PEBBLES WITH INTRACARPATHIAN SOURCE AREA IN THE GRAVELS FROM THE COTMEANA AND OLTEȚ PIEDMONTS (ROMANIA)

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Abstract. For purposes of this paper, the intra-Carpathian source area includes the south-east of the Transylvanian Basin, the Perșani and Baraolt mountains, as well as the north-Carpathian source areas (the northern slope of the Făgăraș Mountains and the north-eastern slope of the Cindrel Mountains). All these source areas are drained by the Olt River that separates the two piedmonts. The detrital material transported by the Olt was preferentially deposited on the left bank, in the Cotmeana Piedmont, very little in the Olteț Piedmont, predominantly sandy. Most petrographic types of pebbles with an intra-Carpathian source area (red quartz sandstones with jasper lithoclasts, silicolites, rhyolites and rhyodacites) occur in the gravels on the western edge of the Cotmeana Piedmont. Olivine-bearing basalt pebbles, volcanic breccias, and granodiorites occur exclusively in the gravels on the western margin of the piedmont. Most of the large pebbles (boulders) also appear in the gravels of this piedmont area. Boulders of jaspers and red sandstones occur exclusively on the western edge of the piedmont. The asymmetric deposition of the detrital material carried by the Olt River suggests a possible paleo-course of it diverted to the east, on the current territory of the Cotmeana Piedmont.

Keywords: Cotmeana, Olteț, pebbles, intra-Carpathian source area.

Rezumat. Galeți cu arie sursă intracarpatică în pietrișurile din piemonturile Cotmeana și Olteț (România). În sensul dat în această lucrare, aria sursă intracarpatică include sud-estul Bazinului Transilvaniei, munții Perșani și Baraolt, precum și ariile sursă nord-carpatice (versantul nordic al Munților Făgăraș și versantul nord-estic al Munților Cindrel). Toate aceste arii sursă sunt drenate de Râul Olt care desparte cele două piemonturi. Materialul detritic transportat de Olt a fost depus preferențial pe malul stâng, în Piemontul Cotmeana, foarte puțin în Piemontul Olteț, predominant nisipos. Cele mai multe tipuri petrografice de galeți cu arie sursă intracarpatică (gresii roșii cuarțoase cu litoclaste de jasp, silicolite, riolite și riodacite) apar în pietrișurile de pe marginea vestică a Piemontului Cotmeana. Galeții de bazalte cu olivină, brecii vulcanice și granodiorite apar exclusiv în pietrișurile de pe marginea vestică a piemontului. Tot în pietrișurile din această arie piemontană apare și majoritatea galeților de dimensiuni mari (bolovani). Bolovanii de jaspuri și de gresii roșii apar exclusiv pe marginea vestică a piemontului. Depunerea asimetrică a materialului detritic cărat de Râul Olt sugerează un posibil paleo-curs al său deviat spre est, pe teritoriul actual al Piemontului Cotmeana.

Cuvinte cheie: Cotmeana, Olteț, pietrișuri, arie sursă intracarpatică.

INTRODUCTION

The central area of the Getic Piedmont is separated by the Olt River into two Piedmont subunits: the Cotmeana Piedmont, to the east, and the Olteț Piedmont, to the west. Strictly speaking, the intra-Carpathian source area of the gravels from the two piedmonts is represented by the south-eastern region of the Transylvanian Basin, the Perșani Mountains and the Baraolt Mountains, drained by the Olt, where conglomerate formations and neogene volcanic rocks outcrop. Also, the middle course of the Olt also drains the north Carpathian source areas, the largest being the northern slope of the Făgăraș Mountains and the north-eastern slope of the Cindrel Mountains. In the broad sense used in this paper, the intra-Carpathian source area of the gravels in the two piedmonts also includes the north Carpathian areas (Fig. 1).

