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Estimation Of Hydrocarbons Generation Potential in the Moesic Platform, Roşiori-Alexandria Depression

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Abstract

Depression Rosiori-Alexandria contains over 5000 sq km of potential hydrocarbons yielding sites with source rock layers thicknesses of over 500 meters placed at various stratigraphical levels within the deposits in the depression area, these deposits can reach 7000 meters depth in the areas of maximum depression.

Organic carbon contents are relatively modest but, taking into account the raw volume of rock involved in the generation processes, the considerable depth at which they are placed and the thermal pattern of the area, influenced by positive temperature anomalies we may assume that most of the potential source rocks either are or were present in the window of oil generation conditions at different moments. Expulsion conditions as well as short migration paths allow the estimated perspective of potential oil reserves in the designated area.

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

Regional geological frame

The Moesian Platform, the major geological unit that contains the Roşiori Alexandria depression is positioned (in relation to the territory of Romania) between the Captain orogen in the north, the Danube to the south and the Black Sea to the east, it makes up about a third of the country's territory.

From the geological point o view it is based on a crystalline base and sediment cover containing elements that belong to four major geological cycles from the interval between Paleozoic to the present day. The following conditions had to be met in order to identify the areas containing hydrocarbons accumulations:

- the existence of hydrocarbons source rocks;
- the existence of migration processes;
- the existence of reservoir rocks;
- the existence of protecting rocks;
- the existence of traps;
- the temporal shift of processes responsible for migration and creation of traps.

Considerations regarding the generation and expulsion of hydrocarbons for the area of research will be presented later; the following will contain references to the other conditions involved in the formation of hydrocarbons accumulations especially the types of traps as well as the areas favorable to the presence of exploitable deposits in the Romanian sector of the Moesian Platform. As mentioned before the Moesian Platform level several cycles of sedimentation occur so the conditions for oil reserves formation must be presented according to these cycles.

The tectonic arrangement of the Moesian Platform (fig.1) allowed the placement of numerous hydrocarbons accumulation sites at the level of each sedimentary cycle.

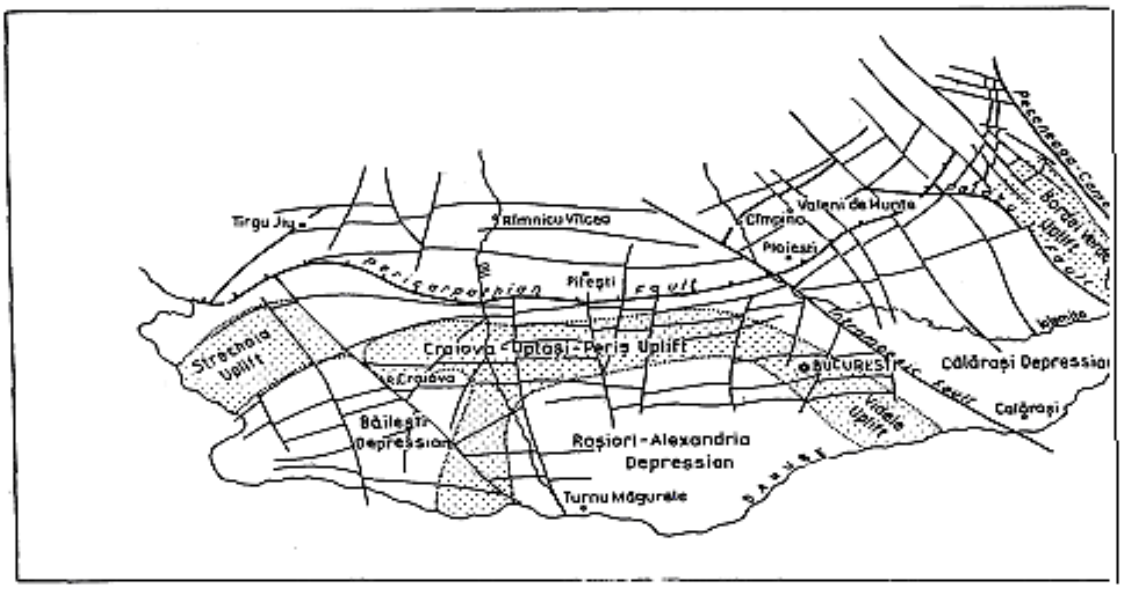

Fig 1. Tectonic arrangement of the Moesian Platform (from Dicea, 1991)

Exploitation of the first oil reserves in the platform also means that a lot of the existing resources have already been discovered and assessed thus it is natural to take into consideration the areas that have overlooked by existing research as new research in these areas will lead to the discovery of new potential sites and new hydrocarbons resources.

