THE QUANTITATIVE MINERALOGY OF FORTY-FIVE CANADIAN BASE METAL SULPHIDE ORE DEPOSITS

A Thesis

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Doctor of Philosophy

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

FIGURE PAGE

ABSTRACT

The quantitative mineralogies of forty-five Canadian base metal sulphide ore deposits are presented. Determinations were made on composite samples by point counting and x-ray diffraction methods. Samples were analyzed for Ni, Co, Cu, Zn, Pb, Fe, Au, Ag, and S.

Analyses of metal and sulphide mineral ratios, ore type, and wall rock associations yielded significant results with respect to grouping of the ores studied and suggested that a differentiation process has been operative during their formation.

Conventional interpretation methods indicated the importance of the pyrrhotite-pyrite and pyrrhotite-pyrite-magnetite relations in the classification of sulphide deposits.

Q-mode factor analysis proved to be an effective and rapid interpretational technique when applied to compositional data. Consideration of the mathematically extracted factors indicated the importance of the pyrrhotite-pyrite relation in classifying sulphide ores when examined in terms of ore and wall rock type variation and that the pyrrhotite-pyrite-sphalerite ternary relation appears to be a continuous series for ores studied.

CHAPTER I

INTRODUCTION

General Statement

The mineral resources of Canada contribute much to the wealth of this country. Development of the Canadian mining industry has expanded rapidly in recent years and is still growing. There is however, no overall picture of the chemical composition or the quantitative sulphide and silicate mineralogies of Canadian ores. Furthermore, data on individual properties in published form is generally scattered and difficult to locate and many operating mines have little or no information in published form.

Detailed study of such information may suggest a general order to the factual data on ore deposits, compared with the diversity in our ideas concerning their genesis. The variation in mineral composition of different types of ores in different metallogenic provinces may be of interest to geophysists and may be used as an aid in determining the most suitable prospecting methods to use and how to interpret the results.

Statement of the Problem

The quantitative mineralogy of Canadian ore deposits is unknown. Consequently the significance of the quantitative mineralogy has never been examined. The aim of the present study was, therefore, to provide and examine this data.

The research progressed in a threefold manner:

First, research was directed to determine the quantitative sulphide and silicate mineralogy of forty-five major Canadian base metal sulphide deposits.

Second, the chemical compositions based on ten elements was determined for the deposits.

Finally, the data collected was analyzed with respect to calculated mineral and metal ratios, mineral and metal content, ore type, geographic location, and factor analysis.

Acknowledgements

The writer wishes to thank all of the mining Companies from which samples have been obtained.

A special note of thanks is due Dr. H. D. B. Wilson who suggested the problem and gave guidance and critism.

Acknowledgements are due the Minister of Mines and Natural Resources of the Province of Manitoba for permission to have a large number of chemical analyses done at the Mines Branch Laboratory by Messers. A. McKay and D. Brown

The writer also extends thanks to Dr. R. B. Ferguson, Dr. A. C. Turnock, and Dr. D. T. Anderson for helpful suggestions and comments, and to my colleagues at The University of Manitoba for many stimulating discussions of the problems encountered.

Thanks are also due to Dr. A. Turek who acted as external examiner.

Previous Work

Published research along the lines of this study appears to be very limited. The National Advisory Committee on Research in the Geological Sciences, during the late 1950's, initiated a questionnaire survey on sulphide mineralization in Canadian sulphide deposits (Wilson, 1961). Results of this survey did indicate some tentative conclusions, but the data submitted by the mining Companies varied greatly in quality, ranging from good, through sketchy, to useless.

CHAPTER II

METHODS OF STUDY

The Samples

A study of this type required samples which were representative of ore bodies and ore types. The best possible sample would be one which is representative of all ore accessible through mine openings. Mill feed composites represent large tonnages which have been drawn from many working places in an ore body or a group of ore bodies and for most mines shows fairly constant base metal contents from month to month. This fairly constant composition indicates reproducibility in sampling and a good representation of the ore zone that has been worked. Another type of sample that would be representative of an ore body would be one that had been collected from ore intersections by a complete exploration drilling program. However, samples of this latter type are not readily available.

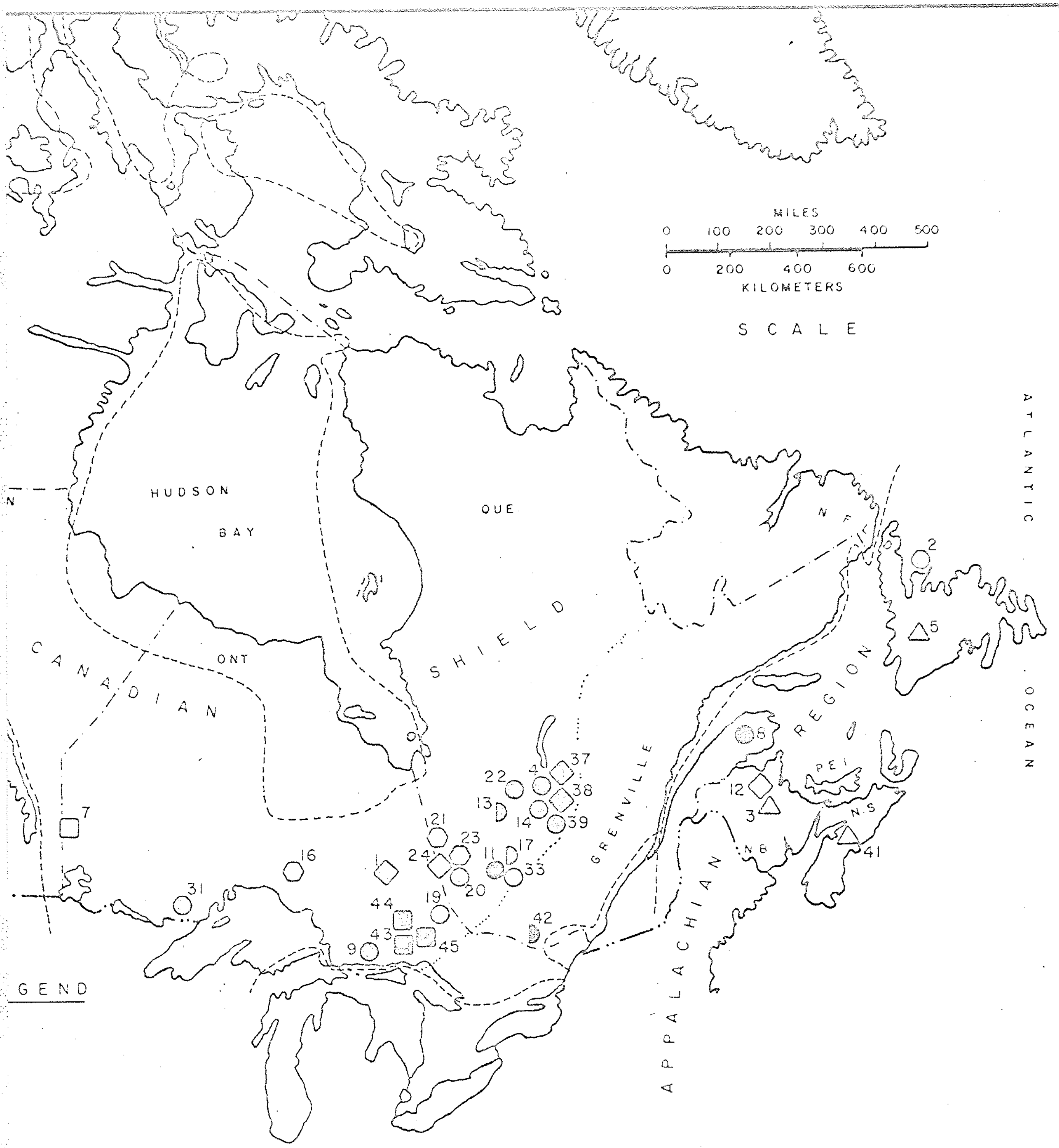
Mill feed composites, covering periods of up to six months and therefore representing a large tonnage, were requested by the author from base metal sulphide mines in Canada. Twenty-seven mill feed composites were received for this study. The representativeness of most samples was given by the mining company as a time factor which could be converted to an equivalent tonnage using the daily milling rate of the mill. One sample was received late in the study from the Noranda area (Lake Dufault Mines Limited) and was only partially analyzed. Eighteen composite samples remaining in the department from Dr. L. C. Kilburn's (1959, 1960) research were chosen to augment the study, making a total of forty-six samples.

Thirty-six mill feed composite samples were obtained for the project. The ten remaining composites were not of mill feed. These were a composite of total diamond drilling (representing 22 million tons), a composite of flotation feed, two composites of sample rejects from underground stoping, and three composites of unknown origin. These samples are listed and described in Tables 1 and 2 (Appendix 1), and located geographically in Figure 1.

Sample Preparation

On receipt, samples were crushed, if necessary, to $-\frac{1}{2}$ inch to facilitate splitting a representative portion for the study using a Brunton splitter. This representative portion, about ten pounds, was stored in double 6 mil plastic bags to prevent oxidation. A split of this representative sample was stored in air tight glass jars for future investigations.

Smaller splits were drawn for the current study. These study samples were screened into two fractions; 1) -65+400 mesh and 2) -400 mesh. The +65 mesh oversize was reground so that the whole sample passed -65 mesh. Sample fractions were stored in air tight containers. Mechanical screening (Rotap) was carried out for at least 15 minutes. Sieve cleaning, such as air blowing, washing, and brushing with a camel



ORPHIC

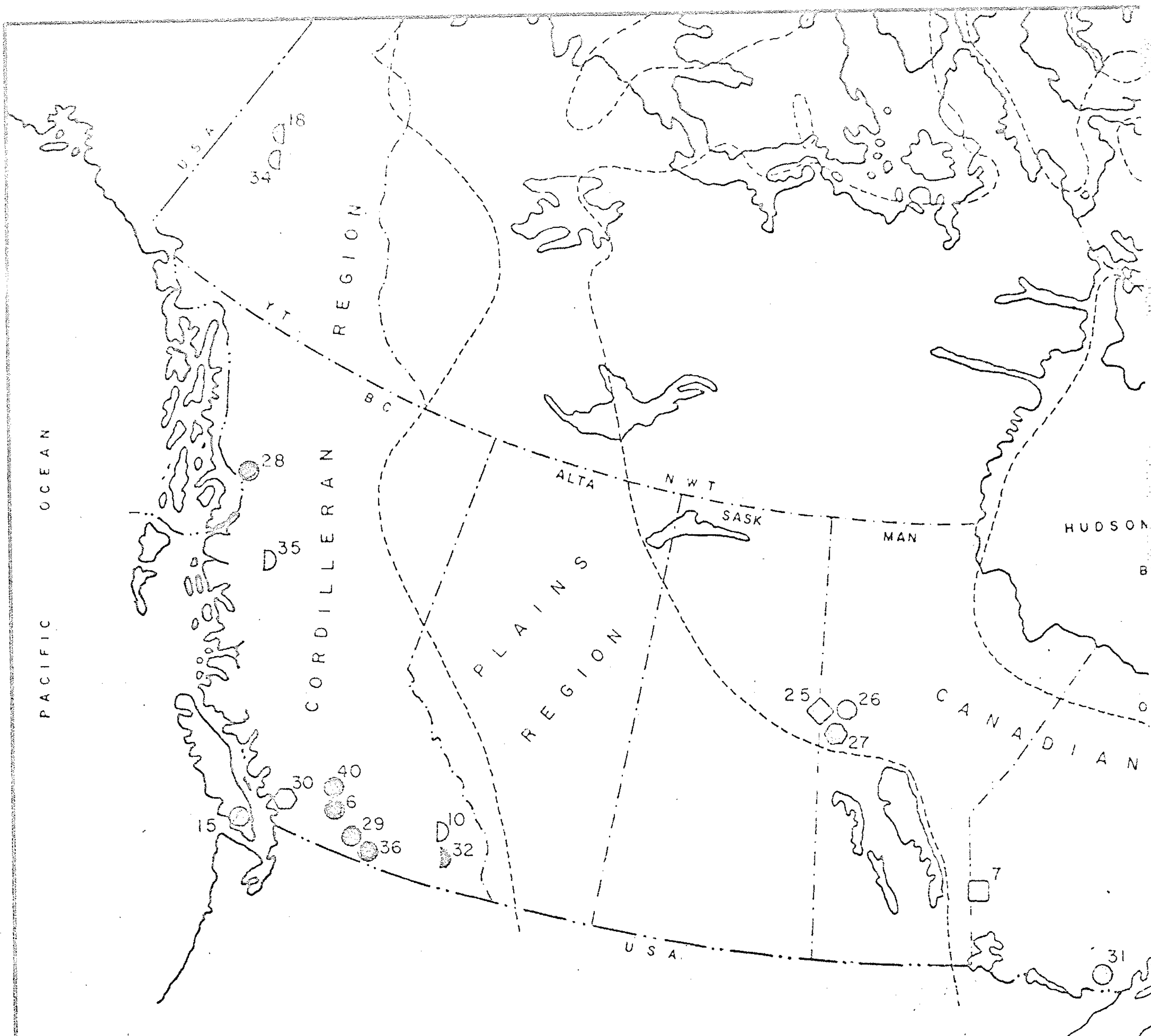
PROPERTY LOCATION MAP

Properties located by deposit symbol and property number.

(⬡ 14)

31 NORTH COLDSTREAM MINES
32 COMINCO, SULLIVAN MINE
33 MANITOU BARVUE, CU CIRCUIT
34 MACKENO MINES
35 SILVER STANDARD MINE
36 GRANBY CONS., PHOENIX COPPER
37 CAMPBELL CHIBOUGAMAU, HENDERSON
38 CAMPBELL CHIBOUGAMAU, MAIN B ZONE
39 CAMPBELL CHIBOUGAMAU, WINZE ZONE
40 BETHLEHEM COPPER
41 MAGNET COVE BARIUM CORP.
42 NEW CALUMET MINES
43 INCO, CREIGHTON MINE
44 NICKEL OFFSET LTD.
45 FALCONBRIDGE, MCKIM MINE

FIGURE 1



SYMBOL LEGEND

□	CU – NI	DEPOSITS
○	CU	DEPOSITS
◇	CU – ZN	DEPOSITS
⬡	ZN – CU	DEPOSITS
△	ZN – PB – CU	DEPOSITS
D	ZN – PB	DEPOSITS
ᗡ	PB – ZN	DEPOSITS

WALL ROCK LEGEND

- ULTRABASIC
- BASIC INTRUSION
- ACID VOLCANIC
- SEDIMENTARY
- ACID INTRUSION
- CONTACT METAMORPHIC

1 KAM KOTIA PORCUPINE
2 FIRST MARITIME MNG.
3 HEATH STEELE
4 MERRILL ISLAND MNG.
5 ASARCO, BUCHANS
6 CRAIGMONT MINES
7 METAL MINES, GORDON LAKE
8 GASPE COPPER
9 RIO ALGOM, PRONTO
10 SHEEP CREEK, MINERAL KING MINE
11 SULLICO, EAST SULLIVAN
12 COMINCO, WEDGE MINE
13 CONIAGUS MINES
14 PATINO MNG, COPPER RAND
15 COWICHAN COPPER, SUNRO MINE
16 GECO MINES
17 MANITOU BARVUE, PB-ZN CIRCUIT
18 UNITED KENO HILL
19 COPPERFIELDS MNG, TEMAGAMI MINE
20 NORANDA MINES, HORNE MINE
21 NORMETAL MNG.
22 OPEMISKA COPPER
23 QUEMONT MNG.
24 WAITE AMULET
25 H.B.M.S., FLIN FLON MINE
26 H.B.M.S., NORTH STAR MINE
27 H.B.M.S., SCHIST LAKE MINE
28 GRANDUC MINES
29 GRANBY CONS., COPPER MTN.
30 ANACONDA, BRITANNIA BEACH MINE
31 NORTH COLDSTREA
32 COMINCO, SULLIVAN
33 MANITOU BARVUE, C
34 MACKENO MINES
35 SILVER STANDARD
36 GRANBY CONS., PH
37 CAMPBELL CHIBOUG
38 CAMPBELL CHIBOUG
39 CAMPBELL CHIBOUG
40 BETHLEHEM COPPE
41 MAGNET COVE BA
42 NEW CALUMET M
43 INCO, CREIGHTON
44 NICKEL OFFSET
45 FALCONBRIDGE, MC

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hair brush was done after each sample screening to prevent contamination. The -65+400 mesh fraction was set aside for point counting. Weights for both fractions were recorded.

Grain Mounts for Sulphide-Opaque Mineral Counting

Three grain mounts or pellets were made for each mine sample. Approximately six grams of sample was used for every three pellets. The pellets were made in two stages using Quick Mount plastic (Fulton Metallurgical Products Corporation). First, a sample-plastic mix (1/3 sample, 2/3 plastic) was poured into forms yielding about a 3/8 inch thick layer. Next, clear plastic was added to the form to build up the pellet for grinding and polishing. The sample-plastic mix failed to solidify for two samples so that bakelite pellets had to be made. New weights were noted for the -65+400 mesh fractions after removal of sample for pellet preparation.

The pellets were ground on iron laps using 200, 400, and 600 mesh silicon carbide grains. Each pellet of a three pellet group was ground to a different depth level to average out any settling effect due to different minerals and grain sizes. Felt laps and 6 and 1 micron diamond paste were used for preliminary polishing with final polishing on felt cloth using Fisher Polishing Alumina (3 micron) on a Fisher Vibromatic Polisher.

The grinding and polishing technique was varied slightly for individual groups of mounts because of the different mineral assembleges.

Completed pellets had a radius of approximately 15 mm and a surface area of about 700 mm^2.

Element Analyses of Fractions

The -65+400 and -400 mesh fractions for all samples of the study groups were analyzed by the Mines Branch Laboratory, Department of Mines and Natural Resources of Manitoba for gold, silver, copper, lead, zinc, iron, cobalt, and nickel. All pulps from these analyses were retained at the university.

Sulphur analyses for each fraction were carried out on these pulps in The University of Manitoba Geology Department Laboratory by the writer using a Leco Automatic Sulphur Titrator.

A record of screened weights retained before and after pellet fabrication is shown in Table 3, Appendix 1.

Sulphide-Opaque mineral Point Counting

Polished grain mounts were stained using the silver nitrate method of Gaudin (1935). Mounts were stained in groups of six and counted as soon as possible after staining. Staining immersion times were varied slightly for each ore body, the average time being about 3 minutes. Slight variations occurred in the colors of stains as given by Gaudin so individual mounts of a variety of known sulphide minerals were prepared, stained, and the colors of the stains recorded.

Galen - light buff   Magnetite - no change

Chalcopyrite - blue

Pentlandite - yellow

Pyrrhotite - reddish orange

Bornite - no change

Sphalerite - white to grey

Arsenopyrite - no change

Chalcocite - no change

All plastic mounts were counted using a Spencer petrographic microscope (American Optical Company) with a X 20 objective and a X 10 eyepiece. Bakelite mounts were counted using a Reichert petrographic microscope (Austria) with a X 45 objective and a X 6.3 eyepiece.

A Swift Automatic Point Counter (7 counters) and stage was used for counting. Stage movement was along 1/3 mm traverses at 1/3 mm intervals. The complete pellet was traversed, intercepting about 5000 points of which 1200 to 1600 were grains and were counted. The counts of three pellet groups were recorded, totalled, and tabulated (Table 1, Appendix 4). The counts for the sulphide-opaque minerals were converted to volume percent.

Samples numbered 17 and 33 were counted as -65 mesh. No -400 mesh separation was made as the available sample was too small.

Silicate Mineral Point Counting

Silicate (gangue) minerals were counted using the Swift Automatic Point Counter and stage mounted on a Carl Zeiss petrologic microscope with a X 10 objective and a X 8 eyepiece. Grains (-65+400) were sprinkled on a glass slide containing a thin layer of non-drying immersion oil. The area counted was about 1 by 3/4 inches. Only one mount was counted for each ore sample. Grains counted averaged about 1000. Results of the silicate counting are shown in Table 2, Appendix 4.

The relative amounts of the various silicate minerals were converted to normalized volume percentages based on 100% silicates from the counts for the silicate minerals alone, that is, minus the counts for the opaques encountered. The volume percent of silicate or gangue mineral as calculated from the sulphide-opaque counting was then multiplied by the normalized silicate volume percentages yielding the volume percentages of the various silicate and gangue minerals in the -65+400 mesh fraction of each sample.

Calculation of Weight Percent Mineralogy of the -65+400 Counted Fraction

Volume percent of minerals was converted to weight percent by using appropriate specific gravities.

Specific gravities for monomineralic units were taken from standard references (Dana and Ford, 1947, Berry and Mason, 1959, and McKinstry, 1959). However, for units of more than one mineral, altered minerals, and altered rock units, a weighted average of specific gravities was used.

Determination of the Quantitative Mineralogy of the -400 mesh Fraction

It was originally hoped that the quantitative (sulphide-opaque) mineralogy of the -400 mesh fraction could be calculated on the basis of the chemical analyses of each fraction and the counted weight percentages in the -65+400 fraction. This however was not possible for the iron minerals such as pyrite, pyrrhotite, and magnetite. Quantitative determinations for these three minerals were made using a Phillips x-ray diffractometer. Details of the procedures are discussed in Chapter III.

The quantities of the remaining sulphide-opaque minerals encountered in the study and contained in the -400 fraction were calculated on the bases of the element analyses and weight percentages in the counted fraction using the following relation;

$$\text{MWP}(-400) = \frac{\text{EA}(-400) \times \text{MWP}(-65+400)}{\text{EA}(-65\ 400)}$$

where MWP = mineral weight percent

EA = element analysis (weight percent)

For example, the amount of chalcopyrite in the fine fraction was calculated on the basis of the copper analysis as follows;

<u>Sample 1.</u>

Copper (-400) = 1.60%　　　Copper (-65+400) = 2.23%

Chalcopyrite (weight percent) by counting = 5.07 (-65+400)

$$\text{Chalcopyrite weight percent } (-400) = \frac{2.23 \times 5.07}{1.60}$$

$$= 7.07$$

Similarily, the amounts of the other metallic minerals present in the fine fractions were calculated according to the following analyses.

zinc analyses - sphalerite

lead analyses - galena

silver analyses - tetrahedrite-bournonite and freibergite

iron analyses - limonite and hematite

copper analyses - bornite, chalcocite, tetrahedrite, tennantite, and chalcopyrite

sulphur analyses - arsenopyrite

The amounts of tennantite, chromite, or unknown minerals were carried over to the fine fraction unchanged because the amounts present were small.

In the copper-nickel deposits, pentlandite was calculated in the fine fraction on the basis of the nickel analyses minus an allowance for nickel in pyrrhotite.

The following average distributions of nickel in pyrrhotite (Po) and pentlandite (Pn) were used (Hawley et al, 1962).

TABLE 1

Deposit No.	Ni in Po	Ni in Pn
7	1.55%	34.0%
43	1.85%	34.8%
44	1.44%	33.7%
45	1.62%	33.7%

The amounts of pyrrhotite were known so that the nickel content of the pyrrhotite could be calculated and subtracted from the -400 fraction analyses for nickel and this remainder used to calculate the amount of pentlandite present using the respective amount of nickel in pentlandite from Table 1.

In deposit number 6 (Craigmont Mines Limited), specularite presented a special problem. The amount of specularite present in the fine fraction was estimated on the basis of the remaining amount of iron after allotting iron to all other iron bearing minerals present.

Micaceous Mineral Correction Factor

Micaceous minerals tend to lie on their basal cleavage when mounted for counting. This preferred orientation greatly increases the count for micas.

A standard biotite sample was prepared to correct the weight percent as calculated by point counting. Quartz, orthoclase, and biotite were crushed and screened in separate batches, retaining only the -65+400 mesh fraction. The standard sample contained 10 weight percent biotite in a 50-50 mixture of quartz and orthoclase. The sample was well mixed and three grain mounts were counted. It was found that the amount of micas present was 26% of the counted value.

The International Nickel Company of Canada Limited has carried out similar procedures and has found that the correction factor for micas was 26% for the -48+65, -65+100, and -100+200 mesh sizes and 33% for the -200+325 mesh size (G. W. Thrall, personal communication). All biotite and muscovite weight percent values determined by point counting were modified by taking 26% of the value.

Reconstitution of Fraction Data for the Total Sample

Data in the form of mineralogical composition (weight percent) and assay results (weight percent and ounces/ton) for the -65+400 and -400 fractions have now been calculated. Reconstitution of these two fractions into a total sample was accomplished by applying mineral and assay factors (Table 3, Appendix 1) to the appropriate data. These factors were calculated from the weights of samples after screening and pellet making. The mineral factor was calculated using the original weights retained following initial screening, and is in the form of a decimal factor of unity for each fraction. For each sample, the mineralogical data for each fraction was multiplied by the appropriate mineral factor and the results summed for the total sample.

The assay results for each sample fraction were processed similarily using the assay factor which was calculated from the fraction weights sent for assay. The -65+400 fraction weight was equal to the original coarse fraction weight minus the amounts used for pellet making. Weights for the -400 fraction remained unchanged.

Bibliographic Compilation

Generally, references and articles on the various deposits are scattered throughout a variety of publications and the quality of the reporting is variable.

The property bibliography compiled for this study shows listing by the most recent company name under four main headings; Appalachian Region, Grenville, Canadian Shield, and Cordilleran Region (Appendix 2).

Analytical Errors

The calculation of an overall analytical error is very difficult in a study of this type where many many methods and techniques have been utilized.

Analytical precision for the assay results have been set down by the Manitoba Mines Branch analysists as follows;

gold	±	.005 oz/ton	nickel	±	.10 weight %
silver	±	.20 oz/ton	zinc	±	.50 weight %
lead	±	.50 weight %	cobalt	±	.01 weight %
copper	±	.10 weight %	iron	±	.20 weight %
sulphur	±	.20 weight %			

The standard error (S.E.) of the Y estimate {the variance of the Y data (mineral percent) on X (intensity ratio)} was calculated by linear regression analyses of the x-ray diffractometer data for the -400 mesh fraction. Results from these regression analyses for 68.26% confidence were as follows;

pyrite	± 7.37 weight %
magnetite	± 1.77 weight %
pyrrhotite	± 2.63 weight %

Compilation of an average point counting error was carried out using the following equation (Avery, 1962);

$$E_i = \sqrt{\frac{P(1 - P)T^2}{N}} \quad \text{for each sample}$$

and average error $= \dfrac{1}{m - 1} \sum_{i=1}^{m} E_i$

where E_i = error expressed as a decimal proportion.

P = decimal proportion of the chief mineral (opaque) or main constituent (silicate).

T = level of confidence (T = 2 in this case, corresponding to an approximate 95% confidence limit).

N = total number of points counted.

m = number of samples (m = 45).

m - 1 = degrees of freedom (It is more theoretically correct to use m rather than m - 1 for the degrees of freedom in the actual calculation as this is a finite population without replacement).

Results for the calculation of the average errors are shown in Tables 2 and 3, and the calculation program in Table 1, Appendix 6.

The average error (Avery method) for the sulphide-opaque counting was found to be 0.94% (2 standard deviations). The maximum variance $\{(\text{standard deviation})^2\}$ was calculated using the equation of Bayly (1960) which is also given in the computing program (Table 1, Appendix 6). Bayly's method yielded a maximum variance of about 2.0 for only

TABLE 2

CALCULATION OF THE AVERAGE POINT COUNTING ERROR
(SULPHIDE-OPAQUE POINT COUNTING)

CALC. MAX. VARIANCES (BAYLY)	CALC. PCT. ERROR-MAIN MINERAL	TOTAL POINTS SAMPLE	POINTS MAIN MINERAL	PERCENT MAIN MINERAL	PR. NO.
1.39	1.63	3126	917	29.33	1
0.94	1.22	4736	1087	22.95	2
2.08	1.40	4681	3009	64.28	3
0.57	1.09	3244	353	10.88	4
1.10	1.43	3507	829	23.64	5
0.78	1.26	3315	514	15.51	6
0.43	0.85	4966	499	10.05	7
0.12	0.50	3536	80	2.26	8
0.36	0.76	5663	506	8.94	9
0.41	0.89	4043	355	8.78	10
0.17	0.55	5196	210	4.04	11
2.16	1.32	4804	3357	69.88	12
0.61	1.00	4961	727	14.65	13
0.26	0.68	4922	294	5.97	14
0.17	0.55	4736	174	3.67	15
0.67	1.01	5461	918	16.81	16
0.38	0.84	4201	342	8.14	17
0.33	0.81	3836	260	6.78	18
0.54	0.92	5428	724	13.34	19
1.32	1.32	5321	1920	36.08	20
1.25	1.47	3777	1081	28.62	21
0.32	0.78	4126	280	6.79	22
1.70	1.43	4873	2344	48.10	23
0.80	1.19	4183	761	18.19	24
1.43	1.35	5204	2049	39.37	25
1.27	1.40	4396	1386	31.53	26
1.09	1.25	5225	1479	28.31	27
0.12	0.48	4099	101	2.46	28
0.04	0.27	4597	39	0.85	29
0.37	0.79	5189	457	8.81	30
0.33	0.74	5283	418	7.91	31
0.94	1.24	4570	1033	22.60	32
0.10	0.43	4625	101	2.18	33
0.52	0.94	4976	618	12.42	34
0.48	0.88	5397	636	11.78	35
0.13	0.48	5022	149	2.97	36
0.41	0.82	5275	522	9.90	37
1.00	1.19	5486	1437	26.19	38
1.39	1.27	5925	2371	40.02	39
0.04	0.28	4382	39	0.89	40
0.24	0.64	5218	299	5.73	41
0.23	0.67	4247	210	4.94	42
0.27	0.72	4256	248	5.83	43
0.13	0.47	5065	148	2.92	44
0.51	0.94	4687	546	11.65	45

AVERAGE ERROR = 0.94 PERCENT
STANDARD DEVIATION = 0.35

TABLE 3

CALCULATION OF THE AVERAGE POINT COUNTING ERROR
SILICATE MINERALOGY

CALC. MAX. VARIANCES (BAYLY)	CALC. PCT. ERROR-MAIN MINERAL	TOTAL POINTS SAMPLE	POINTS MAIN MINERAL	PERCENT MAIN MINERAL	PR. NO.
5.95	4.31	536	283	52.80	1
3.50	3.17	958	385	40.19	2
1.00	1.79	942	77	8.17	3
2.94	2.73	1318	576	43.70	4
3.64	3.38	765	246	32.16	5
2.96	3.08	759	179	23.58	6
4.32	3.79	585	175	29.91	7
5.16	3.86	654	381	58.26	8
4.11	3.11	891	610	68.46	9
4.60	3.83	643	244	37.95	10
4.64	3.75	705	320	45.39	11
1.08	1.85	995	93	9.35	12
3.24	3.06	985	357	36.24	13
2.90	2.96	929	265	28.53	14
4.69	3.72	723	362	50.07	15
3.15	3.16	787	211	26.81	16
2.95	2.86	1138	419	36.82	17
3.46	2.78	1219	756	62.02	18
5.68	4.21	564	285	50.53	19
0.50	1.27	988	41	4.15	20
2.10	2.52	1043	218	20.90	21
3.02	2.75	1318	605	45.90	22
0.96	1.67	1365	145	10.62	23
1.64	2.07	1667	387	23.22	24
1.19	1.85	1363	184	13.50	25
1.41	2.08	1081	146	13.51	26
2.65	2.65	1325	484	36.53	27
2.75	2.79	1127	366	32.48	28
2.33	2.48	1428	462	32.35	29
2.61	2.51	1540	643	41.75	30
2.32	2.48	1419	454	31.99	31
1.90	2.34	1216	258	21.22	32
2.84	2.48	1618	849	52.47	33
2.03	2.31	1516	427	28.17	34
2.00	2.12	2037	721	35.40	35
2.37	2.56	1286	386	30.02	36
2.52	2.75	1005	256	25.47	37
2.47	2.57	1351	452	33.46	38
2.87	2.84	1120	386	34.46	39
3.12	2.65	1411	785	55.63	40
3.12	2.91	1147	471	41.06	41
4.25	3.67	681	243	35.68	42
2.00	2.52	881	148	16.80	43
1.92	2.30	1381	332	24.04	44
2.62	2.82	955	244	25.55	45

AVERAGE ERROR = 2.78 PERCENT
STANDARD DEVIATION = 0.68

two samples indicating a confidence level of 95.45%.

Comparison of the calculated errors (Avery method) with the graphical values as given by Barringer (1953) in Figure 2 indicate very close agreement. Calculated errors and maximum variances are shown in Table 2 for the sulphide-opaque point counting.

Silicate counting resulted in a calculated average error of 2.78% (2 standard deviations) using Avery's equation. The calculated maximum variance was found to be 6.0 by the Bayly method. The calculated silicate errors and maximum variances for individual samples are shown in Table 3.

Sulphur Determinations

Sulphur determinations were made on each sample fraction using the Leco Automatic Sulphur Titrator. For various ranges of sulphur concentrations, standard solutions containing different amounts of KI (potassium iodide) are required. Weighted standards of sulphur in a quartz filler were made up to test each KI solution used and correction curves prepared. Each sulphur determination was corrected using the appropriate correction curve (Figure 3). Titration solutions used were 4.4 and 17.7 grams KI per 1000 ml for sulphur ranges of 0 to 10% and <10% respectively.

FIGURE 2

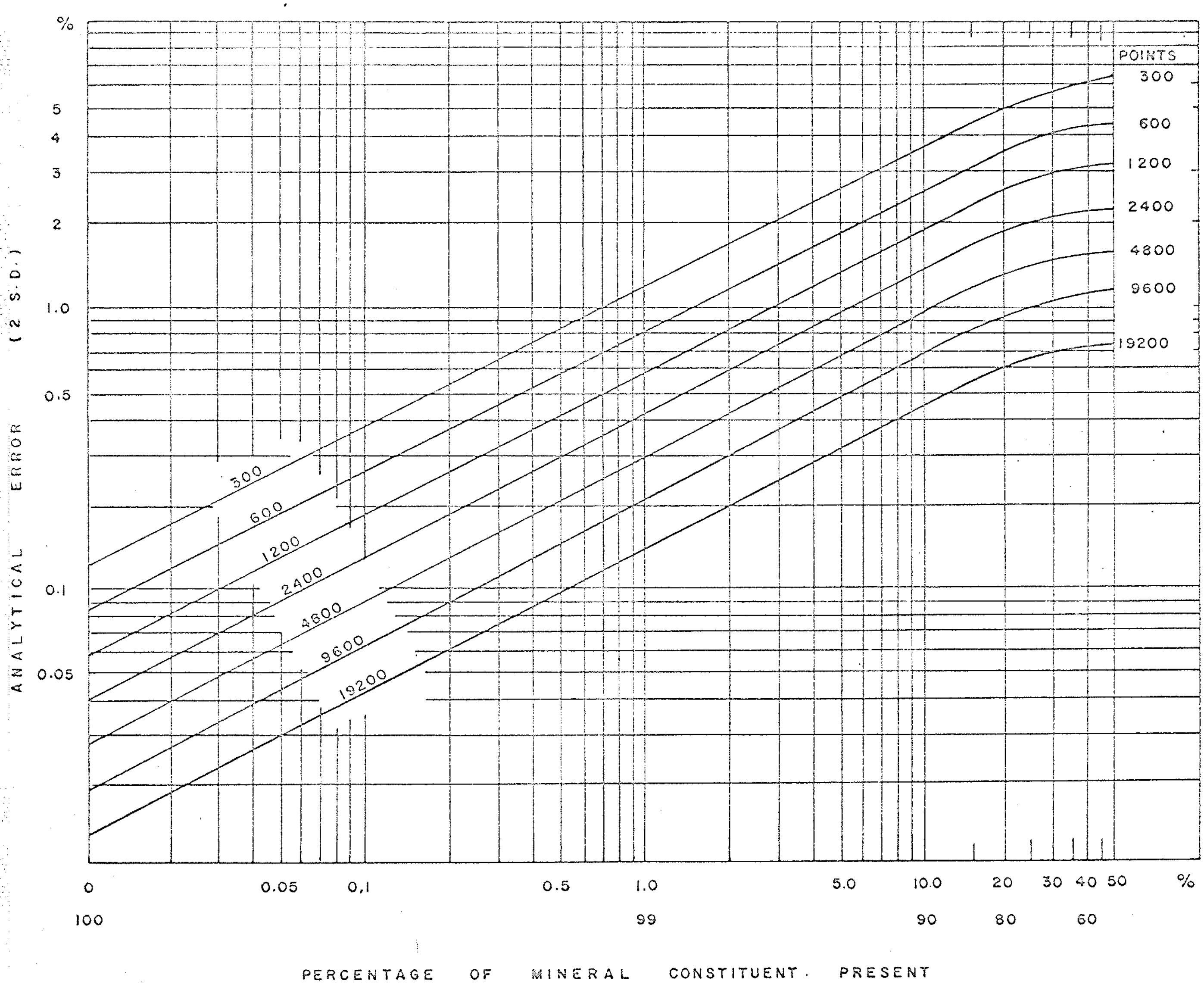


CHART RELATING ANALYTICAL ERROR TO THE NUMBER OF POINTS COUNTED. (AFTER A. R. BARRINGER, TRANSACTIONS, INSTITUTE OF MINING AND METALLURGY, V-63, 1953)

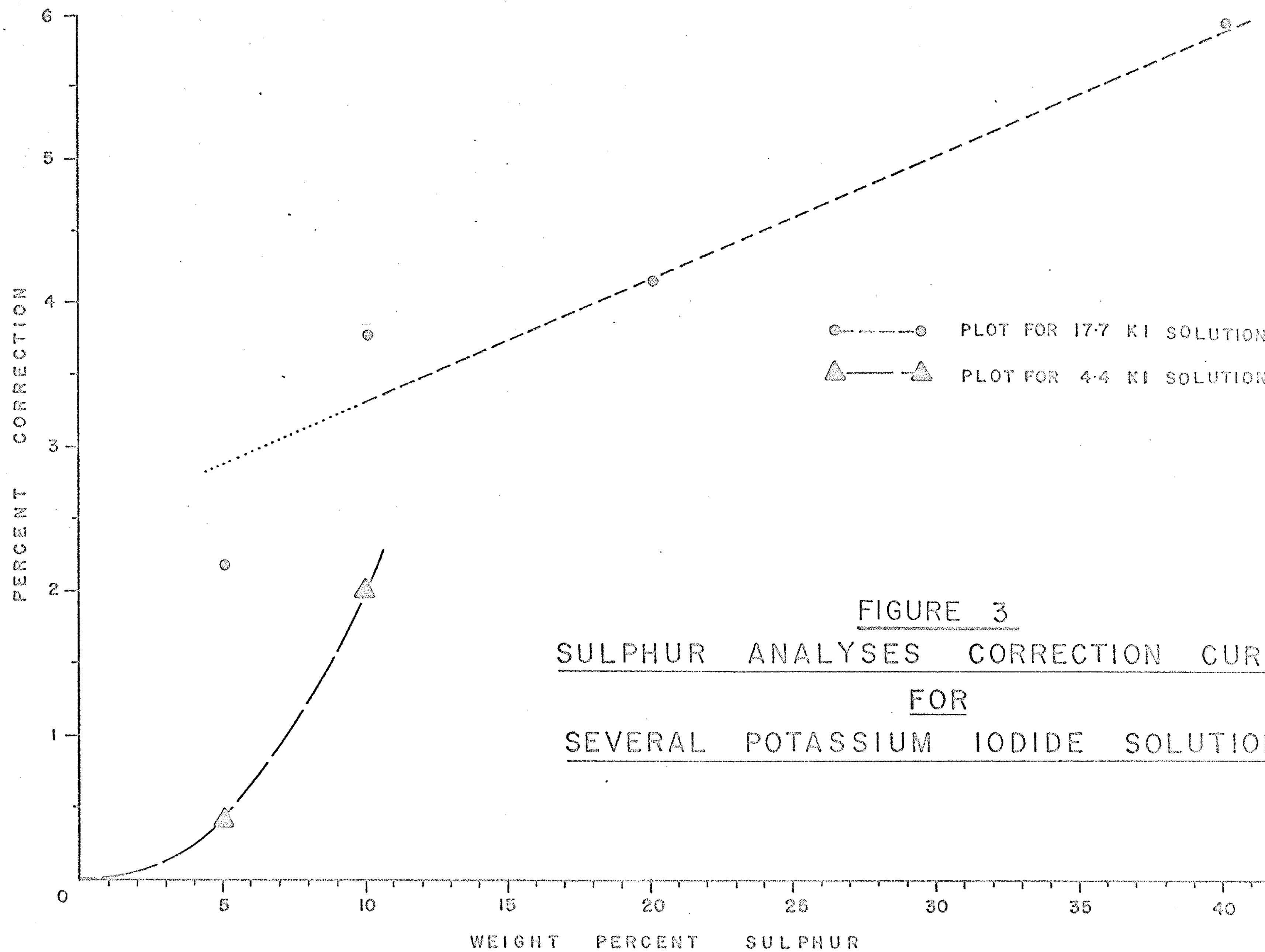


FIGURE 3

SULPHUR ANALYSES CORRECTION CURVES

FOR

SEVERAL POTASSIUM IODIDE SOLUTIONS

CHAPTER III

QUANTITATIVE DETERMINATION OF PYRITE, MAGNETITE, AND PYRRHOTITE USING AN X-RAY DIFFRACTOMETER

General Statement

The problem of obtaining the quantities of pyrite, magnetite, and pyrrhotite in the fine fraction was overcome by utilization of an x-ray diffractometer using the method developed by C. C. Bristol (1965). This method is based on the principle that the amount of mineral or substance present varies with the intensities of x-ray diffraction reflections for any crystalline substance. In practice, the method is based on the linear relationship between the ratios of the intensities of specific reference reflections for each of the selected minerals to that of an internal standard and the selected mineral. In this study, sodium chloride (NaCl) was chosen as the internal standard.

Statistical Treatment of the Diffractometer Data

Dr. C. C. Bristol (1965) has indicated that the relation between the percent mineral in a sample and the intensity ratio ($I_{mineral}/I_{internal\ standard}$) could be represented by a straight line. Calibration graphs of the relation between the intensity ratio (X) and mineral percent (Y) were estimated using regression analysis. Both X and Y in this study are subject to error and strictly speaking, the simple regression is not valid. However, in view of the non-uniformity and magnetude of the error in intensity as compared to the small and constant error in mineral percent, the simple regression was used and it is safe to assume that it will yield a reasonable estimate of the relation.

The diffractometer data was regressed using a Single and Multiple Regression Analysis computer program (No. 6.0.148) from the library of the Computer Department at The University of Manitoba. The program was supplied and its use discussed by Dr. J. E. Klovan of the Computer Department. The general method used to estimate the regression curve of Y on X was the method of least squares. The program calculated estimates of the following statistical parameters;

i) Regression coefficient (slope of the line).

ii) Y intercept.

iii) Multiple correlation coefficient (fraction of Y variance accounted for by the regression).

iv) Standard error of the Y data (positive square root of the variance of the Y data).

v) Standard error of the estimate (positive square root of the variance of Y left unexplained by the regression of Y on X).

vi) Significance of regression [F] (F test of the variance accounted for by the regression. Applicable only in cases of multiple regression analysis in this program).

Procedures Followed in this Study

The following reflections were chosen for this study; NaCl (200), pyrite (200), magnetite (311), and pyrrhotite ($10\bar{1}2$)(Figure 4).

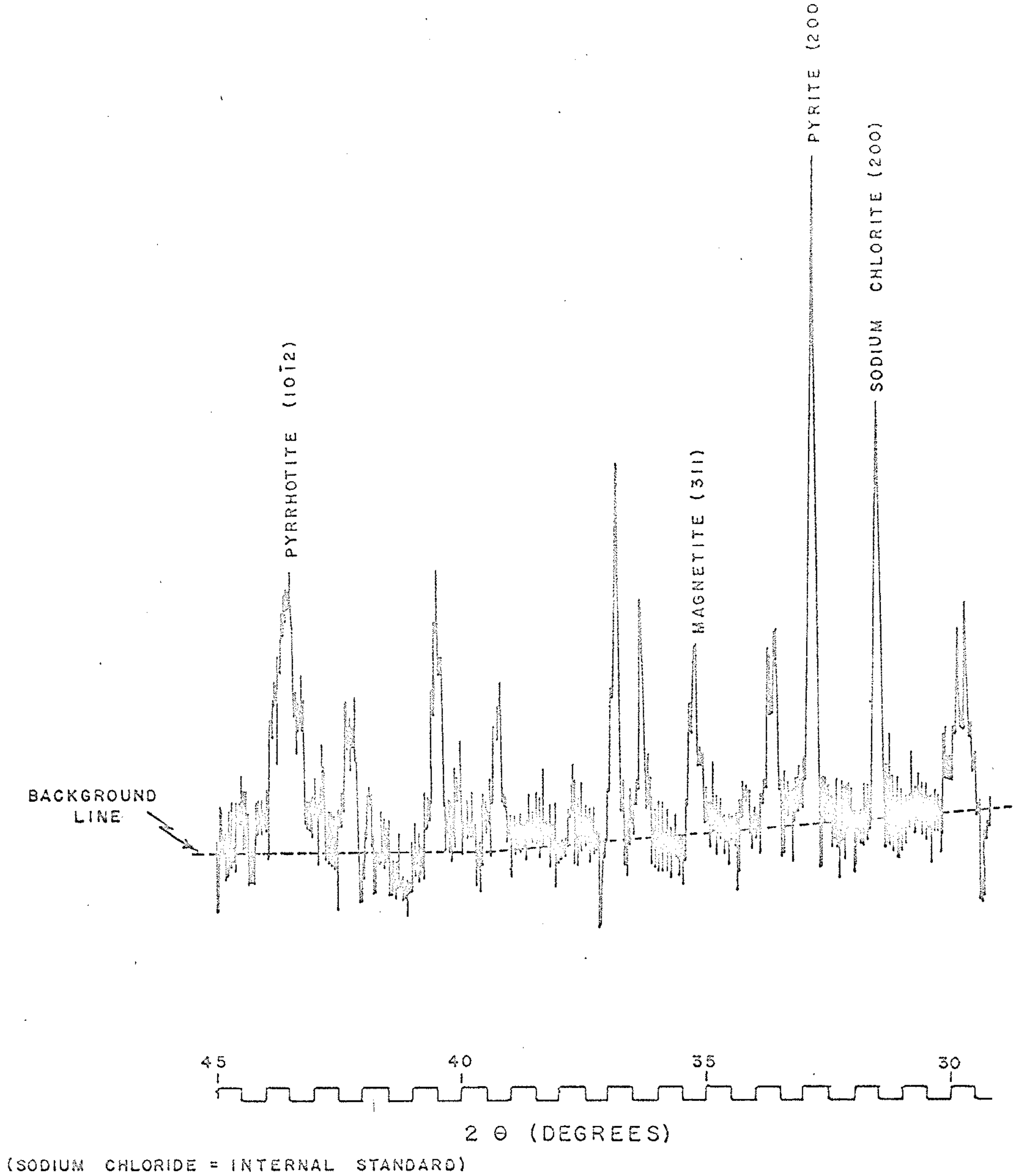


FIGURE 4

REPRODUCTION OF AN X-RAY DIFFRACTOGRAM ILLUSTRATING THE REFLECTIONS UTILIZED IN THIS STUDY.

Calibration was done by using a number of production standards containing weighed amounts of the three minerals under study, the internal standard, and a quartz filler. All constituents were ground to -400 mesh using the Willer Bleuler grinder. Two gram standard samples were made up containing selected weight percent ranges of the three opaque minerals, 5% NaCl, and the quartz filler and were stored in stoppered glass vials. Each sample was mixed using a steel ball in the vial for ten minutes prior to diffraction. Three mounts of each standard were diffracted over a 2 θ range of 30° to 45° undergoing a three-fold or more oscillation pattern so that each sample had at least nine diffractograms for analyses. The intensity ratios ($I_{mineral}$ / $I_{internal\ standard}$) were calculated for the three opaque minerals and the results processed by regression analysis on an IBM 360 computer. Pertinent statistical results for the production standards are shown in Tables 1, 3, and 5, Appendix 7. The data processed is shown in Tables 2, 4, and 6, Appendix 7, and plots of the regression lines are shown in Figures 1, 2, and 3, Appendix 7.

The -400 mesh property sample fractions were prepared for diffracting by making up two gram samples containing 5% NaCl, and mixing in a glass vial with a steel ball for at least 10 to 15 minute periods. Three mounts for each property were diffracted and oscillated over a 2 θ range of 30° to 45° three times to give nine diffractograms. Following calculation and averaging of the intensity ratios for pyrite, magnetite, and pyrrhotite of each sample, the amounts of these minerals present were calculated using the best fit linear equation as determined by the three regression analyses.

A Norelco x-ray generator and a Phillips diffractometer mounted with a copper target x-ray tube operating at 50 kV/20 mA and a nickel filter were used. The goniometer scan speed was set at 1° of 2 θ per minute. The proportional counter was operated at 1.8 kV. General recorder scale factor settings (except the 2 second delay setting) varied with each sample and the pulse height analyzer was set at a threshold value of 7.0 and no window was used. In this study, the background of the diffractograms possessed a break in slope so that the best fit background line was essentially two lines with different slopes (Figure 4). Pulse heights were scaled off these background lines.

Results

Examination of the regression analyses results for the production standards indicated good correlation coefficients. Calculated mineral percentages in the -400 fractions showed reasonable agreement with the counted counterparts. However, the Y intercept values (mineral percent) appeared too high and samples which had nil or small amounts of these three minerals in the counted fractions had significant amounts (by diffraction) in the fines.

A second calibration was made using counted samples as standards. Counted standards should yield more representative and accurate quantitative results than the weighed and mixed standards due to the following;

i) the mineral percent is based on what is in the sample, not on what is thought to be in the sample.

ii) grain size is no longer a factor.

iii) the problem of purity of the standard sulphide minerals has been removed.

iv) diffraction has been carried out on actual mixtures of sulphide and silicate minerals of varied origins, not on artificial standards.

A number of counted samples (-65+400) were chosen to cover the desired ranges of mineral concentration. These samples or representative amounts were ground to -400 mesh and made up into two gram samples containing 5% NaCl (sodium chloride). The samples were well mixed using a spatula and a steel ball for periods of about 20 minutes. The counted standards were diffracted producing nine diffractograms for each standard. The intensity ratios were calculated and the data processed for the least squares best fit linear equation.

Reprocessing of the -400 mesh fraction intensity ratio data using the counted standards regression equations (Tables 7, 9, and 11, Appendix 7) gave results similar to those for the production standards and also overcame the aforementioned discrepancies regarding too high values. Further, comparison of the regression analyses results for the two types of calibration standards showed that the regression line constants and correlation coefficients were comparable or better for the counted standards.

Data used for the counted standards regression analyses are shown in Tables 8, 10, and 12, Appendix 7. Plots of the regression lines are shown in Figures 4, 5, and 6, Appendix 7.

Discussion of the Results and the Method

Reproducibility was only fair when dealing with large percentages of the minerals, especially pyrite. A large portion of the variation is due to the effect of copper radiation on iron minerals and the scattering produced. Utilization of an iron x-ray tube might have resulted in better reproducibility. The complex mineralogies of many of the samples has also produced some side effects. However, the regression analyses of the standards gave high correlation coefficients indicating a high degree of correlation of the data. Calibration or analytical errors as previously noted in Chapter II, are very good for magnetite and pyrrhotite but are generally larger for pyrite as compared with the point counting errors. The writer feels that the method has given reasonable results and that further work is warranted to improve the method as applied to sulphide-opaque minerals.

The linear regression computer program used in this study is listed in Table 2, Appendix 6.

CHAPTER IV

APPLICATION OF Q-MODE FACTOR ANALYSIS TO COMPOSITIONAL DATA OF SULPHIDE ORES

In a study of the sulphide-opaque mineralogy of ore deposits, each mineral may be assumed to be a portion of a continuous range of compositional variation. The amount of mineral present can be considered to be a unique attribute of the particular ore deposit sample. Following this line of reasoning, every sulphide ore deposit sample or ore deposit can be considered to consist of as many components as there are minerals present and therefore makes the use of factor analysis possible.

If for example, a sulphide ore sample is analyzed into ten mineral classes (variables), the sample can be defined in ten-dimensional space as a vector whose position is uniquely determined by the amounts of minerals in each of the ten mineral classes. Having determined the unique position of each sample vector, the angles between each vector and every other vector can be calculated. The cosine of these angles can then represent the degree of proportional similarity between the ore deposit samples. If two sample vectors are colinear, then the angle between them is zero and the cosine will be 1.0, indicating perfect similarity. If on the other hand, vectors are 90° apart, the cosine will be zero, indicating complete dissimilarity. Imbrie and Van Andel (1964) have defined this measure of similarity as cosine theta and also give a formula for its calculation. A table of similarity coefficients can be formed which will show the degree of similarity between all sample vectors. Such a table is called a Cos Θ matrix. The Cos Θ matrix contains all the information on the relationships between the sample vectors but does not show these relationships in an easily interpretable form.

For analyzing a table of coefficients of this kind, the most suitable procedure that has been developed is factor analysis. A detailed explanation of what factor analysis is and how it works is beyond the scope of this paper. For a more thorough treatment see Fruchter (1954), Imbrie and Van Andel (1964), Imbrie and Purdy (1962), Harbaugh and Demirmen (1964), and Klovan (1966).

The characteristic feature of factor analysis is the representation of a table of compositional data (N ore deposit samples, n mineral classes or variables) as a set of N algebraic vectors in n-dimensional space. A Cos Θ matrix of similarity coefficients is calculated from this (N by n) data array using the equation of Imbrie and Van Andel;

$$\text{Cos } \theta_{ip} = \frac{\sum_{j=1}^{n} (X_{ji})(X_{jp})}{\sqrt{\sum_{j=1}^{n} (X_{ji})^2 \sum_{j=1}^{n} (X_{jp})^2}}$$

where $X_{j,i}$ represents the value of the j^{th} variable in the i^{th} sample ($j = 1, 2, \ldots\ldots n$ and $i = 1, 2, \ldots. p, \ldots N$). Factor analysis attempts to determine the minimum number of independent dimensions (factors) needed to account for most of the information in the table of similarity coefficients (Cos Θ matrix). More specifically, factor analysis on a set of compositional data may be initiated with one or more of three objectives; 1) to simplify the information contained in a data table, 2) to classify the samples into natural groups, and 3) to resolve each sample into a small number of component factors, each component factor representing the contribution of a functional unit.

If a factor analysis were carried out on a table of chemical analyses of plagioclase crystals (where n = amounts of Ca, Na, Al, Si, and O), objective (1) would be achieved by noting that the number of dimensions needed to represent the information of the data table was only two. These dimensions would be identified as factors and be interpreted as two end-member samples with compositions $NaAlSi_3O_8$ and $CaAlSi_2O_8$. Thus, the number of variables could be reduced from five to two, a reflection of intrinsic functional relationship causing the five elements to act together as two functional units. Objective (2) is achieved by graphical methods and noting the distribution of observed points. Objective (3) would be achieved by noting for each given sample, the composition of that sample in terms of contributions from the two component factors (interpreted end-member minerals).

This is done in factor analysis by erecting mutually orthogonal axes in multi-dimensional space in such a way that the first axis accounts for most of the information in the Cos Θ matrix, the second axis accounts for most of the remaining information, and so on. Mathematically, the problem is one of calculating, in order, the positive eigenvalues (roots of a characteristic equation) of the Cos θ matrix. By noting how many axes are required to explain most of the information, the minimum number of dimensions in which to portray the sample vectors is determined. The mutually orthogonal axes are called factor axes.

As the factor axes located by this method are rarely in the most meaningful positions with respect to the locations of the sample vectors, they are usually rotated to positions which make the interpretation easier. This is most often done by means of a mathematical technique known as the varimax procedure (Kaiser, 1959).

The positions of the sample vectors in relation to the rotated factor axes are determined by projecting the sample vectors onto the axes. The projections are termed factor loadings and the sizes of the numbers indicate the extent to which the factor axes controls the position of each sample vector. The table (matrix) of factor loadings shows the relationships between the sample vectors in the way that is mathematically most concise. Another useful piece of information can be obtained from the factor loadings. The sum of the squared loadings for a specific sample vector is referred to as its communality and reflects the degree to which that sample vector is explained by the sets of factor axes. A communality of 1.0 indicates a perfect explanation.

Normalization of factor loadings is convenient when plotting of factors is to be carried out. Each factor loading is squared to give the factor component. Each squared element is divided by the corresponding communality of that row (that is, each sample). The conversion of factor loadings to factor components merely emphasizes the higher loadings which in effect, stretches out the corners of the plot.

In interpreting results, the first rotated factor is the most significant and should be the easiest to interpret. The statistical significance of the factors declines as successive factors are extracted and the last is the least significant. The contribution of each factor to the mean communality is a quantitative measure of the importance of that factor. It should be made clear that factors extracted from a correlation matrix, are, in themselves, only mathematical abstractions. There is no guarantee that mathematical factors correspond to actual factors that exist in nature. Mathematical factors may strongly reflect the influence of actual factors. Identification of factors is a matter of interpretation.

Conventional methods of inspection of the data can be employed to accomplish similar aims. However, when the data are large, the manipulations become involved and time consuming. The introduction of high speed computers has made factor analysis a valuable method for the analyzing of large volumes of information, in which the relationships between samples is not readily apparent. The analyses of compositional data by trial and error conventional inspection methods that may take several weeks to process can now be processed in minutes using electronic computers and factor analysis. In this study, forty-five samples of sulphide ore deposits containing twelve variables (amounts of sulphide-opaque minerals) was analyzed for "f" factor components (where f 1 to 10) in less than five minutes.

The Q-mode factor analysis computer program used in this study was prepared by J. E. Klovan of The University of Calgary (Department of Geology). A listing of the program is included in a thesis by J. Solohub (1967).

CHAPTER V

RESULTS OF THE STUDY

Basic Data Obtained

The basic data from this study is shown in tables as amounts (weight percent) of sulphide-opaque and silicate minerals for 1) -65+400 mesh fraction and 2) total sample (reconstituted) in Tables 1 and 9, Appendix 5, and Tables 4 and 20. The chemical analyses for these two groups are shown in Table 6, Appendix 5, and Table 22. All data and calculations have been numerically indexed with reference to the ore deposits listed on Figure 1 and in Table 1, Appendix 1. Symbol explanation is included with Tables 4, 20, 1 (Appendix 5), and 9 (Appendix 5). Table 23 indicates the assay equivalents for assay results given in verbal form.

Data Processing

Calculated results for mineralogical and chemical analyses for the -65+400 fraction and the total sample were put on punch cards for data processing using IBM 1620 and 360 computers. The main computer programs used are included in Appendix 6.

Sulphide-Opaque Mineralogy (total sample)

The basic sulphide-opaque data for the total sample was tabulated and processed to give a number of mineral ratios, normalized three mineral groups, and a table of normalized sulphide-opaque mineralogy

TABLE 4

SULPHIDE-OPAQUE MINERALOGY(WEIGHT PERCENT)
TOTAL SAMPLE

SL	GN	CP	PY	MG	PO	HM	PN	AS	TT	NO.
0.96	0.0	6.02	39.74	0.44	4.31	0.0	0.0	0.0	0.0	1
0.12	0.0	3.87	29.10	4.80	0.90	0.0	0.0	0.0	0.0	2
12.20	3.24	3.08	69.59	3.03	2.59	0.0	0.0	0.0	0.0	3
0.30	0.0	11.51	9.61	1.00	13.03	0.0	0.0	0.0	0.0	4
23.59	12.60	4.15	8.52	0.0	0.0	0.0	0.0	0.0	0.0	5
0.0	0.0	7.68	1.55	19.85	1.17	0.0	0.0	0.0	0.0	6
0.0	0.0	1.68	3.50	10.74	14.48	0.0	4.42	0.0	0.0	7
0.0	0.0	4.21	2.10	0.17	1.17	0.0	0.0	0.0	0.0	8
0.08	0.01	7.57	1.62	0.72	11.91	0.0	0.0	0.0	0.0	9
8.72	2.21	0.18	8.68	0.62	0.95	0.0	0.0	0.0	0.0	10
0.10	0.0	1.95	6.14	1.42	1.16	0.0	0.0	0.0	0.0	11
2.08	0.10	10.58	75.83	1.37	1.67	0.0	0.0	0.0	0.0	12
23.31	0.71	0.19	16.32	0.88	1.75	0.0	0.0	0.0	0.0	13
0.11	0.0	7.75	5.86	2.27	1.64	0.0	0.0	0.0	0.0	14
0.0	0.0	5.32	6.90	1.11	2.29	0.0	0.0	0.0	0.0	15
7.73	0.22	7.11	25.25	2.13	6.44	0.0	0.0	0.0	0.0	16
8.53	0.96	0.32	12.85	0.03	0.0	0.0	0.0	0.0	0.0	17
6.93	7.78	0.29	5.24	0.0	0.22	0.0	0.0	0.27	0.0	18
0.03	0.05	17.73	3.59	0.45	0.37	0.0	0.0	0.0	0.0	19
0.0	0.0	8.69	26.60	9.73	36.77	0.0	0.0	0.0	0.0	20
9.52	0.13	8.96	38.41	2.38	3.23	0.0	0.0	0.0	0.0	21
0.04	0.01	9.87	8.71	8.09	3.25	0.0	0.0	0.0	0.0	22
2.29	0.01	5.33	40.02	3.53	15.30	0.0	0.0	0.0	0.0	23
5.05	0.05	17.88	26.62	4.77	10.64	0.0	0.0	0.0	0.0	24
8.38	0.10	14.38	51.09	1.56	3.74	0.0	0.0	0.03	0.0	25
0.07	0.0	37.75	28.96	0.75	1.30	0.0	0.0	0.0	0.0	26
21.36	0.0	13.70	36.90	0.79	1.24	0.0	0.0	0.0	0.0	27
0.16	0.0	7.11	3.59	4.92	3.54	0.0	0.0	0.0	0.0	28
0.0	0.0	1.63	2.55	5.39	0.86	0.0	0.0	0.0	0.0	29
2.44	0.15	3.37	14.76	1.31	0.53	0.0	0.0	0.0	0.0	30
0.0	0.0	8.00	11.73	3.30	0.85	2.18	0.0	0.0	0.0	31
12.74	9.71	0.0	8.56	1.43	31.05	0.39	0.0	0.0	0.0	32
0.13	0.0	2.65	3.85	0.0	0.0	0.0	0.0	0.0	0.0	33
12.63	19.08	0.0	4.10	0.0	0.30	0.0	0.0	0.09	0.0	34
14.07	9.45	0.49	6.80	0.0	1.48	0.0	0.0	1.85	0.34	35
0.09	0.06	2.66	5.37	3.32	0.56	0.35	0.0	0.0	0.0	36
1.61	0.0	12.39	5.16	0.49	10.50	0.0	0.0	0.0	0.0	37
1.35	0.0	8.29	5.17	0.61	32.19	0.0	0.0	0.0	0.0	38
0.02	0.0	7.63	3.62	0.44	51.07	0.0	0.0	0.0	0.0	39
0.0	0.0	1.53	2.07	1.76	0.59	0.0	0.0	0.0	0.0	40
5.55	4.41	2.68	2.77	0.0	0.27	0.0	0.0	0.0	0.0	41
8.98	2.64	0.74	4.04	0.43	6.19	0.0	0.0	0.0	0.0	42
0.0	0.27	2.78	3.04	2.66	10.38	0.0	1.96	0.0	0.0	43
0.0	0.05	1.29	4.80	1.82	4.06	0.0	0.97	0.0	0.0	44
0.01	0.19	2.08	5.79	2.62	14.19	0.0	3.39	0.0	0.0	45
			54.12	11.09	16.25					46

TABLE 4 (CONTINUED)

SULPHIDE-OPAQUE MINERALOGY(WEIGHT PERCENT)
TOTAL SAMPLE

FR	SP	T-B	LM	CR	BO	CC	MC	UK	TN	NO.
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5
0.0	9.83	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6
0.0	0.0	0.0	0.0	2.61	0.0	0.0	0.0	0.0	0.0	7
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.32	0.0	8
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9
0.0	0.0	1.02	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17
1.13	0.0	0.0	1.69	0.0	0.0	0.0	0.0	0.0	0.0	18
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	19
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	21
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	22
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	23
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	24
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	25
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	26
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	27
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	28
0.0	0.0	0.0	0.0	0.0	0.83	0.0	0.0	0.0	0.0	29
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	30
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	31
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	32
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	33
1.58	0.0	0.0	0.30	0.0	0.0	0.0	0.0	0.0	0.0	34
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	35
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	36
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	37
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	38
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	39
0.0	0.0	0.0	0.0	0.0	0.79	0.18	0.0	0.0	0.0	40
0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.49	0.0	0.07	41
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	42
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.22	0.0	43
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	44
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	45

TABLE 4 (CONTINUED)

SULPHIDE-OPAQUE MINERALOGY(WEIGHT PERCENT)
TOTAL SAMPLE

GAN	SUL	OPA	NO.
48.53	51.03	51.47	1
61.21	33.99	38.79	2
6.27	90.70	93.73	3
64.55	34.45	35.45	4
51.14	48.86	48.86	5
59.92	10.40	40.08	6
62.57	24.08	37.43	7
92.03	7.80	7.97	8
78.09	21.19	21.91	9
77.62	21.76	22.38	10
89.23	9.35	10.77	11
8.37	90.26	91.63	12
56.84	42.28	43.16	13
82.37	15.36	17.63	14
84.38	14.51	15.62	15
51.12	46.75	48.88	16
77.31	22.66	22.69	17
76.45	21.86	23.55	18
77.78	21.77	22.22	19
18.21	72.06	81.79	20
37.37	60.25	62.63	21
70.03	21.88	29.97	22
33.52	62.95	66.48	23
34.99	60.24	65.01	24
20.73	77.72	79.27	25
31.17	68.08	68.83	26
26.01	73.20	73.99	27
80.68	14.40	19.32	28
88.74	5.87	11.26	29
77.43	21.25	22.57	30
73.94	20.58	26.06	31
36.12	62.06	63.88	32
93.37	6.63	6.63	33
61.92	37.78	38.08	34
65.52	34.48	34.48	35
87.59	8.74	12.41	36
69.85	29.66	30.15	37
52.39	47.00	47.61	38
37.22	62.34	62.78	39
93.08	5.16	6.92	40
81.76	18.24	18.24	41
76.98	22.59	23.02	42
78.69	18.65	21.31	43
87.01	11.17	12.99	44
71.73	25.65	28.27	45

TABLE 4 (CONTINUED)

SYMBOLS USED FOR SULPHIDE-OPAQUE MINERALS

SYMBOL	MINERAL
SL	SPHALERITE
GN	GALENA
CP	CHALCOPYRITE
PY	PYRITE
MG	MAGNETITE
PO	PYRRHOTITE
HM	HEMATITE
PN	PENTLANDITE
AS	ARSENOPYRITE
TT	TETRAHEDRITE
FR	FREIBERGITE
SP	SPECULARITE
T-B	TETRAHEDRITE-BOURNONITE
LM	LIMONITE
CR	CHROMITE
BO	BORNITE
CC	CHALCOCITE
MC	MARCASITE
UK	UNKNOWN
TN	TENNANTITE
GAN	GANGUE
SUL	SULPHIDES
OPA	OPAQUES

(Table 5). The -65+400 fraction data was similarily processed and the results tabulated in Appendix 5. Sulphide-opaque mineralogical symbols are included with Table 5.

In this study, only the total sample data was interpretted.

Basic Classification of the Ores

The ore deposits were classified according to the wall rocks in which they occur and according to ore type.

The wall rock classification was made from the literature (see Property Bibliography) and divided into six groups;

Basic Intrusions (and minor basic volcanic rocks)

Ultrabasic Intrusions

Acid Volcanic Rocks

Sedimentary Rocks

Acid Intrusions

Contact Metamorphic (skarn types)

The wall rocks of the various properties are listed in Table 1, Appendix 1.

