



## AMIS0152

### ***Certified Reference Material***

**Zinc oxide ore  
Skorpion Mine, Namibia**

### ***Certificate of Analysis***

#### **Recommended Concentrations and Limits<sup>1</sup> (at two Standard Deviations)**

#### ***Certified Concentrations<sup>2</sup>***

Zn M/ICP	5.88	±	0.26	%
Zn P	5.75	±	0.26	%
Zn F	5.86	±	0.28	%
Zn XRF	5.90	±	0.14	%
Cu M/ICP	413	±	21	ppm
Cu P	400	±	31	ppm
Fe M/ICP	1.55	±	0.08	%
Fe P	1.50	±	0.14	%
Mn M/ICP	2712	±	162	ppm
Mn P	2757	±	177	ppm
Specific Gravity	2.81	±	0.12	%

#### ***Informational means***

Ag P	0.41	ppm
As M/ICP	12.6	ppm
As P	10.3	ppm
Pb M/ICP	20	ppm
Pb P	18	ppm

1. Manufacturers recommended limits for use of the material as control samples, based on two standard deviations, calculated using "Between Laboratory" statistics for treatment of the data for trivial, non-trivial and technically invalid results. See sections 1, 9 and 12.
2. There is additional certified major element data presented on p2 and uncertified trace element data presented as an appendix.

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

## *Certified Concentrations*

Al <sub>2</sub> O <sub>3</sub>	3.77	±	0.12	%
CaO	0.38	±	0.02	%
Fe <sub>2</sub> O <sub>3</sub>	2.21	±	0.12	%
K <sub>2</sub> O	1.36	±	0.06	%
MgO	0.57	±	0.04	%
MnO	0.36	±	0.02	%
SiO <sub>2</sub>	81.10	±	3.50	%
TiO <sub>2</sub>	0.17	±	0.02	%

## *Provisional Concentrations*

Cr <sub>2</sub> O <sub>3</sub>	0.05	±	0.01	%
S M/ICP	0.045	±	0.01	%

## *Informational means*

S Combustion / LECO	0.04	%
S P	0.043	%

1. **Intended Use:** AMIS0152 can be used to check analysis of samples of Zinc oxide 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:** AMIS0152 was supplied by Anglo American Plc from their Skorpion mine situated 800km south of Windhoek in Namibia. The Skorpion Zinc deposit occurs associated with the Rosh Pinah Formation of the Late Proterozoic Gariep Belt, which is an arcuate north trending tectonic unit some 400km long by 80km wide. This belt consists of sediments deposited in association with late pre-Cambrian continental rifting, which resulted in the formation of sedimentary basins. These basins are commonly sites for sedimentary exhalative ("SEDEX") base metal mineralisation, which involves hot, metal-rich brines from depth rising along the extensional faults before emerging from the sea floor and interacting with the cold seawater. This results in the deposition of metal sulphides into topographic lows along with other sediments. Compressive tectonic processes resulted in the obliteration of the extensional features, folding of the strata and the development of thrust faulting.

The Skorpion ore body is unique in that it comprises an oxide deposit created during intense weathering of previous zinc sulphide ore minerals. The ore accumulated as alluvial accumulations

of supergene zinc oxide minerals, of detrital nature, deposited within a palaeochannel and interfingered with limestone, forming a very complex orebody, up to 180m thick and containing 21.6Mt ore grading 10.6% zinc.

**3. Mineral and Chemical Composition:** The unusual mineralisation comprises the clays sauconite, smithsonite, hemimorphite and hydrozincite. There is no evidence of sulphide mineralization below the orebody, but there is a thin polymetallic sulphide occurrence 400km to the west that might be the source of the zinc in the silicate-carbonate ore.

**4. Appearance:** The material is a very fine Pale GreenishYellow powder (Corstor colour chart 5Y 8/2).

**5. Handling instructions:** The material is packaged in Laboratory Packs and Explorer Packs that must be shaken or otherwise agitated before use. Normal safety precautions for handling fine particulate matter are suggested, such as the use of safety glasses, breathing protection, gloves and a laboratory coat.

