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AMIS0474

Certified Reference Material

Copper ore, Sulphide, Kansanshi Mine, Zambia

Certificate of Analysis

Recommended Concentrations and Limits[1.] *(at two Standard Deviations)*

Certified Concentrations[2.]

Au Pb Collection	0.16	±	0.02	g/t
Co 2A_MICP	26.28	±	2.63	ppm
Co 4A_MICP	26.66	±	4.3	ppm
Cu FUS	3127	±	129.5	ppm
Cu 2A_MICP	3032	±	282	ppm
Cu 4A_MICP	3078	±	158	ppm
U 4A_MICP	9.22	±	1.13	ppm
SG	2.75	±	0.07	Dimensionless

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, 9 and 12*
2. *There is additional certified major element data presented on page 2 and uncertified trace elements data presented as an appendix.*

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

Certified Concentrations

LOI	4.2	±	0.26	%
Al_2O_3 XRF	5.64	±	0.08	%
CaO XRF	5.04	±	0.10	%
Fe_2O_3 XRF	3.24	±	0.11	%
K_2O XRF	0.93	±	0.02	%
MgO XRF	1.01	±	0.07	%
Na_2O XRF	1.38	±	0.08	%
P_2O_5 XRF	0.07	±	0.01	%
SiO_2 XRF	76.01	±	0.54	%
TiO_2 XRF	0.47	±	0.02	%

Provisional Concentration

Cr_2O_3 XRF	0.1	±	0.02	%

Informational Concentrations

MnO XRF	0.04	±	0.01	%
S Comb/LECO	0.73	±	0.08	%

1. Intended Use: AMIS0474 is a certified reference material which may be used to demonstrate the validity of measurement results of a single analysis of sulphide copper ores 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.

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Directors: C E Pettit (British), R Naidoo, N N Robinson, K V Gerber, M Padayachee

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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 was made using sulphide ore sourced from the Kansanshi Mine, located in the North Western Province of Zambia, The mine is located approximately 10 kilometres north of the town of Solwezi, 180 kilometres to the northwest of the Copperbelt town of Chingola and 16 kilometres south of the Democratic Republic of Congo border. Kansanshi, Africa's largest copper mine, is 80% owned by Kansanshi Mining PLC, a First Quantum subsidiary. The remaining 20% is owned by a subsidiary of ZCCM.

The Kansanshi deposit occurs within the Lufilian arc, a major tectonic province characterized by broadly north directed fold and thrust structures, which hosts the world class Central African Copperbelt. The deposit at Kansanshi occurs within a broad, northwest trending, north-west closing antiform, which can be traced for approximately 12 kilometres. Kansanshi is a vein deposit developed within a tectonised rock sequence and, as such, constitutes a major mineralization control. The main veins and vein swarms dip sub vertically, perpendicular to the fold axes, in the plane of maximum extension.

3. Mineral and Chemical Composition: Deep tropical weathering has resulted in supergene enrichment and subsequent partial oxidation of the deposit. Primary copper sulphide mineralization is dominated by chalcopyrite, with very minor bornite, accompanied by relatively minor pyrite and pyrrhotite. Oxide mineralization is dominated by chrysocolla with malachite, limonite and cupriferous goethite. The mixed zone includes both oxide and primary mineralization but also carries significant chalcocite, minor native copper and tenorite. Some copper appears to be carried in clay and mica minerals, where it is essentially refractory.

4. Appearance: The material is a very fine powder. It is colored Blueish Grey. (5B 7/1)

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. 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 randomly selected for homogeneity testing and third party analysis. Statistical analysis of both homogeneity and the consensus test results were carried out by independent statisticians.

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7. Methods of Analysis requested:

1. Au – Pb collection, ICP-OES/ICP-MS.
2. Cu. Fusion AAS or ICP-OES.
3. Cu. Acid soluble: AAS or ICP-OES.
4. Multi-acid digest multi-element scan - (to include Cu). ICP-OES or ICP-MS.
5. Aqua regia digest multi-element scan - (to include Cu). ICP-OES or ICP-MS.
6. Majors (Al_2O_3, CaO, Cr_2O_3, Fe_2O_3, K_2O, MgO, MnO, Na_2O, SiO_2, TiO_2, P_2O_5, LOI) XRF fusion
7. SG – gas pycnometer

8. Information requested:

1. State aliquots used for all determinations.
2. All results for major elements to be reported as oxides in percentages.
3. All results for multi-element scans to be reported in ppm.
4. All results for Au to be reported in ppb.
5. Report all QC data, to include replicates, blanks and certified reference materials used.
6. State and provide brief description of analytical techniques used.
7. Send a PDF, excel and CSV of the results. (CSV template format was sent to the labs.)

