African Mineral Standards
REFERENCE MATERIALS FOR AFRICAN ORES

Tel: +2711 923 7000 Fax: +2711 923 7027 e-mail: info@amis.co.za web: www.amis.co.za
30 Electron Avenue, Isando, 1600. P.O. Box 856, Isando, 1600, South Africa.
A Division of Set Point Industrial Technology (Pty) Ltd. Reg.No. 1989/000201/07.

African Mineral Standards

Certificate of Analysis

Multi-Element Uranium Standard, Karoo Sandstone, South Africa

AMIS0098

Recommended Concentration and two "Between Laboratory" Standard Deviations

Certified Concentrations

U (M/ICP)	819	±	96	ppm
U (XRF)	848	±	74	ppm
As (M/ICP)	595	±	56	ppm
Ba (M/ICP)	501	±	42	ppm
Co (M/ICP)	37	±	4	ppm
Mn (M/ICP)	3401	±	246	ppm
Mo (M/ICP)	558	±	60	ppm
Mo (XRF)	572	±	66	ppm
S (M/ICP)	0.30	±	0.02	%
Sr (M/ICP)	272	±	22	ppm
Zn (M/ICP)	216	±	30	ppm
Specific Gravity	2.73	±	0.14	g/cc

Provisional Concentration

Cr (M/ICP)	465	±	88	ppm
Cu (M/ICP)	48	±	6	ppm
Ni (M/ICP)	43	±	8	ppm
Pb (M/ICP)	61	±	8	ppm
V (M/ICP)	92	±	14	ppm
Zr (M/ICP)	94	±	16	ppm

** Or, by applying a chemical conversion factor of U x 1.1793 = U_3O_8*
U_3O_8 by multi acid digestion: 966 ± 113 ppm
U_3O_8 by XRF: 1000 ± 87 ppm

Intended use: AMIS0098 is suitable for monitoring the accuracy of a single analysis of sandstone rock for the certified elements.

The material can be used for routine quality control by inserting within a batch of samples. It can also be used for method development or for the calibration of equipment.

The recommended mean and "Between Lab" standard deviations for this standard reflect the average 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 and this is acceptable. Good laboratories however will report results within the two standard deviation levels with a failure of <10 %.

Origin of material: This standard was made from Karoo sandstone material supplied by Uramin (Pty) Inc. from their Ryst Kuil project, situated about 60km south-east of Beaufort West, in the Western Cape Province, South Africa.

The Karoo Basin is a Permo-Triassic Gondwanaland basin. It is being explored for uranium, which occurs in basal sandy members of upward fining megacycles in the Adelaide Subgroup of the Beaufort Group. The host rock comprises a fine-grained greywacke to mud pebble conglomerate, containing ore grade, organic rich, pods.

The geology and associated mineralization is described in “Le Roux, J.P., and Toens, P.D.. (1986). A review of the uranium occurrences in the Karoo Sequence, South Africa. Anhauser,C.R., and Maske.S.(Eds)(1986). *Mineral Deposits of Southern Africa. Vol II, 2119-2134.*

Mineral and chemical composition: The host greywackes are composed of quartz, feldspar and rock fragments in equal proportions. The principle ore mineral is coffinite, with minor amounts of urano-organic compounds and rare uraninite, occurring with pyrite, arsenopyrite and molybdenum sulphide.

The uncertified major and trace element chemical composition is presented in the appendix to this certificate.

Appearance: The material is a very fine Yellowish Grey coloured powder (Corstor 5Y 8/2).

Radioactivity: Shipments of this material require special labelling and placarding. AMIS 0098 contains U (10.6 Bq/g) and Th (0.05 Bq/g) and is classified as EXCEPTED MATERIAL in terms of “Safety Standards Series No. TS-R-1: Regulations for the Safe Transport of Radioactive Material, International Atomic Energy Agency 2005 paragraph 403, Table 1”.

