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CERTIFICATE OF ANALYSIS FOR

FELSIC VOLCANIC BLANK CHIP

CERTIFIED REFERENCE MATERIAL

OREAS 27

Table 1. Certified Values, SDs, 95% Confidence and Tolerance Limits for OREAS 27

Constituent	Certified Value	1SD	95% Confidence Limits		95% Tolerance Limits	
			Low	High	Low	High
Fire Assay						
Au, Gold (ppb)	< 1	IND	IND	IND	IND	IND
4-Acid Digestion						
Ag, Silver (ppm)	0.219	0.050	0.179	0.258	IND	IND
Al, Aluminium (wt.%)	7.14	0.448	6.60	7.67	6.95	7.33
As, Arsenic (ppm)	4.33	0.65	3.88	4.77	IND	IND
Ba, Barium (ppm)	2988	126.1	2879	3097	2903	3072
Be, Beryllium (ppm)	3.04	0.151	2.89	3.19	2.55	3.54
Bi, Bismuth (ppm)	0.090	0.020	0.079	0.101	IND	IND
Ca, Calcium (wt.%)	1.31	0.110	1.21	1.41	1.14	1.48
Cd, Cadmium (ppm)	0.41	0.05	0.38	0.43	0.28	0.53
Co, Cobalt (ppm)	1.74	0.169	1.59	1.90	IND	IND
Cr, Chromium (ppm)	79	13	63	96	71	88
Cu, Copper (ppm)	4.61	1.08	3.48	5.74	2.90	6.32
Fe, Iron (wt.%)	2.43	0.141	2.30	2.57	2.33	2.54
Hf, Hafnium (ppm)	7.59	0.557	6.89	8.29	7.32	7.86
K, Potassium (wt.%)	3.21	0.114	3.06	3.36	3.11	3.31
Li, Lithium (ppm)	20.9	1.74	19.0	22.7	17.9	23.9
Mg, Magnesium (wt.%)	0.118	0.006	0.114	0.123	IND	IND
Mn, Manganese (wt.%)	0.033	0.004	0.029	0.037	0.026	0.040
Mo, Molybdenum (ppm)	10.2	3.7	7.3	13.1	6.1	14.4
Na, Sodium (wt.%)	2.84	0.172	2.60	3.08	2.73	2.95
Nb, Niobium (ppm)	20.1	2.7	16.6	23.6	19.1	21.1
Ni, Nickel (ppm)	< 4	IND	IND	IND	IND	IND
P, Phosphorus (wt.%)	0.027	0.002	0.024	0.029	0.025	0.028
Pb, Lead (ppm)	25.0	1.89	23.5	26.6	23.5	26.6
Rb, Rubidium (ppm)	144	8.7	133	154	137	151
Sb, Antimony (ppm)	1.19	0.098	1.11	1.27	IND	IND
Sc, Scandium (ppm)	4.06	0.300	3.70	4.42	IND	IND
Sn, Tin (ppm)	4.06	0.212	3.84	4.28	3.85	4.27
Sr, Strontium (ppm)	191	5.3	186	195	184	198
Ta, Tantalum (ppm)	1.53	0.22	1.23	1.83	1.35	1.71
Th, Thorium (ppm)	15.1	1.5	13.7	16.4	14.0	16.1
Ti, Titanium (wt.%)	0.110	0.004	0.105	0.114	0.106	0.113
Tl, Thallium (ppm)	0.75	0.058	0.68	0.82	IND	IND
U, Uranium (ppm)	5.54	0.328	5.28	5.81	5.16	5.92
V, Vanadium (ppm)	3.33	0.47	2.75	3.92	IND	IND
W, Tungsten (ppm)	1.82	0.28	1.66	1.97	IND	IND
Y, Yttrium (ppm)	15.1	1.46	13.4	16.8	14.0	16.2
Zn, Zinc (ppm)	117	4.7	112	121	109	125
Zr, Zirconium (ppm)	278	20.3	251	305	272	283

Note: intervals may appear asymmetric due to rounding

Table 2. Indicative Values for OREAS 27

Constituent	Unit	Value	Constituent	Unit	Value	Constituent	Unit	Value
Fire Assay								
Pd	ppb	*< 5*	Pt	ppb	*< 5*			
4-Acid Digestion								
Ce	ppm	*90*	Ho	ppm	*0.47*	Se	ppm	*1.00*
Cs	ppm	*6.91*	In	ppm	*0.050*	Sm	ppm	*6.70*
Dy	ppm	*3.33*	La	ppm	*44.4*	Tb	ppm	*0.79*
Er	ppm	*1.02*	Lu	ppm	*0.075*	Te	ppm	*< 0.1*
Eu	ppm	*1.84*	Nd	ppm	*31.6*	Tm	ppm	*0.097*
Ga	ppm	*23.6*	Pr	ppm	*9.29*	Yb	ppm	*0.55*
Gd	ppm	*5.63*	Re	ppm	*< 0.005*			
Ge	ppm	*0.20*	S	wt.%	*0.007*			

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 27 has been prepared from coarse rhyodacite material sourced from a quarry approximately 30km east of Melbourne, Australia. It is characterised by extremely low background gold of less than 1 part per billion.

