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AMIS0257 Certified Reference Material

Platinum (PGM) UG2 Ore
Bushveld Complex, South Africa

Certificate of Analysis

Recommended Concentrations and Limits¹
(at two Standard Deviations)

Certified Concentrations²

Pt Pb Collection	1.66	±	0.16	g/t
Pd Pb Collection	0.95	±	0.08	g/t
Pd NIS	0.96	±	0.08	g/t
Co M/ICP	192	±	14	ppm
Cu P	67	±	7	ppm
Cr XRF	14.47	±	0.26	%
Ni P	174	±	16	ppm
Ni XRF	1024	±	75	ppm
Specific Gravity	3.65	±	0.12	

Provisional Concentrations

Au Pb Collection	0.11	±	0.02	g/t
Pt NIS	1.67	±	0.26	g/t
Ir NiS	0.12	±	0.02	g/t
Rh	0.32	±	0.04	g/t
Ru NiS	0.58	±	0.08	g/t
Co P	12	±	2	ppm
Cu M/ICP	65	±	10	ppm
Ni M/ICP	961	±	157	ppm

Indicated Mean

Au NIS 0.11 g/t

$4E (Pt, Pd, Au (all NiS) + Rh) = 3.06 \text{ g/t}$

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 Limits
(at two Standard Deviations)**

Certified Concentrations

Al ₂ O ₃	12.54	±	0.20	%
CaO	2.81	±	0.04	%
Cr ₂ O ₃	21.16	±	0.34	%
Fe ₂ O ₃	19.93	±	0.40	%
MgO	14.38	±	0.26	%
MnO	0.20	±	0.01	%
SiO ₂	28.13	±	0.30	%
TiO ₂	0.58	±	0.02	%

Provisional Concentrations

K ₂ O	0.12	±	0.02	%
Na ₂ O	0.47	±	0.06	%

1. Intended Use: AMIS0257 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 ore materials; derived from the UG2 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 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 was made using Pt/Pd UG2 rich chromitite material supplied by Anglo Platinum Limited from the Western limb of the Bushveld Complex.

3. Mineral and Chemical Composition: The UG2 chromitite ore consists of fine to medium size cumulus chromite grains with substantial amounts of post-cumulus orthopyroxene crystals. The footwall is a coarse grained pegmatoidal pyroxenite with sporadic occurrences of chromitite blebs, lenses and stringers. The hanging wall is predominantly fine to medium grained orthopyroxenite with three or more chromitite stringers referred to as the UG2 leaders. The concentrates produced have had most of the chromitite and some of the silicates removed

Major element chemistry data from thirteen 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 Medium Dark Grey (Corstor Colour Gauge).

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 <54µm. Wet sieve particle size analysis of random samples confirmed the material was 98.5% <54µm. 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. Co, Cu and Ni. Multi-acid total digestion, including HF, with ICP-OES finish.
4. Co, Cu and Ni. Aqua regia digestion with ICP-OES finish.
5. Cr, Co, Cu and Ni. Pressed pellet XRF.
6. S by LECO
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 nine laboratories were each given eight randomly selected packages of sample. Twenty four 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 recalculated 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 24 out of 29 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 Ammtec (Australia)
- 3 ALS Chemex Laboratory Group Johannesburg SA
- 4 ALS Chemex Laboratory Group Perth WA
- 5 ALS Chemex Laboratory Group Vancouver CA
- 6 ALS OMAC (Ireland)
- 7 Anglo Platinum - Eastern Bushveld Regional Laboratory
- 8 Genalysis Laboratory Services (South Africa) Pty
- 9 Genalysis Laboratory Services (W Australia P)
- 10 GNK Laboratories (Pvt) Ltd
- 11 Intertek Utama Services (Indonesia)
- 12 Labtium Inc Finland
- 13 Mintek (South Africa)
- 14 Nkomati JV Laboratory SA
- 15 Performance Laboratories SA (Randfontein)
- 16 Set Point Laboratories (Isando) SA
- 17 SGS Australia Pty Ltd (Newburn) WA
- 18 SGS Geosol Laboratories Ltda (Brazil)
- 19 SGS Mineral Services Lakefield (Canada)
- 20 SGS South Africa (Pty) Ltd - Booyens JHB
- 21 SGS Vancouver (Canada)
- 22 Ultra Trace (Pty) Ltd WA
- 23 Xstrata Alloys
- 24 Zimplats Head Office Assay Laboratory

11. Assay Data: Data as received from the laboratories for the important certified elements listed on p1 are set out below. A proficiency report has been sent to the managers of the participating laboratories. Additional digital data from this round robin is available on request.

