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AMIS0067

Certified Reference Material

Platinum (PGM) Merensky Reef Ore

Certificate of Analysis

Recommended Concentrations and two “Between Laboratory” Standard Deviations

Certified Concentrations

Pt Pb (Coll)	1.95	±	0.16	g/t
Pd Pb (Coll)	0.98	±	0.08	g/t
Au Pb (Coll)	0.15	±	0.02	g/t
Pt (NIS)	1.98	±	0.18	g/t
Pd (NIS)	0.98	±	0.08	g/t
Co (M/ICP)	88	±	7.40	ppm
Co (P)	40	±	4.60	ppm
Cu (M/ICP)	895	±	44	ppm
Cu (P)	896	±	45	ppm
Cu (XRF)	887	±	48	ppm
Ni (M/ICP)	1728	±	182	ppm
Ni (P)	1367	±	112	ppm
Ni (XRF)	1767	±	147	ppm
Specific Gravity	3.10	±	0.08	

Provisional Concentrations

Au NIS	0.14	±	0.03	g/t
Ir NiS	0.05	±	0.01	g/t
Rh NiS	0.12	±	0.02	g/t
Ru NiS	0.25	±	0.06	g/t

4E = 3.223 g/t (Pt, Pd, Rh plus Au)

NB Additional certified and uncertified major and trace element data is presented on p2 and as an appendix.

1. Intended Use: AMIS0067 can be used to check analyses of PGE, Cu and Ni concentrate materials, derived from the UG2 or other mafic rocks, with a similar grade and matrix.

It is a matrix matched Certified Reference Material, fit for use as control samples in routine assay laboratory quality control when inserted within runs of samples and measured in parallel to the unknown. Its purpose is to monitor inter-laboratory or instrument bias and within lab precision. It can be used, indirectly, to establish the traceability of results to an SI system of units.

The recommended concentrations and limits for this material are property values based on a measurement campaign (round robin) and reflect consensus results from the laboratories that participated in the round robin.

Slight variations in analytical procedures between laboratories will reflect as slight biases to the recommended concentrations (see 19). Good laboratories will report results within the two standard deviation levels with a failure rate of <10 %.

The material can also be used for method development and for the calibration of equipment.

Intended Use: AMIS0067 is suitable for monitoring the accuracy of a single analysis of PGE, Cu and Ni ores hosted by Merensky Reef or similar other mafic rocks. The material can be used for routine quality control by inserting within a batch of samples.

The major and trace element composition of this material has also been determined but it has not been certified. The iterated statistics are set out below and as an appendix and this information may be useful for instrument calibration or method development.

2. Origin of Material: This standard was made using Merensky Reef Pt/Pd ore material supplied by Lonmin Limited from the Western limb of the Bushveld Complex. This specific material is a blend of sample pulp rejects.

3. Mineral and Chemical Composition: The Merensky Reef comprises components of feldspathic pyroxenite, pyroxenite and anorthosite. Peak PGE values are associated with a thin chromitite stringer. Mineralization in this Merensky Reef comprises 2-5% disseminated or net textured magmatic sulphides, predominantly pyrrhotite, pentlandite, chalcopyrite and pyrite. The PGE's occur as micron-sized satellite grains around but rarely within the sulphides.

This major element chemistry (below) is also certified and was determined from (predominantly) XRF data supplied by 12 of the laboratories.

Recommended Concentrations and two “Between Laboratory” Standard Deviations

Certified Concentrations

Al ₂ O ₃	11.93	±	0.19	%
CaO	7.05	±	0.12	%
Cr ₂ O ₃	0.63	±	0.03	%
Fe ₂ O ₃	9.99	±	0.28	%
K ₂ O	0.19	±	0.02	%
MgO	16.31	±	0.26	%
MnO	0.16	±	0.01	%
Na ₂ O	1.07	±	0.07	%
SiO ₂	51.12	±	0.84	%
TiO ₂	0.23	±	0.02	%

Informational Mean

LOI	0.51	%
S Combustion / LECO	0.43	%

4. Appearance: The material is a very fine Light Blueish Grey powder (Corstor colour chart - 5B 8/1).

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 100% <54um. Wet sieve particle size analysis of random samples confirmed the material was 100% <54um. It was then blended in a bi-conical mixer, systematically divided and then sealed into 1kg Laboratory Packs. Samples were randomly selected for homogeneity testing and third party analysis. Statistical analysis for the consensus test results were carried out by an independent statistician. Explorer Packs are subdivided from the Laboratory packs as required.

