ORE RESEARCH & EXPLORATION

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CERTIFICATE OF ANALYSIS FOR

HIGH GRADE IRON ORE REFERENCE MATERIAL

OREAS 40

Table 1. Certified Values, 1SD's and 95% confidence intervals for OREAS 40

Constituent	Certified Value	1SD	95% Confidence Interval	
			Low	High
Aluminium oxide, Al_2O_3 (wt.%)	0.130	0.018	0.118	0.142
Calcium oxide, CaO (wt.%)	0.015	0.005	0.012	0.018
Ferric iron, Fe^{3+} (wt.%)	64.96	IND	IND	IND
Ferrous iron, Fe^{2+} (wt.%)	1.76	0.61	1.14	2.39
Iron, Fe_{total} (wt. %)	66.72	0.39	66.45	66.99
LOI, (wt.%)	-0.248	0.051	-0.268	-0.228
Magnesium oxide, MgO (wt.%)	0.017	0.010	0.012	0.023
Manganese oxide, MnO (wt.%)	0.020	0.001	0.020	0.021
Phosphorous, P (wt.%)	0.004	0.002	0.003	0.006
Potassium oxide, K_2O (wt.%)	0.018	0.004	0.015	0.021
Silicon dioxide, SiO_2 (wt.%)	4.64	0.07	4.60	4.69
Sulphur, S (wt.%)	0.008	0.002	0.006	0.010
Titanium dioxide, TiO_2 (wt.%)	0.050	0.004	0.047	0.052
Vanadium, V (ppm)	13	4	9	18

Note: values may appear asymmetric due to rounding;
*negative LOI indicates a gain on ignition through oxidation of ferrous to ferric iron;
#ferric iron calculated by difference.

INTRODUCTION

OREAS certified reference materials (CRMs) are intended to provide a low-cost method of evaluating and improving the quality of precious and base metal analysis of geological samples. To the analyst they provide an effective means of calibrating analytical equipment, assessing new techniques and routinely monitoring in-house procedures. 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.

SOURCE MATERIAL

Located in the Buccaneer Archipelago, the Koolan Island hematite deposits form part of the Yampi Sound group of iron ore deposits in the West Kimberly region 130km north west of Derby in Western Australia. High grade hematite mineralisation is developed in basal conglomerates and sandstones of the Palaeoproterozoic Yampi Formation at or close to the contact with the underlying Elgee Siltstone Group. On Koolan Island, regional folding about SE trending axes has produced semi continuous outcrop of mineralisation over a strike length of 15km.

COMMINUTION AND HOMOGENISATION PROCEDURES

The material constituting OREAS 40 was prepared in the following manner:

- drying to constant mass at 105° C;
- crushing;
- milling to minus 75 microns;
- homogenisation;
- packaging into 10g units in laminated foil pouches and 1kg units in plastic jars.

ANALYTICAL PROGRAM FOR OREAS 40

Ten commercial laboratories participated in the analytical certification program to characterise the analytes contained in Table 1 (see cover page) which shows certified values, one standard deviations and 95% confidence intervals. The round robin laboratory results together with uncorrected means, medians, one sigma standard deviations, relative standard deviations and percent deviation of lab means from the corrected mean of means (PDM^3) are presented in an appendix (see Tables A2 – A14 below). The analytical methods employed by each laboratory are indicated as codes at the head of each laboratory data set and described in Table A1 of the appendix.

The labs were instructed to dry at 105° C before weighing for analysis and to analyse for Al_2O_3, CaO, Fe_{total}, MgO, MnO, P, K_2O, SiO_2 and TiO_2 by lithium borate fusion XRF, LOI by thermogravimetry at 1000° C and Fe^{2+} by titration. Cu, Pb, V and Zn were determined by borate fusion XRF, 4-acid ICPOES or pressed powder pellet XRF however in this report only V has been analysed due to the poor inter-laboratory consensus of results for Cu, Pb and Zn. Sulphur was determined by borate fusion XRF, pressed powder pellet XRF or Leco analyser.

Following homogenisation of OREAS 40 the product was divided into 20 lots. Each lab received a batch of six 30g samples that consisted of two 30g samples from each of any three lots at random. This two-stage nested design for the interlaboratory sampling programme is amenable to analysis of variance (ANOVA) treatment and enables a comparative assessment of within- and between-unit homogeneity.

