CERTIFICATE OF ANALYSIS FOR

Medium Grade Copper Ore (Mt Isa Mine, Queensland, Australia)
CERTIFIED REFERENCE MATERIAL
OREAS 163

Table 1. Certified Values, SDs, 95% Confidence and Tolerance Limits for OREAS 163.

Constituent	Certified Value	95% Confidence Interval		Tolerance Interval 1-α=0.99, ρ=0.95	
		Low	High	Low	High
Peroxide Fusion					
Copper, Cu (wt.%)	1.71	1.65	1.76	1.67	1.74
Iron, Fe (wt.%)	11.1	10.8	11.4	10.8	11.3
Sulphur, S (wt.%)	9.98	9.80	10.15	9.66	10.29
Calcium oxide, CaO (wt.%)	0.92	0.82	1.02	0.88	0.96
Magnesium oxide, MgO (wt.%)	5.34	5.18	5.50	5.23	5.45
Aluminium oxide, Al_2O_3 (wt.%)	3.16	3.11	3.22	3.09	3.23
Silicon dioxide, SiO_2 (wt.%)	63.4	62.1	64.7	62.2	64.7
Silver, Ag (ppm)	5	3	7	IND	IND
Lead, Pb (ppm)	461	411	511	445	476
Zinc, Zn (ppm)	102	95	109	88	116
Cobalt, Co (ppm)	230	224	237	225	236
Acid Digest					
Copper, Cu (wt.%)	1.76	1.71	1.81	1.73	1.79
Iron, Fe (wt.%)	11.07	10.99	11.15	10.84	11.30
Sulphur, S (wt.%)	10.4	9.9	10.9	10.3	10.4
Calcium oxide, CaO (wt.%)	0.860	0.849	0.871	0.846	0.874
Magnesium oxide, MgO (wt.%)	5.42	5.34	5.50	5.33	5.51
Aluminium oxide, Al_2O_3 (wt.%)	3.24	3.17	3.30	3.16	3.32
Silver, Ag (ppm)	4.3	4.0	4.5	4.0	4.5
Lead, Pb (ppm)	492	483	501	472	512
Zinc, Zn (ppm)	108	101	115	102	113
Cobalt, Co (ppm)	230	222	238	223	236

SI unit equivalents: ppm, parts per million ≡ mg/kg ≡ µg/g ≡ 0.0001 wt.% ≡ 1000 ppb, parts per billion.

Note: intervals may appear asymmetric due to rounding

Table 2. Indicative Values for OREAS 163.

Constituent	Unit	Value	Constituent	Unit	Value	Constituent	Unit	Value
Borate Fusion XRF								
Al_2O_3	wt.%	3.23	Fe_2O_3	wt.%	15.53	SnO_2	ppm	< 13
As	ppm	450	K_2O	wt.%	0.074	SO_3	wt.%	25.36
BaO	ppm	11.2	MgO	wt.%	5.21	SrO	ppm	< 12
CaO	wt.%	0.838	MnO	wt.%	0.025	TiO_2	wt.%	0.110
Cl	ppm	185	NiO	ppm	44.5	V_2O_5	ppm	26.8
CoO	ppm	292	P_2O_5	wt.%	0.082	ZnO	ppm	131
Cr_2O_3	ppm	58	PbO	ppm	522	ZrO_2	ppm	54
CuO	ppm	21349	SiO_2	wt.%	63.35			
Thermogravimetry								
LOI[1000]	wt.%	10.57						
Laser Ablation ICP-MS								
Ag	ppm	4.00	Hf	ppb	1190	Sn	ppm	1.30
As	ppm	434	Ho	ppb	205	Sr	ppm	2.50

SI unit equivalents: ppm, parts per million ≡ mg/kg ≡ µg/g ≡ 0.0001 wt.% ≡ 1000 ppb, parts per billion.

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.

Table 2. Indicative Values for OREAS 163 continued.

Constituent	Unit	Value	Constituent	Unit	Value	Constituent	Unit	Value
Laser Ablation ICP-MS								
Ba	ppm	*7.00*	In	ppm	*0.90*	Ta	ppb	*285*
Be	ppm	*0.50*	La	ppm	*15.1*	Tb	ppb	*240*
Bi	ppm	*39.1*	Lu	ppb	*70.0*	Te	ppb	*< 200*
Cd	ppm	*0.30*	Mo	ppm	*11.3*	Th	ppm	*3.46*
Ce	ppm	*26.8*	Nb	ppm	*2.91*	Tl	ppm	*21.5*
Co	ppm	*219*	Nd	ppm	*11.7*	Tm	ppb	*65.0*
Cr	ppm	*43.5*	Ni	ppm	*28.0*	U	ppm	*2.72*
Cs	ppm	*0.69*	Pb	wt.%	*0.048*	V	ppm	*18.8*
Cu	ppm	*17350*	Pr	ppm	*3.32*	W	ppm	*1.68*
Dy	ppm	*1.00*	Rb	ppm	*2.55*	Y	ppm	*5.59*
Er	ppm	*0.45*	Re	ppb	*30.0*	Yb	ppb	*510*
Eu	ppb	*390*	Sb	ppm	*18.9*	Zn	ppm	*108*
Ga	ppm	*4.25*	Sc	ppm	*1.75*	Zr	ppm	*36.8*
Gd	ppm	*2.02*	Se	ppm	*< 5*			
Ge	ppb	*1650*	Sm	ppm	*2.11*			

SI unit equivalents: ppm, parts per million ≡ mg/kg ≡ µg/g ≡ 0.0001 wt.% ≡ 1000 ppb, parts per billion.
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.

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.

SOURCE MATERIAL

OREAS 163 is a medium grade copper ore certified reference material (CRM) prepared and certified by Ore Research & Exploration Pth Ltd. The material was sourced from Xstrata's Mt Isa copper ore deposits located near the township of Mt Isa in north-west Queensland. The ore deposits are hosted by brecciated siliceous rock masses within the Urquhart Shale comprising complex and dissociated veins with chalcopyrite, pyrite and pyrrhotite with grades of 3-4% copper. OREAS 163 is one of a suite of seven CRMs characterised for Cu, Fe, S, CaO, MgO, Al_2O_3, SiO_2, Ag, Pb, Zn and Co by both sodium peroxide fusion ICP and 4-acid ICP methods.

