Time reprocessing and depth imaging of vintage seismic data: the Southern Adriatic Sea case study

Edy Forlin*, Giuseppe Brancatelli*, Nicolò Bertone, Anna Del Ben, Riccardo Geletti*

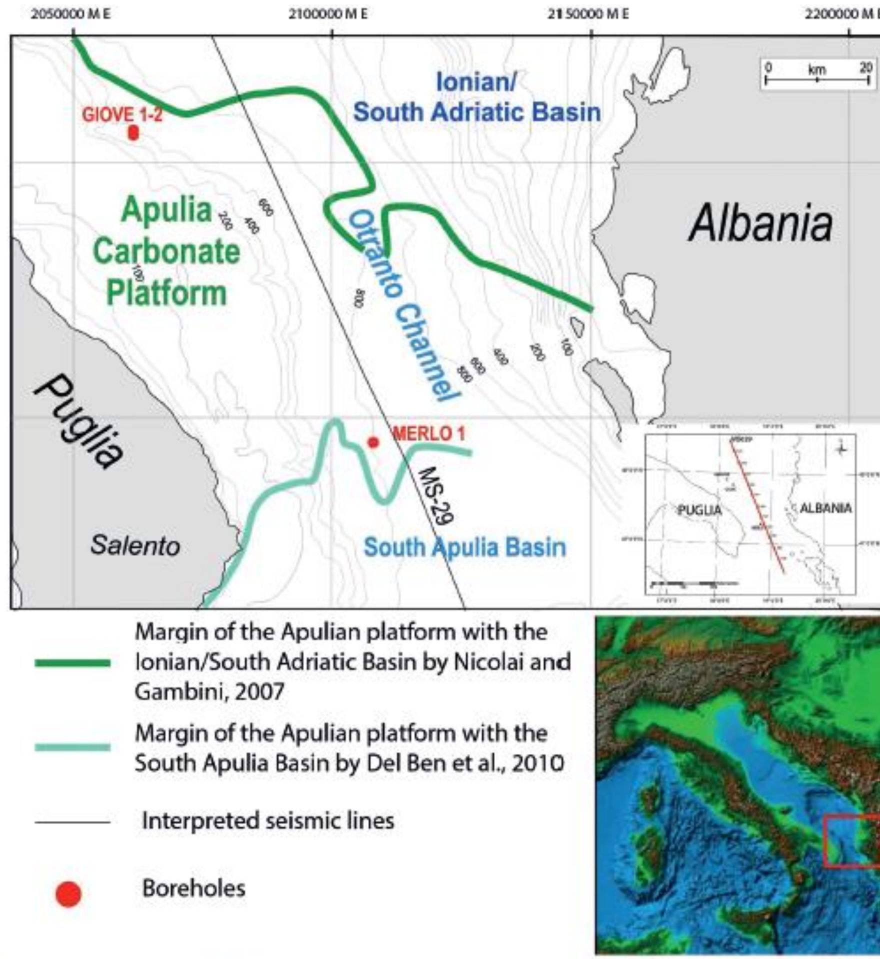
*National Institute of Oceanography and Applied Geophysics OGS, Trieste, Italy
° Department of Mathematics and Geosciences, University of Trieste, Italy

Objectives

- Improve the of quality and resolution of vintage data;
- New interpretations lead to save money and limit the impact of new acquisitions.

MS-29: acquired in April and May 1971, in the Otranto Channel area of the South Adriatic Sea - Total length: 231 km (1156 shot points, SP)

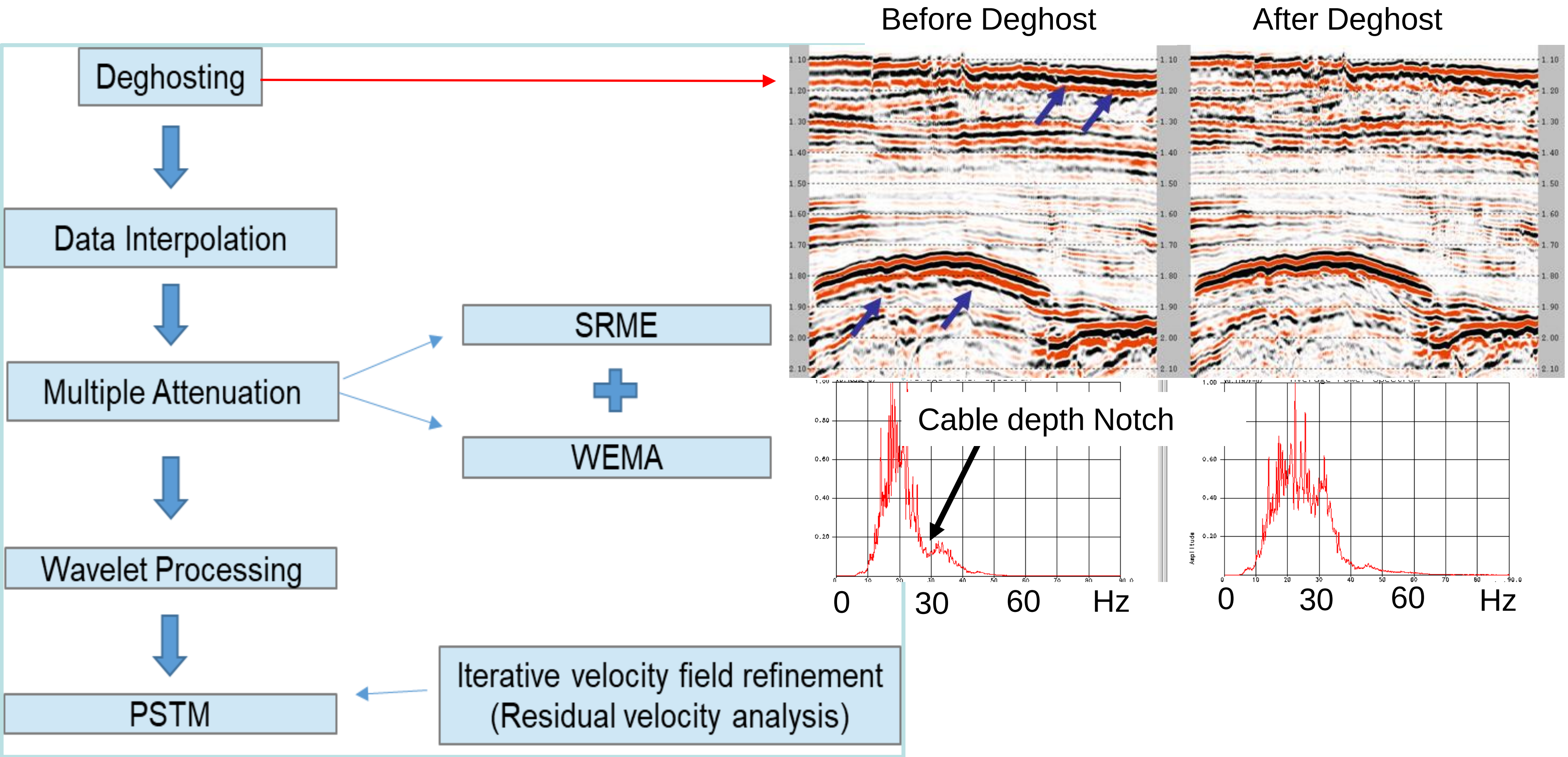
Source	Flexotir - 3 guns (50 g/gun of Dynamite, Geodin-B)
Source depth	15 m
Streamer length	2400 m
Streamer depth	25 m
Number of channels	24
Number of hydrophone/trace	20
Shot interval	200 m
Near offset	300 m
Sample rate	4 ms
Record length	8 s (TWT)
Recording filters	Low out 10 Hz; High 70 Hz



