



CERTIFICATE OF ANALYSIS FOR
COPPER SULPHIDE ORE REFERENCE MATERIAL
OREAS 113

Summary Statistics for OREAS 113

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
SP Fusion ICP											
Ag (ppm)	~25	IND	IND	IND	IND	IND	IND	IND	IND	IND	IND
As (ppm)	238	33	171	304	138	337	14.0%	27.9%	41.9%	226	250
Cd (ppm)	~16	IND	IND	IND	IND	IND	IND	IND	IND	IND	IND
Co (ppm)	754	28	698	811	669	840	3.77%	7.54%	11.3%	717	792
Cu (wt.%)	13.3	0.5	12.3	14.3	11.8	14.8	3.74%	7.48%	11.2%	12.6	13.9
Fe (wt.%)	28.0	2.1	23.8	32.2	21.7	34.3	7.55%	15.1%	22.6%	26.6	29.4
Pb (ppm)	248	14	221	276	207	290	5.54%	11.1%	16.6%	236	261
Sb (ppm)	7.6	1.0	5.6	9.5	4.7	10.5	12.8%	25.6%	38.4%	7.2	8.0
Zn (ppm)	4158	196	3766	4551	3569	4748	4.72%	9.45%	14.2%	3951	4366
4-Acid ICP											
Ag (ppm)	22.6	1.7	19.2	25.9	17.6	27.6	7.37%	14.7%	22.1%	21.4	23.7
As (ppm)	234	13	208	260	195	272	5.48%	11.0%	16.5%	222	246
Cd (ppm)	15.5	2.0	11.5	19.5	9.5	21.5	12.8%	25.7%	38.5%	14.7	16.3
Co (ppm)	766	27	713	820	686	847	3.49%	6.99%	10.5%	728	805
Cu (wt.%)	13.5	0.4	12.8	14.3	12.4	14.6	2.74%	5.48%	8.23%	12.9	14.2
Fe (wt.%)	28.2	1.0	26.1	30.3	25.1	31.3	3.70%	7.41%	11.1%	26.8	29.6
Pb (ppm)	230	28	175	285	147	313	12.0%	24.0%	36.0%	219	242
Sb (ppm)	8	2	4	12	2	14	26.8%	53.7%	80.5%	7	8
Zn (ppm)	4178	248	3683	4673	3435	4921	5.92%	11.8%	17.8%	3969	4387

Note - intervals may appear asymmetric due to rounding; IND - indeterminate

Prepared by:
Ore Research & Exploration Pty Ltd
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INTRODUCTION

OREAS reference materials (RM) are intended to provide a low cost method of evaluating and improving the quality of precious and base metal analysis of geological samples. To the explorationist, they provide an important control in analytical data sets related to exploration from the grass roots level through to resource definition. To the analyst, they provide an effective means of calibrating analytical equipment, assessing new techniques and routinely monitoring in-house procedures.

OREAS 113 is a very high grade Cu ore certified reference material (CRM) prepared from material sourced from the Tritton Copper Project near Nyngan, New South Wales. The deposit consists of sulphide ore bodies (massive pyrite and chalcopyrite breccias) underlying oxide ores. OREAS 113 is one of a suite of five CRMs and was prepared from chalcopyrite breccia ore. All five CRMs have been characterised for Ag, As, Cd, Co, Cu, Fe, Pb, Sb and Zn by 4-acid ICP and sodium peroxide fusion ICP methods.

COMMINUTION AND HOMOGENISATION PROCEDURES

The material was prepared in the following manner:

- a) *drying at 65^o C to constant mass;*
- b) *crushing and screening;*
- c) *multi-stage milling to 100% minus 35 microns;*
- d) *final homogenisation;*
- e) *packaging into 10g units sealed under nitrogen in laminated foil pouches.*

ANALYSIS OF OREAS 113

Ten commercial laboratories participated in the analytical program to characterise Ag, As, Cd, Co, Cu, Fe, Pb, Sb and Zn. Their 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 (PDM³) are presented in Tables A2 and A19 (Appendix). The parameter PDM³ 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 explained, together with other abbreviations used, in Table A1 (Appendix).

Each participating laboratory received 5 samples of 30g 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. All ten laboratories reported 4-acid data for the requested elements while eight included sodium peroxide fusion results. Laboratories were instructed to assay samples as received.

