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CERTIFICATE OF ANALYSIS FOR

CERTIFIED REFERENCE MATERIAL

OREAS 473

Clay-Hosted Rare Earth Element (REE) Ore

TREO + Y_2O_3 = 1433 ppm

Jupiter REE Project, Laverton Region, Western Australia

Accredited for compliance with ISO 17034

Table 1. Certified Values, Uncertainty & Tolerance Intervals in OREAS 473.

Constituent	Certified Value	95% Expanded Uncertainty		95% Tolerance Limits	
		Low	High	Low	High
Borate / Peroxide Fusion ICP					
Al_2O_3, Aluminium(III) oxide (wt.%)	22.95	22.40	23.50	22.58	23.32
Ba, Barium (wt.%)	0.405	0.393	0.417	0.398	0.411
Be, Beryllium (ppm)	3.11	2.88	3.34	2.99	3.23
Bi, Bismuth (ppm)	0.43	0.35	0.51	IND	IND
CaO, Calcium oxide (wt.%)	0.911	0.851	0.971	0.888	0.934
CeO_2, Cerium(IV) oxide (ppm)	655	633	677	646	664
Co, Cobalt (ppm)	15.8	14.7	16.9	15.2	16.4
Cr, Chromium (ppm)	66	62	70	63	69
Cs, Caesium (ppm)	10.7	10.1	11.3	10.4	11.0
Cu, Copper (ppm)	65	54	76	61	69
Dy_2O_3, Dysprosium(III) oxide (ppm)	12.0	11.3	12.6	11.6	12.3
Er_2O_3, Erbium(III) oxide (ppm)	5.44	5.14	5.73	5.27	5.60
Eu_2O_3, Europium(III) oxide (ppm)	7.34	6.99	7.69	7.13	7.55
Fe_2O_3, Iron(III) oxide (wt.%)	10.02	9.77	10.26	9.83	10.20
Ga, Gallium (ppm)	30.9	28.8	32.9	29.8	32.0
Gd_2O_3, Gadolinium(III) oxide (ppm)	21.9	21.0	22.7	21.4	22.4
Hf, Hafnium (ppm)	12.4	11.8	13.1	12.0	12.9
Ho_2O_3, Holmium(III) oxide (ppm)	2.09	1.98	2.20	2.01	2.17
In, Indium (ppm)	< 0.2	IND	IND	IND	IND
K_2O, Potassium oxide (wt.%)	3.66	3.56	3.75	3.59	3.73
La_2O_3, Lanthanum(III) oxide (ppm)	306	298	315	300	313
Li, Lithium (ppm)	17.3	15.9	18.8	IND	IND
Lu_2O_3, Lutetium(III) oxide (ppm)	0.66	0.60	0.73	0.63	0.70
MgO, Magnesium oxide (wt.%)	1.33	1.30	1.37	1.31	1.36
MnO, Manganese oxide (wt.%)	0.0576	0.0555	0.0597	0.0562	0.0590
Mo, Molybdenum (ppm)	2.19	1.94	2.43	IND	IND
Na_2O, Sodium oxide (wt.%)	0.937	0.902	0.971	0.913	0.960
Nb, Niobium (ppm)	20.3	19.0	21.5	19.7	20.9
Nd_2O_3, Neodymium(III) oxide (ppm)	242	232	252	237	247
Ni, Nickel (ppm)	38.7	31.9	45.4	35.7	41.7
P_2O_5, Phosphorus(V) oxide (wt.%)	0.614	0.587	0.640	0.599	0.629
Pb, Lead (ppm)	48.0	45.0	51.0	46.0	50.0
Pr_6O_{11}, Praseodymium(III,IV) oxide (ppm)	71	69	74	70	72
Rb, Rubidium (ppm)	147	142	152	144	151
S, Sulphur (wt.%)	0.048	0.033	0.063	IND	IND
Sb, Antimony (ppm)	1.20	0.96	1.44	IND	IND
Sc, Scandium (ppm)	22.3	20.9	23.8	21.6	23.1

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
Borate / Peroxide Fusion ICP continued					
SiO_2, Silicon dioxide (wt.%)	48.96	47.28	50.64	48.39	49.54
Sm_2O_3, Samarium(III) oxide (ppm)	34.9	33.7	36.2	34.1	35.7
Sn, Tin (ppm)	5.06	4.41	5.71	4.45	5.67
Sr, Strontium (ppm)	727	704	750	712	741
Ta, Tantalum (ppm)	1.22	1.08	1.36	1.13	1.31
Tb_4O_7, Terbium(III,IV) oxide (ppm)	2.56	2.41	2.71	2.48	2.64
Th, Thorium (ppm)	30.7	29.4	31.9	30.0	31.3
Ti, Titanium (wt.%)	1.06	1.01	1.10	1.03	1.08
Tl, Thallium (ppm)	0.88	0.76	1.00	0.82	0.94
Tm_2O_3, Thulium(III) oxide (ppm)	0.73	0.66	0.80	0.70	0.76
TREO, Total Rare Earth Oxides (ppm)	1373	1331	1415	1353	1393
TREO+Y_2O_3, Total Rare Earth Oxides + Yttrium oxide (ppm)	1433	1393	1473	1413	1453
U, Uranium (ppm)	3.90	3.70	4.09	3.78	4.02
V, Vanadium (ppm)	175	164	186	170	181
W, Tungsten (ppm)	4.66	4.04	5.27	4.34	4.98
Y_2O_3, Yttrium(III) oxide (ppm)	64	62	67	63	66
Yb_2O_3, Ytterbium(III) oxide (ppm)	4.47	4.22	4.73	4.31	4.63
Zn, Zinc (ppm)	110	101	118	106	113
Zr, Zirconium (ppm)	520	499	541	507	533
Borate Fusion XRF					
Al_2O_3, Aluminium(III) oxide (wt.%)	22.92	22.60	23.24	22.73	23.12
BaO, Barium oxide (wt.%)	0.448	0.426	0.469	0.441	0.454
CaO, Calcium oxide (wt.%)	0.915	0.895	0.936	0.904	0.926
CeO_2, Cerium(IV) oxide (ppm)	664	600	728	658	670
Dy_2O_3, Dysprosium(III) oxide (ppm)	< 100	IND	IND	IND	IND
Eu_2O_3, Europium(III) oxide (ppm)	< 100	IND	IND	IND	IND
Fe_2O_3, Iron(III) oxide (wt.%)	10.10	9.97	10.23	10.03	10.17
Gd_2O_3, Gadolinium(III) oxide (ppm)	74	23	126	IND	IND
Ho_2O_3, Holmium(III) oxide (ppm)	< 100	IND	IND	IND	IND
K_2O, Potassium oxide (wt.%)	3.63	3.59	3.68	3.61	3.66
La_2O_3, Lanthanum(III) oxide (ppm)	344	251	437	335	353
Lu_2O_3, Lutetium(III) oxide (ppm)	< 100	IND	IND	IND	IND
MgO, Magnesium oxide (wt.%)	1.34	1.31	1.36	1.32	1.35
MnO, Manganese oxide (wt.%)	0.0562	0.0505	0.0619	0.0535	0.0588
Na_2O, Sodium oxide (wt.%)	0.952	0.909	0.994	0.936	0.968
P_2O_5, Phosphorus(V) oxide (wt.%)	0.617	0.596	0.637	0.608	0.625
Pr_6O_{11}, Praseodymium(III,IV) oxide (ppm)	85	63	107	IND	IND

