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AMIS0317

Certified Reference Material

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

Certificate of Analysis

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

Certified Concentrations

Pt Pb Collection	0.235	0.018	g/t
Pd Pb Collection	0.48	0.04	g/t
Cu M/ICP	1571	131	ppm
Cu P	1568	91	ppm
Ni P	2340	233	ppm
Specific Gravity	2.96	0.18	

Provisional Concentration

Au Pb Collection	0.165	0.022	g/t
Co M/ICP	126	24	ppm
Co P	107	14	ppm
Ni M/ICP	2492	350	ppm
Ni XRF	2566	342	ppm

PGM 3E = 0.880 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, 10 and 13.*

2. *There is additional certified major element data presented on p2 and uncertified trace element data presented as an appendix.*

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Major Element Recommended Concentrations and Limits (at two Standard Deviations)

Certified Concentrations

Al ₂ O ₃	7.34	0.06	%
CaO	6.32	0.08	%
Cr ₂ O ₃	2.92	0.04	%
Fe ₂ O ₃	11.66	0.14	%
K ₂ O	1.12	0.01	%
MgO	12.26	0.16	%
MnO	0.15	0.01	%
Na ₂ O	0.88	0.10	%
SiO ₂	49.07	0.60	%
TiO ₂	0.45	0.02	%
S Comb / LECO	1.75	0.10	%

Provisional Concentrations

LOI	5.41	1.44	%
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1. Intended Use: AMIS0317 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 AMIS0317 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 a Medium Dark Grey.

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. 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
8. Bureau Veritas (USA)
9. Genalysis Laboratory Services (W Australia P)
10. Intertek Utama Services (Indonesia)
11. LabtiumInc 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.

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
B	0.24	0.48	0.16	140			1550			2590		
B	0.23	0.47	0.16	140			1560			2600		
B	0.23	0.47	0.16	140			1600			2690		
B	0.24	0.48	0.15	140			1590			2640		
B	0.24	0.47	0.16	140			1610			2640		
B	0.23	0.48	0.18	130			1560			2600		
B	0.23	0.47	0.17	130			1550			2550		
B	0.23	0.47	0.16	130			1560			2590		
C	0.24	0.45	0.18			100			1500			2500
C	0.23	0.48	0.16			100			1600			2500
C	0.24	0.50	0.15			100			1500			2500
C	0.24	0.45	0.17			100			1500			2500
C	0.22	0.47	0.18			200			1400			2400
C	0.24	0.47	0.15			100			1400			2500
C	0.22	0.45	0.14			100			1500			2400
C	0.24	0.46	0.18			100			1500			2400
D	0.23	0.45	0.16	135	106		1560	1490		2630	2240	
D	0.24	0.47	0.17	130	110		1560	1530		2590	2290	
D	0.25	0.48	0.16	135	111		1610	1540		2590	2330	
D	0.24	0.47	0.18	135	109		1610	1530		2620	2330	
D	0.24	0.47	0.16	135	109		1550	1530		2580	2290	
D	0.24	0.45	0.17	130	111		1550	1510		2550	2260	
D	0.23	0.46	0.17	130	107		1560	1510		2560	2280	
D	0.23	0.46	0.18	130	106		1580	1480		2630	2250	
E	0.23	0.44	0.18	115	133		1460	1490		2200	2820	
E	0.23	0.44	0.17	125	100		1430	1470		2170	2110	
E	0.22	0.42	0.16	124	100		1440	1500		2110	2130	
E	0.23	0.45	0.18	113	102		1460	1520		2110	2130	
E	0.23	0.44	0.16	128	102		1490	1500		2180	2180	
E	0.23	0.43	0.16	119	102		1480	1470		2240	2170	
E	0.22	0.41	0.16	126	99		1470	1420		2190	2140	
E	0.22	0.43	0.17	115	101		1440	1430		2150	2170	

