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August 17, 1973

Mrs. R.S.Y. Wolfe
Homestake Mining Company
650 California Street
San Francisco, Calif. 94108

Dear Mrs. Wolfe:

In response to your letter of August 13, 1973, I enclose Copy No. 4 of your book titled Wisconsin Massive Sulfide Search.

I look forward to talking to Mr. Colen upon his return, to explain our reasons for not proceeding with the extremely attractive joint venture project that we discussed.

Very truly yours,

Paul I. Eimon
Manager of Exploration

ESSEX INTERNATIONAL, INC.

PIE:td
enclosure

HOMESTAKE MINING COMPANY
650 CALIFORNIA STREET
SAN FRANCISCO, CALIFORNIA 94108

CABLE: HOMESTAKE
TELEPHONE (415) 981-8150

August 13, 1973 No. 179

SXM
AUG 16 1973
RECEIVED

Mr. Paul Eimon
Manager of Exploration
Essex International, Inc.
1704 West Grant Road
Tucson, Arizona 85705

Dear Mr. Eimon:

In view of the telephone message you left for Mr. Colen on Friday afternoon, August 10, 1973, that Essex International had decided not to pursue negotiations regarding our Wisconsin exploration program, we would like to have returned to us Copy No. 4 of our book titled "WISCONSIN MASSIVE SULFIDE SEARCH" sent to you with Mr. Colen's letter No. 131 dated June 21, 1973. We would appreciate your mailing it back to us at your earliest convenience.

Mr. Colen, I am sure, will be writing you shortly to express his appreciation for the time and consideration you gave to the possibilities of this program.

Sincerely,

R. S. Y. Wolfe

(Mrs.) R.S.Y. Wolfe

July 2, 1973

Mr. Henry R. Colen
Vice President, Exploration
Homestake Mining Company
650 California Street
San Francisco, Calif. 94108

Dear Henry:

I have had time to review your Wisconsin Massive Sulfide Search memorandum which I received last week. First, I want to compliment you on the quality of the presentation of the report. I am extremely interested in the proposal on the part of Essex, but will first have to discuss the proposition with Howard Lanier, who will be in Tucson on July 5. I would expect to communicate with you relative to the seriousness of our interest in the proposal on or about July 11 or 12.

Thank you for sending the proposal to us.

Best regards and happy prospecting,

Paul I. Eimon
Manager of Exploration

ESSEX INTERNATIONAL, INC.

PIE:td

P.SS - Thanks for your call. I attach the recent Information Bulletin on Essex International, Inc. by Paine Webber Jackson & Curtis. Note the paragraph I have circled on page 1 as well as the next to the last paragraph in the article.

P.I.E.

enclosure

HOMESTAKE MINING COMPANY
650 CALIFORNIA STREET
SAN FRANCISCO, CALIFORNIA 94108

CABLE: HOMESTAKE
TELEPHONE (415) 981-8150

June 21, 1973

No. 131

CONFIDENTIAL

Mr. Paul Eimon
Manager of Exploration
Essex International, Inc.
1704 West Grant Road
Tucson, Arizona 85705

Dear Paul:

Enclosed is the report I promised to send you during our telephone conversation this morning.

Very truly yours,

HOMESTAKE MINING COMPANY

Henry

Henry R. Colen,
Vice President, Exploration

HRC:ry

Enc. - Copy #4 of WISCONSIN MASSIVE SULFIDE SEARCH

#4

WISCONSIN MASSIVE SULFIDE SEARCH

A PROGRAM OF DETAILED

EXPLORATION OF SPECIFIC MASSIVE SULFIDE TARGETS

AND

FURTHER EXAMINATION OF THE

POTENTIAL OF THE PRECAMBRIAN SHIELD

OF PART OF THE NORTHCENTRAL UNITED STATES

HOMESTAKE MINING COMPANY

JUNE, 1973

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Figure 2 - Greenstone Belts in Wisconsin - Homestake Exploration Areas — Following Page 13

SUMMARY AND CONCLUSIONS

A comprehensive study and review of the rock types in the Precambrian Shield of the northcentral United States has shown that the geologic environment is favorable for the occurrence of a variety of base and precious metal ore deposits.

Our primary objectives in this region are to locate relatively high-grade volcanogenic copper-zinc deposits and/or nickel-copper deposits.

Reconnaissance work since 1969 has identified nine specific geologic and geophysical targets. All are located in volcanic sequences with basaltic and rhyolitic pyroclastic and tuffaceous rocks exposed in outcrops. Two anomalous areas occur in northwestern Wisconsin, within a few miles of the Ladysmith orebody. The remaining anomalies are found in northeastern Wisconsin. Three holes have been drilled on the Goodman Lumber lands in northeastern Wisconsin and they all carried massive pyrrhotite with significant quantities of chalcopyrite, sphalerite, gold and silver.

In 1973, our work will involve detailed ground geophysics, geochemistry, and geology to better define the targets. After targets are adequately defined, they will be tested by diamond drilling. Concurrent reconnaissance work will be done to further study additional anomalies known from airborne surveys.

A budget for this program totaling $145,000 for 1973 is recommended to effectively explore areas of interest ahead of competitors. Recommended expenditures for 1974 and subsequent years will depend upon the 1973 results.

INTRODUCTION

The geology of northern Wisconsin establishes that most or all of this region is underlain by an extension of the Superior block of the Precambrian Shield.

Although outcrops are not abundant in many areas, work to date has proven that much of the Precambrian surface is overlain by relatively shallow glacial cover, generally from 30 to 100 feet thick. Therefore, most of the region can be explored by modern geochemical and geophysical methods, and relatively inexpensive drilling. The combination of extensive shallow cover and a generally favorable land acquisition picture make northern Wisconsin a prime region for metal exploration. Except for portions of the Keweenaw Copper Belt and the various iron formations, the region remains poorly explored.

