

# AMIS0010

## Certificate of Analysis

### UG2 Reef (high feed grade) PGE Reference Material

#### Recommended Concentrations and two "Between Laboratory" Standard Deviations

#### Certified Concentrations

Platinum	2.05 ± 0.29 g/t	(NIS Collection)
Platinum	2.13 ± 0.20 g/t	(Pb Collection)
Palladium	1.33 ± 0.10 g/t	(NIS Collection)
Palladium	1.32 ± 0.15 g/t	(Pb Collection)
Chromium	15.84 ± 1.08%	(XRF)
Chromium	15.77 ± 0.62%	(Fusion ICP)
Copper	755 ± 55 ppm	(Partial Acid Digestion*)
Copper	750 ± 66 ppm	(Total Acid Digestion)
Copper	778 ± 43 ppm	(Fusion ICP)
Nickel	175 ± 23 ppm	(Partial Acid Digestion)
Nickel	1116 ± 118 ppm	(XRF)
Nickel	1112 ± 131 ppm	(Fusion ICP)
Cobalt	859 ± 88 ppm	(Partial Acid Digestion)
Specific Gravity	3.74 ± 0.24 gm/cc	

#### Provisional Concentrations

Rhodium	0.41 ± 0.08 g/t	
Ruthenium	0.80 ± 0.14 g/t	
Iridium	0.170 ± 0.036 g/t	
Copper	716 ± 146 ppm	(XRF)
Nickel	1084 ± 166 ppm	(Total Acid Digestion)
Cobalt	1023 ± 207 ppm	(Total Acid digestion)
Cobalt	1099 ± 156 ppm	(Fusion ICP)

#### Indicated Means

Gold	0.026 g/t	(NIS Collection)
Gold	0.025 g/t	(Pb collection)

\* Please note that this value difference between the weaker extraction and the 4 acid extraction is due to AAS and ICP calibration at most of the laboratories.

**Intended Use:** AMIS-10 is suitable for monitoring the accuracy of a single analysis of PGE, Cu and Ni ores hosted by UG2 Reef or other similar chromitite rich mafic rocks. The material can be used for routine quality control by inserting within a batch of samples, method development and for the calibration of equipment.

The recommended mean and "Between Lab" standard deviations for this standard reflect the average 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 and this is acceptable. Good laboratories however will report results within the two standard deviation levels with a failure of <10 %.

**Origin of Material:** This standard was made using Pt/Pd rich UG2 chromitite (UG2) material supplied by Anglo Platinum Limited from the Western limb of the Bushveld Complex. This specific material was made from a bulk sample collected underground from the East Shaft section of the Waterval Mine.

**Approximate Mineral and Chemical Composition:** AMIS-10 comprises approximately 50% UG2 Chromitite seam, 45% pegmatoidal pyroxenite footwall and 5% pyroxenite hanging wall. The UG2 Chromitite is composed of chromite (60-90% by volume), orthopyroxene (5-25%), plagioclase (5-15%) as well as accessory amounts of other minerals, of which the more important are clinopyroxene, base metal sulphides, platinum-group minerals, ilmenite and magnetite. The base metal sulphides are predominantly pentlandite, pyrrhotite, pyrite, chalcopyrite and to a lesser extent millerite. The Platinum Group Minerals identified in the UG2 are cooperite, laurite, braggite, Pt-Fe Alloy and sperrylite.

SiO <sub>2</sub> %	Cr <sub>2</sub> O <sub>3</sub> %	FeO %	Al <sub>2</sub> O <sub>3</sub> %	MgO %	CaO %	Na <sub>2</sub> O %	MnO %	TiO <sub>2</sub> %
26.3	23.7	19.2	14.8	13.3	3.1	0.9	0.8	0.7
		K <sub>2</sub> O %	V <sub>2</sub> O <sub>5</sub> %	P <sub>2</sub> O <sub>5</sub> %	CL %	H <sub>2</sub> O LOI %	S %	
		0.5	0.2	0.0	0.0	-1.08	<0.01	

**Appearance:** The material is a very fine powder. It is coloured a light brownish grey (Munsell 5YR 6/1, Corstor 5YR 6/2).

**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 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.

**Method of Analysis:**

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. Cu and Ni. Multi-acid total digestion, including HF, with ICP-OES finish.
4. Cu and Ni. Aqua regia digestion with ICP-OES finish.
5. Cr, Co, Cu and Ni. Pressed pellet XRF.
6. Cr, Co, Cu and Ni. Fusion, ICP-OES or ICP-MS
7. Specific Gravity. Gas pycnometer.

