

## AMIS0006

### *Certificate of Analysis*

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

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

#### *Certified Concentrations*

Platinum	1.43 ± 0.15 g/t	(NIS Collection)
Platinum	1.38 ± 0.14 g/t	(Pb Collection)
Palladium	0.93 ± 0.13 g/t	(NIS Collection)
Palladium	0.91 ± 0.08 g/t	(Pb Collection)
Rhodium	0.29 ± 0.03 g/t	
Iridium	0.10 ± 0.01 g/t	
Copper	820 ± 56 ppm	(Partial Acid Digestion)
Copper	823 ± 82 ppm	(Total Acid Digestion)
Copper	838 ± 79 ppm	(Fusion ICP)
Nickel	853 ± 79 ppm	(Fusion ICP)
Cobalt	1210 ± 57 ppm	(Fusion ICP)
Specific Gravity	3.46 ± 0.22 gm/cc	

#### *Provisional Concentrations*

Ruthenium	0.42 ± 0.08 g/t	
Chromium	7.94 ± 0.41%	(Fusion ICP)
Chromium	7.89 ± 0.35%	(XRF)
Nickel	131 ± 14 ppm	(Partial Acid Digestion)
Nickel	797 ± 178 ppm	(Total Acid Digestion)
Nickel	820 ± 65 ppm	(XRF)
Cobalt	1070 ± 118 ppm	(Partial digestion)
Cobalt	1165 ± 174 ppm	(Total digestion)

#### *Indicated Means*

Gold	0.02 g/t	(Pb collection)
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**Intended Use:** AMIS-6 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-7 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.

AL2O3 % ICP	Na2O % ICP	Fe % Titr.	MgO % ICP	Cr2O3 % Titr.	CaO % ICP	MnO % ICP	TiO2 % ICP	V2O5 % ICP
18	12.34	11.55	8.475	11.6*	2.06	0.34	0.195	0.06
		SiO2 % ICP	K2O % ICP	P2O5 % SQ	CL % S.Q	H2O LOI %	S % S.Q	
		0.035	0.02	0.02	0.01	-0.8	<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 <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.

**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. Specific Gravity. Gas pycnometer.

\* Corrected 29 Jan 2009. The Cr value was quoted on the original certificate. By applying the Cr oxide conversion factor of 1.4615 this value is 11.6%.

6. 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:** 20 laboratories were each given eight randomly selected packages of sample and various results from the 19 of those laboratories that reported back timeously were used for the determinations below. The following round robin results are displayed:

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

Lab Code	Pt (NIS) g/t	Pt (Pb Collection) g/t	Pd (NIS) g/t	Pd (Pb Collection) g/t	Rh g/t	Ir g/t	Cu (P) ppm	Cu (T) ppm	Cu (F) ppm	Ni (F) ppm	Co (F) ppm	SG gm/cc
A		1.428		0.933								
A		1.218		0.812								
A		1.323		0.883								
A		1.407		0.929								
A		1.302		0.859								
A		1.334		0.887								
A		1.323		0.884								
A		1.313		0.878								
B	1.520	1.320	1.010	0.965	0.281	0.105	866	885	860	800	1220	3.310
B	1.400	1.260	0.945	0.910	0.267	0.097	854	885	880	800	1200	3.310
B	1.460	1.300	1.070	0.890	0.282	0.100	854	870	880	800	1240	3.300
B	1.480	1.410	1.020	0.970	0.279	0.100	880	870	880	850	1260	3.320
B	1.520	1.340	1.030	0.955	0.289	0.104	850	870	860	850	1220	3.340
B	1.500	1.300	0.991	0.885	0.285	0.101	880	875	880	850	1260	3.310
B	1.510	1.380	1.020	0.950	0.286	0.104		880	860	850	1220	3.310
B	1.450	1.260	0.972	0.890	0.270	0.100	852	890	860	850	1220	3.310
C	1.380	1.260	0.933	0.929	0.291	0.101	853		821	811	1200	
C	1.320	1.240	0.913	0.923	0.287	0.094	838		788	812	1170	
C	1.380	1.270	0.934	0.918	0.291	0.100	848		788	826	1150	
C	1.330	1.310	0.923	0.935	0.285	0.097	858		788	820	1190	
C	1.390	1.280	0.939	0.938	0.292	0.101	850		780	811	1160	
C	1.390	1.270	0.940	0.934	0.299	0.100	833		818	808	1180	
C	1.380	1.300	0.928	0.946	0.292	0.101	845		805	804	1180	
C	1.400	1.290	0.946	0.950	0.299	0.102	831		809	805	1170	

