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CERTIFICATE OF ANALYSIS FOR

PORPHYRY COPPER-GOLD-MOLYBDENUM REFERENCE MATERIAL

OREAS 501c

Summary Statistics for Key Analytes.

Constituent	Certified Value	1SD	95% Confidence Limits		95% Tolerance Limits	
			Low	High	Low	High
Fire Assay						
Au, Gold (ppm)	0.221	0.007	0.219	0.224	0.217*	0.226*
4-Acid Digestion						
Ag, Silver (ppm)	0.461	0.053	0.436	0.486	0.422	0.500
Cu, Copper (wt.%)	0.276	0.008	0.273	0.278	0.270	0.281
Mo, Molybdenum (ppm)	97	3.0	96	98	95	99

Note: intervals may appear asymmetric due to rounding; *Tolerance Limits are calculated for a 30g sample weight from 20 x INAA analyses on 1g subsamples using the reduced analytical subsample method which utilises the known relationship between SD and sample weight (Ingamells and Switzer, 1973).

Table 1. Fire Assay - Certified Values, SDs, 95% Confidence & Tolerance Limits for OREAS 501c.

Constituent	Certified Value	1SD	95% Confidence Limits		95% Tolerance Limits	
			Low	High	Low	High
Au, Gold (ppm)	0.221	0.007	0.219	0.224	0.217	0.226

Note: intervals may appear asymmetric due to rounding; *determined from RSD of gold INAA data for 30g analytical subsample weight.

Table 2. 4-Acid Digest - Certified Values, SDs, 95% Confidence & Tolerance Limits for OREAS 501c.

Constituent	Certified Value	1SD	95% Confidence Limits		95% Tolerance Limits	
			Low	High	Low	High
Ag, Silver (ppm)	0.461	0.053	0.436	0.486	0.422	0.500
Al, Aluminium (wt.%)	7.49	0.331	7.36	7.61	7.34	7.63
As, Arsenic (ppm)	23.9	2.00	23.1	24.6	22.4	25.3
Ba, Barium (ppm)	1044	53	1025	1062	1020	1067
Be, Beryllium (ppm)	2.94	0.178	2.87	3.01	2.84	3.03
Bi, Bismuth (ppm)	0.69	0.041	0.67	0.71	0.65	0.72
Ca, Calcium (wt.%)	2.64	0.154	2.58	2.70	2.59	2.69
Cd, Cadmium (ppm)	0.18	0.03	0.16	0.19	0.13	0.23
Ce, Cerium (ppm)	69	5.4	66	71	66	71
Co, Cobalt (ppm)	15.1	0.74	14.8	15.4	14.7	15.6
Cr, Chromium (ppm)	80	10	76	84	76	84
Cs, Cesium (ppm)	11.7	0.63	11.4	11.9	11.3	12.1
Cu, Copper (wt.%)	0.276	0.008	0.273	0.278	0.270	0.281
Dy, Dysprosium (ppm)	4.63	0.451	4.34	4.93	4.50	4.77
Er, Erbium (ppm)	2.62	0.235	2.45	2.79	2.54	2.70
Fe, Iron (wt.%)	4.45	0.222	4.37	4.52	4.37	4.53
Ga, Gallium (ppm)	19.1	0.84	18.7	19.4	18.5	19.6
Gd, Gadolinium (ppm)	5.04	0.401	4.77	5.31	4.80	5.28
Hf, Hafnium (ppm)	2.60	0.165	2.53	2.66	2.48	2.71
Ho, Holmium (ppm)	0.93	0.038	0.91	0.94	0.88	0.97
In, Indium (ppm)	0.075	0.006	0.073	0.078	0.069	0.082
K, Potassium (wt.%)	3.22	0.198	3.15	3.30	3.12	3.33
La, Lanthanum (ppm)	35.2	2.49	34.3	36.0	33.9	36.4
Li, Lithium (ppm)	33.8	2.00	33.1	34.5	32.8	34.9
Lu, Lutetium (ppm)	0.36	0.036	0.34	0.39	0.35	0.38
Mg, Magnesium (wt.%)	1.51	0.091	1.47	1.54	1.47	1.54
Mn, Manganese (wt.%)	0.055	0.003	0.054	0.056	0.054	0.056
Mo, Molybdenum (ppm)	97	3.0	96	98	95	99
Na, Sodium (wt.%)	2.02	0.094	1.99	2.05	1.98	2.06
Nb, Niobium (ppm)	18.4	1.77	17.6	19.1	17.7	19.0
Nd, Neodymium (ppm)	30.0	3.3	27.8	32.2	29.0	31.0
Ni, Nickel (ppm)	60	3.6	59	61	58	62
P, Phosphorus (wt.%)	0.101	0.005	0.099	0.102	0.098	0.103
Pb, Lead (ppm)	21.5	1.42	20.9	22.0	20.7	22.2
Pr, Praseodymium (ppm)	7.91	0.749	7.42	8.40	7.64	8.19
Rb, Rubidium (ppm)	196	13	191	202	190	203
S, Sulphur (wt.%)	0.347	0.017	0.341	0.353	0.336	0.357

Note: intervals may appear asymmetric due to rounding.

Table 2. 4-Acid Digest continued.

