[PS]The Pre-Neogene Unconformity as Evidence for Major Sediment Delivery Systems into the Eastern Carpathians*

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Abstract

The Moesian Platform spans the margins of Southern Romania and Northern Bulgaria. Several Paleozoic terranes of Avalonian and Baltican origin, which were accreted during the Late Ordovician, comprise the Moesian Platform. Crustal faults separate the Moesian Platform from the surrounding tectonic provinces including the Moldavian Platform, Scythian Platform, and North Dobrogea Orogen. Moreover, it has been affected by Paleozoic, Triassic, and Jurassic extensional deformations followed by compressional episodes associated with the Alpine orogenesis that formed the Balkan and Carpathian Mountains. The Pre-Neogene Unconformity, PNU as it is known in Romanian literature, it is a geological interface separating a largely clastic Neogene aged section from underlying Mesozoic and Paleozoic aged carbonate and clastic strata. The PNU gives rise to high impedance seismic reflection that can be confidently interpreted across the platform using 2D seismic. Modern 3D seismic has enabled detailed interpretation of the PNU surface geometry and paleogeography within East Moesia. The study area is located within the Eastern Moesian Platform, approximately 150 km northeast of Bucharest. The 2014 vintage Padina 3D seismic survey, multiple reprocessed 1990's vintage 2D seismic lines, and well data were used for detailed interpretations of paleo-geography and depositional systems during Paleogene and early Neogene periods. The Paleogene aged Movila Miresii incised valley acted as a sediment delivery system for the Focsani Basin and Eastern Carpathians. It developed along the NW-SE trending suture zone that separates the Eastern Moesian Platform from the North Dobrogea Orogen to the north. The orientation of the incised valley suggests a southern sediment provenance that is likely associated with highlands as a result of the Balkan Orogen. Paleogene sedimentary fill seems to be absent in the deep incised valleys of the Moesian Platform, but thick Paleogene sequences are preserved in the South within the foreland of the Balkans and further North in the East Carpathians Thrust-Sheets. Eocene-Oligocene aged sandstones are the dominant petroleum reservoirs within the Eastern Carpathians and have produced approximately 800 MMBOE. Understanding the depositional framework for this petroleum system is of commercial importance. As no shallow marine or slope deposits are found in outcrop, a missing element for the paleo-geographic reconstruction has been the sediment delivery system.

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Introduction

The Moesian Platform lies within Southern Romania and Northern Bulgaria. It is comprised of Paleozoic terranes which have been subjected to pre-K extensional events followed by marginal compression during the Alpine orogeny (Sandulescu, 1984) (Fig. 1). The Pre-Neogene Unconformity (PNU) is the geological boundary separating the Neogene section from underlying Mesozoic and Paleozoic strata (Fig. 2).
The aim of the study is to describe the relationship between the paleogeography associated with the PNU and the Neogene sediments deposited above.

Methodology

Seismic interpretation was carried out on a 425 km^2 3D seismic survey and multiple 2D seismic lines to define the structural and stratigraphic framework. Well data across the Urziceni area (Romanian Eastern Moesian Platform) was incorporated to provide stratigraphic calibration of seismic units. In addition, biostratigraphic analysis of well cuttings and cores was used to define the top of the lower Middle Miocene sequence.

