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PETROGRAPHY AND PROVENANCE OF THE FRĂTEŞTI BEDS GRAVELS (SOUTHERN DACIAN BASIN)

GHENCIU Monica, CULESCU Flori

Abstract. Pebbles of quartzo-feldspathic gneisses, quartzites, cherts, sandstones, andesites, andesitic tuffs, and hornblende gneisses have been identified in the Frăteşti Beds gravels (Lower Pleistocene) from the southern Dacian Basin, Giurgiu Town area. As rare petrographic types we mention the pebbles of spessartite gneisses, andesitic tuffs, and sandstones with lithoclasts of jasper. All these rocks are also present in the coarse gravels of the contemporary Cândeşti Beds (Lower Pleistocene) in the Getic Piedmont east of the Olt River, with certain Carpathian provenance. The paper argues in favor of the Carpathian origin of the Frăteşti Beds gravels.

Keywords: Frăteşti Beds, gravels, provenance.

Rezumat. Petrografia şi provenienţa pietrişurilor din Stratele de Frăteşti (sudul Bazinului Dacic). În pietrişurile Stratelor de Frăteşti (Pleistocen inferior) din sudul Bazinului Dacic, zona Giurgiu, au fost identificate gnaise cuarţo-feldspatice, cuarţite, cherturi, gresii, roci andezitice şi gnaise cu hornblendă. Ca tipuri petrografice rare, menţionăm galeţii de gnaise cu spessartin, tufuri andezitice şi gresii cu litoclaste de jaspuri. Toate aceste roci apar şi în pietrişurile grosiere ale Stratelor de Cândeşti (Pleistocen inferior) din Piemontul Getic de la est de Olt, cu certă provenienţă carpatică. Lucrarea aduce argumente în favoarea originii carpatice a pietrişurilor din Stratele de Frăteşti.

Cuvinte cheie: Strate de Frăteşti, pietrişuri, provenienţă.

INTRODUCTION

Stratigraphic data. The Frăteşti Beds or Gravels (LITEANU, 1952; 1953) represent the Lower Pleistocene fluvial deposits of sands with gravels in the southern Dacian Basin. The stratotype is near the Frăteşti Village, Giurgiu County (LITEANU, 1953). These deposits occupy much of the Wallachian Depression, starting from the lower basins of the Siret and Prut rivers and continuing along the Danube till the west of the Olt River. The sands and gravels horizon extends to the north in the lower basins of the Ialomiţa, Argeş and Vedea rivers (GHENEA et al., 1969). In the investigated region, the Frăteşti Beds outcrop on the southern margin of the Burnas Plain and the valleys that drain this plain (BANDRABUR et al., 1966). The thickness of the sands level with gravels is of 10-13 m in the drillings from the Giurgiu Town area.

Over the Frăteşti Beds lies a horizon of sandy marls and clays of 3-4 m thick representing the southern extension of the marly complex intercepted in the drillings from Bucharest (LITEANU, 1952). The marly complex in the Burnas Plain is largely eroded and covered by loessoid deposits with limestone concretions, of Late Mid-Pleistocene and Upper Pleistocene age (BANDRABUR et al., 1966). North of Giurgiu, on the southern margin of the Burnas Plain between the villages of Daia and Frateşti, the Lower Pleistocene sandbanks with gravels lie over the Romanian gray clayey marls (LITEANU, 1953). Older deposits, of Dacian and Cretacic age, are known from the drillings performed along the Danube.

Petrographic data. The first information on the petrographic composition of sands and gravels in the Dacian Basin were provided by MRAZEC (1899) who studied the samples from the drilling near the Mărculeşti Village, Ialomiţa County. Granites, ortophyres (orthoclase trahites), leptynites (quartzo-feldspathic gneisses in this case), Liassic quartzitic sandstones, micaceous sandstones, cherts, garnet-bearing micaschists, and Mesozoic white limestones were identified in the gravel. The sand contain quartz, muscovite, feldspar, garnet, rutile, magnetite, sphene, zircon, apatite, corundum, and kyanite granules. Based on petrographic observations, the author concludes that the studied detritic material is of Carpathian origin.

