Technical science and innovation

Volume 2024 | Issue 2 | Article 7

5-15-2024

ENGINEERING AND GEOLOGICAL ZONING OF THE DISTRIBUTION AREAS OF THE EOCENE CLAYS OF NORTHERN TAMDYTAU

Mirabbas Mirsaatovich Zakirov
Tashkent State Technical University, Tashkent city, Republic of Uzbekistan, DSc, Professor, e-mail: mzakirov1957@mail.ru, http://orcid.org/0000-0001-9572-6661;, mzakirov1957@mail.ru

Inobat Abduvaxidovna Agzamova
Tashkent State Technical University, Tashkent city, Republic of Uzbekistan, PhD, Professor, e-mail: inobat1963@mail.ru, https://orcid.org/0000-0002-3102-4289;, inobat1963@mail.ru

Dilshod Kalandarovich Begimkulov
Tashkent State Technical University, Tashkent city, Republic of Uzbekistan, PhD, Associate Professor, e-mail: begimkulov@mail.ru, https://orcid.org/0000-0003-2213-6091;, begimkulov@mail.ru

Golibjon Ernazar ogli Ochilov
Tashkent State Technical University, Tashkent city, Republic of Uzbekistan, e-mail: g.ochilov91@mail.ru;, g.ochilov91@mail.ru

Temur Makhmarajabovich Khudoyberdiyev
Tashkent State Technical University, Republic of Uzbekistan, Senior Lecturer, e: temurxudoyberdiyev@mail.ru, https://orcid.org/0000-0001-6402-8457;, temurxudoyberdiyev@mail.ru

See next page for additional authors

Recommended Citation

Zakirov, Mirabbas Mirsaatovich; Agzamova, Inobat Abduvaxidovna; Begimkulov, Dilshod Kalandarovich; Ochilov, Golibjon Ernazar ogli; Khudoyberdiyev, Temur Makhmarajabovich; and Madiyarov, Dastan Jamal uli (2024) "ENGINEERING AND GEOLOGICAL ZONING OF THE DISTRIBUTION AREAS OF THE EOCENE CLAYS OF NORTHERN TAMDYTAU," *Technical science and innovation*: Vol. 2024: Iss. 2, Article 7.
DOI: https://doi.org/10.59048/2181-0400
E-ISSN: 2181-1180
.1570

Available at: https://btstu.researchcommons.org/journal/vol2024/iss2/7

UDC 677.027.622+543.422.4

ENGINEERING AND GEOLOGICAL ZONING OF THE DISTRIBUTION AREAS OF THE EOCENE CLAYS OF NORTHERN TAMDYTAU

M.M.ZAKIROV, I.A.AGZAMOVA, D.K.BEGIMKULOV, G.E.OCHILOV, T.M.KHUDOYBERDIEV, D.J.MADIYAROV (Tashkent State Technical University, Tashkent city, Republic of Uzbekistan)*

Received: March 26, 2024; Accepted: May 15, 2024; Online: July 01, 2024.

Abstract: *The article discusses scientific research on the integrated assessment of the problem of ensuring the sustainability of buildings and structures for industrial and civil purposes. The relevance is due to the development of various zoning methods to establish territories with reliable results on the spread of special soils. Especially in cases where swelling clays are common in the territory, characterized by high sensitivity to weather and climatic conditions. Based on the above, the purpose of engineering and geological zoning of the areas of distribution of Eocene clays of Northern Tamdytau was to identify areas of new construction, to ensure the safe operation of buildings and linear structures (pipelines, roads and railways). Engineering-geological zoning is not only the separation and description of conditions, but also the allocation of various geological elements in difficult geological conditions, differing in morphology, depth, composition and properties with different formation history. This is all, ultimately, a taxonomic systematization with qualitative, quantitative characteristics and assessment of engineering and geological conditions. The schematic map of engineering and geological zoning compiled by the authors makes it possible to determine the progressive anthropogenic impact on the geological environment of the territory of Northern Tamdytau, associated with further activation of the processes of clay swelling, cracking, shrinkage, etc. Their negative impact on buildings, as we have repeatedly noted, is the stronger the closer the swelling clays lie to the surface. The clarified basic engineering-geological and seismic properties of Eocene clays and the scheme of engineering-geological zoning compiled according to them make it possible to significantly reduce the time, volume of engineering-geological surveys and design developments and are the engineering-geological basis of seismic micro-zoning.*

