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AMIS0341

Certified Reference Material

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

Certificate of Analysis

Recommended Concentrations and Limits[1.] *(at two Standard Deviations)*

Certified Concentrations

Li M/ICP	4733	±	405	ppm
Li FUS	5041	±	222	ppm
Nb FUS	125	±	9	ppm
Nb M/ICP	111	±	18	ppm
Ta M/ICP	627	±	144	ppm
Ta FUS	740	±	62	ppm
Th FUS	5.3	±	1	ppm
Th M/ICP	4	±	2	ppm
U FUS	12.8	±	1	ppm
U M/ICP	12.3	±	3	ppm
Specific Gravity	2.72	±	0.08	Dimensionless

Provisional Concentrations

Ta XRF	742	±	101	ppm
Nb XRF	103	±	18	ppm
F ISE	3494	±	516	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.

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Major Oxides

Certified Concentrations (at two Standard Deviations)

Al_2O_3	16.58	±	0.28	%
CaO	0.73	±	0.03	%
Fe_2O_3	1.34	±	0.06	%
K_2O	3.41	±	0.06	%
MgO	0.36	±	0.04	%
MnO	0.22	±	0.01	%
Na_2O	3.67	±	0.10	%
P_2O_5	0.63	±	0.02	%
SiO_2	69.71	±	1.46	%

Provisional Concentrations

Cr_2O_3	0.06	±	0.01	%
LOI	1.47	±	0.26	%

Indicated Mean

TiO_2	0.02	%

1. Intended Use: AMIS0341 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.

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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 <54um. Wet sieve parti**c**le 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 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 (Al_2O_3, CaO, Cr_2O_3, Fe_2O_3, K_2O, MgO, MnO, Na_2O, P_2O_5, SiO_2, TiO_2, V_2O_5. 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.

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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 and 2 laboratories 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 - Booysens JHB
15 SGS Vancouver (Canada)
16 Ultra Trace (Pty) Ltd WA
17 Shiva Analyticals India
18 UIS Analytical Services (pty) Ltd

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11. Assay Data: Data as received from the laboratories for the important certified elements listed on p1 and p2 are set out below.

Li FUS ppm	Li M/ICP ppm	Nb FUS ppm	Nb M/ICP ppm	Nb XRF ppm	Ta M/ICP ppm	Ta FUS ppm	Ta XRF ppm	Th FUS ppm	Th M/ICP ppm	U FUS ppm	U M/ICP ppm	F ISE ppm
4990	4883	122	112	115	629	704	720	5.57	2.70	13.18	10.96	4000
5030	4883	125	116	115	610	720	740	5.66	3.50	13.52	10.58	4000
5040	4836	126	110	115	631	722	720	5.79	3.90	13.27	10.93	3900
5040	4929	122	108	110	617	711	720	5.73	3.80	13.16	10.92	3800
4970	4929	123	113	115	653	704	700	5.19	3.50	13.00	11.72	3900
5010	4743	126	109	115	634	709	680	5.69	3.70	13.33	11.71	4000
4980	4883	122	109	115	600	728	700	5.56	3.60	13.17	10.74	4100
4960	4976	120	110	115	628	731	730	5.59	2.50	12.92	11.77	3900
5243	4880	131	100	120	637	778	700	5.49	4.60	12.30	12.82	3260
5148	4800	130	101	110	620	794	700	5.67	4.80	13.10	12.92	3220
5111	4910	134	108	100	602	791	700	5.79	4.50	13.25	12.62	3340
5020	4890	124	100	130	565	735	700	5.73	4.50	12.80	12.50	3320
5029	4910	121	101	130	619	734	700	5.37	4.60	12.80	12.57	3280
5120	5100	130	106	120	618	776	700	5.75	4.90	13.25	12.58	3030
5254	4980	128	107	130	623	771	700	5.75	4.70	13.25	13.04	3290
5236	4820	132	100	120	619	787	700	5.59	4.90	13.05	13.05	3320
5500	5050	123	119	108	708	690	710	5.45	5.00	13.15	10.80	3300
5100	4890	123	118	107	690	730	700	5.61	4.50	12.50	11.20	2800
5500	4920	121	126	108	694	740	720	5.79	5.00	13.00	11.00	3300
5600	4960	124	123	108	699	730	710	5.80	5.00	12.60	11.50	3300
5600	4870	123	118	108	704	710	720	5.15	4.50	12.50	10.50	3100
5500	4940	124	119	109	700	730	700	5.66	4.50	12.95	10.60	3200
5400	4850	122	120	107	715	720	720	5.79	4.50	13.15	11.50	2900
4439	5060	119	114	108	705	750	710	6.00	4.00	13.20	12.20	3200
4594	4692			100	526	752	700	4.10	3.40	12.70	14.50	3600
4636	4646			100	514	735	700	4.30	3.36	12.40	14.00	3700
4672	4599			100	526	743	700	4.10	2.90	12.30	14.50	3800
4485	4506			100	525	761	700	4.70	2.94	11.80	14.50	3700
4518	4692			100	500	767	800	4.30	2.96	12.10	13.50	3800
4514	4506			100	531	763	700	4.00	2.44	11.90	14.00	3800
4620	4692			100	524	740	700	4.60	3.07	12.30	14.00	3800
	4739			100	503		700	4.10	3.18	12.10	13.50	3600
	3995			140	674		830					3470
	4321			140	680		820					3470
	4042			140	681		830					3570
	4181			140	661		830					3540
	4274			140	677		830					3630
	4181			140	683		830					3560
	4274			140	690		820					3600
	4088			140	657		830					3590
	4502			166			688					3600
	4313			159			713					3340
	4351			151			723					3640
	4197			159			714					3510
	4344			161			717					3490
	4584			163			709					3540
	4302			162			704					3440
	4676			144			734					3530
	4780			88			741					3492
	4790			88			743					3115
	4680			88			750					3148
	4840			88			741					3332
	4740			87			745					3249
	4770			88			747					3351
	4800			88			735					3275
	4710			89			744					3153
	4597			104			817					3300
	4550			105			836					3200
	4610			104			811					3800
	4609			103			809					3300
	4509			101			818					3500
	4427			105			823					3600
	4425			103			829					2800
	4458			107			806					2500
				100								3262
				100								3411
				100								3608
				100								3381
				100								3737
				100								3956
				100								3629
				100								3611

