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Estimation of Prognosis Hydrocarbons Resources in Băileşti Depression, Moesian Platform

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Abstract

Bailesti Depression, positioned in the western side or Moesian Platform,is not very well explored untill now concerning its hydrocarbons potential due to its speciffic geological conditions. It consists of a diping zone descending from north-north west to south soth east with a stratigraphical columnspeciffic to Moesian Platform, presenting all its main sedimentation cycles with cummulative thickness exceding 6000-7000 m in the most subsided areas.

Depression deposits suffered during their evolution an important termal methamorfism that enables a great part of them to generate hydrocarbons.This feature correlated with the speciffic structural arangement provide the necessary conditions for the existence of exploitable petroleum accumulations. Takeing into account the characteristics of the already known productive structures from Moesian Platform we may estimate the petroleum prognosis potential for each promissing formation/interval of Bailesti Depression deposits.

Keywords: *rock surce, reservoir, traps, field.*

Regional Geologic Pattern

Moesian Platform occurs in the South east part of Romania between the Carpathian Orogenic Belt, Danube and the Black Sea. It is undernapping The Carpathians Orogen, dipping under the Foredeep deposits reaching until under the flisch napes of Eastern Carpathians. Although we may consider that the limit between Platform and Orogenic belt is could de drawn according to Percarpathic Fault, this one representing the outer limit of foredeep deposits extension above the Platform formations.

The geological evolution of Moesian Platform (the existence of more distinct sedimentary cycles having thick deposits of more than few thousands meters, the lithofacial, structural arrangements and stratigraphical variety of the geological formations) favored petroleum generation and accumulation thus now this represent a zone oh high interest for hydrocarbons E&P.

The tectonic arrangement of Moesian Platform (fig. 1) permitted the occurrence of numerous hydrocarbons accumulations to the level of every sedimentary cycle.

Also from the first oil pools exploitation in the Moesian Platform unit until now the most important part of hydrocarbons accumulations/resources, or those placed in “classic” trap conditions, have been already emphasized, thus it if naturally to look for petroleum in the areas which haven’t take into account until now, less prospected and which may provide us new

promising surfaces and new hydrocarbons resources. Also now we may benefit of better technologies which are improving our prospecting, evaluation and exploitation conditions permitting the access to new promising traps.

Until now the majority of petroleum accumulations discovered and exploited are placed in the northern part of Moesian Platform, more precisely north of the platform basement inflexion zone (in the eastern part) and respectively nearby the Oltean Uplift (in the western part of the platform). The others known major structures of Moesian Platform, Bailesti Depression, Rosiori-Alexandria Depression and Calarasi Depression (fig. 1) remained less explored although they accomplish the necessary conditions for the existence of some important oil and gas accumulations but they are placed to bigger depths and/or in subtle trap conditions thereby we cannot emphasized them until now.

