



African Mineral Standards

MATRIX REFERENCE MATERIALS

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AMIS0455

Certified Reference Material

**Gold and Uranium Ore
Witwatersrand, South Africa**

Certificate of Analysis

**Recommended Concentrations and Limits^{1, 2}
(at two Standard Deviations)**

Certified Concentrations

Au Pb Collection	52.24	±	3.16	g/t
U M/ICP	3512	±	269	ppm
U XRF	3593	±	138	ppm
S Combustion / LECO	3.69	±	0.20	%

1. Manufacturers recommended limits for use of the material as control samples, based on two standard deviations, calculated using "Between Laboratory" statistics for treatment of the data for trivial, non-trivial and technically invalid results. See sections 1, 10 and 13.
2. There is additional uncertified element data presented as an appendix.

Major Element Recommended Concentrations and Limits (at two Standard Deviations)

Certified Concentrations

Al ₂ O ₃	4.83	±	0.11	%
Cr ₂ O ₃	0.17	±	0.01	%
Fe ₂ O ₃	6.95	±	0.23	%
K ₂ O	0.73	±	0.03	%
SiO ₂	81.19	±	1.66	%
TiO ₂	0.40	±	0.02	%

Provisional Concentrations

CaO	0.09	±	0.02	%
MgO	0.31	±	0.06	%
LOI	4.33	±	0.47	%

Informational Concentration

MnO	0.04	%
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1. **Intended Use:** AMIS0455 can be used to check the analysis of gold and uranium ores, hosted by siliceous rocks, with a similar grade and matrix.

It is a matrix matched Certified Reference Material, fit for use as control samples in routine assay laboratory quality control when inserted within runs of samples and measured in parallel to the unknown. Its purpose is to monitor inter-laboratory or instrument bias and within lab precision. It can be used, indirectly, to establish the traceability of results to an SI system of units.

The recommended concentrations and limits for this material are property values based on a measurement campaign (round robin) and reflect consensus results from the laboratories that participated in the round robin.

Slight variations in analytical procedures between laboratories will reflect as slight biases to the recommended concentrations (see 19). Good laboratories will report results within the two standard deviation levels with a failure rate of <10 %.

The material can also be used for method development and for the calibration of equipment.

2. **Origin of Material:** This standard is a blend of Ventersdorp Contact Reef, Carbon Leader Reef and Vaal Reef material provided by Anglo Gold Ashanti in South Africa. It was made from a mixture of pulp reject sample material, collected during routine underground sampling.

3. **Approximate Mineral and Chemical Composition:** The major gangue mineral is quartz with minor pyrite, uraninite and thucolite. Gold occurs primarily as discrete grains. Trace element chemistry data from 12 of the labs has been compiled but has not been certified. Summary statistics for this data are set out in the appendix.

4. Appearance: The material is a very fine powder. It is colored Dark Gray.

5. Handling instructions: The material is packaged in Laboratory Packs and Explorer Packs that must be shaken or otherwise agitated before use. Normal safety precautions for handling fine particulate matter are suggested, such as the use of safety glasses, breathing protection, gloves and a laboratory coat.

6. Radioactivity: Shipments of this material require special labeling and placarding. AMIS0428 contains U (44.91Bq/g) and Th (1.54Bq/g) and is classified as EXEMPTED MATERIAL in terms of "Safety Standards Series No. TS-R-1: Regulations for the Safe Transport of Radioactive Material, International Atomic Energy Agency, 2005, para 403, Table 1".

7. Method of Preparation: The material was crushed, dry-milled and air-classified to <54um. Wet sieve particle size analysis of random samples confirmed the material was 98.5% <54um. It was then blended in a bi-conical mixer, systematically divided and then sealed into 1kg Laboratory Packs. Explorer Packs are subdivided from the Laboratory packs as required. Samples were scientifically selected for homogeneity testing and third party analysis. Statistical analysis of both homogeneity and the consensus test results were carried out by independent statisticians.