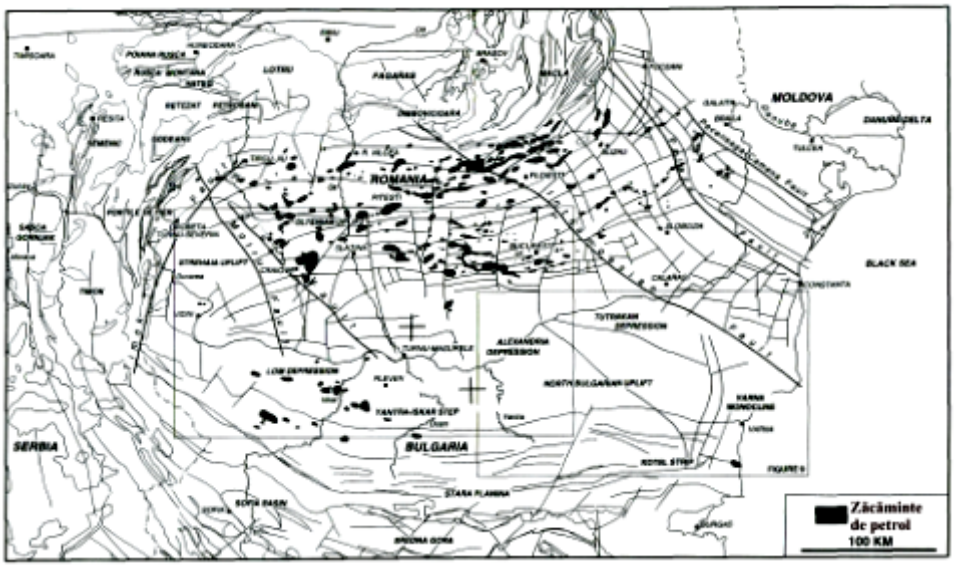

Fig.2. Distribution of reserves at the level of the Moesian Platform (from Tari et.al., 1996)

Types of traps

The Moesian Platform shows a great variety of trap types dictated by the combination of stratigrapical and lithological structural conditions.

A grouping of trap types according to age and sedimentation basin sectors (sub basins) can be achieved by interpreting existing seismic profiles (fig.3).

A first type of trap is identified for areas in the south part of the Moesian Platform in the Paleozoic, formed by sealing of Devonian-Carboniferous deposits along the flanks of depressions areas and/or intrusive magmatic bodies affecting these formations. This level also shows fault alignments that tectonically sealed the formations additionally flower structure arrangements that meet the conditions of trap formation appear.

The surface of unconformity corresponding to the upper and (eventually) lower premian carboniferous generating hiatus generates toplap lapouts for deposits in the primary sedimentary cycle.

Structural sealed traps conditioned by the platform's stepped descent (fault line) are present n the northern sector, the area of depression below the orogen. Also the discordant covering of the paleorelief generates drapefold - anticline peak structural arrangements.

Reef constructions, dome structures molded on the raised underlying blocks and tectonically sealed traps are present at Jurassic-medium Cretaceous level. Grouping of accumulation areas given by the existence of the Oltean uplift and the Videle uplift in the western sector and by the presence of structural alignments adjacent to the base inflection in the eastern sector.

The neogene sedimentary cycle is characterized by traps generated on one hand by the existence of fault alignments, tectonic seals, and on the other hand by the variation of transgressive/regessive sequences that caused the formation of onlap and toplap lapouts thus generating lithological traps. The same conditions show the formation of lithologically delimitated, lens shaped reservoirs typical mainly to the top end of the sedimentary cycle.

