Doctoral dissertation

THE OCCURRENCE OF SILVER IN THE DEPOSIT ON THE FORE-SUDETIC MONOCLINE AND ITS BEHAVIOR IN THE TECHNOLOGICAL PROCESS

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Summary

The doctoral dissertation is a detailed study of Ag geochemistry in the Cu-Ag ore deposit in the Fore-Sudetic Monocline and the preservation of native silver during a technological, ore enrichment processes. The main goal of this doctoral dissertation is a detailed characterization of Ag-bearing minerals in the deposit and the verification of previously published data (in the years 1970 - 2000) on Ag-bearing minerals based on application of modern methods of chemical analysis in the microfield. This work also presents the characteristics of the relationship between the presence of Ag and other elements (Cu, Fe, Hg, Se and Pb) in the deposit based on lithological profiles of the deposit supplemented with of the whole rock compositional analysis and calculations of the Pearson linear correlation coefficient for Ag and Cu, Fe, Hg, Se and Pb in each profile. Another goal of this study is to characterize the behavior of native Ag phases in the ore enrichment process in O/ZWR (Concentrator Plant).

The following analytical methods were used in this study: a chemical analysis of the whole rock, an optical microscopy in reflected light, a scanning electron microscopy and a chemical analysis in the microfield using an electron microprobe. The analyzes were performed on samples collected from the entire deposit area and all lithological types of ore.

In the Cu-Ag ore deposit in the Fore-Sudetic Monocline, silver forms its own minerals, i.e. native Ag phases (native silver, silver amalgams), naumannite, Cu-Ag sulfides (stromeyerite, mercury stromeyerite, copper stromeyerite, mckinstryite, jalpaite), Cu-Fe-S type sulfides and cupropearceite. Stromeyerite is the most common own Ag mineral, and it is present in the entire deposit area, in all lithological types of ore. Native Ag phases also occur throughout the deposit, in all lithological types of ore, but in trace amounts. An important own mineral of Ag is a Ag sulfosalt, cupropearceite, identified for the first time in the deposit by the author of the dissertation. The remaining Ag minerals are locally present in the deposit in small amounts. Apart from its own minerals, Ag occurs in the form of admixtures in the structure of the Cu and Cu-Fe minerals. The most important for the distribution of Ag in the

deposit are Cu and Cu-Fe sulfides, which constitute the main group of ore minerals in the deposit. The highest Ag content was determined in chalcocite (up to 15.13 wt.%, average ca. 4 wt.%), bornite (up to 8.66 wt.%, average ca. 1 wt.%) and digenite (up to 3.21 % wt.%, average ca. 0.5 wt.%). Covellite (ca. 0.3 wt.% on average), tennantite (ca. 0.3 wt.% on average) and chalcopyrite (ca. 0.05 wt.% on average) are much poorer in Ag. In the deposit areas, where the Ag bulk content exceeds 100 ppm and the native Ag phases are not found, the Cu and Cu-Fe sulfides are the main carriers of Ag.

The distribution of Ag in the deposit, both in the horizontal and vertical cross-section, shows certain relationships. A silver bulk content increases from the west of the deposit area (average 26 ppm in the Polkowice-Sieroszowice mine), to its eastern part (average 105 ppm, in the Lubin mine). In the central part of the deposit, where an anomaly from the main Ag distribution trend appears, the highest Ag content recorded in the deposit occurs. In the vertical profile, the Cu-bearing shale is the richest zone of the Ag mineralization, whereas the levels of dolomite and sandstone are poorer in Ag. The poorest Ag mineralization occurs in the Pb-bearing zone located in a separate ore horizon, just above the Cu-bearing zone, and in the lower part of the Zechstein sandstone. The vertical profile of the deposit clearly shows the coexistence of Cu and Ag mineralization, and to a lesser extent Ag and Cu-Fe mineralization.

Considerations related to the behavior of native silver in the technological process are based on the assumption that native silver exhibits plastic properties, which enhance ability to form aggregates with small metallic iron fragments from the ore grinding process and together are transported to a flotation waste. The investigations in this study showed that such a process takes place very rarely and that aggregates composed of native Ag phases and metallic iron particles in the waste are traceable. The main carriers of Ag in the waste are Cu minerals common in the deposit, which are Ag carriers in the form of isomorphic admixtures.