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AMIS0150

Certified Reference Material

Platinum (PGM) UG2 Concentrate Eastern Limb, Bushveld Complex, South Africa

Certificate of Analysis

Recommended Concentrations and Limits¹ (at two Standard Deviations)

Certified Concentrations²

Pt Pb Collection	86.59	±	7.34	g/t
Pd Pb Collection	48.88	±	2.36	g/t
Au Pb Collection	1.14	±	0.10	g/t
Pt NIS	87.16	±	5.86	g/t
Pd NIS	49.69	±	4.62	g/t
Au NIS	1.15	±	0.12	g/t
Ir NiS	5.68	±	0.48	g/t
Rh NiS	14.35	±	0.82	g/t
Ru NiS	23.99	±	2.04	g/t
Co M/ICP	310	±	22.5	ppm
Cu M/ICP	4124	±	213	ppm
Cu P	4224	±	185	ppm
Cu XRF	4169	±	374	ppm
Ni M/ICP	8106	±	564	ppm
Ni P	7730	±	295	ppm
Ni XRF	8271	±	514	ppm
Specific Gravity	3.06	±	0.20	

Provisional Concentrations

Co P	284	±	34	ppm
Co XRF	334	±	50	ppm

$4E = \text{Platinum} + \text{Palladium} + \text{Rhodium} + \text{Gold} = 152 \text{ g/t}$

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	3.96	±	0.14	%
CaO	2.28	±	0.10	%
Cr ₂ O ₃	2.87	±	0.12	%
Fe ₂ O ₃	12.74	±	0.34	%
MgO	22.36	±	0.46	%
MnO	0.15	±	0.01	%
SiO ₂	46.65	±	1.32	%
TiO ₂	0.31	±	0.01	%

Provisional Concentrations

K ₂ O	0.071	±	0.022	%
LOI	5.96	±	1.52	%

Informational Mean

Na ₂ O	0.26	%
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1. Intended Use: AMIS0150 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.

2. Origin of Material: AMIS0150 is a commissioned CRM made from Two Rivers Mine UG2 Concentrate material. This mine is located in the southern lobe of the Eastern Limb of the Bushveld Complex; 60 km west of the town of Lydenburg, in Mpumalanga province, South Africa. The mine is an incorporated Joint venture between African Rainbow Minerals (ARM) with 55% stake and Impala Platinum (Implats) with 45% stake holding.

3. Mineral and Chemical Composition: The UG2 reef is contained within a well-layered ultramafic to mafic succession called the Rustenburg Layered Suite. There are two horizons which host economically exploitable quantities of PGMs, namely the Merensky reef and the underlying UG2 chromitite layer. The Merensky reef is generally composed of a feldspathic pyroxenite hanging wall,

overlying a basal chromitite unit, followed by an anorthosite to anorthositic-norite footwall. The UG2 reef is defined as a main chrome unit with the mineralisation wholly contained within this unit.

The UG2 chromitite 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 mining method is a mechanized bord and pillar layout.

Two Rivers has a conventional MF2 (Mill and Float) design concentrator plant, with a 225 000 tonnes per month design capacity, where initial processing is done. The concentrate produced has had most of the chromitite and some of the silicates present in the ore removed.

Major element chemistry data from 12 of the labs has been certified. Uncertified summary statistics for trace element data are set out in the appendix.

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

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

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

7. Methods of Analysis requested:

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

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

8. Information requested:

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

9. Method of Certification: Twenty six laboratories were each given eight randomly selected packages of sample. Eighteen 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 17 laboratories that provided results timeously were (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 Research (Crown Campus)
7. Barplats Laboratory SA
8. Genalysis Laboratory Services (South Africa) Pty
9. Genalysis Laboratory Services WA
10. Impala Mineral Processes Laboratory
11. Northam
12. Rappa Research Laboratory
13. Set Point Laboratories (Isando) SA
14. Set Point Laboratories (Mokopane) SA
15. SGS Mineral Services Callao (Peru)
16. SGS Mineral Services Lakefield (Canada)
17. SGS South Africa (Pty) Ltd - Booyens JHB
18. 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.

