



Province of Manitoba

DEPARTMENT OF MINES AND NATURAL RESOURCES

MINES BRANCH

PUBLICATION 51-3

GEOLOGY

of the

OISEAU (BIRD) RIVER AREA

Lac du Bonnet Mining Division

by

J. F. DAVIES

Winnipeg
1952

1.00

Electronic Capture, 2011

The PDF file from which this document was printed was generated by scanning an original copy of the publication. Because the capture method used was 'Searchable Image (Exact)', it was not possible to proofread the resulting file to remove errors resulting from the capture process. Users should therefore verify critical information in an original copy of the publication.



Province of Manitoba

DEPARTMENT OF MINES AND NATURAL RESOURCES

HON. J. S. McDIARMID
Minister

J. G. COWAN, Q. C.
Deputy Minister

MINES BRANCH

J. S. RICHARDS
Director

PUBLICATION 51-3

GEOLOGY

of the

OISEAU (BIRD) RIVER AREA

Lac du Bonnet Mining Division

by

J. F. DAVIES

Winnipeg
1952

TABLE OF CONTENTS

	Page
Introduction	1
Location and access	1
Topography, drainage, and growth	2
Previous work	2
Present work	4
General geology	5
Table of formations	7
Description of rock types	8
Rice Lake group	8
Andesite, basalt, chlorite schist	8
Hornblende gneiss, granitized basalt	9
Rhyolite, dacite, breccia	10
Conglomerate	10
Feldspathic quartzite	11
Intrusive rocks	12
Peridotite	13
Gabbro	13
Gabbro-peridotite association	14
Granitic rocks	15
Structural geology	16
Folding	16
Faulting	18
Economic geology	19
Chromite	19
Sulphide deposits	22
Quartz-pyrite veins	23
Pegmatite deposits	23
Suggestions to prospectors	23
Summary	24

GEOLOGY OF OISEAU (BIRD) RIVER AREA

INTRODUCTION

During the summer of 1951, the Oiseau (Bird) River¹ region was geologically mapped and the mineral deposits in it examined. This work constituted a continuation of the systematic mapping of the belt of Archaean volcanic and sedimentary rocks extending eastward from Lac du Bonnet to the interprovincial boundary, a program carried out in 1947, 1948 and 1949 by G. D. Springer. The area is of special interest on account of the large deposits of chromite and the copper-nickel prospects which occur within its boundaries, and because of the possibilities of tin-, beryllium-, and lithium-bearing pegmatites which have been found in the areas to the east and north.

LOCATION AND ACCESS

The area mapped is bounded by longitudes 95° 30' and 95° 50' west and latitudes 50° 20' and 50° 30' north. On the east it adjoins the area covered by geological map 48-7, Cat Lake-Winnipeg River Area, Manitoba Mines Branch, by G. D. Springer.

The Bird River region lies immediately east of Lac du Bonnet, an expansion of the Winnipeg River. Bird River post office, now abandoned, is located about twenty miles north-northeast of the village of Lac du Bonnet and is accessible by boat or motor road from there.

The river is easily navigated all season. Within the limits of the map sheet it contains one portage about a mile long and two shorter ones; all are well cut out. The use of the long portage may be avoided by using the motor road that closely parallels the river and which may be reached from it by several short trails.

Numerous winter roads and both summer and winter logging roads are scattered throughout the region north of Bird River.

¹ Oiseau River is more popularly known as Bird River and will be so designated throughout the text of this report.

Peterson Creek is not navigable at any time of the year. Anson Lake may be reached by trail from Coppermine Bay on the north shore of Lac du Bonnet. The Winnipeg River, in the south-east corner of the map area, may be reached from Pointe du Bois, which in turn is connected by motor road with Lac du Bonnet village.

TOPOGRAPHY, DRAINAGE, AND GROWTH

The region is characterized by the usual Precambrian topography of low undulating rock ridges separated by tracts of swamp, muskeg, and glacial drift. Rock outcrops are abundant in those parts underlain by granitic rocks and less so in those parts underlain by sedimentary and volcanic rocks. East of Lac du Bonnet and north of Bird River outcrops are usually small and widely scattered.

Excepting Bird River, which flows westward into Lac du Bonnet, drainage is poor. Bird River occupies a drift-filled valley one quarter to one third mile wide, along which restricted farming activity is conducted.

Growth consists of spruce, jack pine, balsam, and black and white poplar. Numerous stands of large timber are present. Some lumbering operations are carried on and considerable pulp wood is removed from the area.

PREVIOUS WORK

The following list of references includes reports on former work within this and adjacent areas:

- Moore, E. S.: Region East of the South End of Lake Winnipeg; Geol. Surv., Canada, Sum. Rept. 1912, p. 262.
- Cooke, H. C.: Geology and Mineral Resources of Rice Lake and Oiseau River Areas, Manitoba; Geol. Surv., Canada, Sum. Rept. 1921, pt. C.
- Wright, J. F.: Geology and Mineral Deposits of Oiseau River Map Area, Manitoba; Geol. Surv., Canada, Sum. Rept. 1924, pt. B.