The ore type classification was made on the bases of the triangular plot of normalized copper-lead-zinc contents (weight percent) of the various ores (Figure 16, Page 101). Normalized values are shown in Table 25. Six classifications were used;

TABLE 5

CALCULATED 100 WEIGHT PERCENT SULPHIDE-OPAQUE MINERALOGY
(NORMALIZED WEIGHT PERCENT MINERALOGY)

TOTAL SAMPLE

SL	GN	CP	PY	MG	PO	HM	PN	AS	TT	NO.
1.87	0.0	11.70	77.21	0.85	8.37	0.0	0.0	0.0	0.0	1
0.31	0.0	9.98	75.02	12.37	2.32	0.0	0.0	0.0	0.0	2
13.02	3.46	3.29	74.25	3.23	2.76	0.0	0.0	0.0	0.0	3
0.85	0.0	32.47	27.11	2.82	36.76	0.0	0.0	0.0	0.0	4
48.28	25.79	8.49	17.44	0.0	0.0	0.0	0.0	0.0	0.0	5
0.0	0.0	19.16	3.87	49.53	2.92	0.0	0.0	0.0	0.0	6
0.0	0.0	4.49	9.35	28.69	38.69	0.0	11.81	0.0	0.0	7
0.0	0.0	52.82	26.35	2.13	14.68	0.0	0.0	0.0	0.0	8
0.37	0.05	34.55	7.39	3.29	54.36	0.0	0.0	0.0	0.0	9
38.96	9.87	0.80	38.78	2.77	4.24	0.0	0.0	0.0	0.0	10
0.93	0.0	18.11	57.01	13.18	10.77	0.0	0.0	0.0	0.0	11
2.27	0.11	11.55	82.76	1.50	1.82	0.0	0.0	0.0	0.0	12
54.01	1.65	0.44	37.81	2.04	4.05	0.0	0.0	0.0	0.0	13
0.62	0.0	43.96	33.24	12.88	9.30	0.0	0.0	0.0	0.0	14
0.0	0.0	34.06	44.17	7.11	14.66	0.0	0.0	0.0	0.0	15
15.81	0.45	14.55	51.66	4.36	13.18	0.0	0.0	0.0	0.0	16
37.59	4.23	1.41	56.63	0.13	0.0	0.0	0.0	0.0	0.0	17
29.43	33.04	1.23	22.25	0.0	0.93	0.0	0.0	1.15	0.0	18
0.14	0.23	79.79	16.16	2.03	1.67	0.0	0.0	0.0	0.0	19
0.0	0.0	10.62	32.52	11.90	44.96	0.0	0.0	0.0	0.0	20
15.20	0.21	14.31	61.33	3.80	5.16	0.0	0.0	0.0	0.0	21
0.13	0.03	32.93	29.06	26.99	10.84	0.0	0.0	0.0	0.0	22
3.44	0.02	8.02	60.20	5.31	23.01	0.0	0.0	0.0	0.0	23
7.77	0.08	27.50	40.95	7.34	16.37	0.0	0.0	0.0	0.0	24
10.57	0.13	18.14	64.45	1.97	4.72	0.0	0.0	0.04	0.0	25
0.10	0.0	54.85	42.07	1.09	1.89	0.0	0.0	0.0	0.0	26
28.87	0.0	18.52	49.87	1.07	1.68	0.0	0.0	0.0	0.0	27
0.83	0.0	36.80	18.58	25.47	18.32	0.0	0.0	0.0	0.0	28
0.0	0.0	14.48	22.65	47.87	7.64	0.0	0.0	0.0	0.0	29
10.81	0.66	14.93	65.40	5.80	2.35	0.0	0.0	0.0	0.0	30
0.0	0.0	30.70	45.01	12.66	3.26	8.37	0.0	0.0	0.0	31
19.94	15.20	0.0	13.40	2.24	48.61	0.61	0.0	0.0	0.0	32
1.96	0.0	39.97	58.07	0.0	0.0	0.0	0.0	0.0	0.0	33
33.17	50.11	0.0	10.77	0.0	0.79	0.0	0.0	0.24	0.0	34
40.81	27.41	1.42	19.72	0.0	4.29	0.0	0.0	5.37	0.99	35
0.73	0.48	21.43	43.27	26.75	4.51	2.82	0.0	0.0	0.0	36
5.34	0.0	41.09	17.11	1.63	34.83	0.0	0.0	0.0	0.0	37
2.84	0.0	17.41	10.86	1.28	67.61	0.0	0.0	0.0	0.0	38
0.03	0.0	12.15	5.77	0.70	81.35	0.0	0.0	0.0	0.0	39
0.0	0.0	22.11	29.91	25.43	8.53	0.0	0.0	0.0	0.0	40
30.43	24.18	14.69	15.19	0.0	1.48	0.0	0.0	0.0	0.0	41
39.01	11.47	3.21	17.55	1.87	26.89	0.0	0.0	0.0	0.0	42
0.0	1.27	13.05	14.27	12.48	48.71	0.0	9.20	0.0	0.0	43
0.0	0.38	9.93	36.95	14.01	31.25	0.0	7.47	0.0	0.0	44
0.04	0.67	7.36	20.48	9.27	50.19	0.0	11.99	0.0	0.0	45

TABLE 5 (CONTINUED)

CALCULATED 100 WEIGHT PERCENT SULPHIDE-OPAQUE MINERALOGY
(NORMALIZED WEIGHT PERCENT MINERALOGY)

TOTAL SAMPLE

FR	SP	T-B	LM	CR	BO	CC	MC	UK	TN	NO.
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5
0.0	24.53	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6
0.0	0.0	0.0	0.0	6.97	0.0	0.0	0.0	0.0	0.0	7
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.02	0.0	8
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9
0.0	0.0	4.56	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17
4.80	0.0	0.0	7.18	0.0	0.0	0.0	0.0	0.0	0.0	18
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	19
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	21
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	22
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	23
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	24
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	25
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	26
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	27
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	28
0.0	0.0	0.0	0.0	0.0	7.37	0.0	0.0	0.0	0.0	29
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	30
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	31
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	32
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	33
4.15	0.0	0.0	0.79	0.0	0.0	0.0	0.0	0.0	0.0	34
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	35
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	36
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	37
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	38
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	39
0.0	0.0	0.0	0.0	0.0	11.42	2.60	0.0	0.0	0.0	40
0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.65	0.0	0.38	41
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	42
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.03	0.0	43
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	44
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	45

TABLE 5 (CONTINUED)

SYMBOLS USED FOR SULPHIDE-OPAQUE MINERALS

SYMBOL	MINERAL
SL	SPHALERITE
GN	GALENA
CP	CHALCOPYRITE
PY	PYRITE
MG	MAGNETITE
PO	PYRRHOTITE
HM	HEMATITE
PN	PENTLANDITE
AS	ARSENOPYRITE
TT	TETRAHEDRITE
FR	FREIBERGITE
SP	SPECULARITE
T-B	TETRAHEDRITE-BOURNONITE
LM	LIMONITE
CR	CHROMITE
BO	BORNITE
CC	CHALCOCITE
MC	MARCASITE
UK	UNKNOWN
TN	TENNANTITE
GAN	GANGUE
SUL	SULPHIDES
OPA	OPAQUES

Cu-Ni	Copper-Nickel producers
Cu	90% copper
Cu-Zn	50-90% copper
Zn-Cu	20-50% copper
Zn-Pb-Cu	5-20% copper
Zn-Pb	0- 5% copper, 0- 50% lead
Pb-Zn	0- 5% copper, 50-100% lead

Table 6 shows a listing of the properties with their ore types and geographic location.

Mineral Ratios

The following mineral ratios were calculated and the results shown in Table 3, Appendix 8; Pyrrhotite/Pyrrhotite+Pyrite, Pyrrhotite/Pyrrhotite+Pyrite+Magnetite, Pyrite/Pyrrhotite+Pyrite+Magnetite, Magnetite/Pyrrhotite+Pyrite+Magnetite, Pentlandite/Pentlandite+Pyrrhotite, Magnetite/Magnetite+Pyrite, Chalcopyrite/Chalcopyrite+Sphalerite+Galena, Sphalerite/Chalcopyrite+Sphalerite+Galena, Galena/Chalcopyrite+Sphalerite +Galena, iron sulphide/iron sulphide+iron oxide, Chalcopyrite/Chalcopyrite +Sphalerite, Sphalerite/Sphalerite+Magnetite, Pyrite/Pyrite+Sphalerite+ Galena, and copper minerals/copper minerals + Pyrite.

The calculated ratios were analyzed relative to ore typs and wall rock distribution.

TABLE 6

PROPERTY NO., LOCATION, AND ORE TYPE.

NO.	LOCATION	ORE TYPE
1	TIMMINS. ONT.	CU-ZN
2	TILT COVE, NFLD.	CU(AU)
3	NEWCASTLE, N.B.	PB-ZN-CU
4	CHIBOUGAMAU, QUE.	CU(AU)
5	BUCHANS, NFLD.	ZN-PB-CU
6	MERRITT, B.C.	CU
7	GORDON LAKE, ONT.	CU-NI
8	GASPE, QUE.	CU
9	SPRAGGE, ONT.	CU
10	TOBY CREEK, B.C.	ZN-PB
11	VAL DOR, QUE.	CU(AU)
12	NEWCASTLE, N.B.	CU-ZN
13	BACHELOR LAKE, QUE.	ZN-PB
14	CHIBOUGAMAU, QUE.	CU(AU)
15	JORDAN RIVER, B.C.	CU
16	MANITOUWADGE, ONT.	ZN-CU(PB)
18	KENO HILL, YUKON TERR.	PB-ZN(AG)
19	TEMAGAMI, ONT.	CU(AU)
20	NORANDA, QUE.	CU(AU)
17	VAL DOR, QUE.	ZN-PB
21	NORMETAL, QUE.	ZN-CU(AU)
22	CHAPAIS, QUE.	CU(AU)
23	NORANDA, QUE.	ZN-CU
24	NORANDA, QUE.	CU-ZN
25	FLIN FLON, MAN.	CU-ZN
26	FLIN FLON, MAN.	CU(ZN)
27	FLIN FLON, MAN.	ZN-CU
28	GRANDUC, B.C.	CU
29	PRINCETON, B.C.	CU
30	BRITTANNIA BEACH, B.C.	ZN-CU
31	KASHABOWIE, ONT.	CU(AU)
32	KIMBERLEY, B.C.	PB-ZN
33	VAL DOR, QUE.	CU
34	KENO HILL, YUKON TERR.	PB-ZN(AG)
35	HAZELTON, B.C.	ZN-PB
36	GREENWOOD, B.C.	CU
37	CHIBOUGAMAU, QUE.	CU-ZN(AU)
38	CHIBOUGAMAU, QUE.	CU-ZN(AU)
39	CHIBOUGAMAU, QUE.	CU(AU)
40	HIGHLAND VALLEY, B.C.	CU
41	WALTON, N.S.	ZN-PB-CU(AG)
42	GRAND CALUMET ISLAND, QUE.	ZN-PB
43	SUDBURY, ONT.	CU-NI
44	SUDBURY, ONT.	CU-NI
45	SUDBURY, ONT.	CU-NI
46	NORANDA, QUE.	ZN-CU

Pyrrhotite/Pyrrhotite Pyrite+Ratio (Po/Po+Py)

The distribution of this ratio relative to ore type and wall rock shows several interesting trends. Ores of a specific type associated with a specific wall rock have, in general, a characteristic ratio value. High values occur with copper-nickel and copper ores associated with ultrabasic and basic intrusions and copper ores associated with acid intrusions and contact metamorphic types. Erratic values occur but the above generalization holds. Ratios for ores in acid volcanic rocks and sedimentary rocks are characteristically low. Several erratic ratios (ie. 20-Horne Mine, Noranda; 23-Quemont; 24-Waite Amulet Mine; and 46-Lake Dufault Mine.) of the Noranda area and 16-(Geco Mine) of the Manitouwadge area have high values for their respective groups which may be due to metamorphic effects, intermediate intrusion associations, or some other undefined replacement type of alteration. The deposits that have definite igneous affiliations have high ratio values and thus, deposits 16, 20, 23, 24, and 46 may have closer igneous affiliations than is currently apparent. Deposit 36 (Granby Consolidated, Phoenix Copper Division) which is a skarn type, has a low ratio value which may be due to the distance of the deposit from any intrusion. Deposit 32 (Cominco, Sullivan Mine) and 42 (New Calumet Mines), classed as contact metamorphic for want of a better term, have unusually high values for deposits of the lead-zinc type which may be due to the high grades of metamorphism of the deposits. Table 7 shows the relation of this ratio relative to ore type and wall rock. Table 8 shows the deposits indexed by mine name according to the grouping of Table 7. It is important to

TABLE 7

RELATION BETWEEN PO/PO + PY RATIOS, ORE TYPE, AND WALL ROCK ASSOCIATIONS.

W A L L R O C K

ORE TYPE	ULTRA-BASIC	BASIC INTRUS.	ACID VOLC.	SEDS.	ACID INTRUS.	CONT. METAM.
	7 .71	44 .77				
CU-NI		43 .81				
		45 .46				
		4 .58	2 .03		11 .16	6 .43
		9 .88	19 .09		28 .50	8 .36
CU		14 .22	20 .58		29 .25	36 .09
		15 .25	26 .04		40 .21	
		22 .27	31 .07			
		39 .94	33 0.0			
		37 .67	1 .10			
CU-ZN		38 .86	12 .02			
			24 .29			
			25 .07			
			21 .08	16 .20		
ZN-CU			23 .28			
			27 .03			
			30 .04			
ZN-PB-CU			3 .04	41 .05		
			5 0.0			
ZN-PB			13 .10	10 .10		32 .78
			17 0.0	35 .18		42 .61
PB-ZN			18 .04			
			34 .07			

VALUES SHOWN AS PROP. NO. RATIO VALUE

21 .08

TABLE 8

DISTRIBUTION OF MINING PROPERTIES BASED ON ORE TYPE AND WALL ROCK ASSOCIATION.

ORE TYPE	WALL ROCK: ULTRABASIC INTRUSION	BASIC INTRUSION AND VOLCANIC ROCK	ACID VOLCANIC ROCK	SEDIMENTARY ROCK	ACID INTRUSION	CONTACT METAMORPHIC
CU--NI	GORDON LAKE	CREIGHTON MINE NI OFFSET LTD MCKIM MINE				
CU		CAMPBELL CHIB.(H) RIO ALGOM-PRONTO MERRILL ISLAND OPEMISKA COPPER PATINO - CU RAND COWICHAN COPPER	HORNE MINE (NOR) TEMAGAMI MINE N. COLDSTREAM NORTH STAR MINE FIRST MARITIME MANITOU BARVUE--CU		BETHLEHEM COPPER COPPER MTN MINE GRANDUC MINE E. SULLIVAN MINE	CRAIGMONT MINE GASPE COPPER PHOENIX COPPER
CU--ZN		CAMPBELL CHIB.(B) CAMPBELL CHIB.(W)	WAITE AMULET KAM KOTIA PORC. FLIN FLON MINE COMINCO--WEDGE			
ZN--CU			QUEMONT MINE NORMETAL MINE BRITTANNIA MINE SCHIST LK. MINE	GECO MINE		
ZN--PB --CU			HEATH STEELE ASARCO - BUCHANS	MAGNET COVE BAR.		
ZN--PB			CONIAGUS MINE MANITOU BARVUE (PB--ZN)	SILVER STANDARD MINERAL KING MINE		COMINCO--SULLIVAN NEW CALUMET MINE
PB--ZN			UNITED KENO HILL MACKENO MINE			

note the abundance of deposits occurring in acid volcanic rocks. Figure 5 illustrates the distribution of the Po/Po+Py ratio geographically. No significant trend was noted here.

Pyrrhotite/Pyrrhotite+Pyrite+Magnetite Ratio (Po/Po+Py+Mg)

The relation between this ratio, ore type, and wall rock (Table 9) is not as prominent as for Pyrrhotite/Pyrrhotite+Pyrite. A similar variation and trend however can be noted.

Pyrite/Pyrrhotite+Pyrite+Magnetite Ratio (Py/Po+Py+Mg)

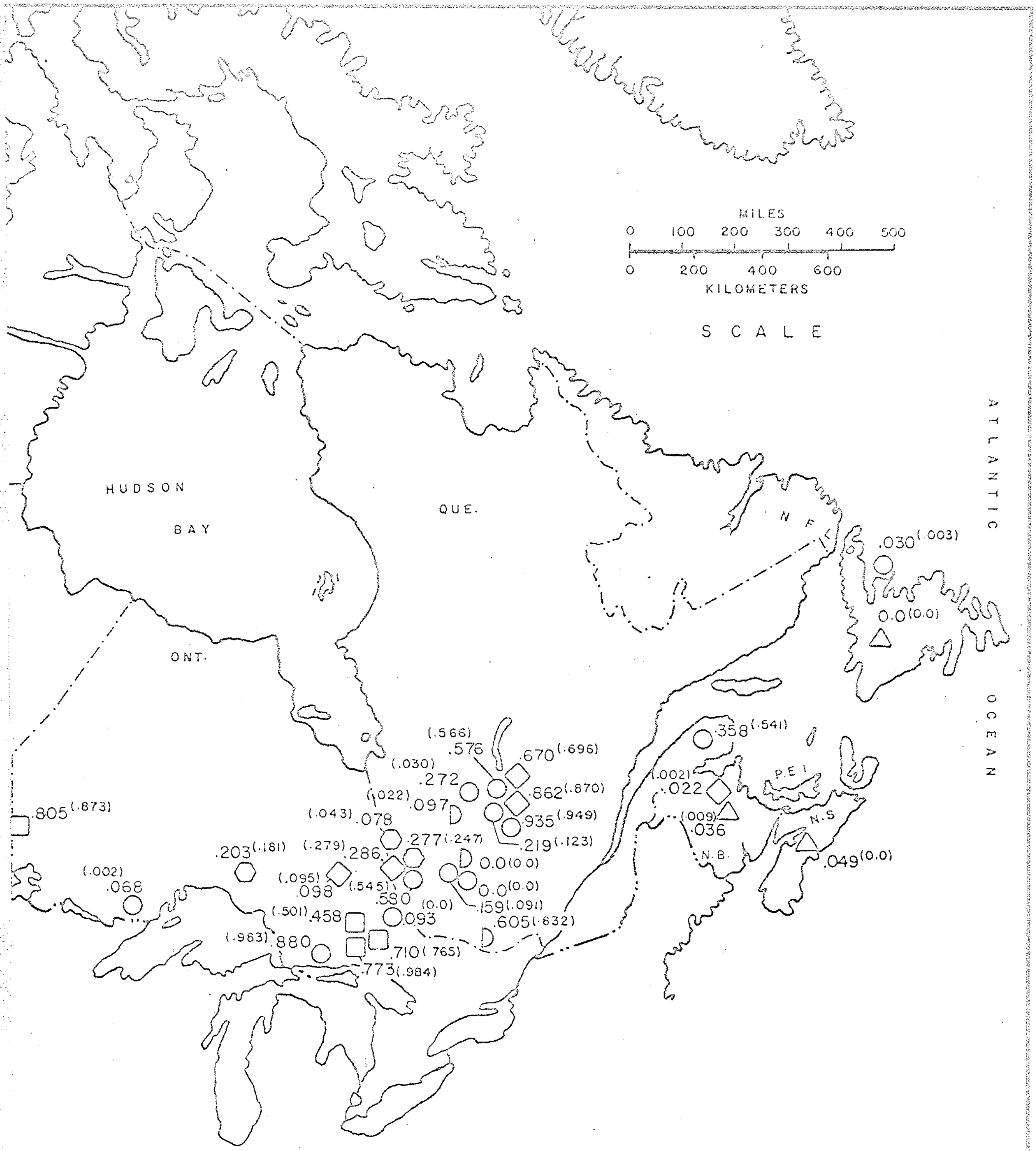
The important feature noted with the distribution of these ratios (Table 10) was the variation of the ratios with changes in ore type. There is a tendancy to higher values with lead-zinc deposits than with copper-nickel deposits although this trend is rather weak.

Magnetite/Pyrrhotite+Pyrite+Magnetite (Mg/Po+Py+Mg)

The distribution of these ratio values (Table 11) indicate a general variation with respect to ore type only, decreasing from copper ores to zinc-lead ores.

Magnetite/Magnetite+Pyrite Ratio (Mg/Mg+Py)

Copper-nickel and copper deposits associated with igneous rocks have higher ratio values (Table 12) than lead-zinc deposits. The change appears to be proportional to increasing lead and zinc. It may be suggested that pyrite increases with increasing galena and sphalerite



PROPERTY LOCATION MAP

SHOWING THE DISTRIBUTION OF TOTAL SAMPLE PO / PO + PY RATIOS

(−400 FRACTION IN BRACKETS)

FIGURE 5

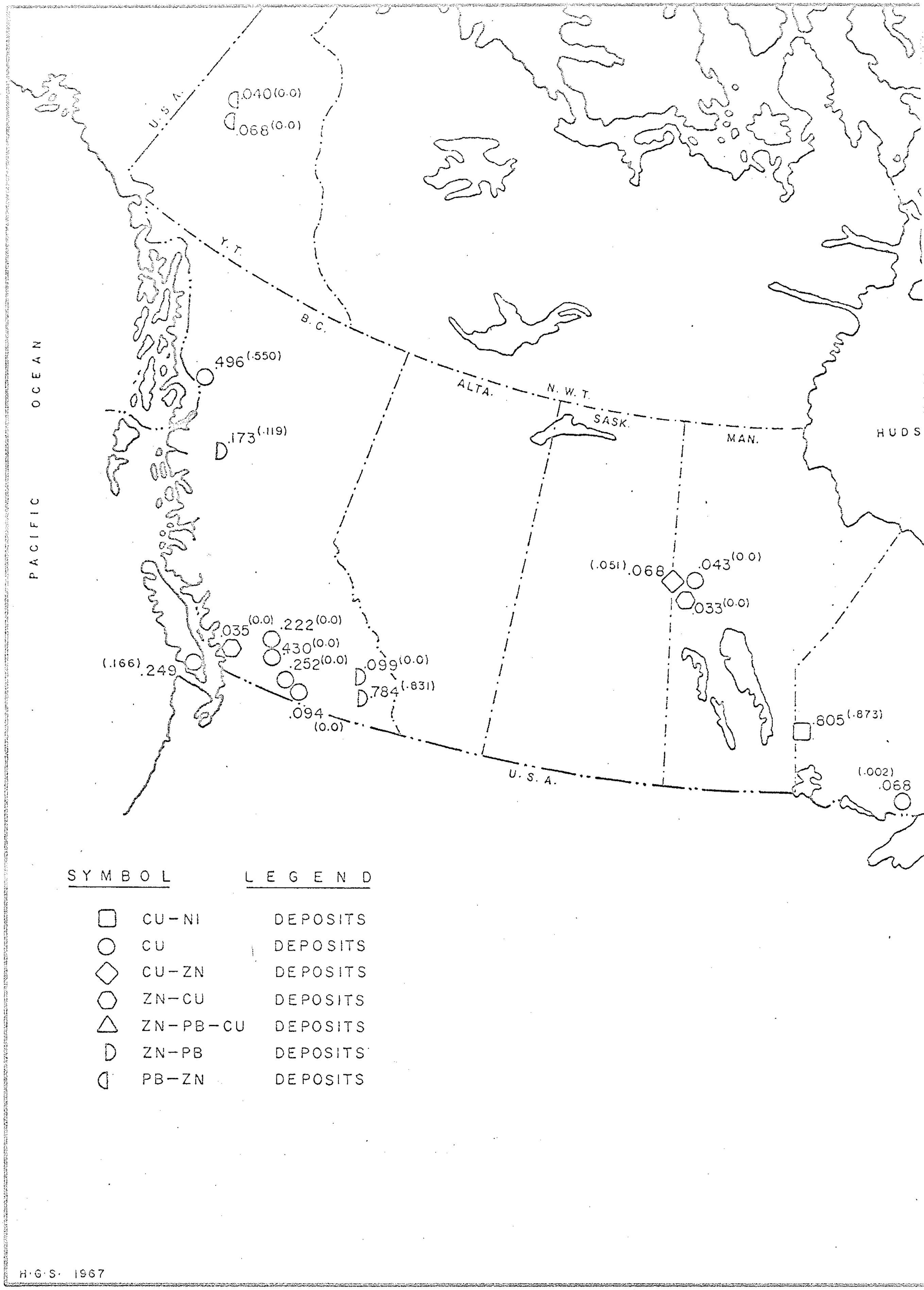

U.S.A.
Y.T.
B.C.
ALTA.
N.W.T.
SASK.
MAN.
HUDS
PACIFIC OCEAN
U.S.A.
.040 (0.0)
.068 (0.0)
.496 (.550)
.173 (.119)
(.051) .068
.043 (0.0)
.033 (0.0)
.035 (0.0)
.222 (0.0)
.430 (0.0)
.252 (0.0)
(.166) .249
.094 (0.0)
.099 (0.0)
.784 (.831)
.805 (.873)
(.002) .068
SYMBOL LEGEND
CU-NI DEPOSITS
CU DEPOSITS
CU-ZN DEPOSITS
ZN-CU DEPOSITS
ZN-PB-CU DEPOSITS
ZN-PB DEPOSITS
PB-ZN DEPOSITS
H.G.S. 1967

TABLE 9

RELATION BETWEEN PO/PO +PY + MG RATIOS, ORE TYPE, AND WALL ROCK ASSOCIATIONS.

ORE TYPE	WALL ROCK: ULTRA-BASIC	BASIC INTRUS.	ACID VOLC.	SEDS.	ACID INTRUS.	CONT. METAM.
CU-NI	7 .50	44 .65 43 .65 45 .50				
CU		4 .55 9 .84 14 .17 15 .22 22 .16 39 .93	2 .03 19 .08 20 .50 26 .04 31 .05 33 0.0		11 .13 28 .29 29 .10 40 .13	6 .05 8 .34 36 .06
CU-ZN		37 .65 38 .85	1 .10 12 .02 24 .25 25 .07			
ZN-CU			21 .07 23 .26 27 .03 30 .03	16 .19		
ZN-PB-CU			3 .03 5 0.0	41 .05		
ZN-PB			13 .09 17 0.0	10 .09 35 .18		32 .76 42 .58
PB-ZN			18 .04 34 .07			

VALUES SHOWN AS	PROP. NO.	RATIO VALUE
	21	.08

TABLE 10

RELATION BETWEEN PY/PY + PO + MG RATIOS, ORE TYPES, AND WALL ROCK ASSOCIATIONS.

ORE TYPE	WALL ROCK: ULTRA-BASIC	BASIC INTRUS.	ACID VOLC.	SEDS.	ACID INTRUS.	CONT. METAM.
CU-NI	7 .12	44 .45				
		43 .19				
		45 .26				
CU		4 .41	2 .84		11 .70	6 .07
		9 .11	19 .81		28 .30	8 .61
		14 .60	20 .36		29 .29	36 .58
		15 .67	26 .93		40 .47	
		22 .43	31 .74			
		39 .07	33 1.0			
CU-ZN		37 .32	1 .89			
		38 .14	12 .96			
			24 .63			
			25 .91			
ZN-CU			21 .87	16 .75		
			23 .63			
			27 .95			
			30 .89			
ZN-PB-CU			3 .41	41 .95		
			5 1.0			
ZN-PB			13 .86	10 .85		32 .21
			17 .99	35 .82		42 .38
PB-ZN			18 .96			
			34 .93			

VALUES SHOWN AS PROP. NO. RATIO VALUE

21 .08

TABLE 11

RELATION BETWEEN MG/MG + PO + PY RATIOS, ORE TYPE, AND WALL ROCK ASSOCIATIONS.

W A L L R O C K

ORE TYPE	ULTRA-BASIC	BASIC INTRUS.	ACID VOLC.	SEDS.	ACID INTRUS.	CONT. METAM.
	7 .37	44 .17				
CU-NI		43 .17				
		45 .12				
		4 .04	2 .14		11 .16	6 .88
		9 .05	19 .10		28 .41	8 .05
CU		14 .23	20 .13		29 .61	36 .36
		15 .11	26 .02		40 .40	
		22 .40	31 .21			
		39 .01	33 0.0			
		37 .03	1 .01			
CU-ZN		38 .02	12 .02			
			24 .11			
			25 .03			
			21 .05	16 .06		
ZN-CU			23 .06			
			27 .02			
			30 .08			
ZN-PB-CU			3 .04	41 0.0		
			5 0.0			
ZN-PB			13 .05	10 .06		32 .04
			17 .01	35 0.0		42 .04
PB-ZN			18 0.0			
			34 0.0			

VALUES SHOWN AS PROP. NO. RATIO VALUE

21 .08

FIGURE 6

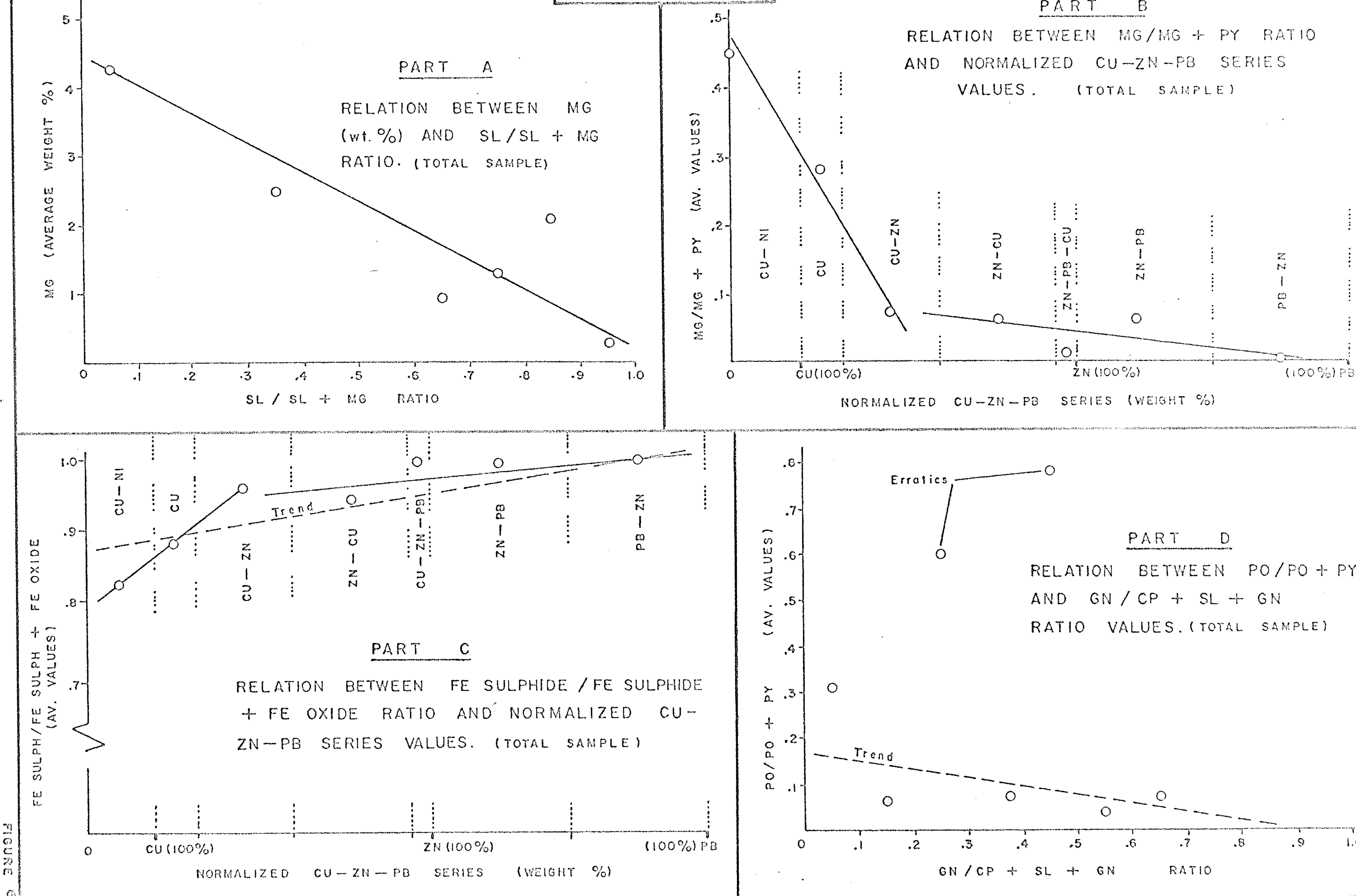


FIGURE 6

so that the decreases in ratio value may be due to decreasing magnetite. This relation is shown in Figure 6-B. However, the decrease is in two stages, falling off steeply for copper-nickel, copper, and copper-zinc deposits and more gently for zinc-copper to lead-zinc deposits.

<u>Chalcopyrite, Sphalerite, and Galena Ratios (Cp/Cp+Sl+Gn, Sl/Cp+Sl+Gn, and Gn/Cp+Sl+Gn)</u>

There appears to be little or no relation between these ratios and wall rock and ore type (Tables 4 (Appendix 1), 13, and 14). The plot of Pyrrhotite/Pyrrhotite+Pyrite (Po/Po+Py) versus Galena/Chalcopyrite +Sphalerite+Galena (Gn/Cp+Sl+Gn) (Figure 6-D) indicates that pyrrhotite decreases gradually with increasing galena content.

<u>Iron sulphide/Iron sulphide + Iron oxide (Fe sulphide/Fe sulphide + Fe oxide)</u>

In this case, the ratio values (Table 15) vary with ore type due to the changes in amount of the oxide minerals. No variation in a regular manner was noted with respect to wall rock. The plot of this ratio against normalized copper-zinc-lead series values (Figure 6-C) shows a two step increase from copper deposits through copper-zinc to lead-zinc deposits indicating a decrease in oxide content through the series from left to right. Figure 6-A clearly shows the decrease in magnetite content with increasing sphalerite and therefore increasing galena content.

TABLE 12

RELATION BETWEEN MG/MG + PY RATIOS, ORE TYPE, AND WALL ROCK ASSOCIATIONS.

ORE TYPE	WALL ROCK: ULTRA-BASIC	BASIC INTRUS.	ACID VOLC.	SEDS.	ACID INTRUS.	CONT. METAM.
CU-NI .45	7 .75	44 .23				
		43 .47				
		45 .31				
CU .28		4 .09	2 .14		11 .19	6 .93
		9 .31	19 .11		28 .58	36 .38
		14 .28	20 .27		29 .68	36 .38
		15 .14	26 .03		40 .46	
		22 .48	31 .22			
		39 .11	33 0.0			
CU-ZN .07		37 .09	1 .01			
		38 .11	12 .02			
			24 .15			
			25 .03			
ZN-CU .06			21 .06	16 .08		
			23 .08			
			27 .02			
			30 .08			
ZN-PB-CU .01			3 .04	41 0.0		
			5 0.0			
ZN-PB .06			13 .05	10 0.0		32 .14
			17 0.0	35 .07		42 .10
PB-ZN 0.0			18 0.0			
			34 0.0			

VALUES SHOWN AS

PROP. NO.	RATIO VALUE
21	.08

AVERAGE VALUES TABLED WITH ORE TYPE

TABLE 13

RELATION BETWEEN CP/CP + SL + GN RATIOS, ORE TYPE, AND WALL ROCK ASSOCIATIONS.

W A L L   R O C K

ORE TYPE	ULTRA-BASIC		BASIC INTRUS.		ACID VOLC.		SEDS.		ACID INTRUS.		CONT. METAM.	
CU-NI	7	1.0	44	.96								
			43	.91								
			45	.91								
CU			4	.98	2	.97			11	.95	6	1.0
			9	.99	19	1.0			28	.98	8	1.0
			14	.99	20	1.0			29	1.0	36	.97
			15	1.0	26	1.0			40	1.0		
			22	1.0	31	1.0						
			39	1.0	33	.95						
CU-ZN			37	.89	1	.86						
			38	.86	12	.83						
					24	.78						
					25	.63						
ZN-CU					21	.48	16	.47				
					23	.70						
					27	.39						
					30	.57						
ZN-PB-CU					3	.17	41	.21				
					5	.10						
ZN-PB					13	.01	10	.02			32	0.0
					17	.03	35	.02			42	.06
PB-ZN					18	.02						
					34	0.0						

VALUES SHOWN AS PROP. NO. RATIO VALUE

21 .08

TABLE 14

RELATION BETWEEN SL/SL + CP + GN RATIOS, ORE TYPE, AND WALL ROCK ASSOCIATIONS.

ORE TYPE	WALL ROCK: ULTRA-BASIC	BASIC INTRUS.	ACID VOLC.	SEDS.	ACID INTRUS.	CONT. METAM.
CU-NI	7 0.0	43 0.0 44 0.0 45 .01				
CU		4 .03 9 .01 14 .01 15 0.0 22 0.0 39 0.0	2 .03 19 0.0 20 0.0 26 0.0 31 0.0 33 .05		11 .05 28 .02 29 0.0 40 0.0	6 0.0 8 0.0 36 .03
CU-ZN		37 .12 38 .14	1 .12 12 .16 24 .22 25 .37			
ZN-CU			21 .51 23 .30 27 .61 30 .41	16 .51		
ZN-PB-CU			3 .66 5 .59	41 .44		
ZN-PB			13 .96 17 .87	10 .59 35 .79		32 .57 42 .73
PB-ZN			18 .46 34 .40			

VALUES SHOWN AS

PROP. NO.	RATIO VALUE
21	.08

TABLE 15

RELATION BETWEEN FE SULPHIDE/FE SULPHIDE + FE OXIDE RATIOS, ORE TYPE, AND WALL ROCK ASSOCIATIONS.

ORE TYPE	WALL ROCK: ULTRA-BASIC	BASIC INTRUS.	ACID VOLC.	SEDS.	ACID INTRUS.	CONT. METAM.
	7 .63	44 .84				
CU-NI		43 .85				
.82		45 .90				
		4 .96	2 .86		11 .84	6 .08
		9 .95	19 .90		28 .59	8 .95
CU		14 .77	20 .87		29 .39	36 .62
		15 .89	26 .98		40 .60	
		22 .60	31 .70			
.88		39 .99	33 1.0			
		37 .97	1 .99			
CU-ZN		38 .98	12 .98			
			24 .89			
.96			25 .97			
			21 .95	16 .94		
ZN-CU			23 .94			
			27 .98			
.94			30 .92			
ZN-PB-CU			3 .96	41 1.0		
.99			5 1.0			
ZN-PB			13 .95	10 .94		32 .96
.97			17 1.0	35 1.0		42 .96
PB-ZN			18 1.0			
1.0			34 1.0			

VALUES SHOWN AS

PROP. NO.	RATIO VALUE
21	.08

AVERAGE VALUES TABLED WITH ORE TYPE

TABLE 16

RELATION BETWEEN PY/PY + SL + GN RATIOS, ORE TYPES, AND WALL ROCK ASSOCIATIONS.

WALL ROCK

ORE TYPE	ULTRA-BASIC	BASIC INTRUS.	ACID VOLC.	SEDS.	ACID INTRUS.	CONT. METAM.
	7 1.0	44 .99				
CU-NI		43 .92				
		45 .97				
		4 .97	2 1.0		11 .98	6 1.0
		9 .95	19 .98		28 .96	8 1.0
CU		14 .98	20 1.0		29 1.0	36 .98
		15 1.0	26 1.0		40 1.0	
		22 1.0	31 1.0			
		39 1.0	33 .97			
		37 .76	1 .98			
CU-ZN		38 .79	12 .97			
			24 .84			
			25 .86			
			21 .80	16 .76		
ZN-CU			23 .95			
			27 .63			
			30 .85			
ZN-PB-CU			3 .82	41 .35		
			5 .19			
ZN-PB			13 .41	10 .44		32 .28
			17 .58	35 .22		42 .26
PB-ZN			18 .26			
			34 .11			

VALUES SHOWN AS PROP. NO. RATIO VALUE

21 .08

Pyrite/Pyrite+Sphalerite+Galena Ratio (Py/Py+Sl+Gn)

This ratio decreases with changing ore type through copper to lead deposits indicating a greater rate of increase of galena and sphalerite than pyrite (Table 16). Lead-zinc deposits are generally composed of galena and sphalerite with only minor pyrite.

Normalized Three Mineral Groups

Four normalized three mineral groups of sulphide-opaque minerals for the total sample data were calculated and tabulated (Tables 17 and 18). The -65+400 fraction calculations are shown in Appendix 5.

Pyrrhotite-Pyrite-Chalcopyrite (Po-Py-Cp)

Point scatter is almost complete in the triangular diagram illustrated in Figure 7. Copper-nickel and copper deposits have a concentration on the pyrrhotite (Po) side of the diagram (ie. associated with higher Pyrrhotite/Pyrrhotite+Pyrite ratio values). Copper-zinc and zinc-copper types occupy an intermediate position between pyrrhotite and pyrite. Zinc-lead and lead-zinc ore types are clustered about the pyrite corner. Field boundaries have been sketched around deposits associated with ultrabasic, basic, and acid intrusion wall rock and with contact metamorphic types. The grouping is not completely diagnostic, although these types appear to be concentrated in the pyrrhotite-chalcopyrite field. Groupings based on these three minerals are not readily apparent, are poorly defined, and are highly influenced by the copper content of the ores.

FIGURE 7

Plot of Normalized CP-PO-PY (Weight %)

(TOTAL SAMPLE)

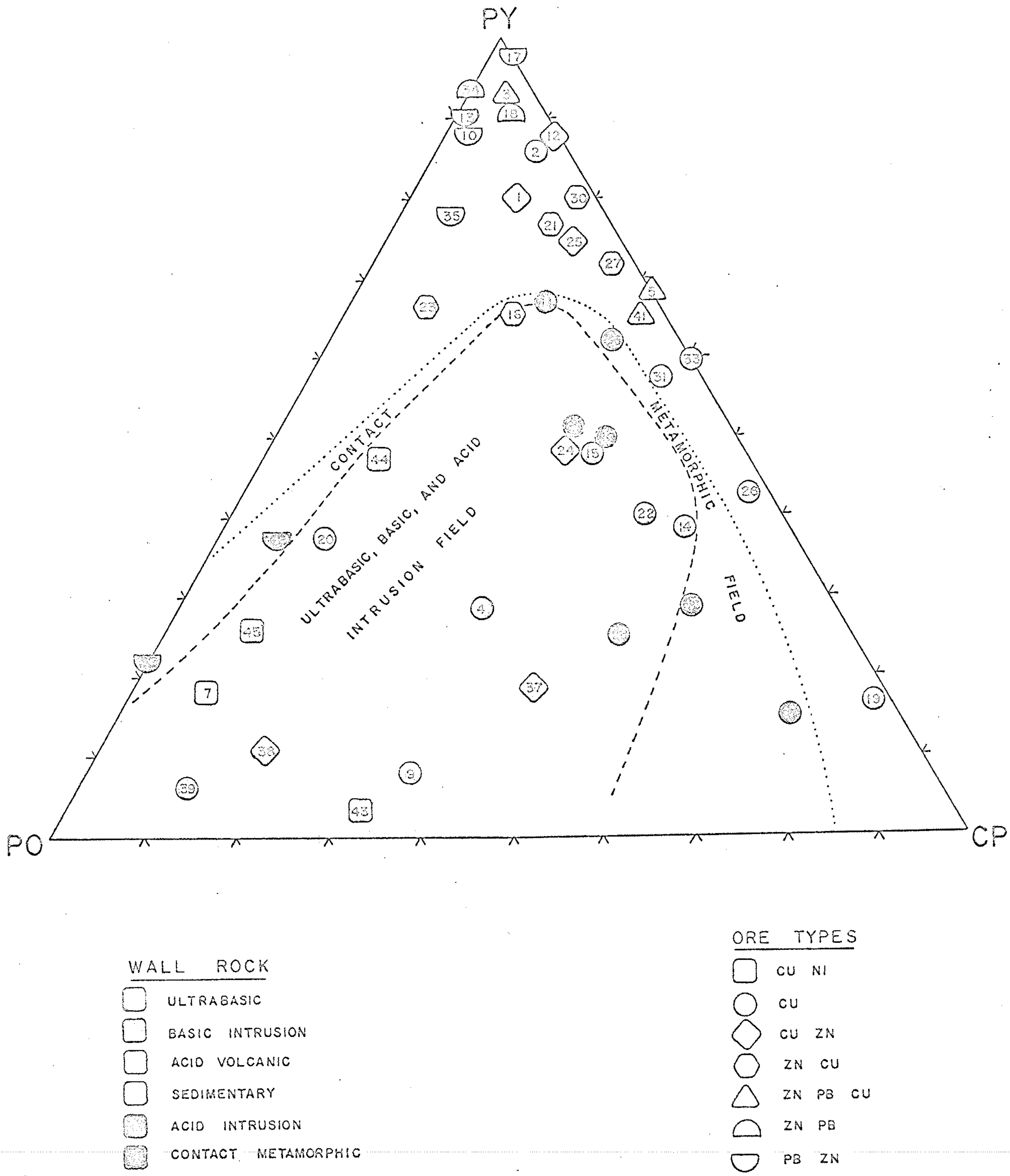


TABLE 17

CALCULATED 100 WEIGHT PERCENT MINERAL GROUPS
(NORMALIZED GROUPS)

TOTAL SAMPLE

CALC 100 PCT			CALC 100 PCT			CALC 100 PCT			
PO	PY	CP	PO	MG	PY	SL	CP	GN	NO.
8.61	79.37	12.02	9.69	0.99	89.32	13.75	86.25	0.0	1
2.66	85.92	11.43	2.59	13.79	83.62	3.01	96.99	0.0	2
3.44	92.47	4.09	3.44	4.03	92.53	65.87	16.63	17.49	3
38.16	28.14	33.70	55.12	4.23	40.65	2.54	97.46	0.0	4
0.0	67.25	32.75	0.0	0.0	100.00	58.48	10.29	31.23	5
11.25	14.90	73.85	5.18	87.95	6.87	0.0	100.00	0.0	6
73.65	17.80	8.55	50.42	37.40	12.19	0.0	100.00	0.0	7
15.64	28.07	56.28	34.01	4.94	61.05	0.0	100.00	0.0	8
56.45	7.68	35.88	83.58	5.05	11.37	1.04	98.83	0.13	9
9.68	88.48	1.83	9.27	6.05	84.68	78.49	1.62	19.89	10
12.54	66.38	21.08	13.30	16.28	70.41	4.88	95.12	0.0	11
1.90	86.09	12.01	2.12	1.74	96.15	16.30	82.92	0.78	12
9.58	89.38	1.04	9.23	4.64	86.12	96.28	0.78	2.93	13
10.75	38.43	50.82	16.79	23.23	59.98	1.40	98.60	0.0	14
15.78	47.55	36.66	22.23	10.78	66.99	0.0	100.00	0.0	15
16.60	65.08	18.32	19.04	6.30	74.66	51.33	47.21	1.46	16
0.0	97.57	2.43	0.0	0.23	99.77	86.95	3.26	9.79	17
3.83	91.13	5.04	4.03	0.0	95.97	46.20	1.93	51.87	18
1.71	16.55	81.74	8.39	10.20	81.41	0.17	99.55	0.28	19
51.03	36.91	12.06	50.30	13.31	36.39	0.0	100.00	0.0	20
6.38	75.91	17.71	7.34	5.41	87.26	51.16	48.15	0.70	21
14.89	39.90	45.21	16.21	40.35	43.44	0.40	99.50	0.10	22
25.23	65.99	8.79	26.00	6.00	68.00	30.01	69.86	0.13	23.
19.30	48.28	32.43	25.32	11.35	63.34	21.98	77.81	0.22	24
5.40	73.82	20.78	6.63	2.77	90.60	36.66	62.90	0.44	25
1.91	42.58	55.51	4.19	2.42	93.39	0.19	99.81	0.0	26
2.39	71.18	26.43	3.19	2.03	94.79	60.92	39.08	0.0	27
24.86	25.21	49.93	29.38	40.83	29.79	2.20	97.80	0.0	28
17.06	50.60	32.34	9.77	61.25	28.98	0.0	100.00	0.0	29
2.84	79.10	18.06	3.19	7.89	88.92	40.94	56.54	2.52	30
4.13	57.00	38.87	5.35	20.78	73.87	0.0	100.00	0.0	31
78.39	21.61	0.0	75.66	3.48	20.86	56.75	0.0	43.25	32.
0.0	59.23	40.77	0.0	0.0	100.00	4.68	95.32	0.0	33
6.82	93.18	0.0	6.82	0.0	93.18	39.83	0.0	60.17	34
16.88	77.54	5.59	17.87	0.0	82.13	58.60	2.04	39.36	35
6.52	62.51	30.97	6.05	35.89	58.05	3.20	94.66	2.14	36
37.43	18.40	44.17	65.02	3.03	31.95	11.50	88.50	0.0	37
70.51	11.33	18.16	84.78	1.61	13.62	14.00	86.00	0.0	38
81.95	5.81	12.24	92.64	0.80	6.57	0.26	99.74	0.0	39
14.08	49.40	36.52	13.35	39.82	46.83	0.0	100.00	0.0	40
3.29	64.07	32.64	4.88	0.0	95.12	43.91	21.20	34.89	41
56.43	36.83	6.75	58.07	4.03	37.90	72.65	5.99	21.36	42
64.07	18.77	17.16	64.55	16.54	18.91	0.0	91.15	8.85	43
40.00	47.29	12.71	38.01	17.04	44.94	0.0	96.27	3.73	44
64.32	26.25	9.43	62.79	11.59	25.62	0.44	91.23	8.33	45

TABLE 18

NORMALIZED PY-PO-SL (WEIGHT PERCENT)
TOTAL SAMPLE

PY	PO	SL	NO.
88.29	9.57	2.13	1
96.61	2.98	.39	2
82.47	3.06	14.45	3
41.89	56.80	1.30	4
26.53	0.00	73.46	5
56.98	43.01	0.00	6
19.46	80.53	0.00	7
64.22	35.77	0.00	8
11.90	87.50	.58	9
47.30	5.17	47.52	10
82.97	15.67	1.35	11
95.28	2.09	2.61	12
39.43	4.22	56.33	13
77.00	21.55	1.44	14
75.08	24.91	0.00	15
64.05	16.33	19.60	16
60.10	0.00	39.89	17
42.29	1.77	55.93	18
89.97	9.27	.75	19
41.97	58.02	0.00	20
75.07	6.31	18.60	21
72.58	27.08	.33	22
69.46	26.55	3.97	23
62.91	25.14	11.93	24
80.82	5.91	13.25	25
95.48	4.28	.23	26
62.01	2.08	35.89	27
49.24	48.55	2.19	28
74.78	25.21	0.00	29
83.24	2.98	13.76	30
93.24	6.75	0.00	31
16.35	59.31	24.33	32
96.73	0.00	3.26	33
24.07	1.76	74.16	34
30.42	6.62	62.95	35
89.20	9.30	1.49	36
29.87	60.79	9.32	37
13.35	83.15	3.48	38
6.61	93.34	.03	39
77.81	22.18	0.00	40
47.47	2.43	50.09	41
21.03	32.22	46.74	42
22.65	77.34	0.00	43
54.17	45.82	0.00	44
28.96	70.98	.05	45

Chalcopyrite-Sphalerite-Galena (Cp-Sl-Gn)

The grouping in Figure 8 is essentially the same as the copper-zinc-lead diagram (Figure 15, Page 99). Deposits occur along the chalcopyrite-sphalerite (Cp-Sl) and sphalerite-galena (Sl-Gn) tie lines only. Ores of chalcopyrite and galena are extremely rare. Ores occurring in ultrabasic, basic, and acid intrusion wall rocks plus the contact metamorphic types are concentrated at the chalcopyrite corner. Properties 32 (Cominco, Sullivan Mine) and 42 (New Calumet Mines) are erratics due perhaps to a poor wall rock group classification.

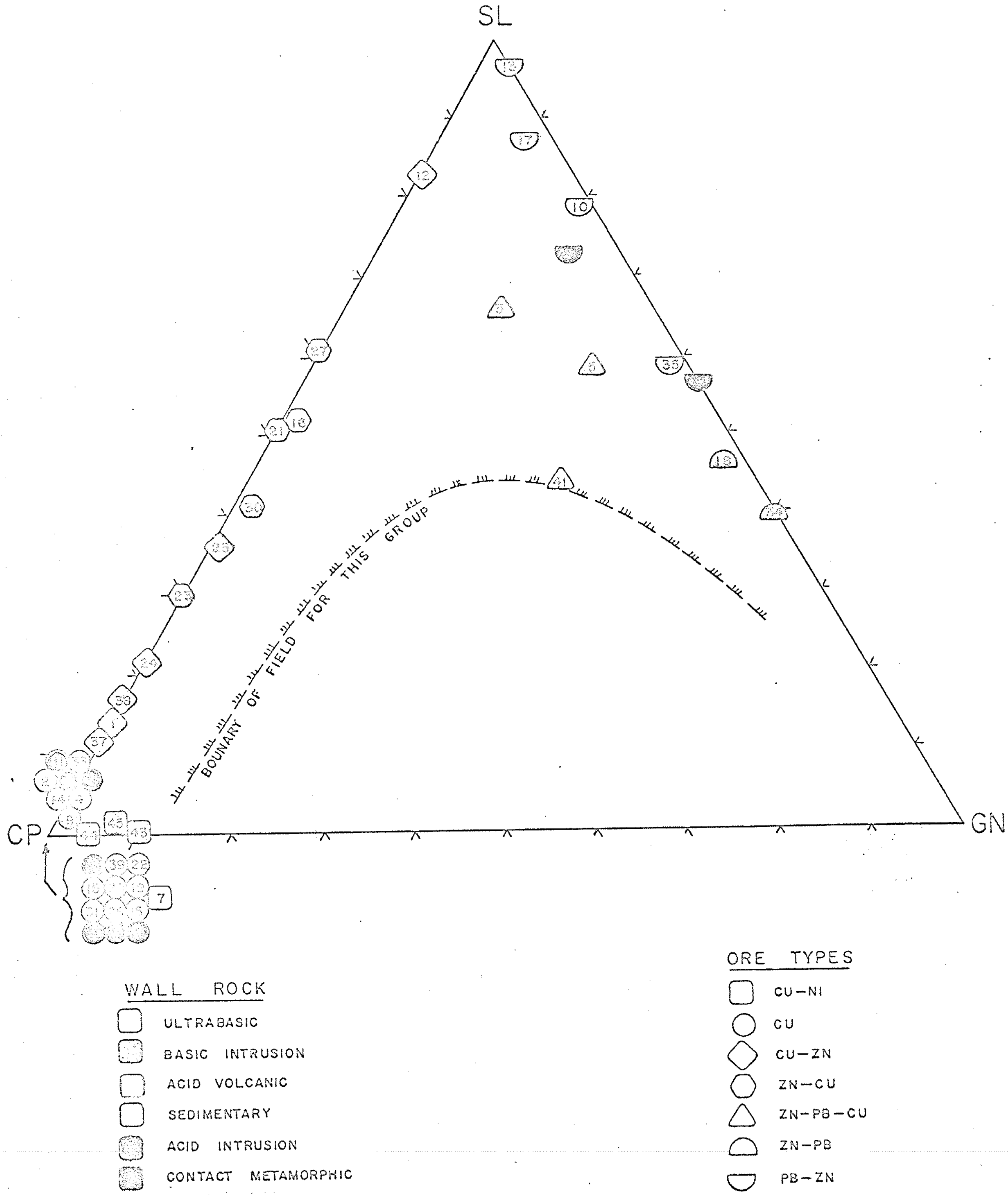
Pyrrhotite-Pyrite-Sphalerite (Po-Py-Sl)

The triangular diagram of normalized (Po-Py-Sl) values (Figure 9) was plotted to compare the actual variables to the interpreted factor components of the factor analysis. The ore deposits lie along the pyrrhotite-pyrite (Po-Py) and pyrite-sphalerite (Py-Sl) tie lines. No deposits fall on the pyrrhotite-sphalerite (Po-Sl) tie line. Point distribution suggests a continuous series varying from high pyrrhotite (Po) through pyrite (Py) to sphalerite (Sl) as the ore type varies from copper-nickel, through copper, copper-zinc, zinc-copper, to zinc-lead types. Wall rock variation shows a concentration of igneous associated types along the Po-Py join indicating appreciable amounts of pyrite and pyrrhotite in these ores. Replacement types of deposits are concentrated along the Py-Sl tie line.

FIGURE 8

Plot of Normalized CP - SL - GN (Weight %)

(TOTAL SAMPLE)



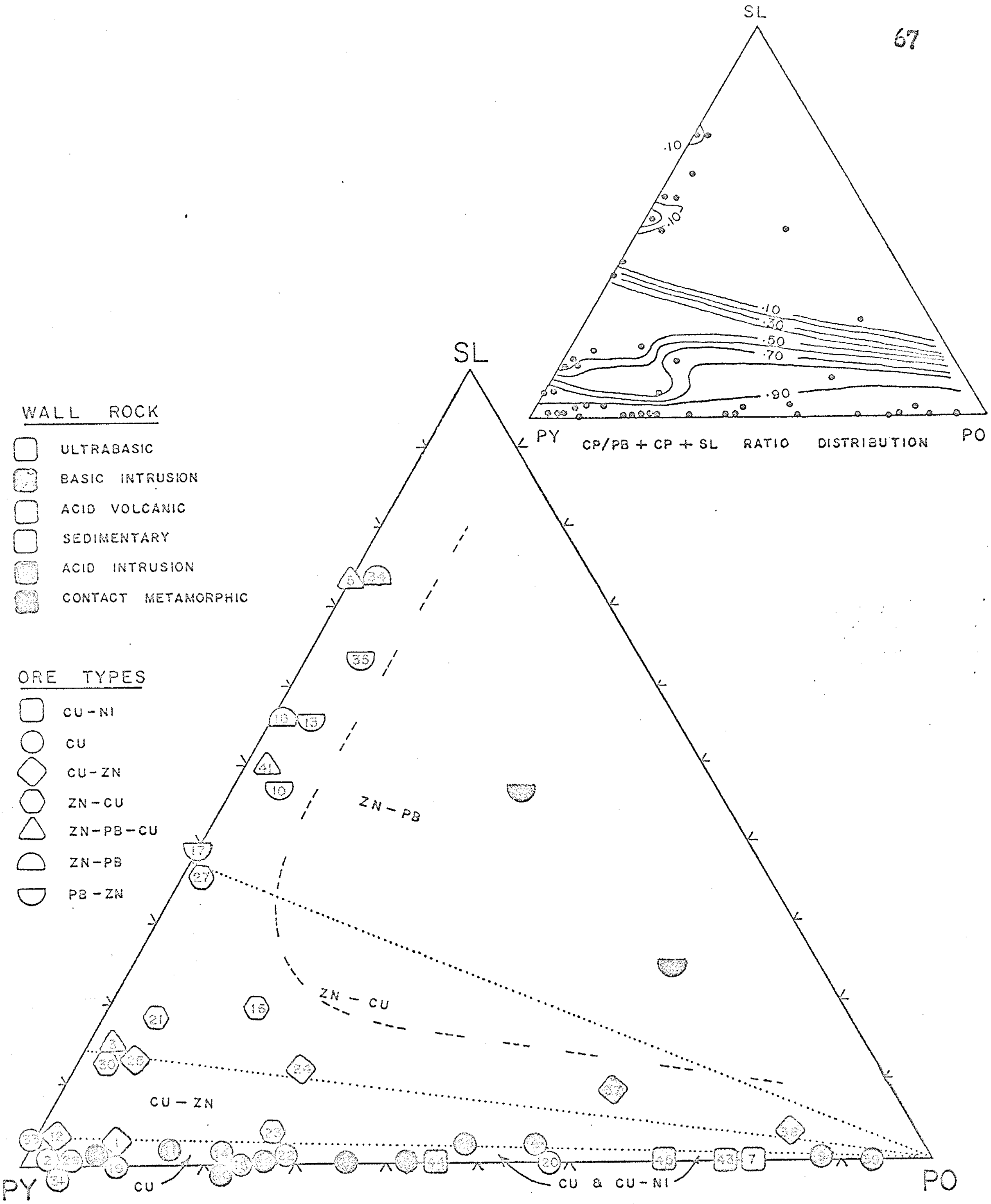


FIGURE 9

Plot of Normalized PO-PY-SL (Weight %)

PLUS THE CP RATIO DISTRIBUTION DIAGRAM

(TOTAL SAMPLE)

Pyrrhotite-Pyrite-Magnetite (Po-Py-Mg)

Property distribution based on the Pyrrhotite-Pyrite-Magnetite (Po-Py-Mg) triangular diagram (Figure 10) indicated moderate scatter. Some order however was shown when the wall rock and ore type distribution was added to the diagram. Three groups have been outlined. Group A (Figure 10) contains ore bodies that occur in ultrabasic or basic intrusive wall rocks. Ore types are copper-nickel and copper. Properties 32 (Cominco, Sullivan Mine) and 42 (New Calumet Mines) are again erratics due to their high pyrrhotite contents and zinc-lead ore types. Deposit 20 (Noranda, Horne Mine) also falls in this field or group but because of its wall rock type (acid volcanic), it is also considered to be erratic.

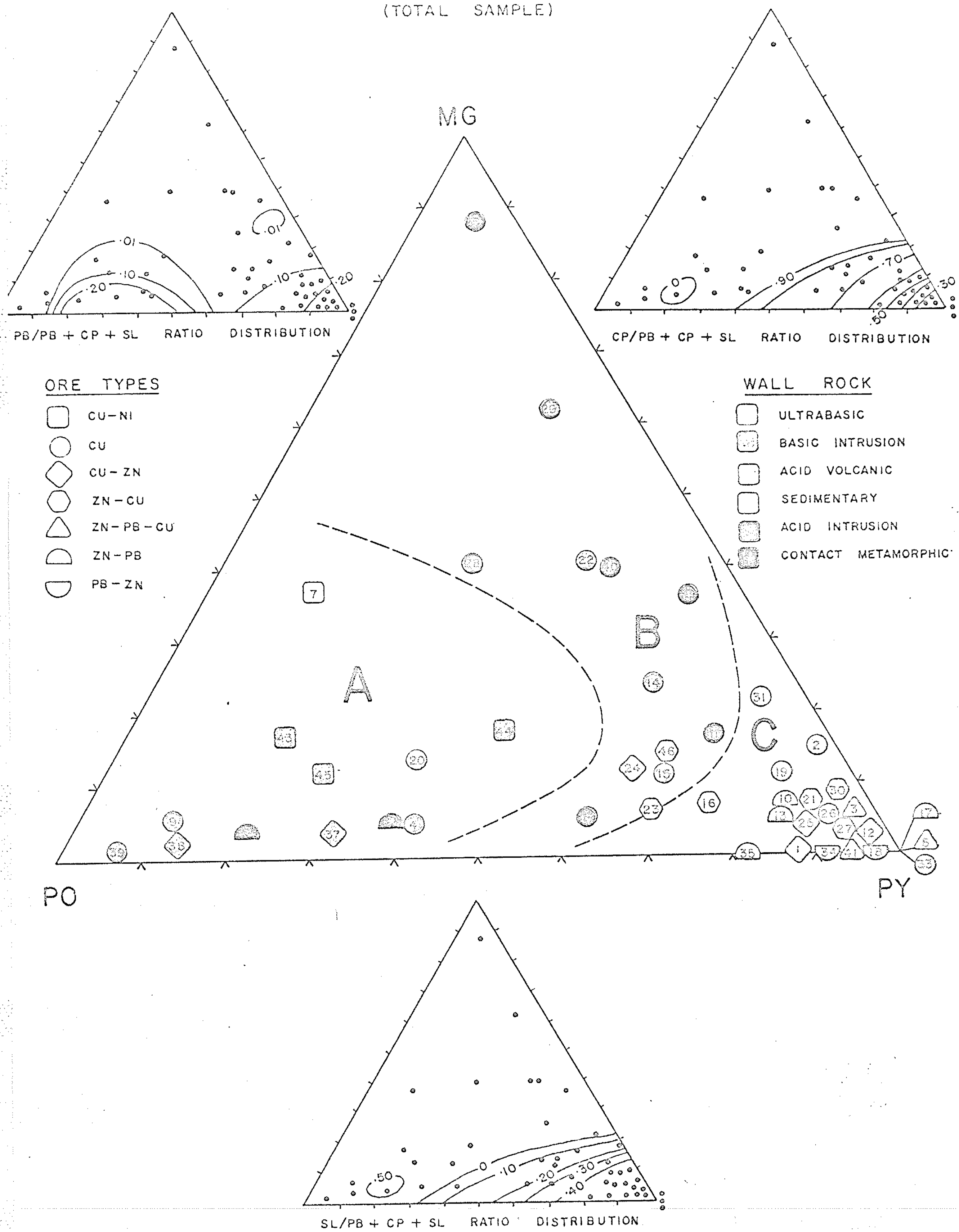
Group B (Figure 10), in general, contains ores with acid intrusion and contact metamorphic wall rocks and copper plus copper-zinc ore types. A number of erratics are present such as 23 (Quemont Mine), 24 (Waite Amulet Mine), 46 (Lake Dufault Mine), 22 (Opemiska Copper), 14 (Patino, Copper Rand Division), and 15 (Cowichan Copper, Sunro Mine). The variation in this group appears to be due mainly to wall rock type. Deposits 14, 15, and 22 should fall within Group A due to their basic types of wall rocks however, these deposits may have been affected by late hydrothermal fluids. Deposits 23, 24, and 46 (Noranda area) occur in acid volcanic rocks and their positions in Group B may be due to metamorphism or remobilization of the sulphide minerals. Deposits 32 (Cominco, Sullivan Mine) and 42 (New Calumet Mines), which have been

FIGURE 10

Plot of Normalized PO - PY - MG (Weight %)

PLUS CP, SL, AND GN RATIO DISTRIBUTION DIAGRAMS

(TOTAL SAMPLE)



placed in Group A and lie close to the boundary between Groups A and B, may belong with Group B because of their ore types and wall rocks. Group B girdles Group A possibly indicating no clean cut division between the groups on the bases of igneous affiliations.

Group C (Figure 10) contains mainly ores in acid volcanic and sedimentary wall rocks and ore types ranging from copper-zinc to lead-zinc. The Group C deposits have no distinct or obvious igneous affiliations and may be classed as replacement types. One should note again the apparent change of deposits from basic rocks along the pyrrhotite-magnetite (Po-Mg) join to the acid rocks at the pyrite (Py) corner, and the progressive change in ore type from copper-nickel to lead-zinc. The distributions of the chalcopyrite, sphalerite, and galena ratios as shown by the small triangular diagrams in Figure 10 further indicate the change in ore type toward the high pyrite ore bodies. The chalcopyrite ratio (Cp/Cp+Sl+Gn) decreases and the sphalerite and galena ratios (Sl/Cp+Sl+Gn and Gn/Cp+Sl+Gn) increase as the deposits change from basic to acid volcanic wall rocks.

Analyses of the pyrrhotite-pyrite-magnetite (Po-Py-Mg) diagram with respect to physical and geological boundaries were made and the following observations were made.

<u>Canadian Shield Group</u>

The fields for ultrabasic, basic intrusion, and replacement types (in acid volcanic and sedimentary wall rocks) were constructed (Figure 11).

These three divisions are clearly defined and show a regular variation of deposits from basic to acid wall rocks as the ore types vary from copper-nickel to zinc-lead. The distribution of the gold/gold+silver ratio (Au/Au+Ag)(Figure 11, small triangular diagram) shows a similar variation pattern with gold values decreasing with increasing pyrite content. Deposits 20 (Noranda, Horne Mine) and 42 (New Calumet Mines) again appear as erratics.

Appalachian Group

The number of deposits in this group is small and the point distribution (Figure 12) therefore not clearly defined. However, the change in ore type toward the pyrite (Py) corner is readily apparent from copper through zinc-lead-copper. The genesis of the Appalachian area deposits have not been clearly defined. However, the point distribution does indicate a differentiation type of variation of ore types from acid intrusion associations to undefined replacement types. The gold ratio (Au/Au+Ag) distribution suggests a decrease in the gold content of the ores toward high pyrite deposits (Figure 12, small triangular diagram).

