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Research Article

ENGINEERING-GEOLOGICAL ZONING TAKEN INTO ACCOUNT OF COMPREHENSIVE DEVELOPMENT OF THE TERRITORY OF THE SOUTHERN PART OF KARAKALPAK USTYURT

***A.P.Akimova[1] , M.M.Zakirov[2], K.M.Djaksimuratov[1], D.K.Begimkulov[2], G.E.Ochilov**[2]
[1]*Nukus Mining Institute at Navoi State Mining and Technology University,*
[2]*Tashkent State Technical University*
**Author for Correspondence: geolog.mbm@mail.ru*

ABSTRACT
The authors of the article first presented research on the engineering-geological zoning of the territory of the southern part of the Karakalpak Ustyurt at the same time, the most objective method for identifying engineering-geological taxonomic units according to well-known characteristics (geomorphological, geological-lithological, geoecological, physical and mechanical properties of soils, manifestations of geological and engineering-geological processes and phenomena) was selected to assess the degree of suitability for construction or national economic development. In engineering-geological zoning, a wide range of authors have been involved in various types of construction. Despite this, there is still no unified methodology for engineering geological zoning. This is explained, in particular, by the diversity of the study area's engineering-geological, physical-geographical and structural-tectonic conditions. Region A was identified according to the selected taxonomic units. It is located in the north-west of the republic and occupies the central and southern parts of the Karakalpak Ustyurt. Structurally, the area is part of the epihercynian platform with the development of gentle and wide zones of uplifts. Region B is represented by Miocene deposits of the Sarmatian stage, distributed on the slopes between the Central Ustyurt and Tuarkyr Kaplankyr uplifts. Region B refers to the area of lacustrine-accumulative plains, which occupies extensive (Barsakelmes and Assakeaudan) depressions. The engineering-geological zoning of the territory of the southern part of the Karakalpak Ustyurt is based on a formational principle that takes into account the zonality of the distribution of stratigraphic-lithological rock complexes. Four regions and 10 sites were identified (sites were identified based on the predominance of one of the engineering-geological factors). In addition, the degree of resistance to technogenic impacts and the increase in seismic intensity is determined depending on the engineering and geological conditions of the site, taking into account the integrated development of the territory.

Keywords: *Uplifts, Depressions, Factors, Engineering-Geological Zoning, Taxonomic Units, Dangerous Natural and Man-Made Processes*

INTRODUCTION

The intensive development of the Ustyurt plateau, which has been particularly active in recent decades, as well as the specific morphometric and geological conditions of the territory determine the intensification and activation of dangerous exogenous geological processes affecting the stability of the geological environment. In this regard, studying the dynamics, mechanisms, factors and patterns of development of dangerous natural and techno-natural processes, forecasting their development, and assessing hazards and risks is impossible for the qualitative development of the study area. The study of hazardous geological processes and zoning of territories according to the complexity of natural conditions and the intensity of development of hazardous geological processes has been carried out and has not lost its relevance for many years.

MATERIALS AND METHODS

An important research method is the cartographic method, supplemented by statistical data and comprehensive characteristics of areas where hazardous geological processes develop. This is due to the study of the territory for suitability for any purposes used for the national economy. This is also explained by the fact that the study area in most cases has a variety of physical-geographical, structural-tectonic and geological-geomorphological conditions. Analysing the influence of natural-technogenic geological-geomorphological, geological-lithological factors on the development of hazardous geological processes, the most objective method of identifying engineering-geological taxonomic units for the conditions of the southern part of the Karakalpak Ustyurt was chosen. At the same time, a consistent unit of dividing the territory into regions occurred according to the characteristics of the geotectonic elements of large territories. Areas with similar types of geomorphology, lithology, micro- and macroreliefs with various rock complexes, and forms with the scale of manifestation of modern geological processes and phenomena.