The very important gold, copper, nickel, and other deposits in the Superior block of the Precambrian Shield in Ontario and Quebec are widely known. The recent discovery by the Great Lakes Copper Division of Kennecott Copper of important high-grade copper-zinc mineralizations near Ladysmith, Wisconsin indicates that new deposits, and indeed, new mining districts can be discovered in Wisconsin during the next decade. (Figure 1)

The Ladysmith discovery stimulated initiation of exploration efforts by the Calumet Division of Universal Oil Products Company and other companies. The Calumet Division enjoyed an advantageous land position because of the ownership of the Goodman Lumber lands by UOP. An active program in the Goodman area as well as other parts of the state was initiated by Calumet in September, 1969 under the supervision of Randall Weege. The work commenced with detailed studies of maps, literature, and outcrops in the field. Over a three-year period the work was expanded to airborne electromagnetic and magnetometer surveys; land acquisition; detailed ground geology, geochemical and geophysical surveys; and diamond drilling. Expenditures over the three-year period totaled $388,000. The details of this work are discussed in the next section.

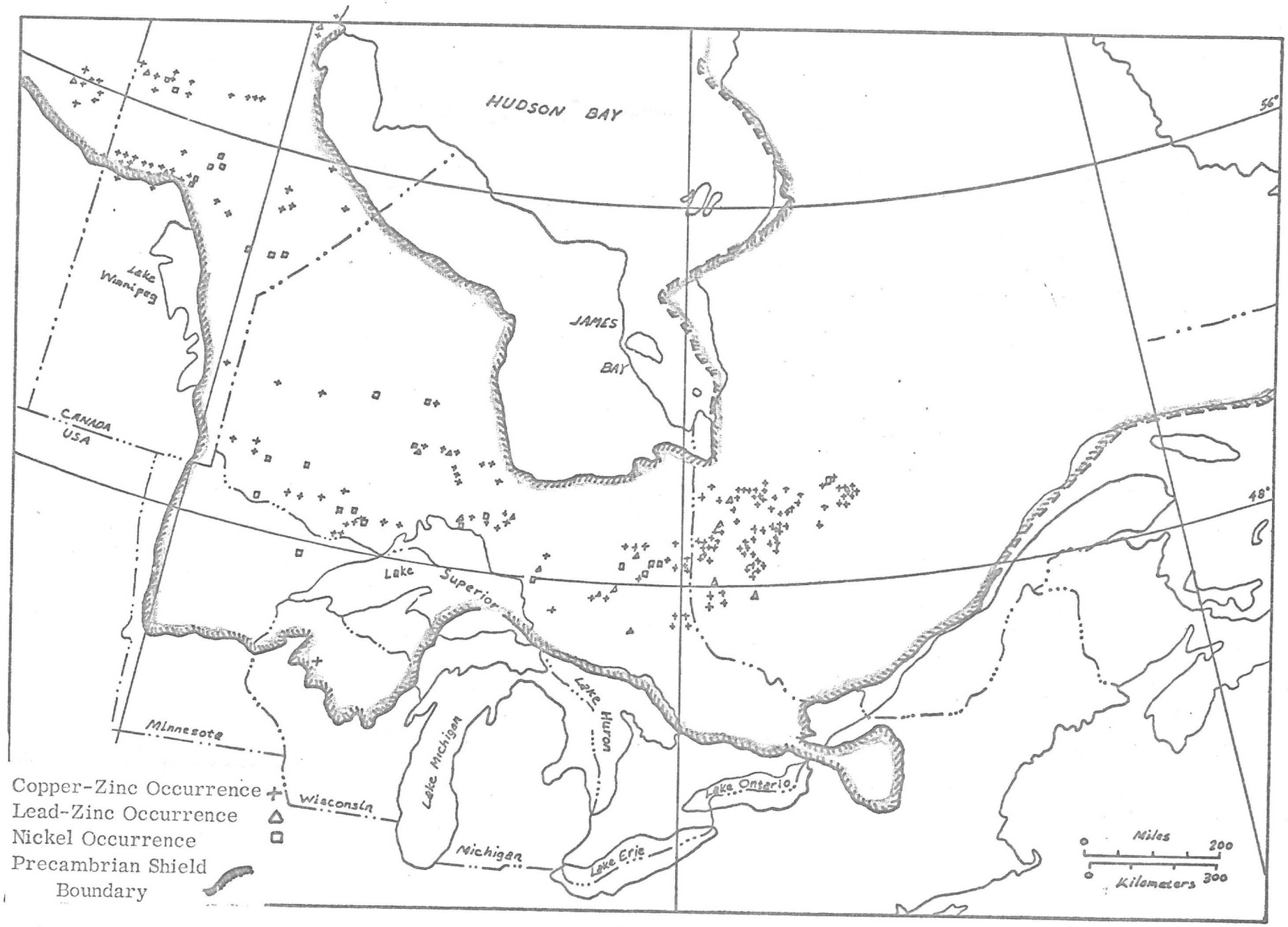


Figure 1

MASSIVE SULFIDE DEPOSITS IN THE CANADIAN SHIELD

Homestake Mining Company is in the final stages of completing an agreement with UOP which will permit us to acquire all of the exploration data and land positions. Also, Randall Weege is now employed by Homestake Mining Company with responsibilities, in part, to continue supervision of exploration in Wisconsin.

The primary targets of the Wisconsin exploration program are large, relatively high-grade volcanogenic deposits of copper and zinc with associated lead, gold, silver, tin, cadmium and other metals. An ideal target model is the Kidd Creek deposit of the Texas Gulf Corporation: approximately 100,000,000 tons of 1.30% Cu, .35% Pb, 8.20% Zn, .042% Cd, 3.4 oz/T Ag and 0.2% Sn. Other targets are nickel-copper deposits associated with gabbroic and ultramafic rocks and gold deposits of any type.