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Assay Data cont:

Al_2O_3 XRF %	CaO XRF %	Cr_2O_3 XRF %	Fe_2O_3 XRF %	K_2O XRF %	LOI %	MgO XRF %	MnO XRF %	Na_2O XRF %	P_2O_5 XRF %	SiO_2 XRF %	TiO_2 XRF %	SG pyc
16.39	0.72	0.06	1.35	3.41	1.47	0.40	0.22	3.66	0.63	70.82	0.02	2.70
16.48	0.71	0.06	1.37	3.40	1.47	0.41	0.22	3.62	0.62	70.85	0.02	2.70
16.35	0.72	0.06	1.36	3.37	1.44	0.38	0.22	3.61	0.62	70.86	0.02	2.70
16.52	0.71	0.06	1.37	3.41	1.47	0.39	0.22	3.59	0.63	70.91	0.02	2.71
16.36	0.71	0.06	1.37	3.39	1.48	0.39	0.22	3.58	0.62	70.88	0.02	2.69
16.38	0.71	0.06	1.36	3.38	1.51	0.39	0.22	3.63	0.62	70.85	0.02	2.70
16.47	0.71	0.06	1.35	3.40	1.43	0.38	0.22	3.63	0.63	70.95	0.02	2.70
16.29	0.70	0.06	1.34	3.38	1.46	0.40	0.22	3.58	0.62	70.90	0.02	2.70
16.70	0.73	0.06	1.30	3.42	1.48	0.37	0.23	3.61	0.65	69.20	0.02	2.72
16.75	0.74	0.07	1.32	3.42	1.48	0.38	0.22	3.60	0.61	69.40	0.02	2.77
16.65	0.73	0.06	1.30	3.42	1.55	0.37	0.23	3.61	0.65	69.20	0.02	2.74
16.45	0.71	0.06	1.27	3.36	1.82	0.37	0.22	3.56	0.64	68.00	0.02	2.69
16.65	0.73	0.06	1.29	3.38	1.50	0.37	0.23	3.59	0.65	69.10	0.02	2.72
16.65	0.73	0.06	1.31	3.42	1.72	0.37	0.23	3.65	0.65	69.10	0.02	2.78
16.75	0.73	0.06	1.34	3.35	1.89	0.38	0.22	3.58	0.60	69.30	0.03	2.72
16.50	0.72	0.06	1.27	3.37	1.64	0.37	0.22	3.65	0.64	68.40	0.02	2.74
16.50	0.72	0.06	1.32	3.41	1.49	0.37	0.22	3.67	0.63	69.40	0.02	2.66
16.55	0.72	0.06	1.32	3.42	1.46	0.37	0.23	3.68	0.64	69.50	0.02	2.73
16.50	0.72	0.06	1.32	3.40	1.56	0.37	0.22	3.64	0.63	69.30	0.02	2.82
16.45	0.72	0.06	1.31	3.40	1.50	0.36	0.22	3.66	0.63	69.30	0.02	2.84
16.45	0.71	0.06	1.30	3.39	1.60	0.37	0.22	3.64	0.63	69.10	0.02	2.75
16.45	0.72	0.06	1.31	3.36	1.51	0.36	0.22	3.63	0.63	69.20	0.03	2.72
16.55	0.72	0.06	1.32	3.41	1.50	0.36	0.22	3.65	0.63	69.50	0.02	2.84
16.50	0.72	0.06	1.31	3.41	1.52	0.36	0.22	3.64	0.63	69.20	0.02	2.66
16.99	0.76	0.06	1.39	3.44	1.56	0.36	0.23	3.72	0.66	71.02	0.03	2.80
17.00	0.75	0.06	1.43	3.47	1.54	0.38	0.23	3.68	0.66	71.07	0.03	2.81
16.90	0.77	0.06	1.41	3.31	1.51	0.35	0.23	3.69	0.66	71.17	0.03	2.80
17.03	0.74	0.06	1.40	3.47	1.49	0.37	0.23	3.74	0.66	70.83	0.03	2.76
17.01	0.75	0.06	1.40	3.50	1.46	0.37	0.22	3.73	0.66	71.04	0.03	2.79