STATISTICAL EVALUATION OF ANALYTICAL DATA FOR OREAS 113

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

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

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

where

x_{ij} is the j th 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 ;
 \bar{x} is the mean of means.

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

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

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

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 was primarily 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:

$$S = 1.483 \frac{\text{median} / x_j - \text{median} (x_i)}{j=1 \dots n \quad i=1 \dots n}$$

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

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.

Table 1. Certified values and 95% confidence intervals for OREAS 113

Constituent	Certified Value	95% Confidence Interval	
		Low	High
Sodium Peroxide Fusion ICP			
Silver, Ag (ppm)	~25	IND	IND
Arsenic, As (ppm)	238	207	269
Cadmium, Cd (ppm)	~16	IND	IND
Cobalt, Co (ppm)	754	708	801
Copper, Cu (wt.%)	13.3	12.7	13.8
Iron, Fe (wt.%)	28.0	26.1	29.8
Lead, Pb (ppm)	248	232	265
Antimony, Sb (ppm)	7.6	6.1	9.0
Zinc, Zn (ppm)	4158	3997	4320
4-Acid Digest ICP			
Silver, Ag (ppm)	22.6	21.3	23.8
Arsenic, As (ppm)	234	223	245
Cadmium, Cd (ppm)	15.5	14.8	16.3
Cobalt, Co (ppm)	766	746	787
Copper, Cu (wt.%)	13.5	13.3	13.8
Iron, Fe (wt.%)	28.2	27.5	28.8
Lead, Pb (ppm)	230	213	247
Antimony, Sb (ppm)	8	5	11
Zinc, Zn (ppm)	4178	4010	4346

Note - intervals may appear asymmetric due to rounding; IND - indeterminate

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.

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

$$\text{Lower limit is } \bar{x} - k'_2(n, p, 1 - \alpha) s_g''$$

$$\text{Upper limit is } \bar{x} + k'_2(n, p, 1 - \alpha) s_g''$$

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 13.3 and 13.8 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:

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

where

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

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

according to the formula

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

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

Table 2. Certified values and tolerance intervals for OREAS 113.

Constituent	Certified Value	Tolerance Interval 1- α =0.99, ρ =0.95	
		Low	High
Sodium Peroxide Fusion ICP			
Silver, Ag (ppm)	~25	IND	IND
Arsenic, As (ppm)	238	214	262
Cadmium, Cd (ppm)	~16	IND	IND
Cobalt, Co (ppm)	754	728	780
Copper, Cu (wt.%)	13.3	13.0	13.5
Iron, Fe (wt.%)	28.0	27.5	28.5
Lead, Pb (ppm)	248	236	261
Antimony, Sb (ppm)	7.6	5.8	9.4
Zinc, Zn (ppm)	4158	4004	4313
4-Acid Digest ICP			
Silver, Ag (ppm)	22.6	21.6	23.5
Arsenic, As (ppm)	234	225	242
Cadmium, Cd (ppm)	15.5	14.6	16.4
Cobalt, Co (ppm)	766	755	778
Copper, Cu (wt.%)	13.5	13.3	13.8
Iron, Fe (wt.%)	28.2	27.7	28.7
Lead, Pb (ppm)	230	219	241
Antimony, Sb (ppm)	8	7	9
Zinc, Zn (ppm)	4178	4108	4248

