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Application of discrete fracture network model to rockfall analysis at Jwaneng Mine, Botswana

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ABSTRACT

Jwaneng open pit mines kimberlite pipes that intruded within the Karoo Supergroup sedimentary deposits in south-east Botswana. The western Cut 7 walls of the mine have an elevated risk of rockfalls. Rockfalls are a leading cause of fatalities in both open pit and underground mine operations. There is a need to quantify rockfall risks so that appropriate and adequate management plans are developed to ensure safe mining. Currently Jwaneng mine uses DIPS RocScience software for rockfall and kinematic analysis. It has been observed that DIPS is inadequate in the required statistical analysis of rockfalls since it does not consider all attributes of fractures. In this RocScience software, attributes of fractures that are considered are orientation and spatial distribution only. Therefore, this assessment excludes other fracture attributes that are important in rockfall analysis such as length, termination, radius and intensity.

To address this deficiency, a DFN model was constructed using the SiroModel software. The DFN model was used for rockfall statistical analysis of the Jwaneng Mine Cut 7 walls at bench scale. The DFN model results showed current 90° bench design is not optimal for the Cut 7 walls. This design angle results in elevated risks of rockfalls. A majority of the potential rockfalls, 90% of the population will have volumes between $1m^3$ and $10m^3$. A 75° bench angle is identified from the model as the optimal bench angle in the research area. This angle is recommended for implementation on the Cut 9 walls because numerous historic data collection projects, have shown that the Cut 9 walls have the similar structural fabric as the Cut 7 walls therefore findings can be postulated across these walls.