9. Method of Certification: Eighteen laboratories were each given eight randomly selected packages of sample. Fourteen submitted results in time for the 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 12), 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”.

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10. Participating Laboratories: The 14 out of 18 laboratories that provided results timeously were (not in same order as in the table of assays):

1. BV Namibia
2. BV Ultratrace Australia (QC)
3. Dundee Precious Metals Tsumeb Laboratory (Namibia)
4. First Quantum Minig Lab
5. Genalysis Perth
6. Intertek Indonesia
7. Intertek South Africa
8. Palaboro Mining Company
9. Setpoint Lab Isando
10. SGS Callao Peru
11. SGS Lakefield
12. SGS South Africa (Randfontein)
13. SGS Vancouver Canada
14. Shiva Analytics

11. Assay Data: Data as received from the laboratories for the important certified elements listed on p1 and 2 are set out below. A proficiency report has been sent to the managers of the participating laboratories. Additional digital data from this round robin is available on request.

Table 1 - Element data

Pb Coll Au g/t	Pb Coll Au g/t	2A_MICP Co ppm	4A_MICP Co ppm	4A_MICP Co ppm	FUS Cu ppm	2A_MICP Cu ppm	4A_MICP Cu ppm	4A_MICP Cu ppm	SG SG No Unit	4A_MICP U ppm
0.16	0.16	27.00	29.00	29.00	3150.00	3122.20	3050.00	3150.00	2.74	9.02
0.15	0.15	29.00	28.00	29.00	3150.00	3175.70	3080.00	3170.00	2.73	8.86
0.14	0.16	28.00	27.00	29.00	3100.00	3133.40	3130.00	3130.00	2.73	8.78
0.15	0.15	27.00	27.00	29.00	3100.00	3088.60	3120.00	3210.00	2.71	8.88
0.14	0.17	28.00	28.00	28.00	3150.00	3158.30	3090.00	3120.00	2.69	8.96
0.16	0.16	28.00	27.00	30.00	3050.00	3145.60	3080.00	3180.00	2.73	9.26
0.16	0.17	27.00	29.00	29.00	3050.00	3096.70	3130.00	3170.00	2.71	8.94
0.17	0.17	27.00	29.00	29.00	3050.00	3113.60	3080.00	3180.00	2.71	8.74
0.16	0.17	25.18	29.00	23.00	3127.00	2906.00	3140.70	3230.00	2.73	10.06
0.16	0.16	25.24	29.00	23.00	3111.00	2958.00	3170.60	3150.00	2.72	10.02
0.17	0.15	25.73	28.00	22.00	3159.00	2899.00	3110.50	2960.00	2.72	10.01
0.16	0.17	25.30	28.00	22.00	3109.00	2948.00	3106.10	3000.00	2.73	10.30
0.17	0.16	25.47	28.00	23.00	3099.00	2915.00	3102.40	2990.00	2.72	9.99
0.18	0.16	25.28	28.00	22.00	3048.00	2912.00	3123.00	3070.00	2.72	10.05
0.16	0.16	25.09	29.00	24.00	3079.00	2979.00	3147.80	2920.00	2.72	10.07
0.16	0.17	25.03	28.00	24.00	3065.00	2875.00	3120.10	2990.00	2.80	10.03
0.16	0.15	26.00	29.00	23.00	3074.00	2790.00	3070.00	3126.00	2.79	9.41
0.16	0.15	27.00	29.00	23.00	3129.00	2834.00	3060.00	3086.00	2.70	8.93
0.16	0.16	26.00	29.00	23.00	3166.00	2816.00	3110.00	3157.00	2.81	9.05
0.16	0.15	26.00	27.00	24.00	3181.00	2802.00	3040.00	2987.00	2.81	9.15
0.16	0.15	26.00	25.00	25.00	3135.00	2826.00	3040.00	2926.00	2.82	9.59
0.16	0.17	26.00	26.00	24.00	3248.00	2829.00	3090.00	3085.00	2.74	9.46
0.16	0.17	27.00	30.00	26.30	3268.00	2801.00	3080.00	3031.00	2.77	9.33
0.16	0.16	26.00	29.00	25.50	3325.00	2773.00	3070.00	3075.00	2.76	9.36
0.17	0.16	28.00	26.23	25.30	3148.00	3040.00	3070.00	3100.00	2.76	9.37
0.14	0.16	29.00	26.58	25.70	3098.00	3060.00	3100.00	2900.00	2.75	9.08
0.16	0.18	27.00	26.36	26.40	3170.00	3050.00	3190.00	3000.00	2.76	9.15
0.17	0.16	28.00	25.80	25.50	2946.00	3030.00	3110.00	2900.00	2.77	8.99
0.15	0.17	28.00	25.71	26.40	3125.00	3080.00	3080.00	3000.00	2.76	9.17
0.17	0.16	28.00	26.42	25.60	3129.00	3100.00	3040.00	3000.00	2.77	9.49
0.18	0.16	28.00	25.95		3086.00	3050.00	3020.00	3100.00		8.97
0.17	0.14	28.00	25.87		3073.00	3070.00	3030.00	2900.00		9.31
0.15	0.14	25.00	27.50		3130.00	3072.00	3056.00	3002.00		8.34
0.15	0.15	25.00	26.90		3150.00	3029.00	3131.00	2920.00		8.28
0.17	0.14	25.00	27.40		3160.00	3085.00	3183.00	3035.00		8.30
0.17	0.14	25.00	27.90		3140.00	2908.00	3120.00	2957.00		9.95
0.18	0.15	24.00	27.20		3130.00	3033.00	3072.00	2918.00		8.29
0.15	0.16	25.00	27.20		3130.00	3098.00	3082.00	2951.00		8.50
0.15	0.15	24.00	27.80		3190.00	3078.00	3011.00	2902.00		8.51
		25.00	26.80		3150.00	3070.00	3144.00	3200.00		8.82
		25.00				3270.00	3033.00	3080.00		
		27.00				3243.00	3074.00	3050.00		
		26.00				3279.00	3108.00	3140.00		
		26.00				3125.00	3062.00	3190.00		
		25.00				3216.00	3104.00	3180.00		
		26.00				3165.00	3176.00	3130.00		
		25.00				3242.00	3093.00	3210.00		
						3240.00	3090.00			

