Mines Branch Information Circular IC 309

STANDARD REFERENCE ORES AND ROCKS AVAILABLE FROM THE MINES BRANCH AS OF OCTOBER 1973

Compiled by

G. H. Faye*

- - -

PREFACE

The current program of preparing standard reference ores and rocks is a major facet of what is now called the Canadian Standard Reference Materials Project (CSRMP). The CSRMP is an offshoot of the activities of the Canadian Association for Applied Spectroscopy (CAAS) which, in 1955, began the production of copper and copper-alloy standards with the assistance of the Mines Branch and various Canadian metallurgical industries.

In 1966, the CAAS, which has since become the Spectroscopy Society of Canada (SSC), entered the geochemical field by issuing a syenitic rock (SY-1) and a sulphide ore (SU-1) as reference materials with provisional analytical results.

During the mid-sixties, the Mines Branch, EMR, became the major collaborator in the production of standard reference materials and gradually this activity was transferred from the SSC to the Mines Branch. This was a logical step because the Branch has the personnel and equipment necessary not only for production but also for distribution and sales. Because of its impartiality, it is an appropriate organization to co-ordinate the inter-laboratory programs that are necessary to obtain analytical results for the certification of standard reference materials.

In January 1973, the CSRMP became officially sponsored by the Mines Branch. Although the Director of the Branch has the overall responsibility for the project, the day-to-day business is conducted by the Chairman of the CSRMP who is, at present, Dr. A.H. Gillieson, Mineral Sciences Division, Mines Branch.

---

*Coordinator, Ores Task Force, Canadian Standard Reference Materials Project, Mineral Sciences Division, Mines Branch, Department of Energy, Mines and Resources, Ottawa, Canada.

Within the CSRMP, there are now three groups active in the preparation of standard reference materials, one for ferrous spectrographic standards, one for radioactive ores and radiometric standards, and one for Canadian metal-bearing ores. Because of the increasing demand for standard reference ores that are typical of major deposits in Canada, the last group is the largest and most active. Consequently, the majority of materials listed in this catalogue are ores or metallurgical products that have been prepared and characterized by this group.

The first catalogue (Mines Branch Information Circular IC 294) of ores and rocks, prepared and sold by the CSRMP, was issued in November 1972. Since that time, four new certified materials have been made available for sale and two more ores are being processed prior to their certification; therefore, the preparation of this up-dated catalogue, or Information Circular, was made necessary.

This Circular describes the standard reference ores and rocks that may be purchased from the Mines Branch through the Chairman, CSRMP, as of October 1973. Where possible, the source, mineralogical and chemical composition, the recommended values of the certified elements, and the price are given for each available material. Also included are brief descriptions of materials that are being processed and their approximate date of availability.

It is anticipated that new Circulars will be prepared periodically as new information on existing materials becomes available and as new standard ores are added to the list.

CONTENTS

MATERIALS CERTIFIED FOR SELECTED ELEMENTS

ORES

MOLYBDENUM ORE, PR-1

Source and Description of PR-1

Molybdenum ore, PR-1, was obtained from the Preissac molybdenum mine near Cadillac, Quebec, in 1970. The Preissac ore is from a vein-type deposit in a sericite granite. The calculated mineralogical composition and the approximate chemical composition of PR-1 are given in the following tables.

Mineralogical Composition of PR-1

Minerals	Calculated mineralogical composition of PR-1 (Wt %)
Fluorite	0.96
Calcite	2.37
Garnet	0.07
Chlorite	1.29
Muscovite	2.30
Feldspar	
Na-feldspar	6.17
K -feldspar	12.29
Quartz	70.27
Rutile	0.05
Molybdenite	1.02
Sphalerite	0.03
Galena	0.04
Chalcopyrite	0.03
Bismuth	0.06
Bismuthinite	0.08
Pyrite	0.58
Pyrrhotite	not calculated
Hematite	"
Magnetite	"
Fe + O + Ni + H_2O	1.26
TOTAL	98.87

Provisional Chemical Analysis of PR-1

O	-	49.2 Wt %	Bi	-	0.11* Wt %
Si	-	39.2	Ti	-	0.03
Al	-	2.39	Pb	-	0.04
Fe	-	1.24*	Zn	-	0.02
Ca	-	1.44	Mn	-	0.02
Mg	-	0.09	Ni	-	0.01
Na	-	0.54	Cu	-	0.01
K	-	1.95	F	-	0.47
S	-	0.79*	H_2O	-	0.29
Mo	-	0.59*			
		Total C			
		as CO_2	-		1.08
		actual CO_2	-		1.04

* Recommended value (see below).

