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CERTIFICATE OF ANALYSIS FOR

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

CERTIFIED REFERENCE MATERIAL

OREAS 37

Table 1. Certified Values, SDs, 95% Confidence and Tolerance Limits for OREAS 37.

Constituent	Certified Value	1SD	95% Confidence Limits		95% Tolerance Limits	
			Low	High	Low	High
Acid digest						
Silver, Ag (ppm)	5.19	0.63	4.77	5.62	4.94	5.44
Arsenic, As (ppm)	449	28	438	461	439	459
Copper, Cu (ppm)	125	5	120	131	122	129
Iron, Fe (wt.%)	23.76	0.56	23.31	24.22	23.45	24.08
Manganese, Mn (wt.%)	0.719	0.017	0.687	0.751	0.707	0.731
Lead, Pb (wt.%)	0.615	0.017	0.599	0.631	0.601	0.629
Thallium, Tl (ppm)	63	5	32	93	60	65
Zinc, Zn (wt.%)	6.26	0.15	6.17	6.35	6.16	6.36
Peroxide Fusion						
Silver, Ag (ppm)	5.0	IND	4.2	5.8	IND	IND
Arsenic, As (ppm)	460	42	424	496	435	485
Copper, Cu (ppm)	129	6	123	135	IND	IND
Iron, Fe (wt.%)	23.53	0.54	22.88	24.19	23.03	24.04
Manganese, Mn (wt.%)	0.769	0.027	0.751	0.786	0.750	0.787
Lead, Pb (wt.%)	0.597	0.02	0.589	0.605	0.583	0.611
Thallium, Tl (ppm)	156	IND	139	174	152	161
Zinc, Zn (wt.%)	6.30	0.18	6.09	6.51	6.17	6.43
Leco						
Sulphur, S (wt.%)	26.79	0.71	26.14	27.45	26.50	27.08

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 37.

Constituent	Unit	Value	Constituent	Unit	Value	Constituent	Unit	Value
Oxidising Fusion XRF								
Al_2O_3	wt.%	*5.56*	Fe_2O_3	wt.%	*33.65*	SnO_2	ppm	*12.7*
As	ppm	*500*	K_2O	wt.%	*1.42*	SO_3	wt.%	*66.03*
BaO	ppm	*234*	MgO	wt.%	*0.692*	SrO	ppm	*23.7*
CaO	wt.%	*0.377*	MnO	wt.%	*0.968*	TiO_2	wt.%	*0.355*
Cl	ppm	*25.0*	NiO	ppm	*51*	V_2O_5	ppm	*71*
CoO	ppm	*70*	P_2O_5	wt.%	*0.180*	ZnO	ppm	*80595*
Cr_2O_3	ppm	*51*	PbO	ppm	*6673*	ZrO_2	ppm	*149*
CuO	ppm	*169*	SiO_2	wt.%	*31.86*			
Thermogravimetry								
LOI^{1000}	wt.%	*17.91*						
Laser Ablation ICP-MS								
Ag	ppm	*4.85*	Hf	ppb	*3265*	Sn	ppm	*1.20*
As	ppm	*465*	Ho	ppb	*565*	Sr	ppm	*5.95*
Ba	ppm	*210*	In	ppm	*0.25*	Ta	ppb	*465*
Be	ppm	*3.10*	La	ppm	*18.2*	Tb	ppb	*525*

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 37 continued.

Constituent	Unit	Value	Constituent	Unit	Value	Constituent	Unit	Value
Laser Ablation ICP-MS								
Bi	ppm	*1.01*	Lu	ppb	*255*	Te	ppb	*200*
Cd	ppm	*116*	Mo	ppm	*8.10*	Th	ppm	*5.64*
Ce	ppm	*35.1*	Nb	ppm	*5.76*	Tl	ppm	*140*
Co	ppm	*56*	Nd	ppm	*16.5*	Tm	ppb	*265*
Cr	ppm	*40.5*	Ni	ppm	*42.0*	U	ppm	*2.06*
Cs	ppm	*6.48*	Pb	wt.%	*0.608*	V	ppm	*47.2*
Cu	ppm	*129*	Pr	ppm	*4.43*	W	ppm	*4.33*
Dy	ppm	*3.12*	Rb	ppm	*86*	Y	ppm	*17.3*
Er	ppm	*1.66*	Re	ppb	*< 10*	Yb	ppb	*1715*
Eu	ppb	*1225*	Sb	ppm	*16.5*	Zn	ppm	*61400*
Ga	ppm	*7.25*	Sc	ppm	*5.15*	Zr	ppm	*111*
Gd	ppm	*3.25*	Se	ppm	*< 5*			
Ge	ppb	*3725*	Sm	ppm	*3.43*			

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 37 is a medium 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 37. 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 37 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. 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 interlaboratory 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

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

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).

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

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

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

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

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

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* 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 zinc by acid digest, where 99% of the time at least 95% of subsamples will have concentrations lying between 4.13 and 4.24 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,

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

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

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 $s_l / 2s_g' > 1$ (i.e. where the weighting factor 1- $s_l / 2s_g' < 0$). 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.

