



Geological validation and reinterpretation in the Outer Flysch of the Romanian Eastern Carpathians using balanced cross-sections

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Considering the concept which states that the restored cross-section should maintain its area/volume constant after the restoration, the use of balanced cross-sections represents a helpful method for the validation of geological interpretation. Based on the geometry evolution, this approach forces the geologist to better understand the relations between geological structures, therefore avoiding miscellaneous interpretation.

In order to solve problems specific to different tectonic settings, several techniques were developed which make use of geometrical models for the evolution of structures. Thus, they are used to solve multiple issues like: the computation of the depth of detachment, validation of the geological interpretation, forward modeling, sequential restoration, and frequently to calculate the width of sedimentary basin where geological strata were deposited.

The Carpathians formed during the Triassic to Tertiary compressional events of continental blocks in the Alpine Orogeny. These highly arcuated mountains have developed throughout several tectogenetic events and consist of a thin skinned stack of thrust nappes and trust sheets associated with related features of thrust systems. They are the result of several openings and closures of oceans followed up by the blocks subduction and collision.

Our study focuses on the Marginal Folds Nappe of the Outer Flysch, a structural body created during the Miocene compressional events whose stratigraphic succession includes late Early – Late Cretaceous up to Early Miocene deposits sedimented in the Ceahlău-Severin Ocean. Thus, using an interactive environment and the 3D geo-modeling capabilities of MOVETM software, we considered the northern cross-section of 1:50.000 Tazlău geological map, which crosses the Bistrița half-window and aimed to use this approach to calculate the length of the sedimentary basin occupied by the studied deposits. Although balanced cross-sections have been used before for Eastern Romanian Carpathians restoration, our intention was to use these methods at a higher scale, more precisely for the 1:50.000 geological map which offers an interpretation with a better resolution and provides information not only on the major tectonic accidents but on the fold structures as well.

However, the methodology of balanced cross-sections appears not to work properly for our study case. At first look, this issue seems to be due to misinterpretation of the subsurface structure, assumption which was later confirmed by field investigations. Analyzing the cross-section we have identified sectors that cannot be restored, frequently in places where normal faults have been interpreted in the geological map's cross-section. Another issue which was remarked is constituted by the high variations of bed thicknesses both in the horizontal, as well as in the vertical direction.

Even though our first aim was to use balanced cross-sections methodology to calculate the basin extension/width of the analyzed geological deposits, the results have revealed other problems which are questioning the geological interpretation. Regarding the final result, we can assert that the balanced cross-sections techniques are suitable to solve the misinterpretation of geological setting and represent a good asset for the validation of geological interpretation at least for the upper part of the subsurface where the identified problems have been checked and confirmed by field investigations.