Location map of the study area (by Del Ben et al., 2011, modified)

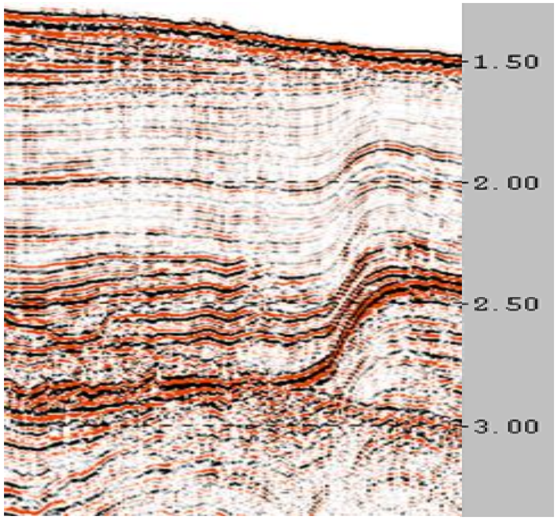
Time reprocessing

- better characterization of seismic facies;
- more reliable imaging of subsurface features;
- greater capacity of detection and interpretation of fluid related amplitude anomalies;
- improved resolution.

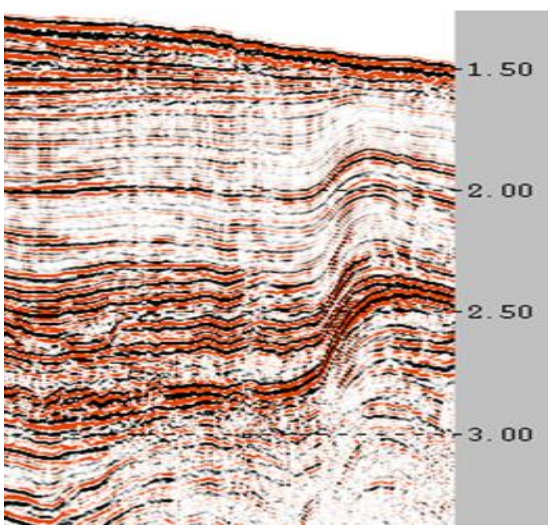


Multiple attenuation

