



African Mineral Standards

MATRIX REFERENCE MATERIALS

Tel: +27 (0) 11 923 0800 Fax: +27 (0) 11 392 4715 web: www.amis.co.za
11 Gewel Street (off Hulley Road), D1 Isando Business Park, Kempton Park, 1609
P.O. Box 856, Isando, 1600, Gauteng, South Africa, a division of the Set Point Group

AMIS0330

Certified Reference Material

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

Certificate of Analysis

**Recommended Concentrations and Limits¹
(at two Standard Deviations)**

Certified Concentrations²

Pt Pb Collection	1.06	±	0.08	g/t
Pd Pb Collection	5.53	±	0.38	g/t
Co M/ICP	703	±	49	ppm
Co P	696	±	43	ppm
Co XRF	745	±	78	ppm
Cu M/ICP	2.319	±	0.105	%
Cu P	2.298	±	0.101	%
Cu XRF	2.288	±	0.162	%
Ni M/ICP	2.528	±	0.140	%
Ni P	2.504	±	0.146	%
Ni XRF	2.553	±	0.162	%
Specific Gravity	3.21	±	0.16	

Provisional Concentrations

Au Pb Collection 0.27 ± 0.04 g/t

PGM 3E= 6.86 g/t

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 ₂ O ₃	9.11	±	0.26	%
CaO	5.49	±	0.12	%
Cr ₂ O ₃	0.17	±	0.01	%
Fe ₂ O ₃	27.37	±	0.72	%
K ₂ O	0.35	±	0.04	%
MgO	5.83	±	0.24	%
MnO	0.087	±	0.008	%
Na ₂ O	1.09	±	0.08	%
SiO ₂	29.94	±	1.26	%
TiO ₂	0.50	±	0.04	%
LOI	13.21	±	0.98	%
S Combustion / LECO	11.66	±	0.84	%

1. Intended Use: AMIS0330 is a certified reference material which may be used to demonstrate the validity of measurement results of a single analysis of nickel-copper-PGM sulphide ores hosted by mafic-ultramafic rocks.

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: AMIS0330 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.

4. Appearance: The material is a very fine powder. It is colored a Dark Blueish Grey (Corstor 5PB 4/1).

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 the consensus test results were carried out by independent statisticians.

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 (Al₂O₃, CaO, Cr₂O₃, Fe₂O₃, K₂O, MgO, MnO, Na₂O, SiO₂, TiO₂. LOI.) XRF fusion.
6. S by LECO
7. SG, gas pycnometer.

8. Information requested:

1. Aliquots used for all determinations.
2. Results for individual PGM's reported in ppb.
3. Results for base metals reported in ppm.
4. QC data, to include replicates, blanks and certified reference materials used.
5. Analytical techniques used.

9. Method of Certification: Twenty five laboratories were each given eight randomly selected packages of sample. Twenty of the laboratories submitted results.

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 recalculated 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: The 20 out of 25 laboratories that provided results timeously were (not in same order as in the table of assays):

1. ALS OMAC
2. ACME Analytical Laboratories Ltd CA
3. Activation Laboratories Pty Ltd (ActLabs) CA
4. ALS Chemex Laboratory Group Brisbane Australia
5. ALS Chemex Laboratory Group Johannesburg SA
6. ALS Chemex Laboratory Group Perth WA
7. BCL Botswana
8. Bureau Veritas (USA)
9. Genalysis Laboratory Services (W Australia P)
10. Intertek Utama Services (Indonesia)
11. LabtiumInc Finland
12. Set Point Laboratories (Isando) SA
13. SGS Australia Pty Ltd (Newburn) WA
14. SGS Geosol Laboratories Ltda (Brazil)
15. SGS Mineral Services Lakefield (Canada)
16. SGS Toronto (Canada)
17. SGS Townsville (Australia)
18. SGS Vancouver (Canada)
19. Tati Nickel Mine Laboratory (Botswana)
20. Ultra Trace (Pty) Ltd WA

11. Assay Data: Data as received from the laboratories for the important certified elements listed on p1 are 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.

