ORE RESEARCH & EXPLORATION P/L ABN 28 006 859 856
37A Hosie Street · Bayswater North · VIC 3153 · AUSTRALIA
61 3 9729 0333 Fax 61 3 9729 8338
info@ore.com.au www.ore.com.au

CERTIFICATE OF ANALYSIS FOR

HIGH GRADE TUNGSTEN-COPPER-GOLD-MAGNETITE ORE CERTIFIED REFERENCE MATERIAL

OREAS 701

Summary Statistics for Key Analytes

Constituent	Certified Value	1SD	95% Confidence Limits		95% Tolerance Limits	
			Low	High	Low	High
Fire Assay						
Au, Gold (ppm)	1.11	0.05	1.08	1.14	1.10*	1.13*
Borate Fusion XRF						
Fe, Iron (wt.%)	23.98	0.549	23.67	24.29	23.83	24.13
Sn, Tin (ppm)	197	38	168	227	183	212
W, Tungsten (wt.%)	2.43	0.035	2.41	2.45	2.41	2.45
WO_3, Tungsten oxide (wt.%)	3.07	0.044	3.04	3.10	3.04	3.10
SiO_2, Silicon dioxide (wt.%)	33.95	0.623	33.58	34.31	33.72	34.17
4-Acid Digestion						
Cu, Copper (wt.%)	0.491	0.012	0.485	0.498	0.482	0.500
Mo, Molybdenum (ppm)	254	21.4	238	269	243	264
Acid Digestion Titration						
FeO, Iron(II) oxide (wt.%)	17.35	0.637	16.97	17.72	16.91	17.78
Davis Tube Recovery						
MassRec, Mass Recovered (wt.%)	20.80	0.482	20.44	21.16	20.51	21.10
Satmagan 135						
Fe_3O_4, Iron(II,III) oxide (wt.%)	17.95	0.446	17.60	18.29	17.69	18.20

Note: intervals may appear asymmetric due to rounding; *determined from RSD of gold INAA data for 30g analytical subsample weight.

Table 1. Certified Values, SDs, 95% Confidence and Tolerance Limits for OREAS 701

Constituent	Certified Value	1SD	95% Confidence Limits		95% Tolerance Limits	
			Low	High	Low	High
Fire Assay						
Au, Gold (ppm)	1.11	0.05	1.08	1.14	1.10*	1.13*
Borate Fusion XRF						
Al_2O_3, Aluminium(III) oxide (wt.%)	12.40	0.134	12.31	12.48	12.30	12.49
CaO, Calcium oxide (wt.%)	5.18	0.103	5.11	5.24	5.14	5.21
Cl, Chlorine (ppm)	227	23	195	260	IND	IND
Cr_2O_3, Chromium(III) oxide (ppm)	< 100	IND	IND	IND	IND	IND
Cu, Copper (wt.%)	0.485	0.023	0.467	0.503	0.474	0.496
Fe, Iron (wt.%)	23.98	0.549	23.67	24.29	23.83	24.13
K_2O, Potassium oxide (wt.%)	3.12	0.042	3.09	3.15	3.10	3.14
MgO, Magnesium oxide (wt.%)	1.32	0.039	1.29	1.35	1.31	1.34
MnO, Manganese oxide (wt.%)	0.428	0.009	0.422	0.435	0.424	0.433
Na_2O, Sodium oxide (wt.%)	0.916	0.040	0.886	0.945	0.899	0.932
P, Phosphorus (wt.%)	0.519	0.009	0.514	0.525	0.515	0.524
S, Sulphur (wt.%)	0.694	0.019	0.679	0.710	0.679	0.710
SiO_2, Silicon dioxide (wt.%)	33.95	0.623	33.58	34.31	33.72	34.17
Sn, Tin (ppm)	197	38	168	227	183	212
TiO_2, Titanium dioxide (wt.%)	0.265	0.009	0.258	0.271	0.254	0.275
W, Tungsten (wt.%)	2.43	0.035	2.41	2.45	2.41	2.45
WO_3, Tungsten oxide (wt.%)	3.07	0.044	3.04	3.10	3.04	3.10
Zn, Zinc (ppm)	338	16.9	317	360	323	353
Thermogravimetry						
LOI, Loss On Ignition @1000°C (wt.%)	1.80	0.34	1.57	2.03	1.71	1.88
4-Acid Digestion						
Ag, Silver (ppm)	1.12	0.14	1.04	1.21	1.05	1.20
Al, Aluminium (wt.%)	6.32	0.270	6.16	6.48	6.14	6.50
As, Arsenic (ppm)	5.58	0.90	5.05	6.10	5.02	6.14
Ba, Barium (ppm)	79	6.4	75	83	76	81
Be, Beryllium (ppm)	0.74	0.052	0.72	0.77	0.70	0.79
Bi, Bismuth (ppm)	6.67	0.79	6.04	7.30	6.48	6.86
Ca, Calcium (wt.%)	3.62	0.159	3.52	3.72	3.52	3.72
Cd, Cadmium (ppm)	< 0.5	IND	IND	IND	IND	IND
Ce, Cerium (ppm)	18.4	1.22	17.3	19.5	17.5	19.3
Co, Cobalt (ppm)	20.6	2.4	18.8	22.3	19.7	21.4
Cr, Chromium (ppm)	28.9	3.5	26.5	31.3	27.3	30.6
Cs, Cesium (ppm)	219	24	192	245	194	243
Cu, Copper (wt.%)	0.491	0.012	0.485	0.498	0.482	0.500
Fe, Iron (wt.%)	23.02	1.455	21.97	24.06	22.41	23.62
Ga, Gallium (ppm)	246	7.4	241	251	234	258
Hf, Hafnium (ppm)	1.27	0.23	1.03	1.52	1.20	1.35
In, Indium (ppm)	0.95	0.10	0.86	1.04	0.91	0.99
K, Potassium (wt.%)	2.57	0.093	2.52	2.62	2.50	2.64
La, Lanthanum (ppm)	9.80	0.405	9.49	10.11	9.28	10.32

