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STRUCTURAL STUDIES

of the

LONG LAKE - HALFWAY LAKE AREA
Rice Lake Mining Division

by

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RICE LAKE MINING DIVISION

INTRODUCTION

The area investigated is located 100 miles, north 55 degrees east of the city of Winnipeg. It comprises about 45 square miles and includes the old mining centres of Central Manitoba, Beresford Lake (Gunnar, Oro Grande, etc.) and Ogama-Rockland, which have produced over $9,300,000 in gold.

The area has been described in previous reports[1] among which those mentioned below are most comprehensive.

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[1] Moore, E. S.: Region East of the South End of Lake Winnipeg; Geol. Surv., Canada, Sum. Rept. 1912.

Cooke, H. C.: Geology and Mineral Resources of Rice Lake and Oiseau River Areas, Manitoba; Geol. Surv., Canada, Sum. Rept., 1921, pt. C., 1922.

Wright, J. F.: Rice Lake Map Area, Southeastern Manitoba; Geol. Surv., Canada, Sum. Rept., 1922, pt. C., 1923.

_____ Geology and Mineral Deposits of a Part of Southeastern Manitoba; Geol. Surv., Canada, Mem. 169, 1932 (reprinted 1938).

Stockwell, C. H. and Lord, C. S.: Halfway Lake-Beresford Lake, Manitoba; Geol. Surv., Canada, Mem. 219, 1939.

Stockwell, C. H.: Gold Mines and Prospects in Rice Lake-Beresford Lake Area, Manitoba; Trans. Can. Inst. Min. and Met., Vol. 43, pp. 613-626, 1940.

_____ Beresford Lake, Map 809A; Geol. Surv., Canada, 1945.

The reader is referred to these reports for general descriptions of the area including such features as access, drainage, topography, and general geology.

PURPOSE OF THE PRESENT WORK

The purpose of the present work was to map the area in general and to pay special attention to geological features associated with ore occurrences. The accompanying map of the area is on a scale of 1 inch to 1310 feet.

ACKNOWLEDGEMENTS

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GENERAL GEOLOGY

All rocks in the area are Precambrian in age. The oldest rocks in the area are the Rice Lake group (1a, 1b, 1c,)[1] which is an assemblage of complexly folded volcanic and sedimentary rocks; these have a general strike of north 70 degrees west.

The Rice Lake group is intruded by medium to basic rocks which range from diorite to peridotite (2). It is impossible, without detailed field mapping, to tell whether the dioritic rocks actually cut across the folded Rice Lake group or whether they are sills which were intruded into the flat-lying sedimentary and volcanic rocks and subsequently folded with them. For the most part, the masses of dioritic and gabbroic rocks are conformable with the sedimentary and volcanic rocks on strike; it is not

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

known whether they are also conformable down the dip. Likewise, conclusive evidence of the age of these dioritic and gabbroic rocks with respect to the granitic rocks of the area is not known.

The Rice Lake group and the medium to basic intrusives form the country rock for a large mass of "granite" in the northwestern part of the area (3a). The main mass of this rock is petrographically a quartz diorite which contains numerous large (as much as 5 millimeters in diameter) grains of grey to bluish-grey quartz. Along its southern contact the "granite" mass is bordered by a zone of hybrid rocks (3b) which lie between it and the sedimentary rocks just north of Long Lake. On the eastern boundary of the mass, the "granite" ends abruptly against volcanic, dioritic, and gabbroic rocks and shows little or no evidence of chilling.

In the vicinity of the Ogama-Rockland mine, a mass of medium- to fine-grained quartz diorite (3c) intrudes the coarser-grained "granite" (3a). Several inclusions of "granite" (3a) in quartz diorite (3c) can be seen. The Ogama quartz diorite (3c) does not have any of the large bluish-grey quartz grains. Still later than the Ogama quartz diorite (3c) is a series of fine-grained dykes of quartz diorite porphyry which intrude the Ogama quartz diorite and show chilled contacts against it and contain abundant inclusions along the walls.

Dykes of feldspar porphyry and quartz-feldspar porphyry intrude the main "granite" mass (3a), the Ogama intrusive (3c) and the older rocks of the area. Their exact age is not known but they are probably related to the same period of intrusion which produced the Ogama quartz-diorite porphyry dykes.

The youngest acid intrusives in the area are pink aplite dykes which intrude all the older rocks. In the southwest part of the area a small amount of pink to red granite was mapped. Possibly the pink aplite dykes are related to it.

The youngest Precambrian rocks in the area are diabase and lamprophyre dykes (4) which occur mainly along one large tensional break near the middle of the area. The main dyke was traced almost continuously from the east shore of McLeod Lake to a point south of the Mirage shaft. At Halfway Lake, the diabase-filled tension fracture is about 250 feet wide. Lack of rotation or other disturbances of wall rock fragments in this fracture is indicated by the undisturbed trend of a narrow pink aplite dyke across wall rock fragments included in the diabase.

