



AMIS0253

Certified Reference Material

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

Certificate of Analysis

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

Certified Concentrations²

Pt Pb Collection	4.03	±	0.32	g/t
Pd Pb Collection	2.34	±	0.18	g/t
Pt NIS	4.06	±	0.28	g/t
Pd NIS	2.43	±	0.28	g/t
Rh NiS	0.82	±	0.08	g/t
Cu P	138	±	12	ppm
Ni P	348	±	24	ppm
Ni XRF	1359	±	155	ppm
Specific Gravity	4.04	±	0.18	

Provisional Concentrations

Au Pb Collection	0.07	±	0.01	g/t
Au NIS	0.06	±	0.01	g/t
Ir NiS	0.30	±	0.04	g/t
Ru NiS	1.36	±	0.22	g/t
Co M/ICP	209	±	53	ppm
Co P	16	±	2.4	ppm
Cu M/ICP	134	±	23	ppm
Ni M/ICP	1220	±	168	ppm

Informational Mean

Cu XRF 132 ppm

1. Manufacturers recommended limits for use of the material as control samples, based on two standard deviations, calculated using "Between Laboratory" statistics for treatment of the data for trivial, non-trivial and technically invalid results. See sections 1, 9 and 12.
2. There is additional certified major element data presented on p2 and uncertified trace element data presented as an appendix.

4E = Platinum + Palladium + Rhodium + Gold (all by FA NIS) = 7.372 g/t

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

Certified Concentrations

Al ₂ O ₃	14.96	±	0.40	%
CaO	1.82	±	0.16	%
Cr ₂ O ₃	32.00	±	0.66	%
Fe ₂ O ₃	24.28	±	1.02	%
MgO	11.39	±	0.56	%
MnO	0.20	±	0.02	%
SiO ₂	14.16	±	0.34	%

Provisional Concentrations

K ₂ O	0.07	±	0.02	%
Na ₂ O	0.31	±	0.06	%
TiO ₂	0.76	±	0.12	%

Informational Mean

S Comb / LECO	0.06	%
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1. Intended Use: AMIS0253 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 rich chromitite material supplied by Anglo Platinum Limited from the Western 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

Major element chemistry data from nineteen of the labs has been compiled and certified. Uncertified summary statistics for trace element data are set out in the appendix.

4. Appearance: The material is a very fine powder. It is colored a Medium Dark Grey (Corstor Colour Gauge).

5. Handling instructions: The material is packaged in Laboratory Packs and Explorer Packs that must be shaken or otherwise agitated before use. Normal safety precautions for handling fine particulate matter are suggested, such as the use of safety glasses, breathing protection, gloves and a laboratory coat.

6. Method of Preparation: The material was crushed, dry-milled and air-classified to <54um. Wet sieve particle size analysis of random samples confirmed the material was 98.5% <54um. It was then blended in a bi-conical mixer, systematically divided and then sealed into 1kg Laboratory Packs. Explorer Packs are subdivided from the Laboratory packs as required. Samples were randomly selected for homogeneity testing and third party analysis. Statistical analysis of both homogeneity and the consensus test results were carried out by independent statisticians.

7. Methods of Analysis requested:

1. Pt, Pd and Au. ICP-OES or ICP-MS, Pb collection with Ag as a co-collector.
2. Au, Pt, Pd, Rh, Ru and Ir. ICP-MS, nickel sulphide collection.
3. Co, Cu and Ni. Multi-acid total digestion, including HF, with ICP-OES finish.
4. Co, Cu and Ni. Aqua regia digestion with ICP-OES finish.
5. Cr, Co, Cu and Ni. Pressed pellet XRF.
6. S by LECO
7. Specific Gravity. Gas pycnometer.
8. XRF (major elements).
9. Multi acid digest ICP scan – trace elements.

Additionally, XRF analyses were requested for the major elements and a multi-element multi acid digest and ICP scan was requested for the trace elements.

8. Information requested:

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

9. Method of Certification: Twenty eight laboratories were each given eight randomly selected packages of sample. Twenty four 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 24 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
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. Rappa Research Laboratory
14. Set Point Laboratories (Isando) SA
15. SGS Australia Pty Ltd (Newburn) WA
16. SGS Chelopech (Bulgaria)
17. SGS Durango (Mexico)
18. SGS Geosol Laboratories Ltda (Brazil)
19. SGS Mineral Services Callao (Peru)
20. SGS Mineral Services Lakefield (Canada)
21. SGS South Africa (Pty) Ltd - Booyens JHB
22. SGS Toronto (Canada)
23. SGS Townsville (Australia)
24. Ultra Trace (Pty) Ltd WA

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.

