Province of Manitoba
DEPARTMENT OF MINES AND NATURAL RESOURCES

MINES BRANCH

PUBLICATION 56-1

GEOLOGY
of the
WINNIPEG RIVER AREA
(Shatford Lake–Ryerson Lake)
Lac du Bonnet Mining Division
Manitoba

by

J. F. DAVIES

Winnipeg

1957

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DEPARTMENT OF MINES AND NATURAL RESOURCES

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GEOLOGY OF THE WINNIPEG RIVER AREA

(Shatford Lake - Ryerson Lake)

INTRODUCTION

In 1954 the Manitoba Mines Branch commenced detailed geological mapping of an area, along and north of the Winnipeg River, bounded by longitude 95° 20' W and the Manitoba-Ontario boundary and latitudes 50° 20' N and 50° 30' N. Reports and maps of two of the map-areas covering this region have been published (Davies, 1955, and Davies, 1956). The present report covers the two remaining map-areas, Shatford Lake - Winnipeg River, and Ryerson Lake - Winnipeg River. Included in this report is an appendix dealing with recent exploration for lithium, at Bernic Lake.

The present area is situated about 30 miles northeast of Lac du Bonnet and a few miles upstream from Pointe du Bois on the Winnipeg River. Pointe du Bois may be reached by an all-weather gravel road from Manitoba highway No. 11. Access to the area, up the river from Pointe du Bois, is by canoe or boat. Shatford, Bernic, Birse, and Ryerson lakes are most easily reached by aircraft, if much equipment is being transported. All these lakes, however, may be reached on foot from the main water routes, Bird River, to the north of the present map area, and Winnipeg River, in the south part of the map area.

PREVIOUS INVESTIGATIONS

A brief outline of work done in the general area between 1912 and 1951 was presented in the report on the Bird Lake area. Only the more important references are listed below.

Moore, E. S.: Region East of the South End of Lake Winnipeg; Geol. Surv., Canada, Sum. Rept. 1912, pp. 226-270.

Wright, J. F.: Geology and Mineral Resources of Oiseau River Area, Manitoba; Geol. Surv., Canada, Sum. Rpt. 1924, pt. B.

_____ : Geology and Mineral Deposits of a part of Southeastern Manitoba; Geol Surv., Canada Memoir 169, 1932 (re-issued 1938).

Springer, G. D.: Geology of the Cat Lake - Winnipeg River Area, Manitoba; Man. Mines Br., Prelim. Rpt. 48-7, 1949.

_____ : Mineral Deposits of the Cat Lake - Winnipeg River Area, Manitoba; Man. Mines Br., Pub. 49-7, 1950.

Davies, J. F.: Geology of the Oiseau (Bird) River Area, Manitoba; Man. Mines Br., Pub. 51-3, 1952.

_____: Geology and Mineral Deposits of the Bird Lake Area, Manitoba; Man. Mines Br., Pub. 54-1, 1955.

_____: Geology of the Booster Lake Area, Manitoba; Man. Mines Br., Pub. 55-1, 1956.

PRESENT STUDY

Field work was done during the period from May 22 to September 14, 1956.

Traverses, covering the areas of volcanic and sedimentary rocks, were run at intervals of 400 and 500 feet. The large areas of granitic rocks were traversed at intervals of about 1,000 feet. Control was maintained by the use of vertical aerial photographs enlarged to a scale of one inch to 1,000 feet.

Base maps were compiled from the aerial photographs. Survey controls consisted of township, section, and claim surveys.

ACKNOWLEDGEMENTS

It is a pleasure to acknowledge the capable and efficient assistance of Mr. N. J. Gass, graduate student in geology at Dalhousie University, Halifax, and Messrs. W. E. Post, G. E. Poulter, and R. E. Buss. Credit for much of the mapping is due Mr. Gass.

Much valuable information was received from the following companies working in the area: Lithium Corporation of Canada, Limited, Montgary Explorations, Limited, Dalhart Minerals Corporation, Limited, Contact Minerals, Limited, and Cove Uranium Mines, Limited. The assistance and courtesies offered by these companies is gratefully acknowledged.

TOPOGRAPHY AND DRAINAGE

The area is characterized by rounded outcrops of low relief, less than 100 feet, separated by tracts of clay and sand overburden and by swamp and muskeg. For the most part outcrop is abundant and well exposed. However, along parts of the Winnipeg River rather extensive areas are either lacking in, or have only a few, outcrops.

The Winnipeg River is readily navigable by canoe or boat equipped with outboard motor. Above Lamprey Falls there are several long stretches of fast water, making travel by paddle and canoe difficult.

The volume of water flowing in the Winnipeg River is controlled by dams in Manitoba and Ontario; the water level may fluctuate considerably over periods of a few days. During low water Lamprey Falls is not navigable by canoe but a short portage leads around it. During very high water the river flows quietly over the falls site. The maximum drop in times of low water is only a few feet. During the summer of 1956 the falls could be navigated by canoe most of the time, and by larger boats all of the time.

None of the other streams in the area is navigable for any distance. Many of them have been dammed by beavers, with consequent flooding of adjacent ground.

Tree growth consists largely of spruce, jackpine, balsam, fir, tamarach, black and white poplar, and birch. No extensive stands of large coniferous trees are present. A considerable amount of pulpwood could probably be obtained in the area. Much of the Winnipeg River is bordered by poplar.

Underbrush consists of alder, hazel, and some willow. Wild fruit, plums, cranberries, and blueberries are common in some parts of the area.

Moose and deer are very numerous throughout the area; migratory waterfowl are fairly abundant.

The lakes and rivers are well stocked with many species of fish, the most important of which are pike, pickerel, perch, tulibee, common sucker, and sturgeon (in the Winnipeg River).

GENERAL GEOLOGY

The area is underlain by Precambrian basic volcanic and quartzo-feldspathic sedimentary rocks of the Rice Lake group. These have been intruded by sill- and stock-like bodies of gabbro, batholithic bodies of granite, and dykes and irregular intrusives of pegmatite.

The volcanic rocks of the Rice Lake group consist of massive to schisto basalt and andesite, parts of which are silicified and granitized. The sedimentary rocks are largely greywacke and quartz-mica schist, with minor conglomerate.

The Rice Lake group occurs as individual belts, separated from one another by granite. The volcanic rocks in all of these restricted belts face north. The sedimentary rocks, which occur only around and north of Ryerson Lake, appear to lie with angular conformity upon the underlying volcanic rocks.

Zones of fine-grained siliceous rock, some of which carry iron sulphides represent silicified lavas.

Gabbro occurs as small bodies intruding the volcanic rocks south of the Winnipeg River.

The batholithic bodies are composed of granites and granodiorites showing considerable variation in colour, texture, structure, and composition. They have been divided for purposes of mapping into two main types, one essentially a pink granite, the other dominantly grey or buff granite and granodiorite.

Pegmatite is widely distributed throughout the area. Beryl and spodumene, in addition to many other less common minerals, are found in some of the pegmatite dykes.

The classification of rocks within the area is shown in the following table of formations:

TABLE OF FORMATIONS

Recent and Pleistocene		Glacial clay and sand
Great Unconformity		
A R C H A E A N	Intrusive Rocks	Pegmatite, pegmatitic granite, pegmatite gneiss Massive pink granite Grey and buff, massive and gneissic granite and granodiorite Hornblende gabbro
	Rice Lake Group	Silicified rocks Conglomerate (?) Greywacke, quartz-mica schist Basalt, andesite; derived hornblende-plagioclase schist, in part granitized.

RICE LAKE GROUP

Rocks of the Rice Lake group outcrop in a belt extending from Bernic Lake to the interprovincial boundary. A second belt occurs along the Winnipeg River from Lamprey Falls to the interprovincial boundary. The area between Shatford Lake and the western part of Bernic Lake is largely underlain by rocks of the Rice Lake group. These rocks are an extension of the north belt.

Basic volcanic rocks, in part schistose, granitized, and silicified, form the bulk of the Rice Lake group. The sedimentary portion, consisting mainly of greywacke and quartz-mica schist, is restricted to the area around Ryerson Lake. A narrow band of conglomerate is exposed on the east shore of Ryerson Lake.

Pronounced folding is not apparent in the rocks of the Rice Lake group. The separate belts all strike in an approximate easterly direction and all apparently face northwards.

Schistosity is well developed in part of the Rice Lake group. No major faults were found in these rocks.

Basalt, andesite, hornblende-plagioclase schist (1) [1]

The rocks of this unit consist of massive to schistose andesite and basalt, part of which is ellipsoidal, and derived hornblende-plagioclase schist, part of which is granitized. The different types are dominant in different parts of the area.