**6. Method of Preparation:** The material was crushed, dry-milled and air-classified to <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. 4 acid digest-ICP finish for Zn, Ag, As, Cu, Fe, Mn, Pb – (M ICP).
2. Aqua regia digest-ICP for As, Cu, Fe, Mn, Pb – (P).
3. 4 acid digest-ICP finish, multi-element scan.
4. Aqua regia digest-ICP, multi-element scan.
5. Fusion-ICP – Zn.
6. Fusion-XRF - Al<sub>2</sub>O<sub>3</sub>, CaO, Cr<sub>2</sub>O<sub>3</sub>, Fe<sub>2</sub>O<sub>3</sub>, K<sub>2</sub>O, MgO, MnO, Na<sub>2</sub>O, SiO<sub>2</sub>, TiO<sub>2</sub>, LOI.
7. Total S.
8. SG by Pycnometer.

**8. Information requested:**

1. State and provide brief description of analytical techniques used.
2. State aliquots used for all determinations.
3. Results for individual analyses to be reported ( not averages )
4. All results for Zn and major elements to be reported in %.
5. All results for multi-element scans to be reported in ppm.
6. Report all QC data, to include replicates, blanks and certified reference materials used.

**9. Method of Certification:** Twenty one laboratories were each given eight packages, comprising eight samples scientifically selected from throughout the batch. Seventeen laboratories reported results in time for certification of the economic elements. Eight of these laboratories reported results for the major elements.

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

1. Alex Stewart International Corporation Zambia
2. ALS Chemex Laboratory Group Brisbane Australia
3. ALS Chemex Laboratory Group Guangzhou (China)
4. ALS Chemex Laboratory Group Johannesburg SA
5. ALS Chemex Laboratory Group La Serena (Chile)
6. ALS Chemex Laboratory Group Lima (Peru)
7. ALS Chemex Laboratory Group Perth WA
8. ALS Chemex Laboratory Group Vancouver CA
9. Genalysis Laboratory Services (South Africa) Pty
10. Set Point Laboratories (Isando) SA
11. SGS Geosol Laboratories Ltda (Brazil)
12. SGS Mineral Services Callao (Peru)
13. SGS Mineral Services Lakefield (Canada)
14. SGS South Africa (Pty) Ltd - Booyens
15. SGS Toronto (Canada)
16. Ultra Trace (Pty) Ltd WA
17. Zincor Laboratory (South Africa)

