



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

Uranium standard made from
calcretized fluvial sediment,
Langer Heinrich, Namibia

AMIS0115

Recommended Concentration and two “Between Laboratory”
Standard Deviations

Certified Concentrations

U (M/ICP)	606	±	69	ppm
U (XRF)	640	±	43	ppm
Ba (M/ICP)	287	±	28	ppm
Mn (M/ICP)	500	±	48	ppm
Sr (M/ICP)	196	±	11	ppm
V (M/ICP)	177	±	18	ppm
Specific Gravity	2.66	±	0.16	g/cc

Provisional Concentrations

Co (M/ICP)	6.0	±	1.3	ppm
Cr (M/ICP)	117	±	32	ppm
Cu (M/ICP)	31	±	6	ppm
Ni (M/ICP)	271	±	55	ppm
P (M/ICP)	408	±	70	ppm
S (M/ICP)	0.037	±	0.006	%
Zn (M/ICP)	46	±	9	ppm
Zr (M/ICP)	48	±	14	ppm

**** Or, by applying a chemical conversion factor of U x 1.1793 = U₃O₈
U₃O₈ by multi acid digestion: 715 ± 81 ppm
U₃O₈ by XRF: 755 ± 51 ppm**

Intended use: AMIS0115 is suitable for monitoring the accuracy of a single analysis of uraniferous calcareous grit. The material can be used for routine quality control by inserting within a batch of samples.

Additional geochemical data is presented for this material that will enable its use for method development and 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 material was supplied by Paladin Energy from their Langer Heinrich Mine, 80km east of Swakopmund in Namibia. This deposit is a "calcrete deposit"; one of the surficial uranium occurrences discovered in Southern Africa during the 1970's.

Uranium mineralization is associated with calcretization of valley-fill fluvial sediments in an extensive tertiary palaeo-channel drainage system. These sediments, also known as the Langer Heinrich Formation, comprise mainly grits and conglomerates. Detrital components include quartz- and feldspar granules, minor mica flakes as well as rock fragments derived from surrounding Proterozoic country rock.

Uranium mineralization occurs in the form of carnotite, which is a secondary uranium and vanadium mineral and has been precipitated from groundwater. Uranium as well as vanadium originates from the Proterozoic country rock, the former was most likely sourced from granites, whereas the latter was probably sourced from mafic schists.

Mineral and chemical composition:

The AMIS0115 major element chemistry for this material has also been determined by predominantly XRF analyses from fifteen of the laboratories. Statistics for the iterated data are set out in a table below. This data has not been independently certified (except the S). Additional trace element chemistry for this product is available on request.

	Mean %	2SD %	RSD%	n
Al ₂ O ₃	8.68	0.35	1.99	110
CaO	14.95	0.36	1.22	98
Cr ₂ O ₃	0.020	0.004	8.99	77
Fe ₂ O ₃	2.09	0.12	2.78	100
K ₂ O	2.67	0.08	1.41	88
MgO	1.16	0.07	2.91	95
MnO	0.067	0.008	5.75	80
Na ₂ O	1.64	0.18	5.42	108
P ₂ O ₅	0.095	0.010	5.39	76
SiO ₂	54.79	1.02	0.93	93
TiO ₂	0.31	0.02	2.57	94
S (Prov.conc)	0.037	0.006	8.32	54
LOI	13.52	0.69	2.55	94

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

Radioactivity: Shipments of this material do not require special marking, labeling or placarding. AMIS0115 does contain U (8.0 Bq/g) and Th (0.03 Bq/g), but due to low activity concentrations it is classified as EXEMPT MATERIAL in terms of "Safety Standards Series No. TS-R-1: Regulations for the Safe Transport of Radioactive Material, International Atomic Energy Agency, 2005, para 403, Table 1".

