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CERTIFICATE OF ANALYSIS FOR

RHYODACITE BLANK CHIP
CERTIFIED REFERENCE MATERIAL
OREAS C27c

Table 1. Certified Values, SDs, 95% Confidence and Tolerance Limits for OREAS C27c.

Constituent	Certified Value	1SD	95% Confidence Limits		95% Tolerance Limits	
			Low	High	Low	High
Fire Assay						
Au, Gold (ppb)	< 2	IND	IND	IND	IND	IND
4-Acid Digestion						
Al, Aluminium (wt.%)	7.51	0.202	7.42	7.60	7.32	7.70
Ba, Barium (ppm)	3001	148	2896	3105	2930	3071
Be, Beryllium (ppm)	3.26	0.124	3.19	3.33	3.12	3.40
Bi, Bismuth (ppm)	0.10	0.01	0.10	0.11	IND	IND
Ca, Calcium (wt.%)	1.31	0.042	1.28	1.33	1.25	1.36
Cd, Cadmium (ppm)	0.40	0.030	0.38	0.42	0.35	0.45
Ce, Cerium (ppm)	92	6.4	88	96	87	96
Co, Cobalt (ppm)	2.74	0.39	2.63	2.85	1.94	3.54
Cs, Cesium (ppm)	7.45	0.349	7.24	7.67	7.11	7.80
Cu, Copper (ppm)	7.49	1.66	6.47	8.52	5.61	9.38
Dy, Dysprosium (ppm)	3.64	0.259	3.38	3.89	3.46	3.81
Er, Erbium (ppm)	0.98	0.077	0.90	1.06	0.92	1.04
Eu, Europium (ppm)	1.48	0.26	1.20	1.75	1.40	1.55
Fe, Iron (wt.%)	2.61	0.170	2.53	2.70	2.47	2.75
Ga, Gallium (ppm)	23.1	0.83	22.5	23.7	22.1	24.1
Gd, Gadolinium (ppm)	6.33	0.511	5.86	6.80	5.87	6.79
Hf, Hafnium (ppm)	5.70	0.331	5.48	5.93	5.46	5.95
In, Indium (ppm)	0.062	0.003	0.061	0.064	IND	IND
K, Potassium (wt.%)	3.12	0.153	3.03	3.21	3.03	3.21

Note: Intervals may appear asymmetric due to rounding.

Table 1 continued.

Constituent	Certified Value	1SD	95% Confidence Limits		95% Tolerance Limits	
			Low	High	Low	High
4-Acid Digestion continued						
La, Lanthanum (ppm)	45.4	3.73	43.0	47.9	42.7	48.2
Li, Lithium (ppm)	37.6	2.75	35.6	39.6	36.0	39.2
Lu, Lutetium (ppm)	0.068	0.010	0.056	0.080	IND	IND
Mg, Magnesium (wt.%)	0.160	0.014	0.153	0.167	IND	IND
Mn, Manganese (wt.%)	0.033	0.002	0.032	0.034	0.030	0.036
Mo, Molybdenum (ppm)	3.64	0.46	3.39	3.89	2.93	4.35
Na, Sodium (wt.%)	2.59	0.105	2.52	2.65	2.47	2.70
Nb, Niobium (ppm)	19.7	1.13	19.0	20.4	19.0	20.5
Nd, Neodymium (ppm)	40.6	2.14	38.5	42.7	38.4	42.8
Ni, Nickel (ppm)	4.62	0.89	4.19	5.05	3.25	5.99
P, Phosphorus (wt.%)	0.036	0.003	0.034	0.038	0.033	0.039
Pb, Lead (ppm)	27.9	2.24	26.6	29.3	26.3	29.6
Pr, Praseodymium (ppm)	11.2	0.44	10.6	11.7	10.6	11.8
Rb, Rubidium (ppm)	150	6	146	153	144	155
S, Sulphur (wt.%)	0.009	0.002	0.008	0.010	IND	IND
Sb, Antimony (ppm)	1.22	0.13	1.14	1.30	1.09	1.35
Sc, Scandium (ppm)	4.21	0.325	4.04	4.39	4.01	4.42
Sm, Samarium (ppm)	7.81	0.231	7.59	8.04	7.40	8.23
Sn, Tin (ppm)	3.98	0.145	3.88	4.08	3.81	4.14
Sr, Strontium (ppm)	186	8	181	191	180	192
Ta, Tantalum (ppm)	1.46	0.050	1.42	1.51	1.40	1.53
Tb, Terbium (ppm)	0.82	0.044	0.78	0.86	0.78	0.86
Th, Thorium (ppm)	15.3	1.01	14.7	15.9	14.5	16.1
Ti, Titanium (wt.%)	0.121	0.006	0.117	0.125	0.114	0.127
Tl, Thallium (ppm)	0.87	0.060	0.83	0.91	0.83	0.90
U, Uranium (ppm)	5.94	0.378	5.71	6.17	5.68	6.20
V, Vanadium (ppm)	5.19	1.09	4.62	5.76	IND	IND
W, Tungsten (ppm)	2.08	0.206	1.96	2.19	1.81	2.34
Y, Yttrium (ppm)	15.0	0.93	14.4	15.5	14.4	15.6
Yb, Ytterbium (ppm)	0.54	0.040	0.51	0.58	IND	IND
Zn, Zinc (ppm)	118	3	116	120	114	122
Zr, Zirconium (ppm)	211	18	197	225	204	218