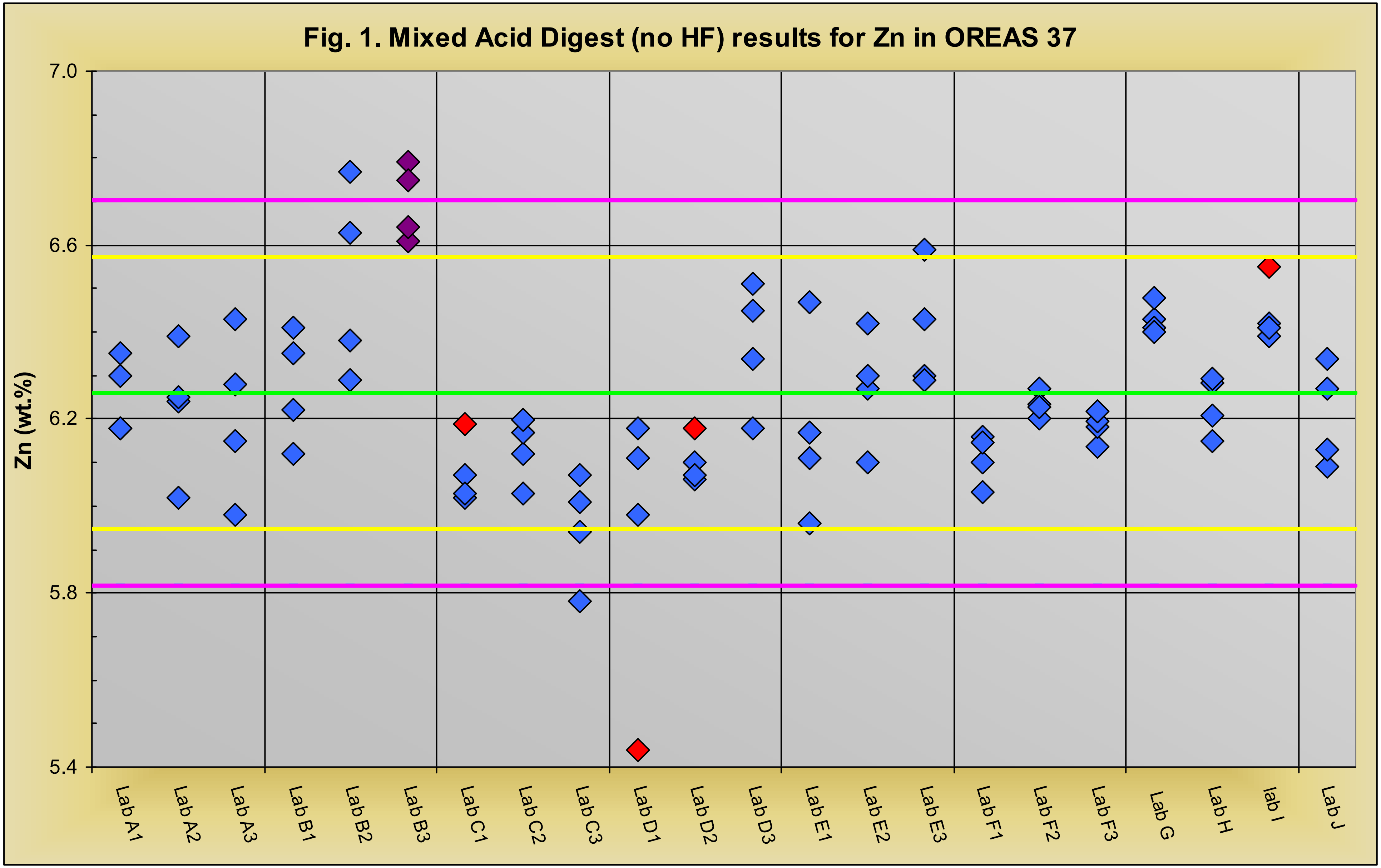
Fig. 1. Mixed Acid Digest (no HF) results for Zn in OREAS 37
Zn (wt.%)
7.0
6.6
6.2
5.8
5.4
Lab A1
Lab A2
Lab A3
Lab B1
Lab B2
Lab B3
Lab C1
Lab C2
Lab C3
Lab D1
Lab D2
Lab D3
Lab E1
Lab E2
Lab E3
Lab F1
Lab F2
Lab F3
Lab G
Lab H
lab I
Lab J

