



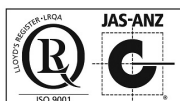
ORE RESEARCH & EXPLORATION P/L · ABN 28 006 859 856
37A Hosie St · Bayswater North · VIC · 3153 · AUSTRALIA
☎ 61 3 9729 0333 ☎ 61 3 9729 8338
📧 info@ore.com.au 🌐 www.ore.com.au

CERTIFICATE OF ANALYSIS FOR

COPPER ORE

CERTIFIED REFERENCE MATERIAL

OREAS 903



COA-870-OREAS903-R2

11-July-2023

Table 1. Certified Values, SDs, 95% Confidence and Tolerance Limits for OREAS 903.

Constituent	Certified Value	1SD	95% Confidence Limits		95% Tolerance Limits	
			Low	High	Low	High
4 Acid Digestion						
Ag, Silver (ppm)	0.432	0.051	0.406	0.458	0.409	0.455
Al, Aluminium (wt.%)	5.89	0.279	5.75	6.03	5.75	6.03
As, Arsenic (ppm)	49.7	3.77	48.0	51.3	47.2	52.1
Ba, Barium (ppm)	197	9	193	202	191	204
Be, Beryllium (ppm)	4.42	0.387	4.23	4.62	4.27	4.57
Bi, Bismuth (ppm)	8.94	0.481	8.70	9.18	8.69	9.20
Ca, Calcium (wt.%)	0.625	0.029	0.613	0.637	0.605	0.646
Cd, Cadmium (ppm)	0.20	0.019	0.19	0.21	0.18	0.22
Ce, Cerium (ppm)	82	5.6	79	86	79	85
Co, Cobalt (ppm)	131	8	127	135	127	135
Cr, Chromium (ppm)	73	4.6	70	75	70	76
Cs, Cesium (ppm)	3.57	0.121	3.50	3.63	3.46	3.68
Cu, Copper (wt.%)	0.652	0.020	0.642	0.661	0.639	0.665
Fe, Iron (wt.%)	4.16	0.179	4.07	4.25	4.06	4.26
Ga, Gallium (ppm)	15.0	1.7	14.4	15.6	14.5	15.5
Hf, Hafnium (ppm)	4.56	0.350	4.35	4.77	4.44	4.68
In, Indium (ppm)	0.16	0.02	0.15	0.17	0.15	0.17
K, Potassium (wt.%)	3.31	0.207	3.19	3.42	3.20	3.41
La, Lanthanum (ppm)	40.2	4.02	38.0	42.4	39.1	41.4
Li, Lithium (ppm)	18.3	0.72	18.0	18.7	17.7	19.0
Lu, Lutetium (ppm)	0.36	0.04	0.34	0.39	0.34	0.39
Mg, Magnesium (wt.%)	0.714	0.051	0.687	0.741	0.695	0.733
Mn, Manganese (wt.%)	0.069	0.003	0.067	0.071	0.067	0.071
Mo, Molybdenum (ppm)	4.32	0.335	4.17	4.47	4.08	4.56
Na, Sodium (wt.%)	0.030	0.001	0.029	0.031	0.029	0.031
Ni, Nickel (ppm)	54	4.7	52	56	52	56
P, Phosphorus (wt.%)	0.107	0.009	0.102	0.112	0.104	0.110
Pb, Lead (ppm)	11.3	1.7	10.4	12.1	10.8	11.8
Rb, Rubidium (ppm)	137	19	126	148	131	142
S, Sulphur (wt.%)	0.500	0.036	0.481	0.518	0.483	0.516
Sb, Antimony (ppm)	1.57	0.141	1.49	1.65	1.51	1.63
Sc, Scandium (ppm)	10.2	0.50	10.0	10.5	9.9	10.6
Se, Selenium (ppm)	6.06	0.85	5.59	6.54	IND	IND
Sn, Tin (ppm)	2.63	0.261	2.50	2.76	2.49	2.77
Sr, Strontium (ppm)	77	3.7	75	79	75	79
Ta, Tantalum (ppm)	0.54	0.08	0.48	0.59	0.48	0.59
Tb, Terbium (ppm)	0.83	0.09	0.76	0.91	0.79	0.88
Th, Thorium (ppm)	13.6	0.71	13.2	14.1	13.2	14.1
Ti, Titanium (wt.%)	0.192	0.037	0.171	0.214	0.181	0.204
Tl, Thallium (ppm)	0.62	0.041	0.60	0.64	0.60	0.65
U, Uranium (ppm)	7.58	0.584	7.26	7.90	7.32	7.84
V, Vanadium (ppm)	74	2.3	73	75	72	76
Y, Yttrium (ppm)	22.5	2.3	21.2	23.7	21.8	23.2
Yb, Ytterbium (ppm)	2.36	0.163	2.23	2.50	2.22	2.50
Zn, Zinc (ppm)	24.3	2.24	23.1	25.4	22.6	26.0
Zr, Zirconium (ppm)	152	11	146	158	147	157

SI unit equivalents: ppm, parts per million $\equiv$ mg/kg $\equiv$ μ g/g $\equiv$ 0.0001 wt.% $\equiv$ 1000 ppb, parts per billion.

