

AMIS0338

Certified Reference Material

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

Certificate of Analysis

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

Certified Concentrations²

Li M/ICP	1682	±	182	ppm
Nb Fus	20.3	±	1.90	ppm
Specific Gravity	2.7	±	0.07	

Provisional Concentrations

Ta Fus	43.6	±	9.8	ppm
As M/ICP	11.0	±	2.0	ppm
Li Fus	1742	±	429	ppm
Nb M/ICP	18.5	±	4.6	ppm
Sn M/ICP	35.6	±	7.0	ppm
F ISE	941	±	152	ppm

Informational Concentrations

Nb XRF	18	ppm
Ta M/ICP	40.1	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.

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

Certified Concentrations

Al ₂ O ₃	13.05	±	0.18	%
CaO	0.59	±	0.02	%
Fe ₂ O ₃	1.63	±	0.09	%
K ₂ O	3.71	±	0.06	%
MgO	0.41	±	0.03	%
MnO	1.00	±	0.03	%
Na ₂ O	3.30	±	0.08	%
P ₂ O ₅	0.16	±	0.01	%
SiO ₂	73.93	±	0.78	%

Provisional Concentrations

Cr ₂ O ₃	0.70	±	0.01	%
LOI	0.88	±	0.18	%

Informational Concentration

TiO ₂	0.040	%
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1. Intended Use: AMIS0338 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 Section 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: AMIS0338 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 Brownish Grey (5YR 6/2)

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. 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.

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 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. 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.

Assay Data -Economic Elements

Lab Code	Li Fus ppm	Li M/ICP ppm	Ta Fus ppm	Ta M/ICP ppm	As M/ICP ppm	Nb Fus ppm	Nb M/ICP ppm	Nb XRF ppm	Sn M/ICP ppm	F ISE ppm
C		1519	40.0	42.8	10.0	20.0	16.7	16.0	31.1	900
C		1578	40.0	42.8	10.0	20.0	17.7	15.0	32.8	900
C		1561	30.0	40.1	10.0	20.0	17.8	15.0	31.9	900
C		1478	30.0	40.7	10.0	10.0	17.0	16.0	31.6	1000
C		1656	40.0	43.6	11.0	20.0	17.4	16.0	34.3	900
C		1585	40.0	40.7	10.0	10.0	17.2	15.0	31.6	900
C		1592	40.0	44.4	10.0	10.0	18.8	15.0	33.8	900
C		1564	40.0	43.2	12.0	10.0	17.2	15.0	32.2	900
D					9.0			16.0	37.5	950
D					10.0			16.0	37.7	950
D					11.0			16.0	37.1	955
D					11.0			16.0	37.8	965
D					10.0			16.0	37.2	980
D					11.0			17.0	36.8	950
D					11.0			16.0	38.6	1030
D					10.0			16.0	37.9	935
E		1760	45.4			20.3				860
E		1810	42.4			18.7				780
E		1790	46.4			21.5				840
E		1780	43.4			18.7				780
E		1800	44.2			18.9				830
E		1830	52.6			23.3				820
E		1780	43.4			18.5				810
E		1790	42.7			18.5				840
G	1767							20.0		1010
G	1767							20.0		1000
G	1814							20.0		970
G	1767							20.0		980
G	1767							20.0		970