*determined from RSD of gold INAA data for 30g analytical subsample weight.

Table 1 continued.

Constituent	Certified Value	1SD	95% Confidence Limits		95% Tolerance Limits	
			Low	High	Low	High
4-Acid Digestion continued						
Li, Lithium (ppm)	128	12.0	117	139	123	133
Lu, Lutetium (ppm)	0.11	0.009	0.10	0.12	0.10	0.11
Mg, Magnesium (wt.%)	0.717	0.067	0.676	0.758	0.695	0.738
Mn, Manganese (wt.%)	0.324	0.015	0.315	0.334	0.316	0.333
Mo, Molybdenum (ppm)	254	21.4	238	269	243	264
Na, Sodium (wt.%)	0.691	0.025	0.674	0.708	0.676	0.707
Nb, Niobium (ppm)	15.0	1.7	13.5	16.4	12.9	17.1
Ni, Nickel (ppm)	14.9	1.9	13.7	16.0	14.1	15.6
P, Phosphorus (wt.%)	0.512	0.022	0.497	0.527	0.500	0.524
Pb, Lead (ppm)	7.72	1.19	6.90	8.53	7.39	8.05
Rb, Rubidium (ppm)	928	94	870	986	861	995
S, Sulphur (wt.%)	0.688	0.023	0.672	0.705	0.672	0.705
Sb, Antimony (ppm)	0.37	0.029	0.33	0.40	0.34	0.40
Sc, Scandium (ppm)	6.21	0.590	5.66	6.76	5.57	6.85
Se, Selenium (ppm)	< 5	IND	IND	IND	IND	IND
Sn, Tin (ppm)	110	11	100	119	103	116
Sr, Strontium (ppm)	117	5.4	114	120	113	121
Ta, Tantalum (ppm)	< 0.5	IND	IND	IND	IND	IND
Tb, Terbium (ppm)	0.30	0.03	0.25	0.34	0.27	0.32
Te, Tellurium (ppm)	0.32	0.06	0.24	0.40	0.25	0.40
Th, Thorium (ppm)	5.74	0.520	5.23	6.25	5.44	6.05
Ti, Titanium (wt.%)	0.154	0.006	0.149	0.158	0.148	0.159
Tl, Thallium (ppm)	5.51	0.75	4.76	6.26	5.42	5.59
U, Uranium (ppm)	8.34	1.18	7.34	9.34	8.05	8.63
V, Vanadium (ppm)	54	1.5	53	55	52	57
Y, Yttrium (ppm)	8.10	0.711	7.52	8.68	7.73	8.47
Yb, Ytterbium (ppm)	0.74	0.09	0.64	0.84	0.72	0.76
Zn, Zinc (ppm)	336	14.8	324	347	323	348
Zr, Zirconium (ppm)	46.4	6.9	40.4	52.4	43.9	49.0
Aqua Regia Digestion						
Ag, Silver (ppm)	1.11	0.16	1.00	1.23	1.05	1.18
Al, Aluminium (wt.%)	4.16	0.194	4.04	4.29	4.04	4.29
As, Arsenic (ppm)	< 6	IND	IND	IND	IND	IND
Au, Gold (ppm)	1.07	0.05	1.03	1.11	1.03	1.11
Ba, Barium (ppm)	46.8	4.22	43.8	49.7	45.1	48.5
Bi, Bismuth (ppm)	6.57	0.78	6.03	7.10	6.37	6.76
Ca, Calcium (wt.%)	2.90	0.219	2.76	3.04	2.83	2.98
Cd, Cadmium (ppm)	< 0.3	IND	IND	IND	IND	IND
Ce, Cerium (ppm)	13.3	1.7	11.7	15.0	12.9	13.7
Co, Cobalt (ppm)	19.3	1.65	18.0	20.5	18.5	20.0
Cr, Chromium (ppm)	32.3	1.99	31.2	33.5	31.1	33.6
Cu, Copper (wt.%)	0.479	0.019	0.467	0.491	0.465	0.493
Fe, Iron (wt.%)	22.84	0.625	22.40	23.28	22.29	23.39

