

**CERTIFICATE OF ANALYSIS FOR**

**CERTIFIED REFERENCE MATERIAL**

**OREAS 751b**

**(Pegmatite Li Ore, Western Australia)**



Accredited for compliance with ISO 17034



COA-1862-OREA751b-R2  
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**Table 1. Certified Values, Uncertainty & Tolerance Intervals for multi-elements by 4-acid digestion in OREAS 751b.**

Constituent	Certified Value <sup>†</sup>	95% Expanded Uncertainty		95% Tolerance Limits	
		Low	High	Low	High
4-Acid Digestion					
Ag, Silver (ppm)	0.151	0.127	0.175	0.131	0.171
Al, Aluminium (wt.%)	4.67	4.56	4.78	4.56	4.78
As, Arsenic (ppm)	4.13	3.68	4.58	3.69	4.56
Ba, Barium (ppm)	300	291	309	292	308
Be, Beryllium (ppm)	6.01	5.77	6.24	5.84	6.17
Bi, Bismuth (ppm)	0.57	0.52	0.62	0.51	0.63
Ca, Calcium (wt.%)	0.499	0.482	0.516	0.487	0.511
Cd, Cadmium (ppm)	0.11	0.07	0.15	IND	IND
Ce, Cerium (ppm)	23.6	21.7	25.4	22.6	24.5
Co, Cobalt (ppm)	2.54	2.39	2.69	2.45	2.63
Cr, Chromium (ppm)	18.4	16.7	20.1	17.1	19.8
Cs, Caesium (ppm)	91	88	94	88	94
Cu, Copper (ppm)	14.6	13.9	15.3	14.1	15.2
Dy, Dysprosium (ppm)	1.23	1.09	1.37	1.16	1.30
Er, Erbium (ppm)	0.48	0.41	0.54	0.43	0.52
Eu, Europium (ppm)	0.43	0.37	0.50	0.41	0.45
Fe, Iron (wt.%)	0.967	0.944	0.989	0.948	0.986
Ga, Gallium (ppm)	28.4	27.4	29.4	27.7	29.1
Gd, Gadolinium (ppm)	1.80	1.62	1.97	1.70	1.89
Hf, Hafnium (ppm)	1.42	1.32	1.51	1.35	1.48
Ho, Holmium (ppm)	0.19	0.16	0.23	0.16	0.22
K, Potassium (wt.%)	1.16	1.13	1.19	1.14	1.18
La, Lanthanum (ppm)	11.6	10.6	12.5	11.1	12.0
Li, Lithium (wt.%)	0.481	0.468	0.494	0.474	0.488
Li <sub>2</sub> O, Lithium oxide (wt.%)	1.03	1.00	1.06	1.01	1.04
Lu, Lutetium (ppm)	0.053	0.042	0.063	IND	IND
Mg, Magnesium (wt.%)	0.224	0.215	0.232	0.217	0.231
Mn, Manganese (wt.%)	0.081	0.079	0.083	0.080	0.083
Mo, Molybdenum (ppm)	2.10	1.97	2.23	1.99	2.21
Na, Sodium (wt.%)	0.648	0.632	0.663	0.633	0.662
Nb, Niobium (ppm)	51	49	52	49	52
Nd, Neodymium (ppm)	10.7	9.6	11.9	10.4	11.1
Ni, Nickel (ppm)	7.84	7.44	8.23	7.44	8.23
P, Phosphorus (wt.%)	0.042	0.041	0.043	0.041	0.043
Pb, Lead (ppm)	8.16	7.77	8.54	7.75	8.56

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

<sup>†</sup>The operationally defined measurand meets the requirements of ISO 17034 and all participating laboratories comply with the requirements of ISO 17025.

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

Table 1 continued.

Constituent	Certified Value†	95% Expanded Uncertainty		95% Tolerance Limits	
		Low	High	Low	High
4-Acid Digestion continued					
Pr, Praseodymium (ppm)	2.80	2.48	3.13	2.67	2.93
Rb, Rubidium (ppm)	769	741	797	750	788
Re, Rhenium (ppm)	< 0.002	IND	IND	IND	IND
S, Sulphur (wt.%)	0.040	0.039	0.041	0.038	0.041
Sb, Antimony (ppm)	0.53	0.49	0.58	0.50	0.57
Sc, Scandium (ppm)	2.57	2.42	2.72	2.44	2.70
Sm, Samarium (ppm)	2.15	1.93	2.36	2.00	2.29
Sn, Tin (ppm)	54	52	56	52	56
Sr, Strontium (ppm)	54	52	56	53	56
Ta, Tantalum (ppm)	125	117	132	120	129
Tb, Terbium (ppm)	0.25	0.23	0.28	0.23	0.27
Th, Thorium (ppm)	4.89	4.58	5.20	4.68	5.10
Ti, Titanium (wt.%)	0.124	0.121	0.127	0.122	0.127
Tl, Thallium (ppm)	5.19	4.98	5.41	5.02	5.37
Tm, Thulium (ppm)	0.058	0.040	0.076	IND	IND
U, Uranium (ppm)	1.99	1.71	2.27	1.80	2.17
V, Vanadium (ppm)	18.6	17.6	19.6	17.9	19.3
W, Tungsten (ppm)	4.63	4.14	5.13	4.26	5.00
Y, Yttrium (ppm)	4.97	4.67	5.28	4.79	5.16
Yb, Ytterbium (ppm)	0.39	0.35	0.43	0.37	0.41
Zn, Zinc (ppm)	112	108	115	109	115
Zr, Zirconium (ppm)	25.2	23.8	26.6	24.2	26.1

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

Note: intervals may appear asymmetric due to rounding.

<sup>†</sup>The operationally defined measurand meets the requirements of ISO 17034 and all participating laboratories comply with the requirements of ISO 17025.