RESULTS AND DISCUSSION

In engineering-geological zoning, a wide range of authors have been involved in various types of construction. Among them, one cannot help but note the works of the founders of engineering-geological research such as F.P. Savarensky, I.V. Popov, V.D. Lomtadze, F.V. Kotlov, E.M. Sergeev, V.T. Trofimov and many others etc. On the territory of Central Asia, research in the field of engineering-geological zoning by G.A. Mavlyanov, S.M. Kasimov, A.M. Khudoybergenov, A.I. Islamov, M.Sh. Shermatov, G.H. Umarov, L . Goncharov, V.Kolpakov, V.Divaev and many others. etc. An analysis of the research conducted on engineering-geological zoning showed that, despite the existence of numerous regulatory documents, guidelines, and instructions from leading organisations in the CIS countries and the Republic of Uzbekistan, there is no single unified methodology for carrying out engineering-geological zoning. In the studies of the above-mentioned authors, when zoning territories, well-known signs (geomorphological, geological-lithological, geoecological, physical and mechanical properties of soils, manifestations of geological and geotechnical processes and phenomena) were used to assess the degree of suitability for construction.

Guided by the principles of G.A. Mavlyanov, E.V. Mavlyanov, V.D. Lomtadze, and S.M. Kasymov [1-7, 9-11] indicating that all maps, be it geological, engineering-geological, hydrogeological geomorphological and other special maps are essentially zoning maps. This is because territories are identified that are homogeneous in geological, engineering and geological terms and, based on a combination of factors, the engineering and geological conditions for the construction of structures of various types or other economic use on them are assessed. In addition, the map of engineering-geological zoning should be special, aimed at solving a certain range of issues that arise when designing certain types of construction or other economic uses of territories. Thus, our engineering-geological zoning is based on a formational principle that takes into account the zonality of distribution of stratigraphic-lithological rock complexes. Four regions and 10 sites were identified (sites were identified based on the predominance of one of the engineering-geological factors). The degree of stability determined by the engineering-geological conditions of the site was established depending on the complexity of the engineering-geological conditions [5] and the following main factors: type of soil strata, surface slope, depth of groundwater, protection of groundwater from pollution, presence of modern geological and engineering-geological processes and phenomena. The qualitative and quantitative characteristics of the listed factors are divided into three groups, which, depending on the degree of sustainability, were assigned a three-point system (high sustainability 3 points, average 2 points and low 1 point).

District A. This region is located in the northwest of the republic and occupies the central and southern parts of the Karakalpak Ustyurt. Structurally, the area is part of the Epihercynian platform with the development of gentle and wide zones of uplifts. The area covers the area of distribution of bedrock rocks

and several local structures are distinguished: Karabaur shaft; Aibogir uplift; Kaplankyr plateau; Kaplankyr Chink (the latter has a partial distribution in the territory of the Karakalpak Ustyurt).

The section includes Cretaceous, Paleogene and Neogene deposits. This area is divided into two sections.

Section A-1. The area is represented by Senonian marls with minor thin interlayers of clayey sandstones, and dolomitized limestones in the lower part of the section. The terrigenous-carbonate formation is represented by clay-marl deposits of the Eocene. The lithological composition is sharply dominated by carbonate rocks, most often marls. The rocks are grey, dark grey, brownish-grey, dense, rarely of medium density, and weakly bituminous with siltstone interlayers. Extreme values of tensile strength are 85.9-243.0 MPa, volumetric mass -2.6-2.64 g/cm3. Degree of resistance to technogenic impact 2 points with an increment of seismic intensity according to engineering-geological analogy, -1

Due to geomorphological conditions, the site is dissected and unfavourable for construction development.

Section A-2. The site is represented by a complex of marly-calcareous rocks of Miocene age. The lower part of the section is limestone with interlayers of marl, rarely clays, gypsum and sandstones. Limestones are represented by grey shell rocks, porous, fissured, cavernous, and homogeneous in chemical composition. The initial stage of gully formation is observed in the area. Eluvial weathering products of semi-rocky rocks are found everywhere. Compressive strength limits from 0.24 to 1.67 MPa. Degree of resistance to technogenic impact 2 points with an increment of seismic intensity according to engineering-geological analogy, -1

In general, for both areas, the complex terrain makes the area difficult to develop; the conditions for construction are limitedly favourable and are associated with numerous volumes of work. In addition, the Site belongs to category 3 of complexity in terms of engineering and geological conditions.

