



African Mineral Standards

MATRIX REFERENCE MATERIALS

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## AMIS0309

### *Certified Reference Material*

**Gold and Copper ore, greenstone,  
Buzwagi Mine (SAG Mill discharge), Tanzania**

### *Certificate of Analysis*

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

#### *Certified Concentrations*

Cu F	1361	±	92	ppm
Cu M/ICP	1406	±	68	ppm
Au Pb Collection	0.96	±	0.06	g/t
Specific Gravity	2.80	±	0.08	

#### *Provisional Concentrations*

Ag M/ICP	2.1	±	0.4	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, 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>	12.37	±	0.18	%
CaO	2.13	±	0.04	%
Fe <sub>2</sub> O <sub>3</sub>	5.31	±	0.14	%
K <sub>2</sub> O	3.96	±	0.08	%
MgO	0.57	±	0.04	%
Na <sub>2</sub> O	1.93	±	0.08	%
SiO <sub>2</sub>	69.40	±	0.50	%
TiO <sub>2</sub>	0.28	±	0.01	%
S Combustion / LECO	1.49	±	0.06	%

## *Provisional Concentrations*

Cr <sub>2</sub> O <sub>3</sub>	0.04	±	0.01	%
MnO	0.06	±	0.01	%

## *Indicated Mean*

LOI 2.74 %

**1. Intended Use:** AMIS0309 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 which hosted in the Nzega Greenstone Belt in the Shinyanga Region of Tanzania, located 6 kilometres southeast from the town of Kahama. The mine is operated by African Barrick Gold. The material supplied was described as "SAG Mill discharge (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 aBlueish Grey (Corstor 5B7/1).

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 g/t	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					2.00	12.50	2.25	0.04	5.50	4.00	0.60	0.06			0.28			2.84
A	1410				2.00	12.50	2.24	0.04	5.50	3.96	0.60	0.06			0.28			2.83
A	1420				2.00	12.40	2.24	0.04	5.50	3.95	0.60	0.06			0.28			2.83
A	1430				2.00	12.50	2.25	0.04	5.50	4.00	0.60	0.07			0.29			2.83
A	1410				2.00	12.50	2.27	0.04	5.50	3.99	0.61	0.06			0.29			2.83
A	1410				2.00	12.50	2.24	0.05	5.50	3.99	0.60	0.06			0.28			2.83
A	1400				2.00	12.60	2.24	0.05	5.60	3.96	0.60	0.06			0.28			2.82
A	1390				2.00	12.40	2.22	0.04	5.50	3.99	0.60	0.06			0.28			2.83
B	1350			0.94	2.50	12.34	2.15	0.04	5.33	4.00	0.58	0.06		69.52	0.28	2.74		2.88
B	1390			0.94	2.00	12.31	2.15	0.04	5.31	4.00	0.58	0.06		69.47	0.28	2.74		2.88
B	1360			0.95	2.00	12.31	2.15	0.04	5.32	3.99	0.58	0.06		69.42	0.28	2.73		2.88
B	1390			0.97	2.50	12.35	2.15	0.04	5.32	4.00	0.57	0.06		69.50	0.28	2.69		2.84
B	1340			0.93	2.00	12.34	2.15	0.04	5.31	4.00	0.58	0.06		69.47	0.28	2.70		2.86
B	1410			0.91	2.50	12.30	2.15	0.04	5.30	3.99	0.58	0.06		69.48	0.27	2.68		2.86
B	1380			0.94	2.50	12.30	2.14	0.04	5.30	4.00	0.57	0.06		69.46	0.27	2.72		2.87
B	1360			0.96	2.00	12.34	2.15	0.04	5.31	4.00	0.58	0.06		69.48	0.27	2.73		2.85
C	1400	1360			2.10												1.48	
C	1300	1300			2.30												1.48	
C	1300	1310			2.30												1.51	
C	1400	1320			2.20												1.48	
C	1300	1340			2.20												1.48	
C	1400	1340			2.20												1.46	
C	1300	1350			2.20												1.48	
C	1500	1370			2.10												1.44	
D	1320				2.00												1.41	2.83
D	1380				2.00												1.43	2.83
D	1390				2.00												1.43	2.83
D	1290				2.00												1.43	2.83
D	1350				2.00												1.43	2.82
D	1330				2.00												1.44	2.82
D	1330				2.00												1.42	2.83
D	1360				2.00												1.44	2.82
G	1275	1295		1.01	2.04													
G	1334	1362		1.01	2.30													
G	1308	1306		1.01	2.28													
G	1292	1298		1.00	2.19													
G	1377	1292		1.02	2.12													
G	1312	1318		1.01	2.21													
G	1190	1393		1.01	2.40													
G	1284	1328		1.01	2.37													
H	1423	1333	0.99			12.50	2.14	0.04	5.41	3.94	0.50	0.06	2.21	69.56	0.28	2.92		2.76
H	1420	1349	0.97			12.40	2.14	0.04	5.42	3.92	0.40	0.06	2.25	69.34	0.28	2.89		2.76
H	1411	1325	0.97			12.60	2.15	0.04	5.46	3.94	0.50	0.06	2.22	69.20	0.29	2.90		2.75
H	1415	1322	1.00			12.20	2.13	0.04	5.43	3.91	0.40	0.06	2.21	69.20	0.27	2.87		2.77
H	1418	1328	0.96			12.50	2.13	0.05	5.45	3.92	0.50	0.06	2.21	69.55	0.28	2.87		2.76
H	1415	1323	0.96			12.40	2.14	0.04	5.43	3.90	0.50	0.06	2.23	69.21	0.27	2.78		2.76
H	1423	1333	0.98			12.40	2.13	0.04	5.45	3.91	0.40	0.06	2.21	69.29	0.27	2.88		2.76
H	1410	1318	0.95			12.30	2.12	0.04	5.42	3.89	0.50	0.06	2.22	68.54	0.27	2.83		2.75
I	1470	1470			1.50	12.30	2.13		5.39	3.96	0.55	0.07	1.97	69.20	0.28	2.23	1.30	
I	1410	1520			1.50	12.30	2.13		5.37	3.96	0.56	0.07	1.99	69.20	0.28	2.16	1.42	
I	1430	1430			1.70	12.30	2.12		5.35	3.94	0.55	0.07	1.96	69.10	0.27	2.22	1.42	
I	1440	1440			1.70	12.30	2.13		5.36	3.94	0.55	0.07	1.97	69.10	0.28	2.23	1.34	
I	1430	1420			1.60	12.30	2.12		5.37	3.98	0.55	0.07	1.98	69.10	0.27	2.17	1.33	
I	1380	1390			1.60	12.30	2.12		5.37	3.95	0.55	0.07	1.98	69.10	0.27	2.22	1.42	
I	1390	1420			1.60	12.20	2.11		5.34	3.98	0.56	0.07	1.99	69.00	0.28	2.23	1.44	
I	1410	1430			1.50	12.20	2.13		5.38	3.96	0.55	0.07	1.97	69.10	0.28	2.24	1.31	

