

# AMIS0279

## *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	0.96	±	0.10	g/t
Pd Pb Collection	2.05	±	0.12	g/t
Au Pb Collection	0.46	±	0.04	g/t
Co M/ICP	159	±	16	g/t
Co P	158	±	15	g/t
Cu M/ICP	8.508	±	0.441	%
Cu P	8.484	±	0.293	%
Ni M/ICP	1.609	±	0.098	%
Ni P	1.589	±	0.098	%
Specific Gravity	3.29	±	0.08	

*3E PGM (Pt+Pd+Au) = 3.47 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.

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#### AMIS

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(Reg. No. 1989/000201/07)

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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>	8.89	±	0.42	%
CaO	3.57	±	0.08	%
Fe <sub>2</sub> O <sub>3</sub>	25.63	±	0.60	%
K <sub>2</sub> O	0.73	±	0.03	%
MgO	2.44	±	0.14	%
MnO	0.11	±	0.01	%
Na <sub>2</sub> O	2.19	±	0.10	%
SiO <sub>2</sub>	35.29	±	1.40	%
TiO <sub>2</sub>	0.38	±	0.03	%
S Combustion / LECO	12.96	±	0.96	%

### *Provisional Concentrations*

Cr <sub>2</sub> O <sub>3</sub>	0.058	±	0.008	%
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1. **Intended Use:** AMIS0279 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.

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4. **Appearance:** The material is colored Dark Grey (Corstor colour chart).
  
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. Eighteen 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.

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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 18 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. ALS Chemex Laboratory Group Brisbane Australia
3. ALS Chemex Laboratory Group Johannesburg SA
4. ALS Chemex Laboratory Group Perth WA
5. ALS Chemex Laboratory Group Vancouver CA
6. Genalysis Laboratory Services (South Africa) Pty
7. Genalysis Laboratory Services (W Australia P)
8. Intertek Utama Services (Indonesia)
9. Set Point Laboratories (Isando) SA
10. SGS Australia Pty Ltd (Newburn) WA
11. SGS Chelopech (Bulgaria)
12. SGS Durango (Mexico)
13. SGS Geosol Laboratories Ltda (Brazil)
14. SGS Mineral Services Lakefield (Canada)
15. SGS South Africa (Pty) Ltd - Booyens JHB
16. SGS Toronto (Canada)
17. SGS Townsville (Australia)
18. 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.

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### Assay data – Economic elements

