

African Mineral Standards

Nickel-Copper Sulphide Standard Phoenix Deposit Botswana

AMIS0060

Certificate of Analysis

Recommended Concentration and two "Between Laboratory" Standard Deviations

Certified Concentrations

Ni (M/ICP)	3117	±	308	ppm
Ni (P)	2909	±	242	ppm
Ni (XRF)	3198	±	276	ppm
Cu M/ICP	3356	±	215	ppm
Cu (P)	3308	±	256	ppm
Cu (XRF)	3305	±	303	ppm
Pt (Pb Collection)	0.19	±	0.02	g/t
Pd (Pb Collection)	0.73	±	0.06	g/t
Co (M/ICP)	106	±	10.3	ppm
Co (P)	93.6	±	7.8	ppm
Co (XRF)	103	±	8.4	ppm
Specific Gravity	2.98	±	0.18	g/cc

Provisional Concentration

Au (Pb Collection)	0.058	±	0.008	g/t
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Intended use: AMIS0060 is suitable for monitoring the accuracy of a single analysis of nickel-copper sulphide ores hosted by amphibolitic 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 Tati Nickel Mining Company, a subsidiary of Norilsk Nickel Africa (Pty) Ltd., from the Phoenix open pit mine in Eastern Botswana. The mine is situated approximately 25 km southwest of Francistown. The deposit occurs in mafic intrusive rocks in the Tati Greenstone Belt of the Rhodesian Craton.

Mineral and chemical composition: Nickel-copper mineralization occurs in metasomatised feldspathic amphibolites intruded by pegmatites and granites. Mineralisation is in the form of massive sulphide lenses with secondary thin mineralized fractures into the country rock. The primary sulphide is pyrrhotite with lesser pentlandite, chalcopyrite and minor spalerite.

The major element chemistry has been calculated, from predominantly XRF data submitted by fourteen of the laboratories, from the eight samples sent each lab. Uncertified statistics from this data are:

	mean	2SD	RSD%	n	unit
Al ₂ O ₃	15.89	0.35	1.12	95	%
CaO	9.84	0.27	1.35	94	%
Cr ₂ O ₃	0.10	0.01	4.93	93	%
Fe ₂ O ₃	9.49	0.39	2.06	107	%
K ₂ O	0.47	0.02	2.41	119	%
MgO	10.21	0.41	2.02	112	%
MnO	0.11	0.01	3.53	104	%
Na ₂ O	1.44	0.14	4.93	110	%
P ₂ O ₅	0.02	0.00	10.92	71	%
S	1.54	0.14	4.49	71	%
SiO ₂	47.14	0.87	0.92	97	%
TiO ₂	0.20	0.01	3.51	109	%
V ₂ O ₅	0.01	0.00	0.00	13	%
LOI	4.04	0.42	5.16	96	%

Additional trace element data is available on request for this material.

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

Methods of analysis requested:

1. 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 one laboratories were each given eight randomly selected packages of sample. The results from the nineteen laboratories that issued results timeously were used for the certification.

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., (Canada).
2. Activation Laboratories Ltd., (ActLabs, Ancaster, ON, Canada).
3. ALS Chemex South Africa (Pty) Ltd.
4. ALS Chemex, (Perth, Australia).
5. ALS Chemex, (Vancouver, Canada).
6. Ammtec Ltd., (Western Australia).
7. Assayers Canada, (Vancouver).
8. Genalysis Laboratory Services (Pty) Ltd., (Australia).
9. Geoscience Laboratories, (Geo Labs, Sudbury, Canada).
10. Intertek Testing Services (China)
11. Labtium Inc. (Finland)
12. Nkomati JV Laboratory
13. OMAC Laboratories (Ireland).
14. Pt Intertek Utama Services (Intertek, Indonesia)
15. Set Point Laboratories (Pty) Ltd (South Africa)
16. SGS Lakefield Research (Canada)
17. SGS Lakefield Research Africa (Pty) Ltd. (Joburg, South Africa)
18. SGS Welshpool (Australia).
19. Ultra Trace (Pty) Ltd. (Australia).

Assay Data: Data as received from the laboratories is set out below. A proficiency report has been sent to the managers of the participating laboratories.

