



Tel: +27 (0) 11 923 0800 Fax: +27 (0) 11 392 4715 web: www.amis.co.za
11 Gewel Street (off Hulley Road), D1 Isando Business Park, Kempton Park, 1609
P.O. Box 856, Isando, 1600, Gauteng, South Africa, a division of the Set Point Group

AMIS0411

Certified Reference Material

**Platinum (PGM) Platreef Ore
Bushveld Complex, South Africa**

Certificate of Analysis

**Recommended Concentrations and two “Between
Laboratory” Standard Deviations¹**

Certified Concentrations²

Pt Pb Collection	0.54	±	0.06	g/t
Pd Pb Collection	0.67	±	0.06	g/t
Pt NIS	0.53	±	0.06	g/t
Pd NIS	0.67	±	0.06	g/t
Co M/ICP	77	±	7	ppm
Co P	55	±	6	ppm
Cu M/ICP	742	±	60	ppm
Cu P	732	±	26	ppm
Cu XRF	695	±	49	ppm
Ni M/ICP	1368	±	101	ppm
Ni P	1213	±	68	ppm
Specific Gravity	2.93	±	0.08	

Provisional Concentrations

Au Pb Collection	0.078	±	0.012	g/t
Au NIS	0.070	±	0.016	g/t
Ir NiS	0.013	±	0.002	g/t
Rh	0.047	±	0.008	g/t
Ru NiS	0.057	±	0.010	g/t
Ni XRF	1342	±	279	ppm

$$4E (Pt, Pd, Au (all NiS) + Rh) = 1.317 \text{ g/t}$$

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 two “Between Laboratory” Standard Deviations

Certified Concentrations

Al ₂ O ₃	5.96	±	0.10	%
CaO	4.76	±	0.10	%
Cr ₂ O ₃	1.24	±	0.06	%
Fe ₂ O ₃	8.61	±	0.12	%
K ₂ O	0.24	±	0.01	%
MgO	13.95	±	0.28	%
MnO	0.22	±	0.01	%
Na ₂ O	0.42	±	0.04	%
SiO ₂	60.31	±	0.52	%
TiO ₂	0.18	±	0.01	%
S Comb / LECO	0.43	±	0.04	%

Provisional Concentration

LOI 3.64 ± 0.66 %

1. **Intended Use:** AMIS0411 is a certified reference material which may be used to demonstrate the validity of measurement results of a single analysis of low grade PGM, Cu and Ni ores, hosted by the Platreef or other mafic rocks with a similar grade and matrix; when measured in parallel to the unknown to be characterised.

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:** This standard was made using Platreef material from the northern limb of the Bushveld Complex. This specific material was supplied by Anglo Platinum Limited and was obtained from the open pit Mogalakwena Mine (previously named PPRust Mine).

3. **Mineral and Chemical Composition:** Platreef is a Pt/Pd/Ni/Cu ore. Mineralization in this Platreef comprises 2-5% disseminated or net textured magmatic sulphides, mainly pyrrhotite, pentlandite and chalcopyrite. The PGE's occur as micron-sized satellite grains around but rarely within the sulphides.

4. **Appearance:** The material is a very fine powder. It is colored Light Grey (Corstor 5Y 7/1).

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 <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.

7. 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. Co, Cu and Ni. Pressed Pellet, XRF.
6. Majors (Al₂O₃, CaO, Cr₂O₃, Fe₂O₃, K₂O, MgO, MnO, Na₂O, SiO₂, TiO₂. LOI.) XRF fusion.
7. SG, gas pycnometer.

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 eight laboratories were each given eight randomly selected packages of sample. Twenty six 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 26 out of 28 laboratories that provided results timeously were (not in same order as in the table of assays):

1. ACME Analytical Laboratories Ltd CA
2. Activation Laboratories Pty Ltd (ActLabs) CA
3. ALS Chemex Laboratory Group Johannesburg SA
4. ALS Chemex Laboratory Group Perth WA

5. ALS Chemex Laboratory Group Vancouver CA
6. ALS OMAC (Ireland)
7. Anglo Platinum - Eastern Bushveld Regional Laboratory
8. Anglo Research (Crown Campus)
9. Barplats Laboratory SA
10. BV Rustenburg (South africa)
11. Genalysis Laboratory Services (South Africa) Pty
12. Genalysis Laboratory Services (W Australia P)
13. Intertek Utama Services (Indonesia)
14. Labtium Inc Finland
15. Nkomati JV Laboratory SA
16. Performance Laboratories SA (Randfontein)
17. Rappa Research Laboratory
18. Set Point Laboratories (Isando) SA
19. SGS Australia Pty Ltd (Newburn) WA
20. SGS Geosol Laboratories Ltda (Brazil)
21. SGS Mineral Services Lakefield (Canada)
22. SGS South Africa (Pty) Ltd - Booyens JHB
23. SGS Townsville (Australia)
24. SGS Vancouver (Canada)
25. Ultra Trace (Pty) Ltd WA
26. Zimplats Head Office Assay Laboratory

11. Assay Data: Data as received from the laboratories for the important certified elements are set out below – Economic elements.

