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CERTIFICATE OF ANALYSIS FOR

Rhyodacite Blank Chip

(Mt Dandenong Igneous Complex, Victoria, Australia)

CERTIFIED REFERENCE MATERIAL

OREAS C27h

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Table 1. Certified Value, Uncertainty & Tolerance Intervals for OREAS C27h.

Constituent	Certified Value	95% Expanded Uncertainty		95% Tolerance Limits	
		Low	High	Low	High
Pb Fire Assay					
Au, Gold (ppb)	< 2	IND	IND	IND	IND
4-Acid Digestion					
Ag, Silver (ppm)	0.171	0.087	0.255	IND	IND
Al, Aluminium (wt.%)	7.75	7.43	8.07	7.62	7.89
As, Arsenic (ppm)	3.00	1.93	4.06	2.22	3.78
Ba, Barium (wt.%)	0.294	0.281	0.308	0.286	0.302
Be, Beryllium (ppm)	3.20	3.03	3.37	3.07	3.33
Bi, Bismuth (ppm)	0.16	0.06	0.27	IND	IND
Ca, Calcium (wt.%)	1.11	1.02	1.21	1.05	1.18
Cd, Cadmium (ppm)	0.40	0.31	0.49	0.34	0.46
Ce, Cerium (ppm)	94	85	103	89	98
Co, Cobalt (ppm)	2.10	1.67	2.52	1.59	2.60
Cs, Caesium (ppm)	6.67	6.19	7.14	6.34	6.99
Cu, Copper (ppm)	5.05	3.26	6.84	3.52	6.58
Fe, Iron (wt.%)	2.47	2.33	2.61	2.36	2.58
Ga, Gallium (ppm)	23.0	21.5	24.5	21.7	24.2
Hf, Hafnium (ppm)	6.61	6.26	6.95	6.27	6.94
In, Indium (ppm)	0.072	0.058	0.087	IND	IND
K, Potassium (wt.%)	3.17	3.00	3.34	3.08	3.25
La, Lanthanum (ppm)	47.8	44.7	50.8	45.1	50.5
Li, Lithium (ppm)	33.2	30.8	35.5	31.8	34.6
Mg, Magnesium (wt.%)	0.149	0.126	0.172	IND	IND
Mn, Manganese (wt.%)	0.033	0.028	0.037	0.030	0.035
Mo, Molybdenum (ppm)	2.88	2.33	3.42	2.64	3.11
Na, Sodium (wt.%)	2.83	2.67	2.99	2.74	2.92
Nb, Niobium (ppm)	19.8	18.3	21.3	18.7	20.9
Ni, Nickel (ppm)	2.05	1.01	3.08	IND	IND
P, Phosphorus (wt.%)	0.030	0.027	0.032	0.027	0.032
Pb, Lead (ppm)	24.0	22.3	25.8	22.6	25.5
Rb, Rubidium (ppm)	150	141	159	146	154
Re, Rhenium (ppm)	< 0.002	IND	IND	IND	IND
Sb, Antimony (ppm)	1.03	0.84	1.22	0.79	1.27
Sc, Scandium (ppm)	4.31	3.85	4.77	3.91	4.71
Se, Selenium (ppm)	< 1	IND	IND	IND	IND
Sn, Tin (ppm)	3.97	3.68	4.26	3.75	4.20
Sr, Strontium (ppm)	178	166	189	173	183

SI unit equivalents: ppb (parts per billion; 1 x 10^{-9}) ≡ µg/kg; ppm (parts per million; 1 x 10^{-6}) ≡ mg/kg; wt.% (weight per cent) ≡ % (mass fraction).

Note: intervals may appear asymmetric due to rounding; IND = indeterminate (due to limited reading resolution of the methods employed. For practical purposes the 95% Expanded Uncertainty can be set between zero and a two times multiple of the upper bound/non-detect limit value).

Table 1. continued.

