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CERTIFICATE OF ANALYSIS FOR

COPPER-GOLD-SILVER CONCENTRATE

CERTIFIED REFERENCE MATERIAL

OREAS 990

Table 1. Certified Values, SDs, 95% Confidence and Tolerance Limits for OREAS 990.

Constituent	Certified Value	1SD	95% Confidence Limits		95% Tolerance Limits	
			Low	High	Low	High
Umpire Labs (dry sample basis)						
Fire Assay						
Ag, Silver (ppm)	1765	14	1756	1774	1757	1773
Au, Gold (ppm)	76.11	0.751	75.65	76.57	74.49*	77.74*
Classical Wet Chemistry						
Cu, Copper (wt.%)	16.87	0.100	16.82	16.93	16.85	16.89
Geochemical Labs (as received sample basis)						
Peroxide Fusion ICP						
Al, Aluminium (wt.%)	0.938	0.024	0.921	0.955	0.917	0.959
As, Arsenic (ppm)	4491	165	4319	4663	4351	4631
Cu, Copper (wt.%)	16.97	0.521	16.61	17.34	16.74	17.20
Fe, Iron (wt.%)	20.18	0.537	19.80	20.55	19.88	20.48
Mg, Magnesium (wt.%)	0.156	0.006	0.151	0.160	0.142	0.170
Mn, Manganese (wt.%)	0.387	0.010	0.379	0.395	0.378	0.395
Pb, Lead (wt.%)	8.64	0.178	8.52	8.77	8.49	8.79
S, Sulphur (wt.%)	30.29	0.804	29.63	30.94	29.59	30.98
Si, Silicon (wt.%)	2.08	0.067	2.03	2.14	2.04	2.13
Ti, Titanium (wt.%)	0.039	0.002	0.036	0.041	IND	IND
Zn, Zinc (wt.%)	13.62	0.211	13.49	13.76	13.39	13.86
4-Acid Digestion						
Ag, Silver (ppm)	1745	37	1708	1783	1704	1786
Al, Aluminium (wt.%)	0.915	0.056	0.872	0.958	0.892	0.939
As, Arsenic (ppm)	4161	328	3932	4389	4030	4291

Note: intervals may appear asymmetric due to rounding.

Table 1 continued.

Constituent	Certified Value	1SD	95% Confidence Limits		95% Tolerance Limits	
Geochemical Labs (as received sample basis)						
4-Acid Digestion continued						
Cd, Cadmium (ppm)	335	13	325	345	327	344
Cr, Chromium (ppm)	9.41	1.25	8.18	10.64	IND	IND
Cu, Copper (wt.%)	16.99	0.434	16.72	17.25	16.65	17.32
Fe, Iron (wt.%)	20.07	0.990	19.38	20.77	19.59	20.56
K, Potassium (wt.%)	0.395	0.022	0.378	0.412	0.387	0.403
Mg, Magnesium (wt.%)	0.164	0.007	0.160	0.169	0.160	0.169
Mn, Manganese (wt.%)	0.372	0.024	0.356	0.388	0.361	0.383
Mo, Molybdenum (ppm)	116	10	108	125	114	119
Ni, Nickel (ppm)	93	7.4	87	100	89	97
Pb, Lead (wt.%)	8.62	0.199	8.51	8.73	8.49	8.75
S, Sulphur (wt.%)	28.29	1.844	26.56	30.03	27.10	29.49
Sb, Antimony (ppm)	4650	321	4383	4916	4503	4797
Zn, Zinc (wt.%)	13.43	0.518	13.10	13.75	13.14	13.72
Zr, Zirconium (ppm)	38.7	5.4	33.7	43.7	36.7	40.7
Infrared Combustion						
S, Sulphur (wt.%)	30.47	0.553	30.23	30.72	29.83	31.12

Note: intervals may appear asymmetric due to rounding.

Table 2. Indicative Values for OREAS 990.

