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CERTIFICATE OF ANALYSIS FOR

**FERRUGINOUS SOIL
REFERENCE MATERIAL
OREAS 45c**

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REPORT 02/471B

Summary Statistics

Table 1. Precious and base metals by fire assay and 4 acid digest ICPOES/MS

Constituent	Recommended value	1 standard deviation
Antimony, Sb (ppm)	0.96	0.17
Arsenic, As (ppm)	13.1	2.0
Bismuth, Bi (ppm)	0.21	0.01
Cadmium, Cd (ppm)	< 0.2	0.06
Chromium, Cr (ppm)	995	36
Cobalt, Co (ppm)	104	5
Copper, Cu (ppm)	629	13
Gold, Au (ppb)	45	10
Lead, Pb (ppm)	24	1.4
Nickel, Ni (ppm)	333	13
Palladium, Pd (ppb)	47	1
Platinum, Pt (ppb)	65	4
Silver, Ag (ppm)	0.28	0.02
Zinc, Zn (ppm)	85	5

IND - indeterminate

Table 2. Precious and base metals by aqua regia ICPOES/MS

Constituent	Recommended value	1 standard deviation
Antimony, Sb (ppm)	0.38	0
Arsenic, As (ppm)	3.8	0.3
Bismuth, Bi (ppm)	0.18	0.02
Cadmium, Cd (ppm)	0.09	0.01
Chromium, Cr (ppm)	791	71
Cobalt, Co (ppm)	91	1
Copper, Cu (ppm)	552	49
Gold, Au (ppb)	41	4
Lead, Pb (ppm)	20	2
Nickel, Ni (ppm)	250	22
Paladium, Pd (ppb)	49	7
Platinum, Pt (ppb)	61	7.8
Silver, Ag (ppm)	0.26	0.03
Zinc, Zn (ppm)	67	6

IND - indeterminate

Table 3. Major elements, LOI, C & S by fusion XRF/ICPOES & Leco

Constituent	Recommended value	1 standard deviation
Si (wt.%)	20.17	0.32
Al (wt.%)	7.33	0.17
Fe (wt.%)	18.59	0.15
Ca (wt.%)	0.513	0.006
Mg (wt.%)	0.271	0.012
Na (wt.%)	0.103	0.006
K (wt.%)	0.346	0.012
Mn (wt.%)	0.116	0.006
Ti (wt.%)	1.36	0.07
P (wt.%)	0.053	0.002
Cr (wt.%)	0.101	0.002
LOI (wt.%)	11.69	0.21
Carbon, C (wt.%)	2.57	0.16
Sulphur, S (wt.%)	0.031	0.005

IND - indeterminate

Table 4. Lithophile trace elements by fusion ICPMS

Constituent	Recommended value	1 standard deviation
Barium, Ba (ppm)	270	6
Cerium, Ce (ppm)	50.2	1.3
Dysprosium, Dy (ppm)	4.0	0.1
Erbium, Er (ppm)	2.1	0.1
Europium, Eu (ppm)	1.18	0.08
Gadolinium, Gd (ppm)	4.2	0.2
Holmium, Ho (ppm)	0.76	0.04
Lanthanum, La (ppm)	26.2	1.1
Lutetium, Lu (ppm)	0.31	0.03
Neodymium, Nd (ppm)	22.8	1.7
Niobium, Nb (ppm)	29	2
Praseodymium, Pr (ppm)	5.61	0.12
Rubidium, Rb (ppm)	23.0	0.6
Samarium, Sm (ppm)	4.7	0.1
Strontium, Sr (ppm)	36.4	0.9
Terbium, Tb (ppm)	0.70	0.04
Thorium, Th (ppm)	10.2	0.8
Thulium, Tm (ppm)	0.31	0.01
Tin, Sn (ppm)	3.4	0.5
Uranium, U (ppm)	2.6	0.3
Ytterbium, Yb (ppm)	2.1	0.1
Yttrium, Y (ppm)	18.1	1.4
Zirconium, Zr (ppm)	294	15

IND – indeterminate

SOURCE MATERIALS

Multi-element soil standard OREAS 45c is one of a pigeon pair prepared from a 50:50 blend of barren soil and soil characterised by anomalous levels of precious and base metals. The anomalous sample was obtained from soil developed over a Ni-Cu-PGE mineralised contact between gabbro and pyroxenite the Southern Murchison region of Western Australia while the barren sample was taken from an in situ layer of mature soil developed over early Tertiary olivine basalt in outer eastern Melbourne, Victoria, Australia.

COMMINUTION AND HOMOGENISATION PROCEDURES

The material was prepared in the following manner:

- a) *drying each sample to constant mass at 105^o C;*
- b) *crushing and screening each sample;*
- c) *milling anomalous soil to minus 25 microns;*
- d) *milling barren soil to minus 75 microns;*
- e) *thorough homogenisation of a 50:50 blend of the PGE anomalous and barren soils;*
- f) *packaging into 10g and 60g units in laminated foil pouches and also in 1kg units in plastic jars.*

ANALYSIS OF OREAS 45c

Seven commercial laboratories participated in the analytical program to characterise elements listed in Tables 1 - 4. Their results together with uncorrected means, medians, one sigma standard deviations, relative standard deviations and percent deviation of lab means from the corrected mean of means (PDM³) are presented in Appendices A, B, C and D. The parameter PDM³ (percent deviation of lab mean from the corrected mean of means) is a measure of laboratory accuracy while RSD (the relative standard deviation) is an effective measure of analytical precision where homogeneity of the test material has been confirmed. The analytical methods employed by each laboratory are given in column headings and explained in Table 1 of each appendix.

With the exception of Lab G, five 60g were submitted to each laboratory for analysis and were taken at spaced intervals during packaging of the standard in order to maximise their representation. Each laboratory was instructed to determine: Au, Pt and Pd by fire assay ICPMS; Ag, As, Bi, Cd, Co, Cr, Cu, Na, Ni, P, Pb, Sb, Zn by four-acid digest and ICPOES or ICPMS; Ag, As, Au, Bi, Cd, Co, Cr, Cu, Ni, Pb, Pd, Pt, Sb, Zn by aqua regia and ICPOES or ICPMS; major elements by fusion XRF or fusion ICPOES; C and S by Leco furnace; lithophile trace elements by fusion ICPMS. Lab G determined As, Au, Ce, La, Lu, Na, Sb, Sm and Yb in twenty replicates via instrumental neutron activation analysis (INAA) using reduced analytical subsample weights of 4g.

STATISTICAL EVALUATION OF ANALYTICAL DATA FOR OREAS 45c

Recommended Value and Confidence Limits

The certified value is the mean of means of accepted replicate values of accepted participating laboratories computed according to the formulae

$$\bar{x}_i = \frac{1}{n_i} \sum_{j=1}^{n_i} x_{ij}$$

$$\bar{\bar{x}} = \frac{1}{p} \sum_{i=1}^p \bar{x}_i$$

where

x_{ij} is the j th result reported by laboratory i ;

p is the number of participating laboratories;

n_i is the number of results reported by laboratory i ;

\bar{x}_i is the mean for laboratory i ;

$\bar{\bar{x}}$ is the mean of means.

The confidence limits were obtained by calculation of the variance of the consensus value (mean of means) and reference to Student's- t distribution with degrees of freedom ($p-1$).

$$\hat{V}(\bar{\bar{x}}) = \frac{1}{p(p-1)} \sum_{i=1}^p (\bar{x}_i - \bar{\bar{x}})^2$$

$$\text{Confidence limits} = \bar{\bar{x}} \pm t_{1-x/2}(p-1)(\hat{V}(\bar{\bar{x}}))^{1/2}$$

where $t_{1-x/2}(p-1)$ is the $1-x/2$ fractile of the t -distribution with $(p-1)$ degrees of freedom.

The distribution of the values are assumed to be symmetrical about the mean in the calculation of the confidence limits.

The test for rejection of individual outliers from each laboratory data set was based on z scores (rejected if $|z_i| > 2.5$) computed from the robust estimators of location and scale, T and S , respectively, according to the formulae

$$S = 1.483 \frac{\text{median } |x_j - \text{median}(x_i)|}{j=1, \dots, n \quad i=1, \dots, n}$$

$$z_i = \frac{x_i - T}{S}$$

where

T is the median value in a data set;

S is the median of all absolute deviations from the sample median multiplied by 1.483, a correction factor to make the estimator consistent with the usual parameter of a normal distribution.

Table 5. Recommended values and 95% confidence intervals for precious and base metals by fire assay and four-acid digest ICPOES/MS in OREAS 45c.

Constituent	Recommended value	95% Confidence Interval	
		Low	High
Antimony, Sb (ppm)	0.96	0.80	1.12
Arsenic, As (ppm)	13.1	11.1	15.1
Bismuth, Bi (ppm)	0.21	0.18	0.22
Cadmium, Cd (ppm)	< 0.2	-	-
Chromium, Cr (ppm)	995	954	1035
Cobalt, Co (ppm)	104	98	110
Copper, Cu (ppm)	629	613	646
Gold, Au (ppb)	45	35	54
Lead, Pb (ppm)	24	23	25
Nickel, Ni (ppm)	333	319	346
Palladium, Pd (ppb)	47	45	48
Platinum, Pt (ppb)	65	59	70
Silver, Ag (ppm)	0.28	0.25	0.32
Zinc, Zn (ppm)	85	80	91

Table 6. Recommended values and 95% confidence intervals for precious and base metals by aqua regia digest ICPOES/MS in OREAS 45c.

Constituent	Recommended value	95% Confidence Interval	
		Low	High
Antimony, Sb (ppm)	0.38	0.29	0.46
Arsenic, As (ppm)	3.8	3.3	4.2
Bismuth, Bi (ppm)	0.18	0.16	0.21
Cadmium, Cd (ppm)	0.09	0.08	0.10
Chromium, Cr (ppm)	791	711	871
Cobalt, Co (ppm)	91	89	92
Copper, Cu (ppm)	552	499	606
Gold, Au (ppb)	41	35	46
Lead, Pb (ppm)	20	18	22
Nickel, Ni (ppm)	250	223	277
Palladium, Pd (ppb)	49	40	58
Platinum, Pt (ppb)	61	48	74
Silver, Ag (ppm)	0.26	0.23	0.28
Zinc, Zn (ppm)	67	61	73

Table 7. Recommended values and 95% confidence intervals for major elements, LOI, C & S by fusion XRF/ICPOES and Leco in OREAS 45c.

Constituent	Recommended value	95% Confidence Interval	
		Low	High
Si (wt.%)	20.17	19.80	20.53
Al (wt.%)	7.33	7.15	7.51
Fe (wt.%)	18.59	18.43	18.75
Ca (wt.%)	0.513	0.505	0.522
Mg (wt.%)	0.271	0.261	0.281
Na (wt.%)	0.103	0.098	0.108
K (wt.%)	0.346	0.331	0.362
Mn (wt.%)	0.116	0.110	0.121
Ti (wt.%)	1.36	1.28	1.44
P (wt.%)	0.053	0.051	0.055
Cr (wt.%)	0.101	0.099	0.102
LOI (wt.%)	11.69	11.41	11.96
Carbon, C (wt.%)	2.57	2.40	2.74
Sulphur, S (wt.%)	0.031	0.026	0.036

Table 8. Recommended values and 95% confidence intervals for lithophile trace elements by fusion ICPMS in OREAS 45c.

Constituent	Recommended value	95% Confidence Interval	
		Low	High
Barium, Ba (ppm)	270	265	276
Cerium, Ce (ppm)	50.2	48.6	51.8
Dysprosium, Dy (ppm)	4.0	3.8	4.1
Erbium, Er (ppm)	2.1	1.9	2.3
Europium, Eu (ppm)	1.18	1.07	1.30
Gadolinium, Gd (ppm)	4.2	3.9	4.4
Holmium, Ho (ppm)	0.76	0.71	0.80
Lanthanum, La (ppm)	26.2	25.0	27.3
Lutetium, Lu (ppm)	0.31	0.29	0.33
Neodymium, Nd (ppm)	22.8	19.7	25.9
Niobium, Nb (ppm)	29	26	31
Praseodymium, Pr (ppm)	5.61	5.35	5.87
Rubidium, Rb (ppm)	23.0	22.4	23.7
Samarium, Sm (ppm)	4.7	4.4	5.1
Strontium, Sr (ppm)	36.4	35.7	37.1
Terbium, Tb (ppm)	0.70	0.65	0.75
Thorium, Th (ppm)	10.2	9.2	11.1
Thulium, Tm (ppm)	0.31	0.29	0.32
Tin, Sn (ppm)	3.4	2.8	4.0
Uranium, U (ppm)	2.6	2.3	2.9
Ytterbium, Yb (ppm)	2.1	2.1	2.2
Yttrium, Y (ppm)	18.1	16.7	19.5
Zirconium, Zr (ppm)	294	275	313

In certain instances statistician's prerogative has been employed in discriminating outliers. Individual outliers and, more rarely, laboratory means deemed to be outlying are shown in bold (Appendices A, B, C & D) and have been omitted in the determination of recommended values.