Brownell, G. M.: Chromite in Manitoba - Geology and Character of a Discovery Deposit; Precambrian, vol. 15, No. 12, 1942.

Bateman, J. D.: Chromite in Manitoba - Extent of Deposits and their Value in Warfare; Precambrian, vol. 15, No. 12, 1942.

_____ : Bird River Chromite Deposit, Manitoba; Trans. Can. Inst. Min. and Met., vol. 46, p. 154, 1943.

_____ : Tin in Manitoba; Can. Min. Jour., vol. 64, No. 5, 1943.

Osborne, T. C.: Petrography and Petrogenesis of the Bird River Chromite-bearing Sill; Unpub. M. Sc. Thesis, University of Manitoba, 1949.

Springer, G. D.: Geology of Cat Lake-Winnipeg River Area; Man. Mines Br. Prel. Rept. 48-7, 1949.

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

The investigations of Moore and Cooke were of a reconnaissance nature and carried out many years ago. Wright conducted one mile to the inch mapping which unavoidably lacked sufficient detail and accuracy to be final.

Brownell and Bateman confined themselves to the study of the two large chromite deposits in the area, using the previously cited works as background material for the area as a whole.

Osborne made a detailed petrographic study of the gabbro, peridotite, and chromite, but spent little time investigating field relationships.

Springer's reports refer to adjacent map areas.

PRESENT WORK

The period between May 28 and September 19, 1951 was spent in mapping the region on a scale of two inches to one mile. The method of mapping was by pace and compass; accurate control was obtained by the use of vertical aerial photographs. The centres of these photographs are indicated on the accompanying map.

Traverses within the volcanic-sedimentary rock group were run at intervals of one thousand to twelve hundred feet; those within the large areas of granitic rock were spaced one half mile or more apart.

On the accompanying map, areas of rock outcrop are enclosed by heavy solid lines, except in areas underlain by granitic rocks where they are not outlined. Large swampy areas are designated by the conventional symbol.

Considerable time was spent examining various mineral deposits in the region; certain ones outside the map area were also examined.

The field work was greatly facilitated by the capable and efficient assistance of A. Lewis, J. Derewianko, S. Watowich, and M. D. Moorhouse, all of the University of Manitoba.

The kind hospitality of residents along Bird River was greatly appreciated.

The object of the work was to provide a reasonably detailed map of the region and more specifically to outline the dimensions and disposition of the bodies of basic rock.

Previous predictions concerning other possible chromite deposits west of the Chrome and Page properties were based almost entirely on detailed study of these latter two deposits and on extrapolations based on Wright's map, which lacks the accuracy and detail required for making such predictions. It may be noted that at the time of Wright's mapping chromite was not known to occur in the region and further that the peridotite, in which the chromite known at present occurs, was mapped together with the gabbro as a single map unit.

The writer found that gabbro bodies are more numerous and of greater extent than was indicated by Wright. Peridotite occurs as a wide band at the base of the gabbro on the Chrome and Page properties. Excepting these, peridotite was found to be associated with only one other gabbro mass. In this instance it occurs as a narrow band partly at the base of and partly within an irregular mass of gabbro of greater dimensions than either of those on the Chrome and Page properties. Drilling of this third peridotite band has indicated the presence of chromite.

Since peridotite is absent, despite the presence of gabbro, in all cases but those mentioned above, the possibilities of discovering additional chromite deposits in the western part of the region are remote. This is the same conclusion as that arrived at by Bateman, although his reasons were different and in fact misleading, mainly because they were based partly on the disposition of Wright's undifferentiated gabbro-peridotite masses, incorrectly designated as small in size.

GENERAL GEOLOGY

Apart from deposits of clay, sand, and gravel of Pleistocene and Recent age, all the rocks of the Bird River region are Precambrian in age. The oldest rocks, those of the Rice Lake group, consist of interbanded acid to basic lava flows and detrital sedimentary rocks, quartzite and conglomerate. The volcanic and sedimentary rocks along the Bird River belt are separated from the belt to the north, along Wanipigow River, Rice Lake, Beresford Lake and eastward, by large areas of granitic rocks. Lithologically they are similar to those in the northern belt, from which the group receives its name, the Rice Lake group. The rocks of the Rice Lake group at both Bird River and Rice Lake bear the same relationship to the intervening granitic rocks.

Intrusive into the volcanic and sedimentary rocks are large sill-like bodies of coarse hornblende gabbro, some of which has serpentinized peridotite associated with it.

Granitic rocks of variable composition and texture intrude both the Rice Lake group and basic intrusive rocks.

Maps of adjacent regions, compiled by officers of the Manitoba Mines Branch, include the basic intrusives and granitic rock under the non-committal classification of "Archaean or Proterozoic". Radioactive age determinations of the well-known pegmatite of the Huron claim along the Winnipeg River have definitely proven this pegmatite to be Archaean. The pegmatite is most probably related to one of the granitic rocks and hence is younger than the basic intrusives and also younger than part, if not all, of the granitic rocks.