STATISTICAL EVALUATION OF OREAS 40

Recommended Value and Confidence Limits

The certified value is the mean of means of accepted replicate values of accepted participating laboratories computed according to the formulae

$$\bar{x}_i = \frac{1}{n_i} \sum_{j=1}^{n_i} x_{ij}$$

$$\ddot{x} = \frac{1}{p} \sum_{i=1}^{p} \bar{x}_i$$

where

x_{ij} *is the jth result reported by laboratory i;*

p *is the number of participating laboratories;*

n_i *is the number of results reported by laboratory i;*

$\bar{x}_i$ *is the mean for laboratory i;*

$\ddot{x}$ *is the mean of means.*

The confidence limits were obtained by calculation of the variance of the consensus value (mean of means) and reference to Student's-*t* distribution with degrees of freedom (*p*-1).

$$\hat{V}(\ddot{x}) = \frac{1}{p(p-1)} \sum_{i=1}^{p} (\bar{x}_i - \ddot{x})^2$$

$$\text{Confidence limits} = \ddot{x} \pm t_{1-x/2}(p-1)(\hat{V}(\ddot{x}))^{1/2}$$

where $t_{1-x/2}(p-1)$ *is the 1-x/2 fractile of the t-distribution with (p-1) degrees of freedom.*

The distribution of the values are assumed to be symmetrical about the mean in the calculation of the confidence limits.

The test for rejection of individual outliers from each laboratory data set was based on *z* scores (rejected if $|z_i| > 2.5$) computed from the robust estimators of location and scale, *T* and *S*, respectively, according to the formulae

$$S = 1.483 \underset{j=1.....n}{median} / x_j - \underset{i=1.....n}{median} (x_i) /$$

$$z_i = \frac{x_i - T}{S}$$

where

T is the median value in a data set;
S is the median of all absolute deviations from the sample median multiplied by 1.483, a correction factor to make the estimator consistent with the usual parameter of a normal distribution.

Individual outliers and, more rarely, laboratory means deemed to be outlying are shown in bold in the tabulated results (Appendix) and have been omitted in the determination of recommended values.

The magnitude of the confidence interval is inversely proportional to the number of participating laboratories and interlaboratory agreement. It is a measure of the reliability of the recommended value, i.e. the narrower the confidence interval the greater the certainty in the recommended value.

Table 2. Recommended values and 95% confidence intervals for OREAS 40

Constituent	Recommended value	95% Confidence Interval	
		Low	High
Aluminium oxide, Al_2O_3 (wt.%)	0.130	0.118	0.142
Calcium oxide, CaO (wt.%)	0.015	0.012	0.018
Ferric iron, Fe^{3+} (wt.%)	64.96#	IND	IND
Ferrous iron, Fe^{2+} (wt.%)	1.76	1.14	2.39
Iron, Fe_{total} (wt. %)	66.72	66.45	66.99
LOI, (wt.%)	-0.248*	-0.268	-0.228
Magnesium oxide, MgO (wt.%)	0.017	0.012	0.023
Manganese oxide, MnO (wt.%)	0.020	0.020	0.021
Phosphorous, P (wt.%)	0.004	0.003	0.006
Potassium oxide, K_2O (wt.%)	0.018	0.015	0.021
Silicon dioxide, SiO_2 (wt.%)	4.64	4.60	4.69
Sulphur, S (wt.%)	0.008	0.006	0.010
Titanium dioxide, TiO_2 (wt.%)	0.050	0.047	0.052
Vanadium, V (ppm)	13	9	18

Note: values may appear asymmetric due to rounding;
*negative LOI indicates a gain on ignition through oxidation of ferrous to ferric iron;
#ferric iron calculated by difference.

Statement of Homogeneity

The standard deviation of each laboratory data set includes error due to both the imprecision of the analytical method employed and to possible inhomogeneity of the material analysed. The standard deviation of the pooled individual analyses of all participating laboratories includes error due to the imprecision of each analytical method, to possible inhomogeneity of the material analysed and, in particular, to deficiencies in accuracy of each analytical

method. In determining tolerance intervals the component of error attributable to measurement inaccuracy was eliminated by transformation of the individual results of each data set to a common mean (the uncorrected grand mean) according to the formula:

$$x'_{ij} = x_{ij} - \bar{x}_i + \frac{\sum_{i=1}^{p}\sum_{j=1}^{n_i} x_{ij}}{\sum_{i=1}^{p} n_i}$$

where

x_{ij} *is the* j*th raw result reported by laboratory* i;

x'_{ij} *is the* j*th transformed result reported by laboratory* i;

n_i *is the number of results reported by laboratory* i;

p *is the number of participating laboratories*;

$\bar{x}_i$ *is the raw mean for laboratory* i.

The homogeneity of each constituent was determined from tables of factors for two-sided tolerance limits for normal distributions (ISO 3207) in which

$$\text{Lower limit is } \ddot{x} - k'_2(n, p, 1-\alpha)s''_g$$
$$\text{Upper limit is } \ddot{x} + k'_2(n, p, 1-\alpha)s''_g$$

where

n *is the number of results*;

$1-\alpha$ *is the confidence level*;

p *is the proportion of results expected within the tolerance limits*;

k'_2 *is the factor for two-sided tolerance limits* (m, α *unknown*);

s''_g *is the corrected grand standard deviation.*

The meaning of these tolerance limits may be illustrated for Iron, Fe_{total} by fusion XRF, where 99% of the time at least 95% of subsamples will have concentrations lying between 66.46% and 66.98 wt.% (see Table 3). 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 (IS0 Guide 35).

