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PHOTOGEOLOGIC REPORT #20BA, INVESTIGATION OF THE WEST HALF, GASPE PENINSULA

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PHOTOGEOLOGIC REPORT #20BA

INVESTIGATION

of the

WEST HALF, GASPE PENINSULA,

QUEBEC, CANADA

PREPARED BY

PHOTOGEOLOGIC UNIT

NEW YORK EXPLORATION DIVISION

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E. Salzman

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PART I

GENERAL DATA

LOCATION (See Figure 1 and Plate I)

The area described herein is located in the eastern part of the Province of Quebec, Canada between Latitudes 48°00'N. and 49°00'N. and Longitudes 65°30'W. and 67°30'W. It contains approximately 4,000 square miles, and extends from Matapedia Valley (Plate I) on the west to Oat Cake Lake (Plate I) on the east, and from the Shickshock Mountains on the north (Plate I) almost to Chaleur Bay (Figure 1) on the south.

PURPOSE OF INVESTIGATION

This study was undertaken in order to prepare a photogeologic map of the western part of Gaspe Peninsula, Quebec, Canada. This map is to provide reconnaissance data for use during the 1959 field season. The project was requested by Mr. Lockwood in a telephone conversation with Dr. Tator on September 11, 1958 (See letter from Mr. O. I. Torkelsen to Mr. Pyre dated September 11, 1958).

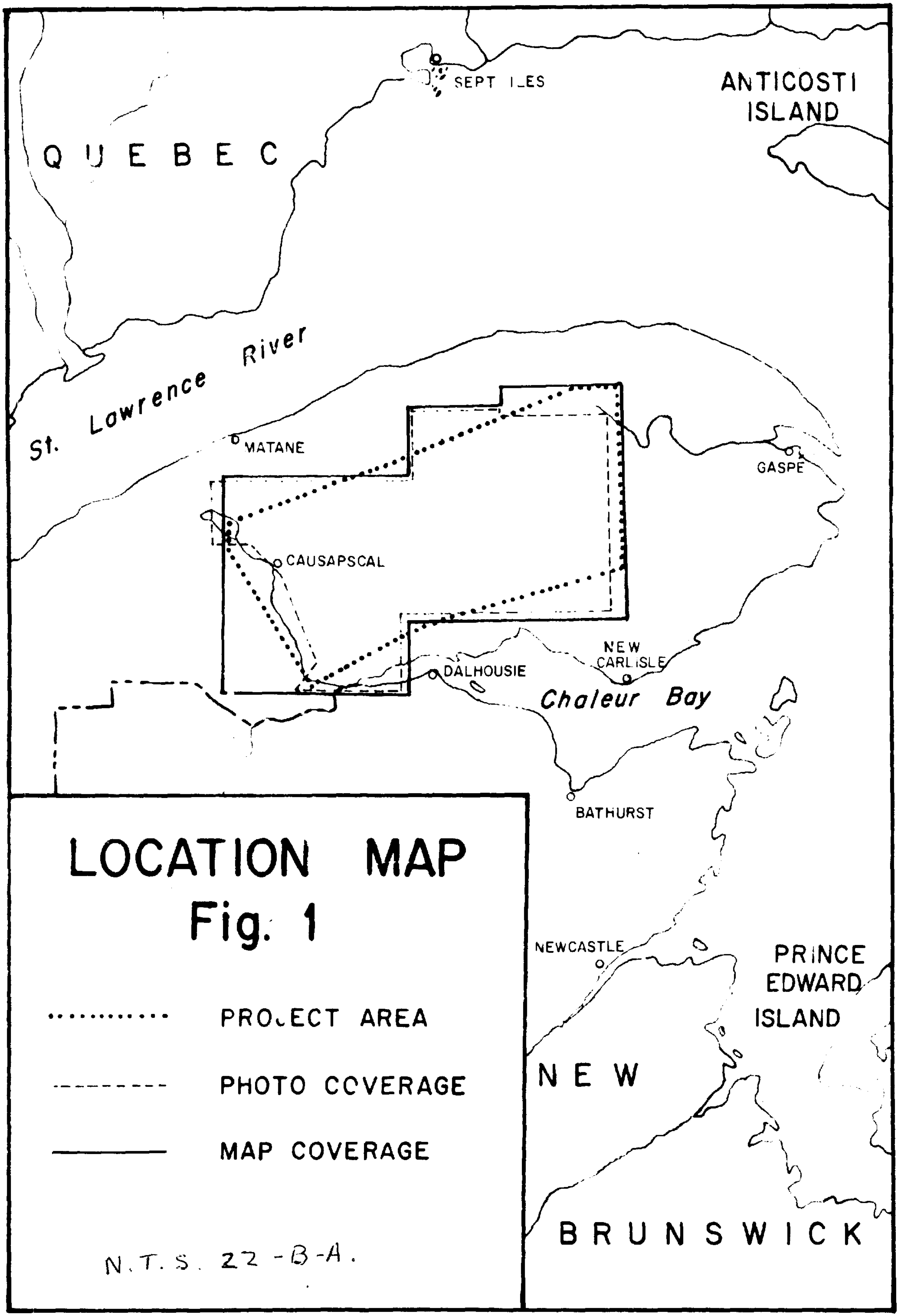
The final map, Photogeologic Map (West Half, Gaspe, Quebec, Canada), Plate II, Sheets 1-4 is the result of a detailed stereoscopic study of the photographs of the project area, and depicts the drainage pattern, important topographic elements (escarpments and slope directions), outcrop pattern, structural data including lineament pattern (see section on Lineaments, page 27), and various cultural features (such as major towns, roads, and trails).

METHOD OF STUDY

Contact aerial photographs (9 x 9) at scales of about 1:43,000 and 1:25,000 were supplied to this unit by British American Oil Company, Ltd. These photographs (1,210 in number) were flown by the Royal Canadian Air Force in 1950 and 1951, and were studied stereoscopically utilizing the Abrams pocket stereoscope and the Fairchild mirror stereoscope. All discernible structural data, drainage lines, and prominent topographic features were annotated directly on the contact prints. These data were then transferred by use of plotting devices to the base sheets (scale 1:50,000).

Available maps and reports were studied in order to gather information on the geology of the project area. The known geology (after McGerrigle, 1953) is depicted on Plate I (scale 1" = 4 miles).

Drainage lines, road nets, and culture on Plate II were compiled from published sources (see reliability diagram, Plate II). The control for Sheets 1 and 4 is considered to be good, as the information on them was taken from topographic sheets. However, no topographic maps were available for the area covered by Sheets 2 and 3. The basic data for these sheets were derived from enlargements to scale of the flightline index sheets which were supplied by British American Oil Company, Ltd. As these uncontrolled enlargements are of



LOCATION MAP
Fig. 1

METHOD OF STUDY (Cont.)

preliminary sheets, the reliability is considered only fair.

The various topographic and geologic maps used during the term of the project were analyzed along with the aerial photographs in order to detect any changes in geologic characteristics.

GEOMORPHIC SETTING

General (See Figure 2)

The project area is divided into two physiographic units (Weeks, L. J., 1957, p. 123), the Shickshock Mountains to the north and the Chaleur Uplands to the south. The Notre Dame Mountains, of which the Shickshock Mountains are the eastern part, trend northeast 400 miles from near Thetford Mines to Mt. Albert (not shown in present mapping). The Shickshock Mountains reach elevations of more than 4,000 feet and their summits present a flat surface which is thought to be part of the general erosion surface believed to have been formed during the Cretaceous Period (Weeks, L. J., 1957, p. 126).

The Shickshock Range is bordered to the south by the Chaleur Uplands, which merges with the Northern Upland of New Brunswick to the southwest.

