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AMIS0314

Certified Reference Material

**Platinum (PGM), Merensky,
Western Limb Tailings Concentrate,
Bushveld Complex, South Africa**

Certificate of Analysis

Recommended Concentrations and Limits^{1, 2} (at two Standard Deviations)

Certified Concentrations

Pt Pb Collection	32.20	±	3.16	g/t
Pd Pb Collection	11.35	±	0.74	g/t
Au Pb Collection	2.53	±	0.26	g/t
Pt NIS	34.17	±	3.02	g/t
Pd NIS	11.74	±	1.00	g/t
Au NIS	2.50	±	0.26	g/t
Ru NiS	5.13	±	0.52	g/t
Co M/ICP	242	±	19	ppm
Co P	212	±	24	ppm
Cu M/ICP	7326	±	254	ppm
Cu P	7115	±	322	ppm
Cu XRF	7183	±	265	ppm
Ni M/ICP	8790	±	868	ppm
Ni P	8429	±	763	ppm
Ni XRF	9073	±	681	ppm
Specific Gravity	3.11	±	0.18	

Provisional Concentrations

Ir NiS	0.91	±	0.18	g/t
Rh	1.89	±	0.24	g/t
Co XRF	271	±	55	ppm

PGM 4E = Platinum (NiS)+ Palladium (NiS)+ Rhodium + Gold (NiS)= 50.30 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, 10 and 13.
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	7.75	±	0.22	%
CaO	5.46	±	0.22	%
Cr ₂ O ₃	0.96	±	0.04	%
Fe ₂ O ₃	15.68	±	0.52	%
K ₂ O	0.14	±	0.01	%
MgO	17.04	±	0.44	%
MnO	0.15	±	0.01	%
Na ₂ O	0.58	±	0.06	%
SiO ₂	44.23	±	0.96	%
TiO ₂	0.22	±	0.01	%
S Combustion / LECO	3.49	±	0.24	%

Provisional Concentration

LOI	4.92	±	1.30	%
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1. Intended Use: AMIS0314 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 Bushveld or 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 tailings concentrate material supplied by Anglo Platinum Limited from the Western Limb of the Bushveld Complex.

3. Mineral and Chemical Composition: This material is predominantly or wholly derived from Merensky Reef which 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.

4. **Appearance:** The material is a very fine powder. It is colored Medium Dark Grey.

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 double cone blender, 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. Pb collection with Ag as a co-collector, ICP-OES or ICP-MS.
2. Pt, Pd, Au, Rh, Ru, Ir. NiS collection, ICP-OES or ICP-MS.
3. Multi element scan to include Co, Cu and Ni. Multi-acid total digestion, including HF, ICP-OES or ICP-MS.
4. Co, Cu and Ni. Aqua regia digestion with ICP-OES or ICP-MS.
5. Co, Cu and Ni. Pressed Pellet, XRF.
6. Majors (Al₂O₃, CaO, Cr₂O₃, Fe₂O₃, K₂O, MgO, MnO, Na₂O, SiO₂, TiO₂. LOI.) XRF fusion.
7. SG, gas pycnometer.

8. **Information requested:**

1. State and provide brief description of analytical techniques used.
2. State aliquots used for all determinations.
3. Results for individual analyses to be reported.
4. All results for individual PGM's to be reported in ppb.
5. All results for base metals to be reported in ppm.
6. Report all QC data, to include replicates, blanks and certified reference materials used.

9. **Method of Certification:** Twenty Five laboratories were each given eight randomly selected packages of sample. Twenty of the laboratories submitted results in time for 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 20 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 Perth WA
3. Anglo Research (Germiston Campus)
4. Genalysis Laboratory Services (South Africa) Pty
5. Genalysis Laboratory Services (W Australia P)
6. Intertek Utama Services (Indonesia)
7. Labtium Inc Finland
8. Northam Platinum LTD
9. OMAC Laboratories Limited (Ireland)
10. Performance Laboratories SA (Randfontein)
11. Set Point Laboratories (Isando) SA
12. SGS Australia Pty Ltd (Newburn) WA
13. SGS Geosol Laboratories Ltda (Brazil)
14. SGS Mineral Services Callao (Peru)
15. SGS Mineral Services Lakefield (Canada)
16. SGS South Africa (Pty) Ltd - Booyens JHB
17. SGS Toronto (Canada)
18. SGS Townsville (Australia)
19. Ultra Trace (Pty) Ltd WA
20. 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.

