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AMIS0319

**Nickel, Copper, PGM Sulphide Ore
Nkomati Mine South Africa**

Certified Reference Material

Certificate of Analysis

**Recommended Concentrations and Limits^{1, 2}
(at two Standard Deviations)**

Certified Concentrations

Pt Pb Collection	0.19	±	0.02	g/t
Pd Pb Collection	0.36	±	0.03	g/t
Co P	97	±	7	ppm
Cu M/ICP	1231	±	82	ppm
Cu P	1225	±	83	ppm
Cu XRF	1221	±	88	ppm
Ni M/ICP	1844	±	211	ppm
Ni P	1680	±	143	ppm
Specific Gravity	2.96		0.20	

Provisional Concentration

Au Pb Collection	0.04	±	0.01	g/t
Co M/ICP	115	±	21	ppm
Ni XRF	1893	±	239	ppm

PGM 3E= 0.59g/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, 10 and 13.
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 Limits (at two Standard Deviations)

Certified Concentrations

Al ₂ O ₃	7.47	±	0.10	%
CaO	6.26	±	0.10	%
Cr ₂ O ₃	2.72	±	0.08	%
Fe ₂ O ₃	12.41	±	0.16	%
K ₂ O	0.84	±	0.02	%
MgO	13.82	±	0.28	%
MnO	0.17	±	0.02	%
Na ₂ O	0.93	±	0.08	%
SiO ₂	46.65	±	0.46	%
TiO ₂	0.59	±	0.02	%
S Combustion / LECO	1.30	±	0.06	%

Provisional Concentrations

LOI 5.38 ± 0.66 %

1. Intended Use: AMIS0319 is a certified reference material which may be used to demonstrate the validity of measurement results of a single analysis of nickel-copper-PGM sulphide ores hosted by mafic-ultramafic rocks

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: The material for AMIS0319 was provided by the Nkomati Nickel Mine, joint venture between ARM Platinum and Norilsk Nickel Africa (Pty) Ltd. The mine is situated in the Machadodorp area, Mpumalanga, approximately 300 km east of Johannesburg in South Africa.

3. Mineral and Chemical Composition: Mineralisation at Nkomati occurs in a number of distinct zones within the Uitkomst Complex, a layered mafic-ultramafic intrusion exposed in a broad valley dissecting the Transvaal Sequence. Economic sulphide mineralization occurs as disseminations, blebs and stringers in three zones, namely the Basal Mineralised Zone (BMZ), in the Basal Gabbro; the Main Mineralised Zone (MMZ), in the Lower Pyroxenite, and the Chromititic Peridotite Mineralised Zone (PCMZ), in the Chromititic Peridotite. The Massive Sulphide Body

(MSB), which was situated mainly in the granite basement below the Uitkomst Complex, has been mined out.

4. **Appearance:** The material is a very fine powder. It is colored aBlueish Grey (Corstor 5B7/1).

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 <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.

7. **Methods of Analysis requested:**

1. Pt, Pd and Au. Pb collection with Ag as a co-collector, ICP-OES or ICP-MS.
2. Multi element scan to include Co, Cu and Ni. Multi-acid total digestion, including HF, ICP-OES or ICP-MS.
3. Co, Cu and Ni. Aqua regia digestion with ICP-OES or ICP-MS.
4. Co, Cu and Ni. Pressed Pellet, XRF.
5. Majors (Al₂O₃, CaO, Cr₂O₃, Fe₂O₃, K₂O, MgO, MnO, Na₂O, SiO₂, TiO₂. LOI.) XRF fusion.
6. SG, gas pycnometer.

8. **Information requested:**

1. State aliquots used for all determinations.
2. All results for major elements to be reported as oxides in percentages.
3. All results for multi-element scans to be reported in ppm.
4. Report all QC data, to include replicates, blanks and certified reference materials used.
5. State and provide brief description of analytical techniques used.

9. **Method of Certification:** Twenty Five laboratories were each given eight randomly selected packages of sample. Twenty of the laboratories submitted results in time for certification.

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 20 out of 25 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 Brisbane Australia
4. ALS Chemex Laboratory Group Johannesburg SA
5. ALS Chemex Laboratory Group Perth WA
6. ALS Chemex Laboratory Group Vancouver CA
7. ALS OMAC (Ireland)
8. Bureau Veritas (USA)
9. Genalysis Laboratory Services (W Australia P)
10. Intertek Utama Services (Indonesia)
11. Labtium Inc Finland
12. Set Point Laboratories (Isando) SA
13. SGS Australia Pty Ltd (Newburn) WA
14. SGS Geosol Laboratories Ltda (Brazil)
15. SGS Mineral Services Callao (Peru)
16. SGS Mineral Services Lakefield (Canada)
17. SGS Toronto (Canada)
18. SGS Townsville (Australia)
19. SGS Vancouver (Canada)
20. Ultra Trace (Pty) Ltd WA

11. Assay Data: Data as received from the laboratories for the important certified elements listed on p1 are set out below.

