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## CERTIFICATE OF ANALYSIS FOR

# CERTIFIED REFERENCE MATERIAL

# OREAS 780

## Fluorite Ore

## Speewah Fluorite Deposit, Western Australia, Australia

**Table 1. Certified Values, Uncertainty & Tolerance Intervals in OREAS 780.**

| Constituent | Certified Value | 95% Expanded Uncertainty | | 95% Tolerance Limits | |
|---|---|---|---|---|---|
| | | Low | High | Low | High |
| **Borate Fusion XRF** | | | | | |
| $Al_2O_3$, Aluminium(III) oxide (wt.%) | 13.61 | 13.46 | 13.76 | 13.54 | 13.68 |
| As, Arsenic (ppm) | 444 | 361 | 527 | IND | IND |
| BaO, Barium oxide (ppm) | 997 | 909 | 1086 | 959 | 1036 |
| Ca, Calcium (wt.%) | 5.67 | 5.57 | 5.77 | 5.62 | 5.72 |
| Co, Cobalt (ppm) | < 100 | IND | IND | IND | IND |
| Cr, Chromium (ppm) | 114 | 73 | 155 | 100 | 128 |
| Cu, Copper (ppm) | 57 | 40 | 75 | IND | IND |
| F, Fluorine (wt.%) | 5.15 | 4.94 | 5.36 | 4.97 | 5.32 |
| Fe, Iron (wt.%) | 2.50 | 2.46 | 2.53 | 2.47 | 2.52 |
| $HfO_2$, Hafnium dioxide (ppm) | < 100 | IND | IND | IND | IND |
| $K_2O$, Potassium oxide (wt.%) | 2.61 | 2.57 | 2.65 | 2.59 | 2.63 |
| MgO, Magnesium oxide (wt.%) | 0.546 | 0.522 | 0.569 | 0.534 | 0.558 |
| Nb, Niobium (ppm) | < 50 | IND | IND | IND | IND |
| $P_2O_5$, Phosphorus(V) oxide (wt.%) | 0.063 | 0.055 | 0.072 | 0.061 | 0.065 |
| Pb, Lead (ppm) | < 50 | IND | IND | IND | IND |
| S, Sulphur (ppm) | 97 | 82 | 112 | 86 | 108 |
| $SiO_2$, Silicon dioxide (wt.%) | 63.83 | 63.35 | 64.31 | 63.63 | 64.03 |
| $TiO_2$, Titanium dioxide (wt.%) | 0.688 | 0.667 | 0.708 | 0.677 | 0.698 |
| W, Tungsten (ppm) | 81 | 59 | 104 | IND | IND |
| Zr, Zirconium (ppm) | 200 | 134 | 267 | 191 | 210 |
| **Thermogravimetry** | | | | | |
| $LOI^{1000}$, Loss on ignition @1000 °C (wt.%) | 5.76 | 5.45 | 6.07 | 5.66 | 5.85 |
| **Ion Selective Electrode** | | | | | |
| F, Fluorine (wt.%) | 4.32 | 3.94 | 4.69 | 4.11 | 4.52 |
| **4-Acid Digestion** | | | | | |
| Ag, Silver (ppm) | 0.345 | 0.302 | 0.387 | 0.308 | 0.381 |
| Al, Aluminium (wt.%) | 6.73 | 6.47 | 6.99 | 6.58 | 6.88 |
| As, Arsenic (ppm) | 428 | 413 | 443 | 421 | 436 |
| Ba, Barium (ppm) | 878 | 850 | 906 | 865 | 891 |
| Be, Beryllium (ppm) | 2.60 | 2.48 | 2.73 | 2.50 | 2.70 |
| Bi, Bismuth (ppm) | 116 | 111 | 121 | 113 | 119 |
| Ca, Calcium (wt.%) | 5.59 | 5.41 | 5.77 | 5.50 | 5.67 |
| Ce, Cerium (ppm) | 88 | 82 | 93 | 85 | 90 |
| Co, Cobalt (ppm) | 1.82 | 1.70 | 1.94 | 1.71 | 1.93 |
| Cr, Chromium (ppm) | 88 | 80 | 96 | 84 | 92 |
| Cs, Caesium (ppm) | 9.71 | 9.26 | 10.17 | 9.37 | 10.06 |
| Cu, Copper (ppm) | 52 | 50 | 55 | 51 | 54 |

