African Mineral Standards
MATRIX REFERENCE MATERIALS

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AMIS0365

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 F	1.320	±	0.065	%
Cu M/ICP	1.287	±	0.044	%
Cu P	1.285	±	0.062	%
Co M/ICP	102	±	7	ppm
Co P	100	±	6	ppm
Cu Soluble ppm	1.060	±	0.084	%
Specific Gravity	2.76	±	0.12	

Provisional Concentration

Au Pb Coll	0.05	±	0.01	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	7.04	±	0.08	%
CaO	2.09	±	0.04	%
Fe_2O_3	5.54	±	0.08	%
K_2O	0.93	±	0.02	%
MgO	0.69	±	0.04	%
MnO	0.060	±	0.002	%
Na_2O	1.18	±	0.06	%
SiO_2	75.82	±	0.42	%
TiO_2	0.54	±	0.02	%

Provisional Concentrations

Cr_2O_3	0.06	±	0.010	%
LOI	4.14	±	0.66	%

1. Intended Use: AMIS0365 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 (Corstor 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 parti**c**le 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. 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 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 20 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 Ammtec (Australia)
6 ALS Chemex Laboratory Group Brisbane Australia
7 ALS Chemex Laboratory Group Johannesburg SA
8 ALS Chemex Laboratory Group Perth WA
9 ALS Chemex Laboratory Group Vancouver CA
10 Bureau Veritas (Namibia)
11 Genalysis Laboratory Services (W Australia P)
12 Intertek Utama Services (Indonesia)
13 Set Point Laboratories (Isando) SA
14 SGS Australia Pty Ltd (Newburn) WA
15 SGS Geosol Laboratories Ltda (Brazil)
16 SGS Mineral Services Callao (Peru)
17 SGS Mineral Services Lakefield (Canada)
18 SGS Townsville (Australia)
19 Skyline Assayers and Labs (USA)
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.

Lab Code	Co F ppm	Co M/ICP ppm	Co P ppm	Cu F ppm	Cu M/ICP ppm	Cu P ppm	Cu Soluble ppm	Al2O3 XRF %	CaO XRF %	Cr2O3 XRF %	Fe2O3 XRF %	K2O XRF %	MgO XRF %	MnO XRF %	Na2O XRF %	SiO2 XRF %	TiO2 XRF %	LOI %	SG pyc
A	0.05	110.00	103.00	13200	12900	12200	10400	7.06	2.10	0.06	5.53	0.93	0.69	0.06		75.88	0.54	3.82	2.82
A	0.05	105.00	98.00	13200	12900	11800	10300	7.04	2.10	0.06	5.54	0.93	0.70	0.06		75.86	0.54	3.82	2.83
A	0.05	110.00	105.00	12900	12900	12500	10400	7.06	2.10	0.06	5.54	0.93	0.70	0.06		75.85	0.54	3.77	2.83
A	0.05	110.00	102.00	13000	13100	11700	10500	7.06	2.11	0.06	5.55	0.93	0.70	0.06		75.89	0.53	3.76	2.82
A	0.05	110.00	105.00	13300	13000	12000	10500	7.06	2.10	0.06	5.53	0.93	0.70	0.06		75.90	0.54	3.79	2.82
A	0.05	105.00	105.00	13400	13000	12700	10400	7.06	2.09	0.06	5.52	0.93	0.70	0.06		75.92	0.54	3.78	2.82
A	0.05	110.00	104.00	13400	13200	12900	10500	7.05	2.10	0.06	5.53	0.93	0.69	0.06		75.89	0.54	3.79	2.83
A	0.05	105.00	106.00	13000	13000	12500	10300	7.05	2.10	0.06	5.52	0.93	0.69	0.06		75.81	0.54	3.84	2.83
B	0.05	100.00			12900		10200												
B	0.05	100.00			12900		10300												
B	0.07	100.00			12900		10200												
B	0.05	100.00			12900		10300												
B	0.05	100.00			13100		10100												
B	0.06	100.00			13100		10200												
B	0.05	100.00			13000		10200												
B	0.07	100.00			13200		10400												