Note: intervals may appear asymmetric due to rounding.

Table 1 continued.

Constituent	Certified Value	1SD	95% Confidence Limits		95% Tolerance Limits	
			Low	High	Low	High
Aqua Regia Digestion						
Ag, Silver (ppm)	0.349	0.038	0.331	0.366	0.332	0.365
Al, Aluminium (wt.%)	0.538	0.036	0.516	0.559	0.513	0.562
As, Arsenic (ppm)	47.5	2.12	46.6	48.4	46.2	48.8
Au, Gold (ppb)	< 5	IND	IND	IND	IND	IND
Ba, Barium (ppm)	63	4.3	60	65	60	66
Be, Beryllium (ppm)	2.69	0.268	2.54	2.85	2.62	2.77
Bi, Bismuth (ppm)	8.76	0.771	8.36	9.16	8.52	8.99
Ca, Calcium (wt.%)	0.633	0.030	0.618	0.649	0.618	0.649
Cd, Cadmium (ppm)	0.21	0.012	0.20	0.21	0.19	0.22
Ce, Cerium (ppm)	46.2	2.56	44.5	48.0	44.3	48.2
Co, Cobalt (ppm)	131	7	127	134	128	134
Cr, Chromium (ppm)	26.1	1.81	25.2	27.1	24.6	27.7
Cs, Cesium (ppm)	0.28	0.04	0.25	0.31	0.27	0.30
Cu, Copper (wt.%)	0.671	0.020	0.663	0.679	0.659	0.682
Fe, Iron (wt.%)	3.94	0.266	3.80	4.08	3.85	4.03
Ga, Gallium (ppm)	1.58	0.22	1.42	1.73	1.49	1.66
Ge, Germanium (ppm)	0.098	0.015	0.087	0.109	IND	IND
Hf, Hafnium (ppm)	0.61	0.052	0.57	0.65	0.58	0.64
In, Indium (ppm)	0.11	0.010	0.11	0.12	0.11	0.12
K, Potassium (wt.%)	0.331	0.029	0.314	0.348	0.314	0.348
La, Lanthanum (ppm)	22.8	3.8	20.7	24.9	22.0	23.6
Lu, Lutetium (ppm)	0.099	0.010	0.089	0.109	IND	IND
Mg, Magnesium (wt.%)	0.234	0.030	0.217	0.251	0.224	0.244
Mn, Manganese (wt.%)	0.071	0.004	0.069	0.073	0.069	0.073
Mo, Molybdenum (ppm)	4.26	0.47	4.01	4.50	4.10	4.41
Ni, Nickel (ppm)	48.7	3.06	47.1	50.3	47.3	50.1
P, Phosphorus (wt.%)	0.103	0.005	0.100	0.105	0.100	0.106
Pb, Lead (ppm)	8.95	0.91	8.49	9.41	8.68	9.22
Rb, Rubidium (ppm)	12.6	1.13	11.9	13.3	11.8	13.4
S, Sulphur (wt.%)	0.501	0.036	0.481	0.521	0.485	0.516
Sb, Antimony (ppm)	0.96	0.11	0.89	1.02	0.92	1.00
Sc, Scandium (ppm)	3.15	0.211	3.03	3.27	3.03	3.27
Se, Selenium (ppm)	5.34	0.57	5.04	5.64	5.07	5.62
Sr, Strontium (ppm)	17.7	1.36	16.9	18.4	17.0	18.4
Tb, Terbium (ppm)	0.47	0.05	0.42	0.52	0.46	0.48
Te, Tellurium (ppm)	0.034	0.006	0.031	0.037	IND	IND
Th, Thorium (ppm)	6.36	0.563	6.03	6.68	6.19	6.52
Ti, Titanium (wt.%)	0.008	0.001	0.007	0.009	0.008	0.009
Tl, Thallium (ppm)	0.14	0.02	0.13	0.15	IND	IND
U, Uranium (ppm)	3.24	0.293	3.06	3.41	3.15	3.33
V, Vanadium (ppm)	13.3	0.72	12.9	13.7	IND	IND
W, Tungsten (ppm)	0.53	0.08	0.48	0.58	0.47	0.59
Y, Yttrium (ppm)	9.23	0.654	8.83	9.62	8.96	9.50

SI unit equivalents: ppm, parts per million $\equiv$ mg/kg $\equiv$ μ g/g $\equiv$ 0.0001 wt.% $\equiv$ 1000 ppb, parts per billion.

