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: January 1994 Date of this Certificate: September 2004

WMG-1

Certified Reference Material for a Mineralized Gabbro with Gold and Platinum Group Elements

Table 1 – Certified Values

Constituent	Unit	Mean	Within-Lab Standard Deviation	Between-Labs Standard Deviation	95% Confidence Limit
Al_2O_3	%	8.32	0.17	0.35	± 0.24
As	ug/g	7	1	2	± 1
Au	ng/g	110	23	25	± 11
Fe_2O_3	%	17.52	0.52	0.43	± 0.29
Ir	ng/g	46.4	5.0	7.0	± 4.1
K_2O	%	0.09	0.02	0.03	± 0.02
La	ug/g	8.2	0.9	0.9	± 0.7
MnO	%	0.151	0.004	0.008	± 0.005
Na_2O	%	0.174	0.029	0.012	± 0.013
Pd	ng/g	382	29	28	± 13
Pt	ng/g	731	45	81	± 35
Rh	ng/g	26.3	3.2	3.5	± 2.0
Ru	ng/g	34.7	2.8	7.3	± 5.1
Sb	ug/g	1.8	0.2	0.4	± 0.3
Zn	ug/g	110	9	17	± 10

DESCRIPTION

The raw material for WMG-1 was obtained from the Wellgreen Complex, Yukon Territory, Canada. WMG-1 was prepared and certified in cooperation with Geological Survey of Canada (GSC). WMG-1 is a mineralized gabbro, which consists largely of pyroxene with prehnite, amphibole, chlorite and accessory magnetite, ilmenite and titanite. Mineralization consists chiefly of chalcopyrite, pyrrhotite, pendlandite, violarite and altaite.

The raw material was dried, crushed, ground, sieved and blended to obtain a minus 74 micron (200 mesh) product. The yield was 76%. The material comes in glass bottles containing 400 g each. This is the only size available. Each bottle was sealed under nitrogen in a laminated aluminum foil-mylar pouch to prevent oxidation.

INTENDED USE

WMG-1 is suitable for the analysis of gold, elements from the platinum group and other elements at major, minor and trace levels. Examples of intended use are for quality control in the analysis of samples of a similar type, method development, arbitration and the calibration of equipment.

INSTRUCTIONS FOR THE CORRECT USE OF THE REFERENCE MATERIAL

The assigned values pertain to the date when issued. WMG-1 should be used “as is”, without drying. The contents of the bottle should be thoroughly mixed before taking samples. The contents of the bottle should be exposed to the atmosphere for the shortest possible time. After opening the sealed pouch, the bottle should be kept in a dessicator, or preferably, resealed under nitrogen in a new heat-sealed laminated foil pouch to prevent oxidation.

HAZARDOUS SITUATION

Normal safety precautions such as the use of safety glasses, breathing protection for fine particulate matter, gloves and a laboratory coat are suggested.

LEVEL OF HOMOGENEITY

The homogeneity of the stock with respect to its gold, platinum and palladium was investigated using twenty-two bottles chosen according to the bottling sequence and a stratified random sampling scheme. Two splits were analysed from each bottle. Fire assay preconcentration was performed on a 10g-sample followed by inductively coupled plasma mass spectrometry. The analyses for gold, platinum and palladium were performed at GSC**.**

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 all three elements. Use of a smaller than indicated mass will invalidate the use of the certified value and associated parameters.

CERTIFIED VALUES AND THEIR UNCERTAINTIES

The first interlaboratory measurement program was held in 1992 for the certification of gold and the platinum group elements. Twelve university, government, industrial and commercial laboratories submitted results. In 1994, thirty-three individual laboratories participated in the interlaboratory measurement program in an attempt to certify other elements. Up to 80 elements were analyzed by methods of each laboratory's choice. For gold and the platinum group elements, fire assay, multi-acid digestion followed by solvent extraction, gravimetric, inductively coupled plasma –optical emission spectroscopy, inductively coupled plasma – mass spectroscopy, graphite furnace atomic absorption spectroscopy, direct current plasma spectroscopy, and neutron activation analysis were used. For the other elements, various acid digestions, fusions, gravimetric, combustion, x-ray fluorescence, hydride generation, inductively coupled plasma – optical emission spectroscopy, inductively coupled plasma – mass spectroscopy, graphite furnace atomic absorption spectroscopy, direct current plasma spectroscopy, and neutron activation analysis were used.

A one-way analysis of variance technique (ANOVA) was used to estimate the consensus value and other statistical parameters (1). The two criteria for certification involve the agreement of within- and between-laboratories standard deviations and the number of sets with acceptable agreement. Table 1 contains the means and associated statistical parameters for the fifteen certified elements. Full details of all phases of the work, including statistical analysis, the methods and the names of the participants are contained in the certification report.

