ORE RESEARCH & EXPLORATION

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CERTIFICATE OF ANALYSIS FOR

COPPER ORE REFERENCE MATERIAL

OREAS 931

Table 1. Certified Values, SDs, 95% Confidence and Tolerance Limits for OREAS 931

Constituent	Certified Value	1SD	95% Confidence Limits		95% Tolerance Limits	
			Low	High	Low	High
4-Acid Digestion						
Ag, Silver (ppm)	14.04	1.90	13.40	14.69	12.72	15.37
Al, Aluminium (wt.%)	5.96	0.344	5.53	6.39	5.85	6.07
As, Arsenic (ppm)	11.6	1.4	11.1	12.1	9.8	13.4
Be, Beryllium (ppm)	1.99	0.128	1.83	2.16	IND	IND
Bi, Bismuth (ppm)	204	16.8	197	211	193	216
Ca, Calcium (wt.%)	0.453	0.041	0.402	0.505	0.426	0.481
Co, Cobalt (ppm)	46.9	2.36	46.1	47.7	45.2	48.5
Cr, Chromium (ppm)	58	7	50	65	55	61
Cu, Copper (wt.%)	3.82	0.110	3.78	3.87	3.71	3.93
Fe, Iron (wt.%)	11.32	0.595	11.04	11.60	11.03	11.61
La, Lanthanum (ppm)	34.0	3.7	29.0	38.9	32.6	35.3
Li, Lithium (ppm)	24.0	3.5	19.6	28.4	22.6	25.3
Mg, Magnesium (wt.%)	1.50	0.095	1.37	1.63	1.43	1.57
Mn, Manganese (wt.%)	0.095	0.007	0.088	0.103	0.092	0.099
Na, Sodium (wt.%)	0.201	0.020	0.174	0.227	0.191	0.210
Nb, Niobium (ppm)	11.0	1.07	9.6	12.4	10.3	11.6
Ni, Nickel (ppm)	28.8	1.86	27.1	30.5	27.1	30.5
P, Phosphorus (wt.%)	0.051	0.003	0.048	0.054	0.047	0.055
Pb, Lead (ppm)	147	10.6	142	152	141	153
S, Sulphur (wt.%)	4.12	0.407	3.92	4.32	4.00	4.24
Sb, Antimony (ppm)	1.70	0.155	1.62	1.78	1.58	1.82
Sc, Scandium (ppm)	< 20	IND	IND	IND	IND	IND
Se, Selenium (ppm)	43.5	4.7	41.2	45.9	41.1	45.9
Sn, Tin (ppm)	42.1	3.61	40.5	43.7	40.6	43.7
Sr, Strontium (ppm)	34.5	4.5	28.6	40.4	32.9	36.0
Th, Thorium (ppm)	12.3	1.21	11.2	13.4	11.5	13.1
Ti, Titanium (wt.%)	0.294	0.031	0.260	0.329	0.282	0.307
U, Uranium (ppm)	< 3	IND	IND	IND	IND	IND
V, Vanadium (ppm)	74	6.2	67	80	71	76

Table 1 continued.

