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BUREAU OF ECONOMIC GEOLOGY

GEOLOGICAL SURVEY

PRELIMINARY REPORT

OPAWICA CHIBOUGAMAU MAP AREA NORTHERN QUEBEC

BY

G. W. H. Norman

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INTRODUCTION

This report gives the general results of mapping during 1935 in the Opawica-Chibougamau map-area, which comprises an area of about 5,000 square miles lying north of Oskelaneo, a station on the Canadian National trans-continental line between Quebec and Cochrane. Accompanying the report is an advance print of the geological map, which shows granite areas and pre-granitic rocks (volcanics, sediments, intrusives). The pre-granitic rocks are the most favourable for mineral deposits, and this report is mainly a brief statement concerning them to serve as a guide to prospectors and others interested in the exploration of the region.

GENERAL GEOLOGY

The larger part of the map-area is underlain by greenstones, sediments, basic intrusive rocks, and granite, similar to corresponding rocks in Rouyn region. The remaining part, which forms the southeast corner of the map-area, is underlain by hornblende and biotite schists and gneisses, granite, and granite-gneiss. The group of rocks that underlie the greater part of the map-area appear to grade into those occupying the southeast corner. The gradation occurs in a northeast-trending zone that passes about 6 miles southeast of Chibougamau lake where the zone is narrow, farther southwest the zone is wide.

The hornblende and biotite schists and gneisses, granite and granite-gneiss that underlie the southeast corner of the map-area are not described in this report, as they seem to offer little inducement to prospectors searching for gold or copper. They may contain non-metallic mineral deposits, but the distance from the railroad would hamper development of such deposits.

The rocks of the larger part of the map-area are divisible into pre-granitic, granitic, and post-granitic. The pre-granitic rocks are volcanic, sedimentary, and basic intrusive rocks, and anorthosite. The volcanic rocks are similar to those termed Keewatin in other parts of the Canadian Shield, and are predominantly greenstones and green schists derived from flows of andesitic composition, but also include basaltic and rhyolitic rocks. In some places narrow bands of well-bedded rocks, breccias, and coarse fragmental rocks accompany the flows. The sediments are assumed, from the meagre evidence obtainable, to be younger than the bulk of the volcanic rocks, but they are possibly of more than one age and some may be interbedded with the Keewatin volcanics. The sediments are as a rule well stratified, grey to dark grey, buff, and in some places green to pale green rocks. They range for the most part from fine-grained cherty or slaty types to moderately coarse-grained types. A high feldspar content is one of their chief characteristics. Conglomerate forms a relatively small proportion of the sediments. The most common boulders in the conglomerate are grey, fine-grained quartz-feldspar to feldspar porphyries and grey felsitic rocks. In general the pre-granitic sedimentary rocks are comparable, in character and in their structural relationships to the volcanics, with the Timiskaming series of

Rouyn district. The basic intrusive rocks occur as sheets and crosscutting bodies in the volcanic, and to a lesser extent in the sedimentary, rocks. They are particularly prevalent in the northern half of the northeastern quarter of the map-area. Altered gabbros are the most common basic intrusives, but east and south of Opémisca lake they are accompanied by pyroxenites and serpentines. Grouped with the basic rocks are quartz-bearing, altered, dark green rocks somewhat like the quartz diorite of Rouyn district. One large mass of altered anorthosite occurs at Chibougamau lake, another much smaller mass occurs on Opawica river.

The granitic rocks range from diorite to granite. The most prevalent types are light coloured and contain a moderate proportion of quartz. They occur in masses of various sizes from dykes and small stocks to large batholiths. The post-granitic rocks are small masses of sediments and dykes of olivine diabase and gabbro. The sedimentary rocks rest unconformably on older rocks and are confined to a narrow strip of country extending from Gwillim lake to McKenzie bay, lake Chibougamau. The diabase and gabbro dykes are probably younger than the sediments, occur in widely separated parts of the area, and have a general east northeast to northeast trend. The two best known, one on lac la Trêve, the other on Opawica lake, extend for 20 miles or more in length and are 100 to 200 feet wide.

