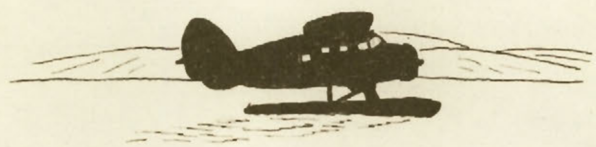
THE

GEOLOGY OF THE ROUND POND MAP AREA

NEWFOUNDLAND

by

R. M. Slipp



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ABSTRACT

The Round Pond map area occupies 150 square miles of south central Newfoundland. The rock formations probably belong to the Paleozoic Period.

Isoclinally folded sedimentary rocks, with interbanded pyroclastic sediments and some andesite flows, are, with the possible exception of a formation of interbanded schist and quartzite, the oldest formations.

Ultra basic rocks present are sheared to a breccia. Intrusive diorite, apparently younger than the ultra basic rocks, underlies eight square miles of the area.

Granitic gneisses are peripheral phases of granitic intrusives of possibly Devonian age. Interbanded schist and quartzite are older than the ultra basic rocks and may be older than the sedimentary rocks. The schist and quartzite were deformed after their recrystallization.

The rocks of the area were mountain built by the Taconic and/or the Acadian orogenies. Erosion produced a subdued topography.

A Pleistocene ice sheet moved southward over the area.

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INTRODUCTION

General Statement.

This thesis is a description of the geology of 150 square miles of map area in south central Newfoundland. The area was mapped by the author and assistants during the summer of 1951. Previous to the writers work very little geological investigation had been carried out in this part of Newfoundland. The mapping shows the following: a belt of steeply tilted sedimentary rocks with a northeast trend occupies most of the area. Lesser amounts of gneiss and igneous types are present. The sedimentary rocks have undergone some metamorphism.

Location and means of access.

The map area, to be referred to as the Round Pond Map Sheet, lies in the southern watershed of Newfoundland within the drainage basin of the Bay East (Salmon) River. Round Pond is approximately 30 miles north of Baie d' Espoir and 60 miles south southeast from the town of Buchans. Approximate limits of the Round Pond Sheet are Latitude N 48° 10' to N 48° 18' and Longitude W 55° 57' to W 56° 12'. The area is most easily reached by means of float equipped aircraft. Access is also possible by a moderately difficult canoe route from the south coast. This route starts at the head of Baie d' Espoir and leads north through a series of streams and lakes.

Mapping procedure and coverage.

The Buchans Mining Company, Buchans, Newfoundland, mapped the area as part of a systematic prospecting program. Pace and compass traverses were run at 1,000 foot intervals over all of the area. Field observations were recorded on base maps and on aerial photographs with a scale of 1'' = 1320'. The amount of outcrop present varied from about 10 per cent on ridge tops to less than one per cent within the low lying areas. Efforts to follow any distinctive marker horizon along strike were thwarted by the paucity of outcrop.

Acknowledgments.

The Buchans Mining Company granted permission to use the information obtained from field mapping in this thesis. Mr. E.A.Swanson and the late Dr. H.J.Maclean of the above company supervised the field work and offered many valuable suggestions. The author is particularly indebted to Mr. Swanson for information pertaining to the distribution of rock types of central Newfoundland.

Sincere thanks are extended to Professor J.E.Riddell for his instruction in laboratory procedures and for his aid in the preparation of this paper.

Previous Work.

The Photographic Survey Corporation, Toronto, made a reconnaissance survey of 6,000 square miles of central Newfoundland during 1949 and 1950 for the Buchans Mining Company, in order to establish the regional distribution of rock types. This survey outlined the areas of sedimentary, gneissic and igneous rocks. The Round Pond Map Sheet is within the area covered by this work.

The only other work, to the author's knowledge, is the reconnaissance survey made by Alexander Murray in 1870. This exploration was accomplished by following the canoe route from the head of Baie d' Espoir to Round Pond and onward to the north as far as Great Burnt Lake.

NOTES ON THE GEOLOGY OF CENTRAL NEWFOUNDLAND.

The information assembled in this section of the thesis is to present a general picture of the geology of Central Newfoundland. The summary is based on recent investigations by geologists of the Newfoundland Geological Survey and the Buchans Mining Company.

The Buchans Mining Company have mapped the geology of about 5,000 square miles of Newfoundland during the past ten years. The greater part of this mapping covered the area between Red Indian Lake and the south coast, and resulted in a more detailed map than was previously available.

General Lithology.

Approximately one half of the area between Red Indian Lake and the south coast is underlain by belts of sedimentary rocks. Intrusive rocks and granitic gneisses separate the belts of sedimentary rocks from each other. The sedimentary rocks are folded and have a persistent northeast trend and a steep attitude. The sediments have undergone a low grade of metamorphism. The northeast trending belts of sedimentary rocks include siltstone, shale, slate, sandstone, quartzite, graywacke, arkose, grit and conglomerate. Locally flow, tuff and agglomerate are interbanded with the sedimentary rocks.

Intrusives and gneisses.

Intrusive and gneissic rock underlie the areas between the belts of sediments. The intrusives vary in composition from acid to ultra basic. Granite occurs in excess of the total of all the other intrusive types. The other intrusives include granidiorite, syenite, monzonite, quartz diorite, diorite, gabbro, perknite and peridotite.

The granitic gneisses occur in bands and usually lie between an area of granite and an area of sedimentary rock. Basic types of gneiss are rare and of small size.

Structural trends.

A notable characteristic of the rock formations of Newfoundland is their northeast trend. This structural feature is prominent on the east and south coasts and the recent work of the Buchans Mining Company shows the same trend for the formations of central Newfoundland. The northeast trend is marked by the outlines of the sedimentary belts and the strikes of S-planes and primary bedding within the formations. Differential erosion controlled by differences in the resistance of bedrock formations has produced various surface features that accentuate the northeast trend. The foliation of the gneisses generally parallels the trend of the sediments but is erratic and in places somewhat vague.

Ages.

The ages of the rock formations of central Newfoundland are not definitely established. The Buchans series of sedimentary and volcanic rocks which underlie the Red Indian Lake region and in which the ore bodies of the Buchans Mine occur are considered Ordovician (Newhouse, 1931; Snelgrove, 1938). This age is based on the lithological similarity between the Buchans Series and Ordovician formations that occur on strike with them in Notre Dame Bay. Similar reasons indicate that some of the sedimentary and volcanic rocks of the Buchans -Red Indian Lake region may be Silurian.