16.87	0.75	0.06	1.40	3.44	1.47	0.37	0.23	3.70	0.66	70.87	0.02	2.78
16.92	0.74	0.06	1.39	3.43	1.48	0.37	0.23	3.69	0.65	71.15	0.03	2.78
16.87	0.75	0.06	1.41	3.41	1.50	0.37	0.23	3.69	0.65	70.79	0.03	2.78
16.42	0.72	0.07	1.34	3.41	1.74	0.35	0.21	3.70	0.61	68.88	0.05	2.77
16.47	0.72	0.07	1.36	3.44	1.72	0.36	0.22	3.67	0.62	69.03	0.02	2.69
16.44	0.72	0.07	1.35	3.41	1.75	0.35	0.22	3.67	0.62	69.03	0.02	2.72
16.51	0.74	0.07	1.36	3.43	1.75	0.35	0.22	3.76	0.62	69.39	0.03	2.60
16.42	0.73	0.07	1.32	3.41	1.72	0.35	0.23	3.70	0.63	68.98	0.03	2.63
16.47	0.73	0.07	1.34	3.46	1.75	0.34	0.22	3.69	0.61	69.16		2.68
16.47	0.72	0.07	1.34	3.44	1.75	0.35	0.22	3.69	0.62	69.00	0.03	2.64
16.44	0.72	0.08	1.37	3.42	1.75	0.35	0.22	3.67	0.61	68.85	0.03	2.66
16.70	0.73	0.06	1.33	3.41	1.43	0.34	0.23	3.75	0.62	69.20	0.02	2.67
16.70	0.73	0.06	1.32	3.39	1.41	0.34	0.23	3.76	0.64	69.00	0.02	2.68
16.70	0.73	0.06	1.32	3.38	1.40	0.36	0.22	3.74	0.64	69.00	0.03	2.66
16.80	0.74	0.06	1.32	3.42	1.43	0.35	0.23	3.74	0.64	69.20	0.03	2.67
16.70	0.72	0.06	1.32	3.42	1.39	0.36	0.23	3.75	0.65	69.10	0.03	2.66
16.70	0.73	0.06	1.32	3.36	1.41	0.35	0.23	3.76	0.63	69.00	0.03	2.67
16.70	0.74	0.06	1.32	3.40	1.39	0.34	0.22	3.74	0.63	69.10	0.02	2.67
16.80	0.72	0.06	1.32	3.36	1.42	0.35	0.22	3.74	0.63	69.20	0.02	2.65
16.50	0.74	0.07	1.30	3.44	1.31	0.36	0.23	3.66	0.64	69.50	0.02	2.79
16.50	0.73	0.07	1.34	3.43	1.31	0.36	0.23	3.62	0.63	69.50	0.02	2.79
16.40		0.07	1.36	3.44	1.31	0.36	0.23	3.60	0.63	69.40	0.02	2.79
16.40	0.73	0.07	1.34	3.43	1.32	0.37	0.23	3.63	0.63	69.50	0.02	2.76
16.50	0.73	0.07	1.33	3.44	1.31	0.37	0.23	3.64	0.63	69.50	0.02	2.78
16.40	0.74	0.07	1.33	3.43	1.29	0.36	0.23	3.67	0.64	69.50	0.02	2.79
16.50	0.74	0.07	1.32	3.42	1.28	0.37	0.23	3.65	0.63	69.50	0.02	2.78
16.50	0.74	0.07	1.35	3.44	1.31	0.37	0.23	3.63	0.61	69.50	0.02	2.79
16.70	0.74	0.06	1.37	3.49	1.42	0.33	0.21	3.92	0.64	70.50	0.01	2.64
16.60	0.75	0.07	1.37	3.47	1.41	0.35	0.22	3.96	0.64	70.10	0.02	2.67
16.80	0.75	0.07	1.36	3.47	1.41	0.32	0.21	3.86	0.63	71.00	0.02	2.63
16.70	0.74	0.07	1.36	3.46	1.39	0.32	0.21	3.92	0.64	70.80	0.02	2.66
16.70	0.74	0.07	1.35	3.47	1.42	0.33	0.21	3.92	0.64	70.50	0.02	2.63
16.80	0.75	0.07	1.35	3.46	1.40	0.34	0.21	3.90	0.63	70.90	0.02	2.65

