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CANADA

DEPARTMENT OF MINES AND TECHNICAL SURVEYS

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GEOLOGICAL SURVEY OF CANADA

PAPER 55-26

LITHIUM DEPOSITS OF  
MANITOBA

(Report and Two Figures)

By

R. B. Rowe

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OTTAWA

1956

*Price, 25 cents*

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# LITHIUM DEPOSITS OF MANITOBA

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## INTRODUCTION

The occurrence of lithium deposits in granitic pegmatites in Manitoba has been known for many years, and considerable attention has been paid recently to the possibility of obtaining lithium mineral concentrates from them. The deposits occur in the Herb Lake, Cat Lake-Winnipeg River, and East Braintree-West Hawk Lake districts, and most of these were examined by the writer during June, July, and part of August 1953.

Very little work has been done recently on the Manitoba lithium deposits so that trails leading to them are overgrown by vegetation. Those desiring to examine the deposits should obtain the services of a guide who knows the locations.

The writer thanks Mr. J. S. Richards, director, and Dr. G. H. Charlewood, chief geologist, Manitoba Mines Branch, for information and many courtesies. Mr. F. D. Shepherd, Winnipeg, very kindly provided the writer with much information. Mr. E. L. Brown, president and managing director, Sherritt Gordon Mines Limited, supplied information concerning the company's Herb Lake property, and Mr. William Kobar, Herb Lake, kindly guided the writer to the occurrences. Thanks are also due Messrs. M. A. Lyons and R. J. R. Schaller, Winnipeg, Mr. K. M. Wengel, Pointe du Bois, and Mr. John Donner, Lac du Bonnet, for information concerning deposits in the Cat Lake-Winnipeg River district. Mr. A. B. Scott, Winnipeg, gave the writer information about the East Braintree-West Hawk Lake district. Capable field assistance was given by H. Rasian and L. Berman.

## GENERAL CONSIDERATIONS

The Manitoba lithium deposits occur in some of the granitic pegmatites that lie within the Precambrian Shield close to its southwestern boundary (See Figure 1). There the Shield consists chiefly of Archaean, or early Precambrian, granitic rocks and remnant 'islands' of highly disturbed and metamorphosed volcanic and sedimentary rocks. The granitic pegmatites are related spatially, and probably genetically, to the granitic rocks. To the west of the boundary of the Shield lie the relatively undisturbed and unmetamorphosed younger strata of the Interior Plains.

The lithium pegmatites occur within belts about 1 mile to 2 miles in width that straddle the contacts between granitic rocks and some of the remnant 'islands'. Many of the pegmatites within these belts do not contain lithium minerals. The lithium pegmatites are generally lenticular in plan, and range from a few inches in width and a few feet in length to over 60 feet in width and over 1,000

feet in length. Lithium minerals found in the pegmatites include lepidolite ( $K_2 Li_3 Al_4 Si_7 O_{21} (OH, F)_3$ ) and other lithia micas, lithiophyllite ( $Li Mn PO_4$ ), petalite ( $Li Si_4 Al O_{10}$ ), montebracite ( $Li Al OH PO_4$ ), and spodumene ( $Li Al Si_2 O_6$ ). Of these, spodumene is by far the most abundant.

## TERMINOLOGY

The pegmatite terminology used in this report was developed by the United States Geological Survey as a result of pegmatite investigations conducted during World War II. For a detailed description of pegmatite terms, the reader should consult a monograph on the internal structure of granitic pegmatites by Cameron, Johns, McNair, and Page (1)<sup>1</sup>. The internal structure, mapping, sampling, and evaluation of pegmatite mineral deposits are discussed in a paper by the writer (7).

For practical purposes, granitic pegmatites may be divided into two groups: zoned pegmatites, and unzoned pegmatites. Most pegmatite mineral deposits occur in zoned pegmatites.

Zones are shells, complete or incomplete, that generally reflect the shape or structure of the pegmatite body, and, where ideally developed, are concentric about an innermost zone or core. Incompletely developed zones form pods, lenses, or chains of lenses; pipe-like, trough-like, or hood-like bodies; or more irregular bodies. Pegmatites containing lithium minerals commonly have one or more incompletely developed zones.

