Province of Manitoba

DEPARTMENT OF MINES AND NATURAL RESOURCES

MINES BRANCH

PUBLICATION 50-6

GEOLOGY

of the

RENNIE - WEST HAWK LAKE AREA

Lac du Bonnet Mining Division

MANITOBA

by

G. D. Springer

Winnipeg
1952

Province of Manitoba

DEPARTMENT OF MINES AND NATURAL RESOURCES

HON. J.S. McDIARMID
Minister

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

MINES BRANCH

J.S. RICHARDS
Director

PUBLICATION 50-6

GEOLOGY

of the

RENNIE - WEST HAWK LAKE AREA

Lac du Bonnet Mining Division

MANITOBA

by

G. D. Springer

Winnipeg
1952

Printed by C. E. Leech, Queen's Printer for Manitoba

CONTENTS

ILLUSTRATIONS

RENNIE - WEST HAWK LAKE AREA

INTRODUCTION

LOCATION AND ACCESS

The Rennie-West Hawk Lake area is located in the Lac du Bonnet Mining Division of southeastern Manitoba and is part of the Boundary area as defined on Map 37-4 of the Manitoba Mines Branch. The area comprises approximately 395 square miles, and is bounded by latitude 49° 35' north on the south, latitude 49° 53' north on the north, longitude 95° 34' west on the west, and the Manitoba - Ontario boundary on the east. The northern part of the area is easily reached by Highway No. 1, which passes through Rennie and south of West Hawk Lake. West Hawk Lake is about 120 miles from Winnipeg by this route. A road branches from the highway at West Hawk Lake and runs southwest, passing north of Falcon Lake and through Glenn in the southwestern corner of the area. The two roads diverge west of West Hawk Lake and the greatest distance between them is 16 miles. The west-central part of the area was reached by aircraft.

TOPOGRAPHY AND DRAINAGE

The topography is similar to other parts of the Precambrian Shield. Outcrops are plentiful and are separated by low areas of muskeg.

The eastern part of the area is relatively high and well drained. West Hawk Lake drains to the northwest to Whiteshell River, and Falcon Lake drains south by Falcon River to Shoal Lake. Summer resorts have been developed around West Hawk, Star, and Falcon Lakes because of their picturesque settings and accessibility. The country to the south and west of these lakes is poorly drained. Small, undrained lakes and muskegs are the prominent surface features. Outcrops are scarce south of the Falcon Lake road. There the land is underlain by large tracts of muskeg and covered by tamarack and various types of evergreen trees including cedar. Lumbering has been done in the past. Treeless floating bogs in places constitute a hazard to travel.

PREVIOUS WORK

Lawson was one of the first geologists to map this part of Canada systematically. His report (1886)[1] on the Lake of the Woods covered Shoal Lake in Ontario and the contiguous portion of Manitoba. Lawson first applied the name Keewatin to the dominantly volcanic group of rocks of this region. Wallace (1917) made a short reconnaissance survey of the area east of Red River in 1916. Bruce, DeLury, and Marshall reported on the economic possibilities of gold, molybdenum, tungsten, and tin between the years 1916 and 1921. A detailed examination of the Falcon Lake stock was made by Brownell in 1941. Stockwell mapped the lithium occurrences in 1926 and 1927, and Bateman re-examined the tin and scheelite deposits in 1942. Two geological maps by DeLury were issued in 1942 by the Manitoba Mines Branch.

PRESENT WORK

The survey covered by this report was carried out during the summer of 1950. The area was mapped geologically on a scale of 2 inches to 1 mile, using pace and compass method. Precise ground locations were determined from vertical aerial photographs on a scale of 4 inches to 1 mile. The photograph numbers are plotted on the accompanying map. Traverses were run one quarter of a mile apart over most of the area The accompanying map (50-1) is published on a scale of one inch to one mile.

The writer was capably assisted in the field by C. M. Allen, D. Lavoie, C. Taylor, and J. Cundall, of the University of Manitoba.

BIBLIOGRAPHY

Bateman, J. D. (1943a): Tin in Manitoba; Can. Min. Jour., vol. 64, No. 5, pp. 273-278.

——— (1943b): Scheelite near Falcon Lake, Manitoba; The Precambrian, Winnipeg, vol. 16, No. 8, pp. 4-7, 13.

Browmell, G. M. (1941): Geology of the Falcon Lake Stock, Southeastern Manitoba; Trans. Can. Inst. Min. and Met., vol. 44, pp. 230-250.

Bruce, E. L. (1918): Molybdenite near Falcon Lake, Manitoba; Geol. Surv., Canada, Sum. Rept. 1917, pt. D, pp. 22-25.

——— (1919): Gold-Quartz Veins and Scheelite Deposits in Southeastern Manitoba; Geol. Surv., Canada, Sum. Rept. 1918, pt. D, pp. 11-15.

---

[1] Dates and pages in parentheses refer to the references listed in the Bibliography on page 2.

DeLury, J. S. (1917): Molybdenite at Falcon Lake, Manitoba; Can. Min. Jour., vol. 38, pp. 460-462.

____________ (1918): Tungsten Ore Deposits near Falcon Lake, Manitoba; Can. Min. Jour., vol. 39, pp. 186-188.

____________ (1919): Some Economic Aspects of the Falcon Lake District, Manitoba; Trans. Can. Inst. Min. and Met., vol. 22, pp. 320-328.

____________ (1921a): Mineral Prospects in Southeastern Manitoba (Rice Lake, Maskwa River and Boundary District); Man. Govt. Bull., Commissioner of Northern Manitoba.

