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VIENNA 2016

Efficient Use of Technology - Unlocking Potential

Vintage Data Reprocessing – Sweetest Smoke May Come From Old Pipes – A 2D Onshore Case

30 May – 2 June 2016

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GEOFIZYKA TORUŃ
GRUPA PGNiG

TOTAL
COMMITTED TO BETTER ENERGY

OUTLINE

- Rationale
- Processing flow
- Imagery enhancement
- Conclusion

Presentation developed by the team:

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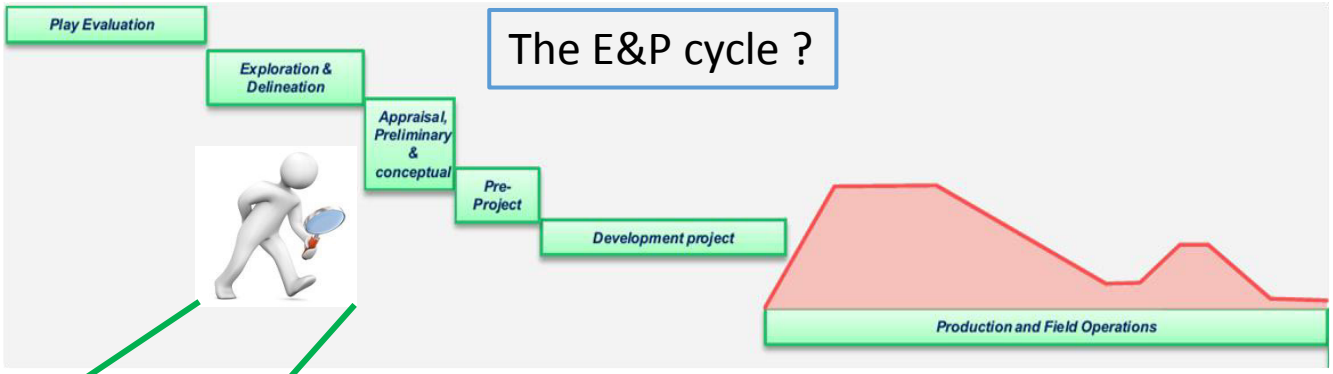
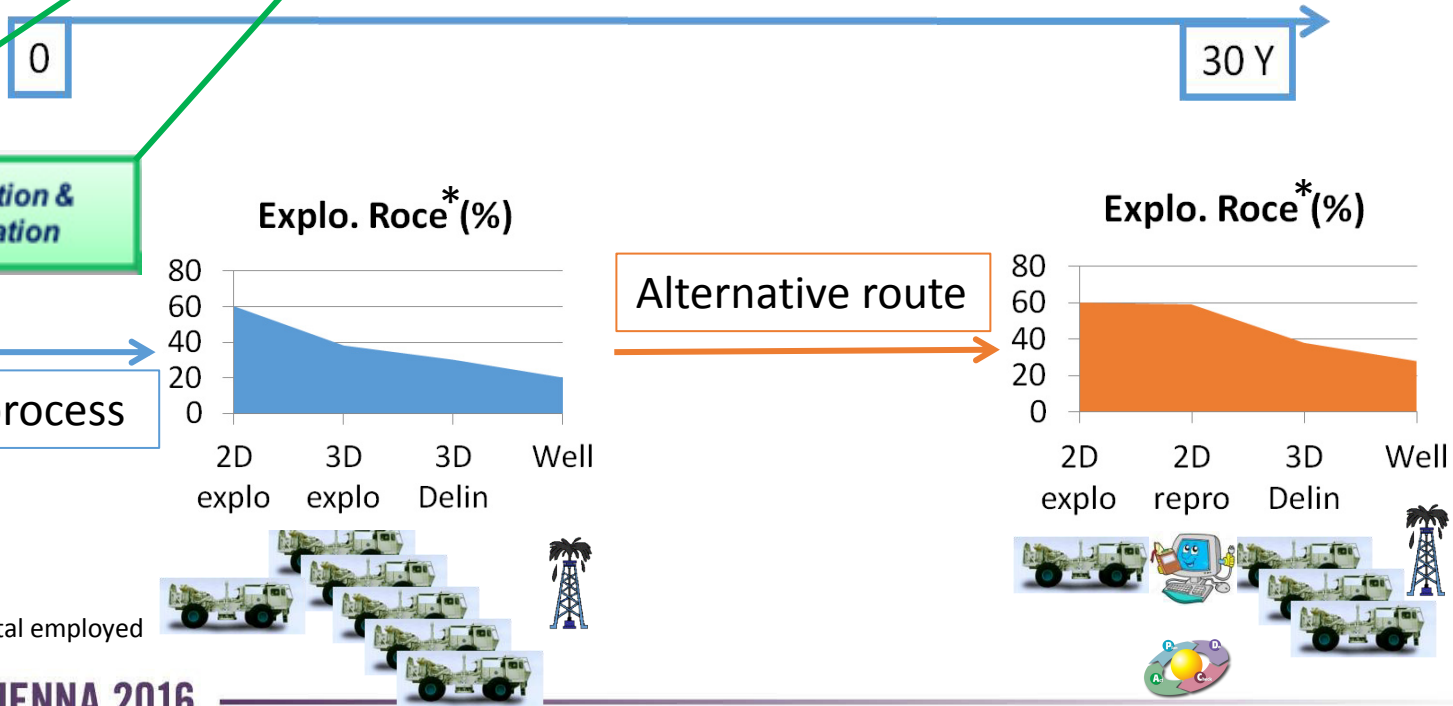
Waldemar Ogonowski – Geofizyka Torun S A
Michal Podolak – Geofizyka Torun S A
David Hall – Total E&P Yemen