Note: intervals may appear asymmetric due to rounding.

Table 1 continued.

Constituent	Certified Value	1SD	95% Confidence Limits		95% Tolerance Limits	
			Low	High	Low	High
Aqua Regia Digestion ICP-OES/MS						
Yb, Ytterbium (ppm)	0.69	0.07	0.62	0.76	IND	IND
Zn, Zinc (ppm)	21.3	1.46	20.6	22.1	20.2	22.5
Zr, Zirconium (ppm)	18.2	1.73	16.9	19.4	17.5	18.8
Sulphuric Acid Leach						
Copper Soluble, Cu-Sol (wt.%)	0.434	0.030	0.417	0.451	0.426	0.442

SI unit equivalents: ppm, parts per million $\equiv$ mg/kg $\equiv$ μ g/g $\equiv$ 0.0001 wt.% $\equiv$ 1000 ppb, parts per billion.

Note: intervals may appear asymmetric due to rounding.

Table 2. Indicative Values for OREAS 903.

Constituent	Unit	Value	Constituent	Unit	Value	Constituent	Unit	Value
Borate Fusion XRF								
Al ₂ O ₃	wt. %	11.48	Fe ₂ O ₃	wt. %	6.19	SnO ₂	ppm	< 13
As	ppm	80	K ₂ O	wt. %	4.23	SO ₃	wt. %	1.25
BaO	ppm	218	MgO	wt. %	1.26	SrO	ppm	95
CaO	wt. %	0.857	MnO	wt. %	0.091	TiO ₂	wt. %	0.501
Cl	ppm	30.0	NiO	ppm	115	V ₂ O ₅	ppm	152
CoO	ppm	178	P ₂ O ₅	wt. %	0.251	ZnO	ppm	18.7
Cr ₂ O ₃	ppm	88	PbO	ppm	10.8	ZrO ₂	ppm	216
CuO	ppm	8206	SiO ₂	wt. %	71.11			
Thermogravimetry								
LOI ¹⁰⁰⁰	wt. %	4.15						
Laser Ablation ICP-MS								
Ag	ppm	0.350	Ho	ppb	885	Sr	ppm	74
As	ppm	50	In	ppm	0.13	Ta	ppb	955
Ba	ppm	192	La	ppm	42.8	Tb	ppb	740
Be	ppm	4.00	Lu	ppb	365	Te	ppb	< 200
Bi	ppm	9.53	Mo	ppm	4.70	Th	ppm	13.8
Cd	ppm	0.10	Nb	ppm	11.2	Tl	ppm	0.60
Ce	ppm	83	Nd	ppm	33.8	Tm	ppb	350
Co	ppm	135	Ni	ppm	53	U	ppm	7.60
Cr	ppm	51	Pb	wt. %	0.001	V	ppm	80
Cs	ppm	3.64	Pr	ppm	9.89	W	ppm	2.28
Dy	ppm	4.16	Rb	ppm	148	Y	ppm	23.8
Er	ppm	2.24	Re	ppb	< 10	Yb	ppb	2400
Eu	ppb	1330	Sb	ppm	1.50	Zn	ppm	10.0
Ga	ppm	15.1	Sc	ppm	10.7	Zr	ppm	165
Gd	ppm	5.49	Se	ppm	5.00	Cu	ppm	6545
Ge	ppb	1500	Sm	ppm	6.93			
Hf	ppb	4750	Sn	ppm	3.50			

SI unit equivalents: ppm, parts per million $\equiv$ mg/kg $\equiv$ μ g/g $\equiv$ 0.0001 wt.% $\equiv$ 1000 ppb, parts per billion.

Note: intervals may appear asymmetric due to rounding.

Table 2 continued.

Constituent	Unit	Value	Constituent	Unit	Value	Constituent	Unit	Value
4 Acid Digestion								
Dy	ppm	4.43	Ho	ppm	0.84	Sm	ppm	6.90
Er	ppm	2.45	Nb	ppm	6.45	Te	ppm	0.039
Eu	ppm	1.30	Nd	ppm	32.2	Tm	ppm	0.36
Gd	ppm	5.82	Pr	ppm	8.76	W	ppm	1.87
Ge	ppm	0.19	Re	ppm	< 0.002			
Aqua Regia Digestion								
B	ppm	11.7	Ho	ppm	0.35	Re	ppm	< 0.001
Dy	ppm	1.88	Li	ppm	1.98	Sm	ppm	4.37
Er	ppm	0.82	Na	wt. %	0.010	Sn	ppm	0.40
Eu	ppm	0.80	Nb	ppm	0.13	Ta	ppm	< 0.01
Gd	ppm	3.61	Nd	ppm	20.2	Tm	ppm	0.099
Hg	ppm	0.060	Pr	ppm	4.89			
Pb Fire Assay								
Au	ppb	49.6						

SI unit equivalents: ppm, parts per million $\equiv$ mg/kg $\equiv$ μ g/g $\equiv$ 0.0001 wt.% $\equiv$ 1000 ppb, parts per billion.