Lab Code	Pt Pb Coll g/t	Pd Pb coll g/t	Au 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
A	0.96	2.08	0.51	150	145		82500	81800		15400	15000	
A	0.95	2.12	0.50	160	158		82400	85200		15500	16500	
A	0.97	2.10	0.50	170	147		82300	82500		15800	15600	
A	0.99	2.10	0.49	160	145		82100	80600		15800	15200	
A	0.95	2.09	0.48	170	159		83400	82500		15800	16600	
A	0.99	2.08	0.51	160	149		83900	82800		15600	15900	
A	1.00	2.10	0.48	165	159		86000	87600		15900	16300	
A	0.98	2.08	0.50	160	151		82900	83300		15300	15700	
C	1.01	2.00	0.45	150	156		86900	84400		16400		
C	0.97	1.99	0.46	146	154		84600	84100		15750		
C	0.98	2.00	0.46	148	154		88600	84000		17250		
C	0.99	2.02	0.45	151	153		87600	83300		17050		
C	0.96	2.00	0.46	149	153		87900	83900		16600		
C	0.98	2.01	0.46	153	155		85300	85900		16050		
C	0.97	1.98	0.45	146	158		88000	85000		16750		
C	0.97	2.00	0.47	149	149		86800	83100		16700		
D	1.04	2.11	0.48	155	154		81900	88800		15200	16600	
D	1.02	2.06	0.48	153	157		86900	85800		16300	16200	
D	1.00	2.12	0.47	153	158		85400	85000		16300	16500	
D	1.00	2.06	0.48	158	158		84500	89300		16900	16600	
D	1.02	2.09	0.50	156	158		85600	84700		16100	16600	
D	1.01	2.11	0.51	154	159		83400	86500		16800	17400	
D	1.03	2.09	0.47	153	156		87600	86600		16700	17500	
D	0.99	2.07	0.46	153	157		85600	84600		16900	16400	
E	0.96	2.05	0.47	160	170		86700	81700		16700	17650	
E	0.95	2.06	0.50	163	170		84600	83500		17050	16950	
E	0.93	2.00	0.48	168	167		84400	82200		16600	16750	
E	0.94	2.04	0.50	170	172		84800	82200		16950	17100	
E	0.93	2.02	0.48	173	165		87200	81700		16450	17450	
E	0.94	2.02	0.48	161	168		87200	83100		16950	17700	
E	0.95	2.03	0.48	163	167		88200	82800		17050	17700	
E	0.88	1.94	0.44	168	166		87000	82100		16750	17450	
F	0.91	2.08	0.48									
F	0.90	1.96	0.43									
F	0.89	2.12	0.45									
F	0.90	2.16	0.45									
F	0.90	2.00	0.44									
F	0.90	1.97	0.43									
F	0.89	1.99	0.46									
F	0.91	2.05	0.46									
G	1.00	1.97	0.49	166	178			86200			16500	
G	1.00	2.02	0.55	169	183			85000			16600	
G	0.92	2.10	0.46	167	181			85700			15400	
G	1.03	2.01	0.47	171	180			85200			16500	
G	1.15	2.05	0.56	169	175			85400			16400	
G	1.14	2.24	0.55	167	176			87200			16300	
G	1.00	2.23	0.49	163	168			85700			17000	
G	1.16	2.24	0.50	168	168			86200			16600	
H	0.87	1.85	0.44	160	150		87200	86100		16050	15850	
H	0.90	1.91	0.42	160	160		88500	87100		16200	15750	
H	0.87	1.85	0.44	160	160		87800	86300		15950	15750	
H	0.87	1.88	0.45	160	150		87800	84600		16050	15550	
H	0.91	1.92	0.46	160	160		88300	86200		16300	15650	
H	0.89	1.89	0.45	170	150		88900	84800		16000	15600	
H	0.92	1.95	0.45	160	160		87700	85800		16050	15650	
H	0.87	1.86	0.41	170	160		91300	86500		16400	15650	
I				152	160		81800					
I				150	158		82700					
I				153	158		84600					
I				158	159		82200					
I				155	159		80700					
I				157	151		83400					
I				163	158		82300					
I				157	147		82000					
J	0.94	2.03	0.44	181	167		86412	83997		14630	15318	
J	0.95	2.02	0.45	176	163		85668	84812		14275	15682	
J	0.96	2.02	0.45	170	167		86984	84254		14415	15754	
J	0.99	2.21	0.45	171	164		87635	84116		14577	16066	
J	1.00	2.21	0.46	169	162		86847	84043		14427	16027	
J	0.97	2.06	0.45	179	164		86703	84170		14648	15991	
J	0.95	2.02	0.44	175	165		87585	84786		14684	16294	
J	1.01	2.18	0.46	168	162		84438	84532		14101	15801	