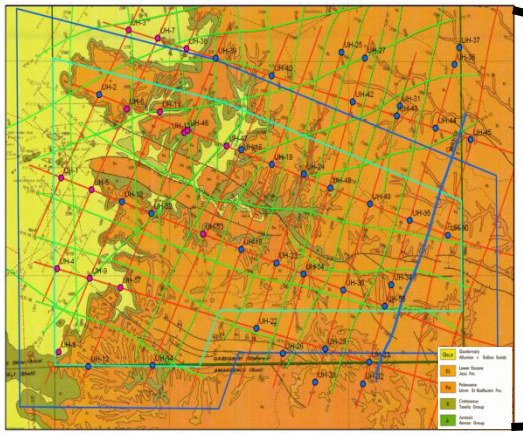
Rationale

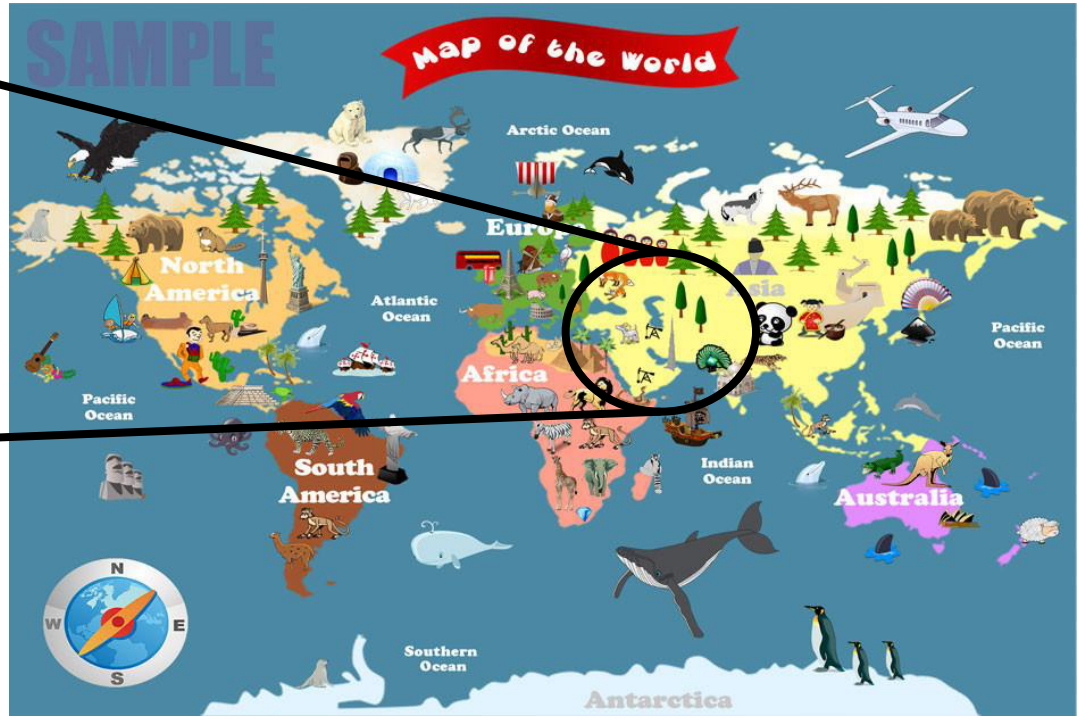




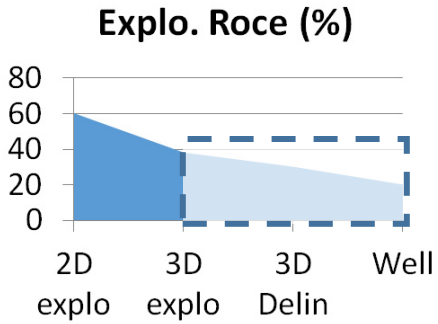
*Return on capital employed

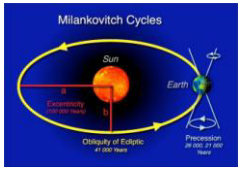
Case study background

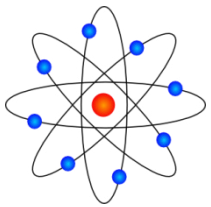




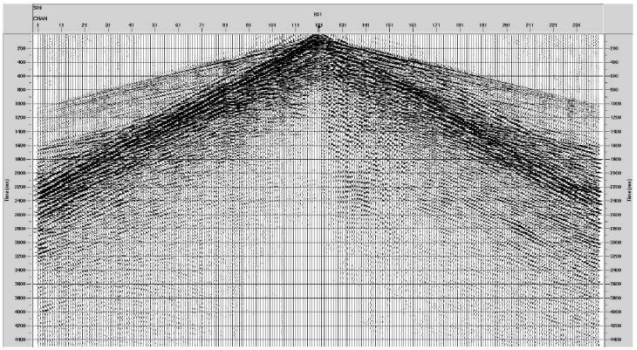
Exploration & Delineation



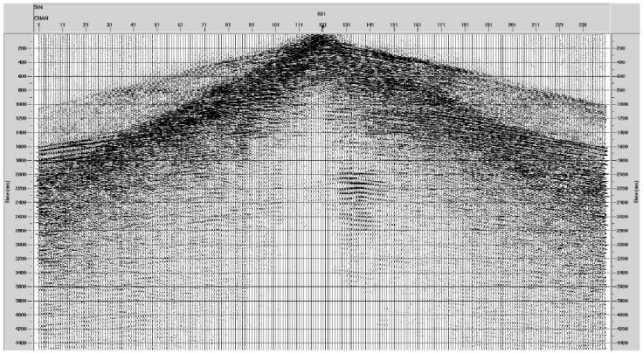




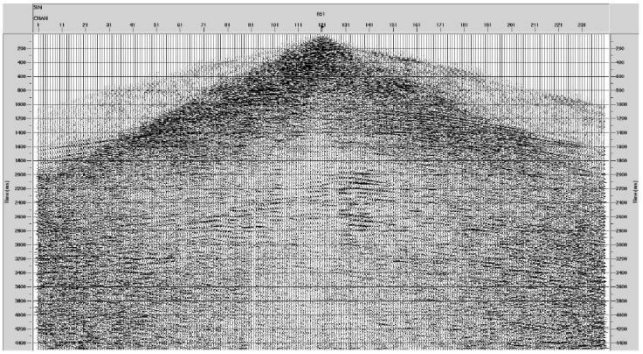
Processing workflow



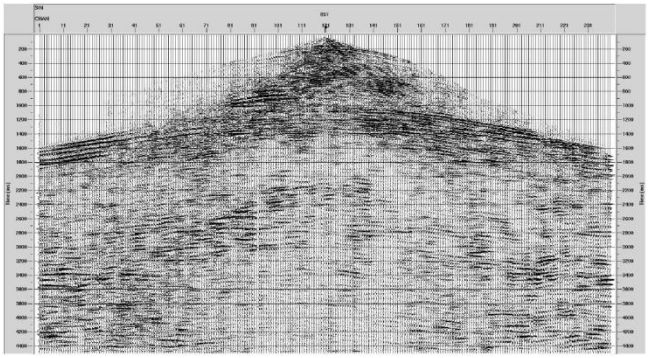
Raw shot gather (SG)



