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AMIS0277

Certified Reference Material

**Platinum (PGM) Platreef Ore
Bushveld Complex, South Africa**

Certificate of Analysis

**Recommended Concentrations and two “Between
Laboratory” Standard Deviations^{1,2}**

Certified Concentrations³

Pt Pb Collection	1.34	±	0.06	g/t
Pd Pb Collection	1.47	±	0.12	g/t
Au Pb Collection	0.20	±	0.02	g/t
Pt NIS	1.33	±	0.08	g/t
Pd NIS	1.52	±	0.12	g/t
Au NIS	0.20	±	0.02	g/t
Ru NiS	0.129	±	0.012	g/t
Co M/ICP	95	±	9	ppm
Cu M/ICP	1318	±	58	ppm
Cu P	1324	±	101	ppm
Cu XRF	1311	±	80	ppm
Ni M/ICP	2305	±	241	ppm
Ni P	2105	±	208	ppm
Ni XRF	2423	±	113	ppm
Specific Gravity	3.05	±	0.16	

Provisional Concentrations

Ir NiS	0.03	±	0.004	g/t
Rh	0.108	±	0.014	g/t
Co P	65	±	8	ppm

$$4E (Pt, Pd, Au (all NiS) + Rh) = 3.157 g/t$$

1. AMIS0277 was originally certified on 18 August 2011. This recertification incorporates some new data. Ruthenium has been promoted to “Certified”, iridium has been promoted from the appendix to “Provisionally Certified”. There are some slight changes to the other analytes.
2. 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.
3. There is additional certified major element data presented on p2 and uncertified trace element data presented as an appendix.

Major Element Recommended Concentrations and two "Between Laboratory" Standard Deviations

Certified Concentrations

Al ₂ O ₃	8.58	±	0.12	%
CaO	7.72	±	0.19	%
Cr ₂ O ₃	1.11	±	0.06	%
Fe ₂ O ₃	10.50	±	0.22	%
K ₂ O	0.30	±	0.01	%
MgO	17.45	±	0.18	%
MnO	0.22	±	0.01	%
Na ₂ O	0.95	±	0.04	%
SiO ₂	47.99	±	0.66	%
TiO ₂	0.22	±	0.01	%

Provisional Concentration

LOI	4.15	±	0.98	%
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1. Intended Use: AMIS0277 is a certified reference material which may be used to demonstrate the validity of measurement results of a single analysis PGE, Cu and Ni ores, hosted by the Platreef or other mafic rocks, with a similar grade and matrix; when measured in parallel to the unknown to be characterised. The material can be used for routine quality control by inserting within a batch of samples, method development and for the calibration of equipment.

The recommended mean and "Between Lab" standard deviations for this material property values based on a measurement campaign (round robin) and reflect the average results from the laboratories that participated in the round robin, after examination of the data set and removal of technically and statistically invalid results (see Clause 9 - this certificate). Slight variations in analytical procedures between laboratories will reflect as slight biases to the recommended concentrations and this is acceptable. Good laboratories however will report results within the two standard deviation levels with a failure of <10 %.

2. Origin of Material: This standard was made using Platreef material from the northern limb of the Bushveld Complex. This specific material was supplied by Anglo Platinum Limited and was obtained from the open pit Mogalakwena Mine (previously named PPRust Mine).

3. Mineral and Chemical Composition: Platreef is a Pt/Pd/Ni/Cu ore. Mineralization in this Platreef comprises 2-5% disseminated or net textured magmatic sulphides, mainly pyrrhotite, pentlandite and chalcopyrite. The PGE's occur as micron-sized satellite grains around but rarely within the sulphides.

Major element chemistry data from 12 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 Med Light Grey (Corstor10Y 6/2).

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. Cu and Ni. Multi-acid total digestion, including HF, with ICP-OES finish (M/ICP).
4. Cu and Ni. Aqua regia digestion with ICP-OES finish (P).
5. Cr, Co, Cu and Ni. Pressed pellet XRF.
6. Cr, Co, Cu and Ni. Fusion, ICP-OES or ICP-MS
7. Specific Gravity. Gas pycnometer.
8. XRF (major elements).
9. Multi acid digest ICP scan – trace elements.

8. Information requested:

1. Aliquots used for all determinations.
2. Results for individual PGM's reported in ppb.
3. Results for base metals reported in ppm.
4. QC data, to include replicates blanks and certified reference materials used.
5. Analytical techniques used.

9. Method of Certification: Twenty eight laboratories were each given eight randomly selected packages of sample. Twenty two of the laboratories submitted results in time for the certification.

The final limits were calculated after a three step examination of the data, first removing incompatible data outside a spread normally expected for similar analytical methods done by reputable laboratories. Then, data from any one laboratory was removed from further calculations, if the mean of all analyses from that laboratory failed a t-test of the global means of the other laboratories. Next, data that fell outside of the 2 standard deviations were removed. The mean and standard deviations were then re-calculated.

