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CERTIFICATE OF ANALYSIS FOR

High Sulphidation Epithermal Ag-Cu-Au Ore

(Mt Carlton, Queensland, Australia)

CERTIFIED REFERENCE MATERIAL

OREAS 603b

Summary Statistics for Key Analytes.

Constituent	Certified Value	1SD	95% Confidence Limits		95% Tolerance Limits	
			Low	High	Low	High
Pb Fire Assay						
Ag, Silver (ppm)	297	8	293	301	292	303
Au, Gold (ppm)	5.21	0.209	5.12	5.29	5.19*	5.22*
4-Acid Digestion						
Ag, Silver (ppm)	301	10	296	305	296	306
Cu, Copper (wt.%)	0.973	0.023	0.963	0.983	0.963	0.983

SI unit equivalents: ppm, parts per million ≡ mg/kg ≡ µg/g ≡ 0.0001 wt.% ≡ 1000 ppb, parts per billion.
*Gold Tolerance Limits for typical 25-50g fire assay method is determined from 20 x 85mg INAA results and the Sampling Constant (Ingamells & Switzer, 1973).
Note 1: intervals may appear asymmetric due to rounding.
Note 2: the number of decimal places quoted does not imply accuracy of the certified value to this level but are given to minimise rounding errors when calculating 2SD and 3SD windows.

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Constituent	Certified Value	SD	95% Confidence Limits		95% Tolerance Limits	
			Low	High	Low	High
Pb Fire Assay						
Ag, Silver (ppm)	297	8	293	301	292	303
Au, Gold (ppm)	5.21	0.209	5.12	5.29	5.19*	5.22*
Aqua Regia Digestion (sample weights 10-50g)						
Au, Gold (ppm)	5.19	0.297	4.97	5.40	5.17*	5.20*
Infrared Combustion						
S, Sulphur (wt.%)	4.57	0.136	4.51	4.63	4.50	4.65
4-Acid Digestion						
Ag, Silver (ppm)	301	10	296	305	296	306
Al, Aluminium (wt.%)	6.48	0.286	6.36	6.61	6.38	6.59
As, Arsenic (ppm)	2433	101	2383	2483	2380	2485
Be, Beryllium (ppm)	1.57	0.21	1.46	1.67	1.46	1.67
Bi, Bismuth (ppm)	154	10	150	159	151	158
Ca, Calcium (wt.%)	0.618	0.027	0.607	0.630	0.607	0.630
Cd, Cadmium (ppm)	12.3	0.81	12.0	12.7	12.0	12.7
Ce, Cerium (ppm)	47.9	3.76	45.6	50.3	46.7	49.2
Co, Cobalt (ppm)	9.38	0.768	9.01	9.76	9.13	9.63
Cr, Chromium (ppm)	26.2	4.3	24.2	28.1	24.9	27.5
Cs, Cesium (ppm)	3.41	0.203	3.31	3.52	3.30	3.52
Cu, Copper (wt.%)	0.973	0.023	0.963	0.983	0.963	0.983
Dy, Dysprosium (ppm)	1.95	0.118	1.84	2.06	1.80	2.10
Er, Erbium (ppm)	0.71	0.08	0.64	0.77	IND	IND
Eu, Europium (ppm)	0.80	0.12	0.68	0.93	IND	IND
Fe, Iron (wt.%)	3.67	0.120	3.62	3.72	3.61	3.74
Ga, Gallium (ppm)	27.2	1.90	26.3	28.1	26.3	28.0
Gd, Gadolinium (ppm)	3.09	0.197	2.87	3.30	2.86	3.31
Ge, Germanium (ppm)	0.21	0.04	0.16	0.25	0.19	0.22
Hf, Hafnium (ppm)	4.17	0.279	4.02	4.32	4.01	4.33
Ho, Holmium (ppm)	0.29	0.016	0.27	0.30	IND	IND
In, Indium (ppm)	3.61	0.186	3.52	3.70	3.49	3.72
K, Potassium (wt.%)	1.96	0.049	1.94	1.98	1.93	1.99
La, Lanthanum (ppm)	22.1	3.9	20.0	24.3	21.3	23.0
Li, Lithium (ppm)	22.4	1.68	21.7	23.2	21.7	23.2
Lu, Lutetium (ppb)	67.2	9.4	53.0	81.3	IND	IND
Mg, Magnesium (ppm)	730	61	706	754	710	750
Mn, Manganese (ppm)	162	11	157	167	158	165

SI unit equivalents: ppm, parts per million ≡ mg/kg ≡ µg/g ≡ 0.0001 wt.% ≡ 1000 ppb, parts per billion.
*Gold Tolerance Limits for typical 25-50g fire assay and 15-40g aqua regia digestion methods are determined from 20 x 85mg INAA results and the Sampling Constant (Ingamells & Switzer, 1973).
Note 1: intervals may appear asymmetric due to rounding.
Note 2: the number of decimal places quoted does not imply accuracy of the certified value to this level but are given to minimise rounding errors when calculating 2SD and 3SD windows.

Table 1 continued.

Constituent	Certified Value	SD	95% Confidence Limits		95% Tolerance Limits	
			Low	High	Low	High
4-Acid Digestion continued						
Mo, Molybdenum (ppm)	10.0	0.66	9.7	10.3	9.6	10.4
Na, Sodium (wt.%)	1.38	0.064	1.36	1.41	1.36	1.41
Nb, Niobium (ppm)	11.1	0.71	10.7	11.4	10.7	11.4
Nd, Neodymium (ppm)	22.3	2.10	20.0	24.5	21.0	23.5
Ni, Nickel (ppm)	11.9	1.18	11.3	12.5	11.1	12.7
P, Phosphorus (ppm)	386	28	373	400	373	399
Pb, Lead (ppm)	862	49	841	883	848	876
Pr, Praseodymium (ppm)	6.06	0.73	5.27	6.85	5.64	6.47
Rb, Rubidium (ppm)	70	3.9	68	72	69	72
S, Sulphur (wt.%)	4.54	0.177	4.46	4.62	4.46	4.62
Sb, Antimony (ppm)	307	17	299	314	299	314
Sc, Scandium (ppm)	4.10	0.342	3.92	4.29	3.93	4.28
Se, Selenium (ppm)	41.1	3.65	39.3	42.9	39.4	42.9
Sm, Samarium (ppm)	4.21	0.375	3.82	4.59	3.86	4.55
Sn, Tin (ppm)	14.4	0.98	14.0	14.9	13.9	15.0
Sr, Strontium (ppm)	323	29	309	336	316	330
Ta, Tantalum (ppm)	0.88	0.056	0.84	0.92	0.85	0.92
Tb, Terbium (ppm)	0.41	0.06	0.38	0.44	0.38	0.45
Te, Tellurium (ppm)	36.5	3.18	35.0	38.1	35.5	37.5
Th, Thorium (ppm)	8.87	1.47	8.08	9.66	8.51	9.23
Ti, Titanium (wt.%)	0.150	0.008	0.146	0.153	0.146	0.153
Tl, Thallium (ppm)	5.52	0.468	5.28	5.75	5.37	5.66
U, Uranium (ppm)	3.82	0.288	3.67	3.97	3.67	3.96
V, Vanadium (ppm)	25.9	1.35	25.3	26.5	25.0	26.9
W, Tungsten (ppm)	12.8	0.70	12.5	13.2	12.3	13.3
Y, Yttrium (ppm)	8.57	0.486	8.36	8.78	8.34	8.81
Yb, Ytterbium (ppm)	0.51	0.08	0.41	0.61	0.46	0.57
Zn, Zinc (wt.%)	0.201	0.005	0.200	0.203	0.198	0.205
Zr, Zirconium (ppm)	146	8	143	150	143	150
Aqua Regia Digestion						
Ag, Silver (ppm)	300	9	296	305	295	305
Al, Aluminium (wt.%)	0.758	0.042	0.738	0.778	0.735	0.781
As, Arsenic (ppm)	2411	128	2355	2468	2359	2464
Be, Beryllium (ppm)	0.31	0.024	0.30	0.32	0.29	0.33
Bi, Bismuth (ppm)	156	7	153	160	153	160
Ca, Calcium (wt.%)	0.396	0.021	0.387	0.405	0.386	0.406

