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APPENDIX ONE

**SAMPLING AND ANALYTICAL TECHNIQUES**

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**A.1.1 FIELD WORK**

Fieldwork at the Zeekoebaart deposit consisted of sampling traverses through the geological succession, and collecting a representative set of sample of important styles of mineralization and host rock. A total of 37 samples were collected from surface outcrop for petrographic and geochemical analysis.

Surface and underground exposures were studied at the Nauga East deposit. The fieldwork consisted of mapping the mineralised exposures and combining the field observations with data supplied by Rand Mines. GPS (Global Positioning System) points were also taken and used for compiling surface maps. A comprehensive set of samples of host rock and mineralization types were collected from both underground and surface outcrops. Unclassified drill core was also sampled at the site and combined with the collected data set of approximately 100 samples and used for petrographic and geochemical analysis.



**A.1.2 SAMPLE PREPARATION**

Hand samples from each major lithological unit were first examined and described, locating areas of interest for polished thin sections and blocks, X-ray powder diffraction and geochemical analysis.

For X-ray powder diffraction and geochemical analysis, hand samples and drill core sections were ground to a fine powder. This was achieved using a Cr-steel set in a Siebtechnik disc swing mill, at facilities provided by the Department of Geology, Rand Afrikaans University. Cr concentrations obtained were thus discarded as they are usually elevated by contamination, from the milling process. These powdered samples were stored in clean glass vials.

Hand samples and drill core sections were attained by conventional methods. Polished blocks and polished thin sections were used. These were prepared by technical staff at the Rand Afrikaans University (department of geology).

### A.1.3 X-RAY POWDER DIFFRACTION

A Philips PW 1710 diffractometer at SPECTRAU at RAU was used to carry out all X-ray powder diffraction analysis to identify major mineral phases within the powdered samples. Bruker EVA software was used for data acquisition and evaluation.

Settings:

Tube anode material	Cobalt
Generator tension	40 kV
Generator current	30 mA
Wavelength $K\alpha_1$	1.79258Å
Divergence diaphragm	1°
Detector diaphragm	0.1mm
Step size	0.02° 2θ
Scan rate	2s per step
Scan type	step



### A.1.4 OPTICAL MICROSCOPY

A Leica DMLP research microscope, at the Department of Geology (Rand Afrikaans University), was used to carry out all transmitted and reflected light petrographic studies. Photomicrographs were taken with the aid of a Leica DC 200 digital camera connected to the microscope.

### A.1.5 SCANNING ELECTRON MICROSCOPY (SEM)

Scanning electron microscopy was carried out at SPECTRAU using a JEOL JSM 5600 with Noran EDS detector. Thin sections and block samples were coated with carbon and analysis were performed with an anode tension of 15 kV and beam current of 15 mA.

### A.1.6 BULK ROCK GEOCHEMISTRY

Twenty eight (28) samples (8 samples from Zeekoebaart and 20 samples from the Nauga East deposit) were analysed by ACME Analytical Labs Ltd in Vancouver, BC, Canada, using inductively coupled plasma-mass spectrometry (ICP-MS). Major, trace and rare earth element data was obtained.

### A.1.7 STABLE ISOTOPE GEOCHEMISTRY

Stable isotope geochemical analysis was carried out by Dr. Uwe Horstmann of the Stable Isotope Laboratory at the Council for Geoscience. Samples that were observed to show dolomite I, II, and III by means of petrographic studies were selected for analysis. Sample powders were obtained by means of an electric hand drill and placed into clean glass vials. 10mg of powder was provided for analysis, and all samples reacted following a technique modified after McCrea (1950). 10mg of the sample and 2ml of 100% H<sub>3</sub>PO<sub>4</sub> were enclosed separately in a reaction vessel, after the method of Coplen *et al.*, (1983). The vessels were evacuated and both sample and acid were thermally equilibrated in a water bath for ~1 hour and subsequently reacted. Reaction temperatures of 25°C for calcite and 50°C for dolomite were used. The samples were left to react for 20-24 hours. The liberated CO<sub>2</sub> was then pumped through cold traps using dry ice and liquid nitrogen.

Isotope analyses were performed using a Finnigan MAT-251 gas-source mass-spectrometer with a sequential, multiport sample inlet system. Isotopic compositions are reported relative to VPDB for carbon and oxygen in terms of  $\delta$ :  $\delta$  (‰) =  $(R_{\text{sample}}/R_{\text{std}} - 1) * 1000$ . Where R is  $^{13}\text{C}/^{12}\text{C}$  or  $^{18}\text{O}/^{16}\text{O}$  for sample and standard. Calibration was done

using international reference standard NBS19, which is defined as reference Vienna-PDB by:  $\delta^{13}\text{C}_{\text{NBS19}} / \text{VPDB} = 1.95\text{‰}$  and  $\delta^{18}\text{O}_{\text{NBS19}} / \text{VPDB} = -2.20\text{‰}$  (Hut, 1987).

