

CERTIFICATE OF ANALYSIS FOR
COPPER-GOLD-SILVER-ZINC-LEAD CONCENTRATE
 (Rosebery metallurgical plant, North-West Tasmania, Australia)
CERTIFIED REFERENCE MATERIAL
OREAS 990c

Table 1. Certified Value, Uncertainty & Tolerance Intervals for OREAS 990c.

Constituent	Certified Value [†]	95% Expanded Uncertainty		95% Tolerance Limits	
		Low	High	Low	High
Umpire Labs (dry sample basis)					
Classical Wet Chemistry					
Cu, Copper (wt.%)	17.13	17.06	17.21	17.10	17.17
Pb Fire Assay (Grav)					
Ag, Silver (ppm)	2732	2701	2763	2691	2773
Au, Gold (ppm)	35.35	34.96	35.74	35.01*	35.69*

SI unit equivalents: ppm (parts per million; 1×10^{-6}) \equiv mg/kg; wt.% (weight per cent) \equiv % (mass fraction).

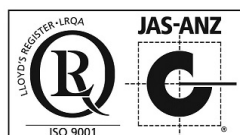
[†]This operationally defined measurand meets the requirements of ISO 17034 and all participating laboratories comply with the requirements of ISO 17025.

*Gold Tolerance Limits for typical 10g fire assay are determined from 20 x 85mg INAA results and the Sampling Constant (Ingamells & Switzer, 1973).

Note: intervals may appear asymmetric due to rounding.



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Table 1 continued.

Constituent	Certified Value [†]	95% Expanded Uncertainty		95% Tolerance Limits	
		Low	High	Low	High
Geoanalytical Labs ('as received' sample basis)					
4-Acid Digestion					
Ag, Silver (ppm)	2751	2642	2860	2699	2803
Al, Aluminium (wt.%)	0.778	0.759	0.797	0.765	0.791
As, Arsenic (ppm)	5834	5522	6147	5658	6010
Bi, Bismuth (ppm)	88	82	94	85	90
Ca, Calcium (wt.%)	0.142	0.136	0.149	0.139	0.146
Cd, Cadmium (ppm)	415	398	432	407	423
Ce, Cerium (ppm)	20.0	16.9	23.1	18.6	21.4
Co, Cobalt (ppm)	7.84	7.03	8.65	7.61	8.07
Cs, Caesium (ppm)	0.68	0.64	0.73	0.64	0.73
Cu, Copper (wt.%)	17.23	16.97	17.49	16.94	17.52
Fe, Iron (wt.%)	17.05	16.61	17.50	16.78	17.32
Ga, Gallium (ppm)	3.51	3.20	3.81	3.41	3.60
Hf, Hafnium (ppm)	0.95	0.85	1.05	0.88	1.02
In, Indium (ppm)	14.3	13.0	15.6	13.9	14.8
K, Potassium (wt.%)	0.335	0.323	0.347	0.326	0.344
La, Lanthanum (ppm)	8.45	6.29	10.60	7.89	9.00
Li, Lithium (ppm)	2.89	2.46	3.32	2.69	3.08
Mg, Magnesium (wt.%)	0.122	0.114	0.131	0.119	0.126
Mn, Manganese (wt.%)	0.368	0.360	0.375	0.361	0.375
Mo, Molybdenum (ppm)	141	135	147	137	145
Na, Sodium (wt.%)	0.034	0.029	0.039	IND	IND
Nb, Niobium (ppm)	1.17	1.02	1.32	IND	IND
Ni, Nickel (ppm)	7.80	7.19	8.40	7.47	8.13
Pb, Lead (wt.%)	7.98	7.83	8.12	7.85	8.10
Rb, Rubidium (ppm)	17.8	15.8	19.8	17.3	18.3
S, Sulphur (wt.%)	27.88	26.12	29.64	27.17	28.59
Sb, Antimony (ppm)	7696	7317	8075	7486	7907
Sc, Scandium (ppm)	1.07	0.99	1.16	1.02	1.12
Sn, Tin (ppm)	4.03	3.49	4.57	3.86	4.20
Sr, Strontium (ppm)	16.4	14.1	18.8	15.8	17.1
Ta, Tantalum (ppm)	0.091	0.066	0.116	IND	IND
Th, Thorium (ppm)	3.84	3.23	4.46	3.64	4.04
Ti, Titanium (wt.%)	0.027	0.025	0.029	0.026	0.028
Tl, Thallium (ppm)	12.8	12.2	13.5	12.3	13.3
U, Uranium (ppm)	2.19	2.06	2.33	2.10	2.28

SI unit equivalents: ppm (parts per million; 1×10^{-6}) \equiv mg/kg; wt.% (weight per cent) \equiv % (mass fraction).

[†]This operationally defined measurand meets the requirements of ISO 17034 and all participating laboratories comply with the requirements of ISO 17025.

Note: intervals may appear asymmetric due to rounding; IND = indeterminate (due to limited reading resolution of the methods employed).

Table 1 continued.

Constituent	Certified Value [†]	95% Expanded Uncertainty		95% Tolerance Limits	
		Low	High	Low	High
4-Acid Digestion continued					
Y, Yttrium (ppm)	5.98	5.36	6.59	5.71	6.24
Zn, Zinc (wt.%)	18.44	18.10	18.77	18.13	18.75
Zr, Zirconium (ppm)	34.0	32.1	35.8	33.0	35.0

SI unit equivalents: ppm (parts per million; 1×10^{-6}) \equiv mg/kg; wt.% (weight per cent) \equiv % (mass fraction).

[†]This operationally defined measurand meets the requirements of ISO 17034 and all participating laboratories comply with the requirements of ISO 17025.

Note: intervals may appear asymmetric due to rounding.

Table 2. Certified Value, Uncertainty & Tolerance Intervals for other measurands in OREAS 990c

