GEOLOGICAL STRUCTURE OF VOLCANOGENIC ROCKS OF THE BERKUTTAUS, DUSHEBULOK, AND SHEYKHJEYLI REGIONS OF THE NORTHERN SULTANOVAY MOUNTAIN

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ABSTRACT

This article provides information on the location, stratigraphic data, geological history and mineralogical composition of basalt-andesite-datsite-rhyolite associations in the northern sections of the Sultanuvais Sheikhdzheili, Dushebulak and Berkuttau mountains. Some of the samples taken from these sites were compared with the requirements of SATBIC (China) for the chemical composition of raw materials for the production of continuous basalt fiber.

Keywords: *retinue. site. Basaltic-andesite. chemical composition. amphibole. tectonics. magmatism. volcanism*

ШИМОЛИЙ СУЛТОНУВАЙС ТОҒИНИНГ БЕРКУТТАУ, ДУШЕБУЛОҚ ВА ШЕЙХДЖЕЙЛИ УЧАСТКАЛАРИДАГИ ВУЛКАНОГЕН ЖИНСЛАРНИНГ ГЕОЛОГИК ТУЗИЛИШИ

АННОТАЦИЯ

Ушбу мақолада шимолий Султонувайс тоғи Шейхджейли, Дущебулак ва Беркуттау участкаларида базальт-андезит-дацит-риолит

ассоциацияларининг жойлашуви, стратиграфик малумотлари, геологик тарихи ва минерологик таркиблари хакида маълумотлар берилган. Бу участкалардан олинган баъзи намуналар SATBIC (Хитой) компаниясининг Узлуксиз Базальт толасини олиш учун хомашёнинг кимёвий таркибига қўйилган талаблари билан солиштирилди.

Калит сўзлар: *свита.. майдон. андезитобазальт. кимёвий таркиб. амфибол.тектоника. магматизм. Вулканизм.*

ГЕОЛОГИЧЕСКОЕ СТРОЕНИЕ ВУЛКАНОГЕННЫХ ПОРОД БЕРКУТТАУСКОГО, ДУШЕБУЛОКСКОГО И ШЕЙХДЖЕЙЛИСКОГО РАЙОНОВ СЕВЕРНОГО СУЛТАНУВАЙСКОГО ГОРА

АННОТАЦИЯ

В данной статье приведены сведения о расположении, стратиграфических данных, геологической истории и минералогическом составе базальт-андезит-датсито-риолитовых ассоциаций в северных разрезах Султанувайс горы Шейхджейли, Душебулак и Беркуттау. Часть образцов, взятых с этих участков, сравнивали с требованиями SATBIC (Китай) по химическому составу сырья для производства непрерывного базальтового волокна.

Ключевые слова: *свита. участка. андезибазальт. химический состав. амфибол.тектоника. магматизм. Вулканизм*

INTRODUCTION

In the last decade, the basalt raw materials of the Sultanuvais mountains were studied by R.A. Khamidov and others (Geology and mineral resources, №6, 2002). Based on the results of his research, paraamphibolites of the Karakuduk Formation (metabasalts and metabasaltic porphyrites) developed in the Aschenyntau tract (samples № 709,731,740a,740b, s-882) are recommended as petrurgical raw materials. In all respects, they meet the technical requirements of the industry (Khodzhaev N.T. etc. 2011s).

The authors of the project, when studying the databank on the chemical composition of basalts, basaltic andesites, andesites and their tuffs developed in the Sultanuvais mountains, identified and recommended for prospecting for petrurgical raw materials the Duschebulak area, as well as the Sheikhdzheili and Berkuttau areas.

All three areas: Sheikhdzheylinskaya (5,3 km^2), Duschebulakskaya (11,7 km^2) and Berkuttauskaya (1,6 km^2), totaling 18,6 km^2, are located within the outcrops of Paleozoic volcanic rocks of the basalt-andesite-dacite-rhyolite association. Basalts and

andesite-basalts of the productive strata in effusive, subvolcanic, and pyroclastic facies form the earliest underwater volcanic structures exposed in the lower sedimentary-volcanogenic section. Among volcanic rocks, lenses of marbled limestones are observed.

