



African Mineral Standards

MATRIX REFERENCE MATERIALS

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AMIS0359

Certified Reference Material

**Gold ore, Lily Mine, Barberton Greenstone Belt,
South Africa**

Certificate of Analysis

**Recommended Concentrations and Limits^{1, 2.}
(at two Standard Deviations)**

Certified Concentrations

Au Pb Collection	3.80	±	0.16	g/t
As M/ICP	2334	±	254	ppm
Specific Gravity	3.39	±	0.14	

Provisional Concentration

Cu M/ICP	105	±	18	ppm
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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 Limits¹ (at two Standard Deviations)

Certified Concentrations

Al ₂ O ₃	2.54	±	0.14	%
CaO	1.82	±	0.10	%
Fe ₂ O ₃	38.83	±	0.50	%
K ₂ O	0.56	±	0.03	%
MgO	5.28	±	0.12	%
MnO	0.72	±	0.06	%
SiO ₂	45.11	±	0.74	%
TiO ₂	0.18	±	0.02	%
S Comb / LECO	6.91	±	0.32	%

Provisional Concentrations

Cr ₂ O ₃	0.048	±	0.014	%
Na ₂ O	0.089	±	0.016	%
LOI	4.15	±	0.58	%

1. Intended Use: AMIS0359 is a certified reference material which may be used to demonstrate the validity of measurement results of a single analysis of a greenstone gold ore hosted by rocks 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: The material for AMIS0359 was provided by Vantage Goldfields from Lily Mine operated by MIMCO, a subsidiary of Vantage Goldfields. Lily Mine is located 27 kilometres north east of the town of Barberton in Mpumalanga Province, South Africa. The mine is situated in the Archaean Barberton Greenstone Belt. Gold is contained in mesothermal veins associated with late tectonic shears and fractures within rocks of the Barberton Supergroup, which comprises an assortment of ultramafic and mafic submarine volcanics, turbiditic greywacke sandstones and shales. Intense shearing, massive quartz veining, silicification of BIF and sulphide enrichment characterize the larger ore bodies.

1. Primarily ICP data converted to oxides.

3. Approximate Mineral and Chemical Composition: The 2m to 15m wide ore body at Lily is contained within a prominent shear zone, situated along and structurally controlled by the Lily Fault, which defines a major structural break along the northern flank of the Archaean Barberton Greenstone Belt. The shear zone is bounded by talc schist in the footwall, greywacke and banded ironstone (BIF), chert and amphibolite in the hanging wall. The primary sulphide is pyrrhotite, with minor arsenopyrite, magnetite, pyrite and rare chalcopyrite. Gold occurs associated with quartz and with the pyrrhotite and arsenopyrite.

4. Appearance: The material is a very fine powder. It is colored a Dark Grey (Corstor).

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 <54µm. Wet sieve particle size analysis of random samples confirmed the material was 98.5% <54µm. It was then blended in a double cone blender, 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 or ICP-MS.
2. Multi-acid digest, including HF, ICP- OES or ICP-MS. Multi element scan.
3. Majors (Al_2O_3 , CaO, Cr_2O_3 , Fe_2O_3 , K_2O , MgO, MnO, Na_2O , SiO_2 , TiO_2 . LOI.) XRF fusion.
4. SG – Gas Pycnometer.

8. Information requested:

1. State aliquots used for all determinations.
2. Report all results for gold in ppm
3. All results for major elements to be reported as oxides in percentages.
4. All results for multi-element scans to be reported in ppm.
5. Report all QC data, to include replicates, blanks and certified reference materials used.
6. State and provide brief description of analytical techniques used.

