African Mineral Standards
REFERENCE MATERIALS FOR AFRICAN ORES

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AMIS0193

Certified Reference Material

Platinum (PGM), Merensky Concentrate Bushveld Complex, South Africa

Certificate of Analysis

Recommended Concentrations and Limits[1.]

(at two Standard Deviations)

Certified Concentrations[2]

Pt Pb Collection	44.45	±	3.14	g/t
Pd Pb Collection	20.20	±	1.64	g/t
Au Pb Collection	2.81	±	0.18	g/t
Pt NIS	44.29	±	4.82	g/t
Pd NIS	20.46	±	0.82	g/t
Au NIS	2.74	±	0.28	g/t
Ir NiS	1.70	±	0.12	g/t
Rh NiS	4.51	±	0.30	g/t
Ru NiS	8.08	±	0.90	g/t
Co M/ICP	364	±	36	ppm
Co P	352	±	28	ppm
Cu M/ICP	8416	±	534	ppm
Cu P	8483	±	576	ppm
Ni M/ICP	13132	±	1185	ppm
Ni P	12990	±	1320	ppm
Ni XRF	13547	±	338	ppm
Specific Gravity	3.14	±	0.18	

Provisional Concentrations

Co XRF	422	±	99	ppm

4E (Pt, Pd, Au & Rh) = 71.97 g/t

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 two "Between Laboratory" Standard Deviations

Certified Concentrations

Al_2O_3	7.77	±	0.40	%
CaO	4.82	±	0.12	%
Cr_2O_3	1.26	±	0.10	%
Fe_2O_3	15.61	±	0.48	%
MgO	16.94	±	0.44	%
MnO	0.17	±	0.01	%
SiO_2	45.70	±	0.68	%
TiO_2	0.202	±	0.014	%
S LECO	3.69	±	0.18	%

Provisional Concentration

K_2O	0.121	±	0.024	%
LOI	3.51	±	0.74	%

1. Intended Use: AMIS0193 is a certified reference material which may be used to demonstrate the validity of measurement results of a single analysis of PGE, Cu and Ni concentrate materials; derived from the Merensky Reef, or from other mafic 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 Section 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: AMIS0193 is a commissioned CRM made from material supplied by SGS Minerals Services, using Anglo Platinum Merensky Reef Pt/Pd concentrate material, from the Western Limb of the Bushveld complex.

3. Mineral and Chemical Composition: The Merensky Reef comprises components of feldspathic pyroxenite, pyroxenite and anorthosite. Peak PGE values are associated with a thin chromitite stringer. Mineralization in this Merensky Reef comprises 2-5% disseminated or net textured magmatic sulphides, predominantly pyrrhotite, pentlandite, chalcopyrite and pyrite. The PGE's occur as micron-sized satellite grains around but rarely within the sulphides.

Major element chemistry data from 16 of the labs has been compiled and certified. Uncertified summary statistics for trace element data are set out in the appendix.

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

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 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 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. Pt, Pd and Au. ICP-OES or ICP-MS, Pb collection with Ag as a co-collector.
2. Au, Pt, Pd, Rh, Ru and Ir. ICP-MS, nickel sulphide collection.
3. Cu and Ni. Multi-acid total digestion, including HF, with ICP-OES finish.
4. Cu and Ni. Aqua regia digestion with ICP-OES finish.
5. Cr, Co, Cu and Ni. Pressed pellet XRF.
6. Cr, Co, Cu and Ni. Fusion, ICP-OES or ICP-MS
7. Specific Gravity. Gas pycnometer.
8. XRF (major elements).
9. Multi acid digest ICP scan – trace elements.

Additionally, XRF analyses were requested for the major elements and a multi-element multi acid digest and ICP scan was requested for the trace elements.

8. Information requested:

1. Aliquots used for all determinations.
2. Results for individual PGM's reported in ppb.
3. Results for base metals reported in ppm.
4. QC data, to include replicates blanks and certified reference materials used.
5. Analytical techniques used.

9. Method of Certification: Twenty five laboratories were each given eight randomly selected packages of sample. Nineteen of the laboratories submitted results.

The final limits were calculated after a three step examination of the data, first removing incompatible data outside a spread normally expected for similar analytical methods done by reputable laboratories. Then, data from any one laboratory was removed from further calculations, if the mean of all analyses from that laboratory failed a t-test of the global means of the other laboratories. Next, data that fell outside of the 2 standard deviations were removed. The mean and standard deviations were then re-calculated.

Analytes with an RSD of near or less than 5 % are reported as “Certified Concentrations” with limits at two “Between Laboratory” standard deviations. Those with RSD’s of between near 5 % and 15 % are reported as “Provisional Concentrations” with limits at two “Between Laboratory” standard deviations. Those with RSD’s over 15 % are reported as “Informational Values”.