7. Methods of analysis requested:

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

8. Information requested:

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

9. Method of certification: Twenty five laboratories were each given eight samples, comprising eight packages of sample scientifically selected from throughout the batch. Certification is based on results from the twenty four labs that returned results timeously.

The 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 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 calculated using all remaining data. Any analysis that fell outside of the mean ± 2 standard deviations was removed from the ensuing data base. The mean and standard deviations were again calculated using the remaining data.

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. Standards with an RSD of near or less than 5 % are certified, RSD's of between near 5 % and 15 % are Provisional, and RSD's over 15 % are Informational.

10. Participating Laboratories: (Not in same order as in the table of assays)

1. ALS Chemex Laboratory Group Brisbane Australia
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. Barplats Laboratory SA
9. Genalysis Laboratory Services (South Africa) Pty
10. Genalysis Laboratory Services WA
11. Impala Mineral Processes Laboratory
12. Northam
13. OMAC Laboratories Limited (Ireland)
14. Performance Laboratories SA
15. Quality Laboratory Services (Rustenburg SA)
16. Rappa Research Laboratory
17. Set Point Laboratories (Isando) SA
18. Set Point Laboratories (Mokopane) SA
19. SGS Australia Pty Ltd (Newburn) WA
20. SGS Mineral Services Callao (Peru)
21. SGS Mineral Services Lakefield (Canada)
22. SGS Toronto (Canada)
23. Ultra Trace (Pty) Ltd WA
24. Zimplats Head Office Assay Laboratory

11. Assay Data: Data as received from the laboratories for the important certified elements listed on p1 is set out below. A proficiency report has been sent to the managers of the participating laboratories. Additional data from this round robin is available on request.