Constituent	Certified	95% Expanded Uncertainty		95% Tolerance Limits	
	Value	Low	High	Low	High
4-Acid Digestion continued					
Ta, Tantalum (ppm)	1.45	1.30	1.61	1.37	1.53
Te, Tellurium (ppm)	< 0.05	IND	IND	IND	IND
Th, Thorium (ppm)	15.3	14.2	16.3	14.8	15.8
Ti, Titanium (wt.%)	0.119	0.110	0.128	0.112	0.126
Tl, Thallium (ppm)	0.80	0.76	0.85	0.77	0.83
U, Uranium (ppm)	5.89	5.62	6.16	5.68	6.10
V, Vanadium (ppm)	4.36	2.15	6.57	IND	IND
W, Tungsten (ppm)	1.54	1.39	1.69	IND	IND
Y, Yttrium (ppm)	15.5	14.3	16.7	14.7	16.2
Yb, Ytterbium (ppm)	0.53	0.40	0.66	IND	IND
Zn, Zinc (ppm)	118	109	126	111	124
Zr, Zirconium (ppm)	245	232	258	235	254

SI unit equivalents: ppm (parts per million; 1 x 10^{-6}) ≡ mg/kg; wt.% (weight per cent) ≡ % (mass fraction).

Note: intervals may appear asymmetric due to rounding; IND = indeterminate (due to limited reading resolution of the methods employed. For practical purposes the 95% Expanded Uncertainty can be set between zero and a two times multiple of the upper bound/non-detect limit value).

Table 2. Indicative Values for OREAS C27h.

Constituent	Unit	Value	Constituent	Unit	Value	Constituent	Unit	Value
Pb Fire Assay								
Pd	ppb	*< 0.5*	Pt	ppb	*< 0.5*			
4-Acid Digestion								
Cr	ppm	*6.33*	Ge	ppm	*0.70*	S	wt.%	*0.006*
Dy	ppm	*3.58*	Ho	ppm	*0.49*	Sm	ppm	*7.65*
Er	ppm	*1.02*	Lu	ppm	*0.065*	Tb	ppm	*0.80*
Eu	ppm	*1.50*	Nd	ppm	*37.5*	Tm	ppm	*0.10*
Gd	ppm	*5.82*	Pr	ppm	*10.2*			
Infrared Combustion								
C	wt.%	*0.222*	S	wt.%	*< 0.01*			
Borate Fusion XRF								
Al_2O_3	wt.%	*15.07*	MgO	wt.%	*0.270*	S	wt.%	*0.006*
CaO	wt.%	*1.51*	MnO	wt.%	*0.047*	SiO_2	wt.%	*69.36*
Fe_2O_3	wt.%	*3.55*	Na_2O	wt.%	*3.84*	TiO_2	wt.%	*0.197*
K_2O	wt.%	*3.85*	P_2O_5	wt.%	*0.071*			
Thermogravimetry								
LOI^{1000}	wt.%	*1.77*						
Laser Ablation ICP-MS								
Ag	ppm	*0.183*	Hf	ppm	*7.78*	Sm	ppm	*7.66*
As	ppm	*2.90*	Ho	ppm	*0.53*	Sn	ppm	*3.83*
Ba	ppm	*2827*	In	ppm	*0.050*	Sr	ppm	*165*
Be	ppm	*3.37*	La	ppm	*46.8*	Ta	ppm	*1.45*

SI unit equivalents: ppb (parts per billion; 1 x 10^{-9}) ≡ µg/kg; ppm (parts per million; 1 x 10^{-6}) ≡ mg/kg; wt.% (weight per cent) ≡ % (mass fraction).

