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AMIS0327

Certified Reference Material

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

Certificate of Analysis

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

Certified Concentrations².

Pt Pb Collection	59.04	±	5.22	g/t
Pd Pb Collection	57.49	±	3.02	g/t
Au Pb Collection	1.68	±	0.16	g/t
Pt NIS	62.16	±	4.24	g/t
Pd NIS	59.31	±	3.60	g/t
Au NIS	1.68	±	0.18	g/t
Ir NiS	4.27	±	0.40	g/t
Rh	12.20	±	0.68	g/t
Ru NiS	18.06	±	1.64	g/t
Co P	235	±	11	ppm
Cu M/ICP	6481	±	462	ppm
Cu P	6530	±	226	ppm
Cu XRF	6463	±	292	ppm
Ni P	9486	±	678	ppm
Specific Gravity	3.20	±	0.10	

Provisional Concentrations

Co M/ICP	284	±	38	ppm
Co XRF	294	±	49	ppm
Ni M/ICP	9865	±	1248	ppm

PGM 4E = 135.4 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	4.25	±	0.14	%
CaO	2.69	±	0.06	%
Cr ₂ O ₃	2.53	±	0.10	%
Fe ₂ O ₃	13.65	±	0.42	%
K ₂ O	0.09	±	0.01	%
MgO	22.17	±	0.50	%
MnO	0.17	±	0.01	%
SiO ₂	47.42	±	0.74	%
TiO ₂	0.28	±	0.01	%
S Combustion / LECO	2.09	±	0.12	%

Provisional Concentrations

Na ₂ O	0.29	±	0.06	%
LOI	3.48	±	0.74	%

1. Intended Use: AMIS0327 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 concentrate material supplied by Anglo Platinum Limited from the Eastern 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.

4. **Appearance:** The material is a very fine powder. It is colored a Light 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.
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. Twenty one 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 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 21 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 Perth WA
4. Anglo Research (Germiston Campus)
5. Genalysis Laboratory Services (South Africa) Pty
6. Genalysis Laboratory Services (W Australia P)
7. Intertek Utama Services (Indonesia)
8. Labtium Inc Finland
9. Northam Platinum LTD
10. OMAC Laboratories Limited (Ireland)
11. Performance Laboratories SA (Randfontein)
12. Set Point Laboratories (Isando) SA
13. SGS Australia Pty Ltd (Newburn) WA
14. SGS Geosol Laboratories Ltda (Brazil)
15. SGS Mineral Services Callao (Peru)
16. SGS Mineral Services Lakefield (Canada)
17. SGS South Africa (Pty) Ltd - Booyens JHB
18. SGS Toronto (Canada)
19. SGS Townsville (Australia)
20. Ultra Trace (Pty) Ltd WA
21. 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.

