Preliminary data on electrum mineralization in Kaklitsa occurrence, Krumovgrad gold field, Eastern Rhodopes Mountain, SE Bulgaria

Предварителни данни върху електрумната минерализация в рудопроявление Къклица, Крумовградско златорудно поле, Източни Родопи, ЮИ България

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Абстракт. Представени са данни за текстурите и минералния състав на рудните тела и състава на околорудните метасоматити в рудопроявление Къклица, Крумовградско златорудно поле, Източни Родопи, ЮИ България. Орудяването е характеризирано като епитермална, нискосулфидна, адулар-серицитов тип електрумна минерализация. Допуска се, че кипенето на разворите е главният процес, благоприятствал отлагането на електрума.

Key words: electrum, adularia, sericite, Krumovgrad gold field, Bulgaria

Introduction

Krumovgrad gold field includes Khan Krum deposit (known also as Ada Tepe deposit) and Kaklitsa, Skalak, Sinap, Sarnak and Kupel occurrences (Желев, 2007), and occupies an area of around 60 km^2 in Eastern Rhodopes Mt, south of the town of Krumovgrad. This work is aimed at characterizing the hydrothermal alteration and gold mineralization in Kaklitsa occurrence.

Kaklitsa occurrence occupies an area of around 1 km^2 and is located 7 km SSW of the town of Krumovgrad, near Kaklitsa village, close to the western board of Ludetina Graben — a SE-trending sleeve of Momchilgrad Paleogene Depression. A basement of Ludetina Graben appears high-grade metamorphic rocks of Kessebir Swelling (Горанов et al., 1995) or Kessebir Gneiss Dome (Бонев, 2002). The Ludetina Graben is filled in with breccias, breccia-conglomerates and sandstones of Shavar Formation of Maastrichtian-Paleocene age, and sediments of Priabonian coal-bearing-sandstone and marl-limestone formations (Горанов et al., 1995). The boundary between the metamorphic and sedimentary rocks is traced by the regional, low-angle Tokachka Detachment Fault (TDF) (Bonev, 1996). According to the geological map of Balkan Mineral and Mining at 1:2 000 scale (kindly given by D. Jelev) the gold mineralization in Kaklitsa occurrence is hosted by the sediments of Shavar Formation. The hydrothermal alteration is defined as argillization, moderate and intense silicification. Three types of ore bodies are outlined: layer-like bodies just above TDF, high-angle stockwork ones and veins. The layer-like bodies are N-S-trending, following the plain of TDF and occupying few levels. The stockwork bodies and veins are E-W, WNW and NW-trending and dip mainly to N, NNE and NE.

Matherial and methods

Ore bodies of the three types were sampled in 2005. Polished sections and polished thin sections were prepared and they were examined in reflected and transmitted light using Leitz Orthoplan-Pol optical microscope. The quantity of observed minerals was fixed in random sections using graphical standards. The chemical composition of gold was determined by EDS-analyses using a Philips 515 SEM with WEDAX-3A system operating at 20 kV.

Results and discussion

The ore bodies are hosted by cataclastic and jointed, hydrothermally altered breccias, breccia-conglomerates and sandstones of Shavar Formation. The rocks are faded and weakly to moderately silicificated. Due to supergene alteration the host rocks are coloured by iron ochres and goethite in yellow, brown and rusty colours. The layer-like bodies above TDF are formed by a pervasive silicification of clastic sediments of Shavar Formation. The stockwork bodies are cross-cut by open-space filling quartz veins.

Massive texture is major one for the layer-like pervasive silicification and quartz veins, followed by macro- and microtexture of microcrystalline quartz pseudomorphs after platy calcite — platy-bladed and lattice-bladed textures (Dong et al., 1995). In voids crustiform quartz texture could be seen. At places, microjoints follow the boundaries of quartz grains thus forming jigsaw-fit puzzle texture (Kieffer, 1971). Stockwork texture appears typical for the stockwork bodies. Often gravel and coarser clasts of hydrothermally altered breccias and breccia-conglomerates are preserved within the ore bodies. The clasts are mainly of metagranites, more rarely of arkosic sandstones and most rarely of quartz-sericite schists and gneisses.

