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Fluid Inclusions In Minerals And Zonation Of Scapolite Metasoms (Eastern Pamir).

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ABSTRACT

In the article the questions of Geochemistry and Mineralogy scapolite Deposit of the East Pamirs. Scapolite mineralization is localized in metasomatity Alpine veins. Scapolite occurs in three generations. Early metamorphic scapolite. Milky-white coarse-grained scapolite. Jewelry clear crystals of scapolite from a later generation. Scapolite different generations differ on a number of indicators. The temperature and pressure of mineral formation, the concentration of the solutions and their composition scapolite different.
Keywords: fluid inclusions, scapolite, metamorphism, temperature, generations, mineral

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INTRODUCTION

The field of jewelry scapolite Kukurt is located in the Central Pamir is the largest and most promising area for colored stones. A rare mineral, purple color, well formed large crystals of scapolite along with its large reserves represent promising opportunities for use of this mineral as jewelry and collectible raw materials.

The Deposit is a stockwork scapolite bodies and lived in scapolitization amphibole-biotite schists and gneisses that have undergone intense processes of metasomatism. The dimensions of the stockwork in the plan are 500x150x75 m depth based on the data of geological prospecting and reaches 65 m. the thickness scapolite bodies and lived ranges from 0.5 m to 2.5 m, length from 2 to 8 m[9].

Scapolite in the area occurs for several generations in different types of rocks and is a cross-cutting mineral. The earliest generation of scapolite observed in globalamericas rocks, where scapolite is a mineral partioipation. Properties and composition of scapolite evolutionary change. The latest generation of scapolite is found in Alpine veins.

MATERIALS AND METHOD

The study of fluid inclusions in minerals, Kukurt deposit showed that the main characteristics of the miner-loopazoid solutions naturally vary in space, determining the existence of termobarogeochemical zoning. A detailed study of metamorphic facies and minerals survey showed that on the field expressed three zones, corresponding to different facies metamorphism is greenschist, epidote-amphibolite, amphibolites [10].

Within each zone, fluid inclusions in minerals differ between a temperature of homogenization, state of aggregation, composition and concentration of solutions. The study of fluid inclusions in minerals, of Kukurt field showed that the main characteristics of mineralizing solutions naturally vary in space, determining the existence of temperature, geochemical and mineralogical zoning. In the first of these zones, timed to greenschist facies metamorphism and located at the periphery of the thermal anticline, scapolite found a large number of single-phase liquid, rarely two-phase gas-liquid inclusions, the size of which does not exceed 10 micrometers. The gas phase volume does not exceed 10 %. The temperature of homogenization of such inclusions is' 300-450°C [1]? [3]. The Solutions are characterized by a sodium chloride composition and have a low concentration (up to 26 %by weight). In the gas phase inclusions predominant H2O vapor on CO2. The number of inclusions in minerals is negligible. In the second zone, located on the wings of the anticline and is dedicated to the epidote-amphibolite facies metamorphism in the minerals increases the number of two-phase inclusions and appear three-phase inclusions with salt crystals. The temperature of the mixture is increased to 400 to 500 ^{0}C. Gradually increase the number and size of inclusions, as well as the content of gas phase in the inclusions, reaching up to 20 % of the total volume of vacuoles. The total concentration of salts in solution also increases. Increases the amount of carbon dioxide inclusions. According to the results of the gas-chromatography analysis within this zone in the mineral inclusions observed change in fluid composition : the ratio of CO_2/H_2O increases to 0.4 to 0.6, there is also increasing methane up to 10%. Mineral-forming solutions are magnesium-calcium-sodium composition. In the third zone located in the nuclear part of the thermal anticline responsible amphibolite facies metamorphism change significantly termobarogeochemical characteristics of minerals[5]. Fluid inclusions is saturated solid phases and up to 80 % of the total volume of vacuoles. Temperature homogenization increases to 500-600^{o}C. The inclusion of liquid and gaseous carbon dioxide are found everywhere, with observed increases in the density of carbon dioxide. The ratio of CO_2/H_2O reaches 2-3. Also increases the amount of methane and other hydrocarbons in the inclusions. According to chromatographic analysis of the fluid consists of water - 20-30 %, carbon dioxide 50-60 % and methane - 10-30 %. The total salt concentration reaches up to 90 % by weight. The solutions according to the aqueous extract is characterized as a sodium-calcium-chloride-hydrocarbonate. Increases the number and size of inclusions. In the vein scapolite observed the phenomenon of boiling solutions.