COMMINUTION AND HOMOGENISATION PROCEDURES

The material constituting OREAS 27 was prepared in the following manner:

- drying to constant mass at 105°C;
- crushing to replicate the appearance of RC drill samples (100% <10mm);
- packaging in units of 1kg (jars), 20kg (bucket) and 200kg (plastic lined 44 gallon drum).

ANALYTICAL PROGRAM

Seven commercial analytical laboratories participated in the program to characterise gold by fire assay with ICP-OES (4 labs), ICP-MS (1 lab), AAS (1 lab) or SXAAS (1 lab) finish. Elements certified via 4-acid digestion include Ag, Al, As, Ba, Be, Bi, Ca, Cd, Co, Cr, Cu, Fe, Hf, K, Li, Mg, Mn, Mo, Na, Nb, Ni, P, Pb, Rb, Sb, Sc, Sn, Sr, Ta, Th, Ti, Tl, U, V, W, Y, Zn and Zr with ICP-OES or ICP-MS finish.

For the round robin program ten 500g test units were taken at predetermined intervals during the bagging stage, immediately following homogenisation and are considered representative of the entire batch. The six samples received by each laboratory were obtained by taking two 100g scoop splits from each of three separate 500g test units. This format enabled nested ANOVA treatment of the results to evaluate homogeneity, i.e. to ascertain whether between-unit variance is greater than within-unit variance. Table 1 (above) presents the certified values together with their associated 1SD's, 95% confidence and tolerance limits and Table 2 shows indicative values.

Table 3 provides performance gate intervals for the certified values based on their associated standard deviations. 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 27 Datapack.xlsx**).

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. Indicative values are provided 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.

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.

Table 3. Performance Gates for OREAS 27

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											
Ag, ppm	0.219	0.050	0.119	0.318	0.070	0.368	22.70%	45.40%	68.09%	0.208	0.230
Al, wt.%	7.14	0.448	6.24	8.03	5.79	8.48	6.28%	12.56%	18.85%	6.78	7.49
As, ppm	4.33	0.65	3.03	5.62	2.39	6.27	14.94%	29.89%	44.83%	4.11	4.54
Ba, ppm	2988	126.1	2736	3240	2610	3366	4.22%	8.44%	12.66%	2839	3137
Be, ppm	3.04	0.151	2.74	3.35	2.59	3.50	4.96%	9.92%	14.88%	2.89	3.20
Bi, ppm	0.090	0.020	0.050	0.130	0.029	0.151	22.43%	44.87%	67.30%	0.085	0.094
Ca, wt.%	1.31	0.110	1.09	1.53	0.98	1.64	8.43%	16.85%	25.28%	1.24	1.37
Cd, ppm	0.41	0.05	0.32	0.50	0.27	0.54	11.10%	22.19%	33.29%	0.39	0.43
Co, ppm	1.74	0.169	1.40	2.08	1.23	2.25	9.73%	19.45%	29.18%	1.65	1.83
Cr, ppm	79	13	54	105	41	118	16.25%	32.50%	48.75%	75	83
Cu, ppm	4.61	1.08	2.44	6.78	1.36	7.86	23.52%	47.04%	70.56%	4.38	4.84
Fe, wt.%	2.43	0.141	2.15	2.72	2.01	2.86	5.77%	11.55%	17.32%	2.31	2.56
Hf, ppm	7.59	0.557	6.48	8.71	5.92	9.26	7.34%	14.69%	22.03%	7.21	7.97
K, wt.%	3.21	0.114	2.98	3.44	2.87	3.55	3.55%	7.10%	10.66%	3.05	3.37
Li, ppm	20.9	1.74	17.4	24.3	15.6	26.1	8.32%	16.64%	24.97%	19.8	21.9
Mg, wt.%	0.118	0.006	0.107	0.130	0.101	0.136	4.94%	9.87%	14.81%	0.112	0.124
Mn, wt.%	0.033	0.004	0.025	0.042	0.020	0.046	13.14%	26.27%	39.41%	0.032	0.035
Mo, ppm	10.2	3.7	2.9	17.6	0.0	21.3	36.03%	72.07%	108.10 %	9.7	10.7
Na, wt.%	2.84	0.172	2.49	3.18	2.32	3.35	6.06%	12.12%	18.18%	2.70	2.98
Nb, ppm	20.1	2.7	14.8	25.4	12.1	28.1	13.28%	26.55%	39.83%	19.1	21.1
Ni, ppm	< 4	IND	IND	IND	IND	IND	IND	IND	IND	IND	IND
P, wt.%	0.027	0.002	0.022	0.031	0.020	0.033	8.01%	16.01%	24.02%	0.025	0.028
Pb, ppm	25.0	1.89	21.3	28.8	19.4	30.7	7.53%	15.06%	22.59%	23.8	26.3
Rb, ppm	144	8.7	127	161	118	170	6.02%	12.04%	18.05%	137	151
Sb, ppm	1.19	0.098	1.00	1.39	0.90	1.48	8.20%	16.41%	24.61%	1.13	1.25
Sc, ppm	4.06	0.300	3.46	4.66	3.16	4.96	7.39%	14.78%	22.17%	3.86	4.26
Sn, ppm	4.06	0.212	3.63	4.48	3.42	4.70	5.23%	10.46%	15.68%	3.86	4.26
Sr, ppm	191	5.3	180	202	175	207	2.80%	5.60%	8.40%	181	200
Ta, ppm	1.53	0.22	1.10	1.96	0.88	2.18	14.14%	28.27%	42.41%	1.45	1.61
Th, ppm	15.1	1.5	12.0	18.1	10.5	19.6	10.03%	20.05%	30.08%	14.3	15.8
Ti, wt.%	0.110	0.004	0.102	0.117	0.099	0.120	3.24%	6.47%	9.71%	0.104	0.115
Tl, ppm	0.75	0.058	0.64	0.87	0.58	0.92	7.67%	15.34%	23.01%	0.71	0.79
U, ppm	5.54	0.328	4.89	6.20	4.56	6.53	5.92%	11.84%	17.76%	5.27	5.82
V, ppm	3.33	0.47	2.39	4.27	1.92	4.75	14.12%	28.25%	42.37%	3.17	3.50
W, ppm	1.82	0.28	1.26	2.37	0.98	2.65	15.34%	30.68%	46.02%	1.73	1.91
Y, ppm	15.1	1.46	12.2	18.0	10.7	19.5	9.69%	19.37%	29.06%	14.4	15.9
Zn, ppm	117	4.7	107	126	103	131	4.03%	8.06%	12.09%	111	123
Zr, ppm	278	20.3	237	318	217	339	7.32%	14.64%	21.96%	264	292

