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

Base Metal Sulphide Ore (Gamsberg Zinc Mine, Sth Africa)

CERTIFIED REFERENCE MATERIAL

OREAS 38

Table 1. Certified Values, SDs, 95% Confidence and Tolerance Limits for OREAS 38.

Constituent	Certified Value	1SD	95% Confidence Limits		95% Tolerance Limits	
			Low	High	Low	High
Acid digest						
Silver, Ag (ppm)	5.49	0.42	5.23	5.75	5.31	5.67
Arsenic, As (ppm)	298	17	289	307	288	308
Copper, Cu (ppm)	111	5	107	116	109	114
Iron, Fe (wt.%)	21.28	0.42	20.97	21.59	20.96	21.60
Manganese, Mn (wt.%)	1.37	0.04	1.27	1.46	1.34	1.39
Lead, Pb (wt.%)	0.592	0.018	0.578	0.605	0.583	0.600
Thallium, Tl (ppm)	63.9	5.5	48.3	79.4	61.6	66.2
Zinc, Zn (wt.%)	10.04	0.14	9.89	10.19	9.94	10.14
Peroxide Fusion						
Silver, Ag (ppm)	~5	IND	IND	IND	IND	IND
Arsenic, As (ppm)	300	26	258	342	288	312
Copper, Cu (ppm)	108	9	99	118	108	108
Iron, Fe (wt.%)	20.98	0.84	20.31	21.66	20.66	21.31
Manganese, Mn (wt.%)	1.57	0.04	1.51	1.62	1.54	1.59
Lead, Pb (wt.%)	0.560	0.01	0.548	0.573	0.546	0.574
Thallium, Tl (ppm)	124	5	101	146	121	126
Zinc, Zn (wt.%)	9.99	0.20	9.85	10.12	9.87	10.11
Leco						
Sulphur, S (wt.%)	22.32	0.34	21.85	22.80	22.03	22.62

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 38.

Constituent	Unit	Value	Constituent	Unit	Value	Constituent	Unit	Value
Oxidising Fusion XRF								
Al_2O_3	wt.%	*5.31*	Fe_2O_3	wt.%	*30.40*	SnO_2	ppm	*12.7*
As	ppm	*340*	K_2O	wt.%	*1.05*	SO_3	wt.%	*55.84*
BaO	ppm	*234*	MgO	wt.%	*0.642*	SrO	ppm	*35.5*
CaO	wt.%	*1.01*	MnO	wt.%	*2.03*	TiO_2	wt.%	*0.345*
Cl	ppm	*< 10*	NiO	ppm	*51*	V_2O_5	ppm	*134*
CoO	ppm	*51*	P_2O_5	wt.%	*0.659*	ZnO	ppm	*127219*
Cr_2O_3	ppm	*51*	PbO	ppm	*6108*	ZrO_2	ppm	*135*
CuO	ppm	*144*	SiO_2	wt.%	*33.56*			
Thermogravimetry								
LOI^{1000}	wt.%	*13.63*						
Laser Ablation ICP-MS								
Ag	ppm	*5.05*	Ge	ppb	*6625*	Se	ppm	*< 5*
As	ppm	*309*	Hf	ppb	*2945*	Sm	ppm	*4.22*
Ba	ppm	*209*	Ho	ppb	*615*	Sn	ppm	*1.10*
Be	ppm	*16.9*	In	ppm	*0.25*	Sr	ppm	*16.8*

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 38 continued.

Constituent	Unit	Value	Constituent	Unit	Value	Constituent	Unit	Value
Laser Ablation ICP-MS								
Bi	ppm	*0.36*	La	ppm	*22.3*	Ta	ppb	*420*
Cd	ppm	*189*	Lu	ppb	*265*	Tb	ppb	*580*
Ce	ppm	*40.6*	Mo	ppm	*8.50*	Te	ppb	*< 200*
Co	ppm	*45.6*	Nb	ppm	*5.41*	Th	ppm	*5.27*
Cr	ppm	*43.0*	Nd	ppm	*18.9*	Tl	ppm	*117*
Cs	ppm	*5.21*	Ni	ppm	*44.0*	Tm	ppb	*260*
Cu	ppm	*115*	Pb	wt.%	*0.555*	U	ppm	*1.80*
Dy	ppm	*3.27*	Pr	ppm	*4.69*	V	ppm	*86*
Er	ppm	*1.80*	Rb	ppm	*60*	W	ppm	*5.20*
Eu	ppb	*2200*	Re	ppb	*< 10*	Y	ppm	*17.7*
Ga	ppm	*7.70*	Sb	ppm	*13.3*	Yb	ppb	*1810*
Gd	ppm	*4.26*	Sc	ppm	*4.50*	Zr	ppm	*100*

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 38 is a high-grade zinc ore matrix-matched certified reference material (MMCRM) prepared by Ore Research and Exploration. It is one of 3 MMCRM's sourced from the Gamsberg Zn deposit located in the Northern Cape Province of South Africa, approximately 20km west of the Black Mountain mine. Gamsberg is a stratiform base metal Broken Hill Style (BHS) deposit located in the mid-proterozoic Bushmanland Province of the Namaqualand Metamorphic Complex (NMC) of South Africa. The NMC is a highly deformed and metamorphosed supracrustal succession of dominantly pelitic schists and quartzites, deposited on a regionally extensive ±2000 Ma basement (Rozendal & Stalder, 2001). The stratiform ores have a close spatial and genetic association with metamorphosed chemical sediments including manganiferous iron formations, quartz-garnet rocks (coticules), Ca-Mn marbles and barite (Rozendal & Stalder, 2001).

COMMINUTION AND HOMOGENISATION PROCEDURES

The material was prepared in the following manner:

- Drying at 65°C to constant mass;
- Crushing and screening;
- Preliminary homogenisation;
- Milling to minus 30 microns;
- Final homogenisation;
- Packaging into 10g units under nitrogen and sealed in laminated foil pouches.

ANALYTICAL PROGRAM

Ten commercial laboratories participated in the analytical program to characterise Ag, As, Cu, Fe, Mn, Pb, S, Tl and Zn in OREAS 38. The laboratories were requested to analyse all elements by three acid ore grade digest (preferred) or strong aqua regia digestion together with sodium peroxide fusion methods. To evaluate and compensate for the effects of batch-to-batch variation at individual laboratories, samples were submitted to six of the laboratories in three batches of four 10g samples at weekly intervals. The remaining four laboratories completed one round only. Their data has been included in all statistical analysis excluding performance gates, where only the six labs incorporating batch to batch variation have been used (for further discussion see 'Performance Gates').

The approximate major and trace element composition of OREAS 38 is provided in Table 2. The non-certified values contained in this table are the means of duplicate assays from one laboratory.

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 the Appendix (Tables A2 to A18). 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 (see 'Statement of Homogeneity' and 'Anova' sections). The analytical methods employed by each laboratory are given in the table captions and described in Table A1 of the Appendix.