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								
Bi	ppm	*0.14*	Lu	ppm	*0.065*	Tb	ppm	*0.79*
Cd	ppm	*0.37*	Mn	wt.%	*0.031*	Te	ppm	*0.13*
Ce	ppm	*89*	Mo	ppm	*2.63*	Th	ppm	*15.2*
Co	ppm	*1.87*	Nb	ppm	*18.9*	Ti	wt.%	*0.118*
Cr	ppm	*5.83*	Nd	ppm	*41.0*	Tl	ppm	*0.50*
Cs	ppm	*6.30*	Ni	ppm	*4.33*	Tm	ppm	*0.11*
Cu	ppm	*6.67*	Pb	ppm	*24.5*	U	ppm	*5.86*
Dy	ppm	*3.64*	Pr	ppm	*11.1*	V	ppm	*4.03*
Er	ppm	*1.04*	Rb	ppm	*142*	W	ppm	*1.58*
Eu	ppm	*1.34*	Re	ppm	*< 0.01*	Y	ppm	*15.2*
Ga	ppm	*21.4*	Sb	ppm	*1.08*	Yb	ppm	*0.60*
Gd	ppm	*5.87*	Sc	ppm	*4.45*	Zn	ppm	*119*
Ge	ppm	*1.18*	Se	ppm	*< 5*	Zr	ppm	*275*

SI unit equivalents: ppm (parts per million; 1 x 10^{-6}) ≡ mg/kg; wt.% (weight per cent) ≡ % (mass fraction).
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. In evaluating laboratory performance with this CRM, the section headed 'Instructions for correct use' should be read carefully.

Table 1 provides the certified values and their associated 95% expanded uncertainty and tolerance intervals, Table 2 shows indicative values, Table 3 provides an indicative particle size distribution, Table 4 provides some indicative physical properties and Table 5 presents the performance gate intervals for all certified values. Tabulated results of all analytes 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 C27h-DataPack.1.0.230807_135807.xlsx**).

SOURCE MATERIAL

OREAS C27h 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. OREAS C27h has a nominal particle size of minus 8mm to simulate RC drill chip samples.

COMMINUTION AND HOMOGENISATION PROCEDURES

The material constituting OREAS C27h 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 units into sealed robust barrier bags and 200kg units into 44-gallon (166L) drums.

PHYSICAL PROPERTIES

OREAS C27h was tested at ORE Research & Exploration Pty Ltd's onsite facility for various physical properties. A sieve analysis was performed on a 1kg sample to determine the particle size distribution of OREAS C27h. Table 3 presents the findings that should be used for informational purposes only.

Table 3. Particle size distribution of OREAS C27h.

Distribution	% (mass fraction)
Above 12.7mm	0.0
Under 12.7mm; Above 6.35mm	38
Under 6.35mm; Above 3.18mm	41
Under 3.18mm; Above 2mm	8
Under 2mm; Above 1.27mm	5
Under 1.27mm; Above 0.5mm	3.5
Under 0.5mm	4.5

Table 4 presents the bulk density, moisture percentage and Munsell colour code for OREAS C27h. These findings should be used for informational purposes only.

Table 4. Physical properties of OREAS C27h.

Bulk Density (g/L)	Moisture (%)	Munsell Notation‡	Munsell Colour‡
1424	0.27	N7	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.

ANALYTICAL PROGRAM

For the analytical program, 60 x 500g units were selected systematically over nine evenly spaced, set intervals during the final splitting and packaging stage and are considered representative of the entire prepared batch. This sampling format covered the samples required for the round robin certification program (10 laboratories x 6 x 500g samples each). One set of samples was unable to be delivered resulting in nine commercial analytical laboratories participating in the program to characterise the elements reported in Table 1. The six 500g chip samples received by each participating laboratory were accompanied with instructions to prepare and assay each sample as follows:

- Dry at 105°C, crush to nominal minus 2mm, riffle split to 250g, pulverise split to 85% minus 75 microns then subsample for assay (9 laboratories);
- Au by 25-40g fire assay with ICP-MS (4 laboratories) and ICP-OES (5 laboratories) finish;
- Full ICP-OES and ICP-MS elemental suites by four acid digestion (HNO_3-$HClO_4$-HCl-HF) (9 laboratories).

