Sedimentologic and Petrographic Analyses of Siliciclastic Oligocene Deposits in the Teleajen Valley, Gura Vitioarei-Copaceni Structure, Romania*

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Abstract

This article 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 (Figure 1 and Figure 2). 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) (Figure 3). The Kliwa Sandstone is represented by a siliceous sandstone, yellow-grey in color, poorly cemented, and with frequent lutitic lenses. The bituminous marls, known as the 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 bitumous and quartzose graywake. 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 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 petrographic and sedimentologic 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 (Figure 4). 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 Syncline are over-thrusted 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 5).

Methods

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 the 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.

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 disappeared during digenesis so the rocks are now very porous and friable.
b) Clay

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

The main facies that are present in the Gura Vitioarei-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.

Petrographic Analyses

30 thin sections were analyzed (Figure 6, Figure 7, Figure 8, Figure 9, Figure 10). The reservoirs consist of quartz sandstones with siliceous cement in association with bitumous and quartzose greywacke. 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 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), heavy minerals (zircon, staurolite, garnet, tourmaline, and apatite), chlorite, glauconite and pyrite, iron oxides and hydroxides.

The quartz is both mono- and poly-crystalline, 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 sericititization of feldspars. The modal composition of the Q-F-L (Quartz-Feldspar-Lithic) samples, projected on the ternary diagram (Figure 11), denote a dominant quartzitic sandstone petrography, with a possible provenance represented by an internal craton (Dickinson and Suczeck, 1979).

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 faces 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.

Selected References

Beca, C., and C. Prodan, 1983, Geology of hydrocarbon deposits: Didactic and Pedagogic, Bucharest, p. 125-160.

Leeder, M.R., 1999, Sedimentology and Sedimentary Basin: from turbulence to tectonics: Blackwell Science Oxford, UK, 592 p.

Matenco, L., and G. Bertotii, 1999, Tertiary tectonic evolution of the external East Carpathians (Romania): Technophysics, v. 316, p. 255-286.

Miall, A.D., 1991, Principles of Basin Analysis, 2nd Ed.: Springer-Verlag, New York, 668 p.

Mutihac, V., and L. Ionesi, 1973, Geology of Romania: Bucharest Technical Publishing, p. 471-489.

Mutihac, V., M. Stratulat, and M. Fechet, 2004, Geology of Romania: Didactic and Pedagogic, R.A., p. 191-195.

Nichols, G.J., 1999, Sedimentology and Stratigraphy: Blackwell Publishing, 355 p.

Reading, H.G., 1996, Sedimentary Environments: Processes, Facies and Stratigraphy, 3rd ed.: Blackwell Science Oxford, U.K., 688 p.

Sandulescu, M., 1984, Geology of Romania: Bucharest Technical Publishing, 355 p.