Analytes with an RSD of near or less than 5 % are reported as "Certified Concentrations" with limits at two "Between Laboratory" standard deviations. Those with RSD's of between near 5 % and 15 % are reported as "Provisional Concentrations" with limits at two "Between Laboratory" standard deviations. Those with RSD's over 15 % are reported as "Informational Values".

This method is different from that used by Government agencies in that the actual "between-laboratory" standard deviation is used in the calculations. This produces upper and lower limits that reflect actual individual analyses rather than a grouped set of analyses. The limits can therefore be used to monitor accuracy from individual analyses, unlike the Confidence Limits published on other standards.

10. Participating Laboratories: The 22 out of 28 laboratories that provided results timeously were (not in same order as in the table of assays):

1. Activation Laboratories Pty Ltd (ActLabs) CA
2. ALS Chemex Laboratory Group Johannesburg SA
3. ALS Chemex Laboratory Group Lima Peru
4. ALS Chemex Laboratory Group Perth WA
5. ALS Chemex Laboratory Group Vancouver CA
6. Anglo Platinum - Eastern Bushveld Regional Laboratory SA
7. Anglo Research (Crown Campus)
8. Anglo Research (Germiston Campus)
9. Genalysis Laboratory Services (South Africa) Pty
10. Genalysis Laboratory Services WA
11. Northam Platinum LTD
12. Performance Laboratories SA
13. Set Point Laboratories (Isando) SA
14. SGS Australia Pty Ltd (Newburn) WA
15. SGS Durango (Mexico)
16. SGS Geosol Laboratories Ltda (Brazil)
17. SGS Mineral Services Callao (Peru)
18. SGS Mineral Services Lakefield (Canada)
19. SGS South Africa (Pty) Ltd - Booyens JHB
20. SGS Toronto (Canada)
21. SGS Townsville (Australia)
22. Ultra Trace (Pty) Ltd WA

11. Assay Data: Data as received from the laboratories for the important certified elements are set out below – Economic elements.

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	1.37	1.53	0.22							91.80	60.70		1280	1250		2260	2030	
A	1.34	1.51	0.20							91.20	64.60		1280	1260		2290	1980	
A	1.36	1.53	0.21							91.30	64.10		1290	1295		2340	1975	
A	1.36	1.51	0.20							91.10	65.90		1300	1290		2300	2020	
A	1.36	1.52	0.22							91.10	64.50		1290	1265		2310	1960	
A	1.36	1.52	0.23							91.50	66.90		1320	1305		2370	1970	
A	1.37	1.53	0.20							90.40	66.30		1300	1265		2310	1945	
A	1.35	1.52	0.21							88.70	66.50		1270	1270		2270	1970	
B	1.21	1.38	0.19							99.70	59.60		1290	1400		2360	2060	
B	1.28	1.47	0.21							97.10	60.90		1290	1380		2360	2070	
B	1.25	1.42	0.20							95.60	58.90		1280	1365		2320	2030	
B	1.34	1.57	0.22							96.80	60.60		1290	1390		2390	2070	
B	1.36	1.56	0.22							96.50	58.40		1250	1400		2350	2010	
B	1.37	1.56	0.21							97.40	60.20		1290	1390		2340	2060	
B	1.37	1.59	0.22							94.70	61.80		1300	1365		2310	2090	
B	1.33	1.56	0.22							97.80	61.20		1310	1400		2390	2110	
E	1.28	1.47						0.10							1298			2436
E	1.19	1.45						0.10							1327			2473
E															1314			2424
E	1.37	1.39						0.10							1304			2406
E	1.42	1.47						0.11							1297			2387
E	1.38	1.52						0.11							1321			2429
E	1.36	1.40						0.11							1279			2425
E	1.39	1.49						0.10							1255			2384
F	1.41	1.49	0.24							95.00	62.00		1290	1270		2450	2100	
F	1.42	1.49	0.23							95.00	61.00		1300	1250		2470	2110	
F	1.42	1.51	0.23							93.00	62.00		1260	1270		2380	2140	
F	1.39	1.53	0.23							93.00	62.00		1260	1300		2390	2080	
F	1.30	1.50	0.20							92.00	63.00		1260	1290		2350	2090	
F	1.38	1.44	0.21							91.00	64.00		1300	1330		2370	2140	
F	1.32	1.40	0.20							93.00	64.00		1230	1290		2380	2090	
F	1.40	1.55	0.21							94.00	62.00		1230	1270		2380	2150	
I				1.34	1.53	0.19	0.03	0.10	0.12									
I				1.36	1.55	0.19	0.03	0.10	0.12									
I				1.34	1.52	0.19	0.03	0.10	0.13									
I				1.37	1.57	0.20	0.03	0.10	0.12									
I				1.32	1.51	0.20	0.02	0.10	0.12									
I				1.32	1.52	0.20	0.03	0.10	0.12									
I				1.34	1.58	0.21	0.03	0.11	0.12									
I				1.37	1.56	0.19	0.03	0.10	0.12									
J	1.34	1.53	0.19	1.34	1.55	0.21		0.12	0.13	129	61.00	104	1350	1270	1262	2160	2220	2397
J	1.37	1.60	0.20	1.35	1.51	0.20		0.11	0.14	127	63.00	105	1340	1270	1268	2200	2220	2407
J	1.33	1.53	0.21	1.33	1.49	0.21		0.11	0.14	128	67.00	106	1370	1260	1276	2180	2240	2427
J	1.34	1.52	0.21	1.33	1.53	0.21		0.12	0.13	128	62.00	103	1360	1270	1265	2170	2230	2407
J	1.36	1.52	0.20	1.35	1.51	0.19		0.11	0.14	125	64.00	106	1360	1280	1272	2150	2230	2408
J	1.36	1.52	0.19	1.36	1.57	0.18		0.12	0.14	125	64.00	108	1360	1250	1269	2210	2230	2409
J	1.33	1.54	0.19	1.39	1.57	0.21		0.12	0.13	130	64.00	100	1360	1250	1265	2210	2190	2402
J	1.31	1.55	0.20	1.35	1.50	0.21		0.11	0.13	129	62.00	105	1340	1260	1274	2190	2280	2426
K	1.33	1.46	0.19					0.12										
K	1.34	1.42	0.20					0.11										
K	1.31	1.44	0.20					0.12										
K	1.31	1.41	0.20					0.12										
K	1.33	1.44	0.20					0.12										
K	1.32	1.45	0.20					0.12										
K	1.31	1.46	0.20					0.11										
K	1.32	1.43	0.20					0.12										

