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CERTIFICATE OF ANALYSIS FOR

Basalt lithogeochem / blank

(Quaternary Newer Volcanics Province, Victoria, Australia)

CERTIFIED REFERENCE MATERIAL

OREAS 30a

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INTRODUCTION

OREAS reference materials are intended to provide a low cost method of evaluating and improving the quality of analysis of geological samples. To the geologist they provide a means of implementing quality control in analytical data sets generated in exploration from the grass roots level through to prospect evaluation, and in grade control at mining operations. To the analyst they provide an effective means of calibrating analytical equipment, assessing new techniques and routinely monitoring in-house procedures.

OREAS reference materials enable users to successfully achieve process control of these tasks because the observed variance from repeated analysis has its origin almost exclusively in the analytical process rather than the reference material itself.

SOURCE MATERIAL

Certified Reference Material OREAS 30a was prepared from unweathered, olivine tholeiitic basalt from the Quaternary Newer Volcanics Province in Victoria, Australia. It is characterised by very low background gold of less than 2 parts per billion.

PERFORMANCE GATES

Table 1 below shows intervals calculated for two and three standard deviations. As a guide these intervals may be regarded as warning or rejection for multiple 2SD outliers, or rejection for individual 3SD outliers in QC monitoring, although their precise application should be at the discretion of the QC manager concerned (also see 'Intended Use' section below). Westgard Rules extend the basics of single-rule QC monitoring using multi-rules (for more information visit www.westgard.com/mltirule.htm). A second method utilises a 5% window calculated directly from the certified value.

Standard deviation is also shown in relative percent for one, two and three relative standard deviations (1RSD, 2RSD and 3RSD) to facilitate an appreciation of the magnitude of these numbers and a comparison with the 5% window. Caution should be exercised when concentration levels approach lower limits of detection of the analytical methods employed as performance gates calculated from standard deviations tend to be excessively wide whereas those determined by the 5% method are too narrow. One approach used at commercial laboratories is to set the acceptance criteria at twice the detection level (DL) ± 10%.

i.e. Certified Value ± 10% ± 2DL (adapted from Govett, 1983).

COMMINUTION AND HOMOGENISATION PROCEDURES

The material constituting OREAS 30a was prepared in the following manner:

- Drying to constant mass at 105°C;
- Milling to 98% minus 75 microns;
- Homogenisation;
- Packaging in 10g and 60g units in laminated foil pouches and 1kg units in plastic wide-mouth jars.

Table 1. Certified Values and Performance Gates for OREAS 30a.

Constituent	Certified Value	Absolute Standard Deviations					Relative Standard Deviations			5% window	
		1SD	2SD Low	2SD High	3SD Low	3SD High	1RSD	2RSD	3RSD	Low	High
Pb Fire Assay											
Au, ppb	< 2	IND	IND	IND	IND	IND	IND	IND	IND	IND	IND
Pd, ppb	< 2	IND	IND	IND	IND	IND	IND	IND	IND	IND	IND
Pt, ppb	< 5	IND	IND	IND	IND	IND	IND	IND	IND	IND	IND
Borate Fusion XRF											
Al2O3, wt.%	15.17	0.121	14.93	15.41	14.81	15.53	0.80%	1.59%	2.39%	14.41	15.93
BaO, ppm	660	76	507	812	431	888	11.54%	23.08%	34.62%	627	693
CaO, wt.%	8.23	0.068	8.10	8.37	8.03	8.44	0.82%	1.64%	2.46%	7.82	8.65
Cr2O3, ppm	283	43	197	369	153	412	15.25%	30.51%	45.76%	269	297
Fe2O3, wt.%	11.78	0.073	11.64	11.93	11.56	12.00	0.62%	1.24%	1.86%	11.19	12.37
K2O, wt.%	2.04	0.016	2.01	2.08	2.00	2.09	0.79%	1.58%	2.37%	1.94	2.15
MgO, wt.%	7.88	0.094	7.69	8.07	7.60	8.16	1.19%	2.39%	3.58%	7.49	8.27
MnO, wt.%	0.158	0.005	0.148	0.168	0.142	0.173	3.26%	6.51%	9.77%	0.150	0.166
Na2O, wt.%	3.15	0.050	3.05	3.25	3.00	3.30	1.59%	3.18%	4.77%	2.99	3.31
P2O5, wt.%	0.591	0.010	0.571	0.612	0.561	0.622	1.72%	3.45%	5.17%	0.562	0.621
SiO2, wt.%	46.97	0.168	46.64	47.31	46.47	47.48	0.36%	0.71%	1.07%	44.63	49.32
SO3, wt.%	0.103	0.012	0.079	0.127	0.068	0.139	11.47%	22.95%	34.42%	0.098	0.108
SrO, ppm	894	64	766	1021	703	1084	7.12%	14.24%	21.36%	849	938
TiO2, wt.%	2.09	0.018	2.05	2.13	2.04	2.14	0.86%	1.73%	2.59%	1.99	2.19
Thermogravimetry											
LOI1000, wt.%	1.68	0.122	1.44	1.93	1.32	2.05	7.23%	14.46%	21.69%	1.60	1.77
Infrared Combustion											
S, wt.%	0.040	0.007	0.025	0.055	0.018	0.062	18.36%	36.72%	55.09%	0.038	0.042
Borate / Peroxide Fusion ICP											
Al, wt.%	7.88	0.127	7.62	8.13	7.49	8.26	1.62%	3.23%	4.85%	7.48	8.27
Ba, ppm	522	24	474	570	450	593	4.58%	9.17%	13.75%	496	548
Be, ppm	2.16	0.30	1.55	2.76	1.24	3.07	14.09%	28.18%	42.27%	2.05	2.26
Ca, wt.%	5.71	0.267	5.18	6.25	4.91	6.51	4.68%	9.35%	14.03%	5.43	6.00
Ce, ppm	58	3.2	52	64	48	67	5.46%	10.92%	16.37%	55	61
Co, ppm	44.9	2.87	39.1	50.6	36.3	53.5	6.39%	12.78%	19.16%	42.6	47.1
Cr, ppm	198	21	157	240	136	261	10.54%	21.08%	31.62%	188	208
Cs, ppm	1.12	0.13	0.87	1.38	0.74	1.51	11.33%	22.66%	33.98%	1.07	1.18
Cu, ppm	43.6	4.19	35.2	52.0	31.0	56.2	9.62%	19.25%	28.87%	41.4	45.8
Dy, ppm	4.19	0.163	3.86	4.52	3.70	4.68	3.88%	7.77%	11.65%	3.98	4.40
Er, ppm	1.93	0.158	1.62	2.25	1.46	2.40	8.17%	16.34%	24.51%	1.83	2.03
Eu, ppm	1.76	0.105	1.55	1.97	1.45	2.07	5.95%	11.89%	17.84%	1.67	1.85
Fe, wt.%	8.12	0.272	7.58	8.67	7.31	8.94	3.34%	6.69%	10.03%	7.72	8.53
Ga, ppm	21.7	1.28	19.2	24.3	17.9	25.6	5.88%	11.77%	17.65%	20.6	22.8
Gd, ppm	5.22	0.194	4.83	5.60	4.63	5.80	3.72%	7.44%	11.16%	4.95	5.48
Hf, ppm	4.77	0.383	4.00	5.53	3.62	5.92	8.03%	16.07%	24.10%	4.53	5.01
Ho, ppm	0.73	0.060	0.61	0.85	0.55	0.91	8.20%	16.39%	24.59%	0.69	0.77
K, wt.%	1.68	0.075	1.53	1.83	1.46	1.91	4.46%	8.91%	13.37%	1.60	1.77