Lab Code	Pt PbColl g/t	Pd PbColl g/t	Au PbColl 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	Cu M/ICP ppm	Cu P ppm	Cu XRF ppm	Ni M/ICP ppm	Ni P ppm	Ni XRF ppm
A	0.43	0.62	0.09					0.04				855			1395		
A	0.38	0.61	0.09					0.04				865			1430		
A	0.41	0.73	0.10					0.05				905			1490		
A	0.44	0.71	0.10					0.04							1570		
A	0.46	0.66	0.10					0.04				880			1445		
A	0.41	0.60	0.09					0.04				880			1450		
A	0.41	0.65	0.10					0.04				865			1410		
A	0.46	0.65	0.11					0.05				890			1495		
B	0.47	0.57	0.06							77.0	49.0	708	730		1400	1180	
B	0.48	0.60	0.07							76.0	49.0	699	711		1390	1140	
B	0.48	0.59	0.07							77.0	50.0	707	717		1400	1160	
B	0.40	0.51	0.06							75.0	48.0	689	711		1350	1130	
B	0.44	0.56	0.06							77.0	49.0	701	726		1390	1160	
B	0.44	0.56	0.06							76.0	49.0	718	725		1390	1160	
B	0.51	0.63	0.08							76.0	50.0	692	728		1400	1150	
B	0.45	0.54	0.06							77.0	50.0	694	728		1390	1190	
D	0.49	0.64	0.07							76.0	54.0	801	753		1370	1210	
D	0.51	0.64	0.06							75.0	54.0	808	754		1380	1200	
D	0.57	0.71	0.08							74.0	53.0	780	742		1340	1170	
D	0.52	0.68	0.07							77.0	54.0	821	746		1390	1200	
D	0.52	0.69	0.07							70.0	54.0	756	758		1290	1200	
D	0.68	0.73	0.08							72.0	53.0	779	764		1330	1210	
D	0.53	0.67	0.07							75.0	52.0	772	758		1310	1210	
D	0.56	0.70	0.08							76.0	55.0	797	753		1380	1190	
E										76.5		703			1342		
E										72.3		691			1279		
E										70.1		737			1255		
E										67.4		700			1213		
E										73.2		720			1267		
E										70.6		682			1217		
E										71.3		730			1302		
E										71.5		747			1344		
F	0.44	0.65	0.08							83.0	56.0	755	692		1360	1150	
F	0.43	0.69	0.08							75.0	59.0	782	745		1250	1200	
F	0.40	0.63	0.08							81.0	54.0	767	671		1320	1120	
F	0.40	0.63	0.07							72.0	54.0	762	684		1290	1120	
F	0.42	0.66	0.08							84.0	56.0	784	694		1290	1150	
F	0.43	0.66	0.08							78.0	53.0	736	689		1280	1130	
F	0.43	0.62	0.08							79.0	56.0	772	718		1270	1180	
F	0.42	0.64	0.08							79.0	55.0	796	716		1280	1140	
G	0.49	0.62	0.07							76.1	51.9	747	713		1380	1175	
G	0.50	0.62	0.07							76.1	59.7	759	711		1390	1155	
G	0.50	0.64	0.08							77.6	53.6	774	732		1410	1180	
G	0.51	0.63	0.07							77.6	62.9	766	728		1380	1185	
G	0.50	0.62	0.07							81.3	56.7	765	713		1390	1155	
G	0.53	0.58	0.07							77.5	58.0	749	720		1350	1170	
G	0.50	0.62	0.07							77.9	57.6	753	715		1360	1160	
G	0.51	0.62	0.07							81.5	60.0	749	707		1360	1155	
H	0.55	0.67	0.08					0.05	0.06					700			1400
H	0.54	0.70	0.09					0.05	0.06					720			1400
H	0.52	0.68	0.09					0.05	0.06					750			1350
H	0.55	0.68	0.08					0.05	0.06					680			1400
H	0.55	0.70	0.08					0.05	0.06					720			1410
H	0.54	0.67	0.08					0.05	0.06					780			1410
H	0.56	0.68	0.09					0.05	0.06					680			1380
H	0.53	0.66	0.09					0.05	0.06					750			1440