Constituent	Certified Value	95% Expanded Uncertainty		95% Tolerance Limits	
		Low	High	Low	High
Geoanalytical Labs ('as received' sample basis)					
Peroxide Fusion ICP					
Al, Aluminium (wt.%)	0.789	0.765	0.812	0.765	0.812
As, Arsenic (ppm)	6140	5916	6364	5995	6284
Ba, Barium (ppm)	1950	1899	2001	1916	1984
Bi, Bismuth (ppm)	88	81	94	85	90
Cd, Cadmium (ppm)	433	409	457	416	450
Ce, Cerium (ppm)	22.2	18.7	25.6	21.3	23.0
Co, Cobalt (ppm)	7.81	6.82	8.79	7.41	8.21
Cs, Caesium (ppm)	0.77	0.58	0.96	IND	IND
Cu, Copper (wt.%)	17.32	17.04	17.60	17.03	17.61
Dy, Dysprosium (ppm)	1.33	1.09	1.58	1.25	1.41
Er, Erbium (ppm)	0.80	0.70	0.89	0.69	0.90
Fe, Iron (wt.%)	17.28	16.97	17.60	16.92	17.65
Ga, Gallium (ppm)	3.69	3.14	4.24	3.47	3.90
Gd, Gadolinium (ppm)	1.62	1.21	2.03	1.45	1.78
Ge, Germanium (ppm)	< 1	IND	IND	IND	IND
Ho, Holmium (ppm)	0.27	0.20	0.34	0.23	0.30
In, Indium (ppm)	16.1	14.9	17.3	15.6	16.7
K, Potassium (wt.%)	0.351	0.302	0.399	0.330	0.372
La, Lanthanum (ppm)	11.6	10.4	12.8	11.3	11.9
Mg, Magnesium (wt.%)	0.129	0.120	0.138	IND	IND
Mn, Manganese (wt.%)	0.384	0.373	0.395	0.376	0.392
Mo, Molybdenum (ppm)	147	140	155	142	153
Nd, Neodymium (ppm)	9.62	8.08	11.15	9.34	9.89
Pb, Lead (wt.%)	8.08	7.92	8.25	7.94	8.23
Pr, Praseodymium (ppm)	2.48	2.20	2.76	2.33	2.64

SI unit equivalents: ppm (parts per million; 1×10^{-6}) \equiv mg/kg; wt.% (weight per cent) \equiv % (mass fraction).

Note: intervals may appear asymmetric due to rounding; IND = indeterminate (due to limited reading resolution of the methods employed. For practical purposes the 95% Expanded Uncertainty can be set between zero and a two times multiple of the upper bound/non-detect limit value).

Table 2 continued.

Constituent	Certified Value	95% Expanded Uncertainty		95% Tolerance Limits	
		Low	High	Low	High
Peroxide Fusion ICP continued					
Rb, Rubidium (ppm)	19.0	16.9	21.1	18.1	19.9
S, Sulphur (wt.%)	30.03	29.34	30.72	29.50	30.55
Sb, Antimony (ppm)	7895	7206	8584	7718	8071
Sc, Scandium (ppm)	< 10	IND	IND	IND	IND
Si, Silicon (wt.%)	1.79	1.73	1.85	1.75	1.83
Sm, Samarium (ppm)	1.77	1.46	2.08	1.49	2.05
Sr, Strontium (ppm)	24.2	20.4	27.9	22.2	26.1
Tb, Terbium (ppm)	0.23	0.14	0.32	IND	IND
Te, Tellurium (ppm)	< 5	IND	IND	IND	IND
Th, Thorium (ppm)	4.53	3.97	5.09	4.26	4.81
Ti, Titanium (wt.%)	0.031	0.028	0.035	IND	IND
Tm, Thulium (ppm)	0.11	0.09	0.14	IND	IND
U, Uranium (ppm)	2.32	1.97	2.67	2.18	2.46
W, Tungsten (ppm)	4.76	3.93	5.59	4.46	5.06
Y, Yttrium (ppm)	7.28	6.27	8.29	6.88	7.69
Yb, Ytterbium (ppm)	0.78	0.56	1.01	IND	IND
Zn, Zinc (wt.%)	18.49	18.06	18.92	18.16	18.81
Ion Selective Electrode					
F, Fluorine (ppm)	330	249	411	303	358
Infrared Combustion					
S, Sulphur (wt.%)	30.04	29.25	30.82	29.77	30.30

SI unit equivalents: ppm (parts per million; 1×10^{-6}) \equiv mg/kg; wt.% (weight per cent) \equiv % (mass fraction).

Note: intervals may appear asymmetric due to rounding; IND = indeterminate (due to limited reading resolution of the methods employed. For practical purposes the 95% Expanded Uncertainty can be set between zero and a two times multiple of the upper bound/non-detect limit value).

Table 3. Indicative Values for OREAS 990c.

Constituent	Unit	Value	Constituent	Unit	Value	Constituent	Unit	Value
Umpire Labs (dry sample basis)								
Thermogravimetry								
H ₂ O-	wt.%	0.144						
Geoanalytical Labs ('as received' sample basis)								
4-Acid Digestion								
B	ppm	91	Ge	ppm	0.24	Sm	ppm	1.83
Ba	ppm	93	Ho	ppm	0.25	Tb	ppm	0.23
Be	ppm	0.15	Lu	ppm	0.10	Te	ppm	0.15
Cr	ppm	3.08	Nd	ppm	7.17	Tm	ppm	0.10
Dy	ppm	1.20	P	wt.%	0.004	V	ppm	3.47
Er	ppm	0.75	Pr	ppm	1.87	W	ppm	4.29
Eu	ppm	0.38	Re	ppm	0.004	Yb	ppm	0.73
Gd	ppm	1.43	Se	ppm	6.21			

SI unit equivalents: ppm (parts per million; 1×10^{-6}) \equiv mg/kg; wt.% (weight per cent) \equiv % (mass fraction).

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 3 continued.

Constituent	Unit	Value	Constituent	Unit	Value	Constituent	Unit	Value
Peroxide Fusion ICP								
Ag	ppm	2567	Hf	ppm	< 10	Re	ppm	0.009
B	ppm	< 50	Li	ppm	3.36	Se	ppm	12.4
Be	ppm	< 1	Lu	ppm	0.11	Sn	ppm	5.31
Ca	wt. %	0.198	Nb	ppm	2.90	Ta	ppm	0.31
Cr	ppm	< 50	Ni	ppm	< 20	V	ppm	9.04
Eu	ppm	0.45	P	wt. %	0.033			
Infrared Combustion								
C	wt. %	0.208						

SI unit equivalents: ppm (parts per million; 1×10^{-6}) \equiv mg/kg; wt. % (weight per cent) \equiv % (mass fraction).

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.

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INTRODUCTION

OREAS reference materials are intended to provide a low-cost method of evaluating and improving the quality of analysis of geological/metallurgical 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. In evaluating laboratory performance with this CRM, the section headed 'Instructions for correct use' should be read carefully.

Tables 1 and 2 provide the certified values and their associated 95% expanded uncertainty and tolerance intervals, Table 3 shows indicative (non-certified) values, Table 4 provides some indicative physical properties and Table 5 presents the performance gate intervals for all certified values. Gold homogeneity (via INAA) is shown in Table 6 and has also undergone uniformity testing in a nested ANOVA program in both the fire assay and INAA data (see 'Homogeneity Evaluation' section).

Tabulated results of all analytes together with 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 990c-DataPack.1.0.230824_092135.xlsx**).

Results are also presented in scatter plots for copper, silver and gold by the umpire laboratories (Figures 1, 2 and 3) together with $\pm 3SD$ (magenta) and certified value (green line). Accepted individual results are coloured blue and individual and dataset outliers are identified in red and violet, respectively.

