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AMIS0344

Certified Reference Material

**Uraniferous Alaskite Ore,
Rössing Uranium Mine, Namibia**

Certificate of Analysis

Recommended Concentrations and Limits¹ (at two Standard Deviations)

Certified Concentrations²

U M/ICP	221	±	26	ppm
U XRF	226	±	19	ppm
Ca M/ICP	2.070	±	0.179	%
Ca XRF	2.090	±	0.052	%
Nb M/ICP	22.4	±	2.4	ppm
Specific Gravity	2.68	±	0.08	

Provisional Concentration

Ta M/ICP	2.0	±	0.4	ppm
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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 (Mixed XRF and ICP data)

Al ₂ O ₃	12.81	±	0.14	%
CaO	2.92	±	0.08	%
Cr ₂ O ₃	0.076	±	0.008	%
Fe ₂ O ₃	3.29	±	0.06	%
K ₂ O	4.29	±	0.04	%
MgO	2.48	±	0.06	%
MnO	0.11	±	0.01	%
Na ₂ O	3.37	±	0.06	%
P ₂ O ₅	0.13	±	0.01	%
SiO ₂	67.98	±	0.36	%
TiO ₂	0.41	±	0.02	%

Provisional Concentrations³

BaO	0.018	±	0.004	%
U ₃ O ₈	0.025	±	0.004	%
V ₂ O ₅	0.012	±	0.002	%

Indicated Concentration

LOI 2.160 %

1. **Intended Use:** AMIS0344 can be used to check analysis of samples of uraniferous alaskite 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 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:** AMIS0344 was supplied by Rio Tinto Limited from their Rössing Uranium Mine situated 70km north-east of Swakopmund in Namibia. The uranium mineralisation is associated with Neoproterozoic Damara Orogen syntactic alaskitic granites that display concordant, discordant and replacement relationships to the heavily folded host gniesses, marbles and limestones of the Khan and Rössing Formations.

3. Mineral and Chemical Composition: The uranium bearing minerals are mainly uraninite and its alteration products, and minor betafite.

4. Appearance: The material is a very fine Light Grey powder (Corstor 5Y 7/1).

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

7. Methods of Analysis requested:

1. Multi-acid digest, including HF, ICP- OES or ICP-MS. Multi element scan to include U.
2. U – XRF.
3. Majors (Al₂O₃, CaO, Cr₂O₃, Fe₂O₃, K₂O, MgO, MnO, Na₂O, SiO₂, TiO₂.) XRF fusion.
4. LOI.
5. SG – Gas Pycnometer

8. Information requested:

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

9. Method of Certification: Thirty five 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 25 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 Johannesburg SA
6. ALS Chemex Laboratory Group Perth WA
7. ALS OMAC (Ireland)
8. Chromatech Services
9. Genalysis Laboratory Services (W Australia P)
10. Performance Laboratories FS (Allanridge)
11. Performance Laboratories SA (Randfontein)
12. Rossing Uranium Limited
13. Set Point Laboratories (Isando) SA
14. SGS Australia Pty Ltd (Newburn) WA
15. SGS Geosol Laboratories Ltda (Brazil)
16. SGS Mineral Services Lakeland (Canada)
17. SGS South Africa (Pty) Ltd – Booyens
18. SGS Toronto (Canada)
19. SGS Vancouver (Canada)
20. Ultra Trace (Pty) Ltd WA