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. Certified Values, Uncertainty & Tolerance Intervals for other measurands in OREAS 751b.**

Constituent	Certified Value	95% Expanded Uncertainty		95% Tolerance Limits	
		Low	High	Low	High
Borate / Peroxide Fusion ICP					
Al, Aluminium (wt.%)	4.80	4.67	4.92	4.72	4.88
B, Boron (ppm)	36.9	21.4	52.3	IND	IND
Ba, Barium (ppm)	301	291	310	291	311
Be, Beryllium (ppm)	6.32	5.43	7.22	IND	IND
Bi, Bismuth (ppm)	0.59	0.47	0.72	IND	IND
Ca, Calcium (wt.%)	0.483	0.452	0.514	0.465	0.501
Ce, Cerium (ppm)	23.4	21.7	25.0	22.6	24.1
Co, Cobalt (ppm)	2.77	2.46	3.08	2.53	3.00
Cs, Caesium (ppm)	89	85	92	87	91
Cu, Copper (ppm)	18.2	15.1	21.3	IND	IND
Dy, Dysprosium (ppm)	1.73	1.51	1.95	1.62	1.84
Er, Erbium (ppm)	0.89	0.76	1.01	0.80	0.98
Eu, Europium (ppm)	0.42	0.36	0.47	0.38	0.46
Fe, Iron (wt.%)	0.964	0.931	0.996	0.936	0.991
Ga, Gallium (ppm)	29.0	27.3	30.7	28.1	29.9
Gd, Gadolinium (ppm)	2.09	1.86	2.32	1.85	2.33
Ge, Germanium (ppm)	1.84	1.37	2.30	IND	IND
Ho, Holmium (ppm)	0.33	0.29	0.36	0.30	0.35
In, Indium (ppm)	< 0.2	IND	IND	IND	IND
K, Potassium (wt.%)	1.19	1.14	1.23	1.16	1.22
La, Lanthanum (ppm)	11.4	10.7	12.2	10.9	11.9
Li, Lithium (wt.%)	0.492	0.475	0.509	0.484	0.500
Li <sub>2</sub> O, Lithium oxide (wt.%)	1.06	1.02	1.10	1.04	1.08
Lu, Lutetium (ppm)	0.13	0.11	0.15	IND	IND
Mg, Magnesium (wt.%)	0.225	0.216	0.235	0.215	0.235
Mn, Manganese (wt.%)	0.081	0.079	0.084	0.080	0.083
Nb, Niobium (ppm)	50	48	52	49	52
Nd, Neodymium (ppm)	10.9	10.0	11.7	10.4	11.3
P, Phosphorus (wt.%)	0.040	0.039	0.041	IND	IND
Pr, Praseodymium (ppm)	2.82	2.65	2.99	2.67	2.97
Rb, Rubidium (ppm)	762	733	791	747	776
Re, Rhenium (ppm)	< 0.1	IND	IND	IND	IND
Sb, Antimony (ppm)	0.57	0.43	0.71	IND	IND
Si, Silicon (wt.%)	39.57	38.31	40.84	38.76	40.39
Sm, Samarium (ppm)	2.21	2.02	2.41	2.02	2.40
Sn, Tin (ppm)	79	75	83	78	81
Sr, Strontium (ppm)	58	54	62	56	60

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

Note: intervals may appear asymmetric due to rounding.

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

Table 2 continued.

Constituent	Certified Value	95% Expanded Uncertainty		95% Tolerance Limits	
		Low	High	Low	High
Borate / Peroxide Fusion ICP continued					
Ta, Tantalum (ppm)	132	128	137	129	136
Tb, Terbium (ppm)	0.30	0.26	0.33	0.27	0.32
Th, Thorium (ppm)	4.91	4.54	5.29	4.72	5.11
Ti, Titanium (wt.%)	0.126	0.118	0.133	0.121	0.130
Tl, Thallium (ppm)	5.34	5.07	5.60	5.16	5.52
Tm, Thulium (ppm)	0.13	0.11	0.16	IND	IND
U, Uranium (ppm)	2.14	1.90	2.39	1.87	2.41
V, Vanadium (ppm)	19.4	17.5	21.3	15.8	22.9
W, Tungsten (ppm)	5.16	3.90	6.41	3.97	6.34
Y, Yttrium (ppm)	9.07	8.49	9.64	8.26	9.88
Yb, Ytterbium (ppm)	0.80	0.64	0.96	IND	IND
Zn, Zinc (ppm)	107	98	116	103	112
Borate Fusion XRF					
Al <sub>2</sub> O <sub>3</sub> , Aluminium(III) oxide (wt.%)	9.13	9.00	9.25	9.04	9.21
BaO, Barium oxide (ppm)	329	288	371	318	341
CaO, Calcium oxide (wt.%)	0.693	0.679	0.707	0.680	0.706
Cr <sub>2</sub> O <sub>3</sub> , Chromium(III) oxide (ppm)	< 100	IND	IND	IND	IND
Fe <sub>2</sub> O <sub>3</sub> , Iron(III) oxide (wt.%)	1.39	1.37	1.42	1.38	1.41
K <sub>2</sub> O, Potassium oxide (wt.%)	1.41	1.39	1.42	1.39	1.42
MgO, Magnesium oxide (wt.%)	0.379	0.365	0.394	0.370	0.389
MnO, Manganese oxide (wt.%)	0.106	0.103	0.109	0.103	0.110
Na <sub>2</sub> O, Sodium oxide (wt.%)	0.883	0.863	0.904	0.866	0.900
Nb, Niobium (ppm)	43.4	32.4	54.4	IND	IND
P <sub>2</sub> O <sub>5</sub> , Phosphorus(V) oxide (wt.%)	0.093	0.088	0.098	0.091	0.095
Rb, Rubidium (ppm)	732	671	794	689	775
SiO <sub>2</sub> , Silicon dioxide (wt.%)	83.76	83.06	84.47	83.27	84.26
SO <sub>3</sub> , Sulphur trioxide (wt.%)	0.091	0.082	0.101	0.086	0.097
TiO <sub>2</sub> , Titanium dioxide (wt.%)	0.210	0.198	0.221	0.204	0.215
Zn, Zinc (ppm)	114	89	138	IND	IND
Zr, Zirconium (ppm)	109	82	137	IND	IND
Thermogravimetry					
LOI <sup>1000</sup> , Loss On Ignition @1000°C (wt.%)	0.697	0.632	0.761	0.661	0.732

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

Note: intervals may appear asymmetric due to rounding.