COMMINUTION AND HOMOGENISATION PROCEDURES

The material was prepared in the following manner:

- Drying at 65°C to constant mass;
- Crushing and screening;
- Multi-stage milling to 100% minus 50 microns;
- Preliminary blending;
- Check assaying;
- Adjustment of grades as necessary;
- Final homogenisation;
- Packaging into 10g units sealed under nitrogen in laminated foil pouches.

ANALYITICAL PROGRAM

Ten commercial laboratories participated in the analytical program to characterise Cu, Fe, S, CaO, MgO, Al_2O_3, SiO_2, Ag, Pb, Zn and Co by both sodium peroxide fusion ICP and 4-acid ICP methods. To maintain anonymity laboratories were randomly designated the letter codes A through J. In some instances laboratories determined one or more analytes using an alternative method to sodium peroxide fusion. These instances include: Lab J where a pyrosulfate fusion for Fe was used, Lab D and Lab H used infra red combustion furnace to determine sulphur and Lab H used lithium borate fusion to determine all analytes except Cu and Zn. Other exceptions include instances where laboratories used an alternative method to 4-acid digest. These include Lab G where a modified aqua regia digest was used to determine all analytes and Lab J where an acid digest (non specified) with AAS finish was used for Ag only. All 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 Tables A2 and A22 (Appendix). The parameter PDM[3] is a measure of laboratory accuracy while the relative standard deviation is an effective measure of analytical precision where homogeneity of the test material has been confirmed.

The approximate major and trace element composition of OREAS 163 is provided in Table 2.The analytical methods employed by each laboratory are explained, together with other abbreviations used, in Table A1 (Appendix). Each participating laboratory received 5 samples of 50g each.

Each set of subsamples submitted to each laboratory was taken at regular intervals during packaging of the standard in order to maximise their representation. Laboratories were instructed to assay samples as received.

STATISTICAL EVALUATION

Certified Value and Confidence Intervals
The certified value is the mean of means of accepted replicate values of accepted participating laboratories computed according to the formulae

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

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;*

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

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

The confidence intervals are obtained by calculation of the variance ($\hat{V}$) of the consensus value ($\ddot{x}$) (mean of means) and reference to Student's-*t* distribution with degrees of freedom (*p*-1).

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

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

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 is assumed to be symmetrical about the mean in the calculation of the confidence interval. The test for rejection of individual outliers from each laboratory data set is 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.

The z-score test is used in combination with a second method of individual outlier detection that determines the percent deviation of the individual value from the median. Outliers in general are selected on the basis of z-scores > 2.5 and with percent deviations > 1.5%. In certain instances statistician's prerogative has been employed in discriminating outliers.

Each laboratory data set is tested for outlying status based on z-score discrimination and rejected if $|z_i| > 2.5$. After individual and lab data set outliers have been eliminated a non-iterative 3 standard deviation filter is applied, with those values lying outside this window also relegated to outlying status.

Individual outliers and, more rarely, laboratory means deemed to be outlying are shown left justified and in bold in the tabulated results (see Appendix) and have been omitted in the determination of certified 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 certified value, i.e. the narrower the confidence interval the greater the certainty in the certified value. A 95% confidence interval indicates a 95% probability that the interval includes the true value of the analyte under consideration.

Indicative (uncertified) values

The indicative (uncertified) values (Table 2) are provided for the major and trace elements determined by oxidising fusion XRF (Al_2O_3 to ZrO_2), LOI at 1000°C and laser ablation with ICP-MS (Ag to Zr) and are the means of duplicate assays from Bureau Veritas, Perth. Additional indicative values by other analytical methods are present where the number of laboratories reporting a particular analyte is insufficient (< 5) to support certification or where inter-laboratory consensus is poor.

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 that 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

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

where,

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

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

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

p is the number of participating laboratories;

$\overline{x}_i$ *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

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

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 Cu by 4-acid digest, where 99% of the time at least 95% of subsamples will have concentrations lying between 0.156 and 0.168 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 (ISO 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,

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

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

according to the formula

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

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

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. 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.

Performance Gates
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 and CRM variability. For an effective CRM the contribution of the latter should be negligible in comparison to measurement errors. Sources of measurement error include inter-lab bias, analytical precision (repeatability) and inter-batch bias (reproducibility).

Two methods have been employed to calculate performance gates. The first method uses the same filtered data set used to determine the certified value, i.e. after removal of all individual, lab dataset (batch) and 3SD outliers. 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 individual analyses generated from the certification program. Table 3 shows performance gates 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.

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.

Table 3. Performance Gates for OREAS 163.

