



## AMIS0145

### ***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	12.59	±	0.48	%
Zn P	12.39	±	0.52	%
Zn F	12.62	±	0.88	%
Zn XRF	12.70	±	0.30	%
Cu M/ICP	854	±	41	ppm
Cu P	844	±	55	ppm
Fe M/ICP	2.27	±	0.10	%
Fe P	2.23	±	0.16	%
Mg M/ICP	0.65	±	0.06	%
Mn M/ICP	5726	±	319	ppm
Mn P	5710	±	278	ppm
Specific Gravity	2.96	±	0.18	

##### ***Provisional Concentrations***

As M/ICP	22.0	±	4.6	ppm
As P	21.6	±	4.7	ppm
Pb P	35.2	±	10.5	ppm
S Comb/LECO	0.08	±	0.02	%
S M/ICP	0.09	±	0.01	%
S P	0.09	±	0.02	%

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

Ag M/ICP	1.02	ppm
Ag P	0.80	ppm
Pb M/ICP	37	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>	7.29	±	0.18	%
CaO	0.78	±	0.06	%
Fe <sub>2</sub> O <sub>3</sub>	3.27	±	0.22	%
K <sub>2</sub> O	2.82	±	0.14	%
MgO	1.16	±	0.12	%
MnO	0.76	±	0.06	%
SiO <sub>2</sub>	61.48	±	2.42	%
TiO <sub>2</sub>	0.33	±	0.04	%

## **Informational Concentration**

Cr<sub>2</sub>O<sub>3</sub> 0.045 %

**1. Intended Use:** AMIS0145 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:** AMIS0145 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 interfingering 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 Yellowish Brown powder (Corstor colour chart – 10YR 6/4).

**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.

**Assay data – Economic Elements**

Lab Code	Zn M/ICP %	Zn P %	Zn F %	Zn XRF %	Ag M/ICP ppm	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 per	Mn P ppm	Pb M/ICP ppm	Pb P ppm
A	13.0		12.9	12.9				22.0	873	808	2.30	1.96	5994	5603	36.0	30.0
A	12.7		12.9	12.9				23.0	912	816	2.34	1.96	5986	5598	38.0	29.0
A	13.0		13.1	12.9				24.0	908	817	2.31	2.00	5902	5702	37.0	30.0
A	12.6		13.0	12.8				23.0	878	814	2.36	1.95	6046	5622	37.0	29.0
A	12.7		13.2	12.8				23.0	906	822	2.32	1.97	5994	5604	37.0	29.0
A	12.8		13.2	12.9				23.0	890	804	2.29	1.92	5920	5510	37.0	29.0
A	12.8		13.0	13.0				22.0	879	825	2.30	1.96	5994	5667	40.0	29.0
A	12.9		13.2	12.8				23.0	874	825	2.27	1.98	5994	5731	41.0	30.0
B	12.6	12.6	12.6		1.50	0.50	25.0	25.2	880	873	2.29	2.28	5840	5690	35.0	34.0
B	12.6	12.6	12.8		1.00	0.50	25.0	26.2	885	877	2.28	2.32	5810	5720	36.0	36.0
B	12.8	12.6	13.0		1.00	0.50	23.0	25.4	890	881	2.28	2.26	5840	5720	38.0	35.0
B	12.5	12.7	12.9		1.50	0.50	25.0	25.6	890	884	2.30	2.33	5780	5750	36.0	34.0
B	12.6	12.8	12.7		1.00	0.50	24.0	26.4	880	875	2.29	2.33	5720	5750	34.0	35.0
B	12.7	12.5	12.9		1.00	0.50	24.0	26.0	885	870	2.30	2.31	5720	5720	35.0	37.0
B	12.8	12.5	12.9		1.50	0.50	23.0	25.2	885	866	2.30	2.27	5740	5720	37.0	35.0
B	12.6	12.7	12.7		1.00	0.50	24.0	24.8	880	867	2.28	2.31	5740	5730	34.0	32.0
C				12.8												
C				12.7												
C				12.6												
C				12.5												
C				12.7												
C				12.7												
C				12.6												
C				12.6												
E	12.2		12.1	12.6	2.00	1.10	24.0	18.0	850	870	2.19	2.04	5700	5700	40.0	40.0
E	12.2		12.7	12.6	3.00	1.00	23.0	19.0	860	850	2.15	2.00	5500	5600	50.0	40.0
E	12.2		12.4	12.6	2.00	1.00	21.0	21.0	850	830	2.20	1.98	5700	5600	40.0	40.0
E	12.3		13.3	12.6	1.00	0.90	22.0	17.0	860	830	2.23	1.95	5800	5500	60.0	40.0
E	12.3		13.7	12.7	2.00	1.00	25.0	20.0	850	830	2.21	1.96	5800	5500	40.0	40.0
E	12.4		13.1	12.6	4.00	1.20	18.0	18.0	860	860	2.23	2.02	5800	5700	40.0	40.0
E	12.4		13.3	12.6	1.00	0.90	23.0	20.0	860	860	2.22	2.01	5800	5700	40.0	40.0
E	12.4		13.3	12.6	2.00	0.90	26.0	18.0	860	850	2.22	2.01	5800	5600	30.0	40.0
F	12.5	12.1			1.00		30.0	23.0	850	870	2.20	2.17	5600	5600	50.0	40.0
F	12.6	12.7			2.00		30.0	22.0	850	890	2.21	2.23	5600	5800	50.0	40.0
F	12.7	12.3			1.00		20.0	22.0	840	850	2.25	2.18	5700	5600	40.0	40.0
F	12.8	12.7			1.00		20.0	20.0	840	880	2.25	2.25	5700	5800	50.0	40.0
F	12.7	12.5			1.00		20.0	24.0	840	880	2.24	2.23	5700	5700	60.0	170.0
F	12.7	12.6			1.00		20.0	21.0	840	900	2.23	2.26	5700	5800	50.0	40.0
F	12.6	12.8			1.00		30.0	24.0	830	890	2.20	2.25	5600	5800	40.0	40.0
F	12.6	12.3			1.00		20.0	23.0	830	860	2.21	2.19	5600	5600	50.0	40.0



