INVESTIGATION OF THE HYDROTHERMAL-METAMORPHOSED ROCKS OF THE NORTH-EAST PART OF THE SMALL CAUCASUS

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Abstract: *in the Lesser Caucasus, hydrothermal-metamorphosed rocks include secondary quartzites, alunitized, pyrophyllitized, and hematitized tuffs. Along with these processes, sericitization, chloritization, calcitization, pyritization, and epidotization took place.*

Processes of alunitization and kaolinization in the North-Eastern part of the Lesser Caucasus (Zaglik alunite Deposit). they are considered to be of hydrothermal origin. The deep ingredients are SO2, H2S, and H2O, which in epithermal conditions were transformed into sulfuric solutions among the tuff thickness, producing pyrometasomatic changes.

Our research has shown that these secondary quartzites of the Ordubad region of the South of the Lesser Caucasus (Paragachay, Gyumushlug) are genetically different from the North-Eastern part of the Lesser Caucasus (Gedabek).

The main contributing factor in their rising is kontaktnogo process of metamorphism, caused by the formation of granitoid interesoval Meghri Ordubad batholith. Features of the geological position of mineral compositions and conditions of formation testify to the manifestation of the process of formation of secondary quartzites.

Keywords: *hydrothermal metamorphosed rocks, secondary quartzites, alunitized tuffs, quartzitization process, kaolinized minerals.*

ИССЛЕДОВАНИЕ ГИДРОТЕРМАЛЬНО-МЕТАМОРФИЗОВАННОЙ ПОРОДЫ СЕВЕРО-ВОСТОЧНОЙ ЧАСТИ МАЛОГО КАВКАЗА

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Аннотация: *на Малом Кавказе к гидротермально-метаморфизованным породам относятся вторичные кварциты, алунитизированные, пирофил литизированные и гематитизированные туфы. Наряду с этими процессами имел и место серицитизация, хлоритизация, кальцитизация, пиритизация и эпидотизация.*

Процессы алунитизации и каолинизации в северо-восточной части Малого Кавказа (Загликское алунитовое месторождение). считаются гидротермального происхождения. Глубинными ингредиентами являются SO2, H2S, H2O которые в эпитермальных условиях среди туфовой толщи преобразовались в сернокислые растворы, производившие пирометасо-матические изменения.

Наша исследования показали, что месторождений вторичные кварциты Ордубадского района юга Малого Кавказа (Парагачайское, Гюмушлугское) генетически отличают от северо-восточный части Малого Кавказа(Гедабекское).

Основным решающим фактором в их оброзовании является процес кантактого метаморфизма, обусловленный формированием гранитоидных интиризувов Мегри

Ордубадского батолита. Особенности геологического положения минерального составов и условия образования свидетельствуют о проявления процесса формирования вторичных кварцитов.
Ключевые слова: *гидротермальные метаморфизованные породы, вторичные кварциты, алунитированные туфы, процесс кварцитизации, каолинизированные минералы.*

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1. INTRODUCTION

Hydrothermal metamorphosed rocks include alunitized, kaolinite and pyrophyllitized tuffs, tuffbreccia, porphyrites and quartz plagioporphyrs, secondary quartzite, as well as ferrous (hematitized and limonitized) tuffs.

Most of them as mentioned above common rocks are aluminized, pyrophyllitized, hematitized tuffs (Zaglik alunite deposit, Fig.1) and secondary quartzite's in the Small Caucasus.

Zaglik alunitized tuff and tuff rocks of upper Jurassic age are located 35 km south-west of Ganja near the village Zaglik composing the mountain Sharu-Kar. Here, the alunite stratum is composed, as if, of individual strata differing from each other in structure, quantitative ratio of constituent minerals, and coloring [1, c. 3].

