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THE MORPHOMETRY OF THE GLACIAL CIRQUES WITHIN THE GILORT BASIN

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Abstract: On the southern slope of the Parang, the glacial landforms are represented by ten small cirques developed at the head of the tributaries of the Gilort that are analysed by means of 21 morphometrical variables. Most of the cirques display a prolonged shape (popularly called *zănoage*). Due to their obsequent character they are well-shaped upstream. The lower step, which develops below a large threshold in most of the cases, displays a greatly inclined slope, while the contour is less obvious because of the periglacial processes. The deepening degree and the declivity of the floor impose the morphographical characteristics of the cirques. From this point of view, we mention the *slope cirques* within the analysed basin, developed more as surface than as depth and displaying a great slope.

Key words: morphometrical variables, glacial landforms, glacial Cirques, Parang

The morphometrical analysis of the ten glacial cirques located within the upper basin of the Gilort aimed at measuring and calculating a set of variables considered being important for the characterization of a cirque. The morphometrical measurements followed the methods introduced in the literature in the field by Evans S.I and Cox N. (1974, 1995, 2006), which were modified, completed and used by different foreign authors: Alonso V. (1993), Garcia Ruiz J.M. & al. (1999), Lowey G.W. (1999), Hughes P.D. (2007), Steffanova P. and Mentlík P. (2007) or Romanian authors: Urdea P. (2000, 2001), Smaranda Toma (2001), Vuia F. (2003), Drăguț L. (2003), Smaranda Simoni (2007), Mîndrescu M. (2007).

The determination of the morphometrical values was based on a set of definitions used by Evans and Cox (1974, 1995) that encouraged their application in much many studies of glacial morphometry in order to verify certain correlations emphasized by the authors of English Lake District. The delimitation of the cirques was made on the basis of the topographical maps at a scale of 1:25,000, of the resulted numerical model of the terrain and of the field observations.

It is necessary to make some operational statements for the stage of the measured variable determination. The delimitation of the cirques along the wall located immediately bellow the ridge is very clear, as they are laterally marked by a convex breach of slope; in case this breach is not obvious, we may consider as a limit of the sector the part where the declivity decreases below 27^0 (Evans, S.I., Cox, N., 1995). In case the threshold of the cirque was not clear, the limit was drawn at a level where the lateral walls became less shaped. At the same time, in

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the areas where the delimitation between the walls and the floor of a cirque is not that obvious "*as ideally the floor display a slope of less than* 20^0 *and the wall located below the ridge slopes of more than* 35^0", the limit was drawn around a declivity of 27^0 (Evans, S.I., Cox, N., 1995). The median axis unifies the middle of the terminal threshold with the ridge drawn along the cirque so that it leaves two approximately equal surfaces on both its sides. The lenght of the cirque was calculated along the median axis and not as the longest distance between two points of the cirque. The width of the cirque represents the maximum distance, perpendicular on the median axis and located between the lateral breaches of the slope. With regard to the exposure of the cirque, it is rather preferred the exposure of the ridge wall, closely correlated with the former glacier and not with the median axis, which is considered not to be representative for the exposure of the cirque (Evans S.I., Cox N., 1995).

Within the Parâng Mountains, the glacial cirques popularly called *căldări* or *găuri* (Gaura Mohorului, Groapa Mândrei, Căldarea lui Murgoci etc.), display a semicircular or semielipsitcal shape. When the rapport between the length and the width is higher than 1 ½ the cirques become elongated. In this case, they are popularly called (especially in the Parâng) *zănoagă*.

Ion Conea (1936) considers that the toponym "*Parâng*" comes from the word *farangos* that in old Greek means *hollow, depression,* which corresponds very well to the landscape from the central part of the massif characterized by the presence of these rocky prolonged depressions (*zănoage*). Their length can sometimes exceed five times the width. When the glacial depression exceeds this proportion we can speak about a glacial valley (Silvia Iancu, 1970).

