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PRELIMINARY DATA ON BISMUTH TELLURIDE FROM IZERSKIE GARBY ZONE, KARKONOSZE-IZERA BLOCK, SOUTH-WESTERN POLAND

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Abstract. This paper describes the first occurrence of bismuth telluride in the Izerskie Garby contact zone. In nature, there are 4 known bismuth tellurides: hedleyite (Bi_7Te_3), pilsenite (Bi_4Te_3), tsumoite (BiTe) and tellurobismuthite (Bi_2Te_3). They are typical accessory minerals of the polymetallic skarns. The Ca-skarns of the "Stanisław" quarry in the Izerskie Garby, bismuth telluride occurs in association with pyrrhotite, chalcopyrite, sphalerite, and wollastonite and tend to form irregular clusters up to 40µm long and 15µm width . Research methods used so far (SEM) does not allow for *unequivocal identification* of studied mineral. Therefore, it is necessary to conduct further tests using the electron microprobe.

Keywords:. bismuth telluride, Izerkie Garby Zone, skarns, Sudetes, SEM.

Introduction

In nature, there are four known bismuth tellurides: hedleyite (Bi_7Te_3), pilsenite (Bi_4Te_3), tsumoite (BiTe) and tellurobismuthite (Bi_2Te_3). Bismuth tellurides are not common minerals but they are characteristic accessory components of polymetallic gold-bearing skarns (Theodore et al. 1991, Zhao et al. 1999) and are usually associated with pyrite, chalcopyrite, pyrrhotite, sphalerite, magnetite, arsenopyrite, joséite-B, native bismuth and native gold (Thompson 1949). During studies on pyrrhotite from Ca-skarns, collected in "Stanisław" quarry in the Izerskie Garby Zone (Rybicki 2011), Bi and Te compounds were found among opaque minerals present in this rock. As stated above, bismuth tellurides are rare mineral phases and have not been reported from "Stanisław" quarry already. This study provides preliminary report on this occurrence and is only an introduction to further studies.

Geological setting

The investigated area is the "Stanisław" quarry, located in the Garby Izerskie Zone within the boundary zone of the Karkonosze massif and metamorphic Izera rock series (Fig. 1). The SE wall-rocks of this quarry consist of hornfelsed schists with intercalations of skarns (Kozłowski 1978, Fila-Wójcicka 2000). The Garby Izerskie Zone is mineralised with quartz (Kozłowski 1978), and a continous increase in quartz content can be observed in both the gneisses and hornfelsed schists toward the centre of this zone, to form an almost monomineralic quartz rock (Kozłowski 1978). The rocks of the Garby Izerskie Zone are cut by non-silicified granitoid apophyses. The skarns, fractured hornfelsed schists and granitoid apophyses were subjected to the activity of F-bearing solutions (Kozłowski 1978). Garby Izerskie fault zone is connected with a tectonic unit of the Sudetes Mountains, named Karkonosze – Izera block, consisted of the Karkonosze granite massif and its metamorphic envelope – Izera area (Mazur 2002). The Karkonosze massif is an intrusion of Variscan age (Kozłowski 1978).

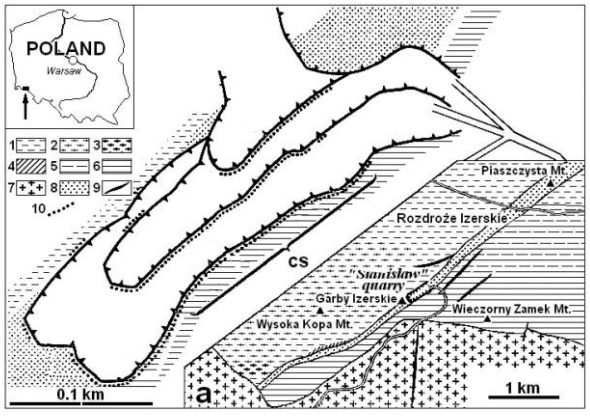

Fig. 1. Geological map of Izerskie Garby Zone (a) and "Stanisław" quarry map (after Kozłowski & Metz 2004).
1 – Izera gneiss, 2 – granite gneisses, 3 – porphyritic granite gneisses; 4 – blastomylonitic gneisses; 5 – hornfels with cordierite; 6 – biotite hornfels; 7 – Karkonosze granite; 8 – quarz vein; 9 – vein rocks; 10 – granite occurence; cs – outcrop of skarns.

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Material and methods

3 samples of skarn containing bismuth tellurides were collected during the field works in "Stanisław" quarry in 2009. Mineralogical studies were multistage. Polished sections were studied by routine microscopical methods of reflected light and using scanning electron microscopy (SEM) in Laboratory of Scanning Microscopy at Faculty of Earth Sciences, University of Silesia with the use of environmental analytical microscope Philips ESEM XL30/TMP with attachment EDS (Energy Dispersive Spectrometer) / EDAX Sapphire type in low-voltage regime (low vacuum to 1 Torr).

Results

In investigated samples, bismuth telluride has been found among pyrrhotite chalcopyrite, sphalerite and wollastonite (Fig. 2, Fig. 3).

