

## **Sedimentological and petrographical analyses of siliciclastic Oligocene deposits in the Teleajen Valley, Gura Vitioarei - Copaceni Structure, Romania**

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### **Summary**

This paper presents the preliminary results of an ongoing study of the siliciclastic Oligocene deposits that compose the Gura Vitioarei – Copaceni Structure in the Teleajen Valley of Romania. The objectives of this study include: the identification of depositional facies and facies associations; the reconstruction of sedimentary bodies (architectural elements); the interpretation of the diagenetic history based on petrographic thin\_section analysis; and an analysis of the effects of depositional and post-depositional processes on the reservoir quality of the Oligocene facies.

The sedimentary deposits are composed of intercalations of quartz arenites (Kliwa Sandstone – potential reservoir facies) and bituminous marls (Podu Morii layers – potential source rock).

The Kliwa Sandstone is represented by a siliceous sandstone, yellow-grey in color, poorly cemented, with frequent lutitic lenses. The bituminous marls, known as Podu Morii layers, display a tabular geometry with parallel stratification as the dominant sedimentary structure, a brown-grey color, and sparkles which indicate a high quantity of organic matter.

The reservoirs are composed of quartzitic sandstone with silicious cement in association with bituminous and quartzose graywacke. The texture of arenites varies from fine to coarse arenites and is bimodal, indicating multiple sources areas. The arenites present medium permeability and porosity, and usually they have a good lateral continuity. The main porosity type is fissural, complemented by a primary and intergranular porosity.

Based on facies and facies associations, the depositional model for the Kliwa Sandstone indicates turbidites in a deep-water setting, with the arenites related to a linear source. The best hydrocarbon reservoirs are represented by channel-fill and splay deposits.

### **Introduction**

The petrographical and sedimentological data play an important role in the methodology for the construction of a geological model that can be used to understand paleo-depositional conditions and to predict the development of hydrocarbon reservoirs.

The study area is located within the Teleajen Valley (Romania), in the southeastern part of the East Carpathian Mountains, in the Valeni High, where Oligocene marine deposits are exposed in outcrop.

The Gura Vitioarei – Copaceni Structure is located at the contact between the Valeni High and the crest of a salt dome, where the Pliocene deposits of the Gura Vitioarei – Copaceni synclinel are overthrust along the Copaceni Fault of the Oligocene High.

These sediments are characterized by an intercalation of quartz arenites (Kliwa Sandstone, potential reservoir facies) with bituminous marls (Podu Morii layer, potential source rock).

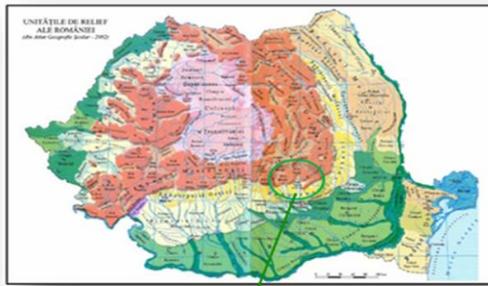


Figure 1: Teleajen Valley, Romania

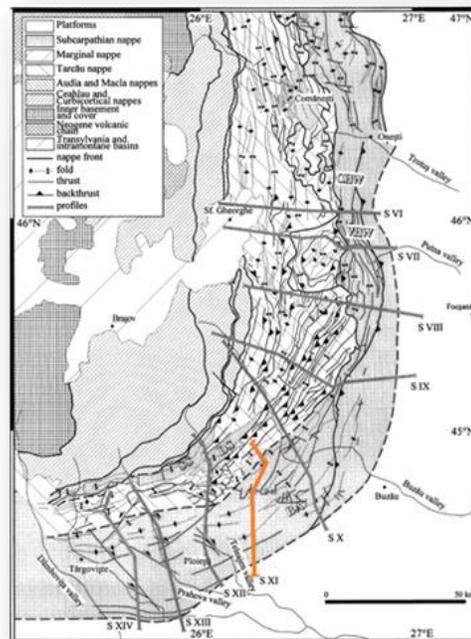
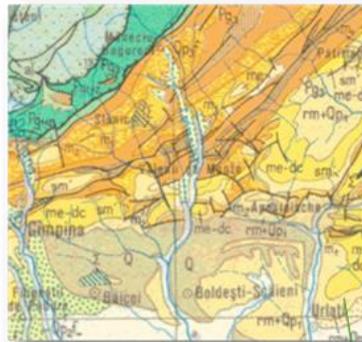


Figure 2: Geological map of the study area, and structural map of the Southern part of Carpathian Trust Belt (after IGR, 1978).

## Methods

### 1. Facies Analysis

The Kliwa Facies is characteristic to the Valeni High, which is exposed across large areas.