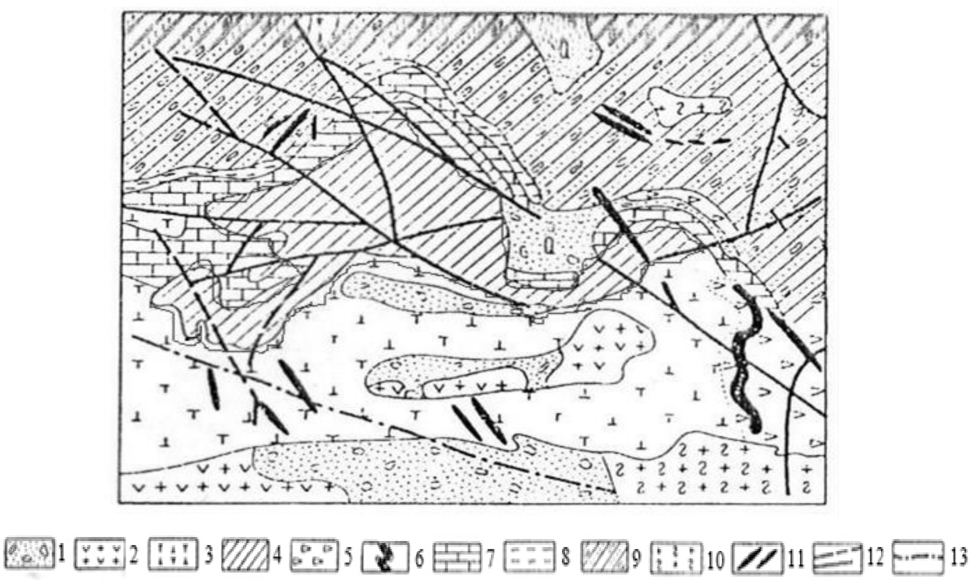

Fig. 1. Geological map of Zaghlik deposit of alunite 1- alluvial, elluvial and delluvial formations (Q); 2-diabase porphyry (K-J1); 3- upper suite - tuffs and tuffites (J3 km); 4-lower suite – alunite stratum (J3ox); 5-hornstones (J2-J3ox-km); 6 - skarn iron ore deposit; 7 – Campaign Maastricht limestone (J3ox-km); 8 - argillite and sandstones with inter-beds of marls (J3kl); 9-porphyrites (J2); 10 - gabbro and granitoids; 11 - dikes of vein-rock; 12- lines of tectonic ruptures; 13 - occurrence element In addition to aluminum raw materials

Alunite in these rocks occurs from the microscopic size of scales to large inclusions (up to 6 cm), in the form of tonsils, buds, lenses and stratum, as well as performs small cracks in the rock like kaolin. [2,3, c. 4]. In schistose varieties, alunite buds are located on schistosity. The color of the alunite rocks is different: pinkish-purple, red, dirty-brown, cream, whitish and gray. The color of pure homogeneous alunite is whitish with a cream shade, sometimes green. Among the alunite rocks, seven types are distinguished by the nature of alunitization.

Secondary quartzites of Gadabay under the microscope, its grains often have a bipyramid shape with oval curves and bay-like depressions. Sometimes they are found in the form of acute-angled debris, located in stripes quite often. Unlike the primary quartz, the grains of the secondary quartz have no distinct limitations, the border of their contact is represented by a jagged line. They do not contain inclusions of glass and liquid, but are often filled with small scales of sericite, kaolinite and grains of zoisite.

2. TYPES OF ALUNITE ACCORDING TO THE ALUNITIZATION CHARACTER

The microscopic research of alunite showed that it forms pseudomorphs in feldspars and dark-colored components. In addition, alunite fills cracks or represents a cementing mass, which indicates hydrothermal formation. In thin sections, alunite has the form of small leaves or needles with a yellowish interference color of the second order, or forms thin aggregate up to cryptocrystalline. Indices of refraction are: $N_g = 1.5953$; Np= 1.5831; N_g-N_p= 0. 012. The specific weight of alunite is 2.7; the specific weight of alunitized rock is 2.81.

The chemical and spectroscopic composition of alunite is given in Tables 1 and 2.

Converting the chemical analysis into the mineralogical composition gave the followings:

$K_20 \cdot 2.5\ A1_20_3 \cdot 3.5\ S0_3 \cdot 4H_20$ - potassium alunite - 56%;

$Na_20 \cdot 2.5\ A1_20_3 \cdot 3.5\ S0_3 \cdot 4H_20$ - sodium alunite – 44.

Table 1. Chemical composition of alunite

Components	Spectroscopically
Ca	0.005
Sn	not found
Pb	not found
Cu	weak lines
Mg	midline
Ca	midlines
Cr	weak lines
Zn	not found
Cd	not found
Ag	not found
Ni	weak lines
CO	not found

Table 2. Spectroscopic composition of alunite

Components	Weight , %
S_iO_2	1,81
$T_i\ O_2$	traces
$A1_20_3$	36,41
Fe_2O_3	0,06
FeO	0,23
MnO	0,02
BaO	0.04
CaO	0.13
MgO	0.08
K_2O	7,51
Na_2O	3,89
$H_2O_{-110}{}^0$	0,41
$H_2O_{+110}{}^0$	9,90
SO_2	38,79
$C0_2$	traces
Sum	100,28

Comparing the analysis of Zaglik and chemically pure alunite (table 3), only increased content of Na_2O is observed in the first when the same amount of alkali in both $Si0_2$ is not characteristic for alunite at all. This component in the form of quartz is finely dispersed in the body of the latter.

Table 3. Analysis of Zaglik and chemically pure alunite

Alunite composition	$A1_20_3$	SO_3	K_2O	H_2O
Theoretical Zaglik alunite	37,00 36,41	38,60 38,79	1,40 1,40	12,00 10,3

Thermal research of Zaglik alunite showed that when being heated from 20 to 320°C, alunite does not undergo any changes, an intensive endothermic reaction occurs at 520–525°, after which, at 735-753°, it is exothermic, and subsequently endothermic reaction is observed immediately,ending at 804–815^0. After this reaction, the sample, heated to 1100°, did not give any effect. In the first endothermic reaction, water is released, however, in the second one $S0_3$ is released and the substance is decomposed [4, c. 6].

3.Secondary quartzite.