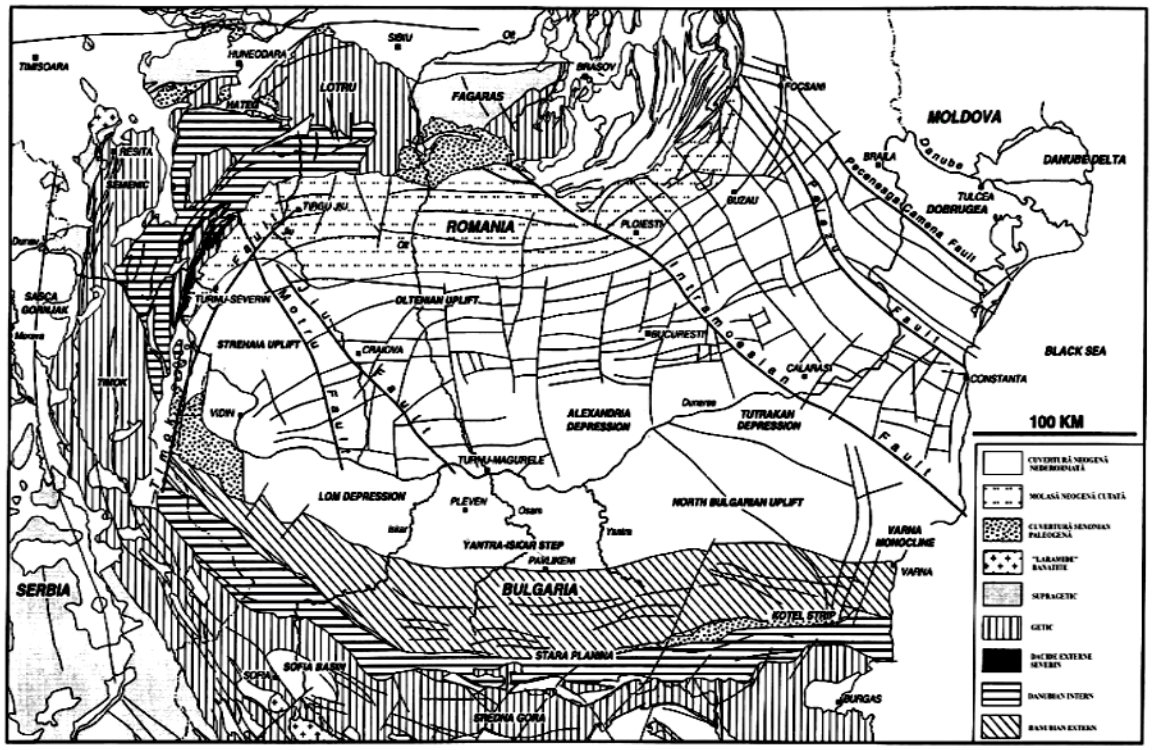

Fig.1. Moesian Platform tectonic arrangement (after Dicea et al. 1991)

Băilesti Depression Geology

Representing the northern part of Lom-Craiova Depression the area mentioned above has a pronounced dip towards south so that nearby the Danube, the Romanian zone limit, we meet a sedimentary cover thicker than 6000-7000 m. From the structural point of view we may emphasize some faults with a V-E strike which may represent favorable seals for oil and gas traps occurrence. Also we must underline the importance of Jiu Fault as major structural element, along that, the whole zone moved significantly.

Related with the existence of west-east oriented faults mentioned above we may estimate the possibility of occurrence of some traps located in the southern bloks of the faults (the layers are dipping south), fault-sealed having a structural closure about 3 to 5 km length and 1 to 1.5 km wide (the supposed productive areas have, generally complexes shapes and smaller surfaces than the above mentioned dimensions, which are maximal dimensions).

Vertical the petroleum accumulation interest formations are consisting of: Triassic, Permian (?), Carboniferous, and eventually Devonian.

Devonian may be considered as a productive objective t the level of the Eifelian sandstones (lower detritial group). At the Darvari fault proximity this is occurring at 4000 m depth dipping towards south until more than 6000 m.

The total thickness of the deposits is estimated to be about 1000 m and the proportion or possible porous rocks around 10 until15%. Only a small part of these porous rocks accomplish the tasks of a reservoir. The structural, vertical closure of these reservoirs is not bigger than 100 m and clay content variations separate probably more complexes and surfaces with different saturations.

Taking into account the thickness of the sandstone reservoirs the traps may have a tabular or marginal G/O/W contact, providing massive and/or stratiform layers (as the neighborhood Bradesti and Bibesti structures).

In these conditions we may consider, for the Devonian deposits, a petroleum resource about 2 to 3 millions tones of oil with a small amount of gases bonded to oil accumulations.

Comparing the density of oil accumulations at the level of all the oil traps present in the Moesian Platform unit, the tectono-sedimentary arrangement and the surfaces occupied by the devonian formations into the Bailesti Depression we may estimate the existence of minimum 6 to 8 possible oil traps with a presumed resource around 15 to 22 million tones of oil.

Also have to be underlined that the southern part of the depression is much too deep to represent interest for oil or even gas eventual accumulations.

Carboniferous, has as principle ca principal petroliferous objectives the so called superior detritial group developed on a thickness range between 200 to 500 m among those 20% may represent possible reservoirs.

The depths of the reservoirs are between 4000 to 5000 m and the surface of these reservoirs is smaller than the devoinan ones on the northern border and extending towards south in the middle of depression.

Although the total thickness of the reservoirs is smaller, they have lower clay content and more favorable reservoir conditions compared with Devonian accumulations (higher porosities estimated according with the neighborhood Bibesti (Devonian) oilfield and Bradesti (Paleozoic-Carboniferous) oilfield.