**Assay data (cont)**

Lab Code	Cu F ppm	Cu M/ICP ppm	Cu XRF ppm	Au Pb Coll g/t	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
J				0.96	2.30	12.50	2.13	0.02	5.36	4.02	0.59	0.06	1.92	69.80	0.28	2.38	1.49	
J				0.96	2.20	12.50	2.14	0.03	5.32	4.00	0.58	0.06	1.92	69.30	0.27	2.41	1.51	
J				0.97	2.20	12.50	2.14	0.03	5.36	4.02	0.58	0.06	1.94	69.70	0.28	2.50	1.48	
J				0.97	2.20	12.40	2.12	0.04	5.30	3.96	0.59	0.06	1.91	69.40	0.27	3.04	1.49	
J				0.97	2.20	12.50	2.13	0.04	5.33	4.03	0.59	0.06	1.94	69.40	0.27	2.57	1.49	
J				0.98	2.20	12.50	2.13	0.03	5.30	4.00	0.57	0.06	1.92	69.30	0.28	2.42	1.53	
J				0.98	2.30	12.40	2.13	0.04	5.33	4.01	0.59	0.06	1.96	69.00	0.27	2.49	1.50	
J				0.96	2.20	12.50	2.13	0.03	5.35	4.00	0.59	0.06	1.91	69.50	0.28	2.53	1.49	
K	1410	1250	1410	0.75	1.59	12.09	2.15	0.04	5.33	3.91	0.48	0.06	1.91	70.46	0.28	3.46		
K	1390	1330	1410	0.80	1.56	11.87	2.09	0.04	5.28	3.96	0.52	0.07	1.96	70.20	0.27	3.42		
K	1400	1270	1420	0.92	1.73	11.73	2.09	0.05	5.28	3.95	0.53	0.07	1.97	69.82	0.28	3.47		
K	1380	1290	1420	0.83	1.66	11.93	2.10	0.05	5.28	3.97	0.55	0.07	1.96	70.46	0.27	3.40		
K	1410	1270	1410	0.82	1.86	11.84	2.10	0.03	5.34	3.99	0.53	0.07	1.92	69.50	0.27	3.42		
K	1390	1280	1410	0.91	2.00	11.84	2.11	0.05	5.32	3.98	0.51	0.06	1.93	69.03	0.27	3.39		
K	1430	1290	1410	0.92	1.94	12.13	2.14	0.05	5.33	3.90	0.49	0.06	1.94	68.92	0.28	3.36		
K	1400	1300	1410	0.77	1.72	12.24	2.16	0.03	5.36	3.93	0.51	0.07	1.96	68.98	0.27	3.44		
M		1390		0.95	2.00	11.95	2.03	0.04	5.19	3.76	0.52	0.06	2.15	69.20	0.26	3.49		2.84
M		1460		0.97	2.00	12.30	2.03	0.04	5.34	3.91	0.54	0.06	2.25	70.10	0.27	3.53		2.76
M		1430		0.98	2.00	12.40	2.03	0.04	5.37	3.92	0.52	0.06	2.37	70.20	0.27	3.50		2.78
M		1440		0.97	2.00	12.00	1.99	0.04	5.22	3.90	0.53	0.06	2.25	68.40	0.28	3.49		2.59
M		1420		0.97	2.00	11.70	2.03	0.04	5.16	3.75	0.52	0.06	2.11	69.00	0.26	3.46		2.70
M		1450		0.96	2.00	12.00	2.05	0.05	5.31	3.85	0.56	0.07	1.90	69.30	0.27	3.47		2.77
M		1440		0.97	2.00	12.00	2.16	0.05	5.48	3.82	0.57	0.07	1.92	69.20	0.28	3.51		2.82
M		1370		0.98	1.00	11.90	1.98	0.04	5.17	3.84	0.52	0.05	2.18	68.40	0.26	3.50		2.67
N	1394	1379			2.30												1.48	
N	1388	1395			2.30												1.47	
N	1399	1392			2.40												1.51	
N	1382	1381			2.20												1.50	
N	1394	1373			2.30												1.52	
N	1390	1380			2.20												1.50	
N	1392	1378			2.10												1.49	
N	1386	1383			2.30												1.50	
O		1420	1360		3.00	12.50	2.14	0.04	5.30	4.01	0.57	0.06	1.90	69.60	0.27	2.63		
O		1460	1350		3.00	12.50	2.13	0.04	5.33	4.01	0.58	0.06	1.92	69.50	0.27	2.54		
O		1440	1380		3.00	12.45	2.13	0.04	5.27	4.00	0.57	0.06	1.88	69.40	0.27	2.60		
O		1430	1360		2.00	12.40	2.15	0.04	5.32	4.00	0.58	0.06	1.85	69.20	0.27	2.75		
O		1420	1380		3.00	12.50	2.13	0.03	5.30	4.00	0.58	0.06	1.84	69.50	0.27	2.56		
O		1460	1360		3.00	12.50	2.14	0.04	5.29	4.01	0.58	0.06	1.88	69.60	0.27	2.61		
O		1400	1360		2.00	12.45	2.13	0.04	5.26	3.97	0.57	0.06	1.86	69.40	0.27	2.61		
