

The relief formed by the descent phenomenon in the north-east part of Kosova

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Abstract

In the diverse relief of north-east part of Kosova a relatively wide range occupies the relief modelled by the descent phenomenon, which is conditioned by morph-structural and climatic factors quite suitable for their development. The morphogenesis activity of descent phenomenon is conditioned by the types of rocks, tectonic process of this region and climatic conditions. These factors condition horizontal and vertical relief fragmentation, slope, especially in Gollaku mountains and in SE part of Kopaonik mountain. Along the tectonic descents, the steepness is detaching and the detaching lines consisting of magmatic rocks show overthrows, demolitions and stony torrents, but the Teri gene composition formations are modelled by sliding and muddy torrents, depending upon the presence of clayey and alevrolite belts on these Teri gene ones. The impact of factors and conditions on the relief of this part, the phenomena like demolitions, overthrows, sliding, muddy torrents, stony torrents, etc, operate here, which play an important morphological role in the modelling of relief.

Key words

Kosova, Descent phenomenon, Morphogenesis activity, Sliding, Stony torrents, Kopaonik

Introduction

The north-eastern part of Kosovo is a natural physiogeographical unit that differs from other parts in the morpho-tectonic and morphological aspect within Kosovo. It has a typical expansion North West-South East (VP-JL) with a medium length and height, where Pançiq (2017 m); the highest peak of the north-eastern part of Kosovo; is situated. The main morphological and morpho-genetic units of this part are the mountains of Kopaonik in North West (VP), the pond of Llap in North East (VL), North western part of Fushë Kosovë in south east and the hilly mountainous relief of Gollak in South East (Cvijic, 1913, 1924). Morphological and morpho- genetic characteristics of this part of Kosovo belong to tectonic zone of Vardar. Lithological diversity and tectonic ruffles and dissociations are also quite well reflected in the forms of the part of this relief.

The aim of this study was to analyse the descent phenomenon in the north-eastern part of Kosovo and the processes that influence its creation, their importance as geo-hazards, location

and spatial distribution. The study will contribute in the selection of methodology to make the first geo-hazards map for the territory of Kosovo.

Materials and Methods

The methods used were cartographical studies, statistical-mathematical evaluations and field activities. The field working methods in the field especially geomorphological and environmental data collection are the most needed geographical studies. The direct observation of processes and occurrences in the field make the problem more imminent and understandable. The field observations have revealed that soil sliding depends on geological features and slope of terrain. The following techniques were applied in the field: GPS to determine location, direction and volume; data entry in GIS; combination with the DTM, erosion and fraction maps etc.; application of satellite images GeoEye 2 with resolution 0.40 m per pixel to identify phenomenon in advance.

The geographical position, the borders and the size:

Among the natural physical and geographical units of Kosovo, the north-east part has an important place, with characteristic features. The natural borders of this part are: the middle valley of the Iber river, area from Mitrovica to the Bistrica river's out-fall (the right affluent) in the north-west, the spine of Qyqavica in the south-west (which is mostly hilly), the valley of the river in Graçanica and the upper valley of the river of Ballaban in the south-east, and the whole north-east and northern side, up to the Pancic peak (2017m), passes along the border line with Serbia–Montenegro.

There is a typical northwest-southeast extension, about 77 km long and 12-40 km wide. The highest altitude is on the north-west extremity at the Pancic peak. The greatest parts of these borders are of morpho-tectonic and morphological nature, which show the visible differences to other parts

The relief shapes of the descent: The vegetation cover plays an important role on the territories built by the Teri gene rocks, with a great extension in this area. They create an unstable condition on the undressed descents or areas with degraded vegetation cover. However, on the afforested territories; particularly on the Kopaonik range-mountains; the descents are sufficient solid, due to morphological and bioclimatic equilibrium, created by the presence of a woody vegetation cover. Direct evidence of such a phenomenon is that there is a rapid development of these phenomena near settlements and traffic routes, which create suitable conditions for the use of forests in an uncontrolled manner. Obviously the rock types play the main role, which are presented with hardness scale and very different stretch here, conditioning the density and performance of descent phenomena. Two main types of rocks found in this area are the magmatic and Teri gene rocks, which have an approximate extension, apart from the fact that first magmatic predominant rocks are at the Kopaonik range mountains, whereas Teri gene rocks are in Gollak. The surfaces analysed; depending on the geological composition; are under the influence of surface water and as such are conditioning rinse of the territory, especially on bare surfaces (Marković, 1983). In tectonic descents composed of magmatic rocks, one comes across overthrows, demolitions and stony torrents; whereas clay layer descents are modelled by sliding and muddy torrents. The impact of factors and conditions on the relief of this part, the phenomena like demolitions, overthrows, sliding, muddy torrents, stony torrents, etc. operate here, which play an important morphological role in the modelling of relief.

