PEBBLES OF VOLCANIC ROCKS IN THE GRAVELS OF THE COTMEANA PIEDMONT (ROMANIA)

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Abstract. The pebbles of volcanic rocks and volcanic products in the gravels of the Cotmeana Piedmont are of rhyolites, dacites, trachytes, andesites, basalts, lavas, ignimbrites, volcanic breccias and tuffs. The rhyolites and dacites pebbles are relatively uniformly distributed throughout the Piedmont area. Andesite pebbles occur more frequently in the north-eastern area. All the other petrographic types are more common in the western half of the piedmont, some types appearing only in this region (breccias and tuffs). The source area of the gravels in the Cotmeana Piedmont corresponds to the hydrographic basins of the Olt and Argeş rivers. The Olt River brought eruptive clastic material from proximal (Cindrel Mountains and Getic Subcarpathians) and distal source areas (Perșani and Baraolt Mountains, north-eastern Făgăraș Mountains and southeastern Transylvanian Basin). The clastic material imput of the Argeş River comes only from the proximal areas (southern slope of the Făgăraș Mountains and Getic Subcarpathians). There are some unclear aspects regarding the provenance of some pebbles in the eastern half of the piedmont, having as possible explanation the presence of a primitive course of the Olt River inside the piedmont area.

Keywords: Cotmeana Piedmont, pebbles, volcanic rocks.

Rezumat. Galeți de roci vulcanice în pietrișurile Piemontului Cotmeana (România). Probele de galeți de roci și produse vulcanice din pietrișurile Piemontului Cotmeana sunt de riolite, dacite, trahite, andezite, bazalte, lave, ignimbrite, brecii vulcanice și tufuri. Galeții de riolite și dacite sunt relativ uniform distribuiți pe toată aria piemontului. Galeții de andezite apar mai frecvent în aria nord-estică. Toate celelalte tipuri petrografice sunt mai frecvente în jumătatea vestică a piemontului, unele aparând doar în această regiune (breciile vulcanice și tufurile). Aria sursă a pietrișurilor din Piemontul Cotmeana corespunde bazinelor hidrografice ale râurilor Olt și Argeș. Oltul a adus material clastic eruptiv din arii sursă proximale (Munții Cindrel și Subcarpații Getici) și distale (Munții Perșani și Baraolt, nord-estul Munților Făgăraș și sud-estul Bazinului Transilvaniei). Aportul de material clastic al Argeșului povine doar din arii proximale (versantul sudic al Munților Făgăraș și Subcarpații Getici). Sunt unele aspecte neclare privind provenieța unor galeți din jumătatea estică a piemontului, având ca posibilă explicație prezența unui curs primitiv al Oltului în aria piemontului.

Cuvinte cheie: Piemontul Cotmeana, galeți, roci vulcanice.

INTRODUCTION

During the field researches for our doctoral thesis regarding the petrographic composition of the gravels in the Cotmeana Piedmont (CULESCU, 2022) pebbles of volcanic origin rocks (volcanic rocks and volcanic products) were identified in 63 observation points from which 108 samples of volcanic rocks and 71 samples of volcanic products were collected. In order of frequency the volcanic rocks consist of rhyolites, dacites , trachytes, andesites, basalts and lamprophyres (one pebble). The volcanic products consist of ignimbrites, lavas and volcanic breccias, to which we attached the only two samples of tuffs (two pebbles), rocks of volcanic-sedimentary origin.

The pebbles of rhyolites (35 observation points) and dacites (20 points) appear relatively uniformly distributed over the whole area of the piedmont (Fig. 1). The andesites are more common in the north-eastern part of the piedmont (4 points out of 6). All other volcanic types of pebbles occur more frequently in the western half: ignimbrites (16 points out of 21), trachytes (7 points out of 8), lavas, predominantly andesitic (6 points out of 8) and basalts (3 points out of 4). The pebbles of volcanic breccias (4 observation points), tuffs (2 points) and lamprophyres (1 point) appear exclusively in the western half of the piedmont (Fig. 1).

MICROSCOPIC STUDY

Rhyolites. The rhyolites mainly consist of potassium feldspar and quartz. Almost all the analysed samples show porphyritic textures (Fig. 2a), rarely aphanitic. Frequently, the quartzo-feldspathic matrix is glassy, in various stages of devitrification, or cryptocrystalline, less often microgranular, impregnated with iron oxides and hydroxides. After the glass dehydration , spherulitic aggregates of fibro-radial chalcedony are formed, with borders of fine sericite or iron oxides and hydroxides.