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Table 2 - Major element data

XRF Al2O3 %	XRF CaO %	XRF Fe2O3 %	XRF K2O %	XRF MgO %	XRF Na2O %	XRF P2O5 %	XRF SiO2 %	XRF TiO2 %	LOI LOI %
5.65	4.95	3.15	0.93	1.03	1.46	0.07	76.21	0.46	4.19
5.64	4.99	3.15	0.92	1.08	1.44	0.07	76.28	0.46	4.20
5.69	4.97	3.13	0.93	1.05	1.45	0.07	76.25	0.47	4.18
5.69	4.96	3.17	0.92	1.03	1.41	0.07	76.22	0.46	4.17
5.62	5.00	3.17	0.92	1.03	1.44	0.07	76.27	0.47	4.12
5.64	5.09	3.13	0.93	1.05	1.44	0.07	76.34	0.46	4.14
5.72	5.09	3.15	0.94	1.05	1.39	0.07	76.21	0.46	4.21
5.67	5.08	3.27	0.94	1.01	1.37	0.08	76.23	0.47	4.19
5.69	5.08	3.26	0.94	1.01	1.40	0.07	75.30	0.46	4.23
5.68	5.09	3.26	0.94	1.02	1.40	0.07	75.90	0.48	4.18
5.68	5.08	3.25	0.95	1.01	1.40	0.07	75.60	0.47	4.20
5.69	5.08	3.26	0.94	1.01	1.40	0.07	75.30	0.45	4.25
5.70	5.08	3.25	0.94	1.01	1.38	0.07	75.20	0.46	4.18
5.69	4.92	3.25	0.94	1.02	1.37	0.07	75.40	0.46	4.23
5.68	5.00	3.25	0.92	1.01	1.38	0.07	75.60	0.46	4.15
5.58	4.97	3.13	0.92	1.02	1.38	0.07	75.40	0.47	4.15
5.56	4.99	3.18	0.92	0.97	1.38	0.07	76.01	0.46	3.80
5.58	4.97	3.14	0.92	0.93	1.39	0.07	75.95	0.45	4.30
5.59	5.00	3.14	0.92	0.93	1.38	0.07	76.10	0.45	4.05
5.63	4.97	3.16	0.94	0.95	1.39	0.07	76.11	0.46	4.52
5.62	5.04	3.19	0.94	0.93	1.37	0.07	76.12	0.46	4.54
5.55	5.02	3.18	0.94	0.94	1.40	0.07	75.95	0.46	4.35
5.65	5.03	3.19	0.93	0.95	1.33	0.07	76.08	0.46	3.86
5.65	5.03	3.28	0.93	0.94	1.34	0.07	76.05	0.46	4.27
5.61	5.02	3.27	0.94	1.00	1.33	0.08	76.02	0.47	4.31
5.61	5.02	3.27	0.93	0.99	1.34	0.08	76.14	0.46	4.24
5.66	5.04	3.26	0.93	0.99	1.35	0.08	76.10	0.46	4.24
5.67	5.03	3.27	0.93	1.00	1.32	0.07	76.18	0.47	4.25
5.66	5.03	3.25	0.93	1.00	1.34	0.07	75.98	0.46	4.24
5.64	5.02	3.26	0.93	0.99	1.35	0.08	76.38	0.47	4.23
5.60	5.08	3.25	0.94	0.99	1.31	0.08	76.14	0.47	4.21
5.63	5.07	3.19	0.94	1.00	1.35	0.07	76.18	0.47	4.14
5.59	5.07	3.17	0.94	1.03	1.33	0.07	76.10	0.48	4.14
5.60	5.06	3.18	0.94	1.02	1.34	0.07	76.10	0.48	4.18
5.62	5.02	3.22	0.94	1.04	1.35	0.07	76.10	0.48	4.13
5.59	5.06	3.17	0.94	1.05	1.35	0.07	76.00	0.48	4.14
5.62	5.05	3.22	0.93	1.04	1.38		76.00	0.48	4.13
5.61	5.01	3.23	0.95	1.03			76.10	0.46	4.14
5.64	4.97	3.21	0.94	1.04			76.10	0.47	4.14
5.60	4.95	3.33	0.93	1.03			76.00	0.47	4.03
5.70	5.01	3.31	0.93	1.03			76.00	0.47	4.06
5.60	5.01	3.29	0.94	1.00			76.00	0.46	4.05
5.60	4.99	3.33	0.94	1.03			75.80	0.47	4.06
5.60	4.96	3.33	0.93	1.02			75.90	0.47	4.03
5.70	4.98	3.31	0.94	1.05			76.20	0.47	4.08
5.60	5.06	3.31	0.94	1.03			76.30	0.47	4.05
5.60	5.08	3.30	0.94	1.03			76.30	0.46	4.06
5.61	5.06	3.28	0.94	1.01			76.20	0.46	4.38
5.61	5.13	3.26	0.94	1.01			76.10	0.47	4.35
5.65	5.08	3.28	0.94	1.02			76.00	0.46	4.39
5.66	5.06	3.27	0.94	1.02			76.20	0.46	4.25
5.60	5.08	3.26	0.94	1.03			76.00	0.46	4.34
5.63	5.12	3.26	0.93	1.02			75.90	0.47	4.34
5.68	5.09	3.27	0.94	1.03			76.10		4.27
5.66	5.09	3.29	0.94	1.02			76.10		4.39
5.68	5.11	3.29	0.92	1.01			75.70		4.23
5.73	5.12	3.27	0.93						4.23
5.68	5.11	3.27	0.94						4.25
5.69	5.11	3.27	0.94						4.25
5.68	5.10	3.27	0.94						4.28
5.66	5.11	3.28							4.40
5.64		3.25							4.32
5.70		3.26							4.23

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12. 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:

Combined standard uncertainty=sqrt((between lab.var/no of labs) + (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]	σL [2]	SW [3]	CSU [4]
Au	Pb Collection	g/t	0.010	0.004	0.008	0.001
Co	2A_MICP	ppm	1.315	1.472	0.564	0.606
Co	4A_MICP	ppm	2.150	1.950	0.811	0.657
Cu	FUS	ppm	64.750	46.131	55.677	22.430
Cu	2A_MICP	ppm	140.845	169.078	39.871	69.265
Cu	4A_MICP	ppm	79.155	45.681	57.752	14.457
U	4A_MICP	ppm	0.565	0.668	0.297	0.303
SG	SG	Dimensionless	0.035	0.040	0.023	0.020
LOI	LOI	%	0.130	0.078	0.107	0.031
Al2O3	XRF	%	0.040	0.031	0.030	0.011
CaO	XRF	%	0.050	0.049	0.021	0.018
Fe2O3	XRF	%	0.055	0.057	0.016	0.020
K2O	XRF	%	0.010	0.006	0.006	0.002
MgO	XRF	%	0.035	0.035	0.012	0.014
Na2O	XRF	%	0.040	0.047	0.015	0.021
P2O5	XRF	%	0.005	0.004	0.002	0.002
SiO2	XRF	%	0.270	0.266	0.139	0.102
TiO2	XRF	%	0.010	0.004	0.006	0.002

1 *S - Std Dev for use on control charts.*
2 *σL - 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.*

13. Certified values: The Certified, Provisional and Informational values listed on page 1 and page 2 of this certificate fulfill the AMIS statistical criteria regarding agreement for certification and have been independently validated by Mr Allan W. Fraser.

14. 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.

15. Certification: AMIS0474 is a new material.

16. 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.

17. 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.

18. 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.

19. 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.

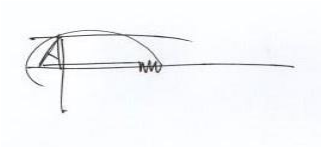
20. Legal Notice: This certificate and the reference material described in it have been prepared with due care and attention. However AMIS, a part of Torre Industries, Nozibele Mbangula and Allan W. Fraser; accept no liability for any decisions or actions taken following the use of the reference material.

MATRIX REFERENCE MATERIALS
A Part of Torre Industries

25 July 2016

Certifying Officers:

African Mineral Standards: _____
Nozibele Mbangula



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MATRIX REFERENCE MATERIALS
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Appendix – uncertified element statistics

