



African Mineral Standards

MATRIX REFERENCE MATERIALS

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AMIS0358

Certified Reference Material

**Copper cobalt oxide ore
Mashitu project, DRC**

Certificate of Analysis

**Recommended Concentrations and Limits¹
(at two Standard Deviations)**

Certified Concentrations²

Co M/ICP	1519	±	125	ppm
Co P	1495	±	105	ppm
Cu F	7727	±	269	ppm
Cu M/ICP	7580	±	314	ppm
Cu P	7568	±	395	ppm
Cu Soluble	7142	±	669	ppm
Specific Gravity	2.74	±	0.14	

Provisional Concentrations

Co F	1583	±	213	ppm
Co Soluble ppm	1276	±	292	ppm

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 ₂ O ₃	11.79	±	0.14	%
CaO	0.21	±	0.02	%
Fe ₂ O ₃	5.52	±	0.10	%
K ₂ O	0.56	±	0.02	%
MgO	14.45	±	0.16	%
MnO	0.11	±	0.01	%
SiO ₂	58.24	±	0.58	%
TiO ₂	0.64	±	0.02	%
LOI	7.26	±	0.54	%

Provisional Concentrations

Cr ₂ O ₃	0.021	±	0.004	%
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Indicated Means

Na ₂ O	0.06	%
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1. Intended Use: AMIS0358 can be used to check analysis of samples of copper cobalt ores with a similar grade and matrix.

It is a matrix matched Certified Reference Material (CRM) 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: AMIS0358 was made using Copper-Cobalt oxide ore from the Mashitu project, owned by the Camrose Resources joint venture and operated by Eurasian Natural Resources Corporation (Africa) (ENRC). The Mashitu project is in the Kolwezi District of Katanga Province in the Democratic Republic of the Congo, 204km North west of Lubumbashi and 48km East of Kolwezi. It is hosted by sedimentary rocks of the Neo-proterozoic Katangan sequence developed within the Lufilian Arc in the Central African Copperbelt. Mineralisation is generally hosted within dolomitic shales and argillites of the Lower Mines Series.

3 Mineral and Chemical Composition: The main economic mineralogy comprises malachite and heterogenite with subordinate chrysocolla and kolwezite. Deeper holes have intersected chalcocite, bornite, chalcopyrite, sphaerocobaltite and carrollite.

4. Appearance: The material is a very fine powder. It is colored a Greyish Orange Pink (Corstor 10R 8/2)

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 homogenized in a double cone blender, systematically divided and 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 consensus test results were carried out by an independent statistician.

7. Methods of Analysis requested:

1. Co, Cu. Acid Soluble AAS.
2. Co, Cu. Fusion AAS or ICP-OES (F).
3. Multi-acid digest multi-element scan - (to include Co, Cu). ICP-OES or ICP-MS (M/ICP).
4. Aqua regia digest – Co, Cu. ICP-OES or ICP-MS (P).
5. Pressed pellet multi-element scan - (to include Co, Cu) (XRF).
6. Majors (Al₂O₃, CaO, Cr₂O₃, Fe₂O₃, K₂O, MgO, MnO, Na₂O, SiO₂, TiO₂. LOI) XRF fusion.
7. SG. Gas pycnometer.

8. Information requested:

1. State and provide brief description of analytical techniques used.
2. State aliquots used for all determinations.
3. Results for individual analyses to be reported.
4. All results for base metals to be reported in ppm.
5. Report all QC data, to include replicates, blanks and certified reference materials used.

9. Method of Certification: Twenty five laboratories were each given eight packages, comprising eight samples scientifically selected from throughout the batch. Twenty one laboratories reported 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 21 out of 25 laboratories that provided results timeously were (not in same order as in the table of assays):

1. Acme Analytical Laboratories Chile
2. ACME Analytical Laboratories Ltd CA
3. Activation Laboratories Pty Ltd (ActLabs) CA
4. Activation Laboratorios 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 Chemex Laboratory Zambia
10. ALS OMAC (Ireland)
11. Genalysis Laboratory Services (W Australia P)
12. Intertek Utama Services (Indonesia)
13. Set Point Laboratories (Isando) SA
14. Set Point Laboratories Botswana
15. SGS Australia Pty Ltd (Newburn) WA
16. SGS Geosol Laboratories Ltda (Brazil)
17. SGS Mineral Services Callao (Peru)
18. SGS South Africa (Pty) Ltd - Booyens JHB
19. SGS Townsville (Australia)
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 is set out below.

