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MINES AND GEOLOGY BRANCH

BUREAU OF GEOLOGY AND TOPOGRAPHY

GEOLOGICAL SURVEY

PRELIMINARY REPORT

STULL (MINK) LAKE AREA, MANITOBA

BY

D. L. Downie

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Introduction

Since 1930 interest in the search for mineral deposits in northeastern Manitoba has been greatly intensified by the development of high-grade gold deposits at Island lake by Island Lake Mines, Limited, by the discovery and development of gold occurrences at Knee lake by Johnston Knee Lake Mines and Knee Lake Gold Mines, Limited, and by the rapid development to production, in 1935, of gold deposits on Elk island in Gods lake by Gods Lake Gold Mines, Limited. Recent discoveries of gold near the Manitoba-Ontario provincial boundary at Stull (Mink) lake and Foster lake in Ontario, and at Little Stull (Little Mink) lake in Manitoba, have drawn the attention of mining companies to Stull Lake area, the Manitoba part of which was investigated by the writer.

The area comprises 4,000 square miles lying between latitudes 54 degrees and 55 degrees and bounded on the west by longitude 94 degrees and on the east by the boundary line between Manitoba and Ontario (See accompanying map). Advance copies of sheet 53-K, issued by the Topographical and Air Survey Bureau, Department of the Interior, were used as a base map for the geological work.

From Norway House, at the north end of lake Winnipeg, a well-travelled canoe route follows Nelson, Echimamish, and Hayes rivers as far as Logan lake. There it turns east across a chain of small lakes to Aswapiswanam lake and follows it and Touchwood lakes to Gods lake, in the northwest part of Stull Lake map-area. The route covers an overall distance of about 200 miles. Eighteen portages are encountered, the longest being 60 chains. From Gods lake the route continues east over a succession of small lakes and streams to Edmund lake. From there the southern part of the area may be reached by ascending Red Sucker river. From Edmund lake the canoe route continues east by way of Margaret lake, thence crossing a chain of small lakes and streams, involving several long portages, to Kistigan lake. From Kistigan lake good canoe routes lead to the north and south parts of the map-area. Only the larger streams are navigable all summer. A few of the smaller streams may be travelled in the early spring, but with the lowering of the water-level they become impassable.

A winter road links Ilford, on the Hudson Bay railway, with Gods lake, and at the present time this is being extended east to Foster lake, Ontario, where the Sachigo River Gold Mines, Limited, is developing a gold prospect.

Because of its relative inaccessibility, the best method of entering the area is by airplane. Canadian Airways, Limited, and Wings, Limited, have established air bases at Norway House, Ilford, and Gods Lake. A weekly air mail service is maintained between Winnipeg and Gods Lake.

General Character of the District

The topography is typical of much of the Canadian Shield. Rounded, hummocky ridges of irregular sizes and shapes are separated by narrow, steep-walled valleys and by low depressions occupied by muskegs, lakes, or streams. The average elevation of hills is about 40 feet above the level of adjacent swamps and lakes. In the vicinity of Red Sucker lake the relief is greater and attains a maximum of 150 feet.

The drainage pattern of Stull Lake map-area is of the disorganized type commonly found in areas of low relief in the Canadian Shield. It has been developed largely by the position, size, and outline of the drift deposits left by Pleistocene ice-sheets.

The streams pursue tortuous courses, are broken by numerous rapids and falls, and have many lake expansions dotted with islands. The larger lake expansions are Stull, Kistigan, Rorke, Red Sucker, Sharpe, Edmund, and Gods lakes.

The map-area lies in the northeastern part of the Hayes River drainage basin. The principal streams, Red Sucker and Kistigan rivers, and their tributaries, flow in a northeasterly direction to Gods river and reach Hudson bay by way of Shamattawa and Hayes rivers.

The northeastern part of the area, lying between Red Sucker and Kistigan rivers, and bounded on the south by Kistigan, Margaret, and Edmund lakes, is almost completely covered with swamps containing small ponds and lakes joined by ill-defined, swampy streams. Even in late August and September, when the swamps are at their driest, traversing this district on foot is impossible. In the area west of Red Sucker river and north of Edmund and Gods lakes, swamps give place to comparatively drier, though poorly drained, muskeg areas. The southern part of the area, with relatively high relief, is better drained and muskegs are less common.

Outcrops as a whole are scarce within the area, and are mostly confined to the margins of the larger streams and the south shore-lines of lakes. Due to the low relief and gentle declivities of the shores, the size and number of outcrops increase greatly as the water-level falls; thus in a dry season or autumn more and larger outcrops will be found than in a wet season or in the early summer weeks.