There is no evidence of more than one period of mountain building or granitic intrusion. It is not claimed that all the granitic rocks, variable as they are, are of precisely the same age, but it is believed by the writer that they all belong to the same period of igneous activity, prolonged as it might be, and that no interval of the magnitude of that between the Archaean and Proterozoic is represented.

Consequently all the basic intrusives should be considered Archaean, since they are older than the Archaean pegmatite; some, and with less certainty all, of the granitic rocks should likewise be considered Archaean. There is little to justify the view that they are Proterozoic.

The accompanying table of formations illustrates the classification proposed for the rocks in the area.

TABLE OF FORMATIONS

Recent and Pleistocene		Glacial drift: clay, sand, gravel
Unconformity		
A R C H A E A N	Intrusive	Pink microcline granite, quartz monzonite Grey granite to quartz diorite, inclusions of older basic rock
		____ Intrusive Contact ____
	Rocks	Hornblende gabbro, some olivine gabbro, augite gabbro, quartz diorite
		Serpentinized peridotite
	Intrusive Contact	
	Rice Lake Group	Feldspathic quartzite, conglomerate, argillite Acid lavas: rhyolite, dacite, minor breccia Basic lavas: andesite, basalt, chlorite schist; hornblende-plagioclase gneiss, part granitized

DESCRIPTION OF ROCK TYPES

Rice Lake Group

Early Precambrian rocks of the Rice Lake group form a belt, up to five miles wide, along the Bird River. The different lithologic units, basalt, rhyolite and dacite, conglomerate, and quartzite, are all conformably interbanded. Rhyolite is interbanded chiefly with quartzite in the middle of the belt. Basalt outcrops as two bands along the north and south borders of the belt of Rice Lake rocks. A few thin basalt flows are interbanded with sediments. The sedimentary rocks outcrop immediately north and south of Bird River.

Andesite, Basalt, Chlorite Schist (1)¹

Fine-grained, dark green to black, massive lavas were mapped in the field as basalt, but some probably have the composition of andesite. Some of these basic flows are medium-grained and some have coarse-grained centres. Several of the thin bands mapped as gabbro may be coarse-grained basalt.

In some outcrops foliation is apparent and in a few instances the basalt has been altered to a chlorite schist. Pillow structures are very common, and although sometimes poorly preserved, in general are useful for determining tops of flows.

Typical dark green basalt consists of about equal amounts of andesine-labradorite and hornblende. The plagioclase occurs as small rods and the hornblende as pale green grass-like blades. The two minerals form aggregates with random orientation. Small quantities of chlorite and biotite are alteration products of hornblende. Considerable fine magnetite is disseminated throughout the rock.

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

Hornblende Gneiss, Granitized Basalt (1A)

Adjacent to the large mass of granite south of Bird River much of the basalt has been entirely recrystallized and, in part or whole, granitized and replaced by granitic material. This process has often been accompanied by a pronounced foliation and in some instances banding of the rock. Ribbon-like injections of felsitic material are common. In places the felsitic material occurs in small elliptical forms resembling pebbles in a conglomerate. Dark green recrystallized but non-granitized basalt consists of medium-grained, well-crystallized andesine and deep green, well-formed hornblende with small amounts of biotite, quartz, sphene, and pyrite.

Intensely granitized gneiss along the north shore of Shatford Lake is decidedly banded, light cream in colour, granular and so resembling a sedimentary rock that its identity may be readily mistaken. Within the area investigated by the writer the rock was mapped as a sedimentary rock by Wright, as it was by Springer, in the area to the east.

However, the fact that the rock is actually an extremely granitized basalt can be established. Light coloured, banded material grades abruptly along its strike into less granitized darker green material and this condition may alternate many times over a length of a few thousand feet. Irregular outlines of less granitized darker material a few feet across can often be observed within the lighter coloured intensely granitized rock. Less frequently bands of non-granitized dark hornblende gneiss are intercalated with completely and partially granitized bands.

The completely replaced, sedimentary-looking granitized gneiss along the north shore of Shatford Lake is fine-grained, finely foliated, and light grey to cream on the weathered surface, and consists of a granular mosaic of quartz and microcline with abundant small shreds of well-formed brown biotite showing optical parallelism. The composition is similar to the microcline granite (8).

Within the areas mapped as hornblende gneiss and granitized basalt great variations in the nature of the rock are to be found. The two types described, dark green, and light coloured, represent the extremes, that is, recrystallized but non-

granitized, and completely granitized gneiss. All grades between these extremes are abundant. Some of these rocks contain abundant small garnets, in places forming up to 20 per cent of the rock.

Rhyolite, Dacite, Minor Breccia (2)

Included within this unit are fine-grained, acid to intermediate flows and subordinate breccia.

The most distinctive, though not most abundant, type of acid lava is very pale green to almost colourless, hard, dense and "cherty", massive to streaky, very silicious-looking rhyolite. The weathered surfaces of the flows are either waxy or chalky in appearance. Some of this rhyolite has clear, opalescent blue or smoky quartz "eyes" ranging in size from 1 millimeter to 5 millimeters in diameter.

