GEOLOGICAL
SURVEY
OF
CANADA

DEPARTMENT OF ENERGY,
MINES AND RESOURCES

PAPER 69-12

# GEOLOGY OF McKENDRICK LAKE MAP-AREA, NEW BRUNSWICK

(Report, Map 17-1969 and figures)

F. D. Anderson
(with a contribution by George D. Hobson)

Price, $1.50

1970


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Price: $1.50 Catalogue No.M44-69-12

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Queen's Printer for Canada
Ottawa
1970

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## ABSTRACT

McKendrick Lake map-area lies in the northeastern part of the Appalachian Mountain system astride the Miramichi Highland and New Brunswick Lowland physiographic subdivisions.

The oldest rocks are Cambro-Ordovician paragneiss, schist and phyllite that occupy the core of a large northeast-trending anticlinorium. Minor structures in these rocks indicate that they have undergone at least three stages of deformation.

Overlying the metamorphic rocks with apparent unconformity (in places the contact may be faulted) is a sequence of basic volcanic rocks and interbedded slate and siltstone. Graptolites from the siltstone have been identified as Upper Silurian (Lower Ludlovian) in age.

Slate, siltstone, greywacke and minor volcanic rocks form the bulk of the remaining deformed Paleozoic rock-units in the map-area. These units are contiguous to the south where they have been dated as Ordovician to Silurian in age.

Granitic rocks ranging in age from Ordovician to Devonian outcrop in the western part of the map-area.

Near horizontal Carboniferous strata unconformably overlie Ordovician and Silurian units. Fossil flora collected are correlative with the Pennsylvanian Clifton Formation.

The main structural feature is a fault that strikes east-northeasterly across the southern part of the map-area. It appears to be strike slip with an apparent displacement of about 4 miles.

A hammer seismic survey was conducted to determine the thickness and extent of a Carboniferous outlier and the nature of the underlying surface.

# GEOLOGY OF McKENDRICK LAKE MAP-AREA, NEW BRUNSWICK

## INTRODUCTION

The McKendrick Lake map-area is on the eastern flank of a belt of highly deformed older Paleozoic rocks that extends northeasterly across central New Brunswick.

Field work was carried out during the summers of 1966 and 1967. Assistance in the field was rendered by R. T. Bell, P. R. Ouimet, W. C. Cull, T. G. Shroeter in 1966 and R. M. Nickerson, P. M. Dimmell, B.H. MacInnis, and R. Penny in 1967. The writer is indebted to employees of Fraser Companies Limited and New Brunswick Forest Service for assistance and co-operation.

### Accessibility

The Plaster Rock-Renous Highway cuts across the southern half of the map-area. The only other all-weather road extends northwesterly from near the mouth of McGraw Brook; this road was constructed and is maintained by Fraser Companies Limited. Several other roads in the map-area were built by various private firms, and are generally passable in the summer months with a four-wheel drive vehicle. Skilled boatmen can navigate Little Southwest Miramichi and Renous rivers at times of highwater. At other times, boulders, rapids and shallows seriously impede passage.

### Physical Features

The map-area lies astride the boundary between the Miramichi Highlands and the New Brunswick Lowland physiographic subdivisions (Weeks, 1957). The highlands in the map-area are deeply incised by tributaries of Miramichi River; elevations range from 1,700 feet in the northwest to about 800 feet in the southeast. Local relief in the northwest is as much as 800 feet. The lowland in the southeastern part of the map-area is generally featureless, and slopes gently southeastward.

Over 90 per cent of the rock exposures in the map-area are along streams and roads. Interstream areas are generally devoid of outcrop.

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Original manuscript submitted: 18 June, 1968
Final version approved for publication: 23 October, 1969
Project 660017
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601 Booth Street,
Ottawa 4, Canada.

## Glaciation

The map-area was glaciated at least once during the Pleistocene. Glacial striae indicate that ice moved easterly in all parts except in the northeast corner where it moved northeasterly.

The area is covered with a thin mantle of till, generally less than 10 feet thick on the tops of hills and thicker on the sides. Large areas underlain by sand and gravel, probably glacial outwash - were noted near the eastern edge of the map-area between Renous and Little Southwest Miramichi rivers.

# GENERAL GEOLOGY

Highly deformed Cambro-Ordovician metasedimentary rocks have been intruded by Devonian and older granitic rocks. These outcrop in the northwestern part of the map-area. Deformed Silurian sedimentary and volcanic rocks that overlie the Cambro-Ordovician rocks with apparent unconformity, extend southeasterly across the central part of the area. Silurian rocks are in turn unconformably overlain by undeformed Carboniferous sediments in the southeast.

## Cambrian and/or Lower Ordovician (1, 2, 3)

The oldest rocks in the map-area are paragneiss and schist (1). They are best exposed along Little Southwest Miramichi River between Libbies and Shore Camp brooks. Because the base is not exposed the thickness is unknown but it is at least 1,500 feet. Dips are gentle to moderate and horizontal layering not uncommon.

Biotite and hornblende paragneisses are the predominate rock types. Distinct lithologic layering and primary sedimentary features such as cross-bedding are well preserved in many places. Interbedded are quartz-chlorite and sericite schists and phyllite, all of which become more abundant in the upper part of the unit.