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

Lab Code	U M/ICP ppm	U XRF ppm	Ca M/ICP ppm	Ca XRF ppm	Nb M/ICP ppm	Ta M/ICP ppm	Al2O3 XRF %	BaO XRF %	CaO XRF %	Cr2O3 XRF %	Fe2O3 XRF %	K2O XRF %	LOI %	MgO XRF %	MnO XRF %	Na2O XRF %	P2O5 XRF %	SiO2 XRF %	TiO2 XRF %	U3O8 XRF %	V2O5 XRF %	SG pyc	
A	213		18200		21.70	2.12																	2.68
A	237		20100		23.00	2.36																	2.69
A	204		18300		21.00	2.05																	2.67
A	213		18100		20.70	2.06																	2.73
A	218		18700		21.00	2.06																	2.71
A	206		18200		19.40	1.92																	2.68
A	218		17600		21.50	2.04																	2.68
A	211		17100		20.70	2.02																	2.68
B	214	224	21800	20807	22.10	2.16	12.80	0.02	2.91	0.08	3.37	4.26	2.45	2.47	0.12	3.33	0.13	67.80	0.40		0.02	2.70	
B	200	219	21100	20807	21.50	2.10	12.85	0.02	2.91	0.08	3.30	4.25	2.54	2.44	0.12	3.31	0.13	67.80	0.39		0.01	2.68	
B	202	225	21100	20878	21.40	2.10	12.90	0.02	2.92	0.08	3.27	4.25	2.44	2.45	0.12	3.35	0.13	68.60	0.40		0.01	2.64	
B	196	223	20500	20807	22.10	2.05	12.80	0.02	2.91	0.08	3.27	4.25	2.36	2.45	0.12	3.34	0.13	67.90	0.40		0.01	2.70	
B	204	224	20500	20664	21.90	2.10	12.75	0.02	2.89	0.08	3.26	4.25	2.78	2.43	0.11	3.30	0.13	68.00	0.40		0.01	2.66	
B	189	223	20300	20878	21.90	1.84	12.75	0.02	2.92	0.08	3.32	4.27	2.36	2.45	0.12	3.33	0.13	67.90	0.40		0.01	2.68	
B	199	221	20500	20592	21.60	2.14	12.70	0.02	2.88	0.07	3.25	4.24	2.66	2.46	0.11	3.26	0.13	67.30	0.39		0.01	2.74	
B	195	222	19600	20878	20.70	2.20	12.85	0.02	2.92	0.08	3.35	4.26	2.45	2.46	0.12	3.31	0.13	68.00	0.40		0.01	2.69	
C	193	300	19600	20521	22.20	2.10	12.64	0.02	2.87	0.08	3.24	4.26	2.76	2.52	0.12	3.37	0.12	66.90	0.39		0.01	2.61	
C	181	304	19000	20521	20.40	1.90	12.71	0.02	2.87	0.08	3.26	4.31	2.75	2.52	0.11	3.43	0.12	67.10	0.40		0.01	2.62	
C	175	288	18900	20521	23.00	2.20	12.71	0.01	2.87	0.08	3.25	4.25	2.71	2.53	0.11	3.40	0.12	67.10	0.41		0.01	2.64	
C	188	292	20600	20735	21.30	2.20	12.71	0.02	2.90	0.08	3.29	4.17	2.72	2.54	0.12	3.39	0.12	67.30	0.38		0.01	2.63	
C	183	296	20000	20664	24.70	2.30	12.73	0.02	2.89	0.08	3.27	4.21	2.71	2.53	0.12	3.37	0.12	67.40	0.38		0.01	2.62	
C	180	293	19200	20807	24.10	2.20	12.64	0.02	2.91	0.08	3.27	4.18	2.70	2.51	0.12	3.35	0.12	67.00	0.38		0.02	2.61	
C	184	300	19800	20735	22.30	1.90	12.72	0.01	2.90	0.08	3.25	4.28	2.67	2.52	0.11	3.42	0.12	67.40	0.39		0.02	2.64	
C	175	297	19500	20521	20.70	1.90	12.68	0.02	2.87	0.08	3.24	4.29	2.69	2.51	0.11	3.41	0.12	67.10	0.40		0.01	2.63	
D	239		19500		22.50	2.31																	
D	243		19600		22.10	1.89																	
D	236		19400		22.10	2.16																	
D	246		19500		22.20	1.99																	
D	231		19400		21.60	1.94																	
D	231		19500		21.40	1.85																	