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.

OREAS reference materials enable users to successfully achieve process control of these tasks because the observed variance from repeated analysis has its origin almost exclusively in the analytical process rather than the reference material itself.

SOURCE MATERIALS

OREAS 903 is a medium grade transitional-oxide copper ore certified reference material. It is one of a suite of four transitional to oxide copper CRMs prepared from samples sourced from CST's Lady Annie Mine, located 120 kms northwest of Mount Isa, Queensland, Australia. Mineralisation at Lady Annie is hosted in dolomitic, carbonaceous and argillaceous sandstones and siltstones. The oxide deposits consist primarily of near surface malachite mineralisation with minor cuprite, chrysocolla and chalcocite extending from surface to a depth of 60 to 100 m. The oxide copper deposit is underlain by deeper transition and sulphide mineralisation. The primary copper sulphide mineralisation at depth is dominated by chalcocite and chalcopyrite and appears to be structurally controlled, being commonly associated with fault-related silicification.

COMMUNITION AND HOMOGENISATION PROCEDURES

The material constituting OREAS 903 was prepared in the following manner:

- Drying to constant mass at 105°C;
- Crushing;
- Milling to 100% minus 30 microns;
- Homogenisation;
- Packaging into 10g units in laminated foil pouches and into 1kg units in plastic jars.

ANALYTICAL PROGRAM

Nineteen commercial analytical laboratories participated in the program to characterise the elements reported in Table 1 to 2. The following methods were employed:

- Four acid digestion with ICP-OES and ICP-MS finish (18 laboratories)
- Aqua regia digestion with ICP-OES and ICP-MS finish (19 laboratories)
- 5% H₂SO₄ acid leach with AAS or ICP-OES finish (14 laboratories)

For the round robin program twenty 1kg test units were taken at predetermined intervals during the bagging stage after final blending and are considered representative of the entire batch. The six samples received by each laboratory were obtained by taking two 110g scoop splits from each of three separate 1kg test units. This format enabled nested ANOVA treatment of the results to evaluate homogeneity.

Tabulated results of all elements together with analytical method codes, uncorrected means, medians, standard deviations, relative standard deviations and per cent deviation of lab means from the corrected mean of means (PDM³) are presented in the detailed certification data for this CRM (**OREAS 903 DataPack-3.0.180823_152253.xlsx**).

Table 1 presents the certified values together with their associated 1SD's, 95% confidence and tolerance limits and Table 2 provides the approximate major and trace element composition.

STATISTICAL ANALYSIS

Certified Values, Standard Deviations, Confidence and Tolerance Limits have been determined for each analytical method following removal of individual and laboratory outliers (see 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 (uncertified) values (Table 2) are provided for the major and trace elements determined by borate fusion XRF (Al₂O₃ to TiO₂), laser ablation with ICP-MS (Ag to Zr) and LOI at 1000°C and are the means of duplicate assays from Bureau Veritas, Perth. Additional indicative values by other analytical methods are present where the number of laboratories reporting a particular analyte is insufficient (< 5) to support certification or where inter-laboratory consensus is poor.

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.

As a guide two or more analytical results lying outside the 2SD window may be regarded as warning or rejection, and rejection for single results lying outside the 3SD window in QC monitoring, although their precise application should be at the discretion of the QC manager concerned.

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 ($1-\alpha=0.99$) at least 95% of subsamples ($p=0.95$) will have concentrations lying between 0.639 and 0.665 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 903 has also been evaluated in an ANOVA study for all certified analytes. This study indicates no evidence that between-unit variance is greater than within-unit variance.

Based on the statistical analysis of the results of the interlaboratory certification program it can be concluded that OREAS 903 is fit-for-purpose as a certified reference material (see 'Intended Use' below).

Performance Gates

Performance gates 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 and CRM variability. For an effective CRM the contribution of the latter should be negligible in comparison to measurement errors. Sources of measurement error include inter-lab bias, analytical precision (repeatability) and inter-batch bias (reproducibility).

Two methods have been employed to calculate performance gates. The first method uses the same filtered data set used to determine the certified value, i.e. after removal of all individual, lab dataset (batch) and 3SD outliers. 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 individual analyses generated from the certification program. Table 3 shows performance gates 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 percent 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 903.