Assay data (cont) – Economic elements

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	1.32	1.51	0.22	1.34	1.59	0.21	0.03	0.11	0.13	100.00	71.00		1340	1320		2340	2220	
L	1.33	1.51	0.22	1.40	1.57	0.22	0.03	0.11	0.13	120.00	72.00		1360	1350		2500	2230	
L	1.30	1.55	0.23	1.34	1.50	0.21	0.03	0.11	0.13	100.00	65.00		1320	1360		2420	2220	
L	1.31	1.48	0.20	1.35	1.53	0.21	0.03	0.11	0.13	105.00	68.00		1330	1350		2430	2270	
L	1.35	1.53	0.23	1.38	1.53	0.22	0.03	0.11	0.13	105.00	70.00		1360	1340		2500	2240	
L	1.35	1.54	0.21	1.34	1.50	0.21	0.03	0.11	0.15	115.00	67.00		1320	1350		2430	2230	
L	1.30	1.50	0.21	1.35	1.49	0.22	0.03	0.11	0.13	100.00	71.00		1350	1360		2420	2270	
L	1.34	1.48	0.21	1.38	1.51	0.22	0.03	0.12	0.13	110.00	66.00		1350	1330		2440	2220	
M	1.36	1.43	0.21				0.03	0.11	0.15	78.00	65.00	100	1300	1480	1400	2020	2400	2400
M	1.42	1.51	0.21				0.03	0.10	0.14	78.00	64.00		1320	1450	1300	2040	2310	2500
M	1.39	1.48	0.20				0.03	0.10	0.13	78.00	62.00	100	1320	1390	1400	2060	2250	2500
M	1.34	1.38	0.21				0.02	0.09	0.13	78.00	60.00		1310	1370	1300	2010	2190	2500
M	1.32	1.39	0.19				0.03	0.11	0.15	78.00	59.00	100	1300	1360	1400	2010	2170	2400
M	1.36	1.45	0.20				0.03	0.10	0.13	78.00	62.00	100	1330	1420	1300	2030	2250	2500
M	1.36	1.43	0.20				0.03	0.11	0.14	78.00	60.00	100	1330	1370	1300	2030	2170	2400
M	1.26	1.37	0.20				0.03	0.11	0.15	78.00	61.00		1340	1390	1400	2060	2220	2500
N	1.37	1.53	0.21	1.48	3.12	0.22	0.03	0.12	0.14	98.00	72.10		1286	1291	1249	2407	2185	2459
N	1.36	1.57	0.21	1.34	1.58	0.19	0.03	0.11	0.13	96.80	69.60		1279	1289	1288	2387	2139	2534
N	1.36	1.56	0.20	1.32	1.58	0.19	0.03	0.11	0.12	96.20	71.30		1281	1276	1312	2377	2157	2582
N	1.37	1.54	0.21	1.33	1.64	0.21	0.03	0.12	0.13	95.50	70.10		1217	1296	1315	2256	2175	2569
N	1.36	1.56	0.25	1.38	1.66	0.21	0.03	0.12	0.14	95.60	71.20		1291	1299	1290	2387	2167	2532
N	1.37	1.55	0.21	1.36	1.65	0.22	0.03	0.12	0.13	97.10	69.20		1242	1283	1284	2281	2141	2528
N	1.39	1.59	0.22	1.41	1.69	0.22	0.03	0.12	0.14	97.60	68.90		1293	1265	1318	2376	2005	2578
N	1.37	1.57	0.22	1.26	1.56	0.19	0.03	0.11	0.12	97.90	73.20		1301	1282	1299	2383	2167	2555
O	1.31	1.43	0.19	1.25	1.46	0.21	0.03	0.11	0.12									
O	1.30	1.42	0.20	1.25	1.48	0.20	0.03	0.10	0.13									
O	1.31	1.43	0.19	1.23	1.44	0.20	0.03	0.11	0.12									
O	1.28	1.43	0.20	1.24	1.47	0.20	0.03	0.11	0.12									
O	1.32	1.40	0.20	1.23	1.45	0.20	0.03	0.11	0.12									
O	1.39	1.42	0.19	1.24	1.49	0.20	0.03	0.11	0.13									
O	1.29	1.39	0.19	1.28	1.45	0.20	0.03	0.10	0.12									
O	1.37	1.40	0.19	1.30	1.50	0.21	0.03	0.10	0.12									
Q	1.32	1.45	0.19	1.32	1.44		0.03	0.10	0.11	95.80	66.90	94.00	1400	1316	1306	2325	2080	2384
Q	1.31	1.47	0.20	1.31	1.45		0.03	0.10	0.10	94.10	66.60	96.00	1385	1315	1313	2323	2150	2395
Q	1.30	1.41	0.19	1.31	1.44		0.03	0.10	0.11	92.50	66.10	96.00	1380	1314	1306	2320	2097	2396
Q	1.30	1.42	0.20	1.32	1.45		0.02	0.09	0.11	96.40	67.00	94.00	1402	1327	1310	2372	2152	2391