O		1400	1360		2.00	12.45	2.13	0.04	5.27	3.99	0.57	0.07	1.87	69.40	0.27	2.55		
P	1310	1430	1260		2.40	12.40	2.09	0.04	5.25	3.84	0.60	0.06		69.30	0.28		1.53	2.77
P	1310	1460	1306		2.30	12.30	2.13	0.04	5.24	3.87	0.57	0.06		69.20	0.28		1.53	2.73
P	1310	1430	1219		2.40	12.30	2.14	0.04	5.31	3.97	0.54	0.06		69.20	0.29		1.54	2.78
P	1360	1490	1271		2.10	12.20	2.09	0.04	5.21	3.85	0.56	0.06		69.10	0.27		1.54	2.76
P	1330	1400	1268		2.30	12.30	2.12	0.04	5.17	3.91	0.56	0.07		69.10	0.29		1.54	2.75
P	1320	1400	1278		2.30	12.30	2.16	0.04	5.27	3.95	0.55	0.07		69.30	0.28		1.51	2.76
P	1320	1380	1283		2.30	12.20	2.11	0.05	5.23	3.89	0.56	0.06		69.20	0.28		1.53	2.77
P	1320	1380	1192			12.30	2.14	0.04	5.28	3.95	0.54	0.07		69.20	0.27		1.52	2.74
Q		1340		0.93	2.00													2.78
Q		1360		0.92	2.00													2.80
Q		1360		0.94	2.00													2.82
Q		1350		0.96	2.00													2.80
Q		1380		0.93	2.00													2.80
Q		1370		0.93	2.00													2.78
Q		1380		1.01	2.00													2.71
Q		1350		0.97	2.00													2.79
S		1410		1.00	11.95	2.11	0.04		5.18	3.91	0.58	0.06	1.88	67.50	0.27	2.36		
S		1420		1.00	11.95	2.09	0.04		5.16	3.91	0.56	0.06	1.87	67.50	0.26	2.47		
S		1430		1.00	11.95	2.09	0.05		5.18	3.92	0.58	0.06	1.88	67.40	0.27	2.39		
S		1440		1.00	12.00	2.09	0.04		5.18	3.91	0.59	0.06	1.88	67.40	0.27	2.36		
S		1440		1.00	11.95	2.08	0.04		5.20	3.92	0.58	0.06	1.88	67.30	0.27	2.50		
S		1430		1.00	11.95	2.23	0.04		5.16	3.90	0.59	0.06	1.88	67.40	0.27	2.41		
S		1420		1.00	11.90	2.08	0.10		5.18	3.89	0.57	0.06	1.86	67.20	0.27	2.64		
S		1420		1.00	11.95	2.08	0.04		5.19	3.92	0.59	0.06	1.88	67.50	0.27	2.34		
T		1387		0.90	3.20	12.29	2.13	0.04	5.33	3.99	0.57	0.06	1.95	69.66	0.27	2.44		2.76
T		1349		0.90	2.60	12.34	2.13	0.04	5.35	4.00	0.57	0.06	1.96	69.66	0.28	2.43		2.74
T		1381		0.90	2.70	12.33	2.12	0.04	5.33	4.00	0.57	0.06	1.95	69.62	0.27	2.38		2.77
T		1486		0.93	2.40	12.33	2.13	0.04	5.33	3.99	0.57	0.06	1.98	69.70	0.27	2.38		2.83
T		1398		0.91	2.40	12.35	2.12	0.04	5.33	4.00	0.56	0.06	1.95	69.83	0.27	2.33		2.75
T		1397		0.92	2.40	12.32	2.13	0.04	5.35	4.00	0.56	0.06	1.96	69.80	0.28	2.37		2.78
T		1273		0.90	2.40	12.32	2.12	0.04	5.32	3.99	0.56	0.06	1.96	69.69	0.27	2.38		2.77
T		1435		0.94	2.30	12.34	2.12	0.04	5.37	3.99	0.56	0.06	1.98	69.70	0.28	2.41		2.79
V		1450		0.99	1.90	12.28	2.31	0.04	5.32	3.94	0.82	0.06	1.93	69.47	0.29	2.50		
V		1470		0.99	1.90	12.33	2.32	0.04	5.33	3.94	0.83	0.06	1.92	69.58	0.28	2.80		
V		1430		1.00	2.00	12.39	2.33	0.05	5.34	3.96	0.84	0.06	1.93	69.66	0.28	2.70		
V		1420		0.97	2.10	12.37	2.33	0.04	5.36	3.96	0.83	0.06	1.92	69.67	0.28	2.50		
V		1450		0.99	2.00	12.34	2.32	0.05	5.35	3.95	0.83	0.06	1.93	69.64	0.29	2.80		
V		1450		0.98	2.20	12.26	2.31	0.03	5.31	3.94	0.82	0.06	1.91	69.32	0.28	2.80		
V		1440		0.99	2.10	12.27	2.32	0.04	5.34	3.94	0.82	0.06	1.91	69.52	0.29	2.80		
V		1440		0.99	1.90	12.35	2.31	0.03	5.36	3.96	0.83	0.06	1.93	69.51	0.28	2.70		