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

**Table 3. Indicative Values for OREAS 751b.**

Constituent	Unit	Value	Constituent	Unit	Value	Constituent	Unit	Value
<b>4-Acid Digestion</b>								
B	ppm	5.00	Hg	ppm	< 1	Se	ppm	0.68
Ge	ppm	0.15	In	ppm	0.016	Te	ppm	0.067
<b>Peroxide Fusion ICP</b>								
Ag	ppm	< 10	Hg	ppm	< 5	S	wt.%	0.042
As	ppm	4.73	Mo	ppm	2.56	Sc	ppm	< 5
Cd	ppm	< 10	Na	wt.%	0.640	Se	ppm	< 10
Cr	ppm	37.6	Ni	ppm	18.1	Te	ppm	< 1
Hf	ppm	3.60	Pb	ppm	12.1	Zr	ppm	97
<b>Borate Fusion XRF</b>								
Ag	ppm	0.155	Hf	ppm	< 80	Sm	ppm	2.32
As	ppm	12.4	Ho	ppm	0.36	Sn	ppm	69
Be	ppm	6.67	In	ppm	< 0.1	SrO	ppm	73
Bi	ppm	< 100	La	ppm	29.6	Ta	ppm	111
Ce	ppm	34.5	Lu	ppm	0.13	Tb	ppm	0.32
Co	ppm	< 100	Mo	ppm	< 50	Te	ppm	< 0.1
Cs	ppm	93	Nd	ppm	10.6	Th	ppm	24.3
CuO	ppm	34.1	NiO	ppm	40.7	Tl	ppm	5.35
Dy	ppm	1.80	Pb	ppm	< 50	Tm	ppm	0.14
Er	ppm	0.95	Pr	ppm	2.82	U	ppm	5.36
Eu	ppm	0.38	Re	ppm	< 0.1	V <sub>2</sub> O <sub>5</sub>	ppm	33.8
Ga	ppm	27.2	Sb	ppm	< 50	W	ppm	< 10
Gd	ppm	2.17	Sc	ppm	3.83	Y	ppm	19.2
H <sub>2</sub> O-	wt.%	0.133	Se	ppm	1.17	Yb	ppm	0.85
<b>Aqua Regia Digestion</b>								
Cs	ppm	90						

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

Note: the number of significant figures reported is not a reflection of the level of certainty of stated values. They are instead an artefact of ORE's in-house CRM-specific LIMS.

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## INTRODUCTION

OREAS reference materials are intended to provide a low-cost method of evaluating and improving the quality of analysis of geological samples. To the geologist they provide a means of implementing quality control in analytical data sets generated in exploration from the grass roots level through to prospect evaluation, and in grade control at mining operations. To the analyst they provide an effective means of calibrating analytical equipment, assessing new techniques and routinely monitoring in-house procedures. OREAS reference materials enable users to successfully achieve process control of these tasks because the observed variance from repeated analysis has its origin almost exclusively in the analytical process rather than the reference material itself. In evaluating laboratory performance with this CRM, the section headed 'Instructions for correct use' should be read carefully.

Table 1 (generated from data supplied by laboratories all accredited to ISO 17025 for 4-acid digestion) and Table 2 (generated from data supplied by laboratories mostly accredited to ISO 17025) provide the certified values and their associated 95% expanded uncertainty and tolerance intervals, Table 3 shows indicative values including major and trace element characterisation, Table 4 provides some indicative physical properties, Table 5 provides indicative mineralogy based on semi-quantitative XRD analysis and 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 lab means from the corrected mean of means (PDM<sup>3</sup>) are presented in the detailed certification data for this CRM (**OREAS 751b-DataPack.1.3.241028\_144953.xlsx**). Results are also presented in scatter plots for Li<sub>2</sub>O (wt.%) by 4-acid digestion and borate/peroxide fusion with ICP in Figures 1 and 2 respectively, together with  $\pm 3SD$  (magenta) and  $\pm 5\%$  (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 751b was prepared from a blend of spodumene concentrate derived from the processing of lithium pegmatite ores sourced from the Greenbushes area of southwest Western Australia, Londonderry lithium-pegmatite ore (containing elevated levels of lithium, rubidium, caesium, tin and tantalum), barren granodiorite and quartz. The barren granodiorite was sourced from the mafic, S-Type, Late Devonian Bulla Granodiorite complex located in northern Melbourne, Australia.

## COMMINUTION AND HOMOGENISATION PROCEDURES

The material constituting OREAS 751b was prepared in the following manner:

- Drying of materials to constant mass at 105 °C;
- Crushing and milling of the barren granodiorite and quartz to > 98 % minus 75  $\mu\text{m}$ ;
- Crushing and milling of ore and spodumene concentrate to 100 % minus 30  $\mu\text{m}$ ;
- Check analysis of ore and spodumene concentrate for contained Li concentration;
- Blending the ore, concentrate and barren materials in appropriate proportions to achieve the desired Li grade;



- Homogenisation using OREAS' novel processing technologies;
- Packaging in 10 g units in laminated foil pouches and 500 g units in plastic wide-mouth jars.

## PHYSICAL PROPERTIES

OREAS 751b was tested at ORE Research & Exploration Pty Ltd's onsite facility for various physical properties. Table 4 presents these findings that should be used for informational purposes only.

**Table 4. Physical properties of OREAS 751b.**

Bulk Density (kg/m <sup>3</sup> )	Moisture (wt.%)	Munsell Notation <sup>‡</sup>	Munsell Color <sup>‡</sup>
751	0.23	N8	Very Light Gray

<sup>‡</sup>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.

## MINERALOGY

The semi-quantitative XRD results shown in Table 5 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. Some amorphous material might be present. 'Clay mineral' appears to be mainly illite, and/or vermiculite. 'Kandite group' appears to be mainly kaolinite. Mica group minerals can be Li-bearing. A trace of petalite might be present in the samples.

**Table 5. Indicative mineralogy of OREAS 751b based on semi-quantitative XRD analysis.**

Mineral / Mineral Group	% (mass ratio)
Spodumene	9
Clay mineral	< 1
Chlorite	1
Kandite group	< 1
Annite - biotite - phlogopite	18
Muscovite	1
Plagioclase	8
K-feldspar and/or rutile	3
Cordierite	< 1
Quartz	61

## ANALYTICAL PROGRAM

Twenty-eight commercial analytical laboratories participated in the program to certify the elements reported in Table 1 and 2. The following methods were employed:

- Lithium borate or sodium peroxide fusion with full suite ICP-OES and ICP-MS elemental packages (up to 24 laboratories depending on the element);
- 4-acid (HNO<sub>3</sub>-HF-HClO<sub>4</sub>-HCl) digestion with full suite ICP-OES and ICP-MS elemental packages (up to 26 laboratories depending on the element);

- Lithium borate fusion whole rock analysis package by X-ray fluorescence (up to 20 laboratories depending on the element);
- Thermogravimetry: Loss on Ignition (LOI) at 1000 °C (8 laboratories used a thermogravimetric analyser, 8 laboratories included LOI with their fusion package and 5 laboratories used a conventional muffle furnace).

For the round robin program twelve 1kg test units were taken at predetermined intervals during the bagging stage, immediately following homogenisation and are considered representative of the entire prepared batch. The six samples received by each laboratory were obtained by taking two 15g scoop splits from each of three separate 1kg 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 (see 'Homogeneity Evaluation' section below).