Economic element data

Lab Code	Pt Pb Coll g/t	Pd Pb Coll g/t	Au Pb Coll g/t	Pt NIS g/t	Pd NIS g/t	Au NIS g/t	Ir NIS g/t	Rh g/t	Ru NIS g/t	Co M/ICP ppm	Co P ppm	Cr XRF %	Cu M/ICP ppm	Cu P ppm	Ni M/ICP ppm	Ni P ppm	Ni XRF ppm
A	1.89	0.89						0.31									1018
A	2.12	0.93						0.33									1008
A	1.66	0.87						0.28									994
A	1.80	0.86						0.29									1024
A	2.04	0.95						0.31									993
A	1.91	0.96						0.32									997
A	1.94	0.97						0.31									1017
A	1.84	0.94						0.32									1026
B	1.39	0.75	0.11							199	11.6		73.8	63.6			
B	1.63	0.95	0.09							202	11.8		66.9	63.9			
B	1.64	0.98	0.10							201	12.4		66.9	66.7			
B	1.69	0.97	0.10							200	12.7		66.0	66.0			
B	1.62	0.98	0.11							187	12.5		60.1	67.5			
B	1.70	0.98	0.11							194	12.6		62.1	69.4			
B	1.53	0.93	0.11							182	14.4		58.5	71.4			
B	1.58	0.96	0.12							185	12.7		59.4	68.8			
D											16.0			72.0		185	
D											18.0			70.0		181	
D											13.0			69.0		188	
D											15.0			68.0		184	
D											12.0			67.0		184	
D											14.0			67.0		188	
D											13.0			67.0		183	
D											14.0			66.0		186	
E	1.57	0.85	0.68							117		15.3	55.7			407.48	
E	2.04	0.99	0.57							93		15.0	51.1			415.65	
E	1.57		0.61							94		14.8	51.9			417.86	
E	1.48	0.77	0.54							95		14.7	50.3			391.1	
E	1.71	1.00	0.69							100		15.2	56.7			347.76	
E	1.45	0.92	0.92							96		15.3	48.5			361.71	
E	1.73	1.04	0.40							97		13.6	53.1			404.75	
E	1.62		0.47							91		14.8	52.7			404.35	

Economic element data (cont)