The gneiss is typically grey to green, and medium to coarse grained. Reddish layers are fairly common where orthoclase forms a high percentage of the rock or where stained with iron oxide, notably about one mile west of the confluence of Lower North Branch Little Southwest Miramichi River. Composition is variable: quartz 20-45 per cent; orthoclase and microcline 30-45 per cent; albite and andesine 20-30 per cent; chlorite, biotite and hornblende 5-10 per cent. Most minerals have undergone some degree of alteration, and secondary quartz and feldspar are common.

Overlying unit 1 is a sequence of phyllite, slate, quartzite and schist (2). The contact appears to be gradational with unit 1. Unit 2 represents not only a lower metamorphic grade but also a separate stratigraphic unit distinct from unit 1. Unit 2 is well exposed along sections of Little Southwest Miramichi River and its tributaries, and along the road extending northwest from McGraw Brook. The northeasterly extension of this unit is well defined (Anderson, 1961; Dawson, 1961). Southwest of the map-area,

the unit was intruded and metamorphosed by large granitic masses (Poole, 1963). The thickness of the unit is unknown, but probably does not exceed 8,000 feet.

Most of unit 2 is a medium to dark greenish grey phyllite. Slate is generally grey-green and not uncommonly dark grey, and exhibits well developed bedding ranging in thickness from laminations to several inches. Quartzite forms beds a few inches to several feet thick, is commonly feldspathic, and occurs interbedded with schist and phyllite. Schist varies considerably in colour and composition; varieties include quartz-sericite, quartz-chlorite, sericite, biotite and chlorite schists.

Phyllite, slate and schist are in most places highly crenulated, and they exhibit cross-cutting cleavages and cleavage and flexure folds. They have undergone several episodes of deformation.

Quartzite and gneiss are relatively competent and rarely show any evidence of repeated deformation, although mineral lineation and fractures are common. Interbedded schist and phyllite, even those layers a centimetre thick, are highly crenulated and have intersecting cleavages. Although rocks of unit 1 have undergone several stages of deformation the effects are not as clearly evident as in unit 2, probably because of the higher proportion of competent rocks and the partial obliteration of evidence of deformations by more intense metamorphism.

Slate, siltstone and minor greywacke, metamorphosed in places to biotite grade, occur along North Renous River west of Morrison Brook. They show little sign of repeated deformation, but nevertheless are here included in unit 2. It is possible that they belong to a unit as yet undifferentiated, or were in a stable area relatively unaffected by the forces that deformed the bulk of rocks in units 1 and 2.

Recognizable volcanic rocks are rare within units 1 and 2. Highly sheared basalt or andesite and associated pyroclastics occur on the north side of a lake about 3 miles northeast of Mains Lake and along the upper part of the stream that flows easterly from the lake.

Rhyolite, phyllite, and minor quartz-feldspar augen-schist and basic volcanic rocks (3) outcrop in the northeast part of the map-area along Little Sevogle River. Similar rocks occur along Parks Brook and about 2 miles north of Catamaran Lake. The thickness of the unit is unknown.

Rhyolite is light grey to green, weathers grey to white, is generally highly sheared, and contains phenocrysts of potash feldspar and rarely quartz. It is intercalated with phyllite, quartz-feldspar augen-schist and basic volcanics.

Phyllite is dark grey to green and highly crenulated.

Quartz-feldspar augen-schist weathers grey to white and is also intensely sheared. The quartz and feldspar augen are crushed and elongated in the plane of the predominant cleavage, and set in a schistose matrix of quartz, feldspar, sericite, and chlorite. Quartz-feldspar augen-schist north of Catamaran Lake lacks associated volcanics; it may be a highly sheared feldspathic quartzite. However, a sill of quartz-feldspar porphyry, now an augen-schist about 30 feet thick, occurs in rocks of unit 2, on the south side of Libbies Brook about 1 mile west of the road.

The basic volcanic rocks include andesite and basalt, and associated pyroclastics. Like other rocks in unit 3 they are intensely sheared. Their relationship with other rocks in the unit is obscure but they appear to be interlayered.

The ages of units 1, 2 and 3 are not definitely known. Units 1 and 2 have been mapped as Ordovician in adjoining areas to north and northeast (Anderson, 1961; Dawson, 1961), and included in a Cambrian and/or Ordovician unit in an adjoining area to the southwest (Poole, 1963). They appear to be structurally dissimilar to any known post-Lower Ordovician in New Brunswick. Units 1 and 2 are pre-Middle Ordovician in age, probably Cambro-Ordovician. Unit 3 is contiguous with an acid volcanic unit, mapped as part of the Middle Ordovician Tetagouche Group that lies to the northeast (Dawson, 1961). However, because of the close spatial relationships and structural similarities of units 1, 2 and 3, unit 3 is here considered to be of Cambro-Ordovician age, and may be as young as Middle Ordovician.

## Ordovician (4)

The youngest layered Ordovician rocks in the map-area are best exposed along South Renous River about 2 miles east of the Plaster Rock-Renous Highway bridge. The unit consists of greywacke, slate, basic volcanics, and minor rhyolite and conglomerate. Greywacke is in beds a few feet thick and interlayered with slate some of which is carbonaceous. Basic volcanics are andesite and basalt and commonly have flow breccia marking their upper surface. Basic dykes, believed to be intrusive equivalents of the andesite and basalt, occur here and there in the unit.

Contacts with the surrounding units are not exposed. However, numerous shear zones within unit 4 suggest that it is bounded by faults.

Graptolites were collected by W.H. Poole from carbonaceous slate and tentatively identified as being Ordovician in age (W.H. Poole, personal communication, 1968). The unit is contiguous with rocks mapped as Middle and (?) Upper Ordovician in an adjoining map-area (Poole, 1963).

