ROMANESTI STRUCTURE, A SUBTLE TRAP CASE STUDY

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ABSTRACT. The Romanesti structure, belonging to the Getic Depression is characterized by the existence of a Diapiric fold at Oligocene deposits level which favored the occurrence of a gas accumulation in the covering younger deposits. The traps are subtle, formed by structural/stratigraphical and hydrodynamic processes. That is why the shape of the gas pools is peculiar and the distributions of fluids are also unusual sometime the gas accumulations being placed under the water saturated levels in the same reservoir.

ПРОУЧВАНЕ НА НЕВИДИМ ЕСТЕСТВЕН НЕФТЕН РЕЗЕРВОАР, РУМЪНСКА СТРУКТУРА

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РЕЗЮМЕ. Румънската структура, принадлежаща към Гетската депресията е определена при съществуващата диапирна гънка към хоризонта на Олигоценски наноси, което благоприятства наличието на петролни натрупвания в по-младата покривна на находищата. Естествените резервоари на нефт и газ са невидими, образувани чрез процесите на структурирно/стратиграфски и хидродинамични процеси. Това е защото формата на газовите находища е специфична и разпространението на флуидите са също така необичайни, понякога нефтените натрупвания се поместват под водните наситени хоризонти на самия резервоар.

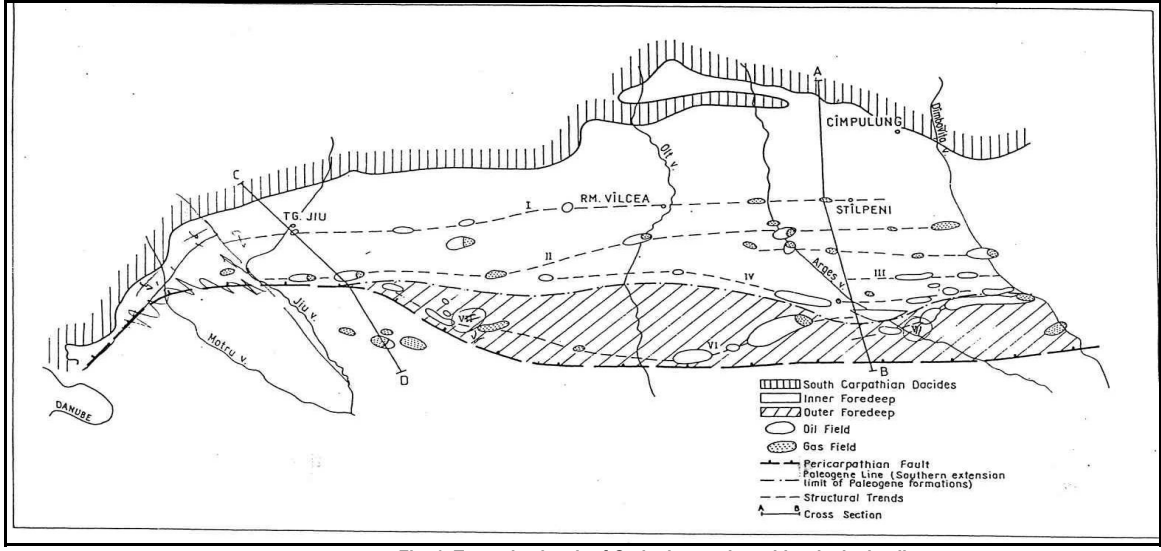

Fig. 1. Tectonic sketch of Getic depression with principals oil accumulations

It is reprezented by post laramic molasse deposits of Dacides (GeticNape, Ceahlau Nape, Severin Nape, Danubian Autohton). In the southern part it is limited by the Pericapatian Fault thrusting the Moesian Platform covered by the upper molasse deposits, Sarmato–Pliocene (Sandulescu 1984; Dicea 1991).

On the northern, epicarpathic flank The Getic depression overlays the crystalline and Mezosoic deposits of the Meridional Carpahian Belt. The stratigraphic column of the Getic Depression (Fig. 2) consists of Paleogene, Miocene and Pliocene deposits (Mutihac 1990; Dicea 1991) The total thickness of these deposits is between 2500 and 5000 m depending of the position on in the sedimentary basin of lower respectively upper molasse.