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			2.74							248	205		7250	6870		9390	7950	
A			2.74							244	206		7240	6860		9490	7920	
A			2.66							254	207		7260	6830		9360	7900	
A			2.54							247	204		7260	6850		9340	7900	
A			2.76							244	208		7170	6860		9400	7860	
A			2.88							251	206		7330	6830		9460	7920	
A			2.73							253	204		7290	6860		9350	8100	
A			2.75							252	205		7280	6860		9460	7940	
B										233	205		7250	7137		9437	9235	
B										230	204		7212	7224		9616	9437	
B										224	207		7259	7224		9566	9210	
B										229	210		7315	7256		9416	9134	
B										228	206		7264	7135		9443	9209	
B										227	208		7288	7154		9611	9266	
B										237	208		7134	7231		9470	9241	
B										226	216		7330	7154		9577	9469	
C				31.20	11.30	2.29	0.80	1.88	4.96	240	236	220	7214	7819		8690	8407	
C				31.20	11.10	2.31	0.90	1.79	4.82	245	234	229	7575	7950		8807	8537	
C				31.30	11.10	2.24	0.80	1.83	4.94	242	236		7473	7876		8603	8692	
C				31.50	11.30	2.44	0.80	1.81	4.88	260	235	232	7409	7967		9073	8496	
C				31.30	11.40	2.34	0.80	1.84	4.78	261	235	227	7514	7831		8918	8603	
C				31.80	11.10	2.37	0.80	1.87	4.79	242	234	228	7537	7973		8633	8459	
C				31.40	11.20	2.33	0.90	1.80	4.87	258	236	228	7433	7757		9132	8532	
C				31.10	11.00	2.36	0.80	1.87	4.80	244	234	231	7466	7832		8647	8556	
D	33.24	10.97	2.31							204	199	300	8011	8048	7500	6830	7185	
D	33.94	11.24	2.34							202	200	300	7947	7947	7500	6745	7051	
D	32.80	10.92	2.31							198	205	300	8074	8118	7300	6727	7175	
D	32.80	10.95	2.34							200	196	300	8027	8099	7300	6772	6842	
D	31.21	10.50	2.34							202	193	300	7741	8242	7600	6814	7083	
D	33.18	11.02	2.35							208	202	300	7907	8066	7600	6831	7080	
D	33.51	11.16	2.26							202	197	300	7826	8256	7300	6862	7129	
D	33.59	11.19	2.35							197	198	300	7924	8198	7300	6673	7020	
E	34.20	11.70	2.72				0.92	1.79	4.92			300			7300			8700
E	34.80	12.10	2.67				0.90	1.74	4.87			300			7400			8700
E	34.70	12.00	2.74				0.99	1.85	5.13			300			7200			8800
E	34.70	12.00	2.68				0.92	1.79	4.89			300			7400			8700
E	34.90	12.10	2.70				0.94	1.75	4.79			300			7200			8700
E	35.00	12.00	2.74				0.90	1.72	4.76			300			7300			8600
E	35.50	12.10	2.82				0.93	1.82	5.04			300			7400			8700
E	34.00	11.80	2.68				0.96	1.86	5.19			300			7400			8700

