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## AMIS0209

### ***Certified Reference Material***

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

### ***Certificate of Analysis***

#### **Recommended Concentrations and Limits<sup>1</sup> (at two Standard Deviations)**

#### ***Certified Concentrations<sup>2</sup>***

Pt Pb Collection	1.21	±	0.10	g/t
Pd Pb Collection	0.63	±	0.06	g/t
Pt NIS	1.20	±	0.10	g/t
Pd NIS	0.64	±	0.06	g/t
Co M/ICP	49	±	6	ppm
Co P	30	±	3	ppm
Cu M/ICP	447	±	20	ppm
Cu P	449	±	24	ppm
Ni M/ICP	909	±	35	ppm
Ni P	747	±	40	ppm
Specific Gravity	2.84	±	0.10	

#### ***Provisional Concentrations***

Au Pb Collection	0.09	±	0.01	g/t
Au NIS	0.09	±	0.02	g/t
Rh	0.09	±	0.02	g/t
Cu XRF	445	±	65	ppm

#### ***Indicated Mean***

Ir NiS	0.031	g/t
Ru NiS	0.17	g/t

$$4E = \text{Platinum (NiS)} + \text{Palladium (NiS)} + \text{Rhodium (NiS)} + \text{Gold (NiS)} = 2.02 \text{ g/t}$$

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 <sub>2</sub> O <sub>3</sub>	5.80	±	0.08	%
CaO	3.10	±	0.06	%
Cr <sub>2</sub> O <sub>3</sub>	0.48	±	0.02	%
Fe <sub>2</sub> O <sub>3</sub>	4.74	±	0.16	%
K <sub>2</sub> O	0.14	±	0.006	%
MgO	6.38	±	0.14	%
Na <sub>2</sub> O	0.46	±	0.03	%
SiO <sub>2</sub>	77.84	±	0.74	%
TiO <sub>2</sub>	0.11	±	0.01	%
S Comb / LECO	0.20	±	0.02	%

***Provisional Concentration***

MnO	0.07	±	0.01	%
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***Indicated Mean***

LOI	0.29	%
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**1. Intended Use:** AMIS0209 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:** AMIS0209 was made using Merensky Reef Pt/Pd ore material supplied by Anglo Platinum Limited from the Western limb of the Bushveld Complex. This specific material is a blend of ore collected from the Turfontein Mine ore silo and footwall material collected from the Boschfontein Shaft that has been further blended down with blank silica.

**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 a Medium Light Grey (Corstor 10Y 6/2).

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

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

**7. Methods of Analysis requested:**

1. Pt, Pd and Au. ICP-OES or ICP-MS, Pb collection with Ag as a co-collector.
2. Au, Pt, Pd, Rh, Ru and Ir. ICP-MS, nickel sulphide collection.
3. Co, Cu and Ni. Multi-acid total digestion (M ICP), including HF, with ICP-OES finish.
4. Co, Cu and Ni. Aqua regia digestion (P) 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 ppm.
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 five 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 25 out of 28 laboratories that provided results timeously were (not in same order as in the table of assays):

- 1 ACME Analytical Laboratories Ltd CA
- 2 Activation Laboratories Pty Ltd (ActLabs) CA
- 3 ALS Chemex Laboratory Group Johannesburg SA
- 4 ALS Chemex Laboratory Group Perth WA
- 5 ALS Chemex Laboratory Group Vancouver CA
- 6 ALS OMAC (Ireland)
- 7 Anglo Platinum - Eastern Bushveld Regional Laboratory
- 8 Anglo Research (Germiston Campus)
- 9 BV Rustenburg (South Africa)
- 10 Genalysis Laboratory Services (South Africa) Pty
- 11 Genalysis Laboratory Services (W Australia P)
- 12 Labtium Inc Finland
- 13 Northam Platinum LTD
- 14 Performance Laboratories SA (Randfontein)
- 15 Set Point Laboratories (Isando) SA
- 16 SGS Australia Pty Ltd (Newburn) WA
- 17 SGS Geosol Laboratories Ltda (Brazil)
- 18 SGS Mineral Services Lakefield (Canada)
- 19 SGS South Africa (Pty) Ltd - Booyens JHB
- 20 SGS Toronto (Canada)
- 21 SGS Townsville (Australia)
- 22 SGS Vancouver (Canada)
- 23 Ultra Trace (Pty) Ltd WA
- 24 Xstrata Alloys
- 25 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 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
B	1.18	0.62	0.08							48.0	33.0		388	482		911	822	
B	1.18	0.63	0.08							44.0	32.0		413	489		906	806	
B	1.22	0.62	0.10							44.0	32.0		418	488		917	789	
B	1.05	0.57	0.07							46.0	31.0		390	470		912	772	
B	1.12	0.58	0.08							44.0	34.0		442	487		926	820	
B	1.10	0.59	0.08							45.0	33.0		396	473		937	794	
B	1.22	0.65	0.09							48.0	33.0		427	495		912	811	
B	1.19	0.64	0.09							50.0	31.0		422	481		906	793	
C	1.18	0.65	0.11					0.08						480			880	
C	1.13	0.58	0.10					0.09						430			810	
C								0.08						450			830	
C	1.21	0.58	0.11					0.08						440			810	
C	1.04	0.53	0.09					0.07						450			860	
C	1.23	0.63	0.10					0.07						460			810	
C	1.03	0.55	0.09					0.09						450			820	
C	1.19	0.61	0.10					0.08						430			790	
D	1.42	0.71	0.09							53.7	30.2	60.0	457	443	370	941	702	900
D	1.39	0.71	0.09							51.7	30.6	50.0	459	448	350	939	719	920
D	1.41	0.71	0.09							51.7	30.4	50.0	459	443	390	945	702	910
D	1.29	0.67	0.08							52.3	30.4	50.0	449	457	390	921	734	900
D	1.40	0.70	0.10							51.4	31.3	60.0	450	457	390	921	732	930
D	1.38	0.68	0.09							52.5	32.2	60.0	454	461	360	923	734	900
D	1.40	0.70	0.09							50.9	30.1	50.0	442	450	360	909	720	900
D	1.35	0.70	0.10							51.0	29.9	50.0	445	444	380	906	707	930