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	Al2O3 XRF %	CaO XRF %	Cr2O3 XRF %	Fe2O3 XRF %	K2O XRF %	MgO XRF %	MnO XRF %	Na2O XRF %	SiO2 XRF %	TiO2 XRF %	LOI %	SG pyc	
A	80.00	47.00	1.17	72.29	41.18	0.77	3.96	10.92	17.02	285	257	308	4135	4112	4226	8607	7391	8006	3.53	2.16	2.87	12.67	0.06	22.20	0.16	0.38	46.94	0.32	6.61	3.04	
A	78.00	47.00	1.13	71.00	39.59	0.76	3.95	10.30	16.79	292	258	323	4106	4076	4196	8560	7515	7928	3.72	2.17	2.86	12.74	0.06	22.34	0.16	0.36	46.96	0.32	6.61	3.06	
A	80.09	47.00	1.15	72.00	40.28	0.80	3.95	10.46	17.27	297	265	308	4145	4163	4238	8604	7634	8021	3.56	2.19	2.87	12.73	0.07	22.29	0.17	0.37	47.33	0.32	6.61	3.03	
A	81.00	48.00	1.14	75.27	42.86	0.79	4.11	11.21	18.49	295	258	325	4222	4032	4214	8556	7502	7991	3.65	2.16	2.86	12.76	0.06	22.29	0.17	0.36	47.12	0.32	6.63	3.03	
A	78.00	49.00	1.16	72.16	42.11	0.77	4.13	11.00	17.81	285	260	315	4132	4045	4222	8200	7567	7999	3.65	2.19	2.90	12.77	0.06	22.38	0.17	0.37	47.26	0.32	6.63	3.06	
A	80.00	49.00	1.15	75.00	44.06	0.77	4.04	11.84	18.00	286	269	317	4081	4196	4232	8375	7621	8005	3.65	2.19	2.87	12.77	0.07	22.27	0.17	0.37	47.61	0.32	6.62	3.02	
A	79.00	48.00	1.20	73.57	42.11	0.79	3.97	10.87	17.62	294	271	337	4126	4170	4245	8222	7648	8051	3.66	2.17	2.86	12.75	0.06	22.47	0.17	0.37	47.47	0.32	6.64	3.04	
A	80.00	48.00	1.13	73.45	41.15	0.78	3.98	10.82	17.43	298	266	318	4280	4230	4232	8289	7580	8000	3.55	2.18	2.88	12.75	0.07	22.44	0.17	0.37	47.31	0.32	6.64	3.05	
B	87.26	48.70	1.18									380			4231			8019													
B	85.92	49.25	1.16									375			4219			7991													
B	86.77	48.92	1.15									377			4211			7964													
B	87.79	49.88	1.14									375			4234			8051													
B	87.30	49.23	1.16									362			4231			8032													
B	87.01	49.99	1.14									371			4226			8037													
B	86.81	49.41	1.12									363			4231			8059													
B	85.82	48.65	1.21									363			4257			8066													
D				92.29	52.29	1.09				430			4600			8190															
D				91.20	55.23	1.20				430			4630			7990															
D				96.50	59.05	1.16				460			4510			7800															
D				98.97	55.59	1.10				440			4480			7580															
D				98.10	54.60	1.05				440			4400			7700															
D				90.26	52.38	1.01				440			4570			7530															
D				93.57	52.74					460			4490			7250															
D				94.18	55.74					460			4510			8240															

Assay data (cont)