SOURCE MATERIAL

OREAS 990c is a copper-gold-silver-zinc-lead concentrate certified reference material (CRM), prepared and certified by Ore Research & Exploration Pty Ltd. The material constituting OREAS 990c was sourced from the Rosebery metallurgical plant owned and operated by MMG Ltd. The Rosebery mine and plant are located in the north-west region of Tasmania, Australia approximately 300 kilometres north-west of Hobart and 125 kilometres south of Burnie. The key minerals of economic importance include sphalerite, galena, chalcopyrite, pyrite, and electrum.

COMMINUTION AND HOMOGENISATION PROCEDURES

The material constituting OREAS 990c was prepared in the following manner:

- Drying to constant mass at 85°C;
- Multi-stage milling to 100% minus 30 microns;
- Homogenisation using OREAS' novel processing technologies;
- Packaging into 10g and 50g units sealed under nitrogen in laminated foil pouches.

PHYSICAL PROPERTIES

OREAS 990c was tested at ORE Research & Exploration Pty Ltd's onsite facility for various physical properties. Table 4 presents these findings that should be used for informational purposes only.

Table 4. Physical properties of OREAS 231b.

Bulk Density (kg/m ³)	Moisture (wt.%)	Munsell Notation [‡]	Munsell Color [‡]
990	0.51	N2	GrayishBlack

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

ANALYTICAL PROGRAM

For the interlaboratory 'round robin' certification program, a 600g sample was taken at each of 10 predetermined sampling intervals immediately following homogenisation and are considered representative of the entire prepared batch of OREAS 990c.

Umpire Laboratories

Fourteen 'umpire' laboratories each received a single 130g sample and undertook copper, gold, silver and moisture analysis on the sample as received. The term 'umpire' here refers to the routine analysis by these laboratories using classical methodologies for precious and base metals.

Strict, pre-assay instructions were provided to ensure proper handling of moisture including:

- Equilibration of sample material to laboratory atmosphere for a minimum of 2 hours;
- Hygroscopic moisture analysis at 105°C determined on a separate subsample and weighed for analysis at the same time as the sample aliquots for Au, Cu and Ag as per ISO 9599.

The laboratories were requested to report analyte concentrations on both a dry (using the moisture value to correct the sample to dry basis) and moisture-bearing basis and include all results for moisture determinations. **The 'Umpire Lab' certified values shown in Table 1 are on a dry sample basis (see also 'Instructions for correct use' section).**

The following analytical methods were undertaken:

- Copper (3 trials on undried sample) by classical wet chemistry (short iodide titration);
- Gold and Silver (3 trials on undried sample) by reduced charge weight (0.5-30g) fire assay with gravimetric finish and full corrections for slag, cupel and silver.

Geoanalytical Laboratories

Fifteen geoanalytical laboratories also participated in the program where each laboratory received 6 x 30g samples by taking two samples from each of three separate 600g test units. This format enabled a nested ANOVA treatment of the results to evaluate homogeneity, i.e., to ascertain whether between-unit variance is greater than within-unit variance. The laboratories were instructed to undertake the following analyses:

- Full ICP-OES and MS elemental suites by 4-acid digestion (up to 14 laboratories depending on the element and with up to 6 laboratories using an AAS finish for Ag, Cu, Pb, S, Sb and Zn);

- Full ICP-OES and MS elemental suites by peroxide fusion (up to 12 laboratories depending on the element);
- Fluorine by ion selective electrode (8 laboratories);
- Total S by IR combustion furnace (11 laboratories).

Instrumental neutron activation analysis (INAA) for Au on 20 x 85mg subsamples was also undertaken at ANSTO, Lucas Heights to confirm homogeneity (see Table 6 below).

STATISTICAL ANALYSIS

Certified Values and their uncertainty intervals (Tables 1 and 2) 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. 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. However, while statistics are taken into account, the exercise of a statistician's prerogative plays a significant role in identifying outliers.

Certified Values are the means of accepted laboratory means after outlier filtering and are the present best estimate of the true value. The INAA data (see Table 6) is omitted from determination of the certified value for Au and is used solely for the calculation of Tolerance Limits and homogeneity evaluation (see 'Homogeneity Evaluation' section below).

95% Expanded Uncertainty provides a 95% probability that the true value of the analyte under consideration lies between the upper and lower limits and is calculated according to the method outlined in ISO 98-3 [6]. All known or suspected sources of bias have been investigated or taken into account.

Indicative (uncertified) values (Table 3) are present where the number of laboratories reporting a particular analyte is insufficient (< 5) to support certification or where interlaboratory consensus is poor.

Standard Deviation intervals (see Table 5) 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.

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 (see 'Intended Use' section for more detail).

The SD for each analyte's certified value is calculated from the same filtered data set used to determine the certified value, i.e., after removal of all individual, lab dataset (batch) and 3SD outliers (single iteration). These outliers can only be removed after the absolute homogeneity of the CRM has been independently established, i.e., the outliers must be confidently deemed to be analytical rather than arising from inhomogeneity of the CRM. **The standard deviation is then calculated for each analyte from the pooled accepted analyses generated from the certification program.**

PERFORMANCE GATES

Table 5 below shows intervals 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 (also see 'Intended Use' section below). Westgard Rules extend the basics of single-rule QC monitoring using multi-rules (for more information visit www.westgard.com/mltirule.htm). 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) \pm 10%.

I.e., Certified Value \pm 10% \pm 2DL (Govett, 1983 [1]).

Table 5. Performance Gates for OREAS 990c.

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
Umpire Labs (dry sample basis)											
Classical Wet Chemistry											
Cu, wt.%	17.13	0.126	16.88	17.39	16.76	17.51	0.73%	1.47%	2.20%	16.28	17.99
Pb Fire Assay (Grav)											
Ag, ppm	2732	22	2688	2776	2666	2798	0.80%	1.61%	2.41%	2595	2869
Au, ppm	35.35	0.620	34.11	36.59	33.49	37.21	1.75%	3.51%	5.26%	33.58	37.12
Geoanalytical Labs ('as received' sample basis)											
4-Acid Digestion											
Ag, ppm	2751	73	2606	2897	2533	2969	2.64%	5.29%	7.93%	2614	2889
Al, wt.%	0.778	0.024	0.731	0.826	0.707	0.850	3.07%	6.13%	9.20%	0.739	0.817
As, ppm	5834	304	5226	6443	4922	6747	5.21%	10.43%	15.64%	5543	6126
Bi, ppm	88	5.5	77	99	71	104	6.27%	12.53%	18.80%	84	92

SI unit equivalents: ppm (parts per million; 1×10^{-6}) \equiv mg/kg; wt.% (weight per cent) \equiv % (mass fraction).

