BULETINUL Universităţii Petrol – Gaze din Ploieşti	Vol. LXII No. 3B/2010	213 - 218	Seria Tehnică

Actual Trends in Romania's Mature Oilfields Exploitation

Mihail-Valentin Batistatu, Florinel Dinu

Universitatea Petrol-Gaze din Ploieşti, Bd. Bucureşti 39, 100680, Ploieşti,
e-mail: mihail_batistatu@yahoo.com, flgdinu@upg-ploiesti.ro

Abstract

The majority of Romanian oilfields are in a mature phase with more than 30 to 50 years from the beginning of their exploitation. Although their recovery factor is usually less than 30% [10] so they are suitable for a secondary enhanced recovery. A proper approach is to provide wider openings for the producing reservoirs in order to obtain a better flow rate. This can be achieved (among the others) by drilling horizontal wells (drains) with an open reservoir interval about 150-300 m depending of the structural features of the oilfield. Moesian Platform [8,6] is characterized by the existence of important carbonate reservoirs suitable for drain type exploitation. In the study case we emphasizes the geological frame, drilling activities and production results for Neocomian reservoirs of Bragareasa and Lipanescu petroliferous structures and the possibilities to extend these results to other oilfields from Romania. We also emphasized the difficulties generated mainly by the geological frame and reservoir shape, thickness and flow properties variation on depth and/or surface.

Key words: *reservoir, drain, fissured, exploitation, attic oil*

Introduction

Romania is among the first countries in the world to produce oil, with the first recorded report of oil production dating from 1857, and so, during over a century and a half of oil production activity over 71,000 wells with depths of up to 7000 meters had been drilled (well no. 7000 at Baicoi had a final depth of 7025 meters), into over 600 oilfields.

Most of these oilfields have been discovered and exploited in the first half of the 20th century and as a result they are at present either abandoned or in an advanced phase of exploitation - mature oilfield/reservoirs with oil reserve recovery factors of over 25%, with many of the wells decommissioned, suspended or put into conservation.

Considering the above mentioned elements the complexity of oilfield conditions encountered in a large number of these oilfields and the "high performance" technologies used even today on many of the reservoirs it is justified to believe that the perspectives still exist for extracting significant quantities of oil from many of the mature oilfields in Romania.

Geological conditions

Traps – geological reservoir models

Volume and quantity of primary data

If we compare the surface area of Romania (237,000 sq.km) to the volume of geological and geophysical research work carried out to outline the oil production structures we may conclude that the degree of territory coverage they offer is more than sufficient and so the degree of knowledge we have on the oilfields and their reservoir geological models is more than satisfactory.

Thus, considering the total length of existing seismic profiles, which is approximately 500,000 km, the resulting coverage is 2 km of seismic profile for each sq. km of the country's area. Also, considering that certain areas, like the Crystalline – Mesozoic zone had initially excluded from the investigation areal to start with it becomes evident that the coverage increases significantly.

The quantity of starting data is also important and obviously focused on areas with the maximum potential for occurrence of oil reserves in the case of other types of geophysical and even geochemical exploration research.

The number of wells that were drilled is obviously very big so supposedly the volume of the obtained information should be very large.

After a critical analysis of this data we will, however, notice that the situation is, unfortunately, not as good as we would want it to be.

The existing seismic profiles are almost exclusively 2D and were generally acquired using low performance equipment and within a 50 year time frame so doubts about their quality are justified and interpreting them will consequently lead to less than satisfactory results. Even though the quality of acquired material has noticeably improved during recent years and the introduction of 3D seismic profiling has aided in obtaining relatively good oilfield and reservoir models for limited areas we may consider that it is still necessary that efforts should be made in the direction of new seismic profiling data acquisition as well as reinterpreting existing information.

Referring to data acquired from drilling/exploitation the first noticeable fact is the low quality of direct geological data with extremely few drilling samples and detritus samples, mostly summary analysis and poor systematization of information, part of which had even been lost. Geophysical investigations in wells were also minimal in many cases [4] and most of the interpretation is quantitative or semi-quantitative. At the same time a noticeable tendency is that while the quantity of acquired for every well data has increased the number and depth of the wells has significantly decreased in recent years.

