PEBBLES OF QUARTZO-FELDSPATHIC GNEISSES WITH ARFVEDSONITE IN THE GRAVELS OF THE COTMEANA PIEDMONT

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Abstract. The Cotmeana Piedmont consists of large deposits of Lower Pleistocene gravels, with great petrographic variety and multiple source area, Carpathian, Subcarpathian and Intracarpathian. During the researches regarding the petrographic composition of the gravels, we identified two pebbles of quartz-feldspathic gneisses with arfvedsonite, of magmatic origin. The protolith of the two gneissic samples (3743 A-1 and 3744 A-6) is a granite, with porphyritic texture in the casse of sample 3743 A-1. In addition to arfvedsonite, the mineralogical association of sample 3743 A-1 also contains oligoclase (porphyroclastic), biotite, allanit, magnetit, quartz, microcline, muscovite, epidote, clinozoisite, apatite, zircon and sphene. The mineralogical association of the sample 3744 A-6 also contains oligoclase, albite, quartz, chlorite, hematite and apatite. Porphyric granites with arfvedsonite, of Liasic age, outcrop in the north-eastern Făgăraș Mountains, inside the Codlea sedimentary basin. This is the provenance area of the two granitic gneisses with arfvedsonite in the Cotmeana Piedmont.

Keywords: arfvedsonite, Cotmeana Piedmont, source area.

Rezumat. Galeți de gnaise cuarțo-feldspatice cu arfvedsonit în pietrișurile din Piemontul Cotmeana. Piemontul Cotmeana este constituit din depozite mari de pietrișuri de vârstă Pleistocen inferior, cu mare varietate petrografică și arie sursă multiplă, carpatică, subcarpatică și intracarpatică. În timpul cercetărilor privind compoziția petrografică a pietrișurilor, am identificat doi galeți de gnaise cuarțo-feldspatice cu arfvedsonit, de origine magmatică. Protolitul celor două probe de gnaise (3743 A-1 și 3744 A-6) este un granit, cu textură porfirică în cazul probei 3743 A-1. Pe lângă arfvedsonit, asociația mineralogică a probei 3743 A-1 mai conține oligoclaz (porfiroclastic), biotit, allanit, magnetit, microclin, cuarț, muscovit, epidot, clinozoizit, apatit, zircon și sfen. Asociația mineralogică a probei 3744 A-6 mai conține oligoclaz, albit, cuarț, clorit, hematit și apatit. Granite porfirice cu arfverdsonit, de vârstă liasică, aflorează în nord-estul Munților Făgăraș, în bazinul sedimentar Codlea. Aceasta este aria de proveniență a celor doi galeți de granite gnaisice cu arfvedsonit din Piemontul Cotmeana.

Cuvinte cheie: arfvedsonit, Piemontul Cotmeana, arie sursă.

INTRODUCTION

Unlike the gravels in the Cândești Piedmont, with a reduced petrographic variety of the pebbles (GHENCIU & STELEA, 2016), the gravels in the Cotmeana Piedmont show a large petrographic variety of pebbles, covering all the genetic types of rocks. This variety was ascertained in 123 observation points in the piedmont area. The metamorphic rocks are represented by quartzo-feldspathic gneisses, quartzites, amphibolic rocks (amphibolites, amphibolic gneisses and amphibolic schists), augen-gneisses and their protolite granites (granitic gneisses), eclogites, greenschists and pegmatites. The igneous rocks are represented by pebbles of rhyolites, dacites, trachytes, andesites, basalts, ignimbrites, lavas, volcanic breccia and granodiorite. Among the sedimentary rocks, quartzous red sandstone (with jasper fragments) and yellow-brown silicolites (with goethite) pebbles frequently appear. Equally common are the volcano-sedimentary rocks, represented by red jaspers (with hematite) and sometimes by volcanic tuffs with zeolites. I did not mention the quartz, present in all observation points in piedmont, but without significance for the source area.

The microscopic study of the collected samples (696 samples and 709 thin sections) led to the identification of particular petrographic types of pebbles in 22 observation points, most on the western margin of the piedmont (18 points). The peculiarity of these samples of pebbles (26 samples) consists in the presence of some rare minerals in their mineralogical association (alkali amphiboles, zeolites), of some minerals which are not very rare but are specific for certain geological formations in the source area (spessartin, chloritoid, disten, olivine), as well as of some specific textures, such as those with poikilitic albite porphyroblasts. The particular petrographic types of pebbles have an index value for the exact identification of the provenance area, at the level of geological subformation, sometimes even at the outcrop level. Among these particular petrographic types we find two pebbles of arfvedsonite-bearing gneisses. In a previous paper (CULESCU & GHENCIU, 2020), we presented the particular pebbles of glaucophane rocks, riebekit-bearing trachytes and olivine-bearing basalts.