Results and Discussion

Demolitions: These descent phenomena are tectonic and possess litological steepness characteristics of the delimited descents of the grab-nor lowlands, mount gorges, valleys and mount blocks, which consist of the main morphological element of the relief. In particular, the line steepness detaching are distinguished by the development of these phenomenon along the valley of Kaçanoll,

especially along its left descent, which come across during the tectonic contact between the ultra-basic and dibasic magmatic rocks with the Mesozoic flysch. These blocks are also incited by the thick net of splitting and tectonic detaching, which penetrate the measure of the magmatic rocks during the generation of destruction, linking closely to the height and slant of this steepness, which is formed during this generation.

The gathering of pieces of materials and demolition blocks was made along the mountainside steepness, creating in there disorder relieves with different undulations, nearness to the valley bed, particularly on the upper sector from its right descent. The river regressive erosion increases during the destruction between these rocks, particularly, on the dragging flysch from the bottom, creating thus an unstable condition of the magmatic rocks over them, which are separated from them in block shapes with different sizes.

Demolitions develop sufficiently also in the upper sector of Bistrica's valley, particularly from the right descent, between Ceraja and Broçan, along the gorges of its affluent, especially of the Sedra's gorge. Parallels to these territories, these phenomena are met with in the south-west descent of the mountain back of Bajrak, Shilak(1630), Pançiq, on the right descent of Bistrica gorge, near the border between Kosovo-Serbia, etc. On a very limited sector, demolitions are developed also in the territory of Gollak, especially in the upper sectors of Batllava river, along the valleys of its affluent of Orllan, Ballaban, Prishtina, Graçanica, etc.

The co-attendants of the demolitions are overthrows, which are developed in the all structural steepness of this area, particularly in the descents with magmatic composition. The transported pieces of materials of these phenomena are of different dimensions, which are formed chiefly by the mechanic discomposing of rocks from frosts and from melted snow water, that is why they come across at a height of 1200-1400 m. The typical one in the developing of overthrows is considered the south-west descent of the mountain back of Pançiq, Shilak, the western descent of the Bajrak mount, up to the Prapshtija peak, etc. The fact that these phenomenon develop mostly in the south-west and western descents, leads us to think that they are linked with the humidity and daily changes of temperatures on these descents. As a consequence of overthrows, also characteristic shapes are created in the mountain sides of steepness, such as enormous colluvial and coluvio-proluvial cones with irregular shapes, very different dimensions of the pieces of materials in their composition, parallel with the shape of relief where they are set. Generally, these materials are alloyed also with those which are transported by flows, created by the snow melting, which raise the dimensions of cones and give them irregular shapes. A part of these cones are stabilized and covered by vegetation, therefore, the greatest part of these are shown sufficiently active on their development, and lack woody plant cover.

The stony and muddy flows: During the morphological evolution of the relief of this area, with the rocks, which are almost impenetrable and of very different solidity a very important role is played by the stony and muddy torrents, which are directly linked with the magmatic and Teri gene composition. As a direct consequence of these rocks the great values of density and depth of the relief are cut up, creating in this way the comfortable conditions for the development of these descent phenomena. The morphological importance of the development of these torrents is expressed in the spotted shapes of erosion and deposition, which also depend on the lithological composition of the relief where they are formed.

The stony torrents are almost completely extended over the territories created by the magmatic rocks, whereas on the Teri gene territories the muddy torrents are seen together with the shapes of the respective relief. On these conditions, stony torrents, in the overwhelming part, are extended on the mountainous range of Kopaonik, especially in the north-west, where the overwhelming part of the magmatic rocks is extended in the shape of two powerful blocks, one between the upper valley of Kačanoll, Bistrica and Sočanica, other block being Pançiç.

A thicker development of the stony torrents is seen in the south-west and south-east descent of the Shilak mountain, on the backside of mountain between Bajrak (1790m) and Pilatovica. The eastern descent of Gredor mountain and that of Ortek, have the beginnings of bifurcation nets or water flows in these territories. The development of these phenomena is visible in the mountain block of Pançiç, especially along the north-west and south-east descent of the mountain water-separator, between the Valley of Dren and Bistrica river which is of a high importance. It is from here that the circuits of the south-west descent of Pançiç and Verlenica begin (1356m).

All these stony torrents are used to transport the enormous pieces of materials, which are gained by the mechanic disintegration of the magmatic rocks, coming from the delimited descents of steepness and circuits. Generally, their formation and growth is linked mostly with the melted snow water, frost phenomenon and avalanches, which form their beds, using also the splitting net and local dispatches with different dimensions. Between the stony torrents, we can find three complex circuits of the south-west descent, between the peak of Pançiç and Verlenica, which are 1.5-2 km long at an altitude of 1200-1800m, whereas, the depth of parceling out in the magmatic rocks are 80-120 m. All these stony torrents join each other at the closing of circuits, forming a single trunk, where the valleys of the two mentioned torrents start.