The magnitude of the confidence interval is inversely proportional to the number of participating laboratories and interlaboratory agreement. It is a measure of the reliability of the recommended value, i.e. the narrower the confidence interval the greater the certainty in the recommended value.

Statement of Homogeneity

The standard deviation of each laboratory data set includes error due to both the imprecision of the analytical method employed and to possible inhomogeneity of the material analysed. The standard deviation of the pooled individual analyses of all participating laboratories includes error due to the imprecision of each analytical method, to possible inhomogeneity of the material analysed and, in particular, to deficiencies in accuracy of each analytical method. In determining tolerance intervals for elements other than gold that component of error attributable to measurement inaccuracy was eliminated by transformation of the individual results of each data set to a common mean (the uncorrected grand mean) according to the formula

$$x'_{ij} = x_{ij} - \bar{x}_i + \frac{\sum_{i=1}^p \sum_{j=1}^{n_i} x_{ij}}{\sum_{i=1}^p n_i}$$

where

x_{ij} is the j th raw result reported by laboratory i ;

x'_{ij} is the j th transformed result reported by laboratory i ;

n_i is the number of results reported by laboratory i ;

p is the number of participating laboratories;

\bar{x}_i is the raw mean for laboratory i .

The homogeneity of each constituent was determined from tables of factors for two-sided tolerance limits for normal distributions (ISO 3207) in which

$$\text{Lower limit is } \ddot{x} - k'_2(n, p, 1 - \alpha) s_g''$$

$$\text{Upper limit is } \ddot{x} + k'_2(n, p, 1 - \alpha) s_g''$$

where

n is the number of results

$1 - \alpha$ is the confidence level;

p is the proportion of results expected within tolerance limits;

k'_2 is the factor for two-sided tolerance limits (m, α unknown);

s_g'' is the corrected grand standard deviation.

The meaning of these tolerance limits may be illustrated for 4-acid copper where 99% of the time at least 95% of subsamples will have concentrations lying between 614 and 645 ppm. Put more precisely, this means that if the same number of subsamples were taken and analysed in the same manner repeatedly, 99% of the tolerance intervals so constructed would cover at least 95% of the total population, and 1% of the tolerance intervals would cover less than 95% of the total population (ISO Guide 35).

The corrected grand standard deviation, s_g'' , used to compute the tolerance intervals is the weighted means of standard deviations of all data sets for a particular constituent according to the formula

$$s_g'' = \frac{\sum_{i=1}^p (s_i (1 - \frac{s_i}{s_g'}))}{\sum_{i=1}^p (1 - \frac{s_i}{s_g'})}$$

where

$1 - (\frac{s_i}{2s_g'})$ is the weighting factor for laboratory i ;

s_g' is the grand standard deviation computed from the transformed (i.e. means - adjusted) results

according to the formula

$$s_g' = \left[\frac{\sum_{i=1}^p \sum_{j=1}^{n_i} (x'_{ij} - \bar{x}'_i)^2}{\sum_{i=1}^p n_i - 1} \right]^{1/2}$$

where \bar{x}'_i is the transformed mean for laboratory i

The weighting factors were applied to compensate for the considerable variation in analytical precision amongst participating laboratories. Hence, weighting factors for each data set have been constructed so as to be inversely proportional to the standard deviation of that data set. Outliers were removed prior to the calculation of s_g' and a weighting factor of zero was applied to those data sets where $s_i / 2s_g' > 1$ (i.e. where the weighting factor $1 - s_i / 2s_g' < 0$).

It should be noted that estimates of tolerance by this method are considered conservative as a significant proportion of the observed variance, even in those laboratories exhibiting the best analytical precision, can presumably be attributed to measurement error.

For gold a more simplified procedure was used in the determination of homogeneity. This entailed using the high precision INAA data alone, obtained on an analytical subsample weight of 4g (compared to 30-50g for the fire assay method). By employing a sufficiently reduced subsample weight in a series of determinations by the same method, analytical

error becomes negligible in comparison to subsampling error. The corresponding standard deviation at a 50g subsample weight can then be determined from the observed standard deviation of the 4g data using the known relationship between the two parameters (Kleeman, 1967). The homogeneity of gold was then determined from tables of factors for two-sided tolerance limits for normal distributions.

Table 9. Recommended values and tolerance limits for precious and base metals by fire assay and four-acid digest ICPOES/MS.

Constituent	Recommended value	Tolerance limits 1-a=0.99, r=0.95	
		Low	High
Antimony, Sb (ppm)	0.96	0.84	1.09
Arsenic, As (ppm)	13.1	12.3	13.1
Bismuth, Bi (ppm)	0.21	0.21	0.21
Cadmium, Cd (ppm)	< 0.2	-	-
Chromium, Cr (ppm)	995	967	1022
Cobalt, Co (ppm)	104	100	107
Copper, Cu (ppm)	629	614	645
Gold, Au (ppb)	45	41	48
Lead, Pb (ppm)	24	23	26
Nickel, Ni (ppm)	333	326	339
Palladium, Pd (ppb)	47	44	49
Platinum, Pt (ppb)	65	60	70
Silver, Ag (ppm)	0.28	0.28	0.29
Zinc, Zn (ppm)	85	80	91

Table 10. Recommended values and tolerance limits for precious and base metals by aqua regia digest ICPOES/MS.

Constituent	Recommended value	Tolerance limits 1-a=0.99, r=0.95	
		Low	High
Antimony, Sb (ppm)	0.38	0.35	0.40
Arsenic, As (ppm)	3.8	3.6	3.9
Bismuth, Bi (ppm)	0.18	0.18	0.19
Cadmium, Cd (ppm)	0.09	0.09	0.10
Chromium, Cr (ppm)	791	764	817
Cobalt, Co (ppm)	91	88	93
Copper, Cu (ppm)	552	536	569
Gold, Au (ppb)	41	30	51
Lead, Pb (ppm)	20	18	22
Nickel, Ni (ppm)	250	244	256
Palladium, Pd (ppb)	49	46	52
Platinum, Pt (ppb)	61	59	62
Silver, Ag (ppm)	0.26	0.22	0.29
Zinc, Zn (ppm)	67	63	70

Table 11. Recommended values and tolerance limits for major elements, LOI, C & S by fusion XRF/ICPOES and Leco.

Constituent	Recommended value	Tolerance limits 1-a=0.99, r=0.95	
		Low	High
Si (wt.%)	20.17	20.05	20.29
Al (wt.%)	7.33	7.28	7.37
Fe (wt.%)	18.59	18.47	18.70
Ca (wt.%)	0.513	0.504	0.522
Mg (wt.%)	0.271	0.263	0.280
Na (wt.%)	0.103	0.101	0.105
K (wt.%)	0.346	0.343	0.350
Mn (wt.%)	0.116	0.115	0.116
Ti (wt.%)	1.36	1.33	1.39
P (wt.%)	0.053	0.051	0.055
Cr (wt.%)	0.101	0.100	0.101
LOI (wt.%)	11.69	11.65	11.72
Carbon, C (wt.%)	2.57	2.49	2.64
Sulphur, S (wt.%)	0.031	0.029	0.034

Table 12. Recommended values and tolerance limits for lithophile trace elements by fusion ICPMS.

Constituent	Recommended value	Tolerance limits 1-a=0.99, r=0.95	
		Low	High
Barium, Ba (ppm)	270	266	274
Cerium, Ce (ppm)	50.2	47.9	52.5
Dysprosium, Dy (ppm)	4.0	3.6	4.4
Erbium, Er (ppm)	2.1	1.9	2.4
Europium, Eu (ppm)	1.18	1.01	1.36
Gadolinium, Gd (ppm)	4.2	3.9	4.5
Holmium, Ho (ppm)	0.76	0.61	0.91
Lanthanum, La (ppm)	26.2	25.5	26.8
Lutetium, Lu (ppm)	0.31	0.30	0.32
Neodymium, Nd (ppm)	22.8	21.7	23.8
Niobium, Nb (ppm)	29	27	30
Praseodymium, Pr (ppm)	5.61	5.33	5.90
Rubidium, Rb (ppm)	23.0	22.7	23.4
Samarium, Sm (ppm)	4.7	4.5	4.9
Strontium, Sr (ppm)	36.4	35.5	37.2
Terbium, Tb (ppm)	0.70	0.68	0.72
Thorium, Th (ppm)	10.2	9.7	10.6
Thulium, Tm (ppm)	0.31	0.31	0.31
Tin, Sn (ppm)	3.4	2.2	4.6
Uranium, U (ppm)	2.6	IND	IND
Ytterbium, Yb (ppm)	2.1	1.9	2.4
Yttrium, Y (ppm)	18.1	17.0	19.2
Zirconium, Zr (ppm)	294	272	316

Performance Gates

Performance gates provide an indication of a level of performance that might reasonably be expected from a laboratory being monitored by this standard in a QA/QC program. They take into account errors attributable to measurement (analytical bias and precision) and standard variability. For an effective standard the contribution of the latter should be negligible in comparison to measurement errors.

The first method uses the standard deviation of the pooled individual analyses generated from the certification program. All individual and lab dataset (batch) outliers are removed prior to determination of the standard deviation. These outliers can only be removed if they can be confidently deemed to be analytical rather than arising from inhomogeneity of the CRM.

Table 13. Performance gates for precious and base metals by fire assay and four-acid digest ICPOES/MS.

Constituent	1 σ		2 σ		3 σ		5%	
	Low	High	Low	High	Low	High	Low	High
Antimony, Sb (ppm)	0.79	1.13	0.63	1.29	0.46	1.46	0.91	1.01
Arsenic, As (ppm)	11.1	15.1	9.1	17.1	7.1	19.1	12.4	13.7
Bismuth, Bi (ppm)	0.19	0.22	0.18	0.23	0.17	0.25	0.20	0.22
Cadmium, Cd (ppm)	IND	IND	IND	IND	IND	IND	IND	IND
Chromium, Cr (ppm)	959	1030	923	1066	887	1102	945	1044
Cobalt, Co (ppm)	98	109	93	115	87	120	99	109
Copper, Cu (ppm)	616	643	603	656	589	669	598	661
Gold, Au (ppb)	34	55	24	65	14	75	42	47
Lead, Pb (ppm)	23	26	21	27	20	28	23	25
Nickel, Ni (ppm)	320	346	307	359	293	372	316	349
Palladium, Pd (ppb)	45	48	44	49	42	51	44	49
Platinum, Pt (ppb)	61	69	56	74	52	78	62	68
Silver, Ag (ppm)	0.26	0.30	0.24	0.33	0.22	0.35	0.27	0.30
Zinc, Zn (ppm)	80	90	76	95	71	100	81	90

Table 14. Performance gates for precious and base metals by aqua regia digest ICPOES/MS.

Constituent	1 σ		2 σ		3 σ		5%	
	Low	High	Low	High	Low	High	Low	High
Antimony, Sb (ppm)	0.31	0.45	0.24	0.51	0.17	0.58	0.36	0.40
Arsenic, As (ppm)	3.5	4.1	3.2	4.4	2.8	4.7	3.6	4.0
Bismuth, Bi (ppm)	0.16	0.20	0.14	0.22	0.12	0.24	0.17	0.19
Cadmium, Cd (ppm)	0.08	0.11	0.07	0.12	0.05	0.13	0.09	0.10
Chromium, Cr (ppm)	720	862	649	933	577	1004	751	830
Cobalt, Co (ppm)	89	92	88	94	86	95	86	95
Copper, Cu (ppm)	503	601	454	650	405	699	525	580
Gold, Au (ppb)	37	44	33	48	30	51	39	43
Lead, Pb (ppm)	18	21	17	23	15	25	19	21
Nickel, Ni (ppm)	228	272	206	294	184	316	238	263
Palladium, Pd (ppb)	42	56	36	62	29	69	47	51
Platinum, Pt (ppb)	53	69	45	76	37	84	58	64
Silver, Ag (ppm)	0.22	0.29	0.19	0.32	0.15	0.36	0.24	0.27
Zinc, Zn (ppm)	61	72	56	78	50	83	63	70

Table 15. Performance gates for major elements, LOI, C & S by fusion XRF/ICPOES and Leco.