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

Lab Code	Pt Pb Coll g/t	Pd Pb coll g/t	Au 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
K	0.97	2.02	0.45	111					93300			
K	0.94	1.99	0.45	116					92900			
K	0.91	1.68	0.45	118					93200			
K	0.94	1.98	0.43	117					91500			
K	0.91	1.66	0.47	118					93900			
K	0.93	1.91	0.43	117					92000			
K	0.84	1.65	0.45	112					90800			
K	0.92	1.93	0.47	112					90400			
L	0.95	2.03	0.53	159	133		86400	85600		16000		
L	0.94	2.04	0.54	162	134		85900	85500		15900		
L	0.96	2.04	0.53	159	135		86000	85900		16100		
L	0.94	2.03	0.50	162	135		86000	85700		16000		
L	0.95	2.05	0.51	164	135		86000	85500		16000		
L	0.94	2.07	0.60	162	135		85300	85000		15800		
L	0.96	2.05	0.52	163	135		85300	86100		16100		
L	0.97	2.04	0.54	164	135		85300	86100		15900		
M			0.48	150	132							
M			0.53	151	143							
M			0.54	151	143							
M			0.53	139	142							
M			0.56	148	145							
M			0.51	152	145							
M			0.50	156	137							
M			0.48	166	144							
N	0.91	1.97	0.48	166	161		85300	85300		15900	15900	
N	0.90	1.95	0.46	164	159		83400	84100		15900	15900	
N	0.91	1.95	0.45	167	160		82400	87800		15600	15800	
N	0.90	1.95	0.47	163	160		85600	86900		15700	15700	
N	0.91	1.95	0.45	167	163		83400	86000		15700	15700	
N	0.90	1.97	0.45	164	160		86900	85400		15700	15900	
N	0.90	1.97	0.46	165	158		82800	85600		15800	15800	
N	0.90	1.96	0.47	165	159		83000	83200		15900	15800	
O	1.03	2.09	0.47			200.00			87200			16200
O	1.01	2.09	0.45			200.00			86800			16100
O	1.00	2.10	0.49			200.00			86700			16200
O	0.96	2.02	0.44			200.00			88000			16300
O	1.08	2.18	0.48			200.00			86700			16100
O	1.08	2.15	0.47			200.00			88200			16400
O	1.07	2.21	0.48			200.00			86800			16200
O	1.04	2.13	0.46			200.00			87600			16400
P					170		80800	87300	87100	15500	15700	16050
P					160		81800	85300	86700	15750	15200	15850
P					160		80800	85600	86700	15450	15400	15950
P					160		81700	84700	86300	15600	15350	15950
P					160		82600	83600	86700	15950	15050	16100
P					170		84400	85500	86300	16400	15100	16050
P					170		84600	85000	86700	16200	15150	16200
P					160		82000	85400	87100	15750	15300	16100
Q				141			76700	16900	87100	14300	67	16100
Q				144			75400	16700	87400	14400	68	16100
Q				144			76600	17400	84300	13800	70	15500
Q				137			78600	17900	88400	14000	69	16400
Q				141			77900	17400	87100	14500	68	16100
Q				140			75700	17300	87100	14500	71	15900
Q				143			77800	17000	87900	14100	67	16200
Q				143			79300	17300	87300	14000	69	16100
R	0.98	2.00	0.43	162	180		84300			16700		
R	1.02	2.04	0.47	163	160		87900			16000		
R	1.01	2.06	0.44	161	170		88800			16000		
R	0.99	1.99	0.46	158	160		86100			15300		
R	1.00	2.04	0.43	158	160		83700			16000		
R	1.04	2.11	0.45	157	150		84300			15400		
R	1.05	2.19	0.47	159	170		83300			16300		
R	1.02	2.12	0.46	159	150		85700			15200		
V			0.41									
V			0.49									
V			0.33									
V			0.41									
V			0.53									
V			0.50									
V			0.53									
V			0.45									

