African Mineral Standards
MATRIX REFERENCE MATERIALS

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AMIS0355

Lithium tantalum tin bearing pegmatite, Volta Grande, Brazil

Certified Reference Material

Certificate of Analysis

Recommended Concentrations and Limits[1. 2.]
(at two Standard Deviations)

Certified Concentrations

Li FUS	7696	±	521	ppm
Li M/ICP	7343	±	828	ppm
Ta XRF	207	±	18	ppm
Sn FUS	469	±	32	ppm
Sn XRF	487	±	43	ppm
Nb M/ICP	49	±	6	ppm
Rb FUS	3639	±	360	ppm
Rb M/ICP	3422	±	286	ppm
Specific Gravity	2.76	±	0.12	

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

Provisional Concentrations

Ta FUS	210	±	41	ppm
Sn M/ICP	75	±	18	ppm
Nb FUS	47	±	7	ppm
Be M/ICP	156	±	24	ppm
Th FUS	4.7	±	0.9	ppm
Th M/ICP	4.4	±	1.1	ppm
U FUS	5.6	±	0.9	ppm

Indicated Mean

U M/ICP	5.1	ppm

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

Certified Concentrations

Al_2O_3	15.49	±	0.24	%
CaO	0.67	±	0.02	%
Fe_2O_3	1.80	±	0.04	%
K_2O	1.58	±	0.04	%
MgO	1.50	±	0.04	%
MnO	0.13	±	0.01	%
Na_2O	3.53	±	0.30	%
P_2O_5	0.10	±	0.01	%
SiO2	71.79	±	0.90	%

Provisional Concentrations

Cr_2O_3	0.04	±	0.01	%
TiO_2	0.07	±	0.01	%
LOI	0.92	±	0.18	%

1. Intended Use: AMIS0355 is a certified reference material which may be used to demonstrate the validity of measurement results of a single analysis of lithium-tantalum-tin bearing pegmatite's.

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 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: The material for AMIS0355 was provided by CIF Mineração S.A. ("CIF"), a subsidiary of AMG Advanced Metallurgical Group N.V. It is from the Volta Grande tantalum, niobium, and tin mine ("Volta Grande") in Minas Gerais state, Brazil. This mine also produces albite and feldspar products for the ceramic industry as an important by-product of mining. CIF has been mining this deposit for the last forty five years.

The Volta Grande pegmatites occur in the Archaean Barbacena greenstone belt on the southern border of the São Francisco craton. The Volta Grande pegmatites form six sub-horizontal tabular bodies characterized by coarse to very coarse-grained spodumene, quartz, albite, microcline, and muscovite.

3. Mineral and Chemical Composition: The primary orebody consists of quartz, albite, spodumene, zinnwaldite, microcline, and lesser amounts of apatite, garnet, tantalite, microlite and cassiterite.

4. Appearance: The material is a very fine powder. It is colored Light Blueish Grey (Corstor 5B 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 partic**l**e 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 randomly 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 & Sn. Fusion, ICP-OES or ICP-MS.
2. Multi element scan. Multi-acid digest, ICP-OES or ICP-MS.
3. Li, Ta & Sn. XRF.
4. Majors (Al_2O_3, CaO, Cr_2O_3, Fe_2O_3, K_2O, MgO, MnO, Na_2O, SiO_2, TiO_2, V_2O_5. LOI.) XRF fusion.
5. SG, gas pycnometer.

8. Information requested:

1. State aliquots used for all determinations.
2. All results for major elements to be reported as oxides in percentages.
3. All results for multi-element scans to be reported in ppm.
4. Report all QC data, to include replicates, blanks and certified reference materials used.
5. State and provide brief description of analytical techniques used.

9. Method of Certification: Twenty three laboratories were each given eight randomly selected packages of sample. Twenty of the laboratories submitted results in time for certification.

Final limits were calculated after first determining if all data was compatible within a spread normally expected for similar analytical methods done by reputable laboratories. Data from any one laboratory was then removed from further calculations when the mean of all analyses from that laboratory failed a "t test" of the global means of the other laboratories. The means and standard deviations were then re-calculated using all remaining data. Any analysis that fell outside of the new two standard deviations was removed from the ensuing data base. The mean and standard deviations were again calculated using the remaining data.

The "between-laboratory" standard deviation is used in the calculation to eliminate technically and statistically invalid data. Upper and lower limits are based on the standard deviation of the remaining data, which reflect individual analyses and can be used to monitor accuracy in routine laboratory quality control. This is different to limits based on standard deviations derived from grouped set of analyses (see 12), which provide important measures for precision and trueness, but which are less useful for routine QC.

Standards with an RSD of near or less than 5 % are termed "Certified", RSD's of between near 5 % and 15 % are termed "Provisional", and RSD's over 15 % are termed "Informational".

10. Participating Laboratories: The 20 out of 23 laboratories that provided results timeously were (not in same order as in the table of assays):

1. ACME Analytical Laboratories Ltd CA
2. Activation Laboratories Pty Ltd (ActLabs) CA
3. ALS Ammtec (Australia)
4. ALS Chemex Laboratory Group Brisbane Australia
5. ALS Chemex Laboratory Group Perth WA
6. ALS Chemex Laboratory Group Vancouver CA
7. ALS OMAC (Ireland)
8. ANSTO Minerals Laboratory (Australia)
9. Bureau Veritas (Namibia)
10. BV Amdel (Australia)
11. Genalysis Laboratory Services (S Australia A)
12. Genalysis Laboratory Services (W Australia P)
13. Intertek Utama Services (Indonesia)
14. Set Point Laboratories (Isando) SA
15. SGS Australia Pty Ltd (Newburn) WA
16. SGS Geosol Laboratories Ltda (Brazil)
17. SGS Mineral Services Lakefield (Canada)
18. SGS Toronto (Canada)

