

# African Mineral Standards

## *Certificate of Analysis*

Copper Oxide Ore  
Reference Material from Lonshi  
Democratic Republic of the Congo

AMIS0032

Recommended Concentration and two "Between  
Laboratory" Standard Deviations

### *Certified Concentrations*

Cu (F)	5.828	±	0.280	%
Cu (P)	5.773	±	0.406	%
Cu (T/ICP)	5.755	±	0.292	%
Co (T/ICP)	53	±	5.9	ppm
Ni (P)	107	±	11	ppm
Ni (T/ICP)	116	±	12	ppm
Au (Pb Collection)	0.51	±	0.046	g/t

### *Provisional Concentrations*

Cu (XRF)	6.07	±	0.30	%
Ag (T)	13.9	±	1.1	ppm
Zn (P)	276	±	38	ppm
Zn (T/ICP)	276	±	40	ppm
U (T/ICP)	24.7	±	5	ppm
Specific Gravity	2.89	±	0.22	g/cc

### *Indicated Means*

As (T/ICP)	30	ppm
Co (P)	51	ppm

**Intended Use:** AMIS0032 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 oxide ore sourced from the Lonshi Copper Mine which is owned and operated by Compagnie Miniere du Sakania sprl (Comisa), a wholly owned Congolese subsidiary of First Quantum Minerals Ltd (FQM). The mine is situated in the Congo Pedicle region of the Province of Katanga, Democratic Republic of the Congo.

Lonshi is a sediment hosted, structurally controlled deposit of Copperbelt type. In contrast to other Copperbelt deposits, Lonshi is interpreted to occur at or near the upper contact of the Upper Roan Group where a sheared and tectonised clastic unit, the Lonshi Conglomerate, is in thrust contact with overlying carbonaceous, silty, dolomitic marbles. This folded and thrust contact is the locus for mineralization which occurs in both the conglomerate and the intensely weathered dolomite.

Primary sulphide mineralization, mainly chalcopyrite, occurs as carbonate clast replacement in the conglomerate, and as disseminations and rare veinlets in both conglomerate and dolomite. Supergene enrichment and subsequent deep oxidation, has resulted in complete carbonate destruction in the dolomite, within the weathering zone, and formation of chalcocite now largely oxidized to malachite and black Cu oxide minerals.

*(for more information, refer to Form 43-101F1 Technical Report, The Lonshi Copper Mine, Katanga Province, Democratic Republic of the Congo, March 26th 2003, Alan J. Stephens Vice President, Exploration, and G. Clive Newall, President, First Quantum Minerals Ltd.)*

**Approximate Mineral and Chemical Composition:**

The major element chemistry has been determined by analyses from 5 laboratories using a mixture of ICP and X-Ray Fluorescence techniques. The mean values, confidence limits at two standard deviations and number of analyses are presented below.

	Al <sub>2</sub> O <sub>3</sub>	CaO	Fe <sub>2</sub> O <sub>3</sub>	K <sub>2</sub> O	LOI	MgO
	%	%	%	%	%	%
mean	12.32	0.50	9.74	2.21	11.18	1.91
2SD	0.67	0.05	0.58	0.29	0.57	0.09
RSD%	2.707	4.742	2.969	6.574	2.562	2.414
n	33	32	33	25	24	33
	MnO	Na <sub>2</sub> O	P <sub>2</sub> O <sub>5</sub>	SiO <sub>2</sub>	S	TiO <sub>2</sub>
	%	%	%	%	%	%
mean	3.97	0.14	0.14	50.05	0.05	0.69
2SD	0.25	0.01	0.00	1.64	0.001	0.02
RSD%	3.174	3.959	1.583	1.640	1.190	1.320
n	32	8	25	33	8	16

**Appearance:** The material is a very fine brown powder (Corstor Colour Gauge - 10YR 4/6).

**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:** Co, Cu, As, Ni, Pb, Zn and Ag; multi-acid digestion, including HF, with ICP-OES or ICP-MS (T). Cu; fusion ICP-OES or MS (F). Co, Cu, As, Ni, Pb, Zn by XRF. Co, Cu, As, Ni, Pb, Zn, aqua regia digestion with ICP-OES or ICP-MS (P). Pb collection for Au. Specific gravity either by gas pycnometer or by water displacement using a pycnometer bottle.

