



African Mineral Standards

MATRIX REFERENCE MATERIALS

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## AMIS0310

### ***Certified Reference Material***

**Gold and Copper ore, greenstone,  
(rougher feed)  
Buzwagi Mine, Tanzania**

### ***Certificate of Analysis***

**Recommended Concentrations and Limits<sup>1. 2.</sup>  
(at two Standard Deviations)**

#### ***Certified Concentrations***

Cu F	1400	±	85	ppm
Cu M/ICP	1399	±	81	ppm
Au Pb Collection	1.03	±	0.04	g/t
Specific Gravity	2.81	±	0.06	

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, 10 and 13.*
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 <sub>2</sub> O <sub>3</sub>	12.25	±	0.32	%
CaO	2.22	±	0.06	%
Fe <sub>2</sub> O <sub>3</sub>	5.46	±	0.18	%
K <sub>2</sub> O	3.88	±	0.08	%
MgO	0.74	±	0.04	%
Na <sub>2</sub> O	1.89	±	0.10	%
SiO <sub>2</sub>	69.38	±	0.84	%
TiO <sub>2</sub>	0.26	±	0.014	%
S Combustion / LECO	1.58	±	0.06	%

## Provisional Concentrations

Cr <sub>2</sub> O <sub>3</sub>	0.30	±	0.01	%
MnO	0.065	±	0.010	%
LOI	2.67	±	0.76	%

## Indicated Mean

Ag M/ICP      2 ppm

**1. Intended Use:** AMIS0310 can be used to check the analysis of gold and 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 material was supplied by the open pit Buzwagi Gold and Copper Mine, hosted in the Nzega Greenstone Belt in the Shinyanga Region of Tanzania, 6 kilometres southeast from the town of Kahama. The mine is operated by African Barrick Gold. The material supplied was described as “rougner feed”.

**3. Approximate Mineral and Chemical Composition:** The Nzega Belt is comprised of basalts and intermediate volcanics intruded by granitoid masses. Buzwagi is a shear hosted quartz-veined deposit, hosted in porphyritic granite. Gold mineralisation occurs in association with sulphides (pyrite) and quartz and as free grains, while copper mineralisation occurs as primary sulphides (chalcopyrite).

**4. Appearance:** The material is a very fine powder. It is colored a Blueish Grey (Corstor 5B 7/1).

**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 particle 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. Multi-acid digest multi-element scan - ( to include Cu & Ag ). ICP-OES or ICP-MS.
2. Pressed pellet multi-element scan - ( to include Cu ). XRF.
3. Au – Pb collection ICP-OES or ICP-MS
4. Majors ( Al<sub>2</sub>O<sub>3</sub>, CaO, Cr<sub>2</sub>O<sub>3</sub>, Fe<sub>2</sub>O<sub>3</sub>, K<sub>2</sub>O, MgO, MnO, Na<sub>2</sub>O, SiO<sub>2</sub>, TiO<sub>2</sub>. LOI. ) XRF fusion.
5. 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 two laboratories were each given eight randomly selected packages of sample. Seventeen 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 17 out of 22 laboratories that provided results timeously were (not in same order as in the table of assays):