This method is different from that used by Government agencies 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 Confidence Limits published on other standards**.**

10. Participating Laboratories: The 19 out of 25 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 Johannesburg SA
3. ALS Chemex Laboratory Group Lima Peru
4. ALS Chemex Laboratory Group Perth WA
5. ALS Chemex Laboratory Group Vancouver CA
6. Anglo Research (South Africa)
7. Genalysis Laboratory Services (South Africa) Pty
8. Genalysis Laboratory Services WA
9. Northam Mine Laboratory SA
10. Performance Laboratories SA
11. Rappa Research Laboratory SA
12. Set Point Laboratories (Isando) SA
13. SGS Geosol Laboratories Ltda (Brazil)
14. SGS Mineral Services Callao (Peru)
15. SGS Mineral Services Lakefield (Canada)
16. SGS South Africa (Pty) Ltd - Booysens JHB
17. SGS Toronto (Canada)
18. SGS Townsville (Australia)
19. Ultra Trace (Pty) Ltd WA

11. Assay Data: Data as received from the laboratories for the important certified elements are set out below.

Economic element data

Lab Code	Pt PbColl g/t	Pd PbColl g/t	Au PbColl g/t	Pt NIS g/t	Pd NIS g/t	Au NIS g/t	Ir NiS g/t	Rh NiS g/t	Ru NiS g/t	Co M/ICP ppm	Co P ppm	Co XRF ppm	Cu M/ICP ppm	Cu P ppm	Cu XRF ppm	Ni M/ICP ppm	Ni P ppm	Ni XRF ppm
C	41.04	16.46	2.51							352	329	300	8248	7779	9500	13634		13600
C	36.01	14.74	2.29							336	319	400	8326	7830	9000	13252		14300
C	39.72	15.72	2.52							338	316	400	8097	7655	9400	13781		13700
C	40.20	15.68	2.56							333	311	400	8320	7644	9400	13417		13700
C	40.10	15.85	2.61							332	309	400	8230	7560	9500	13213		14000
C	40.58	15.97	2.50							339	310	400	8106	7600	9600	13864		14200
C	40.80	16.10	2.53							348	314	500	8287	7598	9600	13900		13600
C	41.13	16.11	2.55							351	316	500	8211	7744	8900	13950		13500
D	46.70	19.20	2.73							346	327		7660	7730		13300	12100	
D	44.20	19.30	2.64							362	383		8080	9280		13700	12100	
D	39.20	18.40	2.61							357	343		8110	8360		14200	12300	
D	43.50	19.10	2.70							366	344		8130	8180		13800	12000	
D	48.00	20.10	2.92							357	348		8050	8270		13400	12000	
D	44.60	18.90	2.71							367	356		8140	8350		13200	12100	
D	45.70	19.30	2.68							386	348		8320	8290		13100	12100	
D	41.60	19.20	2.66							372	338		8120	8100		13100	12200	
E	46.50	20.80	2.89							383	381		8060	8200		12000	13600	
E	46.40	20.80	2.82							379	371		7920	8210		12500	13500	
E	46.80	21.00	2.80							388	376		8210	8350		12300	13700	
E	47.10	21.00	2.75							384	370		8230	8110		12700	13700	
E	45.60	20.60	2.80							389	375		8340	8290		12700	13700	
E	46.40	21.00	2.88							370	368		8630	8080		12900	13400	
E	46.50	20.70	2.80							378	377		7900	8240		12900	13600	
E	44.60	20.00	2.66							385	375		8070	8130		12400	13400	
G	44.34	19.33	2.71							330		400	6800		8500			13300
G	43.80	19.22	2.68							330		400	7700		8500			13400
G	45.48	20.42	2.97							390		400	9100		8400			13400
G	44.66	19.72	2.76							360		400	8300		8400			13500
G	44.14	19.09	2.69							340		400	7900		8500			13500
G	43.58	19.46	2.71							330		400	7300		8400			13200
G	44.69	19.67	2.89							370		400	8600		8300			13100
G	44.69	19.88	2.89							320		400	7600		8500			13300
H			2.86							376	355		8356	8318			14000	
H			2.88							387	359		8362	8396			14000	
H			2.87							388	360		8379	8366			14000	
H			2.81							382	356		8454	8328			14000	
H			2.87							379	358		8431	8343			13800	
H			2.90							385	365		8468	8393			14200	
H			2.79							376	362		8385	8374			14000	
H			2.79							384	358		8382	8340			14200	
I	43.50	20.80	2.93	43.70	20.60	2.98	1.76	4.19	7.36	338	353	352	8650	8310	8843	14200	13600	13715
I	43.20	20.60	2.91	43.40	20.50	2.91	1.63	4.18	7.56	333	357	352	8770	8580	8724	14200	13700	13551
I	44.70	20.50	2.86	43.60	20.40	2.98	1.71	4.22	7.52	334	355	354	8950	8690	8749	14100	13600	13601
I	43.60	20.70	2.92	43.40	20.70	2.93	1.71	4.19	7.49	339	350	353	8950	8540	8787	14300	13600	13638
I	43.20	20.50	2.82	43.80	20.50	2.92	1.71	4.09	7.21	337	352	356	8760	8550	8829	14200	13600	13719
I	43.50	20.70	2.83	43.10	20.80	2.97	1.69	4.27	7.41	340	353	355	8990	8550	8787	14100	13600	13646
I	43.70	20.90	2.93	43.50	20.50	2.92	1.66	4.31	7.30	334	355	352	8730	8510	8838	14000	13500	13707
I	44.60	20.30	2.75	44.00	20.60	2.95	1.69	4.36	7.28	336	354	351	8690	8460	8822	14000	13600	13698
J	46.32	22.00	2.92	44.87	20.00	2.69	1.69	4.55	7.99	346	339		8395	7661		13108	12105	
J	41.74	19.64	2.77	45.65	20.43	2.72	1.73	4.64	8.23	349	344		8272	7791		12845	12283	
J	46.30	22.29	2.96	45.97	20.43	2.72	1.76	4.59	8.21	344	341		8572	7902		13137	12267	
J	46.37	21.99	2.95	46.23	19.88	2.71	1.74	4.54	7.93	346	346		8259	8065		12885	12527	
J	47.26	22.28	3.00	45.19	20.21	2.66	1.72	4.63	8.27	329	354		8065	8159		12739	12510	
J	46.59	21.87	2.91	44.39	20.03	2.58	1.70	4.56	7.92	339	340		8443	7966		13123	12199	
J	46.31	21.82	2.88	46.51	20.66	2.74	1.76	4.69	8.33	339	337		8383	7926		12986	12156	
J	44.10	20.36	2.73	45.56	20.26	2.68	1.74	4.63	8.20	337	348		8318	8134		13021	12543	

