



AMIS0168

Certified Reference Material

**Platinum (PGM) UG2 Concentrate
Bushveld Complex, South Africa**

Certificate of Analysis

Recommended Concentrations and Limits¹ (at two Standard Deviations)

Certified Concentrations²

Pt Pb Collection	122.5	±	8.3	g/t
Pd Pb Collection	61.2	±	3.0	g/t
Au Pb Collection	1.20	±	0.14	g/t
Pt NIS	123	±	5.2	g/t
Pd NIS	60.8	±	1.50	g/t
Au NIS	1.18	±	0.08	g/t
Ir NiS	8.60	±	0.74	g/t
Rh NiS	23.5	±	0.56	g/t
Ru NiS	33.0	±	1.4	g/t
Co M/ICP	333	±	35	ppm
Co P	307	±	27	ppm
Cu M/ICP	5046	±	296	ppm
Cu P	5003	±	289	ppm
Cu XRF	5003	±	323	ppm
Ni M/ICP	1.016	±	0.073	%
Ni P	0.956	±	0.064	%
Specific Gravity	3.04	±	0.18	

Provisional Concentrations

Co XRF	356	±	67	ppm
Ni XRF	1.044	±	0.137	%

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.

$$4E = \text{Platinum} + \text{Palladium} + \text{Rhodium} + \text{Gold} = 208.4 \text{ g/t}$$

Major Element Recommended Concentrations and Limits (at two Standard Deviations)

Certified Concentrations

Al ₂ O ₃	2.36	±	0.06	%
CaO	2.04	±	0.08	%
Cr ₂ O ₃	1.20	±	0.06	%
Fe ₂ O ₃	11.62	±	0.26	%
MgO	23.98	±	1.02	%
MnO	0.128	±	0.012	%
SiO ₂	49.48	±	1.50	%
TiO ₂	0.213	±	0.016	%

Provisional Concentrations

K ₂ O	0.100	±	0.014	%
Na ₂ O	0.16	±	0.04	%
LOI	5.29	±	1.18	%

1. Intended Use: AMIS0168 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 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 UG2 Reef Pt/Pd concentrate material supplied by Anglo Platinum Limited from their Rustenburg Concentrators.

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 9 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 Blueish Grey (Corstor 5B 7/1).

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 particle 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. 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 two laboratories were each given eight randomly selected packages of sample. Seventeen of the laboratories submitted results.

Final limits were calculated after first determining if all data was compatible within a spread normally expected for similar analytical methods done by reputable laboratories. Data from any one laboratory was then removed from further calculations when the mean of all analyses from that laboratory failed a "t test" of the global means of the other laboratories. The means and standard deviations were then re-calculated using all remaining data. Any analysis that fell outside of the new two standard deviations was removed from the ensuing data base. The mean and standard deviations were again calculated using the remaining data.

The "between-laboratory" standard deviation is used in the calculation to eliminate technically and statistically invalid data. Upper and lower limits are based on the standard deviation of the remaining data, which reflect individual analyses and can be used to monitor accuracy in routine laboratory quality control. This is different to limits based on standard deviations derived from grouped set of analyses (see 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 seventeen laboratories that provided results timeously were (not in same order as in the table of assays):

1. ALS Chemex Laboratory Group Brisbane Australia
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 - Mogalakwena Analytical Laboratory (MPL)
7. Anglo Research (Crown Campus)
8. Genalysis Laboratory Services (South Africa) Pty
9. Genalysis Laboratory Services WA
10. Northam
11. Performance Laboratories SA
12. Rappa Research Laboratory
13. Set Point Laboratories (Isando) SA
14. Set Point Laboratories (Mokopane) SA
15. SGS Mineral Services Callao (Peru)
16. SGS Mineral Services Lakefield (Canada)
17. SGS South Africa (Pty) Ltd - Booyens JHB

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.