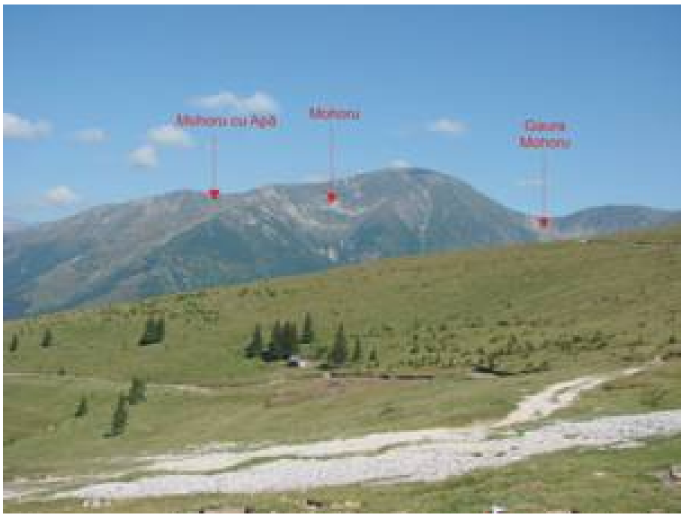

Fig. no 1. The glacial cirques along the Mohoru Valley

According to the criterion of the shape in plane and of the association mode there can be distinguished four types of glacial cirques: simple semicircular, simple elongated (*zănoage*) (Groapa Mândrei, Gruiu, Setea Mică, Pleşcoaia); complex (or conjugated) (Galbenu, Mohoru that comprises three simple cirques – Photo 1), complexes of glacial cirques (located on the northern side). According to the criterion of the position within the hydrographical basin, they can be *head* or *lateral cirques*, when they join the elongated cirques or the glacial valleys; they can be detached or not.

The head cirques are well-shaped, displaying steep slopes, rocks in the open, the bottom covered by coarse frost-shattered rocks, chaotically disposed. In most of the cases, the permanent river system cannot from at their upper part. Their position is sometimes reflected by the circular shape. Thus, sometimes, when the watershed among two or many tributaries was low, the level of the ice exceeded it (Silvia Iancu, 1970). This characterized the lobated cirques (Cioara, Tidvele), the contour of which emphasize the presence of many concavities and their bottom is separated by low thresholds or glaciated knobs. The Tidvele –Galbenu cirques is a complex cirque resulted by the unification of two other cirques, one displaying two lobes (Cioara) and the other a simple one (Tidvele).

The well-developed elongated cirques can display *arched directions* (Gaura Mohorului), reflecting the direction of the periglacial river system, on the basis of which it developed, as well as the topoclimatic, morphologic, and structural conditions that favoured their regressive development.

The deepening degree and the declivity of the floor impose the morphographical characteristics of the cirque. From this point of view, we noticed the southern slope of the Parâng for the *slope cirques (zănoagele)*, developed more as surface than as depth and displaying a great slope (Gruiu, Groapa Mândrei, Setea Mică, Gaura Mohorului, Mohoru). Most of the times, these cirques lack the terminal threshold that is replaced by a fluvio-glacial accummulation (frequently displaying a terrace aspect) (Cioara, Gaura Mohorului, Setea Mică). Within the Gilort basin, the floor of some glacial cirques appears as a much prolonged step. These are well-delimited both at the upper and lower part of the slopes. The bottom is less inclined and finishes with a scarp on the edge of which there develop thresholds of different types sometimes displaying a structural character (Mohoru cu Apă).

From the point of view of the shaping degree and of the general aspect of the floor, the cirques generally display a mixt character resulted from the combination of the characters of the step and slope cirques (Silvia Iancu, 1970). There are cirques that start with the features specific to the step cirques and continue with the ones characterizing the slope cirques. These are the most numerous ones (Mohoru, Pleşcoaia, Mohoru cu Apă, Ieşu), but there can be noticed opposite cases, when the prolonged depression starts with the features of the slope cirques and ends with a step, as it can be seen in the case of Gruiu cirque.

The glacio-nival cirques are semicircular excavations with extremely low morphometrical indices as compared to the glacial cirques developed in the proximity of the permanent snow limit developed through the action of the nival processes induced by snow and firn accumulations. These cirques do not display features specific to the glacial morphology being generated by the crionival processes. They represent the catchment basin of some torrents (Tărtărău, Pleşcoaia, Tidvele, Dengheru).

Within the Gilort basin, the most developed cirques belonging to this category are located on Mândra-Tărtărău interfluve at 1,914 m and Tidvele (1,932 m). The altitude of these cirques represents an important clue in estimating the Pleistocene limit of the perennial snow (Niculescu Gh., Nedelcu E., Silvia Iancu, 1960; Niculescu Gh., 1965; Silvia Iancu, 1960, 1970; Posea Gr., Popescu N., Ielenicz M., 1974; Urdea P., 2000, 2001; Simoni Smaranda, 2007). These cirques appeared in those areas where the steep slope, the low altitude or the exposure of the slopes did not allow the development of a glacier.

