СПИСАНИЕ НА БЪЛГАРСКОТО ГЕОЛОГИЧЕСКО ДРУЖЕСТВО, год. 79, кн. 3, 2018, с. 27–28
REVIEW OF THE BULGARIAN GEOLOGICAL SOCIETY, vol. 79, part 3, 2018, p. 27–28
National Conference with international participation "GEOSCIENCES 2018"

LA-ICP-MS of molybdenite from the Panicherevo deposit, Sarnena Sredna Gora Mountain, Bulgaria

LA-ICP-MS на молибденит от находище Паничерево, Сърнена Средна гора, България

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Keywords: molybdenite, Rhenium, LA-ICP-MS, Panicherevo, Bulgaria.

Introduction

There are numerous deposits and occurrences located in different geotectonic units and settings with molybdenite as minor mineral in Bulgaria.

The Panicherevo deposit is situated in the Eastern Sarnena Sredna Gora Mountain, northwest of the town of Nova Zagora. It is located in the granites of the Kazan pluton and partly in the rocks of the Pirdop gneiss complex (Staykov, 1963). The ore is concentrated in two quartz-molybdenite stockwork bodies spreading in E-W direction and dipping 35–45° to SSW. They outcrop at the surface and can be traced in depth with thickness from 90 up to 140 m (Mankov et al., 2017, unpublished report).

The deposit has been prospected in the last several years by means of boreholes (Mankov et al., 2017, unpublished report). The ore veins have thickness from 1 mm to 40 cm. The main ore minerals are molybdenite, pyrite and chalcopyrite accompanied by less common galena, sphalerite, rutile, magnetite, hematite, fahl ore. The main gangue minerals are quartz and calcite. The hydrothermal alterations are feldspatization, epidotization, chloritization and sericitization.

This study provides results for the content of trace elements in the molybdenite from Panicherevo deposit.

Methods

Polished sections were used for microscopic study and analyses of molybdenite. Laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS) was applied for the determination of trace elements in molybdenite. NIST SRM 610 glass and MASS1 sulfide standards were used for external standardization. LA-ICP-MS spots were selected far from the grains' boundaries to avoid interlamellae depositions in molybdenite aggregates and targeting to characterize microscopically homogeneous areas.

Results and conclusions

The quartz-molybdenite assemblage occurs as veins with thickness from 1 mm to 30–40 cm. Molybdenite is deposited mostly as lamellar aggregates or single crystals with sizes up to 0.5 cm.

The LA-ICP-MS analyses reveal the presence of two types of trace elements incorporated in molybdenite: 1) isostructural substitution of Mo (by Re, W and Nb) and of S (by Se and Te); 2) micro-scale mineral inclusions bearing Pb, Bi, Ag, Cu, Zn, Sb, Sn, Ga, Co, Fe, etc. Some elements can enter into molybdenite by both mechanisms.

Molybdenite is a well-known important carrier of Re. Rhenium concentrations vary widely between 8.7 ppm and 316.2 ppm, the average content is 113.9 ppm. The flat depth profiles indicate homogeneous Re distribution (Fig. 1a). Some variations in concentration can be attributed to zonal distribution within the molybdenite grains (Fig. 1b).

Tungsten contents range from 2.5 ppm to 91.3 ppm, average 16.1 ppm, as W and Re display positive correlation.

Niobium concentrations range from 7.6 ppm to 16.3 ppm. Its presence can be either as isomorphic substitution of Mo or as impurities (Fig. 1a, b) probably from niobates which commonly occur in alteration assemblages in granite.