Note - intervals may appear asymmetric due to rounding; IND - indeterminate

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 113

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
SP Fusion ICP											
Ag (ppm)	~25	IND	IND	IND	IND	IND	IND	IND	IND	IND	IND
As (ppm)	238	33	171	304	138	337	14.0%	27.9%	41.9%	226	250
Cd (ppm)	~16	IND	IND	IND	IND	IND	IND	IND	IND	IND	IND
Co (ppm)	754	28	698	811	669	840	3.77%	7.54%	11.3%	717	792
Cu (wt.%)	13.3	0.5	12.3	14.3	11.8	14.8	3.74%	7.48%	11.2%	12.6	13.9
Fe (wt.%)	28.0	2.1	23.8	32.2	21.7	34.3	7.55%	15.1%	22.6%	26.6	29.4
Pb (ppm)	248	14	221	276	207	290	5.54%	11.1%	16.6%	236	261
Sb (ppm)	7.6	1.0	5.6	9.5	4.7	10.5	12.8%	25.6%	38.4%	7.2	8.0
Zn (ppm)	4158	196	3766	4551	3569	4748	4.72%	9.45%	14.2%	3951	4366
4-Acid ICP											
Ag (ppm)	22.6	1.7	19.2	25.9	17.6	27.6	7.37%	14.7%	22.1%	21.4	23.7
As (ppm)	234	13	208	260	195	272	5.48%	11.0%	16.5%	222	246
Cd (ppm)	15.5	2.0	11.5	19.5	9.5	21.5	12.8%	25.7%	38.5%	14.7	16.3
Co (ppm)	766	27	713	820	686	847	3.49%	6.99%	10.5%	728	805
Cu (wt.%)	13.5	0.4	12.8	14.3	12.4	14.6	2.74%	5.48%	8.23%	12.9	14.2
Fe (wt.%)	28.2	1.0	26.1	30.3	25.1	31.3	3.70%	7.41%	11.1%	26.8	29.6
Pb (ppm)	230	28	175	285	147	313	12.0%	24.0%	36.0%	219	242
Sb (ppm)	8	2	4	12	2	14	26.8%	53.7%	80.5%	7	8
Zn (ppm)	4178	248	3683	4673	3435	4921	5.92%	11.8%	17.8%	3969	4387

Note - intervals may appear asymmetric due to rounding; IND - indeterminate

PARTICIPATING LABORATORIES

Acme Analytical Laboratories Ltd, Vancouver, BC, Canada
Activation Laboratories, Ancaster, ONtario, Canada
ALS Chemex, Brisbane, QLD, Australia
ALS Chemex, Vancouver, BC, Canada
Amdel Limited, Adelaide, SA, Australia
Genalysis Laboratory Services Pty Ltd, Perth, WA, Australia
Intertek Testing Services, Jakarta, Indonesia
OMAC Laboratories Ltd, Loughrea, County Galway, Ireland
SGS Australia, Perth, WA, Australia
Ultra Trace Pty Ltd, Perth, WA, Australia

PREPARER AND SUPPLIER OF THE REFERENCE MATERIAL

Reference material OREAS 113 has been prepared and certified by:

*Ore Research & Exploration Pty Ltd
6-8 Gatwick Road
Bayswater North VIC 3153
AUSTRALIA*

<i>Telephone</i>	<i>(03) 9729 0333</i>	<i>International</i>	<i>+613-9729 0333</i>
<i>Facsimile</i>	<i>(03) 9729 4777</i>	<i>International</i>	<i>+613-9729 4777</i>
<i>Email</i>	<i>info@ore.com.au</i>	<i>Web</i>	<i>www.ore.com.au</i>

OREAS 113 available in 10g units sealed under a nitrogen environment in laminated foil pouches.

INTENDED USE

OREAS 113 is a reference material intended for the following:

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

STABILITY AND STORAGE INSTRUCTIONS

OREAS 113 is a reference material made from very high grade copper sulphide ore from the Tritton Copper Mine. 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.

INSTRUCTIONS FOR THE CORRECT USE OF THE REFERENCE MATERIAL

The certified values for OREAS 113 refer to the concentration level of Ag, As, Cd, Co, Cu, Fe, Pb, Sb and Zn in its packaged state. The CRM should not be dried prior to weighing and analysis.

LEGAL NOTICE

Ore Research & Exploration Pty Ltd has prepared and statistically evaluated the property values of this reference material to the best of its ability. The Purchaser by receipt hereof releases and indemnifies Ore Research & Exploration Pty Ltd from and against all liability and costs arising from the use of this material and information.

CERTIFYING OFFICER:

Craig Hamlyn (B.Sc. Hons - Geology)

REFERENCES

ISO Guide 35 (2006), Certification of reference materials - General and statistical principals.

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

APPENDIX

Analytical Data for OREAS 113

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
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

Table A2. Fusion results for Ag in OREAS 113 (abbreviations as in Table A1; values in ppm).

