African Mineral Standards
MATRIX REFERENCE MATERIALS

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AMIS0399

Certified Reference Material

Copper ore, sulphide, Kansanshi Mine, Zambia

Certificate of Analysis

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

Certified Concentrations[2.]

Cu Fusion	1.013	±	0.085	%
Cu M/ICP	1.014	±	0.037	%
Cu P	0.997	±	0.035	%
Cu Soluble	4081	±	298	ppm
Co M/ICP	84	±	9	ppm
Co P	83	±	8	ppm
Specific Gravity	2.82	±	0.08	

Provisional Concentration

Au Pb Collection	0.10	±	0.02	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	11.17	±	0.22	%
CaO	8.82	±	0.08	%
Fe_2O_3	6.78	±	0.12	%
K_2O	1.75	±	0.04	%
MgO	1.96	±	0.06	%
MnO	0.080	±	0.002	%
Na_2O	2.49	±	0.12	%
SiO_2	53.52	±	0.64	%
TiO_2	1.05	±	0.04	%
S Comb / LECO	1.28	±	0.12	%

Provisional Concentrations

Cr_2O_3	0.05	±	0.01	%
LOI	9.00	±	2.06	%

1. Intended Use: AMIS0399 is a certified reference material which may be used to demonstrate the validity of measurement results of a single analysis of sulphide 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 a predominantly sulphide 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 Medium Dark Grey.

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 four laboratories were each given eight randomly selected packages of sample. Twenty one 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 21 out of 24 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. Genalysis Laboratory Services (South Africa) Pty
11. Genalysis Laboratory Services (W Australia P)
12. Intertek Minerals Zambia
13. Intertek Utama Services (Indonesia)
14. Set Point Laboratories (Isando) SA
15. SGS Australia Pty Ltd (Newburn) WA
16. SGS Geosol Laboratories Ltda (Brazil)
17. SGS Mineral Services Callao (Peru)
18. SGS Mineral Services Lakefield (Canada)
19. SGS South Africa (Pty) Ltd - Booysens JHB
20. Skyline Assayers and Labs (USA)
21. 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 Fusion 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 %	Na_2O XRF %	SiO_2 XRF %	TiO_2 XRF %	LOI %	S Comb LECO %	SG pyc
A			100			9800														
A			100			9900														
A			100			9800														
A			100			9700														
A			100			9800														
A			100			9800														
A			100			9900														
A			100			10000														
B	0.12	88.0	89.2		9879	9227	3960	11.2	8.83	0.05	6.77	1.72	1.96	0.08	2.49	53.6	1.02	9.19	1.26	2.70
B	0.11	87.9	89.4		9947		3860	11.1	8.83	0.05	6.75	1.74	1.99	0.08	2.48	53.4	1.02	9.36	1.30	2.70
B	0.10	89.9	90.8		9988	9448	3900	11.1	8.78	0.05	6.74	1.73	1.98	0.08	2.49	53.2	1.01	9.56	1.36	2.70
B	0.11	85.8	89.5		9786	9586	3740	11.1	8.77	0.04	6.70	1.72	1.98	0.08	2.44	53.0	1.01	9.46	1.30	2.70
B	0.11	88.7	88.9		9971	9418	3770	11.1	8.82	0.05	6.76	1.71	1.98	0.08	2.51	53.5	1.02	9.48	1.33	2.70
B	0.12	84.9	87.6		9817	9324	3860	11.1	8.81	0.05	6.72	1.71	1.99	0.08	2.51	53.3	1.01	9.42	1.29	2.69
B	0.14	84.4	88.1		9815	9499	3810	11.1	8.82	0.05	6.79	1.72	1.97	0.08	2.49	53.4	1.02	9.43	1.30	2.71
B	0.11	85.5	86.9			9286	4090	11.1	8.78	0.05	6.74	1.72	1.97	0.08	2.48	53.2	1.02	9.47	1.25	2.70

Assay data. (Cont)

