Ore Research & Exploration P/L **ABN** 28 006 859 856
37A Hosie Street, Bayswater North, VIC 3153, Australia
P +61 3 9729 0333 | **E** info@ore.com.au | **oreas.com**

CERTIFICATE OF ANALYSIS FOR

CERTIFIED REFERENCE MATERIAL

OREAS 993b

Copper-Gold Concentrate, Orange, NSW, Australia

Table 1. Certified Value, Uncertainty & Tolerance Intervals for Cu by titration in OREAS 993b.

Constituent	Certified Value†	95 % Expanded Uncertainty		95 % Tolerance Limits	
		Low	High	Low	High
Umpire Laboratories (dry sample basis)					
Classical Wet Chemistry					
Cu, Copper (wt.%)	23.45	23.42	23.47	23.42	23.47

SI unit equivalents: wt.% (weight per cent) ≡ % (mass fraction).

†The operationally defined measurand meets the requirements of ISO 17034 [10] and all participating laboratories comply with the requirements of ISO 17025 [9].

Note: intervals may appear asymmetric due to rounding.

Table 2. Certified Value, Uncertainty & Tolerance Intervals for Au by fire assay (full corrections) and Ag by acid digestion (no HF) in OREAS 993b.

Constituent	Certified Value	95 % Expanded Uncertainty		95 % Tolerance Limits	
		Low	High	Low	High
Umpire Laboratories (dry sample basis)					
Pb Fire Assay (full corrections)					
Au, Gold (ppm)	33.32	32.91	33.73	32.87*	33.76*
Acid Digestion (no HF)					
Ag, Silver (ppm)	40.6	39.7	41.5	40.4	40.8

SI unit equivalents: ppm (parts per million; 1 x 10^{-6}).

*Gold Tolerance Limits for typical 10g fire assay methods are determined from 10 x 1 g INAA results and the Sampling Constant (Ingamells & Switzer, 1973).

Note: intervals may appear asymmetric due to rounding.

Table 3. Certified Values, Uncertainty & Tolerance Intervals for multi-elements by 4-acid digestion and S by infrared combustion in OREAS 993b.

Constituent	Certified Value†	95 % Expanded Uncertainty		95 % Tolerance Limits	
		Low	High	Low	High
Geoanalytical Laboratories ('as received' sample basis)					
4-Acid Digestion					
Ag, Silver (ppm)	40.4	39.2	41.5	39.7	41.0
As, Arsenic (ppm)	103	94	111	98	107
Ba, Barium (ppm)	96	79	112	92	99
Be, Beryllium (ppm)	< 0.5	IND	IND	IND	IND
Bi, Bismuth (ppm)	22.9	21.3	24.4	22.3	23.4
Ca, Calcium (wt.%)	0.827	0.802	0.851	0.811	0.843
Cd, Cadmium (ppm)	15.0	14.1	15.8	14.4	15.5
Ce, Cerium (ppm)	16.8	15.3	18.3	16.2	17.4
Co, Cobalt (ppm)	154	149	159	151	157
Cr, Chromium (ppm)	57	53	61	55	59
Cs, Caesium (ppm)	0.65	0.58	0.72	0.62	0.67
Cu, Copper (wt.%)	23.58	23.10	24.06	23.37	23.79
Dy, Dysprosium (ppm)	1.05	0.88	1.22	IND	IND
Er, Erbium (ppm)	0.60	0.49	0.71	IND	IND
Fe, Iron (wt.%)	24.53	23.78	25.28	24.18	24.88
Ga, Gallium (ppm)	4.14	3.88	4.40	3.97	4.31
Gd, Gadolinium (ppm)	1.30	1.07	1.52	IND	IND
Ge, Germanium (ppm)	0.45	0.17	0.72	0.38	0.51
Hf, Hafnium (ppm)	0.71	0.63	0.79	0.64	0.78
Ho, Holmium (ppm)	0.20	0.19	0.21	IND	IND
In, Indium (ppm)	1.45	1.38	1.53	1.40	1.51

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

Note: intervals may appear asymmetric due to rounding.

†These operationally defined measurands meet the requirements of ISO 17034 [10] and all participating laboratories comply with the requirements of ISO 17025 [9].

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 continued.

Constituent	Certified Value†	95 % Expanded Uncertainty		95 % Tolerance Limits	
		Low	High	Low	High
Geoanalytical Laboratories ('as received' sample basis)					
4-Acid Digestion continued					
K, Potassium (wt.%)	0.668	0.641	0.696	0.654	0.683
La, Lanthanum (ppm)	10.2	9.3	11.1	9.8	10.6
Li, Lithium (ppm)	23.7	22.4	24.9	22.7	24.6
Mg, Magnesium (wt.%)	0.443	0.422	0.464	0.432	0.454
Mn, Manganese (wt.%)	0.014	0.013	0.015	0.014	0.014
Mo, Molybdenum (wt.%)	0.219	0.209	0.229	0.215	0.222
Na, Sodium (wt.%)	0.430	0.416	0.444	0.418	0.442
Nb, Niobium (ppm)	1.87	1.71	2.02	1.75	1.98
Nd, Neodymium (ppm)	7.32	6.58	8.06	6.97	7.67
Ni, Nickel (ppm)	256	246	265	250	261
P, Phosphorus (wt.%)	0.020	0.019	0.021	0.019	0.021
Pb, Lead (ppm)	469	448	491	462	477
Pr, Praseodymium (ppm)	1.94	1.70	2.18	IND	IND
Rb, Rubidium (ppm)	22.9	21.4	24.4	22.0	23.8
Re, Rhenium (ppm)	4.54	4.02	5.06	4.31	4.77
S, Sulphur (wt.%)	27.19	25.61	28.76	26.78	27.59
Sb, Antimony (ppm)	49.1	45.4	52.8	47.4	50.8
Sc, Scandium (ppm)	5.75	5.25	6.26	5.65	5.86
Se, Selenium (ppm)	189	172	206	182	196
Sn, Tin (ppm)	1.96	1.75	2.16	1.78	2.14
Sr, Strontium (ppm)	159	153	165	157	162
Ta, Tantalum (ppm)	0.099	0.091	0.106	IND	IND
Tb, Terbium (ppm)	0.19	0.17	0.21	IND	IND
Te, Tellurium (ppm)	9.94	8.86	11.03	9.26	10.62
Th, Thorium (ppm)	2.05	1.89	2.21	2.00	2.10
Ti, Titanium (wt.%)	0.118	0.114	0.122	0.115	0.121
Tl, Thallium (ppm)	0.29	0.25	0.33	0.27	0.31
U, Uranium (ppm)	0.80	0.74	0.87	0.74	0.86
V, Vanadium (ppm)	63	60	66	61	65
W, Tungsten (ppm)	2.47	2.27	2.68	2.31	2.63
Y, Yttrium (ppm)	5.63	5.23	6.02	5.40	5.85
Yb, Ytterbium (ppm)	0.58	0.46	0.71	IND	IND
Zn, Zinc (wt.%)	0.332	0.317	0.347	0.327	0.338
Zr, Zirconium (ppm)	27.3	25.5	29.1	26.4	28.1
Infrared Combustion					
S, Sulphur (wt.%)	29.67	29.03	30.32	29.37	29.97

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

†These operationally defined measurands meet the requirements of ISO 17034 [10] and all participating laboratories comply with the requirements of ISO 17025 [9]. Note: intervals may appear asymmetric due to rounding;

IND = indeterminate (due to limited reading resolution of the methods employed).