Lab Code	Pt (NIS) g/t	Pt (Pb Collection) g/t	Pd (NIS) g/t	Pd (Pb Collection) g/t	Rh g/t	Ir (NiS) g/t	Cu (P) ppm	Cu (T) ppm	Cu (F) ppm	Ni (F) ppm	Co (F) ppm	SG gm/cc
D	2.340		1.290					900				3.41
D	1.570		0.880					900				3.41
D	1.600		0.800					900				3.43
D	1.990		1.050					900				3.44
D	1.540		0.860					900				3.42
D	2.610		1.220					900				3.41
D	1.290		0.740					900				3.42
D	1.360		1.060					900				3.43
E	1.419	1.361	0.936	0.892	0.272	0.107	842	813				3.410
E	1.438	1.394	0.920	0.906	0.270	0.100	842	840				3.410
E	1.403	1.374	0.942	0.904	0.273	0.112	851	853				3.410
E	1.436	1.401	0.917	0.916	0.268	0.099	810	874				3.410
E	1.368	1.376	0.917	0.902	0.265	0.122	792	805				3.400
E	1.398	1.368	0.919	0.891	0.277	0.120	828	813				3.410
E	1.418	1.364	0.890	0.902	0.273	0.108	819	848				3.410
E	1.403	1.382	0.939	0.909	0.267	0.116	815	866				3.410
F	1.471	1.113	0.943	0.707	0.295	0.101		754				
F	1.474	1.393	0.946	0.873	0.298	0.100		766				
F	1.439	1.314	0.928	0.851	0.292	0.094		763				
F	1.460	1.346	0.937	0.860	0.292	0.094		764				
F	1.464	1.352	0.925	0.891	0.292	0.100		765				
F	1.474	1.310	0.954	0.850	0.297	0.098		777				
F	1.457	1.275	0.948	0.837	0.296	0.099		776				
F	1.450	1.243	0.945	0.859	0.296	0.099		778				
G		1.502		0.839	0.275							
G		1.344		0.813	0.248							
G		1.478		0.825	0.264							
G		1.451		0.869	0.255							
G		1.495		0.843	0.250							
G		1.556		0.877	0.278							
G		1.423		0.854	0.264							
G		1.576		0.825	0.266							
H		1.430		0.970				880	900	850	1220	3.65
H		1.480		1.010				877	890	890	1250	3.66
H		1.490		1.020				860	900	890	1250	3.71
H		1.470		1.010				891	900	840	1180	3.66
H		1.450		0.982				874	870	850	1230	3.66
H		1.500		1.030				886	880	830	1160	3.64
H		1.490		1.030				889	880	840	1200	3.70
H		1.440		1.040				886	890	850	1170	3.67
I		1.315		0.884			838	814	820	850	1210	
I		1.285		0.887			828	823	810	840	1220	
I		1.305		0.892			826	816	820	880	1240	
I		1.330		0.897			829	785	840	860	1240	
I		1.325		0.885			825	811	810	850	1200	
I		1.350		0.890			823	815	810	850	1220	
I		1.370		0.913			836	837	810	830	1190	
I		1.400		0.900			830	828	820	850	1220	

