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CERTIFICATE OF ANALYSIS FOR

CERTIFIED REFERENCE MATERIAL

OREAS 520c

Iron Oxide Copper-Gold Ore
(Ernest Henry Mine, Queensland, Australia)

Table 1. Certified Value, Uncertainty & Tolerance Intervals for Au by fire assay in OREAS 520c.

Constituent	Certified Value†	95 % Expanded Uncertainty		95 % Tolerance Limits	
		Low	High	Low	High
Pb Fire Assay					
Au, Gold (ppm)	0.192	0.188	0.195	0.187*	0.196*

SI unit equivalents: ppm (parts per million; 1×10^{-6}) $\equiv$ mg/kg.

[†]This operationally defined measurand meets the requirements of ISO 17034 and all participating laboratories comply with the requirements of ISO 17025.

*Gold Tolerance Limits for typical 30 g fire assay are determined from 20 x 1 g INAA results and the Sampling Constant (Ingamells & Switzer, 1973).

Note: intervals may appear asymmetric due to rounding.



Accredited for compliance with ISO 17034



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Table 2. Certified Value, Uncertainty & Tolerance Intervals for other measurands in OREAS 520c.

Constituent	Certified Value	95 % Expanded Uncertainty		95 % Tolerance Limits	
		Low	High	Low	High
4-Acid Digestion					
Ag, Silver (ppm)	0.819	0.761	0.876	0.784	0.853
Al, Aluminium (wt.%)	6.22	6.07	6.37	6.13	6.31
As, Arsenic (ppm)	91	87	95	89	93
Ba, Barium (wt.%)	0.401	0.375	0.426	0.389	0.412
Be, Beryllium (ppm)	2.24	2.12	2.36	2.17	2.31
Bi, Bismuth (ppm)	1.70	1.61	1.78	1.63	1.76
Ca, Calcium (wt.%)	2.12	2.06	2.17	2.08	2.15
Cd, Cadmium (ppm)	0.36	0.32	0.40	0.33	0.40
Ce, Cerium (ppm)	111	106	116	108	114
Co, Cobalt (ppm)	121	117	125	118	124
Cr, Chromium (ppm)	71	67	75	69	73
Cs, Caesium (ppm)	3.97	3.84	4.10	3.85	4.09
Cu, Copper (wt.%)	0.291	0.284	0.299	0.288	0.295
Dy, Dysprosium (ppm)	4.03	3.82	4.24	3.88	4.18
Er, Erbium (ppm)	1.69	1.57	1.81	1.63	1.75
Eu, Europium (ppm)	1.76	1.59	1.93	1.69	1.83
Fe, Iron (wt.%)	12.56	12.23	12.89	12.30	12.82
Ga, Gallium (ppm)	18.2	17.5	18.8	17.7	18.7
Gd, Gadolinium (ppm)	5.82	5.46	6.19	5.63	6.02
Hf, Hafnium (ppm)	4.96	4.69	5.24	4.74	5.19
Ho, Holmium (ppm)	0.63	0.58	0.69	0.60	0.67
In, Indium (ppm)	0.13	0.12	0.14	0.12	0.14
K, Potassium (wt.%)	2.15	2.09	2.21	2.11	2.19
La, Lanthanum (ppm)	73	70	76	72	75
Li, Lithium (ppm)	18.3	17.5	19.2	17.8	18.9
Lu, Lutetium (ppm)	0.20	0.18	0.21	0.18	0.21
Mg, Magnesium (wt.%)	1.06	1.03	1.09	1.04	1.09
Mn, Manganese (wt.%)	0.083	0.081	0.085	0.082	0.084
Mo, Molybdenum (ppm)	45.3	43.3	47.4	44.2	46.5
Na, Sodium (wt.%)	1.81	1.76	1.86	1.77	1.85
Nb, Niobium (ppm)	14.7	13.8	15.6	14.2	15.2
Nd, Neodymium (ppm)	40.6	38.5	42.8	39.8	41.4
Ni, Nickel (ppm)	45.9	44.0	47.8	44.7	47.0
P, Phosphorus (wt.%)	0.069	0.066	0.071	0.067	0.070
Pb, Lead (ppm)	127	123	131	123	130
Pr, Praseodymium (ppm)	11.3	10.6	12.0	10.9	11.7
Rb, Rubidium (ppm)	94	91	98	92	97
Re, Rhenium (ppm)	0.020	0.017	0.024	0.018	0.023

SI unit equivalents: ppm (parts per million; 1×10^{-6}) $\equiv$ mg/kg; wt.% (weight per cent) $\equiv$ % (mass fraction).

Note: intervals may appear asymmetric due to rounding.

Table 2 continued.

Constituent	Certified Value	95 % Expanded Uncertainty		95 % Tolerance Limits	
		Low	High	Low	High
4-Acid Digestion continued					
S, Sulphur (wt.%)	0.575	0.555	0.596	0.564	0.587
Sb, Antimony (ppm)	3.52	3.35	3.70	3.36	3.69
Sc, Scandium (ppm)	8.49	8.10	8.88	8.33	8.65
Se, Selenium (ppm)	1.04	0.90	1.18	IND	IND
Sm, Samarium (ppm)	7.28	7.01	7.54	7.08	7.47
Sn, Tin (ppm)	4.13	3.87	4.39	3.96	4.29
Sr, Strontium (ppm)	238	233	244	235	242
Ta, Tantalum (ppm)	1.07	0.97	1.16	1.01	1.13
Tb, Terbium (ppm)	0.82	0.76	0.87	0.78	0.85
Te, Tellurium (ppm)	0.24	0.21	0.28	0.21	0.27
Th, Thorium (ppm)	10.6	10.1	11.0	10.2	10.9
Ti, Titanium (wt.%)	0.312	0.301	0.323	0.306	0.318
Tl, Thallium (ppm)	0.70	0.66	0.74	0.68	0.72
Tm, Thulium (ppm)	0.21	0.19	0.24	0.20	0.22
U, Uranium (ppm)	11.9	11.4	12.4	11.6	12.2
V, Vanadium (ppm)	57	55	59	56	58
W, Tungsten (ppm)	19.7	18.9	20.5	19.1	20.3
Y, Yttrium (ppm)	18.5	17.8	19.2	18.0	19.0
Yb, Ytterbium (ppm)	1.37	1.29	1.46	1.31	1.43
Zn, Zinc (ppm)	496	484	509	488	505
Zr, Zirconium (ppm)	188	182	194	183	194
Aqua Regia Digestion					
Ag, Silver (ppm)	0.782	0.721	0.843	0.745	0.818
Al, Aluminium (wt.%)	1.02	0.97	1.07	0.99	1.04
As, Arsenic (ppm)	87	84	90	85	89
Be, Beryllium (ppm)	0.90	0.84	0.96	0.86	0.94
Bi, Bismuth (ppm)	1.71	1.63	1.79	1.66	1.76
Ca, Calcium (wt.%)	1.06	1.03	1.10	1.04	1.08
Cd, Cadmium (ppm)	0.35	0.32	0.38	0.33	0.37
Ce, Cerium (ppm)	70	67	73	68	72
Co, Cobalt (ppm)	117	112	121	114	120
Cr, Chromium (ppm)	27.6	26.5	28.8	26.9	28.4
Cs, Caesium (ppm)	1.11	1.06	1.16	1.08	1.14
Cu, Copper (wt.%)	0.289	0.282	0.296	0.284	0.294
Dy, Dysprosium (ppm)	2.59	2.38	2.79	2.48	2.69
Er, Erbium (ppm)	0.97	0.90	1.04	0.93	1.02
Eu, Europium (ppm)	0.94	0.81	1.06	0.87	1.00

SI unit equivalents: ppm (parts per million; 1×10^{-6}) $\equiv$ mg/kg; wt.% (weight per cent) $\equiv$ % (mass fraction).

Note: intervals may appear asymmetric due to rounding; IND = indeterminate (due to limited reading resolution of the methods employed).

Table 2 continued.

Constituent	Certified Value	95 % Expanded Uncertainty		95 % Tolerance Limits	
		Low	High	Low	High
Aqua Regia Digestion continued					
Fe, Iron (wt.%)	11.38	11.04	11.73	11.20	11.57
Ga, Gallium (ppm)	4.74	4.42	5.07	4.54	4.95
Gd, Gadolinium (ppm)	3.67	3.06	4.29	3.45	3.90
Hf, Hafnium (ppm)	1.45	1.34	1.56	1.40	1.50
Ho, Holmium (ppm)	0.40	0.34	0.46	0.37	0.43
In, Indium (ppm)	0.093	0.083	0.102	0.086	0.100
K, Potassium (wt.%)	0.357	0.341	0.373	0.347	0.367
La, Lanthanum (ppm)	50	48	52	49	52
Li, Lithium (ppm)	7.19	6.73	7.65	6.99	7.39
Lu, Lutetium (ppm)	0.11	0.09	0.12	IND	IND
Mg, Magnesium (wt.%)	0.656	0.638	0.674	0.642	0.670
Mn, Manganese (wt.%)	0.069	0.068	0.071	0.068	0.070
Mo, Molybdenum (ppm)	43.8	41.7	45.9	42.7	44.9
Na, Sodium (wt.%)	0.143	0.135	0.152	0.139	0.148
Nb, Niobium (ppm)	0.77	0.61	0.92	0.71	0.82
Nd, Neodymium (ppm)	25.9	23.1	28.7	24.9	26.9
Ni, Nickel (ppm)	39.6	37.9	41.4	38.5	40.8
P, Phosphorus (wt.%)	0.058	0.056	0.060	0.057	0.059
Pb, Lead (ppm)	110	105	115	108	112
Pr, Praseodymium (ppm)	7.28	6.48	8.09	6.92	7.65
Rb, Rubidium (ppm)	20.0	18.9	21.1	19.5	20.5
Re, Rhenium (ppm)	0.021	0.019	0.023	0.019	0.023
S, Sulphur (wt.%)	0.542	0.525	0.559	0.531	0.553
Sb, Antimony (ppm)	2.54	2.41	2.66	2.41	2.66
Sc, Scandium (ppm)	3.00	2.84	3.17	2.88	3.13
Sm, Samarium (ppm)	4.65	4.13	5.17	4.39	4.91
Sn, Tin (ppm)	2.55	2.42	2.69	2.46	2.65
Sr, Strontium (ppm)	47.4	44.4	50.4	45.8	48.9
Tb, Terbium (ppm)	0.52	0.49	0.56	0.50	0.54
Te, Tellurium (ppm)	0.20	0.16	0.24	0.19	0.22
Th, Thorium (ppm)	6.96	6.60	7.31	6.72	7.19
Ti, Titanium (wt.%)	0.070	0.064	0.076	0.068	0.073
Tl, Thallium (ppm)	0.23	0.22	0.25	0.22	0.25
Tm, Thulium (ppm)	0.12	0.10	0.14	0.12	0.13
U, Uranium (ppm)	10.1	9.7	10.5	9.8	10.4
V, Vanadium (ppm)	26.7	25.6	27.7	26.0	27.3
W, Tungsten (ppm)	13.8	12.9	14.7	13.3	14.2