____________ (1921b): The Mineral Resources of Southeastern Manitoba; Ind. Dev. Bd., Manitoba.

____________ (1942): West Hawk and Falcon Lakes Area, Southeastern Manitoba; Manitoba Mines Branch, Map 37-3.

____________ (1942): Boundary Area, Southeastern Manitoba; Manitoba Mines Branch, Map 37-4.

Lawson, A. C. (1886): Report on the Geology of the Lake of the Woods Region, with Special Reference to the Keewatin (Huronian ?) Belt of the Archaean Rocks; Geol. Surv., Canada. Ann. Rept. 1885, pt. CC.

Marshall, J. R. (1918): Star Lake Area, Manitoba; Geol. Surv., Canada, Sum. Rept. 1917, pt. D, pp. 21-22.

Stockwell, C. H. (in Wright, J. F.) (1938): Geology and Mineral Deposits of a Part of Southeastern Manitoba; Geol. Surv., Canada, Mem. 169.

Wallace, R. C. (1917): Area between Red River and Eastern Boundary of Manitoba, and between Winnipeg River and National Transcontinental Railway, Manitoba; Geol. Surv., Canada, Sum. Rept. 1916, pp. 175-178.

GENERAL GEOLOGY

GENERAL STATEMENT

All consolidated rocks in the area are of Precambrian age. The oldest rocks form a group of volcanic and sedimentary rocks, which are designated Keewatin following the accepted usage of the term in the Shoal Lake district of Ontario. These rocks have been intruded by a number of stocks and batholiths, most of which are granodiorites. Remnants of the older rocks are present in the granodiorites, and two of the latter are considered to be granitized equivalents of the volcanic-sedimentary rocks.

The relative ages of the granites are not known where intrusive relations are obscure or where one mass is separated from another by Keewatin greenstones.

The accompanying table of formations illustrates the classification of rocks within the area.

TABLE OF FORMATIONS

Quaternary	Recent and Pleistocene	Fine sandy loam, sand, gravel
		Unconformity
Archaean or Proterozoic	Granitic Intrusives	Diabase and lamprophyre dykes Simple and complex pegmatite dykes Pyroxenite Falcon Lake stock Pink granodiorite and biotite granite Microcline granite Pink granodiorite Granodiorite and quartz diorite Pink porphyritic granodiorite Porphyritic granodiorite Pink and grey granodiorite Quartz diorite Grey gneissic granodiorite and quartz diorite Quartz-feldspar porphyry dykes or sills
		Intrusive Contact
Archaean	Keewatin	Metavolcanic and metasedimentary rocks Sedimentary rocks -- greywacke, quartzite, argillite, schist, conglomerate Volcanic rocks -- andesite, basalt, rhyolite, agglomerate

KEEWATIN VOLCANIC ROCKS (1) (2) (3)[1]

Rocks classed as Keewatin volcanic rocks outcrop in two belts which trend southwest across the Manitoba-Ontario boundary. The north band includes the district around West Hawk Lake and Falcon Lake This band is 5 miles wide at its eastern end but narrows to $1\frac{1}{2}$ miles to the west and finally disappears beneath overburden at Glenn. Indian Bay in Shoal Lake is underlain by the south band of volcanic rocks, which is 4 miles wide at the boundary. This band can be traced a short distance west of Indian Bay to a large area of muskeg.

Pillow lavas of andesitic and basaltic composition are typical representatives of the Keewatin lava flows (1). They are especially abundant in the north band. The pillows are generally well formed, and thus are useful in the determination of tops of flows and consequently in outlining structures.

Fine-grained to medium-grained flows are associated with the pillow lavas. Coarse-grained gabbroic rocks, which probably represent the centres of flows, occur in some localities. Many of the finer-grained varieties are schistose.

Two zones of grey porphyritic acid flows, rhyolite (2) in composition, outcrop east of Indian Bay. The phenocrysts are composed mainly of quartz and some albite. Fine-grained quartz and feldspar make up the groundmass.

Pyroclastics, classed as agglomerates, occur in widely scattered localities. The fragments are small and angular. They are, for the most part, much more acidic in composition than the groundmass. The groundmass has a somewhat tuffaceous appearance. This rock was probably formed from dust and larger particles blown from the vents of volcanoes.

The region to the west and south of Star Lake is underlain by another type of fragmental rock (3) formerly referred to as conglomerate but believed by the author to be an agglomerate. Most of the fragments are fine- to medium-grained andesite composed essentially of andesine and hornblende, but fragments of brown quartzite and vein quartz occur sparingly. The fragments are oval-shaped, and most are about 1 inch in diameter. The matrix is of andesitic composition but is darker in colour than the fragments. The fragments are closely packed in the matrix in the vicinity of Star Lake but become more scattered to the west where there is a gradation into typical andesite and basalt.

---

[1] Numbers in parenthesis refer to corresponding map units used on the accompanying map.

The matrix of this rock is probably volcanic in origin. However, the rocks as a whole must have had a complex history, as the fragments were probably rounded by water action before they were incorporated in the flows.

Another smaller area of agglomerate is exposed to the south, between the Falcon Lake road and Barren Lake.

Greer[1] mentions agglomerates of a similar nature in the Shoal Lake area of Ontario, where well-rounded fragments of grey felsitic material occur in a dark green groundmass.

KEEWATIN SEDIMENTARY ROCKS (4)

Keewatin sedimentary rocks are not as abundant as volcanic rocks. A wide zone crosses West Hawk and continues to the west end of Star Lake. A narrow belt, only a few hundred feet wide, follows the north shore of Falcon Lake.

