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CERTIFICATE OF ANALYSIS FOR

CERTIFIED REFERENCE MATERIAL

OREAS 232c

Gold Ore (Fosterville Gold Mine, Victoria)

Table 1. Certified Values, Uncertainty & Tolerance Intervals in OREAS 232c.

Constituent	Certified Value	95% Expanded Uncertainty		95% Tolerance Limits	
		Low	High	Low	High
Pb Fire Assay					
Au, Gold (ppm)	0.947	0.937	0.957	0.939*	0.955*
PhotonAssay (recommended gross mass 485-515 g)					
Au, Gold (ppm)	0.956	0.944	0.968	0.954*	0.959*
Aqua Regia Digestion (sample weights 10-50 g)					
Au, Gold (ppm)	0.902	0.883	0.921	0.893*	0.910*
Cyanide Leach					
Au, Gold (ppm)	0.827	0.810	0.844	0.820*	0.834*
4-Acid Digestion					
Ag, Silver (ppm)	0.119	0.091	0.147	0.101	0.137
Al, Aluminium (wt.%)	7.53	7.27	7.78	7.41	7.64
As, Arsenic (ppm)	218	211	224	213	222
Ba, Barium (ppm)	714	695	734	700	728
Be, Beryllium (ppm)	2.31	2.19	2.42	2.22	2.39
Bi, Bismuth (ppm)	0.33	0.30	0.36	0.31	0.35
Ca, Calcium (wt.%)	0.750	0.733	0.767	0.735	0.766
Ce, Cerium (ppm)	82	78	87	80	85
Co, Cobalt (ppm)	14.8	14.0	15.6	14.4	15.2
Cr, Chromium (ppm)	120	110	130	115	125
Cs, Caesium (ppm)	8.99	8.48	9.51	8.75	9.23
Cu, Copper (ppm)	34.4	32.8	36.1	33.3	35.5
Dy, Dysprosium (ppm)	3.38	3.14	3.63	3.23	3.54
Er, Erbium (ppm)	1.72	1.53	1.90	1.65	1.78
Eu, Europium (ppm)	1.27	1.19	1.36	1.22	1.33
Fe, Iron (wt.%)	4.02	3.92	4.13	3.96	4.09
Ga, Gallium (ppm)	19.8	19.0	20.7	19.4	20.3
Gd, Gadolinium (ppm)	5.03	4.69	5.37	4.92	5.15
Hf, Hafnium (ppm)	4.05	3.84	4.26	3.90	4.20
Ho, Holmium (ppm)	0.64	0.58	0.69	0.61	0.67
In, Indium (ppm)	0.069	0.058	0.080	0.062	0.076
K, Potassium (wt.%)	2.78	2.70	2.86	2.73	2.83
La, Lanthanum (ppm)	41.0	38.8	43.1	40.0	41.9
Li, Lithium (ppm)	46.5	44.9	48.1	45.5	47.5
Lu, Lutetium (ppm)	0.28	0.25	0.30	0.26	0.30
Mg, Magnesium (wt.%)	1.67	1.61	1.72	1.64	1.70
Mn, Manganese (wt.%)	0.035	0.034	0.037	0.035	0.036
Mo, Molybdenum (ppm)	1.02	0.91	1.12	0.95	1.08
Na, Sodium (wt.%)	0.672	0.649	0.694	0.659	0.684
Nb, Niobium (ppm)	15.5	14.4	16.5	15.0	16.0
Nd, Neodymium (ppm)	35.4	33.0	37.8	34.5	36.3

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

*Gold Tolerance Limits for typical 30 g lead fire assay, 460 g net mass PhotonAssay, 25 g aqua regia digestion and 30 g cyanide leach are determined from 20 x 85 mg INAA results and the Sampling Constant (Ingamells & Switzer, 1973).

Note: intervals may appear asymmetric due to rounding.

Table 1 continued.

Constituent	Certified Value	95% Expanded Uncertainty		95% Tolerance Limits	
		Low	High	Low	High
4-Acid Digestion continued					
Ni, Nickel (ppm)	61	60	63	60	63
P, Phosphorus (wt.%)	0.071	0.069	0.074	0.070	0.073
Pb, Lead (ppm)	17.5	16.5	18.6	17.0	18.1
Pr, Praseodymium (ppm)	9.40	8.88	9.93	9.19	9.62
Rb, Rubidium (ppm)	158	151	166	153	163
Re, Rhenium (ppm)	< 0.002	IND	IND	IND	IND
S, Sulphur (wt.%)	0.070	0.069	0.072	0.069	0.072
Sb, Antimony (ppm)	185	177	192	181	189
Sc, Scandium (ppm)	14.7	14.1	15.4	14.3	15.1
Sm, Samarium (ppm)	6.71	6.28	7.14	6.51	6.91
Sn, Tin (ppm)	3.75	3.52	3.99	3.61	3.90
Sr, Strontium (ppm)	120	116	124	117	122
Ta, Tantalum (ppm)	1.19	1.10	1.28	1.14	1.24
Tb, Terbium (ppm)	0.66	0.62	0.70	0.63	0.69
Te, Tellurium (ppm)	< 0.05	IND	IND	IND	IND
Th, Thorium (ppm)	15.1	13.9	16.2	14.4	15.7
Ti, Titanium (wt.%)	0.486	0.470	0.501	0.475	0.497
Tl, Thallium (ppm)	0.84	0.78	0.89	0.81	0.87
Tm, Thulium (ppm)	0.25	0.22	0.29	0.24	0.26
U, Uranium (ppm)	2.67	2.52	2.83	2.56	2.78
V, Vanadium (ppm)	109	105	113	107	112
W, Tungsten (ppm)	2.42	2.21	2.64	2.28	2.57
Y, Yttrium (ppm)	16.7	15.4	17.9	16.1	17.2
Yb, Ytterbium (ppm)	1.74	1.56	1.92	1.67	1.80
Zn, Zinc (ppm)	96	93	99	94	98
Zr, Zirconium (ppm)	138	133	143	135	141
Aqua Regia Digestion					
Ag, Silver (ppm)	0.114	0.104	0.124	IND	IND
Al, Aluminium (wt.%)	2.71	2.63	2.79	2.65	2.78
As, Arsenic (ppm)	215	207	223	210	220
B, Boron (ppm)	< 10	IND	IND	IND	IND
Ba, Barium (ppm)	90	84	95	88	92
Be, Beryllium (ppm)	1.23	1.11	1.34	1.18	1.28
Bi, Bismuth (ppm)	0.29	0.27	0.32	0.27	0.31
Ca, Calcium (wt.%)	0.236	0.226	0.246	0.228	0.244
Cd, Cadmium (ppm)	0.043	0.033	0.054	IND	IND
Ce, Cerium (ppm)	60	56	64	58	62
Co, Cobalt (ppm)	13.5	13.0	14.0	13.1	13.8
Cr, Chromium (ppm)	104	100	107	101	106
Cs, Caesium (ppm)	7.07	6.69	7.46	6.85	7.29

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.

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 1 continued.

Constituent	Certified Value	95% Expanded Uncertainty		95% Tolerance Limits	
		Low	High	Low	High
Aqua Regia Digestion continued					
Cu, Copper (ppm)	34.2	32.8	35.5	33.2	35.1
Fe, Iron (wt.%)	3.52	3.45	3.59	3.46	3.57
Ga, Gallium (ppm)	8.69	8.19	9.18	8.42	8.95
Hf, Hafnium (ppm)	0.69	0.64	0.74	0.65	0.73
In, Indium (ppm)	0.027	0.023	0.031	0.024	0.030
K, Potassium (wt.%)	0.940	0.905	0.976	0.918	0.963
La, Lanthanum (ppm)	29.4	27.1	31.7	28.4	30.5
Li, Lithium (ppm)	36.4	34.5	38.2	35.1	37.6
Lu, Lutetium (ppm)	0.11	0.09	0.13	IND	IND
Mg, Magnesium (wt.%)	1.39	1.35	1.43	1.36	1.42
Mn, Manganese (wt.%)	0.025	0.024	0.026	0.025	0.026
Mo, Molybdenum (ppm)	0.96	0.88	1.05	0.93	1.00
Na, Sodium (wt.%)	0.127	0.121	0.132	0.122	0.131
Ni, Nickel (ppm)	58	56	59	56	59
P, Phosphorus (wt.%)	0.063	0.061	0.065	0.062	0.064
Pb, Lead (ppm)	8.05	7.78	8.32	7.80	8.30
Rb, Rubidium (ppm)	91	87	95	87	94
Re, Rhenium (ppm)	< 0.001	IND	IND	IND	IND
S, Sulphur (wt.%)	0.070	0.069	0.071	0.066	0.074
Sb, Antimony (ppm)	138	127	149	134	141
Sc, Scandium (ppm)	6.20	5.79	6.61	6.00	6.40
Sn, Tin (ppm)	1.49	1.40	1.57	1.41	1.57
Sr, Strontium (ppm)	22.5	21.2	23.9	21.9	23.2
Ta, Tantalum (ppm)	< 0.01	IND	IND	IND	IND
Tb, Terbium (ppm)	0.48	0.42	0.54	0.45	0.51
Th, Thorium (ppm)	12.7	12.0	13.4	12.3	13.1
Ti, Titanium (wt.%)	0.178	0.170	0.187	0.174	0.183
Tl, Thallium (ppm)	0.56	0.53	0.60	0.54	0.58
U, Uranium (ppm)	1.49	1.39	1.59	1.43	1.54
V, Vanadium (ppm)	71	69	74	70	73
W, Tungsten (ppm)	0.41	0.37	0.46	0.37	0.45
Y, Yttrium (ppm)	9.08	8.55	9.61	8.72	9.43
Yb, Ytterbium (ppm)	0.78	0.71	0.86	IND	IND
Zn, Zinc (ppm)	79	77	82	78	81
Zr, Zirconium (ppm)	27.6	25.8	29.4	26.7	28.5

SI unit equivalents: ppm (parts per million; 1×10^{-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 2. Indicative Values for OREAS 232c.