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 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	126	62.90	1.27	125	61.70							400			5000			9900
A	127	62.80	1.24	129	63.10							400			5000			10000
A	125	62.10	1.22	128	63.40							400			5000			9900
A	126	62.00	1.23	125	61.10							300			5200			10000
A	128	62.80	1.30	129	63.50							400			5100			9900
A	126	62.70	1.29	126	63.20							400			5500			10100
A	127	62.80	1.26	126	64.10							400			5300			10000
A	129	64.90	1.33	126	62.30							400			5200			10100
B	122	59.10	1.27	123	60.70	1.20	8.28	23.80	33.20	305	310	300	4940	5020	4800	10600		9500
B	126	59.40	1.31	123	60.60	1.23	8.15	23.40	32.70	307	311	300	4980	5080	4900	10600		9600
B	125	60.10	1.28	121	59.30	1.16	8.11	23.10	32.20	309	305	200	4990	4990	4700	10600		9500
B	125	60.20	1.31	124	60.60	1.28	8.31	23.60	32.90	307	301	300	4910	4880	4700	10600		9700
B	127	59.70	1.26	124	60.00	1.26	8.26	23.40	33.00	303	308	300	4880	5000	4700	10600		10000
B	123	60.10	1.26	121	60.20	1.25	8.13	23.20	32.50	306	297	300	4890	5100	4600	10600		9800
B	128	59.60	1.27	127	61.50	1.23	8.41	23.90	33.40	309	308	200	5000	5000	4700	10600		9800
B	122	59.50	1.29	126	61.80	1.29	8.26	23.80	33.30	305	302	200	4910	4890	4600	10600		9200
C			1.15									314			4887			10400
C			1.14									310			4878			10100
C			1.18									313			4866			10200
C			1.15									313			4882			10200
C			1.14									313			4923			10200
C			1.16									315			4926			10100
C			1.14									309			4884			10100
C			1.14									311			4928			10200
G				123	59.70	1.14	8.45	22.60	32.60									
G				128	61.60	1.18	8.77	23.40	33.90									
G				127	61.30	1.17	8.79	23.30	33.70									
G				125	60.40	1.17	8.89	22.80	33.20									
G				124	59.30	1.14	8.97	22.40	32.70									
G				125	60.20	1.19	8.67	22.80	33.30									
G				128	61.40	1.17	8.83	23.30	33.90									
G				121	58.20	1.14	8.87	21.90	31.90									
I										330	300	370	5020	5160	5180	9760	9470	10300
I										330	310	360	5040	5300	5100	9860	9820	10200
I										340	300	380	5110	5110	5140	10000	9580	10250
I										350	300	370	5300	5150	5110	10200	9560	10150
I										330	300	370	5040	5180	5150	9930	9760	10250
I										330	300	380	4950	5150	5170	9670	9480	10350
I										330	300	370	5050	5080	5170	9820	9520	10350
I										330	300	360	5000	5150	5110	9730	9500	10100
J		60.30	1.21							320	300		4760	4850		9510	9250	
J		60.10	1.20							330	310		4790	5150		9600	10100	
J		60.00	1.20							330	310		4900	4980		9670	9830	
J		56.60	1.13							320	310		4840	5070		9520	9900	
J		60.70	1.21							330	330		4880	5260		9320	10250	
J		61.10	1.25							330	300		5020	4920		9550	9610	
J		60.60	1.25							340	310		4950	5030		9630	9890	
J		61.70	1.28							360	320		5380	5130		10350	10150	
K	126	59.80	1.26							330	300		5120	4920		9750	9330	
K	125	60.00	1.27							330	300		5060	4870		9770	9190	
K	125	60.00	1.27							330	300		5040	4880		9860	9250	
K	125	59.50	1.26							330	300		5130	4850		9990	9330	
K	127	57.20	1.22							340	300		5110	4890		9910	9170	
K	129	56.60	1.21							340	310		5060	4950		9950	9520	
K	129	58.20	1.23							340	300		5060	4870		9970	9270	
K	127	59.40	1.27							340	300		5130	4790		10150	9080	

