ORE RESEARCH & EXPLORATION P/L · ABN 28 006 859 856
37A Hosie St · Bayswater North · VIC · 3153 · AUSTRALIA
61 3 9729 0333 Fax 61 3 9729 8338
info@ore.com.au www.ore.com.au

CERTIFICATE OF ANALYSIS FOR

Low Grade Copper Ore (Mt Isa Mine, Queensland, Australia)

CERTIFIED REFERENCE MATERIAL

OREAS 161

Table 1. Certified Values, SDs, 95% Confidence and Tolerance Limits for OREAS 161.

Constituent	Certified Value	95% Confidence Interval		Tolerance Interval 1-α=0.99, ρ=0.95	
		Low	High	Low	High
Peroxide Fusion					
Copper, Cu (wt.%)	0.400	0.391	0.409	0.387	0.413
Iron, Fe (wt.%)	4.32	4.20	4.44	4.21	4.43
Sulphur, S (wt.%)	2.96	2.94	2.99	2.89	3.04
Calcium oxide, CaO (wt.%)	0.16	0.13	0.18	IND	IND
Magnesium oxide, MgO (wt.%)	3.59	3.47	3.72	3.52	3.66
Aluminium oxide, Al_2O_3 (wt.%)	2.51	2.48	2.54	2.42	2.60
Silicon dioxide, SiO_2 (wt.%)	84.2	82.2	86.3	82.0	86.5
Silver, Ag (ppm)	<5	IND	IND	IND	IND
Lead, Pb (ppm)	109	93	125	100	118
Zinc, Zn (ppm)	19	6	32	IND	IND
Cobalt, Co (ppm)	119	111	127	114	124
Acid Digest					
Copper, Cu (wt.%)	0.409	0.402	0.416	0.402	0.416
Iron, Fe (wt.%)	4.26	4.17	4.35	4.19	4.32
Sulphur, S (wt.%)	3.06	2.92	3.20	3.01	3.10
Calcium oxide, CaO (wt.%)	0.158	0.152	0.164	0.150	0.167
Magnesium oxide, MgO (wt.%)	3.72	3.67	3.77	3.66	3.78
Aluminium oxide, Al_2O_3 (wt.%)	2.49	2.40	2.58	2.45	2.54
Silver, Ag (ppm)	1.10	1.02	1.17	IND	IND
Lead, Pb (ppm)	135	128	143	130	141
Zinc, Zn (ppm)	22	15	29	19	26
Cobalt, Co (ppm)	119	117	120	116	121

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 161.

Constituent	Unit	Value	Constituent	Unit	Value	Constituent	Unit	Value
Oxidising Fusion XRF								
Al_2O_3	wt.%	*2.52*	Fe_2O_3	wt.%	*6.17*	SnO_2	ppm	*< 13*
As	ppm	*345*	K_2O	wt.%	*0.074*	SO_3	wt.%	*7.54*
BaO	ppm	*11.2*	MgO	wt.%	*3.58*	SrO	ppm	*< 12*
CaO	wt.%	*0.152*	MnO	wt.%	*0.015*	TiO_2	wt.%	*0.084*
Cl	ppm	*85*	NiO	ppm	*25.5*	V_2O_5	ppm	*17.9*
CoO	ppm	*153*	P_2O_5	wt.%	*0.065*	ZnO	ppm	*24.9*
Cr_2O_3	ppm	*88*	PbO	ppm	*145*	ZrO_2	ppm	*54*
CuO	ppm	*5026*	SiO_2	wt.%	*84.48*			
Thermogravimetry								
LOI^{1000}	wt.%	*3.51*						
Laser Ablation ICP-MS								
Ag	ppm	*1.15*	Hf	ppb	*1280*	Sn	ppm	*0.40*
As	ppm	*291*	Ho	ppb	*170*	Sr	ppm	*1.30*

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 161 continued.