Keywords: *Eocene clays, swelling processes, shrinkage, cracking, stability of buildings, engineering and geological zoning, increments of seismic intensity, seismic effect, initial seismicity, "average" soil conditions.*

Annotatsiya: *Maqolada sanoat va fuqarolik maqsadlari uchun mo'ljallangan bino va inshootlarning turg'unligini ta'minlash muammosini kompleks baholash bo'yicha ilmiy tadqiqotlar muhokama qilingan. Dolzarblik maxsus gruntlarning tarqalishi haqidagi ishonchli natijalarga ega bo'lgan hududlarni ajratish uchun rayonlashtirishning turli xil usullarini ishlab chiqish bilan bog'liq. Ayniqsa, hududda ob-havo va iqlim sharoitlariga yuqori sezuvchanligi bilan ajralib turuvchi ko'pchuvchan gillar keng tarqalgan hollarda dolzarblik yanada ortadi. Yuqoridagilarga asoslanib, Shimoliy Tomditov eotsen gillarining tarqalish maydonlarini muhandislik-geologik rayonlashtirishdan maqsad yangi qurilish maydonlarini aniqlash, binolar va chiziqli inshootlarning (quvurlar, avtomobil va temir yo'llar) xavfsiz ishlashini ta'minlashdan iborat. Muhandislik-geologik rayonlashtirish nafaqat sharoitlarni taqsimlash va tavsiflash, balki murakkab geologik sharoitlarda morfologiyasi, yotish chuqurligi, tarkibi va xususiyatlari bilan farq qiluvchi, har xil shakllanish tarixiga ega bo'lgan turli xil geologik elementlarni ajratish hamdir. Bularning barchasi, oxir-oqibat, muhandislik-geologik sharoitlarni sifat va miqdoriy jihatdan tavsiflash hamda baholash bilan amalga oshirilgan taksonomik tizimlashtirishdir. Mualliflar tomonidan tuzilgan muhandislik-geologik rayonlashtirishning sxematik xaritasi Shimoliy Tomditov hududining geologik muhitiga gillarning ko'pchishi, darzliklar hosil bo'lishi, qisqarishi va boshqa jarayonlarni yanada faollashuvi bilan*

*Mirabbas Mirsaatovich Zakirov - DSc, Professor, e-mail: mzakirov1957@mail.ru, http://orcid.org/0000-0001-9572-6661
Inobat Abduvakhidovna Agzamova, PhD, Professor, e-mail: inobat1963@mail.ru, https://orcid.org/0000-0002-3102-4289
Dilshod Kalandarovich Begimkulov - PhD, Associate Professor, e-mail: begimkulov@mail.ru, https://orcid.org/0000-0003-2213-6091
Golibjon Ernazar ogli Ochilov - PhD, e-mail: g.ochilov91@mail.ru.
Temur Makhmarajabovich Khudoyberdiyev - Senior Lecturer, e: temurxudoyberdiyev@mail.ru, https://orcid.org/0000-0001-6402-8457
Dastan Jamal uli Madiyarov, Master's student, , e-mail: dastanbekjamalovich@gmail.com, https://orcid.org/0009-0005-0544-4027.

bog'liq progressiv texnogen ta'sirni aniqlash imkonini beradi. Biz bir necha bor ta'kidlaganimizdek, ularning binolarga salbiy ta'siri ko'pchuvchan gillar yer yuzasiga qanchalik yaqin bo'lsa, shuncha kuchliroq bo'ladi. Eotsen gillarining aniqlangan asosiy muhandislik-geologik va seysmik xususiyatlari hamda ularga muvofiq tuzilgan muhandislik-geologik rayonlashtirish sxemasi loyihaoldi ishlanmalarning muhandislik-geologik izlanishlari muddatini, hajmini sezilarli darajada kamaytirishga imkon beradi va seysmik mikrorayonlashtirishning muhandislik-geologik asosi hisoblanadi.

