

Chemical state and geochemical behavior of Au in the synthetic crystals of Fe, Fe-In and In-bearing sphalerite

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Sphalerite is a widespread mineral of hydrothermal ore deposits and one of the main sources of such critical metals as In and Ge. The presence of In-bearing sphalerite has been widely reported in “high-temperature” deposits. Previously we demonstrated [1] that In- and Fe- sphalerite can contain high concentrations of Au in comparison with pure ZnS. In the present study several crystals of In, In-Fe, and Fe-bearing sphalerite have been synthesised in Au-saturated system using gas transport and salt flux methods. Synthetic sphalerite contained from 0 to 2.5 mol.% In₂S₃, and from 0 to 40 mol.% FeS. The samples were studied using EPMA, LA-ICP-MS and XAS. The concentration of Au increased from 5 to ~1200 ppm with increase of In concentration from 0.088 to 2.5 mol.%. The maximum concentration of Au in Fe-bearing sphalerite (600 ppm) has been observed in 30 mol.% FeS sample. This fact may be related to the maximum amount of Fe³⁺ in FeS - ZnS solid solution series. In these cases, Au incorporates in the crystal structure of ZnS in the form of solid solution according to the scheme: $Au^{+} + In^{3+}(Fe^{3+}) \leftrightarrow 2 Zn^{2+}$. The highest concentration of Au was determined in (Zn, Fe, In)S and was equal to ~5000 ppm. The distribution of all studied elements (In, Fe, Au) in crystals is homogeneous according to the LA-ICP-MS time-resolved analysis. The synthesised samples may be used as a calibration standard for performing LA-ICP-MS and EPMA trace elements analysis. The financial support for this study was provided by RSF (grant 14-07-00693).

[1] Tonkacheev *et al.* (2015) Proc. SGA 13th Biennial Meeting, vol.2, p. 847-850