Element	Gen Method	Std_Mean	N	SD	2SD	RSD_%	Unit
Ag	2A_MICP	0.06	8	0.02	0.04	29.32	ppm
Ag	3A_ICPMS	0.11	8	0.02	0.04	17.75	ppm
Ag	4A_MICP	0.93	36	1.85	3.69	198.59	ppm
Al	2A_MICP	5742.00	24	460.76	921.52	8.02	ppm
Al	3A_ICPMS	5937.50	8	118.77	237.55	2	ppm
Al	4A_MICP	26568.04	72	7226.52	14453.05	27.2	ppm
Al2O3	4A_MICP	5.96	8	0.08	0.15	1.28	%
Al2O3	FUS	5.62	24	0.13	0.26	2.35	%
Ars	2A_MICP	6.68	30	0.5	1	7.48	ppm
Ars	3A_ICPMS	6.50	8	0.53	1.07	8.22	ppm
Ars	4A_MICP	10.38	36	8.95	17.9	86.26	ppm
Ba	2A_MICP	39.59	32	2.64	5.28	6.66	ppm
Ba	3A_ICPMS	39.88	8	1.46	2.92	3.66	ppm
Ba	4A_MICP	124.59	64	6.47	12.95	5.2	ppm
Ba	FUS	127.43	7	0.79	1.57	0.62	ppm
BaO	XRF	0.01	8	0.01	0.01	37.64	%
Be	3A_ICPMS	0.20	8	0	0	0	ppm
Be	4A_MICP	0.93	49	0.14	0.27	14.77	ppm
Bi	2A_MICP	0.19	24	0.02	0.03	8.54	ppm
Bi	3A_ICPMS	0.15	7	0.01	0.02	5.4	ppm
Bi	4A_MICP	0.18	37	0.02	0.03	9.66	ppm
Ca	2A_MICP	34091.67	24	2047.89	4095.77	6.01	ppm
Ca	3A_ICPMS	35037.50	8	997.05	1994.1	2.85	ppm
Ca	4A_MICP	35864.80	56	1298.55	2597.09	3.62	ppm
CaO	4A_MICP	5.80	8	0.07	0.15	1.27	%
CaO	FUS	4.92	24	0.29	0.57	5.85	%
Cd	3A_ICPMS	0.02	7	0.01	0.02	40.18	ppm
Cd	4A_MICP	0.04	15	0.01	0.03	36.14	ppm
Ce	2A_MICP	43.62	16	8.51	17.02	19.51	ppm
Ce	3A_ICPMS	38.80	7	0.62	1.25	1.61	ppm
Ce	4A_MICP	61.76	24	30.69	61.39	49.69	ppm
Co	3A_ICPMS	25.74	8	0.4	0.8	1.55	ppm
Cr	2A_MICP	204.55	40	32.71	65.41	15.99	ppm
Cr	3A_ICPMS	192.13	8	6.42	12.85	3.34	ppm
Cr	4A_MICP	504.08	48	76.7	153.39	15.21	ppm
Cr2O3	FUS	0.10	15	0.01	0.01	5.9	%
Cr2O3	XRF	0.10	55	0.01	0.02	9.62	%
Cs	2A_MICP	0.62	7	0	0.01	0.61	ppm
Cs	3A_ICPMS	0.58	7	0.01	0.02	1.55	ppm
Cs	4A_MICP	0.78	32	0.08	0.15	9.84	ppm
Cu	3A_AAS	70.00	8	0	0	0	ppm
Cu	3A_ICPMS	3121.25	8	58.42	116.83	1.87	ppm
Cu	4A_AAS	3114.29	7	15.12	30.24	0.49	ppm
Cu	XRF	3275.00	8	103.51	207.02	3.16	ppm
Cu	AS	70.83	40	56.97	113.93	80.43	ppm