Zones are classified as: (a) border zones, (b) wall zones, (c) intermediate zones, and (d) cores. The outermost zone of a pegmatite body is the border zone, the next zone is the wall zone, and the zones between the wall zone and the core are intermediate zones. Not all types of zones are always represented in a zoned pegmatite; for instance many pegmatite bodies have no intermediate zones, and hence are composed of border zone, wall zone, and core. Nor can a true picture of the internal structure of a granitic pegmatite be always obtained from outcrops, because all the zones may not appear at that level of erosion.

Although zones are quantitatively and economically the most important internal structural units, zoned pegmatite bodies may also contain fracture fillings and, or, replacement bodies.

Fracture fillings are tabular units that fill fractures in previously consolidated pegmatite.

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<sup>1</sup>Numbers in parentheses refer to those of references cited at the end of this report.

Replacement bodies are formed primarily by the replacement of pre-existing pegmatite, with or without obvious structural control.

The principal minerals of each internal structural unit are included in the name given the unit, and are listed in order of decreasing abundance, as, for example, quartz-cleavelandite-muscovite pegmatite. In general, the accessory minerals are not included in the name unless they are of economic significance.

The general term 'pegmatitic' is inadequate to describe the grain size of crystals within pegmatite bodies, and the following classification has been adopted:

Term	Maximum crystal dimension <sup>1</sup> (Inches)
Very fine grained	-1/4
Fine grained	1/4 to 1
Medium grained	1 to 4
Coarse grained	4 to 12
Very coarse grained	+12

## DESCRIPTIONS OF DISTRICTS AND PROPERTIES

### HERB LAKE DISTRICT (See Figure 1)

#### Sherritt Gordon Property (4, 13)

The Sherritt Gordon property, of seventeen claims, covers three spodumene pegmatites that occur west of the narrows of Crowduck Bay, Wekusko Lake, and is held by Sherritt Gordon Mines Limited, suite 2918, 25 King Street West, Toronto 1, Ontario. A trail leading to the pegmatites begins at the narrows about 5 miles from the settlement of Herb Lake. The Herb Lake district may be reached from the town of The Pas to Wekusko station by railway and thence by road and boat, or by aircraft based at The Pas, Sherridon, and Flin Flon.

The spodumene pegmatites, known as Dyke No. 1, Dyke No. 2, and Dyke No. 3, occur in quartz diorite near its contact with microcline-biotite granite. According to Stockwell (13, p. 11), the quartz diorite is a border phase of the microcline-biotite granite and the pegmatites were derived from the granite.

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<sup>1</sup> When applied to the mineral assemblage of an internal structural unit, the term refers to the average maximum crystal dimension.



Dyke No. 2, the most important, has been traced by diamond drilling for a distance of 900 feet. Nineteen diamond drill-holes, placed at intervals of about 50 feet, intersected the pegmatite body at an average depth of about 50 feet, and a twentieth at about 150 feet. The pegmatite cut by the nineteen shallow holes contained an average of 13.57 per cent spodumene over an average width of 18.5 feet, and that cut by the deeper hole contained 23.1 per cent spodumene over 14 feet. Sink-float assays using a liquid medium of 3.1 specific gravity were used to determine the spodumene content.

The surface width of the pegmatite body can be measured at one place where it is about 25 feet. The strike is north 65 degrees west and the dip at the surface about 65 degrees southwest.

Six outcrops were found by the writer and five of these consist chiefly of perthite-cleavelandite-quartz-spodumene-muscovite pegmatite. Therefore, the bulk of the pegmatite body can be considered as spodumene-bearing from wall to wall for practical purposes. The spodumene crystals are apple-green and range up to about 1.5 feet in length. Crushing to plus 1/4 minus 1/2 inch is reported to liberate most of the spodumene. In places many of the spodumene crystals are oriented with their long axes perpendicular or sub-perpendicular to the walls of the pegmatite body. The perthite is white to pink and occurs as crystals and aggregates of crystals up to 3 feet in length. White to pink cleavelandite, and quartz are fine grained, whereas most of the muscovite is medium grained and occurs in books. Black tourmaline, red garnet, and a blue-green mineral are present in places in small amounts, and a few small crystals of golden beryl were found in broken rock in a small trench.