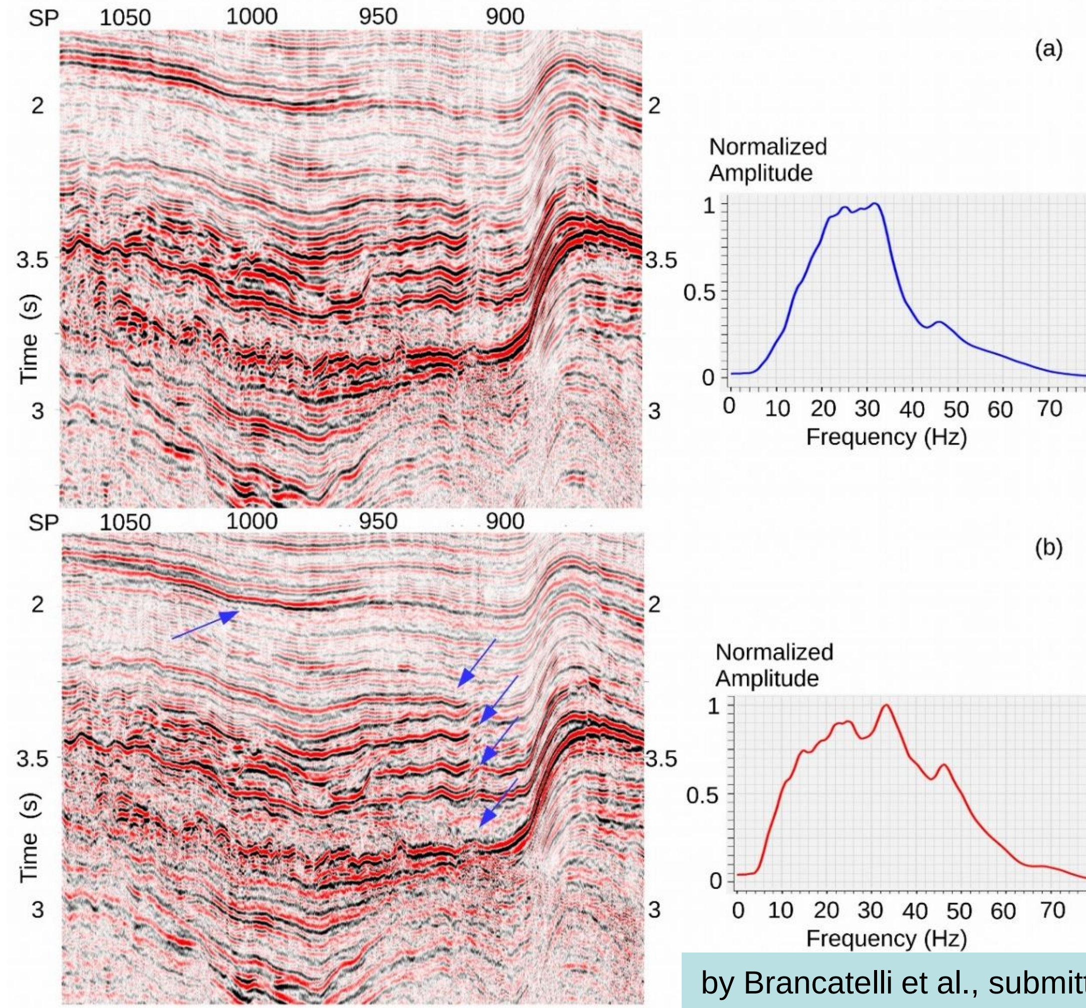
Before SRME



After SRME (interpolated data)



Wavelet Processing: Q Correction, Minimum Phase Conversion, Surface Consistent Decovolution



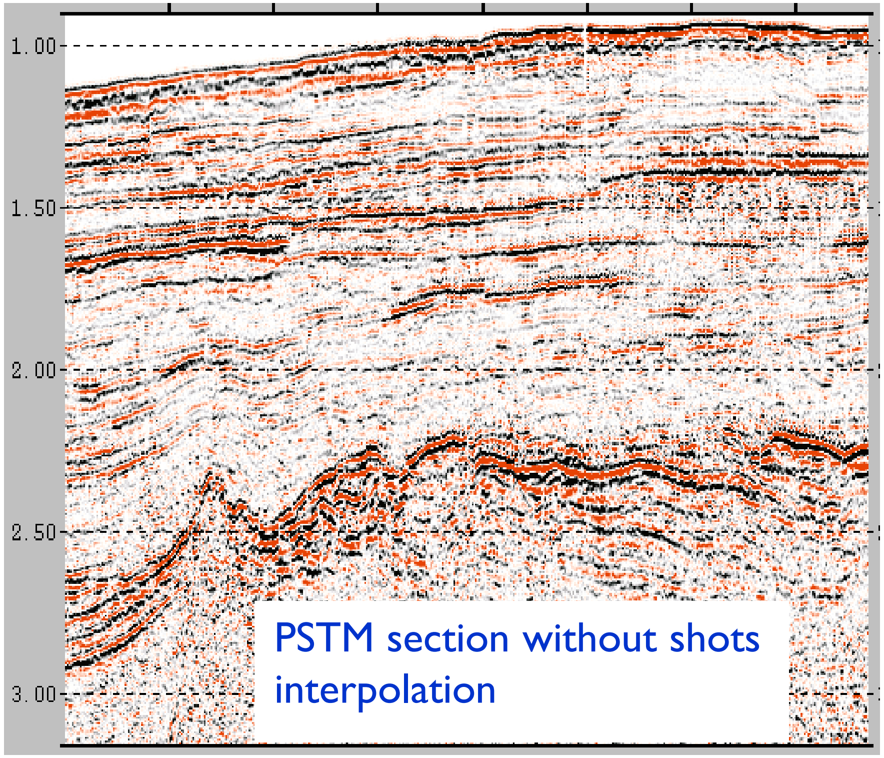
by Brancatelli et al., submitted

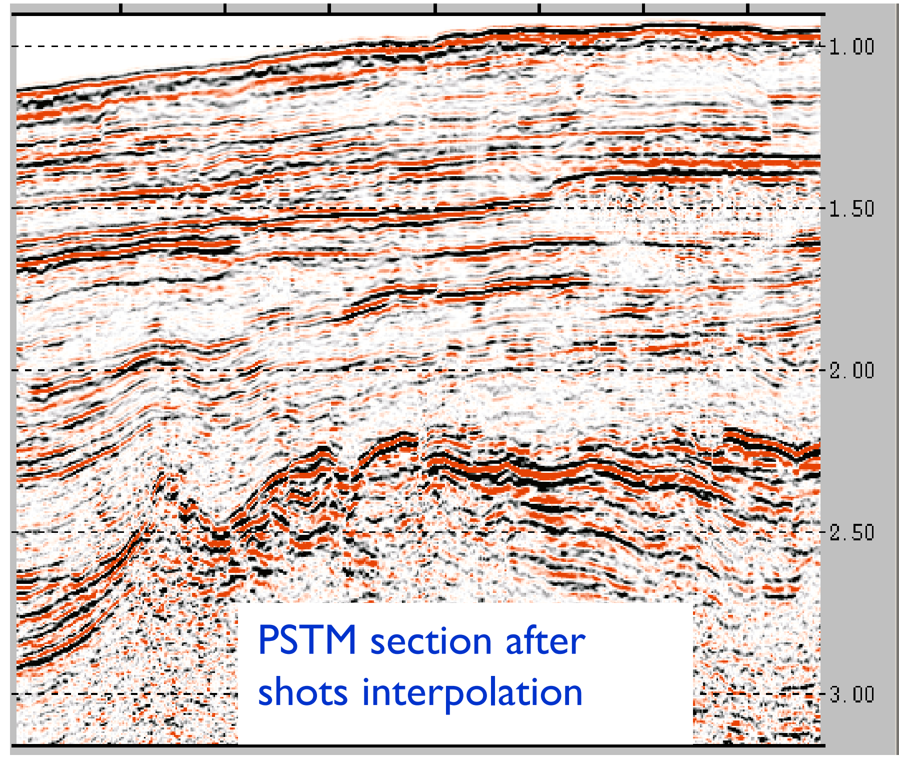
Portion of stack section before (a) and after wavelet processing (b) with the respective frequency spectra.