SI unit equivalents: ppm (parts per million) ≡ mg/kg ≡ µg/g ≡ 0.0001 wt.% ≡ 1000 ppb (parts per billion).

Note 1: intervals may appear asymmetric due to rounding.

Note 2: the number of decimal places quoted does not imply accuracy of the certified value to this level but are given to minimise rounding errors when calculating 2SD and 3SD windows.

Table 1 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 / Peroxide Fusion ICP continued											
La, ppm	28.9	1.83	25.3	32.6	23.4	34.4	6.34%	12.67%	19.01%	27.5	30.4
Li, ppm	12.4	2.5	7.4	17.5	4.9	20.0	20.18%	40.35%	60.53%	11.8	13.1
Lu, ppm	0.22	0.015	0.19	0.25	0.17	0.26	6.72%	13.44%	20.16%	0.21	0.23
Mg, wt.%	4.69	0.091	4.50	4.87	4.41	4.96	1.95%	3.90%	5.86%	4.45	4.92
Mn, wt.%	0.117	0.003	0.111	0.124	0.107	0.127	2.79%	5.57%	8.36%	0.111	0.123
Mo, ppm	4.61	0.73	3.15	6.07	2.42	6.80	15.81%	31.62%	47.44%	4.38	4.84
Nb, ppm	45.4	1.76	41.8	48.9	40.1	50.6	3.87%	7.75%	11.62%	43.1	47.6
Nd, ppm	27.4	1.55	24.3	30.5	22.7	32.0	5.68%	11.35%	17.03%	26.0	28.7
Ni, ppm	145	6	132	158	125	164	4.49%	8.98%	13.47%	138	152
P, wt.%	0.257	0.008	0.241	0.274	0.233	0.282	3.17%	6.34%	9.51%	0.245	0.270
Pr, ppm	7.05	0.565	5.92	8.18	5.36	8.75	8.01%	16.01%	24.02%	6.70	7.41
Rb, ppm	36.8	2.09	32.6	41.0	30.5	43.0	5.69%	11.37%	17.06%	34.9	38.6
Sc, ppm	19.7	1.82	16.1	23.4	14.3	25.2	9.23%	18.45%	27.68%	18.7	20.7
Si, wt.%	21.87	0.438	20.99	22.74	20.55	23.18	2.00%	4.01%	6.01%	20.77	22.96
Sm, ppm	5.68	0.412	4.86	6.51	4.45	6.92	7.25%	14.50%	21.75%	5.40	5.97
Sr, ppm	741	24	692	789	668	814	3.28%	6.55%	9.83%	704	778
Ta, ppm	2.80	0.236	2.33	3.27	2.09	3.51	8.43%	16.86%	25.29%	2.66	2.94
Tb, ppm	0.75	0.060	0.63	0.87	0.57	0.93	7.97%	15.94%	23.91%	0.71	0.79
Th, ppm	3.71	0.306	3.10	4.32	2.79	4.63	8.25%	16.50%	24.75%	3.53	3.90
Ti, wt.%	1.22	0.027	1.17	1.28	1.14	1.30	2.24%	4.48%	6.72%	1.16	1.28
Tm, ppm	0.26	0.04	0.18	0.34	0.14	0.37	14.94%	29.87%	44.81%	0.25	0.27
U, ppm	1.37	0.14	1.08	1.66	0.94	1.81	10.53%	21.05%	31.58%	1.30	1.44
V, ppm	208	13	181	235	167	248	6.48%	12.95%	19.43%	197	218
Y, ppm	19.4	1.10	17.3	21.6	16.2	22.7	5.63%	11.26%	16.89%	18.5	20.4
Yb, ppm	1.53	0.126	1.28	1.78	1.15	1.90	8.22%	16.44%	24.65%	1.45	1.60
Zn, ppm	107	10	87	126	77	136	9.10%	18.21%	27.31%	101	112
Zr, ppm	200	10	179	220	169	230	5.15%	10.29%	15.44%	190	210
4-Acid Digestion											
Ag, ppm	< 0.1	IND	IND	IND	IND	IND	IND	IND	IND	IND	IND
Al, wt.%	7.90	0.331	7.23	8.56	6.90	8.89	4.19%	8.39%	12.58%	7.50	8.29
As, ppm	1.55	0.25	1.05	2.06	0.80	2.31	16.12%	32.23%	48.35%	1.48	1.63
Ba, ppm	537	17	503	570	486	587	3.14%	6.29%	9.43%	510	563
Be, ppm	2.18	0.159	1.86	2.49	1.70	2.65	7.29%	14.58%	21.87%	2.07	2.29
Bi, ppm	0.032	0.008	0.016	0.047	0.009	0.054	24.19%	48.39%	72.58%	0.030	0.033
Ca, wt.%	5.67	0.273	5.12	6.21	4.85	6.48	4.82%	9.63%	14.45%	5.38	5.95
Cd, ppm	0.14	0.02	0.10	0.18	0.08	0.20	14.86%	29.71%	44.57%	0.13	0.14
Ce, ppm	58	3.9	50	66	46	69	6.72%	13.44%	20.16%	55	61
Co, ppm	45.1	1.96	41.1	49.0	39.2	51.0	4.36%	8.72%	13.08%	42.8	47.3
Cr, ppm	156	19	118	193	99	212	12.09%	24.19%	36.28%	148	164
Cs, ppm	1.17	0.053	1.07	1.28	1.01	1.33	4.50%	9.01%	13.51%	1.11	1.23
Cu, ppm	44.4	1.41	41.6	47.3	40.2	48.7	3.18%	6.37%	9.55%	42.2	46.6
Dy, ppm	4.36	0.243	3.88	4.85	3.64	5.09	5.56%	11.13%	16.69%	4.15	4.58

SI unit equivalents: ppm (parts per million) ≡ mg/kg ≡ µg/g ≡ 0.0001 wt.% ≡ 1000 ppb (parts per billion).