Tayanch so'zlar: *Eotsen gillari, ko'pchish, darzlik hosil bo'lish, qisqarish jarayonlari, binolarning turg'unligi, muhandislik-geologik rayonlashtirish, seysmik intensivlikning oshishi, seysmik effekt, dastlabki seysmiklik, "o'rtacha" grunt sharoitlari.*

Аннотация. *В статье рассматриваются научные исследования по комплексной оценки проблемы обеспечения устойчивости зданий и сооружений промышленного и гражданского назначения. Актуальность обуславливается в разработке различных способов районирования для установления территорий с достоверными результатами о распространении специальных грунтов. Особенно в случаях, когда на территории распространены набухающие глины, характеризующиеся высокой чувствительностью к погодно-климатическим условиям. Исходя из вышесказанного целью инженерно-геологического районирования площадей распространения эоценовых глин Северного Тамдытау явилось выявление площадей нового строительства, обеспечения безопасной эксплуатации зданий и линейных сооружений (трубопроводов, авто и железных дорог). Инженерно-геологическое районирование – это не только разделение и описание условий, но и выделение в сложных геологических условиях различных геологических элементов, различающихся по морфологии, глубины залегания, составу и свойствам с различной историей формирования. Это все, в конечном счете, таксономическая систематизация с качественной, количественной характеристикой и оценкой инженерно-геологических условий. Составленная авторами схематическая карта инженерно-геологического районирования дает возможность определить прогрессирующее техногенное воздействие на геологическую среду территории Северного Тамдытау, связанное с дальнейшей активизацией процессов набухания глин, трещинообразования, усадки и др. Негативное воздействие их на здания, как мы неоднократно отмечали, тем сильнее, чем ближе к поверхности залегают набухающие глины. Уточненные основные инженерно-геологические и сейсмические свойства эоценовых глин и составленная по ним схема инженерно-геологического районирования позволяют намного сократить сроки, объемы инженерно-геологических изысканий пред проектные разработки и являются инженерно-геологической основой сейсмического микрорайонирования.*

Ключевые слова: *Эоценовые глины, процессы набухания, трещинообразования, усадка, устойчивость зданий, инженерно-геологическое районирование, приращения сейсмической интенсивности, сейсмический эффект, исходная сейсмичность, "средние" грунтовые условия.*

Introduction

Currently, scientific research is underway in the world on comprehensive assessments of the problem of ensuring the sustainability of buildings and structures for industrial and civil purposes. This leads to the development of various methods of zoning territories to develop new requirements for the foundations of buildings and structures. Especially in cases where swelling clays are common in the territory, characterized by high sensitivity to weather and climatic conditions. In turn, special attention is paid to solving geological problems of creating maps of engineering and geological zoning of swollen soils, which are widespread in India, China, the USA, Canada, Egypt, Romania, Russia, and the republics of Central Asia.

In recent years, when there is significant archival material on engineering surveys, which allows performing engineering and geological zoning with small amounts of field work. And subsequently, it is possible to predict the activation of processes such as swelling, subsidence, shrinkage, cracking, flooding, mudflows, etc. As a result, residential and industrial buildings, communications may be destroyed, and the saddest thing is that the elements take away human lives. Only in the Krasnodar Territory such settlements as: Krymsk (2002, 2012), Novorossiysk (2002), Gelendzhik (2012), Tuapse, Sochi (2012-2013), cracking in the buildings of the village of Tamdy, on the territory of new buildings in the southwestern part of Zarafshan, in the country village of geologists and other areas.

In general, maps of engineering and geological zoning are compiled to identify geological objects existing in the territory that have any common engineering and geological features of their mapping and description. The creation of schematic maps of engineering and geological zoning on a scale of 1:100,000 - 1:200,000 and smaller is necessary for design, survey and construction organizations of the mining industry and other interested organizations in order to: 1) conducting engineering and geological surveys of new construction sites; 2) ensuring the safe operation of enterprises, buildings and structures, pipeline transport and field operation; 3) performing reconstruction, major repairs and restoration of facilities, including buildings and structures of the transport system.

Based on the above, the purpose of engineering and geological zoning of the areas of distribution of Eocene clays of northern Tamdytau was to identify areas of new construction, to ensure the safe operation of buildings and linear structures (pipelines, roads and railways).

