Smart Recovery of Cobalt as a By-Product of Primary Copper Extraction:
Geometallurgical ore-type classification using FTIR spectroscopy

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Cobalt is a transition metal whose physico-chemical properties make it a critical component in many tech applications, including high-strength alloys, magnets, rechargeable batteries used in electric cars, wind energy turbines, and energy storage systems. Cobalt is recovered as a by-product from extraction of nickel and/or copper ore. The largest cobalt output is derived from copper sediment-hosted deposits in the Democratic Republic of Congo (DRC). Efficient co-recovery of cobalt is challenging because the ratios of copper and cobalt within the deposit is variable. In addition, differences in mineralogy and texture are observed which imply that a fixed extraction process is not optimal for the entire deposit. In order to stabilise the mining value chain and optimize plant performance, comprehensive understanding of ore properties and geometallurgical factors which influence process performance is mandatory. Relevant ore properties depend on the processing options available (gravity, flotation, leaching) and the type of product considered (cobalt salt or metal). These properties can, in turn, be used to classify the resources by defining ore-types which are suited for a given processing route. To obtain insight into the spatial distribution of relevant properties and build a 3D geometallurgical model, it is necessary to develop techniques that have potential to measure properties rapidly and, preferably, within the mine. We have investigated the application of portable Fourier Transformed InfraRed (FTIR) to quantify the modal mineralogy of drillcore samples which are representative of the sulphide zone within a DRC Cu-Co deposit. Results were validated using QEMSCAN analysis. Prediction of gangue and target mineral grades was achieved using multivariate data analysis of the FTIR spectra through Partial Least Squares Regression. It is shown that the modal mineralogy obtained from FTIR can be used to classify ore types according to the type of copper-cobalt mineralization, copper-cobalt mineral grades, and gangue mineralogy. When the resulting geometallurgical model of the deposit is integrated into the mine planning process, the recovery of copper and cobalt can be optimized.