**Assay Data (cont): Economic elements**

Lab Code	Pt Pb Coll g/t	Pd Pb Coll g/t	Au Pb Coll g/t	Pt NiS g/t	Pd NiS g/t	Au NiS g/t	Ir NiS g/t	Rh NiS g/t	Ru NiS g/t	Co M/ICP ppm	Co P ppm	Co XRF ppm	Cu M/ICP ppm	Cu P ppm	Cu XRF ppm	Ni M/ICP ppm	Ni P ppm	Ni XRF ppm
E				1.25	0.65	0.10	0.04	0.10	0.19			50.0			430			920
E				1.24	0.65	0.10	0.03	0.10	0.19			50.0			450			920
E				1.24	0.66	0.10	0.03	0.10	0.19			50.0			430			930
E				1.25	0.66	0.10	0.04	0.10	0.20			50.0			420			920
E				1.25	0.66	0.10	0.03	0.10	0.20			50.0			430			910
E				1.24	0.66	0.10	0.04	0.10	0.20			50.0			440			940
E				1.28	0.66	0.10	0.04	0.10	0.20			50.0			430			920
E				1.22	0.65	0.10	0.03	0.10	0.19			50.0			450			910
F	1.27	0.67	0.09							44.0	27.0		423	446		883	709	
F	1.30	0.68	0.09							44.0	28.0		416	452		900	736	
F	1.29	0.68	0.09							44.0	28.0		418	448		900	737	
F	1.20	0.64	0.09							44.0	27.0		422	444		900	724	
F	1.18	0.62	0.08							42.0	27.0		412	446		859	740	
F	1.13	0.59	0.08							45.0	28.0		413	444		871	736	
F	1.24	0.66	0.08							44.0	28.0		421	443		880	732	
F	1.25	0.65	0.10							45.0	27.0		425	442		891	743	
G	1.21	0.67	0.09							50.0	30.0		460	460		920	760	
G	1.17	0.64	0.09							50.0	30.0		440	470		890	780	
G	1.19	0.61	0.09							50.0	30.0		440	460		890	740	
G	1.18	0.59	0.09							50.0	30.0		450	460		920	760	
G	1.24	0.67	0.09							50.0	30.0		450	460		900	760	
G	1.11	0.64	0.09							50.0	30.0		450	460		910	760	
G	1.25	0.66	0.09							50.0	30.0		440	460		890	750	
G	1.10	0.64	0.09							50.0	30.0		440	440		890	720	
I	1.11	0.57	0.08	1.19	0.61	0.08	0.03	0.09	0.17	50.0	30.8		454	451		923	748	
I	1.26	0.66	0.08	1.19	0.60	0.08	0.03	0.10	0.17	49.2	29.9		451	441		906	745	
I	1.21	0.65	0.08	1.16	0.61	0.08	0.04	0.09	0.17	48.8	31.0		454	456		915	763	
I	1.20	0.64	0.08	1.24	0.60	0.08	0.04	0.09	0.18	49.7	31.0		453	456		923	761	
I	1.21	0.65	0.08	1.20	0.60	0.08	0.04	0.10	0.18	49.4	30.2		452	447		882	731	
I	1.24	0.67	0.09	1.17	0.60	0.09	0.04	0.09	0.17	49.5	29.9		451	453		888	754	
I	1.14	0.61	0.08	1.19	0.61	0.08	0.03	0.10	0.17	50.2	30.4		468	444		917	730	
I	1.10	0.60	0.08	1.12	0.60	0.08	0.03	0.09	0.17	49.4	30.4		456	447		912	749	
J	1.24	0.63	0.09							50.0	30.0		440	470		890	790	
J	1.24	0.62	0.09							50.0	30.0		450	440		920	760	
J	1.24	0.62	0.41							50.0	30.0		440	470		900	780	
J	1.26	0.63	0.08							50.0	30.0		440	440		920	740	
J	1.22	0.63	0.10							50.0	30.0		450	480		920	790	
J	1.22	0.63	0.10							50.0	30.0		440	460		900	750	
J	1.27	0.64	0.09							50.0	30.0		440	450		900	750	
J	1.26	0.64	0.09							50.0	30.0		450	440		920	740	
K				1.15	0.56	0.08	0.03	0.09	0.16						434			876