PREVIOUS WORK

In September, 1969, the Calumet Division of UOP initiated an exploration program to search for metal deposits in northern Wisconsin. The present program evolved from this initial work with Homestake acquiring all data, land, and key personnel. To date, UOP has made the following expenditures:

1970	$131,000
1971	234,000
1972	23,000
Total	$388,000

The program consisted of five phases:

1. Reconnaissance Geology, Geophysical, and Geochemical Work
2. Airborne Electro-magnetic Surveys
3. Property Acquisition
4. Detailed Geological, Geophysical, and Geochemical Work
5. Diamond Drilling

Phase I - Reconnaissance Work

This phase consisted of a literature search and study, outcrop examination, reconnaissance soil sampling, isolated E. M. surveys, and a detailed magnetic survey made by taking continuous readings along existing roads with a magnetometer pulled on a wooden toboggan.

Results from this program provided a magnetic base map for plotting geological and geochemical data. Magnetic trends and rock types were established providing the basic information necessary to select areas to be flown.

During this period the following work was completed:

Method	Amount
Soil Sampling	2,395 samples collected and analyzed
Regional ground magnetics	512 miles
Detailed ground magnetics	232,510 feet
EM-16 Survey	188,350 feet
Horizontal Loop EM Survey	29,300 feet

Phase II - Airborne EM

Initially, 2,094 line-miles were flown using the INPUT method between Ladysmith and Park Falls, Wisconsin. At a later date, 1399 line miles were flown near Goodman, Wisconsin and 467 miles near Mountain, Wisconsin. These last two surveys utilized the Geoterrex EM system in an Otter aircraft.

Ladysmith-Park Falls Survey

As a result of this survey, 52 anomalous zones were isolated that required additional ground follow-up. Subsequent ground work eliminated many of the anomalies from high priority consideration. However, the combined results of both the ground reconnaissance and airborne work led to the selection

of ten areas that were favorable and required land acquisition. In the present program, two of these areas are considered to be of especially high priority.

Goodman Area

UOP controls the mineral rights to approximately 60, 000 acres in the Goodman, Wisconsin area. It is known that the area is underlain by Precambrian rocks and outcrops were examined to determine if favorable volcanic rocks were exposed. Accordingly, exposed rocks were mapped as well as a pipe line ditch currently in progress, and specimens were collected. This work showed that the rocks were favorable types in a greenstone belt and that some of the rocks carried significant quantities of pyrite and minor chalcopyrite.

During February, 1971, the area was flown with an Otter-type aircraft and the Geoterrex EM system. Over 200 anomalies were detected, but most of them were cultural features, such as power lines, pipe lines, fences, etc. and were eliminated from further consideration. However, forty-one anomalies were considered to be caused by bed rock conductors. Of the forty-one anomalies, two were tested by ground geophysics and diamond drilling. Both anomalies were caused by massive pyrrhotite with minor,but significant, associated chalcopyrite and sphalerite. These areas are discussed in more detail later in the report.

Under the present program we are planning to test fourteen anomalous zones in six separate areas. It is probable, however, that reconnaissance work will show that some of the other anomalies should be further tested.

Mountain Area

This area was flown to test for conductors along the Hager Rhyolite-Waupee basic volcanic contact interpreted by us to represent an old volcanic paleoslope favorable for massive sulfide deposits in other areas. A highly

rated anomaly was found along the projection of this contact. A prospecting permit has been obtained over the anomaly, but no ground geophysics or diamond drilling has been done to date.

Phase III - Property Acquisition

UOP leased over 7,000 acres in ten widely scattered areas in the Ladysmith-Park Falls area considered favorable for various reasons. Ground work eliminated five of these areas from high-priority consideration at this time. Two of the anomalous zones are included in the present program and the remaining three have not been tested. All but three of these leases have been allowed to lapse, however, and we are now in the process of again leasing the favorably located properties.

In the Goodman area, only two anomalous zones were on or near private properties. These properties were leased, but also have been allowed to lapse. As at Ladysmith, we are in the process of leasing the desirable lands.

Phase IV - Detailed Geological, Geophysical, and Geochemical Work

Considerable ground work has been done. The following table shows the total footage survey by various methods. Lines were normally brushed on 400 foot centers and measurements were taken every 25 or 50 feet along the lines:

Type of Work	Footage
Brushing	332,950
Surveying	89,260
Magnetics	319,060
EM-16 Survey	318,200
Horizontal Loop EM	122,250
Vertical Loop EM	58,850
I. P.	19,500
Soil Sampling	85,100
Gravity Survey	13,800

Phase V - Diamond Drilling

During the course of the previous exploration, sixteen diamond drill holes totaling 8,406 feet were completed.

Results

The results from this program verified the existence of greenstone belts with favorable rock types carrying massive pyrrhotite-pyrite with significant values in copper, zinc, gold and silver. The work was primarily of a reconnaissance nature and has isolated nine separate areas, all attractive for various reasons, and several of which may be the best exploration bets in the State of Wisconsin.

GEOLOGIC MODEL OF MASSIVE SULFIDE TARGETS

GENERAL

Two principal types of massive sulfide deposits are found in geologic environments similar to those that have been delineated by our work in northern Wisconsin: volcanogenic copper-zinc deposits, and nickel-copper deposits associated with gabbroic and ultramafic rocks. Since both types may cause nearly identical geophysical responses, either type may be discovered in the areas under consideration. Target anomalies occurring in rhyolitic, pyroclastic and tuffaceous rocks within basic volcanic sequences are more likely to be caused by the copper-zinc type of deposit exemplified by deposits at Noranda, Matagami, and Kidd Creek. Nickel-copper deposits at Lynn Lake and Thompson, Manitoba are typical of the second type and serve as models in this category for our exploration program.