Constituent	Certified Value	1SD	2SD window		3SD window		Relative Standard Deviations			5% window	
			Low	High	Low	High	1RSD	2RSD	3RSD	Low	High
4 Acid Digestion											
Ag, ppm	0.432	0.051	0.331	0.533	0.280	0.584	11.72%	23.43%	35.15%	0.410	0.454
Al, wt. %	5.89	0.279	5.33	6.45	5.05	6.73	4.73%	9.47%	14.20%	5.60	6.18
As, ppm	49.7	3.77	42.1	57.2	38.4	61.0	7.59%	15.18%	22.76%	47.2	52.1
Ba, ppm	197	9	180	215	171	224	4.47%	8.94%	13.41%	188	207
Be, ppm	4.42	0.387	3.65	5.20	3.26	5.58	8.74%	17.48%	26.22%	4.20	4.64
Bi, ppm	8.94	0.481	7.98	9.90	7.50	10.38	5.38%	10.75%	16.13%	8.49	9.39
Ca, wt. %	0.625	0.029	0.568	0.682	0.539	0.711	4.57%	9.15%	13.72%	0.594	0.656
Cd, ppm	0.20	0.019	0.17	0.24	0.15	0.26	9.21%	18.42%	27.64%	0.19	0.21
Ce, ppm	82	5.6	71	93	65	99	6.83%	13.67%	20.50%	78	86
Co, ppm	131	8	114	147	106	156	6.41%	12.82%	19.22%	124	137
Cr, ppm	73	4.6	64	82	59	87	6.37%	12.74%	19.11%	69	76
Cs, ppm	3.57	0.121	3.33	3.81	3.21	3.93	3.38%	6.76%	10.13%	3.39	3.75
Cu, wt. %	0.652	0.020	0.612	0.691	0.593	0.711	3.02%	6.03%	9.05%	0.619	0.684
Fe, wt. %	4.16	0.179	3.80	4.52	3.62	4.69	4.30%	8.60%	12.90%	3.95	4.37
Ga, ppm	15.0	1.7	11.7	18.4	10.0	20.0	11.17%	22.33%	33.50%	14.3	15.8
Hf, ppm	4.56	0.350	3.86	5.26	3.51	5.61	7.68%	15.36%	23.04%	4.33	4.79
In, ppm	0.16	0.02	0.13	0.20	0.11	0.21	10.51%	21.02%	31.53%	0.15	0.17
K, wt. %	3.31	0.207	2.89	3.72	2.69	3.93	6.25%	12.50%	18.75%	3.14	3.47
La, ppm	40.2	4.02	32.2	48.3	28.2	52.3	10.00%	20.00%	30.00%	38.2	42.2
Li, ppm	18.3	0.72	16.9	19.8	16.2	20.5	3.94%	7.87%	11.81%	17.4	19.2
Lu, ppm	0.36	0.04	0.29	0.44	0.25	0.48	10.43%	20.85%	31.28%	0.35	0.38
Mg, wt. %	0.714	0.051	0.613	0.815	0.562	0.866	7.08%	14.17%	21.25%	0.678	0.750
Mn, wt. %	0.069	0.003	0.062	0.076	0.059	0.079	4.98%	9.96%	14.94%	0.066	0.072
Mo, ppm	4.32	0.335	3.65	4.99	3.31	5.32	7.75%	15.51%	23.26%	4.10	4.54
Na, wt. %	0.030	0.001	0.027	0.033	0.026	0.035	4.93%	9.87%	14.80%	0.029	0.032
Ni, ppm	54	4.7	44	63	40	68	8.79%	17.57%	26.36%	51	57
P, wt. %	0.107	0.009	0.089	0.125	0.080	0.134	8.43%	16.86%	25.29%	0.101	0.112
Pb, ppm	11.3	1.7	7.9	14.6	6.3	16.3	14.78%	29.57%	44.35%	10.7	11.9
Rb, ppm	137	19	98	175	79	194	13.95%	27.91%	41.86%	130	143
S, wt. %	0.500	0.036	0.428	0.571	0.392	0.607	7.17%	14.34%	21.51%	0.475	0.525
Sb, ppm	1.57	0.141	1.29	1.85	1.15	1.99	8.99%	17.98%	26.97%	1.49	1.65
Sc, ppm	10.2	0.50	9.2	11.2	8.7	11.7	4.87%	9.73%	14.60%	9.7	10.7
Se, ppm	6.06	0.85	4.36	7.77	3.51	8.62	14.06%	28.12%	42.18%	5.76	6.37
Sn, ppm	2.63	0.261	2.11	3.15	1.85	3.41	9.92%	19.84%	29.76%	2.50	2.76
Sr, ppm	77	3.7	70	85	66	88	4.85%	9.70%	14.55%	73	81
Ta, ppm	0.54	0.08	0.37	0.70	0.29	0.79	15.58%	31.17%	46.75%	0.51	0.56
Tb, ppm	0.83	0.09	0.66	1.01	0.57	1.10	10.54%	21.07%	31.61%	0.79	0.88
Th, ppm	13.6	0.71	12.2	15.1	11.5	15.8	5.22%	10.44%	15.67%	13.0	14.3
Ti, wt. %	0.192	0.037	0.119	0.266	0.082	0.303	19.08%	38.15%	57.23%	0.183	0.202
Tl, ppm	0.62	0.041	0.54	0.70	0.50	0.74	6.58%	13.16%	19.74%	0.59	0.65

