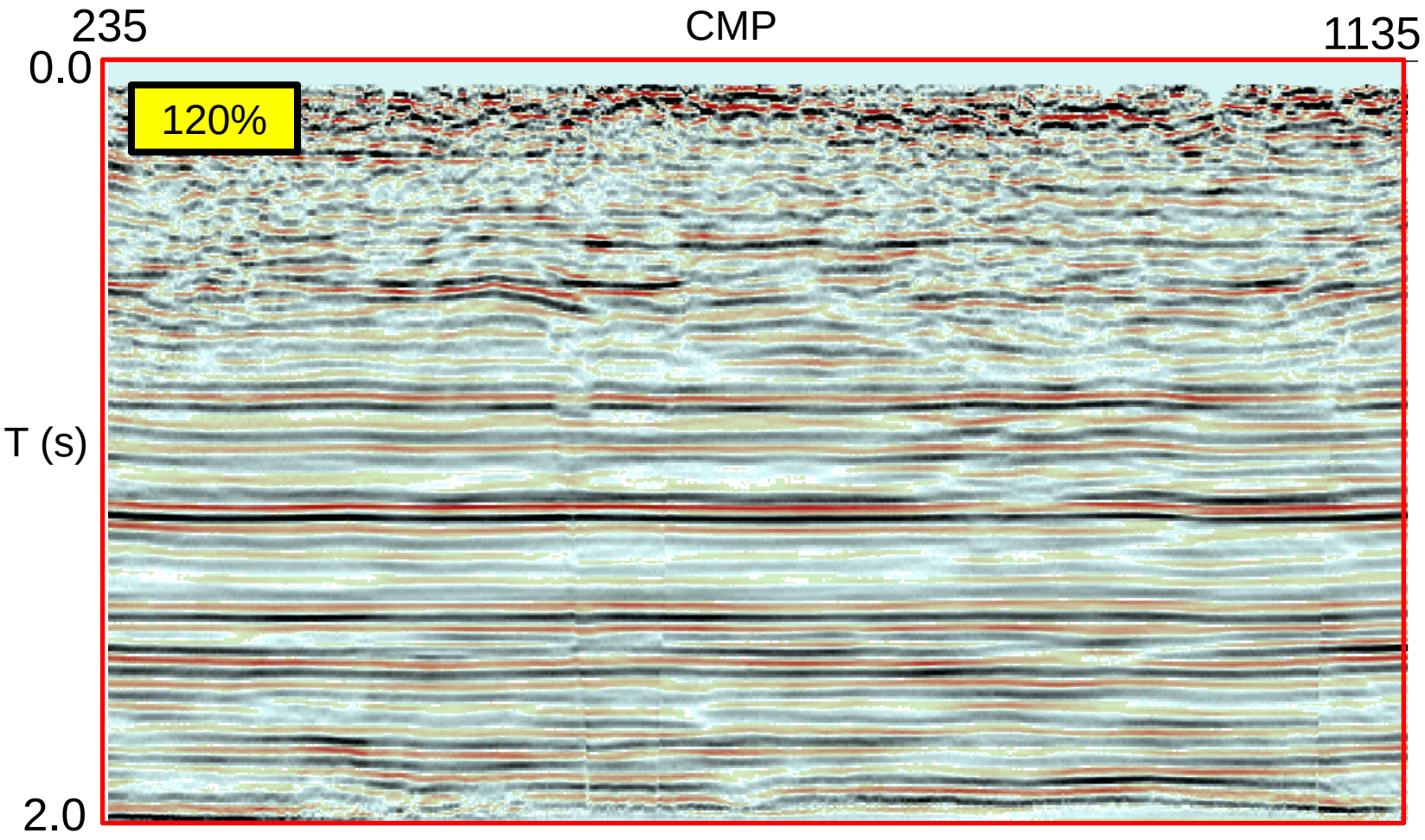
Revisit Hussar data



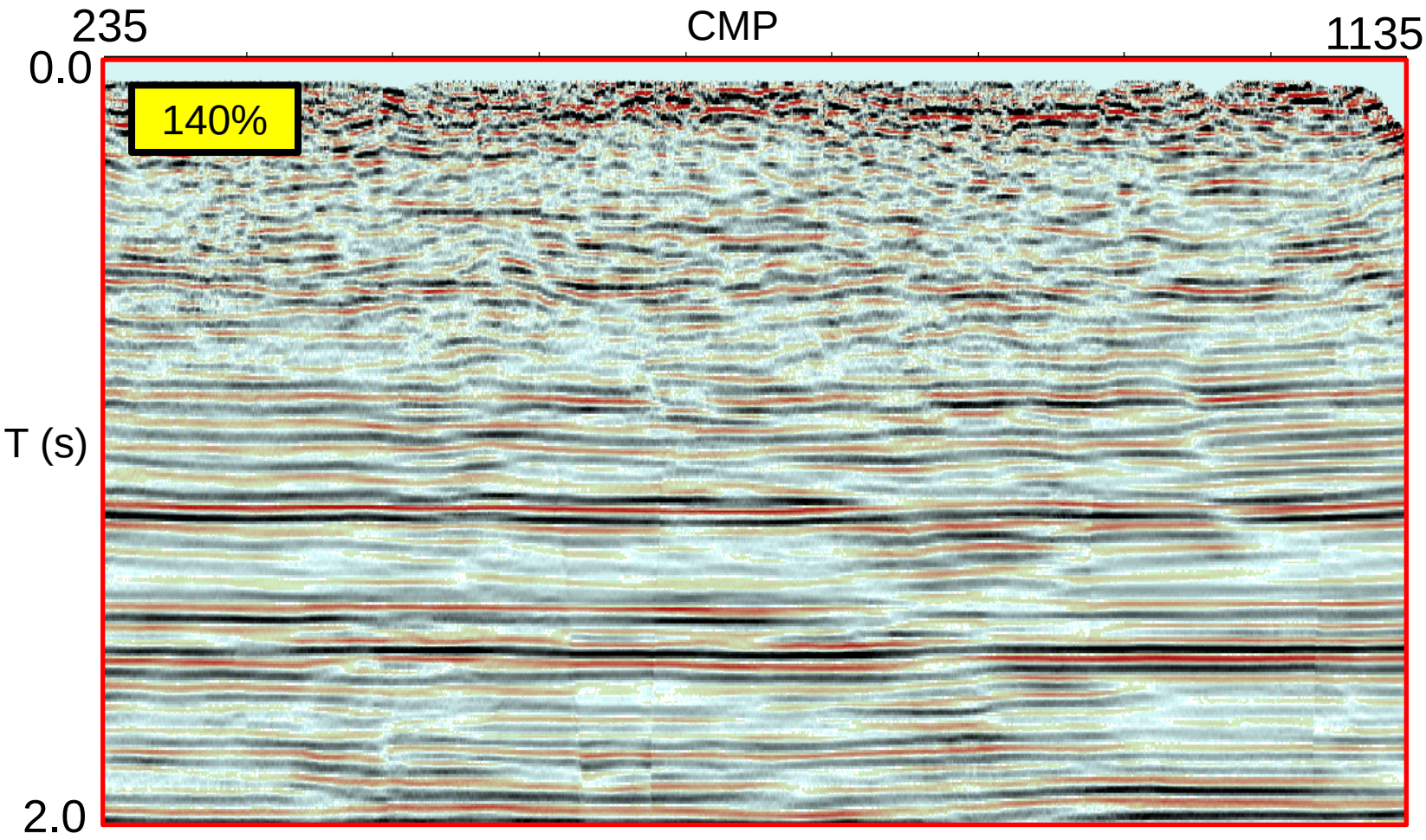
Check for oblique reflectors



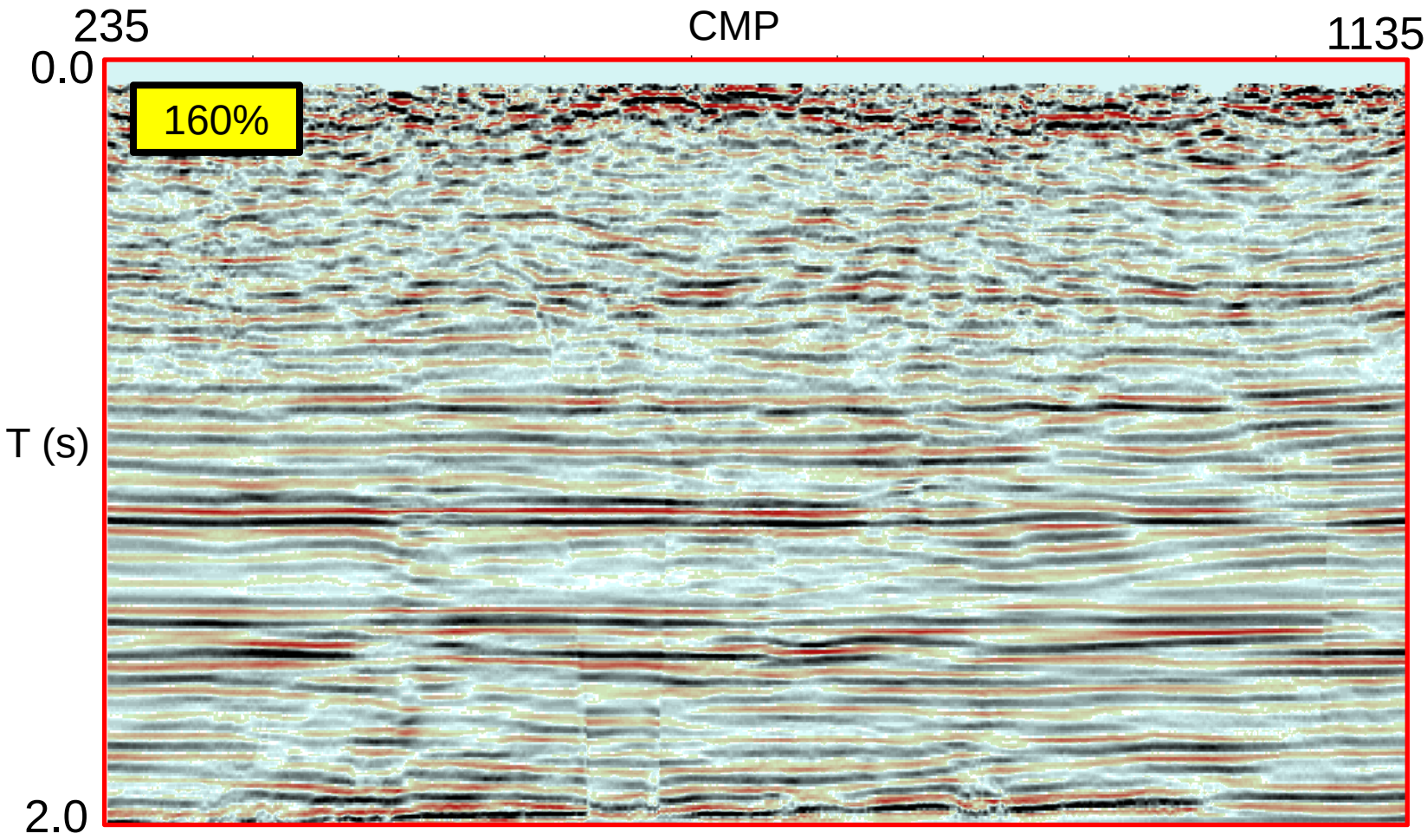
120%



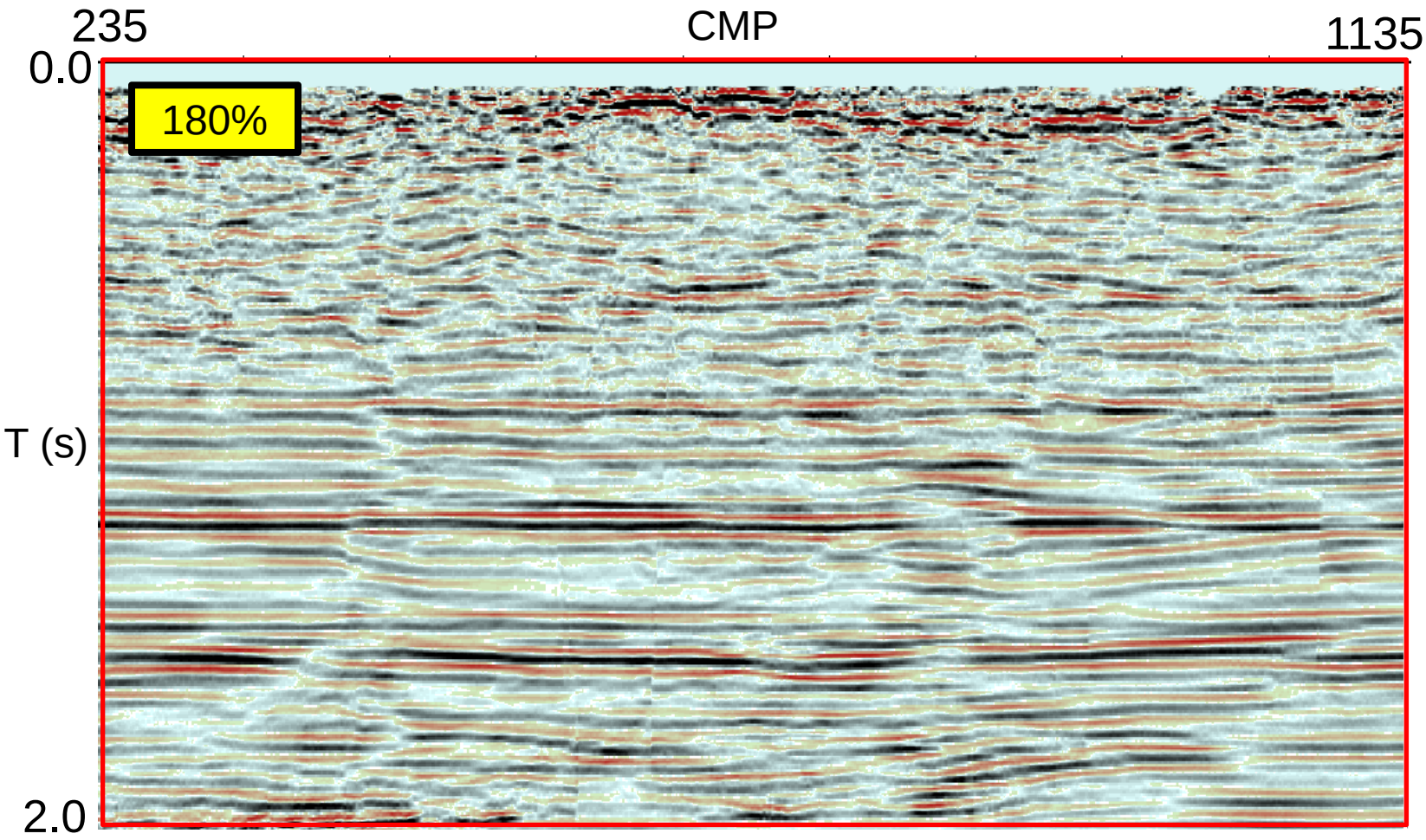
140%



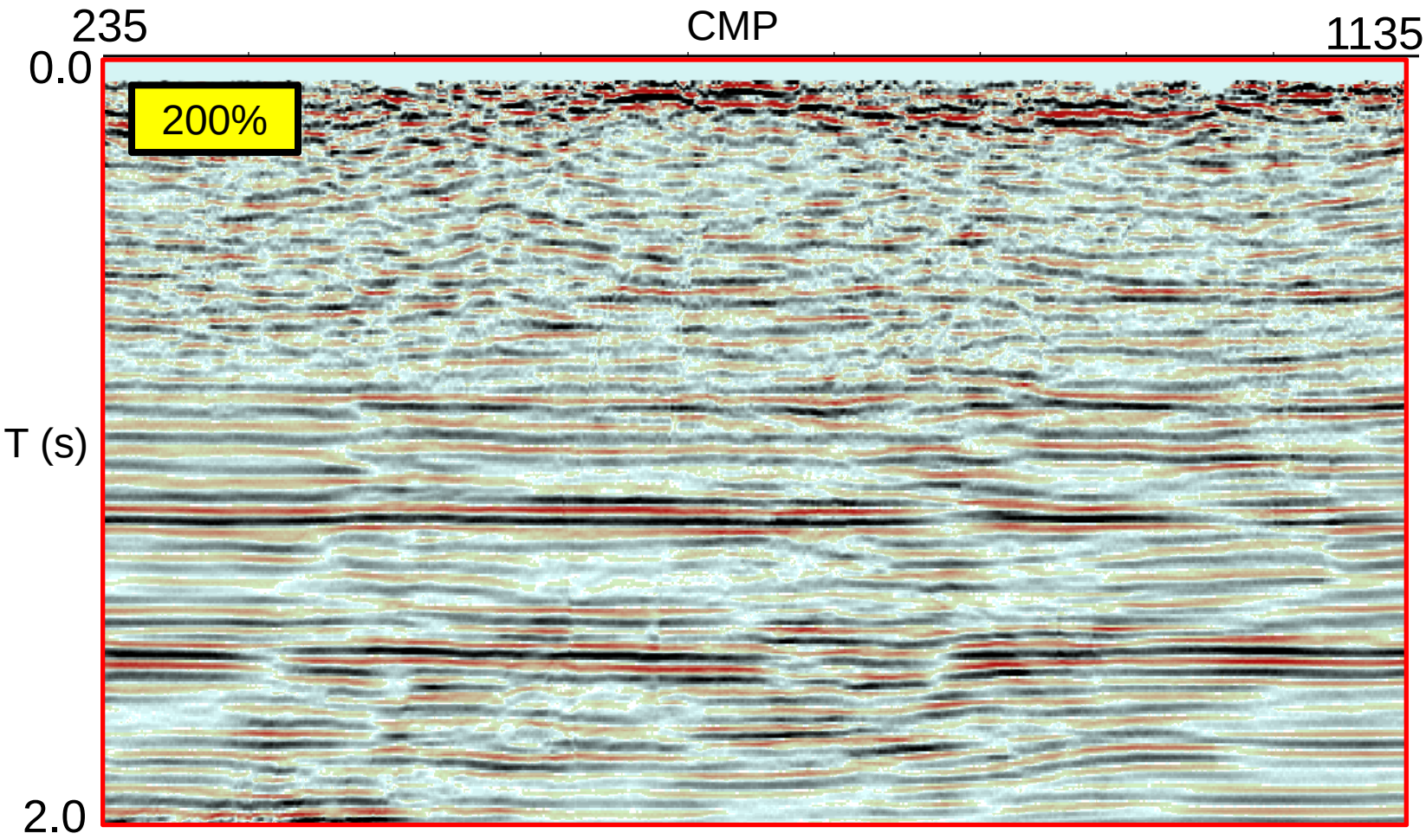
160%



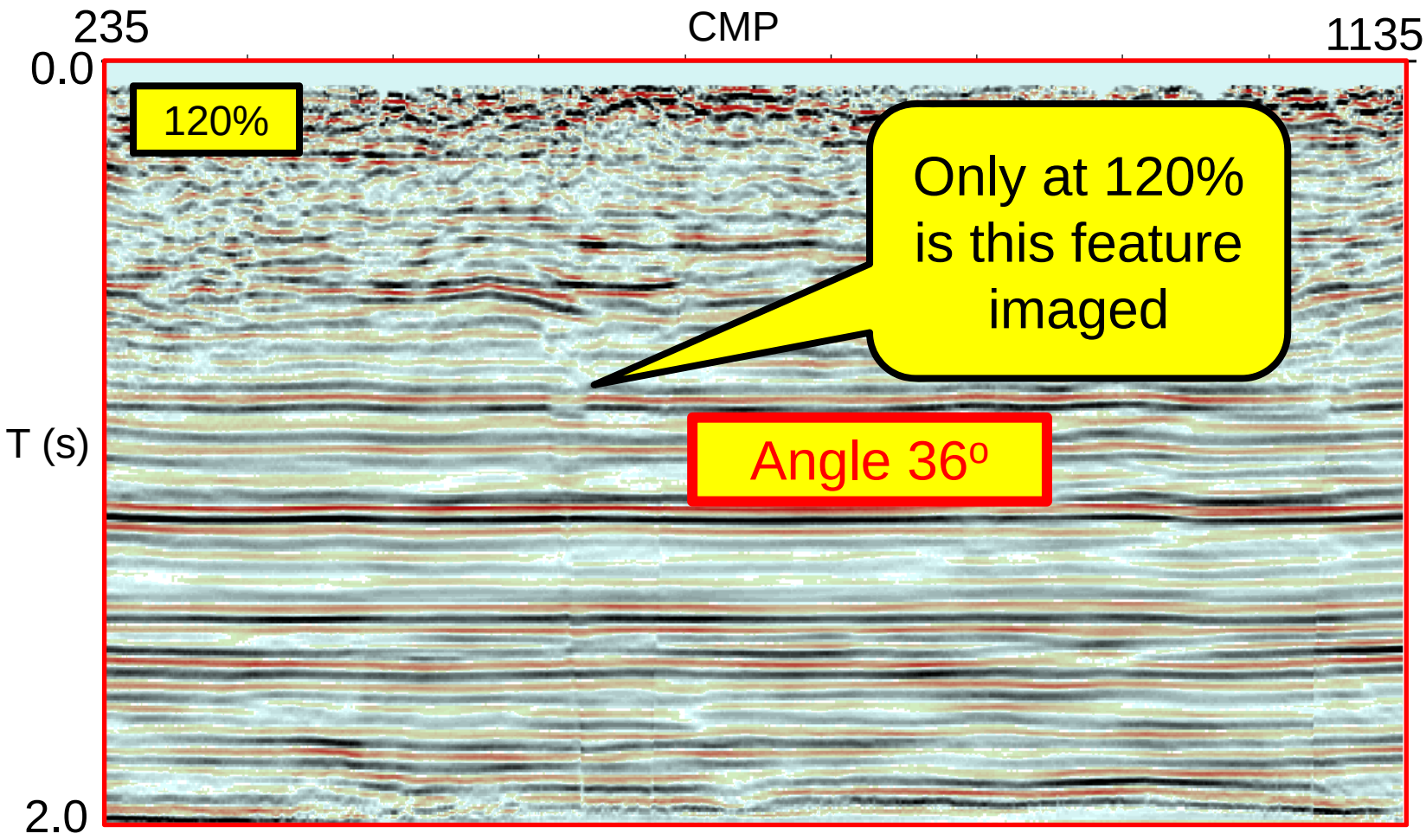
180%