Lab Code	Pt Pb Coll g/t	Pd Pb Coll g/t	Au Pb Coll g/t	Pt NiS g/t	Pd NiS g/t	Au NiS g/t	Ir NiS g/t	Rh g/t	Ru NiS g/t	Co M/ICP ppm	Co P ppm	Cr XRF %	Cu M/ICP ppm	Cu P ppm	Ni M/ICP ppm	Ni P ppm	Ni XRF ppm
F				1.66	1.36	0.12			0.54	120	13.0	14.4	68.6	69.3	722	163	1025
F				1.55	1.40	0.13			0.67	123	13.0	14.5	65.2	68.4	746	162	1013
F				1.94	1.40	0.11			0.67	118	13.0	14.4	65.2	66.5	714	163	1002
F				1.88	1.41	0.11			0.64	117	13.0	14.4	65.2	68.9	718	162	1012
F				1.70	1.20	0.13			0.59	116	12.0	14.3	67.3	68.4	728	163	1018
F				1.59	1.23	0.12			0.56	119	12.0	14.4	67.9	68.9	739	164	1017
F				1.81	1.32	0.10			0.66	118	12.0	14.4	67.5	67.9	714	167	1013
F				1.92	1.28	0.12			0.68	115	12.0	14.2	65.8	65.8	734	167	1014
H	1.68	0.94	0.12	1.53	0.93	0.12	0.12	0.31	0.56	202	6.0	14.4	67.0	63.0	938	175	
H	1.65	0.96	0.10	1.58	0.93	0.11	0.12	0.32	0.58	202	6.0	14.4	66.0	61.0	927	172	
H	1.66	0.93	0.11	1.42	0.95	0.10	0.12	0.32	0.58	203	5.0	14.3	65.0	62.0	909	173	
H	1.70	0.96	0.12	1.47	0.89	0.11	0.12	0.31	0.57	201	6.0	14.4	65.0	62.0	923	174	
H	1.59	0.92	0.10	1.63	0.98	0.12	0.13	0.33	0.60	201	6.0	14.3	66.0	61.0	918	176	
H	1.62	0.90	0.11	1.47	0.90	0.11	0.12	0.31	0.55	201	6.0	14.4	66.0	60.0	914	176	
H	1.66	0.95	0.12	1.52	0.95	0.11	0.12	0.32	0.56	199	5.0	14.3	66.0	60.0	917	173	
H	1.71	0.97	0.12	1.48	0.95	0.11	0.12	0.33	0.58	198	6.0	14.4	65.0	60.0	908	175	
I	1.58	0.87	0.12					0.16					200		980		
I	1.59	0.90	0.12					0.24					200		975		
I	1.56	0.87	0.13					0.23					205		1010		
I	1.55	0.88	0.12					0.26					210		1000		
I	1.72	0.95	0.13					0.24					210		970		
I	1.61	0.96	0.14					0.22					210		995		
I	1.63	0.96	0.14					0.27					190		990		
I	1.56	0.94	0.13					0.25					190		990		
J	1.72	0.95	0.08							200	20.0		90.0	90.0	1040	170	
J	1.78	0.96	0.14							200	20.0		70.0	70.0	1020	180	
J	1.79	0.97	0.10							200	20.0		70.0	70.0	1030	180	
J	1.75	0.94	0.11							190	20.0		60.0	60.0	1010	180	
J	1.71	0.95	0.10							190	20.0		70.0	60.0	1030	180	
J	1.76	0.98	0.13							190	20.0		60.0	60.0	1020	190	
J	1.75	0.98	0.13							200	20.0		60.0	70.0	1030	190	
J	1.73	0.95	0.08							200	20.0		60.0	70.0	1010	170	
L				1.61	1.01	0.09	0.12	0.33	0.58	189					948		
L				1.68	1.02	0.10	0.13	0.35	0.63	194					975		
L				1.49	1.02	0.11	0.11	0.31	0.55	192					968		
L				1.55	0.95	0.13	0.12	0.31	0.56	190					966		
L				1.46	0.90	0.10	0.11	0.30	0.55	192					973		
L				1.49	0.91	0.11	0.11	0.31	0.58	192					973		
L				1.41	0.91	0.13	0.11	0.31	0.57	191					962		
L				1.51	0.92	0.12	0.11	0.32	0.59	190					959		
M	1.58	0.88	0.09					0.12	0.32	0.60							
M	1.63	0.89	0.12					0.13	0.31	0.60							
M	1.61	0.88	0.08					0.13	0.31	0.60							