SI unit equivalents: ppm, parts per million $\equiv$ mg/kg $\equiv$ μ g/g $\equiv$ 0.0001 wt. % $\equiv$ 1000 ppb, parts per billion.

Note: intervals may appear asymmetric due to rounding.

Table 3 continued.

Constituent	Certified Value	1SD	2SD window		3SD window		Relative Standard Deviations			5% window	
			Low	High	Low	High	1RSD	2RSD	3RSD	Low	High
4 Acid Digestion											
U, ppm	7.58	0.584	6.41	8.75	5.83	9.33	7.70%	15.40%	23.10%	7.20	7.96
V, ppm	74	2.3	69	79	67	81	3.16%	6.32%	9.48%	70	78
Y, ppm	22.5	2.3	17.8	27.1	15.5	29.5	10.37%	20.74%	31.11%	21.3	23.6
Yb, ppm	2.36	0.163	2.04	2.69	1.87	2.85	6.91%	13.82%	20.74%	2.25	2.48
Zn, ppm	24.3	2.24	19.8	28.8	17.6	31.0	9.22%	18.43%	27.65%	23.1	25.5
Zr, ppm	152	11	130	173	120	184	7.06%	14.12%	21.18%	144	159
Aqua Regia Digestion											
Ag, ppm	0.349	0.038	0.272	0.425	0.234	0.463	10.93%	21.85%	32.78%	0.331	0.366
Al, wt. %	0.538	0.036	0.465	0.610	0.429	0.646	6.71%	13.42%	20.13%	0.511	0.564
As, ppm	47.5	2.12	43.2	51.7	41.1	53.9	4.47%	8.93%	13.40%	45.1	49.9
Au, ppb	< 5	IND	IND	IND	IND	IND	IND	IND	IND	IND	IND
Ba, ppm	63	4.3	54	71	50	76	6.80%	13.60%	20.39%	60	66
Be, ppm	2.69	0.268	2.16	3.23	1.89	3.50	9.93%	19.86%	29.79%	2.56	2.83
Bi, ppm	8.76	0.771	7.22	10.30	6.44	11.07	8.81%	17.61%	26.42%	8.32	9.20
Ca, wt. %	0.633	0.030	0.572	0.694	0.542	0.725	4.81%	9.63%	14.44%	0.602	0.665
Cd, ppm	0.21	0.012	0.18	0.23	0.17	0.24	5.79%	11.58%	17.37%	0.20	0.22
Ce, ppm	46.2	2.56	41.1	51.3	38.6	53.9	5.54%	11.07%	16.61%	43.9	48.5
Co, ppm	131	7	116	146	108	153	5.70%	11.40%	17.11%	124	137
Cr, ppm	26.1	1.81	22.5	29.8	20.7	31.6	6.93%	13.86%	20.79%	24.8	27.4
Cs, ppm	0.28	0.04	0.20	0.37	0.15	0.41	15.32%	30.64%	45.96%	0.27	0.30
Cu, wt. %	0.671	0.020	0.631	0.710	0.611	0.730	2.95%	5.89%	8.84%	0.637	0.704
Fe, wt. %	3.94	0.266	3.41	4.47	3.14	4.74	6.75%	13.49%	20.24%	3.74	4.14
Ga, ppm	1.58	0.22	1.13	2.02	0.91	2.25	14.18%	28.36%	42.54%	1.50	1.66
Ge, ppm	0.098	0.015	0.068	0.127	0.053	0.142	15.15%	30.30%	45.45%	0.093	0.103
Hf, ppm	0.61	0.052	0.51	0.71	0.45	0.77	8.56%	17.12%	25.68%	0.58	0.64
In, ppm	0.11	0.010	0.09	0.13	0.08	0.14	9.33%	18.67%	28.00%	0.11	0.12
K, wt. %	0.331	0.029	0.274	0.388	0.245	0.417	8.65%	17.29%	25.94%	0.315	0.348
La, ppm	22.8	3.8	15.1	30.5	11.3	34.3	16.80%	33.59%	50.39%	21.7	23.9
Lu, ppm	0.099	0.010	0.078	0.120	0.068	0.131	10.58%	21.15%	31.73%	0.094	0.104
Mg, wt. %	0.234	0.030	0.174	0.294	0.144	0.324	12.88%	25.77%	38.65%	0.222	0.246
Mn, wt. %	0.071	0.004	0.063	0.079	0.059	0.083	5.55%	11.11%	16.66%	0.067	0.074
Mo, ppm	4.26	0.47	3.31	5.20	2.84	5.67	11.06%	22.13%	33.19%	4.04	4.47
Ni, ppm	48.7	3.06	42.6	54.8	39.5	57.9	6.27%	12.55%	18.82%	46.3	51.2
P, wt. %	0.103	0.005	0.093	0.112	0.088	0.117	4.67%	9.35%	14.02%	0.098	0.108
Pb, ppm	8.95	0.91	7.14	10.76	6.24	11.67	10.11%	20.23%	30.34%	8.50	9.40
Rb, ppm	12.6	1.13	10.3	14.8	9.2	15.9	8.95%	17.90%	26.84%	11.9	13.2
S, wt. %	0.501	0.036	0.429	0.573	0.392	0.610	7.23%	14.45%	21.68%	0.476	0.526
Sb, ppm	0.96	0.11	0.74	1.17	0.64	1.28	11.19%	22.39%	33.58%	0.91	1.01
Sc, ppm	3.15	0.211	2.73	3.57	2.52	3.78	6.70%	13.41%	20.11%	2.99	3.31
Se, ppm	5.34	0.57	4.20	6.49	3.62	7.07	10.75%	21.49%	32.24%	5.08	5.61
Sr, ppm	17.7	1.36	15.0	20.4	13.6	21.8	7.69%	15.38%	23.08%	16.8	18.6
Tb, ppm	0.47	0.05	0.36	0.57	0.31	0.63	11.34%	22.68%	34.02%	0.45	0.49
Te, ppm	0.034	0.006	0.022	0.047	0.015	0.054	18.70%	37.40%	56.10%	0.033	0.036
Th, ppm	6.36	0.563	5.23	7.48	4.67	8.05	8.86%	17.72%	26.57%	6.04	6.67
Ti, wt. %	0.008	0.001	0.006	0.011	0.004	0.012	16.52%	33.03%	49.55%	0.008	0.009
Tl, ppm	0.14	0.02	0.09	0.19	0.06	0.21	17.66%	35.32%	52.98%	0.13	0.14
U, ppm	3.24	0.293	2.65	3.82	2.36	4.12	9.03%	18.06%	27.09%	3.08	3.40
V, ppm	13.3	0.72	11.8	14.7	11.1	15.5	5.43%	10.86%	16.29%	12.6	14.0
W, ppm	0.53	0.08	0.37	0.70	0.28	0.78	15.56%	31.13%	46.69%	0.50	0.56
Y, ppm	9.23	0.654	7.92	10.54	7.27	11.19	7.08%	14.17%	21.25%	8.77	9.69