Although the drainage of the area is largely disorganized, some adjustment to rock structure is apparent. In several places streams follow the direction of gneissosity of granite-gneisses or the strike of bedded rocks. Most of the larger bodies of water lie in the softer, more easily eroded sediments and volcanics, whereas the smaller lakes and streams lie within the harder, more resistant granite areas. This relationship is rendered less apparent by the depths to which erosion has gone. In some lake basins the older sedimentary and volcanic rocks are now represented merely by inclusions or fringes along shores of lakes and rivers.

Several lakes in massive granite areas have an irregular outline with no apparent pattern or trend, whereas in areas of granite-gneiss they are elongated along the direction of gneissosity. In areas underlain by sediments and lavas the smaller lakes are elongated along the strike of the rocks and the larger lakes may send out long bays parallel to the strike of bedding or schistosity, and also along a contact between two formations.

Glaciation

Glacial grooves and striae on rock exposures in all parts of the area show that the region was over-ridden by a continental ice-sheet. The direction of these ice markings indicates that on the eastern margin of the map-area the ice-sheet advanced south 8 degrees east, in the central part it advanced south, and at the western margin, south 25 degrees west. No cross striae were noted. The general southerly direction of ice movement is confirmed by the fact that the drift deposits are invariably concentrated on the south-facing slope of the ridges, the bedrock on north-facing slopes in most places being left exposed.

The fan-shaped manner in which these ice markings spread out suggests the presence, at one time, of a local ice centre about 75 miles north of the map-area. Presumably, the striae were made by ice movements during the last stages of Pleistocene glaciation.

Climate

Climatic conditions in The Pas district of northern Manitoba may be taken as closely approximating those in Stull Lake map-area. F.J. Alcock[1] describes this climate as follows:

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[1] Alcock, F.J.: Geol. Surv., Canada, Mem. 119, p. 12 (1920).

"Records kept since 1910 at The Pas ..... show that for a period of six years from 1911 to 1916 the total annual precipitation including both rain and melted snow averaged 15.14 inches. The average rainfall for the months of June, July, and August for a period of seven years, was 7.23 inches, showing that a large part of the precipitation comes at the growing season when it is most required. In this respect it compares favourably with Winnipeg which had an average precipitation of 7.87 inches for these months during the same period. The average snowfall is about 35 inches.

The winters are long and cold; the summers are short and hot. During the growing months, however, the long days due to the higher latitude give a much greater amount of possible sunshine than in southern Ontario. The average monthly mean temperature for June, July, and August is a little higher than that at Prince Albert or at Edmonton. Observations by W.A. Johnston along the Hudson Bay railway showed that in 1916 no killing frosts occurred from May 14 to September 14 and in 1917 none occurred from May 30 to October 3. The small lakes freeze over in October, but it is usually November before the larger lakes .... freeze, and it is generally late in May and often early in June before they are free of ice".

Population and Industry

The white population is limited to a few prospectors in summer and trappers in winter. The native population consists of a few Indian families of the Cree tribe, of the Gods Lake Reserve. Numerous Indian camps are scattered over the area. All the camps observed were deserted, the Indians evidently preferring to remain at the Gods Lake post during the summer months.

Few moose were seen. Black bear, however, are fairly common. Ducks and fish are plentiful in all parts of the area and constitute an important source of food for the Indians.

Trapping is the most important occupation at present. The chief fur-bearing animals are muskrat, mink, beaver, fox, and a few otter and marten.

Forest

The region as a whole is well covered with green timber and has escaped most of the forest fires that have swept the adjacent country. Most of the timber is small, rarely having a butt of more than 14 inches. The best timber is found near the shores of rivers and lakes and on the larger islands. As a rule, only stunted spruce and tamarack are found on the inland muskeg area, and tamarack forms fringes around the margins of swamps. Jackpine grows on sand plains and is typical of granite areas, whereas spruce, poplar, and birch are found over clay-covered areas. The underbrush is not dense except along narrow streams; it consists chiefly of alder and willow.

General Geology

All the consolidated rocks of the area are Precambrian in age. The oldest formations include lava flows with a few interbeds of sediments, and are probably the same age as the Hayes River group which occurs in the adjoining Oxford House area described by J.F. Wright.[1] The volcanic-sedimentary group is

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[1] Wright, J.F.: "Oxford House Area"; Geol. Surv., Canada, Sum. Rept. 1931, pt.C, pp. 1-25.

overlain by sediments which are correlated with the Oxford group of the same area. The older group is cut by small bodies of peridotite, diorite, and gabbro that were not seen in the younger sediments and may be related in origin to the lava flows. The older and younger groups are invaded by large bodies of granitic rocks and are cut by dykes of granite, quartz porphyry, and feldspar porphyry. The sediments, volcanics, and large bodies of granitic rocks are cut by dykes of pegmatite, aplite, lamprophyre, and diabase. The diabase is the youngest consolidated rock in the district.

