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[EA]Petroleum Systems and Reservoir Distribution Laws in the Pannonian Basin - Romanian Sector*

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Abstract

The petroleum systems in the Pannonian Basin contain liquid and gaseous hydrocarbons trapped in the fractured, weathered crystalline basement and in clastic or carbonate sediments (of Mesozoic, Neogene or Pliocene age) with reservoir properties. The tectonic evolution of the Pannonian Basin includes three main stages: a pre-rift phase, a synrift phase and a post-rift phase, who played a crucial role in assuring the necessary conditions for the generation and trapping of the hydrocarbons. Several total petroleum systems have been defined in the Pannonian Basin system. These TPSs are composite and have various source rocks ranging in age from Mesozoic to Neogene. The petroleum systems show evidence of vertical migration and mixing, with different hydrocarbons in associated reservoirs and with mixed oils within individual reservoirs. Sometimes, the petroleum systems are not isolated to individual subbasins. For these and other reasons we tried to find a way to understand how the distribution of oil was produced, which were the directions of migration in this area. We can define areas of interest and establish future exploration and the most adequate seismic investigation methodology (seismic signal parameters, recording template for the best vertical and horizontal resolution) of one specific objective (consistent with the expected reservoir depth). Five steps are necessary to achieve this goal: clarifying the stratigraphic and structural features at a regional scale; defining Petroleum systems; analysis of existing fields; interpretation of active hydrocarbon reservoirs distribution laws in area; establish the best investigation methodology for the next exploration. An important benefit is reducing geological and economical risk by accurately establishing the objective depth and by choosing an exploration program perfectly adapted to the structural-stratigraphic conditions. Based on the data from existing of productive fields (age and depth of the reservoir trap type), we applied this approach to the Romanian part of Pannonian Basin. We established for every subbasin the most suitable areas to be considered, their depth and lithology. We can choose the prospecting method with the highest resolution focused on the reservoir depth. This is very important for future exploration because we can also know the area without perspective. This kind of analysis may also be affixed in other petroleum provinces, in their development exploration stage.

Introduction

The petroleum systems in the Pannonian Basin contain liquid and gaseous hydrocarbons trapped in the fractured, weathered crystalline basement and in clastic or carbonate sediments (of Mesozoic, Neogene or Pliocene age) with reservoir properties. The tectonic evolution of the Pannonian Basin includes three main stages: a pre-rift phase, a synrift phase and a post-rift phase, who played a crucial role in assuring the necessary conditions for the generation and trapping of the hydrocarbons.

The Neogene Basin is composed of a complex system of extensional subbasins separated from one another by uplifted basement blocks but are tied together by a widespread blanket of younger Neogene and Quaternary sediment fill. One of the principal subbasins, the Great Hungarian Plain, including the (Derecske- Ciocaia/Abramut /Moftinu, Békés-Zimand/Socodor Basins and Makó -Tomnatec trough,) extends in western Romania too. These basins rest on thrust sheets, highly deformed older rock of the Inner Carpathian foldbelt and are separated by basement horst blocks and uplifts (Teremia, Battonya -Turnu, Salonta, Mihai Bravu, Madaras uplifts.

These subbasins typically contain early to middle Miocene age synrift sediments and intercalated volcanics and are, in turn, blanketed by a postrift late Neogene fill that covers the entire system and defines the present Pannonian Basin. Pervasive syndepositional rifting, growth faulting, and strike-slip deformation characterized the synrift stage, whereas the post-rift stage was marked by a structural setting in which thermal subsidence and rapid sedimentation took place. The latter stage was accompanied by differential subsidence without major deformation, continuing from the late Miocene to the Holocene

Methodology and Theory

Several total petroleum systems have been defined in the Pannonian Basin system (Figure 1). These TPSs are composite and have various source rocks ranging in age from Mesozoic to Neogene. The petroleum systems show evidence of vertical migration and mixing, with different hydrocarbons in associated reservoirs and with mixed oils within individual reservoirs. Sometimes, the petroleum systems are not isolated to individual subbasins.

The Romanian area of the Pannonian Depression includes over 70 oil and gas fields. These fields were discovered in 200 – 4000 m interval and are connected to the petroleum systems of the different sedimentary subbasins. The fields contain hydrocarbon accumulations in the Basement, Middle Miocene (Badenian, Sarmatian), Pontian and Pliocene reservoirs.

