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CERTIFICATE OF ANALYSIS FOR

CERTIFIED REFERENCE MATERIAL

OREAS 680b

Ni–Cu–PGE Ore

Dishaba (South Africa) & Cosmos Mines (Western Australia)

Table 1. Certified Values, Uncertainty & Tolerance Intervals in OREAS 680b.

Constituent	Certified Value	95% Expanded Uncertainty		95% Tolerance Limits	
		Low	High	Low	High
Pb Fire Assay					
Au, Gold (ppb)	170	167	173	169*	172*
Pd, Palladium (ppb)	241	232	251	236	246
Pt, Platinum (ppb)	408	388	427	397	418
NiS Fire Assay					
Au, Gold (ppb)	157	138	176	155*	159*
Ir, Iridium (ppb)	34.3	27.7	40.9	31.3	37.2
Pd, Palladium (ppb)	236	205	266	219	252
Pt, Platinum (ppb)	385	335	434	359	411
Rh, Rhodium (ppb)	51.0	45.5	56.5	46.9	55.1
Ru, Ruthenium (ppb)	104	86	122	96	112
Infrared Combustion					
S, Sulphur (wt.%)	5.22	5.07	5.36	5.10	5.33
Borate / Peroxide Fusion ICP					
Al_2O_3, Aluminium(III) oxide (wt.%)	12.28	12.00	12.56	12.11	12.45
As, Arsenic (ppm)	86	80	92	82	90
Ba, Barium (ppm)	291	281	300	284	297
Be, Beryllium (ppm)	1.43	1.26	1.60	1.34	1.52
Bi, Bismuth (ppm)	15.2	14.1	16.4	14.7	15.7
CaO, Calcium oxide (wt.%)	7.52	7.33	7.72	7.39	7.65
Cd, Cadmium (ppm)	< 10	IND	IND	IND	IND
Ce, Cerium (ppm)	39.6	37.5	41.7	37.9	41.2
Co, Cobalt (ppm)	336	317	355	328	344
Cr, Chromium (wt.%)	0.536	0.514	0.558	0.525	0.547
Cs, Caesium (ppm)	5.29	4.93	5.66	5.14	5.45
Cu, Copper (wt.%)	0.894	0.868	0.919	0.882	0.906
Dy, Dysprosium (ppm)	3.21	2.99	3.42	3.05	3.36
Er, Erbium (ppm)	1.77	1.64	1.90	1.66	1.89
Eu, Europium (ppm)	1.04	0.92	1.15	0.94	1.13
Fe_2O_3, Iron(III) oxide (wt.%)	18.03	17.67	18.40	17.78	18.29
Ga, Gallium (ppm)	15.8	14.7	16.9	14.6	17.0
Gd, Gadolinium (ppm)	3.83	3.56	4.10	3.67	3.99
Ho, Holmium (ppm)	0.63	0.57	0.68	0.60	0.66
In, Indium (ppm)	1.02	0.87	1.17	IND	IND
K_2O, Potassium oxide (wt.%)	1.46	1.40	1.52	1.42	1.50
La, Lanthanum (ppm)	18.9	17.7	20.2	18.1	19.7
Li, Lithium (ppm)	14.0	11.5	16.4	11.9	16.1
Lu, Lutetium (ppm)	0.24	0.20	0.28	0.21	0.27
MgO, Magnesium oxide (wt.%)	6.69	6.54	6.85	6.59	6.80

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

*Gold Tolerance Limits for typical 30 g lead fire assay and 10 g nickel sulphide fire assay are determined from 20 x 85 mg INAA results and the Sampling Constant (Ingamells & Switzer, 1973).

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
Borate / Peroxide Fusion ICP continued					
MnO, Manganese oxide (wt.%)	0.149	0.144	0.154	0.147	0.152
Mo, Molybdenum (ppm)	3.22	2.69	3.75	IND	IND
Nb, Niobium (ppm)	6.45	5.41	7.49	5.70	7.20
Nd, Neodymium (ppm)	20.9	19.7	22.1	19.9	21.9
Ni, Nickel (wt.%)	2.09	2.00	2.18	2.04	2.14
P_2O_5, Phosphorus(V) oxide (wt.%)	0.230	0.205	0.255	0.222	0.238
Pb, Lead (ppm)	103	94	111	100	106
Pr, Praseodymium (ppm)	5.06	4.77	5.36	4.92	5.21
Rb, Rubidium (ppm)	87	83	91	85	88
S, Sulphur (wt.%)	5.25	5.11	5.40	5.18	5.33
Sb, Antimony (ppm)	1.55	1.23	1.86	IND	IND
Sc, Scandium (ppm)	22.2	20.6	23.8	21.2	23.2
Se, Selenium (ppm)	< 20	IND	IND	IND	IND
SiO_2, Silicon dioxide (wt.%)	42.39	41.23	43.54	41.66	43.11
Sm, Samarium (ppm)	4.22	3.98	4.45	4.06	4.37
Sn, Tin (ppm)	6.25	4.67	7.84	5.95	6.55
Sr, Strontium (ppm)	355	341	369	347	364
Tb, Terbium (ppm)	0.56	0.52	0.59	0.51	0.61
Th, Thorium (ppm)	8.91	8.00	9.83	8.25	9.58
TiO_2, Titanium dioxide (wt.%)	0.875	0.853	0.897	0.855	0.894
Tl, Thallium (ppm)	0.45	0.35	0.55	IND	IND
Tm, Thulium (ppm)	0.26	0.23	0.30	0.24	0.29
U, Uranium (ppm)	1.99	1.75	2.22	1.76	2.21
V, Vanadium (ppm)	249	236	263	245	254
W, Tungsten (ppm)	2.78	2.23	3.34	2.42	3.15
Y, Yttrium (ppm)	17.2	16.6	17.8	16.5	17.9
Yb, Ytterbium (ppm)	1.65	1.50	1.80	1.56	1.74
Zn, Zinc (ppm)	689	658	720	675	703
Zr, Zirconium (ppm)	82	72	92	76	88
4-Acid Digestion					
Ag, Silver (ppm)	2.25	2.10	2.40	2.18	2.31
Al, Aluminium (wt.%)	6.55	6.34	6.76	6.45	6.65
As, Arsenic (ppm)	86	82	90	83	88
Ba, Barium (ppm)	288	276	299	282	293
Be, Beryllium (ppm)	1.29	1.21	1.36	1.24	1.33
Bi, Bismuth (ppm)	15.5	14.8	16.1	15.0	16.0
Ca, Calcium (wt.%)	5.42	5.29	5.56	5.34	5.51
Cd, Cadmium (ppm)	1.74	1.63	1.86	1.67	1.81
Ce, Cerium (ppm)	39.9	38.0	41.7	38.9	40.9
Co, Cobalt (ppm)	330	319	341	324	336

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
4-Acid Digestion continued					
Cr, Chromium (wt.%)	0.379	0.343	0.416	0.365	0.394
Cs, Caesium (ppm)	5.41	5.09	5.74	5.25	5.57
Cu, Copper (wt.%)	0.873	0.852	0.894	0.863	0.884
Dy, Dysprosium (ppm)	3.28	3.04	3.52	3.20	3.36
Er, Erbium (ppm)	1.85	1.72	1.99	1.78	1.92
Eu, Europium (ppm)	1.08	0.98	1.18	1.03	1.13
Fe, Iron (wt.%)	12.49	12.21	12.77	12.31	12.68
Ga, Gallium (ppm)	15.7	14.7	16.6	15.0	16.3
Gd, Gadolinium (ppm)	3.90	3.53	4.27	3.72	4.09
Hf, Hafnium (ppm)	1.88	1.76	2.00	1.71	2.04
Ho, Holmium (ppm)	0.66	0.59	0.73	0.64	0.68
In, Indium (ppm)	1.01	0.96	1.07	0.98	1.05
K, Potassium (wt.%)	1.21	1.18	1.24	1.19	1.24
La, Lanthanum (ppm)	18.6	17.6	19.7	18.1	19.1
Li, Lithium (ppm)	14.0	13.1	14.9	13.6	14.5
Lu, Lutetium (ppm)	0.26	0.24	0.28	0.24	0.27
Mg, Magnesium (wt.%)	3.92	3.83	4.01	3.86	3.98
Mn, Manganese (wt.%)	0.113	0.110	0.116	0.111	0.115
Mo, Molybdenum (ppm)	3.04	2.88	3.21	2.93	3.15
Na, Sodium (wt.%)	1.29	1.25	1.32	1.26	1.32
Nb, Niobium (ppm)	6.97	6.58	7.37	6.69	7.26
Nd, Neodymium (ppm)	20.9	19.6	22.3	20.3	21.6
Ni, Nickel (wt.%)	2.05	2.00	2.10	2.00	2.10
P, Phosphorus (wt.%)	0.104	0.100	0.108	0.102	0.106
Pb, Lead (ppm)	103	99	107	101	105
Pr, Praseodymium (ppm)	5.07	4.82	5.33	4.95	5.20
Rb, Rubidium (ppm)	86	82	90	83	89
Re, Rhenium (ppm)	0.008	0.006	0.010	IND	IND
S, Sulphur (wt.%)	5.07	4.90	5.24	4.97	5.16
Sb, Antimony (ppm)	1.59	1.47	1.70	1.48	1.69
Sc, Scandium (ppm)	23.2	22.0	24.5	22.5	24.0
Se, Selenium (ppm)	12.5	11.3	13.6	11.7	13.3
Sm, Samarium (ppm)	4.38	3.99	4.78	4.26	4.51
Sn, Tin (ppm)	4.39	4.07	4.72	4.17	4.62
Sr, Strontium (ppm)	363	349	377	356	370
Ta, Tantalum (ppm)	0.51	0.46	0.56	0.48	0.54
Tb, Terbium (ppm)	0.57	0.53	0.61	0.55	0.59
Te, Tellurium (ppm)	2.15	1.94	2.36	2.02	2.29
Th, Thorium (ppm)	9.23	8.34	10.13	8.69	9.78
Ti, Titanium (wt.%)	0.523	0.503	0.542	0.515	0.531
Tl, Thallium (ppm)	0.44	0.41	0.47	0.42	0.46

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).