SI unit equivalents: ppm (parts per million; 1×10^{-6}) $\equiv$ mg/kg; wt.% (weight per cent) $\equiv$ % (mass fraction).

Note: intervals may appear asymmetric due to rounding; IND = indeterminate (due to limited reading resolution of the methods employed).

Table 2 continued.

Constituent	Certified Value	95 % Expanded Uncertainty		95 % Tolerance Limits	
		Low	High	Low	High
Aqua Regia Digestion continued					
Y, Yttrium (ppm)	10.8	10.4	11.3	10.6	11.1
Yb, Ytterbium (ppm)	0.74	0.68	0.80	0.70	0.78
Zn, Zinc (ppm)	445	432	459	436	455
Zr, Zirconium (ppm)	57	54	60	55	58
Peroxide Fusion ICP					
Al, Aluminium (wt.%)	6.40	6.29	6.52	6.30	6.50
As, Arsenic (ppm)	92	86	97	87	96
Ba, Barium (wt.%)	0.422	0.409	0.436	0.415	0.430
Be, Beryllium (ppm)	2.44	1.81	3.07	2.30	2.58
Ca, Calcium (wt.%)	2.17	2.10	2.23	2.13	2.21
Ce, Cerium (ppm)	115	111	120	112	119
Co, Cobalt (ppm)	119	114	124	116	122
Cr, Chromium (ppm)	80	72	87	77	82
Cs, Caesium (ppm)	4.09	3.84	4.35	3.88	4.31
Cu, Copper (wt.%)	0.288	0.279	0.297	0.282	0.294
Dy, Dysprosium (ppm)	4.30	4.02	4.58	4.10	4.49
Er, Erbium (ppm)	1.95	1.79	2.12	1.85	2.06
Eu, Europium (ppm)	1.70	1.55	1.86	1.65	1.76
Fe, Iron (wt.%)	13.20	12.91	13.50	13.04	13.36
Ga, Gallium (ppm)	19.0	17.6	20.4	17.9	20.1
Gd, Gadolinium (ppm)	6.21	5.85	6.58	5.93	6.49
Ge, Germanium (ppm)	2.80	2.53	3.07	2.50	3.09
Hf, Hafnium (ppm)	5.33	4.82	5.84	5.08	5.58
Ho, Holmium (ppm)	0.77	0.73	0.82	0.74	0.81
K, Potassium (wt.%)	2.20	2.12	2.27	2.15	2.24
La, Lanthanum (ppm)	75	72	78	73	77
Li, Lithium (ppm)	20.3	17.5	23.2	17.9	22.7
Lu, Lutetium (ppm)	0.22	0.19	0.25	0.20	0.23
Mg, Magnesium (wt.%)	1.09	1.07	1.12	1.07	1.11
Mn, Manganese (wt.%)	0.085	0.082	0.089	0.084	0.087
Mo, Molybdenum (ppm)	43.8	40.6	47.0	41.9	45.6
Na, Sodium (wt.%)	1.78	1.71	1.85	1.74	1.81
Nb, Niobium (ppm)	15.7	15.0	16.4	15.1	16.3
Nd, Neodymium (ppm)	41.5	39.8	43.2	39.5	43.5
Ni, Nickel (ppm)	48.1	43.9	52.3	44.2	51.9
P, Phosphorus (wt.%)	0.072	0.070	0.074	0.070	0.073
Pb, Lead (ppm)	130	121	139	126	134
Pr, Praseodymium (ppm)	11.8	11.4	12.3	11.4	12.2

SI unit equivalents: ppm (parts per million; 1×10^{-6}) $\equiv$ mg/kg; wt.% (weight per cent) $\equiv$ % (mass fraction).

Note: intervals may appear asymmetric due to rounding.

Table 2 continued.

Constituent	Certified Value	95 % Expanded Uncertainty		95 % Tolerance Limits	
		Low	High	Low	High
Peroxide Fusion ICP continued					
Rb, Rubidium (ppm)	93	90	97	91	96
S, Sulphur (wt.%)	0.581	0.558	0.604	0.565	0.597
Sb, Antimony (ppm)	3.61	3.24	3.98	3.41	3.82
Sc, Scandium (ppm)	8.33	7.38	9.27	8.06	8.59
Si, Silicon (wt.%)	25.10	24.41	25.79	24.76	25.43
Sm, Samarium (ppm)	7.28	6.90	7.65	6.97	7.58
Sn, Tin (ppm)	4.83	4.00	5.67	4.51	5.15
Sr, Strontium (ppm)	244	236	252	239	249
Ta, Tantalum (ppm)	1.19	0.90	1.49	1.05	1.34
Tb, Terbium (ppm)	0.84	0.79	0.89	0.80	0.88
Te, Tellurium (ppm)	< 1	IND	IND	IND	IND
Th, Thorium (ppm)	10.7	10.1	11.3	10.4	11.0
Ti, Titanium (wt.%)	0.335	0.325	0.346	0.328	0.343
Tl, Thallium (ppm)	0.73	0.60	0.86	IND	IND
Tm, Thulium (ppm)	0.26	0.23	0.29	0.24	0.28
U, Uranium (ppm)	11.9	11.3	12.5	11.5	12.3
V, Vanadium (ppm)	59	53	65	55	62
W, Tungsten (ppm)	20.0	18.5	21.6	18.8	21.2
Y, Yttrium (ppm)	21.0	19.8	22.1	20.4	21.6
Yb, Ytterbium (ppm)	1.58	1.39	1.78	1.50	1.67
Zn, Zinc (ppm)	511	491	530	500	521
Zr, Zirconium (ppm)	199	187	210	194	204
3-Acid Digestion (no HF)					
Ag, Silver (ppm)	0.815	0.691	0.938	IND	IND
As, Arsenic (ppm)	85	81	89	82	88
Co, Cobalt (ppm)	117	112	121	114	119
Cu, Copper (wt.%)	0.291	0.281	0.301	0.286	0.295
Fe, Iron (wt.%)	11.99	11.42	12.57	11.79	12.19
Mo, Molybdenum (ppm)	40.8	39.0	42.7	40.1	41.6
S, Sulphur (wt.%)	0.565	0.541	0.589	0.549	0.580
Ion Selective Electrode					
Cl, Chlorine (ppm)	321	226	417	300	343
F, Fluorine (ppm)	700	623	776	676	724
Infrared Combustion					
S, Sulphur (wt.%)	0.583	0.564	0.601	0.569	0.596

SI unit equivalents: ppm (parts per million; 1×10^{-6}) $\equiv$ mg/kg; wt.% (weight per cent) $\equiv$ % (mass fraction).

Note: intervals may appear asymmetric due to rounding; IND = indeterminate (due to limited reading resolution of the methods employed. For practical purposes the 95% Expanded Uncertainty can be set between zero and a two times multiple of the upper bound/non-detect limit value).

Table 3. Indicative Values for OREAS 520c.