Q	1.31	1.49	0.20	1.30	1.45		0.03	0.10	0.11	95.80	66.30	98.00	1388	1306	1320	2323	2120	2405
Q	1.31	1.45	0.19	1.35	1.40		0.02	0.09	0.10	97.00	67.70	99.00	1402	1306	1318	2369	2092	2400
Q	1.34	1.45	0.19	1.30	1.40		0.02	0.10	0.10	94.70	68.50	96.00	1378	1311	1322	2317	2102	2399
Q	1.34	1.47	0.20	1.31	1.40		0.03	0.10	0.11	97.20	66.70	99.00	1400	1327	1320	2396	2150	2406
R				1.57	1.60	0.21	0.33	0.11	0.18	130			1615			2635		
R				1.57	1.57	0.21	0.25	0.10	0.16	130			1655			2610		
R				1.58	1.62	0.19	0.17	0.11	0.16	130			1595			2630		
R				1.54	1.57	0.22	0.18	0.10	0.16	135			1560			2635		
R				1.43	1.59	0.19	0.14	0.10	0.15	130			1545			2620		
R				1.54	1.57	0.21	0.27	0.10	0.16	130			1590			2595		
R				1.50	1.61	0.21	0.18	0.09	0.15	125			1550			2590		
R				1.51	1.59	0.20	0.18	0.10	0.15	125			1530			2580		
S	1.32	1.48	0.20							92.00	60.00		1350	1310		2260	2090	
S	1.34	1.48	0.20							91.90	59.20		1360	1290		2250	2050	
S	1.30	1.42	0.20							91.20	60.70		1340	1310		2220	2140	
S	1.31	1.45	0.21							90.70	61.20		1340	1300		2200	2090	
S	1.23	1.44	0.22							94.50	59.90		1380	1280		2290	2050	
S	1.30	1.48	0.21							93.10	59.40		1340	1280		2180	2040	
S	1.38	1.53	0.23							91.10	59.30		1320	1270		2170	2070	
S	1.36	1.45	0.21							92.60	59.50		1350	1290		2190	2080	
T	1.37	1.49	0.21							93.40	63.20		1325	1385	1300	2330	2030	2390
T	1.33	1.48	0.20							90.10	64.40		1270	1400	1310	2220	2070	2380
T	1.37	1.49	0.22							95.40	64.10		1320	1375	1310	2270	2040	2390
T	1.34	1.47	0.21							95.40	64.30		1320	1385	1320	2290	2020	2400
T	1.37	1.50	0.20							97.40	62.50		1315	1360	1310	2290	2000	2380
T	1.38	1.49	0.21							96.50	64.60		1445	1400	1300	2420	2060	2390
T	1.36	1.50	0.20							97.10	63.40		1335	1390	1290	2330	2060	2390
T	1.39	1.51	0.21							97.70	65.10		1330	1420	1310	2300	2100	2370
U			0.20															2120
U			0.21															2140
U			0.19															2090
U			0.22															2080
U			0.20															2090
U			0.20															2120
U			0.20															2130
U			0.20															2110
V	1.27	1.46	0.18							106	70.00		1310	1285	1300	2201	1821	2400
V	1.20	1.35	0.19							107	70.00		1326	1416	1400	2193	1968	2300
V	1.09	1.22	0.15							108	72.00	100	1326	1341	1600	2218	1868	2400
V	1.24	1.38	0.16							109	71.00		1339	1330	1500	2120	1853	2600
V	1.32	1.59	0.19							103	71.00	100	1276	1327	1300	2189	1841	2400
V	1.18	1.44	0.19							110	73.00	200	1307	1357	1400	2011	1938	2300
V	1.21	1.49	0.19							105	73.00		1307	1375	1600	2175	1944	2400
V	1.20	1.35	0.18							104	72.00	100	1325	1388	1400	2185	1973	2600
X	1.50	1.37	0.22							101	68.00		1390	1422		2510	2312	
X	1.50	1.41	0.21							99.00	66.00		1359	1334		2401	2220	
X	1.52	1.45	0.23							98.00	69.00		1340	1404		2317	2255	
X	1.47	1.35	0.24							98.00	67.00		1355	1371		2497	2189	
X	1.52	1.47	0.22							97.00	69.00		1351	1397		2236	2230	
X	1.48	1.37	0.22							98.00	67.00		1377	1380		2344	2258	
X	1.49	1.42	0.															