Region B. This area is represented by Miocene deposits of the Sarmatian stage in southern Ustyurt, distributed on the slopes between the Central Ustyurt and Tuarkyr Kaplankyr uplifts. Geomorphologically, this area belongs to the South Ustyurt depression, the sides of which are complicated by local uplifts. In the central part, it borders the Aksakeaudan - Sarykamysh trough. The northern side of the trough adjacent to the Central Ustyurt swell is complicated by the Shakhpakhta step, which is separated from the more submerged part of the trough by a flexure-fracture zone. The northern part of the Central Ustyurt (Karabaur) swell is almost ubiquitous in eluvial-diluvial formations, a product of the weathering of bedrock Cretaceous and Neogene rocks. On the southern slope of the Karabaur swell, undifferentiated Neogene-Quaternary deposits have a limited distribution. At the same time, Paleogene deposits are classified as terrigenous-carbonate formations, Neogene deposits are classified as carbonate formations and quaternary deposits are classified as desert formations. In general, this area has two sections.

Section B-1. The area is represented by the Sarmatian stage of Neogene deposits, the lower part of the section is represented by clayey-marly gypsum rocks, and the upper part of the section is represented by limestones with layers of gypsum marls and clays up to 80 m thick. The water content of Sarmatian deposits is not universal: in structurally elevated areas it is completely drained. Volumetric mass limits range from 2.0 to 2.17 g/cm3, compressive strength from 0.54 to 1.87 MPa. Degree of resistance to technogenic impact 3 points with an increment of seismic intensity according to engineering-geological analogy, 0.

Among the geological processes and phenomena, weathering, karst and aeolian processes are widely developed. Engineering-geological conditions here are generally favourable, excluding a narrow strip of the adjacent slopes of the Central Ustyurt and Tuarkyr Kaplankyr uplifts, where gully formation and partial landslides are widespread. In addition, karst processes are widely developed in limestones. When developing a site, special attention must be paid to studying the development of hazardous geological processes.

Section B-2. Quaternary deposits have a distribution of insignificant thickness ranging from several to 35-40 m, overlying more ancient deposits. They are almost universally anhydrous and form the upper part of the aeration zone. They are represented by a layer of gypsum loams and sandy loams with the inclusion of fragments of shells and marl. Volumetric mass 1.65 g/cm3, density 2.3 g/cm3. Weathering and salt

formation of soils in the aeration zone are widespread in the area. This site is like B-1 from the point of view of engineering and geological conditions, generally favourable, excluding a narrow strip of the adjacent slopes of the Central Ustyurt and Tuarkyr Kaplankyr uplifts, where gully formation and partial landslides are widely developed. In addition, karst processes are widely developed in limestones. When developing a site, special attention must be paid to studying the development of hazardous geological processes. The degree of resistance to technogenic impact is 3 points with an increment of seismic intensity according to engineering-geological analogy, 0 [11-15].

Region C. The region belongs to the area of lacustrine-accumulative plains, which occupies vast depressions and marginal parts. They were formed in quaternary time and are characterized by accumulative landforms that arose in the conditions of reservoirs. Against the modern background of the relief, the Barsakelmes and Assakeaudanian depressions are confined to low areas. They are the largest depressions, which have steep steep slopes, with a height in some places from 10 to 40 m. Where modern-quaternary deposits are predominantly distributed. The vast bottom of the Assakeaudan depression is characterized by gently undulating relief. In both depressions, hummocky sands are common - peculiar accumulations of sandy-clayey material near bushes. The Assakeaudan depression extends in the latitudinal direction for almost 80 km. In addition to only large dry lands on the southern slope of the Karabaur swell, alluvial quaternary deposits are common.

Lake-accumulative plains are represented within the internal ridge and by Sarykamysh Lake. From the ridge towards the lake, there are four steps of terraces. The height of the ledges ranges from 0.5 to 1.25 m. The area is covered with bushes and dried algae. Throughout the entire territory of the region, gullies of the second and third degrees of gully formation are observed. There are no plants in the area of the ravines, which indicates the development of the process.

Section C-1. The area is represented by sandy loam, fragments of marl and clays; lower down the section there is interlaying of gravel, sandy loam, and fine-grained sand with the inclusion of poorly rounded pebbles and plates of gypsum and halite salts. Degree of resistance to technogenic impact 1 point with an increment of seismic intensity according to engineering-geological analogy, +1.