It is difficult to determine, at a regional scale, the relative contributions of specific source beds to individual reservoirs and trap sequences because the geochemical data necessary for correlation of petroleum and source rocks are available only locally. For these reasons we tried to find a way to understand how the distribution of oil was produced, which were the directions of migration in this area.

We can define areas of interest and establish future exploration and the most adequate seismic investigation methodology (seismic signal parameters, recording template for the best vertical and horizontal resolution) of one specific objective (consistent with the expected reservoir depth).

Five steps are necessary to achieve this goal:

- clarifying the stratigraphic and structural features at a regional scale;
- defining Petroleum systems (main elements, geographic extension);
- analysis of existing fields (active reservoirs age and depth at regional scale);
- interpretation of active hydrocarbon reservoirs distribution laws in area;
- establishing of the best investigation methodology for the next exploration.

The Northern part of Pannonian basin has a distinct geological feature. A strike-slip system fault on NE-SW direction was developed, forming a large pull-apart sub-basin that functioned during Miocene-Lower Pliocene time (Figure 2). In the Southern part, this sub-basin stops on the Pădurea Craiului Mountains prolongation. The Middle part of Pannonian basin has a distinct geological feature. The most uplifted part is situated in the Tinca - Derna area and the most deepened in Zimand - Socodor subbasin (Figure 3).

The Southern part of Pannonian basin has the most favourable condition for accumulation in alterated basement. The structural isochronous map built at Top Basement shows six main uplift areas: at the west the first uplifted area that includes Pordeanu, Chereştur and Teremia oil and gas fields, at North-East an uplifted area that includes Şeitin, Sânpetru German, Bodrog and Sântana oil and gas fields.

Conclusion

An important benefit is reducing geological and economical risk by accurately establishing the objective depth and by choosing an exploration program perfectly adapted to the structural-stratigraphic conditions. Based on the data from existing of productive fields (age and depth of the reservoir trap type), we applied this approach to the Romanian part of Pannonian Basin. We established for every subbasin the most suitable areas to be considered, their depth and lithology. We can choose the prospecting method with the highest resolution focused on the reservoir depth. This is very important for future exploration because we can also know the area without perspective. This kind of analysis may also be affixed in other petroleum provinces, in their development exploration stage.

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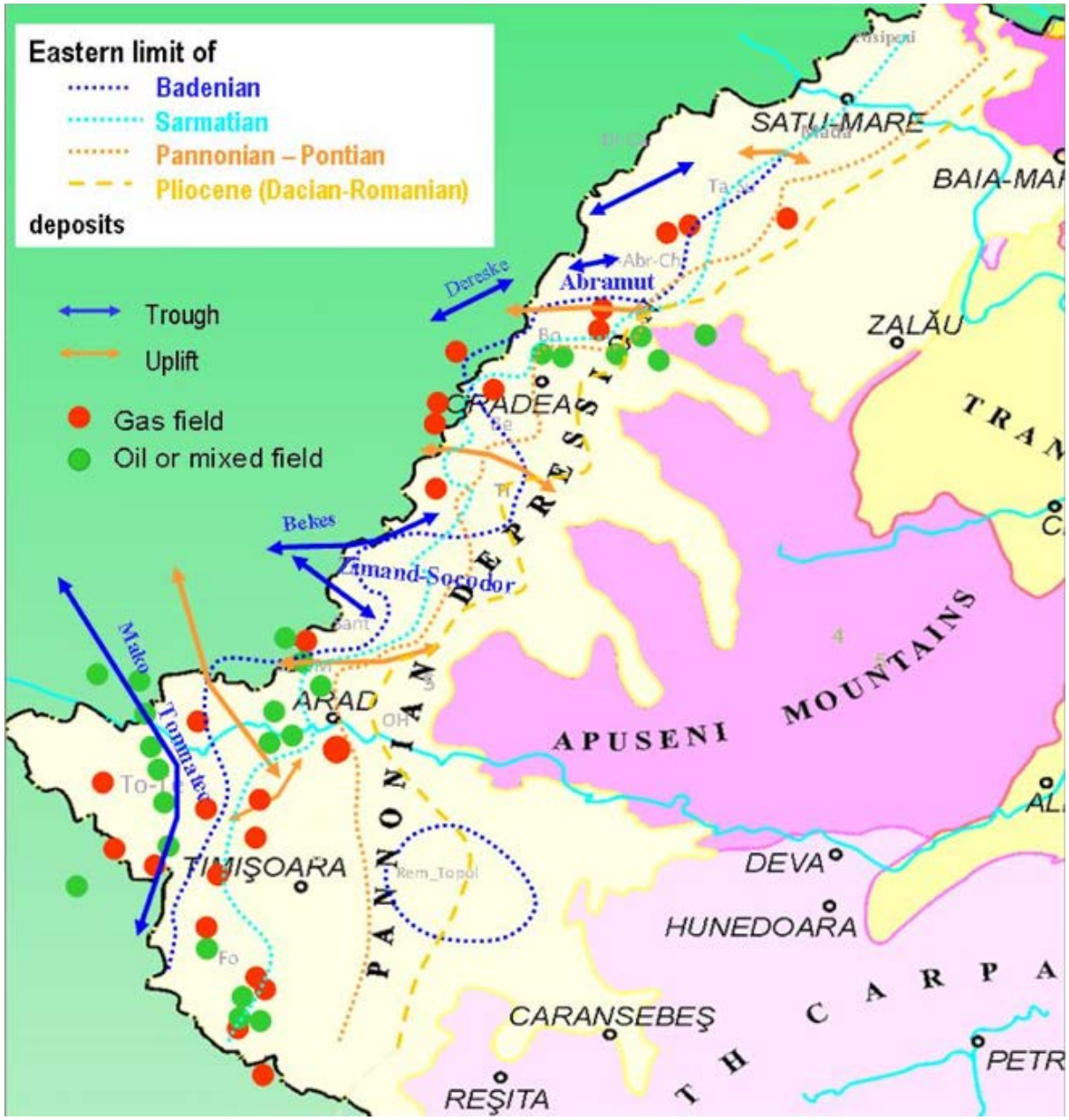

