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The impact of the drill spacing on the approach to mineral resource estimation

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2021
https://hdl.handle.net/10539/33394

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ABSTRACT

Mineral Resource estimation is a vital step in the mining value chain as its outcomes form the foundation of all further mine design, planning and decision making. It is important to use an appropriate Mineral Resource estimation methodology suited to the project phase, and amount of data available, in order to generate a meaningful and reliable estimate. The purpose of this research is to investigate and assess the impact of data spacing on the Mineral Resource estimation methodology.

This research is presented as a case study applied to the Ventersdorp Contact Reef of the Witwatersrand Basin. The methodology is presented for six different scenarios of increasing data density from an initial surface drilling program, with minimal, widely spaced data, to resource exploitation, with denser sampling data typical of a South African underground gold mine layout.

The methodology for defining homogenous domains is refined and adjusted as additional data becomes available. Geozones delineated during early project phases, based on widely spaced data, require adjustment as trends emerge from closely spaced sampling data.

For initial project phases, with limited data, global estimation techniques using statistical distribution theory is appropriate. Application of the Sichel t lognormal distribution and the 2-parameter lognormal distribution highlight the significance of identifying an appropriate distribution model for a global mean estimate.

As data density increases, the spatial distribution theory captured by the semi-variogram becomes more relevant and local estimation theory is applied. An overall increased nugget effect and decreased variogram range is observed as data density increases. For the ordinary kriging, the impact of the variogram model together with the data configuration and block to be estimated is presented in terms of kriging performance indicators, including block variance, kriging variance, the Lagrange multiplier, slope of regression and kriging efficiency.

This research demonstrates the necessity of aligning the estimation methodology to the stage of the resource development as a function of the amount of and spatial distribution of the available data. Data spacing has a substantial effect of on geological domaining, resource estimation methodology, resource classification, and subsequently reserve estimation and mine planning.