MATRIX REFERENCE MATERIALS
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AMIS0485

Certified Reference Material

Gold and Uranium Ore
Witwatersrand, South Africa

Certificate of Analysis

Recommended Concentrations and Limits[1. 2.]
(at two Standard Deviations)

Certified Concentration

Au Pb Collection	116.8	±	5.6	g/t
U 4A_MICP	8932	±	746.6	ppm
U XRF	8707	±	607.2	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 page 2 and uncertified trace element data presented as an appendix*
3. *Or, by applying a chemical conversion factor of U x 1.1793 = U3O8; U3O8 by multi acid digestion:10533 ±880.5 ppm, U3O8 by XRF 10268 ± 716.0 ppm.*

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Provisional Concentrations

Al_2O_3 XRF	6.42	±	0.09	%
CaO XRF	0.29	±	0.04	%
Cr_2O_3 XRF	0.17	±	0.01	%
Fe_2O_3 XRF	7.96	±	0.23	%
K_2O XRF	0.99	±	0.02	%
MgO XRF	0.46	±	0.08	%
MnO XRF	0.06	±	0.01	%
Na_2O XRF	0.42	±	0.20	%
P_2O_5 XRF	0.17	±	0.01	%
S Comb/LECO	4.79	±	0.23	%
SiO_2 XRF	73.41	±	0.53	%
TiO_2 XRF	0.59	±	0.02	%
U_3O_8 XRF	1.05	±	0.01	%
LOI	6.64	±	0.50	%
SG	2.84	±	0.04	Dimensionless

1. Intended Use: AMIS0485 can be used to check the analysis of gold and uranium ores, hosted by siliceous 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: This standard is a blend of Ventersdorp Contact Reef, Carbon Leader Reef and Vaal Reef material provided by Anglo Gold Ashanti in South Africa. It was made from a mixture of pulp reject sample material, collected during routine underground sampling.

3. Approximate Mineral and Chemical Composition: The major gangue mineral is quartz with minor pyrite, uraninite and thucolite. Gold occurs primarily as discrete grains. Trace element chemistry data from 19 of the labs has been compiled but has not been certified. Summary statistics for this data are set out in the appendix.

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

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 require special labeling and placarding. AMIS0485 contains U (108.84 Bq/g) and Th (3.47 Bq/g) and is classified as EXEMPTED 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 parti**c**le 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 scientifically 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, including HF, ICP- OES or ICP-MS. Multi element scan to include U (4A_MICP)
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, P_2O_5, U_3O_8 , LOI.) XRF fusion
5. SG (gas pycnometer)
6. S Combustion/LECO

9. Information requested

1. State aliquots used for all determinations
2. Report all results for gold and uranium 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.

10. Method of Certification: Twenty four laboratories were each given eight scientifically selected packages of sample. Nineteen 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 13), 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 19 out of 24 laboratories that provided results timeously were (not in same order as in the table of assays):

1. ALS Chemex Laboratory Group Johannesburg (South Africa)
2. Anglo Gold Asahnti Vaal
3. Argetest (Turkey)
4. BV Namibia
5. BV Ultratrace (Australia)
6. Chemical and Physical Analytical Lab (CPAL) Jordan (JAEC)
7. Genalysis Perth
8. Harmony
9. Quality Lab (Tanzania)
10. Ready Lead Assay Laboratory (South Africa)
11. Rossing Uranium Namibia
12. Set Point Laboratories (Husab) Namibia
13. Set Point Laboratories (Isando) SA
14. SGS Mineral Services Lakefield (Canada)
15. SGS Performance Barbeton (South Africa)
16. SGS South Africa (Pty) Ltd – Randfontein JHB
17. SGS Tarkwa (Ghana)
18. Shiva Analyticals (India)
19. Suntech Geomet (South Africa)

12. Assay Data: Data as received from the laboratories for the important certified elements listed on p1 are set out below.