Typical light-coloured rhyolite consists of about 95 per cent cryptocrystalline quartz and acid feldspar with minute quantities of carbonate and sericite.

In addition to the type described above other acid flows are light to dark grey and green weathering and some are even black. Most are equigranular but some are porphyritic containing small milky plagioclase phenocrysts, as well as the quartz "eyes" mentioned above. Fresh surfaces of these lavas range from light cream with a tinge of green, pale brown, pale green, to dark grey. All are translucent.

The darker flows contain, in addition to quartz and feldspar, considerable brown biotite and sometimes sericite, with minute quantities of pyrite, carbonate, and apatite.

Some of the darker intermediate lavas are dacites and consist of quartz and andesine with abundant biotite and some chlorite, actinolite, and epidote.

Conglomerate (3)

Near the east border of the map area are several bands of conglomerate. The faulted bands of sedimentary rock between the Page claims and Bird River are mainly conglomerate and south

of the road at the east boundary of the area a band of conglomerate underlies quartzite. Thin lenses of conglomerate, too small to map, occur interbedded with the quartzites in the area.

Bedding is usually more apparent in the conglomerate than in quartzite but no regular gradation in size of pebbles is obvious enough to be useful in top determinations.

The pebbles are usually a light cream colour on both fresh and weathered surfaces. They are hard, dense and "cherty", range in size from 1/8 inch to 6 inches across, and are usually well rounded, although sometimes flattened.

The pebbles consist of a fine cryptocrystalline aggregate of quartz and acid feldspar, either orthoclase or albite, with a little carbonate, sericite, biotite, epidote, and pyrite. These pebbles, therefore, are felsite, and greatly resemble some of the light cream-coloured rhyolite described above.

The groundmass of the conglomerate is feldspathic quartzite (4), described below.

One mile north of the motor road and a few hundred feet east of the range line between Range 14E and Range 15E, a band of conglomerate about 400 feet thick is composed of pebbles of basalt identical with that of map unit 1. The pebbles are very well rounded, range in size from 1/2 inch up to 4 inches across and are set in a dark green basic groundmass. Neither pebbles nor groundmass are at all similar to those of a pyroclastic volcanic rock, and the rock is truly a conglomerate rather than an agglomerate.

Feldspathic Quartzite (4)

The feldspathic quartzite is a light cream to orange weathering, light to dark grey medium-grained rock, often containing bluish quartz "eyes". It generally occurs in thick massive beds. Bedding is most apparent where thin argillaceous or slaty beds are interlaminated with the quartzite. In one or two places thin beds of cherty material are interbedded with both argillite and quartzite.

Crossbedding, grain gradation, and other primary structures are absent, thus rendering it impossible to determine tops of beds within the sedimentary rocks.

Some phases of the quartzite are so coarse-grained and massive as to be distinguished only with great difficulty from granitic rocks. In such cases evidence of argillaceous beds and/or conglomerate lenses must be carefully sought.

The feldspathic quartzite consists of an irregular mixture of fine- to coarse-grained rounded quartz with various amounts of plagioclase, microcline, biotite, sericite, and minute quantities of hematite, magnetite, tourmaline, pyrite, carbonate, and chlorite. The feldspar may constitute up to 25 per cent of the rock but is usually much less. The total quartz-feldspar content averages 75 or 80 per cent of the mineral constituents. The most obvious feature of the quartzite as seen under the microscope is the irregularity in size and shape of the grains in any one section. The largest grains, opalescent quartz "eyes", are often 10 millimeters or more in diameter.

Argillaceous beds consist of over 50 per cent dirty brown clayey material and biotite and sericite, the remainder being uniformly fine-grained quartz.

Intrusive Rocks

Rocks ranging in composition from peridotite to microcline granite intrude the Rice Lake group. Peridotite and gabbro are often associated in sill-like bodies, giving rise to the term "Bird River sill". The impression gained from reading previous literature on the "Bird River sill" is misleading. The fact is that there are numerous sill-like bodies of basic rocks, some of which consist of peridotite and gabbro, and others of gabbro alone. The concept of a single, once-continuous, sill is believed to be erroneous.

Acid to intermediate intrusives, granite, quartz monzonite, and quartz diorite, in masses of batholithic dimensions, are younger than the basic rocks. Two types of granitic rocks were distinguished in the field: an older, grey, hybrid quartz diorite often containing altered inclusions of older basic rock, and a fresh-looking pink microcline granite and quartz monzonite. The contact between the two is ill-defined and gradational over a considerable width in which grey hybrid quartz diorite contains patches and injections of the microcline-bearing intrusives.

Peridotite (5)

Serpentinized peridotite underlies the gabbro on the two chrome-bearing segments of the faulted sill on the Chrome and Page claims. A third band of peridotite occurs partly at the base of a large tongue of gabbro and partly within an irregular mass of gabbro on the National and Ledin claims.