The sedimentary deposits are composed of intercalations of quartz arenites (Kliwa Sandstone) and bituminous marls (Podu Morii layer) (source rock).

The Kliwa Sandstone is represented by a siliceous sandstone, yellow-grey in color, poorly cemented, with frequent lutitic lenses.

The bituminous marls, known as Podu Morii layers, display a tabular geometry with parallel stratification as the dominant sedimentary structure, a brown – grey color, and sparkles which indicate a high quantity of organic matter.

A number of 40 samples were collected from the study area, from which 13 lithosomes have been identified. The total thickness estimated for this outcrop is about 4.5 m.

The identified facies belong to:

- a) Kliwa Sandstone is a siliceous sandstone with siliceous cement, the cement disappear during the diagenesis process, in present the rocks are very porous and friable
- b) Clay

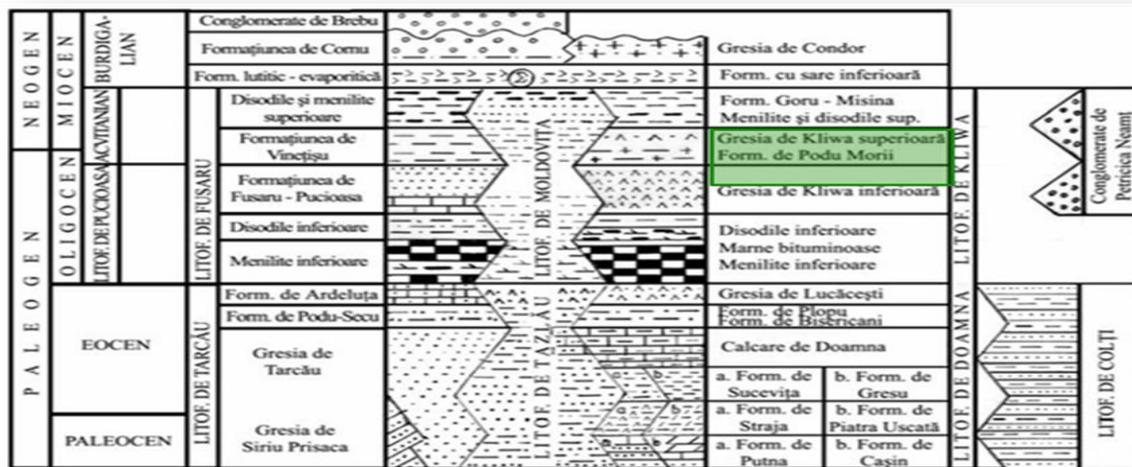
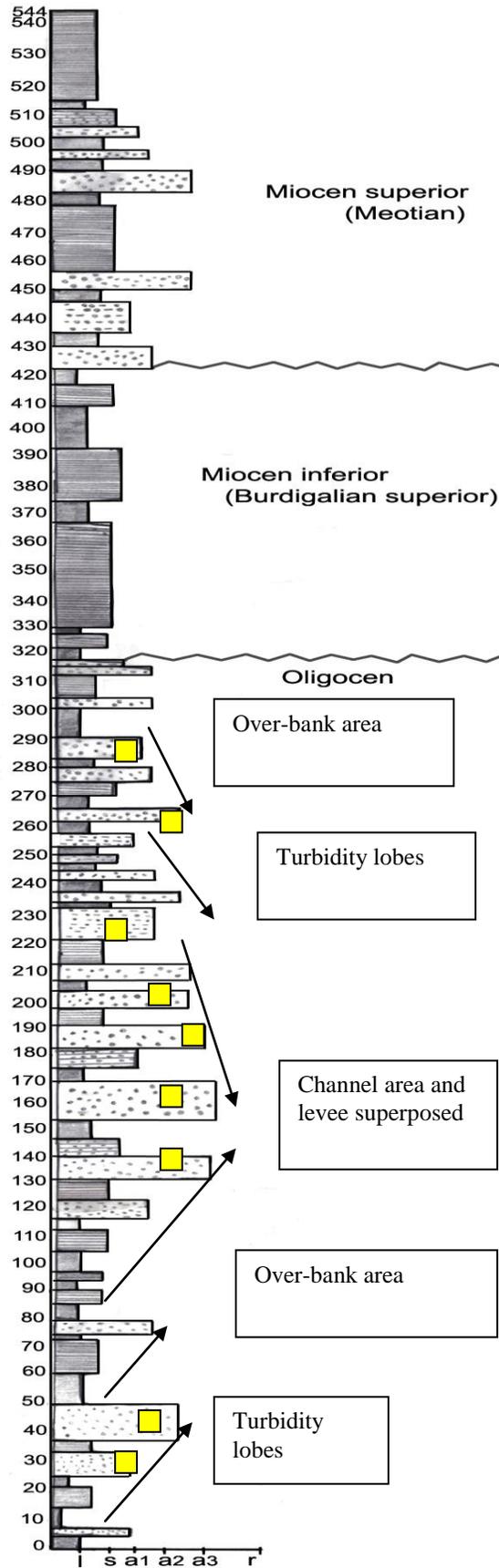


Figure 3: Stratigraphic column (after Mutihac,2004)

The lithosomes thickness varies between 2-50 cm, with irregular and flat boundaries.