Economic elements assay data

Lab Code	Pt PbColl g/t	Pd PbColl g/t	Au 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
A	1.00	5.41	0.25	690	710		23600	23200		24800	25500	
A	0.98	5.33	0.28	700	710		23900	23100		24700	25600	
A	1.01	5.30	0.28	680	700		23600	22800		24800	24900	
A	1.02	5.31	0.26	690	700		23900	23200		25200	25600	
A	1.03	5.32	0.29	690	710		23700	23200		24700	25600	
A	1.03	5.49	0.26	690	710		23400	23800		24600	25300	
A	0.99	5.34	0.25	670	700		23200	23100		24500	25400	
A	1.01	5.36	0.27	680	700		23800	22500		25000	25300	
B				900			24300			25800		
B				900			23500			26400		
B				800			23400			26000		
B				900			23500			26600		
B				800			23500			26000		
B				900			23400			26500		
B				900			23900			26200		
B				900			23500			26700		
C			0.27	742				23600				
C			0.24	717				23900				
C			0.34	712				23900				
C			0.28	705				23300				
C			0.26	666				23500				
C			0.29	672				23200				
C			0.30	688				23100				
C			0.25	702				23300				
D	1.04	5.59	0.25	736	710	770	23200	22670	21590	24590	23980	25890
D	1.07	5.66	0.25	692	700	780	23310	22820	20800	24920	24300	26250
D	1.13	5.69	0.27	724	710	770	23430	22790	21780	24950	24210	26190
D	1.14	5.66	0.26	693	710	770	23010	22840	21570	24240	23950	26150
D	1.12	5.59	0.25	700	710	770	22880	22630	19200	24270	23820	25610
D	1.04	5.46	0.25	741	710	780	23700	22900	21920	25380	24180	26010
D	1.09	5.29	0.25	731	710	770	23510	22890	21660	24980	24340	25980
D	1.11	5.27	0.24	728	710	770	23560	22590	21390	25020	23840	25830

Economic elements assay data (cont)