Spodumene grain counts on outcrops could be made in only three places, and the results are as follows:

Length of measurement in feet	Per cent spodumene by weight
15.0	14.1
3.5	18.3
3.0	15.6

Sink and float concentration tests were made by Sherritt Gordon and it is reported that a spodumene concentrate could be produced commercially by this method. The company has no immediate plans for working the deposit.

## CAT LAKE-WINNIPEG RIVER DISTRICT

(See Figure 1)

A few tons of lepidolite, montebasite, and spodumene were shipped from the Cat Lake-Winnipeg River district several years ago, but there has been no production recently. In the past few years, interest has been shown in the spodumene pegmatites at Cat Lake.

Although parts of the district are accessible by means of the Oiseau River and Winnipeg River canoe routes, most of the deposits are reached most conveniently by aircraft based at the town of Lac du Bonnet.

### General Geology (8, 9, 11, 12)

The consolidated rocks of the district are Precambrian in age, and consist principally of the very old Rice Lake group of meta-sedimentary and meta-volcanic rocks and a younger group of granitic rocks. Other rocks include acidic to basic dyke rocks, basic to ultrabasic intrusive rocks, and numerous granitic pegmatites. Many of the pegmatites contain one or more of the minerals beryl, cassiterite, columbite-tantalite, lepidolite, montebasite, petalite, and spodumene, and the locations of the most important of these are shown on a map contained in a recent report by Springer (9).

The lithium pegmatites occur in meta-volcanic rocks and in granitic rocks close to the contact with meta-volcanic rocks. They range up to 1,260 feet in length and 65 feet in width, and are generally lenticular or tabular in plan. Some of the pegmatite bodies have septa, and contain inclusions of wall-rock. Many are relatively flat-dipping, but steep-dipping to vertical bodies were observed. Both discordant and concordant bodies were seen, but because of the scarcity of outcrops, the structural control was not apparent in most cases. The Eagle group of pegmatite bodies at Cat Lake are well exposed and their emplacement was probably controlled by a group of en échelon fractures.

All the lithium pegmatites examined by the writer have internal structure. Zones are by far the most important structural units; only one replacement body of mappable size was found and fracture fillings are small and of no importance. Montebasite and spodumene occur in zones or lenticular pods, whereas lepidolite and other lithia micas occur in replacement bodies, and as replacements of other minerals. Spodumene is by far the most abundant lithium mineral, and Figure 2 illustrates the internal structure of spodumene pegmatites in the district.

Eagle Claims (5, 9)

The Eagle group of thirty-five claims was staked to cover a group of spodumene pegmatites near the northwest shore of Cat Lake, and is held by Northern Chemicals Limited, 419 Somerset Building, Winnipeg. Several buildings were erected on the property, and a small amount of surface blasting was done apparently to provide fresh surfaces on some of the outcrops or to obtain specimens. There was no activity at the time of the writer's visit.

The pegmatites occur in granite and meta-volcanic rock and are exposed over a distance of about 1,750 feet. The ten largest of these pegmatite bodies were mapped by the writer on a scale of 1 inch to 60 feet, and are en échelon lenses that range up to 245-feet in length and 30 feet in width as exposed. Some of the bodies are apparently unzoned and consist of plagioclase-quartz-microcline pegmatite with or without spodumene. Others consist of a discontinuous, narrow border zone of plagioclase-quartz-microcline pegmatite, a wall zone of plagioclase-quartz-microcline pegmatite with or without spodumene, and pods of quartz-spodumene-microcline pegmatite and quartz-spodumene pegmatite. Most of the pods are 2 to 3 feet in length and 6 to 8 inches in width. The spodumene is white to pale green and very fine to medium grained.

F. D. No. 5 Claim (9)

This claim is held by Northern Chemicals Limited, 419 Somerset Building, Winnipeg, and is situated near the north shore of Cat Lake. A dome-shaped outcrop about 90 feet by 45 feet in plan, and two smaller outcrops about 150 feet south of it were found. The dome-shaped outcrop consists of fine- to medium-grained microcline-quartz-plagioclase-biotite pegmatite that contains a few fine-grained beryl crystals, and a lens of medium-grained quartz-spodumene-microcline pegmatite about 25 feet in length and 4 feet in width. The two small outcrops consist of very coarse-grained microcline crystals in a groundmass of medium-grained quartz and spodumene.

