American Mineralogist, Volume 93, pages 1630–1640, 2008

A solution model for high-temperature PbS-$AgSbS_2$-$AgBiS_2$ galena

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Abstract

Significant quantities of silver can be accommodated in galena as a coupled substitution with Ag + Sb and/or Ag + Bi for 2 Pb atoms. The limitations of this solubility are quantified experimentally for the cubic ($Fm\bar{3}m$) α-galena phase. Above 441.7 °C, the α-galena phase has complete solid solution across the Pb_2S_2-$AgSbS_2$-$AgBiS_2$ (galena-miargyrite-matildite) ternary. Dry sinter experiments at 400, 375, and 350 °C extend the known miscibility gap on the Pb_2S_2-$AgSbS_2$ binary into ternary compositions. Phase equilibrium and miscibility gap data and self-consistent thermodynamic data for other high-temperature phases in this system combined with data for other sulfides and sulfosalts are used to constrain an asymmetric regular solution model for the α-galena phase (Pb_2,AgSb,AgBi)S_2. Phase relations in this system suggest that simple retrograde re-equilibration during cooling can produce phase assemblages and textures commonly observed in Ag-bearing ore deposits. Bulk metal ratios of deposits in conjunction with the application of this thermodynamic model may be used to understand district Ag-distribution or as an exploration tool.

Keywords: Experimental petrology, Ag in galena, phase equilibria, thermodynamics, silver deposits