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	Al2O3 XRF %	CaO XRF %	Cr2O3 XRF %	Fe2O3 XRF %	K2O XRF %	MgO XRF %	MnO XRF %	Na2O XRF %	SiO2 XRF %	TiO2 XRF %	LOI XRF %	S LECO	SG	
A	1.97	0.97	0.15	1.92	0.93	0.12	0.07	0.11	0.24	81	44	103	866	863	890	1640	1333	1719	11.80	7.05	0.60	9.95	0.18	16.36	0.17	1.21	51.48	0.24	0.67	0.44	3.09	
A	2.00	1.00	0.16	1.99	0.96	0.12	0.08	0.12	0.23	79	41	88	869	850	886	1645	1333	1721	11.82	7.14	0.60	9.99	0.18	16.37	0.17	1.21	52.15	0.24	0.63	0.44	3.10	
A	1.94	0.96	0.16	1.94	0.95	0.12	0.07	0.11	0.23	84	42	93	834	871	868	1637	1222	1724	11.78	7.09	0.60	9.90	0.18	16.19	0.17	1.20	51.81	0.23	0.65	0.43	3.06	
A	1.92	0.96	0.15	1.92	0.91	0.13	0.06	0.11	0.22	78	36	84	862	849	875	1668	1222	1713	11.73	7.11	0.60	9.95	0.18	16.40	0.17	1.17	51.87	0.23	0.64	0.43	3.09	
A	1.94	0.97	0.15	1.94	0.94	0.13	0.06	0.11	0.24	85	45	96	877	859	884	1681	1444	1723	11.91	7.14	0.60	9.96	0.19	16.48	0.17	1.19	52.28	0.23	0.64	0.42	3.10	
A	2.00	1.01	0.16	1.91	0.94	0.12	0.06	0.12	0.22	83	44	78	844	867	898	1641	1444	1743	11.81	7.11	0.60	9.95	0.18	16.36	0.17	1.21	51.92	0.23	0.63	0.42	3.09	
A	1.91	0.97	0.14	1.93	0.93	0.13	0.06	0.11	0.24	80	43	103	850	838	911	1663	1444	1769	11.73	6.99	0.60	9.83	0.18	16.47	0.17	1.22	51.17	0.24	0.63	0.43	3.09	
A	1.94	1.00	0.15	2.01	0.91	0.12	0.07	0.11	0.22	83	44	88	871	836	882	1634	1333	1720	11.75	7.07	0.60	9.92	0.19	16.42	0.16	1.21	51.66	0.25	0.64	0.41	3.10	
B	1.89	0.96	0.14																													
B	1.89	0.96	0.15																													
B	1.86	0.95	0.14																													
B	1.90	0.98	0.15																													
B	1.89	0.94	0.14																													
B	1.96	0.99	0.15																													
B	1.92	0.99	0.15																													
B	1.96	0.99	0.15																													
C																																
C				2.12	0.98	0.17																										
C				2.01	1.00	0.17																										
C				1.98	1.00	0.16																										
C				1.99	0.98	0.17																										
C				2.13		0.17																										
C				2.08	0.98	0.17																										
C				1.98	0.95	0.15																										
D	1.95	0.95	0.15	1.96	0.96	0.15	0.05	0.13	0.24	87	38		901	884	862	1751	1349	1786	12.02	7.11	0.64	9.96	0.20	16.32	0.16	1.03	51.77	0.23	0.49	0.42	3.10	
D	2.02	0.99	0.15	1.95	0.94	0.15	0.04	0.12	0.22	87	38		904	900	866	1749	1382	1806	12.03	7.16	0.63	9.94	0.20	16.40	0.16	1.02	51.76	0.24	0.46	0.40	3.11	
D	2.05	1.00	0.16	1.91	0.96	0.15	0.04	0.12	0.24	85	37		883	883	867	1723	1348	1799	12.09	7.16	0.64	9.95	0.19	16.43	0.16	1.04	51.61	0.24	0.46	0.40	3.06	
D	2.06	0.98	0.16	1.95	0.95	0.15	0.05	0.12	0.23	84	38		868	892	890	1699	1363	1796	12.05	7.16	0.65	9.99	0.20	16.36	0.16	1.03	51.79	0.23	0.48	0.38	3.08	
D	1.99	0.97	0.16	1.91	0.95	0.15	0.04	0.12	0.23	86	39		885	919	866	1713	1415	1792	11.94	7.10	0.63	9.94	0.20	16.32	0.16	1.02	51.51	0.24	0.49	0.40	3.12	
D	1.95	0.98	0.15	1.96	0.96	0.15	0.05	0.13	0.24	88	38		913	900	857	1758	1396	1781	12.03	7.10	0.63	9.93	0.19	16.28	0.16	1.04	51.52	0.23	0.46	0.41	3.09	
D	2.04	1.00	0.15	1.96	0.94	0.15	0.04	0.12	0.22	85	38		894	890	865	1728	1371	1800	11.98	7.12	0.64	9.93	0.19	16.37	0.16	1.04	51.59	0.24	0.49	0.39	3.13	
D	2.07	1.00	0.15	1.84	0.97	0.15	0.04	0.13	0.24	85	38		881	884	869	1709	1373	1799	12.05	7.15	0.64	9.95	0.19	16.35	0.16	1.02	51.62	0.24	0.47	0.40	3.10	
E	2.04	0.97	0.15	1.91	0.99	0.15	0.04	0.12	0.24																							
E	2.02	0.97	0.16	1.84	0.97	0.15	0.04	0.12	0.25																							
E	2.03	0.97	0.16	1.89	0.99	0.15	0.04	0.12	0.25																							
E	2.03	0.96	0.16	1.98	1.02	0.15	0.04	0.12	0.23																							
E	2.01	0.96	0.15	1.94	1.00	0.16	0.05	0.12	0.24																							
E	2.04	0.97	0.15	1.94	0.99	0.16	0.04	0.12	0.25																							
E	1.96	0.96	0.15	1.89	0.97	0.15	0.04	0.12	0.24																							
E	1.96	0.94	0.15	1.97	0.96	0.15	0.05	0.12	0.25																							
F	2.02	1.02	0.15																													
F	2.06	1.02	0.15																													
F	2.05	1.03	0.15																													
F	1.98	1.00	0.15																													
F	2.02	1.02	0.15																													
F	2.01	1.01	0.15																													
F	1.99	1.00	0.15																													
F	2.04	1.02	0.15																													
G				1.95	1.04				0.12																							
G				1.92	1.10				0.14																							
G				2.03	1.02				0.13																							
G				2.12	1.00				0.12																							
G				2.19	1.00				0.12																							
G				2.46	1.04				0.13																							
G				2.05	1.01				0.13																							
G				2.15	1.03				0.12																							
H	2.18	0.99	0.15							89	45	100	917	924	870	1869	1460	1880	11.81	7.12	0.64	10.14	0.20	16.45	0.16	0.96	50.90	0.23	0.94	3.13		
H	2.16	1.00	0.15							92	43	160	921	911	830	1884	1445	1870	11.92	7.04	0.64	10.12	0.20	16.43	0.16	0.96	50.63	0.23	0.94	3.12		
H	2.16	0.99	0.15							90	44	150	911	931	800	1904	1448	1820	11.85	7.06</												