The peridotite is medium grained and brownish weathering. The fresh surface is dark green with translucent flecks of more brilliant green. Indistinct bands of coarse pyroxenite are sometimes found within the peridotite.

The peridotite band on the Chrome and Page properties is up to 800 feet wide, narrows down and dies out at the west end, and is faulted against granite on the east. The band on the National and Ledin properties is about 200 feet wide. On these properties only one outcrop of the peridotite was seen and it was flanked on both sides by other rocks. Information regarding its probable width and length was obtained from diamond drill core and geophysical investigation conducted by parties interested in the claims.

The peridotite is largely altered to felted aggregates of fibrous chlorite, talc, and tremolite. These often occur in forms pseudomorphic after olivine and pyroxene. Occasionally remnant grains of enstatite are encountered in thin sections. Patches of carbonate and granular, dusty, disseminated magnetite often figure as prominent constituents of the rock. Chlorite interstitial to the pseudomorphs is an almost isotropic variety, sometimes exhibiting a very dark olive drab interference colour. Veinlets of another variety of chlorite in pale green fibres with dark blue-grey interference colours, cut the rock. This type also occurs throughout the groundmass. The proportions of the alteration products vary considerably from place to place and no regular gradation from top to bottom of the peridotite could be determined.

Gabbro (6)

Specimens of gabbro exhibit great variation in composition and texture. The most common type is coarse grained, dark green, massive, and contains about equal quantities of plagioclase and ferromagnesian minerals. Mottled gabbro in which

hornblende is interstitial to large patches of white plagioclase is a distinctive rock. In a few specimens hornblende is so subordinate to plagioclase that the rock approaches anorthosite. Other phases of the gabbro are very coarse and contain large grains of hornblende in excess of plagioclase. Still other phases are medium grained. The various types bear no definite relationship to one another but are distributed haphazardly throughout the sills.

The body of gabbro (6a) south of Bird River, at the east edge of the area, is somewhat schistose and injected by numerous small masses of granite.

The essential minerals of the gabbro are plagioclase and hornblende. The plagioclase occurs as well-formed tablets only slightly altered. In the anorthositic phases the plagioclase grains occur in clusters. The composition of the feldspar ranges from Ab₃₀ to Ab₇₀ but probably most specimens of plagioclase are around Ab₅₀. Hornblende is usually in the form of pale green to deep green blades or patches. Much of it approaches actinolite in appearance. In some specimens, instead of hornblende, uraltite is the main ferromagnesian mineral and in these instances the uraltite is quite definitely interstitial to the plagioclase and probably represents alteration of primary pyroxene.

Common accessory minerals are titanomagnetite, sphene, clinozoisite, carbonate, biotite and introduced quartz and orthoclase. In one specimen examined, introduced quartz amounted to 50 per cent. Generally it comprises only a few per cent of the rock.

The writer was unable to determine any regular gradation in composition of the rock from top to bottom of the sill. Certainly the distribution of the various textural types and types of different proportions of felsic and mafic minerals is haphazard. Similarly a study of the composition of the plagioclase in 14 specimens from the Chrome property showed no marked increase in soda towards the top of the sill.

However, Osborne, from a study of a great many specimens of drill core, recorded a gradation from basic to intermediate composition from bottom to top.

Gabbro-peridotite association:

The consensus amongst geologists who have examined the chrome-bearing "Bird River sill" is that the gabbro and peridotite differentiated in place from an olivine gabbro magma.

Osborne's dissertation on the petrographic features of the sill affords ample evidence that this is the case. The nature of the chromite deposits within the peridotite provides convincing evidence of segregation from a horizontal sheet-like body of magma, although there is room for speculation regarding the mechanics of the segregation.

Regarding the gabbro-peridotite-chromite relationship, Bateman (1943, p. 166) states:

"..... although the sill is regarded as once continuous, there are apparent isolated intrusions (as mapped by Wright) at the west end of the south limb The borders of the sill prior to folding were likely thinner than the centre and irregular, being marked by embayments and promontories. As the limb of the fold plunges eastward the westerly limit represents the upward projection of the sill; and as the structure has been deeply truncated by erosion, the isolated exposures may represent remnants of original promontories. Had erosion been less deep these exposures might now be continuous. In view of these considerations, the isolated exposures of the sill at the west end are not likely to extend to depth, and the chromite deposits in them are probably small, shallow, and irregular."

Detailed mapping by the writer has revealed the presence of large irregular masses of gabbro instead of isolated exposures at the west end of the area, and further, the general absence or scarcity of associated peridotite. In view of these observations, Bateman's contentions regarding a once-continuous sill are considered untenable.

The situation as concerns these gabbro masses west of the chrome-bearing sill is best interpreted as resulting from intrusion of a gabbro magma from some source where it had already largely differentiated, leaving behind the crystalline peridotite fraction. This in no way invalidates the conviction that the chrome-bearing sill, a body entirely separate from those being discussed but one which ultimately had the same magmatic source, intruded to its present position prior to differentiation.

