

AMIS0342

Certified Reference Material

**Lithium, tantalum pegmatite ore,
 Mt. Cattlin Spodumene Mine, Australia**

Certificate of Analysis

Recommended Concentrations and Limits¹ (at two Standard Deviations)

Certified Concentrations

Li FUS	1603	±	199	ppm
Li M/ICP	1612	±	167	ppm
Nb FUS	68	±	5	ppm
Nb M/ICP	60	±	20	ppm
Ta FUS	169	±	17	ppm
Th FUS	3.5	±	0.5	ppm
Th M/ICP	2.9	±	1.2	ppm
U FUS	8.86	±	1.9	ppm
Specific Gravity	2.67	±	0.08	Dimensionless

Provisional Concentrations

Ta XRF	177	±	39	ppm
Nb XRF	60	±	13	ppm
F ISE	1074	±	208	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 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

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

Major Oxides

Certified Concentrations (at two Standard Deviations)

Al ₂ O ₃	16.24	±	0.18	%
CaO	0.43	±	0.02	%
Fe ₂ O ₃	1.36	±	0.06	%
K ₂ O	3.26	±	0.04	%
MgO	0.54	±	0.04	%
MnO	0.07	±	0.002	%
Na ₂ O	5.61	±	0.16	%
P ₂ O ₅	0.19	±	0.01	%
SiO ₂	70.53	±	1.14	%

Provisional Concentrations

Cr ₂ O ₃	0.05	±	0.01	%
LOI	0.91	±	0.18	%

Indicated Mean

TiO ₂	0.02	%
------------------	------	---

1. Intended Use: AMIS0342 can be used to check analysis of samples of pegmatitic lithium-tantalum ores, with a similar grade and matrix.

It is a matrix matched 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 Section19). 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.

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

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

2. Origin of Material: AMIS0341 is a commissioned CRM made using ore sourced from the Mt Cattlin Spodumene Mine situated at Ravensthorpe 430km east south east of Perth in Western Australia. The ore was supplied by Galaxy Resources through SGS Mineral Services Ltd. The Mt Cattlin project is located in the Phillips River Mineral Field, within the Ravensthorpe Terrain, which forms part of the Archaean greenstone belt. The pegmatite's which comprise the orebodies comprise sub-horizontal dykes, hosted by both volcanic and intrusive rocks.

3. Mineral and Chemical Composition: The pegmatite's comprise quartz, albite, microcline, perthite, spodumene, muscovite and lepidolite. The predominant lithium mineral is spodumene. There are economically significant grades of tantalum present as columbite, tantalite and microlite,

4. Appearance: The material is a very fine powder. It is colored a Very Light Grey (Corstor 5Y 8/1).

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 scientifically selected for homogeneity testing and third party analysis. Statistical analysis of both homogeneity and the consensus test results were carried out by independent statistician.

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. F by ISE.
4. Ta, Nb, U, Th. XRF.
5. Majors (Al₂O₃, CaO, Cr₂O₃, Fe₂O₃, K₂O, MgO, MnO, Na₂O, P₂O₅, SiO₂, TiO₂, V₂O₅. LOI.) XRF fusion.
6. 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. Report all QC data, to include replicates, blanks and certified reference materials used.

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

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

9. Method of Certification: Twenty one laboratories were each given eight scientifically selected packages of sample. Sixteen of the laboratories submitted results.

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 16 out of 21 laboratories that provided results timeously 1 laboratory that provided results for re-certification were (not in same order as in the table of assays):

- 1 ACME Analytical Laboratories Chile
- 2 ACME Analytical Laboratories Ltd CA
- 3 Activation Laboratories Pty Ltd (ActLabs) CA
- 4 ALS Chemex Laboratory Group Vancouver CA
- 5 ALS OMAC (Ireland)
- 6 BV Amdel (Australia)
- 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 Geosol Laboratories Ltda (Brazil)
- 12 SGS Mineral Services Callao (Peru)
- 13 SGS Mineral Services Lakefield (Canada)
- 14 SGS South Africa (Pty) Ltd - Booyens JHB
- 15 SGS Vancouver (Canada)
- 16 Shiva Analyticals India
- 17 Ultra Trace (Pty) Ltd WA

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

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

11. **Assay Data:** Data as received from the laboratories for the important certified elements listed on p1 is set out below.