Selenium and Te present in molybdenite as isostructural substitution for S. Tellurium is between 4.0 ppm

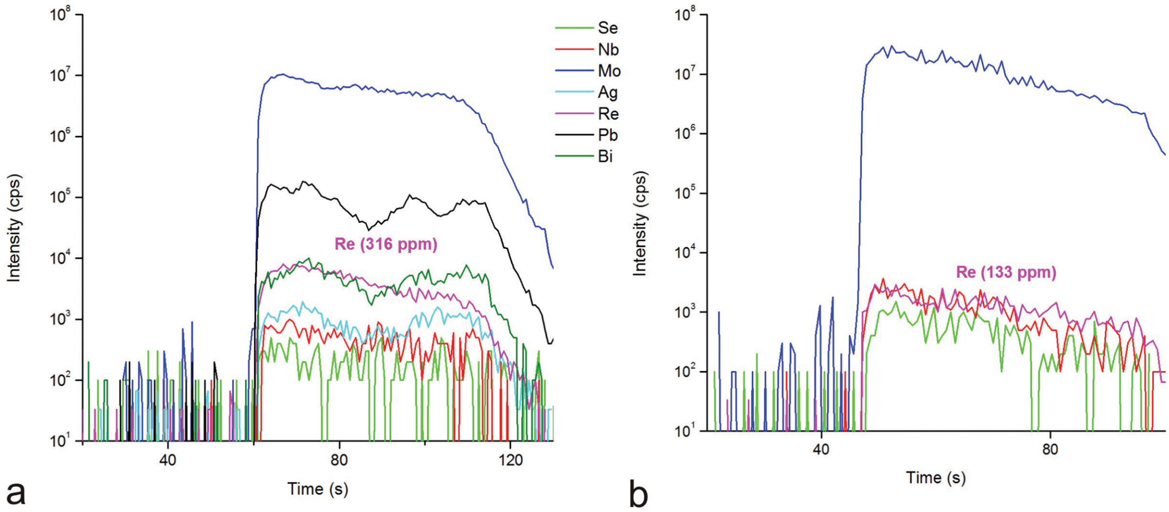

Fig. 1. Time resolved LA-ICP-MS depth spectra showing trace elements: *a*, isomorphous and homogenous Re, non-homogenous Nb and Se, and positive correlations of Pb-Bi-Ag inclusions. Polished section, drilling № 16, depth 80.55 m; *b*, non-homogenous Re, Nb and Se. Polished section, gallery № 2, sample № 32-1.

and 35.8 ppm, average 6.0 ppm. Selenium contents are between 101.5 ppm to 204.2 ppm (average content of 140.7 ppm) and are in the range reported by Pašava et al. (2016) for several deposits types.

Based on depth profile distribution and positive correlations, existing among Pb, Bi and Ag (Fig. 1a), these elements most likely occur as μm-sized interlamellae Ag- and Bi-bearing galena or Pb-Ag-Bi sulphosalt depositions in molybdenite aggregates: Pb (2.54–6 111.1 ppm), Bi (0.3–255.7 ppm), Ag (0.2–85.7 ppm). The same is true for Zn content in molybdenite. Both galena and sphalerite are common minerals in Panicherevo deposit.

LA-ICP-MS analyses detected also (in ppm): As (<MDL–42.6), Au (<MDL–0.6 ppm), Co (<MD–24.1), Cu (<MDL–101.1), Fe (<MDL–11 162.6), Ga (<MDL–47.6), Hg (<MDL–8.4), In (<MDL–0.7), Mn (<MDL–143.3), Ni (<MDL–10.9), Sb (<MD–24.4), Sn (<MDL–26.2), Ti (<MDL–284.7), Tl (<MDL–4.6), V (13.0–94.4), and Zn (<MDL–161.9).

Conclusions

It is well documented that the molybdenite from different types of deposits possesses a specific pattern of lattice bound trace elements and the presence of relevant mineral phases occurring in the form of microscale inclusions. The highest contents of Re in molybdenite are reported in porphyry copper deposits. The content of Re in molybdenite from Panicherevo deposit (8.7–16.2 ppm, average 113.9 ppm) is much lower than that reported for molybdenite from the Elatsite porphyry copper deposit (650–5 707 ppm) obtained by LA-ICP-MS too (Krumov, Bogdanov, 2017). However, the relatively high Re concentrations that have been obtained so far may lead to more thorough exploration of the deposit, which would help clarify the process of ore deposition.

Acknowledgments: This study is supported financially by Sofia University Fund grant 80.10-130/2018 and Geomac LTD with manager Slavcho Mankov.

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