According to given conditions we may estimate a number of petroliferous structures and oilfields similar with the Devonian ones.

Triassic represents the most important hydrocarbons bearing geological formation from Bailesti Depression. Although the sedimentary cycle covers the interval Permian-Triassic, for Bailesti Depression, the potential petroleum reservoirs are located in Triassic deposits. The different degree of erosion to the unconformity between Permo-Triassic and Middle Jurassic-Upper Cretaceous cycles induce a random distribution of Triassic deposits on the surface of the depression. Also below the unconformity there are present different members of Triassic formation.

Correlated with the succession from the neighborhood structures the oil accumulations may be hosted both into the Inferior Red Formation, Carbonated Formation and Superior Red Formation.

Accorded with the lithofacial and isopachs maps in the areas of maximal depth of the depression the thickness of Triassic deposits may exceed 1200-1300 m.

The traps have a subtle character and are related with the unconformities surfaces (above and below them), by one side, and in the same time, with the paleorelief, and, last but not the least with the facial variations.

Determination of the amount of generated hydrocarbons

The estimation of the amounts of generated hydrocarbons from the source rocks has been done by a simulation of generative processes of the source rocks

Must be emphasized that a good evaluation of the petroligenous potential can be done only by a correct interpretation of the data provided of the Rock-Eval analysis of estimated source rocks. In this case we may determine the initial generative capacity (I.G.C), residual generative capacity (R.G.C) and also volumetric estimation of migrated hydrocarbons (M.H.C.).

The rocks considered to be source rocks by the authors of the generating models, for the actual evaluation, have been considerate the ones belonging to the first sedimentation cycle, Medium Cambrian-Superior Carboniferous.

The organic matter content estimated for the present model is between 0.8 to 1.5%.

As long as regards Bailesti Depression we estimated a surface of source rocks development about 8000 km^2.

These areas have been obtained by computing the extension of the deposits mentioned above occurring at depths of 3500 m or more, in order to accomplish the necessary conditions of organic matter maturation.

For Bailesti Depression the simulations have been done with data from 1101 Bailesti well and 26 Dabuleni well, both of them positioned in the research area and having the necessary depth.

For generative potential estimation and prognosis resources evaluation we appealed also to the data from the prospecting (reference) wells of Moesian Platform (table 1).

Table 1. Estimation of generative capacities.

Initial Generative Capacity (tones)	Migrated Hydrocarbons Capacity (tones)
$1,77 \times 10^9$	$0,53 \times 10^9$

Reservoir rocks, accumulation capacity, resources

Concerning the age of hydrocarbons bearing formations we considered as a interest interval layers belonging to the first and second sedimentation cycles of Moesian Platform, respectively medium cambrian- carboniferous and permo-triassic cycles (fig. 2) these ones including in theirs deposits the series of all potential reservoirs and resources of petroleum.

Taking into account the low tectonization degree of Moesian Platform deposits it is better to make, first of all a correlation or estimated reservoirs reported to eventually source rocks. Thus admitting that the first source rocks belong to Silurian deposits (graptolites schists facies), we will meet the first potential reservoirs and resources will be found in Devonian, respectively sandstone formation. This one has been identified on almost all the surface of the Moesian Platform, in the wells from: Chilii, Darvari, Bals, Ramnesti, Strambeni, Barla, Urziceni, Smirna, Zavoaia, etc. The principals lithological varieties encountered here are micro conglomerates, siliceous sandstones, claily sandstones, argillites, limestones and dolomites.