GEOCHEMICAL PARAMETERS

The entire area under consideration has been subjected to continental glaciation and thus is subject to varying degrees of effectiveness of geochemical prospecting. End moraines are present both in northwestern and northeastern Wisconsin which has resulted in thick overburden in certain places. Areas between the moraines are covered by ground moraines, outwash, glacial lake deposits.

In areas of thin overburden, however, soil sampling has been a useful indicator of mineralization. Experimental work has shown that both copper and zinc are reliable indicators and it is quite possible that nickel will prove to be useful.

At present, we are studying applications of deep geochemical testing of basal glacial tills.

GEOPHYSICAL PARAMETERS

Our target models represent high concentrations of sulfide minerals and therefore, probably relatively good conductors. As such, most deposits are detectable by both ground and airborne electromagnetic methods. Induced polarization and VLF electro-magnetic systems are useful in detecting less concentrated mineralization.

Many deposits contain pyrrhotite and magnetite making magnetic methods useful, particularly when associated with EM anomalies.

COPPER-ZINC MASSIVE SULFIDE TYPE

TYPE EXAMPLE - KIDD CREEK

Texas Gulf's Kidd Creek Mine in the Timmins area was found by geophysics in 1964, began production in 1966 and now produces at more than 9,000 tons per day, having a recovered grade of 1.30% Cu, .35% Pb, 8.20% Zn, .042% Cd, 3.4 oz/T Ag and 0.2% Sn. The deposit consists of massive sulfides concordant with the enclosing steeply dipping rhyolite host rocks and overlain by andesite. Reserves in 1970 were in excess of 90 million tons with depth and some lateral dimensions not delineated.

FAVORABLE AREAS

Based on the information available at this time, the following areas are thought to have favorable environments for copper-zinc massive sulfide deposits:

1. Zone #5 UOP land in Section 32
2. Mountain Area
3. Chalcopyrite Line Area (also Ni-Cu possibilities)
4. Area #6 Ladysmith
5. Area #5 Ladysmith
6. Zone #9 Florence County Land

SIZE AND GRADE

Ore deposits of this type vary from small pods to very large lenses. Most deposits carry major quantities of copper and zinc with minor, but recoverable, values in gold and silver. In some deposits, lead is present, and at Kidd Creek tin is recovered. Typical massive copper-zinc deposits are listed on the following page:

Ore Body	Tons (000's)	% Copper	% Zinc
Garon Lake	225	2.27	-0-
New Hosco	2,200	2.7	-0-
Radiore	117	1.05	8.45
Matagami Lake	20,000	0.7	12.0
Aldermac	2,100	1.65	-0-
Horne (Noranda)	49,000	2.2	-0-
Mobrun	3,000	0.69	2.18
Quemont	15,000	1.3	2.2
Waite	1,100	4.7	3.1
Normetal	8,500	2.6	5.0
Ladysmith	2,500 (est.)	2.5	?
FlinFlon	59,000	2.2	4.4
Kidd Creek	100,000	1.3	8.20

MINERALOGY

The above deposits typically carry large amounts of pyrite, pyrrhotite, magnetite, chalcopyrite, and sphalerite. Minor galena, chalcocite, gold and silver are commonly present.

GEOLOGIC SETTING

Copper-zinc massive sulfide deposits are commonly located in thick volcanic piles displaying cyclic deposition of rock types. In the classic case, basic volcanic rocks grade upward to younger dacitic and rhyolitic tuffs and pyroclastics. The sulfide deposits are located at breaks between the last acid phases of one cycle and the initial and basic phase of the next cycle. Banded tuffs, cherts, carbonates and iron formations are found at these horizons.

Younger sill or dike-like basic intrusions are associated with many deposits. It is evident that the metal rich solutions of these deposits were derived from deep volcanic sources and were directed through fractured and brecciated zones in the underlying rocks into and onto unconsolidated pyroclastic and tuffaceous rocks on the sea floor.

NICKEL-COPPER MASSIVE SULFIDE TYPE

TYPE EXAMPLE - LYNN LAKE MINE

The Lynn Lake Mine, owned and operated by Sherritt Gordon Mines Ltd., was discovered by prospecting in 1941. Sufficient ore had been outlined by 1950 to support the cost of plant and railway construction and production of the first nickel-copper concentrate began in 1953. Ore reserves, estimated at the end of 1970 totaled 12,600,000 tons averaging 0.77% Ni and 0.38% Cu including 12 1/2% dilution. The ore from the "EL" ore body was significantly higher grade than the other ores. When production began, the 2.4 million ton "EL" ore body averaged 2.5% Ni and 0.93% Cu. The "EL" ore body was mined out by the end of 1963.

TYPE EXAMPLE - THOMPSON MINE

At the time production started at the Thompson Mine in 1960, the proven ore reserves amounted to 25,000,000 tons containing 2.97% Ni plus copper (Zurbrigg, 1963, Thompson Mine Geology; Bull. Can. Inst. Mining Met., Vol. 56, p. 451). Through the years since 1960, these reserves have been essentially maintained. In The International Nickel Company prospectus for March, 1968 (p.7), which gives the latest published figures, proven ore reserves for Manitoba were listed as 67,313,000 tons, with a nickel content

of 1,270,000 tons (1.89%) and a copper content of 90,000 tons (0.13%). From the same source, the tonnage mined in Manitoba during 1967 was 1,976,000 grading 2.77% Ni and 0.18% Cu. The INCO 1969 annual report (pp. 7 and 8) gives the approximate daily production from the Thompson Mine during 1969 as 8,000 tons per day, and from the Birchtree Mine as 4,000 tons per day.