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
F	28.20	10.60	2.23							217	200		6950			7370		
F	28.90	11.10	2.33							214	192		6490			7450		
F	30.50	11.40	2.33							227	190		6980			7550		
F	31.70	11.40	2.32							227	207		7470			7430		
F	31.60	11.50	2.29							229	210		7740			7690		
F	29.60	10.80	2.13							223	198		7160			7640		
F	30.70	11.30	2.25							235	201		7660			7460		
F	31.30	11.80	2.30							223	220		7380			7180		
G	34.60	11.60	2.64							243	204		7140	6910		8050	7860	
G	32.50	11.00	2.54							231	212		6910	7080		7900	8110	
G	32.90	11.20	2.55							233	204		6880	6980		7790	7800	
G	34.70	11.90	2.71							232	208		6910	7030		7730	7990	
G	35.50	12.10	2.69							236	204		6920	6990		7740	8030	
G	34.50	11.70	2.72							238	210		6840	7080		7850	8220	
G	33.60	11.50	2.59							231	207		6930	7090		7820	8040	
G	33.20	11.20	2.56							241	204		6690	6990		7860	7910	
H	31.90	11.10	2.55							229	216		6650			7730		
H	32.90	11.20	2.58							241	219		7140			8200		
H	33.00	11.30	2.55							246	225		7140			8320		
H	33.00	11.40	2.59							247	216		7210			8360		
H	32.20	10.90	2.53							252	214		7260			8550		
H	32.30	11.00	2.59							243	215		7190			8260		
H	32.70	11.20	2.55							246	217		7210			8350		
H	32.00	10.80	2.53							252	212		7240			8570		
J	29.20	10.80	2.53	34.30	11.70		0.94	1.87	5.04	240	224	270	7260	7150	7290	8790	8260	9480
J	29.30	10.70	2.49	33.30	11.90		0.93	1.88	4.92	250	226	270	7320	7410	7280	8900	8320	9470
J	30.30	10.90	2.52	33.90	11.30		0.94	1.75	4.80	250	230	270	7280	7250	7270	9040	8360	9480
J	30.50	11.00	2.56	33.90	11.10		0.93	1.79	4.77	260	216	280	7320	7160	7270	8990	8160	9490
J	30.30	11.10	2.55	33.30	11.80		0.91	1.85	5.18	245	220	270	7360	7310	7260	8960	8160	9480
J	30.10	10.70	2.50	34.90	11.70		0.95	1.87	4.94	250	220	280	7380	7020	7260	8920	8140	9480
J	31.40	11.10	2.60	35.80	11.60		0.97	1.88	4.93	240	219	270	7350	6940	7260	8820	8120	9470
J	29.30	10.40	2.47	33.20	11.80		0.92	1.86	4.68	245	223	270	7340	7070	7250	9010	8170	9470
K	31.44	11.12	2.47					1.47					7370			8880		
K	33.21	11.75	2.61					1.71					7260			8950		
K	30.86	11.02	2.43					1.75					7240			8920		
K	29.35	10.38	2.27					1.43					7280			8820		
K	31.93	11.44	2.50					1.69					7140			8790		
K	29.98	10.72	2.38					1.69					7190			9040		
K	30.42	11.03	2.37					1.86					7080			8660		
K	30.93	11.09	2.45					1.91					7180			9010		
M	32.40	11.15	2.56							239	250		7260	7280		8360	8630	
M	32.60	11.15	2.66							243	260		7290	7290		8380	8710	
M	33.30	11.35	2.59							252	250		7580	7420		8950	8770	
M	34.00	11.50	2.69							239	250		7250	7240		8260	8750	
M	32.80	11.25	2.69							244	260		7380	7480		8510	8740	
M	33.10	11.35	2.63							246	250		7480	7600		8420	8760	
M	33.80	11.50	2.70							249	260		7460	7340		8630	8770	
M	33.60	11.15	2.71							251	250		7450	7310		8530	8690	
N				33.42	11.67	2.34	0.95	2.03	5.28			240			7110			8710
N				33.52	11.46	2.44	0.90	1.92	5.27			250			7150			8670
N				33.29	11.62	2.31	0.89	1.87	5.29			230			7130			8600
N				33.37	11.31	2.41	0.90	1.93	5.23			240			7130			8590
N				33.75	11.58	2.35	0.92	1.96	5.28			240			7120			8660
N				33.61	11.56	2.41	0.92	2.00	5.27			240			7190			8670
N				33.21	11.42	2.35	0.89	1.93	5.25			220			7090			8610
N				33.82	11.61	2.43	0.93	2.02	5.22			240			7170			8740
P															7275			9385
P															7075			8918
P															7045			8858
P															6990			8955
P															7017			8872
P															6951			8828
P															7078			8902
P															7183			9069
Q				35.28	13.06	2.50		2.04	5.45	275			7460			8920		
Q				35.72	13.16	2.64		2.05	5.93	270			7405			8800		
Q				35.01	12.70	2.45		1.96	5.74	280			7570			9340		
Q				35.56	12.81	2.65		2.04	5.70	270			7310			8590		
Q				35.56	12.80	2.65		2.03	6.12	275			7520			8730		
Q				34.42	12.64	2.49		1.97	5.61	270			7500			8630		
Q				33.84	12.16	2.46		1.94	5.32	270			7500			8655		
Q				34.67	12.45	2.53		1.96	5.37	270			7590			8665		
R	30.23	11.39	2.46	35.28	13.06	2.50		2.04	5.45									
R	30.16	11.48	2.53	35.72	13.16	2.64		2.05	5.93									
R	30.22	11.50	2.51	35.01	12.70	2.45		1.96	5.74									
R	30.21	11.24	2.53	35.56	12.81	2.65		2.04	5.70									
R	30.07	11.39	2.50	35.56	12.80	2.65		2.03	6.12									
R	30.10	11.36	2.53	34.42	12.64	2.49		1.97	5.61									
R	30.09	11.36	2.54	33.84	12.16	2.46		1.94	5.32									
R	30.14	11.34	2.49	34.67	12.45	2.53		1.96	5.37									

