



## AMIS0093

### ***Certified Reference Material***

**Nickel copper sulphide ore  
Phoenix Deposit, Botswana**

### ***Certificate of Analysis***

#### **Recommended Concentrations and Limits<sup>1</sup> (at two Standard Deviations)**

##### ***Certified Concentrations<sup>2</sup>***

Ni M/ICP	2722	±	134	ppm
Ni P	2596	±	260	ppm
Ni XRF	2710	±	111	ppm
Cu M/ICP	2958	±	156	ppm
Cu P	2859	±	266	ppm
Cu XRF	2947	±	139	ppm
Pd Pb Collection	0.47	±	0.04	g/t
Pt Pb Collection	0.11	±	0.012	g/t
Co M/ICP	173	±	9	ppm
Co XRF	173	±	15	ppm
Specific Gravity	3.06	±	0.06	

##### ***Provisional Concentrations***

Au Pb Collection	0.047	±	0.014	g/t
Co P	159	±	23	ppm

1. Manufacturers recommended limits for use of the material as control samples, based on two standard deviations, calculated using "Between Laboratory" statistics for treatment of the data for trivial, non-trivial and technically invalid results. See sections 1, 9 and 12.
2. There is additional certified major element data presented on p2 and uncertified trace element data presented as an appendix.

# Major Element Recommended Concentrations and Limits (at two Standard Deviations)

## *Certified Concentrations*

Al <sub>2</sub> O <sub>3</sub>	16.94	± 0.38	%
CaO	9.74	± 0.30	%
Cr <sub>2</sub> O <sub>3</sub>	0.17	± 0.014	%
Fe <sub>2</sub> O <sub>3</sub>	13.68	± 0.26	%
K <sub>2</sub> O	0.10	± 0.01	%
MgO	10.42	± 0.24	%
MnO	0.13	± 0.01	%
Na <sub>2</sub> O	0.98	± 0.06	%
SiO <sub>2</sub>	40.24	± 0.52	%
TiO <sub>2</sub>	0.25	± 0.01	%
S ICP	2.84	± 0.20	%

## *Provisional Concentration*

LOI 6.20 ± 0.84 %

## *Informational mean*

P<sub>2</sub>O<sub>5</sub> 0.024 %

**1. Intended Use:** AMIS0093 can be used to check analysis of samples of nickel copper sulphide ores with a similar grade and matrix.

It is a matrix matched Certified Reference Material, fit for use as control samples in routine assay laboratory quality control when inserted within runs of samples and measured in parallel to the unknown. Its purpose is to monitor inter-laboratory or instrument bias and within lab precision. It can be used, indirectly, to establish the traceability of results to an SI system of units.

The recommended concentrations and limits for this material are property values based on a measurement campaign (round robin) and reflect consensus results from the laboratories that participated in the round robin.

Slight variations in analytical procedures between laboratories will reflect as slight biases to the recommended concentrations (see 19). Good laboratories will report results within the two standard deviation levels with a failure rate of <10 %.

The material can also be used for method development and for the calibration of equipment.

**2. Origin of Material:** AMIS0093 was provided by the Tati Nickel Mining Company, a subsidiary of Norilsk Nickel Africa (Pty) Ltd., from the Phoenix open pit mine in Eastern Botswana. The mine is situated approximately 25 km southwest of Francistown. The deposit occurs in mafic intrusive rocks in the Tati Greenstone Belt of the Rhodesian Craton.

**3. Mineral and Chemical Composition:** Nickel-copper mineralization occurs in metasomatised feldspathic amphibolites intruded by pegmatites and granites. Mineralisation is in the form of massive sulphide lenses with secondary thin mineralized fractures into the country rock. The primary sulphide is pyrrhotite with lesser pentlandite, chalcopyrite and minor spalerite. The major element concentrations have been calculated from data provided by ten of the round robin labs (see above). Uncertified trace element data is provided as an appendix to this certificate.

