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CERTIFICATE OF ANALYSIS FOR

ZINC TAILINGS

CERTIFIED REFERENCE MATERIAL

OREAS 630

Summary Statistics for Key Analytes.

Constituent	Certified Value	1SD	95% Confidence Limits		95% Tolerance Limits	
			Low	High	Low	High
Fire Assay						
Au, Gold (ppm)	0.259	0.007	0.255	0.262	0.249	0.268
4-Acid Digestion						
Ag, Silver (ppm)	10.5	0.37	10.1	10.8	10.1	10.9
Cu, Copper (ppm)	384	16	374	394	376	393
Pb, Lead (wt.%)	0.272	0.019	0.257	0.286	0.263	0.280
Zn, Zinc (wt.%)	0.540	0.026	0.523	0.556	0.530	0.550

Note: intervals may appear asymmetric due to rounding.

Table 1. Certified Values, SDs, 95% Confidence and Tolerance Limits for OREAS 630.

Constituent	Certified Value	1SD	95% Confidence Limits		95% Tolerance Limits	
			Low	High	Low	High
Fire Assay						
Au, Gold (ppm)	0.259	0.007	0.255	0.262	0.249*	0.268*
Peroxide Fusion ICP						
Al, Aluminium (wt.%)	7.24	0.137	7.15	7.34	7.12	7.36
As, Arsenic (ppm)	676	48	639	713	649	703
Ca, Calcium (wt.%)	1.62	0.127	1.51	1.73	1.57	1.66
Cu, Copper (ppm)	386	14	377	395	373	399
Fe, Iron (wt.%)	8.47	0.248	8.31	8.63	8.28	8.65
K, Potassium (wt.%)	3.16	0.107	3.07	3.25	3.07	3.25
Mg, Magnesium (wt.%)	1.13	0.054	1.09	1.16	1.10	1.15
Mn, Manganese (wt.%)	2.29	0.070	2.24	2.34	2.23	2.36
Pb, Lead (wt.%)	0.277	0.016	0.266	0.288	0.269	0.285
S, Sulphur (wt.%)	7.71	0.169	7.54	7.89	7.50	7.93
Sb, Antimony (ppm)	45.6	4.8	40.7	50.4	41.1	50.0
Si, Silicon (wt.%)	21.82	0.717	21.29	22.35	21.41	22.24
Sr, Strontium (ppm)	204	20	182	225	196	211
Ti, Titanium (wt.%)	0.282	0.010	0.274	0.290	0.272	0.292
Zn, Zinc (wt.%)	0.552	0.015	0.542	0.562	0.541	0.563
4-Acid Digestion						
Ag, Silver (ppm)	10.5	0.37	10.1	10.8	10.1	10.9
Al, Aluminium (wt.%)	7.19	0.291	6.98	7.41	7.07	7.32
As, Arsenic (ppm)	667	21	651	684	651	684
Be, Beryllium (ppm)	1.59	0.103	1.50	1.68	1.52	1.66
Bi, Bismuth (ppm)	7.60	0.599	7.09	8.12	7.40	7.81
Ca, Calcium (wt.%)	1.58	0.050	1.55	1.61	1.54	1.62
Cd, Cadmium (ppm)	13.2	0.53	12.8	13.5	12.6	13.7
Cr, Chromium (ppm)	17.2	2.3	15.2	19.1	IND	IND
Cs, Cesium (ppm)	5.80	0.177	5.66	5.94	5.70	5.91
Cu, Copper (ppm)	384	16	374	394	376	393
Fe, Iron (wt.%)	8.64	0.373	8.42	8.86	8.45	8.83
Ga, Gallium (ppm)	20.9	1.93	19.2	22.5	20.2	21.5
Hf, Hafnium (ppm)	4.95	0.263	4.74	5.16	4.81	5.09
In, Indium (ppm)	0.40	0.013	0.39	0.41	0.38	0.42
K, Potassium (wt.%)	3.12	0.116	3.04	3.20	3.02	3.22
La, Lanthanum (ppm)	22.1	4.1	18.4	25.8	20.5	23.6
Li, Lithium (ppm)	23.6	1.71	22.2	24.9	22.7	24.4
Mg, Magnesium (wt.%)	1.12	0.074	1.07	1.17	1.10	1.14
Mn, Manganese (wt.%)	2.24	0.069	2.19	2.29	2.18	2.30
Mo, Molybdenum (ppm)	11.1	0.38	10.9	11.3	10.7	11.4
Na, Sodium (wt.%)	0.557	0.021	0.541	0.574	0.540	0.574
Nb, Niobium (ppm)	9.05	0.631	8.53	9.56	8.81	9.29
Ni, Nickel (ppm)	11.3	0.23	11.2	11.4	10.8	11.8
P, Phosphorus (wt.%)	0.046	0.004	0.043	0.049	0.044	0.047

