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CERTIFICATE OF ANALYSIS FOR

CERTIFIED REFERENCE MATERIAL

OREAS 292

Gold-Antimony Ore (Costerfield, VIC, Australia)

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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, ppm	11.06	0.353	10.36	11.77	10.00	12.12	3.19%	6.38%	9.58%	10.51	11.62
Aqua Regia Digestion (sample weights 10-50g)											
Au, ppm	9.70	0.691	8.32	11.09	7.63	11.78	7.12%	14.24%	21.36%	9.22	10.19
Peroxide Fusion ICP											
Sb, wt.%	4.54	0.217	4.11	4.98	3.89	5.19	4.77%	9.54%	14.32%	4.32	4.77
4-Acid Digestion											
Ag, ppm	0.760	0.098	0.565	0.955	0.467	1.052	12.84%	25.67%	38.51%	0.722	0.798
Al, wt.%	6.76	0.341	6.08	7.44	5.74	7.78	5.04%	10.08%	15.12%	6.42	7.10
As, ppm	495	74	346	644	271	718	15.05%	30.10%	45.15%	470	519
Ba, ppm	549	33	484	615	451	647	5.96%	11.93%	17.89%	522	577
Be, ppm	2.53	0.172	2.18	2.87	2.01	3.05	6.81%	13.62%	20.43%	2.40	2.66
Bi, ppm	0.55	0.051	0.45	0.66	0.40	0.71	9.26%	18.52%	27.79%	0.53	0.58
Ca, wt.%	0.594	0.029	0.535	0.652	0.506	0.681	4.91%	9.83%	14.74%	0.564	0.623
Cd, ppm	0.067	0.015	0.038	0.096	0.023	0.111	21.83%	43.66%	65.49%	0.064	0.070
Ce, ppm	68	11	45	90	34	101	16.49%	32.99%	49.48%	64	71
Co, ppm	11.5	1.7	8.0	14.9	6.3	16.7	15.12%	30.23%	45.35%	10.9	12.0
Cr, ppm	105	12	81	130	68	142	11.67%	23.35%	35.02%	100	110
Cs, ppm	13.6	0.91	11.8	15.4	10.9	16.3	6.65%	13.30%	19.95%	12.9	14.3
Cu, ppm	58	4.7	49	68	44	72	8.05%	16.11%	24.16%	55	61
Dy, ppm	2.75	0.36	2.03	3.47	1.67	3.83	13.14%	26.29%	39.43%	2.61	2.89
Er, ppm	1.62	0.17	1.28	1.96	1.11	2.13	10.56%	21.11%	31.67%	1.54	1.70
Eu, ppm	0.95	0.10	0.76	1.14	0.66	1.24	10.12%	20.25%	30.37%	0.90	1.00
Fe, wt.%	3.40	0.207	2.99	3.82	2.78	4.02	6.09%	12.19%	18.28%	3.23	3.57
Ga, ppm	17.0	1.17	14.7	19.4	13.5	20.5	6.84%	13.69%	20.53%	16.2	17.9
Gd, ppm	3.69	0.350	2.99	4.39	2.64	4.74	9.48%	18.97%	28.45%	3.51	3.88
Ge, ppm	0.33	0.05	0.23	0.43	0.18	0.48	14.97%	29.94%	44.92%	0.32	0.35
Hf, ppm	3.27	0.250	2.77	3.77	2.52	4.02	7.63%	15.26%	22.89%	3.11	3.44
Ho, ppm	0.54	0.08	0.38	0.69	0.30	0.77	14.83%	29.66%	44.49%	0.51	0.56
In, ppm	0.062	0.007	0.049	0.075	0.042	0.081	10.57%	21.15%	31.72%	0.059	0.065
K, wt.%	2.87	0.139	2.60	3.15	2.46	3.29	4.82%	9.64%	14.47%	2.73	3.02
La, ppm	35.3	5.1	25.1	45.6	20.0	50.7	14.50%	29.00%	43.50%	33.6	37.1
Li, ppm	24.1	9.3	5.4	42.8	0.0	52.1	38.70%	77.41%	116.11%	22.9	25.3
Lu, ppm	0.25	0.04	0.17	0.32	0.13	0.36	15.46%	30.93%	46.39%	0.23	0.26
Mg, wt.%	1.32	0.058	1.20	1.43	1.15	1.49	4.36%	8.72%	13.08%	1.25	1.38
Mn, wt.%	0.098	0.006	0.086	0.110	0.079	0.116	6.31%	12.61%	18.92%	0.093	0.103
Na, wt.%	0.369	0.016	0.338	0.401	0.322	0.416	4.26%	8.51%	12.77%	0.351	0.388
Nd, ppm	30.0	2.59	24.8	35.1	22.2	37.7	8.64%	17.28%	25.91%	28.5	31.4
Ni, ppm	37.8	4.1	29.6	46.1	25.4	50.2	10.92%	21.84%	32.76%	36.0	39.7
P, wt.%	0.049	0.005	0.039	0.059	0.034	0.063	10.14%	20.27%	30.41%	0.046	0.051
Pb, ppm	46.9	5.1	36.6	57.1	31.5	62.3	10.94%	21.88%	32.81%	44.5	49.2
Pr, ppm	7.94	0.734	6.47	9.40	5.73	10.14	9.25%	18.50%	27.75%	7.54	8.33
Rb, ppm	168	10	148	189	138	199	6.02%	12.03%	18.05%	160	177
Re, ppm	< 0.002	IND	IND	IND	IND	IND	IND	IND	IND	IND	IND

SI unit equivalents: ppm (parts per million; 1 x 10^6) ≡ mg/kg ≡ µg/g ≡ 0.0001 wt.%.