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
F	0.23	0.48	0.15	109	98		1530	1590		2380	2410	
F	0.24	0.49	0.16	111	107		1580	1640		2340	2420	
F	0.23	0.47	0.17	123	106		1570	1560		2420	2200	
F	0.23	0.47	0.16	129	120		1540	1580		2380	2320	
F	0.24	0.48	0.17	116	102		1560	1620		2400	2380	
F	0.23	0.46	0.16	132	88		1460	1580		2220	2400	
F	0.24	0.47	0.17	117	85		1560	1550		2420	2290	
F	0.23	0.47	0.17	106	93		1570	1560		2400	2320	
G	0.24	0.51	0.15	130	110		1620	1580		2610	2460	
G	0.24	0.50	0.14	130	110		1610	1610		2580	2440	
G	0.23	0.51	0.16	130	110		1580	1620		2550	2480	
G	0.25	0.51	0.14	130	110		1580	1600		2560	2450	
G	0.24	0.50	0.18	130	120		1580	1600		2530	2460	
G	0.24	0.50	0.15	120	110		1570	1580		2530	2420	
G	0.23	0.50	0.15	130	110		1600	1570		2540	2380	
G	0.22	0.50	0.17	130	110		1550	1590		2500	2470	
H	0.23	0.49	0.16	144	116		1750	1580		2740	2500	
H	0.23	0.51	0.17	145	115		1720	1620		2740	2680	
H	0.23	0.51	0.16	144	115		1750	1630		2650	2590	
H	0.23	0.47	0.15	144	118		1710	1610		2570	2640	
H	0.23	0.49	0.15	143	117		1740	1650		2620	2620	
H	0.21	0.52	0.14	146	120		1760	1630		2640	2600	
H	0.23	0.51	0.16	141	116		1700	1530		2630	2550	
H	0.22	0.49	0.15	145	112		1780	1630		2730	2520	
I	0.25	0.48	0.18	122	108	100	1687	1575	1600	2246	2293	2700
I	0.25	0.48	0.19	123	105	200	1646	1556	1700	2220	2261	3000
I	0.26	0.48	0.17	123	106	100	1655	1555	1700	2248	2263	2700
I	0.25	0.48	0.18	113	107	100	1608	1573	1600	2200	2280	2800
I	0.25	0.48	0.17	114	103	100	1621	1551	1600	2239	2207	2600
I	0.25	0.48	0.17	124	107	100	1653	1574	1700	2265	2244	2700
I	0.25	0.47	0.18	122	105	100	1701	1566	1700	2220	2247	2700
I	0.26	0.48	0.18	114	105	100	1626	1583	1600	2114	2254	2700
J	0.24	0.48	0.18	100	100	122	1600	1600	1500	2600	2500	2300
J	0.23	0.48	0.16	100	100	127	1600	1600	1500	2700	2500	2300
J	0.24	0.47	0.17	100	100	122	1600	1600	1500	2700	2500	2300
J	0.24	0.46	0.17	100	100	130	1600	1600	1500	2600	2500	2300
J	0.23	0.47	0.17	100	100	119	1700	1600	1500	2700	2500	2300
J	0.23	0.47	0.17	100	100	127	1600	1600	1500	2700	2500	2300
J	0.23	0.46	0.17	100	100	135	1600	1500	1500	2600	2400	2300
J	0.24	0.46	0.18	100	100	121	1600	1500	1500	2600	2400	2300
L				111	105		1607	1586		2530	2208	
L				103	105		1623	1605		2517	2172	
L				110	105		1603	1617		2591	2122	
L				111	104		1615	1609		2474	2118	
L				112	106		1635	1589		2493	2292	
L				113	105		1680	1610		2635	2186	
L				115	104		1674	1574		2584	2169	
L				112	104		1624	1616		2495	2167	
M	0.24	0.48	0.19						1507			2498
M	0.23	0.47	0.15						1534			2510
M	0.24	0.48	0.17						1529			2499
M	0.23	0.47	0.17						1513			2499
M	0.23	0.46	0.16						1508			2502
M	0.23	0.47	0.18						1487			2515
M	0.22	0.46	0.16						1525			2524
M	0.23	0.48	0.17						1488			2466
N			0.17	133	94		1600			2710	2020	
N			0.16	135	94		1600			2700	2040	
N			0.17	135	95		1580			2670	2020	
N			0.17	138	95		1590			2720	2040	
N			0.18	133	93		1590			2770	2000	
N			0.17	139	92		1580			2750	1970	
N			0.17	138	94		1620			2720	2040	
N			0.17	132	92		1580			2770	1980	
O	0.24	0.48	0.17	111	124		1370			2296	2210	
O	0.24	0.49	0.16	115	132		1456			2382	2280	
O	0.24	0.49	0.16	112	132		1462			2366	2235	
O	0.24	0.48	0.17	110	131		1459			2360	2195	
O	0.24	0.48	0.17	113	133		1442			2333	2261	
O	0.24	0.48	0.17	112	131		1436			2297	2240	
O	0.24	0.48	0.18	114	135		1427			2267	2302	
O	0.24	0.49	0.18	108	133		1448			2327	2194	