Bodies of granite, granite-gneiss, and quartz diorite underlie the greater part of the area. The volcanic and sedimentary rocks occur chiefly as four belts lying within the large areas of granitic rocks. (See accompanying map) The belts generally trend easterly and, for the most part, comprise rocks of both the Hayes River and Oxford groups. The volcanic and sedimentary members closely resemble the Keewatin and Timiskaming rocks, respectively, of Ontario.

Table of Formations

Quaternary	Recent Pleistocene	Peat, lacustrine clay, sand, gravel, boulders, boulder clay
Precambrian		Diabase
		Quartz-porphyry, feldspar-porphyry, pegmatite, aplite, lamprophyre
		Granite, granite-gneiss, quartz diorite, porphyritic granite
	Oxford group	Arkose, greywacke, conglomerate, quartzite, grit, chert, argillite, slate, garnetiferous and micaceous schists, and gneisses
	Hayes River group	Andesite, basalt, rhyolite, schist, gneiss, agglomerate, tuff, breccia, quartzite, slate, iron formation

Hayes River Group

The Hayes River group comprises a complex group of interbedded sediments and lava flows. The volcanic members distinctly predominate and grade in composition from basalt to rhyolite. They show a heterogeneous assortment of textures, but massive, fine-grained types are the most common. Ellipsoidal and amygdaloidal structures are common, but are local in extent. Only one exposure of flow breccia was observed. The sedimentary members of the group occur at various horizons as relatively thick beds of pyroclastics, slates, quartzites, and iron formation.

Lava Flows. Basalt occurs as thin flows between other members of the group and forms only a minor constituent. They are massive, fine-grained, black rocks. Some phases are porphyritic and show greyish white crystals of labradorite in a black, fine-grained matrix. Rocks of this type outcrop on the northeast shore of Monument bay.

Massive, fine-grained, dark green rocks, andesitic in composition, are the characteristic types of the Hayes River group. On the weathered surface they are smooth and light green. Over wide areas they are altered to greenstones. Ellipsoidal markings are common, but are not well preserved. The best exposures of pillow lava are found on islands in Sharpe and Red Sucker lakes and at the east end of Gods lake. Andesite porphyry is exposed at a number of places near Little Stull lake. Chlorite, hornblende, and hornblende-biotite schists occur locally in all parts of the area underlain by greenstones.

Acid lavas grading from dacite to rhyolite occur locally near the top of the group. Porphyritic rhyolite is the characteristic rock type at Webber lake. There, it is a pale green, glassy looking rock weathering greyish white. Quartz phenocrysts stand out as glassy, eye-like crystals. Locally, the flows have been sheared and converted to sericite schists, in many places impregnated with pyrite.

Massive, dark green to black dacites and rhyolites, which are pale green on weathered surfaces, are associated with andesitic lava at Sharpe and Little Stull lakes.

At the north end of Monument bay, on Stull lake, dacites and rhyolites like some of the lavas of the Hayes River group are interbedded with clastic sediments at the base of the Oxford group.

Pyroclastics. At Red Sucker lake relatively thick beds of agglomerate outcrop on the islands just south of the contact between the two pre-granitic groups. Elongated, subangular fragments of lava, averaging about 5 inches in length, are embedded in dark green, volcanic material. Associated with the agglomerate are dark green, fine-grained, well-bedded tuffs which in many places have a slaty cleavage parallel to the bedding planes.

At Stull lake tuffs and volcanic breccia are exposed at low water-level along the northeast shore of Monument bay. The tuffaceous rocks are dark green and consist of angular fragments of lava that range from a few millimetres to one-quarter inch in size, and are cemented together with fine-grained, ashy material. The volcanic breccia is a spotted rock with dark green, angular fragments of lava embedded in a more acid, volcanic matrix.

Good exposures of agglomerate occur immediately south of Margaret lake; there angular fragments of acidic lava up to 6 inches long stand out well on the weathered surface.

Sediments. Quartzite and slate occur at various horizons within the group. They outcrop on small reefs and islands in the north part of Edmund lake and on islands in Red Sucker lake. The quartzite in places consists of alternating beds of light and dark rock which stand out as prominent bands on the weathered surface. In thin section the light bands show angular and subangular fragments of quartz associated with calcite and blades of sericite, with a few grains of magnetite. In the dark bands biotite is present instead of sericite. The slates are fine-grained, well-bedded rocks showing alternating bands of dark green and black material. A slaty cleavage parallels the bedding planes. The slates are very similar to the associated tuffaceous rocks and may be their altered equivalents.