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
S	33.00	11.30	2.52	35.00	11.60	2.58	1.02	1.94	5.03	300	200	300	7300	7200	7100	8800	8800	9100
S	33.00	11.10	2.49	36.00	11.80	2.58	1.02	1.98	5.06	300	200	290	7300	7300	7100	8700	8700	9200
S	32.00	11.20	2.49	34.00	11.60	2.53	1.04	2.03	5.06	300	200	297	7300	7200	7000	8600	8600	9100
S	33.00	11.20	2.55	35.00	11.60	2.53	0.99	1.98	5.05	300	200	296	7300	7300	7100	8600	8600	9300
S	33.00	11.30	2.54	36.00	11.60	2.55	1.01	1.96	5.06	300	200	287	7300	7200	7000	8800	8800	9200
S	32.00	11.40	2.51	35.00	11.70	2.54	0.99	1.93	5.07	300	200	275	7400	7300	7100	8700	8700	9100
S	32.00	11.20	2.55	34.00	11.60	2.53	1.04	1.98	5.05	300	200	281	7400	7300	7100	8800	8800	9200
S	33.00	11.10	2.52	34.00	11.40	2.55	1.02	1.94	5.05	300	200	290	7300	7100	7100	8700	8700	9300
T				33.30	11.40	2.55	0.74	1.69	5.01			270			7060			9490
T				32.30	11.80	2.31	0.75	1.74	5.19			260			7110			9470
T				31.00	10.90	2.25	0.69	1.61	4.89			260			7040			9450
T				33.80	11.30	2.52	0.72	1.71	5.19			290			7050			9420
T				33.30	11.40	2.51	0.75	1.69	5.20			240			7040			9450
T				31.50	11.30	2.22	0.75	1.67	5.10			280			7140			9450
T				32.90	11.10	2.53	0.75	1.68	5.13			260			7080			9480
T				32.60	11.60	2.28	0.74	1.72	4.90			270			7120			9360
V			2.65	34.60	11.60	2.74				250	230		7420	7200		8880	8540	
V			3.11	35.00	11.55	2.72				250	230		7460	7210		8980	8460	
V			2.96	34.40	11.40	2.72				260	220		7630	7170		9140	8510	
V			3.23	34.20	11.30	2.67				260	220		7540	7120		8990	8340	
V			2.95	35.00	11.75	2.73				250	220		7490	7140		8960	8450	
V			2.93	34.30	11.60	2.78				250	220		7370	7160		8830	8560	
V			2.45							250	230		7460	7150		8870	8350	
V			2.89	33.50	11.55	2.67				250	220		7440	7180		8960	8410	
X	33.38	11.92	2.60	36.06	12.02	2.52	0.99	1.96	5.20	240			7195			8386		
X	33.63	12.11	2.65	36.78	12.21	2.53	1.00	2.02	5.43	239	217		7200	6935		8388	7996	
X	32.76	11.87	2.59	36.54	12.06	2.50	0.99	1.99	5.23	236	218		7334	6956		8374	8089	
X	31.97	11.42	2.48	35.78	11.94	2.51	0.97	1.93	5.10	239	221		7225	6919		8282	8341	
X	31.31	11.54	2.45	36.68	12.23	2.52	0.99	2.03	5.38	240	220		7221	7034		8154	8290	
X	33.00	11.64	2.57	36.58	12.21	2.56	1.01	2.03	5.26	239	221		7328	7090		8562	8422	
X	32.52	11.88	2.63	36.63	11.99	2.55	1.00	2.04	5.23	241	213		7301	6875		8177	8031	
X	32.94	11.87	2.61	35.74	11.95	2.49	0.96	1.96	5.06	231	224		7198	7328		8172	8576	
Y	32.18	11.17	2.47															
Y	33.37	11.67	2.48															
Y	31.98	11.38	2.42															
Y	33.14	11.79	2.45															
Y	32.46	11.63	2.51															
Y	32.83	11.45	2.51															
Y	33.42	11.17	2.39															
Y	30.39	11.46	2.44															

