ORE RESEARCH & EXPLORATION P/L ABN 28 006 859 856
37A Hosie Street · Bayswater North · VIC 3153 · AUSTRALIA
61 3 9729 0333 61 3 9761 7878
info@ore.com.au www.ore.com.au

CERTIFICATE OF ANALYSIS FOR

ANOMALOUS FERRUGINOUS SOIL REFERENCE MATERIAL

OREAS 45d

Table 1. Fire Assay - Certified Values, SDs, 95% Confidence and Tolerance Limits for OREAS 45d

Constituent	Certified Value	1SD	95% Confidence Limits		95% Tolerance Limits	
			Low	High	Low	High
Fire Assay with ICP-OES / ICP-MS / AAS (undried basis)						
Gold, Au (ppb)	23	2	22	24	22	24
Palladium, Pd (ppb)	35	2	34	35	33	36
Platinum, Pt (ppb)	48	3	47	50	46	51

Note: intervals may appear asymmetric due to rounding.

Table 2. Fusion XRF - Certified Values, SDs, 95% Confidence and Tolerance Limits for OREAS 45d

Constituent	Certified Value	1SD	95% Confidence Limits		95% Tolerance Limits	
			Low	High	Low	High
Fusion XRF (dry basis)						
Aluminium Oxide, Al_2O_3 (wt.%)	15.99	0.187	15.89	16.10	15.90	16.08
Barium Oxide, BaO (ppm)	198	23	180	216	0	0
Calcium Oxide, CaO (wt.%)	0.264	0.005	0.261	0.267	0.232	0.296
Chromium Oxide, Cr_2O_3 (ppm)	879	41.4	859	899	829	929
Iron(III) Oxide, Fe_2O_3 (wt.%)	21.38	0.200	21.27	21.49	21.26	21.50
Potassium Oxide, K_2O (wt.%)	0.510	0.005	0.507	0.512	0.505	0.514
Magnesium Oxide, MgO (wt.%)	0.421	0.016	0.412	0.430	0.410	0.433
Manganese Oxide, MnO (wt.%)	0.066	0.005	0.063	0.068	0.064	0.068
Sodium Oxide, Na_2O (wt.%)	0.125	0.016	0.116	0.135	IND	IND
Phosphorus Oxide, P_2O_5 (wt.%)	0.099	0.006	0.096	0.102	0.097	0.101
Silicon Dioxide, SiO_2 (wt.%)	49.63	0.327	49.45	49.81	49.42	49.84
Titanium Oxide, TiO_2 (wt.%)	1.49	0.026	1.47	1.50	1.47	1.50
Vanadium Oxide, V_2O_5 (ppm)	425	37.2	399	451	IND	IND
Loss on ignition, LOI (wt.%)	9.37	0.124	9.30	9.44	9.31	9.43

Note: intervals may appear asymmetric due to rounding.

Table 3. 4-Acid ICP - Certified Values, SDs, 95% Confidence and Tolerance Limits for OREAS 45d

Constituent	Certified Value	1SD	95% Confidence Limits		95% Tolerance Limits	
			Low	High	Low	High
Four Acid Digestion ICP-OES / ICP-MS (undried basis)						
Aluminium, Al (wt.%)	8.15	0.253	8.02	8.28	7.94	8.37
Arsenic, As (ppm)	13.8	0.86	13.5	14.1	13.2	14.4
Barium, Ba (ppm)	183	9.7	179	187	177	189
Beryllium, Be (ppm)	0.79	0.11	0.73	0.86	0.71	0.88
Bismuth, Bi (ppm)	0.31	0.03	0.29	0.33	0.29	0.34
Calcium, Ca (wt.%)	0.185	0.015	0.179	0.192	0.176	0.194
Cerium, Ce (ppm)	37.2	3.06	35.3	39.0	35.3	39.0
Cobalt, Co (ppm)	29.5	1.61	28.7	30.2	28.6	30.3
Chromium, Cr (ppm)	549	32.8	531	566	534	564
Cesium, Cs (ppm)	3.91	0.299	3.72	4.10	3.78	4.04
Copper, Cu (ppm)	371	12.8	366	377	363	379
Dysprosium, Dy (ppm)	2.26	0.210	2.05	2.48	2.09	2.44
Erbium, Er (ppm)	1.38	0.105	1.26	1.49	1.16	1.59
Europium, Eu (ppm)	0.57	0.09	0.48	0.66	0.53	0.61
Iron, Fe (wt.%)	14.52	0.782	14.13	14.90	14.23	14.81
Gallium, Ga (ppm)	21.2	1.01	20.7	21.7	20.5	22.0
Gadolinium, Gd (ppm)	2.42	0.26	2.07	2.76	2.20	2.63
Hafnium, Hf (ppm)	3.83	0.164	3.73	3.92	3.62	4.03