Lab Code	Au Pb coll g/t	Pt Pb coll g/t	Pd Pb coll 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	Specific Gravity g/cc
A	0.06	0.20	0.71	115	97		3361	3280		3309	2955		2.52
A	0.06	0.19	0.71	110	99		3359	3267		3314	2991		2.72
A	0.06	0.20	0.70	114	104		3377	3312		3232	3047		2.93
A				113	102		3335	3295		3376	3048		2.77
A	0.06	0.20	0.71	114	102		3251	3399		3012	3044		2.53
A	0.06	0.20	0.70	118	104		3467	3318		3321	2996		2.51
A	0.06	0.19	0.70	110	104		3371	3428		3257	2998		2.79
A	0.06	0.20	0.71	107	101		3309	3318		3240	3042		2.57
B	0.06	0.20	0.72	105	91	104	3060	3500	3250	2780	3170	3230	2.93
B	0.06	0.19	0.70	105	94	103	3070	3670	3240	2820	3250	3240	2.91
B	0.06	0.20	0.73	99	90	103	2600	3400	3250	2660	3090	3240	2.91
B	0.06	0.19	0.70	109	90	104	2990	3420	3250	2930	3120	3250	2.88
B	0.06	0.19	0.71	105	88	101	3010	3360	3250	2840	3030	3270	2.96
B	0.06	0.20	0.73	104	90	101	2930	3440	3250	2800	3160	3240	2.95
B	0.06	0.19	0.71	112	91	103	3250	3360	3250	3020	3100	3250	2.83
B	0.06	0.20	0.73	107	93	110	3020	3460	3260	2870	3200	3250	2.98
C	0.06	0.18	0.72	96	90		3380	3370	3930	3000	2790	3430	2.78
C	0.06	0.19	0.73	97	92		3250	3400	3630	2870	2880	3380	2.80
C	0.05	0.17	0.64	103	93		3340	3430	3940	3030	2950	3380	2.76
C	0.06	0.19	0.72	102	92		3260	3410	3530	2840	2940	3380	2.75
C	0.06	0.19	0.73	107	92		3530	3430	3590	3040	2890	3390	2.72
C	0.05	0.19	0.72	108	93		3240	3470	3770	2820	2980	3380	2.75
C	0.06	0.18	0.72	112	91		3350	3390	3450	2960	2770	3390	2.73
C	0.05	0.18	0.72	108	90		3260	3370	3470	2900	2800	3400	2.74
D	0.06	0.20	0.76	104	94		3360	3310	3310	2950	2800	2930	2.99
D	0.06	0.20	0.75	103	94		3340	3310	3330	2930	2840	2950	2.97
D	0.06	0.20	0.76	102	92		3310	3280	3310	2950	2800	2950	2.96
D	0.06	0.20	0.76	104	92		3340	3270	3330	2960	2770	2920	2.93
D	0.05	0.17	0.64	101	96		3290	3480	3340	2880	2940	2920	2.99
D	0.06	0.20	0.75	103	98		3300	3450	3340	2880	2920	2960	2.95
D	0.06	0.20	0.77	100	96		3140	3350	3310	2750	2850	2960	3.00
D	0.06	0.20	0.77	105	96		3290	3380	3330	2890	2860	2940	3.01
E	0.05	0.22	0.78	104			3430	3270		3120			2.84
E	0.06	0.21	0.78	105			3340	3320		3060			2.80
E	0.06	0.21	0.79	105			3530	3250		3200			2.90
E	0.06	0.22	0.81	104			3410	3250		3110			2.91
E	0.06	0.21	0.77	107			3420	3350		3130			2.86
E	0.06	0.21	0.77	102			3400	3240		3100			2.86
E	0.06	0.20	0.73	101			3420	3190		3110			2.86
E	0.06	0.20	0.77	102			3440	3290		2940			2.81
F	0.07	0.24	0.76	112			3283			3182			
F	0.07	0.21	0.75	114			3328			3245			
F	0.07	0.23	0.77	107			3340			3200			
F	0.07	0.22	0.78	112			3342			3273			
F	0.07	0.23	0.77	107			3308			3283			
F	0.07	0.22	0.78	111			3293			3257			
F	0.07	0.22	0.78	111			3349			3263			
F	0.07	0.22	0.75	115			3210			3180			
G													
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G													
H	0.06	0.19	0.70	103	97		3295	3080		3250	2990		
H	0.06	0.19	0.72	110	98		3321	3130		3270	3010		
H	0.06	0.17	0.69	98	98		3354	3110		3300	3010		
H	0.06	0.17	0.66	107	100		3325	3180		3290	3060		
H	0.06	0.18	0.69	100	100		3406	3170		3350	3060		
H	0.06	0.19	0.68	105	100		3414	3160		3400	3040		
H	0.06	0.19	0.68	106	100		3385	3180		3330	3070		
H	0.06	0.18	0.68	103	101		3428	3230		3370	3130		
I	0.06	0.20	0.73	105	96		3288	3181	2884	3086	2879	2843	3.11
I	0.06	0.20	0.74	105	96		3302	3259	2904	3083	2920	2860	3.10
I	0.06	0.20	0.73	106	92		3307	3082	2912	3169	2756	2870	3.09
I	0.06	0.20	0.75	105	90		3286	3026	2901	3056	2697	2862	3.09
I	0.06	0.20	0.73	103	95		3287	3183	2895	3112	2848	2868	3.16
I	0.06	0.20	0.74	105	77		3293	2556	2913	3117	2311	2866	3.10
I	0.06	0.20	0.71	105	88		3289	2862	2903	3077	2606	2862	3.08
I	0.06	0.20	0.73	103	86		3275	2871	2885	3076	2615	2840	3.08