Regarding production data these have been altered by intentionally and accidentally erroneous reports that by their nature are capable of inducing changes in the parameters necessary in constructing the reservoir model.

Model Complexity – subtle traps

Combining the structural / stratigraphic / lithological / hydrodynamic factors with different degrees of influence and proprieties have led to the creation of oil traps models with different degrees of complexity and so many of the times indentifying them is difficult and, moreover, making the scale and shape of the oil traps / reservoirs difficult to comprehend.

As such we may note that even "classic" oil trap structures such as the gas domes in the Transylvanian Basin [3] display complications caused by facies variations, pinch out, collectors turning into shales or structural complications, inter-formation disharmony (fig. 1).

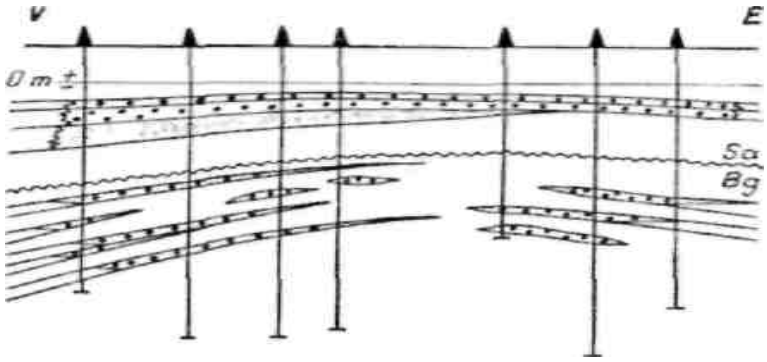

Fig. 1. Geological cross section Dumbravioara structure [3].

Another important that we have to emphasize is the heterogeneity of the reservoirs/collectors induced by the sedimentary facies variations and/or diagenetic and alteration processes able to change rocks propresties as cementing, fissure, chemical diagenesis, etc. As a consequence different zones of the reservoirs will have a distinct behavior during the exploitation processes

A good example of such processes is provided of the neocomian oil reservoirs from the central-eastern part of the Moesian Platform. So oil structures as Bragareasa, Lipanescu and others presents at the top of neocomian layers a fractured carbonated (limestone) reservoir [7] turning on some areas of the reservoir into detrital limestones – calcarenit with evidently better reservoir properties as higher porosity and permeability avoiding a better flow rate and providing an important enhancement of the exploitation processes and recovery factor.

Another relevant example is provide by the crystalline basement reservoirs of the Pannonian Bassin (Depression) which presents different alteration degrees on the top of the crystalline formation developing peculiar reservoir properties [1,2,9].

Related with the facts presented above we may emphasize that even in mature, exploited areas there are reservoirs parts with an important remaining oil saturation which has to be produced in the future applying adequate and economically feasible technologies, ensuring a better recovery factor, prolonging the exploitation time providing also a economical/commercial benefit.

Technological approach

The most important technological solutions have to take into account both reservoir conditions as: attic oil, zones with differential reservoir saturation, oil water contact unconformity, differential flow rates, etc., and production costs versus oil price.

Usual techniques

Among the most used technologies [5] we may enumerate:

- Water injection,
- Steam injection,

- Restrictive exploitation (debit and pumping time),
- Insitu combustion,
- Horizontal drains exploitation.

Because of the restricted space of the present paper therefore we will present some aspects regarding the last enumerated technology, horizontal drains, its benefits and limitations. From the beginning we must say that in order to obtain the best results we may apply it on distinctive reservoirs conditions as:

- Strong consolidate and/or cemented rocks as medium to well cemented sandstones, carbonated matricial (well cemented) and/or fissured limestone, dolomite, crystalline fissured rocks,
- Deposits (layers) low dipping angle and/or thick reservoirs in order to permit horizontal drilling into the productive section (collector),
- Attic oil existence,
- Gravitational flow,
- Active marginal or table water.

