



African Mineral Standards

REFERENCE MATERIALS FOR AFRICAN ORES

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African Mineral Standards

Certificate of Analysis

Copper Sulphide Ore
Reference Material from Kansanshi, Zambia

AMIS0120

Recommended Concentration and two “Between Laboratory” Standard Deviations

Certified Concentrations

Au Pb Coll	1.42	±	0.16	ppm
Co M/ICP	557	±	43	ppm
Cu F	15.14	±	0.993	%
Cu M/ICP	15.32	±	0.958	%
Cu P	15.14	±	1.13	%
Ni M/ICP	1355	±	95	ppm
SG	3.35	±	0.18	g/cc
U M/ICP	80	±	6.3	ppm

Provisional Concentrations

Pb M/ICP	9.1	±	2.4	ppm
Zn M/ICP	141	±	18.4	ppm

Indicated Mean

Ag M/ICP 2.3 ppm

Recommended Concentration and two “Between Laboratory” Standard Deviations

Certified Concentrations (Major Elements)

Al2O3	5.18	±	0.22	%
CaO	3.54	±	0.36	%
K2O	0.34	±	0.04	%
MgO	0.68	±	0.06	%
MnO	0.039	±	0.004	%
S	18.01	±	1.32	%
SiO2	27.83	±	1.6	%
TiO2	0.49	±	0.04	%

Provisional Concentrations (Major Elements)

Fe2O3	26.80	±	3.04	%
LOI	9.54	±	1.78	%
Na2O	2.34	±	0.28	%

Indicated Mean

P2O5 0.11 %

Intended Use: AMIS0120 is suitable to monitor the accuracy of a single analysis of copper ore. The material can be used for routine quality control by inserting within a batch of samples, method development and for the calibration of equipment.

The recommended mean and "Between Lab" standard deviations for this standard reflect the average 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 and this is acceptable. Good laboratories however will report results within the two standard deviation levels with a failure of <10 %.

Origin of Material: This standard was made using sulphide ore sourced from the Kansanshi project, located in the North Western Province of Zambia, approximately 15 kilometres north of the town of Solwezi and 16 kilometres south of the Democratic Republic of Congo border. The Kansanshi project is majority owned by Cyprus Amax Kansanshi Holdings Limited, which is 100% owned by First Quantum Minerals Ltd (FQM).

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 property geology is dominated by the northwest-trending Kansanshi Antiform, which exposes rocks of the Late Proterozoic Kansanshi Mine Formation in the core of a major refolded fold. Copper mineralization occurs both in and between steeply dipping, generally north-south trending quartz-carbonate veins and vein swarms, and as foliation parallel stratabound mineralization, within albite and carbonate altered phyllitic rocks of the Mine Formation.

Deep tropical weathering has resulted in supergene enrichment and subsequent partial

oxidation of the deposit. Mineralization comprises copper oxide and mixed copper oxide/chalcocite mineralization hosted by saprolitized phyllites, decalcified marbles and schists. This secondary mineralization is underlain by a large tonnage of primary sulphide mineralization, with chalcopyrite and subordinate bornite as the dominant minerals. Oxide and mixed oxide/sulphide copper mineralization grading plus 0.5% copper occurs principally within two essentially flat lying orebodies, separated by a mostly barren marble unit. In some areas, the marble unit has been completely decalcified during weathering and in these cases the two ore bodies are combined. Deeper primary sulphide mineralization occurs in other discrete flat lying phyllite units.

(for more information, refer to the First Quantum Minerals Ltd Kansanshi Fact Sheet, Sept 2006, www.first-quantum.com.)

Appearance: The material is a very fine Dark Grey powder (Corstor Colour Gauge).

Method of Preparation: The material was crushed, dry-milled and air-classified to 100% <54um. Wet sieve particle size analysis of random samples confirmed the material was 100% <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 an independent statistician.