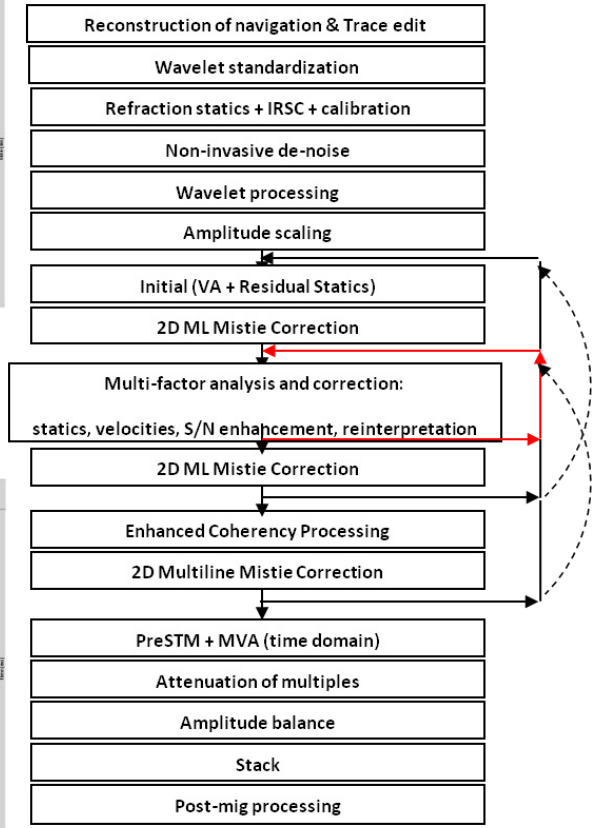
SG after denoising



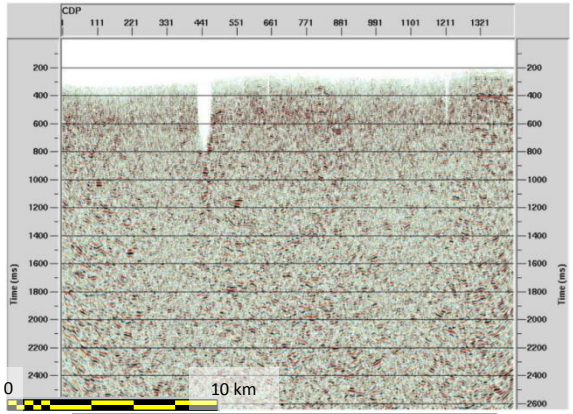
SG after deconvolution



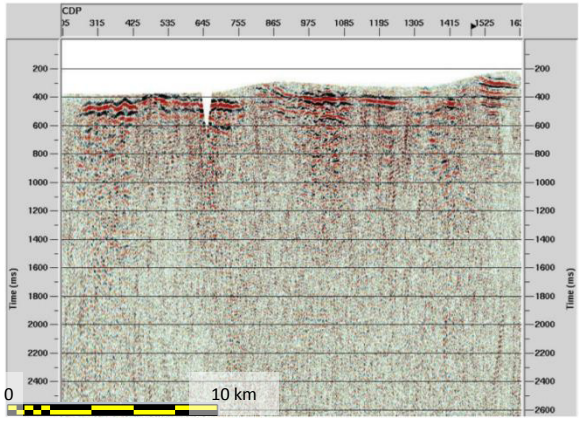
SG after full pre-stack seq.



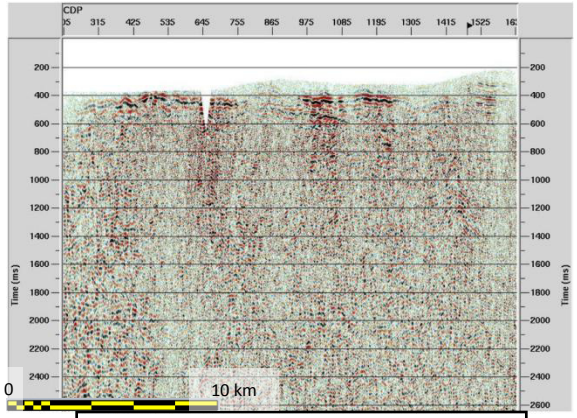
Processing workflow



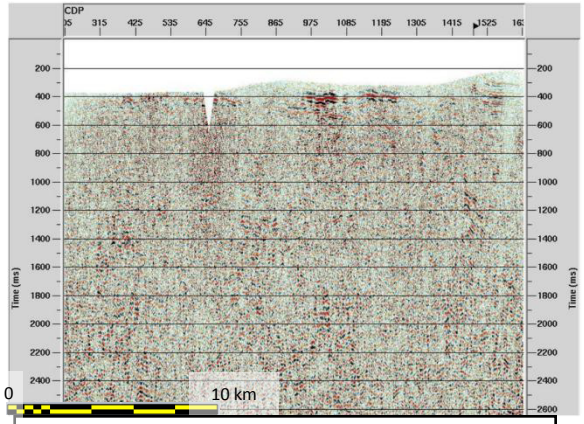
Vintage final stack !



Raw stack



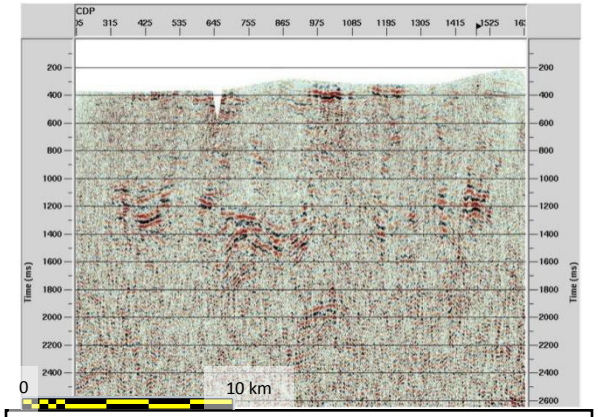
Stack after denoising



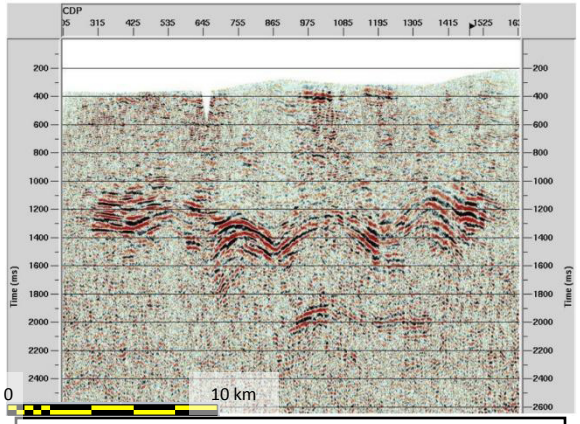
Stack after deconvolution

- Reconstruction of navigation & Trace edit
- Wavelet standardization
- Refraction statics + IRSC + calibration
- Non-invasive de-noise
- Wavelet processing
- Amplitude scaling
- Initial (VA + Residual Statics)
- 2D ML Mistie Correction
- Multi-factor analysis and correction:
  statics, velocities, S/N enhancement, reinterpretation
- 2D ML Mistie Correction
- Enhanced Coherency Processing
- 2D Multiline Mistie Correction
- PreSTM + MVA (time domain)
- Attenuation of multiples
- Amplitude balance
- Stack
- Post-mig processing