## STATISTICAL ANALYSIS

**Certified Values and their uncertainty intervals** (Tables 1 and 2) have been determined for each analyte following removal of individual, laboratory dataset (batch) and 3SD outliers (single iteration).

For individual outliers within a laboratory batch the z-score test is used in combination with a second method that determines the per cent deviation of the individual value from the batch median. Outliers in general are selected on the basis of z-scores  $> 2.5$  and with per cent deviations (i)  $> 3$  and (ii) more than three times the average absolute per cent deviation for the batch. Each laboratory data set mean is tested for outlying status based on z-score discrimination and rejected if  $> 2.5$ . After individual and laboratory data set (batch) outliers have been eliminated a non-iterative 3 standard deviation filter is applied, with those values lying outside this window also relegated to outlying status. However, while statistics are taken into account, the exercise of a statistician's prerogative plays a significant role in identifying outliers.

**95 % Expanded Uncertainty** provides a 95 % probability that the true value of the analyte under consideration lies between the upper and lower limits and is calculated according to the method outlined in ISO 98-3:2008 [5, 15]. All known or suspected sources of bias have been investigated or taken into account.

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

### **Homogeneity Evaluation**

The tolerance limits (ISO 16269:2014) shown in Tables 1 and 2 were determined using an analysis of precision errors method and are considered a conservative estimate of true homogeneity. The meaning of tolerance limits may be illustrated for lithium ( $\text{Li}_2\text{O}$ ) by 4-acid digestion with ICP, where 99 % of the time ( $1-\alpha=0.99$ ) at least 95% of subsamples ( $p=0.95$ ) will have concentrations lying between 1.01 and 1.04 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. ***Please note that tolerance limits pertain to the homogeneity of the CRM only and should not be used as control limits for laboratory performance.***

Based on the statistical analysis of the results of the interlaboratory certification program, it can be concluded that OREAS 751b is fit-for-purpose as a certified reference material (see 'Intended Use' below).

## 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 below). Westgard Rules extend the basics of single-rule QC monitoring using multi-rules (for more information visit [www.westgard.com/mltrule.htm](http://www.westgard.com/mltrule.htm)). A second method utilises a 5 % window calculated directly from the certified value.

Standard deviation is also shown in relative percent for one, two and three relative standard deviations (1RSD, 2RSD and 3RSD) to facilitate an appreciation of the magnitude of these numbers and a comparison with the 5 % window. Caution should be exercised when concentration levels approach lower limits of detection of the analytical methods employed as performance gates calculated from standard deviations tend to be excessively wide whereas those determined by the 5 % method are too narrow. One approach used at commercial laboratories is to set the acceptance criteria at twice the detection level (DL)  $\pm 10\%$ .

*i.e., Certified Value  $\pm 10\% \pm 2DL$  [1].*

**Table 6. Performance Gates for OREAS 751b.**

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											
Ag, ppm	0.151	0.027	0.097	0.205	0.071	0.231	17.74%	35.48%	53.22%	0.144	0.159
Al, wt. %	4.67	0.151	4.37	4.97	4.22	5.12	3.22%	6.45%	9.67%	4.44	4.90
As, ppm	4.13	0.44	3.25	5.00	2.81	5.44	10.60%	21.21%	31.81%	3.92	4.33
Ba, ppm	300	11	278	322	267	333	3.64%	7.28%	10.92%	285	315
Be, ppm	6.01	0.253	5.50	6.51	5.25	6.76	4.21%	8.42%	12.63%	5.71	6.31
Bi, ppm	0.57	0.036	0.49	0.64	0.46	0.68	6.44%	12.87%	19.31%	0.54	0.60
Ca, wt. %	0.499	0.020	0.459	0.539	0.439	0.559	4.02%	8.05%	12.07%	0.474	0.524
Cd, ppm	0.11	0.03	0.04	0.18	0.01	0.21	30.57%	61.13%	91.70%	0.11	0.12
Ce, ppm	23.6	2.25	19.0	28.1	16.8	30.3	9.56%	19.12%	28.69%	22.4	24.7
Co, ppm	2.54	0.115	2.31	2.77	2.19	2.88	4.52%	9.03%	13.55%	2.41	2.66
Cr, ppm	18.4	2.6	13.3	23.6	10.7	26.2	13.97%	27.95%	41.92%	17.5	19.4
Cs, ppm	91	4.3	82	100	78	104	4.73%	9.46%	14.19%	86	95
Cu, ppm	14.6	0.74	13.1	16.1	12.4	16.9	5.08%	10.16%	15.25%	13.9	15.4
Dy, ppm	1.23	0.14	0.94	1.52	0.80	1.66	11.71%	23.42%	35.13%	1.17	1.29
Er, ppm	0.48	0.05	0.37	0.58	0.32	0.64	10.96%	21.92%	32.88%	0.45	0.50
Eu, ppm	0.43	0.08	0.28	0.59	0.20	0.66	17.95%	35.90%	53.84%	0.41	0.45
Fe, wt. %	0.967	0.026	0.915	1.018	0.890	1.043	2.65%	5.30%	7.94%	0.918	1.015
Ga, ppm	28.4	1.54	25.3	31.5	23.8	33.0	5.42%	10.83%	16.25%	27.0	29.8
Gd, ppm	1.80	0.108	1.58	2.01	1.47	2.12	5.99%	11.99%	17.98%	1.71	1.89
Hf, ppm	1.42	0.089	1.24	1.59	1.15	1.68	6.27%	12.55%	18.82%	1.35	1.49
Ho, ppm	0.19	0.016	0.16	0.23	0.14	0.24	8.42%	16.84%	25.26%	0.18	0.20
K, wt. %	1.16	0.032	1.10	1.22	1.06	1.25	2.74%	5.47%	8.21%	1.10	1.22

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

Note 1: intervals may appear asymmetric due to rounding.

Note 2: the number of decimal places quoted does not imply accuracy of the certified value to this level but are given to minimise rounding errors when calculating 2SD and 3SD windows.