Belts of Pre-granitic Rocks

The pre-granitic rocks, other than those of the southeast corner of the map-area, lie in three main belts trending east to east southeast. The three belts from north to south are: the Lac la Trêve-Chibougamau Lake

belt, the Opawica-Windy Lake belt, and the Penache-Eagle river belt. The Lac la Trêve-Chibougamau Lake belt is the widest and contains all the important mineral discoveries yet made. Its western part is separated from the Opawica-Windy Lake belt by the Obatogamau River granite mass which is about 14 miles wide. Its eastern part swings round the east side of the Obatogamau River granite area to unite with the Opawica-Windy Lake belt between Eau Jaune and Obatogamau lakes. The Opawica-Windy Lake belt extends east southeast across the central part of the map-area. It averages about 10 miles in width and is separated from the Penache-Eagle River belt by the Father Lake granite mass. West of Father lake this mass is about 26 miles wide and narrows to about 16 miles east of the lake. Included in it are small roof pendants of greenstone and sediments and one possibly continuous band of greenstone about a mile wide extending west from the northern end of Father lake to Wetetnagami river. The Penache-Eagle River belt was not thoroughly explored, but is known to extend east along the south side of the map-area and apparently varies from about 3 to 10 miles wide. In the following pages the three belts will be described in order from north to south.

Lac la Trêve-Chibougamau Lake Belt

The southern boundary of the Lac la Trêve-Chibougamau Lake belt east of Obatogamau lake trends northeast. Between Obatogamau and Presqu'ile lakes the greenstones underlie the whole area, so as to join the northern belt to the middle, Opawica-Windy Lake belt. West of Presqu'ile lake the boundary lies near Obatogamau river as far as its junction with Chibougamau river, beyond which

the boundary runs nearly due west. The belt is bounded on the north by a granite area, the southern limit of which lies a short distance north of the outlet of lac la Trêve, and runs northeast beyond the limits of the map-area. The belt is about 12 to 13 miles wide at lac la Trêve and widens eastward to a maximum of about 28 miles, but a part of the latter width is granite, areas of which occur at Opémisca lake and Chibougamau lake. The granite mass at Opémisca lake is 8 miles wide and 16 miles long, that at Chibougamau lake ranges from 4 to 10 miles wide and extends interruptedly from Scott lake eastward beyond Chibougamau lake.

In the western part of the belt, west of lac des deux Orignaux, the prevailing rocks are sediments, which are cut by a few dykes and small stocks of granite and also by a few small bodies of gabbro. The northern third of the belt, in this locality, is underlain by pillowed lavas (greenstone). The greenstone in places forms prominent ridges with excellent exposures, particularly north and for a few miles west of lac la Trêve, in contrast with the sedimentary rocks which are poorly exposed. The granite stocks and a fresh diabase dyke that runs east northeast across lac la Trêve form low, prominent hills and ridges, and near such prominences sedimentary rocks are exposed.

Features worthy of mention in this region are the occurrence of small, granitic intrusions, the rock structure northeast of lac la Trêve, and that north of lac Inconnu. The granitic rocks are quartz rich to syenite types, but their relative freshness and the highly metamorphic character of sediments adjacent to them are not encouraging indications of mineral deposits. Near the granite stock south of lac la Trêve the sediments are altered to biotite-rich rocks and are cut by closely spaced, narrow, lit-par-lit injections of

granite. The structure southeast of the long, narrow arm extending northeast from the north side of the lake was not determined, but the distribution of the volcanic and sedimentary rocks suggests close, plunging folds. Such structures where present are worth examination. North of the western part of lac Inconnu the trend of the formations changes rather suddenly from an east northeast to a northwesterly direction. The relative movements between rock masses in the vicinity should be greater than elsewhere and in consequence a greater degree of faulting, folding, and dragging of the strata should be present.

The Lac la Tréve-Chibougamau Lake belt east of lac des deux Orignaux possesses a greater diversity of rock types and a more complex structure than the part that lies west of the lake. The area of sedimentary rocks to the west forks at the lake into two bands, one of which passes south, the other north, of Opémisca lake. The southern band is fairly well delimited for about 36 miles. Southeast of lake Chibougamau a few outcrops of well-banded, altered, sedimentary rocks occur which may be a continuation of the belt of sediments south of Opémisca lake. The band of sediments that passes north of Opémisca lake was not fully delimited, but outcrops of sediments that occur in places between Barlow lake and the south end of Gwillim lake may represent a continuation of the band. If so, the band of sedimentary rocks extending eastward from Bourbeau lake may represent a still further continuation, though broken and interrupted by faults and intrusive masses.

