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SEM-data for placer gold related with some valley around Borov Dol porphyry copper deposit, R. Macedonia

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Abstract

This paper presents SEM data from research of gold aggregates which was found from schlich prospection which was performed along the creek Meckin Dol, around the Borov Dol Cu-Au porhyry deposit. The size of the tested gold aggregates ranges from 30 μm to about 600 μm.Form of gold aggregates was isometric – irregular form.The chemical composition of gold aggregates display an average gold content ranging from 74.15% - 99.32%, silver with an average content of 0.3% - 24.68%,and an average copper content of 0.04 to 11.06%. Fe, Bi, Se, and Te are represented with content less than 1%. In general the examined gold aggregates, by their chemical composition, are characterized by high purity ranging from 750 to 996.

Key words: placer gold, chemical composition, gold morphology, porhyry deposit.

Introduction

In Macedonia are known many of metal and non-metal minerals, including gold. Studies of gold in Macedonia have a long history. The large number of gold occurrences, about thirty, are more or less studied and provide impetus for further serious research (Bogoevski, 1998; Percival et al, 1994; Serafimovski et al, 1999; Stefanova et al, 2007, Kovacev et al, 2007; Volkov et al, 2008; Stefanova et al, 2012). Most of these economic phenomena are not interesting but because the genetic aspect can be quite interesting.

Our main goal in this research was to study the gold aggregates that were found in stream sediments along the creek Meckin Dol. Taking these facts into account tests were made in order to examine the range of physical characteristics such as size and shape of the gold aggregates and mineral content of the same. Primary source of this placer gold should be very close upstream where occur primary porphyry mineralization of copper and gold within the Borov Dol deposit. Downstream along the creek gold occurs even further up to Kriva Lakavica River, which is backed up by the historical data.

Materials and methods

In this research schlich prospection was applied. About 10-15 kg, from each sampling location was taken. After panning off, magnetic separation of the magnetic fraction was performed manually. Both fractions obtained were observed under binocular. The gold aggregates found were separated manually and subjected to further study.

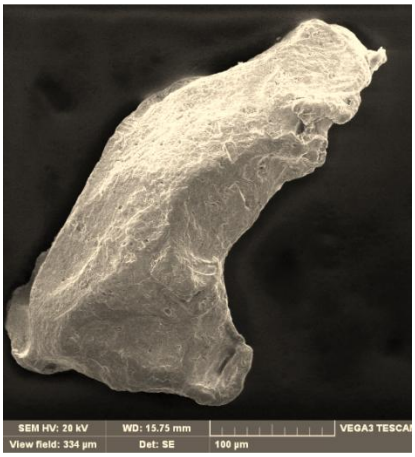
To determine the morphological features of gold – primarily the roundness, flatness, and serrations of grains – scanning electron microscopy (SEM) was used. This type of analysis allowed the length of transport and nature of the environment in which the schlich material was deposited to be determined. The SEM study was performed in the laboratory of electron microscopy at the Faculty of Natural and Technical Sciences , "Goce Delcev" University, Stip, Macedonia. Analyses were performed on a VEGA3 LMU. Etalons are from TESCAN. Specific operating conditions: Tension 20 keV; Test Method: EDS; Type of analysis: Quantitative - X-act: 10mm^2 (Slicon Drift detector); -Max resolution125eV; - Resolutionof MnKα, FKα,CKα according to ISO 15632:2012.

Results and discussion

Studies were performed along MeckinDol in the length of about 0.6 km. Out of the total 13 schlichs, 5 schlichs were taken for more detailed processing. We found a total of 56 gold grains of different shapes and sizes. The other minerals are presented by chalcopyrite, which is the bearer of the copper mineralization at this locality, followed by pyrite and galena. Less prevalent are sphalerite, malachite, azurite, specularite etc. As nonmetal minerals occur zircon, mica, and epidote.

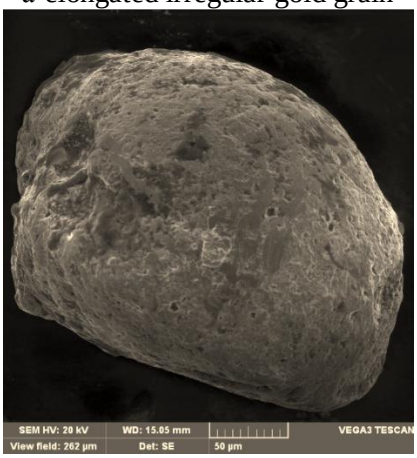
The most important mineral of this prospection is gold which is found in elongated, dendritic irregular shapes and less frequently in spherical-round shape. In order to precisely define and determine the size and shape of gold aggregates detailed investigations scanning electronic microscope were performed (Fig.1). From these examinations it can be said that isometric form prevails (Fig. 1f) while elongated gold aggregates (Fig. 1a and 1b), round-spherical shape (Fig.1b and 1c) and platness form were found also (Fig. 1e).