Assay data. (cont)

Lab Code	Co F ppm	Co M/ICP ppm	Co P ppm	Cu F ppm	Cu M/ICP ppm	Cu P ppm	Cu Soluble ppm	Al2O3 XRF %	CaO XRF %	Cr2O3 XRF %	Fe2O3 XRF %	K2O XRF %	MgO XRF %	MnO XRF %	Na2O XRF %	SiO2 XRF %	TiO2 XRF %	LOI %	SG pyc
C	0.05	94.00	104.00	13500															2.80
C	0.06	101.00	104.00	12700															2.82
C	0.06	113.00	97.00	13600															2.81
C	0.06	100.00	100.00	13500															2.80
C	0.05	107.00	99.00	13500															2.81
C	0.05	108.00	102.00	12900															2.82
C	0.06	101.00	105.00	13200															2.83
C	0.05	110.00	100.00	13100															2.81
D	0.06	100.00			13100			6.97	2.06	0.07	5.51	0.92	0.72	0.06	1.16	75.10	0.54	3.83	2.77
D	0.04	100.00			13000			7.02	2.07	0.07	5.54	0.93	0.72	0.06	1.16	75.50	0.53	3.86	2.78
D	0.05	100.00			13100			7.05	2.06	0.06	5.57	0.93	0.71	0.06	1.16	75.80	0.54	3.80	2.77
D	0.04	120.00			12900			7.06	2.07	0.06	5.56	0.93	0.72	0.06	1.17	75.90	0.54	3.78	2.78
D	0.05	100.00			13100			7.00	2.05	0.06	5.55	0.93	0.72	0.06	1.16	75.40	0.54	3.84	2.79
D	0.05	100.00			13100			6.97	2.07	0.06	5.53	0.92	0.71	0.06	1.16	75.40	0.54	3.85	2.79
D	0.07	100.00			13100			7.01	2.08	0.07	5.55	0.92	0.72	0.06	1.16	75.60	0.54	3.80	2.78
D	0.06	100.00			13000			7.02	2.06	0.06	5.56	0.93	0.72	0.06	1.16	75.70	0.53	3.78	2.79
E	0.05	102.00	113.00	13800				7.05	2.10	0.07	5.60	0.93	0.69	0.06	1.23	76.00	0.56	3.88	
E	0.05	104.00	111.00	13800				7.06	2.09	0.07	5.57	0.93	0.68	0.06	1.23	76.00	0.55	3.97	
E	0.06	100.00	111.00	13700				7.07	2.11	0.06	5.57	0.93	0.68	0.06	1.22	75.90	0.56	4.03	
E	0.06	101.00	111.00	14200				7.06	2.10	0.07	5.59	0.93	0.67	0.06	1.21	76.00	0.56	3.98	
E	0.06	101.00	113.00	14300				7.07	2.09	0.07	5.57	0.93	0.68	0.06	1.22	76.00	0.55	3.94	
E	0.04	106.00	114.00	13800				7.07	2.09	0.07	5.54	0.93	0.68	0.07	1.22	76.00	0.56	3.95	
E	0.05	105.00	114.00	13500				7.04	2.11	0.07	5.56	0.93	0.68	0.06	1.21	76.00	0.56	3.99	
E	0.05	99.00	112.00	13700				7.04	2.10	0.07	5.58	0.93	0.68	0.06	1.22	75.90	0.55	3.99	
F	0.05	100.00	100.00	13270	12490	12900	10810	7.08	2.07	0.07	5.42	0.94	0.68	0.06	1.20	75.70	0.54	4.48	2.50
F	0.06	100.00	100.00	13180	13080	12810	10800	7.03	2.06	0.07	5.40	0.93	0.68	0.05	1.19	75.20	0.53	4.49	2.66
F	0.05	100.00	100.00	13240	13140	12910	10810	7.04	2.04	0.07	5.41	0.94	0.67	0.05	1.20	75.50	0.54	4.47	2.52
