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ESTCOURT-BAKER LAKE AREA

TEMISCOUATA AND KAMOURASKA COUNTIES

W.A. Gorman

Final report

1977

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GOUVERNEMENT DU QUEBEC

MINISTERE DES RICHESSES NATURELLES

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ESTCOURT-BAKER LAKE

AREA

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by

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THE ESTCOURT-BAKER LAKE AREA
COUNTIES OF KAMOURASKA AND TEMISCOUATA

by W. A. Gorman

INTRODUCTION

General Statement

A program of geological mapping in the Quebec-Maine border area, initiated by the Quebec Department of Mines in 1952 as a result of the discovery of copper-nickel mineralization near St. Fabien de Panet Montmagny County, the previous year, has been continued northeastward along the strike of the mineralized rocks. The Estcourt-Baker Lake Area was mapped geologically in 1956 as part of this program.

The area lies south of St. Lawrence River, about 120 miles east northeast of Quebec City. It is wholly within the Appalachian physiographic province, and entirely on the southeast flank of the Notre Dame-Shickshock Range. Geologically the area is underlain by a great sequence of Paleozoic sedimentary rocks, probably ranging from Lower Cambrian to Middle Devonian in age. The youngest sedimentary rocks have been intruded by at least two lamprophyre dykelets. A thin mantle of glacial till covers most of the area and solifluction, fluvioglacial, and stream deposits form relatively thick deposits in the valleys. Very little prospecting has been done in the area, and no economic minerals have been located. A limestone quarry was operating in the area at the time of the survey, and several gravel deposits were being exploited. Roofing slate was once produced near St. Marc des Etroits.

Location

The Estcourt-Baker area is about 120 miles east-northeast of Quebec City. It is bounded on the north by latitude 47° 30' north, on the east and south by the Province of New Brunswick, and on the west by the State of Maine and longitude 69° 15' west. It includes the townships of Botsford and Robinson, parts of the townships of Pohenegamook, Cabano, Estcourt and Packington and parts of the Seigneury of Temiscouata in Temiscouata county and part of the Township of Pohenegamook in Kamouraska county. The area mapped geologically comprises about 250 square miles.

Access and Settlement

The principal towns of Estcourt, Sully, Riviere Bleue and St. Marc des Etroits are all served by a branch line of the Canadian National Railways, and by Provincial Highway 31, which links St. Alexandre, in the St. Lawrence valley, with Fort Kent, Maine. Both the railway and the highway trend southeasterly across the western two-thirds of the area. Secondary roads afford easy access to all but the southwest and northeast corners of the area. Access to the extreme northeast corner is possible by Provincial Highway 2, linking Riviere du Loup, with Edmunston, New Brunswick. A branch line of the Canadian National Railways parallels Highway 2.

The largest town in the area is Riviere Bleue (St. Joseph de la Riviere Bleue) with a population of 1,500 in 1956. Other centers, with their alternate names and their populations are: Estcourt, (St. Pierre d'Estcourt), 1,100; Sully, (St. David d'Estcourt), 600; St. Marc des Etroits, (Les Etroits, St. Marc du Lac Long), 250; St. Benoit Abbe (Packington), 250; and St. Jean de La Lande, 100. Estcourt is the most important industrial center, with one saw mill producing over 10 million board feet of lumber each year. About a dozen other saw mills and several wood products plants are operated in the area.

About half the labour force is engaged in forestry and allied industries. Most of the remainder are engaged in mixed farming, dairy-farming, or sheep raising.

Field work

The writer was ably assisted by Michel Brochu and Richard Vaillancourt of Quebec City, and Robert May of Brownsburg, Quebec. Pace and compass traverses were carried out at one-half mile intervals, and arial photographs were used at all times as an aid in locating outcrop. The roads and railroads were also traversed, and complex areas were traversed on lines four hundred feet apart. The data were plotted on base maps supplied by the Department of Mines and Technical Surveys, Ottawa.

A mantle of glacial till covers the area and natural outcrops are quite scarce through most of the area. Most exposures were located along the roads and railways, but were also fairly common along the lakes and streams. In open country the outcrops averaged less than two per square mile.

Previous Work

Logan (1850), Richardson (1870), Bailey & McInnes (1889) and Dresser (1912) all traversed the northwest edge of the area, but McGerrigle (1934) was the first to do any systematic study of the area. His map shows approximately the same contacts as are shown on the map accompanying this report. Almost all the rocks strike southwesterly into an unmappped portion of the state of Maine, but a narrow band in the northwest corner strikes into the St. Pacome-Estcourt area, mapped by the author in 1955. McGerrigle's reconnaissance mapping of 1934 indicated the general character of the rocks lying to the north and northeast, and Greiner remapped the Cabano area to the north of the central part of the present area in some detail in 1957.