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	8.64	7.78	1.07	10.55	0.29	17.45	0.23	0.96	48.10	0.22	4.06		3.05
A	8.69	7.84	1.08	10.60	0.29	17.55	0.23	0.97	48.40	0.22	4.11		3.05
A	8.68	7.83	1.09	10.60	0.29	17.55	0.23	0.97	48.30	0.22	4.21		3.04
A	8.67	7.81	1.07	10.60	0.29	17.50	0.23	0.97	48.30	0.22	4.12		3.03
A	8.67	7.80	1.09	10.55	0.29	17.50	0.23	0.96	48.20	0.23	4.11		2.97
A	8.69	7.81	1.11	10.55	0.29	17.50	0.23	0.98	48.20	0.23	4.10		2.99
A	8.69	7.85	1.13	10.60	0.29	17.60	0.23	0.98	48.40	0.23	4.02		2.96
A	8.70	7.85	1.11	10.60	0.29	17.60	0.23	0.97	48.40	0.23	4.12		2.96
B													3.08
B													3.14
B													3.11
B													3.11
B													2.99
B													2.97
B													2.93
B													2.92
E													3.12
E													3.17
E													3.04
E													3.05
E													3.08
E													3.11
E													3.16
E													3.11
J	8.62	7.87	1.25	10.50	0.33	17.10	0.22	0.92	48.10		4.93	0.64	3.01
J	8.60	7.89	1.25	10.60	0.34	17.20	0.23	0.87	48.30		4.87	0.62	2.97
J	8.60	7.84	1.28	10.60	0.34	17.30	0.22	0.90	48.00		4.84	0.64	2.98
J	8.61	7.85	1.18	10.50	0.33	17.40	0.23	0.88	48.40		4.86	0.63	3.01
J	8.62	7.90	1.16	10.60	0.33	17.00	0.23	0.86	48.20		4.85	0.62	2.98
J	8.57	7.91	1.16	10.70	0.34	17.30	0.23	0.95	47.90		4.81	0.63	3.02
J	8.44	7.73	1.16	10.40	0.35	16.50	0.22	0.88	47.40		4.84	0.60	2.98
J	8.50	7.80	1.12	10.40	0.33	16.70	0.22	0.89	47.70		4.82	0.62	3.01
L	8.64	7.80	1.12	10.53	0.30	17.54	0.23	0.96	48.27	0.22	3.85		3.09
L	8.62	7.79	1.13	10.48	0.30	17.46	0.23	0.95	48.18	0.22	3.88		3.10
L	8.63	7.78	1.13	10.48	0.30	17.51	0.23	0.95	48.21	0.22	3.86		3.10
L	8.63	7.78	1.12	10.49	0.30	17.51	0.23	0.95	48.25	0.21	3.86		3.08
L	8.65	7.79	1.13	10.52	0.30	17.53	0.23	0.95	48.28	0.22	3.87		3.07
L	8.66	7.80	1.13	10.53	0.30	17.54	0.23	0.96	48.28	0.22	3.88		3.07
L	8.63	7.78	1.12	10.48	0.30	17.51	0.23	0.96	48.21	0.21	3.90		3.10
L	8.62	7.80	1.13	10.51	0.30	17.53	0.23	0.95	48.24	0.22	3.85		3.09
M	8.56	7.83	1.14	10.50	0.30	17.40	0.23	0.95	48.20	0.21	4.25	0.64	
M	8.50	7.81	1.13	10.50	0.30	17.40	0.22	0.95	48.10	0.21	4.10	0.63	
M	8.59	7.84	1.14	10.60	0.30	17.50	0.22	0.95	48.20	0.21	4.12	0.60	
M	8.49	7.76	1.14	10.50	0.29	17.30	0.23	0.95	47.80	0.21	3.99	0.66	
M	8.59	7.83	1.15	10.60	0.30	17.50	0.23	0.96	48.20	0.21	4.01	0.62	
M	8.53	7.75	1.13	10.50	0.30	17.30	0.22	0.94	47.80	0.21	4.12	0.63	
M	8.55	7.86	1.14	10.60	0.30	17.40	0.23	0.95	48.20	0.21	4.16	0.61	
M	8.49	7.84	1.15	10.60	0.30	17.40	0.22	0.96	48.30	0.21	4.33	0.63	
N	8.58	7.73	1.12	10.68	0.30	17.51	0.22	0.96	48.37	0.21	3.88	0.59	
N	8.52	7.74	1.12	10.63	0.30	17.50	0.22	0.96	48.15	0.21	3.88	0.61	3.09
N	8.52	7.71	1.11	10.70	0.30	17.51	0.22	0.96	48.28	0.21	3.89	0.62	3.04
N	8.53	7.73	1.11	10.63	0.30	17.48	0.22	0.97	48.33	0.21	3.90	0.63	3.14
N	8.52	7.71	1.11	10.66	0.30	17.50	0.22	0.96	48.37	0.21	3.89	0.64	3.16
N	8.54	7.70	1.11	10.65	0.30	17.48	0.22	0.97	48.32	0.21	3.89	0.65	3.17
N	8.54	7.70	1.12	10.62	0.30	17.44	0.22	0.96	48.57	0.21	3.89	0.64	3.11
N	8.47	7.71	1.12	10.66	0.30	17.48	0.22	0.97	48.40	0.21	3.92	0.63	3.09
O													3.09
O													3.08
O													3.07
O													3.06
O													3.07
O													3.01
O													3.10
O													3.07
Q	8.33	7.72	1.06	10.49	0.29	17.29		0.97	47.52	0.22	4.65		3.01
Q	8.31	7.72	1.07	10.51	0.29	17.29		0.97	47.48	0.22	4.68		3.02
Q	8.33	7.74	1.06	10.48	0.29	17.30		0.98	47.51	0.22	4.71		3.00
Q	8.33	7.72	1.07	10.50	0.29	17.31		0.99	47.47	0.22	4.68		3.00
Q	8.32	7.73	1.06	10.47	0.29	17.32		0.98	47.51	0.22	4.64		3.02
Q	8.34	7.73	1.07	10.49	0.29	17.30		0.98	47.50	0.22	4.70		3.01
Q	8.33	7.74	1.06	10.47	0.29	17.27		0.97	47.51	0.22	4.69		3.02
Q	8.33	7.74	1.07	10.49	0.29	17.30		0.98	47.54	0.22	4.68		3.00
R	8.35	4.27	0.94	10.35		18.60			53.76				3.16
R	8.28	4.29	0.94	10.34		18.54			53.55				3.17
R	8.11	4.24	0.94	10.37		18.53			53.64				3.13
R	8.41	4.30	0.94	10.37		18.59			53.71				3.16
R	8.37	4.26	0.93	10.41		18.51			53.64				3.15
R	8.17	4.31	0.93	10.36		18.60			53.56				3.20
R	8.31	4.24	0.95	10.44		18.52			53.76				3.13
R	8.36	4.22	0.93	10.19		17.99			52.81				3.13
S	8.59	7.57	1.10	10.30	0.29	17.45	0.23	0.95	47.30	0.22	3.73		2.82
S	8.59	7.58	1.08	10.20	0.29	17.55	0.22	0.94	47.40	0.21	3.74		2.85
S	8.57	7.59	1.09	10.25	0.29	17.45	0.22	0.96	47.40	0.21	3.73		2.83
S	8.60	7.58	1.08	10.15	0.29	17.50	0.22	0.94	47.50	0.22	3.71		2.85
S	8.58	7.52	1.14	10.00	0.26	17.55	0.22	0.97	47.50	0.21	3.72		2.84
S	8.59	7.53	1.12	10.05	0.26	17.55	0.22	0.95	47.50	0.21	3.71		2.85
S	8.59	7.54	1.11	10.10	0.26	17.55	0.22	0.96	47.40	0.21	3.75		2.82
S	8.61	7.53	1.10	10.00	0.26	17.55	0.22	0.96	47.50	0.21	3.70		2.82

