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

AMIS0247

Certified Reference Material

Copper cobalt oxide ore
Kinsevere, DRC

Certificate of Analysis

Recommended Concentrations and Limits[1.]
(at two Standard Deviations)

Certified Concentrations[2.]

Co F	1064	±	47	ppm
Co M/ICP	1034	±	73	ppm
Co P	1061	±	112	ppm
Cu F	4.123	±	0.325	%
Cu M/ICP	4.134	±	0.225	%
Cu P	4.094	±	0.117	%
Specific Gravity	2.86	±	0.10	

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_2O_3	13.58	±	0.26	%
Fe_2O_3	3.39	±	0.18	%
K_2O	2.69	±	0.12	%
MgO	4.73	±	0.19	%
SiO_2	62.65	±	0.98	%
TiO_2	0.85	±	0.04	%
LOI	6.45	±	0.74	%

Provisional Concentrations

CaO	0.07	±	0.02	%
MnO	0.030	±	0.004	%
Na_2O	0.07	±	0.01	%

Indicated Mean

Cr_2O_3	0.03	%

1. Intended Use: AMIS0247 can be used to check analysis of samples of copper cobalt ores with a similar grade and matrix.

It is a matrix matched Certified Reference Material (CRM) 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: AMIS0247 is a commissioned CRM made from “DSH” material supplied by SGS Minerals Services from the Kinsevere Copper Mine, 27 km north on Lubumbashi, in the Katanga Province of the Democratic Republic of Congo (DRC). Kinsevere, formerly owned by Anvil Mining Limited, is now 95% owned by Minmetals Resources.

The Kinsevere Project comprises three known structurally modified stratiform copper deposits; Tshifufia, Tshifufiamashi and Kinsevere Hill. These are hosted within interbedded calcareous siltstones and silty dolomites of the Mines Group, overturned to a steep eastward dip during the Lufilian Orogeny (approximately 550 Ma). Deep weathering, extending to approximately 100 m below surface, has led to the development of a large oxide resource hosted by highly altered dolomitic and argillaceous sediments. Underlying sulphide mineralisation comprises chalcopyrite in crosscutting veins and stringers.

3. Mineral and Chemical Composition: Oxide ore mineralogy at Tshifufia, Tshifufiamashi and Kinsevere Hill is composed predominantly of malachite and pseudomalachite, with minor chrysocolla and rare intergrown heterogenite. These occur as disseminations and/or in veins and veinlets, which sometimes coalesce into prominent “clots”. Underlying sulphide mineralisation comprises chalcopyrite, chalcocite, and bornite; typically occuring as finely disseminated, bedding parallel layers, stratiform veins or as replacement of pyrite nodules. Lesser cross cutting quartz-carbonate- sulphide veins are also observed. Sulphide remobilisation during faulting has also led to the development of variably mineralised breccias.

Within the oxide zone, cobalt mineralogy is composed predominantly of rare intergrown heterogenite (CoO(OH)). Heterogenite is generally limited to vuggy infills in well-developed malachite veins along with manganese oxides.

Within the sulfide zone, carrollite is the dominant cobalt mineral. It appears to be an early formed mineral since it is rimmed or replaced by chalcopyrite or bornite. It is more resistant to weathering than Cu sulfides and often survives into the supergene and mixed zones. The presence of very coarse and disseminated carrollite plus pyrite in late stage siliceous and dolomitic veins appears to denote another phase of mineralization that may postdate the principal copper mineralizing event.

4. Appearance: The material is a very fine Pale Yellow powder (Corstor 5Y 7/4).

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 parti**c**le size analysis of random samples confirmed the material was 98.5% <54um. It was then homogenized in a double cone blender, systematically divided and 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. Co, Cu. Fusion AAS or ICP-OES (F).
2. Multi-acid digest multi-element scan - (to include Co, Cu). ICP-OES or ICP-MS (M/ICP).
3. Aqua regia digest – Co, Cu. ICP-OES or ICP-MS (P).
4. Pressed pellet multi-element scan - (to include Co, Cu) (XRF).
5. Majors (Al2O3, CaO, Cr2O3, Fe2O3, K2O, MgO, MnO, Na2O, SiO2, TiO2. 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 base metals to be reported in ppm.
5. Report all QC data, to include replicates, blanks and certified reference materials used.