Constituent	Unit	Value	Constituent	Unit	Value	Constituent	Unit	Value
Umpire Labs (as received sample basis)								
Thermogravimetry								
H_2O-	wt.%	*0.230*						
Geochemical Labs (as received sample basis)								
Fire Assay								
Au	ppm	*73.77*						
Peroxide Fusion ICP								
Ag	ppm	*1727*	In	ppm	*28.9*	Se	ppm	*< 20*
B	ppm	*< 50*	K	wt.%	*0.415*	Sn	ppm	*< 100*
Ba	ppm	*2174*	La	ppm	*9.00*	Sr	ppm	*24.6*
Be	ppm	*1536*	Li	ppm	*7.38*	Ta	ppm	*< 0.1*
Bi	ppm	*96*	Mo	ppm	*125*	Te	ppm	*< 2*
Ca	wt.%	*0.212*	Nb	ppm	*6.50*	Th	ppm	*4.38*
Cd	ppm	*365*	Ni	ppm	*127*	Tl	ppm	*17.2*
Co	ppm	*8.26*	P	wt.%	*0.107*	U	ppm	*2.95*
Cr	ppm	*< 100*	Rb	ppm	*25.6*	V	ppm	*< 20*
Cs	ppm	*0.18*	Re	ppm	*0.092*	W	ppm	*123*
Ga	ppm	*15.7*	Sb	ppm	*5020*	Y	ppm	*7.51*
Ge	ppm	*< 1*	Sc	ppm	*< 10*			
4-Acid Digestion								
Ba	ppm	*1482*	In	ppm	*26.6*	Sr	ppm	*20.4*
Be	ppm	*< 0.5*	La	ppm	*9.06*	Ta	ppm	*0.11*

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
Geochemical Labs (as received basis)								
4-Acid Digestion continued								
Bi	ppm	*113*	Li	ppm	*2.74*	Tb	ppm	*0.21*
Ca	wt.%	*0.161*	Lu	ppm	*0.11*	Te	ppm	*< 50*
Ce	ppm	*25.1*	Na	wt.%	*0.044*	Th	ppm	*4.62*
Co	ppm	*5.47*	Nb	ppm	*< 10*	Ti	wt.%	*0.033*
Cs	ppm	*1.04*	Nd	ppm	*10.7*	Tl	ppm	*20.5*
Dy	ppm	*1.06*	P	wt.%	*0.037*	Tm	ppm	*0.099*
Er	ppm	*0.63*	Pr	ppm	*3.09*	U	ppm	*< 50*
Eu	ppm	*0.93*	Rb	ppm	*19.9*	V	ppm	*4.96*
Ga	ppm	*3.73*	Re	ppm	*51*	W	ppm	*46.1*
Gd	ppm	*1.78*	Sc	ppm	*2.19*	Y	ppm	*4.43*
Ge	ppm	*0.069*	Se	ppm	*< 5*	Yb	ppm	*0.67*
Hf	ppm	*1.00*	Sm	ppm	*2.17*			
Ho	ppm	*0.21*	Sn	ppm	*25.9*			
Aqua Regia Digestion								
Ag	ppm	*1810*	Ge	ppm	*0.052*	Sb	ppm	*4055*
Al	wt.%	*0.280*	Hf	ppm	*0.23*	Sc	ppm	*0.22*
As	ppm	*4188*	Hg	ppm	*9.57*	Se	ppm	*< 5*
B	ppm	*158*	Ho	ppm	*0.088*	Sm	ppm	*1.31*
Ba	ppm	*2707*	In	ppm	*18.2*	Sn	ppm	*6.67*
Be	ppm	*< 5*	K	wt.%	*0.083*	Sr	ppm	*9.11*
Bi	ppm	*82*	La	ppm	*6.75*	Ta	ppm	*< 5*
Ca	wt.%	*0.148*	Li	ppm	*1.38*	Tb	ppm	*0.12*
Cd	ppm	*281*	Lu	ppm	*0.038*	Te	ppm	*40.5*
Ce	ppm	*15.5*	Mg	wt.%	*0.116*	Th	ppm	*2.81*
Co	ppm	*4.99*	Mn	wt.%	*0.324*	Ti	wt.%	*< 0.01*
Cr	ppm	*6.75*	Mo	ppm	*101*	Tl	ppm	*16.0*
Cs	ppm	*0.50*	Na	wt.%	*< 0.01*	Tm	ppm	*0.031*
Cu	wt.%	*17.40*	Nb	ppm	*0.32*	U	ppm	*1.54*
Dy	ppm	*0.52*	Nd	ppm	*6.84*	V	ppm	*1.06*
Er	ppm	*0.24*	Ni	ppm	*87*	W	ppm	*2.63*
Eu	ppm	*0.32*	P	wt.%	*0.037*	Y	ppm	*1.83*
Fe	wt.%	*17.05*	Pb	wt.%	*3.77*	Yb	ppm	*0.22*
Ga	ppm	*5.99*	Pr	ppm	*1.77*	Zn	wt.%	*10.17*
Gd	ppm	*1.05*	S	wt.%	*15.45*	Zr	ppm	*8.43*
3-Acid Digestion (no HF)								
Cu	wt.%	*16.69*	S	wt.%	*25.08*	Zn	wt.%	*12.02*
Pb	wt.%	*8.32*	Sb	ppm	*4263*			
Thermogravimetry								
LOI^{1000}	wt.%	*14.69*						

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.

