Lifting the lid on resource drill hole data after mining

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ABSTRACT

Resource estimates are the corner stone of technical and investment decision-making. Prior to mining, resource estimation uncertainty has the greatest potential to lead to poor investment decisions, despite a significant component of resource estimation uncertainty being unknowable at this critical stage in the mining cycle. This presents a conundrum to the resource geologist in terms of risk evaluation and resource classification.

Ahead of mining, there is considerable focus on analysis to determine the 'optimal' drill hole spacing, taking grade and geological continuity into account; cost-benefit analyses balance improved resource definition against cost; the law of diminishing returns and the exponential cost increases acting together as spacing is reduced. After completing the resource drilling to an agreed spacing, resource estimation is then undertaken, often including an attempt to bracket the resource estimation uncertainty. In many cases conditional simulation is used, based on a modelled, but largely assumed, variogram model. It is also assumed that the histogram of the available drill hole sample data is representative of the in-ground mineralisation.

The purpose of this paper is not to diminish the importance of drill hole spacing and simulation studies, but rather to illuminate an important aspect of estimation uncertainty that, although previously recognised, is typically overlooked – the question of how representative the available data set is in characterising the true (but unknown) distribution of mineralisation. To do this, we lift the lid on one of OceanaGold's former operations, the mined-out Globe Progress Mine, by resurrecting a high quality, close-spaced, reverse circulation (RC) grade control data set.

The exhaustive Globe Progress grade control data was used to repeatedly 'redrill' the deposit by extracting 35 m × 35 m spaced subsets from the original 5 m × 5 m spaced grade control data. Utilising closely spaced grade control data removed the need for assumptions regarding short range continuity, which are necessary with forward-looking analyses that are based upon broader spaced resource drilling. The extraction process used a nearest neighbourhood algorithm, repeatedly moving the origin in 5 mE, or 5 mN increments. Individual resource estimates were then completed for each of the extracted drill hole data sets (49 in total) as well as a grade control estimate based upon the exhaustive data set. Whilst the data unpinning each of the estimates changed, the geological assumptions, variography, and modelling parameters remained constant. This approach was taken to isolate the impact of changing the input data. The 49 estimates were then compared against each other and the grade control estimate.

The mean of all 49 sensitivity estimates was close to that of the grade control estimate in terms of contained gold, tonnes and grade. Whilst it is acknowledged that the grade control estimate itself is subject to some degree of estimation uncertainty, the close match between the average of the 49 estimates and the grade control estimate suggests that the resource estimation methodology is reasonable and appropriate. Whilst this comparison is important, the focus of this study is on the component of estimation uncertainty related to the underlying data, and this is reflected in the spread across the estimates. The spread across the 49 global estimates (highest to lowest) for this particular case study was found to be significant (approximately 20 per cent in grade and metal) and that is attributable solely to the underlying data. This exercise quantifies a component of the estimation

uncertainty that is inherent to all drill hole data and is distinct from the uncertainties associated with modelling methodology choices, sample and subsample quality and drill hole spacing-related interpolation uncertainty. Importantly, this uncertainty is unknowable prior to mining; we can only directly compare the resource drill hole data against grade control data after mining has taken place.

For the case study, approximately 65 per cent of the estimates fell within 5 per cent of the grade control estimate for contained-gold, suggesting that for many projects the histogram of drill hole data is unlikely to differ noticeably from that of the in-ground resource. However, about 15 per cent of the estimates in this study differed by more than 7.5 per cent, suggesting that a not-insignificant proportion of estimates will be materially compromised. Whether or not the available drill hole data is representative comes down to the 'luck of the draw' and cannot be known at the time of resource estimation.

Given the challenge of attempting to evaluate forward-looking estimation uncertainty, a component of which that can only be quantified retrospectively, what should we do as resource geologists? What are the implications for risk evaluation, resource classification and reconciliation? Furthermore, without rigorous post-mining data checks, resource geologists may conflate suboptimal modelling with the shortcomings of the underlying data.