**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.

**Method of Certification:** 19 laboratories were each given eight randomly selected packages of sample and results were used for the determinations below. Round robin results for the analyses that resulted in Certification are displayed. These include:

- Pt and Pd by the NiS method;
- Pt and Pd analyses by the Pb collection method;
- Cu, Ni, Co and Cr by the aqua regia digestion method (P), the multi-acid digestion method (T), the Fusion ICP method (F) and by XRF.
- SG by either water or gas displacement in a pynometer.

Lab	Pt (NiS) ppm	Pt (Pb Collection) ppm	Pd (NiS) ppm	Pd (Pb Collection) ppm	Cr (XRF) %	Cr (F) %	Cu ( T ) ppm	Cu ( P ) ppm	Cu ( F ) ppm	Ni ( P ) ppm	Ni (XRF) ppm	Ni ( F ) ppm	Co ( P ) ppm	Specific Gravity gm/cc
A	2.200	1.990	1.340	1.300	15.40	15.70	780	786	800	168	1090	1200	842	3.63
A	2.210	2.040	1.350	1.340	15.50	15.50	820	782	780	164	1100	1150	828	3.66
A	2.090	1.970	1.250	1.270	15.50	15.50	810	778	780	164	1110	1100	818	3.64
A	2.030	2.110	1.240	1.340	15.50	15.90	805	772	800	170	1210	1250	824	3.63
A	2.200	2.140	1.330	1.350	15.50	16.10	790	800	780	170	1120	1250	854	3.65
A	2.200	2.040	1.390	1.240	15.40	15.80	775	780	780	164	1090	1200	810	3.65
A	2.070	1.990	1.250	1.190	15.50	15.60	800	786	820	160	1110	1100	810	3.63
A	1.980	1.960	1.210	1.160	15.50	15.90	790	794	800	168	1110	1150	840	3.61
B	1.850	2.160	1.230	1.240										3.72
B	1.620	2.160	1.100	1.400										3.73
B	1.740	2.070	1.180	1.360										3.72
B	1.880	2.160	1.230	1.410										3.72
B	1.960	2.090	1.280	1.360										3.72
B	1.850	2.060	1.220	1.370										3.70
B	1.710	2.160	1.290	1.430										3.72
B	1.840	2.170	1.180	1.430										3.70
C		2.160		1.310		15.90	776	789	780	194		1150	953	
C		1.910		1.155		15.80	744	777	800	184		1120	933	
C		1.965		1.215		15.30	735	763	750	177		1080	921	
C		2.040		1.245		15.75	738	785	760	186		1150	936	
C		1.900		1.145		15.75	741	787	770	185		1120	945	
C		2.160		1.330		15.75	738	790	790	188		1120	955	
C		2.110		1.290		15.70	740	780	790	186		1130	942	
C		1.825		1.125		15.80	769	778	770	186		1140	934	
D	2.220	2.230	1.420	1.390	15.39		712	727		175	1154		902	
D	2.330	2.230	1.440	1.380	15.43		716	725		174	1145		901	
D	2.440	2.230	1.520	1.400	15.42		698	726		178	1166		909	
D	2.350	2.280	1.450	1.390	15.40		683	756		180	1138		945	
D	2.440	2.220	1.510	1.370	15.41		675	742		178	1138		926	
D	2.350	2.300	1.430	1.400	15.41		688	734		177	1145		911	
D	2.450	2.290	1.510	1.420	15.42		676	729		177	1160		908	
D	2.500	2.280	1.540	1.400	15.40		682	731		178	1148		909	

