

# AMIS0282

## *Certified Reference Material*

**Multi element-PGM ore  
Sudbury Basin, Canada**

## *Certificate of Analysis*

### **Recommended Concentrations and two “Between Laboratory” Standard Deviations<sup>1</sup>**

#### ***Certified Concentrations<sup>2</sup>***

Pt Pb Collection	0.97	±	0.10	g/t
Pd Pb Collection	1.41	±	0.12	g/t
Au Pb Collection	0.19	±	0.01	g/t
Cu M/ICP	1.68	±	0.12	%
Cu P	1.68	±	0.11	%
Ni M/ICP	4971	±	560	ppm
Ni P	4850	±	555	ppm
Specific Gravity	2.82	±	0.12	

#### ***Provisional Concentrations***

Co M/ICP	78	±	10	ppm
Co P	74	±	14	ppm

$$3E \text{ PGM (Pt + Pd + Au)} = 2.57 \text{ g/t}$$

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.

---

#### AMIS

(A Division of Torre Analytical Services (Pty) Limited)  
(Reg. No. 1989/000201/07)

A: 11 Avalon Road, West Lake View Ext 11, Modderfontein, South Africa

P: PO Box 856, Isando, 1600, Gauteng, South Africa

T: +27 (0) 11 923-0800

W: [www.amis.co.za](http://www.amis.co.za)

Directors: C E Pettit (British), R Naidoo, N N Robinson, K V Gerber, M Padayachee

## Major Element Recommended Concentrations and two “Between Laboratory” Standard Deviations

### *Certified Concentrations*

Al <sub>2</sub> O <sub>3</sub>	13.38	±	0.20	%
CaO	2.14	±	0.04	%
Fe <sub>2</sub> O <sub>3</sub>	8.24	±	0.12	%
K <sub>2</sub> O	3.80	±	0.06	%
MgO	1.70	±	0.12	%
MnO	0.07	±	0.004	%
SiO <sub>2</sub>	60.62	±	0.64	%
TiO <sub>2</sub>	0.50	±	0.01	%
S Comb / LECO	2.38	±	0.08	%

### *Provisional Concentrations*

Cr <sub>2</sub> O <sub>3</sub>	0.07	±	0.01	%
LOI	2.18	±	0.54	%

**1. Intended Use:** AMIS0282 is a certified reference material which may be used to demonstrate the validity of measurement results of a single analysis Nickel-Copper-PGM ores, hosted by mafic rocks, with a similar grade and matrix; when measured in parallel to the unknown to be characterised. The material can be used for routine quality control by inserting within a batch of samples, method development and for the calibration of equipment. The recommended mean and "Between Lab" standard deviations for this material property values based on a measurement campaign (round robin) and reflect the average results from the laboratories that participated in the round robin, after examination of the data set and removal of technically and statistically invalid results (see Clause 9 - this certificate). 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 %.

**2. Origin of Material:** This standard was made using material provided by Quandra FNX Mining Ltd and SGS Minerals Services. The material is from project areas within the confines or peripheral to the Sudbury Structure and the associated 1.85 billion year old Sudbury Igneous Complex; located approximately 400 km north of Toronto, in close proximity to the City of Greater Sudbury, northeastern Ontario, Canada.

**3. Mineral and Chemical Composition:** The vast bulk of sulphides in the Sudbury ores consist essentially of varying proportions of pyrrhotite, chalcopyrite and pentlandite with varying amounts of other Cu-, Ni-, Co-, PGM-bearing minerals and gold.

Major element chemistry data from 12 of the labs has been compiled and certified. Uncertified summary statistics for trace element data are set out in the appendix.

---

#### AMIS

(A Division of Torre Analytical Services (Pty) Limited)  
 (Reg. No. 1989/000201/07)

A: 11 Avalon Road, West Lake View Ext 11, Modderfontein, South Africa

P: PO Box 856, Isando, 1600, Gauteng, South Africa

T: +27 (0) 11 923-0800

W: [www.amis.co.za](http://www.amis.co.za)

Directors: C E Pettit (British), R Naidoo, N N Robinson, K V Gerber, M Padayachee

4. **Appearance:** The material is a Dark Gray.
  
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. ICP-OES or ICP-MS, Pb collection with Ag as a co-collector.
  2. Au, Pt, Pd, Rh, Ru and Ir. ICP-MS, nickel sulphide collection.
  3. Cu and Ni. Multi-acid total digestion, including HF, with ICP-OES finish.
  4. Cu and Ni. Aqua regia digestion with ICP-OES finish.
  5. Cr, Co, Cu and Ni. Pressed pellet XRF.
  6. Cr, Co, Cu and Ni. Fusion, ICP-OES or ICP-MS
  7. Specific Gravity. Gas pycnometer.
  8. XRF (major elements).
  9. Multi acid digest ICP scan – trace elements.