Note 1: intervals may appear asymmetric due to rounding.

Note 2: the number of decimal places quoted does not imply accuracy of the certified value to this level but are given to minimise rounding errors when calculating 2SD and 3SD windows.

Table 1 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											
Er, ppm	2.04	0.111	1.82	2.27	1.71	2.38	5.41%	10.81%	16.22%	1.94	2.15
Eu, ppm	1.82	0.151	1.52	2.12	1.37	2.27	8.30%	16.59%	24.89%	1.73	1.91
Fe, wt.%	8.06	0.323	7.42	8.71	7.09	9.03	4.00%	8.01%	12.01%	7.66	8.47
Ga, ppm	22.3	0.90	20.5	24.1	19.6	25.0	4.02%	8.05%	12.07%	21.2	23.5
Gd, ppm	5.41	0.370	4.67	6.15	4.30	6.52	6.83%	13.66%	20.49%	5.14	5.68
Ge, ppm	0.13	0.02	0.08	0.17	0.05	0.20	19.23%	38.45%	57.68%	0.12	0.13
Hf, ppm	4.81	0.249	4.32	5.31	4.07	5.56	5.18%	10.35%	15.53%	4.57	5.05
Ho, ppm	0.78	0.038	0.71	0.86	0.67	0.90	4.82%	9.63%	14.45%	0.74	0.82
In, ppm	0.072	0.010	0.052	0.091	0.042	0.101	13.62%	27.25%	40.87%	0.068	0.075
K, wt.%	1.71	0.084	1.54	1.88	1.46	1.96	4.93%	9.86%	14.79%	1.62	1.79
La, ppm	28.3	1.95	24.4	32.2	22.5	34.2	6.89%	13.77%	20.66%	26.9	29.7
Li, ppm	10.9	0.70	9.5	12.3	8.8	13.0	6.45%	12.89%	19.34%	10.4	11.5
Lu, ppm	0.23	0.018	0.19	0.26	0.17	0.28	7.92%	15.84%	23.76%	0.22	0.24
Mg, wt.%	4.58	0.186	4.20	4.95	4.02	5.13	4.06%	8.12%	12.18%	4.35	4.80
Mn, wt.%	0.116	0.004	0.108	0.123	0.104	0.127	3.45%	6.90%	10.35%	0.110	0.121
Mo, ppm	4.27	0.224	3.82	4.71	3.59	4.94	5.25%	10.50%	15.75%	4.05	4.48
Na, wt.%	2.38	0.101	2.18	2.58	2.08	2.68	4.23%	8.47%	12.70%	2.26	2.50
Nb, ppm	45.5	2.12	41.3	49.8	39.1	51.9	4.67%	9.34%	14.00%	43.2	47.8
Nd, ppm	27.5	0.74	26.0	29.0	25.3	29.7	2.70%	5.40%	8.10%	26.1	28.9
Ni, ppm	140	6	129	152	124	157	4.00%	8.01%	12.01%	133	147
P, wt.%	0.255	0.008	0.239	0.271	0.231	0.279	3.12%	6.23%	9.35%	0.242	0.267
Pb, ppm	3.75	0.223	3.30	4.19	3.08	4.41	5.95%	11.89%	17.84%	3.56	3.93
Pr, ppm	6.96	0.238	6.48	7.44	6.25	7.67	3.42%	6.84%	10.25%	6.61	7.31
Rb, ppm	37.1	2.03	33.0	41.1	31.0	43.2	5.48%	10.96%	16.45%	35.2	38.9
S, wt.%	0.044	0.004	0.035	0.052	0.031	0.057	9.93%	19.86%	29.79%	0.041	0.046
Sc, ppm	20.0	1.43	17.1	22.8	15.7	24.2	7.17%	14.34%	21.51%	19.0	20.9
Sm, ppm	5.96	0.318	5.33	6.60	5.01	6.92	5.34%	10.68%	16.02%	5.66	6.26
Sn, ppm	1.88	0.144	1.59	2.17	1.45	2.32	7.66%	15.33%	22.99%	1.79	1.98
Sr, ppm	776	42	693	859	651	901	5.36%	10.72%	16.08%	737	815
Ta, ppm	2.97	0.189	2.59	3.35	2.41	3.54	6.36%	12.72%	19.07%	2.82	3.12
Tb, ppm	0.78	0.052	0.68	0.88	0.63	0.94	6.60%	13.21%	19.81%	0.74	0.82
Th, ppm	3.78	0.245	3.29	4.27	3.05	4.51	6.47%	12.94%	19.41%	3.59	3.97
Ti, wt.%	1.22	0.050	1.12	1.32	1.07	1.37	4.08%	8.15%	12.23%	1.16	1.29
Tl, ppm	0.13	0.011	0.11	0.15	0.10	0.16	8.30%	16.59%	24.89%	0.12	0.14
Tm, ppm	0.27	0.03	0.21	0.33	0.18	0.36	10.95%	21.91%	32.86%	0.25	0.28
U, ppm	1.34	0.071	1.20	1.49	1.13	1.56	5.27%	10.55%	15.82%	1.28	1.41
V, ppm	201	6	190	212	184	217	2.77%	5.54%	8.31%	191	211
W, ppm	0.21	0.04	0.13	0.28	0.09	0.32	18.55%	37.10%	55.65%	0.20	0.22
Y, ppm	19.5	0.95	17.6	21.4	16.7	22.4	4.87%	9.73%	14.60%	18.6	20.5
Yb, ppm	1.55	0.067	1.42	1.69	1.35	1.76	4.34%	8.68%	13.02%	1.48	1.63
Zn, ppm	109	4	102	116	98	120	3.25%	6.49%	9.74%	104	114
Zr, ppm	204	5	194	214	189	219	2.52%	5.04%	7.56%	194	214

SI unit equivalents: ppm (parts per million) ≡ mg/kg ≡ µg/g ≡ 0.0001 wt.% ≡ 1000 ppb (parts per billion).

Note 1: intervals may appear asymmetric due to rounding.

Note 2: the number of decimal places quoted does not imply accuracy of the certified value to this level but are given to minimise rounding errors when calculating 2SD and 3SD windows.

