Sphalerite as a matrix for noble, non-ferrous metals and semimetals: A EPMA and LA-ICP-MS study of synthetic minerals

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Sphalerite (Zn, Fe)S is one of the main components of ores of hydrothermal and magmatic origin. The purpose of this work is to characterize distribution pattern and possible concentration range of these elements in synthetic sphalerite using EPMA and LA-ICP-MS. ZnS crystals were grown using the gas transport method with NH_4Cl as a transport agent. A mixture of the starting materials were ZnS or ZnS with 3-5 wt% FeS. Initial phases were powdered and loaded into a silica glass ampoule together with ~20 mg NH_4Cl and small strip of noble metal (Au, Ag, Pd, or Pt) or CdS, ZnSe, Cd_2S_3 or In_2S_3. The loaded ampoules were placed into a horizontal tube furnace which was then heated and kept at the experimental temperature during 30-60 days. The temperature gradient in the furnace was 50-100 °C, and the temperature measured at the hot end of the ampoules was 850 °C. Several different sphalerites with various admixtures were synthesized. The first series of samples was Fe-free sphalerite. The distribution pattern of Cd, Mn, Au in ZnS is close to homogeneous. EPMA yields the following trace element concentrations: C_{Mn} = 0.761±0.035; C_{Cd} = 0. 555±0.096; C_{Ag} = 0.061±0.035 wt.%. The second series of sphalerite contained up to 0.03 formula units of Fe (1.73 wt.%). The concentration of Au, as measured by LA-ICP-MS, is 234 ± 34 ppm. The distribution of gold is homogeneous. In the presence of Ag_2S sphalerite $(Zn_{0,97},Fe_{0,02})S_{1,01}$ contains C_{Ag}= 343 ± 86 ppm, the distribution of Ag is heterogeneous. The concentration of Au in sphalerite $(Zn_{0,95},Fe_{0,03})S$ sample, that contained admixture of Mn, In, Se, Cd (C_{Mn}= 0.240 ± 0.020, C_{In}=0.290 ± 0.011, C_{Se}=0.126 ± 0.040, C_{Cd}=0.484 ± 0.060) was found to be as high as 0.3 wt. %. Thus, sphalerite can be considered as an effective concentrator of trace elements, including noble metals (Ag, Au). The concentration of gold and silver in sphalerite can reach 0.3 wt. %