The corrected grand standard deviation, s_g'', used to compute the tolerance intervals is the weighted means of standard deviations of all data sets for a particular constituent according to the formula:

$$s''_g = \frac{\sum_{i=1}^{p}\left(s_i\left(1 - \frac{s_i}{s'_g}\right)\right)}{\sum_{i=1}^{p}\left(1 - \frac{s_i}{s'_g}\right)}$$

where

$$1 - \left(\frac{s_i}{2s'_g} \right) \text{ is the weighting factor for laboratory } i \text{ ;}$$

s'_g *is the grand standard deviation computed from the transformed (i.e. means - adjusted) results*

according to the formula:

$$s'_g = \left[\frac{\sum_{i=j}^{p} \sum_{j=i}^{n_i} (x'_{ij} - \bar{x}'_i)^2}{\sum_{i=1}^{p} n_i - 1} \right]^{1/2}$$

where $\bar{x}'_i$ *is the transformed mean for laboratory i*

Table 3. Recommended values and tolerance limits for OREAS 40

Constituent	Recommended value	Tolerance limits 1- α =0.99, ρ =0.95	
		Low	High
Aluminium oxide, Al_2O_3 (wt.%)	0.130	0.122	0.139
Calcium oxide, CaO (wt.%)	0.015	0.015	0.015
Ferric iron, Fe^{3+} (wt.%)	64.96#	IND	IND
Ferrous iron, Fe^{2+} (wt.%)	1.76	1.55	1.98
Iron, Fe_{total} (wt. %)	66.72	66.46	66.98
LOI, (wt.%)	-0.248*	-0.279	-0.217
Magnesium oxide, MgO (wt.%)	0.017	0.016	0.018
Manganese oxide, MnO (wt.%)	0.020	0.020	0.020
Phosphorous, P (wt.%)	0.004	0.004	0.005
Potassium oxide, K_2O (wt.%)	0.018	0.017	0.019
Silicon dioxide, SiO_2 (wt.%)	4.64	4.59	4.69
Sulphur, S (wt.%)	0.008	0.008	0.008
Titanium dioxide, TiO_2 (wt.%)	0.050	0.049	0.050
Vanadium, V (ppm)	13	13	14

*negative LOI indicates a gain on ignition through oxidation of ferrous to ferric iron;
#ferric iron calculated by difference. Note: values may appear asymmetric due to rounding.

The weighting factors were applied to compensate for the considerable variation in analytical precision amongst participating laboratories. Hence, weighting factors for each data set have been constructed so as to be inversely proportional to the standard deviation of that data set. A weighting factor of zero was applied to those data sets where $s_l / 2s_g' > 1$ (i.e. where the weighting factor $1 - s_l / 2s_g' < 0$). It should be noted that estimates of tolerance by this method are considered conservative as a significant proportion of the observed variance, even in those laboratories exhibiting the best analytical precision, can presumably be attributed to measurement error. Outliers were removed prior to the calculation of tolerance intervals and a weighting factor of zero was applied to those data sets where $s_l / 2s_g' > 1$ (i.e. where the weighting factor $1 - s_l / 2s_g' < 0$).

Performance Gates

Performance gates provide an indication of a level of performance that might reasonably be expected for a particular analyte from a laboratory being monitored by this standard in a QA/QC program. They incorporate errors attributable to measurement (analytical bias and precision) and standard variability. For an effective standard the contribution of the latter should be negligible in comparison to measurement errors. Two methods have been employed to calculate performance gates.

The first method uses the standard deviation of the pooled individual analyses generated from the certification program. All individual and lab dataset (batch) outliers are removed prior to determination of the standard deviation. These outliers can only be removed if they can be confidently deemed to be analytical rather than arising from inhomogeneity of the CRM. Performance gates have been calculated for one, two and three standard deviations of the accepted pool of certification data and are presented in Table 4. As a guide these intervals may be regarded as informational (1σ), warning or rejection for multiple outliers (2σ), or rejection for individual outliers (3σ) in QC monitoring although their precise application should be at the discretion of the QC manager concerned.

For the second method a ±5% error bar on the recommended value is used as the window of acceptability (refer Table 4).

Both methods should be used with caution 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.

