Tectogeomorphologic Geometamorphoses in Northwestern Romania – the Silvania Mountains

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Abstract. Apparently uniform and homogenous, the territory between the Rodna Mountains (Eastern Carpathians) and the Central Apuseni Mountains, namely the Plopiş and Meseş Mountains, is described by the presence of some old tectostructures and paleo-orogens under sedimentary layers of tertiary sandstones. Three major statements regarding this territory were advanced in the geography-geology field:

a. Linking unit between the Apuseni Mountains and the Eastern Carpathians, called by V. Mihailescu (1921, 1930, 1935-1936) "the Intra-Carpathian yoke";
b. Carpathian subunit, linked to the Apuseni Mountains (Coteţ, Martiniuc, 1960);
c. A complex structural block developed as a result of Silvania's lifting up, with a distinct evolution (Mutihac, 1992).

Within another conception, the mentioned territory could be attributed to a mountainous system, linked, as regarding their genesis and evolution in time, to the Eastern Carpathian through the Rodnei Mountains and to the Apuseni Mountains through Gilău and Bihor Mountains down to the Banat Mountains. This Hercynian orogen was fragmented, sunk and then involved into the tectostructural Tertiary movements. The postectonic movements fragmentized the respective system and determined its affiliation to the Transylvanian Depression rigid craton, considered a remaining of Gondwana. The Silvania Mountains, with a geomorphologic landscape resembling to that of the European basins and catenas, is the result of this geologo-geomorphologic evolution and changes. The initial Hercynian tectogene was intensely modeled in subaerial regime determining a palympsestic morphology unique within the Romanian territory.

1. General Considerations

Apparently uniform and homogenous, the territory between the Rodna Mountains and the Central block of Apuseni Mountains, namely the Plopiş and Meseş Mountains, "screens" some old tectostructures and paleoreliefs by sedimentary layers of Tertiary sandstones.

The most recent geologic researches on the mentioned area, focuses with predilection on the crystalline formations and on the sedimentary layers (for example Săndulescu, 1984, Balintoni, 1994, 1996), led to the conclusion that, excepting the Gilău Mountains, the crystalline formations of the "Someş series" (belonging to the Bihor Unit – the Bihor Autochthonous) afflorates on the ridge of the Remeti graben within the Rez and Meseş Mountains (Plopiş) and within the Faget and Ţicău crystalline isles. As regarding the Preluca Mountains, the opinions are contradictory, according to some of them they belong to the Baia de Arieş series (Roşu, 1983), while others associate them to the Rebra series being considered as a component of another unit, different from the Bihor one.

Regardless of the asserted opinions, it is obvious that the Preluca Massif keeps orographically and morphologically a landscape that resembles to that of the above mentions crystalline isles.

The crystalline formations are appreciated to be Precambrian or possibly Carboniferous. On this crystalline layer, Postsenonian Mesozoic formations and locally Permian ones are sporadically found.

The second stratigraphic sequence belongs to the Superior Triasic and the Low Cretaceous. A distinct prealpine paleogeographic situation was thus identified, with obvious implications in the actual morphology.

The Alpine morphologic and tectogene deformations induced structural and geomorphologic readjustments, reactivation of old faults and dislocation of the existing deposits, especially of the Tertiary formations.

When analyzing the evolution of the geologic-geomorphologic events, the following phases could be distinguished:

a) The Danian-Paleocene phase developed at the end of the Superior Cretaceous and continued in

the Paleocene, when the marine transgression from the Transylvanian basin took place, contributing to the creation of a communication way towards West through the Şimleu Basin. The correspondent formations are to be found in the Jibou-Benesat-Ulmeni area where they form the Danian-Pliocene layers with their well-known series (Joja, 1956);

b) The basin phase (Badenian-Sarmatian-Panonian) characterized by transgressions (for example the Badenian or Panonian transgression) and regressions (Upper Sarmatian, Pontian) which determined an uniform morphology, made of ridges, insular massifs and basins that induced a differentiated sedimentation and modeling.

c) The subaerial modeling phase (morphosculptural), developed along the Upper Tertiary and Quaternary, described by processes of selective erosion, large denudation or fluvial modeling that resulted in the appearance of extended piedmontan layers, fluvial terraces and altitudinally ordered glacises. The region's actual geomorphic physiognomy is an outcome of the processes that took place at the end of this phase.

2. Geologic and geomorphologic References

Along the Precambrian and Paleozoic eras, the analyzed region belonged to a large geosynclinal area.

The Hercynian orogenesis (Middle Carboniferous) determined the formation of a mountainous system and the transformation of the studied territory into a rigid block that under the action of a subaerial modeling would have become a pediplena (Pop, 1964).

