THE GEOLOGICAL AND GRADE CONTINUITY OF THE PAJINGO EPITHERMAL GOLD SYSTEM

Thesis Submitted By

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Statement of Contributions

A number of persons from the Newmont Mining Corporation were involved in the development of this project, namely Mr Ian Bulter and Mr Andrew Aitchison. Mr Steve Harrison and Mr Geoff Phillips provided ongoing support and cooperation for the extent of the project.

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ABSTRACT

The aim of this project was to define the geological and grade continuity of the Vera South gold deposit, and to use this knowledge to apply geostatistical resource estimation techniques to the deposit. The deposit occurs within the Pajingo Epithermal System (PES), 72km south of Charters Towers in northeast Queensland, Australia (Porter 1990). The PES deposits are classified as volcanic hosted low-sulphidation epithermal quartz vein systems, and a thorough literature review of epithermal style deposits showed that the characteristics of the Vera South deposit are almost identical to those of the classic low sulphidation model. The PES deposits are currently owned by the Newmont Mining Corporation, and the Vera South deposit is still actively being mined. Current proven and probable resources for the deposit are 75,000mt @ 16.4g/t and 1,229,000mt @ 11.6g/t.

The geological continuity of the main mineralised quartz vein (V1) was first investigated through the application of vein characteristic correlations using parametric and non-parametric statistical tests. The results showed that the highest gold grades occur in association with the widest sections of V1 that dip between 70°–80°, have dip directions between 140°–190°, and where V1 is slightly concave in shape. The comparison of these associations with mapping of V1 and grade contouring showed that higher gold grades are associated with andesitic inclusions in the hangingwall of V1, and with brecciated zones in the hangingwall and around faults. The high grades in the hangingwall occur in small pods that extend from the hangingwall to the centre of V1, particularly in areas where V1 thickens and changes strike direction. High grades are also constrained by the Crown and smaller cross-cutting faults. High grade trends also straddle the ridges of the concave structures, were greatest dilation and thus highest fluid flow is believed to have occurred. V1 is believed to be an accumulation of multiple veins up to 50cm wide that have coalesced to form a single structure up to 16.4m in these zones.

A preliminary attempt was then made to try and determine what constraints the geometry of the host structure placed on mineralisation. Linear elastic fracture mechanics theory found that the theoretical driving stresses and pore fluid pressures required to dilate the Vera-Nancy Structure to 16.4m at a depth of 2km would be ~245MPa and ~260MPa respectively. To obtain such pore fluid pressures, hydrostatic mineralising fluids would have to have been derived from depths of ~13.2km. This depth is considered unrealistic, such that the deposit probably formed within a regional extensional environment and/or from over-pressured fluids.

Numerical models by Zhang *et al* (1995) that describe the flow of fluids along a normal fault were then compared to the Vera South deposit. The number of similarities between the two models indicates the concentration of fluid flow in the fault zone and hangingwall of a host structure due to the opening of sub-vertical fracture sets in shallow environments could have occurred in the Vera South deposit in response to fault movement. This theory explains the concentration of higher gold grades in the hangingwall of V1 and the concentration of quartz stringer veins in restraining bends.

The grade continuity of V1 was investigated using autocorrelation and variography. Variography was utilised to determine whether the distribution of gold in the various domains was showing a preferred spatial continuity, while autocorrelation was utilised using specific grade intervals to determine whether samples over or between certain gold grades were localised in specific spatial orientations. Four domains were created where the first constrained the Vera South Deeps ore body which is physically separated from the Vera South Upper ore body, and then the Vera South Upper ore body was divided into three domains based on the orientation of V1. The autocorrelation and variography results showed that continuous high grade trends occur within the Vera South ore body. Autocorrelation showed these trends have plunges and plunge bearings of 45°–65° and 215°–255°, while variography showed they have plunges and plunge bearings of 22°–68° and 237°–271°. These high grade trends are interpreted to represent the main fluid flow channel ways in which gold was deposited during mineralisation.

Fractal analysis of the gold sample populations were then performed and the results were found to be compatible with the hypothesis that more than one mineralising event and/or mechanism was active during the formation of the Vera South deposit and along the extent of the Vera-Nancy Structural Corridor at the same time, as proposed by Mustard *et al* (2003). Scatter plots of the samples from each fractal grade range population showed that the samples that comprise the lower fractal grade populations are evenly distributed across the entire width and depth of the Vera South deposit, while the samples that comprise the higher fractal grade populations are evenly distributed within the central region of the deposit and individual domains.

The geological and grade continuity interpretations were then integrated into geostatistical resource estimations for the deposit, to optimise the resource estimates and determine whether geostatistical resource estimation techniques can be applied successfully to the deposit. It was found face chip sample data should not be used for resource estimations, due to unreliable results that were subject to large biases. Reliable resource estimates were able to be created through the ordinary kriging of diamond drill sample data. Directional variography produced plots that adequately described the spatial continuity between the samples, and block models with 10m x 10m cell dimensions produced mean kriged grade estimates that closely resembled the raw mean input grades.

The high grade trends identified during autocorrelation and variography were also observed in the block models. The highest grades occur in pods that are continuations of each other, and which occur within zones in the ore body hypothesized by Davis (2003c) to represent releasing bends. The plunges and plunge bearings of the trends in the directional and omni-directional block models were between 35°–60° and 237°–271°, and 30°–55° and 237°–271° respectively.

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