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
Borate Fusion XRF continued					
SiO_2, Silicon dioxide (wt.%)	48.36	47.68	49.05	48.15	48.57
Sm_2O_3, Samarium(III) oxide (ppm)	< 100	IND	IND	IND	IND
SO_3, Sulphur trioxide (wt.%)	0.093	0.079	0.107	IND	IND
Tb_4O_7, Terbium(III,IV) oxide (ppm)	< 100	IND	IND	IND	IND
TiO_2, Titanium dioxide (wt.%)	1.76	1.73	1.79	1.75	1.77
Tm_2O_3, Thulium(III) oxide (ppm)	< 100	IND	IND	IND	IND
V_2O_5, Vanadium(V) oxide (ppm)	316	258	375	298	335
Yb_2O_3, Ytterbium(III) oxide (ppm)	< 100	IND	IND	IND	IND
ZnO, Zinc oxide (ppm)	153	118	189	IND	IND
ZrO_2, Zirconium dioxide (ppm)	670	610	730	649	691
Thermogravimetry					
LOI^{1000}, Loss on ignition @1000 °C (wt.%)	7.68	7.35	8.02	7.64	7.73
4-Acid Digestion					
Al, Aluminium (wt.%)	11.64	11.17	12.11	11.41	11.87
Ba, Barium (wt.%)	0.407	0.395	0.418	0.399	0.414
Be, Beryllium (ppm)	2.97	2.83	3.11	2.85	3.09
Bi, Bismuth (ppm)	0.40	0.38	0.43	0.38	0.43
Ca, Calcium (wt.%)	0.638	0.615	0.662	0.623	0.653
Ce, Cerium (ppm)	512	486	538	498	525
Co, Cobalt (ppm)	15.8	15.2	16.4	15.3	16.3
Cr, Chromium (ppm)	56	53	59	54	58
Cs, Caesium (ppm)	10.5	10.0	11.0	10.1	10.9
Cu, Copper (ppm)	61	59	63	60	62
Dy, Dysprosium (ppm)	10.1	9.6	10.6	9.7	10.5
Er, Erbium (ppm)	4.58	4.31	4.86	4.44	4.73
Eu, Europium (ppm)	6.13	5.78	6.48	5.93	6.34
Fe, Iron (wt.%)	6.78	6.59	6.98	6.67	6.90
Ga, Gallium (ppm)	31.1	29.5	32.7	30.4	31.9
Gd, Gadolinium (ppm)	18.7	17.3	20.1	18.0	19.3
Hf, Hafnium (ppm)	5.90	5.49	6.31	5.68	6.13
Ho, Holmium (ppm)	1.71	1.59	1.83	1.64	1.78
In, Indium (ppm)	0.10	0.10	0.11	0.10	0.11
K, Potassium (wt.%)	2.96	2.84	3.07	2.87	3.04
La, Lanthanum (ppm)	241	222	260	233	249
Li, Lithium (ppm)	16.8	16.2	17.4	16.3	17.3
Lu, Lutetium (ppm)	0.53	0.49	0.57	0.51	0.56
Mg, Magnesium (wt.%)	0.742	0.709	0.774	0.728	0.756

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					
Mn, Manganese (wt.%)	0.0423	0.0407	0.0440	0.0416	0.0430
Mo, Molybdenum (ppm)	2.25	2.10	2.39	2.16	2.34
Na, Sodium (wt.%)	0.695	0.674	0.716	0.678	0.712
Nb, Niobium (ppm)	19.3	18.3	20.3	18.8	19.8
Nd, Neodymium (ppm)	202	185	219	195	209
Ni, Nickel (ppm)	38.2	36.8	39.5	37.0	39.3
P, Phosphorus (wt.%)	0.268	0.257	0.278	0.262	0.273
Pb, Lead (ppm)	47.2	45.2	49.2	46.0	48.4
Pr, Praseodymium (ppm)	58	54	62	56	60
Rb, Rubidium (ppm)	141	128	154	135	147
Re, Rhenium (ppm)	< 0.002	IND	IND	IND	IND
S, Sulphur (wt.%)	0.041	0.039	0.043	0.040	0.042
Sb, Antimony (ppm)	1.26	1.19	1.33	1.21	1.31
Sc, Scandium (ppm)	21.4	20.5	22.3	20.8	22.0
Sm, Samarium (ppm)	29.4	27.8	31.0	28.4	30.4
Sn, Tin (ppm)	4.74	4.51	4.98	4.57	4.92
Sr, Strontium (ppm)	701	673	730	688	715
Ta, Tantalum (ppm)	1.09	1.02	1.16	1.04	1.15
Tb, Terbium (ppm)	2.07	1.92	2.22	1.99	2.15
Th, Thorium (ppm)	30.1	27.6	32.5	28.9	31.2
Ti, Titanium (wt.%)	0.976	0.934	1.017	0.955	0.997
Tl, Thallium (ppm)	0.85	0.80	0.90	0.82	0.88
Tm, Thulium (ppm)	0.59	0.55	0.63	0.56	0.62
U, Uranium (ppm)	3.58	3.37	3.79	3.48	3.68
V, Vanadium (ppm)	169	162	176	166	172
W, Tungsten (ppm)	4.17	3.92	4.42	3.99	4.35
Y, Yttrium (ppm)	46.0	43.4	48.7	44.6	47.5
Yb, Ytterbium (ppm)	3.66	3.42	3.90	3.53	3.79
Zn, Zinc (ppm)	107	103	110	104	109
Zr, Zirconium (ppm)	244	229	258	237	250

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 2. Indicative Values for OREAS 473.

Constituent	Unit	Value	Constituent	Unit	Value	Constituent	Unit	Value
Borate / Peroxide Fusion ICP								
Ag	ppm	*0.277*	Cd	ppm	*< 10*	Se	ppm	*< 20*
As	ppm	*15.8*	Ge	ppm	*1.44*	Te	ppm	*< 1*
B	ppm	*79*	Re	ppm	*< 0.1*			
Borate Fusion XRF								
As_2O_3	ppm	*15.4*	Hg	ppm	*< 20*	Rh	ppm	*< 1*
Au	ppm	*< 20*	I	ppm	*< 10*	Ru	ppm	*< 1*
Bi_2O_3	ppm	*< 11*	In	ppm	*< 10*	Sb_2O_3	ppm	*< 36*
Cd	ppm	*< 10*	Ir	ppm	*< 10*	Sc_2O_3	ppm	*28.3*
Cl	wt.%	*0.249*	MoO_3	ppm	*< 1.5*	Se	ppm	*< 1*
Co_3O_4	ppm	*< 50*	Nb_2O_5	ppm	*88*	SnO_2	ppm	*< 100*
Cr_2O_3	ppm	*112*	Nd_2O_3	ppm	*224*	SrO	ppm	*879*
Cs_2O	ppm	*< 11*	NiO	ppm	*80*	Ta_2O_5	ppm	*< 100*
CuO	ppm	*99*	Os	ppm	*< 10*	Tc	ppm	*< 1*
Er_2O_3	ppm	*114*	PbO	ppm	*74*	Te	ppm	*42.2*
F	ppm	*< 5000*	Pd	ppb	*< 1000*	Th	ppm	*34.5*
Fr	ppm	*< 30*	Pm	ppm	*< 10*	Tl	ppm	*< 50*
Ga_2O_3	ppm	*164*	Pt	ppb	*< 1000*	U_3O_8	ppm	*7.13*
Ge	ppm	*< 30*	Ra	ppm	*< 20*	WO_3	ppm	*< 100*
H_2O-	wt.%	*1.52*	Rb_2O	ppm	*171*	Y	ppm	*69*
HfO_2	ppm	*< 100*	Re	ppm	*< 10*			
Infrared Combustion								
C	wt.%	*0.033*	S	wt.%	*0.035*			
4-Acid Digestion								
Ag	ppm	*0.033*	Ge	ppm	*0.75*	Te	ppm	*0.053*
As	ppm	*1.60*	Hg	ppm	*0.011*			
Cd	ppm	*0.031*	Se	ppm	*2.79*			

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).