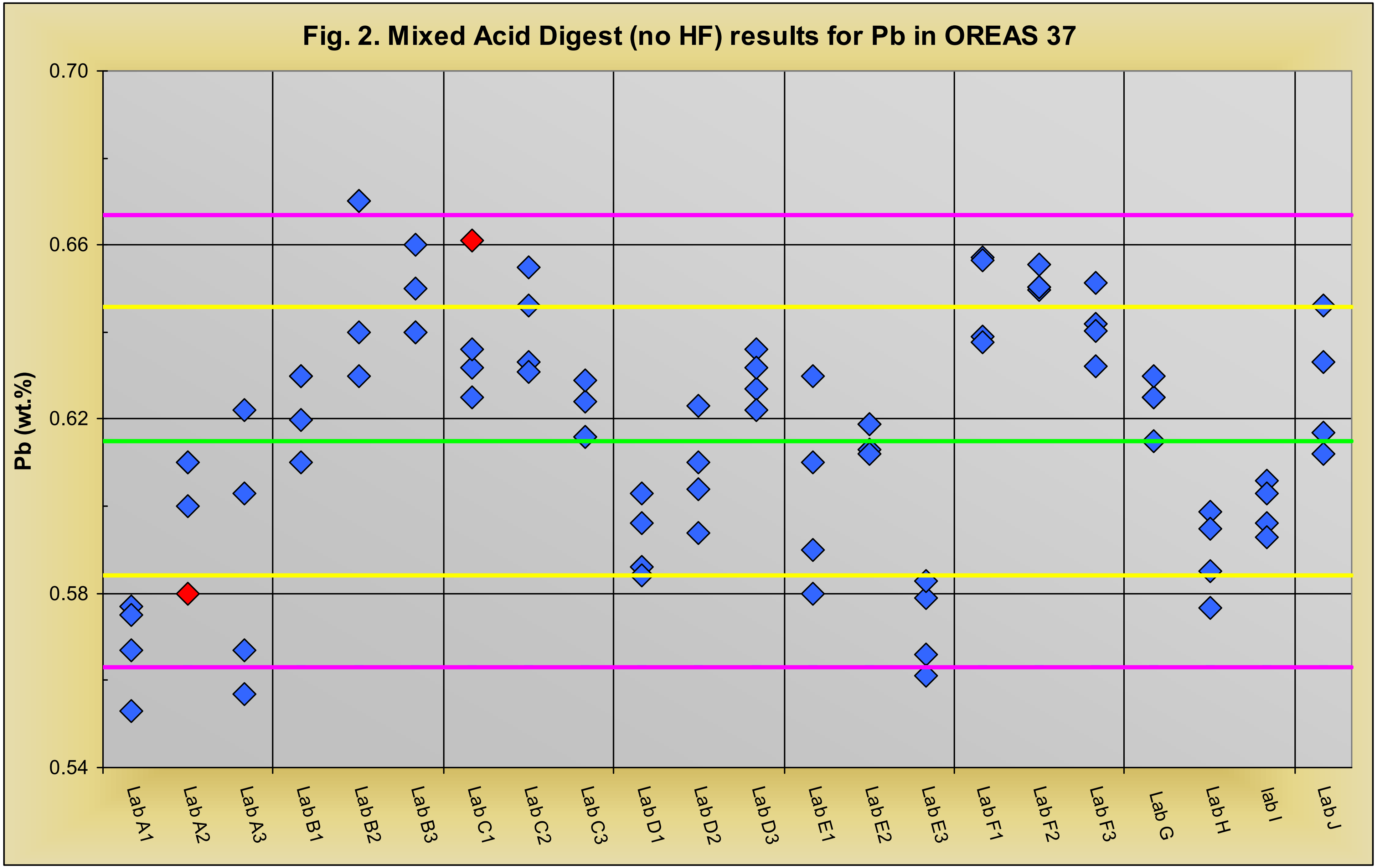

Fig. 2. Mixed Acid Digest (no HF) results for Pb in OREAS 37
Pb (wt.%)
0.70
0.66
0.62
0.58
0.54
Lab A1
Lab A2
Lab A3
Lab B1
Lab B2
Lab B3
Lab C1
Lab C2
Lab C3
Lab D1
Lab D2
Lab D3
Lab E1
Lab E2
Lab E3
Lab F1
Lab F2
Lab F3
Lab G
Lab H
lab I
Lab J

ANOVA Study

The sampling format for OREAS 37 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 37. 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 37. 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 0.692 indicates that there is no significant evidence that suggests 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 37 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 37.

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)	5.19	0.63	3.93	6.45	3.30	7.08	12.13%	24.26%	36.38%	4.93	5.45
As (ppm)	449	28	393	505	366	533	6.20%	12.41%	18.61%	427	472
Cu (ppm)	125	5	115	136	109	142	4.27%	8.54%	12.81%	119	132
Fe (wt.%)	23.76	0.56	22.65	24.88	22.10	25.43	2.34%	4.68%	7.02%	22.58	24.95
Mn (wt.%)	0.719	0.017	0.685	0.753	0.668	0.770	2.37%	4.73%	7.10%	0.683	0.755
Pb (wt.%)	0.615	0.017	0.580	0.650	0.563	0.667	2.81%	5.63%	8.44%	0.584	0.646
Tl (ppm)	63	5	52	73	47	78	8.18%	16.36%	24.54%	59	66
Zn (wt.%)	6.26	0.15	5.97	6.55	5.82	6.70	2.35%	4.71%	7.06%	5.95	6.57
Peroxide Fusion											
Ag (ppm)	~5	IND	IND	IND	IND	IND	IND	IND	IND	IND	IND
As (ppm)	460	42	375	544	42	375	9.19%	18.37%	27.56%	437	483
Cu (ppm)	129	6	118	141	6	118	4.47%	8.94%	13.41%	123	136
Fe (wt.%)	23.53	0.54	22.46	24.61	0.54	22.46	2.29%	4.58%	6.87%	22.36	24.71
Mn (wt.%)	0.769	0.027	0.715	0.822	0.027	0.715	3.50%	7.00%	10.50%	0.730	0.807
Pb (wt.%)	0.597	0.02	0.566	0.628	0.02	0.566	2.57%	5.14%	7.70%	0.567	0.627
Tl (ppm)	156	IND	IND	IND	IND	IND	IND	IND	IND	IND	IND
Zn (wt.%)	6.30	0.18	5.94	6.67	0.18	5.94	2.90%	5.80%	8.70%	5.99	6.62
S (wt.%)	26.79	0.71	25.37	28.21	0.71	25.37	2.65%	5.31%	7.96%	25.45	28.13