8. Methods of Analysis requested:

1. Au – Pb collection ICP-OES or ICP-MS.
2. Multi-acid digest, including HF, ICP- OES or ICP-MS. Multi element scan to include U (M/ICP).
3. U XRF.
4. Majors (Al₂O₃, CaO, Cr₂O₃, Fe₂O₃, K₂O, MgO, MnO, Na₂O, SiO₂, TiO₂. LOI.) XRF fusion.
5. SG (gas pycnometer).
6. Additionally, XRF analyses were requested for the major elements and a multi-element multi acid digest and ICP scan was requested for the trace elements.

9. Information requested

1. State aliquots used for all determinations.
2. Report all results for gold and uranium in ppm.
3. All results for major elements to be reported as oxides in percentages.
4. All results for multi-element scans to be reported in ppm.
5. Report all QC data, to include replicates, blanks and certified reference materials used.
6. State and provide brief description of analytical techniques used.

10. Method of Certification: Nineteen laboratories were each given eight scientifically selected packages of sample. Nineteen of the laboratories submitted results in time for certification.

Final limits were calculated after first determining if all data was compatible within a spread normally expected for similar analytical methods done by reputable laboratories. Data from any one laboratory was then removed from further calculations when the mean of all analyses from that laboratory failed a "t test" of the global means of the other laboratories. The means and standard deviations were then re-calculated using all remaining data. Any analysis that fell outside of the new two standard deviations was removed from the ensuing data base. The mean and standard deviations were again calculated using the remaining data.

The “between-laboratory” standard deviation is used in the calculation to eliminate technically and statistically invalid data. Upper and lower limits are based on the standard deviation of the remaining data, which reflect individual analyses and can be used to monitor accuracy in routine laboratory quality control. This is different to limits based on standard deviations derived from grouped set of analyses (see 13), which provide important measures for precision and trueness, but which are less useful for routine QC.

Standards with an RSD of near or less than 5 % are termed “Certified”, RSD’s of between near 5 % and 15 % are termed “Provisional”, and RSD’s over 15 % are termed “Informational”.

11. Participating Laboratories: The 19 out of 19 laboratories that provided results timeously were (not in same order as in the table of assays):

1. Bureau Veritas (Namibia)
2. BV Rustenburg (South Africa)
3. Chromatech Services
4. Genalysis Laboratory Services (W Australia P)
5. Harmony Assay Laboratories
6. Intertek Testing Services Ltd Shanghai (Beijing)
7. Met-Solve Analytical Services
8. Performance Laboratories Barberton
9. Performance Laboratories SA (Randfontein)
10. Set Point Laboratories (Isando) SA
11. SGS Ankara (Turkey)
12. SGS Geosol Laboratories Ltda (Brazil)
13. SGS Mineral Services Lakefield (Canada)
14. SGS South Africa (Pty) Ltd - Booyens JHB
15. SGS Vancouver (Canada)
16. Suntech Geometallurgical SA
17. Super Laboratory Services (Klerksdorp SA)
18. Super Laboratory Services (Springs SA)
19. Ultra Trace (Pty) Ltd WA

12. Assay Data: Data as received from the laboratories for the important certified elements listed on p1 are set out below.

Assay data (cont)