SI unit equivalents: ppm, parts per million $\equiv$ mg/kg $\equiv$ μ g/g $\equiv$ 0.0001 wt. % $\equiv$ 1000 ppb, parts per billion.

Note: intervals may appear asymmetric due to rounding.

Table 3 continued.

Constituent	Certified Value	1SD	2SD window		3SD window		Relative Standard Deviations			5% window	
			Low	High	Low	High	1RSD	2RSD	3RSD	Low	High
Aqua Regia Digestion											
Yb, ppm	0.69	0.07	0.54	0.84	0.46	0.91	10.79%	21.57%	32.36%	0.65	0.72
Zn, ppm	21.3	1.46	18.4	24.3	17.0	25.7	6.84%	13.68%	20.52%	20.3	22.4
Zr, ppm	18.2	1.73	14.7	21.6	13.0	23.3	9.54%	19.08%	28.62%	17.2	19.1
Sulphuric Acid Leach											
Cu-Sol, wt. %	0.434	0.030	0.374	0.494	0.344	0.524	6.90%	13.79%	20.69%	0.412	0.456

SI unit equivalents: ppm, parts per million $\equiv$ mg/kg $\equiv$ μ g/g $\equiv$ 0.0001 wt. % $\equiv$ 1000 ppb, parts per billion.

Note: intervals may appear asymmetric due to rounding.