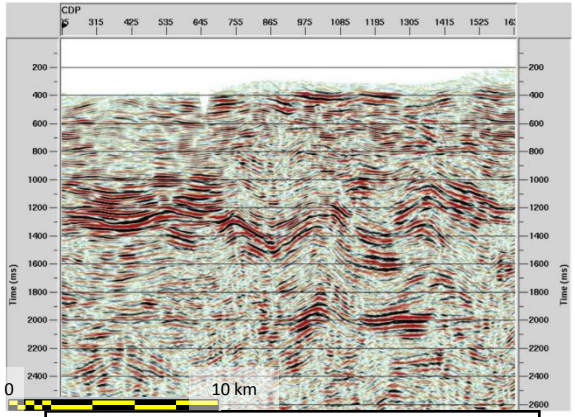
Processing workflow



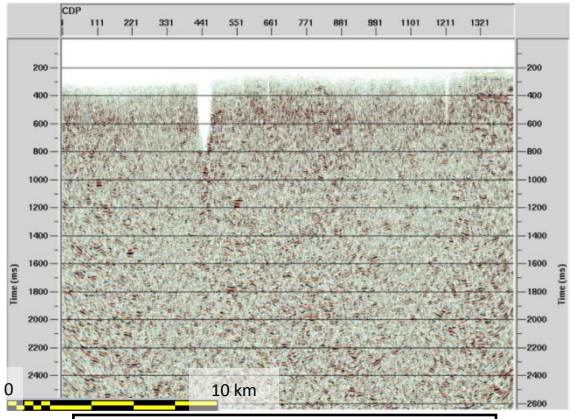
Stack after refraction statics



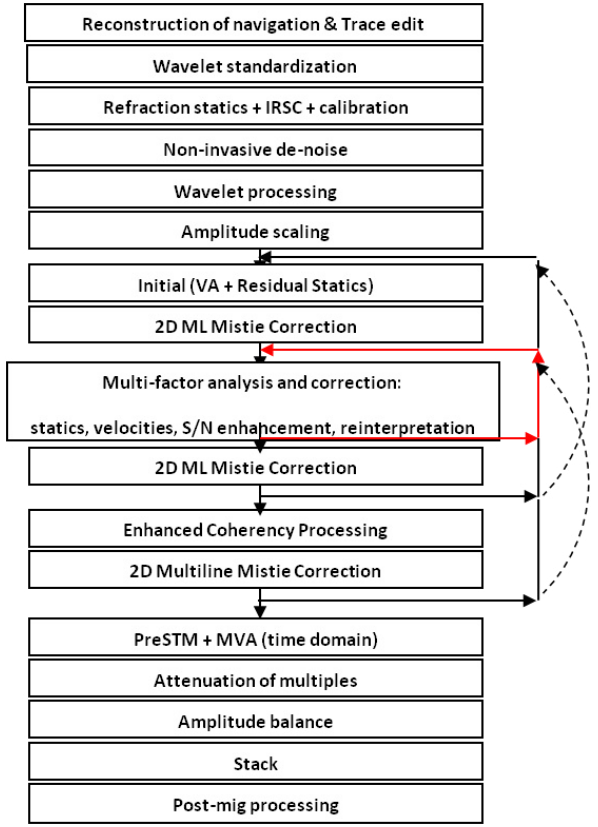
Stack after residual statics



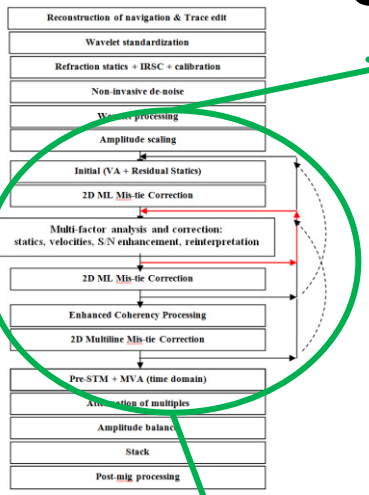
Final reprocessed stack

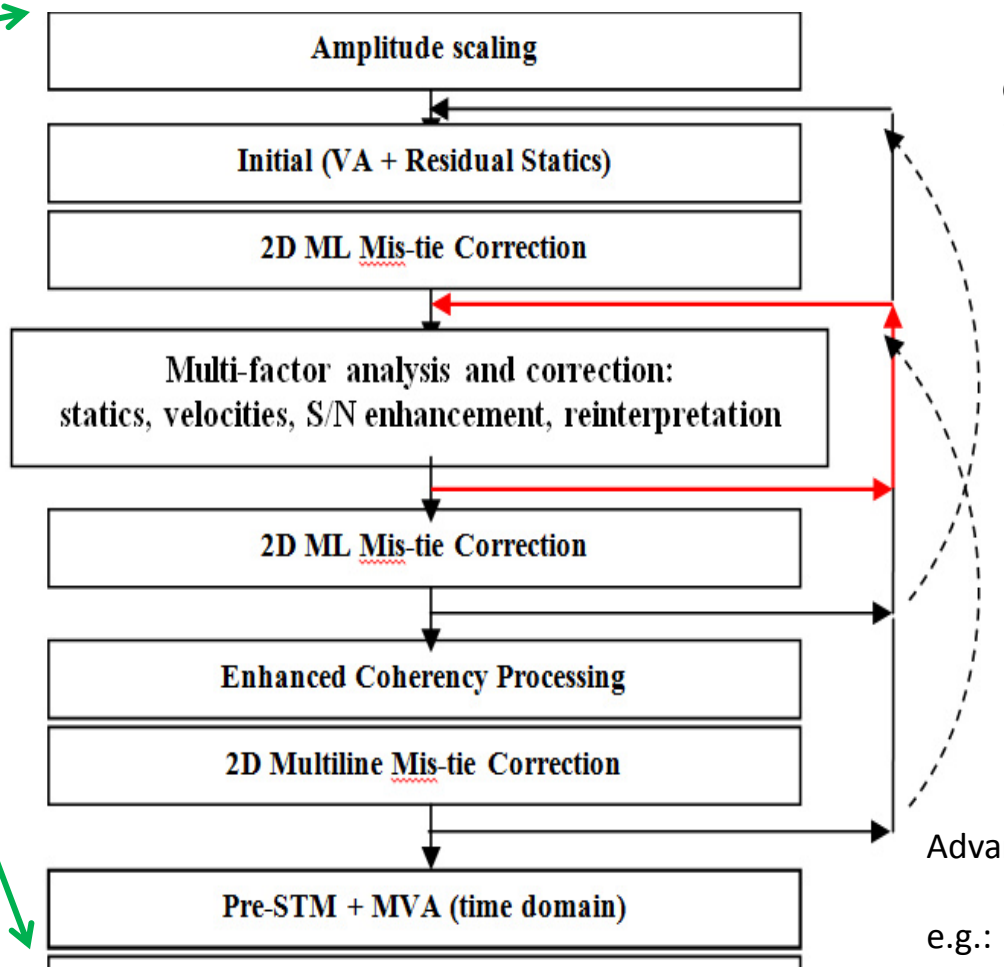


Vintage final stack !



Processing workflow - multifactor separation





Standard is 2-factor analysis: vel – statics. The red loop.

Multifactor is an extension of the loop (dashed arrows)

Generalization of basic iterations: (VA – resid. stat.):

Separation of more factors:

- **(v)** velocities,
- **(s)** residual statics,
- **(p)** phase rotation,
- **(c)** static cycle skips,
- **(n)** noise elimination,
- **(r)** reinterpretation,

Advanced workflow is considered:

e.g.: **v, s, p, v, s, c, r, v, s, r,** …

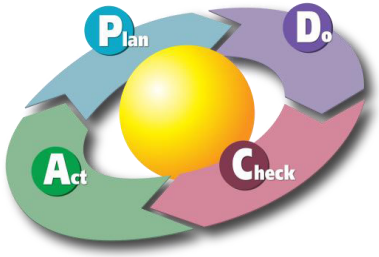
Processing workflow - multifactor separation

Principle:

•Introduce geophysicist skills and experience in a multi-loop flow

