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AMIS0192

Certified Reference Material **Platinum (PGM), Merensky Ore** **Bushveld Complex, South Africa**

Certificate of Analysis

Recommended Concentrations and Limits¹ ***(at two Standard Deviations)***

Certified Concentrations²

Pt Pb Collection	7.93	±	0.40	g/t
Pd Pb Collection	4.04	±	0.18	g/t
Au Pb Collection	1.68	±	0.12	g/t
Pt NiS	7.86	±	0.52	g/t
Pd NiS	4.04	±	0.16	g/t
Au NiS	1.61	±	0.12	g/t
Rh NiS	1.01	±	0.08	g/t
Co M/ICP	179	±	14	ppm
Co P	131	±	15	ppm
Cu M/ICP	1562	±	112	ppm
Cu P	1550	±	104	ppm
Ni M/ICP	2776	±	258	ppm
Ni P	2556	±	236	ppm
Ni XRF	2909	±	264	ppm
Specific Gravity	3.10	±	0.16	

Provisional Concentrations

Ir NiS	0.40	±	0.08	g/t
Ru NiS	1.78	±	0.30	g/t

$$4E \text{ (Pt, Pd, Au (all NiS) \& Rh)} = 14.51 \text{ g/t}$$

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 two “Between Laboratory” Standard Deviations

Certified Concentrations

Al ₂ O ₃	12.22	±	0.16	%
CaO	6.58	±	0.14	%
Cr ₂ O ₃	2.99	±	0.10	%
Fe ₂ O ₃	11.92	±	0.22	%
K ₂ O	0.15	±	0.01	%
MgO	15.13	±	0.30	%
MnO	0.17	±	0.014	%
Na ₂ O	0.90	±	0.03	%
SiO ₂	48.23	±	0.50	%
TiO ₂	0.24	±	0.01	%
S LECO	0.63	±	0.08	%

Informational Concentration

LOI 0.86 %

1. Intended Use: AMIS0192 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 ores; 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: AMIS0192 is a commissioned CRM made from material supplied by SGS Minerals Services, using Anglo Platinum - Merensky Reef underground sample 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 18 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).

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. 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.