Economic element data (cont)

Lab Code	Pt PbColl g/t	Pd PbColl g/t	Au PbColl g/t	Pt NiS g/t	Pd NiS g/t	Au NiS g/t	Ir NiS g/t	Rh NiS g/t	Ru NiS g/t	Co M/ICP ppm	Co P ppm	Co XRF ppm	Cu M/ICP ppm	Cu P ppm	Cu XRF ppm	Ni M/ICP ppm	Ni P ppm	Ni XRF ppm
K	44.42	20.61	2.81	43.47	20.44	2.87	1.63	4.51	7.96									
K	43.60	20.67	2.68	43.25	20.21	2.75	1.63	4.51	7.94									
K	44.80	20.64	2.79	43.24	20.20	2.74	1.61	4.56	7.89									
K	44.93	20.26	2.82	43.67	20.30	2.80	1.62	4.49	7.85									
K	45.15	20.39	2.89	43.92	20.31	2.75	1.63	4.47	7.94									
K	43.34	20.21	2.82	43.45	20.16	2.78	1.61	4.53	7.98									
K	44.57	20.66	2.76	44.08	20.12	2.74	1.62	4.58	7.94									
K	44.82	20.38	2.90	43.46	20.11	2.77	1.63	4.45	7.99									
L	45.30	19.75	2.88							366	361		8740	9020				
L	44.80	19.55	2.86							368	365		8790	8890				
L	44.20	19.15	2.85							374	360		8980	9070				
L	46.20	20.50	2.92							373	364		8930	9070				
L	44.80	19.90	2.87							378	356		8990	8850				
L	45.50	20.10	2.94							370	358		8800	8830				
L	45.60	20.20	2.91							374	360		8820	8900				
L										371	361		8800	8870				
M	41.20	19.15	2.77							374	331	400	8530	8560	8760			13650
M	42.80	19.60	2.87							378	332	410	8560	8680	8730			13650
M	42.60	19.35	2.74							377	328	410	8680	8620	8730			13650
M	43.00	19.60	2.84							369	336	400	8530	8740	8700			13700
M	46.20	20.50	2.80							373	332	400	8660	8700	8730			13650
M	46.70	20.70	2.93							360	332	390	8400	8670	8720			13600
M	41.30	19.00	2.76							362	331	400	8340	8680	8750			13600
M	41.60	18.95	2.86							369	332	400	8570	8640	8720			13450
N	44.80	19.95	2.79							356	341		8290	8330		12850	13050	
N	46.50	20.50	2.84							354	345		8240	8650		13150	13050	
N	44.20	20.50	2.76							361	345		8330	8430		13100	13350	
N	44.80	20.00	2.73							355	341		8260	8540		13300	13050	
N	44.90	20.10	2.70							358	338		8300	8310		13250	13150	
N	45.80	20.40	2.82							357	338		8350	8250		12700	13300	
N	45.40	20.40	2.81							362	333		8420	8300		13100	13100	
N	47.20	21.00	2.96							355	337		8300	8150		13400	12950	
O	42.90	19.00	2.99			2.92				370	336		8740	8910				
O	41.20	17.85	2.87			3.06				367	337		8400	8890				
O	41.60	18.90	2.86			2.89				363	340		8870	8900				
O	41.90	18.85	2.82			2.69				363	338		8230	9010				
O	41.50	18.75	2.78			2.92				363	332		8460	8950				
O	42.00	18.65	2.81			2.86				366	333		8540	8800				
O	41.30	18.35	2.70			2.89				351	336		8380	8860				
O	41.40	18.65	2.80			2.95				370	333		8660	8980				
Q	45.90	20.70	2.71	47.50	21.40	2.78	1.83	4.74	8.63	390	362	390	8650	8560	8680	13200	13100	13670
Q	45.10	20.00	2.59	46.20	20.70	2.66	1.78	4.56	8.23	390	357	400	8650	8650	8680	13400	13300	13670
Q	45.80	20.30	2.68	45.30	19.70	2.70	1.69	4.45	8.33	390	352	400	8550	8430	8720	13300	13100	13740
Q	44.50	19.60	2.64	45.60	20.40	2.57	1.76	4.54	8.31	385	352	400	8640	8530	8690	13500	12900	13700
Q	46.70	20.80	2.63	47.60	21.10	2.64	1.82	4.64	8.60	390	352	400	8610	8630	8680	13400	13000	13700
Q	46.80	20.90	2.84	45.90	20.20	2.71	1.71	4.57	8.30	380	356	400	8550	8580	8700	13300	13100	13680