Assay data: Economic Elements

Lab Code	Pt PbColl g/t	Pd PbColl g/t	Au PbColl g/t	Co M/ICP ppm	Co P ppm	Co XRF ppm	Cu M/ICP ppm	Cu P ppm	Cu XRF ppm	Ni M/ICP ppm	Ni P ppm	Ni XRF ppm
A	0.18	0.35	0.04	116	100		1280	1210		1800	1770	
A	0.19	0.36	0.04	115	100		1290	1230		1780	1810	
A	0.19	0.35	0.04	115	100		1300	1240		1790	1800	
A	0.19	0.36	0.03	117	100		1310	1220		1830	1770	
A	0.19	0.35	0.04	117	100		1310	1230		1830	1780	
A	0.19	0.35	0.04	116	100		1290	1200		1780	1780	
A	0.18	0.35	0.04	115	90		1310	1210		1780	1760	
A	0.18	0.36	0.04	117	100		1310	1210		1840	1780	
B	0.18	0.37	0.03			100			1300			1800
B	0.19	0.38	0.04			100			1300			1900
B	0.18	0.36	0.05			100			1200			1800
B	0.19	0.38	0.04			100			1100			1800
B	0.19	0.38	0.04			100			1200			1800
B	0.19	0.37	0.04			100			1200			1800
B	0.18	0.37	0.03			200			1200			1800
B	0.17	0.35	0.03			100			1200			1800
C				110	90	130	1180	1220	1300	1770	1660	1900
C				110	90	120	1220	1230	1240	1850	1680	1900
C				110	100	130	1180	1170	1270	1770	1600	1910
C				110	100	120	1160	1200	1260	1730	1630	1890
C				120	100	120	1190	1220	1240	1770	1680	1900
C				120	100	120	1180	1210	1250	1770	1640	1900
C				110	100	130	1170	1220	1260	1730	1670	1910
C				110	110	120	1190	1240	1260	1760	1690	1900
D	0.19	0.37	0.04	126	95		1192	1151		1781	1567	
D	0.20	0.37	0.04	128	97		1190	1183		1799	1612	
D	0.20	0.37	0.05	124	94		1189	1137		1748	1572	
D	0.20	0.37	0.04	129	95		1199	1152		1740	1622	
D	0.19	0.37	0.04	129	99		1192	1169		1748	1628	
D	0.19	0.36	0.05	122	96		1176	1159		1757	1606	
D	0.19	0.37	0.05	129	94		1188	1157		1754	1571	
D	0.19	0.36	0.04	128	92		1194	1129		1756	1564	