Research Methods and the Received Results

There are different types of zoning based on different starting positions and conducted according to different classification criteria.

The first type is genetic-morphological, or natural-historical, zoning. At the same time, on the basis of certain principles and classification features, territorial units of different orders are identified, isolated, classified and characterized.

The second type is estimated engineering and geological zoning, which provides for an assessment of the complexity of engineering and geological conditions of various territorial complexes based on the use of various qualitative or quantitative indicators. Engineering and geological zoning is essentially an independent type of genetic and morphological zoning and can be general and special in its content.

I.V. Popov (1961), proposed to distinguish according to the following criteria: regions - by geostructural feature, districts - by geomorphological, subdistricts - by geological structure and sites - by other characteristics.

V.T. Trofimov (1979) proposed and justified the following classification features for the separation of taxonomic units of different ranks in the genetic and morphological engineering and geological zoning of large territories. The region as the largest engineering and geological unit is distinguished by structural and tectonic features. It is divided into provinces, isolated on the basis of taking into account the nature of rocks (rock classes in accordance with the general classification of soils by E.M. Sergeev and others), composing the territory of the region [1, 6, 7, 12, 14, 15].

I.M. Haime, V.S. Khorev (1986) compiled a mock-up of a medium-scale map of the engineering and geological zoning of the central section of Baikal - Amur Mainline (BAM). On the basis of the principles of formation-tectonic and geological-genetic analysis, a consistent identification and justification of structural units with different geological history and, accordingly, with different complexes of engineering and geological conditions was carried out. On the map, the boundaries separate engineering and geological regions of three orders, engineering and geological regions and areas designated by a combination of alphabetic and numeric indexes.

Engineering-geological zoning includes methods of systematization of engineering-geological conditions of the territory, assessment of their uniformity both vertically and horizontally. Scientists understand these fundamental principles of zoning in different ways, sometimes complementing each other. According to S.M.Kasymov (1979), engineering-geological zoning is the division of the studied territory into subordinate taxonomic elements characterized by internal commonality and external differences in engineering-geological conditions. According to I.S.Komarov, engineering-geological zoning is the sequential division of the studied territory into parts (territorial units), which are characterized by increasing uniformity in engineering–geological conditions. G.A.Golodkovskaya understands engineering – geological zoning as "the allocation and description of individual territories united by the commonality of certain indicators" [2, 3, 12-15,]. According to S.M.Kasymov [6, 13], engineering-geological zoning is not only the separation and description of conditions, but also the allocation of various engineering-geological elements in difficult geological conditions, differing in morphological position due to the different history of their formation. This is all, ultimately, a taxonomic systematization with qualitative, quantitative characteristics and evaluation.

Territories where swelling bentonite clays of a specific composition, with peculiar engineering-geological and seismic properties, lie under a small cloak, require a special approach when zoning them. It is necessary to take into account the weathering, the depth of occurrence of clays, their material composition, hypergenic processes, which are the basis for understanding the true cause of varying degrees of swelling of clays due to shrinkage.

Thus, researchers most often use classification features of genetic and morphological zoning, where a region is distinguished by structural and tectonic features; an area by geomorphological; an area by lithological; a subdistrict and a site by hydrogeological; the nature and condition of rocks, etc.

To compile a schematic map of the engineering-geological zoning of the Eocene clays of Northern Tamdytau according to the conditions of rock occurrence, their engineering-geological and seismic properties [2, 7-13], the following areas were identified in the studied territory: mountainous region; foothill region; plain region, differing in geological structure, history of geological and tectonic development, relief, hydrogeological, engineering-geologi-cal, seismic characteristics; areas: with a possible decrease in seismicity by 1 point (-1); with initial seismicity (0); with a possible increase in seismicity by 1 point (+1) (Table. 1) [11].