F	0.05	100.00	100.00	13360	12950	12980	10780	7.07	2.06	0.07	5.40	0.93	0.69	0.05	1.22	75.50	0.56	4.49	2.53
F	0.06	100.00	100.00	13360	12770	13130	10800	7.03	2.06	0.07	5.43	0.94	0.68	0.06	1.23	75.60	0.54	4.49	2.55
F	0.05	100.00	100.00	13460	12740	12930	10870	7.01	2.05	0.07	5.40	0.94	0.68	0.06	1.20	75.20	0.54	4.49	2.65
F	0.04	100.00	90.00	13270	12960	12870	10860	7.12	2.06	0.07	5.46	0.95	0.69	0.05	1.21	76.00	0.54	4.50	2.49
F	0.05	100.00	100.00	13310	13140	12850	10870	7.05	2.07	0.06	5.41	0.94	0.71	0.06	1.20	75.40	0.54	4.46	2.60
G	0.06	98.98	101.60					7.11	2.05	0.06	5.48	0.91	0.65	0.06	1.14	75.66	0.56	4.17	
G	0.06	104.51	98.89					7.13	2.07	0.06	5.58	0.92	0.65	0.06	1.14	76.11	0.53	4.11	
G	0.06	100.80	101.09					7.09	2.08	0.06	5.54	0.93	0.65	0.06	1.15	75.88	0.56	4.06	
G	0.06	103.21	99.52					7.09	2.08	0.07	5.55	0.92	0.66	0.06	1.16	75.85	0.53	4.17	
G	0.06	102.48	98.68					7.07	2.05	0.06	5.53	0.92	0.66	0.06	1.14	75.95	0.54	4.17	
G	0.06	98.05	105.07					7.15	2.09	0.06	5.56	0.91	0.65	0.06	1.19	76.27	0.54	4.09	
G	0.06	97.20	101.93					7.03	2.05	0.06	5.47	0.91	0.65	0.06	1.19	75.27	0.53	4.12	
G	0.06	101.49	98.04					7.19	2.06	0.06	5.53	0.94	0.66	0.06	1.12	76.07	0.55	4.17	
I		101.00	100.00																2.71
I		101.00	98.00																2.73
I		102.00	97.00																2.72
I		100.00	98.00																2.71
I		98.00	99.00																2.71
I		96.00	96.00																2.73
I		95.00	98.00																2.72
I		98.00	99.00																2.72
J	0.05	112.00	93.90	12700	13026	12600		7.02	2.20	0.06	5.58	0.92		0.06		75.29	0.55	4.52	2.75
J	0.05	111.00	91.20	13100	12619	12900		6.97	2.19	0.05	5.56	0.92		0.06		74.65	0.55	4.49	2.75
J	0.05	110.00	93.30	12800	12800	12800		6.99	2.19	0.06	5.54	0.92		0.06		74.77	0.55	4.43	2.76
J	0.07	114.00	95.50	13100	13096	12900		7.02	2.18	0.05	5.59	0.93		0.06		75.45	0.55	4.53	2.75
J	0.05	113.00	95.40	13300	13095	12700		7.06	2.17	0.06	5.61	0.93		0.06		75.40	0.55	4.51	2.75
J	0.06	111.00	89.80	13500	12689	12500		7.02	2.16	0.05	5.58	0.93		0.06		75.36	0.55	4.48	2.76
J	0.05	112.00	94.60	13500	13093	12700		6.94	2.18	0.06	5.60	0.93		0.06		75.02	0.55	4.47	2.75
J	0.06	111.00	95.50	13400	12849	12600		7.00	2.16	0.05	5.56	0.93		0.06		75.03	0.55	4.65	2.76
L	0.05	111.00	100.00		13500		11200	7.05	2.10	0.07	5.55	0.93	0.67	0.06	1.19	76.01	0.53	4.00	