Li FUS ppm	Li M/CP ppm	Nb FUS ppm	Nb M/CP ppm	Nb XRF ppm	Ta FUS ppm	Ta XRF ppm	Th FUS ppm	Th M/CP ppm	U FUS ppm	F ISE ppm
1548	1578	66	64	80.00	161	170	3.30	2.23	10.14	1000
1504	1483	66	73	80.00	160	180	3.70	2.12	9.99	900
1425	1521	64	66	70.00	157	170	3.70	2.15	10.50	900
1511	1508	67	66	60.00	160	170	3.50	2.18	10.36	900
1536	1453	68	70	80.00	162	180	3.50	2.13	10.47	1000
1586	1388	68	72	80.00	161	160	3.30	2.27	10.76	800
1547	1425	67	69	70.00	161	190	3.60	2.24	10.76	1000
1559	1425	69	75	60.00	159	180	3.40	2.17	10.29	900
1561	1540	70	59	58.00	169	200	3.76	2.98	8.60	1200
1516	1379	69	58	58.00	174	200	3.76	3.36	8.70	1200
1585	1573	69	58	58.00	162	200	3.49	2.87	8.50	1200
1536	1620	69	60	57.00	163	200	3.74	3.23	9.00	1200
1599	1362	64	57	57.00	160	200	3.80	3.04	8.50	1200
1688	1373	66	53	57.00	165	200	3.70	3.33	8.70	1200
1555	1688	66	56	58.00	162	200	3.67	2.86	8.80	1200
1604	1749	66	55	58.00	162	200	3.65	3.32	8.70	1200
1713	1670	71	48	66.00	165	195	3.10	2.80	8.57	1200
1701	1670	69	42	69.00	171	188	3.30	3.00	8.64	1200
1792	1680	71	48	65.00	172	197	3.10	3.20	8.39	1200
1663	1710	65	41	68.00	169	187	3.40	3.00	8.62	1200
1699	1720	68	43	68.00	165	200	3.40	3.20	8.11	1200
1691	1690	64	45	66.00	160	198	3.10	3.00	8.82	1200
1685	1690	64	50	67.00	170	206	3.40	2.80	8.26	1200
1664	1660	68	48	66.00	160	195	3.10	2.00	8.24	1200
	1681	69	68	60.00	182	203		3.10	10.00	4800
	1653	66	67	65.00	175	209		3.00	9.50	4000
	1609	68	61	65.00	182	211		2.70	9.50	3600
	1697	70	67	65.00	172	202		2.70	10.00	3900
	1669	74	68	60.00	178	212		2.20	9.50	4200
	1695	73	67	60.00	170	207		2.90	10.00	4200
	1690	69	64	65.00	170	202		3.94	9.50	4100
	1723	66	63	60.00	181	214		3.69	9.50	3900
	1680		60	89.00	177	160		3.56	8.74	900
	1660		65	74.00	176	160		3.72	8.46	880
	1640		65	87.00	178	160		4.17	8.86	930
	1660		65	88.00	176	160		4.09	8.31	910
	1640		65	85.00	181	170		3.26	8.50	950
	1660		65	76.00	174	160		3.41	8.23	970
	1660		65	91.00	166	160			8.80	960
	1640		65	88.00		160			8.20	960
	1710			60.00		166			7.47	1080
	1680			60.00		162			7.93	1070
	1700			70.00		169			7.51	1080
	1680			60.00		166			7.65	1100
	1680			70.00		164			7.51	1090
	1670			60.00		165			7.59	1130
	1660			60.00		168			7.90	1120
	1650			60.00		166			7.63	1110
	1487			48.00		180			8.74	
	1580			48.00		180			8.35	
	1626			48.00		180			8.67	
	1626			48.00		180			8.77	
	1626			47.00		180			9.09	
	1626			48.00		180			8.72	
	1626			47.00		180			8.45	
	1626			47.00		180			8.32	
				80.00						
				80.00						
				80.00						
				80.00						
				80.00						
				80.00						
				80.00						
				80.00						
				80.00						

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

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

Assay Data Cont:

Al ₂ O ₃ XRF %	CaO XRF %	Cr ₂ O ₃ XRF %	Fe ₂ O ₃ XRF %	K ₂ O XRF %	LOI %	LOI %	MgO XRF %	MnO XRF %	Na ₂ O XRF %	P ₂ O ₅ XRF %	SiO ₂ XRF %	TiO ₂ XRF %	SG pyc	SG pyc
16.82	0.44	0.05	1.44	3.31	0.93	0.85	0.52	0.07	5.62	0.21	71.13	0.03	2.74	2.67
16.80	0.44	0.05	1.39	3.30	0.94	0.88	0.52	0.07	5.71	0.20	71.03	0.03	2.74	2.77
16.70	0.45	0.04	1.40	3.31	0.91	0.89	0.51	0.07	5.76	0.20	71.23	0.04	2.74	2.70
16.71	0.44	0.04	1.41	3.30	0.90	0.83	0.51	0.07	5.74	0.20	71.44	0.03	2.74	2.76
16.71	0.44	0.04	1.41	3.32	0.90	0.88	0.52	0.07	5.70	0.20	71.28	0.03	2.74	2.74
16.71	0.44	0.05	1.40	3.32	0.93	0.94	0.52	0.07	5.73	0.20	71.19	0.03	2.73	2.75
16.74	0.43	0.04	1.41	3.32	0.94	0.95	0.51	0.07	5.76	0.20	71.32	0.03	2.73	2.69
16.66	0.45	0.05	1.41	3.31	0.91	0.97	0.52	0.07	5.76	0.20	71.43	0.03	2.74	2.75
16.16	0.43	0.05	1.36	3.26	1.09	0.86	0.52	0.08	5.66	0.19	69.68	0.02	2.57	2.63
16.19	0.43	0.05	1.34	3.26	1.09	0.88	0.50	0.07	5.63	0.19	69.84	0.02	2.54	2.63
16.20	0.43	0.05	1.34	3.28	1.09	0.87	0.52	0.07	5.66	0.19	70.10	0.02	2.57	2.61
16.20	0.43	0.05	1.34	3.27	1.13	0.92	0.52	0.07	5.67	0.19	70.02	0.04	2.55	2.61
16.07	0.42	0.05	1.34	3.26	1.08	0.88	0.51	0.07	5.59	0.19	69.58	0.02	2.59	2.60
16.18	0.43	0.05	1.35	3.27	1.08	0.91	0.51	0.07	5.65	0.19	70.13	0.01	2.57	2.61
16.20	0.44	0.05	1.34	3.27	1.03	0.87	0.51	0.07	5.66	0.18	70.11	0.03	2.59	2.63
16.16	0.43	0.05	1.34	3.26	1.04	0.91	0.51	0.07	5.64	0.19	69.90	0.03	2.61	2.62
16.40	0.43	0.05	1.33	3.22	0.95		0.54	0.07	5.48	0.20	70.10	0.03	2.60	2.66
16.35	0.43	0.05	1.33	3.23	0.97		0.54	0.07	5.53	0.20	69.80	0.03	2.63	2.66
16.50	0.44	0.05	1.35	3.25	0.96		0.55	0.07	5.69	0.20	70.40	0.03	2.63	2.66
16.40	0.43	0.05	1.31	3.21	0.97		0.54	0.07	5.46	0.20	69.90	0.03	2.63	2.66
16.40	0.43	0.05	1.33	3.25	0.88		0.54	0.07	5.50	0.20	70.00	0.02	2.63	2.66
16.70	0.45	0.05	1.37	3.30	0.76		0.56	0.07	5.55	0.19	71.40	0.02	2.62	2.65
16.40	0.43	0.05	1.33	3.25	0.95		0.54	0.07	5.50	0.20	70.10	0.01	2.63	2.64
16.35	0.43	0.05	1.37	3.28	1.01		0.54	0.07	5.55	0.19	70.80	0.01	2.63	2.64
16.66	0.44	0.02	1.47	3.30	1.00		0.40	0.06	5.58	0.21	70.70	0.01	2.69	
16.75	0.44	0.02	1.48	3.31	1.00		0.46	0.06	5.59	0.21	71.26	0.01	2.67	
16.71	0.44	0.04	1.47	3.29	0.99		0.42	0.06	5.58	0.21	70.92	0.01	2.64	
16.62	0.44	0.02	1.48	3.28	1.01		0.47	0.06	5.56	0.21	70.58	0.01	2.66	
16.60	0.44	0.02	1.49	3.27	1.00		0.40	0.06	5.58	0.21	70.16	0.01	2.68	
16.57	0.43	0.02	1.46	3.26	0.98		0.39	0.06	5.57	0.21	70.20	0.01	2.67	
16.50	0.44	0.04	1.46	3.28	0.99		0.40	0.06	5.58	0.21	70.19	0.04	2.64	
16.65	0.44	0.02	1.49	3.30	1.00		0.42	0.06	5.57	0.21	70.48	0.03	2.69	
16.23	0.51	0.03	1.52	3.24	0.70		0.54	0.07	5.48	0.20	70.78	0.03	2.68	
16.26	0.51	0.04	1.52	3.25	0.80		0.55	0.07	5.56	0.20	70.97	0.03	2.66	
16.26	0.52	0.04	1.53	3.25	0.80		0.55	0.07	5.50	0.20	70.76	0.03	2.68	
16.18	0.52	0.04	1.52	3.23	0.80		0.54	0.07	5.63	0.21	70.67	0.03	2.68	
16.20	0.51	0.05	1.53	3.24	0.80		0.55	0.07	5.56	0.20	70.76	0.03	2.67	
