58-6

CANADA

DEPARTMENT OF MINES AND TECHNICAL SURVEYS

GEOLOGICAL SURVEY OF CANADA

PAPER 58-6

GORDON LAKE NICKEL DEPOSIT ONTARIO

By

E. R. Rose

OTTAWA

1958

Price, 25 cents

CANADA
DEPARTMENT OF MINES AND TECHNICAL SURVEYS

GEOLOGICAL SURVEY OF CANADA

Paper 58-6

GORDON LAKE NICKEL DEPOSIT, ONTARIO 1956

By

E. R. Rose

OTTAWA
1958

Price, 25 cents

EDMOND CLOUTIER, C.M.G., O.A., D.S.P.
QUEEN'S PRINTER AND CONTROLLER OF STATIONERY
OTTAWA, 1958

Price: 25 cents Cat. No. M44-58/6

CONTENTS

Illustrations

GORDON LAKE NICKEL DEPOSIT, ONTARIO
1956

INTRODUCTION

Location and Access

Gordon Lake formerly known as Lynn Lake, a small body of water immediately north of the central part of Werner Lake in the Kenora district of northwestern Ontario, lies about 60 miles north of Kenora and 13 miles east of the Manitoba border (Figure 1). Werner Lake area is at present difficult of access, and is supplied by winter road from Point du Bois and Bird River in Manitoba, but may be reached in summer by float planes based at Kenora. An Ontario Hydro-Electric power development construction road extends northward from Minaki on the main line of the Canadian National Railways in Ontario to a point in the English River system about 20 miles south of Werner Lake.

History

Discovery of cobalt minerals in 1920 by prospector M. Carlson near the west end of Werner Lake resulted in the development of the Werner Lake Cobalt Mine from which several hundred tons of cobalt concentrates were produced, mainly from 1940 until the mine and mill were closed in 1944. The cobalt concentrates were shipped by air to Kenora. Further prospecting in the area was rewarded by additional discoveries including a sulphide mineral occurrence, carrying nickel and copper, found in 1942 by H. Byberg and A. Vanderbrink in dark basic rock near the southeast shore of Gordon Lake. During the war years Noranda Mines Limited trenched and diamond drilled the property. The claims were dropped, later re-staked by Aero Prospecting Syndicate, and acquired by Rexora Mining Corporation. Falconbridge Nickel Mines Limited optioned the ground in 1948 and further explored it by geophysical surveys and diamond drilling. Additional work was carried on in the area by Dome Exploration (Canada) Limited, International Nickel Company of Canada Limited, Frederick Mining and Development Limited, Radio-active Minerals Limited, Rexora Mining Corporation Limited and Toburn Gold Mines Limited. In 1952 Quebec Nickel Corporation Limited acquired all of the ground explored by Noranda, Rexora, Falconbridge and International Nickel, and began underground exploration and development. The property now forms part of the holdings of the Eastern Mining and Smelting Corporation Limited. A shaft 300 feet deep was sunk near the discovery outcrop on Gordon Lake and an exploration drift was driven westerly under the lake at the 300-foot level for almost a mile (Figure 2). Test drifts were driven at intervals at right angles to the main drift in mineralized areas. In 1956 construction of a production shaft and crosscut to the main exploration drift was in progress. It is reported (Northern Miner, 1957) that this shaft has now been sunk to the 1,050-foot horizon, and that additional levels are to be driven at the 500-foot, 750-foot, 900-foot and 1,150-foot horizons.

Previous Geological Work and Acknowledgments

The area is included in the regional geological map of D. R. Derry (1930) issued by the Ontario Department of Mines, and in the Kenora sheet, map 266A, of the Geological Survey of Canada, compiled by T. I. Tanton (1939). The copper-nickel-cobalt occurrences in the Rex-Werner Lakes area, Ontario were described by E. O. Chisholm (1949) then Ontario Department of Mines resident geologist in Kenora. The area forms part of the more detailed Ontario Department of Mines geological map prepared by H. D. Carlson (1956) and as yet unpublished. In May 1956 Dr. Carlson then resident geologist of the Ontario Department of Mines at Kenora visited Gordon Lake with the writer and kindly supplied maps and much information on the general geology of the area. Through the courtesy of the company management the writer was permitted to examine the underground workings and mine plans and to collect mineral samples. Mr. Allan W. Grant, Mine Manager at Gordon Lake, was most helpful in this and in many other ways. The writer wishes to gratefully acknowledge the use of parts of the company mine plans and of Dr. Carlson's unpublished manuscript map for reproduction with modifications. Field work was done in 1956.