SI unit equivalents: ppm, parts per million ≡ mg/kg ≡ µg/g ≡ 0.0001 wt.% ≡ 1000 ppb, parts per billion.
Note 1: intervals may appear asymmetric due to rounding.
Note 2: the number of decimal places quoted does not imply accuracy of the certified value to this level but are given to minimise rounding errors when calculating 2SD and 3SD windows.

Table 1 continued.

Constituent	Certified Value	SD	95% Confidence Limits		95% Tolerance Limits	
			Low	High	Low	High
Aqua Regia Digestion continued						
Cd, Cadmium (ppm)	12.4	0.79	12.0	12.8	12.2	12.7
Ce, Cerium (ppm)	27.2	1.07	26.6	27.9	26.5	28.0
Co, Cobalt (ppm)	9.05	0.402	8.85	9.24	8.80	9.29
Cr, Chromium (ppm)	26.1	2.7	24.9	27.4	25.2	27.0
Cs, Cesium (ppm)	0.79	0.030	0.78	0.81	0.77	0.82
Cu, Copper (wt.%)	0.985	0.015	0.979	0.990	0.974	0.995
Fe, Iron (wt.%)	3.47	0.177	3.39	3.55	3.41	3.52
Ga, Gallium (ppm)	6.27	0.509	5.99	6.56	6.07	6.48
Ge, Germanium (ppm)	0.19	0.05	0.15	0.24	0.16	0.23
Hf, Hafnium (ppm)	0.90	0.085	0.85	0.95	0.86	0.94
Hg, Mercury (ppm)	1.14	0.075	1.09	1.18	1.10	1.17
In, Indium (ppm)	3.53	0.144	3.46	3.61	3.43	3.64
K, Potassium (wt.%)	0.211	0.012	0.206	0.216	0.204	0.218
La, Lanthanum (ppm)	12.9	0.87	12.5	13.3	12.5	13.4
Li, Lithium (ppm)	6.73	0.75	6.33	7.13	6.46	7.01
Mg, Magnesium (ppm)	304	13	297	312	295	313
Mn, Manganese (ppm)	142	8	139	146	139	146
Mo, Molybdenum (ppm)	9.63	0.333	9.48	9.78	9.29	9.96
Na, Sodium (wt.%)	0.053	0.007	0.050	0.057	0.051	0.055
Ni, Nickel (ppm)	11.4	0.92	10.9	11.8	10.9	11.8
P, Phosphorus (ppm)	146	10	141	151	138	154
Pb, Lead (ppm)	634	33	619	649	624	644
Rb, Rubidium (ppm)	8.58	0.849	8.08	9.09	8.33	8.84
Re, Rhenium (ppb)	3.76	0.64	3.54	3.98	IND	IND
S, Sulphur (wt.%)	3.50	0.166	3.42	3.58	3.44	3.57
Sb, Antimony (ppm)	259	26	248	271	252	267
Sc, Scandium (ppm)	1.00	0.11	0.95	1.06	0.93	1.08
Se, Selenium (ppm)	41.0	2.79	39.4	42.6	39.8	42.1
Sn, Tin (ppm)	12.9	0.57	12.6	13.2	12.5	13.3
Sr, Strontium (ppm)	40.5	5.1	38.1	43.0	39.4	41.7
Tb, Terbium (ppm)	0.23	0.04	0.18	0.28	0.21	0.25
Te, Tellurium (ppm)	38.5	1.48	37.8	39.3	37.4	39.7
Th, Thorium (ppm)	4.74	0.58	4.40	5.08	4.56	4.92
Ti, Titanium (ppm)	149	12	141	157	144	154
Tl, Thallium (ppm)	5.33	0.317	5.15	5.50	5.17	5.48
U, Uranium (ppm)	1.71	0.138	1.63	1.79	1.65	1.76

SI unit equivalents: ppm, parts per million ≡ mg/kg ≡ µg/g ≡ 0.0001 wt.% ≡ 1000 ppb, parts per billion.
Note 1: intervals may appear asymmetric due to rounding.
Note 2: the number of decimal places quoted does not imply accuracy of the certified value to this level but are given to minimise rounding errors when calculating 2SD and 3SD windows.

Table 1 continued.

Constituent	Certified Value	SD	95% Confidence Limits		95% Tolerance Limits	
			Low	High	Low	High
Aqua Regia Digestion continued						
V, Vanadium (ppm)	8.78	0.853	8.39	9.17	8.25	9.31
W, Tungsten (ppm)	4.56	0.288	4.40	4.72	4.40	4.72
Y, Yttrium (ppm)	3.96	0.381	3.77	4.15	3.85	4.07
Yb, Ytterbium (ppm)	0.17	0.03	0.15	0.20	IND	IND
Zn, Zinc (wt.%)	0.199	0.007	0.196	0.202	0.195	0.202
Zr, Zirconium (ppm)	30.0	5.7	27.4	32.5	29.0	31.0

SI unit equivalents: ppm, parts per million ≡ mg/kg ≡ µg/g ≡ 0.0001 wt.% ≡ 1000 ppb, parts per billion.
Note 1: intervals may appear asymmetric due to rounding.
Note 2: the number of decimal places quoted does not imply accuracy of the certified value to this level but are given to minimise rounding errors when calculating 2SD and 3SD windows.

Table 2. Indicative Values for OREAS 603b.

Constituent	Unit	Value	Constituent	Unit	Value	Constituent	Unit	Value
Pb Fire Assay								
Pd	ppb	*< 3*	Pt	ppb	*< 5*			
Infrared Combustion								
C	wt.%	*0.106*						
4-Acid Digestion								
Au	ppm	*5.43*	Pd	ppb	*< 50*	Ru	ppb	*< 10*
Ba	ppm	*408*	Pt	ppb	*< 10*	Tm	ppb	*80.6*
Hg	ppm	*< 2*	Re	ppb	*4.04*			
Ir	ppb	*< 5*	Rh	ppb	*20.0*			
Aqua Regia Digestion								
B	ppm	*< 10*	Ir	ppb	*< 5*	Rh	ppb	*24.2*
Ba	ppm	*50*	Lu	ppb	*25.4*	Ru	ppb	*< 10*
Dy	ppm	*0.94*	Nb	ppm	*0.84*	Sm	ppm	*2.16*
Er	ppm	*0.25*	Nd	ppm	*11.7*	Ta	ppm	*< 0.01*
Eu	ppm	*0.37*	Pd	ppb	*< 10*	Tm	ppb	*30.0*
Gd	ppm	*1.53*	Pr	ppm	*3.28*			
Ho	ppm	*0.13*	Pt	ppb	*< 5*			
Borate Fusion XRF								
Al_2O_3	wt.%	*12.62*	MgO	wt.%	*0.120*	SiO_2	wt.%	*65.30*
CaO	wt.%	*0.860*	MnO	wt.%	*0.020*	SO_3	wt.%	*11.20*
Fe_2O_3	wt.%	*5.32*	Na_2O	wt.%	*1.89*	TiO_2	wt.%	*0.240*
K_2O	wt.%	*2.39*	P_2O_5	wt.%	*0.091*			
Thermogravimetry								
H_2O-	wt.%	*0.565*	LOI^{1000}	wt.%	*8.53*			
Laser Ablation ICP-MS								
Ag	ppm	*312*	Hf	ppm	*4.92*	Sm	ppm	*4.19*
As	ppm	*2440*	Ho	ppm	*0.33*	Sn	ppm	*15.0*
Ba	ppm	*6260*	In	ppm	*3.38*	Sr	ppm	*368*
Be	ppm	*1.70*	La	ppm	*30.8*	Ta	ppm	*0.93*

