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CERTIFICATE OF ANALYSIS FOR

Rhyodacite Blank Chip

(Mt Dandenong Igneous Complex, Victoria, Australia)

CERTIFIED REFERENCE MATERIAL

OREAS C27e

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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
Pb Fire Assay											
Au, ppb	< 2	IND	IND	IND	IND	IND	IND	IND	IND	IND	IND
4-Acid Digestion											
Ag, ppm	0.149	0.032	0.084	0.213	0.052	0.245	21.59%	43.18%	64.77%	0.141	0.156
Al, wt.%	7.36	0.228	6.90	7.81	6.67	8.04	3.10%	6.20%	9.30%	6.99	7.73
As, ppm	5.59	0.64	4.31	6.86	3.67	7.50	11.42%	22.83%	34.25%	5.31	5.86
Ba, ppm	2378	70	2239	2518	2169	2588	2.93%	5.87%	8.80%	2259	2497
Be, ppm	3.19	0.174	2.84	3.53	2.66	3.71	5.45%	10.90%	16.35%	3.03	3.34
Bi, ppm	1.08	0.17	0.75	1.41	0.58	1.58	15.35%	30.70%	46.06%	1.03	1.13
Ca, wt.%	0.910	0.030	0.850	0.970	0.820	1.000	3.30%	6.59%	9.89%	0.864	0.955
Cd, ppm	0.84	0.09	0.67	1.01	0.58	1.10	10.25%	20.50%	30.76%	0.80	0.88
Ce, ppm	86	2.8	80	91	77	94	3.23%	6.45%	9.68%	82	90
Co, ppm	4.66	0.205	4.25	5.07	4.05	5.27	4.39%	8.79%	13.18%	4.43	4.89
Cr, ppm	13.7	1.9	9.9	17.5	8.0	19.4	13.92%	27.85%	41.77%	13.0	14.4
Cs, ppm	7.96	0.321	7.32	8.60	7.00	8.92	4.04%	8.07%	12.11%	7.56	8.36
Cu, ppm	14.1	1.4	11.2	17.0	9.8	18.5	10.23%	20.45%	30.68%	13.4	14.8
Dy, ppm	3.64	0.110	3.42	3.86	3.31	3.97	3.02%	6.05%	9.07%	3.46	3.82
Er, ppm	1.18	0.057	1.06	1.29	1.01	1.35	4.84%	9.69%	14.53%	1.12	1.24
Eu, ppm	1.45	0.091	1.27	1.63	1.17	1.72	6.27%	12.54%	18.81%	1.37	1.52
Fe, wt.%	2.58	0.081	2.42	2.75	2.34	2.83	3.12%	6.25%	9.37%	2.46	2.71
Ga, ppm	22.1	0.83	20.4	23.7	19.6	24.6	3.77%	7.55%	11.32%	21.0	23.2
Gd, ppm	6.32	0.279	5.77	6.88	5.49	7.16	4.42%	8.84%	13.25%	6.01	6.64
Hf, ppm	4.96	0.182	4.60	5.33	4.42	5.51	3.67%	7.34%	11.00%	4.71	5.21
Ho, ppm	0.53	0.013	0.50	0.55	0.49	0.57	2.49%	4.98%	7.47%	0.50	0.55
In, ppm	0.20	0.04	0.12	0.29	0.07	0.33	21.46%	42.92%	64.38%	0.19	0.21
K, wt.%	3.06	0.056	2.95	3.18	2.89	3.23	1.84%	3.68%	5.51%	2.91	3.22
La, ppm	42.5	1.67	39.2	45.9	37.5	47.5	3.93%	7.87%	11.80%	40.4	44.7
Li, ppm	36.9	1.42	34.0	39.7	32.6	41.1	3.84%	7.69%	11.53%	35.0	38.7
Lu, ppm	0.11	0.007	0.09	0.12	0.09	0.13	6.46%	12.91%	19.37%	0.10	0.11
Mg, wt.%	0.363	0.016	0.331	0.395	0.315	0.411	4.42%	8.84%	13.26%	0.345	0.381
Mn, wt.%	0.031	0.001	0.029	0.034	0.027	0.035	4.22%	8.44%	12.66%	0.030	0.033
Mo, ppm	2.44	0.187	2.06	2.81	1.88	3.00	7.68%	15.37%	23.05%	2.32	2.56
Na, wt.%	2.16	0.077	2.01	2.32	1.93	2.39	3.56%	7.12%	10.68%	2.05	2.27
Nb, ppm	17.6	0.76	16.1	19.1	15.3	19.9	4.34%	8.67%	13.01%	16.7	18.5
Nd, ppm	38.1	1.58	35.0	41.3	33.4	42.9	4.14%	8.29%	12.43%	36.2	40.0
Ni, ppm	10.3	0.37	9.6	11.1	9.2	11.5	3.59%	7.17%	10.76%	9.8	10.9
P, wt.%	0.052	0.002	0.049	0.056	0.047	0.057	3.26%	6.53%	9.79%	0.050	0.055
Pb, ppm	25.8	1.11	23.6	28.1	22.5	29.2	4.30%	8.60%	12.90%	24.5	27.1
Pr, ppm	10.1	0.54	9.0	11.2	8.5	11.7	5.34%	10.67%	16.01%	9.6	10.6
Rb, ppm	159	4	152	166	148	170	2.26%	4.53%	6.79%	151	167
Re, ppm	< 0.002	IND	IND	IND	IND	IND	IND	IND	IND	IND	IND