Table 1 continued.

Constituent	Certified Value	95% Expanded Uncertainty		95% Tolerance Limits	
		Low	High	Low	High
4-Acid Digestion continued					
Tm, Thulium (ppm)	0.26	0.22	0.31	0.24	0.28
U, Uranium (ppm)	1.93	1.75	2.11	1.83	2.04
V, Vanadium (ppm)	246	238	253	240	251
W, Tungsten (ppm)	2.81	2.58	3.04	2.64	2.97
Y, Yttrium (ppm)	16.7	15.8	17.6	16.3	17.1
Yb, Ytterbium (ppm)	1.71	1.60	1.82	1.64	1.77
Zn, Zinc (ppm)	691	672	710	680	701
Zr, Zirconium (ppm)	62	56	67	59	64

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.

Table 2. Indicative Values for OREAS 680b.

Constituent	Unit	Value	Constituent	Unit	Value	Constituent	Unit	Value
Pb Fire Assay								
Ir	ppb	*78.8*	Rh	ppb	*195*	Ru	ppb	*361*
NiS Fire Assay								
Os	ppb	*35.6*						
Infrared Combustion								
C	wt.%	*0.033*						
Borate / Peroxide Fusion ICP								
Ag	ppm	*2.01*	Hf	ppm	*2.23*	Re	ppm	*< 0.1*
B	ppm	*32.9*	Hg	ppm	*0.28*	Ta	ppm	*0.43*
Ge	ppm	*1.61*	Na_2O	wt.%	*1.64*	Te	ppm	*2.36*
4-Acid Digestion								
B	ppm	*81*	Ge	ppm	*0.34*	Hg	ppm	*0.062*
Borate Fusion XRF								
Al_2O_3	wt.%	*12.17*	Fe_2O_3	wt.%	*17.41*	SiO_2	wt.%	*41.29*
As	ppm	*102*	K_2O	wt.%	*1.42*	Sn	ppm	*25.0*
BaO	ppm	*398*	MgO	wt.%	*6.61*	Sr	ppm	*383*
CaO	wt.%	*7.66*	MnO	wt.%	*0.150*	TiO_2	wt.%	*0.855*
Cl	ppm	*258*	Na_2O	wt.%	*1.73*	V_2O_5	ppm	*470*
Co	ppm	*330*	Ni	wt.%	*2.10*	Zn	ppm	*705*
Cr_2O_3	ppm	*7570*	P_2O_5	wt.%	*0.241*	Zr	ppm	*123*
Cu	wt.%	*0.728*	Pb	ppm	*155*			
Thermogravimetry								
LOI^{1000}	wt.%	*3.70*						

SI unit equivalents: ppm (parts per million; 1 x 10^{-6}) ≡ mg/kg; wt.% (weight per cent) ≡ % (mass fraction).
Note: the number of significant figures reported is not a reflection of the level of certainty of stated values. They are instead an artefact of ORE's in-house CRM-specific LIMS.

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INTRODUCTION

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 handling and 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 demonstrated 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 680b-DataPack.1.0.260730_141544.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 as scatter plots for Ni by borate/peroxide fusion with ICP and by 4-acid digestion, Cu by borate/peroxide fusion with ICP and by 4-acid digestion, and Au, Pd, and Pt by Pb fire assay in Figures 1–7, respectively. The plots include the certified value (green line), ±3 SD control limits (magenta), and ±5 % control limits (yellow). Accepted individual results are shown in blue, while individual and dataset outliers are highlighted in red and violet, respectively.

INTENDED USE

OREAS 680b 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 680b may be used to calibrate the entire procedure by producing a pure substance CRM transformed into a calibration solution.

OREAS 680b 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/ validation 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).

SOURCE MATERIAL

OREAS 680b was prepared from a blend of PGE ores, high-grade nickel and copper ores, and barren gabbronorite. The principal PGE ore component was sourced from the Dishaba Mine within the Bushveld Complex, South Africa, while the primary nickel sulphide ore was sourced from the Cosmos Mine in Western Australia. The barren gabbronorite diluent was sourced from Black Hill Quarry, South Australia. Minor additions of UG2 Reef material and copper concentrate were incorporated to achieve the targeted PGE and Cu concentrations, respectively.

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:

- Lead collection fire assay: ≥ 25 g
- Nickel sulphide collection fire assay: ≥ 10 g
- S by infrared combustion furnace / CS analyser: ≥ 0.1 g
- Borate fusion /Sodium peroxide with ICP-OES and/or MS finish: ≥ 0.2 g
- 4-acid digestion with ICP-OES and/or MS finish: ≥ 0.25 g

INSTRUCTIONS FOR HANDLING, STORAGE & CORRECT USE

Fine powders pose a risk to eyes and lungs and therefore standard precautions including the use of safety glasses and dust masks 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 refer to the concentration levels in the packaged state. There is no need for drying prior to weighing and analysis.

Single-Use Sachets

OREAS 680b is available in single-use, 60 g laminated foil sachets sealed under an inert gas environment. 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.

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 5 are intended only to be used as an initial 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, SDs 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 differs from the certified value, the significance of this bias should be assessed against the combined standard uncertainty of the certified value and the laboratory's own measurement uncertainty. Where the observed difference lies within this combined uncertainty, the bias is generally not considered significant.

PERIOD OF VALIDITY

The certification of OREAS 680b remains valid, within the specified measurement uncertainties, until at least November 2040, 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.

COMMINUTION AND HOMOGENISATION PROCEDURES

The materials constituting OREAS 680b was prepared in the following manner:

- Drying of sulphide-rich ores to constant mass at 85 °C
- Drying of low-sulphide ores and barren material to constant mass at 105 °C
- Crushing and multi-stage milling of the barren material to >98 % minus 75 microns
- Crushing and multi-stage milling of the ores to 100 % minus 30 microns
- Blending the ores and barren material in appropriate proportions to achieve desired grades
- Homogenisation using OREAS' novel processing technologies
- Packaging in 60 g units under nitrogen in laminated foil pouches

PHYSICAL PROPERTIES

OREAS 680b 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 680b.

Bulk Density (kg/m^3)	Moisture (wt.%)	Munsell Notation‡	Munsell Color‡
1127	0.43	N5	Medium Gray

‡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

Table 4. Indicative mineralogy of OREAS 680b by semi-quantitative XRD analysis.

Mineral / Mineral Group	% (mass ratio)
Chalcopyrite	3
Pyrrhotite	3
Pentlandite	3
Pyrite	1
Spinel group	1
Serpentine	< 1
Chlorite	< 1
Annite - biotite - phlogopite	1
Ca amphibole	1
Clinopyroxene	13
Orthopyroxene	22
Talc	2
Plagioclase	42
K-feldspar	6
Quartz	2
Magnesite	1

The semi-quantitative XRD results shown in Table 4 above 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 may be present. 'Spinel group' appears to include mainly chromite and/or magnetite. A trace of gypsum and siderite type carbonate may be present.

ANALYTICAL PROGRAM

Twenty-four commercial analytical laboratories participated in the program to certify the elements 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)
- Au, Pd and Pt by Pb collection fire assay (25-50 g charge weight) with ICP-OES (12 laboratories), ICP-MS (5 laboratories) or AAS finish (2 laboratories)
- Au, Pt, Pd, Ir, Os, Rh and Ru by nickel sulphide (NiS) collection fire assay with ICP-OES, ICP-MS or INAA finish (up to 6 laboratories depending on the element)
- Total S by IR combustion furnace (21 laboratories)
- Full ICP-OES and ICP-MS elemental suites by sodium peroxide or lithium borate fusion (up to 21 laboratories depending on the element)
- Full ICP-OES and ICP-MS elemental suites by 4-acid (HNO_3-HF-$HClO_4$-HCl) digestion (up to 22 laboratories depending on the element)

For the round robin program, twelve 2.5 kg test units were collected at predetermined intervals during the bagging stage, immediately after homogenisation. Each participating laboratory received six test portions. The samples received by each laboratory were obtained by taking samples from six different 2.5 kg test units to maximise representation (i.e., from either the odd or even sampling (lot) intervals).