Assay Data (cont) Economic Elements

Lab Code	Li Fus ppm	Li M/ICP ppm	Ta Fus ppm	Ta M/ICP ppm	As M/ICP ppm	Nb Fus ppm	Nb M/ICP ppm	Nb XRF ppm	Sn M/ICP ppm	F ISE ppm
H	1597	1448	41.4	46.7	12.0	21.0	22.6		36.0	880
H	1648	1442	40.1	45.8	11.0	22.0	22.0		35.8	862
H	1682	1543	43.5	45.8	12.0	22.0	22.0		35.1	909
H	1594	1567	39.8	45.6	11.0	21.0	21.9		35.3	920
H	1620	1549	41.5	45.0	11.0	22.0	21.9		35.1	864
H	1671	1643	41.5	46.4	12.0	22.0	22.0		34.9	896
H	1628	1690	40.0	47.1	11.0	20.0	22.1		34.6	816
H	1626	1661	41.4	46.1	11.0	20.0	21.8		34.5	964
I	1710		50.0	29.6	12.9	20.0	15.8		35.0	
I	1710		50.0	25.1	11.4	20.0	15.2		35.0	
I	1710		50.0	19.3	11.5	20.0	14.6		34.0	
I	1700		50.0	30.1	11.8	20.0	17.1		35.0	
I	1740		50.0	28.5	11.9	20.0	15.7		35.0	
I	1760		60.0	30.5	11.7	20.0	17.8		35.0	
I	1750		50.0	25.2	10.6	20.0	14.8		35.0	
I	1780		50.0	27.9	11.4	20.0	16.1		35.0	
K										
K										
K										
K										
K										
K										
K										
K										
K										
L										
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L										
M		1640	47.5	70.0	12.0	20.0		10.0	50.0	1000
M		1700	49.0	80.0	10.0	20.0		20.0	40.0	1000
M		1730	47.5	70.0	10.0	20.0		20.0	50.0	900
M		1680	47.0	80.0	10.0	20.0		20.0	40.0	1000
M		1660	48.5	70.0	10.0	20.0		10.0	50.0	1000
M		1720	47.0	80.0	12.0	20.0		10.0	50.0	1000
M		1710	47.5	80.0	10.0	20.0		20.0	40.0	1000
M		1700	47.0	80.0	12.0	20.0		10.0	40.0	1000
N				55.8		21.0				
N				55.9		22.0				
N				52.6		20.0				
N				56.6		22.0				
N				52.6		19.0				
N				54.9		21.0				
N				54.6		19.0				
N				54.1		22.0				
O	2093									1100
O	2133									1600
O	2180									2100
O	2161									1400
O	2266									1800
O	2257									1300
O	2009									1800
O	2164									1400

Assay Data (cont) Economic Elements

Lab Code	Li Fus ppm	Li M/ICP ppm	Ta Fus ppm	Ta M/ICP ppm	As M/ICP ppm	Nb Fus ppm	Nb M/ICP ppm	Nb XRF ppm	Sn M/ICP ppm	F ISE ppm
P				43.5			22.5		40.0	
P				44.0			20.8		40.0	
P				44.2			20.5		40.0	
P				46.6			20.2		40.0	
P				46.0			20.6		42.0	
P				43.1			19.9		41.0	
P				43.4			20.2		39.0	
P				43.8			20.7		40.0	
Q	1449	1704	33.7	26.2	52.0	23.3	16.9	25.0		
Q	1389	1720	28.1	27.9	55.3	24.2	17.6	25.0		
Q	1397	1750	23.0	25.9	56.7	20.7	17.0	24.0		
Q	1343	1739	33.4	22.1	53.7	19.7	16.8	25.0		
Q	1323	1871	26.2	26.8	64.0	21.5	16.5	25.0		
Q	1417	1811	27.8	28.9	57.7	21.3	16.5	26.0		
Q	1438	1767	24.2	23.1	60.2	19.7	17.6	25.0		
Q	1519	1753	28.1	28.1	55.3	18.5	16.0	27.0		
R		1640		42.0	11.0		19.0		30.0	
R		1610		41.0	12.0		18.0		30.0	
R		1660		39.0	11.0		18.0		30.0	
R		1640		40.0	10.0		17.0		30.0	
R		1680		40.0	13.0		18.0		40.0	
R		1650		39.0	10.0		17.0		30.0	
R		1660		41.0	11.0		18.0		30.0	
R		1640		41.0	10.0		18.0		30.0	
T								17.0		
T								14.0		
T								17.0		
T								18.0		
T								16.0		
T								12.0		
T								15.0		
T								13.0		
U										1130
U										1103
U										1071
U										1022
U										1020
U										1129
U										985
U										1036
V	1803		39.0		13.0	23.0				
V	1931		37.0		13.0	21.0				
V	1871		39.0		10.0	21.0				
V	1925		42.0		15.0	20.0				
V	1835		43.0			20.0				
V	1816		42.0		15.0	20.0				
V	1847		43.0		12.0	21.0				
V	1885		42.0		16.0	20.0				

