2D-Seismic Data Processing, New Zealand GLOBE Claritas™

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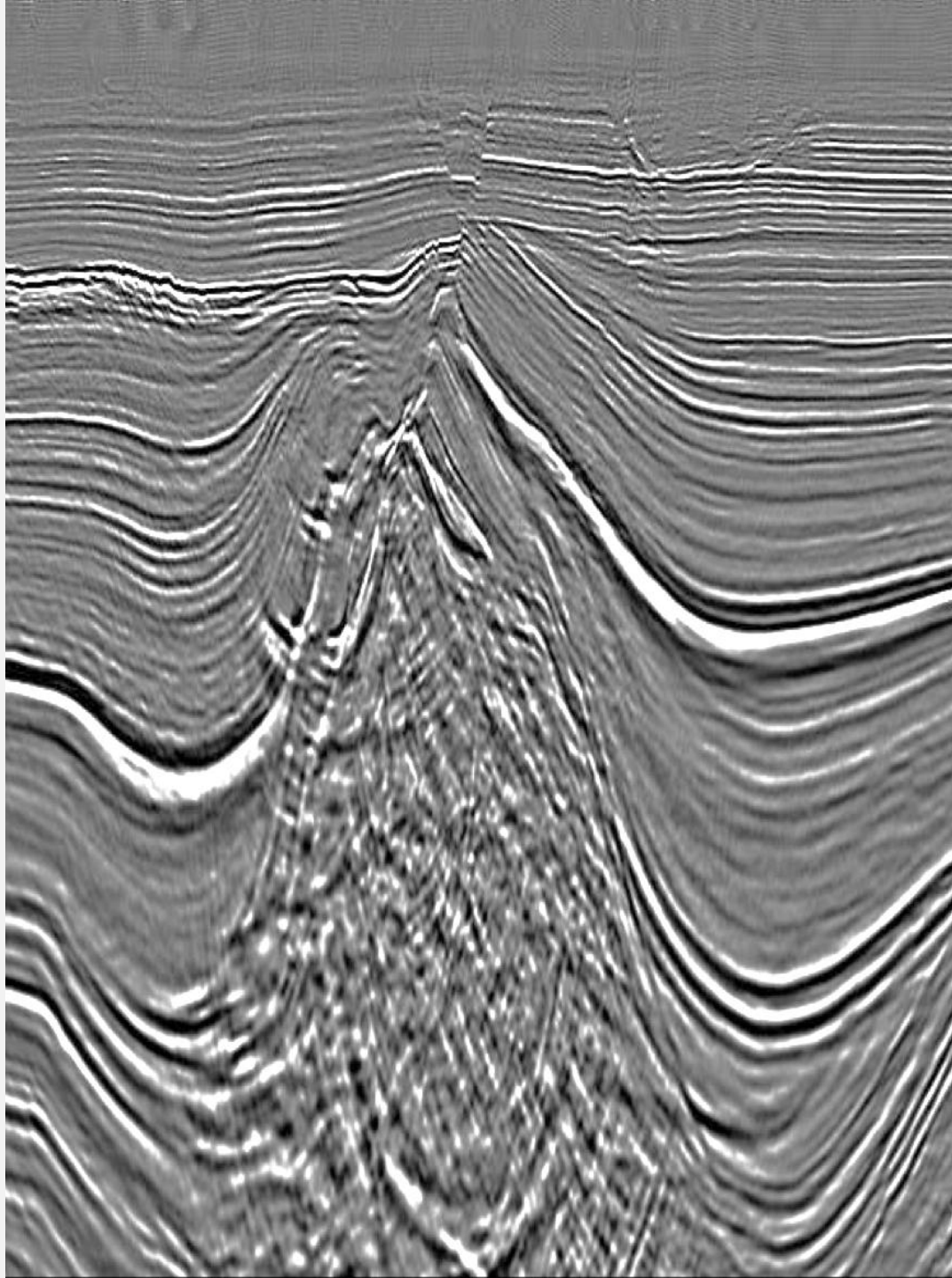
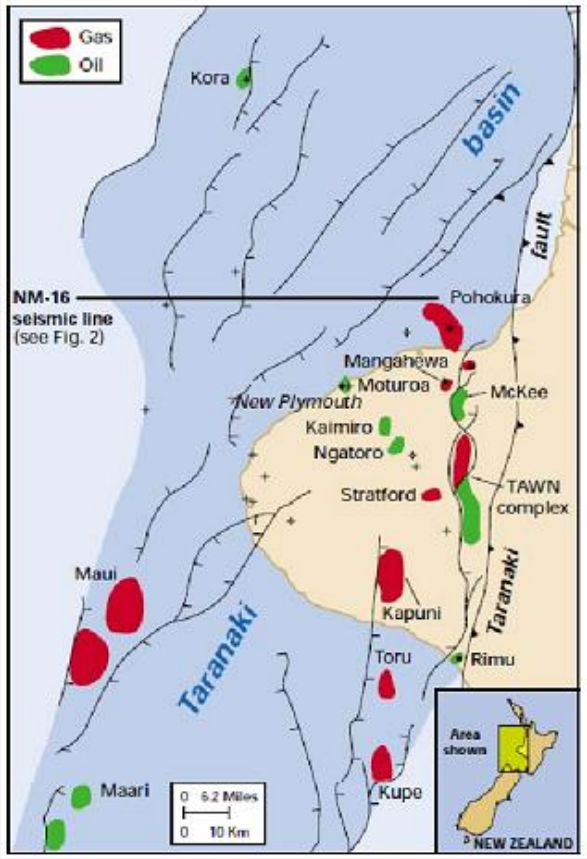


Objectives and Study Area

Objective : Perform 2D seismic data processing to image subsurface structure of line TRV-434, Taranaki Basin.