Certification of PR-1 for Molybdenum, Bismuth, Iron and Sulphur

Nineteen laboratories participated in the program to certify PR-1 for molybdenum, bismuth, iron, and sulphur. A statistical evaluation of the analytical results for these elements yielded the recommended values tabulated below.

Recommended Values and Their Confidence Intervals for Selected Elements in PR-1

	Mo	Bi	Fe	S
		(Wt %)		
Recommended Values	0.594	0.111	1.244	0.793
95% Confidence Interval				
Low	0.578	0.107	1.225	0.777
High	0.610	0.114	1.263	0.809

A full account of the work done on PR-1 is given in the Mines Branch Technical Bulletin TB 139, entitled "Molybdenum Ore, PR-1: Its Characterization and Preparation for Use as a Standard Reference Material". A copy of this bulletin will be forwarded automatically with each shipment of PR-1.

ZINC-TIN-COPPER-LEAD ORE, MP-1

Source and Description of MP-1

The material for ore standard MP-1 was obtained from the deposit of Brunswick Tin Mines Limited in southwestern New Brunswick in 1971. It consists of material from two sulphide veins blended with a small amount of mineralized rock. The calculated mineralogical composition and the approximate chemical composition of MP-1 are given in the following tables.

Calculated Mineralogical Composition of MP-1

Minerals		Calculated Mineralogical Composition (Wt %)
Sphalerite*	ZnS-24.0, FeS-0.8, CdS-0.1, InS-0.1, MnS-0.07	25.1
Chalcopyrite	Cu-1.3, Fe-1.2, S-1.3	3.8
Stannite-Kesterite	Cu-0.8, Sn-0.8, Fe-0.2, Zn-0.2, S-0.9	2.9
Galena	Pb-1.9, S-0.3	2.2
Cassiterite	Sn-1.6, O-0.4	2.0
Arsenopyrite	As-0.8, Fe-0.6, S-0.3	1.7
Pyrite	Fe-0.6, S-0.7	1.3
Bismuth		0.03
Wolframite	WO_3-0.03, FeO + MnO-0.01	0.04
Molybdenite	Mo-0.01, S-0.01	0.02
Quartz	SiO_2-34.7	34.7
Chlorite	SiO_2-1.9, Al_2O_3-1.7, FeO-3.0, MgO-0.1, H_2O-0.3	7.0
Fluorite	Ca-3.4, F-3.2	6.6
Topaz	SiO_2-1.8, Al_2O_3-2.9, F-0.9, H_2O-0.5	6.1
Kaolinite	SiO_2-2.7, Al_2O_3-2.3, H_2O-0.8	5.8
Feldspar	SiO_2-0.5, Al_2O_3-0.1, K_2O-0.1 Na_2O-0.1	0.8
Rutile	TiO_2-0.05	0.05
TOTAL		100.14

*The metals Fe, Cd, In, and Mn are incorporated in the lattice of sphalerite, but some In also occurs as the mineral roquesite.

Provisional Chemical Analysis of MP-1

(Wt %)

O	-	26.8	Zn	-	16.3*
Si	-	19.4	Sn	-	2.50*
Al	-	3.63	Cu	-	2.15*
Fe	-	5.68	Pb	-	1.93*
Mg	-	0.04	As	-	0.79*
Ca	-	3.36	In	-	0.071*
K	-	0.10	Bi	-	0.025*
Na	-	0.01	Mo	-	0.014*
Ti	-	0.07	Cd	-	0.07
Mn	-	0.05	W	-	0.02
S	-	11.8			
H_2O at 980°C	-	1.57			
C	-	0.10			
F	-	4.04			
		Total	-	100.5	
		Corrected for O in H_2O	-	1.4	
		Corrected Total	-	99.1	

* Recommended value (see below).

