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CERTIFICATE OF ANALYSIS FOR

Gold Ores (Agate Creek & Fosterville Mines, Australia)

CERTIFIED REFERENCE MATERIAL

OREAS L14

Table 1. Certified Value, Expanded Uncertainty & Tolerance Limits for OREAS L14.

Method / Constituent	Certified Value	95% Expanded Uncertainty		95% Tolerance Limits	
		Low	High	Value	Low
Pb Fire Assay					
Au, Gold (ppm)	3.24	3.22	3.26	3.23	3.25

Mass fraction SI unit equivalents: ppm (parts per million) ≡ mg/kg; intervals may appear asymmetric due to rounding.

*Gold Tolerance Limits for a typical 30g fire assay are determined from 20 x 85mg INAA results and the Sampling Constant (Ingamells & Switzer, 1973).

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INTRODUCTION

The OREAS L Series of gold ore reference materials are intended to provide a low-cost method of evaluating and improving the quality of analysis of geological gold ore samples. For laboratory analysts they provide an effective means of calibrating analytical equipment, assessing new techniques and routinely monitoring in-house procedures. OREAS reference materials enable users to successfully achieve process control of these tasks because the observed variance from repeated analysis has its origin almost exclusively in the analytical process rather than the reference material itself. In evaluating laboratory performance with this CRM, the section headed ‘Instructions for correct use’ should be read carefully.

Table 1 provides the total mass fraction of gold in naturally occurring, geological gold ore. The certified value is metrologically traceable to the SI unit for mass. The Expanded Uncertainty is calculated according to the method described in ISO/JCGM Guide [7] and encompasses the combined effects of all sources of uncertainty using a coverage factor determined from the Student *t*-distribution corresponding to the appropriate degrees of freedom at 95% confidence. The tolerance limits for all certified values are also shown in Table 1 following an analysis of precision errors and provide a measure of homogeneity of the CRM.

Table 2 provides major and trace element characterisation by Bureau Veritas in Perth, Western Australia entailing:

- Major oxides by lithium borate fusion with X-ray fluorescence;
- LOI at 1000°C by thermogravimetric analyser;
- Total Carbon and Sulphur by Infrared combustion furnace;
- Trace element characterisation by laser ablation with ICP-MS finish.

These values are ‘indicative’ only (non-certified) and are provided for informational purposes.

Table 3 provides some indicative physical properties and Table 4 provides performance gate intervals for gold based on the pooled standard deviation [13].

Gold homogeneity (via INAA) is demonstrated in Table 5 and is also validated by a nested ANOVA using the fire assay data (see ‘**nested ANOVA**’ section).

Tabulated results of all elements (including Au INAA analyses) together with uncorrected means, medians, standard deviations, relative standard deviations and percent deviation of lab means from the corrected mean of means (PDM[3]) are presented in the detailed certification data for this CRM (**OREAS L14-DataPack.1.0.211218_142710.xlsx**).

Results are also presented in a scatter plot for gold by fire assay (Figure 1) 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.

SOURCE MATERIAL

OREAS L14 was prepared from a blend of high-grade gold-bearing ores and barren metasediments and basalt. The majority of the gold ore was sourced from the Agate Creek Gold Mine (Queensland, Australia) and a small quantity of ore from the Fosterville Mine (Victoria, Australia) was also added. The Agate Creek deposit is hosted within a faulted block of Silurian granodiorite intruded by Permian rhyolitic ignimbrite dykes and associated vein breccias. Gold mineralisation occurs within chalcedonic quartz veins, stockworks, and breccias associated with Permian felsic volcanic rocks overlying Proterozoic basement. The Fosterville ore is hosted by a metamorphosed interbedded turbidite sequence of sandstones, siltstones and shales. Primary gold mineralization occurs as disseminated arsenopyrite and pyrite in a quartz–carbonate veinlet stockwork. Visible gold is spatially associated with antimony mineralization, in the form of stibnite that occurs with quartz and varies from replacement and infill of earlier quartz-carbonate stockwork veins, to massive stibnite-only veins of up to 0.5m in width (Hitchman, Philips, & Greenberger, 2017).

