



African Mineral Standards

MATRIX REFERENCE MATERIALS

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AMIS0354

Certified Reference Material

**Platinum (PGM), Merensky
Bushveld Complex, South Africa**

Certificate of Analysis

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

Certified Concentrations²

Pt Pb Collection	2.25	±	0.25	g/t
Pd Pb Collection	1.34	±	0.08	g/t
Au Pb Collection	0.71	±	0.05	g/t
Cu M/ICP	582	±	31	ppm
Cu P	586	±	36	ppm
Cu XRF	587	±	58	ppm
Ni P	1493	±	161	ppm
Specific Gravity	3.330	±	0.130	

Provisional Concentrations³

Pt NIS	2.19	±	0.34	g/t
Pd NIS	1.33	±	0.17	g/t
Au NIS	0.68	±	0.09	g/t
Ir NiS	0.08	±	0.02	g/t
Rh	0.25	±	0.04	g/t
Ru NiS	0.39	±	0.07	g/t
Co M/ICP	145	±	21	ppm
Co P	91.1	±	11.4	ppm
Ni M/ICP	1839	±	226	ppm
Ni XRF	1886	±	436	ppm

$4E = \text{Platinum (NiS)} + \text{Palladium (NiS)} + \text{Rhodium} + \text{Gold (NiS)} = 4.45 \text{ g/t}$

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.
3. Rh was analyzed by mixed methods i.e NiS and Pb Collection



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

Certified Concentrations

Al ₂ O ₃	5.50	±	0.13	%
CaO	4.01	±	0.11	%
Cr ₂ O ₃	1.94	±	0.04	%
Fe ₂ O ₃	18.32	±	0.32	%
K ₂ O	0.09	±	0.01	%
MgO	23.65	±	0.37	%
MnO	0.24	±	0.01	%
Na ₂ O	0.37	±	0.05	%
SiO ₂	44.63	±	0.38	%
TiO ₂	0.59	±	0.02	%
S Comb/LECO	0.36	±	0.03	%

1. Intended Use: AMIS0354 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 ores; derived from the Merensky 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: AMIS0354 was made from material supplied by Anglo Platinum, using Merensky Reef underground sample material from the Western Limb of the Bushveld complex.

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.

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

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

6. Method of Preparation: The material was crushed, dry-milled and air-classified to <54µm. Wet sieve particle size analysis of random samples confirmed the material was 98.5% <54µm. It was then blended in a bi-conical mixer, systematically divided and then sealed into 1kg Laboratory Packs. Explorer Packs are subdivided from the Laboratory packs as required. Samples were scientifically 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, Au and Rh. Pb collection with Ag as a co-collector, ICP-OES or ICP-MS.
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.

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.

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

1. ALS Chemex Laboratory Group Johannesburg SA
2. ALS Chemex Laboratory Group Perth WA
3. ALS OMAC (Ireland)
4. American Assay Laboratories (USA)

5. Anglo Platinum - Eastern Bushveld Regional Laboratory
6. BV Rustenburg (South Africa)
7. Genalysis Laboratory Services (South Africa) Pty
8. Genalysis Laboratory Services (W Australia P)
9. Intertek Utama Services (Indonesia)
10. Labtium Inc Finland
11. Northam Platinum LTD
12. Performance Laboratories SA (Randfontein)
13. Set Point Laboratories (Isando) SA
14. SGS Australia Pty Ltd (Newburn) WA
15. SGS Geosol Laboratories Ltda (Brazil)
16. SGS Mineral Services Callao (Peru)
17. SGS Mineral Services Lakefield (Canada)
18. SGS South Africa (Pty) Ltd - Booyens JHB
19. SGS Townsville (Australia)
20. SGS Vancouver (Canada)
21. Ultra Trace (Pty) Ltd WA
22. 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. 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 elements assay data