Table 1 continued.

Constituent	Certified Value	1SD	95% Confidence Limits		95% Tolerance Limits	
			Low	High	Low	High
Aqua Regia Digestion continued						
Ga, Gallium (ppm)	213	19.5	200	226	205	220
Hf, Hafnium (ppm)	< 1	IND	IND	IND	IND	IND
Hg, Mercury (ppm)	< 5	IND	IND	IND	IND	IND
In, Indium (ppm)	0.74	0.060	0.68	0.81	0.70	0.78
K, Potassium (wt.%)	2.07	0.077	2.02	2.11	2.01	2.12
La, Lanthanum (ppm)	6.02	0.93	5.13	6.91	5.82	6.22
Li, Lithium (ppm)	112	13	101	123	107	117
Lu, Lutetium (ppm)	0.083	0.009	0.072	0.093	IND	IND
Mg, Magnesium (wt.%)	0.689	0.026	0.673	0.706	0.670	0.709
Mn, Manganese (wt.%)	0.248	0.019	0.234	0.261	0.241	0.254
Mo, Molybdenum (ppm)	249	19.3	234	264	243	254
Na, Sodium (wt.%)	0.073	0.006	0.068	0.077	IND	IND
Nb, Niobium (ppm)	9.19	1.53	7.56	10.83	8.62	9.77
Ni, Nickel (ppm)	13.5	2.5	11.9	15.2	12.8	14.2
P, Phosphorus (wt.%)	0.479	0.011	0.471	0.487	0.464	0.493
Pb, Lead (ppm)	5.92	0.69	5.36	6.48	5.60	6.24
S, Sulphur (wt.%)	0.683	0.026	0.664	0.702	0.665	0.701
Sc, Scandium (ppm)	5.26	0.62	4.80	5.72	4.89	5.63
Se, Selenium (ppm)	3.98	0.358	3.65	4.31	IND	IND
Sn, Tin (ppm)	85	4.7	81	89	83	88
Sr, Strontium (ppm)	45.3	4.8	41.6	49.0	43.6	47.0
Tb, Terbium (ppm)	0.27	0.05	0.20	0.34	0.25	0.29
Te, Tellurium (ppm)	0.29	0.04	0.25	0.33	0.24	0.33
Th, Thorium (ppm)	5.42	0.248	5.12	5.73	5.24	5.61
Ti, Titanium (wt.%)	0.095	0.004	0.093	0.098	0.085	0.106
Tl, Thallium (ppm)	5.11	0.192	4.86	5.36	4.94	5.28
U, Uranium (ppm)	8.39	1.34	7.37	9.40	8.17	8.60
V, Vanadium (ppm)	51	2.5	49	53	49	53
Y, Yttrium (ppm)	7.84	0.378	7.50	8.17	7.46	8.21
Zn, Zinc (ppm)	311	15.7	300	321	302	320
Zr, Zirconium (ppm)	17.6	2.4	15.3	19.9	16.7	18.4
Acid Digestion Titration						
FeO, Iron(II) oxide (wt.%)	17.35	0.637	16.97	17.72	16.91	17.78
Davis Tube Recovery						
MassRec, Mass Recovered (wt.%)	20.80	0.482	20.44	21.16	20.51	21.10
Satmagan 135						
Fe_3O_4, Iron(II,III) oxide (wt.%)	17.95	0.446	17.60	18.29	17.69	18.20

Note: intervals may appear asymmetric due to rounding.

Table 2. Indicative Values for OREAS 701.

