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MINERAL EVALUATION OF THE LAKE SUPERIOR REGION OF NORTHEASTERN MINNESOTA
A PROGRESS REPORT ON FIELD SURVEYS

Minnesota Department of Natural Resources
Division of Minerals
Minerals Exploration Section

Report 132-I

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MINERAL EVALUATION OF THE LAKE SUPERIOR REGION OF NORTHEASTERN MINNESOTA - A PROGRESS REPORT ON FIELD SURVEYS

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INTRODUCTION

The Lake Superior region of northeastern Minnesota has long been known to have potential for the occurrence of valuable mineral resources. These include copper, iron, nickel, silver, gold, cobalt, titanium, vanadium, anorthosite (a source of aluminum) and others. Occurrences of these mineral resources are known in the Keweenawan volcanics and intrusives (including the Duluth Complex) and Middle Precambrian sediments.

In rocks similar to those in the Lake Superior region of northeastern Minnesota, silver has been mined east of Thunder Bay, on Silver Islet; copper with silver has been mined extensively in northern Michigan; and copper-nickel mining has been proposed in Ontario, 15 miles north of Grand Portage. In Minnesota, extensive copper-nickel deposits have been discovered in the Ely-Hoyt Lakes area.

The Division of Minerals of the Minnesota Department of Natural Resources has the responsibility for the administration of approximately ten million acres of state controlled mineral lands in Minnesota. A large portion of these mineral lands are in the Lake Superior region of northeastern Minnesota. In order to properly administer the mineral lands, the Division of Minerals continually evaluates the mineral resource potential of these lands for various land use considerations.

In 1976, a program was initiated to evaluate the mineral resource potential of the Lake Superior region of northeastern Minnesota (Figure 1). This program includes: A determination of the types of mineral resources that could occur, based on the geology of the region; a survey of the literature, exploration data, and historical records to determine the nature and location of reported mineral occurrences; and field examination and laboratory testing of reported mineral occurrences.

In 1976, this program concentrated mainly on native copper occurrences described in this progress report. Presently, an extensive survey of the literature, exploration data and historical records is underway for all mineral resources in the region. Field examination and laboratory testing of reported mineral occurrences, of all types, will continue during 1977-78. The entire area covered by this program is more than 3,000 square miles (Figure 1).

AREAS EXAMINED IN 1976

At the outset of this program, an article in a St. Louis County Historical Society publication reported the occurrence of native copper in the Knife and French River areas (Figure 1). The initial examinations, by the Minerals Division for native copper, were in the French and Knife River areas. These areas are shown in Figures 2 and 3. The lakeshore and stream beds actually examined are shown on these maps, and copper occurrences located by the Minerals Division surveys are indicated by dots. After these areas were examined, a Coastal Zone strip map of the North Shore was obtained for use as a base map, the basic geology and outcrop data were obtained from Dr. John C. Green at the University of Minnesota - Duluth. Streams and lakeshore areas were selected for examination, based upon Dr. Green's data. Portions of the following stream beds, plus several unnamed creeks, were examined (see Figure 4):

French River
Schmidt Creek
Knife River
Lester River
Silver Creek
Crow Creek
Split Rock River
Talmadge River
Little Knife River
Sucker River
Stewart River
Encampment River
Gooseberry River

These examinations concluded the work planned in the area covered by Coastal Zone maps 1-5 except for Chester Creek in Duluth and a section of Lakeshore in the W1/2 of Section 6-53-9. A total of 15 days were spent examining, or looking for, information on mineral prospects and occurrences. Places or people visited include: Dr. John Green at the University of Minnesota - Duluth, Webb Adams (a prospector) in Grand Marais, the St. Louis County Historical Society, and the Lake County Historical Society.

