Abstract

The PhD thesis deals with hydrothermal mineralization in the Polish Tatra Mountains that was the object of mining in the past. Taking into account the implementational nature of the thesis two goals were set: to make an inventory of the relics of mining in the Tatra Mountains and to restore the evolution of the hydrothermal mineralization on the Polish side of the Tatra.

The field work in the Western Tatra Mountains revealed numerous relics and traces of mining activity in the form of craters after collapsed shafts and mine dumps. Five preserved objects have been found, four adits and a large dump accompanied by a crater in the place of a collapsed shaft. All of them have been surveyed and the results are presented in the form of plans and cross-sections. Samples for laboratory analyses were collected: fragments of ore veins from the dumps and gang minerals from the adits. No traces of mine workings have been found in the High Tatra Mountains, hence samples were collected from zones of tectonic deformations.

Mineralogical and geochemical analyses were performed on samples taken selectively in a limited number because of the protected status of the study area. Electron microprobe (EPMA) was used to identify major and accessory elements in the minerals that compose the hydrothermal veins. Trace elements, up to 1 ppm, in tetrahedrite and chalcopyrite were analyzed using mass spectroscopy with inductively coupled plasma (LA-ICP-MS). Fluid inclusions in quartz associated with the ore mineralization were studied and isotope compositions were determined for selected ore minerals, barite and carbonates.

The performed analyses of chemical composition of the mineralization in the Western Tatra demonstrated that the predominant components in the ore veins are tetrahedrite -(Zn) and tetrahedrite-(Fe), intergrown with chalcopyrite, occasionally with pyrite and galena. The minerals of the tetrahedrite group have undergone advanced weathering which resulted in marked concentrations of silver and mercury. Analyzes of trace elements in tetrahedrite revealed distinct enrichment in Bi (up to 0.60 weight %) and Hg (up to 0.96 weight %). Moreover, contents higher than 100 ppm were found for Co, Mo and Cd, below 10 ppm for Ga, Ge, In, Sn, Te, Ta, W, and below 1 ppm for Au, Tl and Re. Contents higher than 100 ppm

were found for Ag, Bi, Cd and Mn only, and below 10 ppm for V, Ge, Se, Tl, Sn, Te and W. The low contents of Sn, In and Ga in tetrahedrite and chalcopyrite suggest that the mineralization was formed at low temperature and pressure.

Two generations of barite were found differing in the content of strontium. Its content reached the maximum of 9.4 weight % SrO in samples from the western slope of the Ornak mountain. Elevated contents of this element indicate low-temperature conditions of barite crystallization. Three varieties of carbonates are present: siderite with variable content of magnesium (Western Tatra), ferroan dolomite (Western and High Tatra) and pure calcite (High Tatra).

The studies on fluid inclusions have shown that the parent solutions of the hydrothermal mineralization had low temperatures of homogenization and low salinity. Basing on the results of eutectic temperature measurements, the fluid inclusions were classified as belonging to the H_2O – NaCl system with a small admixture of KCl.

The isotope studies have pointed to the formation of the ore mineralization from mixed, magmatic-meteoric solutions and to the magmatic provenance of sulphur.

Taking into account these results and also microscopic observations and SEM-BSE, the crystallization sequence of the hydrothermal minerals in the Western Tatra has been restored as: carbonates I - quartz I – barite I - quartz II + carbonates + ore mineralization + barite II – supergenic mineralization

Mineralization in the Polish part of the Tatra was classified as belonging to the **dolomite/siderite-quartz phase with tetrahedrite.** The presence of the **quartz-carbonate phase with copper sulphides** has been also proven. The **quartz-carbonate phase with copper sulphides** predominates in the Slovak part of the Tatra Mountains.