Paper Number: 5378

Rank Statistical Analysis of Selected South African Gold Endowment

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The size-frequency relationship for mineral deposits generally follows an inverse power law distribution at various scales from regional to district to camp. This means that most of the value of an ore system will be contained by the largest deposit. In general, these tend to have the largest signature or footprint and can thus be expected to be found early on in the exploration history. Another implication is that for a well-sampled exploration search space, such as many of the mature metallogenic districts of South Africa, the previous exploration is a useful guide to the residual potential. This residual minerals endowment can be modelled by rank statistical analysis of known deposits (using Zipf's Law) to identify potential undiscovered deposits. This analysis may also reveal that the exploration search space may need to be expanded or changed.

The Barberton Mountainland has been mined for gold for over 140 years and has produced in excess of 320,000 kg Au [2] (>10 Moz Au). Declared resources add an additional 350,000 kg Au. The largest Barberton deposits do not fit the theoretical distribution line well (Fig 1) suggesting that their resources have not been adequately accounted for. According to Zipf's Law, approximately 60 % of theoretical Au endowment is presently unaccounted for. Following this, there should be an additional 22 deposits in size in the range of 10,000-30,000 kg Au (0.35 -1.0 Moz Au). Ignoring important economic considerations for the time being such as depth of mineralisation, orebody continuity, or mining and metallurgical constraints, for junior explorers and small-scale miners this may still represent a viable target and warrants continued exploration. By comparison, the gold districts of Sabie-Pilgrims Rest and Murchison fit their theoretical distributions much more closely, and thus represent less prospective targets for discovery of residual resources.

Whilst the margin of error should not be neglected, the opportunity for additional discovery is demonstrated. With a clearer understanding of the potential residual target size, exploration programs can be better designed to maximise value creation within this mature terrane.

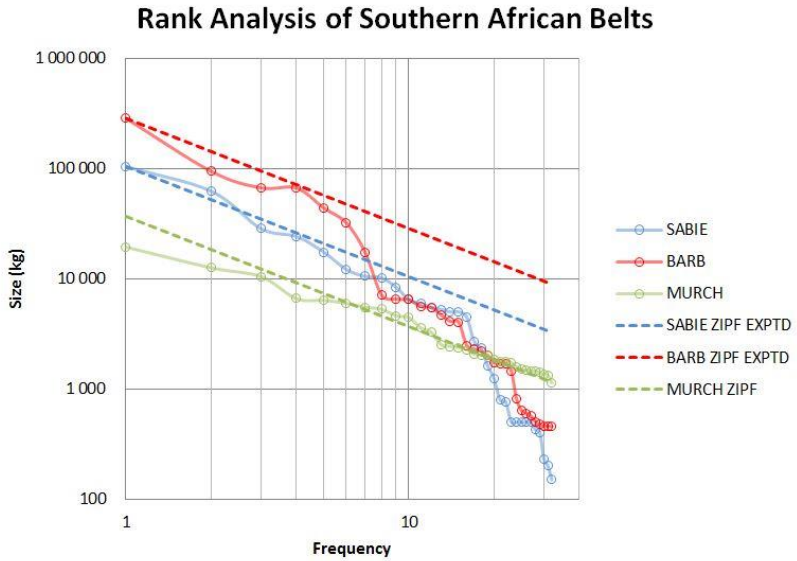

Figure 1. Size-frequency plot of three South African gold districts, Barberton, Sabie-Pilgrim's Rest and Murchison, with actual distributions of known deposits (solid lines) and theoretical distributions for each, calculated using Zipf's Law (dashed lines)

References:

[1] Anhaeusser C.R. (1986) In: *Mineral Deposits of Southern Africa Vol 1,* Geol Soc S Afr: 113-154

[2] Ward J.H.W. (1999) The Metallogeny of the Barberton Greenstone Belt, Council for Geoscience, Memoir 86, 108 pp