Constituent	Certified Value	1SD	95% Confidence Limits		95% Tolerance Limits	
			Low	High	Low	High
4-Acid Digestion continued						
W, Tungsten (ppm)	19.8	2.1	18.3	21.2	IND	IND
Y, Yttrium (ppm)	19.6	1.27	18.1	21.1	18.5	20.8
Zn, Zinc (ppm)	480	31.9	465	494	466	493
Aqua Regia Digestion						
Ag, Silver (ppm)	14.18	2.45	13.29	15.08	12.38	15.98
Al, Aluminium (wt.%)	2.59	0.208	2.31	2.87	2.47	2.71
As, Arsenic (ppm)	11.3	1.4	10.7	11.9	8.3	14.3
Ba, Barium (ppm)	41.3	1.99	39.2	43.5	39.7	43.0
Bi, Bismuth (ppm)	206	18.1	198	215	198	215
Ca, Calcium (wt.%)	0.343	0.021	0.320	0.366	0.328	0.357
Co, Cobalt (ppm)	45.3	3.17	43.7	46.9	43.9	46.7
Cr, Chromium (ppm)	34.0	2.35	31.5	36.4	32.1	35.8
Cu, Copper (wt.%)	3.81	0.073	3.78	3.84	3.72	3.89
Fe, Iron (wt.%)	10.96	0.641	10.63	11.29	10.73	11.19
K, Potassium (wt.%)	0.242	0.016	0.222	0.263	IND	IND
Mg, Magnesium (wt.%)	1.35	0.17	1.16	1.54	1.30	1.40
Mn, Manganese (wt.%)	0.087	0.004	0.084	0.091	0.085	0.090
Mo, Molybdenum (ppm)	< 2	IND	IND	IND	IND	IND
Na, Sodium (wt.%)	< 0.03	IND	IND	IND	IND	IND
Ni, Nickel (ppm)	28.7	3.4	24.8	32.6	27.4	30.0
P, Phosphorus (wt.%)	0.052	0.009	0.042	0.062	0.050	0.054
Pb, Lead (ppm)	146	7.1	143	150	141	151
S, Sulphur (wt.%)	4.09	0.41	3.88	4.30	3.96	4.22
Sb, Antimony (ppm)	< 1.2	IND	IND	IND	IND	IND
Se, Selenium (ppm)	42.2	3.34	40.0	44.4	39.7	44.7
Sn, Tin (ppm)	33.0	3.10	31.0	35.0	31.2	34.9
Sr, Strontium (ppm)	17.9	1.75	15.6	20.1	IND	IND
Ti, Titanium (wt.%)	0.060	0.012	0.045	0.076	0.057	0.064
V, Vanadium (ppm)	28.8	3.9	23.5	34.0	27.2	30.3
W, Tungsten (ppm)	14.3	2.4	11.3	17.3	IND	IND
Zn, Zinc (ppm)	472	30.0	458	486	459	485
Infrared Combustion						
S, Sulphur (wt.%)	4.49	0.171	4.42	4.56	4.38	4.61
Borate Fusion XRF						
Co, Cobalt (ppm)	< 50	IND	IND	IND	IND	IND
Cu, Copper (wt.%)	3.82	0.089	3.76	3.87	3.74	3.90
Fe2O3, Iron(III) oxide (wt.%)	16.48	0.437	16.20	16.77	16.28	16.69
Pb, Lead (ppm)	159	28	133	184	IND	IND
S, Sulphur (wt.%)	4.53	0.143	4.41	4.65	4.37	4.69
SiO2, Silicon dioxide (wt.%)	55.01	0.448	54.64	55.37	54.60	55.41
Zn, Zinc (ppm)	495	18.7	483	506	473	517

Table 1 continued.

Constituent	Certified Value	1SD	95% Confidence Limits		95% Tolerance Limits	
			Low	High	Low	High
Peroxide Fusion ICP						
Ag, Silver (ppm)	13.62	2.48	11.79	15.45	IND	IND
As, Arsenic (ppm)	< 15	IND	IND	IND	IND	IND
Bi, Bismuth (ppm)	205	9.0	199	210	197	212
Co, Cobalt (ppm)	46.6	5.9	43.7	49.5	44.0	49.2
Cu, Copper (wt.%)	3.83	0.116	3.78	3.88	3.72	3.94
Fe, Iron (wt.%)	11.48	0.389	11.27	11.69	11.24	11.73
Pb, Lead (ppm)	155	32	148	162	144	165
S, Sulphur (wt.%)	4.48	0.097	4.43	4.53	4.36	4.60
Sb, Antimony (ppm)	< 4	IND	IND	IND	IND	IND
Se, Selenium (ppm)	50	5	48	53	46	55
Si, Silicon (wt.%)	25.78	0.495	25.25	26.32	24.75	26.82
Sn, Tin (ppm)	< 60	IND	IND	IND	IND	IND
Zn, Zinc (ppm)	490	20.8	481	499	465	515

Note: intervals may appear asymmetric due to rounding

INTRODUCTION

OREAS reference materials are intended to provide a low cost method of evaluating and improving the quality of analysis of geological samples. To the geologist they provide a means of implementing quality control in analytical data sets generated in exploration from the grass roots level through to prospect evaluation, and in grade control at mining operations. To the analyst they provide an effective means of calibrating analytical equipment, assessing new techniques and routinely monitoring in-house procedures.