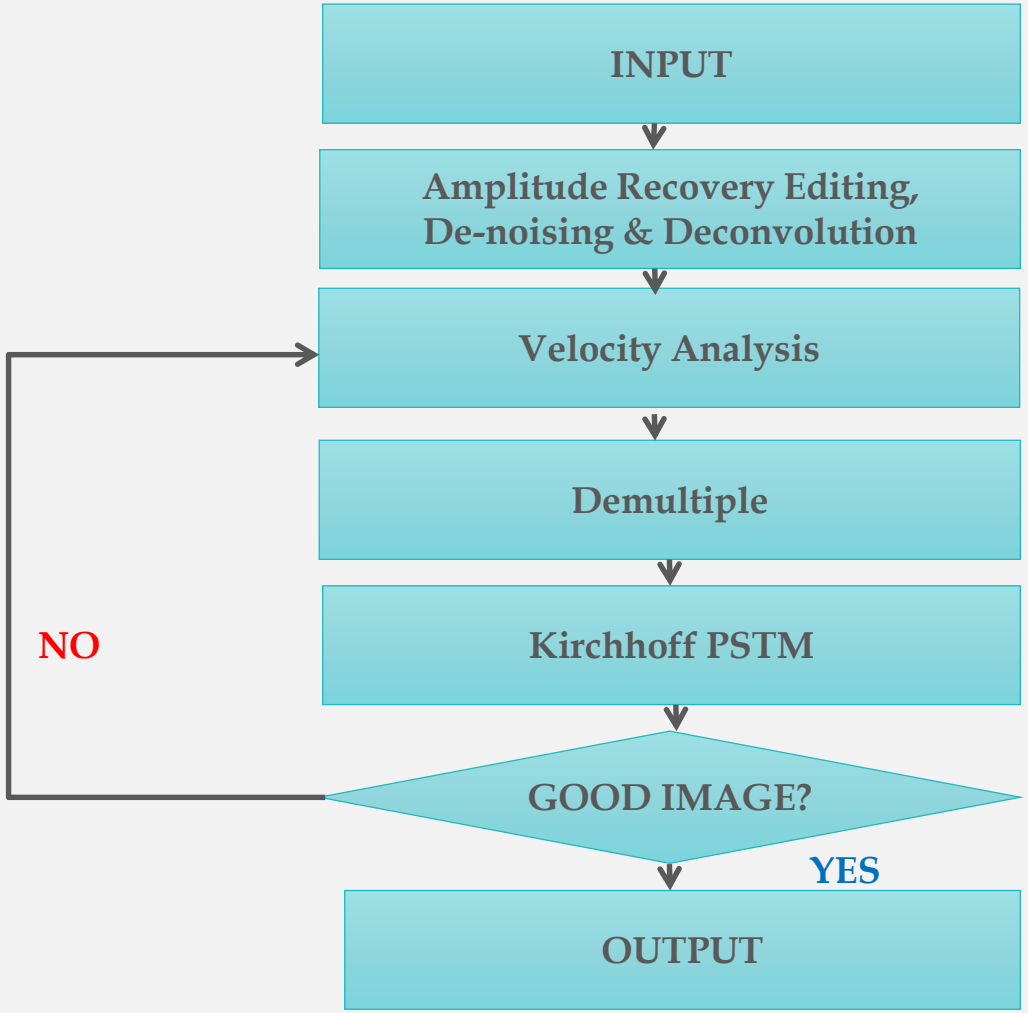
Study Area



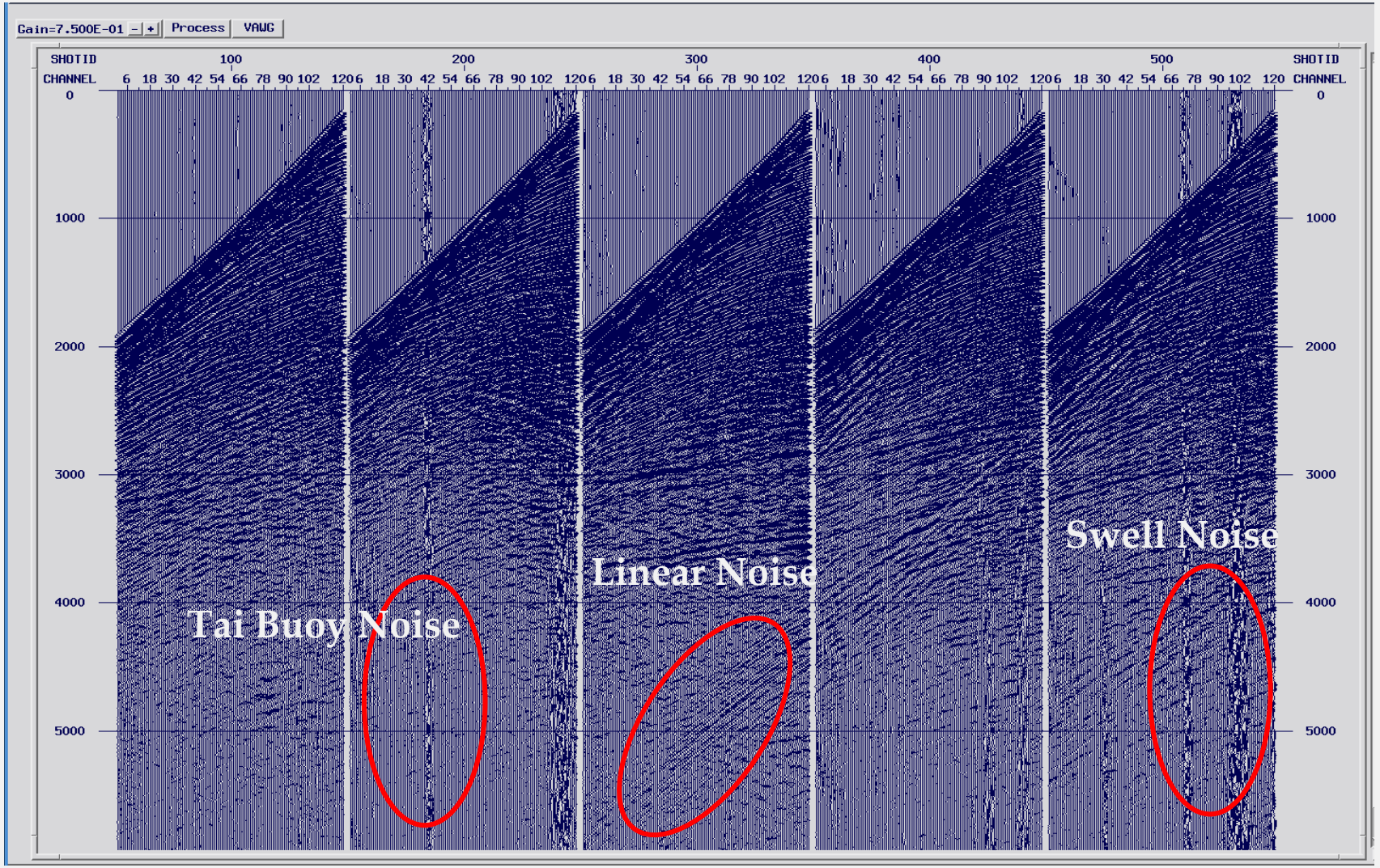
- Complicated faults and structures in Taranaki Basin
- Approximately Late Cretaceous structures developed due to Tasman Sea opening
- Sediment of Post-Rift overlied previously Syn-rift sequence during Paleogene period
- Sediment filling simultaneously in Neogene period

Map of Taranaki Basin, New Zealand showing acquisition seismic line.
Source: Journal of Geology and Mining Research, June 2013

Processing Workflow

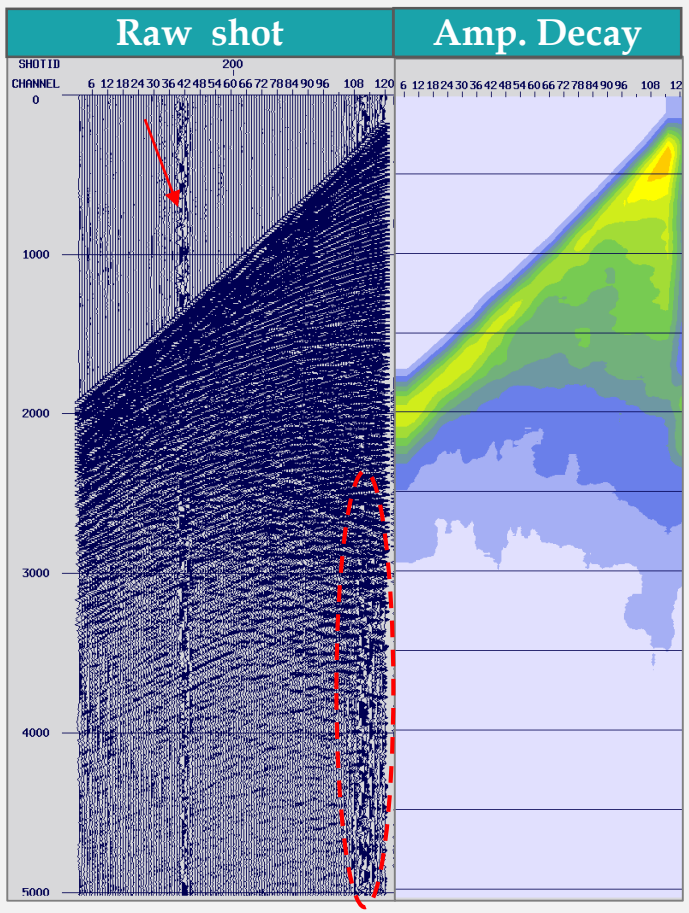


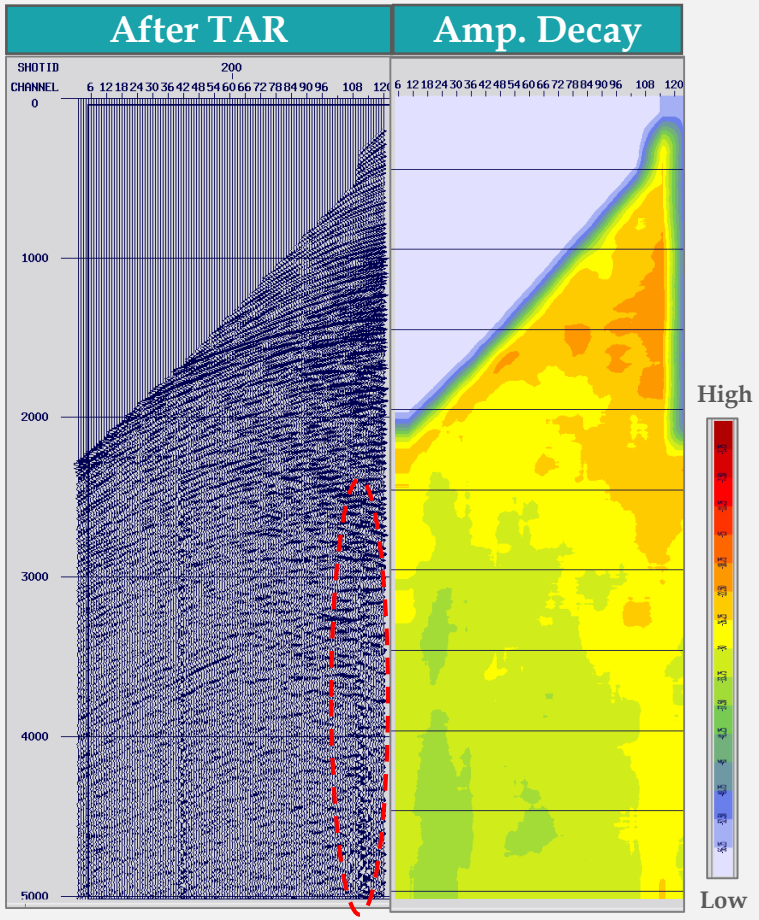
RAW Data

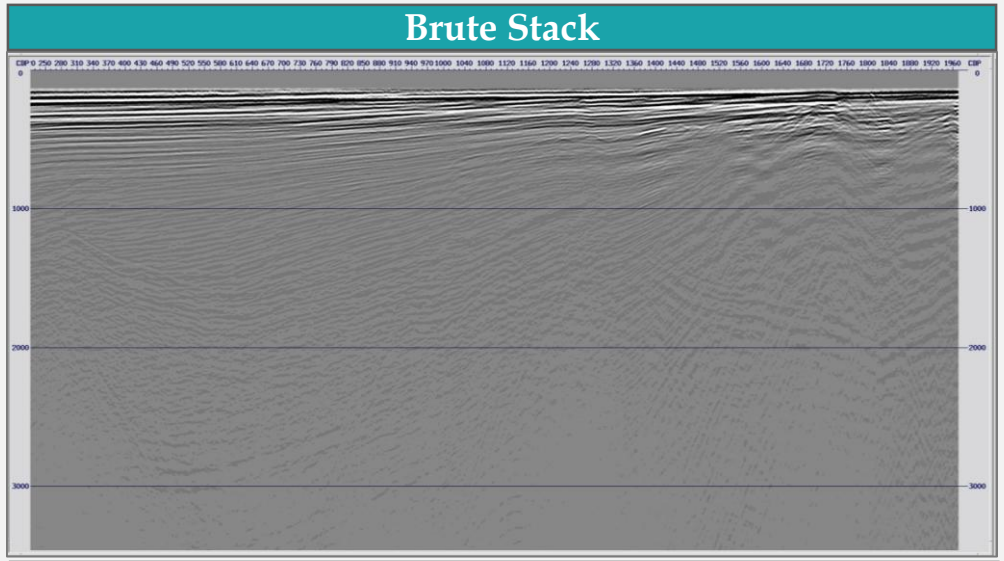


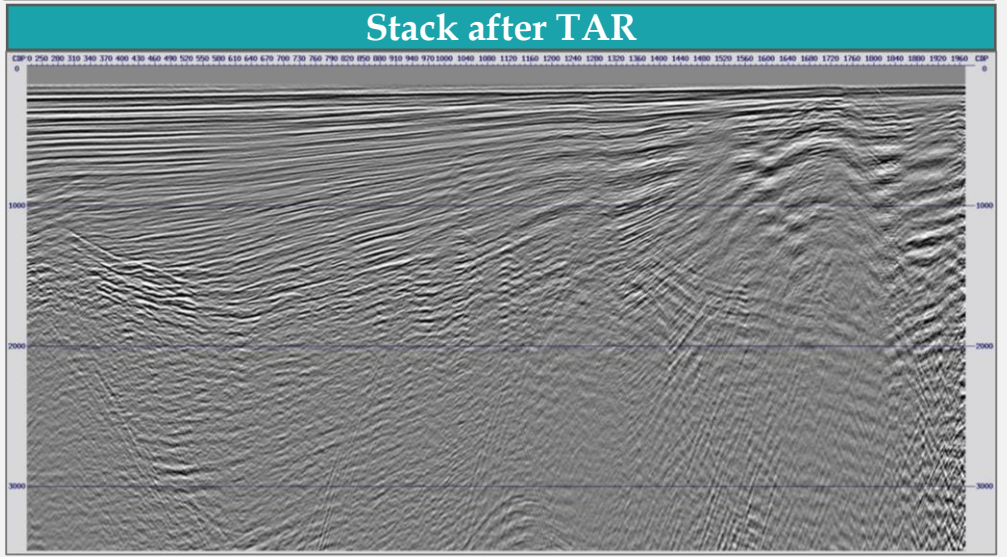
- Amplitude is dimming with deep because of attenuation.
- Present different types of noise

True Amplitude Recovery (TAR)









- Raw shot has high amplitude in the shallow and high amplitude decay in the deeper part.
- Gain function (T^2) and exponential gain (1 dB/sec) were applied to compensate amplitude loss due to geometrical spreading.