Note: Intervals may appear asymmetric due to rounding.

Table 2. Indicative Values for OREAS C27c.

Constituent	Unit	Value	Constituent	Unit	Value	Constituent	Unit	Value
Fire Assay								
Pd	ppb	*< 0.5*	Pt	ppb	*< 0.5*			
4-Acid Digestion								
Ag	ppm	*0.235*	Hg	ppm	*< 0.01*	Te	ppm	*< 0.05*
As	ppm	*3.19*	Ho	ppm	*0.50*	Tm	ppm	*0.10*
Cr	ppm	*159*	Re	ppm	*< 0.002*			
Ge	ppm	*0.19*	Se	ppm	*1.00*			

Note: Intervals may appear asymmetric due to rounding.

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.

SOURCE MATERIALS

OREAS C27c is a rhyodacite blank chip certified reference material (CRM) supplied, prepared and certified by Ore Research & Exploration Pty Ltd. The material was sourced from a quarry east of Melbourne (Victoria), Australia. Table 1 above contains 52 certified values by full ICP-OES/MS suite by 4-acid digestion and Au by fire assay. The analytical data for these analytes have been processed by robust statistical procedures to determine certified values, 95% confidence intervals and tolerance limits. Indicative values for 12 additional elements are also provided (Table 2). Performance gates (based on the pooled SD) are also provided as a guide to QC monitoring (Table 3). Tabulated round robin laboratory 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 C27c DataPack.xlsx**).

COMMINUTION AND HOMOGENISATION PROCEDURES

The material constituting OREAS C27c was prepared in the following manner:

- Drying to constant mass at 105° C;
- Crushing to achieve a nominal particle size of minus 6mm to simulate RC drill chip samples;
- Homogenisation via three passes through rotary splitters;
- Packaging in 500g and 1kg units into sealed robust barrier bags, 20kg units into plastic buckets and 200kg units into 44 gallon (166L) drums.

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 25-50g fire assay with ICP-MS (4 labs), ICP-OES (5 labs) and ICP-AAS (1 lab) finish;
- Full elemental suite via four acid digestion (HNO_3-$HClO_4$-HCl-HF) with ICP-OES and ICP-MS finish (10 labs).

For the round robin program ten 1kg samples were taken at 10 predetermined sampling intervals during the final stage of rotary splitting and are considered representative of the entire batch of OREAS C27c. These 10 x 1kg samples were pulverised (to 95% passing 75

microns), homogenised and each split into six 120g subsamples. Six 120g samples were submitted to each laboratory for analysis.