Constituent	Unit	Value	Constituent	Unit	Value	Constituent	Unit	Value
Aqua Regia Digestion (sample weights 10-50g)								
Au	ppm	0.111						
4-Acid Digestion								
B	ppm	< 10	Ge	ppm	0.28	Hg	ppm	0.095
Aqua Regia Digestion								
B	ppm	8.53	Hg	ppm	0.031	Ru	ppm	0.024
Ba	ppm	416	Pd	ppb	38.3	Se	ppm	0.80
Ge	ppm	0.17	Pt	ppb	< 5	Ta	ppm	0.010
Peroxide Fusion ICP								
Ag	ppm	1.29	Cd	ppm	0.44	LOI ¹⁰⁰⁰	wt. %	3.35
B	ppm	41.8	Hg	ppm	< 0.1	Re	ppm	0.14
Bi	ppm	1.84	In	ppm	0.13	Se	ppm	< 1
3-Acid Digestion (no HF)								
Al	wt. %	2.54	La	ppm	59	Sr	ppm	114
B	ppm	< 5	Li	ppm	14.4	Ta	ppm	< 0.3
Ba	wt. %	0.218	Lu	ppm	< 5	Tb	ppm	0.68
Be	ppm	1.04	Mg	wt. %	0.667	Te	ppm	< 5
Bi	ppm	< 5	Mn	wt. %	0.070	Th	ppm	12.6
Ca	wt. %	0.980	Na	wt. %	0.132	Ti	wt. %	0.166
Cd	ppm	< 1	Nb	ppm	1.24	Tl	ppm	< 5
Ce	ppm	89	Ni	ppm	37.5	U	ppm	10.1
Cr	ppm	25.4	P	wt. %	0.061	V	ppm	31.1
Cs	ppm	2.11	Pb	ppm	116	W	ppm	< 5
Ga	ppm	13.8	Rb	ppm	95	Y	ppm	13.3
Ge	ppm	< 5	Re	ppm	< 5	Yb	ppm	0.88
Hf	ppm	1.69	Sb	ppm	< 5	Zn	ppm	467
Hg	ppm	< 1	Sc	ppm	4.62	Zr	ppm	86
In	ppm	< 5	Se	ppm	< 5			
K	wt. %	0.996	Sn	ppm	< 10			
Infrared Combustion								
C	wt. %	0.280						
Borate Fusion XRF								
Al ₂ O ₃	wt. %	12.28	Fe	wt. %	13.15	S	wt. %	0.603
As	ppm	90	K ₂ O	wt. %	2.63	SiO ₂	wt. %	54.91
Ba	ppm	4210	MgO	wt. %	1.85	Sn	ppm	40.0
CaO	wt. %	3.04	MnO	wt. %	0.110	Sr	ppm	340
Cl	ppm	190	Na ₂ O	wt. %	2.48	TiO ₂	wt. %	0.550
Co	ppm	110	Ni	ppm	60	V	ppm	65
Cr	ppm	70	P	wt. %	0.070	Zn	ppm	515
Cu	ppm	2900	Pb	ppm	150	Zr	ppm	190
Thermogravimetry								
LOI ¹⁰⁰⁰	wt. %	2.04						

SI unit equivalents: ppb (parts per billion; 1×10^{-9}) $\equiv$ $\mu\text{g/kg}$; ppm (parts per million; 1×10^{-6}) $\equiv$ mg/kg ; wt. % (weight per cent) $\equiv$ % (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 3 continued.

Constituent	Unit	Value	Constituent	Unit	Value	Constituent	Unit	Value
Laser Ablation ICP-MS								
Ag	ppm	0.750	Hf	ppm	5.27	Sm	ppm	7.54
As	ppm	91	Ho	ppm	0.76	Sn	ppm	5.00
Ba	ppm	4275	In	ppm	0.13	Sr	ppm	236
Be	ppm	2.40	La	ppm	75	Ta	ppm	1.18
Bi	ppm	1.79	Lu	ppm	0.21	Tb	ppm	0.85
Cd	ppm	0.25	Mn	wt. %	0.088	Te	ppm	0.15
Ce	ppm	113	Mo	ppm	44.3	Th	ppm	10.6
Co	ppm	125	Nb	ppm	16.3	Ti	wt. %	0.338
Cr	ppm	76	Nd	ppm	42.2	Tl	ppm	0.40
Cs	ppm	3.68	Ni	ppm	47.0	Tm	ppm	0.26
Cu	ppm	2870	Pb	ppm	133	U	ppm	11.8
Dy	ppm	4.29	Pr	ppm	12.2	V	ppm	59
Er	ppm	1.90	Rb	ppm	90	W	ppm	21.0
Eu	ppm	1.67	Re	ppm	0.030	Y	ppm	20.3
Ga	ppm	18.0	Sb	ppm	3.80	Yb	ppm	1.59
Gd	ppm	5.90	Sc	ppm	8.70	Zn	ppm	533
Ge	ppm	2.33	Se	ppm	< 5	Zr	ppm	197

SI unit equivalents: ppm (parts per million; 1×10^{-6}) $\equiv$ mg/kg; wt. % (weight per cent) $\equiv$ % (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 OF CONTENTS

INTRODUCTION	10
SOURCE MATERIAL	10
COMMUNITION AND HOMOGENISATION PROCEDURES	11
PHYSICAL PROPERTIES.....	11
MINERALOGY	11
ANALYTICAL PROGRAM	12
STATISTICAL ANALYSIS	12
Homogeneity Evaluation.....	13
PERFORMANCE GATES	15
PARTICIPATING LABORATORIES.....	20
PREPARER	24
METROLOGICAL TRACEABILITY	24
COMMUTABILITY	25
INTENDED USE	25
MINIMUM SAMPLE SIZE	25
PERIOD OF VALIDITY & STORAGE INSTRUCTIONS	26
INSTRUCTIONS FOR HANDLING & CORRECT USE	26
LEGAL NOTICE.....	27
QMS CERTIFICATION.....	27
DOCUMENT HISTORY	28
CERTIFYING OFFICER	28
REFERENCES	28

LIST OF TABLES

Table 1. Certified Value, Uncertainty & Tolerance Intervals for Au by FA in OREAS 520c.	1
Table 2. Certified Value, Uncertainty & Tolerance Intervals for other measurands in OREAS 520c.....	2
Table 3. Indicative Values for OREAS 520c.	7
Table 4. Physical properties of OREAS 520c.	11
Table 5. Indicative mineralogy of OREAS 520c based on semi-quantitative XRD analysis.	11
Table 6. Neutron Activation Analysis of Au on 20 x 1 g subsamples.	14
Table 7. Performance Gates for OREAS 520c.	16

LIST OF FIGURES

Figure 1. Au by Fire Assay in OREAS 520c	21
Figure 2. Co by 4-Acid digestion in OREAS 520c	22
Figure 3. Cu by 4-Acid digestion in OREAS 520c	23

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 (all laboratories accredited to ISO 17025) and Table 2 (most laboratories accredited to ISO 17025) provide the certified values and their associated 95% expanded uncertainty and tolerance intervals, Table 3 shows indicative values including major and trace element characterisation, Table 4 provides some indicative physical properties and Table 5 provides indicative mineralogy based on semi-quantitative XRD analysis. Gold homogeneity (via INAA) is shown in Table 6 and is also demonstrated by a nested ANOVA (see 'Homogeneity Evaluation' section) and Table 7 presents the performance gate intervals 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 (PDM³) are presented in the detailed certification data for this CRM (**OREAS 520c-DataPack.1.0.250217_131140.xlsx**). Results are also presented in scatter plots for Au by fire assay, Co and Cu by 4-acid digestion (Figures 1 to 3, respectively) together with $\pm 3SD$ (magenta) and $\pm 5\%$ (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 520c was predominantly prepared from a blend of iron oxide copper-gold (IOCG) ore and barren rhyodacite. Minor quantities of barren basalt, iron oxide ore and gold ore were also added to help achieve target grades. The IOCG ore was sourced from the Ernest Henry Mine located about 38 kilometres north-east of Cloncurry in north-west Queensland. The barren rhyodacite was sourced from a quarry in the Mt Dandenong Igneous Complex located approximately 34km east of Melbourne, Australia. For the minor source materials, the basalt was sourced from olivine tholeiitic basalt from the Quaternary Newer Volcanics Province in Victoria, Australia. The iron oxide ore was sourced from an iron ore mine located in the Northern Cape province of South Africa. The gold ore was sourced from the Magdala deposit from the Stawell Gold Mine located in west-central Victoria, Australia.

IOCG mineralisation at the Ernest Henry Mine is hosted in breccia with strongly altered and replaced felsic volcanic fragments in a matrix of magnetite, calcite, pyrite, biotite, chalcopyrite, K feldspar, titanite, and quartz. Accessory minerals include garnet, barite, molybdenite, fluorite, amphibole, apatite, monazite, arsenopyrite, LREE fluorocarbonate, galena, cobaltite, sphalerite, scheelite, uraninite, and tourmaline. Copper occurs as native copper, bornite, and chalcopyrite. Gold is mainly in chalcopyrite's molecular framework. Significant cobalt, molybdenum, rare earth elements, and low uranium levels are also present.

COMMINUTION AND HOMOGENISATION PROCEDURES

The material constituting OREAS 520c was prepared in the following manner:

- Drying of ore and barren materials to constant mass at 105 °C;
- Crushing and milling of the IOCG and gold ore materials to 100 % minus 30 µm;
- Crushing and milling of the barren materials to > 98 % minus 75 µm;
- Blending the ores and barren materials in appropriate proportions to achieve the desired grades;
- Homogenisation using OREAS' novel processing technologies;
- Packaging in 10 g and 60 g units sealed under nitrogen in laminated foil pouches and 500 g units in plastic jars.

PHYSICAL PROPERTIES

OREAS 520c was tested at ORE Research & Exploration Pty Ltd's onsite facility for various physical properties. Table 4 presents these findings that should be used for informational purposes only.

Table 4. Physical properties of OREAS 520c.

Bulk Density (kg/m ³)	Moisture (wt.%)	Munsell Notation [‡]	Munsell Color [‡]
669	0.64	10R 5/4	Pale Redish Brown

[‡]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.

MINERALOGY

The semi-quantitative XRD results shown in Table 5 below have been normalised to 100% and represent the relative proportion of crystalline material. Totals greater or less than 100% are due to rounding errors. A trace amount of maghemite might be present. Chlorite and kaolinite and calcite and/or chalcopyrite are reported together due to pattern overlap. Some amorphous material might be present.

Table 5. Indicative mineralogy of OREAS 520c based on semi-quantitative XRD analysis.