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
T	8.51	7.61	1.08	10.19	0.30	17.31		0.90	47.75	0.20	4.77		2.98
T	8.65	7.70	1.11	10.34	0.30	17.40		0.92	48.27	0.20	4.75		3.09
T	8.55	7.62	1.08	10.25	0.30	17.34		0.91	47.42	0.20	4.76		2.90
T	8.60	7.67	1.10	10.28	0.30	17.35		0.92	47.94	0.19	4.78		2.92
T	8.63	7.65	1.10	10.31	0.31	17.40		0.92	48.00	0.19	4.74		3.10
T	8.57	7.61	1.09	10.22	0.30	17.31		0.91	47.85	0.19	4.78		3.10
T	8.52	7.65	1.09	10.26	0.30	17.32		0.91	47.87	0.20	4.77		3.01
T	8.58	7.59	1.09	10.19	0.30	17.28		0.91	47.72	0.20	4.75		3.03
V	8.45	7.64	1.16	10.50	0.29	17.50	0.22	0.92	48.00	0.21	3.56		
V	8.69	7.67	1.16	10.60	0.30	17.60	0.22	1.02	48.30	0.22	4.12		
V	8.48	7.68	1.16	10.50	0.30	17.50	0.22	0.89	47.90	0.22	4.06		
V	8.49	7.65	1.16	10.50	0.29	17.40	0.22	0.91	48.00	0.22	4.07		
V	8.56	7.65	1.16	10.50	0.30	17.50	0.22	0.96	48.20	0.22	4.09		
V	8.48	7.73	1.16	10.50	0.30	17.60	0.22	0.96	47.90	0.22	3.92		
V	8.57	7.68	1.17	10.60	0.29	17.60	0.21	0.93	48.20	0.22	4.16		
V	8.44	7.61	1.15	10.50	0.29	17.50	0.22	0.96	47.70	0.22	4.10		
X	8.61	7.59		10.40	0.30	17.40	0.22	0.95	48.10	0.21	3.44	0.53	
X	8.56	7.62		10.40	0.30	17.40	0.21	0.94	48.00	0.22	3.43	0.54	
X	8.53	7.63		10.40	0.30	17.50	0.22	0.93	48.00	0.21	3.45	0.54	
X	8.54	7.61		10.40	0.30	17.50	0.21	0.93	48.10	0.21	3.44	0.59	
X	8.53	7.67		10.40	0.29	17.50	0.21	0.96	47.90	0.22	3.41	0.56	
X	8.51	7.58		10.40	0.30	17.50	0.21	0.96	48.10	0.21	3.39	0.54	
X	8.55	7.60		10.40	0.31	17.40	0.22	0.94	48.10	0.21	3.40	0.57	
X	8.60	7.64		10.40	0.29	17.50	0.21	0.91	48.00	0.21	3.47	0.58	
Z													3.11
Z													3.14
Z													3.16
Z													3.10
Z													3.12
Z													3.13
Z													3.13
Z													3.18
ZA												0.62	2.93
ZA												0.61	2.92
ZA												0.62	2.93
ZA												0.62	2.92
ZA												0.63	2.91
ZA												0.63	2.92
ZA												0.62	2.92
ZA												0.63	2.90