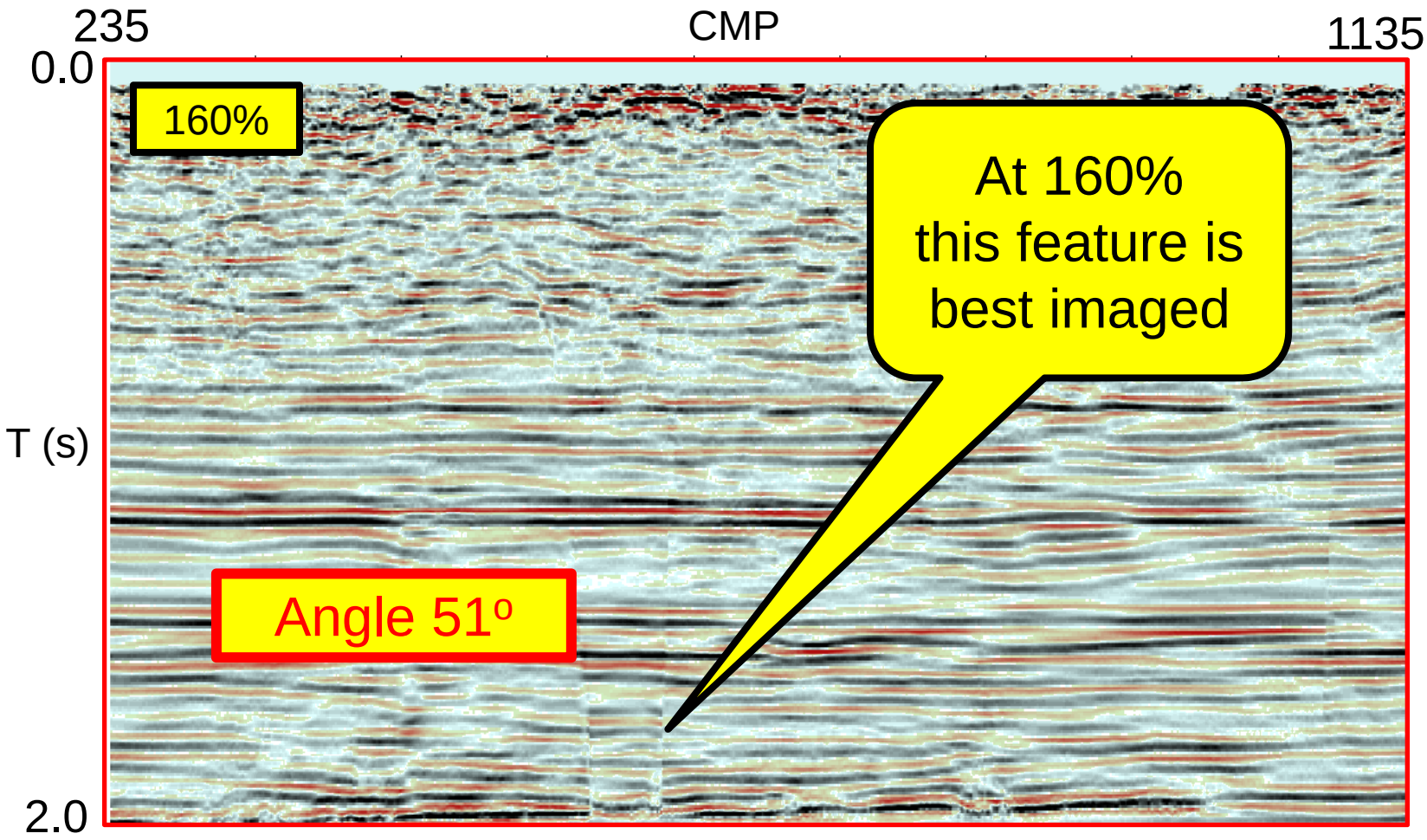
200%



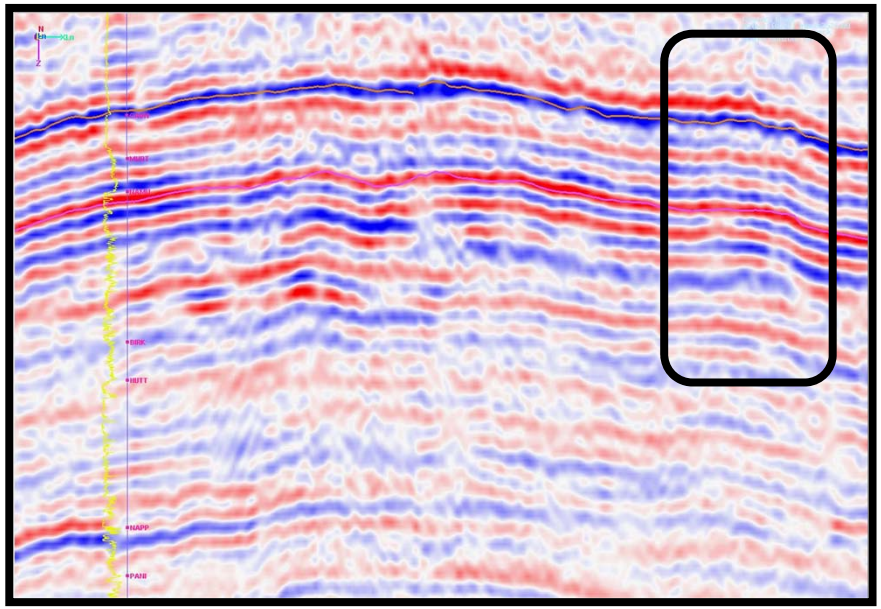
Back to 120%

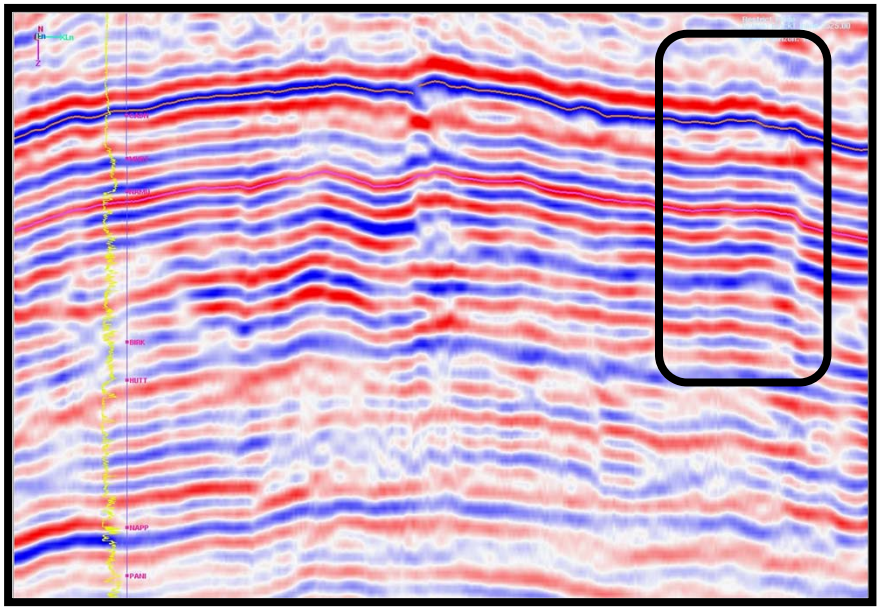

235
CMP
1135
0.0
120%
Only at 120% is this feature imaged
T (s)
Angle 36º
2.0

160%

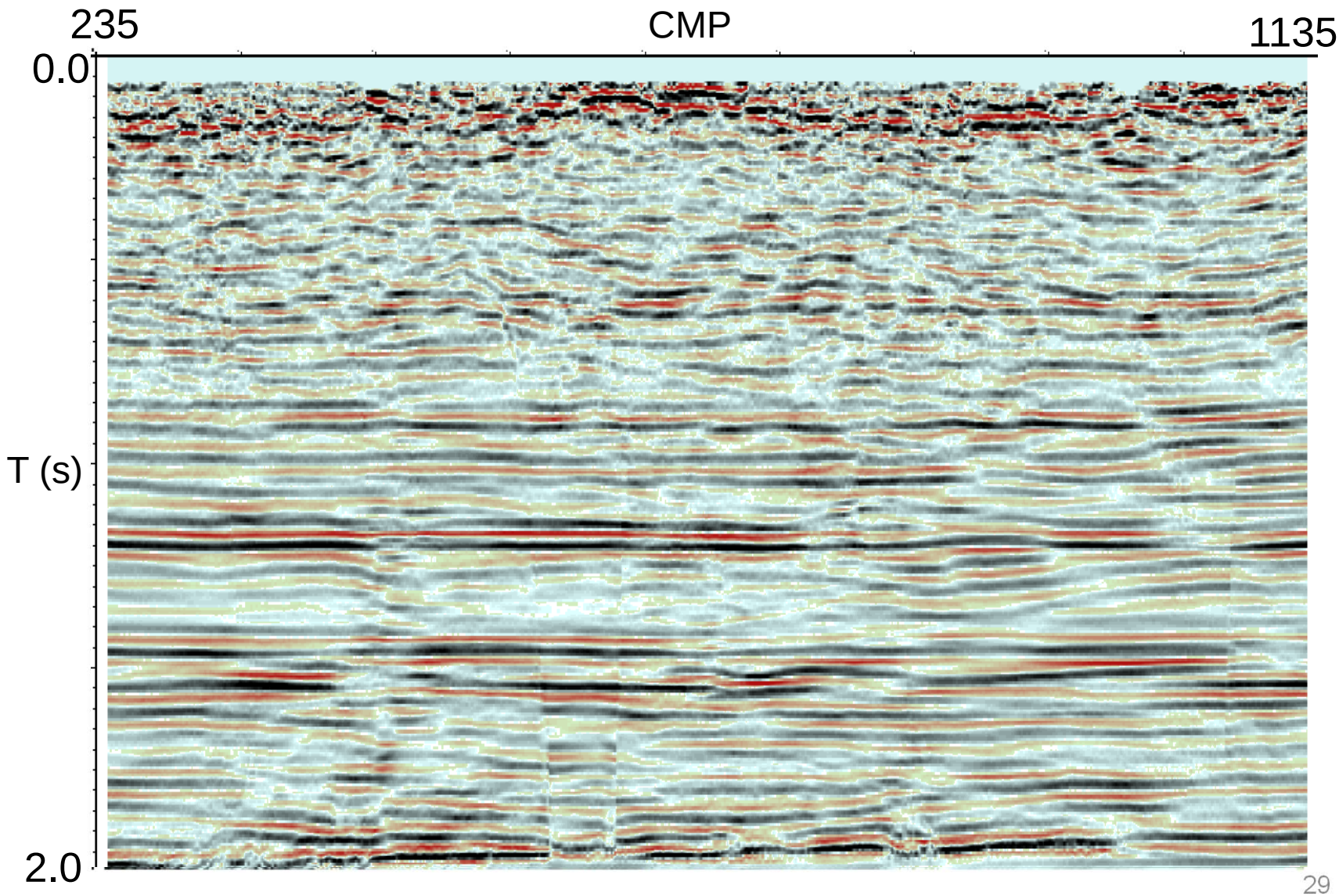

235
CMP
1135
0.0
T (s)
2.0
160%
At 160%
this feature is
best imaged