Dy	4A_MICP	2.96	16	0.62	1.24	20.99	ppm
Er	4A_MICP	2.01	16	0.29	0.58	14.34	ppm
Eu	4A_MICP	0.68	16	0.22	0.45	32.95	ppm
Fe	2A_MICP	20575.00	24	1524.08	3048.16	7.41	ppm
Fe	3A_ICPMS	20537.50	8	427.41	854.82	2.08	ppm
Fe	4A_MICP	21915.86	71	799.86	1599.73	3.65	ppm
Fe	FUS	20425.00	8	494.97	989.95	2.42	ppm
Fe2O3	FUS	3.29	21	0.07	0.13	2	%
Ga	2A_MICP	2.31	16	0.5	1.01	21.76	ppm
Ga	3A_ICPMS	2.18	8	0.05	0.09	2.13	ppm
Ga	4A_MICP	7.59	36	1.89	3.77	24.85	ppm
Gd	4A_MICP	3.26	16	1.08	2.16	33.01	ppm
Ge	4A_MICP	0.77	24	0.52	1.04	67.62	ppm
Hf	2A_MICP	0.33	8	0.01	0.03	4.03	ppm
Hf	3A_ICPMS	0.21	8	0.01	0.02	4.29	ppm
Hf	4A_MICP	1.80	36	0.59	1.18	32.8	ppm
Hg	2A_MICP	1.75	4	0.5	1	28.57	ppm
Hg	3A_ICPMS	0.02	4	0.01	0.01	38.49	ppm
Hg	4A_MICP	0.02	8	0.01	0.01	35.63	ppm
Ho	4A_MICP	0.67	16	0.16	0.32	23.74	ppm
Ind	2A_MICP	0.09	7	0	0	0	ppm
Ind	3A_ICPMS	0.10	8	0	0.01	4.75	ppm
Ind	4A_MICP	0.11	37	0	0.01	3.85	ppm
K	2A_MICP	2755.00	24	217.71	435.43	7.9	ppm
K	3A_ICPMS	2662.50	8	74.4	148.8	2.79	ppm
K	4A_MICP	6686.81	72	2088.93	4177.86	31.24	ppm
K2O	FUS	0.97	16	0.03	0.05	2.63	%
La	2A_MICP	20.34	32	3.29	6.58	16.17	ppm
La	3A_ICPMS	18.07	7	0.28	0.55	1.52	ppm
La	4A_MICP	33.33	40	2.82	5.64	8.46	ppm
Li	2A_MICP	4.52	32	0.52	1.03	11.4	ppm
Li	3A_ICPMS	4.63	8	0.52	1.04	11.19	ppm
Li	4A_MICP	6.65	64	0.94	1.89	14.19	ppm
Lu	3A_ICPMS	0.28	7	0	0	0	ppm
Lu	4A_MICP	0.37	24	0.03	0.07	8.85	ppm
Mg	2A_MICP	5325.00	24	556.58	1113.16	10.45	ppm
Mg	3A_ICPMS	5300.00	8	75.59	151.19	1.43	ppm
Mg	4A_MICP	5854.74	78	239.59	479.18	4.09	ppm
MgO	FUS	1.06	24	0.05	0.09	4.43	%
Mn	2A_MICP	258.35	23	5.46	10.91	2.11	ppm
Mn	3A_ICPMS	255.13	8	5.14	10.28	2.01	ppm
Mn	4A_MICP	289.72	79	20.17	40.34	6.96	ppm
MnO	FUS	0.04	16	0.01	0.01	14.57	%
MnO	XRF	0.04	56	0.01	0.01	16.72	%
Mo	2A_MICP	7.41	32	0.92	1.83	12.36	ppm
Mo	3A_ICPMS	7.68	8	0.72	1.44	9.39	ppm