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### 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 pycnometer
A	8.77	3.56	0.06	25.87	0.72	2.54	0.11		35.81	0.41	6.92	13.30	3.33
A	8.83	3.56	0.06	25.75	0.73	2.54	0.11		35.75	0.39	6.96	13.30	3.33
A	8.77	3.55	0.06	25.76	0.72	2.55	0.10		35.77	0.40	6.97	13.10	3.30
A	8.80	3.56	0.06	25.79	0.73	2.55	0.11		35.80	0.41	6.94	13.30	3.28
A	8.84	3.56	0.06	25.87	0.73	2.54	0.11		35.81	0.40	6.96	13.30	3.32
A	8.83	3.56	0.06	25.75	0.73	2.54	0.11		35.74	0.40	6.92	13.30	3.36
A	8.81	3.56	0.06	25.74	0.73	2.54	0.11		35.75	0.40	6.96	13.30	3.32
A	8.80	3.56	0.06	25.77	0.73	2.55	0.11		35.76	0.40	6.91	13.30	3.30
B													
B													
B													
B													
B													
B													
B													
C	9.09	3.61	0.05	25.73	0.73	2.37	0.11	2.24		0.39		13.25	3.43
C	9.11	3.53	0.05	25.16	0.72	2.32	0.11	2.18		0.38		13.20	3.29
C	9.03	3.60	0.05	25.59	0.72	2.37	0.11	2.24		0.39		13.00	3.40
C	9.16	3.55	0.05	25.45	0.73	2.34	0.11	2.20		0.39		12.95	3.28
C	9.18	3.58	0.05	25.45	0.72	2.35	0.11	2.20		0.39		12.80	3.28
C	9.24	3.65	0.05	26.02	0.75	2.40	0.11	2.28		0.40		13.10	3.19
C	8.96	3.54	0.05	25.23	0.72	2.34	0.11	2.21		0.38		13.45	3.28
C	9.28	3.60	0.05	25.59	0.73	2.37	0.11	2.24		0.39		13.10	3.28
D												12.40	
D												12.50	
D												12.30	
D												12.30	
D												12.40	
D												12.40	
D												12.50	
D												12.50	
E	9.24	3.37	0.06	25.09	0.73	2.35	0.10	2.12		0.39		12.60	3.28
E	9.32	3.41	0.05	25.31	0.73	2.37	0.10	2.12		0.39		12.70	3.24
E	8.62	3.51	0.05	24.95	0.75	2.34	0.11	2.17		0.39		12.60	3.23
E	8.84	3.47	0.05	25.23	0.76	2.37	0.11	2.25		0.40		12.80	3.23
E	8.88	3.62	0.05	25.73	0.76	2.40	0.11	2.25		0.40		12.80	3.27
E	9.22	3.37	0.05	25.09	0.73	2.35	0.10	2.10		0.39		12.60	3.17
E	9.24	3.39	0.05	25.31	0.73	2.35	0.10	2.12		0.39		12.50	3.22
E	8.69	3.54	0.05	25.23	0.75	2.35	0.11	2.20		0.39		12.70	3.37
F													3.25
F													3.16
F													3.28
F													3.26
F													3.27
F													3.22
F													3.21
F													3.26
G	8.54	3.51	0.06	25.60	0.73	2.40	0.11	2.19	35.30	0.37	5.56	12.50	
G	8.63	3.52	0.06	25.60	0.73	2.42	0.11	2.21	35.50	0.38	5.05	12.50	
G	8.56	3.52	0.06	25.60	0.72	2.40	0.11	2.18	35.30	0.37	5.71	12.20	
G	8.57	3.50	0.06	25.60	0.71	2.40	0.11	2.21	35.40	0.38	5.32	12.70	
G	8.56	3.50	0.06	25.50	0.71	2.40	0.11	2.19	35.30	0.37	5.41	12.40	
G	8.55	3.55	0.06	25.70	0.72	2.42	0.11	2.23	35.50	0.38	4.94	12.60	
G	8.56	3.52	0.06	25.60	0.72	2.42	0.11	2.22	35.40	0.38	5.21	12.60	