Constituent	1 σ		2 σ		3 σ		5%	
	Low	High	Low	High	Low	High	Low	High
Si (wt.%)	19.84	20.49	19.52	20.82	19.19	21.14	19.16	21.18
Al (wt.%)	7.15	7.50	6.98	7.68	6.81	7.85	6.96	7.69
Fe (wt.%)	18.44	18.74	18.29	18.89	18.14	19.04	17.66	19.52
Ca (wt.%)	0.507	0.519	0.501	0.525	0.495	0.531	0.488	0.539
Mg (wt.%)	0.260	0.283	0.248	0.295	0.236	0.306	0.258	0.285
Na (wt.%)	0.097	0.109	0.091	0.115	0.085	0.121	0.098	0.108
K (wt.%)	0.334	0.358	0.322	0.370	0.310	0.382	0.329	0.364
Mn (wt.%)	0.110	0.121	0.105	0.127	0.099	0.132	0.110	0.121
Ti (wt.%)	1.29	1.43	1.22	1.50	1.14	1.57	1.29	1.43
P (wt.%)	0.051	0.055	0.049	0.057	0.046	0.060	0.050	0.056
Cr (wt.%)	0.098	0.103	0.096	0.105	0.093	0.108	0.095	0.106
LOI (wt.%)	11.48	11.89	11.27	12.10	11.06	12.31	11.10	12.27
Carbon, C (wt.%)	2.41	2.72	2.26	2.88	2.10	3.04	2.44	2.70
Sulphur, S (wt.%)	0.026	0.036	0.021	0.041	0.017	0.046	0.030	0.033

Table 16. Performance gates for lithophile elements by fusion ICPMS.

Constituent	1 σ		2 σ		3 σ		5%	
	Low	High	Low	High	Low	High	Low	High
Barium, Ba (ppm)	264	276	259	282	253	288	257	284
Cerium, Ce (ppm)	48.9	51.5	47.5	52.9	46.2	54.2	47.7	52.7
Dysprosium, Dy (ppm)	3.9	4.1	3.8	4.2	3.6	4.3	3.8	4.2
Erbium, Er (ppm)	2.0	2.3	1.9	2.4	1.7	2.5	2.0	2.2
Europium, Eu (ppm)	1.10	1.27	1.01	1.35	0.93	1.44	1.12	1.24
Gadolinium, Gd (ppm)	4.0	4.3	3.8	4.5	3.6	4.7	4.0	4.4
Holmium, Ho (ppm)	0.71	0.80	0.67	0.85	0.62	0.89	0.72	0.80
Lanthanum, La (ppm)	25.1	27.3	23.9	28.4	22.8	29.5	24.9	27.5
Lutetium, Lu (ppm)	0.28	0.34	0.26	0.37	0.23	0.39	0.30	0.33
Neodymium, Nd (ppm)	21.1	24.5	19.4	26.1	17.8	27.8	21.6	23.9
Niobium, Nb (ppm)	26	31	24	33	22	36	27	30
Praseodymium, Pr (ppm)	5.49	5.74	5.37	5.86	5.24	5.98	5.33	5.89
Rubidium, Rb (ppm)	22.4	23.7	21.8	24.3	21.2	24.9	21.9	24.2
Samarium, Sm (ppm)	4.6	4.9	4.5	5.0	4.3	5.1	4.5	5.0
Strontium, Sr (ppm)	35.5	37.3	34.5	38.2	33.6	39.1	34.5	38.2
Terbium, Tb (ppm)	0.66	0.74	0.61	0.79	0.57	0.83	0.66	0.73
Thorium, Th (ppm)	9.3	11.0	8.5	11.8	7.6	12.7	9.6	10.7
Thulium, Tm (ppm)	0.30	0.31	0.29	0.32	0.28	0.33	0.29	0.32
Tin, Sn (ppm)	2.8	3.9	2.3	4.4	1.8	5.0	3.2	3.5
Uranium, U (ppm)	2.3	2.9	2.0	3.1	1.7	3.4	2.4	2.7
Ytterbium, Yb (ppm)	2.0	2.3	1.9	2.4	1.8	2.5	2.0	2.2
Yttrium, Y (ppm)	16.7	19.5	15.4	20.8	14.0	22.2	17.2	19.0
Zirconium, Zr (ppm)	279	309	264	324	249	339	279	309

Performance gates have been calculated for one, two and three standard deviations of the accepted pool of certification data and are presented in Tables 14-16. As a guide these intervals may be regarded as informational (1 σ), warning or rejection for multiple outliers (2 σ), or rejection for individual outliers (3 σ) in QC monitoring although their precise application should be at the discretion of the QC manager concerned.

For the second method a $\pm 5\%$ error bar on the recommended value is used as the window of acceptability (refer Tables 14-16).

Both methods should be used with caution 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.

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PREPARER AND SUPPLIER OF THE REFERENCE MATERIAL

The reference material OREAS 45c has been prepared and certified and is supplied by:

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It has been packaged in unit sizes of 10g and 60g units in laminated foil pouches and is also available in 1kg unit in plastic jars.

INTENDED USE

OREAS 45c is a multi-element reference material intended for the QC monitoring of analytical data.

STABILITY AND STORAGE INSTRUCTIONS

OREAS 45c has been prepared from a blend of ferruginous soils. It is therefore considered to have long-term stability under normal storage conditions.

INSTRUCTIONS FOR THE CORRECT USE OF THE REFERENCE MATERIAL

The recommended values for OREAS 45c refer to the concentration levels of elements after removal of hygroscopic moisture at 105° C. It is therefore recommended that the reference material be dried at this temperature prior to analysis.

LEGAL NOTICE

Ore Research & Exploration Pty Ltd has prepared and statistically evaluated the property values of this reference material to the best of its ability. The Purchaser by receipt hereof releases and indemnifies Ore Research & Exploration Pty Ltd from and against all liability and costs arising from the use of this material and information.

CERTIFYING OFFICER: Dr Paul Hamlyn

REFERENCES

ISO Guide 35 (1985), Certification of reference materials - General and statistical principals.

ISO Guide 3207 (1975), Statistical interpretation of data - Determination of a statistical tolerance interval.

Kleeman, A. W. (1967), *J. Geol. Soc. Australia*, **14**, 43.

APPENDIX A

Analytical Results for precious and base metals by fire assay and four-acid digest ICPOES/MS in OREAS 45c

Table A1. Key to abbreviations used in Tables A2 – A15.

Abbreviation	Explanation
Std.Dev.	one sigma standard deviation
Rel.Std.Dev.	one sigma relative standard deviation
PDM ³	percent deviation of lab mean from corrected mean of means
FA	Fire assay (lead collection with HCl leach)
4A	four acid (HF-HNO ₃ -HClO ₄ -HCl) digestion
OES	inductively coupled plasma optical emission spectrometry
MS	inductively coupled plasma mass spectrometry

Table A2. Analytical results for silver in standard AANi1 (refer Table A1 for abbreviations; values in ppm).

Replicate No.	Lab A	Lab B	Lab C	Lab D	Lab E	Lab F
	4A*MS	4A*MS	4A*MS	4A*MS	4A*MS	4A*MS
1	0.10	0.29	0.25	0.50	< 0.5	0.30
2	< 0.1	0.28	0.25	0.50	< 0.5	0.30
3	< 0.1	0.30	0.30	0.50	< 0.5	0.30
4	0.20	0.28	0.30	0.50	< 0.5	0.30
5	< 0.1	0.27	0.25	0.50	< 0.5	0.30
Mean	0.2	0.3	0.3	0.5	< 0.5	0.3
Median	0.2	0.3	0.3	0.5	< 0.5	0.3
Std.Dev.	0.1	0.0	0.0	0.0	-	0.0
Rel.Std.Dev.	47.1%	4.01%	10.1%	0.00%	-	0.00%
PDM ³	-47.3%	-0.23%	-5.15%	75.6%	-	5.39%

Table A3. Analytical results for arsenic in standard AANi1 (refer Table A1 for abbreviations; values in ppm).

Replicate No.	Lab G	Lab A	Lab B	Lab C	Lab D	Lab E	Lab F
	INAA (4.0g)	4A*MS	4A*MS	4A*MS	4A*MS	4A*MS	4A*MS
1	11.7	11.0	3.1	13.5	13.0	16.0	11.8
2	12.2	12.0	3.4	13.5	13.0	16.0	11.8
3	11.9	11.0	2.6	14.5	14.0	16.0	11.0
4	12.1	11.0	3.7	13.5	13.0	16.0	11.6
5	12.4	10.0	3.0	14.0	13.0	18.0	11.9
6	11.6						
7	11.8						
8	11.0						
9	12.8						
10	12.7						
11	13.1						
12	12.5						
13	12.8						
14	12.2						
15	12.4						
16	12.0						
17	12.1						
18	12.4						
19	13.0						
20	12.0						
Mean	12.2	11.0	3.2	13.8	13.2	16.4	11.6
Median	12.2	11.0	3.1	13.5	13.0	16.0	11.8
Std.Dev.	0.5	0.7	0.4	0.4	0.4	0.9	0.4
Rel.Std.Dev.	4.3%	6.43%	13.2%	3.24%	3.39%	5.45%	3.13%
PDM ³	-6.47%	-15.9%	-75.8%	5.5%	0.92%	25.4%	-11.2%

Table A4. Analytical results for gold in standard AANi1 (refer Table A1 for abbreviations; values in ppb).

Replicate No.	Lab G	Lab A	Lab B	Lab C	Lab D	Lab E	Lab F
	INAA (4.0g)	FA*MS	FA*MS	FA*MS	FA*MS	FA*MS	FA*MS
1	52.2	47	46	30	34	46	59
2	51.8	48	46	32	34	48	62
3	49.3	47	47	35	30	46	58
4	56.2	47	47	35	26	47	60
5	45.6	47	46	32	26	47	59
6	43.8						
7	52.5						
8	47.1						
9	50.0						
10	46.5						
11	56.9						
12	48.7						
13	45.6						
14	55.4						
15	52.0						
16	53.5						
17	46.8						
18	50.0						
19	41.8						
20	52.2						
Mean	50	47	46	33	30	47	60
Median	50	47	46	32	30	47	59
Std.Dev.	4	0	1	2	4	1	2
Rel.Std.Dev.	8.3%	0.95%	1.18%	6.61%	13.33%	1.79%	2.54%
PDM ³	11.7%	5.66%	3.90%	-26.6%	-32.8%	4.77%	33.4%

Table A5. Analytical results for bismuth in standard AANi1 (refer Table A1 for abbreviations; values in ppm).

Replicate No.	Lab A	Lab B	Lab C	Lab D	Lab E	Lab F
	4A*MS	4A*MS	4A*MS	4A*MS	4A*MS	4A*MS
1	0.20	0.23	0.20	0.20	0.20	0.22
2	0.21	0.23	0.20	0.20	0.20	0.21
3	0.19	0.23	0.20	0.20	0.20	0.20
4	0.20	0.24	0.20	0.20	0.20	0.22
5	0.20	0.23	0.20	0.20	0.20	0.22
Mean	0.2	0.2	0.2	0.2	0.2	0.2
Median	0.2	0.2	0.2	0.2	0.2	0.2
Std.Dev.	0.0	0.0	0.0	0.0	0.0	0.0
Rel.Std.Dev.	3.54%	1.93%	0.00%	0.00%	0.00%	4.18%
PDM ³	-3.69%	11.7%	-3.69%	-3.69%	-3.69%	3.05%

Table A6. Analytical results for cadmium in standard AANi1 (refer Table A1 for abbreviations; values in ppm).

Replicate No.	Lab A	Lab B	Lab C	Lab D	Lab E	Lab F
	4A*MS	4A*MS	4A*MS	4A*MS	4A*MS	4A*MS
1	< 0.1	0.10	0.20	< 0.1	< 0.5	<0.1
2	< 0.1	0.09	0.15	< 0.1	< 0.5	<0.1
3	< 0.1	0.09	0.25	< 0.1	< 0.5	<0.1
4	< 0.1	0.09	0.15	< 0.1	< 0.5	<0.1
5	< 0.1	0.09	0.15	< 0.1	< 0.5	<0.1
Mean	< 0.1	0.1	0.2	< 0.1	< 0.5	< 0.1
Median	< 0.1	0.1	0.2	< 0.1	< 0.5	< 0.1
Std.Dev.	-	0.0	0.0	-	-	-
Rel.Std.Dev.	-	4.86%	24.9%	-	-	-
PDM ³	-	-	-	-	-	-

Table A7. Analytical results for cobalt in standard AANi1 (refer Table A1 for abbreviations; values in ppm).

