

AMIS0339

Certified Reference Material

Li 2.270% Ta 333ppm Pegmatite AU

Certificate of Analysis

**Recommended Concentrations and Limits¹
(at two Standard Deviations)**

Certified Concentrations²

Li M/ICP	2.27	±	0.10	%
Ta M/ICP	310	±	44	ppm
Ta Fus	333	±	24	ppm
Th Fus	2.0	±	0.3	ppm
U Fus	6.0	±	1.0	ppm
U M/ICP	4.3	±	1.8	ppm
Nb Fus	102	±	7	ppm
Nb M/ICP	97.6	±	24.1	ppm
Specific Gravity	3.0	±	0.08	Dimensionless

Provisional Concentrations

Li Fus	2.19	±	0.4	%
Ta XRF	316	±	43	ppm
Sn Fus	169	±	21	ppm
Nb XRF	98.1	±	11.1	ppm
Bi M/ICP	39.7	±	7.9	ppm
F ISE	1352	±	241	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)

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Major Oxides

Certified Concentrations (at two Standard Deviations)

Al ₂ O ₃	23.00	±	0.50	%
CaO	0.66	±	0.03	%
Fe ₂ O ₃	2.22	±	0.10	%
K ₂ O	1.49	±	0.04	%
MgO	0.42	±	0.03	%
MnO	0.33	±	0.01	%
Na ₂ O	1.21	±	0.05	%
P ₂ O ₅	0.25	±	0.01	%
SiO ₂	64.00	±	0.94	%

Provisional Concentrations

TiO ₂	0.04	±	0.01	%
LOI	1.04	±	0.13	%

Informational Concentration

Cr ₂ O ₃	0.07	%
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1. **Intended Use:** AMIS0339 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: AMIS0339 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 Very Light Grey (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 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. 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.

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9. Method of Certification: Twenty two laboratories were each given eight scientifically selected packages of sample. Seventeen 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 17 out of 22 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. Genalysis Laboratory Services (W Australia P)
7. Intertek Testing Services Ltd Shanghai (Beijing)
8. Intertek Utama Services (Indonesia)
9. Labtium Inc Finland
10. Set Point Laboratories (Isando) SA
11. SGS Australia Pty Ltd (Newburn) WA
12. SGS Geosol Laboratories Ltda (Brazil)
13. SGS Mineral Services Callao (Peru)
14. SGS Mineral Services Lakefield (Canada)
15. SGS South Africa (Pty) Ltd - Booyens JHB
16. SGS Vancouver (Canada)
17. Shiva Analyticals India
18. UIS Analytical Services (pty) Ltd
19. Ultra Trace (Pty) Ltd WA