Iron formation was observed only on the east shore of Monument bay, where it is interbedded with coarse clastics and lava flows. It consists of alternating bands of rusty-weathering, dark brown material and grey chert.

Oxford Group

Rocks of this group are everywhere closely folded and the beds dip steeply. They are composed chiefly of medium-grained, arkosic rocks, with local developments of conglomerate at various horizons, and fine-grained, quartzose types such as quartzite and chert. Relatively thin beds of argillite and slate are present at some localities. Micaceous and garnetiferous schists and gneisses are widespread. In some areas conglomerate marks the base of the sedimentary group. The conglomerate holds pebbles and boulders derived from the underlying Hayes River group, and was evidently deposited on an erosion surface of the underlying rocks. At other localities basal conglomerate is lacking; deposition was apparently continuous between the two groups and no definite boundary can be drawn between them.

The sediments underlie four main areas, namely, Red Sucker Lake, Stull Lake, Little Stull Lake, and Margaret Lake areas, and vary widely in lithology and composition at these four localities.

Red Sucker Lake. Conglomerate occurs in this area as lenses at the base of the group. The pebbles have been highly squeezed and metamorphosed and are not always apparent even on weathered surfaces. In a few exposures the pebbles and boulders have been less highly altered and can be identified as lava, chiefly, with a few of granite, quartzite, and grey schist. The matrix of the conglomerate varies from a dark green, fine-grained rock resembling andesite to a fine-grained, micaceous quartzite and a medium-grained arkose. The conglomerate is invaded by small bodies of white, albite-bearing granite. The intrusive rock occurs as dyke-like bodies up to 20 feet long and about 4 feet wide, and as oval patches varying from 2 inches to 5 feet long. Such oval patches closely resemble pebbles and boulders, but are probably intrusive since some of the overlying quartzite beds are injected by similar granite in the form of uniform globular nodules to form so-called "Beaded Gneisses".

The sediments overlying the conglomerate consist of thick beds of grit, quartzite, and greywacke. The grit and quartzite are light grey rocks with flakes of biotite alined parallel to the bedding planes and lying in a matrix of angular fragments of quartz and feldspar. On the islands along the north shore of the lake the grit gives place to a more compact, dark rock which contains more biotite and may be termed a greywacke. Belts of garnetiferous and micaceous schists and slates are commonly found between beds of the foregoing rock.

Most of the sediments are poorly bedded and at only one exposure was good crossbedding observed. One exposure of greywacke shows poorly preserved ripple-marks. The sediments are cut by a prominent, distinctive, albite-bearing, pegmatite dyke which is an offshoot from the main mass of granite north of the lake. This dyke outcrops on numerous small islands to the west and is at least 6 miles long.

Stull Lake. At this locality thin lava flows are intercalated between thin sedimentary beds at the base of the Oxford group, and the boundary line between the Oxford group sediments and Hayes River lavas must necessarily be arbitrary. This association of sediments and lava is best exposed along the east shore of Monument bay at its northern extremity, where, at low water-level, there is a continuous series of outcrops across the strike. There thin flows of basalt porphyry, dacite, and rhyolite are intercalated with beds of conglomerate, arkose, iron formation, and volcanic breccia.

Conglomerate is developed locally as lenses of variable size, and also as rather persistent beds at various horizons. Some of the beds have been traced for 10 miles and may continue farther. They range from a few feet to 2,500 feet in thickness. A band of conglomerate along the north shore of Stull lake, near the entrance to Monument bay, is about 2,500 feet thick, and is composed of rounded, elongated pebbles and boulders a few inches to 1½ feet long embedded in a grey, arkosic matrix. About 1 mile farther north conglomerate forms a series of lenses and reaches a maximum thickness of 2,500 feet. Rounded boulders of diorite, volcanic breccia, peridotite, rhyolite, and greywacke, up to 3 feet in diameter, lie in a dark, fine-grained, quartzite matrix. Approximately one-half mile north of the latter occurrence is a thick pebble conglomerate, with flattened, lens-like pebbles embedded in an arkosic matrix. Along the north part of the east shore of Monument bay thin lenses of conglomerate are interbedded with arkosic sediments and volcanics. Elongated pebbles of acidic and basic lava, chert, and quartzite from 1 inch to 14 inches long are embedded in coarse, reddish brown, cherty arkose. Some of the pebbles are wholly or in part replaced by ankerite associated with pyrite. Pebble conglomerate outcrops at two points on the west shore of Monument bay. The pebbles are elongated roughly parallel to the dip of the beds. The pebbles have been highly metamorphosed and their composition is difficult to determine, but quartzite seems to predominate. The matrix is a dark grey, glassy quartzite which weathers greyish white.

