

### **Mineralogical Controls on Critical Elements (Bi, In, Te) and Ag Deportment in the Ruwai Zn-Pb-Ag Skarn Deposit, Central Kalimantan, Indonesia**

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Skarn deposits make significant contributions to the global supply of Zn and Pb and are recognized for their potential to yield critical elements as by-products. However, only few studies have focussed on the mineralogical controls on the distributions of these elements within the ores, hindering efforts to optimize their recovery.

To address this research gap, this study focuses on the Zn-Pb-Ag Ruwai skarn deposit, the largest polymetallic skarn deposit in Indonesia, with a total resource of 14 Mt. of ore at ~5 wt.% Zn, ~3% wt.% Pb, ~108 g/t Ag. Ore samples were selected based on their mineralogical and compositional variability, with a particular focus on Bi, In, Te and Ag concentrations. By integrating bulk geochemical, mineralogical, and microanalytical data, the study investigated the geological/mineralogical controls on the deportment and mineralogical partitioning of these elements across different ore types.

The main ore minerals are galena and sphalerite, with minor amounts of pyrite, chalcopyrite and pyrrhotite, and trace occurrences of Ag-Bi sulfosalts and tellurides. Integration of modal mineralogy with EPMA and LA ICP-MS results, validated by bulk geochemical data, reveals highly variable deportments for the critical elements across the sample suite. This variability mostly reflects differences in both mineral abundances and the concentrations of the critical elements within the samples. In general, galena is the most important host for Ag and Bi; sphalerite carries In; tellurides along with small contributions from galena host Te. Minor contributions also come from Ag-Bi bearing minerals. Moreover, the observed correlation between modal mineralogy and elemental deportment suggests a potential regularity in the partitioning of these element across the different mineral phases that can be used for deportment predictions.