African Mineral Standards
MATRIX REFERENCE MATERIALS

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AMIS0410

Certified Reference Material

Copper ore, oxide, Kansanshi Mine, Zambia

Certificate of Analysis

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

Certified Concentrations[2.]

Cu M/ICP	1.713	±	0.067	%
Cu P	1.679	±	0.094	%
Cu Soluble ppm	1.231	±	0.028	%
Co M/ICP	144	±	10	ppm
Co P	138	±	9	ppm
Specific Gravity	2.79	±	0.12	

Provisional Concentrations[2]

Au Pb Collection	0.085	±	0.018	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_2O_3	12.19	±	0.16	%
CaO	6.24	±	0.10	%
Cr_2O_3	0.04	±	0.01	%
Fe_2O_3	7.76	±	0.32	%
K_2O	1.69	±	0.04	%
MgO	1.44	±	0.12	%
MnO	0.090	±	0.002	%
SiO_2	55.65	±	0.94	%
TiO_2	0.91	±	0.02	%

Provisional Concentration

LOI	7.70	±	1.22	%

1. Intended Use: AMIS0410 is a certified reference material which may be used to demonstrate the validity of measurement results of a single analysis of oxide copper 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: This standard was made using oxide ore sourced from the Kansanshi Mine, located in the North Western Province of Zambia. The mine is located approximately 10 kilometres north of the town of Solwezi, 180 kilometres to the northwest of the Copperbelt town of Chingola and 16 kilometres south of the Democratic Republic of Congo border. Kansanshi, Africa's largest copper mine, is 80% owned by Kansanshi Mining PLC, a First Quantum subsidiary. The remaining 20% is owned by a subsidiary of ZCCM.

The Kansanshi deposit occurs within the Lufilian arc, a major tectonic province characterized by broadly north directed fold and thrust structures, which hosts the world class Central African Copperbelt. The deposit at Kansanshi occurs within a broad, northwest trending, north-west closing antiform, which can be traced for approximately 12 kilometres. Kansanshi is a vein deposit developed within a tectonised rock sequence and, as such, constitutes a major mineralization control.

The main veins and vein swarms dip sub vertically, perpendicular to the fold axes, in the plane of maximum extension.

(for more information, refer to the following: http://www.first-quantum.com/files/doc_downloads/Kansanshi_April%20_2012-FINAL.pdf, www.first-quantum.com.)

3. Mineral and Chemical Composition: Deep tropical weathering has resulted in supergene enrichment and subsequent partial oxidation of the deposit. Primary copper sulphide mineralization is dominated by chalcopyrite, with very minor bornite, accompanied by relatively minor pyrite and pyrrhotite. Oxide mineralization is dominated by chrysocolla with malachite, limonite and cupriferous goethite. The mixed zone includes both oxide and primary mineralization but also carries significant chalcocite, minor native copper and tenorite. Some copper appears to be carried in clay and mica minerals, where it is essentially refractory.

4. Appearance: The material is a very fine powder. It is colored Pale Yellow 5Y 8/3.

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 partic**l**e 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. Au – Pb collection, ICP-OES/ICP-MS.
2. Cu. Acid Soluble AAS or ICP-OES.
3. Cu. Fusion AAS or ICP-OES.
4. Multi-acid digest multi-element scan - (to include Co, Cu). ICP-OES or ICP-MS.
5. Aqua regia digest – Co, Cu. ICP-OES or ICP-MS.
6. Majors (Al_2O_3, CaO, Cr_2O_3, Fe_2O_3, K_2O, MgO, MnO, Na_2O, SiO_2, TiO_2. LOI.) XRF fusion.
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. Nineteen 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 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 19 out of 25 laboratories that provided results timeously were (not in same order as in the table of assays):