Method of preparation: The material was crushed, dry-milled and air-classified to 100% <54um. Wet sieve particle size analysis of random samples confirmed the material was 100% <54um. It was then blended in a bi-conical mixer, systematically divided and then sealed into 1kg Laboratory Packs. Samples were randomly selected for homogeneity testing and third party analysis. Statistical analysis for the consensus test results were carried out by an independent statistician. Explorer Packs are subdivided from the Laboratory packs as required.

Methods of analysis requested:

1. Multi-acid digest, including HF, ICP- OES or ICP-MS. Multi element scan (to include U).
2. Majors (Al_2O_3, CaO, Cr_2O_3, Fe_2O_3, K_2O, MgO, MnO, Na_2O, SiO_2, TiO_2. LOI.) ICP fusion.
3. U and Mo, XRF fusion.
4. SG (gas pycnometer)

Method of certification: Twenty laboratories were each given eight randomly selected packages of sample. The results from the seventeen laboratories that issued results timeously were used.

The mean and standard deviation for all data was calculated. Outliers were defined as samples beyond the mean $\pm$ 2 Standard Deviations from all data. These outliers were removed from the data and a new mean and standard deviation was determined.

Standards with an RSD of near or less than 5 % are then certified, RSD's of between near 5 % and 15 % are given Provisional Concentrations and limits, those with RSD's over 15 % are given Indicated Concentrations.

This method is different from that used to calculate the Confidence Interval shown on many Government-produced standards in that the actual "between-laboratory" standard deviation is used in the calculations. This produces upper and lower limits that reflect actual individual analyses rather than a grouped set of analyses. The limits can therefore be used to monitor accuracy from individual analyses, unlike the Certified Limits published on other standards which quote a Confidence Interval.

Participating laboratories: (Not in same order as in the table of assays)

1. Activation Laboratories Ltd., (ActLabs, Ancaster, ON, Canada).
2. ALS Chemex South Africa (Pty) Ltd.
3. ALS Chemex, (Perth, Australia).
4. ALS Chemex, (Vancouver, Canada).
5. Amdel Limited, (Perth, Australia).
6. Anglo Research (Crown Campus, South Africa).
7. Assayers Canada, (Vancouver).
8. Genalysis Laboratory Services (Pty) Ltd., (Australia).
9. Geoscience Laboratories, (Geo Labs, Sudbury, Canada).
10. Labtium Inc. (Finland)
11. Mintek (South Africa)
12. OMAC Laboratories (Ireland).
13. Pt Intertek Utama Services (Intertek, Indonesia)
14. Set Point Laboratories (Pty) Ltd (South Africa)
15. SGS Lakefield Research (Canada)
16. SGS Welshpool (Australia).
17. Ultra Trace (Pty) Ltd. (Australia)

Assay Data: Data as received from the laboratories is set out below. A proficiency report has been sent to the managers of the participating laboratories.