1. Activation Laboratories Pty Ltd (ActLabs) CA
2. ALS Chemex Laboratory Group Brisbane Australia
3. ALS Chemex Laboratory Group Johannesburg SA
4. ALS Chemex Laboratory Group Perth WA
5. ALS Chemex Laboratory Group Vancouver CA
6. Bureau Veritas (Namibia)
7. Genalysis Laboratory Services (W Australia P)
8. Intertek Utama Services (Indonesia)
9. Set Point Laboratories (Isando) SA
10. SGS Australia Pty Ltd (Newburn) WA
11. SGS Geosol Laboratories Ltda (Brazil)
12. SGS Mineral Services Callao (Peru)
13. SGS Mineral Services Lakefield (Canada)
14. SGS South Africa (Pty) Ltd - Booyens JHB
15. SGS Toronto (Canada)
16. SGS Townsville (Australia)
17. 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	Cu F ppm	Cu M/ICP ppm	Cu XRF ppm	Au Pb Coll ppm	Ag M/ICP ppm	Al2O3 XRF %	CaO XRF %	Cr2O3 XRF %	Fe2O3 XRF %	K2O XRF %	MgO XRF %	MnO XRF %	Na2O XRF %	SiO2 XRF %	TiO2 XRF %	LOI %	S Comb / LECO %	SG pyc
A	1382	1379			1.80												1.59	
A	1396	1387			1.70												1.58	
A	1373	1375			1.80												1.59	
A	1394	1390			1.90												1.60	
A	1391	1383			2.10												1.58	
A	1383	1396			2.00												1.57	
A	1399	1378			1.90												1.59	
A	1379	1372			1.70												1.59	
B																		
B																		
B																		
B																		
B																		
B																		
B																		
B																		
C	1370	1390	1266		2.80	12.20	2.16	0.05	5.29	3.80	0.70	0.06		68.50	0.26		1.61	2.78
C	1410	1390	1265		2.50	12.20	2.16	0.04	5.30	3.81	0.72	0.07		68.50	0.27		1.59	2.77
C	1450	1370	1279		2.60	12.10	2.17	0.04	5.33	3.81	0.68	0.06		68.50	0.26		1.60	2.76
C	1400	1320	1267		2.50	12.20	2.15	0.04	5.37	3.83	0.72	0.06		68.60	0.27		1.60	2.77
C	1360	1380	1252		2.60	12.20	2.16	0.03	5.31	3.85	0.74	0.06		68.50	0.26		1.61	2.77
C	1390	1380	1246		2.50	12.30	2.17	0.04	5.34	3.80	0.73	0.06		68.50	0.26		1.63	2.76
C	1350	1380	1286		2.50	12.20	2.17	0.04	5.32	3.79	0.73	0.07		68.30	0.26		1.64	2.78
C	1360	1380	1284		2.60	12.20	2.14	0.04	5.29	3.77	0.73	0.06		68.50	0.27		1.61	2.77
D																		
D																		
D																		
D																		
D																		
D																		
D																		
D																		
E	1435			1.06	2.32													
E	1337			1.06	2.36													
E	1369			1.05	2.11													
E	1156			1.05	2.04													
E	1274			1.06	1.89													
E	1318			1.05	1.95													
E	1345			1.07	1.45													
E	1153			1.05	2.05													

Assay data (cont)

