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Stibnite vein from Dębowina near Bardo (polish Sudetes)

KEYWORDS:
Bardo Structure, stibnite, Ag-deposit, old mines, propylitic, SEM.

ABSTRACT.
In the contact zone of the Bardo Structure and Kłodzko-Złoty Stok Intrusion and Kłodzko Metamorphic, metasomatic ore-bearing quartz-carbonate veins rich in Sb, Zn, Cu, Ag, Au, Pb are present. In 1771 the mine „Reiche Silber Glück" within stibnite vein was founded in Dębowina near Bardo. Its entrance was discovered again in 2007. The stibnite vein is mainly build of stibnite and sphalerite and of quartz and dolomite rich in Mn. Stibnite crystallizes as columnar or forming radiate centres and aciculars. Its crystals reach size to 2 mm. Sphalerite appears as individual anhedral and polymineralic grained concentrations reaching size to 2,5 mm. Earlier pyrite and arsenopyrite crystallized – they occur locally in this deposit. There were found also in the deposit tetrahedrite rich in Ag, what wasn't reported earlier in studies from the mine in Dębowina.

Introduction

Stibnite-quartz vein and quartz-carbonate veins occur in terranes dominated by metasedimentary sequences, for example in a lot of places all over the world e.g. Alaska, Canada, Europe (Neiva et al. 2008). Quartz-carbonate veins rich in Sb, Zn, Cu, Ag, Au, Pb in Dębowina were studied by Kaluza in 1818, Fechner in 1901 and Petrascheck in 1933 (Lis and Sylwestrzak 1986). The author of this paper introduces review of minerals from „Reiche Silber Glück" mine in Dębowina near Bardo. Silver mine originated in 1771, three years after miners founded the company eg. „gwarectwo" (Mączka and Stysz 2008). The mine did not work constantly and did not bring profits. It worked to the end of 18 century (Dziekoński 1972). Later it was the object studied by geologists and mineralogists (Mączka and Stysz 2008). Petrascheck (1933) described that place as ore-rich with pyrite, zinc blende, arsenopyrite, galena, stibnite and chalcopyrite. He examined that ore appeared with pyrite and calcite in diorites or syenites which are an overlay and metagreywackes. It can be distinguished two types antimony-bearing ores: within igneous intrusions and in metagreywackes. The old mine was inaccessible and forgotten for a long time, but in 2007 it was discovered again (Mączka and Stysz 2008).

Geological setting

The object of investigations is the „Reiche Silber Glück" mine located about 400 meters SW from the Bardo Pass (Fig 1). Bardo Pass is located within Bardo Structure and Kłodzko-Złoty Stok Intrusion.

Rocks of that structure consist of Upper Devonian and Lower Carboniferous greywacke sandstone, mudstone and pudding stone, which are covered with quaternary boulder clay. Sedimentary rocks are in many places cut by igneous rocks – diorites or syenites. Porphyry rocks are genetically related to Variscan orogeny (Mikulski 1998). Porphyry deposits from near the end of a magmatic episode or during a change of deformation styles when the arc is undergoing limited contraction (Sillitoe 2000). In many parts of the Variscan orogenic belt, quartz vein mineralization is related to the influx of deep-sourced fluids during late-orogenic exhumation Sb, Zn Cu, Ag, Pb ore and had been extracted from Paleozoic sedimentary sequences (Wagner&Cook 1998, Wagner&Cook 2000). Propylically altered of fragmental porphyry induced ore precipitation within vein. Therefore in intrusions appear propylitic metasomatic mineralizations rich in sulfides of Sb, Zn, Cu, Ag, Fe, Pb, Au. The „Reiche Silber Glück" mine is located in one this intrusions. The origin of stibnite-bearing vein in Dębowina is not precisely defined.