Constituent	Certified Value	1SD	95% Confidence Limits		95% Tolerance Limits	
			Low	High	Low	High
Sb, Antimony (ppm)	2.27	0.163	2.20	2.33	2.19	2.34
Sc, Scandium (ppm)	12.9	1.4	12.3	13.6	12.5	13.3
Se, Selenium (ppm)	2.07	0.56	1.83	2.30	1.85	2.28
Sm, Samarium (ppm)	5.74	0.499	5.44	6.04	5.50	5.97
Sn, Tin (ppm)	3.38	0.207	3.29	3.48	3.22	3.55
Sr, Strontium (ppm)	322	17	316	328	313	331
Ta, Tantalum (ppm)	1.32	0.128	1.25	1.39	1.26	1.38
Tb, Terbium (ppm)	0.80	0.061	0.76	0.84	0.77	0.83
Te, Tellurium (ppm)	0.25	0.021	0.24	0.26	0.22	0.28
Th, Thorium (ppm)	18.9	1.79	18.2	19.6	18.0	19.7
Ti, Titanium (wt.%)	0.480	0.024	0.471	0.489	0.469	0.491
Tl, Thallium (ppm)	0.97	0.055	0.95	1.00	0.94	1.00
Tm, Thulium (ppm)	0.36	0.024	0.34	0.38	0.34	0.39
U, Uranium (ppm)	5.13	0.54	4.92	5.34	4.79	5.46
V, Vanadium (ppm)	120	8	117	122	116	123
W, Tungsten (ppm)	4.48	0.349	4.38	4.58	4.07	4.89
Y, Yttrium (ppm)	24.9	1.39	24.4	25.5	24.3	25.6
Yb, Ytterbium (ppm)	2.42	0.25	2.30	2.55	2.32	2.52
Zn, Zinc (ppm)	81	4.7	79	83	77	85
Zr, Zirconium (ppm)	81	7.5	78	84	77	84

Note: intervals may appear asymmetric due to rounding.

Table 3. Aqua Regia Digest - Certified Values, SDs, 95% Confidence & Tolerance Limits for OREAS 501c.

Constituent	Certified Value	1SD	95% Confidence Limits		95% Tolerance Limits	
			Low	High	Low	High
Ag, Silver (ppm)	0.444	0.027	0.429	0.458	0.418	0.470
Al, Aluminium (wt.%)	2.17	0.116	2.11	2.23	2.09	2.24
As, Arsenic (ppm)	24.3	1.54	23.7	24.8	23.1	25.5
Au, Gold (ppm)	0.214	0.009	0.210	0.217	0.209^	0.219^
Ba, Barium (ppm)	428	20	420	437	416	440
Be, Beryllium (ppm)	0.59	0.08	0.52	0.66	0.53	0.65
Bi, Bismuth (ppm)	0.70	0.042	0.68	0.72	0.67	0.73
Ca, Calcium (wt.%)	1.02	0.085	0.98	1.07	0.98	1.06
Ce, Cerium (ppm)	64	4.7	61	66	62	66
Co, Cobalt (ppm)	14.2	0.60	13.9	14.5	13.9	14.5
Cr, Chromium (ppm)	68	2.7	66	69	65	70
Cs, Cesium (ppm)	9.88	0.560	9.61	10.16	9.62	10.15
Cu, Copper (wt.%)	0.275	0.006	0.273	0.276	0.269	0.280
Dy, Dysprosium (ppm)	3.31	0.249	3.07	3.56	3.17	3.46
Er, Erbium (ppm)	1.74	0.24	1.43	2.05	1.65	1.83
Fe, Iron (wt.%)	4.10	0.247	4.00	4.20	4.03	4.18
Ga, Gallium (ppm)	8.56	0.94	8.12	8.99	8.14	8.97
Gd, Gadolinium (ppm)	4.02	0.381	3.67	4.37	3.86	4.18
Hf, Hafnium (ppm)	0.40	0.038	0.38	0.42	0.38	0.42

^determined from RSD of gold INAA data for 25g analytical subsample weight.

Note: intervals may appear asymmetric due to rounding.

Table 3. Aqua Regia Digest continued.