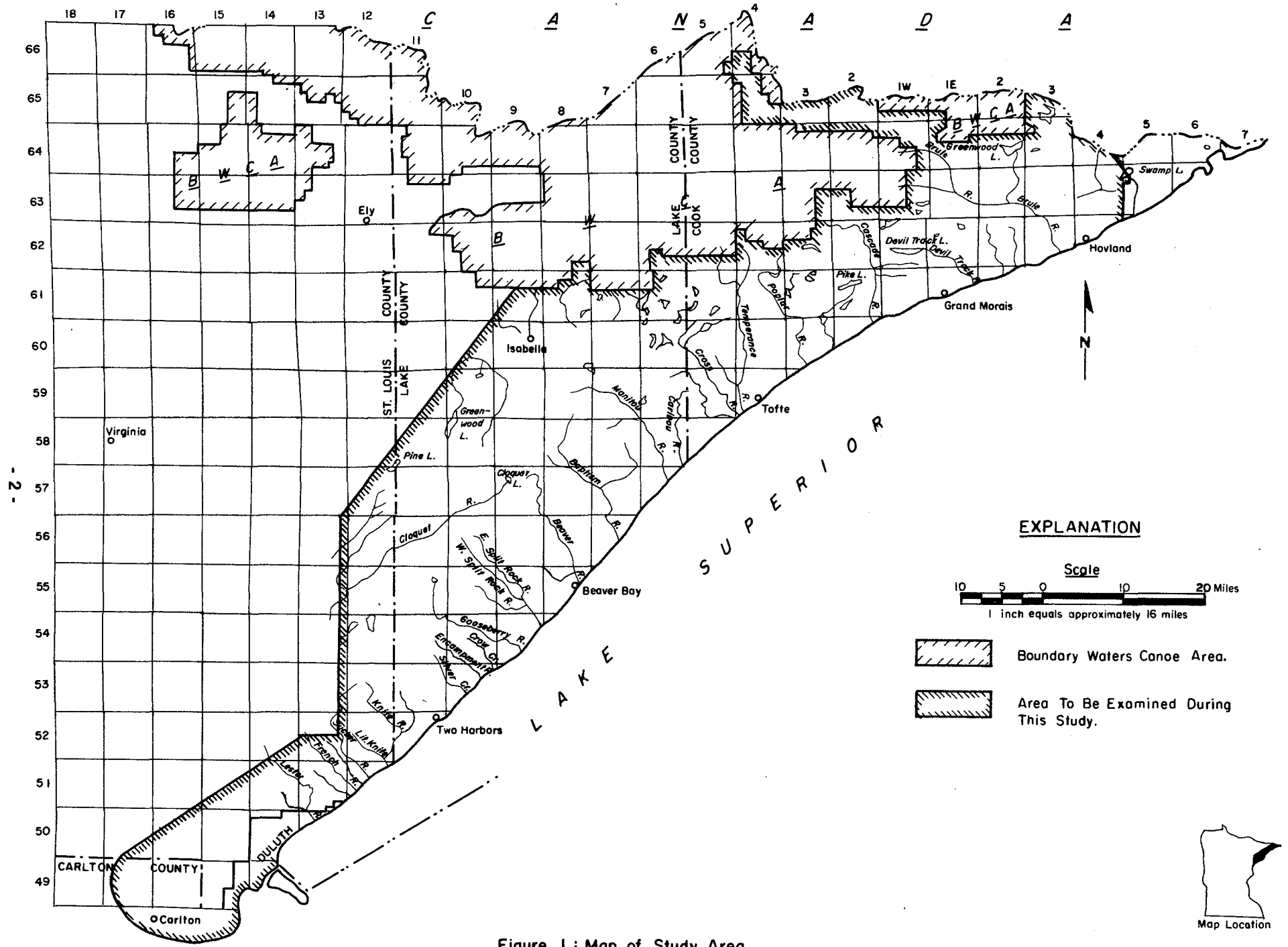

Figure 1 : Map of Study Area

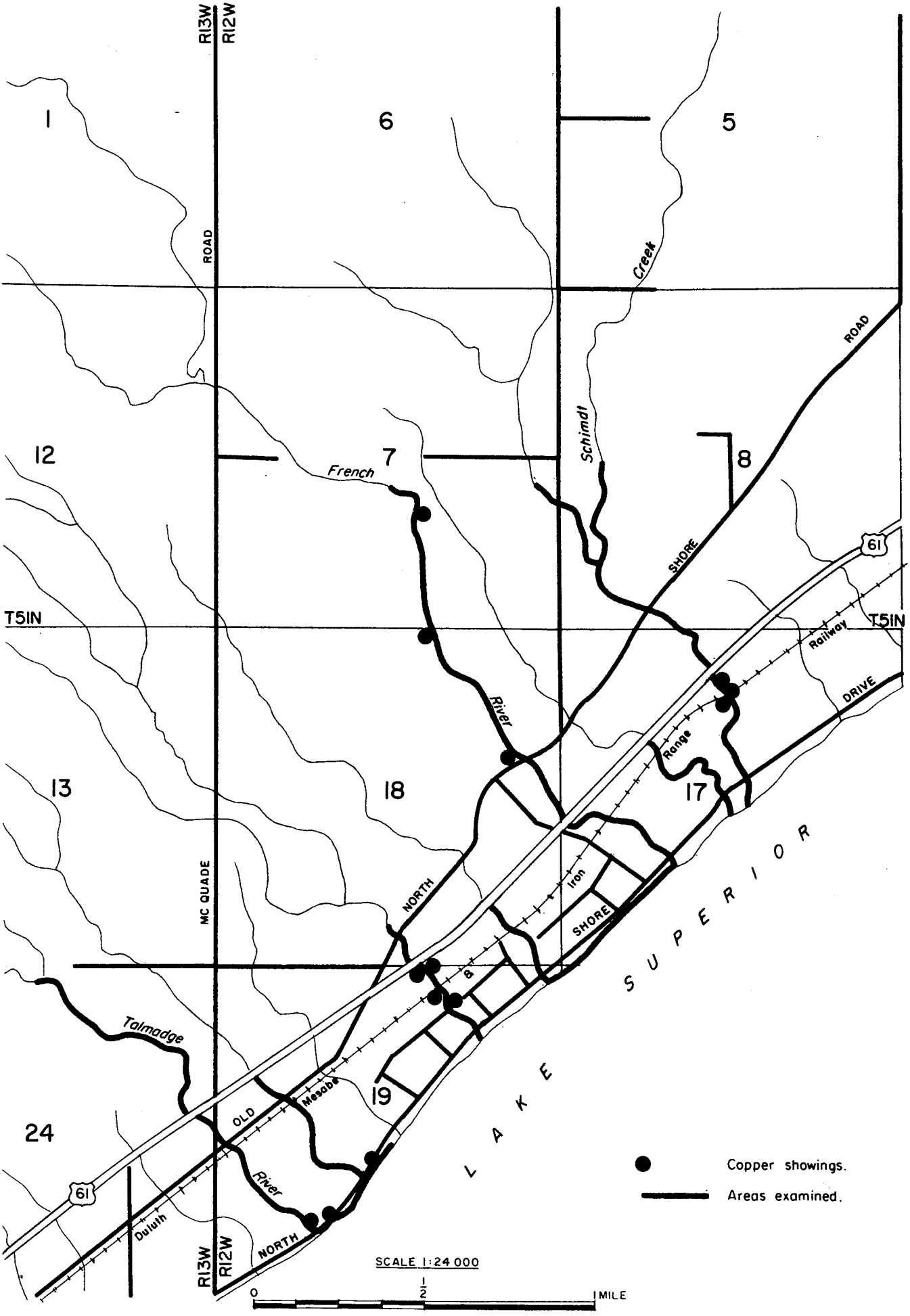
R13W
R12W
1
6
5
ROAD
Creek
ROAD
12
7
8
French
Schimdt
SHORE
61
T51N
T51N
Railway
River
DRIVE
13
18
17
Range
MC QUADE
NORTH
Iron
SHORE
LAKE SUPERIOR
Talmadge
Mesabe
19
24
OLD
River
61
Duluth
R13W
R12W
NORTH
Copper showings.
Areas examined.
SCALE 1:24 000
0
1/2
MILE