Constituent	Unit	Value	Constituent	Unit	Value	Constituent	Unit	Value
Laser Ablation ICP-MS								
Ba	ppm	*9.25*	In	ppm	*0.13*	Ta	ppb	*295*
Be	ppm	*0.30*	La	ppm	*16.4*	Tb	ppb	*170*
Bi	ppm	*16.6*	Lu	ppb	*60.0*	Te	ppb	*200*
Cd	ppm	*0.30*	Mo	ppm	*9.00*	Th	ppm	*2.81*
Ce	ppm	*28.5*	Nb	ppm	*2.18*	Tl	ppm	*12.9*
Co	ppm	*113*	Nd	ppm	*12.8*	Tm	ppb	*75.0*
Cr	ppm	*73*	Ni	ppm	*15.0*	U	ppm	*1.81*
Cs	ppm	*0.27*	Pb	wt.%	*0.013*	V	ppm	*10.8*
Cu	ppm	*4170*	Pr	ppm	*3.49*	W	ppm	*1.83*
Dy	ppm	*0.87*	Rb	ppm	*2.15*	Y	ppm	*4.45*
Er	ppm	*0.47*	Re	ppb	*< 10*	Yb	ppb	*410*
Eu	ppb	*385*	Sb	ppm	*7.20*	Zn	ppm	*17.5*
Ga	ppm	*4.25*	Sc	ppm	*0.50*	Zr	ppm	*39.0*
Gd	ppm	*1.68*	Se	ppm	*< 5*			
Ge	ppb	*2050*	Sm	ppm	*2.56*			

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 161 is a low 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 161 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 D and Lab H where infra red combustion furnace was used 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 to 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 161 is provided in Table 2. The non-certified values contained in this table are the means of duplicate assays from one laboratory. 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;*

$\bar{x}_i$ *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).

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

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

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

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

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

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

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

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 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:

$$s_g'' = \frac{\sum_{i=1}^{p}(s_i(1 - \frac{s_i}{s_g'}))}{\sum_{i=1}^{p}(1 - \frac{s_i}{s_g'})}$$

where,

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

$$s_g' \text{ is the grand standard deviation computed from the transformed (i.e. means-adjusted) results}$$

according to the formula

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

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

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 161.

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.%)	0.400	0.013	0.374	0.427	0.361	0.440	3.30%	6.59%	9.89%	0.380	0.420
Iron, Fe (wt.%)	4.32	0.17	3.97	4.67	3.80	4.84	4.03%	8.06%	12.1%	4.11	4.54
Sulphur, S (wt.%)	2.96	0.05	2.86	3.07	2.81	3.12	1.71%	3.41%	5.12%	2.82	3.11
Calcium oxide, CaO (wt.%)	0.20	0.07	0.06	0.35	-0.01	0.42	34.9%	69.8%	104.7%	0.19	0.22
Magnesium oxide, MgO (wt.%)	3.59	0.17	3.26	3.93	3.09	4.09	4.64%	9.28%	13.9%	3.41	3.77
Aluminium oxide, Al_2O_3 (wt.%)	2.51	0.05	2.40	2.62	2.35	2.67	2.17%	4.33%	6.50%	2.38	2.63
Silicon dioxide, SiO_2 (wt.%)	84.2	2.6	79.0	89.5	76.4	92.1	3.11%	6.23%	9.34%	80.0	88.5
Silver, Ag (ppm)	<5	IND	IND	IND	IND	IND	IND	IND	IND	IND	IND
Lead, Pb (ppm)	109	21	67	152	45	173	19.5%	39.0%	58.6%	104	115
Zinc, Zn (ppm)	19	4	11	27	7	31	21.5%	43.0%	64.5%	18	20
Cobalt, Co (ppm)	119	11	98	141	87	152	9.08%	18.2%	27.2%	113	125
Acid Digest											
Copper, Cu (wt.%)	0.409	0.012	0.385	0.432	0.374	0.444	2.88%	5.76%	8.64%	0.388	0.429
Iron, Fe (wt.%)	4.26	0.12	4.01	4.50	3.89	4.63	2.90%	5.79%	8.69%	4.05	4.47
Sulphur, S (wt.%)	3.06	0.17	2.72	3.39	2.56	3.56	5.48%	11.0%	16.4%	2.91	3.21
Calcium oxide, CaO (wt.%)	0.158	0.009	0.140	0.176	0.132	0.185	5.58%	11.2%	16.7%	0.150	0.166
Magnesium oxide, MgO (wt.%)	3.72	0.07	3.57	3.86	3.50	3.93	1.94%	3.87%	5.81%	3.53	3.90
Aluminium oxide, Al_2O_3 (wt.%)	2.49	0.12	2.25	2.74	2.12	2.86	4.92%	9.83%	14.7%	2.37	2.62
Silver, Ag (ppm)	1.10	0.11	0.88	1.31	0.77	1	9.97%	19.9%	29.9%	1.04	1.15
Lead, Pb (ppm)	135	10	115	156	105	166	7.58%	15.2%	22.7%	129	142
Zinc, Zn (ppm)	22	6	9	35	3	41	28.8%	57.5%	86.3%	21	23
Cobalt, Co (ppm)	119	3	112	125	109	128	2.56%	5.12%	7.68%	113	124