SOURCE MATERIALS

OREAS 990 is a copper-gold-silver concentrate certified reference material (CRM) prepared and certified by Ore Research & Exploration Pty Ltd. The material constituting OREAS 990 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 source materials constituting OREAS 990 were prepared in the following manner:

- Drying of materials to constant mass at 85°C;
- Deagglomeration and multi-stage milling to 100% <30 microns;
- Homogenisation;
- Packaging into 60g units sealed under nitrogen in laminated foil pouches.

ANALYTICAL PROGRAM

Fourteen umpire laboratories and fourteen geochemical analytical laboratories participated in the round robin certification program to certify the 32 analytes reported in Table 1.

The umpire laboratories each received a 100g sample and employed the following methods:

- Copper was determined by short iodide titration (12 laboratories) or eletro-gravimetry (2 laboratories);
- Gold by reduced charge fire assay with full corrections and gravimetric (10 laboratories) or AAS finish (1 laboratory);
- Silver by fire assay with gravimetric (10 laboratories) or AAS finish (1 laboratory);
- Moisture (H_2O-) at 105°C by thermogravimetry (14 laboratories).

The umpire laboratories were given strict pre-assay sample instructions relating to moisture correction. These instructions included:

- Equilibration of sample material to lab atmosphere for a minimum of 2 hours;
- Hygroscopic moisture analysis at 105°C determined on a separate subsample and weighed for analysis at the same time as the sample aliquots for Cu, Au and Ag as per ISO 9599.

The umpire laboratories were also requested to report metal concentrations on both a dry and moisture-bearing basis and include all results for moisture determinations. A value for

moisture (H_2O-) is provided in the indicative values table for informational purposes only (see Table 2).

The certified values for copper, gold and silver are on a dry sample basis.

The geochemical laboratories each received six 40g samples and employed the following methods:

- 4-acid (HF-HNO_3-$HClO_4$-HCl) digestion for full ICP-OES and ICP-MS elemental suites (up to 12 laboratories depending on the element) with the following exceptions where an AAS finish was used: one laboratory for Ag, four laboratories for Cu, two laboratories Pb, two laboratories for S, one laboratory for Sb and three laboratories for Zn;
- Peroxide fusion for full ICP-OES and ICP-MS elemental suites (up to 13 laboratories depending on the element);
- Instrumental neutron activation analysis for Au and Ag on 20 x 1g subsamples to confirm homogeneity (1 laboratory).
- Infrared combustion furnace for S (9 laboratories).

Samples for the round robin program were taken at ten predetermined sampling intervals immediately following final homogenisation and are considered representative of the entire batch of OREAS 990. For the geochemical laboratory round robin the six samples received by each laboratory were obtained by taking two 40g 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 32 certified values together with their associated 1SD's, 95% confidence and tolerance limits and Table 2 shows 146 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 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 990 DataPack.xlsx**).

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.

Certified Values are the means of accepted laboratory means after outlier filtering. Indicative (uncertified) values (Table 2) 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.

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 values include all sources of measurement uncertainty: between-lab variance, within-run variance (precision errors) and CRM variability. For an effective CRM the contribution of the latter should be negligible in comparison to measurement errors. OREAS 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 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 990.

