

# GM 16873

REPORT OF OPERATIONS (EXPLORATION) FOR LAKE ALBANEL PROJECT

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ALBANEL MINERALS LTD.

REPORT OF OPERATIONS.

September 15th, 1958.

Ministère des Richesses Naturelles, Québec

17 NOV 1965

SERVICE DES GITES MINÉRAUX

No GM- 16873

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CHAPTER I.INTRODUCTION

This is a detailed report of explorations and results obtained therefrom on claims held by Albanel Minerals Limited near Lake Albanel, Quebec, during the two field seasons of 1956 and 1957.

Related reports cover the details and results of prospecting carried on over a widespread area centered about Lake Albanel during the season of 1957.

The present report, while primarily detailing the programs of 1956 and 1957, is also intended to recapitulate the information and findings derived from all sources, including work done previous to 1956. It is hoped that it will provide a thorough study of the iron deposits in the area, in the light of present information, and that the conclusions and recommendations incorporated in the report are valid and of use in future planning.

The report was prepared through the efforts of various members of the staffs of Albanel Minerals Limited, The Cleveland-Cliffs Iron Company and M. J. O'Brien Limited. Those directly responsible for the preparation of the report and its various conclusions and recommendations made up a rather informal committee and this committee was able to use information embodied in direct contributions and in related reports. A tabulation on Page 2 lists many of the individuals involved and the thanks of the committee go to all who have assisted in the preparation of the report.

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CHAPTER IISUMMARYINTRODUCTION

Albanel Minerals, Ltd., control 481 claims (19,240 acres) containing nine open pit ore bodies of magnetic taconite constituting a reserve of 201,750,000 tons of desirable magnetite concentrates readily pelletizable to a product having an average natural analyses of 62.25% iron and 7.57% silica. There are no metallurgically undesirable accessory elements in this product.

LOCATION AND ACCESS

This iron range, extending for 36 miles along the south shore of Lac Albanel, is in the Mistassini Region of New Quebec, bounded by latitudes 50°45' N. and 51°15' N. and longitudes 72°30' W. and 73°30' W. as shown on Fig. 1.

The Canadian National Railways has indicated its readiness to extend presently existing rail facilities from the company's optioned dock site on deep water (45') on the Saguenay River, to the properties. The approximate rail distance will be 304 miles to this dock, or 556 miles to Montreal for an all-year all-rail shipment. Rail rates quoted by Canadian National Railways are based on a guaranteed annual minimum of two million tons of "hook and haul" movement.

RESERVES

The table below highlights the reserves, concentrating characteristics and product analyses pertinent to "B" Group and Sandspit claim groups which can be considered for initial development.

	<u>"B" Group</u>	<u>Sandspit</u>
Crude tons	169,433,313	176,008,413
Liberation grind		200-270 mesh
Weight recovery	31.20	31.13
Product tons	52,066,857	54,791,419
Analyses - % dry	52,863,193	
Crude - iron	31.80	29.55
Conc. - iron	65.80	66.35
" - silica	7.57	7.87
Pellets - iron	63.57	64.07
" - silica	7.62	7.91
Pellet Analyses Natural		
Iron	62.93	63.43
Phos.	.008	.004
Si	7.54	7.83
S	.005	.005
Moist.	1.00	1.00

sec. B3  
 Sandspit  
 B Group  
 $32.77 \times 95 = 31.13$   
 $32.85 \times 94 = 31.20$

345,441,726  
 106,458,276  
 107,654,612

The other seven ore bodies have not been as completely explored and tested, but have an indicated reserve of 302,000,000 tons of crude ore which will yield 95,000,000 tons of magnetic concentrates of similar grade. Additional exploration on these, and other as yet undrilled groups, can undoubtedly add to the grand total of 201,750,000 tons of product presently estimated.

The principal iron mineral is magnetite, mineable by open pit methods (see diagrammatic sections Fig. 2) and concentratable by straight magnetic separation which places a premium on the reserve because of less expensive mining, concentration and agglomeration. Although the principal iron mineral is magnetite, there are appreciable iron units present as non-magnetic minerals which may be recovered with additional refinements in metallurgical techniques.

### PRODUCTION PLANS

Our economic studies indicate output should be at a rate of 1,500,000<sup>or</sup> tons of product per year with initial output coming from Sandspit; 3,000,000 tons of product per year split equally between Sandspit and "B" Group. Fig. 3 shows the proposed location of the plant site and attendant facilities for Sandspit and "B" group.

### CAPITAL COSTS

#### To be Recovered by Amortization or Depreciation

	<u>Study A<sup>(3)</sup></u> <u>Sandspit</u> <u>only</u>	<u>Study B<sup>(4)</sup></u> <u>Sandspit &amp;</u> <u>"B" Group</u>
A. Pre-Development Charges	\$2,174,335 <sup>(1)</sup>	\$2,918,635 <sup>(2)</sup>
B. Pre-Production Stripping	25,000	265,000
C. Plant and Equipment		
1. Mining	2,033,800	4,325,600
2. Milling and General	19,791,200	39,849,400
3. Pelletizing	10,500,000	21,000,000
D. Townsite	2,517,425	5,020,225
E. Roads and Air Strip	287,500	425,000
F. Trackage at Mines	225,000	450,000
G. Ore Storage, Reclaim and Dock	7,558,000	12,315,000
H. Diversion Channel		1,071,120
Sub-Total	<u>\$45,112,260</u>	<u>\$87,639,980</u>

#### To be Recovered by Sale of Facilities

Townsite	\$7,552,275	\$15,060,675
----------	-------------	--------------

#### To be Recovered by Rebate on Power Purchased

Power Facilities	\$7,500,000	\$9,000,000
------------------	-------------	-------------

(1) - Chargeable to Sandspit - \$915,294

(2) - Chargeable to "B" Group and Sandspit - \$1,357,853 and \$687,169 respectively.

(3) - Production of 1,500,000 T. per yr. from Sandspit deposit.

(4) - Production of 3,000,000 T. per yr. - 1,500,000 tons each from Sandspit and "B" Group.

CAPITAL COSTS (Cont'd)

	<u>Study A</u>	<u>Study B</u>
<u>To be Furnished by Others</u>		
Railroad	--	--
Public Road to Area	--	--
Grand Total	\$60,164,535	\$111,700,655
Cost per Annual Ton of Prod.	\$40.11	\$37.23
" " " " " "		
(after sale of facil. and rebate)	\$30.07	\$29.21

OPERATING COSTS

<u>Estimated Operating Costs</u> <sup>(1)</sup> (Per Ton Product)	<u>Study A</u> <sup>(3)</sup> <u>Sandspit only</u>	<u>Study B</u> <sup>(4)</sup> <u>Sandspit &amp; "B" Group</u>
Mining	\$1.44	\$1.46
Milling	3.74	3.77
Pelletizing	1.69	1.69
General Mine Expense	0.58	0.58
Taxes	0.15	0.15
Loading and Stocking <sup>(2)</sup>	0.15	0.15
Depreciation	0.72	0.74
Amortization	0.29	0.64
Total	\$8.76	\$9.18

- (1) - No royalty or administrative fee included.  
 (2) - On all-rail shipments, only loading amounting to \$0.05 would be required.  
 (3) - Production of 1,500,000 T. per yr. from Sandspit deposit.  
 (4) - Production of 3,000,000 T. per yr. - 1,500,000 each from Sandspit and "B" Group.

PRODUCT VALUE

Based on 1958 Old Range Bessemer price plus \$1.00 structure premium escalated from a base of 51.50% natural Fe content to actual natural iron content of product plus the amount for low phosphorous content.

Lower Lake Value

"B" Group -- Pellet Analysis: (Natural)  
 62.93% Fe    7.54 Sil.    .008 Phos.    1.00% H<sub>2</sub>O  
 62.93 x 0.24951 = \$15.7017  
 Phos. Allowance = 0.6290  
 Total = \$16.3307

Sandspit -- Pellet Analyses: (Natural)  
 63.43% Fe    7.83 Sil.    .004 Phos.    1.00% H<sub>2</sub>O  
 63.43 x 0.24951 = \$15.8264  
 Phos. allowance = 0.7380  
 Total = \$16.5644

PRODUCT VALUE (Cont'd)Transportation ChargesTo East Coast

Albanel to Port Alfred	\$2.55
Loading	0.19
Total	\$2.74
Port Alfred to Phila. and Balt.	1.50
Unloading	0.28
Total	\$4.52

To Montreal

A. Rail-Vessel	
Albanel to Port Alfred (Loaded)	\$2.74
Port Alfred to Montreal (340 mi. at 0.0024)	0.83
Unloading	0.28
Total	\$3.85
B. All Rail - Albanel to Montreal (556 mi x 0.0068)	\$3.81

To Hamilton

A. Rail-Vessel	
Albanel to Port Alfred (Loaded)	\$2.74
Port Alfred to Hamilton (710 mi. x 0.0018)	1.28
Unloading	0.28
Total	\$4.30
B. All Rail - Albanel to Hamilton (881 mi. x 0.0062)	\$5.51

To Pittsburgh(1)

All Rail	\$7.83
Portion to be absorbed by Purchaser	2.81
Net	\$5.02

To Youngstown(1)

All Rail	\$7.69
Portion to be absorbed by Purchaser	2.16
Net	\$5.53

(1) - Estimated rates by Canadian National and assuming purchaser would absorb portion of rail rate equal to cost from L. Lake to consuming center.

F.O.B. Mine Value

	Study A		Study B	
	Rail-Vessel	All Rail	Rail-Vessel	All Rail
E. Coast Market	\$12.04	--	\$11.92	--
Montreal	12.71	\$12.75	12.60	\$12.64
Hamilton	12.26	11.05	12.14	10.94
Pittsburgh(1)	--	11.54	--	11.42
Youngstown(1)	--	11.03	--	10.92

INDICATED MARGIN (BEFORE CORPORATE INCOME TAX)

E. Coast Market	\$3.28	--	\$2.74	--
Montreal	3.95	4.09	3.42	\$3.56
Hamilton	3.50	2.39	2.96	1.86
Pittsburgh(1)	--	2.88	--	2.34
Youngstown(1)	--	2.37	--	1.84

(1) - Assuming purchaser would absorb portion of rail rate equal to cost from L. Lake to consuming center.

SUMMARY REPORT - CHAPTER III

CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS:

1. Exploration, metallurgical investigations, and engineering studies conducted to date on the Albanel iron ore deposits have disclosed the existence of a minimum of 200,000,000 tons of merchantable product analyzing 63% iron.
2. A minimum of development would be required for an immediate project exploitation. Detailed economic studies, on two of the presently known deposits, indicate that 107,000,000 tons of merchantable material could be produced utilizing presently known and established processes.
3. An additional 95 million tons of magnetic concentrates of similar grade are estimated on other ore deposits, which to date, are only partially explored and tested. Additional exploration on these, and others as yet unexplored, can undoubtedly add to the presently estimated reserves.
4. The Albanel product is exceptionally desirable, having a favorable iron-silica ratio, an extremely low phosphorus and sulfur content and no other metallurgically undesirable accessory elements.
5. The Albanel climate is no more severe than that of the Lake Superior Region and will permit year-round production under favorable labor and operating conditions.
6. Albanel is more advantageously located than the other New Quebec

and Labrador iron ore deposits for the following reasons:

a) Railway access to the property will be provided by the Canadian National Railway at no capital cost to Albanel Minerals, Ltd. This rail connection will give access to both deep water shipping on the Saguenay and St. Lawrence Rivers; and, by all-rail shipments, to ore consumers in Canada and the United States.

b) Electric power will be provided by the Quebec Hydro Commission from present facilities in the Lake St. John Region.

c) Roads already exist within 70 miles of Albanel and it can reasonably be anticipated that the Provincial Government will provide highway access.

7. The rates quoted by the Canadian National Railway on all-rail shipments to potential ore consuming markets are major and favorable factors in the economics of the Albanel deposits. These rates, combined with the indicated profit margin, open up competitive outlets not only in the Montreal and Hamilton areas but particularly in the Pittsburgh and Youngstown areas. An added advantage of all-rail shipments is that delivery on a year-round basis can materially reduce stocking problems for the consumer and producer.

RECOMMENDATIONS:

Your technical staff are of the opinion that the information and data developed to date and incorporated in this report are reliable and conservative and we recommend the project for favorable consideration by the Board of Directors.

In view of the fact that approximately six years will be required to reach production, we recommend that the necessary development work be initiated as soon as possible.

Relating to early production from Sandspit and "B" Groups, additional project engineering and studies are required and recommended as follows:

- (a) Collect bulk samples for flowsheet development.
- (b) Conduct additional diamond core drilling to supplement the widely spaced drill sections.
- (c) Establish the survey control network for topographic maps, claim boundaries and facilities surveys.
- (d) Continue project engineering studies and planning.
- (e) Investigate and establish improved access to the deposits in advance of the railway completion.

In addition to the program for Sandspit and "B" Groups outlined above, we recommend that the other claims be maintained in good standing by the performance of the necessary exploratory work.

In view of the possibility of substantial product deliveries by all-rail haul, we recommend that further investigation be undertaken on the

feasibility of water shipments from existing dock facilities at Port Alfred, Quebec City and possibly Montreal, before a final decision is reached on dock construction at Ha! Ha! Bay.

CHAPTER IV.THE PROPERTY

The property of Albanel Minerals Ltd., on December 31, 1957, consisted of 558 forty-acre mining claims arranged in fourteen groups and located between the southeast shore of Lake Albanel and the Temiscamie River in the Territory of Mistassini, New Quebec. The center of the area is at Latitude 51°00' and Longitude 73°00'. This point lies approximately 160 air miles north of Lake St. John and 95 air miles north of Chibougamau (see Figures 1 and 4).

The claim groups are underlain by the Temiscamie Iron Formation, a member of the Mistassini sedimentary series of Proterozoic age.

Information resulting from the 1957 program allows a reduction of the holdings and the number of claims to be carried into 1959 will be cut down to 481.

List of Claim Groups.

The claims were progressively acquired by staking during the years 1952 to 1957 covering those parts of the Iron Formation considered most favourable based on the amount of glacial drift and/or rock cover and mineralogical variations along the length of the formation.

The claim groups are listed as follows with the name of the group and the number of claims which will comprise each group at December 31, 1958:

<u>SCARP GROUPS</u>		<u>KALLIO GROUPS</u>		<u>RIVER GROUPS</u>	
<u>NAME</u>	<u>NO. OF CLAIMS</u>	<u>NAME</u>	<u>NO. OF CLAIMS</u>	<u>NAME</u>	<u>NO. OF CLAIMS</u>
Albanel	45	Canso East	30	"B" Group	49
Sandspit	27	Canso west	32	Temiscamie	21
Sandspit West	22	Plateau East	14	Goethite	5
Kupotagen	35	Plateau west	6	Indian Grave	10
Valiant Bay	46	Albanel West	30	Kallio Creek	5
Richmond	58	Kallio Lake	10	"D" Group	9
		Sandspit East	25	Main Camp	1
		Kallio Camp	1		
	—		—		—
	233		148		100

The Claim Groups have been arranged in three columns because they fall naturally into three classes, covering deposits that occur on three distinct geological structures. A plan of these Groups is shown as Figure 4, Page 121.

#### Description of Claim Groups.

The Scarp Groups cover occurrences of the Iron Formation where its gentle, southeast dip gives a normal outcrop close to and roughly parallel to the southeast shore of Lake Albanel. The iron-rich beds form an almost continuous, rock-surface scarp facing northwest and are characterized by low, flat dips. In this structure, as in all the Albanel Iron Range, the proportion of magnetite to hematite in the Iron Formation varies. In much of the length the proportion of magnetite is sufficiently high that the material can be classified as a magnetic ore. Elsewhere the ratio decreases to a point where recovery by magnetic concentration is not economic. There are other parts in the structure where thick overburden and heavy rock capping prevent profitable mining. The claim groups are located on those sections where conditions are favourable.

The groups in the second column cover outcrop of the magnetic beds in a zone parallel to and one mile to two miles southeast of the Scarp groups. These may be called the Kallio Groups. Here strike faulting has sliced the rock into segments and elevated these slices so that the magnetic beds outcrop. The beds are relatively undisturbed except in vertical displacement with the result that one or more repetitious exposures of the magnetic beds occur in a zone about a mile in width and the original strike and low southeast dips are maintained. The massive oxide beds appear to have resisted erosion in a manner similar to the Scarp structure and this zone is typified topographically by long, parallel, northwest-facing scarps on which the flat-dipping oxide horizons are exposed.

The groups in the third column, locally known as the River Groups, cover showings close to and parallel with the Temiscamie River where it flows southwest some three to four miles southeast of the southeast shore of Lake Albanel. The iron-rich beds have been brought back up to surface by a combination of strike-faulting and strong folding. The axes of the folds have a general southwest-northeast strike and steep dips and the attitude of the bedding in these groups is characterized by widely varying dips and canoe-shaped outcrop.

#### Extent of Range.

The iron-bearing members of the sediments extend along the east shore of Lake Albanel from the north end of the lake to the Richmond River. The distance involved is about 45 miles and the widths vary up to five miles. A comparison of the extent of the Albanel Range with the Marquette Range is provided by Figure 5, Page 122. On this figure the map of the claim groups at Lake Albanel is superimposed on a map of the Marquette Range in Michigan on the same scale. They have been shaded for easy visibility.

CHAPTER V.ACCESSPresent Access.

The Albanel Iron Range is presently accessible by float or ski-equipped aircraft from Chibougamau (95 air miles) and Roberval (176 air miles). Presently available aircraft vary in useful-load capacity from 600 to 2400 pounds.

An alternative approach is by canoe route from Lake Waconichi to Lake Albanel via Lake Mistassini. This route originates at the south end of Lake Waconichi at the highway recently constructed from Chibougamau.

Chibougamau itself is now serviced by a branch line of the Canadian National Railway from the southwest, originating at Barraute in the County of Abitibi. This branch is presently being extended to Lake St. John where it will connect with the Canadian National Railway lines in that area.

Chibougamau is also accessible by highway from the provincial highway network extending north from Quebec City into the Lake St. John region.

Future Access.

A rail line to Lake Albanel can be anticipated if freight possibilities warrant. Meanwhile, expediency might make advisable the improvement of access by any one of the following feasible procedures, which are listed in order of increasing cost:

- (1) Establishment of one or more landing strips at Lake Albanel to accommodate wheeled aircraft of several tons capacity from Chibougamau, Roberval, Val d'Or or Montreal.
- (2) Establish a winter freighting service by tractor and sleighs from

Chibougamau.

- (3) Establish a water route from the highway at Waconichi Lake to Lake Albanel by building two marine railways, connecting the three lakes (Waconichi, Mistassini and Albanel), and providing barges and towing craft.
- (4) Build a highway to Lake Albanel by extending the road recently completed to Waconichi Lake.

CHAPTER VI.HISTORY AND TITLESA. Original Discovery.

The first geological work in the Mistassini territory was done by the Geological Survey of Canada during the latter part of the last century. Richardson visited the region in 1870 and reported the presence of limestones at Lake Mistassini. In 1884-85, A. P. Low led an epic expedition to the region and reported on its resources. He particularly remarked on the

-----  
 Richardson, J., (1872), "Report on the country north of Lake St. John", Geol. Sur. Can. Rept. of Progress, 1870-71, pp. 285-308.

Low, A. P., (1885), "Report of the Mistassini Expedition 1884-85", Geol. Sur. Can., Ann. Rept., 1885, Vol. 1, Pt. D, pp. 1-55d.  
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occurrence of iron-bearing rocks near the mouth of the Temiscamie River. Barlow, a geologist for the Chibougamau Commission, visited the region briefly in 1910 and classified the sedimentary rocks of the Mistassini basin as Ordovician, in contradiction to Low's Cambrian classification. Still later, another Survey Geologist, G. W. H. Norman, made a brief visit to the area in 1938 and mentioned Iron Formation as occupying a small area immediately north of the mouth of Temiscamie River and close to the eastern shore of Lake Albanel.

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 Barlow, A.E. (1911), "Geology and Mineral Resources of the Chibougamau Region, Quebec", Dept. of Colonization, Mines, and Fisheries, Que., Mines Branch (1911), pp. 131-133.

Norman, G.W.H. (1940), "Thrust Faulting of Grenville Gneisses Northwestward against the Mistassini Series of Mistassini Lake, Quebec", Jour. Geol., Vol. XLVIII, No. 5, July-Aug., 1940, pp. 515-525.  
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B. Early Exploration.