Constituent	Unit	Value	Constituent	Unit	Value	Constituent	Unit	Value
Fire Assay								
Pd	ppb	*14*	Pt	ppb	*5*			
Borate Fusion XRF								
As	ppm	*63*	Mo	ppm	*160*	V2O5	ppm	*85*
BaO	ppm	*59*	Ni	ppm	*15.4*	Zr	ppm	*23.8*
Co	ppm	*10.2*	Pb	ppm	*< 10*			
4-Acid Digestion								
Dy	ppm	*1.56*	Hg	ppm	*< 10*	Sm	ppm	*2.32*
Er	ppm	*0.88*	Ho	ppm	*0.35*	Tm	ppm	*0.11*
Eu	ppm	*0.25*	Nd	ppm	*10.0*	W	wt.%	*2.45*
Gd	ppm	*2.19*	Pr	ppm	*2.72*			
Ge	ppm	*1.73*	Re	ppm	*0.28*			
Aqua Regia Digestion								
B	ppm	*10.0*	Ge	ppm	*1.31*	Re	ppm	*0.072*
Be	ppm	*0.34*	Ho	ppm	*0.27*	Sb	ppm	*0.23*
Cs	ppm	*251*	Nd	ppm	*8.19*	Sm	ppm	*1.85*
Dy	ppm	*1.41*	Pd	ppb	*7*	Ta	ppm	*0.33*
Er	ppm	*0.70*	Pr	ppm	*1.93*	Tm	ppm	*0.097*
Eu	ppm	*0.19*	Pt	ppb	*< 1*	W	wt.%	*0.380*
Gd	ppm	*1.73*	Rb	ppm	*817*	Yb	ppm	*0.58*
Infrared Combustion								
S	wt.%	*0.772*						

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 701 was prepared from high grade skarn tungsten-magnetite ore from the White Rock W-Sn deposit (also known as the Rye Park mine and is located in southern-central NSW, Australia) with the addition of a minor quantity of Cu-Au concentrate. The skarn mineralisation at White Rock is hosted in flat-lying magnetite lenses within interbedded Silurian dacitic volcaniclastics with minor limestone (Hawkins Volcanics), immediately adjacent to a Late Silurian age greisenised, granite intrusive (Rye Park Granite).

These lithological units lie regionally within the Eastern Subprovince of the Lachlan Orogen and adjacent to the Frogmore Fault Zone. Skarn mineralisation occurs in lenses up to 12m in thickness and is best developed within the limestone units. Tungsten minerals include ferberite ($FeWO_4$) with lesser scheelite ($CaWO_4$) and these occur with very minor, variable amounts of pyrrhotite, pyrite, cassiterite, molybdenite, chalcopyrite

and sphalerite within massive magnetite. Gangue minerals include hedenbergite, andradite, grossular, hornblende, actinolite, feldspar, quartz, epidote, biotite and fluorite.

COMMINUTION AND HOMOGENISATION PROCEDURES

The material constituting OREAS 701 was prepared in the following manner:

- multi-stage crushing to minus 5mm;
- drying to constant mass at 105°C;
- multi-stage milling to 100% minus 30 microns;
- homogenisation;
- packaging into 10 and 60g units in laminated foil pouches and 1kg units in plastic jars.

ANALYTICAL PROGRAM

Twenty three commercial analytical laboratories participated in the program to certify the 114 analytes reported in Table 1. The following methods were employed:

- Gold via 25-40g fire assay with AAS (10 labs) or ICP-OES (2 labs) finish;
- Instrumental neutron activation analysis for Au on 1g subsamples to confirm homogeneity (1 laboratory).
- Borate fusion XRF for full elemental suite (up to 15 laboratories)
- Loss on ignition (LOI) at 1000°C (10 laboratories)
- Four acid digestion for full elemental suite ICP-OES and ICP-MS (12 laboratories; with the exception of Cu and Sn - 13 laboratories);
- Gold via 0.25-30g aqua regia digestion with ICP-MS (6 labs) or AAS (4 labs) finish;
- Aqua regia digestion for full elemental suite ICP-OES and ICP-MS (12 laboratories);
- FeO via acid digestion with titrimetric finish (12 laboratories);
- Mass recovered via Davis tube recovery (10 laboratories);
- Fe_3O_4 via Satmagan (10 laboratories);

For the round robin program twenty 800g test units were taken at predetermined intervals during the bagging stage, immediately following final blending, and are considered representative of the entire batch. Each laboratory received six 100g samples selected from evenly spaced intervals from the 20 sampling lots to maximise representation of the entire batch (eg. 16, 19, 2, 5, 8 and 11). Table 1 presents 114 certified values together with their associated 1SD's, 95% confidence and tolerance limits and Table 2 shows 45 indicative values. Table 3 provides performance gate intervals for the certified values of each method group based on their 1SD's. Tabulated results of all elements (including Au INAA analyses) together with uncorrected means, medians, standard deviations, relative standard deviations and percent deviation of lab means from the corrected mean of means (PDM^3) are presented in the detailed certification data for this CRM (**OREAS 701 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. For Tolerance Limits only individual outliers have been removed.