Angle 51º

Commercial **3D** CSP processing

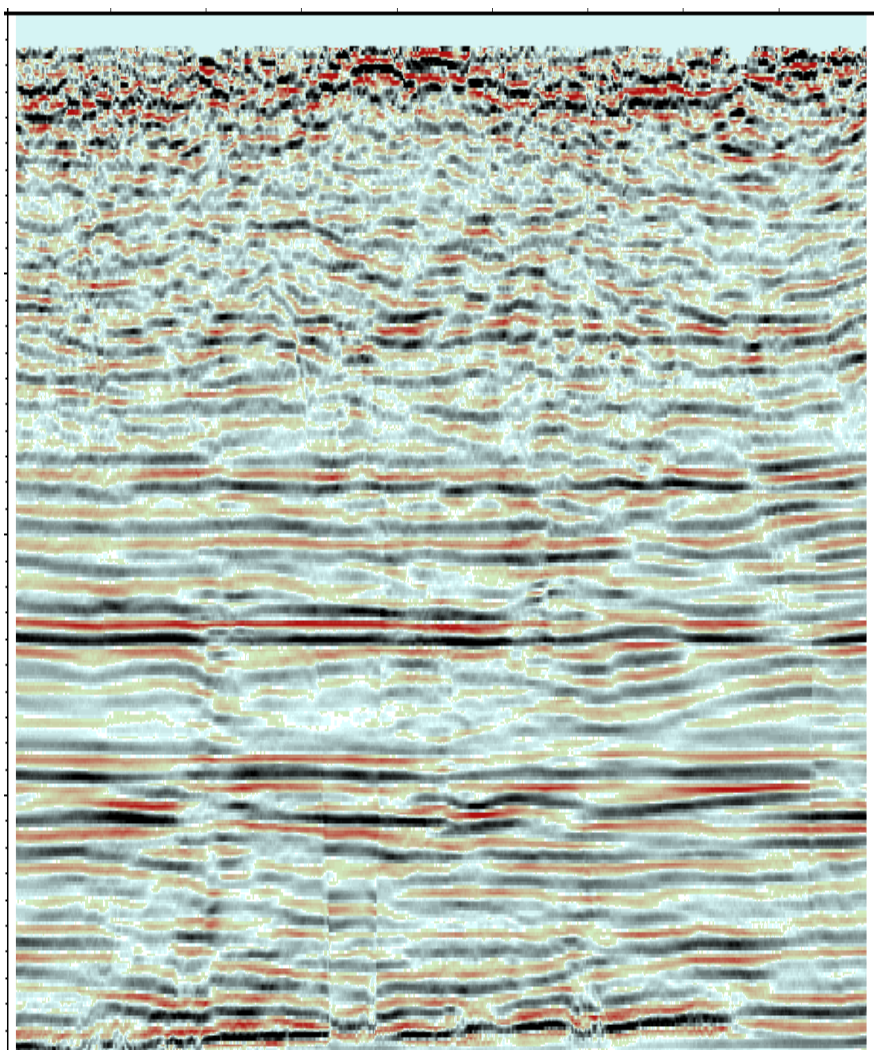


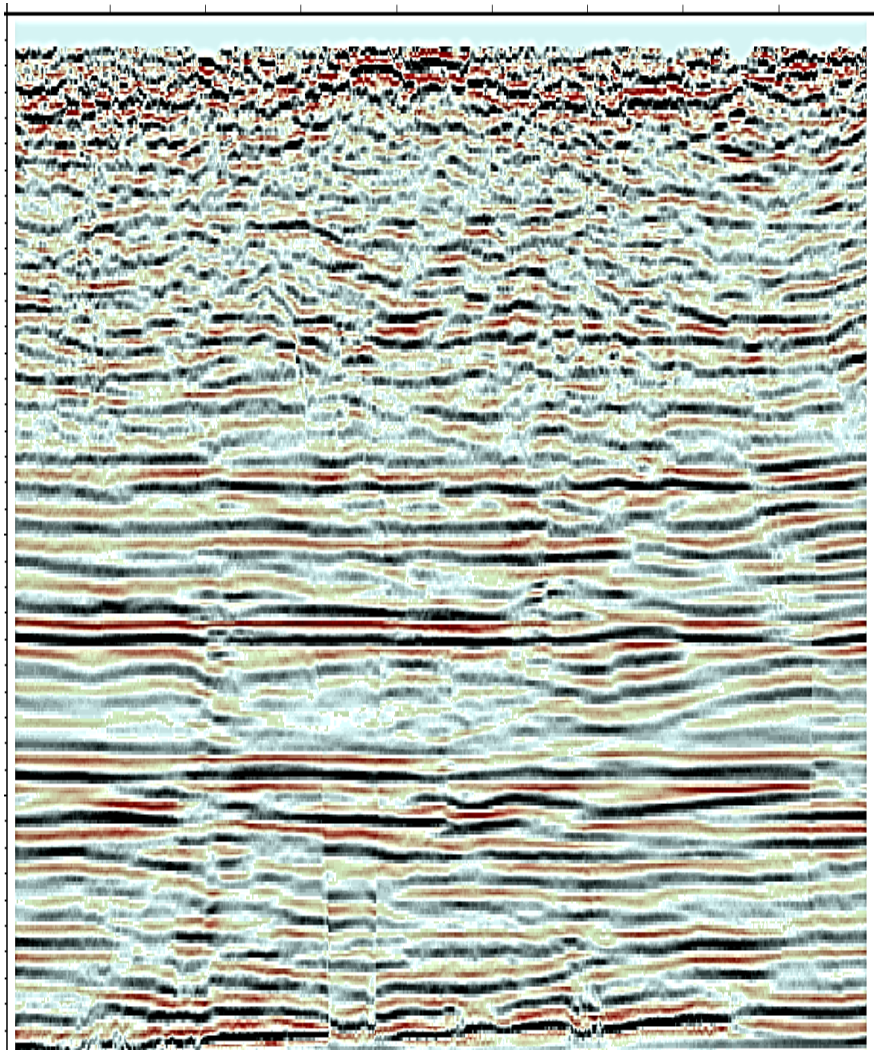


More image enhancement



More image enhancement





Comments and Conclusions

Conclusions

- Velocity analysis of CSP gathers appears to compensate for static corrections
- CSP imaging appears to produce higher spatial resolution
- Improved resolution of oblique reflectors by increasing V_{mig}
- Deconvolution after migration

More work

- Match Hussar statics with velocity change
- Match 2D Hussar data with 3D data
- Evaluate velocity analysis for oblique angles
- Are they real ?
- Why not found with other processing methods
- …