Constituent	Certified Value	1SD	2SD window		3SD window		Relative Standard Deviations			5% window	
			Low	High	Low	High	1RSD	2RSD	3RSD	Low	High
Peroxide Fusion											
Copper, Cu (wt.%)	1.71	0.08	1.55	1.86	1.48	1.94	4.51%	9.01%	13.5%	1.62	1.79
Iron, Fe (wt.%)	11.1	0.4	10.3	11.9	9.88	12.28	3.61%	7.22%	10.8%	10.5	11.6
Sulphur, S (wt.%)	9.98	0.25	9.48	10.47	9.24	10.71	2.46%	4.93%	7.39%	9.48	10.47
Calcium oxide, CaO (wt.%)	0.92	0.12	0.68	1.16	0.55	1.29	13.2%	26.5%	39.7%	0.87	0.97
Magnesium oxide, MgO (wt.%)	5.34	0.21	4.92	5.76	4.70	5.98	3.97%	7.95%	11.9%	5.07	5.61
Aluminium oxide, Al_2O_3 (wt.%)	3.16	0.08	3.01	3.32	2.93	3.40	2.47%	4.94%	7.41%	3.00	3.32
Silicon dioxide, SiO_2 (wt.%)	63.4	1.8	59.9	66.9	58.1	68.7	2.77%	5.55%	8.32%	60.3	66.6
Silver, Ag (ppm)	5	1	3	7	2	8	17.5%	35.0%	52.4%	5	5
Lead, Pb (ppm)	461	65	330	591	265	656	14.2%	28.3%	42.5%	438	484
Zinc, Zn (ppm)	102	12	79	125	67	137	11.4%	22.8%	34.3%	97	107
Cobalt, Co (ppm)	230	10	210	251	200	261	4.45%	8.91%	13.4%	219	242
Acid Digest											
Copper, Cu (wt.%)	1.76	0.07	1.62	1.90	1.56	1.97	3.91%	7.81%	11.7%	1.67	1.85
Iron, Fe (wt.%)	11.07	0.15	10.76	11.38	10.60	11.53	1.40%	2.80%	4.20%	10.51	11.62
Sulphur, S (wt.%)	10.4	0.5	9.4	11.4	8.8	11.9	4.95%	9.89%	14.8%	9.9	10.9
Calcium oxide, CaO (wt.%)	0.860	0.015	0.830	0.890	0.815	0.905	1.74%	3.49%	5.23%	0.817	0.903
Magnesium oxide, MgO (wt.%)	5.42	0.12	5.18	5.66	5.06	5.78	2.24%	4.48%	6.72%	5.15	5.69
Aluminium oxide, Al_2O_3 (wt.%)	3.24	0.10	3.04	3.43	2.94	3.53	3.02%	6.04%	9.05%	3.07	3.40
Silver, Ag (ppm)	4.3	0.6	3.0	5.5	2.4	6.1	14.5%	28.9%	43.4%	4.0	4.5
Lead, Pb (ppm)	492	14	464	520	450	534	2.84%	5.67%	8.51%	467	516
Zinc, Zn (ppm)	108	9	89	126	80	135	8.62%	17.2%	25.9%	102	113
Cobalt, Co (ppm)	230	11	208	252	197	263	4.81%	9.61%	14.4%	218	241

SI unit equivalents: ppm, parts per million ≡ mg/kg ≡ µg/g ≡ 0.0001 wt.% ≡ 1000 ppb, parts per billion.
Note: intervals may appear asymmetric due to rounding

PARTICIPATING LABORATORIES

1. Acme Analytical Laboratories Ltd, Vancouver, BC, Canada
2. Activation Laboratories, Ancaster, ONtario, Canada
3. Activation Laboratories, Perth, WA, Australia
4. ALS Chemex, Brisbane, QLD, Australia
5. ALS Chemex, Vancouver, BC, Canada
6. Amdel Laboratories, Perth, WA, Australia
7. Bureau Veritas (Ultra Trace) Geoanalytical, Perth, WA, Australia
8. Genalysis Laboratory Services Pty Ltd, Perth, WA, Australia
9. SGS Mineral Services Australia, Perth, WA, Australia
10. SGS Mineral Services, Lakefield, ON, Canada

PREPARER AND SUPPLIER OF THE REFERENCE MATERIAL

Reference material OREAS 163 has been prepared and certified and is supplied by:

ORE Research & Exploration Pty Ltd   Tel: +613-9729 0333
37A Hosie Street   Fax: +613-9729 8338
Bayswater North VIC 3153   Web: www.ore.com.au
AUSTRALIA   Email: info@ore.com.au

OREAS 163 is available in 10g units sealed in nitrogen-purged laminated foil pouches.

INTENDED USE

OREAS 163 is a reference material intended for the following:

i) For the monitoring of laboratory performance in the analysis of Cu, Fe, S, cao, mgo, Al_2O_3, sio_2, Ag, Pb, Zn and Co in geological samples;
ii) For the calibration of instruments used in the determination of the concentration of Cu, Fe, S, cao, mgo, Al_2O_3, sio_2, Ag, Pb, Zn and Co;
iii) For the verification of analytical methods for Cu, Fe, S, CaO, MgO, Al_2O_3, SiO_2, Ag, Pb, Zn and Co.

STABILITY AND STORAGE INSTRUCTIONS

OREAS 163 is a reference material made from medium grade copper ore material from the Mt Isa Copper Operations. In its unopened state in the nitrogen-purged laminated foil pouches and under normal conditions of storage it has a shelf life beyond five years.

HANDLING INSTRUCTIONS

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

INSTRUCTIONS FOR THE CORRECT USE

The certified values for OREAS 163 refer to the concentration level of Cu, Fe, S, CaO, MgO, Al_2O_3, SiO_2, Ag, Pb, Zn and Co in its packaged state. The CRM should not be dried prior to weighing and analysis.

METROLOGICAL TRACEABILITY

The analytical samples were selected in a manner to represent the entire batch of prepared CRM. This 'representivity' 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 that underlie the consensus values. Each analytical data set has been validated by its assayer through the inclusion of internal reference materials and QC checks during analysis.

The laboratories were chosen on the basis of their competence (from past performance in inter-laboratory programs undertaken by ORE Pty Ltd) for a particular analytical method, analyte or analyte suite, and sample matrix. Most of these laboratories have and maintain ISO 17025 accreditation. The certified values presented in this report are calculated from the means of accepted data following robust statistical treatment as detailed in this report.

Guide ISO/TR 16476:2016, section 5.3.1 describes metrological traceability in reference materials as it pertains to the transformation of the measurand. In this section it states, *"Although the determination of the property value itself can be made traceable to appropriate units through, for example, calibration of the measurement equipment used, steps like the transformation of the sample from one physical (chemical) state to another cannot. Such transformations may only be compared with a reference (when available), or among themselves. For some transformations, reference methods have been defined and may be used in certification projects to evaluate the uncertainty associated with such a transformation. In other cases,* **only a comparison among different laboratories using the same method is possible. In this case, certification takes place on the basis of agreement among independent measurement results** *(see ISO Guide 35:2006, Clause 10)."*

COMMUTABILITY

The measurements of the results that underlie the certified values contained in this report were undertaken by methods involving pre-treatment (digestion/fusion) of the sample. This served to reduce the sample to a simple and well understood form permitting calibration using simple solutions of the CRM. Due to these methods being well understood and highly effective, commutability is not an issue for this CRM. All OREAS CRMs are sourced from natural ore minerals meaning they will display similar behaviour as routine 'field' samples in the relevant measurement process. Care should be taken to ensure 'matrix matching' as close as practically achievable. The matrix and mineralisation style of the CRM is described in the 'Source Material' section and users should select appropriate CRMs matching these attributes to their field samples.