9. Method of Certification: Twenty six laboratories were each given eight randomly selected packages of sample. Twenty four of the laboratories submitted 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 24 out of 26 laboratories that provided results timeously were (not in same order as in the table of assays):

- 1 Activation Laboratories Pty Ltd (ActLabs) CA
- 2 ALS Chemex Laboratory Group Johannesburg SA
- 3 Genalysis Laboratory Services (South Africa) Pty
- 4 Genalysis Laboratory Services (W Australia P)
- 5 Intertek Utama Services (Indonesia)
- 6 MIMCO SA
- 7 Performance Laboratories Barberton
- 8 Performance Laboratories FS (Allanridge)
- 9 Performance Laboratories SA (Randfontein)
- 10 Performance Laboratories Zimbabwe
- 11 Set Point Laboratories (Isando) SA
- 12 SGS Australia Pty Ltd (Newburn) WA
- 13 SGS Geosol Laboratories Ltda (Brazil)
- 14 SGS Mineral Services Lakefield (Canada)
- 15 SGS Mwanza (Tanzania)
- 16 SGS NSW (Australia)
- 17 SGS South Africa (Pty) Ltd - Booyens JHB
- 18 SGS Tarkwa (Ghana)
- 19 SGS Toronto (Canada)
- 20 SGS Townsville (Australia)
- 21 SGS Vancouver (Canada)
- 22 Super Laboratory Services (Balfour SA)
- 23 Super Laboratory Services (Springs SA)
- 24 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	As M/ICP ppm	Cu M/ICP ppm	Ni M/ICP ppm	Zn M/ICP ppm	Al ₂ O ₃ XRF %	CaO XRF %	Cr ₂ O ₃ XRF %	Fe ₂ O ₃ XRF %	K ₂ O XRF %	MgO XRF %	MnO XRF %	Na ₂ O XRF %	SiO ₂ XRF %	TiO ₂ XRF %	LOI %	S Comb/LECO %	SG pyc
A	3.84	2240	115	180	80.00	2.61	1.88	0.05	38.87	0.58	5.21	0.74	0.09	45.33	0.20	3.82		3.42
A	3.82	2140	110	170	80.00	2.64	1.88	0.05	38.91	0.58	5.22	0.75	0.11	45.38	0.19	3.82		3.47
A	3.87	2140	110	185	80.00	2.62	1.87	0.05	38.84	0.57	5.19	0.74	0.11	45.34	0.19	3.86		3.43
A	3.86	2200	110	175	80.00	2.63	1.87	0.05	38.78	0.57	5.19	0.74	0.11	45.33	0.19	3.82		3.44
A	3.92	2120	110	180	75.00	2.62	1.87	0.05	38.80	0.57	5.20	0.74	0.09	45.32	0.18	3.84		3.43
A	3.86	2020	115	180	85.00	2.60	1.87	0.05	38.81	0.58	5.19	0.74	0.09	45.35	0.19	3.81		3.44
A	3.82	2190	115	180	80.00	2.61	1.88	0.05	38.81	0.58	5.21	0.75	0.09	45.42	0.19	3.80		3.44
A	3.80	2250	110	170	80.00	2.63	1.87	0.05	38.84	0.58	5.19	0.74	0.09	45.39	0.19	3.82		3.41
D	3.93																	
D	3.75																	
D	3.83																	
D	3.83																	
D	3.85																	
D	3.85																	
D	3.93																	
D	3.86																	
E	3.74	1990	91	138	84.00			0.04		0.55			0.08		0.17		6.90	3.52
E	3.64	1920	91	136	90.00			0.04		0.54			0.08		0.17		6.88	3.52
E	3.53	1970	92	143	63.00			0.04		0.53			0.08		0.17		6.92	3.49
E	3.45	1910	90	136	62.00			0.04		0.53			0.08		0.17		6.91	3.50
E	3.52	1900	92	137	75.00			0.04		0.57			0.09		0.17		6.92	3.50
E	3.93	1920	87	137	59.00			0.03		0.52			0.08		0.15		6.89	3.48
E	3.37	1950	103	141	76.00			0.04		0.60			0.09		0.17		6.87	3.52
E	3.53	1980	103	129	70.00			0.04		0.58			0.09		0.17		6.92	3.37

Assay data (cont)