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 six laboratories were each given eight randomly selected packages of sample. Twenty one 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 21 out of 26 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 Platinum - Eastern Bushveld Regional Laboratory
7. Anglo Research (South Africa)
8. Genalysis Laboratory Services (South Africa) Pty
9. Genalysis Laboratory Services WA
10. Northam Platinum LTD
11. Performance Laboratories SA
12. Rappa Research Laboratory SA
13. Set Point Laboratories (Isando) SA
14. SGS Australia Pty Ltd (Newburn) WA
15. SGS Geosol Laboratories Ltda (Brazil)
16. SGS Mineral Services Callao (Peru)
17. SGS Mineral Services Lakefield (Canada)
18. SGS South Africa (Pty) Ltd - Booyens JHB
19. SGS Toronto (Canada)
20. SGS Townsville (Australia)
21. 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 Order	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
A	6.78	3.98	1.71							178	126		1665	1670		2820	2520	
A	8.07	3.78	1.67							181	129		1680	1700		2860	2560	
A	7.99	4.01	1.72							179	129		1665	1680		2830	2510	
A	8.03	4.14	1.86							179	129		1685	1660		2890	2540	
A	7.71	4.04	1.80							180	127		1695	1670		2870	2510	
A	7.89	4.12	1.80							185	129		1705	1710		2930	2520	
A	8.01	4.00	1.72							180	128		1680	1670		2830	2520	
A	7.91	3.97	1.82							185	130		1710	1690		2900	2550	
B																		
B	8.33	4.09	1.61							186	125		1635	1590		2780	2440	
B	8.29	4.09	1.63							186	127		1630	1620		2800	2440	
B	8.21	4.05	1.64							188	125		1640	1605		2780	2440	
B	8.14	4.00	1.69							176	127		1525	1605		2650	2480	
B	8.23	4.10	1.66							175	122		1520	1580		2600	2410	
B	8.37	4.11	1.69							186	126		1630	1610		2750	2450	
B	7.37	3.62	1.45							185	126		1605	1600		2760	2430	
C	8.33	4.28	1.62							169	132		1540	1535		2690	2400	
C	8.21	4.25	1.64							169	133		1530	1525		2700	2430	
C	8.53	4.34	1.68							167	135		1525	1565		2650	2470	
C	8.52	4.37	1.65							165	134		1510	1525		2600	2420	
C	8.51	4.37	1.63							172	137		1545	1590		2660	2470	
C	8.18	4.21	1.63							168	134		1510	1570		2660	2470	
C	8.34	4.32	1.64							168	134		1525	1555		2660	2470	
C	8.56	4.35	1.72							167	132		1520	1550		2630	2380	
D	8.03	4.03	1.78							168	132		1605	1980		2790	2730	
D	8.03	4.02	1.77							173	131		1635	1910		2850	2670	
D	8.18	4.09	1.80							172	136		1670	2020		2880	2790	
D	8.32	4.14	1.78							175	134		1660	1910		2910	2690	
D	8.06	4.00	1.68							176	131		1695	1930		2910	2710	
D	8.22	4.09	1.74							173	130		1675	1900		2890	2650	
D	8.06	4.06	1.69							172	135		1665	2010		2890	2750	
D	8.16	4.06	1.72							175	133		1600	1940		2870	2700	
E	7.82	3.72	1.78							178	124	200	1376	1385	1900.00	2701	2388	3000
E	7.74	3.68	1.65							178	121	300	1396	1414	1400.00	2685	2445	3100
E	7.97	3.86	1.82							173	120	300	1314	1393	1500.00	2692	2347	3100
E	7.75	3.33	1.66							177	122	200	1340	1396	1600.00	2585	2392	2900
E	7.83	3.60	1.76							158	120	300	1320	1402	1400.00	2596	2379	2800
E	7.78	3.50	1.67							169	120	300	1395	1397	1700.00	2614	2313	2900
E	7.87	3.63	1.70							178	122	300	1359	1390	1500.00	2595	2395	2900
E	7.27	3.30	1.59							176	118	300	1343	1371	1600.00	2571	2361	2800
F	5.63	2.47	1.22							171	124		1470	1460		2660	2400	
F	6.89	2.92	1.40							180	127		1530	1470		2710	2460	
F	5.44	2.62	1.35							175	127		1580	1520		2680	2430	
F	6.53	2.85	1.38							175	131		1520	1490		2730	2500	
F	7.03	3.15	1.46							174	134		1500	1500		2690	2550	
F	7.31	3.16	1.53							178	129		1530	1450		2770	2470	
F	7.00	2.91	1.53							175	128		1560	1510		2780	2460	
F	7.65	3.43	1.61							179	131		1530	1490		2770	2480	

Economic element data (cont)

Lab Order	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
Y				7.76	4.04	1.65	0.39	1.02	1.55									
Y				7.32	3.87	1.75	0.37	0.96	1.43									
Y				7.30	3.90	1.74	0.38	0.97	1.48									
Y				7.80	4.09	1.56	0.41	1.04	1.66									
Y				7.63	4.00	1.43	0.39	1.02	1.56									
Y				7.52	4.02	1.66	0.39	1.00	1.55									
Y				7.49	4.01	1.56	0.38	1.02	1.57									
Y				7.54	4.00	1.51	0.39	1.00	1.56									
Z				8.24	4.10	1.54	0.50	1.04	2.01									
Z				8.21	4.11	1.55	0.44	1.03	1.97									
Z				8.34	4.16	1.60	0.45	1.05	1.99									
Z				8.27	4.14	1.57	0.48	1.05	2.03									
Z				8.28	4.10	1.58	0.52	1.05	2.01									
Z				8.20	4.06	1.57	0.46	1.03	1.96									
Z				8.32	4.13	1.56	0.44	1.05	2.01									
Z				7.37	3.60	1.41	0.36	0.90	1.74									