The phenocrysts, usually corroded by the matrix, are of potassium feldspar, often perthitic (with albite separations), and quartz. Very rarely appear golden glass vesicles with brown coloured edges, probably palagonite. The same glass appears in the spaces between the phenocrysts grouped in aggregates. In a sample of rhyodacite (3749A) biotite sheets with filiform habitus appear, probably of restitic nature (Fig. 2b).

Dacites. The matrix of the dacites samples has textures similar to those of the rhyolites, resulting from devitrification and recrystallization processes. The microgranular matrix is more common than in rhyolites and sometimes has mirmekitic structures of potassium feldspar and quartz. The phenocrysts are of plagioclase, quartz, hornblende, biotite and iron oxides, probably magnetite. Potassium feldspar occurs less frequently. As in the rhyolites case, the phenocrysts are corroded by the matrix, especially the quartz and hornblende (Fig. 2c.). Quartz also contains glass inclusions. Plagioclase, usually zoned and with more acid (albitic) borders, occurs in isolated phenocrysts or in phenocryst aggregates. It is partially sericitized and less corroded by the matrix, as the biotite. Secondary, epidote, chlorite and clinozoisite form on biotite.

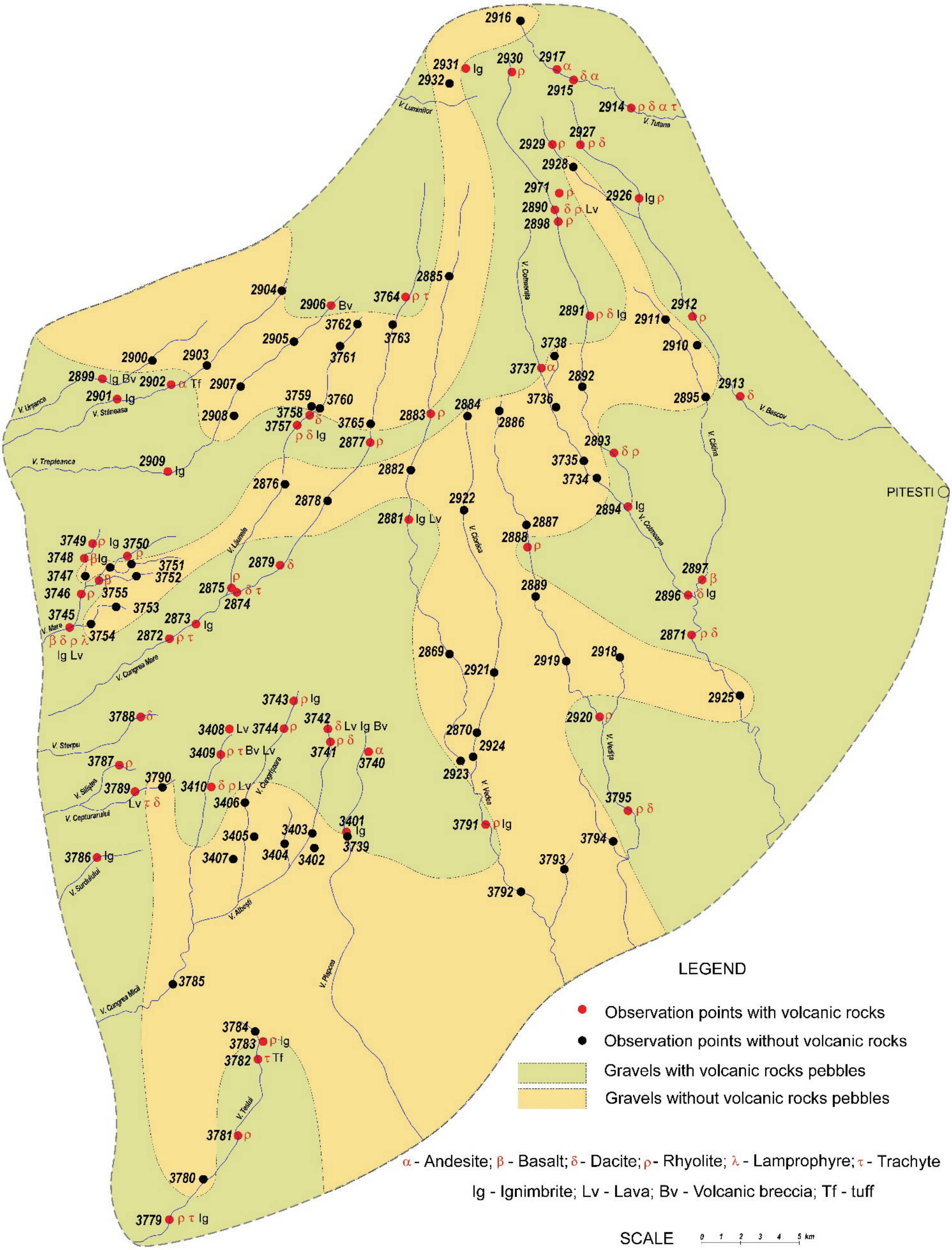

Figure 1. Areal distribution of the volcanic rocks pebbles in the Cotmeana Piedmont.

Trachytes. Characteristic for trachytes is the microlitic matrix with fluidal texture, of predominantly feldspathic nature, in which potassium feldspar predominates quantitatively over plagioclase. Potassium feldspar also appears as phenocrysts (Fig. 2d). Plagioclase crystalloclasts may also appear in the matrix. Quartz is missing or rarely occurs in recrystallized aggregates. Riebeckite appears in a single sample, in the northeast of piedmont (CULESCU & GHENCIU, 2020). In the examined samples, the matrix is impregnated with iron oxides and hydroxides, locally associated with epidote and chlorite.

Andesites. Most andesite samples are latiandesite, with small amounts of potassium feldspar in the matrix. The microlitic matrix, sometimes slightly fluidal, consists of rods of plagioclase, quantitatively subordinated potassium feldspar, and granules of iron oxides (magnetite and hematite). In a single sample the matrix is microgranular and contains plagioclase phenocrysts and partially resorbed hornblende phenocrysts.