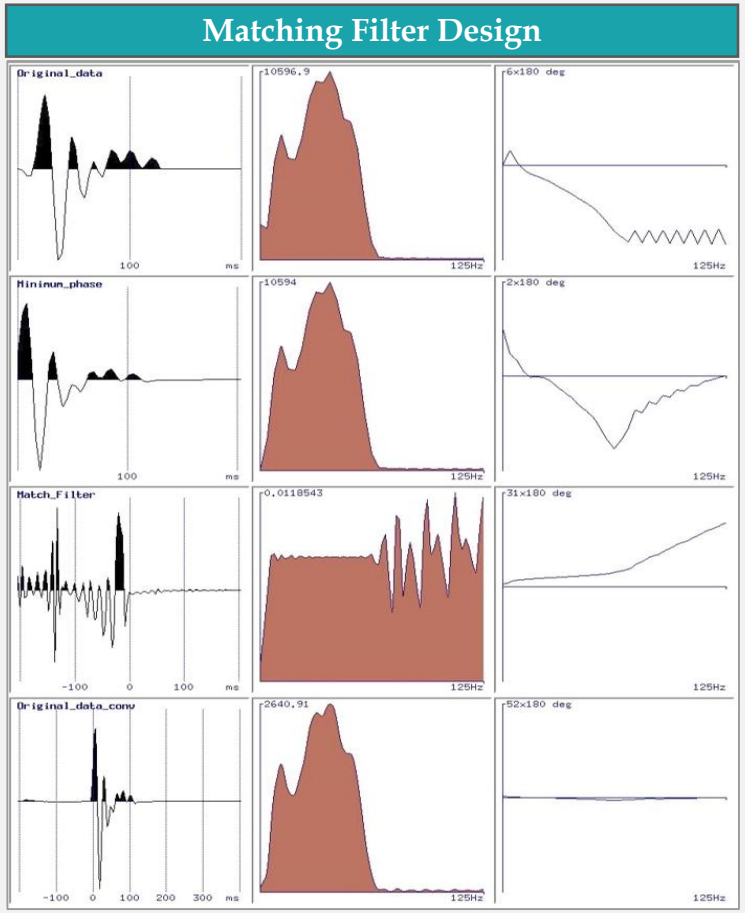
Deconvolution

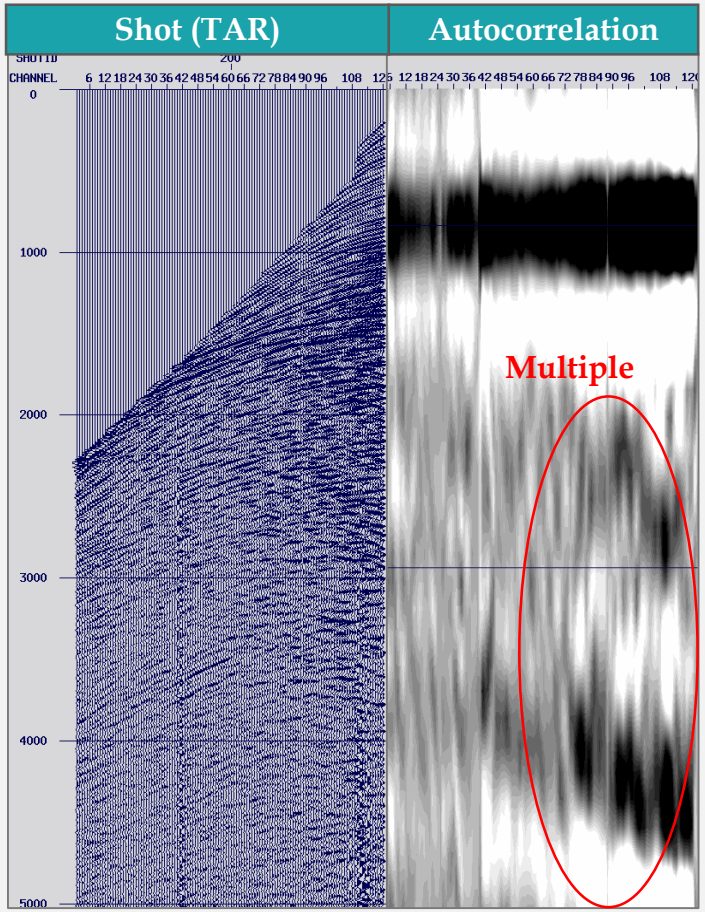
1) Original Signature

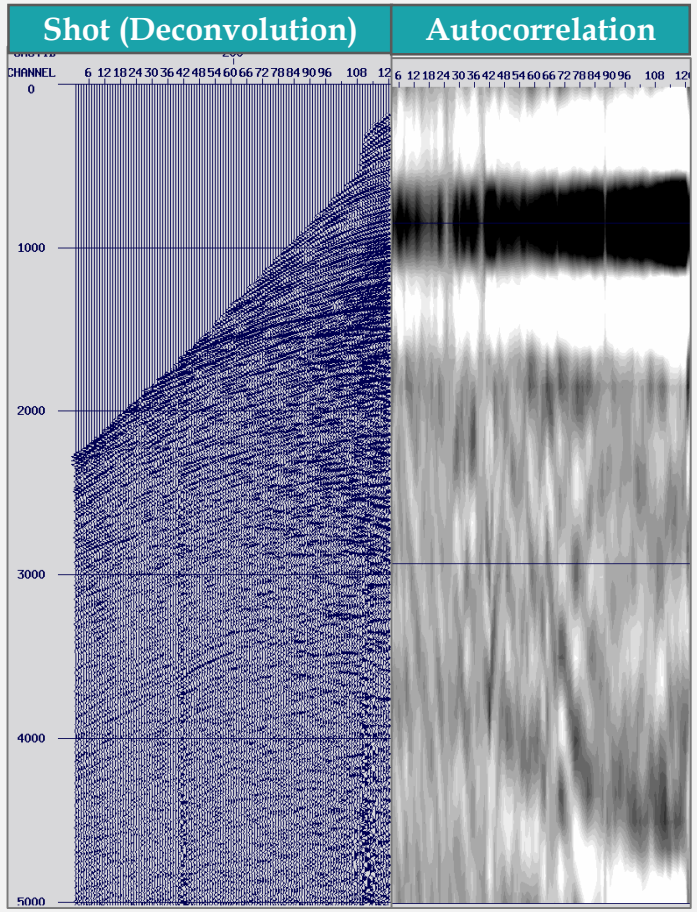
2) Minimum Phase

3) Matching Filter [1 ⊗ 2]

4) Output Minimum Phase [1 * 3]