19. SGS Townsville (Australia)
20. 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 M/ICP ppm	Li FUS ppm	Ta M/ICP ppm	Ta FUS ppm	Ta XRF ppm	Sn M/ICP ppm	Sn FUS ppm	Sn XRF ppm	Nb M/ICP ppm	Nb FUS ppm	Rb M/ICP ppm	Rb FUS ppm	Be M/ICP ppm	Be FUS ppm	Th M/ICP ppm	Th FUS ppm	U M/ICP ppm	U FUS ppm
A		7530		210		62.50			51.00		3400		125		3.74		1.44	
A		7770		168		81.20			49.00		3490		123		3.94		2.27	
A		7890		154		80.40			48.10		3490		127		4.50		2.07	
A		7530		203		66.40			50.70		3430		115		4.39		2.48	
A		7420		217		65.40			52.20		3470		118		4.36		1.85	
A		7600		215		66.00			51.80		3480		117		4.01		1.58	
A		7890		223		78.80			53.40		3730		123		4.47		1.72	
A		7910		223		67.10			52.80		3460		115		4.04		1.95	
B	7150			203		66.30	441		45.20	42.00	3420	3460	141		4.10	4.50	4.70	5.10
B	7200			212		67.40	454		46.30	40.70	3440	3500	147		4.20	4.70	5.00	5.30
B	7210			201		67.30	437		47.80	37.60	3390	3500	149		4.30	4.50	5.00	5.60
B	7170			207		65.90	460		47.50	44.20	3410	3560	146		4.30	4.90	4.80	5.70
B	7260			199		70.50	441		51.00	40.50	3390	3270	154		4.00	4.30	4.90	5.10
B	7200			213		69.40	454		49.20	43.50	3500	3410	149		4.30	4.70	5.00	5.20
B	7100			213		68.70	464		48.60	44.90	3460	3450	148		4.40	4.90	4.80	5.40
B	6820			227		64.90	466		47.30	42.30	3340	3690	142		4.20	5.20	4.80	5.60
C	6996	9511	214	194	218			458	46.00	45.40	3236		151	165				
C	7112	9386	216	203	211			451	46.90	45.40	3483		150	165				
C	7028	9500	212	195	210			452	46.00	43.00	3311		146	156				
C	7087	9380	214	197	211			453	47.10	46.20	3137		154	164				
C	7103	9401	212	205	196			463	46.10	45.70	3226		158	161				
C	7087	9250	216	196	212			445	46.20	46.80	3096		157	161				
C	6910	9388	211	195	188			471	46.70	46.20	3343		158	156				
C	7108	9502	212	199	197			462	46.80	44.60	3147		160	164				
D		8110		230	206		570	390		55.00			163		4.01		4.55	
D		7930		225	203		480	374		40.00			160		4.09		5.31	
D		7970		210	207		490	391		50.00			152		4.31		4.83	
D		7890		210	208		480	391		60.00			150		3.40		4.32	
D		7820		210	195		480	384		80.00			145		3.96		4.90	
D		7880		215	202		480	386		65.00			148		3.63		4.77	
D		8010		225	205		480	385		65.00			152		4.29		5.28	
D		7790		205	201		470	389		70.00			147		4.02		5.12	
E	6890				240			500	53.60		3000		148		3.30		3.60	
E	6950				220			500	55.00		3030		149		3.40		4.10	
E	6980				250			510	54.30		2810		146		3.20		4.20	
E	6960				190			510	54.10		3100		149		3.90		4.70	
E	7040				220			510	53.40		2880		149		3.00		4.00	
E	6850				240			510	53.70		3050		147		3.70		4.70	
E	6700				230			460	52.70		2890		146		3.40		4.40	
E	6660				210			470	52.80		2820		144		3.30		4.30	
F			213						49.00		3380				4.70		5.50	
F			210						48.00		3340				4.80		5.40	
F			212						47.50		3370				4.80		5.50	
F			215						49.00		3380				4.70		5.70	
F			210						50.00		3360				4.90		5.70	
F			215						49.00		3370				4.60		5.40	
F			215						49.00		3360				4.70		5.40	
F			216						49.00		3350				4.70		5.50	
G	7530	8440	29	235	220	69.00	480	480		49.50		3090	168	267	5.90	5.00	4.20	5.50
G	7560	8910	25	226	210	71.00	478	500		49.00		3360	169	289	5.30	4.30	4.20	5.10
G	8080	8880	26	242	210	68.00	462	460		51.50		3370	167	279	5.10	5.10	4.40	5.40
G	7380	9050	28	242	210	75.00	455	480		53.00		3420	158	287	5.20	5.00	4.20	5.30
G	7650	9090	22	244	220	73.00	474	500		53.30		3400	162	286	4.70	4.90	4.00	5.30
G	7390	8930	33	258	210	75.00	463	500		56.10		3340	158	285	5.50	4.80	4.30	5.40
G	7310	9110	29	249	210	72.00	445	470		53.50		3400	151	278	4.90	5.00	4.20	5.20
G	7610	9140	27	252	230	70.00	453	470		54.40		3380	168	282	4.60	4.80	4.20	5.30
H	7874	7790	197	189		86.50	471		48.30	49.00	3644	3769	181	170	4.89	4.60	6.32	5.30
H	7889	7965	197	185		83.10	483		48.40	48.00	3516	3773	182	166	4.72	4.50	6.11	5.20
H	7782	7827	198	182		89.10	476		49.70	47.00	3503	3681	181	172	4.72	4.60	5.88	5.50
H	7738	7902	195	183		86.00	467		47.30	49.00	3343	3772	181	164	5.05	4.10	6.16	5.10
H	7786	8159	198	197		99.00	472		48.40	48.00	3693	3759	177	171	5.08	4.50	6.47	5.30
H	8049	8211	202	186		99.20	478		50.90	47.00	3804	3752	185	177	5.16	4.50	6.30	5.20
H	7761	8308	195	192		88.90	476		48.40	48.00	3511	3724	182	174	4.62	4.40	5.98	4.80
H	8063	8035	204	189		88.90	478		49.50	46.00	3726	3708	188	172	4.81	4.60	6.41	5.10
I	6570					68.40			51.40		3210		144		4.20		5.20	
I	7060					73.40			54.80		3390		161		4.10		5.40	
I	7150					70.70			52.90		3500		154		4.30		5.40	
I	7160					70.60			56.60		3490		157		4.40		5.50	
I	6860					67.10			50.60		3270		141		4.00		5.00	
I	7130					71.50			55.20		3400		156		4.30		5.60	
I	6780					61.50			47.60		3280		132		4.20		4.90	
I	6760					62.60			47.90		3270		134		4.00		5.00	