9. Method of Certification: Twenty two laboratories were each given eight packages, comprising eight samples scientifically selected from throughout the batch. Seventeen laboratories reported results in time for certification

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: The 17 out of 22 laboratories that provided results timeously were (not in same order as in the table of assays**):**

1. Activation Laboratories Pty Ltd (ActLabs) CA
2. Alex Stewart International Corporation Zambia
3. ALS Chemex Laboratory Group Brisbane Australia
4. ALS Chemex Laboratory Group Johannesburg SA
5. ALS Chemex Laboratory Group Vancouver CA
6. Genalysis Laboratory Services (South Africa) Pty
7. Genalysis Laboratory Services W Australia
8. Intertek Utama Services (Indonesia)
9. Set Point Laboratories (Isando) SA
10. SGS Australia Pty Ltd (Newburn) WA
11. SGS Durango (Mexico)
12. SGS Geosol Laboratories Ltda (Brazil)
13. SGS Mineral Services Callao (Peru)
14. SGS Mineral Services Lakefield (Canada)
15. SGS South Africa (Pty) Ltd - Booysens JHB
16. SGS Toronto (Canada)
17. Ultra Trace (Pty) Ltd WA

11. Assay Data: Data as received from the laboratories for the important certified elements listed on p1 is set out below.

Lab Code	Co F ppm	Co M/ICP ppm	Co P ppm	Co XRF ppm	Cu F ppm	Cu M/ICP ppm	Cu P ppm	Cu XRF ppm	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		1050	1010	1100		40300	41300	42400	13.5	0.06	0.01	3.41	2.65	4.72	0.03	0.08	62.20	0.81	6.21		
A		1060	1020	1100		40700	41600	42400	13.5	0.06	0.02	3.46	2.66	4.73	0.03	0.08	62.10	0.81	6.17		
A		1090	1000	1100		41500	40600	42700	13.6	0.07	0.01	3.46	2.66	4.77	0.03	0.08	62.60	0.83	6.37		
A		1070	990	1100		40900	40400	42600	13.7	0.06	0.02	3.45	2.67	4.75	0.03	0.08	62.60	0.82	6.33		
A		1080	1010	1100		41600	41400	42600	13.6	0.07	0.02	3.43	2.65	4.75	0.03	0.08	62.50	0.82	6.19		
A		1060	1000	1100		41100	40900	42400	13.5	0.06	0.02	3.43	2.66	4.74	0.03	0.08	62.30	0.82	6.30		
A		1080	1000	1100		40700	40900	42400	13.5	0.06	0.02	3.40	2.66	4.72	0.03	0.08	62.10	0.81	6.38		
A		1080	1020	1100		40500	41400	42400	13.7	0.06	0.01	3.39	2.66	4.74	0.03	0.08	62.50	0.82	6.21		
C	999	1048	1141		42702					0.07						0.08					
C	1074	1118	1139		45313					0.07						0.08					
C	998	1020	1140		37951					0.07						0.08					
C	965	1018	1136		44680					0.07						0.07					
C	1040	1022	1117		42295					0.07						0.08					
C	1051	1094	1107		42561					0.07						0.07					
C	953	1058	1090		40782					0.07						0.08					
C	944	1064	1100		39696					0.07						0.08					
D		956	1060			40600									0.03	0.07					
D		982	1050			40400									0.03	0.07					
D		972	1010			40900									0.03	0.07					
D		966	1000			41500									0.03	0.07					
D		971	1020			40800									0.03	0.07					
D		987	966			37500									0.03	0.07					
D		1010	1100			40600									0.03	0.07					
D		996	1060			40700									0.03	0.07					
E		1010	913		42300	42400			13.5	0.07	0.03	3.35	2.67	4.67	0.04		62.72	0.84			
E		1040	908		42500	43000			13.6	0.07	0.02	3.36	2.65	4.68	0.04		62.87	0.84			
E		1030	911		42300	42300			13.5	0.07	0.02	3.34	2.64	4.64	0.04		62.57	0.83			
E		1000	921		40900	42200			13.6	0.07	0.03	3.36	2.65	4.68	0.03		62.80	0.83			
E		998	901		40600	42300			13.6	0.07	0.02	3.36	2.65	4.69	0.04		62.83	0.84			
E		1010	908		41500	42600			13.6	0.07	0.02	3.36	2.66	4.70	0.04		62.99	0.84			
E		1010	902		41600	42200			13.6	0.07	0.03	3.35	2.67	4.69	0.04		62.78	0.84			
E		1010	940		42400	42300			13.5	0.07	0.03	3.35	2.66	4.67	0.04		62.60	0.84			