All ten commercial labs participated in the acid digest work and employed flame AAS, ICP-OES or ICP-MS instrumental finishes. Up to eight of these labs (depending on the analyte) also carried out sodium peroxide fusion ICP-OES/MS analysis to evaluate the presence of an acid insoluble component. Sulphur was determined via Leco by nine labs with the remaining lab employing aqua regia digest with an ICP-OES finish. Each of the four samples submitted to each laboratory were taken at regular intervals during packaging of the standard in order to maximise their representation. Comparisons of inter-laboratory bias and precision are graphically presented in scatter plots for acid digest Pb and Zn (Figures 1 and 2) together with ±3SD (magenta) and ±5% (yellow) control lines and certified value (green line). Accepted individual results are coloured blue and individual and dataset outliers are identified by red and violet, respectively.

STATISTICAL EVALUATION

Certified Value and Confidence Interval

Each batch of results is treated as a separate data set in testing for outliers. The certified value is determined from the mean of lab means after filtering of individual and batch outliers. It is 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.

Following identification of z-score outliers a 3SD filter is applied, with those values lying outside this window relegated to outlying status also. In certain instances, statistician's prerogative has been employed in discriminating outliers. The test for outlying laboratory batches is also based on z-score discrimination (rejected if $|z_i| > 2.5$) and these batches are

deleted from the respective lab mean before calculation of the mean of lab means (Certified Value). All outliers are shown in bold and aligned left in the tabulated data of the Appendix and to reiterate, have been omitted in the determination of the certified value.

The magnitude of the confidence interval is inversely proportional to the number of participating laboratories and inter-laboratory 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.

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 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*;

$\bar{x}_i$ *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 l*imits;

k'_2 *is the factor for two – sided tolerance l*imits (m, α *unknown*);

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

The meaning of these tolerance limits may be illustrated for zinc by acid digest, where 99% of the time at least 95% of subsamples will have concentrations lying between 9.94 and 10.14 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,

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

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

according to the formula

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

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

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. Individual outliers (shown in bold in Tables A2 to A18) were removed prior to the calculation of tolerance intervals and a weighting factor of zero was applied to those data sets where $s_I / 2s_g' > 1$ (i.e. where the weighting factor $1 - s_I / 2s_g' < 0$). Data sets displaying poor resolution (i.e. where the ratio of the reading increment divided by the measured value is < $^1/_{20}$) were also omitted.

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. Despite the limitations of this method, the tolerance intervals presented in Table 1 are considered to confirm a high level of homogeneity for this CRM.

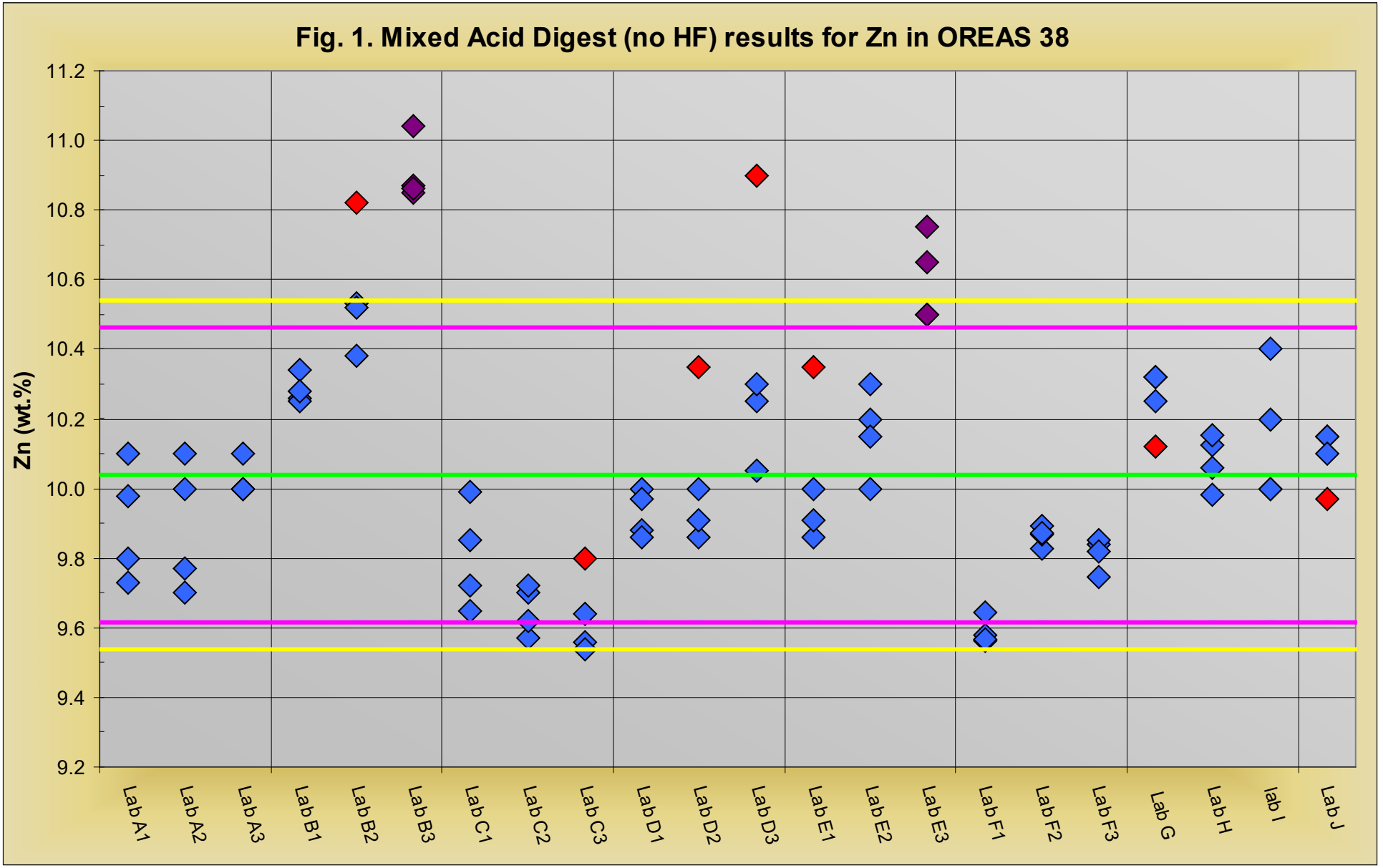
Fig. 1. Mixed Acid Digest (no HF) results for Zn in OREAS 38
Zn (wt.%)
11.2
11.0
10.8
10.6
10.4
10.2
10.0
9.8
9.6
9.4
9.2
Lab A1
Lab A2
Lab A3
Lab B1
Lab B2
Lab B3
Lab C1
Lab C2
Lab C3
Lab D1
Lab D2
Lab D3
Lab E1
Lab E2
Lab E3
Lab F1
Lab F2
Lab F3
Lab G
Lab H
lab I
Lab J