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 161 has been prepared and certified and is supplied by:

ORE RESEARCH & EXPLORATION

ORE Research & Exploration Pty Ltd
37A Hosie Street
Bayswater North VIC 3153
AUSTRALIA

Tel: +613-9729 0333
Fax: +613-9729 8338
Web: www.ore.com.au
Email: info@ore.com.au

OREAS 161 is available in 10g units sealed in nitrogen-purged laminated foil pouches.

INTENDED USE

OREAS 161 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 161 is a reference material made from low 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 161 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	3rd 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 161

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
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 161 (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*MS	Lab F PF*OES	Lab G PF*OES	Lab H PF*OES	Lab I PF*ICP	Lab J PF*OES
1	0.442	0.412	0.405	**0.002**	0.399	0.385	0.407	0.380	0.432	0.390
2	0.442	0.431	0.400	0.422	0.395	**0.403**	0.411	0.390	0.419	0.410
3	0.445	0.423	0.400	0.391	**0.380**	0.382	0.386	0.400	0.441	0.390
4	0.447	0.426	0.395	0.402	0.401	0.385	0.385	0.390	0.429	0.410
5	0.439	0.417	0.390	0.415	0.400	0.394	0.399	0.390	0.431	0.410
Mean	**0.443**	0.422	0.398	0.326	0.395	0.390	0.398	0.390	**0.430**	0.402
Median	0.442	0.423	0.400	0.402	0.399	0.385	0.399	0.390	0.431	0.410
Std.Dev.	0.003	0.008	0.006	0.182	0.009	0.009	0.012	0.007	0.008	0.011
Rel.Std.Dev.	0.70%	1.84%	1.43%	55.7%	2.20%	2.22%	3.03%	1.81%	1.83%	2.72%
PDM[3]	10.7%	5.40%	-0.55%	-18.4%	-1.30%	-2.60%	-0.67%	-2.55%	7.54%	0.45%

Table A3. Fusion results for Fe in OREAS 161 (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	4.13	4.52	4.45	4.15	**4.09**	4.31	4.44	4.20	4.44	4.40
2	4.15	4.62	4.36	4.14	4.31	4.13	4.53	4.21	**4.31**	4.30
3	4.21	4.59	4.42	4.18	4.23	4.07	4.79	4.15	4.47	4.30
4	4.16	4.65	4.47	4.12	4.25	4.05	4.43	4.15	4.37	4.40
5	**4.29**	4.47	4.36	**4.33**	4.24	4.27	4.56	4.08	4.44	4.40
Mean	4.19	4.57	4.41	4.18	4.22	4.17	4.55	4.16	4.41	4.36
Median	4.16	4.59	4.42	4.15	4.24	4.13	4.53	4.15	4.44	4.40
Std.Dev.	0.06	0.07	0.05	0.08	0.08	0.12	0.14	0.05	0.07	0.05
Rel.Std.Dev.	1.53%	1.62%	1.15%	2.02%	1.92%	2.83%	3.16%	1.24%	1.48%	1.26%
PDM[3]	-3.09%	5.75%	2.10%	-3.18%	-2.25%	-3.60%	5.30%	-3.78%	1.96%	0.89%