Replicate No.	Lab A PF*OES	Lab B PF*MS	Lab C PF*MS	Lab D PF*MS	Lab E -	Lab F -	Lab G -	Lab H -	Lab I PF*OES	Lab J -
1	<10	20.0	21.0	29.0	NR	NR	NR	NR	29.0	NR
2	<10	20.0	22.0	27.0	NR	NR	NR	NR	24.0	NR
3	< 10	20.0	22.0	30.0	NR	NR	NR	NR	21.0	NR
4	< 10	20.0	22.0	31.0	NR	NR	NR	NR	28.0	NR
5	< 10	20.0	22.0	28.0	NR	NR	NR	NR	38.0	NR
Mean		20.0	21.8	29.0					28.0	
Median		20.0	22.0	29.0					28.0	
Std.Dev.		0.0	0.4	1.6					6.4	
Rel.Std.Dev.		0.00%	2.05%	5.45%					23.0%	
PDM ³		-19.0%	-11.7%	17.4%					13.4%	

Table A3. Fusion results for As in OREAS 113 (abbreviations as in Table A1; values in ppm).

Replicate No.	Lab A PF*OES	Lab B PF*MS	Lab C PF*MS	Lab D PF*MS	Lab E -	Lab F -	Lab G PF*OES	Lab H -	Lab I PF*OES	Lab J -
1	219	240	225	290	NR	NR	300	NR	142	NR
2	210	250	224	270	NR	NR	200	NR	148	NR
3	212	230	223	290	NR	NR	300	NR	142	NR
4	251	235	222	250	NR	NR	200	NR	137	NR
5	198	250	218	280	NR	NR	200	NR	135	NR
Mean	218	241	222	276			240		141	
Median	212	240	223	280			200		142	
Std.Dev.	20	9	3	17			55		5	
Rel.Std.Dev.	9.15%	3.71%	1.21%	6.06%			22.8%		3.60%	
PDM ³	-8.34%	1.33%	-6.49%	16.0%			0.91%		-40.8%	

Table A4. Fusion results for Cd in OREAS 113 (abbreviations as in Table A1; values in ppm).

Replicate No.	Lab A PF*OES	Lab B PF*MS	Lab C PF*MS	Lab D PF*MS	Lab E -	Lab F -	Lab G -	Lab H -	Lab I PF*OES	Lab J -
1	16.0	20.0	16.0	19.0	NR	NR	NR	NR	<50	NR
2	16.0	10.0	17.0	17.7	NR	NR	NR	NR	<50	NR
3	17.0	20.0	16.0	18.4	NR	NR	NR	NR	<50	NR
4	16.0	10.0	16.0	17.9	NR	NR	NR	NR	<50	NR
5	16.0	20.0	17.0	17.7	NR	NR	NR	NR	<50	NR
Mean	16.2	16.0	16.4	18.1						
Median	16.0	20.0	16.0	17.9						
Std.Dev.	0.4	5.5	0.5	0.6						
Rel.Std.Dev.	2.76%	34.23%	3.34%	3.08%						
PDM ³	0.00%	-1.23%	1.23%	12.0%						

Table A5. Fusion results for Co in OREAS 113 (abbreviations as in Table A1; values in ppm).

Replicate No.	Lab A PF*OES	Lab B PF*OES	Lab C NR	Lab D PF*MS	Lab E -	Lab F -	Lab G PF*OES	Lab H -	Lab I PF*OES	Lab J -
1	722	780	NR	795	NR	NR	740	NR	NR	NR
2	724	780	NR	775	NR	NR	750	NR	NR	NR
3	722	780	NR	792	NR	NR	730	NR	NR	NR
4	731	800	NR	749	NR	NR	720	NR	NR	NR
5	718	780	NR	759	NR	NR	740	NR	NR	NR
Mean	723	784		774			736			
Median	722	780		775			740			
Std.Dev.	5	9		20			11			
Rel.Std.Dev.	0.66%	1.14%		2.60%			1.55%			
PDM ³	-4.10%	3.93%		2.60%			-2.43%			

Table A6. Fusion results for Cu in OREAS 113 (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 PF*OES	Lab F PF*OES	Lab G PF*OES	Lab H -	Lab I PF*OES	Lab J -
1	13.0	12.9	14.0	>10	12.5	13.0	13.4	NR	11.3	NR
2	13.3	13.5	14.2	>10	12.6	13.4	13.5	NR	11.2	NR
3	13.2	13.0	14.2	>10	12.6	13.3	13.2	NR	11.3	NR
4	13.3	13.4	14.3	>10	12.1	13.1	13.2	NR	11.3	NR
5	13.4	13.4	14.2	>10	12.5	13.0	13.2	NR	11.4	NR
Mean	13.2	13.2	14.2		12.5	13.1	13.3		11.3	
Median	13.3	13.4	14.2		12.5	13.1	13.2		11.3	
Std.Dev.	0.2	0.3	0.1		0.2	0.2	0.2		0.1	
Rel.Std.Dev.	1.15%	2.04%	0.74%		1.61%	1.39%	1.21%		0.65%	
PDM ³	-0.24%	-0.24%	6.83%		-6.02%	-1.06%	0.07%		-14.9%	