Constituent	Unit	Value	Constituent	Unit	Value	Constituent	Unit	Value
4-Acid Digestion								
B	ppm	*30.3*	Ge	ppm	*0.25*	Se	ppm	*< 1*
Cd	ppm	*0.054*	Hg	ppm	*< 0.01*			
Aqua Regia Digestion								
Dy	ppm	*2.25*	Ho	ppm	*0.39*	Se	ppm	*0.24*
Er	ppm	*1.01*	Nb	ppm	*0.50*	Sm	ppm	*5.39*
Eu	ppm	*0.78*	Nd	ppm	*27.1*	Te	ppm	*0.023*
Gd	ppm	*3.95*	Pd	ppb	*< 10*	Tm	ppm	*0.12*
Ge	ppm	*0.081*	Pr	ppm	*7.01*			
Hg	ppm	*0.007*	Pt	ppb	*< 5*			
Borate Fusion XRF								
Al_2O_3	wt.%	*14.69*	Fe_2O_3	wt.%	*5.92*	S	wt.%	*0.068*
As	ppm	*200*	K_2O	wt.%	*3.40*	SiO_2	wt.%	*67.29*
BaO	ppm	*755*	MgO	wt.%	*2.85*	Sn	ppm	*50*
CaO	wt.%	*1.05*	MnO	wt.%	*0.046*	Sr	ppm	*127*
Cl	ppm	*7.50*	Na_2O	wt.%	*0.920*	TiO_2	wt.%	*0.871*
Co	ppm	*10.0*	Ni	ppm	*65*	V_2O_5	ppm	*215*
Cr_2O_3	ppm	*200*	P_2O_5	wt.%	*0.165*	Zn	ppm	*80*
Cu	ppm	*40.0*	Pb	ppm	*20.0*	Zr	ppm	*241*
Thermogravimetry								
LOI^{1000}	wt.%	*2.42*						
Infrared Combustion								
C	wt.%	*0.040*	S	wt.%	*0.065*			
Laser Ablation ICP-MS								
Ag	ppm	*0.150*	Hf	ppm	*6.56*	Sn	ppm	*4.50*
As	ppm	*201*	Ho	ppm	*1.17*	Sr	ppm	*116*
Ba	ppm	*705*	In	ppm	*0.075*	Ta	ppm	*1.28*
Be	ppm	*2.50*	La	ppm	*41.1*	Tb	ppm	*0.95*
Bi	ppm	*0.35*	Lu	ppm	*0.48*	Te	ppm	*< 0.2*
Cd	ppm	*< 0.1*	Mn	wt.%	*0.036*	Th	ppm	*15.3*
Ce	ppm	*78*	Mo	ppm	*1.00*	Ti	wt.%	*0.524*
Co	ppm	*15.2*	Nb	ppm	*16.8*	Tl	ppm	*0.30*
Cr	ppm	*147*	Nd	ppm	*36.3*	Tm	ppm	*0.49*
Cs	ppm	*8.50*	Ni	ppm	*63*	U	ppm	*2.98*
Cu	ppm	*33.0*	Pb	ppm	*17.5*	V	ppm	*114*
Dy	ppm	*5.58*	Pr	ppm	*9.73*	W	ppm	*3.75*
Er	ppm	*3.40*	Rb	ppm	*157*	Y	ppm	*30.6*
Eu	ppm	*1.26*	Re	ppm	*< 0.01*	Yb	ppm	*3.14*
Ga	ppm	*19.0*	Sb	ppm	*180*	Zn	ppm	*100*
Gd	ppm	*5.93*	Sc	ppm	*14.9*	Zr	ppm	*233*
Ge	ppm	*1.68*	Sm	ppm	*7.32*			

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: the significant figures reported for indicative values do not represent measurement uncertainty and follow OREAS reporting conventions.

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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 samples. To the geologist they provide a means of implementing quality control in analytical data sets generated in exploration from the grassroots level through to prospect evaluation, and in grade control at mining operations. To the analyst they provide a means of checking instrument calibration, 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 Handling, Storage & Correct Use' should be read carefully.

Table 1 presents the certified values together with their associated 95 % expanded uncertainty and tolerance intervals. Table 2 provides indicative values, including major and trace element characterisation, Table 3 lists indicative physical properties, while Table 4 reports indicative mineralogy determined by semi-quantitative XRD analysis. Gold homogeneity, assessed by INAA, is shown in Table 5 and is further evaluated through a nested ANOVA (see *Homogeneity Evaluation* section). Finally, Table 6 presents the performance gate intervals for all certified values.

Tabulated results of all analytes together with uncorrected means, medians, standard deviations, relative standard deviations and per cent deviation of laboratory means from the corrected mean of means (PDM^3) are presented in the detailed certification data for this CRM (**OREAS 232c-DataPack.1.0.261109_132211.xlsx**). The certified values and uncertainties in this Certificate are the sole authoritative figures. Any additional significant figures in the DataPack are provided for reference only and do not affect the certified results.

Results are also presented in scatter plots for Au by fire assay, PhotonAssay, aqua regia digestion (sample weights 10-50 g) and cyanide leach together with ±3SD (magenta) and ±5 % (yellow) control lines and certified value (green line). Accepted individual results are coloured blue and individual and dataset outliers are identified in red and violet, respectively.

INTENDED USE

OREAS 232c is intended to monitor analytical procedures used to determine the measurands listed in Table 1, including relevant sample preparation and measurement steps. OREAS 232c should be analysed as a routine sample for quality control and method-performance assessment. OREAS 232c is intended for the following uses:

- For the monitoring of laboratory performance in the analysis of analytes reported in Table 1 in geological samples
- For the verification and validation of analytical methods for analytes reported in Table 1
- For the verification of instrument calibration and, where appropriate, the calibration of measurement procedures used to determine the concentrations of measurands reported in Table 1. When a certified value is used for calibration, its associated uncertainty must be appropriately propagated into the user's measurement uncertainty calculation. Where the 95% expanded uncertainty corresponds to a coverage factor of approximately two, the standard uncertainty may be estimated as one-quarter of the width of the expanded uncertainty interval provided in Table 1

SOURCE MATERIAL

OREAS 232c was prepared from a blend of gold-bearing ore, barren hornfels and basalt. The ore was sourced from the Fosterville Gold Mine, located near Bendigo in Victoria, Australia. Gold mineralisation is structurally controlled within a sequence of sandstones, siltstones and shales and occurs in association with disseminated pyrite and arsenopyrite and in quartz-carbonate veins.

MINIMUM SAMPLE SIZE

For application of the certified values in this certificate, the following minimum test portions apply to the respective operationally defined methods:

- Au by lead collection fire assay: ≥ 25 g
- Au by PhotonAssay — recommended gross mass of the filled jar assembly: 485–515 g
- Au by aqua regia digestion ICP finish: ≥ 10 g
- Au by cyanide leach: ≥ 5 g
- 4-acid digestion with ICP-OES and/or MS finish: ≥ 0.25 g
- Aqua regia digestion with ICP-OES and/or MS finish: ≥ 0.5 g

**Recommended gross fill mass refers to the mass of the entire jar assembly, including jar base, lid, and contents. This range was developed using an approximately 40 g empty jar. Users of other jar–lid configurations should confirm that the fill mass and sample geometry are appropriate.*

The recommended gold test portions are informed by the INAA homogeneity assessment and the interlaboratory certification data. The minimum test portions for other measurands reflect the analytical conditions represented in the certification program. Applicability of the certified values to smaller test portions has not been established.

INSTRUCTIONS FOR HANDLING, STORAGE & CORRECT USE

Fine powders pose a risk to eyes and lungs and therefore appropriate precautions, including safety glasses and suitable respiratory protection, are advised.

Pre-homogenisation of the CRM prior to subsampling and analysis is not necessary as there is no particle segregation under transport [12].

All certified values contained within this report refer to the concentration levels in the packaged state. There is no need for drying prior to weighing and analysis.

Single-Use Sachets

OREAS 232c is available in single-use, 60 g laminated foil sachets. Following analysis, any remaining material should be discarded. It is the user's responsibility to prevent contamination and avoid prolonged exposure of the sample to the atmosphere prior to analysis.

Repeat-Use Packaging (e.g., 500 g Plastic Jars)

After taking a subsample, users should replace the lid of the jar promptly and securely to prevent accidental spills and airborne contamination. OREAS 232c contains a non-hygroscopic* matrix with an indicative value for moisture provided to enable users to check for changes to stored material by determining moisture in the user's laboratory and comparing the result to the value in Table 3 in this certificate.

The relatively low sulphur concentration (~0.07 wt.% S) suggests a limited potential for oxidation of sulphide minerals to sulphates during appropriate storage.