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

Li M/CP ppm	Li Fus ppm	Ta M/CP ppm	Ta Fus ppm	Ta XRF ppm	Bi M/CP ppm	Nb M/CP ppm	Nb Fus ppm	Nb XRF ppm	Sn Fus ppm	Th Fus ppm	U Fus ppm	U M/CP ppm	F ISE ppm
22521	24809	317	319	292	43.4	83.0	100	87.0	157	6.60	7.20	4.24	2100
22895	24620	315	325	299	44.8	83.6	102	87.0	163	6.60	6.52	4.39	3400
22625	24681	310	329	305	44.1	86.3	102	86.0	160	7.00	6.21	4.61	2100
22963	25375	314	333	295	43.1	81.8	105	87.0	163	7.10	6.08	4.59	1900
23015	25944	300	334	306	43.9	78.6	102	88.0	160	6.70	6.08	4.53	1600
22878	25346	320	318	297	41.4	84.5	103	87.0	162	6.20	6.01	4.52	3200
22854	24377	317	330	298	43.4	80.8	101	87.0	158	7.30	6.03	4.32	3400
22878	25960	309	329	299	49.3	85.6	102	88.0	157	6.10	6.66	4.57	2700
22186	20400	298	289	347	48.0	123.0	85.1	95.0	159	2.11	5.42	4.26	1100
23707	20300	282	286	358	49.0	113.0	81.3	95.0	159	1.95	5.77	3.10	1000
23493	20500	302	304	358	49.0	116.0	77.9	96.0	159	2.02	5.97	4.34	1100
21375	20700	300	317	365	48.0	111.0	83.2	94.0	163	2.15	5.62	3.40	1000
22786	21300	288	269	366	48.0	114.0	88.6	95.0	157	2.14	5.87	3.18	1100
21118	20800	278	282	352	45.0	111.0	83.0	96.0	155	2.15	5.52	4.59	1200
21247	20500	290	251	350	47.0	112.0	81.5	96.0	157	2.13	5.63	3.81	1100
21576	20800	291	264	355	48.0	110.0	80.5	97.0	162	2.13	5.68	3.94	1100
22000	23300	289	358	300	35.5	91.4	106	103	192	2.11	5.24	5.20	1501
21600	22100	286	338	310	37.1	96.7	98.4	103	165	1.91	5.40	5.20	1531
21200	22900	277	347	290	39.8	95.5	104	103	172	1.95	5.52	5.20	1498
21700	22500	296	363	290	39.0	93.1	109	109	202	1.96	5.70	5.10	1419
22000	22100	289	347	300	38.5	93.3	107	103	159	1.73	5.52	5.00	1362
21000	22900	267	348	300	37.0	91.7	105	104	158	1.92	5.37	1.30	1462
21600	22200	273	344	300	34.5	93.9	104	103	170	2.26	5.39	5.10	1516
21000	23800	275	352	300	36.7	94.8	105	102	160	2.58	5.44	5.10	1504
22231	21417	306	301	300	34.6	102.5	107	100	190	2.00	5.90		1270
22541	21184	318	312	300	34.3	101.2	105	100	180	2.10	6.10		1320
24037	20813	329	308	300	34.7	104.2	106	100	170	1.80	5.70		1250
23802	21556	324	308	300	37.7	100.2	105	100	180	2.20	6.70		1310
23896	21928	319	305	300	35.4	99.6	109	100	180	2.10	6.00		1260
23407	21649	312	313	300	33.6	104.1	109	100	180	2.00	6.20		1260
22758	21417	307	313	300	35.7	104.1	109	100	180	2.10	6.70		1400
22231	21510	318	317	300	36.8	104.7	105	121	180	2.50	6.30		1350
22541	19094	318	330	411	38.4	100.0	100	137	169	2.00	6.00		1240
24037	19187	305	330	411	38.3	100.0	100	136	168	2.00	6.50		1230
23802	18769	325	330	415	37.7	90.0	100	131	169	2.00	6.50		1190
23896	19094	308	330	430	37.2	100.0	100	130	185	2.00	7.00		1270
25364	19001	319	330	419	37.7	100.0	100	118	184	2.00	6.50		1240
23407	19094	328	340	409	37.3	100.0	100	126	168	2.00	6.00		1310
22758	19094	324	330	402	38.4	90.0	100	120	171	2.00	6.50		1280
22300	19326	324	330	418	37.8	80.0	100	100	183	2.00	6.50		1330
22200	21587	340	338	300	40.6		95.0	100	179	1.80	5.46		1410
22500	21431	350	342	300	39.8		95.0	100	181	2.00	5.29		1410
22900	21322	340	335	300	39.6		100	100	160	1.90	5.54		1460
22500	21441	330	352	300	38.8		100	120	177	2.00	5.58		1430
22600	21215	330	345	300	36.3		90	120	184	1.90	5.35		1480
23800	21519	340	336	300	34.3		100	120	166	1.80	5.72		1440
23200	21758	340	334	300	37.2		100	120	173	1.80	5.35		1430
	21467	340	345	300	36.6		100	120	176	2.00	5.61		1390
		319	320	42.8			95.0	120		2.00	6.40		1361
		331	310	41.4			99.0	120		1.90	6.50		1325
		333	310	40.7			99.0	120		1.90	5.90		1402
		344	300	43.5			103	100		1.80	5.80		1420
		331	310	41.1			103	100		2.10	6.00		1378
		318	310	39.2			93.0	100		2.30	6.50		1424
		326	310	39.5			99.0	100		1.90	6.20		1309
		347	310	38.7			99.0	100		1.90	6.00		1313
		331	320				104	100					1400
		341	330				106	100					1500
		356	310				99.0	100					1400
		341	310				105	100					1400
		343	340				96.0	110					1500
		341	330				97.0	100					1400
		338	320				101	100					1500
		331	340				104	100					1500
			350					100					
			350					100					
			340					100					
			350										
			350										
			340										