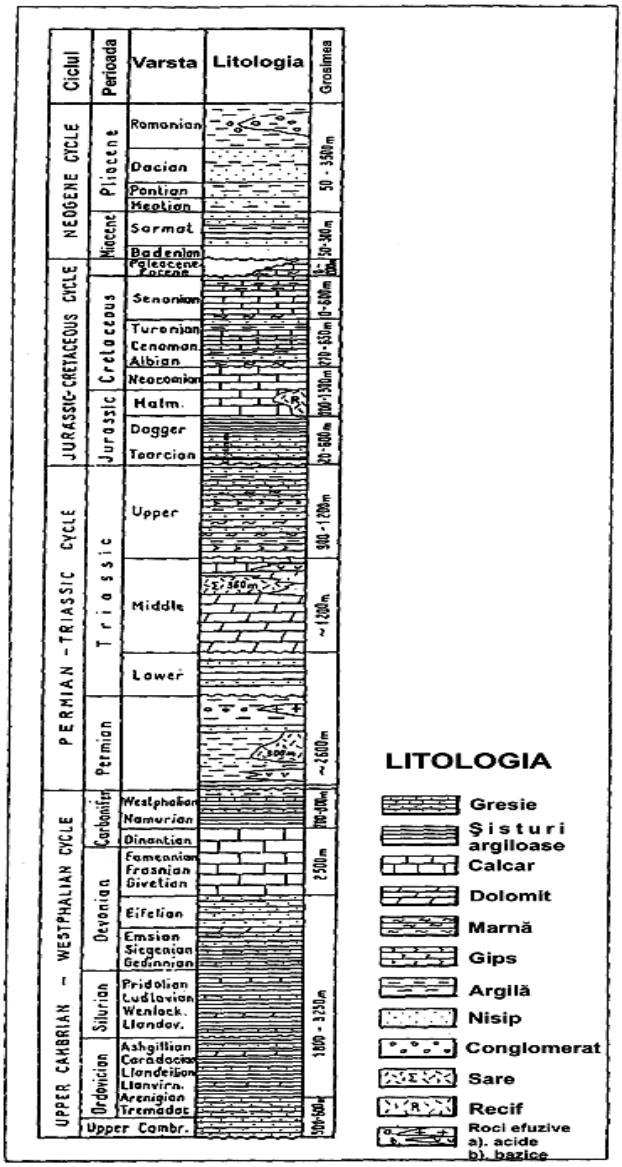

Fig.2. Stratigraphical column of Moesian Platform deposits

As we may observe these reservoirs have o significant clay content which, corroborated with the low porosities of the rocks, mainly where these rocks are situated to a big depth, induced, as an effect, low effective porosities of the potential reservoirs.

Proved as a productive formation until now, only on the northern border of the platform (Bibesti - Turburea - Bulbuceni lineament) it is possible to be found with hydrocarbons accumulations also in the depression zones.

Carbonated formations (middle carbonated group) belonging to the Superior Devonian- Lower Carboniferous interval have very low porosities but may be encountered, locally and in relative thin sections with well developed fracture zones able to accumulate and release hydrocarbons, forming fractured reservoirs with 0.1-0.4% voids ratio, providing acceptable reservoirs. Also granular reservoirs are forming as a result of carbonate formations alteration and resedimentation forming calcarenites, with good porosities (for instance 9-11% on Bibesti structure).

The next interesting formation, presenting potential reservoirs, consists of lower detritic series belonging to Medium Carboniferous. This one is better developed in the Depression zones and the potential reservoirs are represented by silica sandstones, grey-wake to sub grey-wake, have a small thickness and limited areas.

Regarding the reservoir rock properties we may estimate that their porosity is very various in the studied zone. Although we do not have direct data concerning porosity values we may estimate it between 8 to 14%.

The most important reservoirs are the Triassic ones. They belong to the red series which may have a cumulative thickness around 1200 – 1300 m.

They are mainly granular reservoirs, consisting of sandstones with very different porosities, clay content and mineral composition.

The medium thickness of Triassic reservoirs is more than 400 m (based on the well logs of neighborhood areas), and the total thickness of potential saturated reservoirs is about 15%.

For a better understanding and estimation or hydrocarbon resources we considered that the structural model and reservoir accumulating conditions are similar with Bradesti and Bibesti Bulbuceni structures, placed in the NE proximity of Bailesti Depression (fig. 3, fig. 4).