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						
Pb, Lead (wt.%)	0.272	0.019	0.257	0.286	0.263	0.280
Rb, Rubidium (ppm)	164	8	157	170	159	168
S, Sulphur (wt.%)	7.73	0.341	7.46	7.99	7.60	7.86
Sb, Antimony (ppm)	43.9	2.62	42.2	45.7	42.4	45.5
Sc, Scandium (ppm)	10.1	0.34	9.9	10.4	9.9	10.4
Sn, Tin (ppm)	3.32	0.171	3.15	3.50	3.17	3.47
Sr, Strontium (ppm)	151	13	141	160	145	156
Ta, Tantalum (ppm)	0.65	0.061	0.59	0.71	0.60	0.70
Th, Thorium (ppm)	12.6	2.2	10.9	14.3	12.1	13.2
Ti, Titanium (wt.%)	0.236	0.011	0.229	0.242	0.228	0.243
Tl, Thallium (ppm)	48.9	4.70	45.3	52.5	47.5	50.3
U, Uranium (ppm)	7.26	0.349	6.98	7.55	7.12	7.41
V, Vanadium (ppm)	45.1	1.33	44.1	46.1	44.3	45.9
W, Tungsten (ppm)	19.9	1.30	18.9	20.9	19.6	20.3
Y, Yttrium (ppm)	20.6	2.4	19.0	22.2	20.1	21.1
Zn, Zinc (wt.%)	0.540	0.026	0.523	0.556	0.530	0.550
Zr, Zirconium (ppm)	169	9	163	175	164	174
Aqua Regia Digestion						
Ag, Silver (ppm)	10.4	0.25	10.2	10.5	10.1	10.7
Al, Aluminium (wt.%)	1.33	0.075	1.28	1.38	1.29	1.36
Au, Gold (ppm)	0.252	0.010	0.240	0.264	0.240	0.264
Be, Beryllium (ppm)	0.29	0.029	0.26	0.33	0.27	0.32
Bi, Bismuth (ppm)	7.23	0.628	6.68	7.78	7.00	7.46
Ca, Calcium (wt.%)	1.48	0.075	1.43	1.52	1.44	1.51
Ce, Cerium (ppm)	44.9	4.25	40.7	49.0	44.1	45.6
Co, Cobalt (ppm)	5.75	0.368	5.40	6.11	5.59	5.91
Cr, Chromium (ppm)	15.5	1.9	14.0	16.9	IND	IND
Cu, Copper (ppm)	387	10	380	394	379	394
Fe, Iron (wt.%)	8.11	0.184	7.99	8.22	7.95	8.26
Ga, Gallium (ppm)	5.20	0.59	4.73	5.67	5.05	5.36
Hf, Hafnium (ppm)	0.82	0.09	0.74	0.90	0.77	0.87
In, Indium (ppm)	0.35	0.029	0.33	0.38	0.34	0.37
La, Lanthanum (ppm)	17.2	3.1	14.0	20.3	16.8	17.6
Li, Lithium (ppm)	7.82	0.399	7.37	8.27	7.57	8.07
Mg, Magnesium (wt.%)	0.751	0.029	0.732	0.770	0.733	0.769
Mo, Molybdenum (ppm)	10.3	0.99	9.4	11.1	9.9	10.6
Ni, Nickel (ppm)	11.0	0.60	10.4	11.6	10.6	11.4
P, Phosphorus (wt.%)	0.043	0.002	0.042	0.045	0.041	0.045
Rb, Rubidium (ppm)	29.0	3.2	25.9	32.0	27.9	30.1
S, Sulphur (wt.%)	7.82	0.234	7.58	8.07	7.65	7.99
Sb, Antimony (ppm)	34.2	3.4	32.2	36.2	32.6	35.8
Sc, Scandium (ppm)	2.22	0.155	2.11	2.32	2.11	2.33