Topography

The Gaspe Peninsula is an upland which has been sharply dissected by stream erosion. McGerrigle (1954, p. 57) describes the surface as a plateau or series of plateaus, but there are tracts in the interior of the project area where the relief is quite low.

The greatest elevation in the project area and in Gaspe' as a whole, is in the Tabletop Mountains (Plate I) which form the eastern end of the Shickshock Mountains. The highest point is the summit of Mt. Jacques Cartier (4,230 feet), but this elevation is closely approached by other summits in the Tabletop Mountains, (Mt. Albert - 3,775 feet, Mt. Richardson - 3,500+ feet). The Shickshock Range extends westward for about 60 miles from the Tabletop Mountains. Beyond the limits of the Shickshock Range, the upland areas average 1,500 to 2,300 feet in elevation.

Drainage Setting

Some broad, regional divisions of the project area can be made by a study of the drainage lines on Plate II.

The most prominent drainage characteristic within the study area is almost entirely confined to the rocks of the Fortin (Table I) series in the southern one-third of the tract. Here the trunk steams flow south-southeast in exceptionally straight channels. The tributaries tend to parallel the parent stream, giving rise to many short, straight stream segments. The strata within this rock unit strike normally to this direction and stream erosion along bedding

Microfilm

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Drainage Setting (Cont.)

planes has given rise to a somewhat rectangular drainage pattern. Flat topped escarpments and moderately to deeply incised stream channels are characteristic of this area.

South of the Fortin series, in rocks of the Whitehead-Pabos formation (Table I), the drainage pattern is quite similar to that described above. However, the drainage texture here is much finer and the formation of escarpments is not widespread.

In the Gaspe Sandstone (Table I) area to the north, the control of the drainage by north trending lineations (see Lineaments, pg. 27) and northeast trending bedding is still quite pronounced. However, on Plate I, Sheet 3, the sandstone units develop an arcuate outcrop pattern convex to the north. The major eastward flowing drainage lines tend locally to parallel these arcs. Numerous small lakes are present along stream courses in this area. On Plate I, Sheet 1 to the west, a similar adjustment of stream course around a sandstone syncline occurs in Causapscal River.

The drainage lines in the limestone areas do not exhibit the continuity of those on surfaces of sandstone outcrop. However, the control exerted by northeast striking bedding planes and northwest trending lineaments is still evident, although not so pronounced. The drainage texture in the limestone areas is fairly coarse except for those areas on Sheet 2 which appear more resistant. In these latter limestone outcrops, lakes are much less numerous than in the limestone areas on Sheet 1. The presence of low relief on Sheet 1 and the possibility of solution activity may play an important role in the formation of these lakes. Many of the individual lakes are elongated in a northwest direction and several series of lakes also parallel this linear trend.

GEOLOGIC SETTING

General (See Plate I)

The project area is in that part of the Province of Quebec that lies southeast of the Champlain - St. Lawrence or Logan Fault which is a thrust fault trending northeastward from Lake Champlain to Quebec City and down St. Lawrence River. The trace of the fault is a gently curving arc. The study area is structurally within the Appalachian Mountain system which is characterized throughout its 2,000 mile length by Paleozoic deformation. The region was little affected by the deformation of the Appalachian Revolution at the end of the Paleozoic, however, the pre-Pennsylvanian rocks of the peninsula have been folded, either by the Taconic orogeny of late Ordovician time or by the Acadian orogeny of late Devonian time, or both.

The rocks of the project area are all Paleozoic in age, with the possible exception of the Shickshock series which may be as old as pre-Cambrian (McGerrigle, 1953). The remainder of the rocks, ranging in age from Lower Ordovician to Middle Devonian are mainly sedimentaries with volcanic rocks locally prominent.

GEOLOGIC SETTING (Cont.)

The Shickshock Mountains are made up largely of metamorphosed volcanics with local intrusive rocks along their eastern limit. In Gaspe, the portion of the Appalachian region under discussion is an upland dissected by valleys and broken by broad lowland areas. The regional slope is southeastward.

In the Province of Quebec, the Appalachian region merges imperceptibly with the St. Lawrence Lowland region to the northwest (Figure 2). The upland region extends northeast from Vermont and gradually decreases in elevation until a point near Quebec City, whereupon it rises again to the northeast and in central Gaspe becomes the Shickshock Mountains, with elevations ranging to more than 4,200 feet. On the south side of the Shickshock Mountains, the descent to the lower Chaleur Uplands is gradual and this latter unit merges with the Northern Uplands of New Brunswick to the southwest.

The structure of the project area as a unit is broadly synclinal with its main downfold included in the central (Devonian) belt. The major axis probably coincides with the axis shown in the Gaspe Sandstone exposures in the western part of the peninsula. The subsidiary anticlines and synclines whose structural trends are approximately northeast, are often of considerable extent.

Stratigraphy (See Table I and Plate I)

Pre-Ordovician (Pre-Cambrian ?)

The rocks which constitute the Shickshock Mountains outcrop only at the northernmost limits of the study area. They are mapped in the northeastern part of Sheet 1, the northwestern part of Sheet 2, and across the top of Sheet 3.

The lithology of these rocks is quite complex, as they are made up of highly altered sediments and volcanics which have been intruded by peridotite masses, locally serpentinized, and surrounded by narrow amphibolite zones. A persistently high southerly dip has been recorded within this rock unit. Alcock attributes their highly altered condition to "shearing along a compressive zone, accompanied by the extrusion of much igneous matter". (Parks, 1931, p. 789).

The age of this series has been postulated as pre-Ordovician (possibly pre-Cambrian) (McGerrigle, 1953).

Lower Ordovician

Deepkill Or Older Unit (Possible Sillery Equivalent)

Rocks of the Sillery ? formation outcrop only in the northwestern corner and along the northernmost boundary of the project area (Plate I). They form part of the northern rock belt of the Gaspe Peninsula.

This formation consists of slaty gray, red, greenish, and black shales, which are highly fissile and contain very steep dips (de la Rue, 1941, p. 12). Thin intercalations of sandstone, quartzite, or limestone are present locally.

TABLE I

STRATIGRAPHY*

ERA	PERIOD			FORMATION	THICKNESS	PROBABLE CORRELATION	LITHOLOGIC DESCRIPTION
PALEOZOIC	DEVONIAN	GASPE SANDSTONES	LOWER OR MIDDLE	Battery Point	5,000-7,000	Hamilton	Greenish gray, coarse, feldspathic (orthoclase) sandstones and pebbly sandstones to conglomerates, some shale; red beds near top.
PALEOZOIC	DEVONIAN	GASPE SANDSTONES	LOWER OR MIDDLE	Lake Branch		Hamilton	Red beds - sandstones, shales, conglomerates.
PALEOZOIC	DEVONIAN	GASPE SANDSTONES	LOWER OR MIDDLE	York River	1,000-6,000	Hamilton	Greenish-gray, fine to coarse, feldspathic (plagioclase) sandstones, with common soft green shale.
PALEOZOIC	DEVONIAN	GASPE SANDSTONES	LOWER OR MIDDLE	Fortin Series	0-5,000	Onondaga ? Oriskany ?	Shaly slates, limestones, sandstones and some conglomerates.
PALEOZOIC	DEVONIAN	GASPE LIMESTONES	LOWER OR MIDDLE	Grande Greve	2,000-4,500	Oriskany	Dark gray, hard, silicious to cherty limestone and calcareous siltstones; well bedded in beds up to 6 inches thick; locally of less resistant type and not separable from the Cape Bon Ami formation.
PALEOZOIC	DEVONIAN	GASPE LIMESTONES	LOWER	Cape Bon Ami	1,050-6,000	Oriskany	Dark gray, soft to hard, argillaceous to finely arenaceous limestones that often are magnesian; well bedded in strata up to 2 feet thick. Much local variation.
PALEOZOIC	SILURIAN	GASPE LIMESTONES	UPPER	Silurian Types Ex - St. Alban Unconformity within this unit	160-3,000		Greenish-gray, soft, argillaceous limestones and finely arenaceous limestones or calcareous siltstones with occasional dark limestones and reefy limestones; some red and green shaly limestones
PALEOZOIC	SILURIAN		MIDDLE	Lake Matapedia - Chaleur Series	3,000 ?	Clinton ?	Upper: fine grained, gray or green-gray argillaceous sandstones or siltstones Middle: gray, dove colored limestone Lower: white and buff, cross-bedded sandstones
PALEOZOIC	ORDOVICIAN		UPPER	Whitehead-Pabos	4,000		Upper: fine grained, dark gray, light bluish - gray weathering limestone Lower: shaly limestones, dark-gray. Locally altered to schists.
PALEOZOIC	ORDOVICIAN		LOWER	Sillery ?		Deepkill ?	Slaty gray, red, greenish, and black shales. Highly fissile. Contains thin interbeds of sandstone, quartzite or limestone locally. Shale may contain pyrite nodules
PALEOZOIC	PRE-ORDOVICIAN PRE-CAMBRIAN ?			Shickshock Series			Highly altered sediments and volcanics; intruded by periodotite masses; locally serpentinized; narrow amphibolite zones.