The Alpine orogenesis subjects the Hercynian morphotectonic edifice to a lateral compression, transforming it into an "isle" area – horst, ridges and local basins developed on the sinking microblocks. The end of the Alpine orogenesis (the Attic, Rhodanic and Valachian movements) also induces plicative and fractural deformations of the Neogene deposits in the areas of marine and lacustrine accumulation, the grabens that separate the "catenas" and the horsts.

The significant lifting up at the end of the Alpine orogenesis (the Valachian movements) endows the old structures on the alignement Meseş - Dealu Mare - Preluca with a remarkable elevation that is physiographically expressed through a mountainous configuration. As a result, erosion increases, contributing to the removing of the Neogene formations and to the formation of the leveled surfaces at 300-350 m and at 550-600 m. The hydrographic network that models the contact depressions developed in the subsidence areas corresponding to the grabens: Lower Someş Depression, Jibou-Ulmeni Depression, Agrij Depression and the internal depressions of Simleu, Zalău si Sălaj.

3. Typology and Functions

The following opinions were advanced in the geologic and geomorphologic literature in relation to the genesis and spatial function of this territory:

a) The hidden mountains of the Northern Transylvania (Szadecky, 1913, Berindei, Mac, 1980);

b) Linking unit between the Apuseni Mountains and the Eastern Carpathians, called by V. Mihăilescu (1921, 1930, 1935-1936) "the Intra-Carpathian yoke";

c) A complex structural block developed as a result of Silvania's lifting up, with a distinct evolution (Mutihac, 1992);

d) Pericarpathian unit belonging to the Banat-Criş hills and depressions (Pop, 2005);

e) Excepting the Meseş and Plopiş Mts., considered as a prolongation of the Apuseni Mts. orogen, many researchers consider the rest of the analyzed territory as a hilly (piedmontan) unit and name it the Silvano-Someşan Hills (Mihăilescu, 1936, 1966, Mac, 1991).

Other assertions are to be found in the specific literature, but we consider them formal and strictly contextual (Pop, 2000).

4. New Approaches and Interpretations

As a result of the field survey, the following elements were identified:

a) The Meseş Mts, Dealul Mare Hill, Ţicău Hill and Preluca Hill are described by Paleogene formations that were strongly disturbed tectonically, vertical strata being identified in some places. Thus, a large monocline developed towards the Transylvanian Plateau and a composite cuesta front towards Silvania. The following question arrises from this situation: how and when such disturbing phenomena

could happen? The answer for when is quite obvious, in Postoligocen;

b) All the ridges (Meseş, Plopiş, Codru) and the crystalline isles are asymmetric: a steep slope to the West or Southwest and a gentler one to the East and Northeast. This clinotropy supposed a pushing impulse/effort from West and Northeast and a rigid barrier in the East, from the Someşan Plateau;

c) The relief on the crystalline formations is ordered vertically in general on two leveled surfaces, while on the adjacent sedimentary another one has developed, at 300-350 m;

d) The main hydrographic network has a general orientation from South to North (the Someş, Crasna, Barcău, Sălaj rivers), that is a longitudinal one, while the secondary net is perpendicular, with evident transversal sectors in the case of many tributary rivers (Cerna, Oarţa, Sărata etc.)

e) Beneath the ridges' and interfluves' level, the denudation process gave birth to basal or slope glacises extremely well represented on the edge of the external and internal depressions.

The geologic and geophysical data reveals the following facts (Fig. 1):

a) The crystalline formations form ridges and hummocks ordered longitudinally along a North-South direction;