*A non-hygroscopic matrix means exposure to atmospheres significantly different, in terms of temperature and humidity, from the climate during manufacturing should have negligible impact on the precision of results. Hygroscopic moisture is the amount of adsorbed moisture (weakly held H_2O- molecules on the surface of exposed material) following exposure to the local atmosphere. Usually, equilibration of material to the local atmosphere will only occur if the material is spread into a thin (~2 mm thick) layer and left exposed for a period of 2 hours.

Authoritative Source of Information

This Certificate of Analysis constitutes the primary and authoritative document for the certified values, associated expanded uncertainties, and their correct use. While the accompanying DataPack provides supporting information, including raw data and uncertainty estimates with additional significant figures, these extended figures are provided solely for transparency, convenience and statistical reference. Users must rely exclusively on the values stated in this Certificate, rounded to an appropriate number of significant figures, for all metrological and analytical purposes. Any discrepancy between values presented in the DataPack and those in this Certificate shall be resolved in favour of the information provided herein.

Notice on Certificate Updates

The version of the Certificate of Analysis (COA) available on the OREAS website is considered the official and most current version. As COAs may be revised following periodic reviews, re-evaluation of data, or the availability of new information, users are strongly advised to refer to the latest online version prior to each use.

It is the user's responsibility to ensure that the most recent and applicable certificate is used to support the traceability, validity, and fitness-for-purpose of the certified reference material (CRM).

Any significant changes to the sections of this certificate will be clearly documented in the revised certificate.

QC Monitoring Using Multiples of the Standard Deviation (SD)

When applying SDs to monitor performance, it is important to recognise that laboratories differ in proficiency, and that different methods have differing levels of precision. Each laboratory has its own inherent SD (specific to an analyte–method–concentration combination), which is not directly comparable to SDs derived from a round robin.

As most data in this round robin came from world-class laboratories, the interlaboratory SDs are narrower than would be expected across a broader mix. To provide more realistic benchmarks, this report presents pooled interlaboratory SDs, incorporating both within-lab variation and between-lab bias. These should be treated as a starting point only, with QC managers refining them against their own control charts.

The performance gates shown in Table 6 are intended only to be used as an initial guide as to what a laboratory may be able to achieve. As sufficient QC results accumulate, laboratories should estimate their own process SDs for this CRM. 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 long-term laboratory results show a mean that differs from the certified value, the significance of this bias should be evaluated using an appropriate decision rule that accounts for the uncertainty of the certified value and the uncertainty of the laboratory mean.

For Use with the Aqua Regia Digestion Method

It is important to note that in the analytical industry aqua regia digestion practices vary between laboratories. This method is a partial empirical digest and differences in recoveries for various analytes are commonplace. These are caused by variations in the digest conditions and can include the ratio of nitric to hydrochloric acids, acid strength, temperatures, leach times and secondary digestions. Some sulphide-hosted base metals may show near-total recovery; however, other analytes, particularly lithophile elements, are generally more sensitive to method parameters. This can result in lack of consensus in an interlaboratory certification program for these elements.

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

PERIOD OF VALIDITY

The certification of OREAS 232c remains valid, within the specified measurement uncertainties, until at least May 2041, provided the CRM is handled and stored in accordance with the instructions provided in this certificate. This certification is nullified if the CRM is in any way changed or contaminated.

Store in a clean, 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.

COMMINUTION AND HOMOGENISATION PROCEDURES

The materials constituting OREAS 232c were prepared as follows:

- Drying of ore and barren materials to constant mass at 105 °C
- Crushing and multi-stage milling of the barren materials to >98 % passing 75 µm
- Crushing and multi-stage milling of the ore to 100 % passing 30 µm
- Blending the ore and barren materials in appropriate proportions to achieve target grades
- Homogenisation using OREAS' novel processing technologies
- Packaging in 60 g laminated foil pouches and 500 g plastic wide-mouth jars

PHYSICAL PROPERTIES

OREAS 232c was tested at ORE Research & Exploration Pty Ltd's onsite facility for various physical properties. Table 3 presents these findings that should be used for informational purposes only.

Table 3. Physical properties of OREAS 232c.

Bulk Density (kg/m^3)	Moisture (wt.%)	Munsell Notation‡	Munsell Color‡
830	0.76	5B 7/1	Light Bluish Gray

‡The Munsell Rock Color 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

Semi-quantitative X-ray diffraction (XRD) analysis was performed by Actlabs, Ancaster, Ontario, Canada. The abundances of crystalline mineral phases were determined using Rietveld refinement of the diffraction pattern, with the results normalised to the identified crystalline phases.

The mineral assemblage is quartz-dominant (~61 wt.%), with appreciable muscovite (~13 wt.%), biotite (~13 wt.%) and plagioclase (~8 wt.%). Minor phases include chlorite, clinopyroxene (augite/diopside) and cordierite, with trace amounts of K-feldspar. The assemblage is characterised by a predominance of quartz and mica minerals, together with subordinate feldspar and ferromagnesian silicates.

Table 4. Indicative mineralogy of OREAS 232c by semi-quantitative XRD analysis.

Mineral / Mineral Group	Mineral abundances (wt%)
Quartz	60.6
Plagioclase	8.2
K feldspar	trace
Augite/Diopside	1.9
Cordierite	1.7
Chlorite	2.3
Muscovite	12.8
Biotite	12.5

ANALYTICAL PROGRAM

Forty-nine geoanalytical laboratories participated in the program to characterise the measurands reported in Table 1. The following methods were employed:

- Instrumental neutron activation analysis (INAA) for Au on 20 x 85 mg subsamples to confirm homogeneity (1 laboratory)
- Gold by Pb collection fire assay (25–50 g charge weight) with AAS (17 laboratories) and ICP-OES (9 laboratories) finish
- Gold by PhotonAssay (protocol PAAU02) with the recommended gross fill mass of 485–515 g (22 laboratories)

- Gold by aqua regia digestion (10–50 g sample weight) with ICP-OES and/or ICP-MS (17 laboratories) finish
- Gold by cyanide leach; a variety of cyanide leach methods were undertaken by the participating laboratories including the use of LeachWELL tablets, alkaline added sodium cyanide solution as well as sodium cyanide liquor with LeachWELL powder. The sample weights included: 5 g (3 laboratories by AAS finish), 20 g (1 laboratory by AAS finish), 30 g (7 laboratories by AAS finish), 40 g (1 laboratory by AAS finish), 50 g (2 laboratories by AAS, 1 laboratory by ICP-MS finish), 200 g (1 laboratory by AAS, 1 laboratory by ICP-OES and 1 laboratory by ICP-MS finish) and 500 g (1 laboratory by AAS finish)
- Full ICP-OES and ICP-MS elemental suites by 4-acid (HNO_3-HF-$HClO_4$-HCl) digestion (up to 23 laboratories depending on the element)
- Full ICP-OES and ICP-MS elemental suites by aqua regia digestion (up to 23 laboratories depending on the element)

Major and trace elements were characterised by Bureau Veritas Geoanalytical (Perth, Australia) using borate fusion with XRF (Al_2O_3 to TiO_2), laser ablation ICP-MS (Ag to Zr), LOI at 1000 °C and C+S by infrared combustion furnace (see Table 2 'Indicative Values').

For the round robin program, twelve 8 kg test units were collected at predetermined intervals during the bagging stage, immediately after homogenisation. With the exception of the Au by PhotonAssay programs, each participating laboratory received six test portions. The samples received by each laboratory were obtained by taking a sample from six different 8 kg test units to maximise representation (i.e., from either the odd or even sampling (lot) intervals).

For the PhotonAssay program, each of the participating laboratories received three 550 g samples. Laboratories were instructed to prepare a PhotonAssay jar from each provided sample and assay each jar in duplicate, generating a total of six results per laboratory. The recommended gross mass fill for each candidate reference material was specified to participants to ensure consistency in measurement conditions.

The 20 individual INAA results used in the homogeneity evaluation were obtained from 85 mg test portions prepared from paired 10 g samples collected from 10 sampling units. This format enabled a nested ANOVA treatment of the INAA results to evaluate homogeneity (see 'Homogeneity Evaluation' section below).

PARTICIPATING LABORATORIES

1. Actlabs, Ancaster, Ontario, Canada
2. AGAT Laboratories, Calgary, Alberta, Canada
3. Alex Stewart International, Mendoza, Argentina
4. ALS, Canning Vale, WA, Australia
5. ALS, Johannesburg, South Africa
6. ALS, Kalgoorlie, WA, Australia
7. ALS, Lima, Peru
8. ALS, Loughrea, Galway, Ireland
9. ALS, Malaga, WA, Australia
10. ALS, Vancouver, BC, Canada