Mineral / Mineral Group	% (mass ratio)
Chlorite and/or kaolinite	2
Annite - biotite - phlogopite	2
Muscovite	5
Plagioclase	13
K-feldspar	8
Quartz	44
Calcite and/or chalcopyrite	3
Magnetite	6
Hematite	15
Goethite	1

ANALYTICAL PROGRAM

Thirty-one commercial analytical laboratories participated in the program to certify the elements reported in Tables 1 and 2. The following methods were employed:

- Gold by fire assay (15-50 g charge weight) with AAS (20 laboratories), ICP-OES (7 laboratories) finish and ICP-MS (2 laboratories) finish;
- Full ICP-OES and ICP-MS elemental suites by 4-acid ($\text{HNO}_3\text{-HF-HClO}_4\text{-HCl}$) digestion (up to 29 laboratories depending on the element);
- Full ICP-OES and ICP-MS elemental suites by aqua regia digestion (up to 29 laboratories depending on the element);
- Full ICP-OES and ICP-MS elemental suites by peroxide fusion (up to 24 laboratories depending on the element);
- Ag, As, Cu, Co, Fe, Mo and S by 3-acid ($\text{HNO}_3\text{-HClO}_4\text{-HCl}$) digestion with ICP-OES finish (up to 12 laboratories depending on the element);
- Fluorine by ion specific electrode (15 laboratories), aqueous leach with ion chromatography (2 laboratories) and pressed powder pellet with XRF (1 laboratory);
- Total Sulphur by infrared combustion furnace (28 laboratories).

To evaluate homogeneity, Actlabs Ancaster in Canada were sent 20 x 10 g pulp samples for Au determination using instrumental neutron activation analysis (INAA) on 1 g subsamples. (see Table 6).

Table 3 shows indicative values including major and trace element characterisation based on two samples analysed at Bureau Veritas in Perth, Western Australia which includes:

- Total Carbon by infrared combustion furnace
- Major oxides by lithium borate fusion with X-ray fluorescence;
- LOI at 1000 °C by thermogravimetric analyser and
- Trace elements by laser ablation (on the fused bead) with ICP-MS finish.

For the round robin program, ten 2.5 kg test units (lots) 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 a 110 g scoop split from six different 2.5kg lots.

The 20 individual INAA results upon which much of the homogeneity evaluation is based, included paired 10 g samples taken from each of the 10 different test units. This format enabled a nested ANOVA treatment of the INAA results to evaluate homogeneity (see 'Homogeneity Evaluation' section below).

STATISTICAL ANALYSIS

Certified Values and their uncertainty intervals (Tables 1 and 2) 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. 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. However, while statistics are taken into account, the exercise of a statistician's prerogative plays a significant role in identifying outliers.

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 6) is omitted from determination of the certified value for Au and is used solely for the calculation of Tolerance Limits and homogeneity evaluation.

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 outlined in ISO 98-3:2008 [6]. All known or suspected sources of bias have been investigated or taken into account.

Indicative (uncertified) values (Table 3) are present where the number of laboratories reporting a particular analyte is insufficient (< 5) to support certification or where interlaboratory consensus is poor.

Homogeneity Evaluation

The tolerance limits (ISO 16269:2014) shown in Tables 1 and 2 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 ($1-\alpha=0.99$) at least 95% of subsamples ($p=0.95$) will have concentrations lying between 0.288 and 0.295 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 33405:2024). ***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 6 below shows the gold INAA data determined on 20 x 1 g subsamples of OREAS 520c. 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 0.71 % calculated for a 30g fire assay sample (3.82% at 1 g weights) confirms the high level of gold homogeneity in OREAS 520c.

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 [2]). 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.

The homogeneity of OREAS 520c has also been evaluated in an Analysis of Variance (**ANOVA**) of the INAA data. The 20 samples were comprised of paired samples from each of 10 sampling lot intervals (representative of the prepared batch) and were randomised prior to assigning sample numbers. The duplicate samples enabled an ANOVA by comparison of within- and between-unit variances across the 10 pairs. The purpose of the

ANOVA 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 520c. The test was performed using the following parameters:

- Gold INAA – 20 results (1 laboratory providing duplicate analyses on 10 samples where each sample can be viewed as a ‘unit’);
- 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.

The data was not filtered for outliers prior to the calculation of the p -value. This process derived a p -value of 0.23, a statistically insignificant result so the Null Hypothesis is accepted.

Table 6. Neutron Activation Analysis of Au (in ppm) on 20 x 1 g subsamples and showing the equivalent results scaled to a 30 g sample mass typical of fire assay determination.

Replicate No	Au 1 g actual	Au 30g equivalent*
1	0.213	0.211
2	0.215	0.211
3	0.218	0.212
4	0.205	0.210
5	0.213	0.211
6	0.220	0.212
7	0.201	0.209
8	0.213	0.211
9	0.209	0.210
10	0.200	0.209
11	0.226	0.213
12	0.201	0.209
13	0.213	0.211
14	0.203	0.209
15	0.219	0.212
16	0.203	0.209
17	0.199	0.208
18	0.217	0.212
19	0.204	0.209
20	0.219	0.212
Mean	0.211	0.211
Median	0.213	0.211
Std Dev.	0.008	0.001
Rel.Std.Dev.	3.82%	0.71%

*Results calculated for a 30g equivalent sample mass using the formula: $x^{30g Eq} = \frac{(x^{INAA} - \bar{X}) \times RSD@30g}{RSD@1g} + \bar{X}$

where $x^{30g Eq}$ = equivalent result calculated for a 30g sample mass
 (x^{INAA}) = raw INAA result at 1 g
 $\bar{X}$ = mean of 1 g INAA results

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 520c 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 520c is fit-for-purpose as a certified reference material (see 'Intended Use' below).

PERFORMANCE GATES

The standard deviations (SD's) intervals reported in Table 7 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.

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 (see 'Intended Use' section for more detail). 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 7 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/mltrule.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) $\pm 10\%$.

I.e., Certified Value $\pm 10\% \pm 2DL$ [1].

Table 7. Performance Gates for OREAS 520c.

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	0.192	0.007	0.179	0.205	0.172	0.211	3.41%	6.83%	10.24%	0.182	0.201
4-Acid Digestion											
Ag, ppm	0.819	0.060	0.698	0.939	0.638	0.999	7.35%	14.70%	22.05%	0.778	0.860
Al, wt. %	6.22	0.169	5.88	6.56	5.71	6.73	2.72%	5.44%	8.16%	5.91	6.53
As, ppm	91	3.5	84	98	80	102	3.87%	7.75%	11.62%	86	96
Ba, wt. %	0.401	0.049	0.302	0.499	0.253	0.548	12.30%	24.61%	36.91%	0.381	0.421
Be, ppm	2.24	0.122	2.00	2.48	1.87	2.60	5.44%	10.89%	16.33%	2.13	2.35
Bi, ppm	1.70	0.110	1.48	1.91	1.37	2.02	6.47%	12.93%	19.40%	1.61	1.78
Ca, wt. %	2.12	0.053	2.01	2.22	1.96	2.27	2.49%	4.98%	7.47%	2.01	2.22
Cd, ppm	0.36	0.04	0.28	0.44	0.24	0.48	11.01%	22.03%	33.04%	0.35	0.38
Ce, ppm	111	9	93	129	84	139	8.27%	16.55%	24.82%	106	117
Co, ppm	121	5	112	130	107	135	3.87%	7.74%	11.61%	115	127
Cr, ppm	71	6.8	57	84	51	91	9.52%	19.05%	28.57%	67	74
Cs, ppm	3.97	0.098	3.77	4.16	3.68	4.26	2.47%	4.93%	7.40%	3.77	4.17
Cu, wt. %	0.291	0.005	0.281	0.302	0.275	0.308	1.88%	3.76%	5.64%	0.277	0.306
Dy, ppm	4.03	0.113	3.80	4.25	3.69	4.37	2.81%	5.61%	8.42%	3.83	4.23
Er, ppm	1.69	0.066	1.56	1.82	1.49	1.89	3.90%	7.80%	11.70%	1.61	1.77
Eu, ppm	1.76	0.18	1.39	2.13	1.21	2.31	10.46%	20.92%	31.39%	1.67	1.85
Fe, wt. %	12.56	0.452	11.65	13.46	11.20	13.92	3.60%	7.20%	10.80%	11.93	13.19
Ga, ppm	18.2	0.69	16.8	19.6	16.1	20.2	3.79%	7.57%	11.36%	17.3	19.1
Gd, ppm	5.82	0.425	4.97	6.67	4.55	7.10	7.30%	14.60%	21.90%	5.53	6.11
Hf, ppm	4.96	0.360	4.24	5.68	3.88	6.04	7.25%	14.50%	21.76%	4.72	5.21
Ho, ppm	0.63	0.050	0.53	0.73	0.48	0.78	7.96%	15.92%	23.89%	0.60	0.66
In, ppm	0.13	0.008	0.12	0.15	0.11	0.16	5.70%	11.40%	17.11%	0.13	0.14
K, wt. %	2.15	0.081	1.99	2.31	1.91	2.40	3.79%	7.57%	11.36%	2.04	2.26
La, ppm	73	4.7	64	83	59	87	6.41%	12.82%	19.23%	70	77
Li, ppm	18.3	1.05	16.2	20.4	15.2	21.5	5.75%	11.51%	17.26%	17.4	19.2
Lu, ppm	0.20	0.011	0.18	0.22	0.16	0.23	5.55%	11.09%	16.64%	0.19	0.21
Mg, wt. %	1.06	0.046	0.97	1.16	0.93	1.20	4.32%	8.64%	12.96%	1.01	1.12
Mn, wt. %	0.083	0.002	0.078	0.088	0.076	0.090	2.99%	5.98%	8.96%	0.079	0.087
Mo, ppm	45.3	3.03	39.3	51.4	36.3	54.4	6.68%	13.35%	20.03%	43.1	47.6
Na, wt. %	1.81	0.067	1.67	1.94	1.61	2.01	3.70%	7.40%	11.10%	1.72	1.90
Nb, ppm	14.7	1.16	12.4	17.0	11.2	18.2	7.90%	15.79%	23.69%	14.0	15.4
Nd, ppm	40.6	2.56	35.5	45.7	33.0	48.3	6.29%	12.59%	18.88%	38.6	42.7
Ni, ppm	45.9	2.13	41.6	50.1	39.5	52.3	4.64%	9.28%	13.92%	43.6	48.2
P, wt. %	0.069	0.002	0.064	0.073	0.062	0.076	3.47%	6.95%	10.42%	0.065	0.072
Pb, ppm	127	7	114	140	107	146	5.19%	10.38%	15.57%	120	133
Pr, ppm	11.3	0.83	9.6	13.0	8.8	13.8	7.37%	14.74%	22.10%	10.7	11.9
Rb, ppm	94	4.2	86	103	82	107	4.50%	8.99%	13.49%	90	99
Re, ppm	0.020	0.002	0.017	0.024	0.015	0.026	8.37%	16.74%	25.11%	0.019	0.022
S, wt. %	0.575	0.024	0.528	0.623	0.504	0.647	4.13%	8.26%	12.39%	0.547	0.604
Sb, ppm	3.52	0.217	3.09	3.96	2.87	4.17	6.15%	12.30%	18.45%	3.35	3.70
Sc, ppm	8.49	0.542	7.41	9.57	6.86	10.12	6.39%	12.77%	19.16%	8.07	8.91
Se, ppm	1.04	0.26	0.53	1.55	0.27	1.81	24.61%	49.21%	73.82%	0.99	1.09