Major element data

Lab Order	Al2O3 XRF %	CaO XRF %	Cr2O3 XRF %	Fe2O3 XRF %	K2O XRF %	LOI %	MgO XRF %	MnO XRF %	Na2O XRF %	SiO2 XRF %	TiO2 XRF %	S Comb/LECO %	SG pyc
A	12.15	6.39	2.92	11.40	0.14	0.70	14.90	0.17	0.89	46.70	0.22	0.72	2.96
A	12.15	6.37	2.89	11.35	0.14	0.77	14.90	0.17	0.89	46.70	0.21	0.73	2.97
A	12.15	6.38	2.95	11.30	0.14	0.89	14.95	0.16	0.89	46.60	0.23	0.73	2.98
A	12.15	6.38	2.98	11.30	0.14	0.89	14.90	0.16	0.89	46.60	0.22	0.72	2.98
A	12.15	6.40	2.95	11.30	0.14	0.76	14.95	0.16	0.89	46.70	0.22	0.72	2.97
A	12.15	6.38	2.96	11.35	0.14	0.70	14.95	0.17	0.90	46.60	0.22	0.74	2.97
A	12.10	6.39	3.00	11.35	0.14	0.68	14.95	0.17	0.89	46.70	0.22	0.72	2.99
A	12.15	6.38	2.86	11.45	0.14	0.79	14.90	0.17	0.89	46.50	0.22	0.72	2.94
B													
B	12.55	6.45	2.89	11.42	0.16	0.91	15.32	0.16	0.90	48.25	0.25	0.67	3.19
B	12.60	6.42	2.88	11.43	0.16	0.88	15.30	0.16	0.90	48.52	0.25	0.69	3.11
B	12.60	6.45	2.89	11.43	0.16	0.89	15.29	0.16	0.90	48.31	0.25	0.68	3.20
B	12.66	6.47	2.90	11.54	0.16	0.88	15.41	0.16	0.91	48.50	0.24	0.67	3.12
B	12.53	6.45	2.89	11.43	0.16	0.90	15.28	0.16	0.90	48.45	0.24	0.67	3.09
B	12.65	6.47	2.90	11.47	0.16	0.87	15.36	0.17	0.91	48.67	0.25	0.68	3.17
B	12.60	6.45	2.90	11.45	0.16	0.87	15.32	0.17	0.91	48.54	0.25	0.68	3.02
C	12.30	6.50	2.99	11.65	0.13	0.71	14.65	0.17	0.85	48.10	0.24		2.98
C	12.35	6.53	2.99	11.65	0.13	0.74	14.70	0.17	0.86	48.20	0.24		3.00
C	12.25	6.51	2.97	11.60	0.13	0.74	14.65	0.17	0.85	48.10	0.25		2.96
C	12.25	6.49	2.97	11.60	0.13	0.68	14.65	0.17	0.85	48.00	0.24		2.95
C	12.30	6.54	3.01	11.70	0.13	0.69	14.75	0.17	0.86	48.40	0.24		2.96
C	12.30	6.53	3.00	11.70	0.13	0.72	14.70	0.17	0.86	48.20	0.24		2.95
C	12.25	6.52	2.98	11.60	0.13	0.77	14.70	0.17	0.86	48.10	0.26		2.95
C	12.35	6.58	3.03	11.80	0.13	0.69	14.80	0.17	0.85	48.60	0.24		2.95
D												0.77	3.11
D												0.76	3.12
D												0.78	3.12
D												0.76	3.12
D												0.77	3.11
D												0.77	3.11
D												0.77	3.12
D												0.78	3.12
E	12.30	6.60	3.20	12.00	0.15	0.83	15.40	0.19	0.93	48.40	0.26		
E	12.20	6.54	3.38	12.00	0.14	0.86	15.40	0.17	0.92	48.00	0.25		
E	12.20	6.52	3.17	11.80	0.15	0.82	15.20	0.18	0.92	47.90	0.24		
E	12.20	6.57	3.16	12.10	0.15	0.99	15.40	0.18	0.89	48.50	0.24		
E	12.20	6.53	3.19	11.90	0.15	0.85	15.40	0.18	0.90	48.00	0.23		
E	12.20	6.52	3.32	12.00	0.15	0.81	15.30	0.19	0.90	48.00	0.25		
E	12.20	6.51	3.20	12.00	0.15	0.93	15.40	0.18	0.88	48.10	0.24		
E	12.10	6.51	3.20	12.00	0.15	0.95	15.30	0.18	0.91	48.10	0.24		
G												0.60	3.16
G												0.60	3.15
G												0.58	3.20
G												0.58	3.18
G												0.58	3.17
G												0.59	3.21
G												0.58	3.16
G												0.60	3.20
H	12.20	6.60	3.01	11.90	0.15	0.43	15.20	0.17	0.92	48.00	0.25	0.78	
H	12.20	6.61	3.02	11.90	0.15	0.43	15.10	0.17	0.92	48.00	0.25	0.76	
H	12.20	6.61	3.02	11.90	0.15	0.39	15.20	0.17	0.92	48.00	0.25	0.72	
H	12.20	6.60	3.00	11.90	0.15	0.51	15.10	0.17	0.91	48.00	0.24	0.65	
H	12.20	6.59	3.00	11.90	0.15	0.47	15.10	0.17	0.92	48.00	0.24	0.62	
H	12.20	6.60	3.01	11.90	0.15	0.55	15.10	0.17	0.90	48.00	0.25	0.60	
H	12.20	6.59	3.01	11.90	0.15	0.56	15.10	0.17	0.92	48.00	0.25	0.59	
H	12.20	6.60	3.01	11.90	0.15	0.46	15.20	0.17	0.90	48.00	0.25	0.79	