Table A7. Fusion results for Fe in OREAS 113 (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 PF*OES	Lab F PF*OES	Lab G PF*OES	Lab H -	Lab I PF*OES	Lab J -
1	27.2	28.6	28.9	29.9	24.7	26.5	26.6	NR	31.6	NR
2	27.2	29.3	29.8	29.9	25.2	27.2	26.6	NR	32.0	NR
3	27.1	28.6	29.4	30.8	25.1	26.4	26.3	NR	31.9	NR
4	27.1	28.7	29.3	27.7	24.5	26.0	26.6	NR	32.1	NR
5	27.1	29.0	28.7	27.9	24.8	25.8	26.4	NR	33.0	NR
Mean	27.1	28.8	29.2	29.2	24.9	26.4	26.5		32.1	
Median	27.1	28.7	29.3	29.9	24.8	26.4	26.6		32.0	
Std.Dev.	0.1	0.3	0.4	1.4	0.3	0.5	0.1		0.5	
Rel.Std.Dev.	0.20%	1.06%	1.47%	4.67%	1.14%	2.05%	0.53%		1.61%	
PDM ³	-3.05%	3.02%	4.33%	4.45%	-11.2%	-5.77%	-5.34%		14.8%	

Table A8. Fusion results for Pb in OREAS 113 (abbreviations as in Table A1; values in ppm).

Replicate No.	Lab A PF*OES	Lab B PF*MS	Lab C PF*MS	Lab D PF*MS	Lab E -	Lab F -	Lab G PF*OES	Lab H -	Lab I PF*OES	Lab J -
1	233	250	281	259	NR	NR	200	NR	NR	NR
2	236	260	276	251	NR	NR	200	NR	NR	NR
3	235	250	254	264	NR	NR	200	NR	NR	NR
4	237	240	247	251	NR	NR	100	NR	NR	NR
5	236	230	243	248	NR	NR	200	NR	NR	NR
Mean	235	246	260	255			180			
Median	236	250	254	251			200			
Std.Dev.	2	11	17	7			45			
Rel.Std.Dev.	0.64%	4.63%	6.63%	2.61%			24.8%			
PDM ³	-5.26%	-0.99%	4.72%	2.47%			-27.6%			

Table A9. Fusion results for Sb in OREAS 113 (abbreviations as in Table A1; values in ppm).

Replicate No.	Lab A PF*OES	Lab B PF*MS	Lab C PF*MS	Lab D PF*MS	Lab E -	Lab F -	Lab G -	Lab H -	Lab I PF*OES	Lab J -
1	7.0	8.0	6.9	8.3	NR	NR	NR	NR	60.0	NR
2	7.0	8.0	7.0	10.3	NR	NR	NR	NR	83.0	NR
3	7.0	8.0	6.7	8.7	NR	NR	NR	NR	114.0	NR
4	7.0	8.0	6.8	26.2	NR	NR	NR	NR	70.0	NR
5	7.0	6.0	6.9	8.2	NR	NR	NR	NR	60.0	NR
Mean	7.0	7.6	6.9	12.3					77.4	
Median	7.0	8.0	6.9	8.7					70.0	
Std.Dev.	0.0	0.9	0.1	7.8					22.5	
Rel.Std.Dev.	0.00%	11.8%	1.66%	63.2%					29.1%	
PDM ³	-7.70%	0.21%	-9.54%	62.7%					921%	

Table A10. Fusion results for Zn in OREAS 113 (abbreviations as in Table A1; values in ppm).

