PETROGRAPHIC STUDY OF THE GRAVELS FROM THE OLTEȚ PIEDMONT (ROMANIA)

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Abstract. The Lower Pleistocene detritic deposits of the Olteț Piedmont, placed west of the Olt River, are predominantly composed of sands, subordinate small gravel, in contrast to the detritic deposits of the Cotmeana Piedmont, placed east of the Olt River, where medium and large pebbles of gravels are predominant. The main petrographic types of pebbles from the gravels in the Olteț Piedmont are of quartzo-feldspathic gneisses, granites, amphibolite rocks, quartzites and eclogites. Their proximal source area is the crystalline basement of the Parâng and Căpățâna Mountains in the north of piedmont. As exotic petrographic types compared to the proximal source area are volcanic rock, quartz redsandstones with jasper lithoclasts and rhyolitic ignimbrites. Their source area is credited to be intracarpathian, an input of clastic material brought by the Olt River, cuantitatively insignificant compared to the one deposited in the Cotmeana Piedmont. The differentiated input of clastic material in the two neighboring piedmonts is due to the subsidence of the eastern sector of the Moesian Platform at the end of the Pliocene, involving the withdrawal of the Pliocene Lake waters and the deviation to the east of the rivers in the new land, including the Olt River.

Keywords: Olteț Piedmont, gravels, petrography, source area.

Rezumat. Studiul petrografic al pietrișurilor din Piemontul Olteţului (România). Depozitele detritice Pleistocen inferioare din Piemontul Olteţului, situat la vest de Râul Olt, sunt predominant alcătuite din nisipuri, subordonat pietrișuri mărunte, în contrast depozitele detritice din Piemontul Cotmeana, situat la est de Râul Olt, unde pietrișurile cu galeți de dimensiuni medii și mari sunt predominante. Principalele tipuri petrografice de galeți din pietrișurile Piemontului Olteț sunt de gnaise cuarțo-feldspatice, granite, roci amfibolice, cuarțite și eclogite. Aria lor sursă proximală este fundamentul cristalin al Munților Parâng și Căpățâna din nordul piemontului. Ca tipuri petrografice exotice în raport cu aria susă proximală sunt galeţii de roci vulcanice, gresii cuarțoase roșii cu litoclaste de jaspuri și ignimbrite riolitice. Aria lor sursă este creditată ca fiind intracarpatică, un aport de material detritic adus de râul Olt, cantitativ insignifiant în comparație cu cel depus în Piemontul Cotmeana. Aportul diferențiat de material clastic în cele două piemonturi vecine se datoreză subsidenței sectorului estic al Platformei Moesice la sfârșitul Pliocenului, implicând retragerea apelor Lacului Pliocen și devierea spre est a râurilor din aria noului teritoriu uscat, inclusiv a râului Olt.

Cuvinte cheie: Piemontul Olteţului, pietrișuri, petrografie, arie sursă.

INTRODUCTION

The Olteț Piedmont is the largest subunit of the Getic Piedmont, occupying 33% of its surface, approximately 4650 km^2. It has a fragmented relief, typical for a piedmont, with altitudes of 550 m at the contact with the Getic Subcarpathians and 200 m at the contact with the Oltenia Plain. To the east it is bounded by the Olt River and to the west by the Gilort and Jiu rivers. The main rivers that cross the Piedmont spring from the Carpathian area. From east to west, these are Bistrița, Luncavăț, Cerna, Olteț and Gilort. The inland rivers, which spring from the piedmont, are Pesceana (a right tributary of the Olt), Amaradia (a left tributary of the Jiu) and the tributaries in the piedmont of all the rivers mentioned above. The hydrographic network has a divergent texture on the dejection cones in the north of piedmont and converges in the depression areas in its southern part. Field observations and sampling were done only on the inland rivers.