Assay data (cont) – Economic elements

Lab Code	Pt PbColl g/t	Pd PbColl g/t	Au PbColl 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	Cu M/ICP ppm	Cu P ppm	Cu XRF ppm	Ni M/ICP ppm	Ni P ppm	Ni XRF ppm
I	0.57	0.71	0.08	0.58	0.69	0.08	0.01	0.05	0.05	75.0	54.0	720	717		1400	1310	
I	0.56	0.70	0.08	0.59	0.72	0.08	0.02	0.05	0.06	75.0	62.0	745	742		1390	1340	
I	0.57	0.72	0.08	0.57	0.70	0.07	0.01	0.05	0.05	75.0	60.0	725	741		1390	1330	
I	0.57	0.71	0.07	0.55	0.69	0.07	0.01	0.05	0.05	80.0	54.0	740	726		1410	1300	
I	0.55	0.67	0.07	0.55	0.70	0.07	0.01	0.05	0.05	80.0	62.0	730	728		1420	1310	
I	0.54	0.67	0.08	0.57	0.68	0.07	0.01	0.05	0.06	75.0	54.0	725	714		1390	1270	
I	0.57	0.69	0.07	0.57	0.70	0.07	0.02	0.05	0.06	75.0	62.0	715	736		1400	1330	
I	0.55	0.67	0.08	0.56	0.70	0.07	0.02	0.05	0.05	75.0	61.0	725	732		1420	1320	
J	0.54	0.67	0.08							74.5	55.0	768	738		1310	1240	
J	0.55	0.70	0.09							78.3	54.0	775	743		1320	1240	
J	0.54	0.68	0.07							74.8	54.0	776	738		1310	1240	
J	0.54	0.69	0.07							81.5	53.0	767	729		1390	1240	
J	0.55	0.70	0.08							77.1	54.0	758	750		1380	1260	
J	0.56	0.71	0.07							73.4	55.0	773	739		1400	1240	
J	0.54	0.71	0.07							78.5	55.0	777	742		1420	1250	
J	0.53	0.70	0.06							81.1	55.0	764	756		1380	1260	
K																	1236
K																	1217
K																	1247
K																	1215
K																	1226
K																	1211
K																	1215
K																	1228
L	0.54	0.67	0.07	0.50	0.66	0.07	0.01	0.05	0.05	75.9	53.0	781	739		1424	1183	
L	0.54	0.67	0.07	0.52	0.68	0.08	0.01	0.05	0.06	74.0	55.0	770	757		1402	1221	
L	0.52	0.68	0.07	0.53	0.67	0.07	0.01	0.05	0.05	74.4	55.0	767	753		1403	1224	
L	0.57	0.69	0.08	0.50	0.65	0.07	0.01	0.05	0.05	75.9	54.0	751	750		1376	1210	
L	0.53	0.66	0.08	0.51	0.67	0.07	0.01	0.05	0.06	74.2	54.0	795	758		1417	1211	
L	0.53	0.67	0.07	0.54	0.69	0.08	0.01	0.05	0.06	75.4	54.0	784	749		1422	1203	
L	0.55	0.67	0.08	0.55	0.68	0.08	0.01	0.05	0.06	73.1	55.0	779	750		1423	1215	
L	0.55	0.67	0.08	0.51	0.66	0.07	0.01	0.05	0.06	74.5	56.0	764	763		1388	1239	
M	0.45	0.65	0.08														
M	0.51	0.64	0.08														
M	0.47	0.65	0.08														
M	0.47	0.63	0.10														
M	0.49	0.63	0.09														
M	0.46	0.63	0.07														
M	0.49	0.64	0.08														
M	0.48	0.65	0.08														
N	0.50	0.65						0.04						687			1326
N	0.47	0.65						0.04						686			1328
N	0.44	0.64						0.04						690			1328
N	0.48	0.65						0.04						708			1350
N	0.42	0.64						0.04						693			1334
N	0.33	0.59						0.04						693			1340
N	0.50	0.62						0.04						688			1332
N	0.48	0.60						0.04						692			1332
O				0.56	0.67	0.07	0.01	0.07	0.06					706			1384
O				0.57	0.67	0.08	0.01	0.07	0.06					687			1379
O				0.65	0.76	0.09	0.02	0.07	0.07					713			1376
O				0.54	0.64	0.06	0.01	0.06	0.06					716			1388
O				0.58	0.69	0.07	0.01	0.07	0.06					713			1377
O				0.56	0.68	0.08	0.01	0.06	0.06					693			1350
O				0.59	0.69	0.08	0.01	0.07	0.06					710			1371
O				0.57	0.69	0.08	0.01	0.07	0.06					710			1385
P				0.54	0.75	0.07	0.01	0.05	0.05								
P				0.54	0.74	0.07	0.01	0.05	0.05								
P				0.54	0.76	0.07	0.01	0.05	0.05								
P				0.55	0.76	0.08	0.01	0.05	0.05								
P				0.54	0.74	0.08	0.01	0.05	0.06								
P				0.54	0.75	0.07	0.01	0.05	0.05								
P				0.54	0.73	0.07	0.01	0.05	0.06								
P				0.54	0.74	0.07	0.01	0.05	0.06								
Q	0.54	0.78	0.08							89.0		765			1550		
Q	0.54	0.82	0.08							88.0		755			1550		
Q	0.56	0.85	0.08							82.0		748			1590		
Q	0.58	0.80	0.08							82.0		756			1540		
Q	0.54	0.82	0.08							81.0		764			1510		
Q	0.50	0.76	0.08							84.0		761			1530		
Q	0.50	0.78	0.08							80.0		764			1520		
Q	0.56	0.88	0.07							80.0		762			1520		
R				0.54	0.68	0.08	0.01	0.05	0.06	70.0		710			1350		
R				0.54	0.66	0.09	0.01	0.05	0.06	80.0		720			1360		
R				0.53	0.68	0.09	0.01	0.05	0.06	70.0		710			1330		
R				0.54	0.69	0.07	0.01	0.05	0.06	70.0		720			1360		
R				0.55	0.69	0.09	0.01	0.05	0.06	80.0		730			1380		
R				0.54	0.68	0.08	0.01	0.05	0.06	80.0		720			1360		
R				0.53	0.70	0.09	0.01	0.05	0.06	70.0		700			1370		
R				0.54	0.69	0.08	0.01	0.05	0.06	80.0		730			1370		
S				0.48	0.63	0.06	0.01	0.05	0.05	74.0		760			1348		
S				0.48	0.63	0.06	0.01	0.05	0.05	73.0		738			1318		
S				0.47	0.61	0.06	0.01	0.05	0.05	72.0		708			1350		
S				0.46	0.63	0.06	0.01	0.04	0.05	77.0		759			1370		
S				0.47	0.64	0.06	0.01	0.05	0.05	76.0		745			1343		
S				0.46	0.63	0.06	0.01	0.05	0.05	74.0		743			1346		
S				0.45	0.61	0.06	0.01	0.04	0.05	74.0		743			1339		
S				0.43	0.64	0.06	0.01	0.04	0.05	76.0		727			1333		
T				0.49	0.81	0.06	0.01	0.06	0.07	80.0		745			1351		
T				0.52	0.80	0.06	0.02	0.07	0.07	82.0		763			1422		
T				0.52	0.82	0.06	0.02	0.06	0.07	81.0		768			1299		
T				0.51	0.61	0.06	0.02	0.07	0.07	84.0		773			1340		
T				0.59	0.70	0.08	0.01	0.07	0.06	82.0		790			1322		
T				0.55	0.69	0.08	0.01	0.06	0.06	83.0		778			1322		
T				0.54	0.68	0.07	0.07	0.07	0.06	82.0		772			1297		
T				0.58	0.69	0.08	0.02	0.07	0.06	83.0		777			1499		
U	0.57	0.69	0.09							80.0	60.0	700	740		1360	1260	
U	0.57	0.69	0.07							80.0	60.0	700	720		1360	1230	
U	0.55	0.68	0.08							80.0	60.0	700	720		1350	1250	
U	0.54	0.68	0.08							80.0	60.0	700	710		1340	1230	
U	0.55	0.70	0.08							80.0	60.0	700	730		1380	1240	
U	0.57	0.70	0.08							80.0	60.0	700	760		1350	1270	
U	0.55	0.68	0.08							80.0	60.0	700	740		1360	1290	
U	0.55	0.69	0.08		</												