Additionally, XRF analyses were requested for the major elements and a multi-element multi acid digest and ICP scan was requested for the trace elements.

**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 two laboratories were each given eight randomly selected packages of sample. Seventeen of the laboratories submitted results.

The final limits were calculated after a three-step examination of the data, first removing incompatible data outside a spread normally expected for similar analytical methods done by reputable laboratories. Then, data from any one laboratory was removed from further calculations, if the mean of all analyses from that laboratory failed a t-test of the global means of the other laboratories. Next, data that fell outside of the 2 standard deviations were removed. The mean and standard deviations were then re-calculated.

---

**AMIS**

(A Division of Torre Analytical Services (Pty) Limited)  
(Reg. No. 1989/000201/07)

A: 11 Avalon Road, West Lake View Ext 11, Modderfontein, South Africa

P: PO Box 856, Isando, 1600, Gauteng, South Africa

T: +27 (0) 11 923-0800

W: [www.amis.co.za](http://www.amis.co.za)

Directors: C E Pettit (British), R Naidoo, N N Robinson, K V Gerber, M Padayachee

Analytes with an RSD of near or less than 5 % are reported as “Certified Concentrations” with limits at two “Between Laboratory” standard deviations. Those with RSD’s of between near 5 % and 15 % are reported as “Provisional Concentrations” with limits at two “Between Laboratory” standard deviations. Those with RSD’s over 15 % are reported as “Informational Values”.

This method is different from that used by Government agencies 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 Confidence Limits published on other standards.

**10. Participating Laboratories:** The 17 out of 22 laboratories that provided results timeously were (not in same order as in the table of assays):

1. Activation Laboratories Pty Ltd (ActLabs) CA
2. Alex Stewart International Corporation Zambia
3. ALS Chemex Laboratory Group Brisbane Australia
4. ALS Chemex Laboratory Group Johannesburg SA
5. Genalysis Laboratory Services (South Africa) Pty
6. Genalysis Laboratory Services W Australia
7. Intertek Utama Services (Indonesia)
8. Set Point Laboratories (Isando) SA
9. SGS Australia Pty Ltd (Newburn) WA
10. SGS Chelopech (Bulgaria)
11. SGS Durango (Mexico)
12. SGS Geosol Laboratories Ltda (Brazil)
13. SGS Mineral Services Callao (Peru)
14. SGS Mineral Services Lakefield (Canada)
15. SGS South Africa (Pty) Ltd - Booyens JHB
16. SGS Toronto (Canada)
17. Ultra Trace (Pty) Ltd WA

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

---

## AMIS

(A Division of Torre Analytical Services (Pty) Limited)  
(Reg. No. 1989/000201/07)

A: 11 Avalon Road, West Lake View Ext 11, Modderfontein, South Africa

P: PO Box 856, Isando, 1600, Gauteng, South Africa

T: +27 (0) 11 923-0800

W: [www.amis.co.za](http://www.amis.co.za)

Directors: C E Pettit (British), R Naidoo, N N Robinson, K V Gerber, M Padayachee

