Geomorphology of the northern part of Side Ridge Gorstian anticlinorium: orography of Shanski and Makhis-Magalinsky high-mountain massifs

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Abstract. The article shows the orography of the Shansky and Makhis-Magalinsky high-mountain massifs, selected in the geomorphological zoning scheme with the rank of subdistricts corresponding to the fourth-order morphostructures. Geomorphological processes, types of relief, the latest tectonic movements and glaciation of mountain ranges are characterized.

1. Introduction

The high-mountainous massifs of the Side Ridge (SR) morhostructure are associated with tectonic blocks formed by transverse, diagonal and longitudinal faults to which the river valleys are confined. These massifs are fourth-order morphostructures or subregions of SR [1].

However, the massifs themselves are also dissected by faults and large gaps into blocks of smaller orders. The watersheds of the valleys are represented by the branches of SR, mostly of the northern direction. In the Ingush and Chechen Republics, there are five high-mountain massifs: Shansky; Mahis-Magalinsky; Tebulos; Komito-Kobulamsky and Donos-Diklossky. In the scheme of geomorphological zoning, they are distinguished in the rank of subdistrict SR [2].

Administratively, the study area is located within the mountainous part of the Chechen and Ingush Republics. Its geological and geomorphological structure on the stretch from the Belaya River in the Western Caucasus to the r. Chanty-Argun in the Eastern Caucasus, in general, corresponds to the morphostructural zonality of the northern wing of the Greater Caucasus megaliclinorium.

Nevertheless, in the east direction, the complexity of the structure is gradually becoming more complex. In particular, in the Order of the geomorphological subregion and further east, to the Shakh-Dag mountain, the greatest heights of the axial part of the Greater Caucasus are confined to the Lateral ridge. The heights of the Main Caucasus (Watershed) ridge here are on average lower than 1000 m, which is due to the peculiarities of the newest tectonic activity.

2. Materials and methods

In the research, a set of methods was used: laboratory-based methods and materials for remote sensing: interpretation of satellite images and topographic maps of scales from 1: 10'000 to 1: 500'000; field methods and materials of expeditionary research of reconnaissance routes along the gorges of the Terek,
Demos-Tskali, Kistinka, Armkhi, Shandon, Salgi, Assa, Sartu, Guloykhi, Chanty-Argun, Meshehi rivers; climbing tops: Salgi, Dzeneladze; A. Japaridze, A. Chavchavadze, Tsereteli, Bachahi, Rustavi, Kuro, Shino, Kideganismagali.

The names of the ridges of their spurs, peaks and saddle saddles, as well as the heights of peaks and passes in the article contain the names indicated on topographic maps of a scale from 1: 200'000 to 1: 10'000, published by the General Staff and the General Directorate of Geodesy and Cartography, also the names given in the classifier routes to the mountain peaks [3] and the list of classified high mountain passes [4].

3. Orography of the Shan and Mahis-Magalinsky high-massifs

The Shansky the high-mountain massif is quite extensive and lies between the antecedent participants of the Tereka Valley and Assy, which are associated with the same-name deep faults. In the west, it is separated by the valley of the Terek River from the Dzhimarai-Kazbek high-mountainous massif of the Central Caucasus (Figure 1), and in the north - the Puy fault, which passes through the gorge of the r. Armhi and its right tributary r. Salgi [5].

Figure 1. The eastern wall of the Shavansky Range, with hanging glaciers, avalanche-scree couloirs, punishments at the base of the wall and the peak of Shang. In the foreground are the shale “feathers” of the ridge of the Yukrolamduk ridge dividing the gorges of the Shandon and Armkhi rivers. Photo by A. Plotnikov

In the basin of the r. Assa, it is connected with a fault by a gorge Sart river. In the south, the border is also associated with a fault (Adayk-Kazbek), which runs along the upper course of the starboard side of the Djuta-Snoskali river valley, establish the Bezhitinskoy depression. The main part of the Shan massif is located in Ingushetia, and the south-western part is in Georgia. The north-western part is bordered by North Ossetia.

Centerline morphostructure of the SR on the Shan massif, as well as on other massifs, is shifted to the south and is associated with high modern and modern tectonic activity, which is manifested by high absolute elevations of the mountain peaks: Kuro (4071.2 m); Shang (4451.8 m); Kideganismagali (4229.1 m) and Chimochis-Magali (3851 m). In addition, appears abnormally high slopes of the longitudinal profiles of rivers appear there. High tectonic activity and the height of the massif determine the intensive manifestation of exogenous processes – nival-glacial, periglacial and gravitational.

The internal part of the Shansky massif is dissected by deep glacial-erosion-tectonic gorges of the Kistinka, Shandon and Armkhi rivers. The depth of the vertical division reaches 2350 m. As a result, high spurs, Ohkkur-Shavana and Yukurulamduk, were formed within the massif, which stretched subparallel from south to north. The main link of the SR is represented by the Kuro, Kidegani ranges and nameless segments.