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

STATISTICAL ANALYSIS

Certified Values and their uncertainty intervals (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 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. 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. However, while statistics are taken into account, the exercise of a statistician's prerogative plays a significant role in identifying outliers.

Certified Values are the means of accepted laboratory means after outlier filtering and are the present best estimate of the true value.

The 95% Expanded Uncertainty provides a 95% probability that the true value of the analyte under consideration lies between the upper and lower limits and is calculated according to the method in ISO Guides [5,14]. All known or suspected sources of bias have been investigated or taken into account.

Indicative (uncertified) values (Table 2) are present where the number of laboratories reporting a particular analyte is insufficient (< 5) to support certification. These major and trace element characterisation values are presented for informational purposes only.

Standard Deviation intervals (Table 5) 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 'Instructions for Correct 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.

PERFORMANCE GATES

Table 5 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 [1]).

Table 5. Performance Gates for OREAS C27h.

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	0.171	0.062	0.048	0.294	0.000	0.356	35.94%	71.88%	107.8%	0.163	0.180
Al, wt.%	7.75	0.284	7.18	8.32	6.90	8.60	3.66%	7.32%	10.99%	7.36	8.14
As, ppm	3.00	0.72	1.55	4.45	0.82	5.17	24.18%	48.36%	72.54%	2.85	3.15
Ba, wt.%	0.294	0.007	0.281	0.308	0.274	0.315	2.34%	4.67%	7.01%	0.280	0.309
Be, ppm	3.20	0.104	2.99	3.41	2.89	3.51	3.25%	6.51%	9.76%	3.04	3.36
Bi, ppm	0.16	0.04	0.08	0.25	0.04	0.29	25.18%	50.36%	75.53%	0.16	0.17
Ca, wt.%	1.11	0.056	1.00	1.23	0.95	1.28	5.02%	10.04%	15.05%	1.06	1.17
Cd, ppm	0.40	0.04	0.32	0.48	0.28	0.53	10.34%	20.68%	31.02%	0.38	0.42
Ce, ppm	94	6.5	81	107	74	113	6.96%	13.93%	20.89%	89	99
Co, ppm	2.10	0.188	1.72	2.47	1.53	2.66	8.96%	17.93%	26.89%	1.99	2.20
Cs, ppm	6.67	0.302	6.06	7.27	5.76	7.57	4.53%	9.06%	13.59%	6.33	7.00
Cu, ppm	5.05	1.17	2.71	7.39	1.54	8.56	23.19%	46.38%	69.57%	4.80	5.30
Fe, wt.%	2.47	0.100	2.27	2.67	2.17	2.77	4.05%	8.09%	12.14%	2.35	2.59
Ga, ppm	23.0	0.63	21.7	24.2	21.1	24.9	2.74%	5.48%	8.21%	21.8	24.1
Hf, ppm	6.61	0.196	6.21	7.00	6.02	7.19	2.97%	5.94%	8.90%	6.28	6.94
In, ppm	0.072	0.006	0.060	0.084	0.054	0.090	8.38%	16.76%	25.14%	0.069	0.076
K, wt.%	3.17	0.134	2.90	3.43	2.76	3.57	4.24%	8.47%	12.71%	3.01	3.32
La, ppm	47.8	2.36	43.1	52.5	40.7	54.8	4.93%	9.87%	14.80%	45.4	50.2
Li, ppm	33.2	2.12	29.0	37.4	26.8	39.6	6.39%	12.78%	19.17%	31.5	34.9
Mg, wt.%	0.149	0.012	0.125	0.173	0.113	0.186	8.18%	16.36%	24.53%	0.142	0.157
Mn, wt.%	0.033	0.003	0.027	0.038	0.024	0.041	8.73%	17.47%	26.20%	0.031	0.034
Mo, ppm	2.88	0.198	2.48	3.27	2.28	3.47	6.89%	13.78%	20.68%	2.73	3.02
Na, wt.%	2.83	0.074	2.68	2.98	2.61	3.05	2.61%	5.22%	7.84%	2.69	2.97
Nb, ppm	19.8	1.56	16.7	22.9	15.1	24.5	7.86%	15.72%	23.59%	18.8	20.8
Ni, ppm	2.05	0.48	1.09	3.00	0.61	3.48	23.37%	46.74%	70.10%	1.94	2.15
P, wt.%	0.030	0.001	0.027	0.032	0.026	0.034	4.47%	8.95%	13.42%	0.028	0.031
Pb, ppm	24.0	1.36	21.3	26.8	20.0	28.1	5.66%	11.32%	16.99%	22.8	25.2
Rb, ppm	150	4	141	159	136	163	2.98%	5.95%	8.93%	142	157
Re, ppm	< 0.002	IND	IND	IND	IND	IND	IND	IND	IND	IND	IND
Sb, ppm	1.03	0.12	0.80	1.26	0.68	1.38	11.34%	22.68%	34.02%	0.98	1.08
Sc, ppm	4.31	0.212	3.88	4.73	3.67	4.94	4.91%	9.83%	14.74%	4.09	4.52
Se, ppm	< 1	IND	IND	IND	IND	IND	IND	IND	IND	IND	IND
Sn, ppm	3.97	0.142	3.69	4.26	3.55	4.40	3.56%	7.12%	10.68%	3.78	4.17
Sr, ppm	178	12	153	203	140	215	7.03%	14.07%	21.10%	169	187
Ta, ppm	1.45	0.132	1.19	1.72	1.06	1.85	9.10%	18.20%	27.30%	1.38	1.53
Te, ppm	< 0.05	IND	IND	IND	IND	IND	IND	IND	IND	IND	IND
Th, ppm	15.3	1.08	13.1	17.4	12.0	18.5	7.05%	14.10%	21.16%	14.5	16.0
Ti, wt.%	0.119	0.006	0.107	0.131	0.100	0.138	5.23%	10.45%	15.68%	0.113	0.125