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 provides the certified values and their associated 95 % expanded uncertainty and tolerance intervals, Table 2 shows indicative values including major and trace element characterisation, Table 3 provides some indicative physical properties, Table 4 shows indicative mineralogy by semi-quantitative XRD analysis and Table 5 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[3]) are presented in the detailed certification data for this CRM (**OREAS 473-DataPack.1.0.260210_151907.xlsx**). The certified values and uncertainties in this Certificate are the sole authoritative figures. Any additional significant figures in the DataPack are provided for reference only and do not affect the certified results.

Results are also presented in scatter plots for Dy_2O_3, Nd_2O_3, Pr_6O_{11} and Tb_4O_7 by borate/peroxide fusion ICP in Figures 1 to 4 respectively, together with ±3SD (magenta) and ±5 % (yellow) control lines and certified value (green line). Accepted individual results are coloured blue and individual and dataset outliers are identified in red and violet, respectively.

INTENDED USE

OREAS 473 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 473 may be used to calibrate the entire procedure by producing a pure substance CRM transformed into a calibration solution.

OREAS 473 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 473 is a certified reference material (CRM) produced from a blend of clay-hosted rare earth element (REE) ores and barren kaolin. The REE-bearing ores were sourced from the Jupiter deposit in the Laverton region of Western Australia.
Mineralisation occurs within a deeply weathered regolith developed over an underlying carbonatite–alkaline volcanic sequence. Supergene processes have resulted in enrichment of total rare earth oxides (TREO), including a significant proportion of magnet rare earth oxides (MREO), notably neodymium and praseodymium, with subordinate dysprosium and terbium. The CRM matrix is quartz-rich and comprises abundant mica–illite and kaolinite-group clays, with additional smectite/vermiculite-type clay minerals. Minor iron oxides (goethite and magnetite), traces of hematite and anatase are present as accessory phases. Rare earth elements are interpreted to occur predominantly within fine-grained secondary phases associated with the clay fraction.

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:

- Borate fusion /Sodium peroxide with ICP-OES and/or MS finish: ≥0.2 g;
- Borate fusion with X-ray fluorescence finish: ≥0.2 g;
- Loss on Ignition (LOI) at 1000 °C: ≥1 g;
- 4-acid digestion with ICP-OES and/or MS finish: ≥ 0.25 g.

INSTRUCTIONS FOR HANDLING & 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 [11].

As per routine analysis at commercial laboratories, the certified values derived by borate fusion with XRF finish are on a dry sample basis.

Analytes by all other methods refer to the concentration levels in the packaged state. There is no need for drying prior to weighing and analysis for these methods.

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)

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 5 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.

PERIOD OF VALIDITY & STORAGE INSTRUCTIONS

The certification of OREAS 473 remains valid, within the specified measurement uncertainties, until at least May 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.

Single-use sachets

OREAS 473 is packaged in single-use, 10 g 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 473 contains a non-hygroscopic* matrix with an indicative value for moisture provided to enable users to check for changes to stored material by determining moisture in the user's laboratory and comparing the result to the value in Table 3 in this certificate. The stability of the CRM in regard to oxidation from the breakdown of sulphide minerals to sulphates is minimal 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 adsorped moisture (weakly held H_2O- molecules on the surface of exposed material) following exposure to the local atmosphere. Usually, equilibration of material to the local atmosphere will only occur if the material is spread into a thin (~2mm thick) layer and left exposed for a period of 2 hours.

COMMINUTION AND HOMOGENISATION PROCEDURES

The materials constituting OREAS 473 was prepared in the following manner:

- Crushing and multi-stage milling of the barren material to >95% minus 75 microns;
- Crushing and multi-stage milling of the ores to 100% minus 30 microns;
- Blending the ores and barren materials in appropriate proportions to achieve desired grades;
- 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 473 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 473.

Bulk Density (kg/m^3)	Moisture (wt.%)	Munsell Notation‡	Munsell Color‡
451	1.21	10YR 8/2	Very Pale Orange

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

MINERALOGY

The semi-quantitative XRD results shown in Table 4 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 may be present. 'Clay minerals' appears to be mainly smectite, vermiculite and/or illite. A trace of anatase may be present in the samples.

Table 4. Indicative mineralogy of OREAS 473 by semi-quantitative XRD analysis.

Mineral / Mineral Group	% (mass ratio)
Hematite	3
Goethite	5
Clay minerals	11
Serpentine	2
Kandite group	30
Annite - biotite - phlogopite	3
Muscovite - illite	12
Ca amphibole	2
Plagioclase	8
K-feldspar and/or rutile	14
Quartz	9
Crandallite group	2

ANALYTICAL PROGRAM

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

- Lithium borate or sodium peroxide fusion with full suite ICP-OES and ICP-MS elemental packages (up to 27 laboratories depending on the element);
- Lithium borate fusion whole rock analysis package by X-ray fluorescence (up to 13 laboratories depending on the element);
- Thermogravimetry: Loss on Ignition (LOI) at 1000 °C (8 laboratories used a thermogravimetric analyser, 6 laboratories included LOI with their fusion package and 3 laboratories used a conventional muffle furnace);
- 4-acid (HNO_3-HF-$HClO_4$-HCl) digestion with full suite ICP-OES and ICP-MS elemental packages (up to 26 laboratories depending on the element).

Samples of this CRM were analysed by Intertek Genalysis Laboratory (Perth, Australia) using ammonium sulphate ionic leaching followed by ICP-MS (method ICL/MS16). A range of ammonium sulphate concentrations and leach pH conditions were tested to assess the method’s effectiveness. Despite these variations, recoveries of rare earth elements remained consistently low, indicating that ammonium sulphate leaching is ineffective for extracting REEs from this material. Therefore, this CRM represents a clay-hosted REE deposit without significant ion-exchangeable rare earth element content typical of ion-adsorbed clays.

For the round robin program, six 2 kg test units were collected at predetermined intervals during the bagging stage, immediately after homogenisation. These units are considered representative of the entire prepared batch. Each participating laboratory received six test portions, obtained by subsampling 15 g from each of the six distinct 2 kg units.

Homogeneity was assessed by submitting 12 pulp samples to a single laboratory for analysis. Paired 15 g samples were drawn from each of the six test units, enabling an Analysis of Variance (ANOVA) to compare within-unit and between-unit variances. This statistical method provides a relative measure of homogeneity and tests the null hypothesis that all units derive from the same population distribution (refer to the ‘Homogeneity Evaluation’ section below).