Table 4. Proposed performance gates for OREAS 40

Constituent	Certified Value	1SD	2SD		3SD		5%	5%
			Low	High	Low	High	Low	High
Aluminium oxide, Al_2O_3 (wt.%)	0.130	0.018	0.094	0.167	0.076	0.185	0.124	0.137
Calcium oxide, CaO (wt.%)	0.015	0.005	0.005	0.024	0.001	0.029	0.014	0.016
Ferric iron, Fe^{3+} (wt.%)	64.96#	IND	IND	IND	IND	IND	IND	IND
Ferrous iron, Fe^{2+} (wt.%)	1.76	0.61	0.54	2.98	0.00	3.59	1.67	1.85
Iron, Fe_{total} (wt. %)	66.72	0.39	65.94	67.50	65.55	67.89	63.39	70.06
LOI, (wt.%)	-0.248*	0.051	-0.349	-0.146	-0.400	-0.095	-0.235	-0.260
Magnesium oxide, MgO (wt.%)	0.017	0.010	0.000	0.037	0.000	0.047	0.016	0.018
Manganese oxide, MnO (wt.%)	0.020	0.001	0.018	0.022	0.017	0.023	0.019	0.021
Phosphorous, P (wt.%)	0.004	0.002	0.000	0.009	0.000	0.012	0.004	0.005
Potassium oxide, K_2O (wt.%)	0.018	0.004	0.010	0.026	0.006	0.030	0.017	0.019
Silicon dioxide, SiO_2 (wt.%)	4.64	0.07	4.50	4.79	4.43	4.86	4.41	4.88
Sulphur, S (wt.%)	0.008	0.002	0.005	0.011	0.003	0.013	0.008	0.008
Titanium dioxide, TiO_2 (wt.%)	0.050	0.004	0.041	0.058	0.037	0.062	0.047	0.052
Vanadium, V (ppm)	13	4	5	22	0	27	13	14

IND - indeterminate; Note - values may appear asymmetric due to rounding; *negative LOI indicates a gain on ignition through oxidation of ferrous to ferric iron; #ferric iron calculated by difference. Note: values may appear asymmetric due to rounding.

PARTICIPATING LABORATORIES

Activation Laboratories, Ancaster, ON, Canada
ALS Chemex, Malaga, WA, Australia
Amdel Laboratories, Cardiff, NSW, Australia
CSIRO ,Urrbrae, SA Australia
Genalysis Laboratory Services, Maddington, WA, Australia
Intertek Testing Services, Jakarta, Indonesia
SGS, Lakefield, Ontario, Canada
SGS, Welshpool, WA, Australia
Spectra Chem , Lower Hutt, New Zealand
Ultra Trace Laboratories, Canning Vale, WA, Australia

PREPARER AND SUPPLIER OF THE REFERENCE MATERIAL

The siltstone reference material OREAS 40 has been prepared and certified and is supplied by:

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It is available in unit sizes of 10g in laminated foil packets or 1kg units in plastic jars.

INTENDED USE

OREAS 40 is a reference material intended for the following:

i) for the calibration of instruments used in the determination of the concentration of Al_2O_3, CaO, Fe_{total}, Fe^{2+}, Fe^{3+}, LOI, MgO, MnO, P, K_2O, S, SiO_2, TiO_2 and V;
ii) for the verification of analytical methods for Al_2O_3, CaO, Fe_{total}, Fe^{2+}, Fe^{3+}, LOI, MgO, MnO, P, K_2O, S, SiO_2, TiO_2 and V;
iii) for the preparation of secondary reference materials of similar composition.

STABILITY AND STORAGE INSTRUCTIONS

The certification of OREAS 40 remains valid, within the specified measurement uncertainties, until August 2029, 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.

INSTRUCTIONS FOR THE CORRECT USE OF THE REFERENCE MATERIAL

The recommended values for OREAS 40 refer to the concentration levels after removal of hygroscopic moisture by drying in air to constant mass at 105° C. If the reference material is not dried prior to analysis, the recommended value should be corrected to the moisture-bearing basis.

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.

CERTIFYING OFFICER

Dr Paul Hamlyn

CERTIFICATION DATE

February 16, 2007

DOCUMENT HISTORY

Revision No.	Date	Changes applied
1	30th August, 2024	Revised date of expiry under 'STABILITY AND STORAGE INSTRUCTIONS' section.
0	16th February, 2007	First publication.

REFERENCES

ISO Guide 35 (1985), Certification of reference materials - General and statistical principals.
ISO Guide 3207 (1975), Statistical interpretation of data - Determination of a statistical tolerance interval.

APPENDIX

Analytical Results for OREAS 40

Table A1. Key to abbreviations used in Tables A2 – A14.

Abbreviation	Explanation
Std.Dev.	one sigma standard deviation
Rel.Std.Dev.	one sigma relative standard deviation
PDM[3]	percent deviation of lab mean from corrected mean of means
4A	four acid (HF-HNO_3-$HClO_4$-HCl) digestion
OES	inductively coupled plasma optical emission spectrometry
XRF	x-ray fluorescence spectrometry
Leco	leco infrared furnace
PPP	pressed powder pellet
BF	lithium borate fusion
LOI	Loss on Ignition

Table A2. Analytical results for Al_2O_3 by lithium borate fusion XRF in OREAS 40 (values in wt.%).