Table 1 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											
Ag, ppm	0.028	0.005	0.018	0.037	0.013	0.042	18.11%	36.22%	54.33%	0.026	0.029
Al, wt.%	3.30	0.210	2.88	3.72	2.67	3.93	6.35%	12.70%	19.05%	3.14	3.47
As, ppm	1.22	0.13	0.96	1.47	0.84	1.60	10.41%	20.82%	31.24%	1.16	1.28
Au, ppm	< 0.02	IND	IND	IND	IND	IND	IND	IND	IND	IND	IND
Ba, ppm	57	4.4	48	66	43	70	7.83%	15.67%	23.50%	54	60
Be, ppm	1.70	0.160	1.38	2.02	1.22	2.18	9.45%	18.90%	28.34%	1.61	1.78
Bi, ppm	0.024	0.006	0.012	0.035	0.006	0.041	24.28%	48.57%	72.85%	0.023	0.025
Ca, wt.%	1.68	0.153	1.38	1.99	1.22	2.14	9.08%	18.16%	27.25%	1.60	1.76
Cd, ppm	0.10	0.01	0.07	0.13	0.06	0.14	13.17%	26.34%	39.52%	0.10	0.11
Ce, ppm	47.4	1.51	44.4	50.4	42.9	51.9	3.18%	6.37%	9.55%	45.0	49.8
Co, ppm	38.5	2.04	34.4	42.6	32.4	44.6	5.29%	10.59%	15.88%	36.6	40.4
Cr, ppm	67	5.6	56	79	51	84	8.37%	16.74%	25.11%	64	71
Cs, ppm	0.93	0.074	0.78	1.08	0.71	1.16	7.97%	15.93%	23.90%	0.89	0.98
Cu, ppm	42.9	1.78	39.3	46.5	37.6	48.3	4.15%	8.31%	12.46%	40.8	45.1
Fe, wt.%	6.64	0.322	6.00	7.28	5.68	7.60	4.84%	9.68%	14.53%	6.31	6.97
Ga, ppm	11.0	1.1	8.7	13.2	7.5	14.4	10.38%	20.76%	31.15%	10.4	11.5
Ge, ppm	0.16	0.04	0.08	0.24	0.03	0.28	25.94%	51.88%	77.82%	0.15	0.16
In, ppm	0.020	0.001	0.017	0.023	0.016	0.025	7.08%	14.16%	21.24%	0.019	0.021
K, wt.%	0.413	0.020	0.373	0.453	0.353	0.473	4.82%	9.63%	14.45%	0.392	0.434
La, ppm	24.0	1.75	20.5	27.5	18.8	29.3	7.27%	14.55%	21.82%	22.8	25.2
Li, ppm	9.92	0.764	8.39	11.45	7.63	12.21	7.71%	15.41%	23.12%	9.42	10.41
Lu, ppm	0.11	0.009	0.09	0.13	0.08	0.14	8.64%	17.29%	25.93%	0.10	0.11
Mg, wt.%	3.24	0.134	2.97	3.51	2.84	3.64	4.12%	8.25%	12.37%	3.08	3.40
Mn, wt.%	0.088	0.004	0.080	0.097	0.076	0.101	4.73%	9.45%	14.18%	0.084	0.093
Mo, ppm	3.95	0.46	3.04	4.87	2.58	5.33	11.63%	23.26%	34.89%	3.76	4.15
Na, wt.%	0.970	0.045	0.881	1.059	0.836	1.104	4.61%	9.21%	13.82%	0.921	1.018
Ni, ppm	125	10	105	144	96	153	7.69%	15.39%	23.08%	118	131
P, wt.%	0.234	0.015	0.205	0.264	0.190	0.279	6.28%	12.57%	18.85%	0.223	0.246
Pb, ppm	2.28	0.139	2.01	2.56	1.87	2.70	6.11%	12.21%	18.32%	2.17	2.40
Rb, ppm	19.4	1.37	16.7	22.2	15.3	23.5	7.07%	14.15%	21.22%	18.5	20.4
S, wt.%	0.041	0.004	0.032	0.049	0.028	0.054	10.69%	21.37%	32.06%	0.039	0.043
Sc, ppm	2.71	0.50	1.72	3.71	1.22	4.21	18.38%	36.76%	55.13%	2.58	2.85
Sn, ppm	1.39	0.108	1.18	1.61	1.07	1.71	7.75%	15.50%	23.26%	1.32	1.46
Sr, ppm	279	23	232	325	209	348	8.36%	16.72%	25.07%	265	293
Ta, ppm	0.082	0.020	0.042	0.122	0.022	0.142	24.42%	48.83%	73.25%	0.078	0.086
Tb, ppm	0.47	0.024	0.42	0.52	0.40	0.54	5.12%	10.25%	15.37%	0.45	0.49
Th, ppm	2.92	0.133	2.66	3.19	2.52	3.32	4.54%	9.08%	13.63%	2.78	3.07
Ti, wt.%	0.833	0.053	0.727	0.939	0.674	0.992	6.38%	12.76%	19.14%	0.791	0.875
Tl, ppm	0.096	0.007	0.081	0.110	0.074	0.118	7.61%	15.22%	22.83%	0.091	0.100
U, ppm	0.86	0.048	0.77	0.96	0.72	1.01	5.58%	11.16%	16.74%	0.82	0.91
V, ppm	116	9	97	134	88	143	7.90%	15.80%	23.70%	110	121
W, ppm	0.068	0.010	0.048	0.088	0.038	0.097	14.59%	29.18%	43.77%	0.064	0.071

SI unit equivalents: ppm (parts per million) ≡ mg/kg ≡ µg/g ≡ 0.0001 wt.% ≡ 1000 ppb (parts per billion).

Note 1: intervals may appear asymmetric due to rounding.

Note 2: the number of decimal places quoted does not imply accuracy of the certified value to this level but are given to minimise rounding errors when calculating 2SD and 3SD windows.

Table 1 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											
Y, ppm	12.3	0.64	11.1	13.6	10.4	14.3	5.19%	10.37%	15.56%	11.7	13.0
Yb, ppm	0.76	0.070	0.62	0.90	0.55	0.97	9.12%	18.24%	27.37%	0.72	0.80
Zn, ppm	97	6.2	85	109	78	115	6.36%	12.71%	19.07%	92	102
Zr, ppm	27.7	5.7	16.2	39.1	10.5	44.8	20.65%	41.30%	61.95%	26.3	29.1

SI unit equivalents: ppm (parts per million) ≡ mg/kg ≡ µg/g ≡ 0.0001 wt.% ≡ 1000 ppb (parts per billion).

Note 1: intervals may appear asymmetric due to rounding.

Note 2: the number of decimal places quoted does not imply accuracy of the certified value to this level but are given to minimise rounding errors when calculating 2SD and 3SD windows.

