Melting Experiments in the ZnS-PbS-FeS-$CuSbS_2$ System at 600 °C

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Considerable remobilization can occur during metamorphism of preexisting base metal sulfide deposits producing ore zones enriched in valuable metals. Low melting point chalcophile elements (LMCE) such as As, Bi, Hg, Sb, Se, Sn, Tl and Te promote partial melting of sulfide assemblages at relatively lower temperatures [1]. In addition, Cu is responsible for inducing melting at low temperature [2,3]. It is generally observed that the remobilized ores are richer in galena (PbS) and sulfosalts (commonly those of Sb and As). Experimental work involving PbS, Cu_2S and Sb_2S_3 record the possibility of a Pb-poor Sb-rich melt above 440 °C [4,5]. We have conducted experiments in evacuated silica tubes at 600 °C in a more complex and naturally representative system ZnS-PbS-FeS incorporating 10 mol % $CuSbS_2$ to investigate the nature of melting at middle amphibolite facies conditions, to which majority of the sulfide deposits are metamorphosed. The results of our experiments show that the melt generated is very low in Fe (1.19–4.13 atom %) and Zn (0.25–0.95 atom %), the Zn-content decreasing with increasing S while Fe increased with increasing S. The S-content varied from 44.88 to 50.39 atom %. While the Pb-content is almost constant (12.74–14.64 atom %), Cu and Sb are anticorrelated. The melt is highly enriched in Cu (14.15–27.67 atom %), which decreases with increasing S. The Sb-content varies from 10.68 to 18.34 atom % and increases with increasing S. With increasing S, Cu decreases with a much steeper rate than the rate of increase in Sb suggesting corresponding increase in another element. Combined Sb + Pb increase with similar rate at which Cu decreases and thus Cu in the melt may be being replaced according to the scheme 2Sb + Pb = 8Cu. The low Fe- and negligible Zn-contents of the melt imply that galena and sulfosalt-rich remobilized vein ores containing smaller amount of chalcopyrite and traces of sphalerite are indicative of sulfide partial melting.

[1] Frost *et al*. (2002) *Can. Mineral*. **40**, 1–18, [2] Stevens *et al*. (2005) *Econ. Geol*. **100**, 781–786, [3] Pruseth *et al*. (2014) *Ore Geol. Rev*. **60**, 50–59, [4] Hoda and Chang (1975) *Can. Mineral*. **13**, 388–393, [5] Pruseth *et al*. (1997) *Econ. Geol*. **92**, 720–732.