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** | | | | | |
| Dy, Dysprosium (ppm) | 3.40 | 3.04 | 3.76 | 3.21 | 3.59 |
| Er, Erbium (ppm) | 1.63 | 1.40 | 1.86 | 1.55 | 1.71 |
| Eu, Europium (ppm) | 1.20 | 1.12 | 1.28 | 1.16 | 1.24 |
| Fe, Iron (wt.%) | 2.42 | 2.34 | 2.50 | 2.38 | 2.46 |
| Ga, Gallium (ppm) | 17.9 | 17.0 | 18.7 | 17.3 | 18.4 |
| Gd, Gadolinium (ppm) | 4.88 | 4.41 | 5.36 | 4.63 | 5.14 |
| Hf, Hafnium (ppm) | 3.70 | 3.47 | 3.93 | 3.56 | 3.83 |
| Ho, Holmium (ppm) | 0.59 | 0.50 | 0.68 | 0.56 | 0.63 |
| In, Indium (ppm) | 0.082 | 0.072 | 0.091 | 0.075 | 0.088 |
| K, Potassium (wt.%) | 2.20 | 2.13 | 2.26 | 2.17 | 2.22 |
| La, Lanthanum (ppm) | 43.7 | 41.3 | 46.1 | 42.5 | 44.9 |
| Li, Lithium (ppm) | 45.3 | 43.6 | 47.0 | 44.5 | 46.0 |
| Lu, Lutetium (ppm) | 0.23 | 0.19 | 0.27 | 0.22 | 0.25 |
| Mg, Magnesium (wt.%) | 0.265 | 0.245 | 0.286 | 0.258 | 0.273 |
| Mn, Manganese (wt.%) | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 |
| Mo, Molybdenum (ppm) | 3.76 | 3.38 | 4.15 | 3.54 | 3.98 |
| Na, Sodium (wt.%) | 0.136 | 0.128 | 0.145 | 0.131 | 0.141 |
| Nb, Niobium (ppm) | 11.7 | 10.8 | 12.5 | 11.2 | 12.1 |
| Nd, Neodymium (ppm) | 35.7 | 33.5 | 37.9 | 34.8 | 36.7 |
| Ni, Nickel (ppm) | 12.8 | 12.1 | 13.5 | 12.3 | 13.4 |
| P, Phosphorus (wt.%) | 0.028 | 0.027 | 0.029 | 0.028 | 0.029 |
| Pb, Lead (ppm) | 16.6 | 15.8 | 17.5 | 16.2 | 17.1 |
| Pr, Praseodymium (ppm) | 9.82 | 9.15 | 10.49 | 9.57 | 10.07 |
| Rb, Rubidium (ppm) | 122 | 114 | 129 | 117 | 126 |
| S, Sulphur (wt.%) | 0.012 | 0.011 | 0.013 | IND | IND |
| Sb, Antimony (ppm) | 5.58 | 5.26 | 5.90 | 5.37 | 5.79 |
| Sc, Scandium (ppm) | 13.3 | 12.6 | 14.1 | 12.9 | 13.7 |
| Se, Selenium (ppm) | 0.92 | 0.74 | 1.10 | 0.84 | 1.00 |
| Sm, Samarium (ppm) | 6.25 | 5.81 | 6.68 | 6.00 | 6.49 |
| Sn, Tin (ppm) | 14.8 | 14.1 | 15.6 | 14.4 | 15.3 |
| Sr, Strontium (ppm) | 63 | 60 | 66 | 61 | 65 |
| Ta, Tantalum (ppm) | 0.89 | 0.81 | 0.97 | 0.84 | 0.93 |
| Tb, Terbium (ppm) | 0.66 | 0.57 | 0.76 | 0.64 | 0.69 |
| Te, Tellurium (ppm) | 0.23 | 0.20 | 0.27 | 0.20 | 0.26 |
| Th, Thorium (ppm) | 15.3 | 14.4 | 16.1 | 14.9 | 15.7 |
| Ti, Titanium (wt.%) | 0.347 | 0.319 | 0.374 | 0.335 | 0.358 |
| Tl, Thallium (ppm) | 0.69 | 0.65 | 0.73 | 0.66 | 0.72 |

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) | 0.22 | 0.18 | 0.26 | 0.20 | 0.24 |
| U, Uranium (ppm) | 2.49 | 2.31 | 2.67 | 2.38 | 2.60 |
| V, Vanadium (ppm) | 91 | 87 | 95 | 89 | 93 |
| W, Tungsten (ppm) | 75 | 72 | 79 | 73 | 77 |
| Y, Yttrium (ppm) | 25.0 | 23.1 | 27.0 | 24.2 | 25.9 |
| Yb, Ytterbium (ppm) | 1.62 | 1.44 | 1.79 | 1.54 | 1.70 |
| Zn, Zinc (ppm) | 29.0 | 27.1 | 30.9 | 27.7 | 30.3 |
| Zr, Zirconium (ppm) | 130 | 124 | 136 | 126 | 133 |

