Main characteristic of gold in some deposits and occurrences related to Tertiary magmatism in Republic Macedonia

Главни характеристики на златото от някои находища и рудопроявления, свързани с терциерния магматизъм в Република Македония

Violeta Stefanova, Violeta Stojanova
Виолета Стефанова, Виолета Стоянова

Faculty of natural and technical sciences, University of Goce Delcev, Stip, R. Macedonia;
E-mail: violeta.stefanova@ugd.edu.mk; violeta.stojanova@ugd.edu.mk

Key words: tertiary magmatism, gold fineness, cluster analysis, element association.

In R. Macedonia there are many occurrences of gold (Bogoevski, 1998). In this report, comparative analysis is presented for several ore occurrences related with Tertiary magmatism in the R. Macedonia – Borovic, Borov Dol, Plavica and Alshar. The localities selected belong to two major geotectonic units – the Vardar zone (ore deposits Borov Dol, Alshar and ore occurrence Borovic) and the Serbo–Macedonian massif (Plavica ore deposit). The Tertiary magmatism of calc-alkaline type is most important for ore-forming processes in the region. The host rocks of the localities are mostly presented by volcanic sediments and volcanic and subvolcanic facies of latite, quartzlatite, andesite, basalt and their pyroclastics (ignimbrites, tuffs and breccias) (Stefanova et al., 2004b). The literature data point out the Oligo-Miocene age of the magmatism for the Buchim and Kratovo–Zletovo ore regions, while the Kozuf area is the magmatism is of the Miocene-Pliocene age (Boev et al., 1993; Boev, Kovachev, 1994).

Ore mineralization

The ores of the Borov Dol deposit are dominated by copper sulphide – chalcopyrite (Tudjarov, 1993), while in the Plavica deposit beside the chalcopyrite, enargite is of essential significance. In the Borovic occurrence, pyrite is more common sulphide mineral than chalcopyrite. In the Alshar deposit, the main ore mineral is arsenic antimonite.

Placer gold characteristics

Stream sediment sampling on the territory of the Borov Dol deposit and Plavica and Borovic occurrences shows the presence of placer gold. On the Alshar deposit area, gold was not established by this method. The sampled gold aggregates – 64 from the Borovic occurrence, 44 from the Plavica occurrence and 37 from the Borov Dol deposit were studied for chemical composition and morphology (Stefanova, 2005).

The performed investigation reveals that the gold in the all localities is very fine. The finest gold is found in the Borovic followed by the Plavica and the Borov Dol. The analyzed 11 gold grains from the Borovic occurrence characterize with very high degree of fineness ranging between 977 and 999. The presence of silver is established in two gold grains only. The other admixtures in the gold are copper and iron. The placer gold from the Borov Dol deposit territory is with fineness of 900–950 while in the proper deposit ores, the gold fineness varies in the range 834–981. Silver with content of 0.82–15.87 wt.% is the major admixture element in the gold. Iron and copper were found as other impurity elements in the gold. The grains of gold have zonation (Stefanova et al., 2004a, 2007). The gold of the Plavica is with fineness of 842–994. The contents of silver varies in the range 0.18–21.07 wt.%. The content of copper and iron in the gold is close or slightly higher than that in the Borov Dol. The all gold grains from the Plavica are chemically homogeneous without any indication for zonality.

The size of the gold ranges from 150 μm to 1 mm in the Borov Dol, from 50 to 200 μm in the Plavica and from 30 to 150 μm in the Borovic (Stefanova, 2005). The gold occurs as elongated, globular, scaly, isometric, randomly shaped and dendritic grains. The gold of isometric morphology prevails in the Borov Dol. In the Plavica along the isometric morphology of the gold, elongated and dendritic forms are commonly encountered too. Isometric, randomly shaped gold grains prevail in the Borovic occurrence.

It should be noted that in the all three localities, the most typical morphology of the gold grains is isometric or randomly shaped one – a characteristic that indicates that the gold studied had not suffered significant deformation.

Geochemistry of gold-bearing stream sediments

Data from chemical analysis of the stream sediments were used here for statistical cluster analysis giving possible determination of the geochemical associations of elements in the studied region (Kovachev et al., 2006). It was found that (Hf-Zr), (Ce-La), (Nb-Ta) sub-clusters are typical for the all studied localities. The other established element associations are: (Zn-Cd) – for the Plavica and Borovic, (Au-Cu) – for the Borov Dol and (Au-Cu-Mo) – for the Plavica, (Hg-In)-P-Ag-Cu-Ca – for the Borov Dol and (Hg-Sb)-Ag – for the Plavica. (Tl-As) and (Au-Sb)-Te element associations were determined in the Alshar deposit (Stefanova, 2005). The latter associations are typomorphic ones for the deposit of arsenic and antimony containing thallium minerals and gold.

References

Bogoevski, K. 1998. *Gold in Macedonia – Geology, Metalogenic, Features, Ore Occurrences, Gold Ore Deposits and Their Evaluation.* Special issue 7, 249 p.

Boev, B., R. Stojanov, G. Denkovski. 1993. Geology of the polymetallic deposit "Alshar", Macedonia. – *Geologica Macedonica*, *7*, 1, 35–39.

Boev, B., V. Kovachev. 1994. Ore mineralization types in the Alshar deposit. – In: *International Conference on Solar Neutrino.* University of Salzbourg.

Kovachev, V., V. Stefanova, B. Boev, V. Mladenov. 2006. Stream sediments and Bleg analysis by prospecting of gold in Alshar (Carlin type deposit), Macedonia. – In: *Proceedings of XVIII Congress of the Carpatian-Balkan Geological Association"*. Belgrade, 281–285.

Stefanova, V. 2005. *Eluvial-alluvial Occurrences of Gold Related with Tertiary Magmatic Activity in Macedonia.* PhD Thesis, Stip, 198 p. (in Macedonian).

Stefanova, V., V. Kovachev, G. Stefanova. 2004a. Morphology and chemistry of gold of the Borov Dol ore occurrence, the Buchim region, Republic of Macedonia. – *Rev. Bulg. Geol. Soc.*, *65*, 1–3, 125–132.

Stefanova, V., R. Nedialkov, R. Moritz. 2004b. Magmatism of the Borov Dol occurrence. – In: *Proceedings of Annual Sci. Conf. "Geology 2004"*. Sofia, BGS, 75–76.

Stefanova, V., V. Kovachev, V. Mladenov, Tz. Stanimirova. 2007. Eluvial-alluvial gold from gold-copper occurrence Borov Dol (R. Macedonia). Part II: Mineralogy of gold and stream sediments. – *Rev. Bulg. Geol. Soc.*, *68*, 1–3, 77–91.

Tudjarov, N. 1993. *Metallogeny of Borov Dol Copper Deposit.* PhD Thesis, Stip, 195 p. (in Macedonian).