PARTICIPATING LABORATORIES

1. Actlabs, Ancaster, Ontario, Canada
2. African Natural Resources & Mines Ltd, Suleja, Niger State, Nigeria
3. AGAT Laboratories, Calgary, Alberta, Canada
4. Alex Stewart International, Mendoza, Argentina
5. ALS, Brisbane, QLD, Australia
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
11. ARGETEST Mineral Processing, Ankara, Central Anatolia, Turkey
12. Bureau Veritas Commodities Canada Ltd, Vancouver, BC, Canada
13. CERTIMIN, Lima, Peru
14. Inspectorate (BV), Lima, Peru
15. Intertek, Perth, WA, Australia
16. Intertek, Townsville, QLD, Australia
17. Intertek Genalysis, Adelaide, SA, Australia
18. Lucid Laboratories Private Limited, Hyderabad, Telangana, India
19. Ontario Geological Survey, Sudbury, Ontario, Canada
20. Performance Laboratories, Ruwa, Harare, Zimbabwe
21. PT Geoservices Ltd, Cikarang, Jakarta Raya, Indonesia
22. PT Indo Mineral Research, Bungursari, West Java, Indonesia
23. PT Intertek Utama Services, Jakarta Timur, DKI Jakarta, Indonesia
24. SGS, Randfontein, Gauteng, South Africa
25. SGS Australia Mineral Services, Perth, WA, Australia
26. SGS Geosol Laboratorios Ltda, Vespasiano, Minas Gerais, Brazil
27. Shiva Analyticals Ltd, Bangalore North, Karnataka, India
28. Stewart Assay & Environmental Laboratories LLC, Kara-Balta, Chüy, Kyrgyzstan
29. UIS Analytical Services, Centurion, South Africa

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 17034:2017 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 [5] and [14]. 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 5, '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 individuals, 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 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 Nd_2O_3 by fusion ICP where 99 % of the time (1-α=0.99) at least 95 % of subsamples (ρ=0.95) will have concentrations lying between 237 and 247 ppm. 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.***

Analysis of Variance (ANOVA) Study

In addition to the precision error method outlined above, homogeneity was also evaluated using an ANOVA study. This involved sending 12 x 20 g pulp samples to the ALS Brisbane, laboratory for analysis by lithium borate fusion with ICP-MS finish (code ME- MS81). The 12 samples consisted of paired samples from each of the six sampling units to enable an

Analysis of Variance (ANOVA) by comparison of within- and between-unit variances across the six pairs. The ANOVA enables a relative measure of homogeneity and permits a test of the null hypothesis that all 'units' are drawn from the same population distribution. An ANOVA constructed in this way tests that no statistically significant difference exists in the variance between-units to that of the variance within-units. A *p*-value < 0.05 would indicate rejection of the null hypothesis at the 95 % confidence level (i.e., a significant difference likely does exist; meaning there is evidence of heterogeneity between the sample intervals).

All *p*-values were found to be statistically insignificant, and the Null Hypothesis is therefore retained. It is important to note that ANOVA provides a relative measure of homogeneity and that a CRM having poor absolute homogeneity can still pass these tests if the within-unit heterogeneity is large and similar across all units. Based on the statistical analysis of the results of the interlaboratory certification program, it can be concluded that OREAS 473 is fit-for-purpose as a certified reference material (see 'Intended Use' below).

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 [7], 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 33405:2024-05 [4], clause 9.2.5, and ISO 17034:2016 [8], clause 7.12.4 b), 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 33405:2024-05, 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 and fulfils the requirements for metrological traceability as specified in ISO 17034 and ISO 33405 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 and mining 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 5 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 5. Performance Gates for OREAS 473.

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											
Al_2O_3, wt.%	22.95	0.730	21.49	24.41	20.76	25.14	3.18%	6.36%	9.54%	21.80	24.10
Ba, wt.%	0.405	0.012	0.380	0.429	0.368	0.442	3.02%	6.04%	9.06%	0.385	0.425
Be, ppm	3.11	0.233	2.64	3.58	2.41	3.81	7.50%	15.00%	22.50%	2.95	3.27
Bi, ppm	0.43	0.05	0.34	0.52	0.29	0.57	10.86%	21.72%	32.57%	0.41	0.45
CaO, wt.%	0.911	0.050	0.811	1.011	0.761	1.061	5.48%	10.97%	16.45%	0.866	0.957
CeO_2, ppm	655	23	608	702	584	725	3.58%	7.17%	10.75%	622	688
Co, ppm	15.8	0.72	14.4	17.3	13.7	18.0	4.55%	9.10%	13.65%	15.0	16.6
Cr, ppm	66	4.1	58	74	54	78	6.15%	12.30%	18.45%	63	69
Cs, ppm	10.7	0.55	9.6	11.8	9.1	12.3	5.11%	10.23%	15.34%	10.2	11.2
Cu, ppm	65	10	44	86	34	96	16.04%	32.08%	48.12%	62	68
Dy_2O_3, ppm	12.0	0.66	10.6	13.3	10.0	13.9	5.51%	11.01%	16.52%	11.4	12.6
Er_2O_3, ppm	5.44	0.213	5.01	5.86	4.80	6.07	3.91%	7.82%	11.73%	5.16	5.71
Eu_2O_3, ppm	7.34	0.414	6.51	8.17	6.10	8.58	5.64%	11.28%	16.91%	6.97	7.71
Fe_2O_3, wt.%	10.02	0.226	9.56	10.47	9.34	10.70	2.26%	4.52%	6.78%	9.52	10.52
Ga, ppm	30.9	1.93	27.0	34.7	25.1	36.6	6.24%	12.49%	18.73%	29.3	32.4
Gd_2O_3, ppm	21.9	1.37	19.1	24.6	17.7	26.0	6.28%	12.57%	18.85%	20.8	23.0
Hf, ppm	12.4	0.50	11.4	13.4	10.9	13.9	4.01%	8.03%	12.04%	11.8	13.1
Ho_2O_3, ppm	2.09	0.100	1.89	2.29	1.79	2.39	4.79%	9.57%	14.36%	1.98	2.19
In, ppm	< 0.2	IND	IND	IND	IND	IND	IND	IND	IND	IND	IND
K_2O, wt.%	3.66	0.090	3.48	3.84	3.39	3.93	2.45%	4.91%	7.36%	3.47	3.84
La_2O_3, ppm	306	11	284	329	272	341	3.73%	7.46%	11.19%	291	322
Li, ppm	17.3	1.22	14.9	19.8	13.7	21.0	7.03%	14.06%	21.10%	16.5	18.2
Lu_2O_3, ppm	0.66	0.045	0.57	0.75	0.53	0.80	6.73%	13.45%	20.18%	0.63	0.70
MgO, wt.%	1.33	0.043	1.25	1.42	1.21	1.46	3.22%	6.45%	9.67%	1.27	1.40
MnO, wt.%	0.058	0.002	0.053	0.062	0.051	0.064	3.65%	7.29%	10.94%	0.055	0.060
Mo, ppm	2.19	0.33	1.53	2.84	1.20	3.17	15.06%	30.12%	45.19%	2.08	2.30
Na_2O, wt.%	0.937	0.027	0.882	0.992	0.854	1.019	2.93%	5.86%	8.80%	0.890	0.983
Nb, ppm	20.3	1.80	16.7	23.9	14.9	25.7	8.88%	17.76%	26.64%	19.3	21.3
Nd_2O_3, ppm	242	11	221	263	210	274	4.37%	8.74%	13.11%	230	254
Ni, ppm	38.7	4.4	29.8	47.5	25.4	52.0	11.45%	22.90%	34.34%	36.7	40.6
P_2O_5, wt.%	0.614	0.025	0.563	0.665	0.538	0.690	4.14%	8.28%	12.42%	0.583	0.645
Pb, ppm	48.0	3.08	41.8	54.2	38.8	57.2	6.41%	12.83%	19.24%	45.6	50.4
Pr_6O_{11}, ppm	71	2.3	67	76	64	78	3.17%	6.34%	9.51%	68	75
Rb, ppm	147	6	135	160	128	166	4.31%	8.61%	12.92%	140	155
S, wt.%	0.048	0.008	0.032	0.064	0.024	0.072	16.93%	33.85%	50.78%	0.045	0.050
Sb, ppm	1.20	0.20	0.81	1.59	0.61	1.79	16.43%	32.85%	49.28%	1.14	1.26
Sc, ppm	22.3	1.65	19.0	25.7	17.4	27.3	7.40%	14.81%	22.21%	21.2	23.5
SiO_2, wt.%	48.96	1.469	46.02	51.90	44.55	53.37	3.00%	6.00%	9.00%	46.51	51.41
Sm_2O_3, ppm	34.9	1.34	32.2	37.6	30.9	38.9	3.84%	7.69%	11.53%	33.2	36.7
Sn, ppm	5.06	0.56	3.93	6.19	3.37	6.75	11.15%	22.29%	33.44%	4.81	5.31
Sr, ppm	727	31	664	790	633	821	4.32%	8.64%	12.96%	690	763
Ta, ppm	1.22	0.120	0.98	1.46	0.86	1.58	9.85%	19.69%	29.54%	1.16	1.28
Tb_4O_7, ppm	2.56	0.135	2.29	2.83	2.15	2.96	5.28%	10.57%	15.85%	2.43	2.69

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

Notes: intervals may appear asymmetric due to rounding; 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.

