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AMIS0252

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	2.89	±	0.28	g/t
Pd Pb Collection	1.53	±	0.14	g/t
Pd NIS	1.54	±	0.16	g/t
Cr XRF	22.21	±	0.44	%
Cu P	107	±	8	ppm
Ni P	289	±	34	ppm
Ni XRF	1312	±	88	ppm
Specific Gravity	4.03	±	0.10	

Provisional Concentrations

Au Pb Collection	0.042	±	0.012	g/t
Pt NIS	3.07	±	0.38	g/t
Ir NiS	0.26	±	0.04	g/t
Rh	0.60	±	0.08	g/t
Ru NiS	1.16	±	0.18	g/t
Co M/ICP	200	±	51	ppm
Co P	12	±	3	ppm
Cu M/ICP	104	±	17	ppm
Ni M/ICP	1212	±	232	ppm

Informational Mean

Au NIS 0.042 g/t

$$4E = \text{Platinum (NiS)} + \text{Palladium (NiS)} + \text{Rhodium (NiS)} + \text{Gold (NiS)} = 5.25 \text{ g/t}$$

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

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

Certified Concentrations

Al ₂ O ₃	15.33	±	0.46	%
CaO	1.82	±	0.14	%
Cr ₂ O ₃	32.46	±	0.64	%
Fe ₂ O ₃	24.36	±	0.34	%
MgO	10.97	±	0.18	%
MnO	0.19	±	0.02	%
Na ₂ O	0.31	±	0.02	%
SiO ₂	13.77	±	0.26	%
TiO ₂	0.77	±	0.06	%

Provisional Concentration

K₂O 0.07 ± 0.01 %

Informational Mean

S Comb / LECO 0.04 %

1. Intended Use: AMIS0252 is a certified reference material which may be used to demonstrate the validity of measurement results of a single analysis of PGE, Cr and Ni ores; 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

4. **Appearance:** The material is a very fine powder. It is colored a Dark Greenish Grey (10Y 6/1)

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

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

7. **Methods of Analysis requested:**

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

8. **Information requested:**

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

9. **Method of Certification:** Twenty three laboratories were each given eight randomly selected packages of sample. Twenty of the laboratories submitted results.

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

The "between-laboratory" standard deviation is used in the calculation to eliminate technically and statistically invalid data. Upper and lower limits are based on the standard deviation of the remaining data, which reflect individual analyses and can be used to monitor accuracy in routine laboratory quality control. This is different to limits based on standard deviations derived from grouped set of analyses (see 12), which provide important measures for precision and trueness, but which are less useful for routine QC.

Standards with an RSD of near or less than 5 % are termed “Certified”, RSD’s of between near 5 % and 15 % are termed “Provisional”, and RSD’s over 15 % are termed “Informational”.

10. Participating Laboratories: The 20 out of 23 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 Vancouver CA
4. Anglo Platinum - Eastern Bushveld Regional Laboratory
5. Anglo Research (Germiston Campus)
6. Genalysis Laboratory Services (South Africa) Pty
7. Genalysis Laboratory Services W Australia
8. Northam Platinum LTD
9. Set Point Laboratories (Isando) SA
10. SGS Australia Pty Ltd (Newburn) WA
11. SGS Chelopech (Bulgaria)
12. SGS Geosol Laboratories Ltda (Brazil)
13. SGS Mineral Services Callao (Peru)
14. SGS Mineral Services Lakefield (Canada)
15. SGS South Africa (Pty) Ltd - Booyens JHB
16. SGS Toronto (Canada)
17. SGS Townsville (Australia)
18. Ultra Trace (Pty) Ltd WA
19. Xstrata Alloys
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.