Replicate No.	Lab A	Lab B	Lab C	Lab D	Lab E	Lab F	Lab G	Lab H	Lab I	Lab J
1	0.430	0.120	0.140	0.138	0.140	0.220	0.110	0.110	0.140	0.150
2	0.420	0.120	0.140	0.141	NR	0.220	0.100	0.120	0.139	0.140
3	0.450	0.120	0.130	0.140	0.140	0.220	0.110	0.110	0.080	0.160
4	0.410	0.120	0.140	0.142	0.140	0.220	0.110	0.120	0.172	0.140
5	0.420	0.120	0.160	0.144	0.150	0.220	0.110	0.110	0.102	0.140
6	0.410	0.120	**0.240**	0.155	0.140	0.220	0.120	0.120	0.123	0.140
Mean	**0.423**	0.120	0.158	0.143	0.142	**0.220**	0.110	0.115	0.126	0.145
Median	0.420	0.120	0.140	0.141	0.140	0.220	0.110	0.115	0.131	0.140
Std.Dev.	0.015	0.000	0.041	0.006	0.004	0.000	0.006	0.005	0.032	0.008
Rel.Std.Dev.	3.56%	0.00%	26.02%	4.24%	3.15%	0.00%	5.75%	4.76%	25.37%	5.77%
PDM3	225%	-7.95%	21.4%	9.56%	8.92%	68.8%	-15.6%	-11.8%	-3.26%	11.2%

Table A3. Analytical results for CaO by lithium borate fusion XRF in OREAS 40 (values in wt.%).

Replicate No.	Lab A	Lab B	Lab C	Lab D	Lab E	Lab F	Lab G	Lab H	Lab I	Lab J
1	0.020	0.350	0.020	0.011	0.020	0.010	0.020	0.020	0.015	0.010
2	0.020	0.360	0.020	0.012	NR	0.010	0.020	0.010	0.010	0.010
3	0.020	0.360	0.010	0.011	0.020	0.010	0.020	0.020	0.015	0.010
4	0.020	0.370	0.010	0.011	0.020	0.010	0.020	0.020	0.010	0.010
5	0.020	0.370	0.020	0.010	0.020	0.010	0.020	0.010	0.015	0.010
6	0.010	0.370	0.020	0.011	0.020	0.010	0.020	0.010	0.015	0.010
Mean	0.018	**0.363**	0.017	0.011	0.020	0.010	0.020	0.015	0.013	0.010
Median	0.020	0.365	0.020	0.011	0.020	0.010	0.020	0.015	0.015	0.010
Std.Dev.	0.004	0.008	0.005	0.001	0.000	0.000	0.000	0.005	0.003	0.000
Rel.Std.Dev.	22.3%	2.25%	31.0%	6.96%	0.00%	0.00%	0.00%	36.5%	19.4%	0.00%
PDM3	22.7%	2333%	11.6%	-26.0%	33.9%	-33.0%	33.9%	0.43%	-10.4%	-33.0%

Table A4. Analytical results for Fe^{2+} by titration in OREAS 40 (values in wt.%).

Replicate No.	Lab A	Lab B	Lab C	Lab D	Lab E	Lab F	Lab G	Lab H	Lab I	Lab J
1	2.67	2.00	1.01	1.13	2.41	1.50	1.88	2.18	NR	1.26
2	2.75	2.09	0.93	0.79	2.41	1.66	1.84	2.18	NR	1.27
3	2.68	2.04	1.09	1.03	2.25	1.66	1.74	2.18	NR	1.29
4	2.83	2.19	0.78	0.46	2.33	1.63	1.79	2.10	NR	1.31
5	2.75	2.07	1.09	0.62	2.18	1.52	1.91	2.18	NR	1.38
6	2.80	1.97	1.01	1.12	2.33	1.53	1.90	2.10	NR	1.32
Mean	2.75	2.06	0.98	0.86	2.32	1.59	1.84	2.15	-	1.30
Median	2.75	2.06	1.01	0.91	2.33	1.58	1.86	2.18	-	1.30
Std.Dev.	0.06	0.08	0.12	0.28	0.09	0.08	0.07	0.04	-	0.04
Rel.Std.Dev.	2.25%	3.78%	11.9%	32.6%	3.92%	4.75%	3.64%	1.87%	-	3.26%
PDM3	56.0%	17.0%	-44.1%	-51.2%	31.6%	-10.0%	4.65%	22.1%	-	-26.0%

Table A5. Analytical results for Fe_{total} by lithium borate fusion XRF in OREAS 40 (values in wt.%).