Physiography

The Estcourt-Baker Lake area lies wholly on the southwest flank of the Notre Dame-Schickshock range, which bisects the Appalachian Region in the province of Quebec. A maturely dissected upland has been modified by the glacial deepening of the trans-structural valleys, some of which were later partially filled by fluvioglacial debris. The valleys commonly are about 600 feet lower than the intervalley hills. Elevations vary across the area from a low of 460 feet in the Madawaska valley to about 1930 on the high ridge overlooking Lake Pohenegamook. Thus the total relief of the area is approximately 1470 feet.

The whole area is drained by rivers flowing into the St. John River system. The western quarter of the area is drained by the south-flowing St. Francis river, which in this area forms the International Boundary. Over one-third of the area near the eastern edge of the map sheet is drained by south flowing Baker brook. The Madawaska river system also drains about one-third of the area, mostly by its main tributary, Cabano River, flowing northward from the central part of the area. Finally a small area about 2 miles deep and nine miles long on the Quebec-New Brunswick border is drained by Little River, a southward flowing tributary of St. John River. Except for a two mile section on Cabano River none of the major streams parallel the structural trend, and at most places cut across the structural trend at right angles. It is believed that glacial deepening of the southeasterly trending valleys accounts for the unusual pattern. It is also probable that glacial damming of the St. Francis valley south of the present area and of the Cabano north of the present area resulted in the formation of spillways between the St. Francis and the Cabano river valleys northeast of Riviere

Bleue, and between the Cabano River system and Baker Lake east of Courchesne.

Two large lakes, Lac Long and Lac Jerry*, 12 and 4 miles long respectively lie wholly within the map area. Three others, Beau Lac, Baker Lake and Lake Pohenegamook lie partly within the map area. About two dozen smaller lakes also are present.

A thin widespread ground moraine covers most of the upland regions, while valley sides are strewn with slope wash slump and solifluction deposits. The major valleys contain thick and extensive outwash deposits, many of them suggestive of home terraces. Eskers occur in the center of some of the smaller valleys, and commonly trend south to southeast. Alluvial deposits are generally absent, but occur in the Madawaska and St. Francis River valley.

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* This lake appears on many maps as Meriumticook, but is not known locally by this name. Although commonly called Jerry, it is also known as Lac Thibauld.

General Geology

The major structural feature of southern Quebec is the Notre Dame-Shickshock range, a ridge of pre-Taconic rock extending from the Vermont border to Gaspe which bisects the Appalachian Province in Quebec. The Estcourt-Baker Lake area lies wholly on the southeastern flank of this range. At the north edge of the present area, rocks of the Cambrian (?) Rosaire and Ordovician (?) Caldwell group are exposed near the crest of the range. They consist of moderately metamorphosed sedimentary and volcanic rocks. The Lower Silurian Touladi River group, consisting of conglomerate quartzite slate and trachyte rests on the Rosaire and Caldwell with angular unconformity. Southeastward beyond the Touladi River group, an enormous thickness of slates

and quartzites with minor limestone interbeds is exposed up to and beyond the southern edge of the area being studies. This sequence is the Lower (?) Devonian Fortin group. Two small lamprophyre dykes cut the Fortin and are therefore post-Lower Devonian in age. Glacial, fluvioglacial and alluvial deposits conceal most of the bedrock in the area. The geological succession is summarized in the table below.

TABLE OF FORMATIONS

AGE	GROUP	FORMATION	LITHOLOGIC DESCRIPTION
Pleistocene and Recent			Alluvium. Solifluction deposits. Kames, eskers, deltaic and glacial lake deposits. Ground moraine
Unconformity			
Lower (?) Devonian	Fortin	Temiscouata Beau Lac Cabano	Dark slate, siltstone, and impure quartzite. Minor limestone, ortho-quartzite and conglomerate. _ _ _ _ _ _ _ Light grey orthoquartzite, black slate, and minor black quartzite. _ _ _ _ _ _ _ Light to dark grey limestone, fissile grey slate, minor quartzite.
Unconformity			
Lower Silurian	Touladi River	Point-aux-Trembles Cabano	Trachytic flow rock _ _ _ _ _ _ _ _ _ _ _ Dark slate and quartzite, Pebble and boulder conglomerate
Unconformity			
Lower Ordovician (?)	Caldwell		Green, red, and grey quartzite, slate, and siltstone, green quartz pebble conglomerate and grit, minor basaltic flows and albite-quartz tuff.
Unconformity			
Lower Cambrian (?)	Rosaire		Grey orthoquartzite, minor grey slate and siltstone _ _ _ _ _ _ _ _ _ _ _ _ _ _ Grey and black slate, siltstone, and phyllite, minor limestone, quartzite, and pebble conglomerate

Rosaire Group

Distribution

About 10 per cent of the area is underlain by rocks of the Rosaire Group. The Rosaire outcrops are confined to the northwest corner in a band about 10 miles wide. Within this band two fingers of Caldwell group rocks cover parts of the Rosaire. The main area of Rosaire outcrop is bounded on the northwest by the Caldwell, and on the southeast by the Touladi River group.

