POLSKIE TOWARZYSTWO MINERALOGICZNE – PRACE SPECJALNE
MINERALOGICAL SOCIETY OF POLAND – SPECIAL PAPERS
Zeszyt 24, 2004; Volume 24, 2004

Ewa KOSZOWSKA[1]

PRELIMINARY REPORT ON TELLURIUM AND BISMUTH MINERALIZATION IN SKARN FROM ZAWIERCIE, SOUTHERN POLAND

Abstract: This paper deals with to the tellurium mineralization occurring in the form telluride minerals and the bismuth mineralization, represented by more diversified mineral phases (tellurides, sulphosalts, sulphide and native mineral). This ore mineralization is related to the garnet-pyroxene skarns, drilled in Palaeozoic rocks in Zawiercie (borehole RK-3), situated at the boundary zone of the Małopolska and Upper Silesia blocks. Silver telluride showing the composition between stűtzite and hessite and bismuth tellurides close in composition to joseite–B and tetradymite were found. They occur in association with bismuthinite, native bismuth and matildite.

Keywords: telluride, bismuth, mineralization, borehole, skarn, association.

INTRODUCTION

The occurrences of telluride ores were early reported at the boundary zone of Małopolska and Upper Silesia blocks. The highest mineralogical diversification, manifested by the formation of tetradymite, tellurobizmutite, csiclovaite, emplektite, cosalite, matildyte, aikinite, hammarite, rucklidgeite and hessite, was described for the quartz veinlets from the boreholes in Ryczów and Pilica (Harańczyk 1975, 1978). Moreover, the occurrences of some these minerals were also noted in rocks from Będkowska valley, Myszków-Mrzygłód and Zawiercie area (Ślósarz 1994, Harańczyk 1978, Muszyński 1991, Podemski 1999).

During preliminary studies of garnet-pyroxene skarn, drilled in RK-3 borehole in Zawiercie, Te, Ag, Bi and S compounds were found among ores present in this rock.

METHODS

Microscopic study of thin sections was performed using NEOPHOT and JENAPOL petrographic microscope. Identification of all the tellurium and bismuth mineral phases required use of a scanning electron microscopy (JEOL 5410) equipped with an energy dispersive spectrometer Voyager 3100 (NORAN) with the accelerating voltage 20 kV. According to the "standardless" procedure of calculation (i.e. using standards from the software library supplied by the manufacturer) the data were normalised to atomic percentage. On the basis of these data, the compositions of the studied phases were calculated.

[1] *Institute of Geological Sciences, Jagiellonian University, ul. Oleandry 2a, Kraków 30-063, e-mail: ewa@ing.uj.edu.pl*

GEOLOGICAL SETTING

In the area of contact of the Małopolska and Upper Silesia blocks thermal activity of granodiorite intrusions, localized by boreholes in the region of Myszków-Mrzygłód, Zawiercie, Pilica and Będkowska valley, was manifested by the occurrence of hornfelses, spotted slates, marbles, skarns, metasomatites, calciphyres and others (Żaba 1999).

Zawiercie is one of the localization in the area, where the large skarn bodies were formed (Koszowska 2000). They originated from mostly Ordovician carbonate rocks, occurring in this region.

Preliminary studies allowed to ascertain that metasomatic skarn complex, drilled in the borehole RK-3 in Zawiercie in the interval 1049-1064 m, is composed of garnet-pyroxene mineral association. Moreover, carbonates, quartz and chlorite are also present. The accompanying ore minerals are represented by chalcopyrite, pyrite, sphalerite, and bismuth, tellurium and silver compounds. The aim of this paper is to give short mineralogical and chemical characteristics of these latter minerals.

TELLURIUM AND BISMUTH MINERALIZATION

Tellurium and bismuth minerals were identified in several samples collected within the 1059 –1064 m interval. Skarn is containing here silicate minerals represented by garnet of andradite-grossular composition, quartz and minor amounts of chlorite and iron silicate. Moreover, two carbonate phases: siderite-sideroplesite and calcite are present.