Certification of MP-1 for Selected Elements

Nineteen laboratories participated in the program to certify MP-1 for the nine selected elements. A statistical evaluation of the analytical results yielded the recommended values tabulated below.

Recommended Values and Their Confidence Intervals for Selected Elements in MP-1

	Zn	Sn	Cu	Pb	Mo	In	Bi	As	Ag
					(Wt %)				(ppm)
Recommended Values	16.33	2.50	2.15	1.93	0.014	0.071	0.025	0.791	59.5
95% Confidence Interval									
Low	16.20	2.39	2.12	1.90	0.013	0.068	0.023	0.768	56.3
High	16.45	2.61	2.18	1.96	0.015	0.074	0.027	0.814	60.6

A full account of the work done on MP-1 is given in Mines Branch Technical Bulletin TB 155, entitled "Zinc-Tin-Copper-Lead Ore, MP-1" Its Characterization and Preparation for Use as a Standard Reference Material". A copy of this bulletin will be forwarded automatically with each shipment of MP-1.

COPPER-MOLYBDENUM ORE, HV-1

Source and Description of HV-1

HV-1 is a mixture of materials taken from large, low-grade, copper-molybdenum porphyry deposits in the Highland Valley area of British Columbia; it is intended to be representative of samples analyzed in large numbers by enterprises associated with the exploitation of these deposits. The calculated mineralogical composition and approximate chemical composition of HV-1 are given in the following tables.

Calculated Mineralogical Composition of HV-1

Minerals	Calculated Mineral Composition (Wt %)
Bornite	0.6
Chalcopyrite	0.3
Pyrite	0.1
Molybdenite	0.1
Quartz	40.7
Plagioclase	26.9
Orthoclase	10.6
Sericite	12.3
Biotite	2.3
Amphibole and pyroxene	2.0
Clay minerals	1.0
Zircon	Trace
Calcite	1.5
Hematite and magnetite	0.6
Rutile	0.3
Barite	0.1
Tramp iron (presence indicated from polished section; calculated by difference)	0.4
TOTAL	99.8

Provisional Chemical Analysis of HV-1

O	-	49.2 Wt %
Si	-	33.9
Al	-	6.61
Fe (total)	-	1.88
Ca	-	1.40
Mg	-	0.34
Na	-	2.26
K	-	2.82
Ti	-	0.16
Mn	-	0.03
Cu	-	0.52*
Mo	-	0.058*
S (comb)	-	0.34
S (grav)	-	0.35
C (total)	-	0.20
H_2O (980°C)	-	1.42
TOTAL	-	101.1
Correction for O in H_2O	-	1.3
Adjusted TOTAL	-	99.8

* Recommended value (see below).

Certification of HV-1 for Copper and Molybdenum

For the certification of HV-1, twenty-three laboratories provided analytical results for copper and molybdenum: the recommended values and their 95% confidence intervals are given in the following table.

Recommended Values and Their Confidence Intervals for Standard Reference Material HV-1

	Copper (Wt %)	Molybdenum (Wt %)
Recommended Value	0.522	0.058
95% Confidence Interval		
Low	0.517	0.056
High	0.526	0.059

A full account of the work done on HV-1 is given in the Mines Branch Technical Bulletin TB 167, entitled "Copper-Molybdenum Ore, HV-1: Its Characterization and Preparation for Use as a Standard Reference Material". A copy of this bulletin will be forwarded automatically with each shipment of HV-1.