Pre Stack Time Migration (PSTM) - Aliasing

Low fold coverage data aliasing problem

Shot interpolation, increasing fold coverage to 1200% and decreasing the offset increment to 200 m.

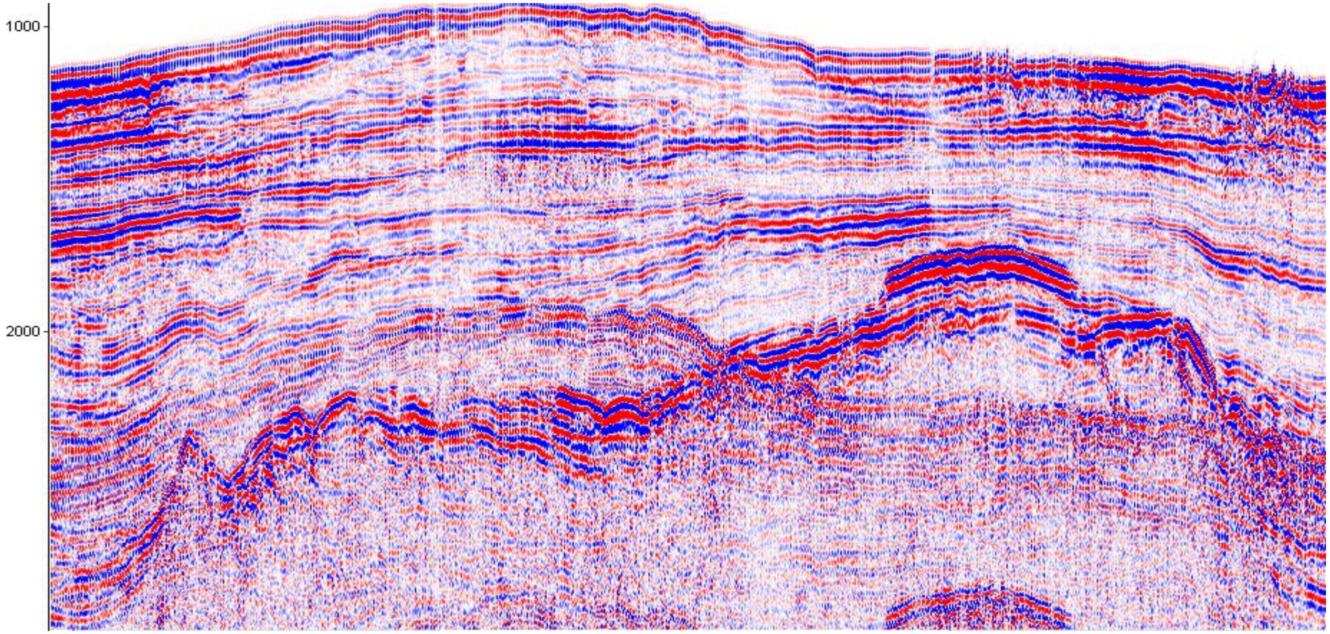




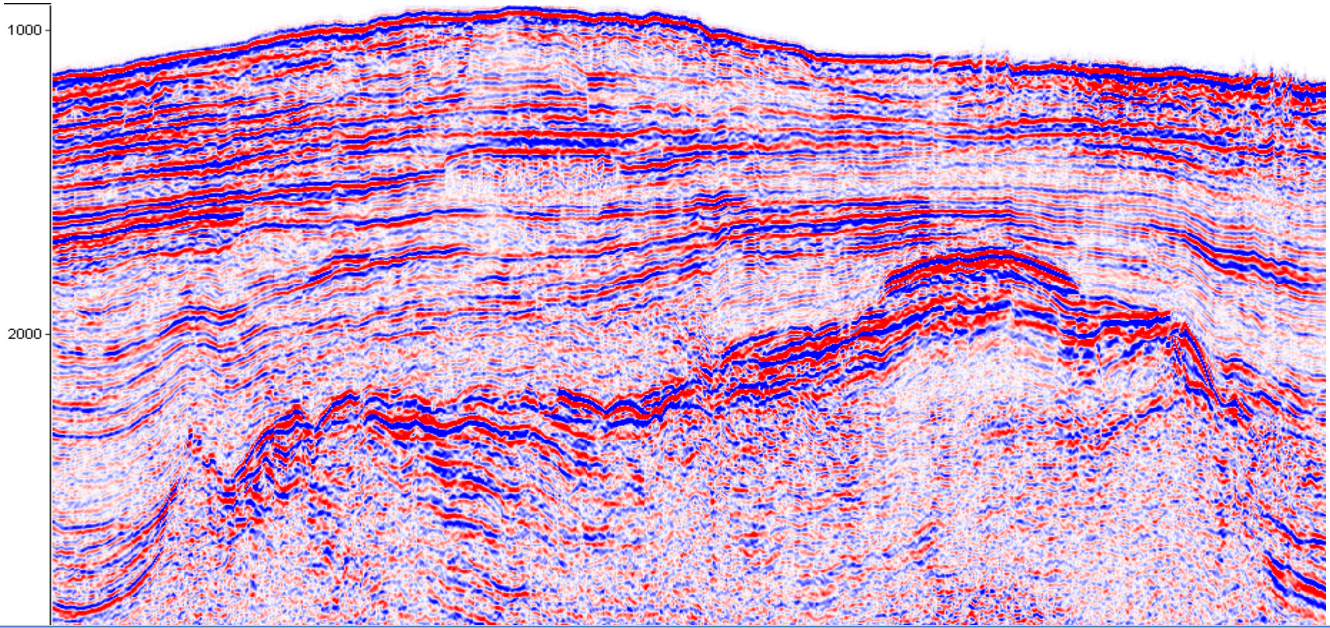
- Coarse aspects
- Poor quality image

- Noise is largely suppressed
- Reflectors are clearer and more continuous

