

Application of Multivariate Localized Uniform Conditioning and Conditional Simulation for a highly complex Stockwork Niobium Deposit in Brazil

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ABSTRACT

In this deposit, niobium is mainly hosted in nelsonite that occur as stockwork veins that ranges in thickness from centimeter to dozens of meters. Discrete nelsonite veins, as logged, cannot be reliably modeled as individual geological unities – there is not enough data that allows traditional geological modeling and there may be thousands of individual veins.

Linear estimation approaches as Ordinary Kriging and Simple Kriging are widely used and successful applied to estimate mineral resources in the mining industry, although it may generate a biased estimate of metal tonnage and ore recovery after a cutoff application. The bias is more evident in narrow veins or deposits with tight mineralization that are modeled with small blocks when the data spacing is much larger than the SMU size. In these cases, where the mining is highly selective, the accurate estimation of the geological units is key to a successful evaluation.

A suitable estimation methodology is necessary to avoid the risks associated to the delineation of recoverable resources that will result in an unbiased estimation. Non-linear techniques are more suitable to estimate such deposits at the SMU scale that will depend on the selectivity grade of the operation.

Uniform Conditioning (UC) can be used as an alternative to generate unbiased estimates for the evaluation of the potential of selective mining. The general framework which forms the basis for the UC is the Discrete Gaussian Model of change of support, based on the correlation between Gaussian-transformed variables. The Localized Uniform Conditioning (LUC) technique has been applied to enrich the UC distribution by localizing the results at the SMUs scale.

As UC does not provide an indication of the risks of the estimation once it is a deterministic approach, a complementary workflow using Conditional Simulations is also applied to access the grade fluctuations at the SMU scale.

The paper provides a brief review of the Localized Uniform Conditioning in the multivariate case (LMUC) estimation and Conditional Simulation techniques and presents a comparative case study based on an alkaline-carbonatite niobium deposit in Central West Region of Brazil.