Table 1

Taxonomic units of engineering and geological zoning of the territory of Northern Tamdytau

Engineering and geological areas and their indexes on the map	Engineering and geological areas and their indexes on the map
Mountain region – A	Areas with a possible decrease in seismicity by 1 point (-1) – A-I
	Areas with initial seismicity (0) – A-II
Foothill region – B	Areas with a possible decrease in seismicity by 1 point (-1) – B-I
	Areas with initial seismicity – B-II
Plain area – C	Areas with initial seismicity (0) – C-I
	Areas with a possible increase in seismicity by 1 point (+1) – C-II

A – mountain region occupies the southern part of the study area and extends from east-northeast to south-southwest. It consists of the mountain hills of Aktau (absolute mark 922 m), Tamdytau (750 m), Shushaktau (700 m), separated by deep (from 100 to 50 m) valleys of temporary watercourses Surgalysai, Azhryktysai, Tamdysai, etc.

As noted above, rocks of the Hercynian and Alpine structural floors, represented by igneous, sedimentary-metamorphic, Paleozoic and Meso-Cenozoic deposits, take part in the geological structure of the area. The modern relief of the mountain complex was formed during the Hercynian, Alpine and Neotectonic stages of development and denudation processes. A noticeable movement occurred along the North Tamdyn regional fault, which determined its residual and discolored origin [4]. According to engineering-geological and seismic properties, areas with a possible decrease in seismicity by 1 point (-1) and with initial seismicity (0) have been identified in the mining complex [3, 9, 11].

B – the foothill region is composed of sandstones, marls, Upper Cretaceous and Paleogene limestones with a thickness of more than 50 m, covered with eluvial-deluvial Quaternary deposits with a thickness of 0.2 to 5.0 m. Sometimes Eocene clays are exposed. These deposits form saline, plastered puffs on the daytime surface, under which gravelly clays lie, turning into massive bedrock with a capacity of more than 50 m. Towards the proluvial plain, their depth increases to 100 m or more and they are covered with Neogene-Quaternary deposits.

The foothill complex was formed with a complex combination of discontinuous and bending deformations. They differ in the intensity and multidirectional nature of tectonic movements. A smooth increase in the elevation of the relief of this complex occurred towards the Tamdytau ridge, where the speed of vertical movements reaches the highest value (+10 mm/year with a possible quadratic error of ± 2.8 mm/year). Before the beginning of the latest movements, the Eocene clay roof was located about 200 m below sea level in the form of a flat horizontal surface. The intensive manifestation of the latest movements at the turn of the Neogene contributed to the exposure of Eocene clays and their inclined occurrence. The preservation of such relief forms in the nude was facilitated by the sharp pulsating efforts of positive tectonic movements in Quaternary time. So, the modern appearance of the relief was formed with the participation of tectonic movements, erosion and deflation.

The areas with a possible decrease in seismicity by 1 point (-1) and with initial seismicity (0) have been identified on the area of this complex (Table 1).

C – the plain region is expressed by proluvial, alluvial-proluvial and ridge-cellular reliefs, which are almost flat surfaces with a slight slope from the Tamdytau mountains. There are takyrs at the junction of ridge-cellular and proluvial reliefs. They are protected by ledges of Aeolian sands up to 10-20 m high and occupy areas of several square kilometers. The absolute surface marks in the east reach 220 m, rarely 250 m, to the west it gradually decreases to 200-180 m [3, 16].

Within this area, areas have been identified according to seismic properties (the magnitude of the increment in seismic intensity): with initial seismicity (0) and with a possible increase in seismicity by 1 point (+1).

According to the schematic map of seismogenic zones and seismic zoning, the territory of Northern Tamdytau is classified as a zone with an earthquake intensity of up to 8 points. However, macroseismic surveys of the study area after the Gazli earthquakes (1976, 1984) showed that the seismic effect in different parts of the territory, depending on engineering and geological conditions, manifests itself in different ways.

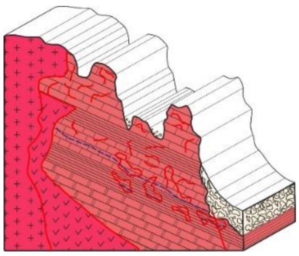
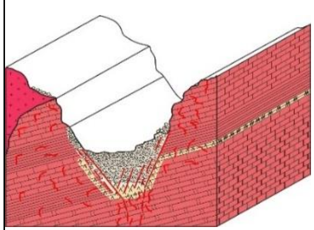
In this regard, special studies have been conducted on the territory of Zarafshan to identify sites with different seismic intensities [3, 5, 7]. As in these works, when identifying areas with different seismic intensity, “average” ground conditions are taken according to [11] and the map of seismic zoning of the territory of the former Union: gravel-gravelly deposits with a thickness of 10-15 m; groundwater is absent or their level is at a depth of more than 10 m; the surface is slightly inclined (10-14^o). At the same time, it was assumed that the city of Zarafshan and the village of Tamdybulak are located in the specified ground conditions and similar conditions are accepted for average ground conditions during seismic microdistricting of the territory of cities. The increment of the score was calculated relative to the average soil with an average density of 1.8 g/cm^3 and a speed of 830 m/s.

