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**SULPHIDE MINERALIZATION IN ŽACLÉŘSKÉ BOUDY  
(SE METAMORPHIC COVER OF THE KARKONOSZE GRANITE):  
RESULTS OF REGIONAL OR CONTACT-METAMORPHIC ACTIVITY**

The south-eastern part of the metamorphic cover of Karkonosze granite is a site of diversified ore mineralisation. Polymetallic mineral assemblage of the “five metals” type superimpose an ore mineralisation of contact-metasomatic origin and the genetically oldest magnetite zone (Mochnacka, Posmourný 1981).

The aim of this paper is to describe ores located in the amphibole schist in Žacléřské Boudy near Mala Úpa (Czech Republic), and to provide suggestion concerning the genesis of this occurrence.

The samples from Žacléřské Boudy were collected on the old mine dump near the abandoned gallery opening a small ore body. Ore mineralisation is generally similar to the mineral association from the deposit Obří důl below Śnieżka Mt. situated at the contact of granite and metamorphic rocks.

According to Chaloupský (1981), and Chaloupský et al. (1989), amphibole schists mentioned above belong to the Velka Úpa Group. This group is composed of Middle Proterozoic mica schists, phyllites, calc-silicate rocks, amphibolites and quartzites.

In the Mala Úpa area (Rambousek 1983) magnetite and sulphide minerals reveal spatial connection with amphibole schists, skarns and erlans. Magnetite ores are connected with skarn, while sulphides occur mainly in amphibole schists (Pertold, Rambousek 1985).

Mineralisation is hosted by amphibole schist complex which includes: amphibole-chlorite schists, amphibole-biotite schists with quartz, amphibole-chlorite schists with quartz, and quartzites. The schistosity of the discussed rocks can be obliterated by ore mineralisation.

Hornblende and cummingtonite are the dominant rock-forming minerals. They are intergrown with biotite, chlorite and quartz. Garnets reveal helicitic structures. In some samples garnets are chloritised and the complete pseudomorphs of chlorite after garnets were also found. Quartzites are mainly composed of quartz, with small amounts of other rock-forming minerals like e.g. micas.

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In some samples ore minerals constitute about 70 vol. %. Sphalerite is the most common ore mineral. Accompanying phases are: pyrrhotite, arsenopyrite, pyrite, chalcopyrite magnetite and ilmenite (or rutile), and traces of galena. The ore assemblages form various structures: massive accumulations, banded (streaky) and net-like ones.

The massive accumulations of irregular shape are composed of sphalerite usually intergrown by pyrrhotite, rarer by chalcopyrite, and occasionally by arsenopyrite. Barren silicates (usually garnets) are also present.

The banded (streaky) structures reflect the foliation of the host rocks. These ore accumulations form wavy streaks usually of irregular boundaries and diversified mineralogical composition. Some of them are composed of massive sphalerite (locally with pyrrhotite intergrowths) with spots of barren minerals, others consist of dispersed arsenopyrite or ilmenite. The bands of massive pyrite are covered with chalcopyrite and goethite, and disseminated arsenopyrite grains were also found in them. The thickness of the bands varies from few millimetres to one centimetre.

The net-like structure is typical of ores dominated by chalcopyrite and pyrrhotite. Meshes in the net are composed of silicate minerals.

Sphalerite, which is the main sulphide, usually forms metablasts intergrown with pyrrhotite, chalcopyrite, arsenopyrite and silicates. Microscope analysis of these intergrowths suggest that pyrrhotite is younger than arsenopyrite and probably younger than some chalcopyrite grains. Sphalerite distribution may suggest its formation by the metasomatic replacement of mica or chlorites.

Arsenopyrite and ilmenite are the oldest ore minerals. Arsenopyrite crystals are idiomorphic. Some grains seem to be replaced by pyrrhotite and sphalerite. Magnetite is a rarely occurring component but probably its two generations are present. The first one occurs as grains included in the accumulations of other ore minerals, the second one forms rims around the sphalerite and pyrrhotite aggregates.

Basing on the studies of the mineral intergrowths it was possible to determine the ore minerals succession:

- ilmenite (and rutile), the oldest mineral(s)
- arsenopyrite, magnetite I
- sphalerite I, pyrrhotite, chalcopyrite, pyrite
- sphalerite II(?), magnetite II
- goethite(?)

Macroscopically sphalerite is almost black. Under the reflected light microscope it reveals very low reflectivity and, occasionally, brown internal reflections. In transmitted light it shows creamy to brown colour.

The examination of fluid inclusions in sphalerite brings additional data on the temperature and pressure of sphalerite formation (Table 1). The temperatures and especially the pressure of sphalerite crystallisation varied in narrow ranges. The crystallisation pressure changed from 1.3 to 1.4 kbar and crystallisation

temperature ranged from 355 to 420 °C. The relatively high pressure inside the inclusions and six planes of the perfect cleavage in sphalerite might have caused partial or complete leakage of some inclusions, thus 118 inclusions were discarded during the investigations leaving the population of 267 inclusions for which credible data were obtained (Table 1). Na-dominated chloride mineral-forming fluid had salinities ranging from 9.1 to 10.5 wt.% NaCl equivalent.

Table 1. The data obtained by the studies of fluid inclusions in sphalerite

| Group | Homogenisation temp., °C | Total salinity, wt. % | Solution type | CO <sub>2</sub> inclusion homogen. temp., °C | CO <sub>2</sub> inclusion density, g/cm <sup>3</sup> | Crystallisation temperature, °C | Pressure, kbar |
|-------|--------------------------|-----------------------|---------------|----------------------------------------------|------------------------------------------------------|---------------------------------|----------------|
| 1     | 282-275                  | 10.5                  | Na>>K         | 28.3                                         | 0.656                                                | 420-404                         | 1.4            |
| 2     | 279-266                  | 11.3                  | Na>>K(Ca)     | 28.4                                         | 0.655                                                | 410-392                         | 1.4            |
| 3     | 270-267                  | 10.0                  | Na>>Ca        | 28.3                                         | 0.656                                                | 398-390                         | 1.4            |
| 4     | 266-253                  | 10.2                  | Na>Ca         | 28.4                                         | 0.655                                                | 392-377                         | 1.3            |
| 5     | 254-245                  | 9.6                   | Na>>Ca        | 28.4                                         | 0.655                                                | 380-361                         | 1.3            |
| 6     | 250-240                  | 9.1                   | Na(>>>Ca?)    | 28.4                                         | 0.655                                                | 370-355                         | 1.3            |

The number of the investigated inclusions in the groups 1–6 were as follows: 1 – 68; 2 – 41; 3 – 42; 4 – 56; 5 – 39; 6 – 21.

Basing on the microscopic and fluid inclusion examinations it may be concluded that sphalerite was formed under the conditions of low pressure and high temperature. Consequently, the currently observed sphalerite and associated pyrrhotite, chalcopyrite and magnetite II, formed after the regional metamorphism and are genetically related to the contact activity of Karkonosze granite.

The relative time of ilmenite, magnetite I and arsenopyrite formation cannot be established unambiguously on the basis of the performed observations. These minerals are older than sphalerite and may have been formed during – or before the regional metamorphism.

The occurrences of the ore minerals at Žacléřské Boudy can be compared with the second stage of mineralisation at the Kowary mine which is genetically linked to the locally developed skarns.

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