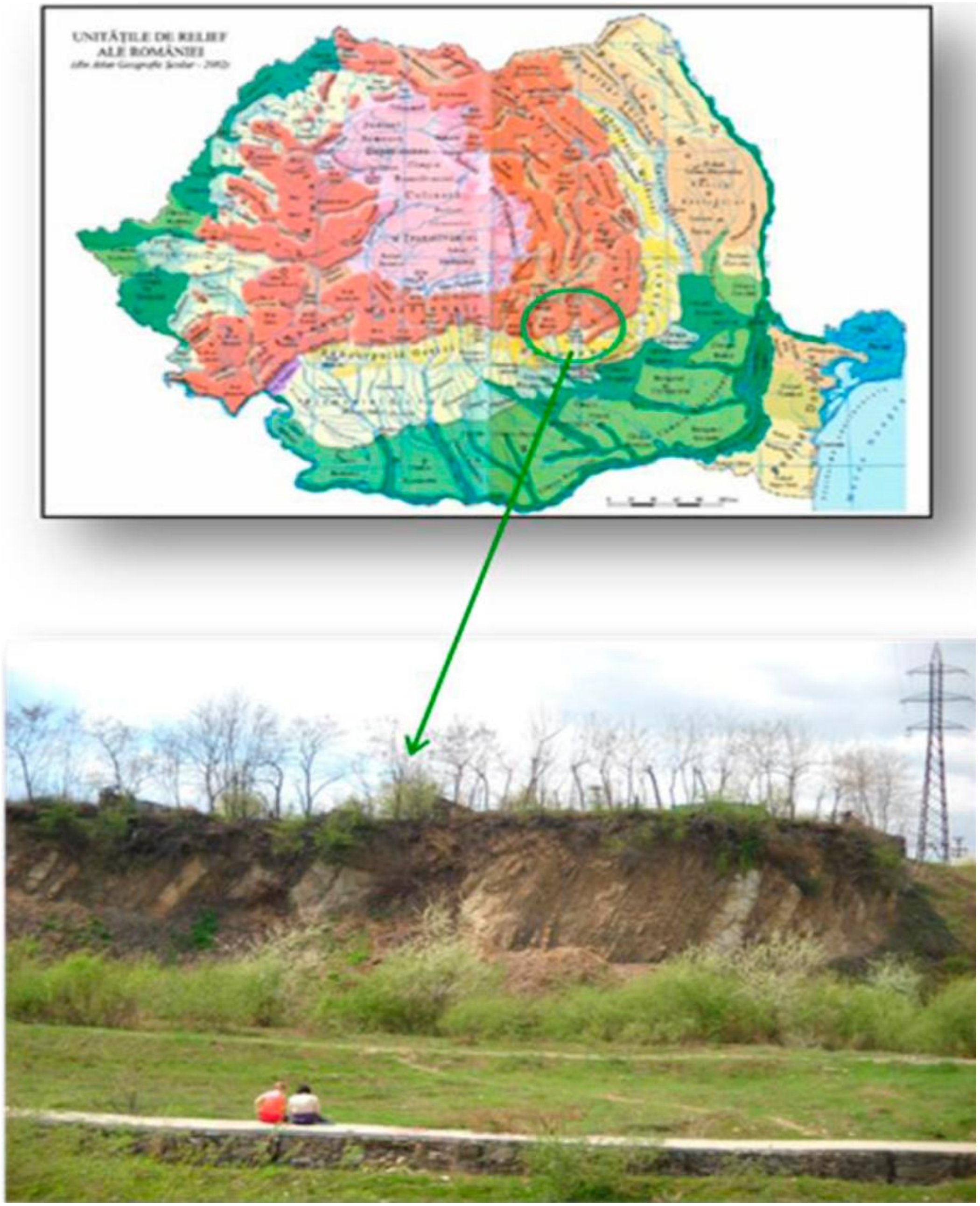

Figure 1. Teleajen Valley, Romania.

Figure 2. Geologic map of the study area, and structure map of the southern part of the Carpathian Trust Belt (after IGR, 1978).