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
Aqua Regia Digestion continued						
Sn, Tin (ppm)	0.78	0.11	0.66	0.90	IND	IND
Sr, Strontium (ppm)	40.3	5.1	36.3	44.2	38.8	41.7
Ti, Titanium (wt.%)	0.066	0.005	0.060	0.073	0.064	0.069
Tl, Thallium (ppm)	14.9	1.06	14.0	15.8	14.5	15.4
U, Uranium (ppm)	3.71	0.172	3.57	3.85	3.61	3.81
Y, Yttrium (ppm)	9.05	0.671	8.52	9.58	8.85	9.26
Zn, Zinc (wt.%)	0.537	0.011	0.528	0.545	0.525	0.548
Zr, Zirconium (ppm)	30.2	3.00	27.3	33.0	29.3	31.0

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 630 is a zinc tailings certified reference material (CRM) prepared and certified by Ore Research & Exploration Pty Ltd. The material constituting OREAS 630 was sourced from the Rosebery metallurgical plant owned and operated by MMG Ltd. The Rosebery mine and plant are located in the north-west region of Tasmania, Australia approximately 300 kilometres north-west of Hobart and 125 kilometres south of Burnie. The key minerals of economic importance include sphalerite, galena, pyrite, chalcopyrite and electrum.

COMMINUTION AND HOMOGENISATION PROCEDURES

The material constituting OREAS 630 was prepared in the following manner:

- Drying to constant mass at 85°C;
- Multi-stage milling to 100% minus 30 microns;
- Packaging in 60g units sealed under nitrogen in laminated foil pouches.

ANALYTICAL PROGRAM

Fourteen geochemical laboratories participated in the program to certify the analytes reported in Table 1. The following methods were employed:

- Four acid digestion for full ICP-OES and ICP-MS elemental suites (up to 12 laboratories depending on the element) except for one laboratory for Mn who used an AAS finish;
- Peroxide fusion for full ICP-OES and ICP-MS elemental suites (up to 13 laboratories depending on the element);
- Aqua regia digestion for full ICP-OES and ICP-MS elemental suites (up to 12 laboratories depending on the element);
- Gold by fire assay with AAS (7 laboratories), ICP-OES (4 laboratories) or gravimetric finish (1 laboratory);
- Instrumental neutron activation analysis for Au and Ag on 20 x 1g subsamples to confirm homogeneity (1 laboratory).

For the round robin program ten 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 20g scoop splits from each of three separate 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 presents the 89 certified values together with their associated 1SD's, 95% confidence and tolerance limits and Table 2 below shows 101 indicative values. Table 3 provides performance gate intervals for the certified values based on their pooled 1SD's and Table 4 shows the gold instrumental neutron activation analysis (INAA) results for twenty 1.0 gram subsamples determined by Actlabs located in Ancaster, Canada.

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 630 DataPack.xlsx**).

Table 2. Indicative Values for OREAS 630.