D	239		19400		22.10	1.92																	
D	234		19600		21.70	1.89																	
E	216		20000	20807	22.90	2.10	12.80	0.02	2.91	0.07	3.28	4.28	1.79	2.43	0.11	3.37		68.10	0.39		0.01	2.56	
E	212		19400	20878	21.90	1.98	12.90	0.02	2.92	0.07	3.27	4.28	1.79	2.45	0.10	3.37		68.10	0.39		0.01	2.57	
E	195		20600	20878	22.00	2.05	12.90	0.02	2.92	0.07	3.26	4.25	1.80	2.44	0.10	3.38		68.10	0.39		0.01	2.58	
E	191		19500	21021	22.00	2.01	12.90	0.02	2.94	0.07	3.25	4.26	1.84	2.48	0.10	3.39		67.90	0.39		0.01	2.57	
E	181		20500	20878	22.70	2.06	12.80	0.02	2.92	0.07	3.26	4.28	1.78	2.48	0.11	3.39		68.00	0.39		0.01	2.57	
E	196		19900	20878	21.70	2.03	12.90	0.02	2.92	0.07	3.27	4.27	1.81	2.46	0.11	3.37		68.00	0.39		0.01	2.51	
E	181		20400	20878	22.00	2.09	12.85	0.02	2.92	0.07	3.25	4.27	1.81	2.43	0.10	3.37		68.20	0.39		0.01	2.57	
E	190		19000	20878	19.50	1.73	12.90	0.02	2.92	0.07	3.26	4.26	1.80	2.44	0.10	3.37		68.10	0.39		0.01	2.57	
F	243	215	20200	20878	20.70	2.83	12.80	0.02	2.92	0.08	3.33	4.34	1.73	2.49	0.12	3.40	0.12	68.00	0.41		0.01		
F	242	212	20700	20807	21.30	2.79	12.80	0.02	2.91	0.10	3.34	4.31	1.80	2.49	0.12	3.44	0.12	68.00	0.41		0.01		
F	224	208	20100	20807	19.10	2.58	12.70	0.02	2.91	0.08	3.31	4.32	1.82	2.49	0.12	3.38	0.12	68.00	0.41		0.01		
F	232	217	20800	20807	20.50	2.77	12.80	0.02	2.91	0.08	3.30	4.30	1.82	2.48	0.12	3.44	0.13	68.00	0.40		0.01		
F	234	215	20200	20807	19.00	2.59	12.80	0.02	2.91	0.08	3.32	4.30	1.76	2.49	0.12	3.39	0.12	68.00	0.41		0.01		
F	231	215	19400	20878	20.80	2.73	12.70	0.02	2.92	0.08	3.32	4.31	1.79	2.48	0.12	3.37	0.12	68.10	0.41		0.01		
F	233	215	20300	20807	19.20	2.16	12.80	0.02	2.91	0.08	3.32	4.30	1.79	2.50	0.12	3.42	0.12	68.00	0.41		0.01		
F	221	219	19000	20735	20.90	2.78	12.80	0.02	2.90	0.08	3.30	4.31	1.78	2.52	0.12	3.39	0.11	68.00	0.41		0.01		
G	194	229	21600	20592	23.20	2.24	12.65	0.02	2.88	0.08	3.25	4.27	1.78	2.45	0.11	3.38	0.13	67.80	0.40		0.01	2.63	
G	194	228	21900	20592	23.40	2.23	12.70	0.02	2.88	0.08	3.25	4.27	1.74	2.46	0.11	3.40	0.13	67.90	0.40		0.01	2.63	
G	194	227	21700	20664	23.10	2.25	12.75	0.02	2.89	0.08	3.27	4.29	1.78	2.47	0.11	3.39	0.13	68.30	0.40		0.01	2.64	
G	195	226	21200	20592	23.10	2.19	12.70	0.02	2.88	0.08	3.26	4.28	1.78	2.47	0.11	3.38	0.13	68.00	0.40		0.01	2.61	
G	202	226	21700	20592	23.60	2.25	12.70	0.02	2.88	0.08	3.26	4.28	1.88	2.47	0.11	3.39	0.13	67.90	0.40		0.01	2.64	
G	198	227	22000	20592	23.00	2.24	12.70	0.02	2.88	0.08	3.26	4.26	1.85	2.45	0.11	3.37	0.13	68.00	0.40		0.01	2.64	
G	196	228	22000	20807	23.20	2.25	12.85	0.02	2.91	0.08	3.25	4.31	1.91	2.47	0.11	3.38	0.13	67.80	0.40		0.01	2.64	
G	194	230	21500	20664	22.60	2.17	12.75	0.02	2.89	0.08	3.25	4.30	1.93	2.45	0.11	3.36	0.13	67.50	0.40		0.01	2.63	

