ORE RESEARCH & EXPLORATION

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CERTIFICATE OF ANALYSIS FOR

COPPER ORE REFERENCE MATERIAL

OREAS 930

Table 1. Certified Values, SDs, 95% Confidence and Tolerance Limits for OREAS 930

Constituent	Certified Value	1SD	95% Confidence Limits		95% Tolerance Limits	
			Low	High	Low	High
4-Acid Digestion						
Ag, Silver (ppm)	9.00	1.09	8.59	9.42	8.27	9.73
Al, Aluminium (wt.%)	6.35	0.285	6.00	6.70	5.99	6.71
As, Arsenic (ppm)	11.1	1.2	10.7	11.5	9.8	12.4
Ba, Barium (ppm)	284	51	225	342	249	318
Be, Beryllium (ppm)	2.03	0.35	1.68	2.38	IND	IND
Bi, Bismuth (ppm)	136	11	132	139	129	143
Ca, Calcium (wt.%)	0.433	0.037	0.386	0.481	0.405	0.462
Cd, Cadmium (ppm)	0.75	0.09	0.68	0.82	IND	IND
Co, Cobalt (ppm)	37.4	2.06	36.6	38.3	36.2	38.7
Cr, Chromium (ppm)	63	2.3	61	65	60	67
Cu, Copper (wt.%)	2.52	0.062	2.50	2.54	2.40	2.63
Fe, Iron (wt.%)	9.47	0.459	9.26	9.68	9.23	9.71
K, Potassium (wt.%)	2.23	0.185	2.02	2.45	2.10	2.37
La, Lanthanum (ppm)	35.4	4.4	29.4	41.3	33.6	37.2
Li, Lithium (ppm)	27.1	2.8	24.4	29.7	25.4	28.8
Mg, Magnesium (wt.%)	1.56	0.119	1.44	1.68	1.52	1.61
Mn, Manganese (wt.%)	0.095	0.005	0.089	0.101	0.093	0.098
Mo, Molybdenum (ppm)	< 1.5	IND	IND	IND	IND	IND
Na, Sodium (wt.%)	0.222	0.012	0.208	0.236	0.205	0.239
Nb, Niobium (ppm)	11.6	1.4	9.8	13.5	11.0	12.3
Ni, Nickel (ppm)	31.1	2.62	28.8	33.3	28.8	33.3
P, Phosphorus (wt.%)	0.056	0.006	0.048	0.064	0.053	0.059
Pb, Lead (ppm)	141	9	137	145	136	145
S, Sulphur (wt.%)	2.88	0.192	2.79	2.96	2.76	2.99
Sb, Antimony (ppm)	1.51	0.126	1.46	1.55	1.40	1.62
Se, Selenium (ppm)	30.1	4.3	28.5	31.7	27.9	32.3
Sn, Tin (ppm)	31.1	3.4	29.7	32.5	30.0	32.1
Sr, Strontium (ppm)	34.8	3.9	29.3	40.3	32.6	37.0
Th, Thorium (ppm)	13.5	1.20	12.0	15.0	12.6	14.4

Table 1 continued.

