



African Mineral Standards

MATRIX REFERENCE MATERIALS

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## AMIS0418

Tantalum, ore grade

***Certified Reference Material***

***Certificate of Analysis***

**Recommended Concentrations and Limits<sup>1, 2</sup>**  
***(at two Standard Deviations)***

### ***Certified Concentrations***

Specific Gravity 2.74 ± 0.08

### ***Provisional Concentrations***

Ta FUS	509	±	62	ppm
Nb FUS	122	±	24	ppm
Bi M/ICP	147	±	22	ppm
Th FUS	2.7	±	0.4	ppm
U FUS	7.1	±	1.0	ppm

### ***Informational Means***

Ta XRF	456	ppm
Nb XRF	114	ppm

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 13.*
2. *There is additional certified major element data presented on p2 and uncertified trace element data presented as an appendix.*

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

## *Certified Concentrations*

Al <sub>2</sub> O <sub>3</sub>	0.61	±	0.04	%
CaO	0.17	±	0.02	%
Cr <sub>2</sub> O <sub>3</sub>	0.12	±	0.01	%
Fe <sub>2</sub> O <sub>3</sub>	5.96	±	0.18	%
MnO	0.16	±	0.01	%
SiO <sub>2</sub>	92.14	±	0.70	%

## *Provisional Concentrations*

K <sub>2</sub> O	0.10	±	0.01	%
TiO <sub>2</sub>	0.06	±	0.01	%

## *Informational Means*

MgO	0.09	%
Na <sub>2</sub> O	0.04	%
P <sub>2</sub> O <sub>5</sub>	0.02	%
LOI	0.30	%

1. **Intended Use:** AMIS0418 was prepared to check analysis of samples of tantalum bearing rock with a similar grade.

It is a 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:** AMIS0418 was made from tantalum concentrate blended down with quartz.

3. **Mineral and Chemical Composition:** Refer to 2. above. Uncertified trace element data received from some of the laboratories is presented as an appendix. This data is for informational purposes only.

**4. Appearance:** The material is a very fine powder. It is colored Light Brown (Corstor 5YR 6/4).

**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 <54um. Wet sieve particle size analysis of random samples confirmed the material was 98.5% <54um. 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 scientifically 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. Multi element scan to include Li, Ta, Nb, As, Bi, Sb, Sn, U, Th. Fusion, ICP-OES or ICP-MS.
2. Multi element scan. Multi-acid digest, ICP-OES or ICP-MS.
3. Ta, Nb, U, Th. XRF.
4. Majors ( Al<sub>2</sub>O<sub>3</sub>, CaO, Cr<sub>2</sub>O<sub>3</sub>, Fe<sub>2</sub>O<sub>3</sub>, K<sub>2</sub>O, MgO, MnO, Na<sub>2</sub>O, P<sub>2</sub>O<sub>5</sub>, SiO<sub>2</sub>, TiO<sub>2</sub>, V<sub>2</sub>O<sub>5</sub>. LOI. ) XRF fusion.
5. SG, gas pycnometer.

**8. Information requested**

1. State and provide brief description of analytical techniques used.
2. State aliquots used for all determinations.
3. Results for individual analyses to be reported.
4. All results for base metals to be reported in ppm.
5. Report all QC data, to include replicates, blanks and certified reference materials used.

