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Refining the methodology for geological zoning used in resource evaluation, through the application of sedimentary characteristics of deposition at Kloof Gold Mine

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ABSTRACT

Mineral Resource estimation within geologically homogenous zones increases the likelihood of achieving stationarity; a requirement for geostatistical estimation; which consequently increases grade estimation confidence. The relationship between the spatial distribution of gold grade and geological controls is confirmed through simulated drainage models, and exaggerated channel width plots, allowing for an investigation of the existing methodology based on sedimentological attributes including channel width and gold values and to establish whether homogenous zones based on geological characteristics of deposition could be identified and incorporated to refine the geozone modelling methodology.

As a starting point, an initial geozone model based on the existing mine methodology was utilised. This methodology is based on solving for the individual sedimentological attribute weightings which is used to group the sedimentological data into distinct facies types. By considering the spatial position and geological similarities, the facies model is then further refined by grouping similar geological processes.

In the refined methodology presented facies boundaries are then identified and digitised by contouring of the delineated facies types (codes), through an Inverse Distance Weighting process, resulting in nine distinct sedimentological domains being identified. Each sedimentological domain is then assigned a unique set of geological “fingerprints” based on the sedimentological weightings of each domain. The weights have a cumulative sum of one hundred, and the larger the weighting, the more relevant the sedimentological attribute is to its associated sedimentological domain and its resulting grade.

Utilising the assigned geological fingerprints of the domains, a macroscopic, qualitative assessment tool of the reef was developed. To establish the effectiveness of the qualitative assessment tool validations within known and unknown facies were carried out. First, underground mappings and a borehole drilling programme were carried out into an area of known facies and grade. The qualitative assessment tools showed that a facies and grade range could be established ahead of the mining face where grade information is scarce. As a second and final validation of the qualitative assessment tool as well as the refined sedimentological model boundaries, a borehole was drilled into an unmined reef pillar of an unknown sedimentological domain and grade. Utilising only the borehole assay results, the unmined pillar showed to be uneconomic for extraction, however introducing the qualitative assessment tool and the refined sedimentological domains, the pillar proved to be economically viable, and was subsequently successfully mined. The qualitative orebody delineation methodology as employed in this research, was observed to be a powerful tool for refining geologically homogeneous zones and consequently leading to better informed economic decisions of future mining projects and thereby preventing value destruction.

In conclusion, through the analyses and interpretation of the sedimentological data, it was observed that the depositional environment of the reef has control over the spatial grade distribution, allowing for homogenous geozones to be delineated and refined based on sedimentological attributes, consequently leading to the identification of unique geological facies, each with a unique set of sedimentological attributes.