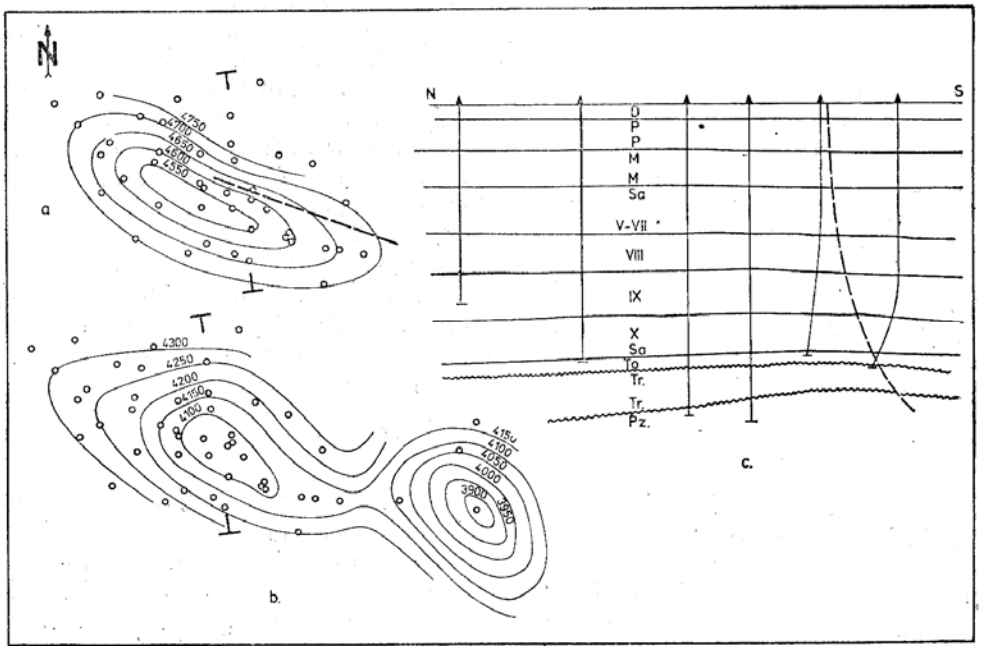

Fig. 3. Bibesti-Bulbuceni structure: a–morphostructural map of paleozoic paleorelief, b–morphostructural map of premiocene paleorelief, c–geologic cross section (after Paraschiv 1979).

In these conditions for a better understanding and evaluation of resuorces we may estimate a medium siye of oil accumulations around 3 to 4 square kilometers (due to erosion the surface and thicknes may be very different), total thickness of oil/gas saturated around 100 m, and a porosity between 12 and 22%.

Tackeing into acount the mentioned data, considering that not all the structures have a complete development of triassic deposits we may consider that the total resource for a triassic oilfield is around 15 to 20 million tones for a medium size geological structure/trap/oilaccumulation, having the mentioned above parameters.