Assay Data: Economic elements

Lab Code	Pt PbColl g/t	Pd PbColl g/t	Au PbColl g/t	Pt NIS g/t	Pd NIS g/t	Au NIS g/t	Ir NIS g/t	Rh NIS g/t	Ru NIS g/t	Co M/ICP ppm	Co P ppm	Co XRF ppm	Cu M/ICP ppm	Cu P ppm	Cu XRF ppm	Ni M/ICP ppm	Ni P ppm	Ni XRF ppm
A	3.05	1.62	0.06	3.09	1.57	0.04	0.26	0.65	1.08	212	12.00		111	107	102	1176	313	1297
A	3.04	1.62	0.05	3.23	1.65	0.04	0.26	0.66	1.18	224	13.00		116	102	98	1341	302	1288
A	2.99	1.59	0.04	3.09	1.57	0.04	0.26	0.64	1.07	235	13.00		109	103	100	1250	305	1290
A	3.08	1.64	0.05	3.20	1.64	0.04	0.27	0.66	1.20	233	12.00		113	103	99	1302	302	1301
A	2.97	1.56	0.04	3.22	1.61	0.04	0.26	0.65	1.15	232	12.00		113	105	99	1285	303	1292
A	3.05	1.59	0.05	3.17	1.62	0.04	0.26	0.65	1.07	228	12.00		112	105	102	1294	307	1298
A	3.02	1.65	0.05	3.17	1.61	0.04	0.26	0.66	1.01	229	12.00		113	103	105	1285	302	1296
A	2.96	1.59	0.06	3.13	1.60	0.04	0.26	0.64	1.13	228	12.00		115	104	99	1314	304	1297
B	2.69	1.40	0.04	2.62	1.40	0.04	0.22	0.54	1.05									
B	2.63	1.44	0.04	2.76	1.45	0.04	0.23	0.57	1.05									
B	2.72	1.37	0.05	2.88	1.41	0.04	0.23	0.57	1.04									
B	2.64	1.38	0.04	2.80	1.40	0.04	0.23	0.58	1.04									
B	2.81	1.47	0.04	2.72	1.34	0.04	0.23	0.58	1.05									
B	2.82	1.44	0.05	2.80	1.35	0.04	0.23	0.58	1.05									
B	2.74	1.46	0.04	2.73	1.46	0.04	0.23	0.58	1.03									
B	2.83	1.47	0.04	2.70	1.45	0.04	0.24	0.56	1.07									
C				3.16	1.61	0.05	0.85	0.57	1.26									
C				3.19	1.60	0.05	0.67	0.56	1.23									
C				3.17	1.59	0.04	0.63	0.58	1.26									
C				3.19	1.59	0.05	0.52	0.57	1.25									
C				3.28	1.62	0.04	0.82	0.58	1.27									
C				3.19	1.59	0.04	0.75	0.57	1.24									
C				3.44	1.64	0.05	0.79	0.60	1.28									
C				3.01	1.54	0.04	0.57	0.54	1.18									
D	3.03	1.57	0.04	3.16	1.60	0.05	0.29	0.59	1.20	203	12.10	239	116	112	116	1105	302	1303
D	3.01	1.55	0.04	3.15	1.60	0.05	0.28	0.58	1.19	202	12.20	243	116	112	120	1106	304	1310
D	3.05	1.59	0.04	3.13	1.57	0.04	0.28	0.57	1.14	200	12.10	254	116	113	116	1100	310	1302
D	3.11	1.61	0.04	3.16	1.58	0.04	0.27	0.58	1.17	201	12.50	218	116	112	116	1079	301	1309
D	2.94	1.57	0.03	3.16	1.60	0.05	0.29	0.59	1.19	202	12.20	234	117	115	118	1105	302	1304
D	2.92	1.54	0.04	3.11	1.58	0.05	0.28	0.58	1.17	208	11.80	236	118	114	118	1119	302	1306
D	3.08	1.58	0.03	3.11	1.57	0.04	0.27	0.58	1.18	200	11.70	244	117	113	117	1100	315	1316
D	3.03	1.57	0.04	3.16	1.57	0.05	0.28	0.59	1.18	202	12.10	238	116	113	120	1087	306	1302
E	2.95	1.46	0.04	3.23	1.57	0.04	0.27	0.64	0.87	240	15.00		100	117		1310	318	
E	2.83	1.44	0.04	3.09	1.57	0.04	0.25	0.63	0.88	240	14.00		110	113		1340	310	
E	2.74	1.31	0.04	3.16	1.49	0.04	0.26	0.62	0.85	245	14.00		105	108		1330	295	
E	2.86	1.47	0.04	3.05	1.47	0.03	0.26	0.62	0.84	235	16.00		105	114		1310	318	
E	2.72	1.36	0.03	3.16	1.47	0.04	0.26	0.62	0.88	230	15.00		100	110		1260	296	
E	2.82	1.43	0.04	3.22	1.56	0.03	0.27	0.63	0.87	240	16.00		105	114		1310	316	
E	2.76	1.38	0.04	3.15	1.49	0.04	0.27	0.64	0.86	250	14.00		110	111		1340	301	
E	2.85	1.47	0.04	3.03	1.50	0.04	0.25	0.61	0.85	245	15.00		105	116		1320	314	