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											
Ca, wt.%	0.142	0.007	0.129	0.156	0.123	0.162	4.60%	9.19%	13.79%	0.135	0.150
Cd, ppm	415	22	371	459	349	482	5.34%	10.67%	16.01%	394	436
Ce, ppm	20.0	1.89	16.2	23.8	14.3	25.7	9.46%	18.91%	28.37%	19.0	21.0
Co, ppm	7.84	0.90	6.05	9.63	5.16	10.53	11.42%	22.84%	34.26%	7.45	8.23
Cs, ppm	0.68	0.033	0.62	0.75	0.58	0.78	4.82%	9.65%	14.47%	0.65	0.72
Cu, wt.%	17.23	0.340	16.55	17.91	16.21	18.25	1.97%	3.95%	5.92%	16.37	18.09
Fe, wt.%	17.05	0.541	15.97	18.13	15.43	18.68	3.17%	6.35%	9.52%	16.20	17.90
Ga, ppm	3.51	0.37	2.76	4.25	2.38	4.63	10.66%	21.32%	31.99%	3.33	3.68
Hf, ppm	0.95	0.10	0.76	1.14	0.66	1.24	10.09%	20.18%	30.26%	0.90	1.00
In, ppm	14.3	1.8	10.8	17.9	9.0	19.6	12.35%	24.70%	37.04%	13.6	15.1
K, wt.%	0.335	0.014	0.307	0.362	0.293	0.376	4.12%	8.24%	12.36%	0.318	0.352
La, ppm	8.45	2.14	4.17	12.73	2.03	14.87	25.34%	50.67%	76.01%	8.02	8.87
Li, ppm	2.89	0.49	1.90	3.88	1.40	4.37	17.14%	34.27%	51.41%	2.74	3.03
Mg, wt.%	0.122	0.012	0.099	0.146	0.088	0.157	9.45%	18.90%	28.35%	0.116	0.129
Mn, wt.%	0.368	0.011	0.346	0.389	0.335	0.400	2.94%	5.89%	8.83%	0.349	0.386
Mo, ppm	141	9	122	160	113	169	6.68%	13.36%	20.04%	134	148
Na, wt.%	0.034	0.005	0.025	0.044	0.020	0.048	13.99%	27.98%	41.96%	0.032	0.036
Nb, ppm	1.17	0.113	0.94	1.39	0.83	1.50	9.67%	19.34%	29.01%	1.11	1.22
Ni, ppm	7.80	0.574	6.65	8.94	6.07	9.52	7.37%	14.74%	22.10%	7.41	8.19
Pb, wt.%	7.98	0.181	7.61	8.34	7.43	8.52	2.27%	4.55%	6.82%	7.58	8.38
Rb, ppm	17.8	2.3	13.1	22.4	10.8	24.8	13.08%	26.16%	39.24%	16.9	18.7
S, wt.%	27.88	2.181	23.52	32.24	21.34	34.42	7.82%	15.65%	23.47%	26.49	29.27
Sb, ppm	7696	323	7050	8343	6727	8666	4.20%	8.40%	12.60%	7312	8081
Sc, ppm	1.07	0.100	0.87	1.27	0.77	1.37	9.35%	18.70%	28.05%	1.02	1.12
Sn, ppm	4.03	0.59	2.84	5.22	2.25	5.82	14.76%	29.52%	44.28%	3.83	4.23
Sr, ppm	16.4	3.1	10.3	22.5	7.3	25.6	18.59%	37.19%	55.78%	15.6	17.2
Ta, ppm	0.091	0.013	0.065	0.117	0.052	0.130	14.42%	28.84%	43.25%	0.086	0.095
Th, ppm	3.84	0.71	2.43	5.26	1.72	5.97	18.45%	36.89%	55.34%	3.65	4.04
Ti, wt.%	0.027	0.003	0.021	0.033	0.017	0.037	11.82%	23.64%	35.47%	0.026	0.028
Tl, ppm	12.8	0.57	11.7	14.0	11.1	14.5	4.42%	8.83%	13.25%	12.2	13.5
U, ppm	2.19	0.136	1.92	2.47	1.78	2.60	6.20%	12.41%	18.61%	2.08	2.30
Y, ppm	5.98	0.75	4.47	7.48	3.72	8.23	12.57%	25.13%	37.70%	5.68	6.28
Zn, wt.%	18.44	0.449	17.54	19.33	17.09	19.78	2.43%	4.87%	7.30%	17.52	19.36
Zr, ppm	34.0	2.14	29.7	38.2	27.5	40.4	6.30%	12.59%	18.89%	32.3	35.7
Peroxide Fusion ICP											
Al, wt.%	0.789	0.019	0.750	0.827	0.731	0.846	2.42%	4.83%	7.25%	0.749	0.828
As, ppm	6140	270	5600	6680	5330	6950	4.40%	8.80%	13.20%	5833	6447
Ba, ppm	1950	57	1836	2064	1779	2122	2.93%	5.86%	8.79%	1853	2048
Bi, ppm	88	6.2	75	100	69	106	7.13%	14.26%	21.39%	83	92
Cd, ppm	433	26	381	485	355	511	5.99%	11.97%	17.96%	411	455
Ce, ppm	22.2	2.19	17.8	26.5	15.6	28.7	9.88%	19.75%	29.63%	21.1	23.3
Co, ppm	7.81	0.764	6.28	9.34	5.52	10.10	9.78%	19.56%	29.34%	7.42	8.20
Cs, ppm	0.77	0.12	0.54	1.01	0.42	1.13	15.31%	30.62%	45.94%	0.73	0.81

SI unit equivalents: ppm (parts per million; 1×10^{-6}) \equiv mg/kg; wt.% (weight per cent) \equiv % (mass fraction).