The greenstones that lie south of the southern band of sediments between Presqu'ile lake and lac des deux Orignaux are for the most part poorly exposed. The true

nature of some of the rocks that occur in this low section of country is doubtful.

The volcanic rocks that lie between Opémisca lake and lac des deux Orignaux in the roughly triangular area bounded by sediments and granite are intruded very extensively by gabbro. This is a rocky region with plentiful outcrops.

The region of volcanic rocks that stretches along the north side of Opémisca lake and eastward from the lake along the northern border of the map-area to its eastern limits is in general a region of plentiful outcrops. Low areas of muskeg or sand-plains occur here and there, however. The volcanic rocks of this region compare in character with those between Opémisca lake and lac des deux Orignaux, and are similarly cut by basic intrusives. The basic intrusives range from gabbro to pyroxenite and serpentine and occur in masses of various sizes, but throughout one belt 2 or 3 miles wide are grouped together in a series of closely spaced, sheet-like masses. This belt extends in a general easterly direction from the central part of Gwillim lake and passes immediately south of Bourbeau lake. A similar belt, possibly a continuation of the Gwillim-Bourbeau belt, extends westward from the southwest end of Gwillim lake to Barlow lake. West of Barlow lake a belt of basic intrusive rocks lies a short distance north of Opémisca lake. The basic intrusive rocks that form these belts stand out as prominent ridges and high hills.

Anorthosite and closely related gabbroic rocks occur in the Lac la Trêve-Chibougamau belt about Chibougamau lake and on Chibougamau river between Opémisca lake and Gladstone falls. At the latter locality the rocks are prevailingly gabbro, and anorthosite is rare. The

Chibougamau Lake anorthosite is cut into separate masses by a granite-diorite intrusive complex. The largest mass lies north of the granite complex and extends eastward from Doré lake across the north side of Chibougamau lake. The largest and two smaller masses, one on the southern part of Doré lake and the other on David lake, may not be separate, but their possible connexions are partly concealed and partly interrupted by dioritic rocks. Another large mass of anorthosite and gabbro lies immediately south of the granite complex. This mass is 2 to 3 miles wide and extends east northeastward from the southwest corner of Chibougamau lake. It consists largely of sheared and altered gabbroic phases, many of which contain a high concentration of magnetite and are comparable with the magnetite-bearing rocks on the north side of the anorthosite east of Bear bay, lake Chibougamau.

Two large granite areas, one at Opémisca lake, the other at Chibougamau lake, lie in the Lac la Tréve-Chibougamau Lake belt. The Opémisca granite completely underlies Opémisca lake and extends southwestward from the lake for about 4 miles. The area underlain by this granite is about 128 square miles. Limited observations indicate it to be a comparatively homogeneous mass. The central part is medium to coarse grained, light coloured, and contains a moderate proportion of quartz. The rock near the border of the mass tends to be darker in colour and in places contains little quartz. It appears to be fresher and on the average less deformed than the Chibougamau granite.

The Chibougamau granite mass is more irregular in outline and in composition than the Opémisca mass. It

is divided into an eastern and a western part by Doré lake and by the areas of anorthosite on Doré and David lakes. The rock of the eastern part ranges from coarse-grained biotite granite to diorite. It is commonly slightly crushed, but in some places it is intensely sheared and converted to fine-grained schists. On the average, however, the mineral components are less altered than those of the western part, between Doré lake and Scott lake. The rock of the western part ranges from light-coloured, coarse-grained granite high in quartz to dark coloured, medium-grained diorite. It is not conspicuously deformed but in many places is partly altered to aggregates of secondary minerals. The coarse-grained, quartz-rich types are more typically developed in the northern part of the western mass. On Scott lake the quartz-rich types underlie an area about 2 miles wide bordered on the south by an area of dioritic rocks slightly more than 1 mile wide. The quartz-rich types are not well exposed north of Simon lake, but seemingly form one continuous body stretching from Scott lake to and along the north side of David lake. Dioritic types are characteristic of the southern part of the western mass and are well exposed south of the quartz-rich types on Scott lake and on Simon lake. They vary in composition without apparent order from diorite to probably granodiorite and are cut by a fine network of white quartz-feldspar aplite seams.