SI unit equivalents: ppb (parts per billion; 1 x 10^{-9}) ≡ µg/g; ppm (parts per million; 1 x 10^{-6}) ≡ mg/kg; wt.% (weight per cent) ≡ % (mass fraction).
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 5 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											
Tl, ppm	0.80	0.025	0.75	0.85	0.73	0.88	3.06%	6.11%	9.17%	0.76	0.84
U, ppm	5.89	0.221	5.45	6.33	5.23	6.55	3.76%	7.52%	11.28%	5.59	6.18
V, ppm	4.36	1.02	2.32	6.40	1.31	7.42	23.35%	46.71%	70.06%	4.14	4.58
W, ppm	1.54	0.115	1.31	1.77	1.19	1.89	7.49%	14.99%	22.48%	1.46	1.62
Y, ppm	15.5	0.73	14.0	16.9	13.3	17.6	4.70%	9.39%	14.09%	14.7	16.2
Yb, ppm	0.53	0.050	0.43	0.63	0.38	0.68	9.45%	18.91%	28.36%	0.50	0.56
Zn, ppm	118	5	107	128	102	133	4.40%	8.80%	13.20%	112	124
Zr, ppm	245	8	228	261	220	270	3.39%	6.79%	10.18%	233	257

SI unit equivalents: ppm (parts per million; 1 x 10^{-6}) ≡ mg/kg.
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.

Homogeneity Evaluation

The tolerance limits (ISO 16269:2014) in Table 1 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 3.52 and 6.58ppm. 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***.

Based on the statistical analysis of the results of the interlaboratory certification program OREAS C27h is deemed sufficiently homogenous and fit-for-purpose as a certified reference material (see 'Intended Use' below).