Except the potassium feldspar, the minerals of the matrix also appear as phenocrysts, especially plagioclase and clinopyroxene, often grouped in aggregates (Fig. 2e). Like the hornblende, the biotite phenocrysts are partially resorbed and have skeletal shapes with remnants of metal oxides. As products of post-magmatic alteration, in the studied andesites samples there are sericite formed on plagioclase, clinozoite and epidote on clinopyroxen and on plagioclase, goethite on iron oxides and actinolite on hornblende.

Basalts. Of the six basalt samples, four are pyroxenic basalts and two are olivine basalts, the latters being commented in a previous paper (GHENCIU & CULESCU, 2020). The pyroxenic basalts have a matrix with microcrystalline and cryptocrystalline texture of plagioclase and clinopyroxene, impregnated with iron oxides, or intergranular texture in which the space between plagioclase crystals is occupied by granules of pyroxene (Fig. 2f).

The phenocrysts are of plagioclase, the most and the largest, clinopyroxen and magnetite. Plagioclase, often magmatically corroded, is sericitized but the more acid borders are fresh. Clinopyroxene occurs in smaller phenocrysts and sometimes includes iron oxides and plagioclase microlites. Very rarely, nests of chalcedony and nests of basaltic glass also appear in the matrix. As alteration products, sericite is formed on plagioclase, and chlorite, epidote, and iron hydroxides are formed on clinopyroxene.

Lavas. The lavas pebbles consist of andesitic, rhyolitic and dacitic lavas. The petrographic separation of the samples was based on the mineralogical nature of the phenocrysts, usually magmatically corroded. All lavas samples are glassy masses with fluidal textures, sometimes chaotic, more or less affected by devitrification processes.

Andesitic lavas have the most obvious fluidal textures, sometimes layered by differentiated devitrification processes (Fig. 2g). These contain magmatically corroded phenocrysts of plagioclase, clinopyroxene, biotite, iron oxides and quartz, rarely andesite lithoclasts with clinopyroxene. The partially devitrified matrix has homogeneous impregnations or nests of iron oxides. As secondary minerals, epidote is formed on plagioclase and clinopyroxene, and sericite on plagioclase.

