



Tel: +2711 923 7000 Fax: +2711 923 7027 e-mail: info@amis.co.za web: www.amis.co.za
30 Electron Avenue, Isando, 1600. P.O. Box 856, Isando, 1600, South Africa.
A Division of Set Point Industrial Technology (Pty) Ltd. Reg.No. 1989/000201/07.

African Mineral Standards

Nickel-Copper Sulphide Standard Nkomati Mine South Africa

AMIS0073

Certificate of Analysis

Recommended Concentration and two “Between
Laboratory” Standard Deviations

Certified Concentrations

Economic Elements

Co (M/ICP)	277	± 17	ppm
Cu (P)	2370	± 200	ppm
Cu (M/ICP)	2414	± 210	ppm
Cu (XRF)	2454	± 100	ppm
Ni (P)	5316	± 418	ppm
Ni (M/ICP)	5459	± 368	ppm
Ni (XRF)	5723	± 212	ppm
Pt (Pb Collection)	0.33	± 0.03	g/t
Pd (Pb Collection)	0.89	± 0.06	g/t
Specific Gravity	3.04	± 0.18	g/cc

Major Elements

Al ₂ O ₃	4.72	± 0.14	%
CaO	10.27	± 0.34	%
Cr ₂ O ₃	0.47	± 0.02	%
Fe ₂ O ₃	18.22	± 0.62	%
K ₂ O	0.46	± 0.02	%
LOI	7.04	± 0.54	%
MgO	17.11	± 0.40	%
MnO	0.21	± 0.02	%
SiO ₂	39.42	± 0.64	%
TiO ₂	0.35	± 0.02	%

Provisional Concentrations

Economic Elements

Au (Pb Collection)	0.063	±	0.01	g/t
Co (P)	260	±	40	ppm
Co (XRF)	315	±	72	ppm

Major Elements

Na ₂ O	0.43	±	0.06	%
P ₂ O ₅	0.04	±	0.01	%
S	4.53	±	0.70	%

Intended use: AMIS0073 is suitable for monitoring the accuracy of a single analysis of nickel-copper sulphide ores hosted by mafic-ultramafic rocks. The material can be used for routine quality control by inserting within a batch of samples.

The recommended mean and "Between Lab" standard deviations for this standard reflect the average 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 and this is acceptable. Good laboratories however will report results within the two standard deviation levels with a failure of <10 %.

Origin of material: The material for this standard was provided by the Nkomati Nickel Mine, a 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.

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.

AMIS0073 is made from Main Mineralised Zone (MMZ) material, which is a heterogeneous unit consisting mainly of altered pyroxenites and harzburgites with calc-silicate xenoliths.

Appearance: The material is a very fine powder coloured Blueish Grey (Corstor 5PB 5/1).

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

Methods of analysis requested:

1. Au, Pt, Pd – Pb collection ICP-OES or ICP-MS.
2. Multi-acid digest multi-element scan - (to include Co, Cu, Ni.). ICP-OES or ICP-MS.
3. Aqua regia digest - Co, Cu, Ni. ICP-OES or ICP-MS.
4. Co, Cu, Ni. XRF.
5. Majors (Al₂O₃, CaO, Cr₂O₃, Fe₂O₃, K₂O, MgO, MnO, Na₂O, SiO₂, TiO₂. LOI.) XRF fusion.
6. SG (gas pycnometer)

Method of certification: Twenty three laboratories were each given eight randomly selected packages of sample. The results from the eighteen laboratories that issued results timeously were used for the certification. Fourteen of those laboratories also returned major element data that could be certified and trace element data that was not certified but which is reported as an appendix.

The mean and standard deviation for all data was calculated. Outliers were defined as samples beyond the mean \pm 2 Standard Deviations from all data. These outliers were removed from the data and a new mean and standard deviation was determined.

Standards with an RSD of near or less than 5 % are then certified, RSD's of between near 5 % and 15 % are given Provisional Concentrations and limits, those with RSD's over 15 % are given Indicated Concentrations.