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 g/t	Ru NiS g/t	Co M/ICP ppm	Co P ppm	Cu M/ICP ppm	Cu P ppm	Cu XRF ppm	Ni M/ICP ppm	Ni P ppm	Ni XRF ppm
A	2.22	1.34	0.70	2.10	1.32	0.67	0.08	0.25	0.39	168	93.0	560	580		1894	1534	
A	2.22	1.39	0.70	2.09	1.32	0.67	0.08	0.26	0.38	169	91.0	572	568		1839	1504	
A	2.12	1.35	0.67	2.04	1.28	0.65	0.08	0.25	0.35	164	94.0	590	581		1872	1552	
A	2.23	1.33	0.69	2.12	1.33	0.68	0.08	0.26	0.41	165	93.0	568	585		1858	1546	
A	2.16	1.38	0.68	1.99	1.30	0.67	0.07	0.25	0.36	163	95.0	575	599		1850	1622	
A	2.14	1.40	0.68	2.04	1.28	0.69	0.08	0.25	0.32	166	93.0	580	583		1845	1551	
A	2.16	1.36	0.69	2.06	1.34	0.66	0.08	0.25	0.36	164	94.0	569	590		1843	1554	
A	2.11	1.35	0.70	2.08	1.31	0.68	0.08	0.26	0.40	166	96.0	584	588		1839	1589	
B	2.38	1.37	0.76							142	89.6	667	604	600	1701	1378	2200
B	2.44	1.36	0.73							141	88.9	657	598	600	1644	1382	2100
B	2.47	1.38	0.74							139	88.9	656	638	600	1652	1415	2100
B	2.46	1.38	0.75							137	88.0	646	595	600	1626	1366	2200
B	2.42	1.38	0.73							136	88.3	665	606	700	1606	1381	2100
B	2.47	1.38	0.75							141	86.6	667	600	600	1681	1377	2100
B	2.43	1.36	0.72							139	89.4	654	615	600	1651	1398	2100
B	2.42	1.37	0.73							137	88.8	648	609	500	1618	1388	2000
C				2.13	1.32	0.62	0.07	0.24	0.37								
C				2.18	1.34	0.64	0.07	0.25	0.41								
C				2.18	1.32	0.68	0.08	0.25	0.41								
C				2.09		0.65	0.07	0.22	0.37								
C				2.05	1.26		0.07	0.23	0.39								
C				2.06	1.31	0.65	0.07	0.24	0.39								
C				2.13	1.32	0.64	0.07	0.24	0.36								
C				2.08	1.31	0.61	0.07	0.24									
D				2.33	1.39		0.08	0.25	0.43					600			2000
D				2.36	1.39		0.09	0.26	0.43					600			1900
D				2.34	1.36		0.09	0.26	0.43					600			2000
D				2.35	1.38		0.08	0.25	0.42					600			1900
D				2.50	1.43		0.08	0.24	0.42					600			2000
D				2.53	1.39		0.09	0.26	0.43					600			1900
D				2.34	1.39		0.08	0.24	0.41					600			1900
D				2.36	1.42		0.08	0.24	0.43					600			2000
F		1.31	0.68							153	87.0	642	549		1970	1420	
F		1.37	0.70							147	86.0	654	540		1940	1430	
F		1.38	0.65							151	89.0	661	550		1890	1420	
F		1.37	0.67							150	86.0	659	543		1890	1380	
F		1.38	0.68							148	88.0	637	563		1920	1420	
F		1.37	0.69							149	88.0	659	568		1950	1370	
F		1.31	0.64							151	86.0	639	545		1890	1390	
F		1.32	0.69							153	88.0	651	565		1870	1410	

Economic elements assay data (cont)