Replicate No.	Lab A	Lab B	Lab C	Lab D	Lab E	Lab F
	4A*MS	4A*MS	4A*MS	4A*OES	4A*OES	4A*OES
1	100	104	100	109	110	98
2	99	110	105	109	110	98
3	100	104	103	110	110	94
4	98	107	101	110	110	94
5	94	110	103	110	105	97
Mean	98	107	102	110	109	96
Median	99	107	103	110	110	97
Std.Dev.	2.2	3.0	2.0	0.5	2.2	2.0
Rel.Std.Dev.	2.27%	2.82%	2.00%	0.50%	2.05%	2.13%
PDM ³	-5.50%	2.83%	-1.60%	5.63%	5.05%	-7.29%

Table A8. Analytical results for chromium in standard AANi1 (refer Table A1 for abbreviations; values in ppm).

Replicate No.	Lab A	Lab B	Lab C	Lab D	Lab E	Lab F
	4A*OES	4A*MS	4A*MS	4A*OES	4A*OES	4A*OES
1	990	796	1039	985	1040	959
2	1005	817	996	1000	1040	970
3	960	805	964	990	1050	935
4	981	819	988	990	1040	944
5	966	793	1057	970	1030	953
Mean	980	806	1009	987	1040	952
Median	981	805	996	990	1040	953
Std.Dev.	18.2	11.8	38.3	11.0	7.1	13.5
Rel.Std.Dev.	1.85%	1.47%	3.79%	1.11%	0.68%	1.42%
PDM ³	-1.42%	-19.0%	1.43%	-0.76%	4.57%	-4.26%

Table A9. Analytical results for copper in standard AANi1 (refer Table A1 for abbreviations; values in ppm).

Replicate No.	Lab A	Lab B	Lab C	Lab D	Lab E	Lab F
	4A*OES	4A*MS	4A*MS	4A*OES	4A*OES	4A*OES
1	632	705	607	628	645	631
2	637	739	608	629	645	640
3	625	700	620	627	640	621
4	646	726	604	626	645	623
5	631	697	628	624	660	631
Mean	634.2	713.4	613.4	626.8	647.0	629.2
Median	632.0	705.0	608.1	627.0	645.0	631.0
Std.Dev.	7.9	18.3	10.2	1.9	7.6	7.6
Rel.Std.Dev.	1.24%	2.56%	1.67%	0.31%	1.17%	1.20%
PDM ³	0.76%	13.4%	-2.55%	-0.41%	2.80%	-0.03%

Table A10. Analytical results for nickel in standard AANi1 (refer Table A1 for abbreviations; values in ppm).

Replicate No.	Lab A	Lab B	Lab C	Lab D	Lab E	Lab F
	4A*OES	4A*MS	4A*MS	4A*OES	4A*OES	4A*OES
1	333	348	334	340	330	314
2	334	353	329	342	340	318
3	326	345	312	340	335	306
4	329	355	335	340	345	309
5	325	344	320	339	345	315
Mean	329.4	349.0	326.0	340.2	339.0	312.4
Median	329.0	348.0	328.6	340.0	340.0	314.0
Std.Dev.	4.0	4.8	9.8	1.1	6.5	4.8
Rel.Std.Dev.	1.23%	1.39%	3.01%	0.32%	1.92%	1.55%
PDM ³	-0.98%	4.91%	-2.01%	2.27%	1.90%	-6.09%

Table A11. Analytical results for lead in standard AANi1 (refer Table A1 for abbreviations; values in ppm).

Replicate No.	Lab A	Lab B	Lab C	Lab D	Lab E	Lab F
	4A*MS	4A*MS	4A*MS	4A*MS	4A*OES	4A*MS
1	23	23	24	26	25	25
2	23	24	26	25	24	25
3	23	23	23	25	24	24
4	23	24	24	24	30	24
5	24	23	23	24	37	25
Mean	23.2	23.5	23.9	24.8	28.0	24.4
Median	23.0	23.3	23.7	25.0	25.0	24.5
Std.Dev.	0.4	0.4	1.3	0.8	5.6	0.5
Rel.Std.Dev.	1.93%	1.77%	5.59%	3.37%	20.04%	2.16%
PDM ³	-3.91%	-2.75%	-0.88%	2.72%	16.0%	1.15%

Table A12. Analytical results for palladium in standard AANi1 (refer Table A1 for abbreviations; values in ppb).

Replicate No.	Lab A	Lab B	Lab C	Lab D	Lab E	Lab F
	FA*MS	FA*MS	FA*MS	FA*MS	FA*MS	FA*MS
1	47	48	28	49	48	44
2	47	48	31	47	48	47
3	47	47	33	48	46	43
4	47	47	35	46	47	46
5	45	47	31	46	47	44
Mean	46.6	47.4	31.7	47.0	47.2	44.8
Median	47.0	47.0	31.3	47.0	47.0	44.0
Std.Dev.	0.9	0.5	2.5	1.4	0.8	1.6
Rel.Std.Dev.	1.92%	1.16%	7.73%	2.91%	1.77%	3.67%
PDM ³	0.00%	1.72%	-31.9%	0.86%	1.29%	-3.86%

Table A13. Analytical results for platinum in standard AANi1 (refer Table A1 for abbreviations; values in ppb).

Replicate No.	Lab A	Lab B	Lab C	Lab D	Lab E	Lab F
	FA*MS	FA*MS	FA*MS	FA*MS	FA*MS	FA*MS
1	67	62	43	65	67	68
2	67	61	47	62	69	74
3	66	58	52	61	67	69
4	65	59	54	61	69	70
5	64	60	49	60	67	71
Mean	66	60	49	61	68	70
Median	66	60	49	61	67	70
Std.Dev.	1.3	1.5	4.3	1.9	1.1	2.1
Rel.Std.Dev.	1.98%	2.44%	8.82%	3.07%	1.62%	3.01%
PDM ³	1.44%	-7.78%	-24.2%	-5.34%	4.52%	8.35%

Table A14. Analytical results for antimony in standard AANi1 (refer Table A1 for abbreviations; values in ppm).

Replicate No.	Lab G	Lab A	Lab B	Lab C	Lab D	Lab E	Lab F
	INAA (4.0g)	4A*MS	4A*MS	4A*MS	4A*MS	4A*OES	4A*MS
1	0.82	0.73	0.30	0.85	1.10	1.00	1.00
2	0.93	0.77	0.29	0.85	1.00	1.40	1.00
3	0.83	0.83	0.29	0.75	1.00	1.20	0.90
4	0.74	0.77	0.30	0.80	1.00	1.20	1.00
5	1.22	0.63	0.31	0.80	1.00	1.80	1.00
6	1.01						
7	0.93						
8	0.73						
9	1.17						
10	1.02						
11	0.95						
12	1.05						
13	1.00						
14	1.30						
15	1.13						
16	0.68						
17	0.98						
18	1.12						
19	1.07						
20	0.92						
Mean	0.98	0.75	0.30	0.81	1.02	1.32	0.98
Median	0.99	0.77	0.30	0.80	1.00	1.20	1.00
Std.Dev.	0.17	0.07	0.01	0.04	0.04	0.30	0.04
Rel.Std.Dev.	16.9%	9.92%	2.8%	5.16%	4.38%	23.0%	4.56%
PDM ³	1.99%	-22.4%	-69.0%	-15.7%	6.16%	37.4%	2.0%

Table A15. Analytical results for zinc in standard AANi1 (refer Table A1 for abbreviations; values in ppm).

Replicate No.	Lab A	Lab B	Lab C	Lab D	Lab E	Lab F
	4A*OES	4A*MS	4A*MS	4A*OES	4A*OES	4A*OES
1	89	81	87	65	90	80
2	81	83	90	70	90	83
3	77	83	89	71	90	86
4	123	83	88	68	90	79
5	80	84	93	72	95	81
Mean	90.0	82.8	89.2	69.2	91.0	81.8
Median	81.0	83.0	89.0	70.0	90.0	81.0
Std.Dev.	19.0	1.1	2.1	2.8	2.2	2.8
Rel.Std.Dev.	21.08%	1.32%	2.33%	4.01%	2.46%	3.39%
PDM ³	5.50%	-2.94%	4.56%	-18.9%	6.67%	-4.11%

APPENDIX B

**Analytical Results for precious and base metals by
aqua regia digest ICPOES/MS in OREAS 45c**

Table B1. Key to abbreviations used in Tables B2 – B15.

Abbreviation	Explanation
Std.Dev.	one sigma standard deviation
Rel.Std.Dev.	one sigma relative standard deviation
PDM ³	percent deviation of lab mean from corrected mean of means
AR	aqua regia digestion
OES	inductively coupled plasma optical emission spectrometry
MS	inductively coupled plasma mass spectrometry

Table B2. Analytical results for silver in standard OREAS 45c (refer Table B1 for abbreviations; values in ppm).

Replicate No.	Lab A	Lab B	Lab C	Lab D	Lab E	Lab F
	AR*MS	AR*MS	AR*MS	AR*MS	AR*MS	AR*MS
1	0.26	0.26	0.24	0.30	0.20	0.29
2	0.24	0.26	0.24	0.20	0.20	0.30
3	0.24	0.27	0.24	0.30	0.20	0.28
4	0.27	0.26	0.24	0.30	0.30	0.28
5	0.26	0.24	0.23	0.30	0.20	0.27
Mean	0.25	0.3	0.2	0.3	0.2	0.3
Median	0.26	0.3	0.2	0.3	0.2	0.3
Std.Dev.	0.0	0.0	0.0	0.0	0.0	0.0
Rel.Std.Dev.	5.28%	4.25%	2.41%	15.97%	20.33%	4.01%
PDM ³	-0.63%	0.94%	-7.04%	9.55%	-13.9%	11.1%

Table B3. Analytical results for arsenic in standard OREAS 45c (refer Table B1 for abbreviations; values in ppm).

Replicate No.	Lab A	Lab B	Lab C	Lab D	Lab E	Lab F
	AR*MS	AR*MS	AR*MS	AR*OES	AR*MS	AR*MS
1	3.1	3.5	4.1	4.0	4.8	2.6
2	3.5	3.3	4.0	4.0	4.6	2.7
3	3.6	3.5	4.2	4.0	5.0	2.4
4	4.0	3.4	4.0	4.0	4.8	2.4
5	3.7	3.6	3.9	4.0	5.2	2.4
Mean	3.6	3.5	4.0	4.0	4.9	2.5
Median	3.6	3.5	4.0	4.0	4.8	2.4
Std.Dev.	0.3	0.1	0.1	0.0	0.2	0.1
Rel.Std.Dev.	9.14%	3.30%	3.36%	0.00%	4.67%	5.66%
PDM ³	-4.91%	-8.10%	6.77%	6.24%	29.6%	-33.6%

Table B4. Analytical results for gold in standard OREAS 45c (refer Table B1 for abbreviations; values in ppm).

Replicate No.	Lab A	Lab B	Lab C	Lab D	Lab E	Lab F
	AR*MS	-	AR*MS	-	AR*MS	AR*MS
1	42	N/A	35	N/A	42	47
2	41	N/A	37	N/A	44	38
3	42	N/A	37	N/A	44	42
4	44	N/A	34	N/A	44	41
5	39	N/A	35	N/A	48	41
Mean	42	-	36	-	44	42
Median	42.0	-	35.5	-	44.0	41.0
Std.Dev.	1.8	-	1.2	-	2.2	3.3
Rel.Std.Dev.	4.37%	-	3.29%	-	4.93%	7.83%
PDM ³	2.48%	-	-11.6%	-	9.37%	2.97%

Table B5. Analytical results for bismuth in standard OREAS 45c (refer Table B1 for abbreviations; values in ppm).

