



AMIS0102

Certified Reference Material

**Zinc and lead SEDEX style ore
Reference Material, Kihabe Project, Botswana**

Certificate of Analysis

**Recommended Concentrations and two “Between
Laboratory” Standard Deviations**

Certified Concentrations

Zn M/ICP	2973	±	257	ppm
Zn P	2888	±	277	ppm
Pb M/ICP	1427	±	139	ppm
Pb P	1413	±	134	ppm
Cu M/ICP	64.6	±	7.2	ppm
Cu P	63.9	±	6.5	ppm
Specific Gravity	2.77	±	0.10	

Provisional Concentrations

Cu XRF	68	±	9	ppm
Ag M/ICP	3.35	±	0.46	ppm

Major Element Recommended Concentrations and two “Between Laboratory” Standard Deviations

Certified Concentrations

Al ₂ O ₃	5.65	±	0.24	%
CaO	4.28	±	0.14	%
Cr ₂ O ₃	0.29	±	0.02	%
Fe ₂ O ₃	2.98	±	0.08	%
K ₂ O	1.81	±	0.06	%
MgO	2.69	±	0.12	%
MnO	0.123	±	0.008	%
P ₂ O ₅	0.081	±	0.01	%
SiO ₂	73.75	±	0.58	%
TiO ₂	0.43	±	0.04	%

Provisional Concentration

Na ₂ O	0.61	±	0.12	%
S ICP	0.31	±	0.08	%
LOI	6.45	±	0.80	%

1. **Intended Use:** AMIS0102 is suitable for monitoring the accuracy of a single analysis of SEDEX style lead-zinc ores hosted in siliceous rocks sedimentary rocks. The material can be used for routine quality control by inserting within a batch of samples. It can also be used for instrument calibration.

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 %.

2. **Origin of material:** This material was provided by Mt Burgess Mining (NL) from their Kihabe Base Metals Project is located on the border of Botswana and Namibia about 700km north-west of the capital, Gaborone, in Ngamiland. The Project is 350km by road from Maun and 50km from Tsumkwe, Namibia. The target is within a Proterozoic belt of metasedimentary rocks, with around one third of the prospective geology occurring in Botswana (PL 69/2003, area ~1,000km²) and two thirds in Namibia.

The belt of Proterozoic sedimentary rocks, composed primarily of carbonate and siliclastic rocks, form a trapezoidal wedge of tightly to isoclinally folded metamorphosed sediments of the Damaran Supergroup, bounded by granites and gneisses of the Quangwadum Complex and Kihabe Complex. The target mineralisation is primarily stratiform to stratabound sedimentary exhalative (SEDEX) sulphides occurring at a known stratigraphic level within the basin. The Company's geological model is that the Belt represents a re-closed rift basin with a fill of arkose, greywacke, quartzites and sabkha-facies stromatolitic dolomites. Mineralisation occurs between dolomite and quartzite for a combined strike length of 450km, within Namibia and Botswana.

The Kihabe Resource is located along a contact between the dolomite footwall and a sequence of rhythmically bedded sandstones, which have been folded and metamorphosed to, respectively, dolomitic marble and chloritic quartzite. The local geology of the deposit is known to be a west-plunging syncline. Mineralisation is developed within the host quartzite within thick, coarse grained beds, and weakens upwards in the stratigraphy as the grain size reduces. Mineralisation forms a series of overlapping stacked horizons controlled by the beds within the quartzite.

3. Chemical Composition: The major element data for this material has been certified and is presented on p2 of this certificate. Trace element data from 11 laboratories has also been iterated and compiled and is appended to this certificate, as uncertified statistics.

4. Appearance: The material is a very fine powder coloured Light Blueish Grey (Corstor 10B 8/1).

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 <54um. Wet sieve particle size analysis of random samples confirmed the material was 98.5% <54um. 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 the consensus test results were carried out by independent statisticians.

