African Mineral Standards
REFERENCE MATERIALS FOR AFRICAN ORES

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AMIS0084

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	5174	±	540	ppm
Zn XRF	5321	±	294	ppm
Pb M/ICP	1963	±	202	ppm
Pb XRF	1945	±	76	ppm
Cu XRF	70	±	10	ppm
Specific Gravity	2.79	±	0.06	

Provisional Concentrations

Zn P	4959	±	662	ppm
Pb P	1941	±	250	ppm
Cu M/ICP	65.5	±	8.1	ppm
Cu P	63.8	±	6.9	ppm
Ag M/ICP	5.2	±	0.66	ppm

1. Intended Use: AMIS0084 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 from the labs that reported it has not been certified but it is compiled into the table below. Summary statistics for the trace elements are presented in the appendix.

		mean	2SD	RSD%	n
Al_2O_3	%	6.21	0.15	0.54	64
CaO	%	10.43	0.28	0.43	79
Cr_2O_3	%	0.03	0.01	4.29	64
Fe_2O_3	%	2.35	0.08	0.70	73
K2O	%	2.31	0.12	0.86	78
MgO	%	6.68	0.20	0.56	80
MnO	%	0.07	0.00	2.25	90
Na_2O	%	0.39	0.21	3.46	88
P_2O_5	%	0.07	0.01	2.73	62
SiO_2	%	53.48	0.82	0.41	79
TiO_2	%	0.31	0.02	1.84	77
S ICP	%	0.15	0.04	4.60	52
LOI	%	16.51	0.74	0.34	96

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 parti**c**le 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:

1. Aliquots used for all determinations.
2. Results for individual PGM's reported in ppb.
3. Results for base metals reported in ppm.
4. QC data, to include replicates, blanks and certified reference materials used.
5. 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 listed on p1 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
A	4980	4890	5582	1850	1910	2443	61.5	64.2	73.0	7.09	2.80
A	4810	4960	5532	1800	1920	2427	56.9	62.6	69.0	6.87	2.81
A	5020	4900	5568	1880	1900	2440	62.1	63.2	84.0	6.82	2.80
A	4710	4980	5561	1780	1920	2379	59.3	61.8	74.0	6.49	2.81
A	4940	4980	5584	1850	1940	2430	59.0	63.0	77.0	6.37	2.81
A	4890	4990	5581	1820	1940	2403	58.3	63.5	72.0	6.16	2.81
A	4910	4980	5511	1820	1940	2400	58.7	67.1	80.0	6.27	2.81
A	5040	4980	5533	1880	1930	2424	71.9	62.8	72.0	6.96	2.81
B	4920	4830		2030	1970		64.4	59.3			2.81
B	4980	4900		2060	1990		62.4	61.0			2.82
B	5080	5260		2040	2150		61.6	63.6			2.82
