GEOLOGICAL SURVEY OF CANADA
DEPARTMENT OF MINES AND TECHNICAL SURVEYS

PRELIMINARY SERIES

SHEET 42 M

LEGEND

PALAEOZOIC

SILURIAN
LOWER SILURIAN
MEDINA GROUP

14 — SEVERN RIVER FORMATION: light grey to buff, very finely-crystalline dolomite, fine- to medium-grained dolomitic sandstone

ORDOVICIAN
UPPER ORDOVICIAN
RICHMOND GROUP

13 — Dolomite, limestone, sandstone

ARCHAEAN

12 — Undivided 8-11, based almost entirely on aeromagnetic data

11 — Massive, fine-grained to pegmatitic, pink granite, quartz monzonite, and granodiorite; minor syenite, monzonite, syenodiorite, quartz diorite, aplite, pegmatite

10 — Massive, fine-grained to pegmatitic, white to grey, quartz monzonite, granodiorite, quartz diorite; minor granite, syenodiorite, diorite

9 — 9a, porphyritic quartz monzonite, granodiorite, granite, quartz diorite; augen gneiss; 9b, aphanitic to fine-grained grey quartz, feldspar, quartz-feldspar porphyry

8 — Foliated, fine- to coarse-grained, white to grey granodiorite, quartz monzonite, quartz diorite; minor granite, syenodiorite, diorite

7 — 7a, gabbro, quartz gabbro, olivine gabbro, anorthositic gabbro, derived amphibolites; minor diorite, quartz diorite; 7b, hornblendite, garnetiferous hornblendite, pyroxenite, undifferentiated ultrabasic rocks; 7c, aphanitic to medium-grained diabase, possibly Proterozoic in part

6 — Migmatite, mixed rocks; mainly quartz-biotite-feldspar gneisses

5 — Undivided 1-4, based almost entirely on aeromagnetic data; 5a, undivided 1 and 3

4 — Very fine- to medium-grained grey banded iron-formation; 4a, interpreted as underlying Palaeozoic strata, from aeromagnetic data

3 — Phyllite; quartz-biotite-plagioclase (oligoclase-andesine) schists and gneisses, some garnetiferous; quartz latite, dacite, and associated pyroclastic rocks, conglomerate; minor staurolite schists, quartzite, interbedded basalt and amphibolite; 3a, mainly conglomerate; 3b, mainly quartz latite, dacite and associated pyroclastic rocks; 3c, amphibolite

2 — Aphanitic to fine-grained light green to black, andesite, basalt, derived amphibolites; minor tuff, agglomerate, gabbro sills and dykes, quartzite, calcareous argillite

1 — Phyllite; quartz-biotite-plagioclase schists and gneisses, some garnetiferous; quartz latite, dacite, and associated pyroclastic rocks; quartzite; minor staurolite- and sillimanite-bearing schists; interbedded basalt and amphibolite

Notes: Units 1-12 not necessarily in chronological order.

$\frac{13}{5}$ and $\frac{14}{5}$ indicates extension of Precambrian rocks (5) under Palaeozoic rocks based on aeromagnetic information

Drift-covered area, little or no outcrop
Sand
Geological boundary (approximate or assumed)
Geological boundary interpreted under drift-covered areas from aeromagnetic data
Bedding, tops known (inclined, vertical, overturned, p indicates pillow determination)
Bedding, tops unknown (inclined, vertical)
Gneissosity, schistosity (inclined, vertical, dip unknown)
Lineation (direction and amount of plunge)
Drag-fold in gneissosity (arrow indicates direction of plunge)
Lineament (from air photographs)
Fault (assumed)
Joints (inclined, vertical)
Glacial striae (direction of ice-movement shown, not known)
Small moraine
Drumlin, drumlinoid ridge
Esker, esker-like ridge
Raised beaches
Fossil locality
Mineral occurrence . . . Au ×
Potassium-Argon age (million years) . . . 2460 M.Y.

MINERALS

Arsenopyrite	asp	Pyrite	py
Chalcopyrite	cp	Pyrrhotite	po
Galena	gn	Silver	Ag
Gold	Au	Sphalerite	sp
Magnetite	mag	Sulphides	s
Nickel	Ni	Tungsten	W

Geology by G. D. Jackson, 1961

See GSC Map 6-1962 for descriptive notes on the geology

Bedrock sampling points
Copper concentration of 5 ppm and over are indicated thus . . . 35

Geochemical compilation by R. H. C. Holman, 1960-61

Analyses by M. A. Gilbert

Geological cartography by the Geological Survey of Canada, 1961 and 1964

Approximate magnetic declination, 04° 13' East

Winter road
Portage
Building
Wireless station
District boundary
Indian Reserve boundary
Fall and rapid
Marsh
Height in feet above mean sea-level . . . 878'

Base-map by the Surveys and Mapping Branch, 1952

PUBLISHED, 1964
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PRINTED BY THE SURVEYS AND MAPPING BRANCH

EXPLANATORY NOTES

This map is one of a series of seven preliminary geochemical maps, on a scale of 1 inch to 4 miles, presenting the results of a survey of the copper content of bedrock exposed at the surface throughout a 43,000 square mile portion of the Red Lake - Lansdowne House region in northwestern Ontario between longitudes 86 and 94 and latitudes 51 and 53 degrees.