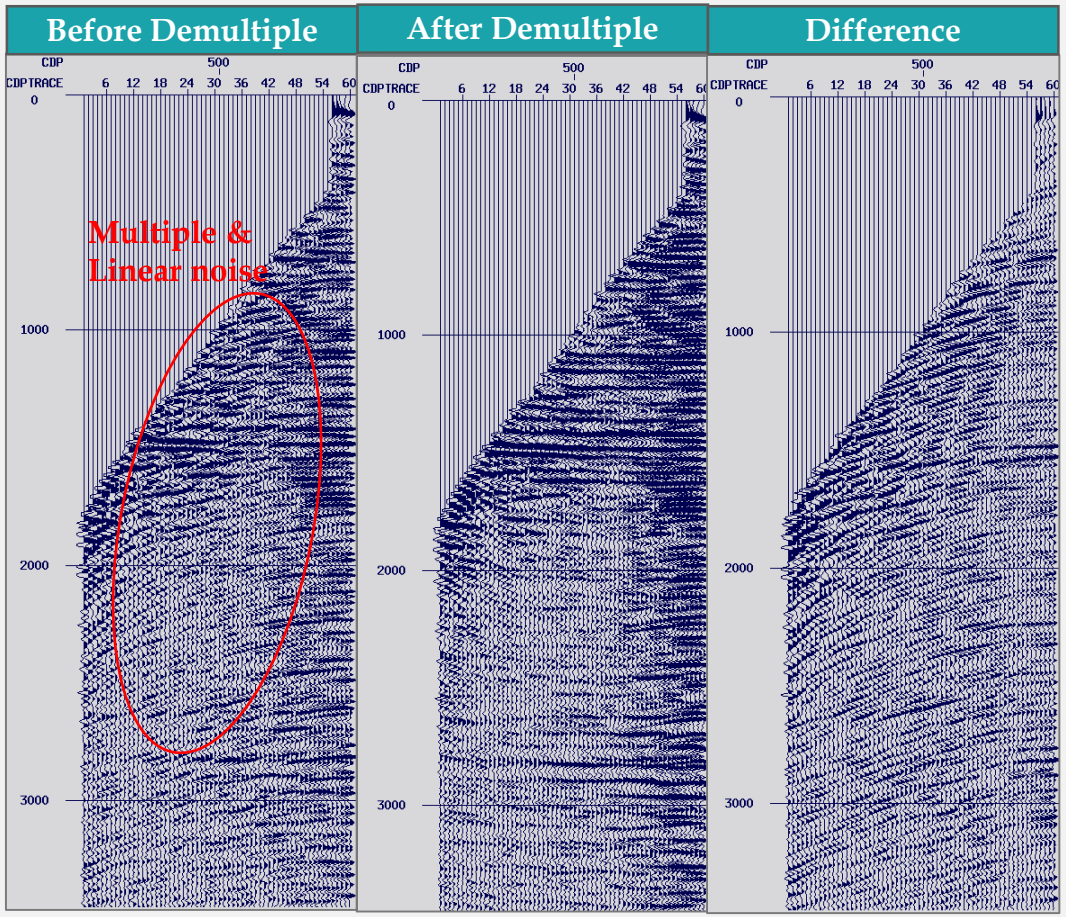


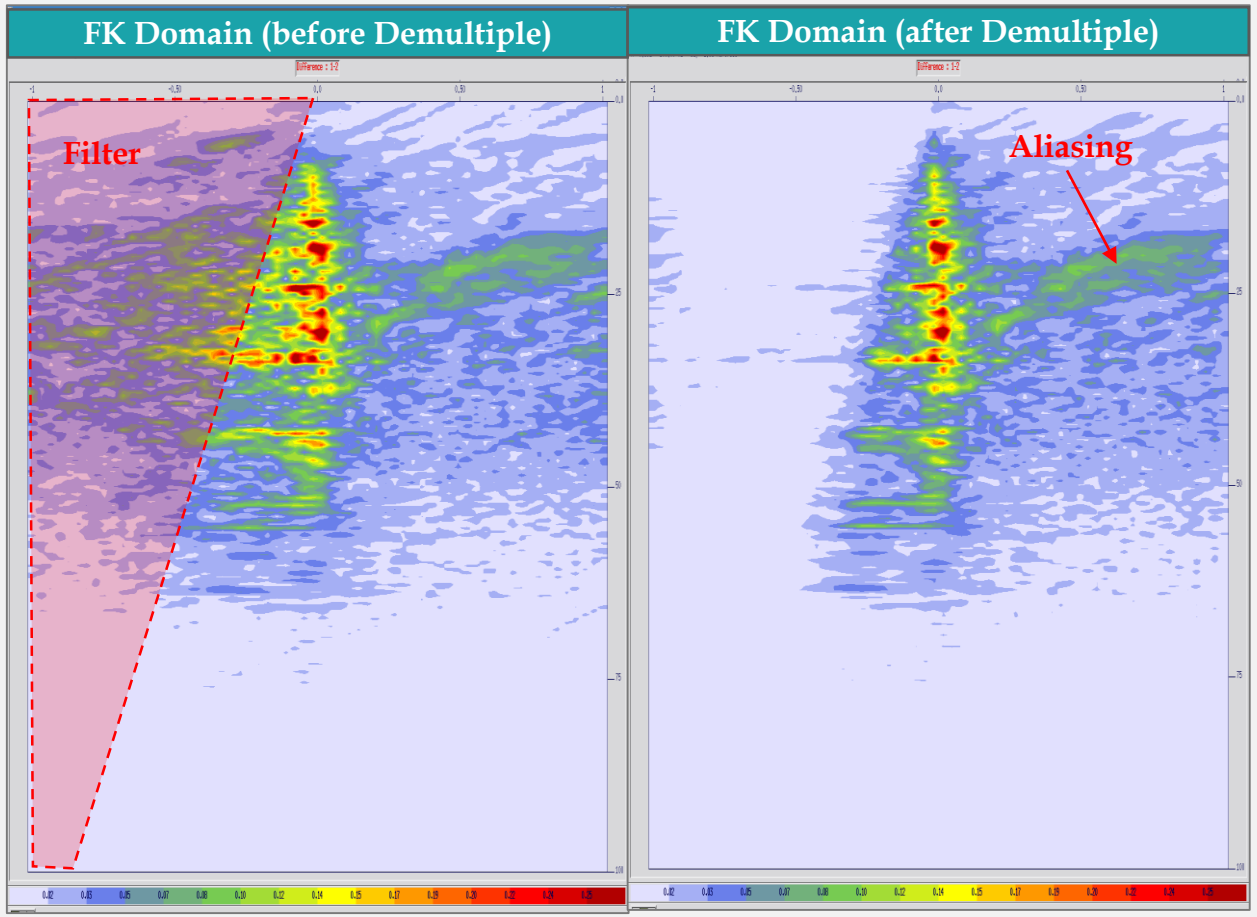


- The original wavelet signature was converted to minimum phase.
- Matching filter operator was applied to seismic data in order to change to minimum phase.

- Short period multiple was attenuated after deconvolution
- Wavelet is more sharp after applied deconvolution.

Multiple Attenuation

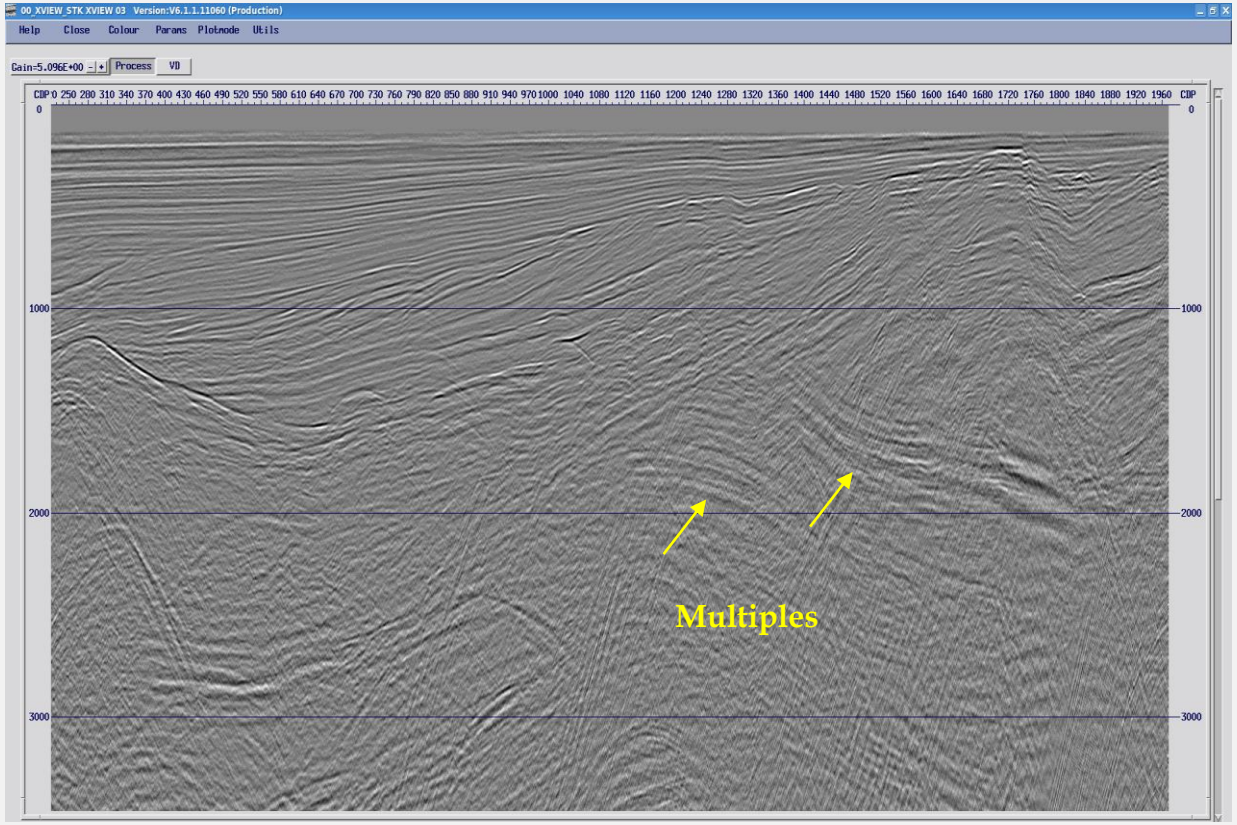




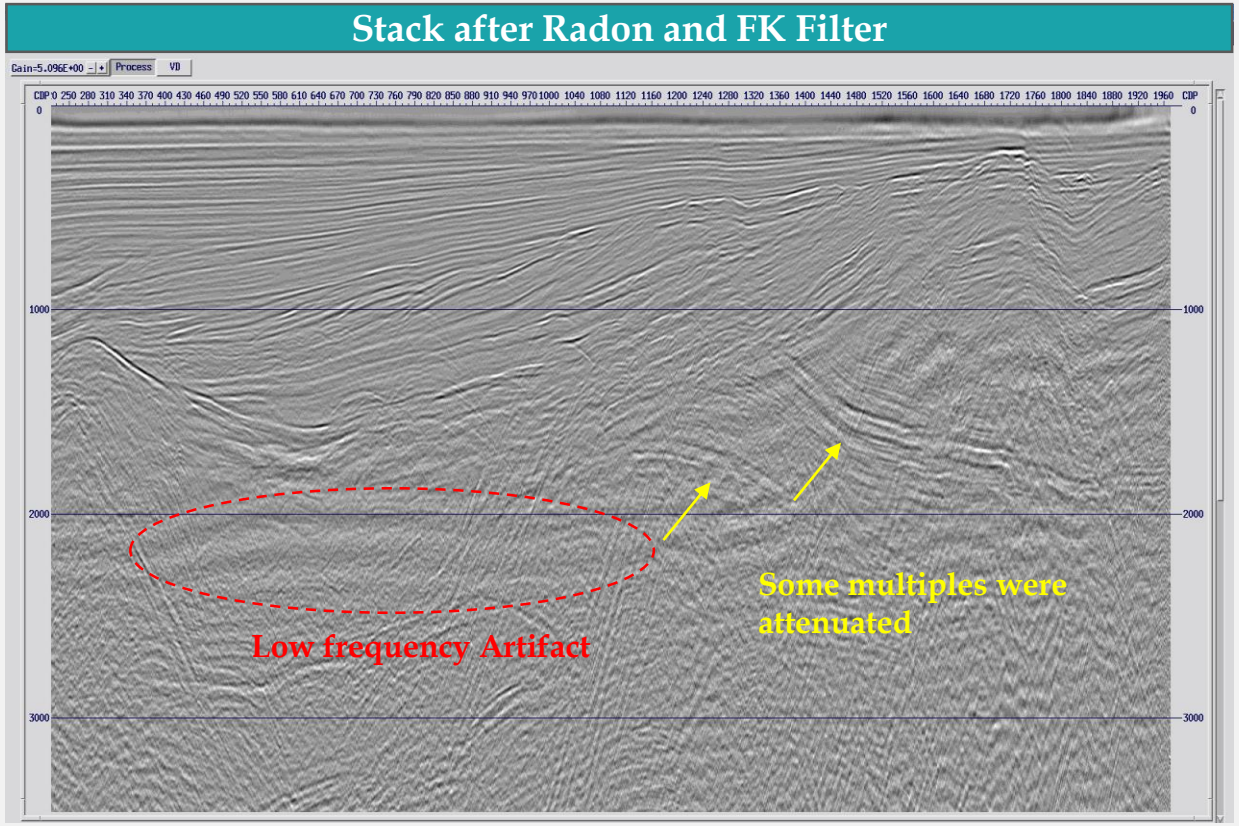
- FK filter was applied to remove linear noise (dip more than 5 ms/trace). In FK domain, multiple and linear noise with high dip were filtered out.
- Curved multiples were attenuated by Radon demultiple (moveout limit -100 and 600 ms).
- Both FK filter and Radon demultiple process improve signal to noise ratio.