Constituent	Unit	Value	Constituent	Unit	Value	Constituent	Unit	Value
Peroxide Fusion ICP								
Ag	ppm	*12.3*	Hf	ppm	*5.33*	Sm	ppm	*7.33*
B	ppm	*< 50*	Ho	ppm	*1.05*	Sn	ppm	*< 100*
Ba	wt.%	*1.09*	In	ppm	*0.42*	Ta	ppm	*0.64*
Be	ppm	*1.83*	La	ppm	*42.7*	Tb	ppm	*0.90*
Bi	ppm	*7.66*	Li	ppm	*28.1*	Te	ppm	*< 1*
Cd	ppm	*13.4*	Lu	ppm	*0.44*	Th	ppm	*16.2*
Ce	ppm	*88*	Mo	ppm	*11.8*	Tl	ppm	*48.6*
Co	ppm	*8.10*	Nb	ppm	*12.1*	Tm	ppm	*0.39*
Cr	ppm	*32.9*	Nd	ppm	*37.2*	U	ppm	*7.91*
Cs	ppm	*5.23*	Ni	ppm	*< 20*	V	ppm	*45.3*
Dy	ppm	*5.28*	P	wt.%	*0.063*	W	ppm	*23.7*
Er	ppm	*3.17*	Pr	ppm	*10.2*	Y	ppm	*30.3*
Eu	ppm	*2.27*	Rb	ppm	*186*	Yb	ppm	*3.50*
Ga	ppm	*21.3*	Re	ppm	*< 0.1*	Zr	ppm	*210*

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
Peroxide Fusion ICP continued								
Gd	ppm	*6.39*	Sc	ppm	*9.37*			
Ge	ppm	*4.50*	Se	ppm	*< 20*			
4-Acid Digestion								
Ba	ppm	*219*	Ge	ppm	*0.16*	Sm	ppm	*7.95*
Ce	ppm	*60*	Ho	ppm	*0.91*	Tb	ppm	*0.93*
Co	ppm	*5.67*	Lu	ppm	*0.43*	Te	ppm	*< 0.05*
Dy	ppm	*4.38*	Nd	ppm	*40.0*	Tm	ppm	*0.41*
Er	ppm	*2.73*	Pr	ppm	*10.5*	Yb	ppm	*2.94*
Eu	ppm	*2.92*	Re	ppm	*0.002*			
Gd	ppm	*7.02*	Se	ppm	*0.99*			
Aqua Regia Digestion								
As	ppm	*675*	K	wt.%	*0.437*	Se	ppm	*0.82*
B	ppm	*7.25*	Lu	ppm	*0.083*	Sm	ppm	*4.74*
Ba	ppm	*54*	Mn	wt.%	*2.14*	Ta	ppm	*0.067*
Cd	ppm	*13.0*	Na	wt.%	*0.040*	Tb	ppm	*0.39*
Cs	ppm	*2.67*	Nb	ppm	*1.03*	Te	ppm	*0.038*
Dy	ppm	*2.25*	Nd	ppm	*23.6*	Th	ppm	*7.98*
Er	ppm	*1.12*	Pb	wt.%	*0.283*	Tm	ppm	*0.15*
Eu	ppm	*1.05*	Pd	ppm	*< 0.01*	V	ppm	*14.2*
Gd	ppm	*4.01*	Pr	ppm	*6.24*	W	ppm	*11.1*
Ge	ppm	*0.14*	Pt	ppm	*< 0.005*	Yb	ppm	*0.81*
Hg	ppm	*0.62*	Re	ppm	*0.002*			
Ho	ppm	*0.40*	Ru	ppm	*< 0.005*			
3-Acid Digestion (no HF)								
Mn	wt.%	*1.48*						
Thermogravimetry								
LOI^{1000}	wt.%	*11.97*						

Note: the number of significant figures reported is not a reflection of the level of certainty of stated values. They are instead an artefact of ORE's in-house CRM-specific LIMS.

STATISTICAL ANALYSIS

Certified Values, 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 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. The Certified Values are the means of accepted laboratory means after outlier filtering.

The 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 zinc (Zn) 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 0.530 and 0.550 wt.%. 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.*

For gold, tolerance can be determined by INAA (see results in Table 4 below) using the reduced analytical subsample method which utilises the known relationship between standard deviation and analytical subsample weight (Ingamells and Switzer, 1973). In this approach the latter parameter is substantially reduced to a point where most of the variability in replicate assays is due to inhomogeneity of the reference material and measurement error becomes negligible. In this instance small subsample weights of 1.0 gram were employed and the 1RSD of 1.16% at a typical 30g charge weight (6.29% at 1.0 gram weights) confirms the high level of gold homogeneity in OREAS 630.