Regional geochemical surveys undertaken for the express purpose of mineral exploration are generally made by sampling stream waters, drainage system detritus, or soils. These techniques have the advantage that secondary dispersion effects, which may be developed in these surficial materials, can often be detected at considerable distances from mineralized zones in bedrock and thus effectively enlarge the exploration target sought. But in this region of low relief and comparatively unweathered bedrock overlain by swamps and glacial deposits, it was thought that the use of these surficial media would introduce especially difficult problems of sampling, chemical analysis and interpretation. Consideration was given, therefore, to the direct sampling of bedrock. This technique has been given little attention previously, probably because of apparent difficulties of sampling and preparing rocks for chemical analysis, together with the fact that certain secondary dispersion effects found in surficial materials may be absent from, or only weakly developed in, bedrock. Apart from these objections, several advantages of working with rocks were apparent: (1) the results would be free from interpretative difficulties arising from the use of surficial materials in a glaciated area; (2) a bedrock study would provide much needed basic data on the regional geochemistry of rocks in this part of the Canadian Shield; and (3) the study would form a sound basis for future work on waters, stream sediments and all other media in this region. For this large scale experimental reconnaissance no special sampling crews were used, and geochemical sampling was restricted to the collection of rock specimens by geological mapping parties without seriously impeding their progress.

Specimens of rock, weighing between 2 and 3 pounds, were taken, where possible, from outcrops at intervals of about a mile along the traverses required for mapping on the scale of 1 inch to 4 miles. At each station a single specimen of the most common rock was taken and its description recorded. The specimens were split and a chip retained for reference. The remainder was passed through a jaw crusher set to deliver about 60 mesh/inch size. After thorough mixing by rolling on paper sheets, a 15 to 20 gram grab sample was taken and ground to finer than 100 mesh/inch size in a ceramic ball mill. This procedure is rapid and contamination is negligible. The finely-ground rock powders were analyzed for copper by fusion with potassium bisulphate followed by colorimetric determination with dithizone using the technique described by Gilbert, GSC Paper 59-3.

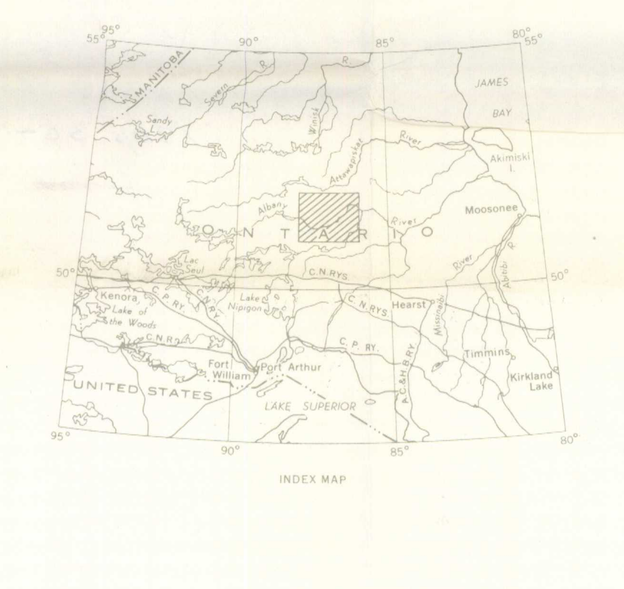
The results of the chemical analyses, together with petrological classifications and other data describing each specimen were recorded on electronic data processing cards for statistical treatment. Standard statistical parameters were calculated that describe the distribution of copper between and within the different map-units, and are given in a table and diagrams on the map margin. The arithmetic mean ($\bar{X}$), geometric mean (G), and median (M) are measures of central tendency and indicate how the copper is distributed between the different rocks occurring in the region. The ranges (W) and standard deviations (S_L) show the degree of scatter or spread of the concentrations within each of the map-units. Ranges given in the table refer to the data used in the computations. Higher concentrations were found in a few specimens containing abundant visible sulphide minerals, these are shown on the map but were excluded from the calculations. Cumulative frequency curves were generally found to approximate more closely to straight lines when plotted logarithmically and suggest, therefore, that the copper is usually distributed approximately lognormally in the rocks. For this reason the means ($\bar{X}_L$) and standard deviations (S_L) were calculated on the logarithms of the copper concentrations. ($\bar{X}_L + S_L$), ($\bar{X}_L + 2S_L$), and ($\bar{X}_L + 3S_L$) are three levels above which 15.9, 2.3 and 0.13 per cent, respectively, of the individual concentrations will lie (assuming a lognormal distribution) and may be used to investigate local deviations from the means.