11. American Assay Laboratories, Sparks, Nevada, USA
12. ANSTO, Lucas Heights, NSW, Australia
13. ARGETEST Mineral Processing, Ankara, Central Anatolia, Turkey
14. Britannia Mining Solutions, Hamilton, Ontario, Canada
15. Bureau Veritas Commodities and Trade, Inc., Sparks, Nevada, USA
16. Bureau Veritas Commodities Canada Ltd, Vancouver, BC, Canada
17. Bureau Veritas Geoanalytical, Perth, WA, Australia
18. Bureau Veritas Minerals, Hermosillo, Sonora, Mexico
19. CERTIMIN, Lima, Peru
20. Gloriosa Laboratory, Otjiwarongo, Otjozondjupa, Namibia
21. Inspectorate (BV), Lima, Peru
22. Intertek, Cupang, Muntinlupa, Philippines
23. Intertek, Perth, WA, Australia
24. Intertek, Townsville, QLD, Australia
25. Intertek Minerals Ltd, Tarkwa, Western Region, Ghana
26. MSA ENVAL Laboratories, Yamoussoukro, Côte d'Ivoire
27. MSALABS, Bougouni, Bamako, Mali
28. MSALABS, Prince George, BC, Canada
29. MSALABS, Val-d'Or, Quebec, Canada
30. MSALABS Bulyanhulu Gold Mine, Bubada, Shinyanga, United Republic of Tanzania
31. MSALABS Carlin, Carlin, Nevada, USA
32. MSALABS Elko, Elko, Nevada, USA
33. MSALABS Geita, Geita, Geita, United Republic of Tanzania
34. MSALABS Timmins, Timmins, Ontario, Canada
35. On Site Laboratory Services, Bendigo, VIC, Australia
36. Paragon Geochemical Laboratories, Surrey, BC, Canada
37. PT Geoservices Ltd, Cikarang, Jakarta Raya, Indonesia
38. PT Intertek Utama Services, Jakarta Timur, DKI Jakarta, Indonesia
39. Ravenswood Gold, Ravenswood, QLD, Australia
40. SGS African Assay Laboratories (Tanzania) Ltd, Mwanza, Mwanza Region, United Republic of Tanzania
41. SGS Australia Mineral Services, Kalgoorlie, WA, Australia
42. SGS Australia Mineral Services, Perth, WA, Australia
43. SGS Canada Inc., Vancouver, BC, Canada
44. SGS Geosol Laboratorios Ltda, Vespasiano, Minas Gerais, Brazil
45. SGS India Private Limited, Visakhapatnam, Andhra Pradesh, India
46. SGS New Zealand Limited, Palmerston, Otago, New Zealand
47. SGS Tarkwa, Tarkwa, Western Region, Ghana
48. Skyline Assayers & Laboratories, Tucson, Arizona, USA
49. Stewart Assay & Environmental Laboratories LLC, Kara-Balta, Chüy, Kyrgyzstan

Please note: To maintain anonymity of participating laboratories, the alphabetical list above does not correspond to the Lab ID numbers shown in the Figures 1 to 4 below.

STATISTICAL ANALYSIS

Certified values and their uncertainty intervals (Table 1) were determined for each measurand after excluding identified individual and laboratory dataset (batch) outliers, including a single iteration of 3SD screening. Outlier evaluation was conducted in accordance with ISO 17034:2016 and ISO 33405:2024. While formal statistical tests were applied, professional statistical judgment was also exercised in determining the validity of potential outliers. Assessment of systematic bias and performance using independent control materials (CRMs) was incorporated to ensure compliance with the referenced standards and to establish metrological traceability of the certified values.

The 95 % expanded uncertainty interval is intended to provide approximately 95 % coverage for the value of the measurand and is calculated according to the method outlined in [6] and [15]. All known or suspected sources of bias have been investigated or taken into account.

Indicative (uncertified) values (Table 2) are present where the number of laboratories reporting a particular analyte is insufficient (< 5) to support certification or where interlaboratory consensus is poor. These data are intended for 'informational purposes' only.

Standard Deviation intervals (see Table 6, 'Performance Gates') provide an indication of a level of performance that might reasonably be expected from a laboratory being monitored by this CRM in a QA/QC program. They take into account errors attributable to measurement uncertainty and CRM variability. For an effective CRM the contribution of the latter should be negligible in comparison to measurement errors. The reported standard deviations reflect contributions from between-laboratory variation, within-laboratory precision and any residual 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). Outlier removal should be supported by evidence of adequate CRM homogeneity and a defensible assessment that the results do not reflect genuine material heterogeneity. ***The standard deviation is then calculated for each analyte from the pooled accepted analyses generated from the certification program.***

Homogeneity Evaluation

For analytes other than gold, the tolerance limits (ISO 16269-6:2014) shown in Table 1 were determined using an analysis of precision errors method and are considered a conservative estimate of true homogeneity. The meaning of tolerance limits may be illustrated for Cu by 4-acid digestion, where the interval 33.3–35.5 ppm Cu is calculated to contain at least 95 % of the subsample population with 99 % confidence. ***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 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 the contribution from measurement error is assumed to be small relative to sampling variability. Table 5 below shows the gold INAA data determined on 20 x 85 mg subsamples of OREAS 232c. 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 0.27 % calculated for a 30 g fire assay sample (5.05 % at 85 mg weights) suggests a low level of sampling-related variation at a 30 g test portion in OREAS 232c.

Table 5. Neutron Activation Analysis of Au (in ppm) on 20 x 85 mg subsamples showing the equivalent results scaled to a 30 g test portion typical of fire assay determination.

Replicate No	Au 85 mg actual	Au 30 g equivalent*
1	1.059	0.998
2	0.944	0.992
3	0.969	0.993
4	0.982	0.994
5	1.035	0.996
6	1.005	0.995
7	1.053	0.997
8	0.947	0.992
9	0.909	0.990
10	0.934	0.991
11	1.024	0.996
12	1.066	0.998
13	1.099	1.000
14	1.021	0.996
15	0.969	0.993
16	0.982	0.994
17	0.993	0.994
18	0.978	0.993
19	0.969	0.993
20	0.943	0.991
Mean	0.994	0.994
Median	0.982	0.994
Std Dev.	0.050	0.003
Rel.Std.Dev.	**5.05%**	**0.27%**

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

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

The homogeneity of OREAS 232c has also been evaluated in an Analysis of Variance (**ANOVA**) of the INAA data. The 20 samples were comprised of paired samples from each of 10 sampling lot intervals (representative of the 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 whether between-unit variation is significantly greater than within-unit variation. This allows an assessment of homogeneity across the entire prepared batch of OREAS 232c. The test was performed using the following parameters:

- Gold 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 were not filtered for outliers before *p*-value calculation, which yielded 0.92 — statistically insignificant, so the Null Hypothesis is accepted. It is important to note that ANOVA does not measure absolute homogeneity; it evaluates whether analytes are similarly distributed across the packaging run and whether variance between subsamples from the same unit differs from that between separate units. A reference material may show poor absolute homogeneity yet still meet a relative homogeneity (ANOVA) criterion if within-unit heterogeneity is substantial and consistent. Based on ANOVA and interlaboratory certification results, OREAS 232c is fit-for-purpose as a certified reference material (see 'Intended Use' below).

METROLOGICAL TRACEABILITY

The measurement scale for the certified values is mass fraction (mass/mass), with the underlying mass measurements metrologically traceable to the International System of Units (SI) through the SI unit of mass [14]. In accordance with common geoanalytical practice, data presented in the tables of this certificate are expressed as mass fractions in weight percent (wt. %), parts per million (ppm) or parts per billion (ppb), with ppm and ppb equivalent to milligrams per kilogram (mg/kg) and micrograms per kilogram (µg/kg), respectively.

Samples submitted to the interlaboratory certification program were selected to be representative of the entire prepared batch of CRM, with this representativeness maintained across the laboratory sample sets. Each analytical dataset was subject to the participating laboratory's internal quality-control procedures, including the use of reference materials and other appropriate QC checks.

Participating laboratories were selected on the basis of demonstrated analytical competence, including prior performance in interlaboratory comparison programs conducted by ORE Pty Ltd, with consideration given to their expertise in the relevant analytical methods, measurands and sample matrices. For the measurands reported in this certificate (Table 1), data were obtained from laboratories accredited to ISO/IEC 17025 where applicable. Where formal accreditation was not held for a specific measurand, evidence supporting analytical competence and metrological traceability was obtained through the inclusion of well-characterised, independently certified reference materials as control samples in the round robin study.

Consistent with ISO 33405:2024 [5], clause 9.2.5, and ISO 17034:2016 [9], clause 7.12.4, the metrological traceability and validity of measurement results used for characterisation were evaluated using appropriate supporting evidence. Agreement of measured control-sample values with their certified values provided additional evidence of the validity of results generated by participating laboratories. The certified values were assigned from the means of accepted laboratory datasets following the statistical procedures described in this report.

Operationally Defined Measurands

The certified values assigned to OREAS reference materials are operationally defined. The value obtained is therefore dependent, to some degree, on the measurement approach and conditions under which the measurand is realised and cannot necessarily be defined independently of them. Accordingly, while the mass-fraction measurement scale is underpinned by mass measurements traceable to the SI, metrological traceability of the certified value is established with reference to the applicable operationally defined measurand.

In accordance with ISO 33405:2024 [5], clause 9.5, characterisation is based on results obtained from a network of competent laboratories working within the applicable operational definition, with concordance of the results assessed as part of the value-assignment process. Individual laboratory implementations may vary, and the resulting interlaboratory variation reflects, in part, differences inherent in the practical realisation of the measurand.

The certified value is therefore applicable to measurements consistent with the stated operational definition. Relevant interlaboratory variation is incorporated, as appropriate, into the uncertainty associated with the certified value. This approach provides the basis for metrological traceability appropriate to operationally defined measurands and supports the requirements of ISO 17034:2016 and ISO 33405:2024.

COMMUTABILITY

Commutability has been considered in relation to the intended use of this CRM. For most conventional geoanalytical measurement procedures, sample preparation and analytical treatment reduce or otherwise condition the material to a form suitable for measurement using well-established calibration procedures. Under these circumstances, significant commutability effects are not generally expected, and a dedicated experimental assessment of commutability was not considered necessary for this CRM.

