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

OREAS
Certified Reference Materials

CERTIFICATE OF ANALYSIS FOR

BASALT BLANK CHIP
CERTIFIED REFERENCE MATERIAL
OREAS 26a

Table 1. Certified Values, SDs, 95% Confidence and Tolerance Limits for OREAS 26a

Constituent	Certified Value	1SD	95% Confidence Limits		95% Tolerance Limits	
			Low	High	Low	High
Fire Assay						
Gold, Au (ppb)	< 1	IND	IND	IND	IND	IND
4-Acid Digestion						
Barium, Ba (ppm)	281	13.5	273	289	263	298
Cadmium, Cd (ppm)	0.052	0.010	0.044	0.061	IND	IND
Cobalt, Co (ppm)	46.1	2.57	44.2	48.1	44.5	47.8
Copper, Cu (ppm)	50	4.6	47	53	48	52
Iron, Fe (wt.%)	7.76	0.419	7.37	8.15	7.57	7.95
Molybdenum, Mo (ppm)	1.50	0.073	1.46	1.54	1.42	1.57
Nickel, Ni (ppm)	163	12.2	155	171	158	168
Lead, Pb (ppm)	2.73	0.35	2.48	2.98	2.46	3.00
Tin, Sn (ppm)	1.57	0.122	1.47	1.68	IND	IND
Thorium, Th (ppm)	2.75	0.112	2.69	2.81	2.62	2.88
Uranium, U (ppm)	0.72	0.049	0.69	0.74	0.63	0.80
Tungsten, W (ppm)	0.50	0.048	0.45	0.55	IND	IND
Zinc, Zn (ppm)	107	4.8	103	110	104	110

Note: intervals may appear asymmetric due to rounding.

INTRODUCTION

OREAS certified 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 mine grade control. To the analyst they provide an effective means of calibrating analytical equipment, assessing new techniques and routinely monitoring in-house procedures.

SOURCE MATERIALS

OREAS 26a is a basalt blank chip certified reference material (CRM) supplied, prepared and certified by Ore Research & Exploration. The material was sourced from a quarry containing fresh olivine tholeiite (Newer Volcanics Province), near Melbourne in Australia.

COMMINUTION AND HOMOGENISATION PROCEDURES

The material constituting OREAS 26a was prepared in the following manner:

- drying to constant mass at 105° C;
- crushing to nominal minus 6 mm;
- packaging in 500g units into sealed robust barrier bags. 20kg buckets and 200kg drums are also available.

ANALYTICAL PROGRAM

Ten commercial analytical laboratories participated in the program to characterise the elements reported in Table 1. The following methods were employed:

- Au via 25-40g fire assay with ICP-MS (5 labs) or ICP-OES (4 labs) finish
- Ba, Cd, Co, Cu, Fe, Mo, Ni, Pb, Sn, Th, U, W and Zn via four acid digestion (HNO_3-$HClO_4$-HCl-HF) with ICP-OES and ICP-MS finish (10 labs)

For the round robin program the samples were taken at 6 predetermined sampling intervals during packaging and are considered representative of the entire batch of OREAS 26a. Five 50g samples were submitted to each laboratory for analysis. Table 1 presents the certified values together with their associated 1SD's, 95% confidence and tolerance limits and Table 2 shows indicative values for the major and trace elements determined by borate fusion XRF (Al_2O_3 to Zn) 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; i) the number of laboratories reporting a particular analyte is insufficient (< 5) to support certification; ii) inter-laboratory consensus is poor; or iii) a significant proportion of results are outlying or reported as less than detection limits. Table 3 provides performance gate intervals for the certified values based on their 1SD's. Tabulated results of all elements together with analytical method codes, uncorrected means, medians, standard deviations, relative standard deviations and per cent deviation of lab means from the corrected mean of means (PDM^3) are presented in the detailed certification data for this CRM (**OREAS 26a Datapack.xlsx**).