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 780.**

| Constituent | Unit | Value | Constituent | Unit | Value | Constituent | Unit | Value |
|---|---|---|---|---|---|---|---|---|
| **Borate Fusion XRF** | | | | | | | | |
| Bi | ppm | *114* | In | ppm | *< 100* | Sm | ppm | *< 170* |
| Cd | ppm | *< 100* | $La_2O_3$ | ppm | *89* | Sn | ppm | *49.3* |
| $CeO_2$ | ppm | *134* | Mn | wt.% | *0.007* | Sr | ppm | *80* |
| Cl | ppm | *44.2* | Mo | ppm | *< 50* | Ta | ppm | *< 80* |
| Cs | ppm | *< 100* | $Na_2O$ | wt.% | *0.194* | Te | ppm | *< 100* |
| Dy | ppm | *< 170* | Nd | ppm | *61* | Th | ppm | *69* |
| Eu | ppm | *< 170* | Ni | ppm | *< 50* | Tl | ppm | *< 100* |
| Ga | ppm | *< 100* | Pr | ppm | *42.8* | U | ppm | *< 17* |
| Gd | ppm | *< 170* | Rb | ppm | *138* | V | ppm | *101* |
| Ge | ppm | *< 100* | Sb | ppm | *129* | $Y_2O_3$ | ppm | *95* |
| $H_2O$- | wt.% | *0.323* | Sc | ppm | *< 100* | Zn | ppm | *34.1* |
| Hg | ppm | *< 100* | Se | ppm | *< 100* | | | |
| **Thermogravimetry** | | | | | | | | |
| $H_2O$- | wt.% | *0.323* | | | | | | |
| **4-Acid Digestion** | | | | | | | | |
| B | ppm | *23.1* | Ge | ppm | *0.22* | Re | ppm | *0.002* |
| Cd | ppm | *0.042* | Hg | ppm | *0.055* | | | |
| **Borate / Peroxide Fusion ICP** | | | | | | | | |
| Al | wt.% | *7.51* | Gd | ppm | *5.70* | Sr | ppm | *65* |
| Ba | ppm | *991* | Ho | ppm | *0.96* | Tb | ppm | *0.82* |
| Bi | ppm | *96* | La | ppm | *42.4* | Th | ppm | *12.7* |
| Ca | wt.% | *5.94* | Li | ppm | *44.4* | Ti | wt.% | *0.445* |
| Ce | ppm | *90* | Lu | ppm | *0.37* | Tl | ppm | *0.49* |
| Cs | ppm | *10.3* | Mg | wt.% | *0.360* | Tm | ppm | *0.39* |
| Dy | ppm | *4.65* | Nd | ppm | *34.2* | V | ppm | *96* |
| Er | ppm | *2.75* | Pr | ppm | *9.28* | W | ppm | *68* |
| Eu | ppm | *1.28* | Si | wt.% | *30.79* | Yb | ppm | *2.47* |
| Fe | wt.% | *2.33* | Sm | ppm | *6.21* | Zn | ppm | *43.3* |

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 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 780-DataPack.1.0.260319_150831.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 F by fusion XRF and F by Ion Selective Electrode in Figures 1 to 2 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 780 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 780 may be used to calibrate the entire procedure by producing a pure substance CRM transformed into a calibration solution.

OREAS 780 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 780 was prepared from a blend of fluorite-bearing materials and barren siliceous waste rock. The fluorine-bearing component was sourced from the Speewah region, Western Australia, where fluorite mineralisation occurs within iron-rich lithologies. Fluorine is present predominantly as fluorite ($CaF_2$), accompanied by minor iron oxides and silicate gangue minerals. The barren waste rock was sourced from Victoria, Australia and is composed predominantly of quartz and muscovite/sericite, with minor vermiculite, phlogopite, plagioclase, K-feldspar and tourmaline. The material is also anomalous in As, Au, Bi, La, Sb, W and Sn.

# 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 with X-ray fluorescence finish: ≥0.2 g;
- Loss on Ignition (LOI) at 1000 °C: ≥1 g;
- Fluorine by ion selective electrode: ≥ 0.2 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].

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

## 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 780 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 780 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 780 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 (~0.01 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 780 was prepared in the following manner:

- Drying to constant mass at 105 °C;
- Crushing and multi-stage milling to >95% minus 75 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 780 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 780.**

| Bulk Density (kg/m$^3$) | Moisture (wt.%) | Munsell Notation‡ | Munsell Color‡ |
|---|---|---|---|
| 819 | 0.34 | 5YR 8/4 | Moderate Orange Pink |

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

## MINERALOGY

The semi-quantitative XRD results shown in Table 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. A trace of anatase may be present. A trace of magnetite and topaz may be present.

**Table 4. Indicative mineralogy of OREAS 780 by semi-quantitative XRD analysis.**

| Mineral / Mineral Group | % (mass ratio) |
|---|---|
| Goethite | 2 |
| Kandite group | 5 |
| Annite - biotite - phlogopite | 1 |
| Muscovite - illite | 25 |
| Tourmaline group | 5 |
| Plagioclase | 1 |
| K-feldspar and/or rutile | 1 |
| Quartz | 52 |
| Fluorite | 9 |

# ANALYTICAL PROGRAM

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

- Lithium borate fusion whole rock analysis package by X-ray fluorescence (up to 19 laboratories depending on the element);
- Thermogravimetry: Loss on Ignition (LOI) at 1000 °C (10 laboratories used a thermogravimetric analyser, 4 laboratories included LOI with their fusion package and 5 laboratories used a conventional muffle furnace);
- Fluorine by ion selective electrode (15 laboratories)
- 4-acid ($HNO_3$-HF-$HClO_4$-HCl) digestion with full suite ICP-OES and ICP-MS elemental packages (up to 19 laboratories depending on the element).