Lab Code	Au Pb Coll g/t	As M/ICP ppm	Cu M/ICP ppm	Ni M/ICP ppm	Zn M/ICP ppm	Al ₂ O ₃ XRF %	CaO XRF %	Cr ₂ O ₃ XRF %	Fe ₂ O ₃ XRF %	K ₂ O XRF %	MgO XRF %	MnO XRF %	Na ₂ O XRF %	SiO ₂ XRF %	TiO ₂ XRF %	LOI %	S Comb/LECO %	SG pyc
F	4.22	2410	125	153	74.00	2.51	1.83	0.05	38.70	0.56	5.20	0.73	0.11	44.90	0.18	3.15		
F	4.40	2530	129	162	78.00	2.51	1.83	0.05	38.80	0.57	5.22	0.72	0.10	44.80	0.18	3.10		
F	3.97	2520	136	158	79.00	2.51	1.83	0.05	38.70	0.57	5.20	0.73	0.10	44.90	0.18	3.19		
F	4.11	2630	142	166	82.00	2.51	1.83	0.05	38.90	0.57	5.20	0.72	0.09	44.90	0.19	3.06		
F	3.81	2560	132	163	79.00	2.54	1.84	0.05	38.90	0.56	5.22	0.73	0.10	44.90	0.18	3.00		
F	3.73	2600	122	166	80.00	2.56	1.84	0.05	38.90	0.57	5.20	0.73	0.10	44.70	0.18	3.20		
F	4.22	2490	124	158	78.00	2.54	1.86	0.06	38.80	0.57	5.18	0.73	0.09	44.90	0.18	2.95		
F	4.03	2650	148	171	81.00	2.57	1.85	0.05	38.80	0.56	5.18	0.73	0.12	44.90	0.19	2.64		
G	3.84																	
G	3.80																	
G	3.77																	
G	4.06																	
G	3.86																	
G	3.70																	
G	3.86																	
G	3.92																	
H	3.59	2302	102	157	74.00	2.55	1.72					0.70	0.09					3.42
H	3.56	2284	97	151	75.00	2.54	1.73					0.69	0.09					3.39
H	3.54	2287	98	152	74.00	2.55	1.71					0.69	0.09					3.40
H	3.66	2227	99	153	74.00	2.50	1.69					0.69	0.09					3.40
H	3.72	2245	98	152	72.00	2.45	1.67					0.67	0.09					3.44
H	3.30	2258	97	151	73.00	2.50	1.71					0.67	0.09					3.47
H	3.50	2223	98	153	71.00	2.50	1.72					0.70	0.09					3.37
H	3.60	2214	100	151	71.00	2.43	1.66					0.67	0.09					3.45
I	3.72	2470	118	215	82.00	2.59	1.68	0.05	38.89		5.22				0.19		6.90	3.44
I	3.91	2420	110	176	78.00	2.61	1.72	0.05	39.46		5.14				0.19		6.84	3.44
I	3.75	2440	111	212	86.00	2.61	1.74	0.05	39.89		5.29				0.19		6.81	3.44
I	3.98	2470	110	176	82.00	2.61	1.71	0.05	39.17		5.21				0.19		6.82	3.43
I	3.70	2530	109	175	78.00	2.65	1.75	0.05	40.03		5.37				0.19		6.83	3.46
I	3.85	2480	109	178	80.00	2.68	1.78	0.05	40.46		5.26				0.20		6.83	3.45
I	3.85	2390	105	168	75.00	2.57	1.72	0.05	39.75		5.27				0.19		6.81	3.44
I	3.74	2410	112	178	80.00	2.70	1.78	0.05	40.75		5.41				0.19		6.88	3.43
J	3.92																	
J	3.87																	
J	3.79																	
J	3.83																	
J	3.89																	
J	3.80																	
J	3.81																	
J	3.84																	
K	3.83		95	130		2.39	1.84	0.04	39.03	0.57	5.24	0.78		44.81	0.18	4.50	6.72	
K	3.84		95	128		2.38	1.84	0.04	39.27	0.57	5.25	0.78		45.15	0.18	4.55	6.72	