Rhyolitic lavas flows contain potassium feldspar phenocrysts, frequently sericitized, quartz and chalcedony aggregates. The fluidal matrix, often with chaotic looking and is partially sericitized, locally impregnated with iron oxides. Quartz phenocrysts are magmatically corroded (Fig. 2h). The devitrification processes generated elongated recrystallized quartz aggregates, parallel to the flow planes or as anastomosed networks. The dacitic lava sample contains phenocrysts with irregular shapes of plagioclase and quartz.

Ignimbrites. All the ignimbrite samples are of rhyolitic nature. These have a glassy or cryptocrystalline quartzo-feldsparthic matrix, more or less sericitized. The texture is usually breccious, locally fluidal, with chaotic looking (Fig. 2i). In the matrix there are clasts, microclasts and phenocrysts of partially sericitized potassium feldspar, quartz, iron oxides (hematite and magnetite) and rhyolites lithoclasts. Quartz and potassium feldspar are usually magmatically corroded. Yellow glass vesicles with goethite rims appear in a single sample. As in the case of rhyolites, the matrix devitification leads to the appearance of spherical aggregates of fibrous chalcedony and recrystallized quartz aggregates.

Volcanic breccias. The samples of volcanic breccias are of rhyolitic and dacitic nature. As in the case of lavas, the differentiation was made on the basis of the mineralogical nature of the crystalloclasts and the petrographic nature of the lithoclasts. Common to both types are breccious textures and silicification processes that affect both the clasts and the matrix.

The typical sample of rhyolitic breccia contains magmatically corroded quartz phenoclasts and sericitized potassium feldspar, rhyolites lithoclasts and microgranular quartz-feldspar matrix lithoclasts. All these elements are trapped in a sericitized cryptocrystalline quartzo-feldspathic matrix with iron oxides and quartz microclasts (Fig. 2j.). In the other samples, the quartz and the feldspar clasts are trapped in a matrix of fibroradial chlorite (pennine), probably of hydrothermal origin, with chlorite nests (prehnite), isolated crystals of epidote and rare aggregates of muscovite.

In the examined samples, the dacitic breccias have a partially devitrified glassy matrix. These contain dacitic lithoclasts, brecciated and welded with fibrous chalcedony, silicified plagioclase phenocrysts, diffuse-edged quartz clasts, breccious fragments of devitrified glass with chlorite on cracks, nests of iron oxides and remnants of biotite and hornblende. The glass appears in small rounded aggregates, with the appearance of deformed drops.

Volcanic tuffs. Only two pebbles have been identified as volcanic vitrolithoclastic tuffs of dacitic composition on the western margin of the piedmont. One of the samples has a partially devitrified glassy matrix, with cryptocrystalline zeolite and iron oxides and hydroxides (hematite, goethite). Numerous spherical vacuoles with a zeolite in tabular crystals with low birefringence, very likely of heulandite, appear in the matrix (Fig. 2k.). The matrix contains few dacitic lithoclasts (quartz, plagioclase, potassium feldspar, biotite) and crystalloclasts of quartz, fully sericitized feldspar and biotite. The matrix in the second sample consists of glass with spherical rosettes of fibrous chalcedony, hematite, goethite and nests of celadonite (a variety of glauconite) bordered with iron oxides and hydroxides (Fig. 2l). Plagioclase and quartz crystals also appear in the matrix, some of them magmatically corroded, as well as lithic fragments of quartz and plagioclase.