Constituent	Certified Value	1SD	95% Confidence Limits		95% Tolerance Limits	
			Low	High	Low	High
Ho, Holmium (ppm)	0.62	0.08	0.52	0.73	0.60	0.65
In, Indium (ppm)	0.047	0.005	0.043	0.051	0.044	0.051
K, Potassium (wt.%)	1.17	0.069	1.14	1.19	1.13	1.20
La, Lanthanum (ppm)	31.9	2.36	30.9	33.0	31.0	32.9
Li, Lithium (ppm)	33.1	1.06	32.6	33.5	32.1	34.0
Mg, Magnesium (wt.%)	1.22	0.055	1.20	1.25	1.20	1.25
Mn, Manganese (wt.%)	0.039	0.001	0.038	0.039	0.038	0.040
Mo, Molybdenum (ppm)	95	4.5	93	97	92	98
Na, Sodium (wt.%)	0.202	0.017	0.194	0.210	0.188	0.216
Ni, Nickel (ppm)	58	3.0	57	59	57	60
P, Phosphorus (wt.%)	0.096	0.004	0.094	0.098	0.093	0.099
Pb, Lead (ppm)	8.43	0.482	8.19	8.68	8.08	8.78
Pr, Praseodymium (ppm)	6.88	0.599	6.26	7.50	6.55	7.21
Rb, Rubidium (ppm)	134	6	131	137	130	139
S, Sulphur (wt.%)	0.343	0.020	0.334	0.351	0.334	0.351
Sb, Antimony (ppm)	1.59	0.25	1.46	1.73	1.50	1.69
Sc, Scandium (ppm)	7.36	0.623	7.09	7.64	7.10	7.62
Sm, Samarium (ppm)	4.38	0.49	3.93	4.82	4.15	4.60
Sn, Tin (ppm)	2.70	0.28	2.55	2.85	2.56	2.83
Sr, Strontium (ppm)	65	9	61	69	63	67
Th, Thorium (ppm)	19.3	1.10	18.8	19.8	18.8	19.9
Ti, Titanium (wt.%)	0.363	0.017	0.354	0.372	0.348	0.379
Tl, Thallium (ppm)	0.73	0.061	0.70	0.77	0.70	0.76
U, Uranium (ppm)	4.87	0.261	4.77	4.98	4.66	5.09
V, Vanadium (ppm)	110	4	109	112	108	113
W, Tungsten (ppm)	2.96	0.44	2.73	3.19	2.74	3.17
Zn, Zinc (ppm)	74	3.8	72	75	71	76
Zr, Zirconium (ppm)	9.34	0.577	9.03	9.66	8.93	9.76

Note: intervals may appear asymmetric due to rounding.

Table 4. Indicative Values for OREAS 501c.

Constituent	Unit	Value	Constituent	Unit	Value	Constituent	Unit	Value
Fire Assay								
Pd	ppb	*< 5*	Pt	ppb	*< 5*			
4-Acid Digestion								
B	ppm	*< 20*	Ir	ppm	*< 0.01*	Rh	ppm	*0.21*
Eu	ppm	*1.40*	Pd	ppb	*< 10*	Ru	ppm	*0.020*
Ge	ppm	*0.18*	Pt	ppb	*< 10*			
Hg	ppm	*0.046*	Re	ppb	*3.13*			
Aqua Regia Digestion								
B	ppm	*< 10*	Nd	ppm	*24.5*	Tb	ppm	*0.60*
Cd	ppm	*0.12*	Pd	ppb	*< 10*	Te	ppm	*0.24*
Eu	ppm	*0.45*	Pt	ppb	*< 5*	Tm	ppm	*0.24*

Note: the number of significant figures reported is not a reflection of the level of certainty of stated values. They are instead an artefact of ORE's in-house CRM-specific LIMS.

Table 4. Indicative Values continued.

Constituent	Unit	Value	Constituent	Unit	Value	Constituent	Unit	Value
Ge	ppm	*0.17*	Re	ppb	*2.15*	Y	ppm	*17.0*
Hg	ppm	*0.020*	Rh	ppm	*0.12*	Yb	ppm	*1.54*
Lu	ppm	*0.22*	Se	ppm	*1.72*			
Nb	ppm	*1.19*	Ta	ppm	*0.011*			
Laser Ablation ICP-MS								
Ag	ppm	*0.450*	Hf	ppm	*7.47*	Sm	ppm	*6.03*
As	ppm	*23.4*	Ho	ppm	*0.96*	Sn	ppm	*4.10*
Ba	ppm	*1065*	In	ppm	*0.075*	Sr	ppm	*316*
Be	ppm	*2.70*	La	ppm	*37.5*	Ta	ppm	*1.39*
Bi	ppm	*0.73*	Lu	ppm	*0.38*	Tb	ppm	*0.84*
Cd	ppm	*0.25*	Mn	wt.%	*0.059*	Te	ppm	*0.40*
Ce	ppm	*70*	Mo	ppm	*98*	Th	ppm	*19.2*
Co	ppm	*16.4*	Nb	ppm	*18.5*	Ti	wt.%	*0.488*
Cr	ppm	*107*	Nd	ppm	*30.7*	Tl	ppm	*1.00*
Cs	ppm	*11.8*	Ni	ppm	*71*	Tm	ppm	*0.40*
Cu	wt.%	*0.268*	Pb	ppm	*21.5*	U	ppm	*5.65*
Dy	ppm	*4.85*	Pr	ppm	*8.95*	V	ppm	*126*
Er	ppm	*2.92*	Rb	ppm	*202*	W	ppm	*5.50*
Eu	ppm	*1.27*	Re	ppb	*30.0*	Y	ppm	*27.9*
Ga	ppm	*17.8*	Sb	ppm	*2.15*	Yb	ppm	*2.64*
Gd	ppm	*5.08*	Sc	ppm	*12.6*	Zn	ppm	*78*
Ge	ppm	*1.33*	Se	ppm	*< 5*	Zr	ppm	*268*
Borate Fusion XRF								
Al_2O_3	wt.%	*14.80*	MgO	wt.%	*2.60*	SiO_2	wt.%	*62.54*
CaO	wt.%	*3.83*	MnO	wt.%	*0.080*	TiO_2	wt.%	*0.810*
Cl	ppm	*125*	Na_2O	wt.%	*2.73*	Zn	ppm	*80*
Cu	wt.%	*0.276*	Ni	ppm	*70*	ZrO_2	ppm	*350*
Fe_2O_3	wt.%	*6.46*	P	wt.%	*0.103*			
K_2O	wt.%	*3.96*	S	wt.%	*0.344*			
Thermogravimetry								
LOI^{1000}	wt.%	*0.965*						

Note: the number of significant figures reported is not a reflection of the level of certainty of stated values. They are instead an artefact of ORE's in-house CRM-specific LIMS.