**11. 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 digital data from this round robin is available on request.

Lab Code	Zn M/ICP %	Zn P %	Zn F %	Zn XRF %	Ag P ppm	As M/ICP ppm	As P ppm	Cu M/ICP ppm	Cu P ppm	Fe M/ICP %	Fe P %	Mn M/ICP ppm	Mn P ppm	Pb M/ICP ppm	Pb P ppm	SG
A	5.70		5.80			19.0	15.0	406	400	1.54	1.41	2703	2694	24.0	24.0	
A	5.67		5.85			19.0	20.0	403	394	1.50	1.39	2747	2668	25.0	20.0	
A	5.75		5.85			20.0	15.0	404	392	1.47	1.38	2764	2697	27.0	22.0	
A	5.77		5.82			18.0	17.0	408	408	1.52	1.42	2722	2664	24.0	22.0	
A	5.71		5.74			16.0	16.0	408	405	1.50	1.43	2772	2671	24.0	21.0	
A	5.72		5.86			19.0	18.0	406	397	1.50	1.43	2732	2675	24.0	19.0	
A	5.72		5.88			19.0	16.0	407	394	1.52	1.43	2735	2740	23.0	20.0	
A	5.77		5.80			19.0	15.0	406	396	1.53	1.41	2710	2690	23.0	22.0	
C			6.01	5.78			10.0	377	412	1.52		2552		22.0	12.0	2.66
C			5.98	5.88		10.0	10.0	372	375	1.51		2565		27.0	13.0	2.63
C			5.92	5.63			9.0	391	369	1.56		2662		15.0	12.0	2.62
C			6.02	5.90			9.0	378	377	1.49		2551		19.0	12.0	2.63
C			6.01	5.86			13.0	369	379	1.49		2524		17.0	14.0	2.64
C			5.94	5.86			8.0	383	366	1.51		2576		16.0	15.0	2.61
C			5.91	5.95		10.0	9.0	373	372	1.52		2523		13.0	12.0	2.62
C			5.99	5.93		11.0	11.0	377	393	1.52		2605		14.0	13.0	2.63
D	5.47		5.86	5.84		13.0	10.0	372	415	1.54	1.59	2590	2980	20.0	20.0	2.77
D	5.34		5.69	5.96		15.0	10.0	370	408	1.52	1.55	2630	2870	21.0	19.0	2.77
D	5.44		6.20	5.94		16.0	10.0	366	418	1.48	1.57	2650	2920	21.0	20.0	2.75
D	5.35		5.65	5.93		15.0	10.0	368	407	1.46	1.58	2530	2940	20.0	19.0	2.78
D	5.42		5.81	5.90		15.0	10.0	363	408	1.51	1.56	2570	2910	20.0	20.0	2.78
D	5.36		5.66	5.96		14.0	10.0	373	392	1.53	1.56	2600	2850	21.0	19.0	2.76
D	5.36		5.74	5.86		15.0	10.0	368	400	1.53	1.54	2600	2860	20.0	20.0	2.76
D	5.40		5.86	5.91		14.0	10.0	366	406	1.53	1.57	2610	2940	20.0	20.0	2.77
E	5.98		5.58	5.79		8.0	12.0	388	369	1.55	1.50	2820	2550			
E	5.81		5.72	5.92		9.0	10.0	390	377	1.51	1.51	2750	2640			
E	5.78		5.56	5.92		9.0	10.0	380	390	1.55	1.54	2760	2670			
E	6.01		5.69	5.86		10.0	11.0	397	393	1.53	1.54	2800	2670			
E	6.07		5.77	5.86		10.0	12.0	392	394	1.51	1.57	2810	2710			
E	5.98		5.83	5.90		8.0	12.0	390	386	1.58	1.56	2840	2670			
E	5.98		5.77	5.90		10.0	12.0	399	385	1.57	1.51	2840	2680			
E	6.28		5.70	5.91		7.0	11.0	402	372	1.58	1.52	2760	2580			
F	5.97	5.88	5.86		0.30	13.0	11.4	420	421	1.55	1.56	2780	2790	20.0	21.0	2.76
F	5.96	5.90	5.92		0.30	13.0	11.6	420	416	1.58	1.53	2780	2710	21.0	21.0	2.77
F	5.93	5.95	5.85		0.30	12.0	11.4	415	414	1.56	1.58	2750	2800	20.0	19.0	2.79
F	5.87	5.89	5.89		0.30	13.0	11.6	405	425	1.58	1.55	2780	2770	20.0	19.0	2.80
F	5.84	5.83	5.94		0.30	12.0	11.8	405	417	1.57	1.58	2730	2820	19.0	20.0	2.80
F	5.92	5.86	5.93		0.40	11.0	11.0	410	413	1.56	1.56	2730	2810	18.0	19.0	2.82
F	5.93	5.88	5.93		0.30	13.0	11.4	415	425	1.59	1.58	2740	2810	19.0	21.0	2.80
F	5.96	5.89	5.90		0.30	12.0	11.2	420	412	1.57	1.54	2770	2750	18.0	19.0	2.81
G	5.72		6.08	5.83	1.20	13.0	9.0	420	410	1.50	1.36	2600	2700	30.0	40.0	
G	5.88		5.99	5.81	0.80	13.0	10.0	430	410	1.55	1.38	2700	2700	20.0	30.0	
G	5.74		5.96	5.82	0.50	13.0	9.0	410	400	1.48	1.36	2700	2700	20.0	20.0	
G	5.74		6.24	5.84	0.50	9.0	7.0	410	410	1.50	1.36	2800	2700	10.0	30.0	
G	5.74		6.02	5.82	0.60	12.0	10.0	410	410	1.49	1.39	2700	2700	10.0	20.0	
G	5.72		5.75	5.82	0.50	9.0	7.0	410	410	1.48	1.38	2700	2700	20.0	20.0	
G	5.74		5.79	5.83	0.60	11.0	7.0	410	410	1.50	1.36	2800	2700	10.0	20.0	
G	5.72		5.59	5.82	0.50	14.0	8.0	410	410	1.50	1.36	2700	2700	20.0	20.0	

Assay data (cont)