Lab Code	Pt Pb Coll	Pd Pb Coll	Au Pb Coll	Pt NIS	Pd NIS	Au NIS	Ir NIS	Rh NIS	Ru NIS	Co M/ICP	Co P	Co XRF	Cu M/ICP	Cu P	Cu XRF	Ni M/ICP	Ni P	Ni XRF	Al2O3 XRF	CaO XRF	Cr2O3 XRF	Fe2O3 XRF	K2O XRF	MgO XRF	MnO XRF	Na2O XRF	SiO2 XRF	TiO2 XRF	LOI %	SG pvc
F	82.80	48.00	1.12	86.97	49.61	1.16	5.79	14.77	25.66		326		4290		8500			3.96	2.36		13.00	0.05	22.40	0.18		46.80	0.31	3.84		
F	83.30	47.80	1.23	87.03	49.78	1.18	5.73	14.74	25.44		320		4292		8510			3.98	2.35		13.10	0.05	22.70	0.18		47.50	0.31	3.85		
F	82.80	47.40	1.10	85.40	49.63	1.12	5.80	14.55	25.00		327		4285		8512			3.93	2.34		13.10	0.06	22.50	0.18		47.00	0.31	3.83		
F	83.90	47.70	1.09	86.93	49.27	1.17	5.77	14.61	25.07		320		4256		8528			3.94	2.33		13.10	0.05	22.50	0.18		47.10	0.31	3.81		
F	83.40	47.40	1.22	86.63	49.63	1.13	5.72	14.63	25.22		318		4267		8475			3.93	2.34		13.10	0.06	22.50	0.18		47.00	0.31	3.82		
F	84.50	48.30	1.11	86.29	49.71	1.16	5.74	14.56	25.13		315		4249		8530			4.06	2.37		13.20	0.05	22.60	0.18		47.30	0.31	3.86		
F	83.00	47.50	1.17	85.61	49.21	1.13	5.76	14.50	25.04		319		4259		8565			3.99	2.37		13.10	0.06	22.70	0.18		47.40	0.31	3.85		
F	83.00	47.80	1.15	86.26	49.41	1.12	5.73	14.64	25.23		318		4262		8571			3.99	2.33		13.10	0.05	22.40	0.18		46.90	0.31	3.85		
G	91.60	47.94	1.09	91.13	53.21	1.12	6.13	15.88	28.36	305	376		4465	4273	9307	9180		2.92	2.44	2.89	12.71		22.02	0.15		48.68	0.32			
G	90.93	48.44	1.01							314	382		4529	4331	9562	9235		2.89	2.55	2.88	12.95		22.26	0.15		48.63	0.32			
G	93.97	49.63	1.07	87.86	49.18	1.02	6.09	14.30	25.04		301	396	4493	4340	9611	9309		3.38	2.53	2.92	13.46		22.74	0.16		49.24	0.31			
G	91.54	47.61	1.05	87.46	51.71	1.12	5.29	15.41	29.85	302	401		4464	4332	9539	9389		3.42	2.62	2.89	13.48		22.72	0.16		46.23	0.33			
G	88.40	49.73	1.08	88.40	52.43	1.13	5.23	15.62	29.34	301	380		4497	4386	9702	9448		3.61	2.63	2.92	13.58		23.17	0.16		49.95	0.34			
G	87.76	49.33	1.11	89.20	49.63	1.03	6.88	14.53	25.78	295	392		4450	4352	9633	9495		3.61	2.48	2.94	13.57		22.90	0.16		48.28	0.33			
G	87.76	49.56	1.05	88.43	49.60	1.02	6.51	14.59	25.26	300	391		4474	4339	9711	9483		3.64	2.53	2.90	13.48		22.78	0.16		47.04	0.33			
G	89.09	50.21	1.09	88.69	49.52	1.03	6.54	14.54	25.61	288	379		4435	4315	9630	9221		3.90	2.50	2.93	13.67		23.37	0.16		48.29	0.33			
H				90.40	51.40	1.10	6.00	14.50	25.30			340		4200		8000		3.85	2.37	2.94	12.60		22.37			45.80				
H				86.90	49.50	1.10	5.70	13.90	24.20			340		4200		8000		3.83	2.31	2.93	12.62		22.43			45.54				
H				88.20	50.20	1.10	5.80	14.20	24.70			340		4100		8000		3.82	2.25	2.96	12.65		22.59			45.45				
H				87.00	49.80	1.10	5.80	14.10	24.60			350		4100		8000		3.75	2.30	2.92	12.58		22.35			45.14				
H				87.70	50.30	1.10	5.80	14.30	24.60			350		4100		8200		3.77	2.28	2.94	12.72		22.41			44.50				
H				88.20	50.40	1.00	5.80	14.40	25.00			350		4200		7900		3.80	2.23	2.95	12.57		22.37			45.44				
H				87.80	49.90	1.00	5.70	14.20	24.80			360		4100		7900		3.80	2.26	2.95	12.61		22.50			45.70				
H				86.40	49.70	1.10	5.70	14.00	24.50			350		4000		7900		3.74	2.24	2.93	12.57		22.24			44.67				
M	77.82	47.39	0.98	83.32	46.80	1.17	5.74	14.09	23.29	322	268		4115	4094	4129	7858	7638	8422	3.99	2.30	2.89	12.65	0.07	22.41	0.15	0.24	47.35	0.32	5.29	