**9. Method of Certification:** Twenty two laboratories were each given eight scientifically selected packages of sample. Eighteen 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 18 out of 22 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 Activation Labortorios Ltda (Chile)
- 4 ALS Chemex Laboratory Group Perth WA
- 5 ALS Chemex Laboratory Group Vancouver CA
- 6 ALS OMAC (Ireland)
- 7 Bureau Veritas (Namibia)
- 8 BV Amdel (Australia)
- 9 Genalysis Laboratory Services (W Australia P)
- 10 Intertek Utama Services (Indonesia)
- 11 Labtium Inc Finland
- 12 Set Point Laboratories (Isando) SA
- 13 SGS Australia Pty Ltd (Newburn) WA
- 14 SGS Mineral Services Callao (Peru)
- 15 SGS Mineral Services Lakefield (Canada)
- 16 SGS South Africa (Pty) Ltd - Booyens JHB
- 17 SGS Vancouver (Canada)
- 18 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	Ta Fus ppm	Ta XRF ppm	Nb Fus ppm	Nb XRF ppm	Bi M/ICP ppm	Th Fus ppm	U Fus ppm	Al2O3 XRF %	CaO XRF %	Cr2O3 XRF %	Fe2O3 XRF %	K2O XRF %	MgO XRF %	MnO XRF %	Na2O XRF %	P2O5 XRF %	SiO2 XRF %	TiO2 XRF %	LOI %	SG pyc
A	480	500	100	93.00	157			0.61	0.16	0.12	5.91	0.10	0.08	0.16		0.01	91.66	0.05	0.46	2.67
A	500	500	110	91.00	160			0.59	0.16	0.13	5.91	0.11	0.07	0.15			92.08	0.05	0.46	2.66
A	470	500	100	92.00	158			0.58	0.17	0.12	5.95	0.10	0.07	0.16			91.89	0.05	0.45	2.67
A	480	500	110	92.00	160			0.59	0.17	0.12	5.89	0.10	0.08	0.16			91.84	0.05	0.44	2.67
A	490	500	110	94.00	153			0.60	0.16	0.12	5.95	0.11	0.08	0.16		0.01	91.78	0.06	0.45	2.66
A	490	500	110	92.00	163			0.59	0.16	0.12	5.90	0.11	0.07	0.16		0.01	91.94	0.04	0.45	2.66
A	480	500	110	94.00	158			0.61	0.16	0.12	5.80	0.11	0.08	0.16		0.01	91.55	0.07	0.46	2.67
A	490	500	110	93.00	161			0.62	0.17	0.12	5.96	0.11	0.08	0.16		0.01	91.73	0.06	0.43	2.67
C																				2.71
C																				2.71
C																				2.72
C																				2.71
C																				2.71
C																				2.71
C																				2.71
C																				2.71
D	661		142			2.98	7.24	0.62	0.16	0.12	5.99	0.11	0.10	0.16	0.02		92.30	0.06	0.30	
D	618		130			2.82	7.26	0.62	0.16	0.12	6.03	0.11	0.10	0.16	0.02		92.40	0.06	0.28	
D	650		136			2.98	7.63	0.62	0.16	0.12	6.00	0.11	0.10	0.16	0.02		92.00	0.06	0.27	
D	672		133			3.03	7.33	0.63	0.16	0.12	6.02	0.11	0.10	0.16	0.02		92.60	0.06	0.28	
D	696		132			3.21	7.94	0.62	0.16	0.12	5.97	0.11	0.10	0.16	0.02		91.90	0.06	0.29	
D	701		142			2.92	7.46	0.62	0.16	0.12	5.96	0.11	0.10	0.16	0.02		92.50	0.06	0.30	
D	679		136			3.47	7.60	0.62	0.16	0.12	5.96	0.11	0.10	0.16	0.02		92.10	0.06	0.29	
D	637		130			2.82	7.51	0.63	0.16	0.12	6.04	0.11	0.10	0.16	0.02		92.50	0.06	0.30	
E	615	560	127	110.00	157	2.60	7.10	0.57	0.18	0.12	6.19	0.10	0.07	0.16	0.04	0.01	92.57	0.06	0.38	2.77
E	607	560	136	120.00	165	2.70	7.20	0.57	0.17	0.12	6.09	0.10	0.09	0.16	0.05	0.01	92.71	0.06	0.37	2.75
E	600	530	112	110.00	142	3.30	8.10	0.56	0.17	0.12	6.12	0.10	0.09	0.16	0.05	0.01	92.77	0.06	0.33	2.76
E	666	520	120	100.00	127	2.60	7.50	0.58	0.17	0.12	6.15	0.10	0.08	0.16	0.04	0.01	92.44	0.07	0.38	2.76
E	605	520	120	120.00	130	2.50	7.10	0.58	0.17	0.12	6.08	0.10	0.08	0.16	0.04	0.01	92.77	0.06	0.36	2.75
E	625	540	128	100.00	130	2.70	7.60	0.57	0.17	0.12	6.15	0.10	0.08	0.16	0.05	0.01	92.63	0.06	0.36	2.76
E	615	550	118	110.00	130	2.60	8.20	0.58	0.18	0.11	6.15	0.10	0.07	0.16	0.05	0.01	92.53	0.06	0.40	2.76
E	651	530	95.30	120.00	126	2.40	7.40	0.59	0.17	0.12	6.12	0.10	0.09	0.16	0.05	0.01	92.61	0.06	0.35	2.76
F					142															
F					149															
F					143															
F					157															
F					148															
F					148															
F					145															
F					145															
F					149															
G	549		120			2.59	7.01	0.60	0.14	0.12	5.88	0.10	0.12	0.16	0.01	0.02	91.90	0.06	0.32	2.85
G	536		122			2.75	7.23	0.62	0.15	0.12	5.96	0.10	0.12	0.16	0.02	0.02	91.80	0.06	0.31	2.77
G	544		119			3.37	7.59	0.60	0.14	0.12	5.90	0.10	0.12	0.16	0.01	0.02	91.70	0.05	0.33	2.77
G	565		119			2.87	7.37	0.59	0.14	0.12	5.87	0.10	0.12	0.15	0.01	0.02	91.50	0.06	0.35	2.87
G	534		118			2.91	7.47	0.60	0.14	0.12	5.87	0.10	0.11	0.15	0.01	0.02	91.60	0.06	0.29	2.74
G	555		122			2.66	7.11	0.61	0.14	0.12	6.05	0.10	0.12	0.14	0.01	0.02	91.40	0.06	0.26	2.75
G	537		118			2.77	7.50	0.59	0.14	0.12	5.90	0.10	0.12	0.14	0.01	0.02	91.60	0.06	0.29	2.74
G	539		123			2.73	6.72	0.60	0.14	0.12	5.95	0.10	0.12	0.15	0.01	0.02	92.10	0.06	0.35	2.68