Assay Data (cont): Economic elements

Lab Code	Li M/ICP ppm	Li FUS ppm	Ta M/ICP ppm	Ta FUS ppm	Ta XRF ppm	Sn M/ICP ppm	Sn FUS ppm	Sn XRF ppm	Nb M/ICP ppm	Nb FUS ppm	Rb M/ICP ppm	Rb FUS ppm	Be M/ICP ppm	Be FUS ppm	Th M/ICP ppm	Th FUS ppm	U M/ICP ppm	U FUS ppm
J	7710		218					516	44.00									
J	7730		200					516	46.00									
J	7740		214					519	46.00									
J	7720		218					515	47.00									
J	7730		215					520	46.00									
J	7740		212					518	46.00									
J	7760		215					513	46.00									
J	7650		210					517	47.00									
K	7650	6394	57	199	214	79.24	477	501		49.00	4878				5.33		4.27	
K	7727	6510	47	197	216	80.30	483	478		45.00	5094				5.12		3.69	
K	7828	6360	158	194	213	101.08	461	502		46.00	5384				5.04		5.25	
K	7605	6373	48	188	211	79.77	464	482		43.00	5160				5.21		4.02	
K	8040	6514	97	199	213	112.50	490	462		45.00	5298				5.00		4.68	
K	7903	6387	91	213	210	119.65	488	504		47.00	5460				5.31		5.37	
K	7945	6712	50	194	212	82.60	484	473		41.00	5428				5.02		4.09	
K	7470	6490	137	192	209	127.52	485	464		45.00	8439				7.84		5.75	
L					400													
L					300													
L					300													
L					300													
L					400													
L					300													
L					300													
L					300													
M	7150					70.80			54.10		3330		151		3.40		5.00	
M	6950					68.30			52.20		3280		148		3.70		5.10	
M	7040					68.90			53.30		3090		152		3.30		4.80	
M	7090					70.40			54.60		3330		157		3.50		5.00	
M	7000					69.30			54.10		3260		156		3.50		5.10	
M	7310					73.10			56.90		3500		162		4.10		5.60	
M	7120					70.20			53.80		3400		159		3.90		5.40	
M	6990					69.30			53.30		3310		153		3.60		5.00	
N		7400		246	200		440	480	50.50		3440		151		5.50		6.10	
N		7460		240	200		450	470	46.00		3470		151		4.80		5.70	
N		7480		251	200		470	480	46.50		3530		150		4.50		5.60	
N		7840		250	200		460	480	48.50		3660		152		4.20		5.40	
N		7430		247	200		440	470	49.50		3640		154		4.30		5.50	
N		7460		249	200		460	470	45.50		3570		149		4.80		5.40	
N		7780		252	200		460	470	45.50		3790		159		4.60		5.70	
N		7750		242	200		480	480	47.00		3710		160		4.70		5.70	
P				200						45.00		3545	220			5.00		6.50
P				165						35.00		3095	215			4.00		5.50
P				205						50.00		3925	245			5.50		6.50
P				180						40.00		3330	205			5.00		6.00
P				200						45.00		3960	205			5.00		6.50
P				210						45.00		3975	215			5.00		6.50
P				180						40.00		3405	230			4.50		6.00
P				180						35.00		3540	255			5.00		6.00
R	6900	7500		200	200		480	500										
R	6600	7740		200	200		490	500										
R	6800	7420		200	200		490	500										
R	6800	7710		200	200		500	500										
R	7000	7330		200	200		470	500										
R	6800	7730		200	200		490	500										
R	6700	7170		200	200		480	500										
R	6800	7350		200	200		490	500										
S		7300		237			500		43.50			3646	153			6.00		6.00
S		7500		242			450		42.00			3663	155			6.00		6.00
S		7600		233			450		43.50			3670	155			4.00		6.00
S		7500		233			450		42.00			3654	163			4.00		6.00
S		7700		242			500		41.50			3872	161			6.00		6.00
S		7200		220			450		45.00			3496	155			4.00		6.00
S		7500		228			450		42.00			3608	164			4.00		6.00
S		7600		228			450		40.50			3579	152			4.00		6.00
T	7320	7380	147	217		84.20	460		49.10	50.00	3320	3870	146	159	4.00	5.70	3.66	6.30
T	7290	7580	169	202		84.60	437		50.90	43.00	3200	3890	140	158	3.70	5.50	3.73	6.06
T	7600	7530	137	219		79.30	449		47.20	49.00	3400	3760	145	155	4.20	5.40	3.90	6.17
T	7460	7480	147	217		88.20	468		49.40	50.00	3290	3830	144	155	3.90	5.70	3.69	6.12
T	7380	7320	149	215		85.30	454		48.80	50.00	3140	3680	141	152	3.70	5.40	3.27	5.95
T	7390	7600	189	212		88.50	458		51.90	51.00	3460	3730	145	155	3.80	5.20	3.75	6.00
T	7530	7570	157	207		87.10	460		48.90	48.00	3380	3780	143	158	4.10	5.50	3.76	6.30
T	7500	7540	153	211		83.00	458		48.40	48.00	3280	3730	139	158	4.10	5.50	3.61	6.18
U	7874	7790	197	189		86.50	471		48.30	49.00	3644	3769	181	170	4.89	4.60	6.32	5.30
U	7889	7965	197	185		83.10	483		48.40	48.00	3516	3773	182	166	4.72	4.50	6.11	5.20
U	7782	7827	198	182		89.10	476		49.70	47.00	3503	3681	181	172	4.72	4.60	5.88	5.50
U	7738	7902	195	183		86.00	467		47.30	49.00	3343	3772	181	164	5.05	4.10	6.16	5.10
U	7786	8159	198	197		99.00	472		48.40	48.00	3693	3759	177	171	5.08	4.50	6.47	5.30
U	8049	8211	202	186		99.20	478		50.90	47.00	3804	3752	185	177	5.16	4.50	6.30	5.20
U	7761	8308	195	192		88.90	476		48.40	48.00	3511	3724	182	174	4.62	4.40	5.98	4.80
U	8063	8035	204	189		88.90	478		49.50	46.00	3726	3708	188	172	4.81	4.60	6.41	5.10