Major element data (cont)

Lab Order	Al2O3 XRF %	CaO XRF %	Cr2O3 XRF %	Fe2O3 XRF %	K2O XRF %	LOI %	MgO XRF %	MnO XRF %	Na2O XRF %	SiO2 XRF %	TiO2 XRF %	S Comb/LECO %	SG pyc
I	12.20	6.72	3.06	12.00	0.15	1.02	15.00	0.16	0.89	48.20	0.24	0.60	
I	12.20	6.67	3.06	11.90	0.15	1.00	15.00	0.17	0.89	47.90	0.23	0.63	
I	12.20	6.68	3.06	11.90	0.14	0.98	15.00	0.16	0.88	48.00	0.24	0.65	
I	12.10	6.63	3.05	11.90	0.15	0.93	15.00	0.16	0.89	47.80	0.25	0.65	
I	12.10	6.67	3.06	11.90	0.15	1.14	15.00	0.16	0.89	47.80	0.23	0.63	
I	12.10	6.67	3.05	11.90	0.15	1.05	15.00	0.16	0.89	47.90	0.24	0.64	
I	12.00	6.67	3.04	11.90	0.15	1.11	14.90	0.17	0.89	47.70	0.23	0.62	
I	12.10	6.64	3.04	11.80	0.15	1.05	15.00	0.16	0.89	47.70	0.24	0.62	
J												0.61	2.98
J												0.62	2.95
J												0.62	2.85
J												0.62	3.22
J												0.61	2.95
J												0.60	2.99
J												0.61	2.97
J												0.62	3.02
K	12.20	6.55	3.02	11.80	0.17	0.87	14.80	0.17	0.88	47.40	0.23	0.62	3.09
K	12.40	6.74	3.08	12.20	0.18	0.96	15.10	0.17	0.93	48.40	0.24	0.64	3.12
K	12.40	6.69	3.23	12.30	0.18	1.00	15.00	0.18	0.90	48.40	0.25	0.64	3.11
K	12.30	6.74	3.09	12.00	0.18	0.99	15.00	0.18	0.89	48.20	0.24	0.61	3.11
K	12.30	6.70	3.13	11.90	0.18	1.04	15.00	0.17	0.89	47.90	0.24	0.63	3.11
K	12.50	6.76	3.10	12.10	0.17	1.47	15.20	0.16	0.92	48.50	0.23	0.63	3.11
K	12.30	6.70	3.06	11.90	0.18	1.06	15.00	0.17	0.91	48.10	0.24	0.63	3.12
K	12.30	6.66	3.09	12.00	0.17	1.06	15.10	0.17	0.91	48.20	0.24	0.62	3.09
N	12.22	6.58	2.96	11.95	0.15	0.74	15.05	0.16		48.36	0.24	0.64	3.11
N	12.22	6.58	2.97	11.94	0.15	0.77	15.06	0.16		48.36	0.24	0.63	3.09
N	12.24	6.58	2.97	11.94	0.15	0.78	15.07	0.16		48.37	0.24	0.64	3.07
N	12.24	6.59	2.98	11.95	0.15	0.74	15.07	0.16		48.35	0.24	0.62	3.08
N	12.21	6.58	2.96	11.94	0.15	0.76	15.07	0.16		48.35	0.24	0.62	3.07
N	12.23	6.59	2.96	11.93	0.15	0.75	15.08	0.16		48.33	0.24	0.62	3.11
N	12.22	6.60	2.96	11.94	0.15	0.76	15.06	0.16		48.29	0.24	0.64	3.10
N	12.22	6.59	2.95	11.93	0.15	0.75	15.05	0.16		48.32	0.24	0.62	3.08
P												0.63	
P												0.67	
P												0.53	
P												0.54	
P												0.65	
P												0.65	
P												0.58	
P												0.62	
Q													3.13
Q													3.15
Q													3.13
Q													3.12
Q													3.13
Q													3.13
Q													3.13
Q													3.13
S													3.07
S													3.24
S													3.10
S													3.08
S													3.26
S													3.09
S													3.23
S													3.19
T	12.10	6.60	3.03	12.03	0.15	0.69	15.08	0.17	0.92	48.46	0.24	0.63	3.15
T	12.21	6.61	3.03	12.12	0.15	0.68	15.11	0.17	0.91	48.53	0.24	0.60	3.16
T	12.19	6.62	3.03	12.04	0.15	0.67	15.06	0.17	0.93	48.37	0.24	0.64	3.10
T	12.14	6.62	3.03	12.04	0.15	0.66	15.09	0.17	0.92	48.45	0.24	0.63	3.03
T	12.22	6.60	3.03	12.02	0.15	0.68	15.07	0.17	0.90	48.49	0.24	0.63	3.03
T	12.24	6.61	3.03	12.12	0.15	0.64	15.08	0.17	0.90	48.52	0.24	0.62	3.22
T	12.15	6.62	3.03	12.08	0.15	0.68	15.09	0.17	0.89	48.57	0.24	0.57	3.13
T	12.10	6.60	3.03	12.03	0.15	0.63	15.09	0.17	0.92	48.51	0.24	0.60	3.12
U													3.16
U													3.16
U													3.15
U													3.16
U													3.17
U													3.16
U													3.17
U													3.17
X	12.40	6.61	2.98	11.87	0.15	1.06	15.40	0.18	1.00	48.50	0.19	0.63	3.10
X	12.30	6.60	2.97	11.84	0.15	1.06	15.30	0.18	1.00	48.30	0.19	0.64	3.11
X	12.20	6.48	2.94	11.68	0.14	1.06	15.10	0.18	1.00	48.40	0.18	0.62	3.10
X	12.20	6.55	2.98	11.82	0.15	1.09	15.20	0.18	1.00	48.30	0.19	0.62	3.10
X	12.40	6.59	2.97	11.99	0.15	1.06	15.50	0.19	1.00	48.80	0.19	0.61	3.10
X	12.30	6.58	2.96	11.80	0.14	1.04	15.30	0.18	1.00	48.20	0.18	0.63	3.10
X	12.30	6.55	2.96	11.83	0.15	1.02	15.20	0.18	1.00	47.90	0.18	0.63	3.10
X	12.50	6.65	2.99	11.92	0.16	1.07	15.50	0.18	1.00	48.70	0.19	0.65	3.10
Z													3.17
Z													3.15
Z													3.12
Z													3.20
Z													3.23
Z													3.17
Z													3.16
Z													3.12