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
Peroxide Fusion ICP continued											
Cu, wt.%	17.32	0.233	16.85	17.79	16.62	18.02	1.35%	2.69%	4.04%	16.45	18.19
Dy, ppm	1.33	0.15	1.04	1.63	0.89	1.78	11.04%	22.08%	33.12%	1.27	1.40
Er, ppm	0.80	0.071	0.65	0.94	0.58	1.01	8.96%	17.91%	26.87%	0.76	0.84
Fe, wt.%	17.28	0.323	16.64	17.93	16.32	18.25	1.87%	3.74%	5.61%	16.42	18.15
Ga, ppm	3.69	0.49	2.71	4.67	2.22	5.16	13.30%	26.60%	39.90%	3.50	3.87
Gd, ppm	1.62	0.25	1.12	2.11	0.87	2.36	15.35%	30.71%	46.06%	1.54	1.70
Ge, ppm	< 1	IND	IND	IND	IND	IND	IND	IND	IND	IND	IND
Ho, ppm	0.27	0.03	0.20	0.33	0.17	0.36	11.93%	23.85%	35.78%	0.25	0.28
In, ppm	16.1	0.72	14.7	17.6	14.0	18.3	4.46%	8.93%	13.39%	15.3	16.9
K, wt.%	0.351	0.034	0.283	0.418	0.249	0.452	9.63%	19.26%	28.88%	0.333	0.368
La, ppm	11.6	0.95	9.7	13.5	8.8	14.5	8.15%	16.31%	24.46%	11.1	12.2
Mg, wt.%	0.129	0.007	0.116	0.143	0.109	0.150	5.30%	10.60%	15.90%	0.123	0.136
Mn, wt.%	0.384	0.013	0.358	0.410	0.345	0.423	3.38%	6.76%	10.14%	0.365	0.403
Mo, ppm	147	9	130	165	121	174	5.92%	11.83%	17.75%	140	155
Nd, ppm	9.62	1.24	7.13	12.11	5.88	13.35	12.94%	25.89%	38.83%	9.14	10.10
Pb, wt.%	8.08	0.192	7.70	8.47	7.51	8.66	2.38%	4.76%	7.14%	7.68	8.49
Pr, ppm	2.48	0.187	2.11	2.86	1.92	3.04	7.52%	15.03%	22.55%	2.36	2.61
Rb, ppm	19.0	1.15	16.7	21.3	15.6	22.4	6.04%	12.09%	18.13%	18.0	19.9
S, wt.%	30.03	0.742	28.54	31.51	27.80	32.26	2.47%	4.94%	7.41%	28.53	31.53
Sb, ppm	7895	587	6721	9068	6134	9655	7.43%	14.87%	22.30%	7500	8289
Sc, ppm	< 10	IND	IND	IND	IND	IND	IND	IND	IND	IND	IND
Si, wt.%	1.79	0.047	1.70	1.88	1.65	1.93	2.61%	5.23%	7.84%	1.70	1.88
Sm, ppm	1.77	0.134	1.50	2.04	1.37	2.17	7.55%	15.11%	22.66%	1.68	1.86
Sr, ppm	24.2	3.4	17.3	31.1	13.8	34.5	14.26%	28.51%	42.77%	23.0	25.4
Tb, ppm	0.23	0.04	0.15	0.31	0.12	0.35	16.82%	33.65%	50.47%	0.22	0.24
Te, ppm	< 5	IND	IND	IND	IND	IND	IND	IND	IND	IND	IND
Th, ppm	4.53	0.54	3.44	5.62	2.90	6.17	12.01%	24.03%	36.04%	4.31	4.76
Ti, wt.%	0.031	0.003	0.026	0.037	0.023	0.040	9.22%	18.44%	27.66%	0.030	0.033
Tl, ppm	12.0	1.04	9.9	14.1	8.9	15.1	8.65%	17.30%	25.96%	11.4	12.6
Tm, ppm	0.11	0.02	0.08	0.15	0.06	0.17	15.66%	31.32%	46.98%	0.11	0.12
U, ppm	2.32	0.39	1.55	3.09	1.16	3.48	16.65%	33.30%	49.95%	2.20	2.43
W, ppm	4.76	0.49	3.79	5.74	3.30	6.22	10.24%	20.48%	30.72%	4.52	5.00
Y, ppm	7.28	0.443	6.40	8.17	5.95	8.61	6.08%	12.15%	18.23%	6.92	7.65
Yb, ppm	0.78	0.13	0.53	1.04	0.40	1.17	16.35%	32.71%	49.06%	0.74	0.82
Zn, wt.%	18.49	0.526	17.44	19.54	16.91	20.07	2.85%	5.69%	8.54%	17.56	19.41
Ion Selective Electrode											
F, ppm	330	39	253	407	214	446	11.69%	23.39%	35.08%	314	347
Infrared Combustion											
S, wt.%	30.04	0.979	28.08	32.00	27.10	32.98	3.26%	6.52%	9.78%	28.54	31.54

SI unit equivalents: ppm (parts per million; 1×10^{-6}) \equiv mg/kg; wt.% (weight per cent) \equiv % (mass fraction).

Note 1: intervals may appear asymmetric due to rounding; IND = indeterminate.

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.

Homogeneity Evaluation

The tolerance limits (ISO 16269:2014) shown in Tables 1 and 2 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 classical wet chemistry, where 99% of the time ($1-\alpha=0.99$) at least 95% of subsamples ($\rho=0.95$) will have concentrations lying between 17.10 and 17.17 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.

The homogeneity of gold has been determined by INAA at ANSTO, Lucas Heights using the reduced analytical subsample method which utilises the known relationship between standard deviation and analytical subsample weight (Ingamells and Switzer, 1973 [2]). 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.

Table 6 below shows the gold INAA data determined on 20 x 85mg subsamples of OREAS 990c. An equivalent scaled version of the results is also provided to demonstrate an appreciation of what this data means if 10g fire assays were undertaken without the normal measurement error associated with this methodology. In this instance, the 1RSD of 0.30% calculated for a 10g fire assay sample (3.26% at 85mg weights) confirms the high level of gold homogeneity in OREAS 990c.

Homogeneity has also been evaluated in an Analysis of Variance (**ANOVA**) of the INAA data. The 20 samples were comprised of paired samples from 10g samples taken from each of the ten 600g test units (representative of the entire prepared batch) and were randomised prior to assigning sample numbers. The duplicate samples enabled an ANOVA by comparison of within- and between-unit variances across the 10 pairs. The purpose of the ANOVA 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. The test was performed using the following parameters:

- Gold by INAA – 20 results (1 laboratory providing duplicate analyses on 10 samples where each sample can be viewed as a ‘unit’);
- 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.

The data was not filtered for outliers prior to the calculation of the p -value. This process derived a p -value of 0.072, a statistically insignificant result so the Null Hypothesis is accepted. It is important to note that ANOVA is not an absolute measure of homogeneity. Rather, it establishes whether or not gold is uniformly distributed throughout the prepared batch of OREAS 151c and whether the variance between two subsamples from the same test unit is statistically indistinguishable from the variance of two subsamples taken from any two separate test units. A reference material therefore can possess poor absolute homogeneity yet still pass a relative homogeneity (ANOVA) test if the within-unit heterogeneity is large and similar across all units.

Each of the fifteen geoanalytical laboratories received six samples made up of paired samples from three different, non-adjacent sampling intervals permitting a nested ANOVA study. A test of these data was conducted for elements present in concentrations at least 20 times the lower limits of detection for the various methods involved. No significant *p*-values were found indicating that no evidence exists 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 990c is fit-for-purpose as a certified reference material (see 'Intended Use' below).

Table 6. Neutron Activation Analysis of Au (in ppm) on 20 x 85mg subsamples and showing the equivalent results scaled to a 10g sample mass typical of fire assay determination.