The physical characteristics of gold, such as the size of the grains, depend on the type of primary mineralization, type and length of transport and erosion processes which the terrain underwent (Mudaliar et al, 2007).

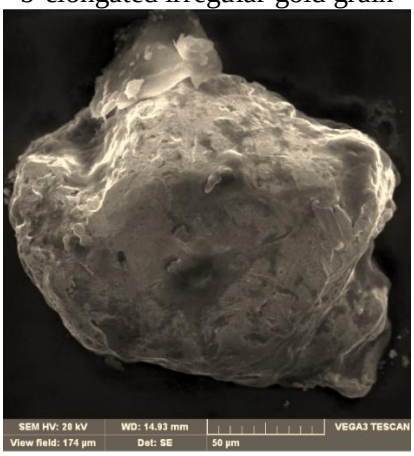


a-elongated irregular gold grain

b-elongated irregular gold grain



c-Aggregate with spherical form



d-rounded form

e- Aggregate with platy form

f–isometric gold grain

Fig. 1 Morphological forms of matching gold aggregates of MeckinDol creek, Borov Dol locality

Studies of gold aggregates forms from the tested locality, display that irregular isometric shapes prevail in the vicinity of primary source while downstream of the creek as a result of transport these forms are lost, i.e. the grains are elongated and rounded off. At a distance up to 50 m from primary mineralization almost identical shapes as well as primary gold prevail. At a distance of 50 to 300 m secondary grains became elongated, they even get triangular shapes with the appearance of small voids on the grain surface. At a distance greater than 300 m primary shapes of grains were lost (Townley et al, 2003; Nakagawa et al, 2005). This morphological forms suggests that gold studied probably there is similar characteristics as the primary gold, and that it has not suffered long transportation. Squamate or flat shape as well as elongated shape that is found on the tested locality is a feature of primary gold that typically occurs in such shapes, although it sometimes may occur in square to rectangular but very irregular shape with expressed sharp contours and edges on grains (Mudaliar et al, 2007; Townley et al, 2003; McClenaghan, 2005; Nakagawa et al, 2005).

Beside the shape, analyses of the chemical composition of gold aggregates were performed, which showed that it was native gold characterized by high purity. Most of the tested gold (Tab. 1) aggregates belong to the group of high grade gold purity (900-950) where the average gold is 88.05%.

Table 1. An average chemical composition of gold aggregates –MeckinDol, BorovDol locality (%)

sample	Fe	Cu	Ag	Au	Bi	Se	Te
MD-1 grain-1	0.39	0.06	0.315	99.32	0.07	0	0
MD-1 grain-2	0.12	0.17	7.6	91.09	0.74	0.16	0.47
MD-1 grain-3	0.05	0.39	0.74	99.26	0.5	0.07	0
MD-3 grain-1	0.15	0.48	7.67	91.43	0.2	0	0.30
MD-3 grain-2	1,23	0.52	3.8	94.5	0.29	0	0
MD-3 grain-3	0.21	0.22	12.58	86.97	0.41	0.01	0.2
MD-4 grain-1	0.11	0.14	24.68	74.15	0.42	0	0.72
MD-4 grain-2	0.54	11,06	3.31	90.24	0	0	0
MD-4 grain-3	0.14	0.59	1.7	98.06	0	0	0
MD-5 grain-1	0.025	0.12	14.83	84.67	0.63	0.17	0.14
MD-5 grain-2	0.38	0.32	8,99	90.07	0.22	0	0.22
MD-5 grain-3	0.35	0.57	18.35	80.57	0.4	0	2,65
MD-7 grain-1	0.1	0.23	20.14	79.02	0.22	0	0.31
MD-7 grain-2	0.78	0.22	24.31	74.34	0	0.06	0.30
MD-7 grain-3	0.18	0.19	12,35	87.13	0	0	0.22

Studies of the relationship between the composition of gold and length of transportation showed that there is no change in microchemical record of alluvial gold during transportation (Chapman et al, 2005).

As for other ingredients the presence of Fe, Cu, Bi, Se, Te is determined. Average iron content is 0.32%, average copper content is 1.02%. Other impurities such as Bi, Se, Te are under represented and in some aggregates they are even not present.

Based on this data it can be said that gold aggregates in general have a homogeneous composition which leads to the assumption that gold aggregates derive from one source (Florencia et al, 2004).

Conclusion

The results of investigations of the morphology of gold aggregates, from the Meckin Dol valley suggests that there is a primary deposit in the immediate vicinity from where the material was disintegrated. The size of the gold aggregates

found ranges from 30 to about 600 μm. Based on tests it was determined that gold aggregates commonly occur in irregular isometric form, then in a round-spherical shape, and in the shape of plates. The irregular shape is the most common.

Studies of the chemical composition showed that gold is characterized by high purity, which ranged from 750 to 996. Of all impurities the silver content is the greatest ranging from <1% to 26.91%. As for other ingredients Fe, Cu, Bi, Se, Te are found in low content.

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