The most specialized dimensions and morphological features are found at the stony torrents, which split the south-east descent of the water-divider mountain, between the valley of Bistrica and Dren, ending on the right of Dren's valley. Almost all along the 7km long descent between Vitanovica and Leshkova, 3-4 km long four stony torrents are extended. Their depth of parceling is 100-150m, whereas, four stony torrents of

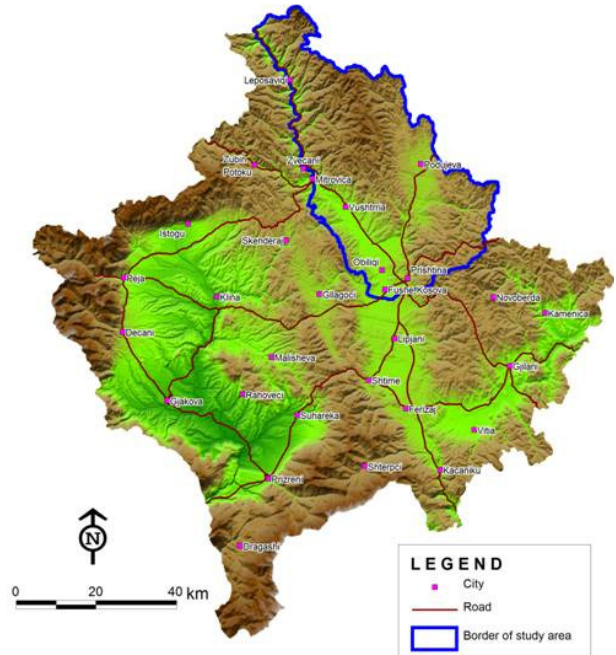


Fig. 1: The geographical position of the north-east side of Kosova



Fig. 2: Magmatic rocks demolition in the valley of Trepca



Fig. 3: Sliding on the left side of the Battlava's valley - Bellopoje

the north-west descent, which end on the left of Bistrica river, are distinguished with smaller dimension (92-2.5km), as a consequence of the structural asymmetry of the south-east descent.

The development of a thick net of the stony torrents is closely connected to the powerful tectonics of magmatic rocks, which is directly linked to a very continuous active tectonic-dynamics during the period of morph-tectonic evolution. Under these conditions, the descent's slant grows, and it is dictated by the continuous descents of the basic level of erosion in the water flows, inciting continuous regressive erosion along these descents. The general morphological features of the beds of these stony torrents are: a very irregular shape, a great slant (15-37m/km), with pieces of material having very different dimensions, they create coluvio-proluvial cones where they end.

A relatively wide extension on the relief of this area, have muddy torrents, which are different from those of stony torrents, because they transport, in the overwhelming part, the pieces of materials of clay and other parts, so in this way, they are characterized by a high disturbing scale. They are the overwhelming part of these torrents belonging to the territories built by the Teri gene rocks of Paleozoic and cretaceous (flysch), which consist of clay, alevroite, etc., and are easily visible by the erosion of the water flows. A thick development of these descent phenomena is distinguished on the south-east side of the Kopaonik mountain range and the north-west side of Gollak, including also the delimitation descents of the grab-nor pond of Llap and the north-east descent of the north-west side of Kosovo's Field (Milivojević et al. 2008).

The greatest part of the enormous bifurcations of the Llap river, especially those of the right affluent like Kačanolli river, Murgulla, etc., their beginnings are at the muddy torrents. We can distinguish the left affluent of Kačanolli and Lumkuq rivers and the right affluent at the middle water flow of Llap river, between Metohia and Llapashtica, which have frequently parceled out the relief, creating many erosion hearths. The dimensions of these flows are 1.5-3 km, the parceling out density of 3.5-6 km km⁻² depth being 30-50 km km⁻², particularly at the plio-quadernary lake depositions of the Llap's pond. The greatest dimensions of these flows are at the delimited descent in the north-east of Kosovo's field, between the water flow of the Llap's river and Lumkuq in Sitnica, which are found on the thickness of the depositions, chiefly of clays of the lake Pliocene. The typical ones are the torrents of Kunovik, Gjelbishta and Dumnica, which have a length of 3-5 km, a bed which is relatively wide and deep in the measure of argillites, creating enormous windings, particularly around Dumnica (Boenzi and Giovanni, 1997).

Sliding-On the descent phenomenon complexity, the slidings with different dimensions pass in some territories into powerful demolitions, particularly during the tectonic steepness with an important place in the modelling of the relief of this part. Sliding is sufficiently developed during the tectonic contacts between the magmatic and Teri gene rocks, therefore during the destruction, mostly the coluvio-proluvial and deluvial piece materials of alienation crust are included.