7. Methods of Analysis requested:

- a. Multi element scan to include Zn, Pb, Cu, Ag. Multi-acid total digestion, including HF, ICP-OES or ICP-MS (M ICP).
- b. Zn, Pb, Cu. Aqua regia digestion with ICP-OES or ICP-MS (P).
- c. Zn, Pb, Cu. Pressed Pellet, XRF.
- d. Majors (Al₂O₃, CaO, Cr₂O₃, Fe₂O₃, K₂O, MgO, MnO, Na₂O, SiO₂, TiO₂. LOI.) XRF fusion.
- e. SG, gas pycnometer.

8. Information requested:

- a. Aliquots used for all determinations.
- b. Results for individual PGM's reported in ppb.
- c. Results for base metals reported in ppm.
- d. QC data, to include replicates, blanks and certified reference materials used.
- e. Analytical techniques used.

9. Method of Certification: Twenty laboratories were each given eight randomly selected packages of sample. Seventeen of the laboratories submitted results.

The final limits were calculated after a three step examination of the data, first removing incompatible data outside a spread normally expected for similar analytical methods done by reputable laboratories. Then, data from any one laboratory was removed from further calculations, if the mean of all analyses from that laboratory failed a t-test of the global means of the other laboratories. Next, data that fell outside of the 2 standard deviations were removed. The mean and standard deviations were then re-calculated.

Analytes with an RSD of near or less than 5 % are reported as "Certified Concentrations" with limits at two "Between Laboratory" standard deviations. Those with RSD's of between near 5 % and 15 % are reported as "Provisional Concentrations" with limits at two "Between Laboratory" standard deviations. Those with RSD's over 15 % are reported as "Informational Values".

This method is different from that used by Government agencies 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 Confidence Limits published on other standards.

10. Participating Laboratories: The 17 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 Chemex Laboratory Group Johannesburg SA
4. ALS Chemex Laboratory Group Perth WA
5. ALS Chemex Laboratory Group Vancouver CA
6. Anglo Research (Crown Campus)
7. Assayers Canada
8. Genalysis Laboratory Services WA
9. Intertek Utama Services (Indonesia)
10. Labtium Inc Finland
11. OMAC Laboratories Limited (Ireland)
12. Set Point Laboratories (Isando) SA
13. SGS Australia Pty Ltd (Newburn) WA
14. SGS Lakefield Research Africa (Pty) Ltd (Booysens SA)
15. SGS Mineral Services Lakefield (Canada)
16. Tati Nickel Mine Laboratory (Botswana)
17. Ultra Trace (Pty) Ltd WA