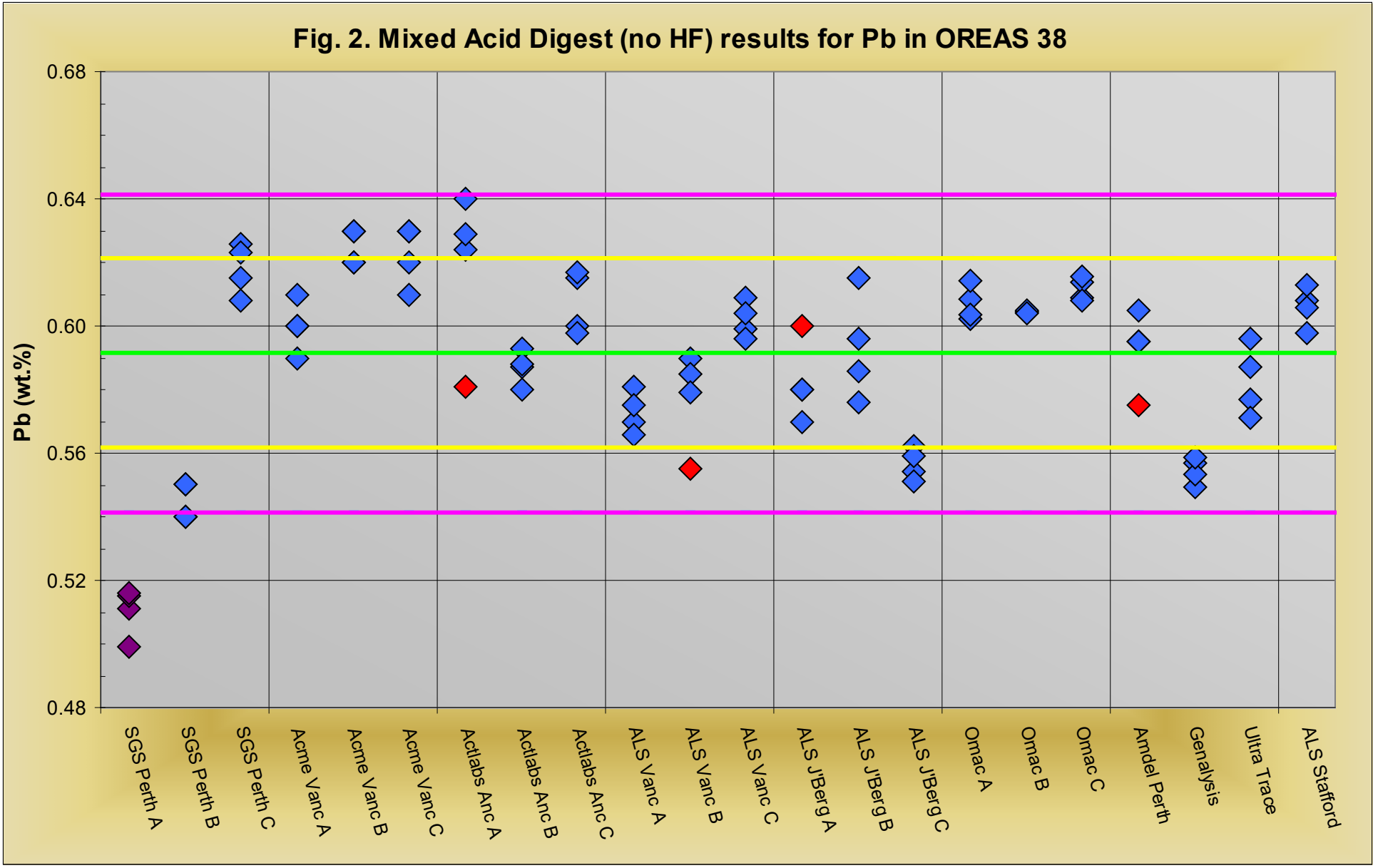
Fig. 2. Mixed Acid Digest (no HF) results for Pb in OREAS 38
Pb (wt.%)
0.68
0.64
0.60
0.56
0.52
0.48
SGS Perth A
SGS Perth B
SGS Perth C
Acme Vanc A
Acme Vanc B
Acme Vanc C
Actlabs Anc A
Actlabs Anc B
Actlabs Anc C
ALS Vanc A
ALS Vanc B
ALS Vanc C
ALS J'Berg A
ALS J'Berg B
ALS J'Berg C
Omac A
Omac B
Omac C
Amdel Perth
Genalysis
Ultra Trace
ALS Stafford

ANOVA Study

The sampling format for OREAS 38 was structured to enable nested ANOVA treatment of the round robin results. During the bagging stage immediately following final homogenization, samples were taken at 10 intervals representative of the entire batch of OREAS 38. Each lab received 4 samples per batch made up of paired samples from two different (non-adjacent) intervals. For example, the four samples that Lab A received consisted of:

- Sample 1 (from sampling interval 1)
- Sample 2 (from sampling interval 6)
- Sample 3 (from sampling interval 1)
- Sample 4 (from sampling interval 6)

The acid digest zinc results were used as the test data for the ANOVA investigation comparing within- and between-unit variance. This approach permitted an assessment of homogeneity across the entire batch of OREAS 38. The test was performed using the following parameters:

- Significance Level α = P (type I error) = 0.05
- Null Hypothesis, H_0: Between-unit variance is no greater than within-unit variance (reject H_0 if p-value < 0.05)
- Alternative Hypothesis, H_1: Between-unit variance is greater than within-unit variance

P-values are a measure of probability whereby values less than 0.05 indicate a greater than 95% probability that the observed differences in within-unit and between-unit variances are real. The same filtered dataset used to calculate the certified value for zinc via acid digest was used yielding a total of 76 samples from nine labs. The derived p-value of 0.9991 indicates no evidence that between-unit variance is greater than within-unit variance. Conclusion: do not reject H_0. Note that ANOVA is not an absolute measure of homogeneity. Rather, it establishes that zinc is uniformly distributed throughout OREAS 38 and that the variance between two aliquots from the same unit is identical to the variance from two aliquots taken from any two separate units.

Performance Gates

Performance gates provide an indication of a level of performance that might reasonably be expected from a laboratory being monitored by this standard 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).

Performance gates have been calculated from the same filtered data set used to determine the certified value, i.e. after removal of all individual and batch 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 deviations are then calculated for each lab's results and then each SD is tested for outlying status using z-score discrimination (rejected if $|z_i| > 2.5$). The 1SD used to calculate performance gates is the mean of the remaining (accepted) lab standard deviations. Because batch to batch bias is an important component of performance gates, only results from the six labs that received 3 submissions of samples have been used in the calculations.
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. Standard deviation is also shown in relative percent for one, two and three relative standard deviations (1RSD, 2RSD and 3RSD) to facilitate comparison with a 5% window calculated directly from the certified value. 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 38.