Lithology

Of the three different rock assemblages recognized within the Rosaire group in the St. Pacome-Estcourt area (Gorman, 1960), only the upper two are present in the Estcourt-Baker Lake area, and of these, the upper orthoquartzite is only present at a few localities. The middle division consisting of black slate, siltstone and phyllites with minor interbeds of grey and black argillaceous limestone and quartzite, probably underlies most of the area assigned to the Rosaire.

The rocks of the middle division are poorly exposed and are best seen in river valleys and artificial cuts. They are characteristically thin bedded, although two-foot thick beds of argillaceous limestone and quartzite are known to occur. The best exposures of the middle division are below a dam on Riviere Providence 1 mile north of Sully.

The essential rock of the upper division is a light to dark grey well sorted medium grained orthoquartzite. In one thin section the rock was composed of 94 per cent quartz, 2 per cent chert, 3 per cent plageoclase and one per cent accessory minerals, mainly sericite, calcite and pyrite, with minor garnet and zircon. A second section contained 99 per cent quartz and chert, with minor plageoclase, biotite, chlorite, sericite, pyrite, and garnet. In both sections, a granoblastic texture has developed by the

secondary growth of individual quartz grains, which average 0.35 mm in diameter, and reach a maximum of 0.7 mm in the first section and 1.2 mm in the second.

Age and Correlation

The Rosaire, first described by Beland (1952, p 4) has been traced from its type locality in Bellechasse county northeastward 80 miles to the present area (Beland 1957a, 1957b, Gorman, 1960) and even beyond to the adjacent Cabano area where it was recognised by Greiner (1953, p. 9). At present it is known to outcrop along the central part of the Notre Dame-Sheckshock range for a distance of 150 miles.

A Lower Cambrian fossil was found by Bailey and McInnis (1889, p. 15) in an area mapped by Greiner as Rosaire. Rasetti (1946, p 702) has questioned the validity of the fossil. From a structural viewpoint, the Rosaire lies beneath the Caldwell, which in turn lies unconformably beneath the Middle Ordovician Beauceville group. Lacking more definite data, the Rosaire is tentatively assigned to the Lower Cambrian.

Caldwell Group

Distribution

About five per cent of the area is underlain by rock of the Caldwell group, which are exposed only in the northwestern part of the area. The Caldwell occurs in two narrow bands having a maximum width of two miles which cross the Rosaire. In addition, a small area of Caldwell type rock outcrops on a high hill in the extreme northwest corner of the area. These rocks may be in fact part of the Armagh group, which is so like the Caldwell that it is commonly distinguisd only by the position of the exposures relative to the crest of the Notre Dame-Sheckshock range, with the Armagh lying to the

northwest and the Caldwell to the southeast. In this area, the crest line is vague, and so the exposures are arbitrarily assigned to the Caldwell group.

Lithology

The most important rock type in the Caldwell group is a dark green to green grey, poorly sorted felspathic quartzite. Common associated rocks include red, green and grey slate, red and grey quartzite, green quartz pebble conglomerate, and grey siltstone. Minor amounts of basalt and tuff are also present.

Most of the rock types have been described previously (Beland, 1957a, 1957b; Gorman, 1956, 1960) and thin sections of the Caldwell from the present area show essentially the same composition. Green quartzites from the Estcourt-Baker Lake area carried 55 - 70 per cent quartz, 8-17 per cent feldspar, 2-26 per cent sericite and chlorite and up to 5 per cent calcite and rock fragments. Almost half the quartz and feldspar and all of the sericite and chlorite occurred in the matrix. Accessories noted include garnet, pyrite, leucoxene, hematite and limonite. An average of three thin sections of green quartzite showed a composition of 64 per cent quartz, 13 per cent feldspar, 10 per cent chlorite, 9 per cent sericite, 2 per cent calcite, 1 per cent rock fragments and 1 per cent accessories. All of the calcite and rock fragments were noted in one slide, which had a compensative diminution in the amount of chlorite and sericite. Some of the quartz fragments have edges corroded by sericite, others show secondary growth. The individual grains are subrounded to subangular and the degree of sorting is commonly poor with the average grain size about one quarter of the maximum grain size in each slide. The average grain size in two slides is about 0.3 mm, and in the third is about 0.7 mm. The red quartzites are

apparently of similar composition except that they contain more hematite and less chlorite.