M	78.05	45.89	1.05	83.34	46.72	1.23	5.75	14.34	23.55	320	272		4027	4074	4121	7860	7642	8413	4.06	2.32	2.87	12.67	0.07	22.38	0.15	0.24	47.41	0.32	5.32	3.17
M	80.32	47.68	1.01	84.29	46.25	1.20	5.81	14.16	23.32	320	274		4034	4198	4129	7752	7654	8433	4.02	2.30	2.87	12.59	0.07	22.24	0.15	0.24	47.44	0.31	3.21	
M	90.08	53.15	1.10	84.02	47.03	1.20	5.77	14.52	23.45	314	273		3932	4172	4108	7713	7665	8410	4.04	2.29	2.87	12.60	0.07	22.22	0.15	0.23	47.30	0.32	5.30	3.17
M	83.61	48.46	1.07	81.65	46.25	1.15	5.65	14.06	22.93	316	276		3854	4168	4100	7790	7609	8426	4.01	2.31	2.89	12.69	0.08	22.49	0.15	0.23	47.55	0.31	3.30	3.16
M	79.88	48.63	1.02	79.53	45.12	1.07	5.36	14.04	22.22	319	280		4066	4242	4125	7941	7883	8451	4.01	2.30	2.88	12.58	0.07	22.33	0.15	0.24	47.31	0.31	3.32	3.15
M	82.53	47.63	1.06	80.58	45.67	1.10	5.49	13.99	23.17	314	274		3990	4188	4108	7671	7673	8415	4.05	2.30	2.90	12.71	0.07	22.40	0.15	0.23	47.55	0.32	5.31	3.23
M	85.48	48.18	1.09	81.82	45.75	1.12	5.49	13.88	22.68	312	275		4003	4203	4120	7653	7684	8393	4.00	2.32	2.90	12.68	0.07	22.46	0.15	0.23	47.50	0.31	5.24	3.21
N	87.27	49.75	1.10	83.94	48.48	1.15	5.45	14.38	23.37																					
N	88.95	49.78	1.10	88.13	50.34	1.21	5.62	15.00	25.01																					
N	89.05	49.19	1.08	88.66	50.62	1.23	5.80	15.12	24.80																					
N	87.96	50.47	1.15	89.15	48.99	1.24	5.72	14.92	24.28																					
N	89.38	50.02	1.18	85.03	48.27	1.23	5.62	14.89	24.35																					
N	89.97	49.64	1.16	86.33	50.14	1.22	5.65	14.78	24.34																					
N	89.12	49.34	1.17	85.22	49.11	1.16	5.63	15.04	24.49																					
N	88.28	49.32	1.15	86.88	49.83	1.16	5.73	14.97	24.47																					
O				84.20	51.60	1.15	5.43	13.60	23.60		300	300		4200	4200	7800	8400	3.96	2.29	2.79	12.60	0.07	22.40	0.16	0.22	46.30	0.32	6.51		
O				85.20	51.50	1.12	5.76	14.00	23.70		290	400		4200	4100	7600	8400	3.95	2.30	2.79	12.70	0.07	22.20	0.15	0.21	46.20	0.31	6.45		
O				84.60	50.20	1.15	5.78	13.80	24.20		290	400		4100	4100	7500	8200	3.92	2.29	2.78	12.70	0.07	22.40	0.15	0.21	46.40	0.31	6.31		
O				87.10	49.90	1.21	6.05	14.30	25.10		300	400		4400	4100	7600	8200	3.97	2.29	2.79	12.70	0.07	22.20	0.15	0.22	46.30	0.31	6.38		
O				82.10	51.70	1.14	5.73	13.70	23.30		290	300		4200	4200	7600	8300	4.01	2.28	2.78	12.70	0.07	22.10	0.15	0.20	46.20	0.31	6.17		
O				83.60	50.90	1.21	5.96	14.00	23.40		290	300		4200	4100	7600	8400	3.98	2.27	2.77	12.70	0.07	22.10	0.18	0.21	45.70	0.31	6.40		
O				84.20	51.10	1.23	5.31	12.90	23.30		280	300		4000	4200	7600	8500	3.97	2.28	2.92	12.70	0.07	22.20	0.16	0.23	46.20	0.31	6.36		
O				85.10	51.70	1.14	5.65	13.40	24.60		300	400		4300	4300	7700	8400	3.93	2.28	2.79	12.70	0.07	22.40	0.16	0.22	46.20	0.31	6.74		
P	89.60	50.60	1.26	91.10	52.30	1.23	5.20	14.10	23.60	300	309	400	4100	3940	2300	9680	10100	8100	3.92	2.24	2.94	12.70	0.09	21.20	0.15	0.21	46.30	0.31	6.95	3.07
P	90.00	51.60	1.29	88.20	51.30	1.19	5.24	14.10	23.10	291	312	300	3920	3970	2500	9730	10400	8600	3.93	2.23	2.92	12.70	0.09	21.20	0.15	0.23	46.10	0.32	7.01	3.06
P	89.90	51.10	1.27	88.40	51.50	1.20	5.44	14.10	23.00	295	312	300	3930	4000	2300	9620	10100	8300	3.91	2.21	2.91	12.50	0.09	21.00	0.15					