This method is different from that used to calculate the Confidence Interval shown on many Government-produced standards in that the actual "between-laboratory" standard deviation is used in the calculations. This produces upper and lower limits that reflect actual individual analyses rather than a grouped set of analyses. The limits can therefore be used to monitor accuracy from individual analyses, unlike the Certified Limits published on other standards which quote a Confidence Interval.

Participating laboratories: (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. Ammtec Limited WA
7. Anglo Research (Crown Campus)
8. Assayers Canada
9. Geoscience Laboratories (GEO LABS) CA
10. Intertek Testing Services Ltd Shanghai (ITS Beijing)
11. Intertek Utama Services (Indonesia)
12. Labtium Inc Finland
13. Nkomati JV Laboratory SA
14. OMAC Laboratories Limited (Ireland)
15. Set Point Laboratories (Isando) SA
16. SGS Australia Pty Ltd (Newburn) WA
17. SGS Mineral Services Lakefield (Canada)
18. Ultra Trace (Pty) Ltd WA

Assay Data (cont):

Lab Code	Au g/t (PbColl)	Co ppm (M/ICP)	Co ppm (P)	Co ppm (XRF)	Cu ppm (M/ICP)	Cu ppm (P)	Cu ppm (XRF)	Ni ppm (M/ICP)	Ni ppm (P)	Ni ppm (XRF)	Pd g/t (PbColl)	Pt g/t (PbColl)	SG g/cc	Al2O3 % (XRF)	CaO % (XRF)	Cr2O3 % (XRF)	Fe2O3 % (XRF)	K2O % (XRF)	LOI % (XRF)	MgO % (XRF)	MnO % (XRF)	Na2O % (XRF)	P2O5 % (XRF)	S % (XRF)	SiO2 % (XRF)	TiO2 % (XRF)	
O	0.05	275	289		2640	2540		5390	5720		0.87	0.33	3.01	4.80	9.85	0.47	18.25	0.46	7.13	17.25	0.21	0.44	0.02	5.63	39.20	0.33	
O	0.05	286	276		2620	2390		5360	5480		0.86	0.31	2.91	4.81	9.88	0.47	18.30	0.46	7.22	17.30	0.21	0.44	0.03	5.46	39.30	0.34	
O	0.05	289	281		2570	2550		5320	5380		0.88	0.32	3.02	4.83	9.94	0.47	18.45	0.46	7.23	17.40	0.21	0.44	0.03	5.52	39.50	0.34	
O	0.08	267	289		2560	2670		5270	5770		0.96	0.32	2.97	4.83	9.99	0.48	18.80	0.47	7.31	17.40	0.21	0.43	0.03	5.40	39.60	0.34	
O	0.07	270	275		2600	2590		5340	5440		0.87	0.33	2.80	4.85	10.00	0.48	18.55	0.46	7.10	17.50	0.21	0.44	0.02	5.52	39.80	0.34	
O	0.10	269	298		2520	2770		5360	6090		0.97	0.32	3.02	4.82	9.96	0.47	18.45	0.45	7.22	17.40	0.21	0.43	0.03	5.43	39.60	0.34	
O	0.05	265	281		2530	2420		5220	5510		0.87	0.33	3.30	4.82	10.05	0.47	18.55	0.46	7.14	17.45	0.21	0.43	0.03	5.44	39.60	0.34	
O	0.05	263	283		2510	2470		5110	5450		0.84	0.33	2.99	4.85	10.10	0.48	18.65	0.46	7.15	17.50	0.21	0.43	0.03	5.45	39.80	0.34	
P	0.06	277	272		2580	2620		5560	5300		0.89	0.35	3.06	4.81	10.29	0.47	18.13	0.48	7.16	17.18	0.21	0.44	0.05	4.66	39.56	0.35	