*1.5% for XRF determinations

Certified Values are the means of accepted laboratory means after outlier filtering. The INAA data is omitted from determination of the certified value for Au and is used solely for the calculation of Tolerance Limits and homogeneity evaluation of OREAS 701. 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 or iv) results are multimodal.

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. 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.

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 tungsten by borate fusion XRF, where 99% of the time (1-α=0.99) at least 95% of subsamples (ρ=0.95) will have concentrations lying between 2.41 and 2.45 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 the tolerance has been determined by INAA 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 sample aliquot is substantially reduced to a point where most of the variability in replicate assays should be due to inhomogeneity of the reference material and measurement error becomes negligible. In this instance a subsample weight of 1.0 gram was employed and the 1RSD of 2.29% (or 0.453% at a 30g charge weight) confirms the high level of gold homogeneity in OREAS 701.

Based on the statistical analysis of the results of the inter-laboratory certification program it can be concluded that OREAS 701 is fit-for-purpose as a certified reference material (see 'Intended Use' below).

Table 3. Performance Gates for OREAS 701

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	1.11	0.05	1.02	1.20	0.97	1.25	4.14%	8.27%	12.41%	1.06	1.17
Borate Fusion XRF											
Al_2O_3, wt.%	12.40	0.134	12.13	12.66	11.99	12.80	1.08%	2.16%	3.24%	11.78	13.01
CaO, wt.%	5.18	0.103	4.97	5.38	4.87	5.49	2.00%	4.00%	5.99%	4.92	5.43
Cl, ppm	227	23	181	274	158	297	10.21%	20.42%	30.63%	216	239
Cr_2O_3, ppm	< 100	IND	IND	IND	IND	IND	IND	IND	IND	IND	IND
Cu, wt.%	0.485	0.023	0.439	0.531	0.416	0.553	4.71%	9.42%	14.13%	0.461	0.509
Fe, wt.%	23.98	0.549	22.88	25.08	22.33	25.63	2.29%	4.58%	6.87%	22.78	25.18
K_2O, wt.%	3.12	0.042	3.03	3.20	2.99	3.24	1.35%	2.71%	4.06%	2.96	3.27
MgO, wt.%	1.32	0.039	1.24	1.40	1.20	1.44	2.92%	5.84%	8.75%	1.25	1.39
MnO, wt.%	0.428	0.009	0.410	0.446	0.401	0.455	2.10%	4.21%	6.31%	0.407	0.450
Na_2O, wt.%	0.916	0.040	0.837	0.995	0.797	1.034	4.32%	8.64%	12.96%	0.870	0.961
P, wt.%	0.519	0.009	0.501	0.538	0.491	0.548	1.82%	3.64%	5.45%	0.493	0.545