PARTICIPATING LABORATORIES

1. Actlabs, Ancaster, Ontario, Canada
2. ALS, Malaga, WA, Australia
3. ALS, Vancouver, BC, Canada
4. Bureau Veritas Commodities Canada Ltd, Vancouver, BC, Canada
5. Bureau Veritas Geoanalytical, Perth, WA, Australia
6. Intertek Genalysis, Adelaide, SA, Australia
7. Intertek Genalysis, Perth, WA, Australia
8. SGS Australia Mineral Services, Perth, WA, Australia
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PREPARER AND SUPPLIER

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METROLOGICAL TRACEABILITY

The interlaboratory results that underpin certified values are metrologically traceable to the international measurement scale (SI) of mass expressed as either per cent (mass fraction), milligrams per kilogram (alternative unit = parts per million (ppm; 1 x 10^{-6})) or micrograms per kilogram (alternative unit = parts per billion (ppb; 1 x 10^{-9})).

The analytical samples were selected in a manner representative of the entire batch of the 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 procedure is possible. In this case, it is impossible to demonstrate absence of method bias; therefore, the result is an operationally defined measurand*** *(ISO Guide 35:2017, 9.2.4c)."* Certification takes place on the basis of agreement among operationally defined, independent measurement results.

COMMUTABILITY

The measurements of the results that underlie the certified values contained in this report were undertaken by methods involving sample preparation and 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 to routine ‘field’ samples in the relevant preparation and measurement processes. Care should be taken to ensure ‘matrix matching’ as close as practically achievable. The matrix 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 C27h is intended to cover all activities needed to produce a measurement result. This includes preparation of the sample, extraction, possible separation steps and the actual measurement process (the signal producing step). OREAS C27h may be used to calibrate the entire procedure by producing a pure substance CRM transformed into a calibration solution.

OREAS C27h is intended for the following uses:

- For the monitoring of sample contamination (due to preparation and/or analysis) in the analysis of analytes reported in Table 1 in geological samples;
- 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.

PERIOD OF VALIDITY & STORAGE INSTRUCTIONS

The certification of OREAS C27h remains valid, within the specified measurement uncertainties, until April 2038, provided the CRM is handled and stored in accordance with the instructions given below. This certification is nullified if the CRM is any way changed or contaminated.

Store in a clean and cool dry place away from direct sunlight.

Long-term stability will be monitored at appropriate intervals and purchasers notified if any changes are observed. The period of validity may well be indefinite and will be reassessed prior to expiry with the aim of extending the validity if possible.

INSTRUCTIONS FOR HANDLING & CORRECT USE

Single-use 500g bags

The entire 500g bag of OREAS C27h should be submitted to the laboratory for preparation (to a minimum specification of 85% passing 75 microns), subsampling and analysis. It is the user’s responsibility to prevent contamination and avoid prolonged exposure of the sample to the atmosphere prior to analysis.

Fine powders pose a risk to eyes and lungs and therefore standard precautions including the use of safety glasses and dust masks are advised.

The certified values refer to the concentration levels in the packaged state. There is no need for drying prior to weighing and analysis.

Minimum sample size

As a practical guide, the minimum mass of sample used should match the typical mass that the laboratories used in the interlaboratory certification program. This means that different sample masses should be used depending on the operationally defined methodology.

- Au by fire assay: ≥25g;
- 4-acid digestion with ICP-OES and/or MS finish: ≥0.25g.

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.

The performance gates shown in Table 5 are intended only to be used as an initial guide as to what a laboratory may be able to achieve. Over a period of time monitoring your own laboratory’s data for this CRM, SD's should be calculated directly from your own laboratory's process. This will enable you to establish more specific performance gates that are fit for purpose for your application as well as the ability to monitor bias. If your long-term trend analysis shows an average value that is within the 95% expanded uncertainty interval then generally there is no cause for concern in regard to bias.

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	24th August, 2023	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

24th August, 2023

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

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