



# African Mineral Standards

## Gold and Uranium Ore Witwatersrand Reference Material High Ore Grade

**AMIS0100**

### *Certificate of Analysis*

#### Certified Concentration and two “Between Laboratory” Standard Deviations

Au Pb Collection	44.97	±	3.1	g/t
U M/ICP	1474	±	76	ppm
U XRF	1480	±	52	ppm
Specific Gravity	2.77	±	0.14	g/cc

(\* Or, by applying a chemical conversion factor of  $U \times 1.1793 = U_3O_8$   
 $U_3O_8$  by multi acid digestion:  $1738 \pm 90$  ppm  
 $U_3O_8$  by XRF:  $1745 \pm 61$  ppm)

**Certified Concentration and two “Between Laboratory” Standard Deviations  
(major elements)**

Al <sub>2</sub> O <sub>3</sub>	2.22	±	0.06	%
Cr <sub>2</sub> O <sub>3</sub>	0.17	±	0.004	%
Fe <sub>2</sub> O <sub>3</sub>	5.26	±	0.072	%
K <sub>2</sub> O	0.31	±	0.02	%
LOI	2.46	±	0.22	%
MnO	0.05	±	0.004	%
SiO <sub>2</sub>	87.98	±	1.16	%
TiO <sub>2</sub>	0.19	±	0.01	%

**Provisional Concentration and two “Between Laboratory” Standard Deviations  
(major elements)**

CaO	0.11	±	0.02	%
MgO	0.58	±	0.10	%

**Indicated Mean (major elements)**

Na <sub>2</sub> O	0.034	%
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**Additional uncertified major element data**

This data is displayed for informative purposes only. Insufficient data for certification was submitted by the laboratories for P<sub>2</sub>O<sub>5</sub> and S.

ELEMENT	MEAN	2SD	RSD%	n
P <sub>2</sub> O <sub>5</sub>	0.04	0.002	2.0	30
S	2.37	0.26	5.5	31

**Intended use:** AMIS0100 was primarily produced to monitor the accuracy of a single analysis of gold ores hosted by siliceous rocks.

The additional geochemical data gathered however also enables its use as a uranium standard and for routine quality control during geochemical exploration programs, by insertion within a batch of stream sediment or soil samples.

It can also be used by laboratories for method development and for the calibration of equipment.

The recommended mean and "Between Lab" standard deviations for this standard reflect the average 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 and this is acceptable. Good laboratories however will report results within the two standard deviation levels with a failure of <10 %.

**Origin of material:** This standard was made from grade-sorted pulp rejects sourced from Anglo Gold Ashanti mine assay laboratories in South Africa. It represents sample material from the basal contacts of the Vaal Reef and the Carbon Leader Reef collected during routine underground sampling.

**Mineral and chemical composition:** The major gangue mineral is quartz with minor pyrite, uraninite and thucolite. Gold occurs primarily as discrete grains.

**Method of preparation:** The material was crushed, dry-milled and air-classified to 100% <54um. Wet sieve particle size analysis of random samples confirmed the material was 100% <54um. It was then blended in a bi-conical mixer, systematically divided and then sealed into 1kg Laboratory Packs. Samples were randomly selected for homogeneity testing and third party analysis. Statistical analysis for the consensus test results were carried out by an independent statistician. Explorer Packs are subdivided from the Laboratory packs as required.

**Methods of analysis requested:**

1. Au. ICP-OES, Pb collection.
2. SG ( gas pycnometer )
3. Multi-acid total digestion, including HF, ICP-OES or MS multi-element scan.
4. XRF fusion whole rock analysis.

**Method of certification:** Twenty three laboratories were each given eight randomly selected packages of sample. The results from the twenty laboratories that issued results timeously were used for the Au, U and SG determinations. Results from fifteen laboratories that reported multi-element scans and whole rock analyses were used for the major minor element determinations. Results for all of the methods are set out below:

**Assay data**

Lab Code	Au Pb Coll g/t	U M ICP ppm	U XRF ppm	SG g/cc	Al2O3 XRF %	CaO XRF %	Cr2O3 XRF %	Fe2O3 XRF %	K2O XRF %	LOI %	MgO XRF %	MnO XRF %	Na2O XRF %	P2O5 XRF %	S XRF %	SiO2 XRF %	TiO2 XRF %
B	44.14	1444	1416	3.25	2.22	0.11	0.17	5.31	0.32	2.01	0.52	0.05	0.10		2.43	88.75	0.19
B	46.03	1469	1436	3.16	2.21	0.11	0.17	5.26	0.32	2.06	0.52	0.05	0.09		2.37	88.31	0.18
B	44.79	1454	1419	3.02	2.20	0.11	0.17	5.30	0.32	2.17	0.52	0.05	0.09		2.35	88.49	0.19
B	44.29	1508	1465	2.89	2.21	0.11	0.17	5.30	0.32	2.07	0.52	0.05	0.10		2.46	88.74	0.18
B	44.45	1487	1473	3.03	2.20	0.11	0.17	5.21	0.32	2.06	0.51	0.05	0.10		2.47	87.81	0.18
B	45.05	1485	1488	2.91	2.21	0.12	0.17	5.29	0.32	2.10	0.52	0.05	0.10		2.49	88.45	0.19
B	41.50	1443	1499	3.24	2.19	0.11	0.17	5.26	0.32	2.05	0.52	0.05	0.09		2.40	88.15	0.18
B	43.94	1461	1484	2.96	2.19	0.11	0.18	5.25	0.32	2.19	0.52	0.05	0.09		2.36	87.92	0.18
C	42.80				2.07	0.11	0.17	4.99	0.31		0.64	0.04	0.02	0.04		87.28	0.21
C	42.30				2.07	0.11	0.16	4.99	0.31		0.65	0.04	0.01	0.04		87.44	0.20
C	42.40				2.05	0.10	0.16	4.99	0.30		0.64	0.04		0.04		87.19	0.19
C	43.50				2.06	0.11	0.17	5.01	0.30		0.64	0.04	0.02	0.04		87.23	0.20
C	43.00				2.08	0.11	0.16	5.07	0.31		0.64	0.04		0.04		87.67	0.19
C	43.70				2.08	0.11	0.17	4.98	0.31		0.65	0.04	0.03	0.04		87.22	0.19
C	43.10				2.08	0.11	0.17	4.97	0.31		0.64	0.04	0.02	0.04		87.77	0.20
C	43.60				2.08	0.11	0.17	4.93	0.31		0.64	0.04	0.01	0.04		87.28	0.19
D	45.60	1330	1428		2.24	0.11	0.18	5.25	0.31		0.52	0.04	0.52	0.05	2.29	88.90	0.19
D	44.80	1310	1431		2.21	0.11	0.17	5.25	0.31		0.51	0.04	0.51	0.04	2.32	88.90	0.19
D	44.90	1310	1390		2.25	0.11	0.17	5.20	0.31		0.52	0.04	0.52	0.04	2.31	88.80	0.19
D	45.50	1300	1371		2.23	0.11	0.17	5.21	0.31		0.51	0.04	0.51	0.04	2.28	88.40	0.19
D	43.70	1310	1425		2.26	0.11	0.17	5.26	0.31		0.52	0.04	0.52	0.04	2.32	88.60	0.19
D	45.90	1320	1276		2.26	0.11	0.17	5.28	0.32		0.52	0.04	0.52	0.04	2.33	89.10	0.19
D	41.60	1270	1377		2.25	0.11	0.17	5.29	0.31		0.52	0.04	0.52	0.04	2.34	89.10	0.19
D	45.80	1350	1407		2.25	0.11	0.17	5.28	0.31		0.51	0.04	0.51	0.04	2.31	88.80	0.19
F	46.07	1703	1443	2.76	1.85	0.16	0.21	5.12	0.32	2.51	1.10	0.05	0.03	0.03	2.26	86.23	0.20
F	45.28	1685	1441	2.79	1.84	0.17	0.27	5.03	0.30	2.51	1.10	0.05	0.03	0.03	2.23	86.12	0.19
F	44.32	1709	1462	2.76	1.89	0.18	0.18	5.12	0.32	2.51	1.10	0.05	0.03	0.03	2.23	86.25	0.20