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
1	19th Sep, 2018	Added major and trace element characterisation.
0	7th Aug, 2012	First publication.

QMS ACCREDITED

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

CERTIFYING OFFICER

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

REFERENCES

ISO Guide 3207 (1975), Statistical interpretation of data - Determination of a statistical tolerance interval.

ISO Guide 30 (2015), Terms and definitions used in connection with reference materials.

ISO Guide 31 (2015), Reference materials – Contents of certificates and labels.

ISO Guide 35 (2017), Certification of reference materials - General and statistical principals.

APPENDIX

Analytical Data for OREAS 163

Table A1. Explanation of abbreviations used in Tables A2 – A11.

Abbreviation	Explanation
Std.Dev.	one standard deviation
Rel.Std.Dev.	one relative standard deviation (%)
PDM[3]	percent deviation of lab mean from corrected mean of means
NR	not reported
AD	acid digest (unspecified)
4A	four acid digest ($HF-HNO_3-HClO_4-HCl$)
MAR	modified aqua regia digest
PF	sodium peroxide fusion
PSF	pyrosulfate fusion
XRF	X-ray fluorescence
AAS	atomic absorption spectrometry
OES	inductively coupled plasma optical emission spectrometry
MS	inductively coupled plasma mass spectrometry
ICP	unspecified/combination of ICP-OES and ICP-MS

Table A2. Fusion results for Cu in OREAS 163 (abbreviations as in Table A1; values in wt.%).

Replicate No.	Lab A PF*ICP	Lab B PF*OES	Lab C PF*OES	Lab D PF*OES	Lab E PF*OES	Lab F PF*OES	Lab G PF*OES	Lab H PF*OES	Lab I PF*ICP	Lab J PF*OES
1	1.81	1.77	1.74	1.63	1.75	1.67	1.59	1.68	1.83	1.70
2	**1.86**	1.78	1.71	1.60	1.79	1.71	1.59	1.66	1.85	1.60
3	**1.76**	1.76	1.73	1.67	1.68	1.61	1.57	1.68	1.80	1.70
4	1.80	1.81	1.73	1.67	1.69	1.65	**1.55**	**1.62**	1.78	1.70
5	1.79	1.84	1.72	1.61	1.72	1.69	1.59	1.67	1.81	1.60
Mean	1.80	1.79	1.73	1.64	1.73	1.67	1.58	1.66	1.81	1.66
Median	1.80	1.78	1.73	1.63	1.72	1.67	1.59	1.67	1.81	1.70
Std.Dev.	0.04	0.03	0.01	0.03	0.05	0.04	0.02	0.02	0.03	0.05
Rel.Std.Dev.	2.02%	1.68%	0.66%	2.01%	2.61%	2.42%	1.26%	1.50%	1.55%	3.30%
PDM[3]	5.64%	4.90%	1.08%	-4.19%	1.08%	-2.50%	-7.51%	-2.67%	6.11%	-2.79%

Table A3. Fusion results for Fe in OREAS 163 (abbreviations as in Table A1; values in wt.%).

Replicate No.	Lab A PF*ICP	Lab B PF*OES	Lab C PF*OES	Lab D PF*OES	Lab E PF*OES	Lab F PF*OES	Lab G PF*OES	Lab H BF*OES	Lab I PF*ICP	Lab J PSF*XRF
1	10.6	11.5	11.2	**11.1**	10.8	10.9	11.3	11.0	11.1	10.9
2	10.5	11.7	11.3	11.7	11.3	10.9	11.3	10.9	10.9	10.7
3	10.5	11.7	11.5	11.5	11.2	10.6	11.4	11.0	11.2	10.7
4	10.5	11.9	11.1	11.5	10.8	10.7	**11.1**	11.0	11.1	10.8
5	10.3	12.0	11.3	11.4	10.6	10.7	11.3	11.2	10.9	10.6
Mean	10.5	11.8	11.3	11.4	10.9	10.7	11.3	11.0	11.0	10.7
Median	10.5	11.7	11.3	11.5	10.8	10.7	11.3	11.0	11.1	10.7
Std.Dev.	0.11	0.22	0.15	0.22	0.30	0.11	0.13	0.09	0.14	0.11
Rel.Std.Dev.	1.05%	1.87%	1.31%	1.92%	2.71%	1.01%	1.16%	0.80%	1.26%	1.06%
PDM[3]	-5.44%	6.05%	1.78%	3.22%	-1.29%	-3.10%	1.68%	-0.66%	-0.39%	-3.10%

Table A4. Fusion results for S in OREAS 163 (abbreviations as in Table A1; values in wt.%).

Replicate No.	Lab A PF*ICP	Lab B PF*OES	Lab C PF*OES	Lab D IRC	Lab E PF*OES	Lab F PF*OES	Lab G PF*OES	Lab H IRC	Lab I PF*ICP	Lab J PF*OES
1	9.9	10.7	10.2	10.2	11.1	9.8	9.7	9.8	11.0	9.9
2	10.0	10.1	10.1	10.0	11.5	10.1	**10.4**	9.8	10.7	10.2
3	9.9	10.1	9.7	9.8	11.4	9.5	10.0	9.7	10.7	9.9
4	9.9	10.7	10.0	10.0	11.0	9.8	9.7	10.0	10.7	10.2
5	9.8	**11.1**	10.3	10.2	10.9	9.9	9.7	9.8	11.0	10.0
Mean	9.9	10.5	10.1	10.0	**11.2**	9.8	9.9	9.8	**10.8**	10.0
Median	9.9	10.7	10.1	10.0	11.1	9.8	9.7	9.8	10.7	10.0
Std.Dev.	0.1	0.4	0.2	0.2	0.3	0.2	0.3	0.1	0.1	0.2
Rel.Std.Dev.	0.62%	3.81%	2.13%	1.54%	2.52%	1.94%	3.11%	1.29%	1.29%	1.67%
PDM[3]	-0.81%	5.54%	0.93%	0.71%	11.9%	-1.58%	-1.03%	-1.64%	8.65%	0.47%

Table A5. Fusion results for CaO in OREAS 163 (abbreviations as in Table A1; values in wt.%).