FAVORABLE AREAS

The geologic setting in the following areas favors the nickel-copper type of massive sulfide mineralization:

1. Armstrong Creek Area
2. Zone #10 Florence County Land
3. Anomaly 37C
4. Chalcopyrite Line Area (Metagabbro)

SIZE AND GRADE

As with all massive sulfide deposits the size and grade varies within wide limits. Average nickel grade of eastern Canada nickel deposits is 1.5%. Nickel-copper ratios range from an average of 2:1 for Lynn Lake type deposits to 15:1 for Thompson type deposits.

MINERALOGY

Sulfides consist of pentlandite, chalcopyrite, pyrrhotite and minor pyrite. Other sulfides of nickel, copper and iron are commonly present. Nickel to copper ratios tend to vary directly with the magnesium content of the associated mafic or ultramafic rock.

GEOLOGIC SETTING

While nickel-copper ore deposits are found in a great variety of Precambrian terranes, they are always associated with basic or ultrabasic igneous rocks. The genetic significance of this association is sometimes enigmatic (particularly at Thompson), but the association is real and useful in exploration.

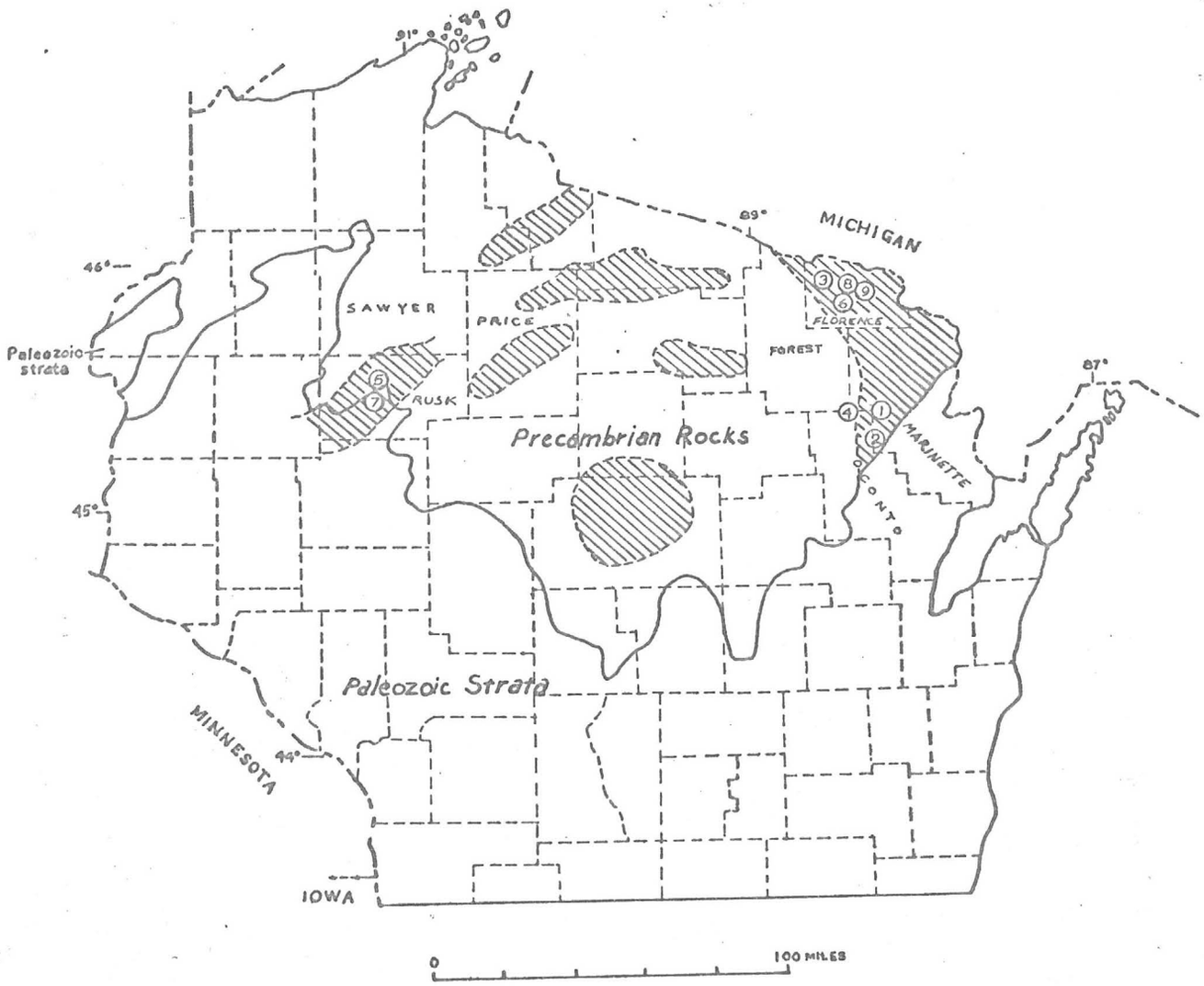
The deposits commonly occur in linear belts near areas of major faulting; therefore, linear anomalies paralleling major structural features in Wisconsin will be closely examined.