During the summers of 1946 and 1957, J. M. Neilson in his capacity of geologist for Mistassini Explorations Limited supervised mineral exploration in the Lake Albanel area. He found that the Iron Formation was considerably more extensive than formerly believed. (One of the 1946 discovery areas now forms Albanel Minerals' Albanel claim group). Although Mistassini Explorations was interested chiefly in base metals, the company staked a large number of claims on the Iron Formation during the winter of 1946-47.

By the summer of 1947, a staking rush had developed and several companies had acquired ground in the area. Most of these acquisitions were of a speculative nature. The principal companies that participated were Conwest Exploration Co. Ltd., Alta Gold Mines Ltd., together with other Pierre Beauchemin interests, Norancon Exploration and Development Ltd., and Dome Exploration Limited. The last-named company performed approximately 3000 feet of diamond drilling on lead-zinc showings along the Temiscamie River. The other participants in the rush did only a limited amount of stripping and trenching. Their holdings subsequently lapsed.

Meanwhile, Mistassini Explorations Ltd. prospected their holdings for iron ore deposits of shipping grade. The search continued through 1948 and 1949 but it was unsuccessful. Warren Fisher, Chief Geologist of Inland Steel Co., examined a few of the showings in 1949 and after that company expressed disinterest, Mistassini Explorations claims were allowed to lapse.

During the 1947 season, W. G. wahl mapped the Temiscamie River area for Quebec Department of Mines. He was able to show the surface extent of the

Iron Formation in that map area.

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 Wahl, W. G. (1953). "Temiscamie River Area, Mistassini Territory", Que. Dept. Mines G.R. 54, 1953.  
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In 1948, J. M. Neilson continued the Department's mapping program in the area adjoining to the southwest. He found further extensions of the iron formation on what is now the "Richmond" claim group.

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 Neilson, J. M. (1953), "Albanel Area, Mistassini Territory", Que. Dept. Mines G.R. 53, 1953.  
 -----

Continuation of the Quebec Department of Mines surveys in 1949 revealed further extensions of iron formation to the northeast in what is now Albanel Minerals' "B" Group.

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 Neilson, J. M. (1950) "Temiscamie Mountains Area, Quebec", Que. Dept. Mines P.R. 238, 1950.  
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In addition to its geological mapping program, the Province of Quebec conducted surveys during 1926, 1928, and 1950 of the 51st Parallel of Latitude (which runs roughly through the center of the iron formation area) and of the shorelines of the major lakes and rivers.

An aerial photographic survey was made by the Royal Canadian Air Force in September, 1948.

C. Acquisition of Present Claims.

Canadian Cliffs Ltd. staked the Temiscamie Group in 1952 and the Albanel, Sandspit and Goethite Groups during 1953 for a total of 277 claims. M. J. O'Brien Ltd. staked approximately 700 claims in 1953 covering parts of the present Plateau East, Kallio Lake, Valiant Bay, Richmond, "B", Indian Grave, Kallio Creek, "D" and Camp Groups.

Subsequent preliminary exploration during 1953 and 1954 reduced the Canadian Cliffs Ltd. holdings to 90 claims <sup>in 1955</sup> and the M. J. O'Brien Ltd. holdings to 156 claims. The latter claims were transferred to O'Brien and Fowler Ltd., a wholly owned subsidiary of M. J. O'Brien Ltd.

In the spring of 1956, Canadian Cliffs Ltd. and M. J. O'Brien Ltd. entered a joint venture to explore and develop the 246 mining claims and to acquire an additional 250 claims covering anomalies indicated by the aeromagnetic survey made for M. J. O'Brien Ltd. during 1955. Selective staking continued during 1956 and 1957 as geological and geophysical information developed.

On March 1, 1957, by Supplementary Letters Patent, the name of Canadian Cliffs Ltd. was changed to Albanel Minerals Ltd. and all claims held by Canadian Cliffs Ltd. and O'Brien and Fowler Ltd. were transferred to Albanel Minerals Ltd. Subsequently the newly staked claims were also transferred bringing the total holdings of Albanel Minerals Ltd., on December 31, 1957, to 558 claims.

D. The Formation of Albanel Minerals Ltd.

As above, Albanel Minerals Ltd. on December 31, 1957, owned 558 claims at Lake Albanel. Albanel Minerals Ltd., which is a dominion incorporation, was formed by M. J. O'Brien Limited and The Cleveland-Cliffs Iron Company to take

over possession of these claims and to carry on the exploration of them. The incorporation of Albanel Minerals Ltd. early in 1957 formalized the existing agreement between M. J. O'Brien Limited and Canadian Cliffs Ltd. under which the claims had been jointly explored since early in 1956. The costs of the joint exploration had been shared by Cliffs and O'Brien on a 55% - 45% basis and on the incorporation of Albanel Minerals Ltd. the interest had been divided on the same ratio. Since then necessary finances have been provided to Albanel Minerals Ltd. on the same basis so that the relative interest of 55% for Cliffs and 45% for O'Brien has been maintained.

E. Development Licenses, etc.

At December 31, 1957, the 235 claims which formed the original holdings of Canadian Cliffs Ltd. and O'Brien and Fowler Limited were held on the Development Licenses numbered on Page 21.

The claims staked since the start of the joint operation in 1956 were under the two-year clause of the Quebec Mining Act, because of their geographic location north of the 50th parallel, and were still held on the original miners' certificates, though the transfers had been registered into the name of Albanel Minerals Ltd. It is expected that when assessment work requirements are fulfilled and necessary taxes paid at the second anniversary of staking, development licenses will be issued for these claims.

F. Assessment Work Status.

Exploration since the initiation of the program in 1952 and 1953 has provided an excess of assessment work over and above what was necessary to keep the claims in good standing. In the case of some groups, this excess is large, in the case of other groups it is relatively small. Some groups will require work to hold them beyond 1959. The assessment work is tabulated in columns 6, 7 and 8 of Figure 6, Page 123.

## TABULATION OF DEVELOPMENT LICENSES OF ORIGINAL HOLDINGS

CANADIAN CLIFFS LTD. and M. J. O'BRIEN LTD.

<u>CLAIM GROUP</u>	<u>DEVELOPMENT LICENSE NO.</u>	<u>CLAIM GROUP</u>	<u>DEVELOPMENT LICENSE NO.</u>
Albanel	26097 ✓	"B" Group	26589
	26098 ✓		26590
	26099 ✓		26591
	26100 ✓		26592
	26101 ✓		26593
	26102 ✓		26594
	26103 ✓		26595
	26104 ✓		26596
Sandspit	26105 ✓		26597
	26106 ✓		26598
	26107 ✓	Temiscamie	24094
	26108 ✓		24095
	26109 ✓		24096
	26110 ✓		24097
	24098		
Valiant Bay	24322	Goethite	24262
	24323		26707
	24324	Indian Grave	26599
	24325		26600
	30850		27372
	30851		
	30852		
Richmond	27369	Kallio Creek	27229
	27370		27230
	27371	"D" Group	27367
Plateau West	26605 ✓		27375
	27373		27376
Kallio Lake	26600		
	26604		
	27231		
	27373		

CHAPTER VII.PHYSICAL GEOGRAPHYA. Topography.

The Mistassini terrain is typical of the Precambrian Shield. Local relief is usually not more than 300 feet although there are a few places in the region with maximum relief greater than 1000 feet. The relief generally is formed by northeast-trending rock ridges.

The Temiscamie River divides the region into a lowland to the northwest and a highland southeast of the river. The lowland is underlain by Mistassini and Alanel sediments and the highland is formed of Grenville granitic and gneissic rock-types.

Lake Alanel, at 1289 feet above mean sea level, and Lake Mistassini, at 1214 feet, provide widespread data on minimum elevations in the lowland area. The Temiscamie Mountains, to the southeast of the river, reach elevations of approximately 2100 feet.

The land surface is extensively mantled with very late Pleistocene deposits. Southwest-trending, drumlinoid, sand and boulder ridges and irregular till deposits conceal about 80 per cent. of the bedrock. The Temiscamie valley was a major meltwater channel during deglaciation in this region and, consequently, it is filled with thick deposits of outwash sand. Several miles south of the Temiscamie Group, the outwash deposits assume the form of a giant esker which extends southwestwards almost continuously for sixty miles or more. This esker could be utilized as a site or route for highway or railroad construction following the practice in Finland.

## B. Drainage.

The Mistassini Territory lies to the west of the Hudson Bay-St. Lawrence River divide. The Temiscamie River with its major tributaries, the Tournemine and Metawishish Rivers, is the main drainage course immediately west of the height-of-land. The Temiscamie, flowing in its lower course parallel to Lake Albanel and a few miles to the east of it, enters Lake Albanel about midway along its eastern shore. Lake Albanel, in turn, discharges into Lake Mistassini at a point due west of the Sandspit claim group through a two-mile succession of chutes and rapids having a total drop of 70 feet. This discharge is known as the Obijun Rapids. It is a potential source of hydroelectric power only a few miles distant from the claim groups.

Lakes Albanel and Mistassini are remnants of a glacial lake which once occupied this region. They are remarkable for their large size. Lake Albanel is 65 miles long and from 3 to 6 miles wide; Lake Mistassini, 110 miles in length and up to 16 miles in width, is the largest freshwater lake in the Province of Quebec.

Lake Mistassini receives the drainage of Lake Waconichi and the Chalifour River to the south, and the Takwa and Papaskwasati Rivers to the north. It is drained, in turn, by the Rupert River flowing to James Bay.

The region thus forms a part of the drainage basin of the Rupert River and the Temiscamie river may be considered as an extension of the Rupert River system. This fact is mentioned because of its possible importance in any future development of known power sites on the lower Rupert River.

The lowland area of the Mistassini-Albanel basin abounds with

smaller lakes. These lakes generally are attenuated in a southwesterly direction partly because of the trend of the glacial features and partly because of bedrock control. There are numerous muskegs throughout the lowland and most of them are the filled-in remnants of lakes; some of the muskegs are several square miles in area.

### C. Climate.

The region is characterized by long, cold winters and short, cool summers. The average mid-winter temperature is said to be around zero degrees and the recorded absolute minimum is minus 56 degrees Fahrenheit (Godfrey, 1949) but winter conditions are hardly more rigorous than in

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 Godfrey, W. E. (1949), "Birds of Lake Mistassini and Lake Alabnel, Quebec", Nat. Mus. of Can., Bull. No. 114, Biol. Series No. 38.  
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the northwestern Quebec mining district. The average temperature in summer is about 60 degrees Fahrenheit.

Summer precipitation is both frequent and heavy. Cloudy periods, drizzling rain, and sudden thunderstorms are caused by the rapid movement of warm and cold fronts over the large water expanses of the Precambrian Shield.

Freeze-up takes place about the end of October and the spring break-up usually occurs in May. Lakes Mistassini and Alabnel, because of their large surface area, great depth, and consequently slow rate of change of temperature, usually do not freeze over until December and the ice usually remains until early in June.

The winter snow accumulates to a thickness of approximately eight

feet in the wooded areas. The rapid spring melt over a drainage basin of 6200 square miles coupled with the inability of the outlets to discharge the meltwater create high-water conditions in Lakes Albanel and Mistassini, and these conditions may prevail until mid-July.

D. Vegetation.

The land surface supports a heavy forest growth. This is promoted by the high summer precipitation and possibly by the calcareous nature of the soil. Black spruce is dominant; tamarack and white cedar are restricted to wet ground; fine stands of white birch, poplar, balsam fir, and white spruce flourish on the glacial ridges; jackpine is indigenous to sandplain areas and second-growth birch and aspen grow on areas of burned-over ground.

E. Natural Resources.

Fish are abundant in the lakes and streams of the region. Gray lake trout, Quebec red trout, and whitefish could support a commercial fishing industry in Lake Mistassini. Speckled trout, pickerel, and Great Northern pike are also present in large numbers.

The smaller fur-bearing animals are becoming rather scarce (except for beaver which have become widespread in recent years), but considerable numbers are trapped each winter by the Indians of the region. Moose and black bears are fairly abundant and there are a few woodland caribou in the highland area.

The spruce stands would be suitable for pulpwood if timbering operations are extended to this drainage basin. This would be possible if the Canadian National Railway extends its lines to Lake Albanel. The spruce and birch can supply any local building needs.

Sand, gravel, and stone deposits are available throughout the

area for road, railroad, or other construction projects.

F. Inhabitants.

The Territory is inhabited by a band of the James Bay Cree tribe who number more than 700 members. The region is not a reservation but a hunting preserve for these Indians. They hunt and trap throughout the district during the winter months and congregate during the summer at Mistassini Post, a Hudson's Bay Company post at the south end of Lake Mistassini. The Indians are skilled in guiding and other bush tasks and can be considered a potential labor force for many purposes.

In the event of future mining operations in this region, it can be foreseen that the rights of the Indian inhabitants would have to be safeguarded in some manner through negotiations with the Quebec government and the federal Department of Indian Affairs.

CHAPTER VIII.GENERAL GEOLOGY

The iron of the Lake Albanel deposits occurs as magnetite, hematite, siderite, and iron silicates (in descending order of present importance), which minerals make up appreciable percentages of certain beds in a series of flat-lying sediments. The sediments are widespread, underlying all the area in the immediate vicinity of both Lakes Albanel and Mistassini. The iron-bearing members are the youngest of the series and are found, over a length of 40 to 45 miles, only east of Lake Albanel.

The outstanding feature of the geology of the Lake Mistassini-Lake Albanel area is the "Grenville Front". This is the line of demarcation between the Grenville geology to the southeast and the Keewatin-Huronian geology to the northwest. This "Front" extends through the Precambrian Shield from Lake Huron to an, as yet, undetermined distance northeast of Lake Albanel. (See Map in Separate binder).

The nature of this "Front" varies in its great length but at Lake Albanel it is characterized by faulting and folding and it clearly separates the two types of geology.

The present discussion of the general geology takes into account this division caused by the "Front" and comprises a brief discussion of the Grenville and a more detailed discussion of the Keewatin-Huronian geology. See Table of Formations, Figure 7, Page 124.

THE GRENVILLE.

The rocks of the Grenville type are essentially a biotite gneiss-hornblende gneiss-schist complex having a northeast-southwest strike and

evidence of complex folding. This general trend is essentially parallel to the "Grenville Front". The age of these foliated gneissic rocks is uncertain but they are classified tentatively as Grenville. Injection gneiss, migmatite and augen gneiss are also included in the gneissic complex although some of these rocks may be directly related to intrusives.

This assemblage of orthogneiss and paragneiss has been intruded by granites of various characters. There is a slight possibility that some of the younger granites found in the Grenville can also be younger than the Mistassini series discussed below and that some of the intrusions of these granites lie on or across the "Grenville Front". This is somewhat more fully discussed below.

Beyond the possibility of granites intruding both the Grenville and Mistassini series, there is no close relationship between the Grenville and the Iron Formation so that no further description of the Grenville need be given.

#### THE KEEWATIN-HURONIAN

In the area of Lakes Mistassini and Alabanel the geology northwest of the "Grenville Front" is made up of two major components. These are the underlying basal complex and the overlying younger Mistassini sediments.

The Basal Complex. This assemblage of rock types is essentially similar to the Keewatin and Temiskaming rocks of northwestern Quebec and Ontario and are made up of metavolcanics and metasediments cut by altered gabbroic and related intrusives including granodiorites. Granite also has a wide distribution. The general regional trend of these rocks is east-west and they tend to be truncated by the "Grenville Front". There is no immediate relationship between the iron formations of the younger Mistassini sediments

and this altered basal complex, hence any further discussion of the basal complex is unnecessary.

Mistassini Sediments. The Mistassini sedimentary series lies on the basal complex and can best be described as a section of a circular basin of about 100 miles radius, whose outer rim has a convex outline to the northwest. The basin is truncated against the "Grenville Front" on its southeast border.

Extent. The sediments underlie Lakes Mistassini and Albanel and probably Lake Waconichi, though there is some interruption of their continuity immediately north of Lake Waconichi. The presently known southern termination of the sediments is at the south end of Lake Waconichi and the northern termination is a few miles northeast of Lake Albanel. The northwestern edge of the basin lies immediately west of and roughly parallel with the northwest shore of Lake Mistassini. The eastern boundary, the "Grenville Front", roughly follows Lake Waconichi and the Chalifour and Temiscamie Rivers. This affords dimensions of approximately 130 miles in length and a maximum width of 30 miles. Another occurrence of sediments of a somewhat similar character has been found at Indicator Lake, about 70 miles northeast of Lake Albanel, and it is probable that further occurrences will be identified in a continuation of this zone towards Mount Wright and the southwestern extremity of the Labrador Trough.

Structure. The rocks of the Mistassini series form a truncated section of a basin. The base of the series outcrops along the arcuate, northwestern border and has very low dips to the southeast. Being arcuate, the strikes vary from north-south towards the southern end of the basin and swing around to slightly north of east at the northern end of the basin.

The dip causes a thickening of the series to the southeast with successively younger members exposed towards the "Grenville Front".

Rock Types.

(a) Albanel Formation. The vast bulk of the Mistassini sediments is composed of dolomites of slightly varying characteristics. Wahl and Neilson have named this dolomitic part of the series the Albanel Formation and have divided it into the Lower Albanel and the Upper Albanel. There is some evidence of disconformity between them and the Upper Albanel has a somewhat more sandy character. Geographically, the Lower Albanel underlies Lake Mistassini and the Upper Albanel underlies Lake Albanel and together they have a thickness that is estimated to be close to 10,000 feet. Here again, the dolomitic rocks have little direct relationship with the Iron Formation and need no further discussion.

(b) Temiscamie Formation. This rock assemblage contains the iron-bearing material that is the subject of this report. It is made up of three parts:- (1) quartzite (20' - 50' thick) at the bottom; (2) Iron Formation (200' - 718' thick) and (3) slate (800' thick) at the top. It lies above and is younger than the Albanel Formation and by comparison forms a relatively minor part of the Mistassini Series. Geographically, the Temiscamie Formation occurs only between Lake Albanel and the Grenville "Front". Descriptions of the members of the Temiscamie Formation are given in the following chapter.

CHAPTER IX.DETAILED GEOLOGYA. The Temiscamie Formation.

This is the youngest part of the Mistassini Series and outcrops east of Lake Albanel from the mouth of the Richmond River to a few miles beyond the northeast end of the lake. Its western border coincides with, or lies a few hundreds of feet east of, the southeast shore of the lake. At the northern extremity, and probably at the southern, the Temiscamie butts against the "Grenville Front", but in its middle lengths some of the underlying dolomite has been faulted to the surface between the Temiscamie and the "Grenville Front".\*

STRATIGRAPHY

The Temiscamie Formation is composed of three major divisions: (1) an underlying quartzite with some conglomerate facies; (2) the iron-bearing cherts or Iron Formation; and (3) the overlying Kallio graywacke slate. The following descriptions are based on reports by Neilson and Quirke.

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Neilson, J.M., Personal Correspondence.

Quirke, T.T., Correspondence previous to publication of his Doctorate Thesis.  
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(1) Quartzite Formation.

Immediately overlying the dolomite of the Mistassini Series, and underlying the Temiscamie Iron Formation is 20-50' of quartzite. The contact is only rarely seen in outcrop. It has been reported to be

\* See Figure 8, Page 125, also 1" = 1000' Geology sheets in separate binder.

unconformable in a few localities. Typically, the lithology is a light coloured pure quartz quartzite with some siderite towards the top. There is evidence of a recrystallized breccia in some localities. The quartzite formation is represented north of Plateau Lake and in the "B" Group by a dark green, sideritic, cherty quartzite. In some places an interbedded argillite or graywacke may be found in this stratigraphic position. The contact with the overlying iron-formation exhibits minor interbedding.

The peculiar nature of the recrystallized breccia warrants some further description. This rock, known as the "antre de marbre chert breccia" occurs on the Temiscamie Group and is also well exposed a mile or so downstream from this group on the southeast side of the Temiscamie River. Stratigraphically it occurs at the contact between Albnel dolomite and the quartzite. The following description is quoted from Neilson:

Antre de Marbre chert breccia - Chert breccia occurs in the Temiscamie River claim groups and it does not have a counterpart in the Lake Albnel groups except for one doubtful exposure on the Kupotagen claim group. The breccia is well exposed in a prominent chert ridge on Temiscamie River where it has been named Antre de Marbre, meaning "marble cave". The rock consists entirely of chert and it has a peculiar brecciated or fragmental appearance. It bears a striking resemblance to the Fleming chert breccia of the Knob Lake area. In places, original pebble beds are seen but most of the chert seems to have been introduced, possibly by hydrothermal action in a fault zone. The best exposures within the claim groups are in the Temiscamie group where the breccia zones occur near the top of the dolomite section. If the zones represent chertification of brecciated dolomite, they have little stratigraphic significance but they do comprise a distinctive rock type.