NICKEL-COPPER-COBALT ORE, SU-1

Source and Description of SU-1

SU-1 is a composite of sample rejects collected in 1958 at the Falconbridge Nickel Mines Limited, Falconbridge, Ontario[1] and is, therefore, representative of the Sudbury nickel-copper ores. SU-1 was originally intended as a reference material primarily for spectroscopists[1]. It has been widely distributed to laboratories throughout the world and a large number of analytical results for minor and trace elements have been accumulated[2,3]. Most of these analyses, however, were obtained by emission spectroscopy and only single values for each element have been obtained from each laboratory. Because of the wide range in the results for most elements, it was not possible previously to assign recommended values for them. However, through recently completed work within the CSRMP, SU-1 has now been certified for nickel, copper, and cobalt.

The provisional chemical analysis of SU-1 is given in the following table.

Provisional Chemical Analysis of SU-1

O	-	31.2 Wt %
Si	-	16.2
Al	-	5.01
Fe	-	22.9
Ca	-	2.86
Mg	-	2.47
Na	-	0.77
K	-	0.53
Ti	-	0.50
Mn	-	0.08
Ni	-	1.51*
Cu	-	0.87*
Co	-	0.063*
Zn	-	0.03
S	-	12.1
P	-	0.04
H (from H_2O)	-	0.33

*Recommended value (see below).

Certification of SU-1 for Nickel, Copper, and Cobalt

For the certification of SU-1, twenty-five laboratories provided analytical results for nickel, copper, and cobalt; the recommended values and their 95% confidence intervals are given in the following table.

Recommended Values and Their Confidence Intervals for Standard Reference Material SU-1

	Nickel (Wt %)	Copper (Wt %)	Cobalt (Wt %)
Recommended Value	1.51	0.87	0.063
95% Confidence Interval			
Low	1.50	0.86	0.061
High	1.52	0.88	0.065

A full account of the work done on SU-1 is given in the Mines Branch Technical Bulletin TB 177, entitled "Nickel-Copper-Cobalt Ores SU-1 and UM-1: Their Characterization and Preparation for Use as Standard Reference Materials". A copy of this bulletin will be forwarded automatically with each shipment of SU-1.

REFERENCES

(1) "Report of Non-metallic Standards Committee Canadian Association for Applied Spectroscopy", Appl. Spectrosc., 15, 159-161 (1961).

(2) "Second Report of Analytical Data for CAAS Syenite and Sulphide Standards", by G.R. Webber, Geochim. Cosmochim. Acta, 29, 229-248 (1965).

(3) "Third Report of Analytical Data for CAAS Sulphide Ore and Syenite Rock Standards", by N.M. Sine, W.O. Taylor, G.R. Webber and C.L. Lewis, Geochim. Cosmochim. Acta, 33, 121-131 (1969).

NICKEL-COPPER-COBALT ORE, UM-1

Source and Description of UM-1

Although UM-1 is called an ore because of its relatively high base-metal sulphide content, it is an ultramafic rock from the Giant Mascot Mine at Hope, British Columbia. UM-1 is one of a suite of three ultramafic rocks (the others being coded as UM-2 and UM-4) that have been termed geochemical standards for the determination of ascorbic acid/hydrogen peroxide-soluble nickel, copper, and cobalt[1] (see p.21). Because UM-1 contains ore-grade concentrations of nickel, copper and cobalt, and since it was available to the CSRMP in a comminuted condition, it was chosen, along with SU-1, for the certification of these three elements.

Details of the mineralogy of UM-1 are given in Reference (1) and provisional chemical analyses of UM-1 are given in the following table.

Provisional Chemical Analysis of UM-1

O	-	36.5 Wt %
Si	-	17.6
Al	-	0.53
Fe	-	13.4
Ca	-	1.67
Mg	-	21.7
Na	-	0.06
K	-	0.02
Ti	-	0.06
Cr	-	0.31
Mn	-	0.12
Ni	-	0.88*
Cu	-	0.43*
Co	-	0.035*
S	-	3.53
H (from H_2O)	-	0.05
C (from CO_2)	-	0.07

*Recommended value (see below).

Certification of UM-1 for Nickel, Copper, and Cobalt

For the certification of UM-1, twenty-five laboratories provided analytical results for nickel, copper, and cobalt; the recommended values and their 95% confidence intervals are given in the following table.