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	2.48	1.16	0.03																
F	2.62	1.21	0.03																
F	2.82	1.32	0.06																
F	2.73	1.31	0.04																
F	2.82	1.37	0.04																
F	2.69	1.30	0.05																
F	2.68	1.33	0.04																
F	2.59	2.25	0.05																
G				3.13	1.54	0.01	0.26	0.55	0.98										
G				3.39	1.55	0.01	0.26	0.56	0.94										
G				3.03	1.49	0.01	0.25	0.54	0.94										
G				2.98	1.48	0.01	0.24	0.53	0.89										
G				2.98	1.49	0.01	0.25	0.52	0.99										
G				3.01	1.48	0.01	0.24	0.53	0.95										
G				2.91	1.48	0.01	0.25	0.52	0.90										
G				3.14	1.59	0.02	0.25	0.55	0.92										
I	3.06	1.59	0.04							194	11.70		91	106	100	1015	278	1060	
I	2.98	1.58	0.05							206	11.70		97	106	100	1010	282	1050	
I	3.10	1.58	0.05							194	11.40		95	102	100	1045	276	1060	
I	2.94	1.53	0.05							198	11.40		90	103	100	1025	280	1080	
I	3.00	1.55	0.05							191	11.60		88	105	100	995	272	1070	
I	2.97	1.53	0.05							199	11.60		89	103	100	1025	282	1050	
I	2.88	1.50	0.05							198	11.10		91	102	100	1060	272	1070	
I	2.99	1.56	0.05							194	11.90		89	106	100	1035	279	1070	
K	2.79	1.47	0.05							181	11.00		106	109		1170	273		
K	2.86	1.49	0.04							179	11.30		97	111		1150	273		
K	2.86	1.47	0.04							179	10.90		96	106		1160	269		
K	2.79	1.43	0.04							174	11.00		96	106		1120	269		
K	2.84	1.46	0.04							182	10.90		97	107		1185	268		
K	3.00	1.54	0.04							181	10.80		94	105		1170	268		
K	2.93	1.51	0.05							179	10.50		91	105		1170	272		
K	2.59	1.32	0.03							182	10.90		93	106		1175	268		
L				3.07	1.68	0.03	0.26	0.65	1.24	270			135			1320			
L				3.10	1.70	0.03	0.27	0.66	1.26	270			150			1345			
L				3.03	1.63	0.05	0.26	0.65	1.23	275			140			1300			
L				3.04	1.67	0.04	0.27	0.66	1.25	270			135			1360			
L				3.11	1.68	0.04	0.27	0.66	1.26	275			135			1305			
L				3.29	1.78	0.03	0.28	0.70	1.34	270			140			1285			
L				3.10	1.69	0.03	0.27	0.66	1.27	270			150			1345			
L				3.38	1.84	0.04	0.29	0.73	1.38	270			145			1380			
M	2.98	1.37						0.63				122						1254	
M	2.84	1.31						0.63				119						1269	
M	2.78	1.23						0.59				133						1258	
M	2.58	1.25						0.59				128						1269	
M	2.69	1.29						0.62				123						1330	
M	2.68	1.19						0.58				122						1329	
M	2.67	1.25						0.59				105						1323	
M	2.74	1.24						0.61				140						1373	
N	2.84	1.57	0.04							186	13.00		108	112		1270	292		
N	2.78	1.41	0.04							180	13.00		111	108		1230	289		
N	2.95	1.59	0.04							170	13.00		108	108		1220	282		
N	2.94	1.46	0.04							173	14.00		112	108		1240	293		
N	2.88	1.53	0.04							190	13.00		110	111		1220	280		
N	2.86	1.50	0.04							173	14.00		112	108		1260	275		
N	2.86	1.53	0.04							175	12.00		108	107		1250	279		
N	2.84	1.55	0.04							185	13.00		116	111		1260	284		
O	2.99	1.51	0.04				0.27	0.64	1.21		11.00	200		99	200			276	1400
O	3.04	1.45	0.04				0.28	0.65	1.24		13.00	200		105				297	1300
O	3.03	1.48	0.04				0.27	0.63	1.16		12.00	200		101	200			282	1300
O	2.89	1.48	0.04				0.27	0.63	1.20		12.00	300		102	200			284	1400
O	3.18	1.65	0.04				0.27	0.63	1.15		12.00	200		102	200			277	1400
O	3.03	1.62	0.03				0.28	0.63	1.21		11.00	200		99	100			277	1300
O	2.97	1.50	0.03				0.28	0.64	1.19		12.00	200		102				284	1400
O	3.24	1.63	0.03				0.26	0.62	1.15		12.00	200		102	300			284	1400
P										231	10.00		111	106		1273			
P										241	9.00		113	104		1271			
P										231	10.00		109	103		1254			
P										235	9.00		108	104		1242			
P										229	6.00		108	101		1234			
P										233	10.00		111	105		1237			
P										237	9.00		109	103		1289			
P										239	10.00		104	103		1223			
Q	2.85	1.51	0.04	2.80	1.54	0.04	0.19	0.57	1.07	136	14.00	253	104	120				306	1304
Q	2.88	1.54	0.05	2.83	1.54	0.04	0.18	0.56	1.06	131	15.00	265	101	118				302	1308
Q	2.82	1.52	0.04	2.83	1.59	0.04	0.17	0.56	1.05	131	16.00	255	100	118				305	1388
Q	2.82	1.54	0.05	2.78	1.52	0.04	0.20	0.56	1.09	133	14.00	261	100	120				312	1286
Q	2.87	1.52	0.04	2.87	1.55	0.04	0.19	0.55	1.05	134	13.00	257	102	119				308	1273
Q	2.80	1.52	0.04	2.83	1.53	0.04	0.19	0.56	1.06	133	14.00	261	101	120				310	1335
Q	2.84	1.53	0.04	2.85	1.51	0.04	0.20	0.56	1.04	136	14.00	267	99	120				310	1221
Q	2.89	1.57	0.04	2.81	1.56	0.05	0.19	0.56	1.06	130	14.00	269	99	120				311	1225
R			0.06																
R			0.06																
R			0.06																
R			0.05																
R			0.06																
R			0.06																
R			0.06																
T	2.67	1.35	0.05							178	10.41	300	104	104		1075	263	1300	
T	2.45	1.23	0.05							175	10.30	200	97	103	100	1029	259	1200	
T	2.38	1.27	0.06							171	9.75	300	101	100	100	1083	246	1300	
T	2.24	1.16	0.05							171	10.65	400	98	102	200	1055	256	1300	
T	2.31	1.16	0.05							174	10.41	400	97	105	100	1054	263	1300	
T	2.29	1.28	0.05							170	10.37	300	98	99	100	1060	261	1300	
T	2.74	1.35	0.07							168	10.06	300	99	105	100	1050	259	1400	
T	2.59	1.28	0.04							172	10.50	300	105	102	100	982	260	1300	