Lab	Pt (NIS) ppm	Pt (Pb Collection) ppm	Pd (NIS) ppm	Pd (Pb Collection) ppm	Cr (XRF) %	Cr (F) %	Cu ( T ) ppm	Cu ( P ) ppm	Cu ( F ) ppm	Ni ( P ) ppm	Ni (XRF) ppm	Ni ( F ) ppm	Co ( P ) ppm	Specific Gravity gm/cc
E		2.280		1.300		15.36	724	741	788	178		1118	865	
E		2.200		0.870		15.26	730	740	745	178		1104	868	
E		2.050		0.950		15.46	738	738	836	176		1210	867	
E		2.040		0.800		15.44	736	744	817	171		1166	865	
E		2.140		0.800		15.52	737	745	782	175		1161	866	
E		2.240		0.820		15.01	721	738	724	173		1128	847	
E		2.060		1.180		14.98	737	735	823	175		1108	852	
E		2.280		1.230		15.11	727	727	773	170		1126	857	
F	1.791	1.964	1.143	1.323		15.56		740	762	207		1287	813	3.64
F	1.710	1.985	1.050	1.332		15.99		730	753	211		1325	801	3.60
F	1.950	1.854	1.090	1.249		16.02		730	761	205		1314	804	3.65
F	1.828	1.875	1.175	1.254		16.02		740	762	205		1312	791	3.63
F	1.726	1.960	1.185	1.310		15.61		740	763	203		1201	808	3.63
F	1.771	1.998	1.161	1.323		15.50		740	742	204		1137	798	3.63
F	1.850	1.992	0.930	1.318		15.23		740	735	197		1162	784	3.61
F	1.787	1.948	1.151	1.299		16.00		730	751	199		1147	800	3.63
G		2.280		1.460	16.00		810	726		201	1120		838	
G		2.270		1.460	16.00		778	740		193	1080		832	
G		2.220		1.420	16.10		776	728		196	1120		844	
G		2.260		1.450	16.10		784	733		201	1110		854	
G		2.280		1.460	15.90		745	730		201	1090		849	
G		2.300		1.450	16.00		750	736		204	1210		858	
G		2.240		1.420	16.10		755	722		201	1120		839	
G		2.270		1.470	16.10		755	722		200	1130		844	
H		1.930		1.170			709	719		183			811	
H		2.150		1.300			724	714		180			821	
H		2.070		1.270			714	707		174			815	
H		2.010		1.220			714	713		178			813	
H		1.860		1.140			709	705		174			799	
H		2.160		1.300			704	720		170			806	
H		1.830		1.120			712	716		182			813	
H		2.100		1.260			692	719		170			808	
I		2.352		1.384							1164			
I		2.200		1.328							1171			
I											1169			
I		2.170		1.284							1180			
I		2.501		1.270							1170			
I		2.391		1.300							1160			
I		2.048		1.207							1140			
I		2.134		1.211										
J	1.946	2.005	1.274	1.247	15.70		715	752		159	1100		920	3.92
J	2.041	1.986	1.314	1.225	15.90		726	722		152	1100		910	3.88
J	2.058	1.989	1.317	1.233	16.10		730	742		156	1100		920	3.98
J	1.984	2.106	1.292	1.319	16.10		712	750		156	1100		920	3.88
J	2.103	2.169	1.356	1.319	16.10		725	754		157	1000		900	3.85
J	2.056	2.167	1.317	1.324	16.20		715	759		159	1100		910	3.82
J	2.111	2.057	1.371	1.300	16.20		691	749		155	1200		920	3.84
J	2.086	2.057	1.357	1.267	15.70		663	753		157	1100		910	3.81
K		1.395		0.886		15.55	789	776	750	179		1120	889	3.65
K		1.715		1.080		15.60	781	781	780	177		1150	887	3.50
K		1.755		1.100		15.40	765	779	740	180		1170	890	3.62
K		1.670		1.040		15.70	782	780	760	179		1120	889	3.57
K		1.695		1.050		14.95	782	785	750	177		1080	889	3.63
K		1.685		1.040		15.35	785	803	760	181		1080	913	3.69
K		1.480		0.916		15.45	786	790	750	180		1110	897	3.62
K		1.565		0.964		15.45	792	781	740	179		1090	891	3.48
L		2.230		1.390				879		179	1050		990	3.81
L		2.210		1.380				781		178	1030		886	3.80
L		2.230		1.390				792		181	1060		894	3.82
L		2.230		1.360				773		179	1050		874	3.81
L		2.090		1.290				761		177	1050		861	3.80
L		2.130		1.330				792		183	1060		894	3.79
L		2.160		1.340				789		182	1040		892	3.79
L		2.210		1.390				763		175	1050		860	3.80