Constituent	Certified Value	1SD	95% Confidence Limits		95% Tolerance Limits	
			Low	High	Low	High
4-Acid Digestion continued						
Ti, Titanium (wt.%)	0.310	0.016	0.290	0.330	0.294	0.325
Tl, Thallium (ppm)	0.80	0.10	0.66	0.95	IND	IND
V, Vanadium (ppm)	79	4.4	75	84	76	83
W, Tungsten (ppm)	14.5	1.11	13.6	15.3	IND	IND
Y, Yttrium (ppm)	20.5	2.4	18.1	22.9	19.1	22.0
Zn, Zinc (ppm)	492	26	481	503	478	506
Zr, Zirconium (ppm)	89	7.7	79	99	82	96
Aqua Regia Digestion						
Ag, Silver (ppm)	9.13	1.19	8.68	9.59	8.07	10.19
Al, Aluminium (wt.%)	2.70	0.211	2.43	2.97	2.60	2.80
As, Arsenic (ppm)	10.3	1.7	9.6	10.9	8.9	11.6
Ba, Barium (ppm)	46.3	3.77	41.1	51.4	42.9	49.6
Bi, Bismuth (ppm)	139	11	134	143	133	144
Ca, Calcium (wt.%)	0.322	0.017	0.299	0.344	0.306	0.337
Co, Cobalt (ppm)	36.4	1.76	35.7	37.2	35.3	37.5
Cr, Chromium (ppm)	35.7	1.93	33.7	37.8	34.1	37.4
Cu, Copper (wt.%)	2.51	0.057	2.50	2.53	2.44	2.59
Fe, Iron (wt.%)	8.87	0.366	8.68	9.06	8.66	9.08
K, Potassium (wt.%)	0.281	0.019	0.256	0.306	0.266	0.296
Mg, Magnesium (wt.%)	1.39	0.109	1.25	1.54	1.34	1.44
Mn, Manganese (wt.%)	0.089	0.005	0.084	0.094	0.085	0.092
Mo, Molybdenum (ppm)	< 1.2	IND	IND	IND	IND	IND
Na, Sodium (wt.%)	< 0.05	IND	IND	IND	IND	IND
Ni, Nickel (ppm)	30.6	1.74	28.5	32.7	29.5	31.8
P, Phosphorus (wt.%)	0.056	0.005	0.051	0.061	0.052	0.060
Pb, Lead (ppm)	142	9	138	145	136	147
S, Sulphur (wt.%)	2.87	0.259	2.74	2.99	2.76	2.97
Sb, Antimony (ppm)	< 1	IND	IND	IND	IND	IND
Se, Selenium (ppm)	28.6	3.1	27.1	30.1	26.6	30.6
Sn, Tin (ppm)	23.4	1.20	22.9	24.0	22.5	24.4
Sr, Strontium (ppm)	15.4	1.01	14.1	16.6	IND	IND
Ti, Titanium (wt.%)	< 0.09	IND	IND	IND	IND	IND
V, Vanadium (ppm)	30.2	2.85	26.5	33.9	28.7	31.7
W, Tungsten (ppm)	< 15	IND	IND	IND	IND	IND
Zn, Zinc (ppm)	488	20	478	497	478	498
Infrared Combustion						
S, Sulphur (wt.%)	3.07	0.118	3.02	3.11	2.95	3.18
Borate Fusion XRF						
Co, Cobalt (ppm)	< 100	IND	IND	IND	IND	IND
Cu, Copper (wt.%)	2.51	0.102	2.46	2.57	2.44	2.58
Fe_2O_3, Iron oxide (wt.%)	13.75	0.317	13.54	13.96	13.58	13.93
Pb, Lead (ppm)	< 160	IND	IND	IND	IND	IND
S, Sulphur (wt.%)	3.09	0.067	3.02	3.15	3.02	3.15

Table 1 continued.

Constituent	Certified Value	1SD	95% Confidence Limits		95% Tolerance Limits	
			Low	High	Low	High
Borate Fusion XRF continued						
SiO_2, Silicon dioxide (wt.%)	58.19	0.362	57.90	58.47	57.45	58.92
Zn, Zinc (ppm)	504	18	492	516	487	522
Peroxide Fusion ICP						
Ag, Silver (ppm)	8.63	1.78	7.35	9.91	IND	IND
As, Arsenic (ppm)	< 20	IND	IND	IND	IND	IND
Bi, Bismuth (ppm)	138	10	131	145	133	144
Co, Cobalt (ppm)	39.1	5.9	35.6	42.6	37.8	40.4
Cu, Copper (wt.%)	2.51	0.084	2.48	2.55	2.43	2.59
Fe, Iron (wt.%)	9.69	0.336	9.51	9.87	9.51	9.86
Pb, Lead (ppm)	< 150	IND	IND	IND	IND	IND
S, Sulphur (wt.%)	3.09	0.099	3.03	3.15	2.97	3.21
Sb, Antimony (ppm)	< 2	IND	IND	IND	IND	IND
Se, Selenium (ppm)	33.6	5.2	30.9	36.4	28.2	39.1
Si, Silicon (wt.%)	27.57	0.630	26.83	28.31	26.85	28.29
Sn, Tin (ppm)	35.1	3.22	32.7	37.5	33.0	37.1
Zn, Zinc (ppm)	499	21	488	510	485	514

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 930 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 930 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 930.xlsx**).