- 4. Appearance:** The material is a very fine Blueish Grey powder (Corstor 5PB 5/1).
- 5. Handling instructions:** The material is packaged in Laboratory Packs and Explorer Packs that must be shaken or otherwise agitated before use. Normal safety precautions for handling fine particulate matter are suggested, such as the use of safety glasses, breathing protection, gloves and a laboratory coat.
- 6. Method of Preparation:** The material was crushed, dry-milled and air-classified to <54um. Wet sieve particle size analysis of random samples confirmed the material was 98.5% <54um. It was then blended in a bi-conical mixer, systematically divided and then sealed into 1kg Laboratory Packs. Explorer Packs are subdivided from the Laboratory packs as required. Samples were randomly selected for homogeneity testing and third party analysis. Statistical analysis of both homogeneity and consensus test results were carried out by an independent statistician.
- 7. Methods of Analysis requested:**
1. Pt, Pd and Au. Pb collection with Ag as a co-collector, ICP-OES or ICP-MS.
  2. Multi element scan to include Co, Cu and Ni. Multi-acid total digestion, including HF, ICP-OES or ICP-MS.
  3. Co, Cu and Ni. Aqua regia digestion with ICP-OES or ICP-MS.
  4. Co, Cu and Ni. Pressed Pellet, XRF.
  5. Majors ( Al<sub>2</sub>O<sub>3</sub>, CaO, Cr<sub>2</sub>O<sub>3</sub>, Fe<sub>2</sub>O<sub>3</sub>, K<sub>2</sub>O, MgO, MnO, Na<sub>2</sub>O, SiO<sub>2</sub>, TiO<sub>2</sub>. LOI. ) XRF fusion.
  6. SG, gas pycnometer.
- 8. Information requested:**
1. State and provide brief description of analytical techniques used.
  2. State aliquots used for all determinations.
  3. Results for individual analyses to be reported.
  4. All results for individual PGM's to be reported in ppb.
  5. All results for base metals to be reported in ppm.
  6. Report all QC data, to include replicates, blanks and certified reference materials used.
- 9. Method of Certification:** Twenty three laboratories were each given eight packages, comprising eight samples scientifically selected from throughout the batch. Eighteen laboratories reported results in time for certification of the economic elements. Ten of these laboratories reported results for the major elements.
- Final limits were calculated after first determining if all data was compatible within a spread normally expected for similar analytical methods done by reputable laboratories. Data from any one laboratory was then removed from further calculations when the mean of all analyses from that laboratory failed a "t test" of the global means of the other laboratories. The means and standard deviations were then re-calculated using all remaining data. Any analysis that fell outside of the new two standard deviations was removed from the ensuing data base. The mean and standard deviations were again calculated using the remaining data.
- The "between-laboratory" standard deviation is used in the calculation to eliminate technically and statistically invalid data. Upper and lower limits are based on the standard deviation of the remaining data, which reflect individual analyses and can be used to monitor accuracy in routine laboratory quality control. This is different to limits based on standard deviations derived from grouped set of analyses (see 12), which provide important measures for precision and trueness, but which are less useful for routine QC.
- Standards with an RSD of near or less than 5 % are termed "Certified", RSD's of between near 5 % and 15 % are termed "Provisional", and RSD's over 15 % are termed "Informational".
- 10. Participating Laboratories:** (Not in same order as in the table of assays):
1. ACME Analytical Laboratories Ltd CA
  2. Activation Laboratories Pty Ltd (ActLabs) CA
  3. ALS Chemex Laboratory Group Johannesburg SA

4. ALS Chemex Laboratory Group Vancouver CA
5. Ammtec Limited WA
6. Assayers Canada
7. Genalysis Laboratory Services (South Africa) Pty
8. Genalysis Laboratory Services WA
9. Intertek Utama Services (Indonesia)
10. Labtium Inc Finland
11. OMAC Laboratories Limited (Ireland)
12. Set Point Laboratories (Isando) SA
13. Set Point Laboratories (Mokopane) SA
14. SGS Australia Pty Ltd (Newburn) WA
15. SGS Lakefield Research Africa (Pty) Ltd (Booyens SA)
16. SGS Mineral Services Lakefield (Canada)
17. Ultra Trace (Pty) Ltd WA
18. Zimplats Head Office Assay Laboratory

**11. Assay Data:** Data as received from the laboratories for the important certified elements listed on p1 is set out below. A proficiency report has been sent to the managers of the participating laboratories. Additional digital data from this round robin is available on request.