Lab Code	Pt PbColl g/t	Pd PbColl g/t	Au 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
E	1.08	5.78	0.33	680	660		22900	22400		24400	24700	
E	1.01	5.54	0.24	680	650		22900	22000		24300	24200	
E	1.01	5.61	0.27	670	680		22600	22800		24100	24600	
E	0.99	5.60	0.27	680	670		23000	22700		24900	24500	
E	1.10	5.83	0.27	680	660		22800	22300		24300	24400	
E	1.03	5.74	0.29	690	660		23300	22400		25000	24300	
E	1.06	5.72	0.31	670	680		22600	22800		23800	24700	
E	1.05	5.81	0.26	670	680		22500	22700		23900	24800	
F	1.08	5.32	0.26			700			23400			24300
F	1.09	5.48	0.26			700			23400			24200
F	1.03	5.35	0.26			700			23800			24500
F	1.09	5.55	0.26			700			23700			24400
F	1.09	5.38	0.25			700			23400			24400
F	1.09	5.61	0.28			700			23600			24300
F	1.07	5.76	0.27			700			23300			24500
F	1.07	5.33	0.28			800			23600			24300
G	1.12	5.71	0.27	646	671		23100	23500		24900		
G	1.12	5.69	0.26	627	675		22500	23200		23900		
G	1.12	5.79	0.28	646	667		23400	23300		24800		
G	1.09	5.62	0.26	655	674		23100	23500		25400		
G	1.06	5.59	0.29	677	677		23300	21800		25300		
G	1.20	5.96	0.27	666	674		23000	23300		24600		
G	1.09	5.81	0.29	677	677		23200	23200		24400		
G	1.07	5.67	0.29	664	671		23100	23500		24500		
H	0.88	5.02	0.26	649	555		20400	22200		22500	24200	
H	0.93	5.20	0.24	669	603		22400	22600		24800	24300	
H	0.93	5.28	0.27	710	655		23100	21400		24800	23100	
H	0.89	5.06	0.24	710	691		21400	22400		23300	24700	
H	0.93	5.20	0.24	789	744		22600	22400		25000	25100	
H	0.97	5.29	0.26	693	621		22300	21600		23800	22500	
H	0.93	5.15	0.25	592	541		22600	21600		24900	23100	
H	0.92	5.22	0.25	577	537		24100	22000		25900	23500	
I	0.92	5.19	0.24	700	500	799	23200	23100	21800	25900	25300	25900
I	0.95	4.94	0.24	600	600	792	23300	23100	22200	26000	25400	26200
I	0.93	4.90	0.23	700	600	830	23200	23100	21700	25900	25300	26200
I	0.96	5.16	0.25	600	600	846	23300	23000	21600	26000	25400	26000
I	0.91	5.00	0.24	700	600	848	23200	23100	22100	25900	25300	25700
I	0.94	5.00	0.24	700	600	789	23200	23100	21700	25900	25300	25900
I	0.95	5.06	0.23	700	600	756	23200	23100	21900	26000	25400	25800
I	0.98	5.13	0.24	700	600		23300	23000	29200	25900	25300	58400
K	1.17	5.79	0.24	690	674	700			23000			25300
K	1.08	5.87	0.27	693	725	700			23200			25300
K	1.10	5.54	0.27	676	709	700			23800			25700
K	1.12	5.40	0.28	688	698	700			23800			25700
K	1.08	5.79	0.26	693	692	800			23800			26000
K	1.12	5.46	0.27	687	692	800			23800			26100
K	1.11	5.57	0.25	692	696	700			23700			25800
K	1.11	5.55	0.26	662	723	800			23600			26000
N	1.08	5.45	0.25	759	693			22000			25500	
N	1.10	5.46	0.26	769	710			22700			27000	
N	1.07	5.36	0.24	731	700			22600			25600	
N	1.05	5.34	0.24	743	727			22300			24900	
N	1.13	5.48	0.25	760	744			22100			25300	
N	1.11	5.42	0.24	724	703			21700			25800	
N	1.05	5.30	0.31	735	710			22200			25400	
N	1.01	5.24	0.23	743	731			22400			25400	
O				712			23300			25900		
O				718			23600			25700		
O				701			23100			26000		
O				693			23100			25800		
O				692			23200			25400		
O				705			23200			25500		
O				698			23100			25900		
O				704			23000			25600		
P	1.13	5.59	0.27	697	706		22708			25561		
P	1.09	5.38	0.26	710	717		22570			25598		
P	1.07	5.52	0.30	697	719		22447			25494		
P	1.14	5.49	0.31	707	712		22648			25623		
P	1.05	5.39	0.27	715	705		22564			25420		
P	1.10	5.53	0.27	715	711		22433			25313		
P	1.07	5.42	0.26	717	687		22598			25481		
P	1.10	5.58	0.28	718	700		22498			25309		
Q	1.03	5.50	0.33						22030			24170
Q	0.98	5.39	0.30						22250			24350
Q	0.99	5.28	0.36						22590			24670
Q	1.00	5.42	0.33						21990			24140
Q	0.97	5.32	0.31						22120			24290
Q	0.97	5.26	0.33						22350			24630
Q	0.98	5.34	0.32						22190			24260
Q	1.00	5.27	0.32						22250			24360

Economic elements assay data (cont)