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Assay Data cont:

Al2O3 XRF %	CaO XRF %	Cr2O3 XRF %	Fe2O3 XRF %	K2O XRF %	MgO XRF %	MnO XRF %	Na2O XRF %	P2O5 XRF %	SiO2 XRF %	TiO2 XRF %	LOI %	LOI %	SG pyc	SG pyc
16.4	0.42	0.05	1.30	3.20	0.52	0.07	5.98	0.20	69.9	0.03	0.98	0.96	3.02	3.05
16.3	0.42	0.05	1.29	3.21	0.47	0.07	5.88	0.20	70.1	0.03	0.97	0.98	3.01	3.05
16.5	0.42	0.05	1.31	3.32	0.49	0.07	5.97	0.20	70.5	0.02	0.97	0.97	3.01	3.03
16.4	0.42	0.05	1.31	3.22	0.50	0.07	5.96	0.20	70.4	0.02	0.97	0.95	3.01	3.00
16.4	0.42	0.05	1.34	3.22	0.50	0.07	5.94	0.19	70.4	0.02	0.97	0.97	3.02	3.00
16.4	0.42	0.05	1.31	3.23	0.49	0.07	5.97	0.20	70.4	0.03	1.01	0.96	3.01	3.04
16.3	0.42	0.05	1.32	3.22	0.47	0.07	5.94	0.20	70.2	0.02	1.05	0.95	3.01	3.05
16.2	0.43	0.06	1.31	3.22	0.47	0.07	5.89	0.21	70.1	0.02	1.04	0.95	3.02	3.05
23.0	0.64	0.07	2.16	1.44	0.42	0.33	1.23	0.25	63.2	0.04	0.94	1.28	2.96	2.98
23.0	0.64	0.07	2.14	1.44	0.42	0.32	1.22	0.25	63.2	0.04	1.09	1.32	2.99	2.94
23.1	0.64	0.07	2.17	1.46	0.42	0.33	1.22	0.25	63.5	0.04	1.14	1.32	3.01	2.97
23.4	0.66	0.08	2.19	1.48	0.43	0.33	1.27	0.24	64.2	0.04	1.14	1.33	2.96	2.97
23.1	0.64	0.07	2.16	1.45	0.42	0.33	1.22	0.25	63.4	0.04	1.10	1.38	2.98	2.97
22.9	0.63	0.07	2.12	1.45	0.42	0.32	1.20	0.25	62.8	0.04	1.28	1.28	3.00	2.97
23.3	0.66	0.10	2.22	1.48	0.43	0.33	1.26	0.24	64.2	0.05	1.09	1.34	3.01	2.96
23.1	0.64	0.07	2.15	1.47	0.42	0.33	1.24	0.25	63.4	0.04	1.06	1.41	2.95	2.97
23.5	0.67	0.04	2.45	1.52	0.32	0.37	1.28	0.27	64.2	0.03	1.15		3.01	2.95
23.5	0.66	0.04	2.49	1.51	0.30	0.36	1.27	0.27	64.0	0.03	1.17		2.99	2.95
23.4	0.67	0.04	2.43	1.52	0.31	0.36	1.30	0.27	63.8	0.03	1.19		2.99	2.94
23.4	0.67	0.04	2.44	1.51	0.29	0.36	1.30	0.27	63.8	0.03	1.14		2.98	2.91
23.6	0.68	0.04	2.43	1.52	0.37	0.37	1.28	0.27	64.4	0.04	1.15		2.98	2.97
23.4	0.67	0.04	2.42	1.51	0.31	0.36	1.29	0.27	63.7	0.03	1.16		3.01	2.88
23.4	0.66	0.04	2.49	1.51	0.31	0.36	1.27	0.27	63.9	0.04	1.15		2.98	2.89
23.7	0.68	0.04	2.45	1.52	0.33	0.37	1.27	0.27	64.6	0.03	1.16		3.00	2.92
22.7	0.67	0.03	2.23	1.46	0.43	0.31	1.20	0.25	63.9	0.04	1.00		2.86	
22.8	0.68	0.05	2.24	1.46	0.42	0.32	1.22	0.25	64.1	0.04	1.00		2.87	
22.7	0.68	0.05	2.24	1.45	0.43	0.32	1.21	0.25	63.9	0.04	1.00		2.87	
22.8	0.68	0.05	2.23	1.47	0.44	0.31	1.20	0.25	64.0	0.04	1.00		2.86	
22.7	0.68	0.04	2.23	1.46	0.43	0.32	1.20	0.25	64.0	0.04	1.00		2.86	
22.7	0.68	0.04	2.25	1.46	0.43	0.32	1.20	0.25	64.0	0.04	1.00		2.86	
22.7	0.68	0.03	2.23	1.46	0.44	0.32	1.23	0.25	63.9	0.04	1.00		2.86	
22.8	0.69	0.05	2.24	1.47	0.44	0.31	1.23	0.25	63.9	0.04	1.00		2.86	
22.8	0.64	0.07	2.15	1.48	0.39	0.32	1.27	0.24	63.4	0.05	1.25		3.00	
22.8	0.65	0.08	2.16	1.48	0.41	0.32	1.26	0.24	63.5	0.04	1.25		2.98	
23.0	0.65	0.08	2.19	1.50	0.39	0.32	1.24	0.24	63.8	0.04	1.26		3.03	
22.6	0.63	0.07	2.13	1.47	0.39	0.31	1.25	0.23	63.5	0.04	1.24		2.99	
22.6	0.64	0.08	2.15	1.48	0.40	0.32	1.24	0.24	63.1	0.04	1.23		2.98	
22.7	0.64	0.08	2.17	1.48	0.40	0.32	1.26	0.24	63.2	0.03	1.24		2.98	
22.7	0.64	0.08	2.17	1.47	0.41	0.32	1.24	0.24	63.3	0.03	1.24		2.97	
22.7	0.65	0.07	2.16	1.47	0.41	0.32	1.25	0.23	63.2	0.03	1.28		2.97	