The gathered materials besides the steepness of detaching and those from complex steepness during the morphological and morpho-climatic evolution are characterized by an unstable condition, incited also by the enormous water flows. The widest extensions of these phenomena are along the delimited descents of the grab-nor pond of Llap, particularly, in the western descent complex steepness, between Pakashtica in the north and Llapashtica in south. The water satiety of the Pliocene lake clays during their contact with the dibasic rocks and the regressive erosion of the affluent of Llap river, have created the conditions for the displacement of measures of the piece materials, settled over these clays. The dimensions and degrees of the sliding development are shown very differently, because the sliding plan on this sector occurs during the contact between the dibasic rocks, which are very tectonic, and Pliocene clays. Therefore, the whole upper side of the complex steepness at an altitude of 700-900 m, are distinguished by some active sliding, such as the rivers of Pakashtica, Dobratin, Obrança, Llapashtica, etc. A relatively thick extension of the sliding is also seen along the eastern descent of the Llap' pond, which is distinguished by the high tectonic scale of the magmatic rocks and those of flysch and mio-pliocene molasses created by the tectonic detaching of Merdar.

As a consequence of this tectonic phenomena there is a wide destruction, during which series of sliding are developed, which are also significant in the very fragmental shapes of the complex steepness and a very degraded relief, particularly between Shakovica in the south and Merdare pass in the north. In the relatively smaller dimensions, slidings are crossed also at the southern descent of this pond, between the water flow of Batllava's river and Ternava river, which are linked with the placement of the lake conglomerate between Dyz and Ternava over the alienation crust of flysch of cretace. Later satiates with water by the water-holder conglomerate, which is incited also by the regressive erosion of the above mentioned torrents, carrying an unstable condition of these last one mentioned and their continuous displacement. The descent phenomena have a great extension also along the south-west descent of the mountain range of Kopaonik, particularly from Mitrovica up to the water flow of Bistrica's River. In this sector, the complex steepness is characterized by a very powerful tectonic carbonated rocks, which built the overwhelming part of this steepness, due to the great amplitude of the tectonic rises of the structure of these rocks (Zindel and House 2008). Under these conditions, the sliding created during the destruction, the greatest part consists of blocks and stony pieces, which are mixed with the clays of the alienation crust of the magmatic rocks. In between all these one can seclude the sliding of the left descent of the valley of the Dren, Terdan, Leposaviç, Bistrica, Stan Terg Rivers, etc., which at present are active, risking the dwelling centers and agricultural lands in the fragmental shapes, placed over the structural degrees. In the sector between Mitrovica and the transversal pass of Lebana, the sliding have a considerable development, particularly at the bottom of this steepness, consisting of lake depositions, with grit, sand and clay

knitting. The last one mentioned, satiated with water by the first one, create an unstable condition for grits and sand. Under these conditions, these are continuously replacing, incited also by the regressive erosion of Prodan, Terstena, Studime, Dumnica's Rivers, etc, risking the dwellings in the north-east of Kosovo's Field in this sector. Almost under similar conditions during the formation of steepness, the complex steepness of the south-west descent of Gollak, between the transversal pass of Lebana and Gračanica are also seen. Here, the sliding totally covers the flysch terigen and molasses rocks of Kosovo's Field, which are incited by the regressive erosion of Besi, Siçeva, Prishtina, Gračanica's Rivers, etc. At the upper flow of these torrents, sliding is developing on the flysch measures, and is characterized by the knitting between penetrated sandy packs with those of impenetrated clays. Therefore, at the down flow, sliding is linked by the knitting of sands and grits with Pliocene lake clays.

The morphogenesis activity of descent phenomenon is directly connected to the types of rocks, which are building this part. The thick tectonic and the continuance rise of the tectonic presence, parallel to the typical climatic conditions. Under these factors and conditions, the great values of density and depth of relief parceling out, the average and greater slant of the descents up to an abysses shape, a vegetable cover, which is relatively poor and in a degrade

condition, especially in Gollak, and in the south-east of Kopaonik range mountains, etc, incite the descent phenomenon development. Along the tectonic descents, therefore the steepness detaching and the detaching lines, consisting of the magmatic rocks, the overthrows, demolitions and stony torrents are visible, but those of the Teri genes composition are modeled by sliding and muddy torrents, according to the presence of clayey and alevrolite belts on these Teri genes ones. Due to the above mentioned factors and conditions on the relief of this part, descent phenomenon operates, such as: demolitions, overthrows, sliding, muddy torrents, stony torrents, etc, which play an important morphological role in the modeling of the relief of this part.

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