Geological and Geomorphological Conditions for the Formation of Landslide Processes in the Mountainous Part of the Chechen Republic and Measures to Fight Them

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ABSTRACT

The territory of the Chechen Republic is characterized by geomorphological diversity and complex geological structure. The southern part of the territory is represented by mountain landscapes. This part of the territory of the Chechen Republic is known as one of the active landslide zones. The wide scope and active manifestation of landslides here is predetermined by the features of the geological structure and the intensity of modern movements of the earth's crust. Landslides in the mountainous part of the Chechen Republic are one of the processes that often manifest and complicate economic activity. The main geological and geomorphological conditions that contribute to the active manifestation and widespread development of landslides here are the presence of powerful thicknesses of clay rocks, complex hydrogeological conditions that lead to uneven dampening of various strata and weakening of their stability. At the same time, any violation of the slope occurrence due to natural erosion or undercutting of the slopes as a result of engineering activities (construction of buildings, structures, cable laying, etc.), etc., leads to mixing of rock masses developed on the slopes. Other factors of landslide formation include the strong division of the area, the abundance of steeply sloping areas with high and uneven gravitational stresses in the rocks composing them. The steepness of the slopes is one of the determining factors in the development of landslide processes. On steep slopes (with an angle of more than 30 degrees.) usually about 50% of landslide arrays are developed. An equally important condition for landslide formation is the weak natural stability of individual rock complexes. A significant portion of Sarmatian-aged clay bundles are highly unstable and can easily move downhill under unfavorable hydrogeological and geomorphological conditions.

An important factor of landslide formation can also be attributed to the degree of waterlogging of rocks on the slopes. The occurrence of water-resistant clay rocks instead of easily permeable at the base of the slopes contributes to their waterlogging by atmospheric precipitation (in the presence of easily permeable varieties of rocks, the surface runoff is transferred to the underground and the slopes remain stable).

In lithological and stratigraphic terms, the territory is characterized by the appearance on the earth's surface of geological layers of the upper Cretaceous, Paleogene-Neogene and Quaternary ages, represented by carbonate and terrigenous rocks. Clay rocks of mainly Sarmatian age are widely distributed in the region against the background of a monoclinal structure complicated by a number of anticlinal folds in the south of the area under consideration (Planiduk, Durin-Lam mountain ranges, etc.) exposed rocks of the upper Cretaceous and foraminiferal layers composed, respectively, strong colored limestones and marls. In the area of Mekhkdettenkort, Amir-Kort, Baitarki, Mazhgar, Tatay-Otar, etc., the Chokrak layers come to the surface, represented mainly by sandstones with rare layers of clay. The lower-middle Sarmatian deposits are traced in a narrow arc-shaped band from the border of the Chechen Republic and Dagestan in the East to

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the village of Sayasan and further to West. Lithologically, they are represented by dark gray, bluish-gray, sometimes layered and marl clay. To the North of the described deposits, a powerful layer of rocks of the upper armata age is exposed. In the upper part, it is composed of dark gray clays with layers of fine-grained yellow-gray Sandstone, and in the lower part-dark gray clays with a capacity of more than 300 m. In the area of the upper Sarmatian sediments, the villages of Gilyany, Zandak, Rogun-Kazha, Ayty-Mokhk, and others are located. Thus, the dependence of landslide processes on the material composition (lithology) of geological horizons is clearly observed here. Their active manifestations are confined mainly to the central zone of the district, in the geological structure of which Sarmatian deposits, represented by clays, take part (the zone of settlements location: Zandak, Gilyany, Sayasan, Engenoy, Chechel-khee, etc.). In the southern part the surface is covered with sand layers of Chokrak and Carbonate rocks of the upper Cretaceous, and in the Northern part – quaternary Akchagyl-Apsheron layers, represented by sand and siltstone rocks. All marked breeds belong to the so-called light-permeable ones. There are practically no or weakly manifested landslide processes. It should also be noted that landslide processes are associated with the activity of modern movements. The above-listed localities, where intense landslides were observed, are located within or near the North-Benoy structure, which is characterized by the activity of modern movements.

Despite many years of experience in researching and predicting landslide processes, their periodically observed activation in the area under consideration causes significant material damage and causes problems in the further development of the infrastructure of localities and the entire area as a whole. In this regard, the improvement of existing methods and the development of new methods of landslide control remain very relevant. The solution of this problem in General is not possible, since in each individual case it is necessary to take into account the characteristics of this area. The following landslide control measures have been proposed in the scientific literature:

- organization of engineering and geological research and regular monitoring of landslide processes;
- interception and diversion of surface and underground water by constructing drainage systems and upland ditches to drain the landslide area;
- measures aimed at increasing the strength of slope soils-silicatization, freezing, cementation, etc.;
- measures to hold landslide masses by driving piles in a staggered order;
- planting of tree and shrub vegetation with well-developed turf to create a closed vegetation cover in order to reduce the intensity of landslide processes.

Each item of these measures requires separate analysis and consideration. At the same time, depending on the location and nature of landslides, certain measures may be more effective.

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