End

160%

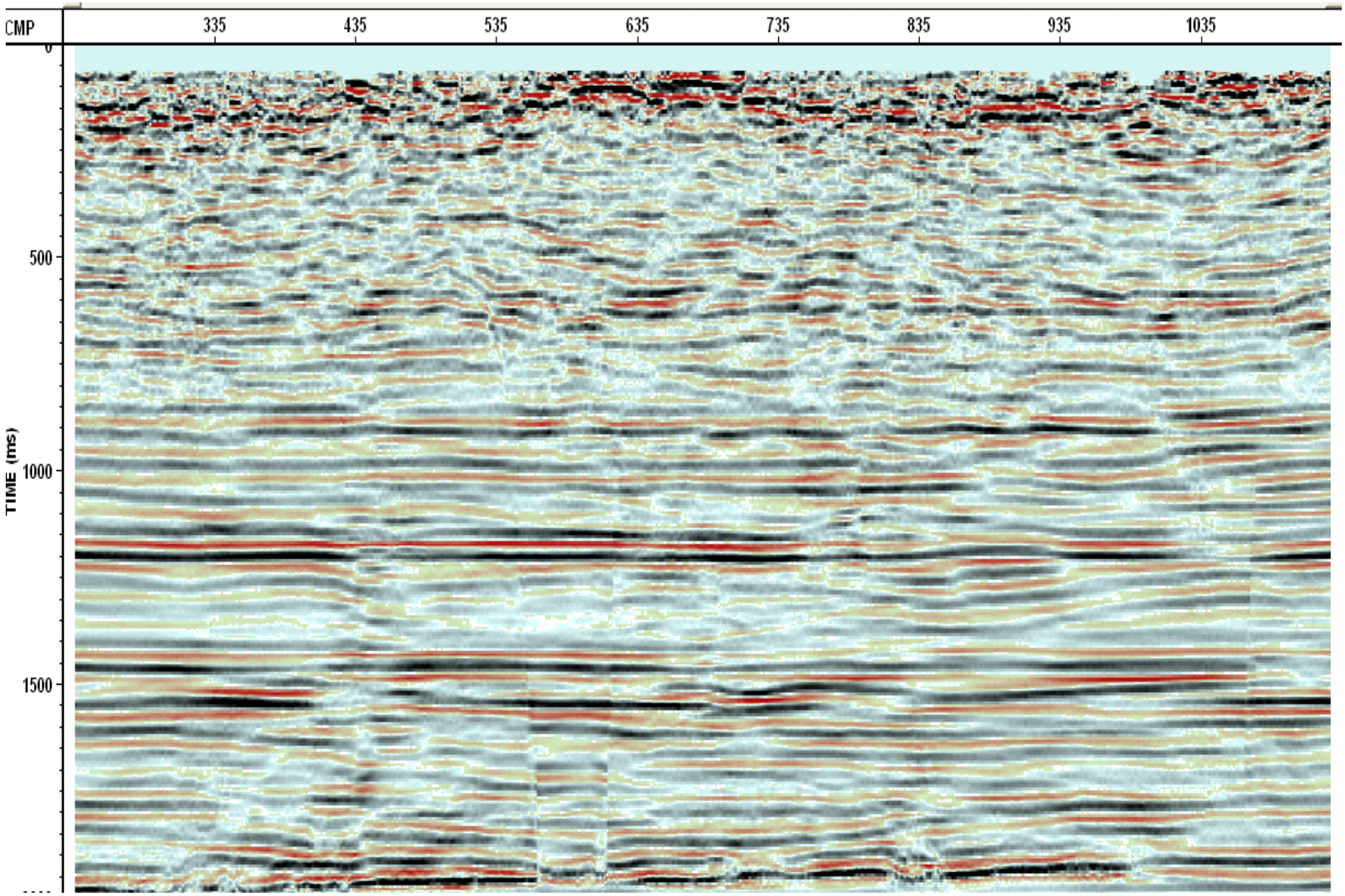
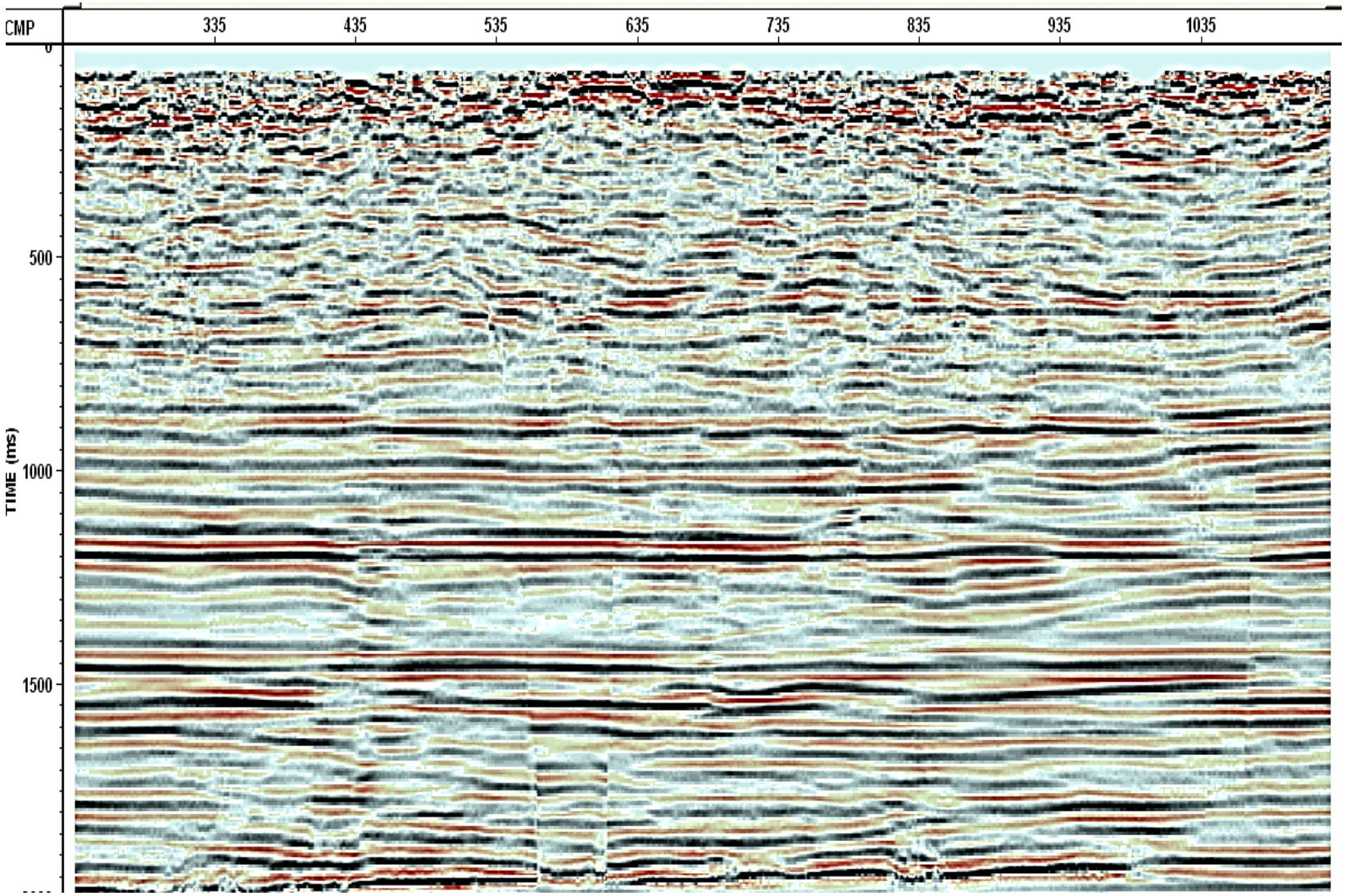
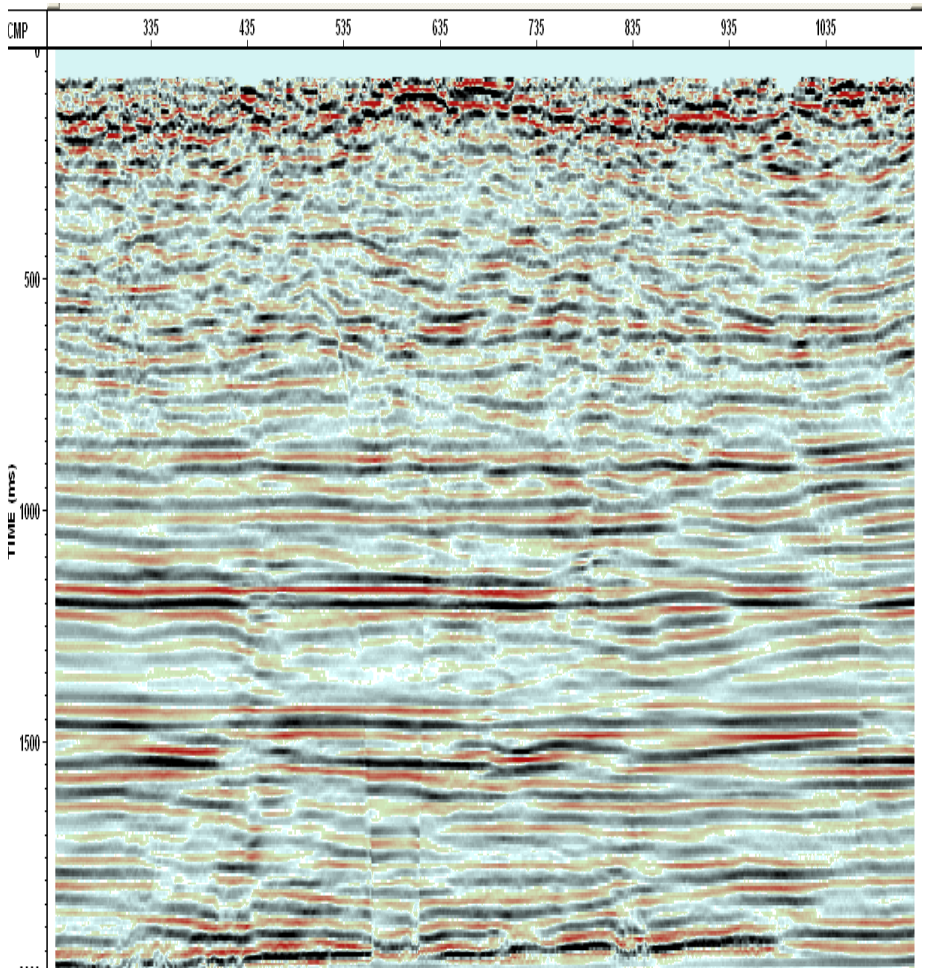