Methods of Analysis Requested:

1. Cu, Fusion AAS or ICP-OES.
2. Multi-acid digest multi-element scan - (to include Cu, Co, Ni, Pb, As, Zn, Ag, U.). ICP-OES or ICP-MS.
3. Aqua regia digest - Cu, Co. ICP-OES or ICP-MS.
4. Pressed pellet multi-element scan - (to include Cu, Co, Ni, Pb, As, Zn, Ag, U.). XRF.
5. Fusion (Majors). XRF.
6. Au. Pb collection ICP-OES or ICP-MS.
7. Cu QBM/AAS Acid Soluble Copper – as per Bwana Mkubwa method supplied.
8. SG. Gas pycnometer.

Method of Certification: Twenty laboratories were each given eight randomly selected packages of sample. Results from the sixteen laboratories that reported back timeously were used for the determinations below:

The mean and standard deviation for all data was calculated. Outliers were defined as samples beyond the mean ± 2 Standard Deviations from all data. These outliers were removed from the data and a new mean and standard deviation was determined. Total results from some laboratories that reported significant failures were also removed. This method is different from that used to calculate the Confidence Interval shown on many Government-produced standards in that the actual “between-laboratory” standard deviation is used in the calculations. This produces upper and lower limits that reflect actual individual analyses rather than a grouped set of analyses. The limits can therefore be used to monitor accuracy from individual analyses, unlike the Certified Limits published on other standards which quote a Confidence Interval.

Participating Laboratories: (Not in the same order as in the table of assays)

1. ACME Analytical Laboratories Ltd CA
2. Activation Laboratories Pty Ltd (ActLabs) CA
3. ALS Chemex Laboratory Group Johannesburg SA
4. ALS Chemex Laboratory Group Perth WA
5. ALS Chemex Laboratory Group Vancouver CA
6. Ammtec Limited WA
7. Assayers Canada

8. Genalysis Laboratory Services WA
9. Intertek Testing Services Ltd Shanghai (ITS Beijing)
10. Intertek Utama Services (Indonesia)
11. Labtium Inc Finland
12. OMAC Laboratories Limited (Ireland)
13. SGS Australia Pty Ltd (Newburn) WA
14. SGS Lakefield Research Africa Pty Ltd (Booysens) SA
15. SGS Mineral Services Lakefield (Canada)
16. Ultra Trace (Pty) Ltd WA