Cordilleran Group

The change in ore type from copper, through copper-zinc, to lead-zinc is clearly indicated in Figure 13. This group appears to be composed mainly of pyrite-magnetite ores for this study and the variation of deposits is from magnetite to pyrite. Deposit 32 (Cominco, Sullivan

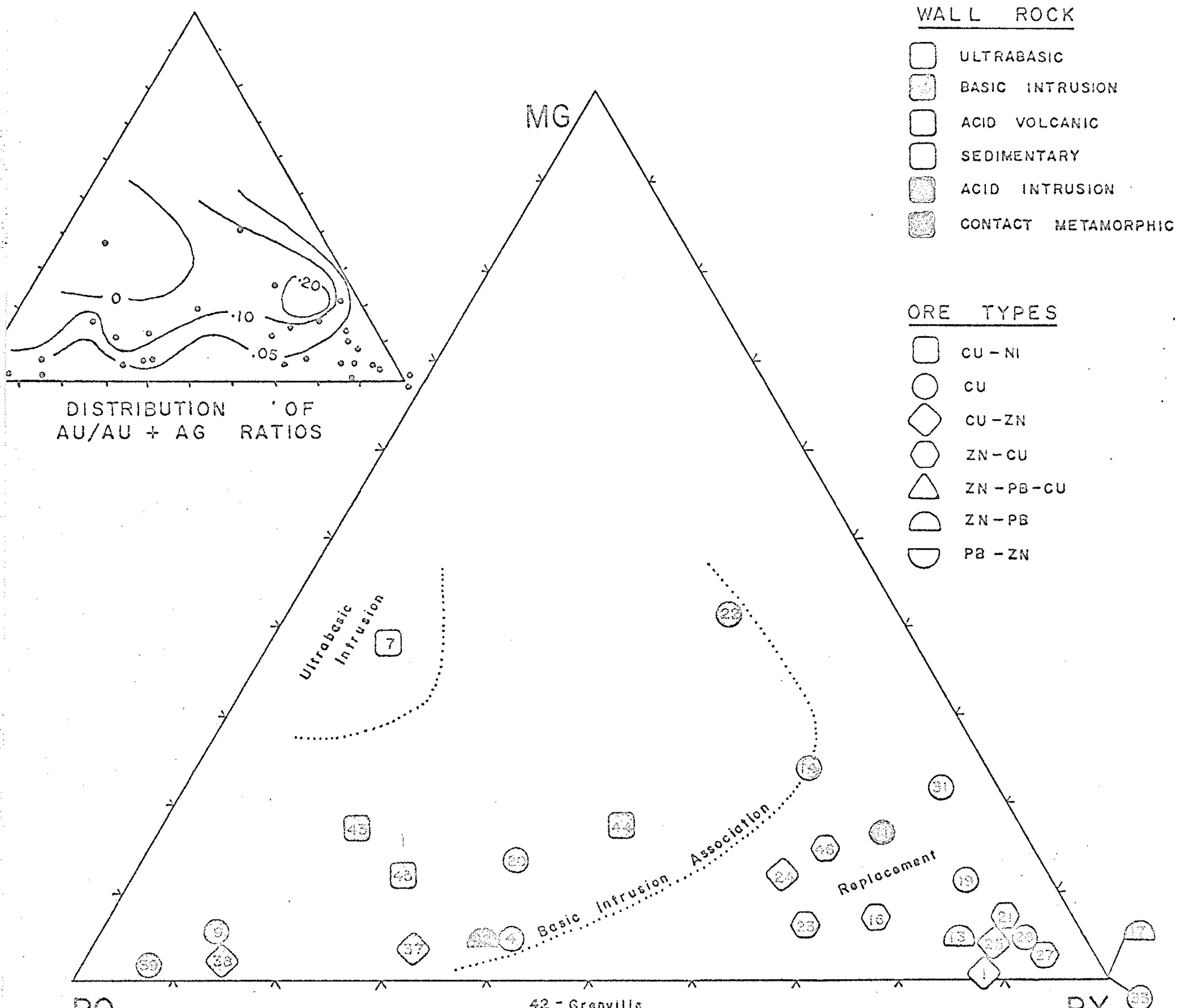
FIGURE 11

Plot of Normalized PO-PY-MG (Weight %)

FOR THE CANADIAN SHIELD GROUP PLUS THE

AU RATIO DISTRIBUTION DIAGRAM

(TOTAL SAMPLE)



CANADIAN SHIELD GROUP

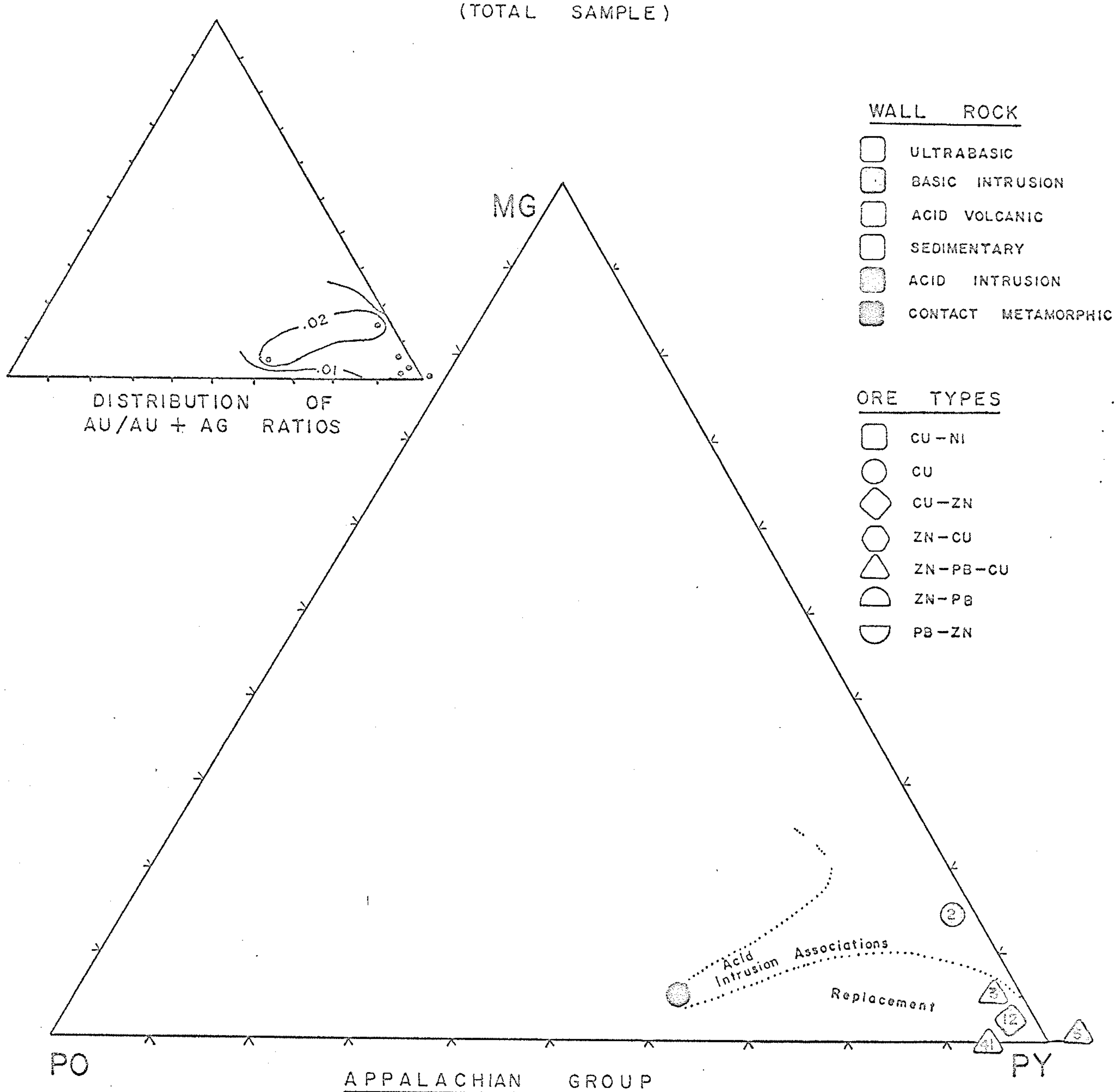
FIGURE 12

Plot of Normalized PO-PY-MG (Weight %)

FOR THE APPALACHIAN GROUP PLUS THE

AU RATIO DISTRIBUTION DIAGRAM

(TOTAL SAMPLE)



Mine) is again anomalous. The location of the point (re: composition) may be due to the proximity of an intermediate intrusion. Deposit 15 (Cowichan Copper, Sunro Mine), a Tertiary copper deposit in gabbro and basalt and having a postulated hydrothermal origin, is clearly separated from the other ores. The diagram indicates a progressive change in ore type with a change in wall rock type, varying from copper deposits in or near acid intrusions to zinc-copper and lead-zinc ores in volcanic or sedimentary wall rocks with no definite igneous affiliation. The gold ratio (Au/Au+Ag) distribution (Figure 13, small triangular diagram) shows a decrease from high magnetite to high pyrite deposits.

Magnetic Characteristics of the Properties

Theoretical magnetic susceptibilities and anomalies were calculated for all deposits to determine whether a relation between a specific mineral ratio and the magnetic susceptibilities or magnetic anomaly existed.

The magnetic susceptibilities were calculated using the following relation (Dobrin, 1960);

$$\text{Magnetic susceptibility } (k) = (Mg \times .50) + (Po \times .13)$$

where Mg and Po are weight percentages of magnetite and pyrrhotite.

The theoretical airborne and ground magnetic anomalies were calculated using the following equation (Dobrin, 1960);

$$I = (k_{Mg} + k_{Po})H$$

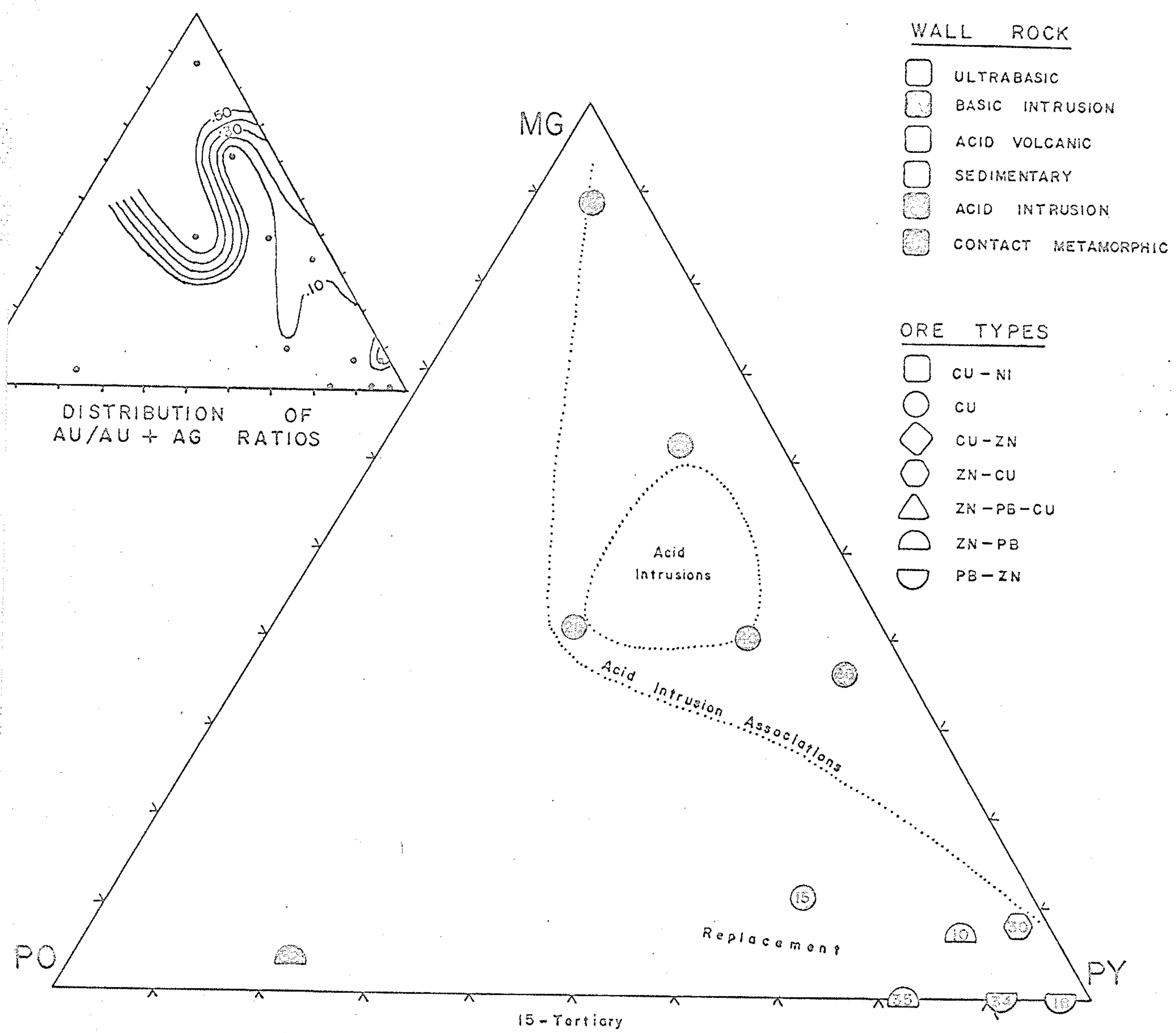
FIGURE 13

Plot of Normalized PO-PY-MG (Weight %)

FOR THE CORDILLERAN GROUP PLUS THE

AU RATIO DISTRIBUTION DIAGRAM

(TOTAL SAMPLE)



CORDILLERAN GROUP

$$V_{max} = 2 \times 10^5 \left(\frac{1}{z_1} - \frac{1}{z_2}\right) It$$

where H = earth's field

I = intensity of magnetism

k = magnetic susceptibility

V_{max} = maximum vertical magnetic intensity

t = thickness of vertical ore sheet

z_1 = depth to top of sheet

z_2 = depth to base of sheet

The values obtained represent only an average value that could be produced from ores of that particular composition. Variations in grain size, size, shape, and depth of burial of the ore body, remnant magnetism, and other physical properties have a profound effect on the size and type of magnetic anomaly that may be actually encountered in the field. As each deposit would have to be evaluated in detail to arrive at a more realistic calculated anomaly, and as the remnant magnetic effect at each deposit is not known, only broad generalizations can be made on the bases of the theoretical magnetic data. Theoretical magnetic data was calculated by computer as programmed in Table 5, Appendix 6. All values as calculated are shown in Table 19.

The ratio, magnetite+pyrrhotite/magnetite+pyrrhotite+pyrite (Mg+Po/Mg+Po+Py)(Table 19), was compared to the theoretical magnetic anomalies (Table 19). The relation between these two parameters was completely erratic indicating that there is apparently no mineral ratio

TABLE 19

CALCULATED SAMPLE MAGNETIC ANOMALY

MG-PO RATIO	SUSCEPTIBILITY K (CALC.) (CGS UNITS)	CALC. MAGNETIC ANOMALY (GAMMAS) GROUND	AIR	PR. NO.
0.107	0.8	780	13	1
0.164	2.5	2516	44	2
0.075	1.9	1851	33	3
0.593	2.2	2193	39	4
0.0	0.0	0	0	5
0.931	10.1	10077	179	6
0.878	7.3	7252	129	7
0.390	0.2	237	4	8
0.886	1.9	1908	34	9
0.153	0.4	433	7	10
0.296	0.9	860	15	11
0.039	0.9	902	16	12
0.139	0.7	667	11	13
0.400	1.3	1348	24	14
0.330	0.9	852	15	15
0.253	1.9	1902	33	16
0.002	0.0	14	0	17
0.040	0.0	28	0	18
0.186	0.3	273	4	19
0.636	9.6	9645	172	20
0.127	1.6	1609	28	21
0.566	4.5	4467	79	22
0.320	3.8	3753	67	23
0.367	3.8	3768	67	24
0.094	1.3	1266	22	25
0.066	0.5	543	9	26
0.052	0.6	556	9	27
0.702	2.9	2920	52	28
0.710	2.8	2806	50	29
0.111	0.7	723	12	30
0.261	1.8	1760	31	31
0.791	4.8	4751	84	32
0.0	0.0	0	0	33
0.068	0.0	38	0	34
0.179	0.2	192	3	35
0.419	1.7	1732	30	36
0.680	1.6	1609	28	37
0.864	4.5	4489	80	38
0.934	6.9	6859	122	39
0.532	1.0	956	17	40
0.049	0.0	35	0	41
0.621	1.0	1019	18	42
0.811	2.7	2679	47	43
0.551	1.4	1437	25	44
0.744	3.2	3154	56	45

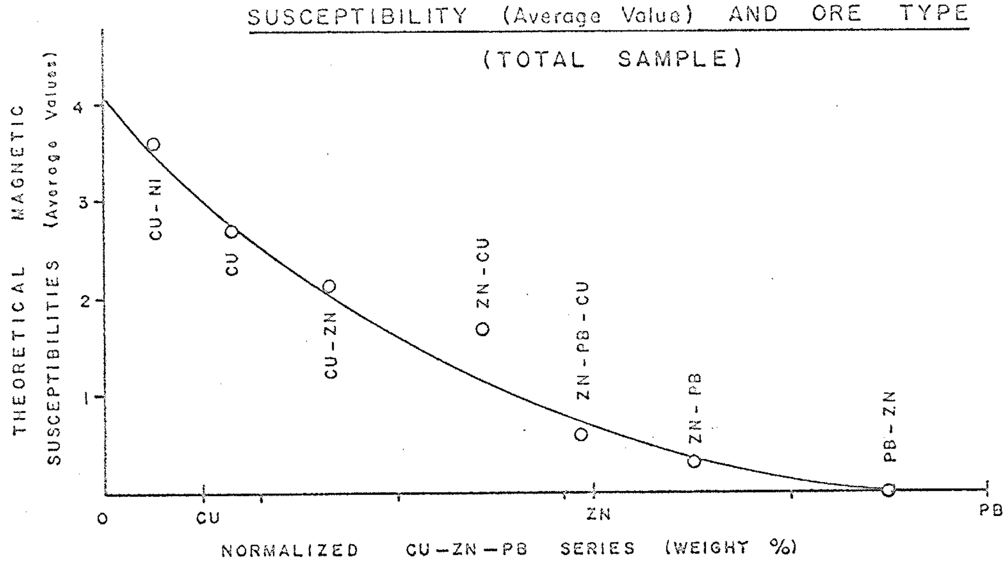
MG-PO RATIO = MG+PO/MG+PO+PY
K (MG) = 0.50 CGS
DYKE THICKNESS = 50 FT.
DYKE TOP = −50 FT.

H = 0.60 OERSTEDS
K (PO) = 0.13 CGS
A/C ALTITUDE = 750 FT.
DYKE BASE = −300 FT.

FIGURE 14-A

RELATION BETWEEN THEORETICAL MAGNETIC SUSCEPTIBILITY (Average Value) AND ORE TYPE

(TOTAL SAMPLE)

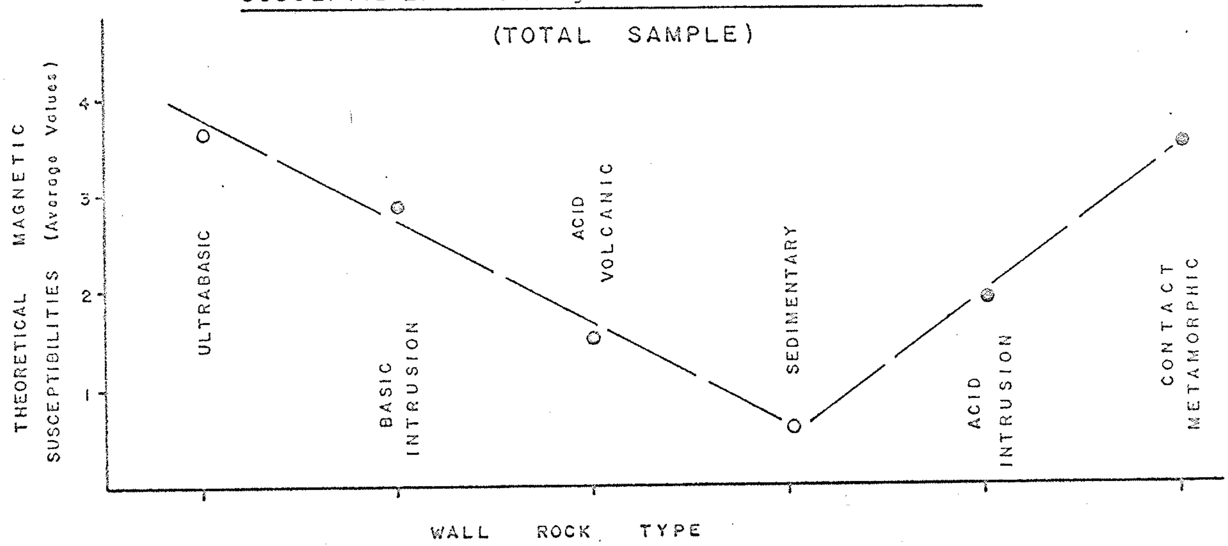


THEORETICAL SUSCEPTIBILITY = (MG · 0.5) + (PO · 0.13)
WHERE MG & PO AS WEIGHT %

FIGURE 14-B

RELATION BETWEEN THEORETICAL MAGNETIC SUSCEPTIBILITY (Average Value) AND WALL ROCK

(TOTAL SAMPLE)



that can be equated to the intensity of the magnetic response. A mineral ratio is no measure of the amounts of magnetic material present, and therefore cannot be related to the quantitative magnetic effects.

Several plots relating the average value of the magnetic susceptibility to ore types and wall rocks were constructed from the data in Table 1, Appendix 8. The relation between theoretical susceptibilities and ore types (Figure 14-A) shows the decrease in susceptibility with the change in ore type from copper-nickel to lead-zinc ores. The graph of wall rock versus susceptibility (Figure 14-B) indicates a decrease in susceptibility from deposits associated with igneous rocks (basic or acid) to replacement ore types associated with acid volcanic and sedimentary wall rocks

Silicate Mineralogy

The total sample silicate mineralogy as determined in this study was tabulated (Table 20) and a grouping of seven more or less key types was produced (Table 21) using the computer. The silicate data for the total sample and the -65+400 fraction were put on punch cards. The -65+400 silicate data is tabulated in Table 9, Appendix 5. A listing of symbols used for silicate minerals and alteration is included with Table 20 and Table 9, Appendix 5. No attempt was made at this time to analyze the silicate data. The number of silicate variables determined was 61.

The silicate mineral groupings compiled were as follows;

TABLE 20

SILICATE MINERALOGY (WEIGHT PERCENT)
TOTAL SAMPLE

CAL	QTZ	CHL	HB 3	HB 1	HB 2	TRE	ACT	AUG	NO.
4.04	41.34	3.15	0.0	0.0	0.0	0.0	0.0	0.0	1
0.59	1.36	37.03	0.0	0.0	0.0	0.0	0.0	0.0	2
0.0	3.68	0.86	0.0	0.0	0.0	0.0	1.73	0.0	3
2.87	21.65	4.67	0.0	0.0	0.0	0.0	0.0	0.0	4
5.81	4.49	0.98	0.0	0.0	0.0	0.0	0.0	0.0	5
10.19	3.06	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6
0.28	6.38	0.0	0.0	7.38	0.0	0.0	0.0	0.0	7
14.68	7.48	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8
0.61	60.22	13.83	0.0	0.0	0.0	0.0	0.0	0.0	9
18.74	14.37	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10
3.43	17.58	15.60	0.0	0.0	0.0	0.0	0.0	0.0	11
1.24	4.17	0.05	0.0	0.05	0.0	0.0	0.0	0.0	12
9.22	11.22	5.42	0.0	0.0	0.0	0.0	0.0	0.0	13
12.28	14.38	3.86	0.0	0.0	0.0	0.0	0.0	0.0	14
0.44	6.86	0.0	0.0	46.23	0.0	0.0	0.72	0.0	15
1.41	29.35	0.0	0.0	1.51	0.0	0.0	0.0	0.0	16
3.52	12.15	0.0	0.0	0.45	0.0	0.0	0.0	0.0	17
3.85	53.70	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18
11.69	10.78	0.0	0.0	0.0	0.0	0.0	0.0	0.0	19
1.54	3.87	2.36	0.0	0.0	0.0	0.0	0.0	0.0	20
0.39	8.74	7.46	0.0	0.0	0.0	0.0	0.0	0.0	21
1.06	3.92	0.0	0.0	9.18	0.0	0.0	2.29	3.52	22
2.71	4.27	2.66	0.0	0.0	0.0	0.0	0.0	0.0	23
0.0	4.38	1.20	0.0	0.0	0.0	0.0	0.0	0.0	24
4.75	6.22	1.20	0.0	0.0	0.0	0.0	0.0	0.0	25
5.93	4.43	7.16	0.0	0.0	0.0	0.0	0.0	0.0	26
3.19	3.22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	27
4.95	11.78	0.0	0.0	1.70	0.0	0.0	0.0	0.0	28
0.69	0.0	0.13	0.0	0.0	0.0	0.0	0.0	15.98	29
0.0	25.19	0.43	0.0	0.0	0.0	0.0	0.0	0.0	30
0.85	16.18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	31
4.08	5.12	0.0	0.0	0.0	0.0	0.55	0.0	0.0	32
0.97	17.68	4.99	0.0	0.68	0.0	0.0	0.0	0.0	33
7.26	22.45	0.35	0.0	0.0	0.0	0.0	0.0	0.0	34
6.42	27.07	0.0	0.0	0.0	0.0	0.0	0.0	0.23	35
22.73	18.59	5.43	0.0	0.0	0.0	0.0	0.76	0.0	36
9.17	15.61	24.07	0.0	0.0	0.0	0.0	0.0	0.0	37
2.76	24.81	9.21	0.0	0.0	0.0	0.0	0.0	0.0	38
1.82	21.49	4.53	0.0	0.0	0.0	0.0	0.0	0.0	39
2.39	22.17	8.02	0.0	0.0	0.0	2.78	0.0	0.0	40
8.06	2.29	0.17	0.0	0.0	0.0	0.0	0.0	0.0	41
7.21	8.79	0.0	0.0	0.0	0.0	34.60	0.0	0.0	42
0.17	9.36	10.79	0.0	15.20	0.0	0.0	0.0	0.71	43
0.0	2.77	1.44	0.0	12.64	0.0	0.0	0.0	0.48	44
1.26	3.57	8.40	0.0	5.36	25.32	0.0	0.0	0.63	45

WALL ROCKS SHOWN IN TABLE 1, APPENDIX 1.

TABLE 20 (CONTINUED)

SILICATE MINERALOGY (WEIGHT PERCENT)
TOTAL SAMPLE

URA	EPI	BIO	GAR	FEL	PYR	DIO	HYP	UWR	NO.
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5
0.0	7.72	0.0	1.05	1.38	0.0	0.0	0.0	0.0	6
0.0	0.0	2.27	0.0	5.48	8.26	0.0	0.0	0.0	7
0.0	0.0	0.0	3.24	0.40	0.0	3.61	0.0	4.91	8
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14
0.0	0.55	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15
0.0	0.0	2.49	1.34	1.89	0.0	0.0	0.0	0.94	16
0.0	0.0	0.44	6.25	0.0	0.0	0.0	0.0	0.0	17
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	19
0.0	0.99	0.0	0.0	0.0	0.0	0.0	0.0	3.13	20
0.0	0.0	0.13	0.38	0.0	0.0	0.0	0.0	3.39	21
0.0	0.0	11.14	0.0	0.0	0.0	0.0	0.0	0.0	22
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.13	23
0.0	3.98	0.0	0.0	0.0	0.0	0.0	0.0	0.0	24
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.37	25
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	26
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.92	27
0.0	3.79	1.24	0.0	0.0	0.0	0.0	0.0	3.00	28
0.0	1.31	0.87	0.0	4.46	0.0	0.0	0.0	0.0	29
0.0	0.0	0.25	0.0	0.90	0.14	0.0	0.0	0.0	30
0.0	0.0	0.28	0.0	0.0	0.0	0.0	0.0	27.10	31
0.0	0.0	0.40	1.37	0.0	0.0	0.0	0.0	0.0	32
0.0	0.49	0.0	0.17	0.0	0.0	0.0	0.0	55.25	33
0.0	0.47	0.0	0.0	0.52	0.0	0.0	0.0	0.75	34
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	35
0.0	9.61	0.0	1.72	0.0	0.0	0.0	0.0	28.75	36
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.64	37
0.0	0.85	0.0	0.0	0.0	0.0	0.0	0.0	0.29	38
0.0	0.13	0.0	0.0	0.0	0.0	0.0	0.0	0.20	39
0.0	4.26	0.40	0.0	0.0	0.0	0.0	0.0	0.0	40
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	31.47	41
0.0	0.0	4.17	3.24	2.63	0.0	12.90	0.0	3.44	42
11.35	1.22	6.77	0.11	0.0	0.0	0.0	10.50	0.0	43
23.48	1.74	1.72	0.0	0.0	0.0	0.0	0.0	0.0	44
10.82	0.91	0.93	0.0	0.0	0.0	0.0	3.52	0.0	45

WALL ROCKS SHOWN IN TABLE 1, APPENDIX 1.

TABLE 20 (CONTINUED)

SILICATE MINERALOGY (WEIGHT PERCENT)
TOTAL SAMPLE

SID	APA	ZOI	MUS	SER	OLI	BAR	FLU	CHD	NO.
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4
0.0	0.0	0.0	0.0	0.0	0.0	27.59	4.55	0.0	5
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6
0.0	0.0	0.0	0.0	0.0	17.55	0.0	0.0	0.0	7
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9
0.0	0.0	0.0	0.0	0.0	0.0	44.51	0.0	0.0	10
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12
0.0	0.0	0.0	0.0	0.0	1.03	0.0	0.0	0.0	13
2.94	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.27	14
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15
0.0	0.0	0.0	8.25	0.0	0.0	0.0	0.0	0.0	16
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.70	0.0	17
3.24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	19
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20
1.56	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.69	21
0.77	0.0	0.0	0.0	0.0	0.30	0.0	0.0	0.0	22
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	23
0.0	0.0	2.79	0.0	0.0	0.0	0.0	0.0	0.0	24
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	25
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	26
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	27
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	28
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	29
0.0	0.0	0.0	0.0	0.12	0.0	1.59	0.0	0.0	30
0.0	0.29	0.0	0.0	0.0	0.0	0.0	0.0	0.0	31
0.0	0.0	1.16	0.16	0.0	0.0	0.0	0.0	0.0	32
0.0	0.0	0.0	0.0	1.35	0.0	0.0	0.0	0.0	33
24.69	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	34
5.26	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	35
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	36
0.0	1.31	2.31	0.0	0.0	0.0	0.0	0.0	0.0	37
0.0	0.33	2.87	0.0	0.0	0.0	0.0	0.0	0.0	38
0.0	0.27	1.67	0.0	0.0	0.0	0.0	0.0	0.0	39
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	40
5.17	0.0	0.0	0.0	0.0	0.0	34.60	0.0	0.0	41
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	42
0.0	0.30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	43
0.0	0.30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	44
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	45

WALL ROCKS SHOWN IN TABLE 1, APPENDIX 1.

TABLE 20 (CONTINUED)

SILICATE MINERALOGY (WEIGHT PERCENT)
TOTAL SAMPLE

SLL	WRP	GYP	OCB	ZEO	QFM	SRP	APL	FQP	NO.
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	22.23	2
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6
0.0	4.05	0.0	0.0	0.0	0.0	10.92	0.0	0.0	7
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14
0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.55	0.0	15
2.38	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17
0.0	0.0	0.0	15.66	0.0	0.0	0.0	0.0	0.0	18
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	19
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	21
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	22
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	23
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	24
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	25
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	26
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	27
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	28
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	29
0.0	0.0	0.11	0.0	0.0	0.0	0.0	0.0	0.0	30
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	31
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	32
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	33
0.0	0.0	0.0	5.43	0.0	0.0	0.0	0.0	0.0	34
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	35
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	36
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	37
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	38
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	39
0.0	0.0	0.0	0.0	2.17	0.0	0.0	0.0	0.0	40
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	41
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	42
0.0	0.0	0.0	0.0	0.0	0.57	0.0	0.0	0.0	43
0.0	0.0	0.0	0.0	0.0	6.31	0.0	0.0	0.0	44
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	45

WALL ROCKS SHOWN IN TABLE 1, APPENDIX 1.

TABLE 20 (CONTINUED)

SILICATE MINERALOGY (WEIGHT PERCENT)
TOTAL SAMPLE

PLA	CCS	SWR	SCWR	SCTWR	STWR	SAWR	CWR	CSCWR	NO.
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4
0.0	0.0	7.72	0.0	0.0	0.0	0.0	0.0	0.0	5
0.0	0.0	0.0	0.0	0.0	0.0	0.0	19.42	0.0	6
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13
0.0	0.0	0.0	27.80	0.0	0.0	0.0	0.0	18.84	14
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15
1.56	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16
0.0	0.0	33.55	0.0	0.0	0.0	0.0	17.02	0.0	17
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18
0.0	0.0	0.0	0.0	47.43	0.0	0.0	7.88	0.0	19
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20
0.0	0.0	12.66	0.0	0.0	0.0	0.0	0.0	0.0	21
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	22
0.0	0.0	8.48	0.0	0.0	0.0	0.0	12.27	0.0	23
0.0	0.0	14.34	0.0	0.0	0.0	0.0	6.90	0.0	24
0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.60	0.0	25
0.0	10.17	3.48	0.0	0.0	0.0	0.0	0.0	0.0	26
0.0	0.0	0.0	18.09	0.0	0.0	0.0	0.0	0.0	27
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	28
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	29
0.0	0.0	36.53	0.0	0.0	0.0	0.0	12.17	0.0	30
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	31
0.0	0.0	0.0	0.0	0.0	12.25	0.0	9.20	0.0	32
0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.79	0.0	33
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	34
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.87	25.22	35
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	36
0.0	0.0	6.57	0.0	0.0	0.0	0.0	10.17	0.0	37
0.0	0.0	6.35	0.0	0.0	0.0	0.0	4.75	0.0	38
0.0	0.0	1.63	0.0	0.0	0.0	0.0	5.19	0.0	39
0.0	0.0	0.0	0.0	0.0	0.0	50.89	0.0	0.0	40
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	41
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	42
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	43
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	44
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	45

WALL ROCKS SHOWN IN TABLE 1, APPENDIX 1.

TABLE 20 (CONTINUED)

SILICATE MINERALOGY (WEIGHT PERCENT)
TOTAL SAMPLE

CSWR	CBWR	PWR	HWR	SSWR	BASWR	ABWR	AWR	BMS	NO.
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5
0.0	0.0	17.10	0.0	0.0	0.0	0.0	0.0	0.0	6
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10
0.0	0.0	47.18	0.0	0.0	0.0	0.0	0.0	0.0	11
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12
0.0	0.0	0.0	0.0	29.95	0.0	0.0	0.0	0.0	13
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14
0.0	0.0	0.0	25.03	0.0	0.0	0.0	0.0	0.0	15
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16
0.0	0.0	3.23	0.0	0.0	0.0	0.0	0.0	0.0	17
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	19
5.21	0.0	0.0	0.0	1.11	0.0	0.0	0.0	0.0	20
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	21
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	22
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	23
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	24
0.0	4.79	0.0	0.0	0.0	0.0	0.0	0.0	0.0	25
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	26
0.59	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	27
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	25.68	28
0.0	0.0	0.0	0.0	0.0	29.53	16.94	0.0	0.0	29
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	30
5.12	24.12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	31
0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.83	0.0	32
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	33
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	34
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	35
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	36
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	37
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	38
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	39
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	40
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	41
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	42
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	43
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	44
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	45

WALL ROCKS SHOWN IN TABLE 1, APPENDIX 1.

TABLE 20 (CONTINUED)

SILICATE MINERALOGY (WEIGHT PERCENT)
TOTAL SAMPLE

GMS	SAF	SPL	SSPL	SBAF	SFWR	WOL	NO.
0.0	0.0	0.0	0.0	0.0	0.0	0.0	1
0.0	0.0	0.0	0.0	0.0	0.0	0.0	2
0.0	0.0	0.0	0.0	0.0	0.0	0.0	3
0.0	0.0	35.36	0.0	0.0	0.0	0.0	4
0.0	0.0	0.0	0.0	0.0	0.0	0.0	5
0.0	0.0	0.0	0.0	0.0	0.0	0.0	6
0.0	0.0	0.0	0.0	0.0	0.0	0.0	7
0.0	0.0	0.0	0.0	0.0	0.0	57.71	8
0.0	3.43	0.0	0.0	0.0	0.0	0.0	9
0.0	0.0	0.0	0.0	0.0	0.0	0.0	10
0.0	5.44	0.0	0.0	0.0	0.0	0.0	11
0.0	0.0	0.0	0.0	0.0	2.86	0.0	12
0.0	0.0	0.0	0.0	0.0	0.0	0.0	13
0.0	0.0	0.0	0.0	0.0	0.0	0.0	14
0.0	0.0	0.0	0.0	0.0	0.0	0.0	15
0.0	0.0	0.0	0.0	0.0	0.0	0.0	16
0.0	0.0	0.0	0.0	0.0	0.0	0.0	17
0.0	0.0	0.0	0.0	0.0	0.0	0.0	18
0.0	0.0	0.0	0.0	0.0	0.0	0.0	19
0.0	0.0	0.0	0.0	0.0	0.0	0.0	20
0.0	0.97	0.0	0.0	0.0	0.0	0.0	21
0.0	0.0	0.0	37.85	0.0	0.0	0.0	22
0.0	0.0	0.0	0.0	0.0	0.0	0.0	23
0.0	0.0	0.0	0.0	0.0	0.0	0.0	24
0.0	0.0	0.0	0.0	0.0	0.0	0.0	25
0.0	0.0	0.0	0.0	0.0	0.0	0.0	26
0.0	0.0	0.0	0.0	0.0	0.0	0.0	27
28.54	0.0	0.0	0.0	0.0	0.0	0.0	28
0.0	0.0	0.0	0.0	18.83	0.0	0.0	29
0.0	0.0	0.0	0.0	0.0	0.0	0.0	30
0.0	0.0	0.0	0.0	0.0	0.0	0.0	31
0.0	0.0	0.0	0.0	0.0	0.0	0.0	32
0.0	0.0	0.0	0.0	0.0	0.0	0.0	33
0.0	0.0	0.0	0.0	0.0	0.0	0.0	34
0.0	0.45	0.0	0.0	0.0	0.0	0.0	35
0.0	0.0	0.0	0.0	0.0	0.0	0.0	36
0.0	0.0	0.0	0.0	0.0	0.0	0.0	37
0.0	0.17	0.0	0.0	0.0	0.0	0.0	38
0.0	0.29	0.0	0.0	0.0	0.0	0.0	39
0.0	0.0	0.0	0.0	0.0	0.0	0.0	40
0.0	0.0	0.0	0.0	0.0	0.0	0.0	41
0.0	0.0	0.0	0.0	0.0	0.0	0.0	42
0.0	0.0	0.0	11.64	0.0	0.0	0.0	43
0.0	0.0	0.0	36.13	0.0	0.0	0.0	44
0.0	0.0	0.0	11.01	0.0	0.0	0.0	45

WALL ROCKS SHOWN IN TABLE 1, APPENDIX 1.

TABLE 20 (CONTINUED)

SYMBOLS USED FOR SILICATE MINERALS AND ALTERATION

SYMBOL	PRODUCT	SYMBOL	PRODUCT
CAL	CALCITE	BIO	BIOTITE(PHLOGOPITE)
QTZ	QUARTZ	GAR	GARNET
CHL	CHLORITE	FEL	ALKALI FELDSPAR
SER	SERICITE	PYR	PYROXENE
OLI	OLIVENE	DIO	DIOPSIDE
BAR	BARITE	HYP	HYPERSTHENE
TRE	TREMOLITE	UWR	UNALTERED WALL ROCK
ACT	ACTINOLITE	SID	SIDERITE
AUG	AUGITE	APA	APATITE
URA	URALITE	ZOI	ZOISITE-CLINOZOISITE
EPI	EPIDOTE	MUS	MUSCOVITE
CHD	CHLORITOID	SLL	SILLIMANITE
FLU	FLUORITE	GYP	GYPSUM-ANHYDRITE
OCB	OTHER CARBONATES	SRP	SERPENTINE
SUL	OTHER SULPHATES	APL	APLITE
HB 1	BLUE GREEN HORNBLENDE	HB 2	PALE GREEN HORNBLENDE
HB 3	GREENISH BROWN HORNBLENDE	QFM	MICROGRAPHIC QUARTZ AND FELDSPAR
PLA	PLAGIOCLASE	FWR	FELDSPAR + WALL ROCK
WOL	WOLLASTONITE	WRP	WALL ROCK + PLAGIOCLASE
SM	SMITHSONITE	CCS	CHERTY CHLORITE SCHIST
FQP	FELDSPAR AND QUARTZ DIORITE, QUARTZ PORPHYRY		

TABLE 20 (CONTINUED)

SYMBOLS USED FOR SILICATE MINERALS AND ALTERATION

SYMBOL	PRODUCT
SWR	SERICITIZED WALL ROCK
CWR	CHLORITIZED WALL ROCK
HWR	HORNBLENDIZED WALL ROCK
CBWR	CARBONATIZED WALL ROCK
PWR	PROPYLLITIZED WALL ROCK
AWR	ALBITIZED WALL ROCK
SCWR	SERICITIZED-CARBONATIZED WALL ROCK
SCTWR	SERICITIZED-CARBONATIZED-TOURMALINIZED WALL ROCK.
STWR	SERICITIZED-TOURMALINIZED WALL ROCK
SAWR	SERICITIZED-ARGILLITIZED WALL ROCK
CSCWR	CHLORITIZED-SERICITIZED-CARBONATIZED WALL ROCK
CSWR	CHLORITIZED-SERICITIZED WALL ROCK
SSWR	SAUSSERITIZED-SILICIFIED WALL ROCK
SLWR	SILICIFIED WALL ROCK
BASWR	BIOTITIZED-AUGITIZED-SERICITIZED WALL ROCK
ABWR	AUGITIZED-BIOTITIZED WALL ROCK
GMS	GREEN METASEDIMENTARY ROCK(CHLORITE RICH)
BMS	BROWN METASEDIMENTARY ROCK(BIOTITE RICH)
SAF	SERICITIZED ALKALI FELDSPAR
SPL	SERICITIZED PLAGIOCLASE
SBAF	SERICITIZED-BIOTITIZED ALKALI FELDSPAR
SFWR	SERICITIZED FELDSPAR + WALL ROCK
SSPL	SAUSSERITIZED PLAGIOCLASE
SSAF	SAUSSERITIZED ALKALI FELDSPAR

TABLE 21

GANGUE MINERAL GROUPS(WEIGHT PERCENT)
TOTAL SAMPLE

CARB-N	SILIC-N	CHL-N	AMPHIB	PYROX	SAUSS-N	SERIC-N	SUM	NO.
4.04	41.34	3.15	0.0	0.0	0.0	0.0	48.53	1
0.59	1.36	37.03	0.0	0.0	0.0	0.0	38.98	2
0.0	3.68	0.86	1.73	0.0	0.0	0.0	6.27	3
2.87	21.65	4.67	0.0	0.0	0.0	35.36	64.55	4
5.81	4.49	0.98	0.0	0.0	0.0	7.72	19.00	5
10.19	3.06	19.42	0.0	0.0	0.0	0.0	32.67	6
0.28	6.38	0.0	7.38	8.26	0.0	0.0	22.30	7
14.68	7.48	0.0	0.0	3.61	0.0	0.0	25.77	8
0.61	60.22	13.83	0.0	0.0	0.0	3.43	78.09	9
18.74	14.37	0.0	0.0	0.0	0.0	0.0	33.11	10
3.43	17.58	15.60	0.0	0.0	0.0	5.44	42.05	11
1.24	4.17	0.05	0.05	0.0	0.0	2.86	8.37	12
9.22	11.22	5.42	0.0	0.0	29.95	0.0	55.81	13
15.22	14.38	24.97	0.0	0.0	0.0	27.80	82.37	14
0.44	6.86	0.0	71.98	0.0	0.0	0.0	79.28	15
1.41	29.35	0.0	1.51	0.0	0.0	0.0	32.27	16
3.52	12.15	17.02	0.45	0.0	0.0	33.55	66.69	17
22.75	53.70	0.0	0.0	0.0	0.0	0.0	76.45	18
11.69	10.78	7.88	0.0	0.0	0.0	47.43	77.78	19
1.54	3.87	7.57	0.0	0.0	1.11	0.0	14.09	20
1.95	8.74	9.15	0.0	0.0	0.0	13.63	33.47	21
1.83	3.92	0.0	11.47	3.52	37.85	0.0	58.59	22
2.71	4.27	14.93	0.0	0.0	0.0	8.48	30.39	23
0.0	4.38	8.10	0.0	0.0	0.0	14.34	26.82	24
9.54	6.22	4.80	0.0	0.0	0.0	0.0	20.56	25
5.93	4.43	7.16	0.0	0.0	0.0	3.48	21.00	26
3.19	3.22	0.59	0.0	0.0	0.0	18.09	25.09	27
4.95	11.78	0.0	1.70	0.0	0.0	0.0	18.43	28
0.69	0.0	0.13	0.0	15.98	0.0	18.83	35.63	29
0.0	25.19	12.60	0.0	0.14	0.0	36.65	74.58	30
24.97	16.18	5.12	0.0	0.0	0.0	0.0	46.27	31
4.08	5.12	9.20	0.55	0.0	0.0	12.25	31.20	32
0.97	17.68	16.78	0.68	0.0	0.0	1.35	37.46	33
37.38	22.45	0.35	0.0	0.0	0.0	0.0	60.18	34
11.68	27.07	26.09	0.0	0.23	0.0	0.45	65.52	35
22.73	18.59	5.43	0.76	0.0	0.0	0.0	47.51	36
9.17	15.61	34.24	0.0	0.0	0.0	6.57	65.59	37
2.76	24.81	13.96	0.0	0.0	0.0	6.52	48.05	38
1.82	21.49	9.72	0.0	0.0	0.0	1.92	34.95	39
2.39	22.17	8.02	2.78	0.0	0.0	50.89	86.25	40
13.23	2.29	0.17	0.0	0.0	0.0	0.0	15.69	41
7.21	8.79	0.0	34.60	12.90	0.0	0.0	63.50	42
0.17	9.36	10.79	15.20	22.56	11.64	0.0	69.72	43
0.0	2.77	1.44	12.64	23.96	36.13	0.0	76.94	44
1.26	3.57	8.40	30.68	14.97	11.01	0.0	69.89	45

Carbonatization	CAL+CBWR+CCB+SID
Silicification	QTZ+SIWR
Chloritization	CHL+CHD+CWR+CSCWR+CSWR
Amphiboles	AMP+HB1+HB2+TRE+ACT+HWR
Pyroxenes	PYR+DIO+HYP+URA+AUG
Sausseritization	SSWR+SSPL+SSAF
Sericitization	SER+SPL+SWR+SCWR+SCTWR+STWR+SAWR +SAF+SBAF+SFWR

The -65+400 fraction silicate mineralogy and grouping is tabulated in Tables 9 and 10, Appendix 5. The silicate mineralogy computer program is listed in Table 7, Appendix 6.

Element Analyses

The ore samples were analyzed for nine elements. The results for the total sample are shown in Table 22. Results for the -65+400 fraction are shown in Table 6, Appendix 5. Only the total sample results are considered in this study.

Metal Ratios

Twelve metal ratios were calculated for each sample. The total sample ratios are shown in Table 24. Plots of many of these total sample ratio values are to be found with various figures to be discussed in the following section. The -65+400 fraction ratio values are in Table 7, Appendix 5.

TABLE 22

METAL ANALYSES
TOTAL SAMPLE

NI	CO	CU	ZN	PB	NO.
		WEIGHT PERCENT			
0.0001	0.0650	1.9200	0.5500	0.0001	1
0.0001	0.0015	1.1400	0.0001	0.0001	2
0.0001	0.1050	0.9200	5.6500	2.0500	3
0.0001	0.0610	2.4800	0.1000	0.0005	4
0.0001	0.0015	1.2200	14.4300	10.8700	5
0.0001	0.0050	2.0800	0.0001	0.0001	6
1.3990	0.0600	0.5600	0.0001	0.0003	7
0.0001	0.0015	1.2400	0.0001	0.0001	8
0.0130	0.0830	1.9800	0.0001	0.0300	9
0.0001	0.0015	0.0800	4.7400	2.2300	10
0.0001	0.0015	0.5700	0.0005	0.0001	11
0.0001	0.0250	3.2700	1.4500	0.1500	12
0.0080	0.0015	0.0800	13.8100	0.9700	13
0.0004	0.0400	2.4300	0.0001	0.0001	14
0.0001	0.0260	1.5900	0.0001	0.0003	15
0.0001	0.0015	2.1900	4.8000	0.1500	16
0.0001	0.0001	0.1000	3.6000	0.5000	17
0.0001	0.0001	0.1100	5.7100	8.6000	18
0.1230	0.0020	4.9400	0.0001	0.0001	19
0.0001	0.0340	2.0000	0.0001	0.0001	20
0.0001	0.0200	2.4700	5.4900	0.1900	21
0.0005	0.0200	5.5300	0.0005	0.0005	22
0.0003	0.0030	1.4500	2.0800	0.0006	23
0.0001	0.0350	5.4800	2.8300	0.0300	24
0.0001	0.0250	4.3200	3.8000	0.2000	25
0.0001	0.0740	12.0800	0.0400	0.0001	26
0.0001	0.0300	4.3100	13.4600	0.0001	27
0.0001	0.0200	1.6800	0.0001	0.0001	28
0.0001	0.0001	0.8800	0.0001	0.0001	29
0.0001	0.0001	0.9900	1.2400	0.0001	30
0.0001	0.0400	2.0800	0.0001	0.0001	31
0.0001	0.0001	0.0001	7.0200	7.0500	32
0.0001	0.0001	0.9000	0.1000	0.0001	33
0.0001	0.0001	0.0003	7.1300	17.1800	34
0.0001	0.0001	0.2900	8.3100	6.0100	35
0.0001	0.0001	0.6400	0.0005	0.0001	36
0.1700	0.0600	3.4600	1.1100	0.0001	37
0.0001	0.0600	2.3800	0.7400	0.0001	38
0.0800	0.0870	2.0100	0.0001	0.0001	39
0.0001	0.0001	0.9500	0.0001	0.0001	40
0.0005	0.0300	0.8100	3.1800	3.9800	41
0.0001	0.0001	0.1500	5.4500	2.0800	42
0.3100	0.0200	0.7600	0.0001	0.1000	43
0.3500	0.0060	0.3300	0.0001	0.1600	44
1.2510	0.0700	0.4200	0.0002	0.0001	45
		3.3	6.6		46

NI-CO-CU-ZN-PB-FE-AU-AG BY MAN. MINES BRANCH LAB.
SULPHUR BY THE UNIV. OF MAN.

TABLE 22 (CONTINUED)

METAL ANALYSES
TOTAL SAMPLE

FE	S	AU	AG	NO.
WEIGHT PERCENT		OZ / TON		
28.0600	21.3500	0.0280	0.4000	1
26.3300	16.0500	0.0490	0.1900	2
38.7700	40.9500	0.0250	2.5800	3
16.4900	11.8000	0.0340	0.7900	4
4.4900	15.6000	0.0430	4.7800	5
24.9500	2.2500	0.0040	0.0001	6
19.2700	6.7500	0.0005	0.5200	7
6.5400	1.6500	0.0060	0.2800	8
13.3800	6.8500	0.0070	0.2600	9
3.2800	8.2500	0.0030	1.2500	10
11.1600	3.4000	0.0040	0.1500	11
39.2300	38.7500	0.0070	0.7000	12
11.6500	14.1000	0.0250	7.1200	13
19.4300	5.7500	0.0700	0.3200	14
15.7200	2.5500	0.0190	0.2000	15
18.5400	18.7500	0.0410	3.0600	16
5.1900	10.4000	0.0350	5.0000	17
8.2400	5.2500	0.0130	38.1800	18
8.9400	5.7500	0.0120	0.3870	19
43.8500	30.6500	0.1510	0.5000	20
23.2100	22.1500	0.0530	2.0780	21
20.1100	8.3500	0.0510	0.7950	22
33.7000	27.1500	0.1390	1.0140	23
27.7100	20.6000	0.0420	1.1700	24
29.6000	30.0500	0.1010	1.8400	25
31.1000	28.8500	0.0130	0.3090	26
21.3800	27.3400	0.0410	1.2910	27
9.8100	3.3000	0.0130	0.0001	28
5.3100	0.8000	0.0040	0.0670	29
7.7800	7.2000	0.0410	0.0610	30
9.1400	7.2000	0.0200	0.0220	31
23.8400	19.3000	0.0001	2.0740	32
1.6000	3.2000	0.0005	0.0001	33
11.6200	8.5500	0.0230	58.8940	34
7.4700	7.7000	0.0900	42.4370	35
9.9000	2.5400	0.0290	0.2200	36
22.6400	10.0900	0.0650	0.1500	37
24.8400	15.7100	0.1520	0.9690	38
30.3000	20.0400	0.0350	0.1600	39
3.1300	0.6500	0.0001	0.0001	40
19.5100	7.8100	0.0001	13.7000	41
7.0000	5.9400	0.0270	3.4450	42
11.8700	4.8700	0.0001	0.0001	43
9.3100	3.0100	0.0001	0.0001	44
19.5200	9.8100	0.0001	0.0001	45

NI-CO-CU-ZN-PB-FE-AU-AG BY MAN. MINES BRANCH LAB.
SULPHUR BY THE UNIV. OF MAN.

TABLE 23

TABLE OF ASSAY EQUIVALENTS FOR USE WITH THE COMPUTER.

ASSAY	COMPUTER
LESS THAN 0.001	0.0005
LESS THAN 0.002	0.0015
LESS THAN 0.005	0.0040
TR AND FAINT TR	0.0005
NIL	0.0001

TABLE 24

METAL RATIOS
TOTAL SAMPLE

CO/CO+NI	NI/CO+NI	CU/CU+NI	NI/CU+NI	CO/CO+CU	AU/AU+AG	AG/AU+AG	NO.
0.998	0.002	1.000	0.000	0.033	0.065	0.935	1
0.938	0.063	1.000	0.000	0.001	0.205	0.795	2
0.999	0.001	1.000	0.000	0.102	0.010	0.990	3
0.998	0.002	1.000	0.000	0.024	0.041	0.959	4
0.938	0.063	1.000	0.000	0.001	0.009	0.991	5
0.980	0.020	1.000	0.000	0.002	0.976	0.024	6
0.041	0.959	0.286	0.714	0.097	0.001	0.999	7
0.938	0.063	1.000	0.000	0.001	0.021	0.979	8
0.865	0.135	0.993	0.007	0.040	0.026	0.974	9
0.938	0.063	0.999	0.001	0.018	0.002	0.998	10
0.938	0.063	1.000	0.000	0.003	0.026	0.974	11
0.996	0.004	1.000	0.000	0.008	0.010	0.990	12
0.158	0.842	0.909	0.091	0.018	0.003	0.997	13
0.990	0.010	1.000	0.000	0.016	0.179	0.821	14
0.996	0.004	1.000	0.000	0.016	0.087	0.913	15
0.938	0.063	1.000	0.000	0.001	0.013	0.987	16
0.500	0.500	0.999	0.001	0.001	0.007	0.993	17
0.500	0.500	0.999	0.001	0.001	0.000	1.000	18
0.016	0.984	0.976	0.024	0.000	0.030	0.970	19
0.997	0.003	1.000	0.000	0.017	0.232	0.768	20
0.995	0.005	1.000	0.000	0.008	0.025	0.975	21
0.976	0.024	1.000	0.000	0.004	0.060	0.940	22
0.909	0.091	1.000	0.000	0.002	0.121	0.879	23
0.997	0.003	1.000	0.000	0.006	0.035	0.965	24
0.996	0.004	1.000	0.000	0.006	0.052	0.948	25
0.999	0.001	1.000	0.000	0.006	0.040	0.960	26
0.997	0.003	1.000	0.000	0.007	0.031	0.969	27
0.995	0.005	1.000	0.000	0.012	0.992	0.008	28
0.500	0.500	1.000	0.000	0.000	0.056	0.944	29
0.500	0.500	1.000	0.000	0.000	0.402	0.598	30
0.998	0.002	1.000	0.000	0.019	0.476	0.524	31
0.500	0.500	0.500	0.500	0.500	0.000	1.000	32
0.500	0.500	1.000	0.000	0.000	0.833	0.167	33
0.500	0.500	0.750	0.250	0.250	0.000	1.000	34
0.500	0.500	1.000	0.000	0.000	0.002	0.998	35
0.500	0.500	1.000	0.000	0.000	0.116	0.884	36
0.261	0.739	0.953	0.047	0.017	0.302	0.698	37
0.998	0.002	1.000	0.000	0.025	0.136	0.864	38
0.521	0.479	0.962	0.038	0.041	0.179	0.821	39
0.500	0.500	1.000	0.000	0.000	0.500	0.500	40
0.984	0.016	0.999	0.001	0.036	0.000	1.000	41
0.500	0.500	0.999	0.001	0.001	0.008	0.992	42
0.061	0.939	0.710	0.290	0.026	0.500	0.500	43
0.017	0.983	0.485	0.515	0.018	0.500	0.500	44
0.053	0.947	0.251	0.749	0.143	0.500	0.500	45

TABLE 24 (CONTINUED)

METAL RATIOS
TOTAL SAMPLE

CU/CU+ZN+PB	ZN/CU+ZN+PB	PB/CU+ZN+PB	CU/CO+CU	AU/AG	NO.
0.777	0.223	0.000	0.967	14.286	1
1.000	0.000	0.000	0.999	3.878	2
0.107	0.655	0.238	0.898	103.200	3
0.961	0.039	0.000	0.976	23.235	4
0.046	0.544	0.410	0.999	111.163	5
1.000	0.000	0.000	0.998	0.025	6
0.999	0.000	0.001	0.903	1040.000	7
1.000	0.000	0.000	0.999	46.667	8
0.985	0.000	0.015	0.960	37.143	9
0.011	0.672	0.316	0.982	416.667	10
0.999	0.001	0.000	0.997	37.500	11
0.671	0.298	0.031	0.992	100.000	12
0.005	0.929	0.065	0.982	284.800	13
1.000	0.000	0.000	0.984	4.571	14
1.000	0.000	0.000	0.984	10.526	15
0.307	0.672	0.021	0.999	74.634	16
0.024	0.857	0.119	0.999	142.857	17
0.008	0.396	0.596	0.999	2936.923	18
1.000	0.000	0.000	1.000	32.250	19
1.000	0.000	0.000	0.983	3.311	20
0.303	0.674	0.023	0.992	39.208	21
1.000	0.000	0.000	0.996	15.588	22
0.411	0.589	0.000	0.998	7.295	23
0.657	0.339	0.004	0.994	27.857	24
0.519	0.457	0.024	0.994	18.218	25
0.997	0.003	0.000	0.994	23.769	26
0.243	0.757	0.000	0.993	31.488	27
1.000	0.000	0.000	0.988	0.008	28
1.000	0.000	0.000	1.000	16.750	29
0.444	0.556	0.000	1.000	1.488	30
1.000	0.000	0.000	0.981	1.100	31
0.000	0.499	0.501	0.500	20739.992	32
0.900	0.100	0.000	1.000	0.200	33
0.000	0.293	0.707	0.750	2560.609	34
0.020	0.569	0.411	1.000	471.522	35
0.999	0.001	0.000	1.000	7.586	36
0.757	0.243	0.000	0.983	2.308	37
0.763	0.237	0.000	0.975	6.375	38
1.000	0.000	0.000	0.959	4.571	39
1.000	0.000	0.000	1.000	1.000	40
0.102	0.399	0.499	0.964	137000.000	41
0.020	0.710	0.271	0.999	127.593	42
0.884	0.000	0.116	0.974	1.000	43
0.673	0.000	0.326	0.982	1.000	44
0.999	0.000	0.000	0.857	1.000	45

TABLE 25

CALCULATED 100 WEIGHT PERCENT CU-PB-ZN
TOTAL SAMPLE

PROP. NO.	CU	ZN	PB	TOTAL	AU/ AU+AG	FE/ FE+ S
1	77.730	22.266	0.004	100.000	0.065	0.568
2	99.983	0.009	0.009	100.000	0.205	0.621
3	10.673	65.545	23.782	100.000	0.010	0.486
4	96.105	3.875	0.019	100.000	0.041	0.583
5	4.600	54.412	40.988	100.000	0.009	0.223
6	99.990	0.005	0.005	100.000	0.976	0.917
7	99.929	0.018	0.054	100.000	0.001	0.741
8	99.984	0.008	0.008	100.000	0.021	0.799
9	98.503	0.005	1.492	100.000	0.026	0.661
10	1.135	67.234	31.631	100.000	0.002	0.284
11	99.895	0.088	0.018	100.000	0.026	0.766
12	67.146	29.774	3.080	100.000	0.010	0.503
13	0.538	92.934	6.528	100.000	0.003	0.452
14	99.992	0.004	0.004	100.000	0.179	0.772
15	99.975	0.006	0.019	100.000	0.087	0.860
16	30.672	67.227	2.101	100.000	0.013	0.497
17	2.381	85.714	11.905	100.000	0.007	0.333
18	0.763	39.598	59.639	100.000	0.000	0.611
19	99.996	0.002	0.002	100.000	0.030	0.609
20	99.990	0.005	0.005	100.000	0.232	0.589
21	30.307	67.362	2.331	100.000	0.025	0.512
22	99.982	0.009	0.009	100.000	0.060	0.707
23	41.069	58.913	0.017	100.000	0.121	0.554
24	65.707	33.933	0.360	100.000	0.035	0.574
25	51.923	45.673	2.404	100.000	0.052	0.496
26	99.669	0.330	0.001	100.000	0.040	0.519
27	24.254	75.745	0.001	100.000	0.031	0.439
28	99.988	0.006	0.006	100.000	0.992	0.748
29	99.977	0.011	0.011	100.000	0.056	0.869
30	44.393	55.603	0.004	100.000	0.402	0.519
31	99.990	0.005	0.005	100.000	0.476	0.559
32	0.001	49.893	50.106	100.000	0.000	0.553
33	89.991	9.999	0.010	100.000	0.833	0.333
34	0.001	29.329	70.670	100.000	0.000	0.576
35	1.985	56.879	41.136	100.000	0.002	0.492
36	99.906	0.078	0.016	100.000	0.116	0.796
37	75.709	24.288	0.002	100.000	0.302	0.692
38	76.280	23.717	0.003	100.000	0.136	0.613
39	99.990	0.005	0.005	100.000	0.179	0.602
40	99.979	0.011	0.011	100.000	0.500	0.828
41	10.163	39.900	49.937	100.000	0.000	0.714
42	1.953	70.964	27.083	100.000	0.008	0.541
43	88.362	0.012	11.627	100.000	0.500	0.709
44	67.333	0.020	32.646	100.000	0.500	0.756
45	99.929	0.048	0.024	100.000	0.500	0.666

TABLE 26

CALCULATED 100 ATOMIC PERCENT CU-PB-ZN

PROP. NO.	TOTAL SAMPLE CU	ZN	PB	TOTAL	AU/ AU+AG	FE/ FE+ S
1	77.225	22.762	0.013	100.000	0.065	0.568
2	99.962	0.009	0.029	100.000	0.205	0.621
3	6.856	43.324	49.820	100.000	0.010	0.486
4	95.956	3.981	0.063	100.000	0.041	0.583
5	2.368	28.822	68.810	100.000	0.009	0.223
6	99.979	0.005	0.016	100.000	0.976	0.917
7	99.807	0.018	0.174	100.000	0.001	0.741
8	99.965	0.008	0.026	100.000	0.021	0.799
9	95.287	0.005	4.708	100.000	0.026	0.661
10	0.654	39.881	59.465	100.000	0.002	0.284
11	99.853	0.090	0.057	100.000	0.026	0.766
12	62.272	28.413	9.315	100.000	0.010	0.503
13	0.458	81.417	18.124	100.000	0.003	0.452
14	99.982	0.004	0.013	100.000	0.179	0.772
15	99.932	0.006	0.061	100.000	0.087	0.860
16	28.747	64.832	6.421	100.000	0.013	0.497
17	1.840	68.158	30.002	100.000	0.007	0.333
18	0.323	17.265	82.412	100.000	0.000	0.611
19	99.991	0.002	0.007	100.000	0.030	0.609
20	99.979	0.005	0.016	100.000	0.232	0.589
21	28.265	64.644	7.090	100.000	0.025	0.512
22	99.961	0.009	0.029	100.000	0.060	0.707
23	40.365	59.580	0.054	100.000	0.121	0.554
24	64.548	34.299	1.152	100.000	0.035	0.574
25	48.636	44.021	7.343	100.000	0.052	0.496
26	99.658	0.340	0.003	100.000	0.040	0.519
27	23.733	76.265	0.002	100.000	0.031	0.439
28	99.974	0.006	0.019	100.000	0.992	0.748
29	99.951	0.012	0.037	100.000	0.056	0.869
30	43.685	56.301	0.014	100.000	0.402	0.519
31	99.979	0.005	0.016	100.000	0.476	0.559
32	0.000	23.907	76.093	100.000	0.000	0.553
33	89.711	10.257	0.033	100.000	0.833	0.333
34	0.000	11.579	88.421	100.000	0.000	0.576
35	1.020	30.066	68.915	100.000	0.002	0.492
36	99.869	0.080	0.051	100.000	0.116	0.796
37	75.177	24.816	0.007	100.000	0.302	0.692
38	75.754	24.236	0.010	100.000	0.136	0.613
39	99.979	0.005	0.016	100.000	0.179	0.602
40	99.955	0.011	0.034	100.000	0.500	0.828
41	4.748	19.178	76.074	100.000	0.000	0.714
42	1.196	44.716	54.088	100.000	0.008	0.541
43	69.968	0.009	30.023	100.000	0.500	0.709
44	38.738	0.012	61.250	100.000	0.500	0.756
45	99.874	0.049	0.078	100.000	0.500	0.666

Normalized Three Metal Groups

A number of the more important normalized three metal (or element) groups were calculated, tabulated, and the results analyzed graphically.

Copper-Zinc-Lead (Cu-Zn-Pb)

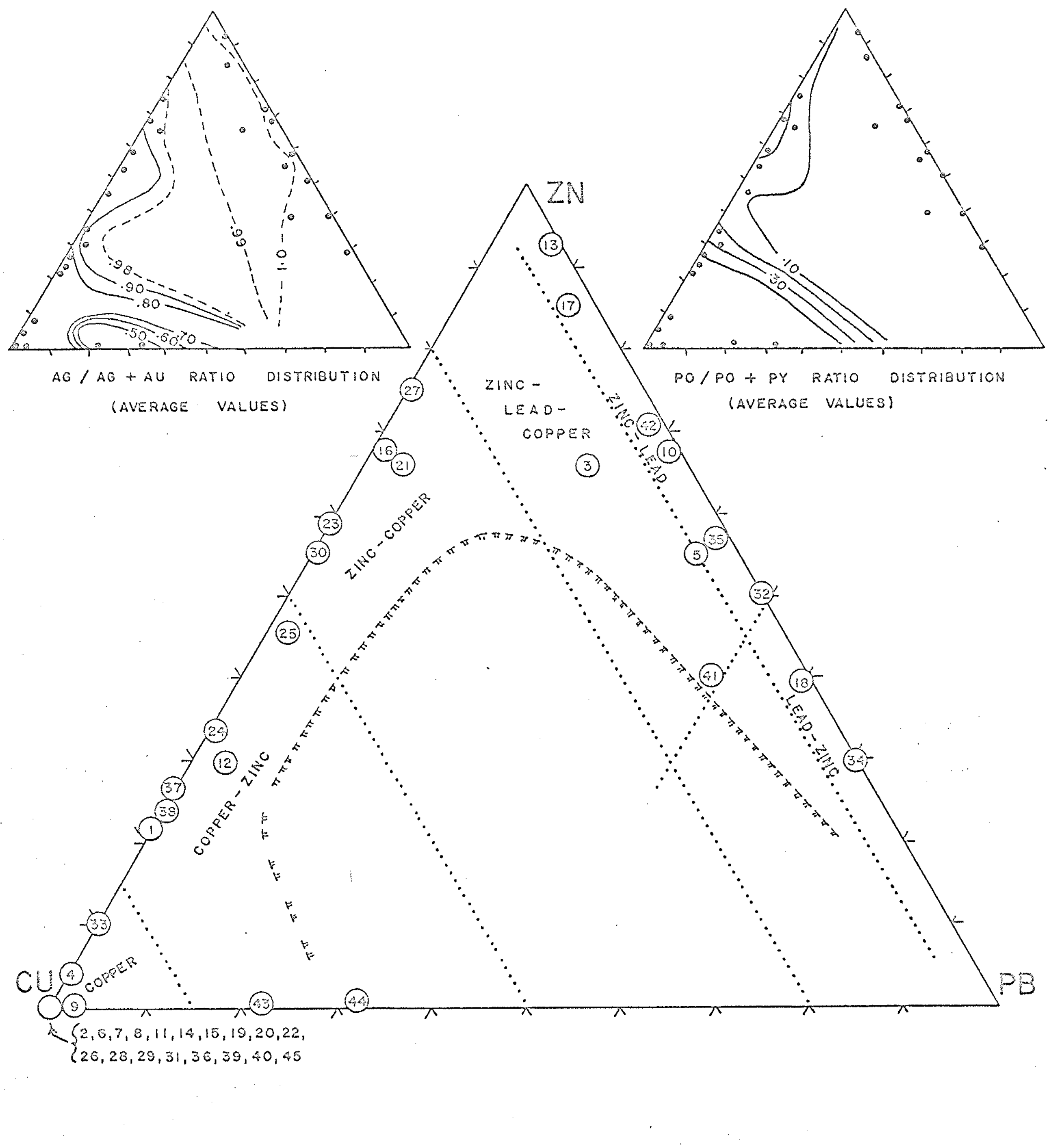
The normalized copper-zinc-lead values (weight percent) as shown in Table 25 were plotted on a triangular diagram (Figure 15) to study the distribution of the ore deposits and to classify the deposits according to ore type. This ore type classification has been discussed previously.