Lab Code	Au Pb Coll g/t	U M/ICP ppm	U XRF ppm	Al2O3 XRF %	CaO XRF %	Cr2O3 XRF %	Fe2O3 XRF %	K2O XRF %	LOI XRF %	MgO XRF %	MnO XRF %	SiO2 XRF %	TiO2 XRF %	S Comb/LECO %
A	52													3.60
A	52													3.77
A	52													3.67
A	52													3.66
A	52													3.56
A	52													3.68
A	52													3.61
A	52													3.84
B	54	3504	3504											
B	49	3506	3506											
B	50	3511	3512											
B	54	3503	3503											
B	54	3505	3505											
B	53	3506	3506											
B	52	3511	3512											
B	53	3498	3498											
C	53	3772	3600	4.83	0.09	0.16	6.90	0.72	81.86	0.28	0.04	81.86	0.38	3.82
C	53	3751	3600	4.87	0.09	0.17	6.92	0.71	82.50	0.27	0.04	82.50	0.37	3.82
C	53	3753	3600	4.89	0.10	0.17	6.88	0.72	81.83	0.27	0.04	81.83	0.38	3.80
C	53	3624	3600	4.86	0.10	0.16	6.91	0.71	82.08	0.28	0.04	82.08	0.39	3.77
C	52	3834	3700	4.86	0.09	0.16	6.88	0.72	82.42	0.27	0.04	82.42	0.39	3.76
C	54	3804	3500	4.89	0.10	0.16	6.91	0.71	82.50	0.27	0.04	82.50	0.38	3.77
C	53	3676	3600	4.90	0.09	0.17	6.90	0.72	82.31	0.28	0.04	82.31	0.39	3.82
C	52	3757	3500	4.84	0.09	0.16	6.89	0.73	82.10	0.28	0.04	82.10	0.38	3.82

Assay data (cont)

Lab Code	Au Pb Coll	U M/ICP ppm	U XRF ppm	Al2O3 XRF %	CaO XRF %	Cr2O3 XRF %	Fe2O3 XRF %	K2O XRF %	LOI XRF %	MgO XRF %	MnO XRF %	SiO2 XRF %	TiO2 XRF %	S Comb/LECO %
D	54						6.88		80.90			80.90		
D	52						6.35		86.60			86.60		
D	52						7.22		83.00			83.00		
D	52						7.44		86.20			86.20		
D	53						6.72		83.80			83.80		
D	55						6.98		80.90			80.90		
D	51						7.01		84.70			84.70		
D	50						6.84		84.70			84.70		
E	53													
E	54													
E	54													
E	53													
E	54													
E	53													
E	53													
E	53													
F	51													
F	51													
F	51													
F	50													
F	50													
F	50													
F	51													
F	51													
G	52	3518		4.87	0.09	0.17	6.86	0.73	81.46	0.31	0.04	81.46	0.40	3.91
G	53	3388		4.86	0.09	0.17	6.91	0.73	81.53	0.31	0.03	81.53	0.40	3.84
G	53	3450		4.86	0.10	0.17	6.90	0.73	81.31	0.32	0.03	81.31	0.40	3.88
G	53	3495		4.83	0.10	0.17	6.85	0.73	81.42	0.32	0.04	81.42	0.39	3.81
G	53	3460		4.86	0.09	0.17	6.90	0.73	81.38	0.32	0.04	81.38	0.41	3.90