16.18	0.51	0.04	1.50	3.23	0.80		0.56	0.07	5.54	0.20	70.59	0.03	2.67	
16.26	0.51	0.03	1.51	3.24	0.80		0.54	0.07	5.59	0.20	70.85	0.02	2.68	
16.26	0.51	0.05	1.52	3.25	0.80		0.54	0.07	5.55	0.20	70.96	0.02	2.66	
16.18	0.42	0.04	1.37	3.25	0.85		0.57	0.07	5.97	0.19	71.06	0.03	2.65	
16.29	0.42	0.04	1.39	3.28	0.80		0.58	0.07	5.98	0.19	71.10	0.02	2.66	
16.17	0.42	0.04	1.38	3.25	0.85		0.56	0.07	5.93	0.19	71.06	0.02	2.65	
16.31	0.42	0.04	1.39	3.28	0.83		0.58	0.07	5.91	0.19	71.00	0.02	2.65	
16.21	0.42	0.04	1.39	3.28	0.86		0.57	0.07	5.94	0.19	71.03	0.02	2.65	
16.18	0.42	0.04	1.37	3.24	0.86		0.57	0.07	5.94	0.18	71.00	0.02	2.66	
16.32	0.43	0.04	1.39	3.29	0.83		0.57	0.07	5.94	0.19	71.04	0.03	2.65	
16.06	0.41	0.04	1.36	3.23	0.87		0.57	0.07	5.97	0.19	70.97	0.03	2.65	
16.20	0.42	0.05	1.34	3.22	0.86		0.57	0.07	5.58	0.20	69.50	0.03	2.66	
16.20	0.43	0.06	1.34	3.24	0.91		0.57	0.07	5.61	0.19	69.50	0.03	2.67	
16.10	0.42	0.06	1.34	3.22	0.96		0.58	0.07	5.61	0.19	69.40	0.03	2.67	
16.20	0.42	0.05	1.35	3.22	0.92		0.57	0.07	5.59	0.20	69.50	0.02	2.67	
16.20	0.42	0.06	1.35	3.24	0.96		0.57	0.07	5.57	0.19	69.60	0.03	2.65	
16.20	0.42	0.05	1.35	3.22	0.97		0.57	0.07	5.55	0.20	69.60	0.03	2.66	
16.20	0.42	0.06	1.35	3.22	0.92		0.57	0.07	5.59	0.20	69.50	0.02	2.65	
16.20	0.42	0.05	1.34	3.23	0.99		0.56	0.07	5.62	0.20	69.40	0.02	2.68	
16.40	0.42	0.05	1.30	3.21	0.79		0.48	0.07	5.49	0.20	70.70	0.02	2.73	
16.50	0.42	0.05	1.30	3.20	0.81		0.48	0.07	5.49	0.20	70.60	0.03	2.73	
16.50	0.42	0.05	1.26	3.19	0.79		0.46	0.07	5.51	0.20	71.20	0.02	2.74	
16.40	0.42	0.05	1.29	3.18	0.79		0.47	0.07	5.54	0.20	70.90	0.02	2.70	
16.30	0.41	0.05	1.28	3.11	0.76		0.57	0.07	5.49	0.19	69.90	0.02	2.71	
16.30	0.42	0.04	1.34	3.18	0.79		0.52	0.07	5.50	0.20	69.70	0.02	2.72	
16.50	0.42	0.05	1.38	3.18	0.77		0.52	0.07	5.57	0.20	70.60	0.02	2.71	
16.40	0.41	0.05	1.31	3.18	0.81		0.49	0.07	5.45	0.20	70.20	0.05	2.72	
16.20	0.42	0.05	1.34	3.25	1.06		0.53	0.07		0.19	70.10	0.03	2.66	
16.20	0.43	0.05	1.35	3.25	1.05		0.55	0.07		0.19	70.20	0.03	2.66	
16.25	0.43	0.05	1.35	3.27	1.01		0.54	0.07		0.19	70.40	0.03	2.66	
16.20	0.42	0.06	1.35	3.25	1.04		0.53	0.07		0.19	70.10	0.02	2.65	
16.20	0.42	0.06	1.35	3.26	1.04		0.53	0.07		0.19	70.10	0.03	2.66	
16.15	0.42	0.05	1.34	3.24	1.00		0.52	0.07		0.19	69.80	0.03	2.66	
16.20	0.42	0.06	1.34	3.25	1.03		0.53	0.07		0.19	70.20	0.02	2.64	
16.35	0.43	0.05	1.36	3.26	1.05		0.54	0.07		0.19	70.80	0.02	2.65	
16.30	0.44		1.40	3.29	0.83		0.52	0.06		0.19	71.40	0.02	2.69	
16.30	0.43		1.39	3.29	0.83		0.51	0.07		0.20	71.60	0.01	2.67	
16.20	0.43		1.38	3.28	0.83		0.51	0.07		0.19	71.00	0.02	2.68	
16.20	0.44		1.38	3.28	0.85		0.49	0.07		0.19	71.10	0.02	2.67	
16.20	0.43		1.39	3.26	0.86		0.52	0.06		0.19	71.00	0.02	2.69	
16.20	0.43		1.39	3.28	0.87		0.52	0.07		0.19	71.00	0.02	2.67	
16.20	0.43		1.38	3.30	0.85		0.51	0.07		0.20	71.50		2.67	
16.20	0.44		1.39	3.31	0.85		0.51	0.07		0.20	71.80		2.68	