Table 2. Indicative Values for OREAS 930

Constituent	Unit	Value	Constituent	Unit	Value	Constituent	Unit	Value
4-Acid Digestion								
Au	ppm	< 0.1	Hf	ppm	2.62	Sm	ppm	5.59
Ce	ppm	69	Ho	ppm	0.68	Ta	ppm	1.00
Cs	ppm	5.98	In	ppm	2.09	Tb	ppm	0.65
Dy	ppm	3.48	Lu	ppm	0.31	Te	ppm	0.085
Er	ppm	1.99	Nd	ppm	30.7	Tm	ppm	0.29
Eu	ppm	1.05	Pr	ppm	8.08	U	ppm	2.56
Ga	ppm	18.5	Rb	ppm	136	Yb	ppm	1.96
Gd	ppm	4.18	Re	ppm	0.002			
Ge	ppm	0.20	Sc	ppm	11.3			

Table 2 continued.

Constituent	Unit	Value	Constituent	Unit	Value	Constituent	Unit	Value
Aqua Regia Digestion								
Au	ppm	0.004	In	ppm	2.04	Tb	ppm	0.46
B	ppm	52	La	ppm	24.6	Te	ppm	0.11
Be	ppm	1.07	Li	ppm	21.0	Th	ppm	13.1
Cd	ppm	0.76	Lu	ppm	0.17	Tl	ppm	0.12
Ce	ppm	49.0	Nb	ppm	0.40	U	ppm	1.65
Cs	ppm	1.87	Rb	ppm	18.1	Y	ppm	11.4
Ga	ppm	8.42	Re	ppm	< 0.001	Yb	ppm	1.12
Ge	ppm	0.11	Sc	ppm	3.53	Zr	ppm	22.0
Hf	ppm	0.64	Si	wt.%	29.02			
Hg	ppm	0.049	Ta	ppm	0.010			
Infrared Combustion								
C	wt.%	0.025						
Borate Fusion XRF								
Al2O3	wt.%	12.89	MgO	wt.%	2.80	Sr	ppm	< 20
BaO	ppm	465	MnO	wt.%	0.128	TiO2	wt.%	0.555
CaO	wt.%	0.630	Na2O	wt.%	0.302	V2O5	ppm	162
Cr2O3	ppm	123	Ni	ppm	21.7	Zr	ppm	112
K2O	wt.%	2.65	P2O5	wt.%	0.127			
LOI	wt.%	3.97	Sn	ppm	59			
Peroxide Fusion ICP								
Al	wt.%	6.76	Ho	ppm	0.90	Sc	ppm	11.6
Ba	ppm	365	In	ppm	2.34	Sm	ppm	6.29
Be	ppm	< 5	K	wt.%	2.34	Sr	ppm	34.7
Ca	wt.%	0.470	La	ppm	32.7	Ta	ppm	1.13
Cd	ppm	0.73	Li	ppm	30.6	Tb	ppm	0.78
Ce	ppm	79	Lu	ppm	0.40	Th	ppm	15.7
Cr	ppm	96	Mg	wt.%	1.66	Ti	wt.%	0.361
Cs	ppm	6.28	Mn	wt.%	0.104	Tl	ppm	0.88
Dy	ppm	4.75	Mo	ppm	< 2	Tm	ppm	0.39
Er	ppm	2.52	Nb	ppm	13.2	U	ppm	3.05
Eu	ppm	1.23	Nd	ppm	33.9	V	ppm	83
Ga	ppm	19.9	Ni	ppm	< 50	W	ppm	14.2
Gd	ppm	5.37	P	wt.%	0.143	Y	ppm	22.1
Ge	ppm	2.51	Pr	ppm	9.25	Yb	ppm	2.39
Hf	ppm	4.48	Rb	ppm	150	Zr	ppm	147

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. Indicative values (Table 2) are provided where i) the number of laboratories reporting a particular analyte is insufficient (< 5) to support certification; ii) interlaboratory consensus is poor; or iii) a significant proportion of results are outlying or multimodal.