The 20 individual INAA results upon which much of the homogeneity evaluation is based, included paired 10 g samples taken from 10 of the 12 different 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. AGAT Laboratories, Thunder Bay, Ontario, Canada
4. Alex Stewart International, Mendoza, Argentina
5. ALS, Johannesburg, South Africa
6. ALS, Lima, Peru
7. ALS, Loughrea, Galway, Ireland
8. ALS, Malaga, WA, Australia
9. ALS, Vancouver, BC, Canada
10. American Assay Laboratories, Sparks, Nevada, USA

(continued on next page)

PARTICIPATING LABORATORIES (continued)

11. ANSTO, Lucas Heights, NSW, Australia
12. Inspectorate (BV), Shanghai, Bao Shan District, China
13. Intertek, Cupang, Muntinlupa, Philippines
14. Intertek, Perth, WA, Australia
15. MINTEK Analytical Services, Randburg, South Africa
16. PT Geoservices Ltd, Cikarang, Jakarta Raya, Indonesia
17. PT Intertek Utama Services, Jakarta Timur, DKI Jakarta, Indonesia
18. Saskatchewan Research Council, Saskatoon, Saskatchewan, Canada
19. SGS, Ankara, Anatolia, Turkey
20. SGS Australia Mineral Services, Perth, WA, Australia
21. SGS Canada Inc., Vancouver, BC, Canada
22. SGS Geosol Laboratorios Ltda, Vespasiano, Minas Gerais, Brazil
23. Shiva Analyticals Ltd, Bangalore North, Karnataka, India
24. 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 scatter plots below.

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). 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.

95% Expanded Uncertainty provides a 95 % probability that the true value of the analyte under consideration lies between the upper and lower limits and is calculated according to the method outlined in [6] and [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. 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

For analytes other than gold, the tolerance limits (ISO 16269:2014) 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 Ni by 4-acid digestion with ICP-OES/MS finish, where 99 % of the time ($1-\alpha=0.99$) at least 95 % of subsamples ($\rho=0.95$) will have concentrations lying between 2.00 and 2.10 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.***

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 measurement error becomes negligible. Table 5 below shows the gold INAA data determined on 20 x 85 mg subsamples of OREAS 680b. 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 0.23 % calculated for a 30 g fire assay sample (4.25 % at 85 mg weights) confirms the high level of gold homogeneity in OREAS 680b.

The homogeneity of OREAS 680b 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 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 680b. 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 prior to calculation of the *p*-value, which was statistically significant ($p = 0.005$). As required by ISO 17034 and ISO 33405, the technical significance of this result was assessed. The nested ANOVA applied to the INAA data failed the *p*-value test due to correlated bias in sampling Lots 1 and 4, and to a lesser extent Lots 5, 8, 9 and 12. However, INAA data for As, Co, Cr, Fe, La and Sc showed no evidence of a similar trend, nor was the trend observed in the Au round robin datasets (Pb fire assay and NiS fire assay). The low *p*-value is therefore considered a statistical artefact rather than evidence of meaningful between-unit heterogeneity. The INAA RSD of 4.25% across 85 mg test portions corresponds to an estimated RSD of 0.227% for an equivalent 30 g test portion, demonstrating that between-unit variation is negligible relative to analytical measurement error.

Interlaboratory dispersion was consistent with historical OREAS performance for Au at this concentration. Considering the combined evidence from the homogeneity study and certification data, OREAS 680b is considered sufficiently homogeneous for its intended use, with any minor between-unit variation incorporated into the uncertainty of the certified value. Accordingly, the null hypothesis is retained.

It is important to note that ANOVA is a relative, rather than absolute, measure of homogeneity. It assesses whether between-unit variance is statistically distinguishable from within-unit variance across the evaluated samples. Consequently, a material may exhibit poor absolute homogeneity yet still satisfy the ANOVA criterion if within-unit heterogeneity is similarly large across all units. Conversely, a statistically significant ANOVA result does not necessarily indicate practically significant between-unit heterogeneity. Based on the ANOVA results, together with the interlaboratory certification data, OREAS 680b is considered fit for purpose as a certified reference material (see Intended Use below).

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

Replicate No	Au 85 mg actual	Au 30 g equivalent*
1	185	183
2	175	183
3	169	182
4	188	183
5	187	183
6	179	183
7	183	183
8	185	183
9	190	183
10	180	183
11	178	183
12	172	182
13	196	184
14	174	183
15	185	183
16	181	183
17	197	184
18	195	184
19	181	183
20	179	183
Mean	183	183
Median	182	183
Std Dev.	7.8	0.41
Rel.Std.Dev.	**4.25%**	**0.23%**

*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 sample mass
(x^{INAA}) = raw INAA result at 85 mg
$\bar{X}$ = mean of 85 mg INAA results

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) or parts per billion (ppb).

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.

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

In accordance with ISO 33405:2024 [5], clause 9.2.5, and ISO 17034:2016 [9], clause 7.12.4b), the use of such control samples provides an acceptable means of demonstrating traceability in the absence of formal accreditation. In this certification program, traceability was further supported by the agreement of measured values for control samples with their known certified values, thereby offering additional confidence in the calibration and validity of measurement results across participating laboratories.

Operationally Defined Measurands
In accordance with ISO 33405:2024, Clause 9.2.4, measurands (analytes) may be certified as operationally defined. For these measurands, traceability to the SI may not be achievable because the analytical procedure involves sample transformations (e.g., leaching or extraction). While instrument calibration can be traceable to appropriate units, the transformation steps themselves are not directly traceable and can only be evaluated through reference comparisons or harmonized procedures.

Accordingly, characterisation of these measurands has been based on the concordance of results obtained from multiple laboratories using a common, well-defined procedure. This approach ensures fitness-for-purpose, fulfilling the requirements for metrological traceability as specified in ISO 17034:2016 and ISO 33405:2024 for operationally defined measurands.

COMMUTABILITY

The certified values reported herein are derived from measurements performed using analytical methods involving sample pre-treatment steps, such as fusion or acid digestion. These processes convert the sample matrix into a chemically simplified and stable form, facilitating calibration traceable to primary standards via solution-based calibration protocols. Due to the established robustness and effectiveness of these pre-treatment methods, issues related to commutability are not expected to impact the suitability of this Certified Reference Material (CRM) for its intended use.

OREAS CRMs are prepared from natural ore materials, ensuring the presence of matrix and mineralogical characteristics representative of typical exploration, mine and process samples. Consistent with ISO 17034:2016 and ISO Guide 30, users are advised to select CRMs with matrix and mineralisation styles closely matching those of their routine samples to minimize matrix effects and enhance analytical comparability. Detailed descriptions of the CRM's source material and mineralogical characteristics are provided in the 'Source Material' section to guide appropriate CRM selection.

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/mltirule.htm). A second method utilises a 5 % window calculated directly from the certified value.

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

i.e., Certified Value ±10 % ±2DL [1].

Table 6. Performance Gates for OREAS 680b.

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, ppb	170	7.3	156	185	149	192	4.27%	8.54%	12.81%	162	179
Pd, ppb	241	7	228	254	222	261	2.71%	5.42%	8.14%	229	253
Pt, ppb	408	20	367	449	346	469	5.02%	10.04%	15.06%	387	428
NiS Fire Assay											
Au, ppb	157	15.5	126	188	111	203	9.86%	19.71%	29.57%	149	165
Ir, ppb	34.3	5.2	23.9	44.6	18.7	49.8	15.17%	30.33%	45.50%	32.5	36.0
Pd, ppb	236	11	213	258	202	269	4.75%	9.50%	14.25%	224	247
Pt, ppb	385	19	346	424	327	443	5.04%	10.07%	15.11%	366	404
Rh, ppb	51.0	2.3	46.5	55.6	44.2	57.8	4.46%	8.92%	13.37%	48.5	53.6
Ru, ppb	104	8	88	119	81	127	7.40%	14.79%	22.19%	99	109
Infrared Combustion											
S, wt.%	5.22	0.149	4.92	5.51	4.77	5.66	2.85%	5.70%	8.55%	4.95	5.48
Borate / Peroxide Fusion ICP											
Al_2O_3, wt.%	12.28	0.379	11.52	13.04	11.14	13.42	3.09%	6.17%	9.26%	11.67	12.89
As, ppm	86	4.5	77	95	73	100	5.20%	10.40%	15.61%	82	90
Ba, ppm	291	12	267	315	255	327	4.13%	8.26%	12.39%	276	305
Be, ppm	1.43	0.24	0.95	1.91	0.71	2.15	16.73%	33.46%	50.18%	1.36	1.50
Bi, ppm	15.2	1.23	12.8	17.7	11.5	18.9	8.10%	16.20%	24.30%	14.5	16.0
CaO, wt.%	7.52	0.218	7.09	7.96	6.87	8.18	2.90%	5.80%	8.70%	7.15	7.90
Cd, ppm	< 10	IND	IND	IND	IND	IND	IND	IND	IND	IND	IND
Ce, ppm	39.6	2.22	35.1	44.0	32.9	46.2	5.62%	11.24%	16.86%	37.6	41.5
Co, ppm	336	14	307	365	293	380	4.31%	8.62%	12.94%	319	353
Cr, wt.%	0.536	0.030	0.477	0.595	0.447	0.625	5.54%	11.09%	16.63%	0.509	0.563
Cs, ppm	5.29	0.282	4.73	5.86	4.45	6.14	5.32%	10.65%	15.97%	5.03	5.56
Cu, wt.%	0.894	0.022	0.850	0.938	0.828	0.959	2.45%	4.90%	7.36%	0.849	0.938
Dy, ppm	3.21	0.221	2.76	3.65	2.54	3.87	6.91%	13.81%	20.72%	3.05	3.37
Er, ppm	1.77	0.102	1.57	1.98	1.47	2.08	5.77%	11.54%	17.31%	1.69	1.86
Eu, ppm	1.04	0.077	0.88	1.19	0.81	1.27	7.40%	14.80%	22.20%	0.99	1.09
Fe_2O_3, wt.%	18.03	0.353	17.33	18.74	16.98	19.09	1.96%	3.91%	5.87%	17.13	18.94
Ga, ppm	15.8	0.81	14.1	17.4	13.3	18.2	5.16%	10.31%	15.47%	15.0	16.6
Gd, ppm	3.83	0.302	3.23	4.43	2.92	4.74	7.89%	15.78%	23.68%	3.64	4.02
Ho, ppm	0.63	0.07	0.50	0.76	0.43	0.82	10.41%	20.83%	31.24%	0.59	0.66
In, ppm	1.02	0.083	0.85	1.19	0.77	1.27	8.14%	16.27%	24.41%	0.97	1.07
K_2O, wt.%	1.46	0.063	1.33	1.59	1.27	1.65	4.35%	8.69%	13.04%	1.39	1.53
La, ppm	18.9	1.34	16.2	21.6	14.9	23.0	7.10%	14.19%	21.29%	18.0	19.9
Li, ppm	14.0	2.1	9.8	18.2	7.7	20.3	15.08%	30.17%	45.25%	13.3	14.7
Lu, ppm	0.24	0.03	0.19	0.29	0.16	0.32	10.57%	21.14%	31.71%	0.23	0.25
MgO, wt.%	6.69	0.217	6.26	7.13	6.04	7.35	3.24%	6.48%	9.72%	6.36	7.03
MnO, wt.%	0.149	0.006	0.138	0.161	0.132	0.167	3.93%	7.85%	11.78%	0.142	0.157
Mo, ppm	3.22	0.71	1.79	4.65	1.08	5.36	22.16%	44.32%	66.48%	3.06	3.38
Nb, ppm	6.45	0.66	5.14	7.76	4.48	8.42	10.17%	20.33%	30.50%	6.13	6.77
Nd, ppm	20.9	1.04	18.8	23.0	17.8	24.0	4.98%	9.96%	14.94%	19.8	21.9