Table A4. Fusion results for S in OREAS 161 (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	**2.89**	3.04	3.00	**3.18**	3.36	2.88	3.07	2.96	2.57	2.94
2	2.96	2.98	3.04	2.89	3.40	2.95	3.03	2.92	2.53	3.00
3	2.97	2.94	2.95	3.02	3.29	2.94	3.00	2.88	2.63	2.98
4	2.96	2.94	2.91	2.98	3.19	2.92	3.03	2.90	2.55	3.03
5	2.98	3.06	2.93	2.91	3.23	2.92	2.95	**2.75**	2.58	2.98
Mean	2.95	2.99	2.97	3.00	**3.29**	2.92	3.02	2.88	**2.57**	2.99
Median	2.96	2.98	2.95	2.98	3.29	2.92	3.03	2.90	2.57	2.98
Std.Dev.	0.04	0.06	0.05	0.12	0.09	0.03	0.04	0.08	0.04	0.03
Rel.Std.Dev.	1.21%	1.87%	1.79%	3.85%	2.65%	0.92%	1.41%	2.76%	1.47%	1.10%
PDM[3]	-0.41%	0.93%	0.06%	1.07%	11.1%	-1.43%	1.74%	-2.78%	-13.2%	0.73%

Table A5. Fusion results for CaO in OREAS 161 (abbreviations as in Table A1; values in wt.%).

Replicate No.	Lab A PF*ICP	Lab B -	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 -	Lab J -
1	0.15	NR	0.30	0.30	0.16	0.15	0.07	0.15	NR	NR
2	0.15	NR	0.30	0.30	0.16	0.21	0.08	0.15	NR	NR
3	0.16	NR	0.30	0.30	0.12	0.18	0.08	0.15	NR	NR
4	0.17	NR	0.30	0.30	0.13	**0.26**	0.08	0.15	NR	NR
5	0.19	NR	0.30	0.30	0.13	0.16	0.08	0.15	NR	NR
Mean	0.16		**0.30**	**0.30**	0.14	0.19	**0.08**	0.15		
Median	0.16		0.30	0.30	0.13	0.18	0.08	0.15		
Std.Dev.	0.02		0.00	0.00	0.02	0.04	0.00	0.00		
Rel.Std.Dev.	10.2%		0.00%	0.00%	13.4%	23.1%	3.84%	0.00%		
PDM[3]	4.29%		90.8%	90.8%	-11.0%	22.1%	-50.9%	-4.61%		

Table A6. Fusion results for MgO in OREAS 161 (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	3.50	3.75	3.70	3.69	3.60	3.33	4.55	3.52	3.42	3.80
2	3.52	3.93	3.70	3.55	3.60	3.40	4.45	3.54	3.40	4.00
3	3.51	3.81	3.65	3.68	3.56	3.36	4.44	3.53	3.38	3.80
4	3.49	3.88	3.61	3.50	3.55	3.41	4.47	3.55	3.37	3.70
5	**3.68**	3.80	3.65	3.81	3.55	3.35	4.57	**3.42**	3.48	3.70
Mean	3.54	3.83	3.66	3.65	3.57	3.37	**4.50**	3.51	3.41	3.80
Median	3.51	3.81	3.65	3.68	3.56	3.36	4.47	3.53	3.40	3.80
Std.Dev.	0.08	0.07	0.04	0.12	0.03	0.03	0.06	0.05	0.04	0.12
Rel.Std.Dev.	2.23%	1.87%	1.05%	3.37%	0.72%	1.01%	1.31%	1.50%	1.28%	3.22%
PDM[3]	-1.46%	6.71%	1.93%	1.49%	-0.57%	-6.20%	25.1%	-2.24%	-5.08%	5.77%