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
Borate Fusion XRF continued											
S, wt.%	0.694	0.019	0.657	0.732	0.638	0.751	2.69%	5.38%	8.08%	0.660	0.729
SiO_2, wt.%	33.95	0.623	32.70	35.19	32.08	35.81	1.83%	3.67%	5.50%	32.25	35.64
Sn, ppm	197	38	122	273	84	311	19.16%	38.33%	57.49%	188	207
TiO_2, wt.%	0.265	0.009	0.246	0.283	0.237	0.292	3.49%	6.97%	10.46%	0.252	0.278
W, wt.%	2.43	0.035	2.36	2.50	2.33	2.54	1.45%	2.89%	4.34%	2.31	2.56
WO_3, (wt.%)	3.07	0.04	2.98	3.16	2.94	3.20	1.45%	2.89%	4.34%	2.92	3.22
Zn, ppm	338	17	305	372	288	389	4.98%	9.97%	14.95%	321	355
Thermogravimetry											
LOI, wt.%	1.80	0.34	1.11	2.49	0.76	2.83	19.16%	38.31%	57.47%	1.71	1.89
4-Acid Digestion											
Ag, ppm	1.12	0.14	0.85	1.40	0.71	1.54	12.23%	24.46%	36.69%	1.07	1.18
Al, wt.%	6.32	0.270	5.78	6.86	5.51	7.13	4.28%	8.55%	12.83%	6.00	6.63
As, ppm	5.58	0.90	3.78	7.38	2.88	8.28	16.14%	32.29%	48.43%	5.30	5.86
Ba, ppm	79	6.4	66	92	60	98	8.05%	16.11%	24.16%	75	83
Be, ppm	0.74	0.052	0.64	0.85	0.59	0.90	6.95%	13.90%	20.85%	0.71	0.78
Bi, ppm	6.67	0.79	5.08	8.26	4.29	9.05	11.91%	23.82%	35.73%	6.34	7.00
Ca, wt.%	3.62	0.159	3.30	3.94	3.14	4.10	4.40%	8.81%	13.21%	3.44	3.80
Cd, ppm	< 0.3	IND	IND	IND	IND	IND	IND	IND	IND	IND	IND
Ce, ppm	18.4	1.22	15.9	20.8	14.7	22.0	6.65%	13.30%	19.95%	17.5	19.3
Co, ppm	20.6	2.4	15.7	25.4	13.3	27.8	11.71%	23.43%	35.14%	19.5	21.6
Cr, ppm	28.9	3.5	22.0	35.8	18.5	39.3	11.96%	23.92%	35.87%	27.5	30.4
Cs, ppm	219	24	171	267	147	291	10.97%	21.94%	32.91%	208	230
Cu, wt.%	0.491	0.012	0.467	0.515	0.455	0.527	2.45%	4.91%	7.36%	0.466	0.516
Fe, wt.%	23.02	1.455	20.11	25.92	18.65	27.38	6.32%	12.64%	18.96%	21.86	24.17
Ga, ppm	246	7	231	261	223	268	3.03%	6.06%	9.08%	233	258
Hf, ppm	1.27	0.23	0.81	1.74	0.58	1.97	18.07%	36.15%	54.22%	1.21	1.34
In, ppm	0.95	0.10	0.74	1.16	0.64	1.26	10.88%	21.76%	32.64%	0.90	1.00
K, wt.%	2.57	0.093	2.38	2.76	2.29	2.85	3.64%	7.28%	10.91%	2.44	2.70
La, ppm	9.80	0.405	8.99	10.61	8.58	11.01	4.14%	8.27%	12.41%	9.31	10.29
Li, ppm	128	12	104	152	92	164	9.42%	18.83%	28.25%	121	134
Lu, ppm	0.11	0.009	0.09	0.13	0.08	0.13	8.72%	17.45%	26.17%	0.10	0.11
Mg, wt.%	0.717	0.067	0.584	0.850	0.517	0.916	9.28%	18.57%	27.85%	0.681	0.753

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											
Mn, wt.%	0.324	0.015	0.294	0.355	0.279	0.370	4.69%	9.37%	14.06%	0.308	0.340
Mo, ppm	254	21	211	297	189	318	8.45%	16.89%	25.34%	241	266
Na, wt.%	0.691	0.025	0.641	0.742	0.616	0.767	3.64%	7.28%	10.91%	0.657	0.726
Nb, ppm	15.0	1.7	11.7	18.3	10.0	19.9	11.08%	22.16%	33.24%	14.2	15.7
Ni, ppm	14.9	1.9	11.0	18.7	9.1	20.6	12.94%	25.89%	38.83%	14.1	15.6
P, wt.%	0.512	0.022	0.468	0.556	0.446	0.578	4.30%	8.61%	12.91%	0.487	0.538
Pb, ppm	7.72	1.19	5.35	10.09	4.16	11.28	15.37%	30.74%	46.11%	7.33	8.10
Rb, ppm	928	94	740	1116	646	1210	10.11%	20.23%	30.34%	882	974
S, wt.%	0.688	0.023	0.642	0.735	0.619	0.758	3.36%	6.72%	10.08%	0.654	0.723
Sb, ppm	0.37	0.029	0.31	0.43	0.28	0.46	8.00%	15.99%	23.99%	0.35	0.39
Sc, ppm	6.21	0.590	5.03	7.39	4.44	7.98	9.51%	19.02%	28.52%	5.90	6.52
Se, ppm	< 5	IND	IND	IND	IND	IND	IND	IND	IND	IND	IND
Sn, ppm	110	11	88	132	77	143	10.11%	20.21%	30.32%	104	115
Sr, ppm	117	5	106	128	101	133	4.62%	9.24%	13.86%	111	123
Ta, ppm	< 0.5	IND	IND	IND	IND	IND	IND	IND	IND	IND	IND
Tb, ppm	0.30	0.03	0.23	0.37	0.19	0.40	11.68%	23.36%	35.04%	0.28	0.31
Te, ppm	0.32	0.06	0.19	0.45	0.13	0.51	20.14%	40.29%	60.43%	0.30	0.34
Th, ppm	5.74	0.520	4.70	6.78	4.18	7.30	9.06%	18.12%	27.19%	5.45	6.03
Ti, wt.%	0.154	0.006	0.141	0.166	0.134	0.173	4.19%	8.39%	12.58%	0.146	0.161
Tl, ppm	5.51	0.75	4.01	7.00	3.26	7.75	13.59%	27.18%	40.77%	5.23	5.78
U, ppm	8.34	1.18	5.98	10.70	4.80	11.88	14.15%	28.31%	42.46%	7.92	8.76
V, ppm	54	1.5	51	58	50	59	2.84%	5.69%	8.53%	52	57
Y, ppm	8.10	0.711	6.68	9.52	5.96	10.23	8.78%	17.56%	26.34%	7.69	8.50
Yb, ppm	0.74	0.09	0.57	0.91	0.48	1.00	11.49%	22.99%	34.48%	0.70	0.78
Zn, ppm	336	15	306	365	291	380	4.40%	8.80%	13.20%	319	352
Zr, ppm	46.4	6.9	32.6	60.2	25.7	67.2	14.89%	29.78%	44.66%	44.1	48.7
Aqua Regia Digestion											
Ag, ppm	1.11	0.16	0.79	1.44	0.62	1.60	14.65%	29.29%	43.94%	1.06	1.17
Al, wt.%	4.16	0.194	3.78	4.55	3.58	4.75	4.67%	9.33%	14.00%	3.96	4.37
As, ppm	< 6	IND	IND	IND	IND	IND	IND	IND	IND	IND	IND
Au, ppm	1.07	0.05	0.97	1.17	0.92	1.22	4.63%	9.26%	13.90%	1.01	1.12
Ba, ppm	46.8	4.22	38.3	55.2	34.1	59.5	9.03%	18.06%	27.08%	44.4	49.1