Replicate No.	Lab A PF*ICP	Lab B PF*OES	Lab C PF*OES	Lab D PF*OES	Lab E PF*OES	Lab F PF*OES	Lab G PF*OES	Lab H BF*OES	Lab I PF*ICP	Lab J PF*OES
1	0.82	0.90	1.00	1.00	0.92	0.82	0.63	0.90	1.15	NR
2	0.81	0.90	0.80	1.10	0.90	0.88	0.62	0.87	1.10	NR
3	0.82	0.90	0.80	1.10	**0.95**	0.73	0.61	0.87	1.12	NR
4	0.81	0.90	0.80	1.10	0.89	0.77	0.61	0.87	1.13	NR
5	0.80	1.00	0.80	1.10	0.89	0.82	0.60	0.89	1.11	NR
Mean	0.81	0.92	0.84	1.08	0.91	0.80	**0.61**	0.88	1.12	
Median	0.81	0.90	0.80	1.10	0.90	0.82	0.61	0.87	1.12	
Std.Dev.	0.01	0.04	0.09	0.04	0.03	0.06	0.01	0.01	0.02	
Rel.Std.Dev.	1.03%	4.86%	10.6%	4.14%	2.80%	7.07%	1.92%	1.61%	1.71%	
PDM[3]	-11.7%	0.03%	-8.67%	17.4%	-1.06%	-12.6%	-33.1%	-4.32%	22.0%	

Table A6. Fusion results for MgO in OREAS 163 (abbreviations as in Table A1; values in wt.%).

Replicate No.	Lab A PF*ICP	Lab B PF*OES	Lab C PF*OES	Lab D PF*OES	Lab E PF*OES	Lab F PF*OES	Lab G PF*OES	Lab H BF*OES	Lab I PF*ICP	Lab J PF*OES
1	5.19	5.42	5.50	5.44	5.10	5.08	6.24	5.37	5.20	5.50
2	5.16	5.52	5.36	5.64	5.33	5.04	6.16	5.34	4.96	5.40
3	5.20	5.52	5.50	5.47	5.25	5.02	6.27	5.28	5.28	5.50
4	5.18	5.64	5.41	5.78	5.13	5.03	6.20	5.39	5.18	5.50
5	5.12	5.67	5.54	5.85	5.29	5.05	**5.88**	5.44	5.12	5.40
Mean	5.17	5.55	5.46	5.64	5.22	5.04	**6.15**	5.36	5.15	5.46
Median	5.18	5.52	5.50	5.64	5.25	5.04	6.20	5.37	5.18	5.50
Std.Dev.	0.03	0.10	0.07	0.18	0.10	0.02	0.16	0.06	0.12	0.05
Rel.Std.Dev.	0.61%	1.80%	1.36%	3.23%	1.93%	0.46%	2.57%	1.11%	2.32%	1.00%
PDM[3]	-3.18%	4.02%	2.29%	5.55%	-2.24%	-5.54%	15.2%	0.45%	-3.59%	2.25%

Table A7. Fusion results for Al_2O_3 in OREAS 163 (abbreviations as in Table A1; values in wt.%).

Replicate No.	Lab A PF*ICP	Lab B PF*OES	Lab C PF*OES	Lab D PF*OES	Lab E PF*OES	Lab F PF*OES	Lab G PF*OES	Lab H BF*OES	Lab I PF*ICP	Lab J PF*OES
1	3.27	3.19	3.21	3.70	3.19	3.08	3.01	3.28	3.18	3.20
2	3.29	3.19	3.14	4.00	3.23	3.16	3.03	3.25	3.12	3.10
3	3.21	3.17	3.23	3.80	3.16	3.00	3.00	3.26	3.17	3.20
4	3.23	3.23	3.08	4.00	**3.06**	3.06	**2.75**	3.26	3.14	3.10
5	3.18	**3.27**	3.16	4.00	3.22	3.13	3.07	**3.34**	3.14	3.10
Mean	3.24	3.21	3.16	**3.90**	3.17	3.09	2.97	3.28	3.15	3.14
Median	3.23	3.19	3.16	4.00	3.19	3.08	3.01	3.26	3.14	3.10
Std.Dev.	0.04	0.04	0.06	0.14	0.07	0.06	0.12	0.04	0.02	0.05
Rel.Std.Dev.	1.38%	1.18%	1.88%	3.63%	2.15%	2.02%	4.20%	1.11%	0.78%	1.74%
PDM[3]	2.32%	1.57%	0.05%	23.3%	0.30%	-2.42%	-6.02%	3.65%	-0.40%	-0.71%

Table A8. Fusion results for SiO_2 in OREAS 163 (abbreviations as in Table A1; values in wt.%).

Replicate No.	Lab A PF*ICP	Lab B PF*OES	Lab C PF*OES	Lab D PF*OES	Lab E PF*OES	Lab F PF*OES	Lab G PF*OES	Lab H BF*OES	Lab I PF*ICP	Lab J PF*OES
1	63.9	64.0	61.0	73.1	64.8	63.3	60.4	62.9	63.3	64.0
2	64.0	64.9	58.0	78.1	66.0	65.7	61.8	62.9	63.5	62.0
3	62.4	64.3	61.4	74.2	65.0	61.1	58.0	63.2	63.2	64.0
4	62.5	65.9	59.7	73.1	**63.0**	63.5	56.3	63.3	63.0	66.0
5	63.5	65.8	60.3	76.5	65.2	64.7	59.8	63.1	63.6	63.0
Mean	63.2	65.0	60.1	**75.0**	64.8	63.7	**59.3**	63.1	63.3	63.8
Median	63.5	64.9	60.3	74.2	65.0	63.5	59.8	63.1	63.3	64.0
Std.Dev.	0.8	0.9	1.3	2.2	1.1	1.7	2.2	0.2	0.2	1.5
Rel.Std.Dev.	1.25%	1.32%	2.22%	2.96%	1.70%	2.72%	3.66%	0.31%	0.39%	2.32%
PDM[3]	-0.28%	2.46%	-5.27%	18.3%	2.17%	0.38%	-6.53%	-0.59%	-0.17%	0.60%

Table A9. Fusion results for Ag in OREAS 163 (abbreviations as in Table A1; values in ppm).