Table 3 continued

Constituent	Certified Value	1SD	95% Confidence Limits		95% Tolerance Limits	
			Low	High	Low	High
Holmium, Ho (ppm)	0.46	0.05	0.39	0.52	0.41	0.50
Indium, In (ppm)	0.096	0.007	0.092	0.100	0.088	0.104
Potassium, K (wt.%)	0.412	0.017	0.405	0.419	0.400	0.425
Lanthanum, La (ppm)	16.9	2.2	15.7	18.1	15.9	17.9
Lithium, Li (ppm)	21.5	1.03	21.1	21.9	20.4	22.5
Lutetium, Lu (ppm)	0.18	0.03	0.15	0.21	IND	IND
Magnesium, Mg (wt.%)	0.245	0.016	0.237	0.252	0.235	0.254
Manganese, Mn (wt.%)	0.049	0.003	0.048	0.051	0.048	0.050
Molybdenum, Mo (ppm)	2.50	0.112	2.45	2.55	2.37	2.63
Sodium, Na (wt.%)	0.101	0.009	0.096	0.105	0.096	0.105
Niobium, Nb (ppm)	14.5	1.11	14.0	15.1	14.0	15.1
Neodymium, Nd (ppm)	13.4	1.5	11.9	14.9	12.4	14.4
Nickel, Ni (ppm)	231	13.4	225	236	224	237
Phosphorus, P (wt.%)	0.042	0.003	0.041	0.044	0.041	0.044
Lead, Pb (ppm)	21.8	1.35	21.2	22.3	20.5	23.0
Praseodymium, Pr (ppm)	3.70	0.41	3.17	4.23	3.12	4.27
Rubidium, Rb (ppm)	42.1	2.40	40.8	43.4	40.8	43.5
Sulphur, S (wt.%)	0.049	0.004	0.047	0.051	0.047	0.050
Antimony, Sb (ppm)	0.82	0.09	0.77	0.87	0.78	0.86
Scandium, Sc (ppm)	49.3	1.89	48.4	50.2	48.0	50.6
Samarium, Sm (ppm)	2.80	0.33	2.45	3.15	2.62	2.99
Tin, Sn (ppm)	2.78	0.200	2.67	2.88	2.62	2.94
Strontium, Sr (ppm)	31.3	1.83	30.5	32.2	29.8	32.9
Tantalum, Ta (ppm)	1.02	0.14	0.94	1.11	0.95	1.09
Terbium, Tb (ppm)	0.40	0.038	0.36	0.44	0.37	0.42
Thorium, Th (ppm)	14.5	1.15	13.9	15.1	13.9	15.1
Titanium, Ti (wt.%)	0.773	0.057	0.741	0.806	0.748	0.798
Thallium, Tl (ppm)	0.27	0.04	0.24	0.29	0.25	0.28
Uranium, U (ppm)	2.63	0.180	2.55	2.72	2.52	2.75
Vanadium, V (ppm)	235	12.2	229	240	229	240
Tungsten, W (ppm)	1.62	0.19	1.50	1.74	1.38	1.85
Yttrium, Y (ppm)	9.53	1.33	8.86	10.20	9.08	9.98
Ytterbium, Yb (ppm)	1.33	0.17	1.18	1.48	1.23	1.44
Zinc, Zn (ppm)	45.7	4.7	43.5	47.9	43.2	48.1
Zirconium, Zr (ppm)	141	21	130	152	133	148

Note: intervals may appear asymmetric due to rounding.

Table 4. Fusion ICP - Certified Values, SDs, 95% Confidence and Tolerance Limits for OREAS 45d

Constituent	Certified Value	1SD	95% Confidence Limits		95% Tolerance Limits	
			Low	High	Low	High
Fusion ICP-OES / ICP-MS (undried basis)						
Aluminium, Al (wt.%)	8.26	0.236	8.15	8.36	8.13	8.38
Barium, Ba (ppm)	183	6.0	180	186	178	189
Calcium, Ca (wt.%)	0.185	0.013	0.178	0.191	0.173	0.197
Cerium, Ce (ppm)	38.0	2.23	36.6	39.5	36.6	39.5
Cobalt, Co (ppm)	31.3	3.8	29.9	32.6	29.6	33.0
Chromium, Cr (ppm)	585	19.6	575	595	571	599
Cesium, Cs (ppm)	3.94	0.167	3.84	4.05	3.80	4.09
Copper, Cu (ppm)	375	22.4	363	388	357	393

Table 4 continued

Constituent	Certified Value	1SD	95% Confidence Limits		95% Tolerance Limits	
			Low	High	Low	High
Dysprosium, Dy (ppm)	3.23	0.289	3.02	3.44	3.05	3.41
Erbium, Er (ppm)	2.03	0.134	1.97	2.10	1.85	2.22
Europium, Eu (ppm)	0.67	0.047	0.64	0.70	0.64	0.70
Iron, Fe (wt.%)	14.78	0.502	14.53	15.02	14.53	15.02
Gallium, Ga (ppm)	21.4	1.11	20.7	22.1	20.6	22.3
Gadolinium, Gd (ppm)	2.83	0.119	2.77	2.89	2.67	2.98
Hafnium, Hf (ppm)	8.90	0.367	8.60	9.20	8.51	9.29
Holmium, Ho (ppm)	0.68	0.040	0.65	0.70	0.62	0.73
Potassium, K (wt.%)	0.426	0.026	0.415	0.436	0.413	0.438
Lanthanum, La (ppm)	17.3	0.68	16.9	17.7	16.7	18.0
Lithium, Li (ppm)	21.7	1.63	19.7	23.7	19.2	24.1
Magnesium, Mg (wt.%)	0.247	0.013	0.241	0.254	0.239	0.256
Manganese, Mn (wt.%)	0.050	0.002	0.050	0.051	0.049	0.052
Sodium, Na (wt.%)	0.097	0.008	0.089	0.104	0.085	0.109
Niobium, Nb (ppm)	17.5	0.99	16.9	18.1	16.8	18.1
Neodymium, Nd (ppm)	14.5	0.92	13.9	15.0	13.6	15.3
Nickel, Ni (ppm)	234	16.0	220	248	217	250
Phosphorus, P (wt.%)	0.040	0.004	0.037	0.044	IND	IND
Praseodymium, Pr (ppm)	3.94	0.153	3.85	4.03	3.74	4.14
Rubidium, Rb (ppm)	42.3	2.39	40.9	43.7	41.0	43.7
Scandium, Sc (ppm)	49.0	2.11	46.7	51.3	47.9	50.1
Silicon, Si (wt.%)	22.63	0.484	22.40	22.86	22.37	22.89
Samarium, Sm (ppm)	3.17	0.178	3.09	3.24	2.97	3.37
Tin, Sn (ppm)	3.13	0.291	2.97	3.28	IND	IND
Strontium, Sr (ppm)	32.9	1.81	31.9	34.0	31.2	34.6
Tantalum, Ta (ppm)	1.30	0.098	1.23	1.37	IND	IND
Terbium, Tb (ppm)	0.51	0.030	0.50	0.53	0.48	0.54
Thorium, Th (ppm)	15.0	0.70	14.6	15.4	14.6	15.4
Titanium, Ti (wt.%)	0.869	0.013	0.863	0.876	0.854	0.884
Thulium, Tm (ppm)	0.32	0.031	0.31	0.34	0.31	0.34
Uranium, U (ppm)	3.00	0.146	2.91	3.09	2.87	3.13
Vanadium, V (ppm)	243	18.3	232	255	237	249
Tungsten, W (ppm)	1.97	0.146	1.83	2.11	IND	IND
Yttrium, Y (ppm)	17.8	1.48	16.8	18.8	16.6	19.0
Ytterbium, Yb (ppm)	2.17	0.139	2.10	2.25	2.03	2.32
Zirconium, Zr (ppm)	333	20.4	320	347	322	345

Note: intervals may appear asymmetric due to rounding.