The ridges have sharp ridges and steep slopes, often exceeding 60°. The tops of the slopes are corroded with carats and circuses filled with small kar and hanging glaciers or snowfields (Figure 1). The ancient carats located below are filled with moraine deposits or sod. The largest are the Kidagano
and Kibishi glaciers. In addition, the slopes of the ridges are dissected by margins and avalanche trays, ending with non-sodded actively developing debris. The gorges of the main rivers in the lower part of the slopes are narrow, V-shaped, and in the upper part they acquire a U-shaped or trough-shaped form and are cluttered with a moraine and crumbling deposits, which is typical of young troughs.

The Shansky massif is very popular among climbers and mountain tourists. Tens of routes were laid on its tops [3] and over 30 passes of various categories of difficulty were classified [7]. The main watershed SR on the Shan massif makes a large and complex arc. In the west, it is represented by the Kuro Range, which in Georgia divides the gorges of the Terek and Kistinka rivers. The range extends from the north-west to the south-east to the town of Kora (3631 m). It has two ridge peaks: Shino (4047 m) and Kuro (4071.2 m). Further east of the Mt. Kora in the arc of the SR, there are three bends, the height of the crests of which does not exceed 4000 m.

In the western part of the massif, the first bend from the south bends around the Kibishi glacier, located in the upper reaches of the r. Kistinka. Then the second from the north - the origins of the r. Dzhavarthorhistskali, which is a right tributary of the Juta river, and then the third bend, again from the south goes around the sources of the Shandon and Armkhi rivers. The first and third bends, formed by the nival-glacial denudation and erosional activity of the Kistinka and Shandon rivers, strongly extend into the Bezhitinsky depression, so the ridge of SR approaches here with the ridge of the Dividing Range to a distance of up to 3.6 km.

From the nodal vertex of 3943 m, towering above the active glacial rocks of the headwaters of the rivers Kistinka and Shandon and above the “dead” car in the sources of the r. Dzhavarthorhistskali in the south, Shavan Ridge branches off. After the vertex of mountain Erzi (3963.3), it changes its direction to the north-west and is already called the Ohkur Ridge. The Shavana-Okhkur Ridge divides the gorges of the Kistinka and Shandon rivers and along its ridge passes the border between Georgia and Ingushetia. This ridge (spur) has a sharply alpine-type character and a large both absolute and relative height (Figure 2).

Figure 2. The upper part of the gorge of the r. Kistinka. In the distance is the western slope of the Shavan Range (right side of the gorge). On the left is the peak of Mt. Kitsch, in the center of Mt. Shan, at the end of the ridge of the peak of the “Georgian corner”. In the foreground to the right is the tip of the Kuro Range (left side of the Kistinka Gorge). View from the slopes of Mt. Kaijan (northeastern part of the Kazbek-Dzhimarai massif). Photo by E. Manukyants

On it to the south, a continuous chain of 19 peaks rise, most of which exceed 4000 m. Here is also the highest mark of this mountain range and of Ingushetia - Mt. Shan (4451.8 m). In the southeastern corner of the Shandon gorge, above the narrow trough and surrounded by punishments, there is Mt. Chimgis (3970 m). After 9 km north of it rises Kideganismagali (4229.1 m). This part of the SR is called Kidegani and has a strictly meridional direction. In the ridge of the ridge the most significant is the top of the Mt. Sakharismt (3963 m), also called Sakharismagali [6] and the Sakharisgel pass (3597 m) is located. The top of Mt. Kideganismagali is a nodal. The short, but high spur Yukrolamduk with peaks
of 4031.2 m, 3600 m, 3781 m, 3663 m, 3575.4 m, which inherits the direction of the Kidegan ridge, separates the lower part of the gorge of r. Shandon and the upper trough of the river valley r. Armhi.

The main ridge of the SR from the top of Kideganismagali rounds from the south a deep circus and trough valley of the Kidagano glacier, and then 5-6 km stretches north-north-east to the top of Martinismt (3898.1 m).

There are a number of passes and peaks of mountains on the north-west on the SR from the top of the town of Kideganismagali to the top of Martinismt: 3968 m; 3935 m; Mt. Chimochismagali (3851 m); Mt. Tatelismagali (3755 m); Mt. Maamgos (3869 m). In front of the top of Mt. Martinismt, the main link of the Side ridge of the Shansky massif sharply turns to the east and soon near the town of Mt. Schuachviri (3112 m) is interrupted by the valley of the r. Assa. From Mt. Martinismt to the northeast, then east to the town of Mt. Terkhkort (3209 m) there stretches a large, punishable spur to Argelam, which is also interrupted by the valley of the r. Assa. On this spur is the border between Ingushetia and Georgia.