MICROSCOPIC STUDY

The pebbles of quartzo-feldspathic gneisses with arfvedsonite were identified on the southwestern margin of the Cotmeana Piedmont, in the hydrographic basin of the Cungrea Mică Valley, more precisely at the springs of the Cungrișoara Valley (samples 3743 A-1 and 3744 A-6). Macroscopically, the sample 3743 A-1 has a weakly oriented texture, rather massive, with rare melanocratic aggregates of arfvedsonite. The sample 3744 A-6 has a typical mylonitic texture, strongly oriented but not foliated, with arfvedsonite parallel alignments along which sigmoidal lenses of arfvedsonite aggregates also appear . In the section parallel to the mylonitization planes, all the arfvedsonite aggregates are more or less wide. In both samples, the arfvedsonite was diagnosed under the microscope. The microscopic study

was done with a Jenapol microscope (Carl Zeiss-Jena) and the photomicrographs were taken with the digital camera Optika C-B3.

Sample 3743 A-1. It has a quartzo-feldspathic matrix with quasi-porphyric texture, resulting from intergranular cataclastic deformation and post-kinematic recrystallization (Fig. 1a, b). In addition to arfvedsonite, the mineralogical association of the sample includes oligoclase, brown-green biotite (with Fe^{2+}), allanite (magnesian epidote with rare earths), magnetite, quartz, microcline, epidote, frequently with allanite cores, clinozoisite, muscovite, apatite, zircon and sfen. Oligoclase occurs in more or less deformed porphyroclasts (Fig. 1a), partially replaced by undeformed post-kinematic microcline (Fig. 1b). Epidote and clinozoisite appear as by-products of this substitution. The epidote also appears secondary on biotite, like the muscovite.

The arfvedsonite is relatively uniform distributed in the matrix. It appears as xenomorphic clasts, sometimes grouped in aggregates with ragged contour, and apparently idiomorphic microclasts. It may contain zircon or biotite inclusions and sometimes may be included in oligoclase. The pleochroism is strong and characteristic, from blue-green to black (frequently), from yellow to black or dark blue-green and from olive green to black. The birefringence colours are masked by the mineral colour.

The microscopic analysis reveals two mineral parageneses in the sample 3743 A-1. The primary paragenesis consists of oligoclase, arfvedsonite, biotite, magnetite, apatite and zircon. The allanite can be attached to this paragenesis. The allanite that appears as isolated crystals in the matrix does not have borders of secondary epidote, therefore it is a primary mineral. Some allanite grains have become support for the epidote post-kinematic crystallization on the expense of the iron released by the muscovitized biotite and of the calcium released by the microclinized oligoclase. The secondary paragenesis consists of microcline, muscovite, epidote and clinozoizite. The pre-kinematic rock was a granite with arfvedsonite and allanite, and porphyric texture. The former oligoclase porphyroblasts are the present porphyroclasts in the gneissic rock.