## Silurian (5, 6, 7)

Contacts between the three Silurian units in the map-area have not been observed; their relative ages were determined by fossils found in the map-area and in adjoining map-areas to the southwest (Poole, 1963).

The oldest Silurian map-unit comprises dark grey slate, siltstone, greywacke, lithic greywacke, grit and conglomerate (5). The rocks are interlayered in graded beds a fraction of an inch to several feet thick. Conglomerate, although forming but a minor part of the unit, is distinctive, and has been traced from South Renous River to Redstone Brook. In many places it grades both laterally and vertically into finer grained rocks. It is composed of fragments up to 3/4 inch in diameter of dark grey slate and argillite, grey to green chert, grey quartzite and siltstone, basic volcanics and quartz. Lithic greywacke and grit as seen in thin section have similar compositions. The unit has been traced for over 50 miles to the southwest and contains Middle Silurian (Wenlockian) graptolites (Poole, 1960, 1963).

In probable fault contact with unit 5 are grey slate, siltstone and quartzose greywacke (6). The strata are commonly graded, exhibit channeling, and here and there contain interbedded dark grey slate similar to that found in unit 5. Minor basic to intermediate volcanic rocks along Catamaran

Brook east of the Carboniferous outlier (13) are here included in this unit although their relationship is unknown because of the numerous faults in this locality. To the southwest graptolites from unit 6 are dated as Silurian (Poole, 1960, 1963).

Interbedded grey to green slate and siltstone, and basic volcanics and minor rhyolite (7), occur between Cambro-Ordovician units 2 and 4 and Silurian unit 5. The slate and siltstone are commonly micaceous, here and there calcareous, and in beds a fraction of an inch to several inches thick. The volcanics are andesitic to basaltic in composition; amygdaloidal phases and flow breccia are common. Pillows were observed in only one outcrop - on Little Southwest Miramichi River about 1 mile west of Parks Brook. Ferruginous slate beds and red chert and stringers were noted in outcrop along Devils Brook and the Plaster Rock-Renous Highway. Buff-weathering carbonate rock, somewhat manganiferous and in 1/10- to 3/4-inch beds, was also found in the basic volcanic sequence in units up to 2 feet thick.

Brown-weathering quartzose calcareous grit is exposed in unit 7 at two localities, both near the contact with unit 5. The first is along the road a few hundred feet east of the bridge over Parks Brook. Here it is in contact with the slate and siltstone from which graptolites were recovered. The second locality is along the Plaster Rock-Renous Highway about 4 1/2 miles east of the western margin of the map-area. Nearby are outcrops of slate and siltstone lithologically similar to graptolitic strata on Parks Brook, but unfortunately bedding and cleavage intersect at about 45 degrees, and no fossil material was recognized, even though from their lithologies and the presence of nearby volcanics they belong to the same map-unit.

Graptolites were also collected along Parks Brook about 1/2 mile from its mouth, and along the road at the mouth of the brook (GSC loc. 75191, 75192). L. M. Cumming identified Monograptus sp. cf. M. varians Wood of probable early Ludlovian age. Rocks apparently contiguous with this unit have been correlated with the Middle Ordovician Tetagouche Group in adjoining map-areas to the northeast (Dawson, 1961) and southwest (Poole, 1963).

The contact between unit 7 and Cambro-Ordovician rocks may be faulted in places, especially along the lower part of Devils Brook near Little Southwest Miramichi River. There, unit 7 rocks are highly sheared and the volcanics carbonatized. For the most part, the contact appears to be normal with the Silurian rocks lying with angular unconformity on the Cambro-Ordovician (2).

## Devonian and Earlier (8, 9, 10)

There are two distinct types of granitic rocks in the map-area: an older cataclastic type (8) and a younger massive type (10). The relative age of the two types has been confirmed by isotopic dating (Poole, 1963).

The older granitic rocks (8) are quartz monzonite to granodiorite in composition, generally pink in colour, and the ferromagnesian mineral, commonly hornblende, is almost entirely altered to chlorite. Gneissosity in the older granitic rocks commonly parallels the oldest structural trends in the Cambro-Ordovician rocks. Because of their close spatial relationship in many places with paragneiss and schist of unit 1 and inherited structural trend, it is probable that these granitic rocks are metasomatic in origin, of pre-Devonian age and represent mobilized basement.

The younger massive granitic rocks (10) are of Devonian age (Poole, 1963), also quartz monzonite to granodiorite in composition, commonly porphyritic, pink to grey, and contain biotite as the main accessory mineral. The phenocrysts are potash feldspar and are up to 2 inches in length. Biotite is little altered. The granitic rocks (10) are massive and homogeneous, and lack mineral lineation. Xenoliths of gneiss and schist up to several tens of feet long and several feet wide, as well as smaller basic inclusions, are scattered throughout the exposed portions of the pluton. Perhaps because of limited exposures in the map-area, no preferred orientation could be determined. No contact was observed between the older (8) and younger (10) granitic rocks. No thermal metamorphic effects attributable to the younger granites were observed, although they may be present.

Diorite and quartz diorite (9) appear to have intruded Cambro-Ordovician rocks along Little Southwest Miramichi River. Although fresh appearing in hand specimen, microscopically they are seen to be highly altered to a degree similar to that of their host and are therefore probably pre-Silurian in age.