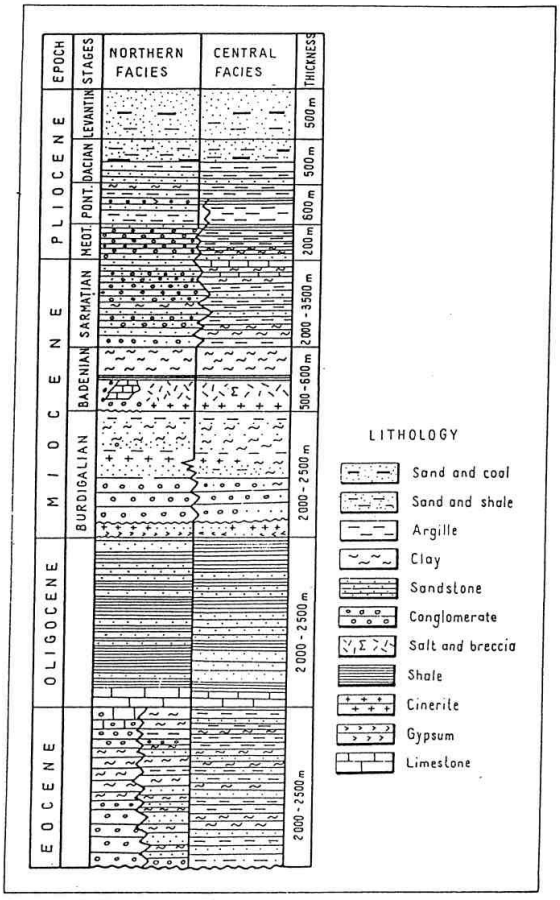

Fig. 2. Stratigraphic column of Getic Depression

The Paleogene is reprezented by Eocene and Oligocene deposits developed in a detritical facies, sandstones for Eocene and mainly pelitic for Oligocene, with a total thickness untill 5000 m, decreasing from North to South limited in the south by a major fault zone, Ticleni – Stilpeni, which separates the Inner and Outer Foredeep zones.

The Miocene has a molasse aspect, consisting of sandstones, limestones, marls and salt deposits from Burdigalian to Sarmatian. It is about 2000 to 3500 m thick. The Pliocene deposits are about 500 to 1800 thick and are formed by sands and marls.

Structural Geology

Stratighaphy

The Romanesti structure is formed by deposits covering the Oligocene-Pliocene interval.

- Oligocene, consists of a 870 m thick pelitic formation (shales and marls) with rare thin sandstone intercalations.
-„Helvetian" deposits transgersidely superposed on Oligocene deposits is about 1500 m thick and consists of an alternant sandstones to sands and marls to shales) clastic series about 1500 m thick.
- Badenian deposits are developed in a sandy/marly facies alternance on the borders of the structure with varring thickness from 0 to 200 m.
- Sarmatian deposits are formed by sandy marls, marly sands and rare limestone thin films. The total thickness of the sarmatian formation is about 150 m.
- Meotian deposits are mainly formed by marls with a few sandy/sandstone intercalations with a total thickness about 200 m.
- Pontian formation is entirly consiosting of marls and has a 200 m thickness.
- Dacian-Romanian deposits, about 400 to 700 m thick consists of a series of sands, marls, clays and coal intercalations.

Tectonics

The Romanesti structure is formed in the general frame of geotectonic evolution of Getic Depression, as a result of moldavian tectonic movements when the foredeep formations thrusted the Moesian Platform deposits along the Pericarpathic Fault.

The structure has an anticline shape oriented approximativelly West-East. The oligocene pelitic deposits involved in folding process have a diapiric role crossind the overlaing Miocene deposits untill about 200-300 m from the surface (Fig. 3) and provideind the necesary onset for a longitudinal faults sistem oriented west-east. Also the existence of these main faults induced a share faults sistem oriented in an 30 to 40 degrees angle rellated with the main stress direction (Fig. 4).