M	1.65	0.89	0.13					0.13	0.32	0.61							
M	1.70	0.95	0.11					0.13	0.34	0.61							
M	1.73	0.93	0.07					0.13	0.35	0.60							
M	1.73	0.94	0.09					0.13	0.31	0.60							
M	1.73	0.96	0.09					0.12	0.32	0.62							
O										145	12.0		59.8	67.1	905	165	
O										146	13.0		59.0	68.9	914	169	
O										144	13.0		56.5	73.2	901	166	
O										142	13.0		58.6	67.0	895	169	
O										141	12.0		57.2	67.6	903	166	
O										148	12.0		56.5	66.5	940	168	
O										147	13.0		56.9	67.1	921	170	
O										141	13.0		57.7	64.7	877	169	
P	1.62	0.94	0.11	1.75	1.01	0.12	0.13	0.37	0.59	195	14.0	14.4	70.0	70.0	1080	181	
P	1.55	0.93	0.10	1.67	0.93	0.13	0.12	0.32	0.51	195	14.0	14.4	70.0	72.0	1080	185	
P	1.57	0.93	0.11	1.77	1.02	0.12	0.13	0.35	0.57	195	14.0	14.5	70.0	72.0	1060	181	
P	1.62	0.95	0.11	1.69	0.97	0.12	0.12	0.33	0.54	195	13.0	14.4	70.0	72.0	1100	182	
P	1.64	0.93	0.11	1.73	0.96	0.12	0.13	0.33	0.53	195	14.0	14.6	70.0	71.0	1070	184	
P	1.67	0.95	0.10	1.70	0.96	0.11	0.12	0.33	0.53	195	14.0	14.5	75.0	73.0	1070	186	
P	1.68	0.98	0.11	1.73	0.91	0.12	0.15	0.32	0.52	185	14.0	14.5	70.0	73.0	1080	187	
P	1.68	0.99	0.11	1.60	0.94	0.12	0.13	0.32	0.53	185	14.0	14.5	75.0	70.0	1070	182	
Q	1.25	0.69	0.08							190	20.0		90.0	70.0	1100	200	
Q	1.35	0.75	0.08							190	20.0		60.0	60.0	1060	190	
Q	1.58	0.89	0.13							180	30.0		60.0	60.0	1050	190	
Q	1.43	0.81	0.09							180	20.0		60.0	60.0	1060	190	
Q	1.76	0.98	0.13							180	30.0		60.0	60.0	1040	200	
Q	1.63	0.92	0.11							180	20.0		60.0	60.0	1060	190	
Q	1.55	0.86	0.12							190	40.0		60.0	70.0	1050	200	
Q	1.57	0.89	0.10							180	30.0		60.0	50.0	1050	200	
S				1.58	0.93	0.09	0.10	0.28	0.49								1080
S				1.66	0.97	0.10	0.10	0.29	0.50								1070
S				1.65	0.99	0.10	0.10	0.29	0.50								1090
S				1.60	0.97	0.08	0.10	0.28	0.45								1100
S				1.75	1.05	0.09	0.09	0.29	0.37								1110
S				1.75	1.04	0.08	0.10	0.29	0.45								1080
S				1.76	1.02	0.08	0.10	0.29	0.45								1100
S				1.72	1.01	0.10	0.10	0.28	0.48								1080
T	1.52	0.93	0.11	1.65	0.94	0.08	0.13	0.32	0.56	182	10.2		64.8	67.4	806	167	976
T	1.51	0.92	0.11	1.65	0.96	0.08	0.13	0.34	0.53	185	10.1		63.5	69.7	823	168	981
T	1.50	0.91	0.12	1.60	0.96	0.08	0.15	0.33	0.52	186	10.3		66.1	68.8	821	172	976
T	1.62	0.96	0.12	1.65	0.97	0.08	0.15	0.33	0.55	182	10.2		64.2	69.4	808	167	980
T	1.61	0.96	0.11	1.58	0.95	0.08	0.13	0.32	0.56	187	10.1		63.5	69.0	826	172	982
T	1.55	0.93	0.11	1.65	0.96	0.10	0.13	0.34	0.55	183	10.1		62.4	69.3	812	170	985
T	1.63	0.93	0.12	1.60	0.96	0.09	0.13	0.32	0.55	188	10.4		65.0	69.7	817	168	972
T	1.55	0.92	0.11	1.61	0.95	0.08	0.13	0.34	0.53	185	10.8		65.3	68.0	811	169	979