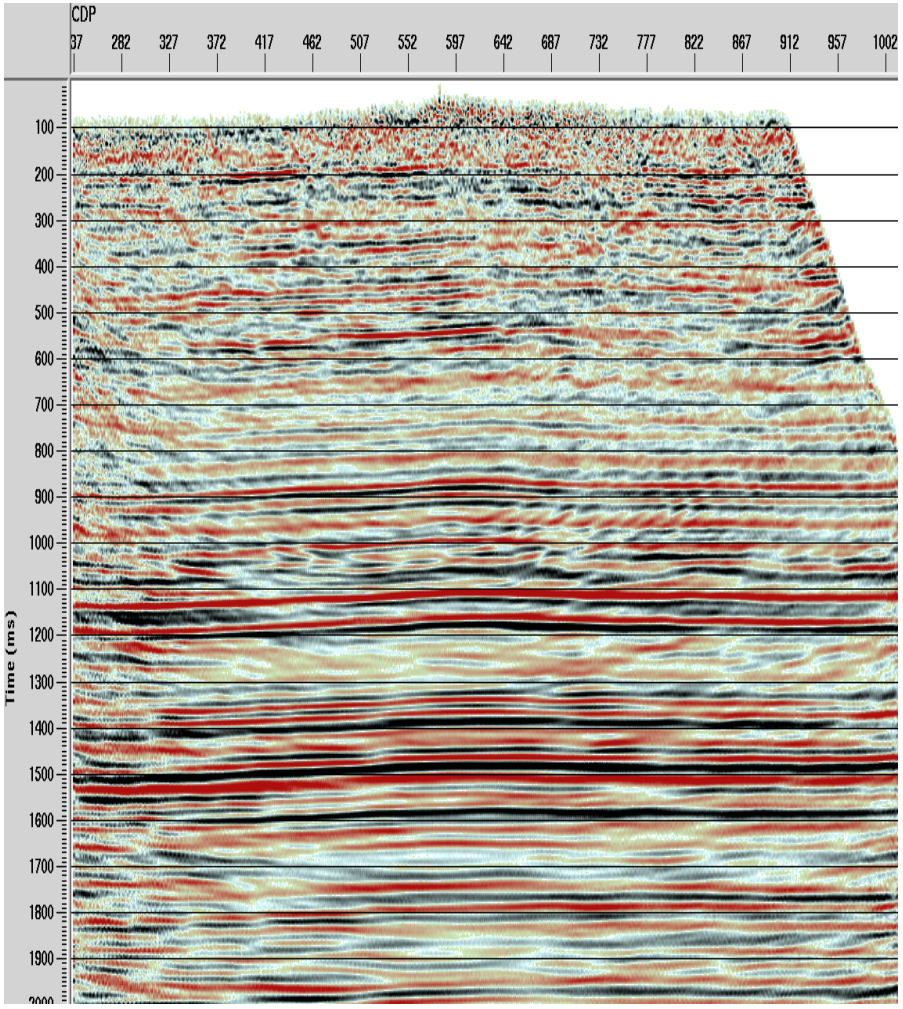
Image enhancement



Compare to conventional data



EOM 160%

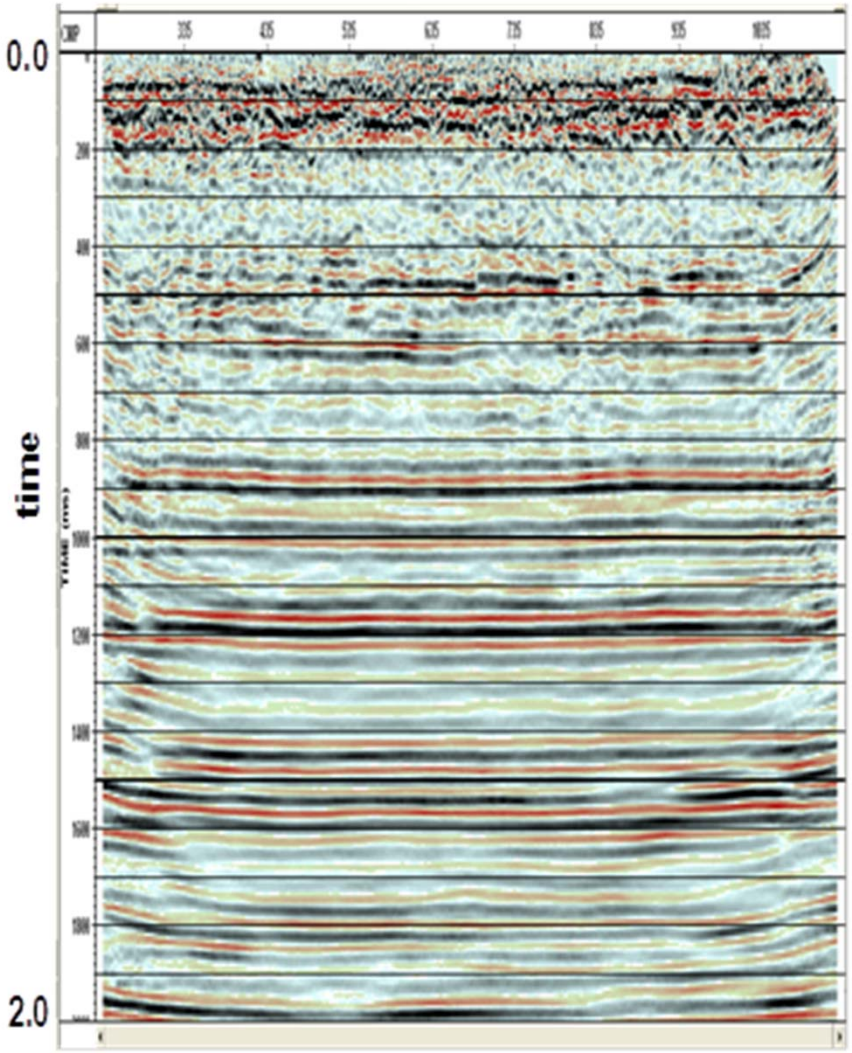


Conventional (Promax) 160%

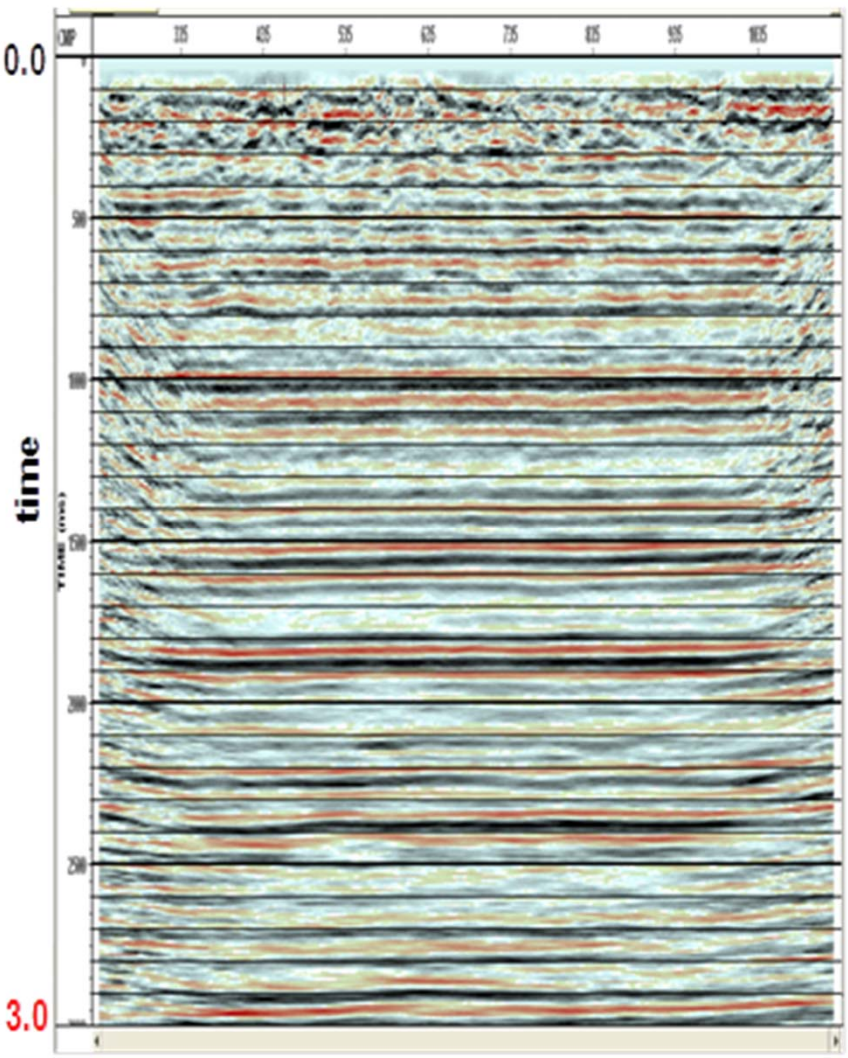
Nassir Saeed

Final stack after Full EOM

EOM P-P section

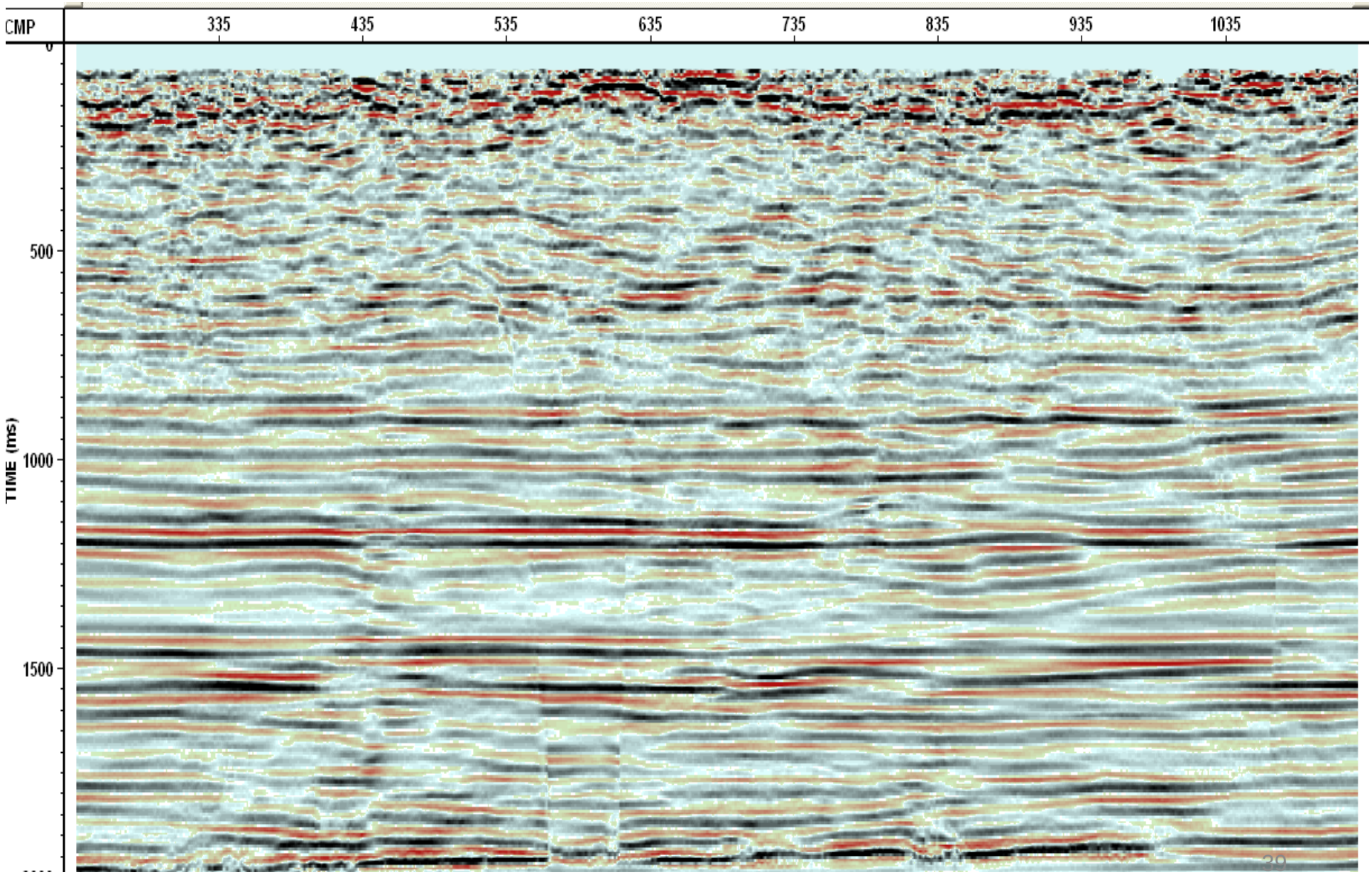