12. Measurement of Uncertainty:

The samples used in this certification process have been selected in such a way as to represent the entire batch of material and were taken from the final packaged units; therefore all possible sources of uncertainty (sample uncertainty and measurement uncertainty) are included in the final combined standard uncertainty determination. The uncertainty measurement takes into consideration the between lab and the within lab variances and is calculated from the square roots of the variances of these components using the formula:

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

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

Analyte	Method	Unit	S ¹	σ_L ²	Sw ³	CSU ⁴
Pt	Pb Coll	g/t	0.035	0.012	0.031	0.004
Pd	Pb Coll	g/t	0.061	0.030	0.042	0.008
Au	Pb Coll	g/t	0.012	0.006	0.008	0.002
Pt	NiS	g/t	0.041	0.041	0.027	0.017
Pd	NiS	g/t	0.061	0.062	0.029	0.024
Au	NiS	g/t	0.010	0.006	0.009	0.003
Ir	NiS	g/t	0.002	0.002	0.002	0.001
Rh	NiS	g/t	0.007	0.006	0.004	0.002
Ru	NiS	g/t	0.006	0.006	0.004	0.003
Co	M/ICP	ppm	4.641	3.379	2.013	1.040
Co	P	ppm	4.205	2.979	1.481	0.838
Cu	M/ICP	ppm	28.788	20.537	17.449	6.166
Cu	P	ppm	50.527	37.038	21.071	10.087
Cu	XRF	ppm	39.801	29.541	29.653	11.885
Ni	M/ICP	ppm	120.595	64.727	58.022	19.487
Ni	P	ppm	103.363	75.776	33.938	21.262
Ni	XRF	ppm	63.168	60.625	32.827	23.345
Al ₂ O ₃	XRF	%	0.062	0.045	0.041	0.016
CaO	XRF	%	0.097	0.086	0.032	0.027
Cr ₂ O ₃	XRF	%	0.032	0.029	0.013	0.010
Fe ₂ O ₃	XRF	%	0.105	0.086	0.046	0.028
K ₂ O	XRF	%	0.005	0.004	0.003	0.001
LOI		%	0.458	0.423	0.076	0.134
MgO	XRF	%	0.095	0.081	0.049	0.027
MnO	XRF	%	0.006	0.005	0.004	0.002
Na ₂ O	XRF	%	0.020	0.017	0.011	0.006
SiO ₂	XRF	%	0.327	0.261	0.169	0.085
TiO ₂	XRF	%	0.007	0.006	0.004	0.002
SG	pyc		0.078	0.047	0.045	0.015

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. Uncertified values: The Certified, Provisional and Indicated values listed on p1 and p2 of this certificate fulfill the AMIS statistical criteria regarding agreement for certification and have been independently validated by Dr Barry Smee.

14. Metrological Traceability: The values quoted herein are based on the consensus values derived from statistical analysis of the data from an inter laboratory measurement program. Traceability to SI units is via the standards used by the individual laboratories the majority of which are accredited and who have maintained measurement traceability during the analytical process.

15. Certification: AMIS0277 is a new material.

16. Period of validity: The certified values are valid for this product, while still sealed in its original packaging, until notification to the contrary. The stability of the material will be subject to continuous testing for the duration of the inventory. Should product stability become an issue, all customers will be notified and notification to that effect will be placed on the www.amis.co.za website.

