ANALYSIS OF SEISMIC REFLECTION DATA WITH LOW SIGNAL-TO-NOISE RATIO

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Abstract
We analyzed seismic reflection data recorded along four profiles in the Oradea area, Romania, with the purpose to obtain information about the geological structure in the subsurface. Most of the seismic records were characterized by low signal-to-noise ratio (S/N). Their processing was done using the same steps but with different parameters (frequencies, stacking velocities) depending on the analyzed data. The thickening/thinning of the sedimentary deposits is clear on all seismic sections. The uplifted basement blocks are indicated by the lack of clear and continuous reflections on seismic sections.

Introduction
Seismic reflections surveys using the active method are performed to obtain information about the geological structure in the investigated areas. High-resolution seismic sections can be obtained after the processing of seismic records characterized by high S/N (Yilmaz, 2001). In case of seismic records with low S/N, interpretable seismic sections can be obtained after a special data processing combined or not with seismic modeling (Panea and Bugheanu, 2016; Panea et al., 2016). In our study, we defined a processing flow that was suitable for the processing of all four datasets. We modified the processing parameters from one dataset to another in order to obtain records with the highest S/N possible.

Description of the study area and seismic reflection data
All four datasets were recorded in the Oradea area, Romania, in a survey performed for hydrocarbon exploration. The variations in elevation are important along the profiles and between them (Figure 1). The seismic data acquisition was done using 96 vertical-component geophones spaced at 25 m. The seismic energy was generated using explosive sources (dynamite) in points spaced at 50 m. The time sampling interval was 2 ms. The maximum length of recordings was 5 s. Examples of seismic records characterized by high and low S/N are displayed in Figures 2 and 3; automatic gain control was applied for better display. The lack of reflected waves on the record from Figure 2 can be explained by the presence of thin sedimentary cover, its absence, and/or errors performed during data acquisition (e.g. the seismic energy was generated at a smaller depth than the designed one, strong energy attenuation in the near surface due to the rough topography, significant lateral velocity and thickness variations in the low-velocity zone).

Description of the data processing
The processing flow contains the following steps: loading the records (SEG-Y format), computation of geometry for linear profiles, trace editing (kill trace), computation and application of static corrections (final datum = 0 m, replacement velocity = 1600-1800 m/s), frequency filtering (band-pass, fk, spiking deconvolution), amplitude corrections, interactive velocity analysis, Normal Move-Out corrections, stacking of traces, post-stack time migration (Kirchhoff) and time-to-depth conversion.
Figure 1: Topographic map showing the position of the seismic lines (source map: http://maps.google.com)

Figure 2: Example of seismic record with low S/N, 96 geophones spaced at 25 m; elevation profile on top. Automatic gain applied, window of 0.5 s.
Results and discussions

All seismic sections were processed at the same final datum (0 meters) to allow a fair comparison. The depth seismic section obtained for line P1 is displayed in Figure 4. The length of P1 is about 20 km. The thickening of sedimentary cover from SW to NE is clear on the displayed section, reaching a value of about 800 m, in the NE part of seismic section. The depth seismic section obtained for line P2 is displayed in Figure 5; its length is 25.8 km.
Sedimentary deposits with variable thicknesses can be identified on the western half of seismic section; the maximum thickness is about 600 m. We display in Figure 6, the depth seismic section obtained for line P3, which had a length of 20.7 km. The maximum thickness of the sedimentary deposits, about 1300 m, is observed toward the center of P3. Figure 7 shows the depth seismic section obtained for line P4; its length is 17.3 km. Thick sedimentary deposits are visible on the western half of P4; the maximum thickness of 1200 m is observed toward the end of line P4.

![Figure 6: Depth seismic section obtained along line P3 (length of 20.7 km)](image)

Figure 7: Seismic section obtained along line P4 (length of 17.3 km); white line – base of sedimentary cover.

**Conclusions**

We processed four seismic reflection datasets to obtain information about the geological structure of the subsurface in the investigated area. Low to high S/N data were recorded along the same line and on different lines. The processing results are represented by depth seismic sections. The thickening and thinning of sedimentary deposits is clear on all seismic sections. The uplifted basement blocks are indicated by the lack of clear and continuous reflections on seismic sections.

**References**