The distribution of points in Figure 15 shows that these ores fall along the Cu-Zn and Zn-Pb tie lines as previously noted by Kilburn (1959, 1960) and Wilson and Anderson (1959). Copper-lead deposits either do not exist or are extremely rare. Figure 16 illustrates a similar distribution of the ores when plotting was done using atomic percent values for copper, zinc, and lead. The atomic percent values are shown in Table 26. The distribution diagram of the averaged values of the pyrrhotite/pyrrhotite+pyrite ratio (Po/Po+Py) (Figure 15, small triangular diagram) illustrates the variation in ratio value with changes in ore type. High ratio values occur at the Cu corner of the diagram and the ratio decreases toward the Pb-Zn side of the diagram. Conversely, the silver-gold ratio (Ag/Ag+Au) is least in the Cu corner and increases toward the Pb-Zn side of the diagram (Figure 15, small triangular

FIGURE 15

Property and Po/Po + Py Distribution Based on Normalized Copper-Lead-Zinc Values (Weight %)

(TOTAL SAMPLE)



············ BOUNDARY OF DEPOSIT TYPE FIELD.

╥╥╥╥╥ BOUNDARY OF CU-ZN-PB RATIO FIELD.

TABLE 27

NORMALIZED WEIGHT PERCENT IRON, SULPHUR, AND OTHER METALS
TOTAL SAMPLE

FE	CO+NI+CU+PB+ZN	SULPHUR	NO.
54.02	4.88	41.10	1
60.50	2.62	36.88	2
43.84	9.86	46.30	3
53.31	8.54	38.15	4
9.63	56.90	33.47	5
85.20	7.12	7.68	6
68.72	7.20	24.07	7
69.34	13.17	17.49	8
59.90	9.43	30.67	9
17.65	37.95	44.40	10
73.75	3.78	22.47	11
47.34	5.91	46.76	12
28.68	36.61	34.71	13
70.27	8.94	20.80	14
79.05	8.13	12.82	15
41.73	16.07	42.20	16
26.23	21.22	52.55	17
29.52	51.67	18.81	18
45.25	25.64	29.11	19
57.29	2.66	40.05	20
43.36	15.26	41.38	21
59.13	16.32	24.55	22
52.34	5.49	42.17	23
48.88	14.77	36.34	24
43.53	12.27	44.19	25
43.11	16.90	39.99	26
32.14	26.76	41.10	27
66.24	11.48	22.28	28
75.96	12.59	11.44	29
45.21	12.96	41.84	30
49.51	11.49	39.00	31
41.67	24.59	33.74	32
27.58	17.25	55.17	33
26.12	54.65	19.22	34
25.08	49.06	25.86	35
75.68	4.90	19.42	36
60.32	12.79	26.89	37
56.80	7.27	35.92	38
57.70	4.15	38.16	39
66.17	20.09	13.74	40
55.24	22.65	22.11	41
33.95	37.25	28.81	42
66.20	6.64	27.16	43
70.71	6.43	22.86	44
62.82	5.60	31.57	45

FIGURE 16

Property Distribution Based on Normalized Copper-Lead-Zinc Values (Atomic %)
(TOTAL SAMPLE)

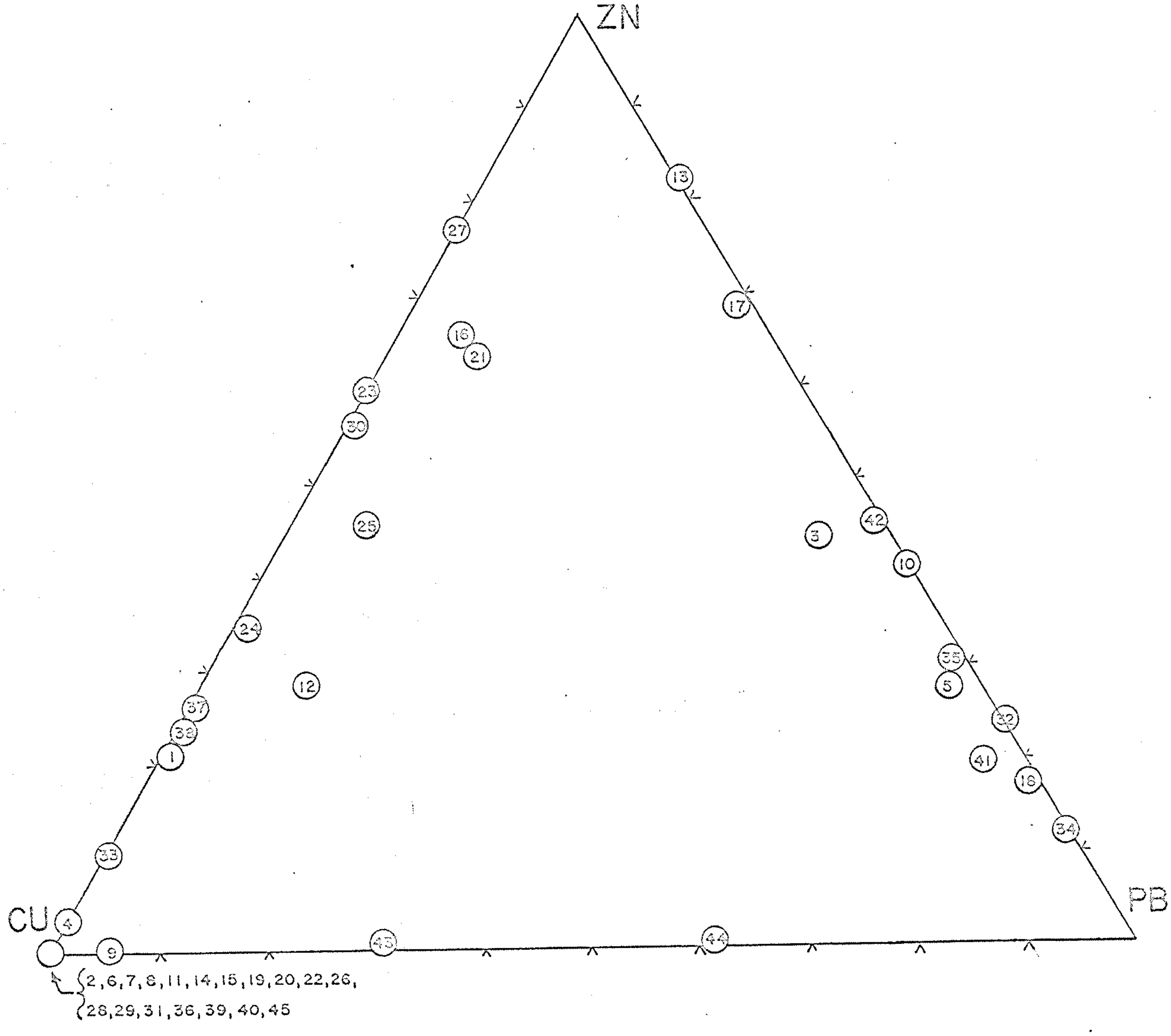


diagram).

Iron-Sulphur-Other Metals

Analyses for iron (Fe), sulphur (S), and other metals (Co Ni Cu Zn Pb) were normalized and tabulated (Table 27). The triangular plot of the ore deposits based on these calculated values (Figure 17) with the ores differentiated according to ore type and wall rock, shows considerable point scatter and poor grouping. Examination of the point distribution according to the groups defined in Figure 10 (Page 69) shows the Group A (ultrabasic and basic wall rocks with copper-nickel and copper ores) deposits lie close to the Fe-S tie line about midway between Fe and S. Group B deposits (copper and copper-zinc ores in acid intrusion and contact metamorphic wall rocks) fall close to the Fe corner along the Fe-S tie line. Group C deposits (zinc-copper and zinc-lead types in acid volcanic and sedimentary wall rocks) have considerable scatter throughout the center of the diagram. Ores with definite igneous associations fall close to the Fe-S tie line whereas ores with less definite igneous affiliations (replacement type) tend to occupy intermediate positions in the diagram.

The distribution of the deposits according to the above metal ratios in their respective physiographic division of the country are shown in Figures 18, 19, and 20. The grouping of the ore types for the Canadian Shield group (Figures 18 and 21) indicates a variation of deposits from high to low iron as the type changes from copper-nickel

FIGURE 17

Plots of Normalized FE - S - OTHER METALS (Weight %)

(TOTAL SAMPLE)

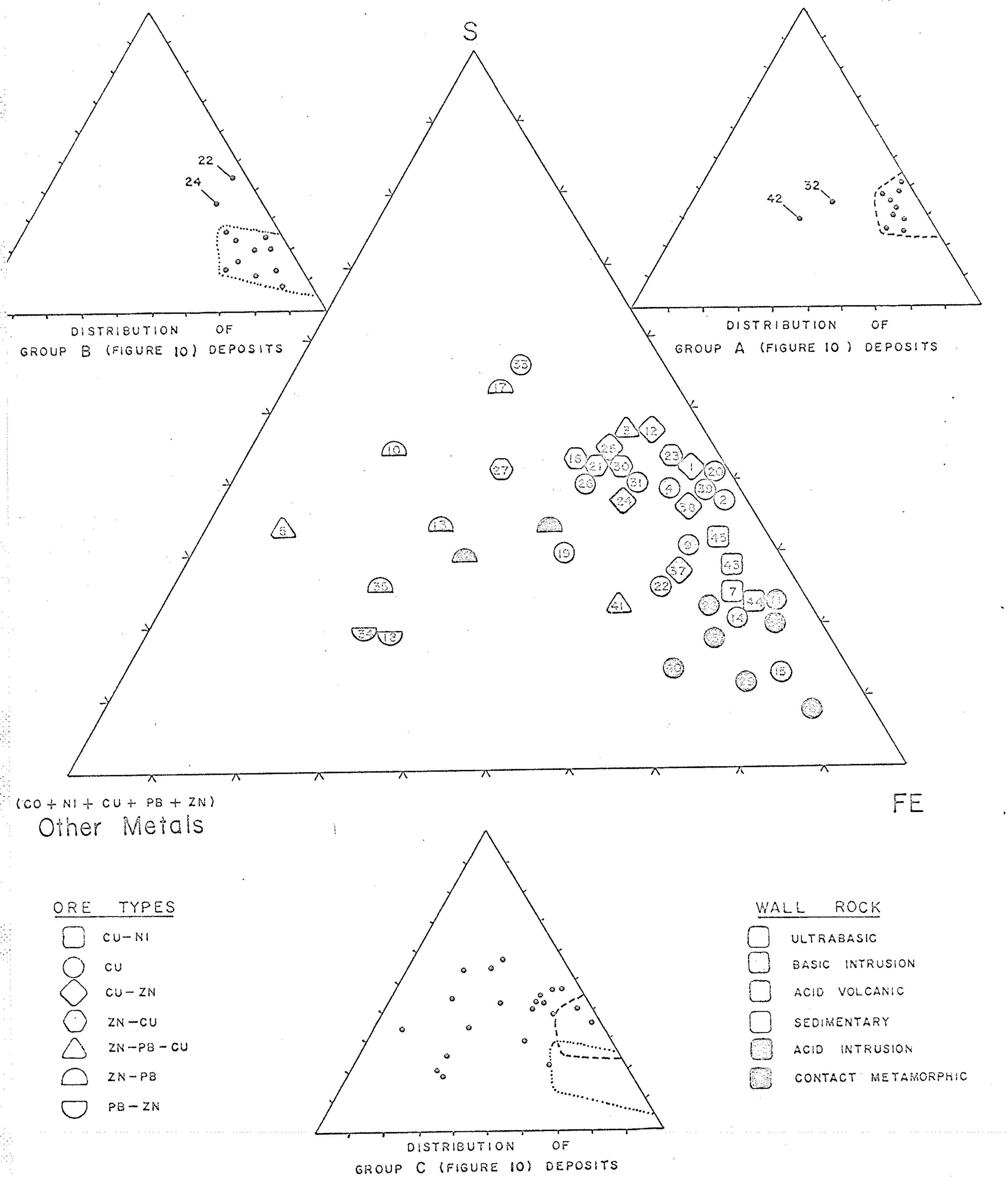
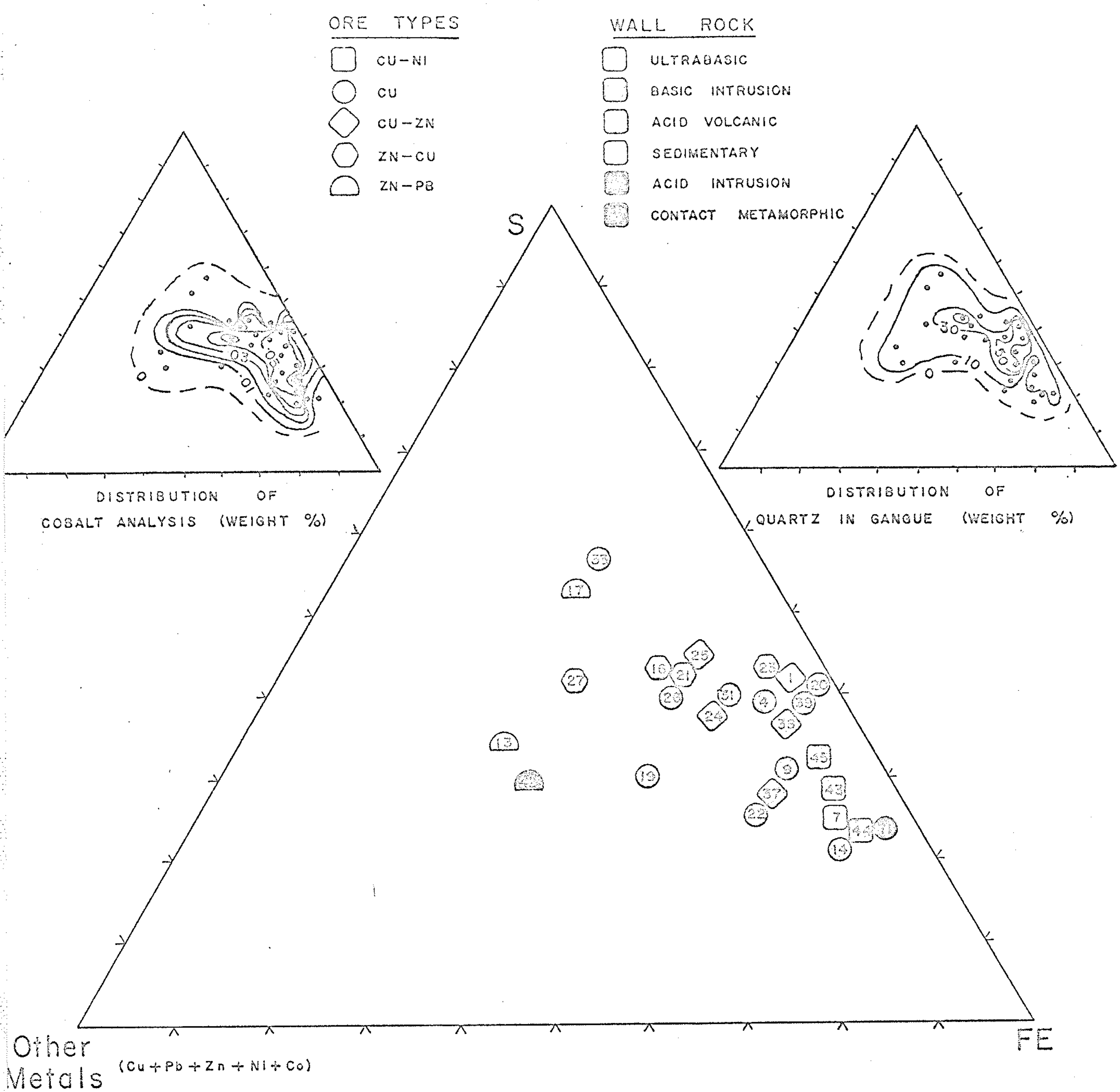


FIGURE 18

Plot of Normalized FE – S – OTHER METALS (Weight %)

PLUS COBALT AND QUARTZ IN GANGUE DISTRIBUTION DIAGRAMS

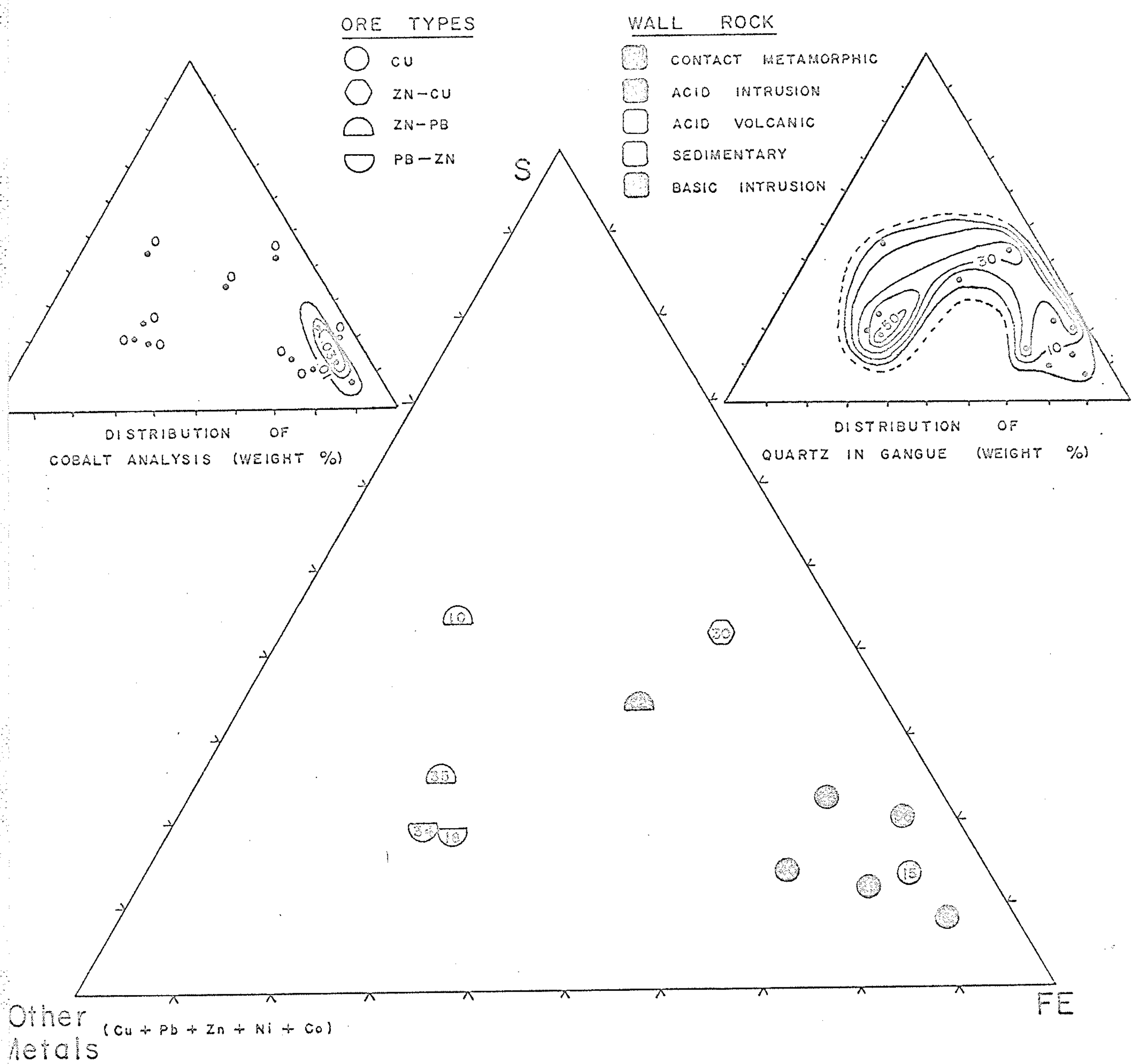
FOR THE CANADIAN SHIELD GROUP. (TOTAL SAMPLE)



CANADIAN SHIELD GROUP

FIGURE 19

Plot of Normalized FE - S - OTHER METALS (Weight %) PLUS COBALT AND QUARTZ IN GANGUE DISTRIBUTION DIAGRAMS FOR THE CORDILLERAN GROUP. (TOTAL SAMPLE)



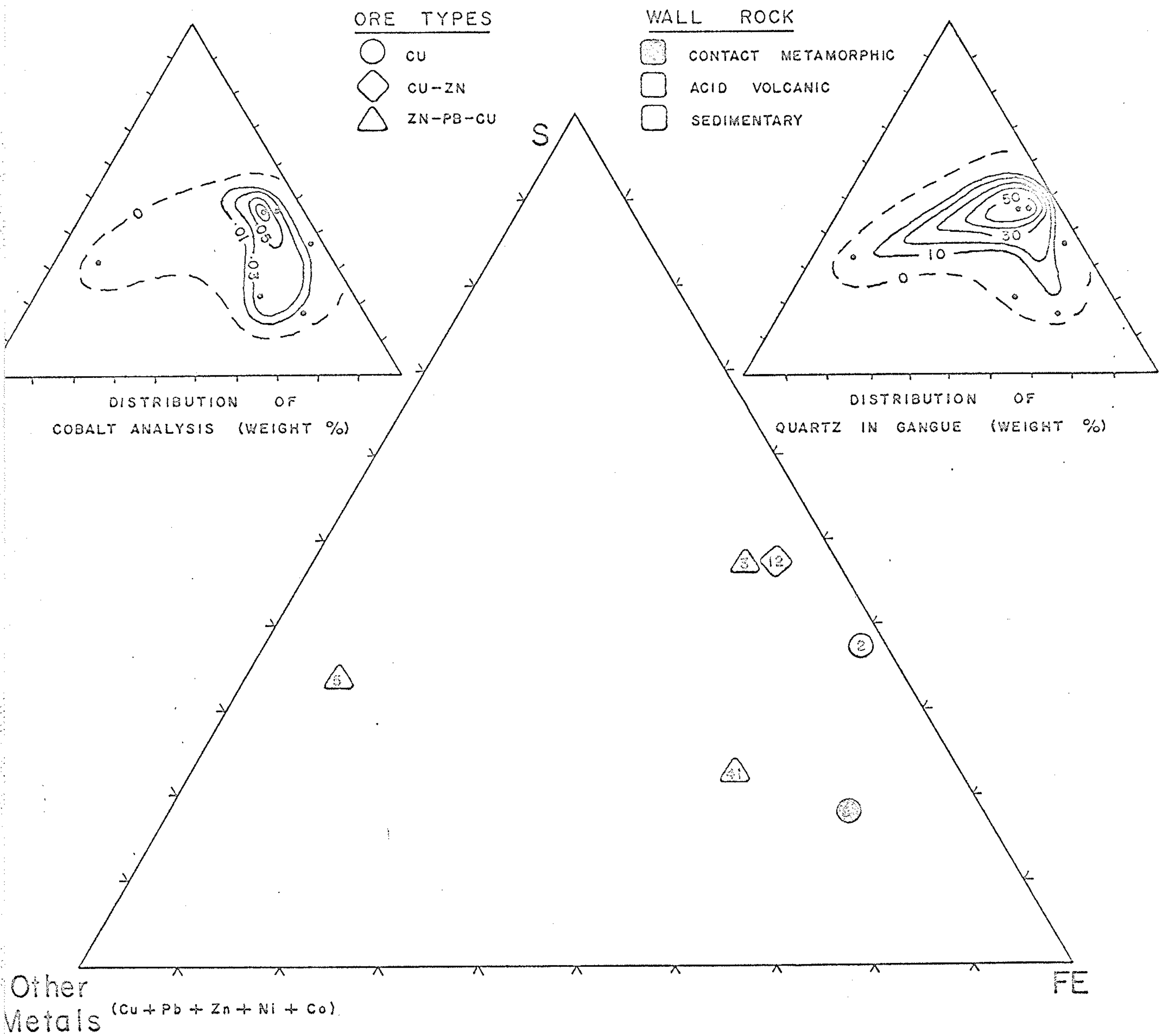
CORDILLERAN GROUP

FIGURE 20

Plot of Normalized FE - S - OTHER METALS (Weight %)

PLUS COBALT AND QUARTZ IN GANGUE DISTRIBUTION DIAGRAMS

FOR THE APPALACHIAN GROUP. (TOTAL SAMPLE)



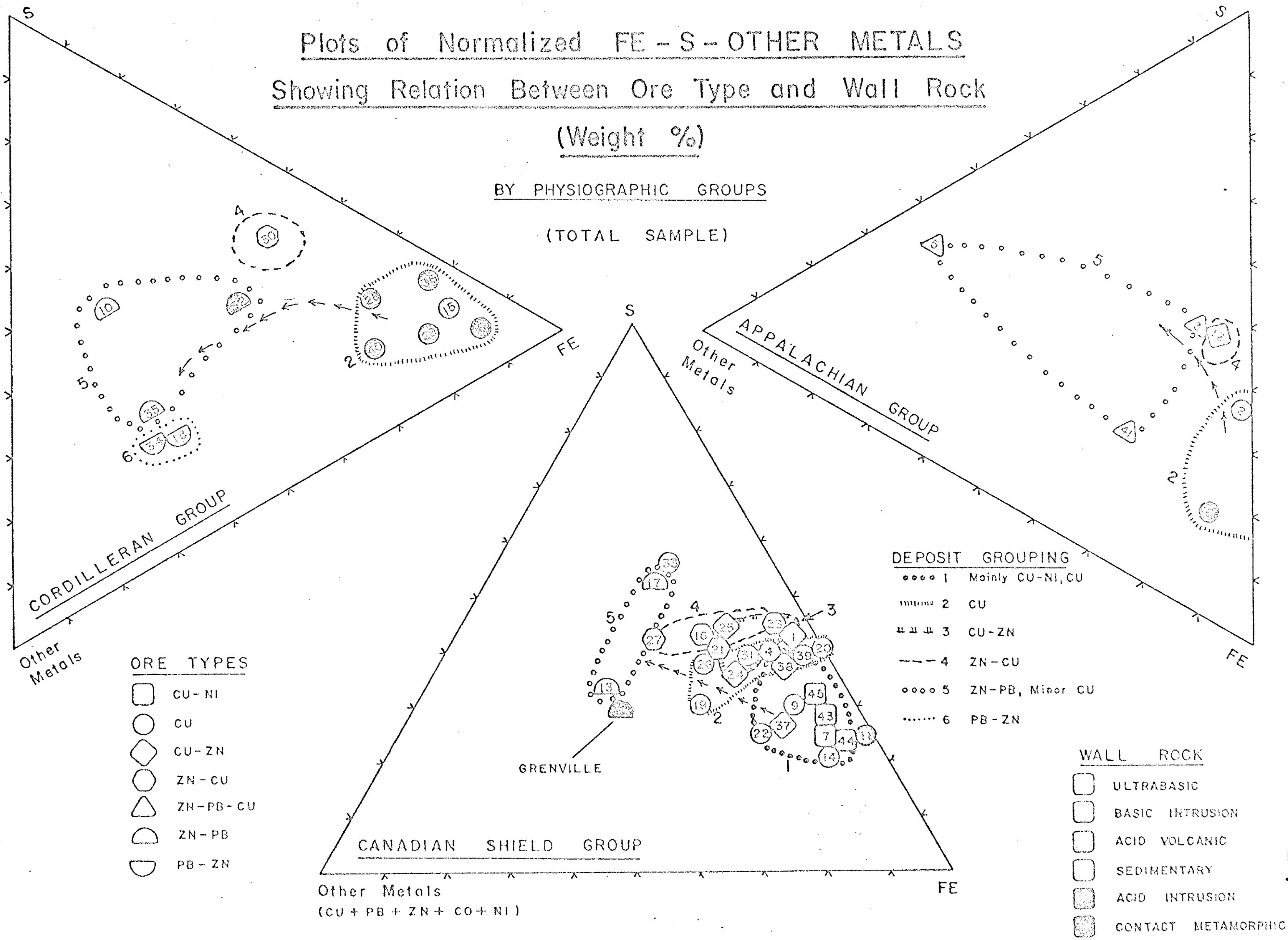
APPALACHIAN GROUP

FIGURE 21

Plots of Normalized FE - S - OTHER METALS Showing Relation Between Ore Type and Wall Rock (Weight %)

BY PHYSIOGRAPHIC GROUPS

(TOTAL SAMPLE)



to lead-zinc. Similarily, the distributions of quartz in gangue and cobalt content of the ores (Figure 18, small triangular diagrams) show that quartz increases and cobalt decreases as the ores change from copper-nickel to lead-zinc types and the wall rocks vary from basic to acid.

Similar results were noted for the Cordilleran group (Figures 19 and 21) and the Appalachian group (Figures 20 and 21). Figure 21 summarizes these variations of the ores in the three physiographic groups according to wall rock and ore type and iron, sulphur, and other metal contents of the ores. It is readily apparent that there is a regular variation of ores with definite igneous associations to ores of questionable igneous or magmatic affiliations as the iron and cobalt content of the ores decreases and the quartz content increases.

<u>Copper+Nickel-Zinc+Lead-Iron (Cu+Ni-Zn+Pb-Fe)</u>

Partial triangular diagrams for these element groups according to physiographic groupings are shown in Figure 22. The normalized values are shown in Table 28. The distribution of the lead ratio values (Pb/Cu+Zn+Pb) is also shown. The deposits have been grouped according to wall rock type. In the Canadian Shield group, ores vary from ultrabasic-basic wall rock types in the Fe corner toward the Cu+Ni and Zn+Pb sides of the diagrams as the wall rocks and ore types change. Several specific mining areas have been singled out regarding these changes. Deposits 39 (Campbell Chibougamau, Winze Zone), 38 (Campbell Chibougamau, B Zone),

TABLE 28

NORMALIZED CU + NI, ZN + PB, AND FE
TOTAL SAMPLE

CU + NI	ZN + PB	FE	NO.
6.28	1.80	91.90	1
4.15	0.00	95.84	2
1.94	16.24	81.81	3
13.00	.52	86.46	4
3.93	81.58	14.47	5
7.69	0.00	92.30	6
9.22	0.00	90.77	7
15.93	0.00	84.05	8
12.93	.19	86.86	9
.77	67.47	31.75	10
4.85	0.00	95.13	11
7.41	3.62	88.95	12
.33	55.73	43.93	13
11.11	0.00	88.88	14
9.18	0.00	90.81	15
8.52	19.27	72.19	16
1.06	43.66	55.27	17
.48	63.15	36.36	18
36.15	0.00	63.84	19
4.36	0.00	95.63	20
7.87	18.11	74.01	21
21.56	0.00	78.42	22
3.89	5.58	90.51	23
15.20	7.93	76.86	24
11.39	10.54	78.05	25
27.95	.09	71.95	26
11.00	34.38	54.61	27
14.62	0.00	85.37	28
14.21	0.00	85.77	29
9.89	12.38	77.72	30
18.53	0.00	81.45	31
0.00	37.11	62.88	32
34.61	3.84	61.53	33
0.00	67.65	32.34	34
1.31	64.85	33.83	35
6.07	0.00	93.92	36
13.25	4.05	82.68	37
8.51	2.64	88.84	38
6.45	0.00	93.54	39
23.28	0.00	76.71	40
2.94	26.05	70.99	41
1.02	51.29	47.68	42
8.20	.76	91.02	43
6.69	1.57	91.72	44
7.88	0.00	92.11	45

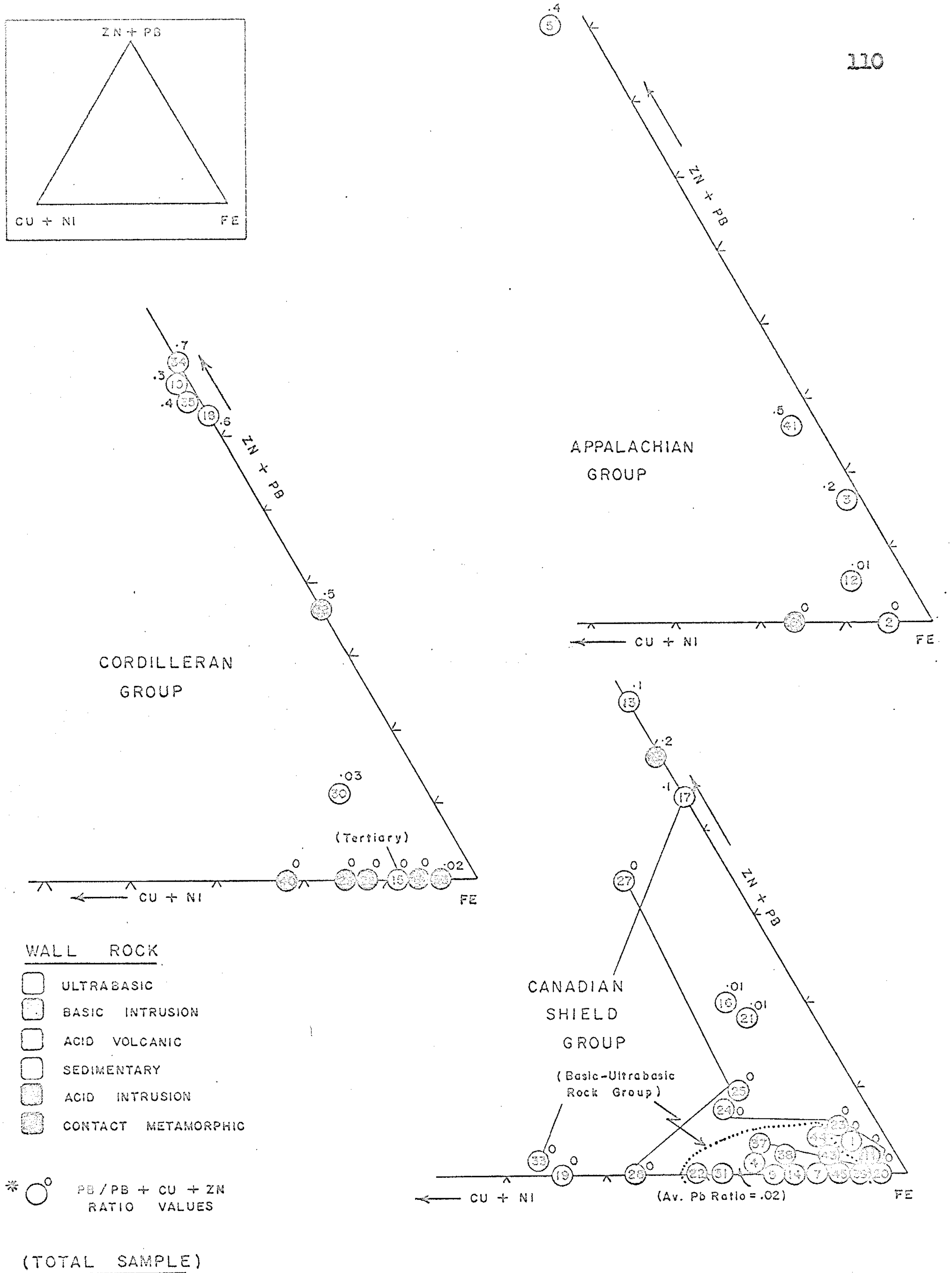


FIGURE 22

Physiographic Group Distribution of Normalized CU + NI, ZN + PB, and FE Values (Weight %)

and 37 (Campbell Chibougamau, Henderson Mine) of the Chibougamau district show copper increasing with decreasing iron from deposit to deposit. Similar changes occur with deposits 20 (Noranda, Horne Mine), 23 (Quemont Mine), and 24 (Waite Amulet Mine) of the Noranda area. Deposits 26 (HBMS, North Star Mine), 25 (HBMS, Flin Flon Mine), and 27 (HBMS, Schist Lake Mine) in Northern Manitoba show a progressive change from copper to zinc ores with decreasing iron. Deposits 33 (Manitou Barvue, copper circuit) and 17 (Manitou Barvue, lead-zinc circuit) are closely associated in Val d'Or area and show that the ore type changes with variations in the iron content of the ores. Similarily, the lead ratio (Pb/Cu+Zn+Pb) values also increase with decreasing iron.

The Cordilleran and Appalachian group diagrams indicate this same relation. Copper ores are associated with high iron values and zinc-lead ores with lesser amounts of iron. The lead ratio values also increase with decreasing iron contents of the samples.

Metal-Sulphur Relations

Figure 23 shows the distribution of all ore samples based on their sulphur and total metal contents (Cu+Zn+Pb+Fe+Co+Ni) (Table 29). The relation is somewhat linear but there appears to be several different trends involved. The smaller plots illustrate the relation according to physiographic groups. The Canadian Shield group and the Appalachian group have similar trends and slopes whereas the Cordilleran group has a steeper slope, indicating a lower sulphur content of these ores. This

TABLE 29

TOTAL WEIGHT PERCENT METALLIC ELEMENTS AND CORRESPONDING SULPHURS.
TOTAL SAMPLE

TOTAL METALLICS	SULPHUR	METALLICS/ METALLICS + S	NO.
30.60	21.35	0.589	1
27.47	16.05	0.631	2
47.50	40.95	0.537	3
19.13	11.80	0.619	4
31.01	15.60	0.665	5
27.04	2.25	0.923	6
21.29	6.75	0.759	7
7.78	1.65	0.825	8
15.49	6.85	0.693	9
10.33	8.25	0.556	10
11.73	3.40	0.775	11
44.13	38.75	0.532	12
26.52	14.10	0.653	13
21.90	5.75	0.792	14
17.34	2.55	0.872	15
25.68	18.75	0.578	16
9.39	10.40	0.474	17
22.66	5.25	0.812	18
14.01	5.75	0.709	19
45.88	30.65	0.600	20
31.38	22.15	0.586	21
25.66	8.35	0.754	22
37.23	27.15	0.578	23
36.09	20.60	0.637	24
37.95	30.05	0.558	25
43.29	28.85	0.600	26
39.18	27.34	0.589	27
11.51	3.30	0.777	28
6.19	0.80	0.886	29
10.01	7.20	0.582	30
11.26	7.20	0.610	31
37.91	19.30	0.663	32
2.60	3.20	0.448	33
35.93	8.55	0.808	34
22.08	7.70	0.741	35
10.54	2.54	0.806	36
27.44	10.09	0.731	37
28.02	15.71	0.641	38
32.48	20.04	0.618	39
4.08	0.65	0.863	40
27.51	7.81	0.779	41
14.68	5.94	0.712	42
13.06	4.87	0.728	43
10.16	3.01	0.771	44
21.26	9.81	0.684	45

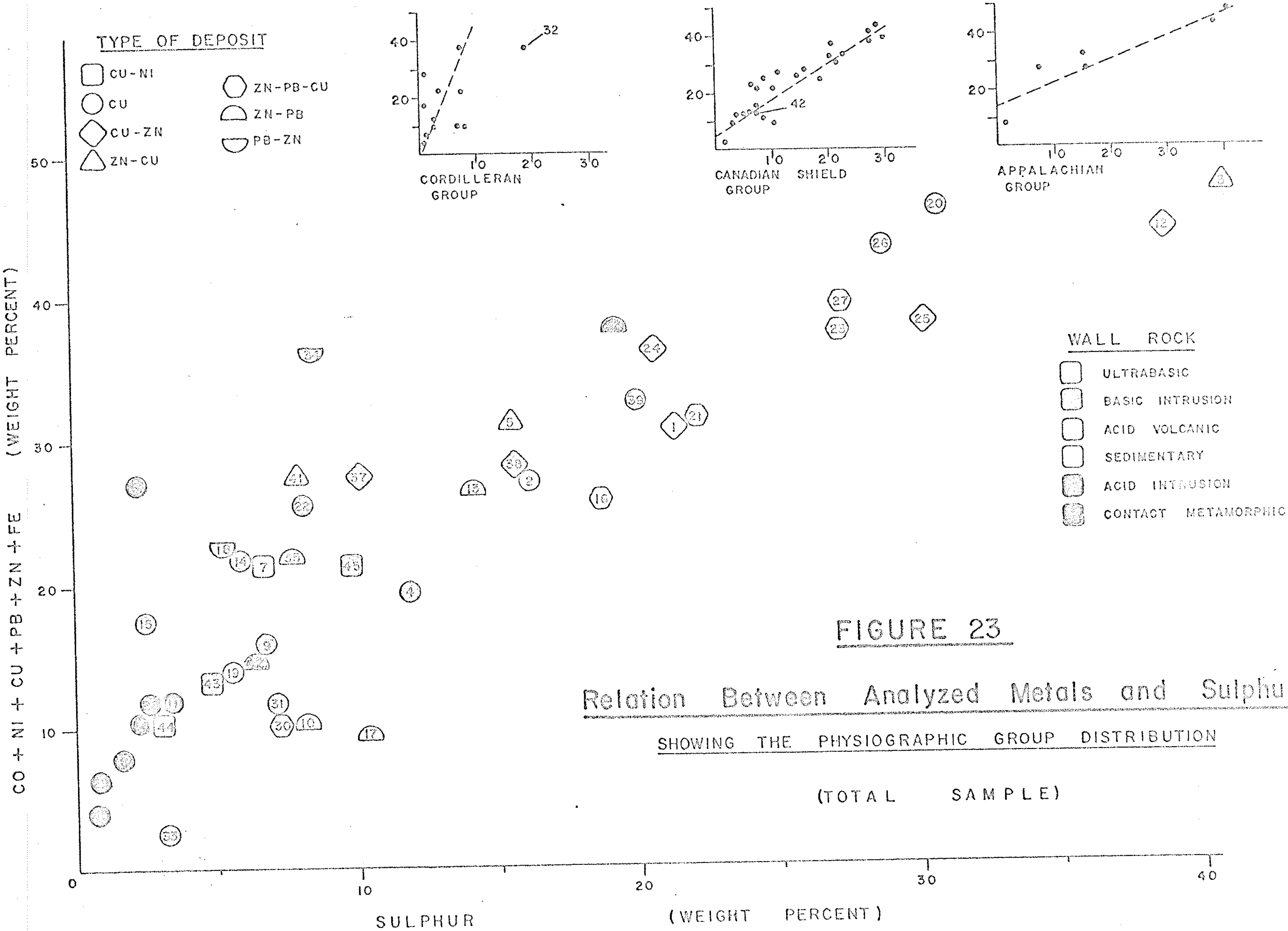


FIGURE 23

Relation Between Analyzed Metals and Sulphur

SHOWING THE PHYSIOGRAPHIC GROUP DISTRIBUTION

(TOTAL SAMPLE)

low sulphur content is probably due to a predominance of high zinc-lead ores containing minerals with a low sulphur-metal ratio.

Q-Mode Factor Analysis

The number of variables was reduced to 12 from 20 for the Q-mode factor analysis by grouping of variables of less numerical significance. The 12 variables used were;

SL	- sphalerite	GN	- galena
CP	- chalcopyrite	PO	- pyrrhotite
PN	- pentlandite	MG	- magnetite
PY+MC	- pyrite+marcasite	BO+CC	- bornite+chalcocite
HM+SP	- hematite+specularite	LM+CR	- limonite+chromite
AS+UNK	- arsenopyrite+unknown		

TT+TN+FR+TB - tetrahedrite+tennantite+freibergite+tetrahedrite-bournonite

expressed as weight percentages.

A significant result of the factor analysis for the forty-five deposits under study was the output showing the various factors and the proportion of the compositional variation that each factor accounted for (Table 30). Interpretation of the output and input for the analysis indicated the following factor-variable equivalence;

Factor 1 (I) = PY		Factor 4 (IV) = CP
Factor 2 (II) = PO		Factor 5 (V) = MG
Factor 3 (III) = SL		Factor 6 (VI) = GN

Factors 1 and 2 (pyrite and pyrrhotite) account for 76% of the

TABLE 30

EIGENVALUES, PERCENT SUMS OF SQUARES, AND CUMULATIVE PERCENT SUMS OF SQUARES FOR THE PRINCIPAL COMPONENTS OF THE SULPHIDE DATA (TOTAL SAMPLE) Q-MODE ANALYSIS.

FACTOR	EIGENVALUES	PERCENT SUMS OF SQUARES	CUMULATIVE PERCENT SUMS OF SQUARES
1	27.15	60.33	60.33
2	3.04	15.64	75.97
3	5.14	11.43	87.40
4	2.68	5.95	93.35
5	2.06	4.57	97.92
6	0.59	1.30	99.22
7	0.15	0.34	99.56
8	0.10	0.23	99.79
9	0.05	0.11	99.90
10	0.03	0.06	99.96

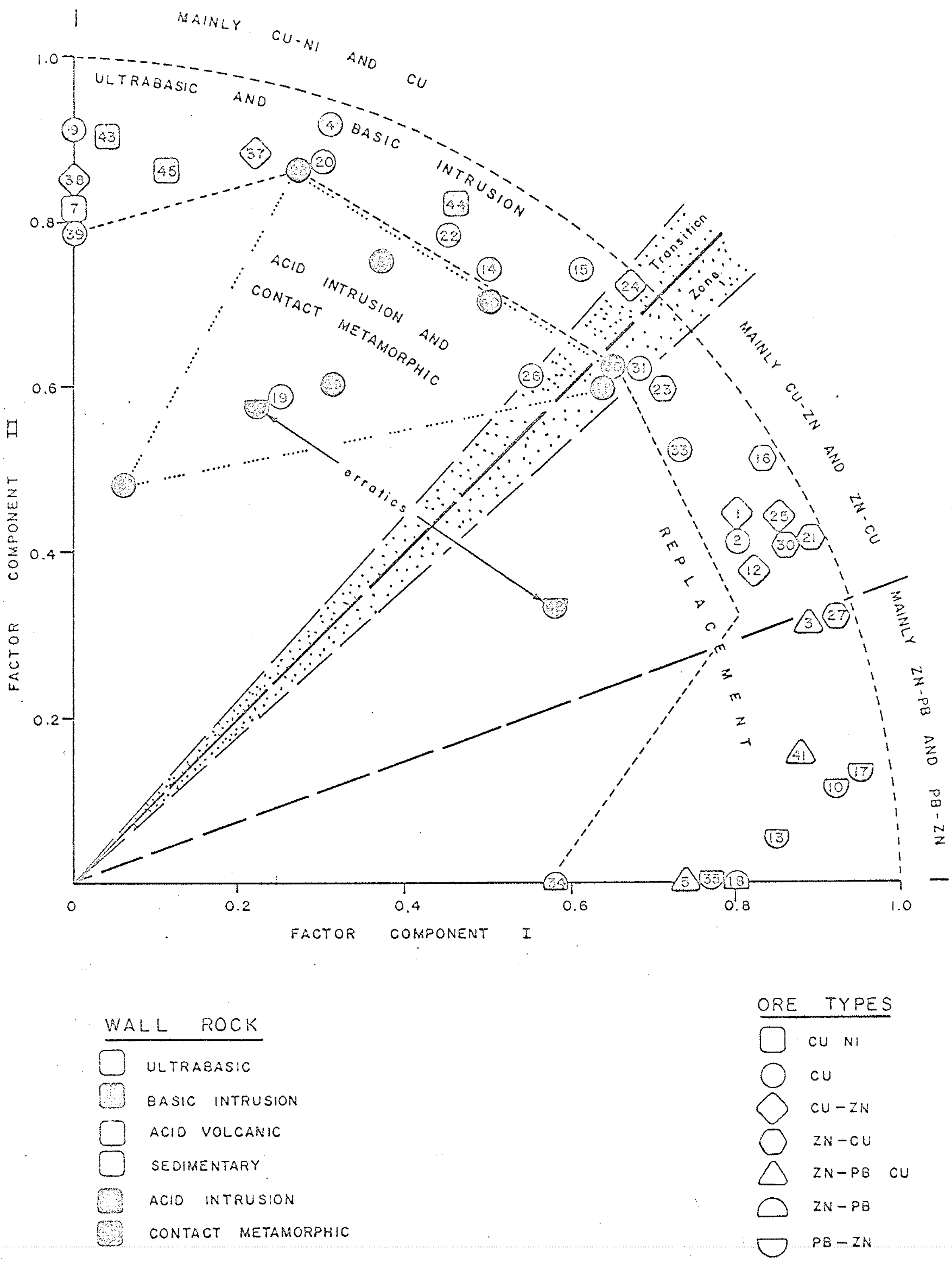
compositional variation in the sulphide-opaque data in this study indicating the importance of the Po/Po+Py ratio as a parameter for describing and classifying ore deposits. The plot of varimax factor components 1 and 2 (Table 31 and Figure 24) clearly indicates that the division of the deposits into various ore types can be explained by the relationship of these two factor components, which reflect mathematically, the pyrite and pyrrhotite contents of these ores. Deposits 32 (Cominco, Sullivan Mine) and 42 (New Calumet Mines) appear as erratics due to their anomalous pyrrhotite contents. Deposit 19 (Copperfields, Temagami Mine) should fall with the other copper types, but its high chalcopyrite content has lowered the communality of this sample. Similarily, deposit 6 (Craigmont Mines) has a low communality due to its high magnetite content and therefore plots out of the general field for copper deposits. In general, deposits associated with acid intrusions and the skarn types (6-Craigmont Mines; 8-Gaspe Copper; 11-Sullico, East Sullivan Mine; 28-Granduc Mines; 29-Granby, Copper Mountain Mine; 36-Granby, Phoenix Copper Division; and 40-Bethlehem Copper) lie in a field associated closely with the ultrabasic-basic intrusion field.

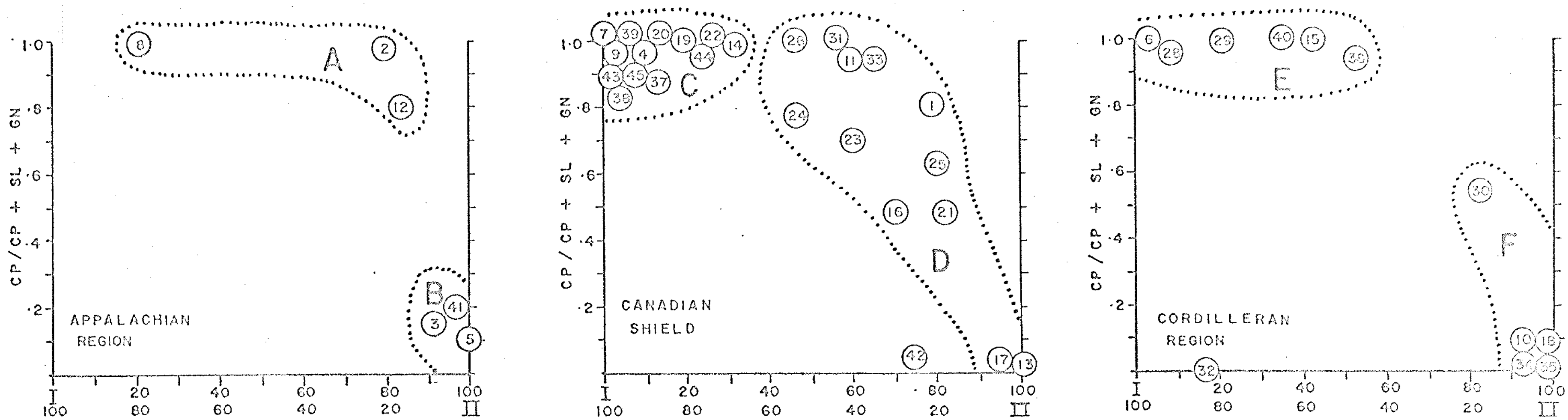
Figure 25, showing the relations between normalized factor components 1 and 2 (Table 32) versus Cp/Cp+Sl+Gn ratio values (upper portion of figure) and Po/Po+Py versus Cp/Cp+Sl+Gn ratio values (lower portion of figure), clearly indicates a relation between chalcopyrite content and the Po/Po+Py ratios of the ores according to physiographic

FIGURE 24

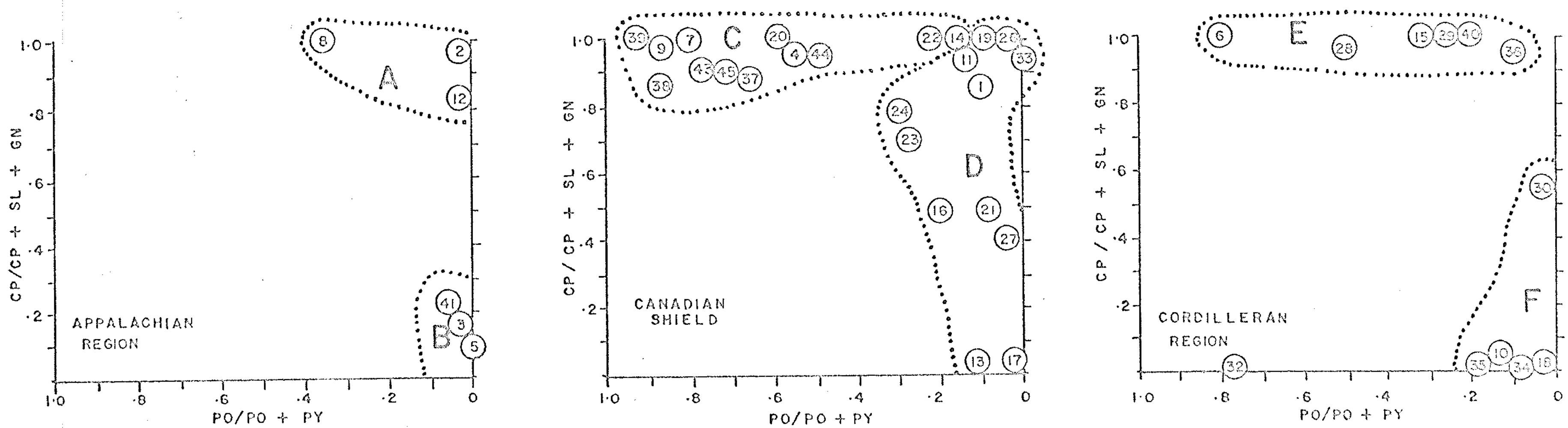
Plot of Varimax Factor Components I and II

(TOTAL SAMPLE)





Normalized Varimax Factor Components I and II (X100) —— Cp/Cp + Sl + Gn Relation
(I ≡ PY, II ≡ PO) (TOTAL SAMPLE)



Po/Po + Py —— Cp/Cp + Sl + Gn Ratio Relation
(TOTAL SAMPLE)

FIGURE 25

FIGURE 25

TABLE 31

Q MODE FACTOR ANALYSIS

TOTAL SAMPLE SULPHIDE DATA

NORMALIZED VARIMAX FACTOR COMPONENTS

SAMPLE NO.	COMMUNALITY	FACTOR COMPONENTS 1	2
1	0.8344	0.7718	0.2282
2	0.8178	0.7851	0.2282
3	0.8830	0.8941	0.1059
4	0.9347	0.1034	0.8966
5	0.5762	0.9940	0.0060
6	0.2336	0.0139	0.9861
7	0.6623	0.0005	0.9995
8	0.7072	0.1989	0.8011
9	0.8400	0.0016	0.9984
10	0.8642	0.9850	0.0150
11	0.9049	0.6040	0.3960
12	0.8236	0.8304	0.1696
13	0.7318	0.9960	0.0040
14	0.8061	0.3168	0.6832
15	0.9220	0.4094	0.5906
16	0.9690	0.7225	0.2775
17	0.9391	0.9809	0.0191
18	0.6235	0.9970	0.0030
19	0.3988	0.1470	0.8530
20	0.8549	0.1100	0.8900
21	0.9493	0.8205	0.1795
22	0.8115	0.2530	0.7470
23	0.8612	0.5887	0.4113
24	0.9785	0.4683	0.5316
15	0.9257	0.7917	0.2083
26	0.6825	0.4568	0.5432
27	0.9553	0.8893	0.1107
28	0.8215	0.0943	0.9057
29	0.4589	0.2102	0.7898
30	0.9230	0.8201	0.1799
31	0.8437	0.5446	0.4554
32	0.4057	0.1426	0.8574
33	0.8136	0.6605	0.3395
34	0.3630	0.9393	0.0607
35	0.5929	0.9975	0.0025
36	0.8136	0.5233	0.4767
37	0.8331	0.0594	0.9406
38	0.7202	0.0019	0.9980
39	0.6588	0.0296	0.9704
40	0.7507	0.3364	0.6635
41	0.7973	0.9691	0.0309
42	0.4475	0.7566	0.2434
43	0.8208	0.0021	0.9979
44	0.8860	0.2418	0.7582
45	0.7481	0.0170	0.9830

TABLE 32

Q MODE FACTOR ANALYSIS

TOTAL SAMPLE SULPHIDE DATA

VARIMAX FACTOR COMPONENTS

SAMPLE NO.	COMMUNALITY	FACTOR COMPONENTS 1	2
1	0.8344	0.8025	0.4364
2	0.8178	0.8013	0.4192
3	0.8830	0.8885	0.3058
4	0.9347	0.3108	0.9155
5	0.5762	0.7568	-0.0589
6	0.2336	0.0569	0.4800
7	0.6623	-0.0176	0.8136
8	0.7072	0.3750	0.7527
9	0.8400	-0.0372	0.9158
10	0.8612	0.9210	0.1137
11	0.9049	0.7393	0.5986
12	0.8236	0.8270	0.3738
13	0.7318	0.8537	0.0541
14	0.8061	0.5054	0.7421
15	0.9220	0.6144	0.7379
16	0.9690	0.8367	0.5186
17	0.9391	0.9598	0.1338
18	0.6235	0.7884	-0.0435
20	0.8549	0.3066	0.8723
21	0.9493	0.8826	0.4128
22	0.8115	0.4531	0.7786
23	0.8612	0.7120	0.5952
24	0.9785	0.6770	0.7213
25	0.9257	0.8561	0.4391
26	0.6825	0.5584	0.6089
27	0.9553	0.9217	0.3252
28	0.8215	0.2784	0.8626
29	0.4589	0.3106	0.6020
30	0.9230	0.8700	0.4074
31	0.8437	0.6779	0.6198
32	0.4057	0.2406	0.5898
33	0.8136	0.7331	0.5255
34	0.3630	0.5840	-0.1484
35	0.5929	0.7690	-0.0383
36	0.8136	0.6525	0.6228
37	0.8331	0.2224	0.8852
38	0.7202	-0.0375	0.8487
39	0.6588	-0.1396	0.7996
40	0.7507	0.5026	0.7058
41	0.7973	0.8790	0.1569
42	0.4475	0.5819	0.3301
43	0.8208	0.0416	0.9050
44	0.8860	0.4629	0.8196
45	0.7481	0.1127	0.8575

area. The Cp/Cp+Sl+Gn and Po/Po+Py ratio values are shown in Table 4, Appendix 1. In the Appalachian region, suite A is mainly copper deposits whereas suite B is mainly zinc-lead deposits. In the Canadian Shield region, a separation of suites is readily apparent as suite C is mainly copper-nickel and copper ores and suite D is mainly zinc-lead ores. The boundary zone between suites C and D contains copper-zinc ores. Similarily, in the Cordilleran region, suites E and F show different ore types, varying from copper in suite E to zinc-lead in suite F. Further, the distribution of points in all diagrams indicates a differentiation trend from copper and copper-nickel ores associated with high pyrrhotite through copper-zinc to zinc-lead ores with high pyrite. It is interesting to note the better separation of suites resulting from the factor plots of the factor analysis.

Figure 26, the plot of normalized factors 1, 2, and 3 (Table 33) was compared to the pyrrhotite-pyrite-sphalerite diagram (Figure 9, Page 67). The improved separation of points is apparent in the factor diagram. The variation in ore type from copper-nickel through copper, copper-zinc, to zinc-copper as related to factor 2 (pyrrhotite) and factor 1 (pyrite) illustrates the change in ore type with changes in the pyrrhotite-pyrite ratio (Po/Po+Py). Wall rock types also follow this trend, varying from ultrabasic to acid types.

Combinations of factor 2 (pyrrhotite) and factor 3 (sphalerite) in ores appear to be extremely rare and when they do exist, must be related to areas of complex origins and types of metamorphism. Deposit

TABLE 33

Q MODE FACTOR ANALYSIS

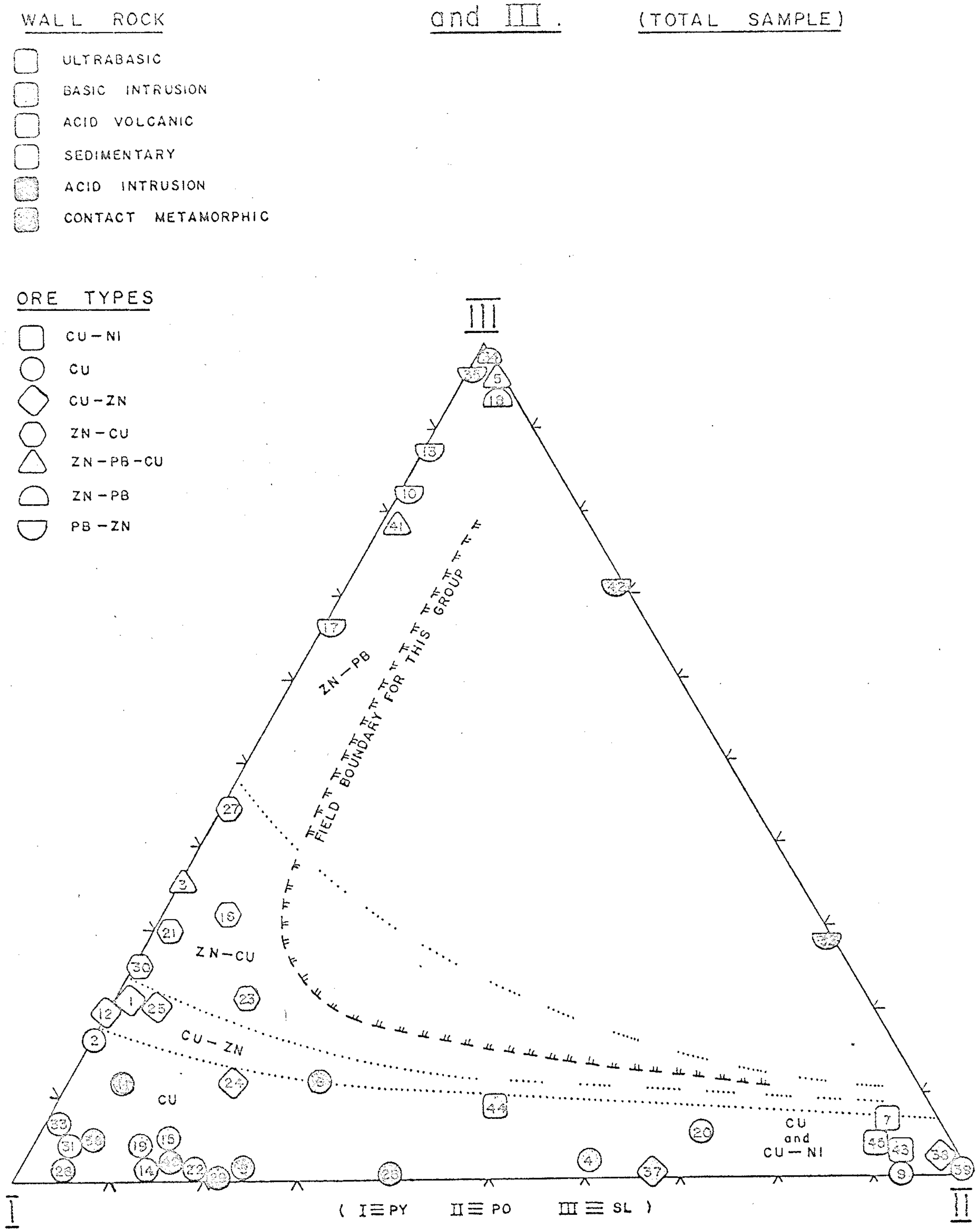
TOTAL SAMPLE SULPHIDE DATA

NORMALIZED VARIMAX FACTOR COMPONENTS

SAMPLE NO.	COMMUNALITY	FACTOR COMPONENTS 1	2	3
1	0.8756	0.7825	0.0111	0.2064
2	0.8928	0.8315	0.0026	0.1660
3	0.8965	0.6396	0.0003	0.3601
4	0.9440	0.3860	0.5957	0.0183
5	0.8285	0.0144	0.0044	0.9812
6	0.2834	0.6268	0.2625	0.1107
7	0.7688	0.0601	0.9387	0.0013
8	0.7676	0.7650	0.2350	0.0001
9	0.9327	0.0782	0.9215	0.0003
10	0.9649	0.1719	0.0063	0.8218
11	0.9563	0.8278	0.0572	0.1150
12	0.8868	0.7942	0.0003	0.2055
13	0.8605	0.1145	0.0043	0.8813
14	0.9061	0.8568	0.1379	0.0053
15	0.9775	0.8177	0.1401	0.0422
16	0.9691	0.6158	0.0698	0.3144
17	0.9551	0.3293	0.0002	0.6735
18	0.8415	0.0296	0.0028	0.9676
19	0.5290	0.8474	0.1188	0.0338
20	0.9194	0.2525	0.6898	0.0577
21	0.9644	0.6866	0.0113	0.3021
22	0.8901	0.8066	0.1914	0.0021
23	0.8617	0.6478	0.1354	0.2169
24	0.9889	0.7143	0.1723	0.1134
25	0.9601	0.7529	0.0102	0.2368
26	0.8350	0.9452	0.0449	0.0099
27	0.9556	0.5508	0.0065	0.4426
28	0.8481	0.6041	0.3941	0.0018
29	0.5068	0.7903	0.2097	0.0000
30	0.9617	0.7491	0.0043	0.2466
31	0.9779	0.9231	0.0375	0.0395
32	0.9816	0.0002	0.7113	0.2884
33	0.9473	0.9190	0.0111	0.0699
34	0.6821	0.0090	0.0040	0.9870
35	0.9109	0.0088	0.0125	0.9787
36	0.9156	0.9001	0.0544	0.0455
37	0.8456	0.3270	0.6659	0.0071
38	0.9563	0.0158	0.9727	0.0114
39	0.9465	0.0000	0.9957	0.0043
40	0.8238	0.8410	0.1467	0.0124
41	0.8838	0.2017	0.0131	0.7852
42	0.9481	0.0073	0.2906	0.7021
43	0.9719	0.0692	0.9209	0.0098
44	0.8980	0.4496	0.4657	0.0847
45	0.9116	0.0782	0.8896	0.0322

FIGURE 26

Plot of Normalized Factors I, II, and III. (TOTAL SAMPLE)



32 (Cominco, Sullivan Mine) and 42 (New Calumet Mines) fall into this group and may be classed as erratics. A continuous series of compositional variation appears evident from factor 2 through factor 1 to factor 3 as shown by the postulated field boundary for the ores in this study. The distribution of copper ratios (Cp/Cp+Sl+Gn) as related to the normalized pyrrhotite-pyrite-sphalerite (Po-Py-Sl) plot (Figure 9, Page 67) shows the concentration of high chalcopyrite values at the Po corner and extending along the Po-Py tie line.

A plot of four normalized varimax factors (Figure 27 and Table 34) with factor 4, chalcopyrite (Cp), represented by weight percent contours again shows that high chalcopyrite is related to the Po-Py side of the diagram with a preference for high pyrrhotite (Po).

Observation of the change in wall rock of the ore bodies in Figures 23 (Page 113), 25, and 26 illustrate the shift from ultrabasic-basic associations to acid volcanic and acid intrusion associations with the change in ore type.