Assay data: Major elements

Lab Code	Al2O3 XRF %	CaO XRF %	Fe2O3 XRF %	K2O XRF %	MgO XRF %	MnO XRF %	Na2O XRF %	P2O5 XRF %	SiO2 XRF %	Cr2O3 XRF %	TiO2 XRF %	LOI %	S COMB/LECO %	SG Pyc
A														2.84
A														2.85
A														2.84
A														2.84
A														2.83
A														2.85
A														2.85
A														2.84
B		0.61	1.78	1.51	1.47	0.12	3.21	0.08	66.40	0.04	0.06	1.26		2.79
B		0.61	1.77	1.48	1.46	0.12	3.16	0.10	66.80	0.04	0.06	1.17		2.82
B		0.67	1.70	1.03	1.51	0.13	3.22	0.10	67.80	0.03	0.06	1.83		2.78
B		0.59	1.68	1.43	1.49	0.12	3.19	0.09	67.30	0.04	0.06	1.47		2.79
B		0.65	1.72	1.57	1.51	0.13	3.34	0.10	68.20	0.04	0.06	1.32		2.77
B		0.62	1.67	1.51	1.52	0.12	3.23	0.10	67.60	0.04	0.06	1.40		2.79
B		0.60	1.69	1.52	1.52	0.12	3.26	0.09	67.60	0.04	0.07	1.25		2.82
B		0.65	1.68	1.54	1.48	0.12	3.27	0.10	67.00	0.04	0.06	1.15		2.78
C	15.44	0.68	1.74	1.57	1.44	0.14	3.93	0.10	71.91	0.04	0.07	1.04		2.77
C	15.50	0.67	1.74	1.56	1.42	0.14	3.96	0.10	71.67	0.04	0.07	1.01		2.77
C	15.49	0.67	1.75	1.58	1.43	0.14	3.96	0.10	71.52	0.04	0.07	1.02		2.78
C	15.51	0.67	1.72	1.58	1.45	0.15	3.99	0.10	71.26	0.04	0.07	1.02		2.78
C	15.54	0.67	1.72	1.57	1.42	0.14	3.97	0.10	71.55	0.04	0.07	1.02		2.77
C	15.48	0.67	1.74	1.58	1.45	0.14	3.97	0.09	71.19	0.04	0.07	1.03		2.78
C	15.47	0.67	1.74	1.57	1.44	0.14	3.96	0.10	71.23	0.04	0.07	1.03		2.78
C	15.49	0.67	1.71	1.57	1.43	0.14	3.98	0.10	70.95	0.04	0.07	1.05		2.78
D	15.50	0.67	1.81	1.58	1.50	0.14	3.62	0.10	72.50	0.04	0.07	0.87		
D	15.50	0.67	1.79	1.57	1.51	0.13	3.60	0.10	72.50	0.04	0.07	0.88		
D	15.50	0.67	1.82	1.56	1.51	0.13	3.59	0.10	72.40	0.04	0.07	0.88		
D	15.50	0.67	1.81	1.58	1.51	0.14	3.63	0.09	72.60	0.04	0.07	0.86		
D	15.50	0.68	1.83	1.58	1.51	0.14	3.60	0.09	72.50	0.04	0.07	0.87		
D	15.50	0.67	1.80	1.58	1.52	0.13	3.60	0.09	72.60	0.04	0.07	0.84		
D	15.50	0.67	1.82	1.57	1.51	0.14	3.62	0.09	72.50	0.04	0.07	0.82		
D	15.50	0.66	1.82	1.58	1.51	0.14	3.64	0.09	72.50	0.04	0.07	0.83		
E	15.55	0.66	1.80	1.58	1.50	0.13	3.17	0.09	71.70	0.04	0.06	0.94	0.04	2.76
E	15.45	0.66	1.78	1.56	1.48	0.13	3.19	0.09	71.20	0.04	0.06	0.87	0.04	2.74
E	15.35	0.66	1.76	1.58	1.50	0.13	3.22	0.10	71.30	0.04	0.06	0.86	0.04	2.73
E	15.35	0.65	1.75	1.54	1.46	0.12	3.21	0.09	70.80	0.04	0.06	0.92	0.03	2.74
E	15.35	0.66	1.76	1.55	1.47	0.12	3.24	0.09	70.80	0.03	0.06	0.85	0.04	2.71
E	15.45	0.66	1.78	1.56	1.48	0.13	3.17	0.09	71.40	0.04	0.06	0.92	0.04	2.82
E	15.35	0.65	1.76	1.55	1.46	0.13	3.09	0.09	70.90	0.04	0.06	0.85	0.04	2.74
E	15.40	0.66	1.78	1.56	1.46	0.13	3.06	0.09	71.00	0.04	0.06	0.87	0.04	2.73
F	15.30	0.67	1.79	1.60	1.49	0.13	4.38	0.11	71.00	0.05	0.07			2.91
F	15.30	0.67	1.80	1.59	1.48	0.13	4.38	0.11	71.90	0.05	0.07			2.91
F	15.30	0.67	1.79	1.59	1.48	0.14	4.38	0.11	71.70	0.05	0.07			2.89
F	15.20	0.67	1.80	1.60	1.49	0.14	4.38	0.11	71.70	0.05	0.07			2.89
F	15.20	0.67	1.80	1.59	1.49	0.13	4.38	0.11	71.90	0.05	0.07			2.92
F	15.20	0.67	1.80	1.59	1.49	0.14	4.38	0.11	71.40	0.05	0.07			2.92
F	15.30	0.67	1.80	1.59	1.49	0.13	4.38	0.11	71.40	0.05	0.07			2.92
F	15.40	0.67	1.80	1.60	1.48	0.14	4.38	0.11	71.40	0.05	0.07			2.89
G	15.19	0.64	1.85	1.61	1.41	0.13	3.32	0.09	72.24	0.05	0.06	1.12		2.78
G	15.24	0.63	1.88	1.60	1.39	0.13	3.31	0.09	72.39	0.05	0.07	1.10		2.73
G	15.19	0.65	1.86	1.57	1.41	0.13	3.34	0.10	71.86	0.05	0.07	1.08		2.77
G	15.38	0.65	1.86	1.59	1.43	0.14	3.29	0.09	72.24	0.05	0.07	1.03		2.80
G	15.34	0.63	1.84	1.60	1.45	0.13	3.31	0.09	71.44	0.05	0.07	1.12		2.75
G	15.30	0.67	1.85	1.58	1.48	0.13	3.52	0.10	71.25	0.05	0.08	1.23		2.76
G	15.48	0.66	1.83	1.58	1.50	0.13	3.51	0.11	71.55	0.05	0.07	1.28		2.73
G	15.26	0.66	1.82	1.58	1.47	0.13	3.49	0.10	70.97	0.05	0.08	1.27		2.85
H	15.38	0.65	1.77	1.56	1.49	0.13	3.51	0.10	71.39	0.04	0.07	0.91		
H	15.42	0.65	1.76	1.55	1.49	0.13	3.51	0.10	71.24	0.04	0.07	0.89		
H	15.46	0.66	1.78	1.57	1.49	0.13	3.53	0.10	71.55	0.04	0.07	0.90		
H	15.43	0.65	1.76	1.55	1.49	0.13	3.52	0.10	71.22	0.04	0.06	0.90		
H	15.39	0.65	1.76	1.56	1.49	0.13	3.52	0.10	71.44	0.04	0.07	0.90		
H	15.53	0.66	1.79	1.57	1.50	0.13	3.55	0.10	71.53	0.04	0.07	0.89		
H	15.38	0.65	1.77	1.55	1.49	0.13	3.51	0.10	71.24	0.04	0.07	0.89		
H	15.49	0.65	1.76	1.57	1.50	0.13	3.55	0.10	71.51	0.04	0.06	0.90		
I	15.80	0.66	1.78	1.56	1.52	0.13	3.56	0.10	73.70	0.03	0.06	0.86		2.65
I	15.70	0.67	1.78	1.58	1.52	0.12	3.53	0.10	73.80	0.03	0.06	0.86		2.72
I	15.75	0.66	1.80	1.57	1.51	0.12	3.54	0.10	73.80	0.03	0.06	0.80		2.70
I	15.85	0.66	1.78	1.57	1.50	0.13	3.57	0.10	73.60	0.03	0.06	0.88		2.69
I	15.80	0.67	1.79	1.59	1.55	0.14	3.59	0.10	73.50	0.04	0.06	0.88		2.69
I	15.75	0.67	1.82	1.60	1.53	0.13	3.60	0.10	73.70	0.04	0.06	0.89		2.70
I	15.75	0.65	1.80	1.57	1.51	0.12	3.55	0.10	73.80	0.03	0.06	0.87		2.72
I	15.75	0.66	1.90	1.57	1.54	0.15	3.56	0.10	73.40	0.04	0.06	0.86		2.70