Economical elements data (cont)

Lab Code	Pt Pb Coll g/t	Pd Pb Coll g/t	Au Pb Coll g/t	Pt NIS g/t	Pd NIS g/t	Au NIS g/t	Ir NiS g/t	Rh g/t	Ru NiS g/t	Co M/ICP ppm	Co P ppm	Cr XRF %	Cu M/ICP ppm	Cu P ppm	Ni M/ICP ppm	Ni P ppm	Ni XRF ppm
U	1.60	0.94	0.12									14.7	74.0		891		
U	1.70	0.93	0.12									14.5	72.0		869		
U	1.50	0.94	0.12									14.7	79.0		861		
U	1.80	1.00	0.12									14.5	79.0		895		
U	1.70	0.97	0.12									14.5	74.0		880		
U	1.78	0.99	0.12									14.6	73.0		874		
U	1.60	0.98	0.12									14.5	76.0		898		
U	1.70	0.95	0.12									14.5	72.0		892		
V	1.74	0.97	0.12							169	11.0	14.6	70.0	67.0	897	153	
V	1.73	1.03	0.13							165	12.0	14.5	71.0	68.0	890	153	
V	1.66	0.98	0.11							169	12.0	14.6	68.0	69.0	906	150	
V	1.72	1.02	0.11							173	12.0	14.6	70.0	70.0	902	152	
V	1.64	1.00	0.10							171	12.0	14.6	71.0	68.0	913	149	
V	1.73	1.02	0.11							174	12.0	14.6	74.0	70.0	931	152	
V	1.79	1.06	0.12							173	12.0	14.6	69.0	70.0	942	154	
V	1.67	0.99	0.11							167	11.0	14.5	69.0	70.0	900	151	
W	1.78	0.99	0.12							188	13.0		62.0	70.0	1010	175	
W	1.63	0.98	0.11							190	13.0		63.0	68.0	1030	173	
W	1.74	0.99	0.11							184	12.0		61.0	66.0	1000	165	
W	1.73	0.99	0.11							189	13.0		62.0	69.0	1020	171	
W	1.58	0.89	0.11							194	13.0		63.0	67.0	1040	169	
W	1.65	0.94	0.11							191	14.0		62.0	70.0	1030	173	
W	1.70	0.96	0.11							189	13.0		61.0	69.0	1010	173	
W	1.66	0.93	0.11							190	13.0		61.0	68.0	1020	173	
X																	1026
X																	1046
X																	1060
X																	1021
X																	1020
X																	1047
X																	1039
X																	1031
Y				1.85	1.00	0.13	0.18	0.34	0.63								
Y				1.83	0.99	0.13	0.20	0.34	0.62								
Y				2.05	1.05	0.14	0.19	0.36	0.63								
Y				1.85	1.02	0.13	0.20	0.35	0.64								
Y				1.98	1.04	0.13	0.20	0.36	0.65								
Y				1.86	0.99	0.13	0.20	0.35	0.65								
Y				1.88	0.98	0.14	0.19	0.34	0.63								
Y				1.79	0.97	0.07	0.18	0.33	0.61								
Z	1.83	0.79	0.15														
Z	1.86	0.83	0.15														
Z	1.81	0.79	0.18														
Z	1.79	0.82	0.17														
Z	1.73	0.73	0.13														
Z	1.76	0.71	0.15														
Z	1.96	0.80	0.14														
Z	1.81	0.72	0.12														
ZA	1.61	0.93	0.10														
ZA	1.64	0.96	0.11														
ZA	1.65	0.96	0.10														
ZA	1.61	0.92	0.11														
ZA	1.67	0.95	0.10														
ZA	1.67	0.93	0.11														
ZA	1.61	0.93	0.11														
ZA	1.66	0.96	0.11														
ZB												14.5					1000
ZB												14.6					1100
ZB												14.4					1000
ZB												14.8					1000
ZB												14.5					1000
ZB												15.0					1000
ZB												14.9					1100
ZB												14.9					1000
ZC				1.74	0.93	0.10	0.13	0.29	0.61			14.4	67.0		210		
ZC				1.80	0.96	0.10	0.11	0.31	0.62			14.6	68.0		229		
ZC				1.74	0.96		0.12	0.31	0.60			14.5	66.0		234		
ZC				1.74	0.95		0.11	0.30	0.59			14.4	66.0		237		
ZC				1.80	0.99	0.10	0.11	0.31	0.60			14.2	65.0		230		
ZC				1.71	0.91	0.11		0.28	0.56			14.0	70.0		233		
ZC				1.69	0.94		0.11	0.27	0.55			14.4	65.0		226		
ZC				1.69	1.00			0.34	0.71			14.2	66.0		220		

Major element data

Lab Code	Al ₂ O ₃ XRF %	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 %	SG pyc
A											3.90
A											3.82
A											3.89
A											3.80
A											3.89
A											3.89
A											3.83
A											3.82

Major element data (cont)