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

Lab Code	Ag M/ICP ppm	Al2O3 XRF %	Au Pb coll ppm	CaO XRF %	Co M/ICP ppm	Cu F ppm	Cu M/ICP ppm	Cu P ppm	Fe2O3 XRF %	K2O XRF %	LOI %	MgO XRF %	MnO XRF %	Na2O XRF %	Ni M/ICP ppm	P2O5	Pb M/ICP ppm	S XRF %	SG g/cc	SiO2 XRF %	TiO2 XRF %	U M/ICP ppm	Zn M/ICP ppm
A 2.00	5.28	1.37	3.57	565	1550000	1540000	151000	27.90	0.35	9.35	0.68	0.05		1350	0.12	10.00	18.90		27.60	0.49	82.50	145	
A 2.00	5.27	1.38	3.53	570	1490000	1550000	150000	27.90	0.35	9.35	0.69	0.04		1360	0.12	10.00	19.10		27.50	0.50	88.00	145	
A 2.00	5.26	1.42	3.53	559	1520000	152000	155000	28.00	0.35	9.37	0.69	0.04		1300	0.12	10.00	18.20		27.50	0.50	86.50	140	
A 2.00	5.29	1.37	3.56	565	1530000	152000	155000	28.10	0.35	9.31	0.69	0.04		1340	0.12	10.00	18.70		27.70	0.51	84.00	140	
A 2.00	5.29	1.40	3.54	570	1490000	1540000	158000	27.80	0.35	9.34	0.69	0.04		1380	0.12	9.00	19.10		27.70	0.51	81.50	150	
A 2.00	5.29	1.37	3.53	560	1490000	1550000	155000	27.90	0.34	9.37	0.69	0.04		1370	0.12	10.00	18.80		27.50	0.51	79.50	150	
A 2.50	5.31	1.38	3.55	560	1550000	1570000	153000	27.80	0.35	9.36	0.69	0.04		1380	0.12	9.00	18.80		27.80	0.50	80.00	150	
A 3.00	5.28	1.39	3.53	555	1570000	1570000	157000	28.00	0.34	9.32	0.69	0.04		1370	0.12	10.00	18.70		27.50	0.53	81.00	145	
B 2.60		1.45		570	1450000	1410000								1400				3.37			93.00	140	
B 2.40		1.33		580	1430000	1420000								1400				3.37			96.00	130	
B 2.60		1.47		570	1440000	1420000								1400				3.36			90.00	130	
B 2.80		1.32		570	1490000	1410000								1400				3.35			91.00	130	
B 2.50		1.36		570	1510000	1420000								1400				3.36			94.00	130	
B 2.50		1.41		560	1490000	1410000								1400				3.37			97.00	140	
B 2.60		1.43		570	1430000	1470000								1400				3.37			93.00	140	
B 2.50		1.40		560	1470000	1410000								1400				3.37			95.00	140	
C 1.41		630	1570000	1600000										1200				3.36			91.00		
C 1.44		640	1600000	1600000	162000									1200				3.33			87.00		
C 1.41		650	1570000	1500000	160000									1200				3.33			91.00		
C 1.34		640	1570000	1600000	159000									1200				3.33			85.00		
C 1.42		630	1600000	1600000	158000									1200				3.33			91.00		
C 1.61		680	1570000	1600000	157000									1200				3.31			87.00		
C 1.47		640	1590000	1600000	154000									1200				3.31			91.00		
C 1.40		670	1560000	1500000	162000									1200				3.33			93.00		
D 2.30		481	1570000											1220		101.00	17.70				76.60	241	
D 2.30		497	1570000											1260		104.00	18.70				79.30	248	
D 2.20		492	1550000											1240		104.00	17.70				78.10	244	
D 2.30		489	1600000											1240		105.00	18.20				77.00	246	
D 2.30		491	1580000											1250		104.00	17.90				78.50	250	
D 2.20		503	1610000											1270		105.00	18.00				78.00	250	
D 2.20		498	1630000											1260		104.00	18.20				78.00	251	
D 2.30			1550000											1280		105.00	18.10				78.30	255	
E																							
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F 5.21	5.31	1.39	3.50		1495000		26.24	0.35	10.68	0.71	0.05	2.23	0.13					27.08	0.48				
F 5.21	5.21	1.40	3.49		1523000		26.54	0.34	10.99	0.71	0.05	2.26	0.13					27.64	0.49				
F 5.21	5.21	1.32	3.47		1503000		26.48	0.36	11.02	0.70	0.05	2.24	0.14					27.29	0.48				
F 5.16	5.16	1.34	3.47		1523000		26.03	0.35	11.16	0.70	0.05	2.24	0.12					27.70	0.48				
F 5.21	5.21	1.38	3.52		1500000		26.72	0.36	10.91	0.71	0.05	2.27	0.13					27.85	0.49				
F 5.21	5.21	1.39	3.47		1529000		26.91	0.35	10.89	0.70	0.05	2.24	0.13					27.23	0.48				
F 5.22	5.22	1.38	3.52		1516000		26.62	0.35	10.87	0.72	0.06	2.34	0.13					27.49	0.49				
F 5.22	5.22	1.39	3.58		1508000		26.94	0.36	10.82	0.72	0.06	2.33	0.13					27.80	0.49				
G																							
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H 2.71	5.31	1.48	3.27	553	1570000	1490000	157000	26.02	0.32		0.66	0.04	2.57	1390	0.09	2.58	17.10	3.46	28.50	0.47	79.80	137	
H 2.72	5.31	1.50	3.27	555	1540000	1470000	157000	25.91	0.32		0.65	0.04	2.56	1400	0.09	2.40	17.20	3.45	28.30	0.48	75.80	129	
H 2.67	5.32	1.42	3.27	555	1540000	1510000	159000	25.84	0.32		0.65	0.04	2.56	1400	0.09	2.32	17.10	3.44	28.40	0.47	77.70	129	
H 2.56	5.33	1.50	3.27	547	1540000	1460000	159000	25.97	0.32		0.65	0.04	2.56	1380	0.09	2.24	16.90	3.48	28.40	0.47	77.20	132	
H 2.57	5.30	1.50	3.26	555	1510000	1490000	160000	25.89	0.32		0.65	0.04	2.54	1400	0.09	2.32	17.00	3.47	28.30	0.47	77.50	133	
H 2.58	5.37	1.54	3.27	544	1540000	1500000	160000	25.91	0.32		0.65	0.04	2.55	1390	0.09	2.48	16.90	3.46	28.30	0.48	80.30	135	
H 2.70	5.34	1.45	3.27	550	1550000	1490000	159000	26.02	0.32		0.66	0.04	2.59	1390	0.09	2.48	17.00	3.48	28.50	0.48	80.50	133	
H 2.51	5.27	1.44	3.24	555	1550000	1490000	160000	25.78	0.32		0.65	0.04	2.56	1390	0.09	2.55	17.00	3.48	28.30	0.47	79.30	131	
I 1.90		1.36	588		1610000	150569								1350					23.00			151	
I 1.80		1.44	560		1600000	148393								1350					29.00			148	
I 1.70		1.46	576		1550000	148834								1310					28.00			158	
I 1.80		1.34	572		1560000	150244								1310					23.00			158	
I 1.70		1.43	560		1590000	144612								1320					26.00			140	
I 1.80		1.43	570		1580000	147706								1290					31.00			150	
I 1.80		1.36	568		1590000	145746								1290					27.00			145	
I 1.80		1.46	562		1600000	147739								1290					23.00			143	
J 2.30	</																						