Granitic Rocks (7, 8)

In the region to the east Springer was able to divide the granitic intrusives into 8 mappable units, with the reserva-

tion that "some of the granitic bodies may be parts of the same intrusive (and) age relations between the different types were not established."

Cook had mapped an "earlier" and a "later" granite, clearly stating that the two could not be distinguished by petrographic means, and that the distinction was based on the presence of basic dykes and faults cutting the earlier granite and the lack of such features in the later granite. The writer considers such criteria quite unreliable.

Two "granites", each with distinctive features, were readily recognizable in the course of this work. One of these is a coarse, white to grey, rock ranging from quartz diorite to oligoclase granite, often containing inclusions of older basic rock in the form of irregular blocks, bands, and ribbons.

The grey intrusive is characterized by andesine feldspar (quartz diorite) and sometimes oligoclase (oligoclase granite). The other is a fresh, massive, pink intrusive, sometimes porphyritic but mostly equigranular. The pink granite quite definitely intrudes the grey one in the area north of the Winnipeg River in the southeast corner of the map area. Dykes of pink pegmatite and aplite apparently derived from the pink granite also frequently cut the older grey one. Although the relative age relations of the grey and pink granite are well established this does not necessarily imply any great interval between their times of intrusion.

The fresh pink granitic rock contains both andesine and microcline. The proportions of andesine and microcline vary from about equal amounts (quartz monzonite) to microcline more than twice as abundant as andesine (microcline granite). The porphyritic phases have large pink microcline phenocrysts.

STRUCTURAL GEOLOGY

FOLDING

From a study of the differentiation of the chromite-bearing sill at both Bird River and Maskwa Lake to the north, Bateman concluded that the rocks of the Rice Lake group and the sill at Bird River constitute the south limb of an anticline, the north limb of which is located at Maskwa Lake.

Springer's mapping of the Cat Lake-Winnipeg River area tended to confirm this conclusion. The writer's observations are in agreement with this interpretation of the structure.

Previous investigators have intimated that the lavas and sediments at Bird River are conformable with one another. The work of 1951 amply indicates that this is so, and furthermore that the different lithologic units, basic volcanics, acid volcanics, and sediments are all interbanded so that no one unit can be said categorically to overlie any other.

In several outcrops it is possible to observe the conformable interbanding of quartzite and rhyolite. Likewise, conformity of contact between basic volcanic rocks and sediments may be seen in a few outcrops.

Numerous pillow structures in the basic volcanics north of Bird River consistently indicate southward facing tops. Tops of sedimentary strata could not be determined, but the beds, conformable with the lavas, have a prevalent southward dip. These observations confirm the belief that the Rice Lake group in this area lies upon the south limb of a major anticline.

Apparently some minor folds have been superimposed on the main structure. South of Bird River near the east border of the map area, one outcrop of basalt showed northerly facing tops. Furthermore, the foliation in granitized basalt and hornblende gneiss around and north of Shatford Lake dips north. Between Bird River and Shatford Lake a synclinal axis has been drawn on the map and made to approximate one on Springer's map of the adjacent area. It is admitted that the interpretation is based on insufficient data. At any rate, if such a fold is present it rapidly dies out towards the west, since top determinations in two places further west again indicate southward facing tops.

On Lac du Bonnet, near the mouth of Bird River, the sedimentary rocks, contrary to the prevailing tendency, dip northward. Lack of data make it impossible to interpret this with certainty but it represents either a local overturning or a minor fold.

Areal mapping of the Rice Lake group of rocks over the entire area between Lac du Bonnet, east to the interprovincial boundary, and northwest again to Cat and Maskwa Lakes reveals that the major anticlinal structure has a regional

eastward plunge. This observation is based entirely on the converging U-shaped pattern of the rocks (see Manitoba Mines Branch map 48-7). Such features as plunge of drag folds or lineation were not available for making structural determinations.

FAULTING

Offset of lithologic units has indicated the presence of several faults varying somewhat in strike but generally trending northwesterly. Topographic expression of these faults is lacking except in the most westerly one where it is possible to trace a straight narrow depression within the granite for several thousand feet. All the faults cut rock contacts and bedding at a moderate to large angle.

Two unusual features of these faults are worthy of mention. Firstly, the displacement along parts of the various faults is considerable and yet they die out quite rapidly. Secondly, there is a decided abrupt thickening and thinning of corresponding bands from one side of the fault to the other. In fact along some faults certain bands on one side lack their corresponding members on the other side.

For these reasons no estimate of the actual displacement can be made although the approximate horizontal displacement along limited sections of any one fault can be determined. The total horizontal displacement of the chromite-bearing peridotite on the Chrome and Page properties is more than a mile, the movement being accommodated by two large faults and one smaller one. The decided differences in thickness of any particular band on either side of a fault probably indicates considerable vertical movement.

The bands of chromite on both properties have themselves been displaced by small faults for distances ranging from a few feet up to 150 feet. These small faults also have been observed to die out rapidly and in some cases to have displaced the north side of a band and yet have had no effect on the south side. Bateman attributes these faults to rotational movement.