* After McGerrigle 1950, pp. 23-24.

The shales frequently contain small pyrite nodules and may be cut by quartz or calcite veins. This latter feature is more common where the beds are more intensely folded.

The sandstones and quartzites which are interbedded with the shales are usually light to dark gray in color, but some are greenish to black. Occasionally, minute muscovite flakes are seen in the sandstones. These intercalations are numerous and relatively thin, ranging from an inch to one foot in thickness. Green and red schists are typical of the Sillery formation.

Thick sandstone zones are also found in the Sillery formation. These are usually quartzose and green-gray in color. They often contain rounded black shale and feldspar fragments, but not in quantity to allow them to be classed as arkose. These sandstones range from fine to coarse grained with the latter predominating. The coarse zones grade locally into quartz conglomerates which are usually strongly developed in the middle of the massive sandstone zones. These massive beds are commonly fractured and are often cut by quartz or calcite veins. De La Rue (1941) believes that these massive sandstone zones were deposited in a near-shore environment during the time the main bulk of the Sillery sediments were being deposited in greater depths.

Lenticular, extensive beds of quartzite with associated limestone-conglomerate are present within the Sillery formation at several localities. They form narrow bands trending east-northeast. These rocks are a fairly common facies of the Sillery formation and they are lithologically similar to the beds of the Kamouraska formation which occur farther west (not shown in the present mapping). These limestone-conglomerates do not appear to be confined to one particular horizon within the Sillery formation, but occur in several distinct bands. The quartzite and conglomerate generally appear as alternating beds with shale intercalations.

The conglomerate is made up of limestone and some sandstone pebbles, which range in size from small fragments to boulders two feet across. Their average size, however, is between two and three inches in diameter. The pebbles are gray limestone, very fine to compact, sometimes sandy, and usually lack fossils. The limestone and minor sandstone and quartz pebbles and black shale fragments are cemented by silica which imparts to the conglomerate facies a superior resistance, thereby causing them to have sharp relief, forming buttes and long ridges which are usually well rounded and bare of vegetation.

In the area along the north shore of Lake Matapedia, the uppermost member of the Sillery formation is a thick series of arkose beds which forms a 6 mile wide band which extends far to the east.

This arkose member is hard, greenish-gray or reddish in color, and is faintly schistose. It frequently contains fragments of red shale which appear to be derived from the lower Sillery beds.

Upper Ordovician

Upper Ordovician rocks occur in an east-west trending zone within the southern margin of the project area (Plate I).

Upper Ordovician (Cont.)

Whitehead - Pabos Formation

The rocks of this southern belt are of two main types. The upper part of the series is a very fine-grained, dark grey, light bluish-grey weathering limestone. The beds average two to four inches in thickness. The limestone beds are separated by narrow bands of shaly limestone that weathers grey and brownish-grey. Locally, lenses and thin beds of intraformational limestone conglomerate are present. Freshly broken pieces of limestone from some beds smell of petroleum. The uppermost member of the series is a 100 foot thick zone of greenish shale, with two inch thick limestone interbeds. This shale zone is locally absent, having been cut out by pre-Silurian erosion or by faulting. A massive crinoidal limestone bed appears to be about 100 feet below the top of the Ordovician series.

Because of its greater competency, the upper part of the series has been less affected by metamorphism as compared to the underlying part. The rocks of the upper part are frequently faulted, with some brecciation, and they are sharply drag folded locally.

In Joncas and Fortin townships (not shown in present mapping) the rocks described above are underlain by a more shaly group of limestones. These are commonly dark grey in color, and they weather to a light brownish-grey. Pure grey limestones similar to those occuring in the upper part of the series are interbedded with the shaly limestone. An east-west striking cleavage direction with a steep dip to the north is strongly developed in these rocks. Locally, the shales and shaly limestones have been altered to sericite shists.

These rocks extend southward and apparently merge with the Pabos formation. Since there is no sharp line of division between the Pabos formation and the overlying Whitehead formation, the Whitehead may be considered as an upper, more calcareous phase of the Pabos.

These formations are fossiliferous, exhibiting crinoid stems, small brachiopods, and bryozoa.

The total thickness of these rock units is estimated at 4,000 feet. The lower limestone probably accounts for 3,000 feet, the upper limestone for 1,000 feet.

Middle Silurian

Lake Matapedia-Chaleur Series (St. Alban Equivalent)

On the south and west side of Lake Matapedia (Plate I, Sheet 1) a 3,000 foot section of Silurian rocks is exposed which has been divided into three units.

Val Brillant Formation

The oldest formation, the Val Brillant, is made up of a series of alternately thickly and thinly bedded, white and buff, commonly cross-bedded sandstones, which attain a thickness of 200 feet. The individual grains are rounded to subangular and are cemented by silica and limonite (Crickmay, 1932, p. 374).

The fossils found in this unit indicate an age equivalent to the basal Chaleur series (Clemville or La Vieille, and Clinton of New York State).

Sayabec Formation

Conformably overlying the Val Brillant formation is the Sayabec formation of probable La Vieille or Gascons age. It typically consists of a grey, dove-colored limestone. Locally, it can be divided into a lower nearly unfossiliferous, arenaceous limestone and dolomite part, and an upper, fossiliferous, dense, argillaceous limestone part. The formation may range between 290 and 500 feet in thickness. The lower part might indicate a transitional period from the sandstone deposition of the older unit.

St. Leon Formation

The youngest Silurian unit found in the Matapedia Valley is the St. Leon formation, which consists of a series of fine-grained, grey or green-grey, argillaceous sandstones or siltstones. A 100 foot thick fossiliferous limestone conglomerate occurs about 1,000 feet above the base of the unit. A minimum thickness of 2,500 feet is advanced for this formation.

The St. Leon formation overlies the Sayabec formation with conformable dip relations, but actual contacts are not exposed. The basal part of the St. Leon unit includes limestone lenses which may indicate a transition phase between the Sayabec and the St. Leon.

According to fossil information, the St. Leon may be correlative with the Gascons or Bouleaux formations which constitute the middle part of the Chaleur series.

Devonian

Great thicknesses of Lower and Lower to Middle Devonian formations underlie the project area. Two general divisions, an upper and a lower were designated the Gaspe Sandstones and the Gaspe Limestones, respectively. The age of the sandstone is either Lower or Middle Devonian. The underlying limestone is Upper Silurian - Lower Devonian to Lower to Middle Devonian.