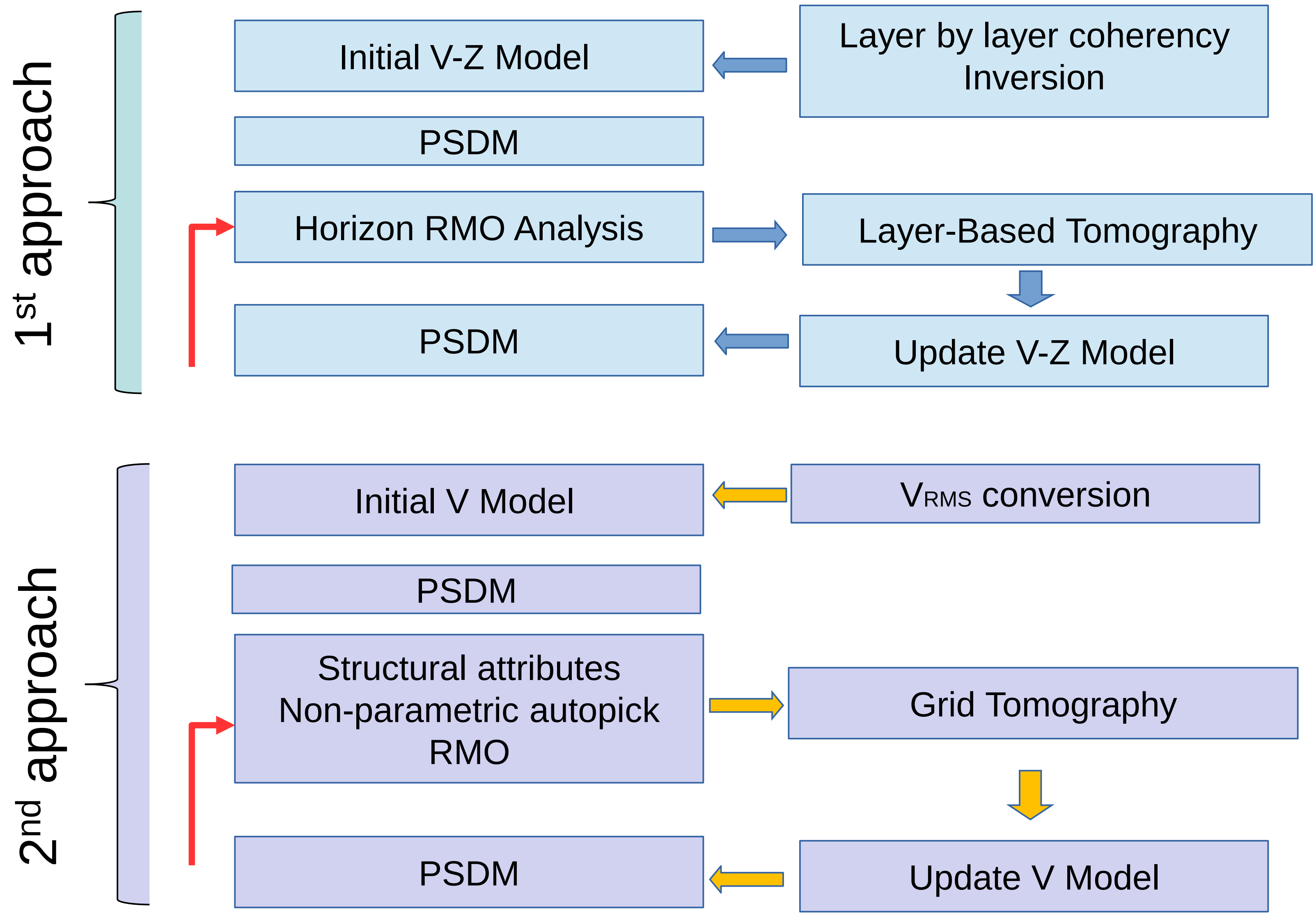
Original processed section



PSTM reprocessed section



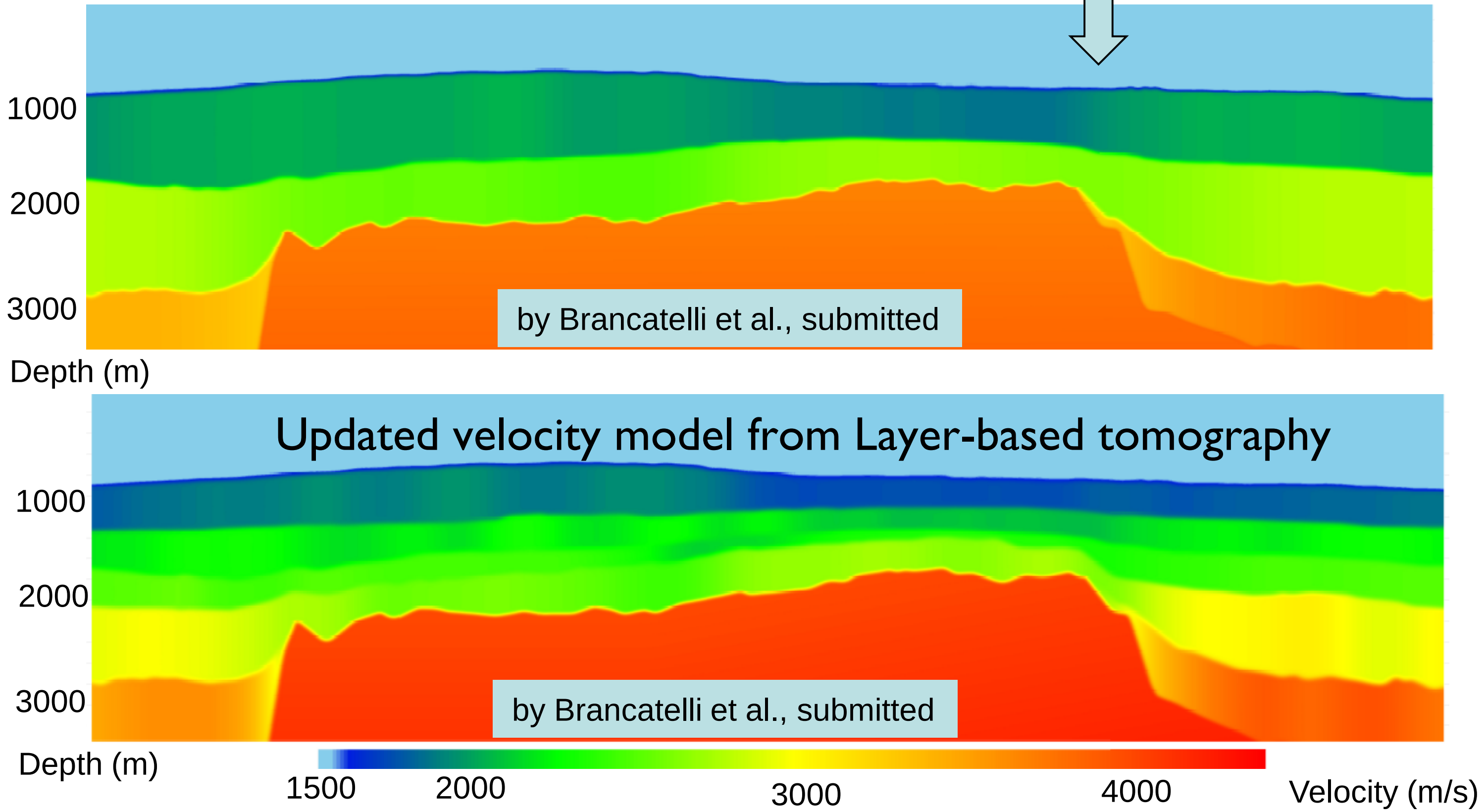
Velocity model and depth imaging



Velocity model and depth imaging 1st approach

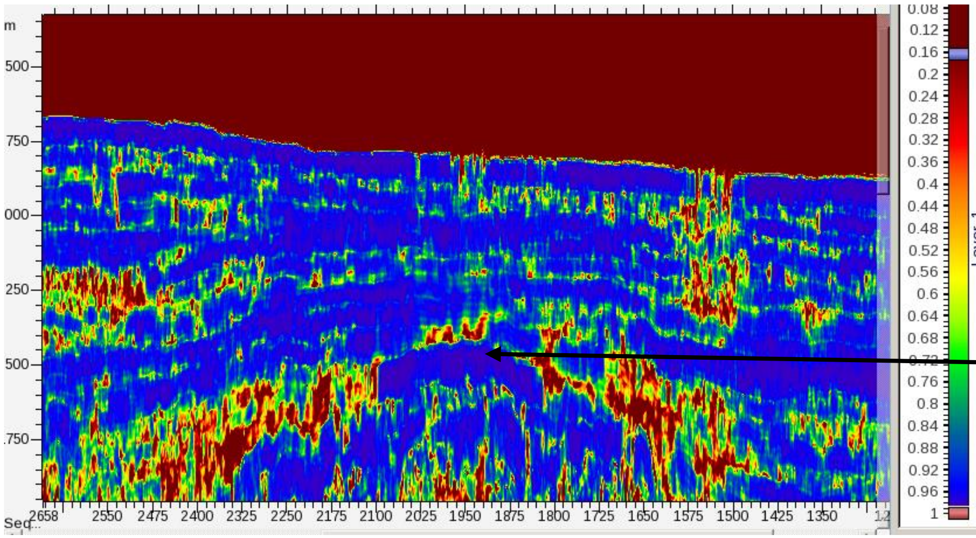
- Coherency inversion along picked time horizons
- CMP Ray Tracing
- Semblance velocity picking