Assay Data: Economic elements

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
A	54.08	51.31	1.49							257	234	300	7208	6643	6900	8204	8496	
A	54.55	49.21	1.49							261	236	300	7441	6668	6900	8321	8472	
A	54.93	49.56	1.46							254	233	200	7316	6843	6700	8201	8459	
A	55.18	50.01	1.46							261	236	300	7445	6733	6700	8301	8556	
A	54.57	49.85	1.46							283	238	300	8370	6851	6700	8990	8753	
A	54.34	49.47	1.42							247	240	300	7003	6850	6700	7943	8745	
A	54.52	50.70	1.48							261	235	300	7233	6711	6600	8254	8603	
A	54.64	47.65	1.46							260		300	7182	6499	6900	8079	8749	
B				61.60	58.90	1.77	4.30	12.20	17.00	257	235	269	6646	5231				7968
B				61.30	58.30	1.73	4.30	12.40	17.20	251	234	267	6499	5276				7877
B				62.30	59.60	1.78	4.10	12.40	17.80	263	231	24	6553	5244				7985
B				62.70	59.00	1.73	4.20	12.30	17.60	255	243	272	6630	5353				7943
B				62.50	59.70	1.79	4.20	12.70	18.10	267	244	265	6551	5164				8150
B				61.10	59.90	1.75	4.10	12.70	17.40	263	241	269	6644	5244				7834
B				62.00	59.80	1.73	4.40	12.40	17.30	254	227	268	6436	5140				8091
B				62.10	59.50	1.72	4.50	12.80	17.40	259	226	263	6434	5313				7942
C										250	230		6647	6579		11000	10400	
C										251	229		6568	6513		10700	10300	
C										255	233		6615	6651		10900	10500	
C										263	235		6690	6522		10800	10400	
C										252	226		6623	6565		10900	10300	
C										250	229		6623	6566		10900	10500	
C										257	231		6661	6668		10800	10800	
C										253	229		6653	6672		10900	10500	
D	54.70	59.30	1.55	60.60	61.40		4.30	12.40	18.30	285	241	310	6470	6380	6490	10400	9630	10600
D	52.50	57.40	1.48	62.90	60.70		4.37	12.20	17.50	285	240	310	6620	6360	6500	10400	9570	10600
D	54.90	58.10	1.52	58.00	59.90		4.15	11.80	17.80	285	238	320	6390	6360	6520	10400	9580	10700
D	54.40	59.00	1.53	61.60	59.70		4.43	11.70	17.50	280	237	320	6420	6360	6500	10700	9330	10600
D	52.90	57.30	1.47	65.50	60.80		4.73	13.00	17.70	285	234	310	6430	6420	6530	10500	9440	10700
D	52.10	57.20	1.51	60.00	60.80		4.29	12.40	17.50	285	234	320	6360	6560	6540	10600	9590	10700
D	54.80	58.80	1.60	65.20	64.10		4.61	13.00	19.00	280	234	320	6240	6300	6540	10400	9510	10600
D	55.50	59.20	1.56	62.10	59.90		4.40	12.70	18.40	280	240	320	6300	6290	6530	10700	9410	10700
E	55.60	53.10	1.62											6460				9790
E	60.01	57.63	1.76											6430				9900
E	57.81	55.36	1.70											6560				10130
E	62.74	60.60	1.86											6500				9960
E	60.32	57.79	1.71											6540				10020
E	59.06	56.92	1.72											6520				10070
E	58.54	57.17	1.77											6620				10230
E	54.74	52.95	1.54											6580				10270