Assay Data – Major Oxides

Lab Code	Al ₂ O ₃ XRF %	CaO XRF %	Cr ₂ O ₃ XRF %	Fe ₂ O ₃ XRF %	K ₂ O XRF %	MgO XRF %	MnO XRF %	Na ₂ O XRF %	P ₂ O ₅ XRF %	SiO ₂ XRF %	TiO ₂ XRF %	LOI %	SG pyc
C	12.9	0.59	0.08	1.65	3.72	0.39	1.00	3.28	0.16	73.6	0.06	1.00	2.62
C	12.9	0.59	0.08	1.63	3.70	0.40	0.99	3.28	0.15	73.8	0.03	1.01	2.62
C	12.9	0.59	0.07	1.61	3.72	0.39	1.01	3.31	0.15	73.4	0.03	1.01	2.62
C	12.8	0.59	0.07	1.63	3.71	0.40	0.99	3.28	0.16	73.3	0.03	1.02	2.62
C	12.9	0.58	0.07	1.61	3.69	0.39	0.99	3.29	0.15	73.6	0.04	1.02	2.60
C	12.9	0.58	0.07	1.62	3.72	0.39	0.99	3.32	0.16	73.6	0.05	0.98	2.62
C	12.9	0.58	0.07	1.60	3.73	0.40	0.98	3.30	0.15	73.4	0.06	1.00	2.62
C	12.9	0.58	0.07	1.59	3.71	0.40	0.99	3.28	0.15	73.3	0.03	1.00	2.61
D	13.0	0.59	0.07	1.62	3.73	0.41	1.01	3.34		73.9	0.05	0.79	
D	13.0	0.59	0.08	1.63	3.71	0.41	1.00	3.33		73.9	0.04	0.79	
D	13.0	0.59	0.07	1.63	3.73	0.41	1.02	3.33		73.9	0.04	0.79	
D	13.0	0.59	0.08	1.62	3.71	0.41	1.03	3.36		73.9	0.04	0.79	
D	13.0	0.60	0.07	1.64	3.73	0.41	1.00	3.35		73.9	0.04	0.79	
D	13.0	0.59	0.07	1.63	3.74	0.41	1.02	3.32		73.9	0.04	0.80	
D	13.0	0.60	0.07	1.62	3.74	0.43	1.02	3.35		73.8	0.05	0.79	
D	13.0	0.59	0.07	1.63	3.71	0.40	1.02	3.34		73.9	0.04	0.79	
E	13.0	0.58	0.07	1.60	3.71	0.42	1.01	3.28	0.16	73.9	0.04	0.85	2.77
E	13.0	0.57	0.07	1.60	3.68	0.42	1.00	3.25	0.16	73.6	0.04	0.83	2.78
E	13.0	0.58	0.07	1.60	3.70	0.42	1.01	3.28	0.16	73.9	0.04	0.90	2.72
E	13.0	0.57	0.06	1.60	3.69	0.42	1.01	3.26	0.16	73.6	0.04	0.86	2.80
E	13.0	0.58	0.07	1.60	3.71	0.42	1.01	3.28	0.16	73.9	0.04	0.88	2.78
E	13.1	0.58	0.07	1.61	3.73	0.42	1.02	3.29	0.16	74.2	0.04	0.83	2.63
E	13.0	0.57	0.06	1.59	3.68	0.41	1.00	3.26	0.16	73.5	0.04	0.90	2.79
E	13.0	0.58	0.07	1.60	3.70	0.42	1.01	3.27	0.16	73.9	0.04	0.85	2.70
G	13.0	0.59	0.07	1.63	3.77	0.40	1.01	3.23	0.16	73.6	0.03	0.84	2.71
G	12.9	0.59	0.07	1.64	3.75	0.41	1.01	3.25	0.16	73.8	0.04	0.83	2.71
G	13.0	0.59	0.07	1.64	3.76	0.39	1.02	3.26	0.16	74.1	0.05	0.84	2.69
G	13.0	0.59	0.08	1.62	3.76	0.39	1.03	3.23	0.16	74.0	0.04	0.84	2.73
G	12.8	0.59	0.07	1.64	3.77	0.41	1.02	3.23	0.16	73.7	0.04	0.84	2.78