K	3.78		95	128		2.40	1.83	0.04	39.23	0.57	5.32	0.78		45.66	0.18	4.57	6.76	
K	3.82		95	128		2.39	1.84	0.04	38.96	0.56	5.31	0.78		45.31	0.19	4.52	6.78	
K	3.86		93	127		2.42	1.83	0.04	39.08	0.57	5.34	0.78		45.49	0.18	4.57	6.72	
K	3.80		95	130		2.39	1.84	0.04	39.33	0.56	5.31	0.78		45.45	0.18	4.58	6.75	
K	3.81		95	131		2.39	1.84	0.04	38.99	0.56	5.31	0.78		45.22	0.18	4.56	6.72	
K	3.78		94	129		2.52	1.84	0.04	39.28	0.56	5.29	0.78		45.34	0.18	4.45	6.77	
L	3.80	2290	121	159	73.00	2.52	1.72	0.04	38.10	0.51	5.39	0.68	0.09	45.00	0.17	4.51	7.89	3.41
L	3.87	2280	121	155	73.00	2.53	1.79	0.05	37.60	0.53	5.36	0.70	0.08	45.10	0.18	4.51	8.00	3.40
L	3.92	2260	124	155	72.00	2.39	1.83	0.05	37.60	0.51	5.29	0.67	0.08	44.80	0.17	4.41	8.20	3.40
L	3.90	2250	120	153	72.00	2.57	1.82	0.04	38.40	0.54	5.34	0.71	0.10	45.30	0.18	4.67	8.25	3.39
L	3.72	2300	120	153	73.00	2.56	1.81	0.04	38.10	0.53	5.36	0.70	0.09	45.40	0.19	4.59	8.07	3.36
L	3.95	2300	122	152	72.00	2.49	1.79	0.04	38.00	0.53	5.39	0.70	0.08	45.00	0.19	4.51	8.08	3.39
L	3.75	2310	120	155	72.00	2.47	1.77	0.31	37.60	0.54	5.32	0.69	0.08	44.50	0.18	4.53	8.17	3.39
L	3.84	2306	121	156	72.00	2.56	1.80	0.06	37.70	0.55	5.36	0.71	0.09	45.10	0.18	4.47	8.17	3.36
M	3.77																	
M	3.88																	
M	3.80																	
M	3.79																	
M	3.87																	
M	3.81																	
M	3.92																	
M	3.85																	
N	3.78		109	148	53.74												6.74	
N	3.67		113	137	54.18												6.65	
N	3.71		120	149	58.55												6.60	
N	3.78		109	148	51.85												6.62	
N	3.78		105	145	53.06												6.60	
N	3.75		104	144	52.59												6.74	
N	3.63		103	159	52.74												6.66	
N	3.74		110	146	54.59												6.69	
O	3.81	2490	112	158	79.00	2.65	1.79			0.57		0.68	0.09			0.18		3.30
O	3.79	2450	108	155	78.00	2.59	1.76			0.54		0.66	0.09			0.18		3.29
O	3.80	2530	112	161	80.00	2.66	1.80			0.55		0.68	0.09			0.18		3.27
O	3.83	2480	107	158	78.00	2.63	1.80			0.55		0.68	0.09			0.18		3.26
O	3.86	2460	110	159	77.00	2.61	1.78			0.55		0.67	0.09			0.18		3.27
O	3.93	2440	110	155	77.00	2.55	1.74			0.54		0.66	0.09			0.18		3.28
O	3.68	2490	109	158	79.00	2.65	1.80			0.55		0.68	0.09			0.18		3.27
O	3.92	2460	110	158	76.00	2.57	1.75			0.54		0.66	0.09			0.18		3.26
P	3.88																	
P	3.85																	
P	3.94																	
P	3.73																	
P	3.86																	
P	4.09																	
P	3.91																	
P	3.87																	