A few smaller masses of granite and syenite, already described[1], occur in the Lac la Trêve-Chibougamau Lake belt. There are also many dykes of quartz porphyry, feldspar porphyry, and quartz-feldspar porphyry, which are

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[1] Geol. Surv., Canada, Mem. 185

probably more widely distributed than the reconnaissance mapping indicates. Such dykes are probably related to the granitic intrusions and are hence probably more abundant near granitic intrusions than elsewhere. They are present northwest of Gwillim lake, southwest of Bourbeau lake, and in the country between these lakes. Small masses of feldspar to hornblende feldspar porphyry intrude gabbro and greenstone about one-quarter mile or so east of the central part of lac des deux Orignaux.

Mineral Deposits of the Lac la Trêve-Chibougamau Lake Belt

Most of the mineral deposits and prospects discovered to date lie in the eastern part of the Lac la Tréve-chibougamau Lake belt. Only a brief description of principal types can be given here; for further information earlier reports[2] should be consulted. The best type examples of the deposits of the district are those at Opémisca lake, Doré lake, lake Chibougamau at Bear bay, Bourbeau lake, Gwillim lake, and Simon lake. The first three are sulphide-rich types, the remainder are quartz veins or quartz-rich types.

Sulphide Deposits. The Opémisca deposit lies in gabbro and pyroxenite midway between Opémisca and Presqu'ile lakes. It consists of elongated, lenticular bodies of sulphides containing irregular masses of quartz and in places magnetite. Chalcopyrite occurs in larger amounts than other sulphides and forms in places solid

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2. Chibougamau Lake Map-area, Quebec; Geol. Surv., Canada, Mem. 185.
Township of McKenzie, Chibougamau Region, Quebec; Que. Bureau of Mines Rept. 1929-1930.
Southern Part of the Opemiska Map-area, Quebec; Geol. Surv., Canada; Sum. Rept. 1930, pt. D.

masses 4 feet or more wide; a low gold content is present throughout most of the deposit. The general trend of the lenticular bodies is easterly and they are for the most part parallel. At least one narrow zone containing quartz, arsenopyrite, and gold crosses the easterly trending, chalcopyrite-rich lenses in a northwesterly direction and there may be others. These zones have a higher gold content than the chalcopyrite lenses. The wall-rocks adjacent to the mineral deposits are not conspicuously altered or sheared.

A number of mineral deposits (for example, the Cedar Bay, Merrill Island, and Kokko Creek deposits) occur at Doré lake. They are sulphide-quartz replacements in sheared zones in anorthosite, with the exception of those on the Obalski property north of Cache bay and a few others. Those on the Obalski property lie partly in anorthosite and partly in highly altered dioritic to granitic rocks. In the mineralized zones the sheared anorthosite is chloritized and is green in colour. Near or beside many of the mineralized zones and parallel to them are dykes of fine-grained quartz porphyry resembling rhyolite in appearance. The characteristic minerals of this type of deposit are chalcopyrite, pyrrhotite, and/or, pyrite, and quartz. Reported assays indicate that local high concentrations of gold also occur. The deposits of this type are lenticular bodies with considerable width compared with their length. Variants of the type containing a high percentage of quartz, such as some deposits on the Obalski property, are more vein-like in structure.

Massive sulphide deposits, consisting principally of pyrrhotite and in places pyrite, but with only a small

proportion of chalcopyrite, occur along a contact of greenstone with serpentine and with altered gabbroic rocks, at Sorcerer mountain, immediately south of Bear bay, lake Chibougamau. The deposits are a series of discontinuous lenses situated at or near the contact, and consist of rock heavily impregnated with sulphides or solid masses of sulphides several feet wide. Sulphide deposits of this type, ranging in size from minor impregnations to massive bodies of nearly pure sulphides, occur at many places in the eastern part of the Lac la Trêve-Chibougamau Lake belt. They lie generally in schistose rocks, either greenstone or sediments, and usually close to the margin of basic intrusive masses. They contain very small amounts of copper and probably rarely more than a trace of gold.