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
Q	0.16	0.28	0.11	105			1568			2080		
Q	0.21	0.42	0.14	106			1612			2071		
Q	0.23	0.47	0.17	102			1518			1971		
Q	0.21	0.45	0.15	102			1511			1972		
Q	0.25	0.45	0.17	103			1520			1972		
Q	0.21	0.43	0.15	99			1467			1909		
Q	0.20	0.37	0.13	105			1606			2081		
Q	0.15	0.28	0.10	102			1515			1975		
S	0.23	0.47	0.21	128	110		1650	1560		2470	2510	
S	0.24	0.48	0.19	129	130		1680	1540		2470	2480	
S	0.25	0.48	0.17	127	120		1650	1480		2420	2450	
S	0.23	0.47	0.17	128	130		1650	1570		2450	2550	
S	0.23	0.48	0.20	126	130		1640	1500		2420	2450	
S	0.24	0.48	0.18	126	120		1630	1540		2410	2460	
S	0.23	0.46	0.18	128	130		1670	1540		2460	2510	
S	0.23	0.47	0.17	129	120		1680	1490		2470	2430	
T	0.24	0.51	0.18	132	109		1500	1600		2390	2410	
T	0.23	0.49	0.14	131	111		1490	1610		2360	2400	
T	0.23	0.47	0.16	132	113		1520	1640		2390	2460	
T	0.24	0.49	0.16	123	114		1400	1630		2220	2460	
T	0.24	0.50	0.16	141	115		1590	1650		2540	2500	
T	0.24	0.48	0.15	144	113		1620	1640		2600	2460	
T	0.23	0.49	0.18	134	111		1530	1620		2410	2450	
T	0.25	0.50	0.19	131	109		1500	1600		2360	2440	
U	0.24	0.50	0.15	120	109		1500	1520		2220	2320	
U	0.24	0.48	0.15	118	110		1480	1530		2220	2310	
U	0.23	0.46	0.17	120	110		1510	1530		2260	2360	
U	0.22	0.43	0.14	119	111		1490	1540		2210	2380	
U	0.24	0.44	0.15	118	111		1460	1550		2170	2350	
U	0.22	0.46	0.14	118	109		1490	1530		2210	2360	
U	0.26	0.50	0.15	119	109		1500	1540		2210	2330	
U	0.24	0.49	0.17	118	110		1500	1540		2210	2330	
V	0.24	0.51	0.15	130	110		1620	1580		2610	2460	
V	0.24	0.50	0.14	130	110		1610	1610		2580	2440	
V	0.23	0.51	0.16	130	110		1580	1620		2550	2480	
V	0.25	0.51	0.14	130	110		1580	1600		2560	2450	
V	0.24	0.50	0.18	130	120		1580	1600		2530	2460	
V	0.24	0.50	0.15	120	110		1570	1580		2530	2420	
V	0.23	0.50	0.15	130	110		1600	1570		2540	2380	
V	0.22	0.50	0.17	130	110		1550	1590		2500	2470	
W	0.28	0.59	0.18	140	110	160	1618	1508	1530	2684	2273	2590
W	0.28	0.53	0.15	142	110	160	1636	1528	1530	2717	2264	2630
W	0.21	0.46	0.17	145	112	160	1661	1545	1520	2770	2301	2700
W	0.23	0.49	0.15	137	112	160	1570	1584	1500	2596	2302	2660
W	0.25	0.50	0.18	142	117	160	1594	1674	1520	2658	2509	2680
W	0.25	0.51	0.17	142	110	160	1624	1490	1540	2708	2279	2760
W	0.27	0.53	0.16	143	111	160	1618	1562	1510	2721	2304	2670
W	0.25	0.50	0.17	139	111	150	1601	1566	1370	2688	2297	2590
X	0.21	0.42	0.14			126			1590			2760
X	0.25	0.50	0.17			126			1610			2790
X	0.24	0.51	0.17			126			1610			2780
X	0.22	0.43	0.16			126			1610			2790
X	0.24	0.49	0.17			125			1600			2780
X	0.25	0.52	0.18			127			1620			2810
X	0.24	0.50	0.17			124			1620			2810
X	0.21	0.42	0.15			128			1610			2790

