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

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**Objectives**

- Improve the 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)

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

Location map of the study area (by Del Ben et al., 2011, modified)
better characterization of seismic facies;
more reliable imaging of subsurface features;
greater capacity of detection and interpretation of fluid related amplitude anomalies;
improved resolution.

Time reprocessing

Deghosting

Data Interpolation

Multiple Attenuation +

SRME

WEMA

Wavelet Processing

PSTM

Iterative velocity field refinement (Residual velocity analysis)

Before Deghost

After Deghost

Cable depth Notch

0 30 60 Hz

0 30 60 Hz
Multiple attenuation
Before SRME

After SRME (interpolated data)

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

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

by Brancatelli et al., submitted
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

1st approach

- Initial V-Z Model
- PSDM
- Horizon RMO Analysis
- PSDM
- Layer by layer coherency Inversion
- Layer-Based Tomography
- Update V-Z Model

2nd approach

- Initial V Model
- PSDM
- Structural attributes Non-parametric autopick RMO
- PSDM
- \( V_{RMS} \) conversion
- Grid Tomography
- Update V Model
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 2\textsuperscript{nd} approach

Continuity section

Non parametric move-out auto-picker
Velocity model and depth imaging

2\textsuperscript{nd} approach

- The starting model is not close to the final model
- No need for horizon interpretation
- Autopick RMO analysis

Tomography may fail to converge

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 de-signature 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


Acknowledgements

Emerson Paradigm for Echos and Geodepth software academic license.