G	52	3565		4.84	0.09	0.17	6.88	0.73	81.44	0.32	0.04	81.44	0.39	3.89
G	52	3524		4.81	0.09	0.17	6.92	0.73	81.36	0.31	0.03	81.36	0.39	3.85
G	53	3472		4.82	0.09	0.17	6.85	0.73	81.47	0.31	0.03	81.47	0.40	3.87
H		3406												
H		3649												
H		3445												
H		3471												
H		3453												
H		3464												
H		3295												
H		3315												
I		3260		4.76	0.09	0.17	6.85	0.74	81.90	0.28	0.04	81.90	0.41	
I		3350		4.75	0.10	0.17	6.86	0.73	82.00	0.28	0.04	82.00	0.41	
I		3360		4.80	0.10	0.17	6.89	0.74	82.20	0.29	0.04	82.20	0.41	
I		3400		4.81	0.10	0.17	6.89	0.74	82.30	0.28	0.04	82.30	0.40	
I		3380		4.79	0.10	0.17	6.89	0.74	82.30	0.29	0.04	82.30	0.41	
I		3400		4.79	0.10	0.17	6.87	0.74	82.20	0.29	0.04	82.20	0.41	
I		3200		4.74	0.09	0.17	6.84	0.73	82.00	0.26	0.04	82.00	0.41	
I		3300		4.83	0.09	0.17	6.93	0.74	82.80	0.30	0.04	82.80	0.42	
J	52													
J	52													
J	52													
J	53													
J	52													
J	53													
J	53													
J	53													
K		3550												3.64
K		3530												3.65
K		3550												3.65
K		3650												3.65
K		3620												3.66
K		3680												3.64
K		3710												3.67
K		3590												3.66
L	53		3702											
L	53		3687											
L	53		3696											
L	53		3692											
L	53		3698											
L	53		3692											
L	53		3690											
L	52		3692											
M	46			4.87	0.08		7.15	0.71	81.06	0.34	0.03	81.06		3.37
M	45			4.93	0.09		7.17	0.70	82.84	0.32	0.03	82.84		3.35
M	45			4.74	0.08		6.79	0.71	82.59	0.31	0.03	82.59		3.23
M	47			4.85	0.08		7.04	0.71	82.31	0.40	0.03	82.31		3.30
M	47													3.31
M	47													3.21
M	48													3.32
M	47													3.41
N	50	3230	3590	4.82	0.10	0.17	6.90	0.73	80.78	0.34	0.04	80.78	0.40	3.65
N	50	3290	3580	4.81	0.10	0.16	6.93	0.73	80.75	0.33	0.04	80.75	0.39	3.66
N	51	3300	3600	4.82	0.10	0.17	6.95	0.73	80.81	0.34	0.04	80.81	0.40	3.65
N	54	3340	3610	4.81	0.10	0.16	6.93	0.73	80.76	0.33	0.04	80.76	0.40	3.61
N	52	3270	3600	4.83	0.10	0.16	6.89	0.73	80.71	0.35	0.04	80.71	0.39	3.65
N	53	3270	3590	4.82	0.10	0.17	6.94	0.73	80.76	0.34	0.04	80.76	0.40	3.63
N	53	3250	3580	4.81	0.09	0.16	6.88	0.73	80.74	0.35	0.04	80.74	0.40	3.63
N	51	3290	3580	4.81	0.10	0.17	6.92	0.73	80.72	0.34	0.04	80.72	0.39	3.64