Replicate No	Au 85mg actual	Au 10g equivalent*
1	35.86	36.206
2	36.83	36.296
3	37.01	36.312
4	36.22	36.239
5	37.20	36.329
6	35.62	36.183
7	36.33	36.249
8	36.55	36.269
9	38.58	36.457
10	39.04	36.500
11	35.57	36.179
12	34.68	36.096
13	34.75	36.103
14	35.37	36.160
15	34.87	36.114
16	34.78	36.105
17	36.14	36.231
18	35.83	36.202
19	36.79	36.292
20	36.77	36.290
Mean	36.241	36.241
Median	36.180	36.235
Std Dev.	1.180	0.109
Rel.Std.Dev.	3.26%	0.30%

*Results calculated for a 10g equivalent sample mass using the formula: $x^{10g Eq} = \frac{(x^{INAA} - \bar{X}) \times RSD@10g}{RSD@85mg} + \bar{X}$

where $x^{10g Eq}$ = equivalent result calculated for a 10g sample mass

(x^{INAA}) = raw INAA result at 85mg

\bar{X} = mean of 85mg INAA results

PARTICIPATING LABORATORIES

1. ♦*Actlabs, Ancaster, Ontario, Canada
2. *AGAT Laboratories, Calgary, Alberta, Canada
3. *AGAT Laboratories, Mississauga, Ontario, Canada
4. ♦AH Knight, St Helens, Merseyside, UK
5. ♦AH Knight, Tianjin, China
6. *ALS, Lima, Peru
7. ALS, Loughrea, Galway, Ireland
8. *ALS, Vancouver, BC, Canada
9. ♦ALS Inspection, Prescot, Merseyside, UK
10. ANSTO, Lucas Heights, NSW, Australia
11. ♦Bachelet, Angleur, Liege, Belgium
12. *Bureau Veritas Commodities Canada Ltd, Vancouver, BC, Canada
13. ♦Erdenet Central Chemical Laboratory, Erdenet, Orkhon province, Mongolia
14. ♦Independent, Perth, WA, Australia
15. ♦*Inspectorate (BV), Lima, Peru
16. ♦Inspectorate (BV), Shanghai, Bao Shan District, China
17. ♦Inspectorate (BV), Witham, Essex, UK
18. *Intertek Genalysis, Perth, WA, Australia
19. ♦Intertek LSI, Rotterdam, Zuid-Holland, Netherlands
20. *Intertek Testing Services Philippines, Cupang, Muntinlupa, Philippines
21. *PT Geoservices Ltd, Cikarang, Jakarta Raya, Indonesia
22. *PT Intertek Utama Services, Jakarta Timur, DKI Jakarta, Indonesia
23. ♦RCI Analytical Services BV, Oosterhout, Netherlands
24. *SGS de Mexico SA de CV, Cd. Industrial, Durango, Mexico
25. ♦SGS Lakefield Research Ltd, Lakefield, Ontario, Canada
26. *Shiva Analyticals Ltd, Bangalore North, Karnataka, India
27. ♦SRL, Perth, WA, Australia

♦ = Umpire laboratory (classical methods); * = Geoanalytical laboratory (instrumental methods).

Please note: To preserve anonymity, the above numbered alphabetical list of participating laboratories does not correspond with the Lab ID numbering on the scatter plots below.

