



## Merensky Reef (low grade) PGE Reference Material

# AMIS0064

## Certificate of Analysis

Recommended Concentrations and two "Between  
Laboratory" Standard Deviations

### Certified Concentrations

Pt (NIS)	1.28	+-	0.14	g/t
Pt (Pb Collection)	1.24	+-	0.12	g/t
Pd (NIS)	0.59	+-	0.062	g/t
Pd (Pb Collection)	0.58	+-	0.06	g/t
Co (M/ICP)	84	+-	8	ppm
Cr (XRF)	5144	+-	326	ppm
Cu (P)	664	+-	49	ppm
Cu (XRF)	654	+-	58	ppm
Cu (M/ICP)	636	+-	66	ppm
Ni (M/ICP)	1452	+-	134	ppm
Ni (P)	1046	+-	82	ppm
Ni (XRF)	1509	+-	126	ppm
Specific Gravity	3.09	+-	0.14	g/cc

### Provisional Concentrations

Au (NIS)	0.10	+-	0.028	g/t
Au (Pb Collection)	0.11	+-	0.02	g/t
Co (P)	29.2	+-	3.6	ppm
Co (XRF)	90	+-	13	ppm
Ir (NiS)	0.023	+-	0.004	g/t
Rh (M/ICP)	0.063	+-	0.008	g/t
Ru (NiS)	0.123	+-	0.020	g/t

### Indicated Means

Cr (M/ICP) 4477 ppm

$4E = 2.056$  g/t (Pt, Pd, Rh plus Au)

**NB Additional uncertified major and trace element data is presented on p2 and as an appendix.**

**Intended Use:** AMIS0064 is suitable for monitoring the accuracy of a single analysis of PGE, Cu and Ni ores hosted by Merensky Reef or similar other mafic rocks. The material can be used for routine quality control by inserting within a batch of samples.

The major and trace element composition of this material has also been determined but it has not been certified. The iterated statistics are set out below and as an appendix and this information may be useful for instrument calibration or method development.

**Origin of Material:** This standard 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.

**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.

This major element chemistry (below) was determined from (predominantly) XRF data supplied by 19 of the laboratories

AMIS0064	%	2SD	RSD%	n
Al <sub>2</sub> O <sub>3</sub>	12.4	0.5	1.85	123
CaO	7.17	0.27	1.89	122
Cr <sub>2</sub> O <sub>3</sub>	0.75	0.06	3.78	125
Fe <sub>2</sub> O <sub>3</sub>	9.58	0.29	1.52	140
K <sub>2</sub> O	0.19	0.01	2.42	92
LOI	0.36	0.155	21.48	84
MgO	16.86	0.32	0.96	122
MnO	0.16	0.01	3.21	117
Na <sub>2</sub> O	1.01	0.06	2.82	93
P <sub>2</sub> O <sub>5</sub>	0.04	0.01	12.98	88
S	0.31	0.033	5.21	77
SiO <sub>2</sub>	50.7	0.7	0.73	124
TiO <sub>2</sub>	0.20	0.02	4.57	115
V <sub>2</sub> O <sub>5</sub>	0.02	0.002	5.68	23

**Appearance:** The material is a very fine Med Light Grey powder (Corstor colour chart - 10Y 6/2).

**Method of preparation:** The material was crushed, dry-milled and air-classified to 100% <54um. Wet sieve particle size analysis of random samples confirmed the material was 100% <54um. It was then blended in a bi-conical mixer, systematically divided and then sealed into 1kg Laboratory Packs. Samples were randomly selected for homogeneity testing and third party analysis. Statistical analysis for the consensus test results were carried out by an independent statistician. Explorer Packs are subdivided from the Laboratory packs as required.

**Methods of analysis requested:**

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. Multi element scan to include Co, Cu and Ni. Multi-acid total digestion, including HF, ICP-OES or ICP-MS.
4. Co, Cu and Ni. Aqua regia digestion with ICP-OES or ICP-MS.
5. Cr, Co, Cu and Ni. Pressed Pellet, XRF.
6. Majors ( Al<sub>2</sub>O<sub>3</sub>, CaO, Cr<sub>2</sub>O<sub>3</sub>, Fe<sub>2</sub>O<sub>3</sub>, K<sub>2</sub>O, MgO, MnO, Na<sub>2</sub>O, SiO<sub>2</sub>, TiO<sub>2</sub>. LOI. ) XRF fusion.
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 seven laboratories were each given eight samples, comprising eight packages of sample scientifically selected from throughout the batch. All results were issued timeously and used for certification.

The 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 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 calculated using all remaining data. Any analysis that fell outside of the mean  $\pm 2$  standard deviations was removed from the ensuing data base. The mean and standard deviations were again calculated using the remaining data.

This method is different from that used by Government agencies 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 Confidence Limits published on other standards. Standards with an RSD of near or less than 5 % are certified, RSD's of between near 5 % and 15 % are Provisional, and RSD's over 15 % are Indicated.