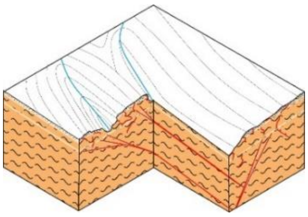
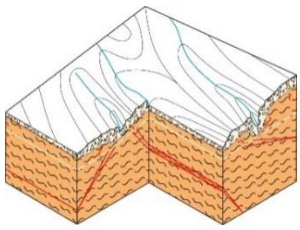
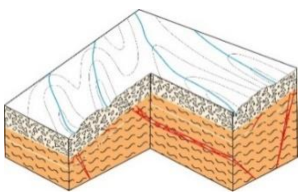
The conducted studies [2, 3, 16] prove that in the developed territory of Zarafshan, where Eocene clays lie at a depth of 5-10 m, the increment of seismic intensity increases by I point compared with average soils due to soil watering. The magnitude of the seismic effect reaches 8 points. But such a gradation of seismicity for the territory of the village Tamdybulak was not performed. Where Eocene clays come to the surface, the depth of their occurrence increases with distance from the foothills.

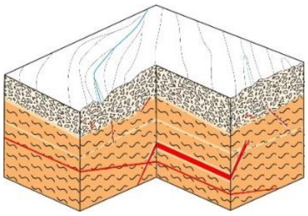
Taking into account the achievements and shortcomings of previous studies, the sites were identified according to seismic properties, taking into account the depth of clay occurrence, access to the surface or their absence. At the same time, areas of Eocene clay outcrops with a depth of up to 5 m; with a depth of up to 10m; with a depth of 15 m or more are highlighted.

Table 2

Engineering and geological characteristics of the sites within the Northern Tamdytau

Sites	Engineering and geological characteristics of the sites	Sections	Recommendations for the development of the territory
Areas where there are no Eocene clays	It is represented by igneous (granites, granodiorites), metamorphic (phyllite shales, marbles, marbled limestones, phyllites), sedimentary (clastic rocks cemented with clays and carbonates, etc.) rocks: located on a highly dissected relief: the slopes are steep, on the northern slope from 60^0 to 70^0, on the southern 50^0-60^0, dissected by valleys of temporary streams from 50 to 100 m, groundwater is fractured, fractured-karst; surface cracks are diverse; karst caves are developed in carbonate rocks. The rocks are dense, durable and have high structural, crystallization and mechanical strength: ρ_s=2.5 – 2.9 g/sm^3; ρ=2.0 – 2.74 g/sm^3; n=2.0 – 30 %; R_c=47.0 – 262.0 MPa; V_p=1.8 – 4.5 km/s; V_s=1.45 – 3.6 km/s; Δj= – 0.7 – 1.6 (excluding relief). According to KMK 2.01.03-96, soils are classified in the second category. It is developed within the districts A-I; A-II; B-I.		This area is not subject to mass development due to complex engineering training. However, with individual construction of civil-industrial facilities, anti-seismic measures may be reduced by 1 point, taking into account the terrain.
	Clastic uncemented (poorly rounded pebbles with gravel-gravelly aggregate) of eluvial-deluvial origin. Their power ranges from 0.5 to 5 m. They are common in the gentle slopes and valleys of temporary watercourses. Groundwater is absent, but it is an area of supply of fractured waters and an area of formation of a solid component of mudflows. Widely developed: gypsum salinization, weathering over the entire capacity. Gypsum is a cementing material of gravel-gravelly deposits: ρ_s=2.6 – 2.75 g/sm^3; ρ=1.7 – 2.65 g/sm^3; R_c=50.0 – 94.0 MPa; V_p=1.1 – 2.1 km/s; V_s=0.5 – 1.1 km/s; Δj= – 0.7 – 1.2. According to KMK 2.01.03-96, soils are classified in the second category and are typical for areas A-II; B-I.		Development requires complex engineering training in connection with the manifestation of mudflows during the flood period. But construction on them is possible with a decrease in anti-seismic by 1 point.