The least altered basic flows occur south of the Winnipeg River and east of Shatford Lake. The rocks there are largely fine- to medium-grained, massive, dark green to black andesite and basalt. Pillow structures useful in determining tops of lows are abundant in these areas. Interlayered with the pillow lavas are fine-grained non-pillowed flows and lenticular bands of medium-grained phases of the gabbro. However, the contacts between the fine-grained and coarse-grained phases of the flows are ill-defined. In addition, poorly-defined pillow structures are sometimes visible in the diabasic flows.

The rocks at the south boundary of the volcanic sequence south of the Winnipeg River are generally recrystallized to hornblende-plagioclase schist, characterized by needle-shaped hornblende crystals, and containing red garnets in places. Considerable grey granite and granodiorite have been injected into these schists.

East of Shatford Lake the pillow lavas are in sharp contact with the pink granite and little alteration is apparent. However, at the south boundary of the silicified rocks (4), a band of garnet-hornblende rock occurs between the silicified zone and the pillow lavas. This garnet band is exposed for a width of up to 50 feet and intermittently for a length of over a mile. Small red garnets form as much as 75 per cent of this band. The average is probably about 40 per cent. Some phyrrhotite occurs in the garnet rock.

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1 Numbers in parenthesis refer to the map units on the accompanying maps.

The volcanic rocks north of Shatford Lake have a heterogeneous aspect in outcrop. These rocks are recrystallized, as well as partly silicified and granitized. Garnets are disseminated throughout these rocks. Some rusty iron-bearing zones, containing disseminated pyrrhotite and magnetite, are present. Most of the rocks in this section exhibit a streaky foliation caused by recrystallization and partial granitization to components of varying colour (various shades of grey to dark green or black), different textures (very fine- to medium-grained), and different compositions (feldspathic and quartzose to amphibolitic). Various amounts of granitic material have been impregnated into the schists. Some completely silicified rock, that of unit 4 on the accompaning maps, is intermixed with the streaky schists.

Some of the volcanic rocks west of Ryerson Lake are even more completely altered than those north of Shatford Lake. Part of the rock is a finely foliated dark grey to black hornblende- plagioclase schist with thin injections of granite parallel to the foliation. Red garnets up to 1/3 inch across are abundant in this type of schist. A great deal of the granitized schist is a streaky, light greyish green, "sandy-textured" rock composed mainly of quartz and feldspar. This represents the extreme in granitized lavas. It is possible to recognize all stages between this rock and the amphibolitic schists.

As the main body of granite west of Ryerson Lake is approached, granitization by replacement and injection becomes less intense. The rocks pass from granitized schists to blocks and bands, tens to hundreds of feet across, of fairly massive basalt intruded by large quantities of massive coarse-grained granite. Pillow structures are visible in some of the lavas. The contacts between the basalt bands and granite are fairly sharp.

South of Ryerson Lake most of the lavas are recrystallized to a well-foliated hornblende-plagioclase schist but in general are not granitized to any extent. In places, the flows are massive, fine grained, and contain some pillows. Numerous magnetic zones are present south of the lake. Most of these are beneath the overburden; only a few rusty and magnetic zones are visible on outcrop. These contain pyrrhotite, magnetite and, in part, considerable granular quartz.

Under the microscope both the fine-grained massive and pillowed lavas, south of Winnipeg River, and east of Shatford Lake, and the medium-grained diabasic flows, which occur only south of the Winnipeg River, are seen to consist of small euhedral laths and rods of labradorite with small flakes and sections of interstitial green hornblende. Most specimens also contain fine disseminated magnetite and sphene.

The highly granitized phases of the lavas west of Ryerson Lake consist of a fine mosaic of quartz and fresh oligoclase with scattered flakes of biotite and many corroded tablets of cloudy, saussuritized andesine. Other minerals present in small amounts are muscovite, carbonate, apatite, and magnetite.

Garnetiferous hornblende-plagioclase schist consists of blades and cross-sections of deep green hornblende intermixed with which are flakes of brown biotite, irregular crystals of red garnet, some plagioclase, and magnetite. The hornblende and biotite display parallel alignment.

Normal hornblende-plagioclase schist consists essentially of parallel rods and laths of andesine or labradorite, and blades of green hornblende.

Some magnetite and a little quartz may be present.

A specimen from one of the magnetite zones south of Ryerson Lake consists of a mosaic of interlocking quartz grains with bands of small hornblende flakes peppered with magnetite. Another specimen, needle-like hornblende-plagioclase schist from Ryerson Lake, contains fine quartz, andesine, and aligned needles of hornblende with numerous grains of magnetite and pyrrhotite. A third specimen of schist, from the band along the creek between Ryerson and Eaglenest lakes, carried a few grains of chalcopyrite and pyrrhotite.

Greywacke, quartz-mica schist (2)

Sedimentary rocks outcrop in an area between Ryerson, Flanders, and Summerhill lakes. For the most part these rocks are greywacke and derived quartz-mica schist. They are fine- to medium-grained, granular, grey to brown, massive to well-bedded rocks, consisting essentially of quartz, feldspar, and biotite. Some of these rocks are garnetiferous. The biotite is always aligned but secondary foliation is not always well-developed. Where foliation is well developed, as in the quartz-mica schist, it is usually parallel to the bedding. In one or two places the foliation transects the bedding.

Under the microscope the greywacke appears as a fine-grained mosaic of quartz and oligoclase showing mutual boundaries, and aligned flakes of brown biotite. Accessory minerals are muscovite, microcline and/or orthoclase, hornblende, epidote, apatite, magnetite, and zircon.

A considerable amount of grey to buff pegmatite is mixed with some of the sedimentary rocks. These occur as irregular intrusives; only the larger intrusives are shown on the map.

Conglomerate (3)

Occurrences of conglomerate-like rock around Booster Lake were described by the writer in a previous publication (Davies, 1956, p. 7). At that locality quartzo-feldspathic sedimentary rocks contained many rounded fragments of grey tonalite. However, many of the tonalite fragments had most unusual shapes for pebbles and consequently the writer was not satisfied that the rock represented a true conglomerate.

Conglomerate-like rocks similar to those near Booster Lake outcrop on the east shore of Ryerson Lake. The groundmass for the fragments is normal quartz-mica schist. The fragments are identical in composition and texture with those from Booster Lake, i.e. they are tonalite consisting of somewhat strained and crushed oligoclase, quartz, biotite, chlorite, and minor orthoclase, pyrrhotite, chalcopyrite, apatite, sphene, calcite, and magnetite. There is little doubt that the two occurrences are of the same conglomerate-like rock. That seen at Ryerson Lake, however, did not contain any fragments of unusual shape. No evidence further to that recorded for the origin of the occurrence at Booster Lake, was found at Ryerson Lake. However, like that at Booster Lake, it is doubtful if the Ryerson Lake band represents an actual conglomerate, though no doubt would arise from an examination of the latter occurrence alone.

Silicified Rocks (4)

Fine-grained, light grey, white and cream-coloured siliceous rocks, usually characterized by lenticular and streaky foliation, are well exposed north of Shatford Lake and along a band extending east and southeast from the lake to the Winnipeg River. These rocks were mapped as quartzite by both Wright and Springer. The writer, from work in the Bird River area (Davies, 1952, p. 9) considered that the westward extension of this band represented schistose volcanic rocks largely replaced by granitic material.

Evidence has been presented to show that the light cream-coloured, siliceous "cherty" and "aplitic" rocks of the Bird Lake area to the north are actually silicified volcanic and sedimentary rock (Davies, 1955, p. 13). The siliceous rocks of the present area are similar to those of the Bird Lake area. Some are massive but for the most part they are crudely foliated, into streaks and long narrow lenses. In places very faint forms resembling fragments are present. These are essentially of the same texture, colour, and composition as the matrix in which they occur.

Texturally the silicified rocks are "cherty" and "aplitic" like those to the north. In a few places they penetrate the volcanic rocks with which they are in contact.

In thin section the silicified rocks appear as very fine-grained to sugary mosaics of quartz and/or microcline and/or albite. These minerals exhibit mutual boundaries. Aligned flakes of muscovite, biotite, and sometimes a little hornblende make up from 15 to 30 per cent of the rock, muscovite being the most abundant of these three minerals. The feldspar content varies from 5 to 40 per cent and quartz 40 to 75 per cent. Pyrite, apatite, and epidote are common accessory minerals.

From the few thin sections examined there is a suggestion that feldspar of the silicified rock, where it is near the microcline-bearing granite, is microcline (east of Shatford Lake); likewise that it is albite where the rock occurs adjacent to the granodiorite (just north of the Winnipeg River).