Lab Code	Au Pb Coll g/t	Co M/ICP ppm	Co P ppm	Cu Fusion 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 %	Na_2O XRF %	SiO_2 XRF %	TiO_2 XRF %	LOI %	S Comb LECO %	SG pyc
D	0.10	90.0	80.0		10300	9860		11.3	8.80	0.05	6.77	1.74	1.92	0.08	2.55	53.0	1.03	7.77		
D	0.09	90.0	80.0		10050	10150		11.3	8.83	0.05	6.84	1.76	1.94	0.08	2.55	53.4	1.03	7.80		
D	0.09	90.0	80.0		9900	10050		11.3	8.82	0.05	6.80	1.76	1.92	0.08	2.54	53.1	1.02	7.88		
D	0.09	90.0	80.0		10050	9930		11.3	8.84	0.05	6.82	1.76	1.93	0.08	2.54	53.3	1.03	7.82		
D	0.08	90.0	80.0		10100	9700		11.3	8.83	0.05	6.84	1.76	1.94	0.08	2.54	53.4	1.03	7.86		
D	0.09	90.0	80.0		10000	9950		11.3	8.83	0.05	6.80	1.75	1.92	0.08	2.53	53.0	1.02	7.91		
D	0.09	90.0	80.0		10050	9950		11.3	8.81	0.05	6.79	1.75	1.92	0.08	2.53	53.1	1.02	7.94		
D	0.08	90.0	70.0		10150	10050		11.3	8.83	0.05	6.83	1.76	1.94	0.08	2.55	53.3	1.03	7.87		
E		83.1	91.0	10394		9910	4292	11.5	8.85	0.05	6.74	1.73	1.95	0.08	2.68	54.4	1.07	8.74	1.36	2.82
E		83.9	93.0	10259		9846	4280	11.4	8.79	0.05	6.72	1.73	1.94	0.08	2.64	54.0	1.06	9.04	1.36	2.81
E		84.0	92.0	10378		9892	4284	11.3	8.82	0.05	6.69	1.83	1.93	0.08	2.65	54.0	1.07	9.15	1.35	2.81
E		82.4	92.0	10272			4197	11.3	8.82	0.05	6.70	1.76	1.93	0.08	2.68	53.9	1.06	9.11	1.36	2.84
E		81.9	92.0	10321		9814	4272	11.3	8.83	0.05	6.76	1.84	1.94	0.08	2.60	54.0	1.07	9.48	1.36	2.81
E		83.0	94.0	10260			4332	11.3	8.77	0.04	6.70	1.76	1.92	0.08	2.59	53.8	1.06	9.77	0.36	2.83
E		81.4	92.0	10367			4227	11.2	8.64	0.06	6.64	1.70	2.09	0.08	2.68	53.3	1.04	9.82	1.39	2.82
E		82.0	94.0	10324			4343	11.3	8.78	0.04	6.71	1.81	1.94	0.08	2.68	53.7	1.06	9.63	0.37	2.82
F	0.09	80.0	85.0	10000	10300	9950	4120	11.2	8.86	0.05	6.73	1.74	1.94	0.08		53.4	1.02	7.56		2.86
F	0.10	80.0	80.0	10300	10400	10000	4000	11.2	8.84	0.05	6.72	1.74	1.94	0.08		53.3	1.03	7.54		2.86
F	0.11	85.0	81.0	10100	10200	9950	4190	11.3	8.85	0.05	6.73	1.74	1.95	0.08		53.4	1.03	7.61		2.87
F	0.10	85.0	82.0	10400	10400	10100	4040	11.2	8.83	0.05	6.74	1.74	1.94	0.08		53.3	1.03	7.61		2.84
F	0.10	85.0	83.0	10200	10300	10300	4090	11.2	8.85	0.05	6.73	1.75	1.96	0.08		53.4	1.03	7.57		2.85
F	0.09	85.0	82.0	10300	10400	9950	4070	11.2	8.85	0.05	6.72	1.75	1.95	0.08		53.3	1.03	7.59		2.87
F	0.09	80.0	85.0	10100	10300	10200	4090	11.3	8.87	0.05	6.74	1.75	1.96	0.08		53.4	1.03	7.55		2.87
F	0.09	80.0	78.0	10100	10300	9800	4140	11.2	8.85	0.05	6.73	1.75	1.95	0.08		53.3	1.03	7.58		2.87
G	0.09	80.0	100.0		10100	9830	3870													2.77
G	0.10	80.0	100.0		10100	9930	3930													2.77
G	0.09	80.0	100.0		9850	9800	3950													2.77
G	0.09	80.0	90.0		9860	9720	4030													2.78
G	0.10	90.0	110.0		9730	9940	4050													2.77
G	0.08	80.0	90.0		10150	9950	4030													2.77
G	0.09	80.0	100.0		9820	10000	4060													2.73
G	0.09	80.0	100.0		9820	9980	4080													2.78
H	0.10	90.0		10500	9250		4040	11.4	8.82	0.04	6.87	1.76	2.01	0.08	2.42	54.0	1.06	9.93		2.84