From geological point of view, the Olteț Piedmont is made up of fluvio-lacustrine deposits of sands and gravels of Lower Pleistocene age (Cândeşti Beds), partially covered by loess and loessoid deposits of Middle and Upper Pleistocene age. The substratum consists of marls and clays of Upper Romanian-Lower Pleistocene age (GHENEA et al., 1971; SĂNDULESCU et al., 1978). According to ANDREESCU et al. (2013) the age of the Cândești Gravels would be Romanian. The gravels deposition in the piedmont is subsequent to the Wallachian orogeny at the end of the Pliocene, which determined the rise of the Carpathian source area having as a consequence the erosion acceleration and the increase of the clastic material input in the piedmont area.

This paper is the first petrographic study of gravel in the Olteț Piedmont, in fact a continuation of the petrographic studies made by us in the Getic Piedmont east of Olt (GHENCIU & STELEA, 2016; CULESCU & GHENCIU, 2020, 2021; GHENCIU & CULESCU, 2021; CULESCU, 2022). Unlike the Cotmeana Piedmont, where gravels are predominant, in the Olteț Piedmont the sands clearly predominate over the gravels. Large valleys in the western part of the Olteț Piedmont (Olteț, Amaradia) and even in its eastern part (Pesceana Valley) are completely free of gravel.

FIELD RESEARCHES

Field researches in the Olteț Piedmont were carried out in 85 observation points, of which 79 with sand (Fig.1) and only 6 with gravel, usually small and in small banks, from which 92 samples of pebbles were collected. The gravels were found in the basins of the Cerna Olteţului, Șasa and Luncavăț valleys. In order of frequency, the main petrographic types of pebbles are quartzo-feldspathic gneisses, granites, amphibolite rocks, eclogites and quartzites. Extremely rare are the siliceous rocks (radiolarites), eruptive rocks and quartz redsandstones.

Cerna Valley basin (3 points, 35 samples)

- Point 3358, RuginoasaV. (7 samples): pebbles of quartz, granites, quartzo-feldspathic gneisses, amphibolite gneisses, eclogites, mylonites and quartz breccias;

- point 3359, Popeasa V. (17 samples): pebbles of quartz, granites, quartzo-feldspathic gneisses, biotite gneisses, amphibolite gneisses, very rarely quartz redsandstones and silicolites;

- point 3360, Hotărasa V. (11 samples): pebble of quartz, granites, quartzo-feldspathic gneisses, amphibolite gneisses, eclogites, altered micaschists, pegmatites, very rare volcanic rocks and silicolites.

Şasa Valley basin (2 points, 26 samples)

- Point 3366, Şasa Valley at the confluence with Trestia Valley (18 samples): pebbles of quartz, quartzites, quartzo-feldspathic gneisses, amphibolite rocks, granites, quartz redsandstones and pegmatites, very rare silicolites;

- point 3368, Trestia Valley (8 samples): pebbles of granite, quartzo-feldspathic gneisses and quartzite, very rare silicolite.

Luncavăţ Valley basin (1 point, 3 samples)

- Point 3770, Gurguianca Valley: fine sands and gravels with pebbles of quartz, quartzo-feldspathic gneisses, quartz redsandstones, amphibolite gneisses, quartzites and silicolites; it is the only point without granite pebbles.

In the proximal source area north of the piedmont (Parâng and Căpăţâna Mountains) punctual petrographic observations were made in the basins of Cerna Olteţului, Luncavăţ, Bistriţa and Bistricioara valleys, from where a total number of 32 samples was collected.