(2) Temiscamie Iron Formation.

(a) Lower "Argillite" Member. The lower "argillite" member is from 15-50' thick. This member is not perceptibly magnetic with a hand magnet. It is black and usually very fine bedded, although the thickness of the beds can vary from one millimeter to several centimeters. The main essential mineral is fine grained anhedral stilpnomelane. Chert and

quartz are uncommon. Chalcedony occurs as concretions. Very fine-grained magnetite occurs as fine wavy layers. Often these layers are multiple and very closely spaced, separated by chalcedony. Fine grained to coarse siderite may make up a large percentage of some bands.

The term "argillite" is misleading. Little clay or materials of clastic origin are present. A more cumbersome but more correct description is "finely bedded sideritic iron-silicate rock".

A field characteristic of this argillite is the development of graphite on any planes of movement. This can include slippage on the bedding and any shearing which may cut the bedding.

The contact with the overlying member is gradational, typified by intimate interbedding.

(b) Lower Sideritic Chert. This member varies from 15 feet to 50 feet in thickness. The rock is coarse bedded. The layers range in thickness from one to thirty centimeters, but the majority are less than five centimeters.

In general the layers consist of two kinds. One is mainly chert or quartz with a great deal of minnesotaite and some siderite. The other is mainly siderite with chert scattered throughout.

Stilpnomelane may occur in distinct layers or with the siderite. Layers of very fine grained magnetite may also occur but are not common. In hand specimen these layers are wavy and look like stylolites. Granules are rare.

The contact with the overlying member is gradational and is usually marked only by a gradual increase of magnetite.

(c) Magnetic Hematitic Sideritic Chert. This is the ore-bearing member. The thickness is usually about 150 feet, though variations from four to 200 feet have been found. The magnetism varies irregularly from very weak to extremely strong. In general, this magnetism decreases towards both the top and bottom contact.

This horizon is characteristically massive and commonly shows a division into upper and lower parts. If the full section is present, these parts are approximately equal.

In the upper part (a) the distribution of the iron oxides is relatively uniform with the oxides occurring as a dissemination of both fine crystals and irregular patches of massive mineral. Magnetite and hematite occur in both these patterns and are intimately mixed in the mass of minerals; (b) a smaller magnetite to hematite ratio exists; (c) it is possible that there is a somewhat higher siderite content; (d) there is very little parallel arrangement of the distribution of the minerals in the plane of the bedding; (e) oolitic and granular textures are characteristic.

In the lower part (a) there is a characteristic parallelism in the disposition of the minerals, particularly the oxides, so that this part is frequently described as banded; (b) the magnetite to hematite ratio is high; (c) there is probably somewhat less siderite; (d) there is very much less of the massive arrangement of the oxides, though the oxide bands are in themselves a concentration.

In the Richmond Group a thin zone of non-magnetic chert separates the upper and lower parts of this horizon.

Mineralogically, the main constituents of the magnetic, hematitic, sideritic chert are chert, quartz and, in most instances, siderite. Magnetite

is an important constituent with hematite much less so. Minor constituents are stilpnomelane, minnesotaite and chlorite. No true jasper has been found, though rounded "pebbles" of a bright red chert occur in the upper part. It is probable that there is a general content of dusty hematite throughout the horizon as the chert is coloured from a light pink to dark red.

The contact of this member with the one above is somewhat gradational but exhibits only minor interbedding.

(d) Upper "Argillite". The upper "argillite" may be from three feet to 40 feet thick. The lower three to 20 feet exhibit excellent parting along the bedding and are usually slightly magnetic. Bedding characteristics and mineralogy are very similar to the lower "argillite". The note on nomenclature of the lower "argillite" applies to the upper "argillite" also.

The contact with the overlying member is marked by interbedding.

(e) Upper Sideritic Chert (Hanging-wall Chert). This may quite likely be the thickest member of the Temiscamie Iron Formation. No drill hole goes through its entire thickness. From structural evidence, it is probably over 100 feet and perhaps 200 feet thick.

The macroscopic characteristics of this unit are very similar to that of the lower sideritic cherty member. However, the upper member has many relic granule textures and little to no minnesotaite.

The contact with the overlying formation was not observed in the field. However, from outcrops on either side of the contact it can be safely stated that the contact is characterized by interbedding of the slate and sideritic cherty Iron Formation.

(f) Magnetic Silicate. This member is only recognized in some of

the areas along the Temiscamie River. Its thickness may vary from zero to 168 feet.

Its position in the section is uncertain. It seems to be a more or less persistent lens within the Upper Sideritic Chert.

This member consists of layers of very fine grained magnetite interbedded with layers made up of minnesotaite, stilpnomelane, siderite and disseminated chert or chert nodules. These individual layers range in thickness up to a maximum of two centimeters and may also vary in thickness along strike which gives the rock an appearance similar to the "wavy banded taconite" of the Mesabi Range, Minnesota. Occasional jasper layers, fragments and intraformational conglomerates are also present. The upper and lower contacts are gradational.

### (3) Kallio Slate Formation.

More than 800 feet of kallio slate overlie the Temiscamie Iron Formation. It is fine to coarse bedded slate and graywacke. Pyrrhotite, pyrite and minor amounts of other sulphides occur as local sparse disseminations. Chert nodules, lenses and layers are quite common. This formation is considered to be the youngest consolidated sediment in the area.

#### LOCAL METAMORPHISM.

A condition which deserves some remarks, and which has been referred to in one or two places above, is the suggestion of metamorphic effects on the Iron Formation in the River structure. This is in contrast to the lack of metamorphism in the Kallio and Scarp structures. As described by Neilson, this metamorphism is expressed in a number of ways: The Iron Formation is more "jaspery", the chert has a more reddish colour which is probably due to development of hematite, secondary magnetite is developed from earlier iron minerals in irregular shaped masses and stringers of a few inches maximum

dimensions which suggest a process of molecular migration, narrow quartz stringers occur which have bordering zones of alteration in which magnetite and specular hematite appear. In addition, there are shearing and crenulation effects at many places. These textural and mineralogical differences may indicate metamorphism due to one or any combination of the following causes: (a) the folding and faulting; (b) basic intrusions of the Coom Lake type; (c) intrusions of post-Mistassini Granites, of which there is a possibility.

#### STRUCTURE.

Structurally, the members of the Temiscamie Formation have the same pattern as the Mistassini Series as a whole. See Map, Figure 8, Page 125.

- (1) Where the basal members of the Formation are exposed, the strike is northeast-southwest and the dips are very flat to the southeast. In other words, the beds here are relatively undisturbed and are concordant with the general basin structure. The chert horizons have resisted erosion and form a cuesta which, in much of the length, shows as a high topographic scarp. The occurrences of iron ore in this environment have been distinguished by the name of Scarp. This descriptive title is applied to the iron ore occurrences themselves, the groups of claims in which they occur and the name is used to distinguish this structure.
- (2) At a distance of two or three miles in from the shore of Lake Albanel, and beyond a belt where the magnetic beds are capped by the Upper Sideritic Chert, the rocks are disturbed by a zone containing several strike faults which probably have high dips. The southeastern walls of the faults have been elevated so that the older rocks, including the magnetic beds, have been brought back up to surface in a series of narrow fault slices. The beds seem to be little disturbed other than being elevated, hence are really part of the

Scarp structure. However, there is a useful purpose in a further subdivision, so these occurrences, the claims in which they lie, and the structure itself have been given the descriptive name of Kallio.

(3) Farther to the southeast, beyond a fairly widespread capping of normally dipping, younger Kallio Slates, the Iron Formation outcrops again in a zone that roughly coincides with the channel of the Temiscamie River and its projection to the southwest. In this river structure the rocks were disturbed to a much stronger degree than in the Kallio structure. Much folding and faulting occurred. The faults and the axes of the folds have steep dips and the northeast-southwest strike of the "Grenville Front". In some cases the folds have been overturned. Much of the folding is tight with the result that bedding attitudes vary widely in strike and dip. The result of this crumpling of the rock has been the elevation of the older horizons so that Iron Formation outcrops to the southeast of Kallio Slates and is succeeded, farther to the southeast and closer to the "Grenville Front", by members of the Albabel dolomites. The fold axes generally plunge to the northeast at low angles but at least one exception to this occurs in the "Anticlinal Structure" on the "B" Group. (See description of "B" Group and Temiscamie Group below).

These occurrences, the claims in which they lie and the structure itself have been given the descriptive name of River.

(4) Two minor classes of structural features are suggested throughout the area but have not as yet been mapped in detail. They are (a) faulting, in a general northwest direction and probably normal in character, is suggested in numerous places, and (b) changes in attitude of the bedding in the Scarp structure would suggest some low arching by cross folding, again with axes in the west to northwest direction.

B. The Dolomites east of the Temiscamie River.

In the central lengths of the basin formed by the Temiscamie Formation, the faulting and folding of the River structure has brought the underlying dolomite to surface, between the Iron Formation and the "Grenville Front". It has been mapped to widths of three miles. Little detailed structural work has been done in this area but the presence of dips up to  $80^{\circ}$  indicated that folding and faulting probably extend into this ground.

C. The Iron Formation Outcrop.

The geological setup just described, along with the distribution of the glacial cover affords a wide variety of outcrop. The iron-bearing beds of the Scarp structure, for the full length of the occurrences of the Temiscamie Formation, have a remarkable constancy of topographical elevation. For the full 40 miles there is no difference in elevation of more than 300 feet. It is possible that what variations do occur are the result of gentle cross-folding. Though the variations in elevation are relatively small, the effect that they have on the disposition of the glacial cover appears to be quite important. Generally speaking, where the elevation of the beds is low, there is less outcrop and the glacial debris attains its major thickness, sometimes up to 100 feet. Where the elevation is high, extensive areas of outcrop or very shallow covering occur in lengths up to six miles and in widths of several thousand feet. From the southeast edge of the exposures where the ore-bearing beds dip below hanging-wall capping, the rate of increase of thickness of the capping is slow.

On the Kallio structure good outcrop occurs only in the centre half of the range and most particularly in that part between Kallio Lake and Canso Bay. The exposures here are relatively narrow, in comparison to the Scarp Structure, but have considerable length because of the fault-slice pattern. Southwest of Kallio Lake the structure shows continued faulting, but

only the hanging-wall beds are exposed, except for one exposure of Kallio-type ore in the Richmond Group. This occurrence lies approximately two miles in from the shore of Lake Albanel.

The River structure is generally lacking in outcrop. The steeply dipping beds of the Temiscamie Iron Formation have resisted erosion and formed ridges that roughly outline the fold-pattern in any locality. Furthermore, the Temiscamie River's present channel appears to coincide with an area of outwash deposits which covered everything except the ridges formed by the Iron Formation. Consequently it is only at those places where folding and faulting have brought the competent beds to the present rock surface that outcrop occurs.

D. Ore Zones. (See Ore Area Maps, 1" = 1000', in separate binder)

Tonnages estimated in all claim groups are tabulated (Chapter XI). The estimate for each group has an accuracy within the limits of the widely spaced sampling. Some minor revisions can be expected when more drilling improves the sampling. This is particularly so in certain groups as discussed below.

(1) Scarp Groups.

Canso East. Due to the lack of outcrop on this group and the wide interval between it and the Canso West Group, it is uncertain as to whether it lies on the Scarp structure or the Kallio structure. However, it is discussed here with the Scarp groups.

A strong airborne anomaly (see Page 60) indicated the presence of much magnetite in this area and the claim group was staked to cover it. The drilling of four widely spaced holes shows that all the group is covered with overburden that varies from seven feet to over 110 feet in depth. Material of good grade and recovery was intersected and it is very possible that further

drilling will show some of the magnetic chert to be under relatively light cover and could therefore provide sufficient tonnage to be minable. Such further drilling is recommended and an investigation of overburden thicknesses by seismic methods might be useful.

Albanel. The Albanel ore, as considered in this section, does not include that in the claims lying between Plateau East and Canso West Groups. There are 16 million tons of concentrate available in the southwest part of this group and an ore body is indicated in that part northwest and northeast of Plateau Lake. Holes 10 and 11 showed poor recovery between these two blocks and a generous allowance was made for this in the ore estimate. However, future drilling might close this gap to some extent.

In estimating the tonnages available in the southwestern block of the Albanel claims, allowance was made for an extension of the ore into the upper tier of claims of the Albanel West Group. The airborne magnetometer survey shows a continuation of a strong anomaly in this southeasterly direction from the outcrop in the Albanel claims. This suggests that relatively thin overburden and capping may overlie the magnetic beds for a considerable distance, creating a satisfactory stripping ratio.

As presently estimated, the tonnage in the indicated ore body northwest and northeast of Plateau Lake is not sufficient for mining. It comprises the material in a flat bed exposed around a curved scarp and capped by Upper Sideritic Chert. With further drilling, this hanging-wall material may prove to be relatively thin and ore found to be continuous under the capping. If so, the estimates would be greatly increased and a minable block of ore proven.

With the possibilities indicated in the two immediately preceding paragraphs, it is advisable that Albanel Minerals acquire the ground

surrounded by the Albanel, Albanel West, Plateau West and Plateau East groups. This would serve several purposes. It would cover the extensions of ore from the two blocks in the Albanel group and also a possible extension from the Albanel West group as discussed below. It would also offer a convenient site for any additional plant that might have to be erected to handle Albanel ore and also dispose of the tailing from that plant.

Sandspit. Surface mapping had indicated a continuous outcrop of magnetic beds for about four miles on the Scarp structure. Overburden is relatively light and topographic profiles are such that widths up to 2000 feet occur. Six drilled sections, spaced from 3000 to 4000 feet apart showed the consistent presence of material with grade, recovery and thickness sufficient to be ore and it has been assumed that this group can be confidently depended upon to provide the tonnages credited to it in the estimate.

A short distance beyond the northeast end of the group, the outcrop of the magnetic beds curves away from the lakeshore in a radical swing to the southeast. It returns to its original direction several miles farther northwest at the Albanel group. This swing of the outcrop is probably due to the arching caused by a cross fold. Overburden covers this area so that the exact condition has not as yet been determined but it is suggested that the combination of arching and erosion has completely removed the beds making up the Scarp structure at this location.

Beyond the southeast end of the group the magnetic beds are warped downward, losing their topographic altitude and a considerable thickness of overburden covers the rock outcrop.

On reconsideration of the ore situation on this group, it was found that in an early effort to trim the claim holdings to the smallest number that could be economically maintained, some ground containing ore was allowed to lapse. The amount involved is small compared to the group as a whole, but it would be advisable for Albanel Minerals to acquire further ground around the Sandspit group. This is particularly true at the northeast end of the group and at both ends of the embayment into the southeast boundary of the group.

It should be pointed out here that part of the ore estimated for this group extends into the northern tier of claims of the Sandspit East Group.

Sandspit West. The aeromagnetic survey indicated a continuation to the southwest of the strong anomaly from the southwest end of the Sandspit group. In the staking of 1956, this ground was claimed and is known as the Sandspit West Extension. During 1957, three holes were drilled into this ground and a further 7000 feet of ore grade material was found continuing from the exposed material on the Sandspit group. However, overburden conditions were found to be sufficiently serious that the ore here was not added to that in the Sandspit group.

It is recommended that further drilling be done on this ground but that it be preceded by a ground magnetometer and seismic survey. It is possible that this further exploration will show much of this material to be minable.

Kupotagen Group. The airborne magnetometer survey indicated a widespread anomaly under this ground but overburden is such that only a very few rock outcrops occur and these are all of the hanging wall chert. Four holes were drilled towards the southwest end of the group and one hole towards the northeast end. Of these five holes, two gave intersections of ore grade material over a satisfactory thickness. Two others cut the magnetic beds where recovery was too low to be of value. The fifth cut a great thickness of hanging-wall chert but no magnetic chert. Because of the widespread distribution of the holes and the evidence of there being parts of the magnetic horizons in which recoveries are below the allowable minimum, very little extension of the ore, away from the two holes in which it was found, could be allowed in the ore estimates. As a result the group shows two small isolated tonnages of ore grade material, neither of which is minable. It is probable that minable material does occur in the claim group but it will take considerable future drilling,

supplemented by magnetometer and seismic surveys, to fully define the conditions. It can be noted here that the magnetite-bearing beds are at a topographically lower elevation than are those occurring farther northeast. This is true also of the Valiant Bay and Richmond groups as discussed below.

Valiant Bay. The ground covered by these claims falls in the Scarp structure wherein the bedding has a flat or very low dip. As a matter of fact, this group would appear to show the least dip of any of the exposures at Lake Albanel. Generally the rock surface is only a few feet above the present elevation of Lake Albanel with some of the ledge being much below the lake level. There is a fair amount of outcrop but much of it is distinguished by a thick layer of frost-heaved bedrock material which, though not apparently transported from its original place, has been sufficiently disturbed that bedding attitudes have been lost. As a result of this, much of the mapping comprises notation of a mantle of broken rock of the different members of the iron formation and experience has indicated that considerable confidence may be placed in the belief that it lies where it was originally part of the undisturbed rock. The mapping shows much of the area where this disturbed bedrock is of a magnetic type and much where it is non-magnetic.

Very considerable difficulty was encountered in drilling this group because of the presence of the broken and disturbed bedrock. The material necessitated running casing through it and there was no clear-cut horizon where the hole entered competent bedrock. Since the material itself was very abrasive and tended to cave and move after penetration, there was high wear on casing, rods, barrels, etc., and, what was possibly more important, core recovery and sludge return were poor and the resultant sampling most unsatisfactory. In all, only five of the nine holes provided core and in most cases the recovery was bad with the result that our sampling of the property has yielded very inconclusive results.

It is noteworthy that surface sampling on most of the magnetic material that is definitely in place and also on a large percentage of the area of broken, disturbed magnetic rock has shown fair recoveries at (-) 100 mesh pulverization. One area in the southern part of the group shows all the samples in an area at least 5000 feet long to have good percentage weight recoveries. The silica is moderately high but could be expected to improve at finer grinds.

Due to the inconclusive results of the drilling to date and the general low-lying nature of the outcrop, the possibilities of developing large minable tonnages from this group would appear small though it can be inferred that there are large tonnages of magnetic materials present. Future exploration of the group must be directed towards clearing up this uncertainty.

Richmond Group. This group lies farthest to the southwest of any claims covering Scarp structure. It was drilled for a length of three and one half miles at approximately one half mile intervals. This showed satisfactory thickness of magnetic material, having very low dips to the southeast, but

recoveries were generally low because of excessive hematite. Also, in most of the group, the silica in the concentrate was too high, even after very fine grinding. A further discouraging feature is that much of the outcrop is covered by overburden varying up to 60 feet in depth. At present this group of claims does not appear to be too attractive, but it is possible that further exploration will remove some of the disadvantages.

(2) Kallio Groups.

Canso West and the northeast claims of Albanel Group. These claims cover exposures of iron formation that are part of the Kallio structure, that is, the fault-sliced structure described previously.

The drilling was on widely spaced sections and showed ore grade material in satisfactory thicknesses on some sections but material of low recovery on other sections. Because of this and the faulting, very little extension away from the actual drill holes could be allowed at those places where grade and recovery were satisfactory. The result is that these claims show several small, widely separated tonnages, none of which are big enough for pitting purposes. It is possible that fill-in drilling may prove greater extensions of the better grade material and the tonnages might be sufficiently increased to provide minable ore.

Plateau East and West. These claims lie on the central fault-sliced structure.

Here again the nature and circumstances of estimation provide only small disconnected tonnages of ore grade material and these form part of the extension of the structures from Canso West. However, there is indicated a separation from the ore grade material of that group by a zone of mineralogical difference that causes low recovery. Southwest of this interruption continuity

of ore appears to resume, but only small blocks of ore can be estimated as much of the ground which may contain ore does not presently belong to Albanel Minerals Ltd. This fault-slice has been followed on surface for some distance to the southwest from the claim groups to where it terminates southeast of the Kallio Lake Group. It is suggested that this fault-slice is similar to and is another repetition of the magnetic beds that have been traced through the Albanel west, Kallio Lake and Sandspit East Groups which are discussed below. It is recommended that the ground covering the exposures extending from Plateau East and West Groups be acquired as mining claims as it becomes available.

Albanel West, Kallio Lake and Sandspit East. Exploration suggests that the magnetic material running through these groups is relatively continuous, forming one fault-slice. Widely spaced drilling has shown considerable mineralogical changes along the strike such that only part of the oxide horizons yield recoveries that are economical. The better sections are those at the east side of the Albanel West Group (Holes AW-1 and AW-2) and around hole KL-3 on the Kallio Lake Group. None of the rest of the drilling showed satisfactory recoveries and the magnetic beds themselves, at the location of hole KL-2 are only four feet thick. This is the only occasion where these horizons have shown a radical thinning and it may be that this phenomenon may be due to faulting which cannot now be identified.