A series of slightly metamorphosed sedimentary rocks near the south coast in the La Poile River area are of Devonian age (Cooper, 1943). The age determination is based on fossil plants found in these rocks. The granite

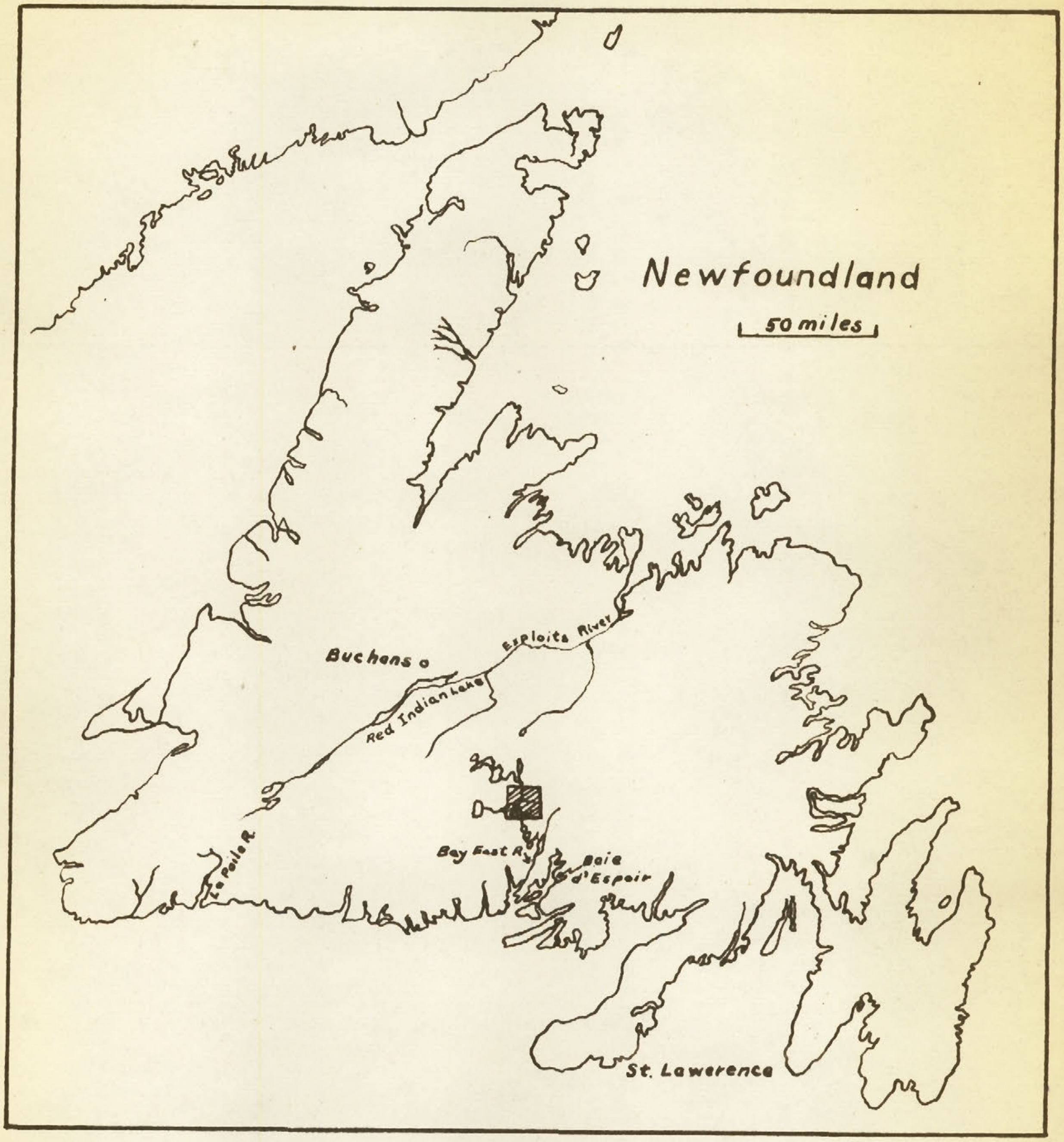

Figure 1. Location map showing the Round Pond area and the places referred to in the section titled- Notes on the geology of central Newfoundland.

of the La Poile River area cuts the Devonian sedimentary rocks and this relationship shows that at least some of the granite masses of south central Newfoundland are no older than Devonian. Other work has shown these granites to be pre-Mississippian (Snelgrove, 1938).

During the summer of 1951, S. Scott of the Photographic Survey Corporation found Ordovician fossils in metamorphosed sedimentary rocks to the northeast of Baie d'Espoir (Weeks, 1952). These formations, named the Baie d' Espoir Series by Jewell (1939) had been tentatively classed by him as Silurian.

In summary, it may be said that the folded belts of sedimentary rocks trending in a northeast direction across central Newfoundland are, in part, Ordovician and Devonian. Probably other Paleozoic periods are represented. Some of the granitic intrusives are Devonian. It is possible that most or all of the granitic intrusives of central Newfoundland are Devonian as Schurchert (1930) has suggested. He compares them with the Devonian intrusives of the Maritime Provinces, New England and the Gaspé of Quebec.

GEOLOGY OF THE ROUND POND AREA.

Physiography.

Topography.

The region is one of gently rolling elongated hills and flat-bottomed valleys. The hills are aligned as ridges trending to the northeast. The relative relief is 200 to 300 feet. The summits of the hills are at elevations between 800 and 900 feet a.s.l. (See Figure 2 & 3). A plain between these limits projected to the north and west would coincide with the High Valley Peneplain (Twenhofel, 1940). This peneplain was described and named by Twenhofel who proposed the Tertiary Period as the time of its formation. During 1946, Twenhofel (1947) made a brief inspection of the Baie d' Espoir area and he states that the flat surfaced upland of that area is the southern extension of the High Valley Peneplain. At Baie d'Espoir the peneplain has an elevation of 800 feet.

The tops of the hills that are underlain by granitic gneisses support a sparse vegetation and are largely devoid of trees. In contrast with the hills underlain by gneisses are the hills underlain by sedimentary rocks. These latter

Figure 2.

View of the High Valley Peneplain facing south. Round Pond in the centre background.

Figure 3.