SI unit equivalents: ppm, parts per million ≡ mg/kg ≡ µg/g ≡ 0.0001 wt.% ≡ 1000 ppb, parts per billion.
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 2 continued.

Constituent	Unit	Value	Constituent	Unit	Value	Constituent	Unit	Value
Laser Ablation ICP-MS continued								
Bi	ppm	*163*	Lu	ppb	*80.0*	Tb	ppm	*0.45*
Cd	ppm	*14.8*	Mn	ppm	*169*	Te	ppm	*40.6*
Ce	ppm	*57*	Mo	ppm	*10.6*	Th	ppm	*10.4*
Co	ppm	*9.50*	Nb	ppm	*11.8*	Ti	wt.%	*0.155*
Cr	ppm	*35.5*	Nd	ppm	*23.0*	Tl	ppm	*6.30*
Cs	ppm	*3.42*	Ni	ppm	*16.0*	Tm	ppb	*95.0*
Cu	wt.%	*0.939*	Pb	ppm	*902*	U	ppm	*3.99*
Dy	ppm	*2.01*	Pr	ppm	*6.45*	V	ppm	*26.2*
Er	ppm	*0.75*	Rb	ppm	*70*	W	ppm	*13.0*
Eu	ppm	*0.74*	Re	ppb	*40.0*	Y	ppm	*9.31*
Ga	ppm	*26.8*	Sb	ppm	*342*	Yb	ppm	*0.58*
Gd	ppm	*3.03*	Sc	ppm	*6.30*	Zn	wt.%	*0.191*
Ge	ppm	*4.65*	Se	ppm	*< 5*	Zr	ppm	*183*

SI unit equivalents: ppm, parts per million ≡ mg/kg ≡ µg/g ≡ 0.0001 wt.% ≡ 1000 ppb, parts per billion.
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.

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 MATERIAL

OREAS 603b was prepared from a blend of silver-copper-gold bearing ores from Evolution Mining's Mount Carlton Operation in Queensland, Australia and argillic rhyodacite waste rock sourced from a quarry east of Melbourne, Australia. Small quantities of copper concentrate (Sepon, Laos) and copper-gold concentrate (Mount Carlton) were added to help achieve the desired copper and gold grades.

The mineralisation assemblage at Mount Carlton consists of pyrite, enargite/tennantite, tetrahedrite, digenite, covellite, sphalerite, galena, alunite, dickite, kaolinite and vuggy silica, hosted in advanced argillic altered rhyodacite containing sulphur-salts.

OREAS 603b is one of a suite of six CRMs developed from Mount Carlton ores ranging in grades from 25 -1015ppm Ag, 0.2 -1.7ppm Au and 0.05 - 5.0% Cu.

COMMINUTION AND HOMOGENISATION PROCEDURES

The material constituting OREAS 603b was prepared in the following manner:

- Drying of ore materials (sulphide-rich) to constant mass at 85°C;
- Drying of rhyodacite waste rock to constant mass at 105°C;
- Crushing and milling of the ore materials to 100% minus 30 microns;
- Crushing and milling of the rhyodacite waste rock to 98% minus 75 microns;
- Blending in appropriate proportions to achieve the desired grades;
- Packaging under nitrogen in 10g and 60g units in laminated foil pouches.

PHYSICAL PROPERTIES

OREAS 603b was tested at ORE Research & Exploration Pty Ltd's onsite laboratory for various physical properties. Table 3 presents these findings which should be used for informational purposes only.

Table 3. Physical properties of OREAS 603b.

CRM Name	Bulk Density (g/L)	Moisture%	Munsell Notation‡	Munsell Color‡
OREAS 603b	637	0.81	N6	Medium Light Gray

‡The Munsell Rock Color Chart helps geologists and archeologists communicate with color more effectively by cross-referencing ISCC-NBS color names with unique Munsell alpha-numeric color notations for rock color samples.

ANALYTICAL PROGRAM

Twenty seven commercial analytical laboratories participated in the program to certify the elements reported in Table 1. The following methods were employed:

- Silver via 30-50g fire assay with gravimetric finish (15 laboratories);
- Gold via 25-50g fire assay with AAS finish (14 laboratories) and ICP-OES (10 laboratories) finish;
- Gold via 10-40g aqua regia digestion with ICP-MS finish (9 laboratories) and AAS (3 laboratories) finish;
- Sulphur by infra-red combustion analysis (19 laboratories);
- 4-Acid digestion for full elemental suite ICP-OES/MS finish (up to 22 laboratories depending on the element).
- Aqua regia digestion for full elemental suite ICP-OES finish (up to 22 laboratories depending on the element) and AAS finish (1 laboratory);
- Gold by instrumental neutron activation analysis (INAA) on 20 x 85mg subsamples to confirm homogeneity (ANSTO, Lucas Heights).

It is important to note that in the analytical industry there is no standardisation of the aqua regia digestion process. Aqua regia is a partial empirical digest and differences in recoveries for various analytes are commonplace. These are caused by variations in the digest conditions which can include the ratio of nitric to hydrochloric acids, acid strength, temperatures, leach times and secondary digestions. Recoveries for sulphide-hosted base metal sulphides approach total values, however, other analytes, in particular the lithophile elements, show greater sensitivity to method parameters. This can result in lack of consensus in an inter-laboratory certification program for these elements.

The approach applied here is to report certified values in those instances where reasonable agreement exists amongst a majority of participating laboratories. The results of specific laboratories may differ significantly from the certified values, but will, nonetheless, be valid and reproducible in the context of the specifics of the aqua regia method in use. Users of this reference material should, therefore, be mindful of this limitation when applying the certified values in a quality control program.

For the round robin program twenty 1kg test units were taken at predetermined intervals during the bagging stage, immediately following homogenisation and are considered representative of the entire prepared batch. Six 100g pulp samples were submitted to each laboratory for analysis received by each laboratory were obtained by taking two 100g samples 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.

Table 1 presents the 109 certified values together with their associated 1SD's, 95% confidence and tolerance limits, Table 2 shows 96 indicative values for major and trace element composition. Gold homogeneity has been evaluated and confirmed by instrumental neutron activation analysis (INAA) on twenty ~85mg sample portions (see Table 4 below) and by a nested ANOVA program for both fire assay and aqua regia digestion (see '**nested ANOVA**' section).

Table 5 provides performance gate intervals for the certified values based on their pooled 1SD's. Tabulated results of all elements together with uncorrected means, medians, standard deviations, relative standard deviations and per cent deviation of lab means from the corrected mean of means (PDM[3]) are presented in the detailed certification data for this CRM (**OREAS 603b DataPack-1.0.190219_135653.xlsx**).