SOURCE MATERIAL

OREAS 931 is one of a suite of sixteen copper CRMs (OREAS 920 to OREAS 935) prepared from material from the CSA mine located near the town of Cobar in central western New South Wales, Australia. The copper ore body is hosted by the Early Devonian CSA Siltstone, a thinly bedded turbiditic sequence of carbonaceous siltstones and mudstones with minor coarser units. The CSA Siltstone is part of the Cobar Supergroup, consisting of lower syn-rift sediments and upper post-rift sag phase sediments. The mineralisation is structurally controlled and confined to a number of steeply dipping bodies within a major shear zone on the eastern margin of the Early Devonian Cobar Basin. It is characterised by low-grade greenschist alteration and epigenetic low-grade mineralisation enveloping higher-grade shoots of vein complexes or sub-massive to massive sulphides. The sulphides include chalcopyrite, pyrrhotite, pyrite, sphalerite, galena, bornite and cubanite. Iron-rich chlorite and silica are prominent alterations in the siltstone host.

COMMINUTION AND HOMOGENISATION PROCEDURES

The material constituting OREAS 931 was prepared in the following manner:

- drying to constant mass at 105°C;
- preliminary blending of copper ores and barren siltstone materials;
- multi-stage milling to approximately 99% less than 75 microns;
- final homogenisation;
- packaging in 10g units sealed under nitrogen, in laminated foil pouches.

ANALYTICAL PROGRAM

Twenty two commercial analytical laboratories participated in the program to characterise the analytes reported in Table 1. The following methods were employed for method specific certification:

- Four acid (HCl-HNO_3-HF-$HClO_4$) digestion with ICP-OES, ICP-MS or AAS finish (21 laboratories);
- Aqua regia digestion with ICP-OES, ICP-MS or AAS finish (20 laboratories);
- Infrared combustion furnace for sulphur (19 laboratories);
- Borate or pyro-sulphate fusion with XRF (12 laboratories);
- Peroxide fusion with ICP-OES, ICP-MS or AAS finish (16 laboratories).

For the round robin program ten 300g test units were taken at predetermined intervals during the bagging stage, immediately following final homogenisation, and are considered representative of the entire batch. The six samples received by each laboratory were obtained by taking two 20g scoop splits from each of three separate 300g test units. This format enabled nested ANOVA treatment of the results to evaluate homogeneity, i.e. to ascertain whether between-unit variance is greater than within-unit variance. Table 1 presents the certified values together with their associated 1SD's, 95% confidence and tolerance limits and Table 2 shows indicative values. Table 3 provides performance gate intervals for the certified values of each analytical method group based on their pooled 1SD's. Tabulated results of all elements together with uncorrected means, medians, standard deviations, relative standard deviations and percent deviation of lab means from the corrected mean of means (PDM^3) are presented in the detailed certification data for this CRM (**Datapack for OREAS 931.xlsx**).

Table 2. Indicative Values for OREAS 931

Constituent	Unit	Value	Constituent	Unit	Value	Constituent	Unit	Value
4-Acid Digestion								
Au	ppm	*< 0.1*	Hf	ppm	*2.38*	Re	ppm	*< 0.005*
Ba	ppm	*185*	Ho	ppm	*0.66*	Sm	ppm	*5.48*
Cd	ppm	*0.81*	In	ppm	*3.10*	Ta	ppm	*0.99*
Ce	ppm	*66*	K	wt.%	*2.01*	Tb	ppm	*0.62*
Cs	ppm	*5.98*	Lu	ppm	*0.29*	Te	ppm	*0.10*
Dy	ppm	*3.40*	Mo	ppm	*1.25*	Tl	ppm	*0.67*
Er	ppm	*1.92*	Nd	ppm	*29.7*	Yb	ppm	*1.82*
Ga	ppm	*17.4*	Pr	ppm	*7.82*	Zr	ppm	*85*
Ge	ppm	*0.24*	Rb	ppm	*128*			

Table 2 continued.