Assay data (cont)

Lab Code	Co F ppm	Co M/ICP ppm	Co P ppm	Co XRF ppm	Cu F ppm	Cu M/ICP ppm	Cu P ppm	Cu XRF ppm	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
F				886		43800	42700	41980	13.4	0.08	0.03	3.63	2.67	4.71	0.02	0.04	62.22	0.88	6.54	0.08	2.80
F				926		43400	43900	41136	13.5	0.10	0.03	3.63	2.68	4.79	0.02	0.04	62.04	0.86	6.52	0.07	2.83
F				937		43800	44300	42176	13.5	0.09	0.03	3.66	2.68	4.76	0.02	0.03	62.37	0.87	6.51	0.07	2.81
F				870		45400	42400	41691	13.5	0.09	0.03	3.68	2.69	4.75	0.02	0.04	62.50	0.87	6.52	0.07	2.80
F				842		44400	43200	41364	13.4	0.09	0.03	3.65	2.67	4.62	0.02	0.04	62.23	0.87	6.44	0.07	2.83
F				884		43100	41300	41759	13.6	0.09	0.03	3.68	2.69	4.75	0.03	0.03	62.78	0.87	6.38	0.07	2.80
F				880		43900	43900	42036	13.4	0.09	0.03	3.64	2.68	4.70	0.02	0.03	62.42	0.87	6.40	0.07	2.83
F				881		43700	43900	41416	13.5	0.09	0.03	3.65	2.68	4.69	0.02	0.04	62.36	0.87	6.42	0.07	2.80
G		1034	985			41900	40300														
G		1025	993			41300	40800														
G		1044	984			41500	40600														
G		1035	979			41800	40400														
G		1026	994			41400	40500														
G		1051	1000			41300	40500														
G		1012	995			41300	40800														
G		1028	1013			40900	40800														
H	1050	950	957	800	38900	36900	36300	42500	13.5	0.08	0.09	3.80	2.67	4.64	0.03	0.26	62.40	0.85	6.74	0.06	2.86
H	1050	928	1030	900	40100	36800	38100	42300	13.7	0.08	0.05	3.73	2.62	4.69	0.03	0.12	62.70	0.86	6.75	0.06	2.84
H	1060	936	1030	900	39800	36600	39100	42400	13.5	0.08	0.08	3.85	2.70	4.65	0.03	0.12	62.40	0.85	6.77	0.05	2.79
H	1050	935	1020	800	38200	37400	38400	41800	13.7	0.08	0.05	3.79	2.63	4.69	0.03	0.14	62.90	0.87	6.75	0.07	2.85
H	1040	932	993	900	40200	37100	36600	42800	13.5	0.08	0.05	3.76	2.68	4.60	0.03	0.13	62.50	0.86	6.73	0.06	2.85
H	1050	916	978	900	38700	35600	36800	42300	13.6	0.08	0.04	3.70	2.71	4.63	0.04	0.14	62.40	0.86	6.74	0.07	2.85
H	1040	971	1040	900	39300	37800	38900	41900	13.7	0.08	0.07	3.73	2.70	4.66	0.03	0.15	62.70	0.87	6.72	0.05	2.86
H	1060	924	948	800	41200	36700	35900	42700	13.6	0.08	0.04	3.65	2.69	4.61	0.03	0.12	62.50	0.86	6.73	0.05	2.85
I	1080	1010	1060		40800	39200	40400		13.5	0.06	0.03	3.32	2.63	4.77	0.03	0.07	63.90	0.84	7.08		2.85
I	1070	1070	1060		39700	41800	40400		13.3	0.06	0.03	3.42	2.58	4.70	0.04	0.05	62.90	0.85	7.07		2.83
I	1040	1090	1050		39200	42300	40000		13.1	0.05	0.03	3.23	2.55	4.66	0.03	0.07	62.20	0.82	6.99		2.92
I	1050	1070	1060		39300	41100	40600		13.4	0.05	0.03	3.32	2.60	4.76	0.03	0.07	63.70	0.84	5.77		2.69
I	1110	1040	1080		40700	39800	40500		13.1	0.06	0.03	3.21	2.49	4.46	0.03	0.07	62.50	0.81	5.72		2.84
I	1070	1060	1060		40900	40800	39600		13.2	0.09	0.02	3.28	2.51	4.49	0.03	0.07	62.80	0.82	5.75		2.97
I	1070	1030	1060		40900	40200	39800		13.1	0.05	0.02	3.19	2.49	4.46	0.03	0.07	62.40	0.81	5.74		2.72
I	1080	1070	1050		40200	41200	39800		13.3	0.05	0.03	3.24	2.51	4.52	0.03	0.07	63.20	0.82	5.72		2.95
J		981	1050			42200				0.06					0.03	0.08					
J		980	1060			42400				0.07					0.03	0.08					
J		985	1060			43100				0.07					0.03	0.08					
J		980	1030			43700				0.07					0.03	0.07					
J		961	1100			42700				0.06					0.03	0.08					
J		965	1070			42300				0.06					0.03	0.07					
J		978	1070			43500				0.07					0.03	0.08					
J		978	1090			44300				0.06					0.03	0.07					
N	1080	1030	1080		40000	39900	40500		13.8	0.07	0.03	3.46	2.64	4.86	0.03	0.08	62.68	0.87			2.89
N	1040	1000	1030		39600	39500	40200		13.7	0.07	0.03	3.39	2.58	4.84	0.03	0.08	63.11	0.87			2.90
N	1080	1030	1070		40100	40200	40100		13.7	0.07	0.03	3.50	2.61	4.92	0.03	0.08	63.54	0.87			2.91
N	1060	1040	1060		39900	40100	39600		13.7	0.07	0.03	3.40	2.64	4.89	0.03	0.08	64.18	0.87			2.93
N	1080	1060	1010		40300	40000	38400		13.8	0.07	0.03	3.40	2.64	4.97	0.03	0.08	65.04	0.88			2.94
N	1060	1030	1050		39800	40000	39600		13.7	0.07	0.03	3.40	2.61	4.92	0.03	0.08	64.40	0.87			2.91