Table 4. Certified Values, Uncertainty & Tolerance Intervals for other measurands in OREAS 993b.

Constituent	Certified Value	95 % Expanded Uncertainty		95 % Tolerance Limits	
		Low	High	Low	High
Geoanalytical Laboratories ('as received' sample basis)					
Pb Fire Assay					
Au, Gold (ppm)	33.65	32.37	34.92	33.39	33.91
Pd, Palladium (ppb)	309	297	321	302	317
Pt, Platinum (ppb)	44.2	39.3	49.1	42.1	46.3
Geoanalytical Laboratories (dry sample basis)					
Oxidising Fusion XRF					
Al_2O_3, Aluminium(III) oxide (wt.%)	3.53	3.40	3.66	3.48	3.58
CaO, Calcium oxide (wt.%)	1.16	1.11	1.20	1.14	1.18
Co, Cobalt (ppm)	193	172	214	IND	IND
Cu, Copper (wt.%)	23.61	23.10	24.11	23.27	23.94
Fe, Iron (wt.%)	24.63	23.99	25.28	24.35	24.92
K_2O, Potassium oxide (wt.%)	0.842	0.812	0.872	0.827	0.857
MgO, Magnesium oxide (wt.%)	0.734	0.690	0.778	0.720	0.748
Mo, Molybdenum (wt.%)	0.225	0.199	0.250	0.211	0.238
Ni, Nickel (ppm)	233	177	290	172	295
P, Phosphorus (wt.%)	0.028	0.025	0.032	IND	IND
S, Sulphur (wt.%)	29.57	28.97	30.18	29.31	29.83
SiO_2, Silicon dioxide (wt.%)	11.54	11.08	12.01	11.41	11.67
Sn, Tin (ppm)	< 100	IND	IND	IND	IND
TiO_2, Titanium dioxide (wt.%)	0.202	0.183	0.221	0.192	0.211
W, Tungsten (ppm)	< 10	IND	IND	IND	IND
Zn, Zinc (wt.%)	0.332	0.311	0.354	0.327	0.338
Geoanalytical Laboratories ('as received' sample basis)					
Thermogravimetry					
LOI^{1000}, Loss on ignition @1000 °C (wt.%)	15.21	14.94	15.47	15.08	15.33
Aqua Regia Digestion					
Hg, Mercury (ppm)	1.07	1.00	1.13	1.04	1.09
Ion Selective Electrode					
F, Fluorine (ppm)	657	630	684	631	683
3-Acid Digestion (no HF)					
Ag, Silver (ppm)	38.9	36.5	41.4	38.2	39.6
As, Arsenic (ppm)	107	100	114	103	110
Co, Cobalt (ppm)	151	145	158	148	154
Ni, Nickel (ppm)	253	238	268	248	258
Pb, Lead (ppm)	465	439	490	457	472
Zn, Zinc (wt.%)	0.342	0.326	0.358	0.336	0.348

SI unit equivalents: ppb (parts per billion; 1 x 10^{-9}) ≡ μg/kg; ppm (parts per million; 1 x 10^{-6}) ≡ mg/kg; wt.% (weight per cent) ≡ % (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 5. Indicative Values for OREAS 993b.

Constituent	Unit	Value	Constituent	Unit	Value	Constituent	Unit	Value
Umpire Laboratories ('as received' sample basis)								
Thermogravimetry								
H_2O-	wt.%	*0.440*						
Geoanalytical Laboratories (dry sample basis)								
Oxidising Fusion XRF								
As	ppm	*108*	Hg	ppm	*< 100*	Se	ppm	*183*
Ba	ppm	*213*	In	ppm	*< 100*	Sr	ppm	*163*
Bi	ppm	*101*	La_2O_3	ppm	*119*	Ta	ppm	*92*
Cd	ppm	*94*	Mn	wt.%	*0.013*	Te	ppm	*< 100*
CeO_2	ppm	*< 100*	Na	wt.%	*0.431*	Tl	ppm	*< 100*
Cl	ppm	*226*	Nb	ppm	*213*	U	ppm	*< 100*
Cr	ppm	*123*	Pb	ppm	*651*	V	ppm	*82*
Cs	ppm	*< 100*	Rb	ppm	*< 50*	Y_2O_3	ppm	*152*
Ga	ppm	*< 100*	Re	ppm	*< 100*	Zr	ppm	*133*
Ge	ppm	*< 100*	Sb	ppm	*52*			
HfO_2	ppm	*< 100*	Sc	ppm	*< 10*			
Geoanalytical Laboratories ('as received' sample basis)								
Infrared Combustion								
C	wt.%	*0.156*						
Ion Selective Electrode								
Cl	ppm	*98*						
4-Acid Digestion								
Al	wt.%	*1.86*	Hg	ppm	*0.64*	Tm	ppm	*< 0.1*
B	ppm	*92*	Lu	ppm	*0.079*			
Eu	ppm	*0.40*	Sm	ppm	*1.54*			
3-Acid Digestion (no HF)								
Al	wt.%	*0.768*	In	ppm	*< 10*	Sc	ppm	*4.17*
Ba	ppm	*13.6*	K	wt.%	*0.189*	Se	ppm	*160*
Be	ppm	*< 0.5*	La	ppm	*9.24*	Sn	ppm	*< 10*
Bi	ppm	*13.9*	Li	ppm	*20.1*	Sr	ppm	*95*
Ca	wt.%	*0.715*	Mg	wt.%	*0.405*	Te	ppm	*17.2*
Cd	ppm	*13.8*	Mn	wt.%	*0.013*	Ti	wt.%	*0.080*
Ce	ppm	*8.50*	Mo	wt.%	*0.221*	Tl	ppm	*< 5*
Cr	ppm	*48.4*	Na	wt.%	*0.090*	U	ppm	*< 10*
Cu	wt.%	*22.18*	Nb	ppm	*< 10*	V	ppm	*47.5*
Fe	wt.%	*24.99*	P	wt.%	*0.018*	W	ppm	*< 10*
Ga	ppm	*< 5*	Re	ppm	*< 5*	Y	ppm	*4.83*
Ge	ppm	*< 10*	S	wt.%	*30.51*	Zr	ppm	*13.7*
Hg	ppm	*< 1*	Sb	ppm	*12.2*			

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

Reference materials are intended to provide a method of evaluating and improving the quality of analysis of geological and downstream metallurgical samples. To the analyst they provide an effective means of calibrating analytical equipment, assessing new techniques and routinely monitoring in-house procedures. OREAS prepared 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.

