African Mineral Standards
REFERENCE MATERIALS FOR AFRICAN ORES

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AMIS0080

Certified Reference Material

Low grade Gold and Uranium Ore

Certificate of Analysis

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

Certified Concentrations[2. 3.]

Au (Pb Collection)	1.14	±	0.10	g/t
U M/ICP[4]	111	±	12.4	ppm
U (XRF)[4]	111	±	9.5	ppm
Specific Gravity	2.70	±	0.16	

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.
3. Recertified, see note on p6.
4. Or, by applying a chemical conversion factor of U x 1.1793 = U3O8; U3O8 by multi acid digestion: 131 ± 14.6 ppm; U3O8 by XRF: 131 ± 11.2 ppm.

1. Intended Use: AMIS0080 can be used to check analyses of low grade gold and uranium ores, hosted by siliceous matrix rock, with a similar grade and matrix.

It is a matrix matched Certified Reference Material, fit for use as control samples in routine assay laboratory quality control when inserted within runs of samples and measured in parallel to the unknown. Its purpose is to monitor inter-laboratory or instrument bias and within lab precision. It can be used, indirectly, to establish the traceability of results to an SI system of units.

The recommended concentrations and limits for this material are property values based on a measurement campaign (round robin) and reflect consensus results from the laboratories that participated in the round robin.

Slight variations in analytical procedures between laboratories will reflect as slight biases to the recommended concentrations (see 19). Good laboratories will report results within the two standard deviation levels with a failure rate of <10 %.

The material can also be used for method development and for the calibration of equipment.

2. Origin of Material: This standard is a blend of Ventersdorp Contact Reef, Carbon Leader Reef and Vaal Reef material provided by AngloGold Ashanti Limited. It was made from a mixture of pulp reject sample material, collected during routine underground sampling in Witwatersrand gold mines, sourced from mine assay laboratories and blended down to a required grade with silica.

3. Mineral and Chemical Composition: The major gangue mineral is quartz with minor clays, pyrite, uraninite and thucolite. The gold occurs as micron-sized grains associated with the clays and rarely within the sulphides.

The major element chemistry has been calculated, from predominantly XRF data submitted by fourteen of the laboratories, from the eight samples sent each lab. Uncertified statistics from this data are:

	unit	mean	2SD	RSD%	n
Al_2O_3	%	2.69	0.07	1.3	68
CaO	%	4.98	0.23	2.3	99
Cr_2O_3	%	0.11	0.01	5.5	85
Fe_2O_3	%	2.46	0.16	3.2	86
K_2O	%	0.82	0.04	2.2	98
LOI	%	5.94	0.54	4.6	87
MgO	%	2.19	0.10	2.2	85
MnO	%	0.28	0.02	2.9	95
Na_2O	%	0.31	0.08	12.7	87
P_2O_5	%	0.04	0.02	23.4	85
S	%	0.08	0.02	11.3	39
SiO_2	%	79.70	1.14	0.7	90
TiO_2	%	0.21	0.01	3.2	96

4. Appearance: The material is a very fine powder. It is colored a Light Grey (Corstor 5Y 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. Radioactivity: Shipments of this material do not require special marking, labeling or placarding. AMIS0080 does contain U (1.4 Bq/g) and Th (0.03 Bq/g) but due to the low activity

concentrations it is classified as EXEMPT MATERIAL in terms of “Safety Standards Series No. TS-R-1: Regulations for the Safe Transport of Radioactive Material, International Atomic Energy Agency, 2005, para 403, Table 1”.

7. Method of Preparation: The material was crushed, dry-milled and air-classified to <54um. Wet sieve partic**l**e size analysis of random samples confirmed the material was 98.5% <54um. It was then blended in a bi-conical mixer, systematically divided and then sealed into 1kg Laboratory Packs. Explorer Packs are subdivided from the Laboratory packs as required. Samples were randomly selected for homogeneity testing and third party analysis. Statistical analysis of both homogeneity and the consensus test results were carried out by independent statisticians.

8. Methods of Analysis requested:

1. Au – Pb collection ICP-OES or ICP-MS.
2. Multi-acid digest U ICP- OES or ICP-MS.
3. U XRF.
4. Majors (Al_2O_3, CaO, Cr_2O_3, Fe_2O_3, K_2O, MgO, MnO, Na_2O, SiO_2, TiO_2. LOI.) XRF fusion.
5. SG (gas pycnometer)

9. Information requested:

1. Aliquots used for all determinations.
2. QC data, to include replicates, blanks and certified reference materials used.
3. Analytical techniques used.