SI unit equivalents: ppm, parts per million ≡ mg/kg ≡ µg/g ≡ 0.0001 wt.% ≡ 1000 ppb, parts per billion.
IND: indeterminate;
Note 1: intervals may appear asymmetric due to rounding.
Note 2: the number of decimal places quoted does not imply accuracy of the certified value to this level but are given to minimise rounding errors when calculating 2SD and 3SD windows.

Table 1 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											
S, wt.%	0.033	0.003	0.027	0.039	0.024	0.042	9.41%	18.81%	28.22%	0.031	0.034
Sb, ppm	1.28	0.093	1.09	1.46	1.00	1.56	7.30%	14.61%	21.91%	1.21	1.34
Sc, ppm	5.14	0.203	4.73	5.54	4.53	5.74	3.94%	7.89%	11.83%	4.88	5.39
Se, ppm	< 2	IND	IND	IND	IND	IND	IND	IND	IND	IND	IND
Sm, ppm	7.65	0.463	6.72	8.57	6.26	9.04	6.05%	12.10%	18.15%	7.27	8.03
Sn, ppm	4.56	0.156	4.25	4.87	4.09	5.03	3.43%	6.85%	10.28%	4.33	4.79
Sr, ppm	173	6	161	185	155	191	3.46%	6.93%	10.39%	165	182
Ta, ppm	1.33	0.067	1.20	1.47	1.13	1.53	5.04%	10.07%	15.11%	1.27	1.40
Tb, ppm	0.80	0.023	0.75	0.84	0.72	0.87	2.95%	5.90%	8.85%	0.76	0.83
Te, ppm	< 0.2	IND	IND	IND	IND	IND	IND	IND	IND	IND	IND
Th, ppm	15.5	0.53	14.4	16.5	13.9	17.1	3.41%	6.83%	10.24%	14.7	16.3
Ti, wt.%	0.170	0.007	0.156	0.184	0.148	0.192	4.23%	8.46%	12.69%	0.161	0.178
Tl, ppm	1.05	0.059	0.93	1.17	0.87	1.23	5.66%	11.32%	16.98%	1.00	1.10
Tm, ppm	0.14	0.02	0.10	0.18	0.08	0.20	14.82%	29.65%	44.47%	0.13	0.14
U, ppm	5.07	0.198	4.68	5.47	4.48	5.67	3.90%	7.79%	11.69%	4.82	5.33
V, ppm	24.2	1.17	21.8	26.5	20.7	27.7	4.84%	9.69%	14.53%	23.0	25.4
W, ppm	1.88	0.095	1.69	2.07	1.60	2.17	5.06%	10.11%	15.17%	1.79	1.97
Y, ppm	15.3	0.40	14.6	16.1	14.2	16.5	2.60%	5.20%	7.80%	14.6	16.1
Yb, ppm	0.79	0.032	0.73	0.86	0.70	0.89	4.09%	8.17%	12.26%	0.75	0.83
Zn, ppm	118	10	98	139	88	149	8.61%	17.23%	25.84%	112	124
Zr, ppm	163	5	153	173	148	178	3.04%	6.08%	9.12%	155	171

SI unit equivalents: ppm, parts per million ≡ mg/kg ≡ µg/g ≡ 0.0001 wt.% ≡ 1000 ppb, parts per billion.
IND: indeterminate;
Note 1: intervals may appear asymmetric due to rounding.
Note 2: the number of decimal places quoted does not imply accuracy of the certified value to this level but are given to minimise rounding errors when calculating 2SD and 3SD windows.