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 (PDM[3]) are presented in the detailed certification data for this CRM (**OREAS 993b-DataPack.1.0.250211_193802.xlsx**).

Results are also presented in scatter plots for Cu by classical wet chemistry, Au by fire assay with full corrections and Mo by 4-acid digestion methods in Figures 1 to 3 respectively, together with ±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 993b was prepared from a sample of copper-gold concentrate supplied by Newmont's Cadia Valley Operations located near Orange in New South Wales, Australia.

COMMINUTION AND HOMOGENISATION PROCEDURES

The material constituting OREAS 993b was prepared in the following manner:

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

PHYSICAL PROPERTIES

OREAS 993b was tested at ORE Research & Exploration Pty Ltd's onsite facility for various physical properties. Table 6 presents these findings that should be used for informational purposes only.

Table 6. Physical properties of OREAS 993b.

Bulk Density (kg/m^3)	Moisture (wt.%)	Munsell Notation‡	Munsell Colour‡
887	0.60	5GY 4/1	Dark Greenish Gray

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

MINERALOGY

The semi-quantitative XRD results shown in Table 7 below were undertaken by ALS Metallurgy in Balcatta, Western Australia. The results have been normalised to 100 % and represent the relative proportion of crystalline material. Totals greater or less than 100 % are due to rounding errors. The most representative minerals in the sample are chalcopyrite, followed by pyrite, plagioclase, quartz, chlorite, muscovite, Ca amphibole, K-Feldspar and annite - biotite - phlogopite. The presence of some amorphous material is very likely. Chalcopyrite might be slightly underestimated due to its poor crystallinity.

Table 7. Indicative mineralogy of OREAS 993b based on semi-quantitative XRD analysis.

Mineral / Mineral Group	% (mass ratio)
Chlorite	2
Annite - biotite - phlogopite	1
Muscovite	1
Ca amphibole	1
Plagioclase	4
K-feldspar	1
Quartz	3
Pyrite	39
Chalcopyrite	49
Molybdenite	< 1
Gypsum	< 1

ANALYTICAL PROGRAM

For the interlaboratory ‘round robin’ certification program, a 1.2 kg sample was taken at each of 12 predetermined sampling intervals immediately following homogenisation and are considered representative of the entire prepared batch of OREAS 993b.

Umpire Laboratories

Eighteen ‘umpire’ laboratories each received a single 85 g 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. 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 Cu, Au & 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 and Table 2 are on a dry sample basis (see also ‘Instructions for handling and correct use’ section below).**

The following analytical methods were undertaken:

- Copper (3 trials on undried sample) by classical wet chemistry (short iodide titration);
- Gold (3 trials on undried sample) by reduced charge weight (5-30g) fire assay with gravimetric finish and full corrections for slag, cupel and silver losses;
- Silver (3 trials on undried sample) by the laboratory's preferred method. This resulted in 3-acid digestion with AAS finish (9 laboratories) and ICP-MS finish (3 laboratories), aqua regia digestion with ICP-OES/AAS finish (2 laboratories), 4-acid digestion with ICP-OES finish (1 laboratory), acid digestion with AAS finish (1 laboratory) and fire assay with gravimetric finish (1 laboratory).

Geoanalytical Laboratories

Twenty-one geoanalytical laboratories also participated in the program where each laboratory received 6 x 100 g samples taken from either the odd or even sampling intervals in order to maximise representation. The laboratories were instructed to undertake the following analyses:

- 4-acid (HNO_3-HF-$HClO_4$-HCl) digestion with full suite ICP-OES and ICP-MS elemental packages (up to 17 laboratories depending on the element);
- Total S by infrared combustion furnace/CS analyser (16 laboratories);
- Pt and Pd by fire assay with ICP-OES (13 laboratories), ICP-MS (4 laboratories) and AAS (1 laboratory) finish. Eight laboratories also undertook Au by fire assay even though it wasn't requested (due to umpire labs covering this analysis). A range of finishes were used including gravimetric (3 laboratories), AAS (2 laboratories), ICP-OES (1 laboratory) and ICP-MS (1 laboratory);
- Oxidising borate fusion with X-ray fluorescence (up to 12 laboratories depending on the element);
- Thermogravimetry: Loss on Ignition (LOI) at 1000 °C (8 laboratories used a thermogravimetric analyser, 3 laboratories used a conventional muffle furnace and 1 laboratory included LOI with their fusion package);
- Hg by low level, aqua regia digestion with ICP-OES, ICP-MS or cold vapour AAS finish (16 laboratories);
- Fluorine by ion selective electrode (ISE), (13 laboratories);
- Ag, As, Co, Ni, Pb and Zn by 3-acid digestion with ICP-OES, ICP-MS or AAS finish (up to 12 laboratories depending on the element).

To evaluate homogeneity, Actlabs in Ancaster, Canada were sent 20 x 10 g pulp samples for Au determination using instrumental neutron activation analysis (INAA) on 1 g subsamples. The 20 samples were comprised of paired samples from 10 of the 12 sampling intervals and were randomised prior to assigning sample numbers. The paired samples enabled an Analysis of Variance (ANOVA) by comparison of within- and between-unit variances across the 10 pairs (see 'Homogeneity Evaluation' below).

STATISTICAL ANALYSIS

Certified Values and their uncertainty intervals (Table 1, 2, 3 and 4) 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.

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 [6] and [16]. All known or suspected sources of bias have been investigated or taken into account.

Indicative (uncertified) values (Table 5) 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 9) 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*** (see ‘Instructions for handling and correct use’ section for more detail).

Homogeneity Evaluation

The tolerance limits (ISO Guide 16269:2014) [7] shown in Tables 1 to 4, were determined using an analysis of precision errors method (a function of repeat analysis of the CRM) and are considered a conservative estimate of true homogeneity. The meaning of tolerance limits may be illustrated for Cu by classical wet chemistry (umpire laboratory data), where 99 % of the time (1-α=0.99) at least 95 % of subsamples (ρ=0.95) will have concentrations lying between 23.42 and 23.47 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 33405:2024-05 [5]). ***Please note that tolerance limits pertain to the homogeneity of the CRM only and should not be used as control limits for laboratory performance.***

For Au, tolerance limits were determined by INAA using the reduced analytical subsample method which utilises the known relationship between standard deviation and analytical subsample mass (Ingamells and Switzer, 1973 [2]). In this approach the latter parameter is substantially reduced to a point where most of the variability in replicate assays is due to inhomogeneity of the reference material and measurement error becomes negligible.