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 10 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 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. Alex Stewart International, Mendoza, Argentina
4. ALS, Brisbane, QLD, Australia
5. ALS, Lima, Peru
6. ALS, Loughrea, Galway, Ireland
7. ALS, Malaga, WA, Australia
8. ALS, Vancouver, BC, Canada
9. American Assay Laboratories, Sparks, Nevada, USA
10. ARGETEST Mineral Processing, Ankara, Central Anatolia, Turkey
11. Bureau Veritas Geoanalytical, Perth, WA, Australia
12. Intertek, Perth, WA, Australia
13. Lucid Laboratories Private Limited, Hyderabad, Telangana, India
14. Ontario Geological Survey, Sudbury, Ontario, Canada
15. PT Geoservices Ltd, Cikarang, Jakarta Raya, Indonesia
16. PT Intertek Utama Services, Jakarta Timur, DKI Jakarta, Indonesia
17. Reminex Centre de Recherche, Marrakesh, Marrakesh-Safi, Morocco
18. SGS, Randfontein, Gauteng, South Africa
19. SGS Australia Mineral Services, Perth, WA, Australia
20. SGS Geosol Laboratorios Ltda, Vespasiano, Minas Gerais, Brazil
21. Shiva Analyticals Ltd, Bangalore North, Karnataka, India
22. Skyline Assayers & Laboratories, Tucson, Arizona, USA
23. Stewart Assay & Environmental Laboratories LLC, Kara-Balta, Chüy, Kyrgyzstan
24. 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 individual, lab dataset (batch) and 3SD outliers (single iteration). These outliers can only be removed after the absolute homogeneity of the CRM has been independently established, i.e., the outliers must be confidently deemed to be analytical rather than arising from inhomogeneity of the CRM. ***The standard deviation is then calculated for each analyte from the pooled accepted analyses generated from the certification program.***

## Homogeneity Evaluation

The tolerance limits (ISO 16269:2014) shown in 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 F by fusion XRF, where 99 % of the time ($1-\alpha=0.99$) at least 95 % of subsamples ($\rho=0.95$) will have concentrations lying between 4.97 and 5.32 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.***

## 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 10 g pulp samples to the ALS Brisbane, laboratory for analysis by oxidising fusion with X-ray fluorescence finish (code ME- XRF24). 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).

Of the sixteen analytes evaluated using ANOVA, only F returned a *p*-value less than 0.05. However, the resolution of the data was limited to 1000 ppm, with reported values restricted to 51,000 ppm or 52,000 ppm. Consequently, the statistical significance is considered unreliable and not indicative of meaningful between-unit variation. The null hypothesis can therefore be 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 780 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 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 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 780.