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### 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 pycnometer
H	8.96	3.57	0.06	26.09	0.71	2.40	0.12	2.14	35.51	0.38			
H	9.11	3.60	0.06	26.16	0.72	2.44	0.12	2.17	34.66	0.37			
H	8.99	3.60	0.06	26.16	0.71	2.44	0.12	2.17	33.59	0.35			
H	8.90	3.58	0.06	26.16	0.72	2.40	0.12	2.16	35.73	0.35			
H	9.01	3.60	0.06	26.09	0.72	2.44	0.12	2.16	34.02	0.35			
H	8.56	3.58	0.06	26.16	0.70	2.35	0.12	2.16	30.59	0.32			
H	9.05	3.60	0.06	26.09	0.71	2.44	0.12	2.16	33.37	0.37			
H	8.96	3.61	0.06	26.23	0.75	2.42	0.12	2.17	34.66	0.35			
J													3.33
J													3.29
J													3.29
J													3.29
J													3.29
J													3.31
J													3.26
J													3.35
N	8.12	3.60	0.06	26.57	0.69	2.43	0.11	2.49	34.34	0.38	4.15		3.32
N	8.15	3.69	0.06	26.49	0.69	2.43	0.11	2.52	34.34	0.37	4.08		3.33
N	8.04	3.68	0.06	26.29	0.72	2.41	0.11	2.47	34.26	0.37	4.31		3.30
N	8.13	3.62	0.06	26.67	0.71	2.46	0.11	2.49	34.37	0.37	4.28		3.32
N	8.22	3.66	0.06	26.85	0.72	2.46	0.11	2.55	34.63	0.38	4.21		3.30
N	8.16	3.63	0.06	26.39	0.77	2.46	0.11	5.66	34.62	0.36	4.17		3.34
N	8.27	3.66	0.06	26.85	0.70	2.46	0.11	2.57	34.39	0.38	4.27		3.30
N	8.15	3.69	0.06	26.54	0.72	2.45	0.11	2.52	34.83	0.37	4.32		3.33
O												12.40	
O												12.70	
O												12.70	
O												11.20	
O												13.20	
O												11.90	
O												11.30	
O												12.40	
P	8.81	3.56	0.06	25.50	0.72	2.50	0.12	2.05	35.50	0.38	5.81	12.70	
P	8.82	3.54	0.06	25.40	0.73	2.51	0.12	2.19	35.50	0.38	6.03	12.90	
P	8.89	3.56	0.06	25.50	0.73	2.50	0.12	2.17	35.60	0.38	5.86	12.90	
P	8.83	3.55	0.06	25.40	0.73	2.51	0.12	2.14	35.50	0.39	5.82	13.10	
P	8.79	3.54	0.07	25.40	0.73	2.48	0.12	2.13	35.30	0.39	5.88	13.10	
P	8.80	3.56	0.07	25.30	0.73	2.48	0.12	2.14	35.40	0.39	5.77	12.80	
P	8.79	3.55	0.07	25.40	0.73	2.49	0.11	2.17	35.40	0.38	5.96	13.20	
P	8.77	3.55	0.07	25.50	0.73	2.48	0.12	2.16	35.30	0.39	5.37	13.00	
Q	9.03	3.59	0.08	25.50	0.74	2.53	0.11	2.27	36.10	0.38	6.79	13.90	3.30
Q	8.84	3.61	0.07	25.50	0.75	2.48	0.11	2.23	36.30	0.39	6.66	13.90	3.28
Q	8.80	3.60	0.07	25.50	0.77	2.46	0.11	2.17	35.70	0.38	6.83	13.90	3.30
Q	9.11	3.52	0.07	25.50	0.72	2.57	0.11	2.25	36.40	0.37	6.81	13.90	3.27
Q	8.93	3.69	0.08	26.00	0.78	2.50	0.11	2.22	36.00	0.39	6.81	14.00	3.28
Q	9.02	3.61	0.08	25.60	0.75	2.51	0.11	2.23	35.90	0.38	6.80	13.80	3.30
Q	8.93	3.60	0.07	25.50	0.77	2.48	0.11	2.24	35.70	0.38	6.83	13.90	3.27
Q	9.07	3.68	0.07	26.00	0.77	2.55	0.12	2.28	36.50	0.39	6.83	14.00	3.29
V												13.03	
V												13.06	
V												13.14	
V												13.18	
V												13.17	
V												13.20	
V												13.13	
V												13.24	

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**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:

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

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

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	0.051	0.036	0.023	0.010
Pd	Pb Coll	g/t	0.059	0.035	0.043	0.011
Au	Pb Coll	g/t	0.024	0.012	0.019	0.004
Co	M/ICP	ppm	8.111	5.719	3.703	1.629
Co	P	ppm	7.336	5.210	4.274	1.638
Cu	M/ICP	%	2207	1522	1381	482
Cu	P	%	1465	964	1023	326
Ni	M/ICP	%	489	345	341	122
Ni	P	%	490	409	328	161
Al <sub>2</sub> O <sub>3</sub>	XRF	%	0.213	0.187	0.137	0.073
CaO	XRF	%	0.044	0.039	0.027	0.015
Cr <sub>2</sub> O <sub>3</sub>	XRF	%	0.004	0.004	0.001	0.002
Fe <sub>2</sub> O <sub>3</sub>	XRF	%	0.300	0.286	0.163	0.110
K <sub>2</sub> O	XRF	%	0.013	0.009	0.009	0.003
MnO	XRF	%	0.004	0.004	0.002	0.001
Na <sub>2</sub> O	XRF	%	0.049	0.041	0.037	0.017
SiO <sub>2</sub>	XRF	%	0.702	0.729	0.382	0.303
TiO <sub>2</sub>	XRF	%	0.013	0.012	0.007	0.004
S Comb/LECO		%	0.481	0.439	0.173	0.148
SG	pyc		0.038	0.025	0.030	0.010

1. S - Std Dev for use on control charts.
2. σ<sub>L</sub> - 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. 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.