Between all of these bands of conglomerate are thick beds of coarse arkose, greywacke, and quartzite. The arkose is normally a massive, coarse-grained, bluish grey rock with greyish white fragments of quartz, feldspar, and chert, and reddish brown, angular fragments of iron formation. It is locally sheared with the development of chlorite and sericite schist. In places the arkose is impregnated with pyrite and weathers reddish brown.

Dark grey, fine-grained, bedded rocks containing a considerable amount of biotite also occur, and are classified as greywacke. They are altered locally to hornblende gneiss and hornblende-biotite gneiss.

Quartzite outcrops at a number of localities on islands and points in the south part of Monument bay. The quartzite is a massive or laminated, glassy, dark grey rock weathering greyish white.

Little Stull Lake. In this area conglomerate is interbedded with arkose at or near the base of the sedimentary group. The arkosic interbeds contain a considerable number of pebbles and the conglomerate does not form a definite horizon. Pebbles of rhyolite, andesite, quartzite, chert, vein quartz, volcanic breccia, and granite occur in varying proportions. In no place observed does any one type of pebble predominate markedly over the others. The matrix is similar to the prevailing arkose and normally consists of a fine-grained, light green or grey rock in which glassy, eye-like fragments of black quartz and white feldspar are just visible to the naked eye, and are embedded in a greenish mass of chlorite and micaceous material. In places the matrix is impregnated with pyrite and weathers reddish brown.

The arkose and conglomerate are overlain by approximately 2,000 feet of arkose and greywache which, in turn, are overlain by exceedingly fine-grained sediments classified as chert, argillite, quartzite, and slate. The chert is a massive, hard, compact, black rock which breaks with a conchoidal fracture. The argillite is a black rock with fine laminations. The slate is a black, compact, brittle rock, probably derived from argillaceous material. The quartzites are similar to other quartzites of the area. The change from arkose and greywacke to fine-grained sediments is rather abrupt and suggests a marked change in conditions of sedimentation. However, no unconformity between the two types was observed.

Margaret Lake. Widespread drift and few outcrops render impossible anything but a very general description of the sediments in this area. The sediments are in general highly altered and recrystallized. Conglomerate outcrops along the southern boundary of the area. Towards the north this gives place to fine-grained, argillaceous and quartzose sediments. Banded hornblende-biotite gneisses are extensively developed.

Intrusive Rocks

The members of the Hayes River group, as already stated, are invaded by small bodies of peridotite, diorite, and gabbro. The Hayes River and Oxford groups are invaded by widespread batholiths of granitic rocks and are cut by dykes of granite, pegmatite, aplite, lamprophyre, porphyry, and diabase. Although many variations in texture and mineralogical composition exist, only the characteristic types that persist over relatively large areas will be described.

Granite, granite-gneiss, and quartz diorite. Two types of granitic rocks with only slight variations prevail over the major part of the map-area. They are classified as microcline granite and oligoclase quartz diorite. The two types are associated, but the relationship of the one to the other is unknown; it is supposed, however, that they are merely different phases of the same magma. Gneissic varieties of each type occur over extensive areas, the largest of which is located between Sharpe and Red Sucker lakes. Here the gneissic structure has a pronounced east-west trend.

The microcline granite is a massive, medium-grained, pink rock composed of microcline, orthoclase, and quartz, with some albite-oligoclase and biotite. Microcline is more abundant than orthoclase.

The oligoclase quartz diorite is a massive, grey rock composed chiefly of oligoclase, with some quartz, biotite, and hornblende, etc.

North of Twin lakes and Red Sucker lake, and along the south shore of Kenyon lake, dark-coloured patches of older rocks occur as inclusions in the granite. Along the north part of Kenyon lake, a band of pink, porphyritic granite with rectangular phenocrysts of orthoclase up to 3 inches in length outcrops over a width of 3 miles.

Dykes and stocks of granite invade the sediments and volcanics at a number of localities, and are interpreted as offshoots from an underlying granite batholith.

Dykes. Pegmatite dykes are common in all parts of the area and cut both the granitic and pre-granitic rocks. They strike in all directions and range in width from a few inches to a few hundred feet. They are pink or white. The pink varieties consist essentially of orthoclase and quartz, whereas the white varieties are composed of albite and quartz. Both types locally contain muscovite. Along Kistigan river dykes of graphic pegmatite were noted.

Pink aplite dykes are closely associated with the pegmatite dykes and each cuts the other. Pegmatites also commonly show aplitic phases along their margins. The aplites are composed almost exclusively of orthoclase and quartz.

Small dykes of dark green lamprophyre cut the granitic and pre-granitic rocks at a number of points in the area. They average about 3 feet in width and in general are massive and fine grained.