Many of the granular quartzose, iron-bearing rocks (4a) south of the Winnipeg River have a very well-bedded appearance. Individual quartz bands 2 to 4 inches in width are either separated by thin partings of darker hornblendic material, or alternate with hornblende-rich bands 1 to 2 inches wide. This banding is straight and persistent and has all the aspects of bedding. Some of the quartzose iron-bearing rocks are fairly massive. All of these siliceous iron zones contain varying amounts of pyrrhotite, pyrite, and some magnetite.

Many of the siliceous iron zones, only the larger of which are shown on the maps, are developed in pillow lavas at the margins of pegmatite intrusives. In one or two places the siliceous bands terminate abruptly against recrystallized schistose lava. In one place remnant pillow structures were preserved in a weakly foliated portion. Frequently the basalt is rusty, dense, and hard for several feet on either side of these siliceous zones. The basalt near the contacts of the siliceous bands contains disseminated pyrrhotite and quartz. One band, that which is partly enclosed by pegmatitic granite northwest of Greer Lake, is very siliceous in places and largely hornblendic in other places along strike.

A band of granular quartzose pyrrhotite-bearing rock occurs north of Shatford Lake. This band occurs at the contact of volcanic and granitic rocks and appears to follow closely around the nose of the granite intrusive. The north limb of this band is highly quartzose; the south part is largely rotten schistose lava with disseminated pyrrhotite. Some graphite was observed in the sheared rock.

It appears that the silica and iron in these zones was introduced. The bedded nature of some of the silicified bands may be due to replacement of bedded basic tuffs. This, however, is uncertain, as no tuffs were observed interbanded with the volcanic rocks. Furthermore, replacement of shear zones most certainly formed some of the siliceous rocks.

INTRUSIVE ROCKS

Intrusive rocks in the area include small stock-like bodies of gabbro, batholithic bodies of granite and granodiorite and dykes and irregular masses of pegmatite and pegmatitic granite. These are all younger than the rocks of the Rice Lake group.

Gabbro (5)

Several gabbro intrusives occur in the area south of Winnipeg River. The gabbro intrudes basalt and in turn is intruded by pegmatitic granite and granodiorite. The gabbro occurs as narrow sill-like bands, small lenticular and irregular stock-like masses. It exhibits a great range in grain size, varying from medium- to very coarse-grained.

The long narrow band running east from Lamprey Falls is for the most part only medium grained, and in some places, rather fine. It is a massive to somewhat foliated, dark green to black, ophitic-textured rock. On account of its rather fine-grained texture it closely resembles some of the medium-grained flows. Outcrops are not abundant but, where observed, are completey lacking in flow features or any evidence of volcanic origin. This band differs, further, from the medium-grained lenticular flows in its narrow width and great length.

The irregular stock-like masses of gabbro occurring north of Aileen Lake and northwest of Greer Lake respectively are remarkably coarse-grained in part. Normal coarse-grained gabbro is intermixed with very coarse-grained material. In places small dyke-like masses of very coarse gabbro, displaying excellent ophitic texture, cut across the normal gabbro in various directions. A third variety in these masses is rather fine grained. All phases grade rapidly into one another and no sharp boundaries are apparent, even in the cross-cutting type.

Similar variations in grain size, though not so pronounced, were noticed in the small lens-shaped mass at the west side of Aileen Lake. The several other very small intrusives south of the Winnipeg River are more uniformly medium- or coarse-grained.

In thin section the coarse gabbro is found to consist of large euhedral tablets and laths of labradorite, Ab_{32} to Ab_{48}, and large pale green hornblende flakes. In one very coarse-grained specimen the ferromagnesian mineral is tremolite. Accessory epidote, magnetite, pyrrhotite, and chalcopyrite are present in some specimens.

The ophitic medium-grained gabbro consists of about equal amounts of labradorite, in small laths, and hornblende.

The occurrence of sulphides in gabbro is discussed more fully in a later section.

Granitic Rocks (6, 7)

Rocks of granitic character form the bedrock over the larger part of the area. They occur as individual large bodies separated by bands of older rock.

These granitic rocks, apart from those that are pegmatitic (8), vary greatly as regards colour, texture, structure, and composition. For mapping purposes, the two broad divisions employed in adjacent areas (Bird Lake and Booster Lake) are used here. These are a dominantly pink massive equigranular to porphyritic microcline-bearing granite and a unit which is chiefly grey or buff granite and granodiorite.

The grey granitic rocks may be massive or gneissic and equigranular or porphyritic. In many places they contain numerous inclusions of recrystallized and granitized volcanic rocks.

The pink variety rarely contains inclusions. It is younger than the grey type and can be seen cutting it at a few localities. Generally, however, the two types have gradational contacts, even on a single outcrop. Some of the pink granite is pegmatitic.

The masses shown on the maps as pink granite are not composed entirely of this rock. A certain amount of grey granite occurs with it. Similarly, considerable pink granite is mixed through those bodies shown on the map as the grey variety. There is, further, some indication that the pink variety grades into the grey where volcanic rocks are nearby or where inclusions of volcanic rock are present in the granite. This might be taken to indicate assimilation of volcanic rocks by pink granite, resulting in the grey type. It is doubtful, however, if all the grey and buff granite originated in this way.

The margins of the two divisions of granitic rocks are not well defined and are shown only approximately on the map.

The massive pink granite is composed mainly of microcline, albite or oligoclase, and quartz. Microcline forms 30 to 40 per cent of the rock, plagioclase 10 to 25 per cent, and quartz about 35 per cent. The common ferromagnesian mineral is biotite, usually in amounts less than 10 per cent. Some specimens contain a little green hornblende. Other accessory minerals include muscovite, epidote, apatite, magnetite, sphene, pyrite and hematite dust. In the porphyritic variety of pink granite phenocrysts are microcline tablets and, in some instances plagioclase.

At the contact of the microcline granite and pillow lavas east of Shatford Lake, a little disseminated pyrite, chalcopyrite, arsenopyrite, magnetite, and molybdenite occur in a siliceous border phase of the granite.

The grey granitic rocks consist of much the same mineral assemblage as above but in different proportions. Plagioclase, oligoclase or andesine,

exceeds or equals microcline in amount. The plagioclase is generally cloudy, saussuritized and sericitized, the microcline fresh and interstitial to the plagioclase. Hornblende, muscovite, and sphene are more abundant in the grey granite than in the pink. Some carbonate and zircon, which are not found in the pink granite, occur in the grey. Besides these compositional differences, the minerals of the grey granite are not as fresh as those in the pink variety.

The grey granitic rocks grade from granite to granodiorite. No specimens of tonalite or quartz diorite such as were found amongst the granitic rocks of the Bird Lake and Booster Lake areas were found in the present area.

Pegmatite, pegmatitic granite, pegmatite gneiss (8)

Dykes and irregular bodies of pegmatite and pegmatitic granite are numerous throughout the two map-areas, especially around Shatford Lake, Ryerson Lake, and south of the Winnipeg River. Many of these intrusives are too small to show on the maps. The pegmatite intrudes basalt, sedimentary rocks and the granitic rocks. They are most abundant in the volcanic and sedimentary rocks of the Rice Lake group. Some of the intrusives have steep dips, others are very flat-lying.

In general the pegmatite dykes are similar to those in the map areas to the north. Most are coarse grained, massive, and pink, flesh, buff, or grey in colour. The pink variety contains microcline and/or albite. The grey variety usually contains albite with little or no microcline. Some of the albite is the platy variety, cleavlandite. The quartz in the pegmatite may be clear, milky, smoky or almost black. It is usually glassy. Common micas present include muscovite, biotite, and pale yellowish-green low-grade lithia micas. Black tourmaline and red garnets are present in many dykes. The following less common minerals are present in certain of the pegmatites: spodumene, beryl, tantalite-columbite, cassiterite, lepidolite, zinnwaldite, zoisite, stibnite, pyrite, topaz, fluorite, apatite, monazite, uraninite and a mineral of the euxenite-polycrase series. The occurrence of these minerals is discussed in a later section.

The large irregular pegmatitic granite intrusive (8a) south of Winnipeg River has many unusual aspects. This body is the albite-bearing variety and is largely buff, cream, grey or white in colour. Unusual textural and structural features are prominent.

The body as a whole consists of various phases differing in texture, structure, and to some degree, composition. The various phases generally show no regular distribution with respect to one another; rather they are irregularly intermixed even over small areas.