Assay data (cont)

Lab Code	Au Pb Coll	U M/ICP ppm	U XRF ppm	Al2O3 XRF %	CaO XRF %	Cr2O3 XRF %	Fe2O3 XRF %	K2O XRF %	LOI XRF %	MgO XRF %	MnO XRF %	SiO2 XRF %	TiO2 XRF %	S Comb/LECO %
O	55	3541												
O	54	3561												
O	54	3480												
O	55	3539												
O	54	3546												
O	56	3503												
O	53	3482												
O	55	3659												
P	49	3530	3666	4.60	0.07	0.18	7.04	0.71	80.70		0.05	80.70	0.42	3.62
P	49	3487	3675	4.40	0.05	0.18	7.03	0.70	81.00		0.04	81.00	0.41	3.65
P	49	3445	3677	4.50	0.06	0.18	7.05	0.70	80.90		0.04	80.90	0.41	3.61
P	49	3581	3691	4.60	0.06	0.18	7.00	0.70	80.40		0.05	80.40	0.42	3.66
P	49	3630	3682	4.50	0.07	0.18	7.05	0.72	80.80		0.05	80.80	0.42	3.64
P	49	3535	3672	4.60	0.06	0.18	7.06	0.71	80.70		0.05	80.70	0.42	3.60
P	49	3535	3686	4.60	0.06	0.18	7.06	0.71	80.80		0.05	80.80	0.42	3.60
P	49	3610	3676	4.50	0.06	0.18	7.04	0.71	80.80		0.05	80.80	0.42	3.59
Q	49	3577	3580	4.77	0.08	0.16		0.69	80.00	0.36	0.04	80.00	0.39	3.72
Q	50	3587	3553	4.79	0.08	0.18		0.72	80.20	0.39	0.03	80.20	0.41	3.78
Q	50	3587	3532	4.68	0.08	0.17		0.69	79.00	0.36	0.03	79.00	0.40	3.79
Q	45	3606	3556	4.72	0.08	0.16		0.72	79.60	0.38	0.03	79.60	0.40	3.75
Q	49	3695	3600	4.76	0.08	0.17		0.70	79.80	0.35	0.04	79.80	0.40	3.75
Q	47	3606	3543	4.76	0.08	0.16		0.70	79.50	0.32	0.04	79.50	0.39	3.80
Q	54	3381	3582	4.72	0.08	0.16		0.70	79.90	0.41	0.03	79.90	0.39	3.70
Q	51	3342	3561	4.65	0.08	0.17		0.72	79.50	0.38	0.03	79.50	0.42	3.75
R	54	3890	3570	4.85	0.10	0.16	6.91	0.73	80.80	0.33	0.01	80.80	0.40	3.55
R	55	3740	3540	4.81	0.10	0.16	6.87	0.73	80.50	0.31	0.02	80.50	0.40	3.55
R	55	3830	3540	4.85	0.10	0.16	6.82	0.72	81.10	0.32		81.10	0.41	3.56
R	54	4060	3550	4.88	0.10	0.15	6.87	0.73	80.90	0.34		80.90	0.40	3.60
R	55	4150	3540	4.78	0.10	0.16	6.81	0.72	80.10	0.33	0.03	80.10	0.40	3.55
R	54	4170	3530	4.84	0.09	0.15	6.86	0.71	80.50	0.34	0.02	80.50	0.40	3.56
R	56	4050	3520	4.85	0.11	0.16	6.87	0.72	80.70	0.34		80.70	0.40	3.56
R	55	4050	3540	4.85	0.10	0.16	6.87	0.72	80.50	0.34	0.01	80.50	0.40	3.55
S	52	3676	3588	4.94	0.10	0.18	7.02	0.75	81.05	0.30	0.03	81.05	0.41	
S	51	3590	3639	4.99	0.11	0.18	7.22	0.75	81.34	0.31	0.03	81.34	0.42	
S	52	3541	3620	5.02	0.11	0.19	7.24	0.75	81.60	0.31	0.04	81.60	0.42	
S	52	3679	3462	4.92	0.10	0.18	6.98	0.73	80.49	0.30	0.03	80.49	0.41	
S	52	3687	3650	4.99	0.11	0.18	7.23	0.75	81.41	0.31	0.03	81.41	0.42	
S	52	3583	3573	4.94	0.10	0.18	7.15	0.75	81.07	0.30	0.03	81.07	0.41	
S	51	3672	3631	4.95	0.10	0.18	7.21	0.75	81.14	0.31	0.03	81.14	0.41	
S	52	3703	3497	4.93	0.10	0.18	7.00	0.74	80.65	0.30	0.03	80.65	0.41	

13. Measurement of Uncertainty: (ref Dr Hugh Bartlett, Hugh Bartlett Consulting CC.)

The samples used in this certification process have been selected in such a way as to represent the entire batch of material and were taken from the final packaged units; therefore all possible sources of uncertainty (sample uncertainty and measurement uncertainty) are included in the final combined standard uncertainty determination.

The uncertainty measurement takes into consideration the between lab and the within lab variances and is calculated from the square roots of the variances of these components using the formula:

$$\text{Combined standard uncertainty} = \sqrt{(\text{between lab.var/no of labs}) + (\text{mean square within lab.var /no of assays})}$$

These uncertainty measurements may be used, by laboratories, as a component for calculating the total uncertainty for method validation according to the relevant ISO guidelines.