Table 2. Indicative Values for OREAS 26a

Constituent	Unit	Value	Constituent	Unit	Value	Constituent	Unit	Value
Fire Assay								
Pd	ppb	< 1	Pt	ppb	< 1			
Borate Fusion XRF								
Al_2O_3	wt.%	*14.44*	Fe_2O_3	wt.%	*11.35*	Pb	ppm	*12.5*
As	ppm	*< 10*	K_2O	wt.%	*0.732*	SiO_2	wt.%	*51.59*
Ba	ppm	*300*	MgO	wt.%	*7.27*	Sn	ppm	*12.5*
CaO	wt.%	*8.60*	MnO	wt.%	*0.150*	SO_3	wt.%	*0.035*
Co	ppm	*50*	Na_2O	wt.%	*3.13*	TiO_2	wt.%	*1.81*
Cr	ppm	*290*	Ni	ppm	*170*	U	ppm	*< 10*
Cu	ppm	*60*	P_2O_5	wt.%	*0.317*	Zn	ppm	*120*
Thermogravimetry								
LOI^{1000}	wt.%	*0.500*						
Laser Ablation ICP-MS								
Ag	ppm	*< 0.1*	Ho	ppm	*0.85*	Sn	ppm	*2.50*
As	ppm	*0.50*	In	ppm	*0.038*	Sr	ppm	*399*
Ba	ppm	*268*	La	ppm	*17.8*	Ta	ppm	*1.20*
Be	ppm	*1.40*	Lu	ppm	*0.23*	Tb	ppm	*0.77*
Bi	ppm	*< 0.02*	Mn	wt.%	*0.106*	Te	ppm	*0.50*
Cd	ppm	*< 0.1*	Mo	ppm	*1.20*	Th	ppm	*2.77*
Ce	ppm	*34.1*	Nb	ppm	*18.6*	Ti	wt.%	*1.07*
Co	ppm	*47.5*	Nd	ppm	*20.0*	Tl	ppm	*< 0.2*
Cr	ppm	*277*	Ni	ppm	*149*	Tm	ppm	*0.28*
Cs	ppm	*0.88*	Pb	ppm	*2.00*	U	ppm	*0.85*
Cu	ppm	*46.0*	Pr	ppm	*4.59*	V	ppm	*157*
Dy	ppm	*4.43*	Rb	ppm	*20.9*	W	ppm	*0.33*
Er	ppm	*2.11*	Re	ppm	*< 0.01*	Y	ppm	*23.0*
Eu	ppm	*1.72*	Sb	ppm	*0.075*	Yb	ppm	*1.52*
Ga	ppm	*20.7*	Sc	ppm	*20.7*	Zn	ppm	*95*
Gd	ppm	*5.11*	Se	ppm	*< 5*	Zr	ppm	*127*
Hf	ppm	*3.58*	Sm	ppm	*5.24*			
4-Acid Digestion								
Ag	ppm	0.068	Ho	ppm	0.80	Sb	ppm	0.075
Al	wt.%	7.55	In	ppm	0.051	Sc	ppm	20.2
As	ppm	< 1	K	wt.%	0.599	Se	ppm	1.27
Be	ppm	0.98	La	ppm	19.4	Sm	ppm	4.56
Bi	ppm	0.017	Li	ppm	8.27	Sr	ppm	409
Ca	wt.%	6.03	Lu	ppm	0.20	Ta	ppm	1.22
Ce	ppm	36.8	Mg	wt.%	4.31	Tb	ppm	0.76
Cr	ppm	219	Mn	wt.%	0.108	Te	ppm	< 2
Cs	ppm	0.78	Na	wt.%	2.30	Ti	wt.%	1.05
Dy	ppm	4.26	Nb	ppm	20.2	Tl	ppm	0.079
Er	ppm	2.06	Nd	ppm	18.9	Tm	ppm	0.30
Eu	ppm	1.55	P	wt.%	0.134	V	ppm	156
Ga	ppm	20.5	Pr	ppm	4.64	Y	ppm	21.9
Gd	ppm	4.92	Rb	ppm	21.3	Yb	ppm	1.66
Ge	ppm	0.23	Re	ppm	< 0.01	Zr	ppm	140
Hf	ppm	3.56	S	wt.%	0.025			

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.

STATISTICAL ANALYSIS

Certified Values, Standard Deviations, Confidence and Tolerance Limits have been determined for each analytical method following removal of individual and laboratory outliers (Table 1). Certified Values are the mean of means after outlier filtering. The 95% Confidence Limit 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. It should not be used as a control limit for laboratory performance.

Standard Deviation values (1SDs) are reported in Table 1 and 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 uncertainty and CRM variability. For an effective CRM the contribution of the latter should be negligible in comparison to measurement errors. The Standard Deviation values include all sources of measurement uncertainty: between-lab variance, within-run variance (precision errors) and CRM variability. The SD for each analyte's certified value is calculated from the same filtered data set used to determine the certified value, i.e. after removal of all individual, lab dataset (batch) and 3SD outliers (single iteration). 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 accepted analyses generated from the certification program.

Performance Gates (Table 3) are 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 per cent 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.