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
Aqua Regia Digestion continued											
Bi, ppm	6.57	0.78	5.01	8.13	4.23	8.91	11.88%	23.76%	35.63%	6.24	6.90
Ca, wt.%	2.90	0.219	2.47	3.34	2.25	3.56	7.56%	15.12%	22.67%	2.76	3.05
Cd, ppm	< 0.3	IND	IND	IND	IND	IND	IND	IND	IND	IND	IND
Ce, ppm	13.3	1.7	9.9	16.7	8.2	18.4	12.75%	25.51%	38.26%	12.7	14.0
Co, ppm	19.3	1.65	16.0	22.6	14.3	24.2	8.56%	17.12%	25.67%	18.3	20.2
Cr, ppm	32.3	1.99	28.4	36.3	26.4	38.3	6.15%	12.29%	18.44%	30.7	34.0
Cu, wt.%	0.479	0.019	0.441	0.517	0.422	0.536	3.98%	7.96%	11.93%	0.455	0.503
Fe, wt.%	22.84	0.625	21.59	24.09	20.96	24.71	2.73%	5.47%	8.20%	21.70	23.98
Ga, ppm	213	20	174	252	154	271	9.17%	18.34%	27.51%	202	223
Hf, ppm	< 1	IND	IND	IND	IND	IND	IND	IND	IND	IND	IND
Hg, ppm	< 5	IND	IND	IND	IND	IND	IND	IND	IND	IND	IND
In, ppm	0.74	0.060	0.62	0.86	0.56	0.92	8.03%	16.06%	24.08%	0.71	0.78
K, wt.%	2.07	0.077	1.91	2.22	1.83	2.30	3.73%	7.46%	11.19%	1.96	2.17
La, ppm	6.02	0.93	4.16	7.88	3.23	8.82	15.48%	30.95%	46.43%	5.72	6.32
Li, ppm	112	13	86	137	74	150	11.33%	22.66%	33.99%	106	117
Lu, ppm	0.083	0.009	0.064	0.101	0.054	0.111	11.34%	22.68%	34.01%	0.078	0.087
Mg, wt.%	0.689	0.026	0.638	0.741	0.612	0.767	3.74%	7.48%	11.23%	0.655	0.724
Mn, wt.%	0.248	0.019	0.209	0.286	0.190	0.305	7.71%	15.42%	23.14%	0.235	0.260
Mo, ppm	249	19	210	287	191	306	7.75%	15.50%	23.25%	236	261
Na, wt.%	0.073	0.006	0.061	0.084	0.056	0.089	7.68%	15.37%	23.05%	0.069	0.076
Nb, ppm	9.19	1.53	6.14	12.25	4.61	13.77	16.61%	33.21%	49.82%	8.73	9.65
Ni, ppm	13.5	2.5	8.6	18.5	6.1	20.9	18.26%	36.52%	54.78%	12.8	14.2
P, wt.%	0.479	0.011	0.457	0.501	0.446	0.512	2.29%	4.57%	6.86%	0.455	0.503
Pb, ppm	5.92	0.69	4.54	7.30	3.85	7.99	11.67%	23.33%	35.00%	5.62	6.21
S, wt.%	0.683	0.026	0.631	0.736	0.604	0.763	3.86%	7.73%	11.59%	0.649	0.717
Sc, ppm	5.26	0.62	4.03	6.49	3.41	7.11	11.73%	23.47%	35.20%	5.00	5.52
Se, ppm	3.98	0.358	3.26	4.70	2.91	5.05	8.99%	17.98%	26.98%	3.78	4.18
Sn, ppm	85	4.7	76	95	71	99	5.48%	10.97%	16.45%	81	90
Sr, ppm	45.3	4.8	35.8	54.8	31.0	59.5	10.50%	21.01%	31.51%	43.0	47.5
Tb, ppm	0.27	0.05	0.17	0.38	0.11	0.43	19.59%	39.18%	58.77%	0.26	0.28
Te, ppm	0.29	0.04	0.21	0.37	0.17	0.41	14.31%	28.61%	42.92%	0.28	0.30
Th, ppm	5.42	0.248	4.93	5.92	4.68	6.17	4.57%	9.14%	13.70%	5.15	5.70