Types of fluid inclusions in scapolite different generations.

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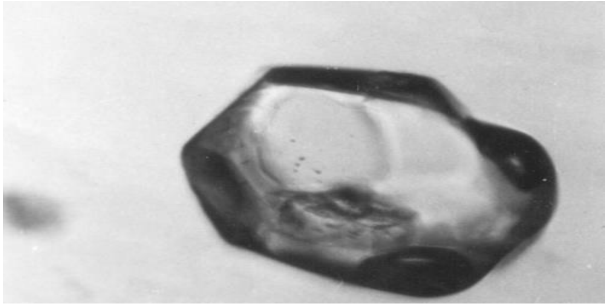

Fig.1. Substantial gas inclusion in scapolite. increase of 900

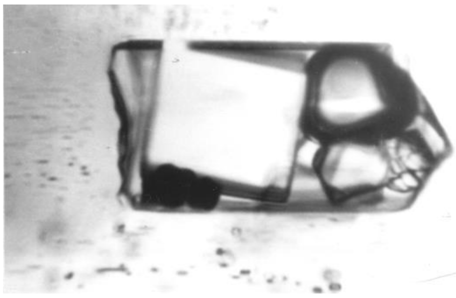

Fig.2. Many phases inclusion in skapolite-3. Increase of 900

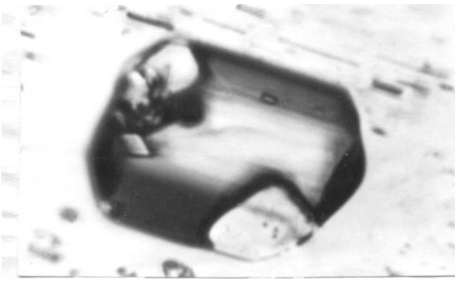

Fig.3. Many phases inclusion in skapolite-4. Increase of 900

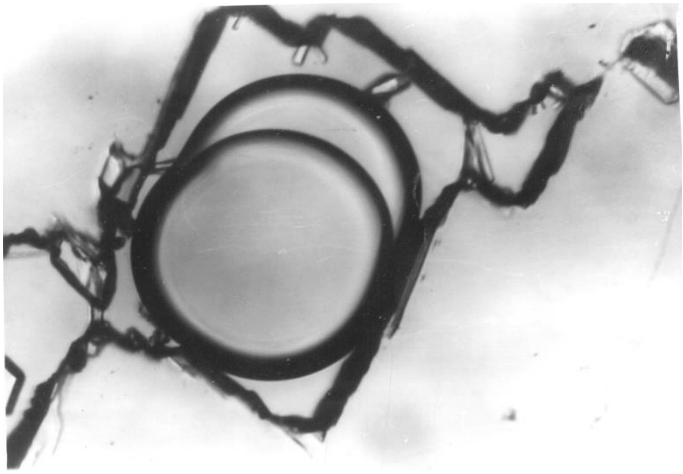

Fig.4. Fluid inclusion with CO_2 in skapolite 3. Increase of 900

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Fig.5. Multiphase of the fluid inclusion in skapolite; 1-Galit; 2-carnallite; 14-quartz; 18-mineral № 18. Increase of 900

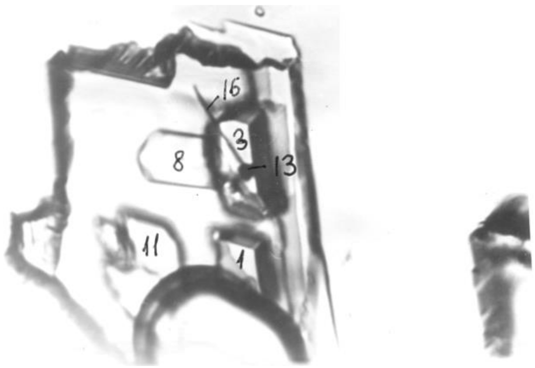

Fig. 6. Multiphase inclusion in the scapolite; 1 - halite; 3 - sylvite; 8 - gypsum; 11 - mineral No. 11; 13 - rutile; 16 – magnesite. Increase of 900