Figure 2

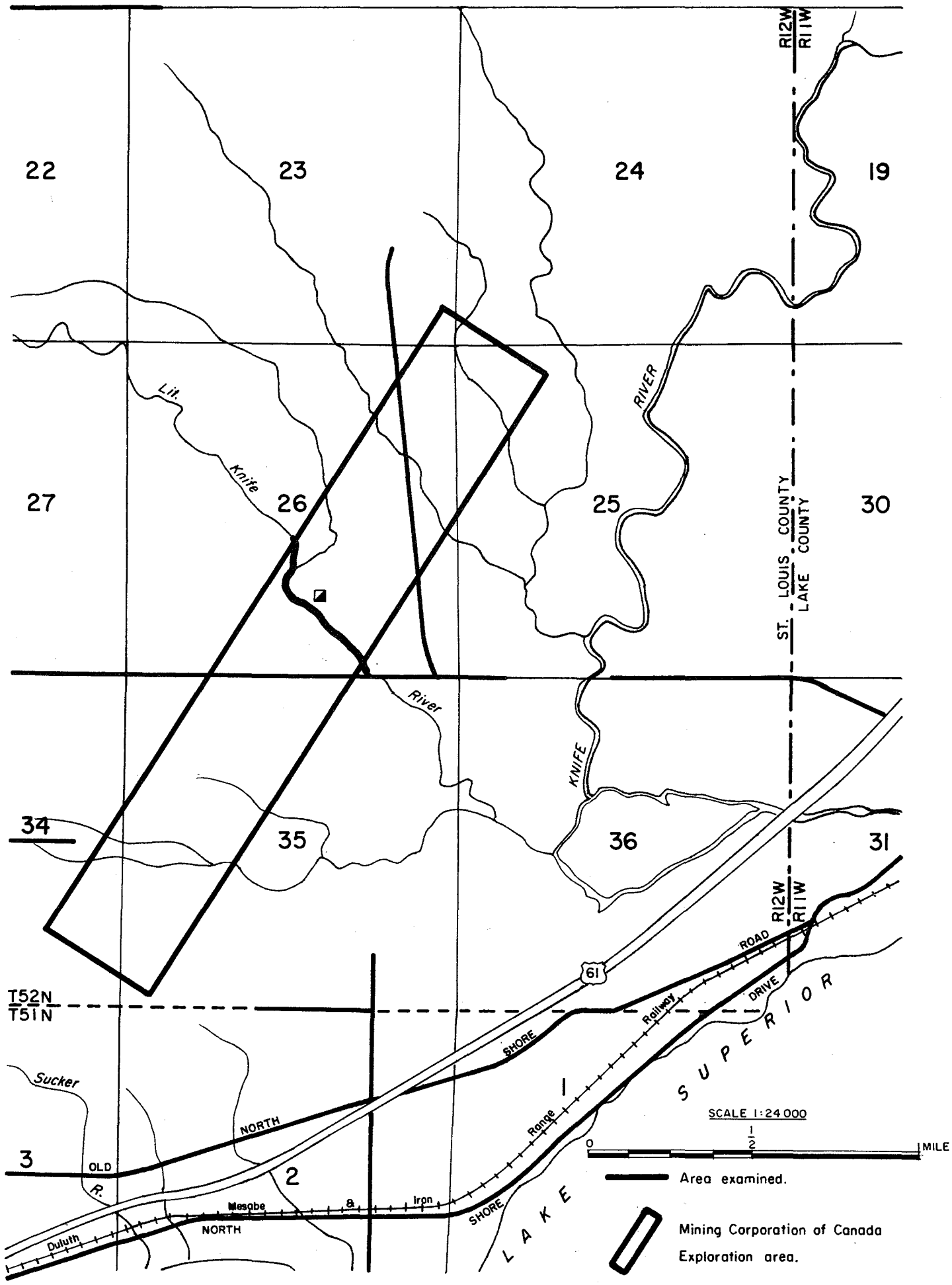
R12W
R11W
22
23
24
19
27
26
25
30
ST. LOUIS COUNTY
LAKE COUNTY
Lit.
Knife
RIVER
River
KNIFE
34
35
36
31
R12W
R11W
ROAD
61
T52N
T51N
SHORE
Railway
DRIVE
SUPERIOR
Sucker
NORTH
3
OLD
R.
2
1
Range
Mesabe
&
Iron
Duluth
NORTH
SHORE
LAKE
SCALE 1:24 000
0
1/2
MILE
Area examined.
Mining Corporation of Canada
Exploration area.
Shaft.