Assay Data (cont):

Lab Code	Pt P/Coil g/t	Pd P/Coil g/t	Au P/Coil g/t	Pt NIS g/t	Pd NIS g/t	Au NIS g/t	I NIS g/t	Rh NIS g/t	Ru NIS g/t	Co M/Coil g/t	Co P ppm	Cu M/Coil ppm	Cu P ppm	Ni M/Coil ppm	Ni P ppm	Al2O3 XRF %	CaO XRF %	CO2 XRF %	Fe2O3 XRF %	K2O XRF %	MgO XRF %	MnO XRF %	Ni2O XRF %	SiO2 XRF %	TiO2 XRF %	LOI XRF %	S LECO	SG		
I				2.04	1.01	0.14	0.04	0.16	0.31	58		1073		1758																
I				2.07	1.01	0.14	0.04	0.16	0.28	73		994		1838																
I				2.01	0.97	0.15	0.04	0.11	0.29	86		985		2083																
I				1.96	0.96	0.15	0.05	0.13	0.29	61		1080		1700																
I				1.99	0.98	0.15	0.05	0.12	0.29	69		1032		1593																
I				1.96	0.96	0.16	0.08	0.14	0.30	75		1020		1755																
I				2.01	0.96	0.15	0.04	0.12	0.28	70		1011		1710																
I				2.07	0.99	0.15	0.04	0.13	0.29	82		990		1822																
J	1.74	0.91	0.14							95	85	881	895	1539	1894															
J	1.74	0.91	0.13							91	81	878	888	1845	1904															
J	1.70	0.90	0.14							88	83	885	892	1839	1900															
J	1.70	0.89	0.14							98	87	879	900	1841	1903															
J	1.70	0.90	0.12							101	85	877	898	1845	1912															
J	1.77	0.93	0.12							88	81	884	903	1838	1875															
J	1.71	0.92	0.13							90	90	890	893	1840	1909															
J	1.73	0.94	0.13							93	86	884	904	1849	1896															
K	2.07	0.99	0.16							82	96	894	1025	1580	1410													3.12		
K	2.05	0.98	0.15							88	96	942	1035	1680	1410													3.11		
K	2.01	0.96	0.15							86	96	923	1025	1615	1420													3.11		
K	2.02	0.98	0.14							83	97	896	1025	1575	1420													3.13		
K	2.02	0.96	0.14							82	99	899	1015	1585	1400													3.12		
K	2.08	0.99	0.16							82	97	899	1015	1610	1395													3.12		
K	2.03	0.96	0.15							86	98	927	1010	1640	1390													3.12		
K	2.03	0.97	0.16							91	97	964	1025	1725	1400													3.12		
L										91	40	890	928	930	1700	1310	1900	12.00	7.12	0.64	10.10	0.19	16.36	0.16	1.10	51.40	0.24	0.50	0.43	
L										94	40	100	923	937	930	1740	1340	1870	12.05	7.08	0.64	10.10	0.20	16.30	0.16	1.11	51.10	0.23	0.49	0.43
L										92	41	100	894	928	920	1690	1320	1840	11.95	7.09	0.62	10.10	0.19	16.30	0.16	1.10	51.20	0.23	0.47	0.42
L										93	40	100	911	930	930	1770	1340	1840	11.95	7.09	0.65	10.10	0.19	16.30	0.16	1.10	51.20	0.23	0.43	0.42
L										93	41	100	913	923	930	1730	1295	1860	11.90	7.12	0.63	10.05	0.19	16.30	0.16	1.10	51.20	0.25	0.42	0.42
L										93	39	100	923	914	930	1770	1280	1860	12.05	7.14	0.64	10.15	0.20	16.40	0.18	1.11	51.20	0.24	0.50	0.43
L										90	38	100	902	903	930	1700	1270	1880	12.05	7.14	0.64	10.15	0.20	16.40	0.18	1.11	51.30	0.23	0.50	0.43
L										92	38	100	890	911	920	1700	1295	1840	12.00	7.10	0.63	10.10	0.20	16.30	0.16	1.10	51.20	0.24	0.43	0.42