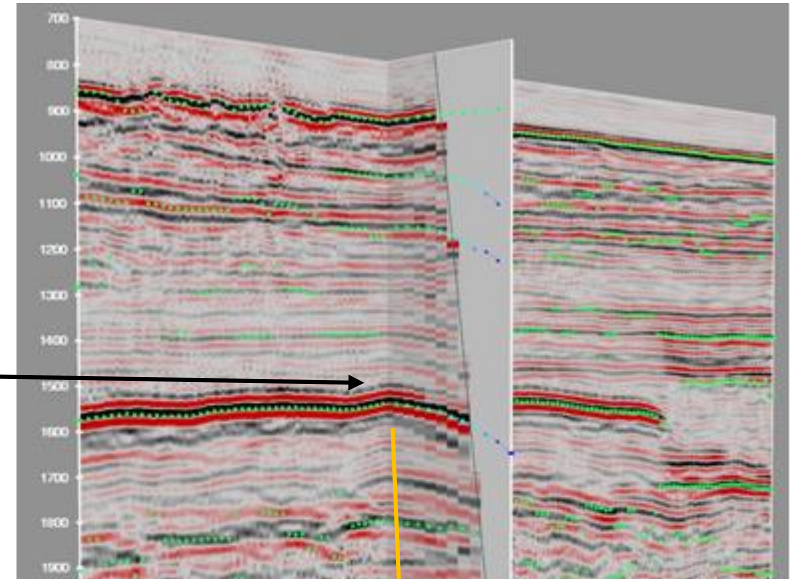
Initial V-Z Model



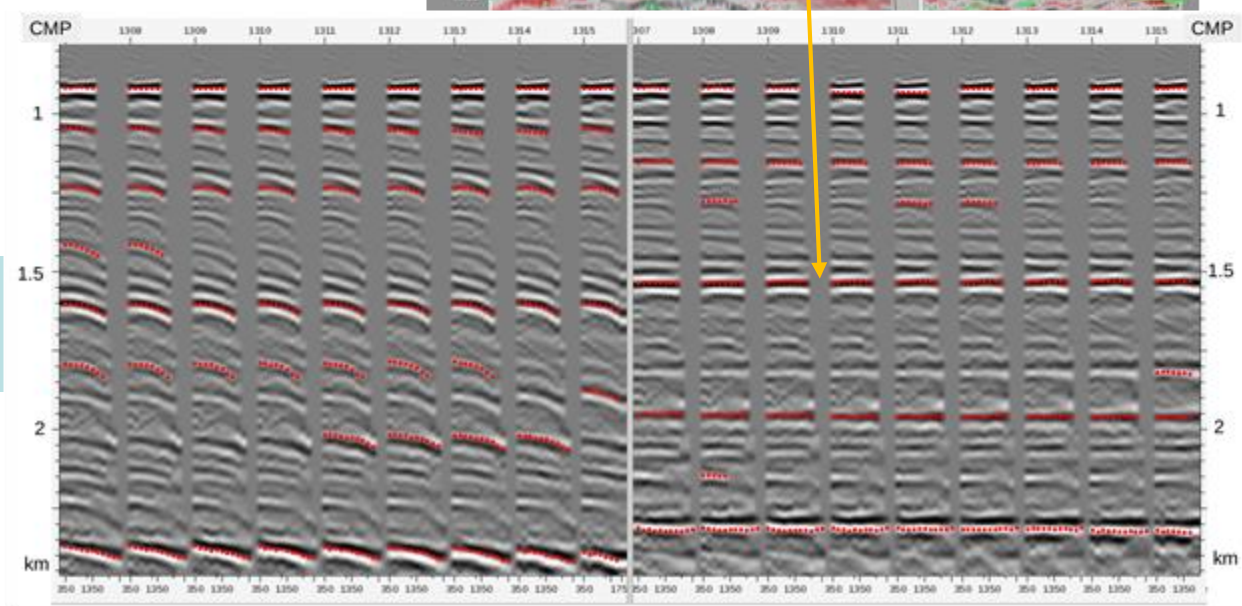
- The starting model is quite close to the final model
- It needs horizons interpretation → Time-consuming