Assay data (cont): Major elements

Lab Code	Al2O3 XRF %	CaO XRF %	Fe2O3 XRF %	K2O XRF %	MgO XRF %	MnO XRF %	Na2O XRF %	P2O5 XRF %	SiO2 XRF %	Cr2O3 XRF %	TiO2 XRF %	LOI %	S COMB/LECO %	SG Pyc
I	15.80	0.66	1.78	1.56	1.52	0.13	3.56	0.10	73.70	0.03	0.06	0.86		2.65
I	15.70	0.67	1.78	1.58	1.52	0.12	3.53	0.10	73.80	0.03	0.06	0.86		2.72
I	15.75	0.66	1.80	1.57	1.51	0.12	3.54	0.10	73.80	0.03	0.06	0.80		2.70
I	15.85	0.66	1.78	1.57	1.50	0.13	3.57	0.10	73.60	0.03	0.06	0.88		2.69
I	15.80	0.67	1.79	1.59	1.55	0.14	3.59	0.10	73.50	0.04	0.06	0.88		2.69
I	15.75	0.67	1.82	1.60	1.53	0.13	3.60	0.10	73.70	0.04	0.06	0.89		2.70
I	15.75	0.65	1.80	1.57	1.51	0.12	3.55	0.10	73.80	0.03	0.06	0.87		2.72
I	15.75	0.66	1.90	1.57	1.54	0.15	3.56	0.10	73.40	0.04	0.06	0.86		2.70
J	15.44	0.67	1.85	1.59	1.49	0.13	3.50	0.10	72.08	0.06	0.07	0.80		
J	15.41	0.67	1.86	1.59	1.49	0.13	3.51	0.10	71.76	0.06	0.07	0.80		
J	15.51	0.67	1.84	1.59	1.49	0.14	3.52	0.10	72.16	0.03	0.07	0.80		
J	15.44	0.67	1.83	1.58	1.50	0.13	3.52	0.10	71.85	0.04	0.07	0.90		
J	15.43	0.67	1.84	1.59	1.49	0.13	3.51	0.10	71.84	0.06	0.08	0.90		
J	15.45	0.68	1.84	1.59	1.50	0.13	3.51	0.10	71.94	0.04	0.07	0.90		
J	15.47	0.68	1.83	1.59	1.52	0.13	3.57	0.10	72.18	0.06	0.07	0.90		
J	15.31	0.67	1.82	1.58	1.49	0.13	3.51	0.10	71.62	0.04	0.07	0.90		
K	15.37	0.70	1.81	1.59	1.46	0.13	3.85	0.09	71.92	0.04	0.07	0.91		2.68
K	15.38	0.68	1.78	1.59	1.47	0.13	3.79	0.10	72.23	0.04	0.07	0.92		2.65
K	15.38	0.72	1.79	1.59	1.44	0.13	3.79	0.11	72.39	0.04	0.07	1.00		2.63
K	15.45	0.68	1.80	1.59	1.45	0.13	3.82	0.10	72.05	0.04	0.08	1.01		2.71
K	15.52	0.66	1.79	1.58	1.48	0.13	3.87	0.11	72.25	0.04	0.07	0.96		2.65
K	15.60	0.68	1.84	1.63	1.50	0.14	3.88	0.11	72.30	0.04	0.06	0.92		2.65
K	15.46	0.67	1.84	1.62	1.50	0.13	3.75	0.10	72.18	0.04	0.07	0.93		2.71
K	15.41	0.67	1.81	1.58	1.48	0.13	3.78	0.10	71.98	0.04	0.07	0.90		2.71
L	15.50	0.67	1.78	1.57	1.43	0.13	3.48	0.10	71.30	0.04	0.06	1.06		
L	15.60	0.67	1.80	1.59	1.46	0.14	3.52	0.11	71.80	0.04	0.06	1.02		
L	15.60	0.68	1.81	1.59	1.45	0.13	3.53	0.10	71.90	0.04	0.06	1.03		
L	15.40	0.67	1.81	1.58	1.43	0.13	3.48	0.10	71.10	0.05	0.06	1.09		
L	15.50	0.68	1.81	1.59	1.45	0.14	3.51	0.10	71.20	0.05	0.06	0.91		
L	15.40	0.67	1.82	1.58	1.45	0.14	3.48	0.10	71.50	0.05	0.06	1.04		
L	15.60	0.67	1.82	1.57	1.45	0.14	3.40	0.10	71.90	0.06	0.06	1.04		
L	15.60	0.68	1.81	1.60	1.46	0.14	3.49	0.10	71.90	0.04	0.06	1.00		
M	15.50	0.67	1.80	1.60	1.49	0.13	3.58	0.10	72.28	0.03	0.06	0.85		2.89
M	15.46	0.68	1.79	1.59	1.49	0.13	3.52	0.10	72.35	0.04	0.07	0.86		2.82
M	15.46	0.67	1.78	1.60	1.49	0.13	3.53	0.10	72.32	0.04	0.07	0.86		2.81