Assay data (cont)

Lab Code	U M/ICP ppm	U XRF ppm	Ca M/ICP ppm	Ca XRF ppm	Nb M/ICP ppm	Ta M/ICP ppm	Al2O3 XRF %	BaO XRF %	CaO XRF %	Cr2O3 XRF %	Fe2O3 XRF %	K2O XRF %	LOI %	MgO XRF %	MnO XRF %	Na2O XRF %	P2O5 XRF %	SiO2 XRF %	TiO2 XRF %	U3O8 XRF %	V2O5 XRF %	SG pyc
H	227	230	20800	21236	23.00	1.70	12.77	0.02	2.97	0.08	3.30	4.29	1.91	2.50	0.12	3.39		67.88	0.40		0.01	2.74
H	220	240	21000	21307	22.50	1.80	12.78	0.02	2.98	0.08	3.31	4.30	1.89	2.50	0.12	3.40		67.90	0.41		0.01	2.76
H	219	240	21000	21236	22.50	1.70	12.82	0.02	2.97	0.08	3.31	4.30	1.91	2.51	0.12	3.39		67.86	0.41		0.01	2.74
H	223	230	21200	21236	22.50	1.80	12.84	0.02	2.97	0.08	3.31	4.30	1.92	2.50	0.12	3.40		67.94	0.41		0.01	2.74
H	223	230	21100	21236	22.00	1.70	12.80	0.02	2.97	0.08	3.30	4.30	1.88	2.50	0.12	3.40		67.85	0.41		0.01	2.74
H	227	240	20800	21236	21.50	1.70	12.82	0.02	2.97	0.08	3.31	4.30	1.88	2.50	0.12	3.40		67.91	0.41		0.01	2.75
H	226	240	20900	21307	23.00	1.70	12.82	0.02	2.98	0.08	3.31	4.31	1.88	2.50	0.12	3.41		67.93	0.40		0.01	2.75
H	228	230	21100	21236	22.50	1.80	12.81	0.02	2.97	0.08	3.30	4.30	1.88	2.50	0.12	3.39		67.85	0.40		0.01	2.74
I	225	222	21400		24.00	2.48																2.69
I	226	221	20900		24.20	2.37																2.71
I	220	223	21100		24.50	2.47																2.74
I	214	220	20800		24.10	2.40																2.68
I	223	224	21100		24.70	2.44																2.69
I	221	223	20600		23.90	2.35																2.70
I	219	221	20500		23.60	2.37																2.71
I	225	224	21100		24.40	2.42																2.68
K		216																				0.03
K		217																				0.03
K		224																				0.03
K		222																				0.03
K		221																				0.03
K		229																				0.03
K		224																				0.03
K		232																				0.03
L		230																				0.03
L		229																				0.03
L		231																				0.03
L		224																				0.03
L		221																				0.03
L		237																				0.03
L		229																				0.03
L		226																				0.03
M	231		21028	20950	21.50	2.00	12.85	0.02	2.93	0.07	3.33	4.29	1.87	2.47	0.11	3.42	0.13	68.11	0.42		0.01	2.68
M	229		20467	20950	21.50	1.95	12.87	0.02	2.93	0.08	3.32	4.29	1.89	2.49	0.11	3.41	0.13	68.06	0.41		0.01	2.75
M	228		20683	20878	22.00	2.01	12.81	0.02	2.92	0.08	3.31	4.28	1.89	2.48	0.11	3.42	0.14	68.03	0.41		0.01	2.71
M	229		21022	20807	22.20	2.02	12.84	0.02	2.91	0.08	3.33	4.28	1.90	2.49	0.11	3.37	0.13	67.97	0.42		0.01	2.77
M	228		20765	20807	22.10	1.98	12.89	0.02	2.91	0.08	3.32	4.30	1.90	2.48	0.11	3.40	0.13	68.09	0.41		0.01	2.78
M	230		20982	20878	21.90	1.96	12.81	0.02	2.92	0.07	3.31	4.29	1.87	2.47	0.11	3.39	0.13	67.95	0.41		0.01	2.80
M	229		20567	20807	21.80	2.03	12.83	0.02	2.91	0.07	3.31	4.30	1.89	2.48	0.11	3.44	0.14	67.99	0.41		0.01	2.77
M	228		20781	20878	21.90	1.96	12.82	0.02	2.92	0.08	3.32	4.29	1.87	2.49	0.11	3.43	0.13	68.06	0.41		0.01	2.72
