GEOLOGICAL SURVEY OF CANADA
DEPARTMENT OF MINES AND TECHNICAL SURVEYS

PRELIMINARY SERIES

SHEET 53 B

LEGEND

PRECAMBRIAN

- 9 — Gabbro, diabase, and serpentinite dykes
- 8 — Medium- to coarse-grained massive pink leucocratic granite
- 7 — Massive to foliated, medium- to coarse-grained porphyritic granite, granodiorite, and quartz diorite
- 6 — Massive to slightly foliated granodiorite, quartz monzonite, and quartz diorite
- 5 — Gabbro, diorite, hornblendite, peridotite, pyroxenite, and serpentinite
- 4 — Banded gneiss, lit-par-lit gneiss; 4a, paragneiss
- 3 — Iron-formation
- 2 — Sedimentary rocks and derived schists
- 1 — Volcanic rocks, undifferentiated basic intrusions; minor intercalated sediments and derived schists

Sequence of units does not necessarily represent relative ages

Drift-covered area, no outcrop
Geological boundary (approximate or assumed)
Bedding (inclined, vertical)
Gneissosity (inclined, vertical, dip unknown)
Lineament (from air photographs)
Fault (approximate)
Jointing (inclined, vertical)
Glacial striae (direction of ice-movement known)
Moraine or thick drift ridge
Area of small moraines
Drumlin, drift ridge
Esker
Mineral occurrence . . . . . ×Cu

MINERAL SYMBOLS

Asbestos........asb
Gold........... Au
Copper......... Cu
Silver.......... Ag

Geology by C.A. Carruthers, 1960 - in part compiled from maps published by the Ontario Department of Mines

See GSC Map 18-1961 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

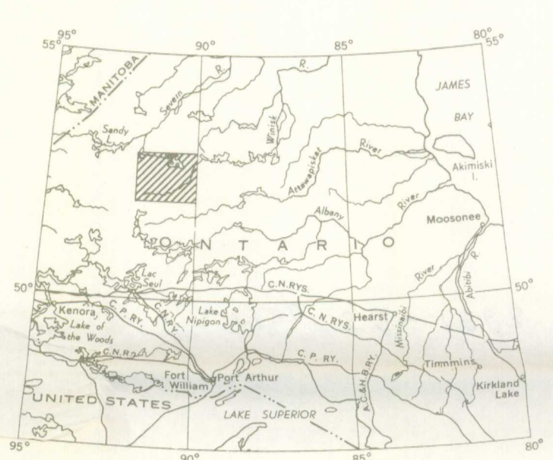
Analyses by M.A. Gilbert

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

Approximate magnetic declination, 01° 37' East

Trail or portage
Marsh
Falls and rapids
Height in feet above mean sea-level 1200

Base-map prepared by the Surveys and Mapping Branch, 1950



INDEX MAP

PUBLISHED, 1964
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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 52-1963
GEOCHEMISTRY (COPPER IN BEDROCK)
NORTH CARIBOU LAKE
ONTARIO

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

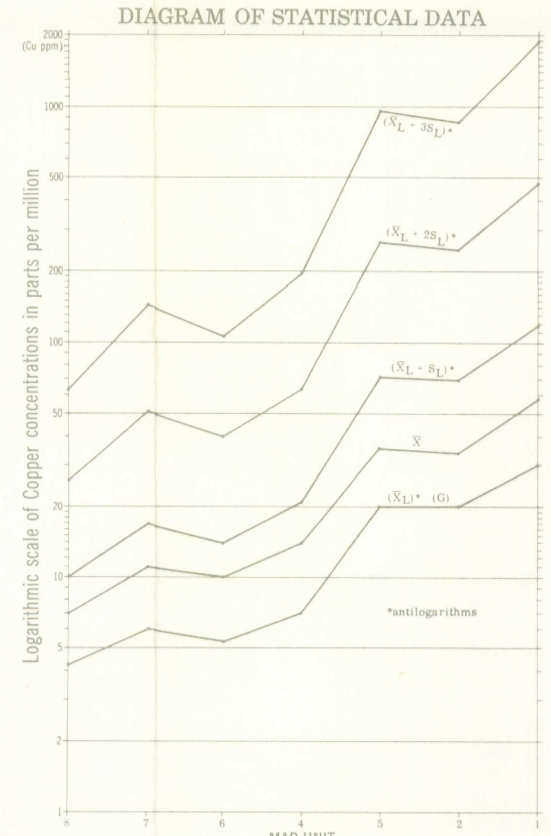
Miles

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)	$\bar{X}_L + S_L$	$\bar{X}_L + 2S_L$	$\bar{X}_L + 3S_L$
8	640	16	159	4.0	<5[d] to 60	<5	7	0.6233	4*	0.3923	1.0156 10*	1.4079 26*	1.8002 63*
7	443	11	49	9.0	<5 to 50	<5	11	0.7775	6*	0.4643	1.2418 17*	1.7061 51*	2.1704 148*
6	1565	40	325	4.8	<5 to 120	<5	10	0.7262	5*	0.4354	1.1616 14*	1.5970 40*	2.0324 108*
5	-	<1	29	-	<5 to 140	28	36	1.3019	20*	0.5604	1.8623 73*	2.4227 265*	2.9831 960*
4	730	19	245	3.0	<5 to 140	6	14	0.8478	7*	0.4799	1.3277 21*	1.8076 64*	2.2875 194*
2	142	4	29	4.9	<5 to 130	23	34	1.2950	20*	0.5504	1.8454 70*	2.3958 249*	2.9462 880*
1	384	10	102	3.8	<5 to 300	43	58	1.4783	30*	0.5964	2.0747 119*	2.6711 469*	3.2675 1900*
Total	3904	100	938	4.2	<5 to 300						*antilogarithms		

(a) - For explanation of Map-units see legend
(b) - Rough estimates that include the areas of all lakes. Total area of map is approximately 5900 sq miles, thus about 30 per cent of the area is obscured by cover other than water
(c) - Expressed as percentages of 3904 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