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Al_2O_3 XRF %	CaO XRF %	Cr_2O_3 XRF %	Fe_2O_3 XRF %	K_2O XRF %	LOI %	MgO XRF %	MnO XRF %	Na_2O XRF %	P_2O_5 XRF %	SiO_2 XRF %	TiO_2 XRF %	SG pyc
16.70	0.76	0.07	1.35	3.48	1.32	0.32	0.21	3.90	0.64	70.60	0.02	2.63
16.50	0.75	0.06	1.34	3.46	1.43	0.36	0.22	3.65	0.63	71.00	0.02	2.65
16.70	0.72	0.06	1.31	3.38	1.38	0.34	0.22	3.68	0.68	69.50	0.02	2.72
16.80	0.72	0.07	1.34	3.40	1.32	0.35	0.21	3.68	0.68	69.90	0.02	2.71
16.40	0.71	0.07	1.27	3.35	1.28	0.34	0.22	3.63	0.68	68.70	0.02	2.72
16.70	0.72	0.07	1.37	3.38	1.37	0.34	0.22	3.64	0.68	69.70	0.02	2.73
16.70	0.72	0.07	1.31	3.36	1.35	0.32	0.22	3.63	0.68	69.50	0.02	2.77
16.60	0.71	0.06	1.29	3.39	1.41	0.32	0.22	3.63	0.69	69.40	0.02	2.73
16.70	0.71	0.08	1.29	3.45	1.40	0.34	0.22	3.63	0.69	69.70	0.02	2.74
16.80	0.72	0.07	1.30	3.36	1.31	0.33	0.22	3.63	0.68	70.00	0.02	2.74
16.85	0.78	0.03	2.02	3.39	1.43	0.27	0.24	3.72	0.64	68.80	0.01	2.69
16.73	0.75	0.03	2.04	3.43	1.38	0.24	0.24	3.72	0.64	68.73	0.01	2.72
16.84	0.76	0.03	2.03	3.41	1.41	0.28	0.24	3.72	0.64	68.95	0.01	2.74
16.82	0.74	0.03	2.05	3.44	1.41	0.26	0.24	3.72	0.64	69.19	0.01	2.73
16.79	0.75	0.03	2.09	3.43	1.38	0.25	0.24	3.70	0.64	69.17	0.01	2.71
16.91	0.77	0.03	2.05	3.44	1.39	0.28	0.24	3.71	0.64	69.53	0.01	2.70
16.99	0.75	0.03	1.92	3.44	1.38	0.28	0.24	3.71	0.64	69.47	0.01	2.71
16.71	0.75	0.03	1.95	3.41	1.38	0.26	0.24	3.72	0.64	68.60	0.01	2.70
16.49	0.81	0.05	1.45	3.39	1.96	0.41	0.22		0.63	69.79	0.03	2.74
16.41	0.80	0.05	1.46	3.38	1.98	0.40	0.22		0.63	69.51	0.03	2.74
16.44	0.80	0.04	1.44	3.38	2.00	0.39	0.22		0.63	69.55	0.02	2.73
16.42	0.79	0.04	1.44	3.38	2.01	0.40	0.22		0.64	69.54	0.02	2.74
16.42	0.80	0.05	1.46	3.37	2.00	0.39	0.22		0.64	69.56	0.02	2.73
16.41	0.80	0.03	1.45	3.38	2.01	0.39	0.22		0.64	69.53	0.02	2.74
16.43	0.80	0.05	1.46	3.37	1.98	0.41	0.22		0.64	69.50	0.02	2.73
16.42	0.80	0.03	1.47	3.38	1.98	0.40	0.23		0.63	69.62	0.02	2.74
16.60	0.74	0.06	1.34	3.41	1.62	0.38	0.23			69.60	0.02	2.71
16.64	0.74	0.06	1.34	3.42	1.63	0.37	0.23			69.68	0.02	2.70
16.68	0.74	0.06	1.34	3.43	1.63	0.37	0.23			69.81	0.02	2.72
16.66	0.74	0.06	1.35	3.44	1.65	0.37	0.23			69.88	0.02	2.70
16.66	0.74	0.06	1.35	3.42	1.64	0.37	0.23			69.69	0.02	2.70
16.60	0.74	0.06	1.35	3.41	1.61	0.38	0.23			69.54	0.02	2.71
16.68	0.74	0.06	1.34	3.42	1.62	0.37	0.23			69.65	0.02	2.71
16.62	0.74	0.06	1.35	3.41	1.63	0.37	0.23			69.57	0.02	2.71
					1.40							2.73
					1.40							2.74
					1.40							2.71
					1.40							2.72
					1.30							2.74
					1.30							2.70
					1.30							2.72
					1.30							2.74
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					1.00							2.70
					1.00							2.80
					1.00							2.70
					1.00							2.71
					1.00							2.73