1. Acme Analytical Laboratories Chile
2. ACME Analytical Laboratories Ltd CA
3. Activation Laboratories Pty Ltd (ActLabs) CA
4. Activation Labortorios Ltda (Chile)
5. ALS Chemex Laboratory Group Brisbane Australia
6. ALS Chemex Laboratory Group Johannesburg SA
7. ALS Chemex Laboratory Group Perth WA
8. ALS Chemex Laboratory Group Vancouver CA
9. ALS OMAC (Ireland)
10. Bureau Veritas (Namibia)
11. BV Amdel (Australia)
12. Genalysis Laboratory Services (South Africa) Pty
13. Genalysis Laboratory Services (W Australia P)
14. Intertek Minerals Zambia
15. Set Point Laboratories (Isando) SA
16. SGS Australia Pty Ltd (Newburn) WA
17. SGS Geosol Laboratories Ltda (Brazil)
18. Skyline Assayers and Labs (USA)
19. 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.

Lab Code	Au Pb Coll g/t	Co M/ICP ppm	Co P ppm	Cu M/ICP ppm	Cu P ppm	Cu Soluble ppm	Al_2O_3 XRF %	CaO XRF %	Cr_2O_3 XRF %	Fe_2O_3 XRF %	K_2O XRF %	MgO XRF %	MnO XRF %	SiO_2 XRF %	TiO_2 XRF %	LOI %	SG pyc
A	0.07	147	147	17119	17433	12110											2.71
A	0.08	152	138	17431	16683	12290											2.63
A	0.08	145	141	17071	17092	12230											2.63
A	0.10	148	147	17299	17622	12210											2.61
A	0.08	151	146	17563	17526	12220											2.71
A	0.08	150	139	17759	16285	12090											2.75
A	0.08	150	150	17428	18130	12260											2.70
A	0.09	152	147	17570	17148	12210											2.66
B	0.07	140	140	17100	16700												
B	0.08	140	130	17100	16550												
B	0.07	140	140	16650	16400												
B	0.08	140	140	17100	16300												
B	0.10	140	150	17000	16400												
B	0.08	140	140	17200	15900												
B	0.07	140	140	16950	16600												
B	0.07	140	140	17300	16550												

Assay data. (cont)