Constituent	Certified Value	Absolute Standard Deviations					Relative Standard Deviations			5% window	
		1SD	2SD Low	2SD High	3SD Low	3SD High	1RSD	2RSD	3RSD	Low	High
Acid Digest											
Ag (ppm)	5.49	0.42	4.65	6.33	4.22	6.75	7.68%	15.37%	23.05%	5.21	5.76
As (ppm)	298	17	264	332	248	349	5.66%	11.33%	16.99%	283	313
Cu (ppm)	111	5	102	121	98	125	4.13%	8.27%	12.40%	106	117
Fe (wt.%)	21.28	0.42	20.44	22.12	20.02	22.54	1.98%	3.96%	5.94%	20.22	22.34
Mn (wt.%)	1.37	0.04	1.29	1.44	1.25	1.48	2.78%	5.57%	8.35%	1.30	1.44
Pb (wt.%)	0.592	0.018	0.555	0.628	0.536	0.647	3.12%	6.24%	9.36%	0.562	0.621
Tl (ppm)	63.9	5.5	52.9	74.9	47.4	80.4	8.61%	17.21%	25.82%	60.7	67.1
Zn (wt.%)	10.06	0.14	9.78	10.33	9.65	10.47	1.36%	2.73%	4.09%	9.56	10.56
Peroxide Fusion											
Ag (ppm)	~5	IND	IND	IND	IND	IND	IND	IND	IND	IND	IND
As (ppm)	300	26	248	352	222	379	8.72%	17.44%	26.16%	285	315
Cu (ppm)	108	9	91	125	82	134	7.94%	15.88%	23.81%	103	114
Fe (wt.%)	20.98	0.84	19.31	22.66	18.48	23.49	3.98%	7.97%	11.95%	19.94	22.03
Mn (wt.%)	1.57	0.04	1.48	1.65	1.44	1.70	2.75%	5.50%	8.26%	1.49	1.65
Pb (wt.%)	0.560	0.01	0.530	0.590	0.515	0.605	2.66%	5.33%	7.99%	0.532	0.588
Tl (ppm)	124	5	115	133	110	137	3.66%	7.33%	10.99%	118	130
Zn (wt.%)	9.99	0.20	9.60	10.38	9.40	10.58	1.96%	3.93%	5.89%	9.49	10.49
Leco											
S (wt.%)	22.32	0.34	21.64	23.01	21.29	23.36	1.54%	3.08%	4.62%	21.21	23.44

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, Vancouver, BC, Canada
2. Activation Laboratories, Ancaster, Ontario, Canada
3. ALS Chemex, Johannesburg, Australia
4. ALS Chemex, Stafford, QLD, Australia
5. ALS Chemex, North Vancouver, BC, Canada
6. Amdel Laboratories, Perth, WA, Australia
7. Bureau Veritas (Ultra Trace) Geoanalytical, Perth, WA, Australia
8. Genalysis, Maddington, WA, Australia
9. SGS Analabs, Welshpool, Perth, WA, Australia
10. OMAC, Loughrea, Ireland

PREPARER AND SUPPLIER

Certified reference material OREAS 38 is prepared, certified and 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 38 has been packaged under nitrogen in laminated foil pouches in 10g units.

INTENDED USE

OREAS 38 is a reference material intended for the following:

i) For the calibration of instruments used in the determination of the concentration of Ag, As, Cu, Fe, Mn, Pb, S, Tl and Zn;
ii) For the verification of analytical methods for Ag, As, Cu, Fe, Mn, Pb, S, Tl and Zn;
iii) For the monitoring of laboratory performance in the analysis of Ag, As, Cu, Fe, Mn, Pb, S, Tl and Zn in geological samples.

STABILITY AND STORAGE INSTRUCTIONS

OREAS 38 is sourced from high grade zinc sulphide ore and has been packaged under dry nitrogen in robust laminated foil pouches. In its unopened state and under normal conditions of storage it has a shelf life beyond five years.

INSTRUCTIONS FOR THE CORRECT USE

The certified values for CRM OREAS 38 refer to the concentration level of Ag, As, Cu, Fe, Mn, Pb, S, Tl and Zn in its packaged state. Therefore, it should not be dried prior to weighing and analysis.

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.

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
3	14th Apr, 2020	Amended Table 1 statistics (original had transition errors)
2	10th Jan, 2019	Amended Table 1 certified values (original had transition errors)
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

14th April, 2020

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

REFERENCES

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

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

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

APPENDIX

Analytical Data for OREAS 38

Table A1. Key to abbreviations used in Tables A2 – A18.

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
PF	sodium peroxide fusion
AR	aqua regia digest (HNO_3-HCl)
3A	three acid digest (HNO_3-HCl-$HClO_4$)
MA	mixed acid digest ($KClO_4$-HNO_3 –HBr –HCl)
OES	inductively coupled plasma optical emission spectrometry
MS	inductively coupled plasma mass spectrometry
AAS	atomic absorption spectrometry
Leco	IR combustion furnace

Table A2. Mixed acid digest (no HF) results for Ag in OREAS 38 (abbreviations as in Table A1; values in ppm)

Replicate No.	Lab A 3A*MS	Lab B 3A*OES	Lab C AR*MS	Lab D AR*OES	Lab E AR*OES	Lab F MA*MS	Lab G AR*OES	Lab H 3A*MS	Lab I 3A*MS	Lab J AR*OES
1	5.40	6.00	5.10	6.00	5.00	5.09	**4.00**	**7.00**	6.00	6.00
2	5.50	6.00	5.00	6.00	6.00	5.29	**6.00**	**7.00**	5.00	6.00
3	5.50	6.00	5.00	5.00	5.00	5.44	**4.00**	**6.00**	5.00	5.00
4	5.60	6.00	5.10	5.00	6.00	5.40	**3.00**	**7.00**	5.00	6.00
5	6.00	6.00	4.72	5.00	**4.00**	5.38				
6	6.00	6.00	4.62	6.00	**3.00**	5.22				
7	6.00	6.00	4.61	6.00	**4.00**	5.26				
8	6.00	5.00	4.79	6.00	**4.00**	5.52				
9	5.10	6.00	5.10	6.00	**4.00**	5.70				
10	4.90	7.00	5.20	6.00	**1.00**	5.70				
11	5.00	6.00	5.10	5.00	**5.00**	5.68				
12	5.30	**9.00**	5.20	4.00	**3.00**	**5.59**				
Mean	5.53	6.25	4.96	5.50	4.17	5.44	**4.25**	**6.75**	5.25	5.75
Median	5.50	6.00	5.05	6.00	4.00	5.42	4.00	7.00	5.00	6.00
Std.Dev.	0.41	0.97	0.22	0.67	1.40	0.20	1.26	0.50	0.50	0.50
Rel.Std.Dev.	7.37%	15.4%	4.39%	12.3%	33.7%	3.73%	29.6%	7.41%	9.52%	8.70%
PDM[3]	0.66%	13.9%	-9.61%	0.20%	-24.1%	-0.92%	-22.6%	23.0%	-4.35%	4.76%