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
Aqua Regia Digestion continued											
Ti, wt.%	0.095	0.004	0.087	0.104	0.083	0.108	4.36%	8.71%	13.07%	0.091	0.100
Tl, ppm	5.11	0.192	4.73	5.49	4.53	5.69	3.76%	7.52%	11.28%	4.85	5.37
U, ppm	8.39	1.34	5.71	11.07	4.37	12.41	15.98%	31.96%	47.94%	7.97	8.80
V, ppm	51	2.5	46	56	44	59	4.94%	9.88%	14.82%	49	54
Y, ppm	7.84	0.378	7.08	8.59	6.70	8.97	4.82%	9.65%	14.47%	7.44	8.23
Zn, ppm	311	16	279	342	264	358	5.06%	10.12%	15.18%	295	326
Zr, ppm	17.6	2.4	12.8	22.4	10.4	24.7	13.57%	27.14%	40.70%	16.7	18.5
Acid Digestion Titration											
FeO, wt.%	17.35	0.637	16.07	18.62	15.43	19.26	3.67%	7.35%	11.02%	16.48	18.21
Davis Tube Recovery											
MassRec, wt.%	20.80	0.482	19.84	21.77	19.36	22.25	2.32%	4.64%	6.95%	19.76	21.84
Satmagan 135											
Fe_3O_4, wt.%	17.95	0.446	17.06	18.84	16.61	19.29	2.48%	4.97%	7.45%	17.05	18.85

Note: intervals may appear asymmetric due to rounding.

PREPARER AND SUPPLIER OF THE REFERENCE MATERIAL

Reference material OREAS 701 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 10 and 60g (single-use laminated foil pouches) and 1kg (plastic jars).

PARTICIPATING LABORATORIES

Acme, Vancouver, BC, Canada
Actlabs, Ancaster, ON, Canada
ALS, Brisbane, QLD, Australia
ALS, Loughrea, County Galway, Ireland
ALS, Johannesburg, Gauteng, South Africa
ALS IOT, Wangara, WA, Australia
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SGS, Lakefield, Ontario, Canada
SGS, Vespasiano, MG, Brazil
Shiva Analyticals, Bangalore North, Karnataka, India

INTENDED USE

OREAS 701 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 701 has been sourced from samples of skarn tungsten-magnetite ore with the addition of a minor quantity of Cu-Au concentrate. It is low in reactive sulphide (~0.7% S) and in its unopened state and under normal conditions of storage 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 THE CORRECT USE OF THE REFERENCE MATERIAL

The certified values determined via fire assay, 4-acid digestion, aqua regia digestion, Davis Tube Recovery and Satmagan 135 refer to the concentration levels in the packaged state. There is no need for drying prior to weighing and analysis.

In contrast the certified values determined via lithium borate fusion XRF and for LOI at 1000° C are on a dry basis. This requires the removal of hygroscopic moisture by drying in air to constant mass at 105° C. If the reference material is not dried prior to analysis, the certified values should be corrected to the moisture-bearing basis.

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

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