Velocity model and depth imaging 2nd approach



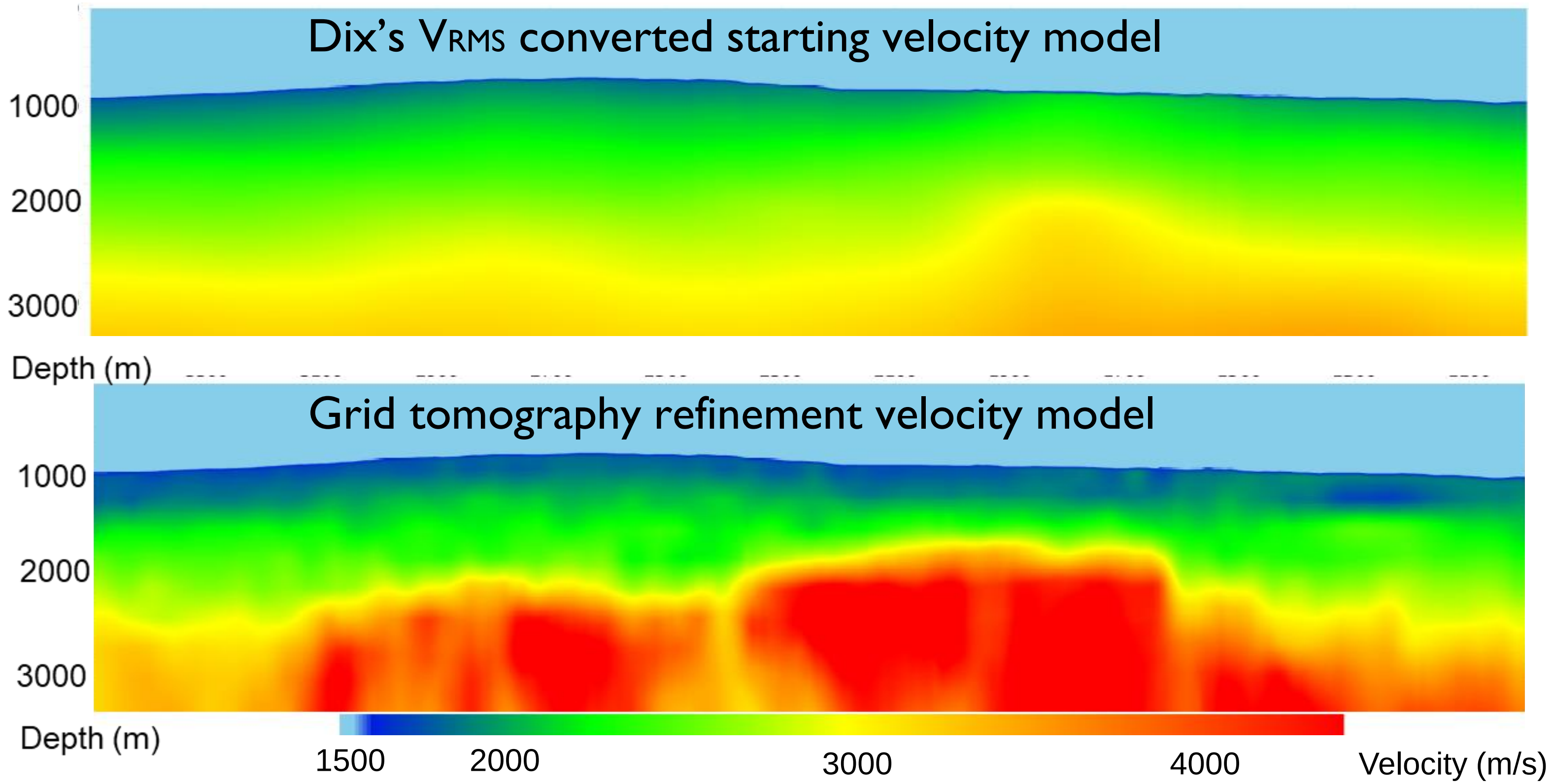


Continuity section



Non parametric move-out auto-picker

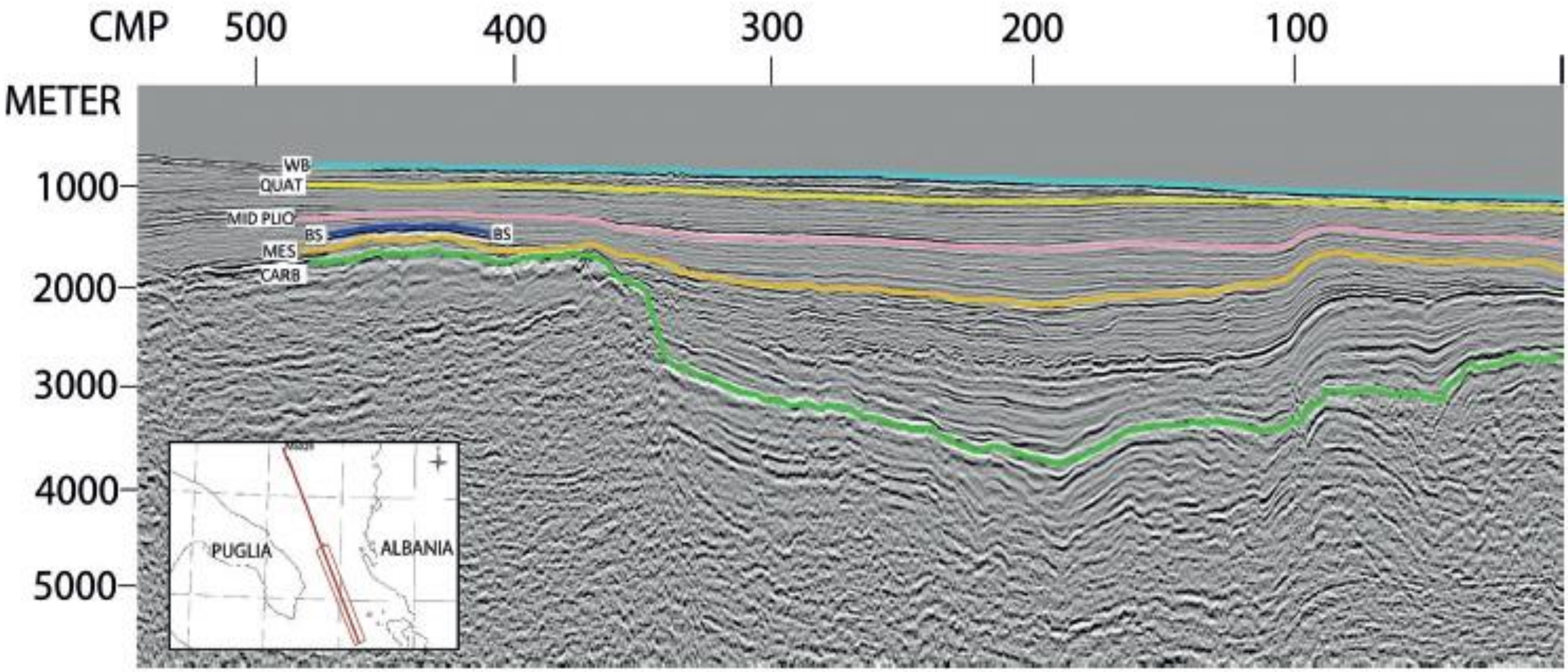
Velocity model and depth imaging
2nd approach



- The starting model is not close to the final model → Tomography may fail to converge
- No need for horizon interpretation
- Autopick RMO analysis → Time-saving

Velocity model and depth imaging

Final PSDM section



Part of the pre-stack depth migrated MS29 seismic line. In detail it is shown the carbonate platform with reef, the adjacent sedimentary basin and the topping esimentary sequence. (WB=Water Bottom; QUAT=Quaternary Base; MID PLIO=Middle Pliocene; BS=Bright Spot; MES=Messinian Erosional Surface; CARB=Carbonate Platform. By Bertone et al., 2018

CONCLUSIONS

- Vintage seismic data represent a significant value for the scientific community.
- The proposed time reprocessing flow allows to overcome the aliasing problems (low fold coverage) affecting the performance of the SRME and the PSTM.
- The application of both SRME and WEMA algorithm strongly attenuates the energy of multiple reflections, showing that this is also an optimal approach for treating vintage, low coverage seismic data.