Assay data (cont): Economic Elements

Lab Code	Pt PbColl g/t	Pd PbColl g/t	Au PbColl g/t	Co M/ICP ppm	Co P ppm	Co XRF ppm	Cu M/ICP ppm	Cu P ppm	Cu XRF ppm	Ni M/ICP ppm	Ni P ppm	Ni XRF ppm
E	0.18	0.37	0.04	110	100		1270	1280		1880	1780	
E	0.17	0.37	0.03	120	100		1290	1290		1870	1770	
E	0.18	0.37	0.04	120	100		1300	1300		1900	1790	
E	0.18	0.36	0.03	120	100		1300	1290		1870	1810	
E	0.19	0.37	0.04	120	100		1250	1300		1850	1820	
E	0.19	0.36	0.03	120	100		1260	1300		1870	1810	
E	0.18	0.38	0.03	120	110		1230	1310		1830	1840	
E	0.18	0.36	0.04	120	100		1280	1290		1880	1800	
F	0.19	0.37	0.04	131	100	160	1226	1231	1210	1955	1784	1970
F	0.19	0.37	0.04	133	100	150	1240	1229	1220	1989	1792	1960
F	0.19	0.39	0.04	130	96	160	1206	1211	1150	1944	1747	1940
F	0.16	0.34	0.03	134	101	150	1212	1233	1170	1912	1804	1960
F	0.19	0.37	0.04	134	99	150	1218	1200	1250	1966	1760	1920
F	0.19	0.36	0.03	129	95	150	1212	1162	1240	1939	1726	1990
F	0.19	0.38	0.04	130	95	150	1242	1173	1200	1969	1727	1940
F	0.19	0.37	0.04	132	96	150	1239	1191	1210	1974	1742	1920
G	0.18	0.32	0.03	140			1230			1870		
G	0.18	0.34	0.03	130			1210			1830		
G	0.18	0.34	0.04	120			1230			1800		
G	0.18	0.34	0.04	120			1220			1840		
G	0.19	0.35	0.04	130			1220			1890		
G	0.18	0.35	0.03	120			1230			1900		
G	0.19	0.34	0.03	140			1270			1960		
G	0.18	0.35	0.04	120			1190			1840		
H				119	95		1270	1170		1990	1630	
H				113	97		1260	1190		1970	1660	
H				116	97		1240	1170		2000	1640	
H				111	97		1230	1170		1960	1640	
H				117	95		1230	1160		2040	1620	
H				109	97		1240	1170		1960	1650	
H				113	99		1230	1190		1970	1680	
H				115	97		1230	1170		2050	1640	
I	0.19	0.31	0.04	74	98		708	1280		1095	1735	
I	0.20	0.34	0.05	122	97		1190	1270		1795	1715	
I	0.20	0.31	0.05	113	91		1225	1240		1720	1650	
I	0.18	0.33	0.04	115	94		1240	1240		1755	1665	
I	0.20	0.34	0.05	114	92		1230	1230		1735	1655	
I	0.22	0.36	0.05	114	93		1240	1230		1725	1625	
I	0.20	0.35	0.04	109	94		1220	1240		1700	1675	
I	0.15	0.33	0.04	110	93		1335	1240		1750	1660	
J	0.17	0.33	0.05	109	96		1200	1220		1630	1660	
J	0.17	0.33	0.03	109	97		1230	1230		1650	1680	
J	0.18	0.36	0.04	110	97		1210	1220		1670	1680	
J	0.19	0.36	0.04	109	96		1220	1220		1660	1650	
J	0.21	0.38	0.03	110	96		1220	1230		1650	1690	
J	0.19	0.37	0.04	109	98		1220	1280		1630	1650	
J	0.20	0.36	0.03	109	96		1220	1220		1670	1680	
J	0.19	0.37	0.04	109	98		1230	1230		1660	1700	
K	0.19	0.36	0.04			116			1250			2060
K	0.21	0.41	0.04			115			1220			2040
K	0.19	0.36	0.04			118			1250			2040
K	0.20	0.36	0.04			117			1240			2040
K	0.19	0.36	0.03			112			1250			2040
K	0.20	0.38	0.03			113			1250			2050
K	0.17	0.34	0.03			116			1240			2050
K	0.18	0.38	0.04			114			1240			2040
L				102	93		1216	1240		1885	1587	
L				102	90		1222	1241		1982	1587	
L				102	90		1269	1240		1919	1600	
L				104	93		1263	1228		1916	1584	
L				101	92		1218	1253		1916	1594	
L				103	91		1287	1238		1933	1565	
L				103	91		1243	1233		1880	1586	
L				101	93		1246	1251		1904	1619	
M	0.18	0.33	0.03	100	100	96	1200	1100	1153	2000	1700	1676
M	0.18	0.34	0.03	100	100	99	1200	1100	1149	1900	1700	1665
M	0.18	0.33	0.05	100	100	115	1200	1100	1150	2000	1800	1680
M	0.17	0.35	0.03	100	100	110	1200	1100	1160	2000	1700	1674
M	0.19	0.33	0.04	100	100	106	1200	1100	1147	1900	1700	1670
M	0.18	0.34	0.03	100	100	99	1200	1100	1148	1900	1800	1675
M	0.18	0.35	0.04	100	100	112	1200	1100	1150	2000	1700	1676
M	0.18	0.34	0.04	100	100	108	1200	1100	1146	2000	1800	1666