Method of preparation: The material was crushed, dry-milled and air-classified to 100% <54µm. Wet sieve particle size analysis of random samples confirmed the material was 100% <54µm. 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. U XRF.
3. Majors (Al₂O₃, CaO, Cr₂O₃, Fe₂O₃, K₂O, MgO, MnO, Na₂O, SiO₂, TiO₂, LOI.) XRF fusion.
4. SG (gas pycnometer).

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

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. ACME Analytical Laboratories Ltd., (Canada).
2. ALS Chemex South Africa (Pty) Ltd.
3. ALS Chemex, (Perth, Australia).
4. ALS Chemex, (Vancouver, Canada).
5. Assayers Canada, (Vancouver).
6. Genalysis Laboratory Services (Pty) Ltd., (Australia).
7. Geoscience Laboratories, (Geo Labs, Sudbury, Canada).
8. Labtium Inc. (Finland)
9. Langer Heinrich Mine Laboratory (Namibia)
10. OMAC Laboratories (Ireland).
11. Pt Intertek Utama Services (Intertek, Indonesia)
12. Set Point Laboratories (Pty) Ltd (South Africa)
13. SGS Lakefield Research (Canada)
14. SGS Lakefield Research Africa (Pty) Ltd. (Joburg, South Africa)
15. SGS Welshpool (Australia).
16. Ultra Trace (Pty) Ltd. (Australia)

Assay Data: Data as received from the laboratories for the important certified elements listed on p1 is set out below. A proficiency report has been sent to the managers of the participating laboratories. Additional data from this round robin is available on request.