F	45.77	1696	1449	2.79	1.90	0.17	0.17	5.01	0.30	2.51	1.10	0.05	0.02	0.03	2.24	86.20	0.19
F	43.52	1703	1454	2.76	1.80	0.16	0.18	5.14	0.31	2.52	1.10	0.05	0.01	0.02	2.17	86.40	0.20
F	44.61	1693	1444	2.76	1.75	0.15	0.17	5.02	0.30	2.52	1.00	0.05	0.02	0.03	2.18	86.64	0.19
F	44.95	1690	1460	2.77	1.84	0.17	0.21	5.13	0.31	2.54	1.10	0.05	0.01	0.03	2.22	86.25	0.20
F	46.07	1713	1444	2.76	1.80	0.16	0.22	5.02	0.32	2.50	1.10	0.05	0.01	0.02	2.19	86.36	0.19
G	45.20	1530	1490		2.18	0.12	0.17	5.25	0.33	2.47	0.56	0.05	0.05			87.10	0.18
G	45.30	1480	1490		2.18	0.12	0.17	5.25	0.33	2.50	0.57	0.05	0.05			87.00	0.19
G	44.70	1480	1480		2.21	0.12	0.17	5.27	0.33	2.45	0.57	0.05	0.04			87.00	0.18
G	47.20	1520	1480		2.18	0.12	0.17	5.26	0.32	2.44	0.57	0.05	0.05			87.00	0.19
G	42.90	1490	1490		2.18	0.12	0.17	5.25	0.32	2.45	0.57	0.05	0.05			87.20	0.19
G	47.50	1500	1460		2.21	0.12	0.17	5.24	0.33	2.42	0.56	0.05	0.05			87.20	0.19
G	46.60	1530	1490		2.18	0.12	0.17	5.26	0.33	2.43	0.56	0.05	0.05			87.30	0.19
G	45.30	1530	1490		2.19	0.12	0.17	5.24	0.32	2.43	0.57	0.05	0.05			87.10	0.19
I	43.50	1450	1500	2.74	2.26	0.10	0.17	5.24	0.30	2.50	0.63	0.05	0.02	0.04	2.54	87.41	0.17
I	39.90	1470	1500	2.68	2.25	0.10	0.17	5.26	0.30	2.50	0.63	0.05	0.02	0.04	2.51	87.84	0.16
I	41.50	1410	1500	2.67	2.24	0.10	0.17	5.23	0.30	2.52	0.63	0.05	0.02	0.04	2.50	87.80	0.16
I	44.00	1510	1500	2.72	2.24	0.10	0.17	5.26	0.30	2.51	0.63	0.05	0.02	0.04	2.66	87.66	0.16
I	43.60	1430	1500	2.72	2.25	0.10	0.17	5.24	0.30	2.51	0.63	0.05	0.02	0.04	2.52	87.68	0.16
I	32.20	1460	1500	2.71	2.27	0.10	0.17	5.24	0.30	2.51	0.63	0.05	0.02	0.04	2.56	87.97	0.16
I	40.10	1470	1500	2.80	2.26	0.10	0.17	5.28	0.31	2.51	0.63	0.05	0.03	0.04	2.58	88.00	0.16
I	44.20	1450	1500	2.76	2.25	0.10	0.17	5.25	0.30	2.51	0.63	0.05	0.02	0.04	2.54	87.89	0.16
J	42.90	1420	1550	2.64	2.09	0.10	0.16	4.97		2.29	0.40	0.05	0.05			83.20	0.18
J	44.20	1440	1580	2.65	2.09	0.10	0.16	4.97		2.36	0.40	0.05	0.06			83.10	0.18
J	44.00	1460	1570	2.66	2.05	0.10	0.16	4.94		2.41	0.40	0.05	0.05			83.10	0.18
J	46.50	1420	1570	2.65	2.07	0.09	0.16	4.93		2.35	0.39	0.05	0.05			83.20	0.19
J	45.30	1440	1600	2.66	2.05	0.10	0.16	5.05		2.34	0.41	0.05	0.04			83.10	0.18
J	48.20	1430	1550	2.65	2.07	0.10	0.15	5.02		2.36	0.41	0.05	0.04			83.20	0.18
J	45.90	1430	1590	2.64	2.08	0.10	0.15	4.99		2.41	0.40	0.05	0.04			83.10	0.18
J	50.70	1400	1570	2.66	2.06	0.10	0.16	4.94		2.31	0.39	0.05	0.06			83.30	0.18