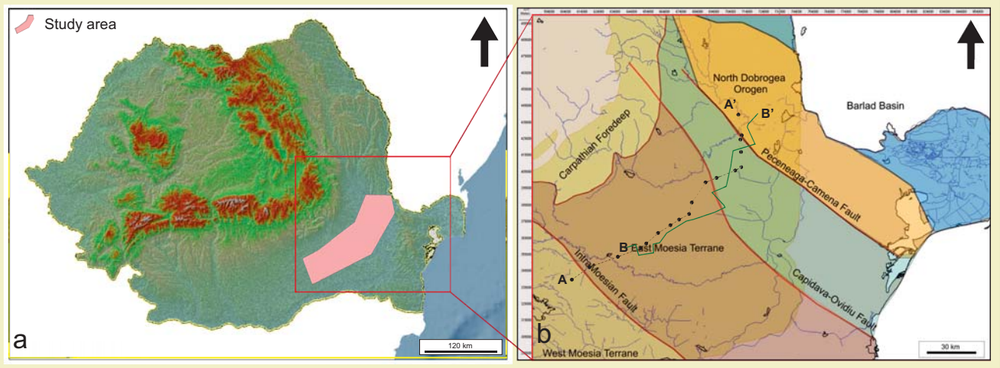

Figure 1 - a) Geographical map showing the location of the study area; b) Tectonic map of the East Moesian Platform and North Dobrogea (redrawn after Sandulescu, 1984) showing a well correlation section (A-A') and an arbitrary seismic line (B-B').

Results

Biostratigraphic analysis of well cuttings indicate two facies including carbonate, fossiliferous limestone (usually found on topographic highs and characterized on Spontaneous Potential logs by a 'box shape' negative deflection) and detritic facies (usually in topographic lows or canyons and characterized by a positive Spontaneous Potential log deflection) (Fig. 2). A depositional environment was established based on interpretation of the wireline log responses.

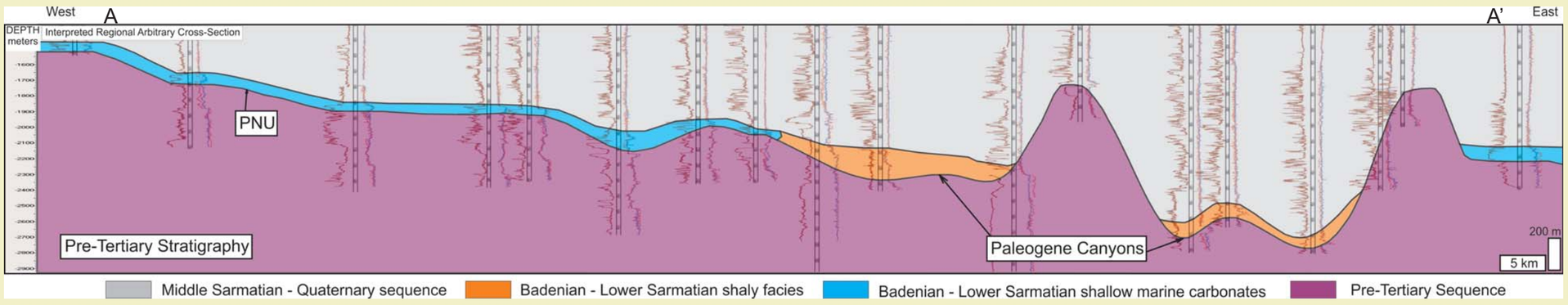

Figure 2 - W-E well correlation section showing the two lower Middle Miocene facies interpreted using well data. Logs used in the interpretation includes Spontaneous Potential, and Shallow and Deep Resistivity.

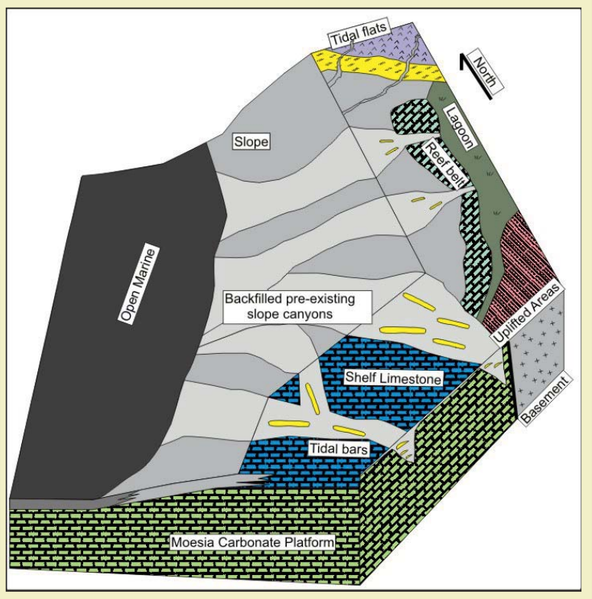

Figure 3 - Proposed depositional model for the lower Middle Miocene strata.

