Compositions of Cu-Pb-Ag-Sb-S melts produced at 500 °C

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In metamorphosed ore deposits, vein ores representing sulfide partial melts are believed to be generally richer in galena, Pb-Ag- and Pb-Cu-Sb-sulfosalts. The Pb-Ag association with sulfide partial melting is also exemplified by the existence of disequilibrium phases of ~$CuSbPbS_3.Ag_2S$ and ~$PbS.Ag_2S$ in the Pb-Zn-Ag deposit at Sindesar-Kurd, Rajasthan, India [1]. Simple pseudo-ternary systems involving end-members Cu_2S, PbS, Sb_2S_3 and Ag_2S have been experimentally studied [2][3][4]. However, the possibility of complex inter-component interactions does not allow the direct extrapolation of these results to natural ores. We have conducted evacuated silica tube experiments at 500 °C in the complex system Cu_2S-Sb_2S_3-PbS-Ag_2S at 10 mole % Ag_2S. The melts obtained are S-deficient, with varying concentrations of Cu (14.65–23.69 atom %), Ag (7.33–20.32 atom %), Sb (9.32–19.92 atom %,) Pb (6.33–11.32 atom %) and S (44.26–48.40 atom %). The PbS-rich bulk compositions yielded galena + melt, while the Sb_2S_3-rich bulk compositions produced only a melt phase and the Cu_2S-rich bulk compositions yielded Ag-tetrahedrite + famatinite + melt. Considerable Ag (4.37 atom %) and Sb (4.10 atom %) in galena and the positive correlation between them suggest their incorporation through the coupled substitution $Ag^{+} + Sb^{3+} = 2Pb^{2+}$. The slight difference in their amounts is due to the incorporation of Cu in minor quantities (up to a maximum of 0.49 atom %).

[1] Rao *et al.* (2017) *Can. Mineral.* **55**, 75–87, [2] Hoda and Chang (1975) *Can. Mineral.* **13,** 388–393, [3] Hoda and Chang (1975) *Am. Mineral.* **60**, 621–633, [4] Pruseth *et al.* (1997) *Econ. Geol.* **92**, 720–732.