Improving resource estimation of narrow vein gold deposits using discrete fracture networks

WR Junkin[1], E Ben-Awuah[1]

[1]Bharti School of Engineering, Laurentian University, Sudbury, Ontario

Narrow vein gold deposits are often characterized by an irregular distribution of gold throughout a mineralized vein. The uncertainty associated with grade throughout host rock before mining poses a challenge to mine planners seeking to maintain grade control and economic viability. Additional data concerning the grade and location of veins within a deposit can help improve planning and allow for production optimization. The nugget effect describes the localized occurrence of high grades mixed with low grades throughout a vein network. The degree to which the nugget effect affects the characterization of an ore body is dependent on two components, a sampling nugget effect (SNE), which requires well-designed sampling protocols to mitigate, and a geological nugget effect (GNE), a reflection of in situ heterogeneity. The GNE is compounded by the combination of an irregular distribution of gold throughout the mineralization and the uncertainty associated with the location of the vein within the host rock. Spatial point process modelling allows for high grade portions of a vein to be predicted through a Poisson process that randomly distributes high grade “nuggets” at specific points. MoFrac discrete fracture network (DFN) modelling software shows potential to be useful in mapping ore bearing geological structures, as all known data is prioritized in the modelling process. By modelling geological structures based on mapped data, a high degree of certainty is achieved concerning the accuracy of the DFN near mapping with increasing uncertainty proportional to distance. MoFrac models discontinuities as a tessellated mesh which allows for undulation of the surface during propagation. This process is guided by an orientation that is sampled from a distribution or dispersion factor assigned to each individual discontinuity. Through incorporation of mapped data and the conditioning to orientation, MoFrac is used to model fracture distribution and geometry. This demonstrates the potential variability in the location of a vein within host rock providing information that can be applied as constraints for grade estimation. The uncertainty in the location of a narrow vein is shown to contribute to the heterogeneity of a deposit and can provide useful insight into mine planning, grade control and production blast optimization.