Silurian - Lower Devonian

Cape Bon Ami Formation

Crickmay (1932, p. 376) states that the Silurian series in the Matapedia area is conformably overlain by Devonian shales, argillaceous limestones, and sandstones which he divided into two formations. The lowermost unit he called the Causapscal formation, which Mc Gerrigle has further subdivided into units correlative with the Cape Bon Ami and Grande Greve formations (McGerrigle, Map 1,000). These units are overlain, apparently conformably by the Gaspe Sandstones.

However, the Cape Bon Ami formation no longer defines the lower Devonian, for according to a personal communication from Dr. H. Knipping of the Calgary office of British American Oil Co., Ltd., the Silurian - Devonian boundary now falls within the Cape Bon Ami unit itself and is no longer indicated by the base of the ex- St. Alban. This fact also makes necessary the reclassifying of the Grande Greve formation into Lower or Middle Devonian.

The Cape Bon Ami formation includes the dark, soft limestones and shales that lie between the dark to light grey, hard, siliceous and cherty limestones and limey siltstones of the Grande Greve formation above, and the greenish, soft limestones of the Upper Silurian below. The type section of this formation is about 1,100 feet thick, while west of the type section the unit averages about 2,000 feet in thickness.

This formation is fossiliferous, but fossils are much less common in this unit than in the underlying Silurian units and in the overlying Grande Greve.

The Cape Bon Ami formation and the Grande Greve formation are gradational with each other and are part of the same time zone. It is possible that the underlying Silurian units and Cape Bon Ami formation comprise the whole of Helderbergian time and extend into the Oriskanian.

Lower Or Middle Devonian

Grande Greve Formation

This formation is the uppermost unit of the Gaspe Limestone series. The Perce Rock limestone is believed to be a phase of the Grande Greve formation.

The base of the Grande Greve formation is marked by the appearance of hard, cherty to siliceous limestones (or limey siltstones). In its type section, this formation is about 1,400 feet thick, but it increases in thickness toward the west, yielding an average thickness in its northern belt of about 2,000 feet.

On the Bald Mountain, the Mississippi, and Saint-Jean anticlines (none of which are shown on Plates I or II), this unit is about 4,000 feet thick.

In general, the Grande Greve formation increases rapidly in thickness from the northern edge of the Devonian basin southward within the first seven miles. It then maintains a relatively uniform thickness until the southern limit of the basin is reached.

The Grande Greve formation consists of siliceous and cherty limestones to limey siltstones. The units of this formation are usually well stratified in beds up to one foot thick which are separated by thin layers of grey shaly rock, Grande Greve Formation (Cont.)

which is silty and somewhat limey. This formation weathers into small, sharply angular fragments with a characteristic light grey color.

The origin of the silica present in the Grande Greve formation is in doubt but it is almost certain that it was deposited with the lime muds rather than introduced after the limestone was solidified (McGerrigle, 1950).

It is believed that the color banding of the limestones has resulted from bleaching of the original dark purple-reds. These colors are thought to be indicative of deposition in shallow waters, possibly even in tidal flats.

This formation contains abundant fossils only in its type section on the Forillon Peninsula (not shown in the present mapping). Elsewhere, fossils have been found at relatively few localities. It is generally accepted that the Grande Greve formation is Oriskanian in age but the possibility of its being Onondagan has been suggested.

The York Lake and Fortin series appear to occupy the same general stratigraphic position, both appearing at the base of the thick Gaspe Sandstones and above the Gaspe Limestones. The York Lake series is recognized to the north of the Saint-Jean Anticline (not shown in the present mapping), whereas the Fortin series is confined to the southern side of this flexure. The fact that the outcrop areas of these units are separated, together with lithological differences, suggests that deposition took place in two separate troughs, the barrier between the two coinciding with the Saint-Jean Anticline. It is possible that this barrier has been in existence from early Devonian time, and this fact would account for some of the differences between the northern and southern exposures of the Gaspe Limestones. It might also explain the absence of all three of the Gaspe Limestone formations in the western part of the Fortin Trough.

York Lake Series (Not shown on Plates I or II)

This unit is a shale-sandstone-limestone zone which in some localities marks a transition between the GrandeGreve and the York River formations.

As this series is followed westward from its type section at York Lake (not shown in the present mapping), the abundance of interbedded limestone increases. Eastward from the type section, the limestones decrease in importance until only shales and sandstones are left. The limestones of this unit are of the type found in the Grande Greve formation. Worm borings are found in the sandstones of this series.

The thickness of this unit is variable. In the type region of Holland and Fletcher townships (not shown in the present mapping), the thickness varied from 2,000 to 4,000 feet.

As the fossil evidence for age determination is inconclusive, it is

York Lake Series (Cont.)

suggested by means of lithological and thickness comparisons, that the York Lake series is closely related in age to the York River formation, whose age may be either Lower or Middle Devonian.

Fortin Series

This unit is a thick succession of sedimentary rocks whose stratigraphic position is roughly equivalent to the York Lake series. Its outcrop area is restricted to the southern side of the Saint-Jean River Anticline (not shown in the present mapping). It underlies an easterly trending belt up to 18 miles in width which extends at least as far west as Matapedia Valley (Plate II, Sheet 1).

Lithologically, the series consists of dark shaly slates with limestone, sandstone, and conglomerate interbeds. The limestones are usually dark grey, soft, shaly, and in ribbon-banded beds up to four feet thick. The sandstones are greenish-grey to brownish-grey in color and fine to medium in grain. The conglomerates consist of pebbles (up to two inches in diameter) of quartz, chert, jasper, various volcanics, and occasional quartzites, with a matrix of sandstone similar to the beds noted above.

The series becomes more sandy toward the eastern end of the peninsula and seems to grade into the generally overlying York River type sediments.

The lower few hundred feet of the series are usually more sandy than the overlying part of the section. The most conspicuous conglomerate interzones are also found in this basal region, the lowest of which beds contain limestone fragments apparently derived from the underlying Grande Greve formation, indicating an erosional surface at the top of the Grande Greve.

In the western part of the Fortin belt (Plate II, Sheet 1) the series rests against Silurian or Silurian-Devonian rocks, and the Grande Greve and Cape Bon Ami units were not recognized. Their absence may be laid to faulting, "whereby the Fortin series was let down graben-like on both sides of the belt which it occupies," (McGerrigle, 1950, p. 76) to overlap in its western extension covering both of these formations, or that it includes both Cape Bon Ami and Grande Greve time without retaining the characteristics of the formation.

A maximum thickness of 5,000 feet is assigned to this series.

Middle Devonian

York River Formation

The rocks of this formation are greenish-grey, fine to medium-grained, feldspathic sandstones, with common interbeds and zones of greenish shale which range in thickness up to 100 feet. These shale beds are more frequently found toward the base of the unit. Limey and fossiliferous sandstone beds occur in a 1,000 to 3,000 foot thick zone above the formation base. This zone is very similar to the York Lake series and may even be correlative

York River Formation (Cont.)

with that unit. The York River formation can be distinguished from the overlying Battery Point formation even though no sharp boundary can be drawn between the two. The former is generally more shaly than the latter, and the sandstones are finer grained, less pebbly, and not so sharply cross-bedded. In the York River formation, grey plagioclase feldspars predominate, whereas, in the Battery Point formation, the main feldspar is brownish-red to flesh-colored orthoclase. It is probable that this formation was deposited in shallow seas bordering the continental areas. The thickness is estimated at between 1,000 to 6,000 feet.

Lake Branch Formation

The Lake Branch unit is restricted to the Lake Branch section of Cascapedia River (Bras du Lac, Sheet 3) and the headwaters of Nouvelle River (Sheet 2). It outcrops to the north of the Battery Point formation (Sheet 3) while no traces of it are found south of the latter unit. Lithologically, the Lake Branch formation is made up of red beds of sandstone, shale, and conglomerate.