10. Method of Certification: Twenty three laboratories were each given eight randomly selected packages of sample. Twenty two of the laboratories submitted results in time for the 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”.

11. Participating Laboratories: The 22 laboratories that provided results timeously were (not in same order as in the table of assays):

1. ACME Analytical Laboratories Ltd., (Canada).
2. Activation Laboratories Ltd., (ActLabs, Ancaster, ON, Canada).
3. AGA - West Wits Laboratory, (South Africa).
4. AGA - Navachab Gold Mine Laboratory, (Namibia).
5. AGA - Vaal River Laboratory (South Africa).
6. ALS Chemex South Africa (Pty) Ltd.
7. ALS Chemex, (Perth, Australia).
8. ALS Chemex, (Vancouver, Canada).
9. Anglo Research (Crown Campus, South Africa).
10. Assayers Canada, (Vancouver).

11. Genalysis Laboratory Services (Pty) Ltd., (Australia).
12. Labtium Inc. (Finland)
13. MAED Laboratories - Knights (South Africa)
14. OMAC Laboratories (Ireland).
15. Performance Laboratories, (South Africa).
16. Pt Intertek Utama Services (Intertek, Indonesia)
17. Set Point Laboratories (Pty) Ltd (South Africa)
18. SGS Lakefield Research (Canada)
19. SGS Lakefield Research Africa (Pty) Ltd. (Joburg, South Africa)
20. SGS Mineral Services - Barberton, (South Africa).
21. SGS Welshpool (Australia).
22. Ultra Trace (Pty) Ltd. (Australia)

12. Assay Data: Data as received from the laboratories is set out below.

Lab Code	Au g/t	U (M-ICP) ppm	U (XRF) ppm	SG
A	1.25			
A	1.18			
A	1.24			
A	1.14			
A	1.03			
A	1.28			
A	1.07			
A	1.16			
B	1.17	123		
B	1.11	124		
B	1.18	122		
B	1.25	126		
B	1.20	122		
B	1.15	122		
B	1.22	124		
B	1.05	125		
C	1.16		93	
C	1.14		90	
C	1.12		88	
C	1.12		96	
C	1.14		91	
C	1.16		96	
C	1.10		94	
C	1.16		97	
D	1.06			
D	1.09			
D	1.16			
D	1.10			
D	1.13			
D	1.19			
D	1.10			
D	1.07			
E	1.34	107	109	
E	1.28	107	105	
E	1.24	106	107	
E	1.22	103	106	
E	1.24	103	108	
E	1.24	113	105	
E	1.29	102	99	
E	1.29	110	109	
F	1.19			
F	1.20			
F	1.18			
F	1.14			
F	1.17			
F	1.19			
F	1.20			
F	1.19			
G	1.18	130	114	2.73
G	1.19	120	109	2.74
G	1.16	130	114	2.74
G	1.15	130	111	2.73
G	1.10	120	113	2.73
G	1.24	120	114	2.74
G	1.11	130	109	2.74
G	1.14	130	114	2.74
H	1.09		119	
H	1.18		116	
H	1.18		116	
H	1.09		118	
H	1.05		115	
H	1.10		115	
H	1.02		114	
H	1.10		117	

Lab Code	Au g/t	U (M-ICP) ppm	U (XRF) ppm	SG
I	1.12	113	110	2.77
I	1.11	113	100	2.79
I	1.18	116	100	2.76
I	1.10	122	110	2.76
I	1.12	120	110	2.78
I	1.14	113	110	2.78
I	1.15	116	100	2.79
I	1.15	110	100	2.78
J	1.02	116	112	2.70
J	1.04	104	111	2.72
J	1.19	110	114	2.72
J	1.12	116	113	2.75
J	1.11	119	109	2.73
J	1.19	111	114	2.69
J	1.05	110	113	2.74
J	1.16	107	116	2.69
K	1.19	109	111	
K	1.17	112	112	
K	1.18	113	113	
K	1.16	112	111	
K	1.18	114	116	
K	1.13	113	108	
K	1.14	115	108	
K	1.21	113	114	
L	1.16			
L	1.16			
L	1.20			
L	1.28			
L	1.16			
L	1.29			
L	1.28			
L	1.24			
M	1.09	115		
M	1.07	112		
M	1.09	113		
M	1.10	113		
M	1.13	111		
M	1.14	112		
M	1.05	114		
M	1.09	112		
N	1.20	113	103	
N	1.12	117	106	
N	1.19	112	105	
N	1.16	115	105	
N	1.12	117	106	
N	1.13	113	105	
N	1.19	115	106	
N	1.16	113	106	
O	1.07	102	90	2.52
O	1.13	106	90	2.53
O	1.16	107	100	2.52
O	1.16	108	100	2.56
O	1.17	105	100	2.58
O	1.13	94	90	2.54
O	1.21	107	90	2.53
O	1.12	106	100	2.56
Q	1.14	112		2.40
Q	1.07	100		2.38
Q	1.16	108		2.43
Q	1.13	112		2.36
Q	1.17	112		2.39
Q	1.14	107		2.42
Q	1.13	111		2.50
Q	1.13	113		2.46