Assay data (cont)- Major Oxides

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
A	7.85	5.61	0.94	15.86	0.14	17.20	0.15	0.62	44.46	0.22	4.80		
A	7.83	5.59	0.93	15.64	0.14	17.17	0.15	0.62	44.30	0.22	4.80		
A	7.85	5.67	0.96	15.65	0.14	17.26	0.15	0.63	44.45	0.22	4.80		
A	7.84	5.63	0.95	15.83	0.14	17.22	0.15	0.65	44.43	0.23	4.80		
A	7.83	5.62	0.99	15.73	0.14	17.16	0.15	0.63	44.40	0.22	4.80		
A	7.83	5.62	0.93	15.60	0.14	17.15	0.15	0.64	44.31	0.22	4.90		
A	7.86	5.65	0.94	15.79	0.14	17.24	0.15	0.63	44.49	0.23	5.10		
A	7.83	5.62	0.95	15.87	0.14	17.16	0.15	0.64	44.37	0.21	4.90		
B												3.61	3.01
B												3.59	2.95
B												3.59	2.96
B												3.61	2.95
B												3.63	2.94
B												3.58	2.97
B												3.61	2.96
B												3.60	3.02
C	7.79	5.20	1.06	15.30	0.13	16.68	0.14	0.44	43.69	0.21	5.70	3.33	3.08
C	7.71	5.12	1.04	15.05	0.13	16.63	0.14	0.42	43.65	0.21	5.62	3.17	3.07
C	7.75	5.11	1.04	15.05	0.14	16.68	0.14	0.45	43.70	0.21	5.71	3.24	3.09
C	7.76	5.19	1.05	15.31	0.14	16.63	0.14	0.45	43.74	0.22	5.57	3.34	3.06
C	7.77	5.13	1.05	15.23	0.14	16.67	0.14	0.44	43.67	0.22	5.73	3.21	3.09
C	7.69	5.11	1.05	15.23	0.13	16.72	0.14	0.41	43.73	0.21	5.74	3.29	3.09
C	7.75	5.17	1.05	15.28	0.14	16.62	0.14	0.43	43.72	0.21	5.72	3.28	3.08
C	7.77	5.19	1.06	15.28	0.13	16.57	0.14	0.42	43.61	0.21	5.75	3.24	3.09
E	7.85	5.53	0.98	15.90	0.14	17.40	0.14	0.56	44.40	0.23	4.58	3.52	
E	7.83	5.58	0.98	15.90	0.14	17.30	0.14	0.56	44.40	0.21	4.72	3.50	
E	7.87	5.56	0.98	16.00	0.15	17.40	0.14	0.55	44.60	0.22	4.60	3.50	
E	7.97	5.61	0.98	16.10	0.13	17.60	0.15	0.57	44.90	0.23	4.48	3.51	
E	7.91	5.57	0.99	16.00	0.14	17.40	0.14	0.56	44.70	0.22	4.54	3.50	
E	7.83	5.58	0.98	16.00	0.15	17.50	0.15	0.56	44.80	0.22	4.59	3.48	
E	7.87	5.53	0.97	15.90	0.14	17.40	0.14	0.55	44.40	0.22	4.62	3.53	
E	7.85	5.51	0.97	15.80	0.14	17.30	0.14	0.56	44.30	0.22	4.40	3.56	