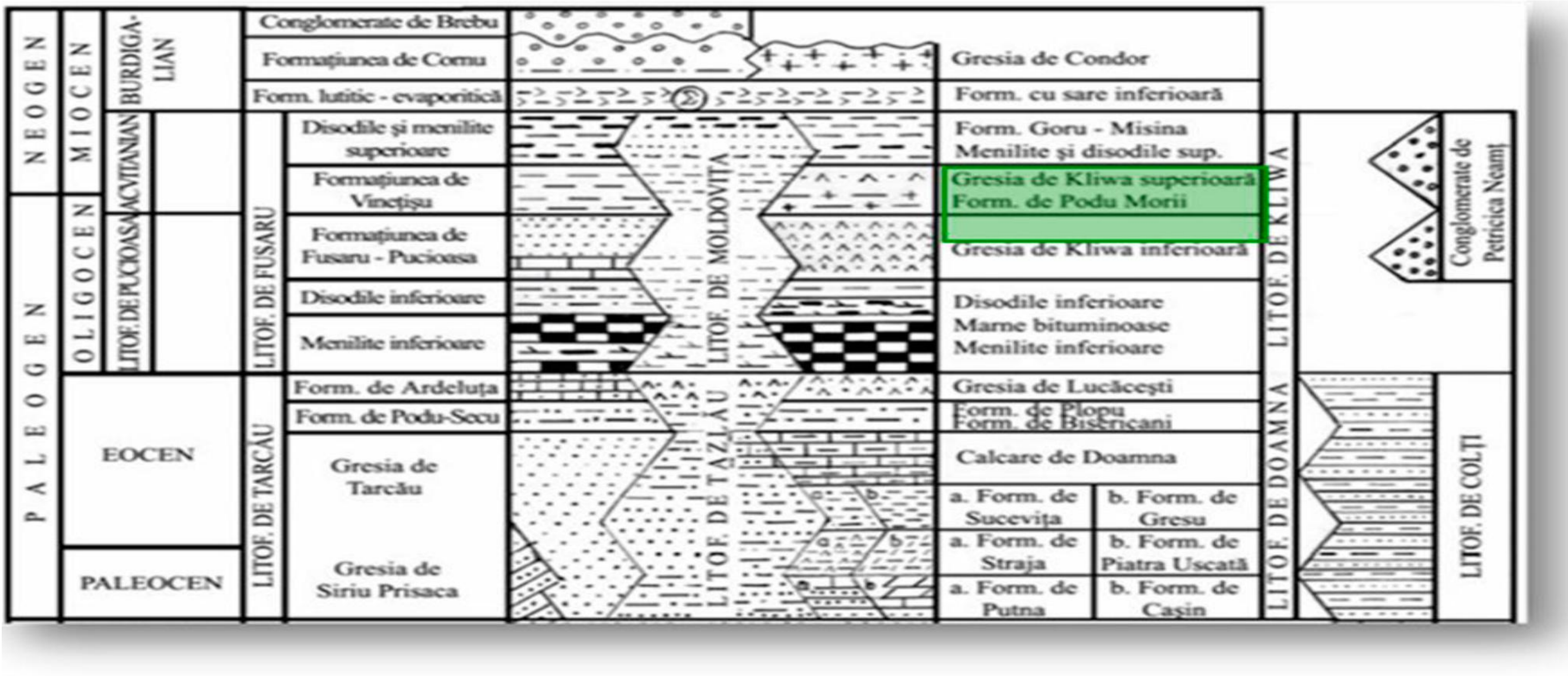

Figure 3. Stratigraphic column (after Mutihac, 2004)