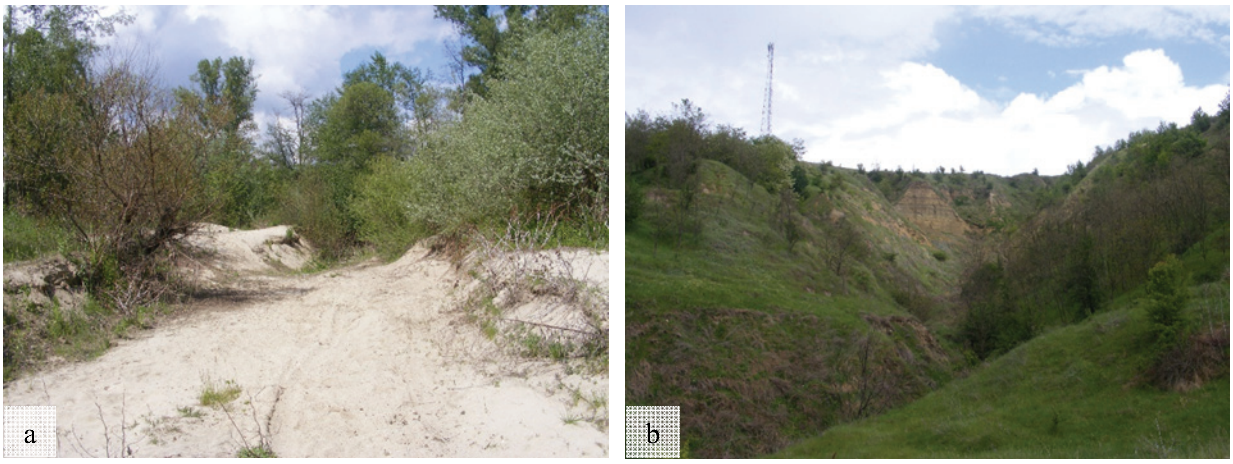

Figure 1. a) Sand deposits on the Nemoiu Valley. b) Big outcrops of sand in the left slope of the Amaradia Valley.

MICROSCOPIC STUDY

Quartzo-feldspathic gneisses. These are medium-grained, sometimes fine-grained rocks. Primary paragenesis, associated with their initial metamorphism (M1), consists of plagioclase and biotite, rare muscovite and garnet (almandine). Secondary paragenesis (M2) consists of microcline (Fig. 2a), substituting in varying proportions the plagioclase, and muscovite II formed on biotite. The proportion of micas is low. Fe-Ti oxides may occur as by-products of the biotite muscovitization. Subsequent alteration processes lead to the sericitization of plagioclase and to the chloritization of non-muscovitized biotite. Being a very mobile mineral phase, the quartz cannot be included with certainty in one or another of these paragenesis.

Frequently, the texture of the rocks is massive, microgranitic. In some samples only the quartzo-feldspathic component has a massive texture, in contrast to the micas that are arranged in parallel alignments. Cataclazed gnaisses sometimes have quasi-augen textures.

Amphibolite rocks. These rocks are represented by amphibolite (Fig. 2b) and amphibolite gneisses (Fig. 2c), the difference between them being the proportion of plagioclase, higher in gneisses. In addition to plagioclase, contain green hornblende, sometimes anthophyllite or cummingtonite, garnet, quartz, apatite, and as secondary minerals sphene, clinozoisite, epidote and chlorite, all formed at the expense of hornblende. Sometimes the hornblende is large, with an anhedral contour (Fig. 2c) and inclusions of garnet, quartz and zircon. Amphibolite rocks are medium-grained or coarse-grained, usually the amphibolite gneisses. The amphibolite with cummingtonite sample is fine-grained. The texture is often massive, especially in gneisses, or weakly oriented.

Eclogites. The mineralogical composition of the studied samples consists of garnet, clinopyroxene (omphacite), orthopyroxene (hypersten), plagioclase, green hornblende, quartz, magnetite, rutile and sphene. The pyroxenes appear only as restites in secondary albite nests (Fig. 2d). The hornblende rarely occurs in independent, large granules with lobed contour, partially replaced by tremolite and actinolite. The quartz occurs in small aggregates of polygonal undeformed granules, sometimes associated with plagioclase.