Lab Code	Au g/t	U (M-ICP) ppm	U (XRF) ppm	SG
R	1.03	143	118	2.61
R	1.12	152	116	2.60
R	1.10	153	116	2.61
R	1.14	149	116	2.59
R	1.09	164	117	2.61
R	1.11	153	116	2.68
R	1.03	161	117	2.61
R	1.01	155	119	2.58
S	1.19	100	106	2.68
S	1.22	102	104	2.73
S	1.16	105	105	2.75
S	1.16	100	105	2.73
S	1.19	103	105	2.71
S	1.18	97	104	2.73
S	1.20	103	105	2.68
S	1.18	105	105	2.77
T	1.13			2.65
T	1.14			2.59
T	1.17			2.61
T	1.23			2.60
T	1.26			2.56
T	1.17			2.66
T	1.13			2.64
T	1.22			2.66
U	1.09			2.83
U	1.13			2.81
U	1.12			2.80
U	1.13			2.81
U	1.14			2.80
U	1.14			2.83
U	1.14			2.81
U	1.10			2.83
V	1.00			
V	1.17			
V	1.02			
V	1.12			
V	1.14			
V	1.02			
V	1.26			
V	1.05			
W	1.13	130	130	2.72
W	1.10	130	128	2.73
W	1.18	130	127	2.71
W	1.12	130	128	2.71
W	1.11	130	127	2.73
W	1.18	120	128	2.74
W	1.14	140	129	2.72
W	1.16	130	129	2.70

13. 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:

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

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

Analyte	CSU*	unit
Au	0.004	ppm
U M/ICP	1.595	ppm
U (XRF)	1.648	ppm
SG	0.025	
Al2O3	0.010	%
CaO	0.025	%
Cr2O3	0.001	%
Fe2O3	0.018	%
K2O	0.004	%
MgO	0.012	%
MnO	0.002	%
Na2O	0.010	%
P2O5	0.002	%
S ICP	0.006	%
SiO2	0.122	%
TiO2	0.001	%
LOI	0.070	%

*CSU= Combined standard uncertainty

14. Certified values: The Certified values listed on p1 this certificate fulfill the AMIS statistical criteria regarding agreement for certification and have been independently validated by Dr Barry Smee.

15. 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.

16. Certification: AMIS0080 is a new material.

17. 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.

18. Minimum sample size: The majority of laboratories reporting used a 30g sample size for the fire assay and 0.5g for the ICP. These are the recommended minimum sample sizes for the use of this material.

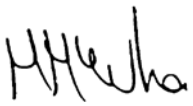
19. Availability: This product is available in Laboratory Packs containing 1kg of material and Explorer Packs containing custom weights (from 50 to 250g) of material. The Laboratory Packs are sealed bottles delivered in sealed foil pouches. The Explorer Packs contain material in standard geochem envelopes, nitrogen flushed and vacuum sealed in foil pouches.

20. 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.

21. 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.

14 April 2008 and 11 August 2009*

Certifying Officers:



African Mineral Standards:_____

Mike McWha
BSc (Hons), FGSSA, MAusIMM, Pr.Sci.Nat

Geochemist:_____

Barry W. Smee
BSc, PhD, P.Geo, (B.C.)