Economic element data

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	4.14	2.48	0.06	4.15	2.45	0.05	0.29	0.85	1.13	230	18.00		140	142		1350	353	
A	4.08	2.45	0.06	4.06	2.44	0.06	0.29	0.82	1.15	230	19.00		145	143		1320	352	
A	4.05	2.46	0.06	4.30	2.62	0.05	0.34	0.87	1.21	240	16.00		155	145		1360	342	
A	3.99	2.43	0.05	4.06	2.58	0.05	0.30	0.82	1.23	235	16.00		145	143		1350	375	
A	4.01	2.40	0.06	4.31	2.47	0.05	0.32	0.81	1.51	225	18.00		145	145		1340	370	
A	4.02	2.37	0.05	4.07	2.41	0.05	0.29	0.81	1.55	215	21.00		150	142		1350	383	
A	4.01	2.36	0.05	4.20	2.60	0.05	0.31	0.84	1.56	225	22.00		145	152		1340	379	
A	4.11	2.43	0.06	4.25	2.64	0.06	0.32	0.84	1.52	225	21.00		140	144		1370	380	
B			0.07															
B			0.07															
B			0.07															
B			0.07															
B			0.07															
B			0.07															
B			0.07															
B			0.07															
E			0.03								16.00			130				335
E			0.07								16.00			134				345
E			0.07								16.00			131				339
E			0.06								15.00			128				328
E			0.08								16.00			133				344
E			0.07								16.00			133				345
E			0.06								17.00			133				347
E			0.07								16.00			132				339
F	2.75	1.58	0.04							254	15.00	200	137	135		1214	312	1000
F	2.82	1.70	0.04							253	15.00	200	139	135		1236	305	1400
F	3.38	1.81	0.04							249	15.00	200	136	135	100	1251	311	1200
F	3.50	1.95	0.05							250	15.00	100	138	135	100	1256	307	1300
F	2.30	1.33	0.03							245	14.00	300	137	133		1244	306	1200
F	1.99	1.14	0.03							255	15.00	200	140	143	100	1256	321	1300
F	1.61	0.97	0.02							265	14.00	300	140	136	200	1316	308	1300
F	2.72	1.51	0.04							250	16.00	200	137	133		1255	314	1300
G	3.34	1.93	0.23															
G	3.38	1.96	0.19															
G	3.44	2.02	0.22															
G	3.26	1.93	0.20															
G	3.86	2.05	0.19															
G	3.43	2.03	0.18															
G	3.32	2.00	0.22															
G	3.27	1.95	0.19															

Economic element data (cont)