M	15.51	0.67	1.80	1.59	1.50	0.13	3.56	0.10	72.26	0.04	0.06	0.87		2.91
M	15.50	0.67	1.80	1.59	1.49	0.13	3.54	0.10	72.30	0.03	0.07	0.88		2.79
M	15.51	0.67	1.80	1.60	1.49	0.13	3.54	0.10	72.28	0.04	0.07	0.86		2.90
M	15.47	0.67	1.80	1.59	1.50	0.13	3.53	0.10	72.29	0.03	0.06	0.88		2.71
M	15.47	0.67	1.80	1.59	1.50	0.13	3.54	0.10	72.30	0.03	0.07	0.86		2.73
N	15.53	0.66	1.79	1.58	1.49	0.14	3.56	0.11	71.86	0.04	0.07	0.89		2.84
N	15.45	0.66	1.79	1.58	1.50	0.13	3.57	0.11	71.88	0.04	0.07	0.92		2.85
N	15.49	0.66	1.78	1.58	1.48	0.13	3.46	0.10	71.85	0.04	0.07	0.92		2.84
N	15.48	0.67	1.80	1.58	1.50	0.13	3.48	0.10	71.84	0.04	0.07	0.90		2.85
N	15.50	0.66	1.78	1.59	1.50	0.12	3.49	0.13	71.84	0.04	0.07	0.91		2.85
N	15.52	0.67	1.80	1.58	1.49	0.13	3.52	0.13	71.90	0.04	0.07	0.92		2.85
N	15.53	0.67	1.80	1.58	1.50	0.13	3.60	0.11	71.94	0.04	0.07	0.89		2.86
N	15.50	0.66	1.79	1.58	1.50	0.13	3.50	0.10	71.90	0.04	0.07	0.90		2.84
O	15.53	0.62	1.79	1.59	1.51	0.13	3.49	0.10	72.06	0.04	0.07	1.91		
O	15.62	0.62	1.79	1.60	1.50	0.13	3.48	0.10	72.40	0.05	0.07	1.44		
O	15.66	0.62	1.81	1.63	1.49	0.13	3.45	0.10	72.45	0.04	0.07	1.37		
O	15.63	0.63	1.80	1.59	1.51	0.13	3.49	0.10	72.27	0.05	0.07	1.59		
O	15.55	0.62	1.80	1.58	1.50	0.13	3.44	0.10	71.96	0.04	0.07	2.06		
O	15.65	0.62	1.80	1.61	1.51	0.13	3.50	0.10	72.31	0.04	0.07	1.50		
O	15.64	0.61	1.81	1.60	1.51	0.13	3.50	0.10	72.55	0.04	0.08	1.29		
O	15.59	0.61	1.81	1.60	1.51	0.13	3.46	0.10	72.12	0.04	0.06	1.75		
P	15.72	0.68	1.78	1.56	1.56	0.14	3.84	0.09	73.47	0.04	0.07	0.79	0.03	2.73
P	15.73	0.68	1.77	1.55	1.54	0.14	3.80	0.10	73.54	0.04	0.07	0.81	0.03	2.73
P	15.76	0.67	1.77	1.55	1.55	0.14	3.82	0.10	73.45	0.06	0.07	0.81	0.03	2.73
P	15.75	0.68	1.79	1.55	1.55	0.14	3.78	0.10	73.54	0.03	0.07	0.79	0.03	2.74
P	15.73	0.68	1.77	1.56	1.55	0.14	3.85	0.10	73.42	0.04	0.07	0.85	0.03	2.74
P	15.71	0.68	1.76	1.55	1.54	0.14	3.85	0.10	73.53	0.03	0.07	0.80	0.03	2.75
P	15.73	0.68	1.76	1.55	1.53	0.14	3.78	0.10	73.59	0.04	0.07	0.80	0.03	2.74
P	15.72	0.68	1.78	1.55	1.55	0.14	3.83	0.10	73.53	0.03	0.07	0.78	0.03	2.75
R	15.43	0.66	1.84	1.55	1.54	0.13	3.61	0.09	71.80	0.05	0.04	1.16	0.03	2.65
R	15.43	0.65	1.78	1.56	1.56	0.13	3.61	0.10	71.60	0.04	0.05	1.16	0.03	2.66
R	15.46	0.65	1.80	1.55	1.55	0.13	3.60	0.10	71.70	0.05	0.05	1.13	0.03	2.64
R	15.47	0.65	1.80	1.56	1.54	0.13	3.61	0.09	71.70	0.04	0.08	1.14	0.03	2.64
R	15.42	0.65	1.79	1.58	1.55	0.13	3.61	0.09	71.40	0.04	0.07	1.15	0.03	2.63
R	15.48	0.65	1.81	1.54	1.55	0.13	3.57	0.09	71.90	0.05	0.04	1.11	0.03	2.64
R	15.46	0.65	1.77	1.57	1.54	0.13	3.61	0.10	71.60	0.04	0.05	1.10	0.03	2.63
R	15.41	0.66	1.79	1.56	1.53	0.13	3.60	0.10	71.70	0.04	0.06	1.09	0.04	2.65