Table 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											
La, ppm	11.6	1.03	9.5	13.6	8.4	14.7	8.96%	17.91%	26.87%	11.0	12.1
Li, wt. %	0.481	0.014	0.452	0.510	0.437	0.524	3.01%	6.01%	9.02%	0.457	0.505
Li <sub>2</sub> O, wt. %	1.03	0.025	0.98	1.08	0.95	1.11	2.47%	4.93%	7.40%	0.98	1.08
Lu, ppm	0.053	0.007	0.038	0.067	0.031	0.075	13.96%	27.92%	41.88%	0.050	0.055
Mg, wt. %	0.224	0.011	0.202	0.245	0.191	0.256	4.88%	9.75%	14.63%	0.213	0.235
Mn, wt. %	0.081	0.002	0.077	0.086	0.074	0.088	2.88%	5.77%	8.65%	0.077	0.085
Mo, ppm	2.10	0.091	1.92	2.28	1.83	2.37	4.32%	8.65%	12.97%	2.00	2.21
Na, wt. %	0.648	0.025	0.598	0.697	0.573	0.722	3.83%	7.66%	11.50%	0.615	0.680
Nb, ppm	51	1.6	48	54	46	55	3.08%	6.17%	9.25%	48	53
Nd, ppm	10.7	1.00	8.8	12.7	7.8	13.7	9.27%	18.53%	27.80%	10.2	11.3
Ni, ppm	7.84	0.339	7.16	8.51	6.82	8.85	4.33%	8.65%	12.98%	7.44	8.23
P, wt. %	0.042	0.002	0.038	0.046	0.036	0.048	4.58%	9.16%	13.74%	0.040	0.044
Pb, ppm	8.16	0.560	7.04	9.28	6.48	9.84	6.87%	13.74%	20.61%	7.75	8.57
Pr, ppm	2.80	0.279	2.25	3.36	1.97	3.64	9.96%	19.92%	29.87%	2.66	2.94
Rb, ppm	769	34	702	836	668	870	4.38%	8.75%	13.13%	730	807
Re, ppm	< 0.002	IND	IND	IND	IND	IND	IND	IND	IND	IND	IND
S, wt. %	0.040	0.002	0.035	0.044	0.033	0.046	5.38%	10.75%	16.13%	0.038	0.042
Sb, ppm	0.53	0.040	0.45	0.61	0.41	0.65	7.48%	14.96%	22.44%	0.51	0.56
Sc, ppm	2.57	0.180	2.21	2.93	2.03	3.11	7.01%	14.02%	21.03%	2.44	2.70
Sm, ppm	2.15	0.167	1.81	2.48	1.65	2.65	7.80%	15.59%	23.39%	2.04	2.25
Sn, ppm	54	3.2	48	60	44	64	5.98%	11.95%	17.93%	51	57
Sr, ppm	54	2.9	49	60	46	63	5.37%	10.74%	16.11%	52	57
Ta, ppm	125	13	99	150	87	162	10.11%	20.22%	30.32%	118	131
Tb, ppm	0.25	0.024	0.20	0.30	0.18	0.32	9.50%	18.99%	28.49%	0.24	0.26
Th, ppm	4.89	0.310	4.27	5.51	3.96	5.82	6.34%	12.69%	19.03%	4.65	5.14
Ti, wt. %	0.124	0.006	0.112	0.136	0.107	0.142	4.73%	9.46%	14.19%	0.118	0.130
Tl, ppm	5.19	0.337	4.52	5.87	4.18	6.21	6.49%	12.98%	19.47%	4.93	5.45
Tm, ppm	0.058	0.010	0.038	0.078	0.028	0.088	17.03%	34.06%	51.09%	0.055	0.061
U, ppm	1.99	0.22	1.54	2.43	1.32	2.66	11.21%	22.42%	33.64%	1.89	2.09
V, ppm	18.6	0.79	17.0	20.2	16.2	21.0	4.27%	8.54%	12.81%	17.7	19.6
W, ppm	4.63	0.408	3.82	5.45	3.41	5.85	8.80%	17.60%	26.40%	4.40	4.86
Y, ppm	4.97	0.316	4.34	5.61	4.03	5.92	6.35%	12.70%	19.04%	4.73	5.22
Yb, ppm	0.39	0.024	0.35	0.44	0.32	0.46	5.98%	11.97%	17.95%	0.37	0.41
Zn, ppm	112	5	101	123	95	128	4.90%	9.80%	14.71%	106	117
Zr, ppm	25.2	1.97	21.2	29.1	19.3	31.1	7.83%	15.67%	23.50%	23.9	26.4
Borate / Peroxide Fusion ICP											
Al, wt. %	4.80	0.125	4.55	5.05	4.42	5.17	2.60%	5.20%	7.79%	4.56	5.04
B, ppm	36.9	8.2	20.6	53.2	12.4	61.3	22.13%	44.25%	66.38%	35.0	38.7
Ba, ppm	301	9	284	318	275	326	2.84%	5.67%	8.51%	286	316
Be, ppm	6.32	0.67	4.99	7.66	4.33	8.32	10.53%	21.06%	31.58%	6.01	6.64
Bi, ppm	0.59	0.09	0.42	0.77	0.33	0.86	14.91%	29.81%	44.72%	0.56	0.62
Ca, wt. %	0.483	0.036	0.412	0.554	0.376	0.590	7.38%	14.75%	22.13%	0.459	0.507
Ce, ppm	23.4	1.69	20.0	26.7	18.3	28.4	7.25%	14.50%	21.75%	22.2	24.5

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

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

Note 2: the number of decimal places quoted does not imply accuracy of the certified value to this level but are given to minimise rounding errors when calculating 2SD and 3SD windows.