DISCUSSION AND RESULTS

The Karakuduk Formation, according to T.Sh. quartzites up to 800 m thick. Z.A. Yudalevich at all. (1993) note that, according to the amount of alkalis, the figurative points of the rock compositions turned out to be enclosed in a calc-alkaline field, and according to the potassium content, they were in a low-potassium field, i.e. the slightly increased total alkalinity of the rocks is mainly due to the sodium content in the rocks. The titanium content of rocks varies from low (less than 0.5% TiO2) to moderate (up to 1.5% TiO2). Characterized by increased magnesia (more than 6.0 and up to 17.0% MgO) and wide variations in the content of alumina (from 11.5 to 21.5% Al2O3). The petrochemical data determine the boninite petrochemical trend of the formation, which, in terms of compositional features (predominant development of basalts and andesite-basalts, increased magnesian and alumina content, moderate titanium content), is close to the volcanic rocks of young island arcs.

The volcanic rocks of the Sheikhdzheili Formation were assigned by T.Sh. According to Z.A. Yudalevich at all. (1993), the diagrams with the participation of SiO_2 clearly show the continuity of the evolution of the composition of rocks from basalts to rhyolites, their calc-alkaline, low-potassium and low-titanium character. The basaltoid compositions are distinguished by a low content of MgO, which is characteristic of basalts of the andesitic formation type.

The position of figurative points of rock compositions on the Al_2O_3-FeO-MgO diagram also emphasizes their correspondence to the calc-alkaline series. According to Z.A. Yudalevich, the petrochemical features and submarine conditions of the formation of volcanic rocks indicate their correspondence to island-arc formations.

The geological structure of the Sheikhdzheili-Area is composed mainly of basalts and basaltic andesites of the Sheikhdzheili Formation, which, earlier (Kulesh, Logvin), were dated to the Early Middle Devonian age -$D_{1\text{-}2}$sh.

In the Working Reference Legend-50 (Keshishyan, 1995), the deposits of the suite are divided into three subformations.

The lower subformation is composed of basalts, andesite-basalts, andesites and their tuffs with intercalations of tuff siltstones and tuff sandstones. The thickness of the deposits of the lower subformation differs significantly between different authors: up to 150 m (according to Kulesh, 1974), up to 500 m (according to Logvin, 2000).

The middle subformation is composed of andesites and their tuffs with interlayers of basalts, dacites, rhyodacites and their tuffs, and limestones. The thickness of the middle subformation is 220 m (according to Kulesh, 1974), up to 755 m (according to Logvin et al., 2000).

The upper subformation is composed of rhyolite, dacite, and rhyodacite lavas with andesite interbeds. Thickness of the upper subformation: 160 m (according to Kulesh, 1974), 275 m (according to Logvin et al., 2000).

The thickness of the formation according to A.A. Kulesh (1974) is 530 m, according to S.I. Logvin (2000) - up to 1530 m. The thickness is probably overestimated.

All rocks of the suite experienced regional metamorphism - prebiotite subfacies, greenschist facies.

The basalts are dark gray, dark green, finely porphyritic with a lepidogranoblastic structure of the groundmass. Phenocrysts make up 35-40% of the rock and are represented by plagioclase, pyroxene, and amphibole (in amygdaloidal basalts, the amygdales are filled with quartz or epidote). Plagioclase in tabular grains 0,5-2,5 mm, partially granular, replaced by chlorite, sericite, epidote. Pyroxene and amphibole of prismatic habit, grain size 0,2-2,0 mm, replaced by chlorite and actinolite with inclusions of rare grains of epidote. The groundmass is fine-structured, transformed and replaced by chlorite, actinolite, and epidote. Accessory ilmenite is transformed into an aggregate of chlorite and leucoxene. There are rare grains of apatite.

Chemical composition of basaltic andesites of the middle subformation of the Sheikhdzheylinskaya suite (according to V.V. Baranov at all., 1987)

№№ sample	Components weight.%											
	SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	MgO	CaO	Na_2O	K_2O	SO_2	Loss on ignition
VII-23	54,9	0,63	17,42	2,26	3,89	0,13	3,7	4,06	6,03	2,0	0,10	4,42
VIII-19	52,64	0,92	18,6	4,83	3,88	0,18	4,0	4,84	4,0	3,28	0,10	2,28
VIII-28	51,35	0,88	16,57	4,14	5,1	0,17	6,05	7,01	4,77	0,65	0,10	2,98
Cp.	53,01	0,81	17,53	3,74	4,29	0,16	4,58	5,3	4,93	1,98	0,10	3,22
Results of chemical analysis of basalts in the Sheikhdzheili site												
Cp.	52,2	0,9	15,7	8,9	..	.-	4,8	8,0	2,3	1,0	0,1	…

* Note - the sum of Fe2O3 + FeO oxides is given

The groundmass is replaced by chlorite, amphibole, and epidote. Accessory is magnetite, ilmenite, sphene, apatite. Above the andesites of the lower part of the section of the middle subformation, there is a horizon of light greenish-gray, light gray shales after dacites, quartz albitophyres and their tuffs with a total visible thickness of up to 199 m.