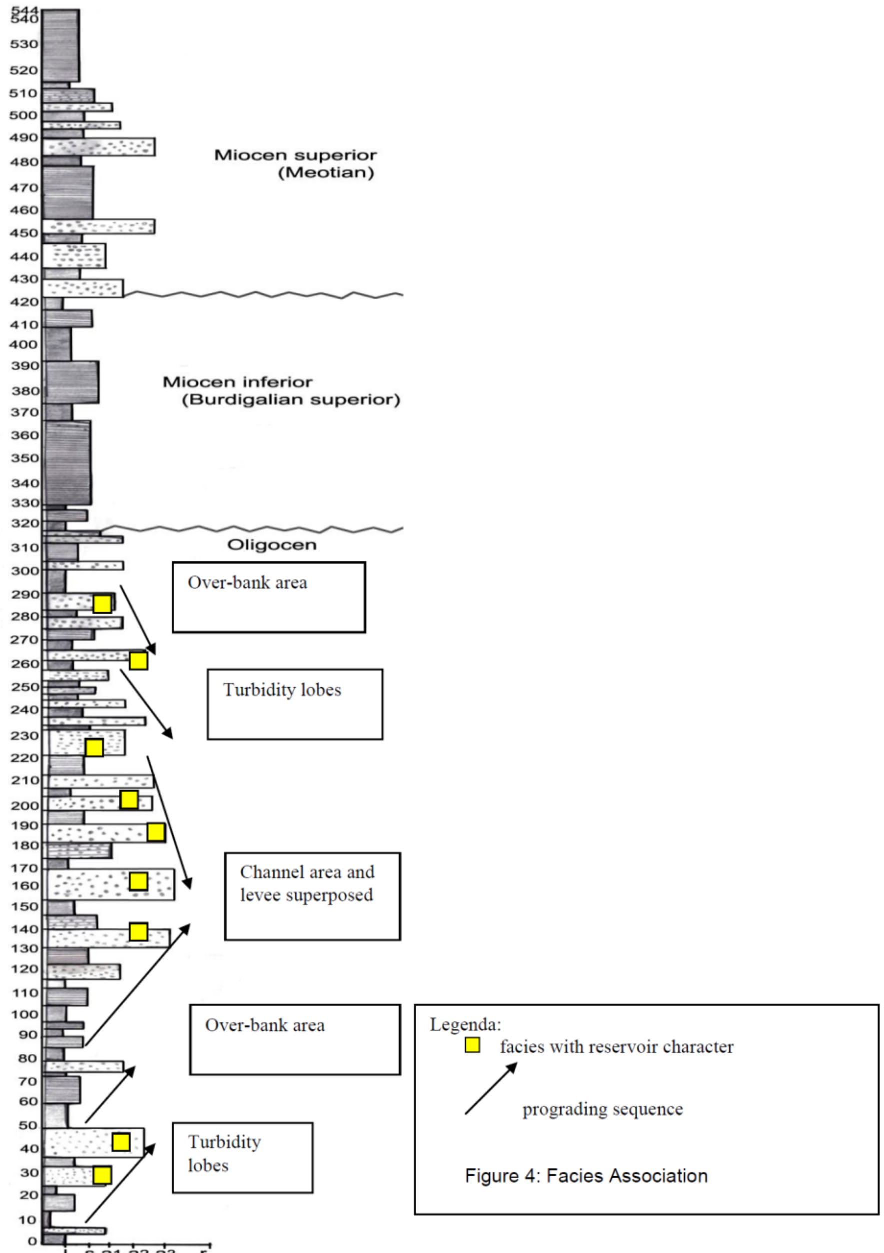

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Figure 4. Detailed stratigraphic column showing detailed facies associations.

Figure 5. Gura Vitioarei outcrop, Kliwa Formation, Oligocene.