The occurrence of basalt with the Caldwell rocks of the Estcourt-Baker Lake area was unexpected but most disconcerting. Basalt is an important member of the group at the type locality 120 miles to the southwest but diminishes in importance northeastward. The last known outcrop of Caldwell basalt is 45 miles to the southwest of the present occurrence, near St. Omer (Beland, 1954). However, the Caldwell group passes through an unmapped section of northern Maine for most of this distance and exposures are scarce, so that it is possible that the basalt is relatively continuous.

In thin section, the rock is seen to be fine grained and amygdular, with a distinct ophitic texture. The amygdules are small and are filled with chlorite, quartz, calcite, magnetite and hematite. The average grain size is about 0.1 mm, with the longer feldspar laths reaching 0.35 mm. The rock is composed of about 33 per cent plagioclase, probably andesine, 30 per cent pyroxene, 24 per cent magnetite, 10 per cent secondary chlorite and 3 per cent secondary hematite.

Two outcrops were identified in the field as felsite. They were very fine grained dark rocks, but when weathered, were white and rich in kaolin. Thin sections aided little in their identification as they were extremely fine grained. However it was noted that almost all the material had a low birefringence. X-ray diffractometer studies and partial spectrographic analysis indicate a composition of about 60 per cent albite, 29 per cent quartz, 4 per cent sericite (estimated from slide) 1 per cent ilmenite and the remaining material probably chlorite. It appears to be interbedded with Caldwell quartzites although it may be an intrusive sill. The almost total absence of potassium (less than 0.5%) makes it difficult to classify

it as an igneous type but it would probably fit best as a quartz-keratophyre or a quartz albitite. Because of the faint bedded appearance noted at one point, it is assumed to be tuffaceous.

Age and Correlation

The Caldwell group was first described by Mackay (1921, p. 20) and has been traced from the type locality on Chaudiere river northeastward by Belanc and Gotman to within 30 miles of the present area, where it enters northern Maine. It reappears along the projected strike in the present area and continues northeastward to the Cabano and Squateck area where Greiner (1955, p. 7) and Lesperance (1955, p. 3) have described lithologically similar and stratigraphically and structurally equivalent formations as the Sloan Lake and Quebec group respectively. Southwestward from the type locality Benoit (1958, p. 3) and Cooke (1937, p. 11, 1951, p. 13) have traced it to the Vermont border, so that it is known to outcrop over a distance of about 250 miles.

Many recent studies in Vermont and southern Quebec indicate that correlations can be made across the Sutton anticlinorium (the structural name for the Notre Dame-Sherbrooke range). The writer believes that the Caldwell can be correlated with the Armagh on the north flank of the anticlinorium, but this is by no means proved.

The age of the Caldwell group is not known definitely. Near the type locality it appears to underlie the Beauceville group of Middle Ordovician age. If the Armagh is equivalent to the Caldwell, as has been suggested, then the Caldwell is probably of Lower Ordovician age.

Touladi River Group

Distribution

Lying to the southeast of the Rosaire and Caldwell groups in

a band never much more than a mile wide is a sequence of conglomerate, quartzite, slate, and trachyte, to which the name Touladi River group has been assigned. It is poorly exposed in the valleys of Cabano and St. Francis rivers, but is well exposed on the ancient glacial lake spillway between the two valleys, and here it has been possible to study the basal part of the section in considerable detail.

Lithology

The Touladi River group consists of the basal Cabano conglomerate, with associated quartzite and slate, and the Pointe aux Trembles trachyte, exposed at only one locality in the Estcourt-Baker Lake area, but well exposed in the Cabano area to the northeast.

The Cabano formation is readily accessible in road and railway cuts about two miles northeast of the town of Riviere Bleue. Here it consists of a basal member about 550 feet thick, made up of boulder and pebble conglomerate with associated black slate and quartzite, a slate bed about 50 feet thick, and finally about 300 feet of pebble conglomerate grading up into an unknown thickness of dark grey slate and quartzite.

The boulders in the basal conglomerate consist of well rounded fragments, up to 2 feet in diameter but averaging about 6 inches, of grey and black orthoquartzite, green impure quartzite, grit, pebble conglomerate, and, more rarely, impure limestone, as well as a few tabular fragments of slate up to six inches long. There is little doubt that the fragments were derived from the adjacent Caldwell and Rosaire groups. The matrix is commonly black sand with minor amounts of argillaceous material. Lenses of black shale occur within the conglomerate beds, and interbeds of massive, medium to coarse, black quartzite up to 2 feet thick separate the individual conglomerate beds, which may be up to 20 feet thick.