Q	45.70	20.20	2.80	47.30	21.80	2.66	1.80	4.85	8.62	375	368	400	8630	8580	8710	13100	13200	13700
Q	45.40	20.10	2.64	46.60	20.60	2.49	1.77	4.56	8.31	375	369	400	8660	8560	8680	13200	13200	13700
S				39.85	17.66	4.48	1.71	4.49	7.45	375	338		8180	8771		12210	12780	
S				41.56	18.42	3.43	1.47	4.12	7.85	377	365		8246	8668		12540	12790	
S				41.91	19.58	4.87	1.81	4.41	7.69	355	338		8047	8487		12310	12490	
S				40.50	17.86	4.23	1.89	4.11	7.44	357	340		8122	8732		12560	12710	
S				43.07	19.99	3.24	1.69	4.70	8.05	372	351		8013	8788		12360	13030	
S				41.34	19.39	3.71	1.75	4.60	7.69	379	349		8192	8692		12560	12620	
S				42.50	20.68	2.86	1.60	4.60	7.67	374	358		8059	8484		12330	12660	
S				40.00	18.83	2.84	1.74	4.10	7.19	366	352		7985	8437		12370	12610	
U	44.59	21.14	2.84	45.82	20.49	2.05	1.64	4.47	8.24	438	383	460	8365	8111	9018	12462	11930	13400
U	44.50	21.46	2.93	47.85	20.73	1.95	1.73	4.55	8.49	439	390	489	8377	8129	9030	12393	11930	13500
U	44.43	21.22	2.82	46.10	20.16	1.95	1.73	4.30	8.30	424	395	490	8359	8275	8976	12409	12075	13400
U	44.37	21.10	2.94	46.95	20.93	2.13	1.69	4.53	8.50	437	383	487	8375	8175	9129	12690	11961	13700
U	44.13	21.26	2.78	46.27	20.54	2.04	1.66	4.44	8.31	378	392	468	8370	8199	9023	12650	12134	13500
U	44.68	21.36	2.74	42.30	20.55	2.05	1.63	4.43	8.28	427	385	487	8300	8215	9051	12409	11965	13500
U	45.04	21.27	2.77	42.88	20.40	2.04	1.68	4.43	8.25	435	395	502	8339	8163	8969	12462	12075	13400
U	44.84	21.30	2.74	42.37	20.24	2.00	1.68	4.38	8.31	437	393	473	8303	8170	8981	12360	12060	13500
V	43.60	19.70	2.70															
V	42.20	19.80	2.77															
V	43.20	19.80	2.72															
V	44.20	20.00	2.78															
V	43.90	19.80	2.72															
V	43.20	19.60	2.82															
V	44.40	20.10	2.81															
V	44.10	20.00	2.74															
W	42.20	20.00	2.69							373	383		8700	7700		13300	13300	
W	40.40	20.50	2.74							380	369		8500	8300		12500	13200	
W	45.10	21.40	2.69							385	366		8200	8000		13700	13400	
W	43.10	21.50	2.49							375	373		8000	7800		12500	13500	
W	39.90	19.70	2.71							379	379		9100	7400		12800	13500	
W	42.00	22.40	2.96							381	375		8900	8000		13700	13100	
W	45.10	21.10	2.61							386	381		8000	7100		14100	13300	
W	45.60	21.60	2.55							374	375		9000	6900		13500	13100	
X				41.30	19.10	2.74	1.44	4.94	8.34									
X				39.80	19.30	2.70	1.33	4.49	7.63									
X				41.50	19.50	2.64	1.38	4.78	8.34									
X				42.40	20.50	2.64	1.44	4.82	8.40									
X				41.00	19.60	2.75	1.40	4.70	8.28									
X				42.50	20.50	2.74	1.45	4.82	8.35									
X				40.40	19.70	2.82	1.49	4.55	7.78									
X				40.00	18.70	2.56	1.33	4.46	7.74									
Y				47.32	20.82	2.57	1.56	4.46	8.70			495			8440			13500
Y				48.25	21.15	2.66	1.62	4.58	9.12			500			8620			13200
Y				48.18	21.33	2.58	1.77	4.59	8.86			490			8430			13300
Y				48.03	21.00	2.63	1.77	4.47	8.78			490			8470			13300
Y				47.56	20.69	2.49	1.62	4.44	8.73			490			8330			13300
Y				47.04	20.80	2.54	1.66	4.42	8.68			480			8380			13300
Y				47.09	20.73	2.57	1.66	4.42	8.76			485			8360			13400
Y				47.39	20.87	2.54	1.66	4.47	8.94			495			8560			13300