However we may say that the last two conditions usually exclude each other and also not all must be accomplished in the same time.

Case study

As an example we choose Lipanescu oil structure. It is placed in the central zone of the East Moesian Platform sector [6] and consists of a faulted monocline dipping towards north. Two faults systems oriented west – east (main faults) and north – south (sustain, sharing faults) provide sealing conditions and divide the structure in distinctive productive blocks. The oil accumulations are hosted by the Neocomian formations placed at about 3000 m depth and covered by middle cretaceous (Albian or Cenomanian) deposits.

Reservoir rock represent the top of Neocomian deposits [6,11] and consist of a fissured limestone and a discontinuous layer of detritial limestone/sandstone unit – calcarenite, with a variable thickness of 0 to 15m. Both units present good porosity and permeability properties but they decrease with depth (into the fissured limestone) until vanishing. The trap is a structural fault sealing one with tabular oil water contact. The water is an active one and the because of the aquiferous dimensions the majority of the wells have enough pressure to produce in eruptive mode for a long period of time.

Being in an advanced exploitation phase the remaining amounts of oil are attic type on the border of the main fault plane [11]. In order to exploit this attic oil was drilled a horizontal well (drain) which intercepted the reservoir and crossed it by a length of more than 200 m (see fig. 2). Due to its firm consistency the reservoir remained uncased on the drain sector (below the 7 inches lyner shoe) in order to provide good flow properties and higher daily productions.

Due to the complicated geological conditions were drilled more bore holes until the target has been reached.(fig. 3) Because of its favorable opening [5] the drain entered into production with up to 140 cubic meters/day debits, much better production rates than the vertical wells from the structure.

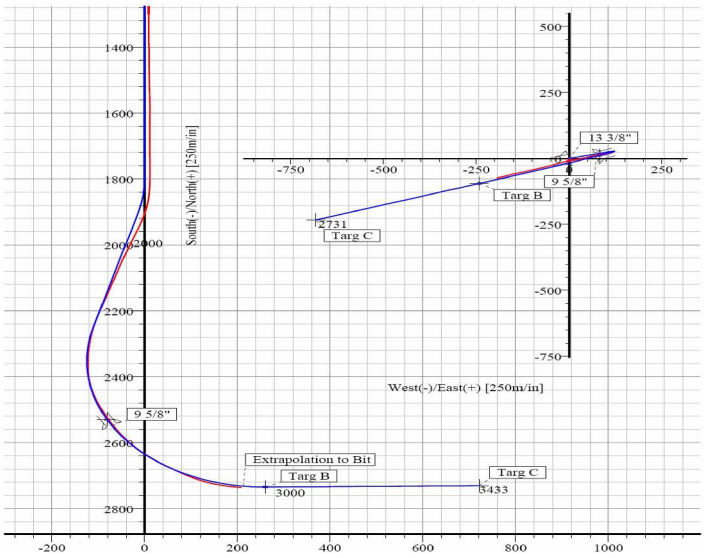

Fig. 2. Horizontal well (drain) traect project in vertical (left) and horizontal (right) plan: Targ B – entering into collector, Targ C – final depth

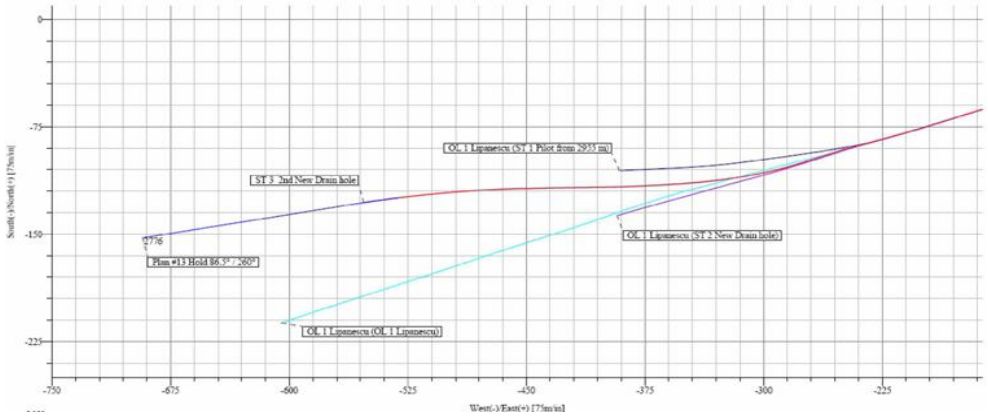

Fig. 3. Realized drain: Ol.1, S.T. 1, S.T. 2 – abandoned and cemented holes, S.T. 3- active