N		240		20878			12.80		2.92	0.06	3.32	4.29	2.16	2.47	0.11	3.32	0.13	68.00	0.41			
N		240		21093			13.00		2.95	0.07	3.35	4.28	2.28	2.47	0.11	3.34	0.13	68.20	0.40			
N		240		21236			13.00		2.97	0.06	3.33	4.30	2.12	2.51	0.10	3.35	0.13	68.40	0.41			
N		240		21093			12.90		2.95	0.07	3.30	4.31	2.14	2.48	0.11	3.35	0.13	68.50	0.41			
N		240		21021			13.00		2.94	0.07	3.32	4.33	2.06	2.51	0.11	3.37	0.13	68.50	0.41			
N		240		21093			12.90		2.95	0.07	3.32	4.32	2.09	2.47	0.10	3.33	0.13	68.30	0.41			
N		240		20950			12.90		2.93	0.06	3.30	4.33	2.08	2.49	0.11	3.32	0.13	68.30	0.40			
N		240		21021			13.00		2.94	0.06	3.32	4.33	2.10	2.51	0.11	3.36	0.13	68.30	0.41			
Q	185	217	21100	20950			12.88		2.93	0.07	3.29	4.35	2.13	2.33	0.12	3.33	0.12	67.44	0.41	0.03		2.70
Q	184	209	21200	20878			12.85		2.92	0.07	3.32	4.29	2.18	2.34	0.12	3.34	0.12	67.37	0.41	0.02		2.71
Q	182	211	21000	20878			13.05		2.92	0.07	3.35	4.30	2.42	2.35	0.12	3.33	0.12	67.96	0.41	0.02		2.69
Q	183	211	21000	20878			12.90		2.92	0.07	3.32	4.30	2.37	2.33	0.12	3.34	0.12	67.86	0.42	0.02		2.70
Q	185	214	21100	21236			12.87		2.97	0.07	3.35	4.31	2.33	2.31	0.12	3.36	0.13	68.19	0.42	0.03		2.70
Q	183	211	21200	21236			12.84		2.97	0.07	3.36	4.29	2.37	2.32	0.12	3.34	0.13	67.62	0.41	0.02		2.71
Q	183	213	21100	21021			12.61		2.94	0.07	3.32	4.30	2.44	2.27	0.12	3.36	0.12	67.66	0.42	0.03		2.69
Q	183	214	21100	21021			12.83		2.94	0.07	3.32	4.30	2.44	2.32	0.12	3.34	0.13	67.78	0.42	0.03		2.69
R		233																				
R		241																				
R		237																				
R		236																				
R		236																				
R		239																				
R		235																				
R		235																				
S	231	187	20000	19591	17.00	1.60	12.92	0.02	2.74	0.07	3.41	4.48	2.69	2.72	0.09	3.21	0.13	67.45	0.44	0.02		2.65
S	232	212	19800	19591	16.10	0.80	12.94	0.02	2.74	0.06	3.41	4.50	2.66	2.70	0.09	3.25	0.13	67.03	0.44	0.03		2.62
S	231	187	20100	19663	15.40	0.70	12.88	0.02	2.75	0.06	3.40	4.51	2.66	2.70	0.09	3.26	0.13	67.24	0.44	0.02		2.64
S	226	195	18900	19591	14.40	0.70	12.93	0.02	2.74	0.07	3.40	4.47	2.62	2.71	0.09	3.26	0.13	67.09	0.44	0.02		2.64
S	229	195	19900	19448	16.30	1.20	12.92	0.02	2.72	0.06	3.45	4.50	2.60	2.70	0.09	3.24	0.13	67.15	0.43	0.02		2.61
S	228	204	19800	19591	17.10	0.20	12.92	0.02	2.74	0.06	3.41	4.56	2.58	2.70	0.09	3.22	0.13	67.07	0.44	0.02		2.62
S	227	187	17300	19591	22.90	0.80	12.92	0.02	2.74	0.07	3.44	4.51	2.62	2.70	0.09	3.25	0.13	66.99	0.44	0.02		2.63
S	228	195	16700	19448	21.80	0.70	12.99	0.02	2.72	0.06	3.41	4.50	2.64	2.68	0.09	3.24	0.13	66.91	0.45	0.02		2.65
T	218	240	22000	21307			12.70	0.02	2.98	0.08	3.33	4.32	1.89	2.44	0.12	3.33	0.13	68.10	0.40			0.01
T	220	230	22000	21307			12.70	0.02	2.98	0.08	3.30	4.29	1.93	2.43	0.11	3.32	0.13	67.90	0.41			0.01
T	224	220	21000	21236			12.70	0.02	2.97	0.08	3.31	4.30	1.96	2.41	0.11	3.34	0.13	68.00	0.40			0.01
T	222	230	22000	21379			12.80	0.01	2.99	0.08	3.33	4.32	1.93	2.44	0.11	3.34						