Probably the bulk of the intrusive consists of a fine- to medium-grained aplitic rock, in part massive and in part banded. The banding is made apparent by slight differences in grain size and colour, by thin trains of mica (muscovite or pale yellowish green mica), by bands containing abundant small red garnets, and by bands of coarser pegmatitic material. Individual bands range in width from 1/10 inch to an inch or so. The narrower bands usually represent thin trains of mica or concentrations of garnets. Garnets, however, also occur disseminated throughout some of the wider bands and these may alternate with non-garetiferous bands. The banding is generally streaky, twisted into small broad open folds, or highly contorted. No individual band

can be traced very far before it fades out. Furthermore, whole patches of banded rock fade out into massive medium-grained rock.

These banded rocks are designated pegmatite gneiss. The banding does not appear to be inherited; the irregular shape of the intrusive precludes the possibility of replacement or rheomorphism of sedimentary rocks. No signs of sedimentary inclusions within the pegmatite or of any sedimentary rocks in the country rock along the margins of the intrusive are present. The foliation likewise does not appear to have been superimposed upon the intrusive, after it had solidified. There are no signs of recrystallization throughout most of thepegmatitic granite. It would appear that the pegmatite gneiss phases of the intrusive are a result of deformation and flowage during early stages of crystallization of the pegmatite, possibly with some assimilation of country rock.

Both the massive medium-grained aplitic rock and the banded and contorted albite pegmatite gneiss contain, in many places, large crystals of graphic quartz-albite intergrowths, some of which are irregular in form but most of which show euhedral outlines. The majority of these crystals measure a few inches to the side, others 10 to 12 inches. Some, on outcrop, show twinning according to the Carlsbad Law. One-half of the twinned crystal has a high reflecting power, the other weak. These are visible only on a sunny day.

Other phases of this body are normal coarse-grained grey, buff, or pink pegmatite, more or less equigranular. Some of this coarse material contains concentrations of pale grey and amber mica in the form of "sun-bursts" (spherical forms consisting of blades radiating from a center), plumes (bundles of radiating blades), multiple crosses (blades crossing one another in various directions), groups of randomly oriented blades, and forms resembling cedar boughs (groups of plumes). These mica forms are illustrated in Figure 1.

In addition to the peculiar micas, the coarse-grained phases also contain considerably more quartz than normal, fine to coarse, grey and purple curvilamellar mica and coarse yellow-green mica. A few yellow and white beryl crystals are found in the coarser phases, especially near the margins of the pegmatite intrusive.

Explanation of Figure 1

a. * Randomly oriented mica blades

b. Multiple cross of mica

c. "Sun-burst" mica

d. Plumose mica

e. * "Cedar-bough" mica

f. Veinlet of plumose lepidolite - Bob 1 claim

* Forms a. to e. occur in pegmatite granite (8a) south of Winnipeg River.

g. Sphere of plumose lepidolite; center is scaly unoriented lepidolite - Bob 1 claim

h. Curvilamellar lepidolite - Bob 1 claim

i. Rhombic, tapering zinnwaldite - Shatford Lake

j. ≠ Portion of a "wheel" of zinnwaldite - Shatford Lake

k. "Hexagonal", tapering zinnwaldite - Shatford Lake

≠ These large "wheels" break into tapering fragments along the radii of the of the wheel, giving forms i. and k. These forms may also occur alone.

Figure 1. Types of Mica found in Pegmatites

STRUCTURAL GEOLOGY

Folding

The rocks of the Rice Lake group along the Winnipeg River are completely separated by granite from those in the northern part of the map-area. The lavas of the northern belt, extending from Bernic Lake to the interprovincial boundary are lacking in any features indicating tops of flows. If these volcanic rocks have the same attitude as that part of the same band to the north then they face north (see Davies, 1955 and Davies, 1956).

Primary structural features useful for determining tops of beds are also lacking in the greywacke. Determination of attitude from the intersection of cleavage and bedding in two adjacent outcrops just north of Ryerson Lake indicates northward-facing overturned beds adjacent to the volcanic rocks. These beds appear to lie on the south limb of a large overturned synclinal drag-fold plunging toward the west.

Dips within the sedimentary rocks are gently to steeply south. Most of the beds dip at moderate angles. The sedimentary rocks lie on top of the lavas with apparent angular conformity. Nowhere is there any evidence of interbanding of greywacke and basalt.

The volcanic rocks east of Shatford Lake and those south of the Winnipeg River are characterized by well-formed pillows. In both places the flows face towards the north. The rocks in these two parts of the area are separated by a large mass of pink granite and it is not known whether or not they represent different parts of the same structural unit.

The manner in which the siliceous iron zone (4a) wraps around the granite intrusive north of Shatford Lake might be taken to indicate a fold. This would certainly be the case if the siliceous band were a sedimentary bed. However, this is not considered to be so. Since the band in question is thought to represent silicification along the contact of the granite, its attitude does not necessarily have any structural significance. On the other hand, this mode of origin for the siliceous iron band does not preclude the possibility that a fold axis passes through the nose of the granite intrusive. No definitive evidence is available.

Likewise lacking is any evidence of folding of the volcanic rocks around the noses of the granite bodies just northeast of Lamprey Falls and at the north end of Aileen Lake.

Shearing and Regional Schistosity

Regional schistosity is well developed in some of the rocks of the area. This is especially the case in the lavas of the belt north of the Winnipeg River. There the foliation generally dips south more or less parallel to the bedding in the sedimentary rocks. Secondary foliation in the sedimentary rocks themselves is generally parallel to the bedding.

No large-scale shearing or faulting was observed. However, there are many places where the rocks are more schistose than normal; in such cases this stronger schistose structure is parallel to the regional schistosity.

Some strong shearing which could be traced only a few tens of feet was noted along the north shore of Birse Lake, at several places in the lavas south of Ryerson Lake, along the north shore of Greer Lake, and, especially in numerous places along the many silicified zones throughout the area. As mentioned previously, many of these siliceous bands are thought to represent shear zones which have been thoroughly silicified.

MINERAL DEPOSITS

Mineral occurrences of economic interest consist of sulphide deposits containing copper, and pegmatite dykes containing lithium and beryllium minerals.

Sulphide mineralization has been known to occur in the area since the 1920's but records of work done in the early days is not available.

In 1924 lithium-bearing pegmatite was discovered on the former Bear claim, south of the Winnipeg River. The deposit was acquired by the Silverleaft Mining Syndicate (Canada) Limited and worked for 3 or 4 years; during this time 75 tons of spodumene and lepidolite were removed. This deposit was drilled recently.

In 1924 cassisterite was discovered in a pegmatite dyke on a small island near the east end of Shatford Lake. This was taken over by the Manitoba Tin Company in 1928. Exploration and development work, including the sinking of a shaft, was carried out until 1930. During the same period, areas of sulphide mineralization and several pegmatite dykes containing beryl were discovered around Shatford Lake.

Other beryl deposits were discovered south of the Winnipeg River, on the Huron claim, in 1925 and at the southeast corner of Greer Lake, on the Grace claims, in 1932. Some beryl dykes southeast of Greer Lake had been discovered prior to 1932. Renewed interest in beryllium has resulted in an attempt to develop some of these beryl deposits.

A geologically interesting deposit of fuchsite, green chromium mica, occurs about 1 1/2 miles south-southeast of Lamprey Falls.

Some feldspar was quarried at, and shipped from Greer Lake a number of years ago.

Sulphide Deposits

Sulphides are found in silicified rocks, basalt, and gabbro.

Sulphides in Silicified Rock and Basalt.

Several of the silicified zones contain abundant disseminated and massive pyrrhotite. Some of these siliceous sulphide occurrences also contain large amounts of pyrite, some arsenopyrite, and small amounts of chalcopyrite.

The largest sulphide-bearing silicified zones, marked 4a on the accompanying map, occur between Bernic and Shatford lakes, east of Shatford Lake along the contact between silicified rock and basalt, and south of the Winnipeg River.

Chalcopyrite occurs, along with pyrrhotite, in parts of most of the sulphide occurrences but usually in very small amounts. In a few places chalcopyrite is quite abundant over very narrow widths.

Many highly magnetic zones were encountered south of Ryerson Lake. Most of these are beneath deep overburden. Of those which outcrop some contain pyrrhotite, some contain magnetite, and others both magnetite and pyrrhotite. Whether containing magnetite, pyrrhotite, or both, the host rock is recrystallized basalt containing considerable granular quartz and, in places, a few large crystals of dark green clinopyroxene. A few grains of chalcopyrite were found in some of the specimens containing pyrrhotite.

A large amount of surface work has been done in the past on many of these sulphide occurrences, apparently with disappointing results. A few have been drilled, also with discouraging results. Work on similar occurrences in the area to the north (Bird Lake and Booster Lake areas) was also unsuccessful in revealing promising amounts of valuable sulphide minerals.

