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Comparative analysis of linear and non-linear estimation techniques for the determination of recoverable resources in a sedimentary hosted cu-co type deposit

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ABSTRACT

Mineral Resource estimation heavily impacts the technical and financial merits of mining feasibility studies, carried out prior to any material extraction. Since exploration requires significant investment, the feasibility of a project needs to be understood as soon as possible in the development of a mining lifecycle. To help define the feasibility of a mining project, resource geologists estimate the Mineral Resource and in-situ recoverable resources available for mining. Techno economic studies are then carried out to assess the economic viability of mining and metallurgical extraction of the recoverable resource. This is achieved by geostatistically estimating the tonnage and grade of mineralisation above a given cut-off grade and at a chosen mining unit or size, (Isaaks and Srivastava, 1989).

The research presented is a comparative case study aimed at assessing the suitability of linear and non-linear estimation techniques in the determination of recoverable resources from exploration drilling data in a sedimentary hosted copper-cobalt type deposit. In an operating mine, recoverable resources are typically determined after a grade control drilling programme, drilled on a tight grid to identify subtle variations in grade within a deposit. By comparison, exploration data is inherently broadly spaced and occurs at a much earlier stage in the mining project life-cycle. The geostatistical techniques considered for the estimation of recoverable resources are ordinary kriging, uniform conditioning, and localised uniform conditioning. The localised estimate is contrasted against a grade control estimate, produced from ordinary kriging, to verify the success in determining the recoverable resources from exploration drilling data.

The research study found that the dense drilling pattern of the grade control data provides an increased understanding of the distribution of average copper grades at Tshifufia than localised uniform conditioning from exploration data. The success of uniform conditioning on exploration data and the subsequent localisation is dependent on the size of the selective mining unit and grades that have been ranked and spatially referenced according to the average ordinary kriging block estimates. This direct proportionality means that where ordinary kriging estimates are high or low, the localised uniform conditioning estimate will be proportionally high and low as well.

Despite the aim of determining the recoverable resources at selective mining unit-scale, localised uniform conditioning grades performed on exploration data provide no more resolution than the ordinary kriging mineral resource estimate, since the underlying data inherently determines the uniform conditioning and localised uniform conditioning. Any additional resolution on the distribution of average grades at selective mining unit level and determination of recoverable resources is subject to the amount and spatial representation of available information during estimation. Therefore, no suitable substitute was determined for grade control drilling and the resulting ordinary kriging grade control mineral resource estimate.