PROPOSED EXPLORATION PROGRAM

PRIORITY RATING

Based on the geologic or geophysical characteristics of the area, the targets are given the following priority rank. (Figure 2)

1. Zone 5 UOP Land Sec. 32
2. Mountain Area
3. Chalcopyrite Line Area
4. Armstrong Creek Area
5. Area #6 Ladysmith
6. Florence County Land #9
7. Area #5 Ladysmith
8. Florence County Land #10
9. Anomaly 37C
10. UOP Land Holdings (Lumber Lands) - reconnaissance work only



GREENSTONE BELTS IN WISCONSIN

Greenstone Belts

Homestake Exploration Areas

1. Zone 5 UOP Land Sec. 32
2. Mountain Area
3. Chalcopyrite Line Area
4. Armstrong Creek Area
5. Area 6 Ladysmith
6. Zone 9 Florence County Land
7. Area 5 Ladysmith
8. Zone 10 Florence County Land
9. Anomaly 37C

Figure 2

PROGRAM BY TARGET AREA

1. Zone 5 UOP Land, Section 32, T36N-R17E, Marinette County, Wisconsin

The largest and most intense part of this strong elongate EM-magnetic anomaly lies under a swamp and could not be drilled until the swamp froze in winter. UOP dropped their exploration work prior to freeze-up, but two holes were drilled on the edge of the swamp in the fringe of the anomaly. Both holes intersected massive sulfides with copper values in the range of 0.1% and zinc 0.5%. Significant quantities of gold and silver were also present.

The sulfides occur in a rhyolite-basic volcanic sequence that has been fractured and intruded by basic dikes. The mineralized zone is found near the edge of a broad circular magnetic low that is tentatively interpreted as being caused by a rhyolite or granitic intrusion. The relationships here appear to be similar to those at the Zone 9 Florence County anomaly where the geology is better known. Zone 9 will be discussed later in this report.

Since all the geophysical work has been completed and UOP owns the land, the only cost will be that of a 500 foot diamond drill hole to test the most intense part of the anomaly.

2. Mountain Area

The contact between the Hager rhyolite and Waupee basic volcanics was flown with Otter aircraft using the Geoterrex Rio Tinto type in phase - out of phase EM system measuring secondary field components at a frequency of 320 cycles per second and a Geometric Model G-803 high performance, proton resonance magnetometer. The contact denotes a break in volcanism which is

important under the volcanogenic theory. Lenses of massive pyritic sulfide containing varying amounts of zinc, copper and lead, as well as important silver and gold, are commonly found at such contacts. The lenses are frequently overlain by thin siliceous iron and manganese rich sedimentary strata (Waupee Volcanics?) and are usually underlain by extensive zones of altered and sulfide impregnated lava (Hager Rhyolite?). Primary breccia textures are also common, particularly at the tops of massive bodies. These are apparently related to some form of irruptive volcanic activity; such as, steam explosions in the underlying lavas with accompanying fragmentation of earlier deposited sulfides. This was apparently followed by redeposition involving turbidite activity, gravity-induced sedimentary slump and downward movement on the old volcanic paleoslope.

A good conductor associated with a magnetic high was found by the airborne work. The position of the anomaly coincides with the projected position of the rhyolite-basic volcanic contact. It is believed that the contact represents an old volcanic paleoslope and that the anomaly may have been caused by sulfides. The magnetic anomaly may be caused by pyrrhotite. The rocks are probably Archean in age, which is the period of geologic time when most massive sulfide deposits were formed. In addition, we have identified a metagabbro intrusive near the anomaly. Basic intrusive rocks are commonly found near massive sulfide deposits and some geologists believe that mafic intrusions indicate that there was metal partition at depth.

In order to test this anomaly, the following work is indicated:

Property Acquisition - Sections 24 and 25, T32N, R17E,
Oconto County, Wisconsin

A prospecting permit has already been issued to UOP for

the period November 1, 1972 to November 1, 1974. Annual costs are 25¢/acre or $320 for the 1,280 acres involved.

Geophysical and Geochemical Work

I. P. survey on 10 lines each 2,000 feet long.

Gravity survey on 10 lines each 2,000 feet long.

Due to the presence of a high tension power line, horizontal loop EM is not practical.

Soil samples (25 foot spacing) on the above lines for a total of 800 samples.

Drilling

After the anomaly is defined, one hole 500 feet deep will be necessary to test the best part of it.

3. Chalcopyrite Line Area

There are three targets in this area, all of which lie north of a line that denoted the edge of chalcopyrite mineralization as determined by examining outcrops. These targets are as follows:

a. Extension of Massive Sulfide Trend Drilled by UOP.

b. Rhyolite-Mafic Volcanic Contact.

c. Metagabbro.

All these targets lie in the Quinnesec formation of probable lower Precambrian age which consists largely of meta-felsic and basic volcanic rocks that have been intruded by gabbro. Each target is described below.

a. Extension of Massive Sulfide Trend Drilled by UOP.

This trend was identified and outlined by the airborne work. Diamond drilling by UOP showed that the anomaly was caused by massive sulfides -- largely pyrrhotite -- but with minor amounts of chalcopyrite and sphalerite. The trend projects into the area now under consideration.

Experimental work by Skinner and Peck (Magmatic Ore Deposits, H. D. B. Wilson, Editor, 1969) showed that there was an immiscible sulfide melt produced during the late stages of cooling of Hawaiian basaltic lavas. According to these authors, pyrrhotite crystallizes early. If any copper is present, it crystallizes as chalcopyrite and is preferentially concentrated along with the pyrrhotite. This depletion of sulfur pushes the reaction toward a cotectic between pyrrhotite and magnetite and these two minerals crystallize out together. As a result, there is an early phase of pyrrhotite where the copper is concentrated and a later phase of pyrrhotite that is barren of copper, but carries magnetite. Therefore, the late barren, highly magnetic phase should cause the best anomalies. The early cupriferous phase should accumulate in depressions due to crystal settling and cummulus concentration. If this is so, the best place to look for copper is in the stratigraphic lows rather than at the best magnetic anomalies.