Again the drilled sections were widely spaced and it is possible that future drilling may prove extensions of the better grade material beyond what was considered safe to be included in the estimate.

There is a further possibility for the Albanel West Group in that the ore from the southwest end of the Albanel Group may extend down-dip into the Albanel west Group under sufficiently thin cover of overburden and rock

capping to be minable. Further drilling should be done to explore this possibility.

Additional claims should be acquired along the northeastern boundary of the Albabel West Group to provide for extension of ore-grade material from holes AW-1 and AW-2 and also the extension southeastward of ore from the Albabel claims. (See also Page 41.)

As pointed out on Page 43, some of the ore estimated for the Sandspit Group extends into the northern tier of claims of the Sandspit East Group. This is ore of the Scarp structure and so is included with the Sandspit rather than the Sandspit East Group.

(3) River Groups.

"B" Group. This group covers the most northeasterly outcrop of the Iron Formation of the River structure, that is, the faulted and folded zone coinciding with the course of the Temiscamie River and lying relatively close to the "Grenville Front". The structure here is typified by longitudinal faults with rather sharp, tight folding in the intervening blocks of ground. The axes of the folds are generally steep, parallel the strike of the faulting and have very shallow plunges. The latter have been noted both to the southwest and to the northeast. The magnetic beds are involved in this folding and the effects are both good and bad. Thickening by folding and faulting occurs and there is a possibility of some thinning on the flanks of the folds. The crests of the folds afford an appreciation of available tonnage in that the exposure around the fold and down the flat plunge has made a very considerable proportion of the magnetic material accessible for mining.

The folding has resulted in steep dips in many places and here open pitting will entail considerable rock stripping. This is very much in

distinction to the deposits of the Scarp and Kallio structures where one border of the pit is usually the "daylighting" outcrop of the foot wall of the magnetics and rock stripping is only necessary on the hanging wall.

The magnetic material is essentially the same stratigraphic unit as in the Scarp and Kallio structures, but there is some suggestion of a higher grade of metamorphism.

There is evidence, not yet substantiated, that in the River structure a second magnetic horizon may occur above the ore-producing bed common to all groups. This second magnetic horizon may be part of, or younger than, the Upper Sideritic Chert. (See Pages 35 and 50.)

At the north corner of the group, surface mapping and one diamond drill hole suggest the presence of some of this upper magnetic horizon. However, information is very incomplete on this part of the claim group and future work will be necessary to clear up this situation. This horizon will be discussed at some greater length in the description of the Teniscamie Group.

The "B" Group was explored by drilling on six cross-sections at 3000 foot intervals turned off from a base line. The drilling was done by angle holes in an attempt to determine the structure on each section. Two additional sections were drilled, intermediate between two of the major sections. This work, as in the Sandspit Group discussed above, showed a consistency in results from section to section that allows considerable confidence in the sampling and in the estimate of tonnage on this group. However, a great amount of additional drilling will be necessary to provide sufficient information, both as to structure and grade, on which to base production

planning.

This fill-in drilling will probably have to be carried out on a hole to hole basis on the general principle that much more information than is provided by the holes presently drilled must be available to give a complete structural interpretation on each section and the spacing of the sections must be sufficiently close that this interpretation can be confidently interpolated from section to section. The amount of drilling necessary for this investigation will probably provide sufficient sampling data.

Several problems, peripheral to the present exposure area, remain to be settled on the "B" Group. These are:

(a) The tracing to the southwest of the magnetic beds in the anticlinal structure explored in holes B-20, B-22, B-24 and B-26. It should be mentioned here that the airborne magnetometer survey indicates the extension of this structure towards and possibly into the Temiscamie Group at a depth of cover which may afford mining possibilities. At present most of this ground is not held by the company and its acquisition is recommended.

(b) The extension of the magnetic beds to the northeast from the present drilling.

(c) Investigation of magnetic outcrops which occur close to the river in the northeastern half of the group.

Temiscamie, Goethite and Indian Grave Groups. These groups lie on the River structure and, as in "B" Group, the folding is intense and faulting is a dominant factor.

The Goethite Group lies to the northwest of the Temiscamie Group and is of interest in that this is the one location where natural concentration of

the iron into hematitic, leached material occurs. However, two holes drilled in this group during 1953 showed the occurrence to be of no value.

The Temiscamie and Indian Grave claims, which are contiguous and lie northwest and southeast respectively of the Temiscamie River, cover an area of outcrop of the magnetic beds. Folding and faulting are very evident but exploration has not advanced sufficiently to detail the structure. In 1953, seven holes were drilled in the Temiscamie Group, of which six were at regular intervals of 600 feet along a southeast dipping limb of a northeast plunging anticline. The seventh hole was drilled into magnetic material outcropping close to the northwest shore of the river. In 1957, two holes were drilled on the Indian Grave claims, one to explore the axis of a northeast-plunging syncline, and the other to explore and sample an outcrop of vertically-dipping magnetic material of the class of the suspected "upper" magnetic horizon.

Holes 1-6 of the Temiscamie Group offer the clearest indication of an upper magnetic horizon. All of these holes were drilled through this material after collaring in or above it. They then entered typical hanging wall chert and continued through the normal succession of beds encountered in the Scarp and Kallio structures and elsewhere on the River structures. In those holes which collared above this "upper" magnetic horizon, the overlying rock was apparently the "Upper Sideritic (or hanging wall) chert.

This "upper" material is distinguished from the normal ore-producing magnetic beds by being markedly banded, or thin bedded, with some of the layers comprised essentially of magnetite and the others of chert. A characteristic feature is the presence of rounded chert nodules strung along some of the bedding planes. The beds vary from a few inches down to one quarter inch in thickness, the nodules are up to two inches in length. The economic

possibilities of this "upper" magnetic horizon are not yet determined. In some intersections the recoveries were good, in others the silica content of the concentrate was too high. Further information must be obtained on this horizon and the metallurgy and mineralogy must be further investigated.

Holes one to six on the Temiscamie Group were drilled as angle holes to the north, intersecting the southeast dipping limb of the northeast plunging anticline where the dips are generally around  $60^{\circ}$ . The outcrop is on relatively steep topography, on the southeast side of a "mountain", with the result that the pit outlines on the sections yield relatively small tonnages with prohibitively high stripping ratios. As a result of this, the property has been somewhat neglected as a possibility of ore. However, the structure deserves considerable further exploration. This opinion is expressed because, to the northeast from the present drilling, the outcrops loop around the nose of the anticline, in its gentle plunge to the northeast. In this part of the structure it is possible that a large tonnage of material is accessible for open-pit mining in a similar manner to that on the Anticline Structure of the "B" Group. Furthermore, this northeast plunging anticline on the Temiscamie Group is probably the same anticline as that on the "B" Group, with the opposite plunge, and it is possible that all the intervening ground might afford ore if the plunge does not carry the magnetic horizons too deep. The anomaly provided by the airborne magnetometer survey over the structure would indicate that this is a possibility.

The Indian Grave drilling verifies the interpretation of a syncline plunging flatly to the northeast and that an appreciable tonnage of ore grade material may exist where the magnetic beds outcrop around this structure. Considerable further drilling is required. The information on the vertically

dipping magnetic beds explored by hole IG-2 is insufficient to provide any appreciation of the value of this material.

Kallio Creek. These claims are on the River structure. An outcrop of magnetic material occurs parallel and close to the northwest bank of the river immediately downstream from the mouth of Kallio Creek. It is three quarters of a mile long and shows a width of about 200 feet. The dips are almost vertical and a fault is indicated along the northwest side of the exposure which would separate the iron formation from Kallio slates. An incline-hole was drilled through the magnetic material. It showed a very shallow depth extension, the magnetic bed being cut off by faulting within 100 feet below the present surface. Because of the relatively small outcrop, and shallow depth, no further drilling was done.

Main Camp. Half a mile from the southeast shore of the river, at the location of the Main Camp, faulting and folding have exposed some of the magnetic beds which are probably the "upper" iron formation. The dips are steep with considerable fault disruption and small outcrop area. As a result, this ground was never acquired by staking.

"D" Group. The "D" Group claims cover exposures of iron formation which are part of the River structure and show steep dips which are obviously the result of folding and probably faulting. Six holes were drilled through this material in 1956. The lack of outcrop and the relatively small number of holes did not provide an accurate picture of the structure but did show (a) the magnetic materials were separated by prohibitive thicknesses of non-magnetic iron formation, and (b) a combination of dips and topography such that a relatively small amount of tonnage was available. As a result, exploration was curtailed. The present indications are that this group is one of lesser importance.

E. Hanging Wall and Foot Wall.

(1) Physical Characteristics.

In physical shape the hanging wall and foot wall of the ore are a factor of the location of the ore, that is, in which of the three types of structure it occurs. This means that in the Scarp and Kallio structures the dips are flat and the primary interest is in the thickness of the hanging wall. From zero, at the outcrop of the magnetic bed, it generally increases towards the southeast and there must be numerous places where the full thickness of the Upper Argillite and Upper Sideritic Cherty member must occur as a normal sequence into the overlying Kallio slate. However, there may also be numerous locations where the topographic falling-away of the actual surface towards the southeast may limit the thickness of the hanging wall over some considerable areas of the magnetic bed. Such areas should be searched for and outlined because of the possibility of greatly increasing some of the presently indicated tonnages under hanging wall which could be economically stripped.

On the River structure the foot wall and the hanging wall are relatively parallel and again have the attitude of the magnetic bed, that is they may be steep to overturned on the limbs of some of the folds and vary from that to absolutely horizontal on the crests. On some of these crests there is some indication that a coincidence between the attitude of the bedding and the actual topography would provide considerable areas of the magnetic beds under stripping conditions that could be handled.

(2) Mineralogical Characteristics.

Two argillitic horizons provide well defined markers for the hanging wall and foot wall of the magnetic beds. These are very similar in character mineralogically and physically but with experience it is, in most cases, possible to distinguish the Upper from the Lower Argillite. One of the

indications is that in numerous places the Upper Argillite is appreciably magnetic, and it lies immediately above the magnetic chert. By way of contrast the Lower Argillite is almost always separated from the magnetic horizon by the Lower Sideritic chert. The boundary between the Lower Sideritic chert and the bottom of the magnetic material is generally an assay-wall, is physically indistinct and varies in its distance from the Lower Argillite. There are a very few locations where the Lower Sideritic Chert is absent and appreciable magnetite extends right down to the lower Argillite.

A further distinction between the foot wall and the hanging wall is that there are no other iron-bearing beds lying below the Lower Argillite whereas the Upper Argillite is topped by the Upper Sideritic Chert horizon which has a very appreciable iron content (generally about 20 per cent.) in the form of siderite. Further, as discussed above, there is a possibility that another magnetic horizon is incorporated with or lies on top of the Upper Sideritic Cherty member.

The Upper Argillite in the Richmond Group is quite clearly divided into an upper non-magnetic portion and a lower magnetic portion, both have the approximate thickness of 20 feet. The magnetite content in the lower horizon increases with depth and the 30 inches immediately against the magnetic chert often exhibits the strongest magnetism of any of the material in the district. It has proved, however, to be so fine-grained that recoveries are poor.

### (3) Geophysical Characteristics.

There is no apparent difference in the magnetic qualities of the hanging wall and foot wall which would distinguish them in a magnetic survey. This statement applies to the rocks of the Iron Formation. The magnetism of the Kallio slates is so negligible that, in those areas where the Kallio

slates are widespread and thick, the magnetic anomaly drops off sufficiently that a rough outline of the areas of the slates can be deduced from the magnetic readings. Insufficient magnetic work was done over the larger areas of the dolomite to truly assess its magnetic character.

(4) Ore Cut-offs.

As a general rule, the upper cut-off is at the bottom of the Upper Argillite and the lower cut-off is at a point, somewhere above the Lower Argillite, at which the magnetic recoveries drop below an economic limit.

The ore estimates were based on percentage weight recoveries obtained from Davis Magnetic Tube tests. These tests were run on composite samples of those parts of the diamond drill core and surface samples where crude analyses had shown an iron content of twenty-five per cent. or higher. Only those parts of the magnetic horizon were used in the estimate where these tests showed the percentage weight recovery to be over 27 per cent., and the silica below 10 per cent. There were certain instances where composites having silica content higher than this were re-tested after further grinding. See Page 81.



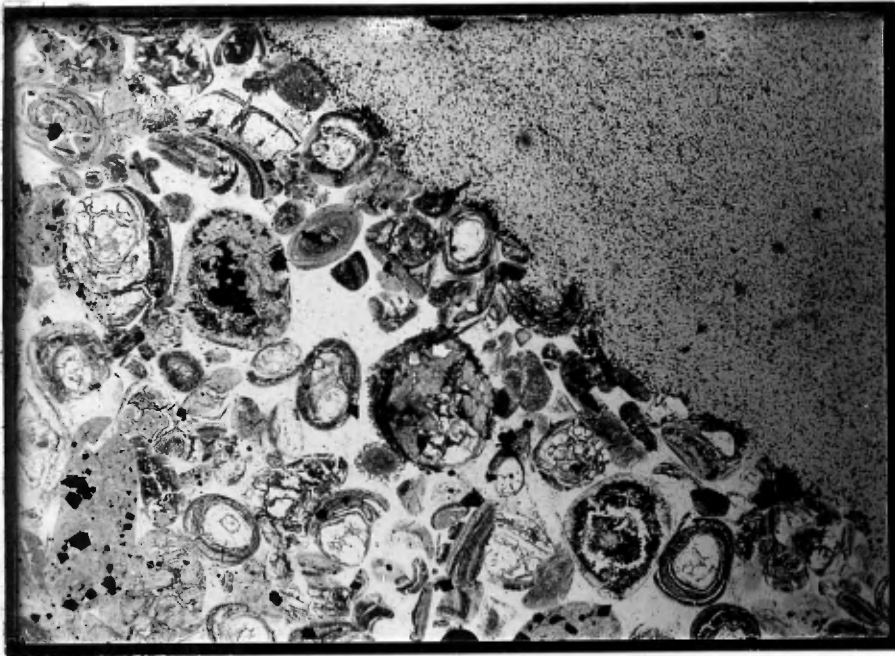
Showing the lithologic facies of the oolitic iron-formation  
in D.D.H. No. 15 Albabel Area. Nature Size.

Consists of (1) carbonate (1 & 2), (2) oxides (3, 4 & 5),  
and (3) silicates (6)

D.D.H. No. 15

Depth: 1. 10'-20'  
2. 33'-37'  
3. 40'  
4. 52'-64'  
5. 140'-150'  
6. 175'

Photomicrograph No. 968



THIN  
SECTION

Carbonate facies - Showing a magnetite-bearing oolitic band in contact with a carbonate chert band. 15x

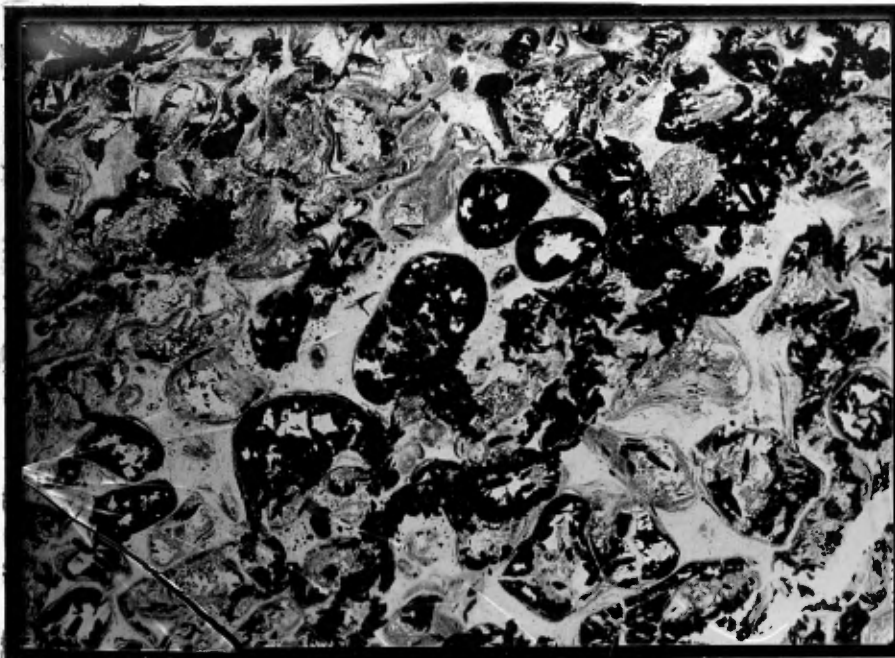
Magnetite, black and euhedral; quartz and chert, white and grey; hematite, black and fine grained; and carbonate, dark grey, high relief.

D.D.H. No. 16

Depth: 100'

Thin Section No. 1702

Photomicrograph No. 427



THIN  
SECTION

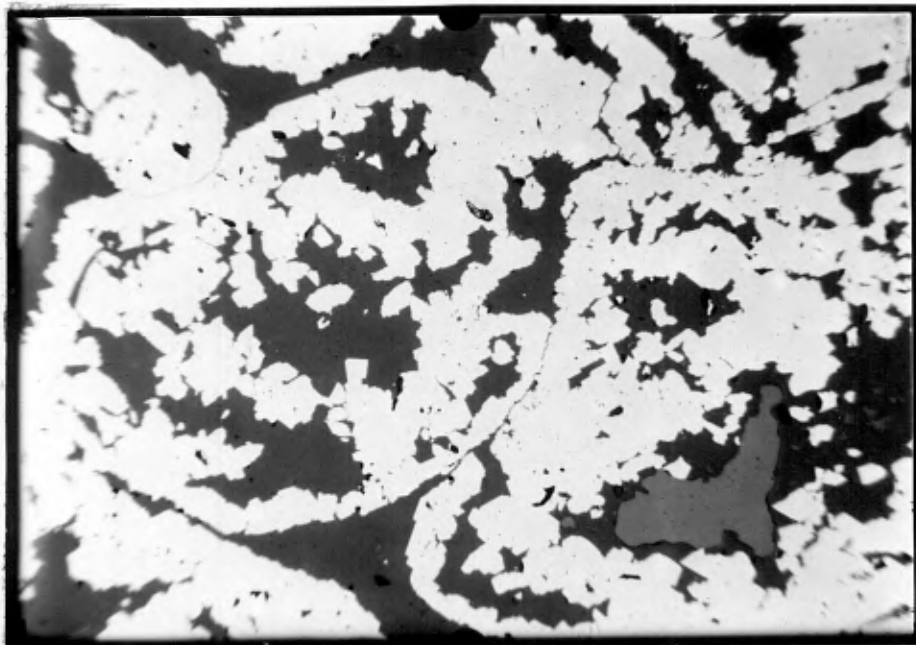
Oxides facies. 15x. Showing the ore (magnetite and hematite) - bearing oolites in red chert. 15x. Ore, black; chert, grey; and hematite-bearing chert, dark grey.

D.D.H. No. 16

Depth: 144'

Thin Section No. 1703

Photomicrograph No. 423



POLISHED  
SECTION

Oxide facies - Showing the magnetite-bearing chert oolites embedded in chert. 80x

Magnetite, white; chert, grey; and carbonate, light grey.

D.D.H. No. 20

Depth: 122'

Polished Section No. 574

Photomicrograph No. 975

Ore particles average 325 mesh.

Note: These photomicrographs were selected from those available at the time this report was written and were chosen merely because they were the most illustrative. It will be noted that in all cases they represent material of the oolitic, granular type of the magnetic hematitic sideritic chert. There were no photomicrographs available at that time illustrating the other two classes of this chert, that is the "massive" and "banded". (See Table of Formations after page 22.)

CHAPTER X.EXPLORATION

A. Exploration of the Lake Albanel iron deposits was initiated by Canadian Cliffs Limited in 1952 and by M. J. O'Brien Limited in 1953 and was continued sporadically through 1954 and 1955. After the linking of the Lake Albanel activities of the two companies in 1955, in anticipation of the formation of Albanel Minerals Limited, the 1956 and 1957 campaigns were planned to complete the information necessary to provide a satisfactory appraisal of the value of the deposits.

A brief resume of the effort previous to 1956 follows.

(1) M. J. O'Brien Limited put staking crews into the area after the breakup in 1953 and staked claims that now comprise the "B", Indian Grave, Kallio Creek, "D", Plateau West, Valiant Bay, and Richmond Groups and part of the Kallio Lake Group.