Multiple Attenuation

Stack before Radon and FK Filter



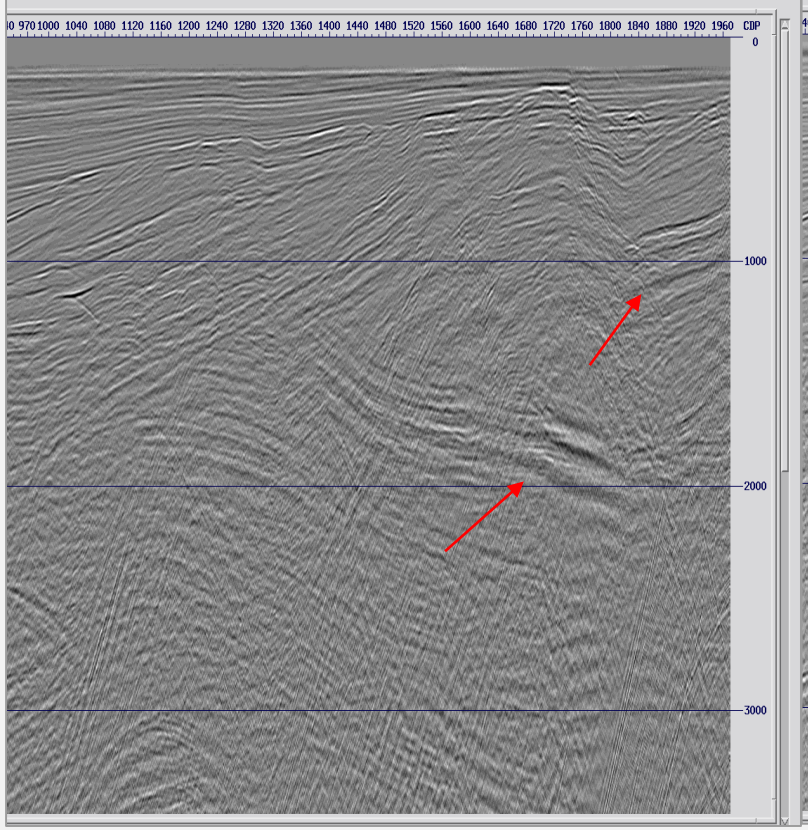
Stack after Radon and FK Filter



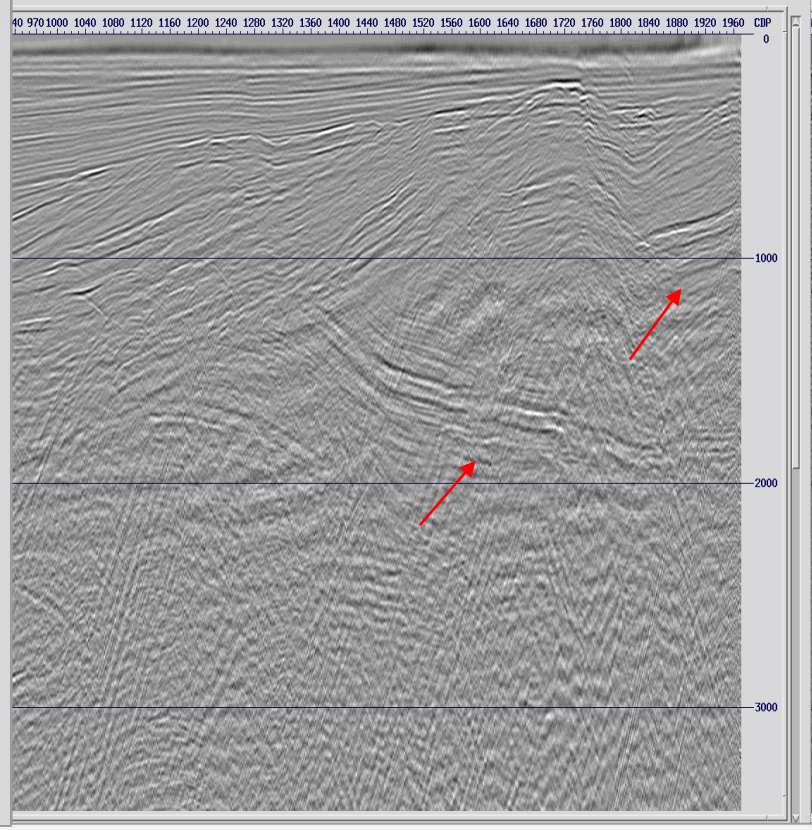
- The improvement was significant in CDP gather but not clearly observed in stack section.