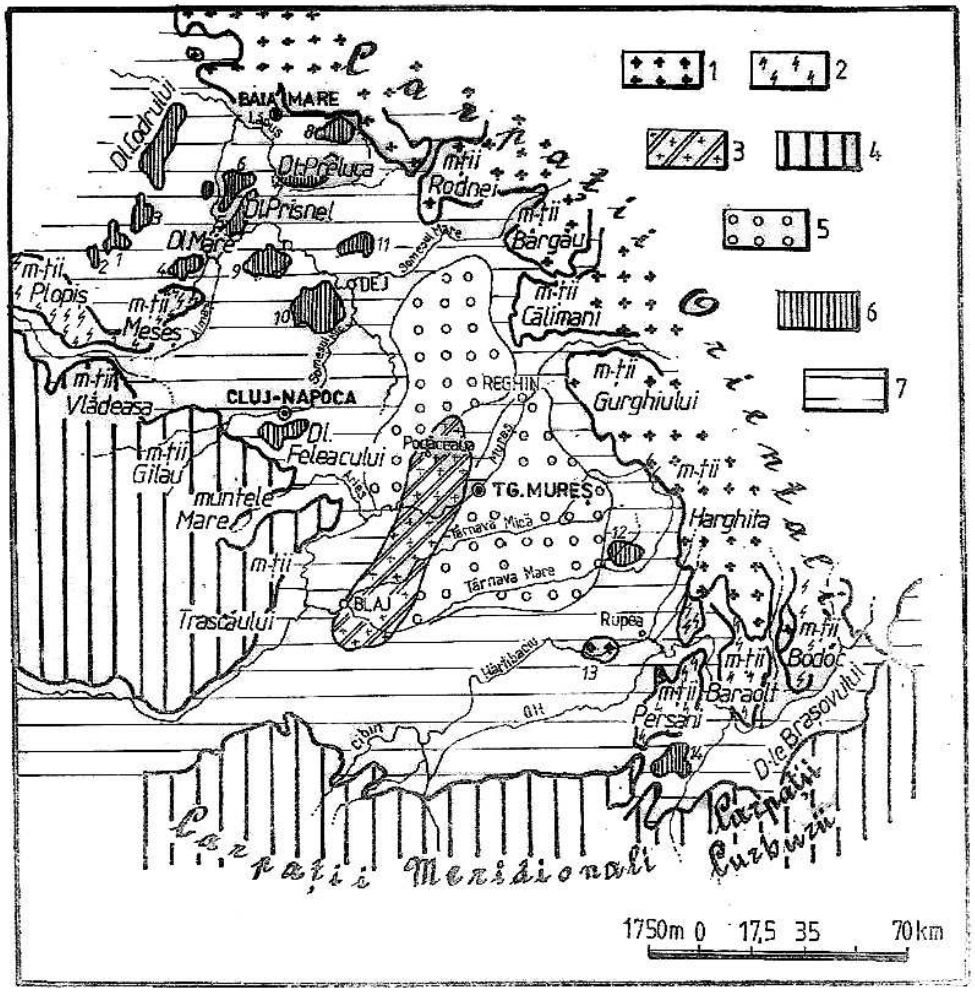

Fig. 1. **Tectostructural framework of the Transylvanian Depression and of the Silvania Mts.**

1. Magmato-volcanic structures – Eastern Carpathians and Rupea Isle; 2. Crystalline and sedimentary structures from the marginal orogens; 3. Areas of neotectonic lifting up and Miocene rocks; 4. Complex Carpathian orogens (Apuseni Mts., Southern Carpathians); 5. Mio-Pliocene formations; 6. Structural hummocks and ridges (1 – 14); 7. Transylvanian Depression and its connection units.

b) A series of tectonic dislocations oriented almost from East to West and fragmenting the crystalline were identified (for example the Moigrad fault);
c) Between the line of ridges and hummocks, sedimentation areas developed, especially with Tertiary (Neogene) formations (Fig. 2);
d) The sedimentary formations are folded or monoclinal. An example in this direction is the Cuceu-Benesat-Ulmeni, the Aghireş-Panic, the Şamşu-Hodod and Mirşid-Doba Anticlines;
e) A general subsidence of the whole tectostructural ensemble towards West-Northwest is to be noticed. The fault (the deep fracture) Carei-Oradea marks the transition from the Silvania tectonic unit to the Pannonian one;
f) Two major phases describe the evolution of this region: the Predanian and the Alpine one.

5. Final considerations

Associating the opinions of some researchers (Coteţ, and Martiniuc, 1960, Mutihac, 1990) with the geologo-geomorphologic and cartographic evidences, as well as with the available information on the region's global tectonics and the field surveys, the following tectonic and geomorphologic considerations could be asserted:

1. The studied geologic and geomorphologic unit appears as a distinct territorial entity in Northwestern Romania, that we named as the Silvania Block Mountains (or the Silvania Mts.). They stretch from the Lăpuş Depression (Posea, 1962) in the East to the Crişul Repede Valley in the West.
2. Major faults and fractures mark the extremities of these block mountains: the Olt-Huedin-Crişul Repede-Oradea fracture to Southwest, the Lower Someş fracture to Northeast, the Carei-Oradea fracture to the West and the Parameseşan fracture to the East.
3. The territory is described by the features that characterize the block mountains, benefitting from an architecture of horsts and grabens. The horsts appear as mountains (Meseş, Plopiş, Preluca, Ţicău, Prisnel, Codru) or hummocks (Simleu, Cosei, Dealu Mare, Dealu Chicera etc.). The grabens are strongly sedimentated and generally modeled as longitudinal valleys, some of them with fluvial terraces (Crasna, Zalău, Sălaj, Someş).
4. The rivers leave the block mountains through gorges (Marca, Porţi, Ţicău).