Three prospecting crews were also active exploring the ground claimed to provide information to guide the staking. Generally the claim groups were located on information provided by the mapping done by Neilson and Wahl, for the Quebec Department of Mines, (op. cit.), and this was found to be most reliable. Some 700 claims were staked during the 1953 season.

In 1954 two experienced iron ore prospectors were given the job of evaluating the ground staked in 1953. The work of these two men supplemented that done in 1953 to the effect that (a) all outcrop of iron formation was found, (b) it was determined that some of the ground staked in 1953 was of little value and so could be dropped, and (c), a matter that had been of some moment up to that time because of the findings in similar

rock types in Labrador and Ungava, it was determined that there was little possibility of finding direct-shipping ore and that the future of the area must depend on magnetic concentration and hence the magnetite content of the minable beds.

The 1955 season saw no work done on the ground but an Airborne Magnetometer Survey was carried out over all the area where the iron formation was known to occur. This provided a great amount of very interesting information and indicated possibilities, in some of the ground not already claimed by Canadian Cliffs Limited and M. J. O'Brien Limited, of there being desirable iron formation under cover that might be sufficiently light to warrant exploration.

Up to the organization of the joint effort, M. J. O'Brien Limited had spent a total of \$112,700.56 at Lake Albanel.

(2) Canadian Cliffs Limited, in 1952, sent Dr. J. M. Neilson to Lake Albanel to investigate the occurrences of Iron Formation on which he had worked during his time as a geologist for Mistassini Explorations Limited. As a result of his examination, he staked the Temiscamie Group.

Plans were made to investigate this ground and a staff of geologists, surveyors and helpers was organized for the 1953 field season. Also one diamond drill was sent in and the technical staff was augmented by a party of two prospectors.

Drilling and mapping of the Temiscamie Group was started at the beginning of the 1953 season, still largely predicated on the possibility of finding direct-shipping ores. This work confirmed the absence of direct-shipping ore in the region and that the Lake Albanel deposits must depend on their magnetite content. As a result of this change of concept, a more

widespread search for magnetic exposures was initiated and two large blocks of claims were staked which are now the Albanel and Sandspit Groups. A further small group of claims was staked to cover the leached deposit and are now the Goethite Group.

The 1953 season provided a well controlled geological map of the Temiscamie and Goethite Groups as well as some reconnaissance mapping in surrounding areas. Considerable stripping was accomplished on these groups and a surface sampling program covered the Temiscamie Group as well as a preliminary test of the Albanel and Sandspit claims. Nine diamond drill holes were completed for a total footage of 3269 feet on the Temiscamie and Goethite holdings. At the end of 1953, Canadian Cliffs' claim holdings were as follows:

L.O. 3119C	Temiscamie	41
L.O. 3120C	Albanel	50
L.O. 3121C	Sandspit	36
L.O. 3131C	Goethite	13
	Base Camp	<u>1</u>
T O T A L		141

Metallurgical work was carried on during the winter of 1953-54 on samples derived from the 1953 season work and results were sufficiently encouraging that it was planned to explore the Albanel and Sandspit Groups during 1954.

A technical crew utilizing one diamond drill undertook the exploration of the Albanel and Sandspit Groups during the 1954 season. Twenty-six holes were drilled for a total of 3682 feet, thirty-two miles of geological traverses and nine and three-quarters miles of magnetic traverses were completed and some eighteen miles of plane survey was carried out for control.

This field work and the analyses and metallurgical testing done on the samples outlined two widespread zones where tonnages and iron content were

sufficient and of such character as to indicate deposits of concentratable ore.

Because of the depressed Iron Ore market in 1954 active field work was suspended in 1955 but metallurgical testing continued.

During the two years 1954 and 1955 no claims were staked by Canadian Cliffs and some of the less attractive claims, of the original staking, were allowed to drop with the result that at the end of 1955 the claim holdings were as follows:

L.O. 3119C	Temiscamie	21
L.O. 3120C	Albanel	36
L.O. 3121C	Sandspit	27
L.O. 3131C	Goethite	<u>6</u>
T O T A L		90

Up to the organization of the joint effort, Canadian Cliffs Ltd. had spent a total of \$159,252.10 at Lake Albanel.

B. Exploration during 1956.

(1) Claim Staking.

The combined operation financed by M. J. O'Brien Limited and Canadian Cliffs Limited started on April 1, 1956. At that time the claim holdings comprised 156 belonging to M. J. O'Brien Limited and 90 belonging to Canadian Cliffs Limited.

As a result of the airborne magnetometer survey done by M. J. O'Brien Limited in the fall of 1955, it was thought necessary to stake further ground to cover those parts of the area where strong anomalous conditions occurred. To carry this out, Eric Rex took a crew into Lake Albanel early in April and staked 250 claims.

Work done during the summer of 1956 and increasing familiarity with the airborne survey indicated that some further ground should be acquired and

a total of 54 claims were staked between June and October. As a result of this activity the year ended with total holdings of 550 claims and the ownership of the claims was as follows:

Canadian Cliffs Limited	90
O'Brien and Fowler Limited	156
Combined Staking	<u>304</u>
T O T A L	550

The 304 claims remained in the names of the original Mining Certificate holders, but early in 1957 the 550 claims were all transferred to Albanel Minerals Ltd.

(2) Geological Surveying. (See 1" = 1000' Geological Sheets, bound separately.)

During this season, the field staff was divided into two groups, each of which was made up of two senior geologists, each with a helper, to carry on mapping; a junior geologist and helper to do superdip work; a senior surveyor with a junior to carry on surveying. The survey parties were provided with two to four line cutters at various times during the season to carry on their work. Geological mapping, on a reconnaissance basis, was done on "D" Group, Richmond, Valiant Bay, Kupotagen, Sandspit East, Kallio Lake, Albanel West, Plateau East, Canso West and Canso East Groups. Mapping of the accuracy desired was completed on all of these groups except Valiant Bay and Albanel West which were only partially covered.

This work permitted considerable extension of the map sheets, at 1" = 1000', which had been started to illustrate the mapping done in earlier years on the Sandspit, Albanel, Temiscamie Groups, etc.

(3) Geophysics. (See 1" = 1000' Geophysical Sheets, bound separately.)

Superdip traverses at a spacing of approximately one quarter mile were run on "D" Group, Richmond, Valiant Bay, Kupotagen, Sandspit, Sandspit East

and West, Albanel and Canso Bay East and West. All of these were completely covered except Valiant Bay, Canso West, Albanel and Sandspit.

(4) Surveying. (See Figure 9, Page 126.)

On the Richmond Group a base line of six and one half miles was cut from the Richmond River north. Various cross lines were surveyed from this base line and the survey so established was tied-in by triangulation network from Trout Point to the 51<sup>o</sup>N. latitude line north of the group.

Valiant Bay. A base line of 3.4 miles was cut and surveyed off the 51st parallel and a further four miles of picket lines were cut.

"D" Group. A system of triangulation was carried up the Temiscamie River from the 51st parallel into the "D" Group and the diamond drill holes surveyed into this system.

Kupotagen. A picket line was turned off the 51st parallel just east of the mouth of the Temiscamie River and was run north and east for five miles through the group to a point somewhat inshore from Kupotagen Bay.

(5) Diamond Drilling. (See Figure 10, Page 127.)

Four machines were operated during the season of 1956 and a total footage of 8,492 feet was obtained in 34 holes. Tabulated as to groups, these are as follows:

<u>Group</u>	<u>No. of Holes</u>	<u>Footage</u>
"D"	6	2,079
Richmond	11	3,046
Valiant Bay	6	1,051
Kupotagen	3	633
Canso Bay West	4	703
Canso Bay East	<u>4</u>	<u>980</u>
T O T A L	34	8,492

For a discussion of drilling conditions in the area, see C(5) below.

Costs for drilling during 1956 were \$7.18/foot in direct payments of invoices to the contractor. Figures on other pertinent charges are not available for 1956.

(6) Other Exploration.

Under the combined operation during 1956, it was decided to extend exploration to the northeast from Lake Albanel in an effort to find any repetitions of the Albanel type of iron ore or any other magnetic bodies that might exist. To encompass this, an arrangement was made with Canadian Aero Service Ltd. to do an airborne magnetometer survey extending to the northeast and east of Lake Albanel to the Peribonca River. This was flown on an average interval of two miles and actually extended to the 71st longitude which was the western extremity of work that had been done by other operators in the area of Lakes Matonipi and Pletipi.

This operation was carried out during the summer of 1956 and the data turned over to the Geological Department of Cleveland Cliffs at Ishpeming. The results were coordinated and maps produced over the winter and explorations planned for 1957.

(7) The costs of the 1956 explorations, financed jointly by Canadian Cliffs Limited and M. J. O'Brien Limited, were \$242,336.72.

C. Exploration during 1957.

(1) Claim Staking.

(a) Eight claims were staked on the Albanel Iron Range to fill out the Albanel Group, to bring the total claim holdings at December 31, 1957, to 558 claims.

(b) In addition, 192 claims were staked on the iron-titanium showings at Lake Benoit (see separate reports).

(2) Geological Surveying. (See 1" = 1000' sheets.)

Some 20 senior and junior geologists and engineers were employed during the 1957 season and their work was divided between the Iron Range and more widespread exploration. The latter effort is covered in separate reports so only that work done on the Iron Range is detailed here.

One mapping party, consisting of a senior and a junior geologist, was busy during the full season completing as much as was possible, in the time available, of the mapping of the claim groups in the Iron Range and of other ground that could provide useful information. As a result, we can plot the geology, valid to the present mapping scale of 1" = 1000', on all the claim groups and much of the intervening ground. Ideally this should be continued to include all the area of Iron Formation and, before any future mining operations, those areas of economic importance should be re-mapped in much greater detail.

When opportunity provided, a second two-man party carried on a surface sampling campaign to complete the work from the previous years. All exposures of magnetic material within the claim groups, not previously covered, were visited and a start was made on sampling those exposures which had been considered not sufficiently valuable to stake. The mapping and sampling that we were able to do on ground not presently claimed has verified previous decisions in some cases and has raised some doubts in other cases. These latter instances are referred to in various places in this report.

(3) Geophysics. (See 1" = 1000' Geophysical Sheets, bound separately.)

A superdip crew operated almost continually from early in May until September. Its time was divided between the Albabel Iron Range and the widespread exploration program (see separate report - Benoit Lake).

The traversing of the claim groups, at the established interval, was completed except for parts of the Temiscamie groups, where a few additional lines would be desirable. Furthermore, a start was made to cover some of the areas outside of the claim groups where it was thought geophysical work might provide useful information.

This coverage is at a very large interval being mainly one quarter of a mile with some spacing much more than that and none any closer than 1000 feet. On the Scarp and Kallio groups, where dips are very low, this wide spacing has been generally satisfactory for the present scale of exploration. However, on the River groups, closing down the interval to 1000 feet did not provide good control in the faulting and folding characterizing that zone.

Previous to any development, the claims should be geophysically surveyed at a much closer interval than has been done to date.

(4) Surveying. (See Figure 9, Page 126.)

Two transits were used during the full season, supplemented by a third instrument for a few weeks. Each of the full-time instruments was operated by a surveyor and helper with two to four axemen as required.

These crews surveyed all the holes drilled in 1957, except one on the Kupotagen and those on the Valiant Bay and Richmond Groups. They also tied-in some of the holes drilled in 1956 and made an especial effort to tie together all the surveying done since 1952.

To further this purpose, advantage was taken of the survey line cut by the Canadian National Railways from Lake Albnel to Chibougamau. This line started from Canso point and followed the east shore of Lake Albnel to its southwestern tip. McGinn's 1954 survey was tied to this line at two points and the 1957 surveying was also linked to McGinn's work at two points and then extended across to the "B" Group from where a traverse was carried down the Temiscamie River to Kallio Creek and thence almost due south across country to the 51st latitude line some distance east of the 37-mile post. The Canadian National Railway line, on the other hand, intersected the 51st parallel near the 30-mile post so that our calculations could be based on an intercept on this original line of some seven miles.

Calculations of the survey notes sufficient to provide a closure onto the 51st parallel was carried out by Canadian Aero Services staff after the field season and the calculations were used by them to produce a topographic map of the area covered by our claim groups on a scale of 1000' = 1". On this map the topography is represented by land-form lines having a vertical interval of 10 feet. This map covers 132 square miles and while being of only moderate accuracy, will serve for preliminary planning and thereby will aid the evaluation of the project to a very great extent.

At some time in the future, a sound survey control should be established over the area. This could probably be best done by a Tellurometer network for the establishment of basic stations. The Tellurometer is a feasible piece of apparatus for the area and permanent stations could be established throughout in such a way that local surveys could be tied together. These points could also be marked for detailed cover by a new air photo survey and a topographic map of extreme accuracy could be obtained at any time thereafter that it might be needed.

(5) Diamond Drilling. (See Figure 10, Page 127)

Four drills and three tractors had been stored at the end of the 1956 season and it was decided to try to get the 1957 drilling program started before or during breakup. It was also planned that, contrary to the 1956 program, the drills should not be scattered individually through the area but should, as nearly as possible, be kept operating as pairs of drills. The drilling company had wished to change over from gasoline to diesel engines on the drills, hoping thereby to accomplish savings in fuel costs, both in quantity and in transportation. A drill foreman and crew of mechanics moved into the property early in March. The six foot depth of snow seriously hampered their efforts to gather up the machines to make the engine replacements and to place them for the start of the season's work, with the result that drilling did not start until well into breakup, at May 2nd. Two camps were set up, one on the "B" Group and one at Plateau Lake and a drill foreman was placed in charge of each pair of drills. Albabel Minerals Ltd. put a technical man at each camp to supervise the work.

From this start the program was as follows:

Drills 1 and 2. These two machines drilled 26 holes on the "B" Group from where they were separated, one machine moving to the Indian Grave Group and on to Kallio Creek, the other into the Richmond Group.

Drills 3 and 4. The other two machines drilled a fairly continuous series of holes from Canso West through the Albabel, Plateau East and West Groups, Albabel west, Kallio Lake, Sandspit East, Sandspit west, Kupotagen and Valiant Bay Groups. During the season, one of the four drills was stopped in July and another in early August, leaving only two drills in operation at the end of August. A tabulation of the number of holes, footages,

etc., achieved during this season is as follows:

<u>Group</u>	<u>No. of Holes</u>	<u>Footage</u>
Canso West	4	1,018
Albanel	6	1,157
Plateau East	4	998
Plateau West	6	1,127
Albanel West	5	1,188
Kallio Lake	3	537
Sandspit East	3	505
Sandspit West	3	696
Kupotagen	2	528
Valiant Bay	3	484
Richmond	5	986
"B" Group	26	8,953
Indian Grave	2	769
Kallio Creek	<u>1</u>	<u>517</u>
T O T A L	73	19,463

As in 1956, it was planned to drill the Scarp and Kallio Groups on cross sections spaced at intervals of approximately 3000 feet. In many cases, this spacing was increased or decreased, by several hundred feet, so that the drilling cross section would coincide with the lines on which geophysical readings had been taken. One or two holes were drilled on each of these cross sections. On the folded River groups, a somewhat similar spacing was undertaken, but it was found that a much greater number of holes was required on each section to provide interpretable data. As it was, time allowed for this closer spacing on only the "B" Group.

Costs for drilling during 1957 were \$7.49/foot, in direct payment of invoices to the Contractor, and \$9.89/foot after other pertinent charges were added. These latter charges were made up as follows:-

Salaries	\$ 6,771.74
Travel	723.63
Telephone	1.05
Office Supplies, etc.	32.16
Payroll taxes	29.20
Aircraft Charter	42,754.77
Maps and prints	1.37
Field Equipment	176.98
Postage and Express	458.87
Special Supplies	1,122.42
Contractor	<u>140,370.22</u>

T O T A L            \$192,442.41

Generally speaking, drilling conditions were fair but the rock proved hard and abrasive and diamond costs were somewhat high. In most of the area overburden encountered was light, generally below 30 feet in depth. Some deep overburden was encountered in the Canso East, Canso West, Sandspit West, Kupotagen, Valiant Bay and Richmond Groups. This ground proved to contain a fairly high percentage of coarse gravel and boulders and was found to be moderately difficult to penetrate. Once bedrock was reached, a good recovery of core was obtained. The only exceptions to this were a few places on the "B" Group where trouble occurred because of faulting.

Special conditions occurred on the Kupotagen and Valiant Bay Groups, near the mouth of the Temiscamie River, where casing had to be driven into considerable thicknesses of broken bedrock. This condition seems to be unique in this area and caused us very considerable difficulty. No satisfactory method was found to penetrate this material. There appeared to be too many voids in the material to allow for satisfactory use of mud and the abrasive character of the material, with its tendency to move after penetration, caused considerable wear on rods, casing and barrels behind the bit.

(6) Other Exploration.

Following up the airborne magnetometer survey carried out during 1956, to the north and west of the Albanel Iron Range, an exploration program was

planned for 1957 to investigate the anomalous conditions indicated in the survey. Three two-man prospecting parties and two two-man geological mapping parties were equipped for this exploration. The prospecting parties were organized particularly to investigate the anomalous areas. The two geological parties were organized primarily to map into the area of Grenville rocks on lines approximately normal to the "Grenville Front" and spaced where water routes provided travelling facilities. During the course of this work, all of the magnetic anomalies were investigated and were found, in all but one case, to be caused by deposits of magnetite of a contact metamorphic character in which the size or grade were such that they were not economic. The one exception was the titaniferous magnetite deposits at Lake Benoit which may become of interest. This exploration program and the results thereof are covered in separate reports which may be consulted.

(7) The costs of the 1957 exploration, financed by Albanel Minerals Ltd., were \$432,163.31, making a total cost, to December 31, 1957, of \$946,452.69.

D. Suggested Future Exploration on the Albanel Iron Range.

In looking toward future exploration a distinct separation occurs between those groups of claims containing Class I ore and those containing Class II ore. Class I ores are those in which initial production is anticipated and which are presently confined to the Sandspit and "B" claim groups. From a consideration of timing, the work on the Class I ores must be largely completed well before the start of production in order to formulate operating plans, whereas the work on the Class II ores might be delayed for an extended period, except for work which may be advisable for the required annual assessment work. It can be anticipated that a great part of the exploration of the groups other than Sandspit and "B" will be delayed to the time when

it can be more satisfactorily and efficiently handled in conjunction with established operations. In the light of this division of future exploration into that required immediately and that which it may be advisable to delay, the following discussion is primarily concerned with Sandspit and "B" Groups.

The work on these two groups, which to date is essentially reconnaissance in character, must be augmented by more detailed geological and geophysical surveys and extensive diamond drilling to permit planning for mining and production. An accurate survey base must also be provided to control these field investigations, to tie-in and adjust all previous work and our present maps and to locate claim boundaries and all other points whose positions must be accurately known. A plat of accurately located picket lines, at a maximum interval of 400 feet and covering each of the two groups, would be required for the geological and geophysical surveys. A Tellurometer network would provide regional control for surveying. Diamond drilling should be laid out in patterns based on present information with such adjustments as are indicated by future exploration.

The following computation of the drilling needed on the Sandspit and "B" Groups is suggested after a study of the present information:-

SANDSPIT GROUP

14 more sections to complete the 1000 foot spacing

8 of these need two holes = 16 holes  
 6 " " " three " = 18 "

No. of holes 34

Average depth = 150 feet

Total footage = 5100 "

Add 10% = 510 "

Total = 5610 "

"B" GROUP

<u>Section</u>	<u>Holes drilled</u>	<u>Holes to be drilled</u>
9000 N	-	6
8000 N	-	6
7000 N	-	6
6000 N	3	3
5000 N	-	6
4000 N	-	6
3000 N	3	3
2000 N	2	4
1000 N	2	4
0	3	3
1000 S	-	6
2000 S	-	6
3000 S	3	3
4000 S	-	6
5000 S	-	6
6000 S	2	4
7000 S	-	6
8000 S	-	6
9000 S	<u>2</u>	<u>4</u>
	20	94

94 holes @ 500' = 47,000 ft.

+ 10% = 4,700 "

Total 51,700 "

As discussed above, a large part of the work on the groups containing Class II ore can be delayed to a time when working conditions will be better with the establishment of major operations in the district. However, it is recommended that these claim groups be maintained in good standing and this will entail the fulfilment of the requirements of the Provincial Mining Act. These requirements call for the performance of certain annual assessment work or quite expensive cash payments in lieu thereof. It is advisable that such expenditures be used for active exploration which will make information available. From this one can anticipate a continued but relatively small annual exploration effort on these claim groups.