Lab Code	Pt PbColl g/t	Pd PbColl g/t	Au 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
R				720	680	700	24100	23400	24000	26100	24900	26600
R				680	700	800	23300	24200	24000	25000	25900	26900
R				680	690	700	23200	24100	23900	25100	25900	26800
R				680	690	700	23400	24100	24000	24900	25800	26700
R				710	690	800	24400	23700	24300	26300	25100	26800
R				660	680	700	22900	23700	23700	24400	25200	26600
R				720	680	700	24500	23600	23700	26000	25800	26600
R				660	690	800	22700	23800	24000	24200	25300	26600
S	1.02	5.34	0.30	730	719	750	23000	23000	23000	25200	24300	26000
S	1.08	5.48	0.28	725	730	730	23200	23600	23000	24700	24600	26000
S	1.02	5.36	0.26	725	707	740	22600	22700	22900	25100	23900	25900
S	1.04	5.74	0.29	740	724	740	23000	23600	23000	25600	24400	26000
S	1.04	5.40	0.26	725	731	750	23100	23300	22900	24900	25100	26000
S	1.08	5.44	0.27	720	741	760	23400	23700	23200	24900	25000	26100
S	1.06	5.52	0.26	745	718	750	23100	22900	23200	25400	24100	26000
S	1.04	5.28	0.27	740	714	740	23300	22900	23100	24100	24300	26000
V	1.04	5.48	0.30	586	654		20900	22600		19200		
V	1.11	5.59	0.30	585	655		20800	22700		19500		
V	1.00	4.97	0.28	588	649		21100	22500		19800		
V	1.13	5.31	0.29	583	658		20900	23100		19500		
V	1.05	5.57	0.28	595	666		21000	22900		19900		
V	1.00	5.40	0.29	585	643		21100	22900		19600		
V	1.05	5.50	0.30	596	658		21300	22500		20100		
V	1.11	5.57	0.31	581	664		20900	22400		19600		
W	1.09	5.56	0.31			730			22800			25200
W	1.11	5.62	0.30			755			22800			25100
W	1.12	5.66	0.27			739			22200			25600
W	1.07	5.63	0.27			728			22800			25100
W	1.06	5.69	0.27			721			22700			25100
W	1.10	5.53	0.26			725			22900			25300
W	1.09	5.48	0.27			727			22600			24900
W	1.06	5.60	0.26			730			23100			25500
X	1.10	5.95	0.34	750			24125			25475		
X	1.05	5.61	0.29	750			24025			24950		
X	1.00	5.48	0.29	767			24350			25350		
X	1.05	5.75	0.32	775			24275			25700		
X	1.01	5.70	0.33	750			24267			25250		
X	1.06	5.63	0.30	750			24533			25175		
X	1.06	5.70	0.30	750			24500			25150		
X	1.00	5.42	0.30	800			24075			25075		
Y	1.07	5.82	0.29	702	713		23200			25900	26000	
Y	1.09	5.87	0.27	698	679		23500			26200	26700	
Y	1.08	5.90	0.28	697	714		23300			26700	26200	
Y	1.09	5.94	0.26	715	707		22400			26700	26100	
Y	1.02	5.89	0.28	691	725		22000			26200	25800	
Y	1.14	5.90	0.28	695	703		22200			25800	26200	
Y	1.10	5.93	0.27	693	725		22500			25100	26900	
Y	1.08	5.88	0.27	695.00	713.00		22300.00			26200	26700	

Major element assay data

Lab Code	Al2O3 XRF %	CaO XRF %	Cr2O3 XRF %	Fe2O3 XRF %	K2O XRF %	MgO XRF %	MnO XRF %	Na2O XRF %	SiO2 XRF %	TiO2 XRF %	LOI %	S Comb/LECO %	SG pyc
A	8.62	5.47	0.16	24.60	0.32	6.03	0.08	0.97	29.20	0.46	14.00		3.12
A	8.68	5.53	0.17	25.40	0.33	6.15	0.08	0.98	29.40	0.47	14.10		3.17
A	8.62	5.40	0.16	25.40	0.33	6.02	0.08	0.98	29.20	0.46	13.85		3.19
A	8.84	5.49	0.17	25.10	0.33	6.18	0.08	1.00	29.90	0.47	14.05		3.11
A	8.68	5.40	0.16	25.40	0.33	6.05	0.08	0.99	29.30	0.46	14.05		3.17
A	8.54	5.35	0.16	24.90	0.32	5.98	0.08	0.96	29.10	0.46	13.95		3.18
A	8.55	5.37	0.16	25.00	0.32	5.99	0.08	0.96	29.30	0.46	14.15		3.18
A	8.64	5.49	0.16	25.40	0.33	6.09	0.08	0.97	29.60	0.46	14.00		3.12
B						5.36			26.80			12.70	
B						5.64			25.50			12.40	
B						5.75			27.20			12.40	
B						5.67			26.90			12.40	
B						5.23			25.40			12.30	
B						5.07			26.80			12.40	
B						5.66			26.40			12.50	
B						5.61			27.00			12.40	
C												11.93	
C												10.85	
C												11.79	
C												11.15	
C												11.40	
C												11.25	
C												11.56	
C												11.52	