Economic element assay 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 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
L		57.70	1.11							360	310		5440	5150		10600	9570	
L		60.80	1.18							360	320		5430	5310		10700	9860	
L		63.00	1.25							350	310		5340	5220		10500	9740	
L		62.20	1.23							350	320		5390	5290		10450	9940	
L		60.80	1.21							350	310		5270	5390		10550	9880	
L		62.50	1.24							350	310		5310	5180		10500	9740	
L		63.70	1.27							350	320		5190	5140		10450	9630	
L		60.60	1.21							350	310		5170	5270		10450	9700	
M		59.20	1.23							350		360	5110	4830	4990	9770	9210	10200
M		61.80	1.27							340		360	5130	5090	4970	9870	9370	10150
M		61.40	1.27							340		350	5110	4840	4960	9910	9480	10150
M		60.00	1.27							340		370	5160	5120	5030	9900	9440	10250
M		57.00	1.20							350		370	5230	4990	4980	10000	9480	10250
M		60.60	1.25							340		360	5050	4960	4840	9860	9320	10100
M		59.50	1.24							340		340	5130	4950	4860	9770	9230	10000
M		62.30	1.28							340		370	5090	4880	5060	9860	9420	10300
N				125	60.88	1.20	8.69	23.55	33.37			793			16722			24399
N				126	61.27	1.20	8.93	23.85	34.07			824			16639			24227
N				126	61.11	1.19	8.91	23.78	34.00			809			16652			24565
N				124	60.46	1.16	8.72	23.50	33.58			849			16621			24082
N				124	60.74	1.18	8.73	23.67	33.51			858			16555			24507
N				125	60.79	1.19	8.74	23.68	33.60			803			16320			24073
N				125	61.04	1.19	8.84	23.73	33.48			851			16433			23894
N				122	59.39	1.14	8.51	23.14	32.72			858			16296			23930
O				123	61.07	1.16	8.65	23.69	33.17	343			5143			10252		
O				122	61.04	1.14	8.63	23.70	33.38	334			5129			10284		
O				122	60.86	1.18	8.69	23.55	33.21	336			5143			10204		
O				123	60.63	1.14	8.61	23.50	33.51	327			5154			10210		
O				123	61.11	1.16	8.74	23.75	33.41	320			5191			10123		
O				124	61.57	1.17	8.79	23.61	33.79	329			5164			10155		
O				123	60.93	1.16	8.71	23.63	33.31	336			5189			10245		
O				123	61.23	1.17	8.63	23.68	33.39	343			5162			10135		
Q	122	64.03	1.06	118	60.40	1.13	7.85	23.17	29.48	352	311		5071	4823		9688	9279	
Q	125	64.28	1.08	118	60.30	1.13	7.75	23.61	31.74	320	309		5074	4794		9611	9234	
Q	125	66.10	1.09	122	61.22	1.14	8.02	23.38	31.52	309	309		5059	4831		9683	9121	
Q	122	62.26	1.14	121	60.98	1.16	8.10	23.57	31.58	302	313		5111	4911		9706	9331	
Q	117	60.96	1.10	123	61.25	1.14	8.20	23.80	30.56	313	323		5272	4970		9925	9652	
Q	118	61.61	1.12	116	60.04	1.12	7.86	23.30	31.46	308	312		5147	4832		9858	9325	
Q	124	60.01	1.17	121	61.33	1.20	7.90	23.36	31.71	326	306		5105	4767		9692	9033	
Q	128	66.54	1.12	123	62.72	1.14	8.26	23.78	31.96	326	309		5179	4805		9839	9220	
R	125	60.20	1.10	118	60.37	1.19	8.21	23.43	33.52									
R	120	60.44	1.10	121	60.63	1.17	8.25	23.35	33.58									
R	122	61.22	1.11	120	61.20	1.23	8.46	23.77	33.98									
R	126	60.30	1.11	120	61.80	1.27	8.52	23.98	34.02									
R	119	61.10	1.11	122	61.07	1.19	8.36	23.83	33.85									
R	120	61.52	1.12	122	59.69	1.18	8.33	23.24	32.89									
R	116	61.58	1.12	125	60.34	1.18	8.45	23.04	33.21									
R	121	61.07	1.12	119	60.61	1.16	8.27	23.55	31.66									
S				121	60.34	0.93	8.79	23.26	32.54									
S				119	59.27	0.90	8.79	23.02	32.57									
S				122	61.30	1.04	9.04	23.93	32.99									
S				121	59.97	0.97	8.44	23.71	32.94									
S				120	60.39	1.04	8.81	23.50	32.59									
S				121	61.34	1.07	8.79	23.35	33.01									
S				120	60.22	1.20	8.70	23.32	32.57									
S				119	59.00	1.06	8.73	23.10	32.03									
T	118	63.03	1.25	140	71.00	1.21	9.10	26.00		355	278	383	4700	4900	5100	10200	11400	11700
T	121	63.12	1.26	142	71.00	1.22	9.24	27.00		369	275	385	5000	5000	5100	10800	11400	11700
T	119	62.94	1.28	139	71.00	1.20	9.20	26.00		360	280	385	4900	5000	5100	10700	11400	11700
T	121	62.66	1.23	149	72.00	1.21	9.22	27.00		357	274	387	4600	4900	5100	10200	11400	11600
T	118	62.88	1.23	146	75.00	1.17	9.32	28.00		363	273	394	4900	4900	5100	10800	11400	11600
T	119	63.10	1.20	145	72.00	1.26	9.41	27.00		365	284	335	4900	5000	5200	10900	11400	11500
T	121	63.70	1.24	144	72.00	1.23	9.37	27.00		372	286	383	5000	4900	5100	10900	11500	11500
T	121	63.04	1.27	145	72.00	1.22	9.12	28.00		359	275	381	4700	5000	5100	10400	11600	11600
U	116	60.12	1.13									337			4900			10900
U	117	59.12	1.19									321			4800			11000
U	116	59.90	1.10									328			4900			11100
U	116	59.07	1.12									318			5000			11000
U	117	59.81	1.15									325			4800			10900
U	115	59.56	1.16									345			4900			11200
U	116	60.40	1.11									325			4800			11000
U	118	61.32	1.10									331			4800			11000
V	102	62.00	1.21							331	315		5083	4908		11058	11467	
V	99	61.00	1.19							333	331		4811	3919		10403	10322	
V	96	62.00	1.15							343	343		4562	4516		10578	8345	
V	99	62.00	1.16							340	340		5244	4607		10707	10110	
V	94	62.00	1.18							351	335		4435	4634		10808	10772	
V	116	64.00	1.14							338	325		5049	4795		10600	9882	
V	116	62.00	1.17							343	337		5134	4781		10365	11152	
V	114.00	62.00	1.21							360	360		5048	4471		10481	11069	