H	0.10	100.0		10100	10100		4030	11.3	8.80	0.05	6.85	1.77	1.98	0.08	2.45	53.9	1.06	9.89		2.85
H	0.10	90.0		10200	9550		4020	11.3	8.82	0.05	6.85	1.77	1.98	0.08	2.43	53.7	1.06	9.91		2.84
H	0.10	90.0		10100	9810		3950	11.3	8.77	0.04	6.83	1.79	1.99	0.08	2.43	53.8	1.05	9.82		2.84
H	0.09	90.0		9920	9800		3870	11.3	8.81	0.04	6.83	1.78	2.01	0.08	2.43	53.9	1.06	9.73		2.84
H	0.09	90.0		10300	9810		3840	11.4	8.89	0.04	6.91	1.78	2.01	0.08	2.46	54.0	1.06	9.77		2.85
H	0.11	90.0		9910	9520		3880	11.4	8.81	0.05	6.85	1.76	1.99	0.08	2.45	54.0	1.06	9.99		2.85
H	0.10	100.0		10100	10200		3980	11.3	8.80	0.04	6.84	1.77	1.99	0.08	2.43	54.0	1.05	10.08		2.84
I		90.0			10250	9900		11.1	8.78	0.05	6.71	1.76	1.96	0.08		53.6	1.04	7.74	1.28	2.73
I		90.0			10000	10100		11.0	8.78	0.05	6.73	1.77	1.96	0.08		53.5	1.04	7.78	1.28	2.75
I		90.0			10100	10300		11.1	8.76	0.05	6.74	1.78	1.98	0.08		53.7	1.02	7.82	1.28	2.74
I		90.0			10100	10050		11.0	8.76	0.05	6.73	1.76	1.96	0.08		53.5	1.04	7.84	1.28	2.75
I		90.0			9970	10250		11.1	8.81	0.05	6.74	1.78	1.98	0.08		53.8	1.04	7.73	1.30	2.72
I		90.0			10150	9920		11.1	8.78	0.05	6.73	1.78	1.97	0.08		53.8	1.05	7.76	1.30	2.74
I		90.0			10150	10200		11.1	8.79	0.05	6.72	1.78	1.96	0.08		53.6	1.04	7.73	1.28	2.74
I		90.0			10050	10200		11.1	8.82	0.05	6.74	1.78	1.98	0.08		53.8	1.04	7.76	1.29	2.73
J	0.09	85.5	82.0	10359	10140		4118													2.87
J	0.10	84.6	82.0	10045	10172		4167													2.81
J	0.09	85.0	82.0	10195	10108		4140													2.84
J	0.11	85.4	82.0	10087	10183		4182													2.86
J	0.09	84.5	83.0	10356	10128		4167													2.84
J	0.10	85.0	83.0	9028	10122		4158													2.88
J	0.09	84.2	82.0	10164	10210		4239													2.86
J	0.09	85.4	83.0	10294	10193		4158													2.87
K	0.11	84.0			10700		4100													2.85
K	0.10	84.0			10200		4000													2.85
K	0.10	86.0			10200		4100													2.87
K	0.09	85.0			10400		4000													2.86
K	0.09	82.0			10100		4000													2.86
K	0.11	86.0			10400		4000													2.85
K	0.09	83.0			10400		4000													2.86
K	0.11	81.0			10200		4000													2.86
L	0.10	84.8	79.6	10047	10125	10088	5883	11.3	8.92	0.05	7.04	1.75	1.84	0.08		53.5	1.05	9.05		2.80
L	0.10	84.5	86.4	10473	10067	10551	5334.64	11.3	8.80	0.02	7.02	1.73	1.81	0.09		52.9	1.05	9.19		2.82
L	0.09	88.1	87.3	10644	10309	10333	5352.56	11.3	8.78	0.03	7.00	1.73	1.81	0.09		52.7	1.04	9.40		2.81
L	0.09	87.6	83.0	10438	10223	10166	5987.48	11.3	8.87	0.03	7.07	1.80	1.83	0.08		53.1	1.05	9.44		2.81
L	0.09	87.9	86.0	10756	10134	10190	5811.19	11.4	8.90	0.02	7.06	1.74	1.85	0.08		53.3	1.06	9.15		2.82
L	0.09	89.9	88.9	10744	10204	10220	5352.56	11.3	8.86	0.02	7.07	1.75	1.82	0.08		53.1	1.05	9.34		2.78
L	0.10	89.3	85.2	10494	10125	10064	5789.04	11.3	8.90	0.02	7.07	1.75	1.81	0.09		53.3	1.05	9.43		2.81
L	0.09	90.7	86.6	10801	9995	10062	5345.76	11.2	8.79	0.02	6.99	1.72	1.81	0.08		52.7	1.04	9.37		2.80