Constituent	Unit	Value	Constituent	Unit	Value	Constituent	Unit	Value
Aqua Regia Digestion								
Au	ppm	*0.006*	Hg	ppm	*0.12*	Ta	ppm	*0.010*
B	ppm	*57*	In	ppm	*2.93*	Tb	ppm	*0.43*
Be	ppm	*0.53*	La	ppm	*23.6*	Te	ppm	*0.15*
Cd	ppm	*0.93*	Li	ppm	*19.8*	Th	ppm	*12.7*
Ce	ppm	*44.4*	Lu	ppm	*0.15*	Tl	ppm	*0.11*
Cs	ppm	*2.04*	Nb	ppm	*0.41*	U	ppm	*1.62*
Ga	ppm	*8.42*	Rb	ppm	*15.3*	Y	ppm	*10.1*
Ge	ppm	*0.16*	Re	ppm	*0.002*	Yb	ppm	*1.01*
Hf	ppm	*0.61*	Sc	ppm	*3.40*	Zr	ppm	*19.9*
Infrared Combustion								
C	wt.%	*0.051*						
Borate Fusion XRF								
Al2O3	wt.%	*11.89*	MgO	wt.%	*2.58*	Sr	ppm	*23.3*
BaO	ppm	*447*	MnO	wt.%	*0.130*	TiO2	wt.%	*0.507*
CaO	wt.%	*0.645*	Na2O	wt.%	*0.282*	V2O5	ppm	*147*
Cr2O3	ppm	*112*	Ni	ppm	*< 10*	Zr	ppm	*97*
K2O	wt.%	*2.37*	P2O5	wt.%	*0.120*			
LOI	wt.%	*4.27*	Sn	ppm	*64*			
Peroxide Fusion ICP								
Al	wt.%	*6.18*	Ho	ppm	*0.83*	Sc	ppm	*10.8*
Ba	ppm	*323*	In	ppm	*3.45*	Sm	ppm	*5.80*
Be	ppm	*< 5*	K	wt.%	*2.11*	Sr	ppm	*34.2*
Ca	wt.%	*0.481*	La	ppm	*40.0*	Ta	ppm	*1.01*
Cd	ppm	*0.77*	Li	ppm	*26.4*	Tb	ppm	*0.74*
Ce	ppm	*74*	Lu	ppm	*0.37*	Th	ppm	*14.4*
Cr	ppm	*62*	Mg	wt.%	*1.54*	Ti	wt.%	*0.333*
Cs	ppm	*6.07*	Mn	wt.%	*0.105*	Tl	ppm	*0.77*
Dy	ppm	*4.35*	Mo	ppm	*< 2*	Tm	ppm	*0.37*
Er	ppm	*2.34*	Nb	ppm	*12.0*	U	ppm	*2.90*
Eu	ppm	*1.22*	Nd	ppm	*31.7*	V	ppm	*75*
Ga	ppm	*18.8*	Ni	ppm	*36.2*	W	ppm	*19.7*
Gd	ppm	*4.96*	P	wt.%	*0.121*	Y	ppm	*21.2*
Ge	ppm	*2.60*	Pr	ppm	*8.66*	Yb	ppm	*2.18*
Hf	ppm	*4.07*	Rb	ppm	*134*	Zr	ppm	*132*

STATISTICAL ANALYSIS

Certified Values, Standard Deviations, Confidence and Tolerance Limits have been determined for each analytical method following removal of individual and laboratory outliers (Table 1). Certified Values are the mean of means after outlier filtering. The 95% Confidence Limit is a measure of the reliability of the certified value, i.e. the narrower the Confidence Interval the greater the certainty in the Certified Value. It should not be used as a control limit for laboratory performance.

Standard Deviation values (1SDs) are reported in Table 1 and provide an indication of a level of performance that might reasonably be expected from a laboratory being monitored by this CRM in a QA/QC program. They take into account errors attributable to

measurement uncertainty and CRM variability. For an effective CRM the contribution of the latter should be negligible in comparison to measurement errors. The Standard Deviation values include all sources of measurement uncertainty: between-lab variance, within-run variance (precision errors) and CRM variability. The SD for each analyte's certified value is calculated from the same filtered data set used to determine the certified value, i.e. after removal of all individual, lab dataset (batch) and 3SD outliers (single iteration). These outliers can only be removed after the absolute homogeneity of the CRM has been independently established, i.e. the outliers must be confidently deemed to be analytical rather than arising from inhomogeneity of the CRM. The standard deviation is then calculated for each analyte from the pooled accepted analyses generated from the certification program.