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 g/t	Ru NiS g/t	Co M/ICP ppm	Co P ppm	Cu M/ICP ppm	Cu P ppm	Cu XRF ppm	Ni M/ICP ppm	Ni P ppm	Ni XRF ppm
I			0.73							150		571			1910		
I			0.72							154		567			1900		
I			0.74							153		575			1870		
I			0.70							152		573			1970		
I			0.73							153		572			1980		
I			0.72							154		558			1990		
I			0.72							154		571			2000		
I			0.73							151		569			1990		
J	2.07	1.33	0.72							146	82.0	600	612		1810	1490	
J	1.89	1.13	0.70							143	83.0	613	618		1830	1510	
J	2.18	1.32	0.71							145	85.0	604	628		1800	1520	
J	2.00	1.28	0.70							144	86.0	606	619		1820	1560	
J	1.84	1.26	0.74							140	83.0	596	601		1820	1510	
J	2.17	1.35	0.68							144	84.0	602	617		1800	1510	
J	1.98	1.29	0.74							142	82.0	593	606		1780	1500	
J	2.16	1.32	0.72							149	88.0	616	621		1860	1540	
K												541			1850		
K												572			1940		
K												551			1900		
K												571			1900		
K												569			1900		
K												569			1880		
K												534			1860		
K												541			1850		
L										134	90.0	573	579		1780	1480	
L										133	92.0	563	583		1670	1460	
L										133	92.0	570	590		1710	1500	
L										124	89.0	521	595		1630	1490	
L										135	92.0	576	591		1740	1500	
L										131	89.0	580	584		1630	1510	
L										130	93.0	554	587		1710	1510	
L										131	90.0	565	588		1680	1480	
M				2.30	1.33	0.63	0.33	0.25	0.49			295			1815		
M				2.27	1.32	0.65	0.26	0.24	0.49			220			1710		
M				2.13	1.27	0.58	0.25	0.24	0.48			240			1805		
M				2.30	1.31	0.62	0.10	0.24	0.49			270			1745		
M				2.08	1.26	0.57	0.04	0.24	0.50			255			1800		
M				2.15	1.25	0.61	0.09	0.23	0.48			210			1830		
M				1.69	1.13	0.48	0.02	0.21	0.39			290			1695		
M				1.78	1.28	0.53	0.05	0.17	0.41			345			1830		
N	2.44	1.40	0.71	2.48	1.46	0.71	0.10	0.27	0.42	160	101.0	580	576		1970	1560	
N	2.42	1.39	0.74	2.55	1.48	0.72	0.09	0.28	0.43	160	102.0	580	574		1970	1590	
N	2.41	1.34	0.76	2.49	1.41	0.75	0.09	0.27	0.42	160	101.0	590	567		1950	1550	
N	2.32	1.34	0.72	2.43	1.46	0.74	0.10	0.27	0.42	160	101.0	595	569		1980	1550	
N	2.34	1.35	0.72	2.46	1.46	0.73	0.09	0.27	0.43	160	100.0	585	564		1950	1590	
N	2.36	1.34	0.73	2.55	1.49	0.74	0.10	0.27	0.42	160	99.0	595	564		1970	1550	
N	2.36	1.37	0.75	2.41	1.40	0.71	0.09	0.27	0.41	160	98.0	590	562		1980	1550	
N	2.22	1.31	0.72	2.39	1.42	0.71	0.09	0.27	0.42	160	97.0	595	574		1950	1560	
O	2.86	1.90	0.84														
O	3.09	1.91	0.86														
O	3.03	1.97	0.89														
O	3.00	1.87	0.85														
O	2.97	1.82	0.83														
O	2.79	1.77	0.82														
O	3.05	1.87	0.82														
O	2.96	1.93	0.82														
P	2.19	1.34	0.50					0.23							410		1460
P	2.29	1.39	0.51					0.23							400		1450
P	2.23	1.33	0.52					0.22							410		1450
P	2.39	1.41	0.53					0.22							420		1480
P	2.31	1.39	0.51					0.22							410		1450
P	2.30	1.38	0.53					0.22							430		1490
P	2.15	1.31	0.52					0.21							440		1520
P	2.38	1.39	0.55					0.22							440		1500
Q	2.10	1.25	0.69	2.11	1.32		0.09	0.26	0.39	145	81.0	566	568	546	1959	1303	1832
Q	2.12	1.27	0.68	2.07	1.31		0.08	0.24	0.38	154	84.0	571	553	548	2052	1340	1827
Q	2.04	1.22	0.68	2.07	1.27		0.08	0.23	0.35	153	84.0	576	552	551	2070	1352	1833
Q	2.05	1.24	0.69	2.06	1.27		0.08	0.23	0.35	149	88.0	575	576	544	2085	1393	1826
Q	2.10	1.26	0.68	2.10	1.27		0.08	0.24	0.37	149	88.0	567	579	548	1993	1337	1823
Q	2.04	1.24	0.67	2.15	1.31		0.09	0.27	0.38	155	87.0	553	580	562	1977	1399	1864
Q	2.12	1.28	0.69	2.15	1.31		0.09	0.27	0.39	154	83.0	553	566	584	1968	1358	1886
Q	2.11	1.27	0.68	2.07	1.28		0.08	0.23	0.35	143	85.0	565	566	544	1967	1359	1827
S										118	87.0	589	580		1795	1528	
S										118	89.0	591	575		1799	1523	
S										117	90.0	585	580		1793	1536	
S										118	89.0	592	575		1794	1540	
S										113	86.0	590	577		1797	1516	
S										119	87.0	592	584		1809	1542	
S										116	87.0	591	582		1812	1533	
S										116	88.0	587	582		1789	1538	