**Assay data – Economic elements**

Lab Code	Pt Pb Coll g/t	Pd Pb Coll g/t	Au Pb Coll g/t	Co M/CP ppm	Co P ppm	Cu M/CP ppm	Cu P ppm	Ni M/CP ppm	Ni P ppm
A	0.92	1.36	0.20	85.00	73.20	16310	16020	4744	4749
A	0.91	1.32	0.20	84.60	71.70	16085	15650	4821	4650
A	0.91	1.38	0.20	85.60	73.50	16172	15827	4891	4721
A	0.91	1.40	0.20	84.30	75.70	16033	16166	4754	4804
A	0.90	1.35	0.19	83.90	75.00	16087	15927	4778	4808
A	0.92	1.37	0.20	84.10	72.70	15698	15768	4803	4695
A	0.91	1.35	0.20	84.00	73.10	15945	15854	4756	4725
A	0.91	1.40	0.20	82.90	73.20	16050	15907	4724	4733
B						15960	17602	5024	4728
B						15971	16593	5019	4870
B						16171	16945	4974	4706
B						16004	17290	5077	4781
B						16641	17281	5074	4709
B						16522	17162	5004	4880
B						16112	17634	4750	4782
B						15886	17313	5047	4809
C	0.99	1.50	0.19	79.00	62.00	17200	17200	5280	4310
C	0.99	1.50	0.19	80.00	64.00	17200	17400	5290	4430
C	1.00	1.50	0.19	80.00	63.00	17100	17200	5300	4400
C	1.00	1.51	0.20	80.00	63.00	16900	16900	5230	4380
C	1.00	1.51	0.19	80.00	63.00	17000	16900	5240	4420
C	0.98	1.50	0.19	78.00	63.00	17200	17200	5300	4390
C	0.98	1.48	0.19	82.00	63.00	17200	17000	5270	4400
C	1.00	1.51	0.19	81.00	63.00	16900	16900	5200	4380
D				74.00	80.00	17200		4710	4950
D				72.00	80.00	17700		4700	4960
D				74.00	82.00	17000		4760	4960
D				79.00	81.00	17100		4850	4920
D				78.00	81.00	17500		4760	5010
D				78.00	78.00	16600		4980	5060
D				73.00	81.00	16700		4830	5020
D				79.00	80.00	16700		4670	4980
E	1.02	1.43	0.19	71.27	64.80	18583		4423	4454
E	1.00	1.43	0.19	71.00	66.00	19041		4377	4537
E	1.00	1.42	0.19	72.83	68.90	19649		4446	4184
E	0.99	1.37	0.19	71.29	68.80	18943		4448	4459
E	1.02	1.41	0.19	73.57	64.40	18231		4548	4420
E	1.06	1.41	0.19	73.10	68.50	18702		4544	4391
E	1.02	1.41	0.19	74.14	69.50	19992		4574	4217
E	1.02	1.42	0.19	69.70	65.20	19709		4413	4377
F	1.01	1.46	0.24	69.00	80.00	17100	17400	4260	4970
F	1.00	1.47	0.19	70.00	78.00	17700	17400	4480	4990
F	1.02	1.48	0.19	71.00	82.00	17200	17600	4460	5350
F	1.03	1.52	0.20	73.00	74.00	17500	17200	4510	4830
F	1.00	1.50	0.20	71.00	74.00	17300	17400	4450	4920
F	1.00	1.47	0.20	69.00	75.00	17200	17300	4430	4960
F	1.02	1.51	0.20	71.00	74.00	17300	16700	4410	4760
F	1.00	1.46	0.19	71.00	77.00	17500	17800	4480	4900
G				70.00		16550		5090	
G				80.00		16500		4970	
G				80.00		16800		5170	
G				70.00		16400		5050	
G				70.00		16500		5010	
G				80.00		16750		5020	
G				80.00		16300		5010	
G				80.00		16850		5160	
K	0.91	1.41	0.19	80.00	80.00	16750	16950	5060	
K	0.93	1.45	0.19	80.00	80.00	16500	17150	5110	
K	0.89	1.36	0.18	80.00	80.00	16450	17350	5060	
K	0.84	1.37	0.18	80.00	80.00	16600	17050	5110	
K	0.78	1.20	0.16	70.00	80.00	16250	16950	5080	
K	0.78	1.23	0.16	80.00	70.00	16700	16300	5150	
K	0.84	1.33	0.17	80.00	60.00	16300	13600	5020	
K	0.96	1.43	0.19	80.00	80.00	16500	17150	5130	
L				87.00		13900	16100	5320	
L				84.00		14600	18500	5440	
L				82.00		15200	16300	5310	
L				82.00		14000	17300	5440	
L				81.00		13600	17000	5380	
L				83.00		13500	16100	5420	
L				82.00		14300	16100	5420	
L				83.00		13200	15800	5330	

**AMIS**

(A Division of Torre Analytical Services (Pty) Limited)  
(Reg. No. 1989/000201/07)

A: 11 Avalon Road, West Lake View Ext 11, Modderfontein, South Africa

P: PO Box 856, Isando, 1600, Gauteng, South Africa

T: +27 (0) 11 923-0800

W: [www.amis.co.za](http://www.amis.co.za)

Directors: C E Pettit (British), R Naidoo, N N Robinson, K V Gerber, M Padayachee