Table 4. Instrumental Neutron Activation Analysis of Au (ppm) on 20 x 1g subsamples of OREAS 630.

Replicate No	INAA 1g
1	0.255
2	0.281
3	0.225
4	0.262
5	0.228
6	0.252
7	0.260
8	0.254
9	0.252
10	0.275
11	0.264
12	0.237
13	0.225
14	0.249
15	0.246
16	0.238
17	0.238
18	0.268
19	0.243
20	0.244
Mean	0.250
Median	0.251
Std Dev.	0.016
Rel.Std.Dev.	6.29%
PDM[3]	-3.43%

The homogeneity of OREAS 630 has also been evaluated in a **nested ANOVA** of the round robin program. Each of the fourteen round robin laboratories received six samples per CRM and these samples were made up of paired samples from three different, non-adjacent sampling intervals. The purpose of the ANOVA evaluation is to test that no statistically significant difference exists in the variance between-units to that of the variance within-units. This allows an assessment of homogeneity across the entire prepared batch of OREAS 630. The test was performed using the following parameters:

- Null Hypothesis, H_0: Between-unit variance is no greater than within-unit variance (reject H_0 if *p*-value < 0.05);
- Alternative Hypothesis, H_1: Between-unit variance is greater than within-unit variance.

P-values are a measure of probability where values less than 0.05 indicate a greater than 95% probability that the observed differences in within-unit and between-unit variances are real. The datasets were filtered for both individual and laboratory data set (batch) outliers prior to the calculation of *p*-values. This process derived no significant *p*-values across the entire 89 certified values except for Gallium (Ga) by 4-acid digestion. This isolated case is 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.

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 630 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 630 is fit-for-purpose as a certified reference material (see 'Intended Use' below).

Table 3. Pooled-Lab Performance Gates for OREAS 630.

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, ppm	0.259	0.007	0.245	0.272	0.238	0.279	2.61%	5.21%	7.82%	0.246	0.272
Peroxide Fusion ICP											
Al, wt.%	7.24	0.137	6.97	7.52	6.83	7.66	1.89%	3.79%	5.68%	6.88	7.61
As, ppm	676	48	580	772	532	820	7.11%	14.23%	21.34%	642	710
Ca, wt.%	1.62	0.127	1.36	1.87	1.23	2.00	7.86%	15.71%	23.57%	1.53	1.70
Cu, ppm	386	14	358	414	344	429	3.67%	7.34%	11.01%	367	405
K, wt.%	3.16	0.107	2.95	3.38	2.84	3.48	3.39%	6.78%	10.17%	3.00	3.32
Mg, wt.%	1.13	0.054	1.02	1.24	0.97	1.29	4.80%	9.60%	14.41%	1.07	1.18
Mn, wt.%	2.29	0.070	2.15	2.43	2.08	2.50	3.07%	6.14%	9.22%	2.18	2.41
Pb, wt.%	0.277	0.016	0.246	0.308	0.230	0.324	5.66%	11.33%	16.99%	0.263	0.291
S, wt.%	7.71	0.169	7.37	8.05	7.21	8.22	2.20%	4.39%	6.59%	7.33	8.10