### Assay data (cont)

Lab Code	Au Pb Coll g/t	U M ICP ppm	U XRF ppm	SG g/cc	Al2O3 XRF %	CaO XRF %	Cr2O3 XRF %	Fe2O3 XRF %	K2O XRF %	LOI %	MgO XRF %	MnO XRF %	Na2O XRF %	P2O5 XRF %	S XRF %	SiO2 XRF %	TiO2 XRF %
K	45.20	1510	1518	2.76	2.06	0.33	0.17	5.30		2.56	0.56	0.05	0.13	0.04		88.44	0.19
K	45.50	1420	1484	2.75	2.19	0.25	0.17	5.29		2.63	0.58	0.05	0.14	0.04		87.95	0.19
K	46.00	1540	1484	2.73	2.17	0.10	0.17	5.27		2.67	0.57	0.05	0.14	0.04		88.08	0.19
K	45.50	1480	1476	2.74	2.16	0.10	0.17	5.28		2.67	0.58	0.05	0.13	0.04		87.85	0.19
K	45.50	1490	1501	2.74	2.20	0.11	0.18	5.29		2.56	0.56	0.05	0.14	0.04		88.14	0.19
K	44.80	1500	1493	2.71	2.20	0.10	0.17	5.31		2.77	0.57	0.05	0.14	0.04		88.23	0.19
K	45.10	1420	1484	2.74	2.24	0.10	0.17	5.28		2.42	0.58	0.05	0.13	0.04		87.85	0.18
K	45.30	1550	1459	2.71	2.18	0.09	0.17	5.25		2.68	0.57	0.05	0.13	0.04		87.68	0.19
L	45.53		1431	2.75													
L	43.31		1437	2.75													
L	44.51		1438	2.76													
L	45.68		1470	2.77													
L	44.57		1464	2.77													
L	44.50		1423	2.78													
L	43.77		1457	2.80													
L	44.41		1481	2.80													
M	42.16																
M	44.63																
M	43.57																
M	44.22																
M	43.43																
M	44.13																
M	44.55																
M	43.63																
N	44.20	1600	1508	2.83	2.17	0.11	0.17	5.20	0.31	2.64	0.58	0.04	0.06			86.20	0.18
N	46.30	1600	1498	2.76	2.25	0.11	0.18	5.19	0.30	2.59	0.59	0.04	0.06			88.20	0.19
N	46.70	1600	1489	2.75	2.23	0.11	0.17	5.19	0.32	2.62	0.61	0.04	0.06			88.30	0.19
N	45.70	1600	1493	2.77	2.23	0.12	0.17	5.26	0.32	2.59	0.63	0.05	0.07			88.00	0.19
N	43.00	1600	1487	2.77	2.25	0.12	0.17	5.38	0.32	2.52	0.61	0.04	0.06			89.50	0.19
N	44.50	1500	1494	2.79	2.23	0.11	0.18	5.32	0.33	2.66	0.63	0.05				89.00	0.19
N	45.60	1600	1504	2.77	2.24	0.11	0.17	5.33	0.31	2.58	0.62	0.05	0.07			88.80	0.19
N	45.40	1500	1492	2.79	2.25	0.11	0.17	5.33	0.31	2.61	0.61	0.05	0.07			88.40	0.19
O	45.40																
O	45.45																
O	43.85																
O	45.05																
O	45.00																
O	45.55																
O	45.90																
O	45.25																
P	46.50																
P	46.60																
P	43.60																
P	47.10																
P	44.80																
P	45.40																
P	45.10																
P	46.20																
Q	47.60	1350	1530		2.23	0.12	0.18	5.23	0.31	2.29	0.57	0.05	0.02			87.97	0.18
Q	47.20	1500	1530		2.23	0.12	0.17	5.22	0.31	2.32	0.58	0.05	0.02			88.18	0.18
Q	46.70	1470	1530		2.22	0.12	0.17	5.18	0.31	2.27	0.57	0.05	0.01			88.11	0.18
Q	47.50	1420	1520		2.21	0.11	0.17	5.22	0.31	2.35	0.58	0.05	0.02			87.99	0.18
Q	46.50	1340	1520		2.23	0.12	0.17	5.22	0.31	2.27	0.58	0.05	0.03			87.98	0.18
Q	47.10	1310	1530		2.23	0.12	0.17	5.26	0.31	2.26	0.58	0.05	0.02			88.16	0.18
Q	47.40	1320	1510		2.22	0.11	0.18	5.22	0.31	2.39	0.58	0.05	0.03			88.09	0.18
Q	46.50	1390	1530		2.23	0.12	0.18	5.23	0.31	2.33	0.58	0.05	0.02			88.20	0.18
R	45.28	1510															
R	41.94	1450															
R	45.10	1450															
R	45.72	1490															
R	41.62	1520															
R	42.56	1460															
R	45.71	1460															
R	41.64	1440															
S	48.40		1590														
S	49.40		1590														
S	48.70		1590														
S	48.70		1570														
S	49.50		1590														
S	48.20		1580														
S	48.50		1580														
S	47.40		1550														
T	40.74	1490															
T	41.18	1489															
T	42.39	1408															
T	40.54	1441															
T	44.68	1415															
T	40.79	1435															
T	40.05	1488															
T	44.76	1443															
U	45.30	1520	1440	2.82													
U	45.40	1510	1445	2.83													
U	44.50	1490	1480	2.82													
U	45.70	1470	1465	2.81													
U	46.20	1480	1480	2.81													
U	45.50	1390	1475	2.81													
U	45.60	1460	1495	2.82													
U	45.20	1470	1460	2.81													
V	44.50	1511															
V	44.00	1490															
V	44.30	1546															
V	44.20	1490															
V	44.80	1527															
V	45.10	1555															
V	40.20	1512															
V	41.70	1540															
W	49.50		1450	2.88						2.36							
W	50.20		1467	2.87						2.37							
W	50.90		1459	2.88						2.34							
W	49.90		1467	2.90						2.36							
W	50.30		1467	2.88						2.30							
W	50.70		1459	2.90						2.36							
W	51.10		1467	2.89						2.35							
W	51.40		1459	2.87						2.32							