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 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											
Ni, wt.%	2.09	0.107	1.88	2.30	1.77	2.41	5.09%	10.19%	15.28%	1.99	2.20
P_2O_5, wt.%	0.230	0.019	0.192	0.269	0.173	0.288	8.30%	16.61%	24.91%	0.219	0.242
Pb, ppm	103	7	89	117	82	123	6.64%	13.28%	19.92%	98	108
Pr, ppm	5.06	0.229	4.61	5.52	4.38	5.75	4.52%	9.05%	13.57%	4.81	5.32
Rb, ppm	87	2.4	82	92	80	94	2.75%	5.51%	8.26%	83	91
S, wt.%	5.25	0.148	4.96	5.55	4.81	5.70	2.82%	5.65%	8.47%	4.99	5.52
Sb, ppm	1.55	0.146	1.25	1.84	1.11	1.98	9.43%	18.86%	28.29%	1.47	1.62
Sc, ppm	22.2	1.84	18.5	25.9	16.7	27.7	8.28%	16.55%	24.83%	21.1	23.3
Se, ppm	< 20	IND	IND	IND	IND	IND	IND	IND	IND	IND	IND
SiO_2, wt.%	42.39	1.311	39.76	45.01	38.45	46.32	3.09%	6.18%	9.28%	40.27	44.50
Sm, ppm	4.22	0.182	3.85	4.58	3.67	4.76	4.32%	8.63%	12.95%	4.01	4.43
Sn, ppm	6.25	1.36	3.52	8.98	2.16	10.35	21.82%	43.65%	65.47%	5.94	6.57
Sr, ppm	355	12	331	379	319	391	3.36%	6.73%	10.09%	337	373
Tb, ppm	0.56	0.022	0.51	0.60	0.49	0.63	3.99%	7.98%	11.98%	0.53	0.59
Th, ppm	8.91	0.714	7.49	10.34	6.77	11.06	8.01%	16.02%	24.03%	8.47	9.36
TiO_2, wt.%	0.875	0.024	0.826	0.923	0.802	0.947	2.76%	5.52%	8.29%	0.831	0.919
Tl, ppm	0.45	0.08	0.29	0.62	0.20	0.70	18.21%	36.42%	54.63%	0.43	0.47
Tm, ppm	0.26	0.025	0.21	0.31	0.19	0.34	9.45%	18.91%	28.36%	0.25	0.28
U, ppm	1.99	0.172	1.64	2.33	1.47	2.50	8.66%	17.32%	25.99%	1.89	2.09
V, ppm	249	15	220	279	205	294	5.90%	11.81%	17.71%	237	262
W, ppm	2.78	0.51	1.77	3.80	1.26	4.30	18.21%	36.41%	54.62%	2.64	2.92
Y, ppm	17.2	0.56	16.1	18.3	15.5	18.8	3.25%	6.50%	9.76%	16.3	18.0
Yb, ppm	1.65	0.116	1.42	1.88	1.30	2.00	7.04%	14.09%	21.13%	1.57	1.73
Zn, ppm	689	23	642	735	619	759	3.37%	6.74%	10.11%	654	723
Zr, ppm	82	4.8	72	91	68	96	5.82%	11.63%	17.45%	78	86
4-Acid Digestion											
Ag, ppm	2.25	0.142	1.96	2.53	1.82	2.67	6.32%	12.64%	18.96%	2.13	2.36
Al, wt.%	6.55	0.198	6.16	6.95	5.96	7.15	3.02%	6.04%	9.05%	6.23	6.88
As, ppm	86	3.8	78	94	74	97	4.47%	8.93%	13.40%	82	90
Ba, ppm	288	14	259	317	244	331	5.03%	10.05%	15.08%	273	302
Be, ppm	1.29	0.083	1.12	1.46	1.04	1.54	6.47%	12.94%	19.40%	1.22	1.35
Bi, ppm	15.5	0.90	13.7	17.3	12.8	18.2	5.82%	11.65%	17.47%	14.7	16.3
Ca, wt.%	5.42	0.148	5.13	5.72	4.98	5.87	2.73%	5.45%	8.18%	5.15	5.70
Cd, ppm	1.74	0.093	1.55	1.93	1.46	2.02	5.37%	10.73%	16.10%	1.65	1.83
Ce, ppm	39.9	1.96	36.0	43.8	34.0	45.8	4.91%	9.82%	14.73%	37.9	41.9
Co, ppm	330	11	307	352	296	363	3.39%	6.78%	10.17%	313	346
Cr, wt.%	0.379	0.054	0.272	0.487	0.218	0.541	14.22%	28.44%	42.66%	0.361	0.398
Cs, ppm	5.41	0.388	4.64	6.19	4.25	6.58	7.17%	14.34%	21.51%	5.14	5.68
Cu, wt.%	0.873	0.022	0.828	0.918	0.806	0.940	2.56%	5.12%	7.67%	0.829	0.917
Dy, ppm	3.28	0.128	3.02	3.54	2.90	3.66	3.91%	7.82%	11.73%	3.12	3.44
Er, ppm	1.85	0.073	1.70	2.00	1.63	2.07	3.96%	7.93%	11.89%	1.76	1.94
Eu, ppm	1.08	0.081	0.92	1.24	0.84	1.32	7.46%	14.92%	22.38%	1.03	1.13
Fe, wt.%	12.49	0.303	11.89	13.10	11.58	13.40	2.43%	4.86%	7.29%	11.87	13.12

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

Note 1: intervals may appear asymmetric due to rounding.