Assay data (cont)

Lab Code	Au Pb Coll g/t	As M/ICP ppm	Cu M/ICP ppm	Ni M/ICP ppm	Zn M/ICP ppm	Al ₂ O ₃ XRF %	CaO XRF %	Cr ₂ O ₃ XRF %	Fe ₂ O ₃ XRF %	K ₂ O XRF %	MgO XRF %	MnO XRF %	Na ₂ O XRF %	SiO ₂ XRF %	TiO ₂ XRF %	LOI %	S Comb/LECO %	SG pyc
Q	3.64																	
Q	3.65																	
Q	3.59																	
Q	3.50																	
Q	3.79																	
Q	3.67																	
Q	3.82																	
Q	3.71																	
R	3.29	2160	112	149	72.00	2.51	1.75			0.58		0.68	0.08		0.18		7.08	
R	3.71	2140	108	142	72.00	2.49	1.72			0.57		0.67	0.08		0.18		7.10	
R	3.58	2160	109	145	71.00	2.51	1.75			0.57		0.67	0.08		0.18		7.03	
R	3.76	2180	107	143	70.00	2.48	1.72			0.57		0.66	0.08		0.18		7.07	
R	3.75	2210	107	144	73.00	2.51	1.76			0.57		0.68	0.08		0.18		7.10	
R	3.70	2160	111	145	70.00	2.49	1.74			0.57		0.67	0.08		0.18		7.05	
R	3.60	2240	106	143	71.00	2.48	1.74			0.57		0.67	0.09		0.18		7.08	
R	3.65	2210	105	142	71.00	2.46	1.72			0.55		0.66	0.08		0.18		7.09	
S	3.83	2350	115	176	54.00	2.60	1.86		38.96	0.56	5.33	0.75		45.28	0.22	3.90		
S	3.87	2310	112	175	52.00	2.61	1.85		38.80	0.57	5.27	0.74		45.32	0.22	3.90		
S	3.87	2330	110	179	50.00	2.59	1.86		38.75	0.57	5.29	0.75		45.29	0.22	4.00		
S	3.85	2370	106	175	57.00	2.61	1.87		39.05	0.56	5.29	0.75		45.18	0.20	4.00		
S	3.87	2390	115	184	56.00	2.61	1.90		39.32	0.57	5.31	0.76		45.19	0.19	4.00		
S	3.80	2320	105	175	57.00	2.59	1.85		38.74	0.56	5.29	0.74		45.47	0.20	4.00		
S	3.80	2350	109	175	56.00	2.59	1.85		38.83	0.57	5.28	0.75		45.39	0.19	4.00		
S	3.82	2330	108	172	58.00	2.60	1.86		39.03	0.58	5.32	0.74		45.37	0.20	4.10		
T	3.80																	
T	3.88																	
T	3.76																	
T	3.82																	
T	3.72																	
T	3.82																	
T	3.84																	
T	3.77																	
U	3.73																	
U	3.79																	
U	3.87																	
U	3.82																	
U	3.77																	
U	3.78																	
U	3.81																	
U	3.77																	
V	3.82																	
V	3.72																	
V	3.76																	
V	3.78																	
V	3.91																	
V	3.44																	
V	3.80																	
V	3.74																	
W	3.93					2.56	1.84	0.06	38.25	0.56	5.31	0.72		45.58	0.18			3.13
W	3.92					2.56	1.84	0.05	38.25	0.56	5.25	0.72		45.54	0.18			3.20
W	3.90					2.55	1.84	0.06	38.36	0.57	5.28	0.72		45.58	0.18			3.34
W	3.81					2.56	1.84	0.05	38.16	0.57	5.25	0.72		45.59	0.18			3.24
W	3.88					2.58	1.85	0.06	38.15	0.56	5.31	0.72		45.67	0.18			3.38
W	3.82					2.57	1.84	0.06	38.13	0.56	5.29	0.72		45.53	0.18			3.33
W	3.88					2.58	1.85	0.05	38.33	0.57	5.32	0.72		45.65	0.18			3.32
W	4.00					2.54	1.84	0.06	38.30	0.56	5.27	0.72		45.54	0.18			3.38
X	3.81					2.55	1.86	0.06	38.60	0.56	5.33	0.72	0.09	44.70	0.19	4.00	7.05	
X	3.59					2.59	1.86	0.05	38.60	0.57	5.31	0.71	0.08	44.80	0.18	3.86	7.06	
X	3.77					2.55	1.87	0.05	38.80	0.57	5.37	0.72	0.08	45.00	0.18	3.94	7.05	
X	3.53					2.55	1.87	0.05	38.60	0.57	5.32	0.72	0.07	44.70	0.18	4.00	7.06	
X	3.69					2.57	1.87	0.05	38.60	0.57	5.33	0.72	0.08	44.80	0.18	3.91	7.08	
X	3.66					2.58	1.85	0.05	38.50	0.56	5.33	0.72	0.08	44.70	0.19	3.87	7.12	
X	3.52					2.59	1.88	0.06	39.10	0.57	5.33	0.73	0.08	45.30	0.19	3.98	7.11	
X	3.57					2.59	1.85	0.05	38.70	0.57	5.38	0.71	0.09	45.00	0.19	4.06	7.10	
Y	3.87																	
Y	3.71																	
Y	3.87																	
Y	3.76																	
Y	3.74																	
Y	3.73																	
Y	3.79																	
Y	3.72																	
Z	3.68	1650	97	160	75.50	2.43	1.89	0.09	38.80	0.54	5.25	0.74	0.08	44.40	0.20	4.05	7.05	3.31
Z	3.69	1610	94	149	73.60	2.36	1.89	0.08	38.90	0.54	5.25	0.73	0.08	44.80	0.20	4.04	7.05	3.33
Z	3.78	1710	95	154	77.10	2.44	1.86	0.08	38.80	0.54	5.23	0.74	0.08	44.40	0.20	4.05	7.13	3.34
Z	3.84	1720	95	155	75.40	2.43	1.87	0.09	39.00	0.55	5.32	0.74	0.08	44.30	0.21	4.07	7.09	3.33
Z	3.80	1600	88	143	71.10	2.60	1.86	0.08	38.80	0.53	5.21	0.73	0.07	44.40	0.21	4.04	7.05	3.33
Z	3.66	1730	97	156	77.00	2.53	1.90	0.09	38.90	0.54	5.24	0.73	0.08	44.40	0.20	4.08	7.04	3.32
Z	3.67	1590	97	158	76.30	2.31	1.87	0.09	38.90	0.53	5.27	0.73	0.08	44.40	0.20	4.08	7.08	3.31
Z	3.78	1660	88	141	71.00	2.47	1.92	0.08	39.10	0.55	5.27	0.72	0.08	44.50	0.20	4.09	7.10	3.33