Sulphides in Gabbro

At the northwest corner of Aileen Lake, south of the Winnipeg River, disseminated sulphides occur in coarse-grained hornblende gabbro. The rocks in this vicinity, basalt and gabbro, are cut by small irregular dykes of granite. A wide, siliceous, pyrite-bearing zone occurs in the volcanic rocks. No valuable sulphides are known to be present with the pyrite. However, disseminated pyrrhotite, pyrite, and chalcopyrite occur in the gabbro along the north side of the outcrop. The sulphides are only locally abundant on surface. Low nickel, and moderate copper, assays were obtained by Lithium Corporation of Canada, Limited from surface material.

This occurrence was drilled during the winter of 1955-1956 by Lithium Corporation of Canada, Limited. The drill core shows gabbro cut by numerous stringers of fine granitic material. Pyrrhotite and chalcopyrite are disseminated throughout the gabbro and fine granite. The amount of chalcopyrite in the core is small. Low copper and nickel assays were obtained from mineralized core.

A few grains of pyrrhotite and chalcopyrite were seen in thin sections of the coarse phases of the two stock-like gabbro intrusives south of the Winnipeg River, one situated 1/4 mile north of Greer Lake, the other 1/2 mile north of Aileen Lake.

Mineral Occurrences in Pegmatite

The pegmatite dykes of the area are of economic interest on account of their content of beryl and lithium minerals. The deposits around Bernic Lake were described in the Mines Branch publication dealing with that area (Davies, 1955). Recent work on some of these deposits is discussed in a later section of this present report.

The pegmatites around Shatford Lake and Greer Lake, and those south of the Winnipeg River contain noticeable amounts of beryl. One dyke, on the Bob 1 claim, also south of the Winnipeg River, contains concentrations of spodumene and lepidolite. At Shatford Lake, some cassiterite occurs in one pegmatite dyke. Cassiterite is also reported from a dyke on the Annie claim, north of the Huron claim.

Beryl Deposits

The most notable occurrences of beryl are situated on the Grace claims southeast of Greer Lake, on the Huron claim west of Greer Lake, and on a group of claims south and east of Shatford Lake. Beryl was also noted in places along the edges of the large pegmatitic granite intrusive south of the Winnipeg River, and in a few other pegmatite dykes along, and south of, the river.

On these properties beryl occurs in pegmatite dykes which characteristically lack important lithium-bearing minerals. The beryl pegmatites are typically very coarse grained and usually pink in colour. They consist mainly of flesh and pink, with some white, albite, and some quartz. Some dykes contain a little microcline in addition to albite. Part of the albite is the platy variety, cleavlandite. The quartz is glassy white, grey, or smoky. Micas present include biotite, muscovite, zinnwaldite, and pale yellowish green, grey, and amber low-grade lithia micas.

In many cases the beryl is intimately associated with patches of glassy quartz. Other uncommon minerals present in the beryl dykes include tantalite-columbite, euxenite-polycrase, topaz, uraninite, apatite, monazite, fluorite, stibnite, and zoisite. These minerals occur in very small amounts.

Huron claim:

The Huron claim, south of the Winnipeg River, is one of a group controlled by Dalhart Minerals Corporation Limited. The Huron pegmatite is well known for the uraninite crystals obtained from it. Radioactive age determinations have been made on these crystals by a number of workers. Age calculations, using the lead isotope method, of about 2,500 million years for the Huron pegmatite agree well with those for the nearby lepidolite-spodumene pegmatite on Bob 1 claim (old Silverleaf deposit) using the Sr/Rb and K_{40}/A_{40} methods. [1]

The pegmatite, which intrudes basalt, is a gently dipping anticlinal-shaped body with dips of 10 degrees or less to the north and south. It is exposed for a length of about 400 feet. The maximum thickness exposed in pits is 10 feet.

Very large crystals of pink and flesh-coloured albite with a few large patches of white quartz make up the bulk of the pegmatite. Some of the albite is in smaller platy crystals, cleavlandite. Only small amounts of mica, both biotite and pale yellow muscovite, as well as a little chlorite, are present.

Green, and yellowish green, beryl with associated columbite is abundant in only one place over an area of about 10 feet by 40 feet along the crest of the anticlinal structure. Some beryl is also found in a trench on the southern exposed edge of the deposit. Large vein-like masses of quartz also occur in these places but not elsewhere in the dyke. Most of the beryl is in large

1 Ages, determined by Nier, Ahrens, and Wilson and associates tabulated in "Some Dates and Subdivisions of the Canadian Shield" by G. L. Cumming, J. T. Wilson, R. M. Farquhar, and R. D. Russell; Proc. Geol. Assoc. of Canada, Vol. 7, Pt. 2, 1955.

crystals, some a foot or more across.

The tantalite-columbite, occurring in fractures in the pink feldspar, is in the form of flat platy or lath-shaped crystals 1/10 inch to 4 inches long. It is recorded [2] that 500 pounds of columbite were removed from this deposit about 1930.

A few small crystals of euxenite-polycrase have been obtained from the columbite-bearing material. Other minerals associated with the beryl and columbite are black vitreous quartz, dark grey massive and granular zoisite, small delicate, striated, honey-coloured crystals of zoisite, and small irregular patches of chlorite. Uraninite and monazite are reported [3] to occur along with the columbite and associated minerals but were not found by the writer. Apparently most of the radioactive material has been removed.

Greer Lake:

Dalhart Minerals Corporation Limited control the Grace group and several adjacent claims on the south side of Greer Lake. A number of pegmatite dykes, intruding gneissic granitic rocks, contain beryl.

The main beryl deposit occurs on the Grace 1 claim. At this locality pegmatite outcrops over a width of about 25 feet and for a length of about 400 feet. In detail the deposit consists of several irregular intrusives of buff and pink pegmatite separated by granite.

The pegmatite is composed of albite and some microcline, with white, smoky, and black quartz, books of yellowish-tinted mica, black tourmaline, and rare columbite. Feldspar is in excess of quartz. Beryl is scattered throughout the entire pegmatite. Pale green beryl crystals vary from 1/2 inch or less to 10 or 12 inches across. Most are small. A few are thin, long and pencil-shaped. Many small anhedra of beryl are also present.

It is difficult to estimate the beryl content of a deposit of this nature. However, a visual estimate on the surface of the pegmatite would indicate an average in the order of 0.5 per cent beryl. Taking the zone as a whole, including the granite, which the closely-spaced but separate irregular pegmatite bodies intrude, the average would be considerably lower.

Dalhart Minerals Corporation have been opening up the surface of this deposit. By the end of 1956 about 25 tons of beryl were reported to have been hand sorted from the pegmatite.

Several other irregular pegmatite dykes, just to the south of the one described above, contain crystals of beryl. At the time of the writer's examination, no work had been done on these.

A narrow pegmatite dyke on the Grace 2 claim has one small area with abundant beryl. The dyke varies in width from 1 1/2 to 5 feet and averages about 3 feet. Its exposed length is about 300 feet. The pegmatite con-

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[2] Unpublished notes, 1930, on file at the Mines Branch, Winnipeg.

[3] Ibid.

sists of pink and flesh feldspar, smoky quartz, and minor tourmaline, mica, and columbite. A spectacular concentration of beryl crystals is exposed on a face, a few square feet in area, of a trench. Crystals of green beryl, some of pleasing tints, forms up to 30 per cent of the face. Many are thin, relatively long, pencil-shaped crystals. The remainder of the surface of the dyke contains little visible beryl.

Other Beryl Occurrences South of Winnipeg River:

A small portion of a pegmatite dyke, outcropping along the south shore of the Winnipeg River, contains numerous beryl crystals. Part of the dyke is under water and only a few square feet were visible when examined. The pegmatite consits of pink feldspar, smoky opalescent quartz, slightly tinted rose quartz, and yellowish mica. Small pencil-shaped beryl crystals are scattered throughout the pegmatite.

On the Annie claim, at the south edge of the pegmatitic granite body, a coarse buff pegmatite phase, consisting of cleavlandite, smoky and white glassy quartz, grey and lilac curvilamillar lithia mica, and a pale yellow mica, contains a very few white beryl crystals. Some cassiterite was taken from this deposit around 1930.

A few small beryl crystals were seen in the pegmatitic granite near the west side of the Clare 1 claim. A few beryl crystals were also found on the Rapid claim in a coarse pink pegmatite which protrudes southward from the main pegmatitic granite intrusive.

Quite a number of small beryl crystals occur in parts of a large pink to buff pegmatite on the Huron 1 claim west of Greer Lake. This same pegmatite contains some red garnet crystals up to 1/2 inch in diameter.