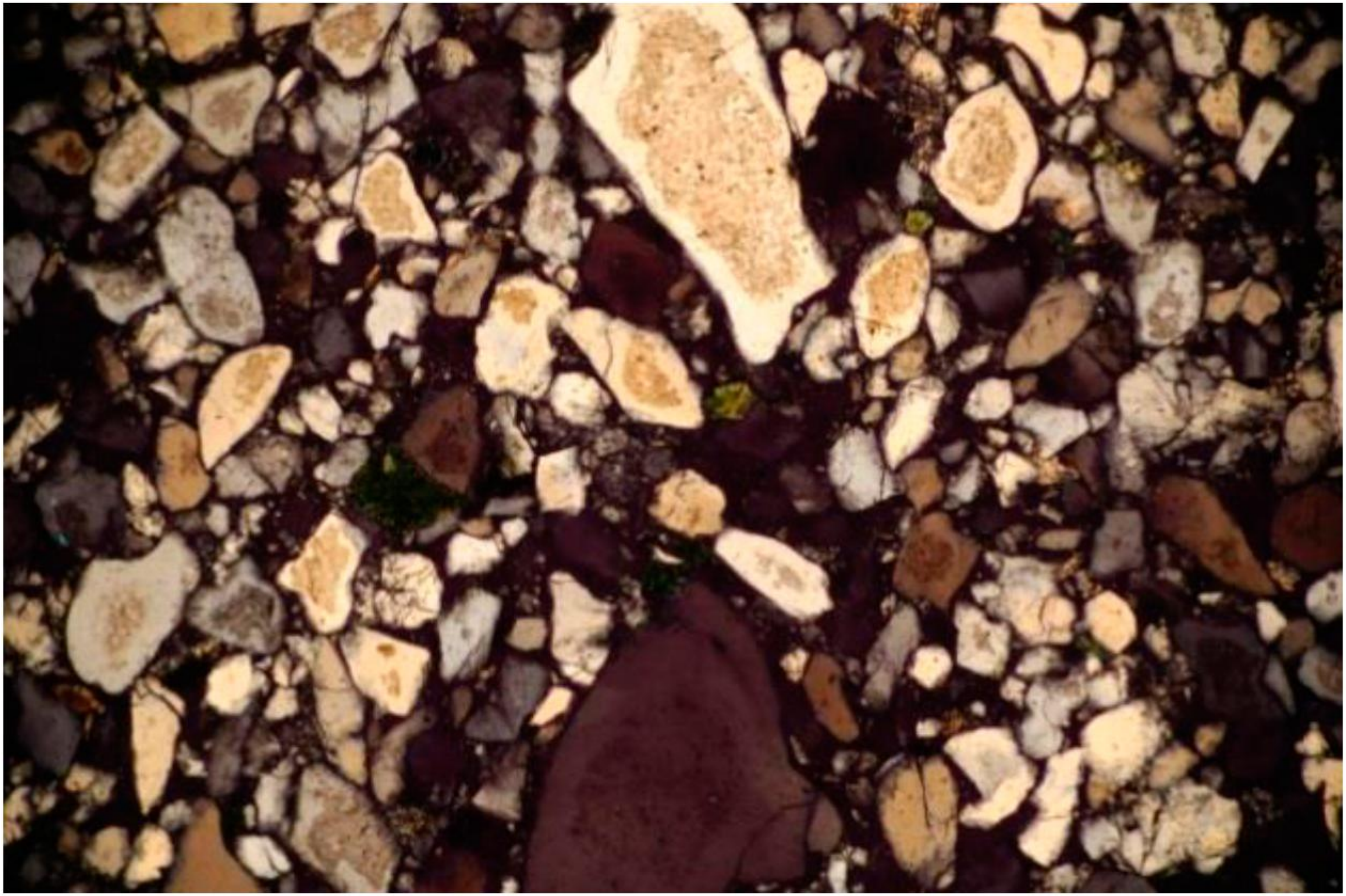

Figure 6. Photomicrograph of Kliwa Sandstone, quartzitic, massive structure Gura Vitioarei, N+ 10X.