Assay data (cont): Economic Elements

Lab Code	Pt PbColl g/t	Pd PbColl g/t	Au PbColl g/t	Co M/ICP ppm	Co P ppm	Co XRF ppm	Cu M/ICP ppm	Cu P ppm	Cu XRF ppm	Ni M/ICP ppm	Ni P ppm	Ni XRF ppm
N	0.19	0.37	0.05	90	101	200	1546	1384	1200	1404	1671	2000
N	0.20	0.37	0.04	112	100	200	1539	1360	1200	1577	1635	2000
N	0.19	0.37	0.04	101	97	200	1542	1339	1200	1386	1601	2000
N	0.20	0.36	0.04	109	97	200	1501	1317	1300	1523	1606	2000
N	0.20	0.37	0.05	112	97	200	1578	1297	1200	1524	1587	2100
N	0.19	0.36	0.04	109	94		1514	1253	1300	1533	1545	2000
N	0.20	0.37	0.05	114	95	100	1548	1357	1300	1616	1536	2000
N	0.20	0.37	0.05	116	94	100	1507	1254	1200	1594	1507	1900
Q	0.17	0.36	0.04						1233			1849
Q	0.17	0.35	0.03						1225			1891
Q	0.18	0.35	0.04						1224			1897
Q	0.18	0.35	0.04						1204			1872
Q	0.17	0.35	0.04						1230			1840
Q	0.17	0.35	0.03						1239			1910
Q	0.16	0.34	0.04						1212			1862
Q	0.17	0.35	0.04						1197			1854
S	0.19	0.35	0.03	99	93		1210	1280		1810	1700	
S	0.18	0.33	0.03	103	104		1250	1260		1780	1680	
S	0.19	0.36	0.04	106	93		1270	1280		1830	1720	
S	0.18	0.35	0.04	107	94		1260	1260		1790	1680	
S	0.19	0.35	0.04	124	97		1230	1240		1780	1450	
S	0.18	0.34	0.04	132	107		1270	1250		1820	1520	
S	0.18	0.35	0.04	128	112		1270	1260		1800	1670	
S	0.19	0.35	0.04	109	91		1270	1260		1890	1490	
U	0.13	0.26	0.04	117	91		1170	1240		1630	1660	
U	0.14	0.27	0.05	107	90		1170	1170		1700	1610	
U	0.14	0.28	0.05	114	95		1120	1200		1600	1600	
U	0.14	0.28	0.04	114	90		1130	1180		1610	1650	
U	0.16	0.32	0.05	123	100		1240	1140		1820	1630	
U	0.15	0.29	0.04	125	99		1270	1170		1810	1650	
U	0.15	0.29	0.04	122	99		1280	1170		1780	1660	
U	0.14	0.27	0.04	111	101		1140	1180		1550	1660	
V	0.19	0.36		98			1266			1544		
V	0.19	0.34		97			1269			1553		
V	0.16	0.31		92			1171			1446		
V	0.16	0.28		99			1273			1549		
V	0.10	0.20		95			1210			1488		
V	0.15	0.28		91			1158			1419		
V	0.19	0.36		97			1257			1525		
V	0.19	0.31		98			1296			1569		
W	0.18	0.32	0.03	130	99		1350	1330		2000	1750	
W	0.17	0.30	0.03	133	104		1370	1310		1980	1760	
W	0.18	0.32	0.04	135	105		1350	1250		1890	1730	
W	0.18	0.33	0.03	128	100		1360	1280		1870	1730	
W	0.16	0.32	0.03	136	101		1340	1270		1920	1720	
W	0.17	0.31	0.03	129	97		1390	1240		1930	1680	
W	0.15	0.31	0.04	132	97		1360	1320		1910	1710	
W	0.16	0.32	0.04	128	97		1320	1350		1910	1750	
X	0.21	0.37	0.04	120	96		1250	1250		1930	1670	
X	0.20	0.37	0.04	125	99		1220	1220		1900	1650	
X	0.20	0.35	0.04	120	101		1250	1240		1910	1680	
X	0.21	0.37	0.04	120	101		1250	1250		1880	1710	
X	0.21	0.36	0.04	115	98		1250	1250		1860	1680	
X	0.21	0.37	0.04	125	96		1250	1250		1880	1620	
X	0.21	0.37	0.04	120	96		1240	1250		1860	1650	
X	0.19	0.35	0.04	125	96		1230	1230		1910	1650	

Assay data: Major Oxides

Lab Code	Al2O3 XRF %	CaO XRF %	Cr2O3 XRF %	Fe2O3 XRF %	K2O XRF %	MgO XRF %	MnO XRF %	Na2O XRF %	SiO2 XRF %	TiO2 XRF %	LOI %	S Comb/LECO %	SG pyc
A	7.52	6.19		12.35	0.83	15.00	0.17	0.93	47.10	0.58	5.96	1.34	2.98
A	7.43	6.15		12.35	0.83	14.85	0.17	0.93	46.60	0.58	6.32	1.34	2.92
A	7.50	6.17		12.45	0.84	14.90	0.18	0.94	47.00	0.58	5.99	1.35	2.97
A	7.45	6.19		12.45	0.84	14.80	0.18	0.94	46.40	0.58	6.17	1.34	2.97
A	7.42	6.18		12.40	0.83	15.05	0.17	0.94	47.10	0.58	5.95	1.34	2.99
A	7.46	6.12		12.40	0.84	14.90	0.17	0.93	46.70	0.59	6.00	1.34	2.91
A	7.48	6.20		12.45	0.84	15.05	0.17	0.93	47.10	0.59	5.88	1.34	2.98
A	7.48	6.30		12.60	0.85	15.15	0.17	0.95	47.00	0.59	5.81	1.34	2.97