Legenda:

-  facies with reservoir character
-  prograding sequence

Figure 4: Facies Association

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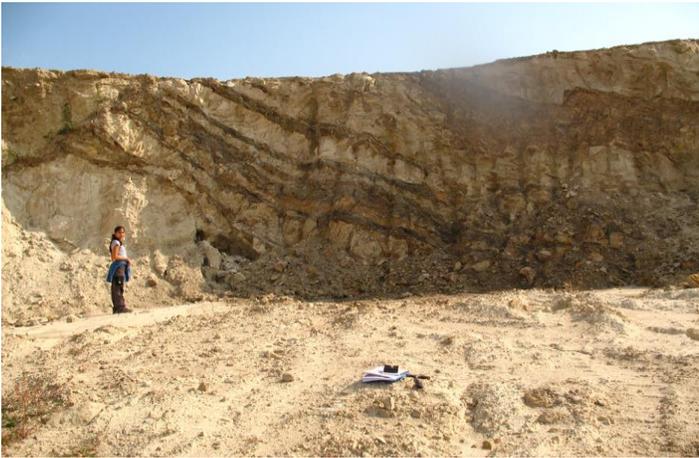


Figure 5: Gura Vitoarei outcrop, Kliwa Formation, Oligocene

The main facies that are present in the Gura Vitoarei – Copaceni Structure include:

- arenaceous - ruditic facies represented by mixed sandstone-gravel layers
- arenaceous facies represented by the Kliwa Sandstone
- arenaceous – lutitic mixed facies, represented by sandstone and clay interbeds
- lutitic facies represented by marls and globigerine marls
- bituminous facies

## 2. Petrographical analyses

A number of 30 thin sections were analyzed. The reservoirs consist of quartz sandstones with siliceous cement in association with bituminous and quartzose graywacke. The texture of arenites varies from fine to coarse arenites, and is bimodal, indicating multiple source areas.

The arenites present medium permeability and porosity, and usually have a good lateral continuity. The porosity types include fissural, primary and intergranular.

Based on facies and facies associations, the Kliwa Sandstone is assigned to turbidites in a deep-water setting.

The arenitic petrofacies is represented by quartz - subquartz sandstone with siliceous cement and graywackes. The arenitic facies are dominated by quartz, feldspar and lithoclasts. Minor constituents include micas (biotite and muscovite) and heavy minerals (zircon, staurolite, garnet, turmaline, apatite), chlorite, glauconite and pyrite, iron oxides and hydroxides.

The quartz is both mono- and polycrystalline, and accounts for 80-85% of the rock.

The feldspar accounts for 10-15% of the rock, and is represented by alkaline and potassium feldspar.

The lithic fragments are represented by silicolite, quartzite and calcareous fragments. The micaceous minerals display elastic distortion.

The bioclasts include diatoms and sponge spicules.

The linkage material is represented by matrix in graywackes, and by cryptocrystalline, microcrystalline and mesocrystalline overgrowth siliceous cements in the quartzitic sandstones. Calcitic cements are also noted, but are rare occurrences. The presence of organic matter is also noted.

The porosity estimated from thin-section petrography is about 8-10%, and is mostly due to fractures, complemented by primary and intergranular porosity.

The arenites present variable permeability and porosity, and they generally have a good lateral continuity.

The diagenetic processes include: sericitization of argillaceous minerals, local recrystallization, corrosion of clasts at the contact with the cement, and partial sericitization of feldspars.

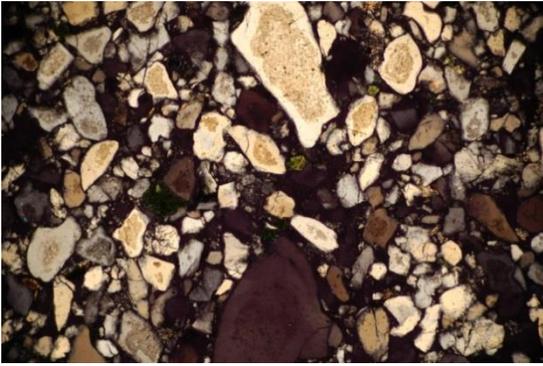


Figure 6: Kliwa sandstone, quartzitic, massive structure Gura Vitioarei, N+ 10X

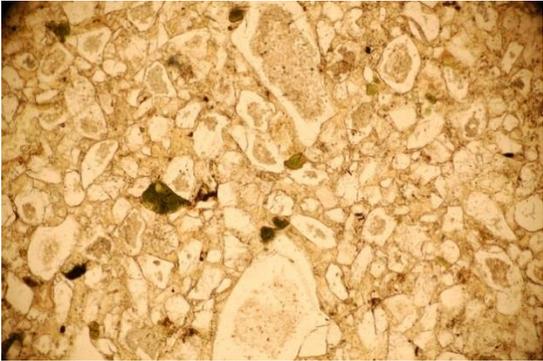


Figure 7: Kliwa sandstone, quartzitic, massive structure. Gura Vitioarei, NII 10X