IND = indeterminate.

Table 5 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											
Th, ppm	30.7	1.42	27.8	33.5	26.4	34.9	4.62%	9.23%	13.85%	29.1	32.2
Ti, wt.%	1.06	0.057	0.94	1.17	0.89	1.22	5.37%	10.73%	16.10%	1.00	1.11
Tl, ppm	0.88	0.076	0.73	1.03	0.65	1.11	8.67%	17.34%	26.01%	0.84	0.92
Tm_2O_3, ppm	0.73	0.042	0.65	0.81	0.60	0.86	5.75%	11.49%	17.24%	0.69	0.77
TREO, ppm	1373	28	1316	1430	1288	1459	2.07%	4.15%	6.22%	1304	1442
TREO+Y_2O_3, ppm	1433	36	1360	1506	1323	1542	2.55%	5.09%	7.64%	1361	1505
U, ppm	3.90	0.184	3.53	4.27	3.35	4.45	4.72%	9.44%	14.16%	3.70	4.09
V, ppm	175	15	146	205	131	220	8.43%	16.87%	25.30%	166	184
W, ppm	4.66	0.397	3.86	5.45	3.47	5.85	8.53%	17.05%	25.58%	4.42	4.89
Y_2O_3, ppm	64	2.7	59	70	56	72	4.23%	8.46%	12.70%	61	68
Yb_2O_3, ppm	4.47	0.177	4.12	4.83	3.94	5.00	3.95%	7.90%	11.85%	4.25	4.70
Zn, ppm	110	7	95	124	88	131	6.57%	13.14%	19.71%	104	115
Zr, ppm	520	29	462	579	432	608	5.63%	11.25%	16.88%	494	546
Borate Fusion XRF											
Al_2O_3, wt.%	22.92	0.386	22.15	23.70	21.77	24.08	1.69%	3.37%	5.06%	21.78	24.07
BaO, wt.%	0.448	0.024	0.400	0.495	0.376	0.519	5.30%	10.61%	15.91%	0.425	0.470
CaO, wt.%	0.915	0.026	0.864	0.967	0.838	0.992	2.80%	5.61%	8.41%	0.870	0.961
CeO_2, ppm	664	73	519	810	447	882	10.93%	21.85%	32.78%	631	698
Dy_2O_3, ppm	< 100	IND	IND	IND	IND	IND	IND	IND	IND	IND	IND
Eu_2O_3, ppm	< 100	IND	IND	IND	IND	IND	IND	IND	IND	IND	IND
Fe_2O_3, wt.%	10.10	0.171	9.76	10.44	9.59	10.61	1.70%	3.39%	5.09%	9.60	10.61
Gd_2O_3, ppm	74	68	0	211	0	280	91.92%	183.84%	275.77%	71	78
Ho_2O_3, ppm	< 100	IND	IND	IND	IND	IND	IND	IND	IND	IND	IND
K_2O, wt.%	3.63	0.052	3.53	3.74	3.48	3.79	1.44%	2.89%	4.33%	3.45	3.82
La_2O_3, ppm	344	57	230	457	174	514	16.51%	33.02%	49.54%	327	361
Lu_2O_3, ppm	< 100	IND	IND	IND	IND	IND	IND	IND	IND	IND	IND
MgO, wt.%	1.34	0.022	1.29	1.38	1.27	1.40	1.65%	3.30%	4.95%	1.27	1.40
MnO, wt.%	0.056	0.006	0.045	0.068	0.039	0.073	10.27%	20.54%	30.80%	0.053	0.059
Na_2O, wt.%	0.952	0.055	0.842	1.062	0.787	1.117	5.78%	11.57%	17.35%	0.904	0.999
P_2O_5, wt.%	0.617	0.025	0.566	0.667	0.540	0.693	4.12%	8.25%	12.37%	0.586	0.647
Pr_6O_{11}, ppm	85	19	46	124	27	143	22.75%	45.51%	68.26%	81	89
SiO_2, wt.%	48.36	0.851	46.66	50.07	45.81	50.92	1.76%	3.52%	5.28%	45.94	50.78
Sm_2O_3, ppm	< 100	IND	IND	IND	IND	IND	IND	IND	IND	IND	IND
SO_3, wt.%	0.093	0.010	0.073	0.113	0.063	0.123	10.67%	21.33%	32.00%	0.089	0.098
Tb_4O_7, ppm	< 100	IND	IND	IND	IND	IND	IND	IND	IND	IND	IND
TiO_2, wt.%	1.76	0.037	1.68	1.83	1.65	1.87	2.11%	4.23%	6.34%	1.67	1.85
Tm_2O_3, ppm	< 100	IND	IND	IND	IND	IND	IND	IND	IND	IND	IND
V_2O_5, ppm	316	53	211	422	158	475	16.66%	33.32%	49.98%	301	332
Yb_2O_3, ppm	< 100	IND	IND	IND	IND	IND	IND	IND	IND	IND	IND
ZnO, ppm	153	33	87	220	54	253	21.63%	43.26%	64.89%	146	161
ZrO_2, ppm	670	46	577	763	530	809	6.94%	13.88%	20.82%	636	703
Thermogravimetry											
LOI^{1000}, wt.%	7.68	0.577	6.53	8.84	5.95	9.41	7.50%	15.00%	22.51%	7.30	8.07

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

Notes: intervals may appear asymmetric due to rounding; 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.

IND = indeterminate.