Tolerance Limits (ISO Guide 3207) were determined using an analysis of precision errors method and are considered a conservative estimate of true homogeneity. The meaning of tolerance limits may be illustrated for copper where 99% of the time ($1-\alpha=0.99$) at least 95% of subsamples ($\rho=0.95$) will have concentrations lying between 48 and 52 ppm. 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).

Based on the statistical analysis of the results of the inter-laboratory certification program it can be concluded that OREAS 26a is fit-for-purpose as a certified reference material (see 'Intended Use' below).

Table 3. Performance Gates for OREAS 26a

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
Fire Assay											
Au, ppb	< 1	IND	IND	IND	IND	IND	IND	IND	IND	IND	IND
4-Acid Digestion											
Ba, ppm	281	13.5	254	308	240	321	4.82%	9.65%	14.47%	267	295
Cd, ppm	0.052	0.010	0.033	0.072	0.023	0.082	18.65%	37.29%	55.94%	0.050	0.055
Co, ppm	46.1	2.57	41.0	51.3	38.4	53.8	5.56%	11.12%	16.68%	43.8	48.5
Cu, ppm	50	4.6	41	59	36	64	9.25%	18.49%	27.74%	48	53
Fe, wt.%	7.76	0.419	6.93	8.60	6.51	9.02	5.40%	10.79%	16.19%	7.38	8.15
Mo, ppm	1.50	0.073	1.35	1.64	1.28	1.72	4.85%	9.70%	14.55%	1.42	1.57
Ni, ppm	163	12.2	139	187	126	199	7.46%	14.92%	22.38%	155	171
Pb, ppm	2.73	0.35	2.03	3.43	1.68	3.78	12.80%	25.60%	38.41%	2.59	2.87
Sn, ppm	1.57	0.122	1.33	1.82	1.21	1.94	7.72%	15.44%	23.17%	1.50	1.65
Th, ppm	2.75	0.112	2.53	2.98	2.41	3.09	4.08%	8.16%	12.25%	2.61	2.89
U, ppm	0.72	0.049	0.62	0.81	0.57	0.86	6.78%	13.56%	20.35%	0.68	0.75
W, ppm	0.50	0.048	0.40	0.60	0.36	0.64	9.62%	19.24%	28.86%	0.47	0.52
Zn, ppm	107	4.8	97	116	92	121	4.53%	9.06%	13.59%	101	112

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, Brisbane, QLD, Australia
4. ALS, Callao, Lima, Peru
5. ALS, Vancouver, BC, Canada
6. BV Amdel, Adelaide, SA, Australia
7. BV Ultra Trace, Perth, WA, Australia
8. Intertek Genalysis, Perth, WA, Australia
9. SGS Mineral Services, Booysens, Gauteng, South Africa
10. SGS Mineral Services, Toronto, Ontario, Canada

PREPARER AND SUPPLIER

Certified reference material OREAS 26a is prepared, certified and supplied by:

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

It is available in 500g units sealed in robust barrier bags, 20kg buckets and 200kg drums.

INTENDED USE

OREAS 26a is intended for the following uses:

- for the monitoring of laboratory performance in the analysis of Au, Ba, Cd, Co, Cu, Fe, Mo, Ni, Pb, Sn, Th, U, W and Zn in geological samples
- for the verification of analytical methods for Au, Ba, Cd, Co, Cu, Fe, Mo, Ni, Pb, Sn, Th, U, W and Zn
- for the calibration of instruments used in the determination of the concentration of Au, Ba, Cd, Co, Cu, Fe, Mo, Ni, Pb, Sn, Th, U, W and Zn

STABILITY AND STORAGE INSTRUCTIONS

OREAS 26a was prepared from fresh alkali olivine basalt chip samples from the Newer Volcanics Province, Victoria, Australia. To ensure a long shelf life it has been sealed in robust plastic barrier bags. In its unopened state under normal conditions of storage it has a shelf life beyond ten years.

INSTRUCTIONS FOR CORRECT USE

The certified values for OREAS 26a refer to the concentration level in its packaged state. 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.

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) for a particular analytical method, analyte or analyte suite, and sample matrix. Most of these laboratories have and maintain ISO 17025 accreditation. The certified and non-certified (indicative) values presented in this report are calculated from the means of accepted data following robust statistical treatment as detailed in this report.

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.

QMS ACCREDITED

ORE Pty Ltd is accredited to ISO 9001:2008 by Lloyd's Register Quality Assurance Ltd for its quality management system including development, manufacturing, certification and supply of CRMs.

CERTIFYING OFFICER

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

REFERENCES

ISO Guide 30 (1992), Terms and definitions used in connection with reference materials.

ISO Guide 31 (2000), Reference materials – Contents of certificates and labels.

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

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