Evidence indicating that such a process may have taken place in the area under consideration is shown by the fact that the only significant concentration of copper in the hole that was drilled by UOP occurred at the base of the massive sulfide zone. In order to test this idea, the

copper bearing horizon (which may be marked by the chalcopyrite line described on the prior page) will be traced and outlined by geophysical methods.

b. Rhyolite-Mafic Volcanic Contact

The contact between the felsic and mafic lavas as mapped by Carl Dutton of the U. S. G. S. runs almost north-south through the area under consideration. Any anomalies along this contact would probably not be detected by the airborne work which was also flown on north-south lines. It lies within the chalcopyrite zone and may represent a paleovolcanic slope similar to the one already described at Mountain.

c. Metagabbro

We have identified a chalcopyrite bearing metagabbro in outcrop in the area. The magnetics appear to outline this body and the contact between the country rock and gabbro will be geophysically studied.

All three of the above targets should be geophysically surveyed as a unit. In order to do this, the following work is necessary:

Property Acquisition - T39N, R17E, Florence County, Wisconsin

Minimal Requirements - 1,000 acres at $5,000/year.

Geophysical and Geochemical Work

I. P. Work	Linear Feet
3 lines 1400 feet long at right angles to trend - one property	4,200
8 lines 1000 feet long at right angles to rhyolite contact	8,000

I. P. Work (con't)		Linear Feet
6 lines 2000 feet long E-W over metagabbro		12,000
	subtotal	24,200

EM and Magnetic Work

EM-16 survey on same lines	24,200
Magnetics on same lines	24,200
Soil samples - 950 samples	

Drilling

3 diamond drill holes - 500 feet deep to test each target.

4. Armstrong Creek Area - T37N, R16E, Forest County, Wisconsin

Airborne EM detected two good conductors that flank a magnetic high in the Armstrong Creek area. The anomalous area coincides with a topographic high which may be a bed rock expression and reflect a basic or ultrabasic intrusive. No outcrops are known to exist. As a result, the geology is unknown and all relationships must be inferred. The geophysical results are indicative of a bed rock conductor with a direct magnetic correlation.

In order to test these anomalies, the following work is indicated:

Property Acquisition - T37N, R16E

Minimal Requirements	- Anomaly 1	360 acres at $1800/year
	- Anomaly 2	206 acres at $1,030/year
Additional Requirements (if drilling finds ore)	Both	320 acres at $1,600/year

Geophysical and Geochemical Work	Linear Feet
EM and Magnetic Work	
Horizontal Loop - all lines	45,000
EM-16 - all lines	45,000
Magnetics - all lines	45,000
Soil samples - 1800 samples	
Drilling	
2 diamond drill holes - 500 feet deep to test each target	

5. Area #6, Ladysmith Area - T37N-R7W, Sawyer County, Wisconsin

This area carries the only significant INPUT bedrock anomaly on leased land that was rated as a sulfide prospect in the immediate Ladysmith area. Since Kennecott has one mine and another area of mineralization in the only other bedrock anomalies that we believed were significant, it should be tested.

From EM work done by UOP, it is concluded that the anomaly is deep seated. Horizontal loop EM would not have penetrated deeply enough to accurately define the anomaly. It is, therefore, recommended that I. P. be run to outline the conductor.

Since UOP has allowed leases to lapse in this area, the land must again be acquired.

Property Acquisition

Minimal Requirements - 170 acres at $850/year

Additional Requirements - 160 acres at $800/year (if drilling finds ore)

Geophysical Work

I. P. Work

Line	From-To	Linear Feet
28 + 00W	N1400 - S1000	2400
24 + 00W	N1400 - S1000	2400
20 + 00W	N1400 - S1000	2400
16 + 00W	N1400 - S1000	2400
12 + 00W	N1400 - S1000	2400
8 + 00W	N1400 - S1000	2400
		14,400

Drilling

One diamond drill hole - 500 feet deep to test the best part of the anomaly.

6. Florence County Land - Zone #9

This anomaly has a short strike length, good conductivity, and a direct magnetic correlation of 500 gammas. It is similar to Zone #5 on UOP land as already mentioned in that the conductor lies on the flank of a broad circular magnetic low. This low coincides with the Hoskin Lake granite as mapped by Dutton. The Hoskin Lake granite is intrusive into the Quinnesec formation of lower Precambrian age. This anomaly was given the highest rating of all the conductors in the Goodman area by Geoterrex, the geophysical contractor.

Property Acquisition - T38N, R17E

Minimal Requirements - 160 acres at $800/year

Additional Requirements - 240 acres at $1,200/year
(if drilling finds ore)

Geophysical and Geochemical Work	Linear Feet
EM and Magnetic Work	
Horizontal Loop - 6 lines 1500 feet long	9,000
EM-16	9,000
Magnetics	9,000
Soil samples - 360 samples	

Drilling

One diamond drill hole - 500 feet deep to test the anomaly.

7. Area #5 - Ladysmith

This area lies immediately to the north of an area drilled by UOP. The UOP drilling showed that considerable pyrite with up to 0.1% Cu, both as chalcopyrite and chalcocite, was present. The rock types include quartz-sericite-chlorite schists (meta-tuffs?) and rhyolites and basalts. It is believed that these rocks are similar to those that host Kennecott's Ladysmith deposit. Therefore, the favorable geologic environment coupled with the fact that sulfides are known to occur nearby, make this area attractive. Horizontal loop by UOP did not disclose any strong anomalies. It is, therefore, evident that any conductors that may be present are either deep or weak. I. P. may detect such conductors and the following work will be done:

Property Acquisition

The present UOP lease (276 acres) will remain in effect until September 16, 1973, but notification of renewal must be made by July 16, 1973.

Geophysical and Geochemical Work

I. P. Work

Line	From-To	Linear Feet
4 + 00E	1200N - 2400N	1200
12 + 00E	1200N - 2400N	1200
20 + 00E	1200N - 2400N	1200
28 + 00E	1200S - 2600N	3800
36 + 00E	900S - 2600N	3500
		10,900

Soil samples - 400 samples

Drilling

One diamond drill hole - 500 feet deep to test the anomaly.