| Constituent | Certified Value | Absolute Standard Deviations | | | | | Relative Standard Deviations | | | 5 % window | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1SD | 2SD Low | 2SD High | 3SD Low | 3SD High | 1RSD | 2RSD | 3RSD | Low | High |
| **Borate Fusion XRF** | | | | | | | | | | | |
| $Al_2O_3$, wt.% | 13.61 | 0.151 | 13.31 | 13.91 | 13.16 | 14.06 | 1.11% | 2.22% | 3.33% | 12.93 | 14.29 |
| As, ppm | 444 | 102 | 240 | 648 | 138 | 750 | 22.96% | 45.91% | 68.87% | 422 | 466 |
| BaO, ppm | 997 | 56 | 885 | 1110 | 829 | 1166 | 5.62% | 11.24% | 16.85% | 948 | 1047 |
| Ca, wt.% | 5.67 | 0.086 | 5.50 | 5.84 | 5.41 | 5.93 | 1.52% | 3.03% | 4.55% | 5.38 | 5.95 |
| Co, ppm | < 100 | IND | IND | IND | IND | IND | IND | IND | IND | IND | IND |
| Cr, ppm | 114 | 23 | 67 | 161 | 44 | 185 | 20.56% | 41.13% | 61.69% | 108 | 120 |
| Cu, ppm | 57 | 12 | 33 | 81 | 21 | 94 | 21.13% | 42.27% | 63.40% | 54 | 60 |
| F, wt.% | 5.15 | 0.170 | 4.81 | 5.49 | 4.64 | 5.66 | 3.30% | 6.60% | 9.91% | 4.89 | 5.40 |
| Fe, wt.% | 2.50 | 0.052 | 2.39 | 2.60 | 2.34 | 2.65 | 2.09% | 4.17% | 6.26% | 2.37 | 2.62 |
| $HfO_2$, ppm | < 100 | IND | IND | IND | IND | IND | IND | IND | IND | IND | IND |
| $K_2O$, wt.% | 2.61 | 0.068 | 2.47 | 2.75 | 2.41 | 2.82 | 2.61% | 5.23% | 7.84% | 2.48 | 2.74 |
| MgO, wt.% | 0.546 | 0.034 | 0.479 | 0.613 | 0.445 | 0.647 | 6.15% | 12.29% | 18.44% | 0.519 | 0.573 |
| Nb, ppm | < 50 | IND | IND | IND | IND | IND | IND | IND | IND | IND | IND |
| $P_2O_5$, wt.% | 0.063 | 0.007 | 0.050 | 0.076 | 0.044 | 0.083 | 10.39% | 20.79% | 31.18% | 0.060 | 0.066 |
| Pb, ppm | < 50 | IND | IND | IND | IND | IND | IND | IND | IND | IND | IND |
| S, ppm | 97 | 23 | 51 | 143 | 28 | 166 | 23.79% | 47.59% | 71.38% | 92 | 102 |
| $SiO_2$, wt.% | 63.83 | 0.614 | 62.60 | 65.06 | 61.99 | 65.67 | 0.96% | 1.92% | 2.89% | 60.64 | 67.02 |
| $TiO_2$, wt.% | 0.688 | 0.028 | 0.632 | 0.743 | 0.604 | 0.771 | 4.06% | 8.12% | 12.18% | 0.653 | 0.722 |
| W, ppm | 81 | 14 | 54 | 109 | 40 | 123 | 16.89% | 33.78% | 50.66% | 77 | 85 |
| Zr, ppm | 200 | 35 | 131 | 270 | 96 | 305 | 17.38% | 34.77% | 52.15% | 190 | 210 |
| **Thermogravimetry** | | | | | | | | | | | |
| LOI$^{1000}$, wt.% | 5.76 | 0.474 | 4.81 | 6.70 | 4.33 | 7.18 | 8.23% | 16.46% | 24.69% | 5.47 | 6.04 |
| **Ion Selective Electrode** | | | | | | | | | | | |
| F, wt.% | 4.32 | 0.52 | 3.28 | 5.35 | 2.76 | 5.87 | 12.01% | 24.01% | 36.02% | 4.10 | 4.53 |
| **4-Acid Digestion** | | | | | | | | | | | |
| Ag, ppm | 0.345 | 0.024 | 0.297 | 0.392 | 0.273 | 0.416 | 6.90% | 13.80% | 20.70% | 0.328 | 0.362 |
| Al, wt.% | 6.73 | 0.350 | 6.03 | 7.43 | 5.68 | 7.78 | 5.21% | 10.41% | 15.62% | 6.39 | 7.07 |
| As, ppm | 428 | 13 | 402 | 455 | 389 | 468 | 3.09% | 6.18% | 9.27% | 407 | 450 |
| Ba, ppm | 878 | 27 | 824 | 932 | 797 | 959 | 3.06% | 6.12% | 9.18% | 834 | 922 |
| Be, ppm | 2.60 | 0.138 | 2.33 | 2.88 | 2.19 | 3.02 | 5.32% | 10.64% | 15.96% | 2.47 | 2.73 |
| Bi, ppm | 116 | 5 | 105 | 127 | 100 | 132 | 4.67% | 9.33% | 14.00% | 110 | 122 |
| Ca, wt.% | 5.59 | 0.162 | 5.26 | 5.91 | 5.10 | 6.07 | 2.91% | 5.82% | 8.73% | 5.31 | 5.87 |
| Ce, ppm | 88 | 4.3 | 79 | 96 | 75 | 101 | 4.84% | 9.67% | 14.51% | 84 | 92 |
| Co, ppm | 1.82 | 0.121 | 1.58 | 2.06 | 1.46 | 2.18 | 6.63% | 13.26% | 19.89% | 1.73 | 1.91 |
| Cr, ppm | 88 | 13 | 62 | 114 | 50 | 127 | 14.55% | 29.11% | 43.66% | 84 | 93 |
| Cs, ppm | 9.71 | 0.498 | 8.72 | 10.71 | 8.22 | 11.21 | 5.13% | 10.25% | 15.38% | 9.23 | 10.20 |
| Cu, ppm | 52 | 2.4 | 48 | 57 | 45 | 59 | 4.57% | 9.14% | 13.70% | 50 | 55 |
| Dy, ppm | 3.40 | 0.331 | 2.74 | 4.06 | 2.41 | 4.39 | 9.75% | 19.50% | 29.24% | 3.23 | 3.57 |
| Er, ppm | 1.63 | 0.22 | 1.19 | 2.07 | 0.97 | 2.29 | 13.49% | 26.98% | 40.46% | 1.55 | 1.71 |
| Eu, ppm | 1.20 | 0.048 | 1.10 | 1.30 | 1.06 | 1.35 | 4.01% | 8.03% | 12.04% | 1.14 | 1.26 |
| Fe, wt.% | 2.42 | 0.082 | 2.26 | 2.59 | 2.17 | 2.67 | 3.40% | 6.81% | 10.21% | 2.30 | 2.54 |
| Ga, ppm | 17.9 | 1.00 | 15.9 | 19.9 | 14.9 | 20.9 | 5.60% | 11.21% | 16.81% | 17.0 | 18.7 |
| Gd, ppm | 4.88 | 0.348 | 4.19 | 5.58 | 3.84 | 5.93 | 7.13% | 14.26% | 21.39% | 4.64 | 5.13 |

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

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

Note 2: the number of decimal places 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 5 continued.**