•Adopt a cycling approach to bring benefit of high-end technologies (e.g. Enhanced Coherency Processing, looking for coherency within the 1st Fresnel zone to improve S/N) to converge to a cleaner dataset

•Increase geophysicist added-value through processing flow key-step reassessment (velocities-statics,etc)



Generalization of basic iterations: (VA – resid. stat.):

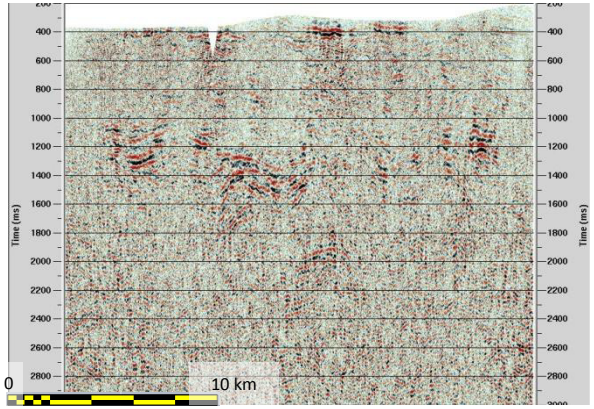
Separation of more factors:

- **(v)** velocities,
- **(s)** residual statics,
- **(p)** phase rotation,
- **(c)** static cycle skips,
- **(n)** noise elimination,
- **(r)** reinterpretation,
- **(t)** misties correction
- **(m)** migration

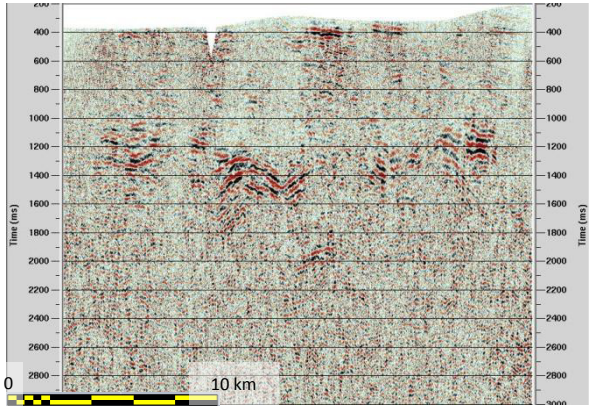
Advanced workflow is considered:

e.g.: **v, s, p, v, s, c, r, t, v, s, r, n, t,**…

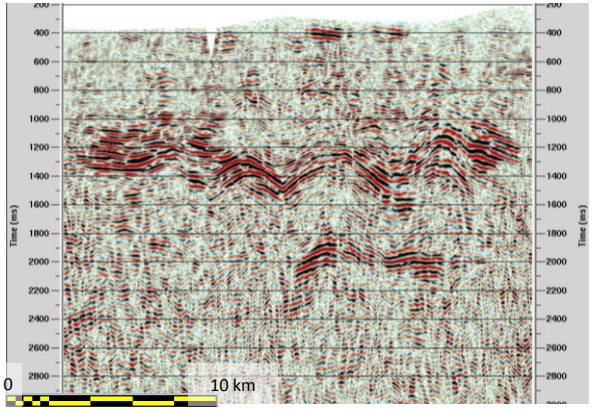
Multifactor separation at work



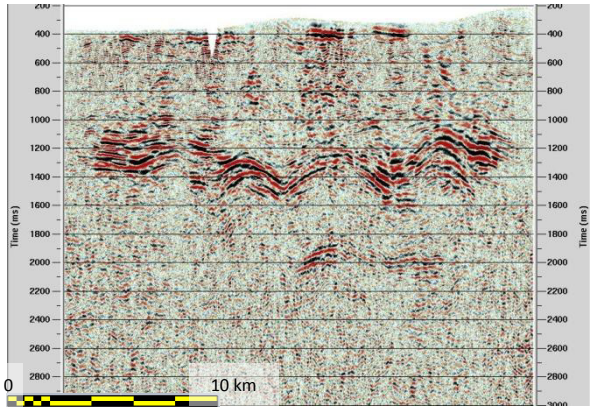
n, **v**, s, v, s, n, t, v, s, n, t, n, t, v, m, v