Lab Code	Au Pb Coll g/t	Co M/ICP ppm	Co P ppm	Cu M/ICP ppm	Cu P ppm	Cu Soluble ppm	Al_2O_3 XRF %	CaO XRF %	Cr_2O_3 XRF %	Fe_2O_3 XRF %	K_2O XRF %	MgO XRF %	MnO XRF %	SiO_2 XRF %	TiO_2 XRF %	LOI %	SG pyc
C	0.08	138	139	16710	15810	12200	12.3	6.35		8.03	1.67	1.35		55.3	0.91	7.76	2.80
C	0.09	137	134	16810	15886	12400	12.3	6.34		8.08	1.68	1.38		55.4	0.91	7.78	2.81
C	0.09	138	137	16890	15930	12300	12.3	6.35		8.06	1.68	1.36		55.4	0.91	7.76	2.80
C	0.08	137	132	16510	15850	12500	12.3	6.32		8.05	1.67	1.34		55.1	0.91	7.77	2.80
C	0.08	137	134	17100	15900	12500	12.1	6.26		7.97	1.66	1.30		54.4	0.90	7.74	2.80
C	0.09	141	136	16990	16010	12500	12.2	6.31		8.03	1.67	1.36		54.9	0.91	7.77	2.81
C	0.09	138	135	17180	16100	12400	12.2	6.27		7.99	1.66	1.34		54.5	0.90	7.76	2.80
C	0.09	142	135	17290	15900	12700	12.2	6.31		8.01	1.66	1.34		54.6	0.91	7.76	2.80
D	0.09	140	140	17150	16900	11550											2.83
D	0.08	140	140	17100	16750	11750											2.83
D	0.08	140	140	16900	16800	11300											2.81
D	0.08	150	140	17150	17150	11350											2.81
D	0.08	150	140	16900	17550	11450											2.84
D	0.08	140	140	16700	17400	11600											2.82
D	0.09	140	140	16900	17450	11450											2.82
D	0.09	140	140	16950	17000	11700											2.81
F	0.09			16926		12400											2.78
F	0.10			16821		12500											2.77
F	0.10			16822		12700											2.80
F	0.09			16642		12400											2.80
F	0.10			16873		11800											2.84
F	0.11			17650		12500											2.76
F	0.11			17812		12500											2.75
F	0.09			17419		12800											2.76
H	0.08	150	135	17000	16450	12220											
H	0.10	150	133	17090	16650	12340											
H	0.09	152	139	17180	16600	12160											
H	0.08	153	96	17140	11080	12120											
H	0.09	150	137	17490	16360	12250											
H	0.11	153	136	17390	16830	12180											
H	0.09	156	138	17700	16440	12170											
H	0.09	152	140	17690	16900	12160											
K		150		17550	16900		12.3	6.29	0.05	7.68	1.72	1.49	0.09	56.2	0.92	7.23	2.76
K		140		17600	16550		12.2	6.25	0.04	7.65	1.72	1.48	0.09	55.8	0.91	7.18	2.76
K		150		17650	16850		12.3	6.23	0.04	7.63	1.71	1.49	0.09	55.8	0.91	7.19	2.73
K		150		17650	16550		12.2	6.24	0.05	7.65	1.73	1.48	0.09	56.0	0.92	7.17	2.75
K		150		17550	17250		12.1	6.18	0.04	7.57	1.70	1.46	0.09	55.6	0.90	7.18	2.75
K		140		17450	16900		12.2	6.22	0.04	7.58	1.70	1.46	0.09	55.9	0.91	7.21	2.77
K		150		17550	17250		12.3	6.25	0.04	7.69	1.72	1.50	0.09	56.2	0.92	7.15	2.74
K		140		17350	17100		12.1	6.20	0.04	7.61	1.71	1.46	0.09	55.7	0.91	7.33	2.76
L	0.08	150		16600		12500	11.4	6.48	0.04	7.95	1.70	1.36	0.09	56.6	0.94	8.04	2.83
L	0.07	150		16600		12500	11.3	6.44	0.03	7.89	1.68	1.34	0.09	56.3	0.95	7.80	2.83