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
Borate / Peroxide Fusion ICP continued											
Co, ppm	2.77	0.46	1.84	3.69	1.38	4.15	16.70%	33.41%	50.11%	2.63	2.91
Cs, ppm	89	3.3	82	95	79	99	3.67%	7.34%	11.01%	84	93
Cu, ppm	18.2	2.9	12.5	24.0	9.6	26.8	15.75%	31.51%	47.26%	17.3	19.1
Dy, ppm	1.73	0.142	1.45	2.02	1.31	2.16	8.19%	16.37%	24.56%	1.65	1.82
Er, ppm	0.89	0.11	0.66	1.12	0.55	1.23	12.73%	25.46%	38.19%	0.84	0.93
Eu, ppm	0.42	0.05	0.31	0.52	0.26	0.58	12.50%	25.00%	37.49%	0.40	0.44
Fe, wt.%	0.964	0.042	0.880	1.048	0.838	1.090	4.36%	8.72%	13.08%	0.915	1.012
Ga, ppm	29.0	1.71	25.6	32.4	23.9	34.1	5.88%	11.76%	17.64%	27.6	30.5
Gd, ppm	2.09	0.191	1.71	2.47	1.51	2.66	9.16%	18.33%	27.49%	1.98	2.19
Ge, ppm	1.84	0.39	1.05	2.62	0.66	3.01	21.30%	42.61%	63.91%	1.75	1.93
Ho, ppm	0.33	0.022	0.28	0.37	0.26	0.39	6.71%	13.43%	20.14%	0.31	0.34
In, ppm	< 0.2	IND	IND	IND	IND	IND	IND	IND	IND	IND	IND
K, wt.%	1.19	0.035	1.12	1.26	1.08	1.29	2.94%	5.88%	8.82%	1.13	1.25
La, ppm	11.4	0.84	9.8	13.1	8.9	13.9	7.31%	14.62%	21.93%	10.9	12.0
Li, wt.%	0.492	0.013	0.466	0.518	0.453	0.531	2.65%	5.30%	7.94%	0.467	0.517
Li <sub>2</sub> O, wt.%	1.06	0.028	1.00	1.12	0.98	1.14	2.65%	5.30%	7.94%	1.01	1.11
Lu, ppm	0.13	0.012	0.10	0.15	0.09	0.16	9.26%	18.53%	27.79%	0.12	0.13
Mg, wt.%	0.225	0.012	0.201	0.250	0.188	0.262	5.43%	10.85%	16.28%	0.214	0.236
Mn, wt.%	0.081	0.003	0.075	0.088	0.071	0.092	4.26%	8.52%	12.78%	0.077	0.086
Nb, ppm	50	1.7	47	54	45	55	3.37%	6.74%	10.10%	48	53
Nd, ppm	10.9	0.81	9.2	12.5	8.4	13.3	7.50%	15.01%	22.51%	10.3	11.4
P, wt.%	0.040	0.001	0.039	0.041	0.038	0.042	1.56%	3.12%	4.69%	0.038	0.042
Pr, ppm	2.82	0.193	2.43	3.20	2.24	3.40	6.84%	13.68%	20.52%	2.68	2.96
Rb, ppm	762	37	687	837	649	874	4.92%	9.84%	14.76%	724	800
Re, ppm	< 0.1	IND	IND	IND	IND	IND	IND	IND	IND	IND	IND
Sb, ppm	0.57	0.11	0.36	0.78	0.25	0.89	18.72%	37.44%	56.15%	0.54	0.60
Si, wt.%	39.57	1.330	36.91	42.23	35.58	43.56	3.36%	6.72%	10.08%	37.59	41.55
Sm, ppm	2.21	0.204	1.80	2.62	1.60	2.82	9.22%	18.44%	27.66%	2.10	2.32
Sn, ppm	79	3.3	73	86	69	89	4.16%	8.33%	12.49%	75	83
Sr, ppm	58	6	46	70	40	76	10.27%	20.53%	30.80%	55	61
Ta, ppm	132	4	124	140	120	145	3.15%	6.29%	9.44%	126	139
Tb, ppm	0.30	0.028	0.24	0.35	0.21	0.38	9.43%	18.85%	28.28%	0.28	0.31
Th, ppm	4.91	0.229	4.46	5.37	4.23	5.60	4.65%	9.30%	13.96%	4.67	5.16
Ti, wt.%	0.126	0.005	0.115	0.136	0.110	0.141	4.13%	8.26%	12.40%	0.119	0.132
Tl, ppm	5.34	0.241	4.85	5.82	4.61	6.06	4.51%	9.02%	13.52%	5.07	5.60
Tm, ppm	0.13	0.02	0.10	0.17	0.08	0.18	12.35%	24.70%	37.05%	0.13	0.14
U, ppm	2.14	0.23	1.69	2.60	1.46	2.82	10.57%	21.15%	31.72%	2.04	2.25
V, ppm	19.4	1.58	16.2	22.5	14.6	24.1	8.16%	16.32%	24.47%	18.4	20.3
W, ppm	5.16	0.76	3.64	6.67	2.89	7.42	14.67%	29.34%	44.01%	4.90	5.41
Y, ppm	9.07	0.580	7.91	10.23	7.33	10.81	6.39%	12.79%	19.18%	8.61	9.52
Yb, ppm	0.80	0.12	0.56	1.04	0.44	1.16	15.01%	30.01%	45.02%	0.76	0.84
Zn, ppm	107	9	90	125	81	133	8.15%	16.29%	24.44%	102	113

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

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

Note 2: the number of decimal places quoted does not imply accuracy of the certified value to this level but are given to minimise rounding errors when calculating 2SD and 3SD windows.

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
Borate Fusion XRF											
Al <sub>2</sub> O <sub>3</sub> , wt. %	9.13	0.168	8.79	9.46	8.62	9.63	1.85%	3.69%	5.54%	8.67	9.58
BaO, ppm	329	49	231	427	182	476	14.88%	29.76%	44.65%	313	346
CaO, wt. %	0.693	0.015	0.664	0.723	0.649	0.737	2.13%	4.26%	6.39%	0.658	0.728
Cr <sub>2</sub> O <sub>3</sub> , ppm	< 100	IND	IND	IND	IND	IND	IND	IND	IND	IND	IND
Fe <sub>2</sub> O <sub>3</sub> , wt. %	1.39	0.022	1.35	1.44	1.33	1.46	1.58%	3.16%	4.75%	1.32	1.46
K <sub>2</sub> O, wt. %	1.41	0.018	1.37	1.44	1.35	1.46	1.25%	2.51%	3.76%	1.34	1.48
MgO, wt. %	0.379	0.021	0.338	0.421	0.317	0.442	5.50%	11.00%	16.49%	0.360	0.398
MnO, wt. %	0.106	0.004	0.098	0.114	0.095	0.118	3.64%	7.27%	10.91%	0.101	0.111
Na <sub>2</sub> O, wt. %	0.883	0.025	0.833	0.934	0.807	0.959	2.87%	5.73%	8.60%	0.839	0.927
Nb, ppm	43.4	10.1	23.2	63.6	13.1	73.7	23.27%	46.55%	69.82%	41.2	45.6
P <sub>2</sub> O <sub>5</sub> , wt. %	0.093	0.006	0.080	0.106	0.074	0.112	6.92%	13.83%	20.75%	0.088	0.098
Rb, ppm	732	44	643	821	599	865	6.06%	12.13%	18.19%	696	769
SiO <sub>2</sub> , wt. %	83.76	0.772	82.22	85.31	81.45	86.08	0.92%	1.84%	2.77%	79.58	87.95
SO <sub>3</sub> , wt. %	0.091	0.012	0.068	0.114	0.057	0.126	12.62%	25.25%	37.87%	0.087	0.096
TiO <sub>2</sub> , wt. %	0.210	0.008	0.195	0.225	0.187	0.232	3.59%	7.18%	10.77%	0.199	0.220
Zn, ppm	114	17	80	148	63	165	14.96%	29.92%	44.88%	108	119
Zr, ppm	109	21	67	152	46	173	19.31%	38.61%	57.92%	104	115
Thermogravimetry											
LOI <sup>1000</sup> , wt. %	0.697	0.082	0.532	0.861	0.450	0.944	11.80%	23.61%	35.41%	0.662	0.732

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

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

Note 2: the number of decimal places quoted does not imply accuracy of the certified value to this level but are given to minimise rounding errors when calculating 2SD and 3SD windows.