Major element assay data (cont)

Lab Code	Al2O3 XRF %	CaO XRF %	Cr2O3 XRF %	Fe2O3 XRF %	K2O XRF %	MgO XRF %	MnO XRF %	Na2O XRF %	SiO2 XRF %	TiO2 XRF %	LOI %	S Comb/LECO %	SG pyc
D	9.10	5.49	0.18	27.69	0.37	5.88	0.09	1.08	30.40	0.49	12.95		3.16
D	9.13	5.53	0.17	27.99	0.36	5.89	0.09	1.08	30.60	0.50	12.90		3.14
D	9.16	5.51	0.17	27.88	0.37	5.89	0.09	1.08	30.40	0.49	12.89		3.17
D	9.09	5.47	0.18	27.68	0.37	5.89	0.09	1.09	30.30	0.50	12.98		3.17
D	9.14	5.49	0.17	27.62	0.35	5.88	0.09	1.09	30.50	0.49	13.26		3.18
D	9.11	5.50	0.17	27.75	0.37	5.89	0.09	1.08	30.30	0.50	13.03		3.17
D	9.05	5.49	0.17	27.66	0.36	5.86	0.09	1.07	30.30	0.50	12.98		3.17
D	9.07	5.45	0.18	27.54	0.37	5.87	0.09	1.07	30.20	0.51	12.80		3.16
E	8.81	5.34	0.15	26.30	0.40	5.69	0.09		30.80	0.48			3.10
E	8.83	5.40	0.16	26.60	0.50	5.73	0.08		30.70	0.48			3.12
E	8.96	5.45	0.16	27.00	0.50	5.80	0.08		31.30	0.49			3.16
E	8.79	5.40	0.16	26.50	0.50	5.71	0.08		30.50	0.48			3.15
E	8.89	5.50	0.18	26.40	0.50	5.71	0.08		30.70	0.48			3.14
E	8.88	5.46	0.16	26.50	0.50	5.74	0.08		30.80	0.48			3.14
E	8.75	5.34	0.15	26.30	0.40	5.69	0.08		30.50	0.48			3.08
E	8.89	5.33	0.16	26.30	0.50	5.72	0.08		30.90	0.48			3.06
F												11.80	
F												11.80	
F												11.90	
F												11.80	
F												11.80	
F												11.80	
F												11.90	
F												11.90	
G													3.25
G													3.27
G													3.25
G													3.26
G													3.24
G													3.25
G													3.26
G													3.24
I	8.93	5.60	0.18	27.56	0.33	5.94	0.09	1.11	29.30	0.53	13.36	10.40	3.19
I	8.85	5.56	0.17	27.35	0.33	5.90	0.09	1.11	28.97	0.51	13.10	10.30	3.20
I	8.80	5.55	0.17	27.41	0.34	5.96	0.09	1.10	28.96	0.51	13.05	10.50	3.19
I	8.83	5.56	0.18	27.46	0.34	6.01	0.09	1.12	29.12	0.52	13.29	10.20	3.20
I	8.80	5.54	0.17	27.29	0.34	5.99	0.09	1.11	28.87	0.51	13.21	10.20	3.20
I	8.90	5.59	0.18	27.56	0.34	6.04	0.09	1.11	29.21	0.52	12.96	10.50	3.19
I	8.95	5.58	0.17	27.48	0.33	6.05	0.09	1.11	29.32	0.51	13.39	10.20	3.19
I	8.98	5.60	0.18	27.65	0.34	5.99	0.09	1.11	29.36	0.52	12.86	10.30	3.19
K													10.90
K													11.00
K													11.30
K													11.30
K													11.30
K													11.40
K													11.20
K													11.20
N	9.03	5.50	0.17	27.40	0.36	5.86	0.09	1.12	30.30	0.52	12.90		
N	9.16	5.53	0.17	27.50	0.36	5.87	0.09	1.10	30.50	0.52	12.70		