Assay data (cont)

Lab Code	Pt Pb Coll g/t	Pd Pb Coll g/t	Au Pb Coll g/t	Pt NIS g/t	Pd NIS g/t	Au NIS g/t	Ir NIS g/t	Rh NIS g/t	Ru NIS g/t	Co M/ICP ppm	Co P ppm	Co XRF ppm	Cu M/ICP ppm	Cu P ppm	Cu XRF ppm	Ni M/ICP ppm	Ni P ppm	Ni XRF ppm	Al2O3 XRF %	CaO XRF %	Cr2O3 XRF %	Fe2O3 XRF %	K2O XRF %	MgO XRF %	MnO XRF %	Na2O XRF %	SiO2 XRF %	TiO2 XRF %	LOI %	SG pyc
Y				77.60	46.70	0.89	5.87	10.92	22.80			310			3830			8890	3.46	2.72	3.06	13.43								
Y				78.30	45.80	0.89	5.81	10.30	22.50			330			3830			9470	3.44	2.76	3.17	13.95								
Y				78.80	45.80	0.91	5.99	10.46	22.50			310			3800			8720	3.50	2.62	2.95	13.10								
Y				75.00	45.00	0.91	6.09	11.21	22.00			300			3950			9080	3.59	2.73	3.08	13.63								
Y				78.70	47.10	0.92	5.88	11.00	23.10			290			3760			8910	3.40	2.66	3.03	13.29								
Y				76.90	45.30	0.96	5.94	11.84	22.40			280			3600			8890	3.27	2.75	2.98	13.18								
Y				79.80	47.60	0.97	5.99	10.87	23.00			260			3690			9170	3.31	2.50	2.81	12.48								
Y				84.30	51.00	1.06	5.55	10.82	23.90						3170			7730	2.87	2.28	2.54	11.29								
Z										301	284		3920	4290			7880	7740												
Z										315	294		4040	4290			8060	7910												
Z										302	279		3940	4360			7870	7980												
Z										296	296		3900	4326			7690	7900												
Z										313	288		3980	4410			8050	7990												
Z										307	283		4010	4230			7890	7850												
Z										306	278		4010	4400			7950	7970												
Z										302	290		3940	4250			7830	7860												