DeLury [1] has reported the presence of beryl and some lepidolite on the former Top of the World claim which was situated about 1/2 mile due east of the Grace 1 claim. This deposit was not seen by the writer. Another occurrence of beryl, on the former Captain claim, which was contiguous, at its northeast corner, with the Top of the World claim, and which was thus situated just at the bottom of or just south of the present map-area, was not found by the writer.

Shatford Lake:

Beryl occurs in a half dozen pegmatite dykes intruding the basalt, silicified rock, and pink granities near the east end of Shatford Lake. These pegmatities are situated on the Dyke claims owned by Contact Minerals, Limited.

The largest of the dykes, and the one on which the most work has been done, outcrops south of, and about 3/4 mile west from, the east end of the lake. At this locality pegmatite outcrops in four places over a distance of 1,500 feet. It is not certain that these outcrops are all part of the same dyke.

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1 DeLury, J.S.: "Beryl in Manitoba"; Can. Min. Jour., Vol. 51, 1930, p.1017.

The pegmatite is coarse, pink and flesh coloured, and conposed essentially of albite and quartz. Albite is much more plentiful than quartz, part of which occurs as large masses within the pegmatite. The feldspar is in the form of large crystals and curved plates.

Considerable surface trenching has been done in two places on this dyke during the past two years. Exposures are clean and afford ready examination.

In the main workings large masses of zinnwaldite, flakes of biotite and yellowish low-grade lithia mica, patches of monazite, crystals of columbite, grains of fluorite, blebs of euxenite-polycrase, a few small crystals of pyrite and stibnite, and several large crystals of almost completely altered Topaz are visible.

Much of the zinnwaldite occurs as large circular forms or wheels with a convex upper surface. Each wheel is composed of individual tapering books with hexagonal and rhombic, curved surfaces. These books taper towards the center of the wheel (see Figure 1). The zinnwaldite is smoky grey in colour with a slightly metallic luster. Its optical properties place it in the lepidolite group, and are close to those for the zinnwaldite from Saxony.

Several large patches of coarse monazite occur in one pit. The monazite is dark reddish to greyish brown and contains abundant dusty hematite and small anhedral inclusions of euxenite-polycrase. Some masses of monazite are 8 by 10 inches on surface. The monazite occurs in fractured feldspar which locally has been deeply reddened by hematite. The monazite content of the entire dyke is very low.

Small tabular crystals of columbite occur in narrow fractures in feldspar and quartz. A small amount of pyrite and stibnite was found in one fracture. Euxenite-polycrase, apart from its occurrence as inclusions in monazite, is found as small anhedra in pink albite mixed with smoky quartz.

Topaz occurs as remnants in large prismatic orthorhombic crystals now largely altered to fine muscovite, pinite. A few discrete grains of topaz remain, but most of each crystal consists of a fine mixture of pinite and incompletely replaced topaz.

Beryl which, next to zinnwaldite, is the most abundant of the rarer minerals is widespread but not great in quantity. It occurs as green and white crystals and anhedra. Most crystals are an inch or so long. One deep green crystal is over 1 1/2 feet long. Much of the beryl is closely associated with quartz. Some, however, is associated with pink albite. It is not uncommon to find a shell of beryl, showing hexagonal outline, surrounding a core of albite. Small "veinlets" of beryl cut the albite core, and many of these "veinlets", conversely, are penetrated by albite. Quartz, also, fills fractures in some beryl crystals. Mineral relationships, in general, indicate that the beryl, quartz, and albite crystallized more or less at the same time.

Although parts of the dyke are locally richer, the average beryl content of this dyke is probably considerably less than 0.25 per cent.

Several small dykes, about 1,000 feet due east of the east end of Shatford Lake contain a few crystals of green beryl. These dykes occur in

silicified rock. Three small dykes in basalt, due south of the island on which the shaft is situated, contain plentiful beryl over small areas.

Another beryl dyke occurs about 4,000 feet southeast of the east end of the lake. This pegmatite intrudes pillowed lavas, and is exposed in two places for lengths of 125 and 150 feet respectively. The total length is probably about 600 feet. The maximum width is about 15 feet.

The dyke is uniformly coarse grained and consists mainly of large pink felspar crystals with the remainder, milky white quartz, and books of biotite, zinnwaldite, and yellowish-green mica. Feldspar comprises about 2/3 of the mineral content. Some of the quartz is in large patches a foot or more across.

Yellow-green beryl crystals are scattered throughout the dyke. Some columbite is present, and a little purple fluorite is found in places.

Several pegmatite dykes intruding the pink microcline granite south of Shatford Lake contain a few crystals of beryl.

Summary of Beryl Dykes:

Beryl may occur in certain pegmatite dykes characterized by distinctive features summarized below.

The beryl pegmatites are generally coarse to very coarse grained. Most of them are buff, flesh or pink in colour. A few are grey. They are composed dominantly of pink feldspar, albite with or without some microcline. The feldspar forms large crystals. The quartz of the pegmatite occurs partly intermixed with the feldspars. In large part, however, quartz forms large patches and lenses. Beryl appears to be closely associated with the quartz. The micas, of various kinds, occur as large books and flakes. Columbite, and frequently other uncommon minerals, are associated with the beryl. Important lithium minerals do not occur in the beryl dykes.

The above features are characteristic of those beryl pegmatites which are essentially unzoned, or basically uniform in texture and composition from wall to wall. Such dykes occur in volcanic rocks close to granite or within, and near the margins of, the granite itself.

In those zoned dykes in which lithium minerals also occur (as on the Buck claim at Bernic Lake, described in report 54-1) the zone in which the beryl occurs displays the same general features, i.e., coarse feldspar, coarse quartz, and large books of mica. The proportions of feldspar and quartz may differ from that in the unzoned beryl dykes. The beryl zone of the zoned dykes lies outside the lithium-bearing zones.

Lithium Deposits

The occurrence of zinnwaldite and other low-grade lithia micas has been discussed on preceding pages. None of these lithia micas are of economic interest as far as recovery of lithium is concerned.

Bob 1 Deposit:

The lithium deposit on the Bob 1 claim (formerly the Bear claim), popularly known as the Silverleaf deposit, was discovered in 1925. It was worked for a few years by the Silverleaf Mining Syndicate (Canada) Limited. The claim is currently held by Lithium Corporation of Canada, Limited. Between 1929 and 1954, little work was done on the deposit. It was drilled in 1954.

The deposit outcrops on the side of a hill. On the outcrop it is more or less semi-circular with a diameter of about 200 feet. Some irregular tongues of aplite-pegmatite protrude into the volcanic rocks on the east side of the deposit. The exposed portion of the pegmatite appears to be in the shape of a gentle trough which plunges westward into a swamp, and is tilted towards the south. A further, small outcrop occurs about 250 feet west of the main exposure. The diamond drilling done on the deposit indicates that the dike extends beneath the swamp for about 550 feet west from the main outcrop. This section, beneath the swamp, appears to be a tabular body dipping approximately 30 degrees to the south. Thus in a crude way the intrusive may be visualized as being a spoon-shaped body tilted toward the south.

Part of the trough-shaped portion of the pegmatite, on the east end, is well exposed in a large open cut. The remainder is largely concealed by piles of material taken from the cut. Stockwell [1] reports the presence of a fault which displaces the north side of the pegmatite eastward. The writer could find no trace of this; it may now be covered.

The outer, lowermost zone, wide and well exposed on the north side of the pegmatite, and narrow on the south, is an aplitic rock consisting of quartz, pink feldspar, some fine scaly yellowish mica and some coarse plumose grey mica. Part of the aplite is banded like that in the large mass of pegmatitic granite to the north. Some of the bands, "lime rock", are due to thin rows of small quartz blebs.

Overlying the aplite rock, and toward the center of the deposit is a shell of quartz-feldspar-spodumene rock. This zone is composed mainly of large tabular crystals of quartz-spodumene intergrowth and buff coloured aggregates of cleavlandite and quartz. In addition, some large crystals of pink microcline and large lenses of glassy quartz are present. Some of the spodumene occurs as long narrow vein-like masses of quartz-spodumene intergrowth that appear to occupy fractures transverse to the margins of the zone. The quartz-spodumene intergrowth consists of small parallel blades of spodumene separated by quartz. The blades are oriented normal to the length of both the crystals and the vein-like masses of intergrowth. Many small blades of spodumene are distributed throughout the quartz-cleavlandite aggregate which fills the spaces between the quartz-spodumene intergrowths. Some of these blades show sieve texture due to abundant quartz anhedra throughout patchy but optically continuous spodumene.