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
U	2.94	1.35	0.04							189	12.00		90	106		1190	276	
U	3.06	1.54	0.05							192	12.00		87	108		1200	276	
U	3.15	1.56	0.06							193	12.00		85	106		1190	278	
U	3.09	1.53	0.06							190	12.00		91	113		1140	287	
U	3.08	1.50	0.06							182	13.00		93	108		1190	286	
U	3.19	1.58	0.06							194	12.00		93	111		1190	280	
U	3.12	1.57	0.05							197	12.00		87	108		1200	278	
U	3.14	1.56	0.06							188	11.00		91	112		1210	270	
V	2.93	1.54	0.04							162	11.00		102	107		1140	293	
V	2.83	1.70	0.04							180	13.00		104	110		1170	301	
V	2.88	1.61	0.04							182	13.00		103	106		1180	308	
V	2.58	1.46	0.04							161	12.00		100	108		1180	310	
V	2.77	1.55	0.04							158	12.00		103	114		1200	300	
V	2.85	1.58	0.04							158	12.00		99	108		1140	293	
V	2.82	1.58	0.04							173	13.00		109	112		1170	296	
V	2.97	1.70	0.05							202	13.00		103	105		1270	298	
W				3.41	1.48	0.07	0.54	0.63	1.30	283			108			1386		
W				3.30	1.44	0.06	0.35	0.62	1.39	276			104			1393		
W				3.38	1.49	0.06	0.40	0.63	1.34	290			110			1431		
W				3.39	1.57	0.06	0.35	0.63	1.34	288			109			1426		
W				3.15	1.47	0.06	0.37	0.59	1.24	287			111			1440		
W				2.80	1.32	0.05	0.33	0.57	1.11	289			109			1430		
W				2.77	1.34	0.04	0.31	0.56	1.10	293			106			1421		
W				2.68	1.16	0.07	0.98	0.52	1.00	283			105			1414		