GENERAL GEOLOGY

Regional Geology

North of Kenora the terrain is typically Archaean with belts of meta-sedimentary and meta-volcanic rocks enclosed in a complex of granitic rocks. Greenstone, meta-volcanic rock of Keewatin type is prominent in the Kenora area, giving way to granite north of Minaki and to an easterly trending belt of para-gneiss, meta-sedimentary rock of the Kisseynew type at Werner Lake.

The general geology of the immediate Werner Lake area taken from Carlson's map is summarized in Table I and is shown on Figure 1.

Table I

TABLE OF FORMATIONS

	Great unconformity
	Faulting and re-distribution of sulphides
	Granite pegmatite
	Intrusive contact
	Granite
	Replacement contact
Archaean(?)	Peridotite, pyroxenite, hornblendite
	Intrusive contact, primary sulphides
	Folding and faulting
	Granodiorite
	Replacement contact
	Quartz diorite
	Intrusive contact
	Paragneiss, schist, amphibolite granulite

No recognizable meta-volcanic rocks, with the possible exception of certain narrow bands of amphibolite, have been found in the Werner Lake area. Meta-sedimentary rocks, quartzite, quartz-biotite gneiss, garnetiferous gneiss, schist and granulite, etc., apparently represent the oldest formations. These rocks are well-banded, foliated, closely folded and strongly faulted, and they are invaded by masses of granitic rocks that range in composition from granite pegmatite and granite through granodiorite to quartz diorite. The granitic rocks do not commonly show sharply cross-cutting relations to the paragneisses but invade them in _lit par lit_ fashion with gradational contacts. Most areas contain intermixed granitic rocks and gneisses, and these rocks are extensively cut by irregular, pink pegmatite dykes. In many localities the grey granodiorite and quartz diorite are impregnated with pink granitic material and in places they are foliated and schistose.

Small bodies of dark ultramafic rock, consisting mainly of serpentinized peridotite, pyroxenite, hornblendite and schist, occur along some of the major fault zones in the older rocks. The ultramafic rocks are massive for the most part, and occur in the form of narrow, discontinuous lenses that are cut and rimmed by thin zones of micaceous hornblendic schist. This rock varies in composition and texture from a soft, talcose, greenish micaceous schist within the ultramafic bodies to a harder, darker hornblende-biotite schist or amphibolite on their margins. All of these rocks are cut by small irregular dykes of pink granitic pegmatite, and all including the pegmatite show evidence of strain in places.

From his regional and petrographic studies Carlson concluded that a period of major faulting followed the emplacement of the quartz diorite masses, and that the ultramafic rocks were intruded along some of the major fault zones. Several of these faults were traced for as much as 15 miles. He further concluded that much, if not all, of the granite was developed as the result of extensive potash metasomatism of the quartz diorite in a period after the intrusion of the ultramafic rocks.

Local and Mine Geology

The discovery outcrop on the east shore of Gordon Lake is no longer visible and most of the deposit underlies the lake, but outcrops of buff-weathered peridotite carrying disseminated chromite, magnetite and pyrrhotite are to be found along the draw about 2,000 feet east of the development shaft, and also in prospect pits near the falls on the creek entering the northeast end of Werner Lake. In these localities the peridotite is intercalated with paragneiss that is invaded by granodiorite on the south and both are cut by discordant irregular pegmatite dykes with sharp contacts. The peridotite appears at surface as a narrow, discontinuous sill with hornblendic and biotitic margins, and an interior zone richer in chromite. Underground exploration on the Gordon Lake property indicates that the peridotite is in discontinuous lenticular bodies of greater vertical than lateral extent. They are mainly concordant with banding in the enclosing paragneiss and thus may be regarded as discontinuous sills, or lenticular plugs.