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 MATERIALS

OREAS 501c was prepared from a blend of porphyry copper-gold ore, barren granodiorite and a minor quantity of Cu-Mo concentrate. The ore was sourced from the Ridgeway

underground mine located in the Cadia Valley Operations (CVO) situated in central western New South Wales, Australia. The barren I-type hornblende-bearing granodiorite was sourced from the Late Devonian Lysterfield granodiorite complex located in eastern Melbourne, Australia.

Mineralisation in the CVO region is hosted by a sequence of late Ordovician to Early Silurian volcanics, intrusives and sediments that occur within the Bogan Gate Synclinorial Zone of the Lachlan Fold Belt. The western portion of this zone is dominated by volcanics and host to the Late Ordovician Goonumbla porphyry copper-gold deposits. These volcanics are interpreted to have erupted from shallow water to partly emergent volcanic centres and show a broad range in composition from shoshonite through to latite to trachyte. Coeval sub-volcanic quartz monzonite porphyries (and attendant mineralisation) have intruded the volcanics. They are generally small, sub-vertical, pipe-like intrusives. Typically the mineralised porphyries contain plagioclase and quartz phenocrysts in a matrix of fine-grained potassium feldspar and quartz with minor biotite and hornblende.

Copper-gold mineralisation occurs as stockwork quartz veins and disseminations associated with potassic alteration. This alteration is intimately associated spatially and temporally with the small finger-like quartz monzonite porphyries that intrude the Goonumbla Volcanics. Sulphides are zoned laterally from the centres of mineralisation. The central portions are bornite-rich with minor chalcopyrite, zoning outward through equal concentrations of bornite and chalcopyrite, to an outermost chalcopyrite-rich zone. Pyrite increases outward at the expense of bornite.

COMMINUTION AND HOMOGENISATION PROCEDURES

The material constituting OREAS 501c was prepared in the following manner:

- drying to constant mass at 105°C;
- multi-stage milling of ore and concentrate to 100% minus 30 microns;
- milling of barren granodiorite to 98% minus 75 microns;
- combining ore, granodiorite and concentrate in appropriate proportions to achieve target grades;
- homogenisation;
- packaging into 10 and 60g units in laminated foil pouches and 1kg units in plastic jars.

ANALYTICAL PROGRAM

Thirty commercial analytical laboratories participated in the program to characterise the elements reported in Tables 1 to 4. The following methods were employed:

- Gold via 25-40g fire assay with AAS (18 labs) or ICP-OES (12 labs) finish;
- Gold via 15-50g aqua regia digestion with ICP-MS (13 labs), ICP-OES (2 labs) or AAS (6 labs) finish;
- Four acid digestion for full elemental suite ICP-OES and ICP-MS (30 laboratories);

- Aqua regia digestion for full elemental suite ICP-OES and ICP-MS (25 laboratories);
- Instrumental neutron activation analysis for Au on 1g subsamples to confirm homogeneity (1 laboratory).

For the round robin program twenty 1kg test units were taken at predetermined intervals during the bagging stage, immediately following final blending, and are considered representative of the entire batch. The six samples received by each laboratory were obtained by taking two 100g scoop splits from each of three separate 1kg 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. Tables 1-3 present the certified values together with their associated 1SD's, 95% confidence and tolerance limits and Table 4 shows 99 indicative values for major and trace element composition. Gold homogeneity has been evaluated and confirmed by instrumental neutron activation analysis (INAA) on twenty ~1 gram sample portions (see Table 5) and by a nested ANOVA program for both fire assay and aqua regia digestion (see '**nested ANOVA**' section). Tables 6-8 provide performance gate intervals for the certified values of each method group based on their pooled 1SD's. Tabulated results of all elements (including Au INAA analyses) 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 (**OREAS 501c DataPack.xlsx**).

STATISTICAL ANALYSIS

Certified Values, Confidence Limits, Standard Deviations and Tolerance Limits (Tables 1 to 3) have been determined for each analyte following removal of individual, laboratory dataset (batch) and 3SD outliers (single iteration). For individual outliers within a laboratory batch the z-score test is used in combination with a second method that determines the per cent deviation of the individual value from the batch median. Outliers in general are selected on the basis of z-scores > 2.5 and with per cent deviations (i) > 3 and (ii) more than three times the average absolute per cent deviation for the batch. In certain instances statistician's prerogative has been employed in discriminating outliers. Each laboratory data set mean is tested for outlying status based on z-score discrimination and rejected if > 2.5. After individual and laboratory data set (batch) outliers have been eliminated a non-iterative 3 standard deviation filter is applied, with those values lying outside this window also relegated to outlying status.

Certified Values are the means of accepted laboratory means after outlier filtering. The INAA data (see Table 5) is omitted from determination of the certified value for Au and is used solely for the calculation of Tolerance Limits and homogeneity evaluation of OREAS 501c.