N	1060	1020	1080		39600	40200	40400		13.6	0.07	0.03	3.37	2.64	4.87	0.03	0.08	63.97	0.87			2.93
N	1080	1040	1080		39200	40100	40500		13.4	0.07	0.03	3.33	2.63	4.81	0.03	0.08	62.90	0.85			2.92
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P		1080	1060			41600	42900														2.84
P		1050	1050			40800	42600														2.84
P		1100	1050			42200	41500														2.82
P		1090	1040			42200	41700														2.81
P		1070	1030			41500	41500														2.81
P		1090	1060			42000	42300														2.80
P		1060	1030			40500	41500														2.82
P		1090	1070			41400	43700														2.81
Q	1090	1190	1180		41300	41100			13.7	0.07	0.02	3.42	2.71	4.78	0.03	0.07	63.10	0.86	6.14		
Q	1110	1200	1160		42100	41000			13.7	0.07	0.02	3.39	2.71	4.76	0.03	0.07	63.20	0.86	6.15		
Q	1090	1180	1160		40700	40500			13.7	0.07	0.02	3.40	2.71	4.77	0.03	0.08	63.10	0.86	6.17		
Q	1060	1180	1150		42500	40800			13.7	0.07	0.02	3.39	2.71	4.76	0.03	0.06	63.10	0.86	6.17		
Q	1070	1170	1180		41700	40100			13.7	0.07	0.03	3.40	2.71	4.74	0.03	0.07	63.20	0.86	6.15		
Q	1090	1150	1200		41100	38400			13.7	0.07	0.02	3.40	2.71	4.76	0.03	0.07	63.20	0.86	6.17		
Q	1090	1140	1220		41400	38200			13.7	0.07	0.02	3.38	2.71	4.76	0.03	0.06	63.20	0.85	6.15		
Q	1080	1160	1170		42800	39100			13.7	0.07	0.02	3.39	2.71	4.77	0.03	0.08	63.10	0.85	6.16		
R		895	881							0.06					0.03	0.07					
R		899	866							0.06					0.03	0.07					
R		897	924							0.06					0.03	0.07					
R		894	903							0.06					0.03	0.07					
R		909	875							0.07					0.03	0.07					
R		892	914							0.06					0.03	0.07					
R		893	905							0.07					0.03	0.07					
R		910	927							0.06					0.03	0.07					
S	1046	1038	1025		40551	41306	40536			0.06					0.03	0.07					2.78
S	1040	1031	1044		40507	41626	40991			0.06					0.03	0.07					2.78
S	1064	1051	1070		41861	42084	42078			0.06					0.03	0.07					2.86
S	1054	1030	1085		40882	41473	40411			0.06					0.03	0.07					2.90
S	1033	1044	1109		40469	40805	42097			0.06					0.03	0.07					2.81
S	1109	1084	1076		42211	41262	40667			0.06					0.03	0.08					2.86
S	1060	1048	1083		40729	42362	41106			0.06					0.03	0.07					2.72
S	1056	1063	1064		41022	40965	40433			0.06					0.03	0.08					2.86
T						44533				14.6		0.03	3.37	2.70	4.78	0.03			0.90			2.89
T						44223				13.5		0.03	3.30	2.50	4.71	0.03			0.89			2.85
T						44132				13.6		0.03	3.33	2.50	4.71	0.03			0.90			3.01
T						44503				14.5		0.03	3.36	2.70	4.76	0.03			0.90			2.91
T						40949				12.7		0.03	3.36	2.80	4.76	0.03			0.85			2.86
T						44451				14.6		0.04	3.37	2.70	4.78	0.03			0.90			2.93
T						44311				14.4		0.03	3.32	2.70	4.73	0.03			0.89			2.86
T						44079				14.4		0.03	3.32	2.80	4.70	0.03			0.89			2.93
U	1100		1130	1150	43900			42800	13.7	0.09	0.03	3.39	2.71	4.60	0.04	0.07	62.36	0.76	6.79		
U	1070		1120	1140	42200			42700	13.5	0.12	0.03	3.47	2.77	4.45	0.03	0.07	61.80	0.81	6.78		
U	1070		1170	1190	42800			43000	13.7	0.07	0.03	3.37	2.77	4.63	0.03	0.08	62.50	0.77	6.88		
U	1070		1190	1150	42700			42600	13.6	0.07	0.03	3.42	2.75	4.49	0.04	0.08	61.80	0.81	6.78		
U	1060		1130	1160	43300			42900	13.4	0.10	0.03	3.41	2.68	4.40	0.05	0.07	61.54	0.82	6.84		
U	1090		1140	1150	43400			42700	13.7	0.07	0.03	3.36	2.74	4.61	0.03	0.08	62.00	0.75	6.85		
U	1060		1170	1160	42600			42900	13.7	0.07	0.03	3.37	2.75	4.61	0.03	0.09	62.37	0.77	6.84		
U	1080		1150	1150	42700			42800	13.7	0.11	0.02	3.42	2.82	4.47	0.05	0.07	61.96	0.81	6.70		
V		1200				40300			13.7	0.04	0.03	3.39	2.78	4.82	0.03					0.13	
V		1200				40300			13.8	0.06	0.03	3.40	2.78	4.91	0.03					0.14	
V		1200				40400			13.8	0.06	0.03	3.60	2.77	4.88	0.03					0.12	
V		1300				40200			13.5	0.06	0.03	3.19	2.78	4.73	0.03					0.14	
V		1300				40200			13.4	0.06	0.03	3.53	2.78	4.97	0.03					0.11	
V		1300				40500			13.9	0.06	0.03	3.52	2.78	4.89	0.03					0.12	
V		1300				40000			14.0	0.06	0.03	3.33	2.78	4.94	0.03					0.15	
V		1200				40100			13.5	0.06	0.03	3.54	2.77	4.99	0.03					0.11	