Quartz Deposits. The gold-bearing quartz deposits at Bourbeau lake, Gwillim lake, and Simon lake differ from one another in mineral composition, form, and structure.

The quartz vein on the Noranda property on the south side of Bourbeau lake lies in a northeasterly trending shear zone in basic intrusive rocks (gabbro, "quartz-diorite"). It is a tabular body of quartz with sharply defined borders. The quartz contains very small amounts of sulphides, principally arsenopyrite. The wall-rocks along the vein have been impregnated with pyrite and carbonates. A pronounced depression that may indicate a fault extends in an easterly direction immediately south of the deposit.

The Gwillim Lake deposit was drilled during the winter of 1934 by the McIntyre Porcupine Mines, Limited. It lies about 2,000 feet north of Gwillim lake and about ½ mile east of the Barlow-McKenzie township line. The deposit is not a simple vein but a shear zone 10 to 20 feet wide in greenstone. Gold assays of samples from this

zone are reported to range from 0.2 to 0.5 ounce a ton. The shear zone is impregnated by a series of small veins and veinlets of quartz and irregular masses of carbonate. The quartz contains small amounts of chalcopyrite, pyrite, and a little sphalerite, and these sulphides occur also sparsely disseminated through the schistose greenstone of the shear zone. The deposit strikes east with local deviations from this direction. Greenstone, 1,000 feet south of the deposit, contains pillow structures and is an altered lava. Part of the greenstone at the deposit is a medium-grained, altered rock that may be either a basic intrusive rock or the coarsest part of a lava flow. Dykes of fine-grained quartz-feldspar porphyry that strike easterly occur along the north shore of Gwillim lake and also near the deposit.

The Simon Lake veins so far discovered are small, but some samples from them are reported to have assayed an ounce of gold to the ton. They occur in altered intrusive rocks that range from chloritic diorite to granite, and form the western part of the Lake Chibougamau mass. The area underlain by these intrusive rocks is about 6 miles long and 5 miles wide and the veins are found well within this area. The best exposed vein at Simon lake is on the north end of Deschenes island. It has been explored by the McKay Exploration Company. The rocks on the north side of the island are dioritic types with a small percentage of quartz. They are cut by narrow dykes and dykelets of medium-grained granite and by irregular seams of coarse-grained material containing a little quartz, but composed principally of light-coloured, altered feldspar. Two short, irregular-shaped bodies of quartz ranging from a few inches to about 3 feet wide, and varying considerably from place to

place in strike and dip have been disclosed. They may be parts of one irregular vein extending in a general northerly direction. The irregular boundaries, strike, and dip of these bodies resemble that of some types of pegmatite dykes. The quartz contains streaks of black tourmaline needles, others of chlorite, and in places small, irregular masses of coarse-grained pyrite, which is also present to some extent in the wall-rocks of the vein. Some of the narrow offshoots of quartz from the main bodies contain small octahedra of magnetite. Large crystals of pale yellow carbonate occur in places in the quartz and form the central part of some of the small veinlets. The wall-rock in places is altered to a pale yellowish, epidote-green material and seemingly has a high content of sericite, but epidote and chlorite are probably important constituents also. A quartz-tourmaline vein very similar to that on Deschenes island occurs in granite at Knoll island, Doré lake.

At present an attempted correlation of even some of the mineral deposits in Chibougamau district with one another and with any particular type of intrusive rock may be more misleading than helpful. It may be pointed out, however, that a few deposits occur within and many more occur near the intrusive rocks that form the western part of the Lake Chibougamau granite mass between Scott and Doré lakes. The deposits that lie within these intrusive rocks at Deschenes island, Simon lake, and at Knoll island, Doré lake, are high-temperature, quartz-tourmaline veins. The deposits on Doré lake that lie in older invaded rocks at no great distance from thes intrusive rocks are lower temperature, copper-gold types. The Opémisca copper gold

deposits are similar in general composition and structure to the Doré Lake deposits, but may not be related in any way to the granitic rocks between Scott and Doré lakes from which they are 7½ miles distant. It is possible, however, that the Opémisca deposits may have been considerably displaced by northeasterly faulting that is a marked feature of the district. In the writer's opinion the distribution of deposits with respect to the western part of the Chibougamau Lake granite mass warrants investigation. Careful prospecting near the contacts of invaded and intrusive rocks between Doré and Scott lakes might test whether the distribution indicated a relationship between low- and high-temperature types of deposits and these intrusive rocks. If a relationship exists other high-temperature deposits may be found within these intrusive rocks and other lower temperature copper-gold deposits about their borders.