LITEANU (1952) has identified quartzites, granitic gneisses, micaschists, conglomerates, sandstones, jaspers, and cherts in the Frăteşti Gravels crossed by the drillings from Bucharest. In the Frăteşti Beds outcropping in the Burnas Plain, LITEANU (1953) found pebbles of rhyolites and cherts. In his opinion, these rocks could come from the Bulgarian Plateau (Pre-Balkans). Remarking the absence of Cretaceous limestone outcroping south of the Danube, the author admits that most of the detritic material in the Frăteşti Beds is of Carpathian origin. The petrographic types considered of Balkan origin (rhyolites, cherts) would be specific for the gravels in the Burnas Plain.

In this paper we present new data on the petrographic composition of the gravels in the Frăteşti Beds. For this were sampled the gravels on the southern margin of the Burnas Plain outcropping in the Onceşti Quarry and near the Daia Village, north of the Giurgiu Town. We have not found gravels outcrops on the valleys in the plain. For the samples to be representative it was taken into account the frequency of the petrographic types encountered on the field and their relevance to identify the provenance area. Forty-eight samples of pebbles were fully collected representing the following petrographic types, in order of frequency estimated on the field: quartz (4 samples, irrelevant to the source area), quartzo-feldspathic gneisses (14 samples), quartzites (2 samples), cherts (17 samples), sandstones (4 samples), volcanic rocks (6 samples), and hornblende gneisses (one sample). The pebbles dimensions are small, rarely exceeding 10 cm.

MICROSCOPIC STUDY

Quartzo-feldspathic gneisses. Are fine to coarse grained leucocratic rocks with oriented to massive (granitic) texture. Their mineral association contains two metamorphic parageneses. The first paragenesis, well represented in the massive gneisses, consists of quartz, plagioclase feldspar (oligoclase), reddish-brown (ferric) biotite, greenish-brown (ferroan) biotite, rare green hornblende, and apatite as accessory mineral. The second paragenesis, especially present in the gneisses with oriented texture, is mainly composed of K-feldspar (microcline) and muscovite formed on the expense of plagioclase, respectively biotite, in medium grade metamorphic conditions. The manganiferous garnet (spessartite) is also present in one sample (Fig. 1). Magnetite, ilmenite, sphene, and minerals from the epidote group are by-products of the two substitution reactions. In post-metamorphic alteration processes, chlorite and sericite are formed on the expense of biotite, respectively oligoclase.

Cherts. Are fine-grained sedimentary rocks with massive or layered textures and various colors of ocher, reddish-brown, red and gray, given by the content of organic matter and iron oxides and hydroxides (hematite, goethite). They consist of a fine-grained chalcedony mass with varying proportions of organic remains (Fig. 2a), frequent silicified radiolarians tests and spicules, organic matter, and quartz microclasts. The radiolarians tests are undeformed in the massive cherts and flattened in the layered ones (Fig. 2b). According to texture and organic content, our samples can be grouped as cherts rich in radiolarians tests, cherts rich in silicified shells and organic matter, and micritic cherts poor in organic remains.