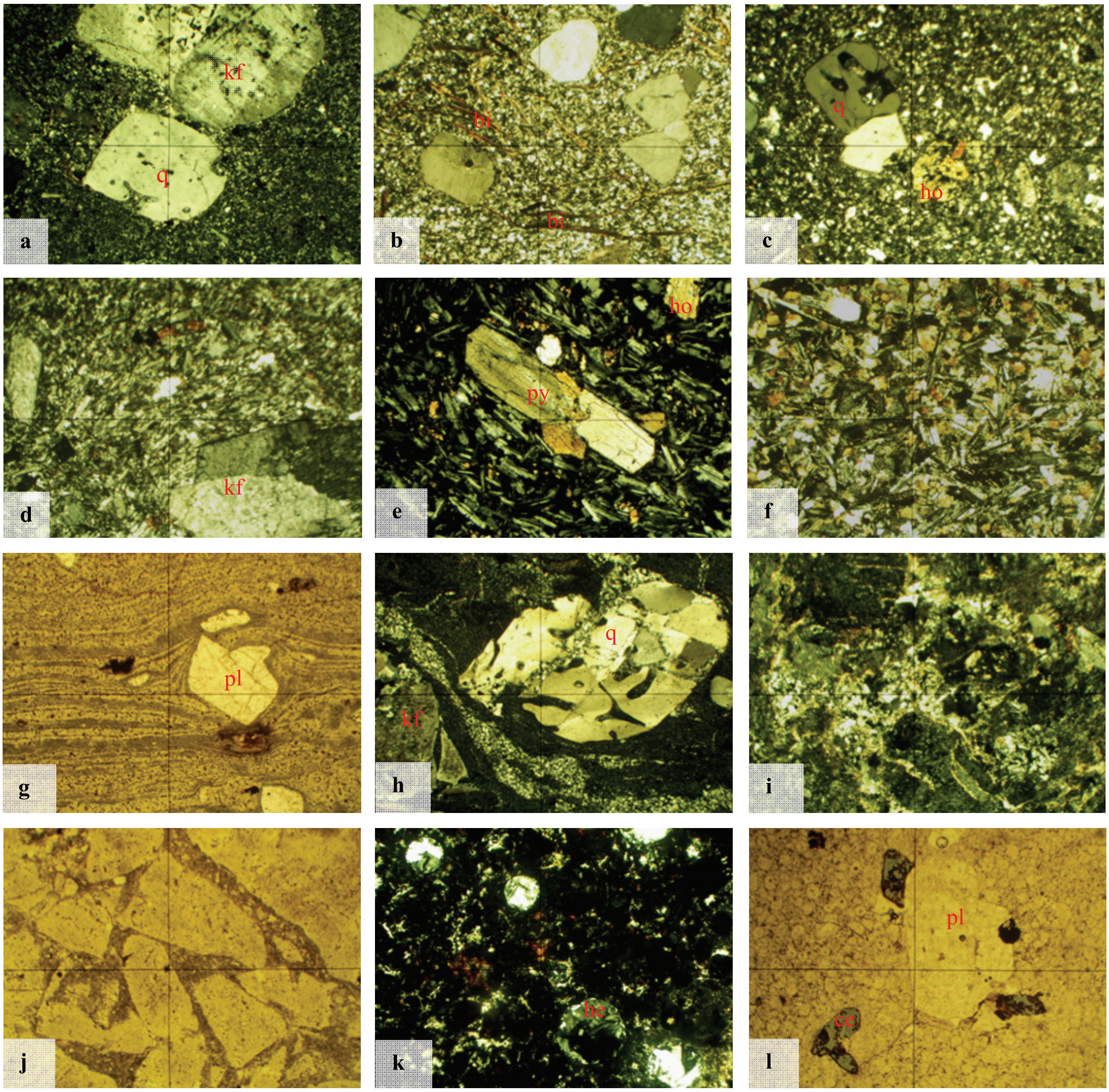

Figure 2. a) Rhyolite with magmatically corroded phenocrysts of potassium feldspar (kf) and quartz (q). b) Rhyodacite with filiform biotite (bi). c) Dacite with magmatically corroded quart (q) and hornblende (ho). d) Trachyte with phenocrysts of potassium feldspar (kf). e) Andesite with phenocrysts of clinopyroxene (py) and hornblende (ho). f) Basalt with intergranular texture. g) Andesitic lava with fluidal texture and corroded crystals of plagioclase (pl). h) Rhyolitic lava with corroded phenocrysts of potassium feldspar (kf) and quatrz (q). i) Rhyolitic ignimbrite with chaotic breccious texture. j) Rhyolitic volcanic breccia. k) Volcanic tuffs with vacuoles of heulandite (he). l)Volcanic tuff with crystals of plagioclase (pl) and nests of celadonite (ce) in a matrix of calcedony. Cross-polarized (a, b, c, d, e, f, h, i, k) and plane-polarized (g, j, l). The photos width is 0.7 mm (k), 1.4 mm (a,e) and 4.2 mm (b,c, d, f, g, h, i, j, l).

SOURCE AREA OF THE VOLCANIC ROCKS

Rhyolites and dacites dykes appear within the Liassic volcanic complex in the north-eastern Făgăraș Mountains (MANILICI, 1960), Poiana Mărului-Șinca Nouă-Holbav area, drained by the Olt River tributaries. The filiform biotite of restitic nature from the rhyolite sample 3749A frequently occurs in the rhyodacites of anatectic origin in the north-eastern Cindrel Mountains (STELEA, 2000), also in the Olt River hydrographic basin.