Assay data (cont)- Major Oxides

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
F	7.81	5.40	0.97	15.90	0.14	17.20	0.15	0.58	44.60	0.23	4.17		
F	7.73	5.42	0.98	15.90	0.13	17.10	0.15	0.59	44.60	0.23	4.14		
F	7.77	5.41	0.98	15.90	0.14	17.10	0.15	0.59	44.50	0.23	4.16		
F	7.82	5.40	0.99	15.90	0.14	17.20	0.15	0.58	44.70	0.23	4.05		
F	7.80	5.39	0.98	15.90	0.14	17.20	0.15	0.58	44.60	0.22	4.01		
F	7.80	5.40	0.98	15.90	0.14	17.10	0.15	0.59	44.60	0.22	4.09		
F	7.81	5.40	0.97	15.90	0.13	17.20	0.15	0.59	44.60	0.23	4.05		
F	7.80	5.41	0.97	15.90	0.14	17.20	0.15	0.59	44.50	0.22	4.05		
H													3.15
H													3.15
H													3.15
H													3.16
H													3.16
H													3.16
H													3.15
H													3.14
J	7.82	5.46	0.95	15.99	0.14	17.10	0.15		44.55	0.23	4.91		3.19
J	7.81	5.47	0.95	15.96	0.14	17.08	0.15		44.51	0.23	4.91		3.21
J	7.82	5.46	0.95	15.90	0.14	17.08	0.15		44.50	0.23	4.95		3.19
J	7.82	5.47	0.95	15.95	0.14	17.07	0.15		44.53	0.23	4.98		3.18
J	7.80	5.47	0.96	15.94	0.14	17.10	0.15		44.53	0.23	4.98		3.20
J	7.82	5.47	0.95	15.94	0.14	17.06	0.15		44.51	0.23	4.95		3.22
J	7.81	5.46	0.96	15.91	0.14	17.08	0.15		44.51	0.24	4.94		3.19
J	7.81	5.46	0.96	15.94	0.14	17.09	0.15		44.53	0.24	4.99		3.19
M	7.72	5.39	0.98	15.45	0.13	16.75	0.14	0.55	43.90	0.21	6.02		3.09
M	7.74	5.40	0.98	15.55	0.14	16.85	0.14	0.55	44.20	0.21	6.13		3.07
M	7.71	5.38	0.98	15.45	0.13	16.80	0.14	0.55	44.00	0.21	6.14		3.08
M	7.76	5.38	0.99	15.50	0.13	16.85	0.14	0.55	44.20	0.21	5.91		3.09
M	7.60	5.28	0.95	15.05	0.13	16.55	0.14	0.55	43.30	0.20	5.95		3.06
M	7.77	5.41	0.98	15.55	0.13	16.90	0.14	0.56	44.30	0.22	6.08		3.03
M	7.71	5.37	0.97	15.45	0.13	16.80	0.14	0.55	44.00	0.21	6.28		3.07
M	7.63	5.30	0.95	15.55	0.12	16.90	0.14	0.53	44.00	0.20	5.95		3.04
N	7.33	5.69	0.94	15.34		16.77			42.64				
N	7.36	5.70	0.94	15.29		16.86			42.62				
N	7.32	5.67	0.96	15.21		16.93			42.35				
N	7.33	5.66	0.96	15.18		16.94			42.35				
N	7.33	5.66	0.95	15.35		16.99			42.68				
N	7.37	5.67	0.96	15.18		16.97			42.36				
N	7.28	5.66	0.95	15.16		16.87			42.48				
N	7.36	5.67	0.96	15.37		16.88			42.49				
P	8.13	5.25	0.92	15.70	0.12	16.60	0.13	0.59	43.20	0.21		3.60	3.23
P	8.27	5.30	0.92	15.50	0.12	16.70	0.14	0.60	43.40	0.21		3.42	3.17
P	8.24	5.27	0.91	15.50	0.12	16.60	0.13	0.59	43.30	0.21		3.40	3.20
P	8.22	5.27	0.92	15.50	0.12	16.60	0.13	0.58	43.30	0.21		3.41	3.16
P	8.25	5.27	0.92	15.50	0.12	16.70	0.13	0.60	43.40	0.21		3.39	3.19
P	8.24	5.25	0.91	15.40	0.12	16.70	0.13	0.60	43.30	0.21		3.38	3.19
P	8.25	5.31	0.92	15.50	0.12	16.70	0.13	0.60	43.30	0.21		3.39	3.18
P	8.38	5.38	0.93	15.80	0.13	16.80	0.13	0.56	43.90	0.21		3.44	3.20
Q	7.53	1.91	0.93	15.30		18.68			44.38			3.45	3.14
Q	7.51	1.87	0.92	15.38		18.27			44.34			3.36	3.25
Q	7.51	1.90	0.93	15.33		18.44			43.86			3.39	3.11
Q	7.43	1.90	0.92	15.03		18.03			43.38			3.35	2.90
Q	7.51	1.96	0.93	15.24		18.67			44.27			3.36	3.18
Q	7.47	1.98	0.92	15.01		18.40			43.61			3.51	3.15
Q	7.51	1.92	0.93	15.13		18.50			43.99			3.33	3.22
Q	7.51	1.97	0.93	15.37		18.47			44.78			3.21	3.11
R													3.14
R													3.25
R													3.11
R													2.90
R													3.18
R													3.15
R													3.22
R													3.11
S	7.65	5.47	0.93	15.94	0.11	17.10	0.15	0.84	44.90	0.22	5.08	3.61	3.07
S	7.65	5.41	0.92	15.90	0.10	17.00	0.15	0.83	44.80	0.22	5.02	3.60	3.06
S	7.62	5.43	0.92	15.88	0.10	17.10	0.15	0.83	44.60	0.22	5.06	3.62	3.05
S	7.64	5.42	0.93	15.93	0.10	17.10	0.15	0.83	44.90	0.22	5.05	3.61	3.08
S	7.70	5.45	0.93	16.00	0.11	17.20	0.15	0.84	44.80	0.22	5.06	3.60	3.06
S	7.67	5.45	0.93	15.95	0.10	17.10	0.15	0.84	44.90	0.22	5.07	3.61	3.06
S	7.65	5.44	0.93	15.94	0.11	17.00	0.15	0.83	44.80	0.22	5.07	3.63	3.08