The diapiric Oligocene devide the structure in two units, a nosthern one, structurally uptifted and a southern lowering one.

Gas accumulations

The Romanesti Structure is a Gas bearing one consisting of 8 productive levels (complexes) named Helvetian VI, V, IV, I, Sarmatian III, II, I and Meotian.

Each complex contain more individual layers with a 2 to 8 m thickness made of sands and/or sandstones. They are partilally or integral sealed forming distinct hydrodynamic individual units. The main sealing mechanism is related with the existence of differrent blocks, but how we will explain latter is more complicated.

Fig. 3. Romanesti structure geologic cross section

Fig. 4. Srtuctural map of He VI producing complex of Romanesti gasfield

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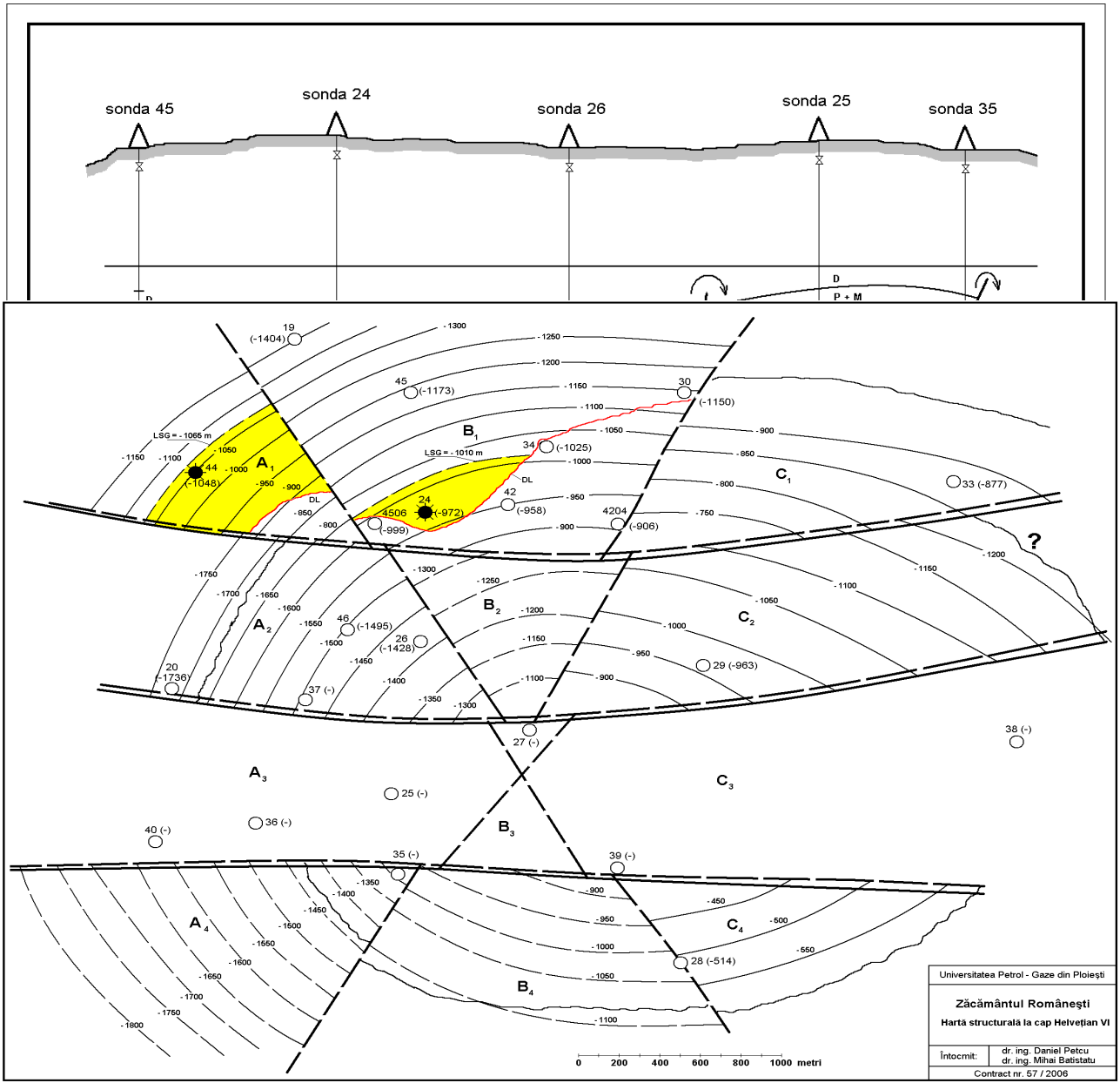
The northern flank is better represented containg more productive blocks. The depth of the gas reservoirs is between 1500 to 500 m and the volumes of gases are usually small.