Lab Code	Au PbColl g/t	Pd PbColl g/t	Pt PbColl g/t	Co M/ICP ppm	Co P ppm	Co XRF ppm	Cu M/ICP ppm	Cu P ppm	Cu XRF ppm	Ni M/ICP ppm	Ni P ppm	Ni XRF ppm	SG
B	0.06	0.48	0.12	180.0	166.0		3020	2880		2710	2510		3.04
B	0.05	0.49	0.11	175.0	161.0		3020	2810		2690	2460		3.06
B	0.05	0.49	0.12	175.0	163.0		2980	2860		2700	2490		3.07
B	0.06	0.49	0.12	170.0	161.0		3010	2890		2660	2490		3.05
B	0.06	0.47	0.11	170.0	165.0		2990	2840		2670	2500		3.05
B	0.05	0.48	0.11	175.0	162.0		3030	2820		2690	2470		3.08
B	0.05	0.48	0.12	180.0	165.0		3040	2870		2750	2490		3.07
B	0.05	0.47	0.11	180.0	164.0		3040	2890		2740	2500		3.08
C	0.05	0.47			190.0			2780			2470		
C	0.04	0.47			190.0			2700			2470		
C	0.04	0.43			180.0			2660			2440		
C	0.04	0.47			190.0			2690			2420		
C	0.04	0.46			190.0			2880			2710		
C	0.04	0.43			180.0			2860			2690		
C	0.04	0.47			180.0			2850			2680		
C	0.04	0.47			180.0			2810			2650		
D	0.05	0.48	0.12	171.0	141.0	200.0	2880	2700		2830	2150	2800	
D	0.06	0.48	0.12	176.0	139.0	200.0	2890	2750		2840	2150	2900	
D	0.05	0.48	0.12	173.0	142.0	200.0	2890	2750		2850	2160	2800	
D	0.06	0.49	0.11	175.0	139.0	200.0	2900	2710		2870	2150	2700	
D	0.05	0.49	0.12	176.0	142.0	200.0	2840	2730		2880	2160	2700	
D	0.06	0.48	0.12	173.0	140.0	200.0	2850	2710		2820	2140	2700	
D	0.05	0.48	0.12	175.0	140.0	200.0	2870	2700		2840	2130	2700	
D	0.05	0.48	0.12	173.0	142.0	200.0	2850	2750		2840	2170	2700	
G	0.05	0.47	0.10	170.0	157.0		2600	2820	2866	2710	2610	2710	3.09
G	0.04	0.48	0.10	168.0	161.0		2550	2860	2914	2660	2620	2749	3.09
G	0.04	0.47	0.10	176.0	160.0		2630	2830	2869	2780	2650	2721	3.09
G	0.06	0.46	0.10	173.0	157.0		2630	2810	2906	2730	2580	2752	3.10
G	0.04	0.46	0.10	170.0	156.0		2620	2790	2867	2750	2590	2714	3.07
G	0.04	0.47	0.10	174.0	160.0		2620	2810	2919	2740	2620	2766	3.09
G	0.04	0.46	0.10	172.0	156.0		2600	2820	2904	2700	2620	2731	3.09
G	0.04	0.47	0.10	167.0	158.0		2520	2770	2885	2640	2560	2718	3.09
H	0.05	0.47	0.11	176.5	181.1		3002	2997		2777	2733		3.04
H	0.05	0.47	0.12	176.1	180.2		2914	3003		2768	2733		2.97
H	0.04	0.46	0.11	173.2	181.7		2951	2952		2718	2727		2.97
H	0.05	0.49	0.11	177.4	180.3		2991	2937		2758	2729		3.03
H	0.04	0.47	0.11	174.9	180.2		2953	2962		2731	2704		3.04
H	0.05	0.49	0.12	176.0	178.1		2965	2969		2748	2703		2.96
H	0.05	0.47	0.11	174.0	180.2		2950	2981		2727	2751		2.96
H	0.05	0.47	0.11	180.3	179.4		3006	2970		2780	2733		3.04
K	0.06	0.49	0.11	167.0	170.0	173.0	2919	2832	2930	2669	2525	2668	3.05
K	0.06	0.47	0.11	168.0	173.0	180.0	2963	2892	2938	2715	2563	2674	3.04
K	0.05	0.45	0.11	166.0	168.0	179.0	2888	2818	2917	2673	2491	2665	3.04
K	0.05	0.49	0.12	169.0	174.0	176.0	2854	2862	2917	2718	2561	2654	3.04
K	0.05	0.48	0.11	168.0	175.0	171.0	2913	2848	2903	2708	2543	2662	3.03
K	0.05	0.48	0.11	168.0	167.0	183.0	3086	2758	2901	2715	2469	2635	3.04
K	0.04	0.45	0.10	170.0	166.0	167.0	2825	2728	2912	2652	2456	2649	3.05
K	0.05	0.49	0.12	168.0	170.0	166.0	2933	2896	2931	2731	2581	2662	3.04
L	0.05	0.53				166.0			3071			2674	
L	0.05	0.50				164.0			3043			2630	
L	0.04	0.53				169.0			3048			2621	
L	0.04	0.51				170.0			3071			2620	
L	0.04	0.50				162.0			3045			2676	
L	0.05	0.51				162.0			3032			2652	
L	0.05	0.51				177.0			3052			2628	
L	0.05	0.50				168.0			3015			2650	