Assay data (cont): Major elements

Lab Code	Al2O3 XRF %	CaO XRF %	Fe2O3 XRF %	K2O XRF %	MgO XRF %	MnO XRF %	Na2O XRF %	P2O5 XRF %	SiO2 XRF %	Cr2O3 XRF %	TiO2 XRF %	LOI %	S COMB/LECO %	SG Pyc
S									71.80					2.70
S									71.20					2.67
S									72.20					2.75
S									71.00					2.75
S									72.20					2.75
S									71.20					2.76
S									72.00					2.76
S									71.60					2.77
T														2.79
T														2.79
T														2.80
T														2.78
T														2.78
T														2.77
T														2.79
T														2.78
U	15.38	0.65	1.77	1.56	1.49	0.13	3.51	0.10	71.39	0.04	0.07	0.91	0.04	2.73
U	15.42	0.65	1.76	1.55	1.49	0.13	3.51	0.10	71.24	0.04	0.07	0.89	0.04	2.81
U	15.46	0.66	1.78	1.57	1.49	0.13	3.53	0.10	71.55	0.04	0.07	0.90	0.04	2.81
U	15.43	0.65	1.76	1.55	1.49	0.13	3.52	0.10	71.22	0.04	0.06	0.90	0.04	2.82
U	15.39	0.65	1.76	1.56	1.49	0.13	3.52	0.10	71.44	0.04	0.07	0.90	0.04	2.72
U	15.53	0.66	1.79	1.57	1.50	0.13	3.55	0.10	71.53	0.04	0.07	0.89	0.04	2.78
U	15.38	0.65	1.77	1.55	1.49	0.13	3.51	0.10	71.24	0.04	0.07	0.89	0.04	2.76
U	15.49	0.65	1.76	1.57	1.50	0.13	3.55	0.10	71.51	0.04	0.06	0.90	0.04	2.79

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))

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	ppm	413.8	328.2	146.9	95.91
Li	FUS	ppm	260.6	210.9	164.5	77.45
Ta	FUS	ppm	20.48	14.89	8.572	4.218
Ta	XRF	ppm	8.890	6.161	6.955	2.517
Sn	M/ICP	ppm	8.769	8.107	3.809	2.908
Sn	FUS	ppm	15.86	9.834	11.83	3.383
Sn	XRF	ppm	21.37	20.06	12.21	7.757
Nb	M/ICP	ppm	2.793	1.992	1.473	0.595
Nb	FUS	ppm	3.344	2.692	2.074	0.989
Rb	M/ICP	ppm	142.8	92.16	100.3	31.36
Rb	FUS	ppm	179.8	148.1	122.2	58.41
Th	M/ICP	ppm	0.568	0.412	0.241	0.117
Th	FUS	ppm	0.472	0.442	0.254	0.171
U	M/ICP	ppm	0.791	0.615	0.308	0.180
U	FUS	ppm	0.472	0.483	0.210	0.185
Be	M/ICP	ppm	12.15	9.069	5.310	2.676
Al2O3	XRF	%	0.118	0.074	0.053	0.019
CaO	XRF	%	0.010	0.006	0.005	0.002
Cr2O3	XRF	%	0.005	0.003	0.003	0.001
Fe2O3	XRF	%	0.023	0.014	0.013	0.004
K2O	XRF	%	0.016	0.010	0.009	0.003
MgO	XRF	%	0.025	0.016	0.012	0.004
MnO	XRF	%	0.004	0.002	0.002	0.001
Na2O	XRF	%	0.150	0.106	0.039	0.028
P2O5	XRF	%	0.005	0.003	0.003	0.001
SiO2	XRF	%	0.445	0.267	0.265	0.073
TiO2	XRF	%	0.005	0.003	0.003	0.001
LOI		%	0.091	0.066	0.030	0.018
SG	pyc		0.060	0.040	0.028	0.011

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. *S_W - 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.