K				1.22	0.55	0.08	0.03	0.10	0.17						428			888
K				1.29	0.54	0.09	0.03	0.09	0.16						416			894
K				1.12	0.48	0.08	0.03	0.09	0.14						432			907
K				1.02	0.43	0.07	0.02	0.07	0.12						420			885
K				1.22	0.48	0.15	0.03	0.08	0.14						430			897
K				1.22	0.46	0.08	0.03	0.08	0.13						427			884
K				0.82	0.34	0.06	0.02	0.06	0.10						438			903
L	1.27	0.64	0.10															
L	1.20	0.62	0.10															
L	1.37	0.62	0.11															
L	1.20	0.61	0.10															
L	1.13	0.59	0.10															
L	1.29	0.63	0.10															
L	1.15	0.60	0.09															
L	1.23	0.54	0.10															
M	1.25	0.63	0.10							44.3	27.5		465	448	500	788	675	1000
M	1.23	0.63	0.10							44.8	27.1		478	448	500	787	668	900
M	1.21	0.62	0.09							44.4	27.0		466	436	500	785	661	900
M	1.22	0.62	0.10							44.9	27.3		449	440	400	796	670	900
M	1.23	0.62	0.10							43.9	28.8		437	442	500	754	691	1000
M	1.23	0.63	0.10							44.0	27.9		439	442	500	775	679	900
M	1.26	0.62	0.11							45.2	27.6		464	447	500	787	680	900
M	1.22	0.62	0.11							44.1	27.8		454	446	500	773	672	1000
N				1.22	1.44	0.25	0.08	0.09	0.13									
N				0.92	1.30	0.19	0.05	0.06	0.08									
N				0.81	1.18	0.16	0.06	0.04	0.08									
N				1.02	1.42	0.19	0.06	0.07	0.09									
N				1.56	1.45	0.16	0.08	0.15	0.23									
N				1.47	1.56	0.19	0.09	0.12	0.19									
N				0.87	1.20	0.16	0.05	0.07	0.10									
N				0.97	1.35	0.17	0.05	0.07	0.09									
P	1.22	0.68	0.09	1.38	0.66	0.10	0.04	0.10	0.18	55.0	32.0		448	446		910	734	
P	1.17	0.67	0.09	1.21	0.66	0.09	0.04	0.10	0.18	50.0	33.0		450	459		915	758	
P	1.17	0.63	0.08	1.28	0.66	0.10	0.04	0.10	0.17	55.0	34.0		466	457		930	756	
P	1.22	0.67	0.09	1.17	0.69	0.09	0.03	0.10	0.17	50.0	35.0		458	453		925	754	
P	1.23	0.69	0.09	1.27	0.69	0.09	0.04	0.10	0.18	50.0	34.0		446	457		915	756	
P	1.21	0.67	0.08	1.25	0.67	0.09	0.03	0.10	0.18	50.0	31.0		452	457		910	767	
P	1.24	0.66	0.09	1.28	0.69	0.10	0.04	0.10	0.19	55.0	33.0		458	455		930	748	
P	1.18	0.65	0.09	1.27	0.67	0.10	0.04	0.10	0.17	55.0	33.0		452	452		915	758	
Q			0.09	1.24	0.66		0.02	0.09	0.19	51.5	28.3	53.0	431	434	405	912	864	732
Q			0.09	1.28	0.62		0.02	0.09	0.19	52.3	29.8	52.0	433	433	411	910	864	727
Q			0.09	1.25	0.67		0.02	0.09	0.18	50.7	29.5	51.0	430	431	409	911	865	720
Q			0.09	1.21	0.62		0.02	0.09	0.19	52.5	29.5	51.0	433	434	409	912	864	718
Q			0.09	1.24	0.66		0.02	0.09	0.19	53.5	29.2	40.0	430	431	417	913	865	741
Q			0.09	1.21	0.62		0.02	0.09	0.18	52.5	28.8	38.0	431	431	421	910	864	748
Q			0.09	1.21	0.67		0.02	0.09	0.19	52.1	29.2	39.0	430	430	423	913	863	752
Q			0.09	1.28	0.62		0.02	0.09	0.19	51.8	28.9	42.0	432	433	415	913	863	740