Conclusions

The majority of oil and gas producing structures of Romania are now in a mature phase of exploitation due to their age and/or recovery factors. Even so because the geological conditions are, often, very complicated we may find unexploited oil and sometime gas amounts on these mature fields. They are also a consequence of exploitations techniques which allowed a non-uniform sweeping of the hydrocarbons from the reservoir.

Applying adequate exploitation technologies we may obtain an increase of the recovery factor in economically profitable conditions because of the remaining oil amounts and also because the infrastructure conditions are already existing in mature structures areas.

In order to obtain such results we have to choose the adequate technology to geological and reservoir features of the oilfield.

Among the successful applied technologies we may emphasize the horizontal wells drilling. Even the drilling costs are high the production data reveal an economical successful choice.

The case study presented in this work underline the good aspects and the difficulties of the horizontal wells drilling and exploitation. As we emphasized the final results enable us to predict a future development of this technology for the mature areas of Romanian oilfields.

References

1. Batistatu, M.V. – *Unele aspecte privind evaluarea resurselor de hidrocarburi pe structura Variaş Vest Bazinul Panonian* – Simpozion Univ. Arad, 2001
2. Batistatu, M.V. – *Capcane subtile la nivelul principalelor zone petrogazeifere din Romania*, Suport de curs, Centrul de perfecţionare Petrom R.A. – Câmpina, 1996.
3. Beca, C., Prodan, D. – *Geologia Zacamintelor de Hidrocarburi*, E.D.P. Bucuresti, 1983.
4. Ionescu, N. – *Exploration History and Hydrocarbon Prospects in Romania*, Springer Verlag, Berlin, 1994.
5. Nistor, I. – *Proiectarea exploatarii zacamintelor de petrol*, Ed.Tehnica, Bucuresti, 1999.
6. Paraschiv, D. – *Geologia zacamintelor de hidrocarburi din Romania*, Ed. Academiei Romane, Studii tehnico-economice, seria A, Bucuresti, 1975
7. Pârvu G. et al. – *Petrolul in colectoare fisurate*, Ed.Tehnica, Bucuresti, 1979.
8. Sandulescu, M. – *Geotectonica Romaniei*, Ed.Tehnica, Bucuresti, 1984
9. Tulucan, A. – *Studiul geologic complex al Sectorului Romanesc al Depresiunii Pannonice cu privire speciala asupra capcanelor de hidrocarburi*, Teza de doctorat, Universitatea Bucuresti, 2001
10. ***** – *Studiu vizind evaluarea potentialului de hidrocarburi al principalelor bazine sedimentare din Romania*, Arhiva Ministerului industriilor, Arhiva I.G.R, 2005-2008.
11. ***** – *Studii de fezabilitate pentru structura Lipanescu - Platforma Moesica*, Arhiva Petrom-OMV, 2003, 2008, 2010.

Tendinţe actuale în exploatarea zăcămintelor mature de ţiţei

Rezumat

Romania cu peste 700 de zacaminte de hidrocarburi aflate in exploatare şi peste 71000 sonde săpate în cei peste 150 de ani de industrie de extractive a petrolului este evident in faza de exploatere matura a acestora. Printre metodele cele mai uzitate de exploatare se numara si dondele orizontale. Acestea au avantajul realizarii unei productii zilnice mari si al posibilitatii exploatarii asa numitului attic oil. In studiul de caz prezentat sunt abordate modelul de foraj si rezultatele in exploatare ale unei astfel de sonde.