23.1	0.66	0.08	2.20	1.49	0.40	0.32	1.20	0.24	64.1	0.04	1.16		2.92	
23.0	0.67	0.08	2.24	1.49	0.42	0.33	1.20	0.25	64.1	0.05	1.05		3.11	
23.0	0.66	0.07	2.25	1.49	0.42	0.33	1.20	0.24	64.2	0.04	1.08		3.09	
23.0	0.66	0.08	2.24	1.49	0.41	0.33	1.20	0.24	64.1	0.04	1.11		3.03	
23.0	0.66	0.08	2.21	1.48	0.41	0.33	1.18	0.24	64.1	0.04	1.10		3.08	
23.0	0.66	0.08	2.23	1.49	0.41	0.34	1.20	0.24	64.1	0.04	1.07		3.03	
23.0	0.66	0.08	2.23	1.48	0.41	0.33	1.20	0.24	64.1	0.04	1.08		3.00	
23.0	0.66	0.07	2.24	1.49	0.41	0.34	1.20	0.24	64.1	0.04	1.02		3.09	
22.8	0.64	0.07	2.18	1.47	0.40	0.32	1.20	0.25	63.6	0.04	1.00		3.01	
22.8	0.64	0.07	2.18	1.47	0.41	0.32	1.20	0.25	63.4	0.04	1.01		3.01	
22.8	0.64	0.07	2.20	1.48	0.40	0.33	1.23	0.25	63.6	0.04	1.01		3.02	
22.8	0.63	0.07	2.18	1.46	0.41	0.33	1.23	0.25	63.4	0.04	1.00		3.08	
22.8	0.63	0.07	2.17	1.46	0.39	0.32	1.21	0.25	63.3	0.04	1.02		3.03	
22.7	0.63	0.07	2.17	1.46	0.39	0.32	1.18	0.24	63.4	0.04	1.01		3.01	
22.8	0.64	0.07	2.20	1.46	0.40	0.32	1.24	0.24	63.5	0.04	1.01		3.03	
22.7	0.63	0.07	2.18	1.46	0.40	0.32	1.21	0.25	63.2	0.04	1.02		3.06	
23.1	0.68	0.08	2.32	1.51	0.40	0.32	1.21	0.24	64.7	0.04	1.01		3.10	
23.0	0.67	0.09	2.29	1.50	0.42	0.33	1.20	0.24	64.7	0.04	1.00		3.03	
23.3	0.68	0.06	2.29	1.51	0.44	0.32	1.21	0.25	65.3	0.04	1.06		3.10	
23.0	0.69	0.08	2.30	1.52	0.43	0.33	1.21	0.24	64.9	0.04	1.10		3.02	
23.1	0.67	0.09	2.31	1.51	0.42	0.32	1.20	0.25	64.9	0.03	1.11		3.00	
22.9	0.67	0.08	2.28	1.52	0.40	0.33	1.21	0.24	64.7	0.04	1.02		2.99	
22.9	0.67	0.08	2.28	1.51	0.44	0.34	1.20	0.24	64.4	0.04	1.05		3.01	
23.0	0.69	0.07	2.29	1.51	0.40	0.33	1.21	0.25	65.1	0.04	1.06		3.06	
23.1	0.66	0.07	2.22	1.48	0.42	0.33	1.17	0.26	64.2	0.04	1.01		3.05	
23.1	0.66	0.07	2.23	1.48	0.42	0.33	1.17	0.26	64.1	0.04	1.02		3.07	
23.0	0.66	0.07	2.21	1.48	0.42	0.33	1.24	0.26	64.1	0.04	1.01		3.05	
23.1	0.65	0.07	2.20	1.47	0.42	0.33	1.19	0.25	64.0	0.04	1.01		3.06	
23.1	0.65	0.07	2.23	1.47	0.42	0.33	1.23	0.25	63.8	0.04	1.02		3.05	
23.1	0.66	0.07	2.21	1.47	0.42	0.33	1.25	0.25	64.0	0.04	1.01		3.04	
23.0	0.65	0.07	2.20	1.48	0.42	0.33	1.17	0.25	63.9	0.04	1.01		3.05	
23.2	0.65	0.07	2.21	1.48	0.42	0.33	1.20	0.25	64.0	0.04	1.00		3.05	
23.3	0.67	0.07	2.32	1.49	0.47	0.33		0.25	64.8	0.04	1.00		2.94	
23.4	0.67	0.08	2.30	1.51	0.47	0.33		0.26	64.5	0.05	1.00		2.90	
23.5	0.67	0.08	2.32	1.52	0.48	0.34		0.25	64.6	0.05	1.00		2.95	
23.2	0.67	0.07	2.30	1.50	0.47	0.33		0.25	64.7	0.05	1.00		2.92	
23.2	0.67	0.07	2.31	1.50	0.47	0.33		0.26	64.8	0.05	1.00		2.95	
23.4	0.67	0.07	2.29	1.52	0.49	0.32		0.25	64.7	0.05	1.00		2.97	
23.4	0.67	0.07	2.33	1.52	0.48	0.33		0.26	64.8	0.05	1.00		2.93	
23.4	0.68	0.08	2.32	1.51	0.47	0.33		0.24	64.6	0.05	1.00		2.95	
23.2	0.67		2.22	1.48	0.44	0.32			64.2	0.05	1.16		2.84	
23.1	0.66		2.21	1.48	0.43	0.32			64.1	0.05	1.10		2.86	
23.2	0.66		2.21	1.47	0.44	0.32			64.0	0.04	1.14		2.85	
23.1	0.65		2.19	1.48	0.43	0.32			64.1	0.04	1.10		2.97	
23.2	0.67		2.20	1.48	0.43	0.32			64.2	0.04	1.09		2.91	
23.2	0.67		2.22	1.48	0.44	0.32			64.2	0.05	1.14		2.97	
23.2	0.66		2.21	1.47	0.42	0.32			64.1	0.05	1.06		2.88	
23.2	0.66		2.20	1.46	0.43	0.32			64.1	0.04	1.12		2.96	