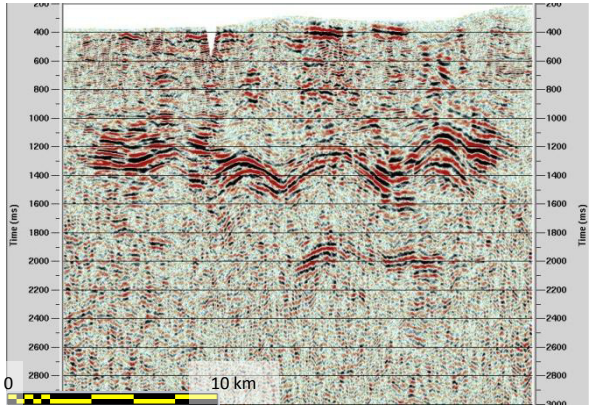
n, v, s, **v**, s, n, t, v, s, n, t, n, t, v, m, v



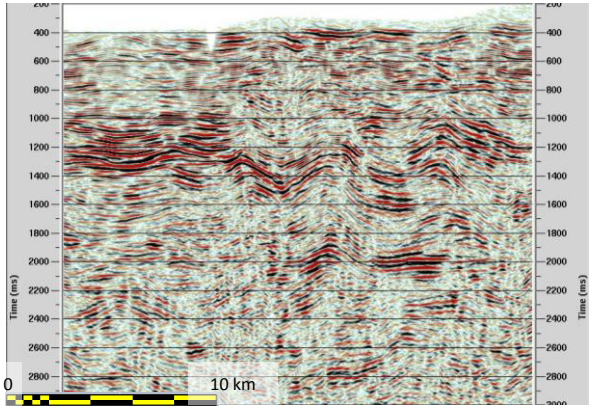
n, v, s, v, s, **n**, t, v, s, n, t, n, t, v, m, v



n, v, s, v, s, n, t, v, **s**, n, t, n, t, v, m, v



n, v, s, v, s, n, t, v, s, n, **t**, n, t, v, m, v

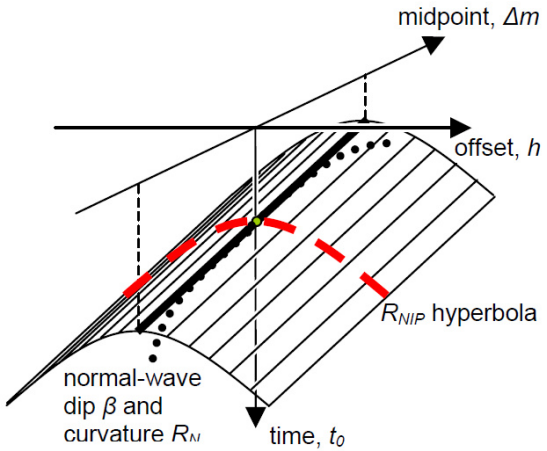


n, v, s, v, s, n, t, v, s, n, t, n, t, v, m, **v**

Note: *not all modules are applied to every line. Notation as defined in the previous slide.*

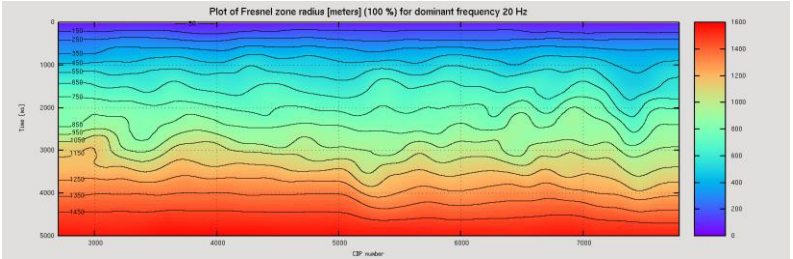
Processing workflow - ECP

Several wavefront attributes are automatically estimated locally, within defined percentage of the 1st Fresnel zone, to characterize wave front and ensure the best local stack: R_{NIP}, local dip, emergence angle, coherency. Then, interactive attributes' analysis follows. Coherency of attributes in space is steered via interpretive, interactive editing.

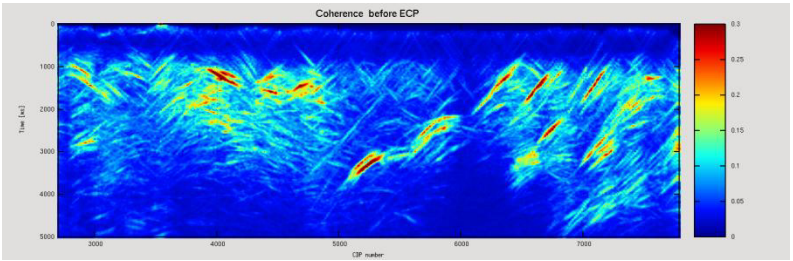


From R.H. Gunther, Practical Approaches to the CRS stack, Vienna 2006, EAGE Conf. & Exhib.