Table A3. Mixed acid digest (no HF) results for As in OREAS 38 (abbreviations as in Table A1; values in ppm)

Replicate No.	Lab A 3A*MS	Lab B 3A*OES	Lab C AR*MS	Lab D AR*OES	Lab E AR*OES	Lab F MA*MS	Lab G AR*OES	Lab H 3A*MS	Lab I 3A*MS	Lab J AR*OES
1	**309**	300	NR	290	290	**310**	260	314	304	320
2	315	300	NR	310	280	296	290	**306**	294	300
3	315	300	NR	280	310	299	290	315	318	300
4	314	300	NR	320	270	298	260	317	317	320
5	284	300	309	310	320	312				
6	284	300	324	270	300	316				
7	275	300	268	290	260	309				
8	293	300	342	270	250	318				
9	275	300	**291**	300	240	303				
10	257	300	282	320	300	298				
11	257	300	283	300	320	303				
12	276	300	285	320	**400**	300				
Mean	288	300	298	298	295	305	275	313	308	310
Median	284	300	288	300	295	303	275	315	311	310
Std.Dev.	21	0	25	19	42	8	17	5	11	12
Rel.Std.Dev.	7.43%	0.00%	8.35%	6.20%	14.3%	2.52%	6.30%	1.54%	3.71%	3.72%
PDM[3]	-3.49%	0.58%	-0.09%	0.03%	-1.09%	2.33%	-7.80%	4.94%	3.35%	3.94%

Table A4. Mixed acid digest (no HF) results for Cu in OREAS 38 (abbreviations as in Table A1; values in ppm)

Replicate No.	Lab A 3A*MS	Lab B 3A*OES	Lab C AR*OES	Lab D AR*OES	Lab E AR*OES	Lab F MA*MS	Lab G AR*OES	Lab H 3A*OES	Lab I 3A*OES	Lab J AR*OES
1	112	110	**90**	105	**92**	**107**	100	119	125	111
2	113	100	**90**	**103**	**99**	112	100	**115**	125	113
3	112	100	**100**	106	**95**	112	100	118	125	111
4	113	100	**90**	106	**92**	113	**150**	118	115	112
5	120	110	100	110	108	111				
6	122	110	121	**118**	105	110				
7	121	110	111	109	106	**108**				
8	122	110	124	106	107	111				
9	100	100	117	111	108	117				
10	101	100	118	111	106	116				
11	**98**	100	119	**109**	109	115				
12	101	100	119	112	106	115				
Mean	111	104	108	109	103	112	113	118	123	112
Median	113	100	114	109	106	112	100	118	125	112
Std.Dev.	9	5	13	4	6	3	25	2	5	1
Rel.Std.Dev.	8.23%	4.94%	12.3%	3.69%	6.25%	2.77%	22.2%	1.47%	4.08%	0.86%
PDM[3]	-0.12%	-6.48%	-2.83%	-2.29%	-7.75%	0.76%	1.00%	5.49%	9.98%	0.33%

Table A5. Mixed acid digest (no HF) results for Fe in OREAS 38 (abbreviations as in Table A1; values in wt.%)

Replicate No.	Lab A 3A*OES	Lab B 3A*OES	Lab C AR*OES	Lab D AR*OES	Lab E AR*OES	Lab F MA*MS	Lab G AR*OES	Lab H 3A*OES	Lab I 3A*OES	Lab J AR*OES
1	20.70	21.00	**16.20**	20.70	21.00	20.46	21.21	21.92	22.00	21.60
2	20.50	20.55	**16.70**	20.50	20.80	20.55	21.11	21.69	22.10	21.50
3	21.20	20.77	**16.30**	21.00	**22.00**	20.76	21.17	22.06	21.60	21.10
4	20.80	20.71	**15.60**	21.10	21.20	20.75	20.96	21.79	21.20	21.40
5	21.60	21.70	**19.30**	22.10	21.00	20.69				
6	21.90	21.21	**18.20**	21.80	21.50	20.82				
7	21.80	21.19	**19.50**	21.70	21.70	20.71				
8	22.30	21.49	**18.70**	**20.60**	22.20	20.72				
9	21.80	21.47	21.10	22.00	21.20	20.43				
10	22.00	21.20	20.40	22.10	21.20	20.64				
11	22.00	21.13	20.50	21.90	21.30	20.52				
12	**22.60**	21.55	20.10	22.30	21.10	20.57				
Mean	21.60	21.16	18.55	21.48	21.35	20.63	21.11	21.87	21.73	21.40
Median	21.80	21.20	19.00	21.75	21.20	20.67	21.14	21.86	21.80	21.45
Std.Dev.	0.66	0.36	1.92	0.66	0.42	0.13	0.11	0.16	0.41	0.22
Rel.Std.Dev.	3.06%	1.69%	10.3%	3.06%	1.98%	0.62%	0.52%	0.73%	1.89%	1.01%
PDM[3]	1.51%	-0.54%	-12.8%	0.96%	0.33%	-3.03%	-0.78%	2.75%	2.10%	0.57%

Table A6. Mixed acid digest (no HF) results for Mn in OREAS 38 (abbreviations as in Table A1; values in wt.%)

Replicate No.	Lab A 3A*AAS	Lab B 3A*OES	Lab C AR*OES	Lab D AR*OES	Lab E AR*OES	Lab F MA*MS	Lab G AR*OES	Lab H 3A*OES	Lab I 3A*OES	Lab J AR*OES
1	1.49	1.41	1.37	1.20	1.08	1.29	**1.88**	1.38	**1.44**	1.31
2	1.54	1.42	1.40	1.18	1.07	1.29	**1.82**	1.45	1.38	1.29
3	1.57	1.43	1.37	1.21	1.14	1.32	**1.83**	1.50	1.38	1.28
4	1.47	1.43	**1.30**	1.22	1.10	1.31	**1.69**	1.50	1.40	1.29
5	1.54	**1.56**	**1.41**	1.19	1.20	1.37				
6	1.58	1.51	1.31	1.20	1.23	1.38				
7	1.56	1.48	1.33	1.19	1.25	1.39				
8	1.53	1.49	1.31	**1.15**	1.29	1.39				
9	1.54	1.50	1.58	1.26	1.14	1.39				
10	1.51	1.50	1.57	1.27	1.14	1.37				
11	1.57	1.49	1.56	1.26	1.16	1.40				
12	1.54	1.51	1.57	1.28	1.15	1.41				
Mean	1.54	1.48	1.42	1.22	1.16	1.36	**1.80**	1.46	1.40	1.29
Median	1.54	1.49	1.39	1.20	1.14	1.37	1.83	1.47	1.39	1.29
Std.Dev.	0.03	0.05	0.11	0.04	0.07	0.04	0.08	0.06	0.03	0.01
Rel.Std.Dev.	2.16%	3.07%	7.99%	3.43%	5.93%	3.18%	4.54%	3.90%	2.02%	0.95%
PDM[3]	12.3%	7.97%	4.01%	-11.2%	-15.2%	-0.74%	31.7%	6.35%	2.30%	-5.73%