The youngest in the area are unconsolidated deposits of glacial drift consisting of sand, clay, and boulder till.

GEOLOGICAL HISTORY OF THE AREA

(1) Volcanism and sedimentation resulting in the formation of the Rice Lake group.

(2) Folding, accompanied and probably followed by the intrusion of medium to basic intrusives.

(3) Formation and emplacement of "granite" (3a).

(4) Time interval unknown.

(5) Intrusion of Ogama intrusive (3c) and porphyry dykes.

(6) Time interval unknown.

(7) Formation and emplacement of pink to red granite and aplite.

(8) Time interval unknown.

(9) Tensional forces which opened fractures with a strike of about north 10 to 20 degrees west and an average east dip of about 50 degrees. These fractures were filled by diabase and lamprophyre.

(10) Post-Precambrian history.

(11) Glaciation.

STRUCTURAL GEOLOGY

A complete structural analysis of the area was not attempted. The general features have been described by Wright, Stockwell, et al. The only structural features investigated were those which were believed to be important as far as the ore deposits of the area are concerned. Two main features seem responsible for the structural control of localization of ore. These are:

1. Fractures and shears in the massive brittle rocks.
2. Main regional faults which produced the fractures and shears in the massive brittle rocks.

No deposits of commercial importance have been found in any of the volcanic or sedimentary rocks of the area. All the commercial deposits occur in massive rocks such as diorite and quartz diorite. In the writer's opinion, this is due to the fact that the laminated volcanic and sedimentary rocks adjusted themselves to the stresses which produced the folding and faulting by movement between the laminations. On the other hand, the massive rocks reacted to the stresses by breaking open, forming fractures or openings along shear planes into which quartz could be deposited. As examples of this may be cited the controlling rock masses at the various properties which have produced gold. Central Manitoba Mines Limited produced from quartz-filled openings in the "Central diorite" mass. The veins at Gunnar Gold Mines Limited are closely related to the mass of coarse-grained diorite described by Stockwell and Lord. The Oro Grande (Beresford Lake Gold Mines) produced from quartz-filled openings along a shear in a diorite mass. Ogama-Rockland Gold Mines Limited produced from quartz-filled openings along a series of shears in quartz diorite.

The regional structures, which were responsible for the formation of the openings which were later filled by quartz and still later mineralized by gold, are the Dove Lake shear, the Central Manitoba shear, the Long Lake shear, the Gunnar shear, and the Oro Grande shear.

The Dove Lake shear was traced continuously from a point about half a mile east of Midway Creek to the narrows on Halfway Lake. It has a strike of about south 50 degrees east and an average dip of about 55 degrees north. The age of this shear cannot be placed exactly, but it appears to offset the diabase dyke at the narrows on Halfway Lake.

The Central Manitoba shear is a branch shear from the Dove Lake shear. It diverges from the Dove Lake shear at a point about 3/4 mile west of the Kitchener shaft and strikes eastward to the Kitchener shaft, thence across the "Central diorite" mass to the Tene and Hope shafts. East of the Hope shaft the shear follows the north contact of the "Central diorite" mass. In the area of the Central Manitoba mine the Central Manitoba shear has a strike of south 75 degrees east. Its dip varies from 68 degrees south in the west part (Growler shaft) to vertical (Tene shaft) and finally to 80 degrees north in the east section (Hope shaft).

The Long Lake shear can be traced for about 3 miles. West of the Ogama power line the shear swings southward from an almost west strike and fades out along the granite contact. East of the Ogama powerline to the Long Lake-Bissett road the shear is well developed and is best exposed about 400 feet southeast of the Ogama-Rockland schoolhouse. On the east end, the shear appears to be absorbed along the bedding planes of the Rice Lake group and could not be traced. The outstanding features of the Long Lake shear is the set of subsidiary (horsetail) shears developed in the vicinity of the granite contact near the Ogama-Rockland mine. The most northerly of these (the Ogama shear) diverges northward from the Long Lake shear east of the Onondaga shaft. It strikes north 50 degrees west through the Onondaga and Ogama shafts and then continues westward to a point north of the Rockland shaft. From that point it swings northward and "frays out" rapidly in the massive granite. The Rockland shear is a branch of the Ogama shear. It diverges from the latter about 400 feet east of the Ogama shaft and strikes north 60 degrees east to the Rockland shaft. Another important subsidiary shear is the South Rockland which diverges from the Long Lake shear at a point about 500 feet southeast of the Ogama-Rockland schoolhouse. From there it strikes north 60 degrees west for a little over half a mile and then it tightens up and fades out in the main granite mass. The Long Lake shear has a vertical dip; its subsidiary (horsetail) shears (The Ogama, Rockland, and South Rockland) shears have average north dips of about 75 degrees.