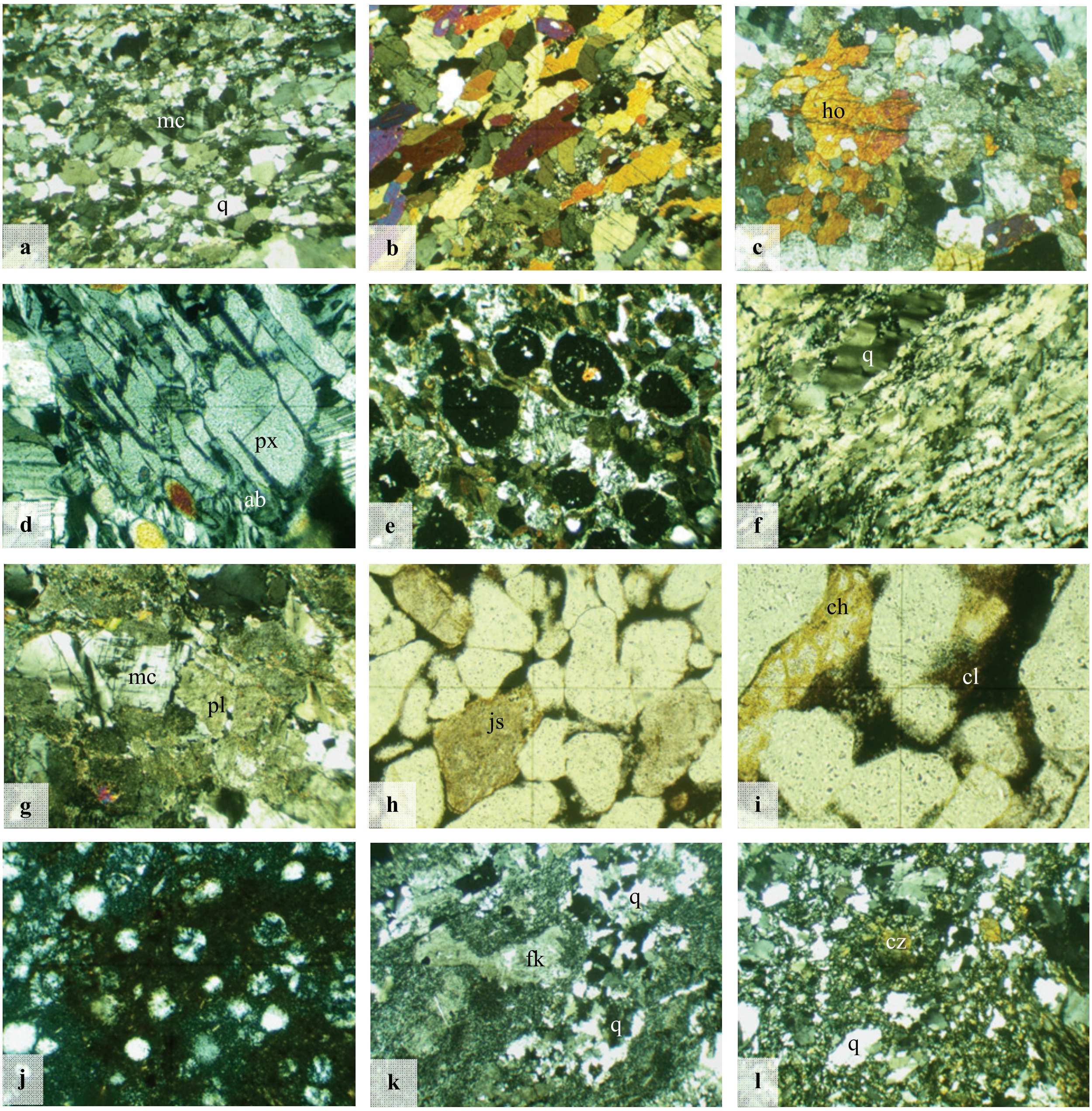

Figure 2. a) Cataclazed quartzo-feldspathic gneiss with clasts of microcline (mc) and quartz (q). b) Amphibolite with oriented texture. c) Amphibolite gneiss with massive texture and large green hornblende (ho). d) Detail in eclogite with restites of pyroxenes (px) in a nest of secondary albite (ab). e) Kelyphitic coronas on garnet in eclogite. f) Mylonitic texture in quartzite with clasts of deformed quartz (q) and matrix of partially recrystallized quartz. g) Granite with sericitized plagioclase (pl) and fresh microcline (mc). h) Redsandstone with jasper lithoclasts (js). i) Detail in redsandstone with clay (cl)-chlorite (ch) cement. j) Siliceous rock with tests of chalcedonized radiolarians. k) Rhyolitic ignimbrite with quartz aggregates (q) and magmatically corroded phenocrysts of potasium feldspar (fk). l) Tectonic breccia with quartz (q) and clinozoisite (cz). Cross-polarized (a, b, c, d, e, f, g, j, k, l) and plane-plane polarized light (h, i). The photos width is 0.7 mm (d, i), 1.4 mm (h) and 4.2 mm (a, b, c, f, g, j, k, l).

Eclogites are formed at high pressures by the metamorphism of the basic and ultrabasic rocks in the upper mantle. During the up-lift at higher crustal levels, specific decompression textures appear in the rocks. Garnet has kelyphitic coronas made of amphibole and plagioclase fibers arranged perpendicular on the garnet grains (Fig. 2e). Symplectitic textures are vermicular aggregates of pyroxene, hornblende and interstitial albite.

Quartzites. Almost all the quartzite samples show cataclastic textures, with deformed quartz, or mylonitic textures, with recrystallized quartz (Fig. 2f). All the samples contain hematite in the form of microlites, hexagonal crystals or red earthy aggregates. In addition to quartz and hematite, there are clasts of biotite, garnet, albite and apatite. The quartzitic mylonites may have S-C structure, in which the S planes are represented by hematite alignments and the C planes by elongated granules of quartz, obliquely recrystallized on the S planes.

Granites. The granite samples were collected from the Cerna and Șasa valleys basins. In all the samples, the granites are identical, coming from the same magmatic body. Are coarse-grained rocks, with a mineralogical composition consisting in plagioclase (oligoclase) and biotite, as minerals of the magmatic paragenesis, potassium feldspar (microcline) and muscovite, as minerals of a post-magmatic paragenesis, sericite, chlorite, clinozoite, as minerals of a retromorphic paragenesis.