The PNU seismic event is characterized by a high amplitude, positive seismic reflection which can be confidently interpreted across the Moesian Platform using the available seismic. The 3D seismic has enabled detailed interpretation of the PNU surface geometry and paleogeography in the region (Fig. 4-5).

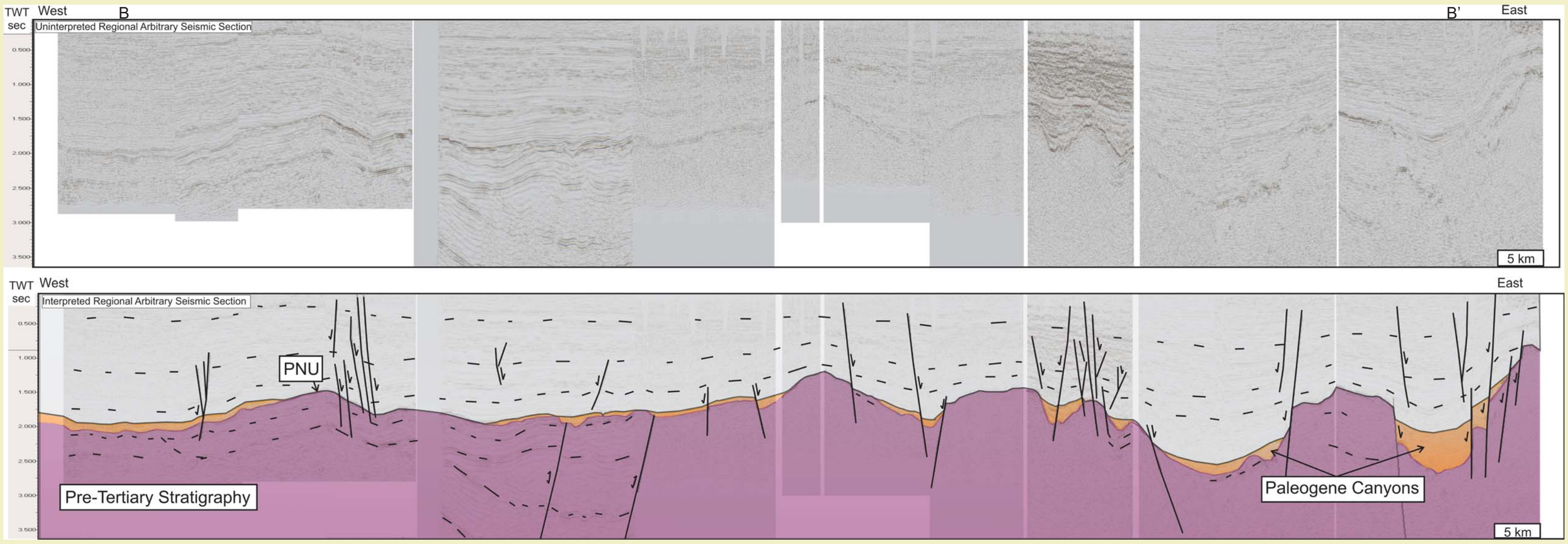

Figure 4 - Regional arbitrary seismic line illustrating the topography associated with the Pre-Neogene Unconformity and the lower Middle Miocene infill deposits.