Secondary quartzites are widely spread in Shahdag-Murovdag zone. They are formed either in the areas of tectonic faults generating in this case “the stripe of quartzitized and limonitized rocks, in which barite deposits (Chovdar, Gushchy, Zaglik, Shamkir), kaolin and fireclay (Chanlibel, Garabulag, Mirzik, Hoshyal Polad-Bulag and others), sulfur pyrite (Chiragdere, Gadabay, Gyzyljin, Shekerbey and others) are often timed, or in the periphery of granitoid massifs with enclosing rocks, forming halos of highly quartzitized rocks. Such quartzites are less common and are found in separate areas along the contacts of Dashkesan and Tovuz granitoid intrusions [5, 6, c. 6].

Secondary quartzites were formed mainly due to Alennichebay quartz plagiopor- phyres, to a lesser extent, due to lower and middle Jurassic and insignificantly upper Jurassic porphyry, their tuffs and tuffbreccia.

The process of quartzitization proceeded with varying degrees of intensity, and therefore the followings are observed:

1) rocks with a small quantity of quartz;

2) the rocks are silicified, where the secondary quartz already constitutes a significant part, but does not replace its main components and mask its character;

3) secondary quartzites, where the main component is secondary quartz.

In quartzites with porphyroblastic structure, quartz grains (porphyroblasts) with their size (1.5-6.5 mm) are well distinguished among the fine-grained (0.02-0.25 mm) cementing mass. At a large quantity of cement, quartz grains are not in contact. When there is little cement, quartz grains have complex lines and their jagged edges protrude into each other and into the cementing mass.

According to the size of quartz grains, secondary quartzites can be divided into thin-grained, fine-grained (0.06-0.28 mm), medium-grained (0.15-0.55 mm) and coarse-grained (more than 0.75 mm). Brecciated differences of secondary quartzites that were formed as a result of quartzitization of tectonic breccia of quartz plagioporphyries, porphyrites and their tuff rocks are also found.

Fine-grained quartzites are found in small quantities (Chovdar, Gyzyljin). They were formed due to the metamorphization of tuffs. These are gray to greenish tinges of dense crypto and fine-grained rocks. The mineralogical composition is mainly represented by quartz and a very small amount of iron hydroxides and clay mud, located mainly along cracks in the rock. Sometimes scales of chlorite and sericite, fine grains of magnetite and calcite are found.

Quartz in secondary quartzite occurs in two types. The first type of quartz is primary, relic, sometimes with idiomorphic shapes, but often corroded and broken by small cracks. These quartz grains are enveloped in sericite and kaolinite flakes, intertwining with each other and rarely enclosing prism of apatite. The second type of quartz is secondary with two generations:

a) first generation quartz composes the main part of the rock and has a xenomorphic shape;

b) quartz of the second generation composes veins intersecting quartzite mass in different directions.

When quartz grains sharply protrude into each other, there is a gradual transformation of the mosaic addition of secondary quartzite into cataclastic. In this case, the quartz grains are broken by cracks, fragmented and have a strong wavy extinction.

4. CONCLUSION

The process of alunitization and kaolinization in the Zaglik alunite deposit is associated with post-volcanic activity of Dashkasan granodiorite intrusion. Numerous rock cracks (tuffs, tuff breccia and tuffites) subjected to alunitization and kaolinization, were the supply channels for gaseous and hydrothermal fluids. Further, the process continued along the schistose planes, where intense alunitization is observed.

Secondary quartzites of Gadabay field are mostly fine-grained, dense, usually massive, light-gray colored rocks. Mostly they have a relic structure. Primary quartz differs from the secondary one for greasy luster and flat-conchoidal fracture.

In the area of ore occurrences, secondary quartzites are dark gray to black with sky-blue phenocrysts of quartz to pea-sized. There is no sharp boundary between the ore body and secondary quartzites.

The secondary quartzites of the Small Caucasus have long attracted the attention of researchers as possible refractory raw materials. To this end, investigations were conducted to identify the most prospective deposits.

References / Список литературы

1. *Efendieva Z. J., Khalifazade Ch.M*. Economic problems and enviro- mental challenges in ore mining in Azerbaijan. Journal of mining science. Vol. 54. № 1, 2018. P. 166-172.
2. *Kashaya M.A.* Physical-chemical conditions of alunite. Baku, 1972. Elm. 81 p.
3. *Babaev I.A., Achmedov D.M.* Genesis of the Alunites of the Zaglik deposit. Baku, 2000: Bilik daryasi. 4, 70-78.
4. *Salimxanov N.M.* Secondary quartzites of Azerbaijan. Baku, 1960. Scholarly notes ADU. 6. P. 3-16.
5. *Afandiyeva Z.J.* Information guide on the mineral deposits of Azerbaijan. Baku. Azerbaijan. Reference Guide. Baku, 2016: ASUOI. 57 p.
6. *Sharifov M.Y., Kofman P.Q., Rayzman B.E.* Distribution of vanadium and strontium in the Zaglik alunite deposit. Baku, 1960. AMEA Azerbaijan SSR. 6. P. 14-16.