Multiple Attenuation

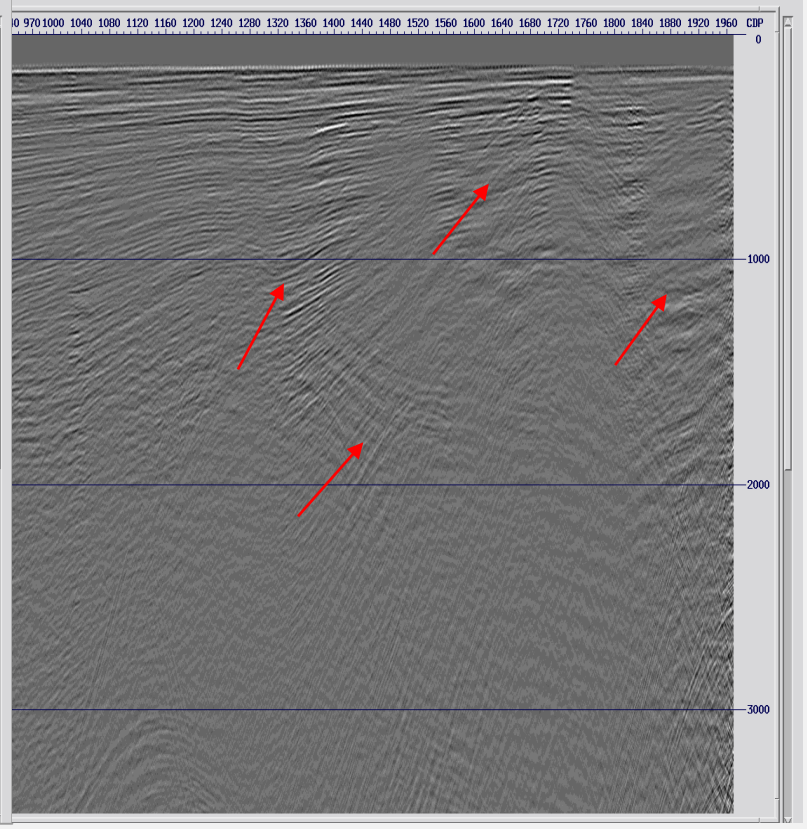
Stack before Radon and FK Filter



Stack after Radon and FK Filter

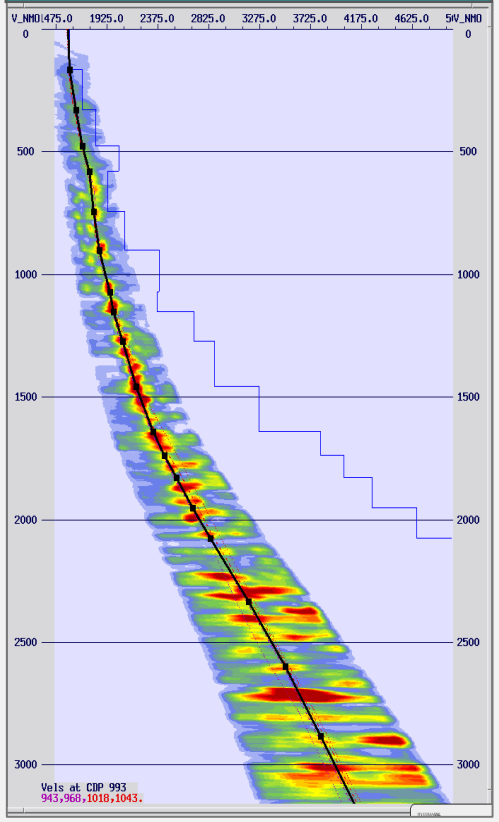


Different Section

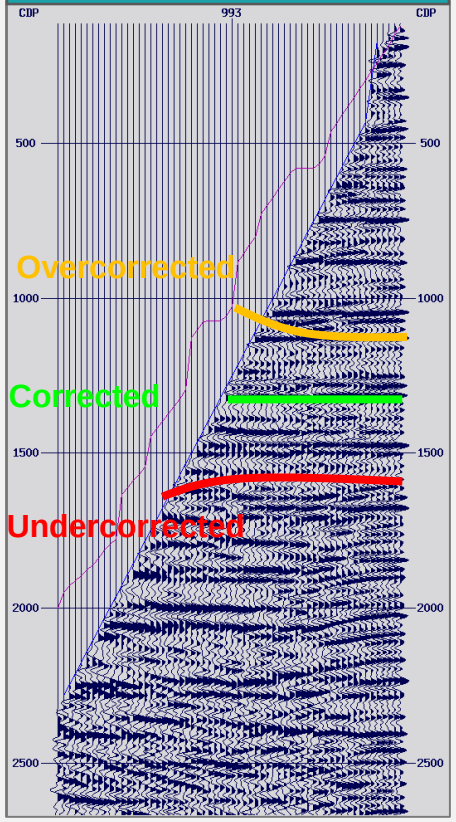


Velocity Analysis

Velocity Semblance



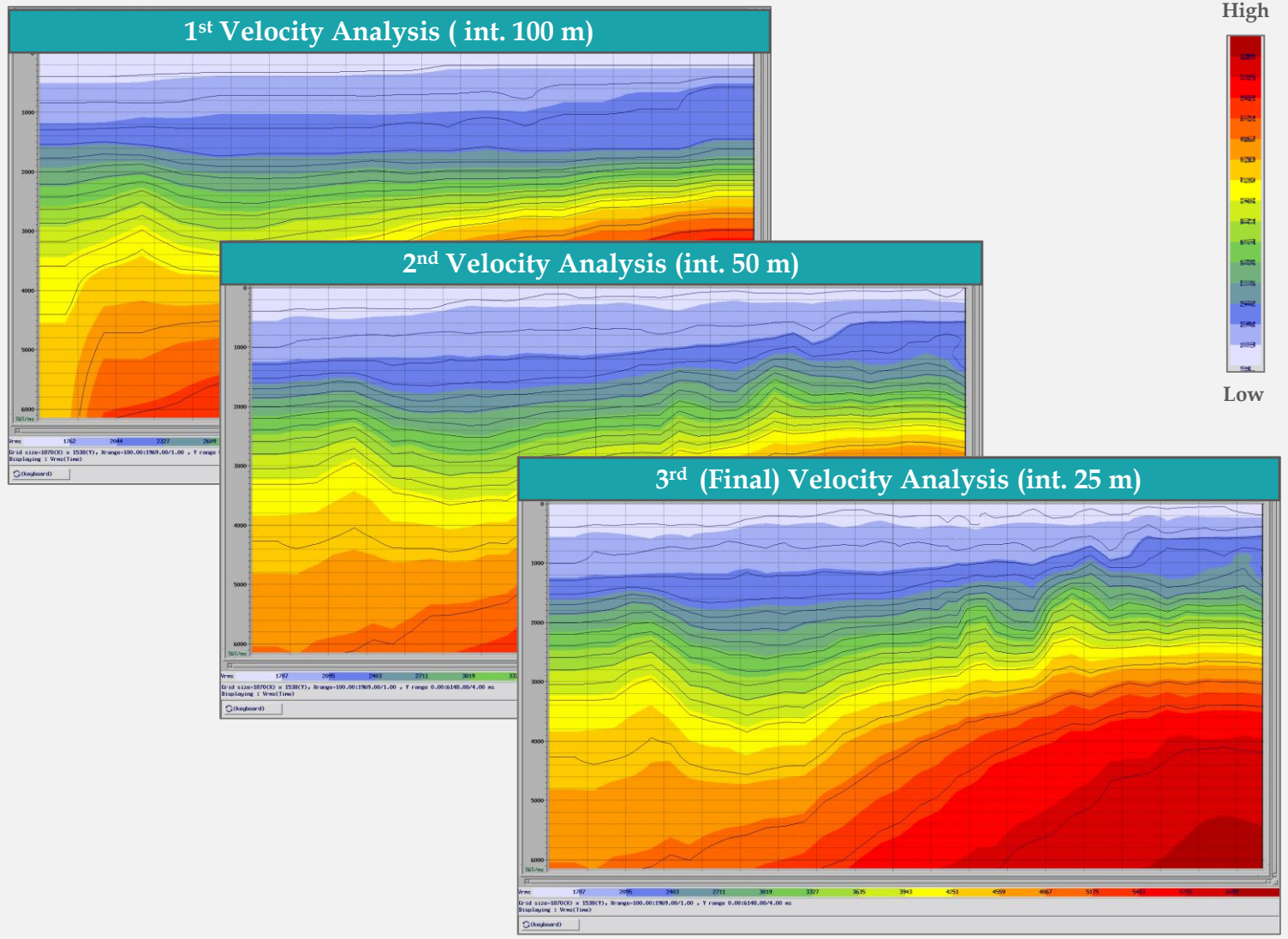
CDP Gather (NMO)



1st Velocity Analysis (int. 100 m)

2nd Velocity Analysis (int. 50 m)

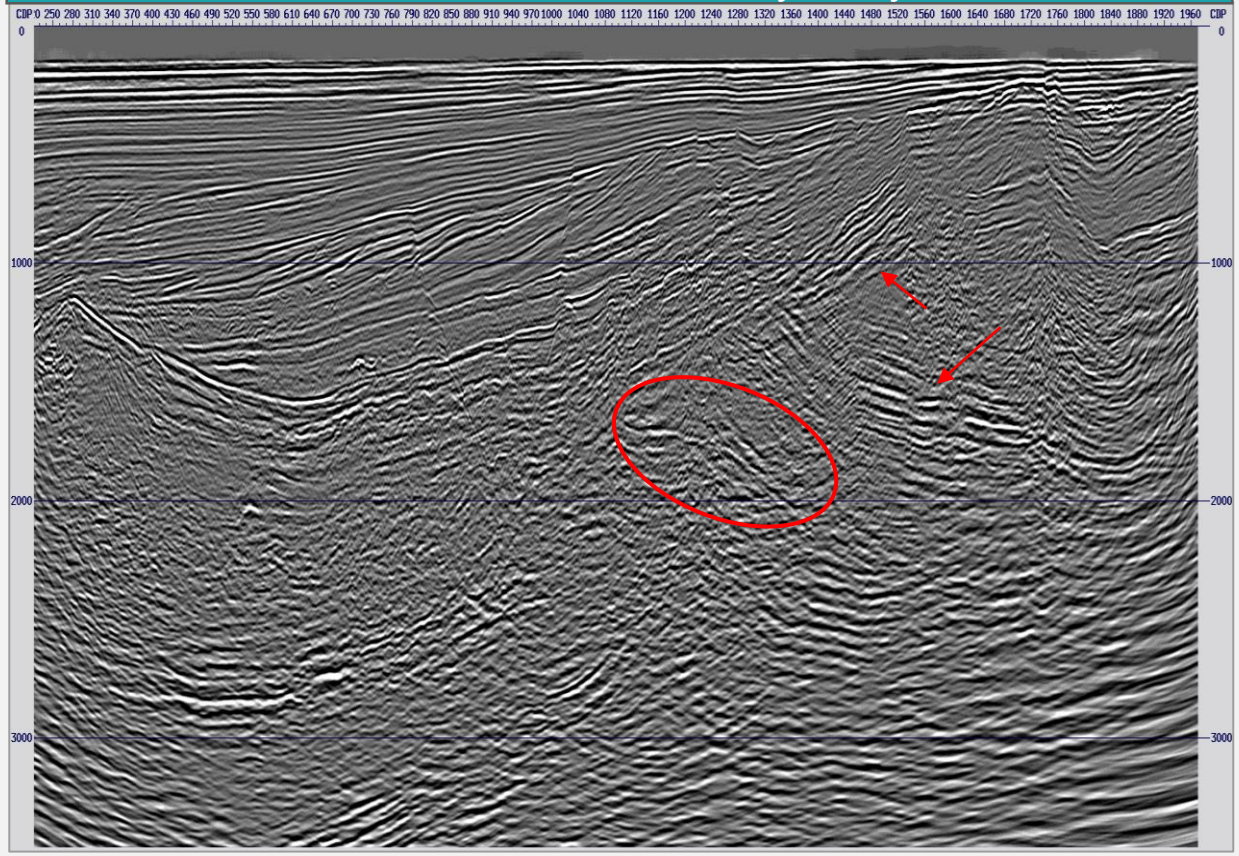
3rd (Final) Velocity Analysis (int. 25 m)



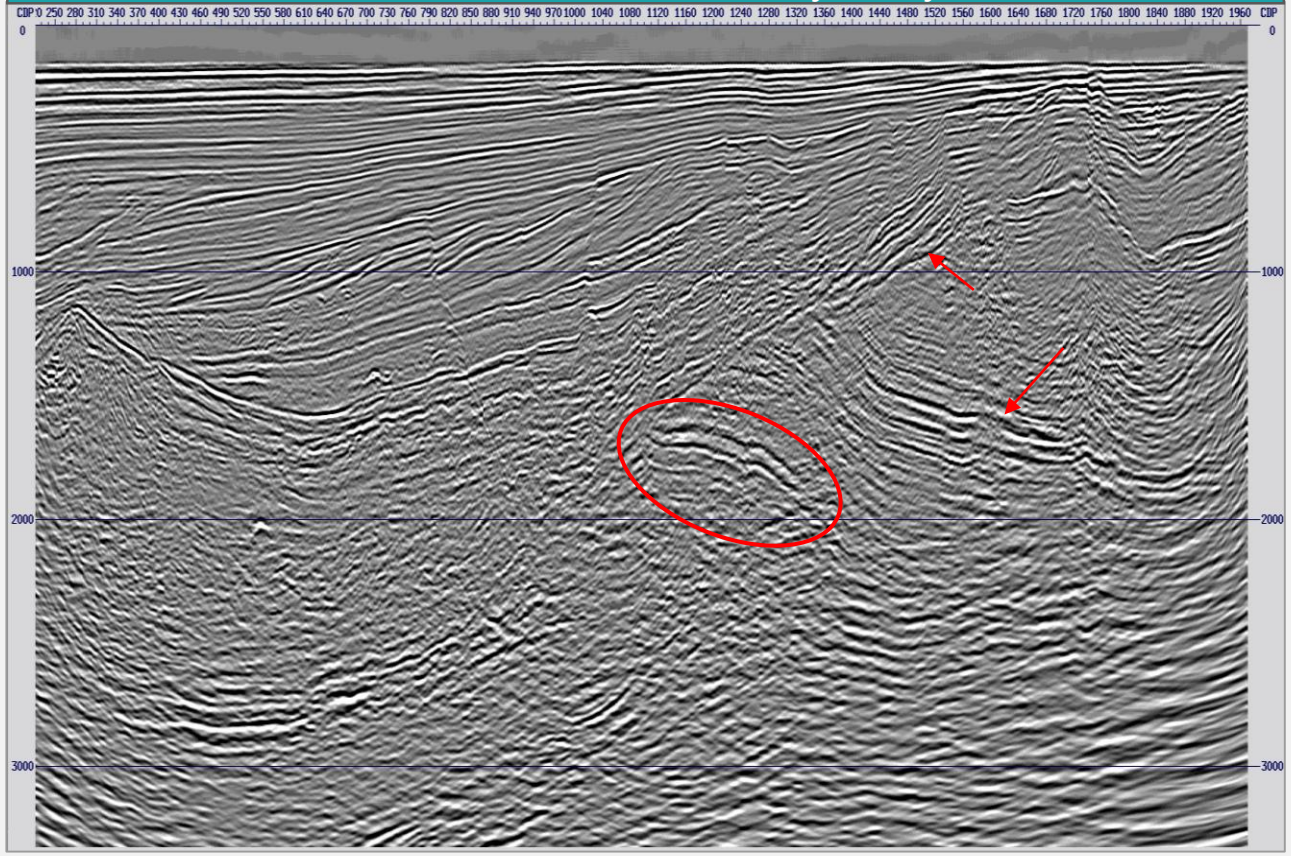
- The input gather with high signal to noise ratio provide high focusing semblance and easy to pick velocity trend.