Major element assay data

Lab Code	Al2O3 XRF %	CaO XRF %	Cr2O3 XRF %	Fe2O3 XRF %	K2O XRF %	LOI %	MgO XRF %	MnO XRF %	Na2O XRF %	S Comb %	SiO2 XRF %	TiO2 XRF %	SG pyc
A	2.38	2.07	1.22	11.10	0.09	5.54	24.20	0.13	0.14	1.99	49.40	0.20	
A	2.37	2.06	1.21	11.20	0.10	5.66	24.30	0.12	0.14	2.01	49.30	0.21	
A	2.39	2.07	1.22	11.40	0.09	5.70	24.40	0.12	0.13	2.08	49.50	0.21	
A	2.36	2.09	1.22	11.50	0.10	5.68	24.50	0.12	0.15	2.00	49.80	0.22	
A	2.39	2.08	1.21	11.60	0.13	5.75	24.40	0.12	0.14	1.97	49.70	0.21	
A	2.36	2.07	1.22	11.40	0.10	5.56	24.30	0.12	0.13	2.05	49.60	0.21	
A	2.38	2.07	1.21	11.40	0.10	5.44	24.30	0.13	0.14	2.01	49.50	0.20	
A	2.36	2.08	1.21	11.40	0.09	5.55	24.40	0.12	0.13	1.95	49.40	0.20	
B	2.38	1.98	1.21	11.40	0.11	5.80	22.90	0.13	0.14		48.50	0.21	2.98
B	2.41	2.02	1.23	11.60	0.11	5.81	23.60	0.13	0.14		49.70	0.21	2.97
B	2.39	2.00	1.22	11.50	0.11	5.83	23.10	0.13	0.18		49.00	0.21	2.98
B	2.40	1.98	1.20	11.40	0.10	5.89	22.70	0.13	0.12		48.60	0.21	3.00
B	2.39	1.99	1.22	11.40	0.12	5.94	22.90	0.12	0.16		49.00	0.21	2.99
B	2.42	2.00	1.23	11.50	0.12	5.82	23.20	0.12	0.16		49.10	0.21	3.00
B	2.39	2.01	1.22	11.50	0.14	5.81	23.40	0.14	0.17		49.30	0.21	2.99
B	2.36	1.96	1.19	11.20	0.10	5.84	22.70	0.13	0.17		47.80	0.20	2.98
I	2.42	2.12	1.22	11.75	0.10	4.50	24.70	0.13	0.21		50.80	0.21	2.93
I	2.40	2.08	1.21	11.60	0.10	4.52	24.40	0.13	0.20		50.30	0.21	2.92
I	2.39	2.10	1.21	11.65	0.10	4.56	24.60	0.13	0.20		50.80	0.22	2.92
I	2.39	2.09	1.21	11.65	0.10	4.53	24.40	0.13	0.20		50.30	0.21	2.88
I	2.37	2.09	1.21	11.65	0.10	4.57	24.60	0.13	0.20		50.50	0.21	2.88
I	2.38	2.10	1.22	11.65	0.10	4.61	24.60	0.13	0.20		50.50	0.21	2.90
I	2.40	2.11	1.21	11.70	0.10	4.41	24.60	0.13	0.19		50.70	0.22	2.91
I	2.36	2.07	1.19	11.55	0.10	4.54	24.30	0.12	0.19		50.30	0.21	2.92
J	2.29	2.02	1.17	11.00	0.10	4.44	23.00	0.12	0.26		48.30	0.21	
J	2.31	2.01	1.16	10.80	0.09	4.37	23.20	0.12	0.25		48.60	0.20	
J	2.30	2.00	1.16	10.85	0.09	4.35	23.10	0.12	0.25		48.50	0.21	
J	2.30	2.00	1.14	10.80	0.09	4.50	23.10	0.12	0.25		48.50	0.22	
J	2.31	2.01	1.13	10.80	0.09	4.42	23.10	0.12	0.24		48.60	0.20	
J	2.31	2.01	1.15	10.90	0.09	4.40	23.00	0.12	0.25		48.40	0.21	