Table A7. Fusion results for Al_2O_3 in OREAS 161 (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	2.51	2.49	2.53	2.90	2.52	2.43	2.25	2.47	2.57	2.60
2	2.49	**2.70**	2.61	2.80	2.48	2.49	2.20	2.48	2.51	2.50
3	2.51	2.51	2.53	2.90	2.46	2.41	2.10	2.48	2.49	2.50
4	2.51	2.63	2.44	2.70	2.45	2.46	2.12	2.51	2.53	2.60
5	2.58	2.55	2.48	3.00	2.46	2.44	2.19	2.43	2.56	2.60
Mean	2.52	2.58	2.52	**2.86**	2.47	2.45	**2.17**	2.47	2.53	2.56
Median	2.51	2.55	2.53	2.90	2.46	2.44	2.19	2.48	2.53	2.60
Std.Dev.	0.03	0.09	0.06	0.11	0.03	0.03	0.06	0.03	0.03	0.05
Rel.Std.Dev.	1.37%	3.34%	2.53%	3.99%	1.13%	1.25%	2.92%	1.16%	1.32%	2.14%
PDM[3]	0.45%	2.73%	0.37%	14.0%	-1.39%	-2.50%	-13.4%	-1.39%	0.93%	2.04%

Table A8. Fusion results for SiO_2 in OREAS 161 (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	68.2	85.7	83.0	92.0	86.7	84.0	81.7	83.2	84.4	86.0
2	57.4	**88.7**	82.6	94.3	86.3	85.3	82.2	83.3	85.8	89.0
3	75.1	86.6	81.9	91.5	85.5	83.6	77.7	83.2	**87.4**	85.0
4	46.9	86.0	83.4	**60.6**	85.3	85.9	77.8	83.2	85.2	87.0
5	89.8	85.5	82.4	94.4	85.3	84.7	77.3	83.0	85.1	89.0
Mean	**67.5**	86.5	82.7	**86.6**	85.8	84.7	79.3	83.2	85.6	87.2
Median	68.2	86.0	82.6	92.0	85.5	84.7	77.8	83.2	85.2	87.0
Std.Dev.	16.5	1.3	0.6	14.6	0.6	0.9	2.4	0.1	1.1	1.8
Rel.Std.Dev.	24.4%	1.50%	0.69%	16.8%	0.75%	1.10%	3.00%	0.11%	1.34%	2.05%
PDM[3]	-19.9%	2.68%	-1.88%	2.75%	1.87%	0.54%	-5.84%	-1.27%	1.59%	3.51%

Table A9. Fusion results for Ag in OREAS 161 (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	1.0	NR	NR	<2	NR	NR	NR
2	<10	NR	<5	1.0	NR	NR	<2	NR	NR	NR
3	<10	NR	<5	1.0	NR	NR	3.5	NR	NR	NR
4	<10	NR	<5	1.0	NR	NR	<2	NR	NR	NR
5	<10	NR	<5	1.0	NR	NR	<2	NR	NR	NR
Mean				1.0			3.5			
Median				1.0			3.5			
Std.Dev.				0.0						
Rel.Std.Dev.				0.00%						
PDM[3]				-55.6%			55.6%			

Table A10. Fusion results for Pb in OREAS 161 (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	100	123	130	140	114	<100	77	NR	100	96
2	100	121	120	160	120	100	86	NR	**200**	100
3	100	126	120	150	115	<100	57	NR	100	99
4	100	116	130	140	119	<100	89	NR	100	100
5	100	125	120	140	116	100	63	NR	<100	100
Mean	100	122	124	146	117	100	74		125	99
Median	100	123	120	140	116	100	77		100	100
Std.Dev.	0	4	5	9	3	0	14		50	2
Rel.Std.Dev.	0.00%	3.24%	4.42%	6.13%	2.22%	0.00%	18.9%		40.0%	1.75%
PDM[3]	-8.39%	12.0%	13.6%	33.8%	7.00%	-8.39%	-31.8%		14.5%	-9.30%

Table A11. Fusion results for Zn in OREAS 161 (abbreviations as in Table A1; values in ppm).