Lab Code	Au PbColl g/t	Pd PbColl g/t	Pt PbColl g/t	Co M/ICP ppm	Co P ppm	Co XRF ppm	Cu M/ICP ppm	Cu P ppm	Cu XRF ppm	Ni M/ICP ppm	Ni P ppm	Ni XRF ppm	SG
M	0.06	0.49	0.11		162.0		3070	2940		2640	2560		
M	0.05	0.51	0.11		162.0		2950	2950		2540	2590		
M	0.05	0.51	0.11		162.0		2890	3100		2550	2590		
M	0.05	0.49	0.10		165.0		2800	3050		2530	2600		
M	0.05	0.50	0.10		158.0		3030	2930		2490	2510		
M	0.06	0.49	0.11		163.0		2880	2920		2560	2540		
M	0.06	0.50	0.11		164.0		3060	2820		2560	2580		
M	0.06	0.51	0.11		170.0		2970	3270		2540	2700		
N	0.04	0.46	0.10	170.0	140.0	190.0	3000	2700	2990	2900	2600	2770	3.03
N	0.05	0.44	0.10	170.0	140.0	150.0	3100	2800	3080	2800	2600	2770	3.03
N	0.05	0.47	0.11	170.0	140.0	190.0	2900	2900	2980	2700	2600	2750	3.02
N	0.06	0.47	0.10	170.0	150.0	160.0	3100	2900	2950	2800	2500	2730	3.01
N	0.04	0.44	0.10	160.0	150.0	180.0	3000	2700	2950	2700	2600	2740	3.04
N	0.06	0.45	0.11	170.0	150.0	170.0	2900	2700	3000	2700	2600	2800	3.02
N	0.05	0.47	0.10	170.0	150.0	200.0	2900	2700	3050	2800	2600	2790	3.04
N	0.06	0.46	0.11	170.0	150.0	170.0	2900	2800	2890	2700	2600	2770	3.09
O	0.05	0.47	0.11	170.0	170.0	176.0	2920	2970	2985	2630	2800	2713	3.08
O	0.06	0.52	0.12	170.0	170.0	177.0	2950	3030	3005	2640	2780	2737	3.04
O	0.05	0.47	0.11	170.0	180.0	176.0	2990	3020	3009	2650	2790	2740	3.05
O	0.06	0.48	0.12	170.0	170.0	180.0	2990	3060	3019	2630	2770	2754	3.08
O	0.07	0.47	0.11	170.0	180.0	180.0	3000	3020	3001	2660	2800	2736	3.05
O	0.05	0.47	0.11	170.0	180.0	179.0	2960	3010	3022	2620	2800	2753	3.06
O	0.04	0.46	0.11	170.0	170.0	179.0	3000	2950	3025	2650	2830	2749	3.08
O	0.05	0.53	0.12	170.0	180.0	178.0	2980	3030	3001	2630	2780	2740	3.06
P	0.04	0.47	0.10	186.0	153.0		3150	2743		3053	2580		
P	0.05	0.49	0.11	179.0	154.0		3127	2811		3173	2753		
P	0.03	0.48	0.11	178.0	154.0		3271	2772		3317	2785		
P	0.04	0.48	0.12	183.0	155.0		3115	2729		3270	2714		
P	0.04	0.48	0.11	177.0	152.0		3179	2682		3144	2634		
P	0.05	0.50	0.11	177.0	152.0		3183	2704		3196	2721		
P	0.04	0.48	0.10	179.0	152.0		3069	2691		3231	2732		
P	0.04	0.47	0.10	177.0	155.0		3057	2691		3084	2710		
Q	0.05	0.47	0.10	182.0	144.0	164.0	3030	2970	2880	2800	2790	2790	2.88
Q	0.05	0.46	0.10	173.0	148.0	167.0	2990	2930	2900	2770	2800	2790	2.89
Q	0.04	0.46	0.10	181.0	144.0	165.0	3030	2870	2870	2790	2770	2770	2.93
Q	0.05	0.50	0.11	178.0	144.0	172.0	3070	2950	2880	2770	2770	2780	2.92
Q	0.05	0.48	0.10	180.0	146.0	169.0	3010	2820	2880	2780	2810	2780	2.91
Q	0.05	0.49	0.11	182.0	145.0	161.0	3100	2940	2790	2870	2800	2700	2.88
Q	0.04	0.44	0.10	183.0	146.0	167.0	3060	3120	2860	2770	2830	2750	2.94