95% Confidence Limits are inversely proportional to the number of participating laboratories and inter-laboratory agreement. It is a measure of the reliability of the certified value. A 95% confidence interval indicates a 95% probability that the true value of the analyte under consideration lies between the upper and lower limits. *95% Confidence Limits should not be used as control limits for laboratory performance.*

Indicative (uncertified) values (Table 4) are provided for the major and trace elements determined by borate fusion XRF (Al_2O_3 to ZrO_2) and laser ablation with ICP-MS (Ag to Zr) 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.

Tables 6-8 show **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.

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 ($\rho=0.95$) will have concentrations lying between 0.270 and 0.281 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).

For gold the tolerance has been determined by INAA using the reduced analytical subsample method which utilises the known relationship between standard deviation and analytical subsample weight (Ingamells and Switzer, 1973). In this approach the sample aliquot is substantially reduced to a point where most of the variability in replicate assays should be due to inhomogeneity of the reference material and measurement error becomes negligible. In this instance a subsample weight of 1 gram was employed and the 1RSD of 0.670% calculated for a 30g fire assay or aqua regia sample (3.58% at 1g weight) confirms the high level of gold homogeneity in OREAS 501c. The homogeneity is of a level such that ***sampling error is minor*** for a conventional fire assay or aqua regia determination. The homogeneity is of a level such that ***sampling error is minor*** for a conventional fire assay or aqua regia determination.

Please note that these RSD's and tolerance limits pertain to the homogeneity of the CRM only and should not be used as control limits for laboratory performance.

Table 5. Neutron Activation Analysis of Au (ppm) on 20 x 1g subsamples.

Replicate No	Au ppm
1	0.217
2	0.221
3	0.219
4	0.207
5	0.225
6	0.228
7	0.231
8	0.228
9	0.212
10	0.215
11	0.230
12	0.217
13	0.212
14	0.236
15	0.215
16	0.215
17	0.214
18	0.222
19	0.231
20	0.217
Mean	0.221
Median	0.218
Std Dev.	0.008
Rel.Std.Dev.	3.58%
PDM[3]	-0.37%

The gold homogeneity of OREAS 501c has also been evaluated in a **nested ANOVA** of the round robin program. Each of the thirty round robin laboratories received six samples per CRM and these samples were made up of paired samples from three different, non-adjacent sampling intervals. The purpose of the ANOVA evaluation is to test that no statistically significant difference exists in the variance between-units to that of the variance within-units. This allows an assessment of homogeneity across the entire prepared batch of OREAS 501c. The test was performed using the following parameters:

- Gold fire assay – 150 samples (26 accepted laboratories each providing analyses on 3 pairs of samples);
- Gold aqua regia digestion – 107 samples (18 accepted laboratories each providing analyses on 3 pairs of samples);
- Null Hypothesis, H_0: Between-unit variance is no greater than within-unit variance (reject H_0 if *p*-value < 0.05);
- Alternative Hypothesis, H_1: Between-unit variance is greater than within-unit variance.

P-values are a measure of probability where values less than 0.05 indicate a greater than 95% probability that the observed differences in within-unit and between-unit variances are real. The dataset was filtered for both individual and laboratory data set (batch) outliers prior to the calculation of the *p*-value. This process derived *p*-values of 0.999 for Au by fire assay

and 0.351 for Au by aqua regia digestion. Both *p*-values are insignificant and the Null Hypothesis is retained. Additionally, none of the other 202 certified values showed significant *p*-values.

It is important to note that ANOVA is not an absolute measure of homogeneity. Rather, it establishes whether or not the analytes are distributed in a similar manner throughout the packaging run of OREAS 501c and whether the variance between two subsamples from the same unit is statistically distinguishable to the variance from two subsamples taken from any two separate units. A reference material therefore, can possess poor absolute homogeneity yet still pass a relative homogeneity test if the within-unit heterogeneity is large and similar across all units.

Based on the statistical analysis of the results of the inter-laboratory certification program it can be concluded that OREAS 501c is fit-for-purpose as a certified reference material (see 'Intended Use' below).

Table 6. Fire Assay - Performance Gates for OREAS 501c.

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
Au, ppm	0.221	0.007	0.208	0.234	0.202	0.241	2.95%	5.89%	8.84%	0.210	0.232

Note: intervals may appear asymmetric due to rounding.

Table 7. 4-Acid Digestion - Performance Gates for OREAS 501c.

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
Ag, ppm	0.461	0.053	0.355	0.567	0.302	0.620	11.49%	22.99%	34.48%	0.438	0.484
Al, wt.%	7.49	0.331	6.82	8.15	6.49	8.48	4.43%	8.85%	13.28%	7.11	7.86
As, ppm	23.9	2.00	19.8	27.9	17.8	29.9	8.39%	16.78%	25.17%	22.7	25.0
Ba, ppm	1044	53	939	1149	886	1202	5.04%	10.08%	15.12%	992	1096
Be, ppm	2.94	0.178	2.58	3.29	2.40	3.47	6.06%	12.11%	18.17%	2.79	3.09
Bi, ppm	0.69	0.041	0.61	0.77	0.57	0.81	5.94%	11.87%	17.81%	0.65	0.72
Ca, wt.%	2.64	0.154	2.33	2.95	2.18	3.10	5.85%	11.69%	17.54%	2.51	2.77
Cd, ppm	0.18	0.03	0.12	0.24	0.09	0.27	16.78%	33.55%	50.33%	0.17	0.19
Ce, ppm	69	5.4	58	79	52	85	7.84%	15.68%	23.52%	65	72
Co, ppm	15.1	0.74	13.6	16.6	12.9	17.3	4.89%	9.78%	14.67%	14.4	15.9
Cr, ppm	80	10	60	100	50	110	12.47%	24.94%	37.42%	76	84
Cs, ppm	11.7	0.63	10.4	12.9	9.8	13.5	5.37%	10.74%	16.11%	11.1	12.2
Cu, wt.%	0.276	0.008	0.259	0.292	0.251	0.300	2.93%	5.86%	8.79%	0.262	0.289
Dy, ppm	4.63	0.451	3.73	5.54	3.28	5.99	9.72%	19.44%	29.17%	4.40	4.87
Er, ppm	2.62	0.235	2.15	3.09	1.92	3.33	8.96%	17.92%	26.89%	2.49	2.75
Fe, wt.%	4.45	0.222	4.00	4.89	3.78	5.11	4.99%	9.99%	14.98%	4.23	4.67