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: AMIS0355 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. Laboratory Packs are sealed bottles delivered in sealed foil pouches. Explorer Packs contain material in standard geochem envelopes, nitrogen flushed and vacuum sealed in foil pouches.

19. Recommended use: The data used to characterize this CRM has been scrutinized using outlier treatment techniques. This, together with the number of participating laboratories, should overcome any "inter-laboratory issues" and should lead to a very accurate measure for the given methods; notwithstanding the underlying assumption that what the good inter-laboratory labs reported was accurate. However an amount of bad data might have had an effect, resulting in limits which in some situations might be too broad for the effective monitoring of a single analytical method, laboratory or production process. Users should therefore set their own limits based on their own data quality objectives and control measurements, after determining the performance characteristics of their own particular method, using a minimum of 20 analyses using this CRM. User set limits should normally be within the limits recommended on p1 and 2 of this certificate.

20. Legal Notice: This certificate and the reference material described in it have been prepared with due care and attention. However AMIS, Set Point Technology (Pty) Ltd, Mike McWha, Dr Barry Smee and Smee and Associates Ltd; accept no liability for any decisions or actions taken following the use of the reference material.

3 January 2013

Certifying Officers:

African Mineral Standards: _____

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

Geochemist: _____

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

Appendix – uncertified trace element statistics

Analyte	Method	Unit	Mean	2SD	RSD%	n
Al	M/ICP	%	7.45	1.38	9.27	112
As	M/ICP	ppm	1.62	1.19	36.6	70
Ba	M/ICP	ppm	33.2	10.2	15.4	112
Be	FUS	ppm	165	14.5	4.38	32
Bi	M/ICP	ppm	0.96	0.23	11.9	101
Ca	M/ICP	%	0.46	0.05	5.90	118
Cd	M/ICP	ppm	0.07	0.10	79.2	36
Ce	M/ICP	ppm	4.98	3.65	36.7	100
Co	M/ICP	ppm	50.7	6.04	5.96	120
Cr	M/ICP	ppm	224	117.8	26.3	129
Cs	M/ICP	ppm	258	32.5	6.29	88
Cu	M/ICP	ppm	335	21.5	3.21	119
Dy	M/ICP	ppm	0.83	0.32	19.4	70
Er	M/ICP	ppm	0.20	0.04	10.6	64
Eu	M/ICP	ppm	0.06	0.07	57.6	68
Fe	M/ICP	%	1.21	0.11	4.61	133
Ga	M/ICP	ppm	71.6	12.6	8.81	111
Gd	M/ICP	ppm	1.05	0.22	10.5	70
Ge	M/ICP	ppm	2.44	6.19	127	64
Hf	M/ICP	ppm	2.84	0.36	6.33	101
Ho	M/ICP	ppm	0.06	0.09	69.3	62
In	M/ICP	ppm	0.15	0.67	225	46
K	M/ICP	%	1.26	0.19	7.37	114
La	M/ICP	ppm	2.66	1.91	35.9	108
Lu	M/ICP	ppm	0.02	0.05	144	64
Mg	M/ICP	%	0.85	0.13	7.63	98
Mn	M/ICP	ppm	995	91.2	4.59	125
Mo	M/ICP	ppm	1.26	0.31	12.4	81
Na	M/ICP	%	2.62	0.43	8.27	96
Nd	M/ICP	ppm	2.12	0.93	21.9	69
Ni	M/ICP	ppm	146	16.3	5.59	120
P	M/ICP	ppm	434	81.3	9.36	96
Pb	M/ICP	ppm	7.07	2.54	18.0	96
Pr	M/ICP	ppm	0.60	0.26	22.1	60
Re	M/ICP	ppm	1.65	6.71	203	35
S	M/ICP	%	0.04	0.01	17.9	65
S	Comb/LECO	%	0.04	0.01	12.6	32
Sb	M/ICP	ppm	0.34	0.15	22.0	95
Sc	M/ICP	ppm	1.99	0.35	8.69	79
Se	M/ICP	ppm	0.47	1.01	109	30
Si	M/ICP	%	31.9	3.39	5.30	32
Sm	M/ICP	ppm	1.16	0.48	20.6	72
Sr	M/ICP	ppm	30.2	29.7	49.2	114
Ta	M/ICP	ppm	207	16.3	3.93	40
Tb	M/ICP	ppm	0.26	0.09	16.5	72
Te	M/ICP	ppm	0.09	0.07	40.5	39
Ti	M/ICP	%	0.04	0.003	4.47	104
Tl	M/ICP	ppm	26.5	10.1	19.0	88
Tm	M/ICP	ppm	10.1	25.7	127	48
V	M/ICP	ppm	15.2	2.41	7.90	81
W	M/ICP	ppm	1.66	0.58	17.6	89
Y	M/ICP	ppm	4.07	1.31	16.1	115
Yb	M/ICP	ppm	0.22	0.09	19.3	63
Zn	M/ICP	ppm	85.3	15.1	8.86	104
Zr	M/ICP	ppm	17.5	4.50	12.9	105