## Assay data (cont)

Lab Code	Ta Fus ppm	Ta XRF ppm	Nb Fus ppm	Nb XRF ppm	Bi M/ICP ppm	Th Fus ppm	U Fus ppm	Al2O3 XRF %	CaO XRF %	Cr2O3 XRF %	Fe2O3 XRF %	K2O XRF %	MgO XRF %	MnO XRF %	Na2O XRF %	P2O5 XRF %	SiO2 XRF %	TiO2 XRF %	LOI %	SG pyc
H					130			0.62	0.17	0.12	5.96	0.09	0.09	0.16	0.08	0.03	92.22	0.05	0.25	2.70
H					125			0.62	0.17	0.12	5.96	0.09	0.09	0.16	0.08	0.03	91.31	0.05	0.26	2.68
H					120			0.63	0.18	0.12	5.98	0.10	0.09	0.16	0.08	0.03	92.16	0.05	0.27	2.67
H					135			0.63	0.17	0.12	6.01	0.10	0.09	0.17	0.08	0.02	92.13	0.05	0.26	2.68
H					120			0.62	0.17	0.12	6.00	0.10	0.09	0.16	0.08	0.03	92.16	0.05	0.26	2.68
H					130			0.64	0.17	0.12	6.05	0.10	0.09	0.16	0.08	0.03	92.10	0.05	0.26	2.67
H					125			0.63	0.17	0.12	5.90	0.09	0.09	0.16	0.08	0.03	92.23	0.05	0.22	2.67
H					130			0.62	0.17	0.12	5.97	0.10	0.09	0.16	0.09	0.02	92.19	0.05	0.26	2.68
J	498		72.00			2.30														2.72
J	490		68.00			2.30														2.70
J	481		66.00			2.30														2.75
J	471		67.00			2.30														2.72
J	489		68.00			2.50														2.69
J	497		71.00			2.40														2.72
J	504		70.00			2.30														2.70
J	502		72.00			2.50														2.65
K	530	459	123	140	141	2.58	6.95	0.62	0.16	0.12	5.98	0.10	0.09	0.16	0.03	0.01	92.04	0.06	0.30	2.77
K	514	475	118	140	146	2.63	7.38	0.62	0.16	0.12	5.95	0.10	0.09	0.16	0.03	0.01	91.98	0.06	0.28	2.67
K	527	467	134	140	145	2.60	7.22	0.62	0.17	0.12	5.94	0.11	0.10	0.16	0.02	0.01	92.19	0.06	0.26	2.79
K	560	475	127	140	142	2.67	7.04	0.62	0.16	0.12	5.97	0.11	0.10	0.16	0.02	0.01	92.13	0.06	0.27	2.70
K	537	459	125	140	146	2.58	6.89	0.62	0.17	0.12	5.97	0.10	0.09	0.16	0.02	0.01	92.25	0.06	0.27	2.69
K	541	442	125	140	145	2.61	7.19	0.62	0.17	0.12	5.97	0.10	0.10	0.16	0.02	0.01	92.23	0.06	0.29	2.81
K	540	467	126	140	145	2.73	7.35	0.63	0.17	0.12	5.93	0.11	0.09	0.16	0.02	0.01	92.07	0.06	0.28	2.71
K	547	442	125	140	151	2.68	6.90	0.63	0.16	0.12	5.90	0.11	0.09	0.16	0.03	0.01	92.21	0.06	0.28	2.79
L	459	358	102	101		3.90	6.49	0.60	0.15	0.12	5.81	0.10	0.12	0.15		0.02	92.40	0.06	0.38	2.75
L	488	356	110	101		3.70	6.80	0.57	0.15	0.12	5.80	0.11	0.11	0.15		0.02	92.10	0.06	0.30	2.74
L	496	344	102	98		4.00	6.70	0.59	0.15	0.12	5.86	0.09	0.10	0.15		0.02	92.50	0.06	0.34	2.75
L	480	359	112	100		3.40	6.39	0.60	0.15	0.12	5.84	0.09	0.09	0.15		0.02	92.50	0.06	0.32	2.76
L	451	362	103	101		4.00	6.79	0.58	0.15	0.12	5.84	0.11	0.10	0.16		0.02	92.90	0.06	0.29	2.74
L	485	366	101	101		3.70	6.43	0.63	0.16	0.12	5.86	0.11	0.12	0.15		0.02	92.80	0.06	0.29	2.75
L	498	381	103	103		3.70	6.10	0.59	0.15	0.12	5.84	0.09	0.11	0.15		0.02	92.20	0.06	0.29	2.74
L	474	368	105	102		3.90	6.36	0.59	0.16	0.12	5.84	0.09	0.10	0.16		0.02	92.80	0.06	0.29	2.73
M	528		118			2.73	6.65	0.64	0.16	0.12	6.14	0.11	0.10	0.16	0.07	0.01	93.50	0.06	0.41	2.74
M	500		112			2.61	6.18	0.62	0.17	0.12	6.09	0.11	0.09	0.16	0.07	0.01	91.70	0.06	0.55	2.73
M	567		133			2.89	6.85	0.63	0.16	0.12	6.03	0.10	0.09	0.16	0.06	0.01	93.30	0.06	0.44	2.75