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											
S, wt.%	2.09	0.085	1.92	2.26	1.84	2.35	4.05%	8.10%	12.14%	1.99	2.20
Sc, ppm	12.5	0.81	10.9	14.1	10.1	15.0	6.46%	12.92%	19.38%	11.9	13.2
Se, ppm	10.1	1.2	7.7	12.4	6.5	13.6	11.70%	23.39%	35.09%	9.6	10.6
Sm, ppm	5.64	0.489	4.66	6.62	4.17	7.11	8.67%	17.34%	26.01%	5.36	5.92
Sn, ppm	3.12	0.54	2.03	4.20	1.48	4.75	17.48%	34.96%	52.44%	2.96	3.27
Sr, ppm	153	8	136	169	127	178	5.49%	10.98%	16.47%	145	160
Ta, ppm	0.58	0.10	0.38	0.79	0.27	0.89	17.64%	35.27%	52.91%	0.55	0.61
Tb, ppm	0.45	0.08	0.30	0.61	0.22	0.69	17.29%	34.58%	51.87%	0.43	0.47
Te, ppm	0.058	0.025	0.008	0.108	0.000	0.133	42.74%	85.48%	128.21%	0.055	0.061
Th, ppm	14.5	1.5	11.5	17.6	10.0	19.1	10.42%	20.83%	31.25%	13.8	15.3
Tl, ppm	0.87	0.14	0.60	1.15	0.46	1.29	15.80%	31.60%	47.40%	0.83	0.92
Tm, ppm	0.23	0.04	0.16	0.30	0.12	0.33	15.55%	31.10%	46.64%	0.22	0.24
U, ppm	2.53	0.190	2.15	2.91	1.96	3.10	7.52%	15.04%	22.55%	2.40	2.66
V, ppm	56	20	17	95	0	115	34.89%	69.79%	104.68%	53	59
Y, ppm	14.8	2.7	9.5	20.1	6.9	22.8	17.86%	35.72%	53.58%	14.1	15.6
Yb, ppm	1.59	0.21	1.17	2.01	0.96	2.22	13.21%	26.43%	39.64%	1.51	1.67
Zn, ppm	105	12	82	129	71	140	10.96%	21.91%	32.87%	100	111
Zr, ppm	108	8	91	125	83	133	7.81%	15.62%	23.43%	103	114
Aqua Regia Digestion											
Ag, ppm	0.739	0.051	0.637	0.842	0.586	0.893	6.90%	13.80%	20.70%	0.702	0.776
Al, wt.%	1.24	0.111	1.02	1.46	0.91	1.57	8.95%	17.91%	26.86%	1.18	1.30
As, ppm	488	66	357	620	291	686	13.50%	26.99%	40.49%	464	513
Ba, ppm	136	14	108	165	93	180	10.56%	21.11%	31.67%	130	143
Be, ppm	1.05	0.14	0.78	1.33	0.64	1.46	12.96%	25.92%	38.89%	1.00	1.11
Bi, ppm	0.62	0.038	0.54	0.69	0.50	0.73	6.20%	12.41%	18.61%	0.59	0.65
Ca, wt.%	0.576	0.038	0.501	0.652	0.463	0.689	6.55%	13.09%	19.64%	0.547	0.605
Cd, ppm	0.067	0.011	0.046	0.089	0.035	0.099	15.87%	31.73%	47.60%	0.064	0.071
Ce, ppm	32.5	3.9	24.6	40.3	20.7	44.2	12.10%	24.19%	36.29%	30.8	34.1
Co, ppm	12.5	0.66	11.2	13.8	10.5	14.5	5.30%	10.60%	15.90%	11.9	13.1
Cr, ppm	38.2	5.6	27.1	49.3	21.5	54.9	14.56%	29.12%	43.67%	36.3	40.1
Cs, ppm	5.04	0.83	3.38	6.70	2.55	7.53	16.49%	32.98%	49.47%	4.79	5.29
Cu, ppm	62	2.6	57	67	54	70	4.19%	8.38%	12.57%	59	65
Fe, wt.%	3.27	0.194	2.89	3.66	2.69	3.86	5.92%	11.85%	17.77%	3.11	3.44
Ga, ppm	3.55	0.55	2.45	4.66	1.89	5.21	15.55%	31.10%	46.66%	3.37	3.73
Ge, ppm	0.083	0.012	0.058	0.107	0.046	0.119	14.91%	29.83%	44.74%	0.078	0.087
Hg, ppm	0.15	0.02	0.12	0.19	0.11	0.20	10.65%	21.29%	31.94%	0.15	0.16
In, ppm	0.038	0.003	0.032	0.044	0.029	0.048	8.37%	16.75%	25.12%	0.036	0.040
K, wt.%	0.572	0.044	0.485	0.659	0.441	0.703	7.62%	15.23%	22.85%	0.543	0.601
La, ppm	16.2	2.2	11.7	20.6	9.5	22.8	13.70%	27.40%	41.10%	15.4	17.0
Li, ppm	12.0	0.99	10.0	14.0	9.0	14.9	8.23%	16.45%	24.68%	11.4	12.6
Mg, wt.%	1.02	0.036	0.94	1.09	0.91	1.12	3.59%	7.18%	10.77%	0.96	1.07
Mn, wt.%	0.101	0.005	0.090	0.111	0.085	0.117	5.22%	10.43%	15.65%	0.096	0.106
Mo, ppm	1.32	0.128	1.06	1.58	0.93	1.70	9.74%	19.49%	29.23%	1.25	1.38

SI unit equivalents: ppm (parts per million; 1 x 10^6) ≡ mg/kg; wt.% (weight per cent) ≡ % (mass fraction).

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											
Na, wt.%	0.031	0.002	0.027	0.035	0.025	0.037	6.23%	12.46%	18.69%	0.029	0.032
Ni, ppm	39.0	2.38	34.3	43.8	31.9	46.2	6.10%	12.19%	18.29%	37.1	41.0
P, wt.%	0.046	0.004	0.038	0.054	0.034	0.059	9.08%	18.15%	27.23%	0.044	0.048
Pb, ppm	41.1	8.7	23.7	58.6	15.0	67.3	21.19%	42.38%	63.58%	39.1	43.2
Rb, ppm	32.2	3.09	26.0	38.4	22.9	41.5	9.59%	19.19%	28.78%	30.6	33.8
Re, ppm	0.001	0.000	0.000	0.002	0.000	0.002	38.31%	76.63%	114.94%	0.001	0.001
S, wt.%	2.12	0.079	1.96	2.28	1.88	2.36	3.73%	7.46%	11.19%	2.01	2.23
Sb, wt.%	4.61	0.237	4.13	5.08	3.90	5.32	5.14%	10.28%	15.42%	4.38	4.84
Sc, ppm	4.97	0.247	4.48	5.47	4.23	5.71	4.96%	9.92%	14.89%	4.72	5.22
Se, ppm	8.73	1.46	5.81	11.65	4.35	13.12	16.73%	33.46%	50.19%	8.30	9.17
Sn, ppm	0.84	0.14	0.56	1.11	0.42	1.25	16.57%	33.14%	49.71%	0.80	0.88
Sr, ppm	113	7	100	127	93	134	6.03%	12.07%	18.10%	108	119
Ta, ppm	< 0.01	IND	IND	IND	IND	IND	IND	IND	IND	IND	IND
Tl, ppm	0.29	0.03	0.23	0.35	0.19	0.38	10.90%	21.81%	32.71%	0.27	0.30
U, ppm	1.06	0.100	0.86	1.26	0.76	1.36	9.39%	18.79%	28.18%	1.01	1.11
V, ppm	16.0	2.2	11.5	20.5	9.3	22.8	14.00%	28.00%	42.01%	15.2	16.8
Y, ppm	7.01	0.217	6.58	7.44	6.36	7.66	3.09%	6.19%	9.28%	6.66	7.36
Zn, ppm	107	3	102	112	99	115	2.51%	5.01%	7.52%	102	112

SI unit equivalents: ppm (parts per million; 1 x 10^6) ≡ mg/kg; wt.% (weight per cent) ≡ % (mass fraction).