Summary of Results

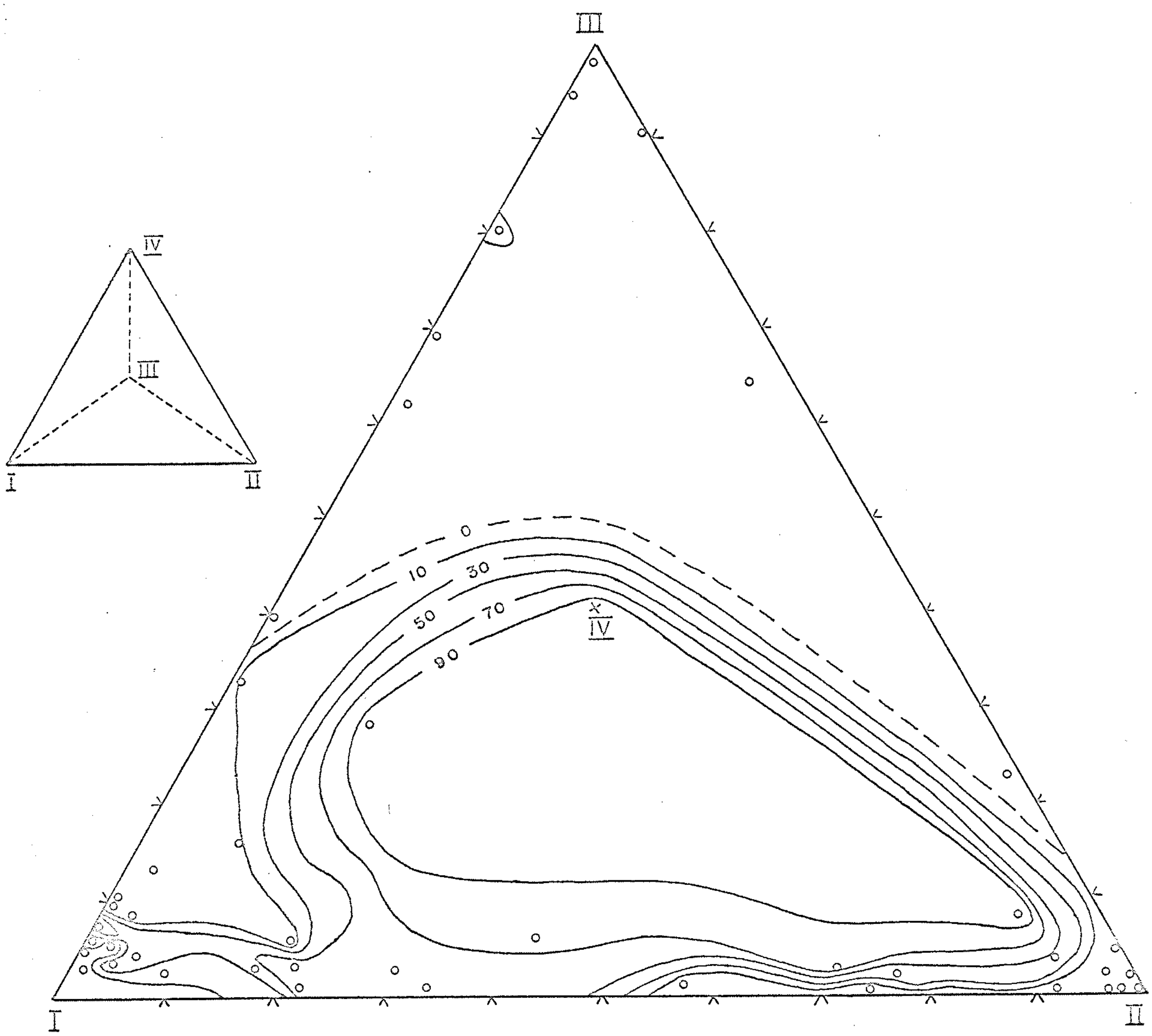
Several methods were employed to bring some order to the abundance of data compiled. The data is generally empirical and the range of possible error small but nevertheless present; therefore definite correlations were not expected, and only general trends were anticipated.

FIGURE 27

Plot of Normalized Factors

I, II, III, and IV

(TOTAL SAMPLE)



I ≡ PY   II ≡ PO   III ≡ SL   IV ≡ CP

(CONTOUR INTERVAL = 20 WEIGHT % IV)

TABLE 34

Q MODE FACTOR ANALYSIS

TOTAL SAMPLE SULPHIDE DATA

NORMALIZED VARIMAX FACTOR COMPONENTS

SAMPLE NO.	COMMUNALITY	FACTOR COMPONENTS 1	2	3	4
1	0.9850	0.8919	0.0353	0.0295	0.0432
2	0.9878	0.9043	0.0166	0.0193	0.0598
3	0.9977	0.8775	0.0137	0.0954	0.0134
4	0.9471	0.1443	0.5217	0.0138	0.3202
5	0.9918	0.0260	0.0002	0.9572	0.0166
6	0.3965	0.0055	0.0609	0.0064	0.9272
7	0.7859	0.0195	0.9179	0.0002	0.0624
8	0.9099	0.1189	0.0960	0.0124	0.7727
9	0.9506	0.0000	0.7651	0.0029	0.2319
10	0.9649	0.3716	0.0167	0.6099	0.0018
11	0.9931	0.7459	0.0756	0.0207	0.1578
12	0.9880	0.9166	0.0109	0.0303	0.0422
13	0.8614	0.2961	0.0123	0.6916	0.0001
14	0.9916	0.2448	0.0628	0.0128	0.6797
15	0.9797	0.4652	0.1155	0.0176	0.4018
16	0.9930	0.6782	0.0956	0.1381	0.0881
17	0.9733	0.6084	0.0038	0.3851	0.0027
18	0.9022	0.0890	0.0020	0.9065	0.0024
19	0.9009	0.0132	0.0042	0.0066	0.9760
20	0.9925	0.2285	0.7111	0.0068	0.0537
21	0.9963	0.7826	0.0264	0.1153	0.0757
22	0.9441	0.2455	0.1091	0.0051	0.6403
23	0.9939	0.7455	0.1876	0.0331	0.0338
24	0.9899	0.4667	0.1551	0.0637	0.3145
25	0.9910	0.7983	0.0230	0.0787	0.1000
26	0.9241	0.2981	0.0098	0.0175	0.6746
27	0.9560	0.5890	0.0099	0.2924	0.1086
28	0.9639	0.0771	0.2110	0.0038	0.7081
29	0.5174	0.2854	0.1435	0.0000	0.5710
30	0.9994	0.8219	0.0151	0.0782	0.0848
31	0.9830	0.5395	0.0247	0.0153	0.4205
32	0.9908	0.0097	0.7595	0.2297	0.0011
33	0.9508	0.5986	0.0063	0.0306	0.3645
34	0.8287	0.0000	0.0002	0.9996	0.0002
35	0.9858	0.0501	0.0095	0.9398	0.0006
36	0.9156	0.5842	0.0464	0.0122	0.3573
37	0.9186	0.0347	0.4569	0.0285	0.4800
38	0.9680	0.0025	0.9560	0.0062	0.0353
39	0.9736	0.0006	0.9914	0.0008	0.0072
40	0.8334	0.3895	0.1053	0.0051	0.5000
41	0.9854	0.1756	0.0050	0.7305	0.0889
42	0.9590	0.0439	0.2977	0.6576	0.0007
43	0.9882	0.0274	0.9040	0.0024	0.0662
44	0.9775	0.4143	0.4981	0.0097	0.0779
45	0.9801	0.0758	0.9013	0.0034	0.0195

Sulphide-Opaque Mineralogy

Mineral Ratios

The analyses of the various mineral ratios calculated indicated several significant trends. The pyrrhotite-pyrite ratio (Po/Po+Py), coupled with ore type and wall rock groupings, yielded a significant indexing method for these ores.

The pyrrhotite-pyrite ratio (Tables 7 and 8) are greatly affected by ore type variation. Copper-nickel and copper ores generally have higher ratio values and the ratio decreases as the ore type changes to copper-zinc, zinc-copper, to lead-zinc types (Figure 6-D). Similarily, this ratio is influenced by the wall rock type. There is a spread of values in each wall rock group, however, the average values clearly indicate a ratio change with wall rock variations as shown by the following values;

Wall Rock	Ore Type	Po/Po+Py (Aver.)
Ultrabasic-basic intrusion	copper-nickel, copper. Rare copper-zinc	0.62
Contact Metamorphic	Mainly copper	0.45
Acid Intrusion	copper	0.28
Acid Volcanic and Sedimentary	copper to lead-zinc	0.11

Ores with the higher ratio value are associated generally with plutonic rocks. Ores with no apparent plutonic or igneous association generally have low ratio values. Some anomalous deposits do exist and may be due to metamorphic effects or the proximity of a hidden intrusion. It may be suggested that the ratio is affected directly by the proximity of the intrusion.

A high ratio value (ie. appreciable amounts of pyrrhotite) indicate a close igneous affiliation whereas a low ratio value (ie. high relative pyrite) may indicate a more distant igneous affiliation (due to hydrothermal or volcanic emanations). It is important to note the large number of deposits, with low pyrrhotite-pyrite ratios (Po/Po+Py), that occur in acid volcanic wall rocks inasmuch as this may be an important prospecting aid.

The distribution of pyrrhotite-pyrite ratios (Po/Po+Py) (average values) relative to the copper-zinc-lead contents of the ores (Figure 15) indicates that high ratio values are mainly associated with copper type ores.

The ratio pyrrhotite/pyrrhotite+pyrite+magnetite (Po/Po+Py+Mg) generally indicates the same trends but the groups appear to be less well defined, especially in metamorphosed areas wherein large amounts of magnetite are present.

Ratios involving pyrite, such as pyrite/pyrrhotite+pyrite+magnetite (Py/Po+Py+Mg) and pyrite/pyrite+sphalerite+galena (Py/Py+Sl+Gn), show a marked variation with ore type only. Wall rock variation is erratic. Basic and ultrabasic wall rock types generally have low ratios, acid intrusion and contact metamorphic wall rock types have intermediate values, and acid volcanic and sedimentary types have the larger values. It has been shown that the ratio value varies with ore type (Tables 10 and 16) from copper to lead-zinc ores.

Ratios illustrating the magnetite variation in ores [magnetite/pyrrhotite+pyrite+magnetite (Mg/Po+Py+Mg), magnetite/magnetite+pyrite (Mg/Mg+Py), and iron sulphide/iron sulphide+iron oxide] indicate that copper and copper-nickel ores with igneous or plutonic associations have higher magnetite ratio values (Tables 11, 12, and 15). Figures 6-A, 6-B, and 6-C show the decrease in magnetite (Mg) as the ores change from copper to lead types.

Chalcopyrite, sphalerite, and galena ratios show variations with ore type but not with wall rock type (Tables 13, 14, and Figure 6-D).

Normalized Mineral Groups

The pyrrhotite-pyrite-chalcopyrite (Po-Py-Cp) diagram gave no well defined groupings but did indicate that most deposits with igneous affiliations were concentrated in the Po-Cp portion of the diagram (Figure 7). Changes in ore type result in a migration of points towards the Py corner as the ores become zinc-lead rich.

The chalcopyrite-sphalerite-galena (Cp-Sl-Gn) diagram (Figure 8) follows the trend as defined by the copper-zinc-lead (Cu-Zn-Pb) relation (Figure 15) and indicates that no ores of the chalcopyrite-galena type are present. Ores with igneous affiliations are concentrated at the chalcopyrite (Cp) corner. Ores in acid volcanic and sedimentary wall rocks (replacement types) fall along the Cp-Sl and Sl-Gn tie lines, suggesting a continuous series relationship.

The diagram of pyrrhotite-pyrite-sphalerite (Po-Py-Sl) (Figure 9) appears significant as these three minerals group the ores in a noteworthy manner. The majority of the ores are grouped along the Po-Py and Py-Sl tie lines with a small number of erratics falling along the Po-Sl join. Point distribution along the Po-Py join clearly shows the differentiation trend of ores of copper and copper-nickel in ultrabasic and basic wall rocks from the pyrrhotite (Po) corner to copper ores occurring in and associated with acid plutonic rocks to the pyrite (Py) corner. The replacement type of ores (copper, copper-zinc, zinc-copper, and zinc-lead), occurring in acid volcanic and sedimentary wall rocks, were concentrated along the pyrite-sphalerite (Py-Sl) join.

Diagrams of the pyrrhotite-pyrite-magnetite (Po-Py-Mg) group distribution indicate that diagrams of this type were diagnostic for the ores studied. Figure 10, which shows three groups as outlined by the writer, indicates that deposits (ores) can be effectively classified in this manner. Point scatter and groupings were not well defined, but the groups were present. No rigorous statistical treatment was involved in the analysis. As a double variation was involved (ie. wall rock and ore type), such a distribution could not be produced by the use of random numbers. Groups A and B contain copper and copper-nickel ores with definite igneous affiliations barring several erratics (Figure 10).

Some of the erratic ores may be due to the counting of minerals such as magnetite, in the wall rock rather than in the actual ore body. Deposits 14 (Patino, Copper Rand Division), 15 (Cowichan Copper, Sunro Mine), and 22 (Opemiska Copper) occur in basic wall rocks but plot with ores of acid igneous associations. These deposits have been classed as hydrothermal deposits in the literature indicating that they occur at some distance from the igneous source and therefore their positions in the diagram may be a reflection of the distance from the igneous source. It is suggested that ores containing abundant relative amounts of pyrrhotite and magnetite have close igneous affiliations. Group C ores (Figure 10), which are mainly pyritic, have been classed by the writer as replacement ores and have no close igneous affiliation according to the literature. It is further suggested that the migration of copper and copper-nickel ores from the Po-Mg side of the diagram to ores of copper, copper-zinc, zinc-copper to lead-zinc types to the Py (pyrite) corner represent a differentiation process analogous to that for igneous rocks.

Analyses of the ores based on the pyrrhotite-pyrite-magnetite (Po-Py-Mg) relations for three physiographic regions (Canadian Shield, Appalachian, and Cordilleran), Figures 11, 12, and 13, also suggest such a differentiation process has been active.

Magnetic Characteristics

Analyses of the theoretical magnetic characteristics of the ores studied indicated that the magnetic effects should decrease with changes in ore type (Figure 14-A). Further, magnetic effects appear to decrease with distance from the igneous source as reflected by the change in wall rock from igneous types to acid volcanic and sedimentary types (Figure 14-B). However, as the actual magnetic characteristics of the deposits were not calculated due to several fundamental problems, any conclusions based on these theoretical considerations are only suggestive.

Element Analyses

Metal Ratios

The distribution of the average values of the silver-gold (Ag/Ag+Au) ratio relative to the copper-zinc-lead contents of the ores (Figure 15, small triangular diagram) shows a gradual increase in the silver content as the ores change from copper to zinc-lead types. This general trend indicates higher gold values in ores associated with copper ores with close igneous associations and higher silver with zinc-lead ores with no distinct igneous or intrusive affiliations. Exceptions are to be expected.

The gold-silver ratio (Au/Au+Ag) distributions (Figures 11, 12, and 13) show a general differentiation trend in which gold-silver ratio values decrease from basic associated copper ores to zinc-lead ores with acid associations or no definite igneous associations.

Miscellaneous metal and mineral distribution studies, such as the cobalt and quartz content of the gangue of these ores (Figures 16, 19, and 20) indicate that a decrease in cobalt occurs as the ores change from copper and copper-nickel ore types in (acid and basic) plutonic associations to zinc-copper and zinc-lead ores with little or no apparent plutonic affiliations, suggesting that a differentiation process has been active. Also, as the amount of quartz in the gangue generally increases as the cobalt decreases, the differentiation trend is again suggested.

Normalized Metal Groups

Diagrams of normalized copper-zinc-lead values (Cu-Zn-Pb) in weight and atomic percentages (Figures 15 and 16) show a distribution similar to that noted by Kilburn (1959, 1960). Deposits occur along the Cu-Zn and Zn-Pb tie lines and not along the Cu-Pb join except for deposits 43 (Inco, Creighton Mine) and 45 (Falconbridge, McKim Mine) which have some lead due to late hydrothermal deposition.

The relation between normalized iron-sulphur-other metals (Fe-S-Other Metals) (Figure 17) suggests that the ores migrate from high iron in basic and acid plutonic environments to low iron in replacement ore types in acid volcanic and sedimentary areas with no apparent igneous affiliations with and accompanying a change in ore type from copper and copper-nickel to zinc-lead and lead-zinc ores. Such variations again suggest a differentiation trend. Similar relations were noted in Figures 18, 19, and 20. Figure 21 summarizes this variation according to wall rock and ore type.

Figure 22, showing the copper+nickel (Cu+Ni), zinc+lead (Zn+Pb), and iron (Fe) relation, illustrated the change in ore type with decreasing iron. It can be shown (Wilson and Anderson (1959), Wilson (1953), and Sherwood (1964) that during fractional crystallization of an igneous melt containing some sulphur, copper, nickel, and iron are removed at an early stage and that the later phases are enriched in zinc and lead. Therefore, the relation in Figure 22 is suggestive of such a process.

The sulphur-metallics relation (Figure 23) indicates that the various physiographic areas have different sulphur-metal relations. Such variations may be due to the sampling of ores at different levels of the earth's crust.

Factor Analysis

Factor analysis proved to be an effective method of reducing the number of variables for the analyses of the sulphide mineralogy data. Such analysis illustrated mathematically the importance of pyrrhotite and pyrite and the ratio of these two minerals in distinguishing the various types of ores and the wall rocks in which they occur.

The use of factors 1 and 2 (Figure 24), which have been interpreted as correlative with pyrite and pyrrhotite contained in these ores, defined fields containing ores with clear-cut igneous associations as opposed to ores with questionable igneous or plutonic associations.

Figure 25 compares the use of factors to the use of interpreted variables. The diagram of factors 1 and 2 has been compared with a similar diagram containing the pyrrhotite-pyrite (Po/Po+Py) ratio values and it was noted that similar plots resulted but better grouping of points was given by the factor plot.

Factor analysis is suited to data which is part of a continuous series with respect to compositional variation. Analysis with respect to factors 1, 2, and 3 (Figures 9 and 26) clearly indicates such a continuous relation for pyrrhotite, pyrite, and sphalerite. In this case, the relation between ore type and wall rock was clearly shown. The analysis of a larger amount of data would be interesting and would no doubt alter several of the factors of less importance. However, as factor 1 and 2 account for such a large part of the compositional variation (Table 30), no change would be expected here. Copper and copper-nickel ores associated with basic and ultrabasic areas contain a strong pyrrhotite (Po) factor which decreases with the change in ore type to mainly copper ores with acid intrusion associations. Ores with a predominant pyrite (Py) factor are generally located in areas of poorly defined igneous or plutonic associations.

CHAPTER VI

CONCLUSIONS

1. The sulphide-opaque and silicate mineralogies have been obtained for forty-five Canadian base metal sulphide ore deposits. Twenty sulphide-opaque and sixty-one silicate minerals were noted.

2. The Po/Po+Py mineral ratio was found to give the most significant results with respect to grouping the various ores studied. Ores of a specific type, associated with a specific wall rock (or environment), in general, have a characteristic ratio value. Copper and copper-nickel ores associated with ultrabasic and basic intrusions and copper ores associated with acid intrusions (plus contact metamorphic types) have the higher ratio values. Such high ratio values are possibly due to the higher temperatures associated with such intrusions. Acid intrusion and contact metamorphic types of ores, which are mainly copper, have an intermediate ratio value which may be suggestive of their somewhat lower temperatures of formation. Copper, copper-zinc, zinc-copper, zinc-lead, and lead-zinc ores which are associated with acid volcanic and sedimentary wall rocks (Replacement Types), have indefinite igneous associations and low ratio values. Exceptions do occur and may be due to the presence of a hidden intrusion for deposits with anomalous high values or the distance from the igneous source for the deposits with anomalous low values. Later metamorphic effects may also have affected and altered the primary mineral ratio values.

The geographic distribution of the pyrrhotite-pyrite ratio (Po/Po+Py) did not indicate any significant trends. This ratio appeared to be most strongly affected by 1) ore type, and 2) wall rock of the deposits.

High Mg/Po+Py+Mg ratio values are associated with acid or basic-ultrabasic intrusive wall rocks which contain mainly copper and copper-nickel ores respectively.

3. The normalized diagram of pyrrhotite-pyrite-sphalerite (Po-Py-Sl) indicated that, for the ores studied, these three minerals represented end-members of a continuous ternary system for classifying the ores. Again, the importance of the pyrrhotite-pyrite relationship was indicated as ores with igneous affiliations plot along the pyrrhotite-pyrite tie line.

The ternary diagram of normalized pyrrhotite-pyrite-magnetite (Po-Py-Mg) for these ores indicated that significant groupings can be obtained. Three postulated groups, containing anomalous types were outlined;

Group	Ore Type	Wall Rock
A	Copper and copper-nickel	Ultrabasic and basic intrusions
B	Copper, minor zinc-lead	Acid intrusion and contact metamorphic (skarn types)
C	Copper, copper-zinc, to lead-zinc	Acid volcanic and sedimentary

Point distribution in the diagrams is suggestive of a differentiational trend as ore types and wall rock vary.

4. Predictions regarding the theoretical magnetic characteristics of the ores were found to be incongruous due to the many indeterminate effects possessed by each individual ore body. However, theoretical considerations indicate that copper and copper-nickel ores associated with plutonic rocks should give the greatest magnetic effects.

5. The distribution of the gold-silver ratios (Au/Au+Ag and Ag/Au+Ag) indicates that gold decreases and silver increases as the ores change from copper and copper-nickel types in ultrabasic and basic areas to copper-zinc, zinc-copper, and zinc-lead ores in acid intrusive areas and acid volcanic-sedimentary wall rocks. This suggests that a fractional crystallization process may have been operative.

6. The ternary relation between iron, sulphur, and other metals suggested that ores migrate from high iron in ultrabasic-basic and acid plutonic environments to low iron in replacement ores occurring in acid volcanic and sedimentary areas with little or no apparent igneous affiliations. This change in iron content is accompanied by a corresponding change in ore type from copper-nickel and copper, through copper-zinc, zinc-copper, to lead-zinc, suggestive of a fractional differentiation trend.

7. The grouping of ore deposits according to wall rock type indicated that a large number of deposits occur in acid volcanic wall

rocks. This may be useful as a prospecting aid.

8. Factor analysis proved to be an effective method of analyzing a large amount of compositional data in a short period of time. The importance of the pyrrhotite-pyrite contents of these ores as a method of classification was shown mathematically. Utilization of extracted factors resulted in essentially the same type of classification as given by conventional inspection methods in considerably less time. In this study, forty-five samples containing twelve variables each were analyzed for ten factors in less than five minutes. The use of such rapid and efficient methods liberates the researcher from many weeks of arduous interpretation by conventional methods, thereby permitting him to utilize his time in more fundamental ways. The uses of factor analysis requires investigation on the part of geological researchers who are often faced with the problem of analyzing and interpreting large amounts of proportional data. The mathematical factors extracted by factor analysis may strongly reflect the influence of actual factors, however, identification of the factors is a matter of interpretation.

9. Distribution studies of the cobalt and quartz in gangue contents of these ores suggested that a differentiation process had been active in the formation of the ores of various types. Cobalt decreased and quartz increased as the ores varied from copper-nickel and copper types to zinc-lead types.

10. The use of x-ray diffraction powder methods for the partial determination of the quantitative sulphide-opaque mineralogies of the

ore deposit samples proved to be very effective and gave reasonable results.

Further Work

The results of this study revealed several interesting trends and methods of classifying sulphide ore deposits. Additional sulphide ores should be investigated to augment the data presented here.

A large amount of the data from this study remains unprocessed at the present time. Some study of the -65+400 fraction data is warranted. Significant variation in the basic results of this study would not be anticipated. A correlation between the sulphide-opaque mineralogy and the wall rock alteration should prove interesting.

Further investigation of the x-ray diffraction method for the quantitative determination of sulphide-opaque minerals is warranted to improve and refine the method.

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APPENDIX 1

Property Data, Sample Type, and Correction Factors

TABLE PAGE

TABLE 1

PROPERTY DATA TABLE SHOWING PROPERTY NUMBER, PROPERTY NAME, REPRESENTATIVE SAMPLE TONS, SAMPLE PERIOD, AND PROPERTY WALL ROCK.

NO. 1

KAM KOTIA PORCUPINE MINES LTD.

SAMPLE TONS=1,035,000 PERIOD. 1963

WALL ROCK = SHEARED RHYOLITE AND ANDESITE.

* * * *

NO. 2

FIRST MARITIME MNG. CORP. LTD.

SAMPLE TONS=122,000 PERIOD. 1963

WALL ROCK = BRECCIATED ANDESITIC FLOWS AND AGGLOMERATES, PORPHYRY INTRUSIONS.

* * * *

NO. 3

HEATH STEELE MINES LTD.

SAMPLE TONS=363,000 PERIOD. 1963

WALL ROCK = SILICEOUS METASEDIMENTARY AND VOLCANIC ROCK COMPLEX PLUS PORPHYRY.

* * * *

NO. 4

MERRILL ISLAND MNG. CORP. LTD.

SAMPLE TONS=118,950 PERIOD. 1963

WALL ROCK = ALTERED ANORTHOSITE.

* * * *

NO. 5

ASARCO, BUCHANS UNIT.

SAMPLE TONS=191,250 PERIOD. 1963

WALL ROCK = VOLCANIC BRECCIAS AND ASSOCIATED TUFFS.

* * * *

NO. 6

CRAIGMONT MINES LTD.

SAMPLE TONS=22,575,000 PERIOD. 1963

WALL ROCK = LIMESTONE, ARGILLITE, SKARN.

* * * *

TABLE 1 (CONTINUED)

PROPERTY DATA TABLE SHOWING PROPERTY NUMBER, PROPERTY NAME, REPRESENTATIVE SAMPLE TONS, SAMPLE PERIOD, AND PROPERTY WALL ROCK.

METAL MINES LTD.,GORDON LAKE. NO. 7

SAMPLE TONS=128,100 PERIOD. 1963

WALL ROCK = PERIDOTITE, PYROXENITE, HORNBLENDITES.

* * * *

GASPE COPPER MINES LTD. NO. 8

SAMPLE TONS=3,354,000 PERIOD. 1963

WALL ROCK = SKARN(LIMESTONE), PORCELLANITE, CHERTY HORNFELS.

* * * *

RIO ALGOM MINES LTD.,PRONTO DIVISION. NO. 9

SAMPLE TONS=138,000 PERIOD. 1963

WALL ROCK = HORNBLENDE AND CHLORITE SCHISTS.

* * * *

SHEEP CREEK MINES LTD.,MINERAL KING MINE. NO.10

SAMPLE TONS=92,000 PERIOD. 1963

WALL ROCK = LIMESTONE, SEDIMENTARY SCHIST.

* * * *

SULLICO MINES LTD.,EAST SULLIVAN MINE. NO.11

SAMPLE TONS=573,000 PERIOD. 1963

WALL ROCK = ANDESITE AND RHYOLITE(SILICEOUS TUFFS).

* * * *

COMINCO,WEDGE MINE. (MASSIVE PYRITE ZONE) NO.12

SAMPLE TONS=90,000 PERIOD. 1963

WALL ROCK = PORPHYRITIC AND TUFFACEOUS RHYOLITE, ARGILLACEOUS FRAGMENTAL HORIZON, GRAPHITE SCHIST.

* * * *

TABLE 1 (CONTINUED)

PROPERTY DATA TABLE SHOWING PROPERTY NUMBER, PROPERTY NAME, REPRESENTATIVE SAMPLE TONS, SAMPLE PERIOD, AND PROPERTY WALL ROCK.

THE CONIAGUS MINES LTD. NO.13

SAMPLE TONS=63,350 PERIOD. 1963

WALL ROCK = AGGLOMERATIC TUFFS.

* * * *

THE PATINO MNG. CORP.,COPPER RAND DIVISION. NO.14

SAMPLE TONS=331,200 PERIOD. 1963

WALL ROCK = ALTERED ANORTHOSITE, GABBRO.

* * * *

COWICHAN COPPER CO.,SUNRO MINE, JORDAN RIVER. NO.15

SAMPLE TONS=324,000 PERIOD. 1963

WALL ROCK = SHEARED GABBRO, BASALT.

* * * *

GECO MINES LTD. NO.16

SAMPLE TONS=603,900 PERIOD. 1963

WALL ROCK = MUSCOVITE SCHIST(ALTERED QUARTZITE).

* * * *

MANITOU BARVUE MINES LTD.,PB ZN CIRCUIT. NO.17

SAMPLE TONS=79,300 PERIOD. 1963

WALL ROCK = SHEARED RHYOLITIC TUFF.

* * * *

UNITED KENO HILL MINES LTD. NO.18

SAMPLE TONS=33,550 PERIOD. 1963

WALL ROCK = ALTERED GREENSTONE, QUARTZITE.

* * * *

TABLE 1 (CONTINUED)

PROPERTY DATA TABLE SHOWING PROPERTY NUMBER, PROPERTY NAME, REPRESENTATIVE SAMPLE TONS, SAMPLE PERIOD, AND PROPERTY WALL ROCK.

NO.19

COPPERFIELDS MNG. CORP., TEMAGAMI MINE.

SAMPLE TONS=18,000 PERIOD. 1963

WALL ROCK = RHYOLITE BRECCIA AND TUFF.

* * * *

NO.20

NORANDA MINES LTD., HORNE MINE.

SAMPLE TONS=2,000,000 PERIOD. 1953,1954

WALL ROCK = RHYOLITE FLOWS AND BRECCIA.

* * * *

NO.21

NORMETAL MINING CORP., LTD.

SAMPLE TONS=350,000 PERIOD. 1954

WALL ROCK = RHYOLITE AGGLOMERATE.

* * * *

NO.22

OPEMISKA COPPER MINES (QUEBEC) LTD.

SAMPLE TONS=67,000 PERIOD. 1954

WALL ROCK = AMPHIBOLITE, PYROXENITE,
HORNBLENDE PORPHYRITE.

* * * *

NO.23

QUEMONT MNG. CORP. LTD.

SAMPLE TONS=2,800,000 PERIOD. 1952, 1953

WALL ROCK = RHYOLITE PORPHYRY AND BRECCIA.

* * * *

NO.24

WAITE AMULET MINES LTD.

SAMPLE TONS=108,000 PERIOD. 1954

WALL ROCK = ANDESITE, DACITE, RHYOLITE.

* * * *

TABLE 1 (CONTINUED)

PROPERTY DATA TABLE SHOWING PROPERTY NUMBER, PROPERTY NAME, REPRESENTATIVE SAMPLE TONS, SAMPLE PERIOD, AND PROPERTY WALL ROCK.

HUDSON BAY M.AND S.,CO.,LTD., FLIN FLON MINE. NO.25

SAMPLE TONS=UNKNOWN. PERIOD. 1955

WALL ROCK = QUARTZ PORPHYRY AND DIORITE, ANDESITE, PYROCLASTICS, TALC SERICITE SCHIST.

* * * *

HUDSON BAY M.AND S.,CO.,LTD., NORTH STAR MINE. NO.26

SAMPLE TONS=UNKNOWN. PERIOD. 1955

WALL ROCK = ANDESITE, QUARTZ PORPHYRY.

* * * *

HUDSON BAY M.AND S.,CO.,LTD., SCHIST LAKE MINE. NO.27

SAMPLE TONS=UNKNOWN. PERIOD. 1955

WALL ROCK = SHEARED QUARTZ PORPHYRY (SERICITE CARBONATE SCHIST).

* * * *

GRANDUC MINES LTD. NO.28

SAMPLE TONS=LIMITED. PERIOD. 1955

WALL ROCK = METASEDIMENTARY ROCKS (SILICIFIED TUFFS, GREYWACKE, IMPURE QUARTZITES).

* * * *

GRANBY CONS. M. S.AND P.,CO.,LTD.,COPPER MTN. MINE. NO.29

SAMPLE TONS=1,871,860 PERIOD. 1955

WALL ROCK = BASALTIC VOLCANIC BRECCIA, DIORITE

* * * *

BRITANNIA M.AND S.,CO.,LTD.,BRITANNIA BEACH MINE, NO.30
(NEW NAME - ANACONDA CO. (CAN) LTD.)

SAMPLE TONS=200,000 PERIOD. 1955

WALL ROCK = SCHISTOSE ALBITE DACITE TO QUARTZ LATITE PORPHYRIES.

* * * *

TABLE 1 (CONTINUED)

PROPERTY DATA TABLE SHOWING PROPERTY NUMBER, PROPERTY NAME, REPRESENTATIVE SAMPLE TONS, SAMPLE PERIOD, AND PROPERTY WALL ROCK.

NORTH COLDSTREAM MINES LTD. NO.31

SAMPLE TONS=180,000 PERIOD. 1963

WALL ROCK = CHERT ROCK (SILICEOUS VOLCANIC SHISTS).

* * * *

COMINCO, SULLIVAN MINE. NO.32

SAMPLE TONS=300,000 PERIOD. 1955

WALL ROCK = ARGILLITE, MINOR QUARTZITE, SILTSTONE.

* * * *

MANITOU BARVUE MINES LTD., CU CIRCUIT. NO.33

SAMPLE TONS=79,000 PERIOD. 1963

WALL ROCK = SERICITE SCHIST (SHEARED RHYOLITE AND TUFFS).

* * * *

MACKENO MINES LTD. NO.34

SAMPLE TONS=UNKNOWN. PERIOD. 1955

WALL ROCK = ALTERED GREENSTONES.

* * * *

SILVER STANDARD MINES LTD. NO.35

SAMPLE TONS=1,800 PERIOD. 1955

WALL ROCK = TUFFACEOUS SANDSTONE, ARGILLITE, GREYWACKE.

* * * *

GRANBY CONS. MNG.,CO., PHOENIX COPPER DIVISION. NO.36

SAMPLE TONS=480,000 PERIOD. 1963

WALL ROCK = LIME SILICATE ROCK (JASPEROID), LIMESTONE.

* * * *

TABLE 1 (CONTINUED)

PROPERTY DATA TABLE SHOWING PROPERTY NUMBER, PROPERTY NAME, REPRESENTATIVE SAMPLE TONS, SAMPLE PERIOD, AND PROPERTY WALL ROCK.

CAMPBELL CHIBOUGAMAU MINES LTD., HENDERSON MINE. NO.37

SAMPLE TONS=70,000 PERIOD. 1963

WALL ROCK = META GABBROIC ANORTHOSITE.

* * * *

CAMPBELL CHIBOUGAMAU MINES LTD., MAIN MINE B ZONE. NO.38

SAMPLE TONS=70,000 PERIOD. 1963

WALL ROCK = META GABBROIC ANORTHOSITE.

* * * *

CAMPBELL CHIBOUGAMAU MINES LTD., WINZE ZONE. NO.39

SAMPLE TONS=70,000 PERIOD. 1963

WALL ROCK = META GABBROIC ANORTHOSITE.

* * * *

BETHLEHEM COPPER CORP., LTD. NO.40

SAMPLE TONS=1,020,000 PERIOD. 1963

WALL ROCK = IGNEOUS BRECCIA, MATRIX = FELDSPAR, QUARTZ,
FRAGMENTS = QUARTZ DIORITE, DACITE PORPHYRY.

* * * *

MAGNET COVE BARIUM CORP., LTD. NO.41

SAMPLE TONS=22,500 PERIOD. 1963

WALL ROCK = LIMESTONE, SANDSTONE.

* * * *

NEW CALUMET MINES LTD. NO.42

SAMPLE TONS=273,700 PERIOD. 1963

WALL ROCK = BIOTITE GNEISS, LIMESTONE.

* * * *

TABLE 1 (CONTINUED)

PROPERTY DATA TABLE SHOWING PROPERTY NUMBER, PROPERTY NAME, REPRESENTATIVE SAMPLE TONS, SAMPLE PERIOD, AND PROPERTY WALL ROCK.

INTERNATIONAL NICKEL CO.,LTD.,CREIGHTON MINE. NO.43

SAMPLE TONS=200,000 PERIOD. 1954

WALL ROCK = QUARTZ DIORITE, NORITE, MICROPEGMATITE.

* * * *

NICKEL OFFSET LTD. NO.44

SAMPLE TONS=UNKNOWN. PERIOD. 1955

WALL ROCK = QUARTZ DIORITE.

* * * *

FALCONBRIDGE NICKEL MINES LTD.,MCKIM MINE. NO.45

SAMPLE TONS=UNKNOWN. PERIOD. 1955

WALL ROCK = GRANITE, NORITE, GREENSTONE.

* * * *

LAKE DUFAULT MINES LTD. NO.46

SAMPLE TONS= 19,500 PERIOD. 1967

WALL ROCK = RHYOLITE FLOWS AND BRECCIAS.

* * * *

TABLE 2

TYPES OF SAMPLE COLLECTED FOR THE STUDY

PR. NO.		PERIOD MONTHS	SAMPLE TYPE
1		23	MILL FEED COMPOSITE(CLASSIFIER OVERFLOW).
2		2	MILL FEED COMPOSITE(CLASSIFIER OVERFLOW).
3		8	MILL FEED COMPOSITE.
4		6	MILL FEED COMPOSITE.
5		5	MILL FEED COMPOSITE.
6		-	COMPOSITE SAMPLE OF TOTAL DIAMOND DRILLING.
7		6	MILL FEED COMPOSITE(ROD MILL DISCHARGE REJECTS).
8		17	MILL FEED COMPOSITE.
9		6	MILL FEED COMPOSITE(BALL MILL FEED).
10		6	MILL FEED COMPOSITE(CLASSIFIER OVERFLOW).
11		6.1	MILL FEED COMPOSITE.
12		4	MILL FEED COMPOSITE(CU RICH PORTION, PYRITE ZONE).
13		6	MILL FEED COMPOSITE.
14		5	MILL FEED COMPOSITE(CLASSIFIER OVERFLOW, 5 MINES, MACHIN POINT, CHIBOUGAMAU JACULET, PORTAGE ISLAND, QUEBEC CHIBOUGAMAU GOLDFIELDS, COPPER RAND CHIBOUGAMAU).
15		8	MILL FEED COMPOSITE.
16		6	MILL FEED COMPOSITE.
17		2	MILL FEED COMPOSITE(CLASSIFIER OVERFLOW).
18		2	MILL FEED COMPOSITE(CLASSIFIER OVERFLOW).
19		3	MILL FEED COMPOSITE.
20	K	12	MILL FEED COMPOSITE.
21	K	12	MILL FEED COMPOSITE.
22	K	6	MILL FEED COMPOSITE.
23	K	48	MILL FEED COMPOSITE.
24	K	3	MILL FEED COMPOSITE.
25	K	-	MILL FEED COMPOSITE.
26	K	-	COMPOSITE OF DIAMOND DRILL CORE.
27	K	-	MILL FEED COMPOSITE.
28	K	-	COMPOSITE OF LIMITED DRILL CORE SAMPLE REJECTS.
29	K	12	MILL FEED COMPOSITE.
30	K	3	MILL FEED COMPOSITE.
31		6	MILL FEED COMPOSITE(MINE CAR SAMPLE REJECTS).
32	K	1	FLOTATION FEED(SINK PLUS FINES COMPOSITE).
33		2	MILL FEED COMPOSITE(CLASSIFIER OVERFLOW).
34	K	-	NOT KNOWN.
35	K	1.2	MILL FEED COMPOSITE.
36		8	MILL FEED COMPOSITE.
37		6	SAMPLE REJECTS, STOPES 344 AND 372.
38		6	SAMPLE REJECTS, STOPES 1-15, 1-25, AND 2-15.
39		6	SAMPLE REJECTS, 1900 FOOT LEVEL.
40		8.5	MILL FEED COMPOSITE.
41		6	MILL FEED COMPOSITE.
42	K	12	MILL FEED COMPOSITE.
43	K	-	MILL FEED COMPOSITE.
44	K	-	NOT KNOWN.
45	K	-	NOT KNOWN.
46		.5	MILL FEED COMPOSITE.

K DENOTES L.C. KILBURN SAMPLE.

TABLE 3

ASSAY AND MINERAL FRACTION CORRECTION FACTORS

SCREENED WEIGHTS (GMS) +400 (FOR ASSAY)	+400 (RETAINED)	-400 (RETAINED)	ASSAY FACTOR +400	-400	MINERAL FACTOR +400	-400	NO.
38.36	44.28	40.08	0.489	0.511	0.525	0.475	1
55.90	61.89	33.01	0.629	0.371	0.652	0.348	2
67.81	76.16	61.28	0.525	0.475	0.554	0.446	3
31.62	37.09	24.92	0.559	0.441	0.598	0.402	4
28.62	35.21	33.10	0.464	0.536	0.515	0.485	5
36.08	41.19	27.63	0.566	0.434	0.599	0.401	6
44.60	50.37	26.08	0.631	0.369	0.659	0.341	7
25.61	31.74	40.44	0.388	0.612	0.440	0.560	8
47.95	53.24	39.20	0.550	0.450	0.576	0.424	9
52.90	58.68	54.30	0.493	0.507	0.519	0.481	10
27.19	32.42	25.22	0.519	0.481	0.562	0.438	11
30.77	38.75	29.67	0.509	0.491	0.566	0.434	12
47.80	53.56	51.48	0.481	0.519	0.510	0.490	13
26.11	31.78	27.86	0.484	0.516	0.533	0.467	14
20.51	25.53	34.12	0.375	0.625	0.428	0.572	15
41.90	48.09	21.86	0.657	0.343	0.687	0.313	16
19.74	0.0	26.31	0.429	0.571	0.0	0.0	17
36.13	41.93	23.17	0.609	0.391	0.644	0.356	18
35.44	40.12	30.39	0.538	0.462	0.569	0.431	19
19.25	39.87	35.20	0.354	0.646	0.531	0.469	20
21.28	26.69	31.69	0.402	0.598	0.457	0.543	21
17.54	22.55	32.61	0.350	0.650	0.409	0.591	22
12.97	23.44	32.00	0.288	0.712	0.423	0.577	23
29.30	35.21	32.93	0.471	0.529	0.517	0.483	24
52.47	58.83	45.84	0.534	0.466	0.562	0.438	25
51.07	58.29	35.96	0.587	0.413	0.618	0.382	26
47.86	54.45	39.47	0.548	0.452	0.580	0.420	27
34.89	40.01	30.67	0.532	0.468	0.566	0.434	28
12.94	17.11	25.78	0.334	0.666	0.399	0.601	29
31.60	36.36	21.41	0.596	0.404	0.629	0.371	30
49.76	54.26	37.19	0.572	0.428	0.593	0.407	31
26.42	31.93	42.73	0.382	0.618	0.428	0.572	32
19.74	0.0	26.31	0.429	0.571	0.0	0.0	33
42.76	48.36	29.63	0.591	0.409	0.620	0.380	34
30.37	35.05	23.43	0.564	0.436	0.599	0.401	35
42.12	46.72	31.03	0.576	0.424	0.601	0.399	36
43.70	48.86	37.78	0.536	0.464	0.564	0.436	37
102.58	108.34	56.82	0.644	0.356	0.656	0.344	38
69.83	75.38	43.78	0.615	0.385	0.633	0.367	39
165.57	120.73	86.36	0.657	0.343	0.583	0.417	40
240.44	246.14	201.69	0.544	0.456	0.550	0.450	41
82.50	88.20	87.75	0.485	0.515	0.501	0.499	42
164.99	170.69	242.20	0.405	0.595	0.413	0.587	43
182.00	187.70	147.24	0.553	0.447	0.560	0.440	44
174.50	180.20	117.39	0.598	0.402	0.606	0.394	45

TABLE 4

PROPERTY MILLING RATES, NAME, AND NAME CHANGES

PROP. NO.	PROPERTY NAME (including Name Changes)	MILL RATE (tons/day)
1.	Kam Kotia Mines Ltd. (Kam Kotia Porcupine Mines Ltd.)	1500
2.	First Maritime Mining Corp. Ltd. (Maritimes Mining Corp., Cape Copper Co.)	2350
3.	Heath Steele Mines Ltd.	750
4.	Merrill Island Mining Corp. Ltd. (Blake Chibougamau Mining Corp.)	650
5.	Asarco, Buchans Unit. (Buchans Mine)	1250
6.	Craigmont Mines Ltd.	5000
7.	Consolidated Canadian Faraday Ltd., Werner Lake Mine. (Metal Mines Ltd., Nickel Mining and Smelting Co. Ltd.)	700
8.	Gaspe Copper Mines Ltd.	7000
9.	Rio Algom Mines Ltd., Pronto Division.	750
10.	Aetna Investments Corp., Ltd., Mineral King Mine. (Sheep Creek Mines Ltd.)	600
11.	Sullico Mines Ltd., East Sullivan Mine.	3000
12.	Cominco, Wedge Mine. (Consolidated Mining and Smelting Co. Ltd.)	750
13.	The Coniagus Mines Ltd.	350
14.	The Patino Mining Corp., Copper Rand Mines Division. (Copper Rand Chibougamau Mining Co.)	1800
15.	The Cowichan Copper Co., Sunro Mine.	1500
16.	Geco Mines Ltd.	3300
17.	Manitou Barvue Mines Ltd. (Golden Manitou Mines Ltd., and Barvue Mines)	1300
18.	United Keno Hill Mines Ltd. (Keno Hill Mining Co.)	500
19.	Copperfields Mining Corp., Temagami Mine. (Temagami Mining Co. Ltd)	200
20.	Noranda Mines Ltd., Horne Mine.	3200
21.	Normetal Mining Corp., Ltd.	1000
22.	Opemiska Copper Mines (Quebec) Ltd.	2000
23.	Quemont Mining Corp., Ltd.	2300

TABLE 4 (CONTINUED)

PROPERTY MILLING RATES, NAME, AND NAME CHANGES

PROP. NO.	PROPERTY NAME (including Name Changes)	MILL RATE (tons/day)
24.	Waite Amulet Mines Ltd. (Waite Amulet Montgomery Property)	2000
25.	Hudson Bay Mining and Smelting Co. Ltd., Flin Flon Mine.	6000
26.	" " " " " " " , North Star Mine.	-
27.	" " " " " " " . Schist Lake Mine.	-
28.	Granduc Mines Ltd.	nil
29.	Granby Consolidated Mining, Smelting, and Power Co., Copper Mountain Mine. (Granby Mining Co.)	5000
30.	The Anaconda Co. (Canada) Ltd., Brittannia Beach Mine. (Brittannia Mining and Smelting Co. Ltd., Howe Sound Mining Co.)	1500
31.	North Coldstream Mines Ltd. (Coldstream Copper Mines Ltd.)	1000
32.	Cominco, Sullivan Mine.	10000
33.	Manitou Barvue Mines Limited. (see No. 17)	
34.	Mackeno Mines Limited. (Galkeno Mines Ltd.)	-
35.	Silver Standard Mines Ltd.	1800
36.	Granby Consolidated Co. Ltd., Phoenix Mine Division. (Granby Mining Co.)	2000
37.	Campbell Chibougamau Mines Ltd.,Henderson Mine.	3500
38.	" " " " , Main Mine "B" Zone.	-
39.	" " " " , Main Mine "Winze" Zone.	-
40.	Bethlehem Copper Corp. Ltd.	4000
41.	Magnet Cove Barium Corp., Magnet Cove Mine.	125
42.	New Calumet Mines Ltd.	750
43.	The International Nickel Co. of Canada Ltd., Creighton Mine.	-
44.	Nickel Offset Ltd. (Foy Offset)	-
45.	Falconbridge Nickel Mines Ltd., McKim Mine.	-
46.	Lake Dufault Mines Ltd.	1300

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APPENDIX 3

Element Analyses by Fraction

TABLE | PAGE

TABLE 1

ELEMENT ANALYSES BY SAMPLE FRACTION

S BY U OF MAN., OTHERS BY MAN. MINES BRANCH
A= +400 FRACTION B= -400 FRACTION

PR. NO.	AU OZ / TON	AG	PB	CU	NI	ZN WEIGHT	CO	FE PERCENT	S
1A	.025	.45	0.00	1.60	0.00	.40	.050	26.35	21.90
1B	.030	.35	0.00	2.23	0.00	.70	.080	29.70	20.85
2A	.060	.25	0.00	1.09	0.00	0.00	.002	27.26	17.90
2B	.030	.10	0.00	1.22	0.00	0.00	.002	24.75	12.85
3A	.030	2.20	1.65	.76	0.00	4.60	.110	40.00	42.45
3B	.025	3.00	2.50	1.09	0.00	6.80	.100	37.40	39.30
4A	.030	.70	.01	2.31	0.00	.10	.070	15.70	11.95
4B	.040	.90	.01	2.70	0.00	.10	.050	17.50	11.65
5A	.070	4.40	8.40	1.13	0.00	14.70	.002	4.70	15.15
5B	.020	5.10	13.00	1.30	0.00	14.20	.002	4.30	16.00
6A	.005	0.00	0.00	1.77	0.00	0.00	.010	27.90	2.00
6B	.005	0.00	0.00	2.48	0.00	0.00	.010	21.10	2.55
7A	.001	.70	.01	.45	1.28	0.00	.060	19.20	6.60
7B	.001	.20	0.00	.76	1.60	0.00	.060	19.40	7.05
8A	.001	.25	0.00	.93	0.00	0.00	.002	6.60	1.35
8B	.010	.30	0.00	1.38	0.00	0.00	.002	6.50	1.80
9A	.010	.10	.05	1.48	.02	0.00	.060	12.03	6.20
9B	.005	.45	0.00	2.59	.01	0.00	.110	15.03	7.60
10A	.005	1.00	2.20	.08	0.00	5.30	.002	3.30	8.95
10B	.001	1.30	1.56	.07	0.00	4.20	.002	2.60	7.55
11A	.005	.10	0.00	.47	0.00	.01	.002	11.50	4.30
11B	.005	.20	0.00	.68	0.00	.01	.002	10.80	2.50
12A	.005	.60	.10	2.43	0.00	1.20	.040	40.80	39.00
12B	.010	.80	.20	4.15	0.00	1.70	.050	37.60	38.45
13A	.030	8.00	.50	.06	.01	10.80	.002	12.55	14.75
13B	.020	6.30	1.40	.09	.01	16.60	.002	10.82	13.45
14A	.085	.45	0.00	2.64	0.00	.90	.040	19.95	7.00
14B	.055	.20	0.00	2.24	.01	0.00	.040	18.95	4.55
15A	.035	.20	.01	1.45	0.00	0.00	.020	14.87	2.50
15B	.010	.20	0.00	1.68	0.00	0.00	.030	16.23	2.55
16A	.010	2.20	0.00	1.65	0.00	3.80	.002	18.69	18.70
16B	.010	4.70	.45	3.22	0.00	6.70	.002	18.24	18.90
17A	.035	5.10	.49	0.00	9.00	3.580	.000	5.20	4.99
17B	.035	4.99	.50	.01	1.00	3.600	.000	5.18	5.41
18A	.015	33.10	10.40	.10	0.00	7.000	.000	8.44	5.50
18B	.010	46.10	5.80	.13	0.00	3.700	.000	7.94	4.80
19A	.020	.30	0.00	5.37	.14	0.00	.002	9.17	6.45
19B	.001	.50	0.00	4.39	.10	0.00	.002	8.64	4.85
20A	.170	.50	0.00	1.32	0.00	0.00	.040	45.93	34.95
20B	.140	.50	0.00	2.36	0.00	0.00	.030	42.71	28.30
21A	.020	1.60	.15	1.61	0.00	3.70	.020	26.93	24.40
21B	.075	2.40	.22	3.04	0.00	6.70	.020	20.70	20.60
22A	.070	.60	.01	3.29	.02	.01	.020	17.89	6.60
22B	.040	.90	.01	6.73	.01	.01	.020	21.31	9.30
23A	.185	.80	.02	.87	.02	1.30	.010	38.99	33.20
23B	.120	1.10	.02	1.68	0.00	2.40	.010	31.56	24.67

TABLE 1 (CONTINUED)

ELEMENT ANALYSES BY SAMPLE FRACTION

S BY U OF MAN., OTHERS BY MAN. MINES BRANCH
A= +400 FRACTION B= -400 FRACTION

PR. NO.	AU OZ / TON	AG	PB	CU	NI	ZN WEIGHT	CO PERCENT	FE	S
24A	.055	.80	.01	4.25	0.00	2.30	.040	29.15	21.75
24B	.030	1.50	.06	6.58	0.00	3.30	.030	26.43	19.55
25A	.120	1.70	.16	3.85	0.00	3.10	.030	29.55	31.10
25B	.080	2.00	.25	4.86	0.00	4.60	.020	29.65	28.85
26A	.015	.35	0.00	10.85	0.00	0.00	.070	32.30	31.10
26B	.010	.25	0.00	13.84	0.00	.10	.080	29.39	25.60
27A	.065	1.20	0.00	4.00	0.00	12.60	.030	21.88	28.45
27B	.055	1.40	0.00	4.69	0.00	14.50	.030	20.78	26.00
28A	.020	0.00	0.00	1.38	0.00	0.00	.020	9.46	3.05
28B	.005	0.00	0.00	2.02	0.00	0.00	.020	10.21	3.55
29A	.010	0.00	0.00	.53	0.00	0.00	0.000	3.50	.65
29B	.001	.10	0.00	1.06	0.00	0.00	0.000	4.71	.90
30A	.055	0.00	0.00	.78	0.00	1.00	0.000	8.26	7.85
30B	.020	.15	0.00	1.30	0.00	1.60	0.000	7.06	6.30
31A	.020	0.00	0.00	1.72	0.00	0.00	.040	8.11	6.85
31B	.020	.05	0.00	2.55	0.00	0.00	.040	10.51	7.60
32A	0.000	.90	3.40	0.00	0.00	6.40	0.000	24.18	18.75
32B	0.000	2.80	9.30	0.00	0.00	7.40	0.000	23.63	19.60
33A	.001	0.00	0.00	.91	0.00	.09	0.000	1.59	1.54
33B	.001	0.00	0.00	.89	0.00	.11	0.000	1.61	1.66
34A	.025	51.90	14.40	0.00	0.00	7.80	0.000	12.42	8.90
34B	.020	69.00	21.20	.01	0.00	6.15	0.000	10.46	8.00
35A	.110	41.60	5.52	.29	0.00	8.70	0.000	7.51	8.20
35B	.065	43.50	6.64	.30	0.00	7.80	0.000	7.41	7.05
36A	.035	.20	0.00	.64	0.00	.01	0.000	9.96	2.90
36B	.020	.25	0.00	.65	0.00	.01	0.000	9.81	2.05
37A	.085	.20	0.00	3.53	.19	1.20	.060	23.03	11.85
37B	.040	.10	0.00	3.37	.15	1.00	.050	22.18	8.05
38A	.175	.90	0.00	2.03	0.00	.60	.070	25.04	16.05
38B	.110	1.10	0.00	3.01	0.00	1.00	.050	24.48	15.10
39A	.035	.10	0.00	1.69	.08	0.00	.090	30.99	21.35
39B	.035	.25	0.00	2.53	.09	0.00	.080	29.19	17.95
40A	0.000	0.00	0.00	.86	0.00	0.00	0.000	2.89	.60
40B	0.000	0.00	0.00	1.11	0.00	0.00	0.000	3.60	.70
41A	0.000	17.30	3.80	.92	.01	4.00	.030	20.90	7.70
41B	.001	9.40	4.20	.68	.01	2.20	.030	17.85	7.95
42A	.030	1.90	1.50	.10	0.00	3.80	0.000	6.41	4.70
42B	.025	4.90	2.63	.19	0.00	7.00	0.000	7.55	7.10
43A	0.000	0.00	.10	.34	.62	0.00	.020	10.65	4.10
43B	0.000	0.00	.10	1.04	1.00	0.00	.020	12.70	5.40
44A	0.000	0.00	.20	.28	.35	0.00	.010	9.13	3.30
44B	0.000	0.00	.10	.39	.35	0.00	.001	9.53	2.65
45A	0.000	0.00	0.00	.33	1.21	0.00	.070	20.00	10.25
45B	0.000	0.00	0.00	.56	1.33	.01	.070	18.80	9.15

APPENDIX 4

Point Counts, -65+400 Mesh Fraction

TABLE PAGE

TABLE 1

SULPHIDE AND OPAQUE MINERAL COUNTS +400 MESH FRACTION

PR NO	GAN	SL	GN	CP	PY	MG	PO	SP	PN	MC	BO	AS	FR	CR	LM	TT	CC	TN	UK	HM
1	549	1	0	34	277	0	34	0	0	0	0	0	0	0	0	0	0	0	0	0
1	607	8	0	45	265	0	29	0	0	0	0	0	0	0	0	0	0	0	0	0
1	798	10	0	53	375	0	41	0	0	0	0	0	0	0	0	0	0	0	0	0
1	1954	19	0	132	917	0	104	0	0	0	0	0	0	0	0	0	0	0	0	0
2	995	2	0	51	406	56	2	0	0	0	0	0	0	0	0	0	0	0	0	0
2	1119	2	0	53	410	62	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2	1185	1	0	42	271	77	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2	3299	5	0	146	1087	195	4	0	0	0	0	0	0	0	0	0	0	0	0	0
3	278	223	30	56	1008	56	1	0	0	0	0	0	0	0	0	0	0	0	0	0
3	218	169	31	31	970	58	13	0	0	0	0	0	0	0	0	0	0	0	0	0
3	216	168	17	51	1031	39	17	0	0	0	0	0	0	0	0	0	0	0	0	0
3	712	560	78	138	3009	153	31	0	0	0	0	0	0	0	0	0	0	0	0	0
4	831	4	0	78	59	2	118	0	0	0	0	0	0	0	0	0	0	0	0	0
4	724	2	0	81	76	4	105	0	0	0	0	0	0	0	0	0	0	0	0	0
4	794	2	0	112	115	7	130	0	0	0	0	0	0	0	0	0	0	0	0	0
4	2349	8	0	271	250	13	353	0	0	0	0	0	0	0	0	0	0	0	0	0
5	701	283	62	43	60	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	916	288	56	52	43	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	596	258	65	34	50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	2213	829	183	129	153	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	879	0	0	69	3	191	0	123	0	0	0	0	0	0	0	0	0	0	0	0
6	773	0	0	65	4	161	0	90	0	0	0	0	0	0	0	0	0	0	0	0
6	665	0	0	51	7	162	0	72	0	0	0	0	0	0	0	0	0	0	0	0
6	2317	0	0	185	14	514	0	285	0	0	0	0	0	0	0	0	0	0	0	0

TABLE 1 (CONTINUED)

6 2317 0 0 185 14 514 0285 0 0 0 0 0 0 0 0 0 0 0 0

SULPHIDE AND OPAQUE MINERAL COUNTS
+400 MESH FRACTION

PR NO	GAN	SL	GN	CP	PY	MG	PO	SP	PN	MC	BO	AS	FR	CR	LM	TT	CC	TN	UK	HM
7	1304	0	0	22	32	110	175	0	45	0	0	0	0	30	0	0	0	0	0	0
7	1335	0	0	16	17	92	164	0	56	0	0	0	0	27	0	0	0	0	0	0
7	1178	0	0	17	18	95	160	0	43	0	0	0	0	31	0	0	0	0	0	0
7	3817	0	0	55	67	297	499	0	144	0	0	0	0	88	0	0	0	0	0	0
8	1080	0	0	24	2	1	2	0	0	0	0	0	0	0	0	0	0	0	1	0
8	1150	0	0	25	3	1	3	0	0	0	0	0	0	0	0	0	0	0	1	0
8	1201	0	0	31	4	1	7	0	0	0	0	0	0	0	0	0	0	0	1	0
8	3431	0	0	80	9	3	12	0	0	0	0	0	0	0	0	0	0	0	3	0
9	1632	0	0	90	4	4	164	0	0	0	0	0	0	0	0	0	0	0	0	0
9	1685	3	0	60	2	2	183	0	0	0	0	0	0	0	0	0	0	0	0	0
9	1592	0	0	78	2	3	159	0	0	0	0	0	0	0	0	0	0	0	0	0
9	4909	3	0	228	8	9	506	0	0	0	0	0	0	0	0	0	0	0	0	0
10	1263	127	22	0	57	0	0	0	0	0	0	0	0	0	0	15	0	0	0	0
10	983	112	33	0	51	0	0	0	0	0	0	0	0	0	0	10	0	0	0	0
10	1182	116	36	0	54	0	0	0	0	0	0	0	0	0	0	15	0	0	0	0
10	3428	355	91	0	162	0	0	0	0	0	0	0	0	0	0	40	0	0	0	0
11	1257	4	0	17	53	14	4	0	0	0	0	0	0	0	0	0	0	0	0	0
11	2183	0	0	36	101	21	13	0	0	0	0	0	0	0	0	0	0	0	0	0
11	1410	0	0	10	56	11	6	0	0	0	0	0	0	0	0	0	0	0	0	0
11	4850	4	0	63	210	46	23	0	0	0	0	0	0	0	0	0	0	0	0	0
12	311	25	0	168	1158	7	3	0	0	0	0	0	0	0	0	0	0	0	0	0
12	295	34	1	138	1134	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	272	39	1	132	1065	9	5	0	0	0	0	0	0	0	0	0	0	0	0	0
12	878	98	2	438	3357	23	8	0	0	0	0	0	0	0	0	0	0	0	0	0

TABLE 1 (CONTINUED)

SULPHIDE AND OPAQUE MINERAL COUNTS
+400 MESH FRACTION

PR NO	GAN	SL	GN	CP	PY	MG	PO	SP	PN	MC	BO	AS	FR	CR	LM	TT	CC	TN	UK	HM
13	1279	264	3	3	166	2	4	0	0	0	0	0	0	0	0	0	0	0	0	0
13	1224	253	2	2	143	2	3	0	0	0	0	0	0	0	0	0	0	0	0	0
13	1210	210	3	1	178	4	5	0	0	0	0	0	0	0	0	0	0	0	0	0
13	3713	727	8	6	487	8	12	0	0	0	0	0	0	0	0	0	0	0	0	0
14	1555	2	0	110	71	21	10	0	0	0	0	0	0	0	0	0	0	0	0	0
14	1277	0	0	92	65	33	9	0	0	0	0	0	0	0	0	0	0	0	0	0
14	1470	2	0	92	74	26	13	0	0	0	0	0	0	0	0	0	0	0	0	0
14	4302	4	0	294	210	80	32	0	0	0	0	0	0	0	0	0	0	0	0	0
15	1555	0	0	54	16	9	6	0	0	0	0	0	0	0	0	0	0	0	0	0
15	1609	0	0	62	16	8	5	0	0	0	0	0	0	0	0	0	0	0	0	0
15	1297	0	0	58	28	11	2	0	0	0	0	0	0	0	0	0	0	0	0	0
15	4461	0	0	174	60	28	13	0	0	0	0	0	0	0	0	0	0	0	0	0
16	1431	102	1	102	337	10	70	0	0	0	0	0	0	0	0	0	0	0	0	0
16	1115	91	0	78	277	8	70	0	0	0	0	0	0	0	0	0	0	0	0	0
16	1217	90	1	60	304	17	80	0	0	0	0	0	0	0	0	0	0	0	0	0
16	3763	283	2	240	918	35	220	0	0	0	0	0	0	0	0	0	0	0	0	0
17	1193	110	4	2	128	1	0	0	0	0	0	0	0	0	0	0	0	0	0.	0
17	1139	79	5	6	114	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	1219	91	8	2	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	3551	280	17	10	342	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	1088	82	46	3	49	0	0	0	0	0	0	3	10	0	19	0	0	0	0	0
18	999	81	63	2	52	0	0	0	0	0	0	1	7	0	20	0	0	0	0	0
18	1089	97	44	3	52	0	0	0	0	0	0	2	8	0	24	0	0	0	0	0
18	3176	260	153	8	153	0	0	0	0	0	0	6	25	0	63	0	0	0	0	0

TABLE 1 (CONTINUED)

SULPHIDE AND OPAQUE MINERAL COUNTS
+400 MESH FRACTION

PR NO	GAN	SL	GN	CP	PY	MG	PO	SP	PN	MC	BO	AS	FR	CR	LM	TT	CC	TN	UK	HM
19	1658	0	0	276	50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	1452	1	0	224	34	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	1470	0	0	224	34	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	4580	1	0	724	118	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	290	0	0	115	510	167	649	0	0	0	0	0	0	0	0	0	0	0	0	0
20	319	0	0	87	379	190	508	0	0	0	0	0	0	0	0	0	0	0	0	0
20	184	0	0	66	239	113	310	0	0	0	0	0	0	0	0	0	0	0	0	0
20	793	0	0	268	1128	470	1467	0	0	0	0	0	0	0	0	0	0	0	0	0
21	800	71	1	69	401	15	24	0	0	0	0	0	0	0	0	0	0	0	0	0
21	667	74	1	64	365	20	14	0	0	0	0	0	0	0	0	0	0	0	0	0
21	694	81	0	66	315	21	14	0	0	0	0	0	0	0	0	0	0	0	0	0
21	2161	226	2	199	1081	56	52	0	0	0	0	0	0	0	0	0	0	0	0	0
22	986	1	0	19	71	79	2	0	0	0	0	0	0	0	0	0	0	0	0	0
22	1201	0	0	41	78	91	2	0	0	0	0	0	0	0	0	0	0	0	0	0
22	1244	0	0	137	61	110	3	0	0	0	0	0	0	0	0	0	0	0	0	0
22	3431	1	0	197	210	280	7	0	0	0	0	0	0	0	0	0	0	0	0	0
23	408	26	0	41	822	56	280	0	0	0	0	0	0	0	0	0	0	0	0	0
23	491	26	0	60	827	48	290	0	0	0	0	0	0	0	0	0	0	0	0	0
23	403	28	0	72	695	39	261	0	0	0	0	0	0	0	0	0	0	0	0	0
23	1302	80	0	173	2344	143	831	0	0	0	0	0	0	0	0	0	0	0	0	0
24	755	54	0	159	228	48	84	0	0	0	0	0	0	0	0	0	0	0	0	0
24	800	52	0	182	242	36	92	0	0	0	0	0	0	0	0	0	0	0	0	0
24	761	52	0	176	291	28	143	0	0	0	0	0	0	0	0	0	0	0	0	0
24	2316	158	0	517	761	112	319	0	0	0	0	0	0	0	0	0	0	0	0	0

TABLE 1 (CONTINUED)

SULPHIDE AND OPAQUE MINERAL COUNTS
+400 MESH FRACTION

PR NO	GAN	SL	GN	CP	PY	MG	PO	SP	PN	MC	BO	AS	FR	CR	LM	TT	CC	TN	UK	HM
25	582	100	0	187	547	8	33	0	0	0	0	0	0	0	0	0	0	0	0	0
25	737	128	0	226	832	17	48	0	0	0	0	0	0	0	0	0	0	0	0	0
25	696	123	2	218	670	11	38	0	0	0	0	1	0	0	0	0	0	0	0	0
25	2015	351	2	631	2049	36	119	0	0	0	0	1	0	0	0	0	0	0	0	0
26	709	0	0	586	507	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	707	0	0	527	541	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	323	0	0	273	212	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	1739	0	0	1386	1260	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27	860	367	0	221	566	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27	738	325	0	203	519	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27	562	291	0	179	394	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27	2160	983	0	603	1479	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28	2085	0	0	77	46	50	45	0	0	0	0	0	0	0	0	0	0	0	0	0
28	691	3	0	37	10	27	18	0	0	0	0	0	0	0	0	0	0	0	0	0
28	880	2	0	60	14	24	30	0	0	0	0	0	0	0	0	0	0	0	0	0
28	3656	5	0	174	70	101	93	0	0	0	0	0	0	0	0	0	0	0	0	0
29	1490	0	0	10	5	13	0	0	0	0	5	0	0	0	0	0	0	0	0	0
29	1509	0	0	13	5	17	0	0	0	0	7	0	0	0	0	0	0	0	0	0
29	1498	0	0	11	1	9	0	0	0	0	4	0	0	0	0	0	0	0	0	0
29	4497	0	0	34	11	39	0	0	0	0	16	0	0	0	0	0	0	0	0	0
30	1417	24	0	32	149	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	1559	29	1	32	162	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	1574	24	1	37	146	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	4550	77	2	101	457	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0

TABLE 1 (CONTINUED)

SULPHIDE AND OPAQUE MINERAL COUNTS
+400 MESH FRACTION

PR NO	GAN	SL	GN	CP	PY	MG	PO	SP	PN	MC	BO	AS	FR	CR	LM	TT	CC	TN	UK	HM
31	1473	0	0	86	127	46	0	0	0	0	0	0	0	0	0	0	0	0	0	14
31	1479	0	0	101	152	56	1	0	0	0	0	0	0	0	0	0	0	0	0	22
31	1437	0	0	78	139	46	0	0	0	0	0	0	0	0	0	0	0	0	0	26
31	4389	0	0	265	418	148	1	0	0	0	0	0	0	0	0	0	0	0	0	62
32	903	138	30	0	52	10	368	0	0	0	0	0	0	0	0	0	0	0	0	7
32	906	155	37	0	73	2	326	0	0	0	0	0	0	0	0	0	0	0	0	1
32	942	171	36	0	69	3	339	0	0	0	0	0	0	0	0	0	0	0	0	2
32	2751	464	103	0	194	15	1033	0	0	0	0	0	0	0	0	0	0	0	0	10
33	1738	0	0	37	44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
33	1548	2	0	23	34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
33	1151	2	0	23	23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
33	4437	4	0	83	101	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
34	1257	233	126	0	60	0	0	0	0	0	0	1	16	0	3	0	0	0	0	0
34	1284	183	146	0	63	0	0	0	0	0	0	1	19	0	8	0	0	0	0	0
34	1205	202	110	0	40	0	0	0	0	0	0	1	14	0	4	0	0	0	0	0
34	3746	618	382	0	163	0	0	0	0	0	0	3	49	0	15	0	0	0	0	0
35	1403	208	67	7	67	0	9	0	0	0	0	22	0	0	0	0	0	5	0	0
35	1480	241	67	6	77	0	4	0	0	0	0	9	0	0	0	0	0	4	0	0
35	1353	187	68	7	58	0	16	0	0	0	0	29	0	0	0	0	0	3	0	0
35	4236	636	202	20	202	0	29	0	0	0	0	60	0	0	0	0	0	12	0	0
36	1656	1	0	42	40	37	0	0	0	0	0	0	0	0	0	0	0	0	0	7
36	1496	1	0	30	60	48	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36	1506	1	0	21	49	26	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36	4658	3	0	93	149	111	0	0	0	0	0	0	0	0	0	0	0	0	0	7