Lab Code	Pt Pb Coll g/t	Pd Pb Coll g/t	Au Pb Coll g/t	Pt NIS g/t	Pd NIS g/t	Au NIS g/t	Ir NIS g/t	Rh NIS g/t	Ru NIS g/t	Co M/ICP ppm	Co P	Co XRF ppm	Cu M/ICP ppm	Cu P	Cu XRF ppm	Ni M/ICP ppm	Ni P	Ni XRF ppm
H	4.22	2.40	0.07							207	16.00		131	136		1195	337	
H	3.80	2.20	0.06							210	17.10		133	136		1170	339	
H	4.10	2.33	0.06							204	17.90		130	137		1150	339	
H	4.12	2.33	0.07							203	17.30		131	136		1160	335	
H	4.13	2.34	0.07							211	17.50		130	136		1165	336	
H	4.15	2.35	0.06							206	17.80		127	136		1140	333	
H	4.11	2.37	0.06							209	17.40		132	137		1165	339	
H	4.14	2.41	0.06							202	17.60		129	136		1160	339	
I	3.70	2.17	0.05							187	15.10		133	143		1150	350	
I	3.86	2.25	0.06							189	15.10		134	142		1175	346	
I	3.59	2.10	0.06							186	14.90		134	143		1165	350	
I	3.71	2.18	0.06							184	15.40		131	143		1155	354	
I	3.51	2.06	0.06							187	15.10		134	144		1175	356	
I	3.71	2.16	0.06							188	14.50		132	140		1170	343	
I	3.74	2.21	0.06							184	14.30		132	139		1150	343	
I	4.28	2.48	0.07							186	15.70		134	136		1160	351	
J	4.10	2.42	0.07	4.09	2.61	0.07	0.32	0.86	1.38	218	17.00		135	129	134	1438	357	1349
J	4.25	2.41	0.10	4.12	2.64	0.06	0.31	0.86	1.38	222	18.00		136	135	130	1442	374	1356
J	3.98	2.39	0.09	4.25	2.73	0.07	0.33	0.90	1.48	227	17.00		135	128	130	1432	351	1358
J	4.18	2.41	0.06	4.14	2.68	0.07	0.31	0.88	1.40	231	17.00		133	128	132	1437	350	1348
J	4.27	2.37	0.07	3.98	2.58	0.07	0.30	0.85	1.29	229	15.00		128	125	128	1371	337	1358
J	4.19	2.43	0.10	4.00	2.63	0.07	0.29	0.84	1.33	229	15.00		132	117	131	1410	323	1351
J	4.22	2.38	0.09	3.81	2.48	0.06	0.28	0.82	1.27	233	16.00		136	126	132	1436	346	1362
J	4.10	2.40	0.07	4.00	2.58	0.07	0.30	0.83	1.20	235	17.00		129	130	130	1384	361	1362
L	3.85	2.12	0.07															
L	3.94	2.08	0.07															
L	3.85	2.11	0.07															
L	3.80	2.11	0.07															
L	3.68	2.08	0.07															
L	3.68	2.04	0.07															
L	3.74	2.05	0.06															
L	3.74	2.03	0.07															
M	4.03	2.34	0.06	3.94	2.39	0.06	0.29	0.83	1.38									
M	4.05	2.33	0.06	4.05	2.38	0.06	0.29	0.82	1.35									
M	3.99	2.39	0.06	4.05	2.42	0.07	0.29	0.84	1.39									
M	4.03	2.37	0.06	3.89	2.33	0.06	0.28	0.80	1.35									
M	4.08	2.39	0.06	4.05	2.42	0.07	0.29	0.83	1.42									
M	4.10	2.34	0.06	3.88	2.33	0.07	0.28	0.80	1.32									
M	4.08	2.37	0.06	3.99	2.38	0.06	0.29	0.81	1.35									
M	4.14	2.36	0.06	4.01	2.36	0.07	0.29	0.81	1.35									
N	3.59	2.06	0.05				0.30	0.81	1.26		16.00	200		136	100		363	1400
N	3.71	2.18	0.05				0.32	0.86	1.39		16.00	200		135	100		356	1400
N	3.77	2.17	0.07				0.29	0.82	1.26		17.00	200		151	100		401	1400
N	3.60	2.02	0.07				0.32	0.85	1.34		15.00	200		134	100		356	1500
N	3.68	2.11	0.07				0.30	0.80	1.25		16.00	200		139	100		366	1400
N	3.80	2.20	0.10				0.30	0.76	1.21		16.00	200		141	200		364	1400
N	3.93	2.32	0.05				0.32	0.83	1.33		15.00			131			343	1400
N	3.85	2.21	0.04				0.29	0.75	1.23		15.00	200		129	100		337	1400
O	3.93	2.28	0.07							165	17.00		163	143		1207	372	
O	3.95	2.22	0.07							178	16.00		164	141		1276	364	
O	4.01	2.28	0.06							173	16.00		169	149		1277	369	
O	4.08	2.32	0.06							173	17.00		166	144		1276	366	
O	3.93	2.30	0.07							170	16.00		168	139		1263	358	
O	4.14	2.16	0.07							165	16.00		171	140		1242	362	
O	3.93	2.30	0.07							165	16.00		167	142		1246	365	
O	4.06	2.23	0.10							165	16.00		170	138		1242	352	
P				3.89	2.28	0.06	0.32	0.70	1.11									
P				3.97	2.29	0.06	0.33	0.68	1.12									
P				4.06	2.24	0.06	0.33	0.69	1.07									
P				3.92	2.26	0.06	0.33	0.70	1.05									
P				3.78	2.17	0.08	0.31	0.67	0.95									
P				3.79	2.11	0.07	0.32	0.66	0.97									
P				3.94	2.11	0.06	0.31	0.66	1.02									
P				3.98	2.22	0.06	0.33	0.68	0.94									
Q										212	15.00		144	137		1176	332	
Q										211	16.00		146	139		1185	335	
Q										201	14.00		145	139		1182	336	
Q										216	17.00		144	140		1174	343	
Q										210	17.00		144	137		1176	337	
Q										213	16.00		147	139		1183	339	
Q										219	15.00		143	133		1162	336	
Q										216	16.00		145	137		1174	334	
R	3.72	2.21						0.78							175			1493
R	3.78	2.22						0.77							163			1354
R	3.95	2.27						0.79							159			1453
R	4.16	2.30						0.80							166			1383
R	4.05	2.28						0.80							152			1434
R	4.05	2.24						0.78							167			1402
R	3.98	2.22						0.77							154			1418
R	4.16	2.28						0.80							160			1396
S	4.00	2.32	0.06	4.00	2.34		0.26	0.74	1.23	214	18.20	230	146	146	145	1285	1125	1366
S	4.17	2.42	0.07	4.09	2.36		0.28	0.78	1.25	214	18.30	249	146	146	147	1273	1135	1384
S	4.25	2.37	0.06	3.93	2.40		0.26	0.74	1.22	210	18.60	237	145	148	144	1300	1150	1366
S	4.07	2.34	0.06	3.98	2.30		0.27	0.76	1.25	214	18.50	236	148	145	143	1277	1135	1370
S	4.13	2.36	0.06	3.99	2.35		0.26	0.74	1.22	217	18.60	239	145	147	142	1300	1125	1380
S	4.19	2.36	0.06	4.08	2.35		0.28	0.78	1.28	214	18.30	243	147	146	145	1290	1135	1361
S	4.08	2.35	0.06	3.96	2.41		0.27	0.78	1.27	214	18.80	232	147	147	145	1285	1134	1367
S	4.13	2.41	0.07	3.99	2.40		0.28	0.78	1.25	217	18.30	248	148	148	146	1312	1128	1356
T	4.08	2.38	0.07							175			117			1125		
T	3.85	2.18	0.06							176			117			1110		
T	3.94	2.24	0.07							177			117			1105		
T	3.96	2.26	0.06							171			112			1075		
T	3.87	2.17	0.06							182			122			1160		
T	3.94	2.22	0.06							175			116			1080		
T	4.21	2.42	0.07							174			116			1100		
T	4.16	2.32	0.07							177			118			1115		
U	4.44	2.46	0.07							180	15.50		109	135	120			