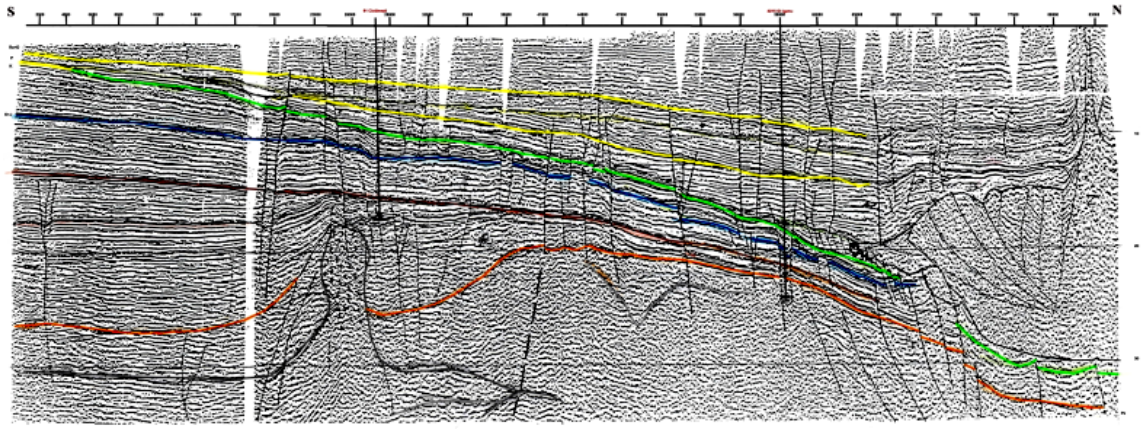

Fig.3. Seismic section of the Moesian Platform, types of traps.

A special category found at every sedimentary cycle level is made up of subtle traps such as:

- *Paleorelief,* protuberances of the paleorelief, create paleomorphic traps. Sometimes these traps also communicate with rock formations such as the collectors above them forming a single hydrodynamic unit a single oil trap; for example the Senonian and basal Sarmatian reservoirs

- *Overlapping fault lines*, create (tectonically sealed or combined) structural traps on different stratigraphic levels.
- *Faulted blocks*, covered by compensating anticlines, present on the sedimentary/base unconformity as well as within the sedimentary units, sealed along the fault plane and sometimes combined with lithological screens.
- *Draped*, resulted from the discordant covering of paleorelief protuberances by overlapping deposits.
- *Growth fault lines*, due to differential compactation and different thickness of the sedimentary cover, present in areas where, for certain periods of time, the rate of subsidence was very high and the corresponding compensation with sedimentary material inequal.
- *Roll-over anticlines*, due to extension processes followed by the formation of listric fault lines and compensation by means of synthetic/antithetic faults covered concordant/discordant by sedimentary covers.
- *Turbidities pinch out,* along the sedimentary basin slope (onlapping / downlapping).
- *Transgressive series* formed superjacent to the discordances and covered by pelitic deposits.
- *Delta fan slope lobes,* these form lens-shaped bodies, porous-permeable lens-shaped bodies or shoe-string type.
- *Delta front type sand bodies*, formed at the external limit of the fluvial system lens-shaped up to (the) sand barrier.
- *Overlapping/thrusting fault lines*, which form flower structures with tectonic/lithological shielded/screened collectors.
- *Sand barriers*, stretched lens-shaped with vertical migration according to shore line variation and the sediment transport system strength, floodplain type.
- *Sand, sandstone bodies balking,* towards the sedimentary shore line (onlapping)
- *Paleovalleys,* containing porous-permeable lens/channels that generated shoe-string type deposits.

Another distinctive feature, especially related to neogen deposits are the variations of permeability values that create areas of impermeability/sealing of traps/fields.

The size of oil traps is very different from one area to another in regard to surface and vertical development ranging from surface areas of several hectares to several hundred hectares and from a few meters to over 100 meters in thickness.