Figure 3

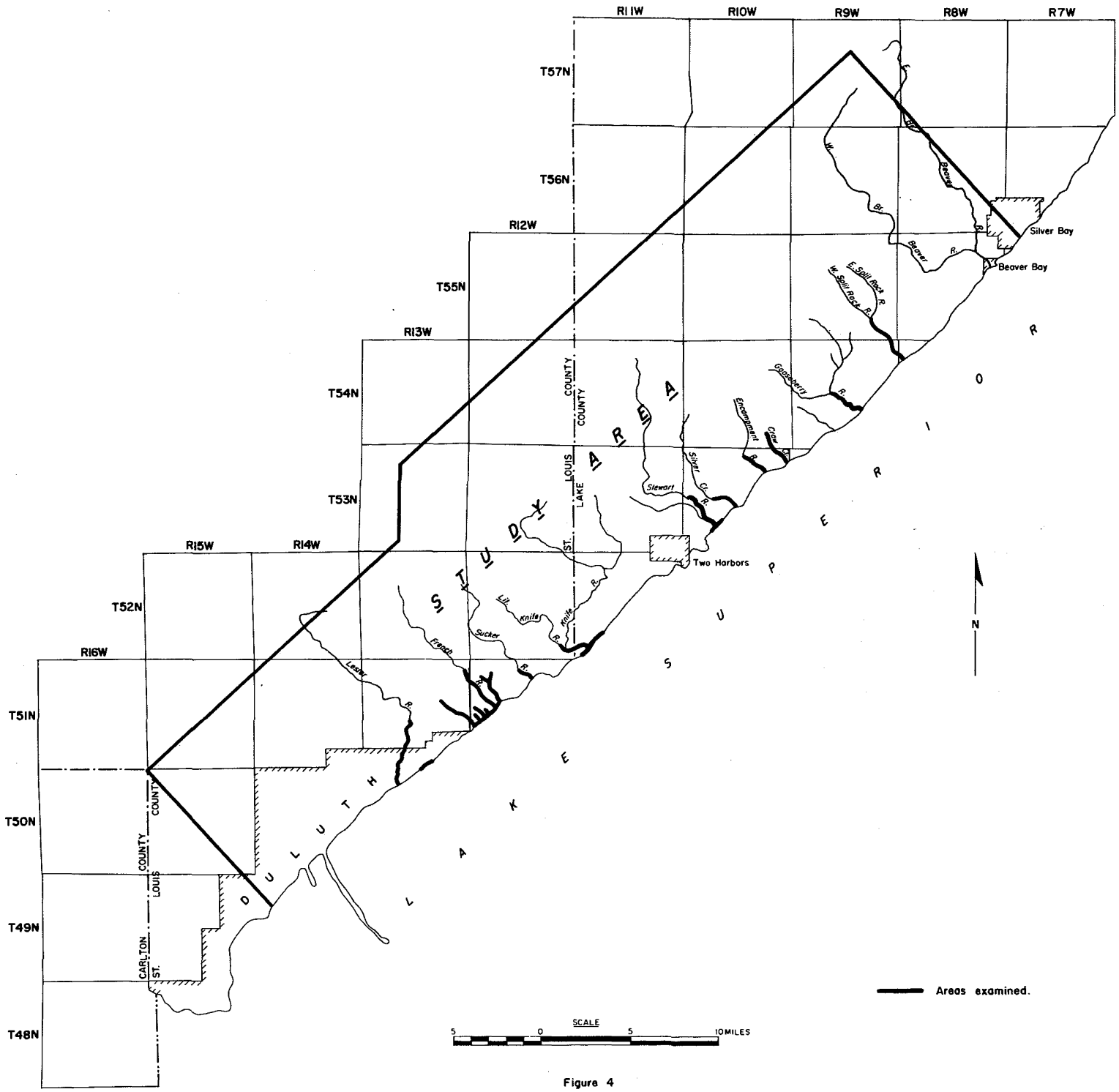
R11W
R10W
R9W
R8W
R7W
T57N
T56N
R12W
T55N
R13W
T54N
T53N
R15W
R14W
T52N
R16W
T51N
T50N
T49N
T48N
COUNTY
LOUIS
LAKE
ST.
CARLTON
COUNTY
STUDY AREA
Two Harbors
Silver Bay
Beaver Bay
Stewart
Silver Cr.
Encampment
Gooseberry
Lester
French
Sucker
Lit. Knife
Knife
W. Beaver Br.
Beaver R.
E. Split Rock R.
W. Split Rock R.
SUPERIOR
DULUTH
LAKE
N
Areas examined.
SCALE
5 0 5 10 MILES

Figure 4

MINERAL OCCURRENCES

Purple fluorite occurrences were noted in two locations; one on the Lester River and one on the shore of Lake Superior in the NW-NW, 3-50-13. Both occurrences were in amygdules and fractures in felsic volcanic rocks. Both are small areas with little more than traces of fluorite.