Irgon Claim (3, 8, 9, 11)

The Irgon claim is situated near the north shore of Cat Lake and is held by the Lithium Corporation of Canada Limited, 403 Avenue Building, Winnipeg. This claim covers most of the Irgon spodumene pegmatite dyke, and it is believed that the original staker was Mr. Peter Osis of Lac du Bonnet.

The dyke occurs in meta-volcanic rock of the Rice Lake group (8), and outcrops in a number of places over a distance of 1,260 feet. It strikes about north 80 degrees west, dips very

steeply to the southwest, and the maximum exposed width is about 65 feet. In most places, the contact between the pegmatite body and the wall-rock is gradational and cannot be placed exactly.

The internal structure of the Irgon dyke is complex, but the body is not zoned in the normal way. Rather it is composed of bands and lenses of fine mineral assemblages. The spodumene occurs in lenses of fine-grained feldspar-quartz-muscovite-spodumene pegmatite and fine- to medium-grained quartz-spodumene-microcline or perthite pegmatite. Plates of spodumene, ranging up to 4 inches in length, are common, but lath-shaped crystals were also found. In general, both spodumene and feldspar are milky white but in some places the feldspar is pink and the spodumene is pale green.

The outcrop surfaces are so obscured by lichen and moss that most of the spodumene-bearing lenses cannot be outlined accurately. Those that can be measured range from a few feet long and a few inches wide to 45 feet long and 12 feet wide. Stockwell (11, p. 125) estimated that the Irgon dyke contains about 25,000 tons of spodumene in each 100 feet of depth. This estimate was made before the outcrop surfaces became obscured by vegetation.

#### Central Claim (9)

The Central claim is situated near the south shore of Cat Lake and covers a flatly dipping spodumene pegmatite that is exposed along a low cliff face for a distance of about 100 feet and a maximum height of 15 feet. The pegmatite body has a border zone, a wall zone, and an apparent core of quartz-spodumene-microcline pegmatite that comprises the bulk of the body.

#### Spot Claims (9)

The Spot group of thirteen claims is located about 4 miles northeast of Maskwa Lake, and is held by Messrs. John Donner and Peter Osis of Lac du Bonnet, Manitoba. The writer did not visit the property, and the following information was supplied by Mr. Donner.

Outcrops of spodumene pegmatite occur in places over a distance of about 2,000 feet on the Spot No. 1 and No. 2 claims. The wall-rocks are meta-volcanic rock and gabbro. The following sampling results are reported by Mr. Donner:

Width represented in feet	Per cent Li <sub>2</sub> O
14.0	2.04
14.0	1.73
10.0	2.09
6.0	2.38
5.3	1.39
5.2	1.16
7.3	1.52
5.1	1.19

Buck Claim (3, 9, 11, 12)

The Buck claim is near the east shore of Bernice Lake, and is held by the Lithium Corporation of Canada Limited, 403 Avenue Building, Winnipeg. The company also holds the adjoining Coe claim and the Pegli group of five claims. Mr. K. E. Miller staked the Buck and Coe claims in 1926 to cover nine lithium pegmatites.

A few tons of montebrasite have been mined from a zoned pegmatite that is well exposed in an open-cut on the Buck claim. The open-cut is 97 feet long and has a maximum width of 32 feet. Ten diamond drill-holes were put down on the Buck claim to explore this deposit.

Cleavelandite-montebrasite pegmatite comprises the third intermediate zone of the Buck pegmatite body. The zone is well exposed along the east wall of the open-cut, and averages about 1 foot in true thickness. By visual estimate, the montebrasite comprises about 10 per cent of the zone. It is medium to coarse grained, white, and euhedral to subhedral, and some of the crystals have a narrow border of red material. The cleavelandite is finer grained than the montebrasite and is white to pink.

Very small pods of fine-grained quartz-spodumene and spodumene-plagioclase-quartz pegmatite occur in places.

Bob Claim (Silverleaf Pegmatite)

(2, 3, 9, 11, 12)

The Bob claim, formerly called the Bear claim, is about 3 miles east of Lamprey Falls on Winnipeg River, and covers the Silverleaf pegmatite. The pegmatite contains spodumene and various lithia micas and was discovered by Messrs. F. B. Evans and R. G. O. Johnston in 1924. Work done by the Silver Leaf Mining Syndicate (Canada) Limited, which held the claim for

several years, includes stripping, trenching, and quarrying. During 1926 and 1927, about 75 tons of lithia mica were shipped to England, Germany, and the United States. The deposit has not been worked since 1928. The Bob claim is held now by Mr. K. M. Wengel, Pointe du Bois, Manitoba.