Table A7. Mixed acid digest (no HF) results for Pb in OREAS 38 (abbreviations as in Table A1; values in wt.%)

Replicate No.	Lab A 3A*AAS	Lab B 3A*OES	Lab C AR*OES	Lab D AR*OES	Lab E AR*OES	Lab F MA*MS	Lab G AR*OES	Lab H 3A*MS	Lab I 3A*MS	Lab J AR*OES
1	**0.511**	0.610	0.624	0.570	0.580	0.614	0.595	0.557	0.596	0.613
2	**0.515**	0.590	0.640	0.566	0.580	0.602	0.595	0.553	0.587	0.606
3	**0.516**	0.600	0.629	0.575	**0.600**	0.603	0.605	0.559	0.571	0.598
4	**0.499**	0.600	**0.581**	0.581	0.570	0.608	**0.575**	0.550	0.577	0.608
5	0.540	0.630	0.580	0.590	0.576	0.605				
6	0.540	0.630	0.587	0.585	0.586	0.605				
7	0.550	0.620	0.588	0.579	0.596	0.604				
8	0.550	0.620	0.593	**0.555**	0.615	0.604				
9	0.615	0.630	0.617	0.599	0.562	0.614				
10	0.623	0.610	0.600	0.604	0.559	0.615				
11	0.608	0.620	0.598	0.596	0.551	0.608				
12	0.626	0.630	0.615	0.609	0.554	0.609				
Mean	0.558	0.616	0.604	0.584	0.577	0.608	0.593	0.555	0.583	0.606
Median	0.545	0.620	0.599	0.583	0.578	0.606	0.595	0.555	0.582	0.607
Std.Dev.	0.047	0.014	0.020	0.016	0.020	0.005	0.013	0.004	0.011	0.006
Rel.Std.Dev.	8.49%	2.24%	3.3%	2.78%	3.40%	0.75%	2.12%	0.73%	1.89%	1.03%
PDM[3]	-5.71%	4.11%	2.16%	-1.26%	-2.39%	2.72%	0.16%	-6.25%	-1.49%	2.49%

Table A8. Mixed acid digest (no HF) results for Tl in OREAS 38 (abbreviations as in Table A1; values in ppm)

Replicate No.	Lab A 3A*MS	Lab B 3A*OES	Lab C AR*OES	Lab D AR*OES	Lab E AR*OES	Lab F MA*MS	Lab G AR*OES	Lab H 3A*MS	Lab I 3A*MS	Lab J AR*OES
1	**114**	100	70	<50	<50	33	<50	**133**	53	60
2	**114**	100	69	<50	<50	37	<50	**133**	54	60
3	**116**	100	71	50	50	39	<50	**127**	52	60
4	**117**	100	70	50	<50	40	<50	**125**	56	60
5	**116**	100	58	50	60	33				
6	**116**	100	67	50	70	36				
7	**115**	100	57	50	60	38				
8	**113**	100	65	<50	70	39				
9	**111**	NR	72	60	50	31				
10	72	NR	72	70	70	32				
11	70	NR	74	60	80	34				
12	83	NR	75	60	60	35				
Mean	105	100	68	56	63	36	<50	129	54	60
Median	114	100	70	50	60	36	<50	130	54	60
Std.Dev.	18	0	6	7	10	3	-	4	2	0
Rel.Std.Dev.	17.6%	0.00%	8.51%	13.1%	15.8%	8.06%	-	3.26%	3.18%	0.00%
PDM[3]	63.8%	56.5%	6.64%	-13.0%	-0.86%	-44.2%	-	102%	-15.9%	-6.08%

Table A9. Mixed acid digest (no HF) results for Zn in OREAS 38 (abbreviations as in Table A1; values in wt.%)

Replicate No.	Lab A 3A*AAS	Lab B 3A*OES	Lab C AR*OES	Lab D AR*OES	Lab E AR*OES	Lab F MA*MS	Lab G AR*OES	Lab H 3A*OES	Lab I 3A*OES	Lab J AR*OES
1	10.10	10.34	9.65	9.86	9.91	9.56	10.25	10.12	10.20	10.15
2	9.98	10.25	9.99	10.00	10.00	9.58	10.32	9.98	10.40	10.10
3	9.80	10.28	9.85	9.97	**10.35**	9.57	10.32	10.15	10.00	**9.97**
4	9.73	10.26	9.72	9.88	9.86	9.65	**10.12**	10.06	10.00	10.15
5	10.00	**10.82**	9.57	9.91	10.30	9.89				
6	9.77	10.52	9.72	10.00	10.00	9.87				
7	10.10	10.38	9.62	**10.35**	10.15	9.87				
8	9.70	10.53	9.70	9.86	10.20	9.83				
9	10.10	**10.85**	9.64	10.25	**10.50**	9.84				
10	10.00	**10.87**	9.56	10.30	**10.75**	9.85				
11	10.00	**10.86**	9.54	**10.90**	**10.50**	9.82				
12	10.00	**11.04**	**9.80**	10.05	**10.65**	9.75				
Mean	9.94	10.58	9.70	10.11	10.26	9.76	10.25	10.08	10.15	10.09
Median	10.00	10.53	9.68	10.00	10.25	9.82	10.29	10.09	10.10	10.13
Std.Dev.	0.15	0.29	0.13	0.30	0.29	0.13	0.09	0.08	0.19	0.08
Rel.Std.Dev.	1.50%	2.72%	1.4%	2.99%	2.86%	1.33%	0.92%	0.76%	1.89%	0.84%
PDM[3]	-0.99%	5.42%	-3.4%	0.71%	2.24%	-2.82%	2.12%	0.40%	1.10%	0.53%

Table A10. Peroxide fusion results for Ag in OREAS 38 (abbreviations as in Table A1; values in ppm)

Replicate No.	Lab A PF*MS	Lab B -	Lab C PF*OES	Lab D -	Lab E -	Lab F -	Lab G PF*OES	Lab H PF*MS	Lab I PF*MS	Lab J PF*OES
1	6.00	NR	< 60	NR	NR	NR	<20	5.00	<5	NR
2	6.00	NR	< 60	NR	NR	NR	<20	5.00	<5	NR
3	6.00	NR	< 60	NR	NR	NR	<20	5.00	<5	NR
4	6.00	NR	< 60	NR	NR	NR	<20	5.00	<5	NR
5	7.00	NR	5.10	NR	NR	NR				
6	6.00	NR	5.20	NR	NR	NR				
7	6.00	NR	5.10	NR	NR	NR				
8	6.00	NR	5.10	NR	NR	NR				
9	5.00	NR	< 50	NR	NR	NR				
10	5.00	NR	< 50	NR	NR	NR				
11	5.00	NR	< 50	NR	NR	NR				
12	5.00	NR	< 50	NR	NR	NR				
Mean	5.75		5.13				<20	5.00	<5	
Median	6.00		5.10				<20	5.00	<5	
Std.Dev.	0.62		0.05				-	0.00	-	
Rel.Std.Dev.	10.8%		0.98%				-	0.00%	-	
PDM[3]	5.75%		-5.75%				-	-8.05%	-	