Assay Data: Major elements

Lab Code	Al2O3 XRF %	CaO XRF %	Cr2O3 XRF %	Fe2O3 XRF %	K2O XRF %	MgO XRF %	MnO XRF %	Na2O XRF %	SiO2 XRF %	TiO2 XRF %	S Comb/LECO %	SG pycnometer
A	15.53	1.86	32.85	24.47	0.07	11.02	0.22	0.30	13.66	0.76	0.04	
A	15.60	1.89	32.72	24.35	0.07	10.97	0.21	0.29	13.72	0.76	0.04	3.98
A	15.56	1.88	32.66	24.36	0.07	11.01	0.21	0.32	13.77	0.74	0.04	3.96
A	15.54	1.88	32.87	24.35	0.07	11.04	0.21	0.28	13.76	0.75	0.04	3.97
A	15.70	1.89	32.62	24.26	0.07	10.98	0.21	0.28	13.79	0.75	0.04	4.03
A	15.54	1.88	32.74	24.33	0.07	11.00	0.21	0.29	13.83	0.75	0.04	4.06
A	15.48	1.88	32.80	24.28	0.07	11.00	0.21	0.29	13.84	0.76	0.04	4.02
A	15.36	1.88	32.87	24.41	0.07	10.99	0.21	0.31	13.79	0.75	0.04	4.05
B												4.03
B												4.03
B												4.02
B												4.01
B												4.05
B												4.00
B												3.99
B												4.00
D	17.90	1.92	31.70	23.57	0.05	12.10	0.19	0.36	9.10	0.69		3.88
D	17.90	1.92	31.60	23.57	0.05	12.00	0.19	0.34	9.00	0.69		3.99
D	17.90	1.92	31.80	23.49	0.05	12.00	0.19	0.36	9.10	0.68		4.04
D	17.90	1.93	31.90	23.57	0.05	12.00	0.19	0.35	9.10	0.68		4.02
D	17.80	1.96	32.00	23.57	0.05	12.00	0.19	0.34	8.90	0.68		4.03
D	17.90	1.93	32.00	23.57	0.05	12.00	0.19	0.35	9.00	0.69		3.98
D	17.90	1.92	32.10	23.49	0.05	12.10	0.19	0.34	9.10	0.69		4.00
D	17.80	1.93	32.10	23.49	0.04	12.00	0.19	0.33	8.90	0.69		3.88
E	15.70	1.87	32.60	24.40	0.07	11.10	0.20	0.31	13.80	0.76		4.09
E	15.60	1.86	32.50	24.40	0.07	11.00	0.20	0.32	13.90	0.76		4.08
E	15.60	1.86	32.60	24.50	0.07	11.10	0.20	0.31	13.80	0.76		4.06
E	15.60	1.86	32.50	24.40	0.07	11.00	0.20	0.31	13.80	0.76		4.07
E	15.70	1.87	32.40	24.30	0.07	11.00	0.20	0.28	13.90	0.76		4.07
E	15.60	1.87	32.40	24.40	0.07	11.00	0.20	0.31	13.90	0.76		4.07
E	15.60	1.86	32.50	24.50	0.07	11.10	0.20	0.31	13.80	0.76		4.09
E	15.70	1.87	32.50	24.50	0.07	11.00	0.20	0.32	13.80	0.76		4.06
I	15.01	1.74	34.85	22.41	0.07	10.95	0.02	0.31	13.54	0.85		4.09
I	15.10	1.75	34.95	22.53	0.07	10.98	0.01	0.30	13.44	0.85		4.01
I	15.01	1.77	35.01	22.56	0.07	11.01	0.02	0.31	13.45	0.84		4.02
I	15.10	1.77	34.90	22.41	0.07	11.07	0.01	0.31	13.52	0.83		4.15
I	15.05	1.75	35.01	22.29	0.07	10.92	0.02	0.30	13.41	0.83		3.98
I	15.02	1.76	35.04	22.51	0.07	11.03	0.01	0.30	13.51	0.83		4.11
I	15.01	1.76	35.10	22.55	0.07	11.01	0.02	0.32	13.52	0.84		3.90
I	14.98	1.75	35.09	22.41	0.07	11.05	0.01	0.31	13.46	0.84		3.90
K					0.06			0.18	0.30			4.09
K					0.06			0.18	0.30			4.10
K					0.06			0.18	0.30			4.06
K					0.06			0.17	0.30			4.15
K					0.06			0.18	0.30			4.06
K					0.06			0.17	0.30			4.02
K					0.06			0.18	0.28			4.03
K					0.06			0.18	0.30			4.06