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
B													2.98
B													2.99
B													2.98
B													2.87
B													3.12
B													2.99
B													3.09
B													2.97

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/LECC %	SG pyc
C	7.38	6.33	2.95	11.6	1.12	12.1	0.15	0.84	48.5	0.44	5.50	1.79	
C	7.39	6.33	2.96	11.7	1.12	12.2	0.15	0.86	48.5	0.44	5.57	1.78	
C	7.37	6.39	2.99	11.7	1.13	12.3	0.15	0.85	49.1	0.44	4.52	1.81	
C	7.43	6.37	2.98	11.7	1.13	12.3	0.15	0.85	48.6	0.44	5.46	1.80	
C	7.44	6.36	2.99	11.7	1.14	12.2	0.15	0.85	48.7	0.44	5.65	1.81	
C	7.38	6.36	2.97	11.7	1.13	12.2	0.15	0.85	48.8	0.44	5.51	1.78	
C	7.34	6.37	2.98	11.7	1.12	12.2	0.15	0.83	48.7	0.44	5.56	1.81	
C	7.43	6.34	2.98	11.7	1.12	12.2	0.15	0.85	48.5	0.44	5.40	1.80	
D	7.32	6.36	2.92	11.6	1.13	12.2	0.16		49.0	0.45	5.59		3.09
D	7.32	6.36	2.90	11.6	1.12	12.2	0.16		49.0	0.46	5.59		3.12
D	7.32	6.36	2.91	11.6	1.13	12.2	0.16		49.0	0.46	5.66		3.10
D	7.31	6.37	2.90	11.6	1.13	12.2	0.16		49.0	0.45	5.68		3.08
D	7.33	6.37	2.90	11.6	1.12	12.2	0.16		49.1	0.45	5.68		3.08
D	7.31	6.38	2.91	11.6	1.13	12.2	0.16		49.1	0.45	5.58		3.08
D	7.31	6.37	2.92	11.6	1.13	12.2	0.16		49.1	0.46	5.58		3.13
D	7.32	6.38	2.91	11.6	1.13	12.2	0.16		49.0	0.46	5.67		3.09
E												1.79	2.93
E												1.78	3.30
E												1.78	3.28
E												1.79	3.29
E												1.84	3.30
E												1.84	3.31
E												1.83	3.43
E												1.84	3.24
F												1.71	3.01
F												1.68	3.03
F												1.70	3.05
F												1.70	3.03
F												1.70	3.03
F												1.68	3.04
F												1.72	3.03
F												1.71	3.03
G	7.40	6.37	2.93	11.7	1.12	12.4	0.15	0.94	50.0	0.44	4.40		2.88
G	7.37	6.36	2.92	11.7	1.12	12.4	0.15	0.93	49.5	0.44	4.45		2.84
G	7.35	6.36	2.92	11.7	1.12	12.4	0.15	0.94	49.6	0.44	4.57		2.86
G	7.31	6.31	2.90	11.6	1.11	12.3	0.15	0.92	49.2	0.44	4.32		2.85
G	7.41	6.37	2.93	11.7	1.13	12.4	0.15	0.94	49.8	0.44	4.35		2.83
G	7.32	6.32	2.92	11.6	1.12	12.3	0.15	0.92	49.3	0.44	4.42		2.88