Lab Code	As (M/ICP) ppm	Ba (M/ICP) ppm	Co (M/ICP) ppm	Cr (M/ICP) ppm	Cu (M/ICP) ppm	Mn (M/ICP) ppm	Mo (M/ICP) ppm	Mo (XRF) ppm	Ni (M/ICP) ppm	Pb (M/ICP) ppm	S (M/ICP) %	SG g/cc	Sr (M/ICP) ppm	U (M/ICP) ppm	U (XRF) ppm	V (M/ICP) ppm	Zn (M/ICP) ppm	Zr (M/ICP) ppm
A																		
A																		
A																		
A																		
A																		
A																		
A																		
A																		
B	602	518	34	401	50	3510	604		45	58			268			92	223	110
B	613	533	35	374	49	3510	607		45	56			270			90	227	114
B	611	523	34	377	49	3490	591		43	59			262			89	227	104
B	614	533	34	381	48	3460	598		42	60			262			89	226	110
B	611	519	35	395	48	3490	593		45	57			263			89	232	112
B	612	527	34	337	49	3500	593		44	62			263			89	225	107
B	602	537	35	406	50	3500	596		43	59			268			89	222	106
B	617	530	35	384	50	3490	604		43	60			268			89	223	104
C															845			
C															856			
C															857			
C															862			
C															859			
C															858			
C															846			
C															850			
D	587	499	35.5	234	47.1	3050	501	569	43.8	27.6	0.2764		273	784	812	92.2	206	
D	606	514	36.7	202	51.1	3050	526	590	43.5	29	0.2792		280	816	825	96.2	207	
D	558	497	34.9	188	45.8	3030	484	538	40.4	27.5	0.2781		258	776	788	79.2	207	
D	613	510	36.3	239	56.1	3040	524	597	43.9	29.2	0.2826		284	822	837	95.5	222	
D	589	490	36.2	323	48.2	3010	517	592	42.5	28.1	0.2752		277	802	815	93.7	214	
D	604	498	36.2	221	49.1	3050	515	591	42.8	28.7	0.279		284	795	824	94.1	213	
D	613	502	37.4	201	50.2	3070	518	563	43.4	28.1	0.2757		287	821	804	94.6	223	
D	601	509	36.5	243	48.8	3070	517	540	44.2	28.7	0.2781		275	810	801	94.8	210	
E	540	490	39	480	45	3500	570	600	38	58		2.75	260	660	920	85	190	
E	540	480	39	480	53	3400	520	600	44	56		2.73	260	760	920	85	180	
E	590	490	38	480	45	3500	540	600	35	59		2.71	260	760	920	87	190	
E	550	490	37	530	45	3500	540	600	35	57		2.7	270	780	930	87	190	
E	510	480	37	540	43	3400	520	600	33	54		2.73	260	730	920	82	180	
E	510	490	38	470	43	3500	530	600	36	56		2.69	260	640	930	85	190	
E	510	480	38	430	44	3400	520	600	38	58		2.73	260	660	920	85	180	
E	510	500	36	470	46	3400	520	600	37	54		2.73	270	650	950	84	180	
F		474	33.8	360	48	3360	574	597	45	29	0.298		261	900	886	83	207	92
F		465	33.2	440	47	3250	564	588	46	27	0.298		237	889	878	81	203	90
F		470	34.7	430	48	3330	585	594	45	29	0.308		257	924	882	77	204	91
F		476	33.8	450	48	3350	580	592	47	28	0.31		249	902	901	82	208	91
F		477	33.9	380	49	3330	581	594	46	28	0.308		257	905	889	77	204	92
F		472	33.5	390	49	3340	572	589	45	28	0.305		258	913	890	76	199	90
F		480	34.1	430	49	3390	577	594	47	28	0.312		254	910	889	81	205	92
F		464	34	470	48	3260	583	602	49	27	0.301		237	888	882	84	199	89

Assay Data (cont):