Lab Code	Al ₂ O ₃ XRF %	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 %	SG pyc
B											3.64
B											3.63
B											3.64
B											3.64
B											3.63
B											3.64
B											3.63
B											3.64
E			22.4	20.2							
E			22.0	19.8							
E			21.7	20.2							
E			21.5	19.8							
E			22.2	20.3							
E			22.4	20.4							
E			19.9	18.5							
E			21.7	20.5							
F	12.3	2.69	21.0	19.5	0.13	14.2	0.20	0.51	27.3	0.56	3.58
F	12.4	2.81	21.2	19.6	0.12	14.2	0.21	0.50	27.3	0.57	3.63
F	12.6	2.81	21.0	19.6	0.13	14.2	0.21	0.46	27.3	0.57	3.61
F	12.6	2.78	21.0	19.5	0.13	14.2	0.24	0.67	27.2	0.57	3.58
F	12.6	2.70	20.9	19.3	0.12	14.2	0.19	0.53	26.8	0.55	3.63
F	12.5	2.77	21.1	19.7	0.13	14.3	0.23	0.49	27.3	0.57	3.59
F	12.5	2.81	21.1	19.6	0.13	14.1	0.23	0.42	27.6	0.56	3.63
F	12.6	2.69	20.8	19.5	0.12	14.1	0.22	0.39	27.5	0.55	3.61
H	12.5	2.81	21.0	20.0	0.12	14.4	0.20	0.44	28.2	0.58	3.75
H	12.5	2.82	21.0	20.0	0.12	14.4	0.20	0.47	28.2	0.58	3.78
H	12.5	2.81	21.0	19.9	0.12	14.3	0.20	0.46	28.2	0.58	3.70
H	12.6	2.80	21.0	19.9	0.12	14.4	0.20	0.46	28.1	0.58	3.72
H	12.4	2.81	20.9	19.9	0.12	14.4	0.20	0.45	28.2	0.58	3.65
H	12.4	2.79	21.1	20.0	0.12	14.3	0.20	0.45	28.2	0.58	3.73
H	12.6	2.81	20.9	19.9	0.12	14.4	0.20	0.44	28.2	0.58	3.78
H	12.5	2.81	21.1	20.0	0.12	14.4	0.20	0.44	28.2	0.58	3.69
J	12.8	2.83		20.0	0.11	14.4	0.20	0.47	28.3	0.57	3.66
J	12.7	2.80		19.9	0.11	14.4	0.20	0.47	27.9	0.56	3.73
J	12.7	2.83		19.9	0.11	14.3	0.20	0.48	27.9	0.57	3.82
J	12.7	2.80		19.9	0.11	14.3	0.21	0.47	28.0	0.59	3.76
J	12.8	2.84		20.1	0.11	14.3	0.20	0.48	27.9	0.58	3.85
J	12.7	2.81		19.9	0.11	14.3	0.20	0.47	28.0	0.57	3.72
J	12.7	2.82		19.8	0.11	14.3	0.20	0.47	28.0	0.57	3.83
J	12.7	2.80		19.9	0.11	14.3	0.20	0.47	27.9	0.57	3.67
L											3.54
L											3.53
L											3.56
L											3.57
L											3.59
L											3.51
L											3.54
L											3.55
O											3.61
O											3.61
O											3.61
O											3.61
O											3.60
O											3.61
O											3.61
O											3.61
P	12.6	2.83	21.1	19.8	0.15	14.5	0.20		28.3	0.57	3.72
P	12.6	2.82	21.1	19.8	0.15	14.5	0.20		28.2	0.58	3.76
P	12.5	2.83	21.2	19.9	0.14	14.5	0.20		28.2	0.58	3.74
P	12.6	2.85	21.1	19.9	0.15	14.5	0.20		28.2	0.57	3.71
P	12.5	2.83	21.3	19.9	0.16	14.5	0.20		28.2	0.57	3.73
P	12.6	2.83	21.2	19.9	0.15	14.5	0.20		28.1	0.59	3.73
P	12.6	2.84	21.2	19.9	0.15	14.5	0.20		28.2	0.58	3.77
P	12.5	2.85	21.2	19.9	0.15	14.5	0.20		28.2	0.58	3.74

Major element data (cont)