PHYSICAL PROPERTIES

OREAS 30a was tested in its pulp form at ORE Research & Exploration Pty Ltd's onsite laboratory for various physical properties. Table 2 presents these findings which should be used for informational purposes only.

Table 2. Physical properties (in pulp form) of OREAS 30a.

Bulk Density (g/L)	Moisture%	Munsell Notation‡	Munsell Color‡
904	1.09	N7	Light Gray

‡The Munsell Rock Color Chart helps geologists and archeologists communicate with colour more effectively by cross-referencing ISCC-NBS colour names with unique Munsell alpha-numeric colour notations for rock colour samples.

ANALYTICAL PROGRAM

Fifteen commercial analytical laboratories participated in the program to characterise the elements reported in Table 1. The following methods were employed:

- Au, Pt and Pd by fire assay with ICP-OES (10 laboratories), ICP-MS (2 laboratories) and AAS (3 laboratories) finish;
- Lithium borate fusion for full suite elemental package by X-ray fluorescence (up to 13 laboratories depending on the analyte);
- Thermogravimetry for LOI at 1000°C (15 laboratories);
- Infra-red combustion furnace for C and S (15 laboratories);
- Lithium borate or sodium peroxide fusion with full suite elemental package by ICP-OES and/or ICP-MS finish (up to 12 laboratories depending on the element);
- Low level 4-acid digestion for full suite elemental package by ICP-OES and/or ICP-MS finish (up to 15 laboratories depending on the element);
- Low level aqua regia digestion for full suite elemental package by ICP-OES and/or ICP-MS finish (up to 14 laboratories depending on the element);

It is important to note that in the analytical industry there is no standardisation of the aqua regia digestion process. Aqua regia is a partial empirical digest and differences in recoveries for various analytes are commonplace. These are caused by variations in the digest conditions which can include the ratio of nitric to hydrochloric acids, acid strength, temperatures, leach times and secondary digestions. Recoveries for sulphide-hosted base metal sulphides approach total values, however, other analytes, in particular the lithophile elements, show greater sensitivity to method parameters. This can result in lack of consensus in an inter-laboratory certification program for these elements.

The approach applied here is to report certified values in those instances where reasonable agreement exists amongst a majority of participating laboratories. The results of specific laboratories may differ significantly from the certified values, but will, nonetheless, be valid and reproducible in the context of the specifics of the aqua regia method in use. Users of this reference material should, therefore, be mindful of this limitation when applying the certified values in a quality control program.

For the round robin program ten 1.2kg test units were taken at predetermined intervals during the bagging stage, immediately following homogenisation and are considered representative of the entire prepared batch. The six samples received by each laboratory were obtained by taking two 120g scoop splits from each of three separate 1.2kg 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 3 presents the 166 certified values together with their associated 95% confidence and tolerance limits and Table 4 shows 51 indicative values. Homogeneity has been evaluated by a nested ANOVA program (see '**Homogeneity Evaluation**' section). Tabulated results of all analytes 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 30a DataPack-1.0.190820_142709.xlsx**).

Table 3. 95% Confidence & Tolerance Limits for OREAS 30a.

Constituent	Certified Value	95% Confidence Limits		95% Tolerance Limits	
		Low	High	Low	High
Pb Fire Assay					
Au, Gold (ppb)	< 2	IND	IND	IND	IND
Pd, Palladium (ppb)	< 2	IND	IND	IND	IND
Pt, Platinum (ppb)	< 5	IND	IND	IND	IND
Borate Fusion XRF					
Al_2O_3, Aluminium(III) oxide (wt.%)	15.17	15.09	15.25	15.12	15.22
BaO, Barium oxide (ppm)	660	607	712	IND	IND
CaO, Calcium oxide (wt.%)	8.23	8.19	8.27	8.21	8.26
Cr_2O_3, Chromium(III) oxide (ppm)	283	264	302	IND	IND
Fe_2O_3, Iron(III) oxide (wt.%)	11.78	11.74	11.83	11.73	11.83
K_2O, Potassium oxide (wt.%)	2.04	2.03	2.05	2.03	2.06
MgO, Magnesium oxide (wt.%)	7.88	7.82	7.94	7.84	7.92
MnO, Manganese oxide (wt.%)	0.158	0.155	0.161	IND	IND
Na_2O, Sodium oxide (wt.%)	3.15	3.12	3.18	3.13	3.17
P_2O_5, Phosphorus(V) oxide (wt.%)	0.591	0.585	0.597	0.585	0.598
SiO_2, Silicon dioxide (wt.%)	46.97	46.89	47.06	46.86	47.09
SO_3, Sulphur trioxide (wt.%)	0.103	0.095	0.112	0.101	0.105
SrO, Strontium oxide (ppm)	894	827	961	IND	IND
TiO_2, Titanium dioxide (wt.%)	2.09	2.08	2.10	2.07	2.10
Thermogravimetry					
LOI^{1000}, Loss on ignition @1000°C (wt.%)	1.68	1.61	1.76	1.66	1.71
Infrared Combustion					
S, Sulphur (wt.%)	0.040	0.036	0.044	IND	IND
Borate / Peroxide Fusion ICP					
Al, Aluminium (wt.%)	7.88	7.77	7.99	7.79	7.96
Ba, Barium (ppm)	522	507	537	509	535
Be, Beryllium (ppm)	2.16	2.01	2.30	IND	IND
Ca, Calcium (wt.%)	5.71	5.53	5.90	5.60	5.83
Ce, Cerium (ppm)	58	56	60	56	60
Co, Cobalt (ppm)	44.9	43.1	46.6	43.6	46.1
Cr, Chromium (ppm)	198	185	212	189	208
Cs, Caesium (ppm)	1.12	1.10	1.15	1.05	1.20
Cu, Copper (ppm)	43.6	39.4	47.7	40.8	46.4
Dy, Dysprosium (ppm)	4.19	4.10	4.27	3.96	4.42
Er, Erbium (ppm)	1.93	1.81	2.05	1.83	2.03
Eu, Europium (ppm)	1.76	1.70	1.82	1.65	1.87
Fe, Iron (wt.%)	8.12	7.92	8.32	8.01	8.23
Ga, Gallium (ppm)	21.7	21.0	22.4	20.5	22.9
Gd, Gadolinium (ppm)	5.22	5.12	5.32	4.96	5.48

SI unit equivalents: ppm, parts per million ≡ mg/kg ≡ µg/g ≡ 0.0001 wt.% ≡ 1000 ppb, parts per billion.
Note : intervals may appear asymmetric due to rounding.