Battery Point Formation

The main point of difference between this unit and the underlying York River formation is in the feldspar content. The sandstones of the York River formation characteristically contain light grey plagioclase, whereas the Battery Point formation contains flesh-pink to brownish-red orthoclase. Beds combining the two feldspars are most common where the two units come together.

The rocks of the lower part of the Battery Point formation are mostly pebbly sandstone, with some conglomerates and greenish shales. The sandstones are greenish-grey in color and they have a banding that may show crossbedding. The pebbles in the sandstone are mainly quartz, chert or flint, volcanic rock, and quartzite, and they are commonly well rounded. Thick (100 feet) lenses of quartz-rich sandstones occur locally on the north side of the Gaspe Basin.

The beds of the upper part of this formation are made up generally of red and brown sandstones, shales, and conglomerates, many of which are very calcareous. Evidences of shallow water deposition were occasionally observed. These coastal red beds appear to be replaced by greenish-grey beds at the same horizon inland from the coast. The thickness of this formation is estimated as between 5,000 to 7,000 feet.

The dating of this unit through the use of fossils has proved indefinite but both the York River and the Battery Point formations are referred to Middle Devonian time, probably equivalent to Hamilton time.

Structural Geology (See Plate I)

The Paleozoic rocks of the study area have undergone extensive folding and faulting. The axes of the major structures trend slightly east of northeast, paralleling the strike of the peninsula itself in this area.

The project area is bounded both to the north and south by mountainous belts whose strata dip inward. Parks (1931) believes that the geosyncline thus formed (the Gaspe Geosyncline) was bounded on the south by another (the Chaleur) geosyncline.

The youngest sediments represented on the Geologic Map, Plate I are those of the Lower or Middle Devonian Gaspe Sandstone series. The axes of the two large synclines within the project area are almost entirely restricted to these units.

By far the dominant structural feature in the area is the central belt of Gaspe Sandstones which trends east-northeast from Matapedia River (Sheet 1) to Riviere Petite Cascapedia-Est (Sheet 4). For twenty-five miles from Matapedia River, the sandstone belt is bounded both to the north and south by faults.

In the center of Sheet 2, the sandstone units start to bowl out into a large syncline whose axis strikes sinuously northeast for almost 45 miles. McGerrigle (1953) maps the nose of this syncline at Riviere Petite Cascapedia-Est (Sheet 4) with a paralleling anticline to the north which has beds of the Lower Devonian Grande Greve formation exposed.

In the northern part of Sheet 3, the sandstone strata and the underlying limestone units were intruded by granite and diorite masses. These intrusions produced considerable faulting. McGerrigle (1953) maps a domal structure within the sandstone units, within which both the Grande Greve and Cape Bon Ami limestones are exposed. Two small flexures are located south of the culmination of this dome.

In the southern part of Sheet 3 the sandstones of York River age and younger are separated from the older units by two faults. One, trending northeast, brings the York River formation into contact with the Middle Silurian Lake Matapedia-Chaleur series, and suggests the faulting out of part of the Grande Greve and Cape Bon Ami formations. The second bounding fault strikes eastward and brings the York River formation into contact with the Fortin formation to the south.

Several small anticlines and synclines are mapped near the southern limit of the York River unit on Sheets 2 and 3. Their axial trends are conformable with those of the larger structures in the area and they appear in both the York River and Fortin units.

The possible graben of the western half of the study area is bounded on the north by two northeast striking anticlines. McGerrigle maps them both as having Lake Matapedia-Chaleur series rocks exposed within them. The southernmost of the two structures is about 35 miles long. It is separated from the anticline to the north (only the northeastward plunging nose of which lies within the project area) by three small flexures, whose axial trends are easterly.

North of this latter anticline is the second of the two large synclines in which the sandstone units are mapped. The axis of this structure strikes northeast from Lake au Sammon (Sheet 1) for about ten miles. At Lake Casault (Sheet 1) the trend changes to due east until the axis crosses Riviere Causapscal (Sheet 2) whereupon it resumes its northeast trend. The anticline to the south intersects this doubly plunging syncline at Lac des Huit-Milles (Sheet 1).

This syncline lies to the south of an easterly trending anticline and syncline which cross Riviere a La Truite (Sheets 1 and 2). These two structures lie almost entirely within the Cape Bon Ami formation (Silurian-Devonian).

McGerrigle maps a small anticlinal nose west of Matapedia River (Sheet 1).

The tract to the south of the major "graben-syncline" described above is almost entirely made up of Fortin series units (Sheets 1 and 2) within which McGerrigle (1953) maps numerous, small, easterly trending structures. These features are grouped around two southward flowing branches of Riviere Assemetquagan (Sheet 2).

The most prominent structure on Sheet 4 is "Bonnecamp Dome", the long axis of which strikes northeast. Middle Silurian beds outcrop within Devonian limestones. This structure is flanked, both to the north and south by parallel trending synclines.

McGerrigle (1953) maps a double anticline, whose axes strike easterly, about two miles west of Oat Cake Lake (Sheet 4). Two large synclines are mapped to the south of this feature and one is noted to the north. Their trends are generally easterly. In reference to the syncline immediately south of the double anticline, McGerrigle finds it impossible to continue the structure any further west than about 65°30'W. He does not indicate any reason for the discontinuance beyond an inability to trace it.

South of the major synclinal axis which enters Sheet 4 from the west, two extensive anticlinal structures are mapped in the Middle Silurian. Both of these structures strike northeast. The southernmost of the two plunges to the west.

Surficial Geology

Four major rock belts trend easterly through the project area and parallel the length of the peninsula. The peninsula as a whole is a broad syncline with its main downfold in the central (Devonian) belt. The subsidiary folds are often of major extent with the general structural grain

Surficial Geology (Cont.)

being northeast to east-northeast.

The northernmost belt lies along the northern coast of the peninsula and ranges in width from 10 to 25 miles. These rocks are found only along the northern border of the project area. This entire belt is made up of sharply folded Lower (Deepkill) and Middle (Normanskill) Ordovician units but only the Deepkill units are found within the area of study. The Deepkill is predominantly slaty, with local sandstones, limestones, and conglomerates.

The north-central belt contains the Shickshock Range which lies in part between the northern and central belts. This is the only belt of the four that does not extend the length of the peninsula. This east-northeast trending band extends 60 miles from Matane River (Sheet 1) to the Tabletop Mountains (Sheet 4) but only the easternmost and the westernmost thirds lie within the project area. The Shickshocks are underlain by basic volcanics altered to hornblendic-chorite schists. The ages of these rocks have not been definitely ascertained, and they have been placed anywhere from pre-Cambrian to Ordovician (McGerrigle, 1953).

The broadest of the four bands (averaging about 40 miles in width) is the central belt which extends from Matapedia Valley (Sheet 1) on the west, across the peninsula to the Gulf of St. Lawrence (not shown in the present mapping) on the east. The rocks of this belt are mainly Devonian in age (Gaspe Sandstones and Limestones) but they are bounded along their northern and southern margins by more or less continuous bands of Silurian rocks. Other Silurian exposures are noted along anticlinal folds within this central belt.

The southern belt borders the Bay of Chaleur (not shown in the present mapping) in a 25 mile wide band, but is seen in the project area only along its southern margins. The underlying rocks, consisting of Ordovician, Silurian, and Devonian sedimentaries with some Silurian and Devonian volcanics, trend east-northeast throughout the length of the peninsula. All of these rocks are folded.