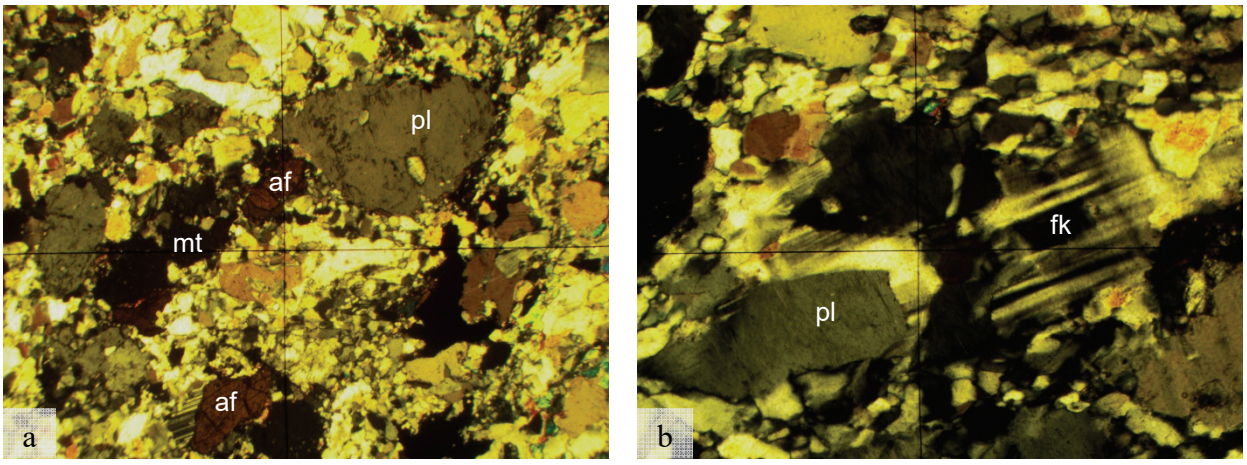

Figure 1. Photomicrographs of sample 3743 A-1. a) Oligoclase porphyroclasts (pl), arfvedsonite (af) and magnetite (mt) in quartzo-feldspathic matrix; b)oligoclase partially replaced by undeformed post-kinematic microcline (fk). Cross-polarized light. The photos width is 4, 2 mm.

Sample 3744 A-6. It has a homogeneous fine-grained quartzo-feldspathic matrix with massive texture, in contrast with the parallelism of the arfvedsonite alignments (Fig. 2a). The mineralogical association of the sample 3744 A-6 is different from that of the sample 3743 A-1 and simpler. In addition to arfvedsonite, it also contains oligoclase, albite, secondary on oligoclase, quartz (included in albite), chlorite (clinochlore), secondary on arfvedsonite, hematite, zircon and apatite. Hematite seems to be secondary on the magnetite crystals included in arfvedsonite. It also occurs as aggregates in the matrix, associated with chlorite.

The arfvedsonite appears as prisms, xenomorphic grains and polygranular aggregates along the mylonitic alignments (Fig. 2c). It may contains inclusions of hematitized magnetite (Fig. 2d) and apatite. Apatite also occurs in the matrix. The arfvedsonite chloritization seems to have been a selective process. While many arfvedsonite grains are not altered, some of them are completely chloritized (Fig. 2c). In a section parallel to the mylonitization planes, large aggregates of fresh arfvedsonite, magnetite and zircon appear.

Based on the relationships between the minerals, we can also distinguish two parageneses in the sample 3744 A-6, a primary one, pre-kinematic, and a secondary one, post-kinematic, with retromorphic character. The primary paragenesis consists of oligoclase, arfvedsonite, quartz I (present in the matrix), magnetite, apatite and zircon. The secondary paragenesis consists of chlorite, albite, quartz II (included in albite) and hematite. The retromorphic process of arfvedsonite chloritization released the sodium required for the albite formation on the expense of oligoclase. The quartz II is a by-product of this process. The primary rock is an arfvedsonite-bearing microgranite.