PARTICIPATING LABORATORIES

1. Acme Analytical Laboratories, Vancouver, BC, Canada
2. Activation Laboratories, Ancaster, Ontario, Canada
3. Activation Laboratories, Thunder Bay, Ontario, Canada
4. ALS, Brisbane, QLD, Australia
5. ALS, Callao, Lima, Peru
6. ALS, Johannesburg, Gauteng, South Africa
7. ALS, La Serena, Coquimbo, Chile
8. ALS, Perth, WA, Australia
9. ALS, Vancouver, BC, Canada
10. BV Amdel, Adelaide, SA, Australia
11. Bureau Veritas (Ultra Trace) Geoanalytical, Perth, WA, Australia
12. Intertek Genalysis, Perth, WA, Australia
13. McPhar Geoservices (Phil) Inc., Manila, Philippines
14. SGS Mineral Services, Lakefield, Ontario, Canada
15. SGS Mineral Services, Perth, WA, Australia
16. SGS Mineral Services, Toronto, Ontario, Canada
17. SGS Mineral Services, Townsville, QLD, Australia
18. SGS Mineral Services, Vancouver, BC, Canada
19. Zarazma Mineral Studies, Tehran, Iran

PREPARER AND SUPPLIER OF THE REFERENCE MATERIAL

OREAS 903 has been prepared, certified and supplied by:



ORE Research & Exploration Pty Ltd
37A Hosie Street
Bayswater North VIC 3153
AUSTRALIA

Tel: +613-9729 0333
Fax: +613-9729 8338
Web: www.ore.com.au
Email: info@ore.com.au

OREAS 903 has been packaged in single-use laminated foil pouches in 10g units. 1kg units in plastic jars are also available upon request.

INTENDED USE

OREAS 903 is intended for the following uses:

- For the monitoring of laboratory performance in the analysis of analytes reported in Table 1 in geological samples
- 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 903 has been sourced from medium grade transitional-oxide copper ore. In its unopened state and under normal conditions of storage it has a shelf life beyond ten years. Its stability will be monitored at regular intervals and purchasers notified if any changes are observed.

INSTRUCTIONS FOR THE CORRECT USE

The certified values refer to the concentration level of analytes in their packaged state. The CRM should therefore 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.

METROLOGICAL TRACEABILITY

The analytical samples were selected in a manner to represent the entire batch of prepared CRM. This 'representivity' was maintained in each submitted laboratory sample batch and ensures the user that the data is traceable from sample selection through to the analytical results that underlie the consensus values. Each analytical data set has been validated by its assayer through the inclusion of internal reference materials and QC checks during analysis.

The laboratories were chosen on the basis of their competence (from past performance in inter-laboratory programs undertaken by ORE Pty Ltd) for a particular analytical method, analyte or analyte suite, and sample matrix. Most of these laboratories have and maintain ISO 17025 accreditation. The certified values presented in this report are calculated from the means of accepted data following robust statistical treatment as detailed in this report.

Guide ISO/TR 16476:2016, section 5.3.1 describes metrological traceability in reference materials as it pertains to the transformation of the measurand. In this section it states, *"Although the determination of the property value itself can be made traceable to appropriate units through, for example, calibration of the measurement equipment used,*

*steps like the transformation of the sample from one physical (chemical) state to another cannot. Such transformations may only be compared with a reference (when available), or among themselves. For some transformations, reference methods have been defined and may be used in certification projects to evaluate the uncertainty associated with such a transformation. In other cases, **only a comparison among different laboratories using the same method is possible. In this case, certification takes place on the basis of agreement among independent measurement results** (see ISO Guide 35:2006, Clause 10)."*

COMMUTABILITY

The measurements of the results that underlie the certified values contained in this report were undertaken by methods involving pre-treatment (digestion/fusion) of the sample. This served to reduce the sample to a simple and well understood form permitting calibration using simple solutions of the CRM. Due to these methods being well understood and highly effective, commutability is not an issue for this CRM. All OREAS CRMs are sourced from natural ore minerals meaning they will display similar behaviour as routine 'field' samples in the relevant measurement process. Care should be taken to ensure 'matrix matching' as close as practically achievable. The matrix and mineralisation style of the CRM is described in the 'Source Material' section and users should select appropriate CRMs matching these attributes to their field samples.

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.

DOCUMENT HISTORY

Revision No	Date	Changes applied
2	11 th July, 2023	Revised heading of Table 3 on pages 9 and 10 (had incorrect references to OREAS 902).
1	3 rd Sep, 2018	Added major and trace element characterization; added performance gates.
0	7 th Aug, 2012	First publication.

QMS ACCREDITED

ORE Pty Ltd is accredited to ISO 9001:2015 by Lloyd's Register Quality Assurance Ltd for its quality management system including development, manufacturing, certification and supply of CRMs.



CERTIFYING OFFICER



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

REFERENCES

ISO Guide 30 (2015), Terms and definitions used in connection with reference materials.

ISO Guide 31 (2015), Reference materials – Contents of certificates and labels.

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

ISO Guide 35 (2017), Certification of reference materials - General and statistical principals.