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

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

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

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

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	46.23	40.03	29.04	15.65
Cu	M/ICP	ppm	33.92	20.38	21.96	6.073
Au	Pb Coll	ppm	0.032	0.029	0.016	0.011
Ag	M/ICP	ppm	0.222	0.145	0.110	0.040
Al <sub>2</sub> O <sub>3</sub>	XRF	%	0.092	0.074	0.053	0.025
CaO	XRF	%	0.042	0.034	0.021	0.011
Cr <sub>2</sub> O <sub>3</sub>	XRF	%	0.005	0.002	0.004	0.001
Fe <sub>2</sub> O <sub>3</sub>	XRF	%	0.066	0.050	0.032	0.015
K <sub>2</sub> O	XRF	%	0.037	0.029	0.018	0.009
MgO	XRF	%	0.037	0.029	0.018	0.009
MnO	XRF	%	0.004	0.002	0.003	0.001
Na <sub>2</sub> O	XRF	%	0.038	0.040	0.016	0.015
SiO <sub>2</sub>	XRF	%	0.038	0.040	0.016	0.015
TiO <sub>2</sub>	XRF	%	0.005	0.002	0.004	0.001
LOI		%	0.005	0.002	0.004	0.001
S	Comb / LECO	%	0.035	0.044	0.015	0.020
SG	pycnometer		0.041	0.038	0.020	0.014

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 Std 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:** AMIS0309 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 or 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.