Economical elements data (cont)

Lab Code	Pt Pb Coll g/t	Pd Pb Coll g/t	Au Pb Coll g/t	Pt NIS g/t	Pd NIS g/t	Au NIS g/t	Ir NIS g/t	Rh NIS g/t	Ru NIS g/t	Co M/ICP ppm	Co P ppm	Co XRF ppm	Cu M/ICP ppm	Cu P ppm	Cu XRF ppm	Ni M/ICP ppm	Ni P ppm	Ni XRF ppm
V				4.42	2.49	0.07	0.41	0.83	1.55	255			0			1250		
V				4.48	2.52	0.07	0.33	0.82	1.52	255			0			1215		
V				4.46	2.48	0.07	0.41	0.83	1.50	260			0			1270		
V				4.12	2.34	0.08	0.34	0.77	1.43	255			0			1255		
V				4.40	2.52	0.07	0.36	0.83	1.54	260			0			1225		
V				4.44	2.52	0.07	0.36	0.83	1.51	260			0			1205		
V				4.50	2.54	0.09	0.37	0.84	1.54	250			0			1205		
V				4.45	2.39	0.07	0.41	0.83	1.50	260			0			1245		
W	4.18	2.46	0.09							214	17.00		116	134		1220	343	
W	4.22	2.51	0.08							217	16.00		124	135		1260	343	
W	4.07	2.42	0.08							221	17.00		119	136		1290	351	
W	4.18	2.47	0.08							218	17.00		126	136		1270	353	
W	4.27	2.52	0.09							229	17.00		123	139		1320	347	
W	4.36	2.54	0.10							234	17.00		124	141		1340	357	
W	4.30	2.56	0.08							226	17.00		121	137		1290	350	
W	3.93	2.27	0.07							219	17.00		113	135		1260	345	
X	4.06	2.48	0.07							188	20.00		148	138		1100	356	
X	4.06	2.37	0.07							192	19.00		145	133		1120	366	
X	3.90	2.27	0.07							187	18.00		144	133		1110	352	
X	3.97	2.31	0.07							200	19.00		149	132		1160	348	
X	4.03	2.43	0.08							183	19.00		143	129		1080	354	
X	4.01	2.37	0.07							185	22.00		143	167		1090	354	
X	4.01	2.23	0.07							182	22.00		143	127		1080	350	
X	4.04	2.29	0.07							191	20.00		149	133		1150	355	
Y	3.99	2.30	0.06					0.83										
Y	4.01	2.37	0.06					0.82										
Y	4.05	2.33	0.06					0.83										
Y	4.03	2.38	0.06					0.83										
Y	4.01	2.36	0.06					0.82										
Y	3.99	2.32	0.06					0.81										
Y	4.00	2.30	0.06					0.82										
Y	4.05	2.34	0.06					0.82										
ZA	4.16	2.33	0.06	4.06	2.37	0.06	0.28	0.85	1.33		18.00	261	145	153	134		346	1436
ZA	4.10	2.35	0.05	4.03	2.36	0.05	0.28	0.85	1.34		17.00	256	140	142	136		346	1436
ZA	4.12	2.33	0.07	4.11	2.35	0.06	0.30	0.85	1.35		17.00	249	157	142	137		350	1430
ZA	4.18	2.31	0.06	4.10	2.33	0.06	0.28	0.83	1.33		17.00	270	136	145	139		354	1435
ZA	4.11	2.37	0.07	4.00	2.37	0.07	0.30	0.86	1.37		18.00	268	125	150	137		364	1431
ZA	4.07	2.37	0.07	4.03	2.33	0.05	0.28	0.82	1.31		17.00	274	121	151	141		365	1435
ZA	4.09	2.30	0.05	4.01	2.30	0.06	0.29	0.82	1.31		17.00	266	131	148	141		364	1437
ZA	4.07	2.33	0.05	4.05	2.39	0.06	0.29	0.87	1.37		15.00	262	156	161	139		374	1443
ZB				4.38	2.60	0.05	0.33	0.91	1.48									
ZB				2.43	2.04	0.19	0.26	0.58	1.98	275			180					1370
ZB				4.29	2.56	0.04	0.32	0.90	1.46	270			170					1365
ZB				4.26	2.54	0.03	0.32	0.89	1.46	270			160					1360
ZB				4.24	2.55	0.04	0.32	0.89	1.46	275			175					1365
ZB				4.34	2.57	0.06	0.32	0.90	1.48	280			170					1400
ZB				4.07	2.42	0.06	0.30	0.85	1.38	275			175					1380
ZB				4.14	2.45	0.06	0.31	0.86	1.40	280			175					1390