B	5090	5230		2100	2130		65.8	62.5			2.81
B	4980	4960		2060	2020		68.3	59.1			2.81
B	4990	4960		2020	2020		63.9	61.6			2.81
B	5120	4890		2060	1990		65.1	63.3			2.81
B	5150	4820		2050	1970		63.9	64.7			2.80
D	5464	5510		2117	2138		65.6	66.2		5.18	
D	5461	5429		2098	2116		66.7	63.8		5.20	
D	5418	5457		2082	2124		65.8	65.4		5.48	
D	5456	5508		2085	2153		67.0	65.0		5.37	
D	5583	5504		2136	2165		64.5	67.1		5.87	
D	5626	5487		2148	2136		67.7	65.5		5.87	
D	5620	5436		2156	2115		67.1	64.5		5.66	
D	5511	5447		2110	2140		63.8	65.1		5.50	
E	4285		4858	1837	1502	1987	58.8	58.5	66.6		2.76
E	4262		4883	1808	1517	1997	64.7	59.1	68.4		2.77
E	4282		4862	1821	1479	1969	56.9	58.1	72.3		2.76
E	4348		4875	1859	1516	1984	67.4	60.0	63.6		2.77
E	4067		4899	1694	1563	1998	58.0	62.0	70.3		2.76
E	4370		4886	1890	1490	1990	64.3	57.9	69.5		2.75
E	4261		4888	1793	1538	1977	74.3	61.3	67.4		2.77
E	4319		4908	1856	1487	1997	59.4	58.0	69.5		2.76
F	4610	4510		1960	2020		76.0	68.0			
F	4640	4730		1930	2110		63.0	67.0			
F	4660	4490		2020	1990		72.0	65.0			
F	4570	4990		2000	2210		70.0	69.0			
F	4340	4750		2000	2080		68.0	64.0			
F	4640	4730		2000	2090		67.0	65.0			
F	4910	4630		2030	2070		69.0	64.0			
F	4720	4660		2030	2080		69.0	69.0			
G	5100	5400	5200	2000	2000	2100	66.0	67.0		5.00	2.79
G	5100	5400	5400	2000	2000	2000	64.0	67.0		5.00	2.78
G	5200	5300	5400	2000	2100	2000	64.0	68.0	200.0	6.00	2.79
G	5300	5400	5300	2100	2100	2000	62.0	68.0	100.0	5.00	2.79
G	5400	5400	5500	1900	2000	2000	63.0	68.0		5.00	2.79
G	5200	5400	5500	2000	2000	2100	62.0	66.0	200.0	5.00	2.79
G	5200	5200	5400	2000	2000	2100	63.0	68.0	100.0	5.00	2.78
G	5300	5400	5500	2100	2000	2000	65.0	66.0	100.0	5.00	2.78
H	5130	5380		1970	1880		69.0	69.0	77.0	3.40	2.78
H	5280	5290		1800	1930		70.0	69.0	78.0	3.60	2.78
H	5330	5300		1870	1890		72.0	70.0	77.0	3.50	2.78
H	5120	5460		1890	1960		70.0	66.0	77.0	3.50	2.79
H	4910	5370		1950	1940		67.0	70.0	79.0	3.60	2.77
H	5090	5350		1880	1930		73.0	68.0	76.0	4.80	2.79
H	5210	5370		1890	1880		70.0	67.0	78.0	3.70	2.77
H	5200	5240		1880	1880		70.0	67.0	74.0	3.70	2.76