EOM P-S section

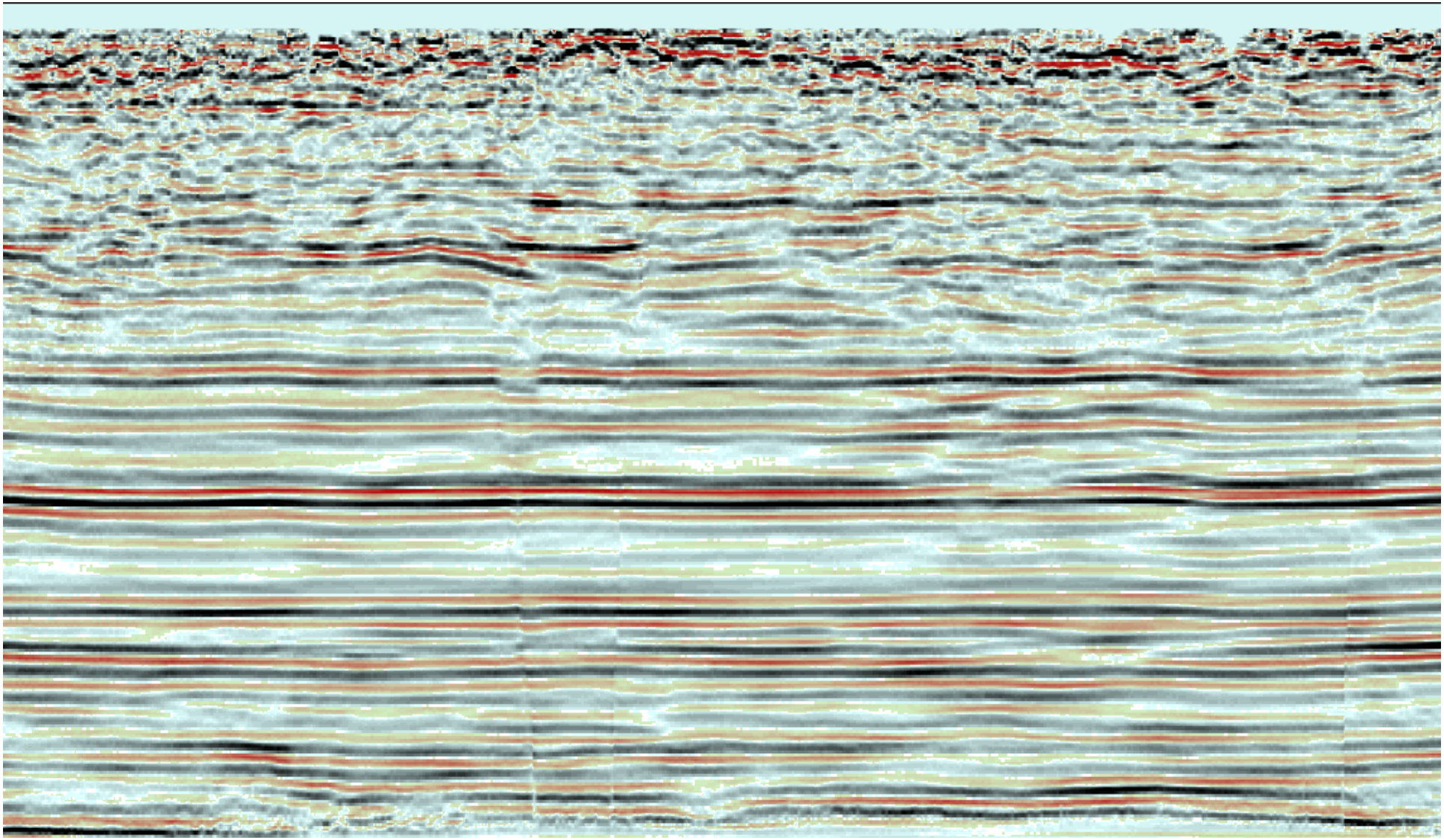


Using one vertical velocity function

160%



120%



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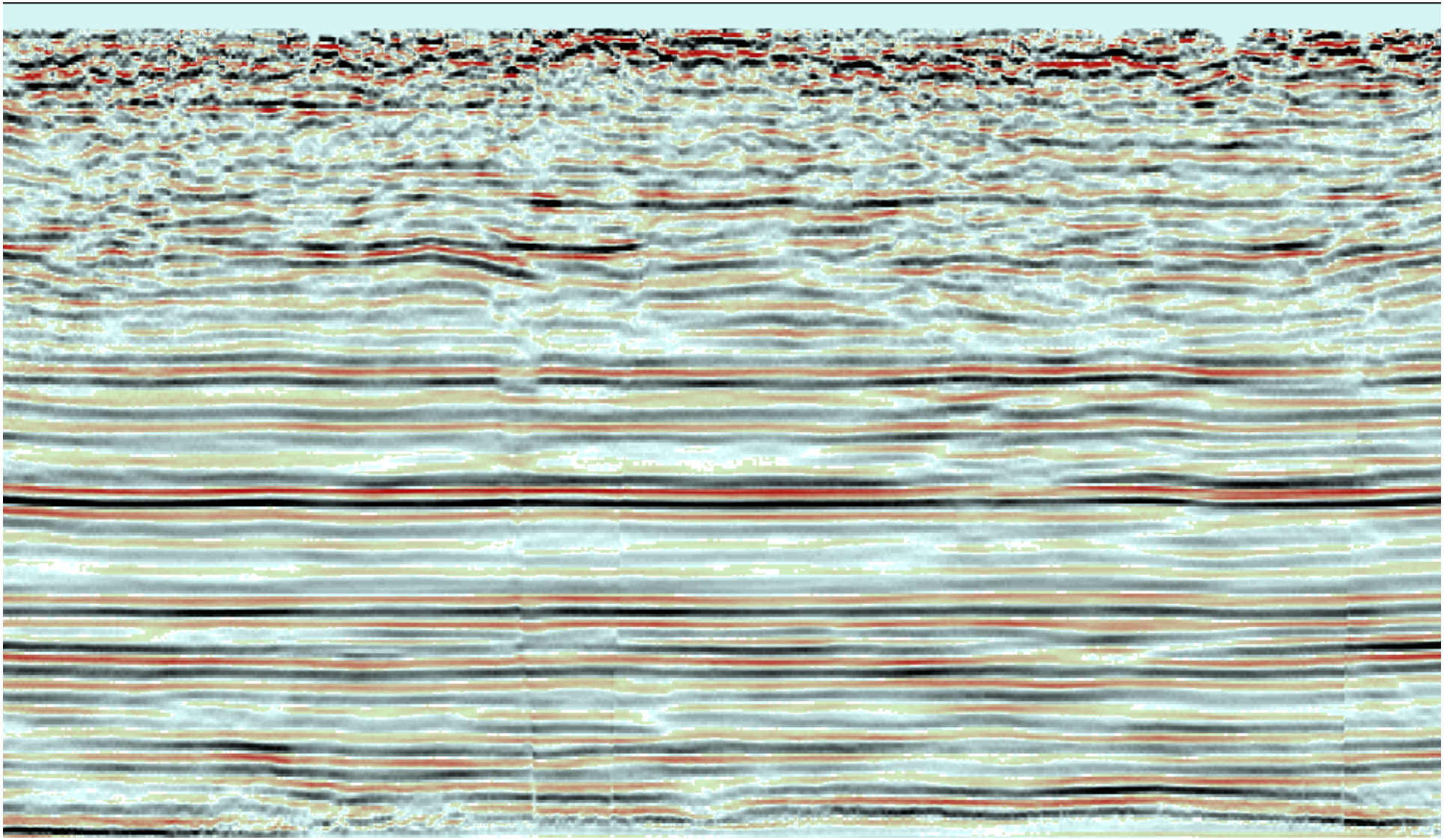
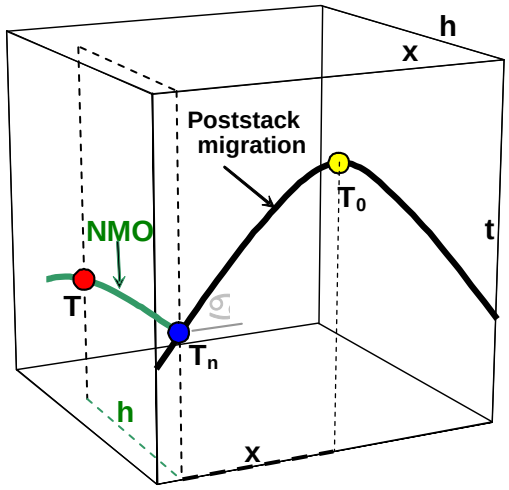
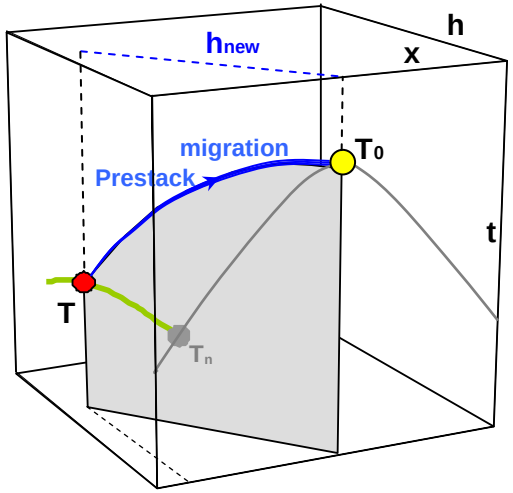