Table A11. Peroxide fusion results for As in OREAS 38 (abbreviations as in Table A1; values in ppm)

Replicate No.	Lab A PF*MS	Lab B PF*OES	Lab C PF*OES	Lab D PF*OES	Lab E -	Lab F -	Lab G PF*OES	Lab H PF*MS	Lab I PF*MS	Lab J PF*OES
1	320	300	**200**	200	NR	NR	280	328	323	**700**
2	350	300	**100**	200	NR	NR	**260**	348	320	300
3	300	300	**100**	300	NR	NR	275	339	320	400
4	350	200	**100**	300	NR	NR	280	340	**308**	400
5	300	300	**100**	400	NR	NR				
6	320	300	**200**	300	NR	NR				
7	310	300	**200**	300	NR	NR				
8	310	300	**200**	300	NR	NR				
9	330	NR	200	300	NR	NR				
10	330	NR	200	300	NR	NR				
11	340	NR	200	300	NR	NR				
12	340	NR	200	300	NR	NR				
Mean	325	288	167	292			274	339	318	450
Median	325	300	200	300			278	340	320	400
Std.Dev.	18	35	49	51			9	8	7	173
Rel.Std.Dev.	5.49%	12.3%	29.5%	17.7%			3.46%	2.43%	2.13%	38.5%
PDM[3]	8.30%	-4.20%	-44.5%	-2.81%			-8.78%	12.9%	5.80%	49.9%

Table A12. Peroxide fusion results for Cu in OREAS 38 (abbreviations as in Table A1; values in ppm)

Replicate No.	Lab A PF*MS	Lab B PF*OES	Lab C PF*OES	Lab D PF*OES	Lab E -	Lab F -	Lab G PF*OES	Lab H PF*OES	Lab I PF*OES	Lab J PF*OES
1	140	90	110	100	NR	NR	100	NR	120	100
2	140	90	110	110	NR	NR	90	NR	120	100
3	130	90	130	100	NR	NR	95	NR	120	100
4	**150**	90	120	110	NR	NR	100	NR	120	100
5	110	110	110	110	NR	NR				
6	120	110	110	110	NR	NR				
7	120	110	110	110	NR	NR				
8	120	110	100	120	NR	NR				
9	120	100	90	110	NR	NR				
10	120	100	100	110	NR	NR				
11	120	100	100	120	NR	NR				
12	120	100	100	110	NR	NR				
Mean	126	100	108	110			96		120	100
Median	120	100	110	110			98		120	100
Std.Dev.	12	9	11	6			5		0	0
Rel.Std.Dev.	9.25%	8.53%	9.82%	5.48%			4.97%		0.00%	0.00%
PDM[3]	16.3%	-7.58%	-0.65%	1.67%			-11.0%		10.9%	-7.58%

Table A13. Peroxide fusion results for Fe in OREAS 38 (abbreviations as in Table A1; values in wt.%)

Replicate No.	Lab A PF*OES	Lab B PF*OES	Lab C PF*OES	Lab D PF*OES	Lab E -	Lab F -	Lab G PF*OES	Lab H PF*OES	Lab I PF*OES	Lab J PF*OES
1	**20.60**	19.69	20.70	19.35	NR	NR	20.20	21.11	**21.60**	**31.40**
2	22.10	19.47	20.50	20.30	NR	NR	20.10	21.00	22.10	**28.80**
3	22.10	19.11	20.30	19.95	NR	NR	20.20	20.90	22.00	**30.90**
4	22.20	19.36	20.00	21.20	NR	NR	20.10	21.03	22.10	**30.20**
5	21.30	20.71	20.90	22.00	NR	NR				
6	20.80	20.88	21.80	21.10	NR	NR				
7	20.60	20.95	21.20	21.20	NR	NR				
8	21.20	21.33	21.40	21.80	NR	NR				
9	21.90	**20.31**	20.70	20.30	NR	NR				
10	22.30	21.13	21.00	19.55	NR	NR				
11	23.20	20.85	20.90	20.10	NR	NR				
12	22.80	20.87	20.90	19.70	NR	NR				
Mean	21.76	20.39	20.86	20.55			20.15	21.01	21.95	**30.33**
Median	22.00	20.78	20.90	20.30			20.15	21.02	22.05	30.55
Std.Dev.	0.85	0.77	0.48	0.89			0.06	0.09	0.24	1.13
Rel.Std.Dev.	3.93%	3.79%	2.31%	4.32%			0.29%	0.41%	1.08%	3.72%
PDM[3]	3.69%	-2.84%	-0.60%	-2.09%			-3.98%	0.12%	4.60%	44.5%

Table A14. Peroxide fusion results for Mn in OREAS 38 (abbreviations as in Table A1; values in wt.%)

Replicate No.	Lab A PF*OES	Lab B PF*OES	Lab C PF*OES	Lab D PF*OES	Lab E -	Lab F -	Lab G PF*OES	Lab H PF*OES	Lab I PF*OES	Lab J PF*OES
1	**1.49**	1.51	1.55	1.51	NR	NR	**2.06**	1.60	1.48	1.63
2	1.59	1.51	1.54	1.62	NR	NR	**2.05**	1.60	1.50	1.49
3	1.58	**1.47**	1.54	1.56	NR	NR	**2.06**	1.60	1.49	1.60
4	1.59	1.50	**1.52**	1.66	NR	NR	**2.06**	1.70	1.48	1.56
5	**1.84**	1.51	1.52	1.67	NR	NR				
6	**1.81**	1.53	1.59	1.58	NR	NR				
7	**1.80**	1.53	1.54	1.56	NR	NR				
8	**1.84**	1.56	1.55	1.61	NR	NR				
9	1.67	NR	1.51	1.53	NR	NR				
10	1.70	NR	1.52	1.52	NR	NR				
11	1.76	NR	1.52	1.53	NR	NR				
12	1.73	NR	1.51	**1.49**	NR	NR				
Mean	1.70	1.52	1.53	1.57			2.06	1.63	1.49	1.57
Median	1.72	1.51	1.53	1.56			2.06	1.60	1.49	1.58
Std.Dev.	0.12	0.03	0.02	0.06			0.01	0.05	0.01	0.06
Rel.Std.Dev.	6.86%	1.73%	1.48%	3.72%			0.24%	3.08%	0.75%	3.89%
PDM[3]	8.43%	-3.37%	-2.15%	0.07%			31.2%	3.65%	-5.20%	0.15%

