# Aspects of Periglaciar Relief in the Parâng Mountains

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**Cuvinte cheie:** forme periglaciare, ghețari de pietre, Munții Parâng

***Aspecte ale reliefului periglaciar din Munții Parâng.*** Cu o bună reprezentare a treptei hipsometrice de peste 1800 m, Munții Parâng se impun ca specificitate a peisajului lor geomorfologic și prin existența unui relief periglaciar expresiv, reprezentat prin forme complexe, datorate atât morfogenezei pleistocene cât și celei actuale și subactuale, în condiții specifice etajului morfotectonic periglaciar, caracterizat prin temperaturi medii multianuale negative. Sub aspectul factorilor ecologici implicați în morfogeneza periglaciară, au fost analizate modalitățile în care relieful major și litologia, reprezentată mai ales prin roci foarte gelive – granitoide, gnaise amfibolite – transmit influențele lor asupra genezei, evoluției și repartiției spațiale a formelor periglaciare.

## 1. Introduction

Although the periglacial elements of Parâng Mountains were the subject of an article published by Silvia Iancu in 1961, after more than 37 years we consider that it is necessary to present things in a different manner, according to the new ideas and notions existing in the geographical literature. In a science like geomorphology, theory and fieldwork should be symbiotic (Thorn, 1992).

Taking into account the fact that the periclacial morphogenetic milieu is that where the influence of freeze-thaw oscillations is dominant (Tricart, 1968), and the ''peculiarity of periglacial facies consists in the mechanical splitting of thew rocks in situ; and freezing is the most important factor of periglacial climate'' (Lozinski, 1909), and where the most fundamental of periglacial processes are those associated with cryogenic weathering, frost heaving and ice segregation (French, 1996), we will understand the suitability of our approach, taking into consideration the specific climatic conditions of the Southern Carpathians.

From the beginning we want to state clearly that, taking into account the fact that the $3^0$C isotherm is considered to be the bottom limit of the solifluction substorey, and therefore of the periglacial level, too, we may consider the periglacial processes - and, of course, the associated forms - as a present-day topic in the alpine zone of the Parâng Moutains. We cannot overlook the presence of the fossile and relict periglacial forms (fig. 1), which are the result of Pleistocene morphogenesis.

An illustrating exemple could be the stone rivers situated at 1,400-1,450 m a.s.l. on the slopes of the Jieț valley.

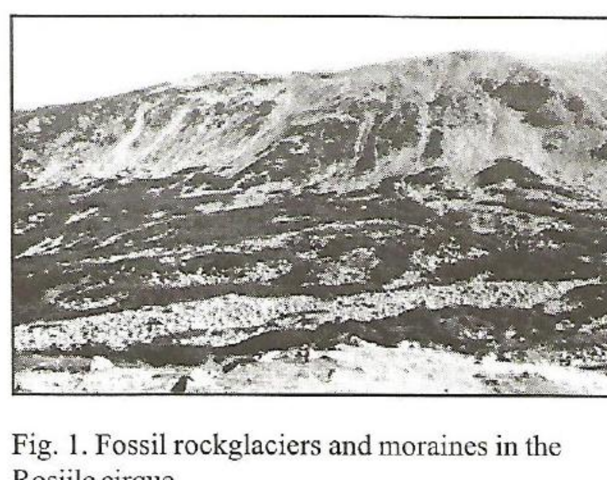

Fig. 1. Fossil rockglaciers and moraines in the Roşiile cirque

**1.Geographic characteristics of the Parâng Mountains**

The Parâng Mountains are situated at 45°22'30" N and 23°35' 10", on the west side of the Southern Carpathians, in the Parâng mountain group, reaching a maximum height of 2,518 m a.s.l. in Parângu Mare Peak. Glacial cirques and valleys are the fundamental geomorphic elements in the landscape of high are a of Parâng Mountains, originated in the Pleistocene glaciers which reached altitudes around 1,200 m a.s.l. during their maximum extension. The largest part of the interfluves is represented by typical sharp crests and pyramidal peaks, peaks and crests that found even at neights over 2,000 m a.s.l., in fact a real gipfelftur. Regarding the area adjacent to the central zone, especially to the East and the South, the glacial landforms are moulded in the smooth and rounded surfaces of the levelled surfaces which belong to the Borascu sculptural complex. Climatic conditions in the highest belt of the Parâng Mountains are characterized by cold temperatures. The long-term average mean annual air temperature is 3.3° C at Parâng meteorological station (1,585 m a.s.l.) and above 2,200 m a.s.l. are generally below -1° C. At such altitudes, the number of annual freeze/thaw cycles is higher than 125 and frost is possible during the entire year. Annual mean precipitations approximate 1,000-1,200 mm (Parâng station - 968 mm), and the high limit of the forest is situated between 1,700-1,800 m.

**3. Field observations and discussions**

First of all, we should that in the Parâng Mountains there is a double conditioning of the spreading of the periglacial landforms, one lithological and the other geomorphological.