The upper conglomerate, which is separated from the lower by

50 feet of slate, is almost exclusively a pebble conglomerate, with only minor interbeds of slate and quartzite. The pebbles in the conglomerate are mostly green, grey, and black quartzite, black and green slate, brown calcareous sandstone, vein calcite and vein quartz. These average about 1/2 inch in diameter with a few pebbles up to two inches long. The matrix is a mixture of argillaceous, arenaceous and calcareous material, and the whole rock is traversed by numerous calcite stringers. It weathers to a rotten brown rubble.

Above the pebble conglomerate are green and grey impure quartzites and slates. The green quartzite differs from the green Caldwell quartzite in the degree of sorting and the absence of chlorite on the bedding planes, and so can be distinguished in this way.

Above the Cabano, in the adjacent map area, is the Pointe-aux-Trembles formation. In the present area, the Pointe-aux-Trembles is represented by one area of outcrop of trachyte in the fields to the west of Aubut station near the north end of Lac Long. The rock consists of amygdules of calcite, often with a rim of chlorite in a matrix of plagioclase (andesene ?), secondary chlorite and calcite.

Age and Correlation

The Cabano conglomerate was first described by Logan (1863, p. 421) who examined exposures along the shores of Lake Temiscouata. McGerrigle (1934, p. 116) noted that exposures of Cabano conglomerate extended into the present area, and reported Ordovician fossils in the overlying slates. Greiner (1956, map) traced the Cabano to Touladi Lake, so that it is now known to outcrop over a distance of 22 miles. Greiner also collected Lower Siluvian fossils from 7 localities in the slates and quartzites, and fairly definitely established the age of the Cabano. The Pointe-aux-Trembles formation in the Cabano area also yield Lower Silurian fossils. The Touladi River group is

therefore assigned to the Lower Silurian.

Fortin Group

Distribution

About 35 per cent of the area, all of which lies to the southeast of the Touladi River group is assigned to the Fortin group. As will be shown later, there is no doubt that the Temiscouata group of slates and impure quartzites first described by McGerrigle (1934, p. 116) is equivalent to the Fortin group of Gaspe. The Fortin group in the present area is made up of three formations, the Cabano River limestone as described originally by McGerrigle (1934, p. 116), the Beau Lac quartzite, a term introduced by the writer, and a great sequence of slates with associated impure quartzites, for which the term Temiscouata is retained.

The Cabano River limestone is best exposed in a quarry on lots 1 and 2, range XI, Cabano township, the Beau Lac quartzite is best exposed in road cuts between lots 24 and 25, range XII, Cabano township, and the Temiscouata is best exposed along the shores of Lac Long, near St. Marc des Estrets.

Lithology

Grey slates are the dominant rock type throughout the whole Fortin group, and so the division of the Fortin into formations is based on the most important associated rock. At the base is the Cabano River formation, about 1500 feet thick, which has a limestone member at or near its base about 175 feet thick. This limestone rests on Pointe-aux-Trembles trachyte on the west side of Lac Long, and on conformable slate on the east side. It is light to dark grey in color and occurs in beds averaging 3 inches thick but with massive members up to 5 feet thick. Thin graphitic slate interbeds occur here and there. The limestone is badly sheared and jointed, and the contained

fossils are badly distorted. It is overlain by grey and black slates, which are commonly quite fissile, an unusual characteristic of the slates of this area. The distribution of the fissile slates is used as a marker in extending the limestone to the northern border of the area, where it ties in with the southward extension of the limestone in an abandoned quarry in the Cabano area.

The slates of the Cabano River pass upwards into the slates of the Beau Lac formation, which is distinguished by the presence of beds of white weathering grey orthoquartzite, a rock that outcrops quite well in the present area. A section from near the top of the Beau Lac to the upper slates of the Cabano River as seen in road cuts just outside the present area is given as a typical example. (thicknesses are approximate)

Top of sequence

100 feet	dark slate with 3 interbeds of light grey orthoquartzite, aggregate thickness 2 feet
100 feet	grey orthoquartzite
20 feet	dark slate
40 feet	grey orthoquartzite
300 feet	dark slate
20 feet	grey orthoquartzite
115 feet	covered
1 foot	grey orthoquartzite
25 feet	dark slate
2 feet	grey orthoquartzite
75 feet	dark slate
4 feet	black quartzite
10 feet	grey orthoquartzite