Replicate No.	Lab A PF*ICP	Lab B -	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 -	Lab J PF*OES
1	<100	NR	<50	20	<20	<100	NR	<100	NR	<30
2	<100	NR	<50	20	<20	<100	NR	<100	NR	<30
3	<100	NR	<50	20	<20	<100	<50	<100	NR	<30
4	<100	NR	<50	20	20	<100	<50	<100	NR	<30
5	<100	NR	<50	10	<20	<100	NR	<100	NR	<30
Mean				18	20					
Median				20	20					
Std.Dev.				4						
Rel.Std.Dev.				24.8%						
PDM[3]				-5.26%	5.26%					

Table A12. Fusion results for Co in OREAS 161 (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	120	112	120	130	114	100	NR	121	140	120
2	120	110	120	140	113	100	NR	104	130	110
3	120	113	120	130	115	90	134	111	130	110
4	120	111	120	130	115	100	137	106	130	120
5	120	113	120	130	115	110	NR	115	<100	120
Mean	120	112	120	132	114	100	136	111	133	116
Median	120	112	120	130	115	100	136	111	130	120
Std.Dev.	0	1	0	4	1	7	2	7	5	5
Rel.Std.Dev.	0.00%	1.17%	0.00%	3.39%	0.66%	7.07%	1.57%	6.09%	3.77%	4.72%
PDM[3]	0.57%	-6.30%	0.57%	10.6%	-4.29%	-16.2%	13.6%	-6.84%	11.0%	-2.78%

Table A13. 4-acid results for Cu in OREAS 161 (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*OES	Lab F 4A*OES	Lab G MAR*OES	Lab H 4A*OES	Lab I 4A*OES	Lab J 4A*OES
1	0.398	**0.439**	0.392	0.384	0.410	**0.452**	0.427	0.411	0.411	0.400
2	0.403	0.419	0.383	0.380	0.411	0.413	0.426	**0.401**	0.414	0.390
3	0.407	0.427	0.401	0.391	**0.420**	0.409	0.424	0.415	0.415	0.400
4	0.400	0.422	0.409	0.395	0.409	0.405	0.422	0.413	0.414	0.410
5	0.405	0.418	0.408	0.407	0.415	0.405	0.428	0.413	0.414	0.420
Mean	0.403	0.425	0.399	0.391	0.413	0.417	0.425	0.411	0.414	0.404
Median	0.403	0.422	0.401	0.391	0.411	0.409	0.426	0.413	0.414	0.400
Std.Dev.	0.004	0.009	0.011	0.011	0.005	0.020	0.002	0.006	0.002	0.011
Rel.Std.Dev.	0.91%	2.05%	2.77%	2.68%	1.10%	4.79%	0.57%	1.35%	0.37%	2.82%
PDM[3]	-1.55%	3.95%	-2.53%	-4.29%	0.99%	1.92%	4.03%	0.41%	1.14%	-1.21%

Table A14. 4-acid results for Fe in OREAS 161 (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	4.31	**4.89**	4.40	4.01	4.26	4.33	4.07	4.21	4.31	4.30
2	4.28	4.70	4.30	4.07	4.28	4.25	4.05	4.16	4.31	4.40
3	4.32	4.78	4.44	4.25	4.27	4.26	4.03	4.22	4.30	4.40
4	4.26	4.73	4.48	4.30	**4.16**	4.25	4.01	4.30	4.30	4.40
5	4.31	4.69	4.46	4.15	4.19	4.25	3.98	4.23	4.30	4.40
Mean	4.30	**4.76**	4.42	4.16	4.23	4.27	4.03	4.22	4.30	4.38
Median	4.31	4.73	4.44	4.15	4.26	4.25	4.03	4.22	4.30	4.40
Std.Dev.	0.03	0.08	0.07	0.12	0.05	0.03	0.03	0.05	0.01	0.04
Rel.Std.Dev.	0.58%	1.72%	1.61%	2.91%	1.27%	0.82%	0.85%	1.19%	0.13%	1.02%
PDM[3]	0.89%	11.7%	3.71%	-2.39%	-0.61%	0.24%	-5.41%	-0.80%	1.08%	2.87%