Assay data (cont) – Economic elements

Lab Code	Pt PbColl g/t	Pd PbColl g/t	Au PbColl 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	Cu M/ICP ppm	Cu P ppm	Cu XRF ppm	Ni M/ICP ppm	Ni P ppm	Ni XRF ppm
V				0.56	0.70	0.06	0.01	0.05	0.06					710			1640
V				0.53	0.67	0.07	0.02	0.05	0.07					720			1620
V				0.51	0.63	0.06	0.01	0.05	0.06					730			1620
V				0.56	0.70	0.07	0.01	0.04	0.06					700			1580
V				0.52	0.64	0.06	0.01	0.05	0.06					700			1570
V				0.48	0.62	0.06	0.01	0.05	0.06					710			1600
V				0.53	0.64	0.07	0.01	0.05	0.06					710			1590
V				0.52	0.62	0.07	0.01	0.04	0.06					720			1610
W	0.57	0.70	0.08							80.0	50.0	740	740		1430	1250	
W	0.54	0.69	0.08							80.0	60.0	740	730		1420	1240	
W	0.54	0.68	0.07							80.0	60.0	750	730		1420	1250	
W	0.57	0.71	0.08							80.0	50.0	730	740		1410	1260	
W	0.54	0.68	0.08							70.0	60.0	740	740		1400	1240	
W	0.51	0.60	0.08							80.0	60.0	740	730		1420	1230	
W	0.55	0.68	0.07							80.0	60.0	750	730		1420	1250	
W	0.54	0.69	0.08							80.0	60.0	720	750		1380	1280	
X	0.52	0.67	0.08	0.51	0.69			0.03	0.03	66.0	46.0	729	726	693	1441	1216	1164
X	0.52	0.68	0.07	0.50	0.70			0.03	0.03	67.0	46.0	727	722	684	1441	1196	1147
X	0.52	0.68	0.07	0.51	0.71			0.03	0.03	64.0	45.0	710	721	687	1440	1218	1151
X	0.51	0.69	0.08	0.51	0.71			0.03	0.02	67.0	45.0	711	721	692	1449	1196	1156
X	0.53	0.69	0.08	0.50	0.70			0.03	0.02	63.0	45.0	726	724	695	1419	1200	1158
X	0.52	0.68	0.08	0.52	0.70			0.04	0.02	65.0	46.0	725	725	687	1458	1218	1164
X	0.52	0.69	0.07	0.49	0.70			0.04	0.02	69.0	46.0	720	719	684	1459	1206	1174
X	0.52	0.67	0.08	0.50	0.71			0.03	0.02	66.0	47.0	733	721	693	1448	1197	1166
Y				0.50	0.68	0.06		0.04		72.0	50.0	738	720	650	1286	1209	1219
Y										72.0	54.0	714	725	658	1266	1217	1239
Y				0.46	0.68	0.06		0.03		74.0	53.0	725	726	644	1262	1197	1210
Y				0.43	0.64	0.05		0.04		72.0	50.0	756	719	642	1184	1204	1201
Y				0.45	0.64	0.05		0.03		74.0	52.0	733	723	638	1271	1227	1191
Y				0.42	0.66	0.06		0.06		72.0	53.0	737	721	654	1276	1271	1226
Y				0.43	0.65	0.06		0.03		73.0	52.0	766	716	653	1258	1176	1218
Y				0.45	0.67	0.07		0.05		73.0	53.0	746	726	661	1297	1249	1235
ZA	0.60	0.78	0.09							68.9	53.1	785	760		1174	1119	
ZA	0.60	0.80	0.09							69.5	53.5	749	796		1195	1126	
ZA	0.61	0.80	0.09							67.3	51.6	781	768		1140	1096	
ZA	0.60	0.80	0.08							67.8	52.0	778	786		1144	1127	
ZA	0.60	0.80	0.08							70.2	53.3	792	717		1184	1096	
ZA	0.61	0.78	0.09							68.4	52.1	769	790		1159	1100	
ZA	0.61	0.79	0.08							69.4	52.3	782	789		1170	1122	
ZA	0.60	0.79	0.09							67.5	52.6	781	771		1172	1125	
ZB	0.56	0.71	0.08							78.8	53.8	706	740		1395	1244	
ZB	0.55	0.69	0.07							78.0	56.1	705	746		1391	1253	
ZB	0.56	0.70	0.08							74.0	56.1	690	736		1364	1235	
ZB	0.56	0.71	0.08							76.6	55.8	700	726		1380	1222	
ZB	0.55	0.71	0.08							79.0	55.4	713	739		1412	1249	
ZB	0.55	0.70	0.08							76.3	53.6	706	727		1397	1228	
ZB	0.57	0.69	0.08							78.5	54.1	714	728		1412	1228	
ZB	0.55	0.69	0.08							78.1	54.4	720	724		1422	1219	