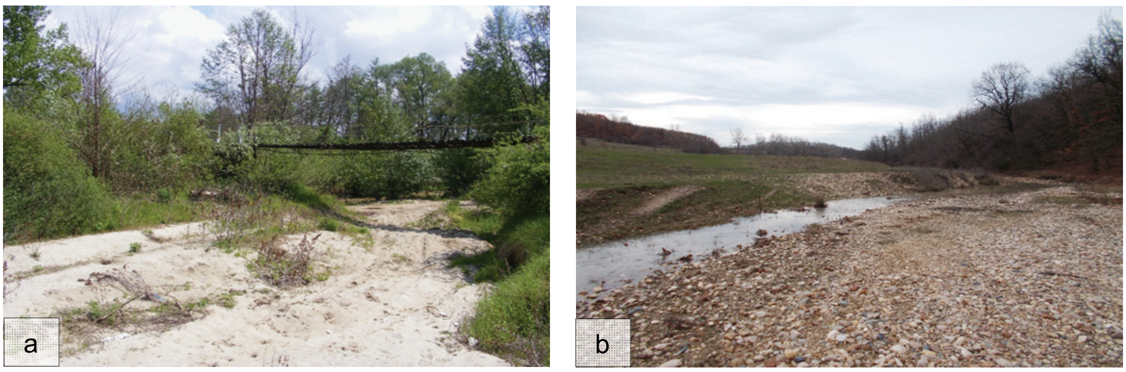

Figure 1. Field photos. a) Sands deposits on the Pesceana Valley in the eastern part of the Olteț Piedmont.
b) Gravels deposits on the Teslui Valley in the south-western part of the Cotmeana Piedmont.

The Olt River represents the main transport route of the clastic material from the intra-Carpathian source area, but the gravel input is uneven, much higher in the Cotmeana Piedmont than in the Olteț Piedmont, where sands predominate (Fig. 1). With the formation of its transverse valley, at the beginning of the Quaternary, the clastic material coming from the south-east of the Transylvanian Basin, the Perșani Mountains, the north of the Leaota Mountains, the north-east of the Făgăraș

Mountains and the north-east of the Cindrel Mountains could reach the central area of the Getic Piedmont transported by Olt. This fact is demonstrated by the presence in the gravel deposits of particular petrographic types of pebbles whose parent rocks only outcrop in the four regions (red quartz sandstones with jasper lithoclasts, yellow-brown silicolites, red silicolites, i.e. jaspers, and volcanic rocks). An indirect but eloquent argument is the presence of some particular petrographic types of pebbles in gravel deposits, for example red sandstones with jasper lithoclasts and many volcanic rocks (rhyolites, olivine basalts, lavas, ignimbrites, volcanic breccias) which do not appear in the Cândești Piedmont, with exclusive Carpathian and Subcarpathian source area (GHENCIU & STELEA, 2016).

FIELD DATA

Cotmeana Piedmont. In the Cotmeana Piedmont there are large deposits of gravel of various sizes, from boulders, 20-50 cm in size, to fine gravel, less than 1 cm in size. Apparently surprisingly, most observation points with boulders (13) occur on the western margin of the piedmont, close to the Olt River, compared to 8 points on the northern margin, in proximity of the Carpathian source area. In the points where the thickness of the deposits could be measured, it varies from 140-150 m in the north of the Piedmont, close to the Carpathian source area, to 50-100 m in the central area and 30-100 m on the western margin.

The field observations and the sampling points cover the entire surface of the piedmont (CULESCU, 2022). The number of points with petrographic types of boulders of interest for the subject of this work, as well as their east-west distribution within the piedmont, are as follows:

- red sandstones: 83 points (55 in the west, 28 in the east);
- red silicolites (jaspers): 84 points (50 in the west, 34 in the east);
- yellow-brown silicolites: 104 points (76 in the west, 28 in the east);
- rhyolites and rhyodacites: 37 points (21 in the west, 16 in the east);
- olivine-bearing basalts: 2 points (both in the west);
- lavas: 6 points (5 in the west, 1 in the east);
- ignimbrites: 12 points (11 in the west, 1 in the east);
- volcanic breccias: 4 points (all in the west);
- granodiorites: 2 points (both in the west).