Dacites have a porphyritic texture with a semi-glassy, microfelsic groundmass. Porphyry segregations contain quartz and plagioclase. The tuffs are composed of fragments of intermediate and felsic compositions strongly extended along schistosity. The horizon should be used as a marker when orienting on the ground.

The total thickness of the entire section of the middle subformation of the Sheikhdzheylinskaya suite (according to S.I. Logvin, 2000) is 755 m.

Basalts of the middle subformation, promising as petrurgical raw materials, were examined by us during reconnaissance in an extended outcrop crossing the old Karatau-Nukus highway near the stone crushing plant. The width of the exit is -50 m, the length is at least 500 m. The basalts are dark gray-green, finely porphyritic. Phenocrysts make up to 30% of the rock and are represented by plagioclase. The rocks are characterized by consistency of composition, both in the cross direction and along the outcrop strike in the sublatitudinal direction. Similar basalts were found at the Sheikhjeili site, near the old Karatau-Nukus highway. 2,5 km northwest of the highway that crosses the middle of the site.

The Sheikhjeili site has the shape of an irregular rectangle, located on the NE slope of the watershed with a height. elev. 335,4 m 0,5 km east of the gabbro outcrop and 0,5 km east of the rhyodacite outcrop of the upper subformation of the Sheikhdzheylinskaya suite. The upper outlet of the rectangle on the watershed, the NE boundary of the area runs 0,75 km-1,0 km from the center line of the watershed. The area of the site proposed for study is 5,3 sq. km.

The exposed rocks dip SE at an angle of 20^0, partially armoring the slope, the rock is sheared, the schistosity as a whole dips SE at an angle of 60^0, changing up to 80^0 to the SW, closer to tectonic contact with the deposits of the Sheikhdzheili Formation. Outside the site, to the NE and SW, dike-shaped bodies of dacitic composition of the Sheikhdzheili subvolcanic complex $\varsigma D_{1\text{-}2}š$ with a small thickness of the first meters and a length of up to 300 m break through. To the northwest of the site, a dike-like body of gabbroids of the first phase of the Zengeboba gabbro-diorite complex υD_2z is noted.

In tectonic terms, all the noted formations sit in a large lenticular body, more than 12 km long and 800 m thick on the flanks, up to 3000 m in the central part and tectonic with NE and SW contacts.

Geological structure of the site Berkuttau-Subvolcanic basaltoids, potentially promising for the production of basalt fiber, are exposed at the top of the northern part of the Berkuttau Mountains and belong to the Berkuttau basaltandesite-dacite-rhyolite association.

The boundaries of the work area are drawn relative to its main elevation: the southern one is along the sublatitudinal fault 200 m south of the mountain from the height. elev. 309,6 m, western - 800 m west of this mark.

The area has the shape of a rectangle with a width of 0,9 km in longitude and a length of 1,8 km. and is composed mainly of basaltic andesites, andesites and their tuffs belonging to the Berkuttau Formation.

The fall of tuff, pyroclastic formations is gentle, northwestern. Subvolcanic basaltic andesites, basalts and andesites form stock-like outcrops ranging in size from 6–15 m to 150x300 m. Volcanogenic rocks overlie massive Lower-Middle Devonian limestones of the Kazansai Formation with angular and azimuthal unconformity. Outside the area, basalt lava flows with visible unconformity on the surface of Middle-Upper Devonian limestones (Artykov at all., 2003).

In the western part of the area there is an outcrop of basalts (150 x 300 m) that has cold contacts with the surrounding tuffs. In the eastern part of the area, small 6-15 m subvolcanic bodies of basaltic andesites and andesites are observed, occurring among propylitized tuffs of medium-basic composition. Along the periphery of the Berkuttau Rise, limestones, andesites, and tuffs are intruded by necks of acidic rocks (rhyolites, rhyodacites, dacites) and overlain by their thin lava flows.

From the north, the area is covered by a cover of Meso-Cenozoic deposits.

Stratified formations are represented by the Paleozoic Kazansai and Berkuttau suites, the Mesozoic Sultanbobinskaya suite and Cenozoic, Quaternary proluvial deposits.