Assay data (cont): Major Oxides

Lab Code	Al2O3 XRF %	CaO XRF %	Cr2O3 XRF %	Fe2O3 XRF %	K2O XRF %	MgO XRF %	MnO XRF %	Na2O XRF %	SiO2 XRF %	TiO2 XRF %	LOI %	S Comb/LECO %	SG pyc
B	7.58	6.35	2.78	12.50	0.84	14.00	0.16	0.93	46.60	0.58	5.51	1.30	
B	7.51	6.27	2.78	12.40	0.84	13.90	0.17	0.93	46.20	0.58	5.47	1.27	
B	7.58	6.30	2.79	12.50	0.84	14.00	0.17	0.92	46.20	0.59	5.46	1.27	
B	7.58	6.33	2.78	12.50	0.84	13.90	0.17	0.89	46.40	0.58	5.57	1.29	
B	7.59	6.29	2.80	12.40	0.83	13.90	0.16	0.91	46.40	0.58	5.57	1.28	
B	7.53	6.33	2.79	12.50	0.84	14.00	0.17	0.93	46.50	0.58	5.60	1.28	
B	7.53	6.29	2.79	12.50	0.85	13.90	0.17	0.92	46.30	0.58	5.51	1.27	
B	7.59	6.29	2.80	12.50	0.84	14.00	0.17	0.92	46.40	0.58	5.51	1.29	
C	7.40	6.21	2.70	12.36	0.82	13.80	0.17	0.93	46.30	0.60	5.14	1.29	2.88
C	7.40	6.24	2.68	12.26	0.83	13.75	0.17	0.87	46.30	0.58	5.16	1.31	2.91
C	7.39	6.21	2.71	12.32	0.84	13.70	0.17	0.86	46.30	0.58	5.18	1.25	2.88
C	7.38	6.19	2.69	12.24	0.83	13.70	0.17	0.87	46.30	0.58	5.43	1.31	2.89
C	7.39	6.20	2.71	12.26	0.83	13.80	0.17	0.87	46.30	0.58	5.18	1.28	2.89
C	7.39	6.19	2.71	12.26	0.83	13.70	0.17	0.86	46.40	0.58	5.21	1.25	2.85
C	7.39	6.20	2.70	12.30	0.83	13.75	0.17	0.87	46.40	0.59	5.12	1.32	2.84
C	7.40	6.22	2.70	12.26	0.83	13.75	0.17	0.87	46.40	0.58	5.13	1.31	2.88
D												1.35	2.98
D												1.32	2.97
D												1.30	3.00
D												1.32	3.03
D												1.32	3.05
D												1.30	2.95
D												1.34	2.96
D												1.32	2.92
E	7.44	6.27	2.71	12.30	0.83	13.75	0.17	0.96	46.50	0.58	5.16		2.79
E	7.41	6.24	2.71	12.32	0.82	13.70	0.17	0.96	46.40	0.57	5.08		2.85
E	7.49	6.30	2.72	12.46	0.84	13.80	0.17	0.98	46.80	0.58	5.17		2.81
E	7.51	6.32	2.72	12.46	0.83	13.80	0.17	0.98	46.90	0.59	5.10		2.87
E	7.49	6.27	2.72	12.50	0.83	13.75	0.17	0.97	46.90	0.58	5.10		2.85
E	7.46	6.24	2.66	12.32	0.84	13.70	0.17	0.97	46.60	0.58	5.20		2.86
E	7.46	6.26	2.69	12.34	0.83	13.75	0.17	0.96	46.60	0.58	5.18		2.85
E	7.43	6.25	2.68	12.30	0.82	13.70	0.17	0.96	46.40	0.58	5.05		2.85