Economic elements assay data (cont)

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 g/t	Ru NIS g/t	Co M/ICP ppm	Co P ppm	Cu M/ICP ppm	Cu P ppm	Cu XRF ppm	Ni M/ICP ppm	Ni P ppm	Ni XRF ppm
V	1.87	1.40						0.24						629			2069
V	2.41	1.50						0.27						631			2098
V	2.56	1.51						0.30						686			2092
V	2.10	1.54						0.30						645			2107
V	2.25	1.48						0.28						646			2090
V	1.84	1.53						0.32						626			2109
V	2.17	1.44						0.26						631			2113
V	2.15	1.42						0.27						647			2089
W	2.16	1.32	0.70							142	102.0	528	635		1690	1580	
W	2.15	1.32	0.71							142	95.1	597	601		1880	1535	
W	2.14	1.34	0.75							140	96.4	601	601		1890	1540	
W	2.22	1.31	0.70							147	98.1	561	609		1780	1515	
W	2.30	1.36	0.74							144	95.3	595	577		1860	1470	
W	2.23	1.33	0.74							142	92.8	583	589		1840	1515	
W	2.25	1.37	0.74							149	88.4	469	592		1520	1510	
W	2.18	1.33	0.73							141	99.2	569	633		1800	1610	
X				2.07	1.31	0.68	0.11	0.33	0.54					560			
X				2.21	1.37	0.73	0.11	0.35	0.55					560			
X				2.28	1.33	0.74	0.11	0.37	0.55					560			
X				1.90	1.18	0.59	0.11	0.34	0.55					560			
X				2.22	1.48	0.72	0.11	0.34	0.56					560			
X				1.98	1.40	0.66	0.10	0.32	0.52					560			
X				2.14	1.41	0.71	0.11	0.34	0.53					560			
X				2.01	1.25	0.68	0.10	0.32	0.53					560			
Y	2.32	1.29	0.71							147	99.1	582	596		1860	1595	
Y	2.25	1.35	0.76							150	97.7	590	588		1910	1595	
Y	2.37	1.38	0.74							154	96.9	610	589		1950	1580	
Y	2.33	1.36	0.72							152	95.3	600	578		1940	1555	
Y	2.22	1.28	0.69							148	99.8	587	591		1845	1600	
Y	2.29	1.29	0.72							150	94.9	598	567		1920	1545	
Y	2.28	1.31	0.72							149	99.2	588	587		1870	1590	
Y	2.34	1.33	0.72							150	98.9	593	586		1900	1585	
ZA	2.42	1.36	0.75							138	97.0	593	598		1920	1560	
ZA	2.35	1.36	0.73							137	98.0	587	612		1920	1590	
ZA	2.33	1.38	0.74							140	96.0	599	614		2000	1580	
ZA	2.45	1.36	0.71							138	96.0	592	604		1920	1580	
ZA	2.21	1.34	0.73							136	96.0	584	579		1930	1530	
ZA	2.29	1.38	0.71							137	98.0	588	605		1940	1580	
ZA	2.24	1.32	0.72							135	95.0	581	593		1900	1550	
ZA	2.43	1.40	0.77							136	100	580	602		1900	1610	
ZB	2.35	1.38	0.68														
ZB	0.45	0.45	0.43														
ZB	2.17	1.32	0.73														
ZB	2.15	1.33	0.76														
ZB	0.99	0.79	0.69														
ZB	2.35	1.36	0.78														
ZB	2.19	1.35	0.65														
ZB	2.20	1.39	0.72														