Analyte	Method	Unit	S ¹	σ_L ²	Sw ³	CSU ⁴
Au	Pb Coll	g/t	1.580	0.991	0.819	0.267
U	M/ICP	ppm	134.472	100.800	69.115	31.303
U	XRF	ppm	68.858	62.838	35.094	22.646
Al ₂ O ₃	XRF	%	0.056	0.046	0.031	0.017
CaO	XRF	%	0.009	0.008	0.004	0.003
Cr ₂ O ₃	XRF	%	0.007	0.007	0.003	0.003
Fe ₂ O ₃	XRF	%	0.117	0.082	0.079	0.029
K ₂ O	XRF	%	0.014	0.012	0.006	0.004
LOI	XRF	%	0.233	0.253	0.073	0.096
MgO	XRF	%	0.029	0.026	0.011	0.009
MnO	XRF	%	0.007	0.005	0.004	0.002
SiO ₂	XRF	%	0.831	0.741	0.302	0.250
TiO ₂	XRF	%	0.011	0.010	0.006	0.004
S	Comb/LECO	%	0.101	0.097	0.040	0.035

1 S - Std Dev for use on control charts.

2 σ_L - Betw Lab Std Dev, for use to calculate a measure of accuracy.

3 Sw - Within Lab Std Dev, for use to calculate a measure of precision.

4 CSU - Combined Standard Uncertainty, a component for use to calculate the total uncertainty in method validation.

14. Certified values: The Certified, Provisional and Indicated values listed on p1 of this certificate fulfill the AMIS statistical criteria regarding agreement for certification and have been independently validated by Ms Margaret M. Fairhurst.

15. Metrological Traceability: The values quoted herein are based on the consensus values derived from statistical analysis of the data from an inter laboratory measurement program. Traceability to SI units is via the standards used by the individual laboratories the majority of which are accredited and who have maintained measurement traceability during the analytical process.

16. Certification: AMIS0455 is a new material.

17. Period of validity: The certified values are valid for this product, while still sealed in its original packaging, until notification to the contrary. The stability of the material will be subject to continuous testing for the duration of the inventory. Should product stability become an issue, all customers will be notified and notification to that effect will be placed on the www.amis.co.za website.

18. Minimum sample size: The majority of laboratories reporting used a 0.5g sample size for the ICP and a 30g sample size for the fire assay. These are the recommended minimum sample sizes for the use of this material.

19. Availability: This product is available in Laboratory Packs containing 1kg of material and Explorer Packs containing custom weights (from 50 to 250g) of material. The Laboratory Packs are sealed bottles delivered in sealed foil pouches. The Explorer Packs contain material in standard geochem envelopes, nitrogen flushed and vacuum sealed in foil pouches.

20. Recommended use: The data used to characterize this CRM has been scrutinized using outlier treatment techniques. This, together with the number of participating laboratories, should overcome any “inter-laboratory issues” and should lead to a very accurate measure for the given methods, notwithstanding the underlying assumption that what the good inter-laboratory labs reported was accurate. However an amount of bad data might have had an effect, resulting in limits which in some situations might be too broad for the effective monitoring of a single analytical method, laboratory or production process. Users should set their own limits based on their own data quality objectives and control measurements, after determining the performance characteristics of their own particular method, using a minimum of 20 analyses using this CRM. User set limits should normally be within the limits recommended on p1 and 2 of this certificate.

21. Legal Notice: This certificate and the reference material described in it have been prepared with due care and attention. However AMIS, Set Point Technology (Pty) Ltd, Mike McWha, and Margaret M. Fairhurst; accept no liability for any decisions or actions taken following the use of the reference material.

15 April 2015

Certifying Officers:



African Mineral Standards: _____
Michael McWha
BSc (Hons), FGSSA, FSAIMM, Pr.Sci.Nat