L	0.06	118.00	98.00		13400		11200	7.11	2.10	0.06	5.50	0.92	0.66	0.06	1.21	75.96	0.53	3.90	
L	0.05	114.00	101.00		13300		11300	7.05	2.10	0.06	5.50	0.93	0.66	0.06	1.19	75.88	0.53	3.90	
L	0.06	120.00	97.00		13600		11400	7.02	2.09	0.06	5.52	0.92	0.67	0.06	1.21	75.81	0.53	4.00	
L	0.05	120.00	102.00		13600		11400	7.06	2.10	0.06	5.54	0.92	0.67	0.06	1.20	75.83	0.53	3.90	
L	0.06	113.00	99.00		13400		11200	7.04	2.10	0.06	5.54	0.93	0.68	0.06	1.21	75.84	0.55	4.00	
L	0.05	110.00	97.00		13200		11400	7.07	2.10	0.06	5.53	0.93	0.69	0.06	1.22	76.00	0.53	4.00	
L	0.05	110.00	97.00		13500		11100	7.08	2.10	0.06	5.54	0.93	0.68	0.06	1.21	76.03	0.53	4.00	
M	0.04	99.70		13400	12400		10700	6.89	2.09	0.09	5.57	0.94	0.71	0.06	1.14	75.79	0.54	4.63	2.74
M	0.06	104.00		13200	12900		10400	6.88	2.07	0.08	5.54	0.93	0.69	0.06	1.12	75.99	0.54	4.61	2.72
M	0.06	102.00		13300	12200		10300	7.02	2.09	0.07	5.56	0.94	0.71	0.06	1.13	75.78	0.55	4.58	2.72
M	0.05	97.80		13000	12700		10400	7.01	2.10	0.07	5.57	0.92	0.71	0.06	1.12	75.84	0.55	4.59	2.73
M	0.05	99.00		13400	12700		10500	7.06	2.09	0.08	5.53	0.92	0.72	0.06	1.14	75.92	0.54	4.65	2.74
M	0.05	99.60		13300	12800		10400	7.07	2.09	0.07	5.53	0.96	0.71	0.06	1.13	75.79	0.55	4.64	2.68
M	0.06	102.00		13200	13000		10600	7.06	2.09	0.07	5.56	0.95	0.70	0.06	1.14	75.90	0.55	4.69	2.72
M	0.04	103.00		13200	12600		10600	6.95	2.09	0.07	5.53	0.93	0.70	0.06	1.12	75.82	0.55	4.68	2.70
N	0.06	105.80	109.00	12940	12746	13526	11382												2.74
N	0.05	105.30	105.00	12515	12688	13201	11371												2.84
N	0.05	104.60	104.00	12769	12873	13433	11220												2.81
N	0.05	103.20	105.00	12605	12880	13550	11012												2.83
N	0.05	107.00	104.00	12936	12865	13171	11393												2.83
N	0.04	106.00	105.00	12572	12882	13527	11335												2.83
N	0.05	104.90	107.00	12788	13064	13434	11179												2.78
N	0.05	104.20	107.00	12299	12630	13892	11553												2.77
O	0.05	108.00	100.00	12700	13600	12700													1.80
O	0.06	101.00	101.00	12700	13300	12600													1.99
O	0.05	106.00	101.00	13200	13100	12600													1.82
O	0.06	101.00	105.00	13100	12500	12700													1.82
O	0.05	103.00	103.00	13600	12900	12900													1.88
O	0.06	107.00	103.00	12700	13200	12600													1.90
O	0.05	105.00	106.00	13200	12700	13200													1.90
O	0.06	106.00	100.00	13200	13100	13000													1.88