TABLE 1 (CONTINUED)

SULPHIDE AND OPAQUE MINERAL COUNTS
+400 MESH FRACTION

PR NO	GAN	SL	GN	CP	PY	MG	PO	SP	PN	MC	BO	AS	FR	CR	LM	TT	CC	TN	UK	HM
37	1218	9	0	165	68	2	179	0	0	0	0	0	0	0	0	0	0	0	0	0
37	1850	15	0	249	98	1	275	0	0	0	0	0	0	0	0	0	0	0	0	0
37	875	5	0	106	45	1	114	0	0	0	0	0	0	0	0	0	0	0	0	0
37	3943	29	0	520	211	4	568	0	0	0	0	0	0	0	0	0	0	0	0	0
38	1074	19	0	102	62	0	478	0	0	0	0	0	0	0	0	0	0	0	0	0
38	1160	18	0	109	69	0	497	0	0	0	0	0	0	0	0	0	0	0	0	0
38	1244	14	0	110	68	0	462	0	0	0	0	0	0	0	0	0	0	0	0	0
38	3478	51	0	321	199	0	1437	0	0	0	0	0	0	0	0	0	0	0	0	0
39	1033	1	0	111	37	0	842	0	0	0	0	0	0	0	0	0	0	0	0	0
39	1028	0	0	132	47	0	803	0	0	0	0	0	0	0	0	0	0	0	0	0
39	1044	1	0	88	33	0	726	0	0	0	0	0	0	0	0	0	0	0	0	0
39	3105	2	0	331	117	0	2371	0	0	0	0	0	0	0	0	0	0	0	0	0
40	1513	0	0	15	8	13	0	0	0	0	6	0	0	0	0	0	1	0	0	0
40	1338	0	0	16	6	8	0	0	0	0	6	0	0	0	0	0	0	0	0	0
40	1416	0	0	8	6	13	0	0	0	0	6	0	0	0	0	0	3	0	0	0
40	4267	0	0	39	20	34	0	0	0	0	18	0	0	0	0	0	4	0	0	0
41	1440	92	27	45	32	0	0	0	0	28	0	0	0	0	0	0	0	1	0	0.
41	1561	100	39	43	41	0	0	0	0	38	0	0	0	0	0	0	0	1	0	0
41	1489	107	30	37	34	0	0	0	0	32	0	0	0	0	0	0	0	1	0	0
41	4490	299	96	125	107	0	0	0	0	98	0	0	0	0	0	0	0	3	0	0
42	1261	78	12	5	16	0	73	0	0	0	0	0	0	0	0	0	0	0	0	0
42	1242	58	11	7	10	0	56	0	0	0	0	0	0	0	0	0	0	0	0	0
42	1250	74	11	4	11	0	68	0	0	0	0	0	0	0	0	0	0	0	0	0
42	3753	210	34	16	37	0	197	0	0	0	0	0	0	0	0	0	0	0	0	0

TABLE 1 (CONTINUED)

SULPHIDE AND OPAQUE MINERAL COUNTS
+400 MESH FRACTION

PR NO	GAN	SL	GN	CP	PY	MG	PO	SP	PN	MC	BO	AS	FR	CR	LM	TT	CC	TN	UK	HM
43	1339	0	0	15	1	9	80	0	16	0	0	0	0	0	0	0	0	0	5	0
43	1296	0	1	12	2	9	99	0	13	0	0	0	0	0	0	0	0	0	1	0
43	1252	0	0	14	1	6	69	0	15	0	0	0	0	0	0	0	0	0	0	0
43	3887	0	1	41	4	24	248	0	44	0	0	0	0	0	0	0	0	0	6	0
44	1476	0	0	13	46	5	46	0	10	0	0	0	0	0	0	0	0	0	0	0
44	1672	0	1	15	47	9	47	0	11	0	0	0	0	0	0	0	0	0	0	0
44	1540	0	0	13	43	5	55	0	11	0	0	0	0	0	0	0	0	0	0	0
44	4688	0	1	41	136	19	148	0	32	0	0	0	0	0	0	0	0	0	0	0
45	1209	0	1	23	57	28	107	0	38	0	0	0	0	0	0	0	0	0	0	0
45	1161	0	0	19	40	25	200	0	38	0	0	0	0	0	0	0	0	0	0	0
45	1362	0	0	20	58	26	239	0	36	0	0	0	0	0	0	0	0	0	0	0
45	3732	0	1	62	155	79	546	0	112	0	0	0	0	0	0	0	0	0	0	0

TABLE 1 (CONTINUED)

SYMBOLS USED FOR SULPHIDE-OPAQUE MINERALS

SYMBOL	MINERAL
SL	SPHALERITE
GN	GALENA
CP	CHALCOPYRITE
PY	PYRITE
MG	MAGNETITE
PO	PYRRHOTITE
HM	HEMATITE
PN	PENTLANDITE
AS	ARSENOPYRITE
TT	TETRAHEDRITE
FR	FREIBERGITE
SP	SPECULARITE
T-B	TETRAHEDRITE-BOURNONITE
LM	LIMONITE
CR	CHROMITE
BO	BORNITE
CC	CHALCOCITE
MC	MARCASITE
UK	UNKNOWN
TN	TENNANTITE
GAN	GANGUE
SUL	SULPHIDES
OPA	OPAQUES

TABLE 2

SILICATE MINERAL COUNTS

CAL	QTZ	CHL	HB 3	HB 1	HB 2	TRE	ACT	AUG	NO.
27	283	19	0	0	0	0	0	0	1
7	16	385	0	0	0	0	0	0	2
0	77	16	0	0	0	0	30	0	3
47	369	69	0	0	0	0	0	0	4
86	68	13	0	0	0	0	0	0	5
104	32	0	0	0	0	0	0	0	6
2	45	0	0	0	43	0	0	0	7
112	54	0	0	0	0	0	0	0	8
6	610	124	0	0	0	0	0	0	9
171	134	0	0	0	0	0	0	0	10
27	143	112	0	0	0	0	0	0	11
27	93	1	0	0	0	0	0	0	12
115	143	61	0	0	0	0	0	0	13
120	144	34	0	0	0	0	0	0	14
4	65	0	362	0	0	0	6	0	15
10	211	0	0	9	0	0	0	0	16
47	166	0	0	5	0	0	0	0	17
53	756	0	0	0	0	0	0	0	18
71	67	0	0	0	0	0	0	0	19
16	41	22	0	0	0	0	0	0	20
7	157	138	0	0	0	0	0	0	21
18	68	0	145	0	0	0	34	51	22
34	55	30	0	0	0	0	0	0	23
39	125	30	0	0	0	0	0	0	24
137	184	0	0	0	0	0	0	0	25
88	67	96	0	0	0	0	0	0	26
69	71	0	0	0	0	0	0	0	27
65	158	0	0	19	0	0	0	0	28
12	0	2	0	0	0	0	0	235	29
0	460	7	0	0	0	0	0	0	30
14	271	0	0	0	0	0	0	0	31
85	109	0	0	0	0	10	0	0	32
15	281	70	0	9	0	0	0	0	33
135	427	6	0	0	0	0	0	0	34
167	721	0	0	0	0	0	0	5	35
301	252	65	0	0	0	0	9	0	36
108	188	256	0	0	0	0	0	0	37
49	452	148	0	0	0	0	0	0	38
32	386	72	0	0	0	0	0	0	39
35	328	106	0	0	0	36	0	0	40
103	30	2	0	0	0	0	0	0	41
57	71	0	0	0	0	243	0	0	42
2	110	112	0	148	0	0	0	7	43
0	46	21	0	173	0	0	0	7	44
14	41	85	0	50	244	0	0	6	45

TABLE 2 (CONTINUED)

SILICATE MINERAL COUNTS

URA	EPI	BIO	GAR	FEL	PYR	DIO	HYP	UWR	NO.
0	0	0	0	0	0	0	0	0	1
0	0	0	0	0	0	0	0	0	2
0	0	0	0	0	0	0	0	0	3
0	0	0	0	0	0	0	0	0	4
0	0	0	0	0	0	0	0	0	5
0	62	0	8	15	0	0	0	0	6
0	0	58	0	67	44	0	0	0	7
0	0	0	17	3	0	21	0	34	8
0	0	0	0	0	0	0	0	0	9
0	0	0	0	0	0	0	0	0	10
0	0	0	0	0	0	0	0	0	11
0	0	0	0	0	0	0	0	0	12
0	0	0	0	0	0	0	0	0	13
0	0	0	0	0	0	0	0	0	14
0	4	0	0	0	0	0	0	0	15
0	0	15	7	14	0	0	0	7	16
0	0	5	62	0	0	0	0	0	17
0	0	0	0	0	0	0	0	0	18
0	0	0	0	0	0	0	0	0	19
0	8	0	0	0	0	0	0	33	20
0	0	2	5	0	0	0	0	60	21
0	0	150	0	0	0	0	0	0	22
0	0	0	0	0	0	0	0	40	23
0	87	0	0	0	0	0	0	0	24
0	0	0	0	0	0	0	0	39	25
0	0	0	0	0	0	0	0	0	26
0	0	0	0	0	0	0	0	20	27
0	39	14	0	0	0	0	0	39	28
0	18	13	0	76	0	0	0	0	29
0	0	4	0	17	2	0	0	0	30
0	0	4	0	0	0	0	0	454	31
0	0	7	21	0	0	0	0	0	32
0	6	0	2	0	0	0	0	849	33
0	7	0	0	10	0	0	0	13	34
0	0	0	0	0	0	0	0	0	35
0	100	0	17	0	0	0	0	386	36
0	0	0	0	0	0	0	0	7	37
0	12	0	0	0	0	0	0	5	38
0	2	0	0	0	0	0	0	3	39
0	49	5	0	0	0	0	0	0	40
0	0	0	0	0	0	0	0	471	41
0	0	30	19	22	0	84	0	28	42
114	11	67	1	0	0	0	95	0	43
332	22	24	0	0	0	0	0	0	44
106	8	9	0	0	0	0	33	0	45

TABLE 2 (CONTINUED)

SILICATE MINERAL COUNTS

SID	APA	ZOI	MUS	SER	OLI	BAR	FLU	CHD	NO.
0	0	0	0	0	0	0	0	0	1
0	0	0	0	0	0	0	0	0	2
0	0	0	0	0	0	0	0	0	3
0	0	0	0	0	0	0	0	0	4
0	0	0	0	0	0	246	48	0	5
0	0	0	0	0	0	0	0	0	6
0	0	0	0	0	175	0	0	0	7
0	0	0	0	0	0	0	0	0	8
0	0	0	0	0	0	0	0	0	9
0	0	0	0	0	0	244	0	0	10
0	0	0	0	0	0	0	0	0	11
0	0	0	0	0	0	0	0	0	12
0	0	0	0	0	0	0	0	0	13
28	0	0	0	0	0	0	0	17	14
0	0	0	0	0	0	0	0	0	15
0	0	0	55	0	0	0	0	0	16
0	0	0	0	0	0	0	8	0	17
31	0	0	0	0	0	0	0	0	18
0	0	0	0	0	0	0	0	0	19
0	0	0	0	0	0	0	0	0	20
19	0	0	0	0	0	0	0	0	21
9	0	0	0	0	0	0	0	0	22
0	0	0	0	0	0	0	0	0	23
0	0	64	0	0	0	0	0	0	24
0	0	0	0	0	0	0	0	0	25
0	0	0	0	0	0	0	0	0	26
0	0	0	0	0	0	0	0	0	27
0	0	0	0	0	0	0	0	0	28
0	0	0	0	0	0	0	0	0	29
0	0	0	0	12	0	17	0	0	30
0	4	0	0	0	0	0	0	0	31
0	0	20	5	0	0	0	0	0	32
0	0	0	0	20	0	0	0	0	33
319	0	0	0	0	0	0	0	0	34
95	0	0	0	0	0	0	0	0	35
0	0	0	0	0	0	0	0	0	36
0	13	22	0	0	0	0	0	0	37
0	5	42	0	0	0	0	0	0	38
0	4	24	0	0	0	0	0	0	39
0	0	0	0	0	0	0	0	0	40
46	0	0	0	0	0	266	0	0	41
0	0	0	0	0	0	0	0	0	42
0	3	0	0	0	0	0	0	0	43
0	4	0	0	0	0	0	0	0	44
0	0	0	0	0	0	0	0	0	45

TABLE 2 (CONTINUED)

SILICATE MINERAL COUNTS

SLL	WRP	GYP	OCB	ZEO	QFM	SRP	APL	FQP	NO.
0	0	0	0	0	0	0	0	0	1
0	0	0	0	0	0	0	0	260	2
0	0	0	0	0	0	0	0	0	3
0	0	0	0	0	0	0	0	0	4
0	0	0	0	0	0	0	0	0	5
0	0	0	0	0	0	0	0	0	6
0	67	0	0	0	0	175	0	0	7
0	0	0	0	0	0	0	0	0	8
0	0	0	0	0	0	0	0	0	9
0	0	0	0	0	0	0	0	0	10
0	0	0	0	0	0	0	0	0	11
0	0	0	0	0	0	0	0	0	12
0	0	0	0	0	0	0	0	0	13
0	0	0	0	0	0	0	0	0	14
0	0	0	0	0	0	0	43	0	15
14	0	0	0	0	0	0	0	0	16
0	0	0	0	0	0	0	0	0	17
0	0	0	140	0	0	0	0	0	18
0	0	0	0	0	0	0	0	0	19
0	0	0	0	0	0	0	0	0	20
0	0	0	0	0	0	0	0	0	21
0	0	0	0	0	0	0	0	0	22
0	0	0	0	0	0	0	0	0	23
0	0	0	0	0	0	0	0	0	24
0	0	0	0	0	0	0	0	0	25
0	0	0	0	0	0	0	0	0	26
0	0	0	0	0	0	0	0	0	27
0	0	0	0	0	0	0	0	0	28
0	0	0	0	0	0	0	0	0	29
0	0	2	0	0	0	0	0	0	30
0	0	0	0	0	0	0	0	0	31
0	0	0	0	0	0	0	0	0	32
0	0	0	0	0	0	0	0	0	33
0	0	0	92	0	0	0	0	0	34
0	0	0	0	0	0	0	0	0	35
0	0	0	0	0	0	0	0	0	36
0	0	0	0	0	0	0	0	0	37
0	0	0	0	0	0	0	0	0	38
0	0	0	0	0	0	0	0	0	39
0	0	0	0	39	0	0	0	0	40
0	0	0	0	0	0	0	0	0	41
0	0	0	0	0	0	0	0	0	42
0	0	0	0	0	7	0	0	0	43
0	0	0	0	0	106	0	0	0	44
0	0	0	0	0	0	0	0	0	45

TABLE 2 (CONTINUED)

SILICATE MINERAL COUNTS

PLA	CCS	SWR	SCWR	SCTWR	STWR	SAWR	CWR	CSCWR	NO.
0	0	0	0	0	0	0	0	0	1
0	0	0	0	0	0	0	0	0	2
0	0	0	0	0	0	0	0	0	3
0	0	0	0	0	0	0	0	0	4
0	0	111	0	0	0	0	0	0	5
0	0	0	0	0	0	0	179	0	6
0	0	0	0	0	0	0	0	0	7
0	0	0	0	0	0	0	0	0	8
0	0	0	0	0	0	0	0	0	9
0	0	0	0	0	0	0	0	0	10
0	0	0	0	0	0	0	0	0	11
0	0	0	0	0	0	0	0	0	12
0	0	0	0	0	0	0	0	0	13
0	0	0	265	0	0	0	0	186	14
0	0	0	0	0	0	0	0	0	15
11	0	0	0	0	0	0	0	0	16
0	0	419	0	0	0	0	214	0	17
0	0	0	0	0	0	0	0	0	18
0	0	0	0	285	0	0	45	0	19
0	0	0	0	0	0	0	0	0	20
0	0	218	0	0	0	0	0	0	21
0	0	0	0	0	0	0	0	0	22
0	0	105	0	0	0	0	145	0	23
0	0	387	0	0	0	0	181	0	24
0	0	0	0	0	0	0	98	0	25
0	146	51	0	0	0	0	0	0	26
0	0	0	484	0	0	0	0	0	27
0	0	0	0	0	0	0	0	0	28
0	0	0	0	0	0	0	0	0	29
0	0	643	0	0	0	0	208	0	30
0	0	0	0	0	0	0	0	0	31
0	0	0	0	0	258	0	189	0	32
0	0	0	0	0	0	0	175	0	33
0	0	0	0	0	0	0	0	0	34
0	0	0	0	0	0	0	22	0	35
0	0	0	0	0	0	0	0	0	36
0	0	73	0	0	0	0	111	0	37
0	0	107	0	0	0	0	78	0	38
0	0	27	0	0	0	0	84	0	39
0	0	0	0	0	0	785	0	0	40
0	0	0	0	0	0	0	0	0	41
0	0	0	0	0	0	0	0	0	42
0	0	0	0	0	0	0	0	0	43
0	0	0	0	0	0	0	0	0	44
0	0	0	0	0	0	0	0	0	45

TABLE 2 (CONTINUED)

SILICATE MINERAL COUNTS

CSWR	CBWR	PWR	HWR	SSWR	BASWR	ABWR	AWR	BMS	NO.
0	0	0	0	0	0	0	0	0	1
0	0	0	0	0	0	0	0	0	2
0	0	0	0	0	0	0	0	0	3
0	0	0	0	0	0	0	0	0	4
0	0	0	0	0	0	0	0	0	5
0	0	163	0	0	0	0	0	0	6
0	0	0	0	0	0	0	0	0	7
0	0	0	0	0	0	0	0	0	8
0	0	0	0	0	0	0	0	0	9
0	0	0	0	0	0	0	0	0	10
0	0	320	0	0	0	0	0	0	11
0	0	0	0	0	0	0	0	0	12
0	0	0	0	357	0	0	0	0	13
0	0	0	0	0	0	0	0	0	14
0	0	0	203	0	0	0	0	0	15
0	0	0	0	0	0	0	0	0	16
0	0	41	0	0	0	0	0	0	17
0	0	0	0	0	0	0	0	0	18
0	0	0	0	0	0	0	0	0	19
51	0	0	0	0	0	0	0	0	20
0	0	0	0	0	0	0	0	0	21
0	0	0	0	0	0	0	0	0	22
0	0	0	0	0	0	0	0	0	23
0	0	0	0	0	0	0	0	0	24
0	137	0	0	0	0	0	0	0	25
0	0	0	0	0	0	0	0	0	26
12	0	0	0	0	0	0	0	0	27.
0	0	0	0	0	0	0	0	319	28
0	0	0	0	0	462	254	0	0	29
0	0	0	0	0	0	0	0	0	30
79	340	0	0	0	0	0	0	0	31
0	0	0	0	0	0	0	42	0	32
0	0	0	0	0	0	0	0	0	33
0	0	0	0	0	0	0	0	0	34
0	0	0	0	0	0	0	0	0	35
0	0	0	0	0	0	0	0	0	36.
0	0	0	0	0	0	0	0	0	37
0	0	0	0	0	0	0	0	0	38
0	0	0	0	0	0	0	0	0	39
0	0	0	0	0	0	0	0	0	40
0	0	0	0	0	0	0	0	0	41
0	0	0	0	0	0	0	0	0	42
0	0	0	0	0	0	0	0	0	43
0	0	0	0	0	0	0	0	0	44
0	0	0	0	0	0	0	0	0	45

TABLE 2 (CONTINUED)

SILICATE MINERAL COUNTS

GMS	SAF	SPL	SSPL	SBAF	SFWR	WOL	NO.
0	0	0	0	0	0	0	1
0	0	0	0	0	0	0	2
0	0	0	0	0	0	0	3
0	0	576	0	0	0	0	4
0	0	0	0	0	0	0	5
0	0	0	0	0	0	0	6
0	0	0	0	0	0	0	7
0	0	0	0	0	0	381	8
0	34	0	0	0	0	0	9
0	0	0	0	0	0	0	10
0	41	0	0	0	0	0	11
0	0	0	0	0	62	0	12
0	0	0	0	0	0	0	13
0	0	0	0	0	0	0	14
0	0	0	0	0	0	0	15
0	0	0	0	0	0	0	16
0	0	0	0	0	0	0	17
0	0	0	0	0	0	0	18
0	0	0	0	0	0	0	19
0	0	0	0	0	0	0	20
0	17	0	0	0	0	0	21
0	0	0	605	0	0	0	22
0	0	0	0	0	0	0	23
0	0	0	0	0	0	0	24
0	0	0	0	0	0	0	25
0	0	0	0	0	0	0	26
0	0	0	0	0	0	0	27
366	0	0	0	0	0	0	28
0	0	0	0	308	0	0	29
0	0	0	0	0	0	0	30
0	0	0	0	0	0	0	31
0	0	0	0	0	0	0	32
0	0	0	0	0	0	0	33
0	0	0	0	0	0	0	34
0	12	0	0	0	0	0	35
0	0	0	0	0	0	0	36
0	0	0	0	0	0	0	37
0	0	0	0	0	0	0	38
0	0	0	0	0	0	0	39
0	0	0	0	0	0	0	40
0	0	0	0	0	0	0	41
0	0	0	0	0	0	0	42
0	0	126	0	0	0	0	43
0	0	550	0	0	0	0	44
0	0	116	0	0	0	0	45

TABLE 2 (CONTINUED)

SYMBOLS USED FOR SILICATE MINERALS AND ALTERATION

SYMBOL	PRODUCT	SYMBOL	PRODUCT
CAL	CALCITE	BIO	BIOTITE(PHLOGOPITE)
QTZ	QUARTZ	GAR	GARNET
CHL	CHLORITE	FEL	ALKALI FELDSPAR
SER	SERICITE	PYR	PYROXENE
OLI	OLIVENE	DIO	DIOPSIDE
BAR	BARITE	HYP	HYPERSTHENE
TRE	TREMOLITE	UWR	UNALTERED WALL ROCK
ACT	ACTINOLITE	SID	SIDERITE
AUG	AUGITE	APA	APATITE
URA	URALITE	ZOI	ZOISITE-CLINOZOISITE
EPI	EPIDOTE	MUS	MUSCOVITE
CHD	CHLORITOID	SLL	SILLIMANITE
FLU	FLUORITE	GYP	GYPSUM-ANHYDRITE
OCB	OTHER CARBONATES	SRP	SERPENTINE
SUL	OTHER SULPHATES	APL	APLITE
HB 1	BLUE GREEN HORNBLENDE	HB 2	PALE GREEN HORNBLENDE
HB 3	GREENISH BROWN HORNBLENDE	QFM	MICROGRAPHIC QUARTZ AND FELDSPAR
PLA	PLAGIOCLASE	FWR	FELDSPAR + WALL ROCK
WOL	WOLLASTONITE	WRP	WALL ROCK + PLAGIOCLASE
SM	SMITHSONITE	CCS	CHERTY CHLORITE SCHIST
FQP	FELDSPAR AND QUARTZ DIORITE, QUARTZ PORPHYRY		

TABLE 2 (CONTINUED)

SYMBOLS USED FOR SILICATE MINERALS AND ALTERATION

SYMBOL	PRODUCT
SWR	SERICITIZED WALL ROCK
CWR	CHLORITIZED WALL ROCK
HWR	HORNBLENDIZED WALL ROCK
CBWR	CARBONATIZED WALL ROCK
PWR	PROPYLLITIZED WALL ROCK
AWR	ALBITIZED WALL ROCK
SCWR	SERICITIZED-CARBONATIZED WALL ROCK
SCTWR	SERICITIZED-CARBONATIZED-TOURMALINIZED WALL ROCK
STWR	SERICITIZED-TOURMALINIZED WALL ROCK
SAWR	SERICITIZED-ARGILLITIZED WALL ROCK
CSCWR	CHLORITIZED-SERICITIZED-CARBONATIZED WALL ROCK
CSWR	CHLORITIZED-SERICITIZED WALL ROCK
SSWR	SAUSSERITIZED-SILICIFIED WALL ROCK
SLWR	SILICIFIED WALL ROCK
BASWR	BIOTITIZED-AUGITIZED-SERICITIZED WALL ROCK
ABWR	AUGITIZED-BIOTITIZED WALL ROCK
GMS	GREEN METASEDIMENTARY ROCK(CHLORITE RICH)
BMS	BROWN METASEDIMENTARY ROCK(BIOTITE RICH)
SAF	SERICITIZED ALKALI FELDSPAR
SPL	SERICITIZED PLAGIOCLASE
SBAF	SERICITIZED-BIOTITIZED ALKALI FELDSPAR
SFWR	SERICITIZED FELDSPAR + WALL ROCK
SSPL	SAUSSERITIZED PLAGIOCLASE
SSAF	SAUSSERITIZED ALKALI FELDSPAR

APPENDIX 5

-65+400 Mesh Fraction Data and Calculations

TABLE 1

SULPHIDE-OPAQUE MINERALOGY(WEIGHT PERCENT) +400 MESH FRACTION

SL	GN	CP	PY	MG	PO	HM	PN	AS	TT	NO.
0.71	0.0	5.07	41.96	0.0	4.41	0.0	0.0	0.0	0.0	1
0.13	0.0	3.71	32.93	6.03	0.11	0.0	0.0	0.0	0.0	2
10.58	2.77	2.71	70.22	3.64	0.67	0.0	0.0	0.0	0.0	3
0.30	0.0	10.78	11.85	0.63	15.45	0.0	0.0	0.0	0.0	4
23.99	9.96	3.87	5.46	0.0	0.0	0.0	0.0	0.0	0.0	5
0.0	0.0	6.62	0.59	22.33	0.0	0.0	0.0	0.0	0.0	6
0.0	0.0	1.36	1.97	8.88	13.57	0.0	4.07	0.0	0.0	7
0.0	0.0	3.31	0.45	0.14	0.53	0.0	0.0	0.0	0.0	8
0.07	0.0	5.74	0.24	0.28	14.01	0.0	0.0	0.0	0.0	9
9.69	2.57	0.19	5.47	0.0	0.0	0.0	0.0	0.0	0.0	10
0.10	0.0	1.63	6.50	1.48	0.65	0.0	0.0	0.0	0.0	11
1.84	0.07	8.54	77.86	0.56	0.18	0.0	0.0	0.0	0.0	12
18.46	0.38	0.16	15.28	0.26	0.35	0.0	0.0	0.0	0.0	13
0.11	0.0	8.33	7.10	2.76	1.00	0.0	0.0	0.0	0.0	14
0.0	0.0	4.88	2.01	0.95	0.40	0.0	0.0	0.0	0.0	15
6.25	0.09	5.49	25.04	0.97	5.55	0.0	0.0	0.0	0.0	16
8.53	0.96	0.32	12.85	0.03	0.0	0.0	0.0	0.0	0.0	17
8.33	9.23	0.27	5.74	0.0	0.0	0.0	0.0	0.28	0.0	18
0.03	0.05	18.77	3.64	0.15	0.0	0.0	0.0	0.0	0.0	19
0.0	0.0	6.34	31.56	12.54	37.75	0.0	0.0	0.0	0.0	20
6.60	0.10	6.03	39.00	2.06	1.74	0.0	0.0	0.0	0.0	21
0.02	0.0	6.10	7.75	10.55	0.24	0.0	0.0	0.0	0.0	22
1.54	0.0	3.47	55.89	3.47	18.31	0.0	0.0	0.0	0.0	23
4.17	0.0	14.13	24.76	3.72	9.59	0.0	0.0	0.0	0.0	24
6.91	0.08	12.89	49.80	0.89	2.68	0.0	0.0	0.03	0.0	25
0.0	0.0	34.16	36.96	0.33	0.0	0.0	0.0	0.0	0.0	26
20.08	0.0	12.78	37.32	0.0	0.0	0.0	0.0	0.0	0.0	27
0.16	0.0	5.92	2.86	4.17	3.49	0.0	0.0	0.0	0.0	28
0.0	0.0	1.02	0.39	1.42	0.0	0.0	0.0	0.0	0.0	29
2.00	0.15	2.73	14.68	0.07	0.0	0.0	0.0	0.0	0.0	30
0.0	0.0	6.69	12.55	4.53	0.03	1.95	0.0	0.0	0.0	31
11.69	4.86	0.0	6.04	0.48	29.70	0.33	0.0	0.0	0.0	32
0.13	0.0	2.65	3.85	0.0	0.0	0.0	0.0	0.0	0.0	33
13.77	16.17	0.0	4.49	0.0	0.0	0.0	0.0	0.10	0.0	34
14.68	8.74	0.48	5.75	0.0	0.78	0.0	0.0	2.08	0.33	35
0.09	0.06	2.65	5.06	3.84	0.0	0.25	0.0	0.0	0.0	36
1.74	0.0	12.65	6.11	0.13	13.97	0.0	0.0	0.0	0.0	37
1.09	0.0	7.11	5.25	0.0	35.02	0.0	0.0	0.0	0.0	38
0.02	0.0	6.45	2.71	0.0	50.86	0.0	0.0	0.0	0.0	39
0.0	0.0	1.37	0.84	1.46	0.0	0.0	0.0	0.0	0.0	40
6.97	4.21	3.03	3.09	0.0	0.0	0.0	0.0	0.0	0.0	41
6.32	1.92	0.51	1.37	0.0	6.78	0.0	0.0	0.0	0.0	42
0.0	0.12	1.26	0.14	0.90	8.45	0.0	1.55	0.0	0.0	43
0.0	0.05	1.09	4.33	0.62	4.34	0.0	0.97	0.0	0.0	44
0.0	0.22	1.63	4.86	2.53	15.81	0.0	3.37	0.0	0.0	45

TABLE 1 (CONTINUED)

SULPHIDE-OPAQUE MINERALOGY(WEIGHT PERCENT)
+400 MESH FRACTION

FR	SP	T-B	LM	CR	BO	CC	MC	UK	TN	NO.
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5
0.01	23.80	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6
0.0	0.0	0.0	0.0	2.41	0.0	0.0	0.0	0.0	0.0	7
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.15	0.0	8
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9
0.0	0.0	1.30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17
0.99	0.0	0.0	1.97	0.0	0.0	0.0	0.0	0.0	0.0	18
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	19
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	21
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	22
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	23
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	24
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	25
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	26
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	27
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	28
0.0	0.0	0.0	0.0	0.0	0.58	0.0	0.0	0.0	0.0	29
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	30
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	31
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	32
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	33
1.40	0.0	0.0	0.32	0.0	0.0	0.0	0.0	0.0	0.0	34
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	35
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	36
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	37
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	38
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	39
0.0	0.0	0.0	0.0	0.0	0.75	0.18	0.0	0.0	0.0	40
0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.78	0.0	0.08	41
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	42
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.25	0.0	43
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	44
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	45

TABLE 1 (CONTINUED)

SULPHIDE-OPAQUE MINERALOGY(WEIGHT PERCENT)
+400 MESH FRACTION

GAN	SUL	OPA	NO.
47.86	52.15	52.15	1
57.10	36.88	42.91	2
9.41	86.95	90.59	3
61.00	38.38	39.01	4
56.72	43.28	43.28	5
58.03	7.21	41.92	6
67.73	20.97	32.26	7
95.42	4.44	4.58	8
79.65	20.06	20.34	9
80.78	19.22	19.22	10
89.63	8.88	10.36	11
10.97	88.49	89.05	12
65.11	34.63	34.89	13
80.71	16.54	19.30	14
91.76	7.29	8.24	15
56.61	42.42	43.39	16
77.31	22.66	22.69	17
73.18	24.84	26.81	18
77.36	22.49	22.64	19
11.81	75.65	88.19	20
44.47	53.47	55.53	21
75.33	14.11	24.66	22
17.33	79.21	82.68	23
43.64	52.65	56.37	24
26.73	72.38	73.27	25
28.55	71.12	71.45	26
29.83	70.18	70.18	27
83.40	12.43	16.60	28
96.59	1.99	3.41	29
80.37	19.56	19.63	30
74.24	19.27	25.75	31
46.90	52.29	53.10	32
93.37	6.63	6.63	33
64.09	35.59	35.91	34
67.16	32.84	32.84	35
88.05	7.86	11.95	36
65.40	34.47	34.60	37
51.52	48.47	48.47	38
39.96	60.04	60.04	39
95.40	3.14	4.60	40
79.84	20.16	20.16	41
83.10	16.90	16.90	42
87.33	11.77	12.67	43
88.60	10.78	11.40	44
71.58	25.89	28.42	45

TABLE 1 (CONTINUED)

SYMBOLS USED FOR SULPHIDE-OPAQUE MINERALS

SYMBOL	MINERAL
SL	SPHALERITE
GN	GALENA
CP	CHALCOPYRITE
PY	PYRITE
MG	MAGNETITE
PO	PYRRHOTITE
HM	HEMATITE
PN	PENTLANDITE
AS	ARSENOPYRITE
TT	TETRAHEDRITE
FR	FREIBERGITE
SP	SPECULARITE
T-B	TETRAHEDRITE-BOURNONITE
LM	LIMONITE
CR	CHROMITE
BO	BORNITE
CC	CHALCOCITE
MC	MARCASITE
UK	UNKNOWN
TN	TENNANTITE
GAN	GANGUE
SUL	SULPHIDES
OPA	OPAQUES

TABLE 2

CALCULATED 100 WEIGHT PERCENT SULPHIDE-OPAQUE MINERALOGY
(NORMALIZED WEIGHT PERCENT MINERALOGY)

+400 MESH FRACTION

SL	GN	CP	PY	MG	PO	HM	PN	AS	TT	NO.
1.36	0.0	9.72	80.46	0.0	8.46	0.0	0.0	0.0	0.0	1
0.30	0.0	8.65	76.74	14.05	0.26	0.0	0.0	0.0	0.0	2
11.68	3.06	2.99	77.51	4.02	0.74	0.0	0.0	0.0	0.0	3
0.77	0.0	27.63	30.38	1.61	39.61	0.0	0.0	0.0	0.0	4
55.43	23.01	8.94	12.62	0.0	0.0	0.0	0.0	0.0	0.0	5
0.0	0.0	15.79	1.41	53.27	0.0	0.0	0.0	0.0	0.0	6
0.0	0.0	4.22	6.11	27.53	42.06	0.0	12.62	0.0	0.0	7
0.0	0.0	72.27	9.83	3.06	11.57	0.0	0.0	0.0	0.0	8
0.34	0.0	28.22	1.18	1.38	68.88	0.0	0.0	0.0	0.0	9
50.42	13.37	0.99	28.46	0.0	0.0	0.0	0.0	0.0	0.0	10
0.97	0.0	15.73	62.74	14.29	6.27	0.0	0.0	0.0	0.0	11
2.07	0.08	9.59	87.43	0.63	0.20	0.0	0.0	0.0	0.0	12
52.91	1.09	0.46	43.79	0.75	1.00	0.0	0.0	0.0	0.0	13
0.57	0.0	43.16	36.79	14.30	5.18	0.0	0.0	0.0	0.0	14
0.0	0.0	59.22	24.39	11.53	4.85	0.0	0.0	0.0	0.0	15
14.40	0.21	12.65	57.71	2.24	12.79	0.0	0.0	0.0	0.0	16
37.59	4.23	1.41	56.63	0.13	0.0	0.0	0.0	0.0	0.0	17
31.07	34.43	1.01	21.41	0.0	0.0	0.0	0.0	1.04	0.0	18
0.13	0.22	82.91	16.08	0.66	0.0	0.0	0.0	0.0	0.0	19
0.0	0.0	7.19	35.79	14.22	42.81	0.0	0.0	0.0	0.0	20
11.89	0.18	10.86	70.23	3.71	3.13	0.0	0.0	0.0	0.0	21
0.08	0.0	24.74	31.43	42.78	0.97	0.0	0.0	0.0	0.0	22
1.86	0.0	4.20	67.60	4.20	22.15	0.0	0.0	0.0	0.0	23
7.40	0.0	25.07	43.92	6.60	17.01	0.0	0.0	0.0	0.0	24
9.43	0.11	17.59	67.97	1.21	3.66	0.0	0.0	0.04	0.0	25
0.0	0.0	47.81	51.73	0.46	0.0	0.0	0.0	0.0	0.0	26
28.61	0.0	18.21	53.18	0.0	0.0	0.0	0.0	0.0	0.0	27
0.96	0.0	35.66	17.23	25.12	21.02	0.0	0.0	0.0	0.0	28
0.0	0.0	29.91	11.44	41.64	0.0	0.0	0.0	0.0	0.0	29
10.19	0.76	13.91	74.78	0.36	0.0	0.0	0.0	0.0	0.0	30
0.0	0.0	25.98	48.74	17.59	0.12	7.57	0.0	0.0	0.0	31
22.02	9.15	0.0	11.37	0.90	55.93	0.62	0.0	0.0	0.0	32
1.96	0.0	39.97	58.07	0.0	0.0	0.0	0.0	0.0	0.0	33
38.35	45.03	0.0	12.50	0.0	0.0	0.0	0.0	0.28	0.0	34
44.70	26.61	1.46	17.51	0.0	2.38	0.0	0.0	6.33	1.00	35
0.75	0.50	22.18	42.34	32.13	0.0	2.09	0.0	0.0	0.0	36
5.03	0.0	36.56	17.66	0.38	40.38	0.0	0.0	0.0	0.0	37
2.25	0.0	14.67	10.83	0.0	72.25	0.0	0.0	0.0	0.0	38
0.03	0.0	10.74	4.51	0.0	84.71	0.0	0.0	0.0	0.0	39
0.0	0.0	29.78	18.26	31.74	0.0	0.0	0.0	0.0	0.0	40
34.57	20.88	15.03	15.33	0.0	0.0	0.0	0.0	0.0	0.0	41
37.40	11.36	3.02	8.11	0.0	40.12	0.0	0.0	0.0	0.0	42
0.0	0.95	9.94	1.10	7.10	66.69	0.0	12.23	0.0	0.0	43
0.0	0.44	9.56	37.98	5.44	38.07	0.0	8.51	0.0	0.0	44
0.0	0.77	5.74	17.10	8.90	55.63	0.0	11.86	0.0	0.0	45

TABLE 2 (CONTINUED)

CALCULATED 100 WEIGHT PERCENT SULPHIDE-OPAQUE MINERALOGY
(NORMALIZED WEIGHT PERCENT MINERALOGY)

+400 MESH FRACTION

FR	SP	T-B	LM	CR	BO	CC	MC	UK	TN	NO.
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5
0.02	56.77	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6
0.0	0.0	0.0	0.0	7.47	0.0	0.0	0.0	0.0	0.0	7
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.28	0.0	8
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9
0.0	0.0	6.76	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17
3.69	0.0	0.0	7.35	0.0	0.0	0.0	0.0	0.0	0.0	18
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	19
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	21
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	22
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	23
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	24
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	25
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	26
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	27
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	28
0.0	0.0	0.0	0.0	0.0	17.01	0.0	0.0	0.0	0.0	29
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	30
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	31
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	32
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	33
3.90	0.0	0.0	0.89	0.0	0.0	0.0	0.0	0.0	0.0	34
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	35
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	36
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	37
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	38
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	39
0.0	0.0	0.0	0.0	0.0	16.30	3.91	0.0	0.0	0.0	40
0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.79	0.0	0.40	41
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	42
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.97	0.0	43
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	44
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	45

TABLE 3

SULPHIDE-OPAQUE MINERAL RATIO CALCULATIONS
+400 MESH FRACTION

PO/PO+PY	PO/PO+PY+MG	PY/PO+PY+MG	MG/PO+PY+MG	PN/PN+PO	MG/MG+PY	NO.
0.095	0.095	0.905	0.0	0.0	0.0	1
0.003	0.003	0.843	0.154	0.0	0.155	2
0.009	0.009	0.942	0.049	0.0	0.049	3
0.566	0.553	0.424	0.023	0.0	0.050	4
0.0	0.0	1.000	0.0	0.0	0.0	5
0.0	0.0	0.026	0.974	0.0	0.974	6
0.873	0.556	0.081	0.364	0.231	0.818	7
0.541	0.473	0.402	0.125	0.0	0.237	8
0.983	0.964	0.017	0.019	0.0	0.538	9
0.0	0.0	1.000	0.0	0.0	0.0	10
0.091	0.075	0.753	0.171	0.0	0.185	11
0.002	0.002	0.991	0.007	0.0	0.007	12
0.022	0.022	0.962	0.016	0.0	0.017	13
0.123	0.092	0.654	0.254	0.0	0.280	14
0.166	0.119	0.598	0.283	0.0	0.321	15
0.181	0.176	0.793	0.031	0.0	0.037	16
0.0	0.0	0.998	0.002	0.0	0.002	17
0.0	0.0	1.000	0.0	0.0	0.0	18
0.0	0.0	0.960	0.040	0.0	0.040	19
0.545	0.461	0.386	0.153	0.0	0.284	20
0.043	0.041	0.911	0.048	0.0	0.050	21
0.030	0.013	0.418	0.569	0.0	0.577	22
0.247	0.236	0.720	0.045	0.0	0.058	23
0.279	0.252	0.650	0.098	0.0	0.131	24
0.051	0.050	0.933	0.017	0.0	0.018	25
0.0	0.0	0.991	0.009	0.0	0.009	26
0.0	0.0	1.000	0.0	0.0	0.0	27
0.550	0.332	0.272	0.396	0.0	0.593	28
0.0	0.0	0.215	0.785	0.0	0.785	29
0.0	0.0	0.995	0.005	0.0	0.005	30
0.002	0.002	0.733	0.265	0.0	0.265	31
0.831	0.820	0.167	0.013	0.0	0.074	32
0.0	0.0	1.000	0.0	0.0	0.0	33
0.0	0.0	1.000	0.0	0.0	0.0	34
0.119	0.119	0.881	0.0	0.0	0.0	35
0.0	0.0	0.569	0.431	0.0	0.431	36
0.696	0.691	0.302	0.006	0.0	0.021	37
0.870	0.870	0.130	0.0	0.0	0.0	38
0.949	0.949	0.051	0.0	0.0	0.0	39
0.0	0.0	0.365	0.635	0.0	0.635	40
0.0	0.0	1.000	0.0	0.0	0.0	41
0.832	0.832	0.168	0.0	0.0	0.0	42
0.984	0.890	0.015	0.095	0.155	0.865	43
0.501	0.467	0.466	0.067	0.183	0.125	44
0.765	0.681	0.209	0.109	0.176	0.342	45

TABLE 3 (CONTINUED)

SULPHIDE-OPAQUE MINERAL RATIO CALCULATIONS
+400 MESH FRACTION

CP/CP+SL+GN	SL/CP+SL+GN	GN/CP+SL+GN	FE SULP/FE SULP + FE OXID	NO.
0.877	0.123	0.0	1.000	1
0.966	0.034	0.0	0.846	2
0.169	0.659	0.172	0.951	3
0.973	0.027	0.0	0.977	4
0.102	0.634	0.263	1.000	5
1.000	0.0	0.0	0.013	6
1.000	0.0	0.0	0.688	7
1.000	0.0	0.0	0.875	8
0.988	0.012	0.0	0.981	9
0.015	0.778	0.206	1.000	10
0.942	0.058	0.0	0.829	11
0.817	0.176	0.007	0.993	12
0.008	0.972	0.020	0.984	13
0.987	0.013	0.0	0.746	14
1.000	0.0	0.0	0.717	15
0.464	0.528	0.008	0.969	16
0.033	0.870	0.098	0.998	17
0.015	0.467	0.518	1.000	18
0.996	0.002	0.003	0.960	19
1.000	0.0	0.0	0.847	20
0.474	0.518	0.008	0.952	21
0.997	0.003	0.0	0.431	22
0.693	0.307	0.0	0.955	23
0.772	0.228	0.0	0.902	24
0.648	0.348	0.004	0.983	25
1.000	0.0	0.0	0.991	26
0.389	0.611	0.0	1.000	27
0.974	0.026	0.0	0.604	28
1.000	0.0	0.0	0.215	29
0.559	0.410	0.031	0.995	30
1.000	0.0	0.0	0.660	31
0.0	0.706	0.294	0.978	32
0.953	0.047	0.0	1.000	33
0.0	0.460	0.540	1.000	34
0.020	0.614	0.366	1.000	35
0.946	0.032	0.021	0.553	36
0.879	0.121	0.0	0.994	37
0.867	0.133	0.0	1.000	38
0.997	0.003	0.0	1.000	39
1.000	0.0	0.0	0.365	40
0.213	0.490	0.296	1.000	41
0.058	0.722	0.219	1.000	42
0.913	0.0	0.087	0.918	43
0.956	0.0	0.044	0.940	44
0.881	0.0	0.119	0.905	45

TABLE 3 (CONTINUED)

SULPHIDE-OPAQUE MINERAL RATIO CALCULATIONS
+400 MESH FRACTION

CP/CP+SL	SL/SL+MG	PY/PY+SL+GN	CU MINERALS/CU MINERALS+PY	NO.
0.877	1.000	0.983	0.108	1
0.966	0.021	0.996	0.101	2
0.204	0.744	0.840	0.037	3
0.973	0.323	0.975	0.476	4
0.139	1.000	0.139	0.415	5
1.000	0.0	1.000	0.918	6
1.000	0.0	1.000	0.408	7
1.000	0.0	1.000	0.880	8
0.988	0.200	0.774	0.960	9
0.019	1.000	0.309	0.214	10
0.942	0.063	0.985	0.200	11
0.823	0.767	0.976	0.099	12
0.009	0.986	0.448	0.010	13
0.987	0.038	0.985	0.540	14
1.000	0.0	1.000	0.708	15
0.468	0.866	0.798	0.180	16
0.036	0.996	0.575	0.024	17
0.031	1.000	0.246	0.180	18
0.998	0.167	0.978	0.838	19
1.000	0.0	1.000	0.167	20
0.477	0.762	0.853	0.134	21
0.997	0.002	0.997	0.440	22
0.693	0.307	0.973	0.058	23
0.772	0.529	0.856	0.363	24
0.651	0.886	0.877	0.206	25
1.000	0.0	1.000	0.480	26
0.389	1.000	0.650	0.255	27
0.974	0.037	0.947	0.674	28
1.000	0.0	1.000	0.804	29
0.577	0.966	0.872	0.157	30
1.000	0.0	1.000	0.348	31
0.0	0.961	0.267	0.0	32
0.953	1.000	0.967	0.408	33
0.0	1.000	0.130	0.238	34
0.032	1.000	0.197	0.123	35
0.967	0.023	0.971	0.344	36
0.879	0.930	0.778	0.674	37
0.867	1.000	0.828	0.575	38
0.997	1.000	0.993	0.704	39
1.000	0.0	1.000	0.732	40
0.303	1.000	0.344	0.346	41
0.075	1.000	0.143	0.271	42
1.000	0.0	0.538	0.900	43
1.000	0.0	0.989	0.201	44
1.000	0.0	0.957	0.251	45

CU MINERALS = CP + BO + CC + TT + T-B + TN + FR

TABLE 4

CALCULATED 100 WEIGHT PERCENT MINERAL GROUPS (NORMALIZED GROUPS)

+400 MESH FRACTION

CALC 100 PCT PC	PY	CP	CALC 100 PCT PC	MG	PY	CALC 100 PCT SL	CP	GN	NO.
8.57	81.57	9.86	9.51	0.0	90.49	12.28	87.72	0.0	1
0.30	89.61	10.10	0.28	15.43	84.25	3.39	96.61	0.0	2
0.91	95.41	3.68	0.90	4.88	94.22	65.88	16.87	17.25	3
40.57	31.12	28.31	55.32	2.26	42.43	2.71	97.29	0.0	4
0.0	58.52	41.48	0.0	0.0	100.00	63.43	10.23	26.34	5
0.0	8.18	91.82	0.0	97.43	2.57	0.0	100.00	0.0	6
80.30	11.66	8.05	55.57	36.36	8.07	0.0	100.00	0.0	7
12.35	10.49	77.16	47.32	12.50	40.18	0.0	100.00	0.0	8
70.09	1.20	28.71	96.42	1.93	1.65	1.20	98.80	0.0	9
0.0	96.64	3.36	0.0	0.0	100.00	77.83	1.53	20.64	10
7.40	74.03	18.56	7.53	17.15	75.32	5.78	94.22	0.0	11
0.21	89.93	9.86	0.23	0.71	99.06	17.61	81.72	0.67	12
2.22	96.77	1.01	2.20	1.64	96.16	97.16	0.84	2.00	13
6.09	43.21	50.70	9.21	25.41	65.38	1.30	98.70	0.0	14
5.49	27.57	66.94	11.90	28.27	59.82	0.0	100.00	0.0	15
15.38	69.40	15.22	17.59	3.07	79.34	52.83	46.41	0.76	16
0.0	97.57	2.43	0.0	0.23	99.77	86.95	3.26	9.79	17
0.0	95.51	4.49	0.0	0.0	100.00	46.72	1.51	51.77	18
0.0	16.24	83.76	0.0	3.96	96.04	0.16	99.58	0.27	19
49.90	41.72	8.38	46.12	15.32	38.56	0.0	100.00	0.0	20
3.72	83.39	12.89	4.07	4.81	91.12	51.85	47.37	0.79	21
1.70	55.00	43.29	1.29	56.90	41.80	0.33	99.67	0.0	22
23.57	71.96	4.47	23.57	4.47	71.96	30.74	69.26	0.0	23
19.78	51.07	29.15	25.19	9.77	65.04	22.79	77.21	0.0	24
4.10	76.18	19.72	5.02	1.67	93.31	34.76	64.84	0.40	25
0.0	51.97	48.03	0.0	0.88	99.12	0.0	100.00	0.0	26
0.0	74.49	25.51	0.0	0.0	100.00	61.11	38.89	0.0	27
28.44	23.31	48.25	33.17	39.64	27.19	2.63	97.37	0.0	28
0.0	27.66	72.34	0.0	78.45	21.55	0.0	100.00	0.0	29
0.0	84.32	15.68	0.0	0.47	99.53	40.98	55.94	3.07	30
0.16	65.13	34.72	0.18	26.48	73.35	0.0	100.00	0.0	31
83.10	16.90	0.0	82.00	1.33	16.68	70.63	0.0	29.37	32
0.0	59.23	40.77	0.0	0.0	100.00	4.68	95.32	0.0	33
0.0	100.00	0.0	0.0	0.0	100.00	45.99	0.0	54.01	34
11.13	82.03	6.85	11.94	0.0	88.06	61.42	2.01	36.57	35
0.0	65.63	34.37	0.0	43.15	56.85	3.21	94.64	2.14	36
42.68	18.67	38.65	69.12	0.64	30.23	12.09	87.91	0.0	37
73.91	11.08	15.01	86.96	0.0	13.04	13.29	86.71	0.0	38
84.74	4.52	10.75	94.94	0.0	5.06	0.31	99.69	0.0	39
0.0	38.01	61.99	0.0	63.48	36.52	0.0	100.00	0.0	40
0.0	65.96	34.04	0.0	0.0	100.00	49.05	21.32	29.63	41
78.29	15.82	5.89	83.19	0.0	16.81	72.23	5.83	21.94	42
85.79	1.42	12.79	89.04	9.48	1.48	0.0	91.30	8.70	43
44.47	44.36	11.17	46.72	6.67	46.61	0.0	95.61	4.39	44
70.90	21.79	7.31	68.15	10.91	20.95	0.0	88.11	11.89	45

TABLE 5

CALCULATED 100 WEIGHT PERCENT MINERAL GROUPS (NORMALIZED GROUPS)

+400 MESH FRACTION

CALC. 100 WT. PCT.			CALC. 100 WT. PCT.			
CU MINERALS	ZN (SL) MINERALS	PB (GN) MINERALS	CU MINERALS	ZN (SL) MINERALS	NI (PN) MINERALS	NO.
87.72	12.28	0.0	87.72	12.28	0.0	1
96.61	3.39	0.0	96.61	3.39	0.0	2
16.87	65.88	17.25	20.39	79.61	0.0	3
97.29	2.71	0.0	97.29	2.71	0.0	4
10.23	63.43	26.34	13.89	86.11	0.0	5
100.00	0.0	0.0	100.00	0.0	0.0	6
100.00	0.0	0.0	25.05	0.0	74.95	7
100.00	0.0	0.0	100.00	0.0	0.0	8
98.80	1.20	0.0	98.80	1.20	0.0	9
10.84	70.47	18.69	13.33	86.67	0.0	10
94.22	5.78	0.0	94.22	5.78	0.0	11
81.72	17.61	0.67	82.27	17.73	0.0	12
0.84	97.16	2.00	0.86	99.14	0.0	13
98.70	1.30	0.0	98.70	1.30	0.0	14
100.00	0.0	0.0	100.00	0.0	0.0	15
46.41	52.83	0.76	46.76	53.24	0.0	16
3.26	86.95	9.79	3.62	96.38	0.0	17
6.70	44.26	49.04	13.14	86.86	0.0	18
99.58	0.16	0.27	99.84	0.16	0.0	19
100.00	0.0	0.0	100.00	0.0	0.0	20
47.37	51.85	0.79	47.74	52.26	0.0	21
99.67	0.33	0.0	99.67	0.33	0.0	22
69.26	30.74	0.0	69.26	30.74	0.0	23
77.21	22.79	0.0	77.21	22.79	0.0	24
64.84	34.76	0.40	65.10	34.90	0.0	25
100.00	0.0	0.0	100.00	0.0	0.0	26
38.89	61.11	0.0	38.89	61.11	0.0	27
97.37	2.63	0.0	97.37	2.63	0.0	28
100.00	0.0	0.0	100.00	0.0	0.0	29
55.94	40.98	3.07	57.72	42.28	0.0	30
100.00	0.0	0.0	100.00	0.0	0.0	31
0.0	70.63	29.37	0.0	100.00	0.0	32
95.32	4.68	0.0	95.32	4.68	0.0	33
4.47	43.94	51.60	9.23	90.77	0.0	34
3.34	60.59	36.07	5.23	94.77	0.0	35
94.64	3.21	2.14	96.72	3.28	0.0	36
87.91	12.09	0.0	87.91	12.09	0.0	37
86.71	13.29	0.0	86.71	13.29	0.0	38
99.69	0.31	0.0	99.69	0.31	0.0	39
100.00	0.0	0.0	100.00	0.0	0.0	40
21.76	48.78	29.46	30.85	69.15	0.0	41
5.83	72.23	21.94	7.47	92.53	0.0	42
91.30	0.0	8.70	44.84	0.0	55.16	43
95.61	0.0	4.39	52.91	0.0	47.09	44
88.11	0.0	11.89	32.60	0.0	67.40	45

CU MINERALS = CP + BO + CC + TT + T-B + TN + FR

TABLE 6

METAL ANALYSES
+400 MESH FRACTION

NI	CO	CU	ZN	PB	NO.
		WEIGHT	PERCENT		
0.0001	0.0500	1.6000	0.4000	0.0001	1
0.0001	0.0015	1.0900	0.0001	0.0001	2
0.0001	0.1100	0.7600	4.6000	1.6500	3
0.0001	0.0700	2.3100	0.1000	0.0005	4
0.0001	0.0015	1.1300	14.7000	8.4000	5
0.0001	0.0040	1.7700	0.0001	0.0001	6
1.2800	0.0600	0.4500	0.0001	0.0005	7
0.0001	0.0015	0.9300	0.0001	0.0001	8
0.0200	0.0600	1.4800	0.0001	0.0500	9
0.0001	0.0015	0.0800	5.3000	2.2000	10
0.0001	0.0015	0.4700	0.0005	0.0001	11
0.0001	0.0400	2.4300	1.2000	0.1000	12
0.0050	0.0015	0.0600	10.8000	0.5000	13
0.0001	0.0400	2.6400	0.0001	0.0001	14
0.0001	0.0200	1.4500	0.0001	0.0005	15
0.0001	0.0015	1.6500	3.8000	0.0001	16
0.0001	0.0001	0.1000	3.6000	0.5000	17
0.0001	0.0001	0.1000	7.0000	10.4000	18
0.1400	0.0015	5.3700	0.0001	0.0001	19
0.0001	0.0400	1.3200	0.0001	0.0001	20
0.0001	0.0200	1.6100	3.7000	0.1500	21
0.0005	0.0200	3.2900	0.0005	0.0005	22
0.0005	0.0100	0.8700	1.3000	0.0005	23
0.0001	0.0400	4.2500	2.3000	0.0005	24
0.0001	0.0300	3.8500	3.1000	0.1600	25
0.0001	0.0700	10.8500	0.0001	0.0001	26
0.0001	0.0300	4.0000	12.6000	0.0001	27
0.0001	0.0200	1.3800	0.0001	0.0001	28
0.0001	0.0001	0.5300	0.0001	0.0001	29
0.0001	0.0001	0.7800	1.0000	0.0001	30
0.0001	0.0400	1.7200	0.0001	0.0001	31
0.0001	0.0001	0.0001	6.4000	3.4000	32
0.0001	0.0001	0.9000	0.1000	0.0001	33
0.0001	0.0001	0.0001	7.8000	14.4000	34
0.0001	0.0001	0.2900	8.7000	5.5200	35
0.0001	0.0001	0.6400	0.0005	0.0001	36
0.1900	0.0600	3.5300	1.2000	0.0001	37
0.0001	0.0700	2.0300	0.6000	0.0001	38
0.0800	0.0900	1.6900	0.0001	0.0001	39
0.0001	0.0001	0.8600	0.0001	0.0001	40
0.0005	0.0300	0.9200	4.0000	3.8000	41
0.0001	0.0001	0.1000	3.8000	1.5000	42
0.6200	0.0200	0.3400	0.0001	0.1000	43
0.3500	0.0100	0.2800	0.0001	0.2000	44
1.2100	0.0700	0.3300	0.0001	0.0001	45

NI-CO-CU-ZN-PB-FE-AU-AG by MAN. MINES BRANCH LAB.
SULPHUR BY THE UNIV. OF MAN.

TABLE 6 (CONTINUED)

METAL ANALYSES
+400 MESH FRACTION

FE	S	AU	AG	
WEIGHT PERCENT		OZ / TON		
26.3500	21.9000	0.0250	0.4500	1
27.2600	17.9000	0.0600	0.2500	2
40.0000	42.4500	0.0300	2.2000	3
15.7000	11.9500	0.0300	0.7000	4
4.7000	15.1500	0.0700	4.4000	5
27.9000	2.0000	0.0040	0.0001	6
19.2000	6.6000	0.0005	0.7000	7
6.6000	1.3500	0.0005	0.2500	8
12.0300	6.2000	0.0100	0.1000	9
3.3000	8.9500	0.0040	1.0000	10
11.5000	4.3000	0.0040	0.1000	11
40.8000	39.0000	0.0050	0.6000	12
12.5500	14.7400	0.0300	8.0000	13
19.9500	7.0000	0.0850	0.4500	14
14.8700	2.5000	0.0350	0.2000	15
18.6900	18.7000	0.0100	2.2000	16
5.1900	10.4000	0.0350	5.0000	17
8.4400	5.5000	0.0150	33.1000	18
9.1700	6.4500	0.0200	0.3000	19
45.9300	34.9500	0.1700	0.5000	20
26.9300	24.4000	0.0200	1.6000	21
17.8900	6.6000	0.0700	0.6000	22
38.9900	33.2000	0.1850	0.8000	23
29.1500	21.7500	0.0550	0.8000	24
29.5500	31.1000	0.1200	1.7000	25
32.3000	31.1000	0.0150	0.3500	26
21.8800	28.4500	0.0650	1.2000	27
9.4600	3.0500	0.0200	0.0001	28
3.5000	0.6500	0.0100	0.0001	29
8.2600	7.8500	0.0550	0.0001	30
8.1100	6.8500	0.0200	0.0001	31
24.1800	18.7500	0.0001	0.9000	32
1.6000	3.2000	0.0005	0.0001	33
12.4200	8.9000	0.0250	51.9000	34
7.5100	8.2000	0.1100	41.6000	35
9.9600	2.9000	0.0350	0.2000	36
23.0300	11.8500	0.0850	0.2000	37
25.0400	16.0500	0.1750	0.9000	38
30.9900	21.3500	0.0350	0.1000	39
2.8900	0.6000	0.0001	0.0001	40
20.9000	7.7000	0.0001	17.3000	41
6.4100	4.7000	0.0300	1.9000	42
10.6500	4.1000	0.0001	0.0001	43
9.1300	3.3000	0.0001	0.0001	44
20.0000	10.2500	0.0001	0.0001	45

NI-CO-CU-ZN-PB-FE-AU-AG BY MAN. MINES BRANCH LAB.
SULPHUR BY THE UNIV. OF MAN.

TABLE 7

METAL RATIOS
+400 MESH FRACTION

CO/CO+NI	NI/CO+NI	CU/CU+NI	NI/CU+NI	CO/CO+CU	AU/AU+AG	AG/AU+AG	NO.
0.998	0.002	1.000	0.000	0.030	0.053	0.947	1
0.938	0.063	1.000	0.000	0.001	0.194	0.806	2
0.999	0.001	1.000	0.000	0.126	0.013	0.987	3
0.999	0.001	1.000	0.000	0.029	0.041	0.959	4
0.938	0.063	1.000	0.000	0.001	0.016	0.984	5
0.976	0.024	1.000	0.000	0.002	0.976	0.024	6
0.045	0.955	0.260	0.740	0.118	0.001	0.999	7
0.938	0.063	1.000	0.000	0.002	0.002	0.998	8
0.750	0.250	0.987	0.013	0.039	0.091	0.909	9
0.938	0.063	0.999	0.001	0.018	0.004	0.996	10
0.938	0.063	1.000	0.000	0.003	0.038	0.962	11
0.998	0.002	1.000	0.000	0.016	0.008	0.992	12
0.231	0.769	0.923	0.077	0.024	0.004	0.996	13
0.998	0.002	1.000	0.000	0.015	0.159	0.841	14
0.995	0.005	1.000	0.000	0.014	0.149	0.851	15
0.938	0.063	1.000	0.000	0.001	0.005	0.995	16
0.500	0.500	0.999	0.001	0.001	0.007	0.993	17
0.500	0.500	0.999	0.001	0.001	0.000	1.000	18
0.011	0.989	0.975	0.025	0.000	0.063	0.938	19
0.998	0.002	1.000	0.000	0.029	0.254	0.746	20
0.995	0.005	1.000	0.000	0.012	0.012	0.988	21
0.976	0.024	1.000	0.000	0.006	0.104	0.896	22
0.952	0.048	0.999	0.001	0.011	0.188	0.812	23
0.998	0.002	1.000	0.000	0.009	0.064	0.936	24
0.997	0.003	1.000	0.000	0.008	0.066	0.934	25
0.999	0.001	1.000	0.000	0.006	0.041	0.959	26
0.997	0.003	1.000	0.000	0.007	0.051	0.949	27
0.995	0.005	1.000	0.000	0.014	0.995	0.005	28
0.500	0.500	1.000	0.000	0.000	0.990	0.010	29
0.500	0.500	1.000	0.000	0.000	0.998	0.002	30
0.998	0.002	1.000	0.000	0.023	0.995	0.005	31
0.500	0.500	0.500	0.500	0.500	0.000	1.000	32
0.500	0.500	1.000	0.000	0.000	0.833	0.167	33
0.500	0.500	0.500	0.500	0.500	0.000	1.000	34
0.500	0.500	1.000	0.000	0.000	0.003	0.997	35
0.500	0.500	1.000	0.000	0.000	0.149	0.851	36
0.240	0.760	0.949	0.051	0.017	0.298	0.702	37
0.999	0.001	1.000	0.000	0.033	0.163	0.837	38
0.529	0.471	0.955	0.045	0.051	0.259	0.741	39
0.500	0.500	1.000	0.000	0.000	0.500	0.500	40
0.984	0.016	0.999	0.001	0.032	0.000	1.000	41
0.500	0.500	0.999	0.001	0.001	0.016	0.984	42
0.031	0.969	0.354	0.646	0.056	0.500	0.500	43
0.028	0.972	0.444	0.556	0.034	0.500	0.500	44
0.055	0.945	0.214	0.786	0.175	0.500	0.500	45

TABLE 7 (CONTINUED)

METAL RATIOS
+400 MESH FRACTION

CU/CU+ZN+PB	ZN/CU+ZN+PB	PB/CU+ZN+PB	CU/CO+CU	AU/AG	NO.
0.800	0.200	0.000	0.970	18.000	1
1.000	0.000	0.000	0.999	4.167	2
0.108	0.656	0.235	0.874	73.333	3
0.958	0.041	0.000	0.971	23.333	4
0.047	0.607	0.347	0.999	62.857	5
1.000	0.000	0.000	0.998	0.025	6
0.999	0.000	0.001	0.882	1400.000	7
1.000	0.000	0.000	0.998	500.000	8
0.967	0.000	0.033	0.961	10.000	9
0.011	0.699	0.290	0.982	250.000	10
0.999	0.001	0.000	0.997	25.000	11
0.651	0.322	0.027	0.984	120.000	12
0.005	0.951	0.044	0.976	266.667	13
1.000	0.000	0.000	0.985	5.294	14
1.000	0.000	0.000	0.986	5.714	15
0.303	0.697	0.000	0.999	220.000	16
0.024	0.857	0.119	0.999	142.857	17
0.006	0.400	0.594	0.999	2206.667	18
1.000	0.000	0.000	1.000	15.000	19
1.000	0.000	0.000	0.971	2.941	20
0.295	0.678	0.027	0.988	80.000	21
1.000	0.000	0.000	0.994	8.571	22
0.401	0.599	0.000	0.989	4.324	23
0.649	0.351	0.000	0.991	14.545	24
0.541	0.436	0.023	0.992	14.167	25
1.000	0.000	0.000	0.994	23.333	26
0.241	0.759	0.000	0.993	18.462	27
1.000	0.000	0.000	0.986	0.005	28
1.000	0.000	0.000	1.000	0.010	29
0.438	0.562	0.000	1.000	0.002	30
1.000	0.000	0.000	0.977	0.005	31
0.000	0.653	0.347	0.500	9000.000	32
0.900	0.100	0.000	1.000	0.200	33
0.000	0.351	0.649	0.500	2076.000	34
0.020	0.600	0.380	1.000	378.182	35
0.999	0.001	0.000	1.000	5.714	36
0.746	0.254	0.000	0.983	2.353	37
0.772	0.228	0.000	0.967	5.143	38
1.000	0.000	0.000	0.949	2.857	39
1.000	0.000	0.000	1.000	1.000	40
0.106	0.459	0.436	0.968	172999.875	41
0.019	0.704	0.278	0.999	63.333	42
0.773	0.000	0.227	0.944	1.000	43
0.583	0.000	0.417	0.966	1.000	44
0.999	0.000	0.000	0.825	1.000	45

TABLE 8

NORMALIZED WEIGHT PERCENT IRON, SULPHUR, AND OTHER METALS
+400 MESH FRACTION

FE	CO+NI+CU+PB+ZN	SULPHUR	NO.
52.39	4.08	43.54	1
58.94	2.36	38.70	2
44.66	7.95	47.39	3
52.11	8.23	39.66	4
10.66	54.97	34.37	5
88.08	5.60	6.31	6
69.59	6.49	23.92	7
74.31	10.49	15.20	8
60.63	8.12	31.25	9
16.64	38.23	45.13	10
70.67	2.90	26.43	11
48.82	4.51	46.67	12
32.46	29.40	38.15	13
67.33	9.05	23.62	14
78.92	7.81	13.27	15
43.63	12.73	43.65	16
26.23	21.22	52.55	17
26.84	55.66	17.49	18
43.39	26.08	30.52	19
55.85	1.65	42.50	20
47.40	9.65	42.95	21
64.35	11.91	23.74	22
52.43	2.93	44.64	23
50.70	11.46	37.83	24
43.59	10.53	45.88	25
43.46	14.69	41.85	26
32.68	24.84	42.49	27
68.01	10.07	21.93	28
74.78	11.33	13.89	29
46.17	9.95	43.88	30
48.50	10.53	40.97	31
45.86	18.59	35.56	32
27.58	17.25	55.17	33
28.54	51.01	20.45	34
24.85	48.01	27.13	35
73.77	4.75	21.48	36
57.78	12.49	29.73	37
57.18	6.17	36.65	38
57.18	3.43	39.39	39
66.43	19.78	13.79	40
55.96	23.43	20.62	41
38.82	32.71	28.47	42
67.28	6.82	25.90	43
68.80	6.33	24.87	44
62.77	5.05	32.17	45

TABLE 9

SILICATE MINERALOGY (WEIGHT PERCENT)
+400 MESH FRACTION

CAL	QTZ	CHL	HB 3	HB 1	HB 2	TRE	ACT	AUG	NO.
3.98	40.76	3.12	0.0	0.0	0.0	0.0	0.0	0.0	1
0.55	1.27	34.54	0.0	0.0	0.0	0.0	0.0	0.0	2
0.0	5.51	1.30	0.0	0.0	0.0	0.0	2.60	0.0	3
2.71	20.47	4.41	0.0	0.0	0.0	0.0	0.0	0.0	4
6.44	4.98	1.08	0.0	0.0	0.0	0.0	0.0	0.0	5
9.88	2.97	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6
0.31	6.91	0.0	0.0	7.99	0.0	0.0	0.0	0.0	7
15.22	7.75	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8
0.63	61.41	14.11	0.0	0.0	0.0	0.0	0.0	0.0	9
19.50	14.96	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10
3.43	17.66	15.67	0.0	0.0	0.0	0.0	0.0	0.0	11
1.62	5.46	0.07	0.07	0.0	0.0	0.0	0.0	0.0	12
10.57	12.86	6.21	0.0	0.0	0.0	0.0	0.0	0.0	13
12.03	14.09	3.77	0.0	0.0	0.0	0.0	0.0	0.0	14
0.47	7.47	0.0	50.27	0.0	0.0	0.0	0.78	0.0	15
1.57	32.51	0.0	0.0	1.67	0.0	0.0	0.0	0.0	16
3.52	12.15	0.0	0.0	0.45	0.0	0.0	0.0	0.0	17
3.69	51.41	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18
11.62	10.72	0.0	0.0	0.0	0.0	0.0	0.0	0.0	19
1.00	2.51	1.53	0.0	0.0	0.0	0.0	0.0	0.0	20
0.47	10.41	8.88	0.0	0.0	0.0	0.0	0.0	0.0	21
1.14	4.21	0.0	9.87	0.0	0.0	0.0	2.46	3.80	22
1.40	2.21	1.37	0.0	0.0	0.0	0.0	0.0	0.0	23
1.75	5.47	1.49	0.0	0.0	0.0	0.0	0.0	0.0	24
6.12	8.03	0.0	0.0	0.0	0.0	0.0	0.0	0.0	25
5.43	4.05	6.56	0.0	0.0	0.0	0.0	0.0	0.0	26
3.66	3.69	0.0	0.0	0.0	0.0	0.0	0.0	0.0	27
5.12	12.18	0.0	0.0	1.76	0.0	0.0	0.0	0.0	28
1.43	0.0	0.14	0.0	0.0	0.0	0.0	0.0	17.39	29
0.0	26.14	0.45	0.0	0.0	0.0	0.0	0.0	0.0	30
0.86	16.24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	31
5.29	6.63	0.0	0.0	0.0	0.0	0.70	0.0	0.0	32
0.97	17.68	4.99	0.0	0.68	0.0	0.0	0.0	0.0	33
7.47	23.12	0.36	0.0	0.0	0.0	0.0	0.0	0.0	34
6.58	27.75	0.0	0.0	0.0	0.0	0.0	0.0	0.24	35
22.85	18.69	5.45	0.0	0.0	0.0	0.0	0.77	0.0	36
8.59	14.62	22.53	0.0	0.0	0.0	0.0	0.0	0.0	37
2.71	24.40	9.05	0.0	0.0	0.0	0.0	0.0	0.0	38
1.96	23.07	4.87	0.0	0.0	0.0	0.0	0.0	0.0	39
2.45	22.73	8.22	0.0	0.0	0.0	2.85	0.0	0.0	40
7.87	2.24	0.17	0.0	0.0	0.0	0.0	0.0	0.0	41
7.78	9.48	0.0	0.0	0.0	0.0	37.36	0.0	0.0	42
0.19	10.38	11.97	0.0	16.86	0.0	0.0	0.0	0.79	43
0.0	2.83	1.47	0.0	12.87	0.0	0.0	0.0	0.49	44
1.25	3.57	8.38	0.0	5.34	25.27	0.0	0.0	0.63	45

WALL ROCKS SHOWN IN TABLE 1, APPENDIX 1.