M	542		118			2.84	6.36	0.62	0.17	0.14	5.95	0.11	0.10	0.16	0.07	0.01	93.30	0.06	0.33	2.76
M	521		121			2.66	6.44	0.64	0.17	0.12	5.95	0.11	0.11	0.16	0.07	0.01	93.30	0.06	0.49	2.72
M	547		121			2.75	6.17	0.61	0.17	0.12	5.79	0.10	0.09	0.16	0.07	0.01	91.30	0.06	0.49	2.76
M	557		123			2.98	6.95	0.63	0.18	0.12	6.03	0.11	0.10	0.16	0.07	0.03	93.60	0.06	0.48	2.75
M	518		115			2.86	6.17	0.63	0.17	0.12	6.01	0.11	0.10	0.16	0.06	0.01	93.50	0.06	0.58	2.73
N		450		110																2.84
N		450		108																2.78
N		440		114																2.83
N		450		111																2.82
N		440		118																2.80
N		450		117																2.82
N		430		112																2.81
N		440		109																2.76
O					155			0.61	0.17	0.14	5.88	0.11	0.13	0.17	0.02	0.02	92.43	0.07	0.20	
O					162			0.60	0.16	0.14	5.78	0.11	0.13	0.17	0.02	0.02	92.56	0.06	0.20	
O					155			0.61	0.16	0.14	5.93	0.11	0.14	0.17	0.02	0.02	92.49	0.06	0.20	
O					159			0.60	0.17	0.16	5.82	0.11	0.13	0.17	0.02	0.02	92.45	0.07	0.20	
O					159			0.61	0.17	0.15	5.84	0.11	0.14	0.17	0.02	0.02	92.42	0.07	0.20	
O					150			0.61	0.17	0.16	5.83	0.11	0.13	0.17	0.03	0.02	92.34	0.07	0.30	
O					150			0.60	0.17	0.17	5.80	0.11	0.14	0.17	0.03	0.02	92.58	0.07	0.20	
O					152			0.60	0.16	0.15	5.76	0.11	0.13	0.17	0.02	0.02	92.36	0.06	0.30	
O																				2.80
O																				2.78
O																				2.79
O																				2.80
O																				2.79
O																				2.79
O																				2.79
O																				2.80
R		460		140				0.62	0.16	0.14	6.03	0.11	0.08	0.16	0.03		91.70	0.04	0.42	
R		440		130				0.62	0.16	0.13	5.98	0.11	0.10	0.15	0.06		91.60	0.05	0.35	
R		440		130				0.56	0.16	0.13	6.00	0.11	0.11	0.16	0.07		92.00	0.05	0.35	
R		450		130				0.56	0.16	0.14	6.04	0.10	0.11	0.16	0.07		92.20	0.05	0.37	
R		430		130				0.52	0.16	0.13	6.01	0.11	0.10	0.16	0.06		92.50	0.05	0.43	
R		440		130				0.48	0.16	0.13	5.99	0.11	0.11	0.16	0.03		92.20	0.05	0.28	
R		440		130				0.61	0.17	0.14	6.13	0.11	0.09	0.16	0.04		91.40	0.05	0.32	
R		440		130				0.64	0.17	0.13	5.99	0.11	0.12	0.16	0.08		92.60	0.05	0.33	
S		550	135	130	146	2.50	7.00	0.62	0.18	0.12	5.95	0.10	0.09	0.16		0.02	91.85	0.06	0.32	2.74
S		560	140	130	146	3.00	7.00	0.62	0.18	0.12	5.89	0.10	0.10	0.16		0.01	91.81	0.06	0.30	2.75
S		560	140	140	148	2.50	7.50	0.62	0.17	0.12	6.00	0.10	0.09	0.16		0.02	91.84	0.06	0.33	2.74
S		550	140	130	144	3.00	8.00	0.64	0.17	0.11	5.98	0.11	0.11	0.16		0.01	91.88	0.06	0.32	2.73
S		550	135	140	150	3.00	7.50	0.62	0.17	0.11	5.90	0.10	0.10	0.16		0.01	91.85	0.06	0.34	2.73
S		570	140	130	150	2.50	7.50	0.64	0.18	0.11	6.00	0.11	0.11	0.16		0.02	91.97	0.06	0.30	2.78
S		560	140	140	154	2.50	8.00	0.64	0.18	0.12	5.99	0.10	0.10	0.16		0.02	91.95	0.06	0.30	2.77
S		550	140	130	154	2.50	7.50	0.62	0.18	0.12	5.93	0.10	0.09	0.16		0.02	92.00	0.06	0.34	2.77
T	480	600	75.00	200		1.80	5.20	0.60	0.18	0.12	5.98	0.10	0.08	0.16	0.03					