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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 ¹	σL ²	SW ³	CSU ⁴
Li	M/ICP	%	0.099	707	653	304
Li	Fus	ppm	1253	1282	541	490
Ta	M/ICP	ppm	22	23.58	8.00	9.70
Ta	Fus	ppm	12.05	11.10	6.75	4.30
Ta	XRF	ppm	21.4	21.46	5.92	7.63
Bi	M/ICP	ppm	3.96	4.08	1.50	1.55
Nb	Fus	ppm	3.60	2.93	2.48	1.16
Nb	M/ICP	ppm	12.06	14.29	4.21	6.43
Nb	XRF	ppm	5.57	5.78	1.72	2.20
Sn	Fus	ppm	10.37	9.46	7.02	4.00
Th	Fus	ppm	0.17	0.06	0.16	0.03
U	Fus	ppm	0.49	0.43	0.28	0.17
U	M/ICP	ppm	0.91	0.51	0.85	0.34
F	ISE	ppm	120.7	124.6	47.6	47.5
Al ₂ O ₃	XRF	%	0.242	0.208	0.089	0.067
CaO	XRF	%	0.016	0.014	0.007	0.004
Cr ₂ O ₃	XRF	%	0.014	0.012	0.004	0.004
Fe ₂ O ₃	XRF	%	0.052	0.048	0.016	0.016
K ₂ O	XRF	%	0.021	0.018	0.008	0.006
MgO	XRF	%	0.015	0.012	0.009	0.004
MnO	XRF	%	0.006	0.005	0.003	0.002
Na ₂ O	XRF	%	0.023	0.017	0.018	0.007
P ₂ O ₅	XRF	%	0.005	0.003	0.003	0.001
SiO ₂	XRF	%	0.469	0.389	0.203	0.125
TiO ₂	XRF	%	0.005	0.004	0.004	0.001
LOI		%	0.063	0.049	0.030	0.015
SG	pyc		0.042	0.028	0.025	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 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.