** This re-certification results from our recent discovery that the results from one laboratory had been discarded. These U results had been reported as oxides. This error was not picked up during data screening or iteration; or by the lab manager when the Round Robin Proficiency Report was circulated. When the U3O8 results were converted to U, re-entered and re-iterated, the U M/ICP and XRF –RSD's both reduced to <5%. We apologize for any inconvenience that might have been caused by our Provisional U values and limits on the original certificate (McW).*

Appendix

Uncertified trace element data added 6 July 2010

AMIS0080 Trace						
Analyte	Method	Unit	Mean	2SD	RSD%	n
Ag	M/ICP	ppm	0.15	0.06	22.0	23
Al	M/ICP	%	1.46	0.08	2.8	16
As	M/ICP	ppm	16.1	2.1	6.5	32
Ba	M/ICP	ppm	108	58	26.8	32
Be	M/ICP	ppm	1.89	1.30	34.4	29
Bi	M/ICP	ppm	2.97	0.82	13.8	30
Ca	M/ICP	%	3.45	0.12	1.8	15
Cd	M/ICP	ppm	0.09	0.09	47.9	26
Ce	M/ICP	ppm	13.9	1.5	5.3	24
Co	M/ICP	ppm	23.8	5.6	11.7	32
Cr	M/ICP	ppm	676	100	7.4	23
Cs	M/ICP	ppm	5.10	2.25	22.0	24
Cu	M/ICP	ppm	34.9	9.3	13.3	31
Dy	M/ICP	ppm	1.48	0.88	29.8	16
Er	M/ICP	ppm	0.82	0.61	37.4	16
Eu	M/ICP	ppm	0.31	0.18	29.3	16
Fe	M/ICP	%	1.66	0.12	3.6	16
Ga	M/ICP	ppm	3.92	0.28	3.5	16
Gd	M/ICP	ppm	1.63	0.90	27.7	16
Ge	M/ICP	ppm	0.08	0.05	29.6	16
Hf	M/ICP	ppm	1.20	0.47	19.5	23
Ho	M/ICP	ppm	0.30	0.21	34.4	16
In	M/ICP	ppm	0.01	0.00	8.4	15
K	M/ICP	%	0.64	0.02	1.5	15
La	M/ICP	ppm	7.06	1.00	7.1	24
Li	M/ICP	ppm	32.4	2.6	4.0	23
Lu	M/ICP	ppm	0.09	0.03	18.4	16
Mg	M/ICP	%	1.42	0.50	17.6	24
Mn	M/ICP	ppm	2100	116	2.8	16
Mo	M/ICP	ppm	5.67	1.67	14.7	24
Na	M/ICP	%	0.29	0.10	17.1	24
Nb	M/ICP	ppm	3.57	0.28	3.9	16
Nd	M/ICP	ppm	8.65	5.68	32.9	16
Ni	M/ICP	ppm	36.3	17.3	23.8	31
P	M/ICP	ppm	158	14	4.3	16
Pb	M/ICP	ppm	18.0	10.9	30.2	32
Pd	M/ICP	ppm	0.005	0.008		7
Pr	M/ICP	ppm	2.28	1.53	33.6	16
Pt	M/ICP	ppm	0.01	0.01		5
Rb	M/ICP	ppm	44.7	6.3	7.0	24
Re	M/ICP	ppm	0.002	0.001	23.4	10
S	M/ICP	%	0.09	0.00	0.0	16
Sb	M/ICP	ppm	47.2	13.0	13.8	24
Sc	M/ICP	ppm	2.50	0.78	15.6	16
Se	M/ICP	ppm	0.78	0.49	31.1	16
Sm	M/ICP	ppm	1.64	1.12	34.2	16
Sn	M/ICP	ppm	2.02	0.29	7.1	25
Sr	M/ICP	ppm	49.7	6.0	6.1	24
Ta	M/ICP	ppm	1.00	0.26	12.8	18
Tb	M/ICP	ppm	0.24	0.12	24.3	16
Te	M/ICP	ppm	0.09	0.06	34.9	21
Th	M/ICP	ppm	5.91	2.00	17.0	30
Ti	M/ICP	%	0.12	0.01	3.2	16
Tl	M/ICP	ppm	0.24	0.03	6.0	21
Tm	M/ICP	ppm	0.14	0.13	47.0	16
V	M/ICP	ppm	50.0	3.0	3.0	22
W	M/ICP	ppm	2.13	0.31	7.2	16
Y	M/ICP	ppm	5.50	0.68	6.2	24
Yb	M/ICP	ppm	0.76	0.53	35.2	16
Zn	M/ICP	ppm	61.8	5.7	4.6	31
Zr	M/ICP	ppm	41.4	22.7	27.5	31