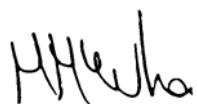
Assay Data (cont):

Lab Code	Ag M/ICP ppm	Al2O3 XRF %	Au Pb coll ppm	CaO XRF %	Co M/ICP ppm	Cu F ppm	Cu M/ICP ppm	Cu P ppm	Fe2O3 XRF %	K2O XRF %	LOI %	MgO XRF %	MnO XRF %	Na2O XRF %	P2O5 XRF %	Pb M/ICP ppm	S XRF %	SiO2 XRF g/cc	TiO2 XRF %	U M/ICP ppm	Zn M/ICP ppm			
K		1.39		588	156600	159265	140427									1390	10.00	18.55	3.42		81.65	153		
K		1.35		575	154700	157885	141891									1364	10.00	18.26	3.46		80.90	151		
K		1.39		575	154900	159229	141465									1369	11.00	18.05	3.47		83.57	149		
K		1.31		592	158900	159349	141261									1403	10.00	18.04	3.47		82.28	154		
K		1.28		588	154400	157643	145436									1393	10.00	18.18	3.44		81.56	150		
K		1.34		587	157300	159502	145521									1403	10.00	17.98	3.46		82.39	152		
K		1.34		588	157400	158338	142353									1394	11.00	17.83	3.44		83.83	153		
K		1.49		588	154900	162862	145623									1408	10.00	18.15	3.37		83.54	157		
L																								
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M	3.50	5.08	1.34	3.80	658	132000	155000	158000	28.75	0.21	10.25	0.69	0.04	2.36	1510	7.60	19.00		28.52	0.51	88.40	160		
M	3.40	5.07	1.44	3.78	610	133000	146000	155000	28.77	0.20	10.35	0.70	0.04	2.36	1410	7.50	19.00		28.50	0.52	83.60	152		
M	3.40	5.08	1.44	3.78	599	137000	159000	150000	28.91	0.22	10.12	0.71	0.04	2.39	1390	7.30	19.80		28.44	0.52	79.20	148		
M	3.40	5.05	1.36	3.72	598	135000	150000	150000	29.07	0.26	10.23	0.71	0.04	2.41	1380	8.00	19.30		28.25	0.51	77.50	147		
M	3.50	5.11	1.40	3.78	605	134000	142000	156000	28.97	0.23	10.13	0.71	0.04	2.37	1430	9.00	19.00		28.60	0.52	79.20	155		
M	3.40	5.15	1.29	3.81	624	136000	150000	153000	28.86	0.25	10.01	0.72	0.04	2.41	1410	7.30	18.60		28.91	0.53	76.40	151		
M	3.50	5.06	1.33	3.74	622	137000	159000	156000	29.14	0.25	10.12	0.71	0.04	2.34	1430	6.60	18.60		28.46	0.51	74.90	155		
M	3.40	5.26	1.33	3.90	617	140000	143000	152000	28.56	0.23	10.01	0.73	0.04	2.46	1400	6.30	18.20		29.44	0.53	73.50	154		
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P	5.00	1.52		560	154000	147500										1330	10.00	17.40	3.25			120		
P	6.00	1.47		550	153500	141000										1320	10.00	17.30	3.36			120		
P	6.00	1.57		540	149000	147500										1290	17.30	3.30				120		
P	6.00	1.57		550	147500	144000										1340	10.00	17.60	3.26			150		
P	5.00	1.60		560	148500	145000										1370	30.00	17.50	3.23			140		
P	7.00	1.51		550	149000	143500										1350	17.40	3.57				140		
P	6.00	1.50		540	145500	140500										1310	10.00	17.20	3.03			130		