Geochemist: _____
Margaret M. Fairhurst, PG, MAusIMM
Oreval

Appendix – uncertified element statistics

Analyte	Method	Unit	Mean	2SD	RSD%	n
Ag	M/ICP	ppm	4.7	3.0	32.3	68
Al	M/ICP	%	2.5	0.26	5.3	71
As	M/ICP	ppm	690	54.4	3.9	62
Ba	M/ICP	ppm	168	18.3	5.4	76
Be	M/ICP	ppm	2.1	0.51	12.2	72
Bi	M/ICP	ppm	5.1	1.04	10.3	65
Ca	M/ICP	ppm	0.07	0.01	8.2	63
Cd	M/ICP	ppm	0.85	0.31	18.1	55
Ce	M/ICP	ppm	286	27.5	4.8	48
Co	M/ICP	ppm	174	23.2	6.7	77
Cr	M/ICP	ppm	810	446	27.5	64
Cs	M/ICP	ppm	5.4	1.0	8.9	58
Cu	M/ICP	ppm	103	19.2	9.3	72
Dy	M/ICP	ppm	35.3	4.0	5.6	32
Er	M/ICP	ppm	17.0	3.9	11.4	32
Eu	M/ICP	ppm	4.0	0.27	3.3	30
Fe	M/ICP	%	4.8	0.34	3.5	63
Ga	M/ICP	ppm	7.0	1.8	12.8	57
Gd	M/ICP	ppm	29.4	2.0	3.5	32
Ge	M/ICP	ppm	0.82	0.88	53.8	31
Hf	M/ICP	ppm	11.9	3.0	12.6	56
Ho	M/ICP	ppm	6.4	0.71	5.6	32
In	M/ICP	ppm	0.05	0.02	16.6	43
K	M/ICP	ppm	0.6	0.07	6.1	71
La	M/ICP	ppm	150	15.8	5.2	56
Li	M/ICP	ppm	8.5	1.0	5.6	72
Lu	M/ICP	ppm	1.7	0.20	5.8	44
Mg	M/ICP	%	0.18	0.01	3.2	69
Mn	M/ICP	ppm	259	22.8	4.4	77
Mo	M/ICP	ppm	10.6	1.6	7.4	68
Na	M/ICP	ppm	0.08	0.02	10.4	64
Na2O	XRF	%	0.13	0.05	12.4	46
Nb	M/ICP	ppm	12.3	5.1	20.7	63
Nd	M/ICP	ppm	103	9.4	4.6	32
Ni	M/ICP	ppm	385	37.5	4.9	79
P	M/ICP	%	357	58.9	8.2	70
Pb	M/ICP	ppm	1641	148	4.5	72
P2O5	XRF	%	0.09	0.01	1.4	31
Pr	M/ICP	ppm	30.5	2.6	4.2	31
Rb	M/ICP	ppm	27.3	3.0	5.5	62
S	M/ICP	ppm	3.6	0.18	2.5	53
Sb	M/ICP	ppm	12.6	7.9	31.2	71
Sc	M/ICP	ppm	6.5	1.8	13.8	71
Se	M/ICP	ppm	8.5	7.6	45.1	40
SG	pyc		2.8	0.06	0.6	46
Si	M/ICP	%	37.5	0.37	0.49	8
Sm	M/ICP	ppm	26.1	1.4	2.8	30
Sn	M/ICP	ppm	3.3	1.3	19.8	58
Sr	M/ICP	ppm	79.5	5.3	3.4	68
Ta	M/ICP	ppm	4.9	1.9	18.9	60
Tb	M/ICP	ppm	5.7	0.71	6.2	47
Te	M/ICP	ppm	0.41	0.37	44.8	55
Th	M/ICP	ppm	376	69.9	9.3	72
Ti	M/ICP	%	0.15	0.07	22.5	59
Tl	M/ICP	ppm	0.39	0.12	15.1	58
U3O8	XRF	ppm	4240	219	0.13	16
Tm	M/ICP	ppm	2.3	0.27	6.0	30
V	M/ICP	ppm	27.8	13.3	23.9	72
W	M/ICP	ppm	1.1	0.39	17.5	56
Y	M/ICP	ppm	128	20.9	8.1	76
Yb	M/ICP	ppm	13.9	3.0	10.8	45
Zn	M/ICP	ppm	256	46.7	9.1	75
Zr	M/ICP	ppm	474	163	17.2	56