Replicate No.	Lab A	Lab B	Lab C	Lab D	Lab E	Lab F
	AR*MS	AR*MS	AR*MS	AR*OES	AR*MS	AR*MS
1	0.18	0.18	0.19	< 20	0.16	0.23
2	0.16	0.19	0.19	< 20	0.16	0.22
3	0.16	0.19	0.19	< 20	0.16	0.21
4	0.17	0.18	0.19	< 20	0.16	0.21
5	0.17	0.19	0.18	< 20	0.16	0.20
Mean	0.2	0.2	0.2	< 20	0.2	0.2
Median	0.2	0.2	0.2	< 20	0.2	0.2
Std.Dev.	0.0	0.0	0.0	-	0.0	0.0
Rel.Std.Dev.	4.98%	2.94%	2.38%	-	0.00%	5.33%
PDM ³	-8.30%	1.53%	2.62%	-	-12.7%	16.8%

Table B6. Analytical results for cadmium in standard OREAS 45c (refer Table B1 for abbreviations; values in ppm).

Replicate No.	Lab A	Lab B	Lab C	Lab D	Lab E	Lab F
	AR*MS	AR*MS	AR*MS	AR*OES	AR*MS	AR*MS
1	0.09	0.08	0.10	0.10	0.10	0.13
2	0.07	0.08	0.10	0.10	0.10	0.10
3	0.08	0.08	0.10	0.10	0.10	0.09
4	0.08	0.09	0.09	0.10	0.10	0.10
5	0.06	0.08	0.10	0.10	0.10	0.10
Mean	0.08	0.08	0.10	0.10	0.10	0.10
Median	0.08	0.08	0.10	0.10	0.10	0.10
Std.Dev.	0.01	0.00	0.01	0.00	0.00	0.02
Rel.Std.Dev.	15.0%	5.45%	6.79%	0.00%	0.00%	14.6%
PDM ³	-18.3%	-11.8%	3.23%	7.53%	7.53%	11.8%

Table B7. Analytical results for cobalt in standard OREAS 45c (refer Table B1 for abbreviations; values in ppm).

Replicate No.	Lab A	Lab B	Lab C	Lab D	Lab E	Lab F
	AR*MS	AR*MS	AR*MS	AR*OES	AR*OES	AR*MS
1	91.9	84.2	93.1	90.0	89.0	77.0
2	90.7	81.8	91.8	89.0	91.0	77.0
3	83.8	85.1	92.8	90.0	91.0	77.0
4	92.9	85.7	90.7	88.0	90.0	77.0
5	89.5	83.5	89.6	89.0	92.0	78.0
Mean	89.8	84.1	91.6	89.2	90.6	77.2
Median	90.7	84.2	91.8	89.0	91.0	77.0
Std.Dev.	3.6	1.5	1.5	0.8	1.1	0.4
Rel.Std.Dev.	3.97%	1.81%	1.60%	0.94%	1.26%	0.58%
PDM ³	-0.99%	-7.28%	1.03%	-1.61%	-0.07%	-14.9%

Table B8. Analytical results for chromium in standard OREAS 45c (refer Table B1 for abbreviations; values in ppm).

Replicate No.	Lab A	Lab B	Lab C	Lab D	Lab E	Lab F
	AR*MS	AR*MS	AR*MS	AR*OES	AR*OES	AR*MS
1	846	761	806	910	700	740
2	840	760	817	815	700	724
3	861	776	847	895	690	734
4	896	790	813	870	660	734
5	853	771	774	895	675	737
Mean	859	772	811	877	685	734
Median	853.0	771.0	812.9	895.0	690.0	734.0
Std.Dev.	22.0	12.3	26.2	37.5	17.3	6.0
Rel.Std.Dev.	2.56%	1.59%	3.23%	4.28%	2.53%	0.82%
PDM ³	8.66%	-2.42%	2.61%	10.9%	-13.4%	-7.20%

Table B9. Analytical results for copper in standard OREAS 45c (refer Table B1 for abbreviations; values in ppm).

Replicate No.	Lab A	Lab B	Lab C	Lab D	Lab E	Lab F
	AR*OES	AR*MS	AR*MS	AR*OES	AR*OES	AR*MS
1	553	623	540	533	483	590
2	551	627	542	530	483	576
3	561	641	549	537	490	585
4	586	634	529	528	460	587
5	556	614	520	527	473	592
Mean	561	628	536	531	478	586
Median	556	627	540	530	483	587
Std.Dev.	14.3	10.3	11.4	4.1	11.6	6.2
Rel.Std.Dev.	2.54%	1.65%	2.13%	0.76%	2.44%	1.06%
PDM ³	1.65%	13.7%	-2.97%	-3.85%	-13.5%	6.10%

Table B10. Analytical results for nickel in standard OREAS 45c (refer Table B1 for abbreviations; values in ppm).

Replicate No.	Lab A	Lab B	Lab C	Lab D	Lab E	Lab F
	AR*OES	AR*MS	AR*MS	AR*OES	AR*OES	AR*MS
1	288	259	257	241	222	227
2	281	264	260	242	223	221
3	293	261	257	250	222	227
4	302	266	255	241	213	224
5	290	261	249	241	219	226
Mean	290.8	262.2	255.6	243.0	219.8	225.0
Median	290.0	261.0	256.8	241.0	222.0	226.0
Std.Dev.	7.7	2.8	3.9	3.9	4.1	2.5
Rel.Std.Dev.	2.63%	1.06%	1.53%	1.62%	1.86%	1.13%
PDM ³	16.3%	4.87%	2.22%	-2.81%	-12.1%	-10.0%

Table B11. Analytical results for lead in standard OREAS 45c (refer Table B1 for abbreviations; values in ppm).

Replicate No.	Lab A	Lab B	Lab C	Lab D	Lab E	Lab F
	AR*MS	AR*MS	AR*MS	AR*OES	AR*MS	AR*MS
1	18	22	20	20	19	20
2	18	22	20	30	18	19
3	19	23	22	30	18	19
4	20	23	19	20	20	19
5	19	22	19	20	19	20
Mean	18.8	22.5	20.0	24.0	18.8	19.4
Median	19.0	22.2	20.1	20.0	19.0	19.0
Std.Dev.	0.8	0.5	1.0	5.5	0.8	0.5
Rel.Std.Dev.	4.45%	2.26%	4.91%	22.82%	4.45%	2.82%
PDM ³	-5.53%	12.87%	0.70%	20.6%	-5.53%	-2.51%

Table B12. Analytical results for palladium in standard OREAS 45c (refer Table B1 for abbreviations; values in ppb).

Replicate No.	Lab A	Lab B	Lab C	Lab D	Lab E	Lab F
	AR*MS	-	AR*MS	-	AR*MS	AR*MS
1	67	N/A	36	N/A	50	44
2	48	N/A	27	N/A	50	47
3	41	N/A	42	N/A	50	43
4	59	N/A	27	N/A	50	46
5	46	N/A	29	N/A	50	44
Mean	52.2	-	32.2	-	50.0	44.8
Median	48.0	-	29.0	-	50.0	44.0
Std.Dev.	10.6	-	6.6	-	0.0	1.6
Rel.Std.Dev.	20.3%	-	20.5%	-	0.00%	3.67%
PDM ³	6.53%	-	-34.3%	-	2.04%	-8.57%

Analytical results for platinum in standard OREAS 45c (refer Table B1 for abbreviations; values in Table B13. ppb).

Replicate No.	Lab A	Lab B	Lab C	Lab D	Lab E	Lab F
	AR*MS	-	AR*MS	AR*OES	AR*MS	AR*MS
1	56	N/A	56	N/A	65	68
2	53	N/A	51	N/A	65	74
3	48	N/A	51	N/A	65	69
4	59	N/A	54	N/A	65	70
5	59	N/A	52	N/A	65	71
Mean	55.0	-	52.8	-	-	70.3
Median	56.0	-	52.0	-	-	69.7
Std.Dev.	4.6	-	2.2	-	-	2.1
Rel.Std.Dev.	8.43%	-	4.11%	-	-	3.01%
PDM ³	-9.49%	-	-13.1%	-	-	15.6%

Analytical results for antimony in standard OREAS 45c (refer Table B1 for abbreviations; values in Table B14. ppm).

Replicate No.	Lab A	Lab B	Lab C	Lab D	Lab E	Lab F
	AR*MS	AR*MS	AR*MS	AR*OES	AR*MS	AR*MS
1	0.44	0.30	0.36	0.40	0.08	0.40
2	0.46	0.29	0.37	0.40	0.06	0.40
3	0.48	0.29	0.40	0.40	0.06	0.30
4	0.48	0.30	0.35	0.40	0.04	0.30
5	0.54	0.31	0.35	0.40	0.04	0.30
Mean	0.5	0.3	0.4	0.4	0.1	0.3
Median	0.5	0.3	0.4	0.4	0.1	0.3
Std.Dev.	0.0	0.0	0.0	0.0	0.0	0.1
Rel.Std.Dev.	7.80%	2.81%	5.08%	0.00%	29.9%	16.1%
PDM ³	27.5%	-20.8%	-3.29%	6.27%	-85.1%	-9.67%

Table B15. Analytical results for zinc in standard OREAS 45c (refer Table B1 for abbreviations; values in ppm).

Replicate No.	Lab A	Lab B	Lab C	Lab D	Lab E	Lab F
	AR*OES	AR*MS	AR*MS	AR*OES	AR*OES	AR*MS
1	75	68	61	67	61	63
2	74	67	62	69	61	61
3	76	68	64	70	62	62
4	78	71	62	73	61	61
5	77	69	62	67	63	62
Mean	76.0	68.6	62.2	69.2	61.6	61.8
Median	76.0	68.0	62.0	69.0	61.0	62.0
Std.Dev.	1.6	1.5	1.0	2.5	0.9	0.8
Rel.Std.Dev.	2.08%	2.21%	1.66%	3.60%	1.45%	1.35%
PDM ³	14.2%	3.05%	-6.56%	3.96%	-7.46%	-7.16%

APPENDIX C

**Analytical Results for major elements, LOI, C & S by
fusion XRF/ICPOES in OREAS 45c**

Table C1. Key to abbreviations used in Tables C2 – C15.

Abbreviation	Explanation
Std.Dev.	one sigma standard deviation
Rel.Std.Dev.	one sigma relative standard deviation
PDM ³	percent deviation of lab mean from corrected mean of means
AF	alkali fusion
BF	lithium metaborate fusion
Leco	Leco furnace method
LOI	Grav method after heating to 1000°C
OES	inductively coupled plasma optical emission spectrometry
MS	inductively coupled plasma mass spectrometry
XRF	x-ray fluorescence

Table C2. Analytical results for aluminium in standard OREAS 45c (refer Table C1 for abbreviations; values in wt. %).

Replicate No.	Lab A	Lab B	Lab C	Lab D	Lab E	Lab F
	AF*OES	BF*XRF	BF*OES	BF*XRF	AF*XRF	BF*OES
1	7.17	7.63	7.15	7.28	7.36	7.31
2	7.07	7.63	7.14	7.27	7.41	7.33
3	7.22	7.62	7.16	7.30	7.41	7.23
4	7.17	7.63	7.12	7.25	7.41	7.21
5	7.31	7.64	7.15	7.26	7.36	7.59
Mean	7.19	7.63	7.15	7.27	7.39	7.33
Median	7.17	7.63	7.15	7.27	7.41	7.31
Std.Dev.	0.09	0.01	0.01	0.02	0.03	0.15
Rel.Std.Dev.	1.21%	0.08%	0.20%	0.26%	0.39%	2.07%
PDM ³	-1.91%	4.14%	-2.49%	-0.76%	0.85%	0.08%

Table C3. Analytical results for carbon in standard OREAS 45c (refer Table C1 for abbreviations; values in wt. %).

Replicate No.	Lab A	Lab B	Lab C	Lab D	Lab E	Lab F
	Leco	Leco	BF*OES	Leco	Leco	Leco
1	2.49	2.61	2.64	2.36	2.85	2.45
2	2.51	2.59	2.64	2.42	2.92	2.45
3	2.46	2.59	2.62	2.39	2.82	2.46
4	2.48	2.59	2.58	2.34	2.75	2.47
5	2.52	2.57	2.67	2.39	2.86	2.48
Mean	2.5	2.6	2.6	2.4	2.8	2.5
Median	2.5	2.6	2.6	2.4	2.9	2.5
Std.Dev.	0.0	0.0	0.0	0.0	0.1	0.0
Rel.Std.Dev.	0.96%	0.55%	1.32%	1.36%	2.18%	0.53%
PDM ³	-2.93%	0.88%	2.36%	-7.34%	10.6%	-4.10%

Table C4. Analytical results for calcium in standard OREAS 45c (refer Table C1 for abbreviations; values in wt. %).