J	2.31	2.01	1.13	10.80	0.09	4.44	23.20	0.12	0.25		48.50	0.20	
J	2.30	2.00	1.15	10.95	0.09	4.40	23.10	0.12	0.26		48.40	0.22	
K	2.38	2.04	1.18	11.48	0.11	5.90	24.46	0.13	0.13		49.99	0.22	3.07
K	2.38	2.05	1.19	11.58	0.11	5.92	24.45	0.13	0.15		50.01	0.24	3.01
K	2.39	2.05	1.20	11.57	0.11	5.93	24.44	0.13	0.15		49.83	0.23	3.02
K	2.40	2.06	1.18	11.54	0.11	5.91	24.48	0.13	0.15		50.11	0.23	3.14
K	2.67	2.06	1.20	11.58	0.11	5.92	24.50	0.13	0.15		49.91	0.22	2.98
K	2.38	2.05	1.19	11.53	0.11	5.92	24.49	0.13	0.14		50.01	0.23	3.08
K	2.38	2.05	1.20	11.60	0.11	5.90	24.42	0.13	0.14		50.10	0.22	2.90
K	2.37	2.05	1.18	11.55	0.11	5.94	24.51	0.13	0.15		49.96	0.22	3.10
L													3.18
L													3.14
L													3.12
L													3.16
L													3.19
L													3.18
L													3.10
L													3.13
M	2.36	2.07	1.19	11.65	0.10	5.12	24.20	0.13	0.15		50.00	0.22	
M	2.37	2.06	1.19	11.60	0.10	5.09	24.10	0.13	0.15		49.80	0.22	
M	2.35	2.04	1.19	11.60	0.10	5.01	24.00	0.13	0.16		49.60	0.21	
M	2.38	2.07	1.20	11.70	0.10	5.07	24.30	0.13	0.14		50.10	0.22	
M	2.37	2.06	1.22	11.65	0.10	5.09	24.20	0.13	0.15		50.00	0.23	
M	2.37	2.07	1.18	11.60	0.08	5.10	23.90	0.13	0.16		48.50	0.22	
M	2.33	2.05	1.17	11.45	0.08	4.77	23.70	0.12	0.16		48.00	0.21	
M	2.39	2.08	1.20	11.70	0.10	5.05	24.30	0.13	0.15		50.30	0.22	
O	2.34	2.11	1.26				23.86			1.95	48.54		
O	2.32	2.00	1.25				23.94			1.94	48.29		
O	2.34	1.98	1.24				23.76			1.95	48.34		
O	2.36	1.99	1.23				23.49			1.95	48.43		
O	2.39	2.01	1.23				23.60			1.95	48.77		
O	2.38	1.99	1.24				23.65			1.94	48.68		
O	2.36	1.99	1.25				23.83			1.94	48.86		
O	2.37	1.99	1.23				23.69			1.94	48.56		
Q	2.36	2.04	1.19	11.78	0.10		24.13	0.13	0.17		50.15	0.21	2.96
Q	2.35	2.05	1.21	11.83	0.10		24.24	0.13	0.17		50.28	0.21	3.03
Q	2.34	2.05	1.20	11.83	0.10		24.30	0.13	0.17		50.31	0.22	3.01
Q	2.35	2.05	1.21	11.89	0.10		24.39	0.13	0.17		50.38	0.21	2.96
Q	2.35	2.05	1.20	11.84	0.10		24.36	0.13	0.17		50.27	0.21	3.00
Q	2.37	2.05	1.21	11.84	0.10		24.29	0.13	0.16		50.34	0.21	3.03
Q	2.35	2.05	1.21	11.85	0.10		24.24	0.13	0.17		50.40	0.21	3.11
Q	2.37	2.04	1.20	11.81	0.10		24.22	0.13	0.17		50.18	0.21	3.00