**Assay data (continued) – Economic elements**

Lab Code	Pt Pb Coll g/t	Pd Pb Coll g/t	Au Pb Coll g/t	Co M/CP ppm	Co P ppm	Cu M/CP ppm	Cu P ppm	Ni M/CP ppm	Ni P ppm
M	1.04	1.52	0.19	63.00				3980	5320
M	1.02	1.49	0.18	62.00				3960	5320
M	1.06	1.53	0.19	66.00				4130	5240
M	1.07	1.53	0.20	65.00				4080	4960
M	1.03	1.49	0.19	63.00				4010	5270
M	1.05	1.52	0.21	64.00				4010	4930
M	1.02	1.48	0.18	64.00				4000	4780
M	0.99	1.51	0.20	65.00				4080	4420
O	1.02	1.43	0.19						
O	1.00	1.43	0.19						
O	1.00	1.42	0.19						
O	0.99	1.37	0.19						
O	1.02	1.41	0.19						
O	1.06	1.41	0.19						
O	1.02	1.41	0.19						
O	1.02	1.42	0.19						
P									
P									
P									
P									
P									
P									
P									
P									
Q	0.96	1.42	0.19	80.60	85.00	17600		5360	5290
Q	0.92	1.34	0.18	79.50	115.00	17800		5380	5000
Q	0.94	1.39	0.18	89.50	87.00	18000		5410	5390
Q	0.93	1.37	0.18	80.40	83.00	17900		5460	5240
Q	0.92	1.36	0.18	84.30	84.00	17700		5360	5200
Q	0.94	1.39	0.19	75.50	84.00	17700		5440	5180
Q	0.92	1.37	0.18	84.80	82.00	17300		5410	5150
Q	0.94	1.41	0.18	88.40	84.00	17400		5400	5210
R	0.90	1.32	0.19	75.00	80.00	16700	17000	5020	4920
R	0.94	1.35	0.19	75.00	75.00	16700	15600	5040	4760
R	0.95	1.36	0.19	70.00	82.00	16900	17200	5040	4820
R	0.91	1.33	0.18	75.00	78.00	16800	17200	5090	4820
R	0.90	1.32	0.19	80.00	80.00	17300	16300	5040	4760
R	0.94	1.34	0.19	75.00	77.00	17200	16800	5060	4820
R	0.92	1.36	0.19	85.00	79.00	16900	17100	5160	4840
R	0.92	1.33	0.19	75.00	86.00	17100	16200	5080	4900
S				79.00	69.00	16100	16300	4988	4962
S				75.00	71.00	16500	16200	4976	5171
S				79.00	70.00	16700	16200	5004	4933
S				80.00	72.00	16800	16500	4925	5113
S				77.00	69.00	16100	16400	4973	4911
S				76.00	68.00	16600	16300	4976	4936
S				77.00	72.00	16700	16400	4970	5034
S				81.00	70.00	17200	16200	4985	4987
T						16200		4000	
T						16200		3800	
T						16100		4100	
T						16200		4100	
T						18800		5000	
T						18800		4900	
T						16100		4500	
T						15680		4400	
U	0.95	1.36	0.18			16700	16100	4600	4500
U	0.94	1.34	0.19			16200	16300	4700	4500
U	0.94	1.35	0.18			16900	16700	4900	4700
U	0.93	1.35	0.18			16600	16700	4800	4600
U	0.94	1.34	0.18			16600	16700	4800	4700
U	0.94	1.36	0.19			16900	16600	4900	4600
U	0.95	1.34	0.18			16500	16200	4800	4500
U	0.94	1.35	0.19			16200	16800	4800	4700
V						17300	17200	4980	5120
V						17600	16400	4960	4900
V						18800	17300	4920	5250
V						18200	16800	5020	4950
V						18200	17400	4940	5360
V						19600	17400	4990	5170
V						17500	17100	4910	5280
V						17800	17300	4750	5020

**AMIS**

(A Division of Torre Analytical Services (Pty) Limited)  
(Reg. No. 1989/000201/07)

A: 11 Avalon Road, West Lake View Ext 11, Modderfontein, South Africa

P: PO Box 856, Isando, 1600, Gauteng, South Africa

T: +27 (0) 11 923-0800

W: [www.amis.co.za](http://www.amis.co.za)

Directors: C E Pettit (British), R Naidoo, N N Robinson, K V Gerber, M Padayachee