Table 8 below shows the gold INAA data determined on 20 x 1 g subsamples of OREAS 993b. An equivalent scaled version of the results is also provided to demonstrate an appreciation of what this data means if 30 g fire assays were undertaken without the normal measurement error associated with this methodology. In this instance, the 1RSD of 0.42 % calculated for a 10 g fire assay sample (1.30 % at 1 g weights) confirms a high level of gold homogeneity.

The homogeneity of OREAS 993b has also been evaluated in an Analysis of Variance (**ANOVA**) of the INAA data. The 20 samples were comprised of paired samples from 10 of the 12 sampling lot intervals 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 (sampling lot) units to that of the variance within (sampling lot) units. This allows an assessment of homogeneity across the entire prepared batch of OREAS 993b. The test was performed using the following parameters:

- Gold INAA – 20 results (1 laboratory providing duplicate analyses on 10 sampling lot intervals 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.

Table 8. Neutron Activation Analysis of Au (in ppm) on 20 x 1 g subsamples showing the equivalent results scaled to a typical fire assay (10 g sample mass) method.

Replicate	Au	Au
No	1 g actual	10 g equivalent*
1	33.50	33.69
2	33.50	33.69
3	33.70	33.76
4	34.20	33.92
5	34.60	34.05
6	33.40	33.66
7	32.90	33.50
8	33.60	33.73
9	34.00	33.85
10	33.80	33.79
11	34.20	33.92
12	34.00	33.85
13	33.50	33.69
14	34.00	33.85
15	34.00	33.85
16	33.20	33.60
17	34.20	33.92
18	34.40	33.98
19	33.20	33.60
20	33.80	33.79
Mean	33.785	33.785
Median	33.800	33.790
Std Dev.	0.438	0.142
Rel.Std.Dev.	**1.30%**	**0.42%**

*Results calculated for a 10g equivalent sample mass using the formula: $x^{10g\ Eq} = \frac{(x^{INAA} - \bar{X}) \times RSD@10g}{RSD@1g} + \bar{X}$

where $x^{10g\ Eq}$ = equivalent result calculated for a 10g sample mass
(x^{INAA}) = raw INAA result at 1g
$\bar{X}$ = mean of 1g INAA results

The data was not filtered for outliers prior to the calculation of the *p*-value. This process derived a *p*-value of 0.24, 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 the analytes are distributed in a similar manner throughout the packaging run of OREAS 993b and whether the variance between two subsamples from the same unit is statistically distinguishable from the variance of two subsamples taken from any two separate 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.

Based on the statistical analysis of ANOVA and the results of the interlaboratory certification program, it can be concluded that OREAS 993b is fit-for-purpose as a certified reference material (see 'Intended Use' below).

PERFORMANCE GATES

Table 9 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) ±10 %.

i.e., Certified Value ±10 % ±2DL [1].

Table 9. Performance Gates for OREAS 993b.

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.%	23.45	0.056	23.33	23.56	23.28	23.62	0.24%	0.48%	0.72%	22.27	24.62

SI unit equivalents: ppm (parts per million; 1 x 10^{-6}) ≡ mg/kg; wt.% (weight per cent) ≡ % (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 9 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
Umpire Labs (dry sample basis)											
Pb Fire Assay											
Au, ppm	33.32	0.564	32.19	34.45	31.62	35.01	1.69%	3.39%	5.08%	31.65	34.98
Acid Digestion (no HF)											
Ag, ppm	40.6	1.55	37.5	43.7	35.9	45.3	3.82%	7.64%	11.46%	38.6	42.6
Geoanalytical Laboratories ('as received' sample basis)											
Pb Fire Assay											
Au, ppm	33.65	1.301	31.05	36.25	29.75	37.55	3.87%	7.73%	11.60%	31.97	35.33
Pd, ppb	309	14	282	337	268	351	4.49%	8.98%	13.48%	294	325
Pt, ppb	44.2	4.9	34.5	53.9	29.6	58.8	10.98%	21.97%	32.95%	42.0	46.4
Geoanalytical Laboratories (dry sample basis)											
Oxidising Fusion XRF											
Al_2O_3, wt.%	3.53	0.111	3.31	3.75	3.20	3.86	3.14%	6.28%	9.42%	3.35	3.71
CaO, wt.%	1.16	0.054	1.05	1.27	1.00	1.32	4.66%	9.32%	13.98%	1.10	1.22
Co, ppm	193	15	164	222	149	237	7.59%	15.18%	22.77%	183	203
Cu, wt.%	23.61	0.297	23.01	24.20	22.72	24.50	1.26%	2.52%	3.78%	22.43	24.79
Fe, wt.%	24.63	0.711	23.21	26.06	22.50	26.77	2.89%	5.78%	8.66%	23.40	25.87
K_2O, wt.%	0.842	0.022	0.798	0.886	0.777	0.907	2.59%	5.18%	7.76%	0.800	0.884
MgO, wt.%	0.734	0.032	0.671	0.797	0.639	0.829	4.30%	8.60%	12.90%	0.697	0.771
Mo, wt.%	0.225	0.017	0.191	0.258	0.174	0.275	7.48%	14.95%	22.43%	0.213	0.236
Ni, ppm	233	37	160	307	123	343	15.71%	31.42%	47.13%	222	245
P, wt.%	0.028	0.003	0.022	0.035	0.019	0.038	11.66%	23.32%	34.98%	0.027	0.030
S, wt.%	29.57	0.633	28.31	30.84	27.67	31.47	2.14%	4.28%	6.42%	28.09	31.05
SiO_2, wt.%	11.54	0.569	10.40	12.68	9.83	13.25	4.93%	9.86%	14.79%	10.96	12.12
Sn, ppm	< 100	IND	IND	IND	IND	IND	IND	IND	IND	IND	IND
TiO_2, wt.%	0.202	0.013	0.176	0.228	0.162	0.241	6.51%	13.02%	19.52%	0.192	0.212
W, ppm	< 10	IND	IND	IND	IND	IND	IND	IND	IND	IND	IND
Zn, wt.%	0.332	0.016	0.300	0.365	0.284	0.381	4.89%	9.78%	14.68%	0.316	0.349
Geoanalytical Laboratories ('as received' sample basis)											
Thermogravimetry											
LOI^{1000}, wt.%	15.21	0.194	14.82	15.59	14.62	15.79	1.28%	2.55%	3.83%	14.45	15.97
Infrared Combustion											
S, wt.%	29.67	0.722	28.23	31.12	27.51	31.84	2.43%	4.87%	7.30%	28.19	31.16
Aqua Regia Digestion											
Hg, ppm	1.07	0.069	0.93	1.21	0.86	1.27	6.50%	13.00%	19.50%	1.01	1.12
Ion Selective Electrode											
F, ppm	657	28	601	713	573	741	4.26%	8.51%	12.77%	624	690
4-Acid Digestion											
Ag, ppm	40.4	1.26	37.8	42.9	36.6	44.1	3.12%	6.23%	9.35%	38.3	42.4
As, ppm	103	9	84	122	74	131	9.26%	18.52%	27.78%	97	108
Ba, ppm	96	20	55	136	34	157	21.35%	42.70%	64.05%	91	100

SI unit equivalents: ppb (parts per billion; 1×10^{-9}) ≡ µg/kg; ppm (parts per million; 1×10^{-6}) ≡ mg/kg; wt.% (weight per cent) ≡ % (mass fraction).