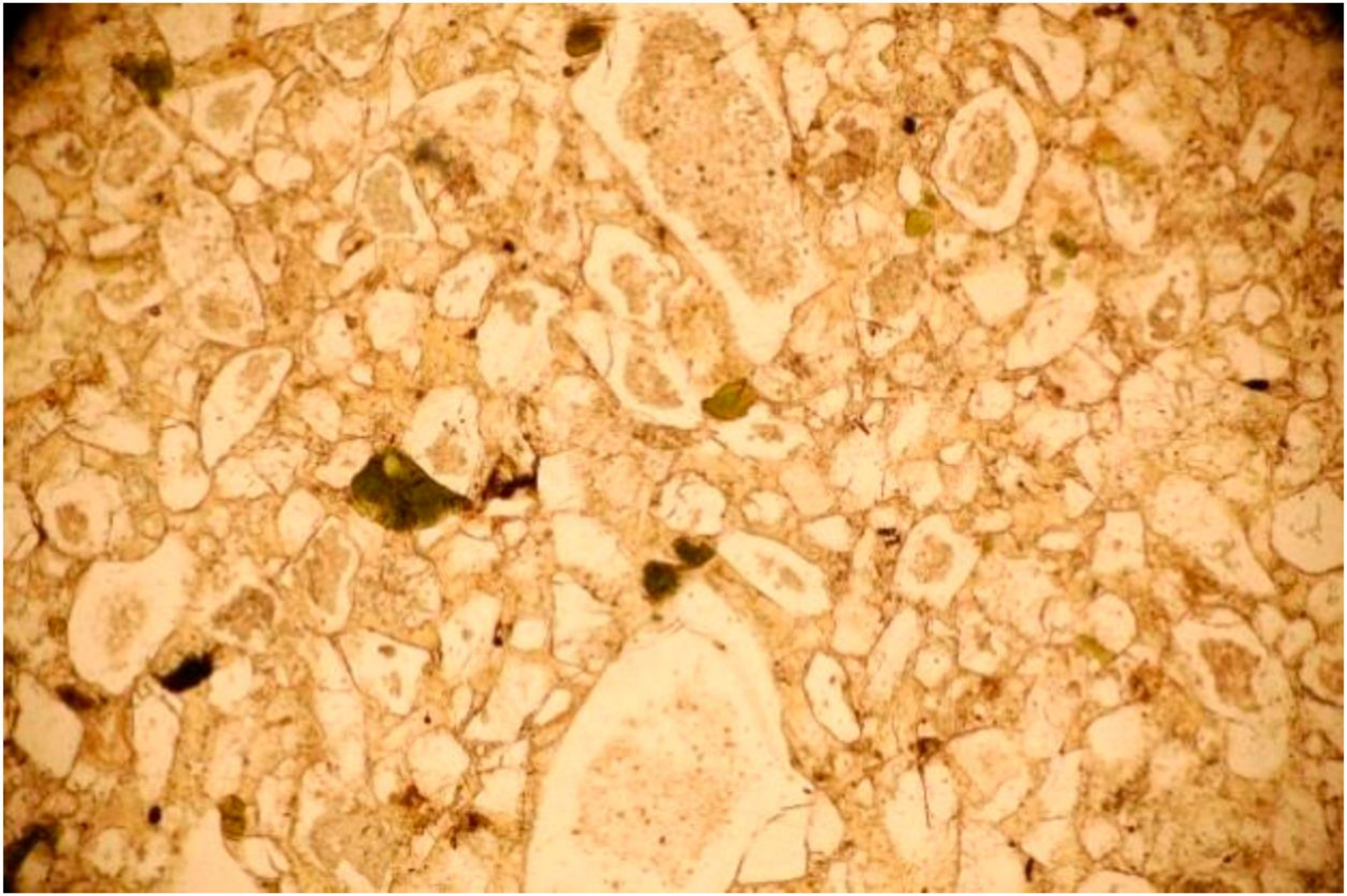

Figure 7. Photomicrograph of Kliwa Sandstone, quartzitic, masive structure. Gura Vitioarei, NII 10X.

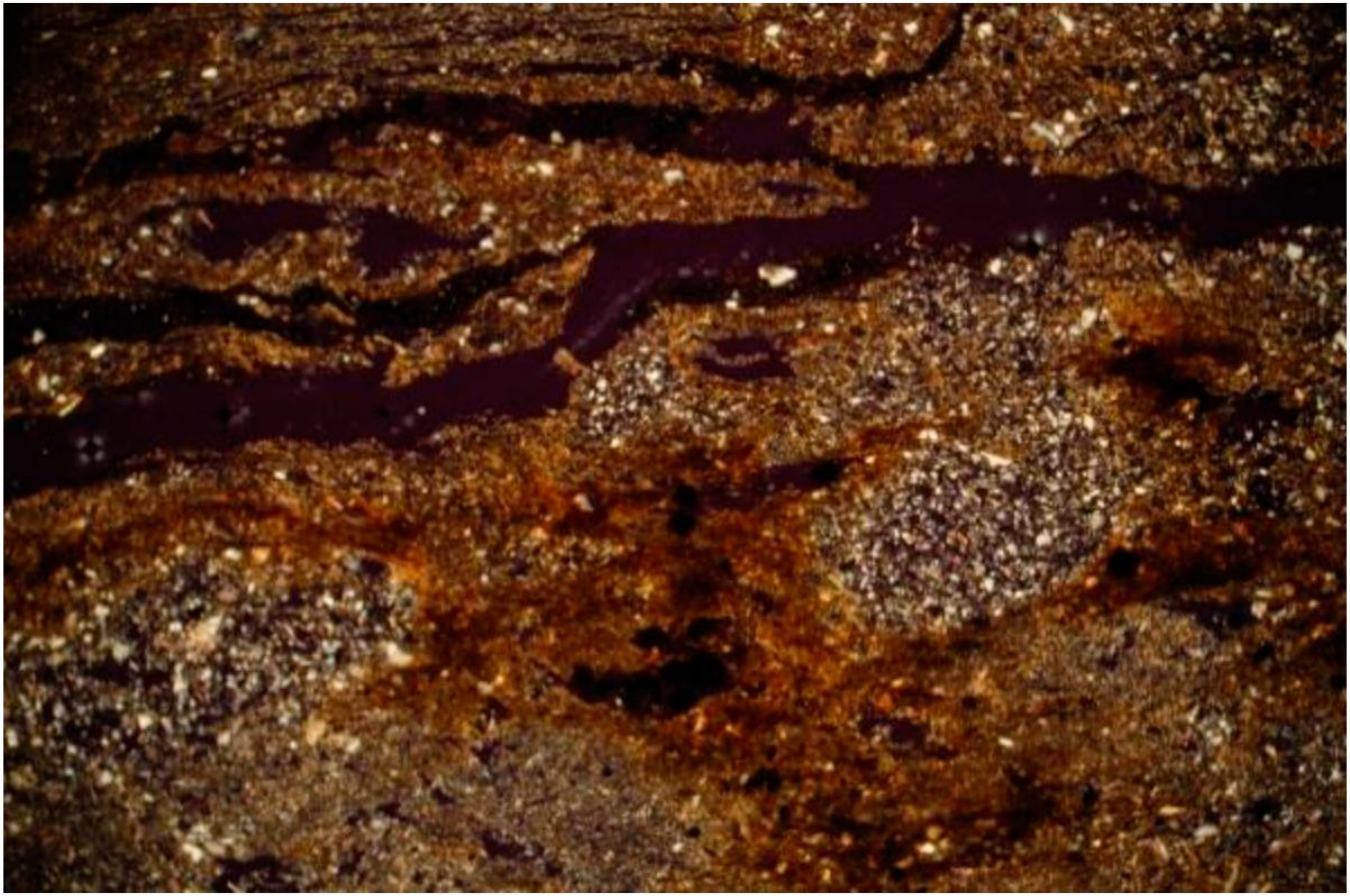

Figure 8. Photomicrograph of graywake, Teleajen Vally, N+ 4X, fracture porosity.