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 930

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	9.00	1.09	6.82	11.19	5.72	12.28	12.14%	24.29%	36.43%	8.55	9.45
Al, wt.%	6.35	0.285	5.78	6.92	5.50	7.21	4.49%	8.97%	13.46%	6.04	6.67
As, ppm	11.1	1.2	8.7	13.5	7.5	14.7	10.83%	21.65%	32.48%	10.6	11.7
Ba, ppm	284	51	182	385	131	436	17.92%	35.85%	53.77%	270	298
Be, ppm	2.03	0.35	1.32	2.74	0.97	3.09	17.43%	34.86%	52.29%	1.93	2.13
Bi, ppm	136	11	114	157	104	167	7.82%	15.63%	23.45%	129	142
Ca, wt.%	0.433	0.037	0.359	0.508	0.321	0.545	8.62%	17.23%	25.85%	0.412	0.455
Cd, ppm	0.75	0.09	0.58	0.93	0.49	1.02	11.79%	23.59%	35.38%	0.72	0.79
Co, ppm	37.4	2.06	33.3	41.5	31.3	43.6	5.50%	11.00%	16.50%	35.6	39.3
Cr, ppm	63	2.3	59	68	56	70	3.70%	7.41%	11.11%	60	66
Cu, wt.%	2.52	0.062	2.40	2.64	2.33	2.70	2.46%	4.92%	7.37%	2.39	2.64
Fe, wt.%	9.47	0.459	8.55	10.39	8.09	10.85	4.84%	9.69%	14.53%	9.00	9.94
K, wt.%	2.23	0.185	1.86	2.60	1.68	2.79	8.29%	16.58%	24.87%	2.12	2.35