TABLE 9 (CONTINUED)

SILICATE MINERALOGY (WEIGHT PERCENT)
+400 MESH FRACTION

URA	EPI	BIO	GAR	FEL	PYR	DIO	HYP	UWR	NO.
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5
0.0	7.49	0.0	1.02	1.34	0.0	0.0	0.0	0.0	6
0.0	0.0	2.46	0.0	5.94	8.93	0.0	0.0	0.0	7
0.0	0.0	0.0	3.36	0.42	0.0	3.74	0.0	5.08	8
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14
0.0	0.60	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15
0.0	0.0	2.75	1.48	2.09	0.0	0.0	0.0	1.05	16
0.0	0.0	0.44	6.25	0.0	0.0	0.0	0.0	0.0	17
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	19
0.0	0.64	0.0	0.0	0.0	0.0	0.0	0.0	2.03	20
0.0	0.0	0.16	0.46	0.0	0.0	0.0	0.0	4.03	21
0.0	0.0	11.99	0.0	0.0	0.0	0.0	0.0	0.0	22
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.62	23
0.0	4.96	0.0	0.0	0.0	0.0	0.0	0.0	0.0	24
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.76	25
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	26
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.05	27
0.0	3.92	1.28	0.0	0.0	0.0	0.0	0.0	3.09	28
0.0	1.43	0.95	0.0	4.86	0.0	0.0	0.0	0.0	29
0.0	0.0	0.26	0.0	0.94	0.15	0.0	0.0	0.0	30
0.0	0.0	0.28	0.0	0.0	0.0	0.0	0.0	27.21	31
0.0	0.0	5.10	17.70	0.0	0.0	0.0	0.0	0.0	32
0.0	0.49	0.0	0.17	0.0	0.0	0.0	0.0	55.25	33
0.0	0.49	0.0	0.0	0.53	0.0	0.0	0.0	0.77	34
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	35
0.0	9.66	0.0	1.73	0.0	0.0	0.0	0.0	28.90	36
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.59	37
0.0	0.84	0.0	0.0	0.0	0.0	0.0	0.0	0.29	38
0.0	0.15	0.0	0.0	0.0	0.0	0.0	0.0	0.20	39
0.0	4.37	0.40	0.0	0.0	0.0	0.0	0.0	0.0	40
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	30.73	41
0.0	0.0	4.50	3.49	2.84	0.0	13.93	0.0	3.72	42
12.59	1.35	7.51	0.13	0.0	0.0	0.0	11.66	0.0	43
23.91	1.77	1.75	0.0	0.0	0.0	0.0	0.0	0.0	44
10.80	0.90	0.93	0.0	0.0	0.0	0.0	3.52	0.0	45

WALL ROCKS SHOWN IN TABLE 1, APPENDIX 1.

TABLE 9 (CONTINUED)

SILICATE MINERALOGY (WEIGHT PERCENT)
+400 MESH FRACTION

SID	APA	ZOI	MUS	SER	OLI	BAR	FLU	CHD	NO.
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4
0.0	0.0	0.0	0.0	0.0	0.0	30.61	5.04	0.0	5
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6
0.0	0.0	0.0	0.0	0.0	18.99	0.0	0.0	0.0	7
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9
0.0	0.0	0.0	0.0	0.0	0.0	46.32	0.0	0.0	10
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12
0.0	0.0	0.0	0.0	0.0	1.18	0.0	0.0	0.0	13
2.88	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.23	14
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15
0.0	0.0	0.0	9.13	0.0	0.0	0.0	0.0	0.0	16
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.70	0.0	17
3.10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	19
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20
1.85	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.00	21
0.82	0.0	0.0	0.0	0.0	0.33	0.0	0.0	0.0	22
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	23
0.0	0.0	3.48	0.0	0.0	0.0	0.0	0.0	0.0	24
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	25
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	26
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	27
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	28
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	29
0.0	0.0	0.0	0.0	0.12	0.0	1.65	0.0	0.0	30
0.0	0.29	0.0	0.0	0.0	0.0	0.0	0.0	0.0	31
0.0	0.0	1.50	0.32	0.0	0.0	0.0	0.0	0.0	32
0.0	0.0	0.0	0.0	1.35	0.0	0.0	0.0	0.0	33
25.42	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	34
5.39	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	35
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	36
0.0	1.23	2.17	0.0	0.0	0.0	0.0	0.0	0.0	37
0.0	0.32	2.82	0.0	0.0	0.0	0.0	0.0	0.0	38
0.0	0.29	1.79	0.0	0.0	0.0	0.0	0.0	0.0	39
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	40
5.05	0.0	0.0	0.0	0.0	0.0	33.78	0.0	0.0	41
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	42
0.0	0.34	0.0	0.0	0.0	0.0	0.0	0.0	0.0	43
0.0	0.30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	44
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	45

WALL ROCKS SHOWN IN TABLE 1, APPENDIX 1.

TABLE 9 (CONTINUED)

SILICATE MINERALOGY (WEIGHT PERCENT)
+400 MESH FRACTION

SLL	WRP	GYP	OCB	ZEO	QFM	SRP	APL	FQP	NO.
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.74	2
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6
0.0	4.38	0.0	0.0	0.0	0.0	11.82	0.0	0.0	7
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14
0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.95	0.0	15
2.64	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17
0.0	0.0	0.0	14.98	0.0	0.0	0.0	0.0	0.0	18
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	19
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	21
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	22
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	23
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	24
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	25
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	26
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	27
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	28
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	29
0.0	0.0	0.11	0.0	0.0	0.0	0.0	0.0	0.0	30
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	31
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	32
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	33
0.0	0.0	0.0	5.59	0.0	0.0	0.0	0.0	0.0	34
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	35
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	36
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	37
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	38
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	39
0.0	0.0	0.0	0.0	2.22	0.0	0.0	0.0	0.0	40
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	41
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	42
0.0	0.0	0.0	0.0	0.0	0.64	0.0	0.0	0.0	43
0.0	0.0	0.0	0.0	0.0	6.42	0.0	0.0	0.0	44
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	45

WALL ROCKS SHOWN IN TABLE 1, APPENDIX 1.

TABLE 9 (CONTINUED)

SILICATE MINERALOGY (WEIGHT PERCENT)
+400 MESH FRACTION

PLI	CCS	S*R	SC*R	SCT*R	ST*R	SI*R	C*R	CSC*R	NO.
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4
0.0	0.0	8.57	0.0	0.0	0.0	0.0	0.0	0.0	5
0.0	0.0	0.0	0.0	0.0	0.0	0.0	18.82	0.0	6
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13
0.0	0.0	0.0	27.24	0.0	0.0	0.0	0.0	18.47	14
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15
1.72	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16
0.0	0.0	33.55	0.0	0.0	0.0	0.0	17.02	0.0	17
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18
0.0	0.0	0.0	0.0	47.18	0.0	0.0	7.84	0.0	19
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20
0.0	0.0	15.06	0.0	0.0	0.0	0.0	0.0	0.0	21
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	22
0.0	0.0	4.39	0.0	0.0	0.0	0.0	6.34	0.0	23
0.0	0.0	17.89	0.0	0.0	0.0	0.0	8.60	0.0	24
0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.65	0.0	25
0.0	9.32	3.19	0.0	0.0	0.0	0.0	0.0	0.0	26
0.0	0.0	0.0	20.75	0.0	0.0	0.0	0.0	0.0	27
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	28
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	29
0.0	0.0	37.92	0.0	0.0	0.0	0.0	12.63	0.0	30
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	31
0.0	0.0	0.0	0.0	0.0	15.88	0.0	11.94	0.0	32
0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.79	0.0	33
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	34
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.89	0.0	35
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	36
0.0	0.0	6.15	0.0	0.0	0.0	0.0	9.52	0.0	37
0.0	0.0	6.25	0.0	0.0	0.0	0.0	4.67	0.0	38
0.0	0.0	1.75	0.0	0.0	0.0	0.0	5.57	0.0	39
0.0	0.0	0.0	0.0	0.0	0.0	52.16	0.0	0.0	40
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	41
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	42
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	43
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	44
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	45

WALL ROCKS SHOWN IN TABLE 1, APPENDIX 1.

TABLE 9 (CONTINUED)

SILICATE MINERALOGY (WEIGHT PERCENT)
+400 MESH FRACTION

CSWR	CBWR	PWR	HWR	SSWR	BASWR	ABWR	AWR	BMS	NO.
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5
0.0	0.0	16.56	0.0	0.0	0.0	0.0	0.0	0.0	6
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10
0.0	0.0	47.40	0.0	0.0	0.0	0.0	0.0	0.0	11
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12
0.0	0.0	0.0	0.0	34.30	0.0	0.0	0.0	0.0	13
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14
0.0	0.0	0.0	27.22	0.0	0.0	0.0	0.0	0.0	15
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16
0.0	0.0	3.23	0.0	0.0	0.0	0.0	0.0	0.0	17
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	19
3.38	0.0	0.0	0.0	0.72	0.0	0.0	0.0	0.0	20
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	21
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	22
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	23
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	24
0.0	6.17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	25
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	26
0.67	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	27
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	26.54	28
0.0	0.0	0.0	0.0	0.0	32.13	18.44	0.0	0.0	29
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	30
5.14	24.22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	31
0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.36	0.0	32
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	33
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	34
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	35
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	36
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	37
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	38
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	39
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	40
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	41
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	42
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	43
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	44
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	45

WALL ROCKS SHOWN IN TABLE 1, APPENDIX 1.

TABLE 9 (CONTINUED)

SILICATE MINERALOGY (WEIGHT PERCENT)
+400 MESH FRACTION

GMS	SAF	SPL	SSPL	SBAF	SFWR	WOL	NO.
0.0	0.0	0.0	0.0	0.0	0.0	0.0	1
0.0	0.0	0.0	0.0	0.0	0.0	0.0	2
0.0	0.0	0.0	0.0	0.0	0.0	0.0	3
0.0	0.0	33.41	0.0	0.0	0.0	0.0	4
0.0	0.0	0.0	0.0	0.0	0.0	0.0	5
0.0	0.0	0.0	0.0	0.0	0.0	0.0	6
0.0	0.0	0.0	0.0	0.0	0.0	0.0	7
0.0	0.0	0.0	0.0	0.0	0.0	59.85	8
0.0	3.50	0.0	0.0	0.0	0.0	0.0	9
0.0	0.0	0.0	0.0	0.0	0.0	0.0	10
0.0	5.47	0.0	0.0	0.0	0.0	0.0	11
0.0	0.0	0.0	0.0	0.0	3.75	0.0	12
0.0	0.0	0.0	0.0	0.0	0.0	0.0	13
0.0	0.0	0.0	0.0	0.0	0.0	0.0	14
0.0	0.0	0.0	0.0	0.0	0.0	0.0	15
0.0	0.0	0.0	0.0	0.0	0.0	0.0	16
0.0	0.0	0.0	0.0	0.0	0.0	0.0	17
0.0	0.0	0.0	0.0	0.0	0.0	0.0	18
0.0	0.0	0.0	0.0	0.0	0.0	0.0	19
0.0	0.0	0.0	0.0	0.0	0.0	0.0	20
0.0	1.15	0.0	0.0	0.0	0.0	0.0	21
0.0	0.0	0.0	36.79	0.0	0.0	0.0	22
0.0	0.0	0.0	0.0	0.0	0.0	0.0	23
0.0	0.0	0.0	0.0	0.0	0.0	0.0	24
0.0	0.0	0.0	0.0	0.0	0.0	0.0	25
0.0	0.0	0.0	0.0	0.0	0.0	0.0	26
0.0	0.0	0.0	0.0	0.0	0.0	0.0	27
29.51	0.0	0.0	0.0	0.0	0.0	0.0	28
0.0	0.0	0.0	0.0	20.50	0.0	0.0	29
0.0	0.0	0.0	0.0	0.0	0.0	0.0	30
0.0	0.0	0.0	0.0	0.0	0.0	0.0	31
0.0	0.0	0.0	0.0	0.0	0.0	0.0	32
0.0	0.0	0.0	0.0	0.0	0.0	0.0	33
0.0	0.0	0.0	0.0	0.0	0.0	0.0	34
0.0	0.46	0.0	0.0	0.0	0.0	0.0	35
0.0	0.0	0.0	0.0	0.0	0.0	0.0	36
0.0	0.0	0.0	0.0	0.0	0.0	0.0	37
0.0	0.17	0.0	0.0	0.0	0.0	0.0	38
0.0	0.31	0.0	0.0	0.0	0.0	0.0	39
0.0	0.0	0.0	0.0	0.0	0.0	0.0	40
0.0	0.0	0.0	0.0	0.0	0.0	0.0	41
0.0	0.0	0.0	0.0	0.0	0.0	0.0	42
0.0	0.0	0.0	12.92	0.0	0.0	0.0	43
0.0	0.0	0.0	36.79	0.0	0.0	0.0	44
0.0	0.0	0.0	10.99	0.0	0.0	0.0	45

WALL ROCKS SHOWN IN TABLE 1, APPENDIX 1.

TABLE 9 (CONTINUED)

SYMBOLS USED FOR SILICATE MINERALS AND ALTERATION

SYMBOL	PRODUCT	SYMBOL	PRODUCT
CAL	CALCITE	BIO	BIOTITE(PHLOGOPITE)
QTZ	QUARTZ	GAR	GARNET
CHL	CHLORITE	FEL	ALKALI FELDSPAR
SER	SERICITE	PYR	PYROXENE
OLI	OLIVENE	DIO	DIOPSIDE
BAR	BARITE	HYP	HYPERSTHENE
TRE	TREMOLITE	UWR	UNALTERED WALL ROCK
ACT	ACTINOLITE	SID	SIDERITE
AUG	AUGITE	APA	APATITE
URA	URALITE	ZOI	ZOISITE-CLINOZOISITE
EPI	EPIDOTE	MUS	MUSCOVITE
CHD	CHLORITOID	SLL	SILLIMANITE
FLU	FLUORITE	GYP	GYPSUM-ANHYDRITE
OCB	OTHER CARBONATES	SRP	SERPENTINE
SUL	OTHER SULPHATES	APL	APLITE
HB 1	BLUE GREEN HORNBLENDE	HB 2	PALE GREEN HORNBLENDE
HB 3	GREENISH BROWN HORNBLENDE	QFM	MICROGRAPHIC QUARTZ AND FELDSPAR
PLA	PLAGIOCLASE	FWR	FELDSPAR + WALL ROCK
WOL	WOLLASTONITE	WRP	WALL ROCK + PLAGIOCLASE
SM	SMITHSONITE	CCS	CHERTY CHLORITE SCHIST
FQP	FELDSPAR AND QUARTZ DIORITE,QUARTZ PORPHYRY		

TABLE 9 (CONTINUED)

SYMBOLS USED FOR SILICATE MINERALS AND ALTERATION

SYMBOL	PRODUCT
SWR	SERICITIZED WALL ROCK
CWR	CHLORITIZED WALL ROCK
HWR	HORNBLENDIZED WALL ROCK
CBWR	CARBONATIZED WALL ROCK
PWR	PROPYLLITIZED WALL ROCK
AWR	ALBITIZED WALL ROCK
SCWR	SERICITIZED-CARBONATIZED WALL ROCK
SCTWR	SERICITIZED-CARBONATIZED-TOURMALINIZED WALL ROCK
STWR	SERICITIZED-TOURMALINIZED WALL ROCK
SAWR	SERICITIZED-ARGILLITIZED WALL ROCK
CSCWR	CHLORITIZED-SERICITIZED-CARBONATIZED WALL ROCK
CSWR	CHLORITIZED-SERICITIZED WALL ROCK
SSWR	SAUSSERITIZED-SILICIFIED WALL ROCK
SLWR	SILICIFIED WALL ROCK
BASWR	BIOTITIZED-AUGITIZED-SERICITIZED WALL ROCK
ABWR	AUGITIZED-BIOTITIZED WALL ROCK
GMS	GREEN METASEDIMENTARY ROCK(CHLORITE RICH)
BMS	BROWN METASEDIMENTARY ROCK(BIOTITE RICH)
SAF	SERICITIZED ALKALI FELDSPAR
SPL	SERICITIZED PLAGIOCLASE
SBAF	SERICITIZED-BIOTITIZED ALKALI FELDSPAR
SFWR	SERICITIZED FELDSPAR + WALL ROCK
SSPL	SAUSSERITIZED PLAGIOCLASE
SSAF	SAUSSERITIZED ALKALI FELDSPAR

TABLE 10

GANGUE MINERAL GROUPS(WEIGHT PERCENT)
+400 MESH FRACTION

CARB-N	SILIC-N	CHL-N	AMPHIB	PYROX	SAUSS-N	SERIC-N	SUM	NO.
3.98	40.76	3.12	0.0	0.0	0.0	0.0	47.86	1
0.55	1.27	34.54	0.0	0.0	0.0	0.0	36.36	2
0.0	5.51	1.30	2.60	0.0	0.0	0.0	9.41	3
2.71	20.47	4.41	0.0	0.0	0.0	33.41	61.00	4
6.44	4.98	1.08	0.0	0.0	0.0	8.57	21.07	5
9.88	2.97	18.82	0.0	0.0	0.0	0.0	31.67	6
0.31	6.91	0.0	7.99	8.93	0.0	0.0	24.14	7
15.22	7.75	0.0	0.0	3.74	0.0	0.0	26.71	8
0.63	61.41	14.11	0.0	0.0	0.0	3.50	79.65	9
19.50	14.96	0.0	0.0	0.0	0.0	0.0	34.46	10
3.43	17.66	15.67	0.0	0.0	0.0	5.47	42.23	11
1.62	5.46	0.07	0.07	0.0	0.0	3.75	10.97	12
10.57	12.86	6.21	0.0	0.0	34.30	0.0	63.94	13
14.91	14.09	24.47	0.0	0.0	0.0	27.24	80.71	14
0.47	7.47	0.0	78.27	0.0	0.0	0.0	86.21	15
1.57	32.51	0.0	1.67	0.0	0.0	0.0	35.75	16
3.52	12.15	17.02	0.45	0.0	0.0	33.55	66.69	17
21.77	51.41	0.0	0.0	0.0	0.0	0.0	73.18	18
11.62	10.72	7.84	0.0	0.0	0.0	47.18	77.36	19
1.00	2.51	4.91	0.0	0.0	0.72	0.0	9.14	20
2.32	10.41	10.88	0.0	0.0	0.0	16.21	39.82	21
1.96	4.21	0.0	12.33	3.80	36.79	0.0	59.09	22
1.40	2.21	7.71	0.0	0.0	0.0	4.39	15.71	23
1.75	5.47	10.09	0.0	0.0	0.0	17.89	35.20	24
12.29	8.03	4.65	0.0	0.0	0.0	0.0	24.97	25
5.43	4.05	6.56	0.0	0.0	0.0	3.19	19.23	26
3.66	3.69	0.67	0.0	0.0	0.0	20.75	28.77	27
5.12	12.18	0.0	1.76	0.0	0.0	0.0	19.06	28
1.43	0.0	0.14	0.0	17.39	0.0	20.50	39.46	29
0.0	26.14	13.08	0.0	0.15	0.0	38.04	77.41	30
25.08	16.24	5.14	0.0	0.0	0.0	0.0	46.46	31
5.29	6.63	11.94	0.70	0.0	0.0	15.88	40.44	32
0.97	17.68	16.78	0.68	0.0	0.0	1.35	37.46	33
38.48	23.12	0.36	0.0	0.0	0.0	0.0	61.96	34
11.97	27.75	0.89	0.0	0.24	0.0	0.46	41.31	35
22.85	18.69	5.45	0.77	0.0	0.0	0.0	47.76	36
8.59	14.62	32.05	0.0	0.0	0.0	6.15	61.41	37
2.71	24.40	13.72	0.0	0.0	0.0	6.42	47.25	38
1.96	23.07	10.44	0.0	0.0	0.0	2.06	37.53	39
2.45	22.73	8.22	2.85	0.0	0.0	52.16	88.41	40
12.92	2.24	0.17	0.0	0.0	0.0	0.0	15.33	41
7.78	9.48	0.0	37.36	13.93	0.0	0.0	68.55	42
0.19	10.38	11.97	16.86	25.04	12.92	0.0	77.36	43
0.0	2.83	1.47	12.87	24.40	36.79	0.0	78.36	44
1.25	3.57	8.38	30.61	14.95	10.99	0.0	69.75	45

TABLE 11

CALCULATED 100 ATOMIC PERCENT CU-PB-ZN
+400 MESH FRACTION

PROP. NO.	CU	ZN	PB	TOTAL	AU/ AU+AG	FE/ FE+ S
1	79.526	20.457	0.016	100.000	0.053	0.546
2	99.961	0.009	0.030	100.000	0.194	0.604
3	6.989	43.528	49.483	100.000	0.013	0.485
4	95.671	4.262	0.068	100.000	0.041	0.568
5	2.589	34.653	62.758	100.000	0.016	0.237
6	99.976	0.006	0.018	100.000	0.976	0.933
7	99.616	0.023	0.361	100.000	0.001	0.744
8	99.954	0.011	0.035	100.000	0.002	0.830
9	90.070	0.006	9.923	100.000	0.091	0.660
10	0.630	42.914	56.456	100.000	0.004	0.269
11	99.822	0.109	0.069	100.000	0.038	0.728
12	60.889	30.939	8.171	100.000	0.008	0.511
13	0.469	86.796	12.735	100.000	0.004	0.460
14	99.984	0.004	0.012	100.000	0.159	0.740
15	99.881	0.007	0.112	100.000	0.149	0.856
16	29.674	70.320	0.006	100.000	0.005	0.500
17	1.840	68.158	30.002	100.000	0.007	0.333
18	0.243	17.475	82.283	100.000	0.000	0.605
19	99.992	0.002	0.006	100.000	0.063	0.587
20	99.968	0.008	0.025	100.000	0.254	0.568
21	27.259	64.459	8.282	100.000	0.012	0.525
22	99.935	0.016	0.050	100.000	0.104	0.731
23	39.379	60.547	0.074	100.000	0.188	0.540
24	64.217	35.759	0.025	100.000	0.064	0.573
25	50.916	42.184	6.900	100.000	0.066	0.487
26	99.996	0.001	0.003	100.000	0.041	0.509
27	23.578	76.420	0.002	100.000	0.051	0.435
28	99.969	0.007	0.024	100.000	0.995	0.756
29	99.919	0.019	0.061	100.000	0.990	0.843
30	43.111	56.871	0.018	100.000	0.998	0.513
31	99.975	0.006	0.019	100.000	0.995	0.542
32	0.001	37.262	62.738	100.000	0.000	0.563
33	89.711	10.257	0.033	100.000	0.833	0.333
34	0.000	14.596	85.404	100.000	0.000	0.583
35	1.064	32.859	66.076	100.000	0.003	0.478
36	99.869	0.080	0.051	100.000	0.149	0.774
37	74.081	25.912	0.007	100.000	0.298	0.660
38	76.670	23.317	0.012	100.000	0.163	0.609
39	99.975	0.006	0.019	100.000	0.259	0.592
40	99.950	0.012	0.038	100.000	0.500	0.828
41	5.279	23.616	71.105	100.000	0.000	0.731
42	1.123	43.925	54.952	100.000	0.016	0.577
43	51.035	0.015	48.950	100.000	0.500	0.722
44	30.033	0.011	69.956	100.000	0.500	0.735
45	99.870	0.031	0.099	100.000	0.500	0.661

TABLE 12

CALCULATED 100 WEIGHT PERCENT CU-PB-ZN
+400 MESH FRACTION

PROP. NO.	CU	ZN	PB	TOTAL	AU/ AU+AG	FE/ FE+ S
1	79.996	19.999	0.005	100.000	0.053	0.546
2	99.982	0.009	0.009	100.000	0.194	0.604
3	10.842	65.621	23.538	100.000	0.013	0.485
4	95.831	4.149	0.021	100.000	0.041	0.568
5	4.664	60.669	34.668	100.000	0.016	0.237
6	99.989	0.006	0.006	100.000	0.976	0.933
7	99.867	0.022	0.111	100.000	0.001	0.744
8	99.978	0.011	0.011	100.000	0.002	0.830
9	96.726	0.007	3.268	100.000	0.091	0.660
10	1.055	69.921	29.024	100.000	0.004	0.269
11	99.873	0.106	0.021	100.000	0.038	0.728
12	65.147	32.172	2.681	100.000	0.008	0.511
13	0.528	95.070	4.401	100.000	0.004	0.460
14	99.992	0.004	0.004	100.000	0.159	0.740
15	99.959	0.007	0.034	100.000	0.149	0.856
16	30.275	69.723	0.002	100.000	0.005	0.500
17	2.381	85.714	11.905	100.000	0.007	0.333
18	0.571	40.000	59.429	100.000	0.000	0.605
19	99.996	0.002	0.002	100.000	0.063	0.587
20	99.985	0.008	0.008	100.000	0.254	0.568
21	29.487	67.766	2.747	100.000	0.012	0.525
22	99.970	0.015	0.015	100.000	0.104	0.731
23	40.083	59.894	0.023	100.000	0.188	0.540
24	64.881	35.112	0.008	100.000	0.064	0.573
25	54.149	43.601	2.250	100.000	0.066	0.487
26	99.998	0.001	0.001	100.000	0.041	0.509
27	24.096	75.903	0.001	100.000	0.051	0.435
28	99.986	0.007	0.007	100.000	0.995	0.756
29	99.962	0.019	0.019	100.000	0.990	0.843
30	43.818	56.177	0.006	100.000	0.998	0.513
31	99.988	0.006	0.006	100.000	0.995	0.542
32	0.001	65.305	34.694	100.000	0.000	0.563
33	89.991	9.999	0.010	100.000	0.833	0.333
34	0.000	35.135	64.865	100.000	0.000	0.583
35	1.999	59.959	38.043	100.000	0.003	0.478
36	99.906	0.078	0.016	100.000	0.149	0.774
37	74.628	25.369	0.002	100.000	0.298	0.660
38	77.183	22.813	0.004	100.000	0.163	0.609
39	99.988	0.006	0.006	100.000	0.259	0.592
40	99.977	0.012	0.012	100.000	0.500	0.828
41	10.550	45.872	43.578	100.000	0.000	0.731
42	1.852	70.370	27.778	100.000	0.016	0.577
43	77.255	0.023	22.722	100.000	0.500	0.722
44	58.321	0.021	41.658	100.000	0.500	0.735
45	99.939	0.030	0.030	100.000	0.500	0.661

TABLE 13

TOTAL WEIGHT PERCENT METALLIC ELEMENTS AND CORRESPONDING SULPHURS.
+400 MESH FRACTION

TOTAL METALLICS	SULPHUR	METALLICS/ METALLICS + S	NO.
28.40	21.90	0.565	1
28.35	17.90	0.613	2
47.12	42.45	0.526	3
18.18	11.95	0.603	4
28.93	15.15	0.656	5
29.67	2.00	0.937	6
20.99	6.60	0.761	7
7.53	1.35	0.848	8
13.64	6.20	0.688	9
10.88	8.95	0.549	10
11.97	4.30	0.736	11
44.57	39.00	0.533	12
23.92	14.75	0.619	13
22.63	7.00	0.764	14
16.34	2.50	0.867	15
24.14	18.70	0.564	16
9.39	10.40	0.474	17
25.94	5.50	0.825	18
14.68	6.45	0.695	19
47.29	34.95	0.575	20
32.41	24.40	0.570	21
21.20	6.60	0.763	22
41.17	33.20	0.554	23
35.74	21.75	0.622	24
36.69	31.10	0.541	25
43.22	31.10	0.582	26
38.51	28.45	0.575	27
10.86	3.05	0.781	28
4.03	0.65	0.861	29
10.04	7.85	0.561	30
9.87	6.85	0.590	31
33.98	18.75	0.644	32
2.60	3.20	0.448	33
34.62	8.90	0.795	34
22.02	8.20	0.729	35
10.60	2.90	0.785	36
28.01	11.85	0.703	37
27.74	16.05	0.633	38
32.85	21.35	0.606	39
3.75	0.60	0.862	40
29.65	7.70	0.794	41
11.81	4.70	0.715	42
11.73	4.10	0.741	43
9.97	3.30	0.751	44
21.61	10.25	0.678	45

APPENDIX 6

Computer Program Listings

TABLE 1

DISK OPERATING SYSTEM/360 FORTRAN 360N-FO-451 13

```
C
C     CALCULATION OF AVERAGE POINT COUNTING ERROR (95.45 PCT C.L.)
C        P2 = CHIEF MINERAL     P1 = NUMBER OF COUNTS
C
      DIMENSION ERR(45),NO(45),P1(45),P2(45),P3(45),N(45),M(45)
      SUME=0.
      BETA=0.
C     T = NUMBER OF STANDARD DEVIATIONS (C.L.), R = GRAIN RADIUS (MAXIMUM
C     FOR FRACTION), B = GRID SPACING, A = EFFECTIVE MEASUREMENT
C     AREA (ONE THIRD OF TOTAL).
      T=2.0
      R=.105
      B=.33
      A=236.0
C
C     CALCULATION OF PERCENT ERROR AND MAXIMUM VARIANCES.
C
      WRITE (2,2)
      WRITE (2,3)
      WRITE (2,4)
      WRITE (2,5)
      WRITE (2,6)
      DO 10  I=1,45
      READ (1,11) NO(I),P2(I),P1(I)
C
C     CALCULATION OF PERCENT ERROR USING AVERY EQUATION.
C
      P3(I)=P2(I)/P1(I)
      P4=P3(I)*100.
      ERR1  =SQRT((P3(I)*(1.-P3(I))*(T*T))/P1(I))
      ERR(I)=ERR1*100.0
      SUME=SUME+ERR(I)
      N(I)=P1(I)
      M(I)=P2(I)
C
C     CALCULATION OF MAXIMUM VARIANCE USING HASOFER EQUATION.
C
      X=(.44*P3(I)*(B*B*B))/(R*A)
      W=R/B
      Y=1.+(5.8*(W*W*W))
      VAR1=X*Y
C
C     CALCULATION OF MAXIMUM VARIANCE USING BAYLY EQUATION.
C
      VC=(P4*(100.-P4))/P1(I)
      F=2.*R
      VS=(132.*(P4*F*F))/A
      VAR2=VC+VS
      WRITE (2,12) VAR1,VAR2,ERR(I),N(I),M(I),P4,NO(I)
   10 CONTINUE
```

```
      CALCULATION OF AVERAGE ERROR AND STANDARD DEVIATION
      OF THE PERCENT ERROR.

      EMEAN=SUME/45.
      DO 20  I=1,45
      BETA=BETA+((ERR(I)-EMEAN)*(ERR(I)-EMEAN))
   20 CONTINUE
      SDEV=SQRT(BETA/44.)
      WRITE (2,14) EMEAN
      WRITE (2,15) SDEV

              FORMATS

    2 FORMAT(1H1,25X,5HTABLE)
    3 FORMAT(1H0,9X,47HCALCULATION OF THE AVERAGE POINT COUNTING ERROR)
    4 FORMAT(1H0,6X,59HCALC.   MAX.    CALC. PCT.   TOTAL    POINTS  PER
     1CENT   PR.)
    5 FORMAT(1H ,2X,63H     VARIANCES      ERROR-MAIN   POINTS   MAIN
     1  MAIN     NO.)
    6 FORMAT(1H ,2X,63H(HASOFER)  (BAYLY)   MINERAL     SAMPLE  MINERAL
     1 MINERAL       )
   11 FORMAT(8X,I3,F8.0,8X,F8.0)
   12 FORMAT(1H ,4X,3(F5.2,5X),2X,I4,4X,I4,5X,F5.2,4X,I3)
   14 FORMAT(1H0,16X,15HAVERAGE ERROR =,F6.2,9H  PERCENT)
   15 FORMAT(1H ,16X,20HSTANDARD DEVIATION =,F6.2)
      CALL EXIT
      END
```

TABLE 2


```
C
C     SINGLE AND MULTIPLE REGRESSION ANALYSIS 6.0.148
C
      DIMENSION A(10,10),C(10),SUMX(10),SUMXY(10),W(10)
      INK=0
C
C     PROGRAM INITIALIZATION.
C
    1 READ (1,200) EK,EN
C      EK IS THE NUMBER OF VARIABLES.
C      EN IS THE NUMBER OF SAMPLES.
      K=EK
      N=EN
      INK=INK+1
      WRITE (2,1000)
      WRITE (2,1001)
      WRITE (2,1001)
      WRITE (2,100)
      GO TO (997,998,999),INK
  997 WRITE (2,1003)
      GO TO 900
  998 WRITE (2,1004)
      GO TO 900
  999 WRITE (2,1005)
      GO TO 900
  900 CONTINUE
      WRITE (2,102) K
      WRITE (2,103) N
      WRITE (2,120)
      SUMY=0.0
      SUMYS=0.0
      DO 2 L=1,K
      SUMX(L)=0.0
      SUMXY(L)=0.0
      DO 2 J=L,K
    2 A(L,J)=0.0
C
C     Y-X DATA READ IN
C
      DO 3 I=1,N
      READ (1,101) Y,W(1),M
C
C     SUMMATION OF Y AND Y SQUARED
C
      SUMY=SUMY+Y
      SUMYS=SUMYS+Y*Y
C
C     SUMMATION OF X(L),X(L)*Y,AND X(L)*X(J)
C
      DO 3 L=1,K
      SUMX(L)=SUMX(L)+W(L)
      SUMXY(L)=SUMXY(L)+W(L)*Y
      DO 3 J=L,K
    3 A(L,J)=A(L,J)+W(L)*W(J)
```

```
C
C     COMPUTATION OF THE CONSTANT VECTOR C(L).
C     COMPUTATION OF THE COEFFICIENT MATRIX FOR THE NORMAL EQUATIONS.
C
      DO 4 L=1,K
      C(L)=EN*SUMXY(L)-SUMX(L)*SUMY
      DO 4 J=L,K
      A(L,J)=EN*A(L,J)-SUMX(L)*SUMX(J)
    4 A(J,L)=A(L,J)
C
C     COMPUTATION OF TH PARTIAL CORRELATION COEFFICIENTS X(L) TO X(J).
C
      WRITE (2,104)
      WRITE (2,105)
    5 WRITE (2,106) L,J,R
C
C     MATRIX INVERSION BY ROLLING METHOD.
C     INVERSE REPLACES ORIGINAL A MATRIX.
C
      K1=K-1
      IF (K1) 1,6,7
    6 A(1,1)=1.0/A(1,1)
      GO TO 12
    7 DO 11 ITER=1,K
      W(K)=1.0/A(1,1)
      DO 8 J=1,K1
    8 W(J)=A(1,J+1)*W(K)
      DO 10 L=1,K1
      DO 9 J=1,K1
    9 A(L,J)=A(L+1,J+1)-A(L+1,1)*W(J)
   10 A(L,K)=-A(L+1,1)*W(K)
      DO 11 J=1,K
   11 A(K,J)=W(J)
C
C     COMPUTATION OF THE PARTIAL REGRESSION COEFFICIENTS.
C
   12 SUM=0.0
      BZERO=SUMY/EN
      DO 14 J=1,K
      W(J)=0.0
      DO 13 L=1,K
   13 W(J)=W(J)+C(L)*A(L,J)
      SUM=SUM+W(J)*C(J)
   14 BZERO=BZERO-W(J)*SUMX(J)/EN
      WRITE (2,107)
      WRITE (2,108)
      J=0
      WRITE (2,109) J,BZERO
      DO 15 J=1,K
   15 WRITE (2,109) J,W(J)
C
C     COMPUTATION OF THE MULTIPLE CORRELATION COEFFICIENT.
C     COMPUTATION OF THE STANDARD ERROR OF THE Y DATA.
C     COMPUTATION OF THE STANDARD ERROR OF THE ESTIMATE.
C     COMPUTATION OF THE SIGNIFICANCE OF REGRESSION (F).
C
```

```
      AYY=EN*SUMYS-SUMY*SUMY
      RMULT=SUM/AYY
      SY=AYY/(EN*(EN-1.0))
      SYX=SY*(EN-1.0)*(1.0-RMULT)/(EN-EK-1.0)
      F=SUM/(EN*EK*SYX)
      RMULT=SQRT(RMULT)
      SY=SQRT(SY)
      SYX=SQRT(SYX)
      WRITE (2,110) RMULT
      WRITE (2,111) SY
      WRITE (2,112) SYX
      WRITE (2,113) F
      WRITE (2,114)
      WRITE (2,115)
      SB=1.0
      DO 16 L=1,K
      DO 16 J=1,K
   16 SB=SB+A(L,J)*SUMX(L)*SUMX(J)
      SB=SYX*SQRT(SB/EN)
      J=0
      WRITE (3,109) J,SB
      DO 17 J=1,K
      SB=SYX*SQRT(EN*A(J,J))
   17 WRITE (2,109) J,SB
      WRITE (2,121)
      WRITE (2,122) BZERO,W(2)
      IF(M-9)1,20,1
C
C     FORMAT STATEMENTS
C
  100 FORMAT (1H0,47H SINGLE AND MULTIPLE LINEAR REGRESSION ANALYSIS)
  101 FORMAT (F5.2,F6.3,68X,I1)
  102 FORMAT (1H0,34H NUMBER OF INDEPENDENT VARIABLES = I4)
  103 FORMAT (1H ,34H NUMBER OF DATA POINTS           = I4)
  104 FORMAT (1H0,46H PARTIAL CORRELATION COEFFICIENTS X(L) TO X(J))
  105 FORMAT (1H ,8X,2H L,8X,2H J,10X,7H R(L,J))
  106 FORMAT (1H ,I10,I10,E20.8)
  107 FORMAT (1H0,32H PARTIAL REGRESSION COEFFICIENTS)
  108 FORMAT (1H ,18X,2H J,11X,5H B(J))
  109 FORMAT (1H ,10X,I10,E20.8)
  110 FORMAT (1H0,35H MULTIPLE CORRELATION COEFFICIENT = E20.8)
  111 FORMAT (1H ,35H STANDARD ERROR OF THE Y DATA     = E20.8)
  112 FORMAT (1H ,35H STANDARD ERROR OF THE ESTIMATE   = E20.8)
  113 FORMAT (1H ,35H SIGNIFICANCE OF REGRESSION (F)   = E20.8)
  114 FORMAT (1H0,26H STANDARD ERROR OF PARTIAL,24H REGRESSION COEFFICIE
     1NTS)
  115 FORMAT (1H ,18X,2H J,10X,6H SB(J))
  120 FORMAT (1H0,43H Y AXIS = MINERAL PCT., X AXIS = INT. RATIO)
  200 FORMAT(2F7.0)
 1000 FORMAT(1H1)
 1001 FORMAT(1H0)
 1003 FORMAT(1H0,21H  MINERAL = MAGNETITE)
 1004 FORMAT(1H0,18H  MINERAL = PYRITE)
 1005 FORMAT(1H0,22H  MINERAL = PYRRHOTITE)
   20 CALL EXIT
      END
```

TABLE 3

```
DISK OPERATING SYSTEM/360 FORTRAN     360N-FO-451   21

  METAL ANALYSES AND RATIO PROGRAM.

  DIMENSION ANI(45),CO(45),CU(45),ZN(45),PB(45),FE(45),AU(45),AG(45)
 1,S(45),NO(45)
  DO 20  I=1,45
  READ (1,10) ANI(I),CO(I),CU(I),ZN(I),PB(I),FE(I),AU(I),AG(I),S(I),
 1NO(I)
20 CONTINUE

   ANALYSES AND RATIO PUNCHING ROUTINE.

  WRITE (2,11)
  WRITE (2,12)
  WRITE (2,13)
  WRITE (2,14)
  WRITE (2,15)
  DO  60  I=1,45
  WRITE(2,16) ANI(I),CO(I),CU(I),ZN(I),PB(I),NO(I)
60 CONTINUE
  WRITE (2,400)
  WRITE (2,276)
  WRITE (2,277)
  WRITE (2,17)
  WRITE (2,12)
  WRITE (2,13)
  WRITE (2,18)
  WRITE (2,19)
  DO  61  I=1,45
  WRITE(2,21) FE(I),S(I),AU(I),AG(I),NO(I)
61 CONTINUE
  WRITE (2,400)
  WRITE (2,276)
  WRITE (2,277)

  METAL RATIO CALCULATIONS - GROUP 1.

  WRITE (2,11)
  WRITE (2,22)
  WRITE (2,13)
  WRITE (2,24)
  DO  40   I=1,45
  CONI=CO(I)/(CO(I)+ANI(I))
  ANICO=ANI(I)/(CO(I)+ANI(I))
  CUNI=CU(I)/(CU(I)+ANI(I))
  ANICU=ANI(I)/(CU(I)+ANI(I))
  CUCO=CO(I)/(CO(I)+CU(I))
  AUAG=AU(I)/(AU(I)+AG(I))
  AGAU=AG(I)/(AU(I)+AG(I))
  WRITE (2,23) CONI,ANICO,CUNI,ANICU,CUCO,AUAG,AGAU,NO(I)
40 CONTINUE
  WRITE (2,400)
```

```
C
C     METAL RATIO CALCULATIONS - GROUP 2.
C
      WRITE (2,17)
      WRITE (2,22)
      WRITE (2,13)
      WRITE (2,55)
      DO  50    I=1,45
      CUBASE=CU(I)/(CU(I)+ZN(I)+PB(I))
      ZNBASE=ZN(I)/(CU(I)+ZN(I)+PB(I))
      PBBASE=PB(I)/(CU(I)+ZN(I)+PB(I))
      COCU=CU(I)/(CU(I)+CO(I))
      RATIO=AG(I)/AU(I)
      WRITE (2,26) CUBASE,ZNBASE,PBBASE,COCU,RATIO,NO(I)
   50 CONTINUE
      WRITE (2,400)
C
C     METALLICS RATIO AND TOTALLING
C
      WRITE (2,11)
      WRITE (2,30)
      WRITE (2,31)
      WRITE (2,13)
      WRITE (2,32)
      WRITE (2,34)
      DO 60  I=1,45
      SUMM=CO(I)+ANI(I)+CU(I)+ZN(I)+PB(I)+FE(I)
      RMET=SUMM/(SUMM+S(I))
      WRITE(2,33) SUMM,S(I),RMET,NO(I)
   60 CONTINUE
C
C     NORMALIZED FE, S, AND OTHER METALS
C
      WRITE (2,11)
      WRITE (2,37)
      WRITE (2,13)
      WRITE (2,38)
      DO 70   I=1,45
      BASM=CO(I)+ANI(I)+CU(I)+PB(I)+ZN(I)
      ALPH=100.0/(BASM+FE(I)+S(I))
      FERR=FE(I)*ALPH
      AMET=BASM*ALPH
      SULP=S(I)*ALPH
      WRITE(2,36) FERR,AMET,SULP,NO(I)
   70 CONTINUE
C
C     NORMALIZING CU + NI, ZN + PB, FE,.
C
      WRITE (2,1016)
      FIDO=0.
      SUM=0.
      A=0.
      B=0.
      C=0.
```

```
      A=CU(I)+ANI(I)
      B=ZN(I)+PB(I)
      C=FE(I)
      SUM=A+B+C
      FIDO=100.0/SUM
      A1=A*FIDO
      B2=B*FIDO
      C3=C*FIDO
      WRITE (2,1111) A1,B2,C3,NO
C
C     FORMATS                                    FORMATS
C
   10 FORMAT(8F7.4,7X,F7.4,I2,I1)
   11 FORMAT(1H1,26X,5HTABLE)
   12 FORMAT(1H ,25X,15HMETAL  ANALYSES)
   13 FORMAT(1H ,24X,13HTOTAL  SAMPLE)
   14 FORMAT(1H0,65H    NI          CO          CU          ZN          PB
     1          NO.)
   15 FORMAT(1H ,37H                            WEIGHT   PERCENT)
   16 FORMAT(1H ,2X,5(F8.4,3X),4X,I3)
   17 FORMAT(1H1,19X,22HTABLE       (CONTINUED))
   18 FORMAT(1H0,65H    FE          S                           AU          AG
     1          NO.)
   19 FORMAT(1H ,17H   WEIGHT PERCENT,22X,8HOZ / TON)
   21 FORMAT(1H ,2X,2(F8.4,3X),12X,F6.4,3X,F8.4,9X,I3)
   22 FORMAT(1H ,37H                            METAL   RATIOS)
   23 FORMAT(1H ,1X,6(F6.3,3X),F6.3,2X,I3)
   24 FORMAT(1H0,66HCO/CO+NI NI/CO+NI CU/CU+NI NI/CU+NI CU/CO+CU AU/AU+A
     1G AG/AU+AG NO.)
   30 FORMAT(1H0,12X,42HTOTAL WEIGHT PERCENT METALLIC ELEMENTS AND)
   31 FORMAT(1H ,22X,23HCORRESPONDING SULPHURS.)
   32 FORMAT(1H0,12X,47HTOTAL         SULPHUR       METALLICS/        NO.)
   33 FORMAT(1H ,12X,F5.2,9X,F5.2,9X,F5.3,10X,I3)
   34 FORMAT(1H ,10X,37HMETALLICS                 METALLICS + S)
   55 FORMAT(1H0,65HCU/CU+ZN+PB ZN/CU+ZN+PB PB/CU+ZN+PB CO/CO+CU       AU
     1/AG        NO.)
   26 FORMAT(1H ,2X,2(F7.3,5X),F7.3,4X,F6.3,2X,F13.3,4X,I3)
  276 FORMAT(1H0,5X,49HNI-CO-CU-ZN-PB-FE-AU-AG BY MAN. MINES BRANCH LAB.
     1)
  277 FORMAT(1H ,5X,28HSULPHUR BY THE UNIV. OF MAN.)
  400 FORMAT(1H0,8X,23H+ SIGNIFIES A PLUS SIGN)
   36 FORMAT(1H ,11X,F6.2,9X,F6.2,11X,F6.2,13X,I3)
   37 FORMAT(1H0,4X,59H  NORMALIZED WEIGHT PERCENT IRON, SULPHUR, AND OT
     1HER METALS)
   38 FORMAT(1H0,13X,52HFE         CO+NI+CU+PB+ZN       SULPHUR
     1 NO.)
 1111 FORMAT(1H ,17X,F6.2,7X,F6.2,7X,F6.2,13X,I3)
 1016 FORMAT(1H ,17X,7HCU + NI,5X,7HZN + PB,6X,2HFE,16X,3HNO.)
      CALL EXIT
      END
C
   13 FORMAT(1H ,31H                  +400 MESH FRACTION)
   10 FORMAT(9F7.4,10X,I2)
```

```
C      ASSAY AND MINERAL CORRECTION FACTORS AS
C      CALCULATED FROM SEIVE ANALYSES WEIGHTS.
C
       WRITE (2,120)
       WRITE (2,121)
       WRITE (2,122)
       WRITE (2,123)
       WRITE (2,124)
       WRITE (2,125)
       DO 40      I=1,45
       READ (1,10)  A,B,C,NO,INK
       DEN1=A+C
       IF(DEN1)14,12,14
    12 ABA=0.0
       BBA=0.0
       GO TO 16
    14 ABA=A/DEN1
       BBA=1.000-ABA
    16 DEN2=B+C
       IF(B)20,18,20
    18 FBC=0.0
       FCC=0.0
       GO TO 22
    20 FBC=B/DEN2
       FCC=1.000-FBC
    22 WRITE(2,24) A,B,C,ABA,BBA,FBC,FCC,NO
       IF(INK-9)40,50,40
    40 CONTINUE
    50 WRITE (2,126)
C
C                    FORMATS
C
    10 FORMAT(F6.2,F7.2,F7.2,8X,I2,19X,I1)
    24 FORMAT(1H ,F7.2,2F8.2,F11.3,3F8.3,5X,I3)
   120 FORMAT(1H ,26X,5HTABLE)
   121 FORMAT(1H ,10X,45HASSAY AND MINERAL FRACTION CORRECTION FACTORS)
   122 FORMAT(1H ,66H SCREENED WEIGHTS (GMS)     ASSAY FACTOR    MINERAL
      1FACTOR      NO.)
   123 FORMAT(1H ,22H   +400     +400     -400)
   124 FORMAT(1H ,66H (FOR    (RETAIN   (RETAIN      +400     -400     +400
      1 -400             )
   125 FORMAT(1H ,23H  ASSAY)   -ED)      -ED))
   126 FORMAT(1H ,12X,23H+ SIGNIFIES A PLUS SIGN)
       CALL EXIT
       END
```

DISK OPERATING SYSTEM/360 FORTRAN 360N-FO-451 21

```
C
C     SULPHIDE-OPAQUE MINERALOGY, RATIO CALCULATION, NORMALIZED
C     GROUPS, AND MAGNETIC ANOMALY CALCULATION PROGRAM.
C
      DIMENSION A1(45),A2(45),A3(45),A4(45),A5(45),A6(45)
      DIMENSION POR(45),PYR(45),AGR(45),AGPY(45),PNPO(45),POPY(45)
      DIMENSION DEN(45),CPR(45),SLR(45),GNR(45),SULOX(45)
      DIMENSION SL(45),GN(45),CP(45),PY(45),AMG(45),PO(45),AHM(45),PN(45
     1),AS(45),TT(45),FR(45),SP(45),TB(45),ALM(45),CR(45),BO(45),CC(45),
     2AMC(45),UK(45),TN(45),GAN(45),SUL(45),OPA(45),NO(45)
      SUM=0.
C
C     READ IN DATA
C
  101 DO 25 I=1,45
      READ (1,10) SL(I),GN(I),CP(I),PY(I),AMG(I),PO(I),AHM(I),PN(I),AS(
     1I),TT(I),FR(I),SP(I),TB(I),ALM(I),CR(I),BO(I),CC(I),AMC(I),UK(I),
     2TN(I),GAN(I),SUL(I),OPA(I),NO(I),IPI
   25 CONTINUE
C
C           SULPHIDE PROGRAM PUNCHING ROUTINE.
C
      WRITE (2,800)
      WRITE (2,603)
      WRITE (2,611)
      WRITE (2,604)
      DO  88    I=1,45
      WRITE(2,605) SL(I),GN(I),CP(I),PY(I),AMG(I),PO(I),AHM(I),PN(I),AS
     1(I),TT(I),NO(I)
   88 CONTINUE
      WRITE (2,400)
      WRITE (2,606)
      WRITE (2,603)
      WRITE (2,611)
      WRITE (2,607)
      DO  89    I=1,45
      WRITE(2,608) FR(I),SP(I),TB(I),ALM(I),CR(I),BO(I),CC(I),AMC(I),UK(
     1I),TN(I),NO(I)
   89 CONTINUE
      WRITE (2,400)
      WRITE (2,606)
      WRITE (2,603)
      WRITE (2,611)
      WRITE (2,609)
      DO  90    I=1,45
      WRITE(2,610) GAN(I),SUL(I),OPA(I),NO(I)
   90 CONTINUE
      WRITE (2,400)
C
C     MINERAL RATIO CALCULATIONS - GROUP 1.
C
      WRITE (2,800)
      WRITE (2,613)
      WRITE (2,611)
```

```
      WRITE (2,614)
      BET=0.0
      DO 40   I=1,45
      POPY(I)=PO(I)/(PO(I)+PY(I)+AMC(I))
      POR(I)=PO(I)/(PO(I)+PY(I)+AMC(I)+AMG(I))
      PYR(I)=(PY(I)+AMC(I))/(PO(I)+PY(I)+AMC(I)+AMG(I))
      AGR(I)=AMG(I)/(PO(I)+PY(I)+AMC(I)+AMG(I))
      AGPY(I)=AMG(I)/(AMG(I)+PY(I)+AMC(I))
      BET=PO(I)+PN(I)
      IF(BET)200,205,200
  205 PNPO(I)=0.0
      GO TO 210
  200 PNPO(I)=PN(I)/BET
  210 CONTINUE
      WRITE(2,615) POPY(I),POR(I),PYR(I),AGR(I),PNPO(I),AGPY(I),NO(I)
   40 CONTINUE
      WRITE(2,400)
C
C     CU-PB-ZN MINERAL RATIO CALCULATIONS.
C
      WRITE (2,606)
      WRITE (2,613)
      WRITE (2,611)
      WRITE (2,616)
      DO 42  I=1,45
      DEN(I)=CP(I)+SL(I)+GN(I)
      CPR(I)=CP(I)/DEN(I)
      SLR(I)=SL(I)/DEN(I)
      GNR(I)=GN(I)/DEN(I)
      SULOX(I)=(PY(I)+AMC(I)+PO(I)+PN(I))/(PY(I)+AMC(I)+PO(I)+PN(I)+AMG(
     1I)+SP(I)+AHM(I))
      WRITE(2,105) CPR(I),SLR(I),GNR(I),SULOX(I),NO(I)
   42 CONTINUE
      WRITE(2,400)
      WRITE (2,800)
      WRITE (2,617)
      WRITE (2,611)
      WRITE (2,618)
      WRITE (2,619)
      DO 44  I=1,45
      SUM1=PO(I)+PY(I)+AMC(I)+CP(I)
      SUM2=PO(I)+AMG(I)+PY(I)+AMC(I)
      SUM3=SL(I)+CP(I)+GN(I)
      AX=100.0/SUM1
      BX=100.0/SUM2
      CX=100.0/SUM3
      XPO=PO(I)*AX
      XPY=(PY(I)+AMC(I))*AX
      XCP=CP(I)*AX
      YPO=PO(I)*BX
      YMG=AMG(I)*BX
      YPY=(PY(I)+AMC(I))*BX
      ZSL=SL(I)*CX
      ZCP=CP(I)*CX
      ZGN=GN(I)*CX
      WRITE (2,620) XPO,XPY,XCP,YPO,YMG,YPY,ZSL,ZCP,ZGN,NO(I)
```

```
44 CONTINUE
   WRITE(2,400)
C
C
C  100 WT. PCT. MINERAL GROUP CALCULATIONS (3).
C
C
   WRITE (2,800)
   WRITE (2,627)
   WRITE (2,611)
   WRITE (2,604)
   DO 75  I=1,45
   FACT=100.0/OPA(I)
   SUM=0.
   CSL=SL(I)*FACT
   CGN=GN(I)*FACT
   CCP=CP(I)*FACT
   CPY=PY(I)*FACT
   CMG=AMG(I)*FACT
   CPO=PO(I)*FACT
   CHM=AHM(I)*FACT
   CPN=PN(I)*FACT
   CAS=AS(I)*FACT
   CTT=TT(I)*FACT
   WRITE (2,605) CSL,CGN,CCP,CPY,CMG,CPO,CHM,CPN,CAS,CTT,NO(I)
75 CONTINUE
   WRITE (2,400)
C
C
C  100 WT. PCT. SULPHIDE MINERALOGY CALCULATIONS.
C
C
   WRITE (2,606)
   WRITE (2,627)
   WRITE (2,611)
   WRITE (2,607)
   DO 77  I=1,45
   FACT=100.0/OPA(I)
   CFR=FR(I)*FACT
   CSP=SP(I)*FACT
   CTB=TB(I)*FACT
   CLM=ALM(I)*FACT
   CCR=CR(I)*FACT
   CBO=BO(I)*FACT
   CCC=CC(I)*FACT
   CMC=AMC(I)*FACT
   CUK=UK(I)*FACT
   CTN=TN(I)*FACT
   WRITE (2,608) CFR,CSP,CTB,CLM,CCR,CBO,CCC,CMC,CUK,CTN,NO(I)
77 CONTINUE
   WRITE (2,400)
C
C  CU-PB-ZN AND CU-SL-NI 100 WT. PCT. MINERAL GROUP CALCULATIONS.
C
   WRITE (2,800)
   WRITE (2,410)
   WRITE (2,611)
   WRITE (2,411)
   WRITE (2,412)
   WRITE (2,413)
```

```
      DO 79   I=1,45
      BETA=CP(I)+BO(I)+CC(I)+TT(I)+TB(I)+TN(I)+FR(I)
      SIGM=BETA+SL(I)+GN(I)
      ABC=100.0/SIGM
      CUM1=BETA*ABC
      ZNM1=SL(I)*ABC
      PBM1=GN(I)*ABC
      CZN1=BETA+SL(I)+PN(I)
      DEF=100.0/CZN1
      ZNM2=SL(I)*DEF
      CUM2=BETA*DEF
      PNM2=PN(I)*DEF
      WRITE(2,414) CUM1,ZNM1,PBM1,CUM2,ZNM2,PNM2,NO(I)
   79 CONTINUE
      WRITE (2,400)
      WRITE (2,415)

      MINERAL RATIO CALCULATIONS - GROUP 2.

      WRITE (2,606)
      WRITE (2,613)
      WRITE (2,611)
      WRITE (2,416)
      DO 80   I=1,45
      BETA1=CP(I)+BO(I)+CC(I)+TT(I)+TB(I)+TN(I)+FR(I)
      CPR1=CP(I)/(CP(I)+SL(I))
      SLR1=SL(I)/(SL(I)+AMG(I))
      PYR1=(PY(I)+AMC(I))/(PY(I)+AMC(I)+SL(I)+GN(I))
      CUM3=BETA1/(BETA1+PY(I)+AMC(I))
      WRITE (2,417) CPR1,SLR1,PYR1,CUM3,NO(I)
   80 CONTINUE
      WRITE (2,400)
      WRITE (2,415)

      MAGNETIC ANOMALY CALCULATIONS

      WRITE (2,800)
      WRITE (2,107)
      WRITE (2,611)
      WRITE (2,108)
      WRITE (2,109)
      WRITE (2,110)
      TH=50.
      DO 82  I=1,45
      AK1=(AMG(I)*.50)+(PO(I)*.13)
      AI=(AK1*.60)/100.
      T1=50.
      T2=300.
      VMAX=200000.*AI*TH*((1./T1)-(1./T2))
      IV=VMAX
      T1=800.
      T2=1050.
      VMA2=200000.*AI*TH*((1./T1)-(1./T2))
      JV=VMA2
      R=(AMG(I)+PO(I))/(PO(I)+AMG(I)+PY(I)+AMC(I))
      WRITE (2,106) R,AK1,IV,JV,NO(I)
   82 CONTINUE
```

```
   NORMALIZING PY-PO SL

   WRITE (2,112)
   WRITE (2,113)
   WRITE (2,114)
   DO 84   I=1,45
   ZPY=0.
   ZPO=0.
   ZSL=0.
   S1=PY(I)+AMC(I)+PO(I)+SL(I)
   SS2=100./S1
   ZPY=(PY(I)+AMC(I))*SS2
   ZPO=PO(I)*SS2
   ZSL=SL(I)*SS2
   WRITE (2,115) ZPY,ZPO,ZSL,NO(I)
84 CONTINUE

   FORMAT  STATEMENTS

112 FORMAT(1H1,59H                             NORMALIZED PY-PO-SL  (WEIGHT PER
  1CENT)  )
113 FORMAT(1H0,59H                                           TOTAL  SAMPLE
   1       )
114 FORMAT(1H0,59H                           PY          PO          SL
   1   NO. )
115 FORMAT(1H ,15X,F8.2,5X,F8.2,5X,F8.2,7X,I3)

301 FORMAT(16F5.2/16F5.2/13F5.2)
 10 FORMAT(19F4.2,4X/4F4.2,61X,I2,I1)
105 FORMAT(1H ,F8.3,2F12.3,7X,F12.3,13X,I3)
106 FORMAT(1H ,6X,F5.3,8X,F4.1,8X,I5,3X,I5,8X,I3)
107 FORMAT(1H0,13X,34HCALCULATED SAMPLE MAGNETIC ANOMALY)
108 FORMAT(1H0,5X,50H MG-PO   SUSCEPTIBILITY    CALC. MAGNETIC      PR
  1.)
109 FORMAT(1H ,5X,50H RATIO       K (CALC.)     ANOMALY (GAMMAS)     NO
  1.)
110 FORMAT(1H ,5X,48H          (CGS UNITS)     GROUND     AIR         )
111 FORMAT(1H ,41X,8H(GAMMAS))
400 FORMAT(1H0,8X,23H+ SIGNIFIES A PLUS SIGN)
410 FORMAT(1H ,5X,44HCALCULATED 100 WEIGHT PERCENT MINERAL GROUPS)
411 FORMAT(1H0,5X,18HCALC. 100 WT. PCT.,13X,18HCALC. 100 WT. PCT.)
412 FORMAT(1H ,65H   CU       ZN (SL)   PB (GN)      CU       ZN (SL)
  1NI (PN)   NO.)
413 FORMAT(1H ,59HMINERALS  MINERALS  MINERALS   MINERALS  MINERALS  M
  1INERALS)
414 FORMAT(1H ,F7.2,2F10.2,F11.2,2F10.2,3X,I4)
415 FORMAT(1H ,7X,47HCU MINERALS = CP + BO + CC + TT + T-B + TN + FR)
416 FORMAT(1H0,65HCP/CP+SL  SL/SL+MG  PY/PY+SL+GN  CU MINERALS/CU MINE
  1RALS+PY   NO.)
417 FORMAT(1H ,F7.3,F10.3,F11.3,10X,F11.3,12X,I4)
603 FORMAT(1H ,51H          SULPHIDE-OPAQUE MINERALOGY(WEIGHT PERCENT))
604 FORMAT(1H0,65H  SL     GN     CP     PY     MG     PO     HM     PN     AS
  1    TT    NO.)
605 FORMAT(1H ,10F6.2,I4)
606 FORMAT(1H1,19X,22HTABLE       (CONTINUED))
```

TABLE 5 (CONTINUED)

```
607 FORMAT(1H0,65H   FR     SP    T-B     LM     CR     BO     CC     MC     UK
   1     TN     NO.)
608 FORMAT(1H ,10F6.2,I4)
609 FORMAT(1H0,25X,40HGAN              SUL           OPA            NO.)
610 FORMAT (1H ,24X,F6.2,6X,F6.2,6X,F6.2,6X,I4)
611 FORMAT(1H ,33H                +400 MESH FRACTION)
613 FORMAT(1H ,4X,42HSULPHIDE-OPAQUE MINERAL RATIO CALCULATIONS)
614 FORMAT(1H0,66HPO/PO+PY PO/PO+PY+MG PY/PO+PY+MG MG/PO+PY+MG PN/PN+P
   10 MG/MG+PY NO.)
615 FORMAT(1H ,F7.3,6X,F5.3,7X,F5.3,7X,F5.3,5X,F5.3,4X,F5.3,I4)
616 FORMAT(1H0,67HCP/CP+SL+GN SL/CP+SL+GN GN/CP+SL+GN FE SULP/FE SULP
   1+ FE OXID   NO.)
617 FORMAT(1H ,5X,44HCALCULATED 100 WEIGHT PERCENT MINERAL GROUPS)
618 FORMAT(1H0,54H  CALC 100 PCT          CALC 100 PCT          CALC 100 P
   1CT)
619 FORMAT(1H ,65H  PO     PY     CP        PO     MG     PY        SL     CP
   1  GN       NO.)
620 FORMAT(1H ,3F6.2,2X,3F6.2,2X,3F6.2,4X,I2)
627 FORMAT(1H ,5X,56HCALCULATED 100 WEIGHT PERCENT SULPHIDE-OPAQUE MIN
   1ERALOGY)
800 FORMAT(1H1,26X,5HTABLE)
    CALL EXIT
    END
```