Trachytes (MANILICI, 1960) and riebekite-bearing trachytes (DIMITRESCU, 1964) also appear in the above mentioned Liassic volcanic complex in the Făgăraş Mountains. Middle Triassic (Ladinian) trachytes, outcrop in the Perşani Mountains, Racoş area, (POPESCU ILEANA et al., 1976). Both regions with trachytes dykes are drained by the Olt River. Pyroxene andesites and hornblende andesites of Upper Pliocene age, outcrop in the Baraolt Mountains (POPESCU ILEANA et al., 1975), also in the Olt River basin.

Pyroxenic basalt dykes (± olivine) outcrop in the same Liasic volcanic complex in the northeastern Făgăraş Mountains (MANILICI & VÂLCEANU, 1962) as well as and in the Perșani Mountains area (eg. POPESCU ILEANA et al., 1976), regions drained by the Olt River. Several basalt dykes also outcrop on the southern slope of the Făgăraş Mountains, in the Argeș River hydrographic basin (DIMITRESCU et al., 1985)

Lavas flows, deposits of ignimbrites and volcanic breccias are found in the Neogene Volcanic Zone of the Baraolt Mountains (POPESCU ILEANA et al., 1975), a region drained by the Olt River. Dacitic tuffs of Miocene age outcrop in the western Perşani Mountains (eg. POPESCU ILEANA et al., 1970), as well as in the slopes of the Olt Valley in the Getic Subcarpathians, Călimănești and Râmnicu Vâlcea areas (eg. POPESCU et al., 1977).

DISCUSSIONS AND CONCLUSIONS

With one exception, the Argeş Valley, all the other volcanic rock source areas are found in the Olt River basin. The Quaternary torrent corresponding to its present course is responsible for the transport and deposition of the clastic material of volcanic nature from distal (Perşani and Baraolt Mountains, north-eastern Făgăraş Mountains, south-eastern Transylvanian Basin) and proximal source areas (Cindrel Mountains, north-western Făgăraş Mountains and the Getic Subcarpathians).

Only proximal source areas are drained by the Argeş River (southern slope of the Făgăraş Mountains and Getic Subcarpathians), with much smaller surfaces compared to those drained by the Olt. The absence of lamprophyres pebbles in the north-eastern part of piedmont, an area where most of the clastic material should come, theoretically at least, from the southern slope of the Făgăraş Mountains, is surprising. According to ANTON & CONSTANTINESCU (1978), there are many lamprophyres dykes in the upper basin of Argeş. Curiously, these lamprophyres do not appear either on the 1:50 000 geological map, Cumpăna sheet (DIMITRESCU et al., 1985). We found a single pebble of lamprophyre, but on the western edge of the piedmont.

No less surprising is the uniform distribution throughout the piedmont area of the rhyolites and dacites pebbles, as well as the presence of andesites and ignimbrites pebbles in the north-eastern area of the piedmont. These petrographic types of pebbles in the piedmont western half represent the clastic material input of the Olt River. We do not have an obvious explanation for their presence in the eastern half because there are no rhyolites, dacites, andesites and ignimbrites in the Argeş River basin. A hypothetical explanation, but only for the south-eastern part of the piedmont, is that the rhyolites, dacites and ignimbrites pebbles here also represent the input of the Olt River, whose primitive course was deviated to the east, as is now the Argeş River, due to the subsidence of the eastern sector of the Moesian Platform.

However, the petrographic nature of pebbles in the detrital sedimentary rocks is the best criterion for identifying their source area, despite some ambiguities. The source areas for the particular petrographic types of pebbles, usually punctual, can be identified with certainty. For the Cotmeana Piedmont this is the case of the glaucophane rocks pebbles, with source area in the Parâng Mountains, at the Lotru River springs (CULESCU & GHENCIU, 2020), as well as of the arfvedsonite gneisses pebbles, with their source area in the north-eastern Făgăraş Mountains, Holbav area (GHENCIU & CULESCU, 2021). For this paper this is the case of the rhyodacite pebble with filiform biotite. Such rhyodacites are found only in the Olt River basin, in the north-eastern part of the Cindrel Mountains.

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