The gold-quartz deposits at Bourbeau lake and at Gwillim lake seem to be unrelated to the copper-gold deposits of Doré lake and to the high-temperature quartz-tourmaline veins in the granitic rocks west of these deposits.

The relative age of the mineral deposits to the system of northeasterly faulting in the district is imperfectly known. Northeasterly faults that apparently displace rocks one mile or more occur at McKenzie narrows and at Bag bay, lake Chibougamau. The McKenzie Narrows fault cuts sediments of probable Huronian age and is, therefore, younger than these sediments. The conglomerate of this younger sedimentary group contains numerous granite boulders but is not in contact with the Lake

Chibougamau granite mass. It does rest unconformably on a small syenite stock southwest of Bourbeau lake and is presumably, therefore, younger also than the Lake Chibougamau granite. The highly deformed state of the Lake Chibougamau granite is also evidence for presuming that the granite is older than the faults. If the mineral deposits are in some way related to granites older than the Huronian sediments of the district they must be older than the northeasterly faults that cut the Huronian sediments. That they are all related to granites older than these sediments is not definitely proved.

Southeast Part of Lac la Trêve-Chibougamau Lake Belt

The area underlain by greenstone between Presqu'ile, Obatogamau, and Windy lakes is in general flat. Low outcrops are present on lake shores along the water's edge, but inland the rocks are for the most part concealed by drift or muskeg. In the hilly country that lies immediately northeast of lac de la Baie the rocks are mapped as granite, although, in places, they contain up to some 50 per cent of greenstone. The included greenstone is metamorphosed to coarse hornblendic rocks and is cut by irregular stockworks of coarse-grained, dark-coloured, granitic rocks. It is improbable that such highly metamorphosed greenstones contain valuable mineral deposits.

The belt of greenstones between Presqu'ile and Obatogamau lakes extends eastward between granite areas on Obatogamau lake and Chibougamau lake, but northeast of Obatogamau lake the trend changes from easterly to northeasterly and the belt is about 4 miles wide. Between

Obatogamau and Chibougamau lakes the greenstones consist of fine-grained, pillowed lavas and medium-grained, basic rocks, some of which may be small, intrusive bodies. They are schistose in places, but on the whole not highly metamorphosed. Rock exposures, although not abundant, are fairly common on lake shores and inland from lakes. Farther east the rocks are more highly deformed and include large masses of basic gabbro and anorthosite. Fairly high ridges in which outcrops are plentiful occur southeast of Chibougamau lake. The deformation and metamorphism of the rocks appear to increase gradually from lake Chibougamau southeast towards Boisvert river. For about 3 miles northwestwards of Boisvert river the rocks are highly metamorphosed and consist largely of garnetiferous hornblende schists.

Opawica-Windy Lake Belt

The rocks of the Opawica-Windy Lake belt as a whole are not more highly metamorphosed than those in the Lac la Trêve-Chibougamau Lake belt. Volcanic rocks ranging from basic to acid types are most common and although sedimentary rocks occur on the south side of Caopatina lake they have not been differentiated in mapping from the volcanic rocks owing to lack of information as to their distribution. It is also probable that sedimentary rocks underlie a linear belt that extends for many miles east and west from Caopatina lake. Intrusive bodies of altered basic rocks, including anorthosite, occur in the Opawica-Windy Lake belt, and these are comparable lithologically and structurally with the basic intrusive rocks in the eastern part of the Lac la Trêve-Chibougamau Lake belt,

but are not so plentiful. Rock outcrops are fairly common in parts of the area, but on the whole it is less hilly and rocky than the Lac la Trêve-Chibougamau Lake belt.