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

	Ag (T) ppm	Au (Pb Collection) g/t	Co (T/ICP) ppm	Cu (F) ppm	Cu (P) ppm	Cu (T/ICP) ppm	Cu (XRF) ppm	Ni (P) ppm	Ni (T/ICP) ppm	Specific Gravity g/cc	U (T/ICP) ppm	Zn (P) ppm	Zn (T/ICP) ppm
A	3.2					55200							559
A	2.4					56200							405
A	2					55500							378
A	1.8					55500							389
A	3.1					54700							403
A	2.9					55000							374
A	3.3					54600							388
A	2.8					54000							379
B	13		54	56100		59600		103	113	3.28		273	290
B	13		52	55600		58000		103	111	3.31		280	284
B	13		53	55700		58600		106	114	3.35		280	290
B	13		53	60300		58600		108	112	3.27		287	287
B	13		52	59400		58900		110	114	3.30		291	288
B	13		53	60500		58900		112	112	3.30		296	290
B	13		53	59200		58700		113	112	3.33		297	289
B	13		53	59200		57800		114	112	3.34		298	288
C	13		52	58000	57600	55988		101	111			255	267
C	13		50	55700	56600	57171		95	108			256	233
C	13		53	56600	57200	57038		100	114			259	255
C	13		53	57600	55900	58109		97	115			254	254
C	12		51	57800	57200	57661		101	113			254	251
C	13		54	59500	56300	56569		96	115			258	264
C	14		49	58100	57500	57038		103	112			267	245
C	13		51	58500	56900	56110		110	112			269	252
D		0.475			59100		62520	114		2.72	27	290	
D		0.477			57900		62700	112		2.74	26	284	
D		0.482			58000		62410	110		2.74	27	284	
D		0.47			58100		62720	110		2.74	26	278	
D		0.47			58300		62640	110		2.70	27	280	
D		0.505			58300		63060	108		2.71	27	282	
D		0.478			57200		62610	106		2.71	27	278	
D		0.484			58100		61920	110		2.68	26	280	
E	14.4	0.486	58		56800	57900			115		28		294
E	13.5	0.518	58		57300	57600			109		28		305
E	13.4	0.462	53		56500	58700			104		27		284
E	13.9	0.494	56		58600	57700			109		26		303
E	12.8	0.475	53		57300	58600			114		27		287
E	14.7	0.483	59		57900	57700			124		27		318
E	13	0.494	54		58800	57400			110		28		291
E	13.4	0.478	59		59700	58200			114		27		309
F													
F													
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F													
F													

	Ag (T) ppm	Au (Pb Collection) g/t	Co (T/ICP) ppm	Cu (F) ppm	Cu (P) ppm	Cu (T/ICP) ppm	Cu (XRF) ppm	Ni (P) ppm	Ni (T/ICP) ppm	Specific Gravity g/cc	U (T/ICP) ppm	Zn (P) ppm	Zn (T/ICP) ppm
G	12.4		58			59900			118			243	259
G	12.2		59			58900			120			246	262
G	12.2		58			57800			120			246	265
G	12.3		58			58200			119			242	261
G	12.3		60			59900			122			244	268
G	12		59			59800			119			240	261
G	12.4		56			59300			121			241	263
G	12.3		55			59200			116			244	266
H													
H													
H													
H													
H													
H													
H													
I	15	0.531	50	58100	56580	57980		110	110		30	300	300
I	14	0.532	50	57500	58520	56290		110	110		28	300	300
I	15	0.542	50	57600	57120	58220		110	110		26	300	300
I	14	0.553	50	58500	56230	57270		110	110		25	300	300
I	14	0.54	50	57800	57060	56260		110	110		26	300	300
I	13	0.523	50	57200	55960	57110		110	110		25	300	300
I	14	0.55	50	56800	57880	57340		110	110		26	300	300
I	15	0.529	50	57500	55620	56700		110	110		26	300	300
J	12.4	0.506	44	57000	59800	58500		103	98	2.91	10	261	240
J	13.5	0.504	48	58400	59900	59000		103	107	2.89	20	260	256
J	13.9	0.505	53	57400	60300	61000		102	115	2.89	20	261	279
J	14.1	0.505	50	56200	60300	58800		100	112	2.94	20	254	274
J	13.8	0.52	51	56700	60300	58700		100	114	2.81	20	254	274
J	13.8	0.501	50	56600	59700	59600		102	114	2.86	20	257	271
J	14.6	0.434	52	57700	59900	58200		100	115	3.09	20	255	286
J	13.1	0.519	49	58700	60300	59400		102	103	3.05	20	261	265
K		0.525			57300			105			31	269	
K		0.537			59900			100			32	269	
K		0.533			59100			102			22	270	
K		0.539			59400			103			29	271	
K		0.525			59100			101			31	265	
K		0.533			59900			100			25	265	
K		0.564			58900			102			24	270	
K		0.502			59700			101			22	267	
L	13.5	0.51	54	60500	53400	55100	58200	112	116	2.98	23	290	265
L	13.9	0.5	54	58400	55000	55100	58400	114	115	2.95	23	290	273
L	14.1	0.51	55	59000	53000	55800	58840	111	121	2.95	24	286	273
L	13.9	0.52	55	58600	54700	54900	58880	114	114	2.98	23	283	273
L	13.4	0.51	52	58700	52700	54200	58880	110	113	3.01	23	285	267
L	14	0.54	55	58700	54800	55000	58520	120	117	2.96	24	290	275
L	14.1	0.52	55	58500	53800	54100	58970	113	114	2.95	24	291	274
L	13.6	0.5	54	58600	54200	53900	58640	117	114	2.95	24	292	266
M	16.8	0.538	49	53100	55100	57600		117	115		24	294	281
M	18.7	0.544	51	59900	54800	58900		113	119		24	290	295
M	17.4	0.536	53	61200	55300	59700		106	120		25	290	292
M	16.5	0.504	51	55100	59600	59700		117	119		24	306	288
M	17.3	0.536	49	63400	59600	59200		122	118		24	306	268
M	15.8	0.524	50	61100	51100	58800		104	114		23	277	277
M	15.8	0.52	50	65000	54500	58000		108	117		24	293	288
M	15.2	0.528	48	64300	59000	57300		115	114		23	298	290
N	14.2		53	59700		59000	61200		114				265
N	14.8		54	60300		57400	60600		113				262
N	14.3		52	60400		58000	62110		111				268
N	14.1		51	60100		58400	61090		108				261
N	14.2		52	60100		58000	61110		111				257
N	14.6		51	60000		57100	60950		110				263
N	14.8		52	57600		58000	61300		109				256
N	14.4		54	60500		57600	61500		113				264
O	17.71		58		62765	64341	68287			2.84		518	350
O	16.63		55		60651	63277	68249			2.84		510	337
O	16.99		55		60935	63151	68580			2.85		529	338
O	9.77		53		59861	62174	68464			2.73		497	325
O	14.18		50		62853	62659	68615			2.84		520	303
O	14.75		53		61429	61625	68479			2.85		520	323
O	14.93		52		62163	61518	68469			2.86		520	311
O	15.8		52		60675	61550	68392			2.86		507	318
P	14	0.48	57			59700			130	2.97			250
P	14	0.53	56				60500		130	2.92			240
P	14	0.5	58				61200		130	3.03			250
P	14	0.5	58				59500		130	2.95			250
P	14	0.5	49				60300		130	2.90			250
P	14	0.49	51				60200		120	3.01			260
P	14	0.54	48				60400		130	3.03			250
P	14	0.49	51				60000		120	2.99			270