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
Umpire Labs (dry sample basis)											
Fire Assay											
Ag, ppm	1765	15	1736	1794	1721	1809	0.83%	1.65%	2.48%	1677	1853
Au, ppm	76.11	0.751	74.61	77.62	73.86	78.37	0.99%	1.97%	2.96%	72.31	79.92
Classical Wet Chemistry											
Cu, wt.%	16.87	0.100	16.67	17.07	16.57	17.17	0.59%	1.18%	1.77%	16.03	17.71
Geochemical Labs ('as received' sample basis)											
Peroxide Fusion ICP											
Al, wt.%	0.938	0.024	0.890	0.986	0.866	1.010	2.57%	5.14%	7.71%	0.891	0.985
As, ppm	4491	165	4161	4821	3995	4987	3.68%	7.36%	11.04%	4266	4715
Cu, wt.%	16.97	0.521	15.93	18.01	15.41	18.54	3.07%	6.14%	9.21%	16.12	17.82
Fe, wt.%	20.18	0.537	19.10	21.25	18.57	21.79	2.66%	5.32%	7.98%	19.17	21.19
Mg, wt.%	0.156	0.006	0.143	0.169	0.137	0.175	4.10%	8.20%	12.31%	0.148	0.164
Mn, wt.%	0.387	0.010	0.366	0.407	0.356	0.418	2.66%	5.33%	7.99%	0.367	0.406
Pb, wt.%	8.64	0.178	8.29	9.00	8.11	9.18	2.06%	4.12%	6.18%	8.21	9.07
S, wt.%	30.29	0.804	28.68	31.89	27.87	32.70	2.66%	5.31%	7.97%	28.77	31.80
Si, wt.%	2.08	0.067	1.95	2.22	1.88	2.29	3.21%	6.42%	9.63%	1.98	2.19
Ti, wt.%	0.039	0.002	0.034	0.044	0.031	0.046	6.31%	12.61%	18.92%	0.037	0.041
Zn, wt.%	13.62	0.211	13.20	14.05	12.99	14.26	1.55%	3.10%	4.65%	12.94	14.31
4-Acid Digestion											
Ag, ppm	1745	37	1671	1819	1634	1856	2.12%	4.24%	6.35%	1658	1833
Al, wt.%	0.915	0.056	0.802	1.028	0.746	1.085	6.17%	12.34%	18.50%	0.870	0.961
As, ppm	4161	328	3505	4816	3178	5143	7.87%	15.75%	23.62%	3953	4369
Cd, ppm	335	13	309	361	296	375	3.91%	7.81%	11.72%	318	352
Cr, ppm	9.41	1.25	6.90	11.92	5.64	13.17	13.34%	26.67%	40.01%	8.94	9.88
Cu, wt.%	16.99	0.434	16.12	17.86	15.69	18.29	2.55%	5.11%	7.66%	16.14	17.84
Fe, wt.%	20.07	0.990	18.09	22.05	17.10	23.04	4.93%	9.86%	14.80%	19.07	21.08
K, wt.%	0.395	0.022	0.350	0.440	0.328	0.462	5.65%	11.30%	16.95%	0.375	0.415
Mg, wt.%	0.164	0.007	0.150	0.179	0.143	0.186	4.40%	8.80%	13.20%	0.156	0.173
Mn, wt.%	0.372	0.024	0.325	0.419	0.301	0.443	6.33%	12.67%	19.00%	0.354	0.391
Mo, ppm	116	10	97	136	87	145	8.33%	16.66%	24.98%	110	122
Ni, ppm	93	7.4	79	108	71	116	7.92%	15.83%	23.75%	89	98
Pb, wt.%	8.62	0.199	8.22	9.02	8.02	9.22	2.31%	4.63%	6.94%	8.19	9.05

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
Geochemical Labs ('as received' sample basis)											
4-Acid Digestion continued											
S, wt.%	28.29	1.844	24.61	31.98	22.76	33.82	6.52%	13.03%	19.55%	26.88	29.71
Sb, ppm	4650	321	4007	5293	3685	5614	6.91%	13.83%	20.74%	4417	4882
Zn, wt.%	13.43	0.518	12.39	14.46	11.87	14.98	3.86%	7.72%	11.58%	12.76	14.10
Zr, ppm	38.7	5.4	28.0	49.4	22.6	54.8	13.86%	27.71%	41.57%	36.8	40.6
Infrared Combustion											
S, wt.%	30.47	0.553	29.37	31.58	28.81	32.13	1.82%	3.63%	5.45%	28.95	32.00

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 Cu by the umpire laboratories employing classical wet chem methods, where 99% of the time (1-α=0.99) at least 95% of subsamples (ρ=0.95) will have concentrations lying between 16.85 and 16.89 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).

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 0.67% at a typical 15g charge weight for umpire assays (2.56% at 1.0 gram weights) confirms the high level of gold homogeneity in OREAS 990.

The homogeneity of OREAS 990 has also been evaluated in a **nested ANOVA** of the round robin program. Each of the fourteen geochemical round robin laboratories received six samples 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 990.