Table 2. Indicative Values for OREAS L14.

Constituent	Unit	Value	Constituent	Unit	Value	Constituent	Unit	Value
Borate Fusion XRF								
Al_2O_3	wt.%	*13.16*	MgO	wt.%	*4.09*	S	wt.%	*0.046*
CaO	wt.%	*3.42*	MnO	wt.%	*0.070*	SiO_2	wt.%	*65.49*
Fe_2O_3	wt.%	*7.11*	Na_2O	wt.%	*1.59*	TiO_2	wt.%	*1.09*
K_2O	wt.%	*2.10*	P_2O_5	wt.%	*0.197*			
Thermogravimetry								
LOI^{1000}	wt.%	*1.41*						
Infrared Combustion								
C	wt.%	*< 0.01*	S	wt.%	*0.020*			
Laser Ablation ICP-MS								
Ag	ppm	*1.30*	Hf	ppm	*5.39*	Sm	ppm	*6.00*
As	ppm	*72*	Ho	ppm	*0.95*	Sn	ppm	*2.50*
Ba	ppm	*461*	In	ppm	*< 0.05*	Sr	ppm	*195*
Be	ppm	*1.80*	La	ppm	*30.4*	Ta	ppm	*0.97*
Bi	ppm	*0.19*	Lu	ppm	*0.35*	Tb	ppm	*0.83*
Cd	ppm	*0.075*	Mn	wt.%	*0.060*	Te	ppm	*< 0.2*
Ce	ppm	*58*	Mo	ppm	*3.10*	Th	ppm	*9.88*
Co	ppm	*26.1*	Nb	ppm	*16.4*	Ti	wt.%	*0.657*
Cr	ppm	*167*	Nd	ppm	*28.2*	Tl	ppm	*0.30*
Cs	ppm	*5.84*	Ni	ppm	*94*	Tm	ppm	*0.38*
Cu	ppm	*33.0*	Pb	ppm	*13.5*	U	ppm	*2.19*
Dy	ppm	*4.79*	Pr	ppm	*7.27*	V	ppm	*119*
Er	ppm	*2.73*	Rb	ppm	*97*	W	ppm	*2.00*
Eu	ppm	*1.35*	Re	ppm	*0.013*	Y	ppm	*25.3*
Ga	ppm	*18.4*	Sb	ppm	*66*	Yb	ppm	*2.48*
Gd	ppm	*5.21*	Sc	ppm	*14.7*	Zn	ppm	*95*
Ge	ppm	*1.40*	Se	ppm	*< 5*	Zr	ppm	*194*

Mass fraction SI unit equivalents: ppm (parts per million) ≡ 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.

COMMINUTION AND HOMOGENISATION PROCEDURES

The material constituting OREAS L14 was prepared in the following manner:

- Drying the ore and barren metasediments/basalt to constant mass at 105°C;
- Crushing and multi-stage milling of the gold ore to 100% minus 30 microns;
- Crushing and multi-stage milling of the barren metasediments and basalt to >98% minus 75 microns;
- Homogenisation using OREAS' novel processing technologies;
- Packaging 2.5kg units into hermetically sealed plastic jars.

PHYSICAL PROPERTIES

OREAS L14 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 L14.

Bulk Density (kg/m^3)	Moisture (wt.%)	Munsell Notation‡	Munsell Color‡
895	0.86	5Y 6/1	Light OliveGray

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

ANALYTICAL PROGRAM

Twenty-eight commercial analytical laboratories participated in the program to certify gold by fire assay (Table 1) using 25-50g charge weights with AAS (23 laboratories) and ICP-OES (5 laboratories) finish.

To confirm homogeneity, gold by instrumental neutron activation analysis (INAA) was undertaken on 20 x 85mg subsamples by the Australian Nuclear Science and Technology Organisation (ANSTO) located in Lucas Heights, NSW, Australia (see Table 5 in the 'Homogeneity Evaluation' section below).