Replicate No.	Lab A PF*OES	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 -	Lab I PF*OES	Lab J -
1	4100	4060	4340	4130	3900	4500	4000	NR	4710	NR
2	4200	4000	4375	4060	4000	4600	4000	NR	4522	NR
3	4200	4120	4363	4250	4300	4500	4000	NR	4675	NR
4	4100	4140	4284	3800	11100	4400	4100	NR	4593	NR
5	4200	4100	4319	3780	3900	4300	4100	NR	4731	NR
Mean	4160	4084	4336	4004	5440	4460	4040		4646	
Median	4200	4100	4340	4060	4000	4500	4000		4675	
Std.Dev.	55	55	36	207	3168	114	55		87	
Rel.Std.Dev.	1.32%	1.36%	0.84%	5.17%	58.2%	2.56%	1.36%		1.87%	
PDM ³	0.04%	-1.79%	4.27%	-3.71%	30.8%	7.25%	-2.85%		11.7%	

Table A11. 4-acid results for Ag in OREAS 113 (abbreviations as in Table A1; values in ppm).

Replicate No.	Lab A 4A*MS	Lab B 4A*MS	Lab C 4A*MS	Lab D 4A*OES	Lab E 4A*OES	Lab F 4A*OES	Lab G 4A*OES	Lab H 4A*OES	Lab I MAR*OES	Lab J 4A*OES
1	20.0	23.0	24.0	34.0	21.0	24.0	24.1	21.5	21.0	22.7
2	20.0	24.0	24.0	33.0	22.0	25.0	23.8	21.6	21.1	22.8
3	20.0	24.5	24.0	31.0	20.0	26.0	24.4	21.1	21.6	23.0
4	20.0	24.0	23.0	35.0	23.0	25.0	23.4	22.0	20.6	22.7
5	20.0	23.0	24.0	29.0	21.0	25.0	23.7	21.2	20.8	22.8
Mean	20.0	23.7	23.8	32.4	21.4	25.0	23.9	21.5	21.0	22.8
Median	20.0	24.0	24.0	33.0	21.0	25.0	23.8	21.5	21.0	22.8
Std.Dev.	0.0	0.7	0.4	2.4	1.1	0.7	0.4	0.4	0.4	0.1
Rel.Std.Dev.	0.00%	2.83%	1.88%	7.43%	5.33%	2.83%	1.61%	1.66%	1.87%	0.52%
PDM ³	-11.36%	5.04%	5.48%	43.60%	-5.16%	10.80%	5.84%	-4.80%	-6.82%	0.98%

Table A12. 4-acid results for As in OREAS 113 (abbreviations as in Table A1; values in ppm).

Replicate No.	Lab A 4A*MS	Lab B 4A*MS	Lab C 4A*MS	Lab D 4A*OES	Lab E 4A*OES	Lab F 4A*OES	Lab G 4A*OES	Lab H 4A*OES	Lab I MAR*OES	Lab J 4A*OES
1	180	235	251	NR	<200	230	224	231	219	223
2	180	245	242	NR	<200	250	237	229	217	226
3	190	245	247	NR	<200	270	232	227	222	220
4	150	235	256	NR	<200	240	218	231	223	221
5	210	245	245	NR	<200	250	225	221	222	225
Mean	182	241	248			248	227	228	221	223
Median	180	245	247			250	225	229	222	223
Std.Dev.	22	5	5			15	7	4	3	2
Rel.Std.Dev.	11.9%	2.27%	2.20%			5.98%	3.26%	1.82%	1.14%	1.06%
PDM ³	-22.2%	3.02%	6.09%			6.01%	-2.88%	-2.63%	-5.70%	-4.63%

Table A13. 4-acid results for Cd in OREAS 113 (abbreviations as in Table A1; values in ppm).

Replicate No.	Lab A 4A*MS	Lab B 4A*MS	Lab C 4A*MS	Lab D 4A*OES	Lab E 4A*OES	Lab F 4A*OES	Lab G 4A*OES	Lab H 4A*OES	Lab I MAR*OES	Lab J 4A*OES
1	20.0	16.0	17.0	15.8	20.0	20.0	15.5	16.0	14.7	13.9
2	20.0	16.0	17.0	15.6	20.0	20.0	15.5	16.0	15.1	13.9
3	10.0	16.0	17.0	15.0	10.0	20.0	15.5	14.0	14.9	13.5
4	20.0	16.0	17.0	16.5	20.0	20.0	14.8	16.0	15.0	14.3
5	20.0	16.5	17.0	14.5	10.0	20.0	15.1	15.0	15.1	14.1
Mean	18.0	16.1	17.0	15.5	16.0	20.0	15.3	15.4	15.0	13.9
Median	20.0	16.0	17.0	15.6	20.0	20.0	15.5	16.0	15.0	13.9
Std.Dev.	4.5	0.2	0.0	0.8	5.5	0.0	0.3	0.9	0.2	0.3
Rel.Std.Dev.	24.8%	1.39%	0.00%	4.95%	34.2%	0.00%	2.09%	5.81%	1.20%	2.25%
PDM ³	16.0%	3.73%	9.53%	-0.26%	3.09%	28.9%	-1.55%	-0.78%	-3.57%	-10.2%