Pb Coll Au g/t	Pb Coll Au g/t	XRF U ppm	4A_MICP U ppm
118.50	116.00	8990.00	8490.50
118.50	118.00	8960.00	8490.70
119.00	117.00	8950.00	8402.90
118.50	117.00	8980.00	8573.60
117.50	117.00	8960.00	8420.20
118.00	118.00	8990.00	8592.90
118.00	118.00	8990.00	8559.50
119.50	118.00	8980.00	8859.10
113.00	118.80	8318.88	9316.54
112.00	119.10	8294.29	9337.31
113.00	118.80	8280.72	9334.54
115.00	120.60	8299.38	9375.44
114.00	118.70	8348.56	9581.20
113.00	120.80	8329.90	9343.27
113.40	121.30	8329.06	9208.47
116.00	116.30	8331.60	9283.79
114.00	117.00	8882.00	9230.00
114.00	114.00	8915.00	9100.00
112.00	111.00	8909.00	9210.00
115.00	112.00	8850.00	8990.00
115.00	113.00	8931.00	9090.00
119.00	112.00	8904.00	9090.00
112.00	114.00	8951.00	8800.00
115.00	117.00	8926.00	9160.00
115.80	118.38	8440.00	8460.00
120.20	117.72	8510.00	8610.00
116.50	117.90	8430.00	8740.00
119.40	116.64	8450.00	8520.00
119.60	116.97	8490.00	8440.00
119.80	121.48	8450.00	8440.00
115.80	117.67	8490.00	8730.00
120.50	118.22	8360.00	8600.00
117.14		8904.00	9023.00
111.62		8904.00	9093.00
118.72		8819.20	9175.00
117.00		8819.20	9122.00
119.42		8904.00	9210.00
120.24		8988.80	9108.00
121.36		8988.80	9110.00
118.00		8734.40	9078.00

13. 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:

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 the relevant ISO guidelines.

Analyte	Method	Unit	S [1]	σL [2]	SW [3]	CSU [4]
Au	Pb Coll	g/t	2.80	3.53	3.40	0.93
U	4A_MICP	ppm	373.30	693.49	108.22	283.55
U	XRF	%	303.60	517.52	131.13	173.20

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 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.*

14. Certified values: The Certified, Provisional and Indicated values listed on p1 and p2 of this certificate fulfill the AMIS statistical criteria regarding agreement for certification and have been independently validated by Mr Allan W. Fraser.

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: AMIS0485 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 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.

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.

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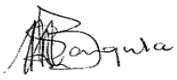
20. Recommended use: The data used to characterize this CRM has been scrutinized using outlier treatment techniques. This, together with the number of participating laboratories, should overcome any "inter-laboratory issues" and should lead to a very accurate measure for the given methods, notwithstanding 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, a part of Torre Industries, Nozibele Mbangula, and Allan W. Fraser; accept no liability for any decisions or actions taken following the use of the reference material.

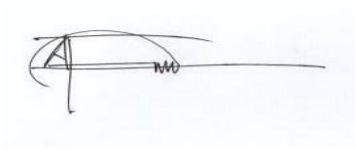
25 August 2016

Certifying Officers:



African Mineral Standards: _____

Nozibele Mbangula



Geochemist:_____

Allan W. Fraser
M.Sc. (Geology), N.D. (Analytical Chem.), Pr.Sci.Nat.

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Appendix – uncertified element statistics