STATISTICAL ANALYSIS

Certified Values, Confidence Limits, Standard Deviations and Tolerance Limits (Table 1) have been determined for each analyte following removal of individual, laboratory dataset (batch) and 3SD outliers (single iteration). For individual outliers within a batch the z-score test is used in combination with a second method that determines the per cent deviation of the individual value from the batch median. Outliers in general are selected on the basis of z-scores > 2.5 and with per cent deviations (i) > 3 and (ii) more than three times the average absolute per cent deviation for the batch. In certain instances statistician's prerogative has been employed in discriminating outliers. Each laboratory data set mean is tested for outlying status based on z-score discrimination and rejected if > 2.5. After individual and laboratory data set (batch) 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. For Tolerance Limits only individual outliers have been removed.

Certified Values are the means of accepted laboratory means after outlier filtering (Table 1). Indicative (uncertified) values (Table 2) are provided where i) a laboratory reported analytes beyond those requested (as part of a full ICP suite package at the same cost as the requested key analytes); ii) the number of laboratories reporting a particular analyte is insufficient (< 5) to support certification; iii) inter-laboratory consensus is poor; or iv) a significant proportion of results are outlying.

95% Confidence Limits are inversely proportional to the number of participating laboratories and inter-laboratory agreement. It is a measure of the reliability of the certified value. A 95% confidence interval indicates a 95% probability that the true value of the analyte under consideration lies between the upper and lower limits. *95% Confidence Limits should not be used as control limits 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. The SD's 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 SD values thus include all sources of measurement uncertainty: between-lab variance, within-run variance (precision errors) and CRM variability. OREAS prepared reference materials have a level of homogeneity such that the observed variance from repeated analysis has its origin almost exclusively in the analytical process rather than the reference material itself.

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 any 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.**

In the application of SD's in monitoring performance it is important to note that not all laboratories function at the same level of proficiency and that different methods in use at a particular laboratory have differing levels of precision. Each laboratory has its own inherent SD (for a specific concentration level and analyte-method pair) based on the analytical process and this SD is not directly related to the round robin program.
The majority of data generated in the round robin program was produced by a selection of world class laboratories. The SD's thus generated are more constrained than those that would be produced across a randomly selected group of laboratories. To produce more generally achievable SD's the 'pooled' SD's provided in this report include inter-lab bias. This 'one size fits all' approach may require revision at the discretion of the QC manager concerned following careful scrutiny of QC control charts.

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.

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 (by 4-acid digestion) where 99% of the time (1-α=0.99) at least 95% of subsamples (ρ=0.95) will have concentrations lying between 5.61 and 9.38 ppm. 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).

Table 3. Performance Gates for OREAS C27c

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	< 2	IND	IND	IND	IND	IND	IND	IND	IND	IND	IND
4-Acid Digestion											
Al, wt.%	7.51	0.202	7.11	7.91	6.90	8.11	2.68%	5.37%	8.05%	7.13	7.88
Ba, ppm	3001	148	2704	3297	2556	3445	4.94%	9.88%	14.82%	2851	3151
Be, ppm	3.26	0.124	3.01	3.50	2.89	3.63	3.80%	7.60%	11.40%	3.09	3.42
Bi, ppm	0.10	0.01	0.08	0.13	0.07	0.14	12.55%	25.10%	37.65%	0.10	0.11
Ca, wt.%	1.31	0.042	1.22	1.39	1.18	1.43	3.25%	6.50%	9.75%	1.24	1.37
Cd, ppm	0.40	0.030	0.34	0.46	0.31	0.49	7.42%	14.84%	22.27%	0.38	0.42
Ce, ppm	92	6.4	79	105	72	111	6.99%	13.99%	20.98%	87	96

Note: Intervals may appear asymmetric due to rounding.

Table 3 continued.