Note: intervals may appear asymmetric due to rounding.

Table 7. 4-Acid Digestion 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
Ga, ppm	19.1	0.84	17.4	20.8	16.5	21.6	4.41%	8.82%	13.22%	18.1	20.0
Gd, ppm	5.04	0.401	4.24	5.84	3.84	6.24	7.95%	15.90%	23.84%	4.79	5.29
Hf, ppm	2.60	0.165	2.27	2.93	2.10	3.09	6.34%	12.69%	19.03%	2.47	2.73
Ho, ppm	0.93	0.038	0.85	1.00	0.81	1.04	4.15%	8.30%	12.45%	0.88	0.97
In, ppm	0.075	0.006	0.064	0.087	0.058	0.093	7.80%	15.61%	23.41%	0.072	0.079
K, wt.%	3.22	0.198	2.83	3.62	2.63	3.82	6.13%	12.25%	18.38%	3.06	3.39
La, ppm	35.2	2.49	30.2	40.1	27.7	42.6	7.09%	14.19%	21.28%	33.4	36.9
Li, ppm	33.8	2.00	29.8	37.8	27.8	39.8	5.92%	11.84%	17.76%	32.1	35.5
Lu, ppm	0.36	0.036	0.29	0.43	0.25	0.47	9.91%	19.82%	29.74%	0.34	0.38
Mg, wt.%	1.51	0.091	1.32	1.69	1.23	1.78	6.04%	12.08%	18.12%	1.43	1.58
Mn, wt.%	0.055	0.003	0.048	0.061	0.045	0.064	5.76%	11.53%	17.29%	0.052	0.058
Mo, ppm	97	3.0	91	103	88	106	3.06%	6.12%	9.18%	92	102
Na, wt.%	2.02	0.094	1.83	2.21	1.74	2.30	4.65%	9.30%	13.94%	1.92	2.12
Nb, ppm	18.4	1.77	14.8	21.9	13.0	23.7	9.64%	19.27%	28.91%	17.4	19.3
Nd, ppm	30.0	3.3	23.4	36.6	20.1	39.9	11.04%	22.07%	33.11%	28.5	31.5
Ni, ppm	60	3.6	53	67	49	71	6.06%	12.11%	18.17%	57	63
P, wt.%	0.101	0.005	0.090	0.111	0.085	0.116	5.09%	10.17%	15.26%	0.096	0.106
Pb, ppm	21.5	1.42	18.6	24.3	17.2	25.7	6.63%	13.26%	19.88%	20.4	22.5
Pr, ppm	7.91	0.749	6.41	9.41	5.67	10.16	9.47%	18.94%	28.41%	7.52	8.31
Rb, ppm	196	13	170	223	156	237	6.85%	13.69%	20.54%	187	206
S, wt.%	0.347	0.017	0.312	0.381	0.295	0.399	4.97%	9.94%	14.90%	0.330	0.364
Sb, ppm	2.27	0.163	1.94	2.59	1.78	2.75	7.20%	14.41%	21.61%	2.15	2.38
Sc, ppm	12.9	1.4	10.1	15.8	8.7	17.2	10.97%	21.93%	32.90%	12.3	13.6
Se, ppm	2.07	0.56	0.94	3.19	0.37	3.76	27.28%	54.57%	81.85%	1.96	2.17
Sm, ppm	5.74	0.499	4.74	6.73	4.24	7.23	8.70%	17.40%	26.10%	5.45	6.02
Sn, ppm	3.38	0.207	2.97	3.80	2.76	4.00	6.12%	12.23%	18.35%	3.21	3.55
Sr, ppm	322	17	289	355	272	372	5.16%	10.33%	15.49%	306	338
Ta, ppm	1.32	0.128	1.06	1.57	0.93	1.70	9.69%	19.39%	29.08%	1.25	1.38
Tb, ppm	0.80	0.061	0.68	0.92	0.62	0.98	7.65%	15.30%	22.95%	0.76	0.84
Te, ppm	0.25	0.021	0.21	0.29	0.19	0.31	8.33%	16.67%	25.00%	0.24	0.26
Th, ppm	18.9	1.79	15.3	22.5	13.5	24.3	9.49%	18.99%	28.48%	17.9	19.8
Ti, wt.%	0.480	0.024	0.432	0.528	0.408	0.552	5.01%	10.02%	15.03%	0.456	0.504

Note: intervals may appear asymmetric due to rounding.