Figure 2 shows a plan of part of the mine workings and geology on the 300-foot level and a diagrammatic cross-section through the exploration shaft at Gordon Lake. The main exploration drift follows a zone of shearing about 60 feet wide that is manifested by foliation (bedding plane slip), drag-folds and breccia in paragneiss, and by zones of schist in and around the ultramafic rocks. Foliation in this zone generally strikes east and dips steeply to the north. The zone is paralleled at a distance of about 75 feet on the foot-wall side by a body of granodiorite, and on the hanging-wall side by paragneiss. The rocks in the shear zone consist mainly of paragneiss and amphibolite intruded by lenticular bodies of ultramafic rocks arranged in linear fashion along the zone. Twelve such lenses of ultramafic rocks ranging in size from 200 feet long by 60 feet wide to 20 feet long by 5 feet wide were encountered in the main drifts. The ultramafic rocks vary in composition from serpentinized peridotite through pyroxenite to hornblendite, and include zones and selvages of micaceous schist. The massive ultramafic rocks are characteristically hard and dark. They are rimmed by a selvage of hornblende-biotite schist that grades to amphibolite and paragneiss. The peridotite is commonly partly serpentinized and in most cases the formation of serpentine is apparently the result of alteration of olivine. Serpentinization of olivine in pyroxenite is also common, and in such cases relatively unaltered pyroxenes of both rhombic and monoclinic forms are present. Rocks of this type are classed as lherzolite. Magnetite and/or chromite in these rocks is also associated in small grains with serpentinized olivine for the most part and also appears to have formed largely by the alteration of olivine. Many irregular small bodies of pegmatite are intermixed with these rocks and appear to cut all the rocks in the shear zone, but the pegmatite is also brecciated in part.

Mineralogy and Mineral Deposits

The ore minerals, nickeliferous pyrrhotite, pentlandite and chalcopyrite, are found as tiny stringers and disseminations in many of the rocks within the shear zone, but they are most abundant within, or near, parts of the ultramafic lenses. Pyrrhotite and pentlandite appear to be closely associated with each other and they occur in the form of disseminations, clots, stringers, and bands of massive to breccia sulphides. They also occur in small amounts as replacement minerals along with chalcopyrite and pyrite in many of the adjoining, fractured, country rocks including the pegmatite. Chalcopyrite is more abundant than the other sulphide minerals in the pegmatite bodies that cut the ultramafic rocks, but also occurs with pyrrhotite and pentlandite elsewhere.

The ore minerals are concentrated in the form of irregular, branching stringers and flat-dipping bands of massive to near-massive sulphides that cut, with sharp contacts, serpentinized peridotite carrying disseminated sulphides. Some of these bands of sulphides are 3 feet or more thick and several feet long, and they commonly carry crystals of pentlandite more than an inch in diameter, as well as an assortment of pieces of gangue minerals and rocks including much biotite, quartz, feldspars, pegmatite, peridotite and other rocks and minerals. Other gangue minerals that were clearly introduced are lacking.

Magnetite and chromite occur as stringers, bands and disseminations in serpentinized peridote, and in places they are enclosed in sulphide minerals. Iron-rich chromite is exposed in test pits and in outcrops of serpentinized peridotite about 2,000 feet east of the development shaft, and also near the east end of Werner Lake. In these localities the chromite is mainly fine grained and disseminated sporadically through the peridotite along with small amounts of fine-grained pyrrhotite, pentlandite, and chalcopyrite. The sulphide minerals characteristically occur interstitially to the chromite grains, and in places penetrate them in tiny veinlets. A tiny white grain of a mineral too small for identification was observed in one polished section and tentatively identified by X-ray powder photograph as cassiterite. Within massive sulphides isolated grains of magnetite commonly have rounded outlines and smooth surfaces that appear as if polished. The sulphide minerals embay and penetrate the magnetite grains in places. Chromite and magnetite appear to be earlier than the sulphides, and pyrite, pyrrhotite, pentlandite and chalcopyrite apparently succeed one another, but this sequence may not truly and completely represent the primary order of deposition because of subsequent modification.

At the abandoned Werner Lake Cobalt Mine near the west end of Werner Lake, cobaltite and the nickeliferous variety of linneaite, siegenite, occur along with pyrite and chalcopyrite in carbonatized, slightly brecciated gneiss near the contact of paragneiss and a narrow basic sill or dyke. All strike easterly and are on the north or hanging-wall side of a band of pink granite. This is near a fault subsidiary to the main Werner Lake-Gordon Lake fault as shown on Figure 1.