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

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:

Combined standard uncertainty=sqrt((between lab.var/no of labs) + (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]
Co	F	ppm	23.2	15.2	18.8	6.31
Co	M/ICP	ppm	36.6	29.6	17.9	9.57
Co	P	ppm	56.0	42.5	23.3	12.5
Cu	F	ppm	1625	1331	890	456
Cu	M/ICP	ppm	1126	818	525	243
Cu	P	ppm	1194	1141	644	440
Al_2O_3	XRF	%	0.18	0.13	0.12	0.05
CaO	XRF	%	0.01	0.01	0.01	0.00
Cr_2O_3	XRF	%	0.01	0.01	0.00	0.00
Fe_2O_3	XRF	%	0.11	0.10	0.06	0.03
K_2O	XRF	%	0.06	0.05	0.03	0.01
LOI		%	0.37	0.30	0.28	0.13
MgO	XRF	%	0.10	0.07	0.05	0.02
MnO	XRF	%	0.002	0.001	0.001	0.000
Na_2O	XRF	%	0.006	0.004	0.004	0.001
SiO_2	XRF	%	0.49	0.38	0.32	0.14
TiO_2	XRF	%	0.02	0.02	0.01	0.01
SG	pyc		0.05	0.04	0.03	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 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. Certified 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: AMIS0247 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. This is the recommended minimum sample size for the use of this material.