Native copper occurrences were more abundant with 17 being observed thus far. As shown on Figure 2, 13 of these are in the French River area. Three others are on the Stewart River (two in the NW-SE of 20-53-10 and one in the SE-NE of 19-53-10) and the last one on the Split Rock River (SW-NE, 35-55-9). These ocurrences are small, generally low grade, and discontinuous in nature. Copper may run as high as 10% in small areas, but the mineralized units are usually about six inches thick and can be traced for less than thirty feet. The copper occurs as native copper, malachite, azurite, chalcocite, covellite and cuprite. Native silver has also been observed microscopically. These occurrences are very easily overlooked if they are not specifically searched for. The native copper very quickly develops an oxide or malachite coating, making it difficult to spot at a distance. The important things to look for are the distinctive malachite green and the bleached appearance of the host rocks. There is a very close association, in most cases, of the copper to prehnite. The showings of copper are generally with prehnite in rubbly flow-tops or interflow sediments. Prehnite, being a very pale green color, usually gives the rock a light colored or bleached appearance. The copper occurrence on the Split Rock River was the only one observed without obvious prehnite. Some copper was also observed occurring in large calcite pods, but only as boulders in the river beds.

In addition to the "in place" copper shows observed, copper-bearing boulders were observed in the bed of every river except the Encampment. Copper-bearing cobbles and boulders are also common along most of the Lake Superior shoreline in the area.

One other copper occurrence in the area is not visible at the surface. The Mining Corporation of Canada explored the Little Knife River area (26-52-12) in 1929-30 (Figure 3). They drilled twenty holes and put down a 110 foot shaft with 200 feet of drifting. They intersected three mineralized flow-top horizons with native copper and a little silver. Because of the dip and strike of the units involved, they are not seen in outcrop along the river. Assays from the drill core ranged up to 1.38 percent copper.

LABORATORY RESULTS

Polished sections and thin sections were made of one flow-top sample and one sandstone sample. These samples were also analyzed by Atomic Absorption methods for several elements. The chemical results are presented in Table 1. The microscopic work shows that SL-3365, the sandstone sample, is composed of epidote, prehnite, quartz, feldspar, sphene and opaques. The copper minerals are native copper, cuprite and chalcopyrite. Magnetite and a trace of native silver are also present. The flow-top sample (SL-3364) is composed of epidote, prehnite and opaques, with relict volcanic textures. An examination of polished sections for SL-3364 showed 3.9% native copper (Cu), 1.7% cuprite (Cu_2O), 0.4% chalcocite (Cu_2S), with traces of covellite (CuS), malachite ($Cu_2CO_3(OH)_2$), and native silver (Ag). The paragenetic sequence for the copper minerals is native copper, chalcocite and covellite, cuprite and malachite.

SAMPLE LOCATIONS

SL-3364: SW1/4 of section 3, T.51N., R.12W. Not in outcrop. Found in bed of Sucker River.

SL-3365: SW-SE of section 18, T.51N., R.12W. Outcropping just below freeway, near tunnel entrance, on an unnamed small creek. Sample should be representative of this occurrence.

L-3343: NE-NW of section 22, T.53N., R.10W. From 10-20 foot calcite vein on Silver Cliff.

TABLE 1

Sample No.	*Ag	As	Au	Co	Cu	Ni	S	Zn
SL-3364	21.0	4.2	0	NA	3.60%	NA	0.032%	NA
SL-3365	10.8	3.1	0	NA	2.04%	NA	0.028%	NA
L-3343	0.016	NA	0	93	87	130	NA	160

NA - Not analyzed
Results in ppm except where noted
*33ppm is approximately 1 oz/ton