Recommended Values and Their Confidence Intervals for Standard Reference Material UM-1

	Nickel (Wt %)	Copper (Wt %)	Cobalt (Wt %)
Recommended Value	0.88	0.43	0.035
95 % Confidence Interval			
Low	0.87	0.43	0.034
High	0.89	0.44	0.035

A full account of the work done on UM-1 is given in the Mines Branch Technical Bulletin TB 177, entitled "Nickel-Copper-Cobalt Ores SU-1 and UM-1: Their Characterization and Preparation for Use as Standard Reference Materials". A copy of this bulletin will be forwarded automatically with each shipment of UM-1.

REFERENCE

(1) "Three Geochemical Standards of Sulphide-Bearing Ultramafic Rock: UM.1, UM.2, UM.4", compiled by E.M. Cameron, Geological Survey of Canada, Paper 71-35 (1972).

PLATINIFEROUS BLACK SAND, PTA-1

Source and Description of PTA-1

The material used to prepare PTA-1 was supplied by B.H. Levelton and Associates, Vancouver, British Columbia. It is essentially a magnetite concentrate from alluvial material taken from the Tulameen River area of British Columbia. Careful mineralogical examination of material similar to PTA-1 has revealed the presence of at least ten minerals known to contain platinum-group elements, with iron-bearing platinum being predominant.

Approximate Chemical Composition of PTA-1

Chemical analyses for the major constituents of PTA-1 gave the following values: Fe-63.0%; Ca-1.20%; Al-3.63%; Mg-0.62%; Cr-none detected.

Certification of PTA-1 for Platinum

For purposes of certification, nine laboratories provided platinum analyses. A statistical evaluation of these results yielded the following recommended platinum value and the 95% confidence interval of the mean.

Recommended Value and the Confidence Limits for Platinum in PTA-1

	(ppm)	(troy oz/ton)
Recommended Value	3.05	0.089
95% Confidence Interval		
Low	2.91	0.085
High	3.17	0.092

An account of the work done on PTA-1 is given in Mines Branch Technical Bulletin TB 138, entitled "Characterization and Preparation of Standard Reference Materials that Contain Noble Metals: (A) PTA (Ores) and (B) PTM (Nickel-Copper-Matte)". A copy of this bulletin will be forwarded automatically with each shipment of PTA-1.

MATTE AND CONCENTRATE

NOBLE-METALS-BEARING NICKEL-COPPER MATTE, PTM-1

Source and Description of PTM-1

Matte PTM-1 was produced from Sudbury ore and was provided by Falconbridge Nickel Mines Limited. This material was chosen for preparation as a standard reference material because it was known to contain appreciable concentrations of most members of the platinum group of metals.

Approximate Chemical Composition of PTM-1

Chemical analyses for the major constituents of PTM-1 gave the following values: Ni-44.8%; Cu-30.2%; Fe-1.58%; S-21.6%.

Certification of PTM-1 for Platinum, Palladium, Rhodium, Gold and Silver

An account of the work done on PTM-1 is given in Mines Branch Technical Bulletin TB 138, entitled "Characterization and Preparation of Standard Reference Materials that Contain Noble Metals: (A) PTA (Ores) and (B) PTM (Nickel-Copper-Matte)". Since the publication of Technical Bulletin TB 138, additional results have been obtained for PTM-1. Recommended values for rhodium and silver have been assigned, and those of platinum, palladium and gold have been revised. These recommended values and their 95% confidence intervals are given in the table on page 15. A new bulletin describing this work is in the course of preparation. A copy of Technical Bulletin TB 138 will be forwarded automatically with each shipment of PTM-1.