Assay data

Lab Code	Co F ppm	Co M/CP ppm	Co P ppm	Co Soluble ppm	Cu F ppm	Cu M/CP ppm	Cu P ppm	Cu Soluble ppm	Al2O3 XRF %	CaO XRF %	Cr2O3 XRF %	Fe2O3 XRF %	K2O XRF %	MgO XRF %	MnO XRF %	Na2O XRF %	SiO2 XRF %	TiO2 XRF %	LOI %	S Comb/LECO %	SG pyc	
A								7370														
A								7540														
A								7940														
A								7490														
A								7700														
A								7830														
A								7470														
A								7390														
B		1600		1300.00				7300														
B		1500		1300.00				7100														
B		1600		1300.00				7500														
B		1600		1300.00				7300														
B		1600		1300.00				7500														
B		1600		1300.00				7400														
B		1600		1300.00				7500														
B		1600		1300.00				7400														
B		1600		1300.00				7400														
D		1555	1485					7636	7676													2.68
D		1537	1481					7797	7646													2.67
D		1516	1466					7744	7640													2.66
D		1545	1509					7767	7643													2.65
D		1536	1497					7712	7711													2.67
D		1522	1484					7721	7783													2.66
D		1534	1460					7736	7667													2.65
D		1545	1479					7736	7712													2.66
E	1200	1400	1200	1001.12	7500	7600	7400	6290	11.69	0.23	0.02	5.50	0.56	14.40	0.10	0.10	57.75	0.66	7.49		2.74	
E	1200	1500	1200	1057.75	7900	7600	7500	6523	11.75	0.23	0.03	5.53	0.57	14.53	0.10	0.10	58.07	0.66	7.49		2.75	
E	1200	1500	1200	1000.00	7700	7600	7600	6400	11.79	0.23	0.03	5.50	0.56	14.45	0.10	0.10	58.03	0.67	7.50		2.76	
E	1300	1500	1200	1035.60	7900	7600	7600	6568	11.70	0.23	0.03	5.49	0.56	14.46	0.10	0.10	57.92	0.66	7.49		2.74	
E	1300	1500	1200	1027.63	7600	7600	7600	6419	11.75	0.24	0.03	5.50	0.57	14.47	0.10	0.10	57.87	0.66	7.49		2.76	
E	1300	1500	1200	1026.03	7900	7900	7400	6512	11.80	0.24	0.03	5.51	0.56	14.52	0.10	0.10	58.10	0.67	7.54		2.77	
E	1200	1400	1200	1014.66	7700	7600	7600	6628	11.80	0.25	0.03	5.53	0.56	14.48	0.10	0.10	58.07	0.67	7.53		2.74	
E	1200	1500	1300	1063.24	7400	7600	7500	6720	11.79	0.25	0.02	5.52	0.57	14.48	0.10	0.10	58.03	0.66	7.53		2.74	

Assay data (cont)