Rotational movement may assist in explaining the peculiarities of the large faults in the region, but by itself is not an entirely satisfactory explanation.

Four of the large faults extend into the granite and displace it. This indicates that either the time of faulting was entirely post-granite or, if the faults originated prior to the intrusion of the granite, that considerable movement occurred along them subsequent to the consolidation of this rock. At any rate, and of more practical interest, displacement of any mineral deposits in the area should be anticipated.

ECONOMIC GEOLOGY

Mineral deposits within the Bird River region may be classified into four groups: (a) chromite deposits, (b) sulphide deposits, consisting mainly of pyrrhotite and chalcopyrite, (c) quartz-pyrite veins, (d) pegmatite deposits. Of these, chromite and sulphide deposits are of the most immediate interest. Sulphide and pegmatite bodies have been known to occur in the area for a number of years, but chromite first received attention during the summer of 1942 when the Chrome property was acquired jointly by God's Lake Gold Mines Limited and Gunnar Gold Mines Limited and the Page property by Hudson Bay Mining and Smelting Company Limited.

CHROMITE

The two largest deposits of chromite, on the Page and Chrome properties, occur as segregated bands within the lower (peridotite) portion of the so-called Bird River sill. The chromite bands consistently lie near the top of the peridotite close to the peridotite-gabbro contact. It has been adequately shown by both Brownell and Bateman that the width of the chromite zone bears a direct relationship to the width of the peridotite.

By analogy it might easily be inferred that the width of the peridotite bears a similar relationship to the gabbro. The writer has indicated that such a supposition is entirely incorrect and it cannot be deduced that where large bodies of gabbro are found, corresponding thicknesses of peridotite, and consequently a wide chromite zone, will of necessity also be found. The accompanying map clearly indicates that wide bodies of gabbro west of the Chrome claims either do not have any lower band of peridotite or else only a narrow band having no proportional relationship to the width of the gabbro.

The deposits on both the Page and Chrome properties are composed of three zones, (1) a main chrome zone 6 to 10 feet wide consisting of alternating dense ore, peridotite and disseminated ore all exhibiting sharp banding, (2) a lower chrome zone, and (3) a stringer zone below the other two. In addition, small lenticular masses of chromite are found within the gabbro near its base.

Dense ore from the main chrome zone consists of 50 per cent chromite in the form of small corroded octahedral and rounded grains, sometimes broken, embedded in a matrix of felted chlorite accompanied by considerable talc, a little tremolite, carbonate and residual enstatite. Many of the chromite grains contain rounded nuclei of the silicate minerals.

Disseminated ore from the same zone contains about 20 per cent chromite in a matrix in which chlorite and tremolite each form about 25 per cent and talc about 15 per cent of the silicates. The groundmass exhibits outlines pseudomorphic after original silicate minerals.

A layer of basic rock between dense ore bands of the main chromite zone consists largely of diallage and chlorite with a few grains of magnetite, clinozoisite, and carbonate.

Chromite from the lower chrome band lies in a matrix composed chiefly of fibrolamellar chlorite with a little carbonate.

The stringer zone chromite ore is similar to that of the lower chrome band. The stringer zone is particularly interesting in that the chromite stringers were clearly injected into the peridotite. Small tongues of chromite, splitting of veinlets, and angular inclusions of wall rock all point to emplacement of these stringers by injection into fractures.

The consistently sharp banding and relationship of the individual bands forming the main band is good evidence of some type of magmatic segregation. However, the lenses of chromite in the gabbro are probably injections. The chromite in these instances lies in a matrix peculiar to the peridotite and foreign to the gabbro, thus adding weight to the idea of injection. Furthermore, at least part if not all of the stringers are injections.

There is a growing conviction amongst geologists that the origin of many magmatic oxide deposits involves the formation of a late residual liquid enriched in metallic oxides. The evidence for the segregation of supposedly early-formed oxide crystals to form banded magmatic deposits is not compelling. A. M. Bateman has recently presented an hypothesis to account for banded magmatic deposits which also show clear evidence of late crystallization of metallic oxides, and liquid injection. The mechanism involves the formation of a heavy residual liquid which "trickles down through the interstices of early-formed silicate crystals to form a late gravitative liquid accumulation".¹

If the crystallizing rock mass undergoes no deformation the oxide deposits are concordant and banded; if pressure is applied the liquid may be injected into the host rock or elsewhere into adjacent rocks.

It is pertinent that "this residual liquid accumulates, not at the bottom of the magma chamber, but well above the bottom where a considerable thickness of early-formed olivine and pyroxene crystals had settled downward on to the chill zone during the early stages of magma crystallization".²

Observations on the Bird River sill, especially evidence of injection of chromite both in the stringer zone within peridotite and in lenses within the gabbro, and the fact that the banded oxides are situated near the top of the peridotite, lend authority to the contention that some such process as late gravitative liquid accumulation may have operated to form these chromite deposits.