Assay data (cont)

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
I	4563			1840			70.2				
I	4422			1850			72.8				
I	4248			1826			67.5				
I	4253			1816			68.4				
I	4335			1871			71.0				
I	4367			1830			72.0				
I	4389			1854			70.4				
I	4456			1889			71.0				
J		4590	5160		1830	1900		65.0	68.0	5.00	2.85
J		4500	5110		1830	1920		65.0	70.0	5.00	2.88
J		4440	5150		1740	1850		62.0	68.0	5.00	2.89
J		4500	5210		1750	1940		63.0	68.0	5.00	2.84
J		4620	5240		1800	1910		62.0	70.0	5.00	2.88
J		4580	5270		1800	1900		63.0	68.0	5.00	2.88
J		4560	5300		1830	1870		64.0	68.0	5.00	2.87
J		4580	5230		1790	1890		65.0	66.0	5.00	2.86
K	5145	5040		2150	1889		63.4	59.9		4.70	
K	5074	5082		2120	2020		61.5	61.2		4.30	
K	5411	5055		2102	1912		52.0	63.1		4.50	
K	5431	5136		2105	2015		60.2	72.3		4.40	
K	5308	5154		2047	2085		65.0	67.5		4.50	
K	5410	5159		2092	1868		60.4	68.1		4.50	
K	4877	5199		2141	1953		71.7	72.4		4.60	
K	5281	5150		2135	2025		62.3	72.7		4.50	
L	5500	5270	5440	2050	2080	1950	63.0		70.0	5.40	2.63
L	5460	5230	5310	2030	2010	1950	62.0		79.0	5.90	2.60
L	5440	5250	5320	2040	2040	1960	61.0		70.0	5.40	2.63
L	5460	5270	5290	2040	2050	1960	60.0		69.0	5.50	2.67
L	5450	5190	5290	2040	2050	1960	67.0		72.0	5.90	2.66
L	5420	5190	5330	2040	2050	1970	58.0		71.0	5.40	2.69
L	5490	5240	5340	2050	2020	1960	58.0		68.0	5.30	2.66
L	5500	5270	5300	2120	2050	1950	59.0		70.0	5.40	2.65
M	5240	4820		1910	1920		65.0	60.0		5.50	2.56
M	5310	4810		1930	1960		66.0	60.0		5.80	2.55
M	5370	4840		1960	1930		67.0	60.0		5.50	2.51
M	5110	4940		1950	2000		66.0	61.0		5.40	2.54
M	5330	4900		1950	1960		66.0	59.0		5.60	2.54
M	5190	4890		1880	1980		65.0	62.0		5.30	2.56
M	5060	4880		2060	1950		63.0	61.0		6.10	2.56
M	5230	4950		1900	1980		63.0	61.0		5.60	2.56
N	5030	4440	5140	1870	1770	1935	64.5	59.1	60.0	4.82	2.75
N	4950	4450	5110	1830	1810	1920	60.3	63.5	60.0	5.12	2.73
N	4980	4410	5130	1850	1760	1925	64.1	58.9	60.0	5.09	2.78
N	4990	4380	5130	1840	1765	1925	63.2	61.2	60.0	4.82	2.82
N	4890	4490	5120	1880	1785	1935	63.5	63.2	60.0	5.07	2.78
N	5140	4590	5150	1930	1825	1915	66.3	66.7	60.0	5.04	2.74
N	5150	4460	5140	1910	1790	1930	64.2	57.1	60.0	5.07	2.75
N	4970	4410	5150	1930	1760	1930	65.0	60.6	60.0	5.16	2.81
O									67.9		2.79
O									69.1		2.81
O									68.3		2.81
O									70.6		2.82
O									68.5		
O									68.1		
O									67.0		
O									67.3		
P	4832	4640		1951	1730		71.1	67.0		6.80	
P	4729	4740		1908	1740		69.4	71.0		6.30	
P	4794	4600		1929	1730		72.0	65.0		5.90	
P	4793	4700		1955	1740		70.6	67.0		6.20	
P	4739	4750		1927	1720		72.9	71.0		6.30	
P	4880	4590		1952	1790		71.9	71.0		6.20	
P	4770	4730		2000	1740		72.9	69.0		6.40	
P	4738	4710		1966	1770		72.9	69.0		6.20	

Assay data (cont)

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
R	5595	5010	5316	1899	1971	1927	66.0	62.0	70.0	5.20	2.77
R	5452	5078	5376	1855	1969	1949	65.0	62.0	74.0	5.10	2.80
R	5565	5199	5295	1878	1980	1936	65.0	62.0	71.0	5.30	2.85
R	5497	5145	5284	1868	2007	1920	67.0	65.0	69.0	5.00	2.89
R	5526	5165	5297	1889	1983	1921	65.0	63.0	68.0	5.20	2.84
R	5534	5060	5295	1877	1985	1911	67.0	62.0	67.0	5.20	2.77
R	5567	5046	5282	1893	1965	1918	65.0	61.0	70.0	5.20	2.78
R	5583	5238	5264	1862	2009	1906	64.0	62.0	69.0	5.00	2.81
T	5430	4510		2090	1790		67.0	59.0		5.40	
T	5360	4550		2070	1780		66.0	59.0		5.40	
T	5300	4670		2010	1800		71.0	59.0		5.20	
T	5350	4540		2070	1770		66.0	60.0		5.40	
T	5350	4550		2010	1740		65.0	60.0		5.40	
T	5240	4610		1970	1750		64.0	62.0		5.20	
T	5260	4640		2020	1830		63.0	61.0		5.30	
T	5310	4560		2000	1780		64.0	62.0		5.20	

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:

Combined standard uncertainty=sqrt((between lab.var/no of labs) + (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
Zn M/ICP	56.711	ppm
Zn P	67.276	ppm
Zn XRF	69.691	ppm
Pb M/ICP	18.537	ppm
Pb P	25.038	ppm
Pb XRF	17.464	ppm

Analyte	CSU*	unit
Cu M/ICP	0.654	ppm
Cu P	0.626	ppm
Cu XRF	1.742	ppm
Ag M/ICP	0.096	ppm
SG	0.007	

13. Uncertified values: The Certified and Provisional values listed on p1 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: AMIS0084 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	%	3.40	0.466	6.86	79
As	M/ICP	ppm	92.40	9.83	5.32	77
Ba	M/ICP	ppm	856	60.5	3.53	72
Be	M/ICP	ppm	0.912	0.168	9.22	62
Bi	M/ICP	ppm	0.116	0.029	12.4	30
Ca	M/ICP	%	7.33	0.638	4.35	77
Cd	M/ICP	ppm	17.95	2.03	5.67	79
Ce	M/ICP	ppm	40.40	7.10	8.78	64
Co	M/ICP	ppm	7.82	2.91	18.6	86
Cr	M/ICP	ppm	130	30.6	11.7	71
Cs	M/ICP	ppm	1.70	0.223	6.57	46
Dy	M/ICP	ppm	1.72	0.559	16.2	32
Er	M/ICP	ppm	0.917	0.359	19.6	32
Eu	M/ICP	ppm	0.642	0.113	8.82	30
Fe	M/ICP	%	1.61	0.177	5.50	79
Ga	M/ICP	ppm	8.94	1.54	8.62	61
Gd	M/ICP	ppm	2.63	0.444	8.43	32
Ge	M/ICP	ppm	0.579	0.934	80.6	24
Hf	M/ICP	ppm	1.61	0.282	8.75	53
Ho	M/ICP	ppm	0.320	0.113	17.7	32
In	M/ICP	ppm	0.049	0.006	5.63	28
K	M/ICP	ppm	1.91	0.129	3.38	71
La	M/ICP	ppm	19.80	2.86	7.23	70
Li	M/ICP	ppm	15.29	2.28	7.47	54
Lu	M/ICP	ppm	0.124	0.046	18.4	31
Mg	M/ICP	%	3.99	0.478	5.99	78
Mn	M/ICP	%	531	46.1	4.34	70
Mo	M/ICP	ppm	1.98	0.578	14.6	70
Na	M/ICP	%	0.230	0.028	6.03	75
Nb	M/ICP	ppm	4.46	3.46	38.8	63
Nd	M/ICP	ppm	17.20	1.15	3.33	31
Ni	M/ICP	ppm	12.03	2.73	11.4	70
P	M/ICP	%	0.029	0.008	13.0	80
Pr	M/ICP	ppm	4.61	0.520	5.65	32
Rb	M/ICP	ppm	75.72	9.47	6.25	55
Sb	M/ICP	ppm	8.89	2.64	14.9	68
Sc	M/ICP	ppm	3.99	0.056	0.70	44
Sm	M/ICP	ppm	3.23	0.333	5.14	30
Sn	M/ICP	ppm	1.90	0.504	13.3	54
Sr	M/ICP	ppm	66.77	6.51	4.88	77
Ta	M/ICP	ppm	0.357	0.384	53.8	37
Tb	M/ICP	ppm	0.335	0.075	11.2	32
Th	M/ICP	ppm	6.10	0.681	5.59	55
Ti	M/ICP	%	0.126	0.059	23.3	79
Tl	M/ICP	ppm	0.696	0.172	12.4	47
Tm	M/ICP	ppm	0.128	0.037	14.6	30
U	M/ICP	ppm	1.82	0.165	4.52	47
V	M/ICP	ppm	102	6.62	3.23	77
W	M/ICP	ppm	0.804	0.529	32.9	45
Y	M/ICP	ppm	7.52	2.03	13.5	63
Yb	M/ICP	ppm	0.913	0.380	20.8	32
Zr	M/ICP	ppm	57.80	6.68	5.78	62