20 feet	dark slate with minor black quartzite	
25 feet	grey orthoquartzite	
20 feet	dark slate	PROBABLE TRANSITION ZONE BEAU LAC TO CABANO RIVER
50 feet	covered	
1 foot	grey orthoquartzite	
55 feet	dark slate	
1 foot	grey orthoquartzite	
115 feet	dark slate	
0.5 feet	grey orthoquartzite	
400 feet	covered	
10 feet	dark slate	
230 feet	covered	
390 feet	dark slate	

Base of Section

The grey orthoquartzite typically weathers white on the surface and tan just beneath the surface. It is commonly fractured and cut by quartzite stringers. The average grain size is 0.3 to 0.5 mm., but a few fragments up to 3 mm. occur. An average of two thin sections showed a composition of 97 per cent quartz and chert, 2 per cent sericite and 1 per cent plageoclase. Accessories are zircon, garnet, and iron minerals. Other rock types in order of abundance are black pure quartzite, dark grey impure quartzite, and pebble conglomerate. The Beau Lac as a whole is strikingly similar to the upper Rosaire but there is no doubt that the two are quite separate in time.

Lying above the Beau Lac formation is the grey and black slate of the Temiscouata, with associated dark grey siltstone, impure dark quartzite, and minor limestone. Several exposures of green-grey quartzite and two of grey orthoquartzite are thought to be older rocks such as Beau Lac brought to the surface along anticlinal crests, but with the limited data available, no such structure could be shown to exist. The green-grey quartzite carries about 45 per cent quartz of which one-third is fine material in the matrix, 33 per cent chlorite, 12 per cent sericite and 10 per cent feldspar. Accessories include zircon, garnet, pyroxene, and hematite. The common dark grey quartzite of the Fortin carries about 40 per cent quartz and 10 per cent feldspar, with a matrix that is commonly a mixture of fine quartz and sericite, although in one slide the matrix was essentially calcite. Iron minerals, especially pyrite, are the most common accessories. The grey slates are often color-banded with shades of light and dark alternating. The slates also occur alternately with siltstone or impure limestone over considerable thicknesses. All the fine grained rocks of the Temiscouata show a well developed cleavage that dips steeply. A few of the slates contain large cubes of pyrite.

Age and Correlation

The basal limestone member of the Fortin group in the Estcourt-Baker Lake area outcrops at three localities, one of them a quarry. It contains coral remains which have been dated by L. M. Cumming as Silurean (?). Two limestone quarries, 3 and 5 miles to the northeast of the quarry in the present area, in a similar structural and stratigraphic position, have been mapped by McGerrigle (1934, p. 117) and Greiner (1958, p. 23). An outline of the nomenclature used by McGerrigle, Greiner, and the writer, and a correlation of the various units, is shown on Table 1, page 19. McGerrigle described

NOMENCLATURE OF SILURIAN AND DEVONIAN ROCKS IN SOUTHERN TEMISCOUATA, P. Q.

McGerrigle, 1934, Temiscouata				Greiner, 1958, Cabano Area			Gorman, 1961 Estcourt-Baker Lake	
Devonian	Mt. Wissick Group	Temiscouata Series		Mid to Lower Devonian	Temiscouata Group		Fortin Group	Temiscouata fm.
								Beau Lac fm.
				Lower Devonian		Touladi fm.		Cabano River fm.
Silurian	Temiscouata Group	Cabano River limestone		Upper and Midole Silurian		Mt. Wissick fm.		
		Pointe-aux-Trembles fm.				Resurrection fm.		
						Pointe-aux Trembles fm.	Touladi River Group	Pointe-aux-Trembles fm.
Ordovician	Cabano Group	Cabano conglomerate		Lower Silurian		Cabano fm.		Cabano fm.
CAMBRIAN			AND	ORDOVICIAN		ROCKS		

TABLE 1

Symbols: ~~~~ Gradational contact, ***** Unconformity,
????? Contact not described, xxxxx Not in contact,
_____ Fossiliferous

the limestone in both quarries as the Cabano River limestone, 200 feet thick. Greiner, however, assigned the westerly limestone to the base of Temiscouata group and reported it to be 100 feet thick and pinching out northeastward. The limestone of the more easterly quarry is assigned on Greiner's revised map to the Lower Devonian Touladi formation, which in the original report is said to underlie the Temiscouata unconformably, and to be separated from the Mt. Wissick by a fault. This early interpretation was necessary, as the age of the Touladi was thought to be Lower Silurian, and it lay between Upper Silurian and Lower Devonian rocks. Because Greiner's report was written before the revision of fossil ages was made by A. T. Boucot, the writer feels that a reinterpretation of the structure is necessary. As the Touladi now appears to be in a normal stratigraphic sequence between the Mt. Wissick and Temiscouata formations, the necessity of bounding it by faults and unconformities is eliminated. As it is now placed in the Lower Devonian, on the basis of fossils, including brachiopods from the more easterly quarry, which both McGerrigle and the writer believed to be in Cabano River limestone, and as it occupies the same stratigraphic position as the Cabano River limestone, then the correlation between the Cabano River and Touladi is considered valid. Therefore, the Silurian age of the limestone of the present area is discarded in favor of a Lower Devonian age. This is done partly because the Silurian fossils are distorted and hard to identify, and partly because they are corals, which are reportedly less reliable than brachiopods in the dating of rocks.