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

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

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

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

Analyte	Method	Unit	S ¹	σ _L ²	SW ³	CSU ⁴
Pt	Pb Coll	g/t	3.672	2.620	2.337	0.870
Pd	Pb Coll	g/t	1.180	0.809	0.773	0.271
Au	Pb Coll	g/t	0.054	0.039	0.034	0.013
Pt	NIS	g/t	2.926	2.646	1.342	0.952
Pd	NIS	g/t	2.310	1.966	1.088	0.668
Au	NIS	g/t	0.062	0.048	0.040	0.018
Ir	NiS	g/t	4.140	0.153	0.182	0.059
Rh	NiS	g/t	3.366	0.434	0.289	0.169
Ru	NiS	g/t	4.248	0.919	0.487	0.331
Co	M/ICP	ppm	11.234	8.005	6.502	2.515
Co	P	ppm	17.178	14.367	5.289	4.369
Co	XRF	ppm	25.235	26.278	8.891	10.007
Cu	M/ICP	ppm	106.58	80.830	60.187	26.465
Cu	P	ppm	92.372	62.255	58.800	19.824
Cu	XRF	ppm	173.70	184.91	50.533	70.234
Ni	M/ICP	ppm	282.06	217.80	175.39	75.526
Ni	P	ppm	147.67	109.29	94.712	38.199
Ni	XRF	ppm	256.92	252.60	96.399	90.116
Al2O3	XRF	%	0.065	0.057	0.028	0.019
CaO	XRF	%	0.046	0.039	0.018	0.012
Cr2O3	XRF	%	0.057	0.050	0.020	0.016
Fe2O3	XRF	%	0.166	0.141	0.053	0.045
K2O	XRF	%	0.011	0.010	0.003	0.003
MgO	XRF	%	0.230	0.177	0.126	0.058
MnO	XRF	%	0.005	0.005	0.003	0.002
Na2O	XRF	%	0.065	0.066	0.014	0.024
SiO2	XRF	%	0.664	0.581	0.204	0.185
TiO2	XRF	%	0.005	0.003	0.004	0.001
LOI	XRF	%	0.759	0.791	0.105	0.280
SG	pyc		0.103	0.110	0.035	0.042

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

13. Certified values: The Certified, Provisional and Indicated values listed on p1 and p2 of this certificate fulfill the AMIS statistical criteria regarding agreement for certification and have been independently validated by Dr Barry Smee.

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

15. Certification: AMIS0150 is a new material.

16. Period of validity: The certified values are valid for this product, while still sealed in its original packaging, until notification to the contrary. The stability of the material will be subject to continuous testing for the duration of the inventory. Should product stability become an issue, all customers will be notified and notification to that effect will be placed on the www.amis.co.za website.

17. Minimum sample size: The majority of laboratories reporting used a 0.5g sample size for the ICP and a 30g sample size for the fire assay. These are the recommended minimum sample sizes for the use of this material.

18. Availability: This product is available in Laboratory Packs containing 1kg of material and Explorer Packs containing custom weights (from 50 to 250g) of material. The Laboratory Packs are sealed bottles delivered in sealed foil pouches. The Explorer Packs contain material in standard geochem envelopes, nitrogen flushed and vacuum sealed in foil pouches.

19. Recommended use: The data used to characterize this CRM has been scrutinized using outlier treatment techniques. This, together with the number of participating laboratories, should overcome any "inter-laboratory issues" and should lead to a very accurate measure for the given methods, notwithstanding the underlying assumption that what the good inter-laboratory labs reported was accurate. However an amount of bad data might have had an effect, resulting in limits which in some situations might be too broad for the effective monitoring of a single analytical method, laboratory or production process. Users should set their own limits based on their own data quality objectives and control measurements, after determining the performance characteristics of their own particular method, using a minimum of 20 analyses using this CRM. User set limits should normally be within the limits recommended on p1 and 2 of this certificate.

