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FACTORS CONTROLLING COBALT OCCURRENCE IN NORTH RUDNA MINING AREA, LGOM, POLAND

INTRODUCTION

Cobalt is one of the major trace metals in copper deposits in the Fore-Sudetic Monocline. It has been a subject of studies and scientific descriptions for many years. Nowadays, there are known mineral phases with cobalt and its spatial distribution. Some authors (Harańczyk 1972; Kucha 1976; Salamon 1993; Piestrzyński et al. 1998) claim that cobalt occurs as diadochic addition in other sulfides and arsenites. A new balance of Co based on atomic relationship is discussed in this paper.

DISTRIBUTION OF METALS IN AREA STUDIED AND MICROSCOPY OBSERVATIONS

In area studied distribution of cobalt in vertical profile is similar to one of described by Piestrzyński et al. (1998). The maximum contents of cobalt is documented in the Kupferschiefer strata and it reaches often several hundred ppm, rarely thousand ppm and more. The other zone showing elevated amount of cobalt is upper part of the Weissliegendes. A thickness of this zone is variable. In general it is about 40 cm, but very often reaches to 80 cm or even 100 cm. An average contents of cobalt in this zone ranges from 100 ppm to 200 ppm, often decreases below 100 ppm, and occasionally increases above 200 ppm but never exceed 500 ppm. Below this enriched zone cobalt contents his between 20-30 ppm only.

The distribution of arsenic is very similar to cobalt. In the Kupferschiefer distribution of As reaches 1800 ppm with an average value 100-300 ppm. In the Weissliegendes contents of arsenic is also similar to cobalt ones. Arsenic amounts usually below 200 ppm, less than 100 ppm and rarely reach 300, 400 ppm.

Within the cobalt enriched zone the following associations of ore minerals are observed: bornite – chalkopyrite, heather bornite – digenite, bornite – chalkopyrite – sphalerite, chalkopyrite – tennantite. In almost all samples pyrite is present as a framboidal conglomeration showing typical sunflower structures. Locally as an aggregate of fine anhedral not framboidal crystals within sandstone cement. Grade of mineralization in samples is different, from 0,5 vol. % up to 20-

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30% vol. %. In a few samples there have been found the following minerals: sphalerite, galena, idaite, stromeyerite, native silver and thuholite complexes. Phases of cobalt aren't observed in any litological types.

DISCUSSION

During microscopy observation cobalt minerals were not observed. Occurrence together of cobalt and arsenic indicate that there should be own cobalt minerals, because the most important of them is cobaltite (CoAsS). Existing of high Pearson factors linear correlation between arsenic and cobalt (0,95 for the Kupferschiefer and 0,94 for upper part of the Weissliegendes) confirm it. Atomically ratio of these elements decided about creating own phases, while percent contents of these elements is not and essentially important. After counting percent contents value of Co and As to atomically value and recounting mutual relationship Co/As the differences between them are exposed. In the Weissliegendes relationship Co/As is near to 1, whereas in the Kupferschiefer there is much more cobalt than arsenic (Fig. 1).