Element	Gen Method	Std_Mean	N	SD	2SD	RSD_%	Unit
Ag	4A_MICP	8.01	40	2.82	5.64	35.24	ppm
Al	4A_MICP	33192.40	40	1906.69	3813.39	5.74	ppm
Al2O3	XRF	6.42	31	0.05	0.09	0.71	%
As	4A_MICP	1089.06	32	397.82	795.65	36.53	ppm
Au	4A_MICP	134.97	8	3.43	6.85	2.54	g/t
Ba	4A_MICP	297.29	24	12.31	24.61	4.14	ppm
Be	4A_MICP	4.61	39	0.42	0.84	9.11	ppm
Bi	4A_MICP	8.98	32	0.48	0.95	5.3	ppm
Ca	4A_MICP	2146.13	40	138	276	6.43	ppm
CaO	XRF	0.29	32	0.02	0.04	6.43	%
Cd	4A_MICP	1.51	32	0.3	0.6	19.73	ppm
Ce	4A_MICP	490.91	32	15.98	31.96	3.25	ppm
Co	4A_MICP	282.38	40	15.37	30.74	5.44	ppm
Cr	4A_MICP	874.28	32	234.95	469.9	26.87	ppm
Cr2O3	XRF	0.17	32	0.01	0.01	3.77	%
Cs	4A_MICP	11.89	31	0.67	1.35	5.67	ppm
Cu	4A_MICP	121.90	40	12.29	24.58	10.08	ppm
Dy	4A_MICP	81.28	24	5.04	10.07	6.2	ppm
Er	4A_MICP	39.00	24	5	10	12.83	ppm
Eu	4A_MICP	7.93	22	0.24	0.49	3.08	ppm
Fe	4A_MICP	55471.75	40	3262.59	6525.17	5.88	ppm
Fe2O3	XRF	7.96	32	0.11	0.23	1.42	%
Ga	4A_MICP	13.06	32	4.55	9.11	34.88	ppm
Gd	4A_MICP	62.07	23	1.87	3.74	3.01	ppm
Ge	4A_MICP	0.58	16	0.28	0.56	48.63	ppm
Hf	4A_MICP	20.02	32	2.79	5.59	13.96	ppm
Ho	4A_MICP	14.48	23	0.62	1.23	4.25	ppm
Ind	4A_MICP	0.09	32	0.01	0.02	8.71	ppm
K	4A_MICP	8171.92	39	269.66	539.31	3.3	ppm
K2O	XRF	0.99	30	0.01	0.02	0.83	%
La	4A_MICP	241.47	32	32.44	64.88	13.44	ppm
Li	4A_MICP	12.82	39	1.06	2.12	8.27	ppm
LOI	LOI	6.64	40	0.25	0.5	3.73	%
Lu	4A_MICP	3.58	32	0.2	0.4	5.6	ppm
Mg	4A_MICP	2736.75	40	149.77	299.55	5.47	ppm
MgO	XRF	0.46	31	0.04	0.08	8.94	%
Mn	4A_MICP	424.87	39	20.55	41.1	4.84	ppm
MnO	XRF	0.06	31	0.01	0.01	11.84	%
Mo	4A_MICP	25.01	36	0.65	1.3	2.61	ppm
Na	4A_MICP	2564.20	40	132.86	265.72	5.18	ppm
Na2O	XRF	0.42	32	0.1	0.2	23.69	%
Nb	4A_MICP	19.98	40	2.25	4.49	11.24	ppm
Nd	4A_MICP	184.62	22	2.82	5.64	1.53	ppm
Ni	4A_MICP	779.30	40	33.92	67.85	4.35	ppm
P	4A_MICP	663.63	32	69.14	138.28	10.42	ppm
P2O5	XRF	0.17	23	0	0.01	2.61	%
Pb	4A_MICP	3883.80	40	209.37	418.73	5.39	ppm
Pr	4A_MICP	53.12	24	2.28	4.57	4.3	ppm
Rb	4A_MICP	39.68	32	3.09	6.18	7.79	ppm
S	4A_MICP	4.98	32	0.7	1.4	14.1	%
S	Comb/LECO	4.79	23	0.11	0.23	2.36	%
Sb	4A_MICP	35.21	40	7.67	15.34	21.79	ppm
Sc	4A_MICP	11.92	31	0.73	1.46	6.11	ppm
Se	4A_MICP	6.60	20	5.68	11.36	86.05	ppm
SG	SG	2.84	24	0.02	0.04	0.73	g/cm3
Si	4A_MICP	34.41	8	0.16	0.31	0.45	%
SiO2	XRF	73.41	30	0.27	0.53	0.36	%
Sm	4A_MICP	49.49	24	3.68	7.36	7.43	ppm
Sn	4A_MICP	4.96	24	0.64	1.28	12.93	ppm
Sr	4A_MICP	157.41	39	8.73	17.46	5.55	ppm
Ta	4A_MICP	10.00	36	2.68	5.36	26.82	ppm
Tb	4A_MICP	12.77	31	0.57	1.14	4.47	ppm
Te	4A_MICP	0.71	31	0.16	0.32	22.71	ppm
Th	4A_MICP	848.97	31	31.65	63.29	3.73	ppm
Ti	4A_MICP	0.25	40	0.06	0.12	23.23	%
TiO2	XRF	0.59	32	0.01	0.02	1.84	%
Tl	4A_MICP	1.10	32	0.74	1.47	66.89	ppm
Tm	4A_MICP	4.93	24	0.71	1.42	14.36	ppm
U3O8	XRF	1.05	15	0.01	0.01	0.57	%
V	4A_MICP	31.50	32	1.85	3.7	5.87	ppm
W	4A_MICP	3.12	32	1.56	3.12	50.01	ppm
Y	4A_MICP	306.31	32	21.35	42.69	6.97	ppm
Yb	4A_MICP	28.35	32	5.86	11.71	20.66	ppm
Zn	4A_MICP	283.63	40	23.87	47.74	8.42	ppm
Zr	4A_MICP	671.13	40	108.86	217.72	16.22	ppm