Results are also presented in scatter plots for gold by fire assay, silver by 4-acid digestion and copper by 4-acid digestion (Figures 1 to 3, respectively) together with ±3SD (magenta) and ±5% (yellow) control lines and certified value (green line). Accepted individual results are coloured blue and individual and dataset outliers are identified in red and violet, respectively.

STATISTICAL ANALYSIS

Certified Values, Confidence Limits, Standard Deviations and Tolerance Limits (Table 1) 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 4) 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 603b.

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 2) are provided for the major and trace elements determined by borate fusion XRF (Al_2O_3 to TiO_2), laser ablation with ICP-MS (Ag to Zr), LOI at 1000°C and C by infrared combustion furnace 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. They 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.**

In the application of SD's in monitoring performance it is important to note that not all laboratories function at the same level of proficiency and that different methods in use at a particular laboratory have differing levels of precision. Each laboratory has its own inherent SD (for a specific concentration level and analyte-method pair) based on the analytical process and this SD is not directly related to the round robin program.

The majority of data generated in the round robin program was produced by a selection of world class laboratories. The SD's thus generated are more constrained than those that would be produced across a randomly selected group of laboratories. To produce more generally achievable SD's the 'pooled' SD's provided in this report include inter-lab bias. This 'one size fits all' approach may require revision at the discretion of the QC manager concerned following careful scrutiny of QC control charts.

Homogeneity Evaluation

The tolerance limits (ISO 16269:2014) shown in Table 1 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 0.963 and 0.983 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). ***Please note that tolerance limits pertain to the homogeneity of the CRM only and should not be used as control limits for laboratory performance.***

Table 4 below shows the INAA data determined on 20 x 85mg subsamples of OREAS 603b. An equivalent scaled version of the results is also provided to demonstrate an appreciation of what this data means if 30g fire assay determinations were undertaken without the normal measurement error associated with this methodology.

Table 4. Neutron Activation Analysis of Au (in ppm) on 20 x 85mg subsamples showing the equivalent results scaled to a 30g sample mass typical of fire assay determination.

Replicate No	Au 85mg actual	Au 30g equivalent*
1	5.430	5.420
2	5.368	5.417
3	5.508	5.424
4	5.276	5.412
5	5.473	5.422
6	5.456	5.422
7	5.400	5.419
8	5.525	5.425
9	5.581	5.428
10	5.412	5.419
11	5.480	5.423
12	5.388	5.418
13	5.353	5.416
14	5.409	5.419
15	5.522	5.425
16	5.348	5.416
17	5.230	5.410
18	5.343	5.416
19	5.454	5.422
20	5.437	5.421
Mean	5.420	5.420
Median	5.421	5.420
Std Dev.	0.086	0.005
Rel.Std.Dev.	1.591%	0.085%

*Results calculated for a 30g equivalent sample mass using the formula: $x^{30g\ Eq} = \frac{(x^{INAA} - \bar{X}) \times RSD@30g}{RSD@85mg} + \bar{X}$

where $x^{30g\ Eq}$ = equivalent result calculated for a 30g sample mass
(x^{INAA}) = raw INAA result at 85mg
$\bar{X}$ = mean of 85mg INAA results

The homogeneity of gold 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 85 milligrams was employed and the 1RSD of 0.085% calculated for a 30g fire assay or aqua regia sample (1.591% at 85mg weights) confirms the high level of gold homogeneity in OREAS 603b.

The homogeneity of OREAS 603b has also been evaluated in a **nested ANOVA** of the round robin program. Each of the twenty-seven 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 603b. The test was performed using the following parameters:

- Gold fire assay – 144 samples (24 laboratories each providing analyses on 3 pairs of samples);
- Gold aqua regia digestion – 72 samples (12 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 datasets were filtered for both individual and laboratory data set (batch) outliers prior to the calculation of *p*-values. This process derived *p*-values of 0.973 for Au by fire assay and 0.652 for Au by aqua regia digestion. Both *p*-values are insignificant and the Null Hypothesis is retained. Additionally, none of the other certified values showed significant *p*-values. Please note that only results for constituents present in concentrations well above the detection levels (i.e. >20 x Lower Limit of Detection) for the various methods undertaken were considered for the objective of evaluating homogeneity.

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 603b 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 603b is fit-for-purpose as a certified reference material (see 'Intended Use' below).

Performance Gates

Table 5 shows 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. One approach used at commercial laboratories is to set the acceptance criteria at twice the detection level (DL) ± 10%.

i.e. Certified Value ± 10% ± 2DL (adapted from Govett, 1983)

Table 5. Performance Gates for OREAS 603b.

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
Pb Fire Assay											
Ag, ppm	297	8	282	313	274	321	2.60%	5.20%	7.80%	283	312
Au, ppm	5.21	0.209	4.79	5.62	4.58	5.83	4.02%	8.04%	12.06%	4.95	5.47
Aqua Regia Digestion (sample weights 10-50g)											
Au, ppm	5.19	0.297	4.59	5.78	4.29	6.08	5.73%	11.47%	17.20%	4.93	5.44
Infrared Combustion											
S, wt.%	4.57	0.136	4.30	4.84	4.17	4.98	2.97%	5.94%	8.90%	4.34	4.80
4-Acid Digestion											
Ag, ppm	301	10	280	321	270	331	3.38%	6.76%	10.13%	286	316
Al, wt.%	6.48	0.286	5.91	7.05	5.62	7.34	4.41%	8.82%	13.23%	6.16	6.81
As, ppm	2433	101	2230	2636	2128	2737	4.17%	8.34%	12.51%	2311	2554
Be, ppm	1.57	0.21	1.16	1.98	0.95	2.18	13.14%	26.28%	39.42%	1.49	1.65
Bi, ppm	154	10	133	175	123	186	6.78%	13.56%	20.35%	146	162
Ca, wt.%	0.618	0.027	0.565	0.671	0.539	0.698	4.29%	8.57%	12.86%	0.587	0.649
Cd, ppm	12.3	0.81	10.7	14.0	9.9	14.8	6.53%	13.07%	19.60%	11.7	13.0
Ce, ppm	47.9	3.76	40.4	55.5	36.7	59.2	7.83%	15.67%	23.50%	45.6	50.3
Co, ppm	9.38	0.768	7.85	10.92	7.08	11.68	8.18%	16.36%	24.54%	8.91	9.85
Cr, ppm	26.2	4.3	17.5	34.9	13.1	39.2	16.61%	33.21%	49.82%	24.9	27.5
Cs, ppm	3.41	0.203	3.01	3.82	2.80	4.02	5.95%	11.91%	17.86%	3.24	3.58
Cu, wt.%	0.973	0.023	0.927	1.019	0.904	1.042	2.38%	4.75%	7.13%	0.924	1.022
Dy, ppm	1.95	0.118	1.72	2.19	1.60	2.31	6.02%	12.05%	18.07%	1.85	2.05
Er, ppm	0.71	0.08	0.55	0.87	0.47	0.94	11.05%	22.11%	33.16%	0.67	0.74
Eu, ppm	0.80	0.12	0.57	1.04	0.45	1.15	14.49%	28.98%	43.47%	0.76	0.84
Fe, wt.%	3.67	0.120	3.43	3.91	3.31	4.03	3.27%	6.53%	9.80%	3.49	3.86
Ga, ppm	27.2	1.90	23.4	31.0	21.5	32.9	7.01%	14.01%	21.02%	25.8	28.5
Gd, ppm	3.09	0.197	2.69	3.48	2.50	3.68	6.37%	12.74%	19.11%	2.93	3.24
Ge, ppm	0.21	0.04	0.13	0.29	0.09	0.33	19.69%	39.38%	59.07%	0.20	0.22
Hf, ppm	4.17	0.279	3.61	4.73	3.33	5.00	6.69%	13.38%	20.07%	3.96	4.38

SI unit equivalents: ppm, parts per million ≡ mg/kg ≡ µg/g ≡ 0.0001 wt.% ≡ 1000 ppb, parts per billion.
Note 1: intervals may appear asymmetric due to rounding.
Note 2: the number of decimal places quoted does not imply accuracy of the certified value to this level but are given to minimise rounding errors when calculating 2SD and 3SD windows.