Assay data. (Cont)

Lab Code	Au Pb Coll g/t	Co M/ICP ppm	Co P ppm	Cu Fusion 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 %	Na_2O XRF %	SiO_2 XRF %	TiO_2 XRF %	LOI %	S Comb LECO %	SG pyc
M		80.7	78.0		10300	10200	4859												1.30	2.75
M		84.8	78.0		10300	10100	4818												1.30	2.76
M		80.2	77.0		10300	10200	4810												1.30	2.75
M		84.5	77.0		10300	10000	4771												1.30	2.76
M		81.2	82.0		10300	10200	4834												1.30	2.78
M		80.7	80.0		10300	10300	4795												1.30	2.75
M		81.6	79.0		10300	10200	4806												1.29	2.76
M		83.4	78.0		10200	10200	4795												1.29	2.74
N	0.07	90.0	80.0		10140	9830	3640													
N	0.13	92.0	84.0		10220	10120	3730													
N	0.10	89.0	82.0		10300	10100	3780													
N	0.10	91.0	82.0		10270	10180	3670													
N	0.07	95.0	78.0		10350	10170	3680													
N	0.10	94.0	83.0		10310	10330	3680													
N	0.11	91.0	80.0		10260	10030	3650													
N	0.11	94.0	84.0		10300	10280	3800													
O	0.10	73.0	90.9					11.3	8.84	0.06	6.74	1.76	1.94	0.07	2.12	54.1	1.07	8.55		
O	0.11	72.1	90.0					11.2	8.84	0.05	6.72	1.76	1.93	0.08	2.11	54.1	1.07	8.44		
O	0.11	79.2	93.7					11.1	8.82	0.06	6.79	1.76	1.92	0.08	2.10	53.9	1.04	8.44		
O	0.11	79.3	87.7					11.2	8.84	0.06	6.85	1.75	1.95	0.08	2.16	54.0	1.05	8.46		
O	0.11	77.3	94.6					11.2	8.85	0.06	6.82	1.77	1.94	0.08	2.13	53.8	1.05	8.53		
O	0.11	78.2	89.8					11.3	8.86	0.06	6.79	1.77	1.96	0.08	2.15	54.2	1.05	8.44		
O	0.11	79.0	95.3					11.2	8.88	0.05	6.74	1.78	1.94	0.08	2.14	54.3	1.08	8.61		
O	0.10	75.8	99.0					11.2	8.80	0.05	6.69	1.76	1.92	0.08	2.15	54.1	1.08	8.58		
P	0.10						3400	11.2	9.08	0.05	6.88	1.78	2.01	0.08	2.41	53.6	1.06	10.70	1.26	
P	0.11						3400	11.1	9.13	0.06	6.87	1.79	1.99	0.08	2.44	53.5	1.06	10.70	1.26	
P	0.12						3400	11.1	9.09	0.06	6.86	1.76	2.00	0.08	2.41	53.8	1.07	10.60	1.26	
P	0.10						3300	11.1	8.94	0.06	6.79	1.75	2.00	0.07	2.43	53.6	1.06	10.10	1.28	
P	0.10						3400	11.1	8.98	0.06	6.92	1.77	2.03	0.08	2.45	54.4	1.06	9.76	1.28	
P	0.10						3300	11.1	9.03	0.05	6.82	1.76	2.00	0.08	2.39	53.5	1.07	10.70	1.28	
P	0.11						3300	11.2	9.07	0.05	6.89	1.74	2.01	0.08	2.41	53.5	1.05	10.80	1.28	
P	0.09						3400	11.0	8.95	0.05	6.81	1.76	1.98	0.08	2.40	53.1	1.05	10.80	1.26	
Q	0.08	80.0	80.0		10000	9860	4060	11.1	8.82	0.05	6.72	1.69	1.93	0.09	2.51	53.1	1.06	10.08		2.89
Q	0.08	80.0	80.0		10000	9920	4210	11.0	8.74	0.05	6.67	1.68	1.91	0.08	2.49	52.8	1.03	10.12		2.88
Q	0.09	80.0	80.0		10000	9860	4010	11.1	8.81	0.05	6.74	1.68	1.92	0.09	2.52	53.3	1.04	10.11		2.82
Q	0.10	80.0	80.0		9950	9870	4120	11.1	8.82	0.05	6.74	1.70	1.93	0.09	2.52	53.2	1.04	10.09		2.84
Q	0.09	80.0	80.0		9950	10100	4160	11.0	8.73	0.05	6.65	1.68	1.91	0.09	2.49	52.7	1.05	10.11		2.89
Q	0.09	80.0	80.0		9850	9890	4120	11.1	8.80	0.05	6.71	1.68	1.92	0.09	2.50	53.0	1.04	10.13		2.85
Q	0.09	90.0	80.0		9860	10150	4090	11.1	8.82	0.05	6.74	1.70	1.93	0.09	2.52	53.2	1.05	10.08		2.81