Table A15. 4-acid results for S in OREAS 161 (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	3.37	3.22	2.90	2.88	2.87	3.00	3.13	NR	3.17	NR
2	3.37	3.15	2.89	2.87	2.87	2.90	3.13	NR	3.18	NR
3	3.38	3.11	3.01	2.95	2.84	2.90	3.12	NR	3.16	NR
4	3.35	3.09	2.99	3.05	2.84	2.90	3.10	NR	3.17	NR
5	3.38	2.97	3.03	3.09	2.80	2.90	3.15	NR	3.17	NR
Mean	3.37	3.11	2.96	2.97	2.84	2.92	3.13		3.17	
Median	3.37	3.11	2.99	2.95	2.84	2.90	3.13		3.17	
Std.Dev.	0.01	0.09	0.06	0.10	0.03	0.04	0.02		0.01	
Rel.Std.Dev.	0.36%	2.95%	2.18%	3.34%	1.01%	1.53%	0.53%		0.22%	
PDM[3]	10.2%	1.61%	-3.10%	-2.97%	-7.02%	-4.53%	2.19%		3.64%	

Table A16. 4-acid results for CaO in OREAS 161 (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	0.160	0.154	0.170	0.154	0.150	0.250	0.150	0.154	**0.196**	0.160
2	0.160	0.154	0.150	0.153	0.150	0.250	0.151	0.140	0.168	0.160
3	0.160	0.154	0.170	0.157	0.150	0.250	**0.142**	0.154	0.168	0.160
4	0.150	0.168	**0.200**	0.158	0.150	0.250	0.148	0.154	0.182	0.160
5	0.160	0.154	0.180	0.163	0.150	0.240	0.149	0.154	0.168	0.170
Mean	0.158	0.157	0.174	0.157	0.150	**0.248**	0.148	0.151	0.176	0.162
Median	0.160	0.154	0.170	0.157	0.150	0.250	0.149	0.154	0.168	0.160
Std.Dev.	0.004	0.006	0.018	0.004	0.000	0.004	0.003	0.006	0.013	0.004
Rel.Std.Dev.	2.83%	3.99%	10.4%	2.51%	0.00%	1.80%	2.33%	4.14%	7.10%	2.76%
PDM[3]	-0.07%	-0.89%	10.04%	-0.71%	-5.13%	56.8%	-6.48%	-4.43%	11.5%	2.46%

Table A17. 4-acid results for MgO in OREAS 161 (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	3.72	3.93	3.63	3.67	3.48	3.41	3.00	3.63	3.73	3.70
2	3.71	3.73	**3.56**	3.64	3.48	3.38	3.05	3.60	3.71	3.80
3	3.72	3.76	3.68	3.72	3.47	3.39	3.03	3.65	**3.65**	3.70
4	3.66	3.85	3.71	3.77	3.45	3.36	2.95	3.66	3.75	3.70
5	3.68	3.81	3.71	3.84	**3.40**	3.39	3.02	3.63	3.73	3.80
Mean	3.70	3.82	3.66	3.73	**3.46**	**3.39**	**3.01**	3.63	3.71	3.74
Median	3.71	3.81	3.68	3.72	3.47	3.39	3.02	3.63	3.73	3.70
Std.Dev.	0.03	0.08	0.06	0.08	0.03	0.02	0.04	0.02	0.04	0.05
Rel.Std.Dev.	0.73%	2.02%	1.74%	2.14%	0.97%	0.54%	1.26%	0.68%	1.05%	1.46%
PDM[3]	-0.56%	2.64%	-1.63%	0.25%	-7.06%	-8.95%	-19.0%	-2.26%	-0.12%	0.57%

Table A18. 4-acid results for Al_2O_3 in OREAS 161 (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	2.25	2.68	2.46	2.59	2.40	2.48	2.12	2.65	2.51	2.40
2	2.22	2.55	**2.38**	**2.53**	2.40	2.46	2.14	2.57	2.51	2.50
3	2.26	2.55	2.49	2.60	2.38	2.48	2.08	2.63	2.55	2.50
4	2.20	2.63	2.51	2.61	2.38	2.46	2.08	2.61	2.57	2.50
5	2.22	2.59	2.51	**2.66**	2.36	2.48	2.10	2.57	2.55	2.60
Mean	2.23	2.60	2.47	2.60	2.38	2.47	**2.10**	2.60	2.54	2.50
Median	2.22	2.59	2.49	2.60	2.38	2.48	2.10	2.61	2.55	2.50
Std.Dev.	0.02	0.06	0.05	0.05	0.02	0.01	0.02	0.03	0.03	0.07
Rel.Std.Dev.	1.10%	2.16%	2.20%	1.79%	0.70%	0.44%	1.11%	1.30%	1.00%	2.83%
PDM[3]	-10.5%	4.36%	-0.85%	4.28%	-4.31%	-0.77%	-15.5%	4.51%	1.93%	0.35%