Assay Data (cont): Economic elements

Lab Code	Pt PbCoil g/t	Pd PbCoil g/t	Au PbCoil 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
F			1.89	61.70	57.80	1.75				286	240		6710	6540			9360	
F			2.06	64.40	60.20	1.79				299	237		6770	6440		9960	9250	
F			1.86	64.60	60.60	1.85				290	228		6770	6580		9730	9230	
F			1.96	63.80	59.90	1.82				294	226		6830	6560		9790	9140	
F			2.04	64.10	60.20	1.85				291	220		6820	6530			9170	
F			2.10	64.40	60.00	1.76				287	229		6610	6660		9760	9270	
F			1.90	66.00	61.50	1.77				280	228		6490	6560			9130	
F			1.81	63.70	59.10	1.79				294	228		6860	6570		9810	9260	
G	58.90	56.10	1.69							287	260		6520	6560		9590	9810	
G	60.70	58.60	1.64							286	280		6600	6730		9540	9890	
G	59.40	56.80	1.71							289	250		6640	6510		9740	9510	
G	59.60	57.20	1.71							288	280		6680	6830		9660	9810	
G	59.10	56.20	1.67							284	280		6530	6540		9590	9640	
G	60.70	57.70	1.73							290	270		6700	6570		9880	9790	
G	59.90	57.40	1.69							283	270		6590	6740		9560	9810	
G	60.30	57.70	1.73							293	270		6700	6660		9650	9720	
H				62.71	59.18	1.60	4.26	12.36	18.13			290			6450			9840
H				61.54	60.44	1.56	4.20	12.57	18.25			290			6510			9880
H				62.91	59.58	1.59	4.30	12.43	18.24			290			6500			9850
H				62.35	58.72	1.59	4.21	12.30	18.09			290			6480			9810
H				63.07	59.66	1.60	4.25	12.48	18.27			290			6520			9840
H				62.05	59.65	1.60	4.24	12.39	18.12			280			6400			9830
H				61.66	59.17	1.57	4.20	12.14	18.19			280			6410			9720
H				62.40	59.39	1.61	4.22	12.26	18.26			290			6440			9790
J	83.80	73.90	2.61				5.25	18.10	25.60							6504		10250
J	136.00	138.00	4.04				8.52	32.10	44.30							6424		10210
J	111.00	72.70	2.49				6.63	23.80	28.90							6474		10220
J	111.00	75.00	2.52				6.30	22.40	27.20							6548		10290
J	113.00	80.30	2.40				6.55	24.00	28.90							6528		10390
J	114.00	80.60	2.79				6.48	23.20	28.90							6565		10450
J	112.00	104.00	3.53				6.65	22.80	31.20							6670		10490
J	116.00	103.00	3.33				6.89	23.90	31.30							6340		9961
L	56.75	55.28	1.64															
L	57.54	56.11	1.61															
L	56.68	55.42	1.61															
L	56.74	54.83	1.58															
L	56.33	54.95	1.65															
L	58.91	57.15	1.67															
L	58.27	56.95	1.68															
L	57.43	55.93	1.64															
M	61.00	60.00	1.72	59.00	57.00	1.67	4.65	12.10	19.00	300	300	293	6500	6500	6200	10700	9800	8582
M	60.00	58.00	1.71	59.00	58.00	1.65	4.62	12.40	19.00	300	300	301	6500	6500	6200	10600	9800	8621
M	57.00	58.00	1.68	59.00	58.00	1.67	4.50	12.40	18.40	300	300	275	6500	6500	6200	10600	9800	8538
M	58.00	58.00	1.72	59.00	57.00	1.60	4.58	12.20	18.20	300	300	285	6600	6600	6200	10700	9900	8559
M	58.00	58.00	1.68	59.00	58.00	1.62	4.51	12.70	18.90	300	300	292	6500	6500	6200	10600	9900	8574
M	58.00	58.00	1.69	59.00	57.00	1.60	4.56	12.00	18.20	300	300	305	6500	6500	6200	10600	9800	8576
M	59.00	59.00	1.76	58.00	57.00	1.61	4.51	12.20	18.40	300	300	295	6600	6500	6200	10700	9800	8563
M	59.00	59.00	1.67	59.00	58.00	1.67	4.63	12.60	19.00	300	300	310	6600	6600	6200	10600	9900	8586
N				62.30	61.10	1.59	4.30	10.40	19.10			320			6370			10600
N				65.00	61.10	1.50	4.33	10.90	20.30			290			6360			10500
N				63.40	63.00	1.68	4.16	10.00	19.20			320			6430			10600
N				60.50	62.70	1.73	3.97	10.70	19.90			320			6410			10600
N				63.60	61.00	1.78	4.05	11.00	20.30			320			6390			10500
N				61.00	58.10	1.83	3.94	10.90	19.90			310			6370			10600
N				66.00	64.80	1.76	4.16	10.80	19.60			320			6380			10600
N				60.10	59.60	1.57	4.13	9.65	17.90			310			6390			10600
P			2.03	63.00	57.00	1.77				300	240		6560	6470		10050	9660	
P			1.96	65.40	60.10	1.74				290	240		6530	6500		10050	9880	
P			2.01	67.70	62.20	1.89				290	230		6490	6470		9910	9910	
P			2.04							290	240		6380	6530		9780	9840	
P			1.75	53.20	51.00	1.60				290	240		6520	6500		10200	10050	
P			1.78	59.90	59.40	1.76				290	240		6540	6440		10100	9720	
P			1.82	58.40	58.20	1.74				290	230		6470	6480		9980	9660	
P			1.60							290	240		6550	6450		9950	9760	
R	60.40	57.80	1.74							287	231		6170	6500		9170	8900	
R	61.00	57.10	1.76							292	232		6230	6700		9330	9000	
R	61.80	57.80	1.75							318	233		6530	6500		9730	8900	
R	61.60	57.20	1.68							284	233		6150	6600		9440	9100	
R	61.20	57.20	1.62							290	240		6160	6400		9050	8900	
R	61.20	57.10	1.69							286	233		6170	6700		8940	8900	
R	60.80	56.40	1.69							314	239		6380	6400		9410	8900	
R	61.10	57.50	1.79							310	240		6230	6600		9330	9000	
S				65.89	62.02	1.78	4.64	12.53	19.16			320			6860			9955
S				60.60	57.70	1.65	4.34	11.73	17.98			320			6875			9965
S												315			6740			9790
S				64.96	61.79	1.90	4.36	12.36	19.13			320			6845			10000
S				65.99	62.86	1.74	4.55	12.81	19.47			315			6715			9890
S				62.68	59.59	1.67	4.34	12.09	18.61			320			6850			10000
S				64.21	61.09	1.79	4.65	12.11	18.92			305			6575			9510
S				64.26	61.36	1.84	4.38	12.20	18.83			320			6930			10000
T	58.50	55.00	1.59							274	227		6100	6300		9000	8890	
T	59.30	56.10	1.69							274	228		6020	6370		8970	9010	
T	63.10	59.70	1.80							275	233		6180	6430		8810	9270	
T	59.20	55.70	1.72							280	236		6190	6420		9060	9500	
T	59.60	54.60	1.69							272	235		6120	6510		8930	9360	
T	63.80	58.70	1.81							277	229		6100	6310		8850	9060	
T	62.40	57.20	1.81							275	232		6070	6480		9000	9340	
U	56.60	56.30	1.58							267	227		5980	6350		8780	9230	
U	55.70	54.00	1.55							243	238		6210			9600		
U	57.00	56.60	1.56							238	226		6250			9720		
U	60.30	59.90	1.54							242	243		6300			9420		
U	62.60	61.60	1.66							234	237		6250			9250		
U	56.90	54.60	1.62							239	225		6180			8960		
U	64.10	60.40	1.75				</											