IND = indeterminate. 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 9 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
Geoanalytical Laboratories ('as received' sample basis)											
Be, ppm	< 0.5	IND	IND	IND	IND	IND	IND	IND	IND	IND	IND
Bi, ppm	22.9	1.92	19.0	26.7	17.1	28.6	8.38%	16.76%	25.14%	21.7	24.0
Ca, wt.%	0.827	0.024	0.778	0.875	0.754	0.899	2.93%	5.87%	8.80%	0.785	0.868
Cd, ppm	15.0	1.11	12.8	17.2	11.6	18.3	7.40%	14.79%	22.19%	14.2	15.7
Ce, ppm	16.8	1.03	14.7	18.9	13.7	19.9	6.14%	12.28%	18.42%	16.0	17.6
Co, ppm	154	7	140	168	134	174	4.42%	8.84%	13.26%	146	162
Cr, ppm	57	4.9	47	67	43	72	8.49%	16.97%	25.46%	54	60
Cs, ppm	0.65	0.039	0.57	0.73	0.53	0.77	6.09%	12.19%	18.28%	0.62	0.68
Cu, wt.%	23.58	0.256	23.07	24.09	22.81	24.34	1.08%	2.17%	3.25%	22.40	24.76
Dy, ppm	1.05	0.092	0.86	1.23	0.77	1.32	8.80%	17.60%	26.40%	0.99	1.10
Er, ppm	0.60	0.047	0.50	0.69	0.46	0.74	7.91%	15.81%	23.72%	0.57	0.63
Fe, wt.%	24.53	0.581	23.36	25.69	22.78	26.27	2.37%	4.74%	7.11%	23.30	25.75
Ga, ppm	4.14	0.272	3.60	4.68	3.32	4.96	6.57%	13.15%	19.72%	3.93	4.35
Gd, ppm	1.30	0.14	1.02	1.57	0.89	1.70	10.48%	20.96%	31.44%	1.23	1.36
Ge, ppm	0.45	0.18	0.09	0.81	0.00	0.99	39.72%	79.44%	119.17%	0.43	0.47
Hf, ppm	0.71	0.067	0.58	0.84	0.51	0.91	9.41%	18.81%	28.22%	0.67	0.75
Ho, ppm	0.20	0.007	0.19	0.22	0.18	0.22	3.34%	6.69%	10.03%	0.19	0.21
In, ppm	1.45	0.037	1.38	1.53	1.34	1.56	2.54%	5.08%	7.62%	1.38	1.53
K, wt.%	0.668	0.035	0.599	0.738	0.564	0.773	5.19%	10.38%	15.57%	0.635	0.702
La, ppm	10.2	0.69	8.8	11.6	8.1	12.3	6.76%	13.52%	20.28%	9.7	10.7
Li, ppm	23.7	1.19	21.3	26.1	20.1	27.2	5.04%	10.09%	15.13%	22.5	24.8
Mg, wt.%	0.443	0.028	0.386	0.500	0.358	0.528	6.41%	12.83%	19.24%	0.421	0.465
Mn, wt.%	0.014	0.001	0.012	0.015	0.012	0.016	4.99%	9.97%	14.96%	0.013	0.015
Mo, wt.%	0.219	0.014	0.190	0.247	0.176	0.262	6.50%	13.01%	19.51%	0.208	0.230
Na, wt.%	0.430	0.012	0.407	0.453	0.395	0.465	2.68%	5.36%	8.04%	0.408	0.451
Nb, ppm	1.87	0.156	1.55	2.18	1.40	2.33	8.38%	16.75%	25.13%	1.77	1.96
Nd, ppm	7.32	0.469	6.38	8.26	5.91	8.73	6.41%	12.83%	19.24%	6.95	7.68
Ni, ppm	256	10	235	276	225	286	3.98%	7.95%	11.93%	243	268
P, wt.%	0.020	0.002	0.017	0.023	0.016	0.025	7.64%	15.28%	22.92%	0.019	0.021
Pb, ppm	469	27	416	523	389	550	5.74%	11.48%	17.22%	446	493
Pr, ppm	1.94	0.187	1.56	2.31	1.38	2.50	9.66%	19.32%	28.97%	1.84	2.03
Rb, ppm	22.9	1.05	20.8	25.0	19.7	26.0	4.59%	9.17%	13.76%	21.7	24.0
Re, ppm	4.54	0.62	3.30	5.78	2.68	6.39	13.63%	27.25%	40.88%	4.31	4.77
S, wt.%	27.19	2.186	22.82	31.56	20.63	33.74	8.04%	16.08%	24.12%	25.83	28.55
Sb, ppm	49.1	4.77	39.6	58.7	34.8	63.4	9.71%	19.41%	29.12%	46.7	51.6
Sc, ppm	5.75	0.497	4.76	6.75	4.26	7.25	8.65%	17.29%	25.94%	5.47	6.04
Se, ppm	189	18	154	225	136	243	9.42%	18.84%	28.26%	180	199
Sn, ppm	1.96	0.146	1.67	2.25	1.52	2.40	7.46%	14.91%	22.37%	1.86	2.06
Sr, ppm	159	6	148	171	142	177	3.58%	7.16%	10.73%	151	167
Ta, ppm	0.099	0.011	0.077	0.121	0.065	0.132	11.23%	22.45%	33.68%	0.094	0.104