Most of the sedimentary rocks are fine grained and are highly quartzose in composition. They range in colour from light grey to dark grey, brown, and black. Most of them are dark greywacke with a fairly high percentage of feldspar. True quartzites are not abundant. Metamorphism has converted some of the sedimentary rocks north of Star Lake into garnetiferous schist. A few argillites, some of which contain clots of biotite, occur in the same vicinity.

The strikes of the sedimentary and volcanic rocks are similar, and the two types are more or less intercalated for some distance from the contacts. Some of the sedimentary rocks still show evidence of bedding, parallel to which secondary lamination is developed. Much of the original fine-grained material has been recrystallized to muscovite, biotite, and rarely, amphibole.

Conglomerate was deposited locally in association with the Star agglomerate described above. Pebbles of andesite were deposited in a fine-grained arkosic matrix. A conglomerate that contains granite pebbles is exposed just across the Ontario boundary at Crowduck Lake, but no similar rock was found on the Manitoba side.

---

1 Greer, Leonard (1930): Geology of the Shoal Lake (West) Area, District of Kenora; Ont. Dept. of Mines, Ann. Rept., vol. 39, pt. 3.

METAVOLCANIC AND METASEDIMENTARY ROCKS (5)

Inclusions of volcanic and sedimentary origin occur in a number of the granitic rocks. Three persistent bands of altered Keewatin rocks, ranging from a few feet up to 600 feet in thickness, are found in the vicinity of Highway No. 1. One of these bands is especially remarkable for its continuity, as it can be traced almost the whole distance across the area from Rennie to Caddy Lake.

The second belt begins at the north end of Ross Lake and follows a deeply eroded valley to the east. An excellent exposure may be seen on the cliff face at Lily Lake, where an injection gneiss has been formed by the intrusion of granite and pegmatite into the older rocks.

The third band begins at the south end of Ross Lake, continues southeast to Hanson Creek, and then follows the west side of the creek to the south.

These infolded bands of Keewatin rocks dip at high angles in most localities. They formed a major discontinuity along which younger granite and a large amount of pegmatite found easy access. The pegmatite is a carrier of radioactive minerals. Volcanic and sedimentary rocks, now existing as biotite and hornblende schists, can be seen to occupy the centres of the bands where they are wide and well exposed. A border of gneissic granite formed by injection of granitic fluids is sometimes present, and as this becomes more pronounced the identity of the older rocks is lost completely.

Another band of basic rock follows the Canadian National railway, north of the occurrences described above. Altered remnants are present in the surrounding granitic rocks.

There is a zone of basic gneiss 6,000 feet in length west of McGillivray Lake. Its origin is probably analogous to that of the other bands.

QUARTZ-FELDSPAR PORPHYRY DYKES OR SILLS

The andesite and basalt in the Falcon Lake district have been intruded by concordant grey dykes or sills which contain phenocrysts of quartz and feldspar. The groundmass is a fine-grained mosaic of quartz and feldspar. Larger aligned biotite and muscovite flakes impart a schistosity to the rock. This schistosity suggests that the dykes were folded along with the surrounding rocks. The fact that they are not found in the nearby granites also indicates that they are pre-granite in age.

The dykes outcrop at a number of points along the north and east shores of Falcon Lake and near the road for about 3 miles west of the lake. The average width is 30 feet, and they can be followed for only short distances along the strike. Due to their relatively small size these dykes are not shown on the accompanying map.

One of the dykes lies on the north side of the shear zone on Thompson No. 2 mining claim near the east end of Falcon Lake. It may be genetically related to the solutions which deposited gold at this locality.

A few quartz and feldspar porphyry dykes occur in the volcanic rocks in the vicinity of Shoal Lake.

GREY GNEISSIC GRANODIORITE AND QUARTZ DIORITE (6)

One of the oldest granitic rocks of the area is the grey gneissic granodiorite and quartz diorite. Parallelism of the ferromagnesian minerals gives this rock a definite lineation. Average composition is 45 per cent oligoclase, 30 per cent quartz, 10 per cent microcline, 10 per cent biotite, and the remainder accessory minerals. The rock is present in the north and central part of the area. In the vicinity of South Cross Lake the granodiorite grades to a quartz diorite which contains bluish quartz.

The granodiorite was probably formed by granitization of old sedimentary and volcanic rocks. The south contact contains many basic schlieren inclusions which become less abundant to the north. Small areas throughout the main mass are more basic owing to the greater abundance of inclusions.

QUARTZ DIORITE (7)

A small stock of quartz diorite is located south of High Lake. The essential constituents are andesine, quartz, hornblende, and biotite. In thin section much of the andesine is seen to be exceptionally well zoned. Some sphene is present. The colour of the rock ranges from dark grey to black, depending upon the ferromagnesian content. Part of the quartz is the blue variety.

Inclusions of recrystallized volcanics are numerous. The quartz diorite in most places is massive and is cut intimately by fine-grained pink granodiorite, pegmatite, and aplite.

The rock may have had a geological history similar to that of the gneissic granodiorite described above.

PINK AND GREY GRANODIORITE (8)

Pink to grey medium-grained massive granodiorite is exposed on the west shore of Shoal Lake. It is intruded by fine-grained pink granodiorite dykes. These rocks were examined where they occur along the shores of Snowshoe Bay and in scattered outcrops to the west.

PORPHYRITIC GRANODIORITE (9)

Pink to grey porphyritic granodiorite underlies the country immediately south of the Falcon Lake greenstone belt. The granodiorite body is 4 miles wide, and the Indian Bay greenstone belt forms its southern boundary. Phenocrysts of microcline or microcline perthite are set in a groundmass consisting of oligoclase, quartz, and biotite. Some sphene also is present.

The rock is cut by numerous dykes of pink granodiorite or quartz diorite.