Assay data. (cont)

Lab Code	Co F ppm	Co M/ICP ppm	Co P ppm	Cu F ppm	Cu M/ICP ppm	Cu P ppm	Cu Soluble ppm	Al2O3 XRF %	CaO XRF %	Cr2O3 XRF %	Fe2O3 XRF %	K2O XRF %	MgO XRF %	MnO XRF %	Na2O XRF %	SiO2 XRF %	TiO2 XRF %	LOI %	SG pyc
R	0.06	102.00	100.00		12800	12800	10000												2.83
R	0.06	100.00	110.00		12200	12550	10500												2.84
R	0.05	104.00	110.00		12900	12250	10450												2.81
R	0.06	104.00	110.00		12650	12500	10450												2.81
R	0.06	103.00	110.00		12650	12750	9870												2.82
R	0.06	101.00	90.00		12900	12500	9980												2.78
R	0.05	103.00	90.00		12650	12800	9900												2.80
R	0.07	105.00	110.00		12450	12450	10600												2.80
S	0.05			12200				6.95	2.07	0.07	5.60	0.94	0.72	0.03	1.17	74.90	0.54	4.39	
S	0.05			12200				7.03	2.09	0.07	5.66	0.94	0.70	0.03	1.15	76.00	0.55	3.76	
S	0.04			12100				7.06	2.10	0.08	5.63	0.95	0.72	0.03	1.17	75.90	0.54	4.10	
S	0.05			12200				6.97	2.08	0.06	5.60	0.96	0.74	0.03	1.17	75.20	0.53	4.37	
S	0.06			12500				7.03	2.06	0.07	5.61	0.94	0.69	0.02	1.16	75.50	0.55	4.33	
S	0.05			11700				7.04	2.09	0.06	5.64	0.94	0.74	0.02	1.18	75.90	0.54	4.11	
S	0.06			12100				6.97	2.08	0.08	5.61	0.93	0.74	0.03	1.19	75.60	0.53	4.28	
S	0.06			12400				6.98	2.10	0.06	5.59	0.94	0.73	0.03	1.19	75.70	0.54	4.44	
T	0.06				12700	12750			2.09	0.06	5.49	0.93	0.68	0.05		75.90	0.54	3.79	2.60
T	0.06				12450	12400			2.10	0.06	5.49	0.93	0.67	0.05		75.90	0.55	3.75	2.69
T	0.05				12500	12900			2.08	0.06	5.45	0.92	0.67	0.05		75.50	0.54	3.78	2.65
T	0.06				12600	12650			2.10	0.06	5.50	0.93	0.68	0.05		75.90	0.54	3.76	2.63
T	0.05				12600	13000			2.09	0.06	5.50	0.93	0.68	0.05		76.00	0.55	3.80	2.69
T	0.04				12750	12450			2.07	0.06	5.43	0.92	0.67	0.05		75.30	0.54	3.77	2.66
T	0.06				12550	13150			2.10	0.06	5.49	0.93	0.68	0.05		76.00	0.55	3.77	2.65
T	0.05				12550	12700			2.07	0.06	5.43	0.92	0.67	0.05		75.50	0.54	3.77	2.67
U		100.00	110.00		12800	13200		7.04	2.10	0.06	5.52	0.94	0.68	0.06		76.00	0.53	3.79	2.60
U		100.00	100.00		12450	13150		7.04	2.12	0.07	5.49	0.94	0.69	0.06		76.00	0.54	3.79	2.57
U		100.00	100.00		12700	12900		7.00	2.11	0.07	5.50	0.93	0.68	0.06		75.50	0.53	3.85	2.55
U		100.00	110.00		13050	13300		7.03	2.11	0.06	5.52	0.94	0.68	0.06		75.60	0.52	3.92	2.58
U		100.00	100.00		12550	13000		7.04	2.12	0.07	5.50	0.94	0.69	0.06		75.90	0.55	3.85	2.59
U		100.00	100.00		12900	13300		7.06	2.11	0.07	5.52	0.94	0.70	0.06		76.00	0.53	3.80	2.57
U		100.00	100.00		13100	12900		7.08	2.13	0.07	5.55	0.95	0.70	0.06		76.10	0.54	3.81	2.60
U		100.00	100.00		12900	12900		7.05	2.11	0.06	5.50	0.95	0.68	0.06		75.70	0.54	3.83	2.57
V		124.07	95.41		13146	10862	12300												
V		121.64	94.64		12799	10534	12290												
V		123.61	95.13		12892	10739	12140												
V		124.25	96.17		13376	10874	12090												
V		123.59	98.67		13222	11161	11970												
V		120.78	98.45		13159	11060	12220												
V		131.33	97.74		14182	11140	12250												
V		120.87	99.98		12668	11350	12300												
X	0.05	110.00	100.00		12903		10640												2.68
X	0.06	104.00	98.00		12226		10510												2.62
X	0.05	104.00	99.00		12611		10520												2.64
X	0.06	103.00	99.00		12356		10380												2.60
X	0.05	102.00	100.00		12398		10620												2.66
X	0.06	110.00	100.00		13012		10320												2.67
X	0.05	103.00	100.00		12558		10400												2.58
X	0.06	104.00	100.00		12813		10410												2.63
Y	0.05				12950	12600	10550	7.05	2.08	0.07	5.52	0.90	0.68	0.06	1.19	77.70	0.56	4.62	2.80
Y	0.07				12900	12900	10500	7.00	2.08	0.07	5.52	0.90	0.68	0.06	1.18	77.30	0.56	4.64	2.74
Y	0.05				13050	12500	10150	7.02	2.07	0.07	5.50	0.90	0.68	0.06	1.18	77.40	0.56	4.60	2.75
Y	0.05				12850	13350	10350	7.05	2.09	0.07	5.54	0.90	0.68	0.06	1.18	77.90	0.57	4.65	2.83
Y	0.06				12950	12600	10000	6.91	2.04	0.07	5.43	0.88	0.67	0.06	1.16	76.30	0.55	4.64	2.72
Y	0.05				13000	13100	9930	6.99	2.07	0.07	5.49	0.90	0.68	0.06	1.18	77.30	0.56	4.42	2.80
Y	0.08				12900	12850	10450	7.00	2.07	0.07	5.51	0.89	0.68	0.06	1.18	77.40	0.56	4.60	2.66
Y	0.05				12850	12750	10150	6.91	2.04	0.06	5.43	0.89	0.67	0.06	1.16	76.30	0.55	4.56	2.92