Assay Data (cont): Economic elements

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
W	58.86	57.88	1.66															
W	60.98	59.68	1.60															
W	60.14	58.71	1.62															
W	60.09	60.71	1.67															
W	60.90	59.35	1.66															
W	57.40	57.10	1.61															
W	59.89	60.69	1.69															
W	60.11	59.47	1.60															
X			1.64							312	235		6620	6130		10400	9230	
X			1.74							309	234		6690	6200		10200	9240	
X			1.74							299	237		6690	6050		10500	9150	
X			1.81							304	238		6610	6150		10400	9290	
X			1.70							296	236		6640	6240		10000	9470	
X			1.68							301	239		6700	6080		10100	9160	
X			1.67							312	238		6620	6260		10400	9370	
X			1.67							301	239		6690	6110		10300	9250	
Y	60.00	56.70	1.71				3.96	11.60	16.80			200			6500			10200
Y	60.40	56.70	1.72				4.17	12.20	17.40			300			6500			10400
Y	62.70	58.90	1.76				4.28	12.40	17.70			300			6600			10400
Y	62.00	58.30	1.73				4.04	11.70	17.00			300			6700			10300
Y	62.00	58.40	1.75				4.09	11.80	17.40			300			6600			10400
Y	61.60	58.00	1.72				3.99	11.70	17.40			300			6600			10300
Y	62.10	57.90	1.77				3.87	11.40	15.70			400			6400			10300
Y	59.30	55.20	1.69				4.11	11.90	17.40			300			6600			10300