Lab Code	Co F ppm	Co M/ICP ppm	Co P ppm	Co Soluble ppm	Cu F ppm	Cu M/ICP ppm	Cu P ppm	Cu Soluble ppm	Al2O3 XRF %	CaO XRF %	Cr2O3 XRF %	Fe2O3 XRF %	K2O XRF %	MgO XRF %	MnO XRF %	Na2O XRF %	SiO2 XRF %	TiO2 XRF %	LOI %	S Comb/LECO %	SG pyc
F	1540	1530			7460	7590	7270	11.60	0.20	0.02	5.47	0.54	13.95	0.11	0.06	57.50	0.64	7.73			2.86
F	1560	1500			7780	7570	7270	11.40	0.21	0.02	5.37	0.53	13.75	0.11	0.03	58.70	0.63	7.61			2.85
F	1520	1510			7720	7470	7440	11.35	0.20	0.02	5.36	0.53	13.75	0.11	0.03	58.40	0.63	7.67			2.76
F	1540	1540			7610	7650	7380	11.60	0.20	0.02	5.49	0.54	14.00	0.11	0.06	57.70	0.64	7.61			2.77
F	1570	1530			7700	7800	7300	11.90	0.21	0.02	5.58	0.55	14.25	0.11	0.06	58.90	0.65	7.72			2.87
F	1530	1540			7570	7730	7650	11.65	0.21	0.02	5.51	0.55	14.15	0.11	0.03	60.20	0.65	7.55			2.75
F	1550	1530			7620	7620	7590	11.40	0.20	0.02	5.32	0.53	13.70	0.11	0.03	58.40	0.63	7.63			2.88
F	1520	1510			7390	7570	7550	11.45	0.21	0.02	5.34	0.54	13.75	0.11	0.03	58.80	0.63	7.65			2.65
I					7418		5723														
I					7368		6175														
I					7249		6156														
I					7378		5767														
I					7196		6070														
I					7430		6054														
I					7381		6098														
I					7091		6208														
J	1560	1540	1500	1250.00	7700	7720	7530	6790	11.88	0.21	0.02	5.46	0.57	14.50	0.11	0.05	58.30	0.64	6.96		2.86
J	1560	1530	1500	1240.00	7800	7710	7640	7050	11.88	0.21	0.02	5.47	0.56	14.53	0.10	0.05	58.31	0.64	6.98		2.89
J	1580	1500	1500	1250.00	7800	7700	7600	6710	11.88	0.21	0.02	5.46	0.56	14.54	0.10	0.05	58.28	0.64	7.00		2.87
J	1560	1540	1520	1250.00	7800	7830	7660	6560	11.84	0.21	0.02	5.45	0.57	14.50	0.10	0.05	58.28	0.64	6.99		2.85
J	1580	1550	1500	1260.00	7850	7930	7530	6650	11.85	0.22	0.02	5.48	0.57	14.53	0.10	0.05	58.30	0.64	6.98		2.85
J	1540	1520	1480	1230.00	7700	7680	7530	6720	11.83	0.21	0.02	5.45	0.56	14.49	0.10	0.05	58.24	0.64	6.96		2.87
J	1580	1590	1490	1250.00	7850	7850	7560	7060	11.86	0.21	0.02	5.45	0.57	14.53	0.10	0.05	58.30	0.64	6.98		2.87
J	1600	1490	1520	1230.00	7850	7650	7550	6700	11.85	0.21	0.02	5.44	0.57	14.48	0.10	0.05	58.27	0.64	6.98		2.85
K	1420	1480			7350	7630			11.80	0.21	0.02	5.44	0.57	14.25	0.11	0.05	58.30	0.63	6.97		2.70
K	1510	1490			7810	7670			12.00	0.22	0.02	5.47	0.57	14.25	0.11	0.05	58.60	0.63	6.98		2.71
K	1470	1500			7610	7710			11.80	0.21	0.02	5.50	0.57	14.35	0.11	0.05	58.50	0.61	6.97		2.71
K	1450	1410			7490	7330			11.80	0.21	0.02	5.48	0.57	14.25	0.10	0.06	58.50	0.62	7.00		2.71
K	1420	1520			7380	7810			11.95	0.21	0.02	5.54	0.57	14.45	0.11	0.05	58.90	0.64	7.02		2.69
K	1450	1500			7500	7780			11.95	0.22	0.02	5.57	0.57	14.45	0.11	0.05	58.90	0.64	7.03		2.74
K	1470	1530			7570	7820			11.80	0.21	0.02	5.47	0.57	14.30	0.11	0.05	58.30	0.63	6.99		2.72
K	1460	1520			7560	7860			11.80	0.21	0.02	5.46	0.56	14.30	0.11	0.05	58.30	0.63	7.03		2.71
L	1510	1530			7630	7810			11.80	0.20	0.02	5.53	0.56	14.20	0.10		58.30	0.62	6.96		2.60
L	1500	1520			7560	7920			11.85	0.21	0.02	5.60	0.57	14.25	0.10		58.60	0.63	6.98		2.62
L	1480	1530			7540	7920			11.85	0.20	0.02	5.54	0.57	14.20	0.10		58.50	0.63	6.93		2.66