11. Assay Data: Data as received from the laboratories for the important certified elements are set out below.

Lab Code	Zn M/ICP ppm	Zn P ppm	Zn XRF ppm	Pb M/ICP ppm	Pb P ppm	Pb XRF ppm	Cu M/ICP ppm	Cu P ppm	Cu XRF ppm	Ag M/ICP ppm	SG	Al2O3 XRF %	CaO XRF %	Cr2O3 XRF %	Fe2O3 XRF %	K2O XRF %	MgO XRF %	MnO XRF %	Na2O XRF %	P2O5 XRF %	SiO2 XRF %	TiO2 XRF %	S ICP %	LOI XRF %
B	3179	2898	2968	1406	1399	1372	68.0	62.0	56.00	3.40	2.81	5.55	4.42		3.04	1.84	2.64	0.13	0.57	0.08	73.83	0.41	0.29	6.48
B	3141	3038	2961	1390	1502	1414	66.0	62.0	53.00	3.30	2.80	5.56	4.44		3.03	1.86	2.66	0.12	0.53	0.07	74.05	0.42	0.29	6.50
B	3121	2966	3017	1390	1415	1381	66.0	61.0	64.00	3.10	2.85	5.55	4.45		3.05	1.87	2.67	0.12	0.54	0.09	73.84	0.41	0.31	6.59
B	3163	3031	2970	1401	1469	1380	68.0	63.0	74.00	3.10	2.84	5.53	4.43		3.02	1.87	2.63	0.13	0.54	0.08	73.65	0.42	0.30	6.80
B	3139	2997	3005	1382	1439	1408	68.0	62.0	63.00	3.20	2.87	5.55	4.47		3.13	1.85	2.63	0.12	0.55	0.08	73.76	0.42	0.30	6.53
B	3100	2881	2949	1379	1406	1410	65.0	61.0	63.00	3.10	2.86	5.52	4.41		3.02	1.86	2.65	0.12	0.52	0.07	73.70	0.42	0.29	6.50
B	3208	2999	2992	1380	1438	1381	67.0	61.0	54.00	3.20	2.90	5.52	4.45		3.03	1.86	2.64	0.12	0.52	0.08	73.89	0.41	0.29	6.52
B	3175	3016	2968	1374	1447	1379	67.0	63.0	59.00	3.10	2.89	5.55	4.45		3.04	1.87	2.67	0.12	0.55	0.08	73.93	0.41	0.30	6.44
D	2820	2740		1510	1460		70.0	75.0		3.60		5.73	4.28	0.28	3.02	1.82	2.65	0.12	0.58		73.70	0.42		5.97
D	2860	2710		1530	1490		67.0	76.0		3.60		5.70	4.29	0.29	3.03	1.83	2.65	0.12	0.59		73.70	0.42		5.95
D	2760	2930		1530	1420		70.0	74.0		3.50		5.70	4.27	0.30	3.06	1.81	2.64	0.12	0.56		73.70	0.42		5.98
D	2750	2910		1500	1500		67.0	72.0		3.50		5.70	4.29	0.28	3.02	1.82	2.64	0.12	0.57		73.70	0.42		6.00
D	2880	3030		1560	1450		68.0	75.0		3.30		5.69	4.30	0.28	3.03	1.83	2.66	0.12	0.57		73.70	0.43		5.83
D	2770	2940		1510	1490		70.0	74.0		3.60		5.69	4.28	0.28	3.03	1.83	2.65	0.12	0.59		73.70	0.42		5.88
D	2820	2960		1540	1510		74.0	75.0		3.70		5.70	4.29	0.28	3.03	1.82	2.65	0.12	0.58		73.70	0.43		5.92
D	2750	2760		1500	1470		69.0	73.0		3.60		5.69	4.28	0.28	3.05	1.82	2.66	0.12	0.57		73.80	0.42		5.92
E	2816	3016		1487	1474		71.2	74.2		2.90														
E	2929	3045		1499	1477		75.0	68.1		2.70														
E	3257	3037		1496	1568		69.1	64.1		3.20														
E	2944	2952		1506	1385		66.2	70.5		2.80														
E	2974	2989		1531	1400		63.9	70.5		2.60														