Q	2.65	5.12	1.38	3.08	554	151500	147000	149500	27.00			0.65	0.05			1300	0.13	9.50	18.45	3.21	27.40	0.49	79.50	141
Q	2.74	4.99	1.48	3.30	543	146000	147500	147000	26.30			0.65	0.04			1280	0.12	9.50	18.00	3.25	27.70	0.48	80.10	139
Q	2.82	5.05	1.43	3.34	552	148000	152000	151000	26.30			0.64	0.04			1305	0.11	9.60	18.15	3.23	28.10	0.48	81.00	144
Q	2.97	5.06	1.36	3.36	549	149000	147300	150000	26.60			0.64	0.04			1285	0.13	9.70	17.70	3.21	28.30	0.48	81.10	142
Q	2.62	4.91	1.39	3.13	520	144000	151500	148500	25.90			0.63	0.04			1210	0.12	9.10	17.60	3.21	27.00	0.48	77.70	133
Q	2.74	5.04	1.42	3.34	553	149000	150500	152000	26.60			0.67	0.04			1290	0.12	9.70	17.80	3.18	28.40	0.48	80.70	142
Q	2.74	5.01	1.40	3.02	538	147000	161500	151000	26.20			0.61	0.04			1250	0.11	9.30	18.25	3.16	28.00	0.48	81.60	141
Q	2.62	5.11	1.46	3.33	518	148500	175000	150000	26.40			0.63	0.04			1205	0.11	9.70	18.05	3.15	28.30	0.48	76.50	132
R	1.62	4.70	1.43	3.30	534	147500			24.30	0.32	8.75	0.60	0.04	2.13	1310	7.50			3.18	24.70	0.47	73.60	128	
R	1.74	4.97	1.65	3.49	545	146500			25.70	0.35	8.68	0.60	0.04	2.22	1340	7.90			3.21	26.10	0.47	78.60	133	
R	1.66	4.85	1.56	3.39	521	146000			25.20	0.35	9.05	0.60	0.04	2.16	1310	7.60			3.18	25.60	0.46	77.10	129	
R	1.71	4.91	1.50	3.35	565	146500			24.80	0.33	8.92	0.59	0.04	2.13	1390	7.10			3.22	25.40	0.45	71.20	131	
R	1.75	4.80	1.50	3.37	547	147000			24.90	0.33	8.93	0.58	0.04	2.11	1340	7.20			3.20	25.00	0.46	74.30	128	
R	1.62	4.79	1.43	3.35	554	147500			24.80	0.34	7.98	0.59	0.04	2.11	1370	7.30			3.15	24.70	0.46	70.30	133	
R	1.68	4.71	1.42	3.26	551	147500			24.20	0.34	8.86	0.59	0.04	2.10	1360	7.60			3.14	24.60	0.44	73.20	133	
R	1.74	5.25	1.51	3.57	555	147500			26.60	0.37	8.75	0.65	0.04	2.34	1380	7.50			3.22	27.40	0.47	72.50	134	
S	2.31	5.14	1.40	3.58		148000	158000		24.78	0.34	8.37	0.65	0.04	2.29	1210	0.10	9.10		3.40	27.09	0.50	84.00	135	
S	2.30	5.04	1.49	3.50		150000	152000		24.91	0.32	8.28	0.63	0.04	2.24	1200	0.10	9.40		3.40	26.55	0.49	81.90	133	
S	3.01	5.22	1.12	3.61		151000	157000		24.52	0.37	8.16	0.66	0.04	2.30	1200	0.09	11.20		3.44	27.33	0.50	84.90	137	
S	2.30	5.13	1.16	3.61	470	149000	151000		25.60	0.33	8.40	0.66	0.04	2.24	1180	0.10	9.60		3.30	27.07	0.49	82.20	132	
S	2.30	5.13	1.37	3.64	464	149000	151000		24.59	0.28	8.49	0.66	0.04	2.24	1180	0.10	9.50		3.32	27.14	0.50	82.30	128	
S	2.33	5.01	1.21	3.68	489	147000	150000		24.80	0.34	8.47	0.67	0.04	2.16	1220	0.11	9.80		3.43	26.91	0.49	83.30	136	
S	2.33	4.96	1.10	3.53	478	145000	152000		25.06	0.27	8.49	0.64	0.04	2.21	1160	0.09	9.60		3.35	26.39	0.48	83.90	130	
S	2.25	5.21	1.35	3.59	4																			

