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Regularities of Distribution, Terms of Deposit and Distribution of the Quarterly Deposits of the South-West of Uzbekistan

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ABSTRACT: The article discusses the main issues of methodological principles of soil science and Quaternary geology about the dependence of the geotechnical features of rocks on their genesis and age. Specifying this position, it should be noted, that these two geological factors primarily determine the composition and regularities of the structure of rock strata and, as a result, in many respects, the features of the arrays composed by them. It is noted, that the influence of the genesis of Quaternary rocks is clearly manifested in the composition and structure of such seemingly homogeneous loess rocks, the engineering and geological properties of which are variable in small areas. The second very important from an engineering-geological point of view is the parameter is the age of the sediments, which predetermines the structure of their sequences and has a great influence on the formation of engineering-geological properties.

KEY WORDS: Quaternary deposits, occurrence conditions, age, genesis, dismemberment, composition, properties, lithology, section, rock types.

I.INTRODUCTION

The quaternary tectonic-sedimentation complex, which composes the uppermost part of the section of the post-platform cover, was formed in the midst of a sharp increase in tectonic movements and the associated repeated glaciations. Under these conditions, a ubiquitous, in many areas powerful (up to 150-300 m) complex of continental deposits was formed. In the consistency of this complex, various types of rocks are developed: from gravelites and cailloutis to heavy clunch.The entire complex of these formations composes the subformation of continental terrigenous Quaternary sediments.Modern factors of sedimentation in different climatic zones, acting and processing both the root and free-open textured substrate, create younger forms of accumulation, which occur a variety of relationships with earlier accumulative formations. The formation of a particular genetic type of deposits is associated with exposure to several agents.Therefore, we distinguish the main subformations of the Quaternary deposits - alluvial, proluvial, deluvial, ash, eluvial, etc., as well as mixed (polygenetic) - proluvial-alluvial, eluvial-deluvial, etc.According to the stratigraphic conditions of occurrence and location, they are divided according to the combined stratigraphic pattern of these formations in the south of Central Asia into four age complexes: Lower Quaternary – Kulyab ($Q_I$kl), for Kashkadarya, Azkamar ($Q_I$as); Mid Quaternary – Ilyak (Q_{II}il), - Karnab and Shorkuduks (Q_{II}kr, QIIsh); Upper Quaternary – Dushanbe (Q_{III}db), –Sukaitinsky (Q_{III}sk); modern – Amu Darya (Q_{IV}ad).

II. SIGNIFICANCE OF THE SYSTEM

The study of the laws of variability of indicators of the engineering and geological properties of soils, as well as the variety of Quaternary deposits according to the conditions of formation and spatial distribution, genesis, age, consistensy, condition and engineering and geological properties allows them to be systematized and necessitates the development of a more complete and specific scheme of their engineering and geological dismemberment.In addition, the lack of engineering-geological separation of the Quaternary sediments of the studied area prevents the generalization and practical use of a significant amount of factual material.

III. LITERATURE SURVEY

Currently, there are many developed genetic classifications of Quaternary sediments for the lowland and mountainous regions in Central Asia (Vasilkovsky N.P .; Dodonov A.E .; Islamov A.N.; Kadirov E.V.; Kostenko N.P.; Loskutov

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V.V.; Mavlyanov G.A .; Mavlyanov E.V .; Nikolaev N.N .; Pulatov K.P .; SkvortsovYu.A .; Tetyukhin G.F .; Chedia O.K. et al.).In 1966, the final scheme of the partition of the Quaternary formations of Uzbekistan was approved and adopted by the All-Union Commission for the Study of Quaternary sediments. The use of these classifications for the region in question is quite acceptable for the under consideration region.
In the works of G.A. Mavlyanov, N.P. Kostenko, V.A. Vasilyeva, G.F. Tetyukhina, O.K. Chedia, A.K. Trofimova, V.V. Loskutova, A.E. Dodonova, K.P. Pulatov and others, one of the main criteria in the division of the Quaternary sediments of the regions of Tajikistan and South-West Uzbekistan is the tectonic-geomorphological factor, in which sedimentation in the mountains and surrounding areas is determined primarily by the latest tectonics, geomorphological features of the region's structure, climate, signs of ancient glaciations, paleontological and archaeological finds, etc. With this integrated approach, the Quaternary formations are divided into four regionally mature sedimentary complexes,which answers to the main plan for the geological development of the study area.

However, from an engineering-geological point of view, such a partition requires some concretization, especially in the geological-genetic partition of these formations, where the difference in the composition and properties of rocks serves as a criterion for the partition (Mavlyanov [1]).The sequential separation of the Quaternary sediments, first according to geomorphological-tectonic, magnetic, paleopedological, biostratigraphic, and then according to genetic, lithological and soil science signs, makes the distinguished geological bodies become more and more homogeneous in geological and engineering-geological terms (in terms of physical and mechanical properties). As applied to our problems, such a partition scheme is of great importance in identifying patterns of variability of geotechnical factors in space, it allows us to make some predictions about changes in the consistency and properties of Quaternary rocks, as well as in geotechnical mapping, where the distinguished geological bodies are located in the following row: formation – Subformation — geological – genetic complex of rocks — type of rock — type of rock — variety of rock (Achilov, Irgashev [2,3]).