Major element assay data

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
A	5.46	4.01	1.94	18.2	0.08	23.6	0.23	0.36	44.8	0.59	0.38	3.38
A	5.45	4.00	1.93	18.2	0.08	23.5	0.23	0.38	44.8	0.58	0.38	3.40
A	5.47	4.01	1.93	18.3	0.08	23.5	0.23	0.38	44.6	0.59	0.38	3.36
A	5.52	4.01	1.94	18.3	0.08	23.5	0.23	0.37	44.7	0.59	0.38	3.43
A	5.50	4.01	1.94	18.2	0.08	23.6	0.23	0.36	44.7	0.59	0.37	3.34
A	5.46	3.99	1.94	18.2	0.09	23.5	0.23	0.37	44.8	0.58	0.38	3.40
A	5.46	4.00	1.93	18.2	0.08	23.6	0.23	0.37	44.7	0.59	0.38	3.32
A	5.47	4.01	1.94	18.2	0.08	23.5	0.23	0.38	44.7	0.58	0.38	3.30
B	5.65	4.01	1.97	18.6	0.08	23.9	0.24	0.30	45.0	0.60		
B	5.54	4.00	1.97	18.6	0.08	23.6	0.24	0.27	44.6	0.61		
B	5.51	3.94	1.93	18.3	0.08	23.4	0.24	0.26	44.2	0.59		
B	5.49	3.94	1.92	18.3	0.09	23.4	0.24	0.28	44.3	0.59		
B	5.60	3.98	1.95	18.5	0.08	23.8	0.24	0.27	44.9	0.62		
B	5.60	3.98	1.96	18.4	0.07	23.4	0.24	0.27	44.5	0.60		
B	5.56	4.00	1.96	18.5	0.08	23.5	0.24	0.26	44.2	0.59		
B	5.56	3.99	1.99	18.6	0.09	23.6	0.25	0.26	44.6	0.59		

Major element assay 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
C												3.37
C												3.37
C												3.34
C												3.32
C												3.37
C												3.35
C												3.34
C												3.32
D	5.47	4.06	1.92	18.4	0.09	23.7	0.23	0.35	44.6	0.59	0.34	
D	5.45	4.06	1.93	18.3	0.08	23.6	0.23	0.35	44.5	0.58	0.35	
D	5.46	4.05	1.93	18.3	0.09	23.7	0.23	0.36	44.6	0.58	0.34	
D	5.49	4.05	1.96	18.4	0.09	23.8	0.23	0.36	44.9	0.58	0.34	
D	5.50	4.04	1.93	18.3	0.09	23.6	0.24	0.36	44.6	0.58	0.34	
D	5.51	4.06	1.93	18.4	0.09	23.8	0.24	0.35	44.8	0.59	0.34	
D	5.48	4.05	1.93	18.3	0.09	23.8	0.24	0.37	44.5	0.58	0.34	
D	5.52	4.03	1.91	18.4	0.09	23.8	0.24	0.36	44.6	0.57	0.35	
F	5.55	4.01	1.95	18.3	0.09	23.7	0.24	0.41	44.7	0.58	0.31	
F	5.55	4.02	1.94	18.3	0.09	23.7	0.24	0.40	44.6	0.58	0.35	
F	5.54	4.03	1.95	18.4	0.09	23.6	0.24	0.40	44.6	0.59	0.36	
F	5.53	4.03	1.96	18.3	0.09	23.7	0.24	0.40	44.7	0.59	0.36	
F	5.54	4.04	1.95	18.3	0.09	23.7	0.24	0.40	44.7	0.59	0.37	
F	5.53	4.03	1.97	18.3	0.09	23.6	0.24	0.40	44.7	0.59	0.41	
F	5.57	4.03	1.96	18.3	0.09	23.7	0.24	0.39	44.7	0.59	0.37	
F	5.54	4.03	1.96	18.2	0.09	23.7	0.24	0.40	44.8	0.58	0.37	
I	5.44	3.91	1.92	17.8	0.09	23.9	0.23	0.35	44.8	0.57		
I	5.42	3.90	1.92	17.8	0.09	23.9	0.23	0.34	44.8	0.57		
I	5.43	3.91	1.96	17.8	0.09	23.9	0.23	0.33	44.8	0.58		
I	5.45	3.90	1.90	17.7	0.09	23.9	0.23	0.32	44.8	0.57		
I	5.44	3.92	1.98	17.8	0.09	24.0	0.23	0.34	44.8	0.58		
I	5.46	3.91	1.98	17.8	0.09	23.9	0.23	0.33	44.8	0.57		
I	5.44	3.92	1.97	17.8	0.09	24.0	0.23	0.33	45.0	0.58		
I	5.47	3.92	1.95	17.8	0.09	23.9	0.23	0.33	44.8	0.58		
J												3.38
J												3.36
J												3.36
J												3.36
J												3.38
J												3.36
J												3.36
J												3.35
L	5.46	4.04	1.93	18.4	0.09	23.7	0.23	0.40	45.3	0.60	0.36	
L	5.45	4.02	1.94	18.5	0.08	23.8	0.24	0.42	45.4	0.61	0.36	
L	5.46	4.07	1.94	18.5	0.09	23.8	0.24	0.42	45.2	0.61	0.36	
L	5.64	4.03	1.93	18.5	0.08	23.8	0.24	0.40	45.3	0.61	0.37	
L	5.54	4.01	1.92	18.4	0.09	23.8	0.24	0.36	45.3	0.59	0.36	
L	5.57	4.05	1.94	18.4	0.08	23.7	0.24	0.42	45.2	0.61	0.36	
L	5.55	4.01	1.93	18.4	0.08	23.7	0.24	0.39	45.1	0.60	0.36	
L	5.57	4.02	1.92	18.4	0.08	23.7	0.24	0.43	45.0	0.59	0.36	
M			1.59									2.95
M			1.55									3.04
M			1.53									2.56
M			1.53									3.89
M			1.45									3.32
M			1.50									3.34
M			1.54									3.14
M			1.52									2.71
N	5.58	4.07	1.93	18.2	0.09	23.4	0.24	0.37	44.7	0.59		3.23
N	5.59	4.07	1.93	18.1	0.09	23.4	0.24	0.37	44.7	0.59		3.26
N	5.57	4.07	1.94	18.2	0.09	23.5	0.24	0.38	44.7	0.60		3.25
N	5.59	4.06	1.93	18.1	0.09	23.5	0.24	0.38	44.6	0.59		3.25
N	5.57	4.06	1.94	18.1	0.09	23.5	0.24	0.38	44.7	0.59		3.28
N	5.59	4.06	1.92	18.1	0.09	23.4	0.24	0.37	44.7	0.59		3.30
N	5.58	4.06	1.92	18.1	0.09	23.4	0.24	0.38	44.6	0.59		3.30
N	5.59	4.07	1.94	18.1	0.09	23.4	0.24	0.38	44.7	0.59		3.31
Q	5.40	4.09	1.92	18.7	0.09	23.8	0.25	0.60	44.5	0.59		3.34
Q	5.40	4.09	1.92	18.6	0.09	23.8	0.25	0.61	44.3	0.59		3.32
Q	5.40	4.07	1.91	18.7	0.09	23.7	0.25	0.60	44.4	0.59		3.35
Q	5.40	4.07	1.91	18.6	0.09	23.7	0.25	0.61	44.1	0.59		3.31
Q	5.40	4.13	1.91	18.8	0.09	23.9	0.25	0.61	44.8	0.59		3.32
Q	5.30	4.07	1.89	18.6	0.09	23.6	0.25	0.60	44.2	0.59		3.33
Q	5.40	4.12	1.91	18.8	0.09	23.9	0.25	0.60	44.8	0.60		3.35
Q	5.40	4.09	1.91	18.7	0.09	23.9	0.25	0.58	44.6	0.59		3.32