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

Table 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 ICP continued											
Ga, ppm	15.7	0.97	13.7	17.6	12.7	18.6	6.19%	12.38%	18.57%	14.9	16.4
Gd, ppm	3.90	0.197	3.51	4.30	3.31	4.49	5.05%	10.10%	15.16%	3.71	4.10
Hf, ppm	1.88	0.119	1.64	2.11	1.52	2.23	6.32%	12.63%	18.95%	1.78	1.97
Ho, ppm	0.66	0.061	0.54	0.78	0.48	0.84	9.31%	18.63%	27.94%	0.63	0.69
In, ppm	1.01	0.069	0.88	1.15	0.81	1.22	6.81%	13.61%	20.42%	0.96	1.06
K, wt.%	1.21	0.026	1.16	1.26	1.13	1.29	2.18%	4.36%	6.53%	1.15	1.27
La, ppm	18.6	1.41	15.8	21.5	14.4	22.9	7.57%	15.14%	22.71%	17.7	19.6
Li, ppm	14.0	1.03	12.0	16.1	10.9	17.1	7.37%	14.73%	22.10%	13.3	14.7
Lu, ppm	0.26	0.020	0.22	0.30	0.20	0.32	7.77%	15.54%	23.31%	0.24	0.27
Mg, wt.%	3.92	0.077	3.77	4.07	3.69	4.15	1.95%	3.91%	5.86%	3.72	4.12
Mn, wt.%	0.113	0.004	0.105	0.121	0.101	0.126	3.62%	7.24%	10.86%	0.108	0.119
Mo, ppm	3.04	0.147	2.75	3.34	2.60	3.48	4.84%	9.69%	14.53%	2.89	3.19
Na, wt.%	1.29	0.043	1.20	1.38	1.16	1.42	3.34%	6.67%	10.01%	1.22	1.35
Nb, ppm	6.97	0.415	6.14	7.80	5.73	8.22	5.95%	11.89%	17.84%	6.63	7.32
Nd, ppm	20.9	1.23	18.5	23.4	17.3	24.6	5.85%	11.70%	17.55%	19.9	22.0
Ni, wt.%	2.05	0.034	1.98	2.12	1.95	2.15	1.66%	3.32%	4.98%	1.95	2.15
P, wt.%	0.104	0.003	0.098	0.110	0.096	0.112	2.68%	5.37%	8.05%	0.099	0.109
Pb, ppm	103	5	92	114	87	120	5.27%	10.54%	15.80%	98	108
Pr, ppm	5.07	0.302	4.47	5.68	4.17	5.98	5.96%	11.92%	17.88%	4.82	5.33
Rb, ppm	86	4.9	76	96	71	101	5.65%	11.31%	16.96%	82	90
Re, ppm	0.008	0.001	0.006	0.011	0.004	0.012	15.42%	30.83%	46.25%	0.008	0.009
S, wt.%	5.07	0.216	4.63	5.50	4.42	5.72	4.27%	8.54%	12.81%	4.81	5.32
Sb, ppm	1.59	0.104	1.38	1.79	1.28	1.90	6.52%	13.05%	19.57%	1.51	1.67
Sc, ppm	23.2	1.48	20.3	26.2	18.8	27.7	6.38%	12.76%	19.15%	22.1	24.4
Se, ppm	12.5	1.3	9.8	15.2	8.4	16.5	10.77%	21.54%	32.31%	11.9	13.1
Sm, ppm	4.38	0.296	3.79	4.98	3.49	5.27	6.76%	13.51%	20.27%	4.16	4.60
Sn, ppm	4.39	0.331	3.73	5.06	3.40	5.39	7.54%	15.08%	22.62%	4.17	4.61
Sr, ppm	363	18	328	398	310	416	4.86%	9.71%	14.57%	345	381
Ta, ppm	0.51	0.06	0.40	0.63	0.34	0.68	10.98%	21.97%	32.95%	0.49	0.54
Tb, ppm	0.57	0.046	0.48	0.66	0.43	0.71	8.12%	16.25%	24.37%	0.54	0.60
Te, ppm	2.15	0.23	1.69	2.62	1.46	2.85	10.77%	21.53%	32.30%	2.04	2.26
Th, ppm	9.23	0.690	7.85	10.61	7.16	11.30	7.47%	14.94%	22.41%	8.77	9.70
Ti, wt.%	0.523	0.022	0.479	0.567	0.457	0.589	4.21%	8.41%	12.62%	0.497	0.549
Tl, ppm	0.44	0.027	0.39	0.50	0.36	0.52	6.10%	12.20%	18.30%	0.42	0.46
Tm, ppm	0.26	0.04	0.19	0.33	0.16	0.37	13.55%	27.10%	40.65%	0.25	0.27
U, ppm	1.93	0.131	1.67	2.19	1.54	2.33	6.80%	13.59%	20.39%	1.84	2.03
V, ppm	246	9	228	263	219	272	3.54%	7.09%	10.63%	233	258
W, ppm	2.81	0.206	2.39	3.22	2.19	3.42	7.35%	14.70%	22.05%	2.67	2.95
Y, ppm	16.7	1.27	14.1	19.2	12.9	20.5	7.61%	15.22%	22.83%	15.9	17.5
Yb, ppm	1.71	0.121	1.47	1.95	1.35	2.07	7.06%	14.13%	21.19%	1.62	1.79
Zn, ppm	691	24	642	739	618	764	3.51%	7.02%	10.52%	656	725
Zr, ppm	62	5.1	52	72	46	77	8.30%	16.59%	24.89%	59	65

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

Note 1: intervals may appear asymmetric due to rounding.

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

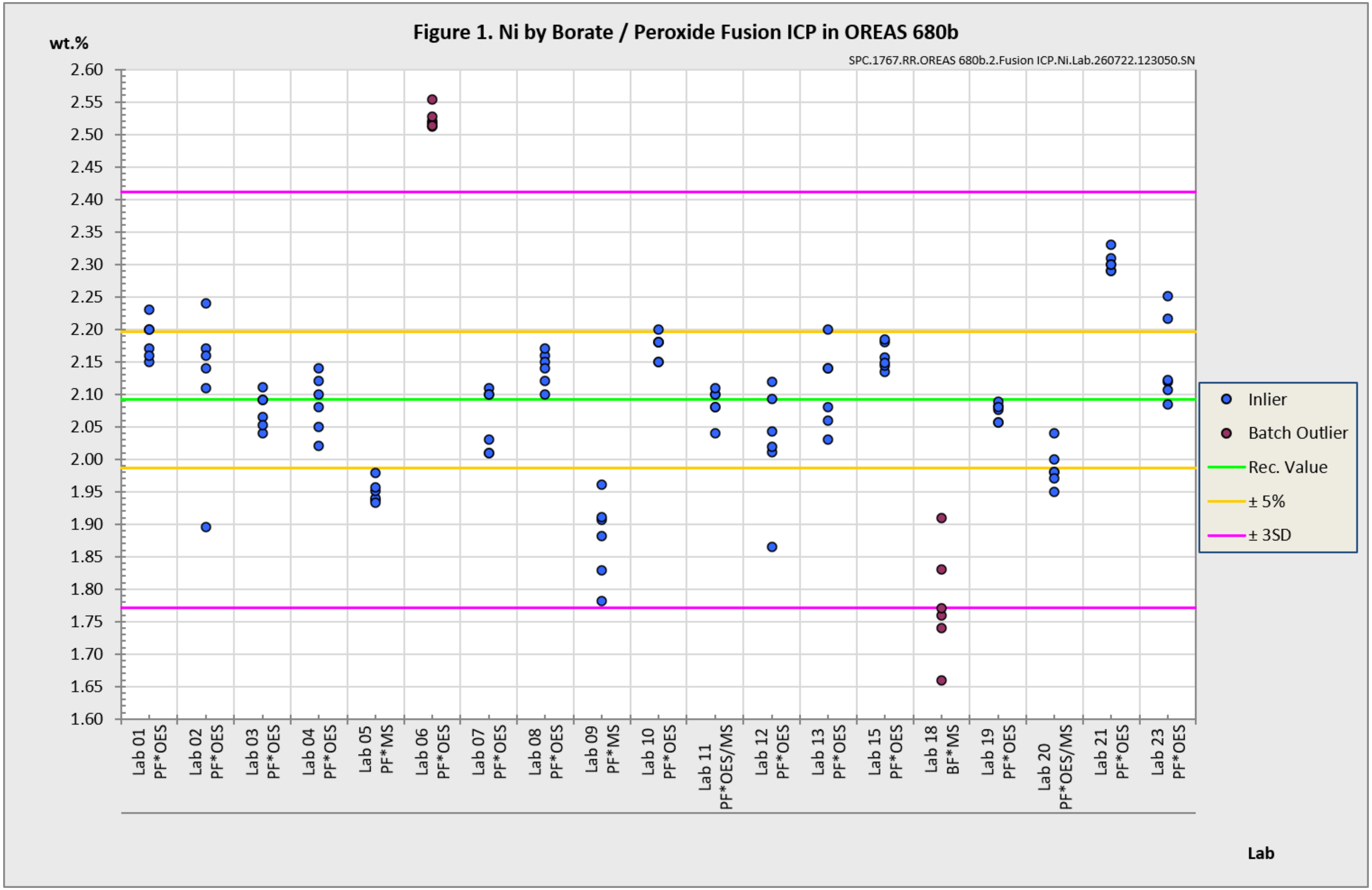
Figure 1. Ni by Borate / Peroxide Fusion ICP in OREAS 680b
SPC.1767.RR.OREAS 680b.2.Fusion ICP.Ni.Lab.260722.123050.SN
wt.%
2.60
2.55
2.50
2.45
2.40
2.35
2.30
2.25
2.20
2.15
2.10
2.05
2.00
1.95
1.90
1.85
1.80
1.75
1.70
1.65
1.60
Lab 01 PF*OES
Lab 02 PF*OES
Lab 03 PF*OES
Lab 04 PF*OES
Lab 05 PF*MS
Lab 06 PF*OES
Lab 07 PF*OES
Lab 08 PF*OES
Lab 09 PF*MS
Lab 10 PF*OES
Lab 11 PF*OES/MS
Lab 12 PF*OES
Lab 13 PF*OES
Lab 15 PF*OES
Lab 18 BF*MS
Lab 19 PF*OES
Lab 20 PF*OES/MS
Lab 21 PF*OES
Lab 23 PF*OES
Inlier
Batch Outlier
Rec. Value
± 5%
± 3SD
Lab