Table 5 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											
Al, wt.%	11.64	0.467	10.71	12.57	10.24	13.04	4.01%	8.02%	12.03%	11.06	12.22
Ba, wt.%	0.407	0.009	0.388	0.425	0.379	0.435	2.29%	4.58%	6.86%	0.386	0.427
Be, ppm	2.97	0.159	2.65	3.29	2.49	3.45	5.35%	10.71%	16.06%	2.82	3.12
Bi, ppm	0.40	0.025	0.35	0.46	0.33	0.48	6.25%	12.50%	18.74%	0.38	0.42
Ca, wt.%	0.638	0.027	0.585	0.692	0.558	0.719	4.19%	8.39%	12.58%	0.606	0.670
Ce, ppm	512	38	436	587	398	625	7.39%	14.78%	22.17%	486	537
Co, ppm	15.8	0.77	14.2	17.3	13.5	18.1	4.86%	9.73%	14.59%	15.0	16.6
Cr, ppm	56	4.6	47	65	42	70	8.12%	16.24%	24.36%	53	59
Cs, ppm	10.5	0.54	9.4	11.6	8.9	12.1	5.16%	10.32%	15.47%	10.0	11.0
Cu, ppm	61	2.3	56	65	54	67	3.71%	7.43%	11.14%	58	64
Dy, ppm	10.1	0.66	8.8	11.4	8.1	12.1	6.56%	13.13%	19.69%	9.6	10.6
Er, ppm	4.58	0.332	3.92	5.25	3.58	5.58	7.25%	14.50%	21.75%	4.35	4.81
Eu, ppm	6.13	0.361	5.41	6.86	5.05	7.22	5.89%	11.78%	17.67%	5.83	6.44
Fe, wt.%	6.78	0.214	6.36	7.21	6.14	7.43	3.15%	6.30%	9.45%	6.45	7.12
Ga, ppm	31.1	1.99	27.2	35.1	25.2	37.1	6.39%	12.79%	19.18%	29.6	32.7
Gd, ppm	18.7	2.3	14.1	23.2	11.9	25.4	12.10%	24.20%	36.30%	17.7	19.6
Hf, ppm	5.90	0.512	4.88	6.93	4.36	7.44	8.68%	17.37%	26.05%	5.61	6.20
Ho, ppm	1.71	0.125	1.46	1.96	1.34	2.08	7.29%	14.58%	21.86%	1.62	1.80
In, ppm	0.10	0.006	0.09	0.12	0.09	0.12	5.95%	11.89%	17.84%	0.10	0.11
K, wt.%	2.96	0.114	2.73	3.19	2.62	3.30	3.85%	7.70%	11.55%	2.81	3.11
La, ppm	241	37	168	314	131	351	15.16%	30.31%	45.47%	229	253
Li, ppm	16.8	0.58	15.6	18.0	15.1	18.6	3.47%	6.94%	10.42%	16.0	17.6
Lu, ppm	0.53	0.043	0.44	0.62	0.40	0.66	8.05%	16.09%	24.14%	0.50	0.56
Mg, wt.%	0.742	0.036	0.669	0.814	0.632	0.851	4.91%	9.82%	14.73%	0.705	0.779
Mn, wt.%	0.042	0.002	0.039	0.046	0.037	0.048	4.45%	8.89%	13.34%	0.040	0.044
Mo, ppm	2.25	0.097	2.05	2.44	1.95	2.54	4.32%	8.65%	12.97%	2.13	2.36
Na, wt.%	0.695	0.024	0.648	0.742	0.624	0.766	3.40%	6.80%	10.19%	0.660	0.730
Nb, ppm	19.3	1.16	17.0	21.6	15.8	22.8	6.03%	12.06%	18.09%	18.3	20.3
Nd, ppm	202	21	160	243	139	264	10.30%	20.59%	30.89%	192	212
Ni, ppm	38.2	1.31	35.5	40.8	34.2	42.1	3.42%	6.84%	10.26%	36.2	40.1
P, wt.%	0.268	0.011	0.246	0.289	0.235	0.300	4.08%	8.15%	12.23%	0.254	0.281
Pb, ppm	47.2	2.17	42.9	51.5	40.7	53.7	4.60%	9.20%	13.80%	44.8	49.6
Pr, ppm	58	4.5	49	67	45	71	7.73%	15.46%	23.19%	55	61
Rb, ppm	141	13	116	166	103	179	8.88%	17.76%	26.64%	134	148
Re, ppm	< 0.002	IND	IND	IND	IND	IND	IND	IND	IND	IND	IND
S, wt.%	0.041	0.002	0.037	0.045	0.035	0.047	5.14%	10.27%	15.41%	0.039	0.043
Sb, ppm	1.26	0.067	1.13	1.40	1.06	1.46	5.33%	10.67%	16.00%	1.20	1.32
Sc, ppm	21.4	1.29	18.8	24.0	17.5	25.3	6.03%	12.05%	18.08%	20.3	22.5
Sm, ppm	29.4	1.46	26.5	32.3	25.0	33.8	4.97%	9.94%	14.90%	27.9	30.9
Sn, ppm	4.74	0.200	4.34	5.14	4.14	5.34	4.23%	8.45%	12.68%	4.51	4.98
Sr, ppm	701	30	642	761	612	791	4.25%	8.50%	12.75%	666	736
Ta, ppm	1.09	0.093	0.90	1.28	0.81	1.37	8.53%	17.07%	25.60%	1.04	1.15
Tb, ppm	2.07	0.174	1.72	2.41	1.54	2.59	8.43%	16.85%	25.28%	1.96	2.17

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

Notes: intervals may appear asymmetric due to rounding; 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.

IND = indeterminate.

Table 5 continued.

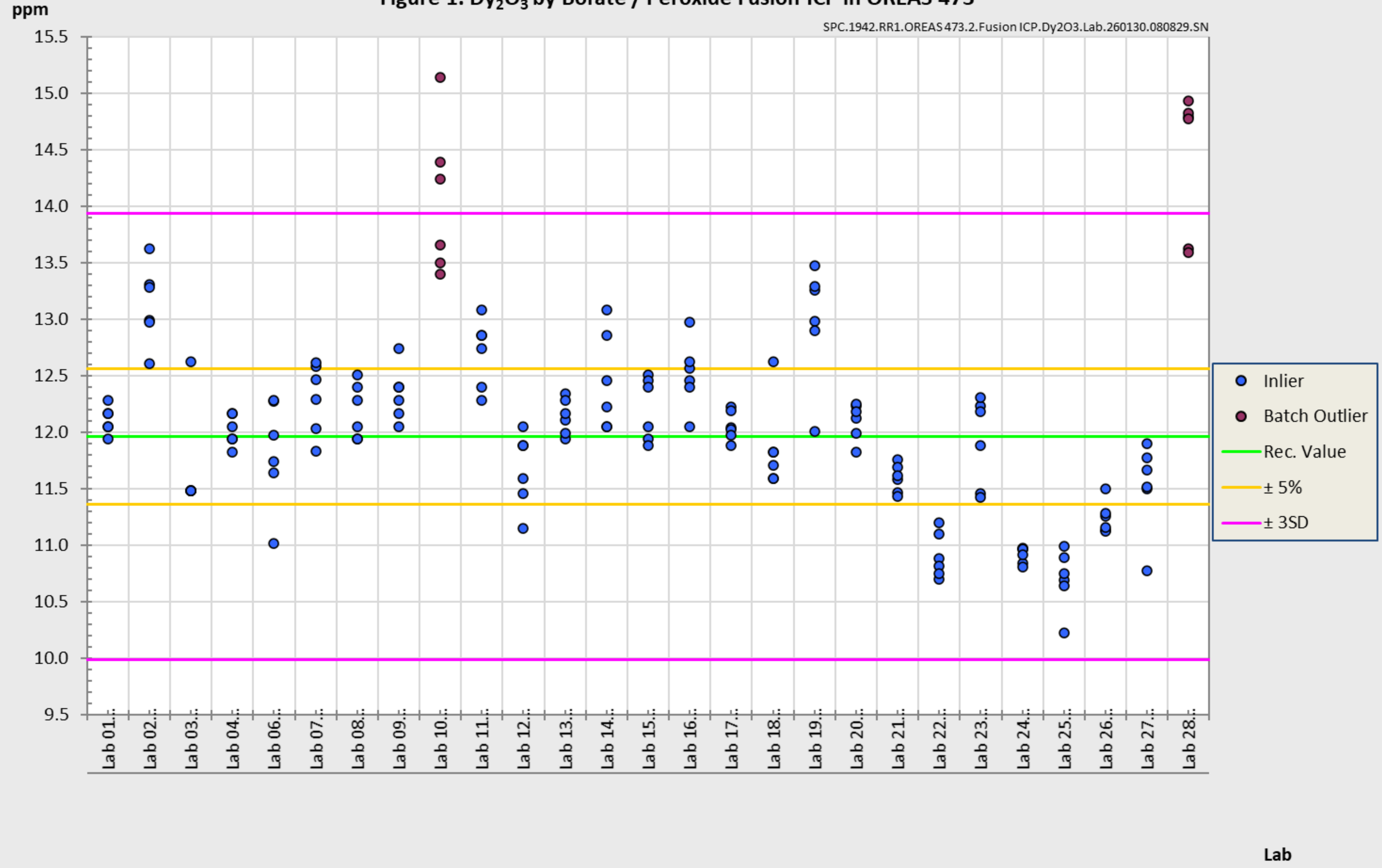
Constituent	Certified Value	Absolute Standard Deviations					Relative Standard Deviations			5 % window	
		1SD	2SD Low	2SD High	3SD Low	3SD High	1RSD	2RSD	3RSD	Low	High
4-Acid Digestion continued											
Th, ppm	30.1	2.93	24.2	35.9	21.3	38.9	9.75%	19.50%	29.25%	28.6	31.6
Ti, wt.%	0.976	0.065	0.846	1.105	0.782	1.170	6.62%	13.25%	19.87%	0.927	1.025
Tl, ppm	0.85	0.077	0.70	1.01	0.62	1.08	9.09%	18.18%	27.27%	0.81	0.89
Tm, ppm	0.59	0.051	0.49	0.69	0.44	0.75	8.65%	17.30%	25.95%	0.56	0.62
U, ppm	3.58	0.235	3.11	4.05	2.88	4.28	6.56%	13.12%	19.67%	3.40	3.76
V, ppm	169	8	154	184	146	192	4.48%	8.96%	13.44%	161	177
W, ppm	4.17	0.243	3.68	4.65	3.44	4.90	5.82%	11.64%	17.46%	3.96	4.38
Y, ppm	46.0	4.7	36.7	55.4	32.0	60.1	10.18%	20.37%	30.55%	43.7	48.3
Yb, ppm	3.66	0.251	3.16	4.16	2.91	4.41	6.85%	13.69%	20.54%	3.48	3.84
Zn, ppm	107	3	100	113	97	117	3.13%	6.26%	9.39%	101	112
Zr, ppm	244	21	201	286	180	307	8.76%	17.51%	26.27%	231	256