Fresh diorite and diabase (9) were observed as dykes and sills relationships with rocks of units 3, 4, and 7. These rocks are probably related to basic volcanic activity within the units and hence Ordovician to Silurian in age. Diabase (9) also cuts unit 6 along Catamaran Brook east of the Carboniferous outlier. The age of this diabase is unknown.

## Carboniferous (11, 12, 13)

Near-horizontal carboniferous strata (11, 12, 13) unconformably overlie steeply dipping Silurian rocks. The oldest (11) is a red to brown conglomerate and sandstone. Pebbles rarely exceed 2 inches in diameter and were derived from older rocks in the region. A reddish, calcite-cemented, quartz-rich, fine conglomerate to grit, up to 15 feet thick, is common near the base of the unit. Because of topography and overlap of unit 12, the apparent thickness of unit 11 varies considerably, although the true thickness is probably constant and not more than a few hundreds of feet.

Unit 12 comprises olive green to grey sandstone, siltstone, shale, and grit. Floral remains from the siltstone and shale identified by W.A. Bell, place the age from Late Westphalian B or early C to Mid or Late Westphalian C of the Pennsylvanian. The comparable time interval in northern New Brunswick is represented by strata of the Clifton Formation.

Green to reddish brown conglomerate (13) between Catamaran Brook and North Renous River is probably an outlier of Carboniferous age. The fragments are angular to subrounded, range in diameter to over 2 feet, and were derived from older rocks within 3 miles north of the outlier. No layers of finer grained material, such as sandstone or shale were observed within the unit. Attitudes shown on the map are probably primary sedimentary attitudes and the unit unaffected by later deformation.

The conglomerate (13) outcrops in the bottoms of valleys and on the tops of hills. The base varies from an elevation of 350 feet in the valleys to over 900 feet on the tops of hills.

Hammer seismic surveys across the conglomerate (<u>see</u> Appendix A), show that the conglomerate is a relatively thin mantle, not over 200 feet thick, lying on a rather irregular surface of older Paleozoic rocks. A few

depressions in the basement may be fault-line valleys related to the Catamaran fault. Irregularities in seismic results of the basement can be attributed to either faults or differences in lithology of rocks comprising the basement. There is no evidence either in outcrop or in results of the seismic survey, to indicate that the conglomerate outlier was faulted.

The conglomerate was deposited rapidly in a narrow elongate basin. This was probably not much larger than the area presently underlain by the conglomerate. The surface was irregular in longitudinal and cross-section (see Figs. A-3 and A-4, Appendix).

## STRUCTURAL GEOLOGY

### Faults

The most prominent feature is a lineament that cuts east-northeasterly across the map-area. Catamaran Brook occupies part of this lineament and the name Catamaran break is given to this feature. The break or lineament has been traced at least 24 miles west (Poole, 1963); little is known of its easterly extension.

Examination of the rocks in the vicinity of the break shows that it is underlain by a fault with a right-lateral displacement of about 4 miles. Although topographically the lineament is relatively narrow, studies in the vicinity of Catamaran Brook east of unit 13, demonstrate that the fault zone is at least a half-mile wide. Figure 1 is a detailed map of part of Catamaran Brook along what is believed to be the southern edge of the fault zone. It illustrates the right-lateral displacement of a diabase dyke.

A lineament detected on aerial photographs in the southwestern part of the map-area separates units 5 and 6 and is interpreted as a fault. The movement along this fault is unknown.

Intense shearing in rocks along the lower part of Devils Brook indicates the presence of a fault that separates Cambro-Ordovician rocks (2) from Silurian rocks (7) in the vicinity. There is no evidence to suspect that the fault extends along the contact of the older and younger rocks.

### Folds

The pre-Carboniferous strata in the map-area has been folded at least once. The older rocks display evidence of an older folding not found in the younger rocks. The latest, and most dominant, folds trend northeasterly, and can be found in all deformed layered rocks.

Silurian rocks trend northeast, dip generally southeast at a moderate to high angle, and overturning is not uncommon.

Paragneiss and schist (1) occupy the core of a large anticlinorium that strikes northeasterly across the northwest part of the map-area. Horizontal dips are common near the crest of the anticlinorium along Little Southwest Miramichi River. Shaw (1936, p. 7) first noted the presence of the anticlinorium with its gneissic core.

Cambro-Ordovician rocks were tightly folded along northwesterly trending axes prior to being folded northeasterly. Crenulations and minor