Major element data

Lab Code	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
C	7.90	4.83	1.30	15.80	0.12	17.00	0.19	0.56	45.20	0.22	3.67		
C	7.83	4.88	1.36	15.70	0.12	17.10	0.20	0.56	45.70	0.24	3.52		
C	7.64	4.81	1.33	15.30	0.12	16.90	0.19	0.56	45.00	0.20	3.57		
C	7.84	4.80	1.36	15.70	0.12	17.10	0.20	0.56	45.60	0.20	3.59		
C	7.85	4.79	1.33	15.60	0.12	16.90	0.19	0.56	45.10	0.21	3.64		
C	7.98	4.83	1.37	15.90	0.12	17.20	0.20	0.58	45.80	0.21	3.69		
C	7.71	4.83	1.30	15.80	0.12	17.00	0.20	0.56	45.40	0.21	3.60		
C	7.65	4.78	1.27	15.30	0.12	16.70	0.20	0.55	44.70	0.22	3.48		
E												3.57	3.13
E												3.62	3.11
E												3.59	3.11
E												3.62	3.14
E												3.63	3.22
E												3.65	3.15
E												3.66	3.19
E												3.64	3.20
G	7.73	4.85	1.29	15.70	0.12	17.00	0.16	0.55	45.30	0.19	4.06	3.67	
G	7.71	4.87	1.28	15.50	0.12	17.00	0.17	0.57	45.30	0.20	3.90	3.53	
G	7.71	4.88	1.29	15.40	0.11	17.10	0.16	0.56	45.50	0.20	3.91	3.58	
G	7.73	4.84	1.28	15.50	0.12	17.00	0.17	0.55	45.30	0.19	3.86	3.60	
G	7.74	4.86	1.28	15.70	0.12	17.00	0.16	0.56	45.40	0.20	3.86	3.62	
G	7.70	4.88	1.28	15.70	0.12	17.00	0.17	0.56	45.40	0.20	3.69	3.60	
G	7.73	4.89	1.28	15.60	0.12	17.10	0.16	0.57	45.40	0.19	3.74	3.63	
G	7.71	4.87	1.29	15.70	0.12	17.10	0.17	0.56	45.50	0.20	3.81	3.57	
H												3.71	2.91
H												3.75	3.02
H												3.74	2.91
H												3.73	2.74
H												3.68	3.03
H												3.75	3.02
H												3.72	3.01
H												3.71	2.96
I	7.91	4.91	1.35	15.80	0.14	17.00	0.17	0.60	45.90	0.20	3.99	3.61	3.12
I	7.97	4.91	1.34	15.80	0.14	17.00	0.17	0.61	46.10	0.20	4.02	3.57	3.15
I	7.96	4.85	1.33	15.70	0.15	17.10	0.17	0.61	45.90	0.20	4.02	3.58	3.13
I	7.82	4.88	1.33	15.60	0.14	16.80	0.17	0.58	45.50	0.20	4.05	3.55	3.13
I	7.90	4.79	1.47	15.60	0.14	16.90	0.17	0.62	45.50	0.20	4.05	3.65	3.12
I	7.87	4.86	1.29	15.60	0.14	16.90	0.17	0.59	45.50	0.20	4.05	3.65	3.16
I	7.84	4.85	1.29	15.60	0.14	16.90	0.17	0.59	45.40	0.19	4.04	3.51	3.13
I	7.80	4.85	1.28	15.70	0.14	16.90	0.17	0.60	45.30	0.19	3.99	3.73	3.13
J											2.85		
J											2.98		3.21
J											2.59		3.20
J											2.56		3.11