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	S _w ³	CSU ⁴
U	M/ICP	ppm	13.230	10.000	5.618	2.945
U	XRF	ppm	9.333	6.712	4.267	1.908
Ca	M/ICP	ppm	894	613	415	168
Ca	XRF	ppm	259	206	91.872	60.108
Nb	M/ICP	ppm	1.195	0.815	0.725	0.259
Ta	M/ICP	ppm	0.225	0.169	0.115	0.053
Al ₂ O ₃	XRF	%	0.075	0.047	0.045	0.014
BaO	M/ICP	%	0.002	0.002	0.001	0.001
CaO	XRF	%	0.036	0.029	0.013	0.008
Cr ₂ O ₃	XRF	%	0.004	0.003	0.002	0.001
Fe ₂ O ₃	XRF	%	0.033	0.024	0.016	0.007
K ₂ O	XRF	%	0.024	0.016	0.016	0.005
LOI		%	0.335	0.267	0.066	0.074
MgO	XRF	%	0.027	0.020	0.014	0.006
MnO	XRF	%	0.005	0.004	0.002	0.001
Na ₂ O	XRF	%	0.035	0.025	0.020	0.008
P ₂ O ₅	XRF	%	0.005	0.004	0.003	0.001
SiO ₂	XRF	%	0.179	0.088	0.146	0.031
TiO ₂	XRF	%	0.008	0.005	0.005	0.002
U ₃ O ₈	XRF	%	0.002	0.003	0.001	0.001
V ₂ O ₅	XRF	%	0.001	0.001	0.001	0.000
SG	pyc		0.044	0.037	0.019	0.012