Table 5. Aqua Regia ICP - Certified Values, SDs, 95% Confidence and Tolerance Limits for OREAS 45d

Constituent	Certified Value	1SD	95% Confidence Limits		95% Tolerance Limits	
			Low	High	Low	High
Aqua Regia Digestion ICP-OES/MS (undried basis)						
Aluminium, Al (wt.%)	4.86	0.286	4.70	5.03	4.74	4.99
Arsenic, As (ppm)	6.50	1.29	5.98	7.03	5.98	7.03
Gold, Au (ppb)	21	2	20	22	19	23
Barium, Ba (ppm)	80	5.5	76	83	77	83
Bismuth, Bi (ppm)	0.30	0.04	0.27	0.33	0.28	0.32
Calcium, Ca (ppm)	890	63.0	858	921	855	924
Cerium, Ce (ppm)	24.8	2.8	22.1	27.4	23.9	25.7

Table 5 continued

Constituent	Certified Value	1SD	95% Confidence Limits		95% Tolerance Limits	
			Low	High	Low	High
Cobalt, Co (ppm)	26.2	3.0	24.6	27.8	25.3	27.1
Chromium, Cr (ppm)	467	36.0	447	487	455	479
Copper, Cu (ppm)	345	16.3	336	354	336	355
Iron, Fe (wt.%)	13.65	0.777	13.21	14.09	13.24	14.07
Gallium, Ga (ppm)	17.9	2.4	16.6	19.3	17.0	18.8
Indium, In (ppm)	0.085	0.006	0.078	0.092	IND	IND
Potassium, K (wt.%)	0.097	0.004	0.094	0.099	0.093	0.101
Lanthanum, La (ppm)	9.96	0.494	9.62	10.29	9.50	10.41
Lithium, Li (ppm)	11.9	1.5	10.5	13.4	10.7	13.2
Magnesium, Mg (wt.%)	0.144	0.007	0.140	0.148	0.137	0.151
Manganese, Mn (wt.%)	0.040	0.002	0.038	0.041	0.038	0.041
Sodium, Na (wt.%)	0.031	0.005	0.029	0.034	0.029	0.033
Nickel, Ni (ppm)	176	11.6	170	183	172	181
Phosphorus, P (wt.%)	0.035	0.001	0.034	0.036	0.033	0.036
Lead, Pb (ppm)	17.0	1.68	16.1	17.9	16.2	17.8
Rubidium, Rb (ppm)	20.9	3.8	17.2	24.6	19.6	22.2
Sulphur, S (wt.%)	0.045	0.006	0.041	0.049	IND	IND
Scandium, Sc (ppm)	41.5	3.73	39.4	43.6	40.1	42.9
Tin, Sn (ppm)	1.95	0.192	1.80	2.11	IND	IND
Strontium, Sr (ppm)	11.0	1.7	10.1	11.9	10.4	11.6
Thorium, Th (ppm)	11.3	1.2	10.4	12.2	10.8	11.8
Uranium, U (ppm)	1.64	0.17	1.50	1.78	1.56	1.71
Vanadium, V (ppm)	201	14.6	192	210	196	205
Yttrium, Y (ppm)	5.08	0.52	4.69	5.48	4.85	5.31
Zinc, Zn (ppm)	30.6	4.1	28.5	32.7	28.9	32.2

Note: intervals may appear asymmetric due to rounding.

Table 6. IR Combustion - Certified Values, SDs, 95% Confidence and Tolerance Limits for OREAS 45d

IR Combustion Furnace (undried basis)						
Carbon, C (wt.%)	1.04	0.033	1.03	1.06	1.03	1.06
Sulphur, S (wt.%)	0.044	0.008	0.041	0.048	IND	IND

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

Table 7. Indicative Values for OREAS 45d

Constituent	Unit	Value	Constituent	Unit	Value	Constituent	Unit	Value
Fusion XRF (dry basis)								
As	ppm	*13.3*	Ni	ppm	*210*	Sr	ppm	*52*
Cl	ppm	*60*	Pb	ppm	*< 100*	Zr	ppm	*292*
Co	ppm	*65*	S	wt.%	*0.048*			
Cu	ppm	*287*	Sn	ppm	*380*			
Fusion ICP-OES / ICP-MS (undried basis)								
Ag	ppm	*< 10*	Ge	ppm	*2.78*	S	wt.%	*0.046*
As	ppm	*42.9*	In	ppm	*0.11*	Sb	ppm	*1.03*
B	ppm	*36.9*	Lu	ppm	*0.35*	Se	ppm	*< 50*
Be	ppm	*0.87*	Mo	ppm	*2.98*	Te	ppm	*< 5*
Bi	ppm	*0.37*	Pb	ppm	*22.0*	Tl	ppm	*< 0.5*
Cd	ppm	*< 2*	Re	ppb	*< 100*	Zn	ppm	*77*

