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Mineralogical variation of skarn ore from the Tellerhäuser deposit, Pöhla, Germany

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The polymetallic Zn-Fe-Sn-Cu-In skarns at Pöhla Tellerhäuser in the western Erzgebirge represent some of the largest unexploited occurrences of Sn and In in Europe. The skarns developed in schists and gneisses at the margin of the Schwarzenberg Gneiss cupola and the Eibenstock granites. The flat-lying skarn layers display extreme mineralogical variability with alternating units of pyroxene, sphalerite, magnetite, amphibole and calc-silicate skarns with hanging wall schist and feeder stockwork. The polymetallic skarn ores represent a complex challenge for mineral processing, with fine-grained, locked target minerals and partitioning of target metals into silicates (e.g. Sn in malayaite). Optical microscopy, QEMSCAN® and electron-probe microanalysis have been used to determine the mineralogical variability of the skarn types with the aim to determine the deportment of the target metals to guide mineral processing test work.

The composition of the skarns is extremely variable reflecting the complex mineralogy and indicating substantial variability associated with replacement reactions through the protolith(s). Cassiterite (SnO_2) is the dominant Sn-bearing mineral in all the skarn types. However, the skarns also carry malayaite (CaSnO[SiO4], up to 0.03 vol%), which locally dominates over cassiterite. Cassiterite is intergrown with Fe-amphibole, grossular garnet, fluorite and magnetite. The cassiterite is unaltered, but some grains have rare iron oxide rims and inclusions. Malayaite shows a similar association to cassiterite and is intergrown as clusters of grains with silicate gangue, particularly Fe amphibole and grossular garnet and remains unaltered with no inclusions.

Zinc is exclusively hosted in sphalerite and varies from 0.02 wt.% in the hanging wall schist to 36.5 wt.% in the sphalerite skarn. The high Zn values are accompanied by high values of Cd (locally in excess of 1000 ppm) and In (up to 180 ppm). Sphalerite grains are locally up to 4 mm, subhedral with chalcopyrite disease and pyrite epitaxial growth along contacts between sphalerite and magnetite. Inclusions in sphalerite include bornite, enargite, chalcocite and arsenopyrite. Magnetite comprises up to 94 vol% (mean 32 vol%) of the magnetite skarn and displays extensive haematite alteration. Intergrown with magnetite are subordinate cassiterite and sphalerite with chalcopyrite disease and high In concentrations.

The mineralogical complexity is the most significant challenge for processing of the Tellerhäuser ore. Some Sn is locked within silicates leading to an expected loss in processing. The diverse gangue mineralogy is likely to interfere with traditional gravity and magnetic separation techniques. Biohydrometallurgy may offer a particularly attractive method of recovery for Zn, Cu and In.

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