Dykes of quartz porphyry are abundant in all parts of the areas underlain by pre-granitic rocks. They are dark, greenish grey, fine-grained, glassy rocks weathering greyish white. Phenocrysts of smoky quartz are conspicuous on weathered surfaces.

In places the dykes are small and so finely grained as to resemble quartzite. A thin section of a typical sample shows angular grains of quartz, with a few grains of orthoclase and untwinned plagioclase, blades of sericite, patches of calcite, and a few grains of pyrite. Some of the dykes are sheared and altered to sericite schist, which is impregnated with pyrite.

Dykes of dark grey feldspar porphyry, spotted with abundant white feldspar phenocrysts, cut all members of the Hayes River and Oxford groups. They range in width from a few feet to as much as 100 feet. Some of the wider dykes have coarse-grained phases near the middle and resemble diorite in appearance. Near Little Stull lake some of these intrusives are sheared and fractured, and are cut by quartz stringers. Some of the quartz stringers are mineralized with pyrite, arsenopyrite, and, rarely, galena.

Diabase dykes are not numerous, but were noted at a few localities. The largest observed is at Webber lake; there it stands up as a prominent ridge, projecting southward from the north shore in a long, narrow point. It is about 200 feet wide and at least a mile long. It is massive and medium grained except in the middle where crystals of augite are up to one-quarter inch long. In thin section, laths of labradorite are seen to be embedded in augite crystals, accompanied by a small percentage of olivine. Diabase dykes cut members of the Hayes River and Oxford groups as well as the prevailing granite, and are considered the youngest rocks of the area.

Age Relations

Members of the Hayes River and Oxford groups are cut at numerous points in the area by granite or its derivatives. The presence of granite pebbles in conglomerate shows that an older granite existed at the time the sediment was deposited, but no body of the older granite is known within the map-area.

Field evidence that the sediments of the Oxford group are younger than the members of the Hayes River group may be summarized as follows.

Red Sucker Lake -

(1) The sediments dip away from the member of the Hayes River group and, at one locality, cross-bedding indicates that the beds are not overturned.

(2) Conglomerate directly overlying the Hayes River group contains pebbles and boulders of lava that presumably were derived from the underlying volcanics.

Stull Lake -

(1) Conglomerate beds contain pebbles and boulders of greenstone, rhyolite, and volcanic breccia, all three of which resemble members of the underlying Hayes River group.

(2) In one exposure massive lava grades into amygdaloidal lava as the contact with conglomerate is approached. As amygdaloidal structure is commonly best developed toward the tops of lava flows, the conglomerate probably overlies the lava.

(3) On the north part of the east shore-line of Monument bay conglomerate overlies the brecciated top of a lava flow which faces south; this conglomerate contains pebbles of practically every rock type exposed to the north.

(4) Fragments of cherty iron formation are contained in coarse arkose interbedded with conglomerate; iron formation, as far as known in this area, occurs only as a member of the Hayes River group.

Little Stull Lake -

(1) Lenses of basal conglomerate contain a high percentage of lava pebbles and a few of volcanic breccia; both of these rocks are typical members of the Hayes River group.

(2) The sediments show a gradation from coarse clastics at the boundary line between the two groups, to fine, argillaceous and cherty members in the centre of the sedimentary area.

(3) Fragments of lava are contained in some of the coarse, arkosic rocks.

Structure

At Red Sucker lake the dips and strikes of the sedimentary beds indicate that they are folded into a syncline with an east-west axis. The north arm is represented merely by inclusions of schist and gneiss in the adjoining granite.

A clear interpretation of the structure at Stull lake is difficult owing to the scarcity of outcrops. The structure is also complicated by an interfingering relationship between the uppermost members of the Hayes River group and the basal sediments of the Oxford group. The rocks strike uniformly east-west. Along the north boundary the sediments dip either vertically or slightly to the south. Along the south boundary they have an average dip of 60 degrees to the south. Due to the scarcity of outcrops along the southern boundary it was not found possible to determine which way the tops of the beds face. However, since evidence elsewhere indicates that the sediments normally overlie the lava, it is probable that the sediments face north and are overturned. It seems likely, therefore, that the sediments form a closely folded syncline with an east-west axis and an overturned southern limb. It is probable that minor anticlinal folds are developed towards the east.

At Little Stull lake the sediments are rather massive and poorly bedded. Consequently, accurate dip readings are difficult to obtain, but in general they dip steeply north. The strike of the beds is roughly parallel to the outline of the area underlain by sediments, and conglomerate occurs along the north and south boundaries. These facts lead to the belief that the sediments lie in a syncline with the north limb overturned. The axis of the fold strikes east-west and is arc shaped, with the concave side facing north. Volcanics and pyroclastics, probably members of the Hayes River group, are exposed in the centre of the east end of the syncline and may have been brought to this position by minor anticlinal folding.