Major element assay 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 %	LOI %	MgO XRF %	MnO XRF %	Na ₂ O XRF %	S Comb %	SiO ₂ XRF %	TiO ₂ XRF %	SG pyc
R													3.19
R													3.17
R													3.19
R													3.18
R													3.18
R													3.16
R													3.17
R													3.19
T	2.10	1.99	1.15	11.70	0.10	5.70	23.90	0.14	0.30	2.00	49.40	0.19	3.02
T	2.10	2.00	1.15	11.70	0.09	5.67	24.00	0.14	0.30	2.01	49.40	0.18	3.02
T	2.10	1.98	1.14	11.70	0.09	5.65	23.80	0.14	0.30	2.00	49.20	0.18	3.03
T	2.10	2.00	1.15	11.70	0.10	5.68	24.00	0.14	0.30	2.00	49.50	0.18	3.02
T	2.10	2.01	1.15	11.70	0.09	5.72	23.90	0.14	0.30	1.98	49.40	0.19	3.04
T	2.10	1.98	1.15	11.70	0.09	5.74	23.80	0.14	0.30	2.00	49.10	0.18	3.01
T	2.20	2.01	1.15	11.70	0.09	5.68	24.00	0.14	0.30	2.01	49.50	0.18	3.03
T	2.10	1.99	1.15	11.70	0.10	5.76	23.90	0.14	0.30	2.00	49.30	0.17	3.03
V										2.13			
V										2.13			
V										2.17			
V										2.09			
V										2.21			
V										2.10			
V										2.22			
V										2.28			

12. Measurement of Uncertainty: The samples used in the certification process were 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	4.144	3.929	2.321	1.517
Pd	Pb Coll	g/t	1.517	0.984	0.992	0.316
Au	Pb Coll	g/t	0.065	0.049	0.031	0.014
Pt	NiS	g/t	2.593	1.984	1.746	0.736
Pd	NiS	g/t	0.754	0.236	0.717	0.126
Au	NiS	g/t	0.036	0.028	0.026	0.011
Ir	NiS	g/t	0.367	0.358	0.130	0.128
Rh	NiS	g/t	0.283	0.126	0.259	0.059
Ru	NiS	g/t	0.724	0.598	0.491	0.236
Co	M/ICP	ppm	17.26	13.46	8.15	4.15
Co	P	ppm	13.62	12.51	6.09	4.49
Co	XRF	ppm	33.56	30.57	22.12	12.91
Cu	M/ICP	ppm	147.9	96.9	96.4	31.1
Cu	P	ppm	144.7	125.3	82.2	45.5
Cu	XRF	ppm	161.6	174.7	72.9	72.1
Ni	M/ICP	ppm	376.0	299.4	159.2	91.9
Ni	P	ppm	485.5	341.9	380.5	139.0
Ni	XRF	ppm	684.0	840.5	129.8	343.7
Al ₂ O ₃	XRF	%	0.031	0.028	0.016	0.010
CaO	XRF	%	0.038	0.033	0.018	0.011
Cr ₂ O ₃	XRF	%	0.029	0.027	0.010	0.009
Fe ₂ O ₃	XRF	%	0.135	0.135	0.058	0.052
K ₂ O	XRF	%	0.007	0.006	0.004	0.002
LOI		%	0.592	0.672	0.069	0.254
MgO	XRF	%	0.509	0.479	0.140	0.161
MnO	XRF	%	0.006	0.006	0.003	0.002
Na ₂ O	XRF	%	0.022	0.024	0.010	0.010
SiO ₂	XRF	%	0.751	0.663	0.336	0.224
TiO ₂	XRF	%	0.008	0.006	0.006	0.002
SG	pyc		0.094	0.099	0.037	0.038

1. S - Std Dev for use on control charts.
2. σ_L - Betw Lab Std Dev, for use to calculate a measure of accuracy.
3. Sw - Within Lab Std Dev, for use to calculate a measure of precision.
4. CSU - Combined Standard Uncertainty, a component for use to calculate the total uncertainty in method validation.