Figure 1. Cu by Classical Wet Chemistry in OREAS 990c

SPC.1723.RR1.OREAS 990c.5.Classical.Cu.Lab.230822.173530.SN

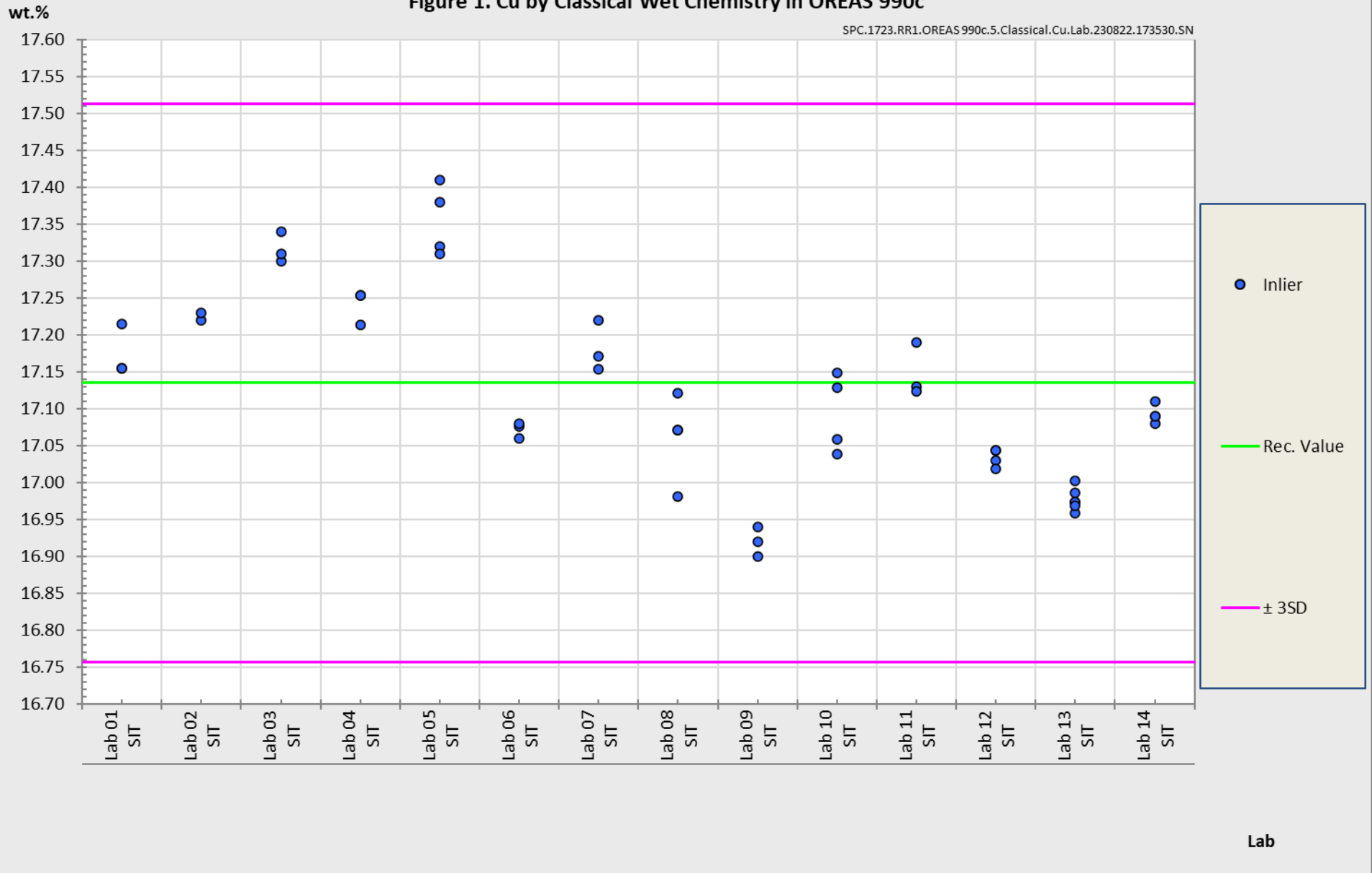


Figure 2. Ag by Fire Assay (Grav) in OREAS 990c

SPC.1723.RR1.OREAS 990c.5.Fire Assay.Ag.Lab.230824.162900.SN

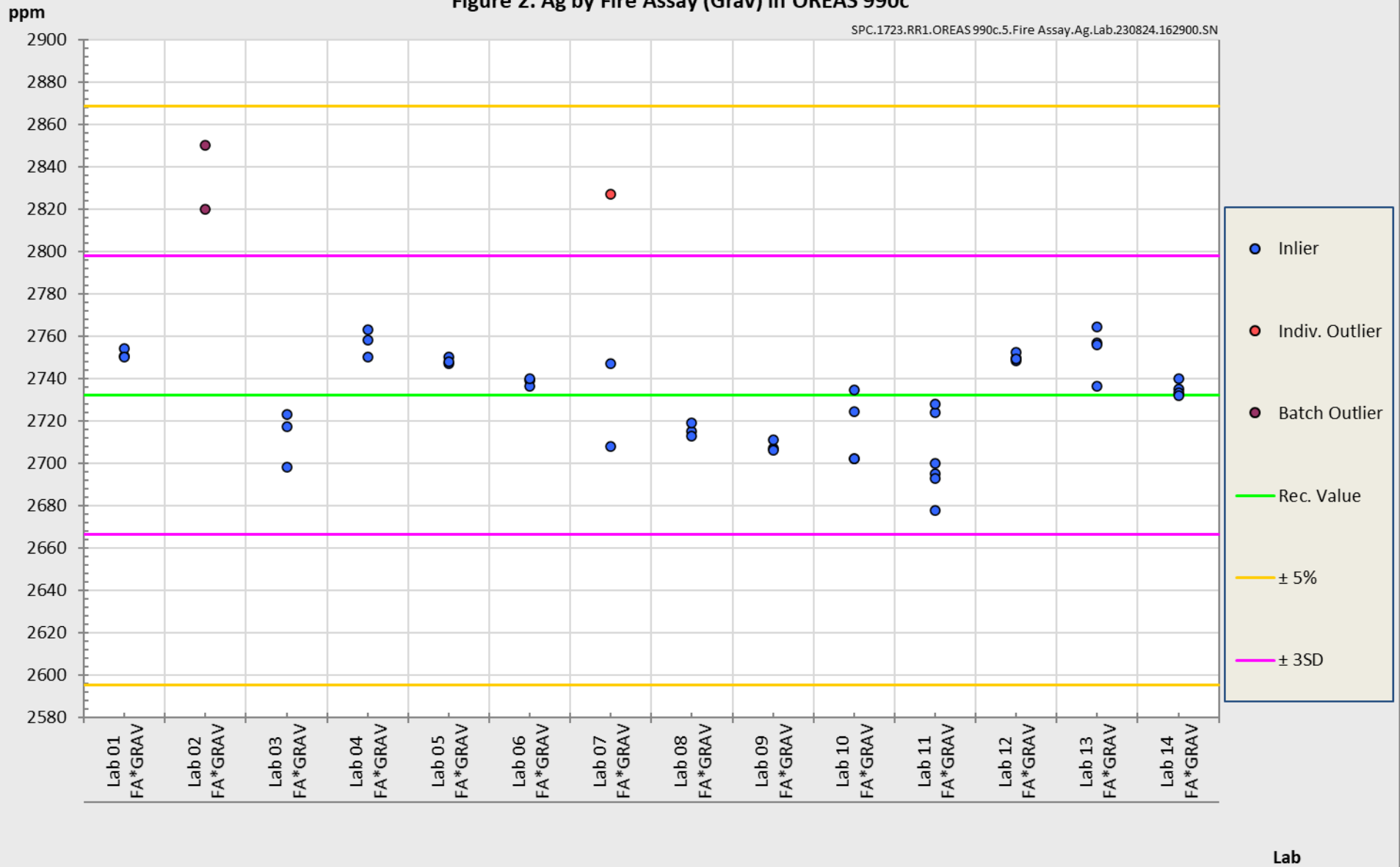
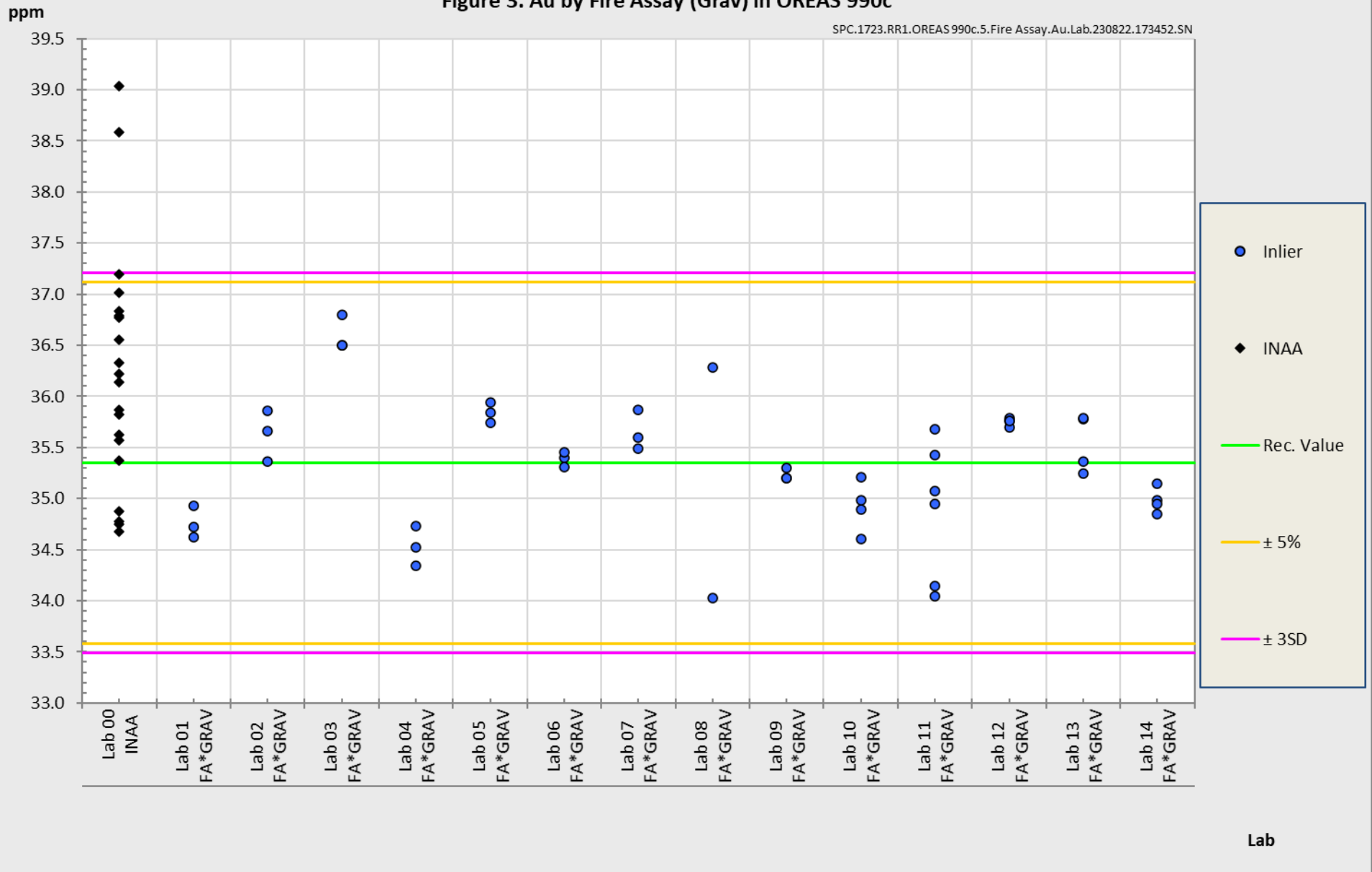