The plagioclase occurs in euhedral and subhedral granules, polysynthetically twinned, sometimes zoned, and more or less sericitized (Fig. 2g). The grains frequently haves unaltered albitic edges. It is sometimes deformed, with bent cleavage planes and undulatory extinction. The microcline, usually in smaller, subhedral granules, replaces the plagioclase along the intergranular spaces. Sometimes invades large spaces forming large anhedral granules with remnants of sericitized plagioclase and inclusions of quartz and biotite.

The biotite is reddish-brown, rich in trivalent Fe and Ti. It contains microcrystalline or acicular rutile inclusions, arranged in three directions (sagenite). It is partially muscovitized, the non-muscovitized biotite being subsequently chloritized, partially or totally. Both transformation reactions release iron oxides (magnetite) and titanium (sphene). Biotite can also appear as inclusions in plagioclase. The quartz, frequently cataclased, shows various degrees of recrystallization.

Redsandstones. The three samples of redsandstones mainly consist of quartz (crystalloclasts and quartzite lithoclasts), rare plagioclase and potassium feldspar crystalloclasts. The red colour is given by the jasper lithoclasts (Fig. 2h). The cement is clay-chlorite (Fig. 2i). A single sample has good degree of sorting and rounding.

Siliceous rocks (radiolarites). There are three samples of siliceous rocks consisting of cryptocrystalline chalcedony and microgranular quartz, fine impregnations of goethite, relatively homogeneous, and clayey impurities. The tests of chalcedonized radiolarians do not contain impurities (Fig. 2j).

Volcanic rocks. These rocks are represented by a single sample of rhyolitic ignimbrite (Fig. 2k). It has a glassy quartz-feldspar matrix, partially devitrified, with chalcedony rosettes. The texture is massive, locally fluidal. The matrix contains anhedral quartz aggregates, with diffuse edges, and deformed phenocrysts of potassium feldspar, some of them magmatically corroded. A system of cracks filled with quartz and opaque minerals crosses the matrix and the phenocrysts. Under the microscope, the general appearance of the rock texture is chaotic.