Magmatic formations in the area are only subvolcanic and vent facies of the Berkuttau volcanic complex. Outside, 3 km northwest, boreholes uncovered plagiogranites of the Aktau trondjemite complex, previously identified from geophysical data (Logvin at all. 2000).

Stratified formations

Lower and middle sections of the Devonian system, Kazansai suite, lower subformation - $D_{1\text{-}2}kz_1$

Gray limestones are massive thick-platy with remains of Lower-Middle Devonian corals and crinoids. Power is up to 180 m.

Limestones are intruded by subvolcanic bodies, dikes, necks of basalts, basaltic

andesites, andesites, overlain with unconformity by tuffs of the Berkuttau Formation, with structural unconformity overlain by clays of the Lower Cretaceous Sultanboba Formation.

Lower (?) department of the Carboniferous system.

Berkuttau Formation – C1(?)br

As a separate complex of the youngest Paleozoic formations, A.N. Churakov (Pek, Churakov, 1936). Shultz S.S. (1972) these formations are described under the name "Ashchenyntau Formation".

The suite is represented by effusive and pyroclastic deposits as part of the basalt-andesite-rhyolite association, divided into three subformations: lower, middle, upper.

At the base of the suite are olivine-pyroxene amygdaloidal basalts and their hyaloclastites. Andesitic, basaltic andesite, and psamitopsefit tuffs predominate in the middle part, with extrusions of lilac andesites with brown hornblende, andesite tuffs and lavas. At the top - dacites, rhyolites, their tuffs. There are lenses of volcanomictic sandstones and gravel conglomerates. The thickness of the suite is from 263 to 350 m. The rocks have a subalkaline composition with a potassium-sodium profile of alkalis, the formation type is basalt-andesite-dacite-rhyolite.

The effusive rocks of the suite have normal potassium-sodium alkalinity and moderate alumina content.

The volcanics overlie with apparent agreement - on the limestones of the Yantak Formation (Artykov, 2003) and unconformably on the Kazansai Formation.

Age of S.S. Schultz (1972) dated it to the Early Carboniferous in comparison with the Valer'yanovsk Formation of the Southern Urals. O.M. Borisov (1979) gave it an Early Middle Carboniferous age. V.V. Mikhailov (2001) considers the age of the formation to be Middle Carboniferous. The authors consider the age of the formation to be conditionally Early Carboniferous in terms of its position in the section, i.e., the occurrence on the limestones of the Yantak Formation containing faunal remains of the Famennian age in the roof, characteristic of the base of the Bisphaera malevkensis – earlandia minima zone (Temirbastau horizon).

Tuffs unconformably overlap the Lower-Middle Devonian limestones of the Kazansai Formation, effusive basalts with visible conformity overlie the Middle-Upper Limestones of the Yantak Formation (Nikitina at all., 2007) under the Meso-Cenozoic cover.

The thickness of the formation exposed in depressions under the cover of Cretaceous deposits is up to 300 m.

Cretaceous system, Lower Division, Upper Aptian

Cretaceous sediments border the Berkuttau site and are sporadically noted within the site, occupying insignificant low areas.

Sultanbobin Formation, Lower Sultan Bobin Subformation - K_1sb_1

The deposits of the subformation overlie transgressively and angular unconformity on the limestones of the Kazansay Formation and tuffs, effusive rocks of the Berkuttau Formation.

Composition: gray-colored clays (gray, greenish-gray, dark gray, sometimes black), sandstones, siltstones, lenses and layers of sandy shell rocks. In shell rock remains of Late Aptian bivalves, in clays - a complex of Late Aptian bivalves. The thickness of the deposits is up to 55 m.

Quaternary system

Combined deposits of the Knyazbulak and Kampyrsai suites - Q.

The Lower Knyazbulak Formation composes the piedmont alluvial valley, overlying Paleozoic and Mesozoic rocks with erosion and unconformity.

Composition: dark gray conglomerate-breccias of various blocks, consisting of pebbles and crushed stone of Paleozoic rocks (limestones, amphibolites, shales in sandy-argillaceous aggregate, weakly cemented with carbonate-gypsum and clayey-carbonate material and lenses of polymictic yellow-gray fine-grained sandstones with an admixture of gravel of siliceous rocks, cemented by clay material.Thickness up to 12 m, wedging out towards the mountains up to 2,0 meters or less.

The upper Kampyrsai Formation fills the valleys of the temporary watercourse.

Composition: sandy-grass, sandy-gravelly mixtures with pebbles and yellowish-gray pebbles, sandy loams with horizons of brown-brown gypsum loams with Paleozoic gruss.

Power - up to 7 m.