Velocity Analysis

Stack Section with 1st Velocity Analysis

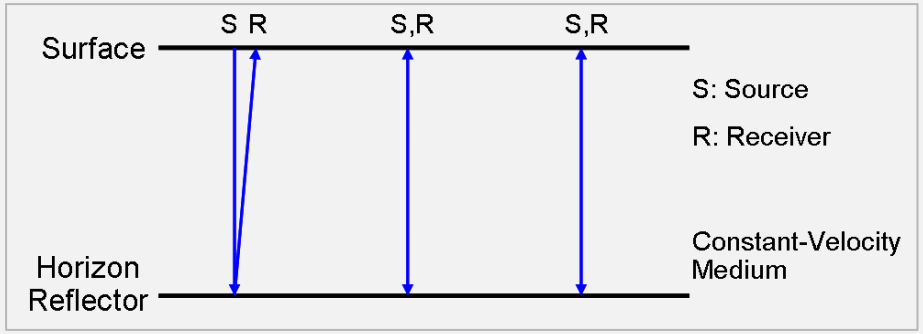


Stack Section with 3rd Velocity Analysis

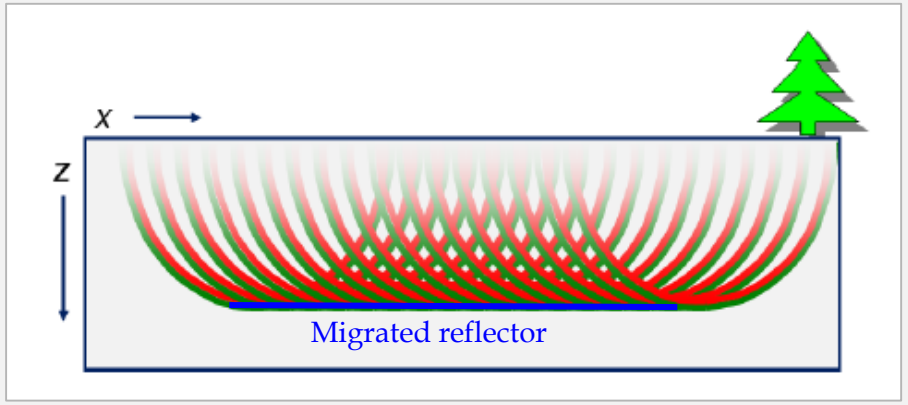


Migration (PSTM)

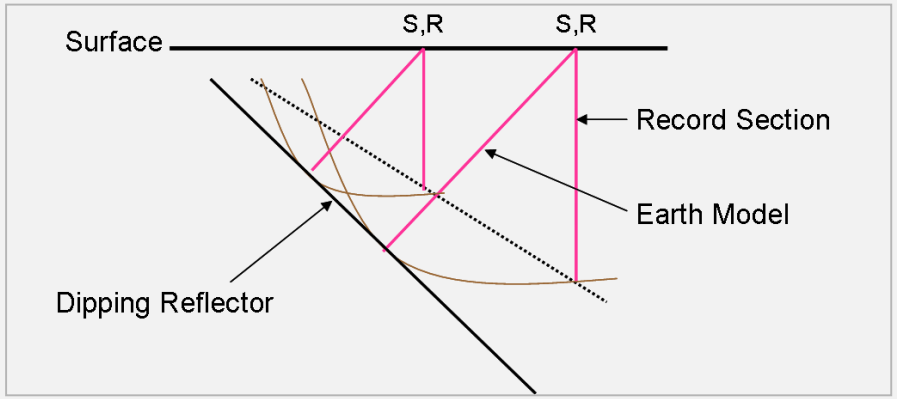
Migrated Horizontal Reflector



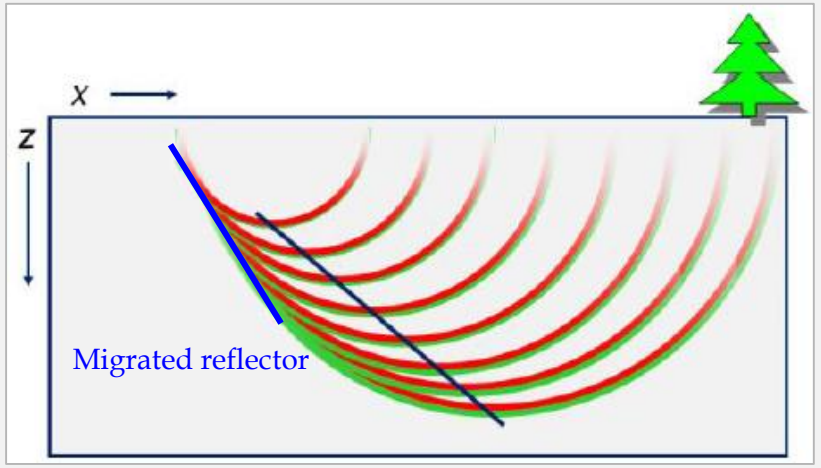
Record Position is the same real position



