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Selection of Precision Surface Mining Methods for Complex Metalliferous Orebodies

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ABSTRACT

Mining and beneficiation can be described as essentially a sequential processes of separation of valuable minerals from waste. There is a great deal of interest in how the industry can be more effective – and efficient – with these processes. In particular, many mining companies are looking towards digital technologies to improve precision mining practices; that is, the targeted identification and separation of valuable ore from waste during the mining process. Greater precision will help unlock the value in many complex orebodies that are currently considered Tier 2 or 3 deposits.

This paper will review the commonly applied precision mining practices. These include:

- GPS flagging of marginal and low grade resources on benches to guide shovel loading and truck destination,
- The use of ROM stockpiles to separate material according to grade and contaminants
- In-fill RC drilling to on benches to establish grade distribution followed by selective extraction by flitches using hydraulic backhoes,
- The use of Grade Engineering™ to separate high and low grade material via differential blasting, followed by vibratory screening,
- The emerging use of hyper-spectral imaging on bench faces in advance of shovel loading to identify high, medium and low grade ore zones.

Each of these methods requires a different process and has a different cost- and value - implication. The more selective that we can make the mining process, the more contained metal is associated with the mill feed. In addition, lower rates of mill feed are associated with higher metallurgical recovery factors principally due to increased crushing and grinding retention times. However, in order to optimize mill feed rates, selective mining processes require greater waste movement capacity, which increases mining costs. It is evident, therefore, that for any given deposit and market conditions, there exists an optimum precision mining method.

The paper adapts the economic models first developed by Lane (1980) to demonstrate how a mining company might go about selecting the optimal precision mining method. A case study on a copper/gold deposit is presented using hypothetical mining and processing cost data.