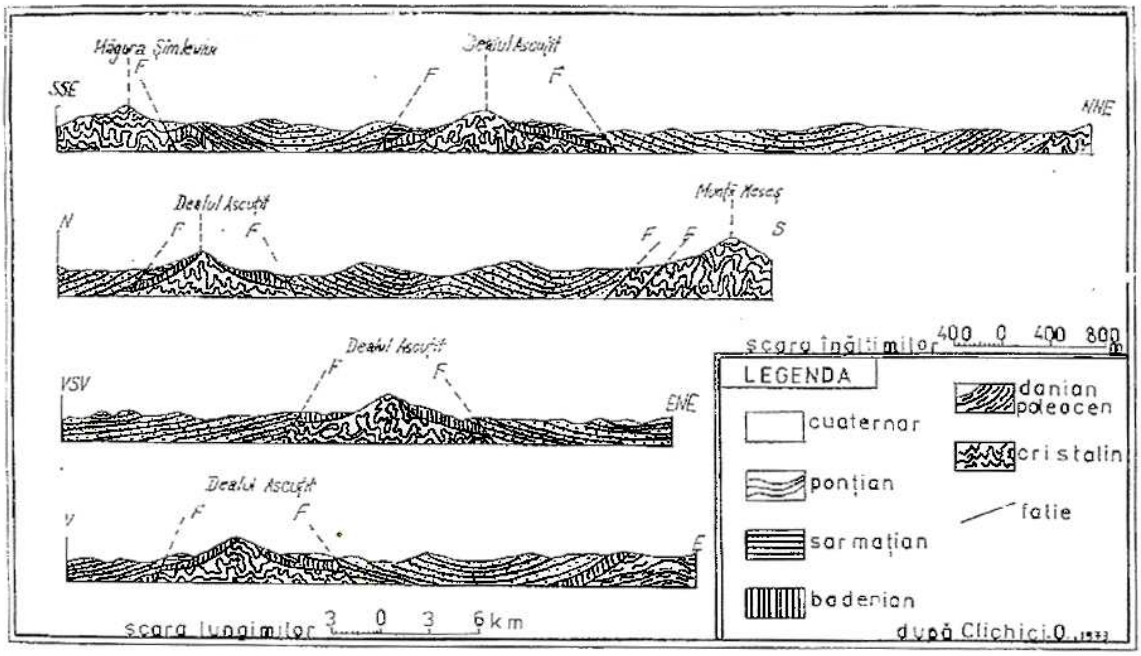

Fig. 2. **Transversal sections in the Şimleu Depression and in its marginal sectors, on various directions**

5. The genesis of this unit should be attributed to the tectonic and orogenic processes that took place in the Proterozoic and the Carboniferous, especially to the Hercynian Orogenesis, that acted between two central blocks: the Transylvanian central block, interpreted today as a remaining of Gondwana in its advance to the East-European Plate and the Pannonian block, a small traveling plate under the impulse of the Atlantic Rift. The first crustal block, Transylvania, stopped the developing of Hercynides towards South, because of its rigidity due to the incorporated old and new orogens. This fact explains the altitude of the ridges Meseş, Prisnel-Ţicău-Preluca-Rodna and the strong distortion of the Paleogene deposits in the southern part of the latter mentioned unit. These formations were crushed towards the Transylvanian craton under the impulse of the orogenetic movements.
6. The system of the Silvania Block Mountains includes several subunits:
   a) The marginal mountainous subunit composed, at its turn, of some subunits: 1.1. Plopiş subunit; 1.2. Meseş s.; 1.3. Prisnel-Ţicău s.; 1.4. Preluca s.; 1.5. Codru s;
   b) The intra-mountainous depressions subunit: 2.1. Simleu Depression; 2.2. Zalău Depression; 2.3. Someş Depression (Jibou-Ulmeni);
   c) The hummocks, hills and pidmontan depressions subunit : 3.1. Simleu Hummock; 3.2. Coseu Hummock; 3.3. Chicera Hummock (to the North of Jibou);
   d) The valley corridors and erosion saddles subunit : 4.1. Hurezu Mare-Bicaz-Oarţa Passage; 4.2. Bogdand-Supur Passage; 4.3. Cehu Silvaniei Passage; Borla-Sărmăşag-Supur Passage.

The increased morphologic dividing constitutes the reflex of the tectonic and hydrographic fragmentation and expression of the differentiated modeling within the Silvania Mountains. Together with the morphologic contrasts imposed by structure and rock, some gentle physiographic elements also appear as a result of the sedimentary deposits modeling in the local sedimentation basins.

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