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											
La, ppm	35.4	4.4	26.6	44.2	22.2	48.6	12.45%	24.91%	37.36%	33.6	37.2
Li, ppm	27.1	2.8	21.6	32.6	18.8	35.3	10.17%	20.34%	30.52%	25.7	28.4
Mg, wt.%	1.56	0.119	1.33	1.80	1.21	1.92	7.60%	15.20%	22.80%	1.49	1.64
Mn, wt.%	0.095	0.005	0.085	0.106	0.079	0.111	5.50%	10.99%	16.49%	0.090	0.100
Mo, ppm	< 1.5	IND	IND	IND	IND	IND	IND	IND	IND	IND	IND
Na, wt.%	0.222	0.012	0.198	0.246	0.185	0.259	5.50%	11.01%	16.51%	0.211	0.233
Nb, ppm	11.6	1.4	8.8	14.5	7.3	15.9	12.32%	24.64%	36.96%	11.1	12.2
Ni, ppm	31.1	2.62	25.8	36.3	23.2	38.9	8.43%	16.86%	25.28%	29.5	32.6
P, wt.%	0.056	0.006	0.043	0.069	0.037	0.075	11.38%	22.76%	34.13%	0.053	0.059
Pb, ppm	141	9	123	159	114	168	6.45%	12.91%	19.36%	134	148
S, wt.%	2.88	0.192	2.49	3.26	2.30	3.45	6.67%	13.35%	20.02%	2.73	3.02
Sb, ppm	1.51	0.126	1.26	1.76	1.13	1.89	8.35%	16.71%	25.06%	1.43	1.58
Se, ppm	30.1	4.3	21.5	38.7	17.2	43.0	14.33%	28.66%	42.99%	28.6	31.6
Sn, ppm	31.1	3.4	24.3	37.8	21.0	41.1	10.84%	21.68%	32.52%	29.5	32.6
Sr, ppm	34.8	3.9	26.9	42.7	23.0	46.7	11.34%	22.68%	34.01%	33.1	36.6
Th, ppm	13.5	1.20	11.1	15.9	9.9	17.1	8.85%	17.70%	26.55%	12.8	14.2
Ti, wt.%	0.310	0.016	0.278	0.342	0.262	0.358	5.19%	10.38%	15.57%	0.294	0.325
Tl, ppm	0.80	0.10	0.59	1.01	0.49	1.12	13.04%	26.07%	39.11%	0.76	0.84
V, ppm	79	4.4	71	88	66	93	5.58%	11.17%	16.75%	75	83
W, ppm	14.5	1.11	12.2	16.7	11.1	17.8	7.67%	15.35%	23.02%	13.7	15.2
Y, ppm	20.5	2.4	15.6	25.4	13.2	27.8	11.89%	23.78%	35.68%	19.5	21.5
Zn, ppm	492	26	439	544	413	571	5.33%	10.66%	15.99%	467	516
Zr, ppm	89	7.7	74	104	66	112	8.66%	17.32%	25.98%	85	94
Aqua Regia Digestion											
Ag, ppm	9.13	1.19	6.75	11.51	5.56	12.70	13.04%	26.08%	39.12%	8.68	9.59
Al, wt.%	2.70	0.211	2.28	3.12	2.07	3.33	7.80%	15.59%	23.39%	2.57	2.84
As, ppm	10.3	1.7	6.9	13.7	5.2	15.3	16.51%	33.01%	49.52%	9.8	10.8
Ba, ppm	46.3	3.77	38.7	53.8	35.0	57.6	8.15%	16.29%	24.44%	44.0	48.6
Bi, ppm	139	11	117	160	106	171	7.81%	15.62%	23.43%	132	146
Ca, wt.%	0.322	0.017	0.288	0.356	0.271	0.373	5.31%	10.62%	15.93%	0.306	0.338
Co, ppm	36.4	1.76	32.9	39.9	31.1	41.7	4.83%	9.66%	14.48%	34.6	38.2
Cr, ppm	35.7	1.93	31.9	39.6	29.9	41.6	5.41%	10.82%	16.23%	34.0	37.5