View of the rising elevation to the northwest. Great Burnt Lake in the background.

hills are fairly well forested except where forest fires destroyed the trees.

The valley bottoms are partly forested and partly occupied by barrens, varying in size from a few acres to a few square miles. Some of the barrens of muskeg are level and others have a gentle slope. The level barrens usually terminate at the drainage end with a fringe of trees. In a few places it was possible to see that glacial debris formed the slight elevations upon which the fringe of trees grow. It appears that the level barrens are relict lake-beds whose origin resulted from the derangement of the drainage system by glaciation.

The second type of barren has a slight slope and has a high water content. Much of these areas are occupied by small crescent shaped ponds that are convex toward lower elevations. Tree growth on these barrens is probably prevented by the presence of too much water in the soil. Vegetation is restricted to a few scrub conifers, bog plants and caribou moss.

Round Pond has the lowest elevation in the area and it is underlain by intrusive rock whose resistance to erosion is less than that of the other rock types in the area. Round Pond has an area of about 30 square miles and is roughly elliptical in plan with the major axis trending east.

Structural Control.

The topography of the Round Pond Area is a reflection of the underlying bedrock. The rock formations which occupy most of the area are folded sedimentary types. Stream erosion has acted upon the less resistant members to form valleys parallel to the strike of the formations. Slaty shales underlie most of the valleys and more resistant graywackes and grits underlie the hills and their slopes. Differential erosion by streams has produced a trellis drainage pattern. The main stream of the area, Bay East River, carries the water from the subsequent tributaries across the trend of the rock formations.

The hills generally lie parallel to the strike of the sedimentary formations. An exception to this structural control of topography is the hill between the north shore of Kikupegh Pond and the northwest arm of Round Pond. The south side of this hill is at a slight angle to the strike of the sediments. The sedimentary rocks at this location have been faulted (cf. p.69) and intruded (cf. p.47) by igneous material similar in composition to the intrusive rock underlying the basin of Round Pond. Differential erosion in this contact zone has produced a hill face that intersects the sedimentary formations at a small angle.

There is a relationship between the elevation of hill summits and the underlying rock type. The highest hills are underlain by granitic gneisses and hills of slightly lower elevation are underlain by sedimentary types. In direct contrast with the elevation of the hills is the lowest elevation of the area, the basin of Round Pond which is underlain by diorite. The diorite is less resistant to erosion than the surrounding older sedimentary rocks and gneisses. Most of the larger lakes in south central Newfoundland are similar: they are underlain by igneous rocks and surrounded by stratified rock types.

Notably absent in this part of Newfoundland is the type of hill known locally as "tolts". These hills are monadnocks steepened on the sides by ice scour. "Tolts" that occur farther north in the Exploits River Valley and rise above the Lawrence Peneplain are described and commented on by Twenhofel (1940).

Drainage.

The Round Pond Area lies within the Bay East (Salmon) River System. The total area of the drainage basin of the Bay East River is estimated to be 1,018 square miles (Conquergood, 1952). The river system is one of the few in Newfoundland favourable to hydro-electric power development. Many large lake basins in uninhabited areas offer ideal sites for storage dams that would allow maximum control of water flow to a hydro-electric power plant situated on the lower reaches of the river.

The Round Pond Area has a trellis drainage pattern which is common to regions of steeply tilted rocks (Lobeck, 1939). The drainage has been deranged by glaciation. Glacial debris has dammed many of the smaller streams to produce small ponds and stillwaters.

The Bay East River is the main drainage channel of the area and flows across the trend of the rock formations (See Figure 4). This stream shows the characteristics of youth. Many small falls and rapids occur along its course and falls have developed at places where the river has failed to erode more resistant rocks sufficiently to produce a graded channel. A pool of stillwater usually occurs immediately upstream from the falls and downstream small potholes with dimensions of a few inches are common.

Figure 4.

Bay East River flowing across a resistant band of grit. Note stillwater on the upstream side of the band of resistant rock.

Glaciation.

The Round Pond Area was glaciated in Pleistocene time. On the Burin Peninsula, which is 80 miles to the southeast, Van Alstine (1948), established the glaciation as Wisconsin. Other work in Newfoundland indicates a wide distribution of the Wisconsin ice sheet and it seems reasonable to include the Round Pond area in the Wisconsin stage of glaciation, (Twenhofel, 1940).

Glacial striae and erratics are present on the tops of the hills of the Round Pond Area as well as at the lower levels, indicating that the entire area has been glaciated. Distribution of glacial drift shows that the ice moved to the south. Boulders, which originally belonged to a conglomerate bed to the north of the area, are scattered over the country south of their place of origin. The drift boulders of the diorite underlying Round Pond show a similar distribution: pieces of this rock are common south of their place of origin and in no instance were they observed north of the outcrop area. Due north of the Round Pond Map Sheet is an area of several square miles of ultra basic rocks. Boulders of these ultra basic types are scattered throughout the Round Pond area. Rôches Moutonnées are present and well developed on the gneissic rocks to the south of the area. Their gentle slopes face north and occasionally show well preserved striae. The steep sides face south. The arrangement of these ice sculptured forms indicates a southward movement of the ice. This agrees with the movement shown by the distribution of drift.

Glacial striae and grooves range in azimuth from 160°T. to 180°T. Two sets of striae intersecting at low angles are present on the sides of some of the hills to the north of the area. These crossed striae occur on the northeast and northwest sides of the hills. Wherever it was possible to ascertain the age relationships of the striae on the hillsides, it was found that the older set approximately paralleled those on the hilltops. On the northeast shoulders of the hills younger striae have a smaller azimuth than the older ones and on the northwest shoulders the younger have a greater azimuth than the older striae. (See Figure 5).

The relationship of the striae may be explained in two ways. The first explanation is that the ice that made the older striae retreated and then readvanced. During this second advance the ice sheet did not build up to the thickness that it had during the first advance and the hills lying in its path were able to deflect the ice from its general line of movement. The younger striae were made during this second advance.