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 37 is prepared, certified and supplied by:

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OREAS 37 has been packaged under nitrogen in laminated foil pouches in 10g units.

INTENDED USE

OREAS 37 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 37 is sourced from medium 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 37 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.

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3rd Sep, 2018

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APPENDIX

Analytical Data for OREAS 37

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 37 (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	5.20	5.00	4.90	6.00	4.00	5.02	<2	**6.00**	5.00	6.00
2	5.10	5.00	4.80	4.00	5.00	4.82	<2	**6.00**	5.00	6.00
3	5.10	4.00	4.70	5.00	6.00	**4.50**	<2	**6.00**	5.00	6.00
4	5.20	3.00	4.80	6.00	5.00	5.01	**2.00**	**8.00**	5.00	7.00
5	6.00	5.00	4.07	5.00	5.00	4.94				
6	6.00	6.00	4.14	6.00	4.00	4.91				
7	6.00	6.00	4.60	5.00	3.00	5.13				
8	6.00	5.00	4.50	6.00	5.00	5.15				
9	4.70	5.00	5.00	6.00	**2.00**	5.07				
10	**5.00**	7.00	4.90	4.00	**2.00**	5.22				
11	4.70	6.00	4.80	5.00	**3.00**	5.08				
12	4.60	6.00	4.80	6.00	**2.00**	5.41				
Mean	5.30	5.25	4.67	5.33	3.83	5.02	<2	**6.50**	5.00	6.25
Median	5.15	5.00	4.80	5.50	4.00	5.04	<2	6.00	5.00	6.00
Std.Dev.	0.55	1.06	0.30	0.78	1.40	0.23	-	1.00	0.00	0.50
Rel.Std.Dev.	10.4%	20.1%	6.32%	14.6%	36.6%	4.48%	-	15.4%	0.00%	8.00%
PDM[3]	2.11%	1.15%	-10.1%	2.75%	-26.1%	-3.24%	-	25.2%	-3.67%	20.4%

Table A3. Mixed acid digest (no HF) results for As in OREAS 37 (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	480	400	NR	430	460	468	**380**	454	445	450
2	472	400	NR	430	460	465	**390**	460	459	460
3	468	400	NR	440	**490**	457	**400**	459	426	450
4	479	400	NR	450	470	458	**360**	**472**	420	470
5	434	400	491	440	440	466				
6	445	500	**408**	430	500	471				
7	439	400	525	460	480	465				
8	435	500	507	450	450	475				
9	419	400	**436**	480	440	454				
10	435	400	427	480	380	456				
11	435	400	428	460	410	448				
12	411	400	428	460	440	444				
Mean	446	417	456	451	452	460	**383**	461	438	458
Median	437	400	432	450	455	462	385	460	436	455
Std.Dev.	23	39	44	18	34	9	17	8	18	10
Rel.Std.Dev.	5.20%	9.34%	9.70%	3.95%	7.42%	2.01%	4.46%	1.65%	4.08%	2.09%
PDM[3]	-0.70%	-7.23%	1.58%	0.37%	0.56%	2.52%	-14.8%	2.69%	-2.60%	1.86%

Table A4. Mixed acid digest (no HF) results for Cu in OREAS 37 (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	130	120	110	117	104	125	**100**	143	140	123
2	129	120	100	118	102	124	**100**	143	130	123
3	128	120	110	132	112	123	**100**	135	135	121
4	131	120	110	118	108	122	**100**	138	125	122
5	137	120	136	121	128	126				
6	135	120	**108**	118	121	124				
7	137	120	134	123	123	124				
8	133	120	124	127	119	124				
9	121	120	132	125	**123**	134				
10	122	120	131	122	120	129				
11	123	110	136	124	119	132				
12	118	110	134	122	120	127				
Mean	129	118	122	122	117	126	**100**	140	133	122
Median	130	120	128	122	120	124	100	141	133	123
Std.Dev.	6	4	13	4	8	4	0	4	6	1
Rel.Std.Dev.	5.00%	3.29%	11.0%	3.59%	7.00%	3.00%	0.00%	2.82%	4.87%	0.78%
PDM[3]	2.54%	-5.70%	-2.71%	-2.57%	-7.09%	0.58%	-20.3%	11.4%	5.59%	-2.57%