Lab Code	Cu F ppm	Cu M/ICP ppm	Cu XRF ppm	Au Pb Coll ppm	Ag M/ICP ppm	Al2O3 XRF %	CaO XRF %	Cr2O3 XRF %	Fe2O3 XRF %	K2O XRF %	MgO XRF %	MnO XRF %	Na2O XRF %	SiO2 XRF %	TiO2 XRF %	LOI %	S Comb / LECO %	SG pyc
F	1400	1370			1.70												1.57	
F	1400	1370			1.70												1.60	
F	1400	1350			1.90												1.61	
F	1400	1370			1.70												1.59	
F	1400	1350			1.80												1.55	
F	1400	1380			1.70												1.57	
F	1400	1340			1.70												1.56	
F	1400	1350			1.90												1.58	
G		1400			2.30												1.53	2.83
G		1280			2.10												1.54	2.83
G		1380			2.20												1.53	2.82
G		1320			1.90												1.55	2.82
G		1330			2.40												1.54	2.83
G		1450			2.30												1.54	2.83
G		1280			2.10												1.53	2.82
G		1380			2.30												1.52	2.82
H		1400		1.00	2.00	12.22	2.24	0.03	5.49	3.91	0.76	0.07		69.56	0.27	2.73		2.88
H		1420		0.99	2.00	12.19	2.24	0.03	5.49	3.90	0.76	0.06		69.53	0.27	2.79		2.87
H		1390		0.99	2.00	12.23	2.24	0.03	5.49	3.89	0.75	0.07		69.48	0.27	2.76		2.84
H		1400		1.00	2.00	12.26	2.24	0.03	5.49	3.90	0.75	0.06		69.51	0.26	2.74		2.82
H		1380		1.03	2.00	12.25	2.24	0.03	5.49	3.90	0.76	0.06		69.56	0.27	2.73		2.82
H		1370		0.98	2.00	12.25	2.24	0.03	5.48	3.89	0.75	0.06		69.48	0.27	2.78		2.84
H		1380		1.05	2.50	12.26	2.24	0.03	5.49	3.90	0.75	0.07		69.50	0.26	2.76		2.86
H		1370		0.94	2.00	12.26	2.24	0.03	5.50	3.90	0.75	0.07		69.51	0.26	2.72		2.84
I	1440	1360	1410		1.32	12.03	2.21	0.03	5.43	3.82	0.71	0.07	1.86	70.02	0.27	3.30		
I	1430	1380	1410		1.43	11.91	2.22	0.03	5.42	3.84	0.69	0.06	1.91	70.02	0.25	3.33		
I	1470	1310	1420		1.51	11.98	2.21	0.03	5.46	3.84	0.68	0.07	1.85	69.21	0.27	3.37		
I	1440	1400	1410		1.57	11.79	2.21	0.03	5.41	3.86	0.69	0.07	1.90	70.61	0.26	3.31		
I	1450	1330	1420		1.58	11.99	2.19	0.04	5.48	3.82	0.68	0.07	1.84	69.87	0.26	3.30		
I	1460	1340	1410		1.63	12.08	2.21	0.05	5.48	3.80	0.68	0.07	1.92	70.16	0.27	3.29		
I	1440	1330	1400		1.58	12.11	2.22	0.04	5.45	3.88	0.70	0.06	1.87	70.15	0.26	3.23		
I	1450	1380	1400		1.64	12.19	2.22	0.05	5.48	3.87	0.70	0.07	1.81	70.57	0.27	3.26		
J																		
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L		1430		1.03	1.00	12.25	2.07	0.03	5.44	3.84	0.70	0.06	2.43	68.80	0.25	3.36		2.77
L		1400		1.07	1.00	12.15	2.19	0.03	5.47	3.79	0.72	0.06	2.13	71.10	0.26	3.38		2.86
L		1410		1.06	2.00	11.80	2.23	0.04	5.50	3.73	0.73	0.07	1.86	68.30	0.26	3.38		2.77
L		1460		1.06	1.00	12.25	2.31	0.04	5.77	3.84	0.75	0.07	1.93	71.00	0.27	3.36		2.87