J											2.95		3.27
J											2.94		3.12
J											2.94		3.16
J											2.75		3.14
K													3.25
K													3.27
K													3.28
K													3.29
K													3.29
K													3.24
K													3.25
K													3.26
L	7.31	4.41	1.18	14.35	0.11	15.80	0.16	0.59	41.70	0.16	2.86	3.90	2.97
L	7.31	4.42	1.21	14.30	0.11	15.80	0.16	0.59	41.70	0.17	3.11	3.90	2.99
L	7.35	4.43	1.19	14.30	0.11	15.90	0.16	0.59	41.90	0.17	2.84	3.98	2.97
L	8.18	4.90	1.30	16.05	0.12	17.40	0.18	0.65	45.70	0.22	3.05	3.98	2.97
L	7.40	4.45	1.15	14.20	0.11	16.05	0.15	0.59	42.30	0.16	2.85	4.00	2.98
L	7.34	4.43	1.20	14.40	0.11	15.95	0.16	0.59	42.10	0.16	2.83	3.88	2.98
L	7.43	4.45	1.15	14.10	0.11	16.10	0.15	0.58	42.40	0.16	3.03	3.89	2.98
L	7.34	4.44	1.18	14.35	0.11	15.95	0.16	0.59	42.00	0.17	2.99	3.96	2.98
M	8.05	4.73	1.23	15.41	0.14	17.25	0.17	0.56	46.15	0.20	3.62	3.86	3.07
M	8.09	4.75	1.23	15.47	0.14	17.29	0.17	0.57	46.25	0.20	3.49	3.85	3.19
M	8.04	4.72	1.23	15.42	0.13	17.31	0.17	0.57	46.00	0.20	3.48	3.87	3.23
M	8.11	4.76	1.24	15.53	0.13	17.30	0.17	0.57	46.25	0.20	3.47	3.78	3.15
M	8.10	4.73	1.23	15.42	0.13	17.25	0.17	0.56	46.15	0.20	3.46	3.83	3.27
M	8.08	4.73	1.23	15.50	0.14	17.26	0.17	0.57	46.20	0.20	3.45	3.74	3.05
M	8.06	4.72	1.23	15.43	0.14	17.26	0.17	0.57	46.30	0.20	3.44	3.75	3.21
M	8.06	4.73	1.23	15.40	0.13	17.26	0.17	0.57	46.18	0.21	3.46	3.84	3.05
N	7.80	4.76	1.26	15.50	0.10	16.50	0.17	0.57	45.60	0.20	3.42	3.76	2.98
N	7.83	4.78	1.27	15.50	0.10	16.60	0.17	0.57	45.80	0.21	3.44	3.79	3.02
N	7.81	4.76	1.27	15.45	0.10	16.55	0.17	0.57	45.70	0.19	3.41	3.82	3.00
N	7.80	4.77	1.26	15.45	0.10	16.50	0.17	0.57	45.60	0.20	3.32	3.82	2.98
N	7.85	4.77	1.28	15.50	0.10	16.55	0.17	0.58	45.80	0.20	3.40	3.79	2.99
N	7.75	4.72	1.26	15.30	0.10	16.40	0.16	0.55	45.40	0.21	3.40	3.83	2.99
N	7.75	4.75	1.27	15.40	0.10	16.50	0.17	0.57	45.50	0.21	3.47	3.79	2.96
N	7.80	4.75	1.26	15.40	0.10	16.45	0.17	0.57	45.50	0.20	3.43	3.76	2.97
O												3.78	3.20
O												3.71	3.20
O												3.69	3.20
O												3.72	3.22
O												3.71	3.21
O												3.73	3.21
O												3.62	3.19
O												3.76	3.19

Major element data (cont)