**Assay Data (cont): Economic elements**

Lab Code	Pt Pb Coll g/t	Pd Pb Coll g/t	Au Pb Coll g/t	Pt NIS g/t	Pd NIS g/t	Au NIS g/t	Ir NiS g/t	Rh NiS g/t	Ru NiS g/t	Co M/ICP ppm	Co P ppm	Co XRF ppm	Cu M/ICP ppm	Cu P ppm	Cu XRF ppm	Ni M/ICP ppm	Ni P ppm	Ni XRF ppm
R				1.15	0.60	0.08	0.03	0.09	0.12									
R				1.14	0.62	0.08	0.03	0.09	0.13									
R				1.14	0.65	0.08	0.03	0.09	0.13									
R				1.13	0.62	0.08	0.03	0.09	0.12									
R				1.12	0.60	0.08	0.03	0.08	0.13									
R				1.12	0.65	0.08	0.03	0.09	0.14									
R				1.14	0.60	0.08	0.03	0.09	0.13									
R				1.14	0.65	0.08	0.03	0.09	0.13									
S	1.24	0.65	0.09							49.0	31.0	49.0	463	463	466	868	724	
S	1.26	0.67	0.09							47.0	31.0	47.0	439	439	476	823	743	
S	1.25	0.64	0.08							50.0	31.0	50.0	458	458	478	879	737	
S	1.23	0.65	0.08							48.0	30.0	48.0	434	434	474	839	727	
S	1.26	0.64	0.09							48.0	30.0	48.0	433	433	476	838	721	
S	1.25	0.64	0.09							48.0	31.0	48.0	432	432	494	822	755	
S	1.26	0.65	0.09							48.0	31.0	48.0	443	443	474	846	730	
S	1.25	0.64	0.09							49.0	31.0	49.0	455	455	491	843	739	
T	1.12	0.60						0.10							440		889	
T	1.11	0.62						0.10							448		909	
T	1.03	0.58						0.09							440		885	
T	1.15	0.59						0.09							444		895	
T	1.37	0.69						0.11							447		901	
T	1.21	0.60						0.10							446		909	
T	1.13	0.61						0.10							447		897	
T	1.01	0.56						0.09							452		915	
U				1.16	0.51	0.08	0.18	0.08	0.16	32.3			466			822		
U				1.21	0.52	0.08	0.18	0.08	0.16	32.0			464			827		
U				1.14	0.49	0.08	0.19	0.08	0.16	33.6			453			813		
U				1.13	0.52	0.08	0.18	0.08	0.16	31.4			449			824		
U				1.19	0.50	0.08	0.19	0.08	0.16	32.5			451			824		
U				1.10	0.50	0.08	0.18	0.07	0.15	32.1			451			847		
U				1.15	0.49	0.07	0.18	0.07	0.15	35.6			457			819		
U				1.11	0.49	0.07	0.18	0.05	0.15	35.6			444			801		
V				1.19	0.62	0.09	0.02	0.08	0.11			40.0			440		940	
V				1.21	0.62	0.08	0.03	0.08	0.11			50.0			430		930	
V				1.19	0.63	0.08	0.02	0.08	0.11			70.0			430		940	
V				1.25	0.64	0.09	0.02	0.08	0.12			50.0			430		900	
V				1.24	0.63	0.08	0.02	0.08	0.11						460		940	
V				1.19	0.63	0.08	0.03	0.08	0.12						420		920	
V				1.25	0.63	0.10	0.02	0.08	0.11			40.0			420		940	
V				1.21	0.63	0.08	0.02	0.08	0.09			40.0			430		940	
W				1.21	0.66	0.08		0.09	0.21	47.0	42.0		435	422		871	740	
W				1.21	0.64	0.10		0.09	0.21	47.0	41.0		433	420		872	742	
W				1.24	0.66	0.09		0.09	0.20	48.0	42.0		436	430		885	774	
W				1.29	0.66	0.09		0.09	0.22	48.0	43.0		435	424		862	769	
W				1.18	0.63	0.09		0.09	0.20	47.0	45.0		434	431		888	773	
W				1.21	0.64	0.09		0.09	0.21	48.0	42.0		434	427		889	770	
W				1.18	0.66	0.09		0.09	0.20	48.0	46.0		435	425		883	770	
W				1.25	0.64	0.09		0.08	0.19	48.0	42.0		433	421		890	753	
X	1.26	0.66	0.09							51.1	32.1		453	467		930	744	
X	1.28	0.66	0.09							48.4	30.0		445	467		919	738	
X	1.27	0.66	0.09							50.8	31.8		446	471		911	755	
X	1.22	0.64	0.10							50.2	31.6		417	465		864	743	
X	1.26	0.66	0.09							49.2	29.7		445	459		900	731	
X	1.26	0.65	0.08							49.0	30.1		448	462		911	733	
X	1.30	0.66	0.09							50.5	30.2		462	452		940	719	
X	1.25	0.66	0.10							52.9	29.9		462	458		934	723	
Y	1.16	0.63	0.14							53.0	29.0		479	451		934	738	
Y	1.18	0.63	0.15							54.0	30.0		490	453		964	743	
Y	1.10	0.59	0.14							53.0	29.0		470	447		936	735	
Y	1.07	0.59	0.15							53.0	29.0		465	454		926	750	
Y	1.22	0.64	0.14							51.0	29.0		468	450		933	746	
Y	1.09	0.59	0.14							54.0	29.0		475	457		950	758	
Y	1.15	0.61	0.15							50.0	28.0		471	441		919	733	
Y	1.14	0.60	0.14							51.0	29.0		469	445		918	736	
Z	1.23	0.64	0.08							48.0	33.0		450	483		894	772	
Z	1.22	0.66	0.09							50.0	32.0		455	489		919	768	
Z	1.23	0.64	0.09							48.0	31.0		448	472		899	761	
Z	1.29	0.62	0.09							49.0	33.0		448	472		895	753	
Z	1.23	0.64	0.09							49.0	31.0		453	465		901	749	
Z	1.14	0.61	0.09							46.0	31.0		453	470		869	755	
Z	1.24	0.68	0.09							46.0	30.0		442	460		891	732	
Z	1.22	0.70	0.09							47.0	31.0		446	462		889	734	
ZA	1.24	0.65	0.09															
ZA	1.18	0.65	0.09															
ZA	1.20	0.63	0.09															
ZA	1.20	0.65	0.08															
ZA	1.18	0.64	0.09															
ZA	1.19	0.65	0.07															
ZA	1.18	0.64	0.08															
ZA	1.18	0.63	0.08															
ZB	1.19	0.62	0.09				0.04	0.10	0.19						400		900	
ZB	1.20	0.63	0.08				0.03	0.10	0.19						500		1000	
ZB	1.14	0.60	0.08				0.03	0.10	0.19						400		900	
ZB	1.14	0.60	0.08				0.04	0.10	0.2						500		900	
ZB	1.22	0.63	0.09				0.04	0.10	0.19						400		900	
ZB	1.27	0.65	0.08				0.04	0.10	0.19						400		1000	
ZB	1.19	0.62	0.09				0.03	0.10	0.18						500		900	
ZB	1.17	0.62	0.08				0.04	0.10	0.19						400		900	

