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CONTEXTUALIZED RISK MITIGATION BASED ON GEOLOGICAL PROXIES IN ALLUVIAL DIAMOND MINING USING GEOSTATISTICAL TECHNIQUES

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ABSTRACT

Background

Quantifying risk in the absence of hard data presents a significant challenge. Onshore mining of the diamondiferous linear beach deposit along the south western coast of Namibia has been ongoing for more than 80 years. A historical delineated campaign from the 1930s to 1960s used coast perpendicular trenches spaced 500 m apart, comprising a total of 26 000 individual samples, to identify 6 onshore raised beaches. These linear beaches extend offshore and are successfully mined in water depths deeper than 30 m. There is, however, a roughly 4 km wide submerged coast parallel strip adjacent to the mostly mined out onshore beaches for which no real hard data is available at present. The submerged beaches within the 4 km coast parallel strip hold great potential for being highly diamondiferous. To date hard data is not yet available to quantify or validate this potential. The question is how to obtain sufficient hard data within the techno economic constraints to enable a resource with an acceptable level of confidence to be developed. The work presented in this thesis illustrates how virtual orebodies (VOBs) are created based on geological proxies in order to have a basis to assess and rank different sampling and drilling strategies.

Overview of 4 papers

Paper I demonstrates the challenge of obtaining a variogram that can be used in variogram-based geostatistical simulations. Simulated annealing is used to unfold the coastline and improve the detectable variography for a number of the beaches. *Paper II* shows how expert opinion interpretation is used to supplement sparse data that is utilised to create an indicator simulation to study the presence and absence of diamondiferous gravel. When only the sparse data is used the resultant simulation is unsuitable as a VOB upon which drilling strategies can be assessed. *Paper III* outlines how expert opinion hand sketches are used to create a VOB. The composite probability map based on geological proxies is adjusted using a grade profile based on adjacent onshore data before it is seeded with stones and used as a VOB for strategy testing. *Paper IV* illustrates how the Nachman model based on a

Negative Binomial Distribution (NBD) is used to predict a minimum background grade by considering only the zero proportions (Z_p) of the grade data.

Conclusions and future work

In the realm of creating spatial simulations that can serve as VOBs it is very difficult to attempt to quantify uncertainty when no hard data is available. In the absence of hard data, geological proxies and expert opinion are the only inputs that can be used to create VOBs. Subsequently these VOBs are used as a base to be analysed in order to evaluate and rank different sampling and drilling strategies based on techno economic constraints. VOBs must be updated and reviewed as hard data becomes available after which sampling strategies should be reassessed. During early stage exploration projects the Z_p of sample results can be used to predict a minimum background grade and rank different targets for further sampling and valuation. The research highlights the possibility that MPS can be used. Higher order MPS should be further investigated as an additional method for creating VOBs upon which sampling strategies can be assessed.