Figure 1. Basin Environment of the Pannonian Basin - Romanian sector (Negulescu E.R., 2015).

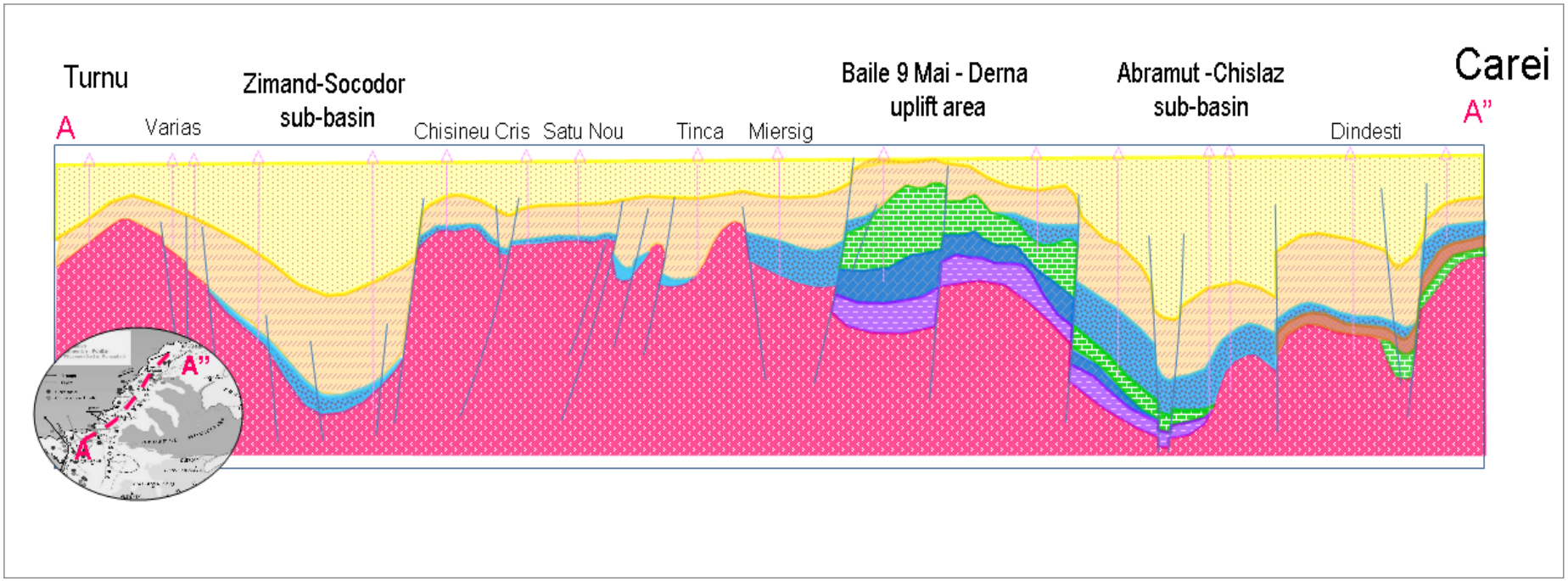

Figure 2. South-North geological cross-section along Pannonian Basin showing the main subbasins and uplifted areas that played an important role in hydrocarbons distribution. (Negulescu E.R., 2015).