In parts of the granite the feldspars are slightly altered to a mixture of carbonates and white mica, and the rock near the deposit contains some disseminated sulphides. In detail the sulphides penetrate and replace brecciated rock and mineral fragments, and replace the cores of crystals now largely altered to serpentine. Pyrite and perhaps also chalcopyrite are apparently succeeded by cobaltite and linnaeite (siegenite).

Relations of Deposits to Structures

As previously described and shown on Figures 1 and 2, discontinuous lenses of ultramafic rock with associated sulphide minerals occur along some of the major fault zones in the area. Within these zones the sulphide ore minerals are mainly concentrated in veinlets and bands in the ultramafic rocks and stringers in the adjacent country rock. For the most part the ore minerals occupy fractures in the sheared rocks along faults.

The principal controlling fractures appear to be the easterly trending main shear fractures that dip steeply northerly parallel to the regional foliation, and a set of subsidiary flatly dipping tension fractures that intersect the first set almost at right angles. Almost horizontal slickensides along the main shear in places indicate some horizontal displacement there, and in places the horizontal intersecting fractures are dragged down along the hanging-wall and up along the foot-wall. Complex drag-folds in the foliated rocks along the main shear zone in places carry sulphide minerals and may have acted also as a minor control in their emplacement.

In detail the sulphides, particularly chalcopyrite, penetrate and emphasize intersecting fractures forming a grid-structure in the rocks in places. The sulphides intimately penetrate brecciated fragments of rocks and minerals, and appear to corrode or replace their margins. In many places the sulphide minerals penetrate along the microscopic cleavages of feldspars in these rocks. Disseminated sulphides are to be found, but most of the sulphide minerals, occurring as they do in stringers and veins, give the appearance of emplacement by injection and replacement.

GEOCHEMISTRY

Relative chemical and mineralogical compositions of the various rocks in the vicinity of Werner Lake were determined by semi-quantitative spectrographic analysis and microscopic examination. Ultramafic rocks from Gordon Lake, from the small lake east of Gordon Lake, and from the east end of Werner Lake are alike in composition. Their content of the ferride elements (Ti, V, Cr, Mn, Fe, Co and Ni) and of copper is greater except for cobalt than that of the granite and granodiorite. The Gordon Lake pegmatite is exceptional in that relative to the ultramafics it has an almost equivalent content of cobalt, nickel and copper and a higher content of titanium.

Table II shows the content of ferride elements and copper in some of the main rock types of the Werner Lake area, as determined spectrographically, and compares them with that of the average igneous rock.

Table II

FERRIDE ELEMENT AND COPPER CONTENT OF SELECTED ROCKS FROM THE WERNER LAKE AREA

Locality	Sample	Ti	V	Cr	Mn	Fe	Co	Ni	Cu
		%	%	%	%	%	%	%	%
Gordon Lake	Pegmatite	.1	.002	.002	.01	1	.01	.1	.5
	Amphibolite	.15	.02	.03	.02	2	.01	.1	.5
	Granodiorite	.05	--	.002	.005	1	.01	--	.003
	Mafic schist	.03	.005	.3	.01	2	.01	.1	.1
	Peridotite	.05	.005	.1	.02	2	.01	.25	.5
Werner Lake Nickel	Peridotite	.05	.01	.3	.02	2	.05	.25	.25
Small Lake Chromite	Peridotite	.05	.02	1.0	.02	5	.01	.25	.25
Werner Lake Cobalt	Hornblendite	.3	.02	.01	.1	2	.01	.01	.005
	Granite	.03	--	.002	.001	3	.05	.01	.005
Lithosphere	Average igneous rock	.5	.015	.02	.10	5.1	.002	.008	.007

Compared with the average igneous rock of the earth's crust all these rocks are slightly higher in cobalt, but only the ultramafic rocks and the Gordon Lake pegmatite are appreciably higher in nickel and in copper than the average igneous rock.