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
4-Acid Digestion continued											
Co, ppm	2.74	0.39	1.95	3.53	1.56	3.92	14.40%	28.79%	43.19%	2.60	2.88
Cs, ppm	7.45	0.349	6.76	8.15	6.41	8.50	4.69%	9.37%	14.06%	7.08	7.83
Cu, ppm	7.49	1.66	4.17	10.82	2.51	12.48	22.17%	44.34%	66.51%	7.12	7.87
Dy, ppm	3.64	0.259	3.12	4.16	2.86	4.42	7.12%	14.25%	21.37%	3.46	3.82
Er, ppm	0.98	0.077	0.83	1.13	0.75	1.21	7.88%	15.76%	23.64%	0.93	1.03
Eu, ppm	1.48	0.26	0.96	1.99	0.71	2.25	17.41%	34.82%	52.23%	1.40	1.55
Fe, wt.%	2.61	0.170	2.27	2.95	2.10	3.12	6.51%	13.02%	19.53%	2.48	2.74
Ga, ppm	23.1	0.83	21.5	24.8	20.7	25.6	3.57%	7.14%	10.71%	22.0	24.3
Gd, ppm	6.33	0.511	5.31	7.35	4.80	7.86	8.08%	16.16%	24.24%	6.01	6.65
Hf, ppm	5.70	0.331	5.04	6.37	4.71	6.70	5.81%	11.61%	17.42%	5.42	5.99
In, ppm	0.062	0.003	0.056	0.069	0.052	0.072	5.39%	10.78%	16.16%	0.059	0.066
K, wt.%	3.12	0.153	2.81	3.42	2.66	3.58	4.91%	9.82%	14.73%	2.96	3.27
La, ppm	45.4	3.73	38.0	52.9	34.2	56.6	8.21%	16.43%	24.64%	43.2	47.7
Li, ppm	37.6	2.75	32.1	43.1	29.4	45.9	7.32%	14.64%	21.96%	35.7	39.5
Lu, ppm	0.068	0.010	0.047	0.088	0.036	0.099	15.37%	30.74%	46.11%	0.064	0.071
Mg, wt.%	0.160	0.014	0.132	0.188	0.118	0.202	8.74%	17.47%	26.21%	0.152	0.168
Mn, wt.%	0.033	0.002	0.028	0.038	0.026	0.040	7.01%	14.03%	21.04%	0.031	0.035
Mo, ppm	3.64	0.46	2.71	4.56	2.25	5.03	12.71%	25.42%	38.13%	3.46	3.82
Na, wt.%	2.59	0.105	2.38	2.80	2.27	2.90	4.06%	8.13%	12.19%	2.46	2.72
Nb, ppm	19.7	1.13	17.5	22.0	16.3	23.1	5.74%	11.48%	17.22%	18.7	20.7
Nd, ppm	40.6	2.14	36.3	44.9	34.2	47.0	5.27%	10.54%	15.80%	38.6	42.6
Ni, ppm	4.62	0.89	2.84	6.39	1.96	7.28	19.21%	38.42%	57.62%	4.39	4.85
P, wt.%	0.036	0.003	0.029	0.043	0.026	0.046	9.18%	18.36%	27.54%	0.034	0.038
Pb, ppm	27.9	2.24	23.5	32.4	21.2	34.7	8.01%	16.02%	24.04%	26.5	29.3
Pr, ppm	11.2	0.44	10.3	12.1	9.9	12.5	3.93%	7.87%	11.80%	10.6	11.7
Rb, ppm	150	6	138	161	133	166	3.78%	7.56%	11.34%	142	157
S, wt.%	0.009	0.002	0.005	0.013	0.003	0.015	23.06%	46.13%	69.19%	0.008	0.009
Sb, ppm	1.22	0.13	0.96	1.48	0.84	1.61	10.53%	21.07%	31.60%	1.16	1.28
Sc, ppm	4.21	0.325	3.56	4.86	3.24	5.19	7.71%	15.42%	23.13%	4.00	4.42
Sm, ppm	7.81	0.231	7.35	8.27	7.12	8.50	2.95%	5.91%	8.86%	7.42	8.20
Sn, ppm	3.98	0.145	3.69	4.27	3.54	4.41	3.64%	7.28%	10.92%	3.78	4.18
Sr, ppm	186	8	171	202	163	209	4.17%	8.35%	12.52%	177	195

Note: Intervals may appear asymmetric due to rounding.