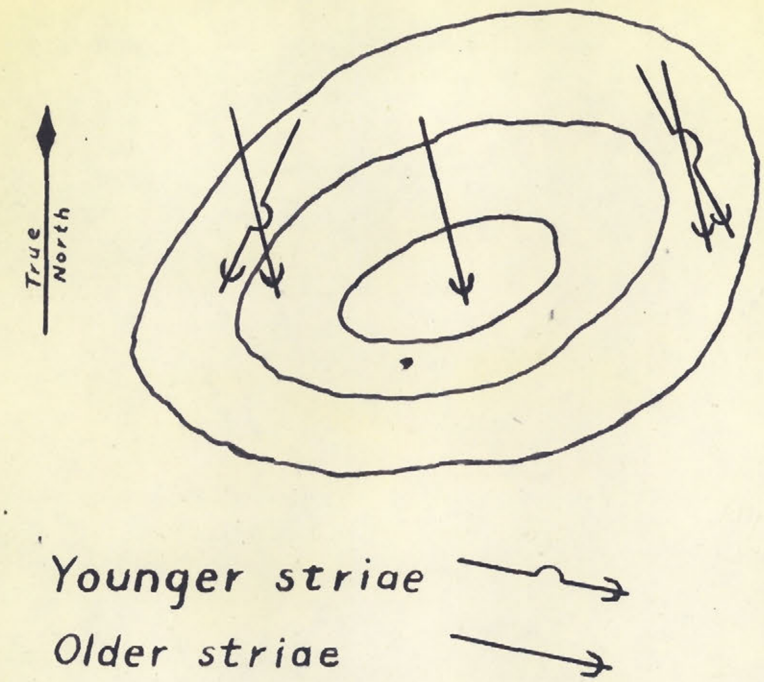

Figure 5.

Sketch showing the relation between striae and a hill. Contour lines represent the hill. Azimuth of the older striae indicate the general direction of ice movement in the Round Pond area.

No supporting evidence for two ice advances was observed and rather than postulate two advances to explain the two sets of striae,the author offers the opinion that they were formed by one sheet at different stages in its history. The older striae were made while the ice sheet was at or near its fullest extent. As the ice sheet began to wane, its thickness decreased to a depth that allowed the hills in its path to deflect it to either side as it moved by them. The slightly deflected ice cut striae across those already present in the bedrock.

Two small eskers, each about one mile long, occur at the northeast corner of Round Pond. These eskers are about 50 feet high and 100 feet wide at the base. They are approximately straight on the long dimension and trend 160°T. The eskers are made up of poorly sorted sand, gravel and boulders. The gravel, pebbles and boulders, vary widely in composition and in the degree of roundness that they have obtained. Northwest of Skunosiss Pond an esker two miles long winds across the country and trends nearly east. This esker is similar to those described above except that it is larger and has a winding course.

A small flat-topped esker occurs at the outlet of Round Pond. This esker appears to have been flattened off by water action. The flat top is about ten feet above the present lake level of 604 feet (a.s.l.). Along the north shore of the lake are old strand lines with the same elevation as the top of the esker. Apparently the lake level was higher in immediate post glacial times than it is at present. It is suggested that glacial debris blocked the outlet of the lake and that subsequent removal of this material allowed the lake to establish its level at the present elevation. However, the difference between the two levels mentioned above is only ten feet and a large run-off from melting ice might have maintained the lake level at sufficient height to produce the features described.

A thin mantle of drift is present in most of the area. Only a few scattered glacial erratics occur on some hill tops, whereas some valley bottoms show a considerable thickness of till. The Bay East River has made a channel ten to 15 feet deep in till just north of Round Pond. This till is made of sand, gravel and various sized boulders and stratification is not noticeable. It is deemed advisable to class the drift of this extensive exposure as till.

About two square miles of fine, fresh quartz and feldspar sands occupy an area about the head of Skunosiss Lake. This area extends about two miles upstream from the lake. The area of sand is nearly level and has a very gentle slope to the northeast toward Lake Skunosiss. The origin of this sand is not clear but the author offers the opinion that it marks the bottom of a lake which once included the present Lake Skunosiss and extended beyond the head of the present lake for at least two miles. There is some evidence of previous damming at the outlet of Lake Skunosiss where necks of land project toward each other from opposite banks of the outlet. There are three sets of these promontories which are made up of coarse boulders and some gravel. They appear to have acted as barriers at the outlet of the lake, thus maintaining a higher lake level until a drainage channel had been cut through them.

General Geology

Table of Formations.*

Quaternary	Gravels	
Devonian (?)	Mica gneiss and quartz gneiss. Diorite	
Ordovician (?)	Ultra Basic Rocks. Volcanic and sedimentary rocks	? ? Schist

*Tentative arrangement of rock formations. See the following sections for the discussion of age relationships.

Note that the listing of formations in the legend of the accompanying map is arbitrary.

Petrography.

Sedimentary Rocks.

Introduction. Sedimentary rocks, all of which show some degree of metamorphism, underlie most of the Round Pond area. The sediments are finer grained at the south. The sedimentary rocks are divided into north and south portions for convenience in discussion.

Southern area.

The sedimentary rocks are fine grained graywacke, impure quartzite and black slaty shale. These types occur interbanded and graywacke is most abundant.

Graywacke.

Distribution. Graywacke is the most widespread rock. It is interbanded with the impure quartzite in thicknesses varying from less than one inch to several feet.

Description. The graywacke is dark grey in color and usually it shows some banding. Quartz and plagioclase make up 60% to 80% of the rock and the quartz usually is greater than the plagioclase. Plagioclase has the range An_{10} - An_{30}. Brown biotite present is concentrated in bands through the rock. Chlorite, some of which is penninite, is associated with the biotite. Minor amounts of an opaque mineral, probably an iron oxide, occur. A few extremely small grains of an isotropic mineral, seen in one thin section, are probably garnet.

Impure quartzite.

Distribution. Throughout the southern part of the map area, impure quartzite is interbanded with the graywacke. The bands of quartzite are thin, relative to the graywacke bands.

Description. The impure quartzite varies from grey to dark grey in color. The dark grey phases are the most impure of the quartzite and carry appreciable amounts of biotite. Small opaque grains seem to be magnetite.

Black slaty shale.

Distribution. Black slaty shale bands some tens of feet thick outcrop along the northwest arm of Round Pond where they are interbedded with graywacke.

Description. The slaty shale, in hand specimen, is a black, fine grained rock. It has a fairly good cleavage and for this reason might be termed a slate. Grains of variable sizes are seen in thin sections of the rock. Grains range from 0.05 m.m. downward. The shale is, for the most part, a mat of minute grains too small to identify with the microscope. Some of the largest grains are quartz and feldspar. These grains are angular and they seem out of harmony with the finer material of the shale. This matter will be discussed in a later section (cf. p.39).