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 29 (geochem labs) certified values. 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 990 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 990 is fit-for-purpose as a certified reference material (see 'Intended Use' below).

Table 4. Instrumental Neutron Activation Analysis of Au (ppm) on 20 x 1g subsamples of OREAS 990.

Replicate No	INAA 1g
1	75.10
2	74.20
3	73.50
4	74.30
5	74.30
6	72.90
7	70.10
8	73.50
9	72.60
10	71.90
11	69.20
12	72.50
13	75.00
14	75.20
15	75.90
16	75.30
17	72.60
18	72.20
19	76.30
20	75.50
Mean	73.61
Median	73.85
Std Dev.	1.883
Rel.Std.Dev.	2.56%
PDM[3]	-3.29%

PARTICIPATING LABORATORIES

1. Actlabs, Ancaster, Ontario, Canada
2. AH Knight, St Helens, Merseyside, UK
3. AHK Mongolia LLC, Ulaanbaatar, Mongolia
4. ALS Inspection, Prescot, Merseyside, UK
5. ALS, Lima, Peru
6. ALS, Loughrea, Galway, Ireland
7. ALS, Oyu Tolgoi, Umnugovi, Mongolia
8. ALS, Perth, WA, Australia
9. ALS, Ulaanbaatar, Khan-Uul District, Mongolia
10. ALS, Vancouver, BC, Canada
11. Bachelet, Angleur, Liege, Belgium
12. Bureau Veritas Geoanalytical, Adelaide, SA, Australia
13. Independent, Perth, WA, Australia
14. Inspectorate (BV), Lima, Peru
15. Inspectorate (BV), Shanghai, Bao Shan District, China
16. Inspectorate (BV), Witham, Essex, UK
17. Intertek Genalysis, Perth, WA, Australia
18. Intertek LSI, Rotterdam, Zuid-Holland, Netherlands
19. Intertek Testing Services Philippines, Cupang, Muntinlupa, Philippines
20. PT Geoservices Ltd, Cikarang, Jakarta Raya, Indonesia
21. RC Inspection, Ulaanbaatar, Khan-Uul District, Mongolia
22. SGS Mineral Services, Townsville, QLD, Australia
23. SGS Nederland B.V., Spijkenisse, Zuid-Holland, Netherlands
24. SGS, Randfontein, Gauteng, South Africa
25. Shiva Analyticals Ltd, Bangalore North, Karnataka, India
26. SRL, Perth, WA, Australia

PREPARER AND SUPPLIER OF THE REFERENCE MATERIAL

Reference material OREAS 990 has been prepared, certified and is supplied by:

ORE Research & Exploration Pty Ltd
37A Hosie Street
Bayswater North VIC 3153
AUSTRALIA

Tel: +613-9729 0333
Fax: +613-9729 8338
Web: www.ore.com.au
Email: info@ore.com.au

It is available in unit sizes of 60g sealed under nitrogen in laminated foil pouches.

INTENDED USE

OREAS 990 is intended for the following uses:

- for the monitoring of laboratory performance in the analysis of analytes reported in Table 1 in metallurgical plant concentrate 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 990 is a sulphide-rich reference material (S ~30.5%) and is reactive under normal atmospheric conditions. To inhibit oxidation and prolong its shelf life it has been sealed under nitrogen in robust laminated foil pouches. In its unopened state under normal conditions of storage it has a shelf life beyond ten years.

INSTRUCTIONS FOR CORRECT USE

Umpire Labs using classical methods:

The umpire lab certified values for Cu, Au and Ag are reported on a dry sample basis. There was considerable variation in moisture content reported by the laboratories (lab means varied from 0.127 to 1.08 wt.% H_2O-) and this can be a significant source of error if not properly controlled. Therefore, all analyses were performed on the samples after equilibration with the laboratory atmosphere for a minimum of 2 hours and hygroscopic moisture analysis at 105°C determined on a separate subsample and weighed for analysis at the same time as the sample aliquot for Cu, Au and Ag as per ISO 9599. If the reference material is not dried prior to analysis, the umpire lab certified values for Cu, Au and Ag should be corrected to the moisture-bearing basis.

Geochemical Labs using conventional methods:

As per routine analysis at geochemical laboratories, the certified values derived by employing predominantly instrumental finishes by 4-acid digestion, peroxide fusion and infrared combustion furnace (S only) refer to the concentration levels in the packaged state. The CRM should not be dried prior to weighing and analysis.

TRACEABILITY

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

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.

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.