Lab Code	Zn M/ICP %	Zn P %	Zn F %	Zn XRF %	Ag P ppm	As M/ICP ppm	As P ppm	Cu M/ICP ppm	Cu P ppm	Fe M/ICP %	Fe P %	Mn M/ICP ppm	Mn P ppm	Pb M/ICP ppm	Pb P ppm	SG
H	6.07	5.68				20.0	11.0	430		1.57	1.48	2800	2700	20.0	30.0	2.91
H	5.95	5.86				10.0	10.0	450		1.55	1.55	2800	2800	30.0	20.0	2.73
H	5.83	5.84				10.0	15.0	420		1.49	1.52	2700	2800	30.0	20.0	2.76
H	6.08	5.80				10.0	12.0	440		1.56	1.53	2800	2800	30.0	30.0	2.73
H	5.65	5.84				20.0	12.0	400		1.46	1.54	2600	2800	40.0	30.0	2.73
H	5.81	5.78				10.0	11.0	410		1.49	1.52	2700	2700	20.0	30.0	2.75
H	5.79	5.67				20.0	13.0	400		1.49	1.50	2700	2700	30.0	20.0	2.75
H	5.92	5.73				10.0	13.0	410		1.53	1.51	2700	2700	30.0	50.0	2.76
I	5.91	6.00			0.30	15.0	6.0	420	420	1.60	1.60	2800	2900	20.0	10.0	
I	5.97	5.93			0.30	14.0	8.0	430	420	1.63	1.60	2800	2900	20.0	20.0	
I	5.95	5.81			0.40	14.0	8.0	430	420	1.62	1.57	2800	2800	20.0	20.0	
I	5.74	5.85			0.30	15.0	9.0	410	420	1.56	1.58	2700	2800	20.0	10.0	
I	5.95	5.91			0.30	14.0	8.0	430	420	1.62	1.60	2800	2900	10.0	10.0	
I	5.79	5.94			0.30	15.0	8.0	420	420	1.58	1.61	2800	2900	20.0	20.0	
I	5.95	5.85			0.30	13.0	8.0	430	420	1.62	1.59	2800	2800	20.0	20.0	
I	5.81	5.91			0.30	14.0	9.0	420	420	1.58	1.60	2800	2900	20.0	20.0	
J			6.00		0.50	50.0	13.0	480	420	1.57	1.53	2800	2700	70.0	10.0	
J			6.18		0.60	40.0	11.0	420	410	1.56	1.51	2800	2700	20.0		
J			6.12		0.40	30.0	12.0	420	400	1.57	1.49	2800	2700	10.0	10.0	
J			5.97		0.40	40.0	13.0	420	410	1.57	1.50	2800	2700	20.0	40.0	
J			6.15		0.50	40.0	11.0	420	400	1.56	1.48	2800	2600	10.0	10.0	
J			6.05		0.50	40.0	13.0	420	400	1.56	1.48	2800	2600	20.0	10.0	
J			6.05		0.40	30.0	13.0	420	390	1.55	1.47	2800	2600	20.0		
J			6.23		0.50	30.0	14.0	420	410	1.55	1.49	2800	2700	30.0	10.0	
K	5.78	5.75			0.60	13.0	9.0	419	398	1.56	1.50	2770	2890	19.0	21.0	
K	5.75	5.70			0.50	10.0	9.0	430	385	1.57	1.48	2820	2870	21.0	20.0	
K	5.74	5.68			0.20	14.0	8.0	427	400	1.63	1.47	2710	2860	22.0	20.0	
K	5.77	5.70			0.50	15.0	7.0	422	384	1.59	1.48	2630	2860	20.0	20.0	
K	5.73	5.78			0.60	14.0	7.0	431	390	1.59	1.48	2870	2860	21.0	18.0	
K	5.76	5.80			0.40	13.0	8.0	427	393	1.63	1.46	2690	2840	22.0	20.0	
K	5.73	5.78			0.40	9.0	7.0	421	391	1.58	1.46	2620	2840	22.0	18.0	
K	5.78	5.68			0.40	6.0	11.0	415	397	1.56	1.46	2590	2850	25.0	18.0	
L	6.08			5.85	0.40	11.0	10.0	420	385	1.54	1.34	2700	2380	20.0	15.0	
L	6.00			5.88	0.20	13.0	10.0	420	402	1.53	1.39	2900	2470	30.0	16.0	
L	6.02			5.93	0.60	14.0	9.0	410	395	1.52	1.35	2700	2400	30.0	15.0	
L	6.01			5.95	0.30	13.0	9.0	410	381	1.52	1.34	2700	2390	20.0	15.0	
L	5.98			5.99	0.50	15.0	10.0	410	382	1.52	1.33	2600	2380	20.0	15.0	