## PARTICIPATING LABORATORIES

1. Actlabs, Ancaster, Ontario, Canada
2. African Natural Resources & Mines Ltd, Suleja, Niger State, Nigeria
3. AGAT Laboratories, Calgary, Alberta, Canada
4. ALS, Johannesburg, South Africa
5. ALS, Lima, Peru
6. ALS, Loughrea, Galway, Ireland
7. ALS, Malaga, WA, Australia
8. ALS, Vancouver, BC, Canada
9. ARGETEST Mineral Processing, Ankara, Central Anatolia, Turkey
10. Bureau Veritas Commodities Canada Ltd, Vancouver, BC, Canada
11. CERTIMIN, Lima, Peru
12. CRS Laboratories Oy, Kempele, Northern Ostrobothnia, Finland
13. Inspectorate (BV), Lima, Peru
14. Intertek, Cupang, Muntinlupa, Philippines
15. Intertek, Perth, WA, Australia
16. Intertek, Townsville, QLD, Australia
17. Labwest Minerals Analysis, Perth, WA, Australia
18. MSALABS, Vancouver, BC, Canada
19. Ontario Geological Survey, Sudbury, Ontario, Canada
20. PT Geoservices Ltd, Cikarang, Jakarta Raya, Indonesia
21. PT Intertek Utama Services, Jakarta Timur, DKI Jakarta, Indonesia
22. Saskatchewan Research Council, Saskatoon, Saskatchewan, Canada
23. SGS, Randfontein, Gauteng, South Africa
24. SGS Australia Mineral Services, Perth, WA, Australia
25. SGS Canada Inc., Vancouver, BC, Canada
26. SGS del Peru, Lima, Peru
27. Shiva Analyticals Ltd, Bangalore North, Karnataka, India
28. Stewart Assay & Environmental Laboratories LLC, Kara-Balta, Chüy, Kyrgyzstan

***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 751b is prepared, certified and supplied by:

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Figure 1. Li<sub>2</sub>O by 4-Acid Digestion in OREAS 751b