Replicate No.	Lab A	Lab B	Lab C	Lab D	Lab E	Lab F	Lab G	Lab H	Lab I	Lab J
1	63.3	66.3	67.0	66.7	67.5	66.9	66.6	66.8	66.2	66.5
2	63.2	66.4	67.4	66.9	NR	67.0	67.6	66.5	66.1	66.5
3	63.6	66.3	67.1	66.8	66.9	66.4	67.1	66.7	66.3	66.7
4	63.4	66.4	67.1	66.8	67.2	66.9	66.7	66.8	66.1	66.7
5	63.4	66.2	67.1	66.7	67.2	66.8	66.2	66.6	66.2	66.5
6	63.5	66.4	67.3	66.7	67.3	66.1	67.1	66.6	66.1	66.5
Mean	**63.41**	66.33	67.18	66.77	67.23	66.69	66.88	66.66	66.17	66.59
Median	63.44	66.34	67.15	66.75	67.21	66.87	66.90	66.62	66.17	66.53
Std.Dev.	0.16	0.06	0.12	0.05	0.21	0.37	0.49	0.12	0.07	0.10
Rel.Std.Dev.	0.25%	0.09%	0.18%	0.07%	0.31%	0.55%	0.73%	0.18%	0.11%	0.15%
PDM3	-4.97%	-0.59%	0.69%	0.07%	0.76%	-0.04%	0.24%	-0.10%	-0.82%	-0.20%

Table A6. Analytical results for LOI by thermogravimetry at 1000^0C in OREAS 40 (values in wt.%).

Replicate No.	Lab A	Lab B	Lab C	Lab D	Lab E	Lab F	Lab G	Lab H	Lab I	Lab J
1	-0.223	-0.110	-0.200	-0.245	-0.290	<0.1	-0.160	-0.238	-0.277	-0.290
2	-0.230	-0.110	-0.400	-0.228	-0.220	<0.1	-0.310	-0.240	-0.280	-0.270
3	-0.242	-0.110	-0.200	-0.238	-0.300	<0.1	-0.260	-0.237	-0.264	-0.260
4	-0.270	-0.240	-0.400	-0.244	-0.260	<0.1	-0.120	-0.237	-0.292	-0.270
5	-0.175	-0.130	-0.200	-0.239	-0.240	<0.1	-0.150	-0.239	-0.296	**-0.320**
6	-0.268	-0.110	-0.200	-0.229	-0.230	<0.1	-0.220	-0.238	-0.230	-0.275
Mean	-0.235	-0.135	-0.267	-0.237	-0.257	<0.1	-0.203	-0.238	-0.273	-0.281
Median	-0.236	-0.110	-0.200	-0.238	-0.250	<0.1	-0.190	-0.238	-0.279	-0.273
Std.Dev.	0.035	0.052	0.103	0.007	0.033	-	0.073	0.001	0.024	0.022
Rel.Std.Dev.	-14.9%	-38.6%	-38.7%	-3.03%	-12.7%	-	-35.8%	-0.49%	-8.85%	-7.67%
PDM3	-5.31%	-45.5%	7.60%	-4.35%	3.56%	-	-18.0%	-3.90%	10.2%	13.3%

Table A7. Analytical results for MgO by lithium borate fusion XRF in OREAS 40 (values in wt.%).

Replicate No.	Lab A	Lab B	Lab C	Lab D	Lab E	Lab F	Lab G	Lab H	Lab I	Lab J
1	< 0.01	<0.01	0.020	0.019	<0.01	<0.01	< 0.05	0.020	0.045	0.020
2	< 0.01	<0.01	0.010	0.019	NR	<0.01	< 0.05	0.020	0.040	0.020
3	< 0.01	0.010	0.020	0.014	<0.01	<0.01	< 0.05	0.020	0.020	0.020
4	< 0.01	<0.01	<0.01	0.016	<0.01	<0.01	< 0.05	0.010	0.045	0.020
5	< 0.01	<0.01	<0.01	**0.004**	<0.01	<0.01	< 0.05	0.020	0.025	0.030
6	< 0.01	0.010	<0.01	0.026	<0.01	<0.01	< 0.05	0.020	0.035	0.020
Mean	< 0.01	0.010	0.017	0.016	< 0.01	< 0.01	< 0.05	0.018	**0.035**	0.022
Median	< 0.01	0.010	0.020	0.018	< 0.01	< 0.01	< 0.05	0.020	0.038	0.020
Std.Dev.	-	0.000	0.006	0.007	-	-	-	0.004	0.011	0.004
Rel.Std.Dev.	-	0.00%	34.6%	44.6%	-	-	-	22.3%	30.0%	18.8%
PDM3	-	-41.5%	-2.50%	-4.45%	-	-	-	7.25%	105%	26.8%

Table A8. Analytical results for MnO by lithium borate fusion XRF in OREAS 40 (values in wt.%).

