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Numerical Modeling of Sb-containing Sulphide Aggregates Formation in the Beregovo Epithermal Ore Field (Intercarpathian, Ukraine)

Alexander Emetz & **Leonid Skakun** (geomin@geof.franko.lviv.ua)

[1] 37/3 Levitsky St., L'viv, 4 Grushevsky St., Geological Department of L'viv National University, L'viv, 290005, Ukraine

The Beregovo ore field (the Beregovo gold-base metal, Muzievo gold-silver-base metal and Kvasovo silver deposits) is situated in the Intercarpathian volcanic belt formed during Neogene Carpathian collision to the west along Carpathian Mountains. The hydrothermal activity was connected with Beregovo explosive paleocaldera filled with rhyolite tuffs. Ore bodies are observed in the tuffs as sulphide, quartz-sulphide, quartz-barite and quartz veins and stockworks among quartz-adularia, quartz-muscovite, quartz-kaolinite and quartz-alunite metasomatites.

The numerical modeling was realized after careful microscopic investigations of the ores. Sb-minerals accompanied the consequent formation of 3 main ore paragenetic assemblages (from the earliest to the latest): (1 - base metal) pyrrhotite-sphalerite-arsenopyrite-galena-native antimony-boulangerite; (2 - silver) pyrite-galena- pyrargyrite-polybasite-acanthite; (3 - cooper-gold) bournonite-fahlore-chalcopyrite-native gold. Native antimony and boulangerite occur in galena as syngenetic micrograins, sometimes as “chains” along sectors of galena crystals. Rarely boulangerite grains occur in sphalerite. Bournonite and pyrargyrite are observed only in galena where replace boulangerite and Sb-bearing galena. Polybasite and tetrahedrite were formed as microblebs both inside galena matrix and sulphide aggregates, and as threads together with acanthite and chalcopyrite respectively along grain boundaries. Spatially they are connected with Sb-enriched galena. Usually Cu minerals (except bournonite) replace Ag sulfosalts. In accordance to Emetz&Skakun (1999), the precipitation of Sb-minerals in the ores happened during decreasing of Sb content when the later sulfosalts replaced the earlier ones. The work was realized to provide a model of formation of the mineral assemblages both in the Muzievo deposit and in epithermal objects having similar mineral environment.

In the presented work the interrelations between Sb-minerals served as indicators of mineral-forming environment. The modeling was executed with CHILLER software package performing recalculations of multicomponent heterogenic chemical equilibrium (Reed, 1982), and SOLTHERM thermodynamic database (Reed & Speecher, 1987).

The modeling solution was composed accordingly to mineral equilibrium in the ores and changes of wallrocks during equilibrium of the hydrothermal solution with quartz, muscovite and adularia. To reflect some principal processes affected changes in mineral-forming hydrothermal environment the modeling solution was saturated by O2 (oxidation) and was watered (meteoric watering and decaying boiling). In sphalerite fluid inclusions have the homogenization temperature from 180 to 230°C; in quartz – from 90 to 300°C. The modeling was realized for 240, 200, 150, 120 and 90°C. To investigate behavior of Ag-minerals and fahlore the additional steps of the modeling were performed during changes of Ag and Cu contents respectively.

The modeling showed that the above-noted mineral assemblages were formed during gradual oxidation and watering of cooling solution. Fugacity of oxygen was increased negligible (lg PO2~-45) on account of watering, but lg PSO2 was increased from -27 for 240°C to almost 0 for 90°C. The division between galena+native antimony and boulangerite for 240-200°C is consisted with the boundary between pyrrhotite and pyrite stability fields.

The received results explain the mineral precipitation in the range “boulangerite - bournonite - pyrargirite - tetrahedrite - polybasite - acanthite” in consequence of hydrothermal solution oxidation (part of the received results is shown in Figure 1). Therefore in widespread silver epithermal deposits where Ag mineralization is presented by intergrowths of the Sb-sulfosalts the ore formation can be explained only by this reason. The additional steps of the modeling showed that the order of the mineral precipitation is correct in different conditions, but for the muscovite stability field the minerals are more usual then for the adularia one. The decreasing of Ag activity leads to lowering of the temperature level of silver sulfosalt formation and to disappearance of acanthite, than - polybasite and pyrargyrite; Sb activity influences conversely. Most stable sulfosalt is bournonite: it forms both together with boulangerite, Ag sulfosalts and tetrahedrite, and independently in diluted solutions. Precipitation of fahlore mainly depends on balance between contents of Cu and Pb. During excess of Pb fahlore is not forming, i.e. fahlore precipitation happens if Cu activity exceeds Pb one. It explains the later development of tetrahedrite in galena of the Muzievo deposit, while tetrahedrite emulsion in sphalerite is earlier. Therefore the hydrothermal solution in the Muzievo deposit was enriched by Cu and depleted by Pb. The hydrothermal oxidation processes were accompanied by decreasing of Sb content (obviously as a result of meteoric watering) and increasing of Ag activity.

Emetz AV & Skakun LZ, Thesis of reports. Strasbourg, France, EUG10, 500, (1999).

Reed MH, Geochim. Cosmochim. Acta, 46, 513-528, (1982).

Reed MH & Spycher NF, SOLTHERM, data base. A computation of thermodynamic data from 25ºC to 300ºC for aqueous species, minerals and gases. Eugene, Univ. Oregon, 30, (1987).