Lab Code	As (M/ICP) ppm	Ba (M/ICP) ppm	Co (M/ICP) ppm	Cr (M/ICP) ppm	Cu (M/ICP) ppm	Mn (M/ICP) ppm	Mo (M/ICP) ppm	Mo (XRF) ppm	Ni (M/ICP) ppm	Pb (M/ICP) ppm	S (M/ICP) %	SG g/cc	Sr (M/ICP) ppm	U (M/ICP) ppm	U (XRF) ppm	V (M/ICP) ppm	Zn (M/ICP) ppm	Zr (M/ICP) ppm
G																		
G																		
G																		
G																		
G																		
G																		
G																		
G																		
H	559	483.63	43	519		3375.2	564		66.99	74.8	0.35239	2.7211	354	850	871.925	44	225	78
H	528	464.079	42	454		3334.2	550		73.08	74.8	0.3325	2.7048	341	842	877.014	42	216	76
H	507	466.137	40	469		3291.57	546		77.43	66	0.33438	2.7151	345	841	880.407	43	214	78
H	538	468.195	41	439		3311.02	549		70.47	72.16	0.34124	2.6976	343	843	884.648	44	216	78
H	528	475.398	42	401		3342.14	562		76.56	79.2	0.34863	2.7016	346	842	874.47	43	216	78
H	554	498.036	44	494		3510.36	589		79.17	73.04	0.36609	2.7309	363	879	883.8	46	225	82
H	558	503.181	44	512		3550.23	598		78.31	64.24	0.36045	2.7043	364	867	882.952	46	230	82
H	551	490.833	43	459		3449.1	580		73.08	81.84	0.35494	2.734	358	860	877.863	45	221	80
I	465		33		48.6	3478	494.9		44.6	83.3		2.61	278	783.8			221	
I	476		37		51.7	3451	507.6		48.2	73.9		2.63	289	777.8			211	
I	495		37		52.3	3526	523.7		45.1	64.9		2.63	289	809			210	
I	514		37		56.6	3545	520		50.4	78.2		2.65	299	781.5			233	
I	475		36		47.6	3424	514.6		43.1	68.1		2.61	285	770			230	
I	483		37		44.8	3467	509.6		46.3	72.6		2.64	288	762.1			220	
I	482		37		50.1	3466	496.4		44.2	61.7		2.62	293	790.5			230	
I	479		37		48.5	3469	512.3		45.4	35.6		2.63	291	746.5			210	
J								565.19							865.14			
J								641.73							975.403			
J								556.16							856.658			
J								596.63							916.031			
J								584.52							873.622			
J								572.3							873.622			
J								578.34							882.103			
J								565.11							865.14			
K	578	512.1	36	323	50	3461	554.4	608	43	63	0.29	2.79	258.03	812.9	918	90	213	101.4
K	599	504.5	35	278	50	3392	555	615	41	62	0.3	2.78	260.02	798.31	934	89	209	100.1
K	571	493.1	35	306	50	3363	548.5	615	42	63	0.3	2.79	261.24	819.84	932	89	207	94.3
K	589	501.5	36	355	51	3456	555.9	608	43	64	0.29	2.7	263.61	833.31	918	90	214	94.6
K	579	494.6	35	337	50	3358	552.3	614	42	61	0.3	2.8	262.06	772.23	929	89	209	98.4
K	598	512.8	36	394	49	3420	560.5	612	43	61	0.29	2.79	261.63	812.07	925	89	210	100
K	587	512.3	35	433	51	3365	563.6	613	45	62	0.3	2.77	264.04	791.38	926	91	213	99.9
K	594	505.5	36	460	52	3449	554.7	613	46	63	0.29	2.78	257.99	832.94	930	92	218	101
L			33		43		477	600	41	64		2.71		1460	820		323	
L			34		44		497	600	42	66		2.7		1510	834		324	
L			13		30		71.4	600	91	17		2.7		74.8	809		574	
L			32		42		478	600	40	63		2.73		1440	816		315	
L			32		46		489	600	40	63		2.73		1510	798		315	
L			33		43		468	600	41	62		2.71		1420	810		313	
L			34		45		484	600	43	66		2.72		1460	817		335	
L			37		51		533	600	46	68		2.7		1580	816		362	
M	588	526	40	650	46	3470	556	550	46	59	0.295	2.68	276	828	840	95	210	160
M	614	523	40	650	48	3550	576	540	44	59	0.3	2.7	281	812	840	100	214	200
M	607	521	40	650	46	3480	576	540	44	56	0.29	2.7	274	790	840	95	212	230
M	577	518	35	650	48	3450	552	530	44	58	0.29	2.69	278	807	840	100	212	230
M	607	522	35	650	50	3480	579	550	46	57	0.295	2.67	286	820	860	95	212	220
M	603	533	35	650	46	3500	583	550	44	57	0.3	2.68	289	824	850	100	214	220
M	591	526	40	650	50	3530	586	550	46	59	0.295	2.7	278	819	860	100	214	210
M	598	510	40	650	46	3530	562	540	48	57	0.305	2.69	272	821	830	100	208	230
N												2.82						
N												2.86						
N												2.83						
N												2.84						
N												2.85						
N												2.86						