Thin conglomerate beds.

Distribution. Several narrow bands of conglomerate lie within the graywacke about 300 feet south of the shale bands. These bands are of interest as they give the strike of the sediments for a distance of two miles.

Description. Most of the conglomerate beds are a few inches thick, rarely approaching a foot in thickness. The beds are made up of small sheared pebbles less than an inch on the long axis. The pebbles are surrounded by crushed quartz and feldspar. Two chlorites, one being penninite, are present in the matrix. Some opaque material occurs.

Fractures in the conglomerate have been filled with prehnite. This prehnite may have come from the diorite to the south (cf. p.47).

Northern Area.

The sedimentary rocks of this portion of the map area are, in general, coarser grained than those to the south. Pyroclastic sediments are present and increase to the north.

Green slaty shale.

Distribution. North of the black shale, which outcrops along the northwest arm of Round Pond, is a band of green slaty shale (indicated as lg on the map). This band extends beyond the map area to the southwest. Included in the green shale is some coarse graywacke and some black shale.

Description. The green shale is a very fine grained, green colored rock with a fairly well developed cleavgge that is nearly parallel with the bedding. Bedding cannot be detected in most hand specimens but in outcrop the presence of thin lenses of graywacke indicate the bedding planes. (See Figure 6).

The green shale is composed of fine quartz, feldspar, magnetite, chlorite and opaque material. Few precise mineral identifications are possible by optical methods because of the extremely fine grain size of the rock.

The green color of the rock appears to be due to a high content of ferrous iron. Chips of the shale boiled in hydrochloric acid changed to a whitish color. The ferrous iron was oxidized and removed in the form of ferric chloride.

Figure 6.

Green slaty shale showing cleavage planes. Note thin resistant bands of graywacke, which are parallel to cleavage planes, weathering up on outcrop surface.

Graywacke and black shale.

Distribution. Graywacke lenses within the green shale are discontinuous , some being a few feet long and others longer. Thicknesses are highly variable in the graywacke lenses.

Narrow black shale bands occur throughout the green shale and they grade imperceptibly, both along and across strike, into the green shale.

Description. The graywacke is coarser than the graywacke found further south along the shores of Round Pond. It is composed of angular quartz and feldspar fragments which are cemented together by similar fine grained particles plus variable amounts of sericite. Bedding is rarely seen in the graywacke although grain gradation is present.

The black shale is similar to that described above.

Agglomerate.

Distribution. North of the green slaty shale, and lying within undifferentiated tuff, grit and slaty shale, is a band of agglomerate (ld on map). This band is five miles long and pinches out at the eastern end. The shape of the band to the west is not well-known but the agglomerate appears to be gradational into shale and grit. The boundary of this stratigraphic unit outlines occurrences of agglomerate and is not a strict geological contact for within it are included black shale and grit.

Description. The coarser phases of the agglomerate are composed of elliptical lava pebbles up to six inches in length. Coarse phases grade along and across strike into finer agglomerate which in some cases passes into grit.

The matrix of the agglomerate is partly composed of small fragments of lava pebbles and partly of angular to subangular quartz and feldspar grains. Minor amounts of sericite occur interstitial to the fragments and grains.

The pebbles of the agglomerate have an axial ratio of $a:b:c = 2:8:1$. They appear to have been flattened and are elongated in the direction of strike. Occasionally some of the elongated pebbles are fractured and the pieces separated.

Grit.

Distribution. Much of the northern portion of the area is underlain by grit. This rock is not appreciably different in chemical composition to the graywacke found to the south but its coarser, sharply angular fragments give the grit a distinctive textural character. For this reason a separate term is warranted.

Description. The grit varies in color from dark to light grey. The coarser grained phases are lighter in color and highly feldspathic.

Angular quartz and feldspar grains averaging 3 m.m. in diameter make up most of the grit. Many grains are less than 3 m.m. and many are as much as 6 m.m. in diameter. Angular pebbles, composed mainly of quartz and feldspar, are abundant locally.

The feldspar is nearly all plagioclase. The composition of the grains examined fall in the range An_{10} - An_{30}, with exceptions to either side. Between and around quartz and feldspar grains are white mica, chlorite and an opaque material. The chlorite is part penninite and the rest appears to be clinochlore.

The grit usually lacks visible bedding. Outcrops of several hundred square feet reveal no bedding whatever.

Locally, shaly material within the grit indicates stratification but no exposures showing stratification are sufficiently large to give a clear picture of the trend of the formations.

Conglomerate and Agglomerate.

Distribution. West of the Bay East River at the extreme north of the area, the grit described above grades into conglomerate (le) which, further north, contains lenses of agglomerate.

Description. The conglomerate is made up of poorly rounded pebbles and boulders that vary in size from less than one inch up to two feet in length. (See Figure 7). Pebbles and boulders examined are felsite (rhyolite?), andesite, chert and granite.

The matrix of the conglomerate is similar to the grit found to the south.

Stratification is completely lacking in the conglomerate where examined. Measurement of the azimuth of the long dimension of the chert boulders indicates a trend of about 050°T.

The agglomerate is andesitic in composition. The rock is composed of angular to subangular fragments up to five inches long. Some fragments have a vaguely rounded outline similar to pillows. The agglomerate was nowhere seen in contact with the conglomerate but it is assumed to occur as small lenses within the conglomerate.

Figure 7.

Conglomerate. Some of the boulders are outlined in ink.

Undifferentiated Tuff, Grit and Shale.

<u>Distribution.</u> The map shows a considerable area (1f) as undifferentiated tuff, grit and shale. Lack of detailed information necessitates this grouping.

<u>Description.</u> The shale and grit are similar to that described above with the notable exception that the grit of the undifferentiated zones contains more shaly material than does the grit previously described. Also the grit of the undifferentiated zone west of the quartz gneiss is mylonized. (See Figure 8).

The tuff is invariably a fine grained rock that is greenish in color. Locally, fragments of quartz and plagioclase up to 3.m.m. in diameter are found. The fragments are commonly angular but in places where they are subangular, the rock assumes the appearance of a "porphery".

Thin section examination showed the finer grains to be plagioclase, chlorite, an amphibole (?), and quartz.

In the field, diligent efforts to trace the tuff horizons met with no success and it is concluded that they are probably discontinuous along strike.