P	0.06	277	279		2600	2740		5750	5380		0.84	0.33	3.02	4.80	10.24	0.47	18.15	0.48	7.14	17.17	0.21	0.44	0.05	4.73	39.52	0.35	
P	0.06	283	274		2720	2670		5750	5230		0.82	0.32	3.11	4.80	10.22	0.47	18.12	0.47	7.17	17.16	0.21	0.44	0.05	4.79	39.45	0.35	
P	0.06	282	274		2690	2690		5690	5320		0.87	0.34	3.11	4.79	10.24	0.47	18.16	0.47	7.10	17.18	0.21	0.44	0.05	4.78	39.51	0.35	
P	0.06	289	289		2780	2630		5880	5160		0.87	0.34	3.05	4.81	10.23	0.47	18.13	0.48	7.04	17.17	0.21	0.44	0.05	4.90	39.53	0.35	
P	0.06	275	270		2650	2610		5630	5220		0.85	0.33	3.10	4.80	10.26	0.47	18.14	0.48	7.11	17.20	0.21	0.43	0.05	4.64	39.54	0.35	
P	0.06	285	275		2650	2660		5720	5320		0.87	0.31	3.05	4.79	10.23	0.47	18.13	0.47	7.18	17.18	0.21	0.44	0.05	4.80	39.51	0.35	
P	0.06	277	272		2630	2710		5550	5210		0.85	0.33	3.08	4.79	10.25	0.47	18.12	0.47	7.23	17.19	0.21	0.44	0.05	4.74	39.51	0.35	
Q		274	240		2470	2310		5090	4970	5500	0.87	0.32	2.96	4.54	10.20	0.42	17.55	0.46	1.50	16.10	0.16	0.34		4.75	38.40	0.35	
Q		267	252		2450	2370		5140	5000	5500	0.77	0.30	2.93	4.46	10.10	0.40	17.35	0.44	1.85	16.05	0.16	0.34		4.71	38.60	0.36	
Q		272	244		2450	2370		5270	5090	5600	0.90	0.34	2.87	4.53	10.15	0.40	17.40	0.44	1.89	15.80	0.16	0.34		4.70	38.40	0.35	
Q		267	249		2420	2350		5010	5200	5500	0.91	0.35	2.94	4.43	10.10	0.41	17.40	0.44	2.20	15.85	0.16	0.37		4.65	38.20	0.35	
Q		272	256		2500	2480		5170	5270	5600	0.91	0.33	2.99	4.38	9.83	0.40	16.90	0.43	5.12	15.30	0.16	0.33		4.82	36.90	0.33	
Q		265	256		2450	2480		5010	5320	5500	0.90	0.34	2.92	4.65	10.85	0.45	18.55	0.47	6.23	16.85	0.17	0.39		4.67	40.90	0.36	
Q		262	258		2430	2480		4970	5220	5500	0.88	0.34	2.94	4.19	9.76	0.40	16.70	0.42	6.99	15.30	0.15	0.32		4.66	38.30	0.34	
Q		263	258		2410	2450		4720	5380	5600	0.88	0.33	2.92	4.48	10.70	0.43	18.25	0.47	6.22	16.90	0.17	0.36		4.60	40.80	0.38	
R	0.06	279	282		2230	2510	2429	5280	5380	5757	0.92	0.32		4.73	9.94		18.26	0.45		17.70	0.19	0.40	0.04	3.99	39.70	0.34	
R	0.06	285	278		2310	2490	2451	5420	5320	5739	0.90	0.31		4.73	9.94		18.25	0.45		17.60	0.19	0.40	0.04	3.99	39.60	0.35	
R	0.07	279	277		2260	2470	2471	5360	5280	5790	0.92	0.32		4.76	10.00		18.36	0.45		17.70	0.19	0.39	0.04	4.01	39.90	0.35	
R	0.07	278	282		2220	2500	2501	5290	5350	5769	0.91	0.31		4.78	10.01		18.40	0.45		17.70	0.19	0.41	0.04	4.09	39.80	0.35	
R	0.06	287	278		2330	2470	2483	5460	5270	5875	0.90	0.31		4.76	10.06		18.59	0.45		17.70	0.20	0.40	0.03	4.08	40.00	0.35	
R	0.07	292	274		2330	2460	2470	5470	5230	5770	0.89	0.31		4.76	10.01		18.40	0.45		17.70	0.19	0.40	0.04	3.97	39.90	0.35	
R	0.06	283	275		2300	2460	2470	5400	5230	5754	0.90	0.31		4.78	10.01		18.35	0.45		17.70	0.19	0.42	0.04	4.00	39.70	0.34	