Q	0.11	80.0	80.0		10050	10050	4240	11.2	8.86	0.05	6.77	1.70	1.94	0.09	2.52	53.4	1.05	10.09		2.82
R	0.11	80.0	71.0		10300	9670	4210	11.1	8.78	0.04	6.71	1.72	1.97	0.08	2.58	53.4	1.05	9.00		
R	0.11	79.0	70.0		10400	9620	4210	11.1	8.77	0.04	6.78	1.72	1.95	0.08	2.59	53.7	1.05	9.00		
R	0.10	80.0	73.0		10600	9730	4250	11.2	8.80	0.04	6.73	1.73	1.97	0.08	2.57	53.7	1.07	8.90		
R	0.11	76.0	72.0		10500	9780	4230	11.2	8.80	0.05	6.78	1.73	1.98	0.08	2.59	53.7	1.07	8.90		
R	0.11	76.0	72.0		10400	9770	4270	11.1	8.76	0.04	6.78	1.73	1.96	0.08	2.56	53.4	1.07	9.00		
R	0.11	76.0	71.0		10300	9780	4240	11.1	8.78	0.05	6.69	1.72	1.96	0.08	2.55	53.5	1.06	9.00		
R	0.10	77.0	71.0		10300	9750	4210	11.1	8.77	0.05	6.73	1.72	1.96	0.08	2.54	53.7	1.07	9.10		
R	0.11	79.0	72.0		10500	9840	4250	11.2	8.81	0.04	6.81	1.72	1.98	0.08	2.57	53.6	1.06	9.10		
S	0.11	83.0	85.0		10350	9910		11.1	8.72	0.04	6.63	1.72	1.92	0.07	2.39	52.8	1.04	8.59		2.78
S	0.12	82.0	84.0		10150	10050		11.0	8.64	0.04	6.60	1.72	1.90	0.06	2.38	52.2	1.02	10.44		2.78
S	0.11	82.0	86.0		10450	9910		11.0	8.64	0.04	6.53	1.68	1.84	0.08	2.32	52.3	1.00	10.11		2.84
S	0.10	83.0	86.0		10100	10050		11.1	8.78	0.04	6.67	1.74	1.92	0.07	2.40	53.0	1.04	10.40		2.80
S	0.14	83.0	85.0		10450	9960		11.0	8.60	0.04	6.49	1.68	1.82	0.08	2.32	52.2	1.01	10.35		2.79
S	0.10	84.0	85.0		10300	10050		10.8	8.52	0.04	6.47	1.70	1.88	0.06	2.33	51.8	1.02	10.47		2.77
S	0.09	80.0	85.0		10500	9910		11.1	8.76	0.04	6.64	1.74	1.93	0.07	2.37	52.9	1.04	10.29		2.83
S	0.12	82.0	84.0		10350	9960		11.0	8.70	0.05	6.61	1.74	1.92	0.07	2.37	53.3	1.04	10.36		2.81
T	0.13				10000		4300													
T	0.09				10000		4200													
T	0.13				10000		4200													
T	0.11				10000		4300													
T	0.12				10000		4300													
T	0.08				10000		4400													
T	0.10				10000		4300													
T	0.08				9900		4400													
V	0.13	82.0	80.0	9340	9020			11.1	8.82	0.05	6.88	1.75	1.95	0.08	2.57	53.5	1.07	7.56	1.05	
V	0.11	83.0	81.0	9310	9320			11.1	8.91	0.05	6.93	1.76	1.96	0.08	2.56	53.4	1.09	7.55	1.11	
V	0.13	84.0	79.0	9170	9450			11.1	8.87	0.05	6.91	1.74	1.96	0.08	2.54	53.5	1.07	7.54	1.19	
V	0.17	84.0	80.0	9240	9250			11.1	8.86	0.05	6.89	1.73	1.96	0.08	2.56	53.6	1.06	7.55	1.13	
V	0.11	82.0	80.0	9190	9220			11.1	8.81	0.05	6.87	1.74	1.96	0.08	2.58	53.5	1.07	7.55	1.14	
V	0.12	81.0	81.0	9160	9040			11.1	8.81	0.05	6.84	1.74	1.96	0.08	2.55	53.6	1.06	7.58	1.12	
V	0.13	80.0	80.0	9140	8970			11.1	8.86	0.05	6.91	1.75	1.95	0.08	2.56	53.4	1.08	7.58	1.12	
V	0.14	81.0	82.0	9440	8850			11.1	8.90	0.05	6.90	1.76	1.95	0.08	2.57	53.4	1.10	7.62	1.14	
X	0.09	82.0	83.0		9743	9756	3980													2.72
X	0.12	81.0	82.0		9779	9902	3860													2.70
X	0.10	80.0	83.0		9565	9860	3900													2.68
X	0.09	80.0	82.0		9692	9716	3800													2.70
X	0.12	80.0	83.0		9604	9981	3840													2.70
X	0.09	80.0	82.0		9723	9741	3880													2.72
X	0.10	83.0	82.0		9825	9782	3860													2.67
X	0.10	81.0	82.0		9820	9637	3910													2.68