Near the contact between the spodumene zone and the overlying, innermost, lepidolite zone, is some coarse curvilamellar lilac-coloured lithia mica, some pale lilac, radiating, lithia mica, and some grey zinnwaldite. Both the

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[1] In Wright (1931, p. 111.)

zinnwaldite and lilac-coloured lithia mica occur as vein-like masses with the mica radiating from the walls (see Figure 1). Some of the mica appears to replace feldspar crystals. The zinnwaldite, which seems to be characteristic of this zone, contains a few plates of columbite, and, in places, numerous small isometric crystals of spessartite. The lilac micas, of the lepidolite group, though also occurring in the spodumene zone appear to be more characteristic of the lepidolite zone.

Stockwell [1] states that the radiating lithia mica and the curvilamellar lithia mica contain only small percentages of lithia and are of no economic value. Optical data places them in the lepidolite group. Both give strong lithium flames.

A little calcite and fluorite are reported from this zone but were not found by the writer.

In the lepidolite zone, overlying and surrounded by the spodumene zone, large masses of fine scaly, purple lepidolite occur in a quartz-cleavlandite rock. Besides the scaly lepidolite, coarse lilac mica, also of the lepidolite group, is present as curvilamellar bulbs, veinlets of radiating flakes, and as flakes radiating out towards the circumference of large round ball-shaped masses whose centers are occupied by fine scaly lepidolite. Stockwell [1] reports the presence of topaz, beryl, montebrasite (amblygonite) and lithiophyllite from the zone. These were not seen by the writer and may lie beneath the rock dump which occupies the western central part of the trough.

The "upper" zone of the pegmatite occurs only on the south margin of the intrusive. It overlies the spodumene zone. It is composed largely of a coarse aggregate of quartz, pink feldspar and books and large flakes of pale yellowish-green mica. The amount of feldspar is small and occurs as a regular intergrowth with quartz.

Since this upper, quartz-book mica zone directly overlies the lower aplitic zone in the southern part of the exposure the two inner lithium zones must pinch out beneath the upper zone.

The drilling done in 1954 by Lithium Corporation of Canada, Limited failed to intersect spodumene- or lepidolite-bearing sections of the dike beneath the swamp west of the open cut.

Cassiterite Deposit

Cassiterite was discovered in 1924 in a pegmatite dike on a small reef near the east end of Shatford Lake. In 1928 the Manitoba Tin Company, Limited did some surface work on the occurrence and, early in 1929, commenced sinking a shaft on the larger of the islands at the south and east end of Shatford Lake. The original discovery had been made on the small reef just west of the large island. By the summer of 1929 the shaft had been sunk to 112 feet and a cross cut at the 100-foot level driven northwest towards the original discovery. A total of 167 feet of cross cutting and 285 feet of drilling was done. Operations ceased in October, 1929. The cassisterite content was found to be very small

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[1] Ibid.

The pegmatite on the reef west of the shaft is now largely covered. It is a pink albite pegmatite consisting of quartz, albite, tourmaline, biotite, and pale yellow mica. The pegmatite occurs along the contact of basalt and the garnetiferous band that lies between the basalt and silicified rock.

Cassiterite is reported to have occurred in a coarse quartz-muscovite phase on the north side of the pegmatite. Some beryl and fluorite are also reported. None of these minerals are readily visible in the present exposure.

Fuchsite Deposit

A deposit of fuchsite occurs about 1 1/2 miles south-southeast of Lamprey Falls, near the contact between granite and volcanic rocks. In 1926 several tons of fuchsite rock were shipped to Winnipeg and used as stucco dash.

Fuchsite, a brilliant green chromium mica, occurs in a band of quartzose rock that is partly fine grained like a dense quartzite and partly aplitic textured. This quartzose rock lies in recrystallized lavas. It closely resembles the silicified rocks of map unit 4. Some of it displays a streaky banding. One band of very fine material has straight persistent parting planes containing sericite. Some pegmatite intrudes the quartz rock. Lenses of the siliceous rock occur in the schistose basalt for several hundred feet along strike but the fuchsite exposure is confined to a length of about 75 feet along the south edge of the outcrop. Under the microscope the siliceous rock appears as a mosaic of small jagged interlocking quartz grains. No feldspar is present.

The fuchsite occurs as narrow lenses and streaks, a few inches to a foot wide, parallel to the banding in the siliceous rock. The lenses and streaks consist of aggregates of small fuchsite scales. Scales and flakes are also disseminated throughout part of the quartzose material. Some chlorite is present along with the disseminated fuchsite. Fuchsite perhaps makes up 5 per cent of the entire rock for a width of 15 or 20 feet and a length of 50 feet.

Stockwell [1] considered that the siliceous rock was a quartzite and that the fuchsite formed by metamorphism of the original constituents of the quartzite. It is equally possible that the fuchsite was formed during silicification of the schistose lavas. Green chromium mica is not uncommon in altered basic schists forming the wall-rocks of quartz veins.

Feldspar

A large pink albite and microcline pegmatite at the southeast side of Greer Lake has been used as a source of feldspar. The pegmatite, which intrudes gneissic grey granite, is composed mainly of pink feldspars with some quartz and various micas in large books. The feldspar is in large crystals and groups of crystals several feet across.

Both soda and potash feldspars occur in the dyke. Large areas of pure potash feldspar, microcline, were present in the central part of the dyke.

Quarrying operations were conducted from 1933 to 1935. Several thousand tons of feldspar were shipped to Minnesota.

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[1] Ibid

APPENDIX

Recent Developments at Bernic Lake

Since publication of the report on the Bird Lake area (Pub. 54-1), which included the country around Bernic Lake, a considerable amount of exploration work has been done on lithium deposits at Bernic Lake.

Montgary Explorations Limited

This company holds a block of claims, covering the site of the property formerly held by Jack Nutt Tin Mines, Limited, on the north shore of Bernic Lake. Development work by Jack Nutt Tin Mines, Limited and its successor, Consolidated Tin Mining Company, Limited, had failed to disclose commercial quantities of cassiterite in the several narrow pegmatite dykes outcropping on the property. A shaft had been sunk on the property. Before the project was abandoned in 1930, several deep holes were drilled. These holes, passing beneath the mine workings, intersected a wide pegmatite dyke, containing spodumene, a few hundred feet below the surface.

The demand for lithium was not great in the 1930's and over the years its presence at Bernic Lake was apparently forgotten. However, late in 1954, Mr. D. S. McLeod, who had been associated with the early work on the property, uncovered the old drill records. The property had been staked, allowed to lapse, and had been restaked a number of times by various individuals between 1930 and 1954. At the time the old records were uncoverd the ground was open for staking. The property was then staked and turned over to Montgary Explorations Limited.

The company drilled a total of 44 holes, most of them vertical, on the lithium pegmatite. Since the pegmatite does not outcrop anywhere, despite excellent rock exposures, the following information is entirely from drill core.

The pegmatite is in the form of a flat-lying bifurcated sheet intruding basalt and hornblende schist. It strikes west of north and dips gently towards the northeast. The hangwall of the dyke is a fairly uniform surface dipping about 10 degrees northeast; it displays neither major bulges nor tongues branching from it.

The eastern, down dip portion of the dyke is a single sheet up to 300 feet thick. Up dip, towards the west, the pegmatite splits into a number of separate sub-parallel lobes and sheets projecting into the country rock from the lower two-thirds of the dyke. The attitude and form of the pegmatite are illustrated in the isometric diagram, Figure 2. This shows most of the spodumene-bearing part of the pegmatite as explored by drill holes, and was compiled from the logs of 23 vertical holes.

The spodumene zone occurs as a single continuous band, generally within the upper half of the pegmatite. This band is over 100 feet thick in the south and west part of the dyke; down dip it appears to be pinching out. Several tongues of spodumene-bearing pegmatite branch off from the thick western part of the lithium band. A couple of other narrow spodumene dykes below the main zone may or may not be connected with the main dyke.

The pegmatite is fine-grained aplitic, to coarse grained, and mostly grey, white and buff in colour. Some sections are pink or flesh-coloured. The pegmatite consists essentially of quartz and albite, in large part cleavlandite. Deep green to black tourmaline is common. A few crystals of pink tourmaline were seen. Micas present include muscovite, biotite, lepidolite, zinnwaldite, and pale yellow-green and amber low-grade lithia micas. Minor cassiterite, beryl, apatite, and amblygonite are also present.

The minerals listed above occur for the most part in the coarse phases of the pegmatite. Many bands of aplite are present within the dykes. These are composed of white to buff albite, and quartz, with some minute laths of spodumene. This aplitic material contains only a low percentage of Li_2O.