Table 7. 4-Acid Digestion 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
Tl, ppm	0.97	0.055	0.86	1.08	0.81	1.14	5.70%	11.39%	17.09%	0.92	1.02
Tm, ppm	0.36	0.024	0.31	0.41	0.29	0.43	6.61%	13.21%	19.82%	0.34	0.38
U, ppm	5.13	0.54	4.04	6.22	3.50	6.76	10.60%	21.21%	31.81%	4.87	5.39
V, ppm	120	8	104	135	96	143	6.55%	13.11%	19.66%	114	126
W, ppm	4.48	0.349	3.78	5.18	3.43	5.52	7.79%	15.58%	23.37%	4.25	4.70
Y, ppm	24.9	1.39	22.2	27.7	20.8	29.1	5.57%	11.15%	16.72%	23.7	26.2
Yb, ppm	2.42	0.25	1.92	2.92	1.67	3.17	10.35%	20.69%	31.04%	2.30	2.54
Zn, ppm	81	4.7	72	91	67	95	5.86%	11.71%	17.57%	77	85
Zr, ppm	81	7.5	66	96	58	103	9.34%	18.67%	28.01%	77	85

Note: intervals may appear asymmetric due to rounding.

Table 8. Aqua Regia Digestion - Performance Gates for OREAS 501c.

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
Ag, ppm	0.444	0.027	0.390	0.498	0.363	0.525	6.09%	12.18%	18.27%	0.422	0.466
Al, wt.%	2.17	0.116	1.93	2.40	1.82	2.51	5.35%	10.70%	16.05%	2.06	2.27
As, ppm	24.3	1.54	21.2	27.3	19.6	28.9	6.34%	12.68%	19.02%	23.0	25.5
Au, ppm	0.214	0.009	0.196	0.232	0.186	0.241	4.28%	8.57%	12.85%	0.203	0.225
Ba, ppm	428	20	387	469	367	489	4.77%	9.54%	14.32%	407	450
Be, ppm	0.59	0.08	0.43	0.75	0.34	0.83	13.89%	27.78%	41.66%	0.56	0.62
Bi, ppm	0.70	0.042	0.61	0.78	0.57	0.83	6.07%	12.14%	18.21%	0.66	0.73
Ca, wt.%	1.02	0.085	0.85	1.19	0.77	1.28	8.31%	16.61%	24.92%	0.97	1.08
Ce, ppm	64	4.7	54	73	50	78	7.34%	14.69%	22.03%	60	67
Co, ppm	14.2	0.60	13.0	15.4	12.4	16.0	4.22%	8.45%	12.67%	13.5	14.9
Cr, ppm	68	2.7	62	73	60	76	3.92%	7.85%	11.77%	64	71
Cs, ppm	9.88	0.560	8.76	11.00	8.20	11.56	5.67%	11.34%	17.01%	9.39	10.38
Cu, wt.%	0.275	0.006	0.263	0.286	0.257	0.292	2.09%	4.17%	6.26%	0.261	0.288
Dy, ppm	3.31	0.249	2.81	3.81	2.57	4.06	7.52%	15.03%	22.55%	3.15	3.48
Er, ppm	1.74	0.24	1.26	2.22	1.02	2.46	13.79%	27.57%	41.36%	1.65	1.83
Fe, wt.%	4.10	0.247	3.61	4.60	3.36	4.84	6.02%	12.04%	18.05%	3.90	4.31
Ga, ppm	8.56	0.94	6.67	10.44	5.73	11.38	11.01%	22.02%	33.02%	8.13	8.99
Gd, ppm	4.02	0.381	3.26	4.78	2.88	5.16	9.48%	18.95%	28.43%	3.82	4.22
Hf, ppm	0.40	0.038	0.32	0.48	0.29	0.51	9.47%	18.93%	28.40%	0.38	0.42

Note: intervals may appear asymmetric due to rounding.