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]	σ_L [2]	S_W [3]	CSU [4]
Au	Pb Coll	g/t	0.012	0.005	0.009	0.0015
Co	M/ICP	ppm	4.361	2.641	1.884	0.643
Co	P	ppm	4.353	3.249	1.521	0.914
Cu	Fusion	ppm	422.4	479.7	158.1	197.21
Cu	M/ICP	ppm	183.0	112.53	98.8	30.51
Cu	P	ppm	175.1	105.0	114.5	31.32
Cu	Soluble	ppm	148.8	117.9	62.8	36.2
Al_2O_3	XRF	%	0.110	0.080	0.046	0.023
CaO	XRF	%	0.037	0.019	0.030	0.007
Cr_2O_3	XRF	%	0.005	0.003	0.003	0.001
Fe_2O_3	XRF	%	0.065	0.049	0.032	0.015
K_2O	XRF	%	0.023	0.015	0.013	0.004
LOI		%	1.034	0.817	0.241	0.228
MgO	XRF	%	0.027	0.021	0.011	0.006
MnO	XRF	%	0.001	0.001	0.001	0.0003
Na_2O	XRF	%	0.064	0.065	0.016	0.023
SiO_2	XRF	%	0.315	0.224	0.158	0.067
TiO_2	XRF	%	0.018	0.013	0.009	0.004
S comb	LECO	%	0.065	0.074	0.020	0.030
SG	pyc		0.044	0.036	0.017	0.011