OREAS CRMs are prepared from naturally occurring geological materials and are intended to behave similarly to routine geological samples when subjected to appropriate measurement procedures. Matrix composition, mineralogy and physical characteristics can nevertheless influence analytical response for some measurement procedures. Users should therefore select CRMs that are sufficiently representative of their routine samples and appropriate for the measurement procedure being monitored. The source material, matrix characteristics and intended use of this CRM are described elsewhere in this certificate to assist users in assessing its suitability for their particular application.

PERFORMANCE GATES

Table 6 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 above). 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 percentages 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 % ± 2 DL [1].

Table 6. Performance Gates for OREAS 232c.

Constituent	Certified Value	Absolute Standard Deviations					Relative Standard Deviations			5 % window	
		1SD	2SD Low	2SD High	3SD Low	3SD High	1RSD	2RSD	3RSD	Low	High
Pb Fire Assay											
Au, ppm	0.947	0.025	0.897	0.996	0.872	1.021	2.62%	5.25%	7.87%	0.899	0.994
PhotonAssay™ (recommended gross mass 485-515 g)											
Au, ppm	0.956	0.048	0.861	1.052	0.813	1.100	4.99%	9.98%	14.97%	0.909	1.004
Aqua Regia Digestion (sample weights 10-50 g)											
Au, ppm	0.902	0.038	0.825	0.979	0.787	1.017	4.26%	8.51%	12.77%	0.857	0.947
Cyanide Leach											
Au, ppm	0.827	0.032	0.764	0.890	0.732	0.922	3.82%	7.64%	11.46%	0.786	0.869
4-Acid Digestion											
Ag, ppm	0.119	0.021	0.077	0.162	0.055	0.183	17.84%	35.68%	53.52%	0.113	0.125
Al, wt.%	7.53	0.198	7.13	7.92	6.93	8.12	2.63%	5.26%	7.89%	7.15	7.90
As, ppm	218	6	205	231	198	237	2.98%	5.96%	8.94%	207	228
Ba, ppm	714	20	674	755	654	775	2.84%	5.69%	8.53%	679	750
Be, ppm	2.31	0.088	2.13	2.48	2.04	2.57	3.82%	7.65%	11.47%	2.19	2.42
Bi, ppm	0.33	0.020	0.29	0.37	0.27	0.39	6.07%	12.15%	18.22%	0.31	0.35
Ca, wt.%	0.750	0.018	0.715	0.786	0.697	0.804	2.38%	4.76%	7.13%	0.713	0.788
Ce, ppm	82	4.0	74	91	70	95	4.89%	9.78%	14.67%	78	87
Co, ppm	14.8	0.70	13.4	16.2	12.7	16.9	4.71%	9.42%	14.13%	14.1	15.5
Cr, ppm	120	14	92	147	79	161	11.45%	22.90%	34.35%	114	126
Cs, ppm	8.99	0.476	8.04	9.94	7.56	10.42	5.29%	10.58%	15.87%	8.54	9.44
Cu, ppm	34.4	1.53	31.4	37.5	29.8	39.0	4.45%	8.90%	13.35%	32.7	36.1
Dy, ppm	3.38	0.210	2.97	3.80	2.76	4.01	6.19%	12.39%	18.58%	3.22	3.55
Er, ppm	1.72	0.110	1.49	1.94	1.38	2.05	6.43%	12.86%	19.29%	1.63	1.80
Eu, ppm	1.27	0.049	1.18	1.37	1.13	1.42	3.83%	7.65%	11.48%	1.21	1.34
Fe, wt.%	4.02	0.086	3.85	4.20	3.76	4.28	2.15%	4.30%	6.45%	3.82	4.22
Ga, ppm	19.8	0.59	18.7	21.0	18.1	21.6	3.00%	6.00%	8.99%	18.9	20.8
Gd, ppm	5.03	0.316	4.40	5.66	4.08	5.98	6.28%	12.55%	18.83%	4.78	5.28
Hf, ppm	4.05	0.236	3.58	4.52	3.34	4.76	5.82%	11.65%	17.47%	3.85	4.25
Ho, ppm	0.64	0.039	0.56	0.71	0.52	0.75	6.07%	12.14%	18.21%	0.61	0.67
In, ppm	0.069	0.008	0.053	0.085	0.045	0.093	11.80%	23.60%	35.40%	0.066	0.072
K, wt.%	2.78	0.044	2.69	2.87	2.65	2.91	1.59%	3.18%	4.76%	2.64	2.92
La, ppm	41.0	2.02	36.9	45.0	34.9	47.0	4.92%	9.84%	14.77%	38.9	43.0
Li, ppm	46.5	1.78	42.9	50.0	41.1	51.8	3.83%	7.66%	11.50%	44.2	48.8
Lu, ppm	0.28	0.013	0.25	0.30	0.24	0.32	4.73%	9.46%	14.20%	0.26	0.29
Mg, wt.%	1.67	0.052	1.56	1.77	1.51	1.82	3.11%	6.22%	9.34%	1.58	1.75
Mn, wt.%	0.035	0.001	0.033	0.038	0.032	0.039	3.07%	6.14%	9.21%	0.034	0.037
Mo, ppm	1.02	0.077	0.86	1.17	0.79	1.25	7.56%	15.11%	22.67%	0.96	1.07
Na, wt.%	0.672	0.012	0.648	0.695	0.636	0.707	1.76%	3.53%	5.29%	0.638	0.705
Nb, ppm	15.5	1.22	13.0	17.9	11.8	19.1	7.86%	15.72%	23.58%	14.7	16.2
Nd, ppm	35.4	1.78	31.8	39.0	30.1	40.7	5.02%	10.05%	15.07%	33.6	37.2
Ni, ppm	61	2.1	57	66	55	68	3.36%	6.71%	10.07%	58	65
P, wt.%	0.071	0.002	0.067	0.075	0.066	0.077	2.58%	5.16%	7.74%	0.068	0.075
Pb, ppm	17.5	1.23	15.1	20.0	13.9	21.2	7.00%	13.99%	20.99%	16.7	18.4
Pr, ppm	9.40	0.355	8.69	10.11	8.34	10.47	3.77%	7.54%	11.31%	8.93	9.87

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 shown does not imply equivalent accuracy; additional digits are provided to minimise rounding errors when calculating 2SD and 3SD intervals.

Table 6 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											
Rb, ppm	158	6	146	171	139	178	4.05%	8.10%	12.15%	150	166
Re, ppm	< 0.002	IND	IND	IND	IND	IND	IND	IND	IND	IND	IND
S, wt.%	0.070	0.002	0.066	0.075	0.063	0.078	3.43%	6.87%	10.30%	0.067	0.074
Sb, ppm	185	8	169	200	161	208	4.28%	8.56%	12.84%	175	194
Sc, ppm	14.7	0.81	13.1	16.3	12.3	17.2	5.48%	10.95%	16.43%	14.0	15.5
Sm, ppm	6.71	0.410	5.89	7.53	5.48	7.94	6.11%	12.22%	18.33%	6.37	7.04
Sn, ppm	3.75	0.185	3.38	4.12	3.20	4.31	4.92%	9.85%	14.77%	3.57	3.94
Sr, ppm	120	5	109	131	104	136	4.47%	8.95%	13.42%	114	126
Ta, ppm	1.19	0.080	1.03	1.35	0.95	1.43	6.71%	13.43%	20.14%	1.13	1.25
Tb, ppm	0.66	0.024	0.61	0.71	0.59	0.73	3.65%	7.30%	10.96%	0.63	0.69
Te, ppm	< 0.05	IND	IND	IND	IND	IND	IND	IND	IND	IND	IND
Th, ppm	15.1	0.83	13.4	16.7	12.6	17.5	5.49%	10.97%	16.46%	14.3	15.8
Ti, wt.%	0.486	0.011	0.464	0.507	0.453	0.518	2.22%	4.44%	6.67%	0.462	0.510
Tl, ppm	0.84	0.045	0.75	0.92	0.70	0.97	5.34%	10.68%	16.02%	0.79	0.88
Tm, ppm	0.25	0.03	0.20	0.31	0.17	0.33	10.59%	21.19%	31.78%	0.24	0.27
U, ppm	2.67	0.131	2.41	2.94	2.28	3.07	4.89%	9.78%	14.68%	2.54	2.81
V, ppm	109	3	103	116	100	119	2.99%	5.98%	8.96%	104	115
W, ppm	2.42	0.224	1.98	2.87	1.75	3.10	9.23%	18.47%	27.70%	2.30	2.55
Y, ppm	16.7	1.61	13.4	19.9	11.8	21.5	9.68%	19.36%	29.04%	15.8	17.5
Yb, ppm	1.74	0.158	1.42	2.06	1.27	2.21	9.07%	18.15%	27.22%	1.65	1.83
Zn, ppm	96	2.1	92	100	90	102	2.24%	4.47%	6.71%	91	101
Zr, ppm	138	6	126	150	120	156	4.40%	8.81%	13.21%	131	145
Aqua Regia Digestion											
Ag, ppm	0.114	0.009	0.097	0.131	0.088	0.140	7.62%	15.23%	22.85%	0.108	0.120
Al, wt.%	2.71	0.074	2.57	2.86	2.49	2.94	2.73%	5.46%	8.19%	2.58	2.85
As, ppm	215	10	196	234	186	244	4.43%	8.86%	13.29%	204	226
B, ppm	< 10	IND	IND	IND	IND	IND	IND	IND	IND	IND	IND
Ba, ppm	90	7.6	75	105	67	113	8.49%	16.97%	25.46%	85	94
Be, ppm	1.23	0.101	1.02	1.43	0.92	1.53	8.24%	16.47%	24.71%	1.16	1.29
Bi, ppm	0.29	0.025	0.24	0.34	0.22	0.37	8.45%	16.91%	25.36%	0.28	0.31
Ca, wt.%	0.236	0.012	0.213	0.260	0.201	0.272	4.99%	9.98%	14.97%	0.224	0.248
Cd, ppm	0.043	0.007	0.030	0.057	0.023	0.063	15.55%	31.09%	46.64%	0.041	0.045
Ce, ppm	60	4.2	52	68	48	72	6.93%	13.86%	20.79%	57	63
Co, ppm	13.5	0.78	11.9	15.0	11.1	15.8	5.81%	11.62%	17.43%	12.8	14.2
Cr, ppm	104	3	98	110	95	113	2.89%	5.79%	8.68%	99	109
Cs, ppm	7.07	0.459	6.16	7.99	5.70	8.45	6.49%	12.98%	19.47%	6.72	7.43
Cu, ppm	34.2	1.32	31.5	36.8	30.2	38.1	3.86%	7.72%	11.57%	32.5	35.9
Fe, wt.%	3.52	0.087	3.34	3.69	3.26	3.78	2.48%	4.97%	7.45%	3.34	3.69
Ga, ppm	8.69	0.423	7.84	9.53	7.42	9.96	4.87%	9.75%	14.62%	8.25	9.12
Hf, ppm	0.69	0.040	0.61	0.77	0.57	0.81	5.82%	11.63%	17.45%	0.66	0.73
In, ppm	0.027	0.003	0.021	0.033	0.018	0.036	11.23%	22.46%	33.69%	0.026	0.029
K, wt.%	0.940	0.056	0.829	1.052	0.773	1.108	5.92%	11.85%	17.77%	0.893	0.988
La, ppm	29.4	2.45	24.5	34.3	22.1	36.8	8.34%	16.67%	25.01%	28.0	30.9