Magmatic formations.

Lower section of the Carboniferous system

Berkuttau complex of subvolcanic and vent formations - C_2?b.

The complex combines rocks of the basalt-andesite-dacite-rhyolite association. They are distinguished by high alumina content of rocks, normal and increased alkalinity of the K-Na type.

Rocks of the early phase - basalts, basaltic andesites and andesites are potentially suitable as raw materials for the production of basalt fibers. Their composition, given from the materials of V.V. Mikhailova, 1988, shows good agreement with the requirements of SATBIC (China) for the chemical composition of raw materials.

An object, № sample.	Chemical composition (in%)								
	SiO_2	Al_2O_3	Fe_2O_3*	FeO	CaO	MgO	TiO_2	Na_2O	K_2O
	Requirements of SATBIC (China)								
SATBIC	52,0-,5	14,0-16,3	3,5-4,5	4,5-5,5	8,0-9,0	6,5-7,5	1,3-1,6	3,0-3,5	7-1,6
Berkutau, sp.56-4, 56, basalt	52,01-,26	16,39-,31	5,88-6,32	4,47-36	5,64-7,99	5,38-30	0,21-52	3,64-30	0,2-58
project 849-1,2: dolerite-basalt	48,65-,14	16,7-18,82	5,6-5,7	3,16-09	3,76-7,5	5,75-55	0,77-37	3,43-0	0,5-0,82
Results of chemical analysis of basalts in the Berkuttau site									
Average	53,0	14,6	8,6		6,7	3,9	0,7	3,9	1,7

* Note - the sum of Fe2O3 + FeO oxides is given.

Comparing the above data with the requirements of SATBIC (China), it can be concluded that the content of silica and alumina for stone casting is within the acceptable limits for the Berkutau, Duschebulak and Sheikhdzheili sites. The content of the sum of iron oxides and carbonates slightly exceeds the limits, however, their values during technological tests do not adversely affect the quality of the final product obtained from basalts. Conclusion - the most suitable in terms of their values to the requirements of SATBIC (PRC) for the chemical composition of the rocks are basalts, andesite-basalts of the Berkutau, Duschebulak and Sheikhdzheili sites.

At the account Berkuttau rocks of medium and medium basic composition andesites and basaltic andesites form small 6-15 m steeply dipping bodies, exposed by shallow erosional valleys. They cut through the limestones of the Kazansay Formation and contain them in xenoliths. In the contact zone, the limestones are marmorized, albitized, and sometimes chloritized.

The basalts form a large stock-shaped body of oval cross-section, 150x300 m in size. Contacts with andesitic tuffs are cold end-to-end. Aphyric and finely porphyritic basalts with high contents of Fe, Ni, Co, Cr, V.

The rocks are potassium-sodium normally alkaline, highly and very highly aluminous. The Middle Carboniferous age was determined from the intrusion by subvolcanic bodies and dikes of andesites and quartz plagioporphyry of flyschoid silty sandy and carbonaceous phyllite-like shales of the Upper Kazansai Formation, for which the Middle Carboniferous age was established by correlation with deposits dated from the remains of spores.

Acid rocks (rhyolites, plagiorhyodacites, dacites) form steeply dipping necks and dikes of various sizes on the outskirts of the volcanic structure, intruding the tuffs of the Berkuttau Formation. They have a gray to light gray color, aphyric and fine porphyritic structure with a cryptocrystalline groundmass and are defined as quartz porphyries.

Tectonic structure of the Berkuttau area.

The area is located in the center of a brachyform hat-shaped anticline structure about 3 km in diameter, located in the zone of influence of the regional Northeast (Berkuttau) fault. The fault forms a system of subparallel NW-trending reverse-slip-slip faults, expressed by crushing, shearing, and mylonitization of limestones and volcanic rocks. Crushing zones reach a width of 80-100 m, mylonitization zones 2-10 m.

All rocks in the fault zone have a stress structure. Faults associated with reverse-slip faults have a sublatitudinal strike.

The geological structure of the Duschebulak area - The area is located in the northwestern part of the Karakuduk ophiolite band - an extended zone of fissure underwater outpourings of basalts and andesites, which together with tuffs and limestones form the lower part of the Karakuduk suite D_{2-3}(?) kk.

Previously, under the name Ashchebulakskaya area, it was recommended to study raw materials for the production of continuous basalt fibers by R.A. Khamidov. According to his data, the metabasites of the Karakuduk Formation form a homogeneous section and in all respects they meet the technical requirements of the industry. The boundaries of the area were corrected during reconnaissance work, and the area decreased due to the exclusion from its boundaries of the watershed part overlapped by tuffs of medium and acidic compositions (the upper part of the section of the Karakuduk suite).