Lab Code	Al ₂ O ₃ XRF %	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 %	SG pyc
S											3.69
S											3.69
S											3.71
S											3.68
S											3.72
S											3.69
S											3.72
S											3.69
T											3.67
T											3.65
T											3.64
T											3.63
T											3.67
T											3.64
T											3.64
T											3.67
U	12.6	2.81	21.5	20.1	0.13	14.4	0.19	0.51	28.0	0.59	
U	12.6	2.82	21.2	20.1	0.13	14.4	0.19	0.53	28.0	0.59	
U	12.6	2.80	21.5	20.1	0.13	14.4	0.19	0.50	28.0	0.58	
U	12.6	2.82	21.2	20.1	0.13	14.4	0.19	0.47	28.0	0.58	
U	12.6	2.81	21.3	20.1	0.13	14.4	0.19	0.51	27.9	0.58	
U	12.6	2.81	21.3	20.1	0.13	14.4	0.19	0.50	28.0	0.58	
U	12.6	2.82	21.1	20.2	0.13	14.4	0.19	0.46	28.1	0.59	
U	12.6	2.81	21.2	20.2	0.13	14.4	0.19	0.47	28.1	0.59	
V	12.4	2.79	21.4	19.9	0.11	14.4	0.19	0.44	28.0	0.58	
V	12.5	2.81	21.2	19.9	0.11	14.4	0.19	0.43	28.1	0.58	
V	12.4	2.79	21.3	19.9	0.11	14.4	0.20	0.44	28.1	0.58	
V	12.4	2.79	21.4	19.9	0.11	14.4	0.19	0.43	28.1	0.59	
V	12.4	2.81	21.3	19.9	0.11	14.4	0.19	0.44	28.0	0.60	
V	12.5	2.79	21.3	19.9	0.11	14.5	0.19	0.43	28.1	0.59	
V	12.5	2.81	21.4	19.9	0.11	14.4	0.19	0.44	28.1	0.57	
V	12.4	2.81	21.2	20.0	0.11	14.4	0.20	0.42	28.2	0.59	
W	12.4	2.73		19.6	0.12	14.7	0.20	0.48	28.0	0.57	3.65
W	12.4	2.78		19.4	0.12	14.5	0.20	0.52	28.0	0.55	3.61
W	12.5	2.73		19.8	0.12	14.7	0.20	0.47	28.0	0.58	3.63
W	12.5	2.80		19.5	0.12	14.6	0.20	0.53	28.1	0.56	3.65
W	12.6	2.76		20.1	0.13	14.8	0.20	0.51	28.3	0.59	3.63
W	12.6	2.78		20.1	0.13	14.8	0.21	0.50	28.5	0.59	3.62
W	12.6	2.78		20.1	0.12	14.8	0.21	0.50	28.4	0.59	3.65
W	12.5	2.75		19.9	0.13	14.7	0.20	0.54	28.1	0.58	3.64
X											3.90
X											3.87
X											4.09
X											3.96
X											4.01
X											3.91
X											3.91
X											4.02
ZB		2.85	21.3	20.1	0.13	14.5	0.20	0.44	28.4	0.57	
ZB		2.79	21.1	20.0	0.12	14.3	0.20	0.45	28.4	0.57	
ZB		2.75	21.0	19.8	0.13	14.2	0.20	0.44	28.0	0.56	
ZB		2.79	21.3	20.1	0.13	14.6	0.21	0.50	28.5	0.59	
ZB		2.81	21.4	20.3	0.11	14.6	0.20	0.48	28.5	0.60	
ZB		2.80	21.4	20.2	0.12	14.6	0.20	0.49	28.5	0.59	
ZB		2.86	21.5	20.3	0.13	14.3	0.21	0.43	28.5	0.59	
ZB		2.76	21.1	19.9	0.13	14.2	0.20	0.45	28.3	0.56	
ZC			21.0	21.8					26.6		3.61
ZC			21.3	22.2					27.0		3.63
ZC			21.2	22.1					26.7		3.60
ZC			21.0	21.9					26.8		3.61
ZC			20.7	21.7					26.7		3.63
ZC			20.5	21.4					26.4		3.62
ZC			21.0	21.6					26.6		3.61
ZC			20.8	21.7					26.5		3.63

12. 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:

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

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	σ _L ²	Sw ³	CSU ⁴
Pt	Pb Coll	g/t	0.080	0.042	0.062	0.013
Pd	Pb Coll	g/t	0.037	0.018	0.031	0.006
Au	Pb Coll	g/t	0.011	0.003	0.010	0.001
Pt	NIS	g/t	0.128	0.119	0.081	0.046
Pd	NIS	g/t	0.037	0.023	0.034	0.010
Au	NIS	g/t	0.017	0.018	0.008	0.007
Ir	NIS	g/t	0.011	0.012	0.004	0.005
Rh		g/t	0.020	0.017	0.012	0.006
Ru	NiS	g/t	0.040	0.037	0.026	0.014
Co	M/ICP	ppm	6.79	5.46	4.43	2.01
Co	P	ppm	1.194	1.080	0.595	0.389
Cr	XRF	%	0.275	0.129	0.066	0.058
Cu	M/ICP	ppm	4.88	3.815	2.545	1.181
Cu	P	ppm	3.71	2.36	2.57	0.76
Ni	M/ICP	ppm	78.7	69.0	13.52	20.84
Ni	P	ppm	7.94	7.62	3.40	2.73
Ni	XRF	ppm	37.7	48.0	10.7	21.5
Al ₂ O ₃	XRF	%	0.095	0.084	0.059	0.033
CaO	XRF	%	0.022	0.021	0.012	0.009
Cr ₂ O ₃	XRF	%	0.170	0.188	0.096	0.085
Fe ₂ O ₃	XRF	%	0.196	0.149	0.122	0.055
K ₂ O	XRF	%	0.008	0.010	0.003	0.004
MgO	XRF	%	0.134	0.135	0.047	0.051
MnO	XRF	%	0.004	0.005	0.002	0.002
Na ₂ O	XRF	%	0.031	0.028	0.020	0.012
SiO ₂	XRF	%	0.152	0.106	0.092	0.045
TiO ₂	XRF	%	0.010	0.006	0.008	0.002
SG	pyc		0.058	0.051	0.023	0.016

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 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 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:** AMIS0257 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. **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 Smees and Smees and Associates Ltd; accept no liability for any decisions or actions taken following the use of the reference material.