Assuming, then, that this limestone is Lower Devonian, what is there to suggest that the rocks to the southeast are also Lower Devonian, and why is the whole sequence assigned to the Fortin group? First, there is no discernable break in the sequence from the Cabano River through the Beau Lac to the Temiscouata, and since the beds almost always face southeast, the rocks

must be Lower Devonian or younger. Greiner's unconformity between his Touladi and his Temiscouata was forced on him by an early erroneous dating of the contained fossils. The thinning and change in character of the Touladi southwestward is not necessarily erosional. It is more likely a facies change connected with tilting in the early Devonian that resulted in the removal of most of the Pointe-aux-Trembles, and all of the Resurrection and Mt. Wissick formations, from the sedimentary sequence in the Estcourt-Baker Lake area, and the preservation of the same formations to a continually greater degree northeastward across the Cabano area. Second, the Temiscouata formation has been traced northeastward to the Squateck area by Lasperance, where it carries Lower Devonian fossils. (Personal communication, J. Beland, December 11, 1959). Twenty miles beyond the Squateck area, Beland (1961 map) has described the most westerly exposures yet mapped of the Fortin group, on strike with the Temiscouata, lithologically the same, and traceable eastward in geologically mapped areas to the Matapedia valley, where Steam (1959, p. 6) found a poorly preserved fauna, later identified by Boucot as Lower Devonian. The 20 mile gap between the most westerly Fortin and the most easterly Temiscouata has been crossed by prospectors, who report Fortin-type rocks throughout this unmapped gap. Thus, there is no doubt that the Temiscouata is equivalent to at least part of the Fortin. That the Beau Lac and Cabano River are part of the Fortin is more difficult to show, since the base of the Fortin is cut off by a fault in most areas to the east where it has been described. However, since the three Lower Devonian formations of the Estcourt-Baker Lake area were laid down consecutively without any apparent break, it follows that all three are parts of the same group, which is called herein the Fortin group.

The Fortin group is known to outcrop over a length of 230 miles, from Beau Lac to the eastern end of the Gaspe peninsula. To the southwest of

the present area, the Fortin immediately enters an unmapped portion of the State of Maine. However, the projected strike recrosses into Quebec after about 70 miles and here the rocks of the St. Juste group are exposed. These rocks are remarkably similar to the Fortin and have at, or near, their base a limestone carrying Devonian fossils (Gorman, 1956, map)

Across the strike about 50 miles from the present area, fossils of Silurian age were found on the Seigas River, N. B. Although these fossils were used to date the Temiscouata originally, Bailey and McInnes (1887, p 37M) suggest that the rocks there more closely resemble the Pointe-aux-Trembles formation.

Igneous Rocks

Only one type of igneous intrusive rock was encountered in the map area, on lot 32, range VIII, of Botsford township. This rock was in the form of two lamprophyre dykes about three and two inches thick respectively. The only recognizable constituent was biotite, which occurred as very abundant phenocrysts up to a quarter inch thick, set in a fine groundmass. These dykes are unlike any other igneous rocks found in the general area. They occupy joints striking southeast across the Fortin group and are not noticeably deformed. They are post Lower Devonian and probably post-Acadian.

Pleistocene and Recent

The presence of a thin but widespread ground moraine, eskers, kames, and glacial striae prove that the area has been glaciated. Although local valley glaciers probably account for some of the above phenomena, erratics of granite and granite gneiss show that at least some of the ice originated in the Laurentian area to the north of St. Lawrence river. Most of the boulders are of local origin, and none were noted in a position that would indicate northward moving ice.

In all, 32 sets of striae were noted in the area, and of these 30 were found in the area underlain by the Fortin group rocks. The 30 sets on Fortin rocks have an average azimuth of 130°, a variation from mean of only 10°, and over 75 per cent of the striae were within 5° of the mean azimuth. This remarkably uniform group of striae was probably produced by the continental ice sheet moving down the southeast flank of the Notre Dame-Chickshock range, relatively unaffected by local topography. The remaining two striae sets, in the western part of the area, on Caldwell and Rosaire group rocks, have azimuths of 160° and 210° respectively. These are thought to have been formed by a valley glacier occupying the valley of Petite Riviere Bleue either before or after the passage of the continental ice sheet. The headwaters of Petite Riviere Bleue and some of its tributaries begin in cirque like areas. A segmented ridge of sand and gravel parallels the valley on one side and then crosses the valley at right angles. Petite Riviere Bleue has breached this ridge, and has cut down through it by as much as 150 feet. Down-river from the breach is a hummocky outwash plain in the area where Petite Riviere Bleue joins the main stream. The ridge is believed to be a kame moraine. Unlike the esker which occupies the valley bottom, this ridge is definitely on the valley side.