The pegmatite body has been traced along strike for a distance of about 525 feet by means of outcrops and six trenches, which are now filled with water (11, p. 115, Figure 19). Part of the body is well exposed on the side of a low hill where several outcrops occur within an area measuring about 280 by 200 feet. The true surface width of the body is not known because of repetition due to faulting.

The Silverleaf pegmatite body consists of several zones and a replacement body. Spodumene occurs in the second and third intermediate zones, and lithia micas occur in the second, third, and fourth intermediate zones and in the replacement body.

The second intermediate zone is discontinuous and consists chiefly of quartz and spodumene aggregates ranging up to 3 feet in length and 7 inches in width. In places, curvilamellar, hemispherical, and radiating lithia micas, quartz, and white to pink cleavelandite occur interstitial to the quartz-spodumene aggregates. The spodumene is white to pale green, and occurs as aligned, fine- to medium-grained needles and plates, or as very fine grains. Veinlets of radiating lithia mica cut some of the quartz-spodumene aggregates. Stockwell (11, pp. 117-118) has estimated that the ratio by weight of spodumene to quartz in the quartz-spodumene aggregates averages 55:45, and that the aggregates constitute 75 per cent of the zone. The zone has a maximum exposed horizontal width of 8 feet and the exposures occupy less than 750 square feet.

The third intermediate zone is also discontinuous and is exposed in three places totalling about 240 square feet. It is composed of perthite-quartz-spodumene-lithia mica pegmatite with scattered patches of lepidolite and pale lilac lithia mica. Spodumene occurs in quartz-spodumene aggregates similar to those already described.

Veinlets of radiating lithia mica occur in the fourth and largest intermediate zone, which is composed chiefly of perthite and quartz. The veinlets occur in some of the perthite crystals and are generally parallel with the perthite cleavage directions.

The replacement body consists principally of cleavelandite and lithia mica, and, as exposed, occupies an area about 44 feet long by 24 feet wide. Remnant perthite crystals and quartz-spodumene aggregates occur in places, indicating that the replacement body probably formed at the expense of the second, third, and fourth intermediate zones. Lepidolite and pale lilac lithia mica occur as patches in pink to red cleavelandite. The micas average about

1/20 inch in diameter and comprise about 30 per cent of the replacement body. It is probable that rock richer in lithia micas has been mined out.

Topaz, beryl, montebrasite, lithiophyllite, and columbite-tantalite were found in the Silverleaf pegmatite by Stockwell (11, 12). The writer found a few pieces of white to pink beryl on the pile of broken rock in the pit, and observed two intergrown beryl crystals on the south wall of the pit.

It is of interest to note that Papish (6) detected germanium in topaz, lepidolite, cleavelandite, and quartz from this pegmatite body.

#### Annie Claim (11)

This occurrence was not visited by the writer, and the following description is taken from a report by Stockwell (11, p. 121):

"The lithium-bearing body on the Annie mineral claim is in rocks of the albite granite group 3/8 of a mile northeast of the dyke on the Bear claim<sup>1</sup>. On the Annie claim lithium-bearing pegmatite mixed with granite and aplite occurs chiefly over an area measuring 50 feet across and was also observed easterly of this locality at distances of 60 and 300 feet. The lithium-bearing pegmatite contains scattered flakes of lilac lithia mica. A small amount of beryl occurs in crystals up to 1 inch across. The grey, curvilamellar, lithia mica contains only 0.90 per cent of lithia. The deposit is of no economic value."

#### Gray Claim (11)

Stockwell (11, p. 121) has described this occurrence as follows:

"The lithium-bearing body on the Gray mineral claim is in rocks of the albite granite group 1/4 of a mile northwest of the dyke on the Bear claim. On the Gray claim a small amount of grey curvilamellar lithia mica similar to that on the Annie claim is scattered through pegmatite and aplite over an area measuring 75 feet by 50 feet. A small amount of beryl is also present. The deposit is of no economic value." The occurrence was not visited by the writer.

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<sup>1</sup> The Bear claim is now the Bob claim.