Assay data – Major Oxides

Lab Code	Al ₂ O ₃ XRF %	CaO XRF %	Cr ₂ O ₃ XRF %	Fe ₂ O ₃ XRF %	K ₂ O XRF %	MgO XRF %	MnO XRF %	Na ₂ O XRF %	SiO ₂ XRF %	TiO ₂ XRF %	LOI %	S Comb LECO %	SG pyc
B												0.44	2.86
B												0.44	2.86
B												0.44	2.86
B												0.44	2.86
B												0.44	2.86
B												0.44	2.86
B												0.44	2.87
D													2.97
D													2.99
D													2.97
D													2.95
D													2.98
D													2.97
D													2.97
D													2.96
F	5.89	4.74	1.26	8.61	0.24	13.9	0.23	0.41	60.5	0.18	3.78		
F	5.85	4.75	1.26	8.66	0.24	13.9	0.22	0.42	60.4	0.18	3.86		
F	5.89	4.74	1.26	8.65	0.24	13.9	0.23	0.42	60.5	0.18	3.70		
F	5.89	4.73	1.26	8.66	0.24	13.8	0.22	0.41	60.5	0.18	3.78		
F	5.86	4.74	1.25	8.63	0.24	13.8	0.23	0.43	60.4	0.19	3.88		
F	5.88	4.75	1.26	8.64	0.24	13.9	0.22	0.42	60.5	0.18	3.71		
F	5.88	4.73	1.28	8.65	0.24	13.9	0.22	0.41	60.4	0.19	3.73		
F	5.85	4.75	1.26	8.64	0.24	13.9	0.23	0.43	60.5	0.18	3.70		
G													2.95
G													2.95
G													2.95
G													2.92
G													2.94
G													2.93
G													2.94
G													2.94