G	7.36	6.36	2.92	11.7	1.12	12.4	0.15	0.94	49.6	0.44	4.58		2.85
G	7.35	6.33	2.90	11.6	1.11	12.3	0.15	0.93	49.5	0.44	4.29		2.87
H	7.37	6.30	2.89	11.6	1.12	12.1	0.15	0.88	49.0	0.45	4.38		
H	7.33	6.29	2.91	11.7	1.13	12.1	0.16	0.88	49.2	0.46	4.27		
H	7.33	6.29	2.91	11.6	1.12	12.2	0.16	0.89	49.1	0.46	4.29		
H	7.33	6.31	2.92	11.7	1.12	12.2	0.16	0.87	49.1	0.45	4.49		
H	7.31	6.31	2.91	11.7	1.12	12.2	0.16	0.87	49.1	0.46	4.41		
H	7.32	6.32	2.91	11.7	1.12	12.2	0.16	0.88	49.1	0.45	4.46		
H	7.32	6.28	2.90	11.7	1.12	12.1	0.16	0.89	49.1	0.45	4.36		
H	7.32	6.30	2.90	11.7	1.12	12.1	0.16	0.88	49.1	0.46	4.42		
I												1.66	
I												1.76	
I												1.76	
I												1.83	
I												1.82	
I												1.81	
I												1.89	
I												1.87	
J	7.20	6.32	2.90	11.7	1.12	12.2	0.15	0.97	48.7	0.46	6.14	1.77	2.94
J	7.24	6.31	2.88	11.7	1.12	12.2	0.15	0.97	48.4	0.46	6.11	1.78	2.95
J	7.22	6.32	2.89	11.8	1.12	12.2	0.15	0.97	48.5	0.45	6.39	1.79	2.94
J	7.24	6.36	2.90	11.8	1.12	12.3	0.15	0.97	48.9	0.46	6.29	1.78	2.95
J	7.27	6.35	2.90	11.8	1.12	12.3	0.15	0.99	48.8	0.46	6.10	1.78	2.95
J	7.23	6.35	2.91	11.8	1.12	12.3	0.15	0.98	49.0	0.45	6.00	1.78	2.94
J	7.35	6.34	2.90	11.8	1.12	12.3	0.15	0.98	49.0	0.46	6.34	1.77	2.95
J	7.21	6.35	2.90	11.8	1.12	12.2	0.15	1.00	48.9	0.46	6.29	1.77	2.95
L												1.76	2.89
L												1.73	2.88
L												1.71	2.87
L												1.72	2.85
L												1.74	2.87
L												1.73	2.84
L												1.72	2.86
L												1.78	2.89
M	7.50	6.25		11.2	1.02	12.4	0.14	0.91	49.9	0.43	5.59	1.66	3.09
M	7.56	6.33		11.3	1.04	12.4	0.14	0.91	50.4	0.45	5.48	1.68	3.06
M	7.48	6.32		11.3	1.03	12.3	0.14	0.91	50.2	0.44	5.47	1.68	3.10
M	7.53	6.29		11.2	1.02	12.3	0.14	0.91	50.1	0.44	5.45	1.67	3.13
M	7.52	6.27		11.2	1.02	12.3	0.15	0.90	49.9	0.44	5.54	1.67	3.07
M	7.48	6.25		11.2	1.03	12.3	0.14	0.91	49.9	0.44	5.49	1.66	3.09
M	7.56	6.35		11.4	1.03	12.4	0.14	0.92	50.4	0.45	5.54	1.69	3.11
M	7.48	6.28		11.2	1.02	12.2	0.14	0.91	50.0	0.44	5.48	1.67	3.13