The ore mineralization in the samples studied is represented mainly by chalcopyrite, pyrite and dark sphalerite. Pyrrhotite occurs locally as inclusions in chalcopyrite. Compared with the dominant ore minerals, the tellurium and bismuth phases appear in insignificant amounts. In some samples where Ag-Bi tellurides were found, there occurs acicular magnetite (probably pseudomorh after haematite).

Anhedral grains of Bi-Te-S phase, up to several dozen microns in size, were found in siderite, on the border of sphalerite. Its composition $Bi_4(Te,Se)_{2.4}S$ corresponds to that of joseite–B (Bi_4Te_2S). Selenium is unevenly distributed in this phase and its content is up to 2.3 wt%.

The grains showing the composition $Bi_{2.0\text{-}2.1}Te_{2.1\text{-}2.3}Fe_{0.1\text{-}0.2}S$, close to (approximately) tetradymite (Bi_2Te_2S), are irregular and small, up to 20 μm in size. They occur in calcite or between quartz and iron silicate grains. Selenium content is variable and the maximum of measured amount is 0.5 wt%. Tetradymite from Ryczów, showing a stoichiometric formula ($Bi_{1,99}Cu_{0,1}Pb_{0,003}Te_{1,9}S_1$), was found locally to contain 0,3 wt% of Se (Harańczyk 1978).

Two different form of silver telluride were recognized. The first is silver telluride, showing the composition from $Ag_{1,75}Te$ to $Ag_{1,8}Te$, intermediate between hessite (Ag_2Te) and stűtzite (Ag_5Te_3), and forming small (4-8 μm) intergrowths in joseite-B (Fig. 1). In comparison to hessite ($Ag_{2,3}Te$) from Ryczów (Harańczyk 1978), it is characterized by deficiency of Ag relative to Te.

The second form of silver telluride ($Ag_{1,75}Te$ to $Ag_{1,9}Te$) occurs in small patches (40 μm) and outgrows with undefined iron silicate. Moreover, small inclusions of $Ag_{1,86}Te$ were found in chalcopyrite.

Minute inclusions (2-4 μm) of matildite ($Ag_{1,0}(Bi,Fe)_{1,0}S_{1,7}$) or stűtzite ($Ag_{1.6}Te$) appear in tetradymite. Although the above mentioned telluride minerals are the two most common phases, several other bismuth minerals are also present. Bismuthinite (Bi_2S_3), native bismuth and matildite ($Ag_{1,0}Bi_{1,0}S_{1,9}$) form inclusions, up to 3-5 μm in size, in gangue minerals, in the vicinity of to chalcopyrite. Moreover, patches (50 μm) containing native bismuth and bismuthinite in gangue minerals were found.

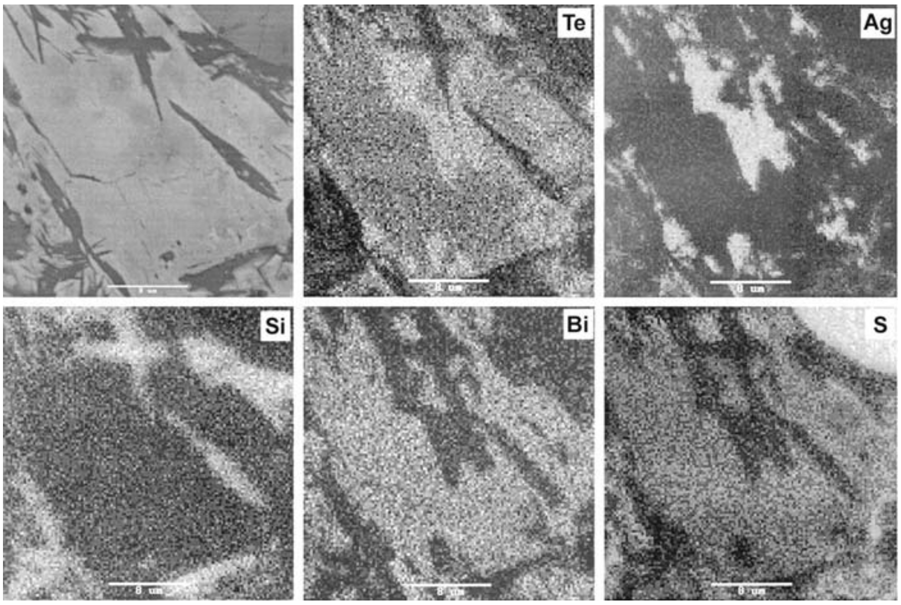

Fig. 1. Topographic image in secondary electrons and the distribution of Te, Ag, Bi and S in intergrowths of Bi-Te-S (joseite-B) and Ag-Te (hessite) phases. Si is present in iron-silicate mineral. Scale bar – 8 μm.