Assay data (cont)- Major Oxides

S	7.66	5.44	0.92	15.90	0.11	17.00	0.15	0.86	44.80	0.22	5.10	3.63	3.06
Lab	Al2O3	CaO	Cr2O3	Fe2O3	K2O	MgO	MnO	Na2O	SiO2	TiO2	LOI	S Comb	SG
Code	XRF	XRF	XRF	XRF	XRF	XRF	XRF	XRF	XRF	XRF		LECO	pyc
	%	%	%	%	%	%	%	%	%	%	%	%	%
T	7.66	5.36	0.97	15.87	0.15	17.27	0.15	0.50	43.83	0.23	5.66		3.01
T	7.69	5.42	0.99	15.82	0.16	17.28	0.15	0.51	43.68	0.23	5.66		3.02
T	7.52	5.34	0.97	15.63	0.15	17.24	0.15	0.49	43.70	0.22	5.64		3.02
T	7.48	5.36	0.96	15.67	0.16	17.25	0.15	0.53	43.75	0.22	5.71		3.04
T	7.69	5.41	1.00	15.75	0.14	17.20	0.15	0.54	43.65	0.21	5.69		3.01
T	7.55	5.38	0.98	15.69	0.15	17.29	0.15	0.51	43.74	0.21	5.63		3.02
T	7.43	5.38	0.96	15.80	0.15	17.23	0.15	0.53	43.61	0.22	5.79		3.03
T	7.53	5.41	0.99	15.73	0.14	17.21	0.15	0.51	43.66	0.22	5.84		3.04
V	7.86	5.47	0.96	15.76	0.14	17.20	0.15	0.59	44.70	0.22	4.11		2.96
V	7.81	5.45	0.95	15.71	0.14	17.15	0.14	0.58	44.50	0.22	4.09		2.96
V	7.76	5.43	0.95	15.66	0.13	17.10	0.14	0.58	44.30	0.21	4.10		2.97
V	7.76	5.42	0.95	15.62	0.14	17.05	0.15	0.58	44.30	0.22	4.13		2.93
V	7.77	5.45	0.95	15.69	0.14	17.15	0.14	0.58	44.50	0.22	4.13		2.95
V	7.77	5.45	0.95	15.70	0.14	17.05	0.15	0.58	44.40	0.22	4.14		2.97
V	7.72	5.40	0.95	15.56	0.13	16.95	0.14	0.57	44.00	0.22	4.16		2.94
V	7.77	5.44	0.95	15.74	0.13	17.10	0.15	0.59	44.40	0.22	4.19		2.96
X	7.83	5.49	0.98	15.92	0.14	17.17	0.15	0.60	44.62	0.22	4.18	3.61	
X	7.87	5.47	0.97	15.85	0.14	17.16	0.15	0.60	44.53	0.22	4.32	3.55	3.11
X	7.88	5.48	0.97	15.88	0.14	17.14	0.15	0.60	44.51	0.22	4.39	3.42	3.10
X	7.88	5.48	0.98	15.85	0.14	17.14	0.15	0.59	44.64	0.22	4.33	3.52	3.13
X	7.90	5.47	0.97	15.92	0.14	17.17	0.15	0.59	44.60	0.22	4.20	3.64	3.13
X	7.87	5.48	0.97	15.88	0.14	17.12	0.15	0.59	44.49	0.22	4.28	3.53	3.14
X	7.85	5.48	0.97	15.88	0.14	17.13	0.15	0.59	44.60	0.22	4.29	3.42	3.08
X	7.87	5.45	0.97	15.88	0.14	17.17	0.15	0.59	44.50	0.22	4.38	3.48	3.10
Y													3.25
Y													3.26
Y													3.27
Y													3.24
Y													3.27
Y													3.27
Y													3.25
Y													3.23

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	PbColl	g/t	1.58	1.16	0.76	0.344
Pd	PbColl	g/t	0.37	0.23	0.23	0.07
Au	PbColl	g/t	0.14	0.099	0.057	0.028
Pt	NIS	g/t	1.51	1.347	0.623	0.455
Pd	NIS	g/t	0.50	0.439	0.197	0.148
Au	NIS	g/t	0.13	0.109	0.071	0.039
Ir	NIS	g/t	0.09	0.093	0.026	0.035
Rh	NIS	g/t	0.12	0.098	0.050	0.032
Ru	NIS	g/t	0.26	0.216	0.125	0.074
Co	M/ICP	ppm	9.69	7.31	5.60	2.40
Co	P	ppm	11.9	9.77	4.40	2.98
Co	XRF	ppm	27.6	30.1	7.7	11.4
Cu	M/ICP	ppm	127	70.1	94.1	22.5
Cu	P	ppm	161	138	89.2	50.3
Cu	XRF	ppm	132	127	68.6	48.9
Ni	M/ICP	ppm	434	339	145	99.2
Ni	P	ppm	382	356	107	119
Ni	XRF	ppm	340	411	89.0	168
Al ₂ O ₃	XRF	%	0.11	0.09	0.04	0.03
CaO	XRF	%	0.11	0.09	0.03	0.03
Cr ₂ O ₃	XRF	%	0.022	0.017	0.009	0.005
Fe ₂ O ₃	XRF	%	0.26	0.20	0.07	0.05
K ₂ O	XRF	%	0.007	0.005	0.004	0.002
MgO	XRF	%	0.22	0.18	0.06	0.05
MnO	XRF	%	0.005	0.004	0.002	0.001
Na ₂ O	XRF	%	0.03	0.03	0.01	0.01
SiO ₂	XRF	%	0.46	0.35	0.20	0.10
TiO ₂	XRF	%	0.007	0.005	0.005	0.001
LOI		%	0.65	0.61	0.01	0.19
S Comb/LECO		%	0.12	0.12	0.05	0.04
SG	pyc		0.09	0.07	0.03	0.02