G	13.1	0.60	0.07	1.64	3.76	0.41	1.03	3.25	0.16	74.3	0.04	0.83	2.74
G	13.1	0.60	0.06	1.62	3.78	0.41	1.02	3.26	0.16	74.1	0.03	0.85	2.70
G	13.0	0.59	0.06	1.63	3.78	0.39	1.01	3.23	0.16	73.7	0.04	0.84	2.73
H	13.2	0.60	0.07	1.61	3.71	0.42	1.02	3.30	0.16	74.3	0.04	1.00	2.69
H	13.1	0.59	0.07	1.61	3.71	0.42	1.02	3.31	0.16	74.2	0.04	1.00	2.71
H	13.1	0.59	0.07	1.62	3.69	0.41	1.02	3.31	0.16	74.4	0.04	1.00	2.69
H	13.1	0.59	0.07	1.63	3.71	0.41	1.02	3.31	0.16	74.4	0.04	1.00	2.70
H	13.1	0.59	0.07	1.62	3.70	0.42	1.02	3.33	0.16	74.5	0.04	1.00	2.69
H	13.1	0.59	0.07	1.64	3.72	0.41	1.02	3.30	0.16	74.4	0.04	1.00	2.68
H	13.1	0.59	0.07	1.63	3.69	0.42	1.02	3.33	0.16	74.6	0.04	1.00	2.67
H	13.1	0.59	0.07	1.62	3.72	0.42	1.02	3.32	0.16	74.4	0.04	1.00	2.72
I	13.0	0.60	0.07	1.73	3.72	0.40	1.03	3.29	0.16	74.9	0.05	0.91	2.73
I	13.1	0.60	0.06	1.74	3.76	0.41	1.03	3.33	0.17	75.2	0.05	0.90	2.72
I	13.0	0.61	0.06	1.75	3.73	0.40	1.03	3.34	0.17	75.3	0.05	0.93	2.74
I	13.1	0.61	0.08	1.75	3.71	0.39	1.02	3.32	0.16	75.1	0.05	0.94	2.72
I	13.0	0.60	0.07	1.74	3.76	0.41	1.02	3.32	0.17	75.2	0.05	0.92	2.73
I	13.0	0.59	0.06	1.72	3.70	0.39	1.02	3.26	0.17	74.9	0.05	0.96	2.72
I	13.1	0.60	0.06	1.77	3.72	0.40	1.02	3.28	0.17	75.1	0.05	0.94	2.72
I	13.1	0.62	0.06	1.77	3.74	0.39	1.02	3.32	0.16	75.1	0.05	0.95	2.71
K													2.66
K													2.63
K													2.64
K													2.62
K													2.67
K													2.62
K													2.64
K													2.65
L													2.60
L													2.63
L													2.57
L													2.58
L													2.61
L													2.59
L													2.63
L													2.58
M	13.1	0.59	0.07	1.62	3.69	0.44	0.99		0.17	73.5	0.05	0.88	2.73
M	13.1	0.58	0.07	1.62	3.69	0.45	0.99		0.17	73.5	0.04	0.87	2.74
M	13.1	0.58	0.07	1.62	3.71	0.45	1.00		0.17	73.5	0.04	0.86	2.73
M	13.1	0.58	0.07	1.62	3.69	0.45	1.00		0.16	73.6	0.04	0.85	2.72
M	13.2	0.59	0.07	1.63	3.72	0.44	1.00		0.17	73.6	0.05	0.86	2.72
M	13.1	0.59	0.07	1.63	3.72	0.46	1.00		0.16	73.5	0.05	0.88	2.73
M	13.2	0.59	0.07	1.63	3.72	0.45	1.00		0.16	73.6	0.04	0.86	2.73
M	13.1	0.59	0.07	1.62	3.72	0.45	1.00		0.16	73.6	0.05	0.84	2.73