During reconnaissance work in the northern part of the area, basaltic andesite pelitic and psammite tuffs were sampled in the outlet of 0,4x2,0 km, between submeridional gabbro intrusions. Pure tuffs without impurities form areas of 60x100x20 m.

In plan, the plot has the shape of a pentagon, elongated in a submeridional-north-westerly direction. The length of the area is 5,5 km, the width is more than 2,1 km, the area is 11,7 square meters.

The natural boundaries of the Duschebulak area are taken as follows: from the north - a plume of Quaternary proluvial deposits of the piedmont plain, limiting the bedrock outcrops; from the NE and SW - zones of deep submeridional faults accompanying fissure zones of underwater volcanic eruptions, from the SE the boundary is drawn along the right watershed of the Ashchebulaksai.

In geological terms, the Duschebulak area is a linear fractured outcrop of rocks of the basalt-andesite-dacitic formation, forming the Karakuduk suite. Basalts and olivine basalts, basaltic andesites occur at the base of the section, andesites above, and andesitic dacitic tuffs above them. The section grows from north to southeast.

Relationships of basalts with terrigenous shales are poorly studied, contacts are mostly tectonized. The lower part of the formation section is intruded by subvolcanic plagiorhyodacite bodies. The entire thickness is broken by gabbro intrusions. The relationships of the Karakuduk Formation with serpentinized ultramafic rocks are tectonic.

In plan view, the basaltoid rocks of the Karakuduk Formation form a frame from the NE and SW, in the middle part intruded by gabbroids of the Sultanuizdag complex υ_2D_{2-3}(?)s, in which 3 lenticular bodies of serpentinites (antigorite composition) are noted: - the northern one with a thickness of up to 200 m and a length of 1700 m ; - medium with a thickness of 5 to 300 m in blown, with a length of more than 3700 m; - western with a thickness of 50 to 350 m, a length of up to 3000 m within the site, which, increasing in thickness up to 500 m, goes south beyond the boundaries of the Duschebulak site . Contacts are usually tectonized.

Karakuduk Formation D_{2-3}(?) kk.

It was singled out in 1958 by a group of geologists of the Uzbek Geological Administration (Alferov at all., 1965). The stratum composes the watershed part of the ridge. Sultanuizdag. It can be traced from the northwest to the southeast for more than 40 km, forming the greenstone belt of the Sultunuvais Mountains. It is composed of greenstone-altered metabasalts, metadiabases, metaandesites, metarhyodacites, garnet and garnetless amphibolites, quartzite-like and quartz-feldspar-micaceous schists, micaceous quartzites and marbles. The suite has a three-membered structure.

The lower part is composed of metabasalts, the middle part is metaandesites, and the upper part is metarhyodacites and metarhyolites.

Thickness 450 m.

K.A. Keshishyan (1995), V.V. Mikhailov (2001) believe that the formation contains picrites (komatiites).

The rocks are moderately aluminous in chemistry with a high-sodium slope of alkalis. Formation type of sodic basalts. The facies of metamorphism is epidote-amphibolite.

The formation is intruded by dikes and dike-like bodies of diabases of plagiorhyodacites and rhyolites of the Karakuduk subvolcanic complex.

Organic residues have not been identified. The relationship with the enclosing

strata is unclear. Z.M. Abduazimova, A.K. Bukharin and others consider the contact with the underlying deposits as tectonic.

Within the Duschebulak site, the formations of the formation are traced for 8 km from the northern end of the ridge. Sultanuvais to the upper reaches of the Beshmazarsay in two bands separated by terrigenous formations of the Kazansay suite, serpentinites and gabbro massifs. The southern extension of the bands outside the site is overlain by Cretaceous-Quaternary rocks, the northern one is under the Cretaceous cover, overlying the rocks of the Karakuduk subvolcanic complex and the ophiolite band in the middle part of the Sultanuvais Ridge.

The rocks are recommended for study as a raw material for the production of basalt fibers form the lower part of the Karakuduk Formation. They are small and cryptocrystalline metabasalts of green and dark green color, gently lying on marbled Devonian limestones. The thickness of the productive stratum increases from northwest to southeast from 50m to 500m.