L		1470		1.07	2.00	11.55	2.09	0.03	5.30	3.67	0.73	0.06	1.90	68.90	0.25	3.37		2.78
L		1440		1.05	1.00	11.65	2.10	0.03	5.30	3.70	0.73	0.06	1.91	69.70	0.25	3.36		2.76
L		1410		1.03		11.90	2.16	0.03	5.36	3.72	0.72	0.06	1.84	69.80	0.25	3.37		2.77
L		1410		1.04	1.00	11.60	2.10	0.03	5.42	3.68	0.73	0.06	1.91	69.30	0.25	3.35		2.69
M		1410		1.04	1.00													2.80
M		1560		1.04	3.00													2.79
M		1440		1.02	2.00													2.77
M		1440		1.00	3.00													2.91
M		1470		1.04	2.00													2.80
M		1450		1.03	2.00													2.80
M		1470		1.05	4.00													2.79
M		1440		1.01	4.00													2.79
N		1410	1400		2.00	12.40	2.22	0.03	5.41	3.91	0.74	0.07	1.81	69.40	0.26	2.53		
N		1380	1400		2.00	12.40	2.23	0.03	5.44	3.92	0.74	0.07	1.73	69.30	0.25	2.58		
N		1400	1390		3.00	12.40	2.22	0.04	5.41	3.90	0.75	0.07	1.82	69.20	0.25	2.54		
N		1440	1380		3.00	12.40	2.23	0.05	5.45	3.92	0.74	0.07	1.85	69.30	0.26	2.51		
N		1430	1400		3.00	12.45	2.24	0.03	5.44	3.91	0.75	0.07	1.82	69.60	0.26	2.48		
N		1450	1400		3.00	12.50	2.23	0.03	5.41	3.90	0.73	0.07	1.88	69.30	0.26	2.66		
N		1430	1400		2.00	12.40	2.23	0.04	5.44	3.90	0.73	0.07	1.85	69.30	0.26	2.47		
N		1400	1420		2.00	12.35	2.22	0.03	5.44	3.89	0.73	0.07	1.78	69.10	0.26	2.40		
O		1470				11.90	2.18	0.03	5.31	3.81	0.75	0.06	1.82	67.30	0.25	2.29		
O		1450		1.00	11.85	2.17	0.03	5.31	3.80	0.76	0.06	0.06	1.84	67.20	0.25	2.44		
O		1460		1.00	11.85	2.18	0.03	5.31	3.80	0.77	0.06	0.06	1.84	67.10	0.26	2.53		
O		1440		1.00	11.85	2.19	0.03	5.32	3.81	0.76	0.07	0.07	1.83	67.10	0.26	2.42		
O		1470		1.00	11.90	2.18	0.03	5.30	3.80	0.75	0.06	0.06	1.84	67.20	0.25	2.42		
O		1460			12.30	2.17	0.03	5.38	3.89	0.70	0.06	0.06	1.85	69.50	0.26	2.37		
O		1450		1.00	11.90	2.17	0.03	5.29	3.79	0.75	0.06	0.06	1.82	67.10	0.25	2.50		
O		1450		1.00	11.90	2.17	0.03	5.32	3.81	0.75	0.07	0.07	1.83	67.30	0.26	2.24		
P		1410		1.50	12.50	2.24	0.04	5.51	3.90	0.76	0.07	0.07				0.27		2.85
P		1410		1.50	12.30	2.25	0.04	5.51	3.89	0.76	0.07	0.07				0.26		2.83
P		1430		2.00	12.60	2.25	0.04	5.51	3.93	0.75	0.07	0.07				0.27		2.83
P		1430		1.50	12.40	2.27	0.04	5.49	3.89	0.76	0.07	0.07				0.27		2.84
P		1400		2.00	12.20	2.24	0.04	5.52	3.87	0.76	0.07	0.07				0.26		2.83
P		1420		2.00	12.40	2.25	0.04	5.51	3.90	0.75	0.07	0.07				0.26		2.84
P		1420		2.00	12.40	2.25	0.04	5.52	3.88	0.75	0.07	0.07				0.27		2.83
P		1420		1.50	12.40	2.27	0.04	5.49	3.87	0.75	0.07	0.07				0.27		2.83