A continuous body of porphyritic granodiorite occurs west of the West Hawk Lake tongue of volcanics and sediments. The rock outcrops in the form of an arc, which is relatively narrow north of Glenn, widens to $3\frac{1}{2}$ miles at Frances Lake, and then narrows rapidly to a few hundred feet and follows Highway No. 1 to the west, almost to Rennie.

The outstanding feature of this granodiorite is the presence of large phenocrysts of microcline. The groundmass is mostly oligoclase, quartz and biotite. The rock is typically pink in colour, and in places a distinct gneissosity is developed. Pegmatite dykes many of which contain considerable magnetite are abundant, but radioactive gamma counts are low and spotty.

GRANODIORITE AND QUARTZ DIORITE (10)

The largest body of intrusive rocks mapped as a single unit is that which underlies most of the area between Rennie and Glenn. The rocks of the batholith range in colour from pink to brown and grey, and in composition from granodiorite to quartz diorite. The average composition is granodiorite near quartz diorite.

The relations of the different rock types are complex. Crosscutting and gradational contacts can be seen in the outcrop, where the only macroscopic changes are those of colour or texture. Thin section shows that most of the rocks are of similar composition, even where they differ markedly in hand specimen.

PINK GRANODIORITE (11)

A stock of fine-grained to medium-grained pink granodiorite occurs north of Glenn. It would appear, from the configuration of the contacts, that the stock pinches out just to the west of the map-area. The border zone in most places is finer grained than the centre. The border zone also contains a higher percentage of microcline, and the rock approaches the composition of a quartz monzonite. It is not known whether this relationship holds true for the whole circumference. Parts of the stock are porphyritic.

Inclusions of porphyritic granodiorite and grey gneissic granodiorite, which occur to the south and north respectively, are common. Inclusions of more basic rock types, which are probably altered volcanics and sediments, occur in places.

MICROCLINE GRANITE (12)

A coarse-grained almost pegmatitic-appearing microcline granite occurs about 5 miles north of Glenn. This is a distinctive type of rock, and no other rock in the area approaches it either in texture or composition. The rock is made up essentially of microcline and quartz. Oligoclase and biotite each occur in amounts up to 5 per cent.

The limits of the intrusion are not known, as only about 2 square miles of it were observed. The boundaries widen rapidly to the west off the edge of the map-sheet. The sharp contacts and characteristic composition of the granite indicate that it is not a phase of nearby intrusives.

PINK GRANODIORITE AND BIOTITE GRANITE (13)

Pink fine-grained to medium-grained granodiorite is common as dykes in many of the other granitic rocks. The granodiorite grades to a biotite granite where the percentage of plagioclase drops to a low value. Oligoclase or andesine, microcline, quartz, and biotite are the essential constituents. The only mappable body is that which occurs directly to the north of the radioactive bands near Highway No. 1.

FALCON LAKE STOCK (14) (15)

The Falcon Lake stock forms an irregular mass about 4 miles long and up to 6,000 feet wide. The stock has been described in detail by Brownell (1941), who discovered that it has three distinct portions: a central core of quartz monzonite, an intermediate zone of graniodiorite and syenodiorite, and an outer rim of quartz diorite, diorite, and gabbro. The rocks that form the rim are not present everywhere. Contacts between the different zones are predominantly gradational. A contact breccia is present between quartz monzonite and granodiorite, the former enclosing angular fragments of the latter.

Brownell considered that the stock is the product of one magmatic intrusion which developed in stages. Cooling of the magma at the borders and the formation of a basic rock, either gabbro or diorite, was followed by the formation of the inner zones. The magma is thought to have become less basic with time as the composition of the plagioclase feldspar is more sodic towards the centre of the stock. The composition of the plagioclase of the quartz monzonite is similar to that of the adjacent diorite. Plagioclase in the quartz diorite is replaced by microcline and quartz which may have diffused outward from the still unconsolidated quartz monzonite core.

Late mineralizing solutions deposited sulphides and gold, both in the stock itself and in fractures in the surrounding rocks.

PYROXENITE (16)

Pyroxenite is exposed intermittently for a length of half a mile and a width of 500 feet, about 3,000 feet southwest of Lily Lake. The rock is composed almost entirely of hypersthene, which has abundant small black inclusions. Contact relations with the surrounding porphyritic granite are obscure, but the pyroxenite may be younger. The rock also is considered to be younger than the other granitic types, although there is no definite geological basis for this assumption.

PEGMATITE DYKES

Pegmatite dykes composed of feldspar, quartz, and mica are numerous throughout the area. They are especially abundant in the pink porphyritic granodiorite.

Dykes of more complex composition, containing lithium and beryllium minerals, occur to the south of the porphyritic granodiorite near Glenn. The radioactive pegmatites along Highway No. 1 also occur in close proximity to the granodiorite, and the molybdenite-bearing pegmatites north of Falcon Lake are found near the contact with the same rock.

DIABASE AND LAMPROPHYRE DYKES

Late dykes of diabase and lamprophyre are scattered in occurrence. Some of them are mineralized with pyrite and pyrrhotite. The sulphides do not carry either precious or base metals, and none of the dykes examined are radioactive. They are all narrow and relatively short in length.

The diabases are commonly porphyritic, and they have the usual ophitic texture. They are composed essentially of labradorite and augite. These two minerals occur as phenocrysts in a fine-grained, sometimes indeterminate, groundmass. The pyroxene may be fresh or show various degrees of alteration to hornblende, chlorite, epidote, and clinozoisite. Quartz is a minor constituent.

The lamprophyres are composed essentially of hornblende, and plagioclase which ranges in composition from oligoclase to labradorite. Augite, hypersthene, quartz, and clinozoisite occur in more minor amounts. Sphene is commonly present. A dyke on the west side of Caddy Lake contains an appreciable quantity of fine grained non-nickeliferous pyrrhotite.