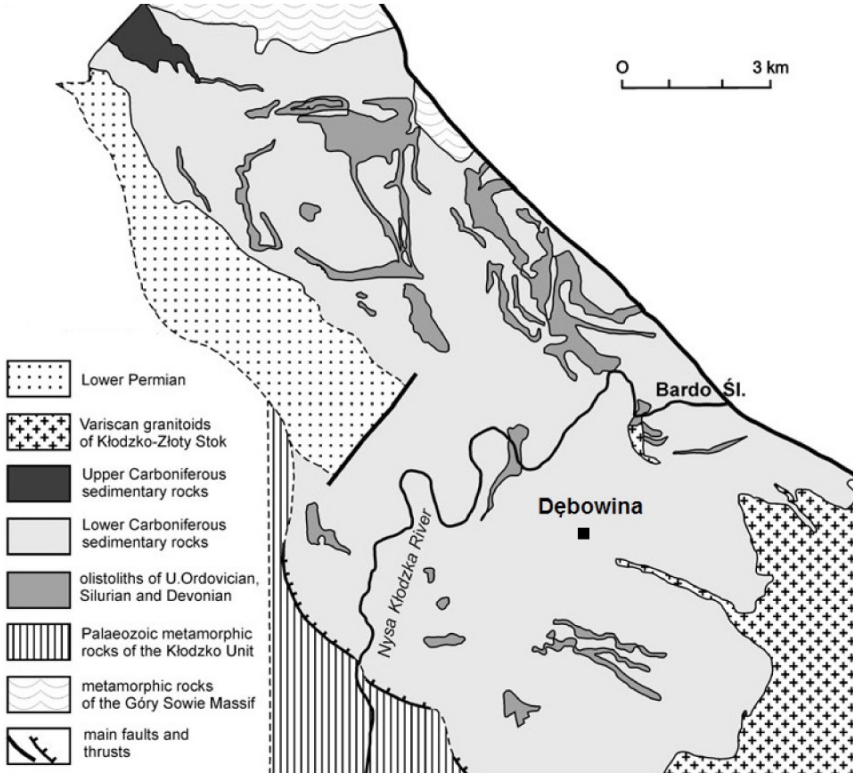

Fig 1. Simplified geological sketch of the Bardo Structure with location of the old mine in Dębowina (after Kryza et al. 2011).

Samples and methods

The author collected 8 samples containing sulfides metals. One of them is a intrusion rock. Other samples are strongly weathering greywackes. Rocks and sulfide minerals are mostly located inside the mine. Two samples were studied. Polished sections were studied by microscope methods reflected light. After that ore minerals were analyzed on a scanning electron microscopy (SEM) in Laboratory of Scanning Microscopy at Faculty of Earth Sciences, University of Silesia with use of environmental analytical microscope Philips ESEM XL30/TMP with attachment EDS (Energy Dispersive Spectrometer)/ EDX Sapphire type in low-voltage regime and low-vacuum.

Results

Microscopic and SEM studies allowed to classify the stibnite-bearing veins from Dębowina as Sb – Zn – Ag deposit. Main minerals components in that vein are quartz, carbonate, stibnite and sphalerite. EDS spectrum of carbonate shows high concentration of manganese (fig 4b.). Quartz and MN-rich dolomite makes up more than 25 vol% of the vein. In generally, coarse-grained stibnite and sphalerite are dominated (fig 2a.). Stibnite occurs as columnar cristals and radiate needles, white and grey, with high reflectance (fig 2a.). Stibnite crystals reach to 2 mm. Sphalerite appears as individual anhedral cristals. Sphalerit cristals reach to 2,5 mm (fig 3b.) Pyrite and arsenopyrite appear seldom. The amounts of pyrite and arsenopyrite increase on perimeter of the vein. Isomorphic crystals of these minerals get stuck in quartz and they have typical optical features (fig 2b. and fig 3a.).

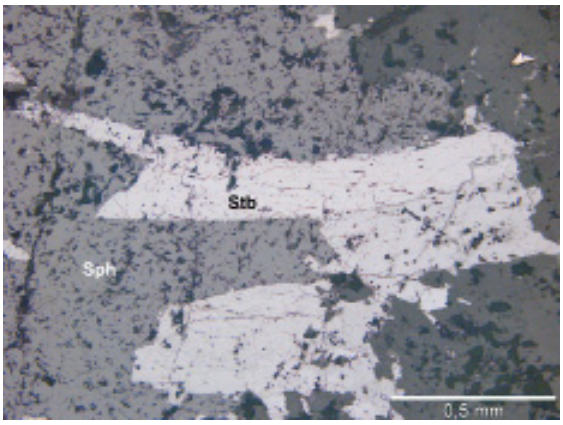

Fig 2a. *Minerals of stibnite-bearing vein from Dębowina in reflected light: Stb – stibnite, Sph – sphalerite. 1 nicol.*