Captain Claims (11)

The writer did not examine this occurrence, and the following description has been taken from a report by Stockwell (11, p. 231):

"The lithium-bearing body on the Captain group of claims is a dyke cutting rocks of the oligoclase granite group in the southern portion of sec. 14, tp. 16, range 16, 3 miles slightly south of east of the dyke on the Bear mineral claim. The deposit may be reached from Winnipeg River by a trail about a mile long. The dyke strikes north 20 degrees east, dips 35 degrees to the southeast, and is exposed for 200 feet along the strike. At its southwest end it is 24 feet wide and at its northeast end is 3 feet wide. Scattered flakes of lepidolite occur in small amount in the middle of the southwest portion of the dyke. A small amount of beryl is also present. The dyke is of no economic value."

EAST BRAINTREE-WEST HAWK LAKE DISTRICT

(See Figure 1)

Several spodumene-bearing pegmatites have been found in an east-west band of meta-volcanic rocks of Precambrian age that has been traced from the settlement of East Braintree to West Hawk Lake, a distance of about 20 miles. The band averages about 1.5 to 2 miles in width, and is bounded on the north and south by granodiorite containing phenocrysts of microcline and microcline perthite. One of the spodumene pegmatites has been diamond drilled but no further work has been done. Transportation facilities are good and further prospecting is warranted.

It is of interest to note that Stockwell (11, p. 126) has observed a regional zonation of pegmatites near West Hawk Lake. Microcline pegmatites were found over a distance of 1/2 mile from a body of microcline granite, microcline-albite pegmatites between 1/2 and 3/4 of a mile, and three lithium pegmatites at 1 1/2, 2 1/4, and 2 1/2 miles. Two albite pegmatites were found at 600 feet and 3/4 mile from the granite.

Artdon Claims (5, 10)

The Artdon group of four claims occur in sec. 9, tp. 8, rge. 15, and are held by Mr. A. B. Scott, 61 Kennedy Street, Winnipeg, who has optioned the claims to the Lithium Corporation of America, Incorporated, Rand Tower, Minneapolis, Minnesota.

The claims were previously optioned by Sherritt Gordon Mines Limited, 25 King Street, West, Toronto, and a diamond drilling program was carried out by that company before the option was dropped (5).



The writer was not able to find the occurrence on this property, and the following description is taken from a report by Springer (10, p. 20): "The body is exposed for a length of 60 feet in an easterly direction and is about 10 feet wide. It has been explored by trenching and diamond drill-holes. The dyke is composed of coarse-grained pink and white feldspar, smoky quartz, biotite, white to pale green beryl, and white to pale green spodumene in crystals as much as 10 inches in length". According to Springer the dyke outcrops on the Artdon No. 2 claim.

#### Lucy Claims (5, 10)

The Lucy group of six claims are held by the East Braintree Lithium Corporation Limited, 468 Main Street, Winnipeg.

A pegmatite containing spodumene occurs on the Lucy No. 1 claim, sec. 10, tp. 8, rge. 15, and can be reached by a corduroy road that meets the West Hawk Lake-East Braintree road 15.4 miles from its junction with No. 1 highway. This road will probably be abandoned upon completion of a new section of the Trans-Canada highway that is presently under construction.

The pegmatite body is exposed for about 70 feet along the face of a low cliff. Fine-grained plagioclase-quartz-muscovite pegmatite comprises the bulk of the exposed part of the body. A lens of quartz-spodumene pegmatite about 45 feet long and 5 feet in maximum width occurs in the central part of the body. The spodumene is white to grey in colour, and the crystals range up to 1.8 feet in length.

