



**A technical risk evaluation of the Kantienpan volcanic
hosted massive sulphide (VHMS) deposit and its
financial viability**

by

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DECLARATION

I declare that the thesis that I hereby submit for the Masters Degree in Earth Science Practise and Management at the University of Pretoria has not previously been submitted by me for degree purposes at any other university.

SIGNATURE OF STUDENT:

A handwritten signature in black ink, written over a horizontal line. The signature is stylized and appears to be the initials 'B' followed by a flourish.

DATE: 2003/07/01



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Job 1: 1-12

“Surely there is a mine for silver, and a place for gold to be refined.² Iron is taken out of the earth, and copper is smelted from ore.³ Miners put an end to darkness, and search out to the farthest bound the ore in gloom and deep darkness.⁴ They open shafts in a valley away from human habitation; they are forgotten by travellers, they sway suspended, remote from people.⁵ As for the earth, out of it comes bread; but underneath it is turned up as by fire.⁶ Its stones are the place of sapphires, and its dust contains gold.⁷ “That path no bird of prey knows, and the falcon’s eye has not seen it.⁸ The proud wild animals have not trodden it; the lion has not passed over it.⁹ “They put their hand to the flinty rock, and overturn mountains by the roots.¹⁰ They cut out channels in the rocks, and their eyes see every precious thing.¹¹ The sources of the rivers they probe; hidden things they bring to light.¹² “But where shall wisdom be found? And where is the place of understanding?”

Job 28: 28

“And he said to humankind, ‘Truly, the fear of the Lord, that is wisdom; and to depart from evil is understanding.’ ”

(The Holy Bible : New Revised Standard Version. 1989. Nashville: Thomas Nelson Publishers.)

ABSTRACT

The Areachap Group represents a mid-Proterozoic fossil island arc environment consisting of amphibolite, hornblende gneiss, quartz-feldspathic gneiss, calc-silicates and pelitic schists. Chemical compositions of these highly deformed upper amphibolite/granulite grade metamorphosed rocks indicate protoliths ranging from rhyolite/rhyodacite, calc-alkaline basalt, tholeiite to ultramafic igneous rocks and sediments. The above-mentioned assemblage is typical of an island arc environment.

Island arc environments are ideal hosts for volcanic hosted massive sulphide (VHMS) type deposits and may successfully be explored by using the VHMS lithogeochemical alteration model. VHMS deposits not only yield strategic base metals such as zinc (Zn), copper (Cu) and lead (Pb), but significant grades of gold (Au) and silver (Ag) are associated with these deposits.

The Areachap Group presents a metallogenic province containing one economic deposit, the Prieska Zn-Cu mine, as well as several sub-economic deposits, including the Areachap mine and other lesser prospects at Bokspuits, Kantienpan, Jacomynspan and Rokoptel. The Prieska Zn-Cu mine is the most significant VHMS deposit of the Areachap Group and occurs within the Copperton volcanic centre. This abandoned mine delivered 47 Mt sulphide ore at 1,7 % Cu and 3,8 % Zn with traces of Ag and Au.

Four volcanic centres were previously identified in the Areachap Group, namely Upington, Klein Begin, Bokspuits and Copperton. Exploration activities were loosely subdivided into the same regions. Regional lithogeochemical sampling campaigns were conducted for the four subproject areas and approximately 5 000 rock samples were analysed for the twelve major oxides and ten trace elements.

The region of interest, the Bokspuits Subvolcanic area, with a well-established infrastructure, is situated near Groblershoop (50 km east) and Marydale (30 km

southeast) in the Northern Cape province and is part of the geological Areachap Group.

Several high copper anomalies and the tholeiitic lithological composition of the Bokspuits Subproject resulted in this area being selected as the main target region. It was attempted to discriminate between different trace element populations using probability plots, but this was not successful. The complexity of the probability plots was attributed to the large variation in different rock types included in the data set. Corrections were made by determining threshold values for each rock type, but this refinement proved unsuccessful, indicating that the rock classification used was incorrect. Option areas were finally selected, based primarily on absolute Cu values. These areas were mapped in more detail prior to ground electromagnetic (EM) surveys and drilling. To test the target selection, a proto-lithological map of the area, based on cluster analyses of the lithogeochemical dataset, was drawn. The proto-lithological maps formed the basis of the follow-up work and the application of the VHMS conceptual model.

A conductor in the Kantienpan target area was located with a time domain electromagnetic (TDEM) survey and this was drilled. The drilling intersected a massive sulphide body with a tonnage of approximately 5 Mt and an average grade of 4.09 % Zn, 0.49 % Cu and traces of Au and Ag.

The orebody was evaluated financially and it was found to be uneconomic as a stand-alone operation. However, if the Kantienpan deposit is considered as an alternative to imported concentrate for the Zincor smelter, this study suggests that the project may be economically feasible. Furthermore, it must be stated that the Areachap Group remains only partly explored and that a world class VHMS deposit may be discovered within the next few years.



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