The lithological character and the succession of the pre-granitic rocks in the eastern part of the area at Windy lake are different from those in the western part at Opawica lake. Less is known regarding the pre-granitic rocks of the central part of the belt, but a description of the lithological character of the rocks in the eastern and western part of the belt probably applies also to some of the rocks in the central part.

The northern part of the belt at Windy lake consists of basic to moderately basic flows fairly well exposed on lake shores and on Opawica river. The basic types occur between Windy lake and the large granite mass that crosses Opawica river about 2 miles northwest of Windy lake. The basic types are medium-grained greenstones devoid of pillow structures. The greater part of Windy lake is underlain by moderately basic flows that possess many undeformed pillows which indicate southward-facing flow tops. A band of acid volcanics several hundred feet wide strikes slightly north of east across the northern part of Windy lake. A few outcrops near the centre of Windy lake and on Opawica river between Windy and Caopatina lakes are of medium-grained, basic, igneous rocks containing hornblende and a little quartz. They are considered to be small, intrusive bodies of altered diabase. The rocks that outcrop on the river between Windy and Caopatina lakes range from fine- to medium-grained greenstones and are in part pillowed lavas. They are much more highly deformed than similar rocks on Windy lake and are in places schistose. The rocks on the

north side of Caopatina lake are covered by drift. The southern part of the lake is underlain by sedimentary rocks and in a few places by schistose, basic, igneous rocks. The sedimentary rocks are for the most part finely banded and fine-grained, light-grey to pale green types. The light-grey types have a high content of white mica; the green types contain chlorite and in places sufficient magnetite to deflect a compass needle 180 degrees. Some biotite is present in some of the sediments. Drag-folds that plunge gently eastward indicate that the tops of the sedimentary beds face south. A few outcrops of basic, igneous rocks that have been converted to fine- or medium-grained hornblende schists lie north of the belt of sediments on Caopatina lake and similar rocks were found in one or two places within the sediments. The south boundary of the Opawica-Windy Lake belt passes eastward across the centre of Surprise lake. The few rocks that outcrop north of this boundary on the northwest shore of Surprise lake and along the river just below the lake are much more highly metamorphosed than the sedimentary and volcanic rocks on Caopatina and Windy lakes. Those outcropping on the river near the outlet are dark green, medium- to coarse-grained hornblende schists derived probably from volcanic rocks, and contain a little biotite and garnet. The rocks on the northwest shore of Surprise lake are light-grey, garnetiferous mica schists of somewhat similar appearance to the sedimentary rocks on Caopatina lake. The belt at Surprise lake is bounded on the south by a belt of granite about 17 miles wide. One band of hornblende schist strikes east within the granite on the south side of Surprise lake. It is $\frac{3}{4}$ mile wide on the east, and widens to some $2\frac{1}{2}$ miles farther west.

The western part of the Opawica-Windy Lake belt between the outlet of the north arm of Opawica lake[1] and the granite area immediately east of the junction of Opawica and Chibougamau rivers is underlain by basic, to moderately basic, igneous rocks. In part they are apparently intrusive, although the boundaries of the intrusive bodies are not sharply marked by clearly visible changes in lithology. The rocks considered intrusive are medium grained and dioritic in appearance. The remaining basic rocks of this section are fine- to medium-grained greenstones, which though lacking typical volcanic structures are considered to be altered basic flows. Lavas with feldspar phenocrysts prevail throughout the southern part of the Opawica belt from the outlet of the north arm of Opawica lake for 6 miles south to the edge of a large granite area. They are moderately dark to light coloured and are probably intermediate in composition between andesites and trachytes. Along the south shore of the north arm of Opawica lake, however, coarse- to fine-grained quartz porphyries, rhyolites, and well-bedded tuffs or sediments occur. Immediately south of the rhyolite and associated rocks is a belt about 40 chains wide of moderately basic greenstone displaying in places deformed pillow structures. The greenstone belt extends east northeast to underlie the narrow strip of land between the two arms of Opawica lake. Some of the quartz porphyries on the south side of the north arm cut across bedded rocks and are, therefore, intrusive. The intrusive types contain phenocrysts of quartz one-quarter inch in

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1. The north arm of Opawica lake is usually referred to as Opawica lake, on the map the name Opawica lake is placed on the southern half.

size, and in places feldspar phenocrysts. The quartz porphyries, however, although intrusive, may not be much younger than the acid volcanic rocks that they intrude. They are similar mineralogically to the rhyolites with which they are associated and it is possible that they may be only the intrusive phases of these flows.