Three diabase dykes and one lamprophyre dyke other than those shown on the map were examined. One small diabase dyke intrudes pegmatitic granodiorite about 6 miles north of Glenn, just outside the map area. The remainder are also outside the area in section 34, township 10, range 14, east of the Principal Meridian, about half a mile east of the railway junction near Rennie.

PLEISTOCENE GEOLOGY

Johnston[1] considered that there were two distinct till sheets in southeastern Manitoba. Two sets of striae were found. one that trends southeast and the other southwest. The latter was thought by Johnston to be associated with the first ice advance, as the lower till sheet does not contain limestone pebbles. The upper till sheet has an abundance of limestone boulders, which must have been derived from the north and west. The theory was advanced that the movement of the ice toward the southeast took place in late Pleistocene time and was due to the deflection of the ice by the Manitoba escarpment.

The two sets of striae are present on the west side of the Rennie - West Hawk Lake map-area. Those trending southwest are much more strongly marked than the others.

Glacial Lake Agassiz, during a period of its history, covered this part of Manitoba. Sand and gravel deposits of lacustrine origin are widespread, and where they are easily accessible the materials are utilized for road metal.

STRUCTURAL GEOLOGY

Information relating to structural geology has been obtained mainly from the Keewatin rocks. Attitudes of the granitic gneisses have been plotted on the map and the granites in general no doubt have undergone more deformation than is indicated on the map.

FOLDING AND SHEARING

The West Hawk Lake - Falcon Lake band of lavas and sedimentary rocks represents the north limb of an anticline. The anticlinal axis has been obliterated by the intrusion of porphyritic granodiorite south of Falcon Lake. The south limb of the anticline is in the volcanics north of Indian Bay, and a synclinal axis passes through the bay near the south shore. This synclinal axis has been traced eastwards into Ontario by Greer[2].

The structure of the west side of the north band of Keewatin rocks is complicated by minor folding. Pillow top information proves that these are true folds and that the attitude of the flows is not due to overturning. A number of

---

1 Johnston, W. A. (1921): Winnipegosis and Upper Whitemouth River Areas, Manitoba - Pleistocene and Recent Deposits; Geol. Surv., Canada, Mem. 128.

2 Greer, Leonard (1930): Geology of the Shoal Lake (West) Area, District of Kenora; Ont. Dept. Mines, Ann. Rept., vol. 39, pt. 3.

closely-spaced short synclinal axes strike and plunge to the northeast. Shearing has taken place along these axes, and the fracturing has provided channelways for solutions which deposited scheelite.

The numerous sulphide veins are probably localized along shear zones. The deposits strike either to the northeast or east.

Economically speaking, the most interesting shear of the entire area is that on the peninsula at the east end of Falcon Lake with which gold is associated.

FAULTING AND JOINTING

Faulting in the granitic rocks is more prevalent than is indicated on the map. Only those faults are plotted which were seen on the surface or show up as undoubted displacements on aerial photographs. Numerous other lineaments may have originated from fault systems, but this is by no means a certainty. The faults strike both to the northeast and northwest.

A system of complementary joints is present throughout the area. The strikes average about north 30 degrees east and north 50 degrees west.

ECONOMIC GEOLOGY

GOLD AND SILVER

A diligent search for gold began in the West Hawk Lake district shortly after the turn of the century. Proof of the efforts expended by prospectors over the years is evidenced by a large number of pits and trenches. Their attention was directed first to the numerous sulphide veins, consisting mainly of pyrrhotite and pyrite, in the Keewatin volcanic and sedimentary rocks. Gold values were proven in some of these, but most veins with heavy sulphide mineralization were either barren or contained only traces of gold.

A more promising locale for gold was found to be quartz veins associated with the stock-like intrusive, now known as the Falcon Lake stock, between Star Lake and Falcon Lake. This area was covered by staking at an early date, and good results from gold assays were reported.

One of the earliest ventures was that carried on at the Penniac Reef Gold mine, later called the Star Lake Gold mine. Considerable underground work was done, including the sinking of an inclined shaft to a depth of 65 feet and drifting both ways from it on the first level. Country rocks are agglomerate and lava which are cut by a phase of the Falcon Lake stock.

Marshall (1918) visited this area in 1917 for the purpose of sampling some of the showings to determine the precious metal content. Returns gave values in gold as well as traces of platinum and silver. Bruce (1919) returned the following year to sample thoroughly the known mineralized quartz veins. The results of the assays from 12 claims showed gold values varying from nil to 2.42 ounces per ton, but platinum was not found at any locality.

Sunbeam Kirkland Gold Mines, Limited, began underground exploration on the Sunbeam claim in 1938. Preliminary trenching and diamond drilling had given encouraging gold values near the northeast edge of the central quartz monzonite body of the Falcon Lake stock. The mineralized zone on the surface was roughly elliptical in shape, encompassing an area of about 1,200 square feet. The ore body has been described as a pipe-like structure which plunges 65 degrees in a direction north 30 degrees west. The structure continues to depth and has an area of over 3,000 square feet on the second level. Brownell (1941) considers that the pipe-like channel which admitted the ore-forming fluids was a product of late consolidation of the magma.

The ore body has been faulted and fractured. Some of the larger zones of movement have been silicified and carry gold. Sulphides, consisting of pyrite, pyrrhotite, arsenopyrite, sphalerite, galena, tennantite, and chalcopyrite, with some associated gold, are concentrated along the smaller fractures.