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:

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

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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	399.579	510.367	104.021	255.867
Li	M/ICP	ppm	274.552	205.859	90.177	78.752
Ta	M/ICP	ppm	71.811	88.966	14.492	39.853
Ta	FUS	ppm	31.190	35.033	16.478	17.765
Ta	XRF	ppm	50.624	50.982	15.889	18.134
Th	FUS	ppm	0.709	0.954	0.217	0.479
Th	M/ICP	ppm	0.909	1.183	0.357	0.595
U	FUS	ppm	0.503	0.525	0.275	0.267
U	M/ICP	ppm	1.461	1.971	0.441	0.988
Nb	FUS	ppm	4.454	4.452	2.771	2.635
Nb	M/ICP	ppm	8.954	13.658	3.197	7.913
Nb	XRF	ppm	21.260	9.414	2.831	3.579
F	ISE	ppm	307.889	211.852	135.183	72.495
Al_2O_3	XRF	%	0.179	0.110	0.072	0.034
CaO	XRF	%	0.024	0.012	0.008	0.004
Cr_2O_3	XRF	%	0.012	0.004	0.002	0.001
Fe_2O_3	XRF	%	0.192	0.022	0.015	0.007
K_2O	XRF	%	0.035	0.021	0.020	0.006
LOI		%	0.228	0.103	0.039	0.030
MgO	XRF	%	0.035	0.014	0.007	0.004
MnO	XRF	%	0.007	0.003	0.003	0.001
Na_2O	XRF	%	0.085	0.044	0.022	0.015
P_2O_5	XRF	%	0.019	0.009	0.007	0.003
SiO_2	XRF	%	0.747	0.588	0.219	0.171
TiO_2	XRF	%	0.006	0.004	0.003	0.001
SG	pyc		0.048	0.029	0.022	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.*

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,Ta,U), 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: AMIS0341 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 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. 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.