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 Smeed.

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: AMIS0168 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 Smee and Smee and Associates Ltd; accept no liability for any decisions or actions taken following the use of the reference material.

01 February 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

See below the multi element trace element data submitted by four of the round robin laboratories, for informational use only.

Analyte	Method	Unit	Mean	2SD	RSD%	n
Ag	M/ICP	ppm	1.46	0.16	5.59	16
Al	M/ICP	%	1.20	0.11	4.62	16
As	M/ICP	ppm	5.19	4.46	42.94	16
Ba	M/ICP	ppm	33.30	6.11	9.18	24
Be	M/ICP	ppm	0.13	0.10	37.95	7
Bi	M/ICP	ppm	2.24	0.28	6.25	8
Ca	M/ICP	%	1.42	0.11	3.97	24
Cd	M/ICP	ppm	0.63	0.09	7.41	8
Ce	M/ICP	ppm	3.80	0.45	5.92	8
Cr	M/ICP	ppm	7831	940	6.00	16
Cs	M/ICP	ppm	0.47	0.05	5.72	8
Dy	M/ICP	ppm	0.74	0.08	5.27	8
Er	M/ICP	ppm	0.51	0.08	7.64	8
Eu	M/ICP	ppm	0.13	0.02	8.22	8
Fe	M/ICP	%	7.84	0.61	3.87	24
Ga	M/ICP	ppm	17.24	28.06	81.36	16
Gd	M/ICP	ppm	0.63	0.08	6.30	8
Hf	M/ICP	ppm	0.46	0.04	3.98	7
Ho	M/ICP	ppm	0.17	0.01	4.48	8
In	M/ICP	ppm	0.14	0.02	5.60	8
K	M/ICP	%	0.10	0.02	7.81	22
La	M/ICP	ppm	1.53	0.41	13.23	15
Li	M/ICP	ppm	5.57	0.78	6.96	15
Lu	M/ICP	ppm	0.09	0.01	4.97	8
Mg	M/ICP	ppm	13.95	0.56	2.01	24
Mn	M/ICP	ppm	974	78.19	4.01	22
Mo	M/ICP	ppm	1.54	0.70	22.93	14
Na	M/ICP	%	0.15	0.10	34.98	24
Nb	M/ICP	ppm	0.81	0.66	40.99	14
Nd	M/ICP	ppm	2.13	0.24	5.54	8
P	M/ICP	ppm	80.54	36.68	22.77	14
Pb	M/ICP	ppm	157	11.62	3.70	23
Pr	M/ICP	ppm	0.50	0.05	5.07	8
Rb	M/ICP	ppm	3.46	0.17	2.52	7
Re	M/ICP	ppm	0.03	0.01	14.24	8
S	M/ICP	%	1.80	0.29	8.13	24
Sb	M/ICP	ppm	9.34	1.18	6.31	16
Sc	M/ICP	ppm	24.39	1.16	2.39	16
Se	M/ICP	ppm	8.43	1.07	6.34	7
Sm	M/ICP	ppm	0.55	0.06	5.72	8
Sn	M/ICP	ppm	0.60	0.12	9.62	7
Sr	M/ICP	ppm	18.03	1.06	2.94	22
Ta	M/ICP	ppm	3.81	7.23	94.87	16
Tb	M/ICP	ppm	0.11	0.01	5.44	8
Te	M/ICP	ppm	2.93	0.32	5.41	8
Th	M/ICP	ppm	0.90	0.10	5.29	7
Ti	M/ICP	%	0.09	0.02	10.58	24
Tl	M/ICP	ppm	0.41	0.05	5.90	8
Tm	M/ICP	ppm	0.08	0.01	4.81	7
U	M/ICP	ppm	0.97	0.25	12.85	7
V	M/ICP	ppm	82.38	67.06	40.70	24
W	M/ICP	ppm	0.37	0.15	20.35	7
Y	M/ICP	ppm	4.09	0.42	5.18	16
Yb	M/ICP	ppm	0.58	0.08	6.52	8
Zn	M/ICP	ppm	122	19.46	8.00	24
Zr	M/ICP	ppm	23.09	34.87	75.53	24