M	1.79	0.96	0.15							82	42	972		1770														3.03		
M	1.86	0.98	0.15							82	40	977		1740														3.02		
M	1.82	0.95	0.15							83	39	982		1820														3.03		
M	1.94	0.99	0.15							86	41	1020		1860														3.01		
M	1.74	0.92	0.14							91	39	1080		1950														3.02		
M	1.85	0.97	0.15							87	39	1020		1830														3.04		
M	1.75	0.93	0.14							85	38	973		1780														3.05		
M	1.88	0.99	0.16							79	38	893		1650														3.04		
N	1.81	0.89		1.93	0.95	0.09	0.08	0.14	0.27																					
N	1.79	0.83		1.88	0.95	0.08	0.07	0.14	0.30																					
N	1.82	0.87		1.94	0.93	0.09	0.06	0.13	0.23																					
N	1.85	0.84		2.07	0.95	0.10	0.07	0.15	0.25																					
N	1.92	0.86		2.02	1.00	0.07	0.08	0.21	0.32																					
N	1.97	1.21		2.13	1.26	0.10	0.09	0.19	0.28																					
N	2.03	1.09		2.20	1.14	0.11	0.07	0.17	0.38																					
N	2.08	1.18		2.26	1.28	0.11	0.06	0.20	0.28																					
O	1.93	0.92	0.14							90	37	914	982	890	1700	1440	1620	12.15	7.01	0.63	9.73	0.20	16.51	0.16	1.06	51.18	0.25	0.66	3.12	
O	1.97	0.97	0.14							94	36	925	983	910	1695	1400	1630	12.19	7.01	0.62	9.74	0.20	16.52	0.16	1.06	51.10	0.25	0.67	3.10	
O	1.89	0.93	0.14							94	37	904	982	900	1685	1425	1630	12.16	6.99	0.63	9.75	0.20	16.53	0.16	1.06	51.22	0.26	0.68	3.18	
O	1.86	0.94	0.14							89	36	904	994	900	1625	1435	1640	12.20	7.01	0.62	9.73	0.21	16.49	0.17	1.05	51.21	0.25	0.68	3.16	
O	1.96	0.97	0.15							89	38	930	1000	910	1675	1445	1630	12.15	6.98	0.63	9.73	0.20	16.51	0.16	1.07	51.24	0.25	0.68	3.17	
O	2.03	0.99	0.15							89	41	930	1015	890	1695	1455	1620	12.21	6.98	0.62	9.76	0.20	16.44	0.17	1.06	51.01	0.25	0.66	3.11	
O	1.87	0.92	0.14							89	41	915	1025	910	1630	1480	1630	12.17	6.98	0.63	9.76	0.21	16.55	0.16	1.06	51.10	0.25	0.63	3.10	
O	1.95	0.98	0.14							88	39	899	1010	900	1595	1455	1620		6.98	0.63	9.73	0.20	16.54	0.16	1.06	51.15	0.25	0.67	3.21	
P	1.88	0.88	0.14							89	42	859	883	1590	1320													3.15		
P	1.81	0.86	0.13							90	41	879	860	1620	1310	12.00	7.08	0.62	10.10	0.18	16.30	0.16	1.14	51.20	0.24	0.43	3.13			
P	1.77	0.86	0.14							89	41	840	859	1560	1300	11.85	7.00	0.62	9.98	0.17	16.10	0.16	1.12	50.80	0.24	0.39	3.11			
P	1.77	0.83	0.13							91	42	859	865	1590	1290	11.90	7.01	0.62	10.00	0.18	16.20	0.16	1.13	50.80	0.24	0.41	3.04			
P	1.77	0.85	0.13							90	41	861	870	1590	1310	11.85	6.99	0.61	9.90	0.18	16.10	0.16	1.12	50.40	0.24	0.37	3.10			
P	1.91	0.90	0.13							89	41	853	868	1560	1300	12.05	7.15	0.73	10.20	0.18	16.36	0.16	1.13	51.30	0.25	0.33	3.07			
P	1.84	0.87	0.13							88	41	862	852	1580	1290	11.80	7.02	0.64	9.96	0.18	16.15	0.16	1.12	50.40	0.23	0.37	2.99			
P	1.81	0.86	0.13							90	41	893	865	1700	1290	11.95	7.06	0.61	10.05	0.18	16.15	0.16	1.13	50.80	0.23	0.35	3.04			
Q				1.71																										