It is obvious that most petrographic types with intra-Carpathian source area occur on the western edge of the Cotmeana Piedmont, especially lavas, ignimbrites and volcanic breccias.

Olteț Piedmont. Out of 85 observation points in this piedmont, small banks of fine gravel were found in only 6 points (GHENCIU & CULESCU, 2022). Small pebbles (0.5-2 cm) of intra-Carpathian source rocks also appear in 4 points in the valleys of Cerna (points 3359 and 3360), Șasa (point 3366) and Luncavăț (point 3370):

- point 3359 - red quartz sandstones with jasper lithoclasts and yellow-brown silicolites;
- point 3360 - yellow-brown rhyolitic ignimbrites and silicolites;
- point 3366 - red quartz sandstones with jasper lithoclasts and yellow-brown silicolites;
- point 3770 - yellow-brown silicolites and jaspers.

MICROSCOPIC STUDY

Red sandstones. They are fine-grained rocks without obvious stratification, consisting mainly of silica, quartz grains, jasper lithoclasts (Fig. 2a, j) and quartzites, chalcedony or hematite cement (Fig. 2b). In addition to silica, there are feldspar crystaloclasts, frequently plagioclase, tourmaline and muscovite, very rarely hornblende. Red jasper lithoclasts, sometimes with radiolarians, are ubiquitous and quartzite ones appear relatively frequently. The grains show different degrees of rolling and sorting, the quartz grains being usually well rolled.

Silicolites. The red silicolites (jaspers) are volcanogenic-sedimentary rocks, formed in a marine environment with the input of volcanic hydrothermal solutions. They consist of a cryptocrystalline mass of chalcedony with hematite, partially replaced by microgranular quartz. Hematite occurs as fine or massive impregnations, in which tabular or acicular crystals of hematite also occur. When the rock mass consists of chalcedony radiolarians, hematite impregnates the radiolarians tests or fills the voids between them (Fig. 2c).

Yellow-brown silicolites are rocks of sedimentary origin, formed in lacustrine or marine environments. They are made of cryptocrystalline or spherulitic chalcedony and microgranular quartz, impregnated with iron hydroxides (goethite) and clay impurities. Goethite occurs as homogeneous impregnations (Fig. 2d) or secondary on hematite nests. In some samples, the whole rock mass is made up of chalcedony radiolarians spherules (Fig. 2k).

Rhyolites and rhyodacites. The rhyolite and rhyodacite pebbles occur only in the Cotmeana Piedmont. They are rocks with porphyritic textures, consisting mainly of potassium feldspar, plagioclase and quartz. Frequently, the quartz-feldspathic matrix is glassy, with various stages of devitrification, or cryptocrystalline, rarely microgranular. The phenocrysts, usually corroded by the matrix, are potassium feldspar, frequently perthitic, plagioclase and quartz. A rhyodacite pebble from the western edge of the piedmont (Valea Geamăna) contains a restitic biotite with a particular, filiform habitus (Fig. 2e).

Rhyolite and dacite veins, described as quartz porphyries, appear within the Liassic volcanic complex in the north-eastern part of the Făgăraş Mountains (MANILICI, 1960), the Poiana Mărului-Șinca Nouă-Holbav area, drained by left tributaries of the Olt, Şinca and Bârsa rivers. Filiform restitic biotite frequently occurs in the matrix of rhyodacite veins of anatectic origin in the north of the Sebeș and Cindrel Mountains, resulting from the collapse of some biotite nodules in the parent granodiorite bodies (STELEA & GHENCIU, 2021).

Olivine-bearing basalts. Only two pebbles of olivine-bearing basalts were identified on the Mare Valley in the north-western Cotmeana Piedmont, samples 3745 I and 3755 D. The basalt from sample 3755 D (Fig. 2f), has an intergranular texture, with plagioclase microlites, grains of clinopyroxene and iron oxides in the spaces between the microlites. The phenocrysts are of plagioclase, olivine and clinopyroxene (CULESCU & GHENCIU, 2022). Plagioclase phenocrysts are sericitized and argillized and have secondary acid rims that outline both idiomorphic and corroded phenocrysts.

