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High-temperature chalcocite in silicate slag melt and implications for mineralogy of sulfides from natural Cu-rich exotic melts

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Chalcocite is a common Cu ore mineral in outer zones of magmatic-hydrothermal porphyry Cu deposits and sediment-hosted Cu deposits. However, the occurrence of chalcocite in magmatic base sulfides is unknown or highly limited. Interestingly, we have observed chalcocite-containing sulfides in cooled silicate slag melts. Sulfides textures, chemical composition, as well as temperature and oxygen fugacity conditions, strongly resemble those known from the lower crust mafic environment.

The analyzed pyrometallurgical slags are a product of historical Cu smelting from Polish strata-bound type Cu ores, related to the marginal, oxidized part of the Zechstein Kupferschiefer formation in the North-Sudetic Basin, Poland. Slags are composed of SiO_2 (42-50 wt%), CaO (17-27 wt%) and Al_2O_3 (17 wt%) with variable amounts of Fe_2O_3 (2-20 wt%) and high K_2O contents (4-7 wt%). The slag material represents re-melted and re-crystallized gaunge, mixed with unextracted ore, which results in exceptionally high Cu content of this melt (~4.4 wt% Cu). Copper is held by metallic Cu (an anthropogenic analogue of native Cu), copper-iron sulfides (chalcopyrite, bornite), and chalcocite. The thermodynamic reconstructions with MELTs software [1] showed that the liquidus temperature of ~1200°C was exceeded. Thus, observed sulfides are not unmelted remains of the original ore.

Although magmatic base sulfides are usually associated with ultramafic and mafic systems, deposits of exotic Cu-rich compositions in alkaline environments are also known [2]. The composition of the analyzed materials is not far from mafic magmas but is featured by low MgO, as well as high K_2O and Cu contents. We believe that either a particular melt chemical composition or distinct pressure conditions (0.1 MPa on the surface compared to 200-500 MPa in typical mafic melts) are the reasons for high-temperature chalcocite crystallization.

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References:

[1] Kadziolka, Pietranik, Kierczak, Potysz & Stolarczyk (2020), *Journal of Archaeological Science* 118, 105142.

[2] Graham, Holwell, McDonald, Jenkin, Hill, Boyce, Smith & Sangster (2017), *Ore Geology Reviews* 80, 961-984.