Table 5 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											
Ho, ppm	0.29	0.016	0.26	0.32	0.24	0.34	5.61%	11.22%	16.83%	0.27	0.30
In, ppm	3.61	0.186	3.23	3.98	3.05	4.16	5.17%	10.33%	15.50%	3.43	3.79
K, wt.%	1.96	0.049	1.86	2.06	1.81	2.11	2.49%	4.99%	7.48%	1.86	2.06
La, ppm	22.1	3.9	14.2	30.0	10.3	33.9	17.80%	35.60%	53.40%	21.0	23.2
Li, ppm	22.4	1.68	19.1	25.8	17.4	27.5	7.48%	14.97%	22.45%	21.3	23.6
Lu, ppb	67.2	9.4	48.4	85.9	39.1	95.2	13.94%	27.88%	41.81%	63.8	70.5
Mn, ppm	162	11	139	184	128	195	6.87%	13.75%	20.62%	154	170
Mo, ppm	10.0	0.66	8.7	11.4	8.0	12.0	6.62%	13.24%	19.86%	9.5	10.5
Na, wt.%	1.38	0.064	1.25	1.51	1.19	1.58	4.65%	9.31%	13.96%	1.31	1.45
Nb, ppm	11.1	0.71	9.6	12.5	8.9	13.2	6.42%	12.83%	19.25%	10.5	11.6
Nd, ppm	22.3	2.10	18.1	26.5	16.0	28.6	9.44%	18.89%	28.33%	21.1	23.4
Ni, ppm	11.9	1.18	9.5	14.3	8.4	15.4	9.89%	19.79%	29.68%	11.3	12.5
P, ppm	386	28	331	442	303	469	7.18%	14.36%	21.54%	367	406
Pb, ppm	862	49	765	959	716	1008	5.63%	11.26%	16.90%	819	905
Pr, ppm	6.06	0.73	4.60	7.52	3.87	8.25	12.04%	24.08%	36.13%	5.75	6.36
Rb, ppm	70	3.9	62	78	59	82	5.50%	11.00%	16.50%	67	74
S, wt.%	4.54	0.177	4.19	4.89	4.01	5.07	3.89%	7.78%	11.67%	4.31	4.77
Sb, ppm	307	17	273	341	256	358	5.56%	11.11%	16.67%	291	322
Sc, ppm	4.10	0.342	3.42	4.79	3.08	5.13	8.34%	16.69%	25.03%	3.90	4.31
Se, ppm	41.1	3.65	33.8	48.4	30.2	52.1	8.89%	17.77%	26.66%	39.1	43.2
Sm, ppm	4.21	0.375	3.45	4.96	3.08	5.33	8.92%	17.85%	26.77%	4.00	4.42
Sn, ppm	14.4	0.98	12.5	16.4	11.5	17.4	6.78%	13.56%	20.35%	13.7	15.2
Sr, ppm	323	29	264	381	235	411	9.07%	18.15%	27.22%	307	339
Ta, ppm	0.88	0.056	0.77	0.99	0.71	1.05	6.38%	12.76%	19.14%	0.84	0.93
Tb, ppm	0.41	0.06	0.28	0.54	0.22	0.60	15.61%	31.22%	46.82%	0.39	0.43
Te, ppm	36.5	3.18	30.2	42.9	27.0	46.1	8.70%	17.39%	26.09%	34.7	38.3
Th, ppm	8.87	1.47	5.92	11.81	4.45	13.29	16.60%	33.20%	49.80%	8.43	9.31
Ti, wt.%	0.150	0.008	0.134	0.165	0.127	0.172	5.12%	10.23%	15.35%	0.142	0.157
Tl, ppm	5.52	0.468	4.58	6.45	4.11	6.92	8.48%	16.96%	25.45%	5.24	5.79
U, ppm	3.82	0.288	3.24	4.39	2.95	4.68	7.55%	15.09%	22.64%	3.63	4.01
V, ppm	25.9	1.35	23.2	28.6	21.9	30.0	5.22%	10.45%	15.67%	24.6	27.2
W, ppm	12.8	0.70	11.4	14.2	10.7	14.9	5.46%	10.91%	16.37%	12.2	13.5
Y, ppm	8.57	0.486	7.60	9.54	7.11	10.03	5.67%	11.34%	17.01%	8.14	9.00
Yb, ppm	0.51	0.08	0.36	0.66	0.28	0.74	14.84%	29.68%	44.52%	0.49	0.54
Zn, wt.%	0.201	0.005	0.191	0.212	0.186	0.217	2.50%	5.00%	7.50%	0.191	0.212
Zr, ppm	146	8	131	162	123	169	5.27%	10.54%	15.81%	139	154
Aqua Regia Digestion											
Ag, ppm	300	9	283	318	274	326	2.87%	5.73%	8.60%	285	315
Al, wt.%	0.758	0.042	0.674	0.842	0.632	0.884	5.55%	11.09%	16.64%	0.720	0.796
As, ppm	2411	128	2156	2667	2028	2795	5.30%	10.60%	15.90%	2291	2532
Be, ppm	0.31	0.024	0.26	0.36	0.24	0.38	7.82%	15.64%	23.46%	0.30	0.33

SI unit equivalents: ppm, parts per million ≡ mg/kg ≡ µg/g ≡ 0.0001 wt.% ≡ 1000 ppb, parts per billion.
Note 1: intervals may appear asymmetric due to rounding.
Note 2: the number of decimal places quoted does not imply accuracy of the certified value to this level but are given to minimise rounding errors when calculating 2SD and 3SD windows.