N	9.14	5.52	0.17	27.50	0.36	5.88	0.09	1.14	30.50	0.52	12.70		
N	9.09	5.55	0.17	27.50	0.36	5.85	0.09	1.13	30.40	0.53	12.80		
N	9.09	5.52	0.17	27.50	0.36	5.85	0.09	1.12	30.40	0.53	12.80		
N	9.16	5.54	0.17	27.50	0.37	5.85	0.09	1.13	30.40	0.53	12.80		
N	9.08	5.51	0.17	27.40	0.37	5.85	0.09	1.11	30.40	0.53	12.80		
N	9.10	5.53	0.17	27.50	0.36	5.86	0.09	1.13	30.40	0.53	12.80		
P													3.08
P													3.12
P													3.13
P													3.14
P													3.16
P													3.05
P													3.11
P													3.07
Q	9.16	5.19		26.60	0.32	5.72	0.07	1.09	29.20	0.47	13.90	11.27	3.28
Q	9.21	5.23		26.80	0.31	5.74	0.08	1.12	29.20	0.49	13.80	11.33	3.29
Q	9.26	5.26		27.10	0.31	5.76	0.07	1.13	29.50	0.48	13.90	11.44	3.33
Q	9.15	5.20		26.60	0.31	5.68	0.07	1.10	29.00	0.48	13.80	11.29	3.35
Q	9.16	5.21		26.70	0.31	5.71	0.07	1.11	29.10	0.48	13.90	11.32	3.31
Q	9.24	5.26		27.00	0.31	5.76	0.08	1.12	29.40	0.48	13.70	11.37	3.34
Q	9.23	5.24		26.80	0.31	5.75	0.07	1.12	29.20	0.48	13.70	11.31	3.34
Q	9.23	5.25		26.90	0.31	5.77	0.08	1.13	29.30	0.48	13.70	11.32	3.32
R	9.20	5.49	0.17	27.30	0.34	5.80	0.09	1.08	30.20	0.51	12.09	11.50	3.32
R	9.20	5.51	0.17	27.60	0.35	5.84	0.09	1.06	30.40	0.52	12.62	11.25	3.33
R	9.21	5.50	0.19	27.40	0.35	5.81	0.09	1.06	30.30	0.51	12.64	13.10	3.32
R	9.18	5.49	0.17	27.20	0.35	5.77	0.08	1.08	30.10	0.50	12.49	11.05	3.31
R	9.20	5.51	0.17	27.50	0.35	5.84	0.09	1.11	30.50	0.51	12.62	11.30	3.32
R	9.20	5.49	0.17	27.20	0.34	5.80	0.09	1.05	30.20	0.51	12.87	11.20	3.32
R	9.19	5.49	0.17	27.20	0.35	5.77	0.09	1.08	30.20	0.51	12.66	11.15	3.32
R	9.20	5.46	0.17	27.30	0.35	5.77	0.09	1.02	30.30	0.51	12.52	11.25	3.32
S	9.21	5.53	0.17	27.40	0.36	5.92	0.09		30.50	0.53	13.00		3.20
S	9.20	5.52	0.17	27.40	0.36	5.93	0.09		30.58	0.52	13.00		3.25
S	9.17	5.53	0.17	27.30	0.36	5.90	0.09		30.52	0.52	13.00		3.24
S	9.18	5.54	0.17	27.40	0.36	5.93	0.09		30.50	0.52	13.00		3.21
S	9.16	5.53	0.17	27.40	0.36	5.92	0.09		30.52	0.52	12.90		3.22
S	9.17	5.52	0.17	27.50	0.36	5.93	0.09		30.50	0.53	13.00		3.23
S	9.17	5.52	0.17	27.40	0.36	5.93	0.09		30.51	0.53	13.10		3.25
S	9.17	5.53	0.17	27.40	0.36	5.91	0.09		30.44	0.52	13.10		3.21
V												11.88	3.91
V												11.95	3.86
V												11.98	4.07
V												11.88	3.97
V												11.92	3.23
V												11.94	3.40
V												11.90	3.67
V												11.85	3.69