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

1. ACME Analytical Laboratories Ltd., (Canada).
2. Activation Laboratories Ltd., (ActLabs, Ancaster, ON, Canada).
3. ALS Chemex South Africa ( Pty ) Ltd.
4. ALS Chemex, (Perth, Australia).
5. ALS Chemex, (Vancouver, Canada).
6. Ammtec Ltd., (Western Australia).
7. Anglo Platinum, Eastern Bushveld Regional Laboratory (South Africa).
8. Anglo Platinum, PPL Assay Laboratory (South Africa).
9. Anglo Research (Crown Campus, South Africa).
10. Anglo Research (Germiston Campus, South Africa)
11. Assayers Canada, (Vancouver).
12. Barplats Laboratory, (South Africa).
13. Becquerel Laboratories, (Canada).
14. Genalysis Laboratory Services ( Pty ) Ltd., (Australia).
15. Geoscience Laboratories, (Geo Labs, Sudbury, Canada).
16. Labtium Inc. ( Finland )
17. Metchem Laboratories
18. Nkomati JV Laboratory







**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.

30 April 2008

**Certifying Officers:**



**African Mineral Standards:** \_\_\_\_\_  
**Mike McWha**  
**BSc (Hons), FGSSA, MAusIMM, Pr.Sci.Nat**



**Geochemist:** \_\_\_\_\_  
**Barry W. Smee**  
**BSc, PhD, P.Geo, (B.C.)**

*N.B. This certificate was amended 22 Sept 2009; the Pt Pb figures had been incorrectly repeated in the Pt NiS column in the original certificate.*

## APPENDIX

Additional useful data collected during the round robin exercise includes these iterated but uncertified certified trace element statistics:

AMIS0064	Method	unit	value	2SD	RSD%	n
Ag	M/ICP	ppm	0.332	0.07	10.8	24
Al	M/ICP	%	6.56	0.75	5.7	87
As	M/ICP	ppm	2.04	1.60	39.2	32
Ba	M/ICP	ppm	60.7	8.45	7.0	87
Be	M/ICP	ppm	0.187	0.12	31.5	39
Bi	M/ICP	ppm	0.218	0.04	8.0	38
Ca	M/ICP	%	5.07	0.32	3.1	76
Cd	M/ICP	ppm	0.148	0.07	22.4	24
Ce	M/ICP	ppm	6.91	1.33	9.6	46
Cs	M/ICP	ppm	0.223	0.05	10.9	32
Dy	M/ICP	ppm	0.832	0.10	6.1	32
Er	M/ICP	ppm	0.546	0.08	7.4	32
Eu	M/ICP	ppm	0.256	0.03	5.7	32
Fe	M/ICP	%	6.68	0.20	1.5	69
Ga	M/ICP	ppm	11.1	1.66	7.5	61
Gd	M/ICP	ppm	0.769	0.08	5.3	28
Ge	M/ICP	ppm	0.224	0.19	41.8	22
Hf	M/ICP	ppm	0.398	0.01	1.9	39
Ho	M/ICP	ppm	0.189	0.01	3.4	31
In	M/ICP	ppm	0.032	0.01	16.4	30
K	M/ICP	%	0.157	0.02	6.2	79
La	M/ICP	ppm	3.31	0.86	13.0	62
Li	M/ICP	ppm	3.87	0.56	7.2	59
Lu	M/ICP	ppm	0.095	0.02	8.3	16
Mg	M/ICP	%	10.0	0.55	2.7	82
Mn	M/ICP	ppm	1138	111	4.9	102
Mo	M/ICP	ppm	1.02	0.14	7.0	38
Na	M/ICP	%	0.751	0.10	7.0	96
Nb	M/ICP	ppm	1.03	0.72	34.8	54
Nd	M/ICP	ppm	3.08	0.36	5.9	30
Os	M/ICP	ppb	17.4	3.99	11.5	16
P	M/ICP	ppm	144	39.0	13.5	83
Pb	M/ICP	ppm	7.55	3.50	23.2	58
Pr	M/ICP	ppm	0.794	0.09	5.4	30
Rb	M/ICP	ppm	6.10	0.78	6.4	44
Re	M/ICP	ppm	0.004	0.001	14.0	22
Sb	M/ICP	ppm	11.5	1.89	8.2	61
Sc	M/ICP	ppm	19.8	2.74	6.9	84
Se	M/ICP	ppm	2.50	1.03	20.7	16
Sm	M/ICP	ppm	0.670	0.08	5.7	30
Sn	M/ICP	ppm	0.879	0.12	6.6	38
Sr	M/ICP	ppm	173	13.7	4.0	79
Tb	M/ICP	ppm	0.128	0.01	4.9	31
Te	M/ICP	ppm	0.399	0.11	13.2	37
Th	M/ICP	ppm	0.778	0.08	5.3	46
Ti	M/ICP	%	0.113	0.01	6.0	103
Tl	M/ICP	ppm	0.058	0.01	12.0	24
Tm	M/ICP	ppm	0.098	0.03	13.4	32
U	M/ICP	ppm	0.668	0.12	9.2	38
V	M/ICP	ppm	112	19.0	8.5	78
W	M/ICP	ppm	0.218	0.11	24.8	44
Y	M/ICP	ppm	5.01	0.36	3.6	61
Yb	M/ICP	ppm	0.590	0.03	2.9	30
Zn	M/ICP	ppm	289	20.2	3.5	67
Zr	M/ICP	ppm	12.7	2.71	10.6	54