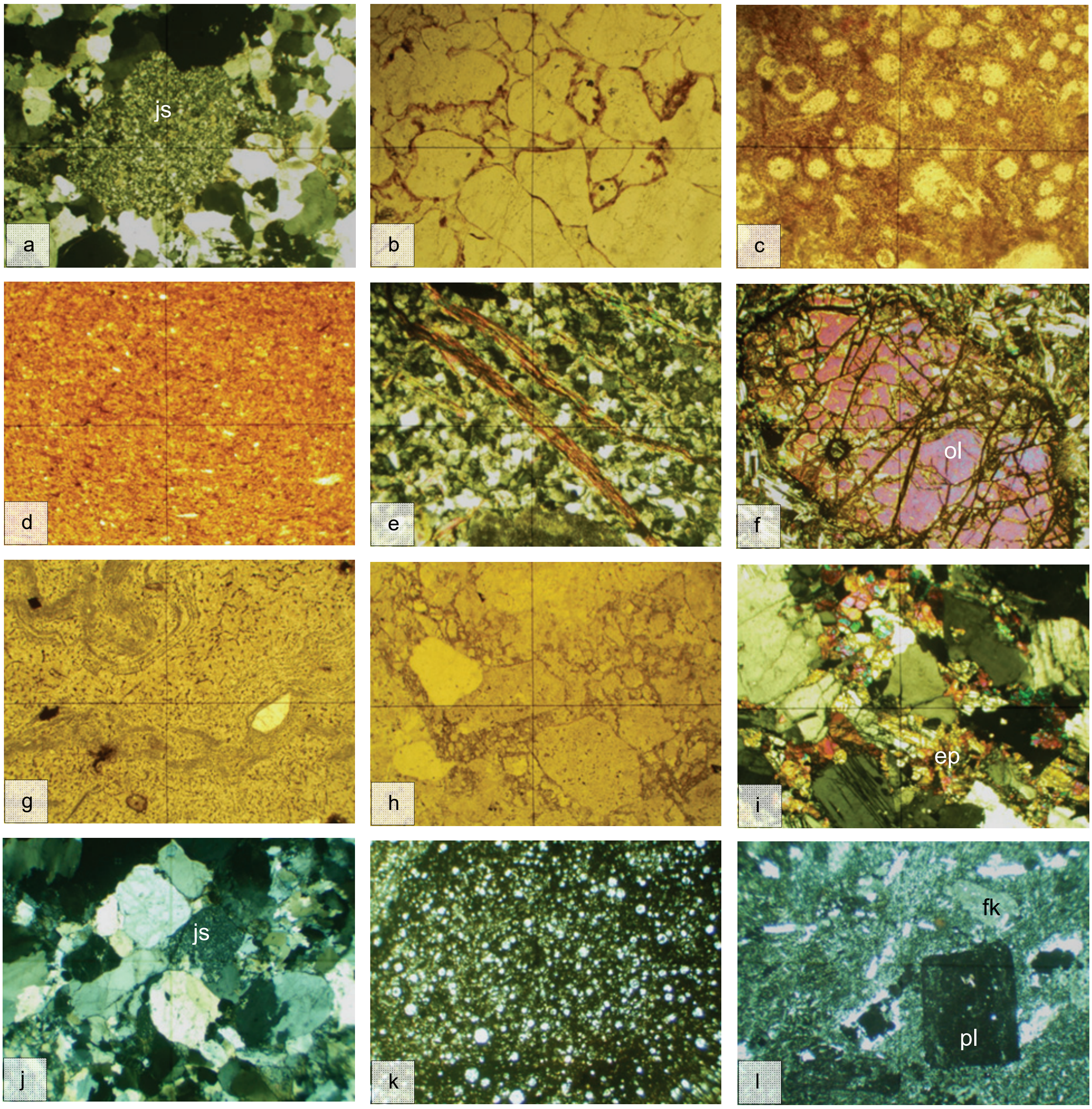

Figure 2. Photomicrographs in pebbles from the piedmonts Cotmeana (a-i) and Olteț (j-l): a) red sandstone with jasper lithoclasts, Vedița Valley; b) red sandstone with hematite cement, Cotmeana Valley; c) jasper with radiolarians tests, Vedea Valley; d) silicolite with homogeneous impregnations of goethite, Geamăna Valley; e) filiform biotite in a rhyodacite pebble, Geamăna Valley; f) olivine (ol)-bearing basalt, Mare Valley; g) andesitic lava with convoluted fluid texture, Cungra Valley; h) volcanic breccia, Albești Valley; i) granodiorite with intergranular magmatic epidote (ep), Vedița Valley; j) red sandstone with jasper lithoclasts (js), Cerna Valley; k) silicolite with radiolarians tests, Cerna Valley basin; l) rhyodacitic ignimbrite with plagioclase cristals (pl) and corroded clasts of potassium feldspar (fk), Cerna Valley basin. The photos width is 4.2 mm (a, f, g, h, i, j, k, l), 1.4 mm (b, d, e) and 0.7 mm (c).

Basalts with phenocrysts of pyroxenes (augite, diopside) and olivine were described by MANILICI & VÂLCEANU (1962) within the Liassic volcanic complex in the north-eastern Făgăraș Mountains, Codlea sedimentary basin. Also, olivine-bearing basalts of Lower Pleistocene age outcrop at Racoșul de Jos, Perșani Mountains (RĂDULESCU & DIMITRESCU, 1966). Both regions are part of the intra-Carpathian source area and the olivine-bearing basalt pebbles could not reach the western edge of the piedmont unless brought by the Olt River.

Lavas. The lava flow samples consist of andesitic lavas, rhyolitic lavas, and a single dacitic lava sample. All lavas appear under the microscope as glassy masses with fluid, sometimes chaotic textures, more or less affected by secondary devitrification processes.