Table A14. 4-acid results for Co in OREAS 113 (abbreviations as in Table A1; values in ppm).

Replicate No.	Lab A 4A*MS	Lab B 4A*OES	Lab C 4A*MS	Lab D 4A*OES	Lab E 4A*OES	Lab F 4A*OES	Lab G 4A*OES	Lab H 4A*OES	Lab I MAR*OES	Lab J 4A*OES
1	790	755	815	593	740	720	700	765	762	758
2	800	765	802	584	730	740	700	756	757	759
3	790	750	806	562	730	800	711	737	759	761
4	830	760	805	625	740	760	678	764	754	759
5	800	750	806	552	740	780	682	734	762	761
Mean	802	756	807	583	736	760	694	751	759	760
Median	800	755	806	584	740	760	700	756	759	759
Std.Dev.	16	7	5	29	5	32	14	15	3	1
Rel.Std.Dev.	2.05%	0.86%	0.60%	4.90%	0.74%	4.16%	1.99%	1.97%	0.45%	0.19%
PDM ³	4.66%	-1.34%	5.29%	-23.9%	-3.95%	-0.82%	-9.41%	-1.97%	-0.98%	-0.88%

Table A15. 4-acid results for Cu in OREAS 113 (abbreviations as in Table A1; values in wt.%).

Replicate No.	Lab A 4A*OES	Lab B 4A*OES	Lab C 4A*OES	Lab D 4A*AAS	Lab E 4A*OES	Lab F 4A*OES	Lab G 4A*OES	Lab H 4A*OES	Lab I MAR*OES	Lab J 4A*OES
1	13.3	12.9	14.2	13.6	13.4	13.8	13.1	12.5	13.3	13.4
2	13.4	12.9	14.2	13.7	12.7	13.8	13.2	12.4	13.4	13.6
3	13.2	13.1	14.2	13.8	13.5	13.9	13.4	12.2	13.4	13.0
4	13.9	13.2	14.3	14.1	13.3	13.5	13.4	12.6	13.5	13.1
5	13.8	13.4	14.1	14.0	13.7	13.9	13.5	12.3	13.5	13.2
Mean	13.5	13.1	14.2	13.8	13.3	13.8	13.3	12.4	13.4	13.2
Median	13.4	13.1	14.2	13.8	13.4	13.8	13.4	12.4	13.4	13.2
Std.Dev.	0.3	0.2	0.1	0.2	0.4	0.2	0.2	0.2	0.1	0.2
Rel.Std.Dev.	2.30%	1.62%	0.37%	1.50%	2.70%	1.34%	1.35%	1.28%	0.44%	1.68%
PDM ³	-0.12%	-3.22%	4.86%	2.25%	-1.56%	1.58%	-1.89%	-8.39%	-0.91%	-2.11%

Table A16. 4-acid results for Fe in OREAS 113 (abbreviations as in Table A1; values in wt.%).