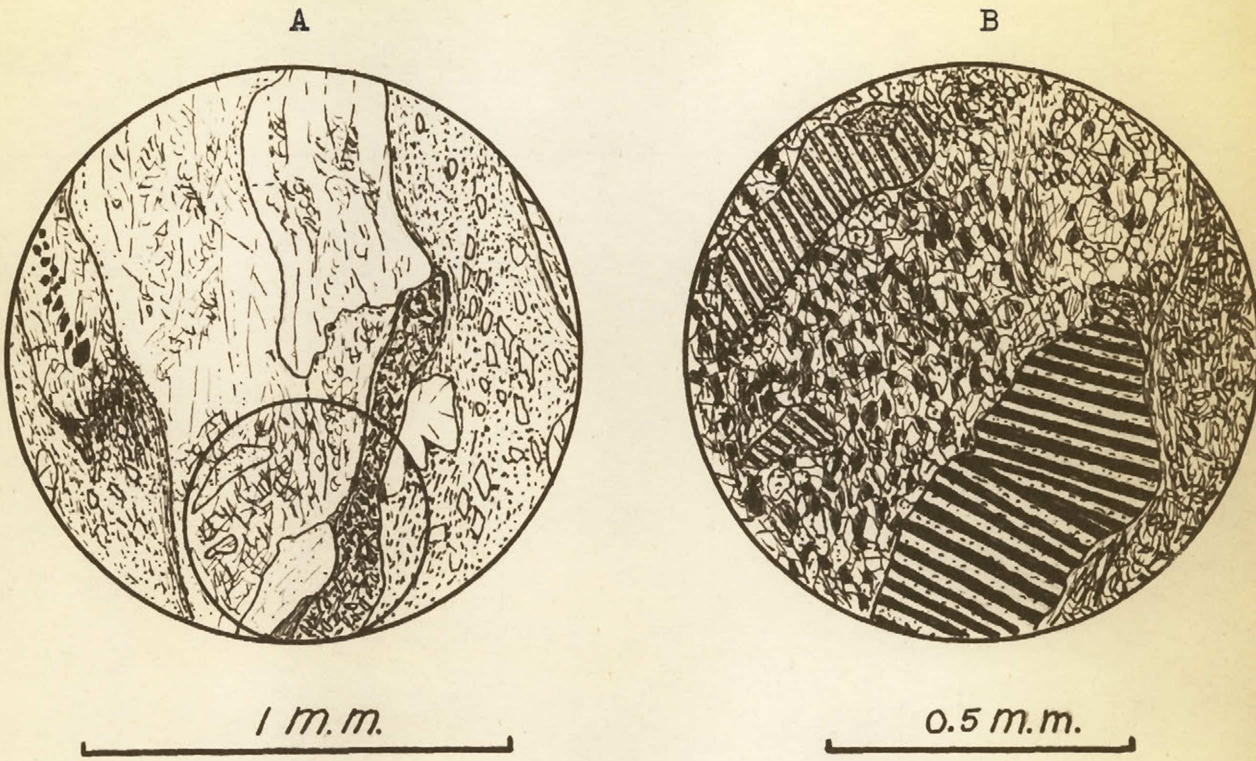

Figure 8.

Drawing to show cataclastic structure in grit. A in plain light. B is the inset shown in A. Drawing B simulates X nicols. Note fractured and rotated grain of plagioclase in B.

Alterations.

<u>Silicification.</u> Some of the clastic sedimentary rocks of the northern part of the area are altered. Notable volumes of rock have been silicified and these occurrences are indicated on the map by the symbol S.

<u>Description.</u> The silicified rock appears to have been tuff that was intercalated with grit. The rock is a pale watery yellow color and is aphanitic in texture. A faint vestige of former banding can be seen on weathered outcrops. Locally minor amounts of pyrite are present in thin trains which mark what were probably original bedding planes. The rock appears to have been completely replaced by silica and minor amounts of pyrite. No other sulphides were found.

A limited number of exposures showed the silicified rock (tuff?) in contact with the grit. At these places the silicification extended only a few feet from the silicified tuff into the grit. Occasionally narrow bands of grit are bordered on both sides by silicified rock. Here the grit is silicified and its presence can be detected only by the lumpy, rough surface on the weathering outcrop. When the silicified grit is broken no differences can be seen on the fresh surface.

Origin of silicification. The alteration probably was by a hydrothermal process associated with the intrusion of a granitic magma. No granites are exposed within five miles of the silicified zone but they are widespread in south central Newfoundland. Some of these granitic intrusions studied by the author have xenoliths, roof pendants and a vague foliation which are the characteristics of barely unroofed granite masses. It is concluded that the silicifying solutions came from a granitic intrusive that is not yet exposed.

Skarn zones. A local alteration is found in the southern most bands of undifferentiated tuff, grit and slaty shale east of the Bay East River.

Distribution. Outcrops showing alteration were not observed in contact with unaltered sediments so the extent of individual altered zones is not known. Paucity of outcrop prohibits estimation of the lateral or strike length of altered zones.

Description. The skarn, in hand specimen, is moderately green in color. It has an even dense texture and lacks the cleavage of the unaltered rocks of the area.

Metamorphic minerals in the skarn include epidote, tremolite, sillimanite and cordierite (?). Calcite is locally abundant and has been introduced.

Minute grains of the cordierite (?) in immersion media had a refractive index range of 1.56 - 1.58. The upper limit may be β or γ but as cordierite has a wide range of indices (Larsen, 1934) they would not suffice to identify the mineral. The association of iron magnesium silicates is amicable to the presence of cordierite.

<u>Origin.</u> The occurrence of the skarn, surrounded by relatively unaltered sedimentary rocks, must be the result of pyrometasomatic alteration. The surrounding sedimentary rocks give no indication that the alteration was caused by the known (mapped) igneous rocks of the region. The grit of this location has strongly developed cataclastic textures caused by movement along nearly vertical planes, and these movements may have initiated conditions conducive to heat and material transfer from depth.

<u>Carbonatization.</u> Some of the sedimentary rocks immediately west of the ultra basic intrusives are fractured and the cracks are filled with carbonate, most of which is calcite.

<u>Origin.</u> The introduced carbonate probably came from the ultra basic rocks, presumably during their brecciation described in the section on intrusive rocks.

Origin of the Sedimentary Rocks.