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

IND = indeterminate. 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 9 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
Geoanalytical Labs ('as received' sample basis)											
4-Acid Digestion continued											
Tb, ppm	0.19	0.013	0.17	0.22	0.15	0.23	6.57%	13.14%	19.71%	0.18	0.20
Te, ppm	9.94	0.981	7.98	11.90	7.00	12.88	9.87%	19.75%	29.62%	9.44	10.44
Th, ppm	2.05	0.100	1.85	2.25	1.75	2.35	4.90%	9.79%	14.69%	1.95	2.15
Ti, wt.%	0.118	0.004	0.110	0.126	0.106	0.130	3.33%	6.66%	9.99%	0.112	0.124
Tl, ppm	0.29	0.023	0.25	0.34	0.22	0.36	7.79%	15.58%	23.37%	0.28	0.31
U, ppm	0.80	0.069	0.66	0.94	0.59	1.01	8.63%	17.25%	25.88%	0.76	0.84
V, ppm	63	4.0	55	71	51	75	6.30%	12.60%	18.90%	60	66
W, ppm	2.47	0.171	2.13	2.82	1.96	2.99	6.93%	13.86%	20.78%	2.35	2.60
Y, ppm	5.63	0.290	5.05	6.21	4.76	6.50	5.15%	10.31%	15.46%	5.35	5.91
Yb, ppm	0.58	0.06	0.47	0.70	0.41	0.76	10.05%	20.10%	30.15%	0.55	0.61
Zn, wt.%	0.332	0.017	0.299	0.366	0.282	0.383	5.02%	10.04%	15.06%	0.316	0.349
Zr, ppm	27.3	1.72	23.8	30.7	22.1	32.4	6.32%	12.64%	18.96%	25.9	28.6
3-Acid Digestion (no HF)											
Ag, ppm	38.9	3.29	32.3	45.5	29.0	48.8	8.46%	16.93%	25.39%	37.0	40.9
As, ppm	107	8	91	123	83	131	7.57%	15.14%	22.71%	102	112
Co, ppm	151	6	138	164	132	170	4.18%	8.35%	12.53%	144	159
Ni, ppm	253	17	220	286	203	303	6.54%	13.07%	19.61%	240	266
Pb, ppm	465	29	407	523	378	551	6.23%	12.47%	18.70%	441	488
Zn, wt.%	0.342	0.016	0.309	0.374	0.293	0.391	4.79%	9.57%	14.36%	0.325	0.359

SI unit equivalents: ppm (parts per million; 1 x 10^{-6}) ≡ mg/kg; wt.% (weight per cent) ≡ % (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.

PREPARER

Certified reference material OREAS 993b is prepared and certified by:

ORE RESEARCH & EXPLORATION

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

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

PARTICIPATING LABORATORIES

1. ♦*Actlabs, Ancaster, Ontario, Canada
2. ♦AH Knight, St Helens, Merseyside, UK
3. ♦AH Knight, Tianjin, China
4. ♦AHK Mongolia LLC, Ulaanbaatar, Mongolia
5. ♦Alex Stewart International, Liverpool, UK
6. *ALS, Brisbane, QLD, Australia
7. *ALS, Lima, Peru
8. *ALS, Loughrea, Galway, Ireland
9. *ALS, Malaga, WA, Australia
10. ♦ALS, Ulaanbaatar, Khan-Uul District, Mongolia
11. *ALS, Vancouver, BC, Canada
12. ♦ALS Inspection, Prescot, Merseyside, UK
13. *American Assay Laboratories, Sparks, Nevada, USA
14. *ARGETEST Mineral Processing, Ankara, Central Anatolia, Turkey
15. ♦Bachelet, Angleur, Liege, Belgium
16. *Bureau Veritas Commodities Canada Ltd, Vancouver, BC, Canada
17. *Bureau Veritas Geoanalytical, Adelaide, SA, Australia
18. *Bureau Veritas MET, Whyalla, SA, Australia
19. *CERTIMIN, Lima, Peru
20. ♦Erdenet Central Chemical Laboratory, Erdenet, Orkhon province, Mongolia
21. ♦Independent, Perth, WA, Australia
22. ♦*Inspectorate (BV), Lima, Peru
23. ♦Inspectorate (BV), Shanghai, Bao Shan District, China
24. ♦Inspectorate (BV), Witham, Essex, UK
25. ♦Inspectorate Griffith India, Gandhidham, Gujarat, India
26. *Intertek, Cupang, Muntinlupa, Philippines
27. *Intertek, Perth, WA, Australia
28. ♦Intertek LSI, Rotterdam, Zuid-Holland, Netherlands
29. *♦Newcrest Laboratory Services, Orange, NSW, Australia
30. ♦Ok Tedi Mine Lab, Mt Fubilan, Western Province, PNG
31. *PT Geoservices Ltd, Cikarang, Jakarta Raya, Indonesia
32. PT Intertek Utama Services, Jakarta Timur, DKI Jakarta, Indonesia
33. ♦SGS Lakefield Research Ltd, Lakefield, Ontario, Canada
34. *Shiva Analyticals Ltd, Bangalore North, Karnataka, India
35. *Skyline Assayers & Laboratories, Tucson, Arizona, USA
36. *Stewart Assay & Environmental Laboratories LLC, Kara-Balta, Chüy, Kyrgyzstan