Replicate No.	Lab A	Lab B	Lab C	Lab D	Lab E	Lab F	Lab G	Lab H	Lab I	Lab J
1	0.019	**0.027**	0.018	NR	0.020	0.020	< 0.01	0.010	0.010	0.010
2	0.023	0.020	0.022	NR	NR	0.020	< 0.01	0.010	0.010	0.010
3	0.021	0.021	0.018	NR	0.020	0.020	< 0.01	0.010	0.010	0.010
4	0.021	**0.028**	0.020	NR	0.020	0.020	< 0.01	0.010	0.010	0.010
5	**0.026**	0.020	0.020	NR	0.020	0.020	< 0.01	0.010	0.010	0.010
6	0.021	0.019	0.020	NR	0.020	0.020	< 0.01	0.010	0.010	0.010
Mean	0.022	0.023	0.020	-	0.020	0.020	< 0.01	**0.010**	**0.010**	**0.010**
Median	0.021	0.021	0.020	-	0.020	0.020	< 0.01	0.010	0.010	0.010
Std.Dev.	0.002	0.004	0.002	-	0.000	0.000	-	0.000	0.000	0.000
Rel.Std.Dev.	11.0%	17.5%	7.66%	-	0.00%	0.00%	-	0.00%	0.11%	0.00%
PDM3	8.44%	11.8%	-2.32%	-	-0.66%	-0.66%	-	-50.3%	-50.2%	-50.3%

Table A9. Analytical results for P by lithium borate fusion XRF in OREAS 40 (values in wt.%).

Replicate No.	Lab A	Lab B	Lab C	Lab D	Lab E	Lab F	Lab G	Lab H	Lab I	Lab J
1	0.004	0.003	0.005	0.003	0.005	0.010	<0.02	NR	0.004	0.006
2	0.009	0.004	0.006	0.003	NR	0.010	<0.02	NR	0.004	0.006
3	0.009	0.003	0.005	0.002	0.005	0.010	<0.02	NR	0.004	0.005
4	0.004	0.004	0.006	0.003	0.004	0.010	<0.02	NR	0.004	0.005
5	0.004	0.003	0.004	0.002	0.004	0.010	<0.02	NR	0.002	0.006
6	0.004	0.004	**0.009**	0.003	0.005	0.010	<0.02	NR	0.002	0.006
Mean	0.006	0.004	0.006	0.003	0.005	**0.010**	<0.02	-	0.004	0.006
Median	0.004	0.004	0.006	0.003	0.005	0.010	<0.02	-	0.004	0.006
Std.Dev.	0.002	0.001	0.002	0.000	0.000	0.000	-	-	0.001	0.001
Rel.Std.Dev.	38.7%	15.6%	29.5%	8.29%	5.17%	0.00%	-	-	31.0%	9.11%
PDM3	31.3%	-21.0%	31.6%	-42.1%	4.36%	126%	-	-	-17.7%	27.8%

Table A10. Analytical results for K_2O by lithium borate fusion XRF in OREAS 40 (values in wt.%).

Replicate No.	Lab A	Lab B	Lab C	Lab D	Lab E	Lab F	Lab G	Lab H	Lab I	Lab J
1	0.030	0.016	0.013	0.018	0.020	0.020	0.020	0.020	<0.01	0.018
2	0.040	0.017	0.012	0.017	NR	0.020	0.020	0.020	**0.005**	0.018
3	0.030	0.016	0.011	0.018	0.020	0.020	0.010	0.020	0.015	0.018
4	0.030	0.016	0.013	0.017	0.020	0.020	0.010	0.020	0.020	0.018
5	0.020	0.013	0.013	0.018	0.020	0.020	0.020	0.020	0.030	0.018
6	0.020	0.013	0.013	0.018	0.020	0.020	0.010	0.020	0.030	0.018
Mean	**0.028**	0.015	**0.013**	0.018	0.020	0.020	0.015	0.020	0.020	0.018
Median	0.030	0.016	0.013	0.018	0.020	0.020	0.015	0.020	0.020	0.018
Std.Dev.	0.008	0.002	0.001	0.000	0.000	0.000	0.005	0.000	0.011	0.000
Rel.Std.Dev.	26.6%	11.4%	6.69%	1.77%	0.00%	0.00%	36.5%	0.00%	53.0%	0.00%
PDM3	57.2%	-15.9%	-30.6%	-1.61%	11.0%	11.0%	-16.8%	11.0%	11.3%	-0.13%

Table A11. Analytical results for SiO_2 by lithium borate fusion XRF in OREAS 40 (values in wt.%).

Replicate No.	Lab A	Lab B	Lab C	Lab D	Lab E	Lab F	Lab G	Lab H	Lab I	Lab J
1	4.58	4.57	4.70	4.70	4.62	4.69	4.67	4.65	4.61	4.69
2	4.56	4.56	4.80	4.71	NR	4.75	4.74	4.63	4.64	4.66
3	**4.65**	4.54	4.70	4.69	4.59	4.55	4.7	4.66	4.66	4.70
4	4.52	4.54	4.80	4.68	4.56	4.63	4.69	4.64	4.65	4.68
5	4.54	4.55	4.80	4.71	4.65	4.59	4.65	4.65	4.62	4.66
6	4.57	4.58	**4.90**	4.71	4.59	4.50	4.74	4.64	4.59	4.665
Mean	4.57	4.56	4.78	4.70	4.60	4.62	4.70	4.65	4.63	4.68
Median	4.57	4.56	4.80	4.70	4.59	4.61	4.70	4.65	4.63	4.67
Std.Dev.	0.04	0.02	0.08	0.01	0.03	0.09	0.04	0.01	0.03	0.02
Rel.Std.Dev.	0.98%	0.36%	1.57%	0.27%	0.74%	1.99%	0.78%	0.23%	0.57%	0.36%
PDM3	-1.59%	-1.88%	3.00%	1.21%	-0.90%	-0.55%	1.17%	0.02%	-0.34%	0.69%

Table A12. Analytical results for S in OREAS 40 (abbreviations as in Table A1; values in wt.%).