### Assay Data: Major elements

Lab Code	Al <sub>2</sub> O <sub>3</sub> XRF %	CaO XRF %	Cr <sub>2</sub> O <sub>3</sub> XRF %	Fe <sub>2</sub> O <sub>3</sub> XRF %	K <sub>2</sub> O XRF %	MgO XRF %	MnO XRF %	Na <sub>2</sub> O XRF %	SiO <sub>2</sub> XRF %	TiO <sub>2</sub> XRF %	LOI %	S Comb/LECO %	SG pyc
B	5.74	3.09	0.49	4.72	0.14	6.25	0.07	0.48	77.30	0.11	1.39	0.19	
B	5.76	3.09	0.49	4.71	0.14	6.26	0.08	0.47	77.30	0.12	1.34	0.21	
B	5.71	3.09	0.49	4.72	0.14	6.27	0.08	0.49	77.30	0.11	1.43	0.20	
B	5.75	3.08	0.50	4.72	0.14	6.26	0.07	0.47	77.30	0.11	1.39	0.21	
B	5.72	3.10	0.49	4.71	0.14	6.28	0.07	0.47	77.40	0.11	1.35	0.19	
B	5.77	3.09	0.49	4.72	0.14	6.25	0.07	0.48	77.30	0.11	1.41	0.19	
B	5.76	3.09	0.49	4.72	0.14	6.28	0.07	0.49	77.30	0.11	1.34	0.19	
B	5.72	3.07	0.49	4.71	0.15	6.28	0.07	0.50	77.30	0.11	1.41	0.20	
D	5.79	3.06	0.50	4.60	0.14	6.45	0.06	0.45	77.70	0.21	0.20		2.77
D	5.76	3.05	0.49	4.62	0.14	6.43	0.07	0.44	77.70	0.18	0.15		2.75
D	5.80	3.08	0.50	4.65	0.14	6.45	0.07	0.45	77.90	0.19	0.17		2.77
D	5.78	3.06	0.50	4.66	0.14	6.45	0.07	0.44	77.70	0.16	0.15		2.75
D	5.80	3.07	0.50	4.68	0.14	6.46	0.07	0.45	77.80	0.16	0.20		2.74
D	5.78	3.05	0.49	4.64	0.14	6.43	0.07	0.43	77.80	0.18	0.19		2.75
D	5.79	3.05	0.49	4.61	0.14	6.46	0.06	0.45	77.70	0.19	0.18		2.69
D	5.77	3.08	0.50	4.65	0.14	6.44	0.07	0.44	77.70	0.16	0.19		2.77
E	5.63	3.14	0.49			6.48			76.69			0.20	
E	5.65	3.18	0.50			6.45			76.42			0.20	
E	5.64	3.17	0.49			6.49			76.90			0.20	
E	5.65	3.15	0.50			6.47			76.55			0.20	
E	5.64	3.09	0.49			6.48			76.69			0.21	
E	5.66	3.14	0.49			6.46			76.49			0.21	
E	5.66	3.15	0.48			6.49			76.20			0.20	
E	5.67	3.08	0.48			6.44			76.35			0.20	
F												0.21	2.81
F												0.21	2.93
F												0.21	2.93
F												0.21	2.91
F												0.21	2.93
F												0.22	2.93
F												0.22	2.93
F												0.22	2.92
G	5.80	3.06	0.50	4.73	0.14	6.34	0.06	0.44	77.60	0.11	0.35		2.73
G	5.78	3.08	0.50	4.76	0.14	6.36	0.07	0.45	77.50	0.11	0.32		2.79
G	5.78	3.09	0.48	4.75	0.14	6.36	0.06	0.44	77.60	0.11	0.30		2.76