E	3305	2976		1517	1420		65.8	70.9		2.70														
E	3165	3031		1543	1405		57.8	71.3		2.90														
E	3195	3031		1506	1394		65.1	68.5		2.70														
F	3020	2730		1440	1420		61.8	61.6		3.57	2.78													
F	3050	2700		1420	1400		59.9	60.1		3.73	2.79													
F	3080	2740		1430	1420		62.4	62.1		3.54	2.78													
F	3050	2730		1430	1410		65.0	62.9		3.56	2.78													
F	2970	2880		1420	1390		59.9	66.0		3.49	2.78													
F	3090	2680		1440	1390		61.3	65.0		4.04	2.77													
F	3080	2660		1430	1380		61.4	61.2		3.71	2.77													
F	3130	2720		1450	1420		62.3	64.3		3.69	2.78													
G	2787	2730			1300		70.4	69.0		4.20														0.34
G	2788	2760			1340		69.2	67.0		4.20														0.51
G	2773	2770			1350		69.9	71.0		3.90														0.34
G	2790	2690			1290		72.0	64.0		3.90														0.52
G	2803	2710			1300		72.7	63.0		3.80														0.46
G	2883	2700			1320		75.1	67.0		4.10														0.39
G	2834	2720			1280		73.8	67.0		3.90														0.30
G	2818	2730			1290		71.6	69.0		3.90														0.26
H	3060	2750		1450	1320		64.0	61.0		3.30		5.69	4.32	0.28	2.91	1.82	2.75	0.12	0.58	0.08	73.78	0.42		6.00
H	3070	2730		1440	1330		64.0	61.0		3.30		5.68	4.32	0.31	2.95	1.82	2.75	0.12	0.61	0.08	73.78	0.43		6.00
H	3050	2750		1400	1350		62.0	61.0		3.40		5.68	4.31	0.29	2.95	1.82	2.76	0.12	0.60	0.08	73.77	0.43		6.10
H	3030	2770		1410	1330		63.0	60.0		3.30		5.67	4.32	0.28	2.95	1.82	2.75	0.12	0.61	0.08	73.75	0.44		6.00
H	2940	2750		1400	1360		61.0	62.0		3.30		5.67	4.31	0.26	2.94	1.81	2.74	0.12	0.59	0.08	73.76	0.42		6.10
H	3000	2710		1400	1320		63.0	60.0		3.30		5.67	4.32	0.27	2.94	1.82	2.76	0.12	0.61	0.08	73.72	0.44		6.10
H	3010	2790		1410	1360		62.0	63.0		3.40		5.68	4.31	0.27	2.91	1.81	2.74	0.12	0.60	0.08	73.76	0.42		6.00
H	2950	2760		1400	1330		62.0	60.0		3.30		5.67	4.30	0.27	2.94	1.81	2.75	0.13	0.60	0.08	73.78	0.44		6.10
I									65.60		2.77	5.34	4.22			1.72	2.46		0.42		71.30	0.41		6.53
I									68.40		2.76	5.29	4.20			1.71	2.44		0.40		70.30	0.41		6.52
I									68.60		2.78	5.48	4.27			1.73	2.58		0.43		72.20	0.41		6.50
I									66.40		2.77	5.49	4.28			1.74	2.52		0.45		72.20	0.42		5.85
I									65.00		2.77	5.44	4.22			1.72	2.49		0.41		71.30	0.41		6.24
I									64.30		2.77	5.41	4.24			1.73	2.50		0.43		71.40	0.41		6.53
I									64.30		2.77	5.42	4.26			1.73	2.51		0.42		71.70	0.41		6.45
I									65.30		2.78	5.45	4.28			1.74	2.51		0.44		72.20	0.41		6.53