**Assay data (continued) – Major Oxides**

Lab Code	Al <sub>2</sub> O <sub>3</sub> XRF %	CaO XRF %	Cr <sub>2</sub> O <sub>3</sub> XRF %	Fe <sub>2</sub> O <sub>3</sub> XRF %	K <sub>2</sub> O XRF %	MgO XRF %	MnO XRF %	Na <sub>2</sub> O XRF %	SiO <sub>2</sub> XRF %	TiO <sub>2</sub> XRF %	LOI XRF %	S Comb / LECO %	SG pycnometer
A											1.92	2.45	2.88
A											1.84	2.52	2.82
A											1.87	2.54	2.88
A											1.90	2.40	2.96
A											1.84	2.44	2.94
A											1.89	2.43	2.82
A											1.91	2.49	2.84
A											1.85	2.46	2.88
B													2.81
B													2.86
B													2.85
B													2.85
B													2.82
B													2.83
B													2.84
B													2.84
C	13.26	2.15	0.08	8.11	3.77	1.69	0.07		60.32	0.50			
C	13.30	2.17	0.08	8.19	3.79	1.71	0.07		60.63	0.50			
C	13.34	2.17	0.08	8.27	3.80	1.70	0.07		60.72	0.50			
C	13.32	2.16	0.09	8.10	3.79	1.71	0.07		60.66	0.50			
C	13.35	2.17	0.07	8.28	3.77	1.70	0.07		60.61	0.50			
C	13.33	2.17	0.07	8.27	3.78	1.70	0.07		60.69	0.50			
C	13.30	2.15	0.08	8.23	3.81	1.70	0.07		60.52	0.50			
C	13.31	2.17	0.06	8.26	3.79	1.69	0.07		60.65	0.49			
G	13.35	2.13	0.07	8.21	3.78	1.69	0.06		60.70	0.50	2.00	2.29	
G	13.45	2.14	0.07	8.21	3.80	1.70	0.06		60.70	0.50	2.00	2.24	
G	13.45	2.14	0.07	8.21	3.81	1.68	0.06		60.70	0.49	1.97	2.37	
G	13.50	2.14	0.06	8.24	3.80	1.70	0.06		60.80	0.47	1.98	2.31	
G	13.40	2.13	0.06	8.19	3.80	1.72	0.06		60.80	0.48	2.03	2.24	
G	13.45	2.14	0.07	8.18	3.78	1.72	0.06		60.70	0.49	2.03	2.33	
G	13.45	2.13	0.07	8.16	3.78	1.70	0.06		60.60	0.48	1.98	2.41	
G	13.50	2.14	0.07	8.22	3.80	1.72	0.06		60.90	0.48	1.99	2.33	
K												2.35	2.81
K												2.33	2.80
K												2.33	2.78
K												2.33	2.74
K												2.35	2.76
K												2.32	2.75
K												2.35	2.76
K												2.33	2.75
L	13.40	2.13	0.07	8.28	3.78	1.71	0.07	3.47	60.60	0.50	1.84	2.39	
L	13.40	2.13	0.07	8.26	3.78	1.70	0.07	3.41	60.70	0.49	1.84	2.45	
L	13.40	2.14	0.07	8.27	3.78	1.70	0.07	3.48	60.60	0.50	1.80	2.33	
L	13.40	2.13	0.07	8.25	3.79	1.69	0.07	3.45	60.60	0.49	1.86	2.41	
L	13.30	2.11	0.07	8.25	3.79	1.70	0.07	3.43	60.60	0.49	1.82	2.31	
L	13.40	2.13	0.07	8.26	3.80	1.70	0.07	3.41	60.50	0.50	1.87	2.43	
L	13.40	2.12	0.07	8.26	3.81	1.71	0.07	3.41	60.50	0.50	1.90	2.30	
L	13.40	2.12	0.08	8.23	3.81	1.71	0.07	3.45	60.60	0.50	1.87	2.33	
M												2.39	
M												2.46	
M												2.42	
M												2.41	
M												2.40	
M												2.54	
M												2.38	
M												2.39	
O												2.43	
O												2.39	
O												2.38	
O												2.37	
O												2.30	
O												2.31	
O												2.35	
O												2.32	

**AMIS**

(A Division of Torre Analytical Services (Pty) Limited)  
(Reg. No. 1989/000201/07)

A: 11 Avalon Road, West Lake View Ext 11, Modderfontein, South Africa

P: PO Box 856, Isando, 1600, Gauteng, South Africa

T: +27 (0) 11 923-0800

W: [www.amis.co.za](http://www.amis.co.za)

Directors: C E Pettit (British), R Naidoo, N N Robinson, K V Gerber, M Padayachee