Table 5 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											
Bi, ppm	156	7	142	170	135	177	4.47%	8.93%	13.40%	149	164
Ca, wt.%	0.396	0.021	0.355	0.438	0.334	0.459	5.27%	10.54%	15.80%	0.377	0.416
Cd, ppm	12.4	0.79	10.8	14.0	10.0	14.8	6.40%	12.81%	19.21%	11.8	13.0
Ce, ppm	27.2	1.07	25.1	29.4	24.0	30.4	3.95%	7.90%	11.84%	25.9	28.6
Co, ppm	9.05	0.402	8.24	9.85	7.84	10.25	4.44%	8.88%	13.32%	8.59	9.50
Cr, ppm	26.1	2.7	20.7	31.5	18.0	34.2	10.32%	20.63%	30.95%	24.8	27.4
Cs, ppm	0.79	0.030	0.74	0.85	0.71	0.88	3.74%	7.47%	11.21%	0.76	0.83
Cu, wt.%	0.985	0.015	0.954	1.015	0.939	1.030	1.54%	3.07%	4.61%	0.935	1.034
Fe, wt.%	3.47	0.177	3.11	3.82	2.94	4.00	5.09%	10.19%	15.28%	3.29	3.64
Ga, ppm	6.27	0.509	5.26	7.29	4.75	7.80	8.11%	16.22%	24.33%	5.96	6.59
Ge, ppm	0.19	0.05	0.10	0.29	0.06	0.33	23.57%	47.14%	70.72%	0.19	0.20
Hf, ppm	0.90	0.085	0.73	1.07	0.64	1.15	9.45%	18.90%	28.34%	0.85	0.94
Hg, ppm	1.14	0.075	0.98	1.29	0.91	1.36	6.64%	13.28%	19.92%	1.08	1.19
In, ppm	3.53	0.144	3.25	3.82	3.10	3.97	4.08%	8.16%	12.23%	3.36	3.71
K, wt.%	0.211	0.012	0.188	0.234	0.176	0.246	5.47%	10.93%	16.40%	0.200	0.222
La, ppm	12.9	0.87	11.2	14.7	10.3	15.6	6.74%	13.48%	20.22%	12.3	13.6
Li, ppm	6.73	0.75	5.23	8.24	4.48	8.99	11.17%	22.33%	33.50%	6.40	7.07
Mg, ppm	304	13	278	330	266	343	4.24%	8.48%	12.72%	289	319
Mn, ppm	142	8	127	158	119	166	5.43%	10.85%	16.28%	135	150
Mo, ppm	9.63	0.333	8.96	10.30	8.63	10.63	3.46%	6.93%	10.39%	9.15	10.11
Na, wt.%	0.053	0.007	0.038	0.068	0.031	0.075	13.84%	27.68%	41.52%	0.051	0.056
Ni, ppm	11.4	0.92	9.5	13.2	8.6	14.1	8.12%	16.23%	24.35%	10.8	11.9
P, ppm	146	10	126	167	116	177	6.95%	13.91%	20.86%	139	154
Pb, ppm	634	33	567	701	534	734	5.26%	10.52%	15.77%	602	666
Rb, ppm	8.58	0.849	6.88	10.28	6.03	11.13	9.89%	19.79%	29.68%	8.15	9.01
Re, ppb	3.76	0.64	2.47	5.04	1.83	5.69	17.09%	34.18%	51.26%	3.57	3.95
S, wt.%	3.50	0.166	3.17	3.84	3.01	4.00	4.74%	9.48%	14.21%	3.33	3.68
Sb, ppm	259	26	208	311	182	337	9.91%	19.81%	29.72%	246	272
Sc, ppm	1.00	0.11	0.78	1.23	0.67	1.34	11.25%	22.50%	33.76%	0.95	1.06
Se, ppm	41.0	2.79	35.4	46.5	32.6	49.3	6.82%	13.64%	20.45%	38.9	43.0
Sn, ppm	12.9	0.57	11.7	14.0	11.2	14.6	4.43%	8.87%	13.30%	12.2	13.5
Sr, ppm	40.5	5.1	30.3	50.8	25.1	56.0	12.67%	25.33%	38.00%	38.5	42.6
Tb, ppm	0.23	0.04	0.15	0.31	0.11	0.35	17.48%	34.95%	52.43%	0.22	0.24
Te, ppm	38.5	1.48	35.6	41.5	34.1	43.0	3.83%	7.65%	11.48%	36.6	40.5
Th, ppm	4.74	0.58	3.57	5.91	2.99	6.49	12.30%	24.59%	36.89%	4.50	4.98
Ti, ppm	149	12	124	174	111	186	8.39%	16.79%	25.18%	141	156
Tl, ppm	5.33	0.317	4.69	5.96	4.37	6.28	5.95%	11.90%	17.85%	5.06	5.59
U, ppm	1.71	0.138	1.43	1.99	1.29	2.12	8.10%	16.20%	24.30%	1.62	1.79
V, ppm	8.78	0.853	7.07	10.49	6.22	11.34	9.72%	19.44%	29.16%	8.34	9.22
W, ppm	4.56	0.288	3.98	5.14	3.70	5.43	6.32%	12.65%	18.97%	4.33	4.79
Y, ppm	3.96	0.381	3.20	4.72	2.82	5.11	9.62%	19.24%	28.86%	3.76	4.16

SI unit equivalents: ppm, parts per million ≡ mg/kg ≡ µg/g ≡ 0.0001 wt.% ≡ 1000 ppb, parts per billion.
Note 1: intervals may appear asymmetric due to rounding.
Note 2: the number of decimal places quoted does not imply accuracy of the certified value to this level but are given to minimise rounding errors when calculating 2SD and 3SD windows.

Table 5 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											
Yb, ppm	0.17	0.03	0.11	0.23	0.09	0.26	16.76%	33.51%	50.27%	0.16	0.18
Zn, wt.%	0.199	0.007	0.184	0.213	0.177	0.220	3.58%	7.15%	10.73%	0.189	0.209
Zr, ppm	30.0	5.7	18.6	41.3	12.9	47.0	19.00%	38.00%	57.00%	28.5	31.5

SI unit equivalents: ppm, parts per million ≡ mg/kg ≡ µg/g ≡ 0.0001 wt.% ≡ 1000 ppb, parts per billion.
Note 1: intervals may appear asymmetric due to rounding.
Note 2: the number of decimal places quoted does not imply accuracy of the certified value to this level but are given to minimise rounding errors when calculating 2SD and 3SD windows.

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5. ALS, Loughrea, Galway, Ireland
6. ALS, Perth, WA, Australia
7. ALS, Reno, Nevada, USA
8. ALS, Santiago, Santiago Metropolitan Region, Chile
9. ALS, Vancouver, BC, Canada
10. American Assay Laboratories, Sparks, Nevada, USA
11. ANSTO, Lucas Heights, NSW, Australia
12. ARGETEST Mineral Processing, Ankara, Central Anatolia, Turkey
13. Bureau Veritas Commodities Canada Ltd, Vancouver, BC, Canada
14. Bureau Veritas Geoanalytical, Perth, WA, Australia
15. Bureau Veritas Minerals, Hermosillo, Sonora, Mexico
16. Inspectorate (BV), Lima, Peru
17. Intertek Genalysis, Perth, WA, Australia
18. Intertek Testing Services, Townsville, QLD, Australia
19. Intertek Testing Services Philippines, Cupang, Muntinlupa, Philippines
20. PT Geoservices Ltd, Cikarang, Jakarta Raya, Indonesia
21. PT Intertek Utama Services, Jakarta Timur, DKI Jakarta, Indonesia
22. PT SGS Indo Assay Laboratories, Jakarta, Indonesia
23. SGS, Ankara, Anatolia, Turkey
24. SGS de Mexico SA de CV, Cd. Industrial, Durango, Mexico
25. SGS del Peru, Lima, Peru
26. SGS Lakefield Research Ltd, Lakefield, Ontario, Canada
27. Shiva Analyticals Ltd, Bangalore North, Karnataka, India

Please note: Above numbered alphabetical list of participating laboratories does not reflect the Lab ID numbering on the scatter plots below.