Imperfections in the seal area that allow the transfer of hydrocarbons to one formation from neighboring reservoirs may be noticed. For instance the base Sarmantian on the Glavacioc structure has, up to the present moment, produced a quantity of hydrocarbons equivalent to over 50% of the initial resource, as projected in relation to the size and proprieties of the collector rock, probably being fueled with oil from the subjacent Senonian.

Roşiori – Alexandria Depression

Situated south of the Leu – Balş – Optaşi – Periş uplift the Roşiori – Alexandria depression is an area of maximum depression, with very thick sedimentary deposits belonging mainly to the first sedimentary cycles (Paleozoic and Permo-Triasic), their combined thickness at some point is in excess of 5000 meters.

Estimation for the quantity of hydrocarbons generated by source rocks was achieved using the process of simulating their generating capacity. Data produced from I.G.R. simulations was used.

It must be mentioned that a good evaluation of the oil producing potential can only be made by interpreting data supplied by Rock-Eval analysis of the designated source rocks. In this case the initial generation capacity (I.G.C.), residual generation capacity (R.G.C.), generated hydrocarbons capacity (T.G.H.C.) as well as the volumetric estimation of migrated hydrocarbons capacity (M.H.C.) can be determined.

Rocks estimated to be source rocks by the authors of the generation simulations (I.G.R.) for the current assessment in the Moesian Platform were rocs belonging to the first sedimentation cycle medium Cambrian- Middle Carboniferous.

Content of organic matter estimated by the authors of the simulation is between 0.8% and 1.5%.

The Rosiori-Alexandria depression has an estimated surface of source rocks of 15.000 sq km.

Surface estimation was obtained through summing of areas where above mentioned deposits are present at a depth of more than 3500 meters to meet the required conditions for the maturation of organic matter.

For the Rosiori – Alexandria Depression, simulations were preformed these wells: 924 Lita, 6 Călugăreni, 104 Băcălesti, 6 Bălcesti.

To estimate generation potential as well as resource prognosis data from referance drilling sites existing at the Moesic Platform level, specifically in the Roşiori-Alexandria depression area was used (Table 1),

Table 1. Estimated generation potential

Initial Generating Capacity (t)	Total Migrated Hydrocarbons (t)
$1{,}65 \times 10^9$	$0{,}5 \times 10^9$

From a structural point of view below the unconformity in the base of medium jurassic deposits, permo-triassic and paleogene formations display significant undulations due to the effects of the Hercinic orogenesis particularly Eochimmeric phase in the late Triassic.

These movements generated the formation of structures that favor the accumulation of hydrocarbons, anticlines, pnch out, sealing underneath the onlap unconformity surfaces, etc.

At depression level different structural stages/steps may be observed, the reservoirs of interest (Paleozoic and Permo-Triassic) are present at the top of isobathic levels between 2500 and 5000 meters or more.

The main point of interest of the Devonian is the Eifelian sandstone formation on the upper part of the lower detritic group. This formation has a thickness of 370 m and was encountered in wells in the area of the Călăraşi Depression and it is possible that in the lower areas in the region of research its thickness is even greater. By studying seismic section and wells' data we can estimate a reservoir content of 20-25% in the whole sediments column. Also the proportion between collector and reservoir thickness does not go above 40-50%.

Appeal zones for hydrocarbons, at the level of these reservoirs are generated by structural elements, dome creation, dome faults so the surface of true saturated areas is around 250-350 hectares.

Collector porosity is on average 10% and values must be corrected with clay content estimated between 0.2 – 0.5.

Water saturation is estimated at approximately 40%.

In these condition the total hydrocarbons resource at the level of this formation is 3,5-4 million tons if all collectors in this series contain accumulations of hydrocarbons. Since this is unlikely to reflect the situation the reasonable approximation of the resource in the eifelien sandstone formation for the Devonian is a medium 2 million tons.

Medium Devonian-lower Carboniferous Because of the high degree of formation compactation it is difficult to ascertain any industrial sized accumulations of hydrocarbons in the carbonated median group representing the medium Devonian-lower Carboniferous.