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:

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

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

Analyte	Method	unit	S ¹	σ _L ²	SW ³	CSU ⁴
Pt	PbColl	g/t	0.198	0.117	0.106	0.031
Pd	PbColl	g/t	4.037	0.050	0.062	0.015
Au	PbColl	g/t	0.063	0.029	0.048	0.008
Pt	NIS	g/t	0.260	0.216	0.177	0.085
Pd	NIS	g/t	0.077	0.072	0.044	0.028
Au	NIS	g/t	0.059	0.038	0.048	0.016
Ir	NiS	g/t	0.038	0.038	0.017	0.014
Rh	NiS	g/t	0.042	0.038	0.022	0.014
Ru	NiS	g/t	0.146	0.149	0.064	0.057
Co	M/ICP	ppm	6.98	4.94	3.25	1.409
Co	P	ppm	7.26	5.20	3.30	1.480
Cu	M/ICP	ppm	55.5	34.7	31.2	9.77
Cu	P	ppm	51.9	36.4	23.7	10.4
Ni	M/ICP	ppm	129	88	53.1	23.2
Ni	P	ppm	118	87	36.7	23.4
Ni	XRF	ppm	132	152	52.0	62.3
Al ₂ O ₃	XRF	%	0.077	0.059	0.049	0.020
CaO	XRF	%	0.066	0.056	0.030	0.019
Cr ₂ O ₃	XRF	%	0.054	0.049	0.018	0.017
Fe ₂ O ₃	XRF	%	0.110	0.090	0.065	0.033
K ₂ O	XRF	%	0.005	0.005	0.003	0.002
LOI		%	0.146	0.134	0.050	0.045
MgO	XRF	%	0.150	0.135	0.055	0.045
MnO	XRF	%	0.007	0.005	0.003	0.002
Na ₂ O	XRF	%	0.014	0.009	0.011	0.004
SiO ₂	XRF	%	0.247	0.182	0.161	0.064
TiO ₂	XRF	%	0.006	0.003	0.005	0.001
S	Comb/LECO	%	0.038	0.028	0.019	0.009
SG	pyc		0.079	0.051	0.043	0.014

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. 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:** AMIS0192 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.