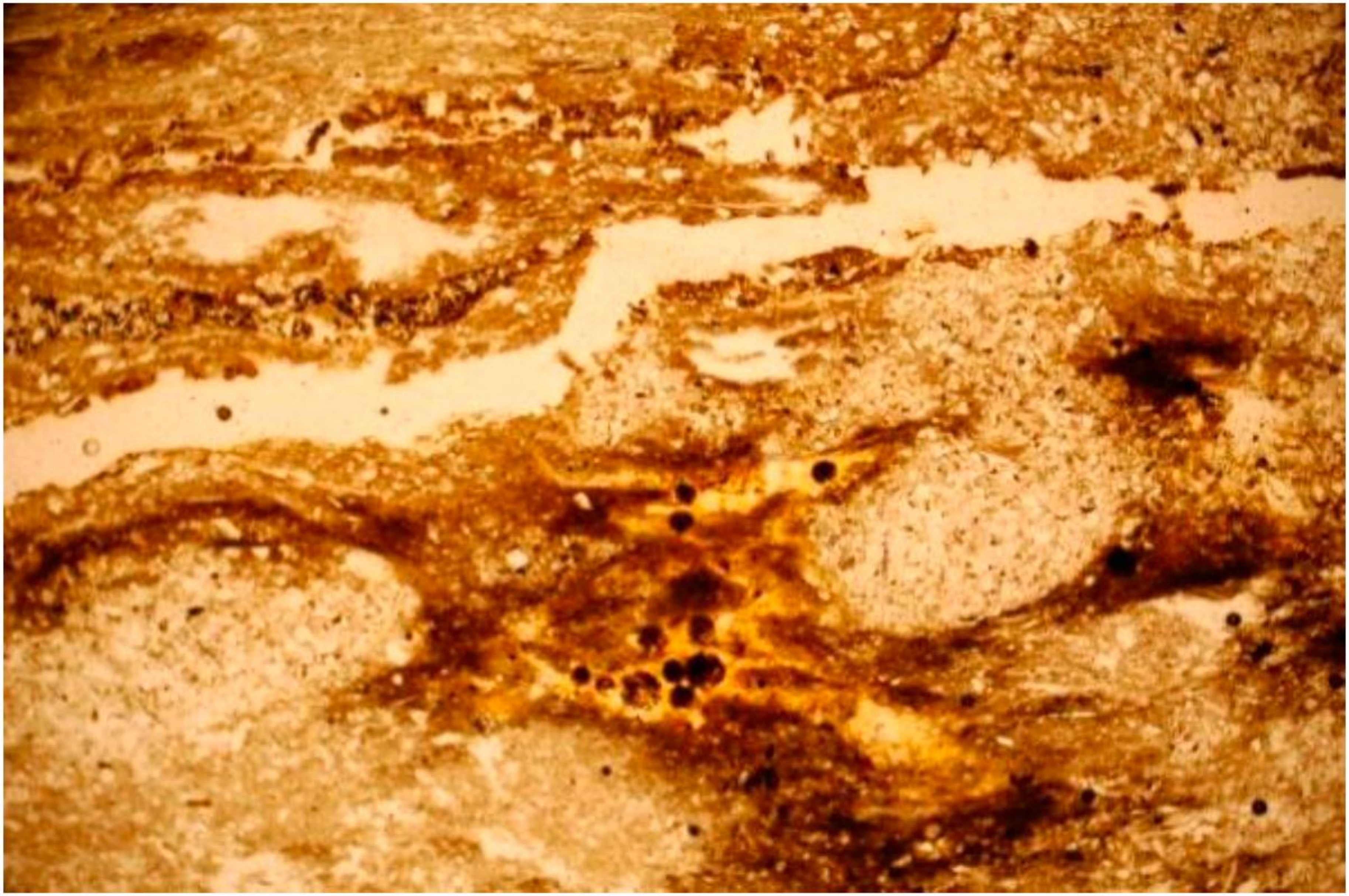

Figure 9. Photomicrograph of graywake, Teleajen Valley, NII 4X.