Migrated Dip Reflector

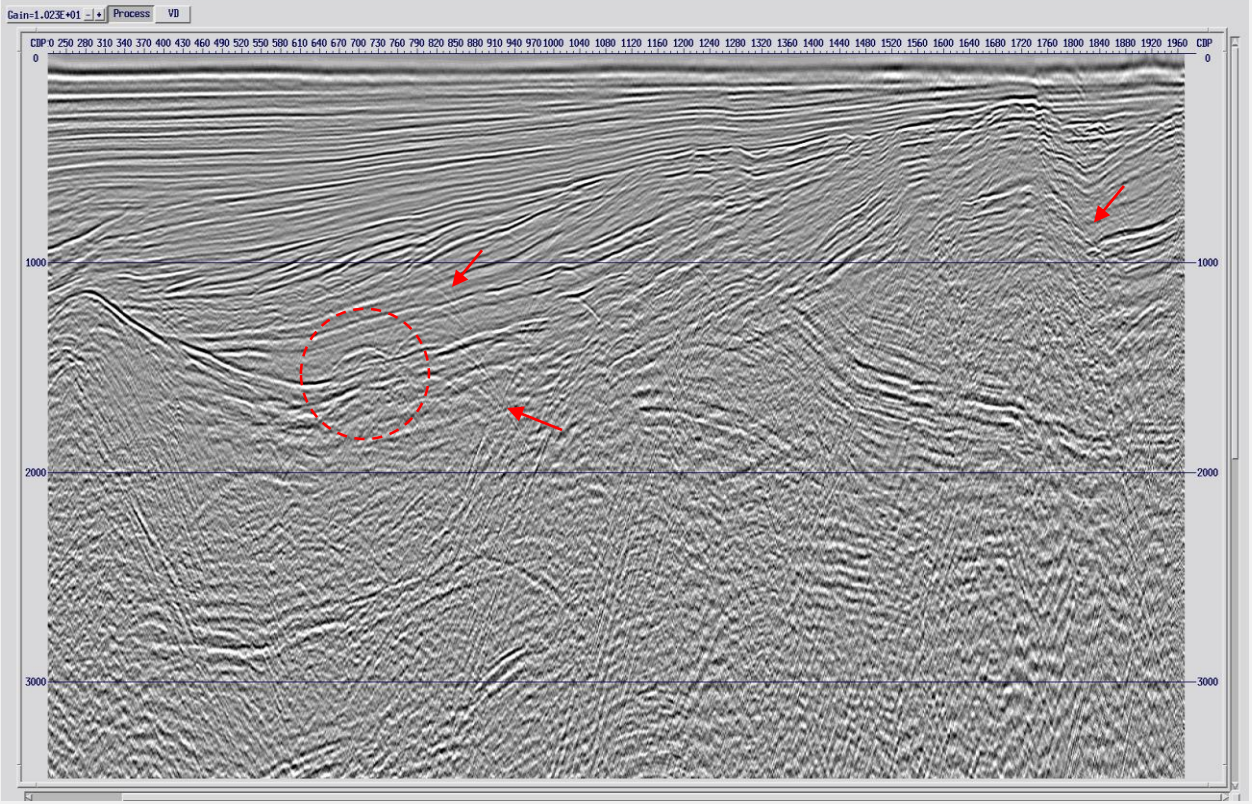


Record position and real position are different position

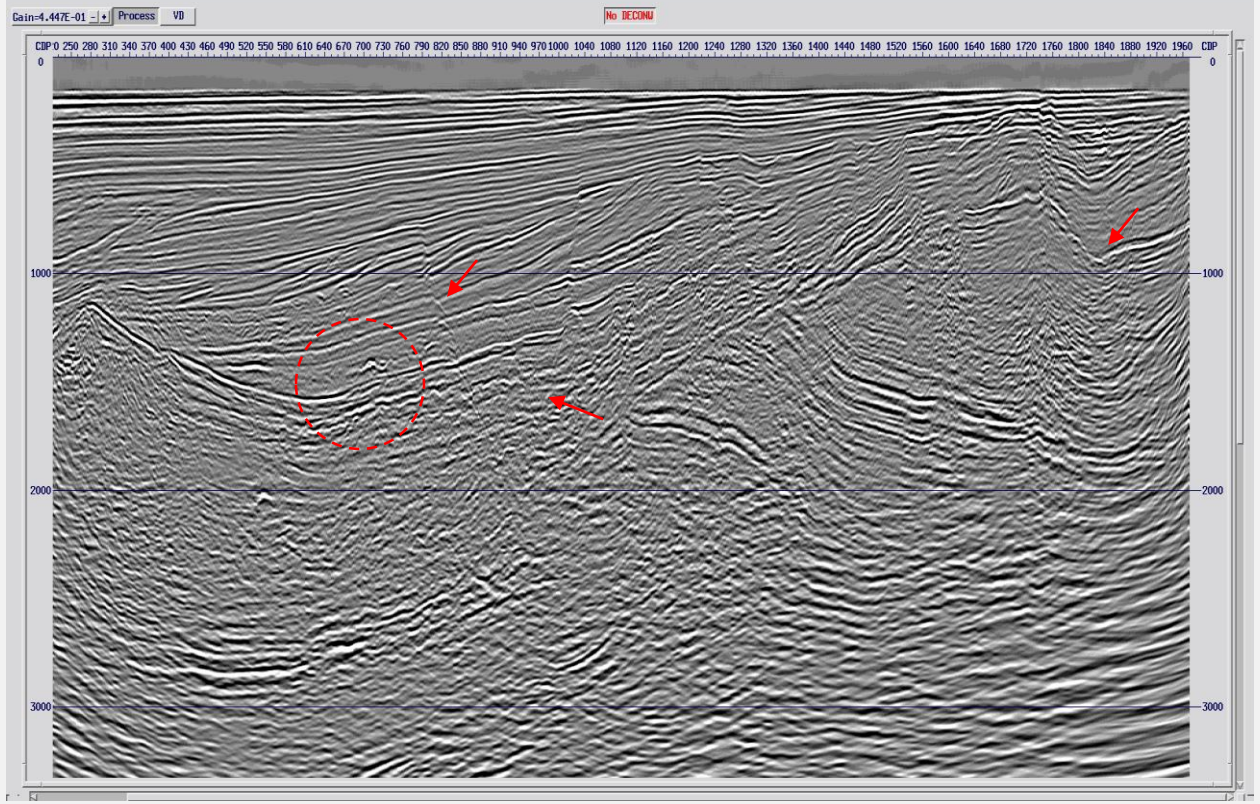


Migration (PSTM)

Stack before Migration

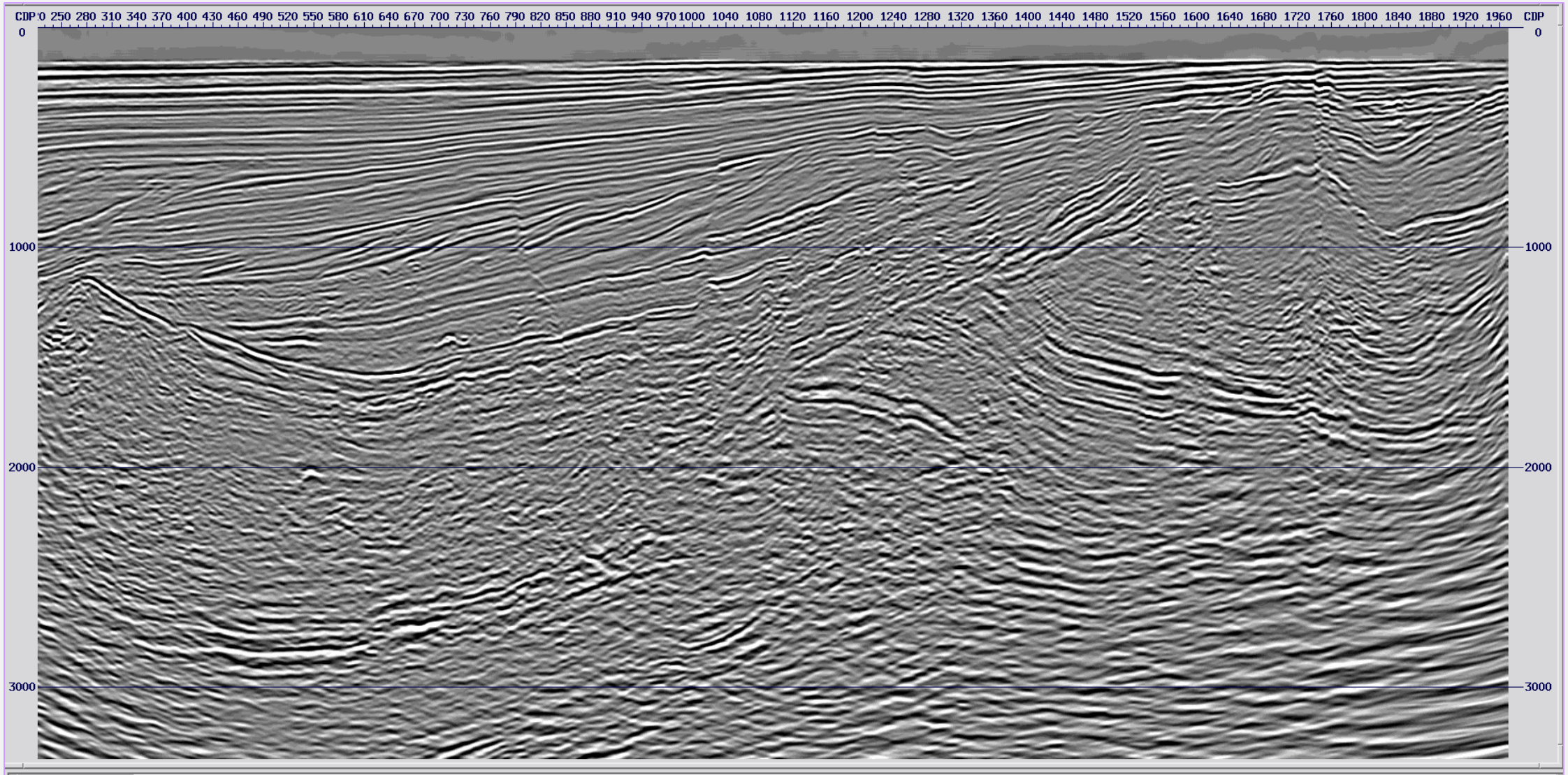


Stack after Migration

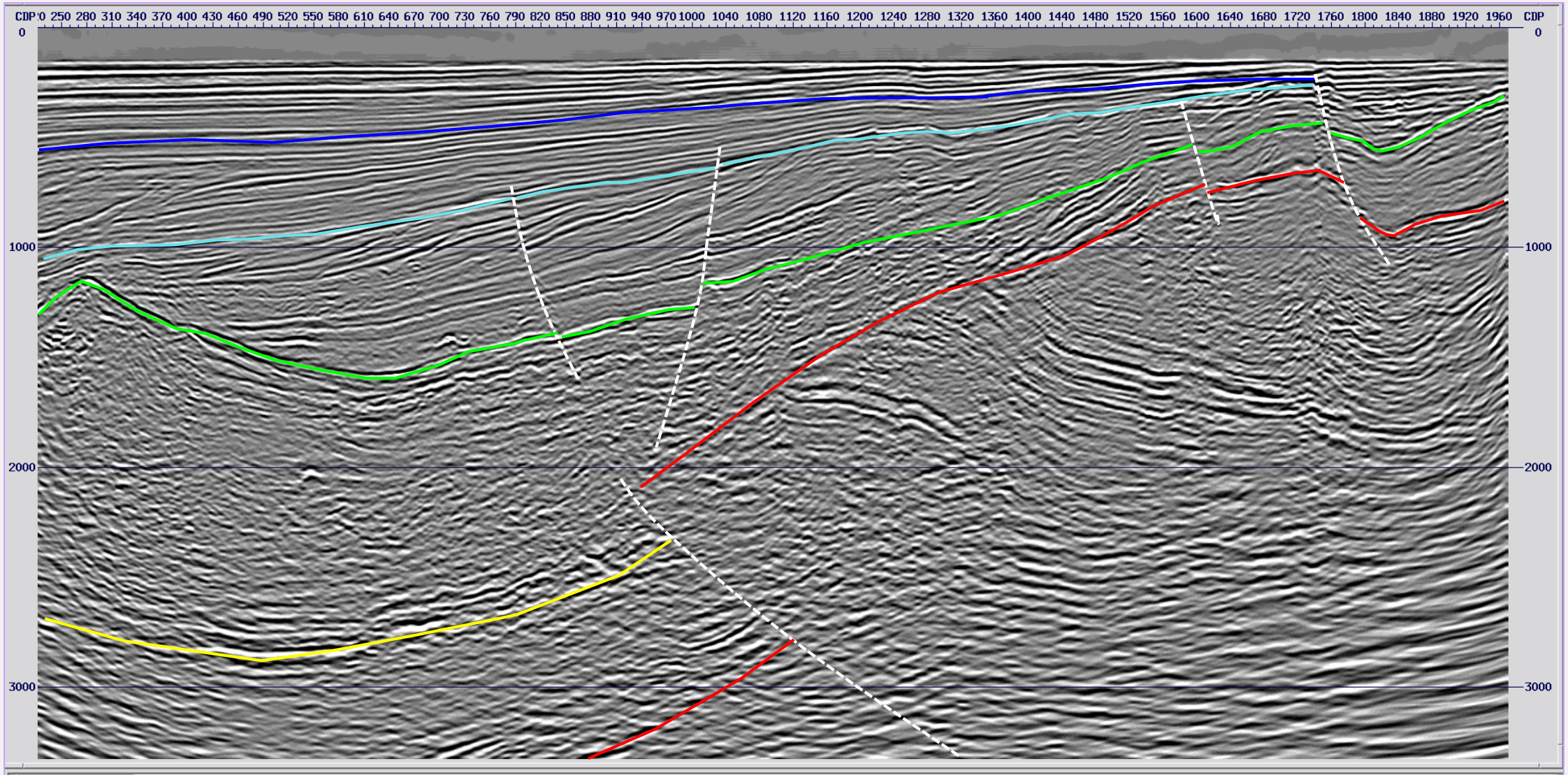


- Pre-stack Kirchhoff time migration (PSTM) was applied on this dataset.
- The structure was significantly improved after migration especially in anticline, syncline and fault zone.

Final Stack Section



Final Stack Section (Interpreted)



Conclusions

- Each parameter is specified in different data set. To get the best result, parameter testing is required.
- This basic seismic processing sequence can produce a reasonable result for final stack section
- Velocity analysis is a very crucial part of processing. Incorrect velocities produce artificial structures in the data and destroys signals while correct velocities enhance the image and positions the structures correctly. Therefore, this part of the processing should be taken cautiously.
- The sequence of each workflow is related to one another. The wrong flow sorting affect directly to data.
- PSTM migration is the most important step that re-position the correct mage the geological structure. The quality of seismic image is related to the level of signal to noise ratio and velocity model.