18 November 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	0.77	0.31	20.18	60
Al	M/ICP	%	6.61	0.47	3.52	107
As	M/ICP	ppm	10.04	2.92	14.56	66
Ba	M/ICP	ppm	65.93	10.19	7.73	95
Be	M/ICP	ppm	0.18	0.05	14.22	37
Bi	M/ICP	ppm	1.07	0.17	7.84	56
Ca	M/ICP	%	4.57	0.32	3.50	108
Cd	M/ICP	ppm	0.20	0.04	9.90	47
Ce	M/ICP	ppm	14.27	2.49	8.73	40
Cr	M/ICP	ppm	17136	5764	16.82	56
Cs	M/ICP	ppm	0.23	0.05	11.52	31
Dy	M/ICP	ppm	0.86	0.05	2.68	8
Er	M/ICP	ppm	0.56	0.07	6.29	8
Eu	M/ICP	ppm	0.31	0.05	7.41	8
Fe	M/ICP	%	8.14	0.75	4.58	94
Ga	M/ICP	ppm	12.69	1.38	5.43	53
Gd	M/ICP	ppm	0.80			8
Ge	M/ICP	ppm	0.26	0.27	51.94	23
Hf	M/ICP	ppm	0.57	0.10	8.80	35
Ho	M/ICP	ppm	0.19	0.02	5.38	8
In	M/ICP	ppm	0.04	0.01	13.84	35
K	M/ICP	%	0.13	0.02	6.65	107
La	M/ICP	ppm	8.06	1.74	10.80	61
Li	M/ICP	ppm	4.49	0.92	10.26	83
Lu	M/ICP	ppm	0.10	0.02	11.13	16
Mg	M/ICP	%	9.06	0.35	1.93	84
Mn	M/ICP	ppm	1238	136	5.49	94
Mo	M/ICP	ppm	2.82	0.63	11.07	69
Na	M/ICP	%	0.67	0.06	4.39	101
Nb	M/ICP	ppm	1.33	0.23	8.60	45
Nd	M/ICP	ppm	5.34	0.14	1.30	8
P	M/ICP	ppm	118	36.57	15.45	73
Pb	M/ICP	ppm	54.54	5.81	5.32	91
Pr	M/ICP	ppm	1.50	0.07	2.25	8
Rb	M/ICP	ppm	4.48	0.43	4.78	46
Re	M/ICP	ppm	0.01	0.002	15.40	23
S	M/ICP	%	0.63	0.06	4.38	74
Sb	M/ICP	ppm	2.08	0.50	12.04	54
Sc	M/ICP	ppm	18.04	1.54	4.26	69
Se	M/ICP	ppm	4.47	1.45	16.22	38
Si	M/ICP	%	22.43	0.37	0.82	8
Sm	M/ICP	ppm	0.91	0.07	3.87	8
Sn	M/ICP	ppm	1.12	0.26	11.64	39
Sr	M/ICP	ppm	165	23.98	7.25	100
Ta	M/ICP	ppm	0.15	0.15	51.21	35
Tb	M/ICP	ppm	0.14	0.01	2.80	14
Te	M/ICP	ppm	1.25	0.36	14.34	48
Th	M/ICP	ppm	2.22	0.33	7.44	46
Ti	M/ICP	%	0.14	0.02	5.92	92
Tl	M/ICP	ppm	0.10	0.02	10.02	36
U	M/ICP	ppm	13.05	1.80	6.90	48
V	M/ICP	ppm	217	20.71	4.78	78
W	M/ICP	ppm	0.45	0.10	11.28	39
Y	M/ICP	ppm	4.51	0.51	5.64	72
Yb	M/ICP	ppm	0.59	0.04	3.51	15
Zn	M/ICP	ppm	121.64	19.37	7.96	85
Zr	M/ICP	ppm	20.33	7.02	17.27	84