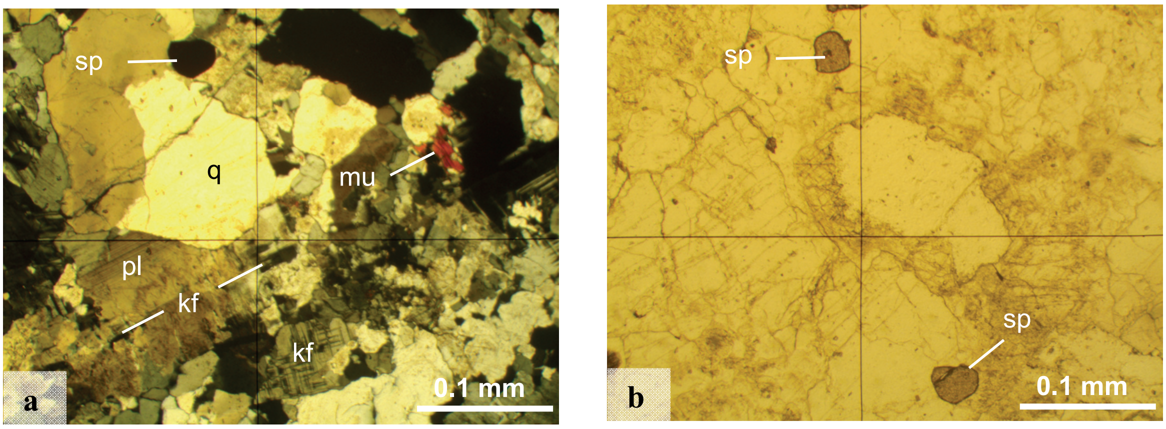

Figure 1. Thin sections in a pebble of quartzo-feldspathic gneiss with microcline (kf) formed on the expense of plagioclase (pl), muscovite (mu), quartz (q) and spessartite (sp). Cross-polarized (a) and plane-polarized light (b).

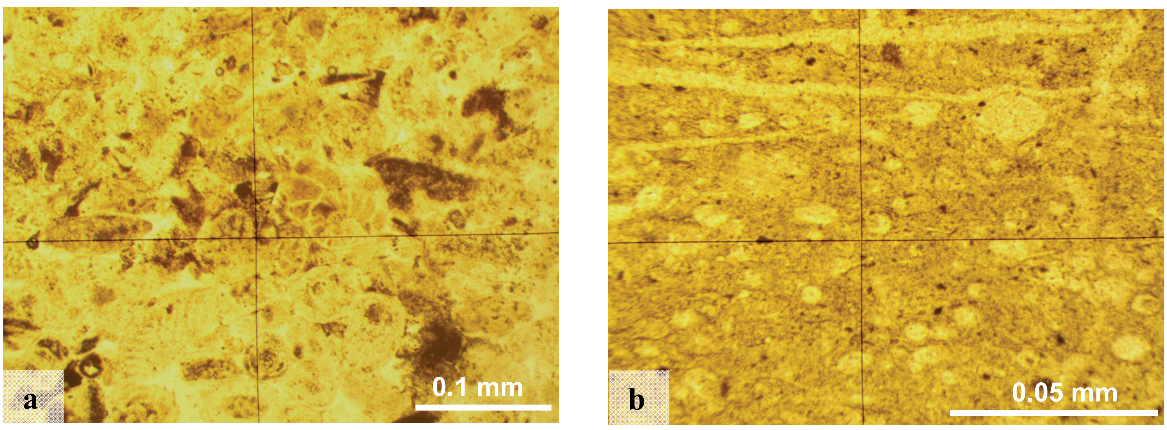

Figure 2. Thin sections in pebbles of cherts with silicified shells (a) and tests of radiolarians (b). Plane-polarized light.

Volcanic rocks. Are represented by andesites (4 samples) rhyodacites (one sample), and andesite tuffs (one sample). The andesites contain phenocrysts of zoned plagioclase, single or grouped in polycrystalline aggregates, phenocrysts and microlites of biotite and hornblende in various stages of decomposition (Fig. 3), and rare phenocrysts of quartz (5-10 percent) corroded by the melt from which the matrix crystallized. Fibrous aggregates of devitrified glass sometimes appear in the matrix. The andesitic tuff consists of a microcrystalline matrix of plagioclase and minor quartz, plagioclase phenocrysts with diffuse contours, and lithoclasts of altered andesite. The rhyodacite sample contains plagioclase phenocrysts with albite borders, corroded phenocrysts of quartz and opacified microlites of biotite. The proportions of plagioclase and quartz are approximately equal.

Sandstones. Are fine-grained quartzitic sandstones of light gray to reddish-gray color, with varying degrees of rounding and sorting. In addition to quartz, these also contain feldspar (albite and K-feldspar), micaceous minerals (sericite, muscovite, chlorite) and lithoclasts of gray quartzites. In a well-rounded and relatively well-sorted sample of reddish-gray sandstone there are also jasper lithoclasts (Fig. 4a).

Quartzites. Are rocks predominantly consisting of quartz, often with mylonitic textures. One of the two samples actually is a quartzitic mylonite with post-kinematically recrystallized matrix, coarse-grained aggregates of post-kinematically recrystallized quartz with intergranular magnetite associated with calcite and siderite (Fig. 4b), and microclasts of deformed relict quartz. A particularity of the quartzitic mylonite is the presence in the matrix of discrete alignments of Fe-Ti oxides (hematite, magnetite, ilmenite).