№№ ample	Content in %											
	SiO_2	Al_2O_3	TiO_2	Fe_2O_3	FeO	MgO	MnO	CaO	Na_2O	K_2O	SO_2	Loss on ignition
0/94	49,5	14,80	0,85	3,28	7,50	8,60	0,19	8,83	3,31	0,62	<0,10	2,50
10/95	50,25	14,30	1,10	2,04	9,05	7,40	0,24	8,55	3,0	0,50	<0,10	2,50
10/97	50,20	13,70	1,15	2,09	9,26	8,10	0,21	9,25	2,92	0,20	<0,10	2,44
10/100	48,30	14,54	0,70	2,90	7,47	10,15	0,17	9,95	2,42	0,15	<0.10	3,00
10/102	51,80	14,89	0,72	2,83	7,18	7,50	0,15	9,25	3,51	0,10	<0.10	1,40
10/103	49,50	13,80	1,16	2,69	9,15	8,30	0,21	8,13	3,76	0,10	<0.10	2,80
average	49,92	14,34	0,94	2,64	8,26	8,34	0,20	8,99	3,15	0,27	<0.10	2,44
Results of chemical analysis of basalts in the Duschebulak site												
Cp.	50,9	14,2	0,9	10,1		7,9		9,0	3,1	0,5		

* Note - the sum of Fe_2O_3 + FeO oxides is given.

Metabasites retained traces of the primary ophitic structure, but were mostly transformed into amphibolites - plagioclase, epidote-amphibole, chlorite-actinolite schists with a nematogranoblastic structure. Metatuffs of medium-basic composition, common in the northern part of the area, are also amphibolized, but retain traces of a psamite pyroclastic structure.

The primary rocks of the base of the section were basalts of the sodium series, they

are moderately and low alkaline, moderately and low alumina. At the level of the thalwegs of the valleys, the metabasalts are dissected by dikes by small subvolcanic bodies of plagiorhyodacites. The abundance of acid intrusions affects the composition of basalts, enriching them with silica. In the near-contact zones of influence of ultrabasic and basic intrusions, basalts are albitized, actinolithized and enriched in iron. Accumulations of magnetite and musketovite in contact-altered rocks are visible to the naked eye. Altered rocks are not suitable as raw materials for the production of basalt fibers.

Within the area, the section of the Kurakuduk Formation grows from north to southeast, so the search for purer subvolcanic basalts should be concentrated in its northern part.

The middle part of the section of the Karakuduk Formation is formed by metaandesites. They gently lie on basalts in the form of deposits with a thickness of 140 m.

Represented by greenstone-altered plagioclase porphyrites of greenish-gray color. Porphyroclasts of albitized plagioclase make up 25-30%, the groundmass 70-75%. Chemical analysis of sample 10/89 (Logvin at all., 2000) defines the rock as high alumina soda series andesites. Due to the high SiO_2 content of more than 60%, andesites are not suitable for the production of fibers.

The upper part of the section of the Karakuduk Formation is exposed on the right watershed of the Achikuduksay and further to the SE. It is composed of andesitic and dacitic pelitic tuffs, which form thin-platy rubble fragments on the surface. The thickness is about 290 m. These rocks are not suitable for petrurgical production.

The suite is accompanied by dikes and columnar volcanic bodies of metabasalts, metaandesites, metarhyodacites, metarhyolites, and metadacites of the Karakuduk subvolcanic complex.

The total thickness of the deposits of the Karakuduk suite exceeds 450 m.

Subvolcanic formations tearing the Karakuduk suite form small, sometimes numerous bodies confined to the thalwegs of the valleys. They are represented by plagiorhyodacites of the Karakuduk complex $\rho\lambda\xi D_{2\text{-}3}$(?)k. Plagiorhyodacites are gray, greenish and pinkish-gray in color, contain porphyritic dissemination of albitized plagioclase and transparent quartz 8-10 mm in size. The groundmass is finely crystalline, represented by microgranoblastic aggregates of quartz, albite, and K-feldspar, partially retaining relic micropoikilospherolitic and granophyric structures.

The intrusive formations of the Duschebulak area gravitate towards its northwestern part and are represented by gabbro and serpintinized ultramafic rocks of

the Sultanuizdag hypermafic-gabbro-plagiogranite complex υ_2D_{2-3}(?)s.

The rocks fill two arcuate e-shaped fracture zones of the left shear. Outcrops of serpentinized ultramafic rocks lie in the center, along the edges of the gabbro intrusion. In a large outcrop of gabbro, serpentinites form megaxenoliths with tectonized contacts.