## Assay data – Major Oxides

Lab Code	Al <sub>2</sub> O <sub>3</sub> XRF %	CaO XRF %	Cr <sub>2</sub> O <sub>3</sub> XRF %	Fe <sub>2</sub> O <sub>3</sub> XRF %	K <sub>2</sub> O XRF %	MgO XRF %	MnO XRF %	SiO <sub>2</sub> XRF %	TiO <sub>2</sub> XRF %	S Comb/LECO %	SG
A			0.02	3.31	2.86	1.10	0.78		0.35	0.08	2.83
A			0.04	3.30	2.84	1.20	0.78		0.35	0.08	2.84
A			0.02	3.25	2.82	1.20	0.78		0.34	0.08	2.82
A			0.03	3.31	2.87	1.20	0.78		0.35	0.08	2.82
A			0.03	3.27	2.83	1.10	0.77		0.34	0.08	2.84
A			0.03	3.28	2.86	1.10	0.78		0.35	0.08	2.82
A			0.03	3.30	2.85	1.20	0.78		0.35	0.08	2.83
A			0.02	3.31	2.89	1.20	0.78		0.35	0.08	2.84
B	7.38	0.80	0.05	3.29	2.86	1.20	0.78	61.69	0.34		3.06
B	7.39	0.80	0.05	3.28	2.85	1.20	0.77	61.75	0.34		3.08
B	7.41	0.81	0.05	3.30	2.85	1.19	0.77	61.60	0.34		3.09
B	7.39	0.81	0.05	3.28	2.86	1.19	0.77	61.67	0.34		3.08
B	7.39	0.80	0.05	3.29	2.87	1.19	0.77	61.74	0.34		3.08
B	7.40	0.81	0.05	3.27	2.85	1.19	0.77	61.65	0.34		3.08
B	7.39	0.80	0.05	3.26	2.86	1.19	0.78	61.75	0.34		3.07
B	7.39	0.81	0.05	3.28	2.86	1.19	0.77	61.66	0.34		3.07
C	7.04	0.87		3.45	3.19	1.22	0.81	60.61	0.57		
C	7.00	0.86		3.44	3.20	1.21	0.81	60.54	0.56		
C	7.12	0.85		3.47	3.24	1.24	0.81	61.23	0.58		
C	7.12	0.86		3.48	3.23	1.24	0.82	61.25	0.57		
C	6.94	0.84		3.40	3.20	1.19	0.80	60.56	0.57		
C	6.96	0.84		3.39	3.19	1.19	0.80	60.10	0.56		
C	6.94	0.84		3.39	3.17	1.19	0.80	60.87	0.56		
C	7.17	0.86		3.47	3.24	1.20	0.81	61.32	0.57		
E	7.31	0.79	0.04	3.24	2.90	1.24	0.78	61.60	0.33	0.08	
E	7.30	0.78	0.05	3.27	2.90	1.24	0.78	61.70	0.33	0.08	
E	7.29	0.79	0.04	3.24	2.87	1.22	0.77	61.60	0.33	0.08	
E	7.29	0.80	0.04	3.25	2.86	1.24	0.77	61.70	0.33	0.08	
E	7.28	0.81	0.05	3.30	2.88	1.20	0.78	61.50	0.33	0.08	
E	7.32	0.80	0.04	3.28	2.87	1.24	0.78	61.60	0.32	0.07	
E	7.27	0.79	0.04	3.24	2.86	1.22	0.77	61.70	0.32	0.07	