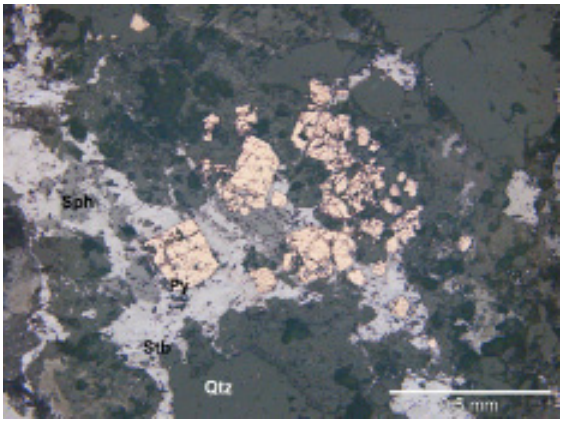

Fig 2b. *Minerals of stibnite-bearing vein from Dębowina in reflected light: Stb – stibnite, Sph – sphalerite, Py – pyrite, Qtz – quartz. 1 nicol.*

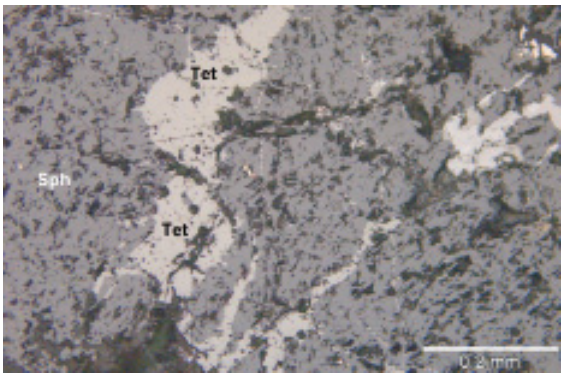

Fig 2c. ***Minerals of stibnite-bearing vein from Dębowina in reflected light: Sph – sphalerite, Tet – tetrahedrit. 1 nicol.***

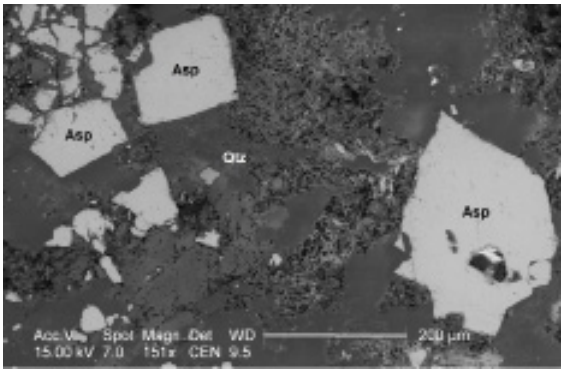

Fig 3a. ***SEM images of stibnite with associated minerals. Asp – arsenopyrite, Qtz – quartz.***

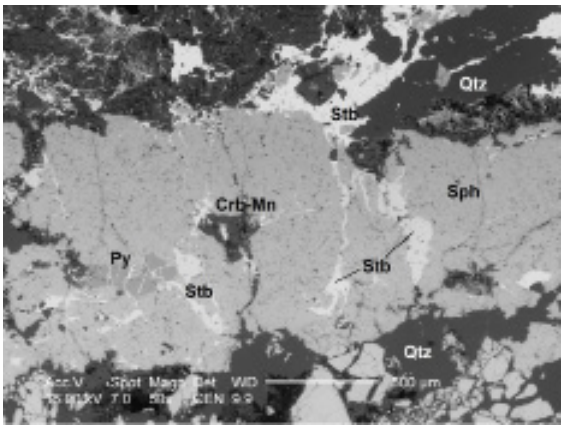

Fig 3b. ***SEM images of stibnite with associated minerals. Stb – stibnite, Sph – sphalerite, Crb-Mn – dolomite rich in Mn, Py – pyrite, Qtz – quartz.***

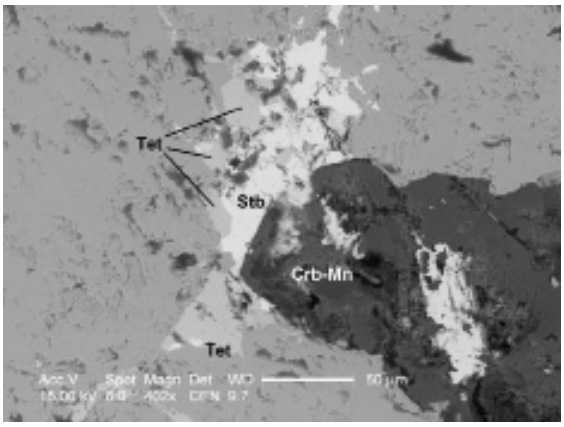

Fig 3c. ***SEM images of stibnite with associated minerals. Stb – stibnite, Sph – sphalerite, Crb-Mn –dolomite rich in Mn, Tet – tetrahedrite rich Ag.***