Table 7 continued

Constituent	Unit	Value	Constituent	Unit	Value	Constituent	Unit	Value
Four Acid Digestion ICP-OES / ICP-MS (undried basis)								
Ag	ppm	*0.202*	Ge	ppm	*0.88*	Se	ppm	*2.72*
Au	ppm	*< 0.1*	Hg	ppb	*< 10*	Te	ppm	*0.12*
Cd	ppb	*53*	Re	ppb	*3*	Tm	ppm	*0.19*
Aqua Regia Digestion ICP-OES / ICP-MS (undried basis)								
Ag	ppm	*0.153*	Hg	ppb	*33*	Se	ppm	*1.09*
B	ppm	*6.57*	Ho	ppm	*0.22*	Sm	ppm	*1.90*
Be	ppm	*0.50*	Lu	ppm	*0.080*	Ta	ppm	*< 0.05*
Cd	ppb	*43*	Mo	ppm	*1.67*	Tb	ppm	*0.26*
Cs	ppm	*2.38*	Nb	ppm	*0.55*	Te	ppm	*0.068*
Dy	ppm	*1.36*	Nd	ppm	*8.69*	Ti	wt.%	*0.079*
Er	ppm	*0.61*	Pd	ppb	*26*	Tl	ppm	*0.15*
Eu	ppm	*0.42*	Pr	ppm	*2.55*	Tm	ppm	*0.078*
Gd	ppm	*1.68*	Pt	ppb	*46*	W	ppm	*< 10*
Ge	ppm	*0.12*	Re	ppb	*3*	Yb	ppm	*0.57*
Hf	ppm	*0.51*	Sb	ppm	*0.41*	Zr	ppm	*20.6*

INTRODUCTION

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

SOURCE MATERIALS

Multi-element soil standard OREAS 45d was prepared from a 50:50 blend of mineralised lateritic soil and barren soil. The lateritic soil is developed over a Ni-Cu-PGE mineralised contact between gabbro and pyroxenite in a layered mafic intrusive from the Southern Murchison region of Western Australia. It contains anomalous precious and base metal values. The barren soil was taken from a layer of mature soil developed in situ over early Tertiary olivine basalt in outer eastern Melbourne, Victoria, Australia.

COMMINUTION AND HOMOGENISATION PROCEDURES

The material constituting OREAS 45d was prepared in the following manner:

- drying to constant mass at 105°C;
- crushing and milling;
- homogenisation;
- packaging in 10g and 60g units into laminated foil pouches and in 1kg units into plastic jars.

ANALYTICAL PROGRAM

Twenty commercial analytical laboratories participated in the program to characterise the elements reported in Tables 1 to 7. The following methods were employed:

- Lithium borate fusion for full suite X-ray fluorescence (14 laboratories)
- Sodium peroxide fusion or lithium borate fusion for full suite ICP-OES and ICP-MS (18 laboratories)
- Four acid digestion for full suite ICP-OES and ICP-MS (20 laboratories)
- Aqua regia digestion for full suite ICP-OES and ICP-MS (18 laboratories)
- Fire assay with ICP-OES and ICP-MS for Au, Pd and Pt (Au: 20 laboratories; Pd and Pt: 19 laboratories)
- Instrumental neutron activation analysis for Au on 1g subsamples to confirm homogeneity (1 laboratory)
- Infra-red combustion furnace for C and S (15 laboratories)
- Thermogravimetry for LOI (17 laboratories)

For the round robin program fifteen 1kg test units were taken at predetermined intervals during the bagging stage, immediately following final blending, and are considered representative of the entire batch. The six samples received by each laboratory were obtained by taking two 110g scoop splits from each of three separate 1kg test units. This format enabled nested ANOVA treatment of the results to evaluate homogeneity, i.e. to ascertain whether between-unit variance is greater than within-unit variance. Tables 1-6 present the certified values together with their associated 1SD's, 95% confidence and tolerance limits. Indicative values are provided (Table 7) for those analytes for which the analytical data are insufficient to permit determination of certified values. Table 8 provides performance gate intervals for the certified values based on their 1SD's.

Tabulated results of all elements (including Au INAA analyses) together with uncorrected means, medians, standard deviations, relative standard deviations and percent deviation of lab means from the corrected mean of means (PDM^3) are presented in the detailed certification data for this CRM (**OREAS 45d Datapack.xlsx**).

STATISTICAL ANALYSIS

Certified Values, Standard Deviations, Confidence and Tolerance Limits have been determined for each analytical method following removal of individual and laboratory outliers (see Tables 1-6). Certified Values are the mean of means after outlier filtering. The 95% Confidence Limit is a measure of the reliability of the certified value, i.e. the narrower the Confidence Interval the greater the certainty in the Certified Value. It should not be used as a control limit for laboratory performance.

Indicative values (Table 7) are provided where i) the number of laboratories reporting a particular analyte is insufficient (< 5) to support certification; ii) interlaboratory consensus is poor; or iii) a significant proportion of results are outlying or reported as less than detection limits.

Standard Deviation values (1SDs) are reported in Tables 1-6 and provide an indication of a level of performance that might reasonably be expected from a laboratory being monitored

by this CRM in a QA/QC program. They take into account errors attributable to measurement uncertainty and CRM variability. For an effective CRM the contribution of the latter should be negligible in comparison to measurement errors. The Standard Deviation values include all sources of measurement uncertainty: between-lab variance, within-run variance (precision errors) and CRM variability. The SD for each analyte's certified value is calculated from the same filtered data set used to determine the certified value, i.e. after removal of all individual, lab dataset (batch) and 3SD outliers (single iteration). These outliers can only be removed after the absolute homogeneity of the CRM has been independently established, i.e. the outliers must be confidently deemed to be analytical rather than arising from inhomogeneity of the CRM. The standard deviation is then calculated for each analyte from the pooled accepted analyses generated from the certification program.

Performance Gates (Table 8) are calculated for two and three standard deviations. As a guide these intervals may be regarded as warning or rejection for multiple 2SD outliers, or rejection for individual 3SD outliers in QC monitoring, although their precise application should be at the discretion of the QC manager concerned.

A second method utilises a 5% window calculated directly from the certified value. Standard deviation is also shown in relative percent for one, two and three relative standard deviations (1RSD, 2RSD and 3RSD) to facilitate an appreciation of the magnitude of these numbers and a comparison with the 5% window. Caution should be exercised when concentration levels approach lower limits of detection of the analytical methods employed as performance gates calculated from standard deviations tend to be excessively wide whereas those determined by the 5% method are too narrow.

Tolerance Limits (ISO Guide 3207) were determined using an analysis of precision errors method and are considered a conservative estimate of true homogeneity. The meaning of tolerance limits may be illustrated for copper by 4-acid digestion, where 99% of the time ($1-\alpha=0.99$) at least 95% of subsamples ($\rho=0.95$) will have concentrations lying between 363 and 379 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 (IS0 Guide 35).