SI unit equivalents: ppm (parts per million; 1×10^{-6}) $\equiv$ mg/kg; wt. % (weight per cent) $\equiv$ % (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 7 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											
Sm, ppm	7.28	0.240	6.80	7.76	6.56	8.00	3.30%	6.60%	9.90%	6.91	7.64
Sn, ppm	4.13	0.325	3.48	4.78	3.15	5.10	7.87%	15.73%	23.60%	3.92	4.33
Sr, ppm	238	8	223	254	216	261	3.20%	6.39%	9.59%	226	250
Ta, ppm	1.07	0.17	0.72	1.41	0.54	1.59	16.30%	32.61%	48.91%	1.01	1.12
Tb, ppm	0.82	0.053	0.71	0.92	0.66	0.98	6.53%	13.06%	19.59%	0.78	0.86
Te, ppm	0.24	0.04	0.17	0.32	0.13	0.36	15.85%	31.71%	47.56%	0.23	0.25
Th, ppm	10.6	0.66	9.3	11.9	8.6	12.5	6.21%	12.41%	18.62%	10.0	11.1
Ti, wt.%	0.312	0.012	0.287	0.336	0.275	0.348	3.92%	7.84%	11.76%	0.296	0.327
Tl, ppm	0.70	0.039	0.62	0.78	0.58	0.81	5.51%	11.03%	16.54%	0.66	0.73
Tm, ppm	0.21	0.014	0.18	0.24	0.17	0.25	6.59%	13.18%	19.77%	0.20	0.22
U, ppm	11.9	0.54	10.8	13.0	10.3	13.5	4.52%	9.03%	13.55%	11.3	12.5
V, ppm	57	2.3	52	62	50	64	4.11%	8.21%	12.32%	54	60
W, ppm	19.7	0.98	17.8	21.7	16.8	22.6	4.96%	9.91%	14.87%	18.7	20.7
Y, ppm	18.5	0.83	16.8	20.2	16.0	21.0	4.51%	9.03%	13.54%	17.6	19.4
Yb, ppm	1.37	0.078	1.21	1.53	1.14	1.61	5.71%	11.42%	17.14%	1.30	1.44
Zn, ppm	496	20	456	536	436	556	4.02%	8.04%	12.05%	471	521
Zr, ppm	188	10	169	208	159	217	5.17%	10.34%	15.51%	179	198
Aqua Regia Digestion											
Ag, ppm	0.782	0.061	0.659	0.904	0.598	0.965	7.82%	15.65%	23.47%	0.743	0.821
Al, wt.%	1.02	0.084	0.85	1.19	0.77	1.27	8.21%	16.43%	24.64%	0.97	1.07
As, ppm	87	4.1	79	95	75	99	4.70%	9.39%	14.09%	83	91
Be, ppm	0.90	0.054	0.79	1.01	0.74	1.06	6.01%	12.02%	18.02%	0.86	0.95
Bi, ppm	1.71	0.115	1.48	1.94	1.37	2.05	6.70%	13.39%	20.09%	1.62	1.80
Ca, wt.%	1.06	0.050	0.96	1.16	0.91	1.21	4.69%	9.39%	14.08%	1.01	1.12
Cd, ppm	0.35	0.029	0.29	0.41	0.26	0.44	8.43%	16.87%	25.30%	0.33	0.37
Ce, ppm	70	3.9	62	78	58	82	5.56%	11.12%	16.67%	67	74
Co, ppm	117	4	109	124	106	128	3.10%	6.20%	9.31%	111	122
Cr, ppm	27.6	1.56	24.5	30.8	23.0	32.3	5.65%	11.29%	16.94%	26.3	29.0
Cs, ppm	1.11	0.071	0.97	1.25	0.90	1.32	6.37%	12.74%	19.11%	1.06	1.17
Cu, wt.%	0.289	0.009	0.272	0.306	0.263	0.315	2.96%	5.91%	8.87%	0.275	0.304
Dy, ppm	2.59	0.130	2.33	2.85	2.20	2.98	5.04%	10.07%	15.11%	2.46	2.72
Er, ppm	0.97	0.064	0.84	1.10	0.78	1.16	6.62%	13.24%	19.86%	0.92	1.02
Eu, ppm	0.94	0.11	0.73	1.15	0.62	1.25	11.23%	22.47%	33.70%	0.89	0.98
Fe, wt.%	11.38	0.568	10.25	12.52	9.68	13.09	4.99%	9.98%	14.97%	10.81	11.95
Ga, ppm	4.74	0.50	3.75	5.74	3.26	6.23	10.45%	20.90%	31.34%	4.51	4.98
Gd, ppm	3.67	0.45	2.78	4.57	2.33	5.02	12.22%	24.44%	36.66%	3.49	3.86
Hf, ppm	1.45	0.17	1.10	1.79	0.93	1.96	11.83%	23.66%	35.49%	1.38	1.52
Ho, ppm	0.40	0.05	0.30	0.51	0.24	0.56	13.02%	26.03%	39.05%	0.38	0.42
In, ppm	0.093	0.006	0.080	0.105	0.074	0.112	6.83%	13.67%	20.50%	0.088	0.097
K, wt.%	0.357	0.024	0.309	0.405	0.285	0.429	6.69%	13.37%	20.06%	0.339	0.375
La, ppm	50	3.7	43	58	39	61	7.39%	14.77%	22.16%	48	53
Li, ppm	7.19	0.654	5.88	8.50	5.23	9.15	9.09%	18.18%	27.27%	6.83	7.55
Lu, ppm	0.11	0.008	0.09	0.12	0.08	0.13	8.05%	16.11%	24.16%	0.10	0.11
Mg, wt.%	0.656	0.023	0.611	0.701	0.588	0.724	3.46%	6.91%	10.37%	0.623	0.689