Assay Data: Major elements

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
B	4.39	2.54	2.82	13.28	0.09	21.84	0.16	0.16	45.93	0.28	4.13	2.06	3.18
B	4.34	2.54	2.77	13.17	0.09	21.69	0.16	0.15	46.08	0.27	4.09	1.96	3.16
B	4.33	2.53	2.75	13.09	0.09	21.72	0.16	0.16	45.61	0.27	4.08	2.02	3.17
B	4.33	2.54	2.78	13.25	0.09	21.85	0.16	0.17	45.93	0.27	4.08	1.97	3.17
B	4.32	2.54	2.77	13.30	0.09	21.86	0.16	0.17	46.26	0.27	4.02	1.99	3.15
B	4.30	2.52	2.75	13.19	0.09	21.76	0.17	0.17	45.56	0.27	4.01	1.89	3.17
B	4.32	2.55	2.77	13.28	0.09	21.87	0.16	0.18	46.13	0.28	4.04	1.99	3.17
B	4.40	2.55	2.78	13.39	0.09	21.89	0.16	0.17	46.21	0.28	4.04	2.04	3.15
C												2.15	3.09
C												2.14	3.08
C												2.17	3.08
C												2.14	3.09
C												2.16	3.07
C												2.16	3.08
C												2.15	3.08
C												2.15	3.07
D	4.29	2.72	2.50	13.79	0.09	22.49	0.17		47.84	0.29	3.47		3.29
D	4.29	2.72	2.50	13.79	0.09	22.49	0.17		47.81	0.29	3.48		3.31
D	4.31	2.73	2.51	13.81	0.09	22.47	0.17		47.74	0.28	3.47		3.31
D	4.29	2.72	2.50	13.77	0.09	22.43	0.17		47.77	0.29	3.49		3.29
D	4.31	2.71	2.50	13.80	0.09	22.45	0.17		47.85	0.28	3.50		3.28
D	4.31	2.72	2.51	13.84	0.09	22.47	0.17		47.86	0.28	3.49		3.32
D	4.30	2.72	2.52	13.84	0.09	22.47	0.17		47.84	0.29	3.51		3.29
D	4.31	2.72	2.51	13.83	0.09	22.51	0.17		47.78	0.29	3.53		3.30
F													3.19
F													3.18
F													3.20
F													3.22
F													3.22
F													3.21
F													3.23
F													3.19
G	4.25	2.68	2.61	13.55	0.09	22.30	0.17	0.25	47.70	0.28	4.22		3.16
G	4.24	2.66	2.61	13.55	0.09	22.20	0.17	0.25	47.60	0.27	4.25		3.15
G	4.27	2.68	2.61	13.60	0.09	22.20	0.17	0.25	47.60	0.28	4.33		3.17
G	4.21	2.65	2.59	13.45	0.09	22.10	0.17	0.26	47.10	0.28	4.41		3.16
G	4.24	2.67	2.61	13.60	0.09	22.30	0.17	0.24	47.70	0.27	4.60		3.17
G	4.22	2.64	2.59	13.45	0.09	22.10	0.17	0.24	47.30	0.27	4.50		3.15
G	4.21	2.65	2.61	13.40	0.09	22.10	0.16	0.25	47.10	0.27	4.26		3.18
G	4.26	2.67	2.64	13.65	0.09	22.30	0.17	0.25	47.70	0.28	4.36		3.15
H	4.10	3.01	2.48	13.26		22.17			45.79				
H	4.11	3.00	2.48	13.22		22.06			45.50				
H	4.12	2.98	2.46	13.26		22.16			45.65				
H	4.12	2.98	2.47	13.24		22.16			45.63				
H	4.12	3.02	2.48	13.28		22.00			45.66				
H	4.08	2.98	2.45	13.22		22.03			45.59				
H	4.06	2.93	2.44	13.24		22.09			45.59				
H	4.09	2.96	2.45	13.17		22.13			45.45				