For gold the tolerance has been determined by INAA using the reduced analytical subsample method which utilises the known relationship between standard deviation and analytical subsample weight (Ingamells and Switzer, 1973). In this approach the latter parameter is substantially reduced to a point where most of the variability in replicate assays is due to inhomogeneity of the reference material and measurement error becomes negligible. In this instance a subsample weight of 1 gram was employed and confirms the high level of gold homogeneity in OREAS 45d.

The homogeneity of OREAS 45d has also been evaluated in an ANOVA study for all certified analytes. This study indicates no evidence that between-unit variance is greater than within-unit variance (i.e. no p-values <0.05).

Based on the statistical analysis of the results of the interlaboratory certification program it can be concluded that OREAS 45d is fit-for-purpose as a certified reference material (see 'Intended Use' below).

Table 8. Performance Gates for OREAS 45d

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
Fusion XRF (dry basis)											
Al_2O_3, wt.%	15.99	0.187	15.62	16.36	15.43	16.55	1.17%	2.34%	3.50%	15.19	16.79
BaO, ppm	198	23	153	243	130	266	11.48%	22.97%	34.45%	188	208
CaO, wt.%	0.264	0.005	0.254	0.274	0.249	0.279	1.86%	3.72%	5.58%	0.251	0.277
Cr_2O_3, ppm	879	41.4	796	962	755	1003	4.71%	9.43%	14.14%	835	923
Fe_2O_3, wt.%	21.38	0.200	20.98	21.78	20.78	21.98	0.94%	1.87%	2.81%	20.31	22.45
K_2O, wt.%	0.510	0.005	0.500	0.519	0.495	0.524	0.94%	1.89%	2.83%	0.484	0.535
MgO, wt.%	0.421	0.016	0.390	0.452	0.374	0.468	3.70%	7.40%	11.09%	0.400	0.442
MnO, wt.%	0.066	0.005	0.056	0.076	0.051	0.081	7.59%	15.19%	22.78%	0.063	0.069
Na_2O, wt.%	0.125	0.016	0.093	0.157	0.077	0.173	12.78%	25.56%	38.35%	0.119	0.131
P_2O_5, wt.%	0.099	0.006	0.088	0.110	0.082	0.116	5.62%	11.23%	16.85%	0.094	0.104
SiO_2, wt.%	49.63	0.327	48.98	50.29	48.65	50.62	0.66%	1.32%	1.98%	47.15	52.12
TiO_2, wt.%	1.49	0.026	1.44	1.54	1.41	1.57	1.77%	3.53%	5.30%	1.41	1.56
V_2O_5, ppm	425	37.2	351	500	314	537	8.75%	17.50%	26.25%	404	446
Fusion ICP-OES / ICP-MS (undried basis)											
Al, wt.%	8.26	0.236	7.78	8.73	7.55	8.96	2.86%	5.72%	8.58%	7.84	8.67
Ba, ppm	183	6.0	171	195	166	201	3.25%	6.50%	9.75%	174	193
Ca, wt.%	0.185	0.013	0.158	0.211	0.145	0.224	7.12%	14.25%	21.37%	0.176	0.194
Ce, ppm	38.0	2.23	33.5	42.5	31.3	44.7	5.87%	11.74%	17.61%	36.1	39.9
Co, ppm	31.3	3.8	23.7	38.9	19.9	42.7	12.18%	24.35%	36.53%	29.7	32.9
Cr, ppm	585	19.6	546	624	526	644	3.36%	6.71%	10.07%	556	614
Cs, ppm	3.94	0.167	3.61	4.28	3.44	4.45	4.23%	8.47%	12.70%	3.75	4.14
Cu, ppm	375	22.4	330	420	308	442	5.96%	11.93%	17.89%	356	394
Dy, ppm	3.23	0.289	2.65	3.81	2.36	4.10	8.95%	17.89%	26.84%	3.07	3.39
Er, ppm	2.03	0.134	1.77	2.30	1.63	2.44	6.61%	13.22%	19.83%	1.93	2.14
Eu, ppm	0.67	0.047	0.57	0.76	0.53	0.81	7.09%	14.17%	21.26%	0.63	0.70
Fe, wt.%	14.78	0.502	13.77	15.78	13.27	16.28	3.40%	6.80%	10.20%	14.04	15.51
Ga, ppm	21.4	1.11	19.2	23.6	18.1	24.7	5.17%	10.34%	15.51%	20.3	22.5
Gd, ppm	2.83	0.119	2.59	3.07	2.47	3.19	4.22%	8.44%	12.66%	2.69	2.97
Hf, ppm	8.90	0.367	8.17	9.63	7.80	10.00	4.12%	8.24%	12.37%	8.45	9.34
Ho, ppm	0.68	0.040	0.60	0.76	0.56	0.80	5.92%	11.84%	17.77%	0.64	0.71
K, wt.%	0.426	0.026	0.373	0.478	0.347	0.504	6.12%	12.23%	18.35%	0.404	0.447
La, ppm	17.3	0.68	16.0	18.7	15.3	19.3	3.91%	7.81%	11.72%	16.5	18.2
Li, ppm	21.7	1.63	18.4	24.9	16.8	26.6	7.49%	14.99%	22.48%	20.6	22.8
Mg, wt.%	0.247	0.013	0.222	0.273	0.209	0.286	5.20%	10.41%	15.61%	0.235	0.260
Mn, wt.%	0.050	0.002	0.046	0.055	0.044	0.057	4.54%	9.07%	13.61%	0.048	0.053
Na, wt.%	0.097	0.008	0.080	0.114	0.071	0.122	8.73%	17.46%	26.19%	0.092	0.102
Nb, ppm	17.5	0.99	15.5	19.5	14.5	20.4	5.67%	11.34%	17.01%	16.6	18.3
Nd, ppm	14.5	0.92	12.6	16.3	11.7	17.2	6.36%	12.72%	19.07%	13.7	15.2
Ni, ppm	234	16.0	202	266	185	282	6.87%	13.73%	20.60%	222	245
P, wt.%	0.040	0.004	0.031	0.049	0.027	0.054	11.04%	22.07%	33.11%	0.038	0.042
Pr, ppm	3.94	0.153	3.63	4.25	3.48	4.40	3.88%	7.75%	11.63%	3.74	4.14
Rb, ppm	42.3	2.39	37.5	47.1	35.1	49.5	5.65%	11.31%	16.96%	40.2	44.4
Sc, ppm	49.0	2.11	44.8	53.2	42.7	55.3	4.30%	8.59%	12.89%	46.6	51.5
Si, wt.%	22.63	0.484	21.66	23.60	21.18	24.08	2.14%	4.27%	6.41%	21.50	23.76

Note: intervals may appear asymmetric due to rounding.