Assay Data (cont): Major elements

Lab Code	Al2O3 XRF %	CaO XRF %	Cr2O3 XRF %	Fe2O3 XRF %	K2O XRF %	MgO XRF %	MnO XRF %	Na2O XRF %	SiO2 XRF %	TiO2 XRF %	S Comb/LECO %	SG pycnometer
L	15.01	2.19	31.90	24.18		11.24			13.76		0.05	
L	14.99	2.18	32.09	24.24		11.27			13.67		0.05	
L	15.11	2.24	32.64	24.69		11.46			13.96		0.04	
L	15.03	2.24	32.27	24.52		11.32			13.71		0.05	
L	15.08	2.19	32.14	24.28		11.27			13.75		0.05	
L	14.99	2.23	32.03	24.21		11.31			13.94		0.06	
L	15.02	2.20	32.34	24.43		11.34			13.68		0.05	
L	15.06	2.23	32.39	24.63		11.37			13.75		0.05	
M												4.00
M												4.01
M												4.26
M												3.97
M												4.24
M												3.98
M												4.04
M												4.04
N	15.30	1.81	32.40	24.40	0.07	11.00	0.19	0.31	13.80	0.78	0.04	
N	15.30	1.81	32.40	24.40	0.07	11.10	0.19	0.32	13.80	0.77	0.03	
N	15.30	1.81	32.40	24.50	0.07	11.10	0.19	0.33	13.70	0.78	0.03	
N	15.30	1.80	32.30	24.50	0.07	11.00	0.19	0.33	13.70	0.77	0.03	
N	15.40	1.80	32.50	24.50	0.07	11.00	0.19	0.32	13.80	0.78	0.04	
N	15.30	1.80	32.40	24.50	0.07	11.00	0.19	0.33	13.80	0.79	0.03	
N	15.30	1.80	32.50	24.50	0.07	11.00	0.19	0.34	13.70	0.78	0.03	
N	15.30	1.81	32.40	24.50	0.07	11.00	0.19	0.32	13.80	0.78	0.03	
O	15.50	1.89	32.40	24.70	0.07	10.80	0.20	0.31	13.90	0.75	0.05	
O	15.40	1.86	32.30	24.60	0.07	10.80	0.20	0.32	13.80	0.74	0.05	
O	15.30	1.85	32.00	24.30	0.07	10.80	0.20	0.31	13.80	0.74	0.07	
O	15.50	1.86	32.20	24.50	0.07	10.80	0.19	0.31	13.70	0.75	0.05	
O	15.50	1.89	32.40	24.70	0.06	10.80	0.19	0.32	13.90	0.75	0.05	
O	15.70	1.91	32.50	24.80	0.06	11.00	0.20	0.32	14.00	0.75	0.06	
O	15.40	1.87	32.10	24.50	0.07	10.80	0.21	0.32	13.80	0.75	0.05	
O	15.40	1.86	32.10	24.40	0.07	10.80	0.20	0.33	13.80	0.74	0.04	
P											0.05	3.87
P											0.04	3.85
P											0.05	3.93
P											0.05	3.96
P											0.05	3.98
P											0.04	3.93
P											0.04	3.97
P											0.04	3.97
Q	15.10	1.84	33.10	24.20			0.20		13.80	0.76	0.03	4.04
Q	15.20	1.86	33.10	24.30			0.21		14.30	0.74	0.03	4.01
Q	15.20	1.84	32.90	24.10			0.19		14.20	0.75	0.03	4.05
Q	15.30	1.83	33.20	24.40			0.20		13.80	0.76	0.03	4.05
Q	15.20	1.84	33.10	24.40			0.19		14.40	0.76	0.03	4.01
Q	15.00	1.83	33.30	24.30			0.18		13.90	0.77	0.03	4.03
Q	15.50	1.82	33.10	24.20			0.20		13.80	0.76	0.03	4.05
Q	15.60	1.82	32.90	24.00			0.21		14.30	0.75	0.03	4.02
T	15.71	1.81	32.39	24.03	0.07	10.91	0.20	0.35	13.71	0.76		
T	15.43	1.84	32.65	24.17	0.06	11.00	0.20	0.30	13.97	0.77		
T	15.43	1.84	32.65	24.17	0.06	11.00	0.20	0.30	13.97	0.77		
T	15.36	1.84	32.41	24.24	0.07	10.92	0.21	0.33	13.78	0.75		
T	15.29	1.82	32.50	24.08	0.06	10.94	0.20	0.29	14.01	0.76		
T	15.41	1.80	32.33	23.95	0.07	10.86	0.20	0.28	13.80	0.77		
T	15.21	1.86	32.62	24.08	0.08	10.76	0.19	0.36	13.94	0.79		
T	15.26	1.82	32.57	24.03	0.07	11.05	0.19	0.32	13.62	0.76		
U		1.75				0.07	0.19	0.31				
U		1.71				0.06	0.19	0.31				
U		1.68				0.06	0.19	0.31				
U		1.93				0.07	0.18	0.34				
U		1.69				0.06	0.18	0.31				
U		1.79				0.07	0.19	0.32				
U		1.68				0.06	0.19	0.30				
U		1.72				0.06	0.19	0.31				
V		1.61				0.07	0.18			0.80		4.03
V		1.65				0.07	0.18			0.83		4.03
V		1.69				0.07	0.18			0.81		4.06
V		1.65				0.07	0.18			0.83		4.05
V		1.62				0.07	0.19			0.86		4.06
V		1.62				0.07	0.18			0.79		4.04
V		1.67				0.07	0.18			0.83		4.05
V		1.67				0.07	0.19			0.84		4.03