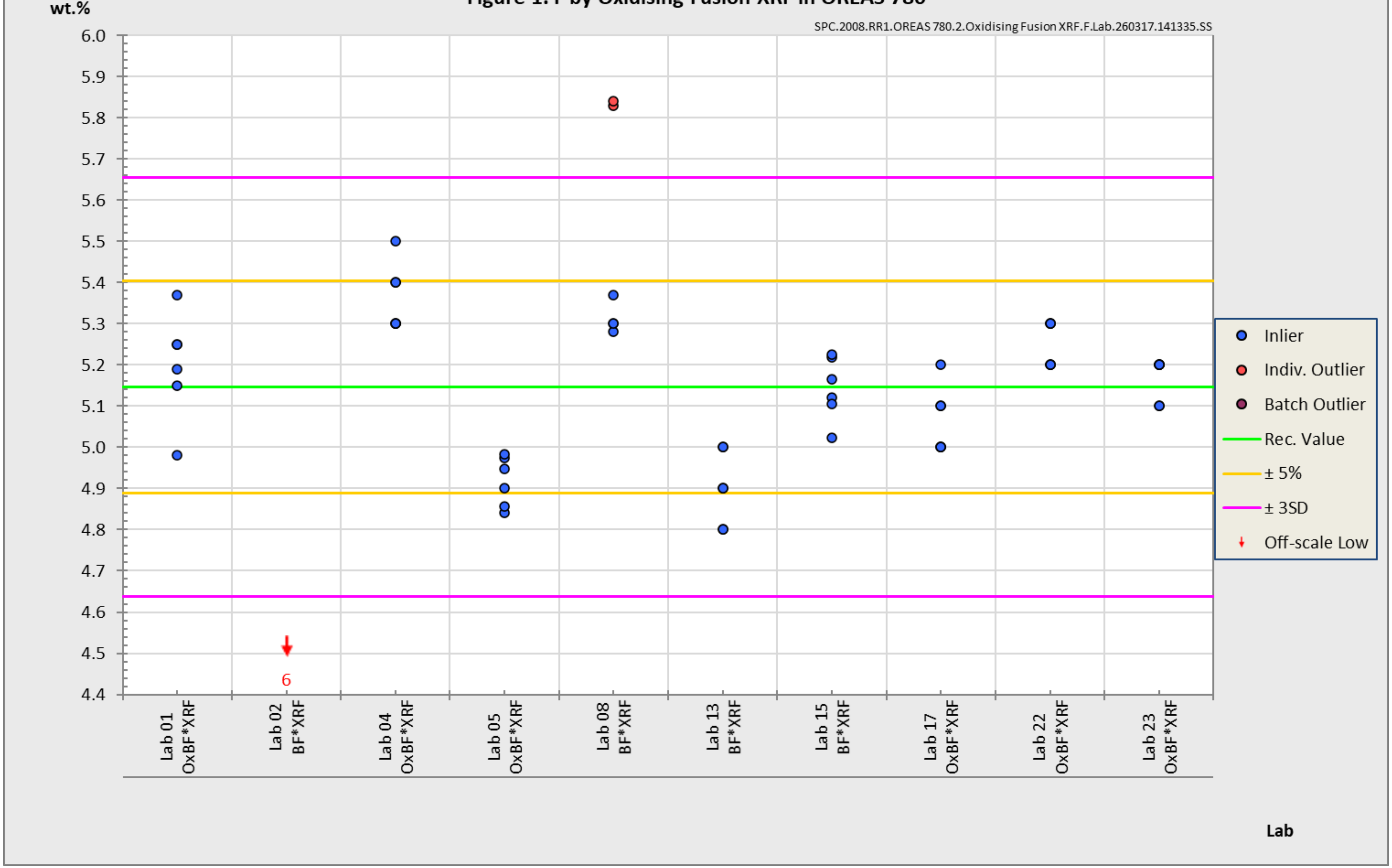
| Constituent | Certified Value | Absolute Standard Deviations | | | | | Relative Standard Deviations | | | 5 % window | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1SD | 2SD Low | 2SD High | 3SD Low | 3SD High | 1RSD | 2RSD | 3RSD | Low | High |
| **4-Acid Digestion continued** | | | | | | | | | | | |
| Hf, ppm | 3.70 | 0.295 | 3.11 | 4.29 | 2.81 | 4.58 | 7.98% | 15.96% | 23.94% | 3.51 | 3.88 |
| Ho, ppm | 0.59 | 0.09 | 0.42 | 0.76 | 0.34 | 0.85 | 14.47% | 28.95% | 43.42% | 0.56 | 0.62 |
| In, ppm | 0.082 | 0.008 | 0.065 | 0.098 | 0.057 | 0.106 | 9.90% | 19.80% | 29.70% | 0.077 | 0.086 |
| K, wt.% | 2.20 | 0.056 | 2.08 | 2.31 | 2.03 | 2.36 | 2.55% | 5.11% | 7.66% | 2.09 | 2.31 |
| La, ppm | 43.7 | 1.96 | 39.8 | 47.6 | 37.8 | 49.6 | 4.48% | 8.96% | 13.44% | 41.5 | 45.9 |
| Li, ppm | 45.3 | 1.46 | 42.4 | 48.2 | 40.9 | 49.7 | 3.23% | 6.46% | 9.69% | 43.0 | 47.6 |
| Lu, ppm | 0.23 | 0.04 | 0.16 | 0.31 | 0.12 | 0.35 | 16.33% | 32.66% | 48.99% | 0.22 | 0.24 |
| Mg, wt.% | 0.265 | 0.034 | 0.196 | 0.334 | 0.162 | 0.368 | 12.98% | 25.97% | 38.95% | 0.252 | 0.278 |
| Mn, wt.% | 0.004 | 0.000 | 0.004 | 0.004 | 0.003 | 0.004 | 3.74% | 7.47% | 11.21% | 0.004 | 0.004 |
| Mo, ppm | 3.76 | 0.297 | 3.17 | 4.36 | 2.87 | 4.65 | 7.89% | 15.77% | 23.66% | 3.58 | 3.95 |
| Na, wt.% | 0.136 | 0.009 | 0.119 | 0.153 | 0.110 | 0.162 | 6.32% | 12.63% | 18.95% | 0.129 | 0.143 |
| Nb, ppm | 11.7 | 1.04 | 9.6 | 13.7 | 8.5 | 14.8 | 8.94% | 17.88% | 26.81% | 11.1 | 12.2 |
| Nd, ppm | 35.7 | 1.65 | 32.4 | 39.0 | 30.8 | 40.7 | 4.62% | 9.23% | 13.85% | 34.0 | 37.5 |
| Ni, ppm | 12.8 | 0.65 | 11.5 | 14.1 | 10.9 | 14.8 | 5.04% | 10.08% | 15.12% | 12.2 | 13.5 |
| P, wt.% | 0.028 | 0.001 | 0.026 | 0.030 | 0.025 | 0.031 | 3.83% | 7.66% | 11.48% | 0.027 | 0.030 |
| Pb, ppm | 16.6 | 1.27 | 14.1 | 19.2 | 12.8 | 20.5 | 7.66% | 15.33% | 22.99% | 15.8 | 17.5 |
| Pr, ppm | 9.82 | 0.445 | 8.93 | 10.71 | 8.49 | 11.15 | 4.53% | 9.05% | 13.58% | 9.33 | 10.31 |