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13. Certified 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 Ms Margaret Fairhurst. The Certified values listed on p1 M/ICP (Nb, U, Li,Ta), FUS (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: AMIS0339 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, and Margaret M. Fairhurst, Thivhafuni Matodzi and Allan Freaser; accept no liability for any decisions or actions taken following the use of the reference material.

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22 December 2014

Amended – 13 February 2017-Certified by Allan Fraser M/ICP (Nb, U), FUS (Th, U)

Amended – 19 July 2017-Certified by Allan Fraser M/ICP (Li, Ta)

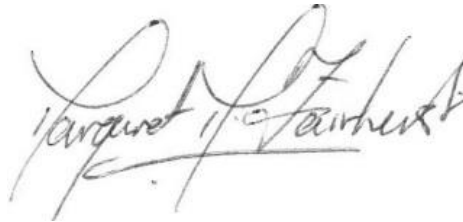
Amended– 24 January 2020- Amendment of COA title

Certifying Officers:



African Mineral Standards: _____

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



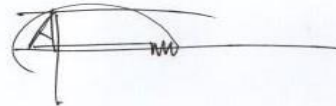
Geochemist: _____

Margaret M. Fairhurst, PG, MAusIMM
Oreval



African Mineral Standards: _____

Thivhafuni Matodzi



Geochemist: _____

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

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Appendix – uncertified element statistics