F	7.48	6.25	2.83	12.49	0.85	14.20	0.17	0.93	46.80	0.59	4.78		2.82
F	7.50	6.27	2.85	12.47	0.84	14.17	0.17	0.94	46.90	0.59	4.72		2.80
F	7.42	6.26	2.84	12.46	0.84	14.05	0.17	0.93	47.00	0.60	4.80		2.81
F	7.41	6.29	2.85	12.54	0.83	14.05	0.17	0.91	46.40	0.58	4.81		2.79
F	7.51	6.21	2.81	12.38	0.85	14.13	0.17	0.94	46.70	0.60	4.85		2.79
F	7.50	6.28	2.85	12.56	0.84	14.22	0.18	0.93	46.90	0.58	4.82		2.79
F	7.47	6.23	2.83	12.46	0.84	14.14	0.17	0.92	46.70	0.58	4.83		2.79
F	7.48	6.22	2.81	12.40	0.84	14.11	0.17	0.97	46.70	0.60	4.74		2.82
G													2.96
G													2.88
G													3.00
G													3.01
G													3.00
G													3.06
G													2.87
G													2.99
H	7.47	6.30	2.73	12.39	0.85	13.97	0.18	0.90	46.88	0.59	5.70		
H	7.49	6.33	2.70	12.34	0.85	13.94	0.18	0.90	46.78	0.61	5.60		
H	7.49	6.32	2.77	12.37	0.84	13.91	0.17	0.89	46.71	0.60	5.50		
H	7.48	6.31	2.71	12.30	0.84	13.91	0.17	0.89	46.67	0.60	5.60		
H	7.48	6.34	2.71	12.38	0.85	13.89	0.18	0.90	46.77	0.61	5.60		
H	7.48	6.33	2.72	12.38	0.85	13.90	0.17	0.90	46.78	0.61	5.90		
H	7.49	6.31	2.70	12.34	0.84	13.90	0.17	0.89	46.67	0.60	5.80		
H	7.49	6.31	2.71	12.37	0.84	13.88	0.18	0.89	46.67	0.59	5.90		
I													3.04
I													3.08
I													3.05
I													3.02
I													3.01
I													3.02
I													3.05
I													3.07
J												1.30	
J												1.29	
J												1.29	
J												1.29	
J												1.30	
J												1.30	
J												1.29	
K	7.67	6.19	2.67	12.70	0.85	13.60	0.19	0.95	46.42	0.59	6.91		2.96
K	7.57	6.25	2.68	12.67	0.85	13.66	0.19	0.88	46.40	0.60	6.95		2.96
K	7.63	6.21	2.68	12.67	0.86	13.66	0.19	0.89	46.57	0.58	6.85		2.97
K	7.54	6.22	2.63	12.62	0.86	13.59	0.19	0.90	46.71	0.59	6.82		2.97
K	7.46	6.19	2.70	12.71	0.85	13.53	0.19	0.91	46.75	0.59	6.78		2.97
K	7.49	6.23	2.65	12.61	0.86	13.60	0.19	0.92	46.67	0.61	6.77		2.97
K	7.53	6.18	2.70	12.72	0.85	13.75	0.19	0.92	46.59	0.60	6.80		2.99
K	7.44	6.25	2.66	12.78	0.86	13.48	0.19	0.89	46.70	0.63	6.70		2.98