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 2. Indicative Values for OREAS 292.

Constituent	Unit	Value	Constituent	Unit	Value	Constituent	Unit	Value
Pb Fire Assay								
Pd	ppb	*< 5*	Pt	ppb	*< 5*			
Peroxide Fusion ICP								
Al	wt.%	*7.03*	Ga	ppm	*12.6*	S	wt.%	*2.09*
As	ppm	*619*	K	wt.%	*2.92*	Sc	ppm	*13.2*
Ba	ppm	*595*	La	ppm	*37.6*	Si	wt.%	*28.15*
Be	ppm	*< 5*	Li	ppm	*< 5*	Sn	ppm	*< 10*
Bi	ppm	*< 5*	Mg	wt.%	*1.36*	Sr	ppm	*140*
Ca	wt.%	*0.693*	Mn	wt.%	*0.112*	Ti	wt.%	*0.380*
Cd	ppm	*< 0.5*	Mo	ppm	*3.10*	V	ppm	*69*
Co	ppm	*18.5*	Nb	ppm	*< 5*	W	ppm	*65*
Cr	ppm	*150*	Ni	ppm	*39.1*	Y	ppm	*26.3*
Cu	ppm	*91*	P	wt.%	*0.057*	Zn	ppm	*122*
Fe	wt.%	*3.70*	Pb	ppm	*45.8*			
4-Acid Digestion								
Hg	ppm	*0.19*	Nb	ppm	*5.81*	Ti	wt.%	*0.216*
Mo	ppm	*1.00*	Sb	wt.%	*3.01*	W	ppm	*2.05*

SI unit equivalents: ppb (parts per billion; 1 x 10^9) ≡ µg/kg; ppm (parts per million; 1 x 10^6) ≡ mg/kg; wt.% (weight per cent) ≡ % (mass fraction).

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
Aqua Regia Digestion								
B	ppm	*18.3*	Nb	ppm	*0.20*	Th	ppm	*4.79*
Dy	ppm	*1.57*	Nd	ppm	*11.7*	Ti	wt.%	*0.007*
Er	ppm	*0.82*	Pd	ppb	*< 10*	Tm	ppm	*0.11*
Eu	ppm	*0.54*	Pr	ppm	*2.87*	W	ppm	*0.66*
Gd	ppm	*2.37*	Pt	ppb	*1.75*	Yb	ppm	*0.77*
Hf	ppm	*0.16*	Sm	ppm	*2.79*	Zr	ppm	*8.24*
Ho	ppm	*0.30*	Tb	ppm	*0.31*			
Lu	ppm	*0.11*	Te	ppm	*0.076*			
Borate Fusion XRF								
Al_2O_3	wt.%	*13.39*	MgO	wt.%	*2.27*	SiO_2	wt.%	*60.24*
CaO	wt.%	*0.839*	MnO	wt.%	*0.141*	SO_3	wt.%	*5.13*
Fe_2O_3	wt.%	*5.24*	P_2O_5	wt.%	*0.138*	TiO_2	wt.%	*0.635*
K_2O	wt.%	*3.56*	Sb	wt.%	*4.77*			
Thermogravimetry								
LOI^{1000}	wt.%	*6.72*						
Infrared Combustion								
C	wt.%	*1.14*	S	wt.%	*2.11*			
Laser Ablation ICP-MS								
Ag	ppm	*0.900*	Hf	ppm	*4.48*	Sm	ppm	*5.87*
As	ppm	*588*	Ho	ppm	*0.99*	Sn	ppm	*3.60*
Ba	ppm	*583*	In	ppm	*0.050*	Sr	ppm	*150*
Be	ppm	*2.50*	La	ppm	*38.3*	Ta	ppm	*1.05*
Bi	ppm	*0.65*	Lu	ppm	*0.39*	Tb	ppm	*0.86*
Cd	ppm	*0.13*	Mn	wt.%	*0.102*	Te	ppm	*< 0.2*
Ce	ppm	*74*	Mo	ppm	*1.70*	Th	ppm	*15.6*
Co	ppm	*13.9*	Nb	ppm	*12.7*	Ti	wt.%	*0.375*
Cr	ppm	*114*	Nd	ppm	*34.1*	Tl	ppm	*0.70*
Cs	ppm	*13.4*	Ni	ppm	*45.0*	Tm	ppm	*0.40*
Cu	ppm	*63*	Pb	ppm	*55*	U	ppm	*2.89*
Dy	ppm	*4.75*	Pr	ppm	*8.74*	V	ppm	*85*
Er	ppm	*2.74*	Rb	ppm	*169*	W	ppm	*8.00*
Eu	ppm	*1.09*	Re	ppm	*0.065*	Y	ppm	*27.2*
Ga	ppm	*17.1*	Sb	wt.%	*4.79*	Yb	ppm	*2.92*
Gd	ppm	*5.32*	Sc	ppm	*12.9*	Zn	ppm	*108*
Ge	ppm	*1.70*	Se	ppm	*< 5*	Zr	ppm	*168*

SI unit equivalents: ppm (parts per million; 1 x 10^6) ≡ mg/kg; wt.% (weight per cent) ≡ % (mass fraction).

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. 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. In evaluating laboratory performance with this CRM, the section headed ‘Instructions for correct use’ should be read carefully.

Table 1 provides performance gate intervals for the certified values, Table 2 shows indicative values, Table 3 provides some indicative physical properties and Table 4 presents the 95% expanded uncertainty and tolerance limits for all certified values. Tabulated results of all analytes 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 292-DataPack.1.3.250826_141042.xlsx**).

Results are also presented in scatter plots for gold by fire assay, gold by aqua regia digestion, and antimony by peroxide fusion (Figures 1 to 3, respectively) together with ±3SD (magenta) and ±5% (yellow) control lines and certified value (green line). Accepted individual results are coloured blue and individual and dataset outliers are identified in red and violet, respectively.

SOURCE MATERIAL

OREAS 292 was prepared from a sample of high-grade gold-antimony ore with a minor addition of barren metasediment. The ore was sourced from the Costerfield Operation (owned by Mandalay Resources Ltd) located approximately 10km northeast of the town of Heathcote in Victoria, Australia.

PERFORMANCE GATES

Table 1 above 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 [1].