For the round robin program twenty 3kg test units were taken at predetermined intervals during the bagging stage, immediately following homogenisation and are considered representative of the entire prepared batch. Six 110g pulp samples were submitted to each laboratory for analysis and comprised of two samples from each of three separate 3kg test units. This format enabled a nested ANOVA treatment of the results to evaluate homogeneity, i.e., to ascertain whether between-unit variance is greater than within-unit variance.

STATISTICAL ANALYSIS

Certified Values and their uncertainty intervals (Table 1) have been determined for each analyte following removal of individual, laboratory dataset (batch) and 3SD outliers (single iteration).

For individual outliers within a laboratory batch the z-score test is used in combination with a second method that determines the per cent deviation of the individual value from the batch median. Outliers in general are selected on the basis of z-scores > 2.5 and with per cent deviations (i) > 3 and (ii) more than three times the average absolute per cent deviation for the batch. In certain instances, statistician's prerogative has been employed in discriminating outliers.

Each laboratory data set mean is tested for outlying status based on z-score discrimination and rejected if > 2.5. After individual and laboratory data set (batch) outliers have been eliminated a non-iterative 3 standard deviation filter is applied, with those values lying outside this window also relegated to outlying status.

Certified Values are the means of accepted laboratory means after outlier filtering and are the present best estimate of the true value. The INAA data (Table 5) is omitted from determination of the certified value for Au and is used solely for the calculation of Tolerance Limits and homogeneity evaluation of OREAS L14 (see 'Homogeneity Evaluation' section below).

The 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 in ISO Guides [7,17]. 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. These major and trace element characterisation values are presented for informational purposes only.

Standard Deviation intervals (Table 4) provide an indication of a level of performance that might reasonably be expected from a laboratory being monitored by this CRM in a QA/QC program. They take into account errors attributable to measurement uncertainty and CRM variability. For an effective CRM the contribution of the latter should be negligible in comparison to measurement errors. The Standard Deviation values include all sources of measurement uncertainty: between-lab variance, within-run variance (precision errors) and CRM variability.

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

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

PERFORMANCE GATES

Table 4 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 (adapted from Govett, 1983).

Table 4. Performance Gates for OREAS L14.

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	3.24	0.070	3.10	3.38	3.03	3.45	2.17%	4.35%	6.52%	3.08	3.40

Mass fraction SI unit equivalents: ppm (parts per million) ≡ mg/kg.

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.

Homogeneity Evaluation

The variability of replicate assays from each laboratory is a result of both measurement and subsampling errors. In the determination of a statistical tolerance interval, it is therefore necessary to eliminate or at least substantially minimise, those errors attributable to measurement. One way of achieving this is by substantially reducing the analytical subsample weight to a point where most of the variability in replicate assays is due to inhomogeneity of the reference material and measurement error becomes negligible. This approach was adopted in the INAA data set where an 85mg subsample weight was employed.

Table 5 below shows the gold INAA data determined on 20 x 85mg subsamples of OREAS L14. An equivalent scaled version of the results is also provided to demonstrate the level of repeatability that would be achieved if 30g fire assay determinations were undertaken without the normal measurement error associated with this methodology. The homogeneity of gold has been determined using the reduced analytical subsample method which utilises the known relationship between standard deviation and analytical subsample mass [3]. In this approach the sample mass is greatly reduced to a point where most of the variability in replicate assays should be due to inhomogeneity of the reference material (i.e., sampling error) and measurement error becomes negligible. In this instance, a subsample weight of 85 mg was employed and the 1RSD of 0.13% was calculated for a 30g fire assay sample (2.42% at 85mg weights) and confirms the high level of gold homogeneity in OREAS L14.

The meaning of tolerance limits (as shown in Table 1) may be illustrated for gold by fire assay, where 99% of the time (1-α=0.99) at least 95% of subsamples (ρ=0.95) will have concentrations lying between 3.23 and 3.25ppm. 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 [8]. ***Please note that tolerance limits pertain to the homogeneity of the CRM only and should not be used as control limits for laboratory performance.***

Table 5. Neutron Activation Analysis of Au.