Performance Gates (Table 3) are calculated for two and three standard deviations. As a guide these intervals may be regarded as warning or rejection for multiple 2SD outliers, or rejection for individual 3SD outliers in QC monitoring, although their precise application should be at the discretion of the QC manager concerned.

A second method utilises a 5% window calculated directly from the certified value. Standard deviation is also shown in relative per cent for one, two and three relative standard deviations (1RSD, 2RSD and 3RSD) to facilitate an appreciation of the magnitude of these numbers and a comparison with the 5% window. Caution should be exercised when concentration levels approach lower limits of detection of the analytical methods employed as performance gates calculated from standard deviations tend to be excessively wide whereas those determined by the 5% method are too narrow.

Table 3. Performance Gates for OREAS 931

Constituent	Certified Value	Absolute Standard Deviations					Relative Standard Deviations			5% window	
		1SD	2SD Low	2SD High	3SD Low	3SD High	1RSD	2RSD	3RSD	Low	High
4-Acid Digestion											
Ag, ppm	14.04	1.90	10.24	17.85	8.34	19.75	13.55%	27.10%	40.65%	13.34	14.75
Al, wt.%	5.96	0.344	5.28	6.65	4.93	6.99	5.76%	11.52%	17.29%	5.67	6.26
As, ppm	11.6	1.4	8.8	14.4	7.4	15.8	12.00%	24.01%	36.01%	11.0	12.2
Be, ppm	1.99	0.128	1.74	2.25	1.61	2.38	6.44%	12.88%	19.32%	1.89	2.09
Bi, ppm	204	17	171	238	154	255	8.24%	16.49%	24.73%	194	214
Ca, wt.%	0.453	0.041	0.371	0.536	0.329	0.577	9.11%	18.22%	27.32%	0.431	0.476
Co, ppm	46.9	2.36	42.2	51.6	39.8	53.9	5.03%	10.06%	15.08%	44.5	49.2
Cr, ppm	58	7	45	71	38	77	11.34%	22.68%	34.01%	55	61
Cu, wt.%	3.82	0.110	3.60	4.04	3.49	4.15	2.87%	5.75%	8.62%	3.63	4.01
Fe, wt.%	11.32	0.595	10.13	12.51	9.53	13.11	5.26%	10.51%	15.77%	10.75	11.89
La, ppm	34.0	3.7	26.5	41.4	22.8	45.1	10.93%	21.86%	32.80%	32.3	35.6
Li, ppm	24.0	3.5	17.0	31.0	13.5	34.5	14.59%	29.18%	43.77%	22.8	25.2
Mg, wt.%	1.50	0.095	1.31	1.69	1.21	1.79	6.35%	12.70%	19.05%	1.42	1.57
Mn, wt.%	0.095	0.007	0.082	0.109	0.076	0.115	6.90%	13.80%	20.69%	0.091	0.100
Na, wt.%	0.201	0.020	0.160	0.241	0.140	0.261	10.10%	20.21%	30.31%	0.191	0.211

Table 3 continued.