Table A5. Mixed acid digest (no HF) results for Fe in OREAS 37 (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	23.70	22.43	**18.50**	23.30	23.00	23.09	23.98	24.76	24.80	23.30
2	23.50	23.39	**18.00**	23.00	22.90	22.95	23.90	24.80	24.70	22.90
3	23.40	22.88	**19.50**	23.20	**24.60**	23.11	24.38	24.34	24.90	23.00
4	23.50	23.36	**18.50**	22.80	23.50	23.03	24.10	24.49	24.40	23.40
5	24.20	23.70	**20.60**	24.20	24.20	22.94				
6	24.40	24.05	**21.10**	24.00	23.40	22.99				
7	24.70	23.80	**21.30**	24.50	24.20	23.00				
8	24.20	24.00	**20.40**	24.40	23.20	23.03				
9	24.70	23.41	23.70	24.90	**24.00**	23.22				
10	24.60	23.78	23.00	24.30	23.40	22.97				
11	24.90	22.81	23.00	24.80	23.50	23.14				
12	24.80	23.23	22.30	24.50	23.30	22.89				
Mean	24.22	23.40	20.83	23.99	23.60	23.03	24.09	24.60	24.70	23.15
Median	24.30	23.40	20.85	24.25	23.45	23.01	24.04	24.63	24.75	23.15
Std.Dev.	0.56	0.50	1.93	0.73	0.53	0.09	0.21	0.22	0.22	0.24
Rel.Std.Dev.	2.30%	2.14%	9.27%	3.03%	2.24%	0.40%	0.87%	0.89%	0.87%	1.03%
PDM[3]	1.91%	-1.52%	-12.4%	0.96%	-0.69%	-3.09%	1.37%	3.51%	3.94%	-2.58%

Table A6. Mixed acid digest (no HF) results for Mn in OREAS 37 (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	0.750	0.710	0.618	0.655	0.631	0.739	**1.040**	0.789	0.750	0.721
2	0.748	0.730	0.591	0.645	0.630	0.735	**1.025**	0.796	0.744	**0.704**
3	0.764	0.700	0.652	0.649	**0.676**	0.745	**1.060**	0.780	0.758	0.716
4	0.764	0.720	0.610	0.634	0.644	0.735	**1.060**	0.775	0.747	0.721
5	<0.01	0.740	0.694	0.667	0.710	0.735				
6	<0.01	0.740	0.641	**0.648**	0.680	0.734				
7	<0.01	0.730	0.701	0.668	0.706	0.735				
8	<0.01	0.750	0.616	0.667	0.672	0.732				
9	0.732	0.720	0.762	0.696	**0.668**	0.738				
10	0.724	**0.740**	0.763	0.674	0.645	0.735				
11	0.739	0.710	0.770	0.693	0.651	0.753				
12	0.727	0.720	0.780	0.678	0.645	0.743				
Mean	0.744	0.726	0.683	0.665	0.663	0.738	**1.046**	0.785	0.750	0.716
Median	0.744	0.725	0.673	0.667	0.660	0.735	1.050	0.784	0.749	0.719
Std.Dev.	0.016	0.015	0.071	0.019	0.027	0.006	0.017	0.009	0.006	0.008
Rel.Std.Dev.	2.10%	2.07%	10.38%	2.88%	4.04%	0.80%	1.63%	1.17%	0.80%	1.12%
PDM[3]	3.41%	0.95%	-4.98%	-7.58%	-7.76%	2.67%	45.5%	9.17%	4.28%	-0.48%

Table A7. Mixed acid digest (no HF) results for Pb in OREAS 37 (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	0.553	0.620	0.636	0.586	0.580	0.639	0.615	0.585	0.593	0.617
2	0.577	0.630	**0.661**	0.603	0.610	0.657	0.625	0.595	0.606	0.633
3	0.575	0.610	0.625	0.584	0.590	0.638	0.630	0.577	0.603	0.612
4	0.567	0.630	0.632	0.596	0.630	0.657	0.625	0.599	0.596	0.646
5	0.600	0.640	0.631	0.594	0.619	0.650				
6	0.610	0.670	0.646	0.610	0.619	0.650				
7	**0.580**	0.630	0.655	0.604	0.612	0.650				
8	0.610	0.670	0.633	0.623	0.613	0.655				
9	0.557	0.660	0.624	0.627	0.566	0.640				
10	0.622	0.640	0.629	0.632	0.583	0.651				
11	0.567	0.650	0.616	0.622	0.561	0.632				
12	0.603	0.640	0.616	0.636	0.579	0.642				
Mean	0.585	0.641	0.634	0.610	0.597	0.647	0.624	0.589	0.600	0.627
Median	0.579	0.640	0.632	0.607	0.600	0.650	0.625	0.590	0.600	0.625
Std.Dev.	0.023	0.019	0.014	0.018	0.023	0.008	0.006	0.010	0.006	0.016
Rel.Std.Dev.	3.93%	2.94%	2.2%	2.95%	3.85%	1.28%	1.01%	1.68%	1.01%	2.47%
PDM[3]	-4.86%	4.20%	3.03%	-0.85%	-2.95%	5.17%	1.42%	-4.26%	-2.52%	1.95%