Replicate No.	Lab A PF*ICP	Lab B -	Lab C PF*MS	Lab D PF*MS	Lab E -	Lab F -	Lab G PF*OES	Lab H -	Lab I -	Lab J -
1	<10	NR	<5	4.0	NR	NR	5.9	NR	NR	NR
2	<10	NR	5.0	5.0	NR	NR	5.9	NR	NR	NR
3	<10	NR	5.0	5.0	NR	NR	6.7	NR	NR	NR
4	<10	NR	<5	4.0	NR	NR	4.7	NR	NR	NR
5	<10	NR	<5	5.0	NR	NR	6.8	NR	NR	NR
Mean			5.0	4.6			6.0			
Median			5.0	5.0			5.9			
Std.Dev.			0.0	0.5			0.8			
Rel.Std.Dev.			0.00%	11.9%			14.0%			
PDM[3]			-3.85%	-11.5%			15.4%			

Table A10. Fusion results for Pb in OREAS 163 (abbreviations as in Table A1; values in ppm).

Replicate No.	Lab A PF*ICP	Lab B PF*OES	Lab C PF*MS	Lab D PF*OES	Lab E PF*MS	Lab F PF*OES	Lab G PF*OES	Lab H -	Lab I PF*ICP	Lab J PF*OES
1	500	457	510	570	453	400	397	NR	500	410
2	500	453	490	560	451	400	423	NR	500	420
3	500	450	480	570	458	300	363	NR	500	410
4	500	460	480	600	455	400	445	NR	500	410
5	500	458	470	590	456	300	380	NR	500	400
Mean	500	456	486	578	455	360	402		500	410
Median	500	457	480	570	455	400	397		500	410
Std.Dev.	0	4	15	16	3	55	33		0	7
Rel.Std.Dev.	0.00%	0.89%	3.12%	2.84%	0.59%	15.2%	8.18%		0.00%	1.72%
PDM[3]	8.54%	-1.10%	5.50%	25.5%	-1.31%	-21.8%	-12.8%		8.54%	-11.0%

Table A11. Fusion results for Zn in OREAS 163 (abbreviations as in Table A1; values in ppm).

Replicate No.	Lab A PF*ICP	Lab B PF*OES	Lab C PF*OES	Lab D PF*OES	Lab E PF*MS	Lab F PF*OES	Lab G PF*OES	Lab H PF*OES	Lab I PF*ICP	Lab J PF*OES
1	<100	117	100	110	107	100	119	100	100	100
2	200	114	100	110	102	100	81	100	100	100
3	200	119	100	130	100	100	70	100	100	94
4	<100	120	100	110	104	100	<50	100	100	110
5	<100	111	**150**	120	**131**	100	68	100	100	93
Mean	**200**	116	110	116	109	100	85	100	100	99
Median	200	117	100	110	104	100	76	100	100	100
Std.Dev.	0	4	22	9	13	0	24	0	0	7
Rel.Std.Dev.	0.00%	3.19%	20.3%	7.71%	11.7%	0.00%	28.0%	0.00%	0.00%	6.81%
PDM[3]	95.8%	13.8%	7.68%	13.6%	6.51%	-2.10%	-17.3%	-2.10%	-2.10%	-2.69%

Table A12. Fusion results for Co in OREAS 163 (abbreviations as in Table A1; values in ppm).

Replicate No.	Lab A PF*ICP	Lab B PF*MS	Lab C PF*OES	Lab D PF*OES	Lab E PF*MS	Lab F PF*OES	Lab G PF*OES	Lab H PF*OES	Lab I PF*ICP	Lab J PF*OES
1	240	223	220	220	226	230	282	**242**	230	230
2	240	223	260	210	229	230	291	234	240	230
3	240	225	240	240	224	220	284	234	250	220
4	240	222	240	210	228	220	249	232	240	220
5	240	220	240	220	226	230	NR	236	240	220
Mean	240	223	240	220	227	226	**277**	236	240	224
Median	240	223	240	220	226	230	283	234	240	220
Std.Dev.	0	2	14	12	2	5	19	4	7	5
Rel.Std.Dev.	0.00%	0.82%	5.89%	5.57%	0.86%	2.42%	6.78%	1.69%	2.95%	2.45%
PDM[3]	4.19%	-3.37%	4.19%	-4.49%	-1.63%	-1.89%	20.0%	2.30%	4.19%	-2.76%

Table A13. 4-acid results for Cu in OREAS 163 (abbreviations as in Table A1; values in wt.%).

Replicate No.	Lab A 4A*OES	Lab B 4A*OES	Lab C 4A*OES	Lab D 4A*AAS	Lab E 4A*OES	Lab F 4A*OES	Lab G MAR*OES	Lab H 4A*OES	Lab I 4A*OES	Lab J 4A*OES
1	1.72	1.83	1.74	1.63	1.78	1.74	1.77	1.80	1.86	1.80
2	1.72	**1.98**	**1.68**	1.60	1.76	1.73	1.76	1.85	1.87	1.80
3	1.71	1.84	1.73	1.58	1.78	1.72	1.76	1.78	1.85	1.80
4	1.69	1.79	1.75	1.67	1.77	1.74	1.75	1.84	1.85	1.70
5	1.70	1.87	1.73	1.68	1.76	**1.69**	1.75	1.77	1.89	1.80
Mean	1.71	1.86	1.73	1.63	1.77	1.72	1.76	1.81	1.86	1.78
Median	1.71	1.84	1.73	1.63	1.77	1.73	1.76	1.80	1.86	1.80
Std.Dev.	0.01	0.07	0.03	0.04	0.01	0.02	0.01	0.04	0.02	0.04
Rel.Std.Dev.	0.76%	3.90%	1.57%	2.65%	0.51%	1.11%	0.33%	2.01%	0.90%	2.51%
PDM[3]	-3.06%	5.78%	-2.04%	-7.37%	0.29%	-2.32%	-0.19%	2.70%	5.80%	1.03%

Table A14. 4-acid results for Fe in OREAS 163 (abbreviations as in Table A1; values in wt.%).