Table 3 continued.

Constituent	Certified Value	95% Confidence Limits		95% Tolerance Limits	
		Low	High	Low	High
Borate / Peroxide Fusion ICP continued					
Hf, Hafnium (ppm)	4.77	4.47	5.07	4.43	5.10
Ho, Holmium (ppm)	0.73	0.70	0.77	0.68	0.78
K, Potassium (wt.%)	1.68	1.64	1.73	1.65	1.72
La, Lanthanum (ppm)	28.9	27.7	30.2	27.7	30.2
Li, Lithium (ppm)	12.4	9.0	15.9	IND	IND
Lu, Lutetium (ppm)	0.22	0.21	0.22	0.19	0.24
Mg, Magnesium (wt.%)	4.69	4.62	4.76	4.61	4.77
Mn, Manganese (wt.%)	0.117	0.116	0.119	0.116	0.119
Mo, Molybdenum (ppm)	4.61	4.11	5.11	IND	IND
Nb, Niobium (ppm)	45.4	44.1	46.7	44.1	46.6
Nd, Neodymium (ppm)	27.4	26.4	28.3	26.3	28.4
Ni, Nickel (ppm)	145	141	148	140	149
P, Phosphorus (wt.%)	0.257	0.247	0.268	0.249	0.265
Pr, Praseodymium (ppm)	7.05	6.65	7.45	6.77	7.34
Rb, Rubidium (ppm)	36.8	35.6	37.9	35.3	38.2
Sc, Scandium (ppm)	19.7	17.9	21.6	IND	IND
Si, Silicon (wt.%)	21.87	21.60	22.13	21.51	22.22
Sm, Samarium (ppm)	5.68	5.42	5.95	5.34	6.03
Sr, Strontium (ppm)	741	723	758	725	756
Ta, Tantalum (ppm)	2.80	2.64	2.96	2.65	2.95
Tb, Terbium (ppm)	0.75	0.71	0.79	0.71	0.79
Th, Thorium (ppm)	3.71	3.52	3.91	3.50	3.93
Ti, Titanium (wt.%)	1.22	1.20	1.24	1.20	1.25
Tm, Thulium (ppm)	0.26	0.23	0.28	0.23	0.29
U, Uranium (ppm)	1.37	1.29	1.45	1.30	1.45
V, Vanadium (ppm)	208	199	216	203	213
Y, Yttrium (ppm)	19.4	18.8	20.1	18.8	20.1
Yb, Ytterbium (ppm)	1.53	1.47	1.59	1.34	1.71
Zn, Zinc (ppm)	107	97	117	98	115
Zr, Zirconium (ppm)	200	189	211	193	206
4-Acid Digestion					
Ag, Silver (ppm)	< 0.1	IND	IND	IND	IND
Al, Aluminium (wt.%)	7.90	7.71	8.09	7.78	8.02
As, Arsenic (ppm)	1.55	1.47	1.64	IND	IND
Ba, Barium (ppm)	537	528	545	527	546
Be, Beryllium (ppm)	2.18	2.09	2.27	2.03	2.33
Bi, Bismuth (ppm)	0.032	0.025	0.038	IND	IND
Ca, Calcium (wt.%)	5.67	5.51	5.82	5.58	5.75

SI unit equivalents: ppm (parts per million) ≡ mg/kg ≡ µg/g ≡ 0.0001 wt.% ≡ 1000 ppb (parts per billion).
Note: intervals may appear asymmetric due to rounding.

Table 3 continued.

Constituent	Certified Value	95% Confidence Limits		95% Tolerance Limits	
		Low	High	Low	High
4-Acid Digestion continued					
Cd, Cadmium (ppm)	0.14	0.13	0.15	IND	IND
Ce, Cerium (ppm)	58	56	60	56	59
Co, Cobalt (ppm)	45.1	44.1	46.0	43.8	46.3
Cr, Chromium (ppm)	156	145	166	152	160
Cs, Caesium (ppm)	1.17	1.14	1.20	1.13	1.22
Cu, Copper (ppm)	44.4	43.7	45.1	43.3	45.5
Dy, Dysprosium (ppm)	4.36	4.10	4.63	4.21	4.52
Er, Erbium (ppm)	2.04	1.94	2.15	1.94	2.15
Eu, Europium (ppm)	1.82	1.67	1.98	1.74	1.91
Fe, Iron (wt.%)	8.06	7.87	8.26	7.97	8.15
Ga, Gallium (ppm)	22.3	21.9	22.8	21.7	23.0
Gd, Gadolinium (ppm)	5.41	5.05	5.77	5.08	5.75
Ge, Germanium (ppm)	0.13	0.11	0.14	IND	IND
Hf, Hafnium (ppm)	4.81	4.69	4.94	4.66	4.97
Ho, Holmium (ppm)	0.78	0.74	0.83	0.74	0.83
In, Indium (ppm)	0.072	0.069	0.075	0.065	0.078
K, Potassium (wt.%)	1.71	1.66	1.76	1.67	1.75
La, Lanthanum (ppm)	28.3	27.2	29.5	27.4	29.2
Li, Lithium (ppm)	10.9	10.4	11.4	10.5	11.3
Lu, Lutetium (ppm)	0.23	0.21	0.24	0.20	0.26
Mg, Magnesium (wt.%)	4.58	4.47	4.68	4.52	4.64
Mn, Manganese (wt.%)	0.116	0.113	0.118	0.113	0.118
Mo, Molybdenum (ppm)	4.27	4.13	4.40	4.09	4.44
Na, Sodium (wt.%)	2.38	2.32	2.43	2.33	2.42
Nb, Niobium (ppm)	45.5	44.4	46.7	44.5	46.6
Nd, Neodymium (ppm)	27.5	26.8	28.3	26.7	28.4
Ni, Nickel (ppm)	140	137	144	137	143
P, Phosphorus (wt.%)	0.255	0.251	0.258	0.249	0.260
Pb, Lead (ppm)	3.75	3.61	3.88	3.54	3.95
Pr, Praseodymium (ppm)	6.96	6.67	7.25	6.78	7.14
Rb, Rubidium (ppm)	37.1	35.8	38.3	35.9	38.2
S, Sulphur (wt.%)	0.044	0.041	0.046	0.041	0.046
Sc, Scandium (ppm)	20.0	19.2	20.7	19.2	20.7
Sm, Samarium (ppm)	5.96	5.66	6.26	5.75	6.17
Sn, Tin (ppm)	1.88	1.81	1.96	1.65	2.12
Sr, Strontium (ppm)	776	753	799	761	790
Ta, Tantalum (ppm)	2.97	2.87	3.08	2.87	3.07
Tb, Terbium (ppm)	0.78	0.75	0.82	0.75	0.82

SI unit equivalents: ppm (parts per million) ≡ mg/kg ≡ µg/g ≡ 0.0001 wt.% ≡ 1000 ppb (parts per billion).
Note: intervals may appear asymmetric due to rounding.