Andesitic lavas have the most obvious fluid textures, sometimes ribboned or convoluted (Fig. 2g). These lavas contain magmatically corroded phenocrysts of plagioclase (Fig. 2g), clinopyroxene, biotite, iron oxides (hematite and magnetite) and quartz, rarely andesite lithoclasts with clinopyroxene, a mineral that also occurs as inclusions in plagioclase. The matrix is partially devitrified and shows layered flow textures. Iron oxides also appear in the matrix, as homogeneous impregnations or grouped in nests. Epidote, formed on plagioclase and clinopyroxene, and sericite, formed on plagioclase, are present as secondary minerals.

Rhyolitic lava flows contain phenocrysts of potassium feldspar, frequently sericitized, quartz and aggregates of chalcedony. The matrix has fluid textures, often with a chaotic appearance, and is partially sericitized. Quartz phenocrysts are intensely magmatically corroded. The dacitic lava sample has a chaotic texture and contains irregularly shaped plagioclase and quartz phenocrysts.

Ignimbrites. The great majority of ignimbrites samples are of rhyolitic nature, rarely rhyodacitic ignimbrites also occur (Fig. 2l). They have a glassy or cryptocrystalline quartz-feldspathic matrix, more or less sericitized. The texture is usually breccia, locally fluid, with a chaotic appearance. Clasts, microclasts of partially sericitized potassium feldspar, plagioclase crystals, magmatic corroded quartz, iron oxides (hematite and magnetite) and rhyolitic lithoclasts appear in the matrix. Quartz and potassium feldspar are usually magmatically corroded while plagioclase is not corroded (Fig. 2l).

Volcanic breccias. All four volcanic breccias samples presented in the work are of rhyolitic nature. Characteristic are the breccia textures and the silicification processes that affect both the clasts and the matrix. As in the case of lavas, the differentiation was made on the basis of the mineralogical nature of crystalloclasts and the petrographic nature of lithoclasts.

The breccia in sample 3742C-7 (Fig. 2h) contains magmatic corroded quartz and sericitized potassium feldspar phenoclasts, rhyolitic lithoclasts, and microgranular quartz-feldspathic matrix lithoclasts. All these elements are trapped in a sericitized cryptocrystalline quartz-feldspathic matrix and quartz microclasts, impregnated with iron oxides.

Lava flows, rhyolitic volcanic breccias and ignimbrite deposits crop out in the Neogene Volcanic Area of the Baraolt Mountains (POPESCU et al., 1975), a region drained by the Olt River and its tributaries.

Granodiorites. Granodiorites pebbles have been identified at two points on the western margin of the Cotmeana Piedmont. They are holocrystalline rocks composed of plagioclase, potassium feldspar and quartz. Melanocrate minerals, usually biotite and hornblende, less often intergranular aggregates of magmatic epidote, also occur in small proportions (Fig. 2i). As secondary minerals, sericite, formed on plagioclase and potassium feldspar, epidote, formed on plagioclase or biotite, muscovite, chlorite and iron oxides, formed on biotite, and sphene, formed on hornblende, are frequent.

In the intra-Carpathian source area, granodiorites outcrop in the north-eastern Făgăraș Mountains (MANILICI 1960), in the basin of the Bârsa River, a left tributary of the Olt. Small bodies of granodiorites, frequently affected by partial anatexis processes, outcrop in the Getic Crystalline in the north-eastern area of the Cindrel Mountains (STELEA & SĂNDULESCU, 1993), drained by the Cibin River, a right tributary of the Olt.

DISCUSSIONS AND CONCLUSIONS

The field data clearly indicate an unequal distribution of the petrographic types of pebbles with intra-Carpathian source area in the two piedmonts, insignificant in the Olteț Piedmont and very important in the Cotmeana Piedmont. In only 4 observation points in the Olteț Piedmont, red sandstones (1 point), silicolites (2 points) and ignimbrites (1 point) pebbles appear. In the Cotmeana Piedmont, the great majority of the intra-Carpathian source area pebbles of various sizes appear in the western half of the piedmont. The olivine-bearing basalts pebbles and volcanic breccias coming from the Perșani Mountains (CULESCU & GHENCIU, 2022), as well as the granodiorites pebbles, coming either from the north-eastern Cindrel Mountains or from the north-eastern Făgăraș Mountains, occur exclusively on the western margin of the Cotmeana Piedmont. Also on the western margin, the rhyolite pebble with filiform biotite was identified, with source area in the north-eastern Cindrel Mountains.

An asymmetric distribution within the Cotmeana Piedmont also shows the large pebbles (boulders), most of them on the western edge of the Piedmont, in 13 observation points. Despite the proximity to the Carpathian and Subcarpathian source areas, the boulders the northern area of the Piedmont were identified only in 8 observation points (CULESCU & GHENCIU, 2021). Moreover, the jasper and red sandstones boulders occur exclusively on the western margin of the piedmont (CULESCU & GHENCIU, 2021).

The presence of boulders on the western margin of the Cotmeana Piedmont indicates a consistent, more precisely exclusive, input of coarse clastic material brought by the Olt River from the intra-Carpathian source area and deposited on its left bank. The same preferential deposition on the left bank is also supported by the minor presence of the gravels in the Olteț Piedmont, where the boulders are completely absent.

In a previous work (CULESCU & GHENCIU, 2021), we explained the asymmetric deposition of the gravels in the two piedmonts by a possible route of the paleo-course of the Olt diverted to the south-east on the territory of the current Piedmont Cotmeana. Later, this south-eastward deflected palaeo-course was blocked by the immense amount of coarse detrital material brought from the intra-Carpathian source area and gradually pushed westward on its present north-south course. The large thickness of the gravel deposits in the central area of the piedmont and on its western margin, however exposed to erosion by the left tributaries of the Olt, supports this hypothesis.

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