Element	Gen Method	Std_Mean	N	SD	2SD	RSD_%	Unit
Mo	4A_MICP	7.84	71	1.06	2.12	13.53	ppm
Na	2A_MICP	491.67	24	88.05	176.11	17.91	ppm
Na	3A_ICPMS	500.00	8	0	0	0	ppm
Na	4A_MICP	8038.51	72	4093.3	8186.6	50.92	ppm
Na2O	FUS	1.43	8	0.02	0.03	1.13	%
Nb	2A_MICP	1.40	7	0	0	0	ppm
Nb	3A_ICPMS	0.90	8	0.04	0.08	4.58	ppm
Nb	4A_MICP	6.49	48	0.88	1.77	13.6	ppm
Nb	FUS	20.13	8	0.83	1.67	4.15	ppm
Nd	4A_MICP	19.33	16	9.36	18.72	48.41	ppm
Ni	2A_MICP	44.49	48	4.36	8.71	9.79	ppm
Ni	3A_ICPMS	46.94	7	0.65	1.31	1.39	ppm
Ni	4A_MICP	47.64	66	2.03	4.06	4.26	ppm
P	2A_MICP	281.36	22	27.48	54.96	9.77	ppm
P	3A_ICPMS	255.00	8	14.14	28.28	5.55	ppm
P	4A_MICP	311.25	69	45.5	91	14.62	ppm
P2O5	FUS	0.07	8	0.01	0.01	7.02	%
Pb	2A_MICP	4.17	24	1.44	2.88	34.53	ppm
Pb	3A_ICPMS	4.74	7	0.37	0.74	7.78	ppm
Pb	4A_MICP	4.86	52	2.29	4.58	47.12	ppm
Pr	4A_MICP	5.14	16	2.5	5.01	48.72	ppm
Pt	Pb Coll	0.01	3	0	0	0	ppm
Rb	2A_MICP	16.96	8	0.18	0.37	1.09	ppm
Rb	3A_ICPMS	18.46	8	0.3	0.59	1.61	ppm
Rb	4A_MICP	30.81	38	5.04	10.08	16.36	ppm
S	2A_MICP	0.66	31	0.04	0.09	6.79	%
S	3A_ICPMS	0.76	8	0.02	0.04	2.55	%
S	4A_MICP	0.68	61	0.03	0.07	4.78	%
S	FUS	0.70	8	0	0	0	%
S	XRF	0.72	16	0.04	0.08	5.46	%
S	Comb/LECO	0.73	8	0.04	0.08	5.16	%
Sb	2A_MICP	0.31	16	0.04	0.09	14.3	ppm
Sb	3A_ICPMS	0.25	7	0.02	0.03	6.59	ppm
Sb	4A_MICP	0.39	32	0.06	0.13	16.18	ppm
Sc	2A_MICP	4.53	24	0.4	0.81	8.89	ppm
Sc	3A_ICPMS	4.45	8	0.09	0.19	2.08	ppm
Sc	4A_MICP	7.42	72	1.7	3.4	22.93	ppm
Se	2A_MICP	5.00	8	0	0	0	ppm
Se	3A_ICPMS	5.00	8	0	0	0	ppm
Se	4A_MICP	5.00	28	0	0	0	ppm
SiO2	4A_MICP	75.63	8	0.65	1.31	0.86	%
SiO2	FUS	76.25	29	2.27	4.55	2.98	%
Sm	4A_MICP	3.70	16	1.46	2.91	39.36	ppm
Sn	2A_MICP	1.91	8	0.11	0.23	5.89	ppm
Sn	3A_ICPMS	1.40	7	0	0	0	ppm
Sn	4A_MICP	2.02	30	0.24	0.47	11.65	ppm