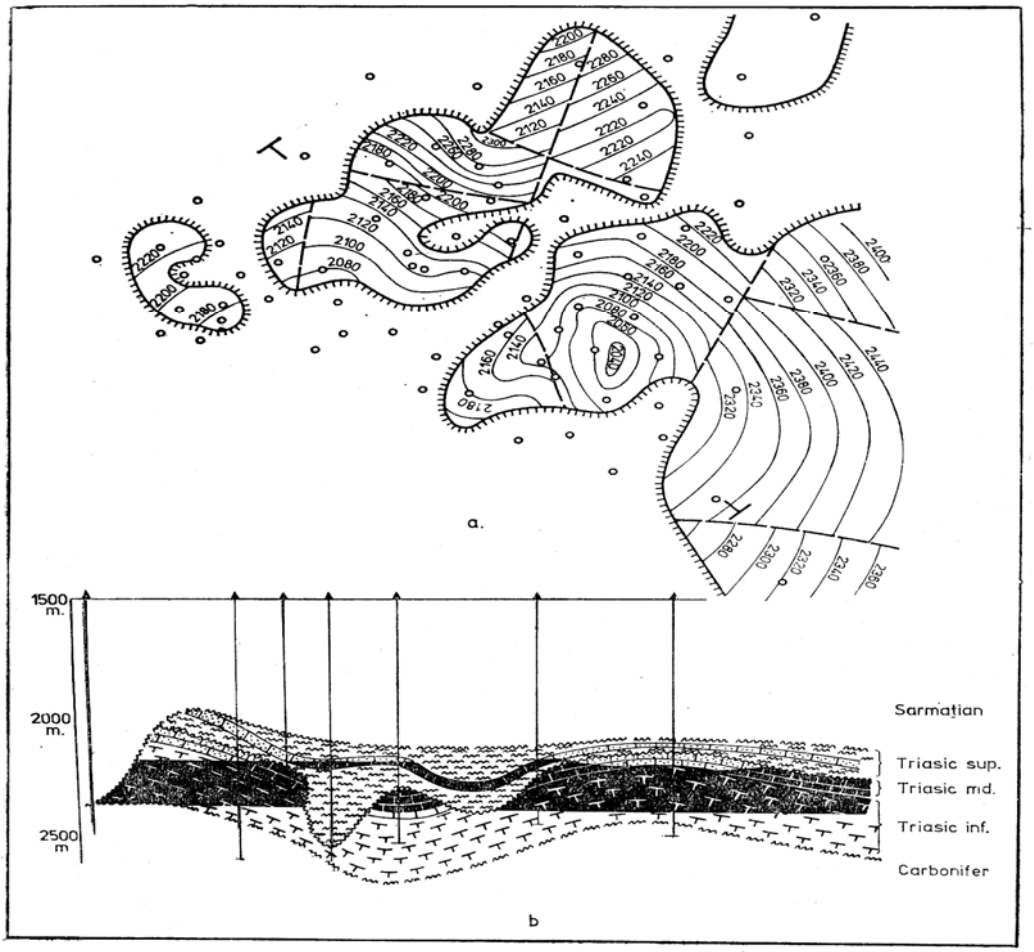

Fig. 4. Bradesti structure: a – structural map at T2 top;
b – geological cross section (after Paraschiv 1979)

Considering as an optimal solution the existence of 6 to 8 structures remaining to be discovered for each of the productive formations, even they are not present together ion the same structure, the total amount of prognosis resources will be:

- Devonian 6-8 structures x 2-3 mil tones =12 –24 mil tones; medium value = 18 mil tones.
- Carbonifer 6-8 structures x 2-3 mil tones =12 –24 mil tones; medium value = 18 mil tone.
- Triassic 6–8 structures x 15 – 20 mil tones = 90–160 mil tones; medium value = 125 mil tones.

Tacking into account the medium values mentioned above, for Bailesti Depression we can presume that the medium value of petroleum resources is about 160 million tones.

Considering the worst conditions for the existence of petroleum accumulations, according with on each structure there will be present minimal accumulation conditions we will have to discover only 6 structures with a 110-115 million tones resources.

Also we may point out the existence, in the pliocene deposits some gas reservoirs, hosted mainly in lithological traps represented by layers pinch out, local facies variations and eventually fault sealed traps, on the existing faults systems. Their number is difficult to estimate and their dimensions are modest. Reporting to the depression extension (surface) and the cumulative thickness of pliocene deposits we may estimate the existence of about 10 structures

with a medium resource about 300 million normal cubic meters counting a total resource of 3 billion of normal cubic meters.

Conclusions

Băileşti Depression placed in the north-west part of Moesian Platform represents a promising zone for hydrocarbons accumulations which has not been explored enough until now.

The great thickness of deposits, mainly of those from the first sedimentation cycles created good conditions for potential source rocks maturation; to the level of oil window thus the generative potential is remarkable.

The quantitative estimations based on the existing data both to the level of Bailesti Depression and Moesian Platform, especially for the two important sedimentation cycles (Paleozoic and Permo-Triassic), modeling of the generation/expelling/accumulation/preservation of hydrocarbons indicate an important potential geological resource which may be developed in the future.

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Resurse de prognoză pentru hidrocarburi în Depresiunea Băileşti, Platforma Moesică

Rezumat

Depresiunea Băileşti, situată în zona de vest a Platformei Moesice, nu a fost până în prezent suficient cercetată în ceea ce priveşte potenţialul de hidrocarburi datorită condiţiilor geologice specifice. Ea se prezintă sub forma unei zone ce coboară spre sud sud est şi prezintă o coloană stratigrafică specifică Platformei Moesice, întâlnindu-se toate ciclurile sedimentare ale acesteia cu grosimi cumulative ce depăşesc 6000 m, în zonele de maximă afundare.

Depozitele depresiunii au suferit în timp un metamorfism termic suficient astfel încât o parte dintre ele au generat hidrocarburi. Corelat cu aranjamentul structural specific,sunt prezente condiţii propice existenţei unor acumulări exploatabile de petrol. Extrapolând caracteristicile zăcămintelor deja evaluate în diferite zone ale Platformei Moesice a putut fi estimat potenţialul de prognoză pentru hidrocarburi al Depresiuni Băileşti pentru fiecare orizont stratigrafic de perspectivă.