Major element data

Lab Code	Al2O3 XRF %	CaO XRF %	Cr2O3 XRF %	Fe2O3 XRF %	K2O XRF %	MgO XRF %	MnO XRF %	Na2O XRF %	SiO2 XRF %	TiO2 XRF %	S Comb/LECO %	SG pyc
A	15.10	1.83	31.80	24.50	0.07	11.50	0.21		14.30	0.77		4.00
A	15.20	1.83	31.90	24.50	0.07	11.50	0.21		14.30	0.78		4.00
A	15.20	1.84	31.80	24.40	0.07	11.50	0.21		14.30	0.78		3.96
A	15.10	1.83	31.80	24.50	0.07	11.50	0.21		14.30	0.77		3.98
A	15.20	1.83	32.00	24.50	0.07	11.50	0.21		14.30	0.77		3.98
A	15.10	1.83	32.00	24.50	0.07	11.50	0.21		14.30	0.78		3.97
A	15.10	1.82	31.90	24.40	0.07	11.50	0.20		14.30	0.77		3.97
A	15.10	1.83	31.90	24.50	0.07	11.50	0.20		14.30	0.78		3.95
B											0.10	
B											0.10	
B											0.08	
B											0.09	
B											0.10	
B											0.08	
B											0.08	
B											0.09	
F	14.90	1.77	32.00	24.40	0.06	11.50	0.28	0.22	13.80	0.77		
F	14.80	1.80	32.20	24.60	0.05	11.50	0.28	0.23	13.90	0.78		
F	14.90	1.79	32.50	24.70	0.05	11.60	0.29	0.23	14.10	0.78		
F	15.30	1.78	32.10	24.50	0.05	11.80	0.29	0.25	14.20	0.78		
F	14.60	1.76	32.30	24.60	0.06	11.40	0.28	0.22	14.30	0.74		
F	14.90	1.80	32.40	24.60	0.05	11.60	0.29	0.27	14.70	0.78		
F	15.10	1.81	32.80	24.70	0.07	11.70	0.29	0.20	14.00	0.76		
F	14.90	1.80	32.60	24.60	0.05	11.70	0.28	0.27	13.80	0.75		
H	14.85	1.76		27.40	0.05	11.30	0.36	0.36	13.60	0.88		3.82
H	14.90	1.77		26.70	0.05	11.30	0.35	0.35	13.75	0.85		3.88
H	14.85	1.76		27.70	0.05	11.25	0.37	0.36	13.60	0.90		3.83
H	15.15	1.82		27.90	0.05	11.40	0.40	0.39	13.95	0.89		3.82
H	15.20	1.79		27.70	0.05	11.45	0.38	0.37	13.95	0.88		3.84
H	15.45	1.78		27.40	0.05	11.70	0.36	0.37	14.05	0.89		3.76
H	15.00	1.77		27.10	0.05	11.35	0.37	0.36	13.80	0.86		3.77
H	15.20	1.78		26.70	0.05	11.40	0.35	0.36	13.95	0.84		3.75

Major element data (cont)