	Ag (T) ppm	Au (Pb Collection) g/t	Co (T/ICP) ppm	Cu (F) ppm	Cu (P) ppm	Cu (T/ICP) ppm	Cu (XRF) ppm	Ni (P) ppm	Ni (T/ICP) ppm	Specific Gravity g/cc	U (T/ICP) ppm	Zn (P) ppm	Zn (T/ICP) ppm
Q													
Q													
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S													
T	14.99				56300	56800			128				164
T	15.39				57100	56400			128				164
T	15.6				56900	56800			124				180
T	15.4				57300	57000			128				156
T	14.2				56500	56800			124				164
T	13.6				55100	57100			120				168
T	14.2				54600	58400			124				156
T	15.2				54900	57800			128				176

The mean and standard deviation for all data was calculated. Outliers were defined as samples beyond the mean  $\pm$  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., (Canada).
2. Alex Stewart (Assayers) Limited, (ASA, Johannesburg, South Africa).
3. ALS Chemex South Africa ( Pty ) Ltd
4. ALS Chemex, (Vancouver, Canada).
5. Ammtec Ltd (Australia)
6. Assayers Canada, (Vancouver).
7. Genalysis Laboratory Services ( Pty ) Ltd., (Australia).
8. Geoscience Laboratories, (Geo Labs, Sudbury, Canada).
9. Geoservice Centre, Geolaboratory, (GTK, Finland).
10. Mintek (South Africa)
11. Pt Intertek Utama Services (Intertek, Indonesia)
12. Set Point Laboratories ( Pty ) Ltd (South Africa)
13. SGS Lakefield Research Africa ( Pty ) Ltd. (Joburg, South Africa)
14. SGS Welshpool (Australia)
15. SRC Labs., (Canada).
16. Ultra Trace ( Pty ) Ltd. (Australia)

**Availability:** This product is available in Laboratory Packs containing 1kg of material or in Explorer Packs containing client specified weights of material (from 50g up to 250g). Laboratory Packs are sealed bottles delivered in sealed foil pouches. Explorer Packs contain material in standard geochem envelopes placed into foil pouches that are nitrogen flushed and vacuum sealed.

**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.

17 May 2007

**Certifying Officers:**



**African Mineral Standards:** \_\_\_\_\_

**Mike McWha**  
**BSc (Hons), FGSSA, MAusIMM, Pr.Sci.Nat**



**Geochemist:** \_\_\_\_\_

**Barry W. Smee**  
**BSc, PhD, P.Geo, (B.C.)**