Major element assay 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
S											0.36	3.20
S											0.36	3.23
S											0.36	3.21
S											0.36	3.20
S											0.37	3.20
S											0.37	3.22
S											0.36	3.20
S											0.36	3.21
U	5.69	4.03	2.01	18.4	0.11	23.3	0.25	0.48	44.8	0.60	0.39	3.34
U	5.76	4.00	1.99	18.4	0.11	23.3	0.25	0.46	44.8	0.60	0.39	3.30
U	5.95	4.00	1.99	18.3	0.12	23.5	0.24	0.59	44.7	0.59	0.39	3.33
U	5.59	4.05	2.00	18.3	0.11	23.3	0.24	0.46	44.7	0.60	0.42	3.35
U	5.67	4.03	1.98	18.3	0.11	23.2	0.26	0.48	44.8	0.59	0.40	3.33
U	5.82	4.00	1.97	18.3	0.12	23.5	0.25	0.48	44.7	0.59	0.39	3.34
U	5.66	4.03	1.98	18.3	0.11	23.3	0.24	0.47	44.7	0.59	0.38	3.31
U	5.72	4.03	2.00	18.3	0.11	23.3	0.25	0.47	44.9	0.60	0.40	3.33
V												3.40
V												3.44
V												3.40
V												3.46
V												3.41
V												3.45
V												3.43
V												3.40
X	5.47	3.96	2.01	17.9	0.09	23.2	0.20		44.6	0.58		
X	5.43	3.92	2.05	17.9	0.09	23.3	0.20		44.6	0.58		
X	5.50	3.93	2.02	17.9	0.08	23.4	0.20		44.7	0.57		
X	5.38	3.92	2.01	17.7	0.08	23.1	0.20		44.2	0.58		
X	5.41	3.89	2.03	17.9	0.09	23.3	0.20		44.6	0.57		
X	5.37	3.87	2.05	17.7	0.09	23.0	0.20		44.1	0.56		
X	5.42	3.93	2.03	17.7	0.09	23.0	0.20		44.3	0.56		
X	5.40	3.95	2.02	17.8	0.09	23.2	0.20		44.3	0.57		
Y												3.42
Y												3.41
Y												3.40
Y												3.40
Y												3.42
Y												3.40
Y												3.40
Y												3.41
ZA	5.49	3.98	1.93	18.1	0.09	23.5	0.24	0.38	44.3	0.61	0.35	3.28
ZA	5.57	4.05	1.96	18.1	0.09	23.8	0.25	0.39	44.6	0.61	0.36	3.27
ZA	5.56	3.99	1.92	18.1	0.09	23.7	0.24	0.33	44.4	0.60	0.36	3.26
ZA	5.54	3.98	1.92	18.1	0.09	23.6	0.24	0.32	44.3	0.61	0.36	3.28
ZA	5.52	4.06	1.96	18.2	0.09	23.7	0.25	0.39	44.3	0.62	0.36	3.19
ZA	5.54	4.07	1.96	18.2	0.09	23.9	0.25	0.39	44.6	0.62	0.36	3.26
ZA	5.54	3.98	1.92	18.1	0.09	23.6	0.24	0.31	44.1	0.59	0.36	3.26
ZA	5.48	3.96	1.91	17.9	0.09	23.5	0.24	0.31	43.9	0.59	0.36	3.27