20 March 2014

Amended – 05 January 2017-Certified by Allan Fraser M/ICP (Nb, Th), FUS (Li, Ta, Nb)
Amended – 19 July 2017-Certified by Allan Fraser M/ICP (Ta,U), FUS (Th,U)

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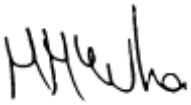
Certifying Officers:

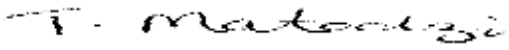


African Mineral Standards: _____

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

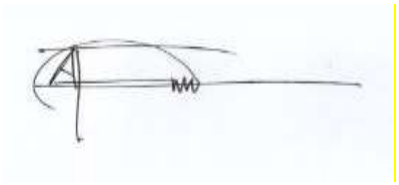
Geochemist: _____

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.

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Appendix – uncertified trace element statistics

Analyte	Method	Unit	Mean	2SD	RSD%	n
Al	M/IICP	%	6.9	3.0	21.7	48
As	Fus	ppm	22.7	9.2	20.2	15
As	M/ICP	ppm	22.5	5.7	12.7	48
Ba	M/IICP	ppm	153	30.0	9.8	54
Bi	Fus	ppm	22.2	4.1	9.3	14
Bi	M/ICP	ppm	24.1	3.0	6.1	38
Ca	M/IICP	%	0.50	0.11	10.7	45
Ce	M/IICP	ppm	1.0	0.51	24.6	31
Co	M/IICP	ppm	3.6	0.89	12.3	48
Cr	M/IICP	ppm	324	215	33.2	64
Cs	M/IICP	ppm	449	23.7	2.6	46
Cu	M/IICP	ppm	54.3	7.3	6.8	54
Dy	M/IICP	ppm	0.27	0.09	16.4	39
Er	M/IICP	ppm	0.14	0.04	14.2	30
Eu	M/IICP	ppm	0.07	0.13	87.6	31
Fe	M/IICP	%	0.90	0.14	7.7	48
Ga	M/IICP	ppm	41.5	6.4	7.7	61
Gd	M/IICP	ppm	0.21	0.14	34.0	53
Ge	M/IICP	ppm	0.34	0.61	89.5	15
Hf	M/IICP	ppm	2.3	2.1	46.3	47
Ho	M/IICP	ppm	0.05	0.02	19.0	23
K	M/IICP	%	2.8	0.31	5.6	52
La	M/IICP	ppm	0.59	0.34	29.2	40
Lu	M/IICP	ppm	0.02	0.01	32.0	26
Mg	M/IICP	%	0.18	0.06	17.5	40
Mn	M/IICP	ppm	1618	232	7.2	47
Mo	M/IICP	ppm	3.6	0.55	7.6	55
Na	M/IICP	%	2.7	0.21	4.0	47
Nd	M/IICP	ppm	0.48	0.39	41.3	48
Ni	M/IICP	ppm	17.0	6.3	18.6	62
P	M/IICP	ppm	2530	292	5.8	31
Pb	M/IICP	ppm	10.7	3.6	17.0	32
Pd	M/IICP	ppm	13.1	3.5	13.2	8
Pr	M/IICP	ppm	0.16	0.08	23.5	31
S	M/IICP	%	0.02	0.01	32.3	24
Sb	Fus	ppm	13.1	2.5	9.4	23
Sb	M/ICP	ppm	11.9	3.9	16.3	38
Si	M/IICP	%	32.3	0.21	0.3	8
Sm	M/IICP	ppm	0.19	0.11	28.5	28
Sn	Fus	ppm	85.4	8.7	5.1	43
Sn	M/ICP	ppm	39.3	30.4	38.8	32
Sr	M/IICP	ppm	25.0	2.1	4.2	37
Tb	M/IICP	ppm	0.05	0.01	13.7	21
Th	XRF	ppm	14.9	12.2	41.1	16
Ti	M/IICP	%	0.01	0.0	2.0	22
Tl	M/IICP	ppm	33.4	13.9	20.8	56
Tm	M/IICP	ppm	0.02	0.02	35.0	18
U	XRF	ppm	21.2	16.0	37.7	40
V	M/IICP	ppm	4.8	1.1	11.6	34
W	M/IICP	ppm	4.5	2.6	29.4	62
Y	M/IICP	ppm	1.7	0.58	16.8	47
Yb	M/IICP	ppm	0.12	0.05	18.6	22
Zn	M/IICP	ppm	108	15.9	7.3	48
Zr	M/IICP	ppm	14.9	17.2	57.5	62

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