COMMINUTION AND HOMOGENISATION PROCEDURES

The material constituting OREAS 292 was prepared in the following manner:

- Drying the source materials to constant mass at 85 degrees Celsius;
- Crushing and multi-stage milling of the ore to 100% passing 30 microns;
- Crushing and multi-stage milling of the barren metasediment to >98% minus 75 microns;
- Preliminary homogenisation;
- Check assaying of the ore material;
- Blending the ore and barren materials in a specific ratio to achieve target grades;
- Packaging in 60g units under nitrogen in laminated foil pouches.

PHYSICAL PROPERTIES

OREAS 292 was tested at ORE Research & Exploration Pty Ltd's onsite facility for various physical properties. Table 3 presents these findings that should be used for informational purposes only.

Table 3. Physical properties of OREAS 292.

Bulk Density (g/L)	Moisture%	Munsell Notation‡	Munsell Color‡
913	0.60	N5	Medium 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

Twenty-two commercial analytical laboratories participated in the program to certify the elements reported in Table 1. The following methods were employed:

- Au by 25-50g fire assay with AAS (14 laboratories) and ICP-OES (5 laboratories) finish;
- Au by 15-30g aqua regia digestion with ICP-MS (9 laboratories), AAS (2 laboratories) and ICP-OES (1 laboratory) finish;
- Sb by peroxide fusion with ICP-OES (11 laboratories) and ICP-MS (2 laboratories) finish and one laboratory used pressed powder pellet with XRF finish;
- Full ICP-OES and MS elemental suites by 4-acid digestion (up to 18 laboratories depending on the element);
- Full ICP-OES and MS elemental suites by aqua regia digestion (up to 19 laboratories depending on the element);
- Instrumental neutron activation analysis (INAA) for Au on 20 x 85mg subsamples to confirm homogeneity undertaken by the Australian Nuclear Science and Technology Organisation (ANSTO) located in Lucas Heights, NSW, Australia.

For the round robin program, twenty 800g test units were taken at predetermined intervals during the bagging stage, immediately following homogenisation and are considered representative of the entire prepared batch. Six 110g pulp samples were submitted to each laboratory for analysis. The samples received by each laboratory were obtained by taking two 110g samples from each of three separate 800g 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.

STATISTICAL ANALYSIS

Standard Deviation intervals (see Table 1) 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.

Indicative (uncertified) values (Table 2) are present where the number of laboratories reporting a particular analyte is insufficient (< 5) to support certification or where inter-laboratory consensus is poor.

Certified Values and their uncertainty intervals (Table 4) 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 and are the present best estimate of the true value. The INAA data (see Table 5) is omitted from determination of the certified value for Au and is used solely for the calculation of Tolerance Limits and homogeneity evaluation (see 'Homogeneity Evaluation' section below).

95% Expanded Uncertainty provides a 95% probability that the true value of the analyte under consideration lies between the upper and lower limits and is calculated according to the method in the ISO Guides [6,15]. All known or suspected sources of bias have been investigated or taken into account. ***The 95% Expanded Uncertainty should not be used as control limits for laboratory performance.***

Table 4. 95% Uncertainty & Tolerance Limits for OREAS 292.

Constituent	Certified	95% Expanded Uncertainty		95% Tolerance Limits	
	Value	Low	High	Low	High
Pb Fire Assay					
Au, Gold (ppm)	11.06	10.90	11.22	11.01*	11.11*
Aqua Regia Digestion (sample weights 10-50g)					
Au, Gold (ppm)	9.70	9.20	10.21	9.66*	9.75*
Peroxide Fusion ICP					
Sb, Antimony (wt.%)	4.54	4.33	4.75	4.47	4.62
4-Acid Digestion					
Ag, Silver (ppm)	0.760	0.665	0.855	0.722	0.797
Al, Aluminium (wt.%)	6.76	6.46	7.06	6.55	6.98
As, Arsenic (ppm)	495	448	541	479	510
Ba, Barium (ppm)	549	524	574	532	566
Be, Beryllium (ppm)	2.53	2.33	2.73	2.35	2.71
Bi, Bismuth (ppm)	0.55	0.50	0.61	0.53	0.58
Ca, Calcium (wt.%)	0.594	0.566	0.621	0.575	0.612
Cd, Cadmium (ppm)	0.067	0.042	0.092	IND	IND
Ce, Cerium (ppm)	68	60	75	64	71
Co, Cobalt (ppm)	11.5	10.4	12.5	10.9	12.0
Cr, Chromium (ppm)	105	96	115	101	109
Cs, Caesium (ppm)	13.6	12.9	14.3	12.9	14.3
Cu, Copper (ppm)	58	55	62	56	60
Dy, Dysprosium (ppm)	2.75	2.19	3.31	2.55	2.95
Er, Erbium (ppm)	1.62	1.37	1.87	IND	IND
Eu, Europium (ppm)	0.95	0.78	1.11	IND	IND
Fe, Iron (wt.%)	3.40	3.26	3.54	3.32	3.49
Ga, Gallium (ppm)	17.0	16.0	18.1	16.3	17.8
Gd, Gadolinium (ppm)	3.69	3.20	4.18	3.42	3.96
Ge, Germanium (ppm)	0.33	0.26	0.41	0.27	0.40
Hf, Hafnium (ppm)	3.27	3.04	3.50	3.14	3.41
Ho, Holmium (ppm)	0.54	0.40	0.67	IND	IND
In, Indium (ppm)	0.062	0.052	0.071	0.056	0.067
K, Potassium (wt.%)	2.87	2.77	2.97	2.79	2.96
La, Lanthanum (ppm)	35.3	31.9	38.8	33.9	36.8
Li, Lithium (ppm)	24.1	19.0	29.2	22.3	25.9
Lu, Lutetium (ppm)	0.25	0.20	0.29	0.23	0.26
Mg, Magnesium (wt.%)	1.32	1.27	1.37	1.29	1.35
Mn, Manganese (wt.%)	0.098	0.094	0.102	0.096	0.100

SI unit equivalents: ppm (parts per million; 1 x 10^6) ≡ mg/kg; wt.% (weight per cent) ≡ % (mass fraction).

Note: intervals may appear asymmetric due to rounding.

*Gold Tolerance Limits for typical 30g fire assay and 25g aqua regia digestion methods are determined from 20 x 85mg INAA results and the Sampling Constant (Ingamells & Switzer, 1973).

Note: intervals may appear asymmetric due to rounding.

IND = indeterminate (due to limited reading resolution of the methods employed).

Table 4. continued.