Replicate No.	Lab A	Lab B	Lab C	Lab D	Lab E	Lab F	Lab G	Lab H	Lab I	Lab J
	Leco	BF*XRF	BF*XRF	BF*XRF	Leco	BF*XRF			PPP*XRF	BF*XRF
1	<0.01	0.007	<0.001	0.006	0.007	0.010	NR	NR	0.015	0.009
2	<0.01	0.006	<0.001	0.006	I/S	0.010	NR	NR	0.016	0.010
3	<0.01	0.007	<0.001	0.007	0.006	0.010	NR	NR	0.020	0.009
4	<0.01	0.009	<0.001	0.006	0.006	0.010	NR	NR	0.015	0.009
5	<0.01	0.008	<0.001	0.006	0.007	0.010	NR	NR	0.015	0.009
6	<0.01	0.009	<0.001	0.007	0.007	0.010	NR	NR	0.015	0.009
Mean	<0.01	0.008	<0.001	0.006	0.007	0.010	-	-	**0.016**	0.009
Median	<0.01	0.008	<0.001	0.006	0.007	0.010	-	-	0.015	0.009
Std.Dev.	-	0.001	-	0.001	0.001	0.000	-	-	0.002	0.000
Rel.Std.Dev.	-	15.8%	-	8.00%	8.30%	0.00%	-	-	12.5%	4.45%
PDM3	-	-3.77%	-	-19.7%	-17.2%	25.5%	-	-	101%	15.1%

Table A13. Analytical results for TiO_2 by lithium borate fusion XRF in OREAS 40 (values in wt.%).

Replicate No.	Lab A	Lab B	Lab C	Lab D	Lab E	Lab F	Lab G	Lab H	Lab I	Lab J
1	0.050	0.050	0.050	0.048	0.060	0.040	0.040	0.050	0.040	0.050
2	0.050	0.060	0.050	0.052	NR	0.040	0.040	0.050	0.050	0.050
3	0.050	0.060	0.050	0.047	0.050	0.030	0.040	0.050	0.050	0.050
4	0.050	0.050	0.050	0.048	0.050	0.040	0.040	0.050	0.045	0.050
5	0.050	0.060	0.040	0.046	0.050	0.040	0.040	0.050	0.040	0.050
6	0.050	0.040	0.050	0.046	0.050	0.040	0.040	0.050	0.045	0.050
Mean	0.050	0.053	0.048	0.047	0.052	**0.038**	**0.040**	0.050	0.045	0.050
Median	0.050	0.055	0.050	0.047	0.050	0.040	0.040	0.050	0.045	0.050
Std.Dev.	0.000	0.008	0.004	0.002	0.004	0.004	0.000	0.000	0.004	0.000
Rel.Std.Dev.	0.00%	15.3%	8.45%	4.71%	8.60%	10.6%	0.00%	0.00%	9.88%	0.00%
PDM3	0.97%	7.71%	-2.39%	-4.41%	5.01%	-22.6%	-19.2%	0.97%	-8.84%	0.97%

Table A14. Analytical results for V in ORE Std 40 (abbreviations as in Table A1; values in wt.%).

Replicate No.	Lab A 4A*OES	Lab B BF*XRF	Lab C BF*XRF	Lab D BF*XRF	Lab E 4A*OES	Lab F 4A*OES	Lab G BF*XRF	Lab H	Lab I PPP*XRF	Lab J BF*XRF
1	12	168	<20	18	15	56	<100	NR	18	6
2	11	174	<20	17	14	56	<100	NR	19	6
3	11	168	<20	13	17	56	<100	NR	17	11
4	11	168	<20	12	16	56	<100	NR	20	11
5	10	179	<20	16	9	56	<100	NR	19	11
6	11	174	<20	20	9	56	<100	NR	18	6
Mean	11	**172**	<20	16	13	**56**	<100	-	18	8
Median	11	171	<20	17	15	56	<100	-	18	8
Std.Dev.	1	5	-	3	4	0	-	-	1	3
Rel.Std.Dev.	5.75%	2.66%	-	19.4%	26.3%	0.00%	-	-	3.83%	36.5%
PDM3	-18.4%	1175%	-	20.0%	-1.07%	316%	-	-	37.1%	-37.7%