Assay Data (cont): Major elements

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
J	4.50	2.69	2.46	13.70	0.08	22.20	0.16	0.28	46.70	0.28		2.05	3.35
J	4.48	2.66	2.46	13.60	0.08	22.10	0.16	0.28	46.60	0.28		2.03	3.33
J	4.46	2.67	2.45	13.70	0.08	22.20	0.16	0.28	46.80	0.28		2.04	3.36
J	4.49	2.67	2.46	13.80	0.08	22.20	0.15	0.29	46.90	0.28		2.04	3.40
J	4.49	2.68	2.48	13.80	0.08	22.20	0.16	0.28	46.80	0.28		2.06	3.36
J	4.49	2.69	2.48	13.80	0.08	22.30	0.16	0.28	46.90	0.28		2.05	3.34
J	4.49	2.70	2.51	14.00	0.08	22.40	0.16	0.28	47.30	0.28		2.07	3.33
J	4.44	2.63	2.42	13.40	0.09	22.00	0.15	0.28	46.50	0.27		2.01	3.36
M	4.08	2.73	2.50	14.00	0.06	22.76	0.18	0.31	47.27	0.29	3.60	2.16	3.16
M	3.97	2.71	2.49	13.90	0.06	22.69	0.18	0.31	47.04	0.28	3.57	2.16	3.14
M	3.94	2.71	2.48	13.90	0.06	22.63	0.18	0.31	47.74	0.28	3.56	2.18	3.12
M	3.97	2.71	2.49	13.90	0.06	22.64	0.18	0.30	47.72	0.28	3.59	2.18	3.15
M	3.96	2.72	2.50	14.00	0.06	22.77	0.19	0.31	47.17	0.29	3.64	2.18	3.14
M	3.93	2.73	2.48	13.80	0.06	22.39	0.18	0.31	47.47	0.28	3.58	2.17	3.13
M	4.12	2.72	2.51	14.00	0.07	22.81	0.19	0.32	47.23	0.28	3.58	2.16	3.15
M	3.97	2.72	2.49	13.90	0.06	22.70	0.19	0.33	47.03	0.28	3.63	2.17	3.14
N	4.11	2.68	2.56	13.70	0.10	22.63	0.17	0.20	46.68	0.28	4.11		3.14
N	4.18	2.70	2.60	13.75	0.10	22.63	0.17	0.18	46.79	0.28	4.11		3.11
N	4.08	2.70	2.58	13.74	0.10	22.66	0.17	0.19	46.88	0.27	4.08		3.13
N	4.13	2.67	2.60	13.74	0.11	22.57	0.17	0.22	46.93	0.28	4.08		3.12
N	4.15	2.68	2.58	13.63	0.11	22.67	0.17	0.22	46.87	0.29	4.06		3.10
N	4.12	2.68	2.55	13.69	0.11	22.56	0.17	0.23	47.08	0.28	4.07		3.10
N	4.12	2.67	2.55	13.66	0.11	22.60	0.17	0.22	46.89	0.27	4.05		3.13
N	4.09	2.67	2.58	13.69	0.10	22.64	0.17	0.19	46.90	0.28	3.99		3.14
P	4.25	2.68	2.51	13.62	0.09	22.40	0.17	0.29	47.50	0.28	3.20		3.03
P	4.22	2.66	2.49	13.60	0.09	22.20	0.17	0.29	47.00	0.28	3.19		3.04
P	4.21	2.66	2.48	13.44	0.09	22.20	0.17	0.30	46.90	0.27	3.20		3.07
P	4.25	2.67	2.51	13.55	0.09	22.30	0.17	0.30	47.20	0.28	3.20		3.08
P	4.24	2.65	2.49	13.47	0.09	22.30	0.16	0.30	47.10	0.28	3.19		3.06
P	4.22	2.65	2.49	13.52	0.09	22.10	0.16	0.29	47.10	0.27	3.24		3.04
P	4.23	2.66	2.49	13.42	0.09	22.30	0.16	0.30	47.00	0.28	3.21		3.06
P	4.27	2.61	2.45	13.24	0.09	21.90	0.16	0.29	47.60	0.27	3.21		3.03
R													3.25
R													3.25
R													3.25
R													3.24
R													3.25
R													3.27
R													3.26
R													3.24
S	4.17	1.96	2.54	13.31		23.53			47.68			2.10	3.07
S	4.18	1.98	2.54	13.40		23.50			47.74			2.11	3.27
S	4.16	1.97	2.50	13.10		23.57			47.31			2.11	3.27
S	4.18	2.02	2.51	13.14		23.83			48.02			2.15	3.29
S	4.13	1.97	2.50	13.08		23.60			47.44			2.26	3.19
S	4.24	2.01	2.54	13.21		23.72			47.63			2.10	3.07
S	4.06	1.92	2.42	12.72		23.00			46.19			2.26	3.26
S	4.22	2.06	2.55	13.30		23.89			48.10			2.12	3.28
U	4.28	2.67	2.57	13.80	0.09	22.50	0.17	0.29	47.80	0.29	2.94		
U	4.24	2.68	2.58	13.80	0.09	22.50	0.17	0.28	47.80	0.29	2.94		
U	4.25	2.68	2.57	13.80	0.09	22.50	0.17	0.28	47.80	0.29	3.04		
U	4.27	2.67	2.58	13.80	0.09	22.50	0.17	0.28	47.70	0.29	3.07		
U	4.25	2.66	2.57	13.80	0.09	22.50	0.17	0.27	47.70	0.29	3.08		
U	4.26	2.67	2.57	13.80	0.09	22.60	0.17	0.28	47.60	0.29	3.11		
U	4.25	2.67	2.57	13.80	0.09	22.50	0.17	0.29	47.70	0.29	3.04		
U	4.25	2.67	2.56	13.80	0.09	22.50	0.17	0.26	47.70	0.29	3.06		
V	4.29	2.69	2.53	13.68	0.09	22.37	0.17	0.29	47.28	0.28	3.18	2.04	
V	4.26	2.68	2.54	13.72	0.09	22.43	0.17	0.29	47.35	0.28	3.19	2.12	3.16
V	4.27	2.68	2.53	13.66	0.09	22.38	0.17	0.29	47.23	0.28	3.18	2.07	3.17
V	4.28	2.69	2.53	13.79	0.09	22.41	0.16	0.28	47.30	0.28	3.19	2.08	3.25
V	4.31	2.67	2.52	13.68	0.09	22.30	0.17	0.29	47.27	0.28	3.15	2.08	3.26
V	4.29	2.68	2.52	13.66	0.09	22.38	0.16	0.28	47.08	0.28	3.18	2.00	3.20
V	4.30	2.66	2.52	13.62	0.09	22.31	0.17	0.29	47.08	0.28	3.19	2.09	3.16
V	4.26	2.69	2.52	13.63	0.09	22.39	0.17	0.29	47.27	0.28	3.09	2.09	3.11
W													3.36
W													3.35
W													3.34
W													3.36
W													3.36
W													3.34
W													3.35
W													3.36
X	4.29	2.97	2.46	13.64	0.10	22.45	0.17	0.33	47.57	0.30	3.60		
X	4.29	2.96	2.48	13.52	0.10	22.41	0.17	0.33	47.55	0.28	3.60		
X	4.29	2.97	2.59	13.70	0.09	22.47	0.17	0.32	47.54	0.28	3.60		
X	4.28	2.95	2.48	13.79	0.09	22.39	0.17	0.33	47.73	0.30	3.60		
X	4.29	2.98	2.53	13.62	0.09	22.55	0.17	0.31	47.65	0.29	3.60		
X	4.28	2.95	2.53	13.60	0.09	22.43	0.17	0.32	47.46	0.29	3.50		
X	4.28	2.96	2.48	13.65	0.09	22.58	0.17	0.32	47.74	0.30	3.50		
X	4.31	2.95	2.42	13.94	0.10	22.58	0.17	0.31	47.72	0.29	3.60		
Y	4.29	2.71	2.55	13.80	0.11	22.80	0.17	0.24	47.50	0.28	3.16	2.10	
Y	4.30	2.73	2.57	13.90	0.08	23.10	0.16	0.28	47.80	0.29	3.08	2.09	
Y	4.31	2.72	2.56	13.60	0.08	22.80	0.17	0.25	47.70	0.29	3.00	2.10	
Y	4.33	2.75	2.58	13.80	0.10	22.80	0.16	0.33	47.60	0.29	3.19	2.10	
Y	4.32	2.77	2.58	13.80	0.09	22.90	0.17	0.25	47.80	0.29	3.09	2.09	
Y	4.32	2.75	2.57	13.90	0.09	23.00	0.16	0.26	47.80	0.29	3.12	2.09	
Y	4.37	2.76	2.58	13.90	0.08	23.10	0.16	0.26	47.90	0.28	3.05	2.10	

