Corundum manifestations in hydrothermally altered rocks from the Asarel porphyry-copper deposit, Central Srednogorie

Проявления на корунд в хидротермално променените скали от медно-порфирното находище Асарел, Централно Средногорие

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Introduction

Corundum is considered to be one of the main minerals of the secondary quartzites. Nakovnik (1968) described corundum facies of the secondary quartzites which is built of quartz, corundum (5 to 10%), rutile and hematite/pyrite and put it in the most internal part of metasomatic column right next to the monoquartz facies. In the genetic classification of metasomatites, Zharikov and Omelyanenko (1978) postulated corundum-andalusite facies conjugated metasomatic rocks in the Secondary quartzite formation. Kanazirski (2011) made detailed facies subdivision of the Secondary quartzite formation. He separated area of andalusite+corundum paragenesis above 394 °C in the quartz-andalusite temperature facies and corundum-andalusite facies conjugated metasomatic rocks. High-aluminum minerals usually deposit in veinlets as a result of cooling and neutralization of the hydrothermal fluids during their interaction with the host rocks.

Corundum is comparatively rare mineral in the secondary quartzites (advanced argillic altered rocks) in Bulgaria. Radonova and Stefanov (1974) reported disseminated rare grains of corundum in pyrophyllite altered rocks from the Asarel porphyry copper deposit. Velinov et al. (1989f[1]) proved corundum as single fine grains, aggregations and veinlets in association with quartz, pyrophyllite, diaspore, sericite, kaolinite, illite, alunite, pyrite and hematite. According to Kanazirski (2011) corundum from the Asarel deposit shows higher temperature conditions and is formed under decrease of acidity during conjugated mineral deposition. Corundum is reported also in Duni, Eastern Srednogorie (Kunov et al., 1996).

Characteristic of corundum manifestations

The Asarel porphyry-copper deposit is located in Panagyurishte ore region, part of the Upper Cretaceous Apuseni-Banat-Timok-Srednogorie magmatic and metallogenic belt. The Asarel magmatic center is a volcano-plutonic edifice emplaced in Paleozoic metamorphic and plutonic basement. Several volcanic (andesites to latites, basaltic andesites, andesites to dacites) and comagmatic porphyritic rocks (quartz-diorite, quartz-monzonite to granodiorite porphyry and granite porphyry) are distinguished (Nedialkov et al., 2007). Propylite, argillic, sericite, paragonite and advanced argillic alteration types are described in the deposit (Kanazirski, 2011; Hikov, 2013). Advanced argillic alteration consists of alunite, pyrophyllite, dickite, kaolinite and diaspore bearing rocks and the most intensively altered monoquartz (silicic) rocks.

New revision of thin sections from the different periods of the studying and development of the open pit was made in aim to elucidate the presence of corundum in the secondary quartzites from the Asarel porphyry copper deposit. The mineral is reasonably rare usually as single fine grains. Very rare aggregations of bigger corundum crystals are seen which are deposited in irregular veinlets among quartz and pyrophyllite, less alunite, diaspore, ± sericite and pyrite. Corundum veinlets are crosscut from later fine kaolinite veinlets.

Except of corundum veinlets another form of corundum manifestation has been established. It is hardly differentiated but maybe it is more widespread. In many places fine stripes in diaspore crystals can be seen whereat the last cannot show its high interference colors. During SEM observation it is established that

[1] Velinov, I., M. Kanazirski, M. Gorova, R. Petrunov, A. Hikov, P. Dragov, E. Dimitrova, A. Kunov. 1989. Topomineralogic Documentation of the New Exploration Drillholes from Asarel Deposit. Unpublished report, Geological Institute BAS, 349 p. (in Bulgarian).

this phenomenon is due to the alternation of fine strips (lamellae) of diaspore and corundum (Fig. 1). The corundum lamellae width is usually from 1 to 3 μm. The two minerals are in association with quartz, pyrophyllite, alunite, APS minerals, pyrite and rutile, rarely dickite, kaolinite and/or sericite. Corundum is poor of admixtures. SEM-EDS show presence only of SiO_2 and rarely of TiO_2. LA-ICP-MS analysis detects only V (206 ppm), Sn (68 ppm) and Nd (14 ppm).

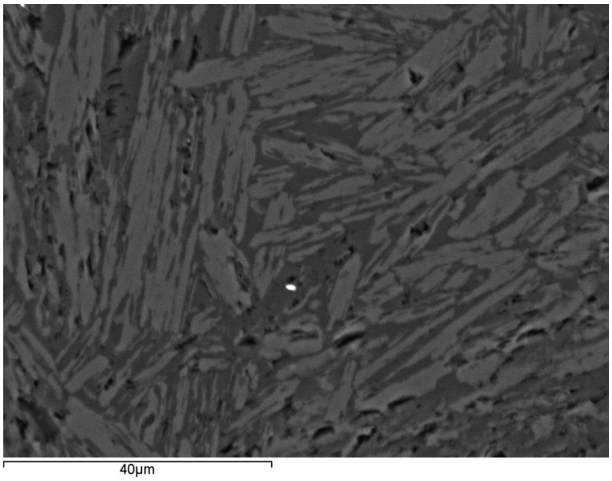

Fig. 1. BSE image of diaspore (dark grey) and corundum (light grey)

Discussion and conclusions

The two observed forms of corundum manifestation in advanced argillic rocks from Asarel deposit show that despite of its rarely encountered, the mineral has wider distribution than was previously thought. Its presence has important significance for elucidation the physicochemical conditions of the formation of hydrothermal alteration and the magmatic-hydrothermal system. First of all, corundum is an indicator of high temperatures of hydrothermal alteration – above 394 °C (Kanazirski, 2011) which can be referred to the initial stage of the development of the Asarel magmatic-hydrothermal system. The deposition of corundum veinlets is explained by Korzhinski (2011) with the cooling and neutralization of the fluids during their penetration and interaction with the host rocks. With the decreasing of acidity of the fluids the solubility of Al_2O_3 falls down which leads to its precipitation and deposition of mono- and bi-mineral products not containing quartz.

The alternation of fine lamellae of diaspore and corundum is probably due to the dehydration of diaspore. Such lamellar structure of the two minerals was observed during the experimental study of dehydration of diaspore (Loffler, Mader, 2001). The experimental runs with heating of diaspore crystals in temperatures above 400 °C show formation of corundum along the cleavage planes of diaspore. The most important for the dehydration is the perfect cleavage plane (010). In this plane the diaspore crystals have internal cracks which enlarged and multiply under heating. The dehydration product is highly porous and serves effective transport paths for the water vapor.

The formation of corundum after dehydration of diaspore shows increasing temperature in the magmatic-hydrothermal system which is most probably connected with intrusion of new magma portion. This reflects one of the stages of development of the magmatic-hydrothermal porphyry system related to emplacement of several discrete stocks in and above the pluton roof zones (Sillitoe, 2010) which leads over again to tectonic activation, hydrothermal alteration and probably ore mineralization.

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