The classifications of types of loesses and loesslike rocks of central and southern parts of Central Asia, including South-West Uzbekistan, based on the genesis, as well as the diagenesis of loesses and their physico-mechanical properties, making it possible to predict the subsidence of rocks, have been worked out by G.A. Mavlyanov [1], K.P. Pulatov, Yu.I. Irgashev et al. [4].
Subsequently, on the basis of this classification, Y. Irgashev [5] worked outa fundamentally new scheme of engineering-geological separation of Quaternary rocks for the right bank of Kashkadaryaaccording tothe age and genetic types. The advantage of this scheme is that in the process of work (drawing up design estimates), based on the geological, geomorphological and hydrogeological study of the territory, it reflects the types of rocks, geological indices, areas of their development and distribution in the relief, typical lithological sections and etc. These data allow us to more reasonably draw updraft of field and laboratory work projects.
The remaining characteristics (consistency and properties) of the Quaternary sediments are determined in the process of field research and are supplemented by the final processing of the collected engineering-geological materials.
The results of a long-term study of the Quaternary deposits of the South-West of Uzbekistan (1960-2007), the development of literary and stock sources indicate the acceptability of the principle of the separation of the Quaternary formations according to their genesis and age for the studied territory and do not contradict the opinion of the above researchers [3, 5]. Thus, the data presented above convincingly indicate that the genesis and age affect the formation of engineering-geological features of rocks, determine the composition of sediments, the structure of their thicknesses, the main features of the spatial variability of the composition of rocks and the total time of lithification of sediments. Therefore, the stratigraphic-genetic approach is the only correct one when studying the engineering-geological features of rocks of any regions, when assessing the engineering-geological conditions of the territory (Trofimov [6]).
Based on the principles of the separation of the Quaternary sediments mentioned above and the considerations stated above, we have drawn up a diagram of the engineering-geological partition of various age and genetic types of Quaternary sediments in the South-West of Uzbekistan. This option of engineering-geological separation develops and improves the previously proposed schemes [5].

The scheme distinguishes 13 geological and genetic types of soils, characterized by various engineering and geological indicators. Based on this dismemberment, we compiled maps of the stratigraphic-genetic complexes of the Quaternary rocks of the territory at the scales of 1: 500 000 and 1: 200 000, and for some areas promising for development at the scales of 1:50 000, 1:25 000 and 1: 5 000.

The geological and genetic type (Mavlyanov, Achilov, Pulatov, Irgashev [1; 2; 4]) was adopted as the basis of the taxonomic unit when dividing Quaternary sediments into homogeneous regions.To distinguish between the geological

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and genetic types of Quaternary sediments in South-West Uzbekistan according to a set of indicators of physical and mechanical properties, we used a simplified version of discriminant analysis — the linear discriminator Z_0. Granulometric composition, soil skeleton density, ductility number, porosity, natural humidity, and relative subsidence coefficient at natural pressure were used as classification indicators.Reference samples were compiled using data obtained from pits drilled in key areas, the geological and genetic characteristics of which have been studied in detail. The discriminant analysis was performed according to the method proposed by G.K. Bondarik, M.I. Goralchuk, V. G. Sirotkin [7], M. F. Achilov [2].

The values of the discriminator and scatter plots of its distribution for rocks of various geological and genetic types of rocks are shown in the table. Based on a visual analysis of scatter plots of the discriminators distribution (Z_0), as well as the calculated difference coefficients, Quaternary deposits can be quite reliably separated by their genesis and age.Differente coefficients calculated by the values of the discriminator (Z_0) allow us to identify the composition and properties, which are separators of the geological and genetic types. The best separators between the proluvial loess rocks of the Ilyak (Karnab) and ash loess are the pulveres cent fracture and poriness [2].

As can be seen from the table, the criterion of differences in both mountain trench is in some cases not u common in assessing the difference between the two sample complexes. Calculation of the discriminator threshold of proluvial and proluvial-alluvial upper Quaternary loess rocks in terms of composition and properties allows us to consider them as one geological body. Consequently, there may be cases, when rocks of different genesis, but close in complex physical and mechanical properties, can be combined into one geological body. But, however, according to the geological and geomorphological characteristics, these genetic types differ significantly, therefore, they are distinguished separately in the dismemberment scheme. The results obtained correspond to the geological and genetic separation of the Quaternary sediments on the geological and lithological map. The proposed division of Quaternary sediments makes it possible to more fully and consistently study their types and establish patterns of distribution of these formations in the territory under consideration, and also provides a real opportunity for studying the variability of indicators of engineering and geological properties of soils (Irgashev [8]).