The glacial valleys mainly appear on the northern and eastern side of the Parâng Mountains where the Lotru and the Jieț valleys together with the head cirques reach a length of 6-7 km and the Latorița valley 3-4 km. The reduced development of these valleys on the southern slope of the Parâng (the Mohoru, the Pleşcoaia, the Setea Mică valleys) can be explained by the unfavorable topoclimatic conditions and by the presence of less evolved pre-Quaternary fluvial elements as compared to the northern and eastern slopes. The transverse cross section of these valleys is generally simple displaying a "U" shape. They are cut in granite, which favored the formation and occurrence of steep slopes.

Another type of transversal profile is the leveled one. The presence of the spurs that alternatively appear along certain valleys, which they partially dam, forming thus basins, is a proof of the fact that glacial erosion was not efficient enough in the Parâng for destroying the pre-Quaternary or inter-glacial morphology of the valleys and forms a straight flume (Silvia Iancu, 1970).

The glacial thresholds located within slope cirques characterized by two or three steps of the floor are quite frequent on the southern part of the main ridge and they were emphasized by the formation of an upper step, probably within an evolved drainage basin installed in a highly inclined slope.

The aspect of the dislevelments that appear in the glacial cirques is quite different, as they can be steep, inclined or in secondary steps, the transition from the steps towards them being either sudden or smoother.

The thresholds generally dam the overdeepening cuvettes (Setea Mică, Cioara, Pleşcoaia) which are mostly knobbed (Ieşu, Mohoru cu Apă).

The relative elevation of the dislevelments oscillates between 10 and 50 meters (at Cioara - Tidvele cirque, respectively Pleşcoaia cirque). Low values characterize the upstream slopes of the eastward cirques or the thresholds generated by differential erosion, the highest values being registered below the head cirques from the central sector of the upper basin.

The variables calculated on the base of those measured according to table 2 are largely used by different authors for characterizing especially the development of the glacial cirques and for facilitating the comparisons between glacial cirques located within different massifs and mountain chains.

The minimum altitude the floor of the glacial cirques from the Gilort basin is located at oscillates between 1,770 meters (Tidvele-Galbenu) and 2,000 meters (Groapa Mândrei), while the maximum altitude between 1,930 meters (Cioara-Galbenu) and 2,200 meters (Setea Mică) (Fig. no 1).

Table no 1

Morphometrical variables of a glacial cirque

(after I.S. Evans, N. Cox, 1995; Urdea, P. 2000, 2001 and Smaranda Simoni, 2007)

Symbol	Morphometrical variable	Measure unit	Calculation mode
Y1	Minimum altitude of the floor	m	measured
Y2	Maximum altitude of the floor	m	measured
Y3	Mean altitude of the floor	m	(Y1+Y2) / 2
Y4	Altitude of the ridge on the median axis	m	measured
Y5	Mean altitude of the cirque	m	(Y1+Y4) / 2
Y6	Maximum altitude of the ridge	m	measured
Y7	Height on the median axis	m	Y4 - Y1
Y8	Maximum dislevelment of the floor	m	Y2 - Y1
Y9	Length on the median axis	m	measured
Y10	Maximum width	m	measured
Y11	Wall height on the median axis	m	Y4 – Y2
Y12	Elongation coefficient	-	Y10 / Y9
Y13	Rapport length/height on the median axis	-	Y9 / Y11
Y14	Perimeter of the cirque	m	measured
Y15	Surface of the cirque floor	sq km	measured
Y16	Surface of the cirque	sq km	measured
Y17	Relative size	km	1000 x (Y16/Y11)
Y18	Circularity index	-	$(4 \Pi \times Y16) / (Y14^2 \times 10^6)$
Y19	Azimuth of the cirque	degrees	measured
Y20	Orientation of the cirque	-	measured
Y21	Mean slope of the cirque	degrees	[arctg (Y11/Y9)] x (180 / Π)