N												2.88						
N												2.87						
O	595.3	524	37.7	489	49.8	3336	533.3		47	62.2	0.39		272	815		97	221	91.8
O	600.4	530	38.4	484	49.2	3398	530.8		47.4	62.3	0.36		274	820.4		102	219	92.8
O	597.9	519	38.1	495	51.8	3247	539.6		48.3	64.1	0.5		275	816.5		101	226	90.8
O	601.8	534	38.4	470	52	3292	523.8		47.2	63.8	0.37		277	821.9		100	224	93.7
O	594.3	528	39.4	535	50.2	3377	538		47.9	65.3	0.32		286	832.4		105	225	90.8
O	642	546	40.6	530	58.4	3585	555.6		50.1	68.5	0.46		288	858.7		103	238	96
O	589.6	510	37.8	484	53.5	3371	534.3		47.3	63.3	0.3		277	820.1		97	218	86.6
O	599	509	37.9	513	50.8	3424	532.1		47.1	62	0.35		278	823.5		100	225	89
P	577.022	491.542	38.8721	395.175	50.3819	3594.32	576.31		46.1604	64.0643	0.31618		279.158	849.511		96.4989	232.39	92.0713
P	575.246	491.769	40.6306	418.96	51.2719	3568.56	585.261		48.3824	65.3699	0.3071		283.348	852.024		103.622	229.028	95.9123
P	579.559	499.833	40.8392	533.284	51.5955	3696.93	596.347		49.7041	65.5463	0.31854		290.061	863.883		103.622	234.152	96.5448
P	577.597	496.396	41.5942	485.565	52.6574	3605.35	591.255		50.0101	66.2167	0.32048		279.99	851.985		104.215	231.387	94.2908
P	585.289	498.581	39.8755	440.049	52.3641	3609.34	590.697		47.0703	66.8283	0.32031		281.387	851.768		99.8908	243.402	94.4288
P	606.609	501.101	40.4517	441.034	52.3742	3615.3	606.147		46.6871	64.8876	0.32981		284.986	853.693		102.18	240.476	93.1178
P	600.627	507.22	40.4617	419.444	52.5866	3725.55	592.394		46.8117	65.6992	0.31834		285.7	861.896		100.484	236.004	93.7388
P	595.284	496.33	40.3921	397.594	51.9596	3606.25	598.648		48.7368	64.3348	0.32936		282.428	857.266		100.908	247.68	93.4858
Q	681	530	37.3	512	49.8	3480	574		47.2	61	0.32	2.54	297	650	820	96	228	98.1
Q	644	490	37	480	48.5	3230	536		46.7	63.3	0.3	2.53	271	620	810	91	211	97.6
Q	671	520	36.8	500	47.9	3380	554		48	63.1	0.31	2.53	288	620	820	94	219	97.6
Q	585	460	37.2	450	46.6	2970	488		45.9	56.9	0.27	2.54	252	570	800	83	197	96.3
Q	647	500	38.9	487	48.5	3270	531		48.4	60.7	0.3	2.53	283	670	810	92	216	102
Q	634	500	37.3	485	47.4	3210	527		49.6	57.7	0.29	2.54	277	690	800	89	211	100.5
Q	618	480	38.2	468	46.7	3100	510		47.8	57.8	0.28	2.53	267	700	810	88	203	96.4
Q	641	500	37.3	484	45.9	3220	530		45.7	56.8	0.3	2.52	278	730	800	90	210	96
R	745	530	37.1	509	45.6	3460	599		40	57.7	0.35			840		98	244	99.1
R	724	510	34.5	497	41.8	3340	579		36.7	57	0.34			780		95	235	94.4
R	723	530	34.8	512	42.7	3480	600		37.8	36.4	0.34			790		99	242	95.8
R	702	500	33.2	486	40.5	3310	560		35.1	35.1	0.32			760		92	228	92
R	751	530	35.5	512	43.5	3480	597		38.4	58.8	0.34			830		103	244	98.2
R	801	530	35.5	516	43.9	3470	603		38	57.9	0.34			810		102	245	98
R	760	510	33.9	507	42.3	3370	587		35.7	35.7	0.34			800		98	239	93.3
R	737	490	33.1	500	40.1	3210	556		35.2	55.5	0.31			760		94	228	92.1
S	623	470	34	470	42.4	3150	521	528	38.2	56.7	0.29	2.55	279	730	804	85	207	15
S	645	470	35.5	471	43.4	3160	522	526	40.6	59.6	0.29	2.62	283	790	797	86	212	86
S	608	540	37.6	471	47.2	3130	515	530	41.9	62.3	0.29	2.61	280	700	803	85	209	98.1
S	630	470	37.9	472	46.6	3180	525	530	41.9	63.7	0.29	2.58	287	740	801	86	211	94.7
S	641	480	37.8	475	45.9	3180	524	525	41.4	62.2	0.29	2.58	283	740	802	88	213	11.5
S	646	480	39	479	48.4	3210	533	523	42.6	63.8	0.3	2.58	287	760	801	89	214	26.7
S	612	470	39.3	459	48.7	3130	518	531	42.5	64.5	0.29	2.54	278	750	797	84	204	93.6
S	593	450	38	451	43.3	3000	496	522	40.7	56.2	0.27	2.53	267	700	795	81	199	93.7
T								521							912			
T								523							906			
T								523							906			
T								523							906			
T								519							902			
T								523							911			
T								518							902			
T								525							905			