The existence of two different lithological entities, on the one hand, the Parâng granitic bodies, and on the other hand, the crystalline schists (amphibolites, amphibolitic gneisses, micaschists and sericitequartzitic schists) requires a certain differentiation of the spreading of the periglacial elements. The granites and granodiorites - very sensitive to weathering, giving large frost-shattered blocks - favour the spreading of the rockglaciers phenomenon, the block fields and the rock rivers (fig. 5). Crystalline schists produce smaller frost-shattered debris, leading to a higher content of fines in the corresponding deposits and soils. Solifluction, ploughing blocks and debris-flow (fig. 2) are frequent in such zone.

Fig. 2. A debris-flow cone in the Mândra cirque

In the high axial area periglacial-glacial ridges and the steep slopes with avalanche couloirs and talus cones are the specific feature of the environment, but in the wide area of development of the Borăscu sculptural complex (Ieşu-Ciobanu, Pleşcoaia-Mohoru, Ştefanu-Urdele-Păpuşa areas) the periglacial pavements, earth hummocks, and solifluxionl forms are representative. The residual outliers of tor type appear on the ridges and the levelled surfaces, too. The component blocks often present smooth surfaces determined by the periglacial eolisation. Regarding this, a proof may be that the basis of these tors lacks in fine fragments, but presents alveoles and micro-depression moulded by deflation.

The domain of the glacial cirques and valleys is characterized by the presence of large block fields. Those situations noticed at the beginning of the century in the Martonne's and Schreter's studies (1907, 1908), and also in later ones (Sârcu and Sfilea, 1956; Iancu, 1961). Yet we should acknowledge that Sârcu and Sficlea (1956) considered the large block fields ''Blockströme or even rock glaciers"(p. 392). A more careful analysis of these things may prove the existence of some rockglaciers, of diverse forms, sizes and evolution phases. In the alpine area of the Parâng Mountains, like in the Retezat Mountains, rock-glaciers are the most characteristic elements of the postglacial relief (Urdea, 1992, 1998). The large spreading of the glacial relief on the North slope favours the appearance of rock glaciers in cirques and valleys, the steep rock walls protect them from incoming direct solar radiation and also offer a large quantity of frost-shattered blocks. In fact, this geomorphologic situation has microclimatic implications, important for rockglaciars genesis and evolution.

The terms known in the Roumanian geographical literature as ''nivation protalus'' are in fact protalus rampart, the embryonic forms of the rockglaciers phenomenon. These incipient landforms were early noticed in Găuri and Gâlcescu cirques by de Martonne (1900). The brilliant French geographer explains the genesis of these landforms which he called ''muraille en fer a cheval'', and his explanations are compatible with the present ones (cf. Haeberli, 1985; Barsch, 1996). The analysis of the rockglaciers and the glacial deposits emphasizes the existence of two main genetic types of rockglaciers, talus rockglaciers and debris rockglaciers, and of course, an intermediate one. The talus rockglaciers are situated below talus slopes and transport mainly frost-shattered rock fragments, and the debris rockglaciers occur below the end moraines and transport mainly morainic or glacial debris (Barsch, 1996). Dealing with the shapes of the rockglaciers, we must underline their variety. In the Parâng Mountains there prevail large lobate shapes and they sometimes change into tongue-like shapes (fig. 3).

Fig. 3. Inactive-active rockglacier Sliveiu

There are also intermediate forms from the incipient (protalus rampart) to the lobate ones, for example the two rockglaciers situated on the upper step of the Găuri cirque.

In many situations (Roşiile, Gemănarea, Ghereşiu, Slăveiu, Păsării, Iezeru, Mija Mare) the detailed topography of the glacial cirques and valley floors allows a reconstitution of the evolution of the glaciers as follows: ablation comlexes => debris-covered glaciers => ice-cored rockglaciers => debris rockglaciers or secondary rockglaciers (Urdea, 1998). The temperatures below 2°C of the springs situated at the basis of some front of rockglaciers (Table 1) indicates the existence of the permafrost, and therefore, of an active periglacial morphogenesis.

Table 1: Temperature of springs

| | | |
|---|---|---|
| Păsării cirque | 10.08.1998<br>26.09.1998 | $1.6^0$ C<br>$0.9^0$ C |
| Gemănarea | 17.08.1998<br>24.09.1998 | $1.8^0$C<br>$1.4^0$C |
| Mija Mare | 20.08.1998 | $1.7^0$C |

Taking into account the fact that the rockglaciers are considered paleoclimatic indicators (Barsch, 1978), the identification of the primary and secondary rockglaciers allows the reconstruction of the evolution of the geomorphological landscape from the Upper Pleistocene and Tardiglacial and even for the period of the Little Ice Age.