Replicate No	Au 85mg actual	Au 30g equivalent*
1	3.24	3.35
2	3.26	3.35
3	3.32	3.35
4	3.42	3.36
5	3.42	3.36
6	3.36	3.35
7	3.48	3.36
8	3.34	3.35
9	3.42	3.36
10	3.32	3.35
11	3.34	3.35
12	3.35	3.35
13	3.33	3.35
14	3.31	3.35
15	3.34	3.35
16	3.26	3.35
17	3.28	3.35
18	3.29	3.35
19	3.45	3.36
20	3.55	3.36
Mean	3.35	3.35
Median	3.34	3.35
Std Dev.	0.081	0.004
Rel.Std.Dev.	**2.42%**	**0.13%**

Au expressed as a mass fraction in ppm (SI units: mg/kg) on 20 x 85mg subsamples showing the equivalent results scaled to a 30g sample mass typical of fire assay determination.

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

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

The homogeneity of OREAS L14 has also been evaluated in a **nested ANOVA** of the round robin program. Each of the forty-two round robin laboratories received six samples per CRM and these samples were made up of paired samples from three different, non-adjacent sampling intervals. The purpose of the ANOVA evaluation is to test that no statistically significant difference exists in the variance between units to that of the variance within units. This allows an assessment of homogeneity across the entire prepared batch of OREAS L14. The test was performed using the following parameters:

Gold fire assay – 168 samples (28 laboratories each providing analyses on 3 pairs of samples):

- Null Hypothesis, H_0: Between-unit variance is no greater than within-unit variance (reject H_0 if *p*-value < 0.05);
- Alternative Hypothesis, H_1: Between-unit variance is greater than within-unit variance.

P-values are a measure of probability where values less than 0.05 indicate a greater than 95% probability that the observed differences in within-unit and between-unit variances are real. The datasets were filtered for both individual and laboratory data set (batch) outliers prior to the calculation of the *p*-value. This process derived a *p*-value of 0.4239 for Au by fire assay. This *p*-value is insignificant and the Null Hypothesis is retained.

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 L14 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.

PARTICIPATING LABORATORIES

1. Actlabs, Ancaster, Ontario, Canada
2. AGAT Laboratories, Thunder Bay, Ontario, Canada
3. ALS, Lima, Peru
4. ALS, Loughrea, Galway, Ireland
5. ALS, Perth, WA, Australia
6. ALS, Reno, Nevada, USA
7. ALS, Vancouver, BC, Canada
8. American Assay Laboratories, Sparks, Nevada, USA
9. ANSTO, Lucas Heights, NSW, Australia
10. ARGETEST Mineral Processing, Ankara, Central Anatolia, Turkey
11. Bureau Veritas Commodities and Trade, Inc., Sparks, Nevada, USA
12. Bureau Veritas Commodities Canada Ltd, Vancouver, BC, Canada
13. Bureau Veritas Geoanalytical, Adelaide, SA, Australia
14. Bureau Veritas Geoanalytical, Perth, WA, Australia
15. Bureau Veritas Minerals, Hermosillo, Sonora, Mexico
16. Inspectorate (BV), Lima, Peru
17. Intertek Genalysis, Adelaide, SA, Australia
18. Intertek Genalysis, Perth, WA, Australia

19. Intertek Tarkwa, Tarkwa, Ghana
20. Intertek Testing Services Philippines, Cupang, Muntinlupa, Philippines
21. MSALABS, Vancouver, BC, Canada
22. On Site Laboratory Services, Bendigo, VIC, Australia
23. PT Geoservices Ltd, Cikarang, Jakarta Raya, Indonesia
24. PT Intertek Utama Services, Jakarta Timur, DKI Jakarta, Indonesia
25. SGS, Ankara, Anatolia, Turkey
26. SGS Australia Mineral Services, Perth, WA, Australia
27. SGS Canada Inc., Red Lake, Ontario, Canada
28. SGS Canada Inc., Vancouver, BC, Canada
29. SGS del Peru, Lima, Peru
30. SGS Tarkwa, Tarkwa, Western Region, Ghana

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

PREPARER AND SUPPLIER

Certified reference material OREAS L14 is prepared, certified and supplied by:

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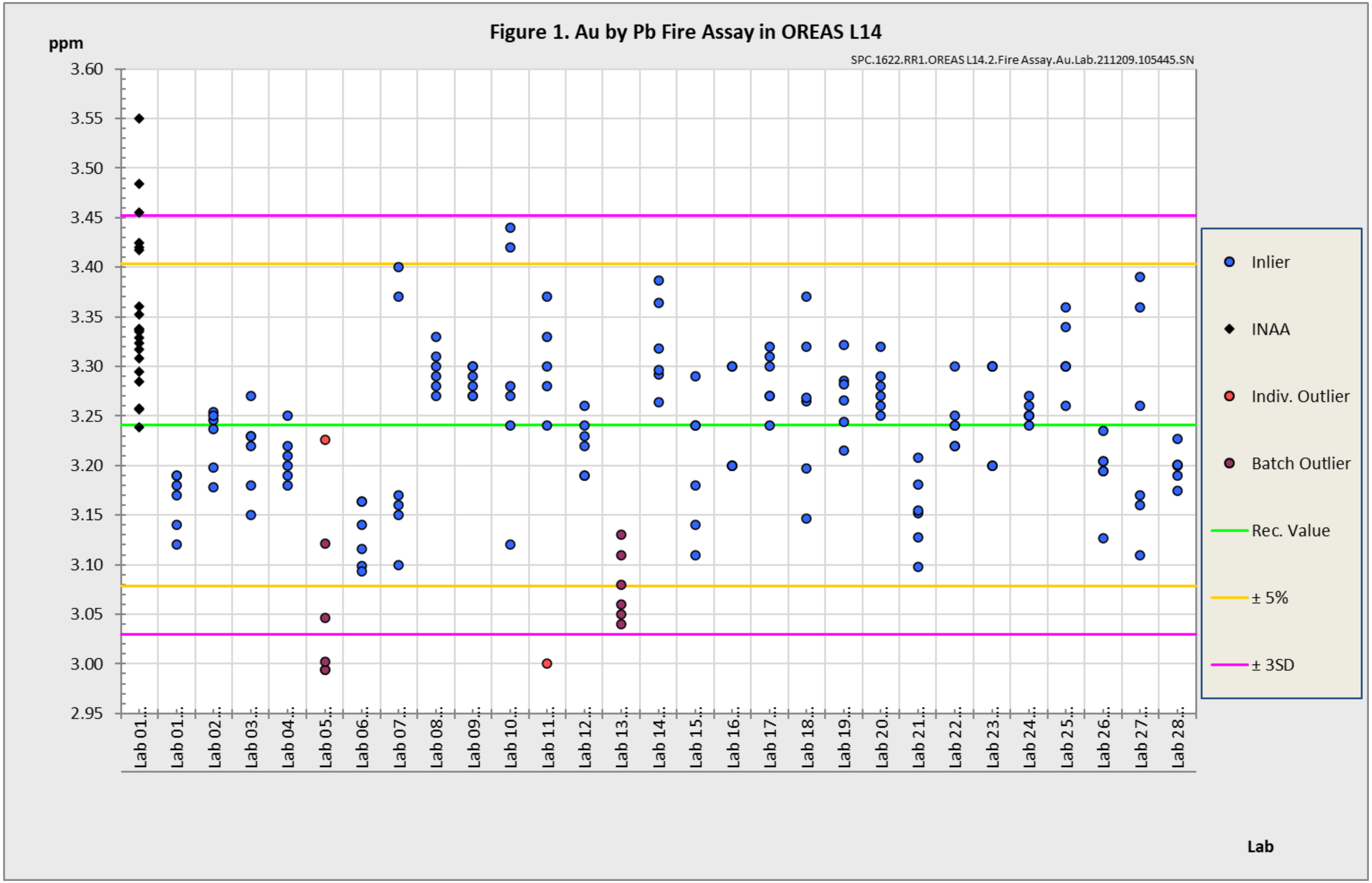
Figure 1. Au by Pb Fire Assay in OREAS L14
SPC.1622.RR1.OREAS L14.2.Fire Assay.Au.Lab.211209.105445.SN
ppm
3.60
3.55
3.50
3.45
3.40
3.35
3.30
3.25
3.20
3.15
3.10
3.05
3.00
2.95
Lab 01...
Lab 01...
Lab 02...
Lab 03...
Lab 04...
Lab 05...
Lab 06...
Lab 07...
Lab 08...
Lab 09...
Lab 10...
Lab 11...
Lab 12...
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Lab 14...
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Lab 16...
Lab 17...
Lab 18...
Lab 19...
Lab 20...
Lab 21...
Lab 22...
Lab 23...
Lab 24...
Lab 25...
Lab 26...
Lab 27...
Lab 28...
Inlier
INAA
Indiv. Outlier
Batch Outlier
Rec. Value
± 5%
± 3SD
Lab