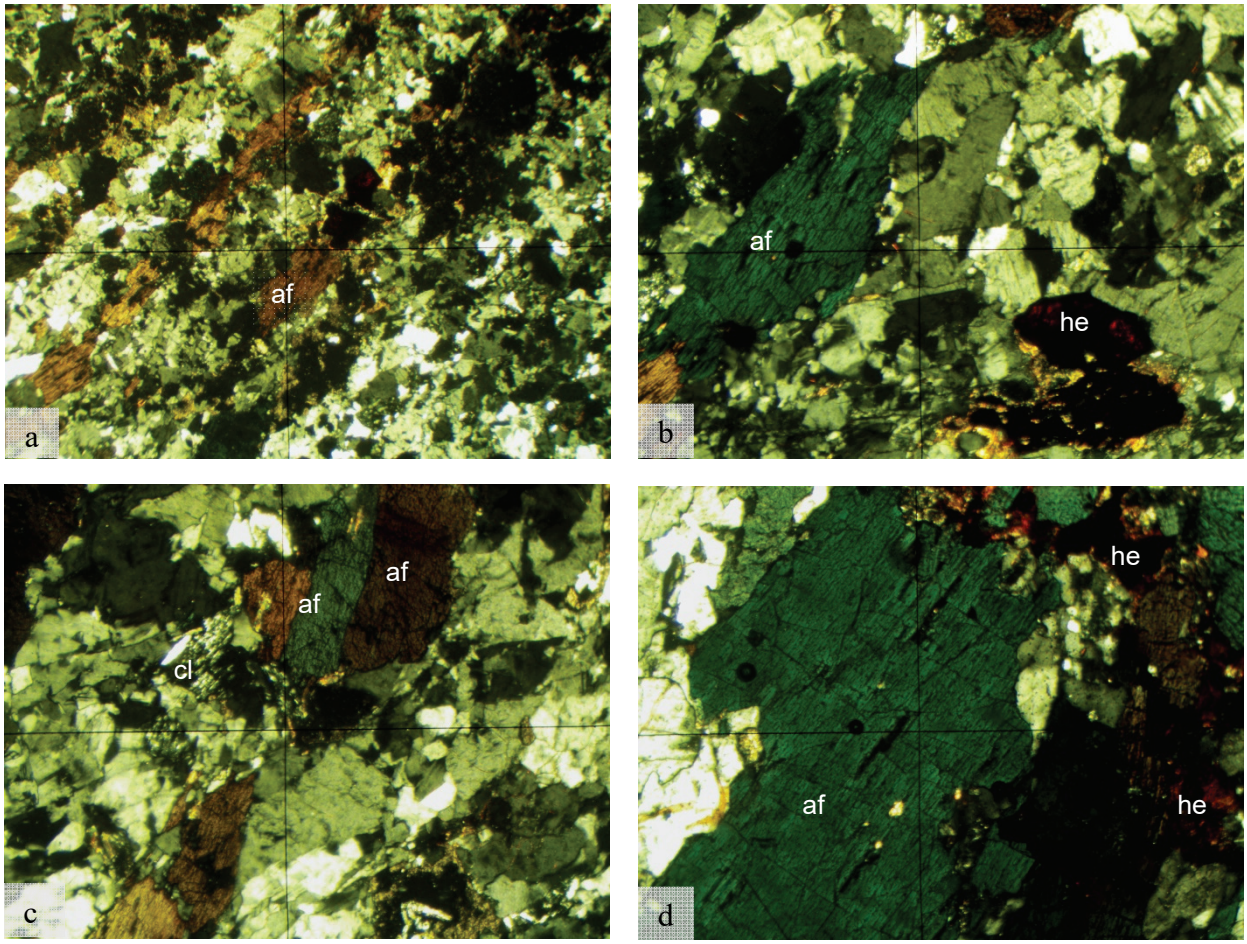

Figure 2. Photomicrographs of sample 3744 A-6. a) parallel alignements of arfvedsonite in quartzo-feldspathic matrix; b) aggregate of hematite (he) and chlorite; c) aggregate of arfvedsonite (af) with some grains completely chloritized (cl); d) inclusions of hematitized magnetite (he) in arfvedsonite (af). Cross-polarized light. The photos width is 1, 4 mm.

DISCUSSIONS AND CONCLUSIONS

The petrographic variety of the pebbles in the gravels of the Cotmeana Piedmont is due to their vast source area, on the one hand, and to its geological diversity, on the other hand. We refer in particular to the source area afferent to the hydrographic basin of the present Olt River, the main transport way of the clastic material in the piedmont. Together with its tributaries, the Olt River drains three different source areas, Intracarpathian (south-eastern Transylvanian Basin), Carpathian (northern and western Făgăraș Mountains, eastern and south-eastern Central South Carpathians) and Subcarpathian (central segment of the Getic Subcarpathians).

The arfvedsonite, a mineral specific to the alkaline magmatic provinces, rarely occurs in the source area of the Cotmeana Piedmont gravels. Alkaline trachytes with arfvedsonite outcrop in the northeastern Făgăraș Mountains (Carpathian source area) inside the Liasic volcanic complex (MANILICI & VÂLCEANU, 1962). In the intracarpathian source area, SZADECZKY (1930) identified arfvedsonite with magnetite inclusions in a fragment of garnet-bearing muscovitic schist, found in the Lower Miocene conglomerates in the Homorod Valley basin, a right tributary of the Olt River. The arfvedsonite in the sample 3743 A-1 also contains magnetite but our sample is a granito-gneissic rock.

Only one paper, inaccessible to us, indicates the presence of arfvedsonite in a porphyric granite vaguely localized in the Brașov Town surroundings (SAVUL & KRÄUTNER, 1936). On a single geological map of this region (JEKELIUS, 1938), we found the porphyric granites with arfvedsonite described by SAVUL & KRÄUTNER (1936), the two authors being quoted by JEKELIUS (1938). In fact, there are four small bodies of porphyric granites with arfvedsonite, Liasic in age, that outcrop near the Holbav Village, inside the Codlea sedimentary basin, drained by the Șinca River, a left tributary of the Olt River.

Our gneisses samples with arfvedsonite had a porphyric granite protolith (sample 3743 A-1) and a microgranitic protolith (sample 3744 A-6), probably a marginal facies of the porphyric granite. So, this is the provenance area of the two pebbles of arfvedsonite-bearing gneisses in the Cotmeana Piedmont. We can consider that their parental rock has been identified at the level of small geological bodies.

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