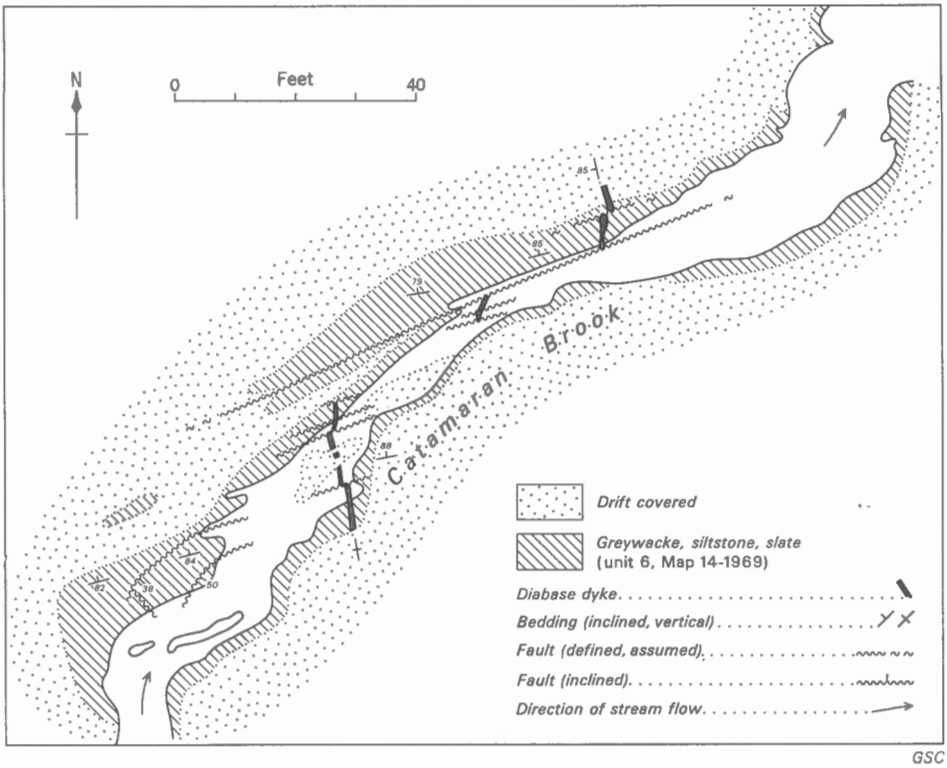


**Figure 1. Southern part of Catamaran fault showing right lateral displacement of a diabase dyke, Catamaran Brook, 3 miles southwest of mouth.**

Figure 1. Southern part of Catamaran fault showing right lateral displacement of a diabase dyke, Catamaran Brook 3 miles southwest of mouth.

folds, from a few inches to several feet from crest to trough, plunge northwest on the northwest flank of the anticlinorium and southeast on the southeast flank.

Penetrative cleavages associated with the deformations parallel the directions of folding. Crenulations are commonly cleavage folds rather than flexure folds.

Examination of cleavages, crenulations, and mega- and macrofolds, have established a sequence of deformation for the Cambro-Ordovician rocks. The strata were first folded and fractured along northwesterly axes. They were then refolded and fractured along east-northeasterly axes that cross-folded the earlier folds and cleavage. The third and most prominent folding trends northeasterly and parallels folding of the post-Cambro-Ordovician strata. A fourth deformation oriented generally east-west, is suggested in some exposures by faint lineations on bedding surfaces and broad warps of older cleavages, and bedding. The fourth deformation is

difficult to assess and may represent local conditions of stress with non-penetrative strain.

Silurian strata exhibit one direction of folding trending northeasterly.

The difference in deformation indicates that tectonic events separate Cambro-Ordovician from younger rocks. The earliest deformation is correlated with the Penobscot disturbance (Neuman, 1966) that appears to be of regional significance and occurred between Early Cambrian and Early Ordovician. The second event may represent the Taconic orogeny although in this section of the Appalachians there is little evidence in nearby map-areas. The youngest deformation was probably the result of the Acadian orogeny.

## ECONOMIC GEOLOGY

Sphalerite, galena and chalcopyrite occur in rocks of unit 3 along Little Sevogle River.

Copper mineralization is present in carbonatized basic volcanics on the lower part of Devils Brook and in metamorphic rocks along Little Southwest Miramichi River about 1 mile west of the mouth of Lower North Branch Little Southwest Miramichi River.

Chalcopyrite occurs in quartz veins up to 2 feet wide at the mouth of a brook flowing south into Little Southwest Miramichi River about 1/2 mile west of Mains Brook.

Galena, sphalerite and chalcopyrite were also noted in highly sheared quartzite and greywacke in a road cut along Plaster Rock-Renous Highway 3/4 mile east of the western edge of the map-area.

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# APPENDIX A

## A HAMMER REFRACTION SEISMIC SURVEY, CATAMARAN BROOK AREA, McKENDRICK LAKE, NEW BRUNSWICK, 21 J/16 EAST HALF

George D. Hobson

A hammer seismic survey was conducted along four lines immediately south of Catamaran Brook in Southesk Parish, New Brunswick. Catamaran Brook flows into the Southwest Miramichi River near the eastern end of the Plaster Rock-Renous Game Refuge. The project area is about 30 miles west-southwest of Newcastle, New Brunswick, between latitudes 46° 50' and 46° 52' and between longitudes 66° 10' and 66° 14' (Fig. A-1). Messrs. C. Jobin and P. Jantzen carried out the field survey in 10 days of August 1967, and G. D. Hobson prepared the field data and interpreted the results.

A Huntec Model FS-3 facsimile seismograph was used to record all seismic data. A 16-pound sledge hammer struck against a steel plate on the ground provided the seismic energy. Explosives were not used as a source of energy.