Lab Code	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
Q	7.78	4.81	1.26	15.84	0.12	17.00	0.17		45.99	0.20	3.39	3.63	3.19
Q	7.78	4.81	1.26	15.83	0.12	17.01	0.17		46.03	0.21	3.35	3.68	3.20
Q	7.79	4.82	1.27	15.89	0.12	17.03	0.17		46.05	0.21	3.39	3.64	3.19
Q	7.78	4.82	1.27	15.83	0.12	16.99	0.17		45.89	0.20	3.39	3.69	3.17
Q	7.79	4.82	1.26	15.86	0.12	17.01	0.17		45.99	0.21	3.31	3.67	3.19
Q	7.77	4.81	1.26	15.83	0.12	16.98	0.17		45.97	0.21	3.35	3.63	3.21
Q	7.79	4.83	1.27	15.84	0.12	17.01	0.17		46.04	0.20	3.33	3.62	3.21
Q	7.78	4.83	1.27	15.86	0.12	17.01	0.17		46.03	0.21	3.41	3.61	3.22
U	7.70	4.92	1.23	16.13	0.13	16.70	0.18	0.70	45.50	0.15	3.96	3.62	3.13
U	7.80	4.92	1.23	16.07	0.12	16.50	0.18	0.70	45.80	0.15	3.90	3.58	3.14
U	7.80	4.90	1.24	16.15	0.12	16.70	0.18	0.70	45.40	0.15	3.90	3.63	3.14
U	7.80	4.88	1.26	16.12	0.12	16.70	0.18	0.70	45.20	0.15	3.84	3.61	3.13
U	7.60	4.80	1.25	15.93	0.12	16.40	0.18	0.70	45.60	0.14	3.96	3.64	3.14
U	8.00	4.80	1.23	15.78	0.12	16.30	0.18	0.70	44.70	0.14	4.89	3.56	3.13
U	7.90	4.98	1.24	16.27	0.13	16.90	0.18	0.70	46.10	0.15	3.75	3.61	3.13
U	7.80	4.88	1.22	16.05	0.13	16.60	0.18	0.70	45.60	0.15	3.86	3.61	3.14
V													3.17
V													3.18
V													3.19
V													3.18
V													3.19
V													3.17
V													3.18
V													3.18
W												3.82	
W												3.69	
W												3.78	
W												3.70	
W												3.74	
W												3.86	
W												3.74	
W												3.05	
Y	7.38	4.38	1.21	15.35		17.03			49.81				3.25
Y	7.67	4.52	1.22	15.39		17.00			50.82				3.24
Y	7.49	4.36	1.20	15.32		16.99			50.10				3.18
Y	7.52	4.36	1.20	15.17		16.84			49.92				3.25
Y	7.57	4.44	1.20	15.16		16.93			49.59				3.28
Y	7.36	4.34	1.19	15.24		16.95			49.68				3.21
Y	7.46	4.36	1.19	15.33		16.93			49.97				3.19
Y	7.47	4.43	1.19	15.45		16.92			50.35				3.13

12. 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	Method	unit	S [1]	σL [2]	Sw [3]	CSU [4]
Pt	PbColl	g/t	1.572	0.845	1.115	0.250
Pd	PbColl	g/t	0.820	0.514	0.463	0.145
Au	PbColl	g/t	0.093	0.036	0.079	0.012
Pt	NIS	g/t	2.410	2.297	1.058	0.823
Pd	NIS	g/t	0.405	0.286	0.311	0.116
Au	NIS	g/t	0.137	0.136	0.065	0.052
Ir	NiS	g/t	0.063	0.048	0.047	0.019
Rh	NiS	g/t	0.154	0.138	0.092	0.054
Ru	NiS	g/t	0.446	0.427	0.185	0.153
Co	M/ICP	ppm	17.849	12.100	8.738	3.339
Co	P	ppm	14.231	11.051	5.402	3.238
Co	XRF	ppm	49.562	52.175	18.415	19.876
Cu	M/ICP	ppm	266.915	171.184	147.854	47.893
Cu	P	ppm	287.876	225.023	97.076	65.742
Ni	M/ICP	ppm	592.369	484.534	288.858	156.589
Ni	P	ppm	660.085	606.310	130.051	192.283
Ni	XRF	ppm	168.887	155.310	95.081	60.137
Al2O3	XRF	%	0.201	0.159	0.119	0.055
CaO	XRF	%	0.058	0.057	0.029	0.022
Cr2O3	XRF	%	0.046	0.040	0.021	0.013
Fe2O3	XRF	%	0.237	0.215	0.116	0.077
K2O	XRF	%	0.012	0.012	0.003	0.004
MgO	XRF	%	0.224	0.215	0.085	0.077
MnO	XRF	%	0.006	0.006	0.003	0.002
SiO2	XRF	%	0.339	0.306	0.203	0.119
TiO2	XRF	%	0.007	0.005	0.005	0.002
LOI		%	0.373	0.355	0.074	0.119
S	Comb/LECO	%	0.087	0.071	0.042	0.023
SG	pyc		0.092	0.067	0.036	0.019

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. Uncertified 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 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: AMIS0193 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.