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
Peroxide Fusion ICP continued											
Sb, ppm	45.6	4.8	36.0	55.2	31.1	60.0	10.55%	21.11%	31.66%	43.3	47.8
Si, wt.%	21.82	0.717	20.39	23.26	19.67	23.97	3.29%	6.57%	9.86%	20.73	22.91
Sr, ppm	204	20	163	244	143	264	9.90%	19.79%	29.69%	193	214
Ti, wt.%	0.282	0.010	0.262	0.302	0.252	0.312	3.52%	7.04%	10.56%	0.268	0.296
Zn, wt.%	0.552	0.015	0.523	0.582	0.508	0.597	2.70%	5.39%	8.09%	0.525	0.580
4-Acid Digestion											
Ag, ppm	10.5	0.37	9.7	11.2	9.4	11.6	3.56%	7.12%	10.68%	10.0	11.0
Al, wt.%	7.19	0.291	6.61	7.78	6.32	8.07	4.05%	8.10%	12.15%	6.83	7.55
As, ppm	667	21	626	709	605	730	3.11%	6.22%	9.33%	634	701
Be, ppm	1.59	0.103	1.39	1.80	1.28	1.90	6.45%	12.89%	19.34%	1.51	1.67
Bi, ppm	7.60	0.599	6.41	8.80	5.81	9.40	7.87%	15.75%	23.62%	7.22	7.98
Ca, wt.%	1.58	0.050	1.48	1.68	1.43	1.73	3.17%	6.34%	9.50%	1.50	1.66
Cd, ppm	13.2	0.53	12.1	14.2	11.6	14.7	4.00%	7.99%	11.99%	12.5	13.8
Cr, ppm	17.2	2.3	12.6	21.8	10.3	24.0	13.32%	26.63%	39.95%	16.3	18.0
Cs, ppm	5.80	0.177	5.45	6.16	5.27	6.33	3.05%	6.11%	9.16%	5.51	6.09
Cu, ppm	384	16	353	416	337	432	4.13%	8.25%	12.38%	365	403
Fe, wt.%	8.64	0.373	7.89	9.39	7.52	9.76	4.32%	8.63%	12.95%	8.21	9.07
Ga, ppm	20.9	1.93	17.0	24.7	15.1	26.6	9.26%	18.51%	27.77%	19.8	21.9
Hf, ppm	4.95	0.263	4.42	5.47	4.16	5.74	5.31%	10.62%	15.92%	4.70	5.19
In, ppm	0.40	0.013	0.38	0.43	0.36	0.44	3.21%	6.43%	9.64%	0.38	0.42
K, wt.%	3.12	0.116	2.89	3.35	2.77	3.47	3.72%	7.44%	11.16%	2.96	3.28
La, ppm	22.1	4.1	14.0	30.2	9.9	34.2	18.38%	36.76%	55.14%	21.0	23.2
Li, ppm	23.6	1.71	20.2	27.0	18.4	28.7	7.24%	14.48%	21.71%	22.4	24.7
Mg, wt.%	1.12	0.074	0.97	1.27	0.90	1.34	6.60%	13.19%	19.79%	1.07	1.18
Mn, wt.%	2.24	0.069	2.10	2.38	2.03	2.45	3.09%	6.18%	9.28%	2.13	2.35
Mo, ppm	11.1	0.38	10.3	11.8	10.0	12.2	3.39%	6.77%	10.16%	10.5	11.6
Na, wt.%	0.557	0.021	0.516	0.599	0.495	0.620	3.73%	7.46%	11.19%	0.529	0.585
Nb, ppm	9.05	0.631	7.78	10.31	7.15	10.94	6.98%	13.96%	20.94%	8.59	9.50
Ni, ppm	11.3	0.23	10.8	11.8	10.6	12.0	2.07%	4.14%	6.20%	10.7	11.9
P, wt.%	0.046	0.004	0.039	0.053	0.035	0.057	7.78%	15.56%	23.35%	0.044	0.048
Pb, wt.%	0.272	0.019	0.234	0.309	0.215	0.328	6.94%	13.88%	20.82%	0.258	0.285
Rb, ppm	164	8	147	180	139	189	5.04%	10.08%	15.12%	156	172
S, wt.%	7.73	0.341	7.05	8.41	6.70	8.75	4.41%	8.83%	13.24%	7.34	8.11
Sb, ppm	43.9	2.62	38.7	49.2	36.1	51.8	5.95%	11.91%	17.86%	41.8	46.1
Sc, ppm	10.1	0.34	9.4	10.8	9.1	11.2	3.40%	6.80%	10.21%	9.6	10.6
Sn, ppm	3.32	0.171	2.98	3.67	2.81	3.84	5.15%	10.29%	15.44%	3.16	3.49
Sr, ppm	151	13	125	176	113	188	8.38%	16.76%	25.14%	143	158
Ta, ppm	0.65	0.061	0.53	0.77	0.47	0.83	9.34%	18.67%	28.01%	0.62	0.68
Th, ppm	12.6	2.2	8.3	17.0	6.1	19.2	17.37%	34.74%	52.10%	12.0	13.3
Ti, wt.%	0.236	0.011	0.214	0.258	0.203	0.269	4.65%	9.30%	13.96%	0.224	0.247
Tl, ppm	48.9	4.70	39.5	58.3	34.8	63.0	9.63%	19.25%	28.88%	46.4	51.3
U, ppm	7.26	0.349	6.57	7.96	6.22	8.31	4.81%	9.61%	14.42%	6.90	7.63
V, ppm	45.1	1.33	42.4	47.8	41.1	49.1	2.96%	5.91%	8.87%	42.8	47.4