L	1490	1500			7720	7870			11.75	0.20	0.02	5.49	0.56	14.15	0.10		58.10	0.62	6.97		2.63
L	1490	1500			7700	7850			11.75	0.20	0.02	5.52	0.56	14.15	0.10		58.10	0.62	6.94		2.68
L	1490	1480			7550	7740			11.80	0.20	0.02	5.52	0.57	14.15	0.10		58.30	0.62	6.94		2.81
L	1480	1460			7570	7730			11.75	0.22	0.02	5.53	0.57	14.15	0.10		58.10	0.62	6.96		2.65
L	1470	1490			7640	7760			11.75	0.20	0.02	5.51	0.56	14.15	0.10		58.00	0.62	6.94		2.63
M	1520	1480			7840	7720			11.80	0.30	0.02	5.60	0.59	15.40	0.11	0.05	55.50	0.63	8.03		2.75
M	1520	1470			7700	7500			12.00	0.20	0.02	5.70	0.57	16.00	0.11	0.05	55.30	0.65	7.75		2.74
M	1490	1480			7740	7750			11.55	0.25	0.02	5.61	0.57	15.20	0.11	0.05	55.90	0.65	8.00		2.80
M	1550	1470			7780	7660			11.65	0.25	0.02	5.49	0.56	15.80	0.11	0.05	56.10	0.64	7.97		2.74
M	1520	1460			7670	7560			11.65	0.25	0.02	5.52	0.56	15.60	0.11	0.05	55.80	0.63	7.96		2.70
M	1520	1430			7670	7540			11.55	0.25	0.02	5.52	0.56	15.70	0.11	0.05	56.00	0.63	8.10		2.73
M	1520	1490			7720	7590			11.55	0.20	0.02	5.49	0.56	15.65	0.10	0.05	55.70	0.63	8.39		2.78
M	1490	1490			7680	7710			11.70	0.21	0.02	5.56	0.55	15.30	0.10	0.05	56.20	0.63	8.10		2.73
O	1800	1450	1490		7900	7000			11.70	0.21	0.02	5.58	0.57	14.40	0.11	0.07	58.30	0.65	7.03		2.75
O	1780	1460	1510		7510	7290			11.70	0.21	0.02	5.57	0.57	14.40	0.11	0.07	58.40	0.65	7.00		2.75
O	1620	1590	1510		7830	7420			11.70	0.21	0.02	5.65	0.58	14.50	0.11	0.07	58.30	0.66	7.01		2.73
O	1710	1470	1520		7370	7090			11.70	0.21	0.02	5.57	0.57	14.40	0.11	0.07	58.40	0.65	7.03		2.73
O	1600	1410	1510		7570	7470			11.70	0.21	0.02	5.59	0.57	14.40	0.11	0.07	58.30	0.65	7.03		2.73
O	1780	1240	1500		7700	6550			11.70	0.22	0.02	5.63	0.57	14.50	0.11	0.06	58.40	0.66	7.02		2.73
O	1790	1280	1490		7620	6830			11.70	0.21	0.02	5.61	0.57	14.50	0.11	0.07	58.40	0.65	7.01		2.73
O	1770	1300	1510		7590	7190			11.70	0.22	0.02	5.62	0.57	14.50	0.11	0.08	58.30	0.65	7.03		2.73
P	1580	1390			7710																2.83
P	1560	1360			7580																2.84
P	1580	1400			7670																2.83
P	1620	1370			7590																2.83
P	1930	1370			7410																2.83
P	1620	1360			7560																2.83
P	1560	1330			7580																2.84
P	1620	1390			7890																2.84
Q	1520	1540		1470.00	7480	7470		7410	11.65	0.22	0.03	5.53	0.57	14.38	0.11	0.04	57.76	0.64	7.54		2.74
Q	1520	1530		1460.00	7620	7310		7360	11.68	0.21	0.03	5.50	0.56	14.41	0.11	0.04	57.45	0.64	7.45		2.73
Q	1530	1540		1450.00	7750	7320		7370	11.70	0.22	0.03	5.51	0.56	14.42	0.10	0.04	57.65	0.65	7.51		2.70
Q	1530	1530		1450.00	7810	7340		7310	11.43	0.28	0.04	5.52	0.55	14.39	0.11	0.05	56.65	0.64	7.55		2.72
Q	1530	1540		1470.00	7480	7210		7480	11.62	0.22	0.03	5.52	0.57	14.45	0.11	0.04	57.54	0.64	7.69		2.71
Q	1530	1550		1480.00	7650	7360		7490	11.42	0.28	0.06	5.57	0.56	14.48	0.12	0.04	57.19	0.64	7.63		2.73
Q	1540	1520		1430.00	7460	7270		7400	11.37	0.27	0.05	5.56	0.58	14.58	0.11	0.04	57.49	0.64	7.59		2.72
Q	1540	1540		1440.00	7680	7210		7400	11.41	0.25	0.04	5.54	0.56	14.50	0.11	0.04	56.82	0.63	7.54		2.73
R	1400	1447	1361		6700	7796	8														