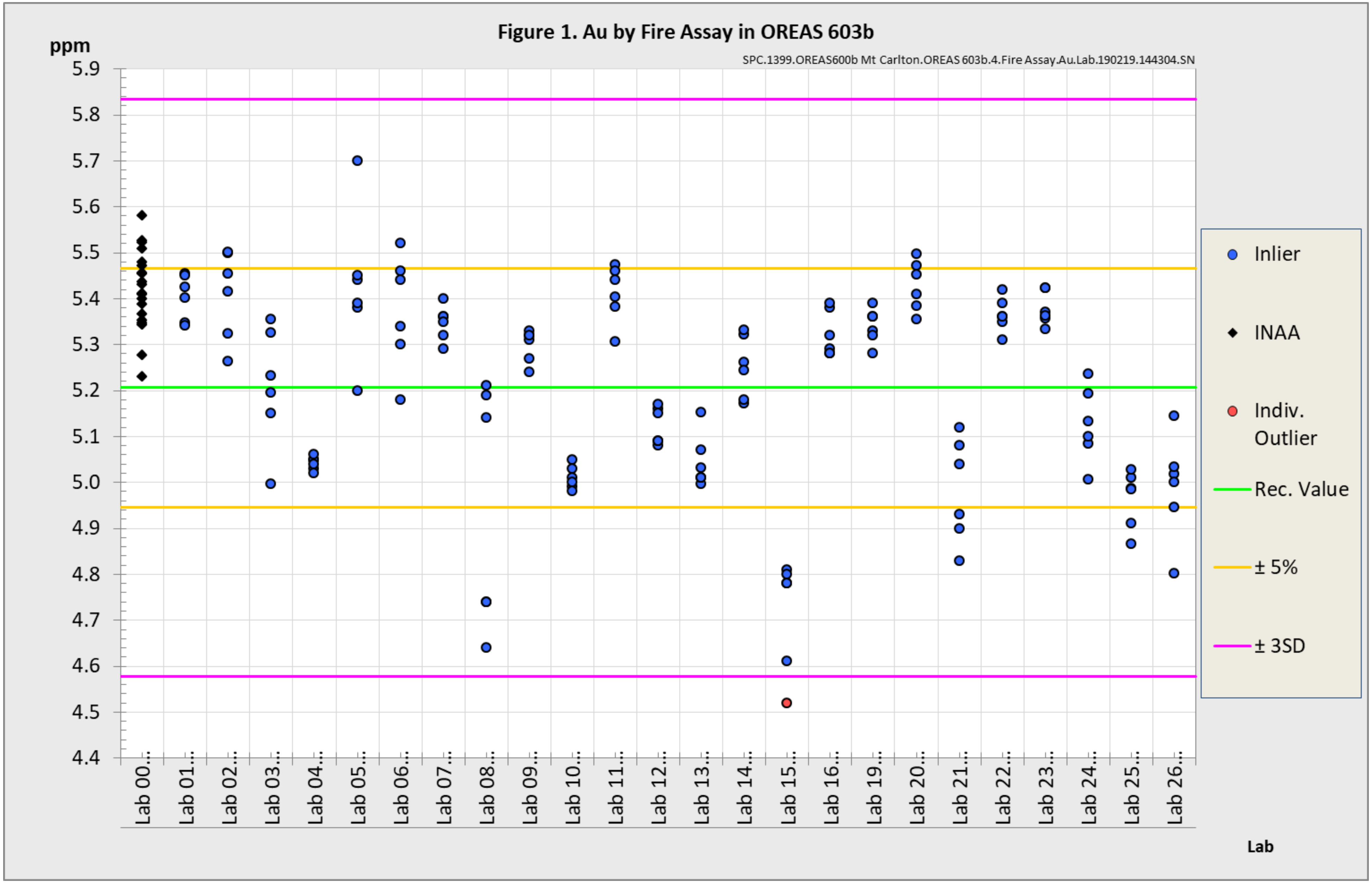
Figure 1. Au by Fire Assay in OREAS 603b
SPC.1399.OREAS600b Mt Carlton.OREAS 603b.4.Fire Assay.Au.Lab.190219.144304.SN
ppm
5.9
5.8
5.7
5.6
5.5
5.4
5.3
5.2
5.1
5.0
4.9
4.8
4.7
4.6
4.5
4.4
Lab 00...
Lab 01...
Lab 02...
Lab 03...
Lab 04...
Lab 05...
Lab 06...
Lab 07...
Lab 08...
Lab 09...
Lab 10...
Lab 11...
Lab 12...
Lab 13...
Lab 14...
Lab 15...
Lab 16...
Lab 19...
Lab 20...
Lab 21...
Lab 22...
Lab 23...
Lab 24...
Lab 25...
Lab 26...
Lab
Inlier
INAA
Indiv. Outlier
Rec. Value
± 5%
± 3SD

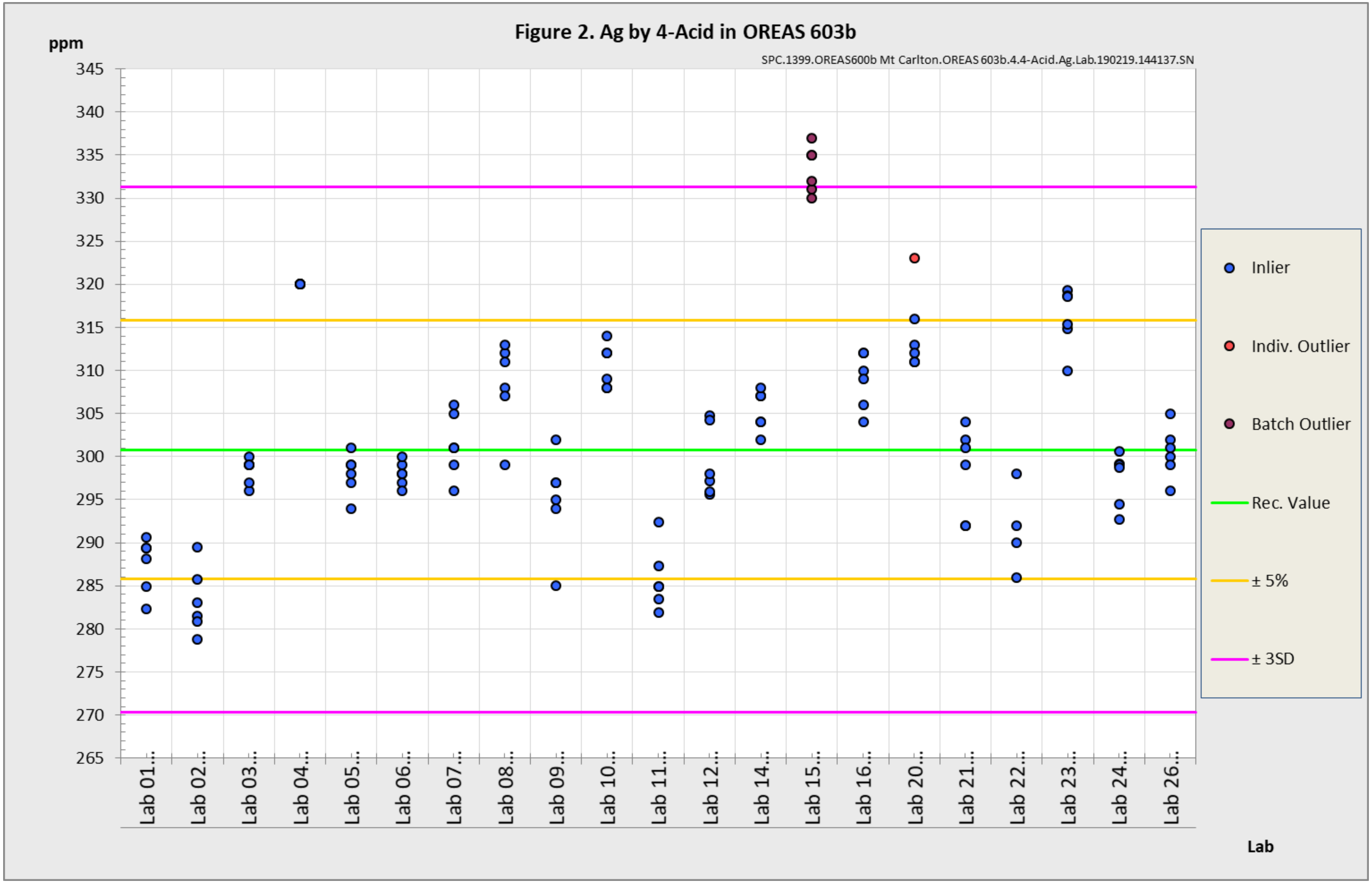
Figure 2. Ag by 4-Acid in OREAS 603b
ppm
SPC.1399.OREAS600b Mt Carlton.OREAS 603b.4.4-Acid.Ag.Lab.190219.144137.SN
345
340
335
330
325
320
315
310
305
300
295
290
285
280
275
270
265
Lab 01...
Lab 02...
Lab 03...
Lab 04...
Lab 05...
Lab 06...
Lab 07...
Lab 08...
Lab 09...
Lab 10...
Lab 11...
Lab 12...
Lab 14...
Lab 15...
Lab 16...
Lab 20...
Lab 21...
Lab 22...
Lab 23...
Lab 24...
Lab 26...
Inlier
Indiv. Outlier
Batch Outlier
Rec. Value
± 5%
± 3SD
Lab