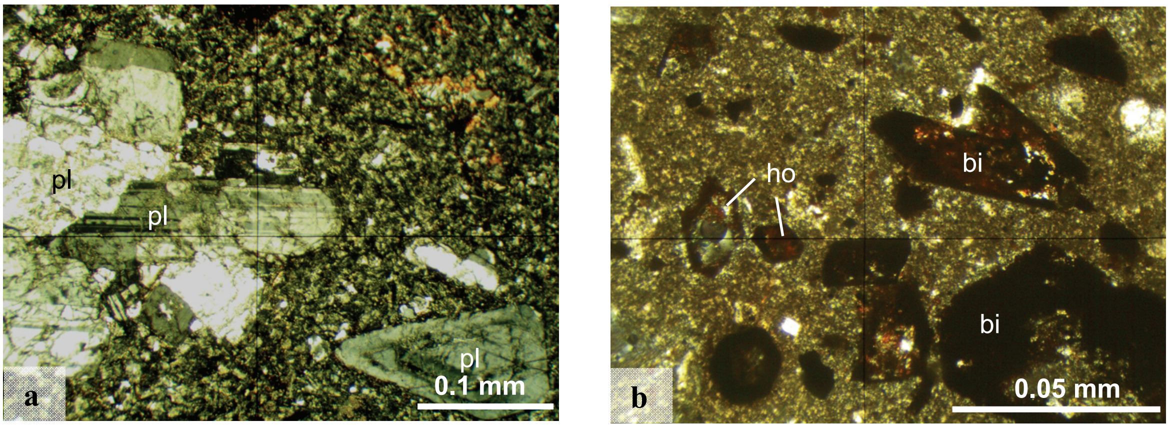

Figure 3. Thin sections in pebbles of andesites: a) euhedral and subhedral phenocrysts of plagioclase (pl); b) opacified phenocrysts of biotite (bi) and hornblende (ho). Cross-polarized light.

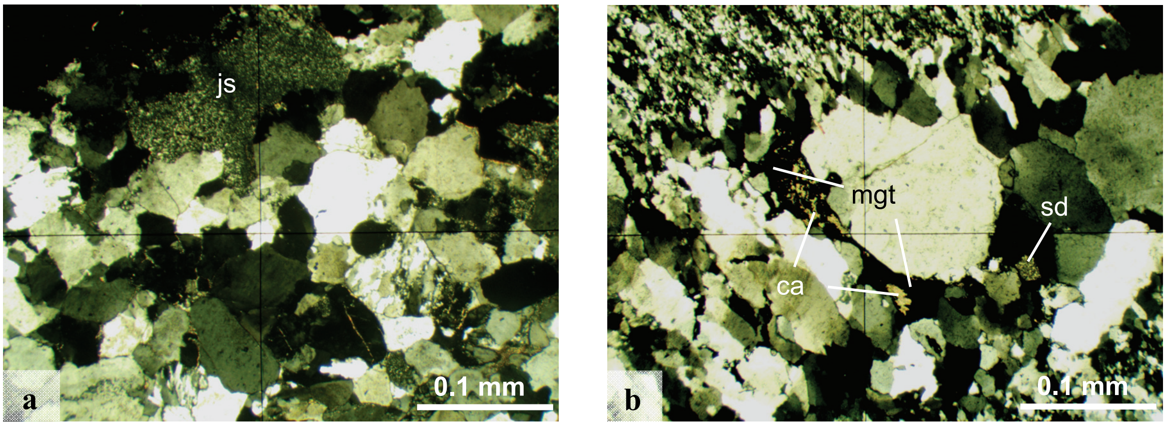

Figure 4. Thin sections in pebbles of sandstones (a) and quartzites (b). **a**) Reddish quartzitic sandstone with lithoclasts of jasper (js). **b**) Quartzite with magnetite associate with calcite (ca) and siderite (sd). Cross-polarized light.