R	0.07	278	278		2230	2480	2453	5320	5260	5701	0.91	0.32		4.76	9.96		18.32	0.45		17.70	0.19	0.40	0.04	4.01	39.70	0.35	
S	0.06	287	283		2654	2575		5653	5563		0.88	0.33		4.72	10.33	0.55	18.34	0.45	6.72	17.42	0.22	0.41	0.02	2.05	39.51	0.34	
S	0.07	289	284		2616	2477		5676	5633		0.92	0.34		4.60	10.32	0.54	19.89	0.46	7.12	17.02	0.22	0.39	0.05	2.00	39.90	0.34	
S	0.06	289	284		2591	2516		5590	5583		0.91	0.34		4.61	10.29	0.54	17.76	0.44	6.75	17.26	0.21	0.41	0.05	2.03	39.07	0.34	
S	0.06	287	280		2597	2494		5586	5506		0.89	0.33		4.70	10.27	0.55	18.12	0.45	6.58	17.46	0.22	0.41	0.05	2.02	40.08	0.34	
S	0.06	281	284		2571	2531		5634	5590		0.89	0.34		4.66	10.29	0.55	18.02	0.44	6.57	17.28	0.22	0.40	0.06	1.96	39.29	0.34	
S	0.06	285	279		2635	2561		5540	5518		0.90	0.34		4.56	10.01	0.54	17.95	0.45	6.62	17.01	0.21	0.39	0.04	1.98	39.74	0.33	
S	0.06	288	281		2612	2560		5594	5514		0.88	0.34		4.64	10.22	0.54	17.89	0.44	6.68	17.22	0.22	0.40	0.05	1.99	39.46	0.34	
S	0.07	293	287		2589	2578		5621	5601		0.92	0.35		4.63	10.14	0.54	18.05	0.44	6.76	17.16	0.22	0.40	0.04	2.12	39.55	0.34	
T	0.06	280	280		2420	2360		5590	5590	3537	0.84	0.32	2.91	4.71	10.32	0.47	17.83	0.46	6.90	17.26	0.20	0.43			39.18	0.34	
T	0.05	280	280		2410	2360		5570	5590	4758	0.89	0.35	2.91	4.75	10.41	0.48	17.85	0.47	7.10	17.21	0.20	0.43			38.84	0.34	
T	0.06	280	280		2420	2360		5580	5550	4005	0.90	0.34	2.85	4.72	10.34	0.48	17.85	0.47	7.50	17.20	0.20	0.43			38.81	0.34	
T	0.07	280	280		2430	2370		5630	5580	4294	0.90	0.34	2.88	4.75	10.42	0.48	17.77	0.47	7.10	17.40	0.20	0.43			38.55	0.34	
T	0.05	280	280		2420	2390		5600	5620	4866	0.80	0.30	2.97	4.73	10.39	0.48	17.71	0.47	7.40	17.18	0.20	0.43			38.65	0.34	
T	0.05	280	280		2420	2390		5630	5590	3559	0.89	0.33	2.97	4.72	10.36	0.48	17.72	0.47	7.20	17.18	0.20	0.43			39.23	0.35	
T	0.06	280	280		2420	2370		5640	5580	4239	0.85	0.32	2.93	4.70	10.44	0.48	17.93	0.47	7.30	17.14	0.20	0.43			38.91	0.34	
T	0.06	280	280		2400	2410		5590	5670	4344	0.84	0.32	2.92	4.75	10.40	0.48	17.70	0.47	7.40	17.39	0.20	0.43			38.61	0.34	
U		276		284			2514							4.65	10.53		18.50	0.45	6.95	16.98	0.22	0.43	0.04			39.48	0.34
U		234		288			2511			5605				4.66	10.58		18.50	0.47	6.96	17.08	0.22	0.43	0.04			39.47	0.35
U		281		284			2496			5640				4.69	10.50		18.29	0.46	7.10	16.90	0.22	0.42	0.04			39.29	0.37
U		286		285			2498			5692				4.69	10.60		18.54	0.47	6.88	17.07	0.22	0.43	0.04			39.59	0.36
U		273		286			2483			5574				4.68	10.55		18.49	0.45	6.83	17.05	0.22	0.43	0.04			39.52	0.36
U		284		284			2519			5																	