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
N	7.34	6.44	2.91	11.5	1.12	12.2	0.16	0.79	48.9	0.44	5.70		
N	7.38	6.48	2.91	11.6	1.13	12.3	0.16	0.79	49.1	0.45	6.10		
N	7.34	6.45	2.87	11.5	1.12	12.3	0.16	0.79	48.9	0.44	6.00		
N	7.33	6.43	2.91	11.5	1.13	12.2	0.16	0.80	48.9	0.45	6.00		
N	7.37	6.47	2.92	11.6	1.13	12.3	0.16	0.81	49.2	0.45	5.60		
N	7.38	6.46	2.93	11.7	1.13	12.3	0.16	0.81	49.1	0.46	6.10		
N	7.32	6.45	2.94	11.7	1.12	12.3	0.16	0.80	48.9	0.45	5.90		
N	7.38	6.47	2.91	11.6	1.13	12.3	0.16	0.81	49.1	0.46	5.70		
O												1.72	2.93
O												1.71	2.92
O												1.73	2.96
O												1.74	2.99
O												1.74	2.94
O												1.72	2.94
O												1.72	2.93
O												1.67	3.00
Q												1.76	
Q												1.74	
Q												1.71	
Q												1.70	
Q												1.72	
Q												1.73	
Q												1.74	
Q												1.65	
S	7.29	6.26	3.10	11.7	1.12	13.2	0.16	0.83	49.0	0.44	6.16	1.93	2.97
S	7.30	6.21	3.04	11.6	1.12	13.0	0.16	0.84	48.9	0.43	6.25	1.86	2.97
S	7.28	6.27	3.02	11.6	1.12	13.0	0.16	0.84	48.7	0.44	6.15	1.91	2.97
S	7.38	6.24	3.09	11.6	1.12	13.2	0.15	0.85	49.6	0.44	6.19	1.85	2.90
S	7.33	6.22	3.10	11.6	1.12	13.2	0.16	0.85	49.7	0.44	6.11	1.91	2.98
S	7.29	6.26	3.10	11.7	1.12	13.2	0.16	0.86	49.4	0.44	6.49	1.89	2.97
S	7.33	6.34	3.12	11.8	1.14	13.2	0.16	0.88	49.3	0.45	6.21	1.90	2.91
S	7.33	6.30	3.11	11.7	1.12	13.2	0.16	0.86	49.6	0.44	6.27	1.90	2.97
T													2.85
T													3.00
T													2.84
T													3.02
T													2.98
T													3.07
T													3.01
T													3.03
U												1.79	
U												1.79	
U												1.78	
U												1.77	
U												1.76	
U												1.76	
U												1.78	
U												1.79	
V	7.40	6.37	2.93	11.7	1.12	12.4	0.15	0.94	50.0	0.44	4.40		2.88
V	7.37	6.36	2.92	11.7	1.12	12.4	0.15	0.93	49.5	0.44	4.45		2.84
V	7.35	6.36	2.92	11.7	1.12	12.4	0.15	0.94	49.6	0.44	4.57		2.86
V	7.31	6.31	2.90	11.6	1.11	12.3	0.15	0.92	49.2	0.44	4.32		2.85
V	7.41	6.37	2.93	11.7	1.13	12.4	0.15	0.94	49.8	0.44	4.35		2.83
V	7.32	6.32	2.92	11.6	1.12	12.3	0.15	0.92	49.3	0.44	4.42		2.88
V	7.36	6.36	2.92	11.7	1.12	12.4	0.15	0.94	49.6	0.44	4.58		2.85
V	7.35	6.33	2.90	11.6	1.11	12.3	0.15	0.93	49.5	0.44	4.29		2.87
W	7.28	6.25	2.99	11.7	1.11	12.3	0.16	0.86	48.8	0.44	5.90		2.86
W	7.31	6.29	3.03	11.8	1.11	12.4	0.15	0.85	49.1	0.43	6.00		2.83
W	7.31	6.31	3.04	11.8	1.12	12.4	0.16	0.86	49.1	0.43	5.95		2.83
W	7.27	6.24	2.99	11.7	1.12	12.3	0.16	0.85	48.8	0.45	6.06		2.84
W	7.34	6.29	3.01	11.8	1.13	12.4	0.15	0.87	49.2	0.44	6.03		2.88
W	7.38	6.33	3.04	11.9	1.13	12.5	0.16	0.87	49.4	0.44	6.05		2.85
W	7.33	6.30	3.01	11.8	1.12	12.4	0.15	0.87	49.2	0.46	6.05		2.85
W	7.28	6.22	2.94	11.9	1.11	12.3	0.15	0.85	48.8	0.49	6.05		2.87
X	7.19	6.28	2.99	11.6	1.10	12.3	0.17	0.83	49.0	0.44	7.23		2.97
X	7.16	6.31	2.91	11.6	1.10	12.3	0.17	0.82	49.0	0.44	7.25		2.99
X	7.00	6.27	2.99	11.7	1.08	12.3	0.17	0.80	49.0	0.44	7.40		2.99
X	7.11	6.30	2.98	11.6	1.10	12.2	0.17	0.82	48.8	0.44	7.14		3.01
X	7.03	6.33	2.90	11.6	1.10	12.3	0.17	0.82	49.0	0.45	7.07		3.01
X	7.12	6.31	2.85	11.7	1.11	12.1	0.17	0.87	49.4	0.45	7.08		3.00
X	7.32	6.32	2.88	11.6	1.13	12.2	0.17	0.86	49.3	0.46	6.96		2.99
X	7.21	6.23	2.85	11.6	1.14	12.1	0.17	0.88	49.2	0.46	6.92		3.00