DISCUSSIONS AND CONCLUSIONS

At the end of Pliocene (Romanian), the Dacian Basin has evolved as fluvial-lacustrine sedimentation area, bounded to the north by the Carpathian orogen and to the south by the Balkan orogen and the raised Pre-Balkans and Dobrogea adjacent areas (JIPA, 2006). Theoretically speaking, in the gravels and sands deposits of the Dacian Basin there should be detritic material of both Carpathian and Balkan origin, especially in its southern part. The source areas reconstitution based on the sediments thickness (e.g. JIPA, 1997) shows that the most active source of sediments was the Carpathian area throughout the evolution of the Dacian Basin (Sarmatian-Quaternary). The Balkan and Dobrogea areas had minor contributions in the southwest, respectively southeast of the basin.

Even minor, an influx of clastic material specific to the Dobrogea area, such as greenschists or basalts, is not found in the Frăteşti Gravels from the Giurgiu area. Regarding the possible Balkan origin of volcanic rocks and cherts evoked by LITEANU (1953), we specify that these rocks, like the reddish sandstones with jasper lithoclasts, are characteristic for the Cândeşti Gravels in the Cotmeana Piedmont, where the pebbles are large in relation to those in the southern part of the Dacian Basin. We must mention here that the petrography of the gravels from this piedmont is subject of the doctoral thesis of the coauthor of this paper.

Like in the Frăteşti Beds, the quartzo-feldspathic gneisses and the quartzites are the most common petrographic types of pebbles in the Cândeşti Gravels from the Getic Piedmont east of the Olt River (e.g. GHENCIU & STELEA, 2016).

The gneisses outcrop on large areas in the crystalline basement of the South Carpathians, but the spessartite-bearing quartzo-feldspathic gneisses only outcrop in the Getic Crystalline of the Sebeş-Cibin Mountains. Although outcrop as lenses, the quartzites frequently occur in the gravel deposits of the piedmont due to their resistance to weathering and transport. The magnetite-hematite quartzitic mylonites, which are rarer, outcrop inside the Infragetic Complex from The Parâng Mountains (e.g. STRUSIEVICZ & STRUTINSKI, 1988), structural equivalent of the Severin Nappe.

Likewise, the andesitic volcanic rocks are frequent in the Cândeşti Gravels of the Cotmeana Piedmont. As small pebbles, the andesites, among which an andesitic tuff, also appear in the Frăteşti Beds. The presence of tuffs at the exterior of the Carpathian arch is known. A lens of andesitic tuff is mentioned by GHENEA (1967) in the lower Pleistocene deposits of the Olteţ Piedmont, south of the Drăgăşani Town. The cineritic material origin, aeolian transported, is attributed to the Quaternary volcanism from the interior of the Carpathian arch. But the pebble of andesitic tuff identified in the gravels from Giurgiu was fluvial transported. We do not exclude the possibility of it coming from the levels of andesitic tuffs and agglomerates which were deposited in the Baraolt Basin during the Lower Pleistocene (LITEANU et al., 1962). The transport was probably provided by a river that crossed the South Carpathians at the beginning of Quaternary.

In conclusion, almost all the petrographic types of pebbles identified in the Frăteşti Gravels from the Burnas Plain also appear in the gravels from the Getic Piedmont, of the same Lower Pleistocene age. Are exceptions the spessartite-bearing quartzo-feldspathic gneisses and the andesitic tuffs, which have not been identified so far in the piedmont but which have lithological correspondent in the Carpathian area. From petrographic point of view, the gravels in the Frăteşti Beds are identical with those in the Cândeşti Beds. If the Cândeşti Gravels can not be questioned about the Balkan source area, given their proximity to the Carpathians and their petrographic composition, we do not see why the Balkan source should be invoked for the similar detritic material in the Frăteşti Gravels. In relation to the Carpathian source area, the gravels in the Frăteşti Beds represent the distal correspondent of the coarse gravels in the Cândeşti Beds.

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Ghenciu Monica, Culescu Flori
Geological Institute of Romania, 1st Caransebeș street, 012271 – Bucharest, Romania.
E-mails: monica_ghenciu@yahoo.com; m_flori_m@yahoo.com

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