The major metasomatic minerals, which have altered the host rocks, are sericite, adularia, pyrite and quartz. Clay minerals and chlorite (each below 2%), and dusty ore mineral were also observed. Sericite has mainly replaced feldspars, where it reaches 20%. It is found also in the gold-bearing hydrothermal quartz in quantity from 1–2 to 5–10%. Its size commonly varies from a few microns to 10 μm, the largest flakes reaching 20 μm. Adularia is often observed with sericite as alteration of feldspars, where it reaches 20% and in the ore bodies, in quartz, in quantity from 1–2 to 10–15%. Commonly it is water-clear, at places is altered by hydrosericite and clay minerals. It is observed as single grains of rhombic, rhomboid and rectangular outlines, and aggregates. Usually it is very small in size — a few microns, the coarser one is 10–20 μm, in single cases it reaches 150 μm. Chlorite has altered biotite and amphibole of metagranites. Clay minerals have altered feldspars and amphibole. Pyrite is euhedral, micron-sized and dispersed in the host rocks; it is pseudomorphosed by goethite. It is also found in quartz microjoints along the foliation of metagranite clasts and in the gold-bearing quartz. The ore bodies are composed mainly of microcrystalline quartz, which reaches 98–99%. Its size is below 200 μm, commonly 20–30 μm. Besides adularia, sericite, and pyrite, micron-sized grains and aggregates of electrum are also dispersed in this quartz. Electrum is most often observed in polished thin sections from the layer-like pervasive silicification just above TDF in quartz interstices, microvoids and microjoints. In this case electrum is commonly dispersed in microblades of microcrystalline quartz pseudomorphosed platy calcite. Its chemical composition according 3 electron microprobe analyses of 3 grains is, on an average: Au=76.36 wt %, Ag= 23.64 wt %, its fineness is 760 ‰. The presence of adularia in the ore bodies of Kaklitsa occurrence; the spatial and temporal relationship of electrum with platy-bladed and lattice-bladed textures, on one side, and the formation of platy calcite in modern geothermal systems from boiling fluids, on other side, are an indication that the boiling of fluids had played a dominant role in the deposition of studied electrum (Browne, 1978; Simmons, Christenson, 1994). Marton et al., 2006 consider the gold deposition in the veins and in the layer-like bodies in Kaklitsa occurrence as a consequence of boiling and mixing of fluids, respectively.

Conclusion

The study carried out showed that the hydrothermal fluids have formed quartz-adularia-sericite-pyrite metasomatites on the host sediments of Shavar Formation and ore bodies composed mainly of microcrystalline quartz and small amounts of adularia, sericite, pyrite and electrum, reaching considerable abudances predominantly in the layer-like pervasive silicification just above TDF. The presented results allow us to classify Kaklitsa occurrence as an epithermal, low-sulfidation, adularia-sericite type electrum mineralization (Жариков, Омельяненко, 1978; Heald et al., 1987; White, Hedenquist, 1995). Our data support the boiling model of electrum deposition.

Acknowledgements: The authors are grateful to Balkan Mineral and Mining for the kindly given geological map and collaboration in sampling Krumovgrad licence area. The authors thank M. Tarassov for doing the electron microprobe analyses.

References

Бонев, Н. 2002. *Строеж и еволюция на Кесебирския гнайсов купол, Източни Родопи*. Автореф., С., 42 с.

Горанов, А., Д. Кожухаров, И. Боянов, Е. Кожухарова. 1995. *Обяснителна записка към Геоложката карта на България в М 1:100 000, к.л. Крумовград и Сапе*. С., 97 с.

Жариков, В., Б. Омельяненко. 1978. Классификация метасоматитов. — В: *Метасом. и рудообраз.*, 9—27.

Желев, Д. 2007. Златно находище „Хан Крум", участък „Ада тепе". — В: *Златните находища в България*. С., Земя'93, 104—115.

Bonev, N. 1996. Tokachka shear zone southwest of Krumovgrad in Eastern Rhodopes, Bulgaria: an extensional detachment. — *Ann. Sofia Univ., 89,* 1, 97—106.

Browne, P. R. L. 1978. Hydrothermal alteration in active geothermal fields. — *Ann. Rew. Earth and Planet. Sci., 6*, 229—250.

Dong, G., G. Morrison, S. Jaireth. 1995. Quartz textures in epithermal veins, Queensland — classification, origin, and implication. — *Econ. Geol., 90*, 1841—1856.

Heald, P., N. Foley, D. Hayba. 1987. Comparative anatomy of volcanic-hosted epithermal deposits: acid-sulfate and adularia-sericite types. — *Econ. Geol., 82*, 1—26.

Kieffer, S. W. 1971. Shock metamorphism of the Coconino Sandstone at Meteor Crater, Arizona. — *J. Geophys. Res., 76,* 5449—5473.

Marton, I., R. Moritz, P. Marchev, S. Hasson, T. Vennemann. 2006. Ada Tepe and neighbouring gold prospects: sedimentary-hosted, epithermal deposits and occurrences in the Eastern Rhodopes, Bulgaria. — *Acta Mineral.-Petrograph., Abstr. Series, 5*, p. 73.

Simmons, S., B. Christenson. 1994. Origins of calcite in a boiling geothermal system. — *Amer. J. Sci., 294,* 361—400.

White, N., J. Hedenquist. 1995. Epithermal gold deposits: styles, characteristics and exploration. — *SEG Newsletters, 23*, 8—13.