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. Uncertified 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 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, who have maintained measurement traceability during the analytical process.

15. Certification: AMIS0344 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 50g to 250g) of material. The Laboratory Packs are sealed bottles delivered in sealed foil pouches. The Explorer Packs contain material in standard geochem envelopes, 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, 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.

10 December 2012

Corrected on 07 August 2014 – pgs 4 and 5 - Assay data tables – Major Oxides Method – XRF instead of M/ICP

Added a note pg 2 under "Certified Concentrations" – Mixed XRF and ICP data

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
Ag	M/ICP	ppm	0.12	0.15	63.3	60
Al	M/ICP	%	6.54	0.66	5.04	112
As	M/ICP	ppm	8.14	4.25	26.1	94
Ba	M/ICP	ppm	153	19.2	6.28	105
Be	M/ICP	ppm	3.00	0.55	9.19	99
Bi	M/ICP	ppm	0.30	0.05	9.10	98
Cd	M/ICP	ppm	0.07	0.05	37.6	67
Ce	M/ICP	ppm	49.8	7.66	7.69	90
Co	M/ICP	ppm	11.0	1.55	7.07	102
Cr	M/ICP	ppm	368	176	23.9	116
Cs	M/ICP	ppm	4.56	0.54	5.95	71
Cu	M/ICP	ppm	48.5	8.46	8.72	113
Dy	M/ICP	ppm	6.25	2.79	22.3	31
Er	M/ICP	ppm	4.37	2.08	23.9	31
Eu	M/ICP	ppm	0.64	0.10	7.64	29
Fe	M/ICP	%	2.28	0.19	4.27	113
Ga	M/ICP	ppm	20.1	3.10	7.69	90
Gd	M/ICP	ppm	4.51	1.22	13.5	30
Ge	M/ICP	ppm	0.31	0.79	126	41
Hf	M/ICP	ppm	2.39	0.80	16.8	100
Ho	M/ICP	ppm	1.32	0.70	26.4	32
In	M/ICP	ppm	0.02	0.01	18.4	68
K	M/ICP	%	3.49	0.40	5.77	104
La	M/ICP	ppm	25.0	3.83	7.66	90
Li	M/ICP	ppm	29.7	2.84	4.79	98
Lu	M/ICP	ppm	0.76	0.17	11.2	53
Mg	M/ICP	%	1.43	0.14	4.90	112
Mn	M/ICP	ppm	851	76.2	4.48	111
Mo	M/ICP	ppm	3.36	0.69	10.3	98
Na	M/ICP	%	2.45	0.16	3.35	109
Nd	M/ICP	ppm	19.8	4.22	10.7	30
Ni	M/ICP	ppm	58.4	9.93	8.50	111
P	M/ICP	ppm	547	84.9	7.76	108
Pb	M/ICP	ppm	37.6	14.7	19.6	105
Pr	M/ICP	ppm	5.63	1.21	10.8	30
Rb	M/ICP	ppm	260	89.7	17.3	97
Re	M/ICP	ppm	0.01	0.01	51.6	25
S	M/ICP	%	0.09	0.01	6.76	81
S Comb	LECO	%	0.09	0.004	1.93	22
Sb	M/ICP	ppm	5.13	1.00	9.70	101
Sc	M/ICP	ppm	7.96	1.15	7.23	93
Se	M/ICP	ppm	1.58	1.12	35.5	28
Si	M/ICP	%	31.8	0.23	0.37	8
Sm	M/ICP	ppm	4.43	0.95	10.7	29
Sn	M/ICP	ppm	6.01	1.03	8.53	101
Sr	M/ICP	ppm	94.9	12.9	6.78	105
Tb	M/ICP	ppm	0.85	0.14	8.17	50
Te	M/ICP	ppm	0.12	0.10	42.9	21
Th	M/ICP	ppm	29.6	3.80	6.41	96
Ti	M/ICP	%	0.24	0.02	4.38	105
Tl	M/ICP	ppm	1.00	0.23	11.5	97
Tm	M/ICP	ppm	0.75	0.34	22.6	31
V	M/ICP	ppm	65.5	7.15	5.45	106
W	M/ICP	ppm	10.4	1.99	9.54	96
Y	M/ICP	ppm	32.2	6.24	9.69	98
Yb	M/ICP	ppm	5.07	1.88	18.5	53
Zn	M/ICP	ppm	25.2	7.00	13.9	106
Zr	M/ICP	ppm	64.9	20.4	15.7	98