

AMIS0008

Certificate of Analysis

Merensky Reef (ore grade) PGE Reference Material

Recommended Concentrations and two "Between Laboratory" Standard Deviations

Certified Concentrations

Platinum (Pb Collection): 8.66 ± 0.78 g/t
Palladium (Pb Collection): 4.36 ± 0.39 g/t
Rhodium: 0.68 ± 0.07 g/t

Copper (Total Digestion): 2262 ± 231 ppm
Copper (Partial Digestion): 2282 ± 156 ppm
Copper (Fusion): 2268 ± 189 ppm

Nickel (Total Digestion): 3782 ± 335 ppm
Nickel (Partial Digestion): 3426 ± 310 ppm
Nickel (Fusion): 3875 ± 307 ppm

Cobalt (Partial Digestion): 206 ± 21 ppm

Specific Gravity: 3.19 ± 0.24 gm/cc

Provisional Concentrations

Platinum (NiS Collection): 9.05 ± 0.91 g/t
Palladium (NiS Collection): 4.41 ± 0.56 g/t
Gold (Pb Collection): 0.36 ± 0.05 g/t
Ruthenium: 1.26 ± 0.12 g/t
Iridium: 0.235 ± 0.04 g/t
Cobalt (Total Digestion): 260 ± 30 ppm

Indicated concentration: Cr (fusion) - 1.27%

Intended Use: AMIS-8 is suitable for monitoring the accuracy of a single analysis of PGE, Cu and Ni ores hosted by Merensky Reef or other similar mafic rocks. The material can be used for routine quality control by inserting within a batch of samples, for method development and for the calibration of equipment.

The recommended mean and "Between Lab" standard deviations for this standard reflect the average results from 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 Merensky Reef material supplied by Anglo Platinum Limited from the Western limb of the Bushveld Complex. The Merensky Reef is a Pt/Pd ore. This specific material was collected underground from 9 Level, No 57 Cross Cut, Panel 9A, Boschfontein Mine.

Approximate Mineral and Chemical Composition: AMIS-8 comprises Merensky Reef hand sorted underground with minor dilution from footwall and hanging wall. 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.

Appearance: The material is a very fine powder light grey (Munsell N7) to light grey (Corstor 5Y 7/1).

Chemistry: The chemical composition is set out below.

SiO₂ %	MgO %	Fe₂O₃ %	Al₂O₃ %	CaO %	Cr₂O₃ %	Na₂O %	LOI H₂O %	S (SQ) %
50.10	18.70	12.46	9.55	5.66	1.91	1.08	0.66	0.52
	TiO₂ %	K₂O %	MnO %	V₂O₅ %	CL (SQ) %	P₂O₅ %		
	0.31	0.30	0.20	0.04	0.02	0.02		

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 99.7% <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 for both homogeneity and the consensus test results were carried out by independent statisticians.

Method of Analysis:

1. Pt, Pd and Au. Pb collection with Ag as a co-collector, ICP-OES or ICP-MS.
2. Pt, Pd, Au, Rh, Ru, Ir. NiS collection, ICP-OES or ICP-MS.
3. Co, Cu and Ni. Multi-acid total digestion, including HF, ICP-OES or ICP-MS.
4. Cr, Co, Cu and Ni. Fusion, ICP-OES or ICP-MS
5. Co, Cu and Ni. Aqua regia digestion with ICP-OES or ICP-MS.
6. Cr, Co, Cu and Ni. Fusion or Pressed Pellet, XRF.
7. SG. 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: Twenty laboratories were each given eight randomly selected packages of sample and various results from the seventeen of those laboratories that reported back timeously were used for the determinations. The following round robin results are displayed:

- Pt and Pd analyses by the Pb collection method;
- Rh analyses by NiS and Fire Assay;
- Cu and Ni by the multi-acid (total) digestion method and
- Cu, Ni and Co by the aqua regia (partial) digestion method.
- Cu and Ni by the Fusion method.
- Specific gravity by water or gas Pycnometer.

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 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.

The tables below present raw data received from the laboratories.