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

Notes: intervals may appear asymmetric due to rounding; 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.

IND = indeterminate.

Figure 1. Dy_2O_3 by Borate / Peroxide Fusion ICP in OREAS 473



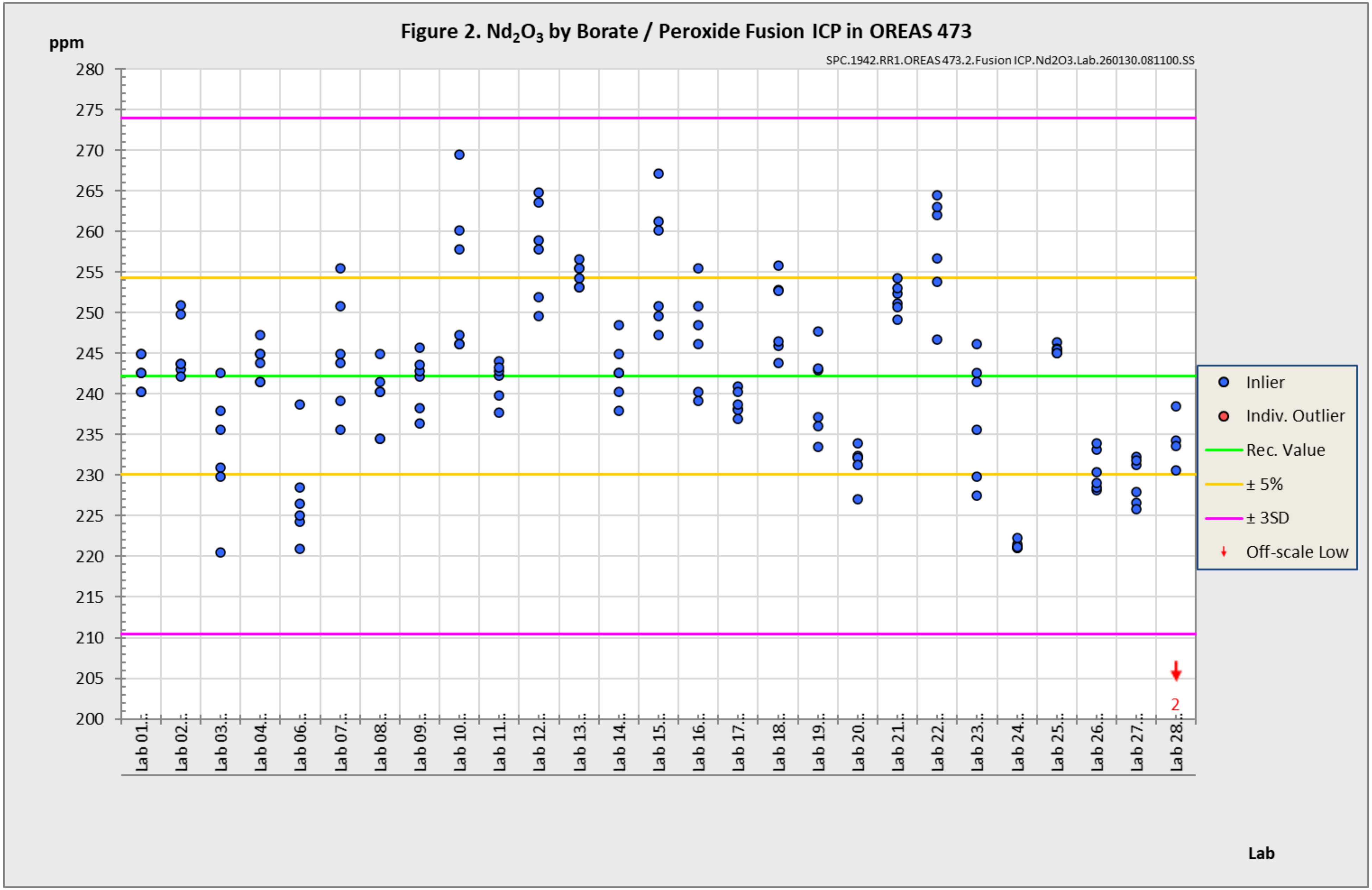
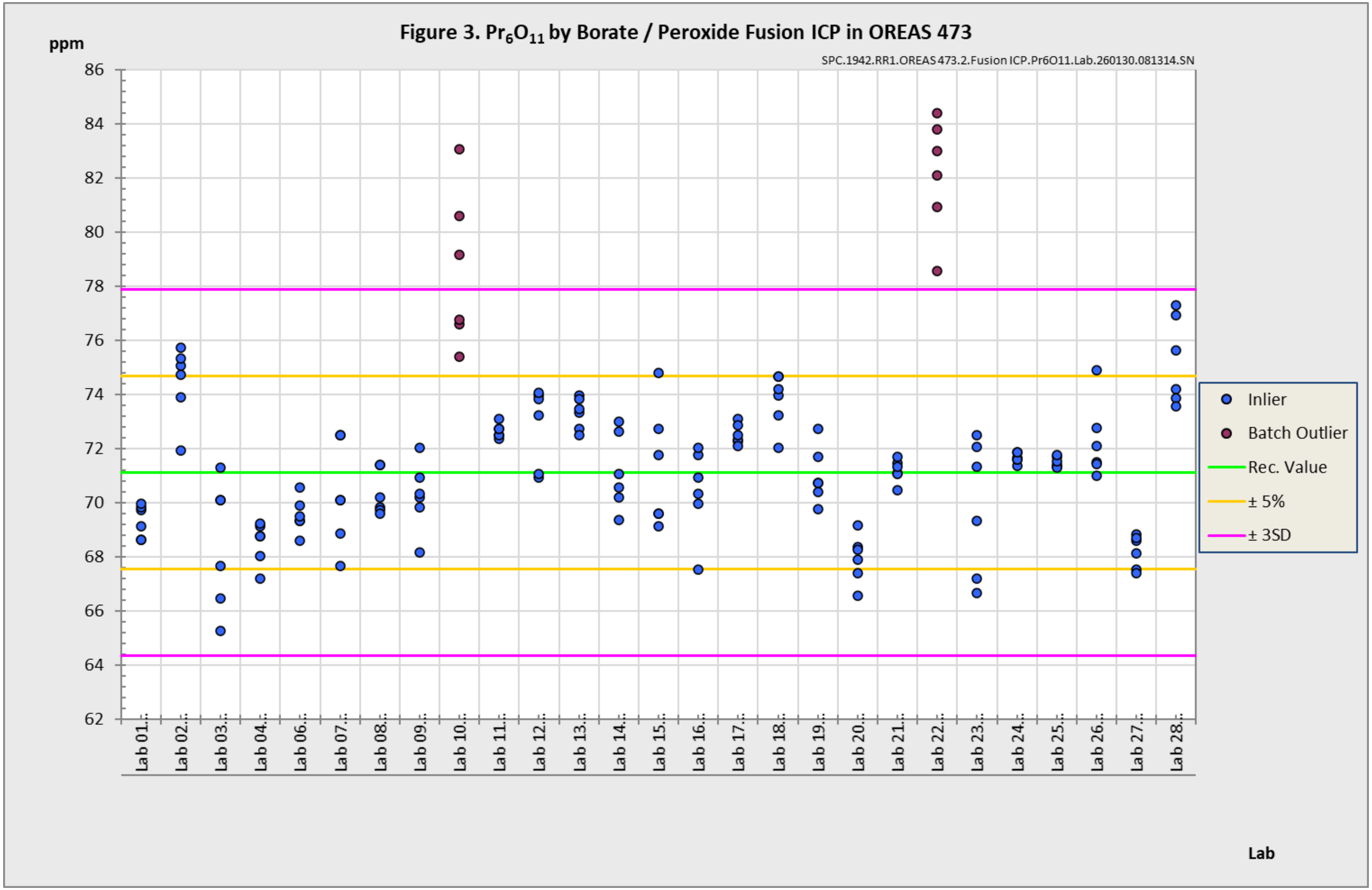