Table 2. Indicative Values for OREAS C27e.

Constituent	Unit	Value	Constituent	Unit	Value	Constituent	Unit	Value
Pb Fire Assay								
Pd	ppb	*< 1*	Pt	ppb	*< 5*			
4-Acid Digestion								
Ge	ppm	*0.57*	Hg	ppm	*0.025*			
Borate Fusion XRF								
Al_2O_3	wt.%	*14.54*	K_2O	wt.%	*3.73*	P_2O_5	wt.%	*0.120*
CaO	wt.%	*1.30*	MgO	wt.%	*0.645*	SiO_2	wt.%	*69.93*
Cl	ppm	*10.0*	MnO	wt.%	*0.050*	SO_3	wt.%	*0.081*
Fe_2O_3	wt.%	*3.79*	Na_2O	wt.%	*3.01*	TiO_2	wt.%	*0.298*
Laser Ablation ICP-MS								
Ag	ppm	*0.183*	Hf	ppm	*6.42*	Sm	ppm	*7.97*
As	ppm	*5.33*	Ho	ppm	*0.55*	Sn	ppm	*4.50*
Ba	ppm	*2425*	In	ppm	*0.16*	Sr	ppm	*173*

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. continued.

Constituent	Unit	Value	Constituent	Unit	Value	Constituent	Unit	Value
Laser Ablation ICP-MS continued								
Ag	ppm	*0.183*	Hf	ppm	*6.42*	Sm	ppm	*7.97*
Be	ppm	*3.10*	La	ppm	*43.2*	Ta	ppm	*1.35*
Bi	ppm	*1.15*	Lu	ppm	*0.12*	Tb	ppm	*0.82*
Cd	ppm	*1.18*	Mn	wt.%	*0.032*	Te	ppm	*< 0.2*
Ce	ppm	*84*	Mo	ppm	*2.40*	Th	ppm	*15.3*
Co	ppm	*4.73*	Nb	ppm	*17.7*	Ti	wt.%	*0.178*
Cr	ppm	*17.5*	Nd	ppm	*38.8*	Tl	ppm	*0.80*
Cs	ppm	*7.89*	Ni	ppm	*11.7*	Tm	ppm	*0.15*
Cu	ppm	*13.7*	Pb	ppm	*25.5*	U	ppm	*5.18*
Dy	ppm	*3.65*	Pr	ppm	*10.3*	V	ppm	*24.0*
Er	ppm	*1.25*	Rb	ppm	*157*	W	ppm	*2.00*
Eu	ppm	*1.45*	Re	ppm	*< 0.01*	Y	ppm	*15.9*
Ga	ppm	*21.0*	Sb	ppm	*1.30*	Yb	ppm	*0.86*
Gd	ppm	*6.14*	Sc	ppm	*5.48*	Zn	ppm	*139*
Ge	ppm	*1.31*	Se	ppm	*< 5*	Zr	ppm	*220*
Thermogravimetry								
LOI^{1000}	wt.%	*1.90*						
Infrared Combustion								
C	wt.%	*0.215*	S	wt.%	*0.028*			

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.

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 C27e is a rhyodacite blank chip certified reference material (CRM). The material was sourced from a quarry containing a rhyodacitic unit of the Mt Dandenong Igneous Complex located approximately 34km east of Melbourne (Victoria), Australia.

PERFORMANCE GATES

Table 1 above shows intervals 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 (also see 'Intended Use' section below). Westgard Rules extend the basics of single-rule QC monitoring using multi-rules (for more information visit www.westgard.com/mltirule.htm). 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. One approach used at commercial laboratories is to set the acceptance criteria at twice the detection level (DL) ± 10%.

i.e. Certified Value ± 10% ± 2DL (adapted from Govett, 1983).