Table 3 continued.

Constituent	Certified Value	95% Confidence Limits		95% Tolerance Limits	
		Low	High	Low	High
4-Acid Digestion continued					
Th, Thorium (ppm)	3.78	3.64	3.92	3.65	3.91
Ti, Titanium (wt.%)	1.22	1.20	1.25	1.20	1.25
Tl, Thallium (ppm)	0.13	0.12	0.13	IND	IND
Tm, Thulium (ppm)	0.27	0.25	0.29	IND	IND
U, Uranium (ppm)	1.34	1.31	1.38	1.27	1.42
V, Vanadium (ppm)	201	198	204	197	205
W, Tungsten (ppm)	0.21	0.19	0.23	IND	IND
Y, Yttrium (ppm)	19.5	19.0	20.0	18.9	20.2
Yb, Ytterbium (ppm)	1.55	1.50	1.61	1.46	1.64
Zn, Zinc (ppm)	109	107	111	106	112
Zr, Zirconium (ppm)	204	201	207	199	209
Aqua Regia Digestion					
Ag, Silver (ppm)	0.028	0.025	0.030	IND	IND
Al, Aluminium (wt.%)	3.30	3.17	3.43	3.25	3.36
As, Arsenic (ppm)	1.22	1.12	1.31	IND	IND
Au, Gold (ppm)	< 0.02	IND	IND	IND	IND
Ba, Barium (ppm)	57	54	59	54	59
Be, Beryllium (ppm)	1.70	1.60	1.80	1.62	1.78
Bi, Bismuth (ppm)	0.024	0.021	0.027	IND	IND
Ca, Calcium (wt.%)	1.68	1.59	1.77	1.63	1.73
Cd, Cadmium (ppm)	0.10	0.09	0.11	IND	IND
Ce, Cerium (ppm)	47.4	46.6	48.2	45.6	49.2
Co, Cobalt (ppm)	38.5	37.4	39.6	37.2	39.8
Cr, Chromium (ppm)	67	64	71	66	69
Cs, Caesium (ppm)	0.93	0.89	0.98	0.90	0.97
Cu, Copper (ppm)	42.9	41.9	43.9	41.6	44.3
Fe, Iron (wt.%)	6.64	6.45	6.83	6.57	6.71
Ga, Gallium (ppm)	11.0	10.2	11.7	10.6	11.4
Ge, Germanium (ppm)	0.16	0.10	0.21	IND	IND
In, Indium (ppm)	0.020	0.020	0.021	IND	IND
K, Potassium (wt.%)	0.413	0.402	0.424	0.403	0.423
La, Lanthanum (ppm)	24.0	23.1	25.0	23.4	24.7
Li, Lithium (ppm)	9.92	9.34	10.49	9.76	10.07
Lu, Lutetium (ppm)	0.11	0.10	0.12	IND	IND
Mg, Magnesium (wt.%)	3.24	3.16	3.32	3.19	3.29
Mn, Manganese (wt.%)	0.088	0.086	0.091	0.086	0.091
Mo, Molybdenum (ppm)	3.95	3.67	4.24	3.77	4.14
Na, Sodium (wt.%)	0.970	0.943	0.997	0.944	0.995

SI unit equivalents: ppm (parts per million) ≡ mg/kg ≡ µg/g ≡ 0.0001 wt.% ≡ 1000 ppb (parts per billion).
Note: intervals may appear asymmetric due to rounding.

Table 3 continued.

Constituent	Certified Value	95% Confidence Limits		95% Tolerance Limits	
		Low	High	Low	High
Aqua Regia Digestion continued					
Ni, Nickel (ppm)	125	119	130	122	127
P, Phosphorus (wt.%)	0.234	0.226	0.243	0.228	0.241
Pb, Lead (ppm)	2.28	2.19	2.38	2.14	2.43
Rb, Rubidium (ppm)	19.4	18.6	20.2	18.8	20.0
S, Sulphur (wt.%)	0.041	0.038	0.043	IND	IND
Sc, Scandium (ppm)	2.71	2.35	3.08	2.59	2.83
Sn, Tin (ppm)	1.39	1.33	1.46	IND	IND
Sr, Strontium (ppm)	279	265	292	269	289
Ni, Nickel (ppm)	125	119	130	122	127
Ta, Tantalum (ppm)	0.082	0.066	0.098	IND	IND
Tb, Terbium (ppm)	0.47	0.44	0.50	0.45	0.49
Th, Thorium (ppm)	2.92	2.84	3.00	2.80	3.05
Ti, Titanium (wt.%)	0.833	0.795	0.871	0.812	0.854
Tl, Thallium (ppm)	0.096	0.093	0.099	IND	IND
U, Uranium (ppm)	0.86	0.83	0.89	0.84	0.89
V, Vanadium (ppm)	116	110	122	113	118
W, Tungsten (ppm)	0.068	0.059	0.076	IND	IND
Y, Yttrium (ppm)	12.3	11.9	12.7	12.0	12.7
Yb, Ytterbium (ppm)	0.76	0.68	0.85	IND	IND
Zn, Zinc (ppm)	97	93	101	95	99
Zr, Zirconium (ppm)	27.7	23.3	32.0	26.0	29.4

SI unit equivalents: ppm (parts per million) ≡ mg/kg ≡ µg/g ≡ 0.0001 wt.% ≡ 1000 ppb (parts per billion).
Note: intervals may appear asymmetric due to rounding.

Table 4. Indicative Values for OREAS 30a.

Constituent	Unit	Value	Constituent	Unit	Value	Constituent	Unit	Value
Borate Fusion XRF								
Cl	ppm	*83*	HfO_2	ppm	*< 100*	V_2O_5	ppm	*328*
Co	ppm	*< 100*	Ni	ppm	*< 100*	Zn	ppm	*161*
Cu	ppm	*133*	Pb	ppm	*< 100*	ZrO_2	ppm	*367*
Infrared Combustion								
C	wt.%	*0.022*						
Borate / Peroxide Fusion ICP								
Ag	ppm	*< 5*	In	ppm	*0.25*	Se	ppm	*6.59*
As	ppm	*< 4*	Na	wt.%	*2.35*	Sn	ppm	*2.17*
B	ppm	*< 50*	Pb	ppm	*3.90*	Te	ppm	*< 0.5*
Bi	ppm	*0.074*	Re	ppm	*< 0.1*	Tl	ppm	*< 0.5*
Cd	ppm	*< 10*	S	wt.%	*0.040*	W	ppm	*0.66*
Ge	ppm	*1.22*	Sb	ppm	*< 0.5*			

SI unit equivalents: ppm (parts per million) ≡ mg/kg ≡ µg/g ≡ 0.0001 wt.% ≡ 1000 ppb (parts per billion).
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 4 continued.