20. Legal Notice: This certificate and the reference material described in it have been prepared with due care and attention. However AMIS, Set Point Technology (Pty) Ltd, Mike McWha, Dr Barry Smee and Smee and Associates Ltd; accept no liability for any decisions or actions taken following the use of the reference material.

9 July 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 – uncertified trace element statistics

See below the multi element trace element data submitted by five of the round robin laboratories, for informational use only.

Analyte	Method	Unit	Mean	2SD	RSD%	n
Ag	M/ICP	ppm	0.83			8
Al	M/ICP	%	1.8	0.5	14.9	32
As	M/ICP	ppm	11.7	4.0	17.0	24
Ba	M/ICP	ppm	44.9	20.1	22.4	24
Be	M/ICP	ppm	0.20			7
Bi	M/ICP	ppm	1.1	0.1	6.5	15
Ca	M/ICP	%	1.7	0.2	7.4	32
Cd	M/ICP	ppm	0.90	0.21	11.7	16
Ce	M/ICP	ppm	3.4	0.3	4.1	16
Cr	M/ICP	ppm	18831	1806	4.8	23
Cs	M/ICP	ppm	0.29	0.10	17.9	16
Dy	M/ICP	ppm	0.55			8
Er	M/ICP	ppm	0.40			8
Eu	M/ICP	ppm	0.11			8
Fe	M/ICP	%	9.6	0.9	4.9	31
Ga	M/ICP	ppm	4.5	1.9	21.2	16
Ge	M/ICP	ppm	0.55	0.24	22.1	16
Hf	M/ICP	ppm	1.1	1.6	74.5	16
Ho	M/ICP	ppm	0.12			8
In	M/ICP	ppm	0.09	0.02	8.9	16
K	M/ICP	%	0.06	0.01	4.6	23
La	M/ICP	ppm	1.6	0.2	4.9	16
Li	M/ICP	ppm	6.7	2.1	16.0	16
Lu	M/ICP	ppm	0.09	0.01	4.2	15
Mg	M/ICP	%	13.1	0.8	3.1	31
Mn	M/ICP	ppm	1125	243	10.8	32
Mo	M/ICP	ppm	2.0	1.4	33.7	21
Na	M/ICP	%	0.17	0.01	2.3	22
Nb	M/ICP	ppm	0.82	0.68	41.2	16
Nd	M/ICP	ppm	1.7			8
P	M/ICP	ppm	78.7	11.6	7.4	16
Pb	M/ICP	ppm	125	16	6.3	24
Pr	M/ICP	ppm	0.40			8
Rb	M/ICP	ppm	2.2	0.5	11.6	16
Re	M/ICP	ppm	0.02			7
S	M/ICP	%	1.5			8
Sb	M/ICP	ppm	14.5	4.0	13.7	24
Sc	M/ICP	ppm	23.1	1.5	3.2	15
Se	M/ICP	ppm	6.0			7
Si	M/ICP	%	22.6			8
Sm	M/ICP	ppm	0.41			8
Sn	M/ICP	ppm	0.57	0.14	12.3	15
Sr	M/ICP	ppm	22.2	3.9	8.7	24
Ta	M/ICP	ppm	0.61	1.16	95.0	16
Tb	M/ICP	ppm	0.09	0.02	12.8	16
Te	M/ICP	ppm	1.9	0.5	12.5	16
Th	M/ICP	ppm	1.1	0.2	10.7	16
Ti	M/ICP	%	0.16	0.05	15.0	24
Tl	M/ICP	ppm	0.25	0.01	2.7	14
Tm	M/ICP	ppm	0.06			7
U	M/ICP	ppm	0.70	0.03	2.2	14
V	M/ICP	ppm	201	53	13.3	24
W	M/ICP	ppm	0.76	0.52	34.5	16
Y	M/ICP	ppm	2.8	0.4	6.6	16
Yb	M/ICP	ppm	0.68	0.48	35.6	24
Zn	M/ICP	ppm	453	42	4.7	24
Zr	M/ICP	ppm	10.3	1.7	8.4	16