Constituent	Certified Value	Absolute Standard Deviations					Relative Standard Deviations			5% window	
		1SD	2SD Low	2SD High	3SD Low	3SD High	1RSD	2RSD	3RSD	Low	High
4-Acid Digestion continued											
Nb, ppm	11.0	1.07	8.8	13.1	7.7	14.2	9.81%	19.61%	29.42%	10.4	11.5
Ni, ppm	28.8	1.86	25.1	32.5	23.2	34.4	6.45%	12.91%	19.36%	27.4	30.2
P, wt.%	0.051	0.003	0.044	0.058	0.041	0.061	6.69%	13.37%	20.06%	0.049	0.054
Pb, ppm	147	11	126	168	115	179	7.23%	14.45%	21.68%	140	154
S, wt.%	4.12	0.407	3.30	4.93	2.90	5.34	9.88%	19.76%	29.64%	3.91	4.32
Sb, ppm	1.70	0.155	1.39	2.01	1.23	2.17	9.13%	18.26%	27.39%	1.61	1.78
Sc, ppm	< 20	IND	IND	IND	IND	IND	IND	IND	IND	IND	IND
Se, ppm	43.5	4.7	34.1	53.0	29.4	57.7	10.83%	21.65%	32.48%	41.4	45.7
Sn, ppm	42.1	3.61	34.9	49.3	31.3	53.0	8.58%	17.16%	25.74%	40.0	44.2
Sr, ppm	34.5	4.5	25.4	43.5	20.9	48.1	13.16%	26.31%	39.47%	32.7	36.2
Th, ppm	12.3	1.21	9.9	14.7	8.7	16.0	9.86%	19.73%	29.59%	11.7	12.9
Ti, wt.%	0.294	0.031	0.232	0.357	0.200	0.388	10.65%	21.29%	31.94%	0.280	0.309
U, ppm	< 3	IND	IND	IND	IND	IND	IND	IND	IND	IND	IND
V, ppm	74	6.2	61	86	55	92	8.41%	16.82%	25.23%	70	77
W, ppm	19.8	2.1	15.6	23.9	13.5	26.0	10.51%	21.03%	31.54%	18.8	20.8
Y, ppm	19.6	1.27	17.1	22.2	15.8	23.4	6.48%	12.96%	19.44%	18.6	20.6
Zn, ppm	480	32	416	543	384	575	6.65%	13.30%	19.95%	456	504
Aqua Regia Digestion											
Ag, ppm	14.18	2.45	9.29	19.08	6.84	21.52	17.25%	34.50%	51.75%	13.47	14.89
Al, wt.%	2.59	0.208	2.17	3.01	1.97	3.21	8.04%	16.08%	24.12%	2.46	2.72
As, ppm	11.3	1.4	8.5	14.1	7.0	15.5	12.54%	25.08%	37.63%	10.7	11.9
Ba, ppm	41.3	1.99	37.3	45.3	35.4	47.3	4.81%	9.61%	14.42%	39.3	43.4
Bi, ppm	206	18	170	242	152	261	8.75%	17.50%	26.25%	196	217
Ca, wt.%	0.343	0.021	0.301	0.384	0.281	0.404	6.02%	12.03%	18.05%	0.326	0.360
Co, ppm	45.3	3.17	38.9	51.6	35.8	54.8	7.01%	14.01%	21.02%	43.0	47.6
Cr, ppm	34.0	2.35	29.2	38.7	26.9	41.0	6.93%	13.87%	20.80%	32.3	35.7
Cu, wt.%	3.81	0.073	3.66	3.95	3.59	4.03	1.93%	3.86%	5.79%	3.62	4.00
Fe, wt.%	10.96	0.641	9.68	12.24	9.04	12.88	5.85%	11.70%	17.55%	10.41	11.51
K, wt.%	0.242	0.016	0.209	0.275	0.193	0.292	6.80%	13.60%	20.40%	0.230	0.254
Mg, wt.%	1.35	0.17	1.01	1.69	0.85	1.85	12.46%	24.92%	37.38%	1.28	1.42
Mn, wt.%	0.087	0.004	0.080	0.095	0.076	0.099	4.23%	8.47%	12.70%	0.083	0.092
Mo, ppm	< 2	IND	IND	IND	IND	IND	IND	IND	IND	IND	IND

Table 3 continued.