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; IND = indeterminate.

Note 2: the number of decimal places shown does not imply equivalent accuracy; additional digits are provided to minimise rounding errors when calculating 2SD and 3SD intervals.

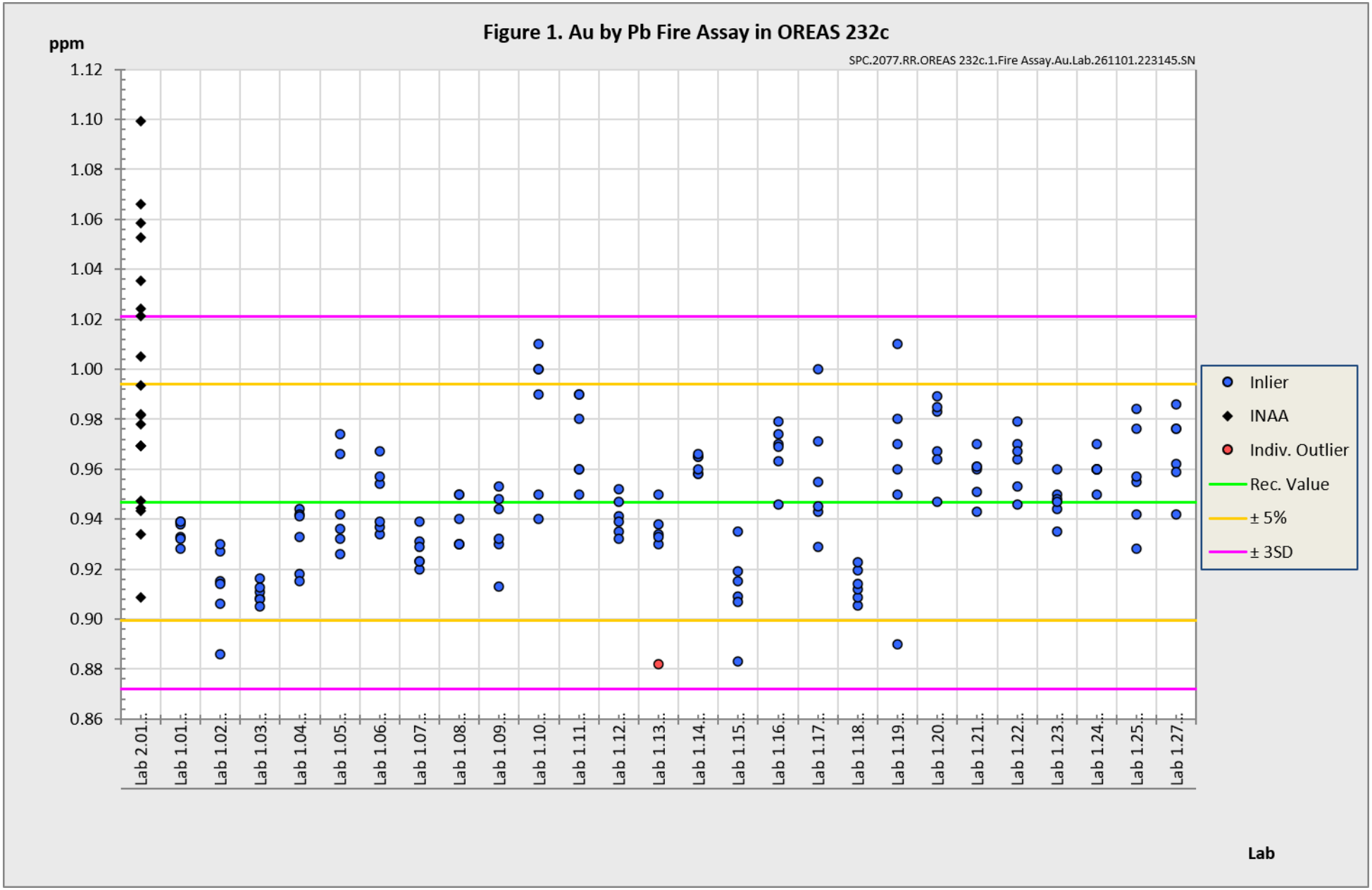
Table 6 continued.