The ultramafic rocks show a higher nickel plus cobalt content (0.25 per cent) than other rocks in the area, and also a higher total nickel, cobalt, and copper content (0.5 per cent). The cobalt: nickel ratio shown by the granite at the Werner Lake Cobalt Mine ($\frac{.05}{.01}$) is greater than that of the ultramafic rocks ($\frac{.01-.05}{.25}$), but the total cobalt plus nickel content is low, 0.06 per cent. The generally higher content of nickel and copper in the ultramafic rocks of the area suggests a possible genetic relationship between them and the nickel-copper deposits.

Cobalt is relatively most abundant in the Werner Lake cobalt deposit and the cobalt:nickel ratio is high there (around $\frac{1.+}{0.7}$), but it also occurs in the Gordon Lake nickel deposit where the cobalt:nickel ratio is lower ($\frac{.01-.1}{1-10}$). Table III gives the cobalt and nickel content of certain sulphides. Cobalt at Gordon Lake apparently occurs in pentlandite and pyrrhotite in amounts ranging from 0.01 to 0.1 per cent. Cobalt was not detected spectrographically in a sample of chalcopyrite from Gordon Lake, but nickel

Table III

COBALT AND NICKEL CONTENT OF CERTAIN SULPHIDES

Sample and Locality	Co	Ni
	%	%
A. Pyrite from magnetite deposits in eastern Ontario (E. R. Rose)	.03-1.0	.005-0.6
B. Pyrite from gold deposits in northern Ontario and Quebec (J. E. Hawley)	.02-0.1	.02 -0.1
C. Accessory pyrite from Finnish Precambrian rocks (average, Rankama and Sahama)	0.2	.09
D. Magmatic sulphides, average of 57 samples (Rankama and Sahama)	0.21	3.14
E. Pentlandite from massive sulphides, Gordon Lake mine	.01-.1	10
F. Massive sulphides in peridotite, Gordon Lake mine	.01-.1	1-10
G. Chalcopyrite in pegmatite, Gordon Lake mine	-----	.01-.1
H. Cobalt ore material, Werner Lake Cobalt mine	1.+	0.7

was detected in a sample of linneaite (siegenite) from the Werner Lake Cobalt Mine. The occurrence of nickel at the Werner Lake cobalt deposit and of cobalt at the Gordon Lake nickel deposit suggest a possible genetic relationship between the deposits, but as the percentages of cobalt and of nickel involved are within the limits shown in pyrite elsewhere (Table III, B; J. E. Hawley), this is not conclusive.

Spectrographic analysis of a sample of the granite from the Werner Lake Cobalt Mine indicates that it contains more cobalt, nickel and copper (0.065 per cent) than the granodiorite at Gordon Lake (0.013 per cent), and it is a possible source rock for the mineralization. However, it seems more likely that the cobalt, nickel and copper content of the granite is due mainly to introduced sulphide minerals. In any case the content of these metals in both rocks is low. In many other respects the Werner Lake granite is very similar to the Gordon Lake granodiorite.

Platinum and palladium have been reported in assays of samples from both the Gordon Lake and Werner Lake deposits.

They were not detected spectrographically nor were platinum- or palladium-bearing minerals identified microscopically in the present study, but they might be present in amounts less than 0.005 per cent. The nature of the Gordon Lake occurrences is similar in some respects to certain platiniferous deposits in Canada and in South Africa, and consequently they are considered favourable for the occurrence of platinum group metals.

ORIGIN AND CONCLUSIONS

Judging from their cobalt, nickel and copper content the ultramafic rocks and the Gordon Lake pegmatite would appear to be the most likely source rocks of the ore minerals at the Gordon Lake deposit. Of these the ultramafic rocks are considered the more probable source because they have a much closer spatial relationship with ore minerals than the pegmatite have, and also because pegmatite does not occur in sufficient quantity to account for the mineralization. Pegmatite dykes elsewhere in the area do not carry these minerals.