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

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

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:

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

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

Analyte	Method	Unit	S ¹	σL ²	SW ³	CSU ⁴
Li	FUS	ppm	99.673	114.182	37.325	66.402
Li	M/ICP	ppm	97.712	67.817	44.814	23.250
Ta	FUS	ppm	8.403	8.479	4.388	3.857
Ta	XRF	ppm	19.375	18.537	5.193	6.209
Th	FUS	ppm	0.264	0.367	0.139	0.214
Th	M/ICP	ppm	0.618	0.628	0.358	0.287
U	FUS	ppm	0.93	0.963	0.237	0.365
Nb	FUS	ppm	2.502	0.884	2.422	0.615
Nb	M/ICP	ppm	9.833	11.926	2.792	5.352
Nb	XRF	ppm	11.599	6.558	2.660	2.506
F	ISE	ppm	1018.092	113.205	30.131	42.980
Al ₂ O ₃	XRF	%	0.187	0.087	0.065	0.028
CaO	XRF	%	0.025	0.007	0.005	0.002
Cr ₂ O ₃	XRF	%	0.009	0.004	0.004	0.001
Fe ₂ O ₃	XRF	%	0.060	0.020	0.014	0.006
K ₂ O	XRF	%	0.036	0.015	0.014	0.005
LOI		%	0.093	0.064	0.031	0.017
MgO	XRF	%	0.041	0.019	0.006	0.006
MnO	XRF	%	0.004	0.001	0.000	0.000
Na ₂ O	XRF	%	0.129	0.075	0.038	0.025
P ₂ O ₅	XRF	%	0.007	0.003	0.003	0.001
SiO ₂	XRF	%	0.577	0.413	0.282	0.123
TiO ₂	XRF	%	0.008	0.005	0.004	0.001
SG	pyc		0.047	0.027	0.014	0.008

1. S - Std Dev for use on control charts.
2. σL - 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.

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

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

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. The Certified, values listed on p1 M/ICP (Nb,Th), FUS (Li, Ta, Nb, Th, U) of this certificate fulfil the AMIS statistical criteria regarding agreement for certification and have been independently validated by Allan Fraser.

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: AMIS0342 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 website.

17. Minimum sample size: The majority of laboratories reporting used a 0.5g sample size for the ICP. 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. 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 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, A Division of Torre Analytical Services (Pty) Ltd, Mike McWha, Dr Barry Smee, Smee and Associates Ltd, Thivhafuni Matodzi and Allan Fraser; accept no liability for any decisions or actions taken following the use of the reference 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

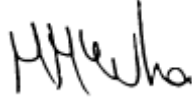
Directors: C E Pettit (British), R Naidoo, N N Robinson, K V Gerber, M Padayachee

20 March 2014

Amended – 06 January 2017-Certified by Allan Fraser M/ICP (Nb, Th), FUS (Li, Ta, Nb, Th)