G	5.79	3.09	0.49	4.74	0.14	6.35	0.06	0.44	77.70	0.11	0.29		2.79
G	5.78	3.07	0.47	4.71	0.14	6.33	0.06	0.43	77.80	0.11	0.30		2.79
G	5.81	3.06	0.48	4.71	0.14	6.36	0.06	0.45	77.70	0.11	0.29		2.83
G	5.79	3.06	0.48	4.70	0.14	6.36	0.06	0.45	77.70	0.11	0.29		2.78
G	5.80	3.06	0.50	4.71	0.14	6.35	0.06	0.44	77.60	0.11	0.28		2.81
I	5.82	3.10	0.48	4.83	0.15	6.39	0.07	0.45	77.98	0.12	0.29	0.22	2.74
I	5.82	3.09	0.48	4.82	0.14	6.38	0.07	0.47	78.20	0.11	0.30	0.21	2.86
I	5.80	3.09	0.48	4.82	0.14	6.38	0.07	0.45	78.05	0.11	0.29	0.21	2.83
I	5.85	3.09	0.48	4.82	0.14	6.39	0.07	0.46	78.33	0.11	0.28	0.22	2.86
I	5.81	3.11	0.48	4.83	0.14	6.39	0.07	0.46	78.35	0.11	0.29	0.21	2.84
I	5.78	3.10	0.48	4.83	0.15	6.37	0.07	0.47	78.07	0.12	0.28	0.21	2.74
I	5.77	3.10	0.48	4.82	0.15	6.38	0.07	0.45	78.12	0.11	0.30	0.21	2.79
I	5.86	3.10	0.48	4.83	0.14	6.39	0.07	0.47	78.28	0.11	0.27	0.21	2.78
J	5.83	3.13	0.47	4.66	0.14	6.42	0.06	0.48	77.72	0.11	0.30		2.83
J	5.84	3.15	0.47	4.60	0.14	6.49	0.06	0.48	77.70	0.15	0.27		2.85
J	5.84	3.16	0.48	4.68	0.14	6.46	0.06	0.48	77.39	0.11	0.28		2.93
J	5.85	3.13	0.47	4.66	0.14	6.43	0.06	0.47	77.68	0.11	0.26		2.92
J	5.84	3.12	0.48	4.68	0.14	6.42	0.06	0.47	77.73	0.10	0.26		2.80
J	5.86	3.17	0.47	4.73	0.14	6.53	0.06	0.48	77.54	0.11	0.27		2.82
J	5.84	3.12	0.47	4.67	0.14	6.44	0.06	0.48	77.74	0.10	0.25		2.72
J	5.87	3.13	0.47	4.68	0.14	6.46	0.06	0.49	77.81	0.11	0.25		2.92
K													2.82
K													2.84
K													2.79
K													2.85
K													2.85
K													2.86
K													2.81
K													2.83
M	5.77	3.07	0.48	4.87	0.13	6.20	0.06	0.46	78.37	0.12	0.37		
M	5.73	3.09	0.49	4.90	0.14	6.31	0.06	0.48	78.42	0.12	0.32		
M	5.71	3.11	0.49	4.85	0.14	6.25	0.06	0.44	78.27	0.12	0.29		
M	5.68	3.06	0.48	4.84	0.14	6.30	0.06	0.47	78.17	0.11	0.32		
M	5.75	3.11	0.49	4.88	0.14	6.35	0.06	0.47	78.47	0.11	0.38		
M	5.73	3.11	0.48	4.89	0.14	6.30	0.06	0.47	78.41	0.11	0.33		
M	5.74	3.12	0.49	4.89	0.15	6.33	0.06	0.45	78.74	0.10	0.33		
M	5.74	3.10	0.48	4.89	0.14	6.26	0.06	0.45	78.39	0.11	0.36		