Recommended Values and Their Confidence Intervals for Selected Elements in PTM-1

	Pt		Pd		Rh		Au		Ag	
	(oz/ton)	(ppm)	(oz/ton)	(ppm)	(oz/ton)	(ppm)	(oz/ton)	(ppm)	(oz/ton)	(ppm)
Recommended Value	0.17	5.8	0.24	8.1	0.026	0.9	0.052	1.8	1.9	66
95% Confidence Interval										
Low	0.16	5.5	0.22	7.4	0.021	0.7	0.047	1.6	1.7	59
High	0.18	6.2	0.26	8.8	0.030	1.0	0.057	1.9	2.1	73

NOBLE-METALS-BEARING SULPHIDE CONCENTRATE, PTC-1

Description of PTC-1

PTC-1, together with the previously described materials PTA-1 (p. 13) and PTM-1 (p. 14), completes the suite of standard reference materials containing the platinum-group metals. PTC-1 is a flotation concentrate of the Sudbury ore; its principal constituents contents are: 5.0% Cu, 0.6% Ni, 0.3% Co, 24.2% Fe, and 24.1% S.

Certification of PTC-1 for Platinum, Palladium, Rhodium, Gold, and Silver

Ten laboratories provided analyses for the certification of the selected elements. A statistical evaluation of these results yielded the recommended values and their 95% confidence intervals given on page 17.

A full account of the work done on PTC-1 is given in Mines Branch Technical Bulletin TB 176, entitled "Noble-Metals-Bearing Sulphide Concentrate, PTC: Its Characterization and Preparation for Use as a Standard Reference Material". A copy of this bulletin will be forwarded automatically with each shipment of PTC-1.

Recommended Values and Their Confidence Intervals for Selected Elements in PTC-1

	Pt		Pd		Rh		Au		Ag	
	(oz/ton)	(ppm)	(oz/ton)	(ppm)	(oz/ton)	(ppm)	(oz/ton)	(ppm)	(oz/ton)	(ppm)
Recommended Value	0.087	3.0	0.37	12.7	0.018	0.62	0.019	0.65	0.17	5.8
95% Confidence Interval										
Low	0.081	2.8	0.35	12.0	0.016	0.55	0.016	0.55	0.16	5.5
High	0.093	3.2	0.38	13.0	0.020	0.69	0.021	0.72	0.18	6.2

MATERIALS WITH PROVISIONAL VALUES FOR SELECTED ELEMENTS

NOTE: Although the rocks listed in this section are referred to as reference materials, reliable recommended values obtained by statistical evaluation of analytical results have not yet been assigned for any of their constituents. Therefore, the analyses given for these materials should be considered as provisional.

ROCKS

SYENITE ROCK STANDARDS, SY-2 AND SY-3

Source and History of SY-2 and SY-3

The syenite rock used to prepare SY-2 was collected from properties in the Bancroft area of Ontario. This material replaces SY-1[1,3], the supply of which was exhausted in 1966. SY-1 was intended for use by spectroscopists and other workers whose primary interest was in the minor elements, especially uranium, thorium, and the rare earths. Early analyses of SY-2 indicated that it was appreciably lower than SY-1 in its content of these elements. Therefore, a third rock standard, SY-3, was prepared by "spiking" SY-2 with material containing minerals of uranium, thorium, and the rare earths. Their approximate chemical analyses are shown hereunder.

Constituent	SY-2 (Wt %)	SY-3
SiO_2	60.8	60.3
Al_2O_3	11.3	11.5
CaO	9.7	8.1
MgO	2.0	2.6
Na_2O	4.2	3.9
K_2O	4.2	3.9
Fe	5.0	4.9
TiO_2	0.1	0.1
MnO	0.3	0.3
H_2O^+	0.2	0.8

Provisional Analyses for Minor and Trace Constituents in SY-2 and SY-3

With the exception of the values for uranium and thorium, which were determined chemically at the Mines Branch, the provisional analyses given in the following table were obtained by emission spectroscopy at the Geological Survey of Canada.

Constituent	SY-2	SY-3
	(ppm)	
Sr	270	300
Ba	430	410
Cr	<20	not detected
Zr	280	260
V	<30	<30
Ni	<20	not detected
Ce	<500	1900
Cu	<8	18
Y	160	870
Nb	not detected	130
Co	<20	not detected
La	<100	1700
Pb	64	120
Sc	<10	12
Yb	17	69
Be	16	16
Ag	<0.05	0.054
Zn	200	180
Ga	33	43
Sn	2.5	4.8
B	35	45
Ge	1.0	1.1
Mo	0.99	0.90
Ti	2.0	2.2
Bi	not detected	0.58
U_3O_8	330	730
ThO_2	300	1020

REFERENCES

(1) "Report of Non-metallic Standards Committee Canadian Association for Applied Spectroscopy", Appl. Spectrosc., 15, 159-161 (1961).