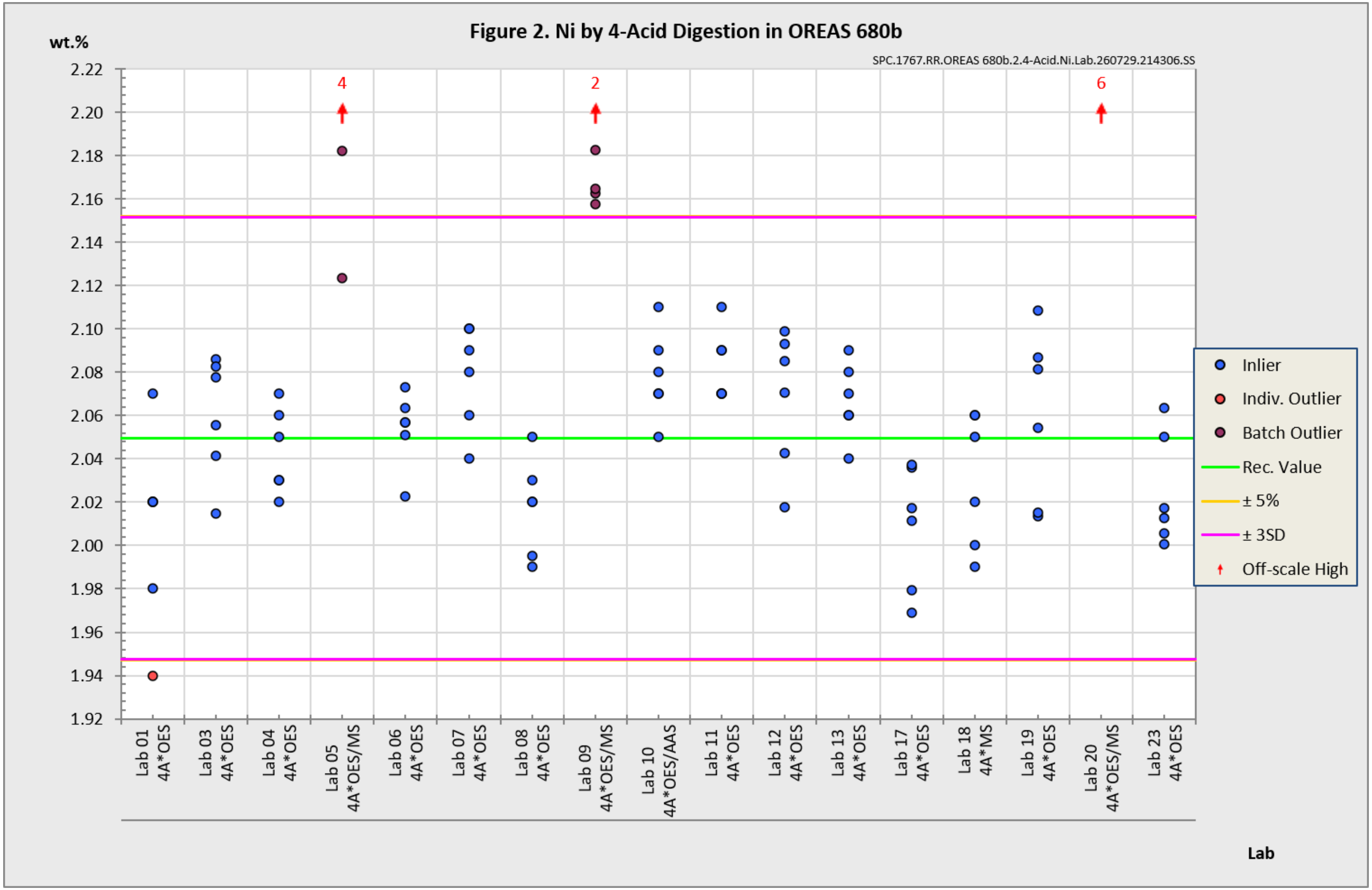
Figure 2. Ni by 4-Acid Digestion in OREAS 680b
SPC.1767.RR.OREAS 680b.2.4-Acid.Ni.Lab.260729.214306.SS
wt.%
2.22
2.20
2.18
2.16
2.14
2.12
2.10
2.08
2.06
2.04
2.02
2.00
1.98
1.96
1.94
1.92
4
2
6
Lab 01 4A*OES
Lab 03 4A*OES
Lab 04 4A*OES
Lab 05 4A*OES/MS
Lab 06 4A*OES
Lab 07 4A*OES
Lab 08 4A*OES
Lab 09 4A*OES/MS
Lab 10 4A*OES/AAS
Lab 11 4A*OES
Lab 12 4A*OES
Lab 13 4A*OES
Lab 17 4A*OES
Lab 18 4A*MS
Lab 19 4A*OES
Lab 20 4A*OES/MS
Lab 23 4A*OES
Lab
Inlier
Indiv. Outlier
Batch Outlier
Rec. Value
± 5%
± 3SD
Off-scale High

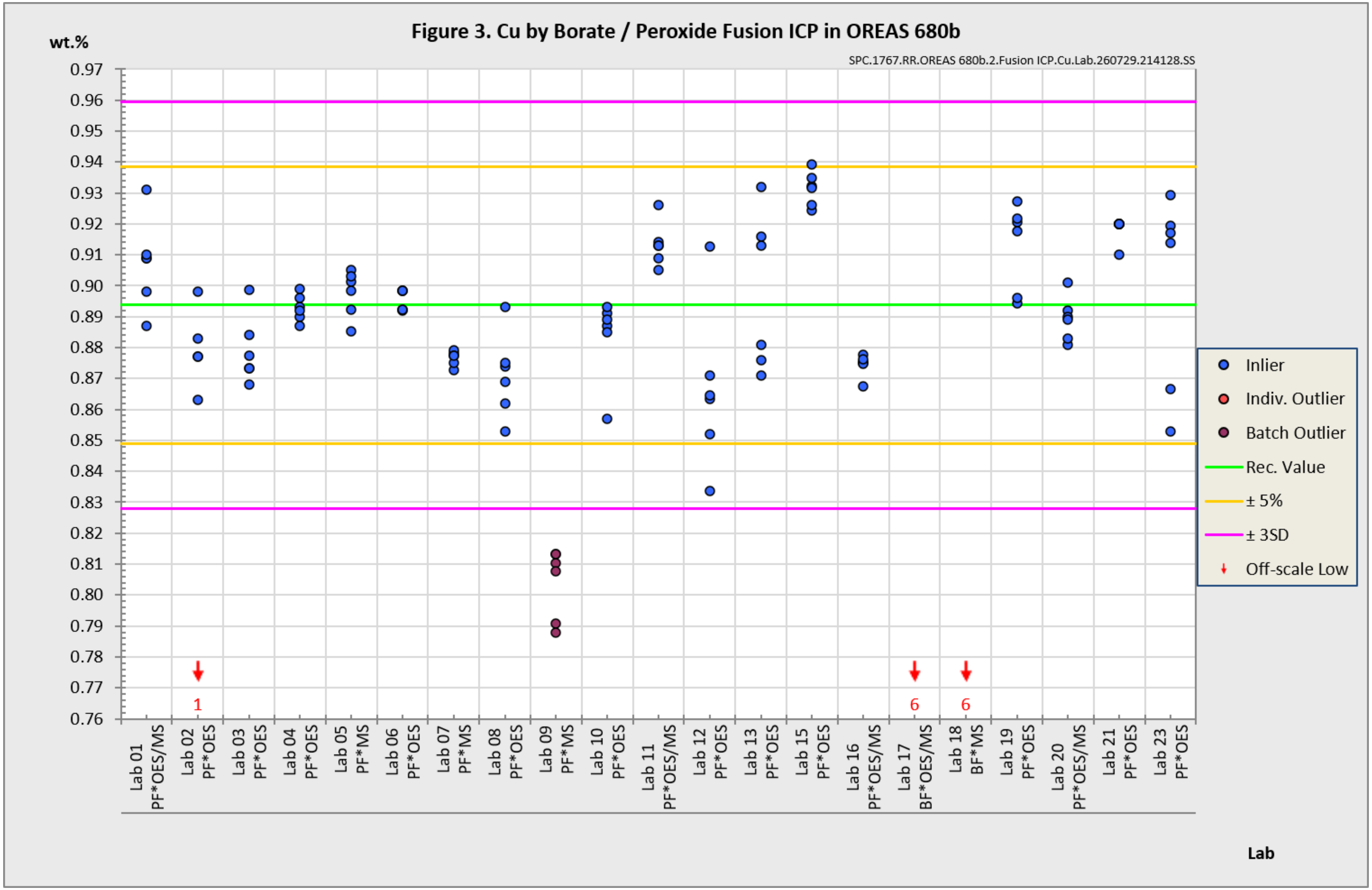
Figure 3. Cu by Borate / Peroxide Fusion ICP in OREAS 680b
SPC.1767.RR.OREAS 680b.2.Fusion ICP.Cu.Lab.260729.214128.SS
wt.%
0.97
0.96
0.95
0.94
0.93
0.92
0.91
0.90
0.89
0.88
0.87
0.86
0.85
0.84
0.83
0.82
0.81
0.80
0.79
0.78
0.77
0.76
1
6
6
Lab 01 PF*OES/MS
Lab 02 PF*OES
Lab 03 PF*OES
Lab 04 PF*OES
Lab 05 PF*MS
Lab 06 PF*OES
Lab 07 PF*MS
Lab 08 PF*OES
Lab 09 PF*MS
Lab 10 PF*OES
Lab 11 PF*OES/MS
Lab 12 PF*OES
Lab 13 PF*OES
Lab 15 PF*OES
Lab 16 PF*OES/MS
Lab 17 BF*OES/MS
Lab 18 BF*MS
Lab 19 PF*OES
Lab 20 PF*OES/MS
Lab 21 PF*OES
Lab 23 PF*OES
Lab
Inlier
Indiv. Outlier
Batch Outlier
Rec. Value
± 5%
± 3SD
Off-scale Low