12. Measurement of Uncertainty: (ref Dr Hugh Bartlett, Hugh Bartlett Consulting CC.)

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	PbColl	g/t	0.125	0.106	0.066	0.036
Pd	PbColl	g/t	0.048	0.037	0.035	0.013
Au	PbColl	g/t	0.029	0.022	0.016	0.007
Pt	NiS	g/t	0.172	0.149	0.095	0.054
Pd	NiS	g/t	0.086	0.072	0.052	0.026
Au	NiS	g/t	0.047	0.046	0.027	0.019
Ir	NiS	g/t	0.010	0.012	0.004	0.005
Rh		g/t	0.017	0.013	0.011	0.005
Ru	NiS	g/t	0.037	0.033	0.021	0.013
Co	M/ICP	ppm	10.67	9.29	2.52	2.81
Co	P	ppm	5.69	4.69	2.00	1.43
Cu	M/ICP	ppm	15.3	11.3	8.91	3.54
Cu	P	ppm	18.2	14.77	8.15	4.8
Cu	XRF	ppm	28.9	34.0	6.94	13.91
Ni	M/ICP	ppm	112.9	83.2	38.6	22.51
Ni	P	ppm	80.6	67.8	24.0	20.59
Ni	XRF	ppm	218	269	37.5	110.0
Al ₂ O ₃	XRF	%	0.064	0.056	0.030	0.019
CaO	XRF	%	0.053	0.047	0.016	0.015
Cr ₂ O ₃	XRF	%	0.022	0.016	0.015	0.006
Fe ₂ O ₃	XRF	%	0.158	0.140	0.068	0.050
K ₂ O	XRF	%	0.004	0.003	0.003	0.001
MgO	XRF	%	0.184	0.159	0.098	0.054
MnO	XRF	%	0.006	0.006	0.003	0.002
Na ₂ O	XRF	%	0.026	0.029	0.011	0.012
SiO ₂	XRF	%	0.191	0.094	0.157	0.036
TiO ₂	XRF	%	0.011	0.008	0.006	0.002
S	Comb/LECO	%	0.015	0.019	0.005	0.008
SG	pyc		0.066	0.062	0.023	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 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. 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 Ms Margaret Fairhurst.

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: AMIS0354 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.

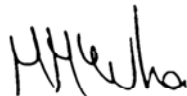
18. Availability: This product is available in Laboratory Packs containing 1kg of material and Explorer Packs containing custom weights (from 50 to 250g) of material. The Laboratory Packs are sealed bottles delivered in sealed foil pouches. The Explorer Packs contain material in standard geochem envelopes, 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, and Margaret M. Fairhurst; accept no liability for any decisions or actions taken following the use of the reference material.


