SOURCES of GRADE VARIABILITY

Understanding and managing grade variability is vital to most mining operations. This paper briefly discusses three sources of grade variability.

Sampling errors contribute some degree of variability to the grade data that is “artificial”. The sampling variance measures its magnitude, which can be reduced by taking a larger sample, however this comes at a cost. Artificial variability, often referred to as noise, should always be carefully monitored through the use of Gy’s Theory of Sampling and quality control e.g. duplicates.

We know how important this is when drilling and sampling a deposit. Likewise in the plant, reacting to variable levels of contaminants can be very costly if a large component of this variability is noise.

The in-situ grade variability is inherent to the resource being explored or being mined. We can’t change it! It can be measured by appropriately combining sampling, geology and variography. It is important to note that it depends on the grade support be it a core sample or a block of ore for instance. The mill-feed grade variability on the conveyor belt can also be measured using (chrono-) variograms.

Process-related grade variability results from the various mining, handling, blending, stockpiling and reclaiming processes undergone by the ore.

Mapping the grade variability profile of an operation is essential if the orebody is to be optimised, and involves collecting reliable data at key locations down the mine and mill value chain.

Poor practices generate inefficiencies that increase grade variability; process re-engineering may be required to make sustainable improvements.

These sources of grade variability are not independent but closely related. Poor sampling adds an unwanted component to grade variability that may lead to inappropriate variograms which, in turn, may adversely impact resource estimation, mine planning as well as mine and mill operations e.g. grade control, blending and metallurgical recovery.

Therefore, grade variability where poorly understood, can result in a significant technical risk. Implications for mine profitability and the resource base are potentially serious.

Given the interactions mentioned earlier, cost-effectively managing grade variability is an area that offers considerable scope for optimisation. A global focus is desirable e.g. improving the mine plan rather than expanding the blending facility may solve more cost-effectively a grade variability problem at the head of the mill.

Sampling, geostatistical and process-variation management techniques are among the tools that help to address and successfully manage grade variability around the operation.