11. 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	0.084	0.044	0.058	0.012
Pd	Pb Coll	g/t	0.036	0.020	0.022	0.005
Au	Pb Coll	g/t	0.008	0.004	0.005	0.001
Pt	NIS	g/t	0.093	0.049	0.076	0.018
Pd	NIS	g/t	0.045	0.032	0.028	0.010
Au	NIS	g/t	0.015	0.014	0.005	0.005
Ir	NiS	g/t	0.006	0.005	0.004	0.002
Rh	NiS	g/t	0.009	0.006	0.007	0.002
Ru	NiS	g/t	0.027	0.021	0.015	0.007
Co	M/ICP	ppm	3.684	2.325	2.029	0.652
Co	P	ppm	2.301	1.651	1.329	0.518
Co	XRF	ppm	14.900	15.214	9.041	6.978
Cu	M/ICP	ppm	21.28	11.319	14.583	3.228
Cu	P	ppm	22.656	19.856	10.093	6.728
Cu	XRF	ppm	23.76	20.97	11.832	7.573
Ni	M/ICP	ppm	90.87	60.51	39.64	16.051
Ni	P	ppm	57.82	43.91	29.127	13.606
Ni	XRF	ppm	73.72	76.23	16.385	27.029
Al ₂ O ₃	XRF	%	0.099	0.071	0.053	0.022
CaO	XRF	%	0.063	0.047	0.033	0.015
Cr ₂ O ₃	XRF	%	0.015	0.012	0.007	0.004
Fe ₂ O ₃	XRF	%	0.138	0.120	0.047	0.038
K ₂ O	XRF	%	0.008	0.006	0.004	0.002
MgO	XRF	%	0.128	0.097	0.063	0.030
MnO	XRF	%	0.005	0.003	0.003	0.001
Na ₂ O	XRF	%	0.041	0.037	0.010	0.012
SiO ₂	XRF	%	0.421	0.322	0.204	0.100
TiO ₂	XRF	%	0.008	0.006	0.005	0.002
LOI	XRF	%	0.101	0.101	0.033	0.036
SG	pyc		0.039	0.026	0.028	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 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.

12. 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.

13. 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.

14. Certification: AMIS0067 replaces AMIS0053

15. 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 website.

16. 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.

17. 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.

18. 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

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.