E	7.31	0.79	0.04	3.24	2.88	1.24	0.77	61.50	0.32	0.07	
F										0.07	3.07
F										0.07	3.03
F										0.08	3.04
F										0.09	3.02
F										0.09	3.09
F										0.08	3.03
F										0.07	3.02
F										0.08	3.00
H	7.12	0.78	0.06	3.14	2.58	1.15	0.71	61.00	0.26	0.07	
H	7.11	0.77	0.07	3.14	2.58	1.16	0.71	60.90	0.26	0.07	
H	7.12	0.77	0.08	3.14	2.59	1.16	0.71	60.90	0.26	0.07	
H	7.18	0.77	0.08	3.16	2.60	1.16	0.72	61.30	0.27	0.07	
H	7.16	0.77	0.04	3.16	2.60	1.16	0.72	61.10	0.26	0.07	
H	7.12	0.77	0.04	3.11	2.58	1.16	0.72	60.90	0.26	0.07	
H	7.08	0.76	0.04	3.10	2.57	1.14	0.71	60.50	0.25	0.07	
H	7.08	0.76	0.04	3.11	2.57	1.15	0.71	60.50	0.26	0.06	
J	7.20	0.78	0.04	2.76		1.04	0.70	62.50		0.05	
J	7.19	0.77	0.06	2.76		1.05	0.70	62.30		0.05	
J	7.38	0.80	0.05	2.81		1.06	0.71	63.90		0.05	
J	7.33	0.79	0.05	2.80		1.06	0.72	63.50		0.05	
J	7.25	0.77	0.04	2.71		1.02	0.69	62.70		0.04	
J	7.25	0.78	0.05	2.75		1.02	0.69	62.70		0.04	
J	7.30	0.78	0.06	2.78		1.05	0.70	63.50		0.05	
J	7.34	0.79	0.06	2.81		1.06	0.71	63.80		0.05	
K	7.21	0.74	0.04	3.23	2.73	1.15	0.74	59.25	0.32	0.07	2.97
K	7.20	0.76	0.04	3.23	2.73	1.16	0.74	59.22	0.33	0.07	3.08
K	7.21	0.75	0.04	3.22	2.76	1.15	0.75	59.45	0.33	0.08	2.96
K	7.19	0.74	0.04	3.22	2.73	1.15	0.74	59.11	0.32	0.07	2.99
K	7.23	0.74	0.04	3.23	2.75	1.15	0.75	59.28	0.31	0.08	3.10
K	7.23	0.76	0.04	3.23	2.73	1.15	0.75	59.28	0.32	0.08	3.06
K	7.24	0.74	0.04	3.26	2.73	1.16	0.75	59.15	0.32	0.06	3.00
K	7.25	0.75	0.04	3.25	2.75	1.16	0.75	59.36	0.32	0.08	3.05
L	7.35	0.87		3.40		1.16	0.76				
L	7.52	0.84		3.43		1.14	0.76				
L	7.40	0.85		3.47		1.11	0.77				
L	7.32	0.80		3.45		1.09	0.77				
L	7.35	0.84		3.33		1.09	0.76				
L	7.28	0.82		3.36		1.11	0.77				
L	7.26	0.81		3.36		1.13	0.79				
L	7.15	0.80		3.32		1.09	0.77				