Constituent	Unit	Value	Constituent	Unit	Value	Constituent	Unit	Value
4-Acid Digestion								
Re	ppm	*< 0.002*	Se	ppm	*< 1*			
Sb	ppm	*0.16*	Te	ppm	*< 0.05*			
Aqua Regia Digestion								
B	ppm	*< 10*	Ho	ppm	*0.44*	Ru	ppb	*8.33*
Dy	ppm	*2.53*	Nb	ppm	*5.25*	Sb	ppm	*0.070*
Er	ppm	*1.08*	Nd	ppm	*22.3*	Se	ppm	*0.27*
Eu	ppm	*0.88*	Pd	ppb	*< 10*	Sm	ppm	*3.60*
Gd	ppm	*3.32*	Pr	ppm	*5.10*	Te	ppm	*< 0.01*
Hf	ppm	*0.56*	Pt	ppb	*1.44*	Tm	ppm	*0.16*
Hg	ppm	*< 0.01*	Re	ppm	*< 0.001*			

SI unit equivalents: ppm (parts per million) ≡ mg/kg ≡ µg/g ≡ 0.0001 wt.% ≡ 1000 ppb (parts per billion).
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

Standard Deviation values (1SDs) are reported in Table 1. They 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.**

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.

Certified Values, Standard Deviations, Confidence and Tolerance Limits have been determined for each analytical method following removal of individual and laboratory outliers (Table 3). 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.

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.*

Indicative (uncertified) values (Table 4) 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.

Homogeneity Evaluation

The tolerance limits (ISO 16269:2014) in Table 3 were determined using an analysis of precision errors method and are considered a conservative estimate of true homogeneity. The meaning of tolerance limits may be illustrated for copper by 4-acid digestion, where 99% of the time (1-α=0.99) at least 95% of subsamples (ρ=0.95) will have concentrations lying between 43.3 and 45.5 ppm. 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***.

The homogeneity of OREAS 30a has also been evaluated in an ANOVA study for all certified analytes occurring at least 20 times the lower limit of detection. No significant *p*-values were found indicating that no evidence exists that between-unit variance is greater than within-unit variance.

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 30a 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 30a is sufficiently homogenous and is fit-for-purpose as a certified reference material (see 'Intended Use' below).

PARTICIPATING LABORATORIES

1. ALS, Lima, Peru
2. ALS, Loughrea, Galway, Ireland
3. ALS, Perth, WA, Australia
4. ALS, Vancouver, BC, Canada
5. Bureau Veritas Commodities Canada Ltd, Vancouver, BC, Canada
6. Bureau Veritas Geoanalytical, Adelaide, SA, Australia
7. Bureau Veritas Geoanalytical, Perth, WA, Australia
8. Inspectorate (BV), Lima, Peru
9. Intertek Genalysis, Perth, WA, Australia
10. Intertek Testing Services Philippines, Cupang, Muntinlupa, Philippines
11. PT Geoservices Ltd, Cikarang, Jakarta Raya, Indonesia
12. PT Intertek Utama Services, Jakarta Timur, DKI Jakarta, Indonesia
13. SGS, Randfontein, Gauteng, South Africa
14. SGS del Peru, Lima, Peru
15. SGS Lakefield Research Ltd, Lakefield, Ontario, Canada

PREPARER AND SUPPLIER

Certified Reference Material OREAS 30a is prepared, certified and supplied by:

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METROLOGICAL 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 undertaken by ORE Pty Ltd) for a particular analytical method, analyte or analyte suite, and sample matrix. Most of these laboratories have and maintain ISO 17025 accreditation. The certified values presented in this report are calculated from the means of accepted data following robust statistical treatment as detailed in this report.

Guide ISO/TR 16476:2016, section 5.3.1 describes metrological traceability in reference materials as it pertains to the transformation of the measurand. In this section it states, *"Although the determination of the property value itself can be made traceable to appropriate units through, for example, calibration of the measurement equipment used, steps like the transformation of the sample from one physical (chemical) state to another cannot. Such transformations may only be compared with a reference (when available), or among themselves. For some transformations, reference methods have been defined and may be used in certification projects to evaluate the uncertainty associated with such a transformation. In other cases,* ***only a comparison among different laboratories using the same method is possible. In this case, certification takes place on the basis of agreement among independent measurement results*** *(see ISO Guide 35:2006, Clause 10)."*

COMMUTABILITY

The measurements of the results that underlie the certified values contained in this report were undertaken by methods involving pre-treatment (digestion/fusion) of the sample. This served to reduce the sample to a simple and well understood form permitting calibration using simple solutions of the CRM. Due to these methods being well understood and highly effective, commutability is not an issue for this CRM. All OREAS prepared CRMs are sourced from naturally occurring ores or rocks meaning they will display similar behaviour as routine 'field' samples in the relevant measurement process. Care should be taken to ensure 'matrix matching' as close as practically achievable. The matrix and mineralisation style of the CRM is described in the 'Source Material' section and users should select appropriate CRMs matching these attributes to their field samples.

INTENDED USE

OREAS 30a is intended to cover all activities needed to produce a measurement result. This includes extraction, possible separation steps and the actual measurement process (the signal producing step). OREAS 30a may be used to calibrate the entire procedure by producing a pure substance CRM transformed into a calibration solution.

OREAS 30a 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 30a was prepared from barren basalt sample. In its unopened state under normal conditions of storage it has a shelf life beyond ten years.

INSTRUCTIONS FOR CORRECT USE

The certified values by lithium borate fusion XRF and for LOI at 1000° C are on a dry sample basis while the certified values by other methods (fire assay, infrared combustion furnace, fusion ICP, 4-acid digestion and aqua regia digestion) are reported on a 'sample as received' 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.

DOCUMENT HISTORY

Revision No.	Date	Changes applied
0	23rd August, 2019	First publication.

QMS ACCREDITATION

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

23rd August, 2019

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

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ISO Guide 31:2015, Reference materials – Contents of certificates and labels.

ISO Guide 35:2017, Certification of reference materials - General and statistical principals.

ISO 16269:2014, Statistical interpretation of data – Part 6: Determination of statistical tolerance intervals.