Regional variations in the concentrations of copper in rocks are likely to follow patterns resulting from a complex history of lithological, metamorphic and structural events. The importance of lithology as a control is evident from the considerable difference between the means of the copper concentrations for some of the map-units. This strong lithological control is likely to obscure smaller and more subtle variations in the distribution of copper induced by other causes. Recognition of this fact is important for a proper interpretation of the data. No satisfactory way could be found of presenting the geochemical data on a single map suitable for preliminary publication so that the influences of different controls over the distribution of copper were clearly shown. For this reason the results are given as simple plots of the copper concentrations determined from each specimen.

MAP 56-1963
GEOCHEMISTRY
(COPPER IN BEDROCK)
FORT HOPE
ONTARIO

Scale: One Inch to Four Miles = $\frac{1}{253,440}$

Miles 4 2 0 4 8 12



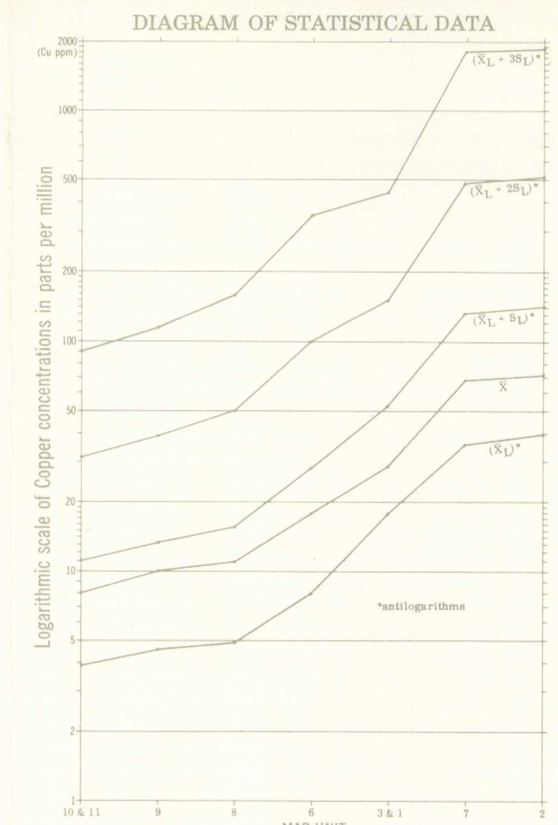
INDEX MAP

TABLE OF STATISTICAL DATA

Map Unit (a)	Area of Outcrop: sq. miles A (b)	Area of Outcrop: per cent (c)	Number of Specimens n	Area per Specimen A/n sq. miles	Copper in parts per million (Cu ppm): Range W (d)	Median M (d)	Arithmetic mean $\bar{X}$ (e)	Logarithmic mean $\bar{X}_L$ (f)	G	Standard deviation S_L (g)	$\bar{X}_L + S_L$	$\bar{X}_L + 2S_L$	$\bar{X}_L + 3S_L$
12	587	11	-	-	-	-	-	-		-	-	-	-
11	541	10	472	2.4	<5 to 130	<5	8	0.5860	4*	0.4557	1.0417 11*	1.4974 31*	1.9531 90*
10	573	11											
9	213	4	51	4.2	<5 to 100	<5	10	0.6543	5*	0.4665	1.1208 13*	1.5873 39*	2.0538 110*
8	1531	28	298	5.1	<5 to 290	<5	11	0.6898	5*	0.5038	1.1936 16*	1.6974 50*	2.2012 160*
7	57	1	128	0.5	<5 to 900	40	69	1.5518	36*	0.5670	2.1188 130*	2.6858 490*	3.2528 1800*
6	338	6	125	2.7	<5 to 500	8	18	0.9086	8*	0.5464	1.4550 29*	2.0014 100*	2.5478 350*
5	669	12	-	-	-	-	-	-		-	-	-	-
3&1	299	6	81	3.7	<5 to 180	20	29	1.2584	18*	0.4604	1.7188 52*	2.1792 150*	2.6396 440*
2	597	11	200	3.0	<5 to 700	50	71	1.5952	39*	0.5583	2.1535 140*	2.7118 520*	3.2701 1900*
Total	5405	100	1355	4.0	<5 to 900						*antilogarithms		

(a) - For explanation of Map-units see legend
(b) - Rough estimates that include the areas of all lakes and of heavy drift. Total area of map is approximately 6000 sq miles, thus Precambrian rocks are totally obscured throughout about 10 per cent of the area by Palaeozoic rocks
(c) - Expressed as percentages of 5405 sq miles
(d) - <5 = less than 5 ppm Cu (detection limit of analytical method); arbitrarily assigned a value of 2 ppm for all computations
(e) - $\bar{X} = \Sigma \bar{X}/n$ where $\bar{X}$ = concentration of copper (ppm) in each specimen
(f) - $\bar{X}_L = \frac{\Sigma \log \bar{X}}{n}$ (logarithms to base 10 used throughout)
antilog $\bar{X}_L$ = G (geometric mean)
(g) - S_L = standard deviation calculated on logarithmically transformed data

DIAGRAM OF STATISTICAL DATA



CUMULATIVE DISTRIBUTION CURVES FOR MAP-UNITS DESCRIBED IN LEGEND