Lab Code	Au Pb coll g/t	Pt Pb coll g/t	Pd Pb coll 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	Specific Gravity g/cc
J				112	96	107			3159		2834	2866	
J				117	94	108			3148		2800	2876	
J				113	92	108			3149		2772	2873	
J				114	91	109			3156		2805	2871	
J				114	91	108			3147		2744	2878	
J				116	92	108			3148		2794	2874	
J				114	89	106			3133		2692	2849	
J				114	92	108			3154		2784	2859	
K	0.06	0.19	0.68	105	82	100	3190	3110		3190	2560	3200	
K	0.06	0.20	0.69	106	84	100	3210	3190		3230	2600	3100	
K	0.06	0.20	0.70	106	82	100	3180	3070		3170	2550	3100	
K	0.06	0.18	0.70	106	84	100	3190	3180		3190	2620	3100	
K	0.06	0.18	0.72	105	83	100	3190	3100		3190	2580	3100	
K	0.06	0.17	0.68	105	83	100	3180	3080		3180	2570	3100	
K	0.06	0.18	0.70	104	83	100	3110	3060		3110	2570	3000	
K	0.06	0.19	0.69	103	83	100	3160	3050		3150	2560	3100	
L	0.07	0.20	0.75	108	94		3130	3230	3392	3110	2890	3258	
L	0.06	0.19	0.73	109	96		3080	3320	3368	3120	2960	3249	
L	0.06	0.20	0.74	108	97		3150	3310	3388	3140	2960	3251	
L	0.06	0.20	0.74	109	97		3170	3340	3380	3160	2970	3266	
L	0.07	0.20	0.75	102	99		3060	3420	3379	2920	3040	3256	
L	0.06	0.20	0.74	110	99		3040	3410	3389	3170	3030	3288	
L	0.06	0.19	0.75	110	99		3180	3440	3381	3190	3060	3231	
L	0.06	0.19	0.74	106	96		3120	3380	3382	3060	3000	3260	
M													
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M													
N					104			3448			2630		
N					112			3524			2687		
N					107			3440			2575		
N					101			3422			2579		
N					100			3306			2484		
N					103			3410			2559		
N					102			3410			2578		
N					103			3465			2632		
O				110			3392			3143			
O				111			3417			3147			
O				108			3386			3192			
O				111			3430			3175			
O				112			3411			3112			
O				110			3444			3251			
O				109			3415			3170			
O				109			3426			3181			
P	0.07	0.18	0.72	84	83	96	3411	3314	3681	3236	2716	4614	3.03
P	0.06	0.19	0.74	90	89	96	3452	3301	3622	3288	2906	4215	3.01
P	0.05	0.19	0.74	85	96	91	3511	3536	3544	3257	3130	4124	2.99
P	0.06	0.19	0.76	86	91	88	3500	3359	3585	3208	2979	3895	2.99
P	0.05	0.17	0.70	90	91	86	3555	3336	3665	3301	2962	3702	3.00
P	0.06	0.18	0.74	93	92	101	3514	3388	3538	3348	3013	3745	3.04
P	0.06	0.18	0.73	86	92	93	3435	3340	3625	3201	2942	3849	3.03
P	0.05	0.17	0.70	90	91	101	3443	3349	3547	3287	2963	3935	3.04
Q	0.06	0.16	0.64										
Q	0.06	0.15	0.63										
Q	0.05	0.16	0.66										
Q	0.06	0.18	0.69										
Q	0.05	0.15	0.60										
Q	0.05	0.16	0.66										
Q	0.05	0.17	0.68										
Q	0.06	0.17	0.71										
R	0.06	0.20	0.74	98	94	100	3460	2970	3400	2930	2830	3300	
R	0.07	0.21	0.79	103	95	100	3570	3080	3400	3060	2870	3300	
R	0.06	0.20	0.76	100	91	100	3530	3090	3400	2970	2770	3300	
R	0.06	0.20	0.77	100	93	100	3550	3080	3500	3000	2870	3300	
R	0.06	0.20	0.77	100	95	100	3510	3070	3400	2990	2850	3300	
R	0.06	0.20	0.77	99	88	100	3530	2850	3400	2980	2700	3300	
R	0.06	0.20	0.76	98	94	100	3480	3030	3400	2950	2840	3300	
R	0.06	0.19	0.75	98	92	100	3480	2960	3400	2930	2740	3300	