8. Florence County Land - Zone #10

Zone #10 is an excellent conductor exhibiting intensity ranging from fair to excellent. There is magnetic association throughout and it appears to be direct,especially in the east half. Even though the high conductivity and formational character suggests a graphitic source, follow-up is recommended in two places where intensity is strongest. Local enrichment of sulfides may have occurred in these two areas.

Property Acquisition

Minimal Requirements - 480 acres at $2,400/year

Additional Requirements - 800 acres at $4,000/year
(if drilling finds ore)

Geophysical and Geochemical Work	Linear Feet
EM and Magnetic Work	
Horizontal Loop - 10 lines 1500 feet long in Sec. 36	15,000
- 6 lines 1500 feet long in Sec. 31	9,000
EM-16	24,000
Magnetics	24,000
Soil samples - 960 samples	
Drilling	
2 diamond drill holes - 500 feet deep to test the best portions of the anomalies	1,000

9. Anomaly 37C

This anomaly has already been defined by ground geophysics and is now ready to drill. It is a fairly strong conductor, possibly multiple, and has an apparently correlating 100 gamma magnetic response.

Property Acquisition - T38N-R18E

Minimal Requirements - 140 acres at $700/year

Drilling

One diamond drill hole - 500 feet deep

10. UOP Land Holding (Lumber Lands) + 60,000 Acres

These lands are strategically located in Florence, Forest and Marinette Counties. If a mineralized district is discovered, they would have a very high exploration potential. A large portion of these lands are underlain by the Quinnesec formation. A blanket exploration permit will be obtained from UOP. Although there are a number of airborne anomalies present that indicate bedrock sources, only reconnaissance work is recommended at the present time. If ore is found at one of the nearby anomalies being tested, these lands would quickly change to a high priority status.

Under the Homestake-UOP agreement, we would have until December 31, 1973 to select the land that we wish to retain from the UOP lumber holdings.

SUMMARY OF WORK TO BE COMPLETED IN 1973

PROPERTY ACQUISITION

Minimum	-	1,520 acres (excluding Federal and UOP Lands)
Maximum	-	2,792 acres (to protect anomalies)

GROUND EXPLORATION

Area	Soil Samples	LINEAR FEET Brushing	I. P.	Horiz. Loop	EM-16	Magnetics and Gravity	Diamond Drilling
1. Zone 5 UOP		- Geophysics Completed -					500
2. Mountain	800	20,000	20,000	--	--	20,000	500
3. Chalcopyrite Line Area	950	24,200	24,200	--	24,200	24,200	1,500
4. Armstrong Creek	1,800	45,000	--	45,000	45,000	45,000	1,000
5. Area #6 Ladysmith	--	Compl.	14,400	Compl.	Compl.	Compl.	500
6. Florence Co. Zone #9	360	9,000	--	9,000	9,000	9,000	500
7. Area #5 Ladysmith	400	Compl.	10,900	--	Compl.	Compl.	500
8. Florence Co. Zone #10	960	24,000	--	24,000	24,000	24,000	1,000
9. Anomaly 37C		- Geophysics Completed -					500
10. UOP Lands (Lumber)		- Reconnaissance Work -					
TOTALS	5,270	122,200	69,500	78,000	102,200	122,200	6,500

COMPETITOR ACTIVITY

Northern Wisconsin has been the site of considerable exploration in recent years by a number of companies including Kennecott, Texas Gulf, U. S. Steel, Asarco, International Minerals, Noranda, Superior Oil, Humble Oil, Duval and probably others of whom we are unaware. It is known that all the known greenstone belts have been flown at least once and, most of them, several times. Kennecott, IMC, Duval, U. S. Steel and of course, UOP, have had extensive drilling campaigns.

UOP, however, was the second company to fly (Kennecott was the first) in the Ladysmith area and the first in part of northeastern Wisconsin. As a result, Homestake now has a preferred land position and personnel thoroughly familiar with the geology, geophysics, and geochemistry of northern Wisconsin.

We feel that we are one step ahead of our competitors and that our chances of discovering a massive sulfide deposit are excellent.

PERSONNEL

In the past, the Wisconsin exploration program was managed by the Calumet Division of UOP and conducted by the people whose resumes are briefly outlined below. The present program will be conducted by the same key people, two of whom have now joined Homestake Mining Company's exploration staff and the other has been offered employment.

NAME: Randall J. Weege

EDUCATION: M. S. University of Wisconsin, 1955

EXPERIENCE: 20 years

NAME: Edward Kerr

EDUCATION: B. S. Geology - Michigan Technological University, 1966

EXPERIENCE: 7 years

NAME: William Beres

EDUCATION: M. S. Michigan Technological University, 1973

EXPERIENCE: 4 years

Several other Homestake geologists, mining engineers, and metallurgical engineers are available for consultation as needed.

WISCONSIN EXPLORATION BUDGET

May 1 to December 31, 1973

Salaries and Wages	
Supervision & Geological	$ 44,000
Clerical	3,600
Other	4,100
Consulting and Technical	
Assaying	3,000
Legal	2,000
Administrative and General	
Travel Expense	13,500
Communications	2,500
Maps, Publications, Photos	300
Field Material and Supplies	2,000
Office Supplies	100
Lab and Sample Expense	1,500
Rent	1,000
Insurance	200
Property Purchase and Holding Costs	
Bonus Payments	14,575
Physical Exploration	
Surface Drilling	42,250
Roads and Trails	1,500
Surface Damages	1,000
Machinery and Equipment	
Field Equipment	1,475
Office Equipment	500
Rentals and Leases	5,000
Operating Expenses	600
Maintenance and Repairs	300
Total	$145,000