The crosscutting and replacement nature of the ore minerals in the ultramafic rocks, together with the occurrence of sulphide minerals within and replacing masses of pegmatite and gneiss, indicates a post-pegmatite emplacement of these minerals. This suggests the possibilities either that the processes of emplacement of the ultramafic rocks, pegmatite and ore minerals were closely connected and overlapping, or that the sulphide minerals associated with the ultramafic rocks were re-mobilized and injected after the emplacement of ultramafic rocks and pegmatite. As the pegmatite does not appear to be a differentiate of the ultramafic rocks or genetically related to them, it seems probable that some re-mobilization of sulphide minerals accompanied emplacement of the pegmatite, a process in turn linked with formation of granite. In the latter instance re-mobilization of sulphide minerals may have been accomplished by fluids under high temperature and pressure. Such fluids could have been developed during granitization (potash metasomatism) or magmatic differentiation, and in view of Carlson's report of extensive potash metasomatism in the area the former possibility must be considered. Such fluids conceivably might have introduced the ore materials entirely from without the ultramafic rocks, but this view is not entirely consistent with the marked spatial relationship shown by ore minerals and ultramafic rocks.

Throughout the world there are many localities where nickel-copper deposits are apparently genetically related to mafic or ultramafic rocks, as at Sudbury, Ontario. This is also true of most chromite and many magnetite deposits. Cobalt minerals are associated with diabase at Cobalt, Ontario and elsewhere, and occur along with the platinum group metals in mixed oxide-sulphide deposits in ultramafic rocks in other places as in the ores of Sudbury (Wilson, 1953) and of the Bushveld Complex in South Africa (Hall, 1932). Chromite, nickeliferous pyrrhotite and chalcopyrite are also found in and around gabbro and serpentinized peridotite sills in the Maskawa-Oiseau and Bird River areas of Manitoba to the west of Werner Lake (Stockwell, 1948; and Wright, 1932), and a similar situation seems to occur in the Mystery-Moak Lakes area of northern Manitoba.

In conclusion it may be said that available geological, mineralogical and geochemical evidence favours a genetic relationship between the nickel-copper deposits at Gordon Lake and the associated ultramafic rocks. There is however evidence to suggest that the nickel-copper minerals as now found there have been re-distributed after emplacement of the ultramafic rocks and of the granitic pegmatite bodies because both are cut by veins of sulphide minerals. Flat-lying fissures in the peridotite have apparently been filled with nearly massive sulphides that in places contain many pieces of assorted minerals and rocks including pegmatite, and the sulphides intimately penetrate and replace the feldspar grains along cleavage directions and at the margins. The fissures may have been tension cracks related to the major compressive forces that were applied to these rocks during the periods in which they were folded and faulted.

The pyritic cobalt-copper deposit at the Werner Lake Cobalt Mine is not clearly related to ultramafic rocks, although a narrow sill of hornblendite occurs on the foot-wall, but it may be allied to such rocks, and could represent the more volatile, lower temperature deposit from such a source at depth.

RECOMMENDATION FOR PROSPECTING

Bodies of mafic and ultramafic rocks should be sought in the area as these are the home of the platiniferous nickel-copper-cobalt deposits. They are most likely to be found along the major fault zones. Conditions most favourable for mineralization appear to be in ultramafic rocks in fault zones in the vicinity of late granite and pegmatite. Shear and tension fractures produced by major compressive forces applied to the rocks of the area provide channels and openings for mineralization. An aeromagnetic survey might be used to advantage in locating covered areas of favourable rock and contained mineral deposits.

REFERENCES

Carlson, H. D.
(1956): Unpublished map and manuscript, Werner Lake area; Ont. Dept. Mines, and paper presented at Prospectors and Developers Association, Annual Meeting in Toronto, March 1956.

Chisholm, E. O.
(1949): The Copper-Nickel-Cobalt Occurrences in the Rex-Werner Lakes Area, Ontario; Precambrian, April 1949, p. 10.

Derry, D. R.
(1930): Geology of the Area from Minaki to Sydney Lake, District of Kenora; Ont. Dept. Mines, vol. XXXIX.

Hall, A. L.
(1932): The Bushveld Igneous Complex, Transvaal; South African Geol. Surv., Mem. 28.

Hawley, J. E.
(1952): Spectrographic Studies of Pyrite in Some Eastern Canadian Gold Mines; Ec. Geol., vol. 47, No. 3.

Stockwell, C. H.
(1948): Structural Geology of Canadian Ore Deposits; Can. Inst. Min. Met., p. 311.

Tanton, I. L.
(1939): Kenora sheet; Geol. Surv., Canada, map 266A.