Lab Code	Pt (Pb), g/t	Pd (Pb), g/t	Rh, g/t	Cu (T), ppm	Cu (P), ppm	Cu (F), ppm	Ni (T), ppm	Ni (P), ppm	Co (P), ppm
A	8.640	4.680	0.643	2340	2330	2360	3760	3320	198
A	8.640	4.580	0.557	2320	2370	2340	3780	3360	198
A	8.340	4.400	0.652	2380	2310	2380	3980	3270	192
A	8.630	4.480	0.655	2330	2290	2340	3890	3310	192
A	8.340	4.290	0.655	2360	2280	2320	3850	3340	192
A	8.560	4.460	0.637	2380	2340	2340	3760	3410	200
A	8.500	4.570	0.686	2350	2300	2360	3810	3220	194
A	8.460	4.570	0.654	2400	2340	2360	3840	3220	200
B	8.790	4.520	0.722	2050	2410	2180	3480	3460	229
B	8.830	4.520	0.851	2030	2360	2190	3480	3380	218
B	8.800	4.560	0.803	2020	2330	2180	3450	3360	220
B	8.940	4.550	0.734	2050	2340	2200	3530	3370	216
B	8.890	4.560	0.821	2030	2350	2170	3470	3370	220
B	9.000	4.570	0.756	2040	2330	2190	3480	3360	213
B	9.010	4.490	0.797	2050	2330	2180	3480	3360	213
B	8.490	4.440	0.793	2040	2350	2190	3470	3360	220
C	8.160	4.370	0.650	2300			3900		
C	8.190	4.350	0.680	2300			3700		
C	8.060	4.350	0.730	2300			3900		
C	8.050	4.430	0.650	2300			3900		
C	5.680	3.990	0.690	2300			3900		
C	8.340	4.450	0.640	2300			3900		
C	8.030	4.300	0.650	2300			3900		
C	7.800	4.130	0.690	2200			3900		