12. Measurement of Uncertainty: (ref Dr Hugh Bartlett, Hugh Bartlett Consulting CC.)

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	PbColl	g/t	2,611	1,739	1,574	0,528
Pd	PbColl	g/t	1,506	0,689	1,280	0,250
Au	PbColl	g/t	0,077	0,041	0,056	0,013
Pt	NiS	g/t	2,119	1,332	1,598	0,485
Pd	NiS	g/t	1,796	1,347	1,102	0,469
Au	NiS	g/t	0,094	0,076	0,057	0,028
Ir	NiS	g/t	0,200	0,173	0,112	0,063
Rh	NiS	g/t	0,343	0,242	0,263	0,098
Ru	NiS	g/t	0,824	0,730	0,417	0,264
Co	M/ICP	ppm	19,14	14,70	6,254	4,122
Co	P	ppm	5,351	2,161	4,745	0,830
Co	XRF	ppm	24,69	15,28	20,52	6,426
Cu	M/ICP	ppm	230,9	171,7	90,72	48,44
Cu	P	ppm	113,2	67,78	81,60	22,3
Cu	XRF	ppm	146,1	149,1	58,18	56,91
Ni	M/ICP	ppm	740,6	505,2	152,3	146,7
Ni	P	ppm	338,8	289,3	125,1	92,60
Al ₂ O ₃	XRF	%	0,073	0,060	0,023	0,018
CaO	XRF	%	0,028	0,024	0,013	0,008
Cr ₂ O ₃	XRF	%	0,047	0,035	0,019	0,010
Fe ₂ O ₃	XRF	%	0,215	0,163	0,090	0,048
K ₂ O	XRF	%	0,004	0,003	0,003	0,001
MgO	XRF	%	0,250	0,192	0,085	0,056
MnO	XRF	%	0,005	0,003	0,003	0,001
Na ₂ O	XRF	%	0,025	0,023	0,012	0,008
SiO ₂	XRF	%	0,372	0,282	0,189	0,087
TiO ₂	XRF	%	0,007	0,004	0,005	0,001
LOI		%	0,373	0,368	0,042	0,123
S	Comb/LECO	%	0,059	0,060	0,022	0,023
SG	pycnometer		0,095	0,072	0,032	0,020

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 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: AMIS0327 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.