Assay data (cont): Major Oxides

Lab Code	Al2O3 XRF %	CaO XRF %	Cr2O3 XRF %	Fe2O3 XRF %	K2O XRF %	MgO XRF %	MnO XRF %	Na2O XRF %	SiO2 XRF %	TiO2 XRF %	LOI %	S Comb/LECO %	SG pyc
L												1.32	2.88
L												1.33	2.88
L												1.34	2.87
L												1.32	2.91
L												1.30	2.90
L												1.30	2.90
L												1.33	2.89
L												1.33	2.89
M	7.47	6.30	2.71	12.52	0.82	13.87	0.19	1.03	46.45	0.60	5.55	1.26	2.96
M	7.47	6.29	2.70	12.52	0.82	13.75	0.19	1.01	46.34	0.60	5.48	1.26	2.96
M	7.26	6.23	2.66	12.40	0.82	13.59	0.19	1.01	46.81	0.59	5.54	1.26	2.95
M	7.36	6.27	2.70	12.47	0.83	13.67	0.19	1.04	46.08	0.59	6.06	1.26	2.96
M	7.27	6.20	2.66	12.33	0.82	13.50	0.18	1.06	46.43	0.59	6.05	1.25	2.95
M	7.35	6.28	2.69	12.51	0.83	13.70	0.19	1.04	46.26	0.59	5.92	1.27	2.96
M	7.33	6.30	2.68	12.41	0.83	13.60	0.19	1.05	46.00	0.59	5.73	1.25	2.96
M	7.37	6.24	2.67	12.45	0.83	13.61	0.19	1.05	46.88	0.59	5.82	1.27	2.95
N												1.35	
N												1.27	
N												1.34	
N												1.27	
N												1.36	
N												1.27	
N												1.35	
N												1.20	
Q	7.84	6.31		12.10	0.77	14.40	0.16	1.00	47.70	0.59	5.44		3.12
Q	7.85	6.29		12.10	0.77	14.40	0.16	0.99	47.60	0.60	5.36		3.12
Q	7.80	6.30		12.10	0.77	14.40	0.16	1.00	47.70	0.59	5.30		3.14
Q	7.77	6.28		12.10	0.77	14.40	0.16	0.99	47.50	0.59	5.28		3.10
Q	7.84	6.31		12.10	0.77	14.40	0.16	1.00	47.80	0.60	5.29		3.20
Q	7.84	6.32		12.10	0.77	14.40	0.16	0.99	47.70	0.60	5.35		3.20
Q	7.80	6.31		12.10	0.77	14.40	0.16	0.99	47.70	0.60	5.42		3.19
Q	7.78	6.25		12.00	0.76	14.30	0.16	0.99	47.30	0.58	5.31		3.14
S												1.29	3.12
S												1.29	3.09
S												1.27	3.08
S												1.27	3.09
S												1.28	3.05
S												1.24	3.07
S												1.27	3.07
S												1.26	3.08
U												1.31	
U												1.30	
U												1.29	
U												1.31	
U												1.30	
U												1.30	
U												1.30	
V												1.25	
V												1.23	
V												1.10	
V												1.18	
V												1.23	
V												1.18	
V												1.23	
V												1.23	
W	7.48	6.24	2.74	12.50	0.84	13.90	0.17	0.96	46.90	0.61	5.24		
W	7.46	6.25	2.73	12.50	0.84	13.90	0.18	0.95	46.80	0.61	5.24		
W	7.52	6.23	2.74	12.50	0.85	13.90	0.17	0.96	46.80	0.61	5.29		
W	7.49	6.25	2.74	12.50	0.84	14.00	0.18	0.96	46.90	0.61	5.20		
W	7.46	6.33	2.77	12.50	0.85	13.90	0.18	0.97	46.80	0.64	5.11		
W	7.51	6.27	2.75	12.50	0.85	13.90	0.18	0.96	46.80	0.62	5.13		
W	7.51	6.22	2.72	12.50	0.84	13.80	0.17	0.97	46.80	0.61	5.23		
W	7.50	6.24	2.73	12.50	0.84	13.80	0.18	0.97	46.90	0.61	5.18		
X	7.48	6.31	2.73	12.36	0.85	13.86	0.18		46.77	0.59	5.37		3.07
X	7.47	6.30	2.73	12.36	0.85	13.85	0.17		46.78	0.59	5.33		3.12
X	7.48	6.29	2.72	12.34	0.85	13.85	0.17		46.69	0.59	5.31		3.09
X	7.48	6.30	2.72	12.31	0.85	13.85	0.17		46.75	0.59	5.37		3.08
X	7.47	6.28	2.72	12.33	0.85	13.82	0.17		46.70	0.59	5.33		3.06
X	7.47	6.29	2.72	12.36	0.85	13.83	0.17		46.70	0.59	5.36		3.07
X	7.47	6.29	2.73	12.38	0.85	13.83	0.18		46.73	0.60	5.36		3.11
X	7.47	6.28	2.72	12.33	0.84	13.82	0.17		46.69	0.59	5.37		3.08

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:

$$\text{Combined standard uncertainty} = \sqrt{(\text{between lab.var/no of labs}) + (\text{mean square within lab.var /no of assays})}$$

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	0.011	0.006	0.007	0.002
Pd	PbColl	g/t	0.014	0.008	0.009	0.002
Au	PbColl	g/t	0.005	0.002	0.004	0.001
Co	M/ICP	ppm	10.61	6.628	4.537	1.656
Co	P	ppm	3.474	1.529	2.793	0.472
Cu	M/ICP	ppm	41.05	22.20	28.43	6.297
Cu	P	ppm	41.40	29.59	18.29	8.407
Cu	XRF	ppm	44.29	35.98	30.90	14.22
Ni	M/ICP	ppm	105.4	72.78	40.16	19.15
Ni	P	ppm	71.58	47.05	32.87	12.53
Ni	XRF	ppm	119.4	132.9	27.93	50.37
Al ₂ O ₃	XRF	%	0.066	0.048	0.041	0.016
CaO	XRF	%	0.046	0.032	0.028	0.010
Cr ₂ O ₃	XRF	%	0.045	0.040	0.017	0.013
Fe ₂ O ₃	XRF	%	0.084	0.066	0.050	0.023
K ₂ O	XRF	%	0.010	0.008	0.006	0.003
MgO	XRF	%	0.139	0.122	0.055	0.041
MnO	XRF	%	0.009	0.007	0.003	0.002
Na ₂ O	XRF	%	0.038	0.035	0.014	0.012
SiO ₂	XRF	%	0.231	0.155	0.159	0.052
TiO ₂	XRF	%	0.010	0.007	0.007	0.002
LOI		%	0.333	0.293	0.104	0.093
S	Comb/LECO	%	0.030	0.022	0.019	0.007
SG	pycnometer		0.096	0.073	0.029	0.020