Replicate No.	Lab A 4A*MS	Lab B 4A*OES	Lab C 4A*OES	Lab D 4A*OES	Lab E 4A*OES	Lab F 4A*AAS	Lab G 4A*OES	Lab H 4A*OES	Lab I MAR*OES	Lab J 4A*OES
1	28.1	29.0	29.6	28.7	28.6	27.8	26.7	27.1	29.1	27.4
2	28.2	28.6	29.4	28.2	26.9	28.6	26.5	27.0	28.4	27.6
3	27.8	28.0	29.3	27.2	28.7	30.9	26.6	27.4	28.6	27.5
4	28.6	29.2	29.5	30.1	28.5	29.4	25.1	26.9	28.3	27.4
5	28.1	28.1	29.4	25.8	28.5	29.9	25.2	27.2	28.3	27.7
Mean	28.2	28.6	29.4	28.0	28.3	29.3	26.0	27.1	28.5	27.5
Median	28.1	28.6	29.4	28.2	28.5	29.4	26.5	27.1	28.4	27.5
Std.Dev.	0.3	0.5	0.1	1.6	0.8	1.2	0.8	0.2	0.3	0.1
Rel.Std.Dev.	1.02%	1.86%	0.44%	5.76%	2.75%	4.06%	3.07%	0.71%	1.11%	0.53%
PDM ³	-0.10%	1.39%	4.43%	-0.67%	0.27%	4.01%	-7.70%	-3.79%	1.26%	-2.37%

Table A17. 4-acid results for Pb in OREAS 113 (abbreviations as in Table A1; values in ppm).

Replicate No.	Lab A 4A*MS	Lab B 4A*MS	Lab C 4A*MS	Lab D 4A*OES	Lab E 4A*OES	Lab F 4A*OES	Lab G 4A*OES	Lab H 4A*OES	Lab I MAR*OES	Lab J 4A*OES
1	240	237	240	234	300	250	226	195	340	192
2	240	228	234	232	200	250	224	198	330	196
3	250	237	245	222	200	280	227	206	340	198
4	250	236	258	248	200	270	215	215	340	195
5	250	230	243	216	300	270	219	194	330	198
Mean	246	234	244	230	240	264	222	202	336	196
Median	250	236	243	232	200	270	224	198	340	196
Std.Dev.	5	4	9	12	55	13	5	9	5	3
Rel.Std.Dev.	2.23%	1.83%	3.63%	5.33%	22.82%	5.08%	2.28%	4.39%	1.63%	1.28%
PDM ³	6.92%	1.53%	6.05%	0.14%	4.31%	14.7%	-3.43%	-12.4%	46.0%	-14.9%

Table A18. 4-acid results for Sb in OREAS 113 (abbreviations as in Table A1; values in ppm).

Replicate No.	Lab A 4A*MS	Lab B 4A*MS	Lab C 4A*MS	Lab D 4A*OES	Lab E 4A*OES	Lab F 4A*OES	Lab G 4A*OES	Lab H 4A*OES	Lab I MAR*OES	Lab J 4A*OES
1	10.0	6.8	6.1	NR	<100	<50	<5	11.0	<50	<5
2	10.0	7.0	5.8	NR	<100	<50	<5	10.0	<50	5.0
3	10.0	7.0	6.3	NR	<100	<50	<5	10.0	<50	<5
4	10.0	6.8	6.0	NR	<100	<50	<5	11.0	<50	<5
5	10.0	7.0	6.5	NR	<100	<50	<5	11.0	<50	<5
Mean	10.0	6.9	6.1					10.6		5.0
Median	10.0	7.0	6.1					11.0		5.0
Std.Dev.	0.0	0.1	0.3					0.5		
Rel.Std.Dev.	0.00%	1.58%	4.40%					5.17%		
PDM ³	29.3%	-10.5%	-20.6%					37.1%		-35.3%

Table A19. 4-acid results for Zn in OREAS 113 (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*OES	Lab F 4A*OES	Lab G 4A*OES	Lab H 4A*OES	Lab I MAR*OES	Lab J 4A*OES
1	4510	4030	4390	3980	4300	4250	3940	3880	4270	4100
2	4570	4100	4384	4080	4000	4410	3930	3890	4180	4096
3	4460	4110	4267	3790	4300	4740	3970	3850	4200	4107
4	4580	4110	4389	4250	4200	4520	3800	3950	4130	4129
5	4510	4100	4387	3710	4300	4620	3880	3840	4130	4089
Mean	4526	4090	4363	3962	4220	4508	3904	3882	4182	4104
Median	4510	4100	4387	3980	4300	4520	3930	3880	4180	4100
Std.Dev.	49	34	54	218	130	189	67	43	58	15
Rel.Std.Dev.	1.09%	0.83%	1.24%	5.50%	3.09%	4.19%	1.70%	1.11%	1.39%	0.37%
PDM ³	8.33%	-2.11%	4.44%	-5.17%	1.00%	7.90%	-6.56%	-7.09%	0.09%	-1.77%