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]
Co	F	ppm	0.005	0.001	0.005	0.0005
Co	M/ICP	ppm	3.355	1.955	2.194	0.563
Co	P	ppm	3.163	2.127	1.816	0.643
Cu	F	ppm	323.6	234.5	231.0	88.04
Cu	M/ICP	ppm	222.5	96.86	182.8	31.34
Cu	P	ppm	309.9	223.1	206.3	78.46
Cu	Soluble	ppm	421.6	384.3	160.7	129.5
Al2O3	XRF	%	0.039	0.020	0.031	0.007
CaO	XRF	%	0.018	0.013	0.010	0.004
Cr2O3	XRF	%	0.005	0.004	0.003	0.001
Fe2O3	XRF	%	0.037	0.026	0.021	0.008
K2O	XRF	%	0.008	0.005	0.006	0.002
LOI		%	0.329	0.271	0.078	0.079
MgO	XRF	%	0.019	0.015	0.008	0.005
MnO	XRF	%	0.001	0.001	0.001	0.000
Na2O	XRF	%	0.031	0.030	0.013	0.011
SiO2	XRF	%	0.209	0.083	0.188	0.034
TiO2	XRF	%	0.010	0.006	0.007	0.002
SG	pyc		0.061	0.048	0.024	0.015

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: AMIS0365 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.