PHYSICAL PROPERTIES

OREAS C27e was tested at ORE Research & Exploration Pty Ltd's onsite facility for various physical properties. A sieve analysis was performed on three separate 1kg samples to determine the particle size distribution of OREAS C27e. Table 3 presents the average of these findings that should be used for informational purposes only.

Table 3. Particle size distribution of OREAS C27e.

Distribution	Mass Percentage (%)
Above 12.7mm	0.6
Under 12.7mm, Above 6.35mm	28.5
Under 6.35mm, Above 3.18mm	39.2
Under 3.18mm, Above 2mm	12.6
Under 2mm, Above 1.27mm	9.5
Under 1.27mm, Above 0.5mm	5.7
Under 0.5mm	3.3

Table 4 presents the bulk density, moisture percentage and Munsell color code for OREAS C27e. These findings should be used for informational purposes only.

Table 4. Physical properties of OREAS C27e.

Bulk Density (g/L)	Moisture (%)	Munsell Notation‡	Munsell Color‡
819.5	0.70	N8	Very Light Gray

‡The Munsell Rock Color Chart helps geologists and archeologists communicate with colour more effectively by cross-referencing ISCC-NBS colour names with unique Munsell alpha-numeric colour notations for rock colour samples.

COMMINUTION AND HOMOGENISATION PROCEDURES

The material constituting OREAS C27e was prepared in the following manner:

- Drying to constant mass at 105° C;
- Crushing to achieve a nominal particle size of minus 8mm to simulate RC drill chip samples;
- Homogenisation using a rotary splitter;
- 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 25-40g fire assay with ICP-MS (4 laboratories) and ICP-OES (6 laboratories) finish;
- Full elemental suite by four acid digestion (HNO_3-$HClO_4$-HCl-HF) with ICP-OES and ICP-MS finish (10 laboratories);

Major and trace elements were also characterised by Bureau Veritas Geoanalytical (Perth, Australia) using borate fusion XRF (Al_2O_3 to TiO_2), laser ablation with ICP-MS (Ag to Zr), LOI at 1000°C and C+S by infrared combustion furnace (see Table 2 'Indicative Values').

For the round robin program ten 1kg samples were taken at 10 predetermined sampling intervals during rotary splitting and are considered representative of the entire prepared batch of OREAS C27e. These 10 x 1kg samples were pulverised (to 95% passing 75 microns), homogenised and each split into six 110g subsamples. Six 110g samples were submitted to each laboratory for analysis. The samples received by each laboratory were obtained by taking two samples from each of three separate 1kg test units. This format enabled a nested ANOVA treatment of the results to evaluate homogeneity, i.e. to ascertain whether between-unit variance is greater than within-unit variance (see 'Homogeneity Evaluation' section).

Tabulated results of all elements together with 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 C27e-DataPack.1.0.200605_124215.xlsx**).

STATISTICAL ANALYSIS

Standard Deviation intervals (see Table 1) 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.

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 (see Intended Use section for more detail).

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.***

Certified Values, Standard Deviations, Confidence Limits and Tolerance Limits (Table 5) have been determined for each analyte following removal of individual, laboratory dataset (batch) and 3SD outliers (single iteration).

For individual outliers within a laboratory 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.

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.***

Indicative (uncertified) values (Table 2) are present where the number of laboratories reporting a particular analyte is insufficient (< 5) to support certification or where inter-laboratory consensus is poor.

Table 5. 95% Confidence & Tolerance Limits for OREAS C27e.