11 November 2014

Certifying Officers:



African Mineral Standards: _____

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



Geochemist: _____

Margaret M. Fairhurst, PG, MAusIMM
Oreval

Appendix – uncertified element statistics

Analyte	Method	Unit	Mean	2SD	RSD%	n
Ag	M/ICP	ppm	48.7	4.3	4.5	70
Al	M/ICP	%	2.8	0.19	3.3	102
As	M/ICP	ppm	2.3	1.3	28.7	37
Ba	M/ICP	ppm	35.6	6.8	9.6	96
Be	M/ICP	ppm	0.12	0.03	14.8	28
Bi	M/ICP	ppm	0.24	0.07	14.2	40
Ca	M/ICP	%	2.7	0.18	3.2	100
Cd	M/ICP	ppm	0.22	0.03	7.2	31
Ce	M/ICP	ppm	5.7	3.1	27.1	31
Cr	M/ICP	ppm	9720	4214	21.7	71
Cs	M/ICP	ppm	0.16	0.07	23.1	32
Dy	M/ICP	ppm	0.94	0.05	2.5	8
Er	M/ICP	ppm	0.65	0.08	5.8	8
Eu	M/ICP	ppm	0.29	0.06	10.9	8
Fe	M/ICP	%	12.5	1.4	5.6	97
Ga	M/ICP	ppm	8.4	1.1	6.6	40
Gd	M/ICP	ppm	0.80	0.0	0.0	8
Ge	M/ICP	ppm	0.30	0.11	17.8	8
Hf	M/ICP	ppm	0.37	0.09	12.0	30
Ho	M/ICP	ppm	0.21	0.02	4.6	7
In	M/ICP	ppm	0.03	0.01	19.2	31
K	M/ICP	%	0.08	0.01	9.1	95
La	M/ICP	ppm	3.0	1.6	26.1	56
Li	M/ICP	ppm	5.8	2.0	17.2	81
Lu	M/ICP	ppm	0.11	0.01	6.2	15
Mg	M/ICP	%	14.0	1.4	5.1	80
Mn	M/ICP	ppm	1736	147	4.2	90
Mo	M/ICP	ppm	1.5	0.69	23.6	56
Na	M/ICP	%	0.27	0.04	6.5	88
Nb	M/ICP	ppm	0.83	0.26	15.4	32
Nd	M/ICP	ppm	2.8	0.22	3.9	8
P	M/ICP	ppm	178	33.4	9.3	64
Pb	M/ICP	ppm	70.4	7.5	5.3	88
Pr	M/ICP	ppm	0.71	0.06	4.0	8
Rb	M/ICP	ppm	3.3	1.4	22.1	38
Re	M/ICP	ppm	0.01	0.0	21.7	15
S	M/ICP	%	0.38	0.06	8.3	101
Sb	M/ICP	ppm	0.77	0.12	8.2	40
Sc	M/ICP	ppm	21.0	2.6	6.1	89
Se	M/ICP	ppm	4.4	0.92	10.6	28
Si	M/ICP	%	20.8	0.40	1.0	8
Sm	M/ICP	ppm	0.76	0.06	4.2	8
Sn	M/ICP	ppm	1.0	0.18	9.0	31
Sr	M/ICP	ppm	72.3	7.1	4.9	90
Ta	M/ICP	ppm	0.58	1.7	148	22
Tb	M/ICP	ppm	0.16	0.03	8.8	15
Te	M/ICP	ppm	0.40	0.14	17.1	40
Th	M/ICP	ppm	0.42	0.08	9.0	38
Ti	M/ICP	%	0.34	0.03	4.5	99
Tl	M/ICP	ppm	0.03	0.01	19.4	29
Tm	M/ICP	ppm	0.11	0.02	9.6	8
U	M/ICP	ppm	0.11	0.04	16.14	37
V	M/ICP	ppm	288	27.9	4.8	87
W	M/ICP	ppm	0.50	0.27	27	23
Y	M/ICP	ppm	4.5	0.75	8.4	80
Yb	M/ICP	ppm	0.70	0.06	4.5	16
Zn	M/ICP	ppm	162	24.8	7.7	95
Zr	M/ICP	ppm	12.4	4.1	16.7	64