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

The samples used in this certification process have been selected in such a way as to represent the entire batch of material and were taken from the final packaged units; therefore all possible sources of uncertainty (sample uncertainty and measurement uncertainty) are included in the final combined standard uncertainty determination.

The uncertainty measurement takes into consideration the between lab and the within lab variances and is calculated from the square roots of the variances of these components using the formula:

$$\text{Combined standard uncertainty} = \sqrt{(\text{between lab.var/no of labs}) + (\text{mean square within lab.var /no of assays})}$$

These uncertainty measurements may be used, by laboratories, as a component for calculating the total uncertainty for method validation according to the relevant ISO guidelines.

Analyte	Method	Unit	S ¹	σ _L ²	SW ³	CSU ⁴
Au	Pb Coll	g/t	0.081	0.030	0.063	0.008
As	M/ICP	ppm	126.9	124.9	39.12	44.45
Cu	M/ICP	ppm	9.044	7.397	3.436	2.261
Ni	M/ICP	ppm	15.25	12.31	4.203	3.579
Al ₂ O ₃	XRF	%	0.070	0.050	0.037	0.015
CaO	XRF	%	0.051	0.042	0.019	0.013
Cr ₂ O ₃	XRF	%	0.007	0.006	0.004	0.002
Fe ₂ O ₃	XRF	%	0.253	0.239	0.134	0.092
K ₂ O	XRF	%	0.014	0.010	0.008	0.003
MgO	XRF	%	0.058	0.049	0.030	0.017
MnO	XRF	%	0.033	0.029	0.008	0.009
Na ₂ O	XRF	%	0.008	0.006	0.005	0.002
SiO ₂	XRF	%	0.367	0.342	0.170	0.123
TiO ₂	XRF	%	0.009	0.006	0.004	0.002
LOI		%	0.288	0.353	0.054	0.145
S	Comb/LECO	%	0.163	0.183	0.033	0.069
SG	pyc		0.073	0.070	0.029	0.025

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 Indicated values listed on p1 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: AMIS0359 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. Laboratory Packs are sealed bottles delivered in sealed foil pouches. 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 therefore 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.