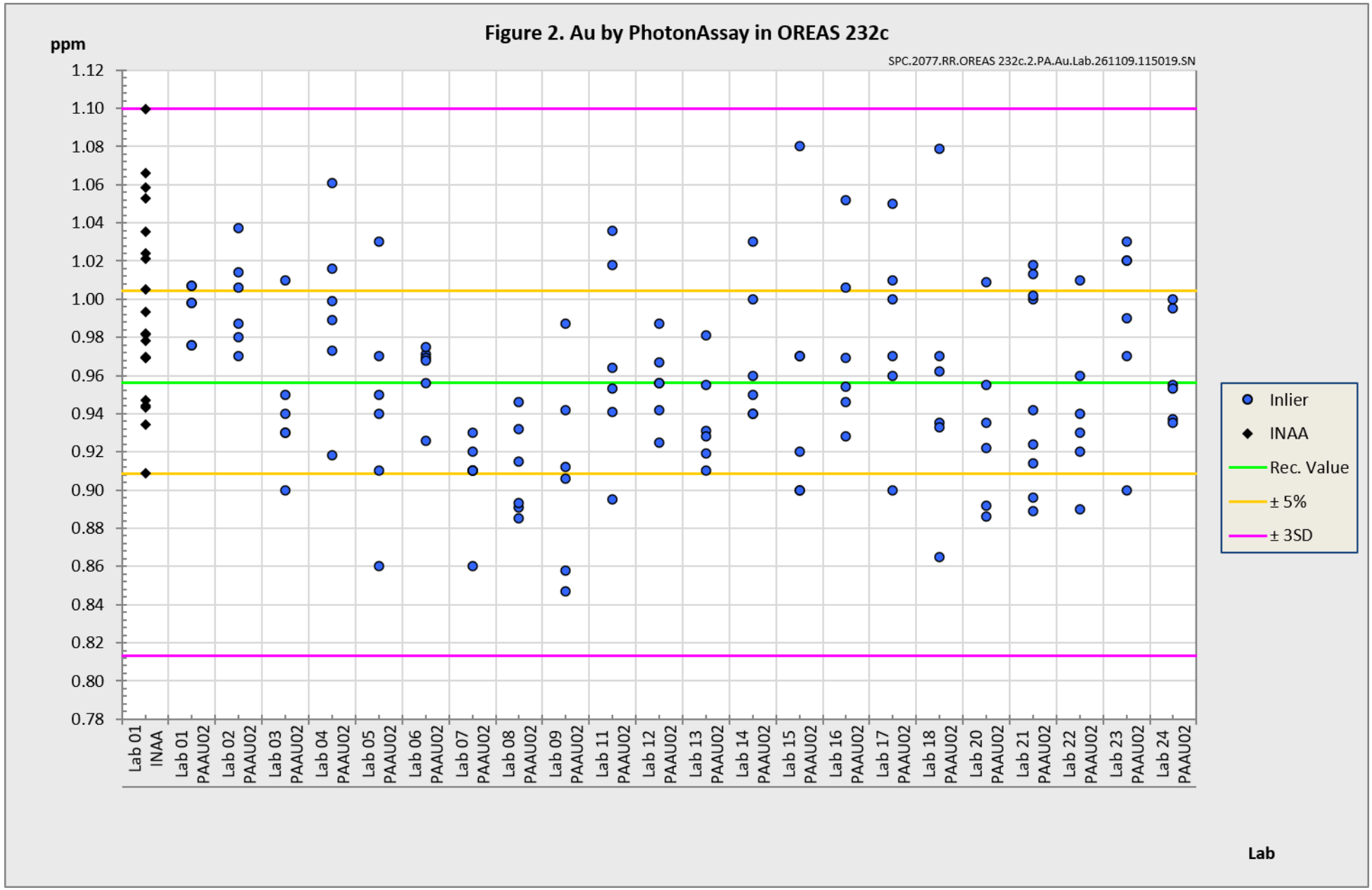
Constituent	Certified Value	Absolute Standard Deviations					Relative Standard Deviations			5 % window	
		1SD	2SD Low	2SD High	3SD Low	3SD High	1RSD	2RSD	3RSD	Low	High
Aqua Regia Digestion continued											
Li, ppm	36.4	1.44	33.5	39.2	32.0	40.7	3.96%	7.91%	11.87%	34.5	38.2
Lu, ppm	0.11	0.01	0.09	0.14	0.07	0.16	12.37%	24.74%	37.10%	0.11	0.12
Mg, wt.%	1.39	0.047	1.30	1.48	1.25	1.53	3.36%	6.73%	10.09%	1.32	1.46
Mn, wt.%	0.025	0.001	0.023	0.027	0.023	0.028	3.33%	6.66%	9.98%	0.024	0.026
Mo, ppm	0.96	0.062	0.84	1.09	0.77	1.15	6.50%	12.99%	19.49%	0.91	1.01
Na, wt.%	0.127	0.008	0.111	0.142	0.104	0.149	5.99%	11.99%	17.98%	0.120	0.133
Ni, ppm	58	1.5	54	61	53	62	2.66%	5.33%	7.99%	55	60
P, wt.%	0.063	0.002	0.059	0.067	0.057	0.069	3.42%	6.83%	10.25%	0.060	0.066
Pb, ppm	8.05	0.290	7.47	8.63	7.18	8.92	3.61%	7.21%	10.82%	7.65	8.45
Rb, ppm	91	4.5	82	100	77	104	4.94%	9.87%	14.81%	86	95
Re, ppm	< 0.001	IND	IND	IND	IND	IND	IND	IND	IND	IND	IND
S, wt.%	0.070	0.001	0.068	0.072	0.067	0.073	1.46%	2.91%	4.37%	0.066	0.073
Sb, ppm	138	20	97	179	76	199	14.82%	29.65%	44.47%	131	145
Sc, ppm	6.20	0.456	5.29	7.11	4.83	7.57	7.36%	14.72%	22.07%	5.89	6.51
Sn, ppm	1.49	0.081	1.33	1.65	1.24	1.73	5.45%	10.91%	16.36%	1.41	1.56
Sr, ppm	22.5	1.86	18.8	26.3	16.9	28.1	8.26%	16.52%	24.78%	21.4	23.7
Ta, ppm	< 0.01	IND	IND	IND	IND	IND	IND	IND	IND	IND	IND
Tb, ppm	0.48	0.043	0.39	0.56	0.35	0.61	8.92%	17.84%	26.76%	0.45	0.50
Th, ppm	12.7	0.74	11.2	14.2	10.5	14.9	5.84%	11.67%	17.51%	12.1	13.3
Ti, wt.%	0.178	0.010	0.158	0.198	0.148	0.209	5.62%	11.25%	16.87%	0.169	0.187
Tl, ppm	0.56	0.031	0.50	0.62	0.47	0.66	5.51%	11.01%	16.52%	0.53	0.59
U, ppm	1.49	0.145	1.20	1.78	1.05	1.92	9.77%	19.54%	29.31%	1.41	1.56
V, ppm	71	2.4	67	76	64	79	3.34%	6.69%	10.03%	68	75
W, ppm	0.41	0.033	0.35	0.48	0.31	0.51	7.93%	15.86%	23.79%	0.39	0.43
Y, ppm	9.08	0.539	8.00	10.16	7.46	10.70	5.94%	11.88%	17.82%	8.62	9.53
Yb, ppm	0.78	0.072	0.64	0.93	0.57	1.00	9.15%	18.29%	27.44%	0.75	0.82
Zn, ppm	79	2.2	75	84	73	86	2.72%	5.45%	8.17%	75	83
Zr, ppm	27.6	2.10	23.4	31.8	21.3	33.9	7.60%	15.19%	22.79%	26.2	29.0

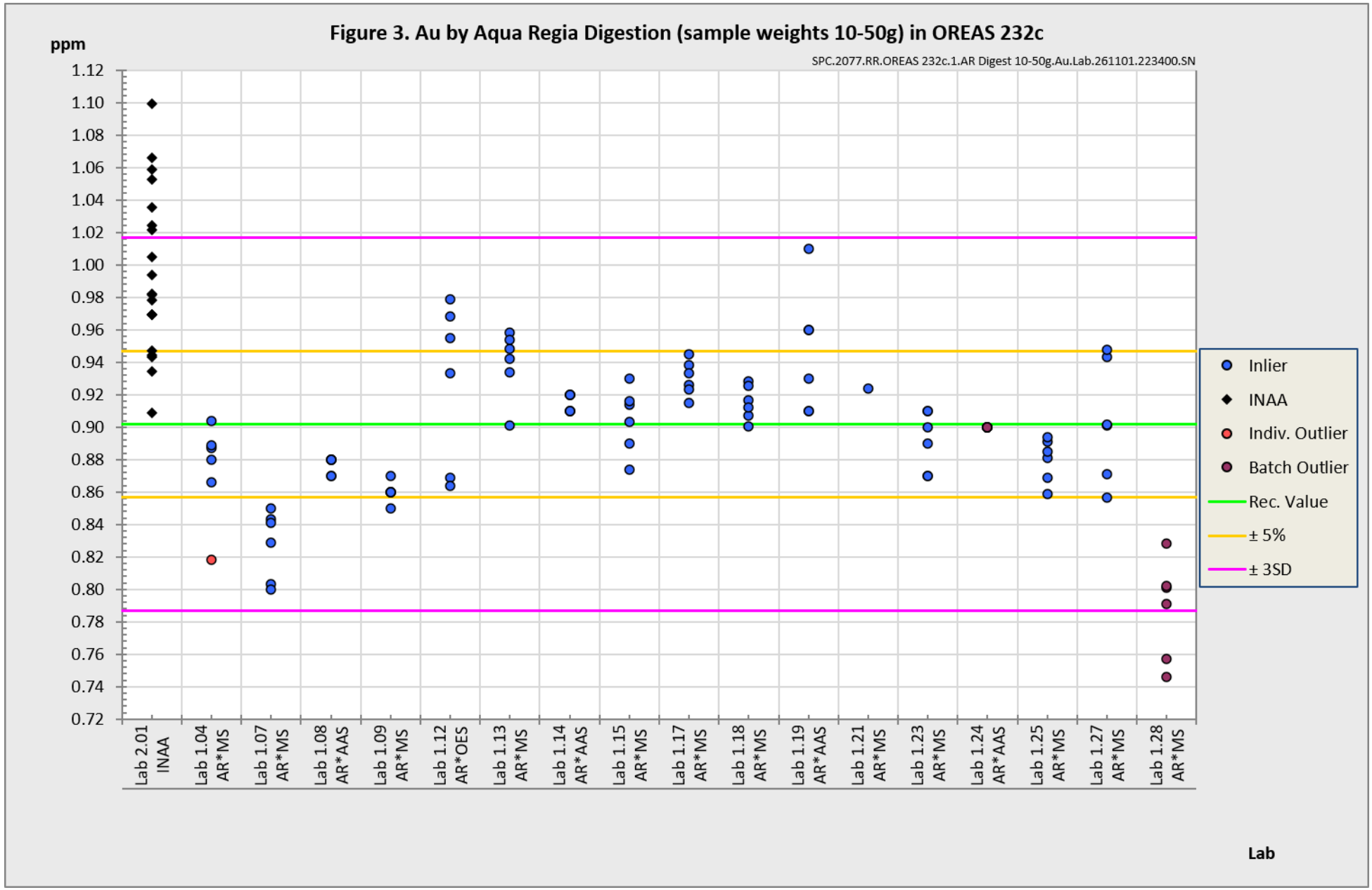
SI unit equivalents: ppm (parts per million; 1 x 10^{-6}) ≡ mg/kg; wt.% (weight per cent) ≡ % (mass fraction).