**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 <sup>1</sup>	$\sigma_L$ <sup>2</sup>	SW <sup>3</sup>	CSU <sup>4</sup>
Ta	Fus	ppm	64.480	29.952	16.378	11.531
Ta	XRF	ppm	81.359	75.240	10.125	26.631
Nb	Fus	ppm	21.462	11.677	4.818	4.173
Nb	XRF	ppm	32.68	19.694	4.014	6.981
Bi	M/ICP	ppm	11.85	9.648	6.761	3.761
Th	Fus	ppm	0.50	0.187	0.140	0.073
U	Fus	ppm	0.76	0.461	0.292	0.179
Al <sub>2</sub> O <sub>3</sub>	XRF	%	0.108	0.013	0.013	0.004
CaO	XRF	%	0.012	0.005	0.004	0.002
Cr <sub>2</sub> O <sub>3</sub>	XRF	%	0.010	0.003	0.001	0.001
Fe <sub>2</sub> O <sub>3</sub>	XRF	%	0.115	0.061	0.053	0.018
K <sub>2</sub> O	XRF	%	0.085	0.004	0.005	0.001
MgO	XRF	%	0.017	0.011	0.007	0.003
MnO	XRF	%	0.0057	0.0035	0.0026	0.0010
Na <sub>2</sub> O	XRF	%	0.024	0.022	0.008	0.007
P <sub>2</sub> O <sub>5</sub>	XRF	%	0.006	0.005	0.002	0.002
SiO <sub>2</sub>	XRF	%	0.492	0.229	0.219	0.070
TiO <sub>2</sub>	XRF	%	0.007	0.003	0.002	0.001
LOI		%	0.080	0.039	0.026	0.012
SG	pyc		0.047	0.030	0.022	0.008

1. S - Std Dev for use on control charts.
2.  $\sigma_L$  - Betw Lab Std Dev, for use to calculate a measure of accuracy.
3. SW - Within Lab Std 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:** AMIS0418 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. 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. 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 Smees and Smees and Associates Ltd; accept no liability for any decisions or actions taken following the use of the reference material.