Occurrences of chromite are known on the National and Ledin claims about 3 miles west of the Chrome property. Peridotite was observed to outcrop in only one place. During 1951 Howbay Gold Mining Company drilled the Ledin 3 claim and both dense and disseminated chromite were found. The peridotite is 200 to 300 feet wide.

¹ Bateman, A. M.: The Formation of Late Magmatic Oxide deposits; *Ec. Geol.*, vol. 46, no. 4, 1951, p. 404.

² *op. cit.*, p. 410.

Small lenses of chromite in gabbro are present on the Ward claim northeast of Coppermine Bay.

The total length of the two faulted segments of the Chrome-bearing sill is about four miles. Only about a mile of this length has been adequately explored and chromite exposed. The width of the peridotite is fairly constant for about 15,000 feet and the chromite likely continues uniformly over this distance.

Assuming the length as 15,000 feet, the average width of the main chrome band as 6.6 feet for the Chrome claims and 8.7 feet for the Page property, an average depth of 650 feet and keeping in mind the uniformity of this type of deposit, it is estimated that probable ore reserves to a depth of 650 feet are in the order of 8 million tons. One drill hole has revealed the chromite to be of the same width and grade at 650 feet depth as at surface. Possible reserves may be double this figure if, as is likely, the deposit persists to twice the proven depth.

As stated previously the chance of discovering commercial bodies of chromite apart from those on the Page, Chrome, and possibly National-Ledin properties are slight. This should be understood to apply only to the area under consideration.

Future utilization of the chromite from Bird River will depend on economical beneficiation of the concentrates to raise the chrome-iron ratio from its present maximum of 1.6:1 to 2.5:1 required by present users of metallurgical chrome, or on changes in metallurgical technology which will allow the utilization of chromite with a low chrome-iron ratio.

SULPHIDE DEPOSITS

Deposits of pyrrhotite containing chalcopyrite and other sulphides occur on the Lucky Boy claims near the east border of the map area and also around Anson Lake.

On the Lucky Boy claims a massive pyrrhotite lens 2 to 4 feet wide and exposed for about 100 feet occurs at the contact of basalt and granite. Some chalcopyrite is disseminated throughout the pyrrhotite. Large nodules of pyrite occur in the pyrrhotite. The mineralized zone is cut by small dykes of felsite and these contain pyrrhotite and pyrite. Although the deposit is not well exposed it appears to be of limited extent.

West of the main pits there is an oxidized zone extending for about 200 feet but this carries only sparsely disseminated pyrrhotite.

Pyrrhotite accompanied by chalcopyrite and sphalerite is found in basalt in two places about one half mile apart, along the south and west edge of the swamp just south and west of Anson Lake. The sulphides are not well exposed and further surface work is difficult.

Other sulphide lenses occur along the north-south section line between Anson Lake and Bird River, north of Coppermine Bay, and north of the Chrome claims. All these occur in basalt. None appears to be of very great extent.

QUARTZ-PYRITE VEINS

Several narrow shear zones containing vein quartz and disseminated or massive pyrite were examined. They are all rather small. Local prospectors report low assays in gold.

PEGMATITE DEPOSITS

Pegmatite dykes are quite numerous around Shatford Lake and west of there. In some dykes a few scattered crystals of beryl and grains of cassiterite and molybdenite are found but in no case were these of sufficient extent or concentration to warrant further investigation.

SUGGESTIONS TO PROSPECTORS

From the work conducted in 1951 the writer is of the opinion that within the region covered it would be a useless expenditure of both time and money to direct much effort towards finding or developing further chromite deposits. Any chromite deposit found within the area in the future will probably be quite small and this prediction should be carefully considered before further unnecessary work is done.

The possibilities of discovering new deposits of sulphides or of extending those already known are more favourable. The use of the dip needle or magnetometer is recommended.

Evidence of gold mineralization is scanty but it is by no means impossible that interesting deposits of gold might be found.

The pegmatites studied in the region appear far less encouraging than those in the Cat Lake-Winnipeg River area.

SUMMARY

The Rice Lake group of acid to basic volcanic rocks and sedimentary rocks are intruded by aill-like bodies of gabbro and peridotite, and of gabbro alone. All these rocks are intruded by younger granitic rocks. Banded chromite deposits are found in, and were formed during the consolidation of, peridotite. Sulphide mineralization is present in basic volcanic rocks and gabbro. Indications of gold mineralization are found in pyrite-bearing quartz veins within the sedimentary rocks and lavas of the Rice Lake Group. Pegmatite dykes carry small amounts of beryl, cassiterite, and molybdenite.

Other features worthy of mention are:

- (a) The writer favours the contention that all the rocks in the area are of Archean or early Precambrian age.
- (b) Gabbro bodies are larger and more widespread than indicated by previous investigators. However, peridotite is not so widespread as may have been anticipated. Consequently, new large deposits of chromite will probably not be found.
- (c) Transverse faulting has affected all the rocks of the region, and it is to be expected that all mineral deposits were displaced by the faults.