The primary need on these groups is for sufficient diamond drilling to complete the reconnaissance stage of the exploration. The requirements to complete this drilling are so indefinite and diverse any estimate made at this time would have little validity. In addition to the diamond drilling, these groups should also undergo more detailed geological and geophysical mapping and the survey control should be tightened and tied in with any regional control. On many of these groups seismic work might be advantageously used to map the buried rock surface and thus delineate areas where the overburden thicknesses were not economically prohibitive.

In future efforts on the Lake Albanel Iron Range, detailed information from much of the ground which is not now held by the company will prove of considerable value. As operations develop in the area, it can be assumed that communications and survey control will be progressively more valuable and any resident geological staff will find much to do in correlating the geology of the Range.

E. Exploration Generalities.

The exploration as carried out in the 1956 season and the improvements undertaken in 1957 produced quite commendable results. A discussion of many of the aspects of the operation is included in this report as an appendix which has been written to aid in future planning (Page 206). This appendix describes much of the technique and also indicates where a lot of minor improvements could be made. At this point it is only advisable to point out some of the more important changes which appear advisable. These recommendations apply particularly to work in the Lake Albanel area and to conditions as they have been to date. It can be assumed that the recommended changes would automatically occur in future exploration at Lake Albanel, in that it would be carried on concurrently with preparations for, and during, production and that infinitely greater facilities and equipment would be available.

The primary recommendation concerns diamond drilling and is that land transportation be improved. This could best be done by having heavier tractors and wagons, particularly so if the tractors were such that they could be equipped with bulldozer blades for the clearing of roads and the clearing and levelling of drill sites. One can envisage conditions, should a great amount of drilling be foreseen, where such equipment might build roads sufficiently good for four-wheel-drive vehicles and that such vehicles be provided.

The other important recommendation concerns survey control for geological mapping, geophysical work, and the location of claim boundaries, etc. The rather sketchy control that we have used to date at Lake Albanel will entail quite extensive and also quite expensive future revision of maps, tabulations, etc. It would appear that the expense of providing a sound

control at an earlier stage would be small compared with the revisory work we must anticipate.

On the same matter, our geological mapping and geophysical surveys should have been done in much greater detail. In any future investigations, plans should be made for more detailed work than was done at Lake Albanel.

CHAPTER XI.

TONNAGES AND GRADE

A. General Statement.

Present ore estimate figures indicate that exploration has shown the Albabel Minerals Ltd. claim groups to contain at least 647,000,000 tons of material containing sufficient magnetic iron oxide to provide some 201,000,000 tons of concentrate. This concentrate, after pelletizing, would have an average analysis of 62.25 per cent. iron and 7.57 per cent. silica. There are no metallurgically undesirable accessory elements in this product.

Because exploration on the different groups varies in its intensity, there arises a natural division of the total indicated tonnage into two classes which have been called Class I and Class II. Class I material has been sufficiently well sampled and outlined by present exploration to be called ore. Class II includes all the other material of ore grade, but which requires further investigation.

Class I ores are confined to the Sandspit and "B" Groups and are made up as follows:-

	<u>Sandspit</u>	<u>"B" Group</u>
Crude tons	176,008,413	169,433,313
Weight recovery	31.13	30.73
Product tons	54,791,419	52,066,857
Analyses - % dry		
Crude - iron	29.55	31.80
Conc. - iron	66.35	65.80
" - silica	7.87	7.57

Class II material comprises 302,000,000 tons of crude ore which would yield 95,000,000 tons of similar concentrates.

A summary of the ore estimate is tabulated as Figures 11a, 11b, 11c, Pages 128a, 128b, 128c, and their distribution is shown on a map as Figure 11, Page 128. It will be noticed that there is no ore in these tabulations classified as Proven. Because the exploration to date has been only of a reconnaissance character, it was thought best to make allowances for this condition and place the ore into the categories of Probable and Prospective and a third grade, Speculative, was added to include some of the more speculative ore.

B. Details of Estimate.

The following factors were used in the estimate:

- i. Density of ore, 12 cu. ft. per ton, or 1 cu. yd. = 2.25 tons;
- ii. 1 yard of earth = 1.25 tons;
- iii. The ratio of rock to earth stripping in calculating equivalent yards is 1 yd. rock = 1.8 yd. earth in the case of the Sandspit Group, and 1 yd. rock = 2.0 yd. earth in the case of the "B" Group, based on estimated stripping costs.

It should be noted that in most places surface mapping and sampling has added detail between the drilled sections and has extensively influenced the judgment used in the estimate.

Further to the estimate, it may be pointed out that no material was considered in which the Davis Magnetic Tube tests showed less than 27 per cent. weight recovery and, in only a few cases, was any material considered in which the silica content was greater than 10 per cent.

C. Sampling.

(1) Surface.

Surface sampling has been carried on since the first staking in 1952. At the end of the field season of 1957 most of the exposures of

magnetic materials in the claim groups had been visited and sampled. Furthermore, a start had been made on sampling the exposures lying outside Albabel Minerals Ltd. claim groups and those of most significance had been sampled.

The samples were taken as chip samples of a minimum weight of 10 pounds. On the larger outcrops the weight of the sample was considerably increased. The samples were analysed for their content of soluble iron and those which contained close to or above 30 per cent. were subjected to Davis Tube magnetic tests. The concentrates from these tests were analysed for their iron and silica content and percentage weight and iron unit recoveries calculated from the results. A list of the surface samples taken previous to December 31, 1957, is included in the Appendices to this Report, Page 222.

(2) Diamond Drill Core.

The diamond drilling was all at EX size which provided a 15/16" core. Core recoveries at this size were found to be satisfactory in all but a very few cases. Where the drilling was located at a considerable distance from the camp, a rough log of the hole was carried during the drilling. This provided the information needed to determine the depth desired on that particular hole.

The core was brought to the camp or closest water communication by the drill company foreman using their tractor and wagons. On arrival at camp the core was formally logged and marked for sampling. Sampling was done for two purposes, (a) geological study and (b) assaying. Since the district is quite inaccessible and transportation costs are high, it was decided to ship only those parts of the core which were necessary for

study and chemical analyses, and that the remainder should be bagged, labelled and stored at Lake Albanel. To provide material for study, short samples of the core were extracted from all the core available from each hole, labelled and boxed for shipment to Ishpeming. These were taken wherever it was thought necessary to fully illustrate the rock types, and at a maximum separation of five feet. All of this skeleton core is now in storage at Ishpeming and is being used for research purposes.

For chemical analyses, all of those parts of the core which showed magnetite were sampled. The sampling was divided to show all of the geological features in the pertinent length of the hole and also to separate those parts where the magnetite content was greater or less. No sample was taken greater than ten feet in length. This material, after being skeletonized for geological purposes, as above, was bagged in whole and shipped for analysis. These samples were analysed for the soluble iron and the crude analyses so provided were tabulated and composited for Davis Tube magnetic testing on the basis of the following grades:-

25.01 - 30.00	% Fe
30.01 - 35.00	% Fe
35.01 +	% Fe

The composites (referred to as AMX's) were made up of weighted amounts from the various samples concerned, were thoroughly mixed and tested in the Davis Tube magnetic apparatus. In all preliminary runs this test was made at pulverization of -100 mesh.

In these standard pulverization tests, certain of these composites gave results where the percentage weight recovery and the iron content of the concentrate were satisfactory, but the silica was above allowable maximum. These samples were usually re-run after further grinding in a laboratory ball mill. It is the results of these tests that were used

in the ore estimate.

The results from all the diamond drill core samples tested, and many of the surface samples, are shown on the exploration cross sections which form part of this report. A list of the composites (AMX's) is included in the Appendices to this Report, Page 227.

## CHAPTER XII.

METALLURGICAL TESTING

As pointed out above, the drill core samples from all of the drilling done at Lake Albanel have been analysed and those parts which warranted it were tested by Davis Tube equipment. Furthermore, some polished section work has been done in the company laboratory at Ishpeming on samples of the ore material. The most recent work comprised a more thorough treatment of the ore which would be initially mined, i.e., that from the Sandspit and "B" Groups. Grand composites were made for each of these groups. These were "built up on the basis of the Geological Department's probable ore estimates for the two areas. The probable ore estimate comprises previously tested treatable iron formation which produces acceptable magnetic concentrates having greater than 27 per cent. weight recovery. The composites were built up on a volumetric basis with respect to the crude tonnage represented by each hole. The results obtained by testing of the grand composites may be taken as overall average results for the two claim groups based on the limited number of drill holes."

Summarizing results of this most recent test, the following data were derived:

1) The following results are obtained by grinding the two grand composites to roughly 88% passing 325 mesh.

Area	Grind Time	Feed % -325M	Head % Fe	Concentrate			Tails % Fe	
				% Wt.	% Fe	% SiO <sub>2</sub>		
Sandspit	24	88.00	29.55	32.77	67.10	6.37	74.41	11.25
"B" Group	24	87.70	31.80	32.85	66.55	6.07	68.75	14.80

2) The following tabulation illustrates the limits or variations that can be expected regarding concentrate per cent. weight and iron unit recoveries for the two areas:

Area	Magnetic Concentrate	
	% Wt.	% Fe Rec.
Sandspit	26.73-36.55	67.34-74.11
"B" Group	29.08-38.81	62.93-78.21

3) Cobbing at 10 mesh eliminates 26.49% and 18.86% of the crude weight for Sandspit and "B" Groups respectively. Assuming the same concentrate grade, a savings in the required finished grind of roughly 4-9% minus 325 mesh is realized by cobbing at 10 mesh over that grind predicted on batch grinding the entire crude to finished size.

4) The calculated power requirements based on Bond's grindability method is 16.1 HP/LT of crude assuming cobbing at 10 mesh for Sandspit and 19.4 HP/LT of crude assuming cobbing at 10 mesh for "B" Group.

The above and other data provide a preliminary idea of the character of the material and the Metallurgical Research Laboratory has suggested a flow sheet (page 85) for the concentrating of the crude ore from Lake Albabel with the following comments:-

"Initial batch test work on drill core samples has indicated that a typical magnetic circuit flow sheet similar to flow sheets being utilized for concentrating magnetic taconites would prove suitable for concentration of the crude ore from Sandspit and "B" Group deposits.

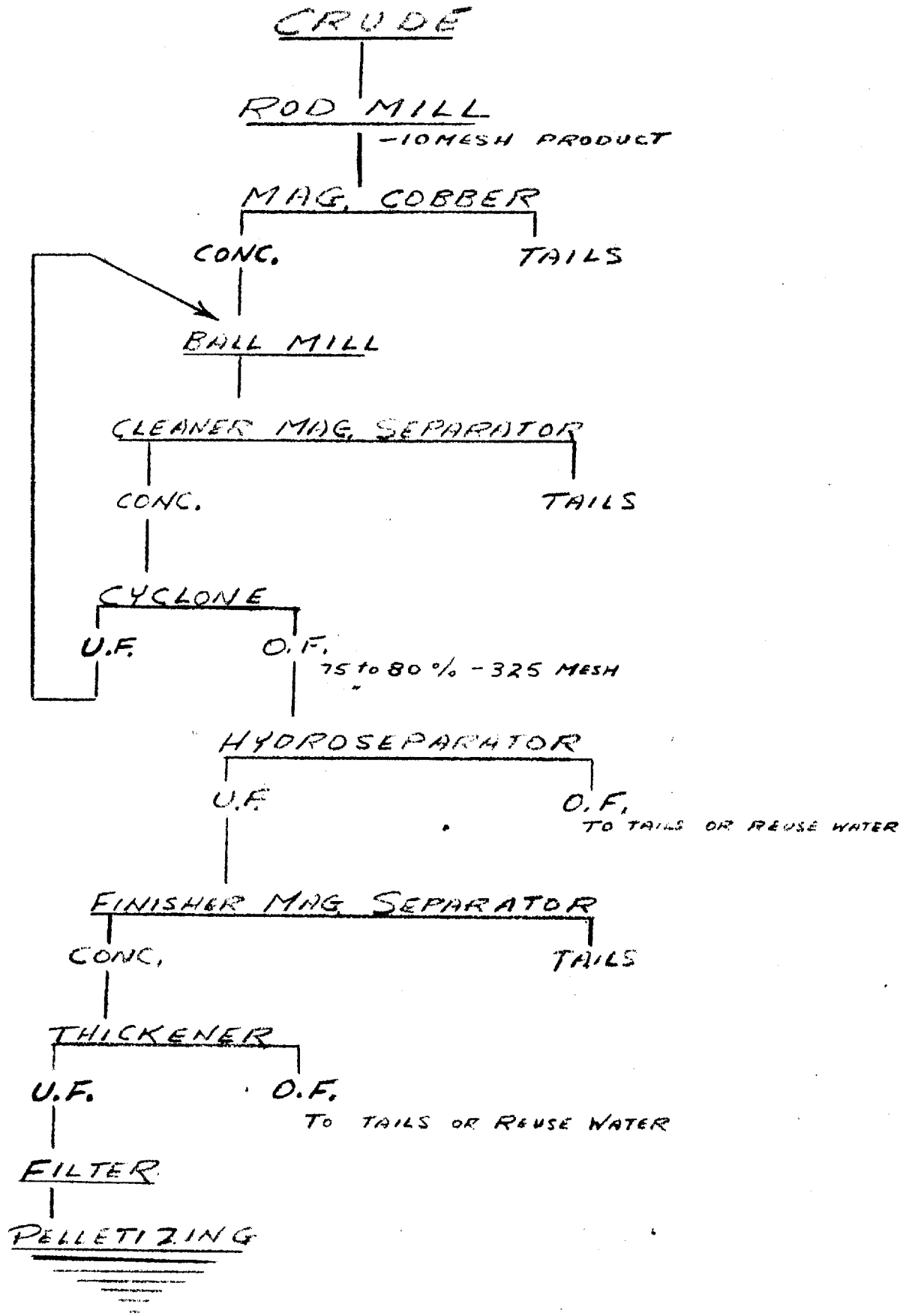
"A proposed flow sheet is detailed on a separate sheet which involves three stages of magnetic separators and two stages of grinding. Preliminary tests indicate that approximately 25% of the weight could be rejected in the magnetic cobber circuit. The final product would be approximately 75 to 80% minus 325 mesh, which appears to be the optimum size for the metallurgy and pelletizing characteristics desired.

"Actual pilot scale tests would be required before an exact flow sheet can be established."

It is planned to provide the Metallurgical Department with a bulk sample of 100 to 200 tons for their use in detailed tests.

A major consideration to us over the last few years has been the matter of the hematite and the carbonate in addition to the magnetite representing the balance of the iron units. To this end thought has been given to the idea of magnetic roasting of this portion and some preliminary studies have been undertaken in this particular field during the 1957 season. Page 86 shows the results of this preliminary work as done at the Ishpeming Metallurgical Research Laboratory.

# PROPOSED FLOWSHEET FOR CONCENTRATION OF SANDSPIT AND "B" GROUP CRUDE ORE



Results of Standard MOC - Magnetic Concentration Tests on Albanel Drill Core Composites

COMPOSITE NO.	DDH NO.	CLAIM GROUP	FOOTAGE	HEADS: % Fe		CONCENTRATE				TAILS % Fe	FEED	
				CRUDE	ROASTED	% WT.	% Fe	% SiO <sub>2</sub>	% Fe RBC.		% -325M	GRIND
AMX-171	V-2	Valiant Bay	35-167	25.70		25.91	66.6	8.86	65.61	12.2	95.83	100 M
					27.10	25.75*	67.50	7.25	67.63	11.20		
AMX-173	V-3	Valiant Bay	35-135	25.70		23.76	67.00	5.78	62.90	12.3	93.42	100 M
					26.60	25.42*	68.70	4.85	67.94	11.05		
Mx-372A	S-30	Sandspit	4- 30	39.80		32.08	70.20	1.94	57.01	25.00	94.50	200 M
					44.10	48.42*	66.80	4.70	81.26	14.46		
Mx-372B	S-30	Sandspit	30- 60	28.60		21.08	67.90	4.62	50.04	18.10	85.16	200 M
					30.30	34.80*	68.60	5.29	83.46	7.25		
Mx-355B	A-15	Albanel	30- 80	35.70		22.77	65.00	6.46	41.58	27.00	91.35	150 M
					39.40	40.48*	67.00	6.48	75.97	14.41		
10	B-10	"B" Group	440-465	31.76		21.27	60.73	7.84	41.33	23.30	97.1	100 M
					35.66	27.82*	63.71	5.86	55.81	19.44		
11	B-10	"B" Group	485-535	29.76		21.45	54.99	10.90	39.65	22.87	97.5	100 M
					34.73	21.72*	63.93	6.86	46.66	20.29		
13	B-10	"B" Group	548-595	29.60		26.89	54.35	14.76	49.35	20.51	96.8	100 M
					33.65	28.53*	61.55	9.46	59.32	16.85		

\* % Wt. recovery based on crude iron assay.

Note: All results adjusted to possible metallurgy that could be obtained on large scale plant operation.

CHAPTER XIII.MINING

The Cleveland-Cliffs Iron Company's Minnesota staff under W. A. Pakkala, General Superintendent, undertook a study of the mining operations of the ore bodies in Sandspit and "B" Groups, based on the present information. Their findings are embodied in this chapter.

Initial study of the situation suggested that rail haul of the crude ore from the two operating areas to one milling unit would be uneconomical and that a plant should be anticipated on each claim group.

With this decision, the study was based on the following tonnage figures:-

	<u>Sandspit</u>	<u>"B" Group</u>
Crude tons	176,008,413	169,433,313
Weight recovery	31.13%	30.73%
Product tons	54,791,419	52,066,857
Concentrate Analysis - % Dry		
Iron	66.35	65.80
Silica	7.87	7.57

Normal Minnesota open-pit procedure appeared to be satisfactory for the mining operation with jet-piercing for blast hole work and 6 cu. yd. electric shovels and large diesel trucks for loading and hauling crude ore to the crushing plants. Additional equipment for surface and rock stripping and pit-bottom and haulage-road maintenance would be required.

The rate of production which seemed best to fit the ore reserve picture was of one and one half million tons of product per year from each of the two deposits. This would give a life of 36.53 years for Sandspit and 34.71 years for "B" Group which would allow for comfortable depreciation and other write-offs.

The data on which the study was based is tabulated as follows:-

SANDSPIT and "B" GROUP DATA

		<u>Sandspit</u>	<u>"B" Group</u>
Crude Ore-Tons		176,008,413	169,433,313
Concentrates-Tons		54,791,419	52,066,857
% Recovery		31.13	30.73
Operating Days/Year		323	323
Tons Concentrates/Year		1,500,000	1,500,000
Tons Concentrates/Day		4,644	4,644
Tons Crude Ore/Year		4,818,503	4,881,224
Tons Crude Ore/Day		14,918	15,112
Surface Stripping:	Cubic Yards	Slight	8,073,762
	Tons	---	10,092,202
Rock Stripping:	Cubic Yards	7,935,180	42,497,704
	Tons	17,854,155	95,619,834
Shifts/Day		3	3
Life of Mine/Years		36.53	34.71
Tonnage Factor			
% Analysis:	Crude Iron	29.55	31.80
	Concentrates-Dry Iron	66.35	65.80
	-Dry Silica	7.91	7.62

The following is a summary of the mining study and will treat the two operations separately. Many of the details of the study are included in the Appendix to this report and may be consulted there, Pages 161 to 170.

### SANDSPIT

#### (1) Production Schedule.

The operating schedule used in the study calls for 20 shifts a week with seven days off for holidays and a five per cent. allowance for contingencies which would result in the equivalent of 323 operating days of three shifts a day per year.

#### (2) Capital Expenditures.

In this study no allowance was made for amortizing any pre-production costs or capital expenditures for treatment plants or wharfs. These items are considered in Chapter XVII where the overall cost picture is taken up.

Stripping. Due to rough terrain, surface stripping was estimated at \$0.50 a yard and rock stripping at \$0.90 a yard. The resulting amount for amortization of these costs becomes \$0.135 per ton of concentrate.

Mining equipment. Based on present prices, the mechanical equipment necessary for operating the Sandspit deposit would have a total cost of \$9,187,700 and the resulting amount for amortization of this cost becomes \$0.160 per ton of concentrate. For list of equipment see Appendix, Page 162.

#### (3) Pit Operating Costs.

Pit operating costs are estimated as follows:-

	<u>\$/ton Crude</u>
Drilling - blast hole	0.175
Blasting	0.090
Power shovels - operating	0.030
"    "    - maintenance	0.020
Trucks - operating	0.065
"    - maintenance	0.025
Tractors - operating	0.007
"    - maintenance	0.008
Pit haulage roads	0.008
Pumping and drainage	0.002
General open pit expense	0.009
Open pit supervision	0.008
Structure and sample drilling	<u>0.001</u>
TOTAL	0.448

(4) Mining Cost Analysis (per ton of product).