L	5.99			6.08	0.60	17.0	11.0	420	397	1.52	1.38	2700	2460	20.0	15.0	
L	6.05			5.84	0.30	13.0	10.0	410	394	1.53	1.39	2700	2480	20.0	16.0	
L	6.05			5.87	0.60	13.0	9.0	420	404	1.53	1.39	2700	2470	20.0	14.0	
M	5.81	5.80	5.71		0.50	10.0	11.0	420	410	1.59	1.57	2700	2700	20.0	20.0	2.83
M	5.67	5.82	5.55		0.40	10.0	12.0	410	420	1.54	1.57	2600	2700	20.0	10.0	2.89
M	5.82	5.76	5.71		0.40	12.0	9.0	420	410	1.54	1.56	2600	2700	30.0	10.0	2.83
M	6.06	5.81	5.74		0.50	12.0	11.0	430	430	1.61	1.54	2700	2700	20.0	40.0	2.91
M	6.01	5.83	5.71		0.40	21.0	10.0	430	430	1.59	1.54	2700	2700	30.0	130.0	2.78
M	5.99	5.93	5.75		0.30	13.0	14.0	430	440	1.59	1.59	2700	2700	30.0	30.0	2.86
M	5.90	5.87	5.74		0.20	10.0	14.0	420	440	1.59	1.57	2700	2700	120.0	20.0	2.88
M	5.95	5.53	5.77		0.30	10.0	13.0	420	420	1.58	1.48	2700	2600	20.0	20.0	2.89
N	5.88	5.52	5.55		0.63	12.0	10.0	402	401	1.55	1.46	2650	2750	13.4	13.0	2.91
N	5.77	5.66	5.47		0.36	11.0	11.0	397	400	1.55	1.49	2630	2790	13.2	12.4	2.91
N	5.85	5.59	5.49		0.35	12.0	11.0	397	404	1.52	1.49	2610	2790	13.7	13.0	2.96
N	5.85	5.50	5.38		0.39	11.0	11.0	403	399	1.55	1.49	2650	2800	14.2	12.8	2.91
N	5.87	5.60	5.50		0.37	11.0	11.0	398	396	1.55	1.48	2650	2780	13.4	13.0	2.88
N	5.83	5.71	5.44		0.36	11.0	11.0	404	407	1.52	1.49	2610	2790	13.5	12.7	2.93
N	5.67	5.52	5.41		0.37	11.0	11.0	388	405	1.51	1.50	2580	2810	14.3	13.2	2.87
N	5.82	5.61	5.48		0.36	12.0	11.0	401	404	1.51	1.48	2590	2760	13.7	12.7	2.92
O																2.83
O																2.84
O																2.82
O																2.84
O																2.79
O																2.83
O																2.84
O																2.82
Q				7.79												
Q				7.77												
Q				7.74												
Q				7.69												
Q				7.75												
Q				7.73												
Q				7.76												
Q				7.74												
R	5.98	5.60	5.79	5.88		23.0	16.0	424	374	1.58	1.32	2895	2443	18.0	13.0	2.76
R	6.05	5.60	6.06	5.98		26.0	16.0	411	378	1.60	1.33	2898	2457	19.0	13.0	2.77
R	6.05	5.67	5.91	6.13		25.0	14.0	418	380	1.62	1.32	2903	2432	19.0	13.0	2.75
R	6.03	5.65	6.01	5.98		24.0	16.0	412	377	1.58	1.31	3008	2444	19.0	13.0	2.76
R	6.07	5.59	5.81	6.01		22.0	16.0	418	384	1.64	1.32	3013	2471	18.0	13.0	2.76
R	6.09	5.55	5.97	5.99		25.0	15.0	405	374	1.60	1.32	2893	2451	19.0	13.0	2.76
R	6.05	5.52	5.95	6.06		25.0	14.0	409	371	1.60	1.31	3029	2441	19.0	13.0	2.76
R	5.95	5.58	5.95	6.05		24.0	15.0	411	374	1.64	1.32	2917	2438	18.0	13.0	2.77
U				5.86												
U				5.71												
U				5.85												
U				6.07												
U				5.98												
U				5.87												
U				5.85												
U				5.84												

