Mineralogical Deportment of Indium in the Neves-Corvo Deposit—Implications for Recovery and Extraction

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Neves-Corvo is a world-class volcanic-hosted massive sulfide (VHMS) deposit located in the Iberian Pyrite Belt (IPB). It is both one of the largest and richest deposits in the IPB. Besides its size, other notable features include its high tin content and the unusual ore types within which most of this tin was originally hosted. High indium concentrations (30–50 ppm in whole ore) also make it an attractive source of this rare metal. However, the mine does not currently profit from this potential.

It was the aim of this study to generate the data required for a detailed quantitative evaluation of different valorization options for indium at Neves-Corvo. In addition to data on the spatial distribution of the element, this also requires a detailed understanding of its mineralogical deportment. While previous studies had reported elevated indium concentrations in a number of different minerals (e.g., stannite, sphalerite, cassiterite, tetrahedrite-tennantite, chalcopyrite) as well as the occurrence of two discrete indium minerals (roquesite, $CuInS_2$, and sakuraiite, $(Cu, Zn, Fe)_3(In,Sn)S_4$), modal mineralogy and consequently the deportment of indium in the studied samples were never quantified.

In the present work, a combination of whole ore geochemistry, automated scanning electron microscope (SEM)-based image analysis and electron probe microanalysis (EPMA) was used to study the mineralogical deportment of indium in a representative set of more than 70 ore and process samples. It was found that, depending on ore type, sphalerite and/or chalcopyrite are the most important host minerals while stannite, roquesite, and sakuraiite are not important due to their generally low abundance. Indium concentrations in sphalerite are highly variable, but are usually 2 to 3 times higher than in coexisting chalcopyrite. The exact concentrations depend on the total concentration of indium in the ore in relation to the abundance of these two minerals. This apparent equilibrium partitioning behavior is thought to be mostly a consequence of the extensive syntectonic recrystallization of the ore minerals.

The clear dominance of sphalerite and chalcopyrite as indium carriers has obvious consequences for valorization options at the mine. First, the indium contained in the ores should be recoverable from the ores with the zinc and copper concentrates. Second, the production of separate concentrates enriched to the minimum concentrations required by smelters will only be possible by the separate processing of indium-rich ores.

To the best knowledge of the authors, this is the first detailed deportment study for indium ever conducted. The results have obvious implications not only for indium valorization at Neves-Corvo, but also in other massive sulfide deposits affected by extensive tectonically induced recrystallisation. They should therefore be of interest to the wider geometallurgical and economic geology communities.

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