In the upper reaches of the r. Armhi valley is the Kidagano valley glacier. It is the largest in the Shan massif. The length of its language in the last century reached 2.5 km. According to V.D. Panov [7], in the period from 1881 to 1966 years, the glacier retreated at an average speed of 20.5 m per year. As a result, four terminal moraines with a height of 60-80 m were formed in the trough valley. The fifth, most ancient terminal moraine is located in front of the transom, represented by a steep ledge 300 m high, which faces the V-shaped gorge of the r. Armhi. The tongue is surrounded by two ridges of lateral moraines up to 50 m high.

4. Orography of the Mahis-Magalinsky high-massifs

The Mahis-Magalinsky high-mountain massif is located on the border territory of the Ingush and Chechen Republics and is bounded by antecedent sections of the valleys of the Assa and Chanty-Argun rivers, laid along faults. The main link in the SR of this massif in the tourist literature is called the Zusunkort ridge [6]. It is tortuous, but generally has a latitudinal direction. The western part of the ridge extends in the direction of the peaks of Shautskhviri (3112.1 m) and Martinismt of the Shan massif. On the ridge Zusunkort from west to east there are peaks 3348.9 m, Artsivismagali (3863 m), Mahismagali (3990 m), 4007 m, 3298 m, and Zuzunkkort (3437.9 m), which are the highest marks of this massif (Figure 3).

Figure 3. Mahismagali massif from the side of the Nelkh gorge Photo by T. Agirov

From the Mt. 4007 m to the northeast, to the Gul North pass stretches the Vegilam ridge with peaks: 3773 m; 3546.8 m; Harsacort (3035.1 m); Kurelam (3074.8 m). After the peak of Kurelam, the ridge sharply decreases and continues to the north in the form of a low web connecting the lateral and rocky ridges. The border between the Chechen and Ingush Republics runs along this jumper. Gul Pass Northern divides the gorge. Guloykhi, located in the Ingush Republic and the gorge r. Geshichu, located in the Chechen Republic. These gorges form the northern boundary of the morphological structure of SR and along their southern slopes passes the regional Puy fault.
From the Mt. Kurelem (3074.8 m) to the southeast at right angles departs the eponymous spur Kurelem. Then after 4 km, also at a right angle from the ridge Vegilam, the Bastilama departs from. The spurs of Kurelam and Bastila are almost parallel to each other and are separated by a narrow gorge Omchu, which drains the r. Bastikhi. The configuration of spurs and gorges and their straightness reflect regional faults. In the valley of the r. Chanty-Argun, the ridge to the Bastylam ends with a peaks of the same name, 3179.6 meters high.

Of the snowfields located at the top of the 4007 ridge of the Zuzunkort a and the springs of the Vegilam and Kurelem ridges originate in the r. Meshehi. The Vegilam and Kurelem ridges are joined at right angles on the Gul South Pass. Accordingly, in the upper reaches of the river two ravines were formed. The gorge of the northeastern direction, starting from two glacial circuses and the ancient circus on the slope of the Zusunkort ridge, is called Vasichu, and the gorge of the south-southeastern direction, beginning under the Gul South pass, is called Dudilkhi. Upper and lower reaches of the gorge, Meshehs have different morphologies — the lower part of the gorge is V-shaped and erosive, and the upper part is U-shaped with a wide bottom, since it is an ancient trog (Figure 4).

**Figure 4.** Gorge r. Meshehi. In the distance, the wall of the Vegilam spur and the confluence of the Vasichu gorges (left) and Dudilkhi (right). One can see the transition of the V-formed gorge to the trough-shaped valley. Photo by T. Agirova

The trough part of the valley itself is in connection with this feature. Meshikhi and its comparatively gentle slopes of the southwestern exposure were very densely populated in the past. The landmark of the gorge is also the famous necropolis Tsoi-Pede, which is located on the cape, washed by the river beds of Meshekhi and Chanty-Argun, which indicates the past population of this high-mountainous region (Figure 5).
East of the gorge of Chanty-Argun, already in the Chechen Republic, the SR is represented by a single mountain chain. Before Mt. Tebulos-Mta, its segment is called the Mutsossky ridge. Further to the summit of the Mt. Diklos-Mta, the chain is called the Pirikitelsky or Tushetsky Range, and the short northeast segment is called the Snow Range or Boghu Range [8]. The morphostructure of SR includes only its highland part.

5. Conclusion
The relief and landscapes of the Shansky and Mahis-Magalinsky high-mountainous massifs of the Lateral Range differ from the Western and Central Caucasus, as well as the high mountains of Dagestan, in their severity and “wildness”. The upper reaches of river valleys are trophies developed during the epoch of the Quaternary glaciations, and their middle and lower parts are represented by deep and narrow V-shaped gorges, sometimes not having low terraces, but also floodplains. The differences are also manifested in the fact that the geological structure and climate change here.

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