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	0.009	0.003	0.007	0.001
Pd	PbColl	g/t	0.02	0.01	0.02	0.003
Au	PbColl	g/t	0.011	0.003	0.010	0.001
Co	M/ICP	ppm	11.8	7.9	4.23	2.02
Co	P	ppm	6.8	4.62	3.07	1.27
Cu	M/ICP	ppm	65.4	41.9	29.5	10.8
Cu	P	ppm	45.5	29.6	26.4	8.6
Ni	M/ICP	ppm	175	120	51	30.4
Ni	P	ppm	117	87	45.2	24.5
Ni	XRF	ppm	171	206	40.0	84.2
Al ₂ O ₃	XRF	%	0.038	0.025	0.030	0.010
CaO	XRF	%	0.04	0.03	0.025	0.009
Cr ₂ O ₃	XRF	%	0.03	0.02	0.02	0.01
Fe ₂ O ₃	XRF	%	0.072	0.048	0.049	0.016
K ₂ O	XRF	%	0.007	0.003	0.006	0.001
MgO	XRF	%	0.083	0.060	0.053	0.020
MnO	XRF	%	0.006	0.005	0.002	0.001
Na ₂ O	XRF	%	0.051	0.045	0.013	0.014
SiO ₂	XRF	%	0.297	0.203	0.197	0.068
TiO ₂	XRF	%	0.009	0.006	0.006	0.002
LOI		%	0.72	0.66	0.15	0.21
S	Comb/LECO	%	0.05	0.04	0.03	0.01
SG	pyc		0.09	0.07	0.04	0.02

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: AMIS0317 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.