Lab Code	Pt (NIS) g/t	Pt (Pb Collection) g/t	Pd (NIS) g/t	Pd (Pb Collection) g/t	Rh g/t	Ir (NiS) g/t	Cu (P) ppm	Cu (T) ppm	Cu (F) ppm	Ni (F) ppm	Co (F) ppm	SG gm/cc
J		1.470		0.950	0.26		944					
J		1.460		0.940	0.26		948					
J		1.460		0.930	0.21		949					
J		1.440		0.930	0.27		947					
J		1.440		0.940	0.27		929					
J		1.450		0.980	0.26		935					
J		1.450		0.950	0.25		930					
J		1.460		0.950	0.28		924					
K		1.286		0.899			818	824	890	860		
K		1.340		0.886			819	840	900	950		
K		1.322		0.915			807	760	840	890		
K		1.311		0.899			802	864	950	930		
K		1.366		0.925			803	847	840	890		
K		1.333		0.881			805	829	910	1010		
K		1.338		0.915			793	808	880	910		
K		1.296		0.880			799	816	900	960		
L	1.431	1.396	0.932	0.912	0.303	0.106	768	783	816	891	1246	3.57
L	1.435	1.413	0.925	0.908	0.302	0.108	779	789	807	928	1248	3.58
L	1.429	1.380	0.923	0.918	0.305	0.107	760	773	793	900	1237	3.55
L	1.401	1.413	0.905	0.918	0.297	0.105	785	782	831	939	1256	3.53
L	1.420	1.444	0.910	0.915	0.298	0.106	769	796	831	936	1305	3.54
L	1.419	1.429	0.914	0.917	0.300	0.106	780	773	787	870	1206	3.49
L	1.410	1.406	0.923	0.888	0.301	0.107	772	789	808	896	1241	3.53
L	1.418	1.426	0.919	0.925	0.303	0.108	794	802	822	858	1228	3.50
M	1.380	1.400	0.960	0.960	0.300	0.116	830	850	900	900	1200	3.44
M	1.370	1.420	0.950	0.950	0.310	0.112	840	800	900	800	1300	3.44
M	1.370	1.430	0.940	0.940	0.310	0.103	850	800	1000	800	1300	3.45
M	1.410	1.450	0.930	0.930	0.320	0.104	820	830	800	800	1100	3.44
M	1.360	1.440	0.890	0.890	0.310	0.112	860	810	800	800	1300	3.43
M	1.380	1.450	0.940	0.940	0.310	0.113	870	830	800	800	1200	3.44
M	1.410	1.410	0.970	0.970	0.310	0.115	850	780	700	700	1200	3.43
M	1.410	1.370	0.970	0.970	0.310	0.118	840	780	800	700	1200	3.43
N	1.460	1.390	0.940	0.940	0.290	0.100	850	800				3.59
N	1.480	1.480	0.940	0.960	0.300	0.100	810	770				3.58
N	1.470	1.460	0.980	0.950	0.300	0.100	830	830				3.66
N	1.520	1.460	0.930	0.960	0.300	0.100	800	770				3.70
N	1.520	1.440	0.930	0.940	0.300	0.100	830	780				3.59
N	1.480	1.520	0.930	0.990	0.290	0.100	830	810				3.58
N	1.460	1.490	0.920	0.960	0.290	0.100	790	770				3.79
N	1.490	1.470	0.980	0.940	0.300	0.100	840	780				3.51
O		1.375		0.893	0.292		813	880	810	850	1200	3.52
O		1.325		0.863	0.279		807	871	800	850	1180	3.58
O		1.325		0.865	0.303		789	855	800	860	1200	3.44
O		1.370		0.890	0.295		825	869	810	840	1170	3.43
O		1.350		0.889	0.234		809	887	800	850	1220	3.42
O		1.335		0.860	0.226		835	845	800	860	1220	3.40
O		1.335		0.871	0.306		817	881	820	840	1240	3.46
O		1.370		0.884	0.218		792	844	810	880	1200	3.39

Lab Code	Pt (NIS) g/t	Pt (Pb Collection) g/t	Pd (NIS) g/t	Pd (Pb Collection) g/t	Rh g/t	Ir (NiS) g/t	Cu (P) ppm	Cu (T) ppm	Cu (F) ppm	Ni (F) ppm	Co (F) ppm	SG gm/cc
P	1.516		0.983		0.303	0.108						
P	1.455		0.937		0.284	0.102						
P	1.463		0.851		0.299	0.102						
P	1.445		0.936		0.283	0.102						
P	1.489		0.925		0.291	0.106						
P	1.490		0.982		0.294	0.107						
P	1.502		0.939		0.286	0.104						
P	1.461		0.920		0.285	0.104						
Q		1.156	1.010	0.838	0.260		790	806				3.35
Q		1.149	0.900	0.843	0.280		800	773				3.29
Q		1.166	0.920	0.850	0.310		790	769				3.31
Q		1.045	0.620	0.758	0.270		780	802				3.33
Q		1.238	0.730	0.886	0.320		790	805				3.33
Q		1.089	0.800	0.788	0.256		780	820				3.32
Q		1.191	0.770	0.859	0.310		780	801				3.35
Q		1.111	0.850	0.820	0.290		790	813				3.36

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)

Amdel Limited (Australia).  
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).  
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.

23 November 2005

**Certifying Officers:**



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

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



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

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