Table 8. Fusion ICP-OES/MS results 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
Sm, ppm	3.17	0.178	2.81	3.52	2.63	3.70	5.63%	11.26%	16.89%	3.01	3.32
Sn, ppm	3.13	0.291	2.55	3.71	2.25	4.00	9.31%	18.63%	27.94%	2.97	3.28
Sr, ppm	32.9	1.81	29.3	36.6	27.5	38.4	5.51%	11.02%	16.52%	31.3	34.6
Ta, ppm	1.30	0.098	1.10	1.50	1.01	1.59	7.55%	15.10%	22.65%	1.24	1.37
Tb, ppm	0.51	0.030	0.45	0.57	0.42	0.60	5.87%	11.75%	17.62%	0.49	0.54
Th, ppm	15.0	0.70	13.6	16.4	12.9	17.1	4.66%	9.33%	13.99%	14.3	15.8
Ti, wt.%	0.869	0.013	0.843	0.896	0.829	0.909	1.53%	3.07%	4.60%	0.826	0.913
Tm, ppm	0.32	0.031	0.26	0.39	0.23	0.42	9.60%	19.19%	28.79%	0.31	0.34
U, ppm	3.00	0.146	2.70	3.29	2.56	3.43	4.86%	9.73%	14.59%	2.85	3.15
V, ppm	243	18.3	207	280	188	298	7.52%	15.03%	22.55%	231	255
W, ppm	1.97	0.146	1.68	2.26	1.53	2.41	7.41%	14.81%	22.22%	1.87	2.07
Y, ppm	17.8	1.48	14.8	20.7	13.3	22.2	8.33%	16.65%	24.98%	16.9	18.7
Yb, ppm	2.17	0.139	1.90	2.45	1.76	2.59	6.40%	12.80%	19.20%	2.06	2.28
Zr, ppm	333	20.4	293	374	272	394	6.11%	12.21%	18.32%	317	350
Four Acid Digestion ICP-OES / ICP-MS (undried basis)											
Al, wt.%	8.15	0.253	7.65	8.66	7.39	8.91	3.11%	6.22%	9.32%	7.74	8.56
As, ppm	13.8	0.86	12.1	15.5	11.2	16.4	6.21%	12.42%	18.63%	13.1	14.5
Ba, ppm	183	9.7	164	203	154	212	5.30%	10.59%	15.89%	174	192
Be, ppm	0.79	0.11	0.57	1.02	0.45	1.13	14.31%	28.62%	42.93%	0.75	0.83
Bi, ppm	0.31	0.03	0.25	0.38	0.21	0.41	10.58%	21.16%	31.73%	0.30	0.33
Ca, wt.%	0.185	0.015	0.155	0.216	0.139	0.231	8.26%	16.53%	24.79%	0.176	0.195
Ce, ppm	37.2	3.06	31.0	43.3	28.0	46.3	8.22%	16.45%	24.67%	35.3	39.0
Co, ppm	29.5	1.61	26.2	32.7	24.6	34.3	5.46%	10.92%	16.38%	28.0	30.9
Cr, ppm	549	32.8	483	614	450	647	5.99%	11.97%	17.96%	521	576
Cs, ppm	3.91	0.299	3.31	4.51	3.01	4.81	7.65%	15.30%	22.95%	3.72	4.11
Cu, ppm	371	12.8	345	397	333	410	3.46%	6.92%	10.38%	353	390
Dy, ppm	2.26	0.210	1.84	2.69	1.63	2.90	9.28%	18.56%	27.84%	2.15	2.38
Er, ppm	1.38	0.105	1.17	1.58	1.06	1.69	7.61%	15.21%	22.82%	1.31	1.44
Eu, ppm	0.57	0.09	0.39	0.75	0.29	0.85	16.17%	32.33%	48.50%	0.54	0.60
Fe, wt.%	14.52	0.782	12.95	16.08	12.17	16.86	5.39%	10.78%	16.17%	13.79	15.24
Ga, ppm	21.2	1.01	19.2	23.2	18.2	24.3	4.75%	9.50%	14.26%	20.2	22.3
Gd, ppm	2.42	0.26	1.89	2.94	1.63	3.20	10.81%	21.63%	32.44%	2.29	2.54
Hf, ppm	3.83	0.164	3.50	4.16	3.33	4.32	4.30%	8.59%	12.89%	3.64	4.02
Ho, ppm	0.46	0.05	0.35	0.57	0.29	0.62	12.03%	24.05%	36.08%	0.43	0.48
In, ppm	0.096	0.007	0.081	0.111	0.074	0.118	7.63%	15.26%	22.88%	0.091	0.101
K, wt.%	0.412	0.017	0.378	0.446	0.361	0.463	4.13%	8.25%	12.38%	0.392	0.433
La, ppm	16.9	2.2	12.6	21.2	10.4	23.4	12.78%	25.56%	38.33%	16.0	17.7
Li, ppm	21.5	1.03	19.4	23.5	18.4	24.6	4.78%	9.57%	14.35%	20.4	22.6
Lu, ppm	0.18	0.03	0.13	0.24	0.10	0.26	14.88%	29.76%	44.64%	0.17	0.19
Mg, wt.%	0.245	0.016	0.213	0.276	0.197	0.292	6.44%	12.87%	19.31%	0.232	0.257
Mn, wt.%	0.049	0.003	0.043	0.055	0.041	0.058	5.86%	11.72%	17.58%	0.047	0.052
Mo, ppm	2.50	0.112	2.28	2.72	2.16	2.84	4.48%	8.96%	13.45%	2.38	2.63
Na, wt.%	0.101	0.009	0.082	0.119	0.073	0.128	9.24%	18.48%	27.72%	0.096	0.106
Nb, ppm	14.5	1.11	12.3	16.8	11.2	17.9	7.64%	15.28%	22.92%	13.8	15.3
Nd, ppm	13.4	1.5	10.4	16.4	9.0	17.8	11.05%	22.10%	33.14%	12.7	14.1
Ni, ppm	231	13.4	204	257	190	271	5.80%	11.61%	17.41%	219	242

Note: intervals may appear asymmetric due to rounding.