17. Minimum sample size: The majority of laboratories reporting used a 0.5g sample size for the ICP and a 30g sample size for the fire assay. These are the recommended minimum sample sizes for the use of this material.

18. Availability: This product is available in Laboratory Packs containing 1kg of material and Explorer Packs containing custom weights (from 50 to 250g) of material. The Laboratory Packs are sealed bottles delivered in sealed foil pouches. The Explorer Packs contain material in standard geochem envelopes, nitrogen flushed and vacuum sealed in foil pouches.

19. Legal Notice: This certificate and the reference material described in it have been prepared with due care and attention. However AMIS, Set Point Technology (Pty) Ltd, Mike McWha, Dr Barry Smee and Smee and Associates Ltd; accept no liability for any decisions or actions taken following the use of the reference material.

10 February 2012
(originally certified 16 November 2011)

Certifying Officers:



African Mineral Standards: _____

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



Geochemist: _____

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

Appendix – uncertified trace element statistics

Analyte	Method	Unit	Mean	2SD	RSD%	n
Ag	M/ICP	ppm	0.57	0.11	9.91	68
Al	M/ICP	%	4.62	0.26	2.86	75
As	M/ICP	ppm	0.74	0.86	57.91	33
Ba	M/ICP	ppm	103	11.67	5.69	72
Be	M/ICP	ppm	0.45	0.14	15.47	45
Bi	M/ICP	ppm	0.72	0.06	3.94	52
Ca	M/ICP	%	5.34	0.27	2.49	75
Cd	M/ICP	ppm	0.19	0.05	12.35	46
Ce	M/ICP	ppm	9.11	1.16	6.36	46
Cr	M/ICP	ppm	5586	779	6.98	54
Cs	M/ICP	ppm	1.64	0.29	8.86	48
Dy	M/ICP	ppm	0.70	0.91	64.91	16
Er	M/ICP	ppm	0.45	0.56	61.51	16
Eu	M/ICP	ppm	0.20	0.20	49.47	16
Fe	M/ICP	%	7.22	0.65	4.48	78
Ga	M/ICP	ppm	10.67	1.27	5.94	53
Gd	M/ICP	ppm	0.63	0.77	61.51	16
Ge	M/ICP	ppm	0.29	0.08	14.40	23
Hf	M/ICP	ppm	0.62	0.08	6.14	54
Ho	M/ICP	ppm	0.24	0.02	3.94	8
In	M/ICP	ppm	0.04	0.01	11.61	46
Ir	M/ICP	ppm	0.03	0.005	7.69	37
K	M/ICP	%	0.26	0.03	4.82	80
La	M/ICP	ppm	3.47	2.18	31.39	79
Li	M/ICP	ppm	37.94	7.59	10.01	88
Lu	M/ICP	ppm	0.11	0.02	9.62	15
Mg	M/ICP	%	10.52	0.96	4.54	72
Mn	M/ICP	ppm	1684	89.42	2.65	75
Mo	M/ICP	ppm	1.97	0.29	7.32	61
Na	M/ICP	%	0.73	0.07	4.77	87
Nb	M/ICP	ppm	1.68	0.35	10.45	56
Nd	M/ICP	ppm	2.43	2.59	53.37	16
P	M/ICP	ppm	97.69	19.33	9.89	73
Pb	M/ICP	ppm	11.37	2.30	10.10	68
Pr	M/ICP	ppm	0.67	0.71	53.34	16
Rb	M/ICP	ppm	14.52	1.28	4.40	54
Re	M/ICP	ppm	0.01	0.002	13.75	32
S	M/ICP	%	0.65	0.05	3.78	78
Sb	M/ICP	ppm	0.80	0.23	14.27	52
Sc	M/ICP	ppm	21.62	1.92	4.45	79
Se	M/ICP	ppm	3.04	1.15	18.94	48
Si	M/ICP	%	22.59	0.52	1.16	7
Sm	M/ICP	ppm	0.57	0.73	64.86	16
Sn	M/ICP	ppm	0.69	0.13	9.81	37
Sr	M/ICP	ppm	109	11.39	5.23	71
Ta	M/ICP	ppm	0.19	0.03	9.22	37
Tb	M/ICP	ppm	0.17	0.03	8.58	16
Te	M/ICP	ppm	0.73	0.30	20.14	56
Th	M/ICP	ppm	0.76	0.75	49.72	64
Ti	M/ICP	%	0.13	0.01	4.07	63
Tl	M/ICP	ppm	0.20	0.05	13.06	46
Tm	M/ICP	ppm	0.12			7
U	M/ICP	ppm	0.76	0.12	8.01	55
V	M/ICP	ppm	135	11.23	4.15	73
W	M/ICP	ppm	3.14	0.63	9.99	46
Y	M/ICP	ppm	6.90	1.29	9.36	72
Yb	M/ICP	ppm	0.77	0.06	3.60	15
Zn	M/ICP	ppm	83.19	17.46	10.49	76
Zr	M/ICP	ppm	19.58	2.71	6.91	62