(a) Production

Pit operating	\$1.489
Stock piling, etc.	0.095
General mine expense	<u>0.180</u>

Total cost of production \$1.764

(b) Depreciation

Mining equipment 0.160

(c) Amortization

Stripping 0.135

TOTAL COST \$2.059

"B" GROUP

(1) Production Schedule.

The operating schedule used in the study calls for 20 shifts a week with several days off for holidays and a five per cent. allowance for contingencies which would result in the equivalent of 323 operating days of three shifts a day per year.

(2) Capital Expenditures.

In this study no allowance was made for amortizing any pre-production costs or capital expenditures for treatment plants or wharfs. These items are considered in Chapter XVII where the overall cost picture is taken up.

Stripping. Due to rough terrain, surface stripping was estimated at \$0.50 a yard and rock stripping at \$0.90 a yard. The resulting amount for amortization of these costs becomes \$0.906 per ton of concentrate.

Mining equipment. Based on present prices, the mechanical equipment necessary for operating the "B" Group deposit would have a total cost of \$11,474,700 and the resulting amount for amortization of this cost becomes \$0.154 per ton of concentrate. For list of equipment see Appendix, Page 168.

(3) Pit Operating Costs.

Pit operating costs are estimated as follows:-

	<u>\$/ton Crude</u>
Drilling - blast hole	0.175
Blasting	0.090
Power shovels - operating	0.030
"    "    - maintenance	0.020
Trucks - operating	0.065
"    - maintenance	0.025
Tractors - operating	0.007
"    - maintenance	0.008
Pit haulage roads	0.008
Pumping and drainage	0.010
General open pit expense	0.009
Open pit supervision	0.008
Structure and sample drilling	<u>0.002</u>
TOTAL	0.457

(4) Mining Cost Analysis.(a) Production

Pit operating	\$1.508
Stock piling, etc:	0.095
General mine expense	<u>0.180</u>
Total cost of production	\$1.783

(4) Mining Cost Analysis (cont'd)(b) Depreciation

Mining equipment	\$0.154
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(c) Amortization

Stripping	<u>0.906</u>
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TOTAL COST	\$2.843
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## CHAPTER XIV.

### MILLING AND TREATMENT

#### A. Plant Sites. See Figure 3(Page 120), Figure 12(Page 129) and Figure 13(Page 130).

The immediate prospects for production from Albnel are based on the Sandspit and "B" Groups' deposits. Both of these have, in the Phase I exploration, shown a consistency of results which allows them to be classified as minable ore. A third less fully substantiated occurrence is in the Albnel Group. Beyond these three occurrences all of the showings of ore-grade material require considerable further exploration.

The Sandspit and "B" Groups both indicate an optimum production of one and one half million tons of pelletized concentrates a year and the present indications of the Albnel deposits would suggest that they are roughly the same size. Future planning will determine the advisability of starting production on one or both of the Sandspit and "B" Groups but the distance separating them would rule out the possibility of milling ore from both deposits in a single mill. Hence a mill site on each group will be required. In both cases, this requirement can be satisfactorily filled. In the Sandspit Group a site between the outcrop and Kallio and Einar Lakes could be used which would provide a rail approach via the land between the two lakes. The "B" Group affords a site on the flat between the outcrop and the river to which rail approach is feasible along the northwest bank of the Temiscamie River.

Should the occurrences in the Albnel Group prove to contain a good

ore supply, the economics of a new plant on the group versus the haul to either the Sandspit or "B" Group mill would have to be carefully investigated. Should this investigation show that a separate plant for this group would be advisable, a location is available west of Plateau Lake. This could be relatively easily approached by rail from the "B" Group spur at a location somewhere near the upper rapids on the Temiscamie.

B. Water Supply.

For the Sandspit mill location, the tailings disposal pond as discussed below will afford satisfactory return-water facility and make-up water could be pumped from Lake Albanel. The water supply for "B" Group can be relatively simple if our present plans for tailings disposal are feasible. These plans are discussed below and entail damming the Temiscamie River a short distance upstream from the mill site and water could be drawn from above this dam.

The Albanel Group situation is somewhat on a par with the Sandspit and could probably be solved in much the same manner.

C. Tailings Disposal.

For Sandspit present planning would indicate that the northeast half of Einar Lake would serve as an initial disposal pond and could be created as such by some diking at its northeast end to prevent any contamination of Kallio Lake. A dam across the centre of the lake would divide the basin into two settling ponds and the return-water could be taken from below this dam in the southwestern half of the lake. The relatively small overflow from this pond would be ditched over the land separating the present head of Einar Lake from a small stream-system which empties into Kupotagen Bay of Lake Albanel. This setup would turn the waters of Einar Lake, which now flow into Kallio Lake, directly into Lake Albanel. The planning to keep

contamination from Kallio Lake is based on the desire to keep Kallio for townsite water supply and recreation purposes. This matter is discussed below in Chapter XV.

For "B" Group, the present planning of tailings disposal depends upon a diversion of the Temiscamie River some miles above "B" Group. This diversion would turn the river from its present channel, across a mile of intervening land, into the northeast end of Lake Albanel. This would entail the digging of a channel from the river toward the lake and building a dam on the Temiscamie River a short distance upstream from the "B" Group mill-site. Tailings could be pumped into the present channel below this dam and the overflow allowed to join the water of the Tournamine River and continue down the Temiscamie channel to its outflow into Lake Albanel. Minor cross dykes could divide the distance below the dam into several settling basins so that the water joining the Tournamine flow would be clear.

The estimated difference in elevation between the Temiscamie River and Lake Albanel at the point of the diversion is approximately 20 feet. It is possible that the new channel might show a sufficiently low gradient that it would be navigable by powered canoes, at least those travelling downstream. Should there be some unnavigable obstruction in this channel, a portage road could be maintained and it might even be advisable to supply some type of wheeled vehicle which could be used by the Indians, etc., for access from Lake Albanel to the Temiscamie River above the dams and tailings disposal facilities.

Discussions with the Dominion Department of Public Works and the Quebec Department of Hydraulic Resources have been initiated in anticipation of applying for permission to make the diversion of the Temiscamie River.

The Department of Public Works is concerned under the Navigable Waters Protection Act and a decision must be first made as to the classification of the Temiscamie River. If it should fall outside the classification of Navigable, the Federal Government would be no longer interested.

The Quebec Department of Hydraulic Resources regulate these matters under the Water Courses Act.

For any future mill on the Albanel Group, the basin of Plateau Lake supplies satisfactory tailings disposal pond. This could be dammed in such a way that return-water would be obtainable for the plant.

A memorandum of discussions with the Quebec Department of Mines on tailings disposal is appended to this report, Page 160.

D. Stock Pile Grounds.

Since mining, milling and rail shipment would be a year-round operation, stock piling facilities at Lake Albanel are unnecessary except for small surges which might occur during the winter season when storms may prevent rail haulage for short periods.

It can be expected that much of the product will be shipped by water from Ha Ha Bay on the Saguenay River and that the quantity so shipped will eventually be sufficient to warrant the construction of wharfs and stock piling facilities at that point. The firm of Arden, Morgan and Associates was asked to make a preliminary investigation of this situation. Their results are available in their report, and they found a feasible location at Anse Benjamin near Port Alfred where physical conditions were satisfactory for erecting a wharf and loading facilities and at which there was room for all necessary stock piling.

E. Railroad Spurs. See Figure 3, Page 120.

The present plans of the Canadian National Railways would probably mean a crossing of the Temiscamie River at the lower rapids within a short distance of the north 51° latitude line. From here the line can be continued towards the Sandspit Group to pass between Kallio and Einar Lakes and so approach the suggested location of the Sandspit plant and would provide adequate rail facilities.

A spur from this line can be carried up the northwest bank of the Temiscamie River to the location of the townsite and so provide for shipment to that point. This spur can later be extended further up the river to provide access to the future "B" Group plant. The spur to the townsite, from the main line to the Sandspit Group, would involve the construction of two and one half to three miles of track.

F. Electric Power.

Preliminary discussion has been carried on with the Quebec Hydro Commission. This has resulted in an assurance by the Commission that power is available in all amounts which we might require from the present distribution network at Lake St. John. This power would be delivered to Lake Albanel by means of an entirely new line built from Lake St. John to Lake Albanel along any railroad which may be constructed. Assuming this railroad construction, power could be delivered within two years from the date of any agreement. The line would be designed to carry 75,000 K.W. and would consist of transformer facilities at both ends as well as the transmission line itself. These facilities would be built by the Quebec Hydro Commission and the estimated cost of construction would have to be covered by a 100 per cent. deposit from the company previous to the start of construction. This deposit

would be returnable to the company as a 10 per cent. deduction from all monthly power bills. Should any other users of power from this line be found, part of the cost of construction would be pro-rated to them and any increase in use of power would entail a reduction in unit cost.

The present planning is based on the Canadian National Railway's recent submission in which (a) the new location means a mileage of approximately 200 miles from Lake St. John, and (b) their revised minimum tonnage requirements allow us to plan for an initial annual production of one and one half million tons of pellets. This would require a power load of approximately 23,000 K.W. The most recent quotation supplied by the Quebec Hydro Commission based on these figures is a construction cost of \$7,300,000 and a power cost of \$50 per K.W. year.

See memoranda and correspondence appended to this Report.

G. Labour Supply.

There is presently no source of labour at Lake Albanel except the Indian population. This can be drawn upon for numerous tasks which have to do particularly with exploration, transportation, etc.

Technical and skilled personnel are presently available throughout Canada and the Lake St. John region is a relatively close source of unskilled labour.

H. Supplies.

The source of practically all supplies during construction and production will be Montreal. This source is adequate and satisfactory.

Some bulk supplies such as fuel, etc., will probably be handled through port facilities on the Saguenay River and a few minor supplies can

be procured through present merchandising facilities at Chicoutimi and Lake St. John.

The timber stand adjacent to Lake Albanel is sufficient to supply any lumber requirements and the right to cut should be procured from the Provincial Department of Lands and Forests. This would entail the establishment of saw milling facilities and local transportation.

CHAPTER XV.TOWNSITE

An underlying consideration of townsite planning is the present attitude of the Provincial Government on this matter. The Department of Mines and the Department of Municipal Affairs are involved. Their present thinking is that residential facilities for isolated operations should be, as far as possible, coordinated into definite settlements or townsites at a spacing of not less than 10 miles; that personnel for local industrial operations be housed in these settlements and that bus transportation be supplied to any various plants. In this way the residential accommodation is grouped so that the necessary facilities will serve as many as possible and do not have to be duplicated in scattered small communities. They feel that in this way it is economical to provide good and satisfactory facilities for everyone and prevent the creation of scattered, poorly serviced settlements.

In the early stages of the establishment of an isolated mining community, the Department of Mines has regulatory powers through the Mining Act. After a period not exceeding five years, the townsite must be organized as a municipality under the Department of Municipal Affairs and the Acts and Regulations of that Department would apply as they do to all communities in the Province of Quebec. In these operations the object of the Department of Mines, during its supervision of the community, is to see that the organization of the townsite and creation of the townsite are properly done and financed. After this early stage the municipality becomes an autonomous community under the Department of Municipal Affairs whose prime object is to see that the financial affairs of the community are handled properly. A

great many more details on these processes and regulations are covered in memoranda included in the appendix of this Report.

In the light of the above discussion, a townsite area has been planned for Lake Albanel. It is situated immediately southeast of the northeast end of Kallio Lake and extends from the shore of that lake towards the Temiscamie River. See Figure 3, Page 120. This location would serve developments on any production in the area between Lake Albanel and the Temiscamie River. The railway spur to the "B" Group would pass through the townsite and so afford railway facilities and a satisfactory landing strip for any type of aircraft can be provided close to the Temiscamie River within a mile of the townsite area. The area would afford about a mile of frontage on Kallio Lake which would provide for recreation facilities and Kallio Lake would also be a satisfactory source of domestic water. Sewage disposal is possible through Kallio Creek and its various branches which drain into the Temiscamie River about 12 miles upstream from where it empties into Lake Albanel.

The townsite area is in country that is underlain by Kallio slates and hence will not be a location of any possible pitting operations in the future and it has adjacent to it a large amount of relatively flat country which would provide for future expansions.

A sufficient part of the townsite must be supplied with roads, water, sewers, power, etc., to provide accommodation for the initial working force and necessary public buildings. Also, roads must be built to the site of whatever operations are undertaken.

Public buildings such as schools, churches, etc., and housing for married and single employees must be initially financed by the company,

though a certain proportion of such expenditures may be redeemed by the sale of the various units to the final user.

The arrangements for the provision of employee housing are numerous and rather complex. It is sufficient here to suggest that as far as possible housing should be arranged on a basis of ownership by the occupants. This has been found by sad experience to be much the best procedure. This ownership arrangement, however, cannot be made 100 per cent. and it should be anticipated that some rental accommodation must be supplied as well as dormitory accommodation for single employees.

A preliminary study of these housing problems can be found in the Appendices to this Report as memoranda of discussions with officials of the Quebec Department of Mines, Quebec Department of Municipal Affairs, the Central Housing and Mortgage Corporation (Ottawa) and related correspondence. See Pages 148 and 155.

CHAPTER XVITRANSPORTATION TO CONSUMER

The final product of mining at Lake Albanel will most likely be in the form of pellets which will be shipped to consumers in North America and Europe. It is anticipated that a portion of the production will be delivered to the consumer via all-year, all-rail shipment, and the remainder by rail and vessel through a tidewater port on the Saguenay River.

The Canadian National Railways completed a branch line connecting Chibougamau to Barraute in 1957, and are presently building a further connection from Chibougamau to their terminus at St. Felicien, on Lake St. John. When this latter connection is completed direct rail transportation from Chibougamau to the Saguenay River at Chicoutimi, and to Montreal and points beyond, will be available.

(See page 2a)

During preliminary discussions in 1955 the railway officials gave assurance that a branch line would be constructed from Chibougamau to Lake Albanel at no capital cost to the property owners or to the operating company. On November 16, 1956 the Canadian National Railways submitted the freight rate and proposed terms of traffic guarantees for ore haul from Lake Albanel to Chicoutimi. The rate was \$2.66 per long ton and the guarantees required a minimum tonnage of 20,000,000 long tons shipped over a period of ten years. There was a provision for recapture of penalties on any annual shipment less than the 2,000,000 long ton minimum. Ore movements were

to be on a "hook-and-haul" basis, exclusive of terminal service. The hook-and-haul basis requires the railway to pick up full trains only at one terminus and deliver same to the other terminus. All marshalling, switching and making-up of trains is the responsibility of the mining company on one hand and the dock or receiving company on the other hand.

Original negotiations with the Canadian National Railways contemplated the extension of the St. Felicien-Chibougamau branch line to Lake Albanel, entailing the construction of approximately 123 miles of new line. There would be an additional 16 miles of new construction from Chicoutimi to the proposed docksite at Ha Ha Bay on the Saguenay River. The total rail haul from Lake Albanel to tide-water would have been 359 miles.

Several meetings with the Canadian National Railways were held during 1957 concerning rail transportation, terminal sites and dock facilities. Realizing the rapid growth in the Chicoutimi district, Albanel Minerals Limited decided that a suitable harbour location should be selected, and the necessary land should be acquired before prices became exorbitant. Arden Morgan and Associates were engaged to study the problem. Three locations were considered, one at Pointe Agonie, immediately east of Chicoutimi, one downstream from Pointe Agonie, and the third at Anse de Benjamin on Ha Ha Bay, all on the Saguenay River. After careful consideration of the three sites, the consultants concluded that Anse de Benjamin was the most suitable

since it required the minimum amount of dredging, had the most favourable topography, and was located only a short distance from Port Alfred, a port for the Aluminum Company of Canada. The railway agreed to the additional 16 miles of construction to extend their facilities from Chicoutimi to this site. Albanel Minerals Limited have taken options on some 700 acres of land, sufficient for terminal, stockpile ground and harbour installations.

Early in 1958, Mr. Alan Scott suggested that the Canadian National Railways consider alternative routes down the valley of the Mistassini River to Dolbeau and down the valley of the Nestawkanow River to connect with the mid-point on the St. Felicien to Chibougamau branch at Lac Chigoubiche. The railway would not entertain the first proposal because of the greater additional new construction but did concur in the second suggestion, and have revised their plans accordingly.

The Dolbeau route holds considerable advantage to Albanel Minerals Limited because the Quebec Hydro Electric Commission would follow the route of the railway in constructing a power line to Lake Albanel. Since high capacity sources of power are presently available only near Lake St. John, the Dolbeau to Albanel route would entail a minimum of line and therefore a smaller capital outlay.

On July 10, 1958, the Canadian National Railways advised Albanel Minerals Limited that the route via the Nestawkanow River had been approved and that new rates and traffic guarantees had been

established. The freight rate via the revised route has been tentatively reduced to \$2.55 per long ton and the minimum annual tonnage reduced to 1,000,000 long tons. The proposed rate is subject to any change in the iron ore scales that might be authorized by the Board of Transport Commissioners. The total rail haul from Lake Albnel to Ha Ha Bay via the Nestawkanow River is 304 miles.

The railway company is prepared to provide rail service whenever required, providing the request is made prior to April 1 in the year construction is to commence, in order that parliamentary approval may be obtained.

At the request of Albnel Minerals Limited, the Canadian National Railways quoted all-rail, all-year rates to various potential consumer points, based on trainload lots and on the movement of 1,000,000 tons per year. The rates are:

Albnel to Montreal, Que., 560 miles	-	\$3.81 per long ton
Albnel to Hamilton, Ont., 881 miles	-	\$5.51 per long ton
Albnel to Youngstown, Ohio	-	\$7.69 per long ton
Albnel to Pittsburgh, Penn	-	\$7.83 per long ton

There would be a slight increase in all the above rates should the all-rail shipments fall below 1,000,000 long tons per year.

The Canadian National Railways will not consider erecting and operating vessel-loading facilities at Ha Ha Bay under present conditions. They did, however, promise to reconsider the proposition at some future time.

Vessel rates have not been established but estimates based

on experience by other shippers suggest that the tolls might be:

Ha Ha Bay to Philadelphia	-	\$1.50 per long ton
Ha Ha Bay to Montreal	-	\$0.83 per long ton
Ha Ha Bay to Hamilton	-	\$1.28 per long ton

The National Harbours Board and the St. Lawrence Ship Channel Authority have both promised their full cooperation in the erection and servicing of the oredock.

CHAPTER XVII.COST ANALYSES

The Cleveland-Cliffs Iron Company's Michigan staff under D. K. Campbell investigated and reported on all those features which bear on the cost of the final product from Albabel Minerals Limited deposits. This was undertaken in the light of present information.

The study has indicated that pelletized iron concentrates can be produced from Lake Albabel at a profit. The indicated margin on shipments to various outlets, and before corporate income tax, is as follows:

	<u>Sandspit only</u>		<u>Sandspit &amp; "B" Groups</u>	
	<u>Rail-Vessel</u>	<u>All Rail</u>	<u>Rail-Vessel</u>	<u>All Rail</u>
E. Coast Market	\$3.28	--	\$2.74	--
Montreal	3.95	\$4.09	3.42	\$3.56
Hamilton	3.50	2.39	2.96	1.86
Pittsburgh <sup>1</sup>	--	2.88	--	2.34
Youngstown <sup>1</sup>	--	2.37	--	1.84

<sup>1</sup> Assuming purchaser would absorb portion of rail rate equal to cost from L. Lake to consuming center.

Should an early decision be made to proceed with the development of the deposits, a period of six and one half years is estimated to be required to initiate production. During this period detailed field and engineering studies must be undertaken, a railway constructed, pits prepared for mining, and plants designed and erected.

The data on which the investigations were undertaken are as follows:-

	<u>Sandspit</u>	<u>"B" Group</u>
Crude tons	176,008,413	169,433,313
Liberation grind	200-270 mesh	
Weight recovery	31.13	30.73
Product tons	54,791,419	52,066,857
Analyses - % dry		
Crude - iron	29.55	31.80
Conc. - iron	66.35	65.80
" - silica	7.87	7.57
Pellets - iron	64.07	63.57
" - silica	7.91	7.62
Pellet Analyses Natural		
Iron	63.43	62.93
Phos.	.004	.008
Si	7.83	7.54
S	.005	.005
Moist.	1.00	1.00

A meeting of the Report Committee was called in April to set up references for this investigation. At this meeting the Committee considered the following proposals:-

1. A 3,000,000 ton per year plant at one deposit.
2. A central plant to which crude ore would be hauled from various deposits.
3. A 3,000,000 ton per year plant at one deposit and hauling one-half of the crude ore from another deposit.
4. Individual plants at each deposit.