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	0.143	0.095	0.079	0.028
Pd	PbColl	g/t	0.068	0.042	0.048	0.014
Au	PbColl	g/t	0.006	0.003	0.004	0.001
Pt	NIS	g/t	0.193	0.135	0.136	0.048
Pd	NIS	g/t	0.068	0.042	0.048	0.014
Au	NIS	g/t	0.006	0.003	0.004	0.001
Pt	NIS	g/t	0.193	0.135	0.136	0.048
Pd	NIS	g/t	0.083	0.071	0.039	0.024
Ir	NiS	g/t	0.016	0.016	0.007	0.006
Rh	NiS	g/t	0.040	0.032	0.017	0.010
Ru	NiS	g/t	0.092	0.077	0.055	0.028
Co	M/ICP	ppm	25.69	23.21	6.833	7.378
Co	P	ppm	1.378	1.066	0.501	0.312
Cu	M/ICP	ppm	8.323	6.601	2.844	1.928
Cu	P	ppm	4.135	3.149	2.065	0.975
Ni	M/ICP	ppm	116.2	95.59	28.23	27.75
Ni	P	ppm	16.83	14.06	5.523	4.280
Ni	XRF	ppm	44.11	14.06	5.523	4.280
Al ₂ O ₃	XRF	%	0.231	0.216	0.109	0.078
CaO	XRF	%	0.075	0.063	0.030	0.020
Cr ₂ O ₃	XRF	%	0.316	0.293	0.136	0.105
Fe ₂ O ₃	XRF	%	0.172	0.138	0.120	0.055
K ₂ O	XRF	%	0.004	0.003	0.003	0.001
MgO	XRF	%	0.093	0.090	0.059	0.038
MnO	XRF	%	0.010	0.008	0.005	0.003
Na ₂ O	XRF	%	0.017	0.012	0.012	0.004
SiO ₂	XRF	%	0.135	0.107	0.084	0.039
TiO ₂	XRF	%	0.030	0.030	0.010	0.011
SG	pyc		0.049	0.026	0.040	0.009

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 Smeed.