Note: intervals may appear asymmetric due to rounding

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 lead (Pb), where 99% of the time (1-α=0.99) at least 95% of subsamples (ρ=0.95) will have concentrations lying between 23.5 and 26.6ppm. 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 (IS0 Guide 35).

The homogeneity of OREAS 27 has also been evaluated in an ANOVA study for all certified analytes. This study tests the null hypothesis that no statistically significant difference exists between the *between-unit variance* and the *within-unit variance* (i.e. p-values <0.05 indicate rejection of the null hypothesis). Of the 39 certified values, no failures were observed indicating no evidence to reject the null hypothesis.

Based on the statistical analysis of the results of the inter-laboratory certification program it can be concluded that OREAS 27 is fit-for-purpose as a certified reference material (see 'Intended Use' below).

PARTICIPATING LABORATORIES

Acme, Vancouver, BC, Canada
ALS, Brisbane, QLD, Australia
ALS, Vancouver, BC, Canada
Amdel (BV), Adelaide, SA, Australia
Intertek Genalysis, Perth, WA, Australia
SGS, Perth, WA, Australia
Ultra Trace (BV), Perth, WA, Australia

PREPARER AND SUPPLIER OF THE REFERENCE MATERIAL

Reference material OREAS 27 has been prepared and certified by:

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It has been packaged in 200kg units in 44 gallon drums.

INTENDED USE

OREAS 27 is intended for the following uses:

- for the monitoring of laboratory performance in the analysis of Ag, Al, As, Au, Ba, Be, Bi, Ca, Cd, Co, Cr, Cu, Fe, Hf, K, Li, Mg, Mn, Mo, Na, Nb, Ni, P, Pb, Rb, Sb, Sc, Sn, Sr, Ta, Th, Ti, Tl, U, V, W, Y, Zn and Zr in geological samples;

- for the verification of analytical methods for Ag, Al, As, Au, Ba, Be, Bi, Ca, Cd, Co, Cr, Cu, Fe, Hf, K, Li, Mg, Mn, Mo, Na, Nb, Ni, P, Pb, Rb, Sb, Sc, Sn, Sr, Ta, Th, Ti, Tl, U, V, W, Y, Zn and Zr;
- for the calibration of instruments used in the determination of the concentration of Ag, Al, As, Au, Ba, Be, Bi, Ca, Cd, Co, Cr, Cu, Fe, Hf, K, Li, Mg, Mn, Mo, Na, Nb, Ni, P, Pb, Rb, Sb, Sc, Sn, Sr, Ta, Th, Ti, Tl, U, V, W, Y, Zn and Zr.

STABILITY AND STORAGE INSTRUCTIONS

The rhyodacite material constituting OREAS 27 has been prepared to a specification of <10mm to simulate RC drill chip samples. In its unopened state under normal conditions of storage it has a shelf life beyond ten years.

INSTRUCTIONS FOR THE CORRECT USE OF THE REFERENCE MATERIAL

The certified values for OREAS 27 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.

LEGAL NOTICE

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

CERTIFYING OFFICER

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

REFERENCES

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.