Assay data (cont)

Lab Code	Co F ppm	Co M/ICP ppm	Co P ppm	Co Soluble ppm	Cu F ppm	Cu M/ICP ppm	Cu P ppm	Cu Soluble ppm	Al ₂ O ₃ %	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	
V	1669	1550				7812	7310	7340														
V	1664	1510				7890	7140	7230														
V	1668	1570				7967	7480	7400														
V	1666	1480				7776	6890	7210														
V	1650	1550				7781	7330	7330														
V	1686	1610				8052	7640	7400														
V	1662	1580				7680	7330	7220														
V	1659	1580				7694	7450	7370														
W	1937	1291				7562	5841									0.06						
W	1795	1284				7137	5884									0.05						
W	1801	1333				7146	6194									0.09						
W	1821	1317				7196	6027															
W	1812	1259				7057	5729									0.05						
W	1818	1289				7084	5875									0.05						
W	1813	1330				7192	6061									0.05						
W	1824	1306				7203	5950									0.05						
X	1484	1480				7752	7491		11.90	0.20	0.02	5.51	0.55	14.40	0.10		58.30	0.65	7.38		2.79	
X	1500	1442				7508	7598		11.80	0.20	0.02	5.50	0.55	14.40	0.10		58.30	0.65	7.39		2.79	
X	1496	1475				7652	7588		11.80	0.20	0.02	5.47	0.55	14.30	0.10		58.00	0.65	7.45		2.77	
X	1498	1467				7654	7371		11.70	0.20	0.02	5.44	0.55	14.20	0.10		57.60	0.64	7.48		2.79	
X	1569	1449				7537	7316		11.80	0.20	0.02	5.46	0.55	14.40	0.10		58.30	0.64	7.38		2.79	
X	1514	1438				7644	7385		11.80	0.20	0.02	5.49	0.55	14.30	0.10		58.40	0.65	7.50		2.80	
X	1480	1487				7598	7449		11.80	0.20	0.02	5.46	0.55	14.30	0.10		58.20	0.65	7.46		2.75	
X	1535	1485				7518	7416		11.80	0.19	0.02	5.43	0.55	14.30	0.10		58.00	0.64	7.41		2.79	
Y	1560					7680		7300	11.79	0.22	0.02	5.46	0.57	14.51	0.10	0.04	58.08	0.64	7.10			
Y	1570					7640		7200	11.82	0.23	0.03	5.51	0.58	14.59	0.11	0.06	58.26	0.64	7.20			
Y	1520					7620		7000	11.81	0.22	0.02	5.51	0.57	14.58	0.10	0.05	58.25	0.63	7.10			
Y	1560					7670		7100	11.79	0.22	0.01	5.48	0.57	14.56	0.10	0.07	58.16	0.63	7.20			
Y	1540					7660		7200	11.84	0.22	0.01	5.52	0.57	14.60	0.10	0.03	58.38	0.63	7.00			
Y	1560					7630		7300	11.82	0.22	0.02	5.51	0.57	14.56	0.11	0.05	58.27	0.63	7.20			
Y	1540					7580		7300	11.80	0.22	0.02	5.49	0.57	14.53	0.10	0.05	58.19	0.63	6.90			
Y	1530					7600		7200	11.79	0.22	0.02	5.50	0.57	14.54	0.10	0.05	58.13	0.63	7.10			

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

The samples used in the certification process were 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:

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

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
Co	F	ppm	106.4	117.1	25.61	44.40
Co	M/ICP	ppm	62.62	37.89	27.16	9.223
Co	P	ppm	52.60	38.83	23.04	11.47
Co	Soluble	ppm	146.2	200.5	27.60	89.77
Cu	F	ppm	134.5	91.49	107.0	37.52
Cu	M/ICP	ppm	164.0	84.37	104.9	21.80
Cu	P	ppm	197.5	140.8	101.3	42.00
Cu	Soluble	ppm	334.6	288.6	120.98	92.27
Al ₂ O ₃	XRF	%	0.074	0.056	0.042	0.018
CaO	XRF	%	0.008	0.006	0.004	0.002
Cr ₂ O ₃	XRF	%	0.002	0.001	0.001	0.0004
Fe ₂ O ₃	XRF	%	0.047	0.031	0.028	0.009
K ₂ O	XRF	%	0.008	0.005	0.005	0.001
LOI		%	0.265	0.220	0.055	0.064
MgO	XRF	%	0.076	0.049	0.053	0.017
MnO	XRF	%	0.005	0.003	0.003	0.001
Na ₂ O	XRF	%	0.019	0.015	0.008	0.004
SiO ₂	XRF	%	0.301	0.176	0.224	0.058
TiO ₂	XRF	%	0.011	0.007	0.006	0.002
SG	pycnometer		0.067	0.048	0.032	0.014

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 Informational 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, who have maintained measurement traceability during the analytical process.