Assay data (cont) – Major Oxides

Lab Code	Al ₂ O ₃ XRF %	CaO XRF %	Cr ₂ O ₃ XRF %	Fe ₂ O ₃ XRF %	K ₂ O XRF %	MgO XRF %	MnO XRF %	Na ₂ O XRF %	SiO ₂ XRF %	TiO ₂ XRF %	LOI %	S Comb LECO %	SG pyc
H	5.97	4.85	1.28	8.61	0.24	14.1	0.21	0.39	60.1	0.19	3.93	0.45	
H	5.97	4.90	1.28	8.71	0.25	14.3	0.21	0.40	60.9	0.18	3.93	0.45	
H	5.96	4.87	1.27	8.65	0.24	14.2	0.21	0.39	60.5	0.18	3.86	0.45	
H	5.98	4.86	1.27	8.64	0.25	14.2	0.21	0.39	60.4	0.18	3.87	0.45	
H	5.99	4.83	1.26	8.60	0.24	14.1	0.21	0.39	60.1	0.18	3.84	0.45	
H	5.97	4.91	1.27	8.72	0.25	14.3	0.22	0.39	61.0	0.19	3.98	0.45	
H	5.97	4.85	1.26	8.62	0.24	14.1	0.22	0.39	60.2	0.18	3.91	0.45	
H	5.99	4.92	1.27	8.72	0.24	14.3	0.21	0.39	61.0	0.18	3.84	0.45	
I	5.98	4.80	1.21	8.57	0.24	13.9	0.22		60.5	0.18	3.38		2.95
I	5.98	4.82	1.22	8.57	0.25	13.9	0.22		60.5	0.18	3.42		2.96
I	5.99	4.81	1.21	8.58	0.25	13.9	0.22		60.5	0.18	3.43		2.96
I	6.00	4.80	1.21	8.57	0.25	13.9	0.22		60.5	0.18	3.41		2.94
I	6.01	4.82	1.22	8.58	0.25	13.9	0.22		60.4	0.18	3.40		2.96
I	6.02	4.82	1.22	8.59	0.25	13.9	0.22		60.5	0.18	3.42		2.95
I	6.02	4.82	1.22	8.58	0.25	13.9	0.22		60.5	0.18	3.37		2.95
I	6.02	4.84	1.23	8.59	0.25	13.9	0.22		60.5	0.18	3.42		2.96
J	5.96	4.69	1.21	8.43	0.24	14.1	0.22	0.40	60.2	0.19	3.85		2.84
J	6.01	4.72	1.22	8.51	0.24	14.2	0.22	0.41	60.6	0.19	3.86		2.87
J	6.01	4.72	1.23	8.51	0.25	14.2	0.22	0.40	60.6	0.19	3.82		2.92
J	5.89	4.63	1.20	8.34	0.24	13.9	0.21	0.39	59.5	0.18	3.99		2.84
J	5.87	4.59	1.20	8.25	0.24	13.9	0.21	0.39	59.2	0.18	3.84		2.87
J	5.87	4.60	1.19	8.32	0.24	13.9	0.21	0.39	59.4	0.18	3.95		2.89
J	6.01	4.72	1.22	8.52	0.24	14.2	0.22	0.40	60.6	0.19	3.62		2.88
J	6.01	4.72	1.22	8.53	0.25	14.1	0.22	0.45	60.5	0.19	3.93		2.85
K												0.37	
K												0.38	
K												0.38	
K												0.38	
K												0.38	
K												0.39	
K												0.34	
K												0.40	
L	6.03	4.77	1.25	8.67	0.24	14.1	0.21	0.44	60.5	0.18	3.31	0.44	3.01
L	6.03	4.78	1.25	8.63	0.24	14.1	0.21	0.43	60.4	0.18	3.31	0.44	3.02
L	6.03	4.79	1.31	8.88	0.24	14.1	0.22	0.44	60.5	0.18	3.25	0.45	2.92
L	6.02	4.78	1.30	8.87	0.24	14.1	0.22	0.43	60.4	0.18	3.25	0.44	2.96
L	6.01	4.79	1.30	8.88	0.24	14.1	0.22	0.44	60.3	0.18	3.30	0.44	2.93
L	6.05	4.80	1.31	8.91	0.24	14.1	0.22	0.44	60.3	0.18	3.25	0.44	2.99
L	6.04	4.78	1.27	8.77	0.24	14.0	0.21	0.43	60.3	0.18	3.26	0.44	2.97
L	6.00	4.79	1.29	8.83	0.24	14.1	0.22	0.43	60.5	0.19	3.24	0.46	2.98
N													3.07
N													3.03
N													2.93
N													3.00
N													2.94
N													2.93
N													2.95
N													2.94
O													3.01
O													3.03
O													3.04
O													2.97
O													3.01
O													3.02
O													3.01
O													2.99
Q	5.93	4.68	1.19	8.48	0.25	14.0	0.22	0.41	60.6	0.18	3.60		
Q	5.97	4.71	1.19	8.55	0.25	14.1	0.23	0.42	60.9	0.19	3.50		
Q	5.96	4.68	1.22	8.51	0.25	14.0	0.22	0.42	60.5	0.18	3.40		
Q	5.94	4.68	1.23	8.49	0.25	14.0	0.22	0.41	60.5	0.18	3.50		
Q	5.94	4.67	1.20	8.43	0.24	14.0	0.22	0.40	60.5	0.17	3.50		
Q	5.92	4.68	1.23	8.49	0.25	14.0	0.22	0.44	60.4	0.19	3.50		
Q	5.94	4.68	1.23	8.52	0.25	14.0	0.22	0.41	60.4	0.19	3.60		
Q	5.92	4.68	1.21	8.51	0.25	14.0	0.22	0.43	60.5	0.18	3.50		
R	5.76	5.00	1.30			13.3			58.6			0.43	
R	5.78	4.97	1.30			13.3			58.8			0.42	
R	5.78	5.01	1.30			13.4			58.9			0.42	
R	5.77	5.04	1.31			13.5			58.8			0.43	
R	5.77	5.03	1.29			13.4			58.7			0.42	
R	5.79	4.98	1.32			13.3			58.5			0.43	
R	5.77	5.05	1.31			13.4			58.8			0.42	
R	5.77	4.99	1.32			13.4			58.8			0.43	
S													2.88
S													2.96
S													2.92
S													2.95
S													2.94
S													2.88
S													2.93
S													2.91