Analyte	Method	Unit	Mean	2SD	RSD%	n
Ag	M/ICP	ppm	0.77	1.0	64.6	16
Al	M/ICP	%	8.5	5.4	31.7	53
As	Fus	ppm	13.3	7.9	30.0	16
As	M/ICP	ppm	13.9	1.3	4.8	43
Ba	M/ICP	ppm	94.5	23.1	12.2	55
Be	M/ICP	ppm	65.1	8.8	6.8	46
Ca	M/ICP	%	0.43	0.13	15.3	54
Cd	M/ICP	ppm	0.17	0.09	26.2	23
Ce	M/ICP	ppm	1.3	1.0	38.6	32
Co	M/ICP	ppm	3.6	1.0	14.4	46
Cr	M/ICP	ppm	339	173	25.4	63
Cs	M/ICP	ppm	258	48.4	9.4	32
Cu	M/ICP	ppm	188	24.1	6.4	56
Dy	M/ICP	ppm	0.45	0.17	19.4	39
Er	M/ICP	ppm	0.16	0.09	28.4	31
Eu	M/ICP	ppm	0.05	0.01	8.9	14
Fe	M/ICP	%	1.5	0.24	8.2	52
Ga	M/ICP	ppm	86.5	10.2	5.9	45
Gd	M/ICP	ppm	0.43	0.19	22.7	31
Ge	M/ICP	ppm	3.8	6.4	83.7	16
Hf	M/ICP	ppm	1.5	0.31	10.4	45
Ho	M/ICP	ppm	0.06	0.0	0.0	7
K	M/ICP	%	1.2	0.16	6.9	53
La	M/ICP	ppm	0.72	0.66	45.9	51
Lu	M/ICP	ppm	0.02	0.01	13.4	15
Mg	M/ICP	%	0.20	0.10	26.5	52
Mn	M/ICP	ppm	2431	299	6.2	62
Mo	M/ICP	ppm	2.1	0.33	7.7	46
Na	M/ICP	%	0.93	0.10	5.3	53
Nd	M/ICP	ppm	0.68	0.40	29.5	31
Ni	M/ICP	ppm	16.2	4.6	14.3	64
P	M/ICP	ppm	910	293	16.1	40
Pb	M/ICP	ppm	6.2	3.2	25.5	40
Pr	M/ICP	ppm	0.18	0.10	27.5	30
Rb	M/ICP	ppm	1084	394	18.2	32
S	M/ICP	%	0.01	0.0	18.5	30
Sb	Fus	ppm	8.8	1.4	7.7	31
Sb	M/ICP	ppm	8.5	1.2	7.0	37
Sc	M/ICP	ppm	1.4	1.1	40.5	31
Si	M/ICP	%	29.8	0.36	0.61	8
Sm	M/ICP	ppm	0.33	0.17	26.5	31
Sn	M/ICP	ppm	96.8	21.7	11.2	38
Sr	M/ICP	ppm	24.1	8.3	17.1	55
Tb	M/ICP	ppm	0.10	0.04	20.2	36
Th	M/ICP	ppm	1.4	1.1	41.3	38
Th	XRF	ppm	23.4	6.2	13.3	8
Ti	M/ICP	%	0.03	0.01	15.9	40
Tl	M/ICP	ppm	9.8	0.8	4.1	44
U	XRF	ppm	6.8	3.9	28.7	24
V	M/ICP	ppm	11.9	3.2	13.5	45
V ₂ O ₅	XRF	%	0.005	0.004	38.6	21
W	M/ICP	ppm	2.6	0.6	12.7	46
Y	M/ICP	ppm	1.8	1.6	44.6	56
Yb	M/ICP	ppm	0.13	0.07	28.8	28
Zn	M/ICP	ppm	76.8	11.5	7.5	53
Zr	M/ICP	ppm	10.6	3.5	16.6	53

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