Sites	Engineering and geological characteristics of the sites	Sections	Recommendations for the development of the territory
Area with outcrops of Eocene clays on the surface or lying close to the surface (up to 1 m)	Coarse and finely dispersed Eocene clays of hydroslude-montmorillonite composition with inclusions and layers of gypsum, up to 3-5 cm thick, strongly fractured, slightly wet, weathered. The thickness of clays is more than 50 m. There is no groundwater. The relief is divided by temporary water streams. Accumulation of weathered and detrital material and riverbed erosion, flooding during floods, crack formation both on the surface and on buildings and structures of Zarafshan and Tamdybulak district center are developed here. The soils are green, light green, slightly and moderately swollen: ρ_s=2.4 – 2.56 g/sm^3; ρ=1.56 – 1.65 g/sm^3; ρ_d=1.33 – 1.45 g/sm^3; W_e=6.6 – 10.9 %; B= –1.1 – (–0.39); δ_H=2.6 – 7.5%; P_H=0.24 – 0.3 MPa; W_H=26 – 35 %. These indicators increase with depth and stabilize at a depth of 3-5 m. V_p=0.83–1.8 km/s; T=0.016 – 0.06 s; δ_p=0.57 – 1.1; Δj=0 – (+0.1). According to KMK 2.01.03-96 soils are classified as the second category and are characteristic of areas B-II-a.		They are favorable for development and construc-tion, but mass development (watering, watering, etc.) of the territory will lead to a deterioration in the engineer-ing-geological and seismic properties of clays with an increase in seismic intensity by 1 point (+1). For reliable operation, it is necessary to apply the provided construc-tion methods on swollen soils. In addition, anti-seismic measures are required
Areas with depth of Eocene clays from 1 to 5 m	They are represented by clays of mainly montmorillonite composition, fractured, slightly salted with gypsum in the form of veins and dikes along large cracks with a thickness from 1 to 2-2.5 cm. At a depth of 1.5-2 m, clastic dykes filled with sandy and gravel material with a thickness of up to 10-15 cm are found in clays. On contact with the upper sediments (gravel-gravelly), gypsum is powdery, rarely crystalline selenite with a thickness of 3-5 cm. The relief is noticeably dissected, the accumulation of detrital material is developed here under the influence of riverbed erosion, in places Eocene clay is exposed; Groundwater is found during flood periods and in built-up parts of the city of Zarafshan and the district center of Tamdybulak at a depth of 3-4 m. The soils are massive, medium and strongly swollen: W_e=11.5–24.0 %; ρ_s=2.6–2.7 g/sm^3; ρ=1.65–1.77 g/sm^3; ρ_d=1.38–1.5 g/sm^3; B= –0.36 – (–0.54); δ_H=9 – 14%; P_H=0.35 – 0.45 MPa; V_p=1.2–1.6 km/s; T=0.016 – 0.06 s; δ_p=0.57 – 0.9; Δj= –0.3 – (+0.1). According to KMK 2.01.03-96, soils belong to the second category and are characteristic of areas B-II-б.		They are favorable for construction. Before development and construction, it is necessary to carry out engineering measures to prevent the swelling of clays and planning, etc. Works against erosion, flooding (waterproofing of structures). It is advisable to carry out anti-seismic measures.
A site with a depth of Eocene clays from 5 to 10 meters	Finely dispersed montmorillonite massive clays, slightly fractured, moist, gypsum up to 1 cm in size is developed along the cracks. Groundwater is absent. In the developed areas, the depth of the groundwater level is up to 7-8 m. Clays are water resistant. The relief is dissected by temporary watercourses, which contributes to the accumulation of weathered and detrital material. Ravine formation and mudslides appear in such areas. The constructed structures are currently in disrepair due to foundation shrinkage and through-cracking on buildings. Clays are green, light green are typical for sites B-I-a.		For construction and development are favorable. With special engineering measures for waterproofing against erosion, swelling, anti-seismic measures are also required