Table 8. Four Acid Digestion ICP-OES/MS results 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
P, wt.%	0.042	0.003	0.037	0.048	0.034	0.050	6.53%	13.05%	19.58%	0.040	0.044
Pb, ppm	21.8	1.35	19.1	24.5	17.7	25.8	6.22%	12.43%	18.65%	20.7	22.8
Pr, ppm	3.70	0.41	2.88	4.51	2.47	4.92	11.03%	22.07%	33.10%	3.51	3.88
Rb, ppm	42.1	2.40	37.3	46.9	34.9	49.3	5.70%	11.39%	17.09%	40.0	44.2
S, wt.%	0.049	0.004	0.041	0.057	0.037	0.061	8.27%	16.53%	24.80%	0.046	0.051
Sb, ppm	0.82	0.09	0.64	1.00	0.55	1.09	10.87%	21.74%	32.61%	0.78	0.86
Sc, ppm	49.3	1.89	45.5	53.1	43.6	55.0	3.83%	7.67%	11.50%	46.8	51.8
Sm, ppm	2.80	0.33	2.15	3.46	1.82	3.78	11.65%	23.30%	34.96%	2.66	2.94
Sn, ppm	2.78	0.200	2.38	3.18	2.18	3.38	7.19%	14.37%	21.56%	2.64	2.92
Sr, ppm	31.3	1.83	27.7	35.0	25.8	36.8	5.85%	11.69%	17.54%	29.8	32.9
Ta, ppm	1.02	0.14	0.75	1.30	0.61	1.43	13.35%	26.70%	40.04%	0.97	1.08
Tb, ppm	0.40	0.038	0.32	0.47	0.28	0.51	9.52%	19.04%	28.55%	0.38	0.42
Th, ppm	14.5	1.15	12.2	16.8	11.1	17.9	7.91%	15.81%	23.72%	13.8	15.2
Ti, wt.%	0.773	0.057	0.659	0.888	0.601	0.945	7.42%	14.84%	22.25%	0.735	0.812
Tl, ppm	0.27	0.04	0.18	0.35	0.14	0.39	15.57%	31.14%	46.71%	0.25	0.28
U, ppm	2.63	0.180	2.27	3.00	2.09	3.18	6.83%	13.67%	20.50%	2.50	2.77
V, ppm	235	12.2	210	259	198	271	5.19%	10.37%	15.56%	223	246
W, ppm	1.62	0.19	1.23	2.00	1.04	2.19	11.84%	23.67%	35.51%	1.54	1.70
Y, ppm	9.53	1.33	6.87	12.19	5.55	13.52	13.94%	27.88%	41.82%	9.06	10.01
Yb, ppm	1.33	0.17	0.99	1.67	0.82	1.84	12.73%	25.46%	38.18%	1.27	1.40
Zn, ppm	45.7	4.7	36.2	55.1	31.5	59.9	10.34%	20.68%	31.02%	43.4	48.0
Zr, ppm	141	21	100	182	79	202	14.59%	29.18%	43.76%	134	148
Aqua Regia Digestion ICP-OES / ICP-MS (undried basis)											
Al, wt.%	4.86	0.286	4.29	5.44	4.00	5.72	5.89%	11.78%	17.67%	4.62	5.11
As, ppm	6.50	1.29	3.92	9.08	2.63	10.37	19.84%	39.67%	59.51%	6.18	6.83
Au, ppb	21	2	17	26	14	28	11.08%	22.16%	33.25%	20	22
Ba, ppm	80	5.5	69	91	63	96	6.89%	13.79%	20.68%	76	84
Bi, ppm	0.30	0.04	0.22	0.38	0.18	0.42	13.73%	27.46%	41.19%	0.28	0.31
Ca, ppm	890	63.0	764	1015	701	1078	7.08%	14.16%	21.24%	845	934
Ce, ppm	24.8	2.8	19.2	30.3	16.4	33.1	11.29%	22.58%	33.86%	23.5	26.0
Co, ppm	26.2	3.0	20.2	32.2	17.2	35.2	11.47%	22.93%	34.40%	24.9	27.5
Cr, ppm	467	36.0	395	539	359	575	7.71%	15.43%	23.14%	444	491
Cu, ppm	345	16.3	313	378	296	394	4.73%	9.46%	14.19%	328	363
Fe, wt.%	13.65	0.777	12.10	15.21	11.32	15.98	5.69%	11.38%	17.07%	12.97	14.33
Ga, ppm	17.9	2.4	13.2	22.7	10.8	25.1	13.28%	26.56%	39.84%	17.0	18.8
In, ppm	0.085	0.006	0.073	0.097	0.067	0.103	6.93%	13.86%	20.78%	0.081	0.089
K, wt.%	0.097	0.004	0.088	0.105	0.084	0.110	4.46%	8.91%	13.37%	0.092	0.101
La, ppm	9.96	0.494	8.97	10.94	8.47	11.44	4.96%	9.92%	14.87%	9.46	10.45
Li, ppm	11.9	1.5	8.9	15.0	7.4	16.5	12.64%	25.27%	37.91%	11.3	12.5
Mg, wt.%	0.144	0.007	0.130	0.158	0.123	0.165	4.90%	9.80%	14.70%	0.137	0.151
Mn, wt.%	0.040	0.002	0.035	0.044	0.033	0.046	5.41%	10.83%	16.24%	0.038	0.042
Na, wt.%	0.031	0.005	0.021	0.042	0.016	0.047	16.70%	33.40%	50.10%	0.030	0.033
Ni, ppm	176	11.6	153	200	142	211	6.57%	13.14%	19.71%	168	185
P, wt.%	0.035	0.001	0.032	0.038	0.030	0.039	4.26%	8.52%	12.78%	0.033	0.036
Pb, ppm	17.0	1.68	13.6	20.3	12.0	22.0	9.86%	19.72%	29.58%	16.1	17.8

Note: intervals may appear asymmetric due to rounding.