05 April 2014

Certifying Officers:



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

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



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

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

### Appendix – uncertified trace element statistics

Analyte	Method	Unit	Mean	2SD	RSD%	n
Al	M/ICP	%	0.34	0.03	4.7	54
As	Fus	ppm	20.8	5.9	14.2	15
As	M/ICP	ppm	6.5	2.0	15.0	39
Ba	M/ICP	ppm	32.6	7.9	12.1	86
Bi	Fus	ppm	149	17.3	5.8	24
Ca	M/ICP	%	0.13	0.03	11.1	48
Cd	M/ICP	ppm	0.08	0.02	15.9	8
Ce	M/ICP	ppm	8.7	1.0	5.7	54
Co	M/ICP	ppm	5.4	1.7	15.5	53
Cr	M/ICP	ppm	875	179	10.2	63
Cs	M/ICP	ppm	0.40	0.06	7.1	43
Cu	M/ICP	ppm	250	23.3	4.7	60
Dy	M/ICP	ppm	0.56	0.13	11.5	39
Er	M/ICP	ppm	0.35	0.07	9.5	38
Eu	M/ICP	ppm	0.09	0.03	14.8	31
Fe	M/ICP	%	4.3	0.47	5.4	54
Ga	M/ICP	ppm	1.4	0.77	27.8	38
Gd	M/ICP	ppm	0.62	0.09	7.3	37
Ge	M/ICP	ppm	1.0	0.09	4.5	8
Hf	M/ICP	ppm	1.8	0.76	21.0	48
Ho	M/ICP	ppm	0.11	0.02	8.1	30
K	M/ICP	%	0.09	0.01	4.9	46
La	M/ICP	ppm	4.3	0.51	5.9	61
Li	Fus	ppm	5.4	1.9	17.7	16
Li	M/ICP	ppm	4.2	0.54	6.4	38
Lu	M/ICP	ppm	0.06	0.02	16.1	37
Mg	M/ICP	%	0.06	0.01	8.9	47
Mn	M/ICP	ppm	1294	122	4.7	53
Mo	M/ICP	ppm	3.0	1.1	18.6	54
Na	M/ICP	%	0.02	0.01	22.7	48
Nb	M/ICP	ppm	103	45.0	21.8	24
Nd	M/ICP	ppm	3.3	0.39	6.0	46
Ni	M/ICP	ppm	32.0	5.5	8.6	54
P	M/ICP	ppm	61.4	48.7	39.7	47
Pb	M/ICP	ppm	9.5	3.0	15.8	37
Pr	M/ICP	ppm	0.92	0.13	7.0	39
S	M/ICP	%	0.09	0.0	2.8	46
Sb	Fus	ppm	3.6	0.72	10.0	16
Sb	M/ICP	ppm	3.5	4.2	60.1	43
Sc	M/ICP	ppm	77.5	13.1	8.4	8
Si	M/ICP	%	42.5	1.0	1.1	8
Sm	M/ICP	ppm	0.68	0.13	9.4	39
Sn	Fus	ppm	2.1	0.88	21.0	39
Sn	M/ICP	ppm	1.8	0.39	10.9	24
Sr	M/ICP	ppm	9.8	1.4	7.0	56
Ta	M/ICP	ppm	474	127	13.4	32
Tb	M/ICP	ppm	0.09	0.02	9.7	38
Th	M/ICP	ppm	2.8	0.36	6.5	24
Ti	M/ICP	%	0.03	0.01	19.1	56
Tm	M/ICP	ppm	0.05	0.02	17.6	31
U	M/ICP	ppm	6.8	0.61	4.5	31
U	XRF	ppm	7.8	4.1	26.5	16
V	M/ICP	ppm	11.8	3.6	15.1	59
W	M/ICP	ppm	10.9	6.5	29.8	79
Y	M/ICP	ppm	3.1	1.0	15.8	85
Yb	M/ICP	ppm	0.39	0.05	6.6	30
Zn	M/ICP	ppm	16.4	5.4	16.4	39
Zr	M/ICP	ppm	37.7	30.4	40.3	72