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15. **Certification:** AMIS0279 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](http://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 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.

19 **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 July 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.)

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### Appendix – uncertified trace element statistics

Analyte	Method	Unit	Mean	2SD	RSD%	n
Ag	M/ICP	ppm	10.8	1.58	7.28	52
Al	M/ICP	%	4.66	0.60	6.45	104
As	M/ICP	ppm	4.66	5.97	64.0	66
Ba	M/ICP	ppm	175	258	73.7	97
Be	M/ICP	ppm	0.40	0.21	25.6	52
Bi	M/ICP	ppm	3.56	8.62	121	64
Ca	M/ICP	%	2.50	0.26	5.13	98
Cd	M/ICP	ppm	12.5	2.44	9.78	101
Ce	M/ICP	ppm	36.3	6.76	9.31	52
Cr	M/ICP	ppm	327	137	21.0	96
Cs	M/ICP	ppm	0.29	0.03	4.97	40
Dy	M/ICP	ppm	5.73	15.2	133	32
Er	M/ICP	ppm	0.76	0.18	12.1	24
Eu	M/ICP	ppm	0.77	0.09	5.79	23
Fe	M/ICP	%	18.1	1.56	4.33	88
Ga	M/ICP	ppm	10.6	2.7	12.9	56
Gd	M/ICP	ppm	2.05	0.24	5.96	22
Ge	M/ICP	ppm	0.96	0.31	16.1	29
Hf	M/ICP	ppm	0.80	0.12	7.62	44
Ho	M/ICP	ppm	0.38	0.37	48.8	30
In	M/ICP	ppm	2.49	0.42	8.41	52
K	M/ICP	%	0.60	0.04	3.66	104
La	M/ICP	ppm	17.7	2.87	8.11	83
Li	M/ICP	ppm	7.00	1.51	10.8	88
Lu	M/ICP	ppm	0.08	0.02	9.98	23
Mg	M/ICP	%	1.45	0.13	4.38	108
Mn	M/ICP	ppm	854	70.3	4.12	107
Mo	M/ICP	ppm	2.50	3.30	66	50
Na	M/ICP	%	1.63	0.12	3.53	103
Nb	M/ICP	ppm	2.28	0.78	17.1	45
Nd	M/ICP	ppm	14.9	0.64	2.14	15
P	M/ICP	ppm	552	177	16.1	88
Pb	M/ICP	ppm	68.7	20.8	15.2	96
Pr	M/ICP	ppm	4.16	0.21	2.48	22
Rb	M/ICP	ppm	11.7	5.99	25.5	57
S	M/ICP	%	12.2	2.11	8.61	38
Sb	M/ICP	ppm	1.46	0.41	14.0	56
Sc	M/ICP	ppm	8.57	2.65	15.4	99
Se	M/ICP	ppm	60.0	27.8	23.1	64
Si	M/ICP	%	16.5	0.97	2.94	15
Sm	M/ICP	ppm	2.58	0.19	3.58	16
Sn	M/ICP	ppm	5.13	1.05	10.2	62
Sr	M/ICP	ppm	309	32.4	5.24	109
Ta	M/ICP	ppm	0.14	0.10	35.4	37
Tb	M/ICP	ppm	1.63	4.86	149	32
Te	M/ICP	ppm	4.98	1.91	19.1	48
Th	M/ICP	ppm	1.40	0.30	10.7	51
Ti	M/ICP	%	0.23	0.03	6.64	80
Tl	M/ICP	ppm	0.26	0.07	13.7	48
Tm	M/ICP	ppm	0.11	0.04	17.1	25
U	M/ICP	ppm	0.52	0.09	8.27	55
V	M/ICP	ppm	80.4	18.26	11.3	104
W	M/ICP	ppm	0.47	0.47	50.1	49
Y	M/ICP	ppm	6.71	1.44	10.7	91
Yb	M/ICP	ppm	0.61	0.11	9.30	32
Zn	M/ICP	ppm	1130	134	5.94	96
Zr	M/ICP	ppm	21.9	16.4	37.6	80

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