Amended – 19 July 2017-Certified by Allan Fraser FUS (U)

Certifying Officers:



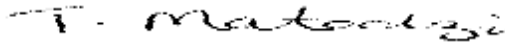
African Mineral Standards: _____

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



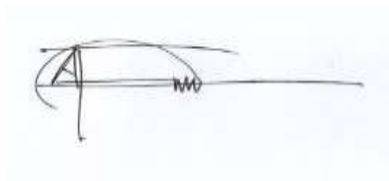
Geochemist: _____

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



African Mineral Standards: _____

Thivhafuni Matodzi



Geochemist: _____

Allan Fraser
M.Sc. (Geology), N.D. (Analytical Chem.), Pr.Sci.Nat.

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

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
Al	M/ICP	%	6.6	3.5	26.6	40
As	Fus	ppm	16.9	5.2	15.3	8
As	M/ICP	ppm	10.8	1.4	6.5	46
Ba	M/ICP	ppm	93.1	19.9	10.7	53
Bi	Fus	ppm	6.3	0.62	4.9	14
Bi	M/ICP	ppm	6.2	0.77	6.3	38
Ca	M/ICP	%	0.30	0.08	14.0	39
Cd	M/ICP	ppm	0.22	0.07	15.7	22
Ce	M/ICP	ppm	2.2	0.42	9.5	39
Co	M/ICP	ppm	3.3	1.0	14.4	39
Cr	M/ICP	ppm	251	165	32.9	56
Cs	M/ICP	ppm	164	28.2	8.6	48
Cu	M/ICP	ppm	53.5	12.0	11.3	48
Dy	M/ICP	ppm	0.41	0.13	15.9	47
Er	M/ICP	ppm	0.22	0.05	12.4	37
Eu	M/ICP	ppm	0.11	0.05	21.2	39
Fe	M/ICP	%	0.90	0.15	8.2	39
Ga	M/ICP	ppm	39.5	5.5	6.9	61
Gd	M/ICP	ppm	0.51	0.25	24.7	48
Ge	M/ICP	ppm	0.43	0.33	38.1	15
Hf	M/ICP	ppm	3.18	1.10	17.3	63
Ho	M/ICP	ppm	0.08	0.03	18.9	39
K	M/ICP	%	2.7	0.25	4.7	38
La	M/ICP	ppm	0.84	0.52	30.9	54
Lu	M/ICP	ppm	0.02	0.01	18.7	29
Mg	M/ICP	%	0.28	0.07	13.2	39
Mn	M/ICP	ppm	491	99.1	10.1	40
Mo	M/ICP	ppm	3.3	1.0	14.3	47
Na	M/ICP	%	4.0	0.23	2.9	32
Nd	M/ICP	ppm	1.5	0.85	29.0	48
Ni	M/ICP	ppm	22.1	6.6	15.0	54
P	M/ICP	ppm	779.2	130.8	8.4	24
Pb	M/ICP	ppm	9.8	2.9	14.6	30
Pr	M/ICP	ppm	0.29	0.12	21.4	46
S	M/ICP	%	0.02	0.0	10.7	16
Sb	Fus	ppm	7.1	1.2	8.1	23
Sb	M/ICP	ppm	7.2	0.86	6.0	39
Si	M/ICP	%	32.5	0.41	0.63	8
Sm	M/ICP	ppm	0.40	0.20	25.1	48
Sn	Fus	ppm	53.8	8.2	7.6	40
Sn	M/ICP	ppm	43.4	10.8	12.5	46
Sr	M/ICP	ppm	11.4	3.0	13.2	45
Ta	M/ICP	ppm	140	42.6	15.3	24
Tb	M/ICP	ppm	0.08	0.03	18.4	39
Ti	M/ICP	%	0.02	0.01	19.5	23
Tl	M/ICP	ppm	15.5	5.3	17.2	64
Tm	M/ICP	ppm	0.03	0.02	28.6	23
U	M/ICP	ppm	6.4	3.0	23.4	31
U	XRF	ppm	16.9	12.2	36.1	40
V	M/ICP	ppm	5.2	2.7	25.7	33
W	M/ICP	ppm	3.3	1.1	17.0	62
Y	M/ICP	ppm	2.4	0.81	17.0	53
Yb	M/ICP	ppm	0.15	0.08	27.5	47
Zn	M/ICP	ppm	49.7	13.6	13.7	31
Zr	M/ICP	ppm	25.9	14.6	28.1	55

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

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