(2) "Second Report of Analytical Data for CAAS Syenite and Sulphide Standards", by G.R. Webber, Geochim. Cosmochim. Acta, 29, 229-248 (1965).

(3) "Third Report of Analytical Data for CAAS Sulphide Ore and Syenite Rock Standards", by N.M. Sine, W.O. Taylor, G.R. Webber and C.L. Lewis, Geochim. Cosmochim. Acta, 33, 121-131 (1969).

SULPHIDE-BEARING ULTRAMAFIC ROCK STANDARDS, UM-1, UM-2 AND UM-4

NOTE: See page 12 for the certification of UM-1 for nickel, copper and cobalt.

Source and Description

UM-1 is a sulphide-bearing ultramafic rock from the Giant Mascot Mine at Hope, British Columbia. Materials UM-2 and UM-4 are similar to UM-1 but are from the Werner Lake-Gordon Lake district of northwestern Ontario. Although these rock samples are classified as standard reference materials, it is to be emphasized that they are intended for a rather special purpose, viz., to provide standards for the determination of ascorbic acid/hydrogen peroxide-soluble copper, nickel, and cobalt in ultramafic rocks. Such standards are useful in the evaluation of the ore potential of ultramafic rocks[1].

Mineralogical Composition

The details of the mineralogy of UM-1, UM-2, and UM-4 are given in Geological Survey of Canada Paper 71-35, entitled "Three Geochemical Standards of Sulphide-Bearing Ultramafic Rock: UM.1, UM.2 and UM.4[1].

Approximate Chemical Composition of UM-1, UM-2 and UM-4

Analyses, from G.S.C. Paper 71-35, for the major and minor elements are given in the following table.

Constituent	UM-1	UM-2	UM-4
		(Wt %)	
SiO_2	37.6	39.2	39.35
TiO_2	0.10	0.24	0.35
Al_2O_3	1.00	7.23	8.98
Total Fe as FeO	17.2	12.95	12.8
MnO	0.16	0.08	0.15
MgO	36.05	25.45	22.5
CaO	2.34	4.68	6.27
Na_2O	0.08	0.32	0.45
K_2O	0.03	0.11	0.18
P_2O_5	0.00	0.02	0.02
H_2O	0.42	6.27	4.86
CO_2	0.26	0.10	0.26
S	3.53	0.94	0.44
Cr_2O_3	0.45	1.51	2.59
NiO	1.22	0.49	0.32
CuO	0.51	0.12	0.07
CoO	0.046	0.023	0.014
ZnO	0.012	0.004	0.008

G.S.C. Values for Copper, Nickel, and Cobalt by Ascorbic Acid/Hydrogen Peroxide Method

The mean values reported in the following table are from G.S.C. Paper 71-35.

Sample	Cu	Ni	Co
		(Wt %)	
UM-1	0.41	0.83	0.029
UM-2	0.095	0.29	0.012
UM-4	0.054	0.19	0.007

REFERENCE

(1) "Three Geochemical Standards of Sulphide-Bearing Ultramafic Rock: UM-1, UM-2, UM-4", compiled by E.M. Cameron, Geological Survey of Canada, Paper 71-35 (1972).

PRICE LIST

PRICE LIST

(Shipping costs included)

The following may be purchased from the Chairman, CSRMP, Mineral Sciences Division, Mines Branch, Department of Energy, Mines and Resources, 555 Booth Street, Ottawa, Ontario, K1A 0G1.