Lab Code	Pt (Pb), g/t	Pd (Pb), g/t	Rh, g/t	Cu (T), ppm	Cu (P), ppm	Cu (F), ppm	Ni (T), ppm	Ni (P), ppm	Co (P), ppm
D	8.980	4.400		2079	2179	2200	3768	3496	199
D	8.220	4.230		2081	2181	2230	3767	3512	199
D	8.320	4.100		2072	2171	2670	3743	3482	199
D	8.730	4.280		2115	2171	2400	3826	3488	200
D	9.050	4.390		2141	2190	2100	3858	3479	199
D	8.860	4.370		2106	2187	2330	3808	3487	197
D	8.320	4.320		2142	2175	2030	3864	3473	196
D	8.870	4.360		2140	2158	2420	3854	3470	197
E	8.415	4.080	0.680	2282	2139		4170	3221	195
E	8.290	4.025	0.643	2201	2209		3842	3305	207
E	8.350	4.050	0.684	2275	2191		3784	3269	203
E	8.540	4.180	0.680	2197	2350		3732	3517	221
E	8.310	4.070	0.658	2217	2243		3670	3330	209
E	8.260	4.065	0.646	2304	2286		3915	3412	212
E	8.320	4.075	0.681	2223	2204		3725	3278	207
E	8.290	4.030	0.631	2262	2276		3705	3386	211
F	8.751	4.347	0.658						
F	8.600	4.222	0.644						
F	8.215	4.052	0.623						
F	9.284	4.350	0.670						
F	8.789	4.178	0.642						
F	8.821	4.198	0.634						
F	8.704	4.128	0.649						
F	9.046	4.269	0.666						
G	8.820	4.620		2330	2310		3770	3140	202
G	8.870	4.690		2330	2250		3770	3090	195
G	9.170	4.840		2370	2240		3820	3060	197
G	9.280	4.840		2320	2240		3750	3070	194
G	8.980	4.740		2320	2250		3750	3100	198
G	9.220	4.840		2340	2290		3740	3130	199
G	9.280	4.770		2310	2320		3870	3200	206
G	8.800	4.610		2380	2330		3830	3150	201
H	8.560	4.390	0.110	2357	2242		4396	3620	224
H	8.340	4.350	0.150	2361	2257		4382	3600	221
H	8.790	4.530	0.200	2347	2218		4284	3549	231
H	8.630	4.500	0.220	2322	2211		4250	3567	224
H	8.680	4.530	0.170	2316	2194		4303	3503	223
H	8.700	4.510	0.180	2310	2228		4250	3546	227
H	8.400	4.280	0.130	2387	2236		4414	3557	224
H	8.540	4.300	0.130	2380	2203		4434	3508	221
I	8.993	4.406	0.693	2144	1933		3917	3016	196
I	8.867	4.191	0.689	1912	1888		3464	2929	191
I	8.848	4.311	0.682	2046	1966		3741	2960	193
I	8.765	4.212	0.687	2062	1963		3765	2925	192
I	8.920	4.341	0.686	2109	2020		3849	2972	194
I	8.946	4.298	0.689	2001	2003		3647	2994	197
I	9.036	4.232	0.690	2172	2106		3925	2966	195
I	8.891	4.236	0.686	2133	2060		3914	2946	190
J	7.420	4.070		2318	2220		3855	3460	210
J	8.100	4.110		2283	2220		3800	3460	212
J	8.240	4.220		2254	2245		3848	3540	210
J	7.980	4.070		2318	2265		3878	3515	215
J	8.350	4.240		2299	2215		3861	3420	210
J	8.160	4.100		2289	2255		3864	3515	221
J	8.050	4.210		2305	2035		3833	3435	204
J	8.140	4.240		2307	2200		3862	3480	203
K	9.350	4.370	0.690	2300	2300	2300	4000	3380	200
K	9.290	4.300	0.680	2400	2330	2200	3900	3460	200
K	9.270	4.310	0.680	2400	2400	2500	4000	3550	200
K	9.320	4.330	0.680	2400	2250	2200	4000	3340	210
K	9.190	4.490	0.640	2400	2360	2400	3800	3470	200
K	9.210	4.400	0.660	2300	2340	2100	4000	3450	200
K	9.260	4.230	0.710	2400	2220	1900	4100	3280	200
K	9.350	4.490	0.690	2500	2360	2200	4000	3470	190
L	9.010	4.470	0.700		2320		3250	3440	
L	9.560	4.690	0.700		2370		3320	3500	
L	8.940	4.420	0.700		2380		3230	3530	
L	9.350	4.450	0.700		2360		3190	3480	
L	9.040	4.450	0.700		2410		3160	3560	
L	9.280	4.500	0.670		2410		3210	3560	
L	9.100	4.480	0.680		2450		3240	3600	
L	9.060	4.500	0.720		2480		3150	3660	
M	7.790	3.670		2210	2210	2230	3820	3620	224
M	8.630	4.080		2180	2200	2250	3860	3620	222
M	8.510	4.000		2170	2270		3890	3590	226
M	8.520	3.990		2170	2260	2190	3840	3760	231
M	8.300	3.940		2220	2260	2240	3820	3640	228
M	8.090	3.780		2220	2310	2240	3840	3710	229
M	8.650	4.120		2200	2280	2220	3910	3750	232
M	8.490	3.930		2180	2260	2220	3970	3750	233
N	8.300	4.320	0.680	2280			3450		
N	8.200	4.410	0.590	2290			3410		
N	8.210	4.300	0.670	2310			3450		
N	8.640	4.480	0.690	2400			3620		
N	8.320	4.370	0.680	2340			3510		
N	8.630	4.510	0.690	2220			3340		
N	8.460	4.310	0.670	2250			3400		
N	8.860	4.570	0.670	2400			3600		
O	8.373	4.615	0.730	2255	2246	2344	3847	2985	207
O	8.139	4.594	0.737	2259	2265	2357	3850	2926	205
O	8.427	4.682	0.728	2240	2154	2364	3844	2908	200
O	8.265	4.674	0.727	2257	2150	2352	3890	2932	203
O	8.517	4.602	0.733	2220	2212	2356	3836	2966	206
O	8.485	4.648	0.716	2273	2245	2368	3907	2960	208
O	8.667	4.674	0.727	2259	2234	2396	3858	2901	202
O	9.023	4.665	0.717	2263	2320	2376	3879	3076	213
P			0.715						
P			0.720						
P			0.663						
P			0.697						
P			0.724						
P			0.748						
P			0.748						
P			0.704						
Q	8.640	4.250	0.795	2440	2410	2020	3870	3420	209
Q	7.860	3.820	0.616	2340	2510	2240	3660	3450	213
Q	9.040	4.420	0.489	2340	2440	2240	3670	3430	211
Q	8.920	4.390	0.542	2400	2370	2220	3730	3420	204
Q	8.850	4.400	0.618	2380	2250	2220	3750	3190	196
Q	7.090	3.490	0.510	2490	2440	2220	3840	3410	212
Q	8.690	4.300	0.684	2490	2360	2230	3830	3360	203
Q	8.710	4.310	0.666	2620	2370	2220	3960	3360	208

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
Ammtec Ltd (Australia)
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)
GTK Finland
Mintek (South Africa)
Set Point Laboratories (Pty) Ltd (South Africa)
SGS Lakefield Research Africa (Pty) Ltd. (South Africa)
SGS Welshpool Minerals (Australia)
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.

18 November 2005

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