Table A8. Mixed acid digest (no HF) results for Tl in OREAS 37 (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	**140**	100	77	50	<50	**33**	<50	**158**	57	60
2	**140**	100	74	50	50	38	<50	**156**	58	60
3	**140**	100	77	50	<50	39	<50	**153**	61	60
4	**141**	100	75	50	<50	41	<50	**152**	**69**	60
5	**144**	100	69	60	50	33				
6	**147**	100	56	50	60	34				
7	**155**	100	64	50	50	36				
8	**153**	100	62	50	60	36				
9	**142**	NR	81	50	<50	28				
10	**147**	NR	82	50	<50	32				
11	**138**	NR	82	50	<50	33				
12	**135**	NR	**77**	50	<50	38				
Mean	**144**	100	73	51	54	35	<50	**155**	61	60
Median	142	100	76	50	50	35	<50	155	60	60
Std.Dev.	6	0	8	3	5	3	-	3	5	0
Rel.Std.Dev.	4.18%	0.00%	11.3%	5.68%	10.1%	9.87%	-	1.76%	8.88%	0.00%
PDM[3]	129%	59.9%	16.6%	-18.7%	-13.7%	-43.8%	-	147%	-2.06%	-4.06%

Table A9. Mixed acid digest (no HF) results for Zn in OREAS 37 (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	6.18	6.22	6.02	5.98	5.96	6.10	6.41	6.28	6.42	6.09
2	6.30	6.41	**6.19**	6.11	6.17	6.15	6.40	6.29	**6.55**	6.27
3	6.35	6.12	6.03	**5.44**	6.11	6.03	6.48	6.15	6.41	6.13
4	6.18	6.35	6.07	6.18	6.47	6.16	6.43	6.21	6.39	6.34
5	6.25	6.38	6.03	6.06	6.27	6.20				
6	6.39	6.63	6.17	6.10	6.42	6.23				
7	6.02	6.29	6.20	6.07	6.30	6.23				
8	6.24	6.77	6.12	**6.18**	6.10	6.27				
9	5.98	**6.79**	6.01	6.18	6.43	6.18				
10	6.15	**6.75**	6.07	6.34	6.59	6.20				
11	6.28	**6.64**	5.94	6.51	6.29	6.22				
12	6.43	**6.61**	5.78	6.45	6.30	6.14				
Mean	6.23	6.50	6.05	6.13	6.28	6.18	6.43	6.23	6.44	6.21
Median	6.25	6.51	6.05	6.15	6.30	6.19	6.42	6.25	6.42	6.20
Std.Dev.	0.14	0.23	0.12	0.27	0.18	0.07	0.04	0.07	0.07	0.12
Rel.Std.Dev.	2.20%	3.53%	1.93%	4.42%	2.84%	1.05%	0.55%	1.09%	1.13%	1.89%
PDM[3]	-0.49%	3.78%	-3.32%	-2.03%	0.38%	-1.35%	2.71%	-0.42%	2.91%	-0.84%

Table A10. Peroxide fusion results for Ag in OREAS 37 (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 -
1	5.00	NR	< 60	NR	NR	NR	<20	5.00	<5	NR
2	5.00	NR	< 60	NR	NR	NR	<20	5.00	<5	NR
3	5.00	NR	< 60	NR	NR	NR	<20	5.00	<5	NR
4	5.00	NR	< 60	NR	NR	NR	<20	5.00	<5	NR
5	6.00	NR	4.70	NR	NR	NR				
6	6.00	NR	4.80	NR	NR	NR				
7	6.00	NR	4.60	NR	NR	NR				
8	6.00	NR	4.70	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	5.33		4.70				<20	5.00	<5	
Median	5.00		4.70				<20	5.00	<5	
Std.Dev.	0.49		0.08				-	0.00	-	
Rel.Std.Dev.	9.23%		1.74%				-	0.00%	-	
PDM[3]	6.43%		-6.21%				-	-0.22%	-	

Table A11. Peroxide fusion results for As in OREAS 37 (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	510	400	400	400	NR	NR	360	**487**	465	500
2	490	400	400	400	NR	NR	435	511	478	500
3	490	400	400	400	NR	NR	415	510	465	500
4	**450**	400	400	500	NR	NR	400	506	480	600
5	430	400	500	400	NR	NR				
6	**470**	500	400	500	NR	NR				
7	420	400	500	400	NR	NR				
8	430	400	500	400	NR	NR				
9	470	NR	400	500	NR	NR				
10	470	NR	500	500	NR	NR				
11	470	NR	500	400	NR	NR				
12	480	NR	500	500	NR	NR				
Mean	465	413	450	442			403	504	472	525
Median	470	400	450	400			408	508	471	500
Std.Dev.	27	35	52	51			32	11	8	50
Rel.Std.Dev.	5.91%	8.57%	11.6%	11.7%			7.89%	2.23%	1.70%	9.52%
PDM[3]	1.13%	-10.3%	-2.14%	-3.95%			-12.5%	9.50%	2.62%	14.2%