Table 8. Aqua Regia Digestion 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
Ho, ppm	0.62	0.08	0.46	0.79	0.38	0.87	13.22%	26.44%	39.65%	0.59	0.66
In, ppm	0.047	0.005	0.037	0.058	0.031	0.063	11.14%	22.29%	33.43%	0.045	0.050
K, wt.%	1.17	0.069	1.03	1.30	0.96	1.37	5.90%	11.80%	17.70%	1.11	1.22
La, ppm	31.9	2.36	27.2	36.7	24.8	39.0	7.40%	14.81%	22.21%	30.3	33.5
Li, ppm	33.1	1.06	31.0	35.2	29.9	36.2	3.20%	6.40%	9.60%	31.4	34.7
Mg, wt.%	1.22	0.055	1.11	1.34	1.06	1.39	4.51%	9.02%	13.54%	1.16	1.29
Mn, wt.%	0.039	0.001	0.036	0.042	0.035	0.043	3.68%	7.35%	11.03%	0.037	0.041
Mo, ppm	95	4.5	86	104	82	108	4.71%	9.42%	14.13%	90	100
Na, wt.%	0.202	0.017	0.168	0.235	0.152	0.252	8.31%	16.63%	24.94%	0.192	0.212
Ni, ppm	58	3.0	52	64	49	67	5.22%	10.44%	15.66%	55	61
P, wt.%	0.096	0.004	0.088	0.104	0.084	0.108	4.28%	8.56%	12.84%	0.091	0.101
Pb, ppm	8.43	0.482	7.47	9.40	6.99	9.88	5.71%	11.42%	17.13%	8.01	8.86
Pr, ppm	6.88	0.599	5.68	8.08	5.08	8.68	8.71%	17.42%	26.14%	6.53	7.22
Rb, ppm	134	6	122	147	116	153	4.54%	9.08%	13.62%	128	141
S, wt.%	0.343	0.020	0.303	0.382	0.284	0.401	5.71%	11.41%	17.12%	0.325	0.360
Sb, ppm	1.59	0.25	1.10	2.09	0.86	2.33	15.41%	30.81%	46.22%	1.52	1.67
Sc, ppm	7.36	0.623	6.12	8.61	5.49	9.23	8.46%	16.93%	25.39%	7.00	7.73
Sm, ppm	4.38	0.49	3.40	5.35	2.91	5.84	11.17%	22.34%	33.51%	4.16	4.59
Sn, ppm	2.70	0.28	2.14	3.26	1.86	3.54	10.38%	20.76%	31.13%	2.56	2.83
Sr, ppm	65	9	46	83	37	93	14.27%	28.55%	42.82%	62	68
Th, ppm	19.3	1.10	17.1	21.5	16.0	22.6	5.71%	11.41%	17.12%	18.3	20.3
Ti, wt.%	0.363	0.017	0.330	0.397	0.313	0.413	4.60%	9.19%	13.79%	0.345	0.381
Tl, ppm	0.73	0.061	0.61	0.85	0.55	0.91	8.29%	16.57%	24.86%	0.70	0.77
U, ppm	4.87	0.261	4.35	5.40	4.09	5.66	5.36%	10.73%	16.09%	4.63	5.12
V, ppm	110	4	103	118	99	122	3.46%	6.92%	10.39%	105	116
W, ppm	2.96	0.44	2.08	3.83	1.64	4.27	14.87%	29.74%	44.61%	2.81	3.10
Zn, ppm	74	3.8	66	81	62	85	5.22%	10.43%	15.65%	70	77
Zr, ppm	9.34	0.577	8.19	10.50	7.61	11.07	6.17%	12.34%	18.51%	8.88	9.81

Note: intervals may appear asymmetric due to rounding.

PREPARER AND SUPPLIER

Certified reference material OREAS 501c is prepared, certified and supplied by:

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It is available in unit sizes of 10g and 60g (single-use laminated foil pouches) and 1kg (plastic jars).

PARTICIPATING LABORATORIES

1. Actlabs, Ancaster, Ontario, Canada
2. Actlabs, Coquimbo, Curarta, Chile
3. Actlabs, Kamloops, BC, Canada
4. AGQ Labs, Santiago, Chile
5. Alex Stewart International, Mendoza, Argentina
6. ALS, Brisbane, QLD, Australia
7. ALS, Lima, Peru
8. ALS, Loughrea, Galway, Ireland
9. ALS, Perth, WA, Australia
10. ALS, Vancouver, BC, Canada
11. American Assay Laboratories, Sparks, Nevada, USA
12. Bureau Veritas Commodities Canada Ltd, Vancouver, BC, Canada
13. Bureau Veritas Geoanalytical, Adelaide, SA, Australia
14. Bureau Veritas Geoanalytical, Perth, WA, Australia
15. Inspectorate (BV), Lima, Peru
16. Inspectorate (BV), Shanghai, Bao Shan District, China
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20. MinAnalytical Services, Perth, WA, Australia
21. Newcrest Laboratory Services, Orange, NSW, Australia
22. PT Geoservices Ltd, Cikarang, Jakarta Raya, Indonesia
23. PT Intertek Utama Services, Jakarta Timur, DKI Jakarta, Indonesia
24. SGS, Ankara, Turkey
25. SGS Australia Mineral Services, Perth, WA, Australia
26. SGS Canada Inc., Vancouver, BC, Canada
27. SGS del Peru, Lima, Peru
28. SGS Mineral Services, Townsville, QLD, Australia
29. SGS Mongolia, Ulan Bator, Mongolia
30. Shiva Analyticals Ltd, Bangalore North, Karnataka, India
31. Zarazma Mineral Studies Company, Tehran, Iran

INTENDED USE

OREAS 501c is intended for the following uses:

- for the monitoring of laboratory performance in the analysis of analytes reported in Tables 1-3 in geological samples;
- for the verification of analytical methods for analytes reported in Tables 1-3;
- for the calibration of instruments used in the determination of the concentration of analytes reported in Tables 1-3.

STABILITY AND STORAGE INSTRUCTIONS

OREAS 501c has been prepared from a blend of porphyry copper-gold ore, barren granodiorite and a minor quantity of Cu-Mo concentrate. It is low in reactive sulphide (S = 0.347 wt,%). 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 CORRECT USE

The certified values of OREAS 501c 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.

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) 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.

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.

QMS ACCREDITED

ORE Pty Ltd is accredited to ISO 9001:2008 by Lloyd's Register Quality Assurance Ltd for its quality management system including development, manufacturing, certification and supply of CRMs.

CERTIFYING OFFICER

22nd June, 2017

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

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