Section C-2. The site is represented mainly by alluvial modern Quaternary sediments in the form of poorly rounded pebbles of various sizes. Most often, pebbles consist of fragments of limestone, marl and clay-mere helium rocks. The deposits are highly saline, with gypsum and halite predominating in the form of powders and crystals. The maximum size of takyrs on the site is up to 1.5 km^2. The territory, a complicating factor in the development of the territory is dangerous geological processes in the form of bottom and lateral erosion, landslides, gully formations and, accordingly, salinization. The engineering and geological conditions of the site are generally unfavourable. Degree of resistance to technogenic impact 1 point with an increment of seismic intensity according to engineering-geological analogy, +1. The territory, a complicating factor in the development of the territory is dangerous geological processes in the form of bottom and lateral erosion, landslides, gully formations and, accordingly, salinization. The engineering and geological conditions of the site are generally unfavourable.

Section C-3. The area is represented by sandy loam, medium and fine-grained sand, and on the ledges of the upper terraces of the lacustrine-accumulative relief there is a thickness of lamellar weathered calcareous-marly pebbles 1.0-2.5 cm in size, cemented by gypsum and halite salts, their thickness varies within 0.5 -0.75 m. Degree of resistance to technogenic impact 1 point with an increment of seismic intensity according to engineering-geological analogy, +1. The engineering and geological conditions of the site are favourable for the construction of modern structures such as “Sardoba”, for providing drinking water for pasture farming and other types of human activities on the site.

Section C-4. The site is represented by a complex of rocks of lacustrine-chemical salt-bearing deposits of modern Quaternary age. It makes up the bottom of the basin and is represented by table salt. It is contaminated with black silt, a product of erosion of the sides of the basin by seasonal precipitation and the result of drainage of groundwater in the basin area. The thickness of these deposits ranges from 2.0 to 10.0

m. Degree of resistance to technogenic impact 1 point with an increment of seismic intensity according to engineering-geological analogy, +1. The engineering and geological conditions of the site are generally unfavourable for construction.

District D. The region covers the territory of the internal and external repairs, with different widths, which are determined by the influence of processes that determine the state of the repair itself, i.e. neotectonic movements. In addition, canyons and ravines are observed everywhere. In addition to internal and external zinc, they have widely developed weakened zones, where displacement of the Neogene limestone strata over Paleogene marls and clays is observed. Gullies occur in small sections with a length of 0.8-1.5 km, depending on the geomorphological conditions, the composition of the state and the properties of the rocks of the slopes.

Section D-1. Along the plateau, interlayering of light grey layered marls, and limestones with shell rocks is observed everywhere. Their condition is fissured, porous, cavernous and homogeneous in chemical composition. Lower along the section there are also fractured ones. The cracks are filled with powder and crystalline gypsum and covered with halite on top. Rocks everywhere are subject to weathering, cracking, and landslides are observed. Degree of resistance to technogenic impact 1 point with an increment of seismic intensity according to engineering-geological analogy, +1. The engineering and geological conditions of the site are not favourable for construction.

Section D-2. The site is represented by a complex of development processes that contribute to the formation of canyons, ravines and karst voids. The distribution of the site throughout the study area is confined to the northern part of the Aksseaudan depression, the eastern sides of the Barsakelmess and some areas of the internal Ustyurt ledge. At the foot of the ridge and the sides of the basins, piles of masses, landslides, and collapses are formed, and ravines begin here, cutting through the ridges and hills to form canyons with steep walls from 10 to 20 m. The degree of resistance to technogenic impact is 1 point with an increase in seismic intensity according to engineering-geological analogy, +1. In the territory, a complicating factor in the development of the territory is dangerous geological processes. The engineering and geological conditions of the site are generally unfavourable.

CONCLUSION

Thus, in the study area with widespread slope gravitational processes, characterized by various engineering-geological conditions, which, under the influence of climatic conditions and neotectonic movements, activate processes such as weathering, gully formation and some gravitational processes on the internal and external ridges.

The engineering-geological zoning of the territory of the southern part of the Karakalpak Ustyurt is based on a formational principle that takes into account the zonality of the distribution of stratigraphic-lithological rock complexes. Four regions and 10 sites were identified (sites were identified based on the predominance of one of the engineering-geological factors). The degree of resistance to technogenic impacts and the increase in seismic intensity is determined depending on the engineering and geological conditions of the site.

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