Constituent	Certified Value	Absolute Standard Deviations					Relative Standard Deviations			5% window	
		1SD	2SD Low	2SD High	3SD Low	3SD High	1RSD	2RSD	3RSD	Low	High
Aqua Regia Digestion continued											
Na, wt.%	< 0.03	IND	IND	IND	IND	IND	IND	IND	IND	IND	IND
Ni, ppm	28.7	3.4	21.8	35.5	18.4	39.0	11.94%	23.89%	35.83%	27.2	30.1
P, wt.%	0.052	0.009	0.033	0.070	0.024	0.080	17.79%	35.58%	53.36%	0.049	0.055
Pb, ppm	146	7	132	160	125	168	4.87%	9.75%	14.62%	139	154
S, wt.%	4.09	0.41	3.27	4.91	2.85	5.32	10.06%	20.11%	30.17%	3.88	4.29
Sb, ppm	< 1.2	IND	IND	IND	IND	IND	IND	IND	IND	IND	IND
Se, ppm	42.2	3.34	35.5	48.9	32.2	52.2	7.92%	15.85%	23.77%	40.1	44.3
Sn, ppm	33.0	3.10	26.8	39.2	23.7	42.3	9.38%	18.77%	28.15%	31.4	34.7
Sr, ppm	17.9	1.75	14.4	21.4	12.6	23.1	9.77%	19.54%	29.31%	17.0	18.8
Ti, wt.%	0.060	0.012	0.037	0.083	0.026	0.095	19.06%	38.13%	57.19%	0.057	0.063
V, ppm	28.8	3.9	21.0	36.6	17.1	40.5	13.56%	27.13%	40.69%	27.3	30.2
W, ppm	14.3	2.4	9.4	19.1	7.0	21.5	16.97%	33.93%	50.90%	13.6	15.0
Zn, ppm	472	30	412	532	382	562	6.36%	12.73%	19.09%	448	496
Infrared Combustion											
S, wt.%	4.49	0.171	4.15	4.83	3.98	5.01	3.81%	7.61%	11.42%	4.27	4.72
Borate Fusion XRF											
Co, ppm	< 50	IND	IND	IND	IND	IND	IND	IND	IND	IND	IND
Cu, wt.%	3.82	0.089	3.64	3.99	3.55	4.08	2.33%	4.65%	6.98%	3.63	4.01
Fe_2O_3, wt.%	16.48	0.437	15.61	17.36	15.17	17.80	2.65%	5.30%	7.96%	15.66	17.31
Pb, ppm	159	28	102	216	73	244	17.94%	35.88%	53.82%	151	167
S, wt.%	4.53	0.143	4.24	4.81	4.10	4.96	3.17%	6.33%	9.50%	4.30	4.75
SiO_2, wt.%	55.01	0.448	54.11	55.90	53.66	56.35	0.81%	1.63%	2.44%	52.26	57.76
Zn, ppm	495	19	457	532	438	551	3.79%	7.58%	11.36%	470	519
Peroxide Fusion ICP											
Ag, ppm	13.62	2.48	8.67	18.57	6.20	21.05	18.17%	36.34%	54.51%	12.94	14.30
As, ppm	< 15	IND	IND	IND	IND	IND	IND	IND	IND	IND	IND
Bi, ppm	205	9	187	222	178	231	4.39%	8.78%	13.17%	194	215
Co, ppm	46.6	5.9	34.9	58.3	29.1	64.2	12.56%	25.11%	37.67%	44.3	48.9
Cu, wt.%	3.83	0.116	3.60	4.06	3.48	4.18	3.04%	6.08%	9.12%	3.64	4.02
Fe, wt.%	11.48	0.389	10.71	12.26	10.32	12.65	3.38%	6.77%	10.15%	10.91	12.06
Pb, ppm	155	32	91	218	59	250	20.64%	41.28%	61.92%	147	162
S, wt.%	4.48	0.097	4.29	4.67	4.19	4.77	2.17%	4.34%	6.50%	4.26	4.70

Table 3 continued.

Constituent	Certified Value	Absolute Standard Deviations					Relative Standard Deviations			5% window	
		1SD	2SD Low	2SD High	3SD Low	3SD High	1RSD	2RSD	3RSD	Low	High
Peroxide Fusion ICP continued											
Sb, ppm	< 4	IND	IND	IND	IND	IND	IND	IND	IND	IND	IND
Se, ppm	50	5	40	61	35	66	10.19%	20.39%	30.58%	48	53
Si, wt.%	25.78	0.495	24.80	26.77	24.30	27.27	1.92%	3.84%	5.75%	24.50	27.07
Sn, ppm	< 60	IND	IND	IND	IND	IND	IND	IND	IND	IND	IND
Zn, ppm	490	21	448	532	428	553	4.25%	8.50%	12.75%	466	515

Note: intervals may appear asymmetric due to rounding

Tolerance Limits (ISO Guide 3207) were determined using an analysis of precision errors method and are considered a conservative estimate of true homogeneity. The meaning of tolerance limits may be illustrated for copper by 4-acid digestion, where 99% of the time (1-α=0.99) at least 95% of subsamples (ρ=0.95) will have concentrations lying between between 3.71 and 3.93 wt.%. Put more precisely, this means that if the same number of subsamples were taken and analysed in the same manner repeatedly, 99% of the tolerance intervals so constructed would cover at least 95% of the total population, and 1% of the tolerance intervals would cover less than 95% of the total population (ISO Guide 35).