15. Certification: AMIS0358 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. This is the recommended minimum sample size 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 50g to 250g) of material. The Laboratory Packs are sealed bottles delivered in sealed foil pouches. The Explorer Packs contain material in standard geochem envelopes, 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.

7 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.)

Uncertified trace element statistics

Analyte	Method	Unit	Mean	2SD	RSD%	n
Ag	M/ICP	ppm	0.39	0.34	43.3	61
Al	M/ICP	%	6.21	0.73	5.83	120
As	M/ICP	ppm	5.43	6.68	61.5	97
Ba	M/ICP	ppm	123	13.3	5.41	102
Be	M/ICP	ppm	3.63	0.66	9.10	102
Bi	M/ICP	ppm	0.37	0.59	79.9	64
Ca	M/ICP	%	0.15	0.02	7.19	116
Cd	M/ICP	ppm	0.16	0.59	180	62
Ce	M/ICP	ppm	67.1	6.00	4.47	48
Cr	M/ICP	ppm	106	24.4	11.5	119
Cs	M/ICP	ppm	0.52	0.05	4.45	28
Dy	M/ICP	ppm	4.27	0.58	6.80	24
Er	M/ICP	ppm	2.44	0.23	4.61	22
Eu	M/ICP	ppm	1.16	0.10	4.23	23
Fe	M/ICP	%	3.83	0.31	4.04	126
Ga	M/ICP	ppm	18.0	4.42	12.3	72
Gd	M/ICP	ppm	4.84	0.45	4.67	24
Hf	M/ICP	ppm	3.63	0.52	7.21	45
Ho	M/ICP	ppm	0.87	0.09	4.94	24
In	M/ICP	ppm	0.11	0.03	13.7	39
K	M/ICP	%	0.47	0.05	5.43	123
La	M/ICP	ppm	33.0	5.25	7.95	96
Li	M/ICP	ppm	202	34.4	8.50	82
Lu	M/ICP	ppm	0.33	0.16	24.9	31
Mg	M/ICP	%	8.50	0.88	5.19	117
Mn	M/ICP	ppm	819	109	6.63	120
Mo	M/ICP	ppm	0.96	1.22	63.4	88
Na	M/ICP	%	0.04	0.03	35.4	112
Nb	M/ICP	ppm	9.53	5.68	29.8	70
Nd	M/ICP	ppm	28.5	2.41	4.23	24
Ni	M/ICP	ppm	66.4	10.37	7.81	110
P	M/ICP	ppm	713	153	10.8	88
Pb	M/ICP	ppm	10.9	6.88	31.7	102
Pr	M/ICP	ppm	7.87	0.47	2.98	23
Rb	M/ICP	ppm	19.0	2.59	6.82	54
S	M/ICP	%	0.08	0.43	269	104
S	Comb/LECO	%	0.08	0.04	28.3	8
Sb	M/ICP	ppm	1.80	8.13	225	73
Sc	M/ICP	ppm	12.5	1.95	7.81	95
Si	M/ICP	%	16.2	22.9	70.8	16
Sm	M/ICP	ppm	5.64	0.23	2.02	15
Sn	M/ICP	ppm	1.74	2.47	71.1	72
Sr	M/ICP	ppm	27.3	3.66	6.70	104
Ta	M/ICP	ppm	0.48	0.89	93.2	54
Tb	M/ICP	ppm	0.66	0.22	16.9	31
Te	M/ICP	ppm	0.33	1.33	199	39
Th	M/ICP	ppm	11.1	1.97	8.91	64
Ti	M/ICP	%	0.22	0.16	35.4	101
Tl	M/ICP	ppm	0.10	0.17	84.6	40
Tm	M/ICP	ppm	0.38	0.05	6.09	23
U	M/ICP	ppm	4.25	0.45	5.26	48
V	M/ICP	ppm	96.6	14.36	7.43	112
W	M/ICP	ppm	1.27	2.00	78.9	63
Y	M/ICP	ppm	21.3	3.57	8.37	94
Yb	M/ICP	ppm	2.17	0.66	15.1	32
Zn	M/ICP	ppm	46.8	10.6	11.3	107
Zr	M/ICP	ppm	129	29.1	11.3	89