Lab Code	Ba (M/ICP) ppm	Co (M/ICP) ppm	Cr (M/ICP) ppm	Cu (M/ICP) ppm	Mn (M/ICP) ppm	Ni (M/ICP) ppm	P (M/ICP) ppm	S (M/ICP) %	SG gas 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	291		150	28	512		450	0.035	2.69	188	597		180	46	44
A	295		150	32	522		450	0.040	2.74	197	581		185	48	45
A	299		150	30	526		450	0.035	2.72	199	586		185	48	55
A	294		150	30	518		450	0.035	2.72	194	580		190	46	52
A	290		150	30	530		450	0.040	2.71	196	591		190	46	24
A	293		150	30	522		450	0.040	2.68	197	589		195	48	49
A	305		150	32	522		450	0.040	2.7	203	602		190	50	57
A	293		150	30	534		450	0.035	2.69	200	584		190	46	59
B	286	6.70		30	440	240	360		2.75	200		665			
B	289	6.80		30	430	250	350		2.73	200		662			
B	299	6.50		30	440	230	370		2.75	210		658			
B	274	6.60		30	410	210	330		2.73	190		659			
B	283	6.70		30	420	220	350		2.76	200		666			
B	277	6.40		30	410	240	340		2.75	190		661			
B	290	6.40		30	430	290	360		2.75	200		661			
B	284	6.50		30	420	210	360		2.75	200		660			
C	290	8.00	93	29	490	240	350		2.71	190	690	700	170	39	
C	290	7.00	84	29	500	270	370		2.7	190	720	700	180	43	
C	290	7.00	100	30	500	270	360		2.71	190	700	700	170	46	
C	280	7.00	100	28	500	270	360		2.71	180	690	710	170	44	
C	280	7.00	70	27	510	290	350		2.7	190	690	700	170	43	
C	280	7.00	99	30	500	240	370		2.7	190	700	700	170	43	
C	290	8.00	71	33	500	260	360		2.71	190	700	700	170	44	
C	280	7.00	66	27	490	250	350		2.71	180	700	710	170	42	
D	263	10.00	120	31	470	255	380			190	545	636	165	13	60
D	265	9.00	110	34	470	302	390			192	551	621	165	16	59
D	265	10.00	110	35	470	254	380			191	554	629	165	14	60
D	271	10.00	120	32	480	248	400			196	565	634	172	15	61
D	265	10.00	120	32	480	259	400			192	561	625	165	14	60
D	272	11.00	120	33	490	299	410			197	563	627	171	17	61
D	265	10.00	110	38	470	280	380			190	563	630	167	17	60
D	263	10.00	120	31	470	256	390			190	562	638	166	15	60
E	391	7.00	146	33	538	275	462	0.035	2.75	203	625	641	169	98	53
E	378	5.40	156	35	529	296	433	0.033	2.76	200	602	651	169	98	48
E	360	8.19	156	34	503	285	417	0.032	2.74	194	610	646	162	94	44
E	287	7.93	160	34	547	290	401	0.038	2.74	204	629	641	170	98	47
E	294	6.58	165	34	557	311	468	0.036	2.72	209	642	636	174	101	47
E	286	7.76	146	32	533	285	398	0.035	2.73	202	628	643	170	98	46
E	283	6.75	157	35	528	274	439	0.033	2.72	199	613	643	169	98	44
E	270	6.08	160	31	505	274	398	0.032	2.72	192	613	642	163	94	43
F	291	6.44	124	29	531	292	434	0.038		201	614		181	71	42
F	285	6.31	129	35	526	270	438	0.038		196	597		178	53	43
F	285	5.83	122	30	529	278	419	0.037		190	592		178	53	40
F	284	6.26	120	31	529	264	433	0.039		196	599		180	49	42
F	289	5.98	126	31	534	277	439	0.038		200	598		182	53	40
F	285	5.90	126	33	523	300	440	0.037		196	608		178	53	44
F	284	6.31	122	30	530	297	443	0.038		193	612		181	50	43
F	286	6.22	124	29	530	277	444	0.038		196	598		180	55	44
G												634		58	
G												633		55	
G												639		58	
G												624		53	
G												638		55	
G												629		54	
G												634			
G												639		54	
H	302	3.00	103	29	473	270				195			189	46	39
H	310	2.00	109	29	478	264				194			190	46	40
H	307	2.00	106	28	481	276				190			186	47	39
H	308	2.00	110	29	471	267				187			188	47	41
H	319	2.00	115	28	480	285				193			190	49	27
H	312	2.00	110	29	477	276				190			188	49	39
H	316	3.00	115	27	477	252				188			188	48	40
H	308	2.00	114	29	470	282				188			187	46	38
I	287	5.36	67	30	471	262		0.037		196	468	634	177		
I	291	5.53	77	30	473	268		0.037		197	484	664	178		
I	290	5.27	63	36	474			0.038		198	490	659	178		
I	286	5.37	75	25	465	229		0.038		195	484	593	175		
I	288	5.07	61	27	476	246		0.037		197	465	653	177		
I	280	5.06	61	27	458	236		0.039		191	465	646	172		
I	292	5.43	83	28	474	230		0.038		198	510	663	178		
I	290	5.17	64	30	471	235		0.041		197	468	613	178		
J	291	5.70	133	28		239				190		669	165	40	120
J	288	6.00	132	30		256				186		669	166	39	115
J	295	5.90	141	29		292				190		666	179	42	120
J	292	5.80	135	31		278				190		665	162	41	120
J	298	5.80	136	28		262				190		666	171	40	116
J	294	5.30	129	27		339				188		666	162	40	116
J	290	5.50	130	26		330				187		667	160	38	116
J	295	5.60	133	31		255				188		666	163	39	118
K	306	5.00	127	51	509	241	416	0.034		207	584	636	188	55	57
K	300	5.00	130	33	518	288	415	0.033		201	599	637	192	48	53
K	293	5.00	126	33	508	271	409	0.034		199	592	633	190	47	52
K	295	5.00	128	32	516	317	420	0.034		201	595	637	190	49	53
K	292	5.00	126	37	508	281	418	0.034		207	606	636	189	53	51
K	295	5.00	123	43	506	291	413	0.030		203	614	637	188	46	49
K	298	5.00	125	32	507	315	420	0.033		203	618	638	189	47	52
K	299	5.00	129	34	515	252	420	0.034		205	605	680	191	48	50