The homogeneity of OREAS 931 has also been evaluated in an ANOVA study for all certified analytes. This study tests the null hypothesis that no statistically significant difference exists between the *between-unit variance* and the *within-unit variance* (i.e. p-values <0.05 indicate rejection of the null hypothesis). Of the 80 certified values, no failures were observed indicating no evidence to reject the null hypothesis.

Based on the statistical analysis of the results of the inter-laboratory certification program it can be concluded that OREAS 931 is fit-for-purpose as a certified reference material (see 'Intended Use' below).

PREPARER AND SUPPLIER OF THE REFERENCE MATERIAL

Reference material OREAS 931 has been prepared and certified by:

ORE Research & Exploration Pty Ltd
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AUSTRALIA

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It has been packaged in 10g units sealed under nitrogen in laminated foil pouches.

PARTICIPATING LABORATORIES

Accurassay, Thunder Bay, ON, Canada
Acme, Santiago, Chile
Acme, Vancouver, BC, Canada
Actlabs, Ancaster, Ontario, Canada
Actlabs, Kamloops, BC, Canada
Actlabs, Thunder Bay, Ontario, Canada
ALS, Brisbane, QLD, Australia
ALS, Burnie, TAS, Australia
ALS, Loughrea, County Galway, Ireland
ALS, Vancouver, BC, Canada
Amdel (BV), Cardiff, NSW, Australia
Intertek Genalysis, Perth, WA, Australia
Intertek Testing Services, Adelaide, SA, Australia
Intertek Testing Services, Beijing, China
Intertek Testing Services, Jakarta Selatan, Indonesia
Intertek Genalysis, Johannesburg, Sth Africa
Intertek Testing Services, Muntinlupa, Philippines
Labtium Oy, Rovaniemi, Finland
MINTEK, Randburg, Sth Africa
PT. Geoservices, Cikarang, Indonesia
SGS, Booysens, Gauteng, South Africa
SGS Didipio, Makati City, Philippines
SGS, Lakefield, Ontario, Canada
SGS Nui Phao, Ha Noi, Vietnam
SGS, Vancouver, BC, Canada
SGS, Vespasiano, MG, Brazil
Shiva Analyticals, Bangalore North, Karnataka, India
Ultra Trace (BV), Perth, WA, Australia

INTENDED USE

OREAS 931 is intended for the following uses:

- for the monitoring of laboratory performance in the analysis of geological samples for the analytes reported in Table 1;
- for the verification of analytical methods for analytes reported in Table 1;
- for the calibration of instruments used in the determination of the concentration of analytes reported in Table 1.

STABILITY AND STORAGE INSTRUCTIONS

OREAS 931 has been prepared from mineralised and altered carbonaceous siltstones and mudstones from the CSA mine located near the town of Cobar in central western New South Wales, Australia. To prolong its shelf life it has been packaged under nitrogen in

robust foil laminate pouches. Under normal storage conditions it is considered to have long-term stability beyond 10 years.

INSTRUCTIONS FOR THE CORRECT USE OF THE REFERENCE MATERIAL

The certified values for OREAS 931 refer to the concentration level in its packaged state. It should not be dried prior to weighing and analysis.

HANDLING INSTRUCTIONS

Fine powders pose a risk to eyes and lungs and therefore standard precautions such as the use of safety glasses and dust masks are advised.

LEGAL NOTICE

Ore Research & Exploration Pty Ltd has prepared and statistically evaluated the property values of this reference material to the best of its ability. The Purchaser by receipt hereof releases and indemnifies Ore Research & Exploration Pty Ltd from and against all liability and costs arising from the use of this material and information.

CERTIFYING OFFICER

Craig Hamlyn (B.Sc. Hons - Geology), Technical Manager – (ORE P/L)

REFERENCES

ISO Guide 3207 (1975), Statistical interpretation of data - Determination of a statistical tolerance interval.

ISO Guide 35 (2006), Certification of reference materials - General and statistical principals.