Assay Data – Major Oxides (cont.)

Lab Code	Al ₂ O ₃ XRF %	CaO XRF %	Cr ₂ O ₃ XRF %	Fe ₂ O ₃ XRF %	K ₂ O XRF %	MgO XRF %	MnO XRF %	Na ₂ O XRF %	P ₂ O ₅ XRF %	SiO ₂ XRF %	TiO ₂ XRF %	LOI %	SG pyc
N												1.04	2.67
N												1.06	2.67
N												1.05	2.68
N												1.05	2.66
N												1.09	2.68
N												1.08	2.66
N												1.04	2.67
N												1.09	2.67
O	13.2	0.58	0.07	1.58	3.72	0.37	0.99	3.52	0.17	74.8	0.04	0.82	2.71
O	13.1	0.57	0.07	1.56	3.64	0.39	0.97	3.51	0.17	73.7	0.04	0.80	2.71
O	13.1	0.58	0.06	1.55	3.66	0.40	0.98	3.48	0.17	74.1	0.04	0.82	2.71
O	13.2	0.57	0.07	1.65	3.70	0.39	0.98	3.53	0.17	74.7	0.04	0.80	2.71
O	13.2	0.57	0.07	1.58	3.69	0.40	0.97	3.51	0.17	74.3	0.04	0.84	2.71
O	13.2	0.57	0.07	1.58	3.72	0.38	0.98	3.52	0.16	74.7	0.04	0.80	2.72
O	13.1	0.58	0.07	1.69	3.69	0.38	0.98	3.50	0.17	74.4	0.04	0.80	2.71
O	13.1	0.57	0.06	1.57	3.66	0.39	0.97	3.50	0.17	74.2	0.04	0.80	2.71
P	13.1	0.58	0.06	1.56	3.69	0.41	1.01	3.23	0.16	73.5	0.04	0.82	2.72
P	13.2	0.59	0.07	1.63	3.76	0.42	0.99	3.30	0.16	75.0	0.04	0.74	2.71
P	13.2	0.58	0.07	1.58	3.71	0.43	1.02	3.28	0.17	73.9	0.05	0.79	2.72
P	13.2	0.59	0.07	1.60	3.73	0.42	1.00	3.26	0.16	74.3	0.05	0.72	2.71
P	13.1	0.57	0.07	1.56	3.68	0.42	1.00	3.23	0.16	73.3	0.04	0.77	2.67
P	13.1	0.57	0.07	1.56	3.66	0.41	1.00	3.22	0.16	73.3	0.04	0.77	2.71
P	13.1	0.58	0.08	1.59	3.65	0.42	1.02	3.22	0.16	73.6	0.04	0.81	2.71
P	13.1	0.59	0.06	1.57	3.65	0.43	1.01	3.39	0.16	73.2	0.04	0.79	2.70
Q	13.2	0.59	0.06	1.91	3.70	0.30	1.10		0.18	73.6	0.03	0.94	2.72
Q	13.2	0.59	0.05	1.75	3.73	0.28	1.11		0.18	74.1	0.03	0.95	2.69
Q	13.2	0.59	0.05	1.77	3.67	0.28	1.10		0.18	73.6	0.03	0.94	2.70
Q	13.3	0.60	0.05	1.74	3.75	0.32	1.11		0.18	74.3	0.03	0.92	2.72
Q	13.1	0.58	0.05	1.74	3.71	0.26	1.11		0.18	73.8	0.03	0.93	2.69
Q	13.3	0.56	0.05	1.76	3.71	0.32	1.11		0.17	74.4	0.03	0.92	2.70
Q	13.3	0.59	0.05	1.81	3.79	0.29	1.11		0.18	75.1	0.03	0.96	2.71
Q	13.3	0.59	0.05	1.77	3.72	0.27	1.11		0.18	74.7	0.03	0.95	2.69
R	13.0	0.63	0.04	1.67	3.65	0.43	0.97	3.36	0.17	74.1	0.05	0.70	
R	13.0	0.63	0.05	1.70	3.68	0.43	0.98	3.32	0.17	74.2	0.05	0.70	
R	13.0	0.63	0.05	1.68	3.67	0.44	0.98	3.35	0.17	74.0	0.05	0.80	
R	13.0	0.62	0.04	1.67	3.67	0.42	0.98	3.34	0.16	74.0	0.05	0.70	
R	13.0	0.63	0.03	1.67	3.68	0.42	0.98	3.36	0.16	74.4	0.04	0.80	
R	13.0	0.63	0.03	1.68	3.67	0.44	0.99	3.29	0.17	74.3	0.04	0.90	
R	13.0	0.63	0.04	1.67	3.66	0.43	0.99	3.36	0.16	74.3	0.04	0.80	
R	13.0	0.62	0.03	1.68	3.66	0.42	0.98	3.35	0.16	74.0	0.04	0.80	
T													
T													
T													
T													
T													
T													
T													
T													
U												0.88	2.70
U												0.86	2.69
U												0.92	2.69
U												0.87	2.72
U												0.88	2.69
U												0.85	2.69
U												0.93	2.72
U												0.90	2.71
V													2.67
V													2.65
V													2.65
V													2.66
V													2.64
V													2.65
V													2.63
V													2.62