Constituent	Certified Value	95% Expanded Uncertainty		95% Tolerance Limits	
		Low	High	Low	High
4-Acid Digestion continued					
Na, Sodium (wt.%)	0.369	0.355	0.383	0.357	0.382
Nd, Neodymium (ppm)	30.0	26.7	33.2	28.1	31.8
Ni, Nickel (ppm)	37.8	35.3	40.4	36.1	39.6
P, Phosphorus (wt.%)	0.049	0.046	0.051	0.047	0.050
Pb, Lead (ppm)	46.9	43.5	50.2	44.9	48.9
Pr, Praseodymium (ppm)	7.94	6.82	9.06	7.40	8.47
Rb, Rubidium (ppm)	168	159	178	162	174
Re, Rhenium (ppm)	< 0.002	IND	IND	IND	IND
S, Sulphur (wt.%)	2.09	2.01	2.18	2.04	2.15
Sc, Scandium (ppm)	12.5	11.9	13.2	12.0	13.0
Se, Selenium (ppm)	10.1	8.6	11.6	9.3	10.9
Sm, Samarium (ppm)	5.64	4.95	6.33	5.17	6.11
Sn, Tin (ppm)	3.12	2.74	3.49	2.90	3.33
Sr, Strontium (ppm)	153	145	160	149	157
Ta, Tantalum (ppm)	0.58	0.43	0.74	0.51	0.66
Tb, Terbium (ppm)	0.45	0.37	0.53	0.42	0.48
Te, Tellurium (ppm)	0.058	0.000	0.123	IND	IND
Th, Thorium (ppm)	14.5	13.3	15.8	14.0	15.1
Tl, Thallium (ppm)	0.87	0.78	0.97	0.82	0.92
Tm, Thulium (ppm)	0.23	0.16	0.29	IND	IND
U, Uranium (ppm)	2.53	2.35	2.70	2.41	2.65
V, Vanadium (ppm)	56	45	67	52	60
Y, Yttrium (ppm)	14.8	13.0	16.7	13.9	15.7
Yb, Ytterbium (ppm)	1.59	1.34	1.84	IND	IND
Zn, Zinc (ppm)	105	98	112	102	109
Zr, Zirconium (ppm)	108	102	114	104	113
Aqua Regia Digestion					
Ag, Silver (ppm)	0.739	0.694	0.785	0.717	0.762
Al, Aluminium (wt.%)	1.24	1.17	1.31	1.20	1.27
As, Arsenic (ppm)	488	446	531	474	503
Ba, Barium (ppm)	136	127	146	132	141
Be, Beryllium (ppm)	1.05	0.94	1.16	0.99	1.12
Bi, Bismuth (ppm)	0.62	0.58	0.66	0.59	0.64
Ca, Calcium (wt.%)	0.576	0.546	0.607	0.559	0.593
Cd, Cadmium (ppm)	0.067	0.058	0.077	IND	IND
Ce, Cerium (ppm)	32.5	28.6	36.3	31.2	33.7
Co, Cobalt (ppm)	12.5	11.7	13.3	12.0	13.0

SI unit equivalents: ppm (parts per million; 1 x 10^6) ≡ mg/kg; wt.% (weight per cent) ≡ % (mass fraction).
Note: intervals may appear asymmetric due to rounding.
IND = indeterminate (due to limited reading resolution of the methods employed).

Table 4. continued.

Constituent	Certified Value	95% Expanded Uncertainty		95% Tolerance Limits	
		Low	High	Low	High
Aqua Regia Digestion continued					
Cr, Chromium (ppm)	38.2	35.2	41.2	36.8	39.6
Cs, Caesium (ppm)	5.04	4.44	5.64	4.85	5.23
Cu, Copper (ppm)	62	59	65	60	64
Fe, Iron (wt.%)	3.27	3.15	3.40	3.20	3.34
Ga, Gallium (ppm)	3.55	3.14	3.97	3.39	3.71
Ge, Germanium (ppm)	0.083	0.058	0.107	IND	IND
Hg, Mercury (ppm)	0.15	0.13	0.18	IND	IND
In, Indium (ppm)	0.038	0.032	0.044	0.033	0.043
K, Potassium (wt.%)	0.572	0.545	0.599	0.554	0.590
La, Lanthanum (ppm)	16.2	14.5	17.8	15.6	16.8
Li, Lithium (ppm)	12.0	11.1	12.9	11.4	12.5
Mg, Magnesium (wt.%)	1.02	0.99	1.04	0.99	1.04
Mn, Manganese (wt.%)	0.101	0.098	0.104	0.098	0.103
Mo, Molybdenum (ppm)	1.32	1.16	1.48	1.26	1.38
Na, Sodium (wt.%)	0.031	0.029	0.032	0.029	0.032
Ni, Nickel (ppm)	39.0	37.2	40.9	38.1	40.0
P, Phosphorus (wt.%)	0.046	0.043	0.049	0.044	0.048
Pb, Lead (ppm)	41.1	35.9	46.4	39.1	43.2
Rb, Rubidium (ppm)	32.2	29.7	34.7	30.7	33.7
Re, Rhenium (ppm)	0.001	0.001	0.001	IND	IND
S, Sulphur (wt.%)	2.12	2.05	2.19	2.06	2.18
Sb, Antimony (wt.%)	4.61	4.43	4.79	4.50	4.71
Sc, Scandium (ppm)	4.97	4.72	5.23	4.69	5.26
Se, Selenium (ppm)	8.73	7.56	9.91	8.20	9.26
Sn, Tin (ppm)	0.84	0.72	0.95	IND	IND
Sr, Strontium (ppm)	113	109	118	111	116
Ta, Tantalum (ppm)	< 0.01	IND	IND	IND	IND
Tl, Thallium (ppm)	0.29	0.26	0.32	0.27	0.31
U, Uranium (ppm)	1.06	0.97	1.15	1.01	1.12
V, Vanadium (ppm)	16.0	14.6	17.4	15.2	16.9
Y, Yttrium (ppm)	7.01	6.70	7.32	6.79	7.23
Zn, Zinc (ppm)	107	104	110	105	109

SI unit equivalents: ppm (parts per million; 1 x 10^6) ≡ mg/kg; wt.% (weight per cent) ≡ % (mass fraction).
Note: intervals may appear asymmetric due to rounding.
IND = indeterminate (due to limited reading resolution of the methods employed).

Homogeneity Evaluation

The tolerance limits (ISO 16269:2014) shown in Table 4 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 antimony by peroxide fusion, where

99% of the time (1-α=0.99) at least 95% of subsamples (ρ=0.95) will have concentrations lying between 4.47 and 4.62 wt.%. Put more precisely, this means that if the same number of subsamples were taken and analysed in the same manner repeatedly, 99% of the tolerance intervals so constructed would cover at least 95% of the total population, and 1% of the tolerance intervals would cover less than 95% of the total population (ISO Guide 35). ***Please note that tolerance limits pertain to the homogeneity of the CRM only and should not be used as control limits for laboratory performance.***

Table 5. Neutron Activation Analysis of Au (in ppm) on 20 x 85mg subsamples and showing the equivalent results scaled to a 30g sample mass typical of fire assay determination.