| Rb, ppm | 122 | 8 | 106 | 138 | 97 | 146 | 6.59% | 13.18% | 19.77% | 115 | 128 |
| S, wt.% | 0.012 | 0.003 | 0.006 | 0.018 | 0.003 | 0.021 | 24.77% | 49.54% | 74.32% | 0.012 | 0.013 |
| Sb, ppm | 5.58 | 0.418 | 4.74 | 6.41 | 4.33 | 6.83 | 7.49% | 14.97% | 22.46% | 5.30 | 5.86 |
| Sc, ppm | 13.3 | 0.76 | 11.8 | 14.9 | 11.1 | 15.6 | 5.71% | 11.41% | 17.12% | 12.7 | 14.0 |
| Se, ppm | 0.92 | 0.15 | 0.61 | 1.23 | 0.45 | 1.38 | 16.87% | 33.74% | 50.60% | 0.87 | 0.96 |
| Sm, ppm | 6.25 | 0.232 | 5.78 | 6.71 | 5.55 | 6.94 | 3.71% | 7.43% | 11.14% | 5.93 | 6.56 |
| Sn, ppm | 14.8 | 0.69 | 13.5 | 16.2 | 12.8 | 16.9 | 4.62% | 9.25% | 13.87% | 14.1 | 15.6 |
| Sr, ppm | 63 | 2.4 | 58 | 68 | 56 | 70 | 3.84% | 7.69% | 11.53% | 60 | 66 |
| Ta, ppm | 0.89 | 0.09 | 0.71 | 1.07 | 0.62 | 1.16 | 10.25% | 20.51% | 30.76% | 0.84 | 0.93 |
| Tb, ppm | 0.66 | 0.09 | 0.49 | 0.83 | 0.41 | 0.92 | 12.88% | 25.76% | 38.64% | 0.63 | 0.70 |
| Te, ppm | 0.23 | 0.03 | 0.17 | 0.30 | 0.14 | 0.33 | 13.91% | 27.82% | 41.73% | 0.22 | 0.24 |
| Th, ppm | 15.3 | 0.69 | 13.9 | 16.6 | 13.2 | 17.3 | 4.50% | 9.01% | 13.51% | 14.5 | 16.0 |
| Ti, wt.% | 0.347 | 0.045 | 0.256 | 0.437 | 0.211 | 0.482 | 13.05% | 26.10% | 39.14% | 0.329 | 0.364 |
| Tl, ppm | 0.69 | 0.051 | 0.59 | 0.79 | 0.53 | 0.84 | 7.39% | 14.79% | 22.18% | 0.65 | 0.72 |
| Tm, ppm | 0.22 | 0.04 | 0.15 | 0.29 | 0.11 | 0.33 | 16.18% | 32.35% | 48.53% | 0.21 | 0.23 |
| U, ppm | 2.49 | 0.153 | 2.18 | 2.80 | 2.03 | 2.95 | 6.15% | 12.31% | 18.46% | 2.37 | 2.62 |
| V, ppm | 91 | 4.1 | 83 | 99 | 79 | 103 | 4.46% | 8.93% | 13.39% | 87 | 96 |
| W, ppm | 75 | 2.9 | 70 | 81 | 67 | 84 | 3.83% | 7.66% | 11.49% | 72 | 79 |
| Y, ppm | 25.0 | 1.78 | 21.5 | 28.6 | 19.7 | 30.4 | 7.10% | 14.20% | 21.29% | 23.8 | 26.3 |
| Yb, ppm | 1.62 | 0.19 | 1.24 | 1.99 | 1.06 | 2.18 | 11.59% | 23.18% | 34.78% | 1.54 | 1.70 |
| Zn, ppm | 29.0 | 2.16 | 24.7 | 33.3 | 22.5 | 35.5 | 7.44% | 14.87% | 22.31% | 27.5 | 30.4 |
| Zr, ppm | 130 | 7 | 116 | 143 | 109 | 150 | 5.17% | 10.35% | 15.52% | 123 | 136 |