11 December 2013

Certifying Officers:



African Mineral Standards: _____

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



Geochemist: _____

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

Appendix – uncertified trace element statistics

Analyte	Method	Unit	Mean	2SD	RSD%	n
Ag	M/ICP	ppm	0.32	0.69	107	14
Al	M/ICP	%	6.4	0.86	6.7	78
As	M/ICP	ppm	44.3	162	183	39
Ba	M/ICP	ppm	40.7	9.5	11.7	55
Be	M/ICP	ppm	0.77	1.8	119	24
Bi	M/ICP	ppm	60.2	138	114	19
Ca	M/ICP	%	1.9	0.21	5.6	68
Cd	M/ICP	ppm	0.06	0.02	17.3	15
Ce	M/ICP	ppm	4.8	0.49	5.1	15
Co	XRF	ppm	196	36.7	9.4	31
Cr	M/ICP	%	13.9	1.2	4.3	39
Cs	M/ICP	ppm	0.19	0.04	12.0	22
Cu	XRF	ppm	70.1	11.5	8.2	36
Dy	M/ICP	ppm	0.48	0.05	5.4	8
Er	M/ICP	ppm	0.33	0.05	7.8	8
Fe	M/ICP	%	13.6	1.3	4.9	65
Ga	M/ICP	ppm	32.7	10.8	16.5	28
Ge	M/ICP	ppm	0.45	0.11	11.9	8
Hf	M/ICP	ppm	0.40	0.06	8.1	20
Ho	M/ICP	ppm	0.10	0.0	0.0	8
In	M/ICP	ppm	0.02	0.01	15.8	15
K	M/ICP	%	0.10	0.01	6.4	79
La	M/ICP	ppm	4.2	5.5	65.7	47
Li	M/ICP	ppm	2.7	0.78	14.4	57
Mg	M/ICP	%	8.2	0.93	5.6	79
Mn	M/ICP	ppm	1411	224	8.0	87
Mo	M/ICP	ppm	2.9	3.3	56.1	48
Na	M/ICP	%	0.34	0.04	5.8	79
Nb	M/ICP	ppm	0.83	0.38	23.2	24
Nd	M/ICP	ppm	2.3	0.22	4.9	8
P	M/ICP	ppm	72.1	47.3	32.8	49
Pb	M/ICP	ppm	4.9	5.5	55.9	44
Pr	M/ICP	ppm	2.3	3.6	78.8	16
Rb	M/ICP	ppm	4.2	0.22	2.6	16
S	Comb/LECO	%	0.03	0.02	31.9	40
S	M/ICP	%	0.03	0.01	24.5	66
Sb	M/ICP	ppm	455	1595	175	32
Sc	M/ICP	ppm	14.5	2.3	8.0	79
Se	M/ICP	ppm	6.1	7.6	62.1	12
Si	M/ICP	%	13.2	0.28	1.1	8
Sm	M/ICP	ppm	0.45	0.05	5.9	8
Sn	M/ICP	ppm	0.70	0.10	7.4	16
Sr	M/ICP	ppm	63.4	5.5	4.3	72
Ta	M/ICP	ppm	0.06	0.02	16.2	15
Tb	M/ICP	ppm	0.08	0.02	12.3	8
Te	M/ICP	ppm	0.06	0.04	32.1	9
Th	M/ICP	ppm	0.56	0.15	13.2	24
Ti	M/ICP	%	0.31	0.06	10.3	56
Tl	M/ICP	ppm	0.02	0.01	21.1	15
Tm	M/ICP	ppm	0.06	0.02	16.8	8
U	M/ICP	ppm	0.33	0.07	11.3	24
V	M/ICP	ppm	1009	119	5.9	56
W	M/ICP	ppm	0.31	0.25	39.8	15
Y	M/ICP	ppm	2.5	0.92	18.3	46
Yb	M/ICP	ppm	0.36	0.05	6.4	8
Zn	M/ICP	ppm	355	190	26.8	76
Zr	M/ICP	ppm	15.0	5.9	19.8	46