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 Certified values: The Certified, Provisional and Indicated values listed on p1 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: AMIS0319 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 or Explorer Packs containing custom weights (from 50 to 250g) of material. Laboratory Packs are sealed bottles delivered in sealed foil pouches. 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.

23 September 2012

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	0.75	0.60	39.9	51
Al	M/ICP	%	4.02	0.45	5.59	64
As	M/ICP	ppm	13.7	6.74	24.5	66
Ba	M/ICP	ppm	131	25.3	9.67	61
Be	M/ICP	ppm	0.56	0.25	21.9	30
Bi	M/ICP	ppm	0.80	1.74	109	39
Ca	M/ICP	%	4.36	0.60	6.85	64
Cd	M/ICP	ppm	0.89	2.38	133	34
Ce	M/ICP	ppm	3108	13361	215	39
Cr	M/ICP	ppm	9867	11871	60.2	33
Cs	M/ICP	ppm	2.21	0.37	8.47	16
Dy	M/ICP	ppm	2.24	0.15	3.33	8
Er	M/ICP	ppm	1.24	0.10	4.18	8
Eu	M/ICP	ppm	0.83	0.06	3.84	8
Fe	M/ICP	%	8.37	1.15	6.89	69
Ga	M/ICP	ppm	10.1	2.04	10.1	31
Gd	M/ICP	ppm	683	1407	103	16
Ge	M/ICP	ppm	0.70			7
Hf	M/ICP	ppm	1.75	0.31	8.97	31
Ho	M/ICP	ppm	0.44	0.02	2.51	7
In	M/ICP	ppm	0.07	0.02	15.6	27
K	M/ICP	%	0.74	0.11	7.56	63
La	M/ICP	ppm	10.2	2.53	12.4	42
Li	M/ICP	ppm	19.8	2.71	6.85	41
Lu	M/ICP	ppm	0.16	0.02	5.43	15
Mg	M/ICP	%	8.08	0.99	6.15	63
Mn	M/ICP	ppm	1287	165	6.41	61
Mo	M/ICP	ppm	1.20	0.81	33.7	45
Na	M/ICP	%	0.70	0.13	8.92	64
Nb	M/ICP	ppm	3.38	0.60	8.84	30
Nd	M/ICP	ppm	5.36	11.1	103	16
P	M/ICP	ppm	308	59.5	9.65	64
Pb	M/ICP	ppm	7.37	5.17	35.1	53
Pr	M/ICP	ppm	2.69	0.24	4.53	8
Rb	M/ICP	ppm	24.4	2.60	5.33	37
S	M/ICP	%	1.30	0.17	6.59	44
Sb	M/ICP	ppm	5.81	19.7	169	43
Sc	M/ICP	ppm	14.6	1.99	6.81	70
Se	M/ICP	ppm	4.63	1.85	20.0	24
Si	M/ICP	ppm	1.65	0.26	8.00	8
Sm	M/ICP	ppm	2.53	0.21	4.10	8
Sn	M/ICP	ppm	1.50	0.16	5.44	22
Sr	M/ICP	ppm	129	34.8	13.5	71
Ta	M/ICP	ppm	0.22	0.16	35.1	31
Tb	M/ICP	ppm	0.38	0.04	5.61	14
Te	M/ICP	ppm	0.78	0.79	50.6	29
Th	M/ICP	ppm	1.69	0.49	14.6	32
Ti	M/ICP	%	0.34	0.07	9.74	57
Tl	M/ICP	ppm	0.17	0.07	20.2	16
Tm	M/ICP	ppm	0.17	0.01	4.10	8
U	M/ICP	ppm	1.90	9.59	253	35
V	M/ICP	ppm	143	59.8	21.0	72
W	M/ICP	ppm	2.19	1.52	34.8	32
Y	M/ICP	ppm	10.8	2.36	10.9	44
Yb	M/ICP	ppm	1.19	0.10	4.15	15
Zn	M/ICP	ppm	96.9	39.6	20.4	64
Zr	M/ICP	ppm	59.4	6.12	5.16	52