12. Measurement of Uncertainty:

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 ISO guidelines.

Analyte	CSU*	Unit	Analyte	CSU*	Unit
Zn M/ICP	22.756	ppm	CaO	0.016	%
Zn P	28.824	ppm	Cr2O3	0.002	%
Zn XRF	25.237	ppm	Fe2O3	0.010	%
Pb M/ICP	13.766	ppm	K2O	0.008	%
Pb P	13.268	ppm	MgO	0.016	%
Pb XRF	11.033	ppm	MnO	0.001	%
Cu M/ICP	0.612	ppm	Na2O	0.018	%
Cu P	0.590	ppm	P2O5	0.001	%
Cu XRF	1.629	ppm	SiO2	0.076	%
Ag M/ICP	0.048	ppm	TiO2	0.004	%
SG	0.013		S	0.019	%
Al2O3	0.028	%	LOI	0.094	%

13. Uncertified values: The Certified, Provisional and Indicated values listed on p1 and 2 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 and who have maintained measurement traceability during the analytical process.

15. Certification: AMIS0102 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 (M and P) ICP, 20g for the pressed pellet XRF and a 0.25g sample size for the fusion XRF. 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 50 to 250g) of material. The Laboratory Packs are sealed bottles delivered in sealed foil pouches. The Explorer Packs contain material in standard geochem envelopes, nitrogen flushed and vacuum sealed in foil pouches.

19. 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.

18 May 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 – uncertified trace element statistics

Element	Method	Unit	Mean	2SD	RSD%	n
Al	M/ICP	%	2.96	0.34	5.7	63
As	M/ICP	ppm	43.5	4.50	5.2	61
Ba	M/ICP	ppm	765	62.9	4.1	63
Be	M/ICP	ppm	0.90	0.17	9.5	62
Bi	M/ICP	ppm	0.31	0.03	4.9	38
Ca	M/ICP	%	3.04	0.32	5.3	63
Cd	M/ICP	ppm	10.7	1.74	8.1	80
Ce	M/ICP	ppm	47.4	5.51	5.8	46
Co	M/ICP	ppm	12.4	3.41	13.8	79
Cr	M/ICP	ppm	1332	478	17.9	54
Cs	M/ICP	ppm	1.49	0.23	7.9	40
Dy	M/ICP	ppm	2.10	0.54	13.0	32
Er	M/ICP	ppm	1.10	0.37	17.0	32
Eu	M/ICP	ppm	0.80	0.16	9.9	30
Fe	M/ICP	%	2.01	0.14	3.4	69
Ga	M/ICP	ppm	8.40	1.14	6.8	46
Gd	M/ICP	ppm	3.01	0.45	7.4	31
Ge	M/ICP	ppm	0.55	0.94	85.9	24
Hf	M/ICP	ppm	1.87	0.31	8.3	48
Ho	M/ICP	ppm	0.40	0.13	16.0	31
In	M/ICP	ppm	0.04	0.01	13.1	31
K	M/ICP	ppm	1.48	0.13	4.3	63
La	M/ICP	ppm	20.9	3.00	7.2	56
Li	M/ICP	ppm	11.4	1.28	5.6	46
Lu	M/ICP	ppm	0.16	0.06	20.1	32
Mg	M/ICP	%	1.56	0.17	5.5	72
Mn	M/ICP	ppm	941	102	5.4	80
Mo	M/ICP	ppm	2.08	0.46	11.2	63
Na	M/ICP	ppm	0.42	0.04	5.0	69
Nb	M/ICP	ppm	4.89	3.79	38.8	54
Nd	M/ICP	ppm	18.9	1.37	3.6	30
Ni	M/ICP	ppm	26.7	3.09	5.8	69
P	M/ICP	%	0.03	0.01	9.9	70
Pr	M/ICP	ppm	4.96	0.52	5.2	32
Rb	M/ICP	ppm	56.7	5.09	4.5	39
Sb	M/ICP	ppm	8.02	1.88	11.7	52
Sc	M/ICP	ppm	4.23	0.68	8.1	59
Sm	M/ICP	ppm	3.61	0.50	7.0	30
Sn	M/ICP	ppm	1.95	0.58	15.0	47
Sr	M/ICP	ppm	70.6	4.35	3.1	70
Ta	M/ICP	ppm	0.68	0.39	28.9	40
Tb	M/ICP	ppm	0.39	0.08	10.1	24
Th	M/ICP	ppm	5.92	0.61	5.2	46
Ti	M/ICP	%	0.22	0.04	9.8	63
Tl	M/ICP	ppm	0.53	0.09	8.5	38
Tm	M/ICP	ppm	0.15	0.05	17.2	31
U	M/ICP	ppm	1.63	0.15	4.5	46
V	M/ICP	ppm	77.7	4.40	2.8	54
W	M/ICP	ppm	0.77	0.33	21.2	39
Y	M/ICP	ppm	9.82	2.91	14.8	62
Yb	M/ICP	ppm	1.02	0.35	17.1	32
Zr	M/ICP	ppm	66.1	9.91	7.5	63