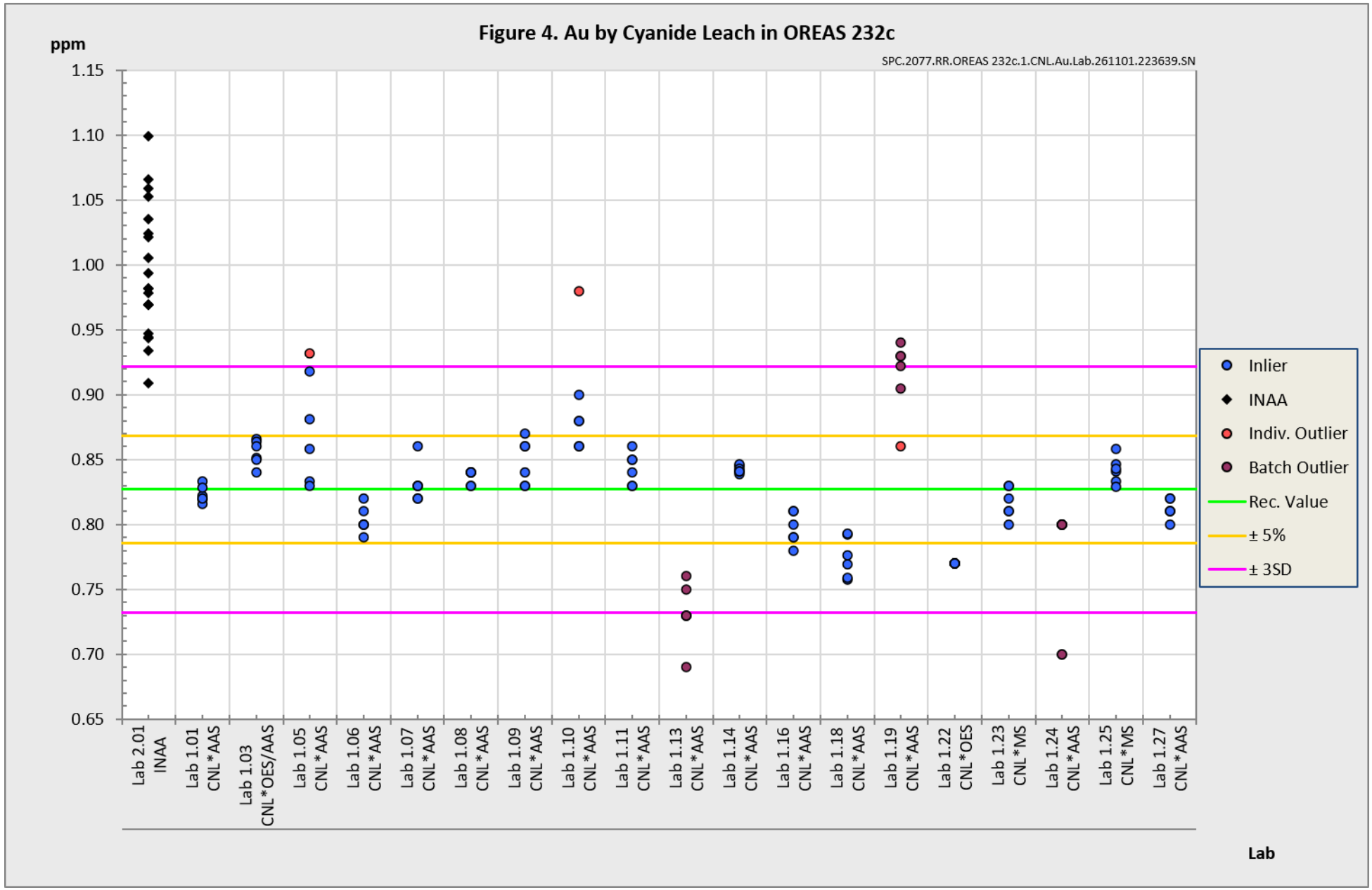
Note 1: intervals may appear asymmetric due to rounding; IND = indeterminate.

Note 2: the number of decimal places shown does not imply equivalent accuracy; additional digits are provided to minimise rounding errors when calculating 2SD and 3SD intervals.


Figure 1. Au by Pb Fire Assay in OREAS 232c
ppm
SPC.2077.RR.OREAS 232c.1.Fire Assay.Au.Lab.261101.223145.SN
1.12
1.10
1.08
1.06
1.04
1.02
1.00
0.98
0.96
0.94
0.92
0.90
0.88
0.86
Lab 2.01...
Lab 1.01...
Lab 1.02...
Lab 1.03...
Lab 1.04...
Lab 1.05...
Lab 1.06...
Lab 1.07...
Lab 1.08...
Lab 1.09...
Lab 1.10...
Lab 1.11...
Lab 1.12...
Lab 1.13...
Lab 1.14...
Lab 1.15...
Lab 1.16...
Lab 1.17...
Lab 1.18...
Lab 1.19...
Lab 1.20...
Lab 1.21...
Lab 1.22...
Lab 1.23...
Lab 1.24...
Lab 1.25...
Lab 1.27...
Lab
Inlier
INAA
Indiv. Outlier
Rec. Value
± 5%
± 3SD


Figure 2. Au by PhotonAssay in OREAS 232c
ppm
SPC.2077.RR.OREAS 232c.2.PA.Au.Lab.261109.115019.SN
1.12
1.10
1.08
1.06
1.04
1.02
1.00
0.98
0.96
0.94
0.92
0.90
0.88
0.86
0.84
0.82
0.80
0.78
Lab 01 INAA
Lab 01 PAAU02
Lab 02 PAAU02
Lab 03 PAAU02
Lab 04 PAAU02
Lab 05 PAAU02
Lab 06 PAAU02
Lab 07 PAAU02
Lab 08 PAAU02
Lab 09 PAAU02
Lab 11 PAAU02
Lab 12 PAAU02
Lab 13 PAAU02
Lab 14 PAAU02
Lab 15 PAAU02
Lab 16 PAAU02
Lab 17 PAAU02
Lab 18 PAAU02
Lab 20 PAAU02
Lab 21 PAAU02
Lab 22 PAAU02
Lab 23 PAAU02
Lab 24 PAAU02
Inlier
INAA
Rec. Value
± 5%
± 3SD
Lab


Figure 3. Au by Aqua Regia Digestion (sample weights 10-50g) in OREAS 232c
ppm
SPC.2077.RR.OREAS 232c.1.AR Digest 10-50g.Au.Lab.261101.223400.SN
1.12
1.10
1.08
1.06
1.04
1.02
1.00
0.98
0.96
0.94
0.92
0.90
0.88
0.86
0.84
0.82
0.80
0.78
0.76
0.74
0.72
Lab 2.01 INAA
Lab 1.04 AR*MS
Lab 1.07 AR*MS
Lab 1.08 AR*AAS
Lab 1.09 AR*MS
Lab 1.12 AR*OES
Lab 1.13 AR*MS
Lab 1.14 AR*AAS
Lab 1.15 AR*MS
Lab 1.17 AR*MS
Lab 1.18 AR*MS
Lab 1.19 AR*AAS
Lab 1.21 AR*MS
Lab 1.23 AR*MS
Lab 1.24 AR*AAS
Lab 1.25 AR*MS
Lab 1.27 AR*MS
Lab 1.28 AR*MS
Inlier
INAA
Indiv. Outlier
Batch Outlier
Rec. Value
± 5%
± 3SD
Lab


Figure 4. Au by Cyanide Leach in OREAS 232c
ppm
SPC.2077.RR.OREAS 232c.1.CNL.Au.Lab.261101.223639.SN
1.15
1.10
1.05
1.00
0.95
0.90
0.85
0.80
0.75
0.70
0.65
Lab 2.01 INAA
Lab 1.01 CNL*AAS
Lab 1.03 CNL*OES/AAS
Lab 1.05 CNL*AAS
Lab 1.06 CNL*AAS
Lab 1.07 CNL*AAS
Lab 1.08 CNL*AAS
Lab 1.09 CNL*AAS
Lab 1.10 CNL*AAS
Lab 1.11 CNL*AAS
Lab 1.13 CNL*AAS
Lab 1.14 CNL*AAS
Lab 1.16 CNL*AAS
Lab 1.18 CNL*AAS
Lab 1.19 CNL*AAS
Lab 1.22 CNL*OES
Lab 1.23 CNL*MS
Lab 1.24 CNL*AAS
Lab 1.25 CNL*MS
Lab 1.27 CNL*AAS
Lab
Inlier
INAA
Indiv. Outlier
Batch Outlier
Rec. Value
± 5%
± 3SD

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REFERENCES

[1] Govett, G.J.S. (1983). Handbook of Exploration Geochemistry, Volume 2: Statistics and Data Analysis in Geochemical Prospecting (Variations of accuracy and precision).

[2] Ingamells, C. O. and Switzer, P. (1973). A Proposed Sampling Constant for Use in Geochemical Analysis, Talanta 20, 547-568.

[3] ISO Guide 30:2015. Terms and definitions used in connection with reference materials.

[4] ISO 33401:2024-01. Reference materials – Contents of certificates, labels and accompanying documentation.

[5] ISO 33405:2024-05. Reference materials – Approaches for characterization and assessment of homogeneity and stability.

[6] ISO Guide 98-3:2008. Guide to the expression of uncertainty in measurement (GUM:1995).

[7] ISO 16269-6:2014. Statistical interpretation of data – Part 6: Determination of statistical tolerance intervals.

[8] ISO 17025:2017, General requirements for the competence of testing and calibration laboratories.

[9] ISO 17034:2016. General requirements for the competence of reference material producers.

[10] Munsell Rock Color Book (2014). Rock-Color Chart Committee, Geological Society of America (GSA), Minnesota (USA).

[11] OREAS-BUP-70-09-11: Statistical Analysis - OREAS Evaluation Method.

[12] OREAS-TN-04-1498: Stability under transport; an experimental study of OREAS CRMs.

[13] OREAS-TN-05-1674: Long-term storage stability; an experimental study of OREAS CRMs.

[14] Thompson, A.; Taylor, B.N. (2008); Guide for the Use of the International System of Units (SI); NIST Special Publication 811; U.S. Government Printing Office: Washington, DC; available at: https://physics.nist.gov/cuu/pdf/sp811.pdf (accessed November 2021).

[15] Van der Veen A.M.H. et al. (2001). Uncertainty calculations in the certification of reference materials, Accred Qual Assur 6: 290-294.

[16] ASTM D7481 – 18, Standard Test Methods for Determining Loose and Tapped Bulk Densities of Powders using a Graduated Cylinder.