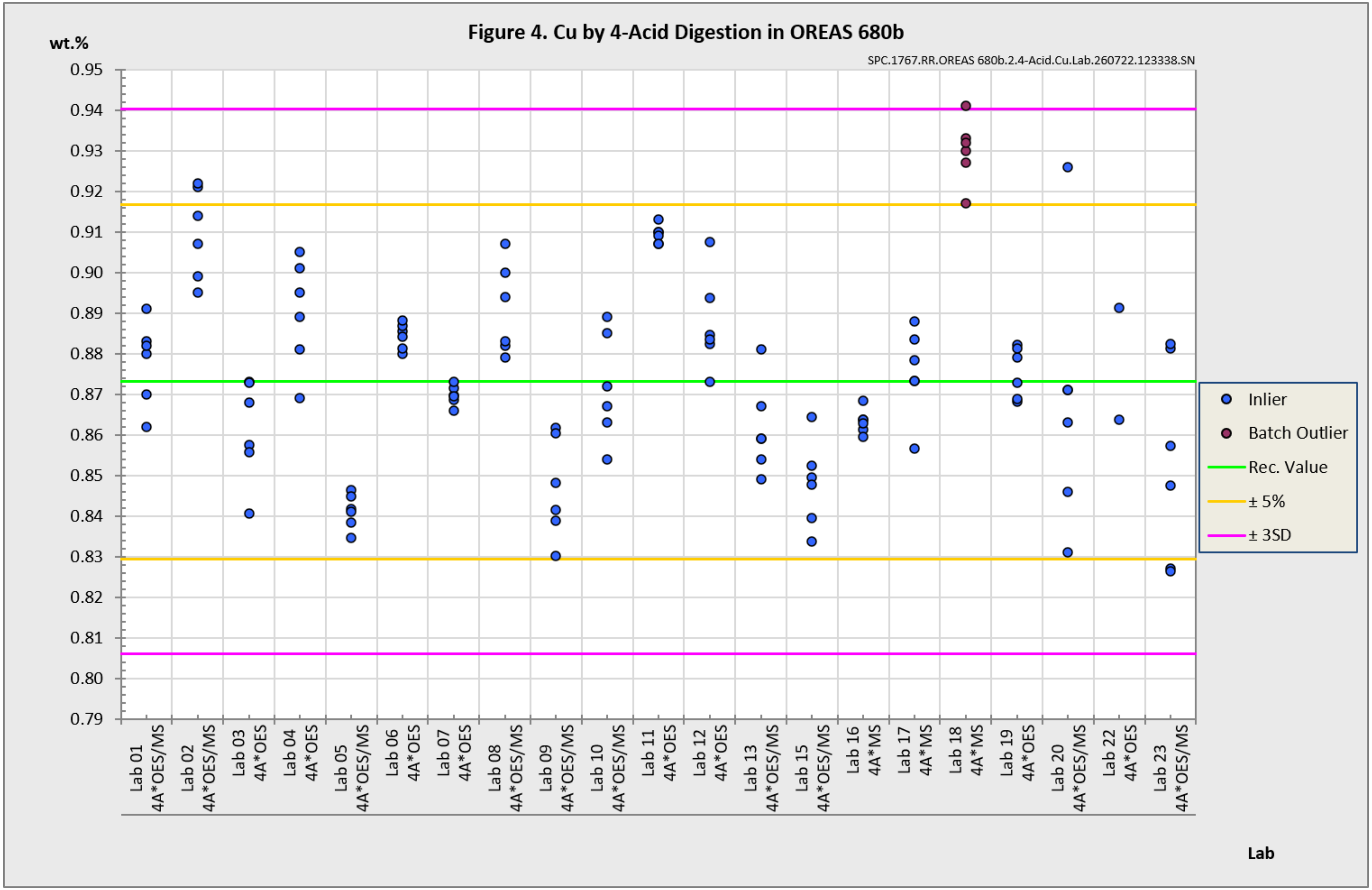

Figure 4. Cu by 4-Acid Digestion in OREAS 680b
wt.%
SPC.1767.RR.OREAS 680b.2.4-Acid.Cu.Lab.260722.123338.SN
0.95
0.94
0.93
0.92
0.91
0.90
0.89
0.88
0.87
0.86
0.85
0.84
0.83
0.82
0.81
0.80
0.79
Lab 01 4A*OES/MS
Lab 02 4A*OES/MS
Lab 03 4A*OES
Lab 04 4A*OES
Lab 05 4A*OES/MS
Lab 06 4A*OES
Lab 07 4A*OES
Lab 08 4A*OES/MS
Lab 09 4A*OES/MS
Lab 10 4A*OES/MS
Lab 11 4A*OES
Lab 12 4A*OES
Lab 13 4A*OES/MS
Lab 15 4A*OES/MS
Lab 16 4A*MS
Lab 17 4A*MS
Lab 18 4A*MS
Lab 19 4A*OES
Lab 20 4A*OES/MS
Lab 22 4A*OES
Lab 23 4A*OES/MS
Inlier
Batch Outlier
Rec. Value
± 5%
± 3SD
Lab

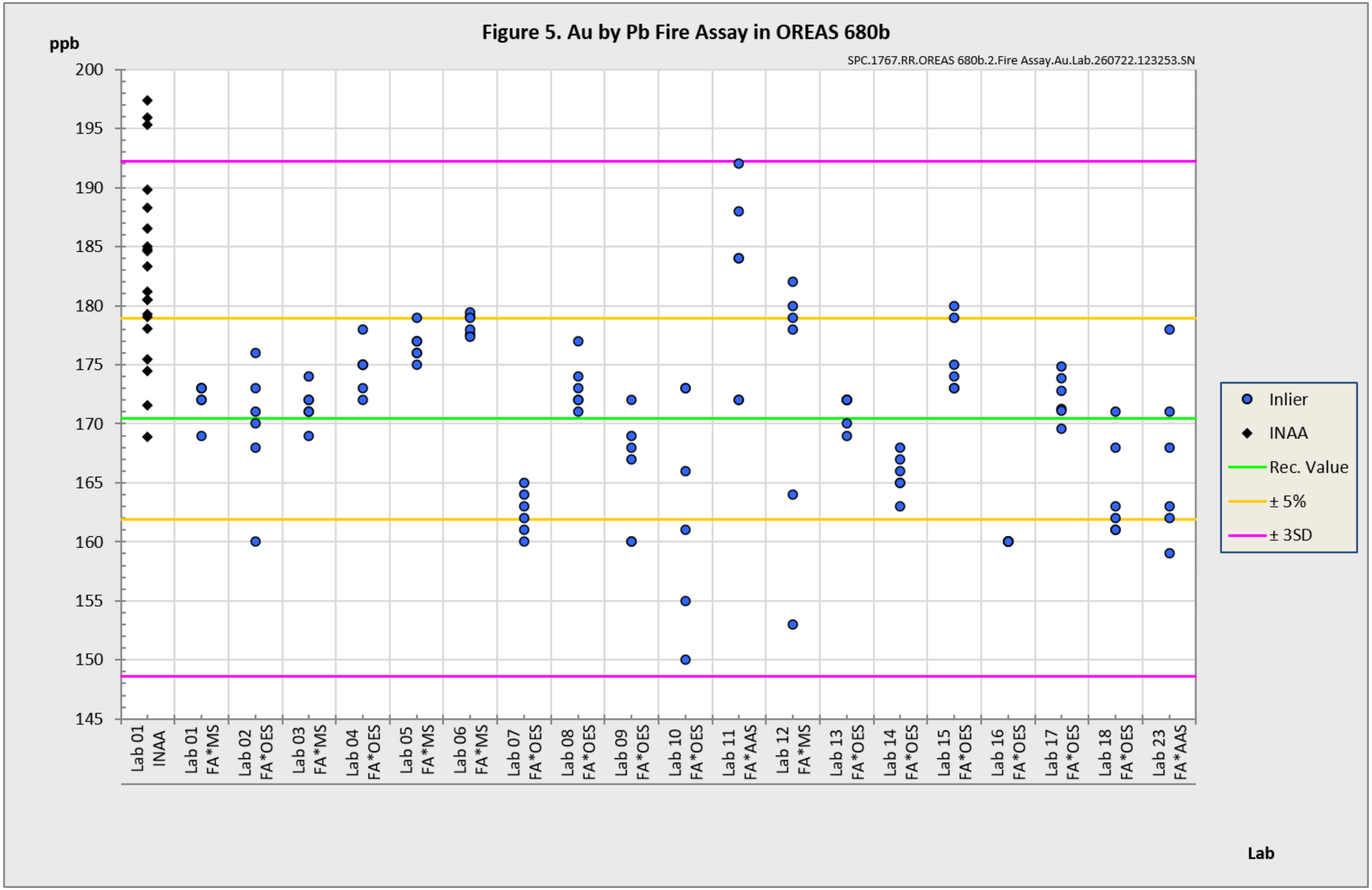
Figure 5. Au by Pb Fire Assay in OREAS 680b
SPC.1767.RR.OREAS 680b.2.Fire Assay.Au.Lab.260722.123253.SN
ppb
200
195
190
185
180
175
170
165
160
155
150
145
Lab 01 INAA
Lab 01 FA*MS
Lab 02 FA*OES
Lab 03 FA*MS
Lab 04 FA*OES
Lab 05 FA*MS
Lab 06 FA*MS
Lab 07 FA*OES
Lab 08 FA*OES
Lab 09 FA*OES
Lab 10 FA*OES
Lab 11 FA*AAS
Lab 12 FA*MS
Lab 13 FA*OES
Lab 14 FA*OES
Lab 15 FA*OES
Lab 16 FA*OES
Lab 17 FA*OES
Lab 18 FA*OES
Lab 23 FA*AAS
Lab
Inlier
INAA
Rec. Value
± 5%
± 3SD