Table A12. Peroxide fusion results for Cu in OREAS 37 (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	**150**	120	120	120	NR	NR	140	NR	140	**100**
2	**150**	120	130	**150**	NR	NR	120	NR	130	**100**
3	**150**	110	120	130	NR	NR	130	NR	140	**100**
4	**140**	120	120	130	NR	NR	125	NR	140	**200**
5	130	130	130	120	NR	NR				
6	130	130	120	130	NR	NR				
7	140	120	130	130	NR	NR				
8	130	130	130	120	NR	NR				
9	130	**100**	**110**	130	NR	NR				
10	130	**100**	**110**	130	NR	NR				
11	130	**100**	**120**	130	NR	NR				
12	140	**100**	**100**	140	NR	NR				
Mean	138	115	120	130			129		138	**125**
Median	135	120	120	130			128		140	100
Std.Dev.	9	12	10	9			9		5	50
Rel.Std.Dev.	6.30%	10.8%	7.95%	6.56%			6.63%		3.64%	40.0%
PDM[3]	6.53%	-10.9%	-7.03%	0.72%			-0.25%		6.53%	-3.15%

Table A13. Peroxide fusion results for Fe in OREAS 37 (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	21.50	23.06	23.60	22.70	NR	NR	22.60	23.64	24.90	**31.70**
2	21.80	23.40	23.20	23.60	NR	NR	22.70	23.86	24.60	**33.40**
3	23.10	22.46	23.50	22.40	NR	NR	22.60	23.87	24.90	**35.10**
4	22.70	23.01	23.10	23.00	NR	NR	22.80	**24.49**	25.20	**34.80**
5	25.00	24.37	**24.80**	23.50	NR	NR				
6	23.80	23.86	23.90	23.10	NR	NR				
7	25.10	24.13	24.10	23.50	NR	NR				
8	24.00	24.09	23.80	24.20	NR	NR				
9	22.70	23.43	22.90	23.10	NR	NR				
10	23.10	23.51	23.00	22.40	NR	NR				
11	24.20	23.35	23.30	22.70	NR	NR				
12	24.20	**22.81**	23.40	21.70	NR	NR				
Mean	23.43	23.46	23.55	22.99			22.68	23.97	24.90	**33.75**
Median	23.45	23.42	23.45	23.05			22.65	23.87	24.90	34.10
Std.Dev.	1.15	0.58	0.54	0.67			0.10	0.37	0.24	1.55
Rel.Std.Dev.	4.91%	2.45%	2.29%	2.91%			0.42%	1.53%	0.98%	4.61%
PDM[3]	-0.43%	-0.33%	0.07%	-2.31%			-3.65%	1.83%	5.80%	43.4%

Table A14. Analytical results fusion Mn in OREAS 37 (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	0.721	0.790	0.770	0.805	NR	NR	**1.050**	0.800	0.752	0.751
2	0.715	0.790	0.740	0.805	NR	NR	**1.050**	0.800	0.734	0.743
3	0.740	0.760	0.770	0.790	NR	NR	**1.040**	0.800	0.752	0.805
4	0.730	0.790	0.750	0.790	NR	NR	**1.060**	**0.900**	0.736	0.798
5	**0.965**	0.770	0.800	0.790	NR	NR				
6	**0.894**	0.750	0.750	**0.751**	NR	NR				
7	**0.965**	0.780	0.780	0.790	NR	NR				
8	**0.899**	0.750	0.740	0.782	NR	NR				
9	0.773	NR	0.720	0.790	NR	NR				
10	0.763	NR	0.720	0.743	NR	NR				
11	0.823	NR	0.730	0.782	NR	NR				
12	0.801	NR	0.730	0.720	NR	NR				
Mean	0.816	0.773	0.750	0.778			**1.050**	0.825	0.744	0.774
Median	0.787	0.775	0.745	0.790			1.050	0.800	0.744	0.774
Std.Dev.	0.093	0.018	0.025	0.026			0.008	0.050	0.010	0.032
Rel.Std.Dev.	11.4%	2.27%	3.36%	3.35%			0.78%	6.06%	1.32%	4.08%
PDM[3]	6.15%	0.52%	-2.41%	1.28%			36.6%	7.35%	-3.25%	0.78%