**Assay Data (cont): Major elements**

Lab Code	Al <sub>2</sub> O <sub>3</sub> XRF %	CaO XRF %	Cr <sub>2</sub> O <sub>3</sub> XRF %	Fe <sub>2</sub> O <sub>3</sub> XRF %	K <sub>2</sub> O XRF %	MgO XRF %	MnO XRF %	Na <sub>2</sub> O XRF %	SiO <sub>2</sub> XRF %	TiO <sub>2</sub> XRF %	LOI %	S Comb/LECO %	SG pyc
P	5.78	3.12	0.48	4.73	0.15	6.30	0.07	0.47	77.99	0.12	0.31		2.87
P	5.81	3.13	0.48	4.73	0.15	6.31	0.07	0.48	78.09	0.12	0.29		2.87
P	5.78	3.12	0.48	4.73	0.14	6.28	0.07	0.47	78.01	0.12	0.30		2.87
P	5.81	3.13	0.48	4.73	0.15	6.31	0.07	0.47	78.10	0.12	0.31		2.87
P	5.81	3.13	0.48	4.74	0.15	6.31	0.07	0.47	78.12	0.12	0.29		2.87
P	5.80	3.13	0.48	4.74	0.15	6.32	0.07	0.47	78.14	0.12	0.28		2.88
P	5.82	3.12	0.48	4.73	0.15	6.31	0.07	0.48	78.12	0.12	0.29		2.87
P	5.78	3.12	0.48	4.72	0.15	6.31	0.07	0.48	77.96	0.12	0.31		2.86
Q	5.78	3.82	0.48	4.99	0.15	6.31	0.06		77.23	0.11			2.83
Q	5.83	3.82	0.48	5.02	0.15	6.35	0.06		77.81	0.12			2.82
Q	5.80	3.79	0.48	5.05	0.14	6.28	0.06		77.42	0.11			2.84
Q	5.81	3.82	0.47	5.03	0.14	6.37	0.06		77.64	0.11			2.84
Q	5.83	3.80	0.47	4.99	0.15	6.36	0.06		77.95	0.11			2.82
Q	5.90	3.83	0.48	5.02	0.16	6.45	0.06		78.32	0.11			2.83
Q	5.85	3.81	0.47	5.01	0.15	6.37	0.06		78.39	0.11			2.83
Q	5.84	3.81	0.48	5.02	0.15	6.36	0.06		77.92	0.11			2.84
R													2.84
R													2.82
R													2.84
R													2.84
R													2.78
R													2.83
R													2.82
R													2.78
T													
T													2.94
T													
T													2.89
T													2.91
T													2.91
T													2.91
T													2.89
T													2.86
V													2.86
V													2.83
V													2.85
V													2.85
V													2.82
V													2.84
V													2.84
W	5.45	2.88	0.58	4.54	0.13	6.39	0.07	0.71	77.10	0.11	0.38	0.19	2.86
W	5.55	2.85	0.55	4.64	0.13	6.60	0.07	0.77	76.70	0.11	0.48	0.19	2.84
W	5.52	2.96	0.46	4.51	0.12	6.51	0.07	0.47	77.30	0.11	0.52	0.19	2.88
W	5.67	3.00	0.47	4.60	0.13	6.37	0.07	0.72	77.50	0.11	0.47	0.19	2.88
W	5.65	3.00	0.47	4.58	0.13	6.39	0.07	0.49	77.90	0.11	0.50	0.19	2.84
W	5.65	2.99	0.47	4.57	0.13	6.43	0.07	0.51	77.10	0.11	0.45	0.19	2.87
W	5.70	3.00	0.48	4.60	0.18	6.44	0.07	0.50	77.50	0.12	0.48	0.20	2.87
W	5.41	2.84	0.48	4.41	0.13	6.60	0.07	0.64	77.90	0.11	0.55	0.20	2.85
X													2.89
X													2.85
X													2.86
X													2.86
X													2.84
X													2.83
X													2.83
X													2.85
Z	5.86	3.13	0.47	4.78	0.15	6.47	0.08	0.48	78.00	0.12	0.30		2.83
Z	5.86	3.14	0.47	4.77	0.15	6.49	0.08	0.49	78.40	0.12	0.23		2.81
Z	5.86	3.07	0.46	4.70	0.14	6.46	0.07	0.47	77.90	0.12	0.29		2.86
Z	5.80	3.09	0.48	4.70	0.14	6.42	0.07	0.48	77.50	0.12	0.28		2.82
Z	5.88	3.14	0.48	4.79	0.15	6.51	0.08	0.49	78.30	0.13	0.23		2.79
Z	5.87	3.06	0.48	4.71	0.14	6.44	0.07	0.44	77.70	0.11	0.51		2.81
Z	5.85	3.06	0.47	4.68	0.14	6.44	0.07	0.47	77.80	0.12	0.32		2.77
Z	5.85	3.12	0.49	4.78	0.14	6.48	0.08	0.48	78.10	0.13	0.34		2.82
ZB	5.78	3.10	0.47	4.81	0.14	6.36	0.06	0.44	77.20	0.11	0.34	0.20	
ZB	5.78	3.09	0.48	4.81	0.13	6.31	0.06	0.44	77.50	0.11	0.32	0.20	
ZB	5.81	3.13	0.48	4.82	0.14	6.36	0.05	0.45	78.20	0.12	0.33	0.20	
ZB	5.85	3.12	0.48	4.80	0.14	6.38	0.07	0.45	78.20	0.12	0.39	0.20	
ZB	5.87	3.11	0.48	4.81	0.13	6.36	0.06	0.45	78.20	0.11	0.37	0.20	
ZB	5.80	3.13	0.47	4.80	0.14	6.36	0.06	0.45	77.90	0.11	0.35	0.20	
ZB	5.86	3.12	0.47	4.82	0.14	6.41	0.06	0.44	78.30	0.12	0.46	0.20	
ZB	5.82	3.13	0.47	4.84	0.14	6.40	0.05	0.46	78.30	0.11	0.43	0.20	