Replicate No.	Lab A 4A*OES	Lab B 4A*OES	Lab C 4A*OES	Lab D 4A*OES	Lab E 4A*MS	Lab F 4A*OES	Lab G MAR*OES	Lab H 4A*OES	Lab I 4A*OES	Lab J 4A*OES
1	11.1	11.8	11.2	11.1	11.0	11.0	10.4	10.7	11.0	11.0
2	11.2	**12.9**	10.9	11.0	10.8	11.0	10.6	10.9	11.2	11.0
3	11.1	11.9	11.1	11.2	11.5	10.8	10.4	10.7	11.0	11.0
4	11.1	11.6	11.3	11.1	10.9	11.0	10.5	**11.5**	11.0	11.0
5	11.2	12.0	11.3	11.1	11.4	10.8	10.5	10.4	11.2	11.0
Mean	11.1	**12.1**	11.2	11.1	11.1	10.9	**10.5**	**10.8**	11.1	11.0
Median	11.1	11.9	11.2	11.1	11.0	11.0	10.5	10.7	11.0	11.0
Std.Dev.	0.1	0.5	0.2	0.1	0.3	0.1	0.1	0.4	0.1	0.0
Rel.Std.Dev.	0.49%	4.25%	1.50%	0.64%	2.70%	0.94%	0.81%	3.75%	0.99%	0.00%
PDM[3]	0.66%	8.88%	0.84%	0.30%	0.12%	-1.42%	-5.45%	-2.27%	0.12%	-0.61%

Table A15. 4-acid results for S in OREAS 163 (abbreviations as in Table A1; values in wt.%).

Replicate No.	Lab A 4A*OES	Lab B 4A*OES	Lab C 4A*OES	Lab D 4A*OES	Lab E 4A*MS	Lab F 4A*OES	Lab G MAR*OES	Lab H -	Lab I 4A*OES	Lab J -
1	11.3	10.4	10.1	>5	9.8	10.0	10.4	NR	10.7	NR
2	11.3	10.4	9.8	>5	9.6	10.0	10.6	NR	10.7	NR
3	11.3	10.3	10.0	>5	>10.0	9.9	10.7	NR	10.7	NR
4	11.2	**9.7**	10.2	>5	9.7	9.9	10.6	NR	10.7	NR
5	11.3	**9.9**	10.1	>5	>10.0	9.8	10.7	NR	10.7	NR
Mean	11.3	10.1	10.0		9.7	9.9	10.6		10.7	
Median	11.3	10.3	10.1		9.7	9.9	10.6		10.7	
Std.Dev.	0.0	0.3	0.2		0.1	0.1	0.1		0.0	
Rel.Std.Dev.	0.40%	3.06%	1.51%		0.82%	0.84%	0.97%		0.00%	
PDM[3]	8.70%	-2.21%	-3.25%		-6.33%	-4.40%	2.23%		3.11%	

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Table A16. 4-acid results for CaO in OREAS 163 (abbreviations as in Table A1; values in wt.%).

Replicate No.	Lab A 4A*OES	Lab B 4A*OES	Lab C 4A*OES	Lab D 4A*OES	Lab E 4A*MS	Lab F 4A*OES	Lab G MAR*OES	Lab H 4A*OES	Lab I 4A*OES	Lab J 4A*OES
1	0.850	0.854	**0.920**	0.883	0.900	0.870	0.852	0.854	0.923	0.790
2	0.850	0.854	0.870	0.845	0.870	0.850	0.850	0.881	0.923	0.810
3	0.850	0.868	0.880	0.869	0.920	0.840	0.853	0.854	0.923	0.810
4	0.850	0.868	0.900	0.863	0.880	0.850	0.848	0.881	0.895	0.780
5	0.860	0.854	0.880	0.844	0.920	0.830	0.846	0.868	0.923	0.820
Mean	0.852	0.859	0.890	0.861	**0.898**	0.848	0.850	0.868	**0.918**	**0.802**
Median	0.850	0.854	0.880	0.863	0.900	0.850	0.850	0.868	0.923	0.810
Std.Dev.	0.004	0.008	0.020	0.017	0.023	0.015	0.003	0.014	0.013	0.016
Rel.Std.Dev.	0.52%	0.89%	2.25%	1.92%	2.54%	1.75%	0.34%	1.61%	1.36%	2.05%
PDM[3]	-0.93%	-0.10%	3.49%	0.09%	4.42%	-1.39%	-1.16%	0.87%	6.73%	-6.74%

Table A17. 4-acid results for MgO in OREAS 163 (abbreviations as in Table A1; values in wt.%).

Replicate No.	Lab A 4A*OES	Lab B 4A*OES	Lab C 4A*OES	Lab D 4A*OES	Lab E 4A*MS	Lab F 4A*OES	Lab G MAR*OES	Lab H 4A*OES	Lab I 4A*OES	Lab J 4A*OES
1	5.24	5.42	5.49	5.39	5.41	4.87	4.56	5.39	5.57	5.30
2	5.21	5.37	**5.29**	5.25	5.32	4.86	4.57	5.42	5.55	5.50
3	5.24	5.52	5.45	5.44	5.65	4.79	4.59	5.44	5.55	5.40
4	5.22	5.52	5.49	5.39	5.41	4.86	4.56	5.46	5.37	5.20
5	5.29	5.47	5.52	5.30	5.65	4.77	4.57	5.34	5.62	5.50
Mean	5.24	5.46	5.45	5.35	5.49	**4.83**	**4.57**	5.41	5.53	5.38
Median	5.24	5.47	5.49	5.39	5.41	4.86	4.57	5.42	5.55	5.40
Std.Dev.	0.03	0.06	0.09	0.08	0.15	0.05	0.01	0.05	0.09	0.13
Rel.Std.Dev.	0.59%	1.19%	1.68%	1.44%	2.78%	0.96%	0.24%	0.85%	1.71%	2.42%
PDM[3]	-3.31%	0.78%	0.53%	-1.21%	1.27%	-10.9%	-15.7%	-0.20%	2.13%	-0.73%

Table A18. 4-acid results for Al$_2$O$_3$ in OREAS 163 (abbreviations as in Table A1; values in wt.%).