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

Figure 1. Cu by Classical Wet Chemistry (umpire lab) in OREAS 993b

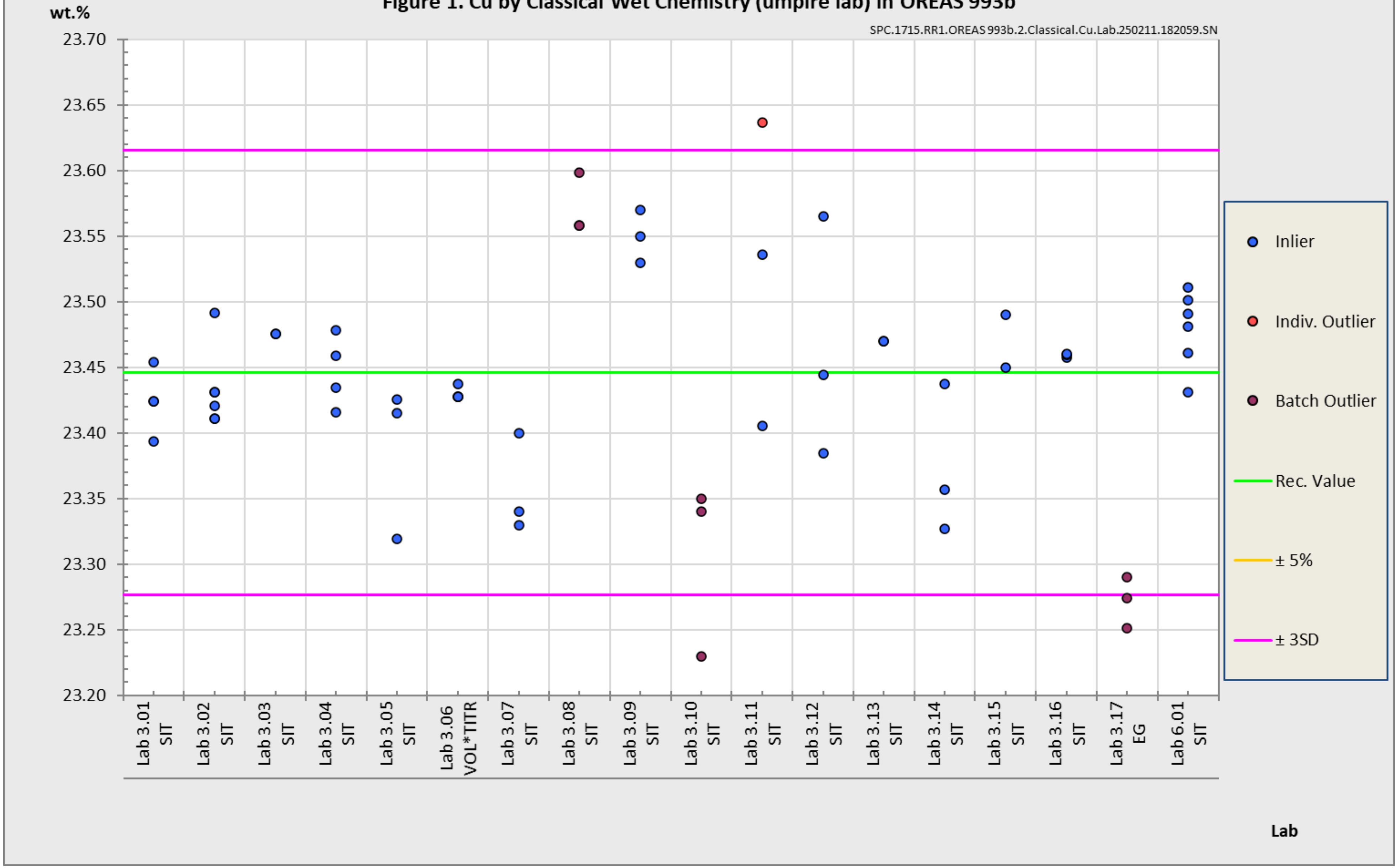
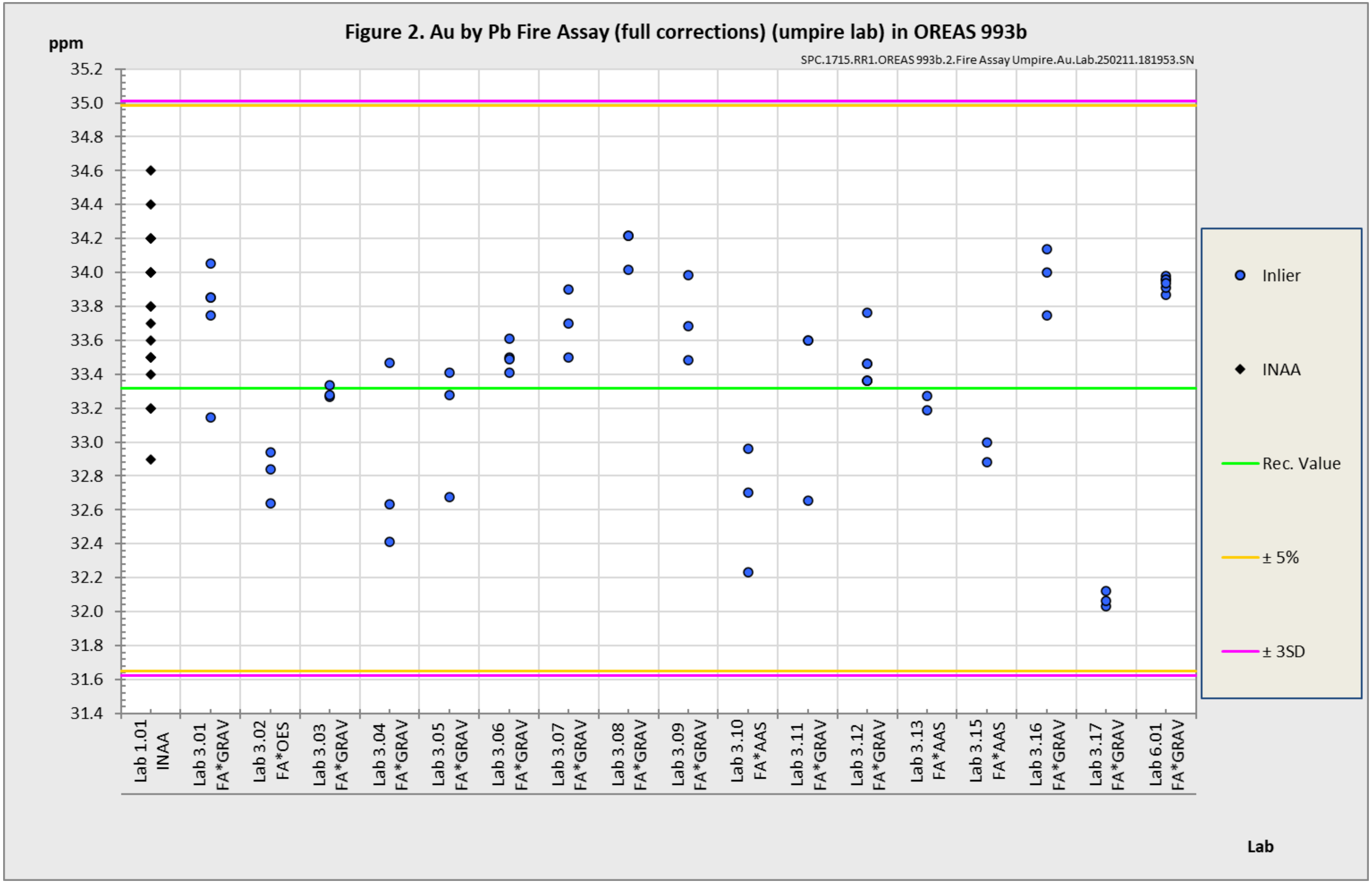