The company was reorganized as Goldbeam Mines, Limited, in 1941. A second shaft was put down to the southeast of the first one, and drifting was begun toward the original development. In March 1943, the company estimated ore reserves to be 110,000 tons averaging 0.256 ounces of gold per ton to a depth of 475 feet. Financing difficulties were encountered, underground operations were suspended, and the property closed in October, 1946.

Falcon Gold Mines, Limited, trenched and diamond drilled gold-bearing quartz veins on its claims including Rod, Hall, and Four Leaf Clover in 1935.

Thor Gold Mines, Limited, completed 1550 feet of diamond drilling on their property in 1938.

A promising gold show was found near the east end of Falcon Lake a number of years ago A shear zone that strikes north 82 degrees east and dips vertically is located on Thompson No. 2 mineral claim. The zone is up to 10 feet wide, the central 3 feet of which is silicified, and mineralized with pyrite, pyrrhotite, and chalcopyrite. It has been trenched continuously for 400 feet, and it is also exposed on a small island 350 feet to the west. A deep pit was sunk at the east end, and the deposit was explored further by a number of diamond drill holes. Country rock is a dark-green fine-grained volcanic. A few feet to the north of the shear zone is a concordant quartz-feldspar porphyry dyke 6 feet wide.

Much of the rock in the shear zone has been altered to a micaceous schist. Pyrite and pyrrhotite are present, and free gold has been reported. Nine claims in this area have been grouped and Falnora Gold Mines, Limited, has been formed to develop the property. Recent reports state that the eastern 250 feet of the deposit average 0.44 ounces of gold per ton across an average width of 2.1 feet. Samples taken by the writer during the past field season showed interesting results. A 4-foot channel sample about 150 feet from the west end assayed 0.33 ounces per ton, and 6 inches of the best mineralized section ran 2.29 ounces per ton. A grab sample 10 feet west of this location assayed 3.41 ounces per ton. Quartz from the pit at the east end gave a trace of gold, and pyrite-bearing quartz from the waste dump assayed 0.07 ounces of gold per ton. Silver is present up to 0.45 ounces per ton, but no platinum was found.

Elsewhere in the area precious metal values are discouraging. Gold in 20 assays ranged from a trace to 0.08 ounces per ton, and silver from a trace to 0.57 ounces per ton. Platinum was not found.

TIN

The first report of tin in Manitoba came from the West Hawk Lake district in 1918. Neil Martin announced that he had recovered globules of metallic tin while roasting sulphides from a zone near the north end of West Hawk Lake. DeLury examined the occurrence and stated that a tin mineral with the physical characteristics of chalcopyrite was present. He supposed that the mineral was a member of an isomorphous group between chalcopyrite and stannite. Assays run at the time ranged from 0.18 to 0.30 per cent tin, but some samples were tin-free.

Batemen (1943a) examined Martin s pits in 1942; systematic sampling failed to reveal tin.

The writer also examined these prospects. Pyrrhotite, chalcopyrite, and sphalerite were seen in the hand specimen and polished section. Assays did not yield tin, but a picked sample ran 0.34 per cent zinc. Some of the chalcopyrite was isolated and roasted under conditions which simulated those which Martin might have used, and no trace of tin was found.

TUNGSTEN

Scheelite was discovered north of Falcon Lake late in 1918. Some cobbed ore was shipped soon after this, but returns were not encouraging. One shipment of 7,921 pounds was concentrated to 177 pounds with a tungstic oxide grade of 71 per cent.

An impetus was given to prospecting for scheelite during the second world war owing to the short supply of this strategic mineral Ultra-violet lamps were in common use by this time, and this instrument enabled prospectors to make discoveries in areas which had been explored previously. New scheelite deposits began to be reported in 1939, and in 1942 J. D. Bateman of the Geological Survey of Canada, and A. S. Dawson of the Manitoba Mines Branch, examined the area to determine the economic possibilities of tungsten. Detailed descriptions of the best occurrences were given at that time (Bateman, 1943b). Investigations by private interests ceased with the alleviation of the tungsten shortage at the end of the war.

The scheelite deposits are associated with shear zones and minor folds in pillow lavas near the contact with pink porphyritic granodiorite. They trend in a northeasterly direction and have been found over a distance of 6 miles, from Barren Lake to West Hawk Lake.

Two main types of deposit are present. One consists chiefly of quartz and brown garnet. The other is a highly epidotized vein type, although quartz, garnet, epidote, amphibole, and calcite may be found at any one locality. These minerals are all coarsely crystalline. The brown to white scheelite is either in small lenses or disseminated. In many places it is difficult to recognize the scheelite from granular quartz, and an ultra-violet lamp is a necessity in prospecting. Epidote and garnet seem to be good indicators of scheelite.

Bateman described the most important scheelite deposits on a number of claims including M.J.T. No. 3, M.J.T. No. 14, the Felrite group, the Lake group, and the Black claims.

Two scheelite-bearing lenses were found on M. J. T. No. 3 claim. The north lens is 32 feet long and averages 1.8 feet wide. This lens strikes north 42 degrees east, plunges in the same direction, and the dip is 85 degrees to the southeast. Practically all the scheelite is confined to one end of the shear zone. Brown garnet and sugary quartz are the gangue minerals. Three channel samples taken by Bateman averaged 0.33 per cent WO_3, and he estimated that the deposit contained 165 tons of this grade.

The south shear zone on M. J. T. No. 3 is 18 feet long and averages 1.8 feet in width. The strike and plunge are to the northeast, and the dip is vertical. Gangue minerals are coarse-grained amphibolite, epidote, and garnet. Three sections sampled by Bateman averaged 0.14 per cent WO_3 across a width of 2.4 feet, and he estimated that the lens contained 60 tons of this grade.