The mean and standard deviation for all data was calculated. Outliers were defined as samples beyond the mean  $\pm 2$  Standard Deviations from all data. These outliers were removed from the data and a new mean and standard deviation was determined. Total results from some laboratories that reported significant failures were also removed. This method is different from that used to calculate the Confidence Interval shown on many Government-produced standards in that the actual "between-laboratory" standard deviation is used in the calculations. This produces upper and lower limits that reflect actual individual analyses rather than a grouped set of analyses. The limits can therefore be used to monitor accuracy from individual analyses, unlike the Certified Limits published on other standards which quote a Confidence Interval.

**Participating laboratories:** (Not in same order as in the table of assays)

1. ACME Analytical Laboratories Ltd CA
2. Activation Laboratories Pty Ltd (ActLabs) CA
3. ALS Chemex Laboratory Group Johannesburg SA
4. ALS Chemex Laboratory Group Perth WA
5. ALS Chemex Laboratory Group Vancouver CA
6. Ammtec Limited WA
7. Anglo Gold Ashanti - Vaal River Laboratory SA
8. Anglo Gold Ashanti - West Wits Laboratory SA
9. Anglo Research (Crown Campus)
10. Assayers Canada
11. Becquerel Laboratories Inc CA
12. Genalysis Laboratory Services WA
13. Intertek Utama Services (Indonesia)
14. Labtium Inc Finland
15. Set Point Laboratories (Isando) SA
16. SGS Australia Pty Ltd (Newburn) WA
17. SGS Lakefield Research Africa (Pty) Ltd (Booyens SA)
18. Super Laboratory - Klerksdorp
19. Super Laboratory Services SA
20. Ultra Trace (Pty) Ltd WA

**Radioactivity:** Shipments of this material require special labeling and placarding. AMIS0100 contains U (18.5 Bq/g) and Th (0.5 Bq/g) and is classified as EXCEPTED 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".

**Availability:** This product is available in Laboratory Packs containing 1kg of material or in Explorer Packs containing client specified weights of material from 50g up to 250g. Laboratory Packs are sealed bottles delivered in sealed foil pouches. Explorer Packs contain material in standard geochem envelopes placed into foil pouches that are nitrogen flushed and vacuum sealed.

**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.

5 February 2009

**Certifying officers:**



**African Mineral Standards:** \_\_\_\_\_

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



**Geochemist:** \_\_\_\_\_

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