The first scheme was eliminated on the basis that insufficient reserves exist at either of the two most likely deposits, namely the "B" Group or Sandspit, to properly write off the capital investment involved.

The next two schemes were eliminated after careful consideration of the high cost and problems of handling crude ore at the weight recovery encountered in these properties.

Upon elimination of the first three schemes, the fourth looked most feasible, namely one and one half million tons per year plants at both "B" Group and Sandspit. However, further discussion with the Canadian National Railway officials disclosed that attractive rail rates could be obtained with a minimum 12 month production of 1,000,000 tons. Therefore, this study has been prepared on the basis of producing 1,500,000 tons per year from the Sandspit deposit initially. Later the "B" Group deposit could be opened at a like rate, giving a total of 3,000,000 tons per year of production from this area.

Certain premises were used in these studies:-

1. The pellets would be shipped as produced to an area near Fort Alfred for stocking and boat loading, or all rail to consuming districts.
2. The wage and supply rates to be encountered will equal those in the Michigan Upper Peninsula area.
3. A 40-hour work week basis is used.
4. Five marketing areas are considered.

For convenience in using the information provided by the investigation, it was divided into two parts. Study A was based on a production of one and one half million tons from Sandspit only. Study B was based on a production of a total of three million tons divided equally between Sandspit and "B" Groups and handled through a separate plant at each deposit. This chapter summarizes the two studies and much of the detail can be found in the Appendix (Pages 171-205) of this report. Since this investigation is an

initial, preliminary study of the situation, it must be expected that other proposals will be investigated and may indicate more efficient basic approaches to the problem of economic production from these deposits.

#### Production and Operating Plans.

The studies indicate that output should be at a rate of one and one half million tons of product per year from the Sandspit Group or three million tons of product per year split equally between Sandspit and "B" Groups. Figure 3 shows the proposed location of the plant sites and attendant facilities (Page 120).

#### Sandspit

The proposed operation on the Sandspit deposit is generally shown on Figure 12, Page 129, and would involve the use of open pit mining methods utilizing six cu. yd. electric shovels and 40-ton diesel trucks. These units would haul to a large gyratory crusher which would reduce the crude ore to a size for feed to a Cascade-type mill. Cascade mill product would be ground to liberation size in rod and ball mills and then pumped to magnetic separation, thickening, and filtering. At the time of the report preparation, no actual flow sheet work has been done due to the preliminary nature of the exploration. However, on the basis of the test results to date, the above appears to be a practical general arrangement.

• Concentrates from the mill would be conveyed directly into either an ACL or shaft furnace pelletizing plant for agglomeration. The pellets would be loaded directly into cars for shipment to the Port Alfred stocking and shipping area, or to the consumer all rail.

Stripping would be wasted northwest of the pit area, toward Lake Albanel.

The Sandspit plant site is tentatively considered east of the pit, and

lying approximately at the midpoint between the north end of Einar Lake and the south end of Kallio Lake. The north end of Einar Lake would be used as a tailings basin with a re-use pumphouse on the south end for returning water to the mill. Make-up water for plant requirements would be taken from Lake Albanel.

"B" Group

The general mining, milling and pelletizing plan as set forth under Sandspit would suffice for the "B" Group deposit.

Concentrates from the mill would be conveyed directly into either an ACL or shaft furnace pelletizing plant for agglomeration. The pellets would be loaded directly into cars for shipment to the Port Alfred stocking and shipping area.

Stripping would be wasted in an area southwest of the pit area while tailings would be disposed of in the present bed of the Temiscamie River. It is anticipated that diversion of the Temiscamie River through a narrow neck near Canso Bay would be feasible and make available the valley of that river for tailings disposal. All mill water would be received from the Temiscamie River with the discharge of the tailings pond being wasted. Railroad service to the mill site would follow along the west bank of the Temiscamie River, Figure 13, Page 130.

Cost Analyses of Final Product.CAPITAL COSTSTo be Recovered by Amortization or Depreciation

	<u>Study A<sup>(3)</sup></u> <u>Sandspit</u> <u>only</u>	<u>Study B<sup>(4)</sup></u> <u>Sandspit &amp;</u> <u>"B" Groups</u>
A. Pre-Development Charges	\$ 2,174,335 <sup>(1)</sup>	\$ 2,918,635 <sup>(2)</sup>
B. Pre-Production Stripping	25,000	265,000
C. Plant and Equipment		
1. Mining	2,033,800	4,325,600
2. Milling and General	19,791,200	39,849,400
3. Pelletizing	10,500,000	21,000,000
D. Townsite	2,517,425	5,020,225
E. Roads and Air Strip	287,500	425,000
F. Trackage at Mines	225,000	450,000
G. Ore Storage, Reclaim and Dock	7,558,000	12,315,000
H. Diversion Channel	<u>                    </u>	<u>1,071,120</u>
Sub-Total	\$45,112,260	\$87,639,980

To be Recovered by Sale of Facilities

Townsite	\$ 7,552,275	\$15,060,675
----------	--------------	--------------

To be Recovered by Rebate on Power Purchased

Power Facilities	\$ 7,500,000	\$ 9,000,000
------------------	--------------	--------------

To be Furnished by Others

Railroad	--	--
Public Road to Area	<u>                    </u>	<u>                    </u>
GRAND TOTAL	\$60,164,535	\$111,700,655

Cost per Annual Ton of Prod.	\$40.11	\$37.23
"    "    "    "    "    "		
(after sale of facil. and rebate)	\$30.07	\$29.21

- (1) - Chargeable to Sandspit - \$915,294.  
(2) - Chargeable to "B" Group & Sandspit - \$1,357,853 & \$687,169 respectively.  
(3) - Production of 1,500,000 tons/year from Sandspit deposit.  
(4) - Production of 3,000,000 tons/year - 1,500,000 tons each from Sandspit and "B" Groups.

OPERATING COSTS

<u>Estimated Operating Costs</u> (Per Ton Product) <sup>(1)</sup>	<u>Study A</u> <sup>(3)</sup> <u>Sandspit</u> <u>only</u>	<u>Study B</u> <sup>(4)</sup> <u>Sandspit &amp;</u> <u>"B" Group</u>
Mining	\$1.44	\$1.46
Milling	3.74	3.77
Pelletizing	1.69	1.69
General Mine Expense	0.58	0.58
Taxes	0.15	0.15
Loading and Stocking <sup>(2)</sup>	0.15	0.15
Depreciation	0.72	0.74
Amortization	<u>0.29</u>	<u>0.64</u>
TOTAL	\$8.76	\$9.18

- (1) - No royalty or administrative fee included.  
 (2) - On all-rail shipments, only loading amounting to \$0.05 would be required.  
 (3) - Production of 1,500,000 tons/year from Sandspit deposit.  
 (4) - Production of 3,000,000 tons/year - 1,500,000 each from Sandspit & "B" Groups.

PRODUCT VALUE

Based on 1958 Old Range Bessemer price plus \$1.00 structure premium escalated from a base of 51.50% natural Fe content to actual natural iron content of product plus the amount for low phosphorous content.

Lower Lake Value

"B" Group -- Pellet Analysis: (Natural)  
 62.93% Fe 7.54 Sil. .008 Phos. 1.00% H<sub>2</sub>O  
 62.93 x 0.24951 = \$15.7017  
 Phos. allowance = 0.6290  
 Total = \$16.3307

Sandspit -- Pellet Analysis: (Natural)  
 63.43% Fe 7.83 Sil. .004 Phos. 1.00% H<sub>2</sub>O  
 63.43 x 0.24951 = \$15,8264  
 Phos. Allowance = 0.7380  
 Total = \$16.5644

PRODUCT VALUE (cont'd)Transportation ChargesTo East Coast

Albanel to Port Alfred	\$2.55
Loading	<u>0.19</u>
TOTAL	\$2.74

Port Alfred to Philadelphia & Baltimore	1.50
Unloading	<u>0.28</u>

TOTAL	\$4.52
-------	--------

To Montreal

A. Rail-Vessel	
Albanel to Port Alfred (Loaded)	\$2.74
Port Alfred to Montreal (340 mi. at 0.0024)	0.83
Unloading	<u>0.28</u>

TOTAL	\$3.85
-------	--------

B. All Rail - Albanel to Montreal (556 mi. x 0.0068)	\$3.81
---	--------

To Hamilton

A. Rail-Vessel	
Albanel to Port Alfred (Loaded)	\$2.74
Port Alfred to Hamilton (710 mi. x 0.0018)	1.28
Unloading	<u>0.28</u>

TOTAL	\$4.30
-------	--------

B. All Rail- Albanel to Hamilton (881 mi. x 0.0062)	\$5.51
--	--------

To Pittsburgh<sup>(1)</sup>

All Rail	\$7.83
Portion to be absorbed by Purchaser	<u>2.81</u>
Net	\$5.02

To Youngstown<sup>(1)</sup>

All Rail	\$7.69
Portion to be absorbed by Purchaser	<u>2.16</u>
Net	\$5.53

(1) - Estimated rates by Canadian National Railways and assuming purchaser would absorb portion of rail rate equal to cost from Lower Lake to consuming center.

PRODUCT VALUE (cont'd)

<u>F.O.B. Mine Value</u>	<u>Study A</u>		<u>Study B</u>	
	<u>Sandspit only</u>		<u>Sandspit &amp; "B" Group</u>	
	<u>Rail-Vessel</u>	<u>All Rail</u>	<u>Rail-Vessel</u>	<u>All Rail</u>
E. Coast Market	\$12.04	--	\$11.92	--
Montreal	12.71	\$12.75	12.60	\$12.64
Hamilton	12.26	11.05	12.14	10.94
Pittsburgh <sup>(1)</sup>	--	11.54	--	11.42
Youngstown <sup>(1)</sup>	--	11.03	--	10.92

INDICATED MARGIN (BEFORE CORPORATE INCOME TAX)

E. Coast Market	\$ 3.28	--	\$ 2.74	--
Montreal	3.95	\$ 4.09	3.42	\$ 3.56
Hamilton	3.50	2.39	2.96	1.86
Pittsburgh <sup>(1)</sup>	--	2.88	--	2.34
Youngstown <sup>(1)</sup>	--	2.37	--	1.84

(1) - Assuming purchaser would absorb portion of rail rate equal to cost from Lower Lake to consuming center.

Some remarks on above cost figures:-

Capital Costs.

These costs have been developed from basic data available in the Cleveland-Cliffs Iron Company office on low grade ore developments and represent present-day cost of labour and equipment. The costs of development of townsite is based on data received from Provincial Government sources.

Following further exploration, metallurgical testing, field and design engineering, further detailed estimates could be prepared. Soil conditions in the plant, townsite and ore storage areas could affect the capital set-up considerably. After development of the final flow sheet, detailed studies may demonstrate that the capital estimated for plant and equipment may be too high.

Operating Costs.

These costs are anticipated average costs over the life of the property based on present labour and supply rates. A power cost of \$0.0065 per K.W.H. was used.

Depreciation Rates.

Depreciation has been developed by breaking the plant and equipment into the categories of movable, motorized, and plant and equipment. The latter category has been set up on the basis of a 35 year life for the presently known reserves.

Amortization.

The amortization rate is calculated to be \$0.24 per ton of product for the Sandspit Group and \$1.04 per ton of product for "B" Group. Covered under this schedule are pre-development charges, stripping, townsite, airstrip, roads, ore storage, reclaiming and dock facilities.

Product Value and Transportation Charges.

A product value based on the 1958 Old Range Bessemer price plus \$1.00 premium escalated has been used. It should be pointed out that the product from the Albabel group is a Bessemer grade and would command a further adjustment for the low phosphorus content. Transportation charges have been based on data received from the Canadian National Railway, published vessel rates now existing in the Lake Area, and quoted prices for other ore movements.

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## ALBANEL MINERALS LIMITED

## SUMMARY STATUS OF ASSESSMENT

TO DUE DATES IN 1958

GROUP	CLAIMS		ASSESSMENT				GOOD STANDING TO:	D.L.'S		ANNUAL FEES	ACREAGE RENTALS		ANNUAL HOLDING CHARGES	
	NO. of CLAIMS	ACREAGE	MANDAYS PERFORMED	REQUIREMENT REPORTED	MANDAYS EXCESS	ANNUAL REQUIREMENT		NO. of D.L.'S	DUE DATES		\$0.25/ACRE	\$3.00/ACRE	DURING EFFECTIVE ASSESS. CREDIT	IN LIEU OF ASSESSMENT
Albanel	45 <sup>44</sup>	1800			3205	1125	1961	9	June 15/Aug 13	\$ 90.00	\$450.00	\$5400.00	\$540.00	\$5940.00
Sandspit	27	1080	5083	2700	2383	675	1962	6	July 20-22	60.00	270.00	3240.00	330.00	3570.00
Sandspit West	22	880	1425	1100	325	550	1959	5	May 4-5	50.00	220.00	2640.00	270.00	2910.00
Kupotagen	35	1400	2670	1750	920	875	1960	7	Apr. 24-30	70.00	350.00	4200.00	420.00	4620.00
Valiant Bay	46	1840	5533	1525	4008	1150	1962	10	July 24/Sept 29	100.00	460.00	5520.00	560.00	6080.00
Richmond	58	2320	9135	2900	6235	1450	1963	12	Apr 11/Sept 24	120.00	580.00	6960.00	700.00	7660.00
Canso East	30	1200	2334	1500	834	750	1960	6	Apr 21/May 4	60.00	300.00	3600.00	360.00	3960.00
Canso West	32	1280	3483	1600	1883	800	1961	7	Apr 26-28	70.00	320.00	3840.00	390.00	4230.00
Plateau East	14	560	2146	700	1446	350	1963	3	Apr 30	30.00	140.00	1680.00	170.00	1850.00
Plateau West	6	240	1701	150	1551	150	1969	2	May 28/Sept 19	20.00	60.00	720.00	80.00	800.00
Albanel West Ext.	30	1200	2144	1500	644	750	1959	6	May 7-9	60.00	300.00	3600.00	360.00	3960.00
Kallio Lake	10	400	955	250	705	250	1961	2	May 8-15	20.00	100.00	1200.00	120.00	1320.00
Sandspit East	25	1000	1415	1250	165	625	1959	5	May 7-9	50.00	250.00	3000.00	300.00	3300.00
"B" Group	49	1960	12969	1225	11744	1225	1968	10	May 23-30	100.00	490.00	5880.00	590.00	6470.00
Temiscamie	21	840	4851	2625	2226	525	1963	5	Aug 22-26	50.00	210.00	2520.00	260.00	2780.00
Goethite	5	200	687	575	112	125	1959	1	Aug 26	10.00	50.00	600.00	60.00	660.00
Indian Grave (incl. camps)	12	480	1554	300	1254	300	1963	3	May 8/Aug 12	30.00	120.00	1440.00	150.00	1590.00
Kallio Creek	5	200	1244	125	1119	125	1967	1	Oct 15	10.00	50.00	600.00	60.00	660.00
"D" Group	9	360	4065	450	3615	225	1975	2	June 22/July 2	20.00	90.00	1080.00	110.00	1190.00
T O T A L S	481	19240						102		\$1020.00	\$4810.00	\$57720.00	\$5830.00	\$63550.00



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ALBANEL MINERALS LTD.

REVISED JUNE 17, 1958.

REVISED ORE ESTIMATES

	TONS CRUDE	PERCENT WT. REC.	TONS CONC.	STRIPPING				EQ. YARDS ROCK TO EARTH	TOTAL EQ. YARDS	RATIO OF EQ. YARDS	CONCENTRATE	
				YARDS ROCK	(2.25) TONS ROCK	YARDS EARTH	(1.25) TONS EARTH				% Fe	% SiO <sub>2</sub>
CLASS I - ORE FOR INITIAL PRODUCTION												
A. SANDSPIT GROUP												
								1:1.8 (Factor)				
Probable	62,973,000	30.21	19,024,143	4,058,331	9,131,245	Slight	---				65.29	7.55
Prospective	113,035,413	30.02	33,933,231	3,876,849	8,722,910	"					64.95	7.97
TOTAL	176,008,413	30.09	52,957,374	7,935,180	17,854,155			14,283,324	14,288,324 plus	0.26	64.30	9.30
										Anticipated Pellet Analysis	62.20	8.99
B. "B" GROUP												
				Approach 500,000	1,125,000	110,000	137,500	1:2.0 (Factor)				
Probable	134,566,650	30.68	41,285,048	31,448,704	70,759,584	6,587,262	8,234,077				65.80	7.10
Prospective	34,866,663	28.88	10,069,492	10,549,000	23,735,250	1,376,500	1,720,625				64.80	6.80
SUB TOTAL	169,433,313	30.31	51,354,540	42,497,704	95,619,834	8,073,762	10,092,202					
Speculative	19,566,666	28.50	5,576,500	3,793,000	8,534,250	333,330	416,662				66.00	6.00
TOTAL	188,999,979	30.12	56,931,040	46,290,704	104,154,084	8,407,092	10,508,864	92,581,408	100,988,500	1.75	65.64	6.94
										Anticipated Pellet Analysis - Probable and Prospective Ore Only	63.43	6.77

345,041,726

365,008,392

107,888,414

## ALBANEL MINERALS LTD.

REVISED ORE ESTIMATES

REVISED JUNE 17, 1958.

## CLASS II - ORE AREAS PARTIALLY EXPLORED

## ALBANEL GROUP

	TONS CRUDE	PERCENT WT. REC.	TONS CONC.	STRIPPING		CONCENTRATE	
				YARDS ROCK	YARDS EARTH	% Fe	% SiO <sub>2</sub>
Probable	83,895,000	30.02	25,185,279	5,425,000		64.75	9.76
Prospective	39,310,000	32.6	12,815,060	11,735,181		63.7	10.63
Speculative	28,573,000	25.7	7,343,261	1,642,591	2,870,000	67.1	5.39
<b>TOTAL</b>	<b>151,778,000</b>		<b>45,343,600</b>	<b>18,802,772</b>	<b>2,870,000</b>		
SANDSPIT GROUP (WEST)	29,268,250	29.47	8,625,353	3,479,500	7,017,700	66.8	6.29
<b>TOTAL</b>	<b>29,268,250</b>		<b>8,625,353</b>	<b>3,479,500</b>	<b>7,017,700</b>		
CANSO BAY EAST	44,183,000	31.06	13,723,240	20,133,000	21,330,000	70.94	3.57
<b>TOTAL</b>	<b>44,183,000</b>		<b>13,723,240</b>	<b>20,133,000</b>	<b>21,330,000</b>		
PLATEAU EAST GROUP	20,666,656	32.54	6,724,929	10,123,500	1,214,600	64.62	9.02
<b>TOTAL</b>	<b>20,666,656</b>		<b>6,724,929</b>	<b>10,123,500</b>	<b>1,214,600</b>		
PLATEAU WEST GROUP	15,416,660	32.89	5,070,539	2,223,000	518,500	62.3	11.20
<b>TOTAL</b>	<b>15,416,660</b>		<b>5,070,539</b>	<b>2,223,000</b>	<b>518,500</b>		
ALBANEL WEST GROUP	14,242,000	32.8	4,671,376	8,039,000	1,253,800	64.76	9.24
<b>TOTAL</b>	<b>14,242,000</b>		<b>4,671,376</b>	<b>8,039,000</b>	<b>1,253,800</b>		
INDIAN GRAVE GROUP	27,050,000	41.04	11,101,320		4,022,000	61.20	13.15
<b>TOTAL</b>	<b>27,050,000</b>		<b>11,101,320</b>		<b>4,022,000</b>		

302,604,566  
 19,566,666  
 322,171,332

55,260,357  
 5,176,300  
 100,836,857

ALBANEL MINERALS LTD.

REVISED ORE ESTIMATES

REVISED JUNE 17, 1958.

	<u>TONS</u> <u>CRUDE</u>	<u>PERCENT</u> <u>WT. REC.</u>	<u>TONS</u> <u>CONC.</u>	<u>STRIPPING</u>	
				<u>YARDS</u> <u>ROCK</u>	<u>YARDS</u> <u>EARTH</u>
TOTAL CLASS I	365,008,392		109,888,414	54,225,884	8,407,092
TOTAL CLASS II	<u>302,604,566</u>		<u>95,260,357</u>	<u>62,800,772</u>	<u>38,226,600</u>
GRAND TOTAL	667,612,958		205,148,771	117,026,656	46,633,692

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