Lab	Pt (NIS) ppm	Pt (Pb Collection) ppm	Pd (NIS) ppm	Pd (Pb Collection) ppm	Cr (XRF) %	Cr (F) %	Cu ( T ) ppm	Cu ( P ) ppm	Cu ( F ) ppm	Ni ( P ) ppm	Ni (XRF) ppm	Ni ( F ) ppm	Co ( P ) ppm	Specific Gravity gm/cc
M	2.076		1.300		14.40		724	729		161	1203		827	
M	2.077		1.309		14.30		764	715		157	1201		820	
M	2.088		1.315		14.40		733	715		158	1199		833	
M	2.061		1.314		14.50		726	736		161	1194		865	
M	2.066		1.306		14.50		719	730		161	1202		838	
M	2.077		1.326		14.60		710	717		160	1196		831	
M	2.052		1.308		14.40		805	730		162	1196		870	
M	2.073		1.308		14.60		711	729		163	1205		863	
N	2.000	2.120	1.360	1.340	16.20	16.20	750	800	800	160		1000	870	3.92
N	1.910	2.160	1.300	1.390	16.30	15.90	770	800	900	160		1000	850	3.84
N	1.900	2.040	1.360	1.310	16.30	16.40	740	800	800	160		1200	890	3.81
N	1.940	2.130	1.360	1.350	16.20	16.40	740	790	800	160		1100	810	3.82
N	1.870	2.100	1.320	1.330	16.20	16.00	740	740	800	160		1100	840	3.79
N	1.930	2.070	1.360	1.380	16.20	16.20	750	760	800	150		1200	800	3.80
N	2.110	2.160	1.310	1.370	16.50	16.00	770	760	800	160		900	880	3.78
N	2.050	2.160	1.360	1.360	16.30	16.00	740	790	800	160		1000	840	3.78
O	2.329	2.045	1.378	1.329		16.22	754	752	803	179		1153	794	3.86
O	2.281	2.161	1.367	1.316		15.95	770	742	782	177		1149	787	3.85
O	2.316	2.138	1.381	1.357		16.28	773	756	802	179		1196	799	3.92
O	2.288	2.047	1.374	1.302		16.12	790	766	784	182		1143	807	3.90
O	2.226	2.134	1.355	1.289		16.01	772	749	786	177		1161	786	3.91
O	2.238	2.179	1.336	1.312		16.11	756	769	777	182		1149	805	3.84
O	2.203	2.073	1.310	1.351		15.98	766	753	780	179		1187	794	3.82
O	2.255	2.258	1.325	1.325		15.92	765	739	784	181		1140	780	3.87
P		2.223		1.320		26.60		1021	1021	191		1071	982	3.33
P		2.168		1.326		26.61		1028	1028	184		1038	976	3.39
P		2.186		1.339		26.21		990	990	184		1041	980	3.55
P		2.194		1.315		27.36		989	989	185		1061	984	3.55
P		2.224		1.346		27.47		994	994	183		1089	982	3.54
P		2.247		1.366		27.18		943	943	182		968	975	3.44
P		2.224		1.331		27.58		960	960	183		1031	971	3.50
P		2.204		1.320		27.76		973	973	185		1071	979	3.48
Q	2.101	2.105	1.318	1.296	16.50		801	776	762	166	1025	992	858	3.82
Q	1.998	2.199	1.425	1.333	16.40		804	791	771	169	1035	1043	879	3.81
Q	2.132	2.109	1.306	1.310	16.50		778	789	769	170	1036	1000	873	3.82
Q	2.125	2.073	1.327	1.298	16.50		790	799	785	172	1013	1027	893	3.81
Q	2.020	2.151	1.314	1.309	16.50		764	787	802	172	1043	1048	881	3.81
Q	2.224	2.148	1.435	1.302	16.50		767	773	762	166	1040	1021	873	3.81
R														
R														
S	2.152		1.345											
S	2.141		1.336											
S	2.120		1.309											
S	2.157		1.337											
S	2.131		1.340											
S	2.125		1.319											
S	2.159		1.326											
S	2.141		1.318											

The mean and standard deviation for all data was calculated. Outliers were defined as samples beyond the mean  $\pm$  2 Standard Deviations from all data. These outliers were removed from the data (shown in red) and a new mean and standard deviation was determined. This method is different from that used to calculate the Confidence Interval shown on many Government-produced standards in that the actual "between-laboratory" standard deviation is used in the calculations. This produces upper and lower limits that reflect actual individual analyses rather than a grouped set of analyses. The limits can therefore be used to monitor accuracy from individual analyses, unlike the Certified Limits published on other standards which quote a Confidence Interval.

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

Anglo American Research Laboratories ( Pty ) Ltd. (South Africa).  
ACME Analytical Laboratories Ltd. (Canada).  
ALS Chemex (Canada).  
ALS Chemex South Africa ( Pty ) Ltd.  
Anglo Platinum Research Center (ARC, South Africa).  
Assayers Canada.  
Eastern Bushveld Research Laboratory (EBRL, Anglo Platinum).  
Genalysis Laboratory Services ( Pty ) Ltd. (Australia).  
Geoscience Laboratories (Geo Labs, Canada).  
Geological Survey of Finland (GTK) Geoservices, Assay Laboratory.  
Innovative Metallurgical Products (Pty) Ltd. (South Africa).  
Mintek (South Africa).  
Muoro Analytical Services (South Africa).  
Omac Laboratories Limited (Ireland)  
Set Point Laboratories ( Pty ) Ltd. (South Africa).  
SGS Welshpool Minerals (Pty) Ltd. (Australia).  
SGS Lakefield Research Africa ( Pty ) Ltd. (South Africa).  
SGS Lakefield Research (Canada).  
Ultra Trace ( Pty ) Ltd. (Australia).

**Availability:** This product is available in Laboratory Packs containing 1kg of material and Explorer Packs containing custom weights (of <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.

**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.

14 March 2006

**Certifying Officers:**



**African Mineral Standards:** \_\_\_\_\_

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



**Geochemist:** \_\_\_\_\_

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