L	0.08	140		16100		12400	11.4	6.48	0.04	7.88	1.69	1.37	0.10	56.5	0.95	8.67	2.83
L	0.08	140		16600		12500	11.3	6.48	0.03	7.77	1.69	1.40	0.09	56.3	0.93	8.77	2.83
L	0.09	150		16600		12400	11.3	6.48	0.04	7.91	1.72	1.36	0.10	56.3	0.94	8.80	2.83
L	0.07	150		16600		12500	11.3	6.46	0.03	7.97	1.71	1.36	0.10	56.5	0.93	8.85	2.82
L	0.08	150		16400		12500	11.3	6.46	0.04	7.95	1.71	1.35	0.09	56.4	0.93	8.88	2.83
L	0.09	150		16300		12500	11.4	6.46	0.04	7.89	1.69	1.33	0.09	56.4	0.94	8.78	2.83
M	0.08	145	139	17750	17400		12.1	6.25	0.04	7.65	1.70	1.48	0.09	55.3	0.92	8.28	2.76
M	0.09	143	140	17350	17500		12.1	6.22	0.04	7.57	1.70	1.49	0.09	55.3	0.91	8.07	2.75
M	0.08	147	144	17900	17100		12.1	6.21	0.04	7.66	1.70	1.49	0.08	55.2	0.91	8.31	2.82
M	0.08	145	139	17650	16800		12.1	6.24	0.06	7.70	1.69	1.48	0.09	55.5	0.92	8.17	2.77
M	0.08	144	139	17650	17050		12.1	6.23	0.04	7.66	1.66	1.48	0.08	55.4	0.91	8.20	2.76
M	0.08	146	141	18200	17400		12.1	6.23	0.04	7.67	1.67	1.50	0.09	55.4	0.91	8.17	2.82
M	0.10	145	137	17700	17400		12.1	6.20	0.04	7.57	1.70	1.48	0.09	55.2	0.90	8.28	2.73
M	0.10	146	140	18050	17200		12.1	6.22	0.04	7.67	1.68	1.50	0.09	55.4	0.91	8.16	2.76
N	0.07	138	126				12.2	6.25	0.04	7.78	1.69	1.47	0.09	56.0	0.91	7.08	
N	0.08	135	123				12.2	6.26	0.04	7.80	1.71	1.48	0.09	56.0	0.92	7.08	
N	0.08	135	128				12.2	6.24	0.04	7.80	1.69	1.48	0.09	56.0	0.92	7.07	
N	0.08	137	124				12.2	6.24	0.05	7.79	1.70	1.48	0.09	56.0	0.91	7.07	
N	0.07	141	123				12.2	6.24	0.04	7.76	1.69	1.49	0.09	56.0	0.92	7.08	
N	0.08	137	121				12.2	6.24	0.04	7.80	1.70	1.48	0.09	56.0	0.91	7.08	
N	0.07	140	123				12.2	6.25	0.04	7.80	1.71	1.48	0.09	56.0	0.93	7.08	
N	0.07	134	120				12.2	6.24	0.04	7.77	1.69	1.47	0.09	56.0	0.92	7.07	
O	0.08	143	142	17660		1306											2.90
O	0.09	142	149	17589		1372											2.84
O	0.08	146	151	17267	17225	1377											2.88
O	0.08	147	148	17115		1361											2.83
O	0.10	147	150	17200		1303											2.83
O	0.09	143	145	17181		1303											2.83
O	0.10	146	149	17177		1313											2.80
O	0.10	145	143	17156		1373											2.84
P	0.08	100		18100		11600											
P	0.07	100		18200		11700											
P	0.07	200		18200		11700											
P	0.08	200		18300		11700											
P	0.08	200		18300		11800											
P	0.08	200		18300		11700											
P	0.06	100		18200		11800											
P	0.09	200		18300		11800											
Q	0.10	114	129	16800													
Q	0.10	122	128	16700													
Q	0.10	121	131	16900													
Q	0.10	124	131	16600													
Q	0.10	117	131	16500													
Q	0.10	120	132	16800													
Q	0.10	117	130	16900													
Q	0.10	119	130	16800													