IV. EXPERIMENTAL RESULTS

An analysis of the distribution characteristics of the various geological and genetic complexes of the Quaternary sediments, which occur first from the surface, allows us to draw the following conclusions:

1. A significant territory (87%) of the region is covered by Quaternary sediments; their age varies in a wide range - from the Lower Quaternary to the Holocene, and the most ancient formations are developed on the slopes of anticlinal hills and ridges and lie on the eroded surface of rocks of the Paleogene and Neogene ages; the lowland and foothill territories of the basins are composed of mid- and upper Quaternary sediments.
2. In the spatial arrangement of the Quaternary sediments composing the piedmont, intermontane, and platform depressions, a distinct change in the eluvial, deluvial, proluvial, and alluvial deposits from the mountains to the central part of the depressions is observed. The thickness of the deposits of Quaternary rocks of various genesis and age in the central regions of the depression is usually significantly higher compared to the peripheral parts. Such generally regular latitudinal and vertical variability of the genesis of sediments and their thickness is causally caused by the tectonic and paleogeographic development of the region during the Quaternary.
3. Within the region, the middle and upper Quaternary proluvial and proluvial-alluvial deposits, composing the plain and foothill parts, are very widespread. They are represented by typical loesses and loesslike loams and sandy loams; sand and gravel rock mass.
4. Within the South-West of Uzbekistan, latitudinal and vertical variability of the engineering-geological features of Quaternary rocks is clearly traced. Latitudinal variability is manifested in a change in thickness, bedding conditions, composition, structure and properties of rocks in accordance with a change in physical and geographical zones. Vertical - is expressed in a change in genetic types (alluvial, proluvial, deluvial-proluvial, eluvial, etc.), and, as a result, in a change in the composition, structure and properties of rocks during the transition from lowlands to highlands and is due to a change in the intensity of erosion-denudation processes.
5. It has been established, that the main source material for the formation of various genetic and age types of Quaternary, including loess rocks of the region, were mainly sandy-clay rocks of the Mesozoic, Paleogene and Neogene age. The formation of the source material, the transfer and the method of its deposition, in particular, the acquisition of the loess appearance, are the result of a change in neotectonic movements, paleoclimate, and long-term geological evolution of the rocks.

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6. The genesis and age of sediment has a huge impact on the formation of engineering-geological features of Quaternary rocks. They determined the composition of the sediments composing various complexes of sediments, the structure of their strata, the main features of the variability of the composition of the rocks and the total lithification time of the sediments, which is reflected both in the properties of the rocks and the properties of the massifs composed by them.

Table 1 Difference coefficients (Δ) of different geological and genetic types of Quaternary rocks for each indicator and discriminator value

Geological and Genetic Index	P_s	P_l	G_l	M_r	W	ρ_{sk}	n	Z_0	Significance criterion t^2 0,95
Sherabad-Surkhandarya intermountain basin (Uzbekistan)									
edQ;dpII	0,06	0,139	$7{,}8\cdot10^{-3}$	0,289	0,024	46,34	0,05	6,29	5,41
pII;vQ	$4{,}4\cdot10^{-4}$	469,11	0,139	1,656	$2{,}5\cdot10^{-6}$	2,143	2408,49	539,16	4,53
pII;pIII	0,069	0,115	$5{,}9\cdot10^{-3}$	358,7	$1{,}9\cdot10^{-6}$	1090,10	$2{,}8\cdot10^{-6}$	5,907	3,95
dpII;pII	0,067	0,136	$7{,}7\cdot10^{-3}$	0,291	0,024	45,91	0,059	6,27	5,81
vQ;vdQ	2,111	0,233	14,31	8,12	$1\cdot10^{-4}$	36,41	0,0118	61,94	17,39
Kashkadaryafoothillbasin(Uzbekistan)									
edQ;dpII	0,07	0,136	$7{,}9\cdot10^{-3}$	0,276	0,021	46,11	0,049	6,12	5,23
pII;vQ	$4{,}2\cdot10^{-4}$	469,0	0,131	1,644	$2{,}4\cdot10^{-6}$	2,121	2404,51	538,96	4,44
pII;pIII	0,066	0,112	$5{,}8\cdot10^{-3}$	359,6	$1{,}8\cdot10^{-6}$	1090,00	$2{,}7\cdot10^{-6}$	5,892	3,89
dpII;pII	0,062	0,126	$7{,}6\cdot10^{-3}$	0,284	0,021	45,67	0,051	6,17	5,79
vQ;vdQ		0,227	14,26	8,02	$1\cdot10^{-4}$	36,12	0,0116	61,79	17,27

Note: P_s, P_l, G_l - respectively, the content of the sandy, silty and clay fraction; M_r is the number of plasticity; W– natural humidity;ρ_{sk} is the density of the skeleton of the soil; n – porosity.

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