SI unit equivalents: ppm (parts per million; 1×10^{-6}) $\equiv$ mg/kg; wt. % (weight per cent) $\equiv$ % (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 7 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											
Mn, wt. %	0.069	0.002	0.065	0.074	0.062	0.076	3.24%	6.47%	9.71%	0.066	0.073
Mo, ppm	43.8	2.73	38.4	49.3	35.6	52.0	6.23%	12.46%	18.69%	41.6	46.0
Na, wt. %	0.143	0.009	0.124	0.162	0.115	0.171	6.55%	13.10%	19.65%	0.136	0.150
Nb, ppm	0.77	0.26	0.25	1.28	0.00	1.54	33.91%	67.81%	101.72%	0.73	0.80
Nd, ppm	25.9	2.39	21.1	30.7	18.7	33.1	9.25%	18.50%	27.76%	24.6	27.2
Ni, ppm	39.6	2.41	34.8	44.5	32.4	46.9	6.09%	12.17%	18.26%	37.6	41.6
P, wt. %	0.058	0.002	0.054	0.062	0.052	0.064	3.56%	7.11%	10.67%	0.055	0.061
Pb, ppm	110	7	96	124	89	131	6.33%	12.65%	18.98%	104	115
Pr, ppm	7.28	0.80	5.68	8.89	4.87	9.69	11.02%	22.05%	33.07%	6.92	7.65
Rb, ppm	20.0	1.68	16.7	23.4	15.0	25.0	8.38%	16.75%	25.13%	19.0	21.0
Re, ppm	0.021	0.001	0.018	0.024	0.017	0.025	6.25%	12.50%	18.75%	0.020	0.022
S, wt. %	0.542	0.029	0.484	0.600	0.454	0.630	5.39%	10.78%	16.17%	0.515	0.569
Sb, ppm	2.54	0.195	2.15	2.92	1.95	3.12	7.67%	15.34%	23.01%	2.41	2.66
Sc, ppm	3.00	0.216	2.57	3.44	2.35	3.65	7.20%	14.41%	21.61%	2.85	3.15
Sm, ppm	4.65	0.54	3.56	5.74	3.02	6.28	11.70%	23.41%	35.11%	4.42	4.88
Sn, ppm	2.55	0.163	2.23	2.88	2.07	3.04	6.36%	12.72%	19.09%	2.43	2.68
Sr, ppm	47.4	5.8	35.8	59.0	30.0	64.8	12.25%	24.50%	36.74%	45.0	49.7
Tb, ppm	0.52	0.025	0.47	0.57	0.45	0.59	4.72%	9.44%	14.16%	0.49	0.55
Te, ppm	0.20	0.05	0.11	0.29	0.06	0.34	22.67%	45.35%	68.02%	0.19	0.21
Th, ppm	6.96	0.414	6.13	7.79	5.71	8.20	5.95%	11.91%	17.86%	6.61	7.30
Ti, wt. %	0.070	0.013	0.045	0.095	0.033	0.108	17.83%	35.65%	53.48%	0.067	0.074
Tl, ppm	0.23	0.021	0.19	0.28	0.17	0.30	8.79%	17.57%	26.36%	0.22	0.25
Tm, ppm	0.12	0.02	0.09	0.15	0.08	0.17	12.44%	24.89%	37.33%	0.12	0.13
U, ppm	10.1	0.52	9.1	11.1	8.5	11.7	5.14%	10.28%	15.42%	9.6	10.6
V, ppm	26.7	1.52	23.6	29.7	22.1	31.2	5.71%	11.42%	17.14%	25.3	28.0
W, ppm	13.8	1.8	10.2	17.4	8.3	19.2	13.17%	26.35%	39.52%	13.1	14.5
Y, ppm	10.8	0.43	10.0	11.7	9.5	12.1	4.00%	8.00%	12.00%	10.3	11.4
Yb, ppm	0.74	0.059	0.62	0.86	0.56	0.92	7.98%	15.97%	23.95%	0.70	0.78
Zn, ppm	445	16	414	477	399	492	3.49%	6.98%	10.47%	423	468
Zr, ppm	57	3.7	49	64	46	68	6.53%	13.05%	19.58%	54	60
Peroxide Fusion ICP											
Al, wt. %	6.40	0.150	6.10	6.70	5.95	6.85	2.34%	4.68%	7.01%	6.08	6.72
As, ppm	92	6.8	78	105	71	112	7.40%	14.80%	22.20%	87	96
Ba, wt. %	0.422	0.014	0.395	0.450	0.381	0.464	3.29%	6.59%	9.88%	0.401	0.444
Be, ppm	2.44	0.57	1.30	3.58	0.73	4.15	23.31%	46.63%	69.94%	2.32	2.56
Ca, wt. %	2.17	0.066	2.04	2.30	1.97	2.36	3.03%	6.05%	9.08%	2.06	2.27
Ce, ppm	115	7	102	129	96	135	5.75%	11.51%	17.26%	110	121
Co, ppm	119	7	106	132	99	139	5.51%	11.03%	16.54%	113	125
Cr, ppm	80	10	60	99	50	109	12.32%	24.63%	36.95%	76	84
Cs, ppm	4.09	0.209	3.68	4.51	3.47	4.72	5.11%	10.21%	15.32%	3.89	4.30
Cu, wt. %	0.288	0.009	0.271	0.305	0.262	0.314	2.97%	5.94%	8.92%	0.274	0.302
Dy, ppm	4.30	0.212	3.87	4.72	3.66	4.93	4.94%	9.88%	14.83%	4.08	4.51
Er, ppm	1.95	0.124	1.71	2.20	1.58	2.32	6.33%	12.66%	18.99%	1.86	2.05
Eu, ppm	1.70	0.131	1.44	1.97	1.31	2.10	7.67%	15.35%	23.02%	1.62	1.79
Fe, wt. %	13.20	0.244	12.71	13.69	12.47	13.93	1.85%	3.69%	5.54%	12.54	13.86

SI unit equivalents: ppm (parts per million; 1×10^{-6}) $\equiv$ mg/kg; wt. % (weight per cent) $\equiv$ % (mass fraction).

Note 1: intervals may appear asymmetric due to rounding; IND = indeterminate.

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 7 continued.

Constituent	Certified Value	Absolute Standard Deviations					Relative Standard Deviations			5 % window	
		1SD	2SD Low	2SD High	3SD Low	3SD High	1RSD	2RSD	3RSD	Low	High
Peroxide Fusion ICP continued											
Ga, ppm	19.0	1.36	16.3	21.7	14.9	23.1	7.14%	14.28%	21.42%	18.1	20.0
Gd, ppm	6.21	0.456	5.30	7.13	4.84	7.58	7.35%	14.69%	22.04%	5.90	6.52
Ge, ppm	2.80	0.280	2.24	3.36	1.96	3.64	10.00%	19.99%	29.99%	2.66	2.94
Hf, ppm	5.33	0.487	4.36	6.31	3.87	6.79	9.13%	18.26%	27.39%	5.07	5.60
Ho, ppm	0.77	0.043	0.69	0.86	0.64	0.90	5.57%	11.15%	16.72%	0.73	0.81
K, wt. %	2.20	0.076	2.04	2.35	1.97	2.42	3.48%	6.97%	10.45%	2.09	2.30
La, ppm	75	2.8	69	80	66	83	3.74%	7.48%	11.22%	71	79
Li, ppm	20.3	2.8	14.7	26.0	11.9	28.8	13.84%	27.69%	41.53%	19.3	21.4
Lu, ppm	0.22	0.014	0.19	0.25	0.18	0.26	6.26%	12.52%	18.78%	0.21	0.23
Mg, wt. %	1.09	0.019	1.05	1.13	1.04	1.15	1.75%	3.49%	5.24%	1.04	1.15
Mn, wt. %	0.085	0.003	0.080	0.091	0.077	0.094	3.36%	6.72%	10.09%	0.081	0.090
Mo, ppm	43.8	3.53	36.7	50.8	33.2	54.3	8.06%	16.12%	24.18%	41.6	46.0
Na, wt. %	1.78	0.041	1.70	1.86	1.65	1.90	2.33%	4.66%	6.99%	1.69	1.87
Nb, ppm	15.7	1.04	13.6	17.7	12.6	18.8	6.61%	13.21%	19.82%	14.9	16.5
Nd, ppm	41.5	2.04	37.4	45.6	35.4	47.6	4.92%	9.83%	14.75%	39.4	43.6
Ni, ppm	48.1	2.54	43.0	53.2	40.5	55.7	5.28%	10.56%	15.85%	45.7	50.5
P, wt. %	0.072	0.004	0.063	0.080	0.059	0.084	5.72%	11.43%	17.15%	0.068	0.075
Pb, ppm	130	8	113	146	105	155	6.36%	12.73%	19.09%	123	136
Pr, ppm	11.8	0.39	11.1	12.6	10.7	13.0	3.27%	6.54%	9.81%	11.2	12.4
Rb, ppm	93	2.4	89	98	86	101	2.59%	5.18%	7.77%	89	98
S, wt. %	0.581	0.032	0.518	0.644	0.486	0.676	5.43%	10.86%	16.29%	0.552	0.610
Sb, ppm	3.61	0.331	2.95	4.27	2.62	4.60	9.15%	18.30%	27.45%	3.43	3.79
Sc, ppm	8.33	0.94	6.45	10.20	5.51	11.14	11.26%	22.52%	33.77%	7.91	8.74
Si, wt. %	25.10	0.840	23.42	26.78	22.58	27.62	3.35%	6.69%	10.04%	23.84	26.35
Sm, ppm	7.28	0.457	6.36	8.19	5.90	8.65	6.28%	12.56%	18.84%	6.91	7.64
Sn, ppm	4.83	0.60	3.62	6.04	3.02	6.64	12.50%	25.01%	37.51%	4.59	5.07
Sr, ppm	244	9	225	263	216	272	3.84%	7.67%	11.51%	232	256
Ta, ppm	1.19	0.19	0.81	1.58	0.62	1.77	15.99%	31.98%	47.97%	1.13	1.25
Tb, ppm	0.84	0.040	0.76	0.92	0.72	0.96	4.74%	9.47%	14.21%	0.80	0.88
Te, ppm	< 1	IND	IND	IND	IND	IND	IND	IND	IND	IND	IND
Th, ppm	10.7	0.65	9.4	12.0	8.8	12.7	6.03%	12.05%	18.08%	10.2	11.3
Ti, wt. %	0.335	0.012	0.311	0.360	0.298	0.373	3.72%	7.43%	11.15%	0.319	0.352
Tm, ppm	0.26	0.016	0.23	0.29	0.21	0.30	6.15%	12.31%	18.46%	0.24	0.27
U, ppm	11.9	0.58	10.8	13.1	10.2	13.7	4.90%	9.80%	14.71%	11.3	12.5
V, ppm	59	7	44	74	36	81	12.65%	25.31%	37.96%	56	62
W, ppm	20.0	1.23	17.6	22.5	16.3	23.7	6.15%	12.29%	18.44%	19.0	21.0
Y, ppm	21.0	1.07	18.8	23.1	17.8	24.2	5.09%	10.19%	15.28%	19.9	22.0
Yb, ppm	1.58	0.130	1.32	1.84	1.19	1.97	8.23%	16.45%	24.68%	1.50	1.66
Zn, ppm	511	23	465	556	443	578	4.43%	8.86%	13.29%	485	536
Zr, ppm	199	13	173	225	160	238	6.53%	13.06%	19.59%	189	209
3-Acid Digestion (no HF)											
Ag, ppm	0.815	0.078	0.659	0.971	0.581	1.049	9.57%	19.15%	28.72%	0.774	0.855
As, ppm	85	2.3	80	89	78	92	2.69%	5.38%	8.07%	80	89
Co, ppm	117	5	107	126	102	131	4.06%	8.12%	12.18%	111	122
Cu, wt. %	0.291	0.009	0.273	0.309	0.264	0.318	3.06%	6.12%	9.18%	0.276	0.305
Fe, wt. %	11.99	0.539	10.92	13.07	10.38	13.61	4.50%	8.99%	13.49%	11.39	12.59

SI unit equivalents: ppm (parts per million; 1×10^{-6}) $\equiv$ mg/kg; wt. % (weight per cent) $\equiv$ % (mass fraction).

Note 1: intervals may appear asymmetric due to rounding; IND = indeterminate.