26 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	0.76	0.44	28.9	77
Al	M/ICP	%	3.88	0.31	4.01	104
As	M/ICP	ppm	17.8	10.2	28.6	106
Ba	M/ICP	ppm	192	27.1	7.05	89
Be	M/ICP	ppm	0.52	0.23	21.8	32
Bi	M/ICP	ppm	0.67	1.18	88.5	51
Ca	M/ICP	%	4.44	0.38	4.23	104
Cd	M/ICP	ppm	1.04	2.05	98.6	63
Ce	M/ICP	ppm	19.6	4.9	12.6	45
Cr	M/ICP	ppm	14314	9739	34.0	60
Cs	M/ICP	ppm	2.25	0.27	6.00	32
Dy	M/ICP	ppm	1.82	0.09	2.51	15
Er	M/ICP	ppm	1.00	0.04	1.96	14
Eu	M/ICP	ppm	0.74	0.05	3.47	15
Fe	M/ICP	%	7.95	0.83	5.22	101
Ga	M/ICP	ppm	10.5	1.70	8.08	52
Gd	M/ICP	ppm	2.14	0.18	4.14	16
Ge	M/ICP	ppm	0.55	0.42	37.7	16
Hf	M/ICP	ppm	1.48	0.19	6.39	45
Ho	M/ICP	ppm	0.36	0.02	2.58	15
In	M/ICP	ppm	0.07	0.02	13.20	46
K	M/ICP	%	0.95	0.10	5.03	110
La	M/ICP	ppm	8.77	2.15	12.2	78
Li	M/ICP	ppm	22.8	3.94	8.65	74
Lu	M/ICP	ppm	0.14	0.01	4.15	22
Mg	M/ICP	%	7.22	0.50	3.44	104
Mn	M/ICP	ppm	1186	123	5.19	103
Mo	M/ICP	ppm	1.57	0.67	21.3	70
Na	M/ICP	%	0.64	0.13	10.3	99
Nb	M/ICP	ppm	2.9	1.36	23.8	53
Nd	M/ICP	ppm	9.4	0.44	2.36	15
P	M/ICP	ppm	247	65.9	13.3	96
Pb	M/ICP	ppm	10.6	3.29	15.6	76
Pr	M/ICP	ppm	2.39	0.12	2.59	16
Rb	M/ICP	ppm	31.4	9.56	15.2	55
Re	M/ICP	ppm	0.01	0.003	12.4	15
S	M/ICP	%	1.80	0.14	3.96	83
Sb	M/ICP	ppm	32.2	94.7	147	70
Sc	M/ICP	ppm	12.1	1.99	8.22	110
Se	M/ICP	ppm	4.87	1.62	16.6	41
Si	M/ICP	%	23.1	0.24	0.52	8
Sm	M/ICP	ppm	2.12	0.11	2.71	16
Sn	M/ICP	ppm	1.85	0.39	10.6	45
Sr	M/ICP	ppm	121	23.7	9.8	109
Ta	M/ICP	ppm	0.21	0.12	28.4	47
Tb	M/ICP	ppm	0.30	0.06	9.5	24
Te	M/ICP	ppm	1.26	0.43	17.2	46
Th	M/ICP	ppm	1.86	0.25	6.68	47
Ti	M/ICP	%	0.24	0.04	7.44	82
Tl	M/ICP	ppm	0.21	0.11	25.9	40
Tm	M/ICP	ppm	0.15	0.02	5.6	16
U	M/ICP	ppm	0.91	3.75	206	50
V	M/ICP	ppm	122	40.0	16.4	104
W	M/ICP	ppm	1.32	0.37	14.1	46
Y	M/ICP	ppm	8.60	1.23	7.13	77
Yb	M/ICP	ppm	0.91	0.13	7.26	24
Zn	M/ICP	ppm	89.3	30.5	17.1	104
Zr	M/ICP	ppm	50.1	13.3	13.3	85