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.

11 August 2008

Certifying officers:



African Mineral Standards: _____

Mike McWha
BSc (Hons), FGSSA, MSAIMM, Pr.Sci.Nat



Geochemist: _____

Barry W. Smee
BSc, PhD, P.Geo, (B.C.)

Appendix

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

Element	Method	Unit	Mean	2SD	RSD%	n
Ag	M/ICP	ppm	0.90	0.27	14.8	63
Al	M/ICP	%	2.66	0.30	5.7	94
As	M/ICP	ppm	16.6	4.79	14.4	87
B	M/ICP	ppm	12.9	7.83	30.3	29
Ba	M/ICP	ppm	89.6	5.17	2.9	82
Bi	M/ICP	ppm	0.84	0.17	9.9	47
Ca	M/ICP	%	7.26	0.64	4.4	99
Cd	M/ICP	ppm	0.50	0.57	57.5	40
Ce	M/ICP	ppm	13.1	0.87	3.3	47
Cr	M/ICP	ppm	2151	424	9.8	89
Cs	M/ICP	ppm	2.03	0.16	4.0	40
Fe	M/ICP	%	12.6	1.08	4.3	101
Ga	M/ICP	ppm	6.30	0.62	4.9	44
Hf	M/ICP	ppm	1.15	0.10	4.2	32
In	M/ICP	ppm	0.13	0.01	4.8	38
K	M/ICP	%	0.40	0.05	5.8	107
La	M/ICP	ppm	6.07	0.32	2.6	62
Li	M/ICP	ppm	18.0	2.43	6.8	56
Mg	M/ICP	%	9.87	0.85	4.3	93
Mn	M/ICP	ppm	1536	131	4.3	94
Mo	M/ICP	ppm	1.46	0.52	17.9	45
Na	M/ICP	%	0.34	0.04	5.6	100
Nb	M/ICP	ppm	1.97	1.22	31.0	39
P	M/ICP	ppm	179	31.5	8.8	79
Pb	M/ICP	ppm	15.4	8.92	29.0	74
Rb	M/ICP	ppm	17.7	0.96	2.7	37
Sb	M/ICP	ppm	21.9	3.77	8.6	74
Sc	M/ICP	ppm	13.3	2.09	7.9	95
Se	M/ICP	ppm	11.8	3.19	13.5	39
Sn	M/ICP	ppm	2.65	0.70	13.3	46
Sr	M/ICP	ppm	82.7	5.72	3.5	87
Ta	M/ICP	ppm	0.35	0.32	46.0	39
Te	M/ICP	ppm	2.29	0.52	11.3	40
Th	M/ICP	ppm	1.72	0.17	5.0	47
Ti	M/ICP	%	0.20	0.02	5.2	94
Tl	M/ICP	ppm	0.21	0.05	12.7	36
U	M/ICP	ppm	2.47	0.32	6.5	48
V	M/ICP	ppm	83.7	9.13	5.5	77
W	M/ICP	ppm	0.32	0.35	54.1	30
Y	M/ICP	ppm	7.87	0.63	4.0	75
Zn	M/ICP	ppm	115	29.0	12.6	101
Zr	M/ICP	ppm	36.6	5.12	7.0	54