Figure 2. Au by Pb Fire Assay (full corrections) (umpire lab) in OREAS 993b



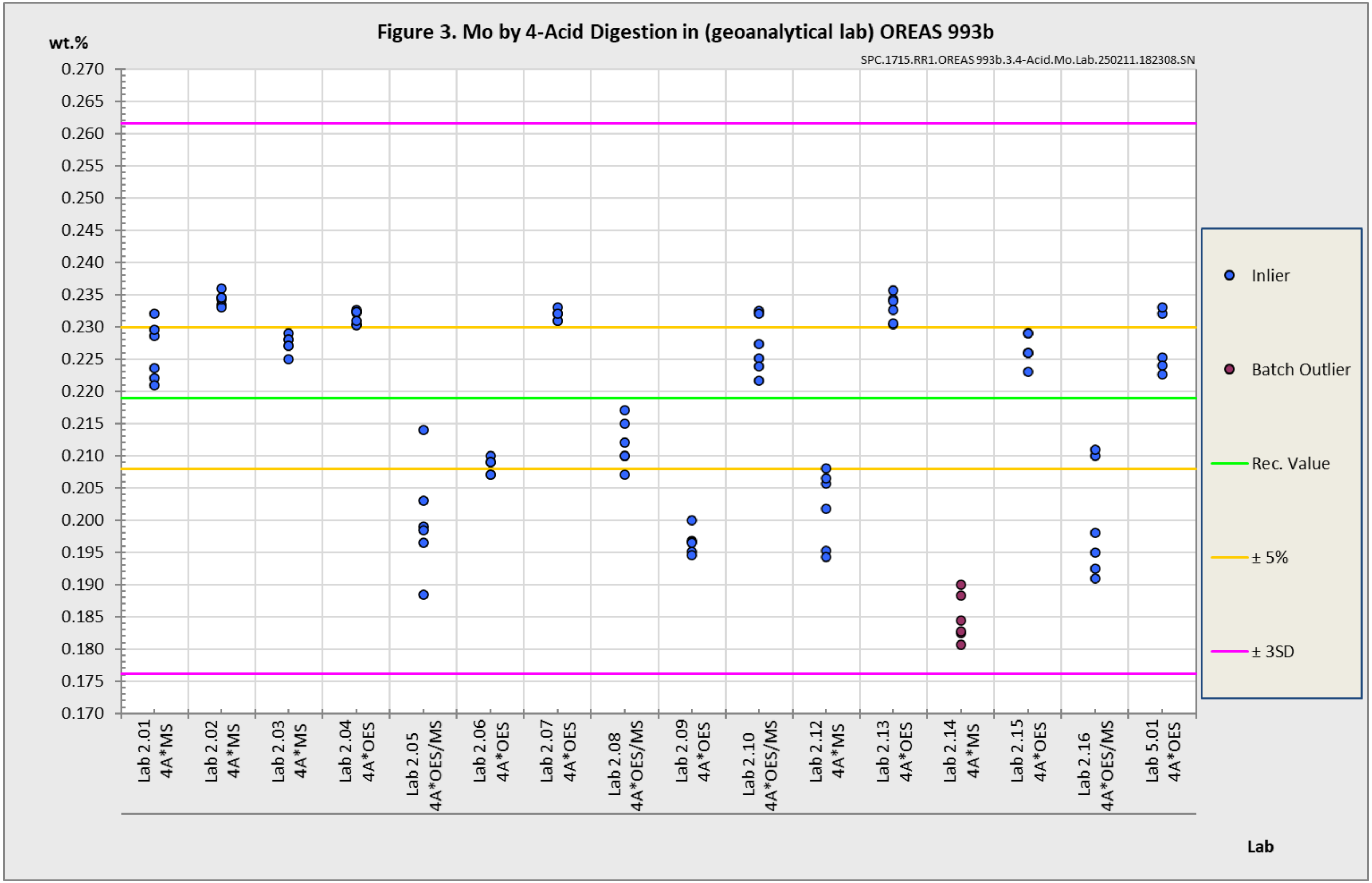


Figure 3. Mo by 4-Acid Digestion in (geoanalytical lab) OREAS 993b
SPC.1715.RR1.OREAS 993b.3.4-Acid.Mo.Lab.250211.182308.SN
wt.%
0.270
0.265
0.260
0.255
0.250
0.245
0.240
0.235
0.230
0.225
0.220
0.215
0.210
0.205
0.200
0.195
0.190
0.185
0.180
0.175
0.170
Lab 2.01 4A*MS
Lab 2.02 4A*MS
Lab 2.03 4A*MS
Lab 2.04 4A*OES
Lab 2.05 4A*OES/MS
Lab 2.06 4A*OES
Lab 2.07 4A*OES
Lab 2.08 4A*OES/MS
Lab 2.09 4A*OES
Lab 2.10 4A*OES/MS
Lab 2.12 4A*MS
Lab 2.13 4A*OES
Lab 2.14 4A*MS
Lab 2.15 4A*OES
Lab 2.16 4A*OES/MS
Lab 5.01 4A*OES
Lab
Inlier
Batch Outlier
Rec. Value
± 5%
± 3SD

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)) [15]. 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 representativeness 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 by classical wet chemistry methods, Au by fire assay, multi-elements by 4-acid digestion and S by IR combustion furnace. 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 [8], 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 33405:2024, 9.2.4c) [5]."* 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 993b 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 993b may be used to calibrate the entire procedure by producing a pure substance CRM transformed into a calibration solution.

OREAS 993b is intended for the following uses:

- For the monitoring of laboratory performance in the analysis of analytes reported in Tables 1 to 4 in geological samples;
- For the verification of analytical methods for analytes reported in Tables 1 to 4;
- For the calibration of instruments used in the determination of the concentration of analytes reported in Tables 1 to 4. 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 to 4).

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 (umpire laboratories): ≥ 0.5 g;
- Au by fire assay (umpire laboratories): ≥ 5 g;
- 3-acid digestion (umpire laboratories): ≥ 0.4 g;
- Au, Pd and Pt by fire assay (geoanalytical laboratories): ≥ 30 g;
- Lithium borate fusion with X-ray fluorescence (geoanalytical laboratories): ≥ 0.2 g;
- Loss on Ignition (LOI) at 1000 °C (geoanalytical laboratories): ≥ 1 g;
- S by infrared combustion furnace/CS analyser (geoanalytical laboratories): ≥ 0.1 g;
- Hg by aqua regia digestion (geoanalytical laboratories): 0.1 g;
- F by ion selective electrode (geoanalytical laboratories): ≥ 0.2 g;
- 4-acid digestion with ICP-OES/MS finish (geoanalytical laboratories): ≥ 0.25 g;
- 3-acid digestion (geoanalytical laboratories): ≥ 0.2 g.

PERIOD OF VALIDITY & STORAGE INSTRUCTIONS

The certification of OREAS 993b remains valid, within the specified measurement uncertainties, until May 2034, provided the CRM is handled and stored in accordance with the instructions given below. This certification is nullified if the CRM is any way changed or contaminated.

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

Long-term stability will be monitored at appropriate intervals and purchasers notified if any changes are observed. The period of validity may well be indefinite and will be reassessed prior to expiry with the aim of extending the validity if possible.

Single-use 50 g sachets sealed under nitrogen

OREAS 993b is high in reactive sulphide content and has been packaged under a nitrogen environment in robust laminated foil pouches. Following analysis, it is the manufacturer's expectation that any remaining material is discarded unless the sachet is promptly resealed under vacuum or nitrogen. It is the user's responsibility to prevent contamination and minimise exposure to the atmosphere.

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, Au and Ag refer to the concentration level 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 Cu, Au and Ag assay. The Cu, Au and Ag data were then corrected to dry basis using the moisture value obtained at each laboratory.

Moisture content varied amongst the laboratories from 0.15-1.0 % with a best consensus value of 0.43 %. The indicative value provided for moisture (H_2O-) 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:

With the exception of the oxidising fusion with XRF (where the certified values are reported on a dry sample basis), all analyses were performed on the samples as received and the certified values are 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 9 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.

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	19th February, 2025	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

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

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