Replicate No.	Lab A	Lab B	Lab C	Lab D	Lab E	Lab F
	AF*OES	BF*XRF	BF*OES	BF*XRF	AF*XRF	BF*OES
1	0.60	0.51	0.51	0.51	0.52	0.52
2	0.60	0.50	0.51	0.52	0.52	0.52
3	0.60	0.51	0.51	0.51	0.52	0.58
4	0.60	0.51	0.52	0.51	0.52	0.63
5	0.60	0.51	0.51	0.51	0.51	0.63
Mean	0.60	0.51	0.51	0.51	0.52	0.58
Median	0.60	0.51	0.51	0.51	0.52	0.58
Std.Dev.	0.00	0.01	0.00	0.00	0.00	0.06
Rel.Std.Dev.	0.00%	1.00%	0.62%	0.87%	0.61%	9.56%
PDM ³	16.9%	-1.12%	-0.01%	-0.25%	1.38%	12.2%

Table C5. Analytical results for chromium in standard OREAS 45c (refer Table C1 for abbreviations; values in wt. %).

Replicate No.	Lab A	Lab B	Lab C	Lab D	Lab E	Lab F
	AF*OES	BF*XRF	BF*OES	BF*XRF	AF*XRF	BF*OES
1	0.102	0.096	0.087	0.100	0.100	0.100
2	0.096	0.103	0.087	0.100	0.100	0.100
3	0.102	0.109	0.088	0.100	0.101	0.100
4	0.099	0.103	0.089	0.100	0.100	0.100
5	0.100	0.103	0.088	0.100	0.101	0.140
Mean	0.100	0.103	0.088	0.100	0.100	0.108
Median	0.100	0.103	0.088	0.100	0.100	0.100
Std.Dev.	0.00	0.00	0.00	0.00	0.00	0.02
Rel.Std.Dev.	2.32%	4.71%	0.75%	0.00%	0.37%	16.6%
PDM ³	-0.64%	2.07%	-12.8%	-0.52%	-0.38%	7.44%

Table C6. Analytical results for iron in standard OREAS 45c (refer Table C1 for abbreviations; values in wt. %).

Replicate No.	Lab A	Lab B	Lab C	Lab D	Lab E	Lab F
	AF*OES	BF*XRF	BF*OES	BF*XRF	AF*XRF	BF*OES
1	0.102	0.096	0.087	0.100	0.100	0.100
2	0.096	0.103	0.087	0.100	0.100	0.100
3	0.102	0.109	0.088	0.100	0.101	0.100
4	0.099	0.103	0.089	0.100	0.100	0.100
5	0.100	0.103	0.088	0.100	0.101	0.140
Mean	0.100	0.103	0.088	0.100	0.100	0.108
Median	0.100	0.103	0.088	0.100	0.100	0.100
Std.Dev.	0.00	0.00	0.00	0.00	0.00	0.02
Rel.Std.Dev.	2.32%	4.71%	0.75%	0.00%	0.37%	16.6%
PDM ³	-0.64%	2.07%	-12.8%	-0.52%	-0.38%	7.44%

Table C7. Analytical results for potassium in standard OREAS 45c (refer Table C1 for abbreviations; values in wt. %).

Replicate No.	Lab A	Lab B	Lab C	Lab D	Lab E	Lab F
	AF*OES	BF*XRF	BF*OES	BF*XRF	AF*XRF	BF*OES
1	0.40	0.37	0.32	0.35	0.34	0.35
2	0.39	0.37	0.33	0.35	0.34	0.35
3	0.40	0.36	0.32	0.35	0.34	0.35
4	0.41	0.37	0.33	0.35	0.35	0.35
5	0.37	0.36	0.34	0.35	0.34	0.57
Mean	0.39	0.36	0.33	0.35	0.34	0.39
Median	0.40	0.37	0.33	0.35	0.34	0.35
Std.Dev.	0.0	0.0	0.0	0.0	0.0	0.1
Rel.Std.Dev.	3.85%	1.26%	2.07%	0.00%	1.09%	25.0%
PDM ³	13.7%	4.43%	-5.15%	1.02%	-1.32%	13.7%

Table C8. Analytical results for loss on ignition volatiles in standard OREAS 45c (refer Table C1 for abbreviations; values in wt. %).

Replicate No.	Lab A	Lab B	Lab C	Lab D	Lab E	Lab F
	LOI	BF*XRF	BF*OES	BF*XRF	LOI	BF*OES
1	11.77	11.70	13.55	11.93	11.61	11.35
2	11.84	11.70	13.55	11.93	11.56	11.35
3	11.46	11.80	13.30	11.92	11.61	11.35
4	11.76	11.80	13.60	11.92	11.63	11.35
5	11.75	11.90	13.55	11.74	11.55	11.35
Mean	11.72	11.78	13.51	11.89	11.59	11.35
Median	11.76	11.80	13.55	11.92	11.61	11.35
Std.Dev.	0.1	0.1	0.1	0.1	0.0	0.0
Rel.Std.Dev.	1.26%	0.71%	0.88%	0.70%	0.30%	0.00%
PDM ³	0.26%	0.81%	15.6%	1.73%	-0.80%	-2.87%

Table C9. Analytical results for magnesium in standard OREAS 45c (refer Table C1 for abbreviations; values in wt. %).

Replicate No.	Lab A	Lab B	Lab C	Lab D	Lab E	Lab F
	AF*OES	BF*XRF	BF*OES	BF*XRF	AF*XRF	BF*OES
1	0.29	0.27	0.26	0.26	0.27	0.28
2	0.28	0.28	0.26	0.26	0.26	0.28
3	0.28	0.28	0.27	0.26	0.27	0.26
4	0.28	0.28	0.27	0.26	0.27	0.31
5	0.28	0.27	0.26	0.26	0.27	0.40
Mean	0.28	0.27	0.26	0.26	0.27	0.31
Median	0.28	0.28	0.26	0.26	0.27	0.28
Std.Dev.	0.004	0.005	0.004	0.000	0.005	0.055
Rel.Std.Dev.	1.59%	1.97%	1.50%	0.00%	1.89%	18.1%
PDM ³	3.94%	0.93%	-3.08%	-4.17%	-1.74%	12.8%

Table C10. Analytical results for manganese in OREAS 45c (refer Table C1 for abbreviations; values in wt. %).

Replicate No.	Lab A	Lab B	Lab C	Lab D	Lab E	Lab F
	AF*OES	BF*XRF	BF*OES	BF*XRF	AF*XRF	BF*OES
1	0.115	0.124	0.108	0.110	0.108	0.120
2	0.114	0.116	0.108	0.120	0.108	0.120
3	0.116	0.124	0.108	0.110	0.116	0.120
4	0.116	0.124	0.108	0.120	0.116	0.120
5	0.116	0.124	0.108	0.110	0.116	0.160
Mean	0.115	0.122	0.108	0.114	0.113	0.128
Median	0.116	0.124	0.108	0.110	0.116	0.120
Std.Dev.	0.001	0.003	0.000	0.005	0.004	0.018
Rel.Std.Dev.	0.84%	2.83%	0.00%	4.80%	3.75%	14.0%
PDM ³	-0.07%	5.90%	-6.16%	-1.36%	-2.14%	10.8%

Table C11. Analytical results for sodium in standard OREAS 45c (refer Table C1 for abbreviations; values in wt. %).

Replicate No.	Lab G	Lab A	Lab B	Lab C	Lab D	Lab E	Lab F
	INAA (4.0g)	AF*OES	BF*XRF	BF*OES	BF*XRF	BF*XRF	BF*OES
1	0.105	0.104	0.104	0.096	0.090	0.104	0.100
2	0.108	0.104	0.111	0.085	0.080	0.104	0.100
3	0.108	0.103	0.111	0.096	0.090	0.104	0.100
4	0.107	0.105	0.111	0.104	0.090	0.104	0.100
5	0.106	0.104	0.111	0.096	0.090	0.141	0.100
6	0.108						
7	0.104						
8	0.105						
9	0.103						
10	0.102						
11	0.104						
12	0.104						
13	0.105						
14	0.104						
15	0.106						
16	0.105						
17	0.108						
18	0.105						
19	0.106						
20	0.104						
Mean	0.105	0.104	0.110	0.096	0.088	0.111	0.100
Median	0.105	0.104	0.111	0.096	0.090	0.104	0.100
Std.Dev.	0.002	0.001	0.003	0.007	0.004	0.017	0.000
Rel.Std.Dev.	1.67%	0.67%	3.02%	6.93%	5.08%	14.9%	0.00%
PDM ³	2.19%	0.70%	6.50%	-7.18%	-14.6%	7.93%	-3.00%

Table C12. Analytical results for phosphorous in OREAS 45c (refer Table C1 for abbreviations; values in wt. %).

Replicate No.	Lab A	Lab B	Lab C	Lab D	Lab E	Lab F
	AF*OES	BF*XRF	BF*OES	BF*XRF	AF*XRF	BF*OES
1	0.0513	0.0567	0.0502	0.0540	0.0515	<0.1
2	0.0529	0.0567	0.0546	0.0530	0.0511	<0.1
3	0.0521	0.0480	0.0546	0.0530	0.0524	0.1000
4	0.0532	0.0567	0.0546	0.0530	0.0506	0.1000
5	0.0526	0.0524	0.0567	0.0530	0.0515	<0.1
Mean	0.0524	0.0541	0.0541	0.0532	0.0514	<0.1
Median	0.053	0.057	0.055	0.053	0.052	<0.1
Std.Dev.	0.001	0.004	0.002	0.000	0.001	-
Rel.Std.Dev.	1.42%	7.21%	4.42%	0.84%	1.26%	-
PDM ³	-1.20%	2.01%	2.01%	0.27%	-3.09%	-

Table C13. Analytical results for sulphur in standard OREAS 45c (refer Table C1 for abbreviations; values in wt. %).

Replicate No.	Lab A	Lab B	Lab C	Lab D	Lab E	Lab F
	Leco	Leco	BF*OES	Leco	Leco	Leco
1	0.027	<0.01	0.030	0.027	0.040	0.030
2	0.028	<0.01	0.035	0.026	0.040	0.030
3	0.030	<0.01	0.035	0.024	0.040	0.030
4	0.030	<0.01	0.040	0.024	0.030	0.030
5	0.030	<0.01	0.035	0.027	0.030	0.030
Mean	0.029	<0.01	0.035	0.026	0.036	0.030
Median	0.030	<0.01	0.035	0.026	0.040	0.030
Std.Dev.	0.00	-	0.00	0.00	0.01	0.00
Rel.Std.Dev.	4.88%	-	10.1%	5.92%	15.2%	0.00%
PDM ³	-6.81%	-	12.5%	-17.7%	15.7%	-3.60%

Table C14. Analytical results for silicon in standard OREAS 45c (refer Table C1 for abbreviations; values in wt. %).

Replicate No.	Lab A	Lab B	Lab C	Lab D	Lab E	Lab F
	AF*OES	BF*XRF	BF*OES	BF*XRF	AF*XRF	BF*OES
1	20.40	19.87	19.77	20.07	20.06	20.78
2	20.20	19.88	19.84	20.17	20.10	20.90
3	20.60	19.87	19.92	20.03	20.10	20.47
4	20.50	19.84	19.74	20.16	20.01	20.72
5	20.50	19.89	19.78	20.10	20.06	21.79
Mean	20.44	19.87	19.81	20.11	20.07	20.93
Median	20.50	19.87	19.78	20.10	20.06	20.78
Std.Dev.	0.15	0.02	0.07	0.06	0.04	0.50
Rel.Std.Dev.	0.74%	0.10%	0.36%	0.30%	0.19%	2.41%
PDM ³	1.35%	-1.47%	-1.78%	-0.31%	-0.51%	3.79%

Table C15. Analytical results for titanium in standard OREAS 45c (refer Table C1 for abbreviations; values in wt. %).

Replicate No.	Lab A	Lab B	Lab C	Lab D	Lab E	Lab F
	AF*OES	BF*XRF	BF*OES	BF*XRF	AF*XRF	BF*OES
1	1.35	1.49	1.34	1.31	1.26	1.42
2	1.33	1.47	1.33	1.31	1.29	1.40
3	1.36	1.49	1.33	1.30	1.29	1.32
4	1.34	1.48	1.32	1.29	1.27	1.40
5	1.37	1.48	1.34	1.30	1.28	1.46
Mean	1.35	1.48	1.33	1.30	1.28	1.40
Median	1.35	1.48	1.33	1.30	1.28	1.40
Std.Dev.	0.02	0.01	0.01	0.01	0.01	0.05
Rel.Std.Dev.	1.17%	0.60%	0.54%	0.64%	0.97%	3.64%
PDM ³	-0.60%	9.12%	-1.74%	-4.14%	-5.71%	3.08%

APPENDIX D

Analytical Results for lithophile trace elements by fusion ICPMS in OREAS 45c

Table D1. Key to abbreviations used in Tables D2 – D24.