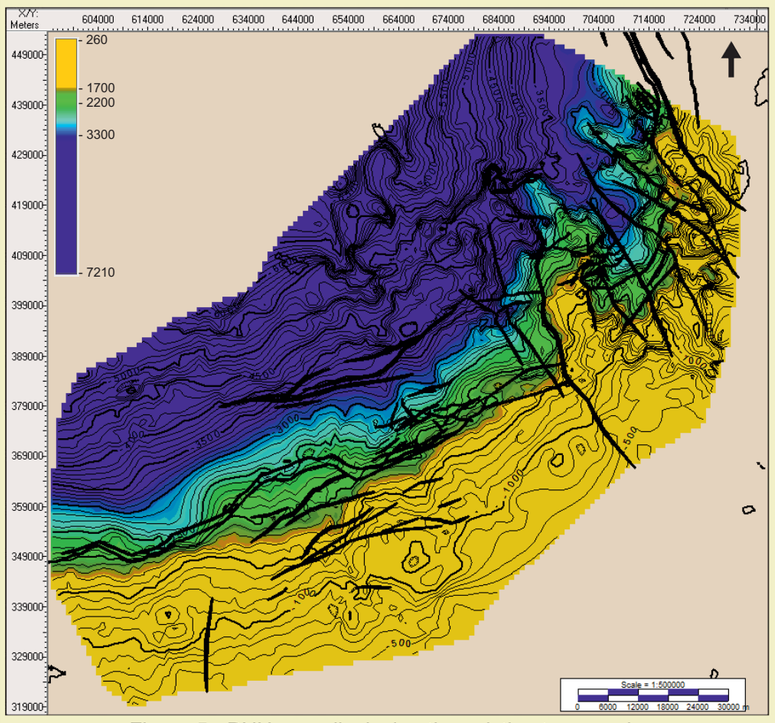

Figure 5 - PNU map displaying the existing topography during lower Middle Miocene.

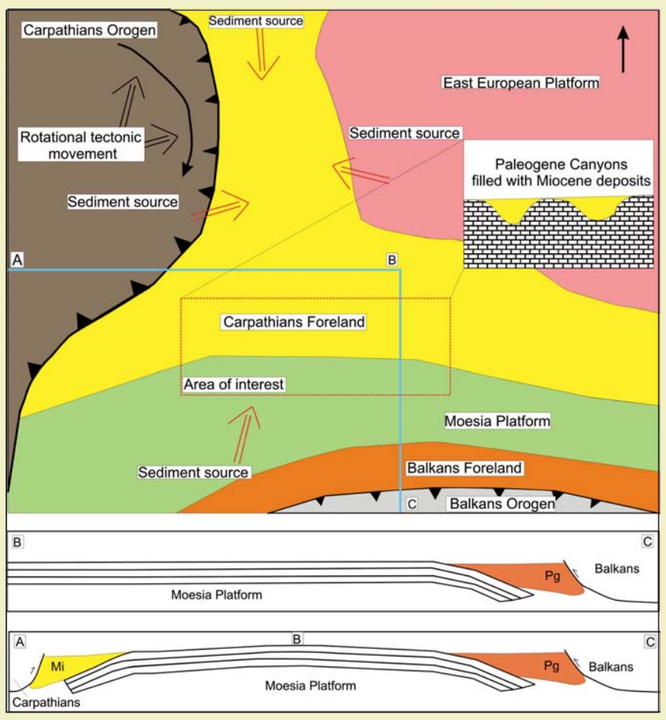

Figure 6 - Sketch map displaying the interaction between the major tectonic units and the foreland associated with the Carpathians (after Tarapoanca, 2004).

Discussion

- Well correlations across the study area suggest a patchy distribution of sediments deposited during lower Middle Miocene. Lateral facies changes are interpreted to be associated with the paleotopography.

- The PNU topography has been interpreted on seismic data and indicates the presence of erosional ''canyons''. They may be associated with the Alpine orogeny and transport sediments towards the foreland of the Balkans.

- The ''canyons'' are believed to have been formed during the Paleogene and filled with Middle Miocene sediments. We suggest that they represent a Paleogene sediment by-pass area.

- The sediment transport direction is uncertain but believed to be Southward. Quartz rich sandstones having a cratonic provenance are deposited in the foreland of the Balkans (Suttill, 2009). These might originate from the Northern Moesian Platform.

- The Paleogene - Miocene Carpathian fold and thrust belt paleo-topography is interpreted to represent barriers that resulted in a restricted Miocene, shallow marine basin, thus favouring the development of a saline basin (Babel, 2004).

Future work

Improved understanding of basin evolution during the lower Middle Miocene through detailed chronostratigraphic interpretation (including age dating) and 3D seismic acquisition for better definition of canyons' dimensions and depositional gradients.

Acknowledgements

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