Figure 2. Nd_2O_3 by Borate / Peroxide Fusion ICP in OREAS 473
ppm
SPC.1942.RR1.OREAS 473.2.Fusion ICP.Nd2O3.Lab.260130.081100.SS
280
275
270
265
260
255
250
245
240
235
230
225
220
215
210
205
200
Lab 01..
Lab 02..
Lab 03..
Lab 04..
Lab 06..
Lab 07..
Lab 08..
Lab 09..
Lab 10..
Lab 11..
Lab 12..
Lab 13..
Lab 14..
Lab 15..
Lab 16..
Lab 17..
Lab 18..
Lab 19..
Lab 20..
Lab 21..
Lab 22..
Lab 23..
Lab 24..
Lab 25..
Lab 26..
Lab 27..
Lab 28..
2
Inlier
Indiv. Outlier
Rec. Value
± 5%
± 3SD
Off-scale Low
Lab

Figure 3. Pr_6O_{11} by Borate / Peroxide Fusion ICP in OREAS 473



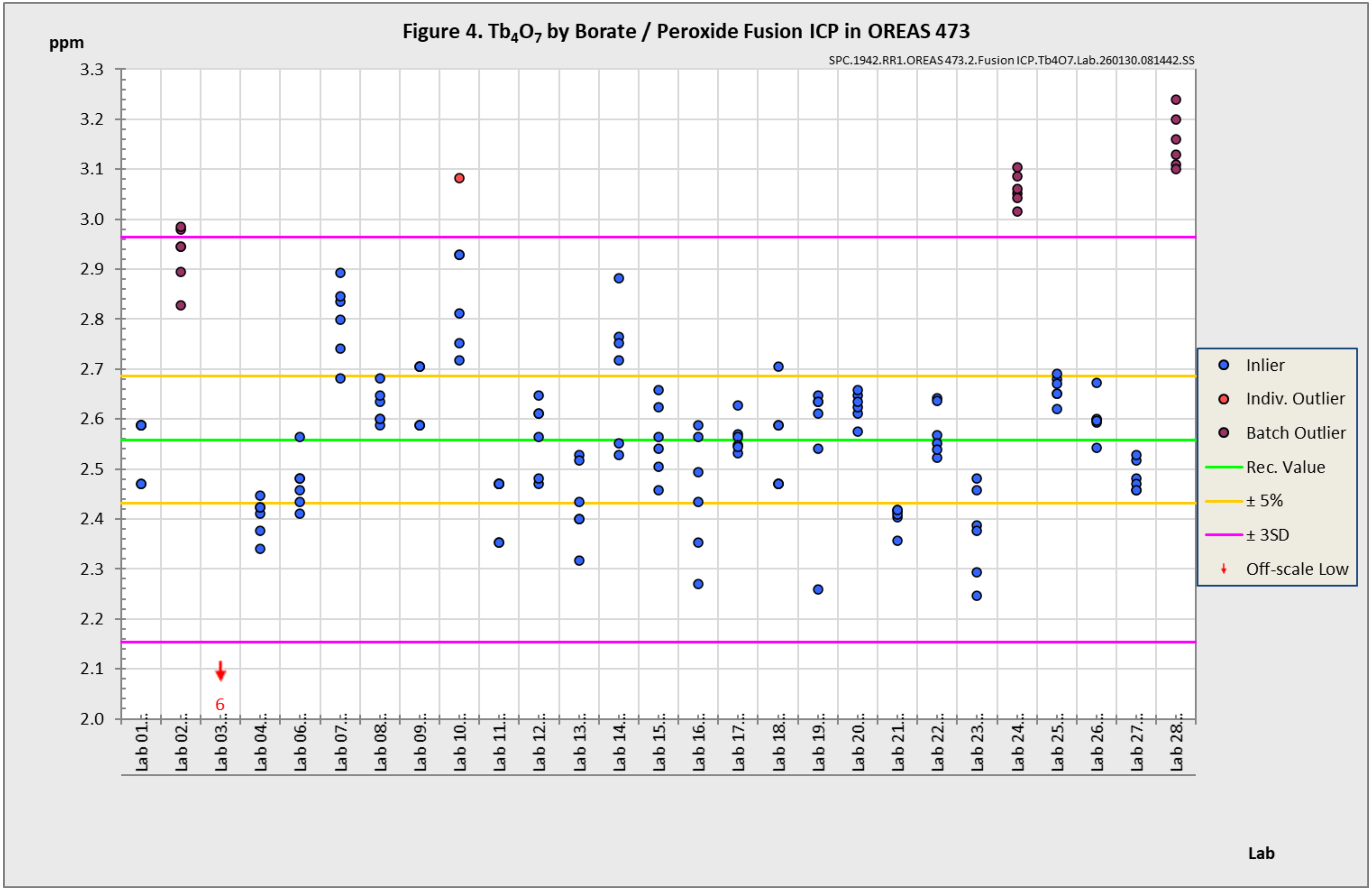


Figure 4. Tb_4O_7 by Borate / Peroxide Fusion ICP in OREAS 473

SPC.1942.RR1.OREAS 473.2.Fusion ICP.Tb4O7.Lab.260130.081442.SS

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