Material	Price Per Unit
Molybdenum Ore PR-1	$50.00 per 200 g
Zinc-Tin-Copper-Lead Ore MP-1	$50.00 per 200 g
Copper-Molybdenum Ore HV-1	$50.00 per 200 g
Platiniferous Black Sand PTA-1	$50.00 per 400 g
Noble-Metals-Bearing Nickel-Copper Matte PTM-1	$100.00 per 400 g
Noble-Metals-Bearing Sulphide Concentrate PTC-1	$100.00 per 400 g
Nickel-Copper-Cobalt Ore SU-1*	$25.00 per 100 g
Nickel-Copper-Cobalt Ore UM-1**	$25.00 per 100 g
Ultramafic Rock Standards UM-1, UM-2, and UM-4	$25.00 per 100 g
Syenite Rock Standards SY-2 and SY-3	$25.00 per 100 g

*Previously issued as Sulphide Ore SU-1 (provisional analysis)

**Also issued as one of a suite of ultramafic rocks, UM-1, UM-2 and UM-4.

PURCHASE PROCEDURE

Purchase orders for standard reference materials should be addressed:

Canadian Standard Reference Materials Project
c/o Mineral Sciences Division
Mines Branch
Ottawa, Ontario
K1A 0G1

Prices are subject to revision and orders will be billed at prices in effect at the time of receipt of order. Payment is expected within 30 days of receipt of the C.S.R.M.P. invoice. Payment on foreign invoices can be made by

(a) banker's draft against a Canadian bank,
(b) bank to bank transfer to a Canadian bank,
(c) letter of credit on a Canadian bank,
(d) International Money Order, or
(e) UNESCO coupons

payable to "Canadian Standard Reference Materials Project". No discounts are available.

Shipments in Canada and to the U.S.A. will be made by first-class mail; South American and overseas orders by non-priority air-mail where possible, otherwise by surface mail. Extra expenses incurred by shipping according to customers' special instruction will be charged extra.

Revised schedules, when issued, will be sent to customers who have made purchases during the previous twelve months and to persons and organizations who request them. Prepaid orders will be despatched within 3 days of receipt of order.

ORES BEING PROCESSED IN OCTOBER, 1973

ORES BEING PROCESSED IN OCTOBER, 1973

The following descriptions are of ores that are being characterized and prepared for use as standard reference materials by the CSRMP as of October, 1973.

Zinc-Lead-Silver Ore, KC-1

KC-1 is composed of material that was hand-picked at the Kidd Creek Mine of Ecstall Mining Limited. It has been ground to minus 200-mesh, thoroughly blended, and tested for homogeneity. KC-1 is being certified for zinc, lead, copper, tin, and silver.

The approximate mineralogical composition of KC-1 is:

Sphalerite	34%
Pyrite	26
Quartz	26
Galena	8
Chlorite	3
Cassiterite	0.8
Pyrrhotite	0.5
Tetrahedrite	0.5
Talc	0.5
Chalcopyrite	0.3
Siderite	0.2
Silver	0.1
Fluorite	0.1
Arsenopyrite	0.1
Stephanite	0.1
Allargentum	0.1
Stannite	0.1

KC-1 will be available for purchase by mid-1974.

Gold Ore, MA-1

Gold ore, MA-1 was obtained from the Macassa Mine of Willroy Mines Limited, near Kirkland Lake, Ontario. The gangue is mainly quartz and the principal sulphide mineral of the ore is pyrite. The gold content of MA-1 is approximately 0.5 oz/ton (17 ppm) and it occurs as electrum and as calaverite ($AuTe_2$). MA-1 will be available for purchase in late 1974.

Radioactive Ore Standards, DHG-1, DLG-1, BL-1, BL-2, BL-3 and BL-4

These materials have been prepared to replace the previous standards of the Canadian Uranium Producers Analytical Sub-committee, the supply of which is now exhausted. Materials from both of the uranium-producing areas of Canada have been selected for these standards. Two of the samples, DHG-1 and DLG-1 consist of waste-grade and ore-grade material, respectively, from the Elliot Lake area of Ontario and contain both thorium and uranium. Four samples designated BL-1, BL-2, BL-3, and BL-4, from the Beaverlodge area of northwestern Saskatchewan, are relatively free of thorium, are in radioactive equilibrium, and cover a range of concentrations that should make them useful as standards for radiometric methods of analysis.