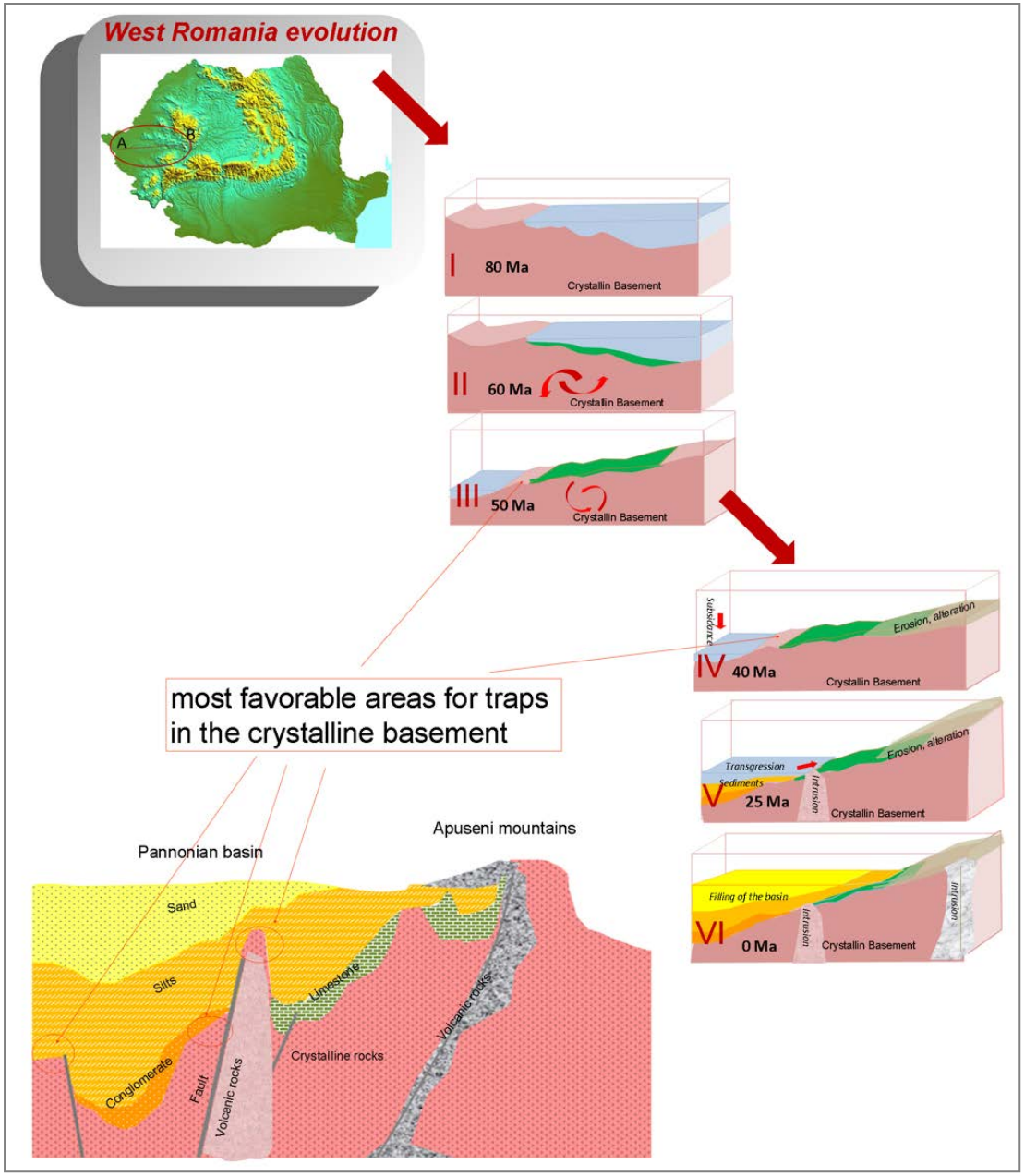

Figure 3. Tectonic evolution of the Pannonian Basin's basement (Negulescu E.R., 2015).