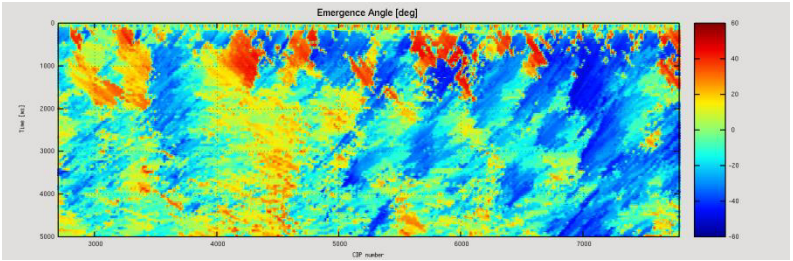
R_F



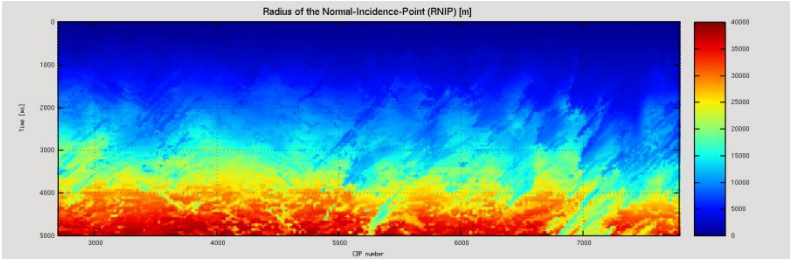
Coh



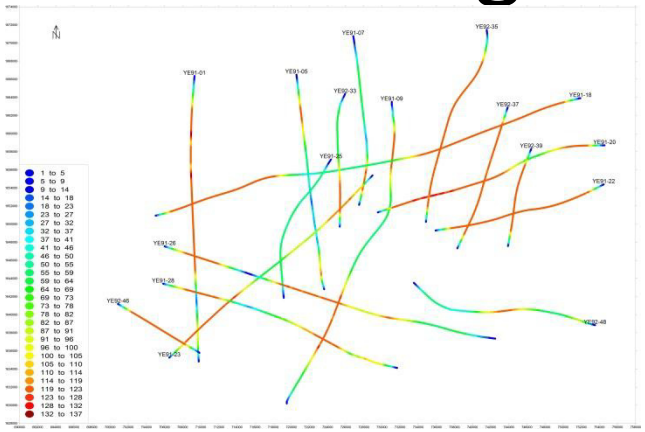
α_{em}



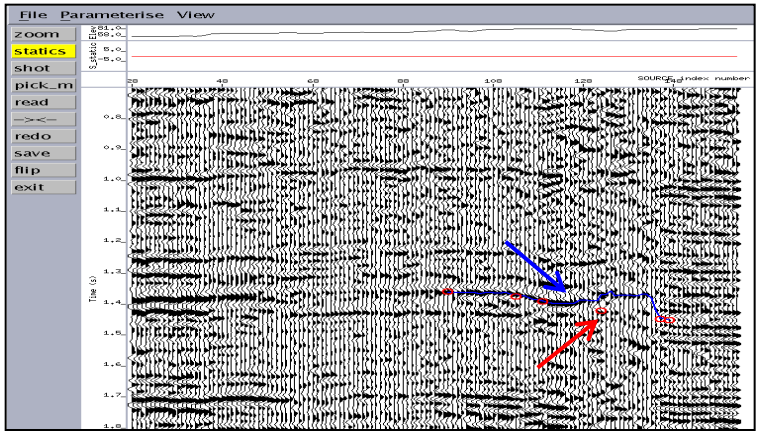
R_{NIP}

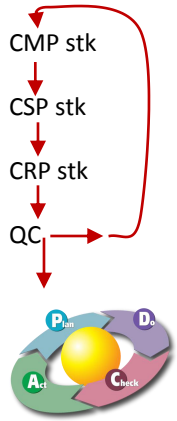


Processing workflow - multiline set

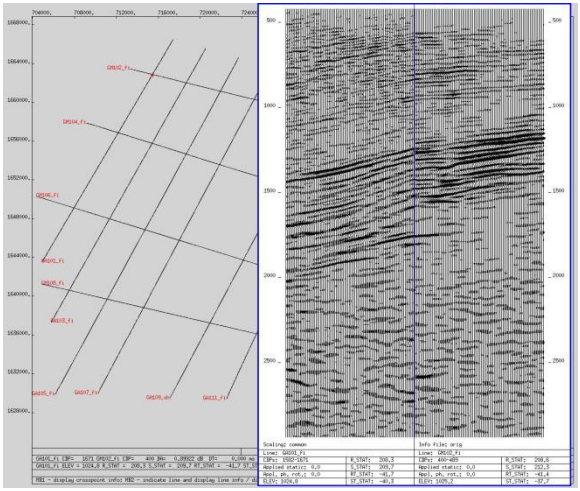


Stripe map of an attribute of 2D multiline project

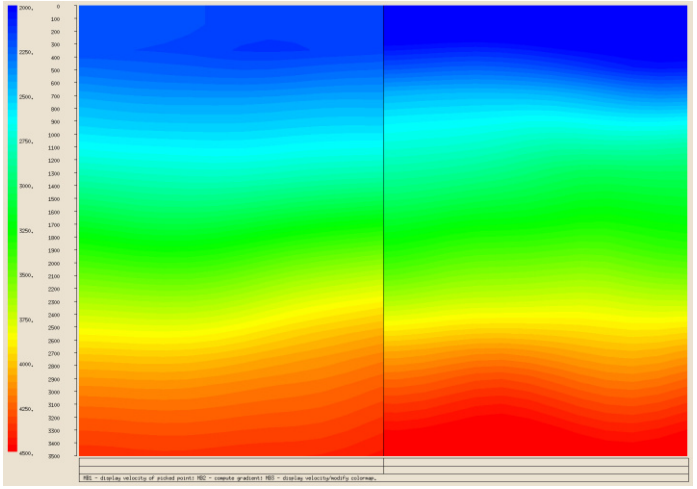




Sample panel of the Interactive Residual Static Correction

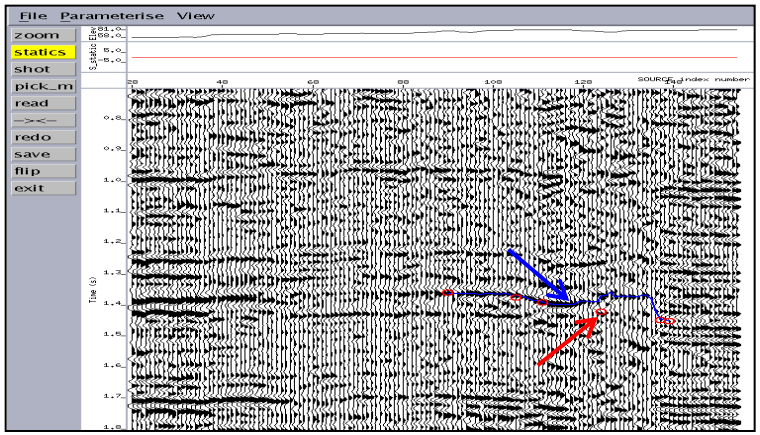


Examination of seismic misties in ML 2D project



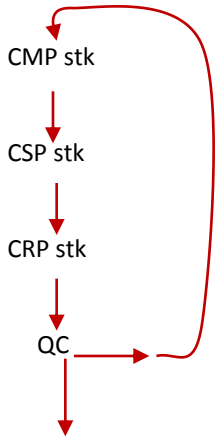
Examin. and correction of velocity misties at intersections

Multiline set – more about IRSC



Two correlations are defined:
Blue line (blue arrow) – present shape
Red line (red arrow) - trial interpretation.

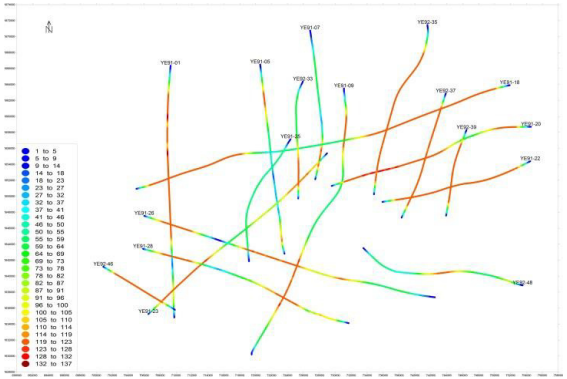
That procedure is repeated for two sections:
- CSP – Common Shot Point stack,
- CRP – Common Receiver Point stack
Both, CSP and CRP are limited-offset, and usually band-limited stacks.