Regarding this problem, one proof could be the presence of some very recently formed stone-banked lobes, with a position of the frost-shattered debris which indicates their movement. On the north-western slope of the Gem'narea Mountain we identified at 2,250 m a.s.l. a lobe about 50 m in length, 15-20 m wide at the basis, 8 m wide and 1-2.5 m height in its frontal side (fig. 4). It is made of angular frost-shattered blocks, many of them shaped like slabs, with an imbricate structure. Many frost-shattered blocks occupy a vertical position, consequenly this stone-banked lobe is an active one. A little higher, the frost-shattered blocks are "organized" into an incipient lobe of 8-12 m in length.

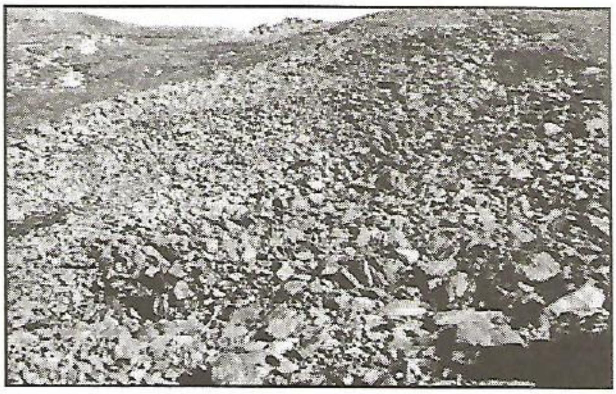

Fig. 4. Stone-banked lobe on the western slope of the Gemănarea Mountain

We want to specify that the elongated depressions with a V- profile along the main and secondary ridges (e.g. Sliveiu ridge) are not made exclusively by the periglacial processes ("periglacial trench", Iancu, 1961). We consider that nivation alone is not able to create trench-like landforms and that landforms depend on tectonic elements, on the lateral extension of the crystalline rocks (Marre, 1998) and on gravitation trenches (Jahn,1964). This process was and is stimulated by the pressure release process (Summerfield, 1991), as a result of liberation from the ice masses. These assertions are sustained by the obvious morphological situations in the Gemănarea-Slivei area, where the periglacial-tectono-gravitational trenches are moulded parallel to the cliffs from behind the cirques or along the lateral walls, in the case of the Slivei Ridge. A similar situation was noticed by Sârcu in the Rodna Mountain (1978), and named "crevasses-faults", or "gravitational faults" by Jahn (1964) in the Tatra Mountains.

We should mention a special situation: in many instances, for example on the western slope of the Mândra-Parângu Mare interfluve are crossed by rock rivers originating from block fields. In some glaces the slopes have the characteristics and aspect of the debris-montled slopes orslopes of frost-sbatered blocks. In levelled surface areas or glacial cirques floor, earth hummock are representative.

We conclude that the Parâng Mountains are characterized by a variety of periglacial elements (fig.5), which appear in diverse development and evolution phases.

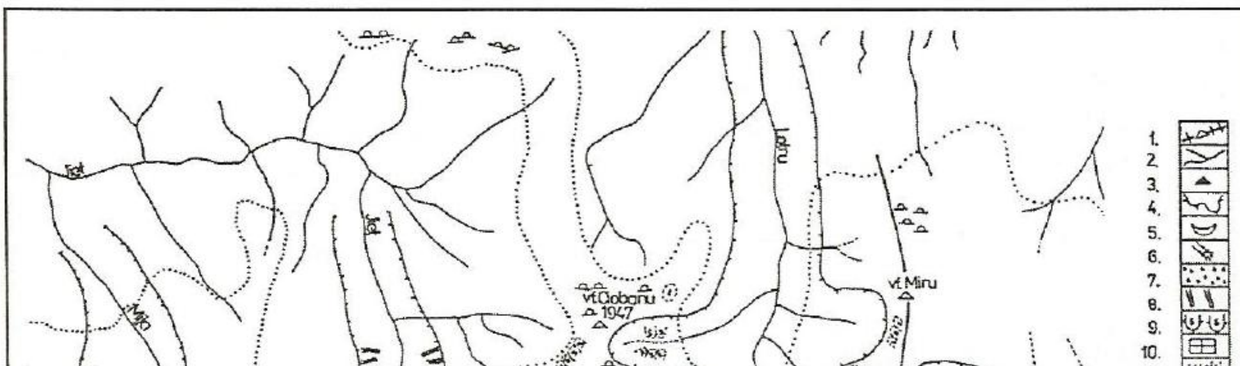


Fig. 5. Parâng Mountains - periglacial relief. 1. ridges and peak, 2. rounded crest, 3. periglacial tors, 4. rockglaciers, 5. protalus rampart, 6. avalanche couloir and talus cone, 7. block fields, 8. stone rivers, 9. stone banked tongues, 10. periglacial pavement, 11. solifluction lobes, garlands and tongues, 12. solifluction terracettes, 13. ploughing blocks, 14. earth hummocks, 15. nivation micro-depression, 16. tectono-periglacial trench

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