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											
W, ppm	19.9	1.30	17.3	22.5	16.0	23.8	6.51%	13.03%	19.54%	18.9	20.9
Y, ppm	20.6	2.4	15.9	25.3	13.5	27.7	11.47%	22.94%	34.40%	19.6	21.6
Zn, wt.%	0.540	0.026	0.487	0.593	0.461	0.619	4.88%	9.77%	14.65%	0.513	0.567
Zr, ppm	169	9	151	186	142	195	5.21%	10.42%	15.63%	160	177
Aqua Regia Digestion											
Ag, ppm	10.4	0.25	9.9	10.9	9.6	11.1	2.40%	4.80%	7.20%	9.9	10.9
Al, wt.%	1.33	0.075	1.18	1.48	1.10	1.55	5.65%	11.29%	16.94%	1.26	1.39
Au, ppm	0.252	0.010	0.231	0.273	0.221	0.283	4.10%	8.20%	12.30%	0.239	0.265
Be, ppm	0.29	0.029	0.24	0.35	0.21	0.38	9.90%	19.80%	29.70%	0.28	0.31
Bi, ppm	7.23	0.628	5.97	8.48	5.35	9.11	8.68%	17.36%	26.04%	6.87	7.59
Ca, wt.%	1.48	0.075	1.32	1.63	1.25	1.70	5.11%	10.23%	15.34%	1.40	1.55
Ce, ppm	44.9	4.25	36.3	53.4	32.1	57.6	9.48%	18.97%	28.45%	42.6	47.1
Co, ppm	5.75	0.368	5.02	6.49	4.65	6.86	6.40%	12.79%	19.19%	5.47	6.04
Cr, ppm	15.5	1.9	11.7	19.2	9.9	21.1	12.11%	24.21%	36.32%	14.7	16.3
Cu, ppm	387	10	367	406	357	416	2.55%	5.10%	7.66%	367	406
Fe, wt.%	8.11	0.184	7.74	8.47	7.55	8.66	2.27%	4.54%	6.81%	7.70	8.51
Ga, ppm	5.20	0.59	4.03	6.37	3.44	6.96	11.28%	22.57%	33.85%	4.94	5.46
Hf, ppm	0.82	0.09	0.64	0.99	0.56	1.08	10.72%	21.44%	32.15%	0.78	0.86
In, ppm	0.35	0.029	0.30	0.41	0.27	0.44	8.29%	16.59%	24.88%	0.34	0.37
La, ppm	17.2	3.1	10.9	23.4	7.8	26.5	18.17%	36.34%	54.52%	16.3	18.0
Li, ppm	7.82	0.399	7.02	8.62	6.62	9.02	5.10%	10.20%	15.31%	7.43	8.21
Mg, wt.%	0.751	0.029	0.694	0.809	0.665	0.837	3.83%	7.66%	11.48%	0.714	0.789
Mo, ppm	10.3	0.99	8.3	12.2	7.3	13.2	9.69%	19.39%	29.08%	9.7	10.8
Ni, ppm	11.0	0.60	9.8	12.2	9.2	12.8	5.45%	10.90%	16.35%	10.4	11.5
P, wt.%	0.043	0.002	0.039	0.048	0.036	0.050	5.33%	10.65%	15.98%	0.041	0.045
Rb, ppm	29.0	3.2	22.6	35.3	19.4	38.5	10.97%	21.94%	32.91%	27.5	30.4
S, wt.%	7.82	0.234	7.35	8.29	7.12	8.52	2.99%	5.98%	8.97%	7.43	8.21
Sb, ppm	34.2	3.4	27.3	41.0	23.9	44.5	10.05%	20.09%	30.14%	32.5	35.9
Sc, ppm	2.22	0.155	1.91	2.53	1.75	2.68	7.00%	14.00%	21.00%	2.11	2.33
Sn, ppm	0.78	0.11	0.56	0.99	0.46	1.10	13.79%	27.57%	41.36%	0.74	0.82
Sr, ppm	40.3	5.1	30.1	50.4	25.1	55.5	12.57%	25.14%	37.71%	38.3	42.3
Ti, wt.%	0.066	0.005	0.057	0.076	0.052	0.081	7.32%	14.64%	21.97%	0.063	0.070
Tl, ppm	14.9	1.06	12.8	17.0	11.7	18.1	7.12%	14.25%	21.37%	14.2	15.7
U, ppm	3.71	0.172	3.37	4.06	3.20	4.23	4.63%	9.27%	13.90%	3.53	3.90
Y, ppm	9.05	0.671	7.71	10.39	7.04	11.07	7.41%	14.81%	22.22%	8.60	9.51
Zn, wt.%	0.537	0.011	0.514	0.559	0.503	0.570	2.09%	4.19%	6.28%	0.510	0.563
Zr, ppm	30.2	3.00	24.1	36.2	21.1	39.2	9.95%	19.91%	29.86%	28.6	31.7