Replicate	Au	Au
No	85mg actual	30g equivalent*
1	11.24	11.276
2	10.82	11.254
3	11.15	11.271
4	11.03	11.265
5	11.36	11.283
6	12.02	11.318
7	10.98	11.262
8	10.86	11.256
9	11.50	11.290
10	11.30	11.279
11	11.33	11.281
12	11.17	11.273
13	11.69	11.300
14	11.70	11.300
15	11.45	11.287
16	11.23	11.276
17	11.28	11.279
18	11.08	11.268
19	11.01	11.264
20	11.37	11.283
Mean	11.278	11.278
Median	11.262	11.277
Std Dev.	0.296	0.016
Rel.Std.Dev.	**2.623%**	**0.140%**

*Results calculated for a 30g equivalent sample mass using the formula: $x^{30g\ Eq} = \frac{(x^{INAA} - \bar{X}) \times RSD@30g}{RSD@85mg} + \bar{X}$

where $x^{30g\ Eq}$ = equivalent result calculated for a 30g sample mass
(x^{INAA}) = raw INAA result at 85mg
$\bar{X}$ = mean of 85mg INAA results

The homogeneity of gold has been determined by INAA at ANSTO 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.

Table 5 above shows the gold INAA data determined on 20 x 85mg subsamples of OREAS 292. An equivalent scaled version of the results is also provided to demonstrate an appreciation of what this data means if 30g fire assays were undertaken without the normal measurement error associated with this methodology. In this instance, the 1RSD of 0.140% calculated for a 30g fire assay sample (2.623% at 85mg weights) confirms the high level of gold homogeneity in OREAS 292.

The homogeneity of gold in OREAS 292 has also been evaluated in a nested Analysis of Variance (**ANOVA**) of the round robin program. Twenty-one round robin laboratories received six samples per CRM and these samples were made up of paired samples from three different, non-adjacent sampling intervals. The purpose of the ANOVA evaluation is to test that no statistically significant difference exists in the variance between units to that of the variance within units. This allows an assessment of homogeneity across the entire prepared batch of OREAS 292. The test was performed using the following parameters:

- Gold fire assay – 114 samples (19 laboratories each providing analyses on 3 pairs of samples);
- Gold aqua regia digestion – 72 samples (12 laboratories each providing analyses on 3 pairs of samples);
- 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 the *p*-value.

This process derived *p*-values of 0.25 for Au by fire assay and 0.94 for Au by aqua regia digestion. Both *p*-values are insignificant and the Null Hypothesis is retained. Additionally, none of the other certified values showed significant *p*-values. Please note that only results for constituents present in concentrations well above the detection levels (i.e., >20 x Lower Limit of Detection) for the various methods undertaken were considered for the objective of evaluating homogeneity

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 292 and whether the variance between two subsamples from the same unit is statistically distinguishable from the variance of two subsamples taken from any two separate units. A reference material therefore can possess poor absolute homogeneity yet still pass a relative homogeneity (ANOVA) test if the within-unit heterogeneity is large and similar across all units. Based on the statistical analysis of ANOVA and the results of the interlaboratory certification program, it can be concluded that OREAS 292 is fit-for-purpose as a certified reference material (see ‘Intended Use’ below).

PREPARER AND SUPPLIER

Certified reference material OREAS 292 was prepared and certified by:

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9. Bureau Veritas Minerals, Ankara, Central Anatolia, Turkey
10. Gekko Assay Labs, Ballarat, VIC, Australia
11. Inspectorate (BV), Lima, Peru
12. Inspectorate (BV), Manila, Philippines
13. Intertek Genalysis, Perth, WA, Australia
14. Intertek Testing Services, Townsville, QLD, Australia
15. Labwest Minerals Analysis, Perth, WA, Australia
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17. PT Geoservices Ltd, Cikarang, Jakarta Raya, Indonesia
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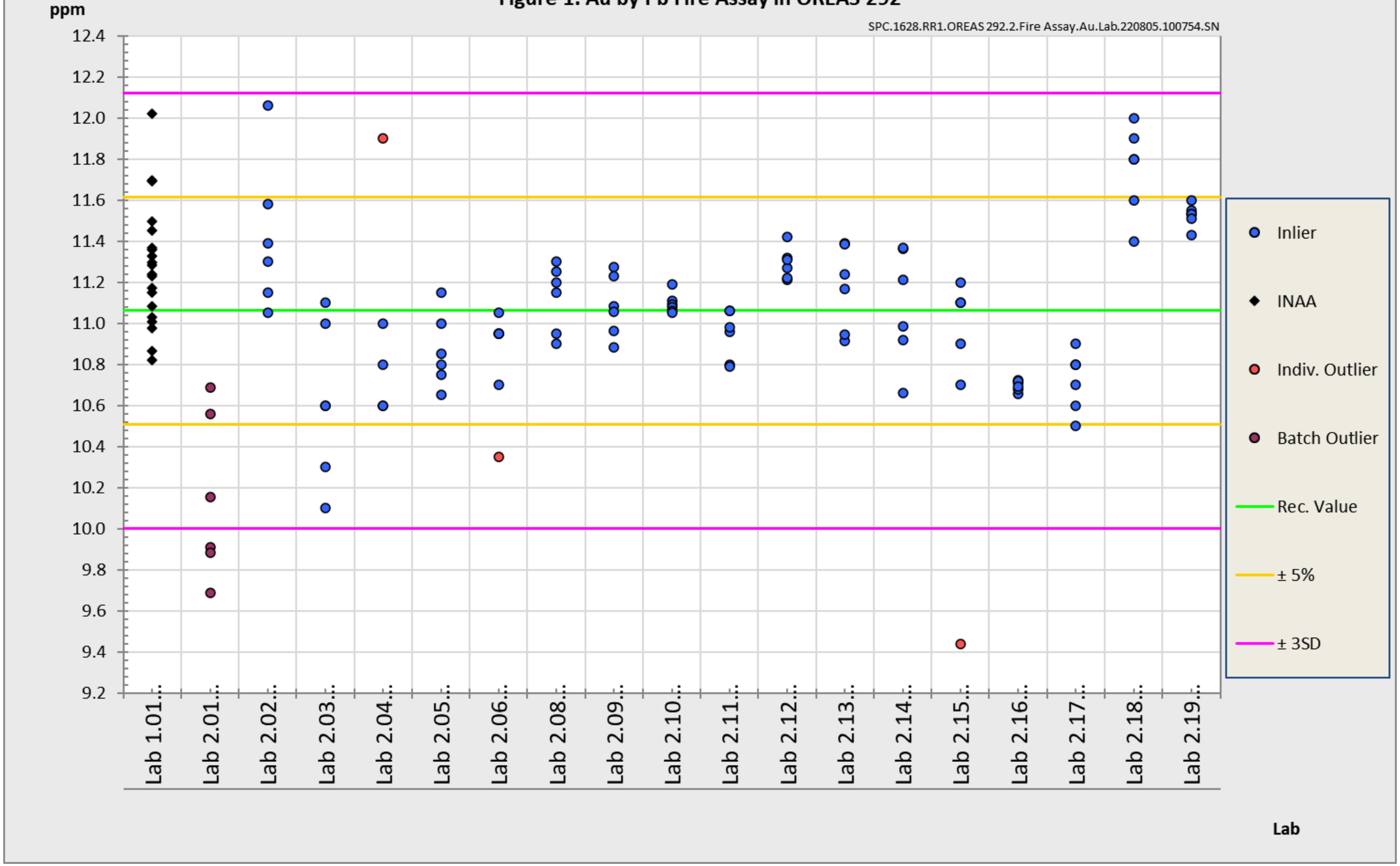
19. SGS Canada Inc., Vancouver, BC, Canada
20. SGS de Mexico SA de CV, Cd. Industrial, Durango, Mexico
21. SGS del Peru, Lima, Peru
22. SGS Geosol Laboratorios Ltda, Vespasiano, Minas Gerais, Brazil