The Gunnar shear was first noted on the north side of the swamp through which the winter road is cut, at a point about half a mile west of No. 1 shaft. From there is was traced on a strike of south 50 degrees east to the north side of the tailings pond north of the main road. The productive shears at Gunnar Gold Mines Limited diverge from the main Gunnar shear about one-quarter mile west of No. 1 shaft and strike north 70 degrees east through the mine area. East of the mine the shears swing rapidly southward and fade out. The productive shears dip steeply south at an average of 75 degrees. The main Gunnar shear has, (at one point where a measurement could be taken) a north dip of 60 degrees.

The Oro Grande shear strikes north 20 degrees west and dips eastward with dips ranging from 45 degrees to 80 degrees. It will be noted that the strike of the Oro Grande shear is considerably different from the strike of the other main shears. During mapping it was quite apparent that the area just west of the west shore of Beresford Lake covers the intersection of two prominent shear directions, one which strikes south 50 to 70 degrees east, the other south 10 to 20 degrees east.

In addition to the main shearing directions cited above, there is a less obvious shearing direction at north 60 degrees east. It appears to have been responsible for the numerous offsets which appear along the course of the large diabase dyke from Halfway Lake southeastward.

ECONOMIC GEOLOGY

The only metals of economic importance discovered in the area are gold and a small amount of silver. The most abundant sulphide minerals noted were pyrite, chalcopyrite, arsenopyrite, and relatively small amounts of pyrrhotite, galena, and sphalerite. The gold does not appear to be related to any of the minerals, and consequently close and careful sampling is the only sure means of determining the amount of gold in a vein.

One outstanding feature was noted in connection with the occurrence of gold. Numerous samples were taken from straight-walled, continuous quartz veins, some with abundant pyrite and chalcopyrite. None of these samples assayed more than a trace of gold. On the other hand, if the quartz veins have been fractured by a later period of shearing, so that the quartz occurs as irregular disconnected veins and lenses in a shear, they usually carry higher values. It seems clear that one period of mineralization filled available openings with quartz and some pyrite, chalcopyrite, and arsenopyrite and that a second period of mineralization supplied gold and little else. The age of the mineralization which supplied the gold is not known exactly. It is certainly later than the age of formation, emplacement, and solidification of the main "granite" mass (3a). Accordingly, the gold mineralization may be related to the younger pink granite or to the period of igneous activity which produced the late diabase and lamprophyre dykes.

Production at Ogama-Rockland Mines Limited came from gold-bearing quartz shoots in the Ogama shear and the Rockland shear. Surface samples taken by the writer establish the presence of gold in the south Rockland shear, but this shear has not been explored underground. Through the management the writer obtained a series of mine samples grading from 0.10 ounce per ton of gold to 1 ounce per ton in approximately 0.10 ounce increments. I. Spector and D. F. Brown of the Provincial Assay Laboratory analyzed this series of samples for silica, alumina, lime, magnesia, sulphur, carbon dioxide, copper, zinc, and arsenic to determine any possible key to gold occurrence. The results indicated no relationship between any of these oxides and elements and the gold. During 1949 the owners deepened the shaft from 750-foot to the 1000-foot level to explore for vein intersections encountered in drilling from the 750-foot level.

The Central Manitoba Mines Limited produced from five shafts. Four shafts, the Growler, Kitchener, Tene, and Hope were sunk on gold-bearing ore shoots in the Central Manitoba shear. One shaft, the Rogers, was sunk on another parallel shear about 600 feet south of the Tene shaft. Underground workings are not accessible now. On surface the Central Manitoba shear is characteristically braided, sometimes across a width of as much as 200 feet. In this braided shear, the quartz lenses which form the ore shoots are distributed irregularly along strike, occurring on first one braid within the main shear, then on another.

As the most productive ore shoots at the Central Manitoba mine, according to surface mapping, lie almost wholly within the "Central diorite" mass, structural features of this mass are of the utmost importance. The strike of the mass is clearly outlined by surface mapping. The dip of the mass is not so well defined. On the south side of the diorite the writer obtained several north dips on the volcanic rocks which form the wall of the diorite. North of the tailings dump, slightly west of north of the mill, average north dips of about 50 degrees were noted. The diorite mass contains two sets of master joints both of which strike slightly across the mass. One set dips south at about 75 degrees or roughly parallel to the main vein system along the Central Manitoba shear. The other set dips north at about 50 degrees or roughly parallel to the volcanics which bound the mass over much of its length on both north and south sides. At least two rusty shear-zones, with north dips of about 50 degrees were mapped on the south edge of the tailings, 550 feet east of the Long Lake-Bissett road. Grab samples were taken from both rusty shears. One sample assayed trace and the other 0.05 oz. gold per ton.

