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Techno-economic optimisation of mining cut for Zimbabwe Platinum Mines' steeply dipping tabular orebody

Wailesi, Maida

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ABSTRACT

Zimbabwe Platinum Mines (Zimplats) extracts Platinum Group Metals (PGMs) in Zimbabwe along the Great Dyke. The orebody being mined at Zimplats is tabular, synclinal in nature and plunges gently at approximately 1.5º towards the north. Layers of igneous rocks within the deposit dip at 9° to 20° near the limbs and flatten near the centre to form a flat-lying floor. Mineral Resources at the mine are classified into 'flats' (Mineral Resources dipping shallower than 9º) and 'steeps' (Mineral Resources dipping at an angle > 9º). Current mining operations are limited to the 'flats' portion of the deposit but as mining progresses towards the north, the ratio of 'steeps' to 'flats' increases. The current mining layout design was based on the 'flats' with a mining cut of 2.5m. In order to exploit the steep dipping orebody limbs, modification of the current mining layout was done in 2016 and trials were conducted on the new design. Results from the trials showed that the design resulted in a lower actual head grade than planned which was attributed to a sub-optimal mining cut.

This research study was done to determine an optimum mining cut at Zimplats mine for the 'steeps' portion of the deposit, focussing on the Mineral Resources dipping between 9° to 14° to create optimum value from extracting the steep Mineral Resources. The study was carried out at P4 mine and two blocks out of the available six blocks were randomly selected for the purpose of this study. In the optimisation process, six mining cuts were selected, 2.00m, 2.10m, 2.20m, 2.30m, 2.40m and 2.50m. Mine designs were generated for each mining cut in Vulcan 3D software and Mineral Reserve calculations were done for each option. Mining schedules were generated through the application of the Vulcan Gantt Scheduler. A techno-economic evaluation was done on the six mining cuts focusing on, Mineral Reserve tonnage, grade, extraction ratio, cost and revenue generated. A discounted cash flow (DCF) analysis was done which incorporated all the evaluation parameters to determine the optimum mining cut which yields the highest Net Present Value (NPV). A sensitivity analysis was done to determine the reliability of the chosen optimum mining cut.

It was found that the optimum mining cut varied depending with the optimisation criteria. However, from the DCF analysis, the 2.10m mining cut option produced the

highest NPV of US$95 million among the other possible mining cuts. Therefore, the research study concludes that the optimum mining cut for the ‘steeps’ Mineral Resources at Zimplats mines is 2.10m. It is being recommended that the company adopts 2.10m for the exploitation of its ‘steeps’ resources. It is also recommended that the company should design a mining method for the ‘steeps’ resources with dip angles greater than 14° for maximum Mineral Resource utilisation.