Pleistocene and Recent

Sand, gravel, boulders, and boulder clay, left by the retreating ice-sheet, have accumulated in the depressions, and on the southward-facing slopes of ridges and hummocks.

Eskers composed of sand and gravel form broad, gentle ridges trending in a northeasterly direction. The most prominent in the area reaches an elevation of 50 feet above the level of the surrounding country. It follows Kistigan river from its origin to the northern margin of the map-area. The eskers are flanked by broad, flat, outwash plains of sand, gravel, and boulders.

Extensive deposits of clay, in places showing stratification, occur throughout much of the area. The clay was carried in heavily laden glacial streams, and was deposited in local depressions in the floor of a lake, possibly a late stage of glacial Lake Agassiz.

Recent deposits of peat form thick beds in muskegs and swamps and extend as a thin mantle over practically all pre-glacial and glacial deposits.

Economic Geology

Prospecting in this area is difficult because much of the ground is low and swampy and outcrops few. The prospector should remember that such outcrops as do occur are most often found on the northward facing slopes of ridges, and on the south shores of lakes. The best times for prospecting in this area are in early spring before "break-up", and in late autumn, when the water-level is low and the mosquitoes and flies are less numerous.

Commercially valuable ore deposits in other parts of the Canadian Shield occur in sedimentary and volcanic rocks, which are invaded by granite and related intrusives. The ore-bodies show a striking relationship to small intrusives such as dykes, sills, or stocks of quartz porphyry, feldspar porphyry, granitic or dioritic rocks. Intrusive bodies of these rocks are common in the sections of this area underlain by sedimentary and volcanic rocks.

Types of mineralization found in the district are as follows.

(1) Pyrite and arsenopyrite in quartz lenses in sheared or fractured zones.

(2) Disseminated pyrite and pyrrhotite in shear zones.

(3) Disseminated pyrite and pyrrhotite in silicified sediments. This is an important type of mineralization. The sediments in general are hard, porous, and brittle, and when fractured tend to preserve their openings, thus allowing mineralizing solutions to permeate the rock.

(4) Disseminated pyrite, pyrrhotite, and arsenopyrite in porphyry dykes, some of which are cut by mineralized quartz stringers.

The favourable areas of sediments and volcanics comprise four main belts, designated Red Sucker Lake, Stull Lake, Little Stull Lake, and Gods Lake belts. Only the east end of the Gods Lake belt lies within the map-area. This has been described by Wright.[1] The economic geology of the other three belts is

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[1] Geol. Surv., Canada, Sum. Rept., 1931, pt. C.

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described below. The easterly extensions of the Stull Lake and Little Stull Lake belts in Ontario have been described by Satterley.[2]

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[2] "Preliminary Geological Report on Stull Lake-Echoing River-Sachigo Lake area, district of Kenora (Patricia portion); Ontario Dept. of Mines, 1936.

Red Sucker Lake Belt

Strata of both the Hayes River and Oxford groups are represented in this area. The Hayes River group, here, consists mainly of andesite overlain by thick beds of agglomerate with associated bedded tuff and quartzite. The character of the Oxford sediments has been described in detail in the section on "General geology".

The rocks as a whole are massive; no extensive shearing or mineralization was noted. However, one shear zone of chlorite and hornblende-biotite schists, exposed only at low water-level along the south shores of the most southern greenstone islands, is cut by narrow quartz stringers well mineralized with pyrite. The schist is associated with massive lava and a banded tuffaceous rock, and may be the altered equivalent of either of these rocks.

A group of claims was staked by T. Wass in 1928, about $2\frac{1}{2}$ miles east of the western extremity of this belt. It is reported[1] that a white, aplitic, albite-bearing granite containing small crystals of cassiterite was discovered on the claims.

[1] Geol. Surv., Canada, Sum. Rept., 1931, pt. C, p. 24.

Outcrops are more numerous here than in the other two belts, and are especially good along the shores of islands. The area, however, is somewhat small to be of great interest to prospectors.

Stull Lake Belt

This prospecting area extends from Stull lake on the Manitoba-Ontario boundary line westward for at least 37 miles to Webber lake. At the boundary it is 6 miles wide. Fifteen miles farther west it narrows abruptly; from there to Webber lake it averages $1\frac{1}{2}$ miles wide.

In Monument bay, Stull lake, the outcrops are scarce even along the shore. The best exposures are along the south shore, and along the northern part of the east shore.