Forming a common scatterpoint (CSP) gather

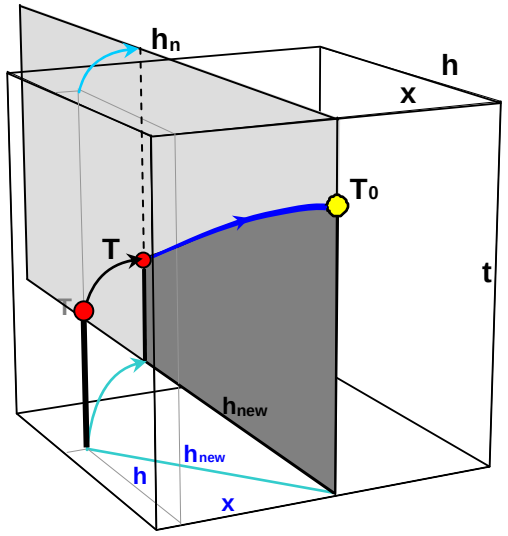


$$T^2 = T_n^2 + \frac{4h^2}{V^2}$$

$$T_n^2 = T_0^2 + \frac{4x^2}{V^2}$$

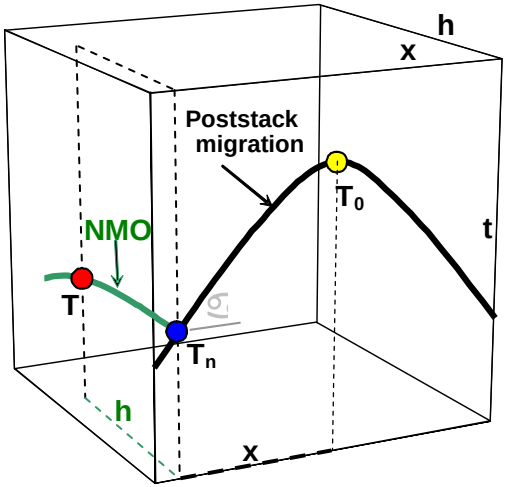


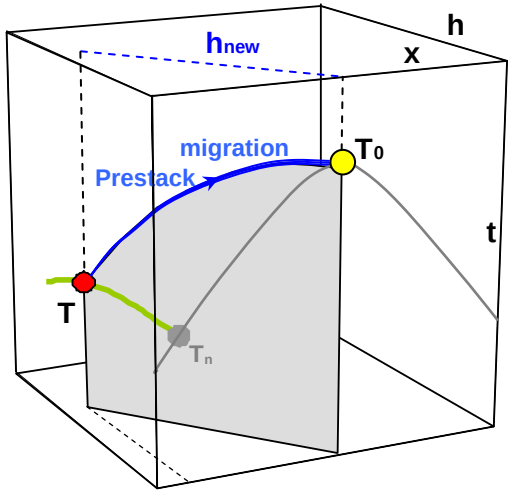
$$T^2 = T_0^2 + \frac{4\left(x^2 + h^2\right)}{V^2}$$

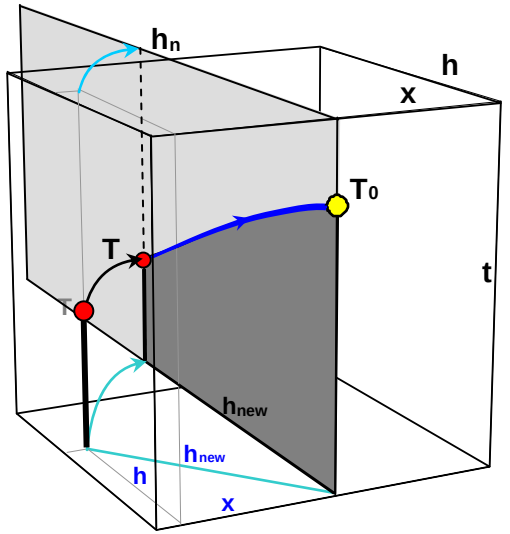


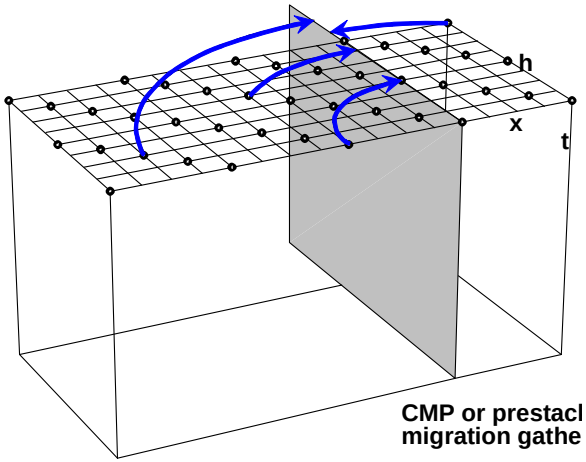
$$h_{new}^2 = x^2 + h^2$$

Forming a common scatterpoint (CSP) gather



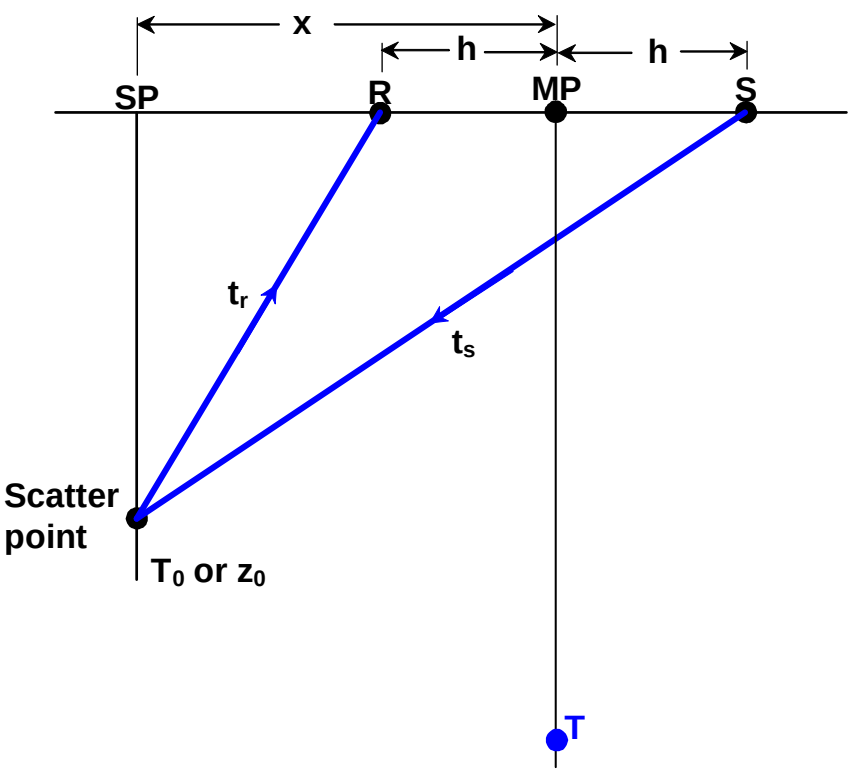


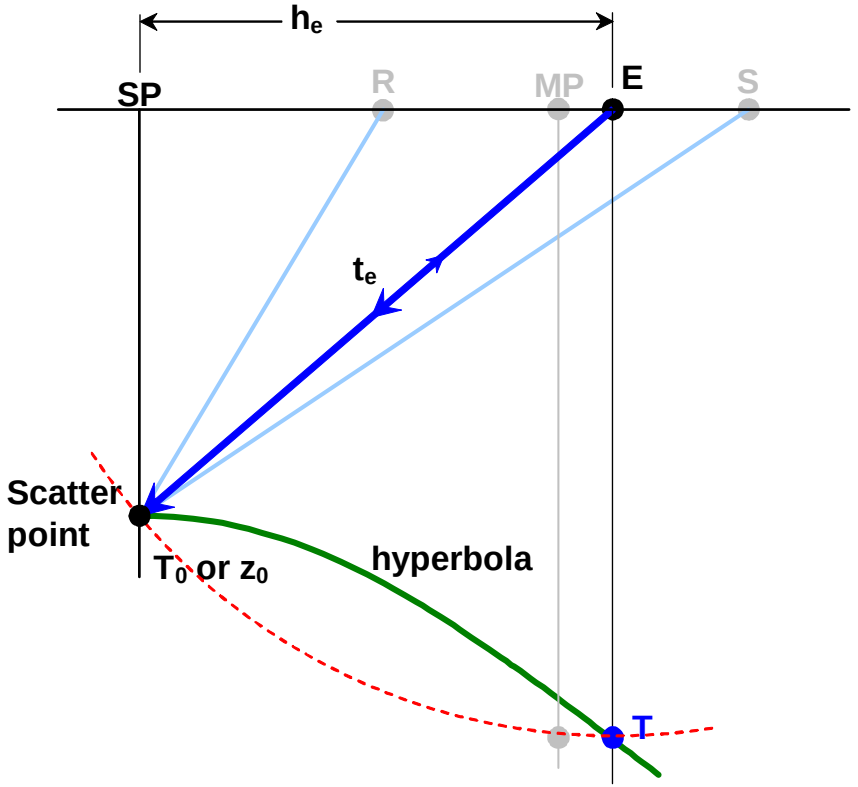




CMP or prestacl
migration gathe

Equivalent offset





$$h_e^2 = x^2 + h^2 - \frac{4x^2h^2}{T^2V^2}$$

Dip smear and EOM