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

13. Certified values: The Certified, Provisional and Indicated values listed on p1 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: AMIS0314 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 or Explorer Packs containing custom weights (from 50 to 250g) of material. Laboratory Packs are sealed bottles delivered in sealed foil pouches. 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 therefore 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.

19 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	6.89	1.26	9.15	78
Al	M/ICP	%	4.18	0.32	3.79	73
As	M/ICP	ppm	11.1	6.75	30.3	53
Ba	M/ICP	ppm	144	19.1	6.66	67
Be	M/ICP	ppm	0.20	0.16	39.3	31
Bi	M/ICP	ppm	4.25	3.05	35.9	36
Ca	M/ICP	%	3.78	0.30	3.92	85
Cd	M/ICP	ppm	2.87	8.02	140	46
Ce	M/ICP	ppm	9.89	0.90	4.56	39
Cr	M/ICP	ppm	4604	2486	27.0	71
Cs	M/ICP	ppm	0.35	0.07	10.2	24
Dy	M/ICP	ppm	0.95	0.16	8.27	24
Er	M/ICP	ppm	0.60	0.07	6.05	24
Eu	M/ICP	ppm	0.25	0.05	10.8	24
Fe	M/ICP	%	10.9	1.00	4.59	87
Ga	M/ICP	ppm	7.94	2.32	14.6	40
Gd	M/ICP	ppm	0.94	0.17	8.95	24
Ge	M/ICP	ppm	0.96	1.16	60.7	12
Hf	M/ICP	ppm	0.67	0.15	11.4	24
Ho	M/ICP	ppm	0.20	0.02	6.10	22
In	M/ICP	ppm	0.06	0.01	9.63	29
K	M/ICP	%	0.12	0.02	8.88	80
La	M/ICP	ppm	4.88	2.92	29.9	72
Li	M/ICP	ppm	7.76	2.47	15.9	67
Lu	M/ICP	ppm	0.09	0.04	20.3	24
Mg	M/ICP	%	10.1	1.08	5.34	80
Mn	M/ICP	ppm	1088	55.7	2.56	76
Mo	M/ICP	ppm	2.74	1.96	35.8	48
Na	M/ICP	%	0.45	0.10	11.4	80
Nb	M/ICP	ppm	2.05	0.14	3.37	24
Nd	M/ICP	ppm	4.64	0.31	3.29	23
P	M/ICP	ppm	255	140	27.4	75
Pb	M/ICP	ppm	95.8	21.5	11.2	79
Pr	M/ICP	ppm	1.20	0.07	2.89	22
Rb	M/ICP	ppm	10.4	17.6	84.5	39
Re	M/ICP	ppm	0.04	0.00	3.89	8
S	M/ICP	%	3.53	0.43	6.13	67
Sb	M/ICP	ppm	12.3	24.7	101	50
Sc	M/ICP	ppm	17.5	1.74	4.96	81
Se	M/ICP	ppm	14.5	7.08	24.4	24
Si	M/ICP	%	20.8	0.49	1.18	8
Sm	M/ICP	ppm	0.93	0.10	5.18	24
Sn	M/ICP	ppm	5.18	8.96	86.5	31
Sr	M/ICP	ppm	111	14.2	6.38	78
Ta	M/ICP	ppm	0.18	0.09	26.5	8
Tb	M/ICP	ppm	0.15	0.07	21.6	23
Te	M/ICP	ppm	6.29	1.91	15.2	16
Th	M/ICP	ppm	1.83	0.83	22.6	23
Ti	M/ICP	%	0.12	0.02	7.06	56
Tl	M/ICP	ppm	8.97	24.0	134	24
Tm	M/ICP	ppm	0.09	0.01	7.33	14
U	M/ICP	ppm	0.37	0.10	13.4	24
V	M/ICP	ppm	111	25.6	11.5	72
Y	M/ICP	ppm	5.27	1.36	12.9	55
Yb	M/ICP	ppm	0.60	0.07	5.53	23
Zn	M/ICP	ppm	130	37.6	14.4	79
Zr	M/ICP	ppm	26.2	16.5	31.6	43