Table A15. Peroxide fusion results for Pb in OREAS 37 (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	0.594	0.590	0.600	0.570	NR	NR	NR	0.583	0.605	**0.510**
2	0.599	0.610	0.610	0.610	NR	NR	NR	0.614	**0.629**	0.570
3	0.611	0.580	0.630	0.560	NR	NR	NR	0.582	0.604	0.580
4	**0.553**	0.610	0.620	0.610	NR	NR	NR	0.603	0.605	0.590
5	**0.566**	**0.660**	0.620	0.590	NR	NR				
6	0.593	**0.660**	0.620	0.610	NR	NR				
7	0.589	**0.650**	0.600	0.590	NR	NR				
8	0.596	**0.670**	0.620	0.630	NR	NR				
9	0.585	NR	0.580	0.600	NR	NR				
10	0.605	NR	0.590	0.610	NR	NR				
11	0.593	NR	0.590	0.590	NR	NR				
12	0.621	NR	0.590	0.590	NR	NR				
Mean	0.592	0.629	0.606	0.597				0.596	0.611	0.563
Median	0.594	0.630	0.605	0.595				0.593	0.605	0.575
Std.Dev.	0.018	0.035	0.016	0.019				0.016	0.012	0.036
Rel.Std.Dev.	3.10%	5.60%	2.68%	3.22%				2.63%	1.99%	6.39%
PDM[3]	-0.82%	5.32%	1.48%	-0.05%				-0.22%	2.31%	-5.78%

Table A16. Peroxide fusion results for Tl in OREAS 37 (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	143	100	187	NR	NR	NR	NR	156	135	NR
2	144	200	194	NR	NR	NR	NR	**163**	140	NR
3	143	200	190	NR	NR	NR	NR	157	152	NR
4	144	100	186	NR	NR	NR	NR	156	149	NR
5	142	200	162	NR	NR	NR				
6	142	200	175	NR	NR	NR				
7	146	100	173	NR	NR	NR				
8	147	200	166	NR	NR	NR				
9	140	NR	171	NR	NR	NR				
10	142	NR	167	NR	NR	NR				
11	141	NR	170	NR	NR	NR				
12	145	NR	**178**	NR	NR	NR				
Mean	143	163	177					158	144	
Median	143	200	174					156	144	
Std.Dev.	2	52	10					4	8	
Rel.Std.Dev.	1.43%	31.8%	5.89%					2.26%	5.53%	
PDM[3]	-8.45%	3.85%	12.9%					1.01%	-8.05%	

Table A17. Peroxide fusion results for Zn in OREAS 37 (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	6.19	6.52	6.07	5.98	NR	NR	**4.23**	6.03	6.55	5.85
2	6.00	6.57	6.16	6.24	NR	NR	**4.27**	6.09	**6.63**	6.17
3	5.89	**6.25**	6.10	6.23	NR	NR	**4.25**	6.07	6.57	6.01
4	5.85	6.45	6.23	6.38	NR	NR	**4.29**	**6.27**	6.55	6.32
5	6.55	6.78	6.31	5.97	NR	NR				
6	6.49	6.93	6.34	6.22	NR	NR				
7	6.58	6.76	6.14	6.18	NR	NR				
8	6.48	7.00	6.12	6.45	NR	NR				
9	6.14	6.68	6.39	6.18	NR	NR				
10	6.32	6.57	6.34	6.34	NR	NR				
11	6.31	6.54	6.12	6.51	NR	NR				
12	6.47	6.44	6.27	6.45	NR	NR				
Mean	6.27	6.62	6.22	6.26			**4.26**	6.12	6.58	6.09
Median	6.32	6.57	6.20	6.24			4.26	6.08	6.56	6.09
Std.Dev.	0.26	0.22	0.11	0.17			0.03	0.11	0.04	0.20
Rel.Std.Dev.	4.10%	3.25%	1.78%	2.78%			0.61%	1.74%	0.58%	3.33%
PDM[3]	-0.47%	5.11%	-1.37%	-0.66%			-32.4%	-2.97%	4.33%	-3.41%

Table A18. Analytical results for S in OREAS 37 (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	**25.40**	26.12	26.00	25.20	27.00	27.47	**26.65**	27.24	26.50	28.60
2	26.20	26.82	26.20	26.00	26.20	27.19	27.10	26.91	25.70	28.60
3	26.50	26.36	**26.90**	25.60	26.90	27.88	27.15	27.03	26.20	28.40
4	26.70	26.04	26.10	25.90	26.20	27.29	27.00	27.19	26.20	28.40
5	27.30	26.46	28.60	26.20	**25.80**	27.43				
6	27.40	**15.55**	**27.80**	26.30	25.00	27.51				
7	27.50	26.22	28.70	26.30	25.10	27.98				
8	27.20	25.30	28.40	**26.50**	25.00	28.04				
9	27.70	NR	26.20	25.40	25.40	28.19				
10	27.40	NR	25.80	23.80	25.90	27.50				
11	27.90	NR	26.20	23.50	26.00	27.79				
12	27.50	NR	25.70	**22.60**	25.60	27.46				
Mean	27.06	24.86	26.88	25.28	25.84	27.64	26.98	27.09	26.15	28.50
Median	27.35	26.17	26.20	25.75	25.85	27.50	27.05	27.11	26.20	28.50
Std.Dev.	0.72	3.79	1.16	1.28	0.67	0.32	0.23	0.15	0.33	0.12
Rel.Std.Dev.	2.67%	15.2%	4.31%	5.06%	2.60%	1.16%	0.84%	0.55%	1.27%	0.41%
PDM[3]	0.99%	-7.22%	0.34%	-5.66%	-3.55%	3.18%	0.68%	1.12%	-2.40%	6.37%