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, Dr Barry Smee and Smee and Associates Ltd; accept no liability for any decisions or actions taken following the use of the reference material.

28 August 2008

Certifying Officers:



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Geochemist:

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APPENDIX

15 laboratories supplied additional trace element data. The iterated but uncertified statistics are presented below.

	Unit	Mean	2SD	RSD %	n
Al	%	2.74	0.30	5.4	95
As	ppm	10.4	6.7	32.2	62
Ba	ppm	39.9	3.9	4.8	71
Be	ppm	0.66	0.46	34.5	56
Bi	ppm	3.28	0.47	7.2	61
Ca	%	2.53	0.15	3.0	98
Ce	ppm	640	85.6	6.7	46
Cr	ppm	153	37.8	12.4	95
Cs	ppm	0.27	0.15	27.4	56
Dy	ppm	10.3	2.4	11.5	32
Er	ppm	4.75	1.27	13.4	32
Eu	ppm	4.83	1.03	10.6	32
Fe	%	19.2	1.4	3.7	91
Ga	ppm	13.1	14.5	55.5	61
Gd	ppm	22.4	7.2	16.2	32
Hf	ppm	2.22	0.47	10.7	55
Ho	ppm	1.73	0.55	15.8	32
K	ppm	0.28	0.02	3.8	84
La	ppm	370	44.3	6.0	75
Li	ppm	3.21	0.97	15.1	55
Lu	ppm	0.80	0.26	16.0	32
Mg	%	0.38	0.04	4.8	85
Mn	ppm	299	32.7	5.5	110
Mo	ppm	170	20.4	6.0	94
Na	%	1.68	0.22	6.4	85
Nb	ppm	5.27	2.51	23.9	47
Nd	ppm	230	41.4	9.0	32
P	ppm	516	102	9.9	61
Pr	ppm	70.8	14.6	10.3	32
Rb	ppm	13.1	5.1	19.4	64
Sb	ppm	17.7	4.5	12.8	64
Sc	ppm	7.78	3.00	19.3	80
Sm	ppm	32.5	6.2	9.6	32
Sn	ppm	49.0	14.9	15.2	78
Sr	ppm	46.0	9.5	10.3	87
Ta	ppm	0.51	0.29	29.0	55
Tb	ppm	2.64	0.44	8.4	32
Te	ppm	61.2	13.1	10.7	62
Th	ppm	4.94	0.44	4.5	53
Ti	%	0.16	0.15	46.7	103
Tl	ppm	0.07	0.04	25.5	40
Tm	ppm	0.65	0.20	15.4	31
V	ppm	43.2	11.0	12.7	77
W	ppm	2.17	1.71	39.4	54
Y	ppm	30.3	8.1	13.3	78
Yb	ppm	4.80	1.51	15.8	32
Zr	ppm	75.4	19.1	12.7	69