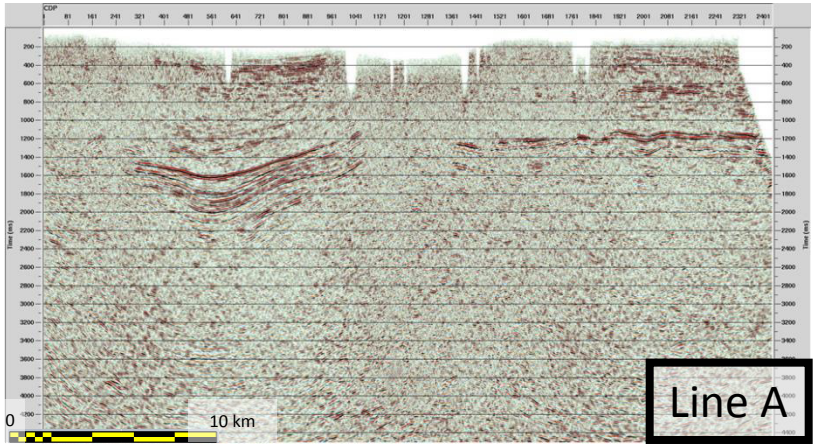
Sample panel of the Interactive Residual Static Correction (IRSC).

Geophysicist experience is essential. Order of shot – receiver statics separation is decided interactively, supported by QC CDP stack.

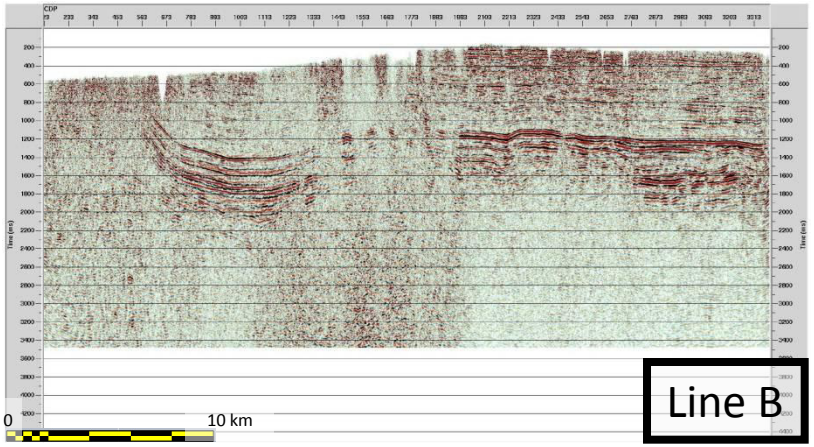
Several loops are possible, with application of fractions of estimated statics.



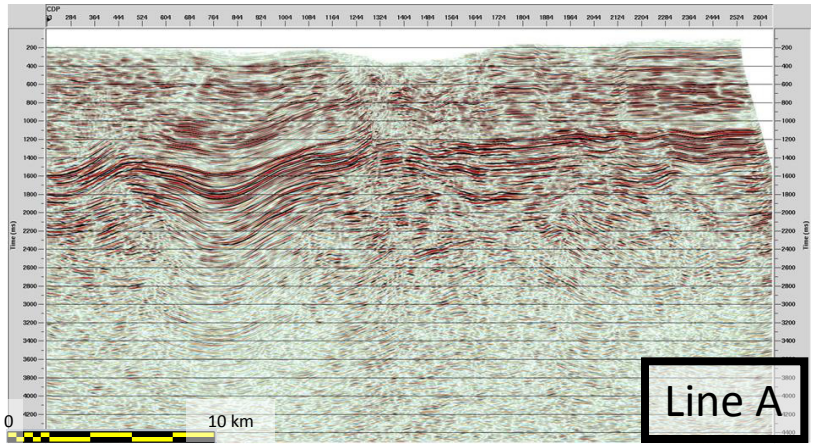
Imagery enhancement



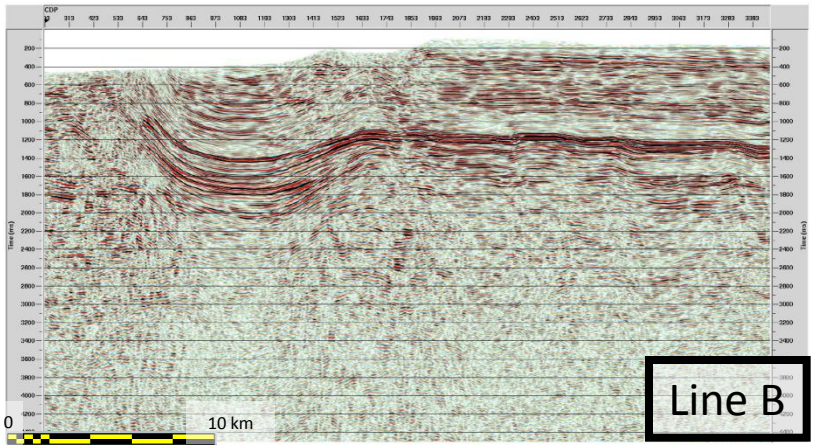
Vintage processing



Vintage processing



Reprocessing



Reprocessing

Messages (conclusion)

- To the contractors : do your best to maintain your knowledge and know-how in this difficult environment : push-button algo may not be the future…
- To decision-maker : do not engage in cost-intensive seismic surveys without extracting the maximum value of existing datasets
- To the audience : how much value is still hidden in the seismic archived databases ?...

Acknowledgements

Special thanks to TOTAL S.A. for permission to publish selected data images. Geofizyka Torun S.A. is acknowledged for permission to publish the brief description of land seismic processing technology.

References

[1] Tlalka, S., 2015, Amplitude preservation in non-invasive methods of land noise elimination, 77th EAGE Conference and Exhibition 2015.

[2] Tlalka, S., Podolak, M., 2016, Enhanced Coherency Processing: ECP. Technical Brochure available from www.gtservices.pl

[3] Civello, S., Janisek, J.M., Strobbia.C., 2D seismic line reprocessing test using common reflection surface technique, 12th Offshore Mediterranean Conference and Exhibition 2015

[4] Berkhout, A.J., 2010, Seismic stacking in a wider perspective, EAGE Conference workshop.