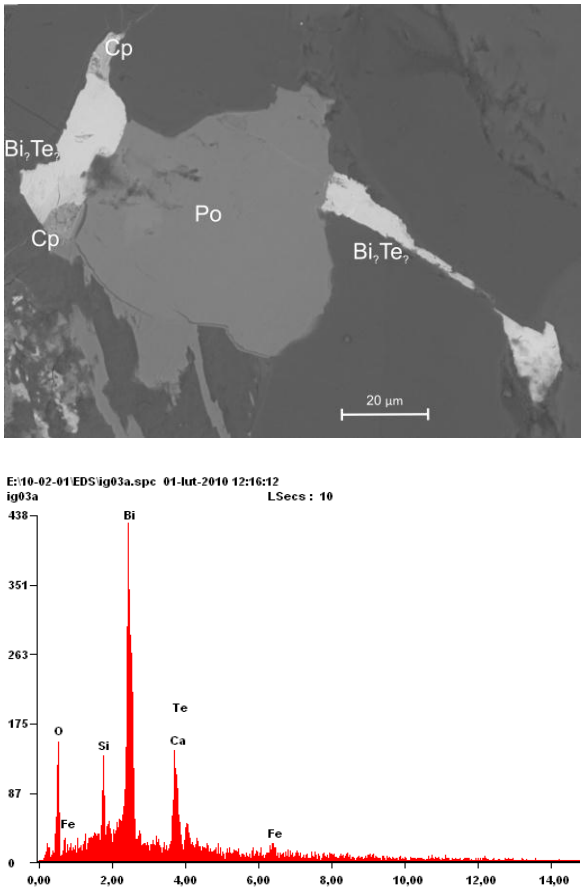

Fig. 2. SEM image of investigated sample. Cp – chalcopyrite, Po – pyrrhotite, $Bi_?Te_?$ - unkwown bismuth telluride (**top**); EDS spectrum obtained from bismuth telluride grain (**bottom**)

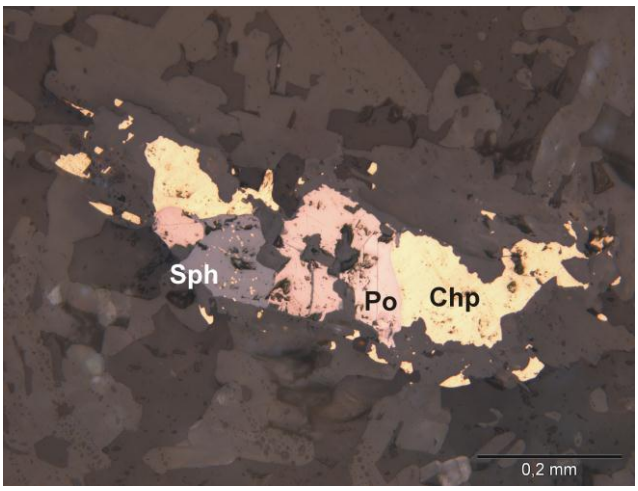

Fig. 3. Pyrrhotite (Po) with chalcopiryte (Chp) and sphalerite (Sph) in wollastonite matrix.

Bismuth telluride in skarns of Izerskie Garby contact zone tend to form thin, irregular clusters up to 40µm long and 15µm width, interwoven mainly with pyrrhotite and chalcopyrite (Fig. 2). The EDS spectrum obtained from bismuth telluride grain shows that bismuth to tellurium peak-height ratio is relatively high (Fig. 3). Ca, Si and O peaks comes from wollastonite.

Conclusions

Skarns from the Izerskie Garby are genetically related to the activity of the Variscan Karkonosze pluton. Contact metamorphism was the last thermal event in the Izerskie Garby Zone and the age of 333 ± 4 Ma is close to the peak of contact metamorphism in this area (Fila-Wójcicka 2004). All 4 naturally occurring bismuth tellurides: hedleyite (see also Warren & Peacock 1945), pilsenite (see also Ozawa & Shimazaki 1982), tsumoite (see also Shimazaki & Ozawa 1978) and tellurobismuthite (see also Balch & Jackson 1863) are accessory minerals in polymetallic skarns but none of them has been described from Izerskie Garby Zone so far.

Investigated bismuth telluride is associated with pyrrhotite, chalcopyrite, wollastonite and sphalerite. The relatively high bismuth to tellurium peak-height ratio in the EDS spectrum may be due to predominance of bismuth (at.%) over tellurium (at.%). On this basis, as the most likely phases should be considered Bi-rich minerals such as hedleyite and pilsenite but the research methods used so far does not allow for *unequivocal identification* of studied mineral. Therefore, it is necessary to conduct further tests on the electron microprobe.

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Abstrakt

Niniejsza praca opisuje pierwsze wystąpienie tellurku bizmutu w strefie kontaktowej Izerskich Garbów. W przyrodzie znane są 4 tellurki bizmutu: hedleyit (Bi_7Te_3), pilsenit (Bi_4Te_3), tsumoit (BiTe) oraz tellurobizmutyt (Bi_2Te_3). Są to typowe minerały akcesoryczne występujące głównie w polimetalicznych skarnach. W Ca-skarnach z kopalni "Stanisław" w Izerskich Garbach, tellurek bizmutu występuje w asocjacji z pirotynem, chalkopirytem, sfalerytem oraz wollastonitem i tworzy nieregularne skupienia o długości do 40 µm i szerkości 15 µm. Wykorzystane do tej pory metody badawcze (SEM) nie pozwalają na jednoznaczną identyfikację tego minerału. W związku z tym konieczne jest przeprowadzenie dalszych badań z wykorzystaniem mikrosondy elektronowej.

Słowa kluczowe: tellurek bizmutu, Izerskie Garby, skarny, SEM

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