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											
Cu, wt.%	2.51	0.057	2.40	2.63	2.34	2.68	2.25%	4.51%	6.76%	2.39	2.64
Fe, wt.%	8.87	0.366	8.14	9.60	7.77	9.97	4.13%	8.26%	12.38%	8.43	9.31
K, wt.%	0.281	0.019	0.243	0.319	0.224	0.338	6.73%	13.47%	20.20%	0.267	0.295
Mg, wt.%	1.39	0.109	1.18	1.61	1.07	1.72	7.84%	15.68%	23.52%	1.32	1.46
Mn, wt.%	0.089	0.005	0.079	0.098	0.074	0.103	5.34%	10.68%	16.02%	0.084	0.093
Mo, ppm	< 1.2	IND	IND	IND	IND	IND	IND	IND	IND	IND	IND
Na, wt.%	< 0.05	IND	IND	IND	IND	IND	IND	IND	IND	IND	IND
Ni, ppm	30.6	1.74	27.1	34.1	25.4	35.8	5.67%	11.34%	17.01%	29.1	32.2
P, wt.%	0.056	0.005	0.046	0.066	0.041	0.071	9.17%	18.33%	27.50%	0.053	0.059
Pb, ppm	142	9	124	160	115	169	6.32%	12.64%	18.96%	135	149
S, wt.%	2.87	0.259	2.35	3.38	2.09	3.64	9.02%	18.04%	27.07%	2.72	3.01
Sb, ppm	< 1	IND	IND	IND	IND	IND	IND	IND	IND	IND	IND
Se, ppm	28.6	3.1	22.3	34.8	19.2	38.0	10.93%	21.87%	32.80%	27.2	30.0
Sn, ppm	23.4	1.20	21.0	25.9	19.8	27.1	5.14%	10.28%	15.42%	22.3	24.6
Sr, ppm	15.4	1.01	13.4	17.4	12.3	18.4	6.55%	13.11%	19.66%	14.6	16.1
Ti, wt.%	< 0.09	IND	IND	IND	IND	IND	IND	IND	IND	IND	IND
V, ppm	30.2	2.85	24.5	35.9	21.6	38.8	9.45%	18.89%	28.34%	28.7	31.7
W, ppm	< 15	IND	IND	IND	IND	IND	IND	IND	IND	IND	IND
Zn, ppm	488	20	447	528	427	548	4.14%	8.27%	12.41%	463	512
Infrared Combustion											
S, wt.%	3.07	0.118	2.83	3.30	2.71	3.42	3.84%	7.67%	11.51%	2.91	3.22
Borate Fusion XRF											
Co, ppm	< 100	IND	IND	IND	IND	IND	IND	IND	IND	IND	IND
Cu, wt.%	2.51	0.102	2.31	2.72	2.21	2.82	4.05%	8.11%	12.16%	2.39	2.64
Fe_2O_3, wt.%	13.75	0.317	13.12	14.39	12.80	14.70	2.30%	4.60%	6.91%	13.07	14.44
Pb, ppm	< 160	IND	IND	IND	IND	IND	IND	IND	IND	IND	IND
S, wt.%	3.09	0.067	2.95	3.22	2.88	3.29	2.17%	4.34%	6.51%	2.93	3.24
SiO_2, wt.%	58.19	0.362	57.46	58.91	57.10	59.27	0.62%	1.25%	1.87%	55.28	61.09
Zn, ppm	504	18	468	540	450	558	3.56%	7.12%	10.68%	479	529
Peroxide Fusion ICP											
Ag, ppm	8.63	1.78	5.07	12.18	3.30	13.96	20.60%	41.19%	61.79%	8.20	9.06
As, ppm	< 20	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
Peroxide Fusion ICP continued											
Bi, ppm	138	10	119	157	109	167	6.93%	13.86%	20.79%	131	145
Co, ppm	39.1	5.9	27.4	50.8	21.5	56.7	15.01%	30.02%	45.02%	37.1	41.0
Cu, wt.%	2.51	0.084	2.34	2.68	2.26	2.76	3.36%	6.71%	10.07%	2.39	2.64
Fe, wt.%	9.69	0.336	9.02	10.36	8.68	10.69	3.47%	6.93%	10.40%	9.20	10.17
Pb, ppm	< 150	IND	IND	IND	IND	IND	IND	IND	IND	IND	IND
S, wt.%	3.09	0.099	2.89	3.29	2.79	3.39	3.20%	6.40%	9.61%	2.94	3.24
Sb, ppm	< 2	IND	IND	IND	IND	IND	IND	IND	IND	IND	IND
Se, ppm	33.6	5.2	23.2	44.1	18.0	49.3	15.49%	30.97%	46.46%	32.0	35.3
Si, wt.%	27.57	0.630	26.31	28.83	25.68	29.46	2.29%	4.57%	6.86%	26.19	28.95
Sn, ppm	35.1	3.22	28.6	41.5	25.4	44.7	9.20%	18.39%	27.59%	33.3	36.8
Zn, ppm	499	21	457	542	435	563	4.26%	8.53%	12.79%	474	524

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 2.40 and 2.63 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 930 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 84 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 930 is fit-for-purpose as a certified reference material (see 'Intended Use' below).

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
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SGS, Booysens, Gauteng, South Africa
SGS Didipio, Makati City, Philippines
SGS, Lakefield, Ontario, Canada
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SGS, Vancouver, BC, Canada
SGS, Vespasiano, MG, Brazil
Shiva Analyticals, Bangalore North, Karnataka, India
Ultra Trace (BV), Perth, WA, Australia

PREPARER AND SUPPLIER OF THE REFERENCE MATERIAL

Reference material OREAS 930 has been prepared and certified by:

ORE Research & Exploration Pty Ltd
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It has been packaged in 10g units sealed under nitrogen in laminated foil pouches.

INTENDED USE

OREAS 930 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 930 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 930 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.