Table 8. Aqua Regia Digestion ICP-OES/MS results 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
Rb, ppm	20.9	3.8	13.2	28.6	9.4	32.4	18.33%	36.66%	55.00%	19.9	21.9
S, wt.%	0.045	0.006	0.033	0.056	0.027	0.062	13.24%	26.48%	39.71%	0.042	0.047
Sc, ppm	41.5	3.73	34.0	48.9	30.3	52.7	9.00%	18.00%	27.00%	39.4	43.5
Sn, ppm	1.95	0.192	1.57	2.33	1.38	2.53	9.82%	19.64%	29.46%	1.85	2.05
Sr, ppm	11.0	1.7	7.6	14.4	5.8	16.2	15.64%	31.28%	46.92%	10.4	11.5
Th, ppm	11.3	1.2	8.9	13.7	7.7	14.9	10.69%	21.38%	32.06%	10.7	11.9
U, ppm	1.64	0.17	1.31	1.97	1.14	2.14	10.15%	20.30%	30.45%	1.56	1.72
V, ppm	201	14.6	172	230	157	244	7.25%	14.50%	21.76%	191	211
Y, ppm	5.08	0.52	4.05	6.12	3.53	6.63	10.16%	20.31%	30.47%	4.83	5.34
Zn, ppm	30.6	4.1	22.3	38.8	18.2	42.9	13.51%	27.01%	40.52%	29.0	32.1
Fire Assay with ICP-OES / ICP-MS / AAS (undried basis)											
Au, ppb	23	2	19	27	17	29	8.77%	17.55%	26.32%	22	24
Pd, ppb	35	2	30	39	28	42	6.66%	13.31%	19.97%	33	36
Pt, ppb	48	3	42	55	39	58	6.45%	12.90%	19.35%	46	51
IR Combustion Furnace (undried basis)											
C, wt.%	1.04	0.033	0.98	1.11	0.95	1.14	3.12%	6.25%	9.37%	0.99	1.10
S, wt.%	0.044	0.008	0.028	0.060	0.020	0.068	18.04%	36.07%	54.11%	0.042	0.047
Thermogravimetry (dry basis)											
LOI, wt.%	9.37	0.124	9.12	9.62	9.00	9.74	1.33%	2.66%	3.98%	8.90	9.84

Note: intervals may appear asymmetric due to rounding

PARTICIPATING LABORATORIES

Acme Analytical Laboratories, Vancouver, BC, Canada
Activation Laboratories, Ancaster, Ontario, Canada
ALS, Brisbane, QLD, Australia
ALS, Callao, Lima, Peru
ALS, Johannesburg, South Africa
ALS, Perth, WA, Australia
ALS, Vancouver, BC, Canada
BV Amdel, Adelaide, SA, Australia
BV Ultra Trace, Perth, WA, Australia
Intertek Genalysis, Perth, WA, Australia
Intertek Testing Services, Beijing, China
Intertek Testing Services, Jakarta, Indonesia
Kalassay, Perth, WA, Australia
OMAC Laboratories (ALS), Loughrea, County Galway, Ireland
SGS Mineral Services, Booysens, Gauteng, South Africa
SGS Mineral Services, Lakefield, Ontario, Canada
SGS Mineral Services, Perth, WA, Australia
SGS Mineral Services, Toronto, Ontario, Canada
Shiva Analyticals, Bangalore North, Karnataka, India
Zarazma Mineral Studies, Tehran, Iran

PREPARER AND SUPPLIER OF THE REFERENCE MATERIAL

Reference material OREAS 45d has been prepared, certified and is supplied by:

ORE Research & Exploration Pty Ltd
37A Hosie Street
Bayswater North VIC 3153
AUSTRALIA

Tel: +613-9729 0333
Fax: +613-9761 7878
Web: www.ore.com.au
Email: info@ore.com.au

It is available in unit sizes of 10g, 60g (single-use laminated foil pouches) and 1kg (plastic jars).

INTENDED USE

OREAS 45d is intended for the following uses:

- for the monitoring of laboratory performance in the analysis of analytes reported in Tables 1-6 in geological samples
- for the verification of analytical methods for analytes reported in Tables 1-6
- for the calibration of instruments used in the determination of the concentration of analytes reported in Tables 1-6

STABILITY AND STORAGE INSTRUCTIONS

OREAS 45d was prepared from a 50:50 blend of mineralised lateritic soil and barren soil. In its unopened state and under normal conditions of storage it has a shelf life beyond ten years. Its stability will be monitored at regular intervals and purchasers notified if any changes are observed.

INSTRUCTIONS FOR THE CORRECT USE OF THE REFERENCE MATERIAL

The certified values for lithium borate fusion XRF and for LOI are on a dry basis whilst all other certified values are reported on an “as received” basis. Mean moisture content for the packaged samples is 2.22 wt.% but may vary after equilibration with the local atmosphere.

HANDLING INSTRUCTIONS

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

LEGAL NOTICE

Ore Research & Exploration Pty Ltd has prepared and statistically evaluated the property values of this reference material to the best of its ability. The Purchaser by receipt hereof

releases and indemnifies Ore Research & Exploration Pty Ltd from and against all liability and costs arising from the use of this material and information.

CERTIFYING OFFICER

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

REFERENCES

Ingamells, C. O. and Switzer, P. (1973), Talanta 20, 547-568.

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

ISO Guide 35 (2006), Certification of reference materials - General and statistical principals.