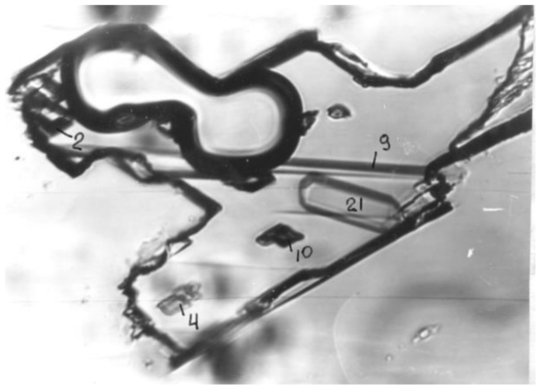

Fig. 7. Multiphase inclusion in calcite; 2 - sylvite; 4 - carbonate; 9 - mineral №. 9; 10-mineral №. 10; 21 – mineral №21, Increase of 900

In addition to regional termobarogeochemical zoning Kukurt field celebrated local termobarogeochemical zoning amphibole-scapolite and albite- scapolite lived. Local zoning is manifested in the higher temperatures of homogenization, solution concentration, carbon dioxide content in the inclusions from edge parts of the veins to the Central part thereof. In cavities lived crystallization occurs for

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jewelry scapolite, that termobarogeokhimicheskal characteristics different from metamorphic scapolite. Mineralization in the cavities lived came from a new portion of the solutions that had other the physical and chemical parameters at lower temperatures of 200-400 ° C, the concentrations of 30 to 40 % by weight and at low pressure up to 0.4-0.7 kbar. The solutions are characterized by a sodium chloride composition. Numerous mineralogical research allowed to determine the Genesis of the of jewelry scapolite Kukurt field. The highest temperature characteristic of the initial stages, during which was formed metamorphic scapolite.

As noted above, temperature homogenization in metamorphic rock and vein scapolite exceed 400°C [11]. In these early stages was formed opaque crystals. For example, complicated by the material composition of mineral assemblages, there are proven Kukurt field can be divided into four main generations of scapolite, which reflects the main stages of the evolution of the metamorphic8hydrothermal solutions - greenschist, epidote-amphibolite, amphibolite and hydrothermal metamorphic stages Industrially productive jewelry scapolite can be considered only one-fourth of the low-temperature stage [8].

RESULTS

The first three stages, which reflects the processes of regional metamorphism in General are indirectly related to the education of jewelry scapolite. On thermometry gas-liquid inclusions in scapolite and associated minerals specified temperature conditions of formation of each stage. Least of all processes scapolitization manifested in low-temperature - greenschist facies metamorphism. Here the process of metasomatism has been chlorite-sericite, quartz-chlorite-sericite and carbonaceous shales. Medium-temperature generation of scapolite 2 maximum shown in the carbonate rocks of the epidote-amphibolite facies. Here the processes of scapolitization subject epidote-biotite-carbonate schists and marbles. Most of the high-temperature phase - amphibolite is an intense metasomatism. The process consisted mainly in scapolitization schists and gneisses and education parageneses of quartz and plagioclase and scapolite. Scapolitization was accompanied by the dissolution of mafic minerals: biotite, diopside and removal of iron, magnesium and potassium. Sometimes these rocks are completely transformed into scapolite metasomatites. Hydrothermal stage of metamorphism is characterized by the increase of mineral formation in open cavities and crevices of scapolite rocks and scapolite-amphibole and albite-scapolite veins. For scapolite this stage it is typical that the vast majority of minerals are minerals free of crystallization. Compared with earlier high-temperature stages significantly changes the chemistry of mineral formation: original sodium- calcium-bicarbonate-chloride solutions were replaced by sodium chloride.

The field of jewelry scapolite Kukurt confined to the zone of maximum development processes scapolitization district. Veins are confined, as a rule, scapolite containing rocks. The second group of facts indicating a close genetic relationship of the host rocks and scapolites lived, is related to the mineralogical composition of both. As mentioned earlier, none of the mineral, in addition to scapolite does not play a significant role in the composition of the core execution; as for cavities with jewelry scapolite, but scapolite contain significant amounts of clay, consisting of various minerals of the host rocks, often converted by hydrothermal fluids. Many crystals jewelry scapolite bear the traces of dissolution and regeneration, have a zonal structure. These facts indicate pulsating action of the rising solutions with concentrations. The formation of scapolite veins occurred in the early stages of activity of the solutions is partly the result of recrystallization scapolite metasomatites and scapolite containing rocks on the place, but mainly due to a decrease in temperature and pressure when promoting solutions for fractured zones. Crystals jewelry scapolite formed later, at the regressive stage of regional metamorphism in the activity of residual solutions in free cavities.