Assay data. (cont)

Lab Code	Au Pb Coll g/t	Co M/ICP ppm	Co P ppm	Cu M/ICP ppm	Cu P ppm	Cu Soluble ppm	Al_2O_3 XRF %	CaO XRF %	Cr_2O_3 XRF %	Fe_2O_3 XRF %	K_2O XRF %	MgO XRF %	MnO XRF %	SiO_2 XRF %	TiO_2 XRF %	LOI %	SG pyc
R	0.09	140	130	17000	17000	12250											2.88
R	0.08	140	140	17300	17300	12450											2.89
R	0.09	140	140	17300	17100	11900											2.81
R	0.08	140	140	17200	17300	12250											2.88
R	0.07	140	140	17150	17150	12400											2.91
R	0.07	140	140	17350	17100	12300											2.77
R	0.07	140	140	17250	17100	12400											2.89
R	0.08	140	140	17100	17300	12350											2.79
S		135	135	16900	16900		12.6	6.18		7.94	1.63	1.40	0.09	57.4	0.92	7.02	2.70
S		130	130	16800	16600		12.6	6.09		7.81	1.60	1.37	0.09	57.3	0.90	7.02	2.69
S		130	135	17400	16300		12.5	6.15		7.91	1.62	1.37	0.09	57.3	0.92	7.02	2.69
S		130	135	17300	15700		12.6	6.08		7.87	1.60	1.37	0.09	57.4	0.91	7.03	2.69
S		135	135	16700	16900		12.6	6.06		7.94	1.59	1.35	0.09	57.3	0.90	7.00	2.70
S		130	130	17100	16400		12.6	6.16		7.91	1.63	1.38	0.09	57.6	0.92	6.95	2.73
S		140	140	17400	17100		12.5	6.14		7.91	1.62	1.38	0.09	57.4	0.92	6.95	2.71
S		130	140	17100	17000		12.5	6.16		7.90	1.63	1.38	0.09	57.3	0.92	6.93	2.71
T		100		17000													
T		100		17000													
T		100		17200													
T		100		17100													
T		100		17100													
T		100		17100													
T		100		17100													
T		100		17100													
T		100		16900													
U		140		17600													2.82
U		138		18200													2.82
U		140		17700													2.81
U		144		17800													2.81
U		142		18100													2.81
U		138		18100													2.82
U		142		17900													2.81
U		142		18100													2.81
V	0.09	145	138	16700	16700	12100	12.2	6.29	0.04	7.63	1.68	1.48	0.09	55.5	0.91	7.36	2.89
V	0.09	145	134	16800	16600	12000	12.3	6.30	0.04	7.65	1.69	1.48	0.09	55.5	0.91	7.38	2.91
V	0.08	145	137	17000	16900	12200	12.3	6.30	0.04	7.63	1.69	1.49	0.09	55.5	0.90	7.40	2.90
V	0.08	145	138	16900	16500	12500	12.3	6.28	0.04	7.64	1.70	1.48	0.09	55.5	0.90	7.37	2.88
V	0.09	140	134	16600	16500	12200	12.3	6.28	0.04	7.61	1.68	1.47	0.09	55.6	0.91	7.41	2.87
V	0.09	140	134	16700	16500	12100	12.3	6.29	0.04	7.63	1.69	1.45	0.09	55.5	0.90	7.36	2.91
V	0.08	140	138	16900	16600	12100	12.3	6.31	0.04	7.64	1.68	1.47	0.09	55.5	0.91	7.35	2.90
V	0.08	140	136	16700	16500	12100	12.3	6.29	0.04	7.63	1.68	1.48	0.09	55.5	0.90	7.39	2.90
Y	0.09	151	146	17170		12250	12.1	6.20	0.04	7.58	1.68	1.47	0.09	55.1	0.89	8.42	2.74
Y	0.09	147	141	17490		12350	12.1	6.18	0.04	7.57	1.69	1.45	0.08	55.0	0.88	8.40	2.71
Y	0.08	148	142	17430		12280	12.1	6.15	0.04	7.56	1.69	1.48	0.08	55.2	0.88	8.42	2.71
Y	0.09	150	139	17190		12310	12.1	6.16	0.05	7.56	1.69	1.47	0.08	55.2	0.89	8.59	2.62
Y	0.08	146	144	17430		12300	12.0	6.16	0.04	7.56	1.67	1.46	0.08	55.1	0.89	8.40	2.70
Y	0.09	148	142	17450		12340	12.1	6.18	0.04	7.59	1.71	1.47	0.08	55.1	0.89	8.37	2.70
Y	0.09	146	146	17470		12280	12.1	6.24	0.04	7.60	1.69	1.46	0.08	55.2	0.89	8.38	2.70
Y	0.08	150	140	17360		12320	12.1	6.19	0.04	7.62	1.70	1.47	0.08	55.3	0.88	8.37	2.70

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:

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]	σL [2]	Sw [3]	CSU [4]
Au	Pb Coll	g/t	0.009	0.005	0.007	0.001
Co	M/ICP	ppm	4.98	3.02	2.80	0.82
Co	P	ppm	4.69	3.11	2.76	0.94
Cu	M/ICP	ppm	333.5	184.82	209.89	49.93
Cu	P	ppm	467.5	324.69	260.76	102.25
Cu	Soluble	ppm	139.9	112.31	86.03	41.26
Al_2O_3	XRF	%	0.083	0.087	0.045	0.036
CaO	XRF	%	0.054	0.054	0.024	0.021
Cr_2O_3	XRF	%	0.003	0.001	0.003	0.001
Fe_2O_3	XRF	%	0.160	0.164	0.039	0.058
K_2O	XRF	%	0.016	0.013	0.011	0.005
LOI		%	0.612	0.628	0.153	0.223
MgO	XRF	%	0.057	0.059	0.013	0.021
MnO	XRF	%	0.002	0.002	0.001	0.001
SiO_2	XRF	%	0.473	0.504	0.150	0.192
TiO_2	XRF	%	0.012	0.010	0.006	0.004
SG	pyc		0.062	0.045	0.024	0.013

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. *S_W - 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 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: AMIS0410 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.