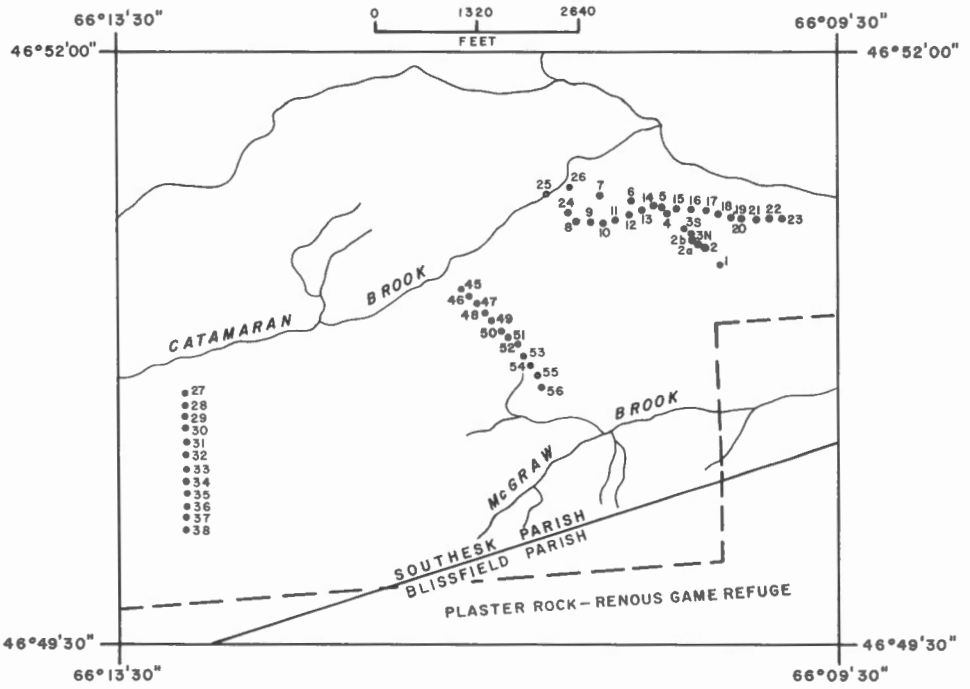


Figure A-1. Seismic locations near Catamaran Brook, Northumberland County, New Brunswick.

Fifty-three single direction refraction seismic profiles were completed over the four control lines. Only two reversed profiles were surveyed. The average length of the geophone-to-source spread was about 800 feet. All seismic locations are shown in Figure A-1.

Surface elevations were carried from a base station by means of two altimeters; the base station elevation was determined from a topographic map since the closest geodetic bench mark was located in a remote area at least 10 miles distant.

Existing all-weather and winter roads were used for access and for seismic control. Along these lines, topographic relief is not excessive, being less than 100 feet on any one particular line.

The objectives of the seismic survey were as follows:

(1) To delineate the surface (an angular unconformity) between the pre-Carboniferous, folded greywacke and the overlying Carboniferous, undeformed conglomerate;

(2) To locate and determine the nature of the southeastern edge of the conglomerate;

(3) To determine the thickness of the conglomerate, which with the other determinations could lead to an explanation of the form and reason for existence of the conglomerate. The elongate outlier was believed to represent either a filled trough-like depression eroded in the greywacke, or a relic of a southeasterly tilted sequence down faulted on its southeastern side.

## RESULTS

### Velocities

Figure A-2 is a histogram of observed seismic velocity versus frequency of occurrence. The velocities are as observed and are not corrected for dip, since reversed profiles were not surveyed. There are generally two velocities observable within the overburden; these show very definite peaks on the histogram. The conglomerate and the greywacke can be differentiated on the basis of seismic velocity within these formations as shown on the histogram. Velocities less than 13,000 feet per second indicate conglomerate bedrock whereas velocities in excess of 13,000 feet per second indicate greywacke.

### Overburden Thickness

Thickness of overburden varies between about 4 feet at seismic location 14 to a maximum of 84 feet at location 23. Location 22 is also covered with relatively thick overburden, 54 feet having been penetrated at that site. In general, overburden thickness is less than 20 feet and the uppermost surface layer 4 to 5 feet thick.