Major element assay data (cont)

Lab Code	Al ₂ O ₃ XRF %	CaO XRF %	Cr ₂ O ₃ XRF %	Fe ₂ O ₃ XRF %	K ₂ O XRF %	MgO XRF %	MnO XRF %	Na ₂ O XRF %	SiO ₂ XRF %	TiO ₂ XRF %	LOI %	S Comb/LECO %	SG pyc
W	9.21	5.40	0.18	27.70	0.37	5.69	0.09	0.83	30.28	0.48	3.02		3.44
W	9.18	5.42	0.18	27.65	0.36	5.68	0.09	0.84	30.52	0.50	3.06		3.46
W	9.28	5.38	0.18	27.77	0.36	5.71	0.09	0.88	28.16	0.49	3.04		3.42
W	9.33	5.36	0.17	27.82	0.36	5.67	0.09	0.85	29.18	0.47	3.11		3.44
W	9.18	5.42	0.18	27.71	0.37	5.64	0.09	0.82	29.15	0.48	3.09		3.45
W	9.14	5.39	0.17	27.51	0.38	5.75	0.09	0.83	29.22	0.49	3.10		3.43
W	9.20	5.44	0.17	27.68	0.38	5.72	0.09	0.84	29.01	0.48	3.11		3.45
W	9.22	5.43	0.19	27.71	0.37	5.68	0.09	0.81	29.23	0.48	3.13		3.45
Y												11.90	
Y												11.90	
Y												12.00	
Y												12.00	
Y												11.90	
Y												12.00	
Y												12.00	
Y												12.10	

12. Measurement of Uncertainty:(ref Dr Hugh Bartlett, Hugh Bartlett Consulting CC.)

The samples used in this certification process have been 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 ¹	σ _L ²	SW ³	CSU ⁴
Pt	PbColl	g/t	0.04	0.02	0.03	0.007
Pd	PbColl	g/t	0.19	0.12	0.11	0.03
Au	PbColl	g/t	0.02	0.009	0.015	0.003
Co	M/ICP	ppm	27.5	16.9	14.7	4.6
Co	P	ppm	21.6	16.6	10.4	5.1
Co	XRF	ppm	39.0	22.8	33.2	9.7
Cu	M/ICP	ppm	526	315	346	93.9
Cu	P	ppm	506	372	262	116
Cu	XRF	ppm	808	806	216	286
Ni	M/ICP	ppm	702	450	424	132
Ni	P	ppm	728	625	321	212
Ni	XRF	ppm	810	828	192	294
Al ₂ O ₃	XRF	%	0.13	0.12	0.04	0.04
CaO	XRF	%	0.06	0.05	0.03	0.02
Cr ₂ O ₃	XRF	%	0.006	0.005	0.004	0.002
Fe ₂ O ₃	XRF	%	0.43	0.43	0.14	0.15
K ₂ O	XRF	%	0.020	0.021	0.006	0.007
MgO	XRF	%	0.12	0.11	0.04	0.03
MnO	XRF	%	0.004	0.004	0.002	0.001
Na ₂ O	XRF	%	0.05	0.06	0.02	0.03
SiO ₂	XRF	%	0.63	0.57	0.24	0.19
TiO ₂	XRF	%	0.022	0.021	0.006	0.007
LOI		%	0.49	0.55	0.12	0.21
S	Comb/LECO	%	0.42	0.41	0.15	0.15
SG	pyc		0.08	0.07	0.02	0.02

1. S - Std Dev for use on control charts.
2. σ_L - Betw Lab Std Dev, for use to calculate a measure of accuracy.
3. Sw - Within Lab Std 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. Certified values: The Certified, Provisional and Indicated 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 and who have maintained measurement traceability during the analytical process.

15. Certification: AMIS0330 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 website.

17. Minimum sample size: The majority of laboratories reporting used a 0.5g sample size for the ICP and a 30g sample size for the fire assay. These are the recommended minimum sample sizes 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 50 to 250g) of material. The Laboratory Packs are sealed bottles delivered in sealed foil pouches. The Explorer Packs contain material in standard geochem envelopes, nitrogen flushed and 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.