Please note: To preserve anonymity, the above numbered alphabetical list of participating laboratories does not correspond with the Lab ID numbering on the scatter plots below.

Figure 1. Au by Pb Fire Assay in OREAS 292



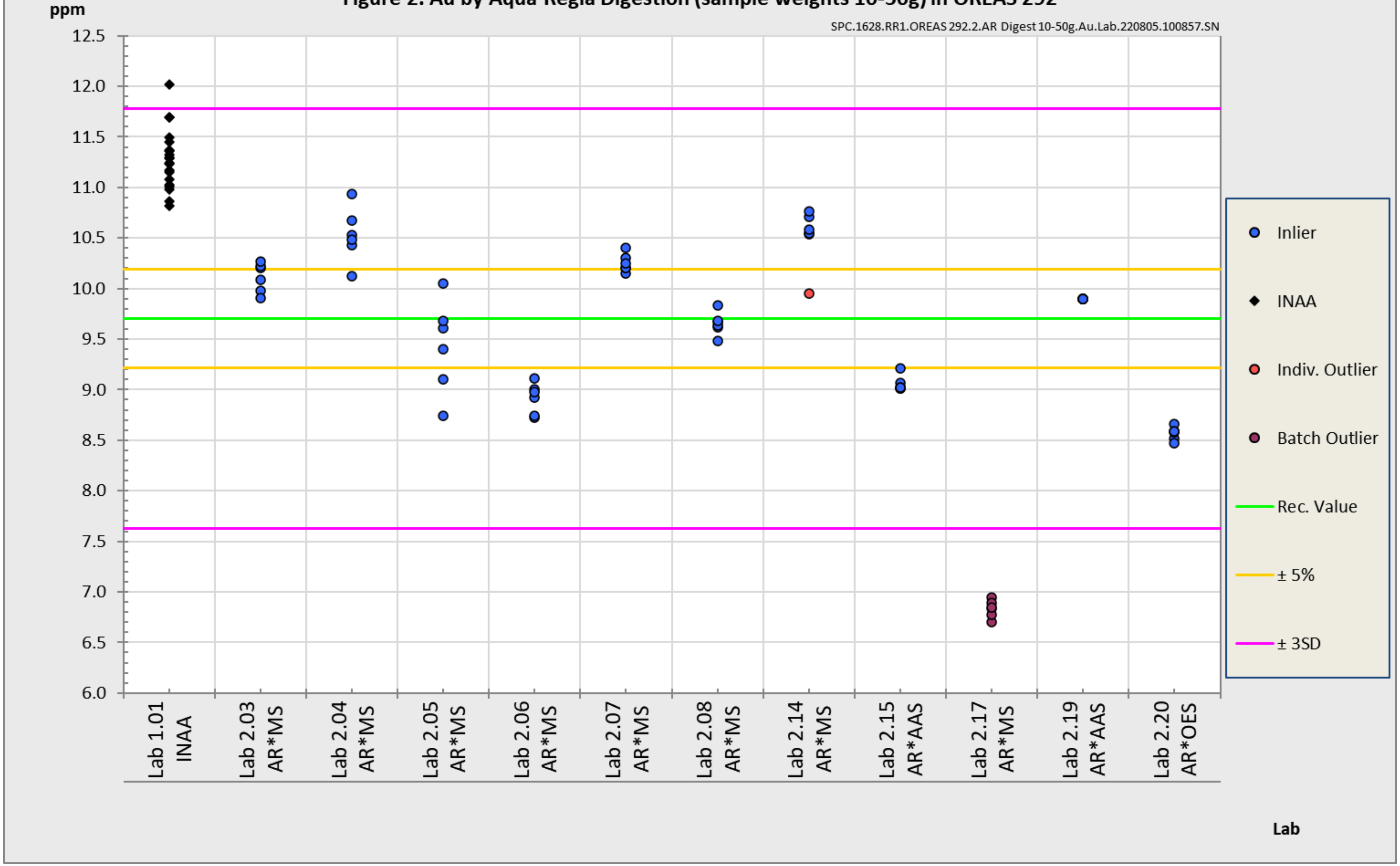
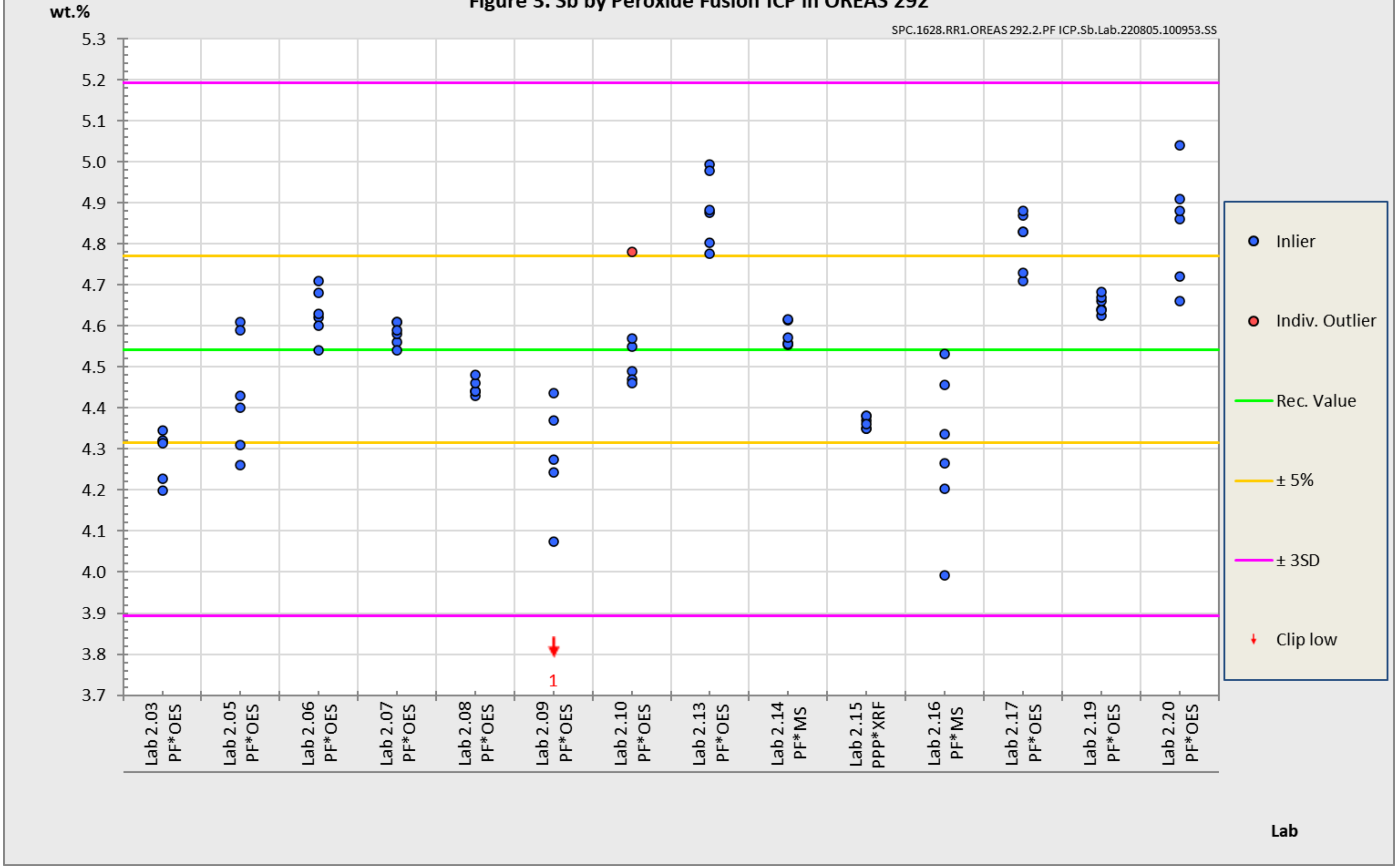