Wilson, H. D. B.
(1953): Geology and Geochemistry of Base Metal Deposits; Ec. Geol., vol.48, No. 5.

Wright, J. F.
(1932): Geology and Mineral Deposits of a Part of South-eastern Manitoba; Geol. Surv., Canada, Mem. 169.

Plate I. Exploration and development shaft, Eastern Mining and Smelting Corporation Limited, Gordon Lake mine. (Rose, 1-5, 1956.)

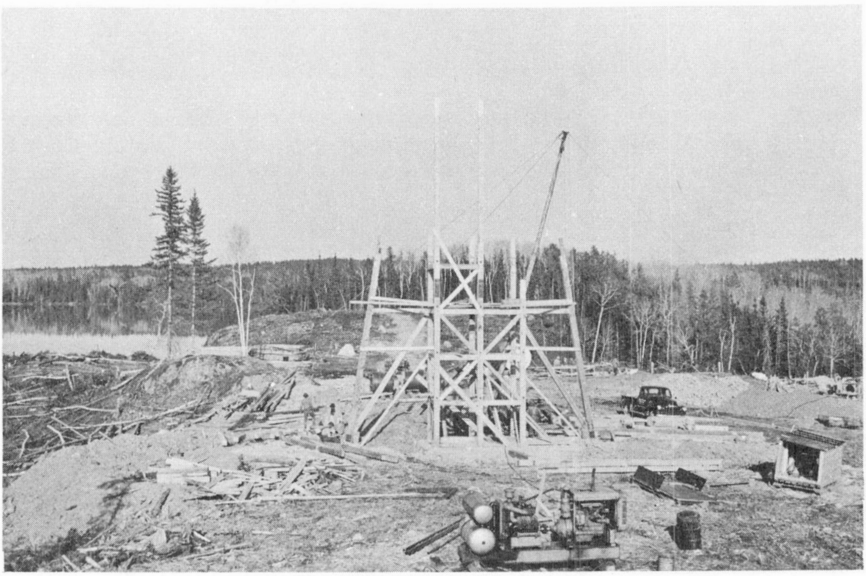

Plate II. Headframe under construction at proposed production shaft, Eastern Mining and Smelting Corporation Limited, Gordon Lake mine. South end of Gordon Lake in background. (Rose, 1-6, 1956.)

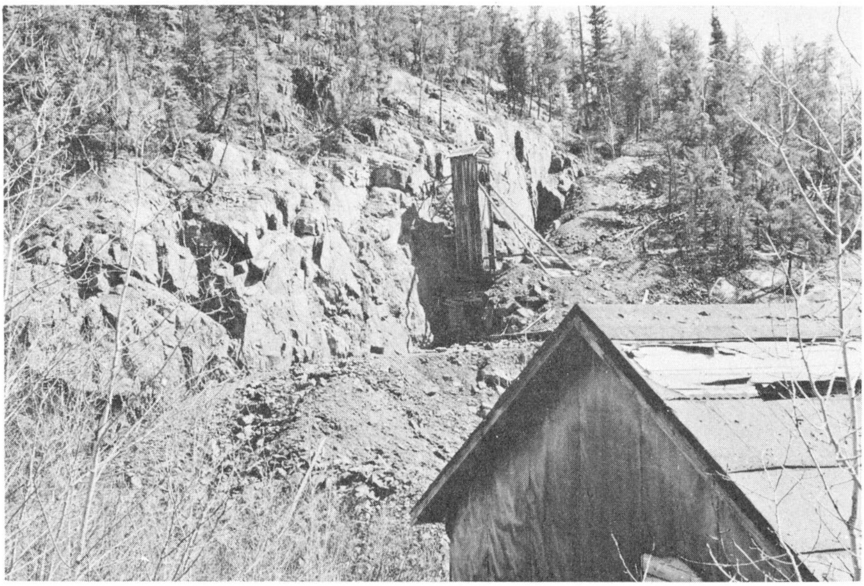

Plate III. View northeast of abandoned shaft-house and open-cut of Werner Lake Cobalt mine. Steeply dipping garnetiferous paragneiss on hanging-wall, to left, and a band of granite on foot-wall. (Rose, 1-2, 1956.)