WHITTLE OPTIMIZATION AT THE TELFER GOLD MINE TODAY

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ABSTRACT

This paper discusses the current implementation of Whittle software at the Telfer Gold Mine. Of interest is the method used to deal with variations in ore hardness, oxidation states, cyanide soluble copper content and different process streams. The preparation of Datamine models for optimization is discussed in some detail.

INTRODUCTION

The Telfer Gold Mine has two primary open cut resources. They are called Main Dome and West Dome. The Main Dome reserve currently contains 649,000 ounces while the West Dome reserve contains approximately 1,152,000 ounces. Both Domes contain fairly thin reef structures following the dome shapes. Ore is also found in stockworks, pods and other narrow veins. Rock types vary from soft siltstones to fairly competent sandstones. Ore treatment is influenced by the oxidation state of the rock and the amount of contained cyanide soluble copper. High grade ore gets treated through the mill/CIL circuit or the mill/CIP circuit while lower grades are treated on leach pads. Final depths of the two main pits will be approximately 200 metres. The Datamine resource models for each of the two domes contain more than a million cells. Batter angles can vary from 50 degrees to 70 degrees. Mining is generally done with drill and blast and shovel or loader and truck combinations, but high grade reefs are cut with dozers to the hangingwall and footwall limits. With this many variables in the equation it is very important to maintain a sense of proportion.

With strip ratios of around 1:1 the biggest cost component is the treatment cost. The cut-off grade for leach ore is currently at 0.3 g/t on a very steep part of the grade tonnage curve. A small change in the cut-off grade can either add or subtract a large amount of ore. The economic ratio of leach ore to mill feed is also not the same as what is dictated by practical considerations. Further complications are related to the large overhead costs involved in running a fully serviced town in a remote location.

GEOLOGY MODELS

The aim in preparing geology models for optimizations is to simulate reality as accurately as possible. In this case the mining methods have a large bearing on how the models are constructed. Large areas of low grade stockworks are mined on 8 metre high benches with hydraulic shovels. In these areas the geology models are created with large cells on the same bench heights as the intended mining. Slightly more selective mining is done on 4 metre high benches in higher grade areas. Model cells are

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set to 4 metre heights here with the smallest mining unit set to approximately the width of a shovel bucket. Some experiments have been carried out with the Datamine MINZON process in an attempt to dilute models in line with mining practice. Although these results have been encouraging, time pressures have prevented full scale use of MINZON. It is really not very realistic to try and simulate small geological structures when the cut-off grade is as low as 0.3 g/t. Essentially the dilution is already built into the low cut-off. The current thinking is to regularise Datamine model cells in stockworks areas to a 6.25 x 12.5 metre dimension and then to use the Datamine PROMOD process to reduce the number of cells in the model. The aim with high grade and well defined structures is to preserve these as far as possible. Wire frames are built around these and a dilution halo of 0.3 metres is added on either side. Datamine sub-cells are sometimes stretched beyond the limits of common sense in this process.

In the geology model "hard" rock and "soft" rock is identified, oxidation states are indicated and cyanide soluble copper levels are included for each cell. Naturally gold grades and densities are included.

PREPARING THE MODEL FOR OPTIMIZATION

For ease of use the Datamine model is set up with parent cell sizes equal to what is intended for the optimization. An air model is added. To take account of variations in mining costs, the model is divided into "productivity areas" along vertical "cookie cutter" boundaries. In each area mining cost adjustment factors are set on 20 metre vertical intervals. Ore types are set according to oxidation state, work hardness of the rock and cyanide soluble copper content of the cell. The cyanide soluble copper content can vary through a large range. Statistical analysis helped to set up sensible ranges. A limit is also reached where treatment through the CIL circuit becomes as expensive as treatment through the CIP circuit. In setting up of these ore types the limit of 25 ore types in the Whittle software has been found to be restrictive. Remember that processing cost adjustments cannot necessarily be used as it is not known which treatment path the ore might follow.

OPTIMIZATION

To avoid the complications imposed by minimum mining width and to speed optimization up, fairly large cells are used, usually about 25x25x8 metres. The 25 metre horizontal dimension is close to a minimum mining width. Up to 20 sub-cells per parent cell are passed from Datamine to Whittle. As a first pass only one subregion is used with a wall angle of 45 degrees in all directions. This facilitates the process of assessing the model without preconceived ideas of where ramps should be placed. It also keeps the process simple so that bugs can be ironed out. Pit shells are calculated for a range of gold price values in $25/ounce increments. The spreadsheet output from FDAN is assessed first to identify large steps in the total tonnage.

Further runs allow for ramps and access into narrow areas. Usually some variations in costing will be tested. (It is usually difficult to determine the exact amount to be allocated to overheads involved with the running of the village). FDAN has been used to assess the effects of cut-over grade variations but without much success. This has been tested more successfully using Datamine.

Finally the results are imported into Datamine. A block model is created with the chosen pit and a wire frame is created around this model. Contoured slices through this wire frame are plotted for visual effect.

CONCLUSION

Whittle has been an invaluable tool for assessing the economic potential of a complex ore body with multiple processing routes. The combination of Whittle and Datamine allows for solutions to most problems. Where limitations exist they are usually sensible and prevent the user from going into ridiculous amounts of detail. So far the four-D capabilities of Whittle have not been explored fully at theTelfer Gold Mine. With more powerful computers it might be possible to use the Whittle software to give guidelines for long term multi-pit scheduling.

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