Lab Code	Au Pb coll g/t	Pt Pb coll g/t	Pd Pb coll 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	Specific Gravity g/cc
S	0.06	0.22	0.71	89	84		3300	3400	3260		2800	3150	2.96
S	0.08	0.22	0.74	95	81		3500	3300	3450		2700	3250	2.99
S	0.07	0.20	0.73	92	84		3500	3400	3190		2800	2940	2.97
S	0.06	0.17	0.73	89	86		3300	3500	3370		2800	3160	3.01
S	0.06	0.18	0.73	94	87		3500	3500	3330		2900	3170	3.01
S	0.06	0.22	0.73	89	88		3400	3600	3330		2900	3130	3.00
S	0.06	0.21	0.73	94	83		3500	3300	3480		2700	3240	2.96
S	0.08	0.21	0.72	93	83		3500	3300	3410		2800	3450	2.97
T	0.05	0.18	0.71	100	99	109	3370	3400	3053	3150	2900	3165	3.03
T	0.05	0.18	0.72	90	100	109	2970	3200	3049	2790	3000	3161	3.03
T	0.06	0.19	0.73	90	95	106	2760	2900	3083	2690	2800	3194	3.03
T	0.05	0.18	0.71	90	87	103	2940	2800	3052	2720	2600	3162	
T	0.05	0.18	0.75	90	98	109	3020	3000	3057	2850	2800	3160	3.02
T	0.05	0.18	0.72	100	100	108	3360	3400	3061	3150	3000	3160	3.04
T	0.05	0.18	0.69	90	97	108	3170	3200	3049	2960	2800	3155	3.02
T	0.06	0.19	0.73	100	98	108	3250	3300	3051	3040	2900	3157	3.02
U	0.06	0.19	0.71	105	96		3380	3310		3260	3010		3.05
U	0.06	0.19	0.69	100	94		3270	3300		3240	2920		3.07
U	0.06	0.19	0.69	105	94		3360	3290		3230	2930		3.03
U	0.06	0.20	0.72	110	96		3310	3290		3220	2930		3.04
U	0.06	0.19	0.70	105	94		3270	3290		3250	2920		3.06
U	0.06	0.19	0.69	110	98		3450	3320		3330	3010		3.08
U	0.06	0.19	0.71	110	96		3340	3290		3300	2930		3.05
U	0.06	0.19	0.72	115	96		3390	3300		3230	2900		3.08

Availability: This product is available in Laboratory Packs containing 1kg of material or in Explorer Packs containing client specified weights of material from 50g up to 250g. Laboratory Packs are sealed bottles delivered in sealed foil pouches. Explorer Packs contain material in standard geochem envelopes placed into foil pouches that are nitrogen flushed and vacuum sealed.

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.

24 April 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.)