Figure 10. Photomicrograph of shale, Teleajen Valley, NII 4X.

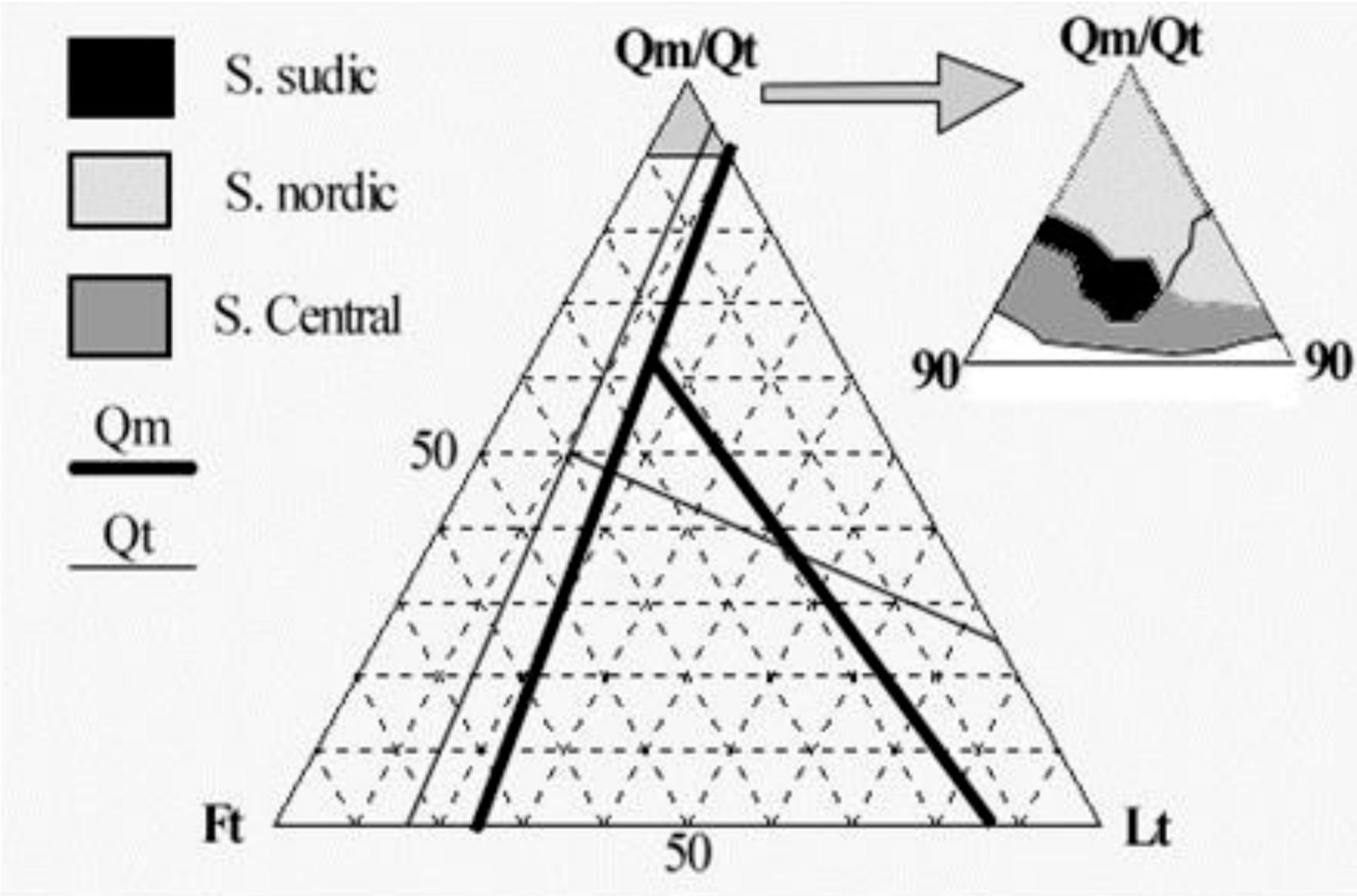

Figure 11. Dickinson and Suczeck (1979) diagram.