Q	0.04	0.42	0.09	188.0	144.0	165.0	3080	2890	2880	2880	2780	2780	2.91
R	0.04	0.47	0.11	149.5	158.5		2830	3120	3140	2400	2490	2520	3.00
R	0.05	0.49	0.12	148.5	148.0		2830	3180	3160	2440	2560	2530	2.96
R	0.04	0.46	0.11	150.5	158.5		2870	3100	3160	2480	2510	2520	3.08
R	0.04	0.46	0.11	149.5	149.5		2850	3100	3170	2440	2510	2510	3.03
R	0.04	0.49	0.11	152.5	161.0		2940	3140	3150	2530	2500	2530	3.06
R	0.04	0.46	0.11	147.5	159.0		2840	3140	3140	2450	2450	2520	3.05
R	0.05	0.49	0.12	150.5	157.0		2920	3210	3160	2520	2530	2530	3.02
R	0.06	0.45	0.10	147.0	159.0		2790	3150	3160	2400	2490	2520	3.02
S	0.04	0.48	0.11	153.0	147.0		2950	2940		2650	2400		3.15
S	0.04	0.49	0.11	159.0	148.0		3050	2900		2780	2390		3.20
S	0.04	0.49	0.11	157.0	147.0		3040	3020		2750	2410		3.15
S	0.04	0.50	0.11	154.0	149.0		2980	2940		2710	2420		3.17
S	0.04	0.49	0.11	157.0	144.0		3100	2850		2760	2350		3.14
S	0.04	0.51	0.11	150.0	147.0		2920	3000		2650	2410		3.16
S	0.04	0.51	0.11	163.0	147.0		3020	2980		2700	2380		3.14
S	0.05	0.50	0.10	159.0	148.0		3110	2880		2810	2400		3.13
T	0.06	0.53	0.10	176.0			2886			2756			
T	0.05	0.53	0.11	180.0			2836			2760			
T	0.06	0.53	0.12	179.0			2900			2787			
T	0.07	0.54	0.11	181.0			2872			2873			
T	0.07	0.54	0.11	186.0			2860			2800			
T	0.06	0.53	0.11	177.0			2821			2770			
T		0.54	0.11	179.0			2863			2774			
T	0.06	0.53	0.12	172.0			2758			2649			
U	0.05	0.44	0.12	170.2	157.0		2750	2717		2670	2420		
U	0.06	0.44	0.12	172.5	164.0		2747	2636		2660	2450		
U	0.05	0.46	0.12	171.1	165.0		2763	2655		2670	2460		
U	0.05	0.42	0.11	171.2	165.0		2740	2631		2620	2590		
U	0.05	0.43	0.12	176.4	164.0		2787	2683		2560	2440		
U	0.06	0.45	0.11	170.9	160.0		2765	2688		2630	2440		
U	0.06	0.45	0.11	172.1	160.0		2772	2640		2700	2420		
U	0.05	0.46	0.12	171.9	162.0		2743	2636		2630	2410		
V	0.04	0.44	0.11	169.0	163.0	172.0	2989	3129	2876	2693	2557	2569	3.02
V	0.04	0.44	0.11	167.0	160.0	175.0	2971	3233	2883	2661	2724	2616	3.11
V	0.04	0.46	0.11	168.0	167.0	165.0	2966	3154	2856	2683	2683	2630	3.14
V	0.04	0.45	0.11	166.0	166.0	170.0	3011	3322	2854	2607	2692	2645	3.06
V	0.04	0.45	0.11	165.0	156.0	164.0	2983	3060	2843	2621	2498	2642	3.04
V	0.04	0.44	0.11	166.0	155.0	187.0	2994	3026	2963	2650	2514	2652	3.04
V	0.04	0.45	0.11	168.0	160.0	178.0	3004	3133	2896	2646	2599	2654	3.06
V	0.04	0.45	0.11	167.0	165.0	180.0	3008	3183	2954	2639	2718	2634	3.09
W	0.04	0.45	0.11										
W	0.04	0.45	0.11										
W	0.05	0.46	0.11										
W	0.04	0.46	0.11										
W	0.04	0.45	0.11										
W	0.04	0.45	0.11										
W	0.04	0.44	0.11										
W	0.05	0.45	0.11										