Besides the esker in the valley of Petite Riviere Bleue, three others occur, in the valley of Baker Brook above Lac Jerry, in the valley of Trout River, Temiscouata Seigneury, and as a group of islands at the north end of Lac Long. Kames or kame moraines other than that of the Petite Riviere Bleue valley have been described by Lee (1955) and Kiewiet de Jonge (1951) in the Madawaska valley, and by Dresser (1912) and the writer (1960) in the Lake Pohenegamook valley. Kame-like ridges also occur at the south end of Lac Jerry.

The St. Francis valley in the Estcourt map area is a mile wide, with terraces developed along the valley at approximately 700 feet. These are thought to have developed at a time when St. Francis river drainage to the St. John valley was blocked, and the water spilled over the Cabano conglomerate about 2 miles north of the town of Riviere Bleue, into the Cabano river system.

In many places throughout the area, a well developed imbricate structure is present in the material littering the lower valley slopes, and was probably developed when solifluction moved much of the unsorted ground moraine down into the valleys.

Structural Geology

Folding

The rocks of the Rosaire and Caldwell groups have been deformed at least twice, by the Late Ordovician Taconic orogeny and the late Devonian Acadian orogeny. The second period of deformation only affects the rocks of the Touladi River and Fortin groups. The folds throughout this area trend northeasterly, and are close to being isoclinal, with the axial plane dipping steeply to the southeast.

In the area underlain by the Caldwell and Rosaire group rocks, marker beds are present, but the exposure is so poor and the folding so complex that even the general position of the fold axes cannot be located with any degree of certainty. Although the folding is probably not as complex in the area underlain by Fortin rocks, and although the exposure is quite good in a few places, the absence of marker bed make interpretation impossible in this area. Only in the spillway area about 2 miles northeast of the town of Riviere Bleue, where good markers near the base of the Touladi River combine with good marker beds, has the structure been worked out with a reasonable

chance of accuracy. Here the folding is seen to be extremely complex.

Despite the poor exposure that masks the detail, and makes interpretation of the minor and intermediate structure impossible, the broad general picture is still apparent. The major structural feature in the area is the Sutton anticlinorium, who's axis lies to the northwest. The Estcourt-Baker Lake area structure is essentially a monocline, with the younger beds lying to the southeast. The monocline has been complicated by minor and a few major folds that cause a few recognizable and probably many unrecognized repetition of strata.

Faulting

The valley of Lake Pohenegamook probably lies along the trace of a tear fault. Evidence for the existence of such a fault is the local area of more intense metamorphism at a few places along the southwest shore of the lake, and the offsetting of the Rosaire by about 6 1/2 miles along Lake Pohenegamook valley.

Although it has been suggested that the escarpment on the south side of Sabano river is a fault line scarp, no evidence was uncovered to support such a view. Other major faults may exist in the area, but the lack of exposure and the scarcity of marker beds make them difficult to identify. Numerous minor faults with offsets of one or two feet are known to occur throughout the area.

Economic Geology

No metallic mineral deposits are known to occur in the Estcourt-Baker Lake area. Malachite stains were noted on 9 samples of basalt from the range road between lot 37, range V, and lot 37, range VI, of Estcourt township. Limestone and slate have been quarried in the area. Sand and gravel deposits are exploited from time to time.

Limestone

A limestone quarry was operating part time in 1956 on lots 1 and 2, range XI, Cabano township, under the name of "Les Amendements Calcaires de Riviere Bleue". The limestone, light to dark grey in color, occurs in massive beds up to five feet thick, with minor slate interbeds, over a width of 175 feet. A 12 pound sample analysed by the Quebec Department of Mines averaged 91.5 per cent calcite. The quarry produces about 10,000 tons of limestone annually, most of which is used for agricultural purposes. A few seams of manganese were noted in the working face of the quarry.

Slate

Slate was quarried as a roofing material over forty years ago a few miles north of the village of St. Marc des Etroits. However, there is no market for slate as a roofing material at the present time.

Sand and gravel

Throughout the area, sand and gravel deposits, formed by fluvioglacial processes, are exploited when road ballast is required. Road building activity kept three of these pits operating all through the summer of 1956.

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