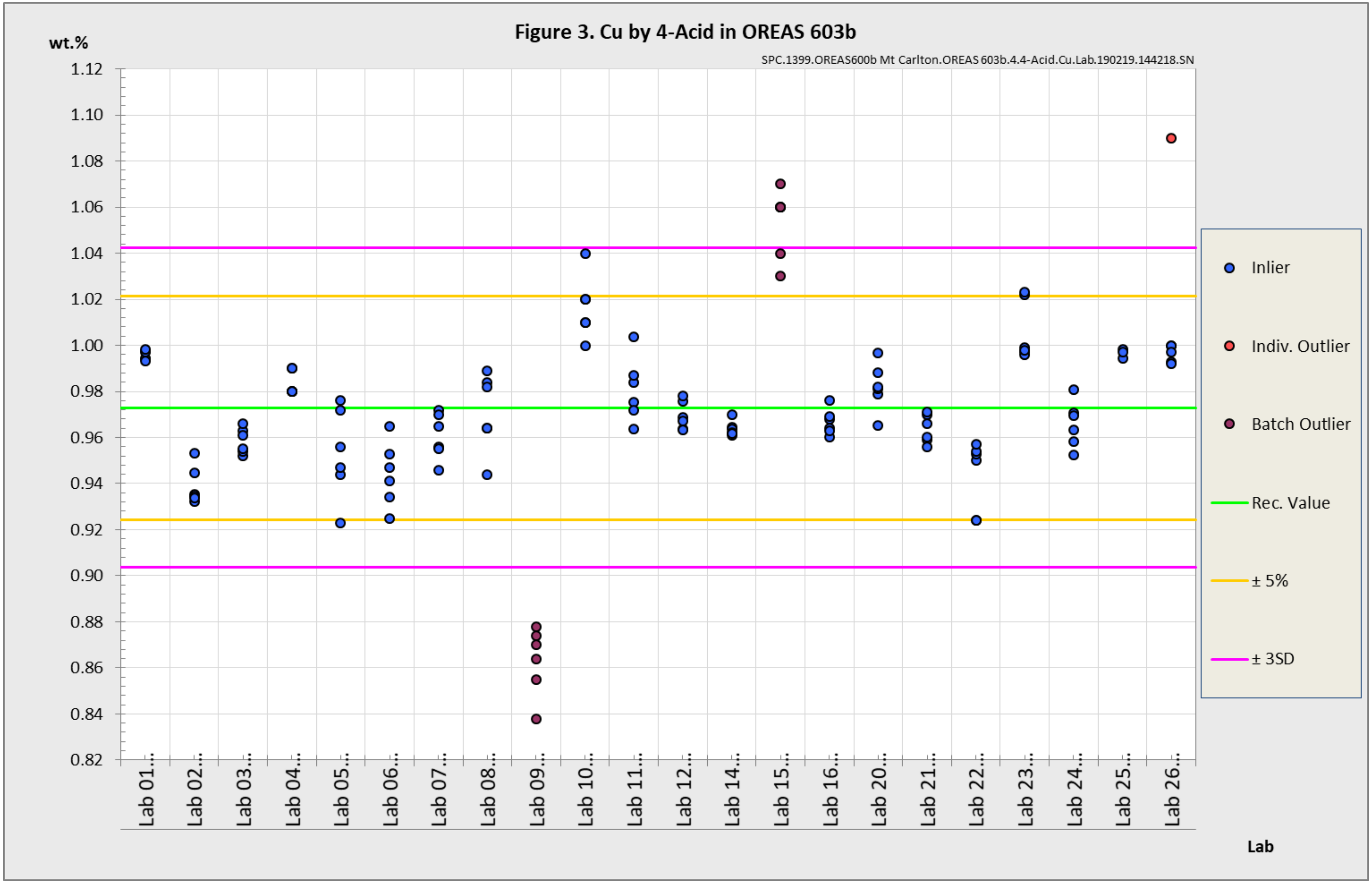
Figure 3. Cu by 4-Acid in OREAS 603b
wt.%
SPC.1399.OREAS600b Mt Carlton.OREAS 603b.4.4-Acid.Cu.Lab.190219.144218.SN
1.12
1.10
1.08
1.06
1.04
1.02
1.00
0.98
0.96
0.94
0.92
0.90
0.88
0.86
0.84
0.82
Lab 01...
Lab 02...
Lab 03...
Lab 04...
Lab 05...
Lab 06...
Lab 07...
Lab 08...
Lab 09...
Lab 10...
Lab 11...
Lab 12...
Lab 14...
Lab 15...
Lab 16...
Lab 20...
Lab 21...
Lab 22...
Lab 23...
Lab 24...
Lab 25...
Lab 26...
Lab
Inlier
Indiv. Outlier
Batch Outlier
Rec. Value
± 5%
± 3SD

PREPARER AND SUPPLIER

Certified reference material OREAS 603b was prepared, certified and supplied by:

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

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Web: www.ore.com.au
Email: info@ore.com.au

It is packaged in 10g and 60g units sealed under nitrogen in laminated foil pouches.

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.

INTENDED USE

OREAS 603b is intended to cover all activities needed to produce a measurement result. This includes extraction, possible separation steps and the actual measurement process (the signal producing step). OREAS 603b may be used to calibrate the entire procedure by producing a pure substance CRM transformed into a calibration solution.

OREAS 603b 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 603b has been prepared from sulphide bearing ores and concentrates blended with rhyodacite. It contains reactive sulphide (~4.57% S) and has been packaged under nitrogen in single use laminated foil pouches. In its unopened state and under normal conditions of storage the CRM 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 for OREAS 603b 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.

DOCUMENT HISTORY

Revision No.	Date	Changes applied
0	21st February 2019	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

21st February, 2019

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

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