23 August 2012

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 – uncertified trace element statistics

Analyte	Method	Unit	Mean	2SD	RSD%	n
Ag	M/ICP	ppm	8.35	2.30	13.8	104
Al	M/ICP	%	4.79	0.44	4.60	104
As	M/ICP	ppm	9.66	8.37	43.3	75
Ba	M/ICP	ppm	80.2	13.0	8.11	93
Be	M/ICP	ppm	0.20	0.11	27.4	27
Bi	M/ICP	ppm	8.43	6.69	39.7	67
Ca	M/ICP	%	3.88	0.28	3.65	100
Cd	M/ICP	ppm	2.31	2.90	62.9	93
Ce	M/ICP	ppm	10.7	2.47	11.6	48
Cr	M/ICP	ppm	752	320	21.3	104
Cs	M/ICP	ppm	0.87	0.17	9.58	32
Dy	M/ICP	ppm	1.17	0.09	3.76	23
Er	M/ICP	ppm	0.64	0.09	7.14	24
Eu	M/ICP	ppm	0.41	0.03	3.09	21
Fe	M/ICP	%	19.3	1.09	2.82	91
Ga	M/ICP	ppm	9.17	5.60	30.6	51
Gd	M/ICP	ppm	1.23	0.14	5.62	23
Ge	M/ICP	ppm	1.13	0.21	9.29	16
Hf	M/ICP	ppm	0.99	0.27	13.8	46
Ho	M/ICP	ppm	0.22	0.03	7.50	23
In	M/ICP	ppm	0.13	0.05	17.7	46
K	M/ICP	%	0.30	0.04	6.56	106
La	M/ICP	ppm	5.41	3.18	29.4	78
Li	M/ICP	ppm	13.04	2.49	9.55	75
Lu	M/ICP	ppm	0.10	0.03	14.01	31
Mg	M/ICP	%	3.40	0.30	4.43	106
Mn	M/ICP	ppm	666	67.8	5.09	108
Mo	M/ICP	ppm	15.3	6.91	22.5	111
Na	M/ICP	%	0.81	0.11	6.96	103
Nb	M/ICP	ppm	2.51	0.68	13.6	56
Nd	M/ICP	ppm	5.31	0.43	4.01	23
P	M/ICP	ppm	220	111	25.3	96
Pb	M/ICP	ppm	32.9	13.7	20.9	102
Pr	M/ICP	ppm	1.33	0.14	5.23	24
Rb	M/ICP	ppm	11.3	5.39	23.9	59
Re	M/ICP	ppm	0.09	0.01	5.12	24
S	M/ICP	%	8.97	9.25	51.6	40
Sb	M/ICP	ppm	2.88	8.95	155	64
Sc	M/ICP	ppm	11.2	1.95	8.70	110
Se	M/ICP	ppm	48.9	17.6	18.0	54
Si	M/ICP	%	14.2	0.27	0.96	8
Sm	M/ICP	ppm	1.23	0.20	8.24	24
Sn	M/ICP	ppm	1.74	0.65	18.9	54
Sr	M/ICP	ppm	96.0	12.6	6.55	104
Ta	M/ICP	ppm	0.26	0.28	53.5	52
Tb	M/ICP	ppm	0.19	0.04	11.6	31
Te	M/ICP	ppm	7.46	1.66	11.1	47
Th	M/ICP	ppm	1.81	0.33	9.18	55
Ti	M/ICP	%	0.29	0.03	5.70	86
Tl	M/ICP	ppm	0.67	2.17	161	44
Tm	M/ICP	ppm	0.10	0.01	4.78	24
U	M/ICP	ppm	0.92	0.21	11.4	54
V	M/ICP	ppm	115	18.0	7.81	105
W	M/ICP	ppm	3.36	4.49	66.9	62
Y	M/ICP	ppm	5.91	0.92	7.81	83
Yb	M/ICP	ppm	0.59	0.11	9.24	30
Zn	M/ICP	ppm	314	58.2	9.27	99
Zr	M/ICP	ppm	35.8	13.5	18.9	89