Table 3 continued.

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
4-Acid Digestion continued											
Ta, ppm	1.46	0.050	1.36	1.56	1.31	1.61	3.41%	6.81%	10.22%	1.39	1.54
Tb, ppm	0.82	0.044	0.73	0.91	0.69	0.95	5.37%	10.74%	16.10%	0.78	0.86
Th, ppm	15.3	1.01	13.2	17.3	12.2	18.3	6.63%	13.25%	19.88%	14.5	16.0
Ti, wt.%	0.121	0.006	0.109	0.133	0.103	0.139	4.96%	9.93%	14.89%	0.115	0.127
Tl, ppm	0.87	0.060	0.75	0.99	0.69	1.05	6.96%	13.93%	20.89%	0.82	0.91
U, ppm	5.94	0.378	5.18	6.70	4.81	7.07	6.36%	12.72%	19.09%	5.64	6.24
V, ppm	5.19	1.09	3.01	7.37	1.93	8.45	20.97%	41.93%	62.90%	4.93	5.45
W, ppm	2.08	0.206	1.67	2.49	1.46	2.70	9.90%	19.80%	29.70%	1.97	2.18
Y, ppm	15.0	0.93	13.1	16.8	12.2	17.8	6.22%	12.44%	18.66%	14.2	15.7
Yb, ppm	0.54	0.040	0.46	0.63	0.42	0.67	7.40%	14.81%	22.21%	0.52	0.57
Zn, ppm	118	3	112	124	109	126	2.39%	4.78%	7.16%	112	124
Zr, ppm	211	18	174	248	156	266	8.76%	17.52%	26.29%	200	222

Note: Intervals may appear asymmetric due to rounding.

PARTICIPATING LABORATORIES

1. Actlabs, Ancaster, Ontario, Canada
2. ALS Brisbane, QLD, Australia
3. ALS, Perth, WA, Australia
4. ALS Vancouver, BC, Canada
5. Bureau Veritas Geoanalytical, Adelaide, SA, Australia
6. Bureau Veritas Geoanalytical, Perth, WA, Australia
7. Intertek Genalysis, Adelaide, SA, Australia
8. Intertek Genalysis, Perth, WA, Australia
9. SGS Australia Mineral Services, Perth, WA, Australia
10. SGS Lakefield Research Ltd, Lakefield, Ontario, Canada

PREPARER AND SUPPLIER OF THE REFERENCE MATERIAL

Reference material OREAS C27c has been prepared, certified and is supplied by:

ORE Research & Exploration Pty Ltd
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Web: www.ore.com.au
Email: info@ore.com.au

It has been packaged in 500g and 1kg units into sealed robust barrier bags, 20kg units into plastic buckets and 200kg units into 44 gallon (166L) drums..

INTENDED USE

OREAS C27c is intended for the following uses:

- For the monitoring of sample preparation procedures in a laboratory environment;
- For the monitoring of laboratory performance in the analysis of geological samples for the analytes reported in Table 1;
- For the verification of analytical methods for analytes reported in Table 1.

STABILITY AND STORAGE INSTRUCTIONS

OREAS C27c was prepared from fresh, barren rhyodacite aggregate material. 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 C27c refer to the concentration levels in its packaged state.

INFORMATION FOR QUARANTINE

OREAS C27c is biologically inactive and sterile (does not contain any organic matter or vegetation) due to the materials being sourced from depths greater than 3 metres.

HANDLING INSTRUCTIONS

OREAS C27c contains a portion of fine powder. 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 9001:2015 by Lloyd's Register Quality Assurance Ltd for its quality management system including development, manufacturing, certification and supply of CRMs.

CERTIFYING OFFICER

20th October, 2017

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

REFERENCES

ISO Guide 30 (2015), Terms and definitions used in connection with reference materials.

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

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

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