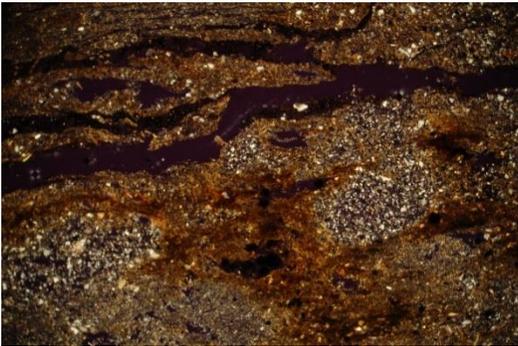


Figure 8: Graywake, Teleajen Vally, N+ 4X, fracture porosity

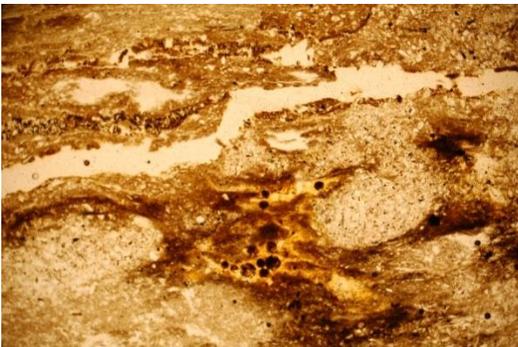


Figure 9: Graywake, Teleajen Valley, NII 4X



Figure 10: Shale, Teleajen Valley, NII 4X

The modal composition of the Q-F-L (Quartz-Feldspar-Lithic) samples, projected on the ternary diagram, denote a dominant quartzitic sandstone petrography, with a possible provenance represented by an internal craton (Dickinson & Suczeck, 1979).

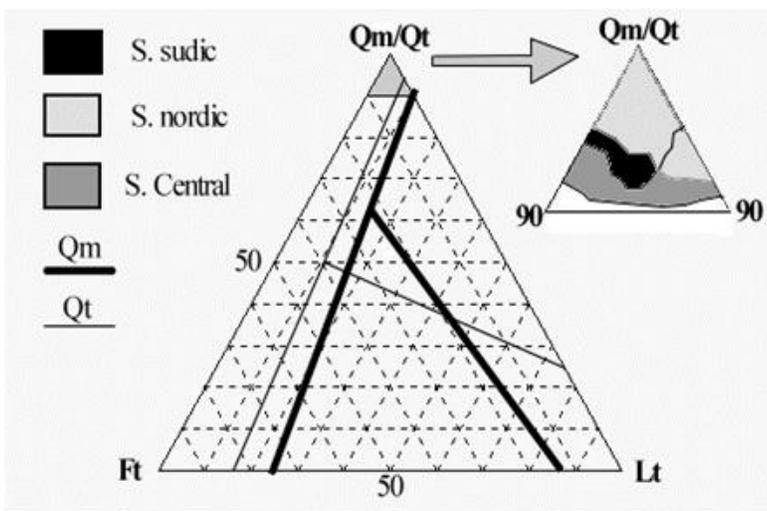


Figure 11: Dickinson & Suczeck (1979) diagram.

## Conclusions

The Oligocene consists of interbedded clay and sandstone layers with individual thicknesses between 2 and 10 meters. The arenitic facies are significant enough to form economic hydrocarbon reservoirs.

The dominant facies are: arenaceous, with secondary conglomerate, argillaceous and marl facies.

The dominant transport process responsible for the accumulation of the observed facies is the turbidity flow, followed by sedimentation from suspension.

The architectural elements within the study area include channels, splays, and overbank deposits, which belong to a deep-water turbidite system.

The best hydrocarbon reservoirs accumulated in the channel and splay areas. Additional levee and overbank facies present poor reservoir potential.

It is inferred that during the Early Oligocene, sedimentation took place under regressive conditions, when the relative sea level dropped and triggered fast progradation of the sediments into the basin. During the Late Oligocene, sedimentation took place under transgressive conditions triggered by fast relative sea level rise, leading to the accumulation of fine-grained

facies within the basin.

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