30 November 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	0.76	0.34	22.4	66
Al	M/ICP	%	1.3	0.17	6.5	83
Ba	M/ICP	ppm	73.1	17.9	12.2	80
Be	M/ICP	ppm	1.9	1.1	28.0	72
Bi	M/ICP	ppm	0.37	0.28	38.6	72
Ca	M/ICP	%	1.3	0.12	4.8	85
Cd	M/ICP	ppm	0.54	0.15	13.6	55
Ce	M/ICP	ppm	13.2	3.0	11.4	55
Co	M/ICP	ppm	21.8	3.9	8.9	69
Cr	M/ICP	ppm	300	65.2	10.9	80
Cs	M/ICP	ppm	1.3	1.6	61.3	64
Dy	M/ICP	ppm	5.2	18.9	181.5	37
Er	M/ICP	ppm	1.1	0.58	25.8	39
Eu	M/ICP	ppm	0.75	0.20	13.1	35
Fe	M/ICP	%	27.1	2.8	5.2	48
Ga	M/ICP	ppm	4.8	1.0	10.0	64
Gd	M/ICP	ppm	1.6	0.32	9.8	40
Ge	M/ICP	ppm	0.56	0.93	82.4	31
Hf	M/ICP	ppm	0.47	0.15	16.6	50
Ho	M/ICP	ppm	0.34	0.11	16.7	40
In	M/ICP	ppm	0.05	0.05	51.1	62
K	M/ICP	%	0.48	0.04	4.4	85
La	M/ICP	ppm	6.9	2.03	14.7	64
Li	M/ICP	ppm	42.7	5.6	6.6	72
Lu	M/ICP	ppm	0.16	0.05	14.1	54
Mg	M/ICP	%	3.1	0.24	3.8	80
Mn	M/ICP	ppm	5475	821	7.5	85
Mo	M/ICP	ppm	0.91	1.2	64.3	88
Na	M/ICP	%	0.07	0.02	12.9	80
Nb	M/ICP	ppm	1.6	0.76	23.2	64
Nd	M/ICP	ppm	6.0	1.5	12.1	39
P	M/ICP	ppm	359	61.2	8.5	68
Pb	M/ICP	ppm	15.3	5.2	17.1	79
Pr	M/ICP	ppm	1.5	0.31	10.3	40
Pt	M/ICP	ppm	59.4	1.8	1.5	8
Rb	M/ICP	ppm	31.3	7.0	11.2	62
S	M/ICP	%	6.5	0.53	4.0	32
Sb	M/ICP	ppm	18.3	4.9	13.4	69
Sc	M/ICP	ppm	5.0	5.6	55.8	62
Se	M/ICP	ppm	3.7	1.0	13.1	48
Si	M/ICP	%	9.3	17.6	94.2	24
Sm	M/ICP	ppm	1.4	0.31	11.4	40
Sn	M/ICP	ppm	1.1	0.32	14.7	56
Sr	M/ICP	ppm	25.2	6.0	11.9	82
Ta	M/ICP	ppm	1.0	0.45	22.6	62
Tb	M/ICP	ppm	0.25	0.10	20.4	55
Te	M/ICP	ppm	0.18	0.18	50.2	62
Th	M/ICP	ppm	1.0	1.0	48.4	70
Ti	M/ICP	%	0.11	0.01	5.9	79
Tl	M/ICP	ppm	0.35	0.31	44.7	70
Tm	M/ICP	ppm	0.15	0.09	28.7	40
V	M/ICP	ppm	62.0	13.7	11.1	72
W	M/ICP	ppm	5.6	6.1	54.6	88
Y	M/ICP	ppm	10.1	1.8	8.9	76
Yb	M/ICP	ppm	1.0	0.16	8.3	53
Zn	M/ICP	ppm	75.7	7.2	4.8	62
Zr	M/ICP	ppm	18.0	11.7	32.6	72