16 November 2010

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

Additional useful data collected during the round robin exercise includes these iterated but uncertified certified trace element statistics:

AMIS0067	Method	Unit	Mean	2SD	RSD%	n
Ag	M/ICP	ppm	0.35	0.07	9.6	55
Al	M/ICP	%	6.32	0.40	3.2	93
As	M/ICP	ppm	1.34	0.95	35.4	53
Ba	M/ICP	ppm	73.13	7.25	5.0	86
Be	M/ICP	ppm	0.19	0.05	12.2	52
Bi	M/ICP	ppm	0.31	0.04	6.6	61
Ca	M/ICP	%	5.07	0.44	4.3	100
Cd	M/ICP	ppm	0.20	0.03	8.2	55
Ce	M/ICP	ppm	7.46	0.65	4.4	53
Cr	M/ICP	ppm	3243	838.8	12.9	93
Cs	M/ICP	ppm	0.29	0.06	9.6	56
Dy	M/ICP	ppm	0.92	0.04	2.2	15
Er	M/ICP	ppm	0.61	0.02	1.6	14
Eu	M/ICP	ppm	0.29	0.03	4.9	16
Fe	M/ICP	%	6.93	0.44	3.1	94
Ga	M/ICP	ppm	10.57	1.24	5.9	55
Ge	M/ICP	ppm	0.20	0.15	37.5	40
Hf	M/ICP	ppm	0.40	0.08	10.1	53
Ho	M/ICP	ppm	0.20	0.03	6.6	16
In	M/ICP	ppm	0.03	0.00	6.4	50
K	M/ICP	%	0.17	0.02	5.8	84
La	M/ICP	ppm	3.58	0.50	6.9	63
Li	M/ICP	ppm	4.56	0.59	6.5	55
Lu	M/ICP	ppm	0.09	0.03	13.7	24
Mg	M/ICP	%	9.84	0.60	3.0	101
Mn	M/ICP	ppm	1225	102.4	4.2	96
Mo	M/ICP	ppm	0.98	0.17	8.6	66
Na	M/ICP	%	0.81	0.09	5.5	96
Nb	M/ICP	ppm	1.00	0.15	7.6	56
Nd	M/ICP	ppm	3.51	0.21	3.0	16
P	M/ICP	ppm	114.5	16.78	7.3	80
Pb	M/ICP	ppm	10.59	1.16	5.5	77
Pr	M/ICP	ppm	0.86	0.06	3.2	16
Rb	M/ICP	ppm	6.87	1.23	8.9	54
Re	M/ICP	ppm	0.01	0.00	11.4	30
S	M/ICP	%	0.44	0.05	5.2	87
Sb	M/ICP	ppm	1.14	0.20	8.9	64
Sc	M/ICP	ppm	22.43	2.68	6.0	71
Se	M/ICP	ppm	2.55	1.01	19.8	40
Si	M/ICP	%	22.85	3.37	7.4	24
Sm	M/ICP	ppm	0.77	0.05	3.3	15
Sn	M/ICP	ppm	0.64	0.10	7.8	45
Sr	M/ICP	ppm	167	16.89	5.0	88
Ta	M/ICP	ppm	0.26	0.07	13.5	56
Tb	M/ICP	ppm	0.13	0.02	7.8	22
Te	M/ICP	ppm	0.54	0.12	11.1	63
Th	M/ICP	ppm	0.86	0.18	10.5	54
Ti	M/ICP	%	0.13	0.01	4.1	103
Tl	M/ICP	ppm	0.05	0.02	17.4	48
Tm	M/ICP	ppm	0.09	0.01	6.7	15
U	M/ICP	ppm	0.62	0.11	9.2	64
V	M/ICP	ppm	121.2	16.62	6.9	95
W	M/ICP	ppm	0.19	0.07	19.5	40
Y	M/ICP	ppm	5.33	0.61	5.7	71
Yb	M/ICP	ppm	0.58	0.19	16.0	24
Zn	M/ICP	ppm	113	10.98	4.9	87
Zr	M/ICP	ppm	13.28	2.04	7.7	70