Availability: This product is available in Laboratory Packs containing 1kg of material or in Explorer Packs containing client specified weights of material from 50g up to 250g. Laboratory Packs are sealed bottles delivered in sealed foil pouches. Explorer Packs contain material in standard geochem envelopes placed into foil pouches that are nitrogen flushed and vacuum sealed.

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.

31 January 2008

Certifying officers:

African Mineral Standards:_____

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

Geochemist:_____

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

APPENDIX

Major Element Statistics

The AMIS0098 major element chemistry has been calculated, from predominantly XRF data submitted by eighteen of the laboratories, from the eight samples sent to each lab. Uncertified but iterated statistics from this data are:

	mean	2SD	unit	n
Al_2O_3	13.32	0.42	%	112
CaO	6.53	0.16	%	110
Cr_2O_3	0.09	0.01	%	96
Fe_2O_3	3.62	0.15	%	124
LOI	6.92	0.05	%	79
K_2O	1.74	0.72	%	110
MgO	1.00	0.05	%	110
MnO	0.44	0.02	%	93
Na_2O	4.35	0.31	%	96
P_2O_5	0.26	0.02	%	85
SiO_2	60.77	0.82	%	94
TiO_2	0.58	0.03	%	113

Appendix (cont)

Uncertified Trace Element Statistics

The AMIS0098 trace element chemistry has been calculated, from data submitted by eighteen of the laboratories, from the eight samples sent to each lab. Uncertified but iterated statistics from this data are:

	mean	2SD	unit	n
Ag	0.3		ppm	55
Be	2.4	0.6	ppm	102
Bi	0.2	0.0	ppm	55
Cd	3.4	0.9	ppm	86
Ce	75	9.9	ppm	71
Cs	2.9	0.3	ppm	74
Dy	4.2		ppm	47
Er	2.2		ppm	40
Eu	1.2	0.3	ppm	55
Ga	17	2.4	ppm	94
Gd	5.0	0.4	ppm	53
Hf	3.1	0.9	ppm	55
Ho	0.8		ppm	48
In	0.05		ppm	47
La	38	5.1	ppm	87
Li	35	4.7	ppm	84
Lu	0.3		ppm	40
Nb	11	1.7	ppm	93
Nd	32		ppm	48
Pr	8.9		ppm	46
Rb	63	4.2	ppm	69
Re	0.3		ppm	47
Sb	10	1.3	ppm	85
Sc	8.9	1.5	ppm	79
Se	1.7		ppm	32
Sm	6.0		ppm	40
Sn	2.9	0.3	ppm	67
Ta	0.9		ppm	66
Tb	0.7		ppm	48
Th	13	1.8	ppm	78
Tl	3.7	0.6	ppm	85
Tm	0.3	0.0	ppm	39
W	3.8	0.8	ppm	79
Y	23	2.2	ppm	88
Yb	2.2	0.1	ppm	53