REASSUMPTION

The ore mineralization at the boundary of Małopolska and Upper Silesia Blocks, dispersed in magmatic rocks (stockwork) and veins in surrounding rock, is of porphyry copper type. Some skarn bodies contain Cu-Mo mineralization, genetically connected with this type (Koszowska 2000).

In the above mentioned skarn, there are zones containing fairly rich concentration of ore minerals, often as massive accumulations from several to a dozen cm thick. Apart from the dominant sulphates, preliminary studies have documented the occurrence of silver and bismuth minerals, mainly tellurides and sulphosalts (hessite, stűtzite, matildite, joseite, tetradymite, bismutinite, native bismuth), indicating the possibility of concentrations of these elements in the discussed rock.

The analysis of distribution of Bi and Te in geologic cross-section in the Myszków-Mrzygłód region (Podemski 2001) indicates that these elements are concentrating mainly in meta-sediments surrounding intrusion, contrary to Cu and Mo, whose increased accumulations are related with magmatic rocks. This suggests Cu-Mo and Bi-Te mineralization to represent a separate stage of ore-forming processes.

In the samples studied, Ag-Bi tellurides are disseminated mostly in the gangue minerals (carbonates and iron-silicate) and locally occur in association with sulphides. It can indicate different physical conditions enabling the mineralogical individualization of Bi, Te and Ag. The discussed minerals form the paragenesis, which was developed during the latest stage of mineralization.

Tellurium and bismuth minerals are formed from high to low thermal conditions (Wedepohl 1978). In the skarn studied they form their own phases: tetradymite, joseite B, hessite and stűtzite. However, the wide stability field of joseite and tetradymite (Glatz 1967) does not allow precise information on the thermal conditions of their precipitation.

ACKNOWLEDGMENTS: This work was supported by KBN grant No. 2PO4D 005 26.

REFERENCES

GLATZ A.C., 1967: The Bi_2Te_3-Bi_2S_3 system and the synthesis of the mineral tetradymite. Am. Mineral. 52: 161-170.

HARAŃCZYK C., 1975: Minerały: aikinit, hammaryt i rezbanyit wśród kruszców z Pilicy. Przegl. Geol., 8, 392-395.

HARAŃCZYK C., 1978: Krakowska paleozoiczna prowincja tellurkowa. Przegl. Geol., 6: 337-343.

KOSZOWSKA E. 2000: Skarns in palaeozoik rocks from Zawiercie, Southern Poland. Mineral. Soc. of Poland – Special papers, 17: 23-26.

MUSZYŃSKI M., 1991: Żyły mineralne w skałach poddewońskiego podłoża monokliny śląsko-krakowskiej. Zeszyty naukowe AGH, 52: 7-129.

PODEMSKI M., 2001: Palaeozoic porphyry molybdenum-tungsten deposit in the Myszków area, Southern Poland. Polish Geological Institute–Special Papers, 6: 1-88.

ŚLÓSARZ J., 1994: Charakterystyka mineralogiczna okruszcowania miedziowo-molibdenowo-wolframowego. Przew. 65 Zjazdu Pol. Tow. Geol. w Sosnowcu. Pr. Nauk. UŚL. 1431: 196-202.

WEDEPOHL K. H., 1978: Handbook of geochemistry. Springer-Verlag Berlin.

ŻABA J., 1999: Ewolucja strukturalna utworów dolnopaleozoicznych w strefie granicznej bloków Górnośląskiego i Małopaleozoicznego. Pr. Państw. Inst. Geol., 166: 5-162.