**12. Measurement of Uncertainty:** The samples used in the certification process were 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 <sup>1</sup>	σ <sub>L</sub> <sup>2</sup>	Sw <sup>3</sup>	CSU <sup>4</sup>
Zn	M/ICP	%	0.126	0.086	0.081	0.027
Zn	P	%	0.134	0.131	0.070	0.050
Zn	F	%	0.140	0.107	0.086	0.037
Zn	XRF	%	0.069	0.048	0.054	0.020
Ag	P	g/t	0.115	0.066	0.096	0.026
As	M/ICP	ppm	2.709	1.905	1.279	0.567
As	P	ppm	1.731	1.145	1.064	0.348
Cu	M/ICP	ppm	10.572	7.081	6.182	2.144
Cu	P	ppm	15.529	10.878	7.520	3.108
Fe	M/ICP	%	0.039	0.025	0.022	0.007
Fe	P	%	0.072	0.058	0.020	0.017
Mn	M/ICP	ppm	80.775	51.618	48.231	15.107
Mn	P	ppm	88.638	70.736	37.169	21.701
Pb	M/ICP	ppm	5.374	2.749	4.148	0.866
Pb	P	ppm	6.392	3.093	5.078	0.997
SG	pycnometer		0.058	0.055	0.031	0.021

1. S - Std Dev for use on control charts.
2. σ<sub>L</sub> - Betw Lab Std Dev, for use to calculate a measure of accuracy.
3. Sw - 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:** AMIS0152 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](http://www.amis.co.za) website.

**17. Minimum sample size:** The majority of laboratories reporting used a 0.5g sample size for the ICP. This is the recommended minimum sample size 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.

30 November 2009

**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 1. – Uncertified trace element statistics

Although requested, very few of the laboratories reported multi-element scan data. The data below is for informational use only.

Analyte	Method	Unit	Mean	2SD	RSD%	n
Al	M/ICP	%	1.97	0.094	2.4	60
Ba	M/ICP	ppm	893	64.8	3.6	64
Be	M/ICP	ppm	3.09	0.180	2.9	62
Bi	M/ICP	ppm	1.77	2.69	76.1	23
Ca	M/ICP	%	0.271	0.028	5.3	62
Cd	M/ICP	ppm	54.3	3.85	3.5	64
Ce	M/ICP	ppm	32.2	1.50	2.3	8
Co	M/ICP	ppm	10.3	1.67	8.1	62
Cr	M/ICP	ppm	273	50.2	9.2	56
Cs	M/ICP	ppm	2.30	0.107	2.3	8
Dy	M/ICP	ppm	2.25	0.082	1.8	7
Er	M/ICP	ppm	1.41	0.064	2.3	8
Eu	M/ICP	ppm	0.469	0.052	5.5	8
Ga	M/ICP	ppm	10.0			19
Gd	M/ICP	ppm	2.23	0.256	5.8	8
Hf	M/ICP	ppm	2.75	2.07	37.6	8
Ho	M/ICP	ppm	0.465	0.028	3.0	8
K	M/ICP	%	1.06	0.084	4.0	56
La	M/ICP	ppm	13.0	8.56	32.9	64
Li	M/ICP	ppm	6.94	0.641	4.6	8
Lu	M/ICP	ppm	0.183	0.026	7.0	8
Mg	M/ICP	%	0.312	0.029	4.6	60
Mo	M/ICP	ppm	2.35	0.918	19.5	58
Na	M/ICP	%	0.090	0.014	7.6	61
Nb	M/ICP	ppm	3.81	0.744	9.8	8
Nd	M/ICP	ppm	14.2	0.465	1.6	8
Ni	M/ICP	ppm	68.6	6.61	4.8	61
P	M/ICP	%	691	68.5	5.0	55
Pr	M/ICP	ppm	3.89	0.131	1.7	8
Rb	M/ICP	ppm	67.5	1.85	1.4	8
Sb	M/ICP	ppm	5.18	6.30	60.8	16
Sc	M/ICP	ppm	3.00			56
Si	M/ICP	%	38.0	0.420	0.6	8
Sm	M/ICP	ppm	2.70	0.141	2.6	8
Sr	M/ICP	ppm	128	7.40	2.9	64
Ta	M/ICP	ppm	0.350	0.107	15.3	8
Tb	M/ICP	ppm	0.353	0.021	2.9	8
Th	M/ICP	ppm	4.50			7
Ti	M/ICP	%	0.089	0.009	5.0	56
Tm	M/ICP	ppm	0.190	0.021	5.6	8
U	M/ICP	ppm	14.0	9.34	33.3	64
V	M/ICP	ppm	20.9	1.58	3.8	56
W	M/ICP	ppm	6.60	8.54	64.7	20
Yb	M/ICP	ppm	1.29	0.089	3.4	8
Zr	M/ICP	ppm	139	7.56	2.7	7