Geologic History

Pre-Quaternary

Parks (1931, p. 795) suggests extensive pre-Upper Ordovician folding which established the Shickshock series (Plate I, Sheets 1, 2, and 3) and the southern mountainous belt as the north and south rims of the Gaspe Geosyncline. He believes it quite probable that another geosyncline was formed to the south. Upper Ordovician seas then breached the southern rim of the Gaspe Geosyncline and proceeded to deposit sediments far to the west.

The extremely metamorphosed rocks of the Shickshock series are mostly igneous in origin. Amygdaloidal augite suggests that the rock was formed by volcanic action.

The peridotite masses of Mt. Albert and Mount Serpentine (neither shown in the present mapping) present various stages of serpentinization of the enclosed olivine. A zone of amphibolite surrounds the Mount Albert mass, and probably represents the first stage of the intrusion (Parks, 1931, p. 797).

Although the evidence supporting Taconic folding of the pre-Silurian sediments of the project area is not absolute, it is, as stated by McGerrigle (1950, p. 95) "reasonably convincing". The Ordovician rocks underwent sharper and more complex folding than the post-Ordovician rocks. This fact, together with the greater metamorphism of the former series leads most workers to believe in Taconic orogeny here. The presence of Silurian conglomerates indicate that local erosion took place between Ordovician time and Silurian time. Crickmay (1932, p. 369) concluded that the Ordovician and the Silurian of the Matapedia Valley (Plate I, Sheet 1) are separated by an orogeny of post-Richmond (?) and pre-Clinton age.

Following the Taconic movements, both the Gaspe and Chaleur geosynclines were downwarped once more giving the Silurian seas access. Parks (1931, p. 796) states that the Silurian seas advanced further to the north but not as far to the west as did the Ordovician seas.

Sedimentation seems to have been fairly constant during Silurian time, but the presence of thick (up to 300 feet) local exposures of basal conglomerate overlying fossiliferous Silurian limestone which are in turn overlain by shales and volcanics of Helderberg age (lower Devonian) may indicate local uplift. The boulders of the conglomerate are mainly limestones of the Matapedia series. It has therefore been believed that, locally at least, uplift and erosion occurred between Silurian and Devonian time in the Gaspe region (McGerrigle, 1950, p. 97). However, according to a personal communication from Dr. H. Knipping (of the Calgary office of British American Oil Co., Ltd.), the lowermost Devonian unit (ex-St. Alban formation) at the base of which the above mentioned conglomerate section would fall has recently been reclassified as Upper Silurian and the Silurian-Devonian boundary now falls within the Cape Bon Ami formation. This would indicate then a hiatus within the Silurian during which uplift and erosion took place. No unconformity is present between the Upper Silurian (ex-St. Alban) and the Lower Devonian (Cape Bon Ami).

Little Silurian volcanism is noted in the Gaspe Geosyncline. However, in the Chaleur Geosyncline (not shown in the present mapping) basaltic flows up to 3,500 feet thick are found in association with Silurian units at Black Cape (not shown in the present mapping) and volcanic ash deposits are found interbedded with Silurian marine deposits. Volcanism of equal magnitude probably took place in the Gaspe Geosyncline to the north, (Parks, 1931, p. 797).

Parks (1931, p. 798) states that the Lower Devonian sediments in the area around Mount Albert are associated with volcanics and McGerrigle (1953) shows large areas of basic volcanics interbedded with Lower Devonian sediments along the north shore of Chaleur Bay (not shown in the present mapping).

Parks (1931, p. 798) suggests that the large proportion of silica contained in the Grande Greve formation was derived from the leaching of volcanic ash deposited by volcanoes in "the heart of the peninsula". However, as of this writing it has not been definitely ascertained whether the silica is of primary or secondary origin (McGerrigle, 1950).

The contact between the Grande Greve formation (uppermost unit of the Gaspe Limestones) and the York River formation (lowermost unit of the Gaspe Sandstones) appears to be conformable, with local time breaks of little importance recurring again and again during the deposition of the sandstone beds. The York Lake unit which is the lowest member of the York River formation grades downward into the Grande Greve formation and upward into the York River formation.

The contact between the York River formation and the overlying Battery Point formation is essentially conformable except in certain localities where cross-bedding and cut-and-fill structures point to emergence and submergence of slight importance.

Subsequent to the deposition of the Gaspe Sandstone series (York River, Lake Branch, and Battery Point formations) folding which had started in Lower Devonian time became more intense. This period of folding was so severe that the relationships between the rocks ranging from Upper Ordovician to Middle Devonian became obscured. Extensive faulting, both parallel and transverse to the structural grain, also occurred.

A thick series of basic volcanics underlies the Middle Devonian in the area along Cascapedia River (Plate I, Sheet 3). Dikes of similar material cut the York River formation in the area north of Square Forks Brook (Plate I, Sheet 3).

Parks (1931, p. 798) concludes that "igneous activity was intermittently manifest throughout the area of Gaspe" from pre-Silurian time to the close of the Devonian.

Parks (1931, p. 796) states that post-Mississippian disturbances are indicated only by the general raising and lowering of the entire area. It is believed (Parks, 1931, p. 797) that general elevation took place throughout the area in late Tertiary time initiating the present erosion cycle.

A temporary depression of the region was caused by the great weight of Laurentide ice during the glacial period. It is the opinion of the present writer that the terraces(not shown in the present mapping) in the Riviere Matapedia area are the result of rebound of the rocks subsequent to the removal of the weight of ice.

Quaternary

Glaciation of the Gaspe Peninsula appears to have occurred in three well defined stages. The area was first glaciated by Laurentide ice after the withdrawal of which, ice is known to have moved radially from the highland areas in two stages (Flint, 1942).

The evidence of glaciation is limited almost exclusively to the presence of erratics of Laurentide type which are areally widespread. Although most of the erratics have been found below a 2,500 foot level, some have been found on Mount Albert (not shown in present mapping) north of the area of Plate I, Sheet 3 at an elevation of 3,775 feet, about 15 feet below the summit (Flint et al, 1942) indicating that Laurentide glaciation of Wisconsin age (Flint et al, 1942) probably affected the entire peninsula. That the ice crossed the highest parts of the Shickshock Mountains has not yet been proved but that theory is not discounted.

Erratics are more abundant in the project area as compared to the region east of the Bonnecamp (Plate I, Sheet 4) structure. However, they appear to be more concentrated in the Matapedia (Plate I, Sheet 1) and the Assemetquagan (Plate I, Sheet 2) valleys.

The erratics are mainly of granite gneiss and anorthosite both of which are characteristic of the shield area north of Saint Lawrence River (not shown in the present mapping).

Anorthosite erratics are much less common than are granite gneiss erratics. From the little information available, the ice appears to have moved south-southeast.

In addition to the Laurentide glaciation, two definite periods of local glaciation are known to have occurred. During the first period, local ice caps were located in the Tabletop Mountain (Plate I, Sheet 4) and Beland-Upper York River (north central part Plate I, Sheet 4) areas and ice flowed radially outward from them. Erratics extend from the Tabletop Mountains (Plate I, Sheet 4) for almost fifteen miles in all directions except westward. It appears from the lack of granite erratics in the Shickshock Mountains just west of Mount Albert (not shown in present mapping), that ice from the Tabletop Mountains did not cross Mount Albert. It is believed that a separate ice cap formed on Mount Albert at a late stage in this glacial epoch. This ice spread to the north, northwest, and south.

The Beland-Upper York River area lies about 20 miles east of the Tabletop Mountain area, and is developed on resistant Grande Greve formation which combines quartz and feldspar porphyries. Ice flow from this highland has been traced by the spread of porphyry and altered sedimentary erratics. The ice from this upland area appears to have been confined on the west by the Tabletop Mountain ice cap, but movement to the north (almost to Saint Lawrence River), the east, and the south (10 miles) was almost unrestricted.