Traps Forming Processes and Traps Shape

The characteristics of the gas traps from Romanesti structure are peculiar, so the entrapment mechanism has to be more complicated with combined and subtle elementsParaschiv 1975, Batistatu 1996).

First of all from the well logs interpretation and exploitation results we may observe that the central part of the structure is not a productive one although we may find several porous permeable layers but they are water saturated. The same layers or better complexes produce, at lower depths gases.

Also we may observe that the clay content of the reservoirs is widely varying so the character of the reservoir may change



in surface for the same layer, the productive area of the complexes being lithological limited.

These facts, combined with structural and production data enable us to emphases more trapping mechanisms for the studied area:

- Structural trapping of the reservoirs by fault seals providing distinct tectonic blocks with different gas water contacts for each productive complex or even strata.
- Lithological trapping by the changes of clay content of the reservoirs on different areas.
- Hydrological trapping at the upper part of the reservoirs.

As the first two types of seals (faults and lithology) are well known we will provide the arguments for the third type of seal.
The main elements of this mechanism are the presence of meteorically waters, diapir folding and capillarity forces.
In facts the presence in the central part of the structure of a shale diapir formed by the Oligocene shale induced in the cap rocks and suprajacent layers a system of micro fractures, making a connection between the surface of the earth and the inner zones above and bordering the shale diapir. We may also speak about an imperfection of the diapir fault seal.
The meteoric waters descended thru this (micro)fractured area until lower layers than usual and the rocks became water saturated.
The clays from the reservoirs became hydrated and changed (increased) their volume partially sealing the pore space.
Also the capillary forces and the water column pressure provide a seals which stops the Archimedic ascendance of the gases contained in the reservoirs.
It remains the problem of timing, the temporal shifting between the moment of trap forming and the gases generation and migration.
The age of diapir ascendance of the shale, related with the overburden crossed by it is related with the recent movements, the youngest sediments affected being the pontian ones, maybe the Valachian tectonic phase. Also the moment of gases migration is a recent one, maybe less than 2 million years. That means that the trap conditions already existed at the moment of migration.

We may see that the traps from Romanesti structure are subtle one combining all the elements enounced before, providing a complicated trapping system. These assumptions have been confirmed by the interpretation of well logs, mainly PNN logs in the existing wells which indicated for the same reservoir water saturated rock in the upper part and gases saturated rock in the lower parts, and also by the production tests.

The same situation, at a more, more larger scale is noticed in de Deep Basin gases oilfields of Canada and San Jose Basin from Texas.

Conclusions

Romanesti structure is placed in the central part of the Getic Depression. It has the shape of an anticline oriented west-east and the main structural features are the effect of a diapiric process concerning the Oligocene shales from the structure. This process involved also the apparence of an complex faults system which devided the whole structure in a series of tectonic blocks.

Traps forming mechanisms are complexes and “subtle” combining a series of different factors of different nature: structural; lithological; hydrodinamic (hydrological). As a consequence of these combined trapping mechanisms the shape and size of the gases accumulations present a peculiat position. So in the upper part of the reservoirs there are present water saturated zones and below them, in the same reservoir me may find gas saturated zones. Also the clay content variations in the reservoirs provide both seal and delineation of gases accumulations.

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