<u>General Statement.</u> The fine grained nature of the sediments at the south of the map area suggest a fair sorting and deposition in relatively quiet water. A few outcrops show cross bedding and cut and fill structures which indicate that the water was not deep. The much coarser rocks to the north, which in many places are admixtures of coarse and fine material, suggest that they were deposited under much different conditions than the sediments of the south.

<u>Sequence of deposition.</u> A limited number of cut and fill structures, grain gradation and cross bedding features show the top of the series to be at the north. However, some beds with similar features show the tops to face south. Statistically, the primary structures indicate that the tops are to the north. Grain size increases northward which suggests that the source of sediments lay in that direction.

The possible sequence of deposition of the sediments follows. Erosion of a moderately elevated land mass to the north provided a fairly constant supply of material to the southern area. At the time of deposition of the shale, now found along the north shore of Round Pond, the land mass began to rise. The rise would account for the larger sized particles of quartz and feldspar in that rock. If this is true, the erratic grains in the shale mark the beginning of a change in conditions of sedimentation.

The thin layers of conglomerate found below the shale are not easily explained. The rounded pebbles are the product of much abrasion but how they were deposited in the finer graywacke is a matter of speculation. Jewell (1939) reports similar conglomerate in fine grained rocks of the Baie d' Espoir series. Possibly the pebbles, during periods of heavy run off, were trundled across a floor of finer grained material.

The black shale changes gradationally, across strike, into green shale to the north. The change to green shale may mark the addition of volcanic ash. Similar rocks found in the Eastern Townships are described by Cooke (1937), who suggests a volcanic origin. Within the green shale small and large lenses of coarse graywacke indicate more rapid deposition.

North of the shale, grain sizes increase progressively to the north. This suggests that the source of sediments rose, although the increased grain size may be partly due to shorter transportation. Admixed pyroclastic sediments show that volcanism accompanied the diastrophism of the distributive area.

Bedding is usually lacking in the rocks to the north of the map area. This fact and the apparent short strike-length of individual bands indicate very rapid accumulation of the sediments. Their unsorted nature necessitates that they were laid down in shoal water, possibly at the mouths of the transporting streams.

Classification of sediments. The sedimentary rocks and their associated pyroclastics of the Round Pond area are the type common to geosynclines. They are similar to those that Kay (1951) lists as peculiar to eugeosynclines. His definition of this type of geosyncline and his discussion of the type area, the Magog Belt, are found in an earlier paper (1943).

Volcanic Rocks.

East of the Bay East River at the north of the map area is a small area of andesite flow and tuff (indicated as 6 on the map). Andesite flows are widely developed north of the map area.

A small lense of andesite occurs at the northwest of the map area. This rock was not studied in detail and it is not known whether it is flow or tuff. It is highly altered and locally contains a high percentage of chlorite and epidote.

The volcanics of both of the above areas lie conformally with the sedimentary rocks.

Intrusive Rocks.

Diorite.

Distribution. Diorite outcrops on the islands and the west, south and east shore of Round Pond. Because of this distribution, the diorite underlying Round Pond is believed to be one body. A similar diorite occurs at the northwest corner of Kikupegh Pond. Several outcrops of diorite lying north of Kikupegh Pond indicate that the Round Pond diorite is joined to the Kikupegh Pond diorite.

Description. The average diorite, in hand specimen, is a medium grained equigranular rock. There is no noticeable tendency of segregation or layering of minerals. The rock is dark grey in color. Thin sections of specimens representative of average diorite, as judged in respect of color and grain size, gave the following proportions by Rosiwal analysis:

Andesine	51.19%
Green hornblende	38.16
Biotite	2.20
Quartz	3.82
Accessories	2.91

The plagioclase occurs in crystals up to 3 m.m. long and many crystals are zoned. (See Figure 9). Measurement of optical properties of the zoned plagioclase shows an inside composition of An $_{60}$ and an outside composition of An $_{30}$. These compositions were checked by measurement of refractive indices in immersion media and the result indicated a composition range An_{60} - An $_{28}$.

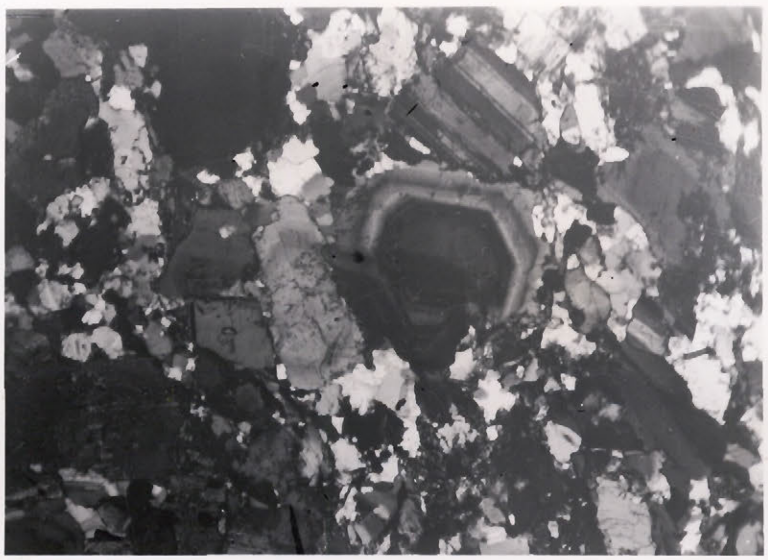

Figure 9.

Photomicrograph (X 27) showing zoned plagioclase crystal in diorite. X nicols.

Secondary white mica, which has the optical properties of sericite, is commonly developed in the plagioclase.

The green hornblende is present in euhedral to subhedral crystals 3 m.m. to 4 m.m. long. (See Figure 10). The hornblende is fresh except where a green chlorite lies in contact with it. Occasionally a fibrous amphibole, thought to be tremolite, has developed on a small scale between the hornblende and chlorite.

Figure 10.

Photomicrograph (X 22) showing relation between hornblende (Hn) and plagioclase (Pl) X nicols.

Brown biotite is present in well developed platy grains rarely larger than 1.5 m.m. The quartz, present in small amounts, is clear and shows a slightly undulatory extinction.

The diorite is variable in composition. The Round Pond body is more basic at the centre than it is at the outer edge. Listed below are the Rosiwal analyses of three thin sections of the diorite which show the change of mineral content. Number one is near the contact, number two is from a position closer to the centre of the mass and number three is from a position near the centre.

