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INCORPORATION OF "INVISIBLE GOLD" TO THE SULPHIDE MINERALS FROM TATRIC UNIT (WESTERN CARPATHIANS, SLOVAK REPUBLIC)

ANDRÁŠ, P.[1], CHOVAN, M.[2] & OZDÍN, D.[2]
[1] Geological Institute, Slovak Academy of Sciences, Severná 5, SK-974 01 Banská Bystrica, Slovak Republic.
E-mail: andras@savbb.sk
[2] Deparment of Mineralogy and Petrology, Comenius University, Mlynská dolina G, SK-842 15 Bratislava, Slovak Republic.

The main gold carriers among the sulphide minerals of the Tatric Unit are arsenopyrite and pyrite. They are usually enriched in Sb and their characteristic feature is the strong inhomogeneity caused preferentially by negative As-Au vs. S-(Sb, Fe) correlation. The Au contents in arsenopyrite reach up to 6700 ppm (point analyses from the Trojárová deposit) and in pyrite vary from 0 to 62 ppm (from the Pezinok deposit). Mössbauer spectroscopy proved that the dominant part of the Au content in gold-bearing sulphide minerals is (with the exception of the Jasenie deposit) represented by invisible gold.

The incorporation of Au into the crystals show many irregularities. We cannot define any definite scheme but we can present several relatively expressive trends:

It is possible to distinguish three types of gold-bearing sulphide crystals: with more or less homogeneous distribution of Au, with Au-enriched crystal cores and Au enriched crystal rims. The Au-enrichment shows an important positive correlation with As contents. This correlation is usually absent in homogeneous sulphide crystals. Au-As enrichment of crystal rims was described from the Malé Karpaty Mts. region (Pezinok, Trojárová deposits) and from some occurrences of Nízke Tatry Mts. (Mlynná dolina Valley). Opposite trend was observed at the Dúbrava, Vyšná Boca and Nižná Boca deposits (Nízke Tatry Mts.).

Incorporation of Au into the sulphide minerals depends on various factors: stoichiometry, stability of the aqueous complexes, presence of a suitable bonding-relations. Important supposition of gold incorporation to the sulphides is the high arsenic concentration. The presented process is usually accompanied by Sb, S and Fe content decrease in connection with the acidification of the ore-forming fluids. Critical value of this decrease is different at various deposits but is usually approximately constant within one single deposit.

Au enters into the crystals during favourable conditions from CO_2 containing aqueous solution of low salinities (from 1 to 11 weight equiv. % NaCl). Homogenization temperatures vary from 230 to 325 °C and the crystallization temperatures are about 330-450 °C. The coprecipitation of Fe, As, S, Sb with Au usually follow the temporary increase of the As-content during the dynamic varying crystallization conditions, the suitable temperature and pH conditions. The quiet stable crystallization conditions seems to be not very suitable for Au-incorporation.

After some common assumptions the submicroscopic gold is situated in lattice deformations. WAGNER *et al.* (1988) and CATHELINEAU *et al.* (1989) published opinion that Au is incorporated to the sulpides in "non-metallic" anion form. BOYLE (1979) and COOK & CHRYSSOULIS (1990) suggested that Au substitutes for As in arsenopyrite. This hypothesis is based on comparison of ionic radii of covalently bonded As and Au. JOHAN *et al.* (1989) used electron-probe data from gold-rich arsenopyrite and stoichiometric calculations to propose that Au is substituting for the excess As, which actually is present in Fe sites. SCHOONEN *et al.* (1992) and FLEET *et al.* (1993) show the great importance of adsorption-redox reactions on surface of the sulphides growth zones in the gold-bearing sulphide ores forming process. The Au transport is possible in form of miscellaneous fluids (by diffusion too) and Au is not incorporated to sulphide structure but to pores, vacancies and on surface of mineral growth-zones. According to this assumption pyrite and arsenopyrite contain in aqueous fluids at the growth plain surfaces oxidizable S-H and S_x-H surface groups (≡ SSH), so they can reduce $AuOH(H_2O)^0$ ligands and create Au-S complexes on surface of arsenopyrite and pyrite crystals (SCHOONEN *et al.* 1992).

The last mentioned mechanism is the most probable one for the investigated Western Carpathian deposits. Such assumption could explain nearly any As:Au correlation in ICP/MS-laser ablation and microprobe point analyses and on the other hand an important As:Au correlation in AAS bulk-analyses of distinct growth zones of gold-bearing sulphide minerals (there were realised parallel analyses of separately dissolved crystal rims and crystal cores).