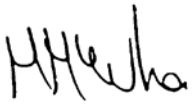
17. Minimum sample size: The majority of laboratories reporting used a 0.5g sample size for the ICP and a 30g sample size for the fire assay. These are the recommended minimum sample sizes for the use of this material.

18. Availability: This product is available in Laboratory Packs containing 1kg of material 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.

19. 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.

24 May 2011

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	2.88	0.32	5.51	54
Al	M/ICP	%	4.17	0.22	2.65	78
As	M/ICP	ppm	8.25	2.35	14.24	64
Ba	M/ICP	ppm	81.04	10.59	6.53	79
Be	M/ICP	ppm	0.11	0.03	15.37	30
Bi	M/ICP	ppm	3.29	0.69	10.52	56
Ca	M/ICP	%	3.31	0.19	2.81	78
Cd	M/ICP	ppm	0.55	0.14	13.08	55
Ce	M/ICP	ppm	26.47	3.33	6.29	32
Cr	M/ICP	ppm	6422	1193	9.29	72
Cs	M/ICP	ppm	0.29	0.04	6.83	29
Dy	M/ICP	ppm	0.78	0.05	3.31	8
Er	M/ICP	ppm	0.53	0.07	7.00	8
Eu	M/ICP	ppm	0.25	0.00	0.00	7
Fe	M/ICP	%	10.87	1.03	4.73	85
Ga	M/ICP	ppm	7.16	1.70	11.85	48
Gd	M/ICP	ppm	0.80	0.00	0.00	8
Ge	M/ICP	ppm	0.77	0.52	33.42	24
Hf	M/ICP	ppm	0.46	0.20	22.23	40
Ho	M/ICP	ppm	0.16	0.00	0.00	7
In	M/ICP	ppm	0.07	0.02	11.35	32
K	M/ICP	%	0.10	0.01	5.15	69
La	M/ICP	ppm	16.79	2.35	7.00	53
Li	M/ICP	ppm	4.57	1.02	11.12	53
Lu	M/ICP	ppm	0.09	0.02	11.73	16
Mg	M/ICP	%	10.13	0.57	2.82	79
Mn	M/ICP	ppm	1252	133	5.31	102
Mo	M/ICP	ppm	3.21	0.86	13.40	63
Na	M/ICP	%	0.43	0.04	5.03	71
Nb	M/ICP	ppm	1.01	0.28	14.11	40
Nd	M/ICP	ppm	7.19	0.27	1.87	8
P	M/ICP	ppm	118	29.66	12.55	75
Pb	M/ICP	ppm	140	15.47	5.53	80
Pr	M/ICP	ppm	10.22	16.40	80.28	16
Rb	M/ICP	ppm	3.67	0.31	4.16	31
Re	M/ICP	ppm	0.03	0.01	13.22	24
S	M/ICP	%	3.75	0.17	2.23	58
Sb	M/ICP	ppm	4.90	1.12	11.41	54
Sc	M/ICP	ppm	18.51	1.58	4.27	62
Se	M/ICP	ppm	15.25	5.31	17.40	48
Si	M/ICP	%	21.51	0.17	0.39	8
Sm	M/ICP	ppm	0.92	0.09	4.99	8
Sn	M/ICP	ppm	1.64	0.54	16.56	39
Sr	M/ICP	ppm	117	8.70	3.73	61
Ta	M/ICP	ppm	0.10	0.05	27.09	30
Tb	M/ICP	ppm	0.12	0.01	4.40	14
Te	M/ICP	ppm	5.42	0.62	5.76	24
Th	M/ICP	ppm	2.22	0.35	7.93	47
Ti	M/ICP	%	0.11	0.01	5.50	72
Tl	M/ICP	ppm	0.27	0.06	11.38	40
U	M/ICP	ppm	9.60	1.34	6.98	32
V	M/ICP	ppm	119	81.31	34.29	63
W	M/ICP	ppm	0.55	0.20	17.93	31
Y	M/ICP	ppm	4.11	0.47	5.69	61
Yb	M/ICP	ppm	0.56	0.08	6.89	16
Zn	M/ICP	ppm	160	12.67	3.96	63
Zr	M/ICP	ppm	14.41	3.03	10.50	54