The lithium-bearing band consists largely of white, glassy quartz, and spodumene. The spodumene occurs as small sub-parallel blades, a fraction of an inch to an inch or more long, intimately mixed with the quartz. Within this zone large lenses, pods, or bands of massive white quartz are present.

The lithium content of this dyke is rather high. Assay results supplied by the company show sections containing as high as 3.34 per cent Li_2O for a maximum width of 76 feet, 2.75 per cent for a maximum width of 79.5 feet, and 1.95 per cent for a maximum width of 130 feet. Ore reserves are reported to be 7,887,218 tons averaging 1.85 per cent Li_2O.

Shaft sinking on the property commenced toward the end of 1956.

Lithium Corporation of Canada, Limited.

A number of flat-lying, lithium-bearing dykes, outcropping at the east end of Bernic Lake were described in the report in the Bird Lake area. These dykes outcrop along both sides of a swamp extending back from the lake.

During the winter of 1955-56 Lithium Corporation of Canada, Limited, drilled a number of holes on this property and were successful in outlining a sheet of lithium-bearing material about 250 feet below the zoned dyke that outcrops near the east side of the Buck claim.

The lower pegmatite dips toward the west at an angle of less than 10 degrees. Its maximum thickness is about 50 feet. The lithium-bearing band was outlined over a length of 1,700 feet and a width of 450 feet. The average thickness of the ore zone, which occurs within the central part of the dyke, is 16 feet. Within this zone are a reported 800,000 tons averaging 2.13 per cent Li_2O.

The pegmatite is, in part at least, distinctly zoned. A border zone and a wall zone, consisting of feldspar, tourmaline, and quartz, are present in many holes. An intermediate zone composed of coarse quartz, albite and course flake mica can be recognized in nearly all holes. This apparently is the first intermediate zone; in places it contains some beryl, blue apatite, and green or black tourmaline. These are the only zones that can definitely be recognized as such in the drill core.

The remaining, central part of the dyke, possibly representing various zones, which cannot be correlated from hole to hole, or established in zonal sequence, consists of bands or lenses, composed of various proportions of

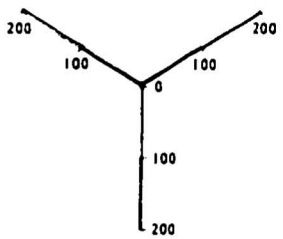
Legend

Spodumene Zone

Pegmatite — minor spodumene

Basalt, hornblende schist

SCALE IN FEET



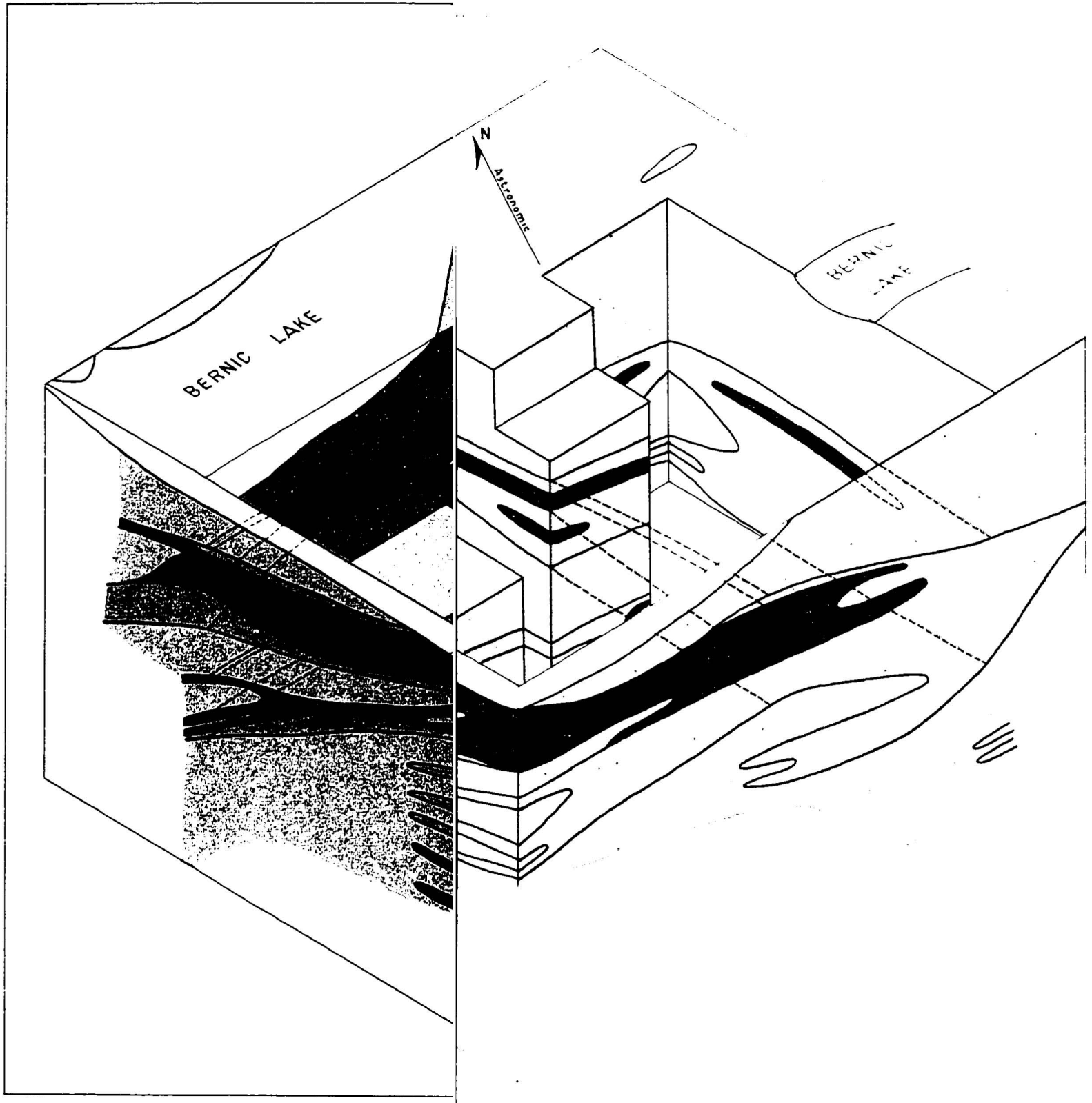
ISOMETRIC DIAGRAM

LITHIUM DEPOSIT BERNIC LAKE

Compiled by
J. F. DAVIES
from drill hole information
supplied by

MONTGARY EXPLORATIONS LIMITED

1957



quartz, albite, lepidolite, petalite, amblygonite, and spodumene.

In some holes the lithium mineral is entirely scaly purple or green lepidolite intimately mixed with fine granular quartz. In others, it is entirely coarse, massive petalite with minor quartz. These two minerals, petalite and lepidolite, appear to be the most abundant lithium minerals. However, some bands of quartz-spodumene intergrowth and of quartz amblygonite rock also occur in the central part of the dyke. Cleavandite may occur with both the spodumene and amblygonite. It is rarely associated with the petalite or lepidolite. In addition to the above assemblages there are bands of cleavlandite, of glassy quartz, and of both cleavlandite and quartz, all without any, or with only small amounts of, lithium minerals.

In any one hole several of the different bands may occur in a certain sequence; in another hole the sequence may be reversed for certain of the bands. Some holes show different bands alternating with one another. Several holes have only one or two of the different bands. None of the holes show all of the assemblages mentioned above.

More information would probably reveal a definite zonal sequence from the wall to the core of the pegmatite.

The upper zoned dyke was also intersected in a few holes. Surface work uncovered another dyke containing abundant white beryl crystals, some several inches across. This occurrence has not been fully outlined on surface.

Other Work.

Perseverance Mining and Development Company, Limited drilled five vertical exploratory holes about a mile west of the east end of Bernic Lake, along the north shore. No pegmatite was intersected.

The same company drilled six vertical holes just north of the small lake half a mile east of Bernic Lake. No pegmatite was found.

North American Rare Metals, Limited drilled six holes from the north shore of Bernic Lake, near the east end. Four of these were inclined southward to intersect the contact of the volcanic rocks and granite. No pegmatite was found.

Cove Uranium Mines Limited drilled several holes about 1 1/2 miles east of the west end of the lake, along the north shore. No pegmatite was intersected.

The amount of drilling that has been done along the length of Bernic Lake, near the contact between volcanic and granitic rocks, is insufficient to locate possible flat-lying pegmatite dykes, such as those which occur on the properties of Montgary Explorations, Limited and Lithium Corporation of Canada, Limited and which do not outcrop.