SO3	XRF	1.75	8	0.02	0.04	1.01	%
Sr	2A_MICP	105.00	30	1.87	3.74	1.78	ppm
Sr	3A_ICPMS	109.88	8	3.87	7.74	3.52	ppm
Sr	4A_MICP	142.32	64	6.74	13.49	4.74	ppm
Sr	FUS	144.50	8	2.07	4.14	1.43	ppm
Ta	4A_MICP	0.35	33	0.14	0.28	40.34	ppm
Tb	3A_ICPMS	0.40	8	0.01	0.01	1.61	ppm
Tb	4A_MICP	0.52	24	0.13	0.25	24.39	ppm
Te	2A_MICP	0.69	16	0.07	0.14	9.99	ppm
Te	3A_ICPMS	0.69	8	0.08	0.16	11.66	ppm
Te	4A_MICP	0.73	30	0.07	0.14	9.56	ppm
Th	2A_MICP	5.17	16	0.32	0.64	6.15	ppm
Th	3A_ICPMS	4.19	8	0.06	0.13	1.53	ppm
Th	4A_MICP	5.71	39	0.95	1.9	16.6	ppm
Ti	2A_MICP	0.04	20	0	0	4.69	%
Ti	3A_ICPMS	0.04	8	0	0	0	%
Ti	4A_MICP	0.15	72	0.03	0.07	22.23	%
TiO2	FUS	0.44	16	0.02	0.04	4.34	%
Tl	2A_MICP	0.09	16	0.01	0.02	9.13	ppm
Tl	3A_ICPMS	0.07	8	0.01	0.01	7.02	ppm
Tl	4A_MICP	0.11	39	0.01	0.03	11.83	ppm
Tm	4A_MICP	0.32	16	0.03	0.07	10.88	ppm
U	2A_MICP	8.86	16	0.21	0.42	2.35	ppm
U	3A_ICPMS	7.57	7	0.12	0.25	1.64	ppm
V	2A_MICP	20.91	23	0.85	1.7	4.06	ppm
V	3A_ICPMS	21.00	8	0.76	1.51	3.6	ppm
V	4A_MICP	60.10	72	13.18	26.36	21.93	ppm
V2O5	XRF	0.01	14	0.01	0.01	35.95	%
W	2A_MICP	0.16	13	0.05	0.1	31.35	ppm
W	3A_ICPMS	0.13	6	0.05	0.1	38.73	ppm
W	4A_MICP	0.63	39	0.21	0.42	33.62	ppm
Y	2A_MICP	11.87	31	0.49	0.98	4.13	ppm
Y	3A_ICPMS	11.69	7	0.11	0.21	0.91	ppm
Y	4A_MICP	13.92	61	0.91	1.83	6.55	ppm
Y	FUS	21.25	8	0.46	0.93	2.18	ppm
Yb	3A_ICPMS	2.06	8	0.05	0.1	2.51	ppm
Yb	4A_MICP	2.34	24	0.23	0.46	9.76	ppm
Zn	2A_MICP	9.00	22	0.89	1.77	9.83	ppm
Zn	3A_ICPMS	8.00	8	1.07	2.14	13.36	ppm
Zn	4A_MICP	10.01	56	1.91	3.83	19.11	ppm
Zn	FUS	11.00	8	0.93	1.85	8.42	ppm
Zr	2A_MICP	8.50	24	1.16	2.32	13.64	ppm
Zr	3A_ICPMS	8.11	7	0.19	0.37	2.3	ppm
Zr	4A_MICP	74.06	64	4.65	9.29	6.27	ppm
Zr	FUS	109.88	8	2.53	5.06	2.3	ppm

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