METROLOGICAL TRACEABILITY

The interlaboratory results that underpin the certified value are metrologically traceable to the international measurement scale (SI) of mass (milligrams per kilogram (mg/kg)) and are expressed as the mass fraction parts per million (ppm). The analytical samples sent to participating laboratories were selected in a manner to be representative of the entire prepared batch of CRM. This 'representivity' was maintained in each submitted laboratory sample batch and ensures the user that the data is traceable from sample selection through to the analytical results. The systematic sampling method was chosen due to the low risk of overlooking repetitive effects or trends in the batch due to the way the CRM was processed. In line with ISO 17025 [10], 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 have and maintain ISO 17025 accreditation for the operationally defined, analytical methodologies and analytes characterised in this certificate of analysis.

Guide ISO/TR 16476:2016, section 5.3.1 describes metrological traceability in reference materials as it pertains to the transformation of the measurand. In this section it states, *"Although the determination of the property value itself can be made traceable to appropriate units through, for example, calibration of the measurement equipment used, steps like the transformation of the sample from one physical (chemical) state to another cannot. Such transformations may only be compared with a reference (when available), or among themselves. For some transformations, reference methods have been defined and may be used in certification projects to evaluate the uncertainty associated with such a transformation.* ***In other cases, only a comparison among different laboratories using the same procedure is possible. In this case, it is impossible to demonstrate absence of method bias; therefore, the result is an operationally defined measurand*** *(ISO Guide 35:2017, 9.2.4c)."* Certification takes place on the basis of agreement among operationally defined, independent measurement results.

COMMUTABILITY

The measurements of the results that underlie the certified values contained in this report were undertaken by methods involving pre-treatment (fusion/digestion) of the sample. This served to reduce the sample to a simple and well understood form permitting calibration using simple solutions of the CRM. Due to these methods being well understood and highly effective, commutability is not an issue for this CRM. All OREAS CRMs are sourced from natural ore minerals meaning they will display similar behaviour as routine 'field' samples in the relevant measurement process. Care should be taken to ensure 'matrix matching' as close as practically achievable. The matrix and mineralisation style of the CRM is described in the 'Source Material' section and users should select appropriate CRMs matching these attributes to the field samples being analysed.

INTENDED USE

OREAS L14 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 L14 may be used to calibrate the entire procedure by producing a pure substance CRM transformed into a calibration solution.

OREAS L14 is intended for the following uses:

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

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. For Au by fire assay the minimum sample mass is 25g.

PERIOD OF VALIDITY & STORAGE INSTRUCTIONS

The certification of OREAS L14 remains valid, within the specified measurement uncertainties, until 18th December 2036, 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.

Repeat-use packaging (2.5kg jars)

After taking a subsample, users should replace the lid of the jar promptly and securely to prevent accidental spills and airborne contamination. OREAS L14 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 stability of the CRM in regard to oxidation from the breakdown of sulphide minerals to sulphates is negligible given its low sulphur concentration (~ 0.02 wt.% S).

*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 absorbed 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 (~2mm thick) layer and left exposed for a period of 2 hours.

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 [14].

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

The certified values for OREAS L14 refer to the concentration level in its packaged state. It should not be dried prior to weighing and analysis.

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 4 are intended only to be used as a first principle 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 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
2	11th June 2026	Revised ‘Source Material’ description.
1	7th March 2023	Revised material description on cover page.
0	18th December, 2021	First publication.

QMS CERTIFICATION

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

18th December, 2021

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

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