Assay data (cont)

Lab Code	Cu F ppm	Cu M/ICP ppm	Cu XRF ppm	Au Pb Coll ppm	Ag M/ICP ppm	Al2O3 XRF %	CaO XRF %	Cr2O3 XRF %	Fe2O3 XRF %	K2O XRF %	MgO XRF %	MnO XRF %	Na2O XRF %	SiO2 XRF %	TiO2 XRF %	LOI %	S Comb / LECO %	SG pyc
Q		1395		0.99	2.10	12.35	2.23	0.03	5.52	3.92	0.75	0.07	1.93	69.85	0.26	2.48		2.83
Q		1408		1.03	2.50	12.30	2.23	0.03	5.53	3.93	0.75	0.06	1.93	69.94	0.27	2.44		2.86
Q		1396		1.00	1.70	12.29	2.21	0.03	5.51	3.93	0.75	0.06	1.95	69.70	0.26	2.44		2.78
Q		1391		1.01	2.80	12.32	2.23	0.04	5.51	3.92	0.75	0.06	1.95	69.69	0.26	2.42		2.85
Q		1424		1.07	2.40	12.31	2.23	0.03	5.50	3.94	0.76	0.06	1.93	69.71	0.27	2.47		2.81
Q		1416		1.02	2.80	12.29	2.21	0.04	5.50	3.93	0.76	0.06	1.95	69.79	0.27	2.44		2.83
Q		1419		0.99	1.90	12.29	2.22	0.04	5.49	3.91	0.75	0.07	1.93	69.78	0.26	2.48		2.84
Q		1398		1.00	2.20	12.35	2.23	0.03	5.51	3.93	0.75	0.07	1.95	69.87	0.27	2.44		2.78
S		1430		1.02	1.90	12.30	2.45	0.04	5.51	3.88	1.05	0.06	1.87	69.57	0.27	2.70		
S		1460		1.03	1.90	12.24	2.44	0.03	5.49	3.89	1.04	0.06	1.89	69.39	0.27	2.60		
S		1460		1.02	1.80	12.28	2.44	0.03	5.48	3.91	1.04	0.06	1.85	69.30	0.26	2.60		
S		1460		1.04	1.90	12.32	2.42	0.03	5.46	3.89	1.04	0.06	1.87	69.52	0.26	2.70		
S		1420		1.04	2.00	12.31	2.45	0.03	5.50	3.89	1.05	0.06	1.87	69.50	0.27	2.70		
S		1450		1.00	2.00	12.34	2.43	0.05	5.50	3.88	1.04	0.06	1.88	69.37	0.26	2.50		
S		1410		1.05	1.90	12.28	2.43	0.03	5.48	3.89	1.03	0.06	1.88	69.80	0.27	2.70		
S		1460		1.00	1.80	12.28	2.42	0.04	5.45	3.89	1.03	0.06	1.88	69.65	0.26	2.60		
T		1399		1.04		12.26	2.23	0.03	5.63	3.89	0.64	0.06	2.19	69.49	0.26	2.76		2.77
T		1392		1.07		12.41	2.23	0.03	5.63	3.91	0.66	0.06	2.19	69.50	0.26	2.75		2.78
T		1396		1.02		12.48	2.22	0.03	5.59	3.89	0.67	0.06	2.22	69.81	0.26	2.77		2.76
T		1400		1.05		12.37	2.22	0.03	5.59	3.89	0.64	0.06	2.21	69.49	0.26	2.77		2.77
T		1390		1.08		12.38	2.22	0.03	5.62	3.91	0.66	0.06	2.23	69.79	0.26	2.77		2.79
T		1396		1.03		12.37	2.23	0.03	5.62	3.90	0.66	0.06	2.22	69.79	0.26	2.71		2.76
T		1396		1.04		12.30	2.23	0.03	5.60	3.86	0.61	0.06	2.25	69.50	0.25	2.76		2.77
T		1400		1.04		12.46	2.23	0.03	5.64	3.90	0.70	0.06	2.23	69.80	0.25	2.78		2.78
U	1400	1290			1.80	12.30	2.22		5.53	3.89	0.74	0.07	1.95	69.30	0.27	2.06	1.57	
U	1440	1340			2.10	12.20	2.22		5.53	3.86	0.74	0.07	1.93	69.40	0.27	2.12	1.68	
U	1440	1340			2.40	12.30	2.22		5.53	3.88	0.74	0.07	1.95	69.30	0.27	2.23	1.58	
U	1470	1320			2.10	12.20	2.21		5.51	3.89	0.73	0.07	1.94	69.20	0.26	2.13	1.56	
U	1470	1310			2.40	12.30	2.22		5.54	3.89	0.74	0.07	1.96	69.30	0.27	2.21	1.54	
U	1440	1340			2.50	12.30	2.22		5.54	3.88	0.74	0.07	1.94	69.20	0.27	2.18	1.59	
U	1360	1330			2.30	12.20	2.23		5.49	3.88	0.73	0.07	1.93	69.20	0.26	2.15	1.53	
U	1350	1320			2.50	12.20	2.22		5.52	3.88	0.74	0.07	1.94	69.20	0.26	2.10	1.68	
V				1.02	1.90	12.20	2.26	0.03	5.46	3.98	0.75	0.07	1.91	69.00	0.27	2.35	1.62	
V				1.06	1.80	12.30	2.26	0.03	5.45	4.01	0.75	0.07	1.93	68.70	0.27	2.36	1.62	
V				1.06	1.90	12.30	2.25	0.03	5.41	4.00	0.77	0.07	1.92	68.70	0.27	2.40	1.59	
V				1.03	1.80	12.40	2.26	0.03	5.47	3.99	0.76	0.07	1.92	69.20	0.26	2.31	1.61	
V				1.04	2.00	12.30	2.27	0.04	5.47	4.01	0.77	0.07	1.94	69.00	0.27	2.39	1.55	
V				1.05	2.00	12.30	2.25	0.03	5.44	4.02	0.76	0.06	1.92	68.80	0.27	2.44	1.62	
V				1.06	2.00	12.30	2.27	0.03	5.51	3.98	0.77	0.06	1.94	69.40	0.27	2.45	1.61	
V				1.03	1.90	12.40	2.27	0.03	5.49	3.98	0.75	0.06	1.92	69.10	0.27	2.43	1.62	

## 12. Measurement of Uncertainty:

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 <sup>1</sup>	$\sigma_L$ <sup>2</sup>	SW <sup>3</sup>	CSU <sup>4</sup>
Cu	F	ppm	42.40	35.07	31.27	15.04
Cu	M/ICP	ppm	40.47	25.72	20.75	6.914
Au	Pb Coll	ppm	0.025	0.017	0.019	0.006
Ag	M/ICP	ppm	0.302	0.200	0.183	0.061
Al <sub>2</sub> O <sub>3</sub>	XRF	%	0.161	0.114	0.082	0.034
CaO	XRF	%	0.039	0.027	0.024	0.009
Cr <sub>2</sub> O <sub>3</sub>	XRF	%	0.004	0.002	0.003	0.001
Fe <sub>2</sub> O <sub>3</sub>	XRF	%	0.086	0.069	0.030	0.020
K <sub>2</sub> O	XRF	%	0.042	0.035	0.018	0.011
MgO	XRF	%	0.023	0.019	0.012	0.006
MnO	XRF	%	0.005	0.003	0.004	0.001
Na <sub>2</sub> O	XRF	%	0.059	0.047	0.039	0.017
SiO <sub>2</sub>	XRF	%	0.487	0.390	0.245	0.126
TiO <sub>2</sub>	XRF	%	0.007	0.004	0.005	0.001
LOI		%	0.379	0.351	0.055	0.111
S	Comb / LECO	%	0.031	0.031	0.018	0.013
SG	pycnometer		0.034	0.028	0.022	0.010

1. S - Std Dev for use on control charts.
2.  $\sigma_L$  - 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:** AMIS0310 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](http://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.