SPC.1862.RR1.OREAS 751b.1.4-Acid.Li2O.Lab.240722.225038.SN

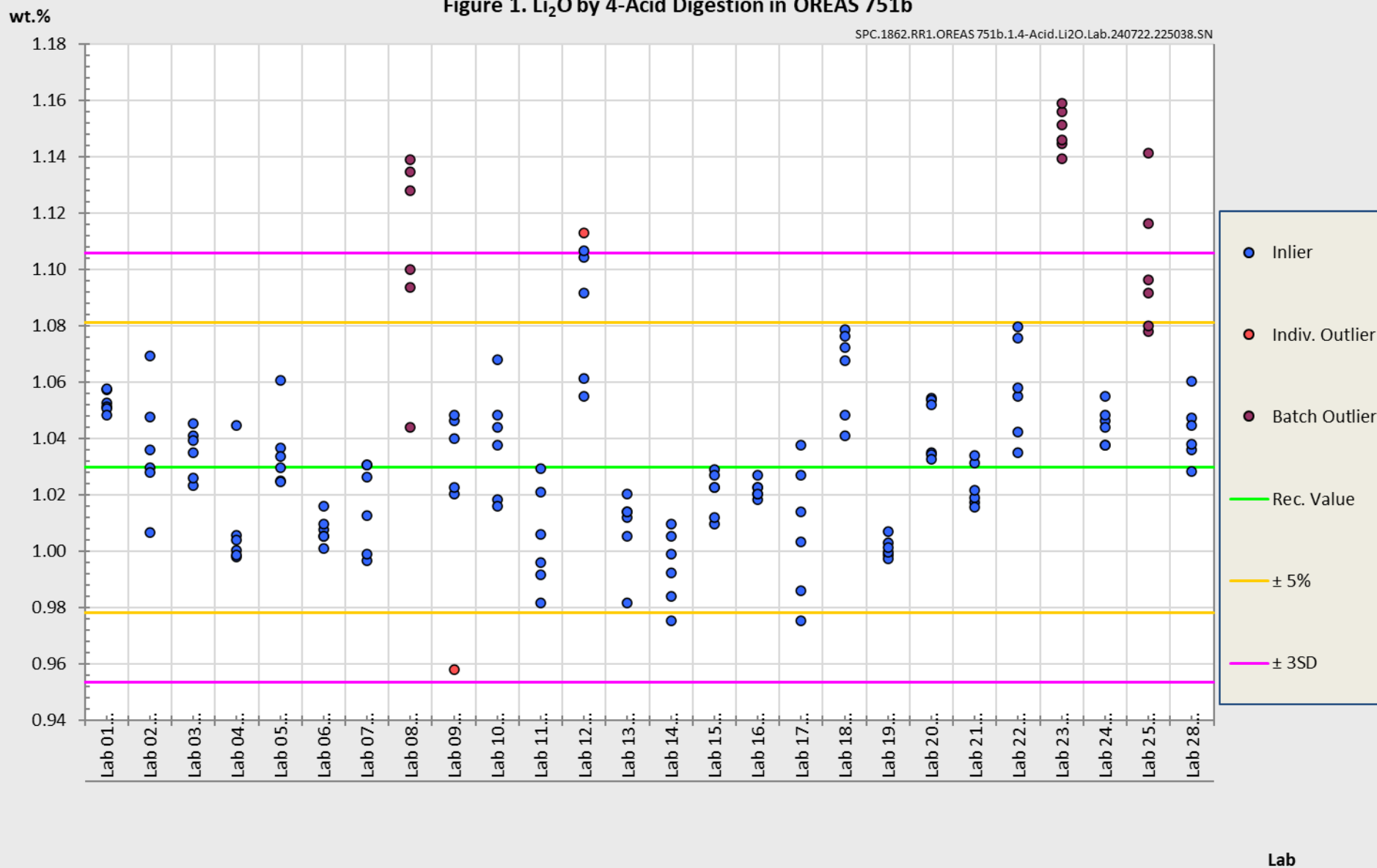
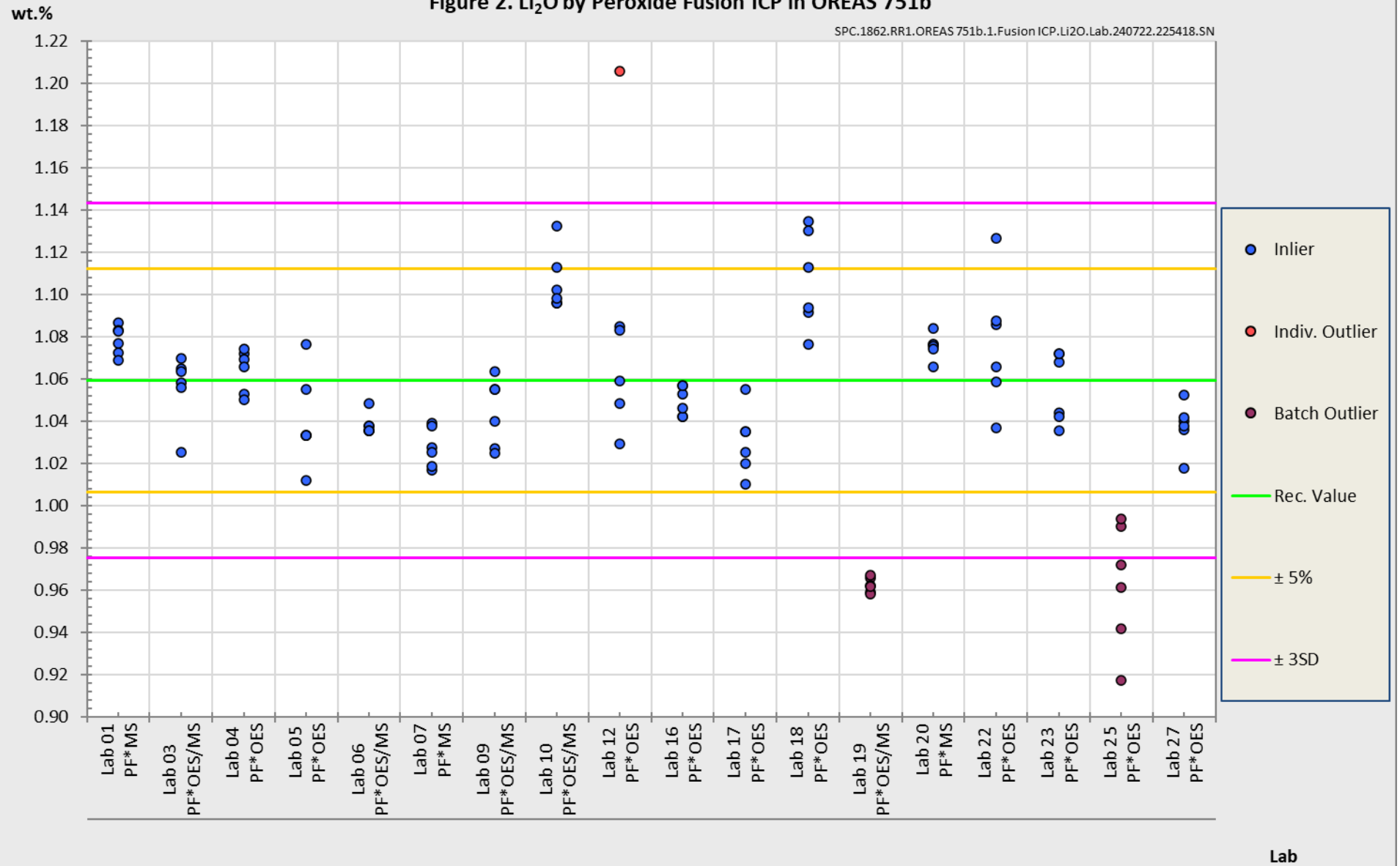


Figure 2. Li<sub>2</sub>O by Peroxide Fusion ICP in OREAS 751b

SPC.1862.RR1.OREAS 751b.1.Fusion ICP.Li2O.Lab.240722.225418.SN



## 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)) [14]. 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 [8], 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 4-acid digestion (Table 1). The other operationally defined measurands characterised in this certificate (Table 2) 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 [7], 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 33405:2024-05, 9.2.4c) [4].”* 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 751b 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 751b may be used to calibrate the entire procedure by producing a pure substance CRM transformed into a calibration solution.

OREAS 751b is intended for the following uses:

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

## MINIMUM SAMPLE SIZE

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

- Lithium Borate / Sodium peroxide fusion with ICP-OES and/or MS finish:  $\geq 0.2\text{g}$ ;
- Borate fusion with X-ray fluorescence finish:  $\geq 0.2\text{ g}$ ;
- Loss on Ignition (LOI) at 1000 °C:  $\geq 1\text{ g}$ ;
- Multi-elements by 4-acid digestion with ICP-OES and/or MS finish:  $\geq 0.25\text{ g}$ .

## PERIOD OF VALIDITY & STORAGE INSTRUCTIONS

The certification of OREAS 751b remains valid, within the specified measurement uncertainties, until at least February 2039, 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 sachets

OREAS 751b is packaged in single-use laminated foil sachets. Following analysis, it is the manufacturer's expectation that any remaining material is 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 751b 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 4 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 (~0.04 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 adsorbed moisture (weakly held H<sub>2</sub>O- 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 [12].

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

### **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 6 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 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

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## DOCUMENT HISTORY

Revision No.	Date	Changes applied
2	12 <sup>th</sup> May, 2025	Mineralogical data based on semi-quantitative XRD analysis have been newly added (refer to Table 5).
1	28 <sup>th</sup> October, 2024	Changed Fe <sub>2</sub> O <sub>3</sub> to Fe for 4-Acid Digestion and Borate / Peroxide Fusion ICP data in Table 1, 2 & 5.
0	30 <sup>th</sup> August, 2024	First publication.

## CERTIFYING OFFICER



12<sup>th</sup> May, 2025

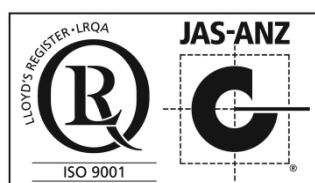
Craig Hamlyn (B.Sc. Hons - Geology), Technical Manager - ORE P/L

## QMS CERTIFICATION

ORE Pty Ltd is accredited for compliance with ISO 17034:2016 (Accreditation number 20483).



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.



## REFERENCES

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