Sites	Engineering and geological characteristics of the sites	Sections	Recommendations for the development of the territory
A site with a depth of Eocene clays from 10 to 15 meters or more	The clays are massive, montmorillonite, but fragmented near large cracks and tectonic disturbances, where weathering and filling with "crushed stones" of weathered clays occur; secondary newly formed minerals are found: jarosite, iron hydroxides, alunite and limonite, which give the clay brownish shades against a green background. They are overlain by Oligocene-Miocene and Quaternary deposits, represented by marl clays, marls, sandy siltstones, gravel-gravelly and sandy loam rocks. The greatest thickness is observed in gravel-gravelly deposits reaching 100 meters or more. There is no groundwater. The relief is slightly fragmented, with a flat surface. Weathering and salinization (up to 3-5 m) with water-soluble salts are developed here. According to KMK 2.01.03-96, soils belong to the second category and are typical for areas B-I		Very favorable for construction and development. Before construction, simple engineering measures are required: planning the territory, strengthening the foundations against mudflows. Additional anti-seismic measures are not required.
	Aeolian, dusty, fine-grained sands of undifferentiated Neogene-Quaternary age with a thickness of up to 30 meters or more. They are common on the Jamankum sand massif. The relief is sandy, where weathering and scattering are developed. In general, the sandy massif is waterless, fresh water lenses appear for a short time during the flood period. ρ_s=2.5–2.7 g/sm^3; ρ=1.5–1.71 g/sm^3; ρ_d=1.3–1.55 g/sm^3; W_e=1.0–3.0 %; V_p=0.9–1.6 km/s; T=0.02 – 0.5 s; Δj= +0.3 – (+0.6). According to KMK 2.01.03-96, soils are classified as category III.		Due to technical and economic reasons, the territory cannot be assimilated due to the powerful Aeolian sands.

The detailed engineering and seismogeological characteristics of the selected sites are reflected on the schematic map of the engineering and geological zoning of the territory located north of the Tamdytau mountains (Fig. 1, Table 2.). At the same time, it was found that clays of almost the same composition, which should have almost the same engineering and geological and seismic properties, differ markedly in depth. Clays lying at a depth of 0 to 5 m differ in engineering, geological and seismic properties from clays of deeper occurrence.

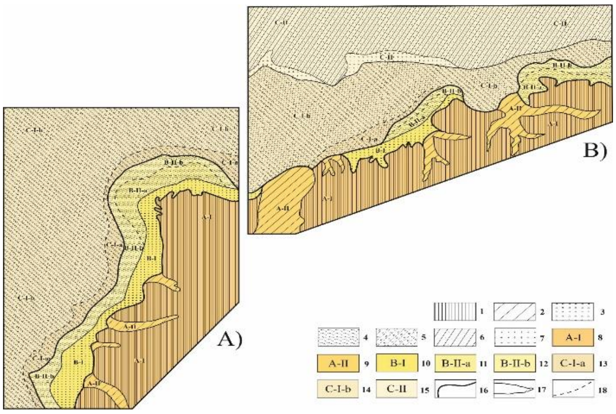


Fig. 1 Schematic map of engineering and geological zoning of the territory of Northern Tamdytau: *1, 3-with a possible decrease by 1 point (–1); 2, 4, 5 - with initial seismicity (0); with a possible increase of 1 point (+ 1). Boundaries: 7 - regions; 8-districts; 9- sections.*

Thus, all the sites allocated in the area differ in terms of a set of indicators of engineering-geological and seismic properties. This must be taken into account when developing these areas for construction.

Conclusion

The compiled schematic map of engineering and geological zoning makes it possible to determine the progressive anthropogenic impact on the geological environment of the territory of Northern Tamdytau, associated with further activation of the processes of clay swelling, cracking, shrinkage, etc. Their negative impact on buildings, as we have repeatedly noted, is the stronger the closer the swelling clays lie to the surface. The clarified basic engineering-geological and seismic properties of Eocene clays and the scheme of engineering–geological zoning compiled according to them make it possible to significantly reduce the time and volume of engineering-geological surveys and design developments.

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