UNCERTIFIED VALUES

Table 2 contains the provisional elements which did not meet either one or both of the two criteria for certification. Table 3 contains the informational values calculated from the mean of two or more sets of results which were considered to be in good agreement.

Table 2 - Provisional Values

Constituent	Unit	Mean	Within-Lab Standard Deviation	Between-Labs Standard Deviation	95% Confidence Limit
Ag	ug/g	2.7	0.2	0.4	± 0.3
Ba	ug/g	114	8	12	± 8
Be	ug/g	0.6	0.2	0.4	± 0.5
CaO	%	15.0	0.4	1.2	± 0.8

WMG-1 Provisional Values (Cont.)

Constituent	Unit	Mean	Within-Lab Standard Deviation	Between-Labs Standard Deviation	95% confidence limit
Cd	ug/g	1.1	0.1	0.5	± 0.5
Ce	ug/g	16	3	4	± 3
Co	ug/g	200	7	21	± 12
Cr	%	0.077	0.002	0.008	± 0.005
Cs	ug/g	0.48	0.08	0.05	± 0.08
Cu	%	0.59	0.01	0.05	± 0.03
Dy	ug/g	2.8	0.2	0.6	± 0.8
Eu	ug/g	0.8	0.1	0.1	± 0.1
Ga	ug/g	10.3	0.9	1.6	± 1.5
Hf	ug/g	1.3	0.1	0.3	± 0.2
Ho	ug/g	0.5	0.05	0.1	± 0.1
Li	ug/g	35	3	6	± 5
Lu	ug/g	0.21	0.03	0.06	± 0.06
MgO	%	11.86	0.19	0.39	± 0.28
LOI	%	4.0	0.1	0.7	± 0.9
Mo	ug/g	1.4	0.2	0.4	± 0.4
Nb	ug/g	6	1	1	± 1
Nd	ug/g	9.0	0.6	0.5	± 0.7
Ni	%	0.27	0.006	0.03	± 0.02
Os	ng/g	24.1	1.7	3.2	± 3.5
P_2O_5	%	0.13	0.01	0.03	± 0.03
Pb	ug/g	15	2	10	± 10
Rb	ug/g	4	0.6	3	± 3
S	%	3.7	0.2	0.2	± 0.2
Sc	ug/g	26	1	4	± 2
Se	ug/g	15	2	3	± 3
SiO_2	%	40.3	0.4	0.6	± 0.6

WMG-1 Provisional Values (Cont.)

Constituent	Unit	Mean	Within-Lab Standard Deviation	Between-Labs Standard Deviation	95% confidence limit
Sm	ug/g	2.3	0.1	0.1	± 0.1
Sn	ug/g	2.2	0.3	0.3	± 0.5
Sr	ug/g	41	1.7	4.6	± 4
Ta	ug/g	0.5	0.1	0.3	± 0.3
Tb	ug/g	0.4	0.06	0.1	± 0.1
Te	ug/g	1.3	0.3	0.6	± 0.8
Th	ug/g	1.1	0.09	0.10	± 0.1
TiO_2	%	0.68	0.02	0.07	± 0.05
Tm	ug/g	0.2	0.03	0.07	± 0.1
U	ug/g	0.65	0.10	0.18	± 0.17
V	ug/g	149	4	66	± 43
W	ug/g	1.3	0.8	0.2	± 0.6
Y	ug/g	12	1	5	± 4
Yb	ug/g	1.3	0.1	0.2	± 0.2
Zr	ug/g	43	3	9	± 8

Table 3 - Informational Values

Constituent	Unit	Range
B	ug/g	20-650
Bi	ug/g	0.2-30
Cl	ug/g	100-200
Er	ug/g	1.0-1.7
Gd	ug/g	1.8-3.1
Ge	ug/g	0.1-4
In	ug/g	0.1-0.2
Pr	ug/g	2.1-2.4
SO_3	%	0.24-0.45
Tl	ug/g	0.08-0.24

TRACEABILITY

The certified values quoted herein are based on the consensus value derived from the statistical analysis of the data from the interlaboratory measurement program.

DATE OF CERTIFICATION

WMG-1 was released in 1994. This 2004 version of this certificate was written in order to release new or upgraded values. This version of the certificate includes nine new certified values, forty-six new provisional values and ten new informational values.

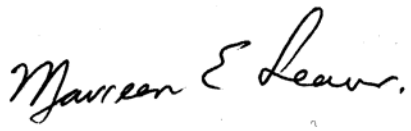
PERIOD OF VALIDITY

These certified values are valid until 2009. The stability of the material will be monitored every two years. Purchasers will be notified of any significant changes.

LEGAL NOTICE

CANMET - Mining and Mineral Sciences Laboratories (MMSL) has prepared this reference material and statistically evaluated the analytical data of the interlaboratory certification program to the best of its 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 OFFICER



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FOR FURTHER INFORMATION

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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