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 7 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
3-Acid Digestion (no HF) continued											
Mo, ppm	40.8	1.83	37.2	44.5	35.3	46.3	4.47%	8.94%	13.42%	38.8	42.9
S, wt. %	0.565	0.021	0.523	0.606	0.502	0.627	3.68%	7.36%	11.03%	0.537	0.593
Ion Selective Electrode											
Cl, ppm	321	93	136	507	43	599	28.83%	57.66%	86.50%	305	337
F, ppm	700	92	515	884	423	976	13.17%	26.35%	39.52%	665	735
Infrared Combustion											
S, wt. %	0.583	0.026	0.531	0.634	0.506	0.659	4.40%	8.80%	13.20%	0.553	0.612

SI unit equivalents: ppm (parts per million; 1×10^{-6}) $\equiv$ mg/kg; wt. % (weight per cent) $\equiv$ % (mass fraction).

Note 1: intervals may appear asymmetric due to rounding; IND = indeterminate.

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.

PARTICIPATING LABORATORIES

1. Actlabs, Ancaster, Ontario, Canada
2. Alex Stewart International, Mendoza, Argentina
3. ALS, Brisbane, QLD, Australia
4. ALS, Lima, Peru
5. ALS, Loughrea, Galway, Ireland
6. ALS, Malaga, WA, Australia
7. ALS, Vancouver, BC, Canada
8. American Assay Laboratories, Sparks, Nevada, USA
9. ARGETEST Mineral Processing, Ankara, Central Anatolia, Turkey
10. Bureau Veritas Commodities Canada Ltd, Vancouver, BC, Canada
11. Bureau Veritas Geoanalytical, Adelaide, SA, Australia
12. Bureau Veritas Geoanalytical, Perth, WA, Australia
13. CERTIMIN, Lima, Peru
14. ESAN Istanbul, Istanbul, Turkey
15. Inspectorate (BV), Lima, Peru
16. Intertek, Cupang, Muntinlupa, Philippines
17. Intertek, Perth, WA, Australia
18. Intertek Genalysis, Adelaide, SA, Australia
19. Intertek Minerals Ltd, Tarkwa, Western Region, Ghana
20. Paragon Geochemical Laboratories, Sparks, Nevada, USA
21. PT Geoservices Ltd, Cikarang, Jakarta Raya, Indonesia
22. PT Intertek Utama Services, Jakarta Timur, DKI Jakarta, Indonesia
23. Saskatchewan Research Council, Saskatoon, Saskatchewan, Canada
24. SGS Australia Mineral Services, Perth, WA, Australia
25. SGS Canada Inc., Vancouver, BC, Canada
26. SGS del Peru, Lima, Peru
27. SGS Geosol Laboratorios Ltda, Vespasiano, Minas Gerais, Brazil
28. SGS Mineral Services, Townsville, QLD, Australia
29. Shiva Analyticals Ltd, Bangalore North, Karnataka, India
30. Skyline Assayers & Laboratories, Tucson, Arizona, USA
31. Stewart Assay & Environmental Laboratories LLC, Kara-Balta, Chüy, Kyrgyzstan

Please note: To preserve anonymity, the numbered alphabetical list of participating laboratories above does not correspond to the Lab ID numbering used in the scatter plots below or in the DataPack.