- The vertical seismic resolution has been improved broadening the frequency bandwidth, applying a designature procedure consisting in three main steps: de-ghosting, Q correction and surface consistent deconvolution.
- Two specific velocity modeling workflows were explored: 1) the coherence inversion technique to build an optimal initial model and the layer-based to refine it; 2) an initial smooth velocity field and the grid tomography (with the aim of the structural attributes and the RMO autopicker) to refine it.
- The reprocessing and depth imaging of the MS-29 seismic line lead to an easier and reliable interpretation of the seismic horizons and the characterization of seismic facies.

References

- Bertone N., Brancatelli G., Geletti R., Del Ben A., 2018. Pre-stack depth migration using two different tomographic Techniques: the Otranto channel case study. 37° GNGTS, 2018 3 (Sessione 3.1), 11-15.
- Brancatelli G., Forlin E., Bertone N., Del Ben A., Geletti R. Time to Depth Seismic Reprocessing of Vintage Data: a Case Study in the Otranto Channel (South Adriatic Sea). Submitted.
- Del Ben A., Forte E., Geletti R., Mocnik A., & Pipan, M., 2011. Seismic exploration of a possible gas-reservoir in the south Apulia foreland. Bollettino di Geofisica Teorica ed Applicata, 52(4).

Acknowledgements

Emerson Paradigm for Echos and Geodepth software academic license.