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	σ _L ²	Sw ³	CSU ⁴
Li	Fus	ppm	214	257	45	105
Li	M/ICP	ppm	91	99	43	41
Ta	Fus	ppm	4.92	5.18	2.60	2.15
Ta	M/ICP	ppm	9.8	10.98	1.99	4.16
As	M/ICP	ppm	0.98	0.51	0.87	0.23
Nb	Fus	ppm	0.96	0.48	0.83	0.20
Nb	M/ICP	ppm	2.29	2.73	0.71	1.12
Nb	XRF	ppm	4.22	4.30	2.40	1.79
Sn	M/ICP	ppm	3.51	3.47	1.54	1.33
F	ISE	ppm	75.8	76.0	34.1	29.1
Al ₂ O ₃	XRF	%	0.091	0.067	0.047	0.021
CaO	XRF	%	0.009	0.006	0.005	0.002
Cr ₂ O ₃	XRF	%	0.004	0.002	0.004	0.001
Fe ₂ O ₃	XRF	%	0.048	0.040	0.020	0.013
K ₂ O	XRF	%	0.029	0.018	0.020	0.006
MgO	XRF	%	0.013	0.011	0.007	0.004
MnO	XRF	%	0.017	0.015	0.007	0.005
Na ₂ O	XRF	%	0.040	0.037	0.020	0.013
P ₂ O ₅	XRF	%	0.005	0.004	0.004	0.001
SiO ₂	XRF	%	0.392	0.280	0.249	0.093
TiO ₂	XRF	%	0.006	0.004	0.004	0.001
LOI		%	0.089	0.068	0.027	0.019
SG	pyc		0.035	0.024	0.021	0.007

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

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: AMIS0338 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, Set Point Technology (Pty) Ltd (a part of Torre Industries), Nozibele Mbangula, and Margaret M. Fairhurst; accept no liability for any decisions or actions taken following the use of the reference material.