Table A15. Peroxide fusion results for Pb in OREAS 38 (abbreviations as in Table A1; values in wt.%)

Replicate No.	Lab A PF*MS	Lab B PF*OES	Lab C PF*OES	Lab D PF*OES	Lab E -	Lab F -	Lab G -	Lab H PF*MS	Lab I PF*MS	Lab J PF*OES
1	0.593	0.560	0.570	0.530	NR	NR	NR	0.560	0.563	0.550
2	0.583	0.560	0.570	0.560	NR	NR	NR	0.558	0.571	0.510
3	0.573	0.540	0.570	0.550	NR	NR	NR	0.556	0.577	0.550
4	0.577	0.550	0.560	0.580	NR	NR	NR	**0.569**	0.573	0.530
5	**0.538**	**0.600**	0.560	0.600	NR	NR				
6	0.568	**0.620**	0.580	0.570	NR	NR				
7	0.562	**0.620**	0.560	0.580	NR	NR				
8	0.560	**0.620**	0.570	0.600	NR	NR				
9	0.565	NR	0.550	0.560	NR	NR				
10	0.585	NR	0.540	0.540	NR	NR				
11	0.596	NR	0.560	0.570	NR	NR				
12	0.583	NR	0.560	0.550	NR	NR				
Mean	0.574	0.584	0.563	0.566				0.561	0.571	0.535
Median	0.575	0.580	0.560	0.565				0.559	0.572	0.540
Std.Dev.	0.016	0.035	0.011	0.022				0.006	0.006	0.019
Rel.Std.Dev.	2.83%	5.93%	1.88%	3.88%				0.99%	1.07%	3.58%
PDM[3]	2.39%	4.20%	0.41%	1.00%				0.07%	1.90%	-4.50%

Table A16. Peroxide fusion results for Tl in OREAS 38 (abbreviations as in Table A1; values in ppm)

Replicate No.	Lab A PF*MS	Lab B PF*OES	Lab C PF*OES	Lab D -	Lab E -	Lab F -	Lab G -	Lab H PF*MS	Lab I PF*MS	Lab J -
1	116	100	158	NR	NR	NR	NR	131	122	NR
2	116	100	159	NR	NR	NR	NR	131	122	NR
3	118	100	160	NR	NR	NR	NR	130	121	NR
4	119	100	**151**	NR	NR	NR	NR	**134**	**119**	NR
5	**114**	100	144	NR	NR	NR				
6	119	100	140	NR	NR	NR				
7	118	100	141	NR	NR	NR				
8	118	100	148	NR	NR	NR				
9	115	NR	149	NR	NR	NR				
10	118	NR	144	NR	NR	NR				
11	122	NR	147	NR	NR	NR				
12	116	NR	147	NR	NR	NR				
Mean	117	100	149					131	121	
Median	118	100	148					131	121	
Std.Dev.	2	0	7					2	2	
Rel.Std.Dev.	1.83%	0.00%	4.57%					1.34%	1.29%	
PDM[3]	-5.07%	-19.2%	20.5%					6.09%	-2.38%	

Table A17. Peroxide fusion results for Zn in OREAS 38 (abbreviations as in Table A1; values in wt.%)

Replicate No.	Lab A PF*OES	Lab B PF*OES	Lab C PF*OES	Lab D PF*OES	Lab E -	Lab F -	Lab G PF*OES	Lab H PF*OES	Lab I PF*OES	Lab J PF*OES
1	9.73	10.06	9.92	9.71	NR	NR	**6.90**	9.85	10.25	10.40
2	9.81	9.85	10.00	9.78	NR	NR	**6.94**	9.77	10.20	9.63
3	9.89	9.76	9.98	9.97	NR	NR	**6.97**	9.72	10.20	9.96
4	9.99	9.63	9.93	10.20	NR	NR	**6.90**	9.77	**10.45**	9.77
5	10.00	**10.70**	**9.32**	10.35	NR	NR				
6	9.94	**10.65**	9.98	10.15	NR	NR				
7	9.88	**10.84**	9.83	10.10	NR	NR				
8	10.00	**10.62**	10.10	10.50	NR	NR				
9	9.98	10.29	9.47	10.25	NR	NR				
10	>10	**10.60**	9.87	10.30	NR	NR				
11	>10	10.34	9.91	**10.90**	NR	NR				
12	>10	10.24	10.10	10.05	NR	NR				
Mean	9.91	10.30	9.87	10.19			**6.93**	9.78	10.28	9.94
Median	9.94	10.32	9.93	10.18			6.92	9.77	10.23	9.87
Std.Dev.	0.09	0.40	0.24	0.32			0.03	0.05	0.12	0.34
Rel.Std.Dev.	0.96%	3.90%	2.40%	3.13%			0.49%	0.55%	1.16%	3.37%
PDM[3]	-0.74%	3.11%	-1.20%	2.01%			-30.6%	-2.10%	2.88%	-0.48%

Table A18. Analytical results for S in OREAS 38 (abbreviations as in Table A1; values in wt.%)

Replicate No.	Lab A Leco	Lab B Leco	Lab C Leco	Lab D Leco	Lab E Leco	Lab F Leco	Lab G AR*OES	Lab H Leco	Lab I Leco	Lab J Leco
1	22.30	21.80	**22.20**	21.20	21.80	23.24	22.30	23.04	22.40	**25.30**
2	22.20	21.61	21.40	22.40	21.80	22.99	22.55	22.96	22.00	**24.10**
3	22.50	**20.17**	21.10	21.20	22.00	23.02	22.90	22.89	22.20	**25.10**
4	22.30	21.63	21.40	21.80	21.70	23.15	**21.05**	**23.31**	22.25	**25.20**
5	22.90	21.94	22.10	22.70	21.30	23.62				
6	22.50	21.45	22.60	22.00	21.40	23.24				
7	22.90	22.28	22.70	22.90	21.40	23.58				
8	22.70	22.17	22.40	22.50	21.60	23.37				
9	23.10	NR	22.10	20.10	21.00	23.47				
10	23.00	NR	22.40	20.30	21.80	23.56				
11	23.20	NR	22.00	20.40	21.40	23.73				
12	23.00	NR	22.40	**21.20**	21.90	23.37				
Mean	22.72	21.63	22.07	21.56	21.59	23.36	22.20	23.05	22.21	**24.93**
Median	22.80	21.72	22.15	21.50	21.65	23.37	22.43	23.00	22.23	25.15
Std.Dev.	0.35	0.66	0.51	0.97	0.29	0.24	0.81	0.18	0.17	0.56
Rel.Std.Dev.	1.52%	3.03%	2.31%	4.51%	1.36%	1.02%	3.63%	0.80%	0.74%	2.23%
PDM[3]	1.76%	-3.10%	-1.15%	-3.43%	-3.28%	4.65%	-0.56%	3.25%	-0.50%	11.7%