### Assay data (continued) – Major Oxides

Lab Code	Al <sub>2</sub> O <sub>3</sub> XRF %	CaO XRF %	Cr <sub>2</sub> O <sub>3</sub> XRF %	Fe <sub>2</sub> O <sub>3</sub> XRF %	K <sub>2</sub> O XRF %	MgO XRF %	MnO XRF %	Na <sub>2</sub> O XRF %	SiO <sub>2</sub> XRF %	TiO <sub>2</sub> XRF %	LOI XRF %	S Comb / LECO %	SG pycnometer
Q	13.30	2.14	0.07	8.27	3.90	1.69	0.07	3.63	60.39	0.46	2.66	2.20	
Q	13.49	2.10	0.07	8.28	3.73	1.65	0.07	3.62	60.19	0.44	2.62	2.12	
Q	13.57	2.11	0.07	8.28	3.82	1.71	0.07	3.60	60.54	0.44	2.59	2.17	
Q	13.37	2.12	0.07	8.27	3.83	1.67	0.07	3.60	60.31	0.45	2.67	2.22	
Q	13.45	2.13	0.07	8.31	3.87	1.67	0.07	3.61	60.48	0.45	2.58	2.21	
Q	13.45	2.10	0.07	8.24	3.81	1.63	0.07	3.57	60.15	0.44	2.56	2.15	
Q	13.43	2.12	0.08	8.33	3.81	1.65	0.07	3.58	60.59	0.45	2.60	2.21	
Q	13.34	2.11	0.07	8.21	3.82	1.63	0.07	3.60	60.23	0.45	2.58	2.22	
R	13.34	2.15	0.08	8.25	3.81	1.76	0.07	3.39	60.97	0.49	2.15	2.39	2.91
R	13.34	2.15	0.08	8.24	3.82	1.76	0.07	3.38	61.00	0.50	2.16	2.37	2.92
R	13.31	2.15	0.07	8.23	3.81	1.77	0.07	3.39	60.98	0.49	2.16	2.38	2.93
R	13.34	2.15	0.08	8.24	3.82	1.77	0.07	3.39	61.01	0.49	2.14	2.37	2.91
R	13.30	2.15	0.08	8.24	3.79	1.75	0.07	3.38	60.99	0.49	2.14	2.36	2.89
R	13.33	2.15	0.08	8.24	3.80	1.76	0.07	3.39	60.91	0.50	2.14	2.38	2.90
R	13.32	2.15	0.08	8.26	3.80	1.76	0.07	3.38	60.94	0.50	2.18	2.39	2.90
R	13.33	2.15	0.08	8.26	3.81	1.76	0.07	3.39	60.96	0.49	2.14	2.37	2.90
S												2.36	2.71
S												2.38	2.73
S												2.36	2.74
S												2.35	2.75
S												2.37	2.77
S												2.39	2.77
S												2.37	2.74
S												2.38	2.74
T	13.18	2.21	0.07	7.93	3.98	1.54	0.06					2.33	
T	13.25	2.34	0.06	7.86	3.98	1.56	0.06					2.46	
T	13.44	2.21	0.07	7.88	3.98	1.51	0.06					2.42	
T	12.97	2.34	0.06	8.15	3.98	1.51	0.06					2.32	
T	13.04	2.22	0.07	7.89	3.98	1.59	0.06					2.44	
T	13.27	2.21	0.07	8.00	3.98	1.61	0.06					2.41	
T	12.96	2.47	0.06	7.81	3.98	1.61	0.05					2.32	
T	13.10	2.28	0.06	7.73	3.98	1.54	0.06					2.33	
U	13.24	2.11	0.07	8.17	3.71	1.76	0.07	3.84	59.98	0.49	2.49		2.79
U	13.38	2.14	0.06	8.21	3.76	1.79	0.07	3.88	59.95	0.49	2.35		2.81
U	13.31	2.12	0.06	8.16	3.74	1.80	0.07	3.90	59.64	0.50	2.32		2.81
U	13.47	2.14	0.06	8.19	3.77	1.83	0.07	3.93	60.18	0.49	2.32		2.79
U	13.45	2.12	0.06	8.15	3.74	1.91	0.07	3.90	59.71	0.50	2.37		2.82
V	13.70	2.22	0.08	8.41	3.86	1.67	0.07	3.35	61.60	0.51	2.33	2.40	2.81
V	13.70	2.17	0.07	8.35	3.77	1.64	0.07	3.36	61.00	0.50	2.36	2.39	2.82
V	13.40	2.19	0.09	8.52	3.88	1.64	0.07	3.35	61.10	0.50	2.32	2.39	2.82
V	13.60	2.16	0.07	8.30	3.82	1.64	0.07	3.33	60.90	0.50	2.43	2.39	2.81
V	13.50	2.18	0.08	8.48	3.87	1.64	0.07	3.33	61.00	0.51	2.34	2.39	2.82
V	13.50	2.20	0.09	8.61	3.85	1.64	0.07	3.66	61.30	0.52	2.35	2.38	2.81
V	13.60	2.18	0.07	8.31	3.86	1.63	0.07	3.32	60.70	0.49	2.45	2.37	2.83
V	13.60	2.17	0.07	8.28	3.83	1.67	0.07	3.35	60.50	0.50	2.45	2.38	2.83

**12. Measurement of Uncertainty:** 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:

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

These uncertainty measurements may be used by laboratories as a component for calculating the total uncertainty for method validation according to ISO guidelines.