**12. Measurement of Uncertainty:** The samples used in the certification process were selected in such a way as to represent the entire batch of material and were taken from the final packaged units; therefore all possible sources of uncertainty (sample uncertainty and measurement uncertainty) are included in the final combined standard uncertainty determination.

The uncertainty measurement takes into consideration the between lab and the within lab variances and is calculated from the square roots of the variances of these components using the formula:

$$\text{Combined standard uncertainty} = \sqrt{(\text{between lab.var/no of labs}) + (\text{mean square within lab.var /no of assays})}$$

These uncertainty measurements may be used, by laboratories, as a component for calculating the total uncertainty for method validation according to the relevant ISO guidelines.

Analyte	Method	Unit	S <sup>1</sup>	σ <sub>L</sub> <sup>2</sup>	Sw <sup>3</sup>	CSU <sup>4</sup>
Au	PbColl	g/t	0.007	0.003	0.005	0.001
Pd	PbColl	g/t	0.019	0.011	0.011	0.003
Pt	PbColl	g/t	0.006	0.003	0.004	0.001
Co	M/ICP	ppm	4.610	3.289	2.358	0.981
Co	P	ppm	11.660	8.749	3.232	2.358
Co	XRF	ppm	7.641	4.904	6.508	2.220
Cu	M/ICP	ppm	78.123	47.059	54.406	14.698
Cu	P	ppm	133.292	92.672	57.393	25.370
Cu	XRF	ppm	69.493	70.049	31.825	26.822
Ni	M/ICP	ppm	68.193	46.491	38.923	14.021
Ni	P	ppm	129.160	91.266	55.000	24.939
Ni	XRF	ppm	55.865	51.993	25.283	18.661
SG	pycnometer		0.026	0.019	0.020	0.008
Al <sub>2</sub> O <sub>3</sub>	XRF	%	0.195	0.168	0.073	0.054
CaO	XRF	%	0.153	0.144	0.048	0.048
Cr <sub>2</sub> O <sub>3</sub>	XRF	%	0.007	0.005	0.004	0.002
Fe <sub>2</sub> O <sub>3</sub>	XRF	%	0.128	0.103	0.082	0.038
K <sub>2</sub> O	XRF	%	0.004	0.004	0.002	0.001
MgO	XRF	%	0.117	0.102	0.055	0.035
MnO	XRF	%	0.006	0.005	0.002	0.002
Na <sub>2</sub> O	XRF	%	0.025	0.025	0.012	0.010
P <sub>2</sub> O <sub>5</sub>	XRF	%	0.005	0.005	0.002	0.002
SiO <sub>2</sub>	XRF	%	0.259	0.192	0.154	0.063
TiO <sub>2</sub>	XRF	%	0.005	0.003	0.003	0.001
LOI	XRF	%	0.416	0.399	0.098	0.134
S	ICP	%	0.101	0.102	0.044	0.039

1. S - Std Dev for use on control charts.
2. σ<sub>L</sub> - Betw Lab Std Dev, for use to calculate a measure of accuracy.
3. Sw - Within Lab Stc Dev, for use to calculate a measure of precision.
4. CSU - Combined Standard Uncertainty, a component for use to calculate the total uncertainty in method validation.