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. F by Oxidising Fusion XRF in OREAS 780



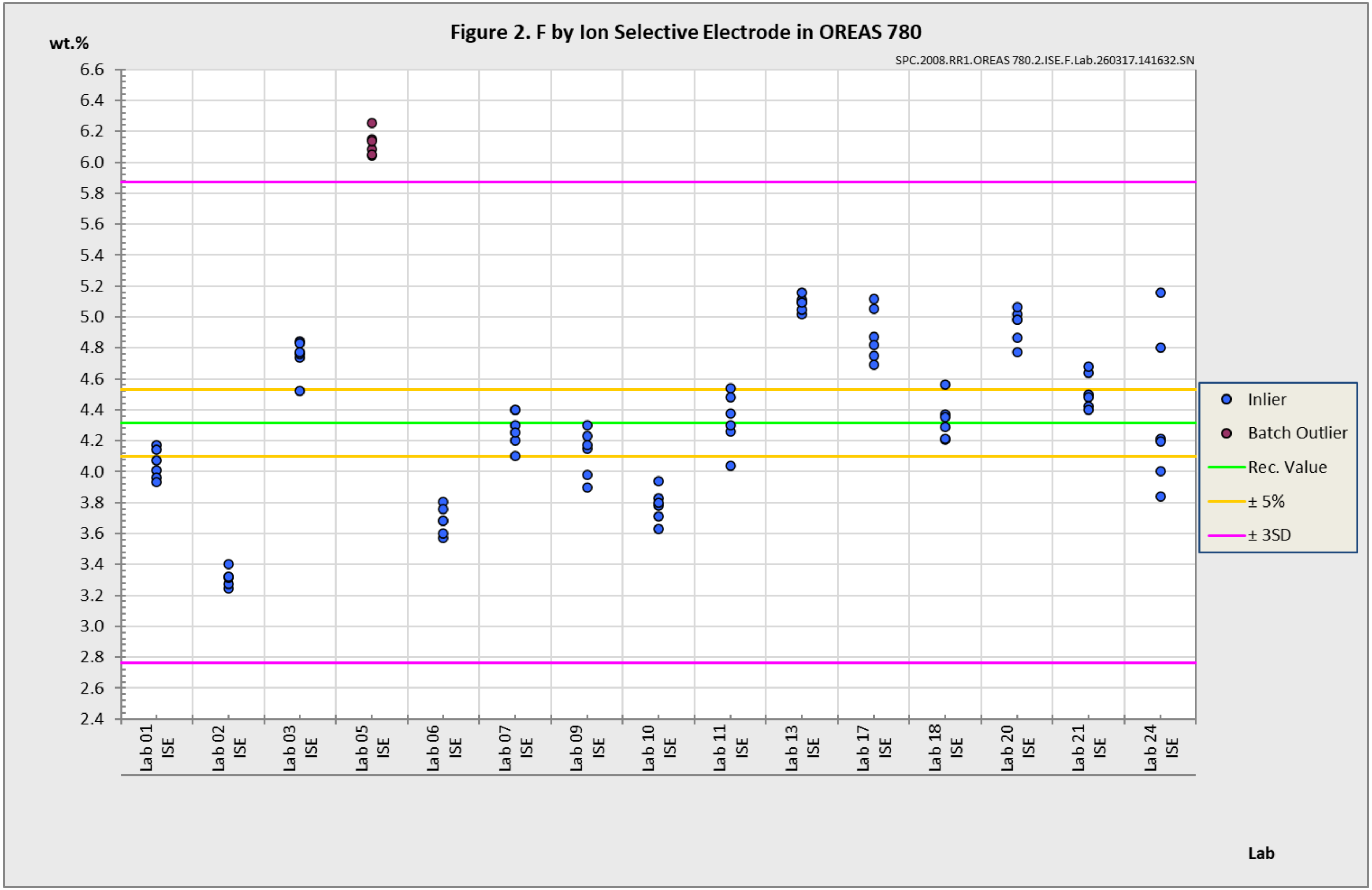


**Figure 2. F by Ion Selective Electrode in OREAS 780**

## PREPARER AND SUPPLIER

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## QMS CERTIFICATION

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

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

## LEGAL NOTICE

Ore Research & Exploration Pty Ltd has prepared and statistically evaluated the property values of this reference material to the best of its ability. The Purchaser by receipt hereof releases and indemnifies Ore Research & Exploration Pty Ltd from and against all liability and costs arising from the use of this material and information.

## DOCUMENT HISTORY

| Revision No. | Date | Changes applied |
|---|---|---|
| 0 | 2nd April 2026 | First publication. |

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