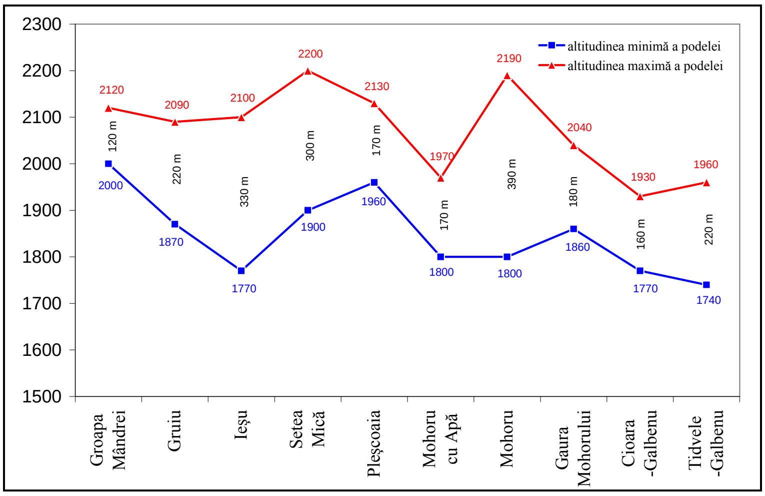

Fig. no 2. Minimum and maximum altitude of the floor of the glacial cirques within the Gilort basin

Table no 2

Morphometrical variable of the glacial cirques from the Gilort basin

GLACIAL CIRQUE	Morphometrical variable																				
	Minimum altitude of the floor (m)	Maximum altitude of the floor (m)	Mean altitude of the floor (m)	Altitude of the ridge on the median axis (m)	Mean altitude of the cirque (m)	Maximum altitude of the ridge (m)	Height on the median axis (m)	Max. dislevelment of the floor (m)	Length on the median axis (m)	Maximum width (m)	Wall height on the median axis (m)	Elongation coefficient	Rap. length/height on the median axis	Perimeter of the cirque (m)	Surface of the floor (sq km)	Surface of the cirque (sq km)	Relative size (km)	Circularity index	Azimuth of the cirque (degrees)	Orientation of the cirque	Mean slope of the cirque (degrees)	Type of cirque according to the geological structure
Groapa Mândrei	2000	2120	2060	2420	2210	2518	420	120	1266	1074	300	0.85	3.01	3335	0.12	0.75	1.78	0.84	330	SE	18	obsequent
Gruiu	1870	2090	1980	2220	2045	2345	350	220	1218	719	130	0.59	3.48	3245	0.18	0.64	1.84	0.77	345	SE	16	obsequent-subsequent
Ieşu	1770	2100	1935	2150	1960	2366	380	330	1727	2549	50	1.48	4.54	6715	4.76	2.95	7.75	0.82	350	SE	12	transversal on an anticline axis
Setea Mică	1900	2200	2050	2294	2097	2294	394	300	839	620	94	0.74	2.13	2566	0.16	0.43	1.10	0.83	200	SW	25	obsequent
Pleşcoaia	1960	2130	2045	2190	2075	2294	230	170	856	982	60	1.15	3.72	3134	0.24	0.55	2.40	0.70	170	S	15	obsequent
Mohoru cu Apă	1800	1970	1885	2130	1965	2270	330	170	1019	589	160	0.58	3.09	2660	0.12	0.42	1.26	0.74	180	S	17	obsequent
Mohoru	1800	2190	1995	2290	2045	2337	490	390	1264	663	100	0.52	2.58	3850	0.30	0.75	1.53	0.64	285	SE	21	obsequent
Gaura Mohorului	1860	2040	1950	2190	2025	2228	330	180	1209	1304	150	1.08	3.66	5858	0.31	2.06	6.23	0.75	345	SE	15	obsequent
Cioara -Galbenu	1770	1930	1850	2120	1945	2146	350	160	1154	1320	190	1.14	3.30	4580	0.44	1.32	3.78	0.79	280	SE	16	obsequent
Tidvele -Galbenu	1740	1960	1850	2050	1895	2137	310	220	1167	1420	90	1.22	3.76	4923	0.44	1.66	5.35	0.86	210	SW	14	obsequent

CONCLUSIONS

Within the upper basin of the Gilort, the glacial relief is represented by ten small head cirques. Most of them display an elongated shape (popularly called *zănoage*). Because of the obsequent character, there are well shaped upstream. The lower step which, in many cases, develops below a large threshold, displays a very inclined slope and a contour estompated by periglacial processes. The deepening degree and the declivity of the slope impose the morphographical features of the cirque. From this point of view, for the analysed basin, there should be noticed *the slope cirques* (*zănoage*), which are more developed as surface than as depth and have steep slopes.

The determination of the morphometrical variables based on the set of definitions used by Evans and Cox (1974, 1995) and then completed by the other mentioned authors emphasized the morphometrical and morphographical characteristics of the glacial landforms from the southern slope of Parâng Massif.

The glacial-nival cirques present an eastern exposure due to the predominant West winds, which favoured the accumulation of snow and the formation of ice on the sheltered slope.

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