Figure 1. Au by Pb Fire Assay in OREAS 520c

SPC.1592.RR1.OREAS 520c.5.Fire Assay.Au.Lab.250205.145258.SN

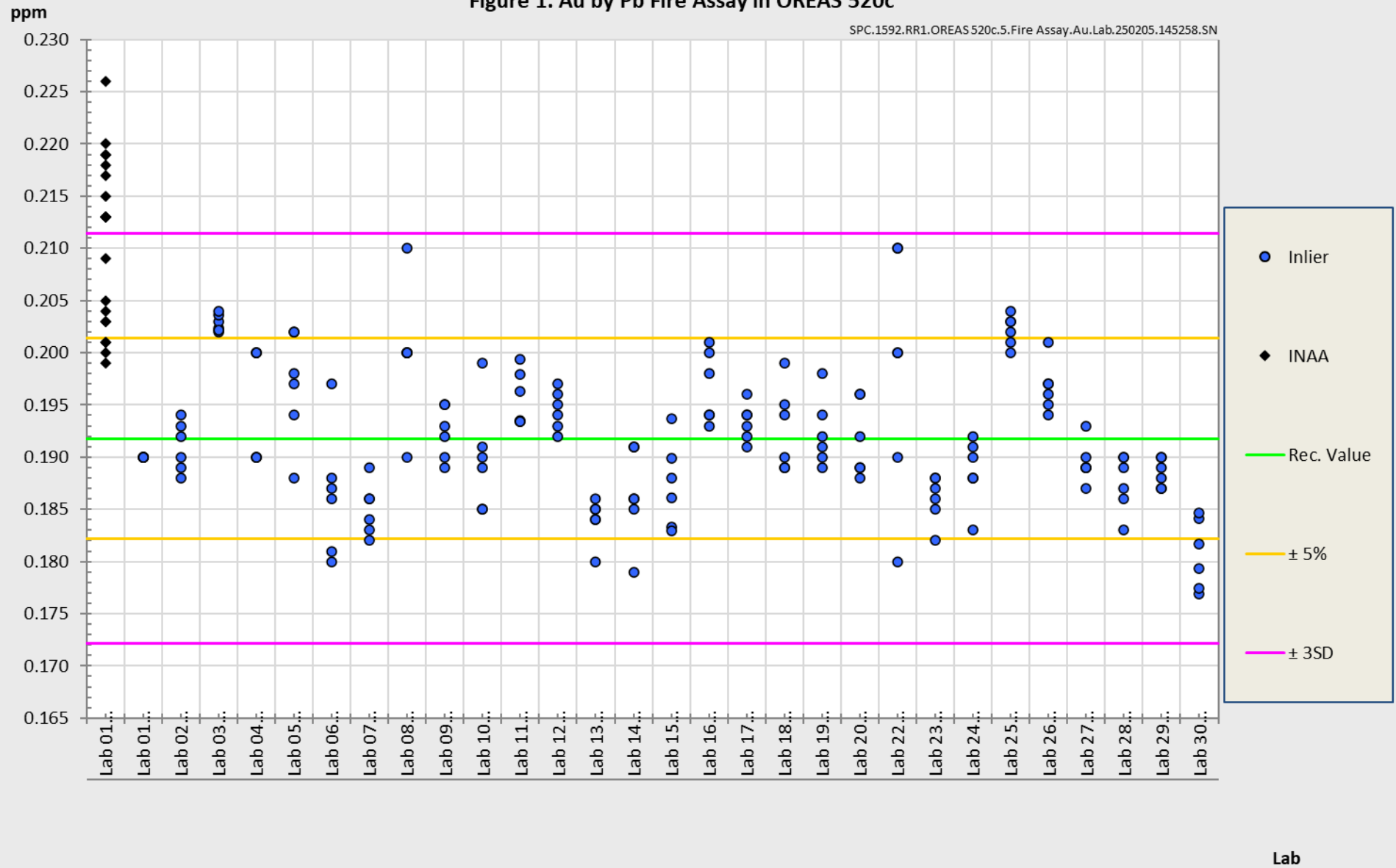


Figure 2. Co by 4-Acid Digestion in OREAS 520c

SPC.1592.RR1.OREAS 520c.5.4-Acid.Co.Lab.250205.145658.SN

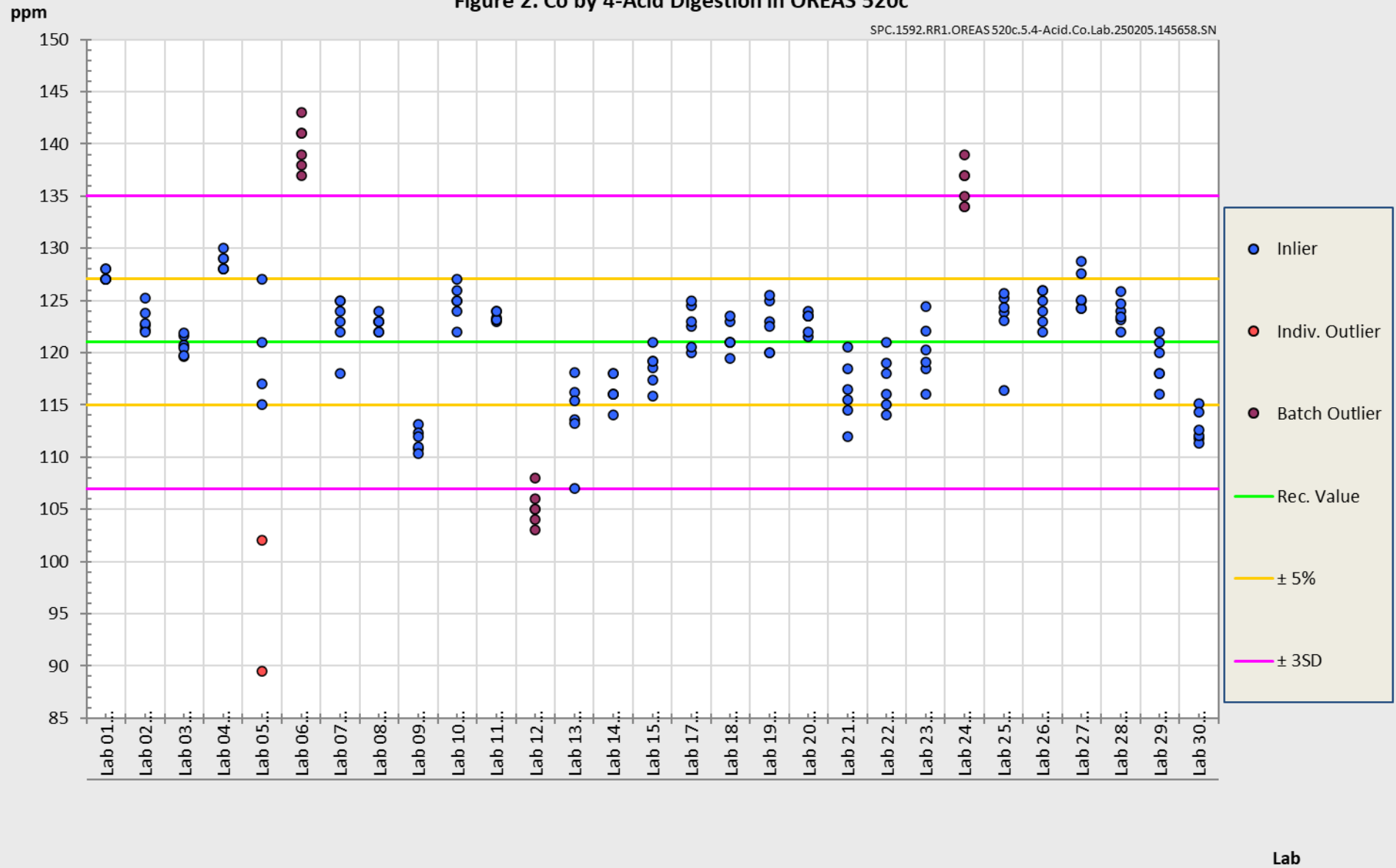
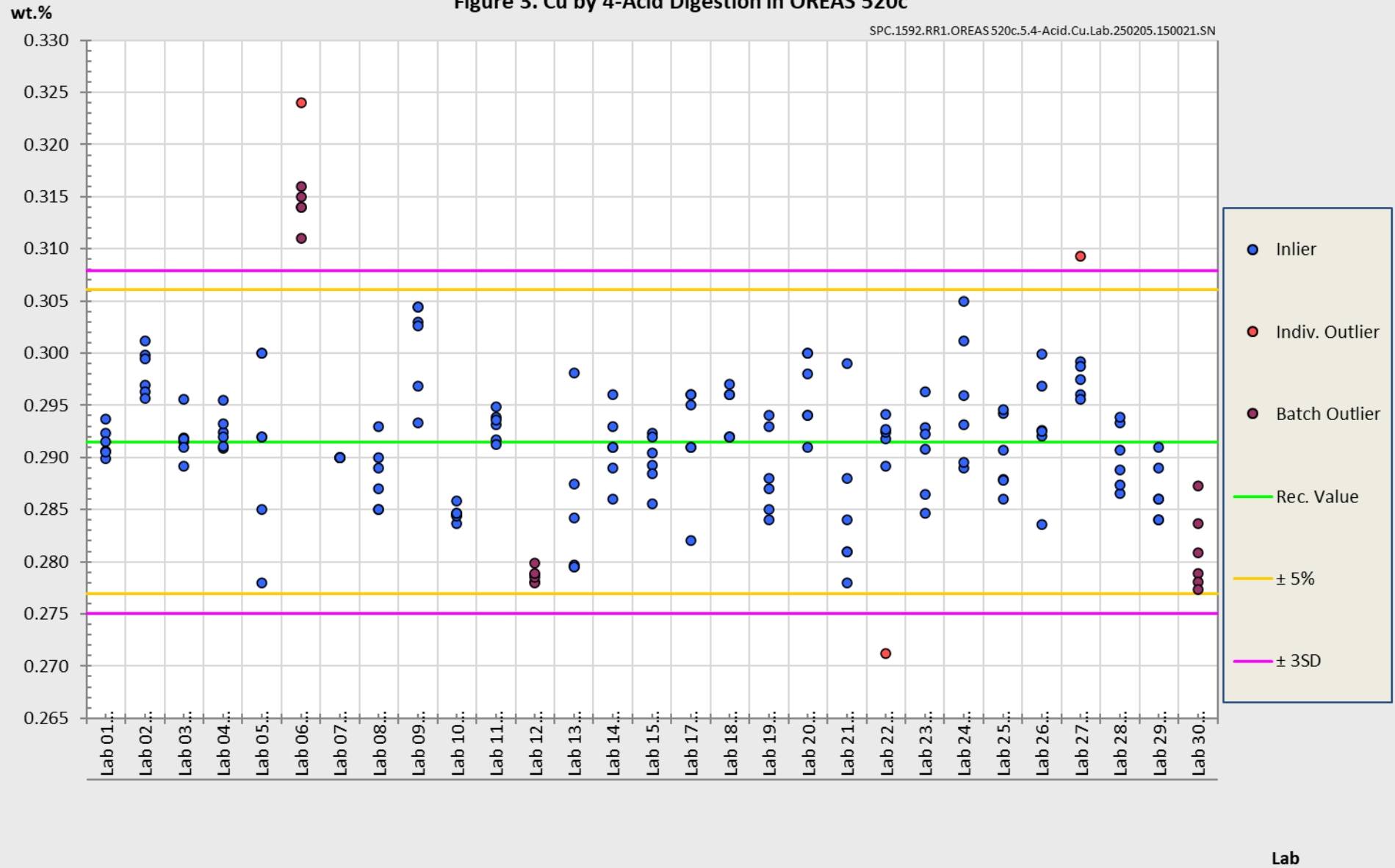


Figure 3. Cu by 4-Acid Digestion in OREAS 520c

SPC.1592.RR1.OREAS 520c.5.4-Acid.Cu.Lab.250205.150021.SN



PREPARER

Certified reference material OREAS 601d is prepared and certified by:

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METROLOGICAL TRACEABILITY

The interlaboratory results that underpin the certified values are metrologically traceable to the international measurement scale (SI) of mass (either as a % mass fraction or as milligrams per kilogram (mg/kg)) [15]. In line with popular use, all data within tables in this certificate are expressed as the mass fraction in either weight percent (wt.%) or parts per million (ppm).

The analytical samples sent to participating laboratories were selected in a manner to be representative of the entire prepared batch of CRM. This representativeness 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. The systematic sampling method was chosen due to the low risk of overlooking repetitive effects or trends in the batch due to the way the CRM was processed. In line with ISO 17025 [10], each analytical data set received from the participating laboratories has been validated by its assayer through the inclusion of internal reference materials and QC checks during and post analysis.

The participating laboratories were chosen on the basis of their competence (from past performance in interlaboratory programs undertaken by ORE Pty Ltd) for a particular analytical method, analyte or analyte suite and sample matrix. These laboratories are accredited to ISO 17025 for Au by fire assay (Table 1). The other operationally defined measurands characterised in this certificate (Table 2) are derived from data procured mostly from ISO 17025 accredited laboratories. The certified values presented in this report are calculated from the means of accepted data following robust technical and statistical analysis as detailed in this report.

Guide ISO/TR 16476:2016 [8], 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) [5].”* 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 (fusion/digestion) 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 CRMs are sourced from natural ore minerals 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 the field samples being analysed.

INTENDED USE

OREAS 520c 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 520c may be used to calibrate the entire procedure by producing a pure substance CRM transformed into a calibration solution.

OREAS 520c is intended for the following uses:

- For the monitoring of laboratory performance in the analysis of analytes reported in Tables 1 and 2 in geological samples;
- For the validation/ verification of analytical methods for analytes reported in Tables 1 and 2;
- For the calibration of instruments used in the determination of the concentration of analytes reported in Tables 1 and 2. When a value provided in this certificate is used to calibrate a measurement process, the uncertainty associated with that value should be appropriately propagated into the user's uncertainty calculation. Users can determine an approximation of the standard uncertainty by calculating one fourth of the width of the Expanded Uncertainty interval given in this certificate (Expanded Uncertainty intervals are provided in Tables 1 and 2).

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: ≥ 25 g;
- 4-acid digestion with ICP-OES and/or MS finish: ≥ 0.25 g;
- Aqua regia digestion with ICP-OES and/or MS finish: ≥ 0.5 g;
- Peroxide fusion with ICP-OES and/or MS finish: ≥ 0.1 g
- 3-acid digestion with ICP-OES finish: ≥ 0.3 g;
- Fluorine by ion selective electrode: ≥ 0.2 g;
- Total Sulphur by infrared combustion furnace/CS analyser: ≥ 0.1 g.

PERIOD OF VALIDITY & STORAGE INSTRUCTIONS

The certification of OREAS 520c remains valid, within the specified measurement uncertainties, until May 2038, 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 (e.g., 10 g and 60 g units)

Following analysis, it is the manufacturer's expectation that any remaining material is discarded unless the sachet is promptly resealed. It is the user's responsibility to prevent contamination and minimise exposure to the atmosphere.

Repeat-use packaging (e.g., 500g plastic jars)

After taking a subsample, users should replace the lid of the jar promptly and securely to prevent accidental spills and airborne contamination. OREAS 520c 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 4 in this certificate. The risk to stability of the CRM in regard to oxidation from the breakdown of sulphide minerals to sulphates is negligible given its low sulphur concentration.

*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 adsorbed moisture (weakly held H₂O- 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 [13].

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 7 are intended only to be used as a preliminary 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 % expanded uncertainty 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.

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QMS CERTIFICATION

ORE Pty Ltd is accredited for compliance with ISO 17034:2016 (Accreditation number: 20483).



ORE Pty Ltd is ISO 9001:2015 certified by Lloyd's Register Quality Assurance Ltd for its quality management system including development, manufacturing, certification and supply of CRMs.



DOCUMENT HISTORY

Revision No.	Date	Changes applied
1	17 th September, 2025	Updating of Table 2 for Aqua Regia certified elements.
0	11 th April, 2025	First publication.

CERTIFYING OFFICER

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