Lab Code	Al2O3 XRF %	CaO XRF %	Cr2O3 XRF %	Fe2O3 XRF %	K2O XRF %	MgO XRF %	MnO XRF %	Na2O XRF %	SiO2 XRF %	TiO2 XRF %	S Comb/LECO %	SG pyc
I												4.04
I												4.04
I												4.02
I												4.01
I												4.01
I												4.08
I												4.02
I												4.01
J	15.12	1.85	32.14	24.47	0.07	11.39	0.22	0.26	14.32	0.77	0.06	4.00
J	15.18	1.84	32.06	24.44	0.07	11.42	0.21	0.27	14.33	0.77	0.06	
J	15.26	1.85	32.04	24.40	0.06	11.41	0.21	0.26	14.32	0.79	0.05	4.02
J	15.00	1.83	32.17	24.39	0.07	11.46	0.22	0.28	14.28	0.77	0.06	4.07
J	15.24	1.85	32.25	24.44	0.07	11.40	0.21	0.27	14.32	0.79	0.06	4.16
J	15.12	1.85	32.07	24.30	0.07	11.49	0.21	0.28	14.27	0.79	0.06	4.02
J	15.14	1.85	32.16	24.48	0.07	11.39	0.21	0.27	14.27	0.79	0.06	4.09
J	15.16	1.84	32.14	24.47	0.07	11.48	0.22	0.27	14.37	0.78	0.06	4.07
M												4.02
M												4.03
M												4.02
M												4.03
M												4.02
M												4.04
M												4.02
M												4.03
N	15.20	1.85	31.50	25.00	0.06	11.40	0.20	0.29	14.50	0.76	0.07	
N	15.20	1.83	31.40	24.70	0.06	11.30	0.21	0.31	14.30	0.75	0.05	
N	15.00	1.85	31.50	24.70	0.07	11.20	0.21	0.30	14.20	0.75	0.06	
N	15.00	1.84	31.40	24.60	0.06	11.20	0.21	0.30	14.30	0.75	0.05	
N	14.90	1.82	31.30	24.60	0.05	11.10	0.19	0.29	14.20	0.75	0.05	
N	14.90	1.82	31.20	24.40	0.06	11.20	0.20	0.29	14.10	0.75	0.06	
N	14.90	1.83	31.70	24.40	0.06	11.20	0.20	0.29	14.10	0.76	0.05	
N	15.10	1.85	31.50	24.90	0.07	11.30	0.20	0.29	14.40	0.75	0.05	
O	14.90	1.80		24.50	0.07	11.60	0.20	0.29	14.10	0.77	0.07	
O	14.90	1.80		24.50	0.07	11.60	0.21	0.28	14.10	0.77	0.06	
O	14.90	1.80		24.60	0.07	11.60	0.20	0.30	14.10	0.76	0.05	
O	15.00	1.79		24.60	0.07	11.60	0.21	0.30	14.00	0.76	0.05	
O	15.00	1.81		24.50	0.07	11.60	0.21	0.30	14.00	0.77	0.04	
O	14.90	1.81		24.60	0.07	11.60	0.20	0.30	14.10	0.77	0.05	
O	15.00	1.78		24.50	0.07	11.60	0.20	0.34	14.00	0.77	0.04	
O	14.90	1.80		24.50	0.07	11.60	0.21	0.32	14.00	0.78	0.05	
Q											0.08	3.94
Q											0.06	3.98
Q											0.07	3.98
Q											0.06	3.94
Q											0.07	3.92
Q											0.07	3.95
Q											0.06	3.99
Q											0.07	3.94
R												4.10
R												4.17
R												4.06
R												4.03
R												4.11
R												4.17
R												4.15
R												4.19
S	14.04	1.43	31.98	21.91	0.06	10.76	0.12	0.34	9.36	0.64		4.00
S	14.07	1.51	32.48	22.38	0.07	10.79	0.13	0.35	10.29	0.65		4.00
S	14.02	1.44	31.98	21.89	0.06	10.86	0.12	0.34	9.47	0.64		3.98
S	14.14	1.51	32.46	22.34	0.06	10.87	0.13	0.35	10.51	0.65		3.99
S	14.05	1.45	32.03	21.90	0.06	10.82	0.12	0.35	9.56	0.64		4.00
S	14.23	1.52	32.45	22.33	0.06	10.81	0.13	0.34	10.62	0.65		3.98
S	14.09	1.45	32.03	21.89	0.06	10.85	0.12	0.34	9.69	0.64		3.99
S	14.24	1.51	32.48	22.32	0.06	10.96	0.12	0.34	10.53	0.65		4.01
T	14.55	1.44	30.40	23.20	0.10	11.30	0.20		13.70	0.68		3.74
T	13.70	1.39	29.70	22.60	0.10	10.90	0.20		13.10	0.66		3.71
T	14.85	1.46	32.20	24.00		11.80	0.21		14.20	0.74		3.71
T	14.20	1.40	30.10	23.50	0.10	11.20	0.20		13.30	0.69		3.72
T	13.75	1.38	29.20	22.30	0.10	10.85	0.19		12.90	0.65		3.72
T	14.55	1.42	31.10	24.30	0.10	11.55	0.21		13.60	0.71		3.74
T	13.25	1.24	29.50	22.40		10.65	0.20		12.60	0.65		3.73
T	13.70	1.33	30.00	22.80	0.10	10.90	0.20		13.10	0.68		3.72
U	14.93	1.73	33.61	23.17	0.08	11.35	0.18	0.30	13.86	0.85		4.14
U	15.10	1.73	33.72	23.22	0.08	11.40	0.18	0.30	14.00	0.85		3.99
U	15.00	1.69	33.80	23.02	0.07	11.39	0.17	0.29	14.12	0.84		4.01
U	15.10	1.72	33.90	23.20	0.08	11.50	0.18	0.30	14.10	0.84		4.21
U	15.09	1.70	33.95	23.09	0.07	11.42	0.18	0.29	14.08	0.84		4.12
U	15.10	1.72	33.78	23.01	0.08	11.32	0.19	0.29	14.13	0.84		4.17
U	15.04	1.70	33.65	23.12	0.07	11.42	0.18	0.29	14.02	0.85		4.01
U	15.10	1.72	33.67	23.24	0.08	11.50	0.18	0.29	14.10	0.85		4.19