The corresponding tectonic preparation scapolite containing rocks played a huge role in shaping the fields and not only as create paths for the circulation of fluids. Structural conditions, in particular, could predetermine a sharp change of physico-chemical conditions of formation. So close the cracks moving up solutions particularly dissolved scapolite containing rocks, at the same time, in these areas there were the most favorable conditions of crystallization jewelry scapolite as a fall in temperature, regulating the rate of crystallization scapolite was carried out smoothly enough.

CONCLUSIONS

Carried out mineralogical-geochemical, and thermobarogeochemical studies of minerals, there are proven fields of gems of node allowed us to obtain new data on temperatures, pressure, composition and concentration of mineral-forming solutions and their change in space and time.

The study of the processes of metamorphism and metasomatism on the field showed their subordination and allowed to identify the schema mineralogical, geochemical and thermobarogeochemical zonation[6].

Four phases are identified for the formation scapolite mineralization and paragenetic associations characteristic of each stage.

Each generation of scapolite is different in their composition, conditions of formation, paragenetic associations. For the greenschist facies metamorphism characterized by the Association: 1 scapolite (marialite-dipir) - albite - chlorite - orthoclase; the epidote-amphibolite: scapolite 2 (mizzonite-dipir) - calcite - albite - tremolite - diopside; amphibolite: 3 scapolite (marialite-dipir) - hornblende - oligoclase - pyroxene - sphene - Apatite; hydrothermal stage: - 4 jewelry scapolite (marialite) - albite - Apatite - kaolin - sericite.

Mineralogical zonality of gems, there are proven fields of the node repeats the metamorphic facies zonation of species.

The conditions of education scapolite selected generations:

- scapolite greenschist facies was formed from chloride - bicarbonate-magnesium-calzievo-sodium solutions at a concentration of 10-25 % at a temperature of 35-450°C and pressures of 4-4. 5 kbar;
- epidote-amphibolite facies from bicarbonate-chloride-calcium-sodium solution with a concentration of 10-25 % at a temperature of 450-550°C and pressures of 5-6 kbar;
- amphibolite facies from bicarbonate-chloride-sodium-calcium solutions at concentrations up to 90 %, a temperature of 550-650°C and pressures of 6-7 kbar;
- hydrothermal stage from sodium chloride solutions with concentration up to 30-40 %, at a temperature of 250-450°0 and a pressure of 0.4-0.6 kbar.

Thermobarogeochemical zonation of the site, there are proven fields of gems is manifested in the temperature increase from 350^0 to 650° C, pressure of 4 to 7 kbar, the concentration of the solutions from 10 to 90 %, and the change in the density of the mineral-forming fluid and its composition from chloride-sodium-calcium via bicarbonate-calcium to chloride-sodium towards the thermal core of the anticline. The formation of scapolite jewelry occurred in the cavities of the cores when the temperature and concentration of the solutions.

Change gas component solutions: the carbon dioxide content of the inclusions increases from the scapolite 1 to scapolite 3 and decreases in the scapolite 4.

Above evidence shows that the geo-logical conditions of the Deposit formation of scapolite jewelry are determined by the stratigraphy, lithology and tectonics of Proterozoic metamorphic complexes. Scapolite mineralization is closely related to metamorphic activity occurred in the conditions of the amphibolite facies, where the processes of scapolitization manifested most intensively [2].

It is established that scapolitization schists and gneisses constitute the most favorable environment for the formation of amphibole-and albite scapolite-scapolite lived with the jewelry scapolite. Thus, the presence of scapolitization rocks within the amphibolite facies of metamorphism is the main geological prerequisite for the production of searching for jewelry scapolite.

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DISCUSSION

However, not all areas of the development scapolitization rocks of amphibolite facies promising for searches month-troidini jewelry scapolite.

As stated above, the Deposit formed at blah-ropriate structural conditions - the development of discontinuities, which can circulate the fluids.

Therefore, within the development scapolitization rocks of the amphibolite facies can be distinguished in terms of prospects for jewellery raw materials: 1) there are proven fields of the southern flank of the anticline, 2) the square of metasomatic rocks in the Central and nuclear parts Galanski anticline, having a similar structure and mineralogical composition.

It should be added that the presence of factors such as layering, alternation of interlayers of different composition, the presence of metasomatic rocks, etc. - is especially favourable for the development of scapolite mineralization.

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