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: AMIS0399 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.

01 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	0.40	0.40	50.0	55
Al	M/ICP	%	5.6	0.86	7.7	115
As	M/ICP	ppm	4.8	8.3	86.1	44
Ba	M/ICP	ppm	264	43.3	8.2	88
Be	M/ICP	ppm	2.0	0.33	8.3	61
Bi	M/ICP	ppm	0.31	0.05	8.8	36
Ca	M/ICP	%	6.3	0.52	4.1	121
Cd	M/ICP	ppm	0.11	0.17	82.3	16
Ce	M/ICP	ppm	156	48.1	15.4	40
Cr	M/ICP	ppm	253	49.9	9.9	116
Cs	M/ICP	ppm	1.7	0.21	6.1	32
Dy	M/ICP	ppm	6.8	2.0	15.0	16
Er	M/ICP	ppm	4.5	1.2	13.3	16
Eu	M/ICP	ppm	1.8	0.51	14.1	16
Fe	M/ICP	%	4.7	0.52	5.5	125
Ga	M/ICP	ppm	16.9	7.1	20.9	64
Gd	M/ICP	ppm	9.3	3.2	17.3	24
Ge	M/ICP	ppm	0.74	0.49	33.2	24
Hf	M/ICP	ppm	3.5	0.94	13.3	39
Ho	M/ICP	ppm	1.5	0.48	15.8	16
In	M/ICP	ppm	0.28	0.03	5.6	37
K	M/ICP	%	1.4	0.21	7.4	122
La	M/ICP	ppm	88.4	22.3	12.6	64
Li	M/ICP	ppm	15.5	3.2	10.2	81
Lu	M/ICP	ppm	0.90	0.11	6.3	24
Mg	M/ICP	%	1.1	0.15	6.8	123
Mn	M/ICP	ppm	613	69.1	5.6	116
Mo	M/ICP	ppm	13.7	4.6	16.7	95
Na	M/ICP	%	1.9	0.22	5.8	120
Nb	M/ICP	ppm	16.1	5.5	16.9	45
Nd	M/ICP	ppm	6037	17284	143	24
Ni	M/ICP	ppm	109	15.1	6.9	112
P	M/ICP	ppm	609	100	8.2	96
Pb	M/ICP	ppm	192	535	140	88
Pr	M/ICP	ppm	10.6	11.6	54.3	32
Rb	M/ICP	ppm	69.7	9.1	6.5	39
S	M/ICP	%	1.3	0.12	4.8	120
Sb	M/ICP	ppm	2.9	8.4	144	31
Sc	M/ICP	ppm	17.3	4.6	13.3	103
Se	M/ICP	ppm	14.3	1.9	6.7	38
Si	M/ICP	%	25.5	0.56	1.1	8
Sm	M/ICP	ppm	9.4	2.8	14.7	16
Sn	M/ICP	ppm	4.0	0.2	2.8	36
Sr	M/ICP	ppm	311	17.2	2.8	124
Ta	M/ICP	ppm	1.3	0.38	14.1	39
Tb	M/ICP	ppm	1.2	0.23	9.4	24
Te	M/ICP	ppm	2.9	1.3	21.8	46
Th	M/ICP	ppm	9.8	2.9	14.7	32
Ti	M/ICP	%	0.45	0.19	20.9	87
Tl	M/ICP	ppm	0.22	0.17	38.4	32
Tm	M/ICP	ppm	0.76	0.29	19.2	16
U	M/ICP	ppm	11.0	2.5	11.2	45
V	M/ICP	ppm	124	32.5	13.2	119
W	M/ICP	ppm	1.3	0.64	23.7	38
Y	M/ICP	ppm	35.9	7.7	10.7	64
Yb	M/ICP	ppm	5.9	1.4	12.2	24
Zn	M/ICP	ppm	22.9	16.5	36.2	101
Zr	M/ICP	ppm	130	30.3	11.6	79