21 September 2015

Certifying Officers:



African Mineral Standards: _____
Nozibele Mbangula



Geochemist: _____
Margaret M. Fairhurst, PG, MAusIMM
Oreval

Appendix – uncertified element statistics

Analyte	Method	Unit	Mean	2SD	RSD%	n
Ag	M/ICP	ppm	3.3	0.70	10.5	57
Al	M/ICP	%	6.0	1.5	12.8	55
As	M/ICP	ppm	10.7	1.8	8.3	54
Ba	M/ICP	ppm	203	30.9	7.6	55
Be	M/ICP	ppm	109	16.4	7.6	47
Bi	Fus	ppm	10.1	1.0	5.1	23
Bi	Fus	ppm	10.1	2.8	13.7	44
Ca	M/ICP	%	0.40	0.07	9.2	54
Cd	M/ICP	ppm	0.11	0.04	20.5	11
Ce	M/ICP	ppm	3.0	0.55	9.2	38
Co	M/ICP	ppm	4.8	1.3	13.9	51
Cr	M/ICP	ppm	316	139	22.0	60
Cs	M/ICP	ppm	264	34.0	6.4	32
Cu	M/ICP	ppm	1948	170	4.4	60
Dy	M/ICP	ppm	0.39	0.12	15.9	32
Er	M/ICP	ppm	0.20	0.0	0.0	29
Eu	M/ICP	ppm	0.10	0.03	17.9	29
Fe	M/ICP	%	1.1	0.13	5.8	53
Ga	M/ICP	ppm	33.2	1.7	2.6	38
Gd	M/ICP	ppm	0.40	0.10	12.7	32
Hf	M/ICP	ppm	0.93	0.18	9.6	47
Ho	M/ICP	ppm	0.07	0.02	13.4	16
K	M/ICP	%	2.9	0.25	4.3	54
La	M/ICP	ppm	1.4	0.59	20.7	48
Lu	M/ICP	ppm	0.03	0.01	18.6	15
Mg	M/ICP	%	0.24	0.04	8.4	53
Mn	M/ICP	ppm	7345	941	6.4	63
Mo	M/ICP	ppm	4.2	0.89	10.7	55
Na	M/ICP	%	2.4	0.18	3.9	53
Nd	M/ICP	ppm	1.3	0.43	15.9	32
Ni	M/ICP	ppm	14.0	4.4	15.9	60
P	M/ICP	ppm	697	60.0	4.3	37
Pb	M/ICP	ppm	15.2	4.5	14.7	45
Pr	M/ICP	ppm	0.36	0.11	14.5	32
Rb	M/ICP	ppm	3318	708	10.7	16
S	M/ICP	%	0.06	0.01	9.8	37
Sb	Fus	ppm	4.2	0.90	10.8	24
Sb	M/ICP	ppm	4.0	0.87	11.0	43
Sc	M/ICP	ppm	1.0	0.00	0.0	35
Si	M/ICP	%	34.2	0.35	0.5	8
Sm	M/ICP	ppm	0.36	0.12	16.2	29
Sr	M/ICP	ppm	43.7	23.1	26.5	55
Ta	XRF	ppm	48.1	13.5	14.0	22
Tb	M/ICP	ppm	0.07	0.02	10.7	16
Ti	M/ICP	%	0.03	0.01	12.2	40
Th	Fus	ppm	1.4	0.33	11.7	40
Th	M/ICP	ppm	1.4	0.23	8.3	40
Tl	M/ICP	ppm	26.0	2.7	5.1	46
U	Fus	ppm	2.1	0.7	15.8	40
U	M/ICP	ppm	1.8	0.4	9.6	44
U	XRF	ppm	7.3	1.9	13.2	15
V	M/ICP	ppm	9.7	2.5	12.9	40
W	M/ICP	ppm	1.4	0.64	22.6	48
Y	M/ICP	ppm	2.2	0.59	13.5	52
Yb	M/ICP	ppm	0.21	0.03	7.4	30
Zn	M/ICP	ppm	50.2	9.0	9.0	54
Zr	M/ICP	ppm	12.1	2.4	9.9	54