In the studied deposit isomorphic pyrite and arsenopyrite are the earliest sulfides to form. The author discovered in analyzed vein Ag-tetrahedrite, which is accessory minerals in it (fig 3c.). It hasn't got typical, characteristic colour and optical features (lower reflected), but is isotropic (fig 2c.). EDS spectrum its chemical composition shows that it is Ag-tetrahedrite (fig 4c.). In the centre of vein there are sphalerite and stibnite. In medium part of vein appear tetraedrite, pyrite and arsenopyrite. The outer layer there are mainly quartz and carbonates with rare arsenopyrite found out (fig 3a.).

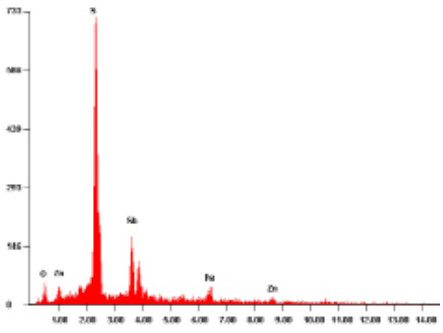

Fig 4a. *EDS spectrum of stibnite.*

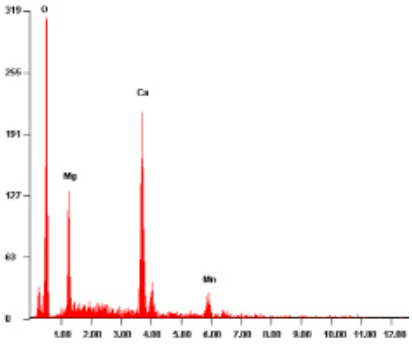

Fig 4b. *EDS spectrum of Mn-dolomite*

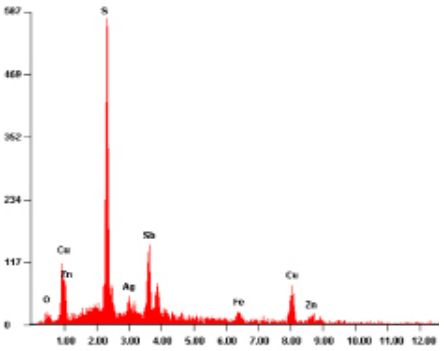

Fig 4c. *EDS spectrum of Ag-tetrahedrite.*

Conclusions

The main components in stibnite-bearing vein are stibnite and sphalerite. In the stibnite-bearing vein accessories appear pyrite and arsenopyrite. In general, arsenopyrite and pyrite are the earliest sulfides and stibnite, sphalerite are late sulfides. The author describes tetrahedrite rich in Ag, which is accessory mineral in vein, but it has never been described in Dębowina region. Experimental studies, with increasing Ph, a Sb-complex is formed, as shown in this reaction (Krupp 1988):

$\frac{1}{2}\ Sb_2S_3 + \frac{1}{2}\ H_2S \leftrightarrow \frac{1}{2}\ Sb_2S_4^{2-} + H^+$

As a consequence, tetrahedrite or other sulphosalts prevail over stibnite in the Sb-bearing deposit. Tetrahedrite replaced by stibnite reflect differentiation of polymetallic fluids in course of vein formation.

Probably the abundance of sulfide or sulphosalts minerals is larger than described before, manly by Petraschecka (1933). The characteristic feature in antimony-bearing ore is high concentration of Mn in carbonates. Carbonates rich in Mn (for example kutnohorite or rhodochrozite in the Baia Mare, Romania) crystallized in other deposits of antimony before precipitation sulfides of Sb-Zn-Ag-Cu (Grancea et al. 2002). The author in studied material haven't found gold and sulfide of Au. However there is a possibility, that gold in the mine in Dębowina not only is dispersed in other minerals, but it forms individual minerals. The studied place is unique, because its role in local mining industry. Future studies will focus on stable isotopes analyzes of carbon and oxygen in Mn-rich dolomite, in order to describe an origin of vein with stibnite and sphalerite. Carbonates will be chemically prepared for the determination of C and O isotopic data at the Silesian University of Technology, Institute of Physics Gliwice Radiocarbon Laboratory (Poland). Ratios 13C/12C and 18O/16O depend on origin of carbon and oxygen in metasomatic fluids (Schwarcz&Burnie 1973).

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