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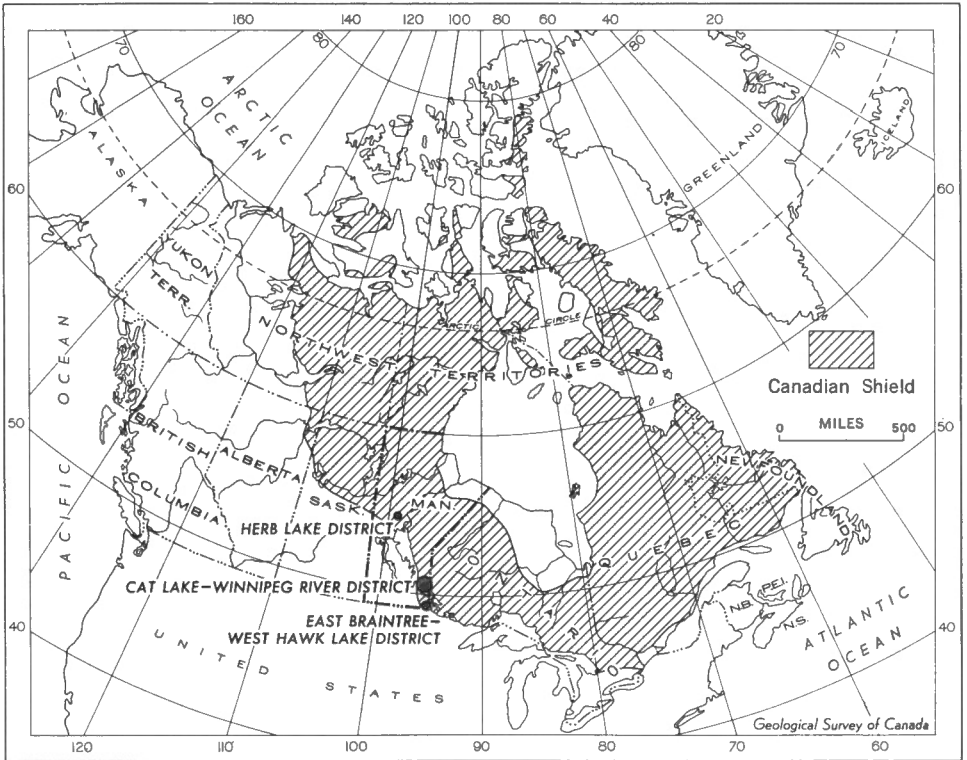


Figure 1. Index map showing location of lithium pegmatite districts, Manitoba.

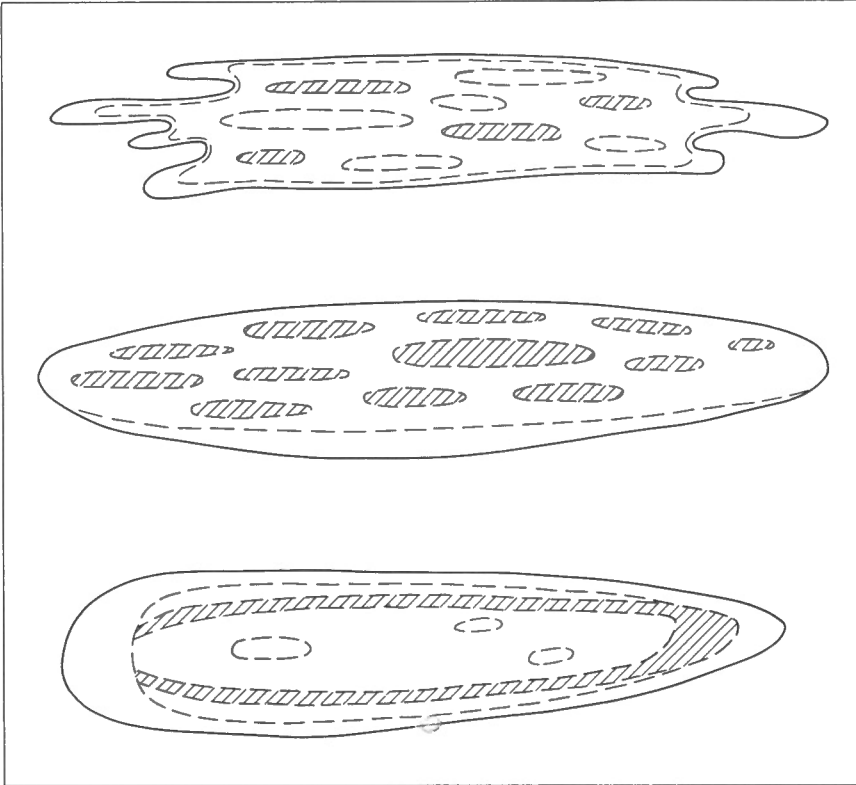


Figure 2. Idealized geological plans illustrating the internal structure of spodumene-bearing pegmatite bodies, Cat Lake-Winnipeg River district, Manitoba. Spodumene-bearing units are shown by diagonal ruling.

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