#### AMIS

(A Division of Torre Analytical Services (Pty) Limited)  
(Reg. No. 1989/000201/07)

A: 11 Avalon Road, West Lake View Ext 11, Modderfontein, South Africa

P: PO Box 856, Isando, 1600, Gauteng, South Africa

T: +27 (0) 11 923-0800

W: [www.amis.co.za](http://www.amis.co.za)

Directors: C E Pettit (British), R Naidoo, N N Robinson, K V Gerber, M Padayachee



Analyte	Method	Unit	S <sup>1</sup>	σ <sub>L</sub> <sup>2</sup>	Sw <sup>3</sup>	CSU <sup>4</sup>
Pt	Pb Coll	g/t	0.049	0.042	0.017	0.013
Pd	Pb Coll	g/t	0.065	0.056	0.023	0.018
Au	Pb Coll	g/t	0.007	0.005	0.004	0.002
Co	M/ICP	ppm	4.876	3.453	2.889	1.087
Co	P	ppm	7.055	6.224	3.149	2.108
Cu	M/ICP	ppm	587.5	419.9	259.4	119.3
Cu	P	ppm	557.4	407.0	345.8	134.4
Ni	M/ICP	ppm	279.9	210.3	66.75	56.57
Ni	P	ppm	277.3	204.3	132.9	60.54
Al <sub>2</sub> O <sub>3</sub>	XRF	%	0.101	0.073	0.072	0.027
CaO	XRF	%	0.021	0.022	0.009	0.008
Cr <sub>2</sub> O <sub>3</sub>	XRF	%	0.007	0.004	0.005	0.002
Fe <sub>2</sub> O <sub>3</sub>	XRF	%	0.065	0.056	0.043	0.022
K <sub>2</sub> O	XRF	%	0.037	0.030	0.026	0.012
LOI	XRF	%	0.273	0.309	0.041	0.117
MgO	XRF	%	0.056	0.053	0.019	0.019
MnO	XRF	%	0.002	0.003	0.0005	0.001
SiO <sub>2</sub>	XRF	%	0.319	0.315	0.140	0.121
TiO <sub>2</sub>	XRF	%	0.008	0.006	0.007	0.003
S	Comb /LECO	%	0.049	0.027	0.038	0.010
SG	pycnometer		0.057	0.059	0.023	0.022

1. S - Std Dev for use on control charts.  
σ<sub>L</sub> - Betw Lab Std Dev, for use to calculate a measure of accuracy.
2. Sw - Within Lab Std Dev, for use to calculate a measure of precision.
3. CSU - Combined Standard Uncertainty, a component for use to calculate
4. 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:** AMIS0282 is a new material.

## AMIS

(A Division of Torre Analytical Services (Pty) Limited)  
(Reg. No. 1989/000201/07)

A: 11 Avalon Road, West Lake View Ext 11, Modderfontein, South Africa

P: PO Box 856, Isando, 1600, Gauteng, South Africa

T: +27 (0) 11 923-0800

W: [www.amis.co.za](http://www.amis.co.za)

Directors: C E Pettit (British), R Naidoo, N N Robinson, K V Gerber, M Padayachee

**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](http://www.amis.co.za) website.

**17. Minimum sample size:** Most of the 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.

---

## AMIS

(A Division of Torre Analytical Services (Pty) Limited)  
(Reg. No. 1989/000201/07)

A: 11 Avalon Road, West Lake View Ext 11, Modderfontein, South Africa

P: PO Box 856, Isando, 1600, Gauteng, South Africa

T: +27 (0) 11 923-0800

W: [www.amis.co.za](http://www.amis.co.za)

Directors: C E Pettit (British), R Naidoo, N N Robinson, K V Gerber, M Padayachee

**19 Legal Notice:** This certificate and the reference material described in it have been prepared with due care and attention. However, AMIS, Melesha Gopi Mungaroo, Daishnee Padayachee, 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.

**Date of Version v0.01:** 24 June 2020

**Version:** v0.01

**Reason for Version v0.01:** Amendment of units of measurement for Co, Cu and Ni

**Date of Version 000:** 27 June 2012

**Version:** 000

**Approving Officer:**

**African Mineral Standards:** \_\_\_\_\_

**Melesha Gopi Mungaroo (Technical Manager)**

**Certifying Officers:**



**African Mineral Standards:** \_\_\_\_\_

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



**Geochemist:** \_\_\_\_\_

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

---

**AMIS**

(A Division of Torre Analytical Services (Pty) Limited)  
(Reg. No. 1989/000201/07)

A: 11 Avalon Road, West Lake View Ext 11, Modderfontein, South Africa

P: PO Box 856, Isando, 1600, Gauteng, South Africa

T: +27 (0) 11 923-0800

W: [www.amis.co.za](http://www.amis.co.za)