21 September 2012

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	3.09	1.61	26.1	68
Al	M/ICP	%	2.23	0.21	4.77	87
As	M/ICP	ppm	16.0	6.65	20.8	69
Ba	M/ICP	ppm	28.3	9.67	17.1	72
Be	M/ICP	ppm	0.11	0.10	44.0	24
Bi	M/ICP	ppm	1.93	2.05	53.2	41
Ca	M/ICP	%	1.87	0.12	3.23	88
Cd	M/ICP	ppm	2.16	6.98	161	38
Ce	M/ICP	ppm	5.55	1.44	12.9	40
Cr	M/ICP	ppm	10854	9550	44.0	56
Cs	M/ICP	ppm	0.25	0.06	11.3	32
Dy	M/ICP	ppm	0.73	0.05	3.6	22
Er	M/ICP	ppm	0.37	0.30	40.4	24
Eu	M/ICP	ppm	0.28	0.34	61.8	24
Fe	M/ICP	%	9.38	0.77	4.13	88
Ga	M/ICP	ppm	5.72	4.34	38.0	48
Gd	M/ICP	ppm	0.57	0.23	19.9	32
Ge	M/ICP	ppm	0.85	1.10	65.3	12
Hf	M/ICP	ppm	0.37	0.14	18.9	31
Ho	M/ICP	ppm	0.16	0.02	7.23	22
In	M/ICP	ppm	0.10	0.03	15.7	40
K	M/ICP	%	0.08	0.01	9.29	92
La	M/ICP	ppm	2.85	2.15	37.8	72
Li	M/ICP	ppm	7.18	1.79	12.4	73
Lu	M/ICP	ppm	0.09	0.04	22.3	23
Mg	M/ICP	%	13.3	1.47	5.55	92
Mn	M/ICP	ppm	1253	101	4.03	81
Mo	M/ICP	ppm	1.63	0.87	26.5	51
Na	M/ICP	%	0.20	0.03	8.37	88
Nb	M/ICP	ppm	0.95	0.38	20.0	32
Nd	M/ICP	ppm	2.77	0.63	11.3	24
Ni	XRF	ppm	10331	614	2.97	40
P	M/ICP	ppm	94.9	61.6	32.4	73
Pb	M/ICP	ppm	90.4	12.9	7.12	80
Pr	M/ICP	ppm	1.24	1.71	69.1	24
Rb	M/ICP	ppm	2.59	1.92	37.1	31
Re	M/ICP	ppm	0.02	0.01	29.4	16
S	M/ICP	%	2.14	0.26	6.05	76
Sb	M/ICP	ppm	16.5	50.6	153	44
Sc	M/ICP	ppm	22.9	4.61	10.1	80
Se	M/ICP	ppm	9.66	0.99	5.13	24
Si	M/ICP	%	22.4	0.52	1.17	8
Sm	M/ICP	ppm	0.61	0.04	3.24	22
Sn	M/ICP	ppm	5.72	19.5	171	40
Sr	M/ICP	ppm	31.5	9.56	15.2	81
Ta	M/ICP	ppm	5.02	5.77	57.5	9
Tb	M/ICP	ppm	0.11	0.05	20.8	31
Te	M/ICP	ppm	3.01	0.88	14.7	32
Th	M/ICP	ppm	1.09	0.85	38.9	39
Ti	M/ICP	%	0.14	0.03	9.95	77
Tl	M/ICP	ppm	3.41	19.7	289	35
Tm	M/ICP	ppm	0.07	0.02	12.2	24
U	M/ICP	ppm	2.20	10.7	242	46
V	M/ICP	ppm	160	65.0	20.3	94
W	M/ICP	ppm	4.20	13.7	164	32
Y	M/ICP	ppm	3.94	1.20	15.3	74
Yb	M/ICP	ppm	0.54	0.08	7.53	30
Zn	M/ICP	ppm	106	53.6	25.2	80
Zr	M/ICP	ppm	16.1	12.8	39.7	44