Abbreviation	Explanation
Std.Dev.	one sigma standard deviation
Rel.Std.Dev.	one sigma relative standard deviation
PDM ³	percent deviation of lab mean from corrected mean of means
AF	alkali fusion
BF	lithium metaborate fusion
MS	inductively coupled plasma mass spectrometry

Table D2. Analytical results for barium in standard OREAS 45c (refer Table A1 for abbreviations; values in ppm).

Replicate No.	Lab A	Lab B	Lab C	Lab D	Lab E	Lab F
	AF*MS	AF*MS	BF*MS	AF*MS	AF*MS	AF*MS
1	269	326	270	260	270	278
2	268	321	268	280	270	274
3	262	322	270	260	270	278
4	266	318	273	275	270	278
5	261	293	275	265	270	279
Mean	265	316	271	268	270	277
Median	266	321	270	265	270	278
Std.Dev.	3.6	13.2	2.5	9.1	0.0	1.9
Rel.Std.Dev.	1.34%	4.17%	0.93%	3.39%	0.00%	0.70%
PDM ³	-1.89%	16.9%	0.25%	-0.86%	-0.12%	2.62%

Table D3. Analytical results for cerium in standard OREAS 45c (refer Table A1 for abbreviations; values in ppm).

Replicate No.	Lab G	Lab A	Lab B	Lab C	Lab D	Lab E	Lab F
	INAA (4.0g)	AF*MS	AF*MS	BF*MS	AF*MS	-	AF*MS
1	50.8	48.3	59.8	49.8	50.6	N/A	51.4
2	50.2	49.3	60.4	49.2	51.7	N/A	49.5
3	48.6	47.9	59.7	50.6	49.6	N/A	51.5
4	50.5	48.3	58.3	47.9	50.5	N/A	52.0
5	52.0	47.8	53.6	50.7	49.8	N/A	50.8
6	51.1						
7	51.7						
8	50.5						
9	53.1						
10	51.1						
11	48.0						
12	53.6						
13	52.1						
14	49.2						
15	53.5						
16	52.6						
17	53.4						
18	53.2						
19	52.4						
20	53.1						
Mean	51.5	48.3	58.4	49.6	50.4	-	51.0
Median	51.8	48.3	59.7	49.8	50.5	-	51.4
Std.Dev.	1.7	0.6	2.8	1.1	0.8	-	1.0
Rel.Std.Dev.	3.23%	1.23%	4.75%	2.31%	1.64%	-	1.88%
PDM ³	2.67%	-3.73%	16.3%	-1.12%	0.49%	-	1.69%

Table D4. Analytical results for dysprosium in standard OREAS 45c (refer Table A1 for abbreviations; values in ppm).

Replicate No.	Lab A	Lab B	Lab C	Lab D	Lab E	Lab F
	AF*MS	AF*MS	BF*MS	-	-	AF*MS
1	4.3	4.1	3.9	N/A	N/A	4.1
2	4.1	4.1	4.0	N/A	N/A	4.0
3	4.0	4.2	4.0	N/A	N/A	3.9
4	4.6	4.0	3.8	N/A	N/A	3.9
5	4.4	3.8	3.9	N/A	N/A	4.0
Mean	4.3	4.0	3.9	-	-	4.0
Median	4.3	4.1	3.9	-	-	4.0
Std.Dev.	0.24	0.15	0.09	-	-	0.08
Rel.Std.Dev.	5.58%	3.75%	2.34%	-	-	2.10%
PDM ³	7.45%	1.42%	-1.34%	-	-	-0.08%

Table D5. Analytical results for erbium in standard OREAS 45c (refer Table A1 for abbreviations; values in ppm).

Replicate No.	Lab A	Lab B	Lab C	Lab D	Lab E	Lab F
	AF*MS	AF*MS	BF*MS	-	-	AF*MS
1	2.3	2.3	1.9	N/A	N/A	2.2
2	2.1	2.2	2.0	N/A	N/A	2.1
3	2.0	2.4	2.1	N/A	N/A	2.2
4	1.9	2.3	2.0	N/A	N/A	2.2
5	2.0	2.2	2.1	N/A	N/A	2.1
Mean	2.1	2.3	2.0	-	-	2.2
Median	2.0	2.3	2.0	-	-	2.2
Std.Dev.	0.15	0.08	0.07	-	-	0.05
Rel.Std.Dev.	7.36%	3.67%	3.43%	-	-	2.54%
PDM ³	-3.35%	6.97%	-4.95%	-	-	1.34%

Table D6. Analytical results for europium in standard OREAS 45c (refer Table A1 for abbreviations; values in ppm).

Replicate No.	Lab A	Lab B	Lab C	Lab D	Lab E	Lab F
	AF*MS	AF*MS	BF*MS	-	-	AF*MS
1	1.20	1.10	1.23	N/A	N/A	1.20
2	1.20	1.10	1.13	N/A	N/A	1.30
3	1.30	1.10	1.22	N/A	N/A	1.20
4	1.30	1.10	1.15	N/A	N/A	1.20
5	1.10	1.00	1.26	N/A	N/A	1.30
Mean	1.22	1.08	1.20	-	-	1.24
Median	1.20	1.10	1.22	-	-	1.20
Std.Dev.	0.1	0.0	0.1	-	-	0.1
Rel.Std.Dev.	6.86%	4.14%	4.48%	-	-	4.42%
PDM ³	3.04%	-8.78%	1.01%	-	-	4.73%

Table D7. Analytical results for gadolinium in standard OREAS 45c (refer Table A1 for abbreviations; values in ppm).

Replicate No.	Lab A	Lab B	Lab C	Lab D	Lab E	Lab F
	AF*MS	AF*MS	BF*MS	-	-	AF*MS
1	4.0	4.2	4.1	N/A	N/A	4.4
2	4.1	4.3	4.0	N/A	N/A	4.2
3	3.8	4.1	4.2	N/A	N/A	4.5
4	4.0	4.2	4.1	N/A	N/A	4.3
5	3.9	4.2	4.2	N/A	N/A	4.4
Mean	4.0	4.2	4.1	-	-	4.4
Median	4.0	4.2	4.1	-	-	4.4
Std.Dev.	0.1	0.1	0.1	-	-	0.1
Rel.Std.Dev.	2.88%	1.68%	1.71%	-	-	2.62%
PDM ³	-4.86%	0.91%	-0.80%	-	-	4.75%

Table D8. Analytical results for holmium in standard OREAS 45c (refer Table A1 for abbreviations; values in ppm).

Replicate No.	Lab A	Lab B	Lab C	Lab D	Lab E	Lab F
	AF*MS	AF*MS	BF*MS	-	-	AF*MS
1	0.70	0.80	0.75	N/A	N/A	0.80
2	0.80	0.80	0.78	N/A	N/A	0.80
3	0.70	0.80	0.73	N/A	N/A	0.70
4	0.70	0.80	0.77	N/A	N/A	0.80
5	0.70	0.70	0.75	N/A	N/A	0.80
Mean	0.7	0.8	0.8	-	-	0.8
Median	0.7	0.8	0.8	-	-	0.8
Std.Dev.	0.0	0.0	0.0	-	-	0.0
Rel.Std.Dev.	6.21%	5.73%	2.56%	-	-	5.73%
PDM ³	-5.01%	2.90%	-0.79%	-	-	2.90%

Table D9. Analytical results for lanthanum in standard OREAS 45c (refer Table A1 for abbreviations; values in ppm).

Replicate No.	Lab G	Lab A	Lab B	Lab C	Lab D	Lab E	Lab F
	INAA (4.0g)	AF*MS	AF*MS	BF*MS	AF*MS	-	AF*MS
1	26.09	25.6	31.2	25.8	27.3	N/A	25.2
2	26.80	25.2	30.8	25.9	28.7	N/A	25.7
3	26.31	24.5	30.8	26.8	27.2	N/A	24.9
4	26.14	25.8	30.4	25.5	27.6	N/A	25.3
5	26.44	25.0	27.6	26.5	27.6	N/A	26.7
6	26.46						
7	26.24						
8	26.69						
9	26.12						
10	26.02						
11	26.25						
12	26.50						
13	26.23						
14	26.07						
15	26.65						
16	26.18						
17	26.47						
18	26.13						
19	26.25						
20	26.28						
Mean	26.3	25.2	30.2	26.1	27.7	-	25.6
Median	26.3	25.2	30.8	25.9	27.6	-	25.3
Std.Dev.	0.2	0.5	1.5	0.5	0.6	-	0.7
Rel.Std.Dev.	0.84%	2.03%	4.84%	2.06%	2.16%	-	2.73%
PDM ³	0.58%	-3.61%	15.3%	-0.36%	5.79%	-	-2.31%

Table D10. Analytical results for lutetium in standard OREAS 45c (refer Table A1 for abbreviations; values in ppm).

Replicate No.	Lab G	Lab A	Lab B	Lab C	Lab D	Lab E	Lab F
	INAA (4.0g)	AF*MS	AF*MS	BF*MS	-	-	AF*MS
1	0.33	0.34	0.40	0.30	N/A	N/A	0.30
2	0.29	0.31	0.30	0.32	N/A	N/A	0.30
3	0.29	0.25	0.30	0.28	N/A	N/A	0.30
4	0.30	0.36	0.30	0.31	N/A	N/A	0.30
5	0.33	0.33	0.30	0.32	N/A	N/A	0.30
6	0.31						
7	0.30						
8	0.29						
9	0.30						
10	0.30						
11	0.30						
12	0.29						
13	0.29						
14	0.28						
15	0.30						
16	0.28						
17	0.30						
18	0.28						
19	0.32						
20	0.30						
Mean	0.30	0.32	0.32	0.30	-	-	0.30
Median	0.30	0.33	0.30	0.31	-	-	0.30
Std.Dev.	0.01	0.04	0.04	0.02	-	-	0.00
Rel.Std.Dev.	4.84%	13.2%	14.0%	5.12%	-	-	0.00%
PDM ³	-4.04%	2.05%	2.70%	-2.44%	-	-	-3.72%

Table D11. Analytical results for niobium in standard OREAS 45c (refer Table A1 for abbreviations; values in ppm).

Replicate No.	Lab A	Lab B	Lab C	Lab D	Lab E	Lab F
	AF*MS	AF*MS	BF*MS	AF*MS	AF*MS	AF*MS
1	30	27	26	31	33	27
2	29	27	26	29	34	27
3	30	27	27	29	33	26
4	30	28	25	29	32	27
5	30	27	27	29	32	27
Mean	30	27	26	29	33	27
Median	30	27	26	29	33	27
Std.Dev.	0.4	0.4	0.5	0.9	0.8	0.4
Rel.Std.Dev.	1.50%	1.64%	2.03%	3.04%	2.55%	1.67%
PDM ³	3.86%	-5.20%	-8.83%	2.46%	14.3%	-6.60%

Table D12. Analytical results for neodymium in standard OREAS 45c (refer Table A1 for abbreviations; values in ppm).

Replicate No.	Lab A	Lab B	Lab C	Lab D	Lab E	Lab F
	AF*MS	AF*MS	BF*MS	-	-	AF*MS
1	22.5	26.1	22.2	N/A	N/A	21.7
2	21.7	25.7	21.7	N/A	N/A	21.8
3	21.2	25.5	22.0	N/A	N/A	21.3
4	21.8	25.5	21.6	N/A	N/A	21.7
5	21.4	23.0	23.0	N/A	N/A	21.8
Mean	21.7	25.2	22.1	-	-	21.7
Median	21.7	25.5	22.0	-	-	21.7
Std.Dev.	0.5	1.2	0.5	-	-	0.2
Rel.Std.Dev.	2.29%	4.90%	2.48%	-	-	0.96%
PDM ³	-4.68%	10.4%	-3.15%	-	-	-4.95%

Table D13. Analytical results for praseodymium in standard OREAS 45c (refer Table A1 for abbreviations; values in ppm).