12 April 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	0.27	0.80	146	53
Al	M/ICP	%	3.60	0.41	5.67	134
As	M/ICP	ppm	6.35	7.66	60.3	59
Ba	M/ICP	ppm	289	33.9	5.9	80
Be	M/ICP	ppm	1.68	0.46	13.8	72
Bi	M/ICP	ppm	0.23	1.78	389	50
Ca	M/ICP	%	1.48	0.12	4.2	139
Cd	M/ICP	ppm	0.47	0.93	98.4	33
Ce	M/ICP	ppm	231	23.1	4.99	37
Cr	M/ICP	ppm	405	114	14.1	135
Cs	M/ICP	ppm	11.6	61.1	262	36
Dy	M/ICP	ppm	6.97	1.09	7.84	32
Er	M/ICP	ppm	5.03	1.05	10.4	32
Eu	M/ICP	ppm	1.88	0.22	5.96	32
Fe	M/ICP	%	3.79	0.29	3.85	127
Ga	M/ICP	ppm	9.95	1.92	9.67	58
Gd	M/ICP	ppm	6.64	5.70	43.0	40
Hf	M/ICP	ppm	2.01	1.07	26.5	39
Ho	M/ICP	ppm	1.54	0.21	6.91	32
In	M/ICP	ppm	0.26	0.06	12.4	40
K	M/ICP	%	0.74	0.11	7.72	139
La	M/ICP	ppm	146	18.1	6.16	69
Li	M/ICP	ppm	7.84	1.18	7.54	75
Lu	M/ICP	ppm	1.01	0.14	6.86	32
Mg	M/ICP	%	0.40	0.06	7.17	139
Mn	M/ICP	ppm	449	71.0	7.90	152
Mo	M/ICP	ppm	4.82	1.76	18.2	62
Na	M/ICP	%	0.89	0.11	6.00	116
Nb	M/ICP	ppm	10.7	5.29	24.7	53
Nd	M/ICP	ppm	74.4	27.4	18.4	36
Ni	M/ICP	ppm	107	10.0	4.66	98
P	M/ICP	ppm	614	187	15.3	88
Pb	M/ICP	ppm	7.40	6.72	45.4	83
Pr	M/ICP	ppm	21.8	1.31	3.01	30
Rb	M/ICP	ppm	36.9	6.52	8.84	46
S	M/ICP	%	0.14	0.02	5.63	112
Sb	M/ICP	ppm	0.24	0.10	20.7	35
Sc	M/ICP	ppm	12.6	2.17	8.61	84
Se	M/ICP	ppm	15.4	5.76	18.7	47
Si	M/ICP	%	35.4	1.12	1.58	16
Sm	M/ICP	ppm	9.76	1.22	6.26	32
Sn	M/ICP	ppm	3.97	1.08	13.7	40
Sr	M/ICP	ppm	303	34.9	5.75	109
Ta	M/ICP	ppm	0.64	0.46	36.4	40
Tb	M/ICP	ppm	2.15	2.36	54.8	40
Te	M/ICP	ppm	3.19	1.09	17.1	28
Th	M/ICP	ppm	10.2	10.5	51.7	38
Ti	M/ICP	%	0.25	0.11	22.5	79
Tl	M/ICP	ppm	0.84	2.79	166	32
Tm	M/ICP	ppm	0.84	0.13	7.67	32
U	M/ICP	ppm	10.9	1.12	5.11	32
V	M/ICP	ppm	76.6	14.6	9.55	93
W	M/ICP	ppm	3.20	12.2	191	37
Y	M/ICP	ppm	36.0	6.60	9.16	75
Yb	M/ICP	ppm	6.18	1.26	10.2	32
Zn	M/ICP	ppm	20.3	9.6	23.8	101
Zr	M/ICP	ppm	68.2	64.9	47.5	72