Serpentinized ultrabasic rocks form steeply dipping bodies 50-550 m wide, 1,7-9,0 km long; one of the bodies (200x600 m in size) lies flat. Serpentinite outcrops are cut with uneven wavy contact by both effusive rocks of the Karakuduk suite and terrigenous shales of the Kazansay suite, all contacts are tectonized.

Serpentine is represented by antigorite with rare veins of fibrous chrysotile. In dark-colored relics of peridotites, olivine segregations are completely replaced by serpentine, to a lesser extent by tremolite, chlorite, talc, and ore minerals; porphyritic segregations of orthorhombic pyroxene are replaced by bastite. The rocks contain disseminated magnetite (mushketovite), chromite, CO-Ni microinclusions, and sulfides. Single grains of chrome-spinels were found in separate samples-mills.

Chromites are replaced by magnetite, the content of Fe_2O_3 is -47,39-65,56%, FeO – 118,29-22,55%, Cr_2O_3 – 5,75-12,0%. Large accumulations of ore minerals were not found in the area. Serpentinites contain elevated amounts of Cu, Zn, Mn and V; rare samples contain gold up to 0,03 g/t. Listvenite-like talc-carbonate and talc-quartz-carbonate rocks are developed in serpentinites along the western tectonized contacts. Large bodies of serpentinites contain lenticular bodies of garnet-pyroxene rocks - rodingites, pyroxene is partially replaced by chlorite and epidote.

Amphibolized gabbro forms both small (50-100 m wide) and large (up to 1,5 km wide) intrusions, cutting both volcanics of the Karakuduk suite and terrigenous schists. The length of gabbro bodies is from 300-500 to 5,5 km. Gabbro has intrusive and tectonized contacts with serpentinites.

Gabbroids have the appearance of light-colored hornblende gabbros, inequigranular, and often contain diabase xenoliths. The rocks have retained a relic gabbro structure. The composition contains an equal amount of amphibole and plagioclase (labrador) or its replacement products - zoisite, clinozoisite, chlorite). Pyroxene is preserved in single relic grains. Accessory minerals are rare in gabbro. These are single grains of ore, apatite or sphene.

The rocks of the Sultanuizdag complex are metamorphosed to the amphibolite facies. As a raw material for the production of basalt fiber, they are not suitable due to their brittleness.

Near the area of work from the west there are small outcrops of peridotites and pyroxenites of the Tebinbulak peridotite-pyroxenite-gabbro complex. These rocks tear

the deposits of the Dzhamansai Formation, forming significant fields of contact changes in the form of quartzites and quartzite-like rocks with rhodonite lenses. As a raw material for the production of fibers, the rocks of the complex are unsuitable due to the high content of magnesium, titanium and iron.

Tectonic structure of the Duschebulak site.

The caricature structure of the area, as stated by a number of geologists, has sufficient real evidence. The area is located in an extended steeply dipping rift zone between two deep faults: the southwestern Ascheninintau and the northeastern - Central.

The Aschenintau Fault dips steeply to the NE, the width of dislocated rocks (shales, meta-effusives, serpentinites) is up to 1 km: from a rupture along the NE contact of the Jamansai Formation to a rupture along the SW contact of the main outcrop of the Karakuduk Formation. Terrigenous shales form crumpled folds in the fault zone.

The central fault also dips steeply to the NE; the Karakuduk Formation, sandwiched between the faults, forms a gently sloping syncline with the hinge uplifting to the north. The occurrence of the seams is inclined, the occurrence of schistosity is steep NE and SW at angles of 50-750.

Despite the abundance of intrusive intrusions, significant manifestations of contact and contact-metasomatic changes and dislocation stress transformations, among the metabasites of the Duschebulak area, there are significant areas of homogeneous rocks suitable for the production of basalt fibers.

Rock sections are composed of basalts, basaltic andesites, plagioclase porphyrite rocks and andesites, and less often dacites and rhyolites. All petrographic varieties of rocks belong to a single volcanic island-arc type, which made it possible, based on the results of chemical analysis of samples taken at the sites, to identify useful strata within them, and within them blocks with rocks that meet the requirements of SATBIC (china) in their composition, such as raw materials for the production of continuous basalt fiber (CBF).

CONCLUSION

It should be noted that the basalts Berkuttau in terms of average content of CaO does not meet the requirements of SATBIK (China) – 1,7% is enough for the production of continuous basalt fiber, it is necessary to take into account the additions of CaO and MgO in the production of CBF.

Based on the above, it is possible to consider the areas of basalt rocks, Duschebulak and Sheikhdzheili prepared for study by their subsequent stages of exploration.

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