**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 <sup>1</sup>	$\sigma_L$ <sup>2</sup>	Sw <sup>3</sup>	CSU <sup>4</sup>
Pt	Pb Coll	g/t	0.050	0.024	0.042	0.007
Pd	Pb Coll	g/t	0.026	0.012	0.023	0.004
Au	Pb Coll	g/t	0.006	0.003	0.004	0.001
Pt	NIS	g/t	0.051	0.037	0.034	0.013
Pd	NIS	g/t	0.026	0.024	0.015	0.009
Au	NIS	g/t	0.009	0.008	0.005	0.003
Ir	NiS	g/t	0.006	0.006	0.002	0.002
Rh	NiS	g/t	0.008	0.006	0.004	0.002
Ru	NiS	g/t	0.033	0.027	0.018	0.009
Co	M/ICP	ppm	2.911	2.039	1.262	0.558
Co	P	ppm	1.424	1.081	0.592	0.318
Cu	M/ICP	ppm	10.15	6.02	7.19	1.889
Cu	P	ppm	12.14	7.32	7.39	2.083
Cu	XRF	ppm	32.59	28.53	15.69	10.959
Ni	M/ICP	ppm	17.36	10.54	11.76	3.28
Ni	P	ppm	19.98	12.17	13.58	3.79
Al <sub>2</sub> O <sub>3</sub>	XRF	%	0.041	0.036	0.020	0.012
CaO	XRF	%	0.029	0.022	0.019	0.008
Cr <sub>2</sub> O <sub>3</sub>	XRF	%	0.010	0.007	0.006	0.002
Fe <sub>2</sub> O <sub>3</sub>	XRF	%	0.082	0.077	0.025	0.026
K <sub>2</sub> O	XRF	%	0.003	0.002	0.002	0.001
LOI		%	0.049	0.045	0.023	0.017
MgO	XRF	%	0.072	0.061	0.029	0.019
MnO	XRF	%	0.005	0.004	0.002	0.001
Na <sub>2</sub> O	XRF	%	0.017	0.014	0.010	0.005
SiO <sub>2</sub>	XRF	%	0.365	0.272	0.208	0.089
TiO <sub>2</sub>	XRF	%	0.005	0.003	0.004	0.001
S	Comb/LECO	%	0.009	0.011	0.005	0.005
SG	pyc		0.047	0.029	0.028	0.008

1. S - Std Dev for use on control charts.
2.  $\sigma_L$  - 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 Smees.

**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:** AMIS0209 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](http://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.

12 April 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	0.23	0.08	16.5	24
Al	M/ICP	%	3.1	0.25	4.0	84
As	M/ICP	ppm	5.5	8.6	78.4	56
Ba	M/ICP	ppm	38.1	3.1	4.1	76
Be	M/ICP	ppm	0.11	0.03	14.5	19
Bi	M/ICP	ppm	0.83	2.6	159	42
Ca	M/ICP	%	2.2	0.17	3.7	76
Cd	M/ICP	ppm	0.53	0.91	86.1	15
Ce	M/ICP	ppm	7.4	0.51	3.5	31
Co	XRF	ppm	48.7	10.6	10.9	37
Cr	M/ICP	ppm	2517	796	15.8	88
Cs	M/ICP	ppm	0.20	0.01	2.4	22
Dy	M/ICP	ppm	0.55	0.10	8.8	16
Er	M/ICP	ppm	0.38	0.05	6.8	16
Eu	M/ICP	ppm	0.17	0.04	10.5	16
Fe	M/ICP	%	3.3	0.25	3.7	86
Ga	M/ICP	ppm	5.2	0.41	4.0	23
Gd	M/ICP	ppm	29.6	83.8	141.6	24
Ge	M/ICP	ppm	0.07	0.02	16.3	6
Hf	M/ICP	ppm	0.62	0.13	10.2	31
Ho	M/ICP	ppm	0.12	0.01	2.2	14
In	M/ICP	ppm	0.01	0.01	35.6	7
K	M/ICP	%	0.12	0.04	15.6	86
La	M/ICP	ppm	3.7	1.1	15.0	60
Li	M/ICP	ppm	2.7	0.67	12.3	56
Lu	M/ICP	ppm	0.06	0.01	7.2	16
Mg	M/ICP	%	3.8	0.28	3.6	84
Mn	M/ICP	ppm	530	53.2	5.0	82
Mo	M/ICP	ppm	2.1	1.1	27.2	64
Na	M/ICP	%	0.35	0.04	5.4	87
Nb	M/ICP	ppm	1.3	0.33	12.9	32
Nd	M/ICP	ppm	3.1	0.17	2.8	15
Ni	XRF	ppm	910	34.7	1.9	43
P	M/ICP	ppm	356	73.5	10.3	81
Pb	M/ICP	ppm	16.9	6.1	18.1	87
Pr	M/ICP	ppm	0.81	0.06	3.8	16
Rb	M/ICP	ppm	4.9	0.58	5.9	30
S	M/ICP	%	0.22	0.02	5.7	62
Sb	M/ICP	ppm	4.0	11.7	148.7	48
Sc	M/ICP	ppm	8.0	1.2	7.5	87
Si	M/ICP	%	35.4	0.18	0.25	7
Sm	M/ICP	ppm	0.58	0.05	4.2	15
Sn	M/ICP	ppm	0.95	0.20	10.6	30
Sr	M/ICP	ppm	81.4	7.3	4.5	72
Ta	M/ICP	ppm	0.09	0.02	13.7	15
Tb	M/ICP	ppm	0.09	0.01	6.1	16
Te	M/ICP	ppm	0.36	0.46	62.9	29
Th	M/ICP	ppm	1.5	0.23	7.7	31
Ti	M/ICP	%	0.06	0.01	7.4	77
Tl	M/ICP	ppm	0.06	0.01	8.1	8
U	M/ICP	ppm	0.50	0.01	1.3	30
V	M/ICP	ppm	59.5	7.5	6.3	80
W	M/ICP	ppm	0.7	0.39	29.5	24
Y	M/ICP	ppm	3.0	0.5	8.1	68
Yb	M/ICP	ppm	0.38	0.05	6.2	16
Zn	M/ICP	ppm	33.3	9.1	13.7	87
Zr	M/ICP	ppm	19.5	3.3	8.3	71