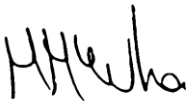
18. Availability: This product is available in Laboratory Packs containing 1kg of material and Explorer Packs containing custom weights (from 50g to 250g) of material. The Laboratory Packs are sealed bottles delivered in sealed foil pouches. The Explorer Packs contain material in standard geochem envelopes,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

20 October 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	0.20	0.19	47.1	19
Al	M/ICP	%	6.8	0.94	6.9	80
As	M/ICP	ppm	29.4	14.7	24.9	88
Ba	M/ICP	ppm	129	24.4	9.5	82
Be	M/ICP	ppm	6.8	1.7	12.6	75
Bi	M/ICP	ppm	4.4	14.2	163	53
Ca	M/ICP	%	0.05	0.01	12.0	89
Cd	M/ICP	ppm	14.9	82.8	278	36
Ce	M/ICP	ppm	229	95.3	20.8	39
Co	XRF	ppm	1002	267.2	13.3	32
Cr	M/ICP	ppm	130	65.6	25.3	72
Cs	M/ICP	ppm	1.3	0.11	4.1	31
Cu	XRF	ppm	42402	805	0.95	30
Dy	M/ICP	ppm	6.3	0.47	3.8	31
Er	M/ICP	ppm	3.5	1.4	19.3	40
Eu	M/ICP	ppm	1.0	0.1	5.2	31
Fe	M/ICP	%	2.3	0.21	4.6	86
Ga	M/ICP	ppm	19.1	5.4	14.2	46
Gd	M/ICP	ppm	7.2	1.3	9.2	31
Ge	M/ICP	ppm	1.1	0.26	12.3	8
Hf	M/ICP	ppm	6.8	2.6	19.2	39
Ho	M/ICP	ppm	1.3	0.11	4.4	30
In	M/ICP	ppm	0.57	0.06	5.6	38
K	M/ICP	%	2.2	0.21	4.9	91
La	M/ICP	ppm	128	35.9	14.0	78
Li	M/ICP	ppm	98.8	11.0	5.6	90
Lu	M/ICP	ppm	0.53	0.08	7.8	39
Mg	M/ICP	%	2.8	0.25	4.4	92
Mn	M/ICP	ppm	224	32.3	7.2	94
Mo	M/ICP	ppm	2.5	1.4	28.2	75
Na	M/ICP	%	0.06	0.06	43.7	88
Nb	M/ICP	ppm	15.9	17.7	55.4	55
Nd	M/ICP	ppm	96.3	12.5	6.5	31
Ni	M/ICP	ppm	119	20.1	8.4	92
P	M/ICP	ppm	808	131	8.1	72
Pb	M/ICP	ppm	12.1	11.5	47.7	72
Pr	M/ICP	ppm	29.3	2.4	4.0	31
Rb	M/ICP	ppm	70.8	14.4	10.2	38
S	M/ICP	%	0.08	0.01	8.2	63
Sb	M/ICP	ppm	3.2	4.0	62.7	57
Sc	M/ICP	ppm	13.0	2.2	8.5	84
Se	M/ICP	ppm	4.2	1.5	18.0	37
Si	M/ICP	%	29.8	0.76	1.3	8
Sm	M/ICP	ppm	11.5	0.93	4.0	31
Sn	M/ICP	ppm	4.2	8.2	97.4	38
Sr	M/ICP	ppm	101	12.0	6.0	80
Ta	M/ICP	ppm	1.5	1.3	41.7	32
Tb	M/ICP	ppm	1.0	0.44	21.4	40
Te	M/ICP	ppm	0.07	0.03	22.9	12
Th	M/ICP	ppm	17.4	2.7	7.8	39
Ti	M/ICP	%	0.25	0.27	54.1	79
Tl	M/ICP	ppm	0.20	0.03	6.5	37
Tm	M/ICP	ppm	0.57	0.06	5.4	31
U	M/ICP	ppm	15.1	1.3	4.3	39
V	M/ICP	ppm	177	33.9	9.6	94
W	M/ICP	ppm	1.5	1.1	35.8	37
Y	M/ICP	ppm	29.8	9.3	15.6	84
Yb	M/ICP	ppm	3.6	0.60	8.4	39
Zn	M/ICP	ppm	30.6	14.6	23.9	80
Zr	M/ICP	ppm	216	48.0	11.1	78