Table A19. 4-acid results for Ag in OREAS 161 (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 AD*AAS
1	1.3	1.0	1.0	1.1	1.0	2.0	<2	<2	1.2	1.2
2	1.1	1.0	1.0	1.1	1.1	1.0	2.9	<2	1.2	1.3
3	1.1	1.0	1.0	1.1	1.1	2.0	<2	2.0	1.2	1.2
4	1.2	1.0	1.0	1.2	1.1	<1	<2	2.0	0.8	1.3
5	1.0	1.0	1.0	1.2	1.1	3.0	<2	3.0	1.1	1.1
Mean	1.1	1.0	1.0	1.1	1.1	**2.0**	**2.9**	**2.3**	1.1	1.2
Median	1.1	1.0	1.0	1.1	1.1	2.0	2.9	2.0	1.2	1.2
Std.Dev.	0.1	0.0	0.0	0.1	0.0	0.8		0.6	0.2	0.1
Rel.Std.Dev.	10.0%	0.00%	0.00%	4.80%	2.41%	40.8%		24.7%	15.7%	6.86%
PDM[3]	4.01%	-8.76%	-8.76%	4.01%	-2.19%	82.5%	165%	113%	0.36%	11.3%

Table A20. 4-acid results for Pb in OREAS 161 (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	140	144	127	135	120	160	250	<200	151	130
2	140	140	128	131	122	130	210	<200	139	130
3	140	143	124	133	122	140	170	<200	147	130
4	140	143	125	139	120	130	160	<200	155	140
5	130	144	125	140	118	140	140	<200	155	130
Mean	138	143	126	136	120	140	**186**		149	132
Median	140	143	125	135	120	140	170		151	130
Std.Dev.	4	2	2	4	1	12	44		7	4
Rel.Std.Dev.	3.24%	1.15%	1.31%	2.84%	1.23%	8.75%	23.6%		4.48%	3.39%
PDM[3]	1.87%	5.42%	-7.13%	0.10%	-11.3%	3.35%	37.3%		10.3%	-2.56%

Table A21. 4-acid results for Zn in OREAS 161 (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	22	30	16	26	17	<20	<50	<100	23	<30
2	21	33	14	23	17	<20	<50	<100	21	<30
3	20	31	16	26	17	<20	<50	<100	18	<30
4	21	37	16	29	16	<20	<50	<100	21	<30
5	19	35	16	28	16	<20	<50	<100	19	<30
Mean	21	33	16	26	17				20	
Median	21	33	16	26	17				21	
Std.Dev.	1	3	1	2	1				2	
Rel.Std.Dev.	5.53%	8.63%	5.73%	8.72%	3.30%				9.56%	
PDM[3]	-6.93%	50.0%	-29.5%	19.3%	-25.0%				-7.83%	

Table A22. 4-acid results for Co in OREAS 161 (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	120	118	124	128	119	120	112	120	104	120
2	120	119	124	124	120	110	113	110	105	120
3	120	117	128	130	120	120	113	120	103	120
4	120	117	126	126	120	110	110	120	104	120
5	120	118	128	122	119	120	112	120	104	120
Mean	120	118	**126**	**126**	120	116	**112**	118	**104**	120
Median	120	118	126	126	120	120	112	120	104	120
Std.Dev.	0	1	2	3	1	5	1	4	1	0
Rel.Std.Dev.	0.00%	0.71%	1.59%	2.51%	0.59%	4.72%	1.09%	3.79%	0.68%	0.00%
PDM[3]	1.22%	-0.63%	6.28%	6.28%	0.80%	-2.15%	-5.53%	-0.46%	-12.3%	1.22%