## Assay data (cont)

Lab Code	Al <sub>2</sub> O <sub>3</sub> XRF %	CaO XRF %	Cr <sub>2</sub> O <sub>3</sub> XRF %	Fe <sub>2</sub> O <sub>3</sub> XRF %	K <sub>2</sub> O XRF %	MgO XRF %	MnO XRF %	SiO <sub>2</sub> XRF %	TiO <sub>2</sub> XRF %	S Comb/LECO %	SG
M										0.10	2.95
M										0.09	2.96
M										0.09	2.98
M										0.09	2.97
M										0.09	2.99
M										0.09	3.03
M										0.09	2.94
M										0.10	3.06
N										0.09	
N										0.08	
N										0.08	
N										0.08	
N										0.08	
N										0.07	
N										0.08	
N										0.07	
P	7.21	0.81	0.06	3.28	2.82	1.23	0.74	62.90	0.33	0.09	2.68
P	7.32	0.82	0.05	3.36	2.92	1.22	0.76	63.50	0.34	0.09	2.68
P	7.27	0.80	0.05	3.29	2.81	1.23	0.76	62.50	0.33	0.10	2.70
P	7.26	0.77	0.06	3.30	2.91	1.17	0.76	63.00	0.34	0.10	2.71
P	7.39	0.79	0.05	3.32	2.86	1.27	0.75	63.30	0.32	0.10	2.70
P	7.36	0.81	0.05	3.31	2.91	1.24	0.76	63.00	0.32	0.09	2.70
P	7.34	0.81	0.06	3.32	2.88	1.30	0.76	63.10	0.33	0.10	2.67
P	7.46	0.81	0.06	3.29	2.81	1.17	0.74	62.70	0.34	0.10	2.68
Q	7.38	0.79	0.05	3.63	2.85	1.34	0.76	61.50	0.31	0.07	2.84
Q	7.43	0.80	0.05	3.47	2.85	1.33	0.76	62.10	0.31	0.07	2.83
Q	7.42	0.79	0.06	3.14	2.86	1.33	0.77	61.90	0.31	0.07	2.82
Q	7.45	0.81	0.04	3.28	2.87	1.34	0.76	61.60	0.32	0.06	2.86
Q	7.31	0.81	0.04	3.57	2.83	1.33	0.75	61.10	0.31	0.06	2.84
Q	7.28	0.78	0.05	3.29	2.83	1.29	0.76	61.40	0.31	0.07	2.86
Q	7.34	0.80	0.05	3.26	2.81	1.31	0.76	61.30	0.32	0.06	2.86
Q	7.33	0.79	0.05	3.36	2.81	1.33	0.76	61.10	0.31	0.06	2.83
R	6.75	0.74	0.04	3.04	2.67	1.10	0.72	57.50	0.30	0.06	
R	6.77	0.75	0.04	3.06	2.67	1.10	0.72	57.50	0.30	0.07	
R	6.82	0.75	0.04	3.07	2.69	1.09	0.72	57.80	0.31	0.07	
R	6.80	0.76	0.04	3.07	2.69	1.10	0.74	58.00	0.31	0.07	
R	6.77	0.74	0.05	3.07	2.67	1.09	0.71	57.70	0.30	0.07	
R	6.79	0.75	0.04	3.06	2.68	1.10	0.73	57.60	0.30	0.06	
R	6.80	0.75	0.04	3.08	2.68	1.10	0.73	57.70	0.31	0.07	
R	6.84	0.76	0.05	3.07	2.69	1.11	0.72	57.50	0.30	0.07	
U											2.95
U											2.92
U											2.93
U											2.93
U											2.92
U											2.94
U											2.93
U											2.95