Fractured type reservoirs may sporadically appear subordinate to the series of carbonate deposits eventually immediately under the unconformity surface due to alteration-cracking in subaerian conditions, with fissure volumes of 0.1-0.3%

Though the thickness of carbonate deposits is great up to 2500m we consider the specific resource for a medium sized structure can be no bigger than 0,5-1 million tons.

Medium-Upper Carboniferous, is represented by the upper detritic group, with a total thickness of up to 600 meters, contains levels of sandstone which according to well logs make up about 15% of the total thickness of the formation.

By applying corrections for the ratio between the thickness of the collectors and that of the reservoirs 0,5), porosity (0,1 - 0,15), the volume of clay in the rock (0,25 - 0,4) and water saturation (0,4) for an average surface of about 300 hectares the resulting average specific resource per structure amounts to 4,5-5 million tons.

Permo-Triassic represents the most important potential series for the existence of hydrocarbons deposits.

Total thickness of these deposits in the Roşiori – Alexandria depression is up to 5000 m.

The deposits are represented by three formations with distinct characters: the lower red formation (with thicknesses up to 2600 m), the carbonated formation (with thicknesses up to 1200 m), and the upper red formation (with thicknesses up to 900-1200 m).

In each of these formations displays granular and fissure type reservoirs made up of sandstone, clay sandstone, calcarenites, fractured limestone, microconglomerates

Porosities in granular reservoirs are extremely varied ranging between 12 and 25 % and the specific volume of fractures is 1 - 6 liters/cubic meter.

The ratio between reservoir rocks and the total formation thickness as resulted by processing data from well logs is 0,08 for detritic formations (upper and lower red) and for the fractured carbonated rock reservoirs total thickness found in wells are no higher then 40-45 m.

Average surface area of a deposit is considered to be around 300 hectares.

It must also be noted that total formation thicknesses vary a lot in relation to the position of the structures within the sedimentary basin and does not surpass 2000 meters.

In regard to the parameters above the specific resource for permo-triassic collectors will be approximately 17 – 18 million tons.

The average resource that may be found per structure is about 25 – 26 million tons.

Taking into account the extent of the research area it is possible that 8 to 10 oil bearing structures may exist in the Paleozoic formations with a total resource of 200-250 million tons of hydrocarbons.

Conclusions

The Roşiori – Alexandria Depression occupies a significantly greater surface area then the other potential areas of research from Moesian Platform and is credited with a hydrocarbons resource of up to 250 million tons.

Objectives of interest are the same and the distribution model for oil bearing structures is similar with the Platform patterns.

Considering the depth values of interest formations we can distinguish two groups of accumulations with the same objectives but different depths.

Depths up to 4500-500 meters, specifically structures found on the edge of the depression where due to erosion not all the formations in the stratigraphic column appear, some may be missing especially in Paleozoic.

Second area is located in the center and characterized by depths of the formations of interest at up to 6000 meters or more. Appeal, are linked to a slight folding of Paleozoic and Triassic deposits, the existence of fault lines and unconformity surfaces. These are accentuated in the synthetic section shown in fig. 3.

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Estimarea potențialului de generare a hidrocarburilor în Depresiunea Roşiori-Alexandria, Platforma Moesică

Rezumat

Depresiunea Roşiori-Alexandria cuprinde suprafețe de perspectivă pentru hidrocarburi de peste 5000 kmp cu grosimi cumulative ale rocilor sursă de peste 500 m plasate la diferite niveluri stratigrafice ale depozitelor constituente ale depresiunii, depozite ce pot depăşi, în zonele de maximă afundare, 7000 m.

Conținuturile în carbon organic sunt relative modeste dar, având în vedere volumele brute implicate în procesele generative, amplasarea acestora la adâncimi considerabile şi regimul termic al zonei, influențat de anomalii de temperatură pozitive putem concluziona că majoritatea potențialelor roci sursă sunt în fereastra de petrol sau au fost prezente în aceasta în diferite momente. Condițiile de expulzare, traseele scurte ale migrației, ne fac să estimăm perspective de existență a unor potențiale zăcăminte de petrol în zona considerată.