Assay data (cont) – Major Oxides

Lab Code	Al ₂ O ₃ XRF %	CaO XRF %	Cr ₂ O ₃ XRF %	Fe ₂ O ₃ XRF %	K ₂ O XRF %	MgO XRF %	MnO XRF %	Na ₂ O XRF %	SiO ₂ XRF %	TiO ₂ XRF %	LOI %	S Comb LECO %	SG pyc
T			1.21										
T			1.22										
T			1.17										
T			1.19										
T			1.19										
T			1.20										
T			1.17										
T			1.19										
U	5.94	4.74	1.21	8.49	0.25	13.9	0.21	0.43	59.9	0.17	4.11		2.79
U	5.95	4.77	1.21	8.49	0.25	13.9	0.21	0.42	60.1	0.18	3.98		2.90
U	5.96	4.76	1.22	8.52	0.25	13.9	0.21	0.42	60.1	0.17	3.99		2.96
U	5.99	4.79	1.22	8.60	0.25	13.9	0.21	0.44	60.1	0.17	4.00		2.89
U	5.97	4.77	1.22	8.57	0.25	13.9	0.21	0.42	59.9	0.17	4.04		3.00
U	5.92	4.73	1.21	8.48	0.25	13.9	0.21	0.42	60.0	0.17	4.05		2.99
U	5.97	4.77	1.22	8.57	0.25	13.9	0.21	0.43	60.0	0.17	4.07		2.88
U	5.95	4.77	1.22	8.58	0.25	13.9	0.21	0.43	60.1	0.17	4.07		2.92
V													2.95
V													2.94
V													2.94
V													2.93
V													2.94
V													2.93
V													2.94
V													2.94
W	5.96	4.74	1.23	8.67	0.24	13.9	0.21	0.45	60.3	0.18	3.22		
W	6.01	4.74	1.24	8.71	0.24	14.0	0.21	0.45	60.1	0.18	3.22		
W	5.95	4.74	1.24	8.66	0.24	13.9	0.21	0.45	60.3	0.18	3.23		
W	5.96	4.74	1.22	8.67	0.24	13.9	0.21	0.45	60.3	0.19	3.23		
W	5.97	4.75	1.24	8.67	0.24	13.9	0.21	0.46	60.5	0.18	3.22		
W	5.95	4.75	1.24	8.68	0.24	13.9	0.21	0.46	60.4	0.18	3.23		
W	5.98	4.74	1.24	8.69	0.24	13.9	0.21	0.45	60.4	0.19	3.31		
W	5.97	4.74	1.24	8.68	0.24	13.9	0.21	0.45	60.2	0.18	3.21		
X	5.79	5.04	1.24	8.66	0.23	13.8	0.24		60.2	0.18			2.91
X	5.73	4.98	1.23	8.61	0.23	13.6	0.25		59.9	0.18			2.92
X	5.74	5.03	1.24	8.68	0.23	13.7	0.25		59.9	0.18			2.91
X	5.74	5.07	1.24	8.67	0.22	13.7	0.24		59.7	0.18			2.92
X	5.73	5.06	1.24	8.66	0.23	13.4	0.24		59.2	0.18			2.92
X	5.79	5.05	1.24	8.65	0.23	13.6	0.24		59.7	0.18			2.94
X	5.77	4.98	1.27	8.63	0.22	13.7	0.24		59.8	0.18			2.91
X	5.73	4.97	1.23	8.58	0.22	13.7	0.24		59.9	0.18			2.92
Y	5.97	4.80	1.26	8.60	0.27	13.8	0.22	0.46	60.4	0.20	3.20	0.43	2.90
Y	6.01	4.80	1.25	8.62	0.27	13.8	0.22	0.45	60.6	0.19	3.21	0.45	2.94
Y	5.95	4.78	1.25	8.64	0.27	13.8	0.22	0.46	60.6	0.19	3.21	0.44	2.90
Y	5.96	4.81	1.27	8.62	0.27	13.8	0.22	0.44	60.6	0.19	3.21	0.44	2.90
Y	5.98	4.78	1.25	8.56	0.27	13.8	0.22	0.45	60.3	0.19	3.16	0.42	2.95
Y	5.99	4.81	1.26	8.64	0.27	13.8	0.23	0.46	60.6	0.19	3.22	0.42	2.91
Y	5.94	4.80	1.27	8.62	0.27	13.8	0.22	0.45	60.6	0.19	3.18	0.46	2.90
Y	6.01	4.78	1.26	8.62	0.27	13.8	0.22	0.45	60.5	0.19	3.17	0.41	2.94
ZA	5.96	4.75	1.26	8.61	0.24	13.9	0.21	0.34	60.6	0.17	3.67		
ZA	5.93	4.83	1.26	8.57	0.24	13.9	0.21	0.37	60.9	0.18	3.64		
ZA	6.00	4.84	1.27	8.69	0.24	14.1	0.22	0.41	61.3	0.18	3.66		
ZA	5.91	4.80	1.26	8.64	0.24	13.9	0.22	0.35	60.9	0.17	3.63		
ZA	6.05	4.83	1.27	8.68	0.23	14.1	0.22	0.38	61.2	0.18	3.68		
ZA	5.92	4.73	1.22	8.39	0.23	13.8	0.21	0.42	60.6	0.18	3.66		
ZA	6.00	4.74	1.25	8.62	0.23	14.0	0.21	0.38	61.2	0.19	3.70		
ZA	5.93	4.78	1.24	8.55	0.24	13.9	0.22	0.31	60.5	0.17	3.59		
ZB	5.87	4.67	1.29	8.64	0.24	14.1	0.22	0.40	60.1	0.17	4.18	0.16	2.78
ZB	5.86	4.69	1.28	8.59	0.24	14.1	0.22	0.40	60.0	0.17	4.19	0.19	2.77
ZB	5.84	4.66	1.27	8.54	0.24	14.2	0.21	0.39	59.8	0.18	4.20	0.22	2.79
ZB	5.85	4.69	1.27	8.58	0.24	14.1	0.22	0.40	59.9	0.18	4.19	0.19	2.76
ZB	5.89	4.68	1.29	8.63	0.24	14.1	0.22	0.39	60.1	0.17	4.20	0.19	2.75
ZB	5.89	4.69	1.27	8.61	0.24	14.2	0.22	0.40	60.0	0.17	4.20	0.17	2.75
ZB	5.89	4.69	1.28	8.58	0.24	14.1	0.22	0.39	59.9	0.17	4.23	0.24	2.74
ZB	5.90	4.71	1.28	8.63	0.24	14.2	0.22	0.39	60.2	0.18	4.20	0.17	2.74

12. Measurement of Uncertainty :*(ref Dr Hugh Bartlett, Hugh Bartlett Consulting CC.)*

The samples used in this certification process have been 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:

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	PbColl	g/t	0.030	0.018	0.016	0.006
Pd	PbColl	g/t	0.029	0.017	0.019	0.005
Au	PbColl	g/t	0.006	0.003	0.005	0.001
Pt	NiS	g/t	0.031	0.024	0.018	0.008
Pd	NiS	g/t	0.030	0.021	0.021	0.007
Au	NiS	g/t	0.008	0.006	0.006	0.002
Ir	NiS	g/t	0.001	0.001	0.001	0.000
Rh	NiS	g/t	0.004	0.003	0.002	0.001
Ru	NiS	g/t	0.005	0.004	0.002	0.001
Co	M/ICP	ppm	3.63	2.03	2.53	0.57
Co	P	ppm	3.21	2.36	2.09	0.74
Cu	M/ICP	ppm	29.9	18.6	13.08	4.77
Cu	P	ppm	13.2	9.41	8.42	3.0
Cu	XRF	ppm	24.4	24.8	13.64	10.34
Ni	M/ICP	ppm	50.3	31.5	25.0	8.17
Ni	P	ppm	33.9	26.2	16.8	8.10
Ni	XRF	ppm	140	172	16.2	70.1
Al ₂ O ₃	XRF	%	0.052	0.040	0.028	0.014
CaO	XRF	%	0.052	0.045	0.012	0.015
Cr ₂ O ₃	XRF	%	0.028	0.022	0.012	0.007
Fe ₂ O ₃	XRF	%	0.060	0.058	0.031	0.021
K ₂ O	XRF	%	0.005	0.004	0.003	0.001
MgO	XRF	%	0.138	0.108	0.054	0.035
MnO	XRF	%	0.005	0.004	0.003	0.001
Na ₂ O	XRF	%	0.023	0.022	0.010	0.008
SiO ₂	XRF	%	0.290	0.215	0.160	0.070
TiO ₂	XRF	%	0.006	0.004	0.004	0.001
LOI		%	0.332	0.308	0.057	0.103
S	Comb/LECO	%	0.026	0.030	0.010	0.013
SG	pyc		0.045	0.030	0.024	0.009

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. Uncertified 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: AMIS0411 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 therefore 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.

22 August 2013

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

Analyte	Method	Unit	Mean	2SD	RSD%	n
Ag	M/ICP	ppm	0.37	0.11	15.6	40
Al	M/ICP	%	3.1	0.19	3.0	98
As	M/ICP	ppm	8.2	17.8	108	73
Ba	M/ICP	ppm	65.9	11.3	8.6	90
Be	M/ICP	ppm	0.30	0.03	5.0	31
Bi	M/ICP	ppm	0.40	0.04	4.7	45
Ca	M/ICP	%	3.3	0.17	2.5	100
Cd	M/ICP	ppm	0.68	2.3	167	37
Ce	M/ICP	ppm	9.6	1.0	5.2	39
Co	XRF	ppm	79.0	24.4	15.4	24
Cr	M/ICP	ppm	6134	3238	26.4	87
Cs	M/ICP	ppm	1.9	0.13	3.5	37
Dy	M/ICP	ppm	1.1	0.10	4.6	16
Er	M/ICP	ppm	0.64	0.13	9.8	16
Eu	M/ICP	ppm	0.27	0.04	6.8	16
Fe	M/ICP	%	5.9	0.43	3.7	97
Ga	M/ICP	ppm	8.0	0.92	5.8	39
Gd	M/ICP	ppm	1.0	0.10	4.6	16
Ge	M/ICP	ppm	0.5	0.59	65.7	16
Hf	M/ICP	ppm	0.7	0.10	6.7	45
Ho	M/ICP	ppm	0.23	0.02	4.5	16
In	M/ICP	ppm	0.03	0.02	40.1	28
K	M/ICP	%	0.20	0.02	5.1	103
La	M/ICP	ppm	4.9	1.2	12.6	68
Li	M/ICP	ppm	42.5	6.3	7.4	93
Lu	M/ICP	ppm	0.10	0.00	0.00	15
Mg	M/ICP	%	8.3	0.48	2.9	99
Mn	M/ICP	ppm	1677	164	4.9	96
Mo	M/ICP	ppm	1.8	0.48	13.6	53
Na	M/ICP	%	0.30	0.02	4.0	95
Nb	M/ICP	ppm	1.4	0.22	7.7	46
Nd	M/ICP	ppm	4.2	0.15	1.8	15
P	M/ICP	ppm	65.6	18.1	13.8	61
Pb	M/ICP	ppm	11.1	2.8	12.7	94
Pr	M/ICP	ppm	1.1	0.05	2.1	15
Rb	M/ICP	ppm	10.8	0.8	3.8	52
S	M/ICP	%	0.45	0.05	6.0	81
Sb	M/ICP	ppm	3.5	13.9	200	56
Sc	M/ICP	ppm	14.2	1.2	4.3	100
Se	M/ICP	ppm	1.8	0.86	24.2	22
Si	M/ICP	%	28.1	0.5	0.93	8
Sm	M/ICP	ppm	1.0	0.04	2.2	14
Sn	M/ICP	ppm	1.8	5.8	159	41
Sr	M/ICP	ppm	53.6	5.0	4.7	91
Ta	M/ICP	ppm	0.14	0.07	23.0	47
Tb	M/ICP	ppm	0.17	0.02	4.8	16
Te	M/ICP	ppm	0.50	1.3	125	44
Th	M/ICP	ppm	1.4	0.14	5.1	45
Ti	M/ICP	%	0.10	0.01	6.9	96
Tl	M/ICP	ppm	0.21	0.03	7.2	39
Tm	M/ICP	ppm	0.11	0.02	9.3	16
U	M/ICP	ppm	0.81	0.16	10.0	48
V	M/ICP	ppm	102	17.8	8.7	99
W	M/ICP	ppm	0.34	0.13	18.7	39
Y	M/ICP	ppm	5.6	0.59	5.2	80
Yb	M/ICP	ppm	0.68	0.05	3.7	15
Zn	M/ICP	ppm	70.4	17.4	12.4	94
Zr	M/ICP	ppm	24.1	3.1	6.3	80