Replicate No.	Lab A 4A*OES	Lab B 4A*OES	Lab C 4A*OES	Lab D 4A*OES	Lab E 4A*MS	Lab F 4A*OES	Lab G MAR*OES	Lab H 4A*OES	Lab I 4A*OES	Lab J 4A*OES
1	3.22	3.21	3.21	3.30	3.21	3.11	2.79	3.25	3.33	3.20
2	3.18	3.17	3.10	3.22	3.16	3.09	2.83	3.46	3.33	3.10
3	3.16	3.27	3.19	3.34	3.36	3.06	2.81	3.31	3.31	3.20
4	3.16	3.25	3.21	3.32	3.21	3.10	2.81	3.38	3.27	3.40
5	3.18	3.21	3.21	3.25	3.36	3.04	2.81	3.38	3.36	3.30
Mean	3.18	3.22	3.18	3.29	3.26	3.08	**2.81**	3.36	3.32	3.24
Median	3.18	3.21	3.21	3.30	3.21	3.09	2.81	3.38	3.33	3.20
Std.Dev.	0.02	0.04	0.05	0.05	0.09	0.03	0.02	0.08	0.03	0.11
Rel.Std.Dev.	0.77%	1.14%	1.50%	1.52%	2.87%	0.95%	0.57%	2.38%	1.03%	3.52%
PDM[3]	-1.74%	-0.40%	-1.62%	1.53%	0.73%	-4.83%	-13.2%	3.69%	2.52%	0.11%

Table A19. 4-acid results for Ag in OREAS 163 (abbreviations as in Table A1; values in ppm).

Replicate No.	Lab A 4A*OES	Lab B 4A*MS	Lab C 4A*MS	Lab D 4A*OES	Lab E 4A*MS	Lab F 4A*OES	Lab G MAR*OES	Lab H 4A*OES	Lab I 4A*OES	Lab J 3A*AAS
1	4.0	4.0	4.0	4.3	4.5	3.0	4.1	4.0	5.4	4.3
2	4.1	4.0	4.5	4.7	4.5	**11.0**	3.8	5.0	5.2	3.9
3	4.0	4.0	4.0	4.5	4.6	4.0	4.2	4.0	5.4	4.0
4	4.1	6.0	4.0	4.6	4.4	3.0	4.0	6.0	5.1	4.1
5	3.8	4.0	4.0	4.2	4.6	5.0	**4.5**	6.0	5.2	3.9
Mean	4.0	4.4	4.1	4.5	4.5	5.2	4.1	5.0	**5.3**	4.0
Median	4.0	4.0	4.0	4.5	4.5	4.0	4.1	5.0	5.2	4.0
Std.Dev.	0.1	0.9	0.2	0.2	0.1	3.3	0.3	1.0	0.1	0.2
Rel.Std.Dev.	3.06%	20.3%	5.45%	4.65%	1.64%	64.4%	6.28%	20.0%	2.55%	4.14%
PDM[3]	-5.97%	3.43%	-3.62%	4.85%	6.02%	22.2%	-3.15%	17.5%	23.7%	-5.03%

Table A20. 4-acid results for Pb in OREAS 163 (abbreviations as in Table A1; values in ppm).

Replicate No.	Lab A 4A*OES	Lab B 4A*MS	Lab C 4A*MS	Lab D 4A*OES	Lab E 4A*MS	Lab F 4A*OES	Lab G MAR*OES	Lab H 4A*OES	Lab I 4A*OES	Lab J 4A*OES
1	500	487	493	503	473	460	490	500	503	480
2	490	479	502	498	464	450	470	500	518	470
3	500	488	483	502	492	440	470	500	509	490
4	510	480	493	514	470	450	490	**400**	504	500
5	490	467	483	**482**	489	440	470	500	512	500
Mean	498	480	491	500	478	**448**	478	480	509	488
Median	500	480	493	502	473	450	470	500	509	490
Std.Dev.	8	8	8	12	12	8	11	45	6	13
Rel.Std.Dev.	1.68%	1.75%	1.63%	2.32%	2.57%	1.87%	2.29%	9.32%	1.21%	2.67%
PDM[3]	1.26%	-2.36%	-0.20%	1.63%	-2.88%	-8.90%	-2.80%	-2.40%	3.54%	-0.77%

Table A21. 4-acid results for Zn in OREAS 163 (abbreviations as in Table A1; values in ppm).

Replicate No.	Lab A 4A*OES	Lab B 4A*OES	Lab C 4A*OES	Lab D 4A*OES	Lab E 4A*MS	Lab F 4A*OES	Lab G MAR*OES	Lab H 4A*OES	Lab I 4A*OES	Lab J 4A*OES
1	111	145	118	107	110	100	90	100	122	100
2	112	155	114	125	108	100	100	100	120	95
3	110	141	118	115	114	100	90	100	**112**	**120**
4	113	137	118	110	108	100	100	100	120	110
5	107	159	116	114	114	100	90	100	122	100
Mean	111	**147**	117	114	111	100	94	100	119	105
Median	111	145	118	114	110	100	90	100	120	100
Std.Dev.	2	9	2	7	3	0	5	0	4	10
Rel.Std.Dev.	2.08%	6.32%	1.53%	5.98%	2.74%	0.00%	5.83%	0.00%	3.48%	9.52%
PDM[3]	2.76%	37.0%	8.52%	6.11%	2.95%	-7.09%	-12.7%	-7.09%	10.8%	-2.44%

Table A22. 4-acid results for Co in OREAS 163 (abbreviations as in Table A1; values in ppm).

Replicate No.	Lab A 4A*OES	Lab B 4A*MS	Lab C 4A*OES	Lab D 4A*OES	Lab E 4A*MS	Lab F 4A*OES	Lab G MAR*OES	Lab H 4A*OES	Lab I 4A*OES	Lab J 4A*OES
1	240	240	248	229	226	220	219	230	216	230
2	240	240	242	224	221	220	219	240	214	220
3	240	241	244	230	238	220	216	240	212	230
4	240	235	248	229	227	220	217	240	210	240
5	240	232	246	224	235	210	217	240	217	240
Mean	240	238	246	227	229	218	218	238	214	232
Median	240	240	246	229	227	220	217	240	214	230
Std.Dev.	0	4	3	3	7	4	1	4	3	8
Rel.Std.Dev.	0.00%	1.65%	1.06%	1.30%	3.03%	2.05%	0.62%	1.88%	1.34%	3.61%
PDM[3]	4.38%	3.34%	6.82%	-1.18%	-0.23%	-5.18%	-5.36%	3.51%	-7.01%	0.90%