Tectonic breccias. There are two samples of tectonic breccias. A sample contains clasts of various sizes of quartz, mono- or polygranular, and clinozoisite associated with zoisite in a finely cataclazed mass with the same mineralogical composition (Fig. 2l). The other breccia sample consists of quartz aggregates and microblastic zoisite and clinozoisite in dendritic aggregates, locally with larger, post-kinematic crystals. Both types of aggregates contain microblastic hematite and numerous grains of sphene, xenotime, monazite, less frequently zircon and apatite.

DISCUSSIONS AND CONCLUSIONS

The main petrographic types of pebbles identified in the gravels of the Olteț Piedmont are of granites, quartzo-feldspathic gneisses, amphibolite rocks, quartzites and eclogites. These indicate a source area corresponding to the Parâng Mountains and the Căpățâna Mountains.

Petrographic information relevant to the origin of the pebbles in the piedmont gravels provide the petrographic samples collected from the mountainous area of the Cerna Valley basin (Parâng Mountains). Here the Cerna River crosses the Olteț granite (HANN et al., 1986), from which come all the granite pebbles identified in the piedmont. It is the same coarse-grained granite with sericitized plagioclase and unaltered microcline, locally invasive, with plagioclase remnants and quartz and biotite inclusions. Its left tributaries in this area cross bodies of quartzo-feldspathic gneisses with micrographitic texture, locally cataclastic, rocks that frequently appear in the gravels of the Cerna Valley basin.

Beyond these observations, the quartzo-feldspathic gneisses, amphibolite rocks, eclogites and quartzites are common rocks for both the Parâng and Căpățâna Mountains. Exotic as against the proximal source area are the volcanic rocks and the redsandstones, which do not appear in the the source area. In part, the siliceous rocks could also be considered exotic. Three lenses of Callovian-Oxfordian limestone with jaspers outcrop under the Kimmeridgian-Titonian limestones in the Buila-Vânturarița carbonatic massif (LUPU et al., 1978). In our opinion, it is a too small source area to produce significant amounts of siliceous clastic material.

The rhyolitic ignimbrites, redsandstones and siliceous rocks identified in the central and northeastern part of the piedmont could come from intracarpathian source areas localized in the Olt River basin, possible removed from older detrital formations. Their minor presence in the Olteț Piedmont is an argument that the clastic material brought by the Olt River was deposited asymmetrically in relation to its present course, preferential on the eastern bank, in the Cotmeana Piedmont. Here, the pebbles of eruptive rocks, quartz redsandstones and siliceous rocks are spread all over the piedmont surface, especially in its western half (CULESCU, 2022). Compared to the source area of the Olteț Piedmont, the source area of the Cotmeana Piedmont, corresponding to the river basins of the Olt and Argeș rivers, is incomparably larger and has a much more diversified geology.

In order to explain the absence of gravels in the Olteț Piedmont, MIHĂILESCU (1946) invoked rise movements and higher erosion rates west of Olt. A higher erosion rate west of Olt should have brought to the surface the Romanian marls substratum on most of the valleys in the Olteț Piedmont. During the field researches, we found the marls only in 4 points in the eastern half of the piedmont, 2 points in the Şasa Valley basin and 2 in the Pesceana Valley basin. Contrary to the author's hypothesis quoted above, in the Cotmeana Piedmont east of Olt the Romanian marls outcrop in 13 points on 11 valleys (CULESCU, 2022). The asymmetric deposition of the clastic material transported by Olt may be the consequence of the subsidence of the eastern sector of the Moesian Platform at the end of the Pliocene, as well as the withdrawal of the of the Pliocene Lake waters and the eastward deviation of the hydrographic network in the Romanian Plain and even in the piedmont, the case of the Argeş River. It is possible that the primitive course of the Olt in the Getic Piedmont area was deviated to the east, the most part of the transported clastic material being deposited in the Cotmeana Piedmont.

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