A scheelite-bearing shear is exposed on the northeast side of an island in a muskeg on PMW No. 2 claim, formerly M.J.T. No. 14. The zone is 52 feet long and up to 2 feet wide. It strikes north 34 degrees east, plunges 60 degrees in the same direction, and dips 80 degrees southeast. Scheelite is disseminated in a gangue, that consists mainly of well-crystallized epidote. Grade has been estimated to be less than 0.1 per cent WO_3.

Two shear zones were found on PMW No. 8 mining claim, formerly Felrite No. 1, about half a mile northwest of the north end of Barren Lake. They consist of short narrow discontinuous scheelite-bearing pods which total up to 160 feet in length. The lenses strike north 30 degrees east, plunge 65 degrees in that direction, and dip 70 degrees to the southeast. Large brown garnet crystals are especially prominent in sugary quartz and recrystallized volcanic rock. There is some disseminated pyrite, pyrrhotite and chalcopyrite. Indicated reserves in the larger lens, according to Bateman, were 30 tons of scheelite ore averaging 0.56 per cent WO_3. The smaller lens immediately to the south gave an average return of 0.17 per cent WO_3.

Other similar deposits have been found in the scheelite belt. They are all localized on small structures, have an erratic distribution and are pockety in nature. Bateman estimated 31 tons of ore grading 1 per cent WO_3 for the four most promising occurrences.

MOLYBDENUM

Molybdenite was discovered near Falcon Lake during the early days of prospecting for gold. Pegmatite dykes and quartz veins in an area west and southwest of Barren Lake were found to contain molybdenite The mineralized bodies are located in volcanic rocks close to the contact with porphyritic granite.

Molybdenite occurs in crystals of varying sizes up to 3 inches and more in diameter in the coarse-grained pegmatites. Large clusters of radiating crystals which weigh as much as 20 pounds were cobbed from the pegmatites when they were first prospected. The main constituents of the dykes are pink feldspar and quartz. Native bismuth and gold have been reported to be associated with the molybdenite in places.

Small veinlets of molybdenite have also been found in quartz veins. The mineral does not occur in crystals of such large size as in the pegmatites. The quartz veins may be a gradational product from the pegmatites, because a mixture of quartz and feldspar commonly occurs along the borders of the quartz veins.

Attempts were made to mine the deposits during the first world war. Hand-cobbing was facilitated by the large size of the crystals, and the dykes were worked by this method until the high-grade material was exhausted. The molybdenite content of the pegmatites was estimated to run as high as 1 per cent in places. Very little material of exceptional quality can be seen in the pits today.

The radioactive pegmatites along Highway No. I contain scattered small flakes of molybdenite, but nothing of commercial interest was seen.

LITHIUM AND BERYLLIUM

Two pegmatite dykes containing lithium and beryllium minerals occur about 3 miles northeast of Glenn on the Greater Winnipeg Water District railway. One of these is located in the northeast corner of Lucy No. 1 mining claim. The exposed dimensions of the pegmatite, as seen in the side of a small hill and a trench, measure 50 feet by 15 feet. The trench strikes north 20 degrees east. The minerals in the dyke are pink and white feldspar in large crystals, granular albite, black tourmaline, blue acicular tourmaline, blue apatite, fluorite, pale silvery lithium mica, pyrophyllite, pale green beryl (approaching aquamarine), and white spodumene in crystals as much as 12 inches in length. Spodumene constitutes up to 25 per cent of the dyke in the south portion, and it is the only important rare-element mineral. Beryl crystals are small and scattered.

The second lithium-bearing dyke outcrops on the AD No. 2 mining claim which adjoins Luoy No. 1 to the west. The body is exposed for a length of 60 feet in an easterly direction and is about 10 feet wide. It has been explored by trenching and a number of diamond drill holes. The dyke is composed of coarse-grained pink and white feldspar, smoky quartz, biotite, white to pale green beryl, and white to pale green spodumene in crystals as much as 10 inches in length.

Small pegmatite dykes which contain minor amounts of spodumene and beryl have been noted to the south and west of West Hawk Lake and north of Star Lake. These are of mineralogical interest only.

BASE METALS

It has been noted previously that heavily mineralized pyrrhotite veins are common in the Keewatin rocks. Twelve of these veins were checked for nickel. Five of the assays gave returns ranging from 0.035 to 0.06 per cent nickel.

Some chalcopyrite and sphalerite are associated with the pyrrhotite but in amounts too low to be of commercial interest.

URANIUM

Radioactive minerals have been reported in the West Hawk Lake district for many years. The late Charles Letain prospected the area and found encouraging evidence of radioactivity near Highway No. 1. No systematic exploratory work was done until 1950, when Whiteshell Uranium Syndicate carried out a scintillometer and sampling program. Overburden was removed from interesting localities by bulldozer and pressure pump, and a number of deep trenches were cut for sampling purposes.

Uranium-bearing minerals occur in persistent pegmatite zones which lie near porphyritic granodiorite and gneissic granodiorite. The pegmatites are associated with altered Keewatin volcanics and sediments. The geology of the three bands has been described above under "metavolcanic and metasedimentary rocks". Most of the work done so far has been concentrated on the eastern half of the north band where the best indications of radioactivity have been found.

The pegmatites are composed of microcline, albite or oligoclase, biotite, hornblende, apatite, and garnet. Pyrite and pyrrhotite are present in places. Small scattered flakes of molybdenite are found occasionally. Magnetite is a prominent constituent in faintly radioactive pegmatites which intrude the porphyritic granodiorite.

High Geiger counter readings are obtained over most of the places of high concentration of biotite, but good readings are found also where little biotite is present.