The period of ice caps was probably followed by a period of valley glaciation, the flow being outward from cirques in the rims of the flat-topped higher summits. The areal extent of this type of glaciation is not known. In the area around the Tabletop Mountains and Mount Albert, cirques, U-shaped valleys, and hanging valleys are noted, and these features are known to be present as far as Matane Lakes (northwest corner Plate II, Sheet 2) to the west, and for some distance to the northwest, north, and northeast.

Glacial striae have been noted along the coasts (not shown in present mapping), in the Matapedia Valley (Plate I, Sheet 1), and in the Mount Albert - Tabletop Mountain area (top of Plate II, Sheets 3 and 4). It is possible that the striae on Mount Albert record the northwest to southeast movement of Laurentide ice across the peninsula. The fact that the measurement of the direction of the glacial striae is quite dependent on the local contour and that the direction of movement or the source of the ice that produced the striae is unknown, renders the information gathered from the striae inconclusive.

Other glacial features are found locally within the project area. Ground moraines have been recorded between the base of Berry Mountain (not shown in present mapping) escarpment and the Lake Branch of Grand Cascapedia River (Plate II, Sheet 3). Kame and kettle topography is well developed in the valley of Lake Matapedia (Plate I, Sheet 1) and eskers have been recognized in a few valleys below cirque basins in the Tabletop Mountains.

It is probable that the Laurentide ice stage was preceded by the formation of valley glaciers which coalesced to form local ice caps. Subsequent widespread glaciation has obliterated the evidence of existence of these two stages.

PART II

INTERPRETATION

GENERAL

The similarity of Photogeologic Map, (West Half, Gaspe, Quebec, Canada) Plate II to Geologic Map (West Half, Gaspe, Quebec, Canada) Plate I is quite evident. As all of the major structural features within the project area were described under the section on Structural Geology in Part I of this report (page 15) and in order to forego repetition, only observed differences between Plates I and II will be described herein. The discussion will be divided into four parts, according to the number of the applicable sheet.

Sheet 1

Structural

a) The eastward trending anticline and syncline north of Riviere Causapscal (Plate I) were not observed during the photo-interpretation phase of the project.

b) A small northeast striking syncline was interpreted at the town of Causapscal (Plate II). This feature was not mapped by McGerrigle (Plate I).

c) Generally speaking, the axes of the structures which are mapped on both plates trend more to the north of east on Plate II than they do on Plate I.

d) The faults bounding the York River unit were not actually observed under stereoscopic examination. However, they were inserted in order to explain the apparent "cutting out" of the Grande Greve formation.

Stratigraphic

a) The contact between the Lower Ordovician units and the Middle Silurian units in the vicinity of Lake Matapedia (Plate II) is interpreted to lie about two miles north of the location mapped by McGerrigle (Plate I).

b) The two northeastward plunging anticlines whose axes cross Matapedia River are mapped on Plate I as having Middle Silurian rocks exposed in their cores. Although these structures were interpreted and mapped during the photogeologic study, no such change in lithology was noted.

Geomorphic

A geomorphic axis* strikes northeast from Matapedia River just south of the town of Milnikek. It is characterized along its 19 mile length (Sheets 1 and 2) by divide topography and the westward deflection of southward flowing drainage lines.

Sheet 2

Structural

a) The small anticlines and synclines mapped on Plate I in the vicinity of Assemetquagan River were not observed under stereoscopic examination.

b) The small anticline near the southern contact of the York River unit and the Grande Greve unit was mapped during the study, but the flanking synclines were not observed.

Stratigraphic

a) The Middle Silurian outcrops located at the southern contact of the Fortin series on Plate I were not mapped during stereoscopic examination.

b) The area of outcrop of several rock units was changed during the mapping.

1) The York River formation in the northern syncline appears almost to "neck out" on the middle of the sheet. This may indicate a high point in the syncline.

2) The anticline to the south of the aforementioned structure is mapped on Plate II farther to the north than it appears on Plate I, causing a reduction in the outcrop area of the Grande Greve formation which is mapped between the two structures.

Geomorphic

The geomorphic axis of Sheet 1 enters Sheet 2 south of Assemetquagan River and continues its northeast trend until it is east of that drainage line.

* A geomorphic axis represents an anomalous alignment of geomorphological features, including drainage divides, drainage curvatures, anomalies, producing areas, and known and interpreted local and regional structural features.

Sheet 3

Structure

a) A small anticline strikes northeast into Hale Brook in the southwestern corner of this sheet. It is about 5 miles long and is almost directly on trend with the aforementioned geomorphic axis. This feature was not mapped by McGerrigle.

b) The small groups of structures in the vicinity of Riviere Grand Nord (Plate I) and the structures at the juncture of Sheets 2 and 3 (Plate I) were not observed during the photographic analysis.

c) The Middle Silurian anticline striking southwest into Sheet 3 from the east (Plate I) was not mapped during the present study. However, a short anticline paralleling the aforementioned trend was interpreted north of the confluence of Cascapedia River with Ruis. Jonatham. The location of the axis of this latter feature coincides almost exactly with the position of the areally more extensive structure mapped by McGerrigle.

Stratigraphic

a) The Devonian limestone units mapped by McGerrigle (Plate I) as striking into a northeast trending fault (southeastern part of the sheet) were observed during the stereoscopic study of the photographs. Due to insufficient data however, it was not possible to differentiate between the Grande Greve and the Cape Bon Ami formations. These two rock units are therefore mapped in this locality as Cape Bon Ami-Grande Greve, Undivided. The positions of the units on Plates I and II are almost identical.

b) The belt of Middle Silurian Lake Matepedia-Chaleur series rocks which strikes southwestward into the southern half of Sheet 3 and terminates at an easterly trending fault was not observed under sterescopic examination.

c) The isolated area of Cape Bon Ami limestone mapped by McGerrigle as being confined between two faults and Middle Silurian rocks was not mapped during the present study.

d) The volcanic rocks mapped on Plate I were not mapped during the present investigation.

e) The small area of Middle Silurian rocks shown in the southeastern corner of Plate I was mapped during the present study, but its eastern limit could not be determined.

f) The small anticline and syncline mapped by McGerrigle south of the domal structure in the northern part of the sheet were not observed during the photoanalysis.

Sheet 4

Structural

a) The small anticline and syncline mapped in the southeastern part of the Fortin series (Plate I) were not observed under stereoscopic examination.

b) A small (5 miles long) northeast striking syncline was mapped about one mile north of the western end of the St. Jean River geomorphic axis. This feature was not mapped by McGerrigle during his investigation.

c) The long anticline mapped by McGerrigle which strikes northeast from the middle of Plate I, Sheet 3 across Plate I, Sheet 4 which exposes Lake Matapedia - Chaleur series rocks in the core was not mapped during the present study. However, a 5 mile long, northeast trending anticline was mapped at the northwestern extremity of the Fortin series outcrop. The axis of this structure coincides with the position of the longer axis as postulated by McGerrigle.

d) McGerrigle maps a northeast striking syncline just to the north of Oat Cake Lake (eastern margin, Sheet 4). He follows this structure into the project area from the east for about eight miles but is unable to continue it any further westward. During the course of interpretation, however, this synclinal belt of York River sandstones was traced to the southwest to connect with the northeast trending belt of sandstone which McGerrigle mapped as nosing off into a southwest plunging syncline. According to the photoanalysis, this sandstone belt is synclinal, with the axis being discontinuous. This apparent offset of the axis may be due either to faulting normal to the trend of the axis or by the appearance of a northeast trending anticline between the two synclines. This anticline was not mapped by McGerrigle. It is located one mile north of Lac Bonaventure, and strikes northeast for about six miles.

e) No dip reversals to corroborate the presence of the northeast trending anticline and syncline south of Oat Cake Lake (as mapped by McGerrigle), were observed during the photoanalysis.

f) No changes in dip were apparent in the vicinity of St. Jean River to indicate the existence of McGerrigle's Riviere St. Jean Anticline. However, a geomorphic axis was mapped in this area, based on the presence of divide topography. This geomorphic axis coincides exactly with the position of McGerrigle's anticlinal axis.

Stratigraphic

a) The presence of the northeast trending band of Lake Matapedia - Chaleur series rocks which extends across Plate I, Sheet 4 was not detected during the photogeologic study.

b) A continuous band of York River sandstones was interpreted to trend northeast across Plate II Sheet 4, connecting two isolated sandstone synclines as mapped by McGerrigle (Plate I, Sheet 4). The presence of this sandstone belt causes the reduction in outcrop area of the Gaspe Limestone series.

c) No change in outcrop presentation was noted in the vicinity of Bonnecamp Dome during the photoanalysis. Therefore, no distinction was made between the limestone units and they are mapped herein as Cape Bon Ami - Grande Greve, Undivided.

d) The area of sandstone outcrop mapped to the south of Oat Cake Lake by McGerrigle was not observed during the interpretation phase of the project.

Geomorphic

a) A geomorphic axis strikes east - northeasterly for 20 miles from Little Cascapedia River. It exhibits divide topography and coincides with the position of the anticlinal axis mapped by McGerrigle in the vicinity of Riviere St. Jean.

LINEAMENTS

Lineaments, as defined by the New York Photogeologic Unit fall into five basic categories. They are as follows (Kupsch, 1957, pg. 37):

Fracture traces: Straight to gently arcuate fine lines which may either be the surface expression of a fault or joint. These features are visible during stereoscopic examination of the aerial photographs as dark lines formed by concentrations of vegetation, or rock or soil contrasts along the trace.

Tonal lineaments: these features are narrow, light or dark, straight bands of local to regional extent.

Topographic lineaments: These features are formed by alignments of topographic elements (streams, scarps, ridges, etc.).

Tonal fracture lineaments: This feature is a linear zone of variously trending fracture traces. They are not visible in photographic view.

Zonal fracture lineaments: A linear zone of parallel fracture traces. Not ordinarily visible in photographic view.

Because of the lack of mosaic coverage of the study area, topographic and zonal fracture lineaments were the only types interpreted. They appear on the final map (Plate II, Sheets 1-4) where they are differentiated into lineaments and fracture zones. In this report, no distinction will be made between topographic lineaments and zonal fracture lineaments, and they will both be referred to as lineaments.

It is pointed out here that the lineaments presented on Plate II by no means represent a complete picture of all the linear features in the study area. Detailed air photo mapping of lineaments is extremely time consuming and for proper analysis, a statistical study of the features should be undertaken.

It has been postulated that the origin of these linear features lies in movements along pre-established lines of weakness in basement rocks. This movement may produce fracturing along a linear zone in an otherwise undisturbed sedimentary column. The displacement of the basement rocks may be very slight, producing offset only in the lowest strata of the sedimentary suite while causing "jointing or multiple fracturing with microscopic displacement in the overlying rock. The lines of weakness in the basement rock may also provide avenues for dike intrusion and mineralization". (Photogeologic Unit, 1956, pg. 165).

The lineaments in the project area conform to three trend directions, with the predominant set striking north-northwest. This direction is almost normal to the major tectonic grain of the region, and is best expressed in long, straight stream segments.

The second major lineament set strikes northwest and is also manifested mainly by long, straight stream reaches.

The third trend direction is north-northeast and corresponds with the strike of the structures within the sedimentary basin. Topographic changes, straight stream segments, and elongated furrows suggest the presence of these features. However, as this direction conforms with the strike of the stratigraphic units, it is entirely possible that these lineaments are due in part to adjustment of streams to bedding planes instead of to fractures. If they are controlled by faulting, the faults are of the bedding-plane type and not easily distinguishable under air photo examination.

Conclusions as to the significance of these linear features in relation to geologic structures cannot be reached at the present time. These data are included for possible future application to structural analysis.

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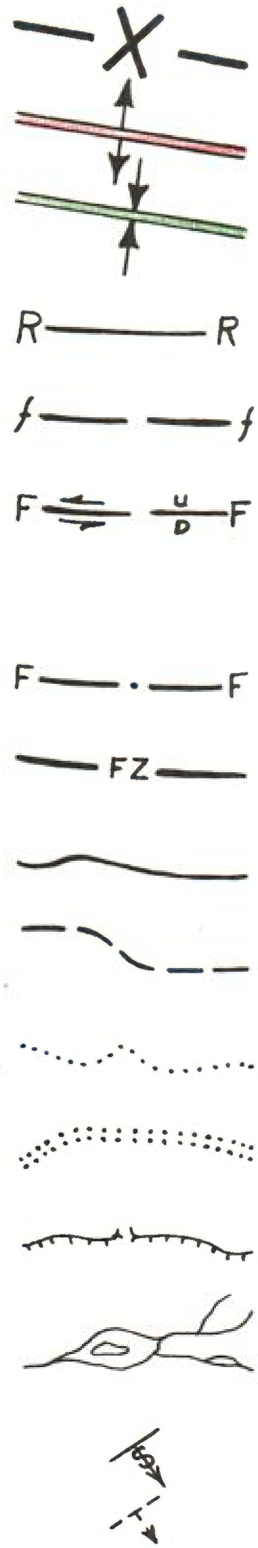
MASTER LEGEND



Geomorphic Axis

Probable Photogeologic Anticlinal Axis

Probable Photogeologic Synclinal Axis

Ridge

Lineament

Probable Fault
(Arrows indicate directions of relative movement. U-D indicate probable upthrown and downthrown blocks).

Possible Fault

Fracture Zone

Observed Photogeologic Contact

Probable Photogeologic Contact

Assumed Photogeologic Contact

Undetermined Contact

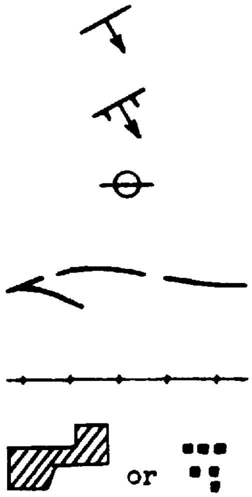
Escarpment

Drainage with Lake or Swamp

Direction of Topographic Slope

Possible Photogeologic Dip

MASTER LEGEND



Photogeologic Dip (Probably Less than 30°)

Photogeologic Dip (Probably Greater than 30°)

Vertical Beds

Roads and Tracks

Railroad

Town or Village

ROCK UNIT LEGEND FOR PLATE II

LOWER DEVONIAN OR MIDDLE DEVONIAN

Dbp	Battery Point Formation
Dlb	Lake Branch Formation
Dyr	York River Formation
Df	Fortin Series (York Lake Formation is possibly equivalent in age)
Dgg	Grande Greve Formation

SILURIAN-LOWER DEVONIAN

Sdc	Cape Bon Ami Formation
Sdc Dgg	Grand Greve - Cape Bon Ami Undivided

SILURIAN

Sil	Upper and Middle Silurian Types

MIDDLE SILURIAN

Sms	Lake Matapedia - Chaleur Series
Sms Sdc	Lake Matapedia - Chaleur Series - Cape Bon Ami Undivided

UPPER ORDOVICIAN

Ow Whitehead - Pabos Formations

LOWER ORDOVICIAN OR OLDER

On Deepkill or Older (Possible Sillery Equivalent)

PRE-ORDOVICIAN (PRE-CAMBRIAN?)

Pos Shickshock Series (Possible Beauceville Equivalent).

IGNEOUS ROCKS

Gr Granite. Devonian or Later