The geology of the Gunnar Mine has been described by Stockwell and Lord. The only addition made by the present work is to outline the main Gunnar shear from which the productive vein shears tail off. At one point 900 feet due south of No. 1 shaft, the Gunnar shear has a north dip of 60 degrees.

The Oro Grande property produced a small amount of gold from quartz-shoots in the Oro Grande shear. This shear is part of a system of shears which are characteristic of the Beresford Lake end of the map area and which strike about south

10 to 20 degrees east as compared with those in the middle part of the map area which strike about south 50 to 70 degrees east. The Oro Grande vein had an east dip varying from 30 to 50 degrees. The country rock of the veins is massive, medium-grained diorite with some more basic banded phases.

Numerous other showings occur in the area but most of them have been covered by previous reports. Eldorado Gold Mines Limited have sunk two shafts on a northwest shear in granite (3a) on the Eldorado claims. Vein quartz occurs at intervals along the shear zone for a length of over 2000 feet. Several hundred feet of drifting were done down to the 500 foot level. Results on the lower track were not sufficiently encouraging and the work was discontinued. The Kiwago shaft explored a quartz-bearing shear in the granite which has about the same strike and dip as the Ogama shear. Quartz diorite of the Ogama type was not noted. The Rex shaft on the power line one mile west of the Central Manitoba shaft was sunk on quartz stringers in a small mass of granite. The main vein on this property (the North Star vein) on which most of the surface work was done is located about 950 feet southwest of the shaft. The Elora shaft was sunk on a quartz-bearing shear in greenstone. A stamp mill extracted a small amount of gold. At the Gold Hill property a shaft was sunk on a quartz-bearing shear similar in appearance to the Ogama shear i.e. broken up lenses of quartz in a zone of highly carbonatized schist. At the Mirage property a shaft was sunk in a zone of talc-serpentine schist. A surface pit near the shaft has exposed flat south-dipping joints in altered, serpentinized rock. These joints are narrow but contain a large amount of visible gold in a gangue of quartz and carbonate. No other ore minerals were noted with the gold. At the Midway property surface pitting has been done for 3,400 feet along a mineralized dyke of quartz-feldspar porphyry. The dyke is sheared and fractured and contains variable amounts of quartz-carbonate veins. On the west shore of Halfway Lake surface pitting and some diamond drilling have been done on a quartz-bearing shear in greenstone. The shear continues out under the lake. It is reported that diamond drilling under the lake has indicated appreciable values in gold on the eastward extension of the shear.

SUMMARY AND CONCLUSIONS

In the writer's opinion, the gold mineralization in the area studied took place considerably later than the time of emplacement of the large "granite" mass (3a). This "granite" has exerted considerable structural influence on the formation of shears and fractures owing to its strong massive nature, i.e., it has been the focus around which forces have acted to shear and open up certain members of the surrounding Rice Lake series and medium to basic intrusives.

All the producing mines in the area have stopped operations at relatively shallow depths of from 500 to 1500 feet. As far as the writer has been able to determine, the structures (shear-zones and fractures) were still well developed in the lower levels of these mines and it was the shortening and narrowing of the quartz veins and lenses which form the ore shoots that resulted in the abandonment of further work. As this tendency for veins and lenses to pinch and swell along strike is well established by surface mapping, there is no reason to believe that the ore bearing shears will behave any differently down the dip. The Central Manitoba shear was productive for a length of 1½ miles and to a depth (where operations were stopped) of about 400 feet. The Gunnar veins were productive for a length of about one-quarter of a mile and to a depth of about 1200 feet. It appears that there is no definite proof of a bottoming of the structures or veins but only evidence that the ore-bearing shears are productive in some parts and non-productive in others. Future exploration should attempt to determine the possible limits of the productive and non-productive parts of the shears.

With regard to prospecting in the area it can be stated that the "laminated" volcanic and sedimentary rocks are not generally favourable to the occurence of commercial gold veins whereas the more brittle massive rocks (diorite and gabbro masses and porphyry dykes) are favourable. The main regional shears (Long Lake shear, Dove Lake shear, Gunnar shear, etc.) are not generally favourable but subsidiary shears which tail off from these main shears are favourable, particularly where they intersect bodies of the massive, brittle rocks of which the masses of dioritic to gabbroic rocks are the most favourable types.

The writer believes that detailed geological work, up to normal mining geology standards, would be of value in studies of the potentialities of some of the old properties. As an example, much remains to be learned of the vein system at the old Central Manitoba mine and its relation to the "Central diorite" mass. If the vein system is entirely within the diorite, as appears probable, then the possibility exists that the whole geological picture may resemble that of the San Antonio mine where all productive veins to date, are included within a mass of structurally similar rock. Further, in this respect, it is important to note that the most productive veins at San Antonio Mines, Limited, do not outcrop at surface, but are confined entirely by the footwall and hanging wall of the San Antonio diabase.