A group of claims was staked by J.B. Mears on Monument bay in July 1935, along the south contact between the sediments and volcanics near the Manitoba-Ontario boundary. The rocks along the shore-line consist of quartzite and greywacke with thin interbeds of chert and conglomerate, and are followed to the south by greenstone. Disseminated pyrite occurs in some of the sediments, but was not found anywhere in abundance. Several shear zones were noted in the greenstone. Some of these are cut by narrow quartz stringers, and are sparingly mineralized with pyrite and arsenopyrite.

Along the north part of the east shore of Monument bay thin, sedimentary beds are intercalated between lava flows. Some of these beds weather rusty brown, are partly altered to carbonate, and are mineralized with pyrite.

At Webber lake the prevailing rock is acidic lava, with a few thin flows of basic lava and narrow beds of greywacke and quartzite. In many places the acidic lavas have been sheared to form talcose, sericite schist, which at a number of points is well mineralized with pyrite.

Little Stull Lake Belt

This belt extends from the Manitoba-Ontario boundary line northwesterly past Little Stull and Margaret lakes to Edmund lake.

Near Little Stull lake the rocks are cut by numerous quartz porphyry and feldspar porphyry dykes, which strike parallel to the bedding and schistosity of the invaded rocks. Many of the dykes carry disseminated grains of pyrite; others are cut by narrow, pyrite-bearing quartz stringers. Three small stocks of granite were noted. One of these is located about 2 miles southwest of

Ken bay south of the lake. The other two outcrop at the two extremities of the south shore of the bay. A strong shear occurs near the contact between the sediments and lavas along the southwest shore, and within the shear small, lenticular bodies of blue quartz were observed at a number of points; in two places observed the quartz carries a few specks of visible gold.

Sheared and fractured zones occur in the body of sediments about Little Stull lake. Some of these are cut by mineralized quartz veins. Gold was panned from the rusty cappings of a few of the veins.

Several groups of claims, as described below, were staked late in the summer of 1936, near Little Stull lake. Little work had been done on any of the claims at the time they were examined.

One of these, staked by A. Mosher and H. Lajeunesse, is located along the southwest shore of Little Stull lake northwest of Ken bay. A strong shear zone on the claims in lava near the contact with sediments follows the shore-line. The lava is altered locally to chlorite and hornblende-biotite schist. Three shallow trenches were put down across the schist zone, which is 25 feet wide. The schist is cut by blue quartz stringers, and both the schist and quartz are well mineralized with pyrite. The vein matter carries inclusions of a fine-grained black rock which resembles a tuff. This rock may represent a narrow, sedimentary bed that served to localize the shear.

Eighteen claims, staked by Wm. Hanson, cover most of the largest island in Little Stull lake, and the adjoining point. The country rock is greenish grey, medium-grained arkose, containing abundant fragments of dark quartz and, in places, narrow pebble beds. The sediments strike north 65 degrees west and dip 75 degrees north; they are invaded along the strike by quartz-feldspar porphyry dykes. A mineralized shear zone on this group of claims occurs along the shore-line. Quartz veins up to 4 feet wide fill fractures in the arkose along the shear zone; the veins are mineralized with pyrite, arsenopyrite, some galena, and, in a few places, visible gold. Gossan on the showing gave gold tailings when panned. The quartz is greyish white, is brecciated and granulated in places, and contains needles of tourmaline and inclusions of a hard, fine-grained, black rock which may be the altered equivalent of cherty argillite.

A group of claims is located near the hook-shaped bay north of the lake. The sediments in this vicinity are well mineralized in places, and are cut by well-mineralized porphyry dykes, some of which are worth investigation.

Mineralized quartz veins were noted near the small boss of granite at the foot of Ken bay south of the lake. Some trenching has been done on a small island at the foot of the bay. The trenches are in a zone of chlorite schist which is about 20 feet wide and is cut by narrow stringers of quartz. The schist outcrops also on the small island to the southwest. Gold is said to have been obtained in samples from this schist zone.

Some work has been done, about 2 miles to the north, on a porphyry dyke at the mouth of the bay. The dyke is about 20 feet wide and in places is well mineralized with pyrite and some chalcopyrite.

Mineralized shear zones were noted in the vicinity of the oval-shaped boss of granite at Margaret lake. The mineralization in places is fairly plentiful, but none of the zones was examined in detail.

At all the prospects examined, the quartz veins are rather narrow, and the vein matter exposed in the trenches is somewhat limited, but, being such recent discoveries, little work had been done on any of them at the time of examination. It would appear that more work is necessary to show their possibilities.

The district in general offers mineral possibilities comparable to other parts of the Canadian Shield in which commercial ore-bodies are found. The mineral occurrences found to date and the character of the geological formations indicate that further prospecting is warranted.