**13 September 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	1.94	0.96	24.8	115
Al	M/ICP	%	6.12	1.15	9.44	96
As	M/ICP	ppm	26.4	6.2	11.8	89
Ba	M/ICP	ppm	685	84.5	6.17	65
Be	M/ICP	ppm	1.87	0.27	7.25	65
Bi	M/ICP	ppm	6.56	2.73	20.8	77
Ca	M/ICP	%	1.55	0.15	4.71	99
Cd	M/ICP	ppm	0.89	1.36	76.6	44
Ce	M/ICP	ppm	64	14.2	11.1	56
Co	M/ICP	ppm	20.8	3.33	8.00	99
Cr	M/ICP	ppm	208	55.3	13.3	90
Cs	M/ICP	ppm	6.57	0.76	5.81	45
Cu	XRF	ppm	1359	133	4.91	24
Dy	M/ICP	ppm	1.24	0.19	7.81	40
Er	M/ICP	ppm	0.57	0.15	13.0	40
Eu	M/ICP	ppm	0.93	0.21	11.5	39
Fe	M/ICP	%	3.77	0.27	3.57	107
Ga	M/ICP	ppm	25.5	7.96	15.6	63
Gd	M/ICP	ppm	2.68	1.35	25.2	35
Ge	M/ICP	ppm	0.09	0.13	73.2	8
Hf	M/ICP	ppm	2.78	0.51	9.25	38
Ho	M/ICP	ppm	0.22	0.03	6.39	40
In	M/ICP	ppm	0.13	0.04	17.0	48
K	M/ICP	%	3.08	0.56	9.00	104
La	M/ICP	ppm	32.4	6.99	10.8	78
Li	M/ICP	ppm	40.8	4.51	5.53	80
Lu	M/ICP	ppm	0.08	0.03	17.0	40
Mg	M/ICP	%	0.43	0.05	6.10	100
Mn	M/ICP	ppm	489	51.7	5.28	102
Mo	M/ICP	ppm	20.1	2.94	7.32	81
Na	M/ICP	%	1.37	0.11	4.03	90
Nb	M/ICP	ppm	16.2	4.5	13.9	56
Nd	M/ICP	ppm	26.9	5.06	9.38	40
Ni	M/ICP	ppm	38.3	7.41	9.66	122
P	M/ICP	ppm	501	107	10.6	80
Pb	M/ICP	ppm	32.3	6.71	10.4	108
Pr	M/ICP	ppm	7.81	1.23	7.89	38
Rb	M/ICP	ppm	202	38.6	9.54	50
Re	M/ICP	ppm	0.05	0.10	91.6	15
S	M/ICP	%	1.61	0.07	2.14	96
Sb	M/ICP	ppm	2.44	2.72	55.9	45
Sc	M/ICP	ppm	4.42	1.40	15.8	77
Se	M/ICP	ppm	0.54	0.23	21.7	10
Si	M/ICP	%	32.4	0.95	1.47	8
Sm	M/ICP	ppm	3.93	0.72	9.20	39
Sn	M/ICP	ppm	13.7	4.62	16.9	69
Sr	M/ICP	ppm	267	31.1	5.84	80
Ta	M/ICP	ppm	0.35	0.27	38.6	39
Tb	M/ICP	ppm	0.25	0.09	19.0	47
Te	M/ICP	ppm	4.07	0.49	6.05	39
Th	M/ICP	ppm	10.6	1.37	6.46	54
Ti	M/ICP	%	0.16	0.02	6.73	68
Tl	M/ICP	ppm	1.03	1.51	73.1	51
Tm	M/ICP	ppm	0.09	0.02	12.0	32
U	M/ICP	ppm	5.14	0.74	7.21	46
V	M/ICP	ppm	33.2	7.34	11.1	79
W	M/ICP	ppm	20.1	3.96	9.88	69
Y	M/ICP	ppm	6.34	1.24	9.74	78
Yb	M/ICP	ppm	0.52	0.11	10.6	47
Zn	M/ICP	ppm	66.8	10.6	7.94	125
Zr	M/ICP	ppm	90.7	35.3	19.5	72