TABLE 6

DISK OPERATING SYSTEM/360 FORTRAN 360N-FO-451 21

```
      CALCULATED 100 WEIGHT AND ATOMIC PERCENT PROGRAM.
      NORMALIZING CU-ZN-PB ASSAY VALUES.

      DIMENSION ANI(45),CO(45),CU(45),ZN(45),PB(45),FE(45),AU(45),AG(45)
     1,S(45),NO(45)

       READ IN DATA

      DO 20  I=1,45
      READ (1,10) ANI(I),CO(I),CU(I),ZN(I),PB(I),FE(I),AU(I),AG(I),S(I),
     1NO(I)
   20 CONTINUE

      WEIGHT PERCENT CALCULATIONS, NORMALIZING.

   25 WRITE (2,1000)
      WRITE (2,1004)
      WRITE (2,13)
      WRITE (2,1001)
      WRITE (2,1002)
      WRITE (2,1005)
      DO 30     I=1,45
      FIDO=100.0/(CU(I)+ZN(I)+PB(I))
      ACU=CU(I)*FIDO
      BZN=ZN(I)*FIDO
      CPB=PB(I)*FIDO
      SUM=ACU+BZN+CPB
      AUAG=AU(I)/(AU(I)+AG(I))
      FES =FE(I)/(FE(I)+S(I))
      WRITE(2,15) NO(I),ACU,BZN,CPB,SUM,AUAG,FES
   30 CONTINUE
      WRITE (2,14)

      ATOMIC PERCENT CALCULATIONS. NORMALIZING.

      WRITE (2,1000)
      WRITE (2,1006)
      WRITE (2,13)
      WRITE (2,1001)
      WRITE (2,1002)
      WRITE (2,1005)

      READ IN ATOMIC WEIGHTS.

      XCU=63.54
      XZN=65.38
      XPB=207.21

      SUMX=XCU+XZN+XPB
      ALPHA=XCU/SUMX
      BETA =XZN/SUMX
      GAMMA=XPB/SUMX
      DO 40     I=1,45
```

```
      A=CU(I)*ALPHA
      B=ZN(I)*BETA
      C=PB(I)*GAMMA
      SUMAT=A+B+C
      ATCU=100.0*(A/SUMAT)
      ATZN=100.0*(B/SUMAT)
      ATPB=100.0*(C/SUMAT)
      SUM1=ATCU+ATZN+ATPB
      AUAG=AU(I)/(AU(I)+AG(I))
      FES =FE(I)/(FE(I)+S(I))
      WRITE(2,15) NO(I),ATCU,ATZN,ATPB,SUM1,AUAG,FES
   40 CONTINUE
      WRITE (2,14)
C
C                        FORMATS
C
   10 FORMAT(9F7.4,10X,I2)
   13 FORMAT(1H ,18X,18H+400 MESH FRACTION)
   14 FORMAT(1H0,18X,23H+ SIGNIFIES A PLUS SIGN)
   15 FORMAT(1H ,8X,I2,2X,3F8.3,F10.3,2F9.3)
 1000 FORMAT(1H1,26X,5HTABLE)
 1001 FORMAT(1H0,7X,55HPROP.     CU       ZN       PB       TOTAL      AU/
     1   FE/)
 1002 FORMAT(1H ,8X,3HNO.,37X,15HAU+AG     FE+ S   )
 1004 FORMAT(1H0,11X,39HCALCULATED 100 WEIGHT PERCENT  CU-PB-ZN)
 1005 FORMAT(1H )
 1006 FORMAT(1H0,11X,39HCALCULATED 100 ATOMIC PERCENT  CU-PB-ZN)
      CALL EXIT
      END
```

TABLE 7

DISK OPERATING SYSTEM/360 FORTRAN 360N-FO-451 21

SILICATE MINERALOGY AND GROUPING PROGRAM.

```
 DIMENSION CAL(45),QTZ(45),CHL(45),AMP(45),HB1(45),HB2(45),TRE(45),
1ACT(45),AUG(45),URA(45),EPI(45),BIO(45),GAR(45),FEL(45),PYR(45),DI
2O(45),HYP(45),UWR(45),SID(45),APA(45),ZOI(45),AMU(45),SER(45),OLI(
345),BAR(45),FLU(45),CHD(45),SLL(45),WRP(45),GYP(45),OCB(45),ZEO(45
4),QFM(45),SRP(45),SUL(45),APL(45),SM(45),FWR(45),FQP(45),PLA(45),C
5CS(45),SWR(45),SCWR(45),SCTWR(45),STWR(45),SAWR(45),CWR(45)
 DIMENSION CSCWR(45),CSWR(45),CBWR(45),PWR(45),HWR(45),SSWR(45),SLW
1R(45),BASWR(45),ABWR(45),AWR(45),BMS(45),GMS(45),SAF(45),SPL(45),S
2SAF(45),SSPL(45),SBAF(45),SFWR(45),WOL(45),NO(45)

 READ IN DATA

 DO 25  I=1,45
 READ(1,12) CAL(I),QTZ(I),CHL(I),AMP(I),HB1(I),HB2(I),TRE(I),ACT(I)
1,AUG(I),URA(I),EPI(I),BIO(I),GAR(I),FEL(I),PYR(I),DIO(I),HYP(I),UW
2R(I),SID(I),APA(I),ZOI(I),AMU(I),SER(I),OLI(I),BAR(I),FLU(I),CHD(I
3),SLL(I),WRP(I),GYP(I),OCB(I),ZEO(I),QFM(I),SRP(I),SUL(I),APL(I),S
4M(I),FWR(I)
 READ(1,13) FQP(I),PLA(I),CCS(I),SWR(I),SCWR(I),SCTWR(I),STWR(I),SA
1WR(I),CWR(I),CSCWR(I),CSWR(I),CBWR(I),PWR(I),HWR(I),SSWR(I),SLWR(I
2),BASWR(I),ABWR(I),AWR(I),BMS(I),GMS(I),SAF(I),SPL(I),SSAF(I),SSPL
3(I),SBAF(I),SFWR(I),WOL(I),NO(I)
25 CONTINUE

 SILICATE MINERAL TABLING.

 WRITE (2,800)
 WRITE (2,801)
 WRITE (2,802)
 WRITE (2,803)
 DO 30   I=1,45
 WRITE (2,804) CAL(I),QTZ(I),CHL(I),AMP(I),HB1(I),HB2(I),TRE(I),ACT
1(I),AUG(I),NO(I)
30 CONTINUE
 WRITE (2,400)
 WRITE (2,275)
 WRITE (2,805)
 WRITE (2,801)
 WRITE (2,802)
 WRITE (2,806)
 DO 35  I=1,45
 WRITE (2,804) URA(I),EPI(I),BIO(I),GAR(I),FEL(I),PYR(I),DIO(I),HYP
1(I),UWR(I),NO(I)
35 CONTINUE
 WRITE (2,400)
 WRITE (2,275)
 WRITE (2,805)
 WRITE (2,801)
 WRITE (2,802)
 WRITE (2,807)
 DO 40  I=1,45
```

```
      WRITE (2,804) SID(I),APA(I),ZOI(I),AMU(I),SER(I),OLI(I),BAR(I),FLU
     1(I),CHD(I),NO(I)
   40 CONTINUE
      WRITE (2,400)
      WRITE (2,275)
      WRITE (2,805)
      WRITE (2,801)
      WRITE (2,802)
      WRITE (2,808)
      DO 45   I=1,45
      WRITE (2,804) SLL(I),WRP(I),GYP(I),OCB(I),ZEO(I),QFM(I),SRP(I),APL
     1(I),FQP(I),NO(I)
   45 CONTINUE
      WRITE (2,400)
      WRITE (2,275)
      WRITE (2,805)
      WRITE (2,801)
      WRITE (2,802)
      WRITE (2,809)
      DO 50   I=1,45
      WRITE (2,804) PLA(I),CCS(I),SWR(I),SCWR(I),SCTWR(I),STWR(I),SAWR(I
     1),CWR(I),CSCWR(I),NO(I)
   50 CONTINUE
      WRITE (2,400)
      WRITE (2,275)
      WRITE (2,805)
      WRITE (2,801)
      WRITE (2,802)
      WRITE (2,810)
      DO 55   I=1,45
      WRITE (2,804) CSWR(I),CBWR(I),PWR(I),HWR(I),SSWR(I),BASWR(I),ABWR(
     1I),AWR(I),BMS(I),NO(I)
   55 CONTINUE
      WRITE (2,400)
      WRITE (2,275)
      WRITE (2,805)
      WRITE (2,801)
      WRITE (2,802)
      WRITE (2,811)
      DO 60  I=1,45
      WRITE (2,812) GMS(I),SAF(I),SPL(I),SSPL(I),SBAF(I),SFWR(I),WOL(I),
     1NO(I)
   60 CONTINUE
      WRITE (2,400)
      WRITE (2,275)
C
C     SILICATE MINERAL GROUPING.
C
      WRITE (2,800)
      WRITE (2,302)
      WRITE (2,802)
      WRITE (2,303)
      DO 70  I=1,45
      CARBON =CAL(I)+CBWR(I)+OCB(I)+SID(I)
      SILICN=QTZ(I)+SLWR(I)
```

```
      CHLION=CHL(I)+CHD(I)+CWR(I)+CSCWR(I)+CSWR(I)
      AMPHIB=AMP(I)+HB1(I)+HB2(I)+TRE(I)+ACT(I)+HWR(I)
      PYROXE=PYR(I)+DIO(I)+HYP(I)+URA(I)+AUG(I)
      SAUSSN=SSWR(I)+SSPL(I)+SSAF(I)
      SERICN=SER(I)+SWR(I)+SCWR(I)+SCTWR(I)+STWR(I)+SAWR(I)+SPL(I)+SAF(I
     1)+SBAF(I)+SFWR(I)
      SUM=CARBON +SILICN+CHLION+AMPHIB+PYROXE+SAUSSN+SERICN
      WRITE (2,300) CARBON ,SILICN,CHLION,AMPHIB,PYROXE,SAUSSN,SERICN,
     1SUM,NO(I)
   70 CONTINUE
      WRITE (2,400)

      FORMATS                      FORMATS

   12 FORMAT(19F4.2,4X/19F4.2,4X)
   13 FORMAT(19F4.2,4X/9F4.2,41X,I2)
  275 FORMAT(1H , 7X,25HWALL ROCKS SHOWN IN TABLE)
  300 FORMAT(1H ,F6.2,5F7.2,F8.2,F7.2,6X,I3)
  302 FORMAT(1H0,10X,39HGANGUE  MINERAL  GROUPS(WEIGHT PERCENT))
  303 FORMAT(1H0,65HCARB-N SILIC-N CHL-N AMPHIB  PYROX SAUSS-N SERIC-N
     1SUM       NO.)
  400 FORMAT(1H0,8X,23H+ SIGNIFIES A PLUS SIGN)
  801 FORMAT(1H ,47H            SILICATE  MINERALOGY (WEIGHT PERCENT))
  805 FORMAT(1H1,19X,22HTABLE        (CONTINUED))
  800 FORMAT(1H1,26X,5HTABLE)
  802 FORMAT(1H ,30H             +400 MESH FRACTION)
  804 FORMAT(1H ,9F6.2,8X,I3)
  812 FORMAT(1H ,6X,7F6.2,14X,I3)
      CALL EXIT
      END
```

APPENDIX 7

X-Ray Diffractometer Regression Analyses Data

LIST OF TABLES

LIST OF FIGURES

TABLE 1

SINGLE AND MULTIPLE LINEAR REGRESSION ANALYSIS
PRODUCTION STANDARDS DATA

MINERAL = PYRITE

NUMBER OF INDEPENDENT VARIABLES = 1

NUMBER OF DATA POINTS = 139

Y AXIS = MINERAL PCT., X AXIS = INT. RATIO

PARTIAL REGRESSION COEFFICIENTS

J	B(J)
0	0.11347198E 01
1	0.12355430E 02

MULTIPLE CORRELATION COEFFICIENT	=	0.97884780E 00
STANDARD ERROR OF THE Y DATA	=	0.24737686E 02
STANDARD ERROR OF THE ESTIMATE	=	0.50795126E 01
SIGNIFICANCE OF REGRESSION (F)	=	0.31360564E 04

EQUATION OF THE LINE OF REGRESSION

$$Y = 1.1347 + 12.3554 X$$

TABLE 2

PRODUCTION STANDARDS REGRESSION DATA
MINERAL - PYRITE
(X-RAY DIFFRACTOMETER INTENSITY RATIOS)

STD NO	MINERAL PCT	INTENSITY RATIO	STD NO	MINERAL PCT	INTENSITY RATIO
1	0.0	0.027	1	0.0	0.038
1	0.0	0.026	1	0.0	0.029
1	0.0	0.048	1	0.0	0.034
1	0.0	0.027	1	0.0	0.041
1	0.0	0.032	2	2.07	0.179
2	2.07	0.162	2	2.07	0.190
2	2.07	0.208	2	2.07	0.196
2	2.07	0.212	2	2.07	0.184
2	2.07	0.150	2	2.07	0.212
2	2.07	0.206	2	2.07	0.135
3	5.30	0.465	3	5.30	0.517
3	5.30	0.406	3	5.30	0.476
3	5.30	0.436	3	5.30	0.372
3	5.30	0.370	3	5.30	0.342
3	5.30	0.366	4	10.52	0.847
4	10.52	0.972	4	10.52	0.805
4	10.52	0.962	4	10.52	0.919
4	10.52	0.894	4	10.52	0.729
4	10.52	0.774	4	10.52	0.785
5	15.81	1.341	5	15.81	1.236
5	15.81	1.373	5	15.81	1.292
5	15.81	1.408	5	15.81	1.185
5	15.81	1.343	5	15.81	1.312
5	15.81	1.528	5	15.81	1.381
5	15.81	1.267	5	15.81	1.337
6	21.04	1.754	6	21.04	1.779
6	21.04	1.470	6	21.04	1.428
6	21.04	1.645	6	21.04	1.874
6	21.04	1.619	6	21.04	1.773
6	21.04	2.412	7	26.33	2.117
7	26.33	2.038	7	26.33	1.975
7	26.33	2.322	7	26.33	2.100
7	26.33	2.137	7	26.33	2.258
7	26.33	2.058	7	26.33	2.018
7	26.33	2.164	7	26.33	1.947
8	36.84	3.140	8	36.84	2.793
8	36.84	3.093	8	36.84	3.514
8	36.84	2.968	8	36.84	3.315
8	36.84	2.716	8	36.84	3.234
8	36.84	3.432	8	36.84	3.152
8	36.84	3.306	8	36.84	2.811
8	36.84	2.486	8	36.84	2.847
8	36.84	2.368	8	36.84	2.363
8	36.84	2.817	8	36.84	2.349
8	36.84	2.298	8	36.84	2.582
8	36.84	2.303	8	36.84	2.606

TABLE 2 (CONTINUED)

PRODUCTION STANDARDS REGRESSION DATA
MINERAL - PYRITE
(X-RAY DIFFRACTOMETER INTENSITY RATIOS)

STD NO	MINERAL PCT	INTENSITY RATIO	STD NO	MINERAL PCT	INTENSITY RATIO
9	50.00	4.818	9	50.00	3.278
9	50.00	3.211	9	50.00	3.443
9	50.00	3.827	9	50.00	3.931
9	50.00	3.701	9	50.00	4.234
9	50.00	2.798	9	50.00	2.725
9	50.00	2.484	10	57.89	4.325
10	57.89	3.857	10	57.89	4.739
10	57.89	4.671	10	57.89	4.299
10	57.89	3.857	10	57.89	4.924
10	57.89	4.609	10	57.89	4.667
10	57.89	4.337	10	57.89	5.436
10	57.89	5.474	10	57.89	5.024
10	57.89	5.024	10	57.89	5.169
11	65.00	4.507	11	65.00	4.352
11	65.00	4.117	11	65.00	4.493
11	65.00	5.074	11	65.00	5.255
11	65.00	4.247	11	65.00	4.292
11	65.00	5.440	12	78.95	6.235
12	78.95	6.870	12	78.95	7.000
12	78.95	5.697	12	78.95	6.908
12	78.95	6.104	12	78.95	6.035
12	78.95	6.179	12	78.95	5.973
12	78.95	7.137	12	78.95	6.342
12	78.95	6.868			

TABLE 3

SINGLE AND MULTIPLE LINEAR REGRESSION ANALYSIS
PRODUCTION STANDARDS DATA

MINERAL = MAGNETITE

NUMBER OF INDEPENDENT VARIABLES = 1

NUMBER OF DATA POINTS = 59

Y AXIS = MINERAL PCT., X AXIS = INT. RATIO

PARTIAL REGRESSION COEFFICIENTS

J	B(J)
0	-0.44658279E 00
1	0.18738144E 02

MULTIPLE CORRELATION COEFFICIENT	=	0.93271542E 00
STANDARD ERROR OF THE Y DATA	=	0.35913544E 01
STANDARD ERROR OF THE ESTIMATE	=	0.13064003E 01
SIGNIFICANCE OF REGRESSION (F)	=	0.38132031E 03

EQUATION OF THE LINE OF REGRESSION

Y = -0.4466 + 18.7381 X

TABLE 4

PRODUCTION STANDARDS REGRESSION DATA
MINERAL - MAGNETITE
(X-RAY DIFFRACTOMETER INTENSITY RATIOS)

STD NO	MINERAL PCT	INTENSITY RATIO	STD NO	MINERAL PCT	INTENSITY RATIO
1	0.0	0.097	1	0.0	0.099
1	0.0	0.131	1	0.0	0.130
1	0.0	0.069	1	0.0	0.059
1	0.0	0.089	1	0.0	0.097
1	0.0	0.098	2	2.14	0.141
2	2.14	0.137	2	2.14	0.150
2	2.14	0.152	2	2.14	0.147
2	2.14	0.138	2	2.14	0.134
2	2.14	0.158	2	2.14	0.167
2	2.14	0.129	2	2.14	0.112
2	4.21	0.234	3	4.21	0.192
3	4.21	0.220	3	4.21	0.239
3	4.21	0.328	3	4.21	0.249
3	4.21	0.223	3	4.21	0.243
3	4.21	0.285	4	6.38	0.348
4	6.38	0.328	4	6.38	0.324
4	6.38	0.442	4	6.38	0.357
4	6.38	0.366	4	6.38	0.316
4	6.38	0.296	4	6.38	0.330
5	8.45	0.411	5	8.45	0.457
5	8.45	0.365	5	8.45	0.365
5	8.45	0.381	5	8.45	0.518
5	8.45	0.401	5	8.45	0.455
5	8.45	0.519	5	8.45	0.353
5	8.45	0.368	5	8.45	0.513
6	10.52	0.731	6	10.52	0.724
6	10.52	0.434	6	10.52	0.577
6	10.52	0.535	6	10.52	0.613
6	10.52	0.439	6	10.52	0.547
6	10.52	0.753			

TABLE 5

SINGLE AND MULTIPLE LINEAR REGRESSION ANALYSIS
PRODUCTION STANDARDS DATA

MINERAL = PYRRHOTITE

NUMBER OF INDEPENDENT VARIABLES = 1

NUMBER OF DATA POINTS = 81

Y AXIS = MINERAL PCT., X AXIS = INT. RATIO

PARTIAL REGRESSION COEFFICIENTS

J	B(J)
0	-0.17400265E 00
1	0.25680161E 02

MULTIPLE CORRELATION COEFFICIENT	=	0.98247784E 00
STANDARD ERROR OF THE Y DATA	=	0.12176531E 02
STANDARD ERROR OF THE ESTIMATE	=	0.22837715E 01
SIGNIFICANCE OF REGRESSION (F)	=	0.21952151E 04

EQUATION OF THE LINE OF REGRESSION

$$Y = -0.1740 + 25.6802\ X$$

TABLE 6

PRODUCTION STANDARDS REGRESSION DATA
MINERAL - PYRRHOTITE
(X-RAY DIFFRACTOMETER INTENSITY RATIOS)

STD NO	MINERAL PCT	INTENSITY RATIO	STD NO	MINERAL PCT	INTENSITY RATIO
1	0.0	0.013	1	0.0	0.029
1	0.0	0.027	1	0.0	0.024
1	0.0	0.014	1	0.0	0.015
1	0.0	0.032	1	0.0	0.015
1	0.0	0.037	2	2.14	0.116
2	2.14	0.118	2	2.14	0.103
2	2.14	0.091	2	2.14	0.111
2	2.14	0.114	2	2.14	0.112
2	2.14	0.134	2	2.14	0.132
2	2.14	0.116	2	2.14	0.127
3	5.26	0.243	3	5.26	0.294
3	5.26	0.191	3	5.26	0.246
3	5.26	0.188	3	5.26	0.272
3	5.26	0.162	3	5.26	0.205
3	5.26	0.211	4	10.52	0.413
4	10.52	0.491	4	10.52	0.391
4	10.52	0.354	4	10.52	0.478
4	10.52	0.444	4	10.52	0.430
4	10.52	0.306	4	10.52	0.381
5	15.74	0.587	5	15.74	0.646
5	15.74	0.594	5	15.74	0.680
5	15.74	0.561	5	15.74	0.714
5	15.74	0.675	5	15.74	0.636
5	15.74	0.488	5	15.74	0.707
5	15.74	0.552	5	15.74	0.614
6	21.07	1.000	6	21.07	0.906
6	21.07	0.776	6	21.07	0.649
6	21.07	0.810	6	21.07	0.864
6	21.07	0.673	6	21.07	0.760
6	21.07	0.976	7	26.30	1.181
7	26.30	1.255	7	26.30	1.115
7	26.30	1.107	7	26.30	0.960
7	26.30	0.909	7	26.30	0.962
7	26.30	1.094	7	26.30	0.874
7	26.30	0.854	7	26.30	0.952
8	36.84	1.357	8	36.84	1.627
8	36.84	1.477	8	36.84	1.413
8	36.84	1.400	8	36.84	1.320
8	36.84	1.202	8	36.84	1.549
8	36.84	1.152	8	36.84	1.515
8	36.84	1.458			

TABLE 7

SINGLE AND MULTIPLE LINEAR REGRESSION ANALYSIS
COUNTED STANDARDS DATA

MINERAL = PYRITE

NUMBER OF INDEPENDENT VARIABLES = 1
NUMBER OF DATA POINTS = 146

Y AXIS = MINERAL PCT., X AXIS = INT. RATIO

PARTIAL REGRESSION COEFFICIENTS

J	B(J)
0	0.24654541E 01
1	0.11804880E 02

MULTIPLE CORRELATION COEFFICIENT = 0.931615650E 00
STANDARD ERROR OF THE Y DATA = 0.20212769E 02
STANDARD ERROR OF THE ESTIMATE = 0.73716955E 01
SIGNIFICANCE OF REGRESSION (F) = 0.94614795E 03

EQUATION OF THE LINE OF REGRESSION
Y = 2.4654 + 11.8049 X

TABLE 8

COUNTED STANDARDS REGRESSION DATA
MINERAL - PYRITE
(X-RAY DIFFRACTOMETER INTENSITY RATIOS)

STD NO	MINERAL PCT	INTENSITY RATIO	STD NO	MINERAL PCT	INTENSITY RATIO
9	0.24	0.093	9	0.24	0.148
9	0.24	0.051	9	0.24	0.083
9	0.24	0.098	9	0.24	0.095
9	0.24	0.092	9	0.24	0.063
9	0.24	0.163	6	0.59	0.561
6	0.59	0.500	6	0.59	0.607
6	0.59	0.644	6	0.59	0.681
6	0.59	0.565	6	0.59	0.694
6	0.59	0.381	6	0.59	0.600
7	1.97	0.158	7	1.97	0.175
7	1.97	0.231	7	1.97	0.164
7	1.97	0.163	7	1.97	0.131
7	1.97	0.182	7	1.97	0.233
7	1.97	0.208	39	2.71	0.178
39	2.71	0.192	39	2.71	0.152
39	2.71	0.276	39	2.71	0.175
39	2.71	0.124	39	2.71	0.245
39	2.71	0.179	39	2.71	0.218
32	6.03	0.509	32	6.03	0.392
32	6.03	0.338	32	6.03	0.422
32	6.03	0.640	32	6.03	0.458
32	6.03	0.741	32	6.03	0.760
32	6.03	1.000	32	6.03	0.677
22	7.75	0.901	22	7.75	0.701
22	7.75	0.722	22	7.75	0.778
22	7.75	0.893	22	7.75	0.735
22	7.75	0.580	22	7.75	0.567
22	7.75	0.702	4	11.85	0.726
4	11.85	0.570	4	11.85	0.580
4	11.85	0.774	4	11.85	0.417
4	11.85	0.606	4	11.85	0.519
4	11.85	0.330	4	11.85	0.432
4	11.85	0.411	31	12.55	0.512
31	12.55	0.441	31	12.55	0.524
31	12.55	0.480	31	12.55	0.537
31	12.55	0.515	31	12.55	0.484
31	12.55	0.540	31	12.55	0.540
30	14.68	1.557	30	14.68	1.247
30	14.68	1.269	30	14.68	1.273
30	14.68	1.191	30	14.68	1.309
30	14.68	0.962	30	14.68	0.936
30	14.68	1.587	24	24.76	3.406
24	24.76	3.225	24	24.76	3.065
24	24.76	2.066	24	24.76	2.609
24	24.76	2.562	24	24.76	1.982
24	24.76	1.897	24	24.76	1.859

TABLE 8 (CONTINUED)

COUNTED STANDARDS REGRESSION DATA
MINERAL - PYRITE
(X-RAY DIFFRACTOMETER INTENSITY RATIOS)

STD NO	MINERAL PCT	INTENSITY RATIO	STD NO	MINERAL PCT	INTENSITY RATIO
20	31.56	2.514	20	31.56	2.642
20	31.56	2.800	20	31.56	2.378
20	31.56	3.049	20	31.56	3.159
20	31.56	2.035	20	31.56	2.290
20	31.56	2.100	2	32.93	1.946
2	32.93	2.181	2	32.93	1.720
2	32.93	2.654	2	32.93	2.364
2	32.93	2.468	2	32.93	2.200
2	32.93	2.020	2	32.93	2.383
2	32.93	1.847	21	39.00	2.465
21	39.00	2.768	21	39.00	3.061
21	39.00	2.867	21	39.00	3.405
21	39.00	2.960	21	39.00	2.901
21	39.00	3.272	21	39.00	3.078
1	41.96	2.093	1	41.96	2.133
1	41.96	2.153	1	41.96	1.896
1	41.96	1.830	1	41.96	1.846
1	41.96	2.219	1	41.96	1.776
1	41.96	1.929	23	55.89	3.720
23	55.89	4.225	23	55.89	3.779
23	55.89	3.390	23	55.89	3.190
23	55.89	3.311	23	55.89	4.062
23	55.89	3.881	23	55.89	3.380
3	70.22	6.333	3	70.22	6.104
3	70.22	6.283	3	70.22	5.194
3	70.22	5.564	3	70.22	5.106
3	70.22	7.785	3	70.22	7.610

TABLE 9

SINGLE AND MULTIPLE LINEAR REGRESSION ANALYSIS
COUNTED STANDARDS DATA

MINERAL = MAGNETITE

NUMBER OF INDEPENDENT VARIABLES = 1
NUMBER OF DATA POINTS = 90

Y AXIS = MINERAL PCT., X AXIS = INT. RATIO

PARTIAL REGRESSION COEFFICIENTS

J	B(J)
0	-0.43510437E 00
1	0.16337143E 02

MULTIPLE CORRELATION COEFFICIENT	=	0.96651655E 00
STANDARD ERROR OF THE Y DATA	=	0.66645098E 01
STANDARD ERROR OF THE ESTIMATE	=	0.17198305E 01
SIGNIFICANCE OF REGRESSION (F)	=	0.12484573E 04

EQUATION OF THE LINE OF REGRESSION
Y =-0.4351 + 16.3371 X

TABLE 10

COUNTED STANDARDS REGRESSION DATA
MINERAL - MAGNETITE
(X-RAY DIFFRACTOMETER INTENSITY RATIOS)

STD NO	MINERAL PCT	INTENSITY RATIO	STD NO	MINERAL PCT	INTENSITY RATIO
1	0.0	0.097	1	0.0	0.056
1	0.0	0.131	1	0.0	0.075
1	0.0	0.073	1	0.0	0.112
1	0.0	0.061	1	0.0	0.071
1	0.0	0.075	30	0.07	0.075
30	0.07	0.069	30	0.07	0.119
30	0.07	0.091	30	0.07	0.106
30	0.07	0.117	30	0.07	0.100
30	0.07	0.123	30	0.07	0.090
32	0.48	0.090	32	0.48	0.115
32	0.48	0.096	32	0.48	0.128
32	0.48	0.095	32	0.48	0.131
4	0.63	0.139	4	0.63	0.123
4	0.63	0.160	4	0.63	0.204
4	0.63	0.150	4	0.63	0.197
4	0.63	0.184	4	0.63	0.137
4	0.63	0.158	4	0.63	0.191
21	2.06	0.125	21	2.06	0.189
21	2.06	0.205	21	2.06	0.129
21	2.06	0.151	21	2.06	0.158
21	2.06	0.129	21	2.06	0.188
21	2.06	0.114	23	3.47	0.339
23	3.47	0.304	23	3.47	0.277
23	3.47	0.273	23	3.47	0.275
24	3.72	0.231	24	3.72	0.236
24	3.72	0.255	24	3.72	0.315
24	3.72	0.220	2	6.03	0.212
2	6.03	0.270	2	6.03	0.243
2	6.03	0.212	2	6.03	0.278
2	6.03	0.277	2	6.03	0.316
2	6.03	0.228	2	6.03	0.290
2	6.03	0.241	7	8.88	0.500
7	8.88	0.509	7	8.88	0.523
7	8.88	0.676	7	8.88	0.687
7	8.88	0.648	7	8.88	0.535
7	8.88	0.544	7	8.88	0.463
22	10.55	0.524	22	10.55	0.516
22	10.55	0.557	22	10.55	0.530
22	10.55	0.476	22	10.55	0.434
22	10.55	0.394	22	10.55	0.567
22	10.55	0.404	6	22.33	1.402
6	22.33	1.214	6	22.33	1.397
6	22.33	1.628	6	22.33	1.449
6	22.33	1.560	6	22.33	1.441
6	22.33	1.524	6	22.33	1.308

TABLE 11

SINGLE AND MULTIPLE LINEAR REGRESSION ANALYSIS
COUNTED STANDARDS DATA

MINERAL = PYRRHOTITE

NUMBER OF INDEPENDENT VARIABLES = 1
NUMBER OF DATA POINTS = 92

Y AXIS = MINERAL PCT., X AXIS = INT. RATIO

PARTIAL REGRESSION COEFFICIENTS

J	B(J)
0	-0.38514996E 00
1	0.30832794E 02

MULTIPLE CORRELATION COEFFICIENT	=	0.97828740E 00
STANDARD ERROR OF THE Y DATA	=	0.12642031E 02
STANDARD ERROR OF THE ESTIMATE	=	0.26346130E 01
SIGNIFICANCE OF REGRESSION (F)	=	0.20052761E 04

EQUATION OF THE LINE OF REGRESSION

Y =-0.3851 + 30.8328 X

TABLE 12

COUNTED STANDARDS REGRESSION DATA
MINERAL - PYRRHOTITE
(X-RAY DIFFRACTOMETER INTENSITY RATIOS)

STD NO	MINERAL PCT	INTENSITY RATIO	STD NO	MINERAL PCT	INTENSITY RATIO
31	0.03	0.064	31	0.03	0.029
31	0.03	0.018	31	0.03	0.041
31	0.03	0.036	31	0.03	0.020
31	0.03	0.015	31	0.03	0.046
31	0.03	0.047	2	0.11	0.081
2	0.11	0.074	2	0.11	0.161
2	0.11	0.179	2	0.11	0.084
2	0.11	0.101	2	0.11	0.124
2	0.11	0.084	2	0.11	0.109
2	0.11	0.130	22	0.24	0.105
22	0.24	0.059	22	0.24	0.082
22	0.24	0.048	22	0.24	0.032
22	0.24	0.026	22	0.24	0.061
22	0.24	0.048	22	0.24	0.041
21	1.74	0.092	21	1.74	0.075
21	1.74	0.092	21	1.74	0.088
21	1.74	0.077	21	1.74	0.119
21	1.74	0.087	21	1.74	0.117
21	1.74	0.055	1	4.41	0.086
1	4.41	0.091	1	4.41	0.106
1	4.41	0.133	1	4.41	0.166
1	4.41	0.134	1	4.41	0.129
1	4.41	0.075	1	4.41	0.138
24	9.59	0.444	24	9.59	0.298
24	9.59	0.411	24	9.59	0.429
24	9.59	0.411	24	9.59	0.404
24	9.59	0.244	24	9.59	0.249
24	9.59	0.252	7	13.57	0.321
7	13.57	0.321	7	13.57	0.300
7	13.57	0.378	7	13.57	0.451
7	13.57	0.428	7	13.57	0.302
7	13.57	0.296	7	13.57	0.463
9	14.01	0.381	9	14.01	0.322
9	14.01	0.380	9	14.01	0.388
9	14.01	0.488	9	14.01	0.500
9	14.01	0.433	9	14.01	0.395
9	14.01	0.370	32	29.64	1.049
32	29.64	0.799	32	29.64	0.967
32	29.64	0.764	32	29.64	0.926
32	29.64	0.938	32	29.64	0.895
32	29.64	0.880	32	29.64	1.060
32	29.64	0.908	20	37.75	1.216
20	37.75	1.460	20	37.75	1.500
20	37.75	1.095	20	37.75	1.301
20	37.75	1.289	20	37.75	1.139
20	37.75	1.252	20	37.75	1.239

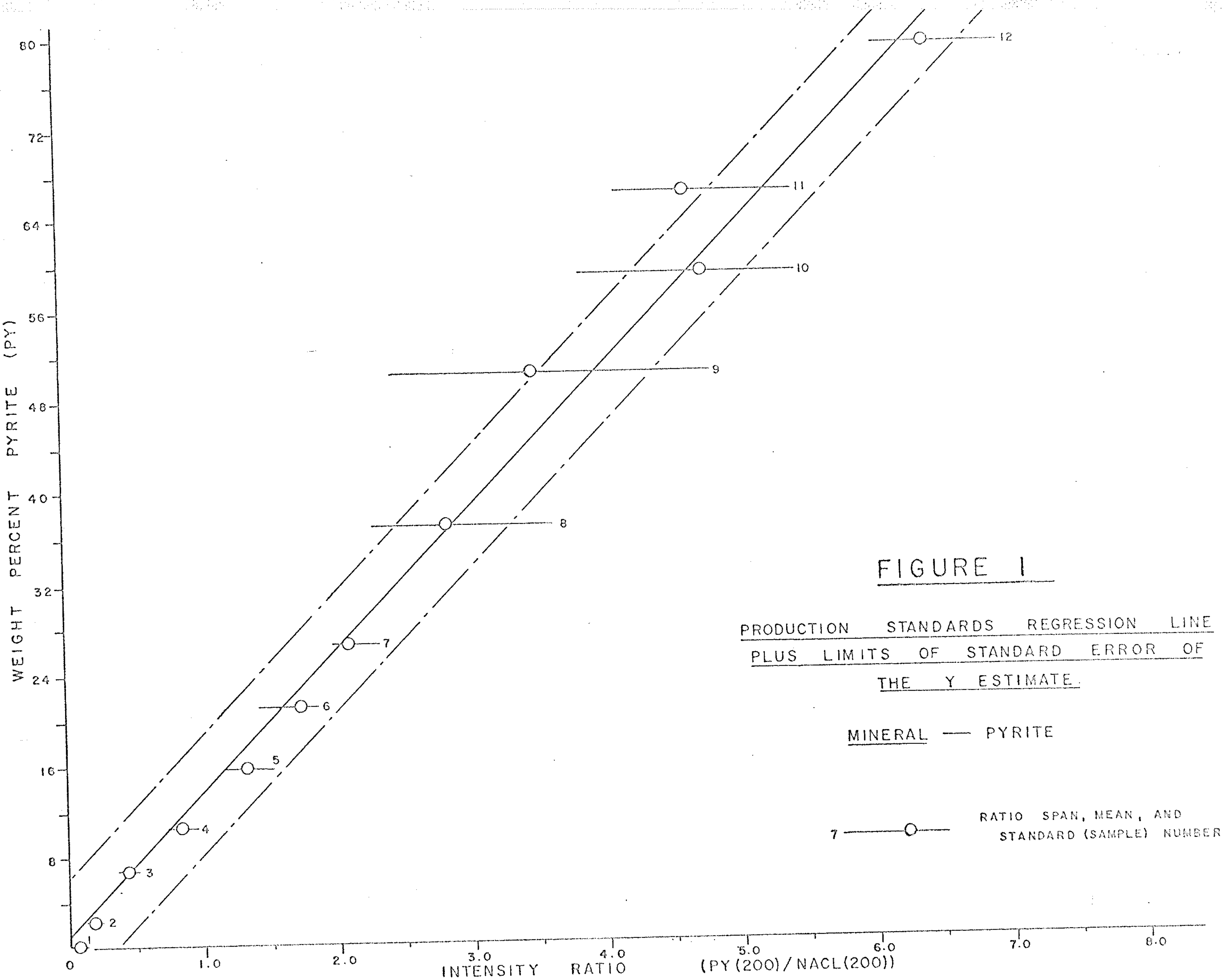

FIGURE 1

PRODUCTION STANDARDS REGRESSION LINE PLUS LIMITS OF STANDARD ERROR OF THE Y ESTIMATE.

MINERAL — PYRITE

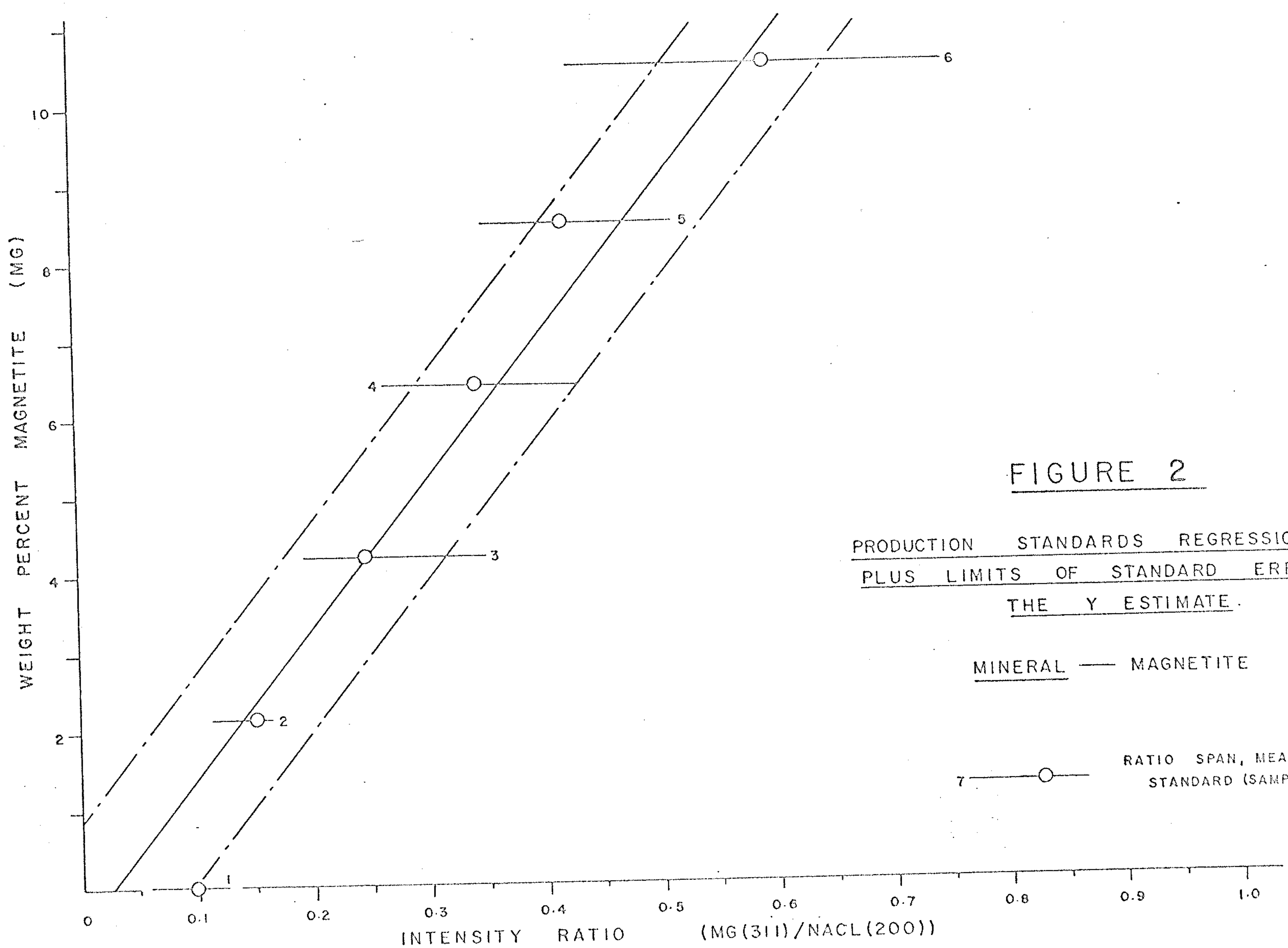

FIGURE 2

PRODUCTION STANDARDS REGRESSION LINE PLUS LIMITS OF STANDARD ERROR OF THE Y ESTIMATE.

MINERAL — MAGNETITE

7 —○— RATIO SPAN, MEAN, AND STANDARD (SAMPLE) NUMBER.

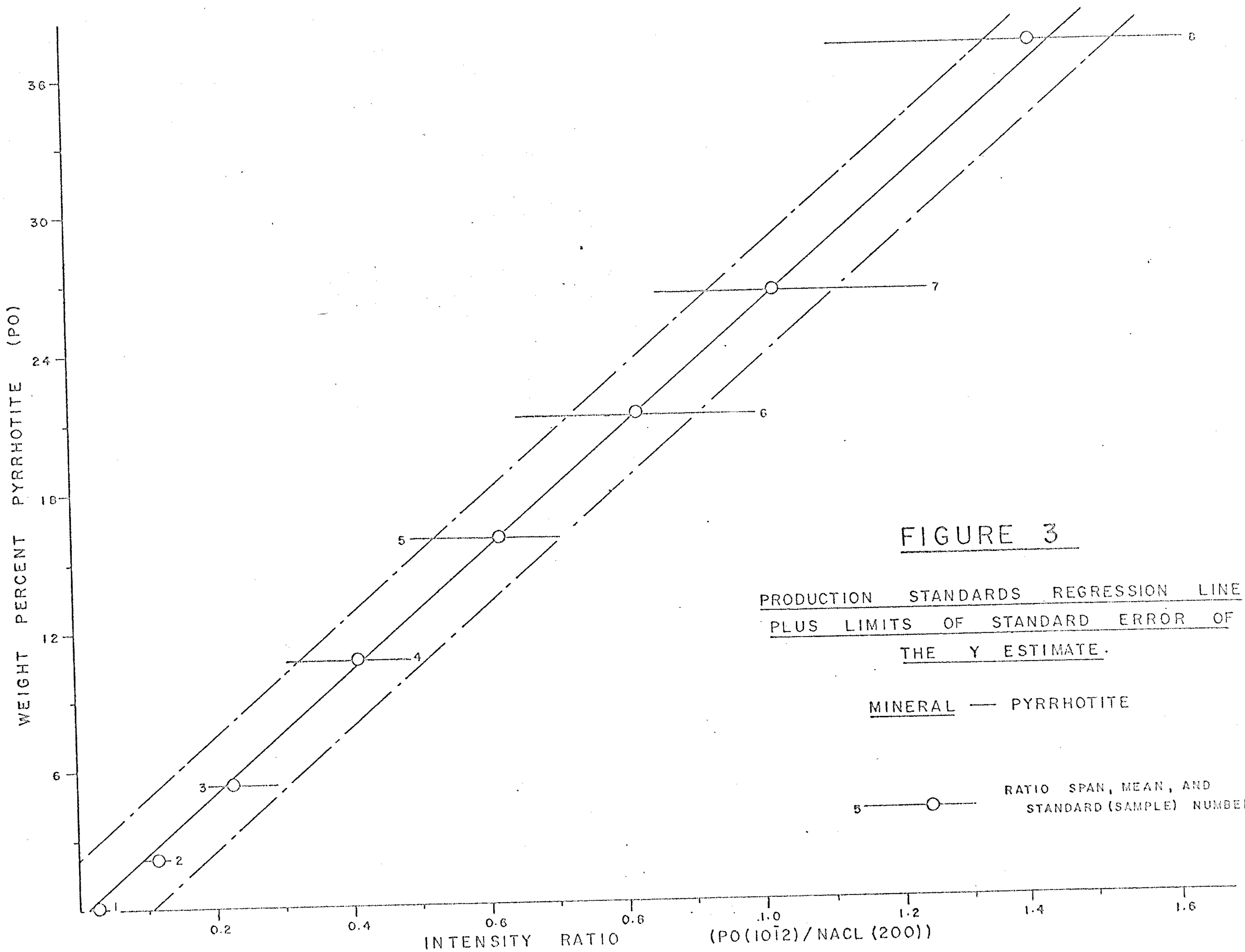

FIGURE 3

PRODUCTION STANDARDS REGRESSION LINE PLUS LIMITS OF STANDARD ERROR OF THE Y ESTIMATE.

MINERAL — PYRRHOTITE

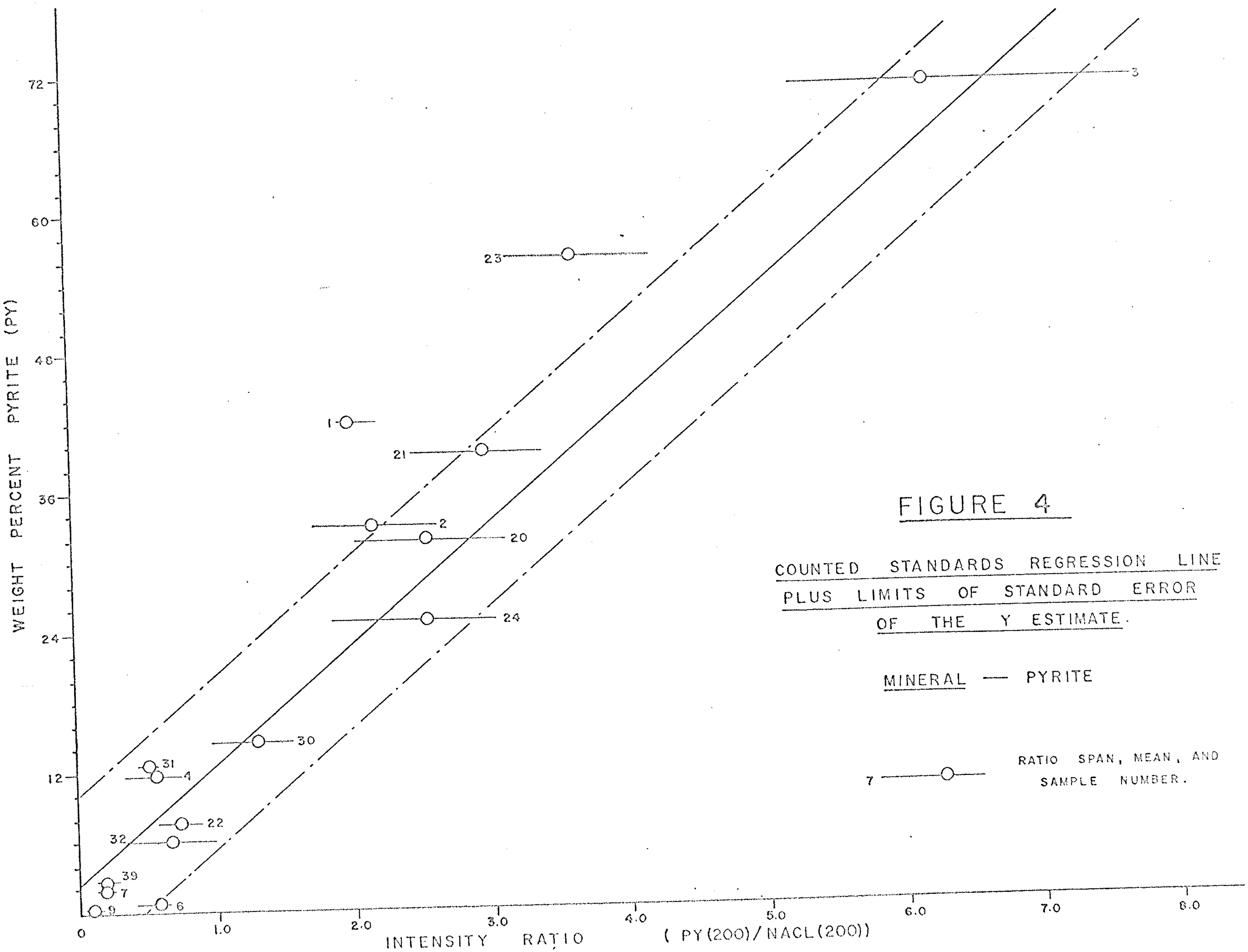

FIGURE 4

COUNTED STANDARDS REGRESSION LINE PLUS LIMITS OF STANDARD ERROR OF THE Y ESTIMATE.

MINERAL — PYRITE

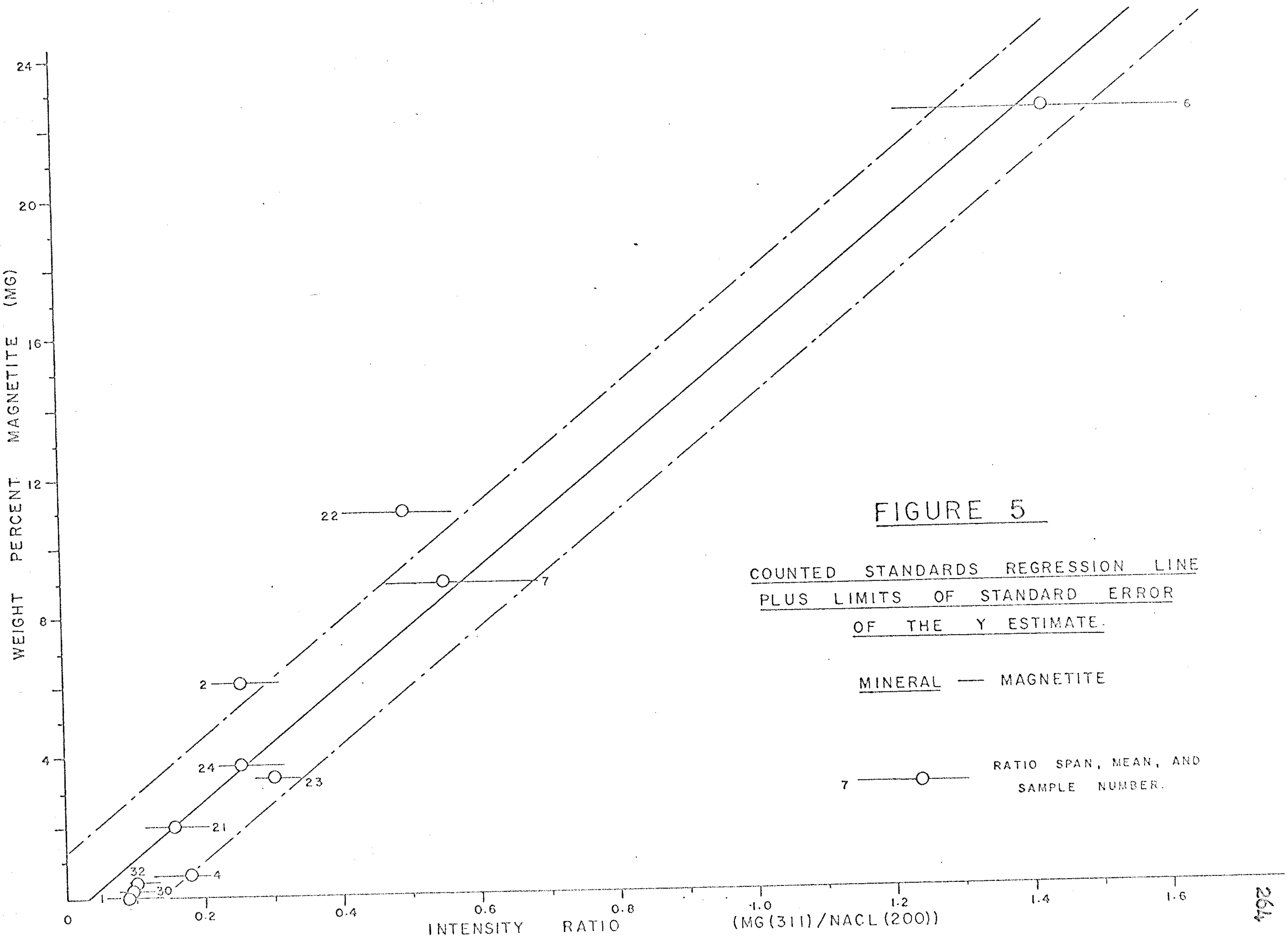

FIGURE 5

COUNTED STANDARDS REGRESSION LINE PLUS LIMITS OF STANDARD ERROR OF THE Y ESTIMATE.

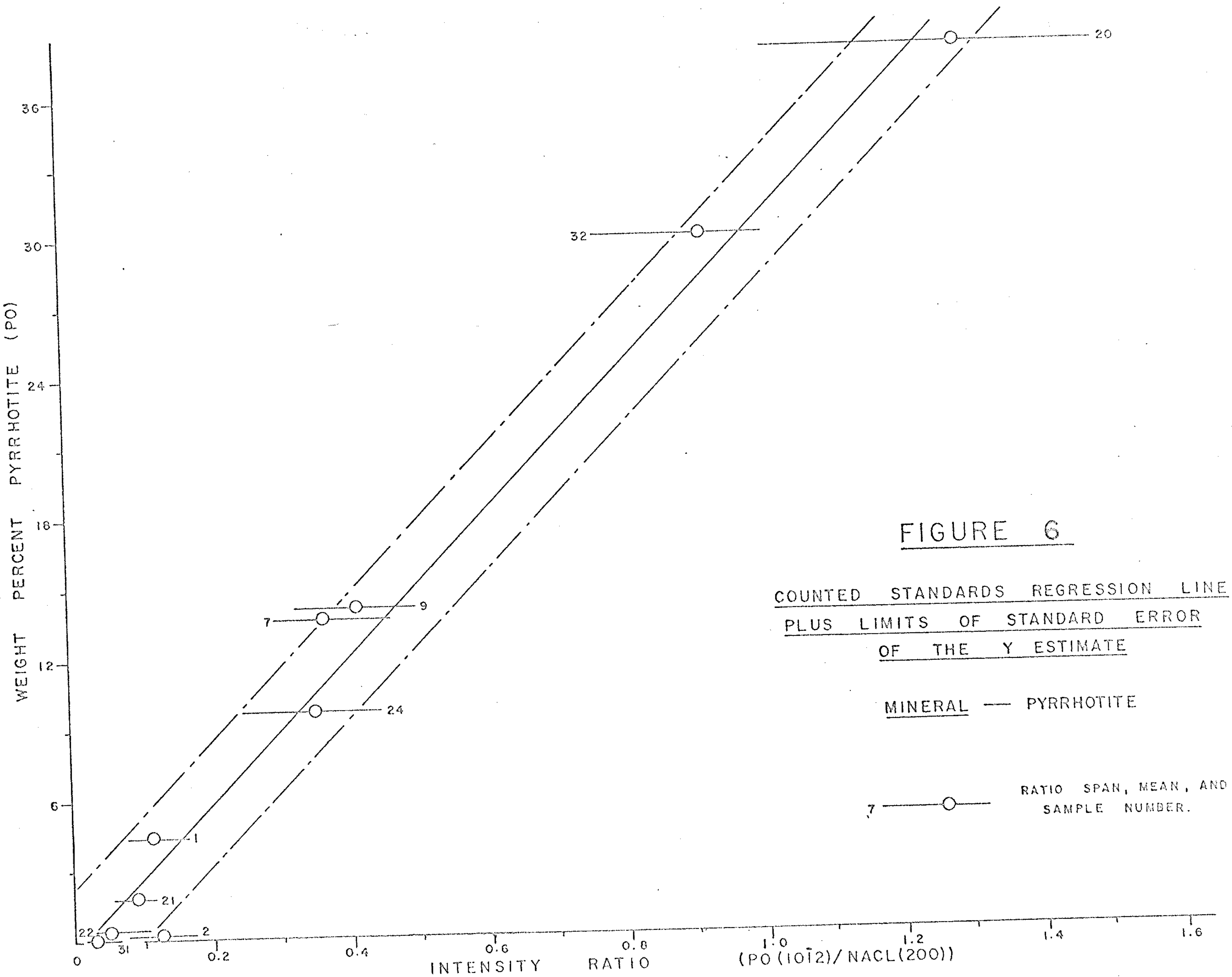

FIGURE 6

COUNTED STANDARDS REGRESSION LINE PLUS LIMITS OF STANDARD ERROR OF THE Y ESTIMATE

MINERAL — PYRRHOTITE

APPENDIX 8

Miscellaneous Total Sample Tables

TABLE | PAGE

TABLE 1

RELATION BETWEEN THEORETICAL MAGNETIC SUSCEPTIBILITIES, ORE TYPE, AND WALL ROCK ASSOCIATIONS.

ORE TYPE	WALL ROCK: ULTRA-BASIC	BASIC INTRUS.	ACID VOLC.	SEDS.	ACID INTRUS.	CONT. METAM.
CU-NI	7 7.3					
	43 2.7					
	44 1.4					
3.6	45 3.2					
CU		4 2.2	2 2.5		11 0.9	6 10.1
		9 1.9	19 0.3		28 2.9	8 0.2
		14 1.3	20 9.6		29 2.8	36 1.7
		15 0.9	26 0.5		40 1.0	
		22 4.5	31 1.8			
2.7		39 6.9	33 0.0			
CU-ZN		37 1.6	1 0.8			
		38 4.5	12 0.9			
			24 3.8			
2.1			25 1.3			
ZN-CU			21 1.6	16 1.9		
			23 3.8			
			27 0.6			
1.7			30 0.7			
ZN-PB-CU			3 1.9	41 0.0		
0.6			5 0.0			
ZN-PB			13 0.7	10 0.4		32 4.8
0.3			17 0.0	35 0.2		42 1.0
PB-ZN			18 0.0			
0.0			34 0.0			
WALL ROCK AVERAGES	3.6	2.9	1.5	0.6	1.9	3.5

ORE TYPE AVERAGES TABLED UNDER ORE TYPE.

VALUES SHOWN AS PROP. NO. RATIO VALUE (k)

21 .08

TABLE 2

CALCULATED 100 WEIGHT PERCENT MINERAL GROUPS (NORMALIZED GROUPS)

TOTAL SAMPLE

CALC. 100 WT. PCT. CU MINERALS	ZN (SL) MINERALS	PB (GN) MINERALS	CALC. 100 WT. PCT. CU MINERALS	ZN (SL) MINERALS	NI (PN) MINERALS	NO.
86.25	13.75	0.0	86.25	13.75	0.0	1
96.99	3.01	0.0	96.99	3.01	0.0	2
16.63	65.87	17.49	20.16	79.84	0.0	3
97.46	2.54	0.0	97.46	2.54	0.0	4
10.29	58.48	31.23	14.96	85.04	0.0	5
100.00	0.0	0.0	100.00	0.0	0.0	6
100.00	0.0	0.0	27.54	0.0	72.46	7
100.00	0.0	0.0	100.00	0.0	0.0	8
98.83	1.04	0.13	98.95	1.05	0.0	9
9.89	71.89	18.22	12.10	87.90	0.0	10
95.12	4.88	0.0	95.12	4.88	0.0	11
82.92	16.30	0.78	83.57	16.43	0.0	12
0.78	96.28	2.93	0.81	99.19	0.0	13
98.60	1.40	0.0	98.60	1.40	0.0	14
100.00	0.0	0.0	100.00	0.0	0.0	15
47.21	51.33	1.46	47.91	52.09	0.0	16
3.26	86.95	9.79	3.62	96.38	0.0	17
8.80	42.96	48.23	17.01	82.99	0.0	18
99.55	0.17	0.28	99.83	0.17	0.0	19
100.00	0.0	0.0	100.00	0.0	0.0	20
48.15	51.16	0.70	48.48	51.52	0.0	21
99.50	0.40	0.10	99.60	0.40	0.0	22
69.86	30.01	0.13	69.95	30.05	0.0	23
77.81	21.98	0.22	77.98	22.02	0.0	24
62.90	36.66	0.44	63.18	36.82	0.0	25
99.81	0.19	0.0	99.81	0.19	0.0	26
39.08	60.92	0.0	39.08	60.92	0.0	27
97.80	2.20	0.0	97.80	2.20	0.0	28
100.00	0.0	0.0	100.00	0.0	0.0	29
56.54	40.94	2.52	58.00	42.00	0.0	30
100.00	0.0	0.0	100.00	0.0	0.0	31
0.0	56.75	43.25	0.0	100.00	0.0	32
95.32	4.68	0.0	95.32	4.68	0.0	33
4.75	37.94	57.31	11.12	88.88	0.0	34
3.41	57.78	38.81	5.57	94.43	0.0	35
94.66	3.20	2.14	96.73	3.27	0.0	36
88.50	11.50	0.0	88.50	11.50	0.0	37
86.00	14.00	0.0	86.00	14.00	0.0	38
99.74	0.26	0.0	99.74	0.26	0.0	39
100.00	0.0	0.0	100.00	0.0	0.0	40
21.64	43.67	34.70	33.13	66.87	0.0	41
5.99	72.65	21.36	7.61	92.39	0.0	42
91.15	0.0	8.85	58.65	0.0	41.35	43
96.27	0.0	3.73	57.08	0.0	42.92	44
91.23	0.44	8.33	37.96	0.18	61.86	45

CU MINERALS = CP + BO + CC + TT + T-B + TN + FR

TABLE 3

SULPHIDE-OPAQUE MINERAL RATIO CALCULATIONS
TOTAL SAMPLE

PO/PO+PY	PO/PO+PY+MG	PY/PO+PY+MG	MG/PO+PY+MG	PN/PN+PO	MG/MG+PY	NO.
0.098	0.097	0.893	0.010	0.0	0.011	1
0.030	0.026	0.836	0.138	0.0	0.142	2
0.036	0.034	0.925	0.040	0.0	0.042	3
0.576	0.551	0.407	0.042	0.0	0.094	4
0.0	0.0	1.000	0.0	0.0	0.0	5
0.430	0.052	0.069	0.879	0.0	0.928	6
0.805	0.504	0.122	0.374	0.234	0.754	7
0.358	0.340	0.610	0.049	0.0	0.075	8
0.880	0.836	0.114	0.051	0.0	0.308	9
0.099	0.093	0.847	0.060	0.0	0.067	10
0.159	0.133	0.704	0.163	0.0	0.188	11
0.022	0.021	0.961	0.017	0.0	0.018	12
0.097	0.092	0.861	0.046	0.0	0.051	13
0.219	0.168	0.600	0.232	0.0	0.279	14
0.249	0.222	0.670	0.108	0.0	0.139	15
0.203	0.190	0.747	0.063	0.0	0.078	16
0.0	0.0	0.998	0.002	0.0	0.002	17
0.040	0.040	0.960	0.0	0.0	0.0	18
0.093	0.084	0.814	0.102	0.0	0.111	19
0.580	0.503	0.364	0.133	0.0	0.268	20
0.078	0.073	0.873	0.054	0.0	0.058	21
0.272	0.162	0.434	0.403	0.0	0.482	22
0.277	0.260	0.680	0.060	0.0	0.081	23
0.286	0.253	0.633	0.113	0.0	0.152	24
0.068	0.066	0.906	0.028	0.0	0.030	25
0.043	0.042	0.934	0.024	0.0	0.025	26
0.033	0.032	0.948	0.020	0.0	0.021	27
0.496	0.294	0.298	0.408	0.0	0.578	28
0.252	0.098	0.290	0.613	0.0	0.679	29
0.035	0.032	0.889	0.079	0.0	0.082	30
0.068	0.054	0.739	0.208	0.0	0.220	31
0.784	0.757	0.209	0.035	0.0	0.143	32
0.0	0.0	1.000	0.0	0.0	0.0	33
0.068	0.068	0.932	0.0	0.0	0.0	34
0.179	0.179	0.821	0.0	0.0	0.0	35
0.094	0.061	0.581	0.359	0.0	0.382	36
0.670	0.650	0.320	0.030	0.0	0.087	37
0.862	0.848	0.136	0.016	0.0	0.106	38
0.934	0.926	0.066	0.008	0.0	0.108	39
0.222	0.133	0.468	0.398	0.0	0.460	40
0.049	0.049	0.951	0.0	0.0	0.0	41
0.605	0.581	0.379	0.040	0.0	0.096	42
0.773	0.646	0.189	0.165	0.159	0.467	43
0.458	0.380	0.449	0.170	0.193	0.275	44
0.710	0.628	0.256	0.116	0.193	0.312	45

TABLE 3 (CONTINUED)

SULPHIDE-OPAQUE MINERAL RATIO CALCULATIONS
TOTAL SAMPLE

CP/CP+SL	SL/SL+MG	PY/PY+SL+GN	CU MINERALS/CU MINERALS+PY	NO.
0.862	0.686	0.976	0.132	1
0.970	0.024	0.996	0.117	2
0.202	0.801	0.818	0.042	3
0.975	0.231	0.970	0.545	4
0.150	1.000	0.191	0.328	5
1.000	0.0	1.000	0.832	6
1.000	0.0	1.000	0.324	7
1.000	0.0	1.000	0.667	8
0.990	0.100	0.947	0.824	9
0.020	0.934	0.443	0.121	10
0.951	0.066	0.984	0.241	11
0.836	0.603	0.972	0.122	12
0.008	0.964	0.405	0.012	13
0.986	0.046	0.982	0.569	14
1.000	0.0	1.000	0.435	15
0.479	0.784	0.761	0.220	16
0.036	0.996	0.575	0.024	17
0.040	1.000	0.263	0.213	18
0.998	0.063	0.978	0.832	19
1.000	0.0	1.000	0.246	20
0.485	0.800	0.799	0.189	21
0.996	0.005	0.994	0.531	22
0.699	0.393	0.946	0.118	23
0.780	0.514	0.839	0.402	24
0.632	0.843	0.858	0.220	25
0.998	0.085	0.998	0.566	26
0.391	0.964	0.633	0.271	27
0.978	0.031	0.957	0.664	28
1.000	0.0	1.000	0.491	29
0.580	0.651	0.851	0.186	30
1.000	0.0	1.000	0.405	31
0.0	0.899	0.276	0.0	32
0.953	1.000	0.967	0.408	33
0.0	1.000	0.114	0.278	34
0.034	1.000	0.224	0.109	35
0.967	0.026	0.973	0.331	36
0.885	0.767	0.762	0.706	37
0.860	0.689	0.793	0.616	38
0.997	0.043	0.995	0.678	39
1.000	0.0	1.000	0.547	40
0.326	1.000	0.346	0.343	41
0.076	0.954	0.258	0.155	42
1.000	0.0	0.918	0.478	43
1.000	0.0	0.990	0.212	44
0.995	0.004	0.967	0.264	45

CU MINERALS = CP + BO + CC + TT + T-B + TN + FR

TABLE 3 (CONTINUED)

SULPHIDE-OPAQUE MINERAL RATIO CALCULATIONS
TOTAL SAMPLE

CP/CP+SL+GN	SL/CP+SL+GN	GN/CP+SL+GN	FE SULP/FE SULP + FE OXID	NO.
0.862	0.138	0.0	0.990	1
0.970	0.030	0.0	0.862	2
0.166	0.659	0.175	0.960	3
0.975	0.025	0.0	0.958	4
0.103	0.585	0.312	1.000	5
1.000	0.0	0.0	0.084	6
1.000	0.0	0.0	0.676	7
1.000	0.0	0.0	0.951	8
0.988	0.010	0.001	0.949	9
0.016	0.785	0.199	0.940	10
0.951	0.049	0.0	0.837	11
0.829	0.163	0.008	0.983	12
0.008	0.963	0.029	0.954	13
0.986	0.014	0.0	0.768	14
1.000	0.0	0.0	0.892	15
0.472	0.513	0.015	0.937	16
0.033	0.870	0.098	0.998	17
0.019	0.462	0.519	1.000	18
0.996	0.002	0.003	0.898	19
1.000	0.0	0.0	0.867	20
0.481	0.512	0.007	0.946	21
0.995	0.004	0.001	0.597	22
0.699	0.300	0.001	0.940	23
0.778	0.220	0.002	0.887	24
0.629	0.367	0.004	0.972	25
0.998	0.002	0.0	0.976	26
0.391	0.609	0.0	0.980	27
0.978	0.022	0.0	0.592	28
1.000	0.0	0.0	0.387	29
0.565	0.409	0.025	0.921	30
1.000	0.0	0.0	0.697	31
0.0	0.567	0.433	0.956	32
0.953	0.047	0.0	1.000	33
0.0	0.398	0.602	1.000	34
0.020	0.586	0.394	1.000	35
0.947	0.032	0.021	0.618	36
0.885	0.115	0.0	0.970	37
0.860	0.140	0.0	0.984	38
0.997	0.003	0.0	0.992	39
1.000	0.0	0.0	0.602	40
0.212	0.439	0.349	1.000	41
0.060	0.727	0.214	0.960	42
0.911	0.0	0.089	0.853	43
0.963	0.0	0.037	0.844	44
0.912	0.004	0.083	0.899	45