Other intrusive rocks are anorthosite, syenite, granite, and one dyke of diabase. The anorthosite is a cigar-shaped mass that extends east southeast from the south arm of Opawica lake, and is cut off on the east by granite. The anorthosite is in many places unaltered, but highly altered types like those at Chibougamau lake are present. Toward its western end the anorthosite contains altered gabbroic phases difficult to distinguish from greenstone. Dykes of the gabbroic phases with large feldspar phenocrysts cut the volcanic rocks in this vicinity. Syenite occurs as a small stock which lies partly on the northwest corner of Opawica island in the north arm of the lake and partly on the adjacent mainland. The syenite is pale red, medium-grained, and contains about 20 per cent hornblende. Small dykes of syenite occur in the volcanics near the parent stock. The diabase dyke is much younger than the granite and belongs to the group of fresh olivine diabase-gabbro dykes that strike east northeast across the area. It cuts across the central part of the south arm of Opawica lake.

Intense shearing occurs within a belt $\frac{1}{2}$ to 1 mile wide that extends along the south side of the north arm of Opawica lake. No definite alinement of the various shear zones was determined. The general movement as indicated by drag-folds is westward on the south side and

eastward on the north side of the belt, but a few drag-folds indicate an opposite movement. The shearing suggests large faults but none was located. A large fault may occur at the southwest corner of the north arm of Opawica lake. Its presence is suggested by the fact that the pillow lavas between the two arms of Opawica lake, if projected westwards along their strike, would pass considerably south of the observed position of similar lavas southwest of the north arm.

The following remarks on prospecting apply to the rather flat region from the northern end of Father lake to Windy and Surprise lakes. Outcrops, although not plentiful, indicate that the prevailing rocks are volcanics and in part sediments or tuffs. Probably the most unfavourable parts for prospecting are the areas underlain by highly metamorphic rocks about Caopatina and Surprise lakes. The greenstone area that extends west for about 8 miles from the southwest corner of Surprise lake contains, in places, rocks mineralized with disseminated pyrite and a few, small, mineralized quartz veins. They were observed particularly near the northern contact of the greenstone with granite about the small lakes that lie 3 miles west of Surprise lake. Shear zones mineralized with pyrite and a few small quartz veins occur at the southern contact of greenstone with granite on lake Doda, the large lake immediately east of Father lake.

In the part of the belt west of Father lake intense shearing occurs along the south side of the north arm of Opawica lake, and a greater variety of intrusive rocks is present than in the eastern part of the belt. For these reasons it is considered to be more favourable

for prospecting than the eastern part of the belt. The anorthosite, and the granite intrusive into it, are well exposed and in places underlie hilly country. The greenstone south of the anorthosite is poorly exposed. Outcrops of greenstone are fairly numerous east of the north arm of Opawica lake and north of the narrow, eastern arm of the lake. One deposit containing gold enough to induce considerable exploratory trenching has been discovered on the large island in the north arm. It occurs a short distance southeast of a syenite stock in dioritic rocks that are fractured and somewhat carbonated along a zone about 10 feet wide that strikes slightly east of north. Numerous small stringers of quartz up to 2 inches thick are present along the fractured zone. In a few of the quartz stringers a little chalcopyrite and traces of galena are present, others contain a little specularite, and a small amount of pyrite occurs in the altered wall-rock. The Opawica Island deposit, although in diorite, is a quite different type from that on Deschenes island, Simon lake. The diorite on Opawica island is believed to be mainly re-crystallized lava, that on Deschenes island is a normal intrusive rock. The deposit on Opawica island may not be important, but it at least indicates that gold occurs in this section.

Penache-Eagle River Belt

The Penache-Eagle River belt of greenstones on the south side of the map-area was explored along only a few waterways. This part of the map-area is mostly low and flat with large areas of muskeg, and before prospecting

it would probably be advisable to examine the country from the air. In this way ground with sufficient outcrops to encourage prospecting might be found.

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