In 1949 Dr. R. B. Ferguson of the University of Manitoba concentrated the heavy minerals from a sample from the Found No. 3 mining claim. An X-ray powder photograph of a fragment of the non-magnetic fraction proved that uraninite was present.

A short summary of assay results for the several claims examined is given below. Found, Found No. 2, and Found No. 3 mining claims are located near the west end of the area worked and the remainder are near the central and eastern part of the zone. Practically all the sampling was done by Whiteshell Uranium Syndicate. The samples were examined by the Radioactivity Laboratory of the Geological Survey of Canada, Ottawa, and the Assay Laboratory of the Manitoba Mines Branch.

Found Claim

Twenty-six channel samples were sent to the Radioactivity Laboratory, Ottawa, for beta activity determinations. Nine samples gave equivalent assays of less than 0.01 per cent U_3O_8, 16 samples varied from 0.01 to less than 0.05 per cent U_3O_8, and 1 sample showed 0.51 per cent U_3O_8.

Four channel samples assayed by the Manitoba Mines Branch had equivalents from 0.014 to 0.037 per cent U_3O_8 and seven picked samples assayed by the wet method varied from 0.031 to 0.58 per cent U_3O_8.

A 1000-gram sample from the main pit on the claim, panned to a 0.5 gram concentrate by the Manitoba Mines Branch, assayed 45.1 per cent U_3O_8.

Found No. 2 Claim

Fourteen channel samples were found by the Radioactivity Laboratory, Ottawa, to have equivalent beta activities varying from 0.010 to 0.049 per cent U_3O_8.

Found No. 3 Claim

Five channel samples examined by the Radioactivity Laboratory, Ottawa, had equivalent activities varying from 0.016 to 0.049 per cent U_3O_8.

Nine channel samples examined by the Manitoba Mines Branch had equivalents from 0.006 to 0.14 per cent U_3O_8, and 1 picked sample indicated 0.17 per cent U_3O_8. Three chemical analyses ran 0.09 (channel), 0.18 (selected), and 0.30 (selected) per cent U_3O_8.

Found No. 9 Claim

Eight picked samples were taken from this claim. The Radioactivity Laboratory, Ottawa, found that 2 of these had beta activities equivalent to 0.006 to 0.08 per cent U_3O_8. Heavy minerals were identified as uraninite, thorite, zircon, and apatite. X-ray powder photographs indicated that some thorite was mixed with uraninite, and 70 per cent of the activity was estimated to be due to uranium and 30 per cent to thorium.

Four chemical analyses by the Manitoba Mines Branch gave 0.008, 0.014, 0.07, and 0.70 per cent U_3O_8 (selected samples). A 700-gram sample was panned to a 1.2 gram concentrate which assayed 43.2 per cent U_3O_8.

Triangle No. 2 Claim

A chemical analysis of a sample from the main pit gave 0.22 per cent U_3O_8 and 0.53 per cent ThO_2.

Triangle No. 6 Claim

The Radioactivity Laboratory, Ottawa, found the beta equivalent activity of 3 samples to be 0.015, 0.087, and 0.11 per cent U_3O_8.

Chemical assays by the Manitoba Mines Branch of 1 picked sample and 1 channel sample ran 0.02 and 0.034 per cent U_3O_8 respectively.

The bulk of the analyses fall within the group 0.01 to 0.05 per cent U_3O_8 which the Geological Survey of Canada considers encouraging for prospecting, and some analyses are in the possible ore grade group between 0.1 and 1.0 per cent U_3O_8. The deposits are difficult to explore because the radioactive minerals are finely divided and disseminated. Much work remains to be done to determine whether ore of commercial grade and volume is present.

The pegmatite in some localities contains some secondary uranium oxide. This is seen especially well in the larger trenches where the oxide has been deposited as a film on fractures. The oxide film fluoresces typically under the ultra-violet lamp.

Radioactive pegmatites similar to those described have been found to the east in Ontario.[1]

MONUMENTAL AND ORNAMENTAL STONE

Three granite quarries are in operation in the area. The Winnitoba Marble Company, Limited, of Winnipeg operates two quarries. One of these is on Highway No. I west of West Hawk Lake in section 29, township 9, range 17, east of the Principal meridian. The quarried rock is a medium-grained grey biotite granite, which is intruded by small white pegmatite dykes. The pegmatitic material constitutes an objectionable feature as it contributes to wastage.

So-called black granite is quarried by the same company on the Fortune mining claim in section 17, township 9, range 17, east of the Principal meridian. This rock is actually a coarse-grained black diorite and is a border phase of the Falcon Lake stock. The first pit opened contained an excessive amount of sulphides which, on weathering, stained the polished blocks. A new quarry was opened where the sulphide content was lower.

Production is dependent upon demand in Winnipeg for the two types as monumental and ornamental stone. Quarried blocks are trucked to the company's polishing plant at Winnipeg. During 1948, 160 tons of grey granite and 190 tons of black granite were quarried.

The Shoal Lake Granite Company operates a quarry about 3 miles northeast of Glenn in section 10, township 8, range 15, east of the Principal meridian. The quarry is situated in a small medium-grained black diorite boss, which measures about 200 feet by 350 feet. Some fine-grained diorite is taken from the margin of the intrusive. Formerly rough blocks were

---

[1] Chisholm, E. O. (1950): Preliminary Report on Radioactive Occurrences in the Kenora Area; Ont. Dept. of Mines, Prelim Rept. 1950-1.

shipped to the Winnipeg market, but at the present time the total production is cut and polished into a variety of monumental stones at the quarry site.

The lighter coloured uniform rocks near the centre of the Falcon Lake stock possibly might provide suitable dimension stone.