Major element data (cont)

Lab Code	Al ₂ O ₃ XRF %	CaO XRF %	Cr ₂ O ₃ XRF %	Fe ₂ O ₃ XRF %	K ₂ O XRF %	MgO XRF %	MnO XRF %	Na ₂ O XRF %	SiO ₂ XRF %	TiO ₂ XRF %	S Comb/LECO %	SG pyc
V	14.14	2.10	30.82	23.92		11.52			12.67			4.20
V	14.48	2.08	30.98	23.88		11.48			12.50			4.21
V	14.23	2.04	31.38	24.20		11.62			12.55			4.22
V	14.09	2.01	31.06	23.87		11.58			12.38			4.22
V	14.43	2.04	30.93	23.87		11.49			12.40			4.25
V	14.23	2.05	31.02	23.97		11.71			12.47			4.18
V	14.25	2.07	30.74	23.65		11.52			12.22			4.21
V	14.59	2.11	31.75	24.32		11.79			12.56			4.22
X												4.13
X												4.15
X												4.14
X												4.14
X												4.15
X												4.17
X												4.12
X												4.13
Y												3.94
Y												3.95
Y												3.98
Y												3.95
Y												3.94
Y												3.96
Y												3.95
Y												3.97
ZA	14.70	1.80	31.80	24.20	0.08	11.00	0.20	0.34	14.30	0.74	0.05	4.03
ZA	14.50	1.78	31.40	24.10	0.08	10.90	0.21	0.30	14.30	0.75	0.06	3.95
ZA	14.60	1.77	31.70	23.80	0.07	10.80	0.21	0.31	14.20	0.75	0.05	3.95
ZA	14.60	1.82	32.10	24.50	0.07	11.00	0.22	0.35	14.50	0.76	0.06	4.01
ZA	14.80	1.81	32.60	24.80	0.07	11.20	0.21	0.29	14.40	0.78	0.06	3.96
ZA	14.70	1.80	32.30	24.60	0.07	11.10	0.22	0.33	14.20	0.76	0.06	3.93
ZA	14.60	1.79	32.10	24.30	0.07	11.00	0.20	0.35	14.10	0.76	0.05	4.03
ZA	15.00	1.83	32.60	24.80	0.07	11.20	0.22	0.36	14.60	0.77	0.05	4.01
ZB												
ZB	14.59	2.12	31.71	24.62		11.84			14.32			
ZB	14.61	2.10	31.81	24.68		11.82			14.21			
ZB	14.64	2.10	31.80	24.66		11.84			14.21			
ZB	14.63	2.10	31.96	24.80		11.89			14.24			
ZB	14.63	2.12	31.85	24.76		11.84			14.25			
ZB	14.59	2.11	31.79	24.62		11.80			14.19			
ZB	14.62	2.12	31.96	24.73		11.87			14.24			

12. Measurement of Uncertainty: The samples used in the certification process were selected in such a way as to represent the entire batch of material and were taken from the final packaged units; therefore all possible sources of uncertainty (sample uncertainty and measurement uncertainty) are included in the final combined standard uncertainty determination.

The uncertainty measurement takes into consideration the between lab and the within lab variances and is calculated from the square roots of the variances of these components using the formula:

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

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

Analyte	Method	Unit	S ¹	σ_L ²	Sw ³	CSU ⁴
Pt	Pb Coll	g/t	0.161	0.091	0.109	0.025
Pd	Pb Coll	g/t	0.086	0.048	0.062	0.014
Au	Pb Coll	g/t	0.007	0.004	0.005	0.001
Pt	NIS	g/t	0.136	0.123	0.096	0.056
Pd	NIS	g/t	0.138	0.163	0.067	0.067
Au	NIS	g/t	0.006	0.007	0.003	0.003
Ir	NiS	g/t	0.019	0.019	0.012	0.008
Rh	NiS	g/t	0.038	0.029	0.023	0.010
Ru	NiS	g/t	0.111	0.099	0.093	0.042
Co	M/ICP	ppm	26.68	21.18	5.05	5.90
Co	P	ppm	1.200	0.830	0.686	0.249
Cu	M/ICP	ppm	11.798	9.889	2.768	2.995
Cu	P	ppm	5.975	3.858	3.136	1.112
Cu	XRF	ppm	20.213	25.023	3.500	10.228
Ni	M/ICP	ppm	83.860	62.761	23.327	18.264
Ni	P	ppm	11.923	7.591	7.873	2.432
Ni	XRF	ppm	77.569	85.549	35.570	35.253
Al ₂ O ₃	XRF	%	0.201	0.120	0.119	0.047
CaO	XRF	%	0.120	0.105	0.017	0.037
Cr ₂ O ₃	XRF	%	0.360	0.454	0.183	0.205
Fe ₂ O ₃	XRF	%	0.508	0.521	0.172	0.185
K ₂ O	XRF	%	0.009	0.008	0.004	0.003
MgO	XRF	%	0.285	0.194	0.136	0.063
MnO	XRF	%	0.011	0.012	0.006	0.005
Na ₂ O	XRF	%	0.032	0.038	0.010	0.016
SiO ₂	XRF	%	0.171	0.161	0.106	0.062
TiO ₂	XRF	%	0.064	0.065	0.014	0.022
S	Comb/LECO	%	0.012	0.014	0.007	0.006
SG	pyc		0.086	0.069	0.039	0.021

