Paper Number: 4650

Practical Application of Gy Sampling Theory in Mining: An Example from Mogalakwena Open Pit Pt Mine

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Sampling and sample preparation is a critical part of the ore control process on any mine. It is important that the grain size and mass reduction steps in the process are optimised for maximum efficiencies as well as maintaining the fundamental sampling error within acceptable limits. All components of the overall sampling error result from the existence of one form or another of 'heterogeneity' in the sampled materials (Gy, 1995). To ensure that an acceptable level of sampling error is maintained during any modification to the protocols and procedures it is first necessary to fully quantify the heterogeneity of the ore. Failure to understand and quantify ore heterogeneity and consequent levels of sampling error at Mogalakwena would have significant business implications for this low-grade high-tonnage polymetallic deposit.

Mogalakwena consists of five open pit mines, using the truck and shovel method, with an annual refined 4_E PGE production of 902oz in 2015 with a reserve mine life more than 26 years. Mineralisation is hosted within the dominantly pyroxenitic rocks of the Platreef, however the ore is highly variable in texture and mineralogy. Ore control sampling is done almost exclusively now using Reverse Circulation (RC) drilling which has been implemented over the last couple of years. As part of this it was essential to ensure the correct re-design of the sampling process.

The method followed is based on Gy's sampling theory. The fundamental sampling constant from Gy's basic equation is different for each ore type, and can be derived from empirical testing of the heterogeneity of the ore. This process is called a 'Heterogeneity Test'. Such tests have existed for several decades, but their practical implementation is sometimes problematic. Furthermore, recent advances in sampling theory have meant that such tests have improved in rigour and these revised approaches (e.g. Minnitt and Assibey-Bonsu, 2010) are followed in this work.

Results from the improved methods of heterogeneity testing have been compared to earlier formulations of the test to establish the improvement and to determine the most cost effective way of heterogeneity testing for all future work.

Figure 1: Collecting the 500kg bulk sample used for the test work from the temporarily stopped conveyor belt.

The construction and use of the final set of sampling nomograms for the full suite of elements (Pt, Pd, Au, Cu and Ni) will be explained, including how these were then used to optimise the RC ore control sampling. Other sampling protocols from exploration diamond drilling to process metal accounting also benefited from this knowledge.

References:

[1] Gy, PM (1995) Trends in Analytical Chemistry 14-2: 67-76
[2] Minnitt, RCA and Assibey-Bonsu, W (2010) Journal of the SAIMM 110: 251-268