Constituent	Certified	95% Confidence Limits		95% Tolerance Limits	
	Value	Low	High	Low	High
Pb Fire Assay					
Au, Gold (ppb)	< 2	IND	IND	IND	IND
4-Acid Digestion					
Ag, Silver (ppm)	0.149	0.122	0.175	IND	IND
Al, Aluminium (wt.%)	7.36	7.23	7.49	7.16	7.56
As, Arsenic (ppm)	5.59	4.94	6.23	4.92	6.25
Ba, Barium (ppm)	2378	2328	2429	2331	2425
Be, Beryllium (ppm)	3.19	3.06	3.31	3.04	3.33
Bi, Bismuth (ppm)	1.08	1.02	1.14	0.75	1.41
Ca, Calcium (wt.%)	0.910	0.894	0.926	0.875	0.945
Cd, Cadmium (ppm)	0.84	0.79	0.89	0.70	0.98
Ce, Cerium (ppm)	86	84	87	83	89
Co, Cobalt (ppm)	4.66	4.52	4.80	4.30	5.02
Cr, Chromium (ppm)	13.7	12.2	15.2	IND	IND
Cs, Caesium (ppm)	7.96	7.72	8.20	7.70	8.22
Cu, Copper (ppm)	14.1	13.3	15.0	12.8	15.5
Dy, Dysprosium (ppm)	3.64	3.56	3.72	3.45	3.83
Er, Erbium (ppm)	1.18	1.13	1.22	1.03	1.32
Eu, Europium (ppm)	1.45	1.33	1.56	1.34	1.55
Fe, Iron (wt.%)	2.58	2.54	2.63	2.49	2.68
Ga, Gallium (ppm)	22.1	21.5	22.7	21.1	23.0
Gd, Gadolinium (ppm)	6.32	6.01	6.63	5.89	6.76
Hf, Hafnium (ppm)	4.96	4.85	5.08	4.68	5.25
Ho, Holmium (ppm)	0.53	0.52	0.54	0.50	0.56
In, Indium (ppm)	0.20	0.17	0.23	0.14	0.26
K, Potassium (wt.%)	3.06	3.03	3.10	2.97	3.16
La, Lanthanum (ppm)	42.5	41.8	43.3	40.3	44.8
Li, Lithium (ppm)	36.9	35.9	37.8	35.3	38.5
Lu, Lutetium (ppm)	0.11	0.10	0.11	IND	IND
Mg, Magnesium (wt.%)	0.363	0.352	0.374	0.348	0.378
Mn, Manganese (wt.%)	0.031	0.030	0.032	0.030	0.033
Mo, Molybdenum (ppm)	2.44	2.35	2.53	2.23	2.65
Na, Sodium (wt.%)	2.16	2.11	2.21	2.11	2.21
Nb, Niobium (ppm)	17.6	17.1	18.2	16.6	18.6
Nd, Neodymium (ppm)	38.1	36.1	40.2	37.2	39.1
Ni, Nickel (ppm)	10.3	10.2	10.5	9.5	11.1
P, Phosphorus (wt.%)	0.052	0.051	0.053	0.051	0.054
Pb, Lead (ppm)	25.8	25.2	26.4	24.3	27.4

SI unit equivalents: ppm, parts per million ≡ mg/kg ≡ µg/g ≡ 0.0001 wt.% ≡ 1000 ppb, parts per billion.
IND: indeterminate;
Note: intervals may appear asymmetric due to rounding.

Table 5. continued.

Constituent	Certified Value	95% Confidence Limits		95% Tolerance Limits	
		Low	High	Low	High
4-Acid Digestion continued					
Pr, Praseodymium (ppm)	10.1	9.4	10.8	9.0	11.2
Rb, Rubidium (ppm)	159	157	161	153	165
Re, Rhenium (ppm)	< 0.002	IND	IND	IND	IND
S, Sulphur (wt.%)	0.033	0.030	0.036	IND	IND
Sb, Antimony (ppm)	1.28	1.22	1.33	1.20	1.35
Sc, Scandium (ppm)	5.14	5.01	5.26	4.93	5.34
Se, Selenium (ppm)	< 2	IND	IND	IND	IND
Sm, Samarium (ppm)	7.65	7.16	8.14	7.23	8.06
Sn, Tin (ppm)	4.56	4.48	4.64	4.34	4.78
Sr, Strontium (ppm)	173	169	177	167	180
Ta, Tantalum (ppm)	1.33	1.29	1.37	1.25	1.41
Tb, Terbium (ppm)	0.80	0.77	0.82	0.76	0.83
Te, Tellurium (ppm)	< 0.2	IND	IND	IND	IND
Th, Thorium (ppm)	15.5	15.2	15.8	14.8	16.2
Ti, Titanium (wt.%)	0.170	0.166	0.174	0.164	0.176
Tl, Thallium (ppm)	1.05	1.01	1.08	1.01	1.08
Tm, Thulium (ppm)	0.14	0.11	0.16	IND	IND
U, Uranium (ppm)	5.07	4.97	5.18	4.86	5.29
V, Vanadium (ppm)	24.2	23.5	24.8	22.7	25.7
W, Tungsten (ppm)	1.88	1.81	1.95	IND	IND
Y, Yttrium (ppm)	15.3	15.1	15.6	14.9	15.8
Yb, Ytterbium (ppm)	0.79	0.77	0.81	IND	IND
Zn, Zinc (ppm)	118	111	126	113	124
Zr, Zirconium (ppm)	163	160	166	155	171