**13. Uncertified values:** The Certified, Provisional and Informational values listed on p1 and p2 of this certificate fulfill the AMIS statistical criteria regarding agreement for certification and have been independently validated by Dr Barry Smee.

**14. Metrological Traceability:** The values quoted herein are based on the consensus values derived from statistical analysis of the data from an inter laboratory measurement program. Traceability to SI units is via the standards used by the individual laboratories, the majority of which are accredited, who have maintained measurement traceability during the analytical process.

**15. Certification:** AMIS0093 is a new material.

**16. Period of validity:** The certified values are valid for this product, while still sealed in its original packaging, until notification to the contrary. The stability of the material will be subject to continuous testing for the duration of the inventory. Should product stability become an issue, all

customers will be notified and notification to that effect will be placed on the [www.amis.co.za](http://www.amis.co.za) website.

**17. Minimum sample size:** The majority of laboratories reporting used a 0.5g sample size for the ICP. This is the recommended minimum sample size for the use of this material.

**18. Availability:** This product is available in Laboratory Packs containing 1kg of material and Explorer Packs containing custom weights (from 50g to 250g) of material. The Laboratory Packs are sealed bottles delivered in sealed foil pouches. The Explorer Packs contain material in standard geochem envelopes, vacuum sealed in foil pouches.

**19. Recommended use:** The data used to characterize this CRM has been scrutinized using outlier treatment techniques. This, together with the number of participating laboratories, should overcome any "inter-laboratory issues" and should lead to a very accurate measure for the given methods, notwithstanding the underlying assumption that what the good inter-laboratory labs reported was accurate. However an amount of bad data might have had an effect, resulting in limits which in some situations might be too broad for the effective monitoring of a single analytical method, laboratory or production process. Users should set their own limits based on their own data quality objectives and control measurements, after determining the performance characteristics of their own particular method, using a minimum of 20 analyses using this CRM. User set limits should normally be within the limits recommended on p1 and 2 of this certificate.

**20. Legal Notice:** This certificate and the reference material described in it have been prepared with due care and attention. However AMIS, Set Point Technology (Pty) Ltd, Mike McWha, Dr Barry Smee and Smee and Associates Ltd; accept no liability for any decisions or actions taken following the use of the reference material.