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

15. Certification: AMIS0252 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 Smees and Smees and Associates Ltd; accept no liability for any decisions or actions taken following the use of the reference material.

22 February 2013

Certifying Officers:



African Mineral Standards: _____

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



Geochemist: _____

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

Appendix – uncertified trace element statistics

Analyte	Method	Unit	Mean	2SD	RSD%	n
Ag	M/ICP	ppm	0.40	1.2	148	32
Al	M/ICP	%	8.0	0.83	5.2	64
As	M/ICP	ppm	15.0	42.9	143	36
Ba	M/ICP	ppm	25.7	9.0	17.6	70
Be	M/ICP	ppm	0.38	0.66	87.5	33
Bi	M/ICP	ppm	10.6	42.0	198	37
Ca	M/ICP	%	1.2	0.20	8.4	76
Cd	M/ICP	ppm	1.3	5.4	205	39
Ce	M/ICP	ppm	3.1	0.62	9.8	40
Co	XRF	ppm	221	120	27.2	38
Cr	M/ICP	ppm	226286	7095	1.6	15
Cs	M/ICP	ppm	0.13	0.12	44.3	47
Cu	XRF	ppm	118	68.4	29.0	36
Dy	M/ICP	ppm	0.27	0.08	15.4	22
Er	M/ICP	ppm	0.17	0.06	19.1	24
Eu	M/ICP	ppm	0.11	0.05	23.5	24
Fe	M/ICP	%	14.7	8.2	27.8	56
Ga	M/ICP	ppm	48.4	12.6	13.0	41
Gd	M/ICP	ppm	0.22	0.09	19.9	21
Ge	M/ICP	ppm	0.56	0.70	61.9	25
Hf	M/ICP	ppm	0.25	0.23	45.5	46
Ho	M/ICP	ppm	0.06	0.01	9.8	22
In	M/ICP	ppm	0.03	0.01	13.1	29
K	M/ICP	%	0.06	0.01	10.0	69
La	M/ICP	ppm	1.5	0.88	30.1	40
Li	M/ICP	ppm	2.3	0.89	19.4	67
Lu	M/ICP	ppm	0.04	0.02	23.3	16
Mg	M/ICP	%	6.4	0.80	6.3	64
Mn	M/ICP	ppm	1378	395	14.3	72
Mo	M/ICP	ppm	2.3	1.2	26.9	57
Na	M/ICP	%	0.23	0.03	7.4	72
Nb	M/ICP	ppm	0.82	0.71	43.1	38
Nd	M/ICP	ppm	1.3	0.30	11.2	24
P	M/ICP	ppm	39.6	46.5	58.7	27
Pb	M/ICP	ppm	3.2	2.5	39.9	30
Pr	M/ICP	ppm	0.32	0.07	11.2	24
Rb	M/ICP	ppm	2.8	1.4	24.8	43
Re	M/ICP	ppm	0.01	0.04	174.5	10
S	M/ICP	%	0.04	0.01	13.0	55
Sb	M/ICP	ppm	12.5	77.7	311.8	43
Sc	M/ICP	ppm	10.6	2.9	13.7	77
Se	M/ICP	ppm	19.7	37.7	95.7	32
Si	M/ICP	%	6.5	0.15	1.2	8
Sm	M/ICP	ppm	0.26	0.09	17.7	24
Sn	M/ICP	ppm	0.44	0.40	45.4	32
Sr	M/ICP	ppm	48.3	8.7	9.0	75
Ta	M/ICP	ppm	0.20	0.29	70.6	15
Tb	M/ICP	ppm	0.05	0.02	18.9	16
Th	M/ICP	ppm	0.26	0.08	16.3	43
Ti	M/ICP	%	0.42	0.09	10.4	64
Tl	M/ICP	ppm	0.04	0.05	63.8	24
Tm	M/ICP	ppm	0.03	0.02	37.0	8
U	M/ICP	ppm	0.13	0.32	122.5	41
V	M/ICP	ppm	1349	530	19.7	72
W	M/ICP	ppm	0.28	0.20	34.8	30
Y	M/ICP	ppm	1.8	0.41	11.6	56
Yb	M/ICP	ppm	0.16	0.09	28.1	23
Zn	M/ICP	ppm	435	378	43.5	72
Zr	M/ICP	ppm	9.4	7.4	39.6	63