SI unit equivalents: ppm, parts per million ≡ mg/kg ≡ µg/g ≡ 0.0001 wt.% ≡ 1000 ppb, parts per billion.
IND: indeterminate;
Note: intervals may appear asymmetric due to rounding.

Homogeneity Evaluation

The tolerance limits (ISO 16269:2014) in Table 5 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 ($1-\alpha=0.99$) at least 95% of subsamples ($\rho=0.95$) will have concentrations lying between 12.8 and 15.5ppm.%. 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). ***Please note that tolerance limits pertain to the homogeneity of the CRM only and should not be used as control limits for laboratory performance***.

The homogeneity of OREAS C27e has also been evaluated in an ANOVA study for all certified analytes present in concentrations that are at least 20 times the lower limit of detection. No significant *p*-values were found except for Bi, In and Ti by 4-acid digestion.

Titanium has a low associated 1RSD of 4.46% meaning the data is well constrained. Bi and In show higher variance but this is not surprising as the concentrations are at the lower end of detection. These isolated cases are most likely due to random* statistical probability as there is no other supporting evidence to suspect greater between-unit variance compared with within-unit variance. The null hypothesis is therefore retained.

**p-values are calculated at the 95% probability level. Therefore, by definition 5% of p-values calculated will naturally fall as 'significant' (<0.05). For every 60 p-values calculated, 3 will 'fail' naturally meaning a significant difference is detected (a false positive) where, in reality, none exists.*

It is important to note that ANOVA is not an absolute measure of homogeneity. Rather, it establishes whether or not the analytes are distributed in a similar manner throughout the packaging run of OREAS C27e and whether the variance between two subsamples from the same unit is statistically distinguishable to the variance from two subsamples taken from any two separate units. A reference material therefore, can possess poor absolute homogeneity yet still pass a relative homogeneity test if the within-unit heterogeneity is large and similar across all units.

Based on the statistical analysis of the results of the inter-laboratory certification program it can be concluded that OREAS C27e is sufficiently homogenous and is fit-for-purpose as a certified reference material (see 'Intended Use' below).

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 Canada Inc., Vancouver, BC, Canada

PREPARER AND SUPPLIER

Certified reference material OREAS C27e was prepared, certified and supplied by:

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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 naturally occurring rocks and sediments 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.

INTENDED USE

OREAS C27e is intended to cover all activities needed to produce a measurement result. This includes extraction, possible separation steps and the actual measurement process (the signal producing step). OREAS C27e may be used to calibrate the entire procedure by producing a pure substance CRM transformed into a calibration solution.

OREAS C27e is intended for the following uses:

- For the monitoring of laboratory performance in the analysis of analytes reported in Table 1 in geological samples;

- For the verification of analytical methods for analytes reported in Table 1;
- For the calibration of instruments used in the determination of the concentration of analytes reported in Table 1.

QC monitoring using multiples of the Standard Deviation (SD)
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-laboratory 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.

STABILITY AND STORAGE INSTRUCTIONS

OREAS C27e was prepared from fresh, barren rhyodacite 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 C27e refer to the concentration levels in its packaged state.

HANDLING INSTRUCTIONS

OREAS C27e is a chip CRM but 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.

LEGAL NOTICE

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

DOCUMENT HISTORY

Revision No.	Date	Changes applied
0	5th June, 2020	First publication.

QMS CERTIFICATION

ORE Pty Ltd is ISO 9001:2015 certified by Lloyd's Register Quality Assurance Ltd for its quality management system including development, manufacturing, certification and supply of CRMs.

CERTIFYING OFFICER

5th June, 2020

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

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