**6 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	2.01	0.46	11.4	85
Al	M/ICP	%	6.20	1.04	8.35	96
As	M/ICP	ppm	48.3	10.4	10.8	87
Ba	M/ICP	ppm	727	89.4	6.15	65
Be	M/ICP	ppm	2.12	0.40	9.35	64
Bi	M/ICP	ppm	6.15	3.50	28	63
Ca	M/ICP	%	1.49	0.16	5.22	105
Cd	M/ICP	ppm	0.49	0.60	60.3	32
Ce	M/ICP	ppm	121	23.1	9.55	53
Co	M/ICP	ppm	30.9	4.20	6.80	100
Cr	M/ICP	ppm	261	67.0	12.8	90
Cs	M/ICP	ppm	6.41	1.04	8.13	47
Cu	XRF	ppm	1351	99.2	3.67	30
Dy	M/ICP	ppm	1.97	0.27	6.79	36
Er	M/ICP	ppm	0.72	0.16	11.2	37
Eu	M/ICP	ppm	1.91	0.27	6.97	37
Fe	M/ICP	%	3.67	0.25	3.45	107
Ga	M/ICP	ppm	26.5	7.99	15.1	64
Gd	M/ICP	ppm	4.71	0.69	7.27	38
Ge	M/ICP	ppm	0.16	0.10	31.8	8
Hf	M/ICP	ppm	3.25	0.67	10.3	40
Ho	M/ICP	ppm	0.31	0.04	6.32	37
In	M/ICP	ppm	0.13	0.04	14.2	47
K	M/ICP	%	3.17	0.55	8.63	106
La	M/ICP	ppm	58.0	14.9	12.8	76
Li	M/ICP	ppm	41	4.61	5.68	80
Lu	M/ICP	ppm	0.09	0.03	14	39
Mg	M/ICP	%	0.32	0.05	8.55	104
Mn	M/ICP	ppm	475	51.4	5.40	102
Mo	M/ICP	ppm	10.7	1.50	7.02	81
Na	M/ICP	%	1.42	0.12	4.31	93
Nb	M/ICP	ppm	50.5	13.6	13.5	54
Nd	M/ICP	ppm	52.5	8.54	8.13	38
Ni	M/ICP	ppm	60.3	6.98	5.79	107
P	M/ICP	ppm	964	142	7.37	78
Pb	M/ICP	ppm	34.2	7.85	11.5	112
Pr	M/ICP	ppm	14.6	4.61	15.8	31
Pt	M/ICP	ppm	14.8	0.60	2.0	8
Rb	M/ICP	ppm	206	54.4	13.2	53
Re	M/ICP	ppm	0.05	0.15	153	24
S	M/ICP	%	1.52	0.08	2.6	105
Sb	M/ICP	ppm	4.16	4.37	52.6	59
Sc	M/ICP	ppm	3.66	0.84	11.5	81
Se	M/ICP	ppm	0.69	0.22	15.8	16
Si	M/ICP	%	33.0	0.75	1.1	8
Sm	M/ICP	ppm	7.63	1.52	10.0	37
Sn	M/ICP	ppm	14.6	5.49	18.9	72
Sr	M/ICP	ppm	279	44.6	8.0	84
Ta	M/ICP	ppm	0.44	0.32	36.0	40
Tb	M/ICP	ppm	0.44	0.12	14.1	47
Te	M/ICP	ppm	3.56	0.54	7.6	38
Th	M/ICP	ppm	16.5	3.69	11.2	54
Ti	M/ICP	%	0.16	0.02	4.7	66
Tl	M/ICP	ppm	0.93	0.63	33.8	49
Tm	M/ICP	ppm	0.11	0.05	22.1	32
U	M/ICP	ppm	6.68	1.53	11.4	47
V	M/ICP	ppm	26.7	5.30	9.9	76
W	M/ICP	ppm	21.0	5.43	12.9	66
Y	M/ICP	ppm	8.38	1.39	8.3	78
Yb	M/ICP	ppm	0.60	0.12	10.2	48
Zn	M/ICP	ppm	66.9	10.4	7.7	120
Zr	M/ICP	ppm	91.9	24.7	13.4	56