APPENDIX ONE

The mineralogy and petrography of a set of 50 samples, covering all macroscopic lithologies in distinct 3 boreholes at the Serra do Navio deposit, was investigated using X-ray powder diffractometry, optical microscopy and scanning electron microscopy. A subtotal of 30 samples was analyzed for whole rock geochemistry, including major, trace and rare earth element as well we as stable isotope geochemistry of carbon and fluid inclusion studies.

A.1. X-ray powder diffraction analyses

X-ray powder diffraction analyses were performed to identify major and minor mineral phases in all samples. Measurements were carried out using a Philips PW1710 diffractometer at Spectrau, Rand Afrikaans University, South Africa. The Bruker Diffrac AT software-package controlled data acquisition and evaluation. Samples were prepared as side-loaded powder pellets in Al-metal sample holders. Most measurements were carried out using the following diffractometer scan settings:

Tube anode material:	Cobalt
Generator tension:	40 kV
Generator Current:	30 mA
Wavelength $K\alpha_1$:	1.79896 Å
Wavelength $K\alpha_2$:	1.79258 Å
Intensity ratio $I_{K\alpha1}/I_{K\alpha2}$:	2
Divergence diaphragm:	1º
Angle range:	5-70º 2θ
Scan rate:	0.02º 2θ
Scan rate:	0.6º 2θ/min (2s per step)
Scan type:	step

A.1.2 Optical microscopy

Reflected and transmitted light microscopy on conventional polished thin sections were performed at the Department of Geology, Rand Afrikaans University. A Leica DMLP research microscope with an adapted Leica DC 200 digital camera was used for petrographic studies and acquisition of photomicrographs.

A.1.3 Scanning Electron Microscopy (SEM)

Scanning electron microscopy studies were conducted on a set of polished thin sections with a Jeol 5600 SEM equipped with a Noran EDS detector, with an ultra thin beryllium window, at Spectrau, Rand Afrikaans University. Carbon-coated samples were examined with a 15 kV, 15 mA electron beam by means of secondary and backscattered electron imaging. Minerals were identified by semi-quantitative EDS-spot analyses.

A.1.4 Fluid inclusion studies

Microthermometric measurements were carried out using a Linkham TMH-600 heating-freezing stage at the Department of Geology, Rand Afrikaans University. The stage is mounted on an Olympus BH 60 infrared binocular microscope with a maximum magnification of 1000x. It has a temperature range from -196ºC (temperature of liquid nitrogen) to + 600ºC. Stage temperature is accurately controlled by a TP93 programmable thermal control unit with a minimum of 0.1 ºC and a maximum of 90ºC cooling or freezing rate per minute with a precision of ±0.1ºC. The stage temperature was calibrated for low temperature ranges with a pure CO_2 sample at its triple point of Tm -56.6ºC and with homogenization temperatures of synthetic H_2O inclusions in quartz (SynFlinc, supplied by FluidInc) for calibration of the zero point of the Celsius temperature scale. The precision of low temperature phase transitions (<10°C) is 0.5°C, while homogenization temperature measurements of H_2O can be determined with a maximum error of ± 5°C.

A.1.5 Whole rock geochemistry

Thirty samples comprising all lithologies from the three boreholes were selected for whole rock geochemical analysis. About 10 grams of powder for each sample were prepared at the Geology Department, Rand Afrikaans University and submitted to ACME Analytical Labs ltd. (Canada) for analyses. Major element data were acquired using *X-ray fluorescence spectrometry* (XRF) on fused beads and pressed pellets. Trace element data, including rare earth-elements (REE) were obtained using *Inductively Coupled Plasma Mass Spectrometry* (ICP-MS).

Carbon stable isotope analyses carried out by Dr. Uwe Horstmann at the Council for Geosciences, Pretoria using a conventional sample preparation and analytical techniques.

Calculation of Eu* and Ce* anomalies were done following Taylor and McLennan (1985) using the formulae,

$Eu/Eu^* = Eu\sqrt{[(Sm_N)*(Gd_N)]}$

$Ce/Ce^* = Ce\sqrt{[(La_N)*(Pr_N)]}$