Replicate No.	Lab A	Lab B	Lab C	Lab D	Lab E	Lab F
	AF*MS	AF*MS	BF*MS	-	-	AF*MS
1	5.59	7.10	5.74	N/A	N/A	5.60
2	5.79	7.10	5.68	N/A	N/A	5.50
3	5.53	7.20	5.76	N/A	N/A	5.40
4	5.59	7.00	5.65	N/A	N/A	5.60
5	5.46	6.20	5.81	N/A	N/A	5.50
Mean	5.59	6.92	5.73	-	-	5.52
Median	5.59	7.10	5.74	-	-	5.50
Std.Dev.	0.12	0.41	0.06	-	-	0.08
Rel.Std.Dev.	2.20%	5.91%	1.08%	-	-	1.52%
PDM ³	-0.37%	23.3%	2.02%	-	-	-1.65%

Table D14. Analytical results for rubidium in standard OREAS 45c (refer Table A1 for abbreviations; values in ppm).

Replicate No.	Lab A	Lab B	Lab C	Lab D	Lab E	Lab F
	AF*MS	AF*MS	BF*MS	AF*MS	AF*MS	AF*MS
1	22.0	23.0	23.3	23.5	24.0	22.9
2	22.1	22.8	22.5	24.1	26.0	23.2
3	22.1	22.9	23.9	23.1	26.0	23.5
4	23.1	23.2	22.6	23.6	26.0	23.5
5	22.1	22.6	24.2	23.6	26.0	22.9
Mean	22.3	22.9	23.3	23.6	25.6	23.2
Median	22.1	22.9	23.3	23.6	26.0	23.2
Std.Dev.	0.46	0.22	0.76	0.36	0.89	0.30
Rel.Std.Dev.	2.07%	0.98%	3.27%	1.51%	3.49%	1.29%
PDM ³	-3.32%	-0.63%	0.97%	2.32%	11.1%	0.67%

Table D15. Analytical results for samarium in standard OREAS 45c (refer Table A1 for abbreviations; values in ppm).

Replicate No.	Lab G	Lab A	Lab B	Lab C	Lab D	Lab E	Lab F
	INAA (4.0g)	AF*MS	AF*MS	BF*MS	-	-	AF*MS
1	4.94	4.7	5.6	4.6	N/A	N/A	4.7
2	5.16	4.6	5.5	4.9	N/A	N/A	4.6
3	5.13	4.4	5.7	4.8	N/A	N/A	4.7
4	4.99	4.6	5.6	4.5	N/A	N/A	4.5
5	5.08	4.6	4.9	4.8	N/A	N/A	4.7
6	5.06						
7	4.93						
8	5.07						
9	5.03						
10	5.08						
11	5.02						
12	5.05						
13	5.14						
14	4.96						
15	5.04						
16	4.96						
17	5.05						
18	4.86						
19	5.00						
20	5.01						
Mean	5.03	4.58	5.46	4.71	-	-	4.64
Median	5.04	4.60	5.60	4.80	-	-	4.70
Std.Dev.	0.08	0.11	0.32	0.18	-	-	0.09
Rel.Std.Dev.	1.49%	2.39%	5.88%	3.86%	-	-	1.93%
PDM ³	6.04%	-3.41%	15.1%	-0.67%	-	-	-2.15%

Table D16. Analytical results for tin in standard OREAS 45c (refer Table A1 for abbreviations; values in ppm).

Replicate No.	Lab A	Lab B	Lab C	Lab D	Lab E	Lab F
	AF*MS	AF*MS	BF*MS	-	AF*MS	AF*MS
1	3.0	4.0	3.0	N/A	< 10	4.0
2	3.0	4.0	3.0	N/A	< 10	3.0
3	3.0	4.0	3.0	N/A	< 10	3.0
4	4.0	4.0	2.5	N/A	< 10	4.0
5	4.0	3.0	3.0	N/A	< 10	3.0
Mean	3.4	3.8	2.9	-	-	3.4
Median	3.0	4.0	3.0	-	-	3.0
Std.Dev.	0.5	0.4	0.2	-	-	0.5
Rel.Std.Dev.	16.1%	11.8%	7.71%	-	-	16.1%
PDM ³	0.74%	12.6%	-14.1%	-	-	0.74%

Table D17. Analytical results for strontium in standard OREAS 45c (refer Table A1 for abbreviations; values in ppm).

Replicate No.	Lab A	Lab B	Lab C	Lab D	Lab E	Lab F
	AF*MS	AF*MS	BF*MS	AF*MS	AF*MS	AF*MS
1	45.0	37.2	34.1	36.7	37.0	36.4
2	45.0	35.6	35.5	39.5	37.0	36.5
3	47.0	36.5	37.2	36.6	37.0	36.4
4	49.0	37.0	34.7	36.1	37.0	37.1
5	47.0	34.9	36.5	35.3	37.0	37.8
Mean	46.6	36.2	35.6	36.8	37.0	36.8
Median	47.0	36.5	35.5	36.6	37.0	36.5
Std.Dev.	1.67	0.97	1.25	1.59	0.00	0.61
Rel.Std.Dev.	3.59%	2.68%	3.53%	4.31%	0.00%	1.66%
PDM ³	28.1%	-0.35%	-2.16%	1.30%	1.74%	1.30%

Table D18. Analytical results for terbium in standard OREAS 45c (refer Table A1 for abbreviations; values in ppm).

Replicate No.	Lab A	Lab B	Lab C	Lab D	Lab E	Lab F
	AF*MS	AF*MS	BF*MS	-	-	AF*MS
1	0.69	0.70	0.70	N/A	N/A	0.70
2	0.61	0.70	0.69	N/A	N/A	0.70
3	0.70	0.80	0.72	N/A	N/A	0.70
4	0.64	0.80	0.66	N/A	N/A	0.70
5	0.67	0.70	0.72	N/A	N/A	0.70
Mean	0.66	0.74	0.69	-	-	0.70
Median	0.67	0.70	0.70	-	-	0.70
Std.Dev.	0.04	0.05	0.02	-	-	0.00
Rel.Std.Dev.	5.59%	7.40%	3.54%	-	-	0.00%
PDM ³	-5.29%	5.87%	-0.72%	-	-	0.14%

Table D19. Analytical results for thorium in standard OREAS 45c (refer Table A1 for abbreviations; values in ppm).

Replicate No.	Lab A	Lab B	Lab C	Lab D	Lab E	Lab F
	AF*MS	AF*MS	BF*MS	AF*MS	AF*MS	AF*MS
1	9.8	11.0	10.5	9.0	9.5	10.0
2	9.7	11.0	10.7	8.9	10.0	11.0
3	9.4	12.0	10.4	12.2	10.0	11.0
4	9.4	11.0	11.0	8.9	9.5	11.0
5	9.4	11.0	11.0	9.1	9.5	11.0
Mean	9.5	11.2	10.7	9.6	9.7	10.8
Median	9.4	11.0	10.7	9.0	9.5	11.0
Std.Dev.	0.2	0.4	0.3	1.4	0.3	0.4
Rel.Std.Dev.	2.04%	3.99%	2.59%	15.0%	2.82%	4.14%
PDM ³	-6.02%	10.3%	5.31%	-5.23%	-4.44%	6.40%

Table D20. Analytical results for thulium in standard OREAS 45c (refer Table A1 for abbreviations; values in ppm).

Replicate No.	Lab A	Lab B	Lab C	Lab D	Lab E	Lab F
	AF*MS	AF*MS	BF*MS	-	-	AF*MS
1	0.30	0.30	0.32	N/A	N/A	0.30
2	0.30	0.30	0.32	N/A	N/A	0.30
3	0.30	0.30	0.32	N/A	N/A	0.30
4	0.30	0.30	0.30	N/A	N/A	0.30
5	0.30	0.30	0.33	N/A	N/A	0.30
Mean	0.30	0.30	0.32	-	-	0.30
Median	0.30	0.30	0.32	-	-	0.30
Std.Dev.	0.00	0.00	0.01	-	-	0.00
Rel.Std.Dev.	0.00%	0.00%	3.72%	-	-	0.00%
PDM ³	-1.64%	-1.64%	3.28%	-	-	-1.64%

Table D21. Analytical results for uranium in standard OREAS 45c (refer Table A1 for abbreviations; values in ppm).

Replicate No.	Lab A	Lab B	Lab C	Lab D	Lab E	Lab F
	AF*MS	AF*MS	BF*MS	AF*MS	AF*MS	AF*MS
1	2.5	2.8	2.8	2.0	3.0	2.4
2	2.4	2.7	2.6	2.2	3.0	2.5
3	2.3	2.8	2.7	2.2	3.0	2.4
4	2.4	2.7	2.4	2.1	3.0	2.4
5	2.4	2.6	2.7	2.3	3.0	2.6
Mean	2.4	2.7	2.6	2.2	3.0	2.5
Median	2.4	2.7	2.7	2.2	3.0	2.4
Std.Dev.	0.07	0.08	0.13	0.11	0.00	0.09
Rel.Std.Dev.	2.95%	3.08%	4.96%	5.28%	0.00%	3.64%
PDM ³	-6.19%	6.32%	2.02%	-15.6%	17.3%	-3.84%

Table D22. Analytical results for yttrium in standard OREAS 45c (refer Table A1 for abbreviations; values in ppm).

Replicate No.	Lab A	Lab B	Lab C	Lab D	Lab E	Lab F
	AF*MS	AF*MS	BF*MS	AF*MS	AF*MS	AF*MS
1	15.8	18.2	19.2	16.6	19.0	18.0
2	15.8	17.8	19.2	17.5	21.0	17.9
3	16.2	18.6	19.5	17.0	19.0	18.0
4	17.2	17.9	18.9	17.2	21.0	18.7
5	16.7	17.0	19.6	17.1	20.0	17.4
Mean	16.3	17.9	19.3	17.1	20.0	18.0
Median	16.2	17.9	19.2	17.1	20.0	18.0
Std.Dev.	0.61	0.59	0.28	0.33	1.00	0.46
Rel.Std.Dev.	3.71%	3.31%	1.44%	1.92%	5.00%	2.58%
PDM ³	-9.72%	-1.10%	6.52%	-5.64%	10.5%	-0.55%

Table D23. Analytical results for ytterbium in standard OREAS 45c (refer Table A1 for abbreviations; values in ppm).

Replicate No.	Lab G	Lab A	Lab B	Lab C	Lab D	Lab E	Lab F
	INAA (4.0g)	AF*MS	AF*MS	BF*MS	AF*MS	-	AF*MS
1	2.23	2.1	2.2	2.1	2.0	N/A	2.23
2	2.34	2.1	2.3	2.2	2.1	N/A	2.34
3	2.02	2.0	2.4	2.1	2.0	N/A	2.02
4	2.08	2.2	2.3	2.3	2.1	N/A	2.08
5	2.22	2.0	2.1	2.3	2.0	N/A	2.22
6	2.24						2.24
7	2.27						2.27
8	2.04						2.04
9	2.15						2.15
10	2.30						2.30
11	2.20						2.20
12	2.13						2.13
13	2.22						2.22
14	1.96						1.96
15	2.34						2.34
16	2.05						2.05
17	2.30						2.30
18	2.05						2.05
19	2.12						2.12
20	2.36						2.36
Mean	2.18	2.08	2.26	2.19	2.04	-	2.18
Median	2.21	2.10	2.30	2.16	2.00	-	2.21
Std.Dev.	0.12	0.08	0.11	0.10	0.05	-	0.12
Rel.Std.Dev.	5.51%	4.02%	5.05%	4.61%	2.68%	-	5.51%
PDM ³	1.85%	-2.86%	5.54%	2.13%	-4.73%	-	1.85%

Table D24. Analytical results for zirconium in standard OREAS 45c (refer Table A1 for abbreviations; values in ppm).

Replicate No.	Lab A	Lab B	Lab C	Lab D	Lab E	Lab F
	AF*MS	AF*MS	BF*MS	-	AF*MS	AF*MS
1	285	283	291	N/A	310	308
2	281	274	287	N/A	320	306
3	276	274	294	N/A	310	309
4	315	288	285	N/A	310	314
5	290	271	301	N/A	300	310
Mean	289	278	292	-	310	309
Median	285	274	291	-	310	309
Std.Dev.	15.2	7.2	6.1	-	7.1	3.0
Rel.Std.Dev.	5.26%	2.58%	2.10%	-	2.28%	0.96%
PDM ³	-1.53%	-5.40%	-0.81%	-	5.48%	5.28%