**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	%	0.286	0.199	0.138	0.057
Zn	P	%	0.256	0.241	0.165	0.101
Zn	F	%	0.439	0.338	0.237	0.110
Zn	XRF	%	0.152	0.135	0.092	0.052
Ag	M/ICP	ppm	0.248	0.213	0.110	0.072
Ag	P	ppm	0.186	0.176	0.081	0.063
As	M/ICP	ppm	2.307	1.400	1.532	0.436
As	P	ppm	2.327	1.454	1.477	0.429
Cu	M/ICP	ppm	20.62	14.16	11.59	4.26
Cu	P	ppm	27.34	19.47	12.49	5.54
Fe	M/ICP	%	0.053	0.026	0.043	0.008
Fe	P	%	0.085	0.074	0.028	0.024
Mg	M/ICP	%	0.036	0.030	0.010	0.011
Mn	M/ICP	ppm	159.6	108.6	86.3	31.3
Mn	P	ppm	138.9	99.4	70.4	29.6
Pb	M/ICP	ppm	7.073	4.297	4.349	1.222
Pb	P	ppm	5.250	4.031	2.177	1.185
SG	pycnometer		0.094	0.103	0.029	0.039

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 Std 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:** AMIS0145 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

*Certified Mg M/ICP and added Major Oxides Data Table– 23 November 2015*

**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	%	3.8	0.16	2.1	62
Ba	M/ICP	ppm	1870	131	3.5	61
Be	M/ICP	ppm	6.2	0.35	2.8	56
Bi	M/ICP	ppm	2.9	2.0	34.7	20
Ca	M/ICP	%	0.55	0.04	4.1	64
Cd	M/ICP	ppm	116	7.3	3.1	61
Ce	M/ICP	ppm	56.1	2.1	1.9	8
Co	M/ICP	ppm	18.8	2.2	5.8	62
Cr	M/ICP	ppm	246	61.0	12.4	62
Cs	M/ICP	ppm	5.1	0.11	1.1	8
Dy	M/ICP	ppm	4.4	0.15	1.7	8
Er	M/ICP	ppm	2.6	0.16	3.2	8
Eu	M/ICP	ppm	0.89	0.06	3.6	8
Ga	M/ICP	ppm	10.0	0.00	0.0	56
Gd	M/ICP	ppm	4.3	0.21	2.5	8
Ho	M/ICP	ppm	0.92	0.04	2.3	8
In	M/ICP	ppm	0.03	0.02	35.6	8
K	M/ICP	%	2.2	0.20	4.7	56
La	M/ICP	ppm	23.6	9.1	19.3	64
Li	M/ICP	ppm	14.1	1.1	3.8	7
Lu	M/ICP	ppm	0.35	0.03	4.1	8
Mo	M/ICP	ppm	1.8	1.2	35.5	50
Na	M/ICP	%	0.18	0.03	9.1	64
Nb	M/ICP	ppm	6.0	0.53	4.5	8
Nd	M/ICP	ppm	25.1	1.3	2.6	8
Ni	M/ICP	ppm	124	7.1	2.9	55
P	M/ICP	ppm	1478	119	4.0	56
Pr	M/ICP	ppm	6.8	0.19	1.4	8
Rb	M/ICP	ppm	154	9.1	2.9	8
Sb	M/ICP	ppm	5.5	4.5	40.4	20
Sc	M/ICP	ppm	4.7	0.93	10.0	64
Si	M/ICP	%	28.9	0.25	0.4	8
Sm	M/ICP	ppm	4.9	0.14	1.4	8
Sn	M/ICP	ppm	2.0	0.0	0.0	7
Sr	M/ICP	ppm	289	16.4	2.8	63
Ta	M/ICP	ppm	0.70	0.11	7.6	8
Tb	M/ICP	ppm	0.71	0.02	1.5	8
Th	M/ICP	ppm	20.0	0.0	0.0	32
Ti	M/ICP	%	0.16	0.02	4.7	56
Tm	M/ICP	ppm	0.38	0.03	3.4	8
U	M/ICP	ppm	27.5	11.2	20.3	62
V	M/ICP	ppm	34.9	2.9	4.1	58
W	M/ICP	ppm	8.4	6.0	36.1	34
Y	M/ICP	ppm	24.4	1.3	2.7	8
Yb	M/ICP	ppm	2.4	0.12	2.6	8
Zr	M/ICP	ppm	145	10.7	3.7	8