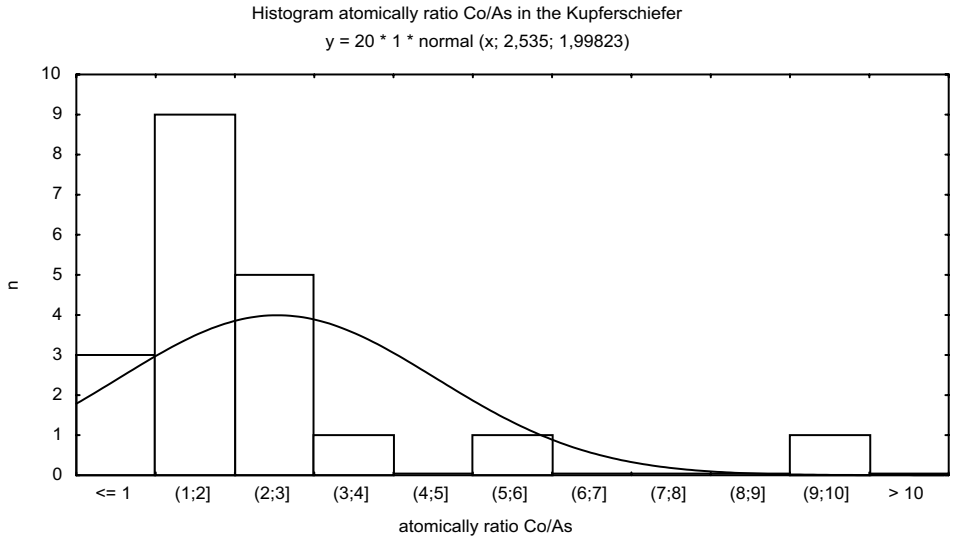

Fig. 1. Histogram atomically ratio Co/As in Kupferschiefer

These data indicate that more then half of cobalt quantity in the Kupferschiefer is located in other minerals than own phases of cobalt. Moreover, there were observed other arsenic minerals such as tennantite, which are not cobalt-bearing. It indicates that arsenic is mostly related to copper minerals. Great quantity of cobalt can be absorbed by pyrites. Large et al. (1999) found cobaltite as a cement in framboidal pyrites. In reduced environment precipitating pyrite can adsorb high quantity of Co and As. Then during crystallisation only a part of Co is introduced in the pyrite cube and the rest is crystallized in the Co-phases. Occurrence of

cobaltite cement is limited only to the floor of rich in organic matter the Kupferschiefer. Pyrite aggregates are mostly observed in samples from the Weissliegendes sandstones. Sometimes they are a dominating sulfides. It would explain high correlation Co/As and their atomically ratio close to 1 in this litological unit. However in the case of the Kupferschiefer the framboidal pyrites are observed rarely, and there is much more cobalt than arsenic. It shouldn't exist in case when its contents were determinate by pyrite. Therefore, tennantite is responsible also for bilans of As in the deposit quite commonly noted however there are no others minerals with similar contents of cobalt. In this case cobalt can be added into the structure of copper minerals which have Fe in composition for example bornite and chalkopyrite.

CONCLUSIONS

Practically all quantity of cobalt occurred in area studied is related to diadochial substitution of Cu and Fe in minerals. It is difficult to estimate quantity ratio of Co in framboidal pyrite and Co in copper sulfides. However spatial relationship in all deposit and the richest bornite mineralization suggest that this mineral is probably most responsible for Co contents.

REFERENCES

HARAŃCZYK C., 1972: Ore mineralization of the Lower Zechstein reducing sediments of the Fore-Sudetic Monocline (in Polish). Arch. Mineral. 30: 1-171(in Polish, English summary).

KUCHA H., 1976: Organic matter, Au, Ni and Co in Zechstein sediments, the Fore-Sudetic Monocline (in Polish). Annual PTG 46/3: 369-471 (in Polish, English summary).

LARGE D.J., SAWŁOWICZ Z., SPRATT J., 1999: A cobaltite-framboidal pyrite association from the Kupferschiefer: possible implications for trace element behaviour during the earliest stages of diagenesis. Mineral. Magazin. 63/3: 353-361.

PIESTRZYŃSKI A., MUCHA J., BACHOWSKI C., GŁUSZEK A., MICHALIK A., SZAROWSKI W., SERAFIN W., TOMANIK R., ZIMOCHA R., 1998: The cobalt in the copper deposit in the Fore-Sudetic Monocline, SW Poland. PTMin Special Papers 10: 119-139 (in Polish).

SALAMON W., 1993: Relation between cobalt and nickel in copper deposits in the Fore-Sudetic Monocline. PTMin. Special Papers 3: 89-96 (in Polish).