15 July 2013

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	0.63	0.88	69.8	48
Al	M/ICP	%	6.1	0.80	6.5	88
As	M/ICP	ppm	6.4	9.1	71.4	41
Ba	M/ICP	ppm	275	86.7	15.7	56
Be	M/ICP	ppm	3.1	0.71	11.5	45
Bi	M/ICP	ppm	13.6	5.1	18.7	56
Ca	M/ICP	%	4.5	0.38	4.2	97
Cd	M/ICP	ppm	0.17	0.08	23.1	28
Ce	M/ICP	ppm	185	26.6	7.2	24
Cr	M/ICP	ppm	248	34.4	6.9	96
Cs	M/ICP	ppm	1.7	0.10	3.0	30
Cu	Fusion	ppm	16885	2076	6.1	40
Dy	M/ICP	ppm	11.3	1.7	7.5	16
Er	M/ICP	ppm	7.9	1.8	11.1	16
Eu	M/ICP	ppm	2.8	0.07	1.3	15
Fe	M/ICP	%	5.3	0.46	4.3	96
Ga	M/ICP	ppm	17.5	2.9	8.4	39
Gd	M/ICP	ppm	11.8	1.1	4.8	16
Ge	M/ICP	ppm	0.94	0.66	35.2	16
Hf	M/ICP	ppm	4.2	1.9	22.3	40
Ho	M/ICP	ppm	2.5	0.46	9.2	16
In	M/ICP	ppm	0.4	0.05	6.1	29
K	M/ICP	%	1.3	0.26	9.6	84
La	M/ICP	ppm	106	14.6	6.9	40
Li	M/ICP	ppm	39.3	5.5	6.9	48
Lu	M/ICP	ppm	1.5	0.12	3.9	16
Mg	M/ICP	%	0.85	0.10	6.1	96
Mn	M/ICP	ppm	645	64.2	5.0	96
Mo	M/ICP	ppm	9.6	2.1	10.8	60
Na	M/ICP	%	1.8	0.28	7.7	91
Na_2O	XRF	%	2.4	0.17	3.6	32
Nb	M/ICP	ppm	46.7	13.2	14.1	39
Nd	M/ICP	ppm	73.5	7.5	5.1	16
Ni	M/ICP	ppm	149	16.8	5.6	104
P	M/ICP	ppm	811	70.2	4.3	72
Pb	M/ICP	ppm	10.8	19.8	91.5	61
Pr	M/ICP	ppm	20.9	0.66	1.6	15
Rb	M/ICP	ppm	64.2	6.8	5.3	40
S	M/ICP	%	0.71	0.10	6.8	90
S	Comb/LECO	%	0.70	0.05	3.5	16
Sb	M/ICP	ppm	0.36	0.10	13.5	30
Sc	M/ICP	ppm	18.9	3.3	8.7	82
Se	M/ICP	ppm	22.7	4.4	9.6	40
Si	M/ICP	%	25.8	0.26	0.50	8
Sm	M/ICP	ppm	12.5	1.3	5.1	16
Sn	M/ICP	ppm	6.2	0.9	6.9	38
Sr	M/ICP	ppm	290	27.7	4.8	93
Ta	M/ICP	ppm	55.5	10.4	9.4	38
Tb	M/ICP	ppm	1.8	0.31	8.6	16
Te	M/ICP	ppm	4.8	0.77	8.0	38
Th	M/ICP	ppm	12.3	3.7	15.0	38
Ti	M/ICP	%	0.33	0.05	7.5	48
Tl	M/ICP	ppm	0.31	0.05	7.8	31
Tm	M/ICP	ppm	1.4	0.24	8.4	16
U	M/ICP	ppm	16.9	2.7	8.0	41
V	M/ICP	ppm	123	29.6	12.0	96
W	M/ICP	ppm	1.9	0.60	15.9	39
Y	M/ICP	ppm	55.2	14.0	12.7	37
Yb	M/ICP	ppm	9.1	0.42	2.3	15
Zn	M/ICP	ppm	23.6	9.8	20.8	83
Zr	M/ICP	ppm	144	32.9	11.4	46