Figure 3. Au by Fire Assay (Grav) in OREAS 990c

SPC.1723.RR1.OREAS 990c.5.Fire Assay.Au.Lab.230822.173452.SN



PREPARER AND SUPPLIER

Certified reference material OREAS 995 is prepared, certified and supplied by:



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METROLOGICAL TRACEABILITY

The interlaboratory results that underpin the certified values are metrologically traceable to the international measurement scale (SI) of mass (either as a % mass fraction or as milligrams per kilogram (mg/kg)). In line with popular use, all data within tables in this certificate are expressed as the mass fraction in either weight percent (wt.%) or parts per million (ppm).

The analytical samples sent to participating laboratories were selected in a manner to be representative of the entire prepared batch of 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. The systematic sampling method was chosen due to the low risk of overlooking repetitive effects or trends in the batch due to the way the CRM was processed. In line with ISO 17025 [9], each analytical data set received from the participating laboratories has been validated by its assayer through the inclusion of internal reference materials and QC checks during and post analysis.

The participating laboratories were chosen on the basis of their competence (from past performance in interlaboratory programs undertaken by ORE Pty Ltd) for a particular analytical method, analyte or analyte suite and sample matrix. These laboratories are accredited to ISO 17025 for Cu, Ag and Au determined by classical methodologies and elements by 4-acid digestion. The other operationally defined measurands characterised in this certificate are derived from data procured mostly from ISO 17025 accredited laboratories. The certified values presented in this report are calculated from the means of accepted data following robust technical and statistical analysis 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 procedure is possible. In this case, it is impossible to demonstrate absence of method bias; therefore, the result is an operationally defined measurand (ISO Guide 35:2017, 9.2.4c)."* Certification takes place on the basis of agreement among operationally defined, independent measurement results.

COMMUTABILITY

The measurements of the results that underlie the certified values contained in this report were undertaken by methods involving pre-treatment (fusion/digestion) 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 'metallurgical concentrate' 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 the field samples being analysed.

INTENDED USE

OREAS 990c 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 990c may be used to calibrate the entire procedure by producing a pure substance CRM transformed into a calibration solution.

OREAS 990c is intended for the following uses:

- For the monitoring of laboratory performance in the analysis of analytes reported in Tables 1 and 2 in geological samples;
- For the verification of analytical methods for analytes reported in Tables 1 and 2;
- For the calibration of instruments used in the determination of the concentration of analytes reported in Tables 1 and 2. When a value provided in this certificate is used to calibrate a measurement process, the uncertainty associated with that value should be appropriately propagated into the user's uncertainty calculation. Users can determine an approximation of the standard uncertainty by calculating one fourth of the width of the Expanded Uncertainty interval given in this certificate (Expanded Uncertainty intervals are provided in Tables 1 and 2).

MINIMUM SAMPLE SIZE

To relate analytical determinations to the values in this certificate, the minimum mass of sample used should match the typical mass that the laboratories used in the interlaboratory (round robin) certification program. This means that different minimum sample masses should be used depending on the operationally defined methodology as follows:

- Cu by classical wet chemistry: $\geq 0.5\text{g}$;
- Ag and Au by fire assay with gravimetric finish and full corrections: $\geq 0.5\text{g}$;
- 4-acid digestion with ICP-OES and/or MS finish: $\geq 0.25\text{g}$;
- Peroxide fusion with ICP-OES and/or MS finish: $\geq 0.1\text{g}$;
- Fluorine by ion selective electrode: $\geq 0.2\text{g}$;
- Total S by Infrared combustion furnace/CS analyser: $\geq 0.1\text{g}$.

PERIOD OF VALIDITY & STORAGE INSTRUCTIONS

OREAS 990c is high in reactive sulphide content and has been packaged under a nitrogen environment in robust laminated foil pouches in single-use 10g and 50g units. In its unopened state in the sachets (sealed under nitrogen), OREAS 990c has a shelf life of at least ten years (until August 2033).

Store in a clean and cool dry place away from direct sunlight.

INSTRUCTIONS FOR HANDLING & CORRECT USE

Pre-homogenisation of the CRM prior to subsampling and analysis is not necessary as there is no particle segregation under transport [13].

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

Umpire laboratories using classical methods:

The umpire laboratory certified values for Cu, Ag and Au refer to the concentration levels on a dry sample basis. At each laboratory analyses were performed on the sample as received (without drying) with the subsample for moisture analysis weighed simultaneously with the subsamples for Au and Cu assay. The Au and Cu data was then corrected to dry basis using the moisture value obtained at each laboratory.

With the exception of one laboratory, moisture content varied amongst the laboratories from 0.07-0.40% with a best consensus mean of 0.144%. The indicative value provided for moisture (H₂O-) should be viewed as informational only. Hygroscopic moisture is a dynamic property of pulp materials and will vary in response to the local laboratory atmosphere following equilibration.

Geoanalytical laboratories using instrumental methods:

All analyses were performed on the samples as received and reported as such in line with conventional instrumental method procedures.

QC monitoring using multiples of the Standard Deviation (SD)

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 interlaboratory 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.

The performance gates shown in Table 5 are intended only to be used as a preliminary guide as to what a laboratory may be able to achieve. Over a period of time monitoring your own laboratory's data for this CRM, SD's should be calculated directly from your own

laboratory's process. This will enable you to establish more specific performance gates that are fit for purpose for your application as well as the ability to monitor bias. If your long-term trend analysis shows an average value that is within the 95% expanded uncertainty interval then generally there is no cause for concern in regard to bias.

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DOCUMENT HISTORY

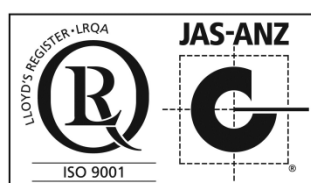
Revision No.	Date	Changes applied
0	28 th September, 2023	First publication.

QMS CERTIFICATION

ORE Pty Ltd is accredited for compliance with ISO 17034.



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



CERTIFYING OFFICER

A handwritten signature in blue ink, appearing to read "Craig Hamlyn".

28th September, 2023

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

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