CCRMP
Canadian Certified Reference Materials Project

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PCMRC
Projet canadien de matériaux de référence certifiés

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Certificate of Analysis

First issued: December 2003 Version: January 2009

CUAR-1

Copper Anode Certified Reference Material

Table 1 – CUAR-1 Certified Values

Element	Unit	Mean	Within-lab Standard Deviation	Between-labs Standard Deviation	Extended standard uncertainty at 95% confidence
Ag	µg/g	294	6	10	± 7
As	µg/g	145	9	15	± 18
Au	µg/g	2.3	0.3	0.4	± 0.3
Fe	µg/g	76	4	13	± 4
Pb	µg/g	864	35	68	± 36
Sn	µg/g	113	22	24	± 17
Te	µg/g	33	4	7	± 4

Table 2 – CUAR-1 Provisional Values

Element	Unit	Mean	Within-lab Standard Deviation	Between-labs Standard Deviation	95% Confidence Interval
Bi	µg/g	83	4	12	± 4
Ni	µg/g	4,109	64	434	± 611
Sb	µg/g	798	34	156	± 56
Se	µg/g	26	4	25	± 4

Table 3 – CUAR-1 Informational Values

Element	Unit	Mean	Standard Deviation	No. of Values
Cu	%	98.6	0.1	15
Zn	µg/g	32	4	15

SOURCE
CUAR-1 is a copper anode donated by Asarco in Amarillo, Texas, USA in January 1994.

DESCRIPTION
The material is in the form of drillings and contains approximately 98% copper plus several elements at trace levels.

INTENDED USE
CUAR-1 is suitable for the analysis of elements at trace levels. Examples of intended use are for quality control in the analysis of samples of a similar type, method development and arbitration.

INSTRUCTIONS FOR USE
The assigned values pertain to the date when issued. CANMET-MMSL is not responsible for changes occurring after receipt by the user. CUAR-1 should be used "as is", without pre-treatment. The contents of the bottle should be thoroughly mixed before taking samples.

METHOD OF PREPARATION
Three hundred and twenty (320) kilograms of copper anode drillings were subjected to magnetic separation and mixed overnight in a 570-L conical blender. The heat caused by the friction between the copper anode drillings during the mixing led to superficial oxidation of the material. Hence the colour of the drillings is appreciably darker than is normally observed. The material was degreased and 425 grams were transferred to each of 685 bottles. This is the only size available.

STATE OF HOMOGENEITY
The homogeneity of the stock was investigated using twenty bottles of CUAR-1 chosen according to a stratified random sampling scheme. Two samples were analyzed from each bottle. The analyses were performed by the analytical laboratory of Kennecott Utah Copper Corporation, Magna, Utah. One-gram samples were digested in nitric and hydrochloric acids and the determination was performed using inductively coupled plasma - atomic emission spectroscopy. Due to problems that may be due to instrumental variation that can arise during a long run, these analyses were repeated.

The second assessment of homogeneity for CUAR-1 was performed by the Analytical Services Group of CANMET-MMSL. Two samples were analyzed from the remaining portions of the original (20) bottles. Samples of one gram were digested in multi-acid medium and the concentrations of iron, nickel, and lead were measured by inductively coupled plasma – atomic emission spectroscopy. After a multi-acid digestion using one to two gram samples, the determination of silver and gold was performed using atomic absorption spectroscopy.

A one-way analysis of variance technique (ANOVA) was used to assess the homogeneity of these elements[1]. The ratio of the between-bottles to within-bottle mean squares is compared to the F statistic at the 95% level of probability. No evidence of inhomogeneity was observed for gold, iron, nickel, lead and silver. Further details are available in the certification report, CCRMP Report 03-1E. Use of a sample size smaller than one gram will invalidate the statistical parameters contained herein.

CERTIFICATION

Eighteen (18) industrial, commercial, and government laboratories participated in an interlaboratory measurement program. Various elements were analyzed by methods of each laboratory's choice. A one-way analysis of variance technique was used to estimate the consensus value and other statistical parameters[1]. Arsenic, gold, iron, lead, silver, tin and tellurium were given recommended values. Antimony, bismuth, nickel, and selenium had provisional values assigned. Informational values were given for copper and zinc. The extended standard uncertainty at 95% confidence was calculated only for the certified values from the variance of interlaboratory measurement program and the homogeneity assessment. Full details of all phases of the work, including statistical analysis, the methods and the names of the participants are contained in CCRMP Report 03-1E.

PERIOD OF VALIDITY

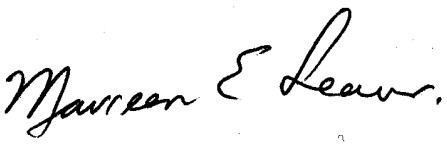
These certified values are valid until December 31, 2031. Updates will be published on the CCRMP web site.

LEGAL NOTICE

CANMET-MMSL has prepared this reference material and statistically evaluated the analytical data of the interlaboratory certification program to the best of their ability. The purchaser, by receipt hereof, releases and indemnifies CANMET-MMSL from and against all liability and costs arising out of the use of this material and information.

CERTIFYING OFFICERS

Joseph Salley – Data Processor



Maureen E. Leaver – CCRMP Coordinator

FOR FURTHER INFORMATION

The report is available free of charge upon request to:

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Reference

1. Brownlee, K.A., Statistical Theory and Methodology in Science and Engineering; John-Wiley and Sons, Inc.; New York; 1960.