Assay Data (cont):

Lab Code	Ba (M/ICP) ppm	Co (M/ICP) ppm	Cr (M/ICP) ppm	Cu (M/ICP) ppm	Mn (M/ICP) ppm	Ni (M/ICP) ppm	P (M/ICP) ppm	S (M/ICP) %	SG gas 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
L	298	5.60	112	80	496	406	400			198	629		179	44	41
L	296	4.90	107	30	480	242	360			192	616		177	44	43
L	320	6.00	109	34	488	270	370			190	630		183	44	43
L	296	5.20	112	30	466	270	370			191	604		179	44	44
L	300	4.80	116	33	491	245	380			189	630		187	49	40
L	315	5.80	161	45	540	436	390			193	645		177	46	37
L	308	6.10	108	50	499	266	400			205	618		179	43	36
L	299	5.10	106	28	480	248	380			193	610		176	44	34
M	300	6.00	108	33	532	246	460	0.040	2.59	212	660		179	44	52
M	300	6.30	107	29	531	323	460	0.050	2.73	212	660		191	43	57
M	310	6.10	110	35	553	261	490	0.040	2.58	224	700		183	46	52
M	310	6.20	108	40	548	267	480	0.040	2.59	221	690		173	43	64
M	300	6.30	110	29	527	272	450	0.020	2.59	210	650		184	42	55
M	300	6.30	110	38	535	244	470	0.040	2.59	217	680		178	44	53
M	290	5.80	110	30	521	311	460	0.040	2.59	210	660		172	43	51
M	280	6.40	114	33	507	293	440	0.040	2.58	205	630		181	54	54
N	270	6.10	100	29	476	297	410	0.030	2.64	198	570	600	165	42	43
N	270	6.00	101	28	483	277	420	0.040	2.62	200	580	600	169	41	48
N	270	6.20	93	29	480	228	430	0.040	2.68	205	620	600	165	42	50
N	270	6.40	98	39	486	253	420	0.040	2.61	205	590	600	171	43	51
N	270	6.50	98	29	483	259	420	0.040	2.65	209	610	600	167	42	51
N	270	6.20	94	32	483	243	420	0.030	2.54	201	590	600	165	41	48
N	260	5.90	89	34	460	248	400	0.030	2.59	196	570	600	160	41	46
N	270	6.40	100	29	493	287	420	0.040	2.59	209	610	600	177	44	51
O	270	6.90	104	40	512	284	420	0.040	2.53	208	590	580	180	44	55
O	260	6.60	104	32	495	235	390	0.040	2.51	201	570	580	174	43	52
O	260	6.80	103	33	494	345	400	0.040	2.53	202	580	580	177	47	55
O	260	6.50	102	30	484	257	390	0.040	2.54	197	560	580	170	46	53
O	260	6.50	104	31	483	249	390	0.040	2.51	198	560	580	171	41	53
O	260	7.10	101	32	492	265	400	0.040	2.52	202	570	570	174	43	52
O	260	6.50	105	31	480	296	390	0.040	2.52	196	560	580	169	41	52
O	260	6.40	98	30	483	260	390	0.040	2.54	195	550	580	172	41	52
P	293	6.00	77	31	542	295	400	0.050	2.34	202	676		181	56	43
P	286	6.00	80	35	545	277	500	0.040	2.34	202	689		186	54	44
P	285	6.00	83	35	549	324	400	0.040	2.36	197	651		185	47	44
P	285	7.00	84	35	578	333	500	0.050	2.4	198	651		184	51	45
P	291	7.00	84	47	583	331	500	0.040	2.4	198	681		188	48	44
P	286	6.00	85	39	556	312	400	0.050	2.44	193	681		188	46	43
P	288	6.00	80	34	548	333	500	0.050	2.51	196	667		181	47	41
P	288	6.00	91	34	576	292	500	0.050	2.37	196	675		187	52	46

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.

14 May 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.)