Figure 2. Au by Aqua Regia Digestion (sample weights 10-50g) in OREAS 292

Figure 3. Sb by Peroxide Fusion ICP in OREAS 292



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 procedure is possible. In this case, it is impossible to demonstrate absence of method bias; therefore, the result is an operationally defined measurand*** *(ISO Guide 35:2017, 9.2.4c)."* Certification takes place on the basis of agreement among operationally defined, independent measurement results.

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. Being matrix-matched, OREAS 292 will display similar behaviour in the relevant measurement process to the routine 'process' samples for which OREAS 292 is designated to monitor. To maintain commutability, care should be taken to always ensure 'matrix matching' as close as practically achievable. The matrix 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 292 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 292 may be used to calibrate the entire procedure by producing a pure substance CRM transformed into a calibration solution. OREAS 292 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.

MINIMUM SAMPLE SIZE

To relate analytical determinations to the values in this certificate, the minimum mass of sample used should match the typical mass that the laboratories used in the interlaboratory (round robin) certification program. This means that different minimum sample masses should be used depending on the operationally defined methodology as follows:

- Au by fire assay: ≥10g;
- Au by aqua regia digestion ICP finish: ≥1g.;
- Peroxide fusion with ICP finish: ≥0.1g;
- 4-acid digestion with ICP-OES and/or MS finish: ≥0.25g;
- Aqua regia digestion with ICP-OES and/or MS finish: ≥0.5g.

PERIOD OF VALIDITY & STORAGE INSTRUCTIONS

The certification of OREAS 292 remains valid, within the specified measurement uncertainties, until August 2037, provided the CRM is handled and stored in accordance with the instructions given below. This certification is nullified if the CRM is any way changed or contaminated.

Store in a clean and cool dry place away from direct sunlight.

Long-term stability will be monitored at appropriate intervals and purchasers notified if any changes are observed. The period of validity may well be indefinite and will be reassessed prior to expiry with the aim of extending the validity if possible.

Single-use sachets

OREAS 292 contains a significant concentration of Sulphur (2.1 wt.% S) and is packaged under dry nitrogen in single-use, laminated foil sachets. Following analysis, it is the manufacturer’s expectation that any remaining material is discarded. It is the user’s responsibility to prevent contamination and avoid prolonged exposure of the sample to the atmosphere prior to analysis.

OREAS 292 contains a non-hygroscopic* matrix with an indicative value for moisture provided to enable users to check for changes to stored material by determining moisture in the user’s laboratory and comparing the result to the value in Table 3 in this certificate.

*A non-hygroscopic matrix means exposure to atmospheres significantly different, in terms of temperature and humidity, from the climate during manufacturing should have negligible impact on the precision of results. Hygroscopic moisture is the amount of adsorped moisture (weakly held H_2O- molecules on the surface of exposed material) following exposure to the local atmosphere. Usually, equilibration of material to the local atmosphere will only occur if the material is spread into a thin (~2mm thick) layer and left exposed for a period of 2 hours.

INSTRUCTIONS FOR HANDLING & CORRECT USE

Pre-homogenisation of the CRM prior to subsampling and analysis is not necessary as there is no particle segregation under transport [12].

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

QC monitoring using multiples of the Standard Deviation (SD)

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 interlaboratory 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.

The performance gates shown in Table 1 are intended only to be used as a first principle guide as to what a laboratory may be able to achieve. Over a period of time monitoring your own laboratory's data for this CRM, SD's should be calculated directly from your own laboratory's process. This will enable you to establish more specific performance gates that are fit for purpose for your application as well as the ability to monitor bias. If your long-term trend analysis shows an average value that is within the 95% confidence interval then generally there is no cause for concern in regard to bias.

For use with the aqua regia digestion method

It is important to note that in the analytical industry there is no standardisation of the aqua regia digestion process. This method is a partial empirical digest and differences in recoveries for various analytes are commonplace. These are caused by variations in the digest conditions and 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.

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
2	26th August, 2025	Changing the certification status of Sb by 4-Acid (certified to indicative).
1	19th September, 2022	Minor revision has been made to the certified values and associated statistics for multi-element aqua regia and 4-acid digestion (one laboratory's aqua regia results were inadvertently mapped as 4-acid digestion and vice versa).
0	9th August, 2022	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

26th August, 2025

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