Note: intervals may appear asymmetric due to rounding.

PARTICIPATING LABORATORIES

1. Actlabs, Ancaster, Ontario, Canada
2. ALS, Lima, Peru
3. ALS, Loughrea, Galway, Ireland
4. ALS, Perth, WA, Australia
5. ALS, Vancouver, BC, Canada
6. Bureau Veritas Geoanalytical, Adelaide, SA, Australia
7. Inspectorate (BV), Lima, Peru
8. Intertek Genalysis, Perth, WA, Australia
9. Intertek Testing Services Philippines, Cupang, Muntinlupa, Philippines
10. PT Geoservices Ltd, Cikarang, Jakarta Raya, Indonesia
11. SGS, Randfontein, Gauteng, South Africa
12. SGS Mineral Services, Townsville, QLD, Australia
13. Shiva Analyticals Ltd, Bangalore North, Karnataka, India
14. SRL, Perth, WA, Australia

PREPARER AND SUPPLIER

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It is packaged under nitrogen in unit sizes of 60g (single-use laminated foil pouches).

INTENDED USE

OREAS 630 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.

STABILITY AND STORAGE INSTRUCTIONS

OREAS 630 has been prepared from primary sulphide bearing ores from the Rosebery deposit. It contains reactive sulphide (7.7% S) and has been packaged under a nitrogen environment (single use laminated foil pouches). In its unopened state and under normal conditions of storage the CRM has a shelf life beyond ten years. Its stability will be monitored at regular intervals and purchasers notified if any changes are observed.

INSTRUCTIONS FOR CORRECT USE

The certified values for OREAS 630 refer to the concentration level in its packaged state. It should not be dried prior to weighing and analysis.

HANDLING INSTRUCTIONS

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

TRACEABILITY

The analytical samples were selected in a manner to represent the entire batch of prepared CRM. This 'representivity' was maintained in each submitted laboratory sample batch and ensures the user that the data is traceable from sample selection through to the analytical results that underlie the consensus values. Each analytical data set has been validated by its assayer through the inclusion of internal reference materials and QC checks during analysis. The laboratories were chosen on the basis of their competence (from past performance in inter-laboratory programs) for a particular analytical method, analyte or analyte suite, and sample matrix. Most of these laboratories have and maintain ISO 17025 accreditation. The certified 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

17th August, 2017

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

REFERENCES

ISO Guide 30 (1992), Terms and definitions used in connection with reference materials.
ISO Guide 31 (2000), Reference materials – Contents of certificates and labels.
ISO Guide 3207 (1975), Statistical interpretation of data - Determination of a statistical tolerance interval.
ISO Guide 35 (2006), Certification of reference materials - General and statistical principals.