	1	2	3
Plagioclase	53.65%	58.85%	46.50%
Hornblende	29.08	34.40	49.00
Biotite	5.25	-	-
Quartz	9.97	3.48	1.83
Accessories	2.02	3.24	2.78
Color Index	36	37	52

Color Index is after a system by Shand (1949).

Accessories include apatite, sphene, pyrite, chlorite and calcite.

Small irregular shaped masses of an amphibole-rich, black-colored rock occur near the centre of the diorite body. None of these masses that were observed were greater than 150 square feet in plan. In hand specimen, the rock appears to be entirely composed of black amphibole crystals one half inch in length. Thin section study shows the rock to be cummingtonite. Spherical inclusions occupy about one half the volume of the cummingtonite and give it a strongly developed poikilitic texture (See Figure 11). The inclusions are composed of a felt of undetermined minerals which probably represent remnants of an earlier crystallized mineral. Minor amounts of a green chlorite are present. A small 2V (questionable) with positive sign, considered with the other optical properties of this mineral, indicate that it is prochlorite.

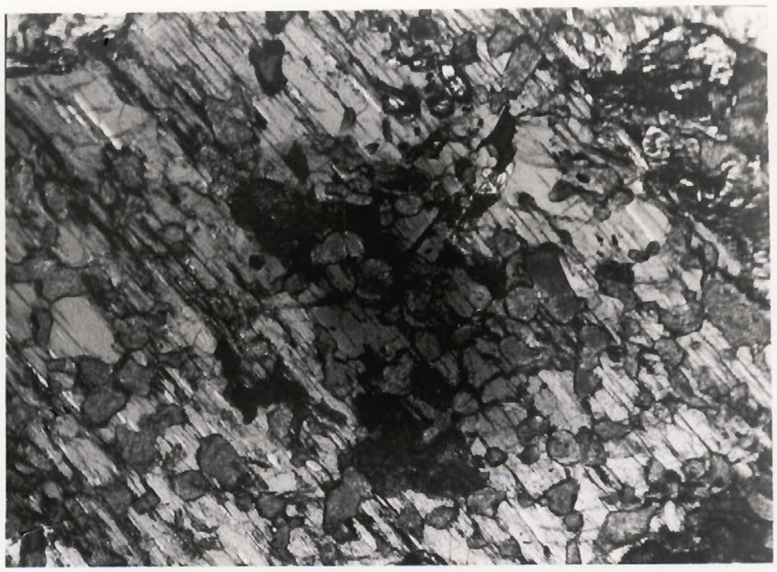

Figure 11

Photomicrograph (X23) showing poikilitic texture in cummingtonite. X nicols.

<u>Origin.</u> The diorite contains many small xenoliths of relatively fresh sedimentary rocks. The xenoliths are at random orientation and are near the contact. In a fault zone between the two diorite bodies, diorite of similar composition surrounds many fragments of the fractured sedimentary rocks. The diorite is foliated parallel to the contact between it and the sedimentary rocks. For these reasons it is concluded that the diorite was intruded as a magma.

Late magmatic reactions were probably responsible for the dark cummingtonite phases at the centre of the diorite. Shand (1949) states that:

> "It is a legitimate conclusion that well-developed poikilitic texture, in any rock that has not undergone metamorphism by external forces, is good evidence of post magmatic crystallization."

Possibly earlier formed green hornblende crystals were transformed, by late magmatic solutions (gases?), to cummingtonite. Cummingtonite ordinarily occurs in fibrous habit but in this rock it is in large, broad crystals and has abundant inclusions. Such a transformation would necessitate the removal of Ca and Al from the hornblende $Ca_2(Mg,Fe,Al)_5[(Si,Al)_4O_{11}]_2(OH)_2$ to give cummingtonite $(Fe,Mg)_7Si_8O_{22}(OH)_2$. Part of the material removed may be present in the sedimentary rocks to the north.

Age. The age of the diorite is not known. It is younger than the sedimentary rocks that it intrudes, which may be Ordovician. Probably the diorite is allied with the granitic intrusives of south Newfoundland which may all be Devonian in age.

Ultra Basic Rocks.

Distribution. Ultra basic rocks outcrop at a few places in the northeast part of the map area. Further north, beyond the map sheet, they outcrop abundantly.

Description. The ultra basic rock is a type of breccia (See Figure 12). It is the author's opinion that this rock was intruded along a fault contact of possible regional extent and, should this be true, the breccia is a conspicuous marker to help trace the fault into adjoining areas. For this reason, Wolosky's (1951) excellent description and his comments on the origin of the breccia are included here:

> "The multiplicity of minor structures commonly found in altered rock of this type (pyroxenites and peridotites)[1] will not be described, except for brief mention.......
> ....Only one type of small scale feature will be dealt with in any detail. It is a type of breccia.........The rounded and angular

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1 Note: Words in brackets added by author. Omissions indicated by ....

Figure 12

Ultra basic breccia. Both outcrops show fragments that are at various orientations. A vague foliation may be seen.

lumps seen projecting above the weathered surface are composed of all types of mafic feldspar-free material. Alteration ranges from almost none to complete replacement, as in the more massive rocks. The matrix, which encloses the solid lumps, is everywhere more or less altered, at least to serpentine and often to carbonate. No fragments were found which could be called anything but pyroxenites or serpentinized or carbonatized equivalents of pyroxenites or peridotites. A great many of these lumps were broken open but no foreign rock fragment were found.

The contrast between matrix and fragments is so strong in all but the most altered of these breccias that the blocks invariably break free from the matrix. The fragments weather up on the surface of the outcrop, as boulders do in a poorly cemented conglomerate.

Microscopic study of a few samples of the breccia show that there is no fundamental difference between the fragments and the matrix except in the degree of alteration. The sharp contacts between fragments and matrix are seen to be due to the fact that the matrix is always highly carbonatized. Where both fragments and matrix are serpentinized, the matrix has developed in it a schisty or slaty parting....

(Origin).....the first step (in the formation of the breccia) is thought to have been the formation of serpentine veinlets in a fracture pattern in pyroxenite. Progressive widening of these veinlets isolated lumps of more solid pyroxenite from each other. Some such process would satisfactorily account for the occurrence shown in figure 9. (a figure in Wolosky's thesis not available here. This figure shows the lumps of pyroxenