

**REGARDS ON METAMORPHIC FORMATIONS FROM SABO-FAGUL
ROTUND AREA (EASTERN CARPATHIANS): I. TULGHES GROUP**

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Introduction

Placed in the South of crystalline - Mesozoic area of the Eastern Carpathians, at the extension of the Balan mining district, the Sabo - Fagul Rotund area has been ignored until now by geological research because, on the one hand, at the north side of Sedloca Valley, the sulphide horizon has been intercepted in the Balan and Fagul Cetatii mines and, on the other hand, because of the lack of money for geological research after the year 1990.

General geological frame

According to the structure of the Eastern Carpathians (Săndulescu, 1984), within the studied area the presence of a pile of overthrust nappes was accepted, which was made of alpine units, in which build fragments of pre-alpine (Variscan) nappes were preserved:

1. Transylvanian nappe, made of Jurassic- lower Cretaceous formations;
2. Bucovinian nappe, made of:
 - 2.1. Mesozoic sedimentary cover (Triassic-Lower Cretaceous);
 - 2.2. Metamorphic basement, made of pre-alpine units (Variscan nappes) (Fig. 1)
3. Sub-Bucovinian nappe, represented by a sedimentary cover (Triassic-Jurassic) and a metamorphic basement (gneisses of Bretila type)

In the south of the investigated area the andesite volcano-sedimentary formation is found, which is associated to the volcano chain Harghita-Calimani.

Lithologic units	Tectonic units
Rarau Formation (Bretila Group), PC Haghimas Granitoids, PC	Rarau Nappe
Balaj mylonitic rocks	Balaj unit
Tulghes Group, C Balan sequence Sandominic sequence	Balan Nappe Sandominic Nappe
Pietrosul Porphyroids	Pietrosul Nappe
Negrisoara Formation, PC?	Negrisoara Nappe
Izvorul Mures mylonitic rocks	Izvorul Mures unit
Rebra Group, PC	Rodna Nappe

Fig. 1. Pre – alpine tectonostratigraphy and main lithologic units of the Bucovinian nappe (after Kräutner, Bindea, 1995 – simplified)

Crystallophillian formations – Tulghes Group

Developed under LT/MP conditions (Barrowian type greenschist facies) the Tulghes Group, which stratotype was described in the Bistrita Mts. (Kräutner et al., 1985-1990), consist of four formations ($Tg_1 - Tg_4$). In the central part of the East Carpathians, only the upper part of the sequence, Tg_3 and Tg_4 , is exposed. This formations occur in two tectonic units, Balan and Sandominic.

I. Balan Nappe:

Within the Balan Nappe from Sabo - Fagul Rotund area the following litho-stratigraphic entities have been divided (Fig. 2 and 4):

1. Tg_4 Formation

1.1. Arama Oltului member has an outstanding direction extension, between the Olt Valley and the Fagul Rotund Valley and an apparent thickness of 250 m until 700 m. From lithologic point of view, it consists of a stock of sericite $\pm$ chlorite $\pm$ graphite $\pm$ quartzite schists, where the following ones were identified:

1.1.1. a quartzite with sericite level, which has continuity on direction between the Olt Valley and the Sabo Valley, also outcropping in the area of upper courses of Sedloca and Babasa streams;

1.1.2. a level of white quartzite feldspathic rocks, associated between the Olt Valley and the Sabo Valley, having a level of green schists with albite;

1.1.3. a level of chlorite sericite schists with disseminations of pyrites $\pm$ chalcopyrites, which outcrop between the Olt Valley and the P. Scurt Valley and, locally, in the area of the upper course of the Babasa stream.

2. Tg_3 Formation

2.1. Sedloca member outcrops between the Olt Valley and the Fagul Rotund Valley, having an apparent thickness which varies between 100 and 300 m. From the lithologic point of view, Sedloca member is represented by:

2.1.1. a level of white quartzite with sericite $\pm$ feldspathic, which outcrop between the Olt Valley and the Sedloca Valley and, locally, in the area of the upper course of the Oltovani stream;

2.1.2. between the Olt Valley and the Fagul Rotund Valley, an alternation of sericite $\pm$ chlorite schist and sericite quartzite, where, locally (Olt, Sedloca and P. Scurt Valleys) pyrite disseminations occur;

2.1.3. the lower side of Sedloca member is ended by rhyolitic metavolcanics which outcrop between the Olt Valley and the Fagul Rotund Valley. Locally, in the Olt, Sabo, Sedloca and P. Scurt valleys, associated with rhyolitic metavolcanics, metagabbros outcrop;

2.2. Valea Baii member outcrops between the Olt Valley and Oltovani Valley, with an apparent thickness between 250 and 500 m. In the south of the Oltovani Valley, formations of the Valea Baii member are probably cut by the overthrusting plan of the Balan nappe.

2.2.1. a level of sericite chlorite schists with pyrite $\pm$ chalcopyrite disseminations, identified between the Olt and Oltovani valleys;

2.2.2. a level of chlorite sericite schists with pyrite disseminations which outcrop locally, in the Olt and Sedloca valleys.

II. Sandominic Nappe

Within the Sandominic Nappe which outcrops the Sabo - Fagul Rotund area, the following lithostratigraphic entities have been divided (Fig. 3 and 4):

1. Tg₄ Formation

1.1. Paraul Crucii member which outcrops between the Olt and Fagul Rotund valleys, having an apparent thickness which varies between 500 and 1000 m;

1.1.1. graphite phyllite with intercalations of black quartzite and graphite metadetrinitic rocks, which outcrop between the Olt and Oltovani valleys;

1.1.2. a sequence made of sericite $\pm$ chlorite phyllites (where there is intercalated a level of metadetrinitic whitish rocks and 2 levels of black quartzite) follows between the Olt Valley and the P. Scurt Valley

1.1.3. an alternation of green schist $\pm$ magnetite outcrops between the Olt Valley and the Fagul Rotund Valley, which are associated to metabasites, black quartzite and sericite $\pm$ chlorite phyllites, where a level of acid metavolcanics is intercalated;

1.1.4. a group of sericite $\pm$ chlorite phyllite outcrops between Sedloca and Fagul Rotund valleys, where a discontinuous level of black quartzite is intercalated.

.....	Quartzites with sericite	Arama Oltului Member (250-700m)	Tg4 Formation
	Sericite chlorite ± quartz schists		
	Greenschists		
	Sericite chlorite ± quartz schists		
+++++	Rhyolitic metatuffs		
	Sericite chlorite ± quartz ± graphite schists		
■ ■ ■ ■ ■ ■ ■ ■ ■ ■	Sericite chlorite ± quartz schists with pyrite ± chalcopyrite disseminations	Sedloca Member (100-300m)	Tg3 Formation
	Sericite chlorite ± quartz ± graphite schists		
..... ■ ■ ■ ■ ■	Quartzites with sericite Sericite + feldspath schist, quartzites with pyrite disseminations		
+++++	Rhyolitic metavolcanics		
+++++ +++++ +++++	Metagabbros		
+++++ +++++ +++++	Sericite+ feldspath schists Rhyolitic metavolcanics		
	Sericite chlorite ± quartz schists	Valea Baii Member (250-500m)	
■ ■ ■ ■ ■ ■ ■ ■ ■ ■	Sericite chlorite schist with pyrite disseminations		
	Sericite chlorite ± quartz ± graphyte schists		
■ ■ ■ ■ ■ ■ ■ ■ ■ ■	Sericite chlorite schist with pyrite disseminations		
	Sericite chlorite schists		

Fig. 2. Lithostratigraphic sequence of the Tulghes Group in the Balan Nappe from the Sabo - Fagul Rotund area (not to scale)

— — — — —	Graphyte phyllites	Paraul Crucii Member (500-1000m)	Tg4 Formation
○ ○ ○ ○ ○	Metadetriric rocks		
• • • • •	Black quartzites		
— — — — —	Graphyte phyllites		
— — — — —	Sericite +chlorite phyllites		
○ ○ ○ ○ ○	Metadetriric rocks		
• • • • •	Black quartzites		
— — — — —	Sericite +chlorite phyllites		
• • • • •	Black quartzites		
— — — — —	Sericite +chlorite phyllites		
□ □ □ □ □	Greenschists and metagabbros		
□ □ □ □ □	Rhyolitic metavolcanics		
□ □ □ □ □	Greenschists and metagabbros		
— — — — —	Sericite chlorite phyllites		
• • • • •	Black quartzites		
— — — — —	Sericite +chlorite phyllites		
• • • • •	Black quartzites		
— — — — —	Sericite +chlorite phyllites		

Fig. 3. Lithostratigraphic sequence of the Tulghes Group in the Sandominic Nappe from the Sabo - Fagul Rotund area (not to scale)

Age of formations from the Tulghes Group

Palynological data (Olaru, Apostoae, 1995; Olaru, Apostoae, 2005, 2005) are elements that suggest the age of sedimentation and contemporaneous volcanism to the Lower Cambrian, with transition to the Upper Cambrian and Lower Ordovician.

Tectonics of the Tulghes group

According to the tectonic situation proposed by Kraütner, Popa (1973) for the Balan mining district, the tectonic division of the formations from the Tulghes group within the Sabo - Fagul Rotund area is generated by the following fault systems (Fig. 4):

- system of directional faults, where could be framed Sabo directional dislocation, which duplicates the formations of the Balan nappe between the Olt and Sabo valleys;
- system of the transversal faults, which is crossed by faults of the conjugated oblique system and does not disturb the overthrust plans of Rarau and Balan nappes;
- system of conjugated oblique faults, which includes most of dislocations from the area and is represented by faults with south-eastern inclinations, N-E directed and rarely, by faults with north-eastern inclinations , WNW directed. This fault system crosses the faults of the other systems, as well as the overthrust plans of Rarau and Balan nappes.

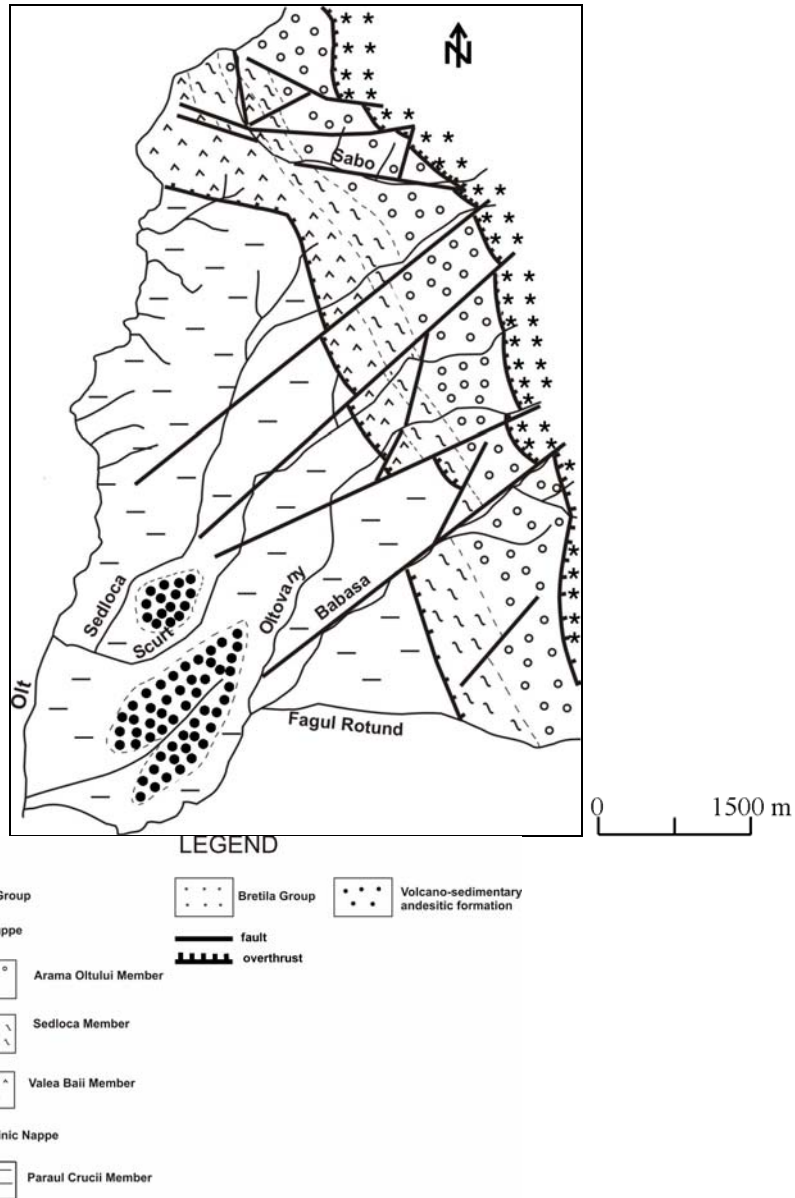


Fig. 4. Map of the Sabo-Fagul Rotund area

Conclusions

- within the Sabo-Fagul Rotund area, the Tulghes group is represented by Balan and Sandominic nappes;
- within the Balan nappe, the members of Arama Oltului, Sedloca and Valea Baii have been identified and within the Sandominic nappe, the Paraul Crucii member has been identified;
- the overthrust plan of the Balan nappe is placed in the Valea Baii member, suggesting that the Balan member, which is the carrier of the main mined horizon, was cut by overthrust;
- for each member of the Balan and Sandominic nappes, some lithostratigraphic reference points have been determined;
- from the tectonic point of view, the Sabo-Fagul Rotund area is characterized by the presence of three fault systems.

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