Directors: C E Pettit (British), R Naidoo, N N Robinson, K V Gerber, M Padayachee

### Appendix – uncertified trace element statistics

Analyte	Method	Unit	Mean	2SD	RSD%	n
Ag	M/ICP	ppm	5.10	1.00	9.77	85
Al	M/ICP	%	6.90	0.92	6.68	95
As	M/ICP	ppm	7.48	5.32	35.58	64
Ba	M/ICP	ppm	812	506	31.16	67
Be	M/ICP	ppm	1.54	0.60	19.35	81
Bi	M/ICP	ppm	4.20	0.78	9.32	39
Ca	M/ICP	%	1.50	0.21	7.15	95
Cd	M/ICP	ppm	4.39	1.29	14.66	88
Ce	M/ICP	ppm	106	24.75	11.62	31
Cr	M/ICP	ppm	420	121	14.44	92
Cs	M/ICP	ppm	0.65	0.10	7.52	32
Dy	M/ICP	ppm	2.33	0.18	3.96	23
Er	M/ICP	ppm	1.38	0.81	29.58	24
Eu	M/ICP	ppm	1.27	0.16	6.30	23
Fe	M/ICP	%	5.79	0.50	4.29	103
Ga	M/ICP	ppm	19.51	2.33	5.96	44
Gd	M/ICP	ppm	4.81	2.82	29.26	24
Ge	M/ICP	ppm	1.05	1.14	54.43	16
Hf	M/ICP	ppm	2.84	0.98	17.23	39
Ho	M/ICP	ppm	0.41	0.04	4.78	23
In	M/ICP	ppm	0.58	0.10	8.47	38
K	M/ICP	%	3.08	0.55	8.97	95
La	M/ICP	ppm	54.27	11.51	10.60	78
Li	M/ICP	ppm	19.70	4.26	10.80	82
Lu	M/ICP	ppm	0.14	0.05	17.96	31
Mg	M/ICP	%	1.01	0.12	5.78	95
Mn	M/ICP	ppm	538	70.46	6.54	96
Mo	M/ICP	ppm	2.14	1.23	28.64	66
Na	M/ICP	%	2.47	0.30	6.11	94
Nb	M/ICP	ppm	5.95	1.89	15.88	43
Nd	M/ICP	ppm	41.74	6	6.62	23
Ni	M/ICP	ppm	804	147	9.14	79
P	M/ICP	ppm	127	25.7	10.1	99
Pr	M/ICP	ppm	12.03	1.11	4.61	23
Rb	M/ICP	ppm	103	22.76	11.05	39
S	M/ICP	%	2.39	0.18	3.78	71
Sb	M/ICP	ppm	2.28	6.15	135	56
Sc	M/ICP	ppm	5.97	1.01	8.47	84
Se	M/ICP	ppm	16.10	6.45	20.01	38
Si	M/ICP	%	28.26	0.50	0.89	8
Sm	M/ICP	ppm	6.21	1.09	8.75	23
Sn	M/ICP	ppm	7.40	1.52	10.25	39
Sr	M/ICP	ppm	341	43.02	6.31	90
Ta	M/ICP	ppm	0.52	0.62	58.93	39
Tb	M/ICP	ppm	0.53	0.28	26.29	31
Te	M/ICP	ppm	4.26	0.86	10.11	39
Th	M/ICP	ppm	14.57	2.92	10.04	39
Ti	M/ICP	%	0.28	0.04	6.33	79
Tl	M/ICP	ppm	1.03	0.15	7.30	39
Tm	M/ICP	ppm	0.15	0.06	20.62	24
U	M/ICP	ppm	1.30	0.39	15.05	38
V	M/ICP	ppm	52.21	19.46	18.64	88
W	M/ICP	ppm	1.58	0.88	27.89	39
Y	M/ICP	ppm	10.44	2.00	9.55	84
Yb	M/ICP	ppm	0.96	0.23	11.99	31
Zn	M/ICP	ppm	208	26.64	6.41	74
Zr	M/ICP	ppm	83.97	32.71	19.48	84

#### AMIS

(A Division of Torre Analytical Services (Pty) Limited)  
(Reg. No. 1989/000201/07)

A: 11 Avalon Road, West Lake View Ext 11, Modderfontein, South Africa

P: PO Box 856, Isando, 1600, Gauteng, South Africa

T: +27 (0) 11 923-0800

W: [www.amis.co.za](http://www.amis.co.za)

Directors: C E Pettit (British), R Naidoo, N N Robinson, K V Gerber, M Padayachee