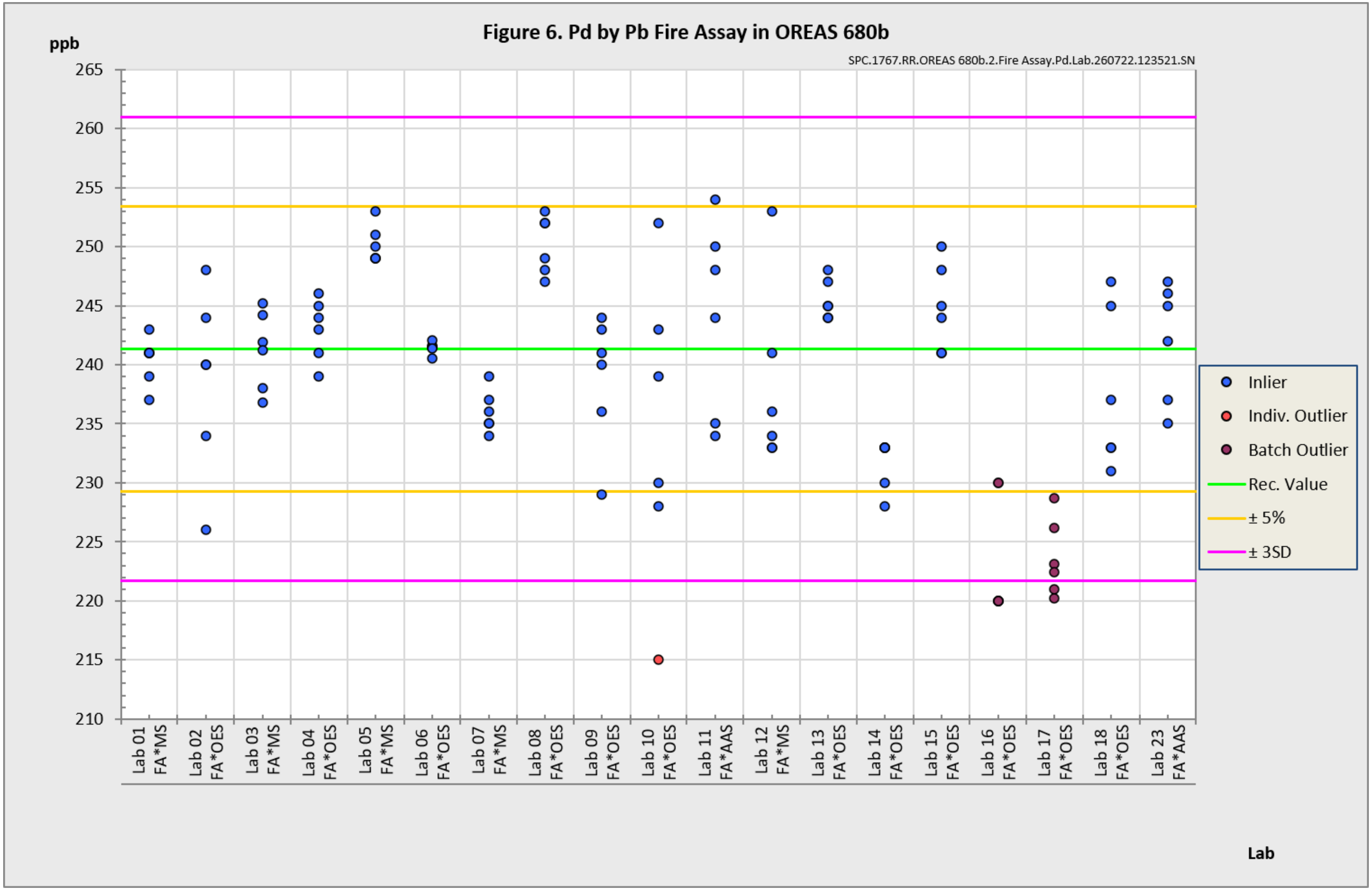

Figure 6. Pd by Pb Fire Assay in OREAS 680b
SPC.1767.RR.OREAS 680b.2.Fire Assay.Pd.Lab.260722.123521.SN
ppb
265
260
255
250
245
240
235
230
225
220
215
210
Lab 01 FA*MS
Lab 02 FA*OES
Lab 03 FA*MS
Lab 04 FA*OES
Lab 05 FA*MS
Lab 06 FA*OES
Lab 07 FA*MS
Lab 08 FA*OES
Lab 09 FA*OES
Lab 10 FA*OES
Lab 11 FA*AAS
Lab 12 FA*MS
Lab 13 FA*OES
Lab 14 FA*OES
Lab 15 FA*OES
Lab 16 FA*OES
Lab 17 FA*OES
Lab 18 FA*OES
Lab 23 FA*AAS
Inlier
Indiv. Outlier
Batch Outlier
Rec. Value
± 5%
± 3SD
Lab

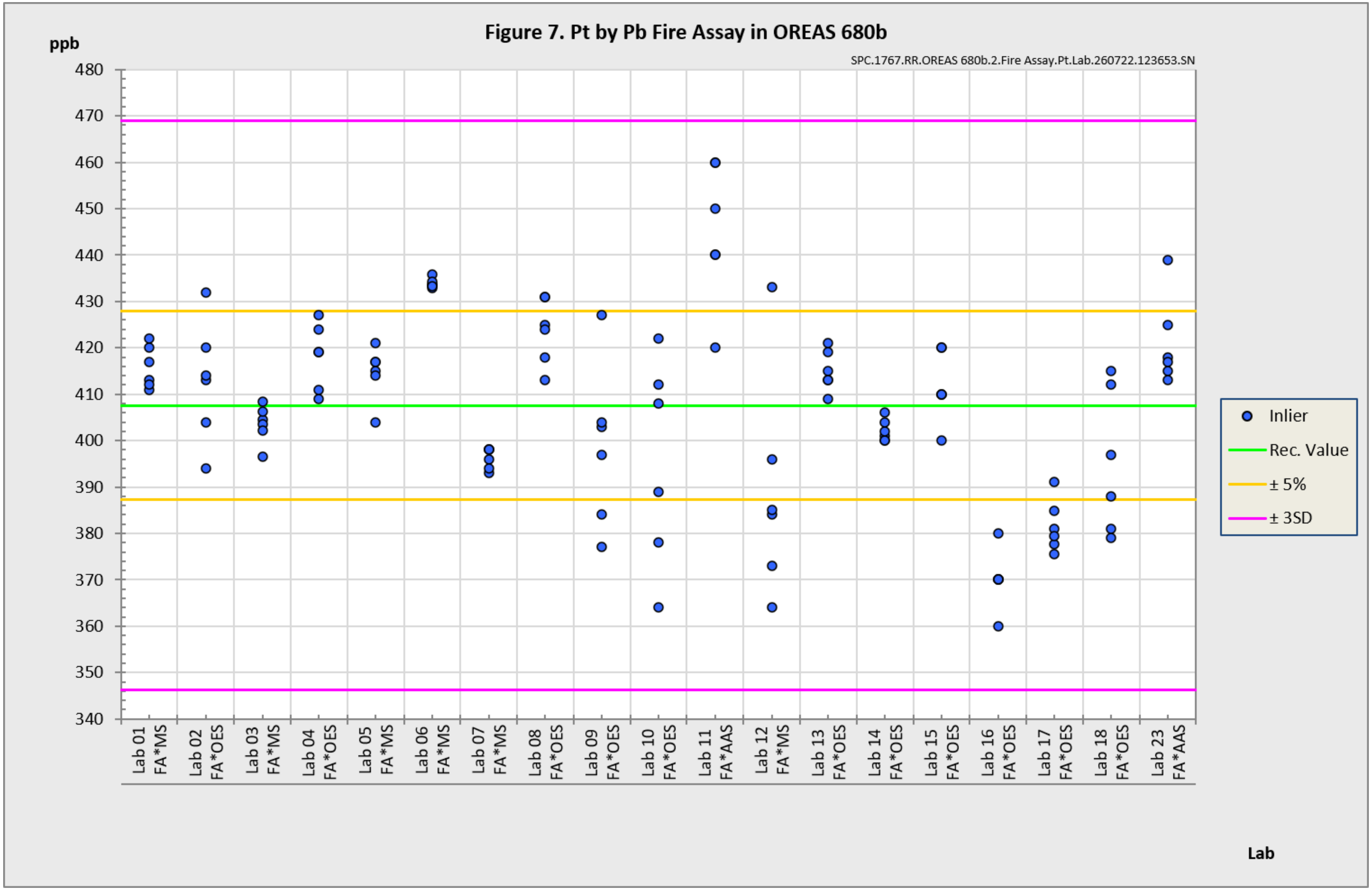

Figure 7. Pt by Pb Fire Assay in OREAS 680b
SPC.1767.RR.OREAS 680b.2.Fire Assay.Pt.Lab.260722.123653.SN
ppb
480
470
460
450
440
430
420
410
400
390
380
370
360
350
340
Lab 01 FA*MS
Lab 02 FA*OES
Lab 03 FA*MS
Lab 04 FA*OES
Lab 05 FA*MS
Lab 06 FA*MS
Lab 07 FA*MS
Lab 08 FA*OES
Lab 09 FA*OES
Lab 10 FA*OES
Lab 11 FA*AAS
Lab 12 FA*MS
Lab 13 FA*OES
Lab 14 FA*OES
Lab 15 FA*OES
Lab 16 FA*OES
Lab 17 FA*OES
Lab 18 FA*OES
Lab 23 FA*AAS
Inlier
Rec. Value
± 5%
± 3SD
Lab

PREPARER AND SUPPLIER

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ACCREDITATION

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

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DOCUMENT HISTORY

Revision No.	Date	Changes applied
0	3rd August 2026	First publication.

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