4 November 2009

**Certifying Officers:**

**African Mineral Standards:** \_\_\_\_\_

**Mike McWha**  
**BSc (Hons), FGSSA, MAusIMM, Pr.Sci.Nat**



**Geochemist:** \_\_\_\_\_

**Barry W. Smee**  
**BSc, PhD, P.Geo, (B.C.)**

**Appendix 1. – Uncertified trace element statistics**

AMIS0093 Trace

Analyte	Method	Unit	Mean	2SD	RSD%	n
Ag	M/ICP	ppm	1.26	0.281	11.1	62
Al	M/ICP	%	8.79	0.674	3.8	70
As	M/ICP	ppm	2.14	1.74	40.7	38
Ba	M/ICP	ppm	31.8	3.10	4.9	85
Be	M/ICP	ppm	0.109	0.092	42.3	27
Bi	M/ICP	ppm	0.770	0.103	6.7	45
Ca	M/ICP	ppm	6.78	0.745	5.5	77
Cd	M/ICP	ppm	1.04	0.370	17.8	52
Ce	M/ICP	ppm	2.96	0.222	3.7	52
Cr	M/ICP	ppm	981	378	19.3	72
Cs	M/ICP	ppm	0.165	0.114	34.6	55
Dy	M/ICP	ppm	0.871	0.100	5.8	36
Er	M/ICP	ppm	0.598	0.150	12.6	40
Eu	M/ICP	ppm	0.274	0.078	14.2	40
Fe	M/ICP	%	9.42	1.18	6.3	80
Ga	M/ICP	ppm	11.0	1.39	6.3	71
Gd	M/ICP	ppm	0.790	0.135	8.5	40
Ge	M/ICP	ppm	0.362	0.509	70.2	31
Hf	M/ICP	ppm	0.746	0.359	24.1	54
Ho	M/ICP	ppm	0.191	0.026	6.7	39
In	M/ICP	ppm	0.076	0.026	16.7	46
K	M/ICP	ppm	0.086	0.009	5.3	70
La	M/ICP	ppm	1.32	0.192	7.3	48
Li	M/ICP	ppm	9.00	1.96	10.9	56
Lu	M/ICP	ppm	0.086	0.019	10.9	31
Mg	M/ICP	%	6.16	0.634	5.1	78
Mn	M/ICP	ppm	940	123	6.6	80
Mo	M/ICP	ppm	0.661	0.732	55.4	46
Na	M/ICP	ppm	0.729	0.083	5.7	76
Nb	M/ICP	%	0.590	0.289	24.5	47
Nd	M/ICP	ppm	1.92	0.238	6.2	38
P	M/ICP	%	85.5	37.5	22.0	56
Pb	M/ICP	ppm	14.8	5.44	18.4	63
Pr	M/ICP	ppm	0.381	0.045	5.9	39
Rb	M/ICP	ppm	2.32	0.169	3.6	38
Re	M/ICP	ppm	0.029	0.022	38.0	31
Sb	M/ICP	ppm	2.29	0.291	6.4	47
Sc	M/ICP	ppm	14.5	1.15	4.0	53
Se	M/ICP	ppm	7.18	3.71	25.8	37
Si	M/ICP	%	18.9	0.471	1.2	15
Sm	M/ICP	ppm	0.564	0.141	12.5	39
Sn	M/ICP	ppm	0.831	0.280	16.8	39
Sr	M/ICP	ppm	81.1	4.51	2.8	70
Ta	M/ICP	ppm	0.269	0.667	123.8	39
Tb	M/ICP	ppm	0.129	0.018	6.9	32
Te	M/ICP	ppm	1.10	0.252	11.5	40
Th	M/ICP	ppm	0.246	0.209	42.3	48
Ti	M/ICP	%	0.138	0.015	5.4	73
Tm	M/ICP	ppm	0.085	0.019	11.4	40
U	M/ICP	ppm	0.239	0.123	25.6	54
V	M/ICP	ppm	89.9	16.4	9.1	76
W	M/ICP	ppm	0.241	0.151	31.4	32
Y	M/ICP	ppm	5.03	0.441	4.4	69
Yb	M/ICP	ppm	0.572	0.138	12.1	40
Zn	M/ICP	ppm	126	18.7	7.4	85
Zr	M/ICP	ppm	31.1	5.79	9.3	45