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

13. 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: AMIS0253 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.

24 December 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	0.11	0.04	17.95	33
Al	M/ICP	%	7.83	0.46	2.94	76
As	M/ICP	ppm	3.93	3.31	42.13	56
Ba	M/ICP	ppm	32.31	5.48	8.48	69
Be	M/ICP	ppm	0.07	0.04	25.16	32
Bi	M/ICP	ppm	0.07	0.02	11.47	39
Ca	M/ICP	%	1.22	0.17	7.06	78
Cd	M/ICP	ppm	0.31	0.05	8.44	38
Ce	M/ICP	ppm	2.99	0.67	11.15	39
Cr	M/ICP	ppm	212001	17621	4.16	40
Cs	M/ICP	ppm	0.17	0.09	24.63	23
Dy	M/ICP	ppm	0.72	0.87	60.39	16
Er	M/ICP	ppm	0.47	0.55	59.19	16
Eu	M/ICP	ppm	0.18	0.16	45.90	16
Fe	M/ICP	%	15.31	2.21	7.22	71
Ga	M/ICP	ppm	47.49	7.59	8.00	56
Gd	M/ICP	ppm	0.60	0.83	69.16	16
Ge	M/ICP	ppm	0.33	0.09	14.17	31
Hf	M/ICP	ppm	0.20	0.00	0.00	34
Ho	M/ICP	ppm	0.13	0.15	56.57	16
In	M/ICP	ppm	0.03	0.01	17.62	42
K	M/ICP	%	0.06	0.01	12.06	86
La	M/ICP	ppm	1.74	0.38	10.90	45
Li	M/ICP	ppm	2.09	0.52	12.55	71
Lu	M/ICP	ppm	0.03	0.02	36.17	16
Mg	M/ICP	%	6.58	0.89	6.78	87
Mn	M/ICP	ppm	1413	137	4.86	62
Mo	M/ICP	ppm	2.40	0.39	8.02	56
Na	M/ICP	%	0.21	0.03	7.09	96
Nb	M/ICP	ppm	0.78	0.34	21.87	46
Nd	M/ICP	ppm	2.61	2.75	52.79	16
P	M/ICP	ppm	29.66	7.56	12.75	35
Pb	M/ICP	ppm	16.37	2.68	8.18	78
Pr	M/ICP	ppm	0.68	0.66	48.41	16
Rb	M/ICP	ppm	2.61	0.75	14.34	46
Re	M/ICP	ppm	0.002	0.000	0.000	18
S	M/ICP	%	0.06	0.02	12.88	101
Sb	M/ICP	ppm	1.57	0.51	16.35	54
Sc	M/ICP	ppm	11.65	2.69	11.57	72
Se	M/ICP	ppm	12.87	10.44	40.57	39
Si	M/ICP	%	6.66	0.14	1.06	8
Sm	M/ICP	ppm	0.62	0.61	49.45	16
Sn	M/ICP	ppm	0.38	0.12	16.41	40
Sr	M/ICP	ppm	46.52	12.13	13.03	72
Ta	M/ICP	ppm	0.23	0.29	64.90	16
Tb	M/ICP	ppm	0.09	0.11	58.38	16
Te	M/ICP	ppm	0.13	0.08	30.86	42
Th	M/ICP	ppm	0.24	0.13	27.91	55
Ti	M/ICP	%	0.40	0.03	3.83	72
Tl	M/ICP	ppm	0.03	0.01	22.22	41
Tm	M/ICP	ppm	0.05	0.05	59.02	16
U	M/ICP	ppm	0.18	0.09	25.26	53
V	M/ICP	ppm	1446	164	5.67	64
W	M/ICP	ppm	0.30	0.30	50.57	43
Y	M/ICP	ppm	1.64	0.29	8.76	56
Yb	M/ICP	ppm	0.24	0.09	18.08	16
Zn	M/ICP	ppm	614	47.81	3.89	67
Zr	M/ICP	ppm	7.97	2.82	17.70	63