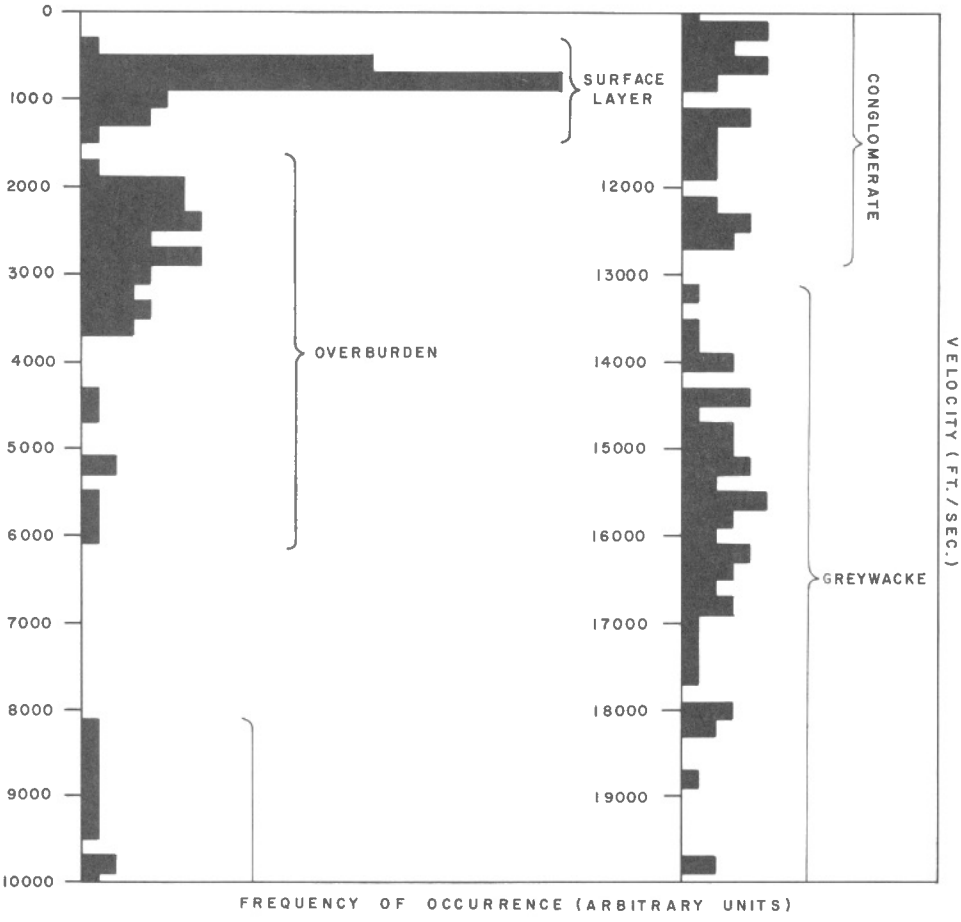


Figure A-2. Histogram of observed seismic velocities near Catamaran Brook, New Brunswick.

Bedrock and Basement

Figures A-3 and A-4 show cross-sections for the four lines of seismic control. The two velocity strata detected within the overburden have been combined and represented as one stratum. The conglomerate and greywacke underlying the overburden are presented indicating observed velocities at each location.

Significant relief is obvious on the top of the greywacke basement and is clearly a pre-Carboniferous feature present at the time of deposition of the conglomerate. Several faults or changes in gross lithology have been interpreted within the basement complex; these features are interpreted from very good basic seismic data which when plotted on time-distance graphs yield in several cases very ambiguous curves that in some instances have been interpreted with some uncertainty. In short, very good data have yielded very poor time-distance plots at several locations and indicate a complex basement. If faults are not present, at least lithologic changes

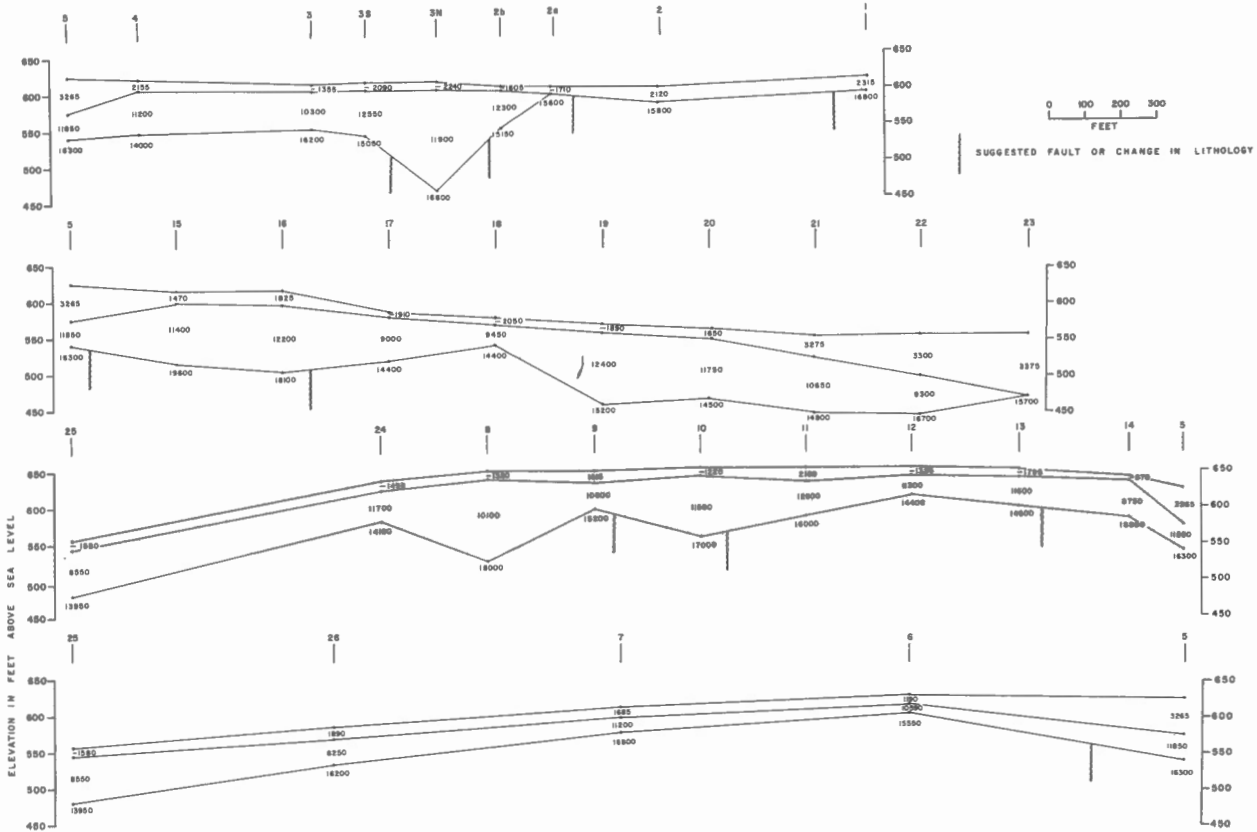


Figure A-3. Cross-sections along three seismic survey lines showing velocity layers. Top layer represents overburden, middle layer the conglomerate and bottom layer the greywacke.

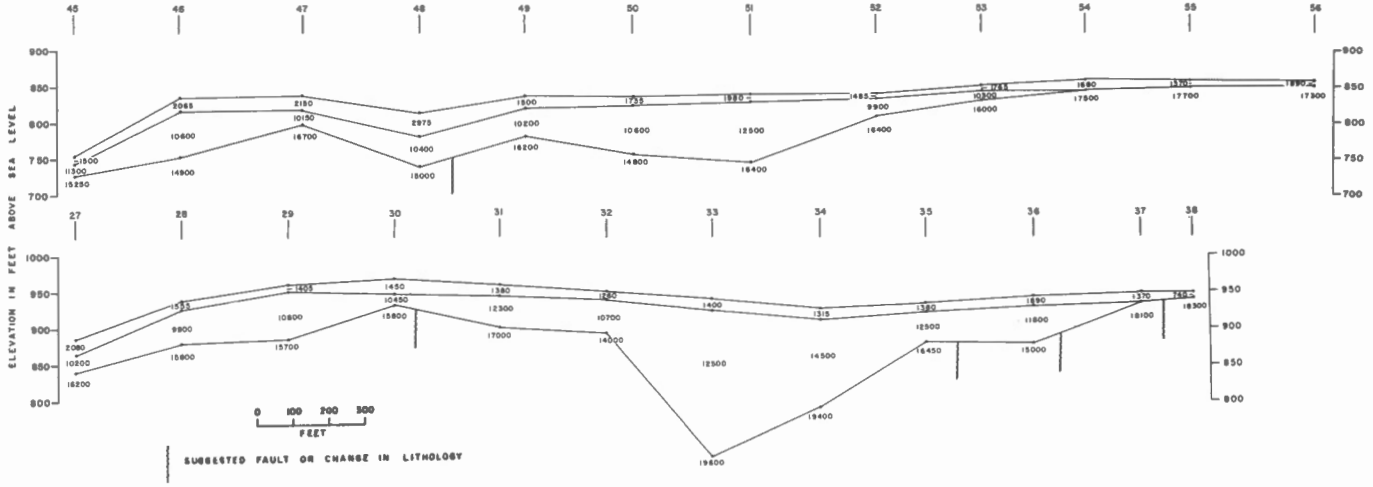


Figure A-4. Cross-sections along two seismic survey lines showing velocity layers. Top layer represents overburden, middle layer the conglomerate and bottom layer the greywacke.

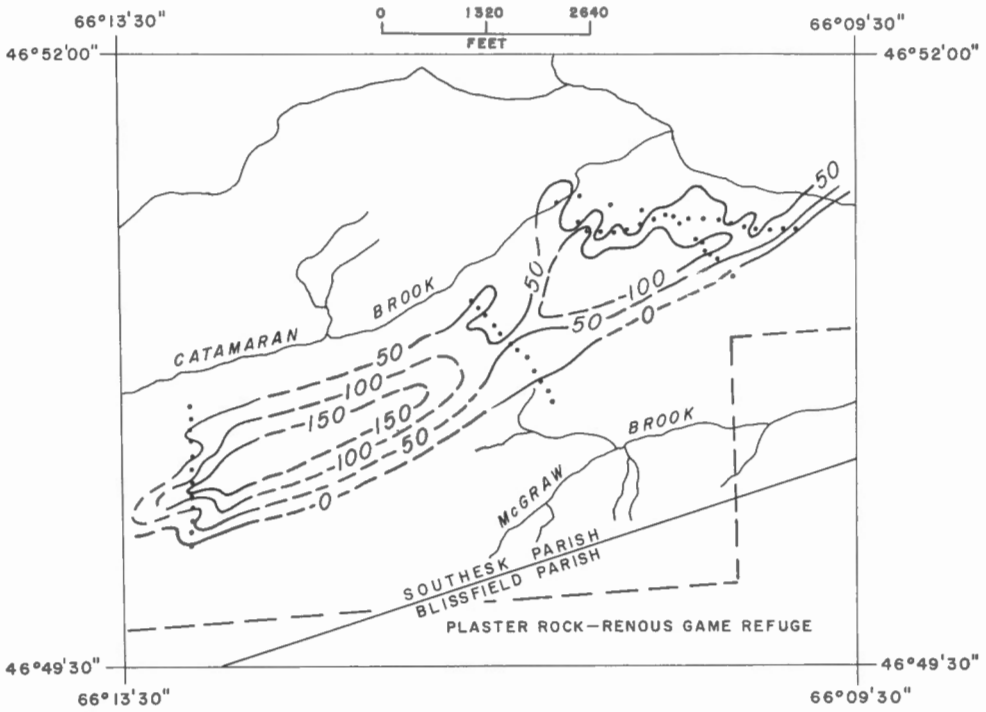


Figure A-5. Isopach map of Carboniferous conglomerate in the outlier near Catamaran Brook. Thickness is in feet.

must be interpreted from the seismic data. It is not however suggested that these features extend upwards into the conglomerate; this possibility is not at all indicated on the time-distance graphs.

## Correlation with Drillholes

No drillholes were available to the seismic team for direct correlation between seismic velocities and lithology within the project area.

## CONCLUSIONS

The base of the conglomerate resting upon the greywacke can be readily identified since an adequate contrast exists between the velocity of propagation of seismic waves within these two formations. The thickness of the conglomerate and hence the topography of the upper surface on this greywacke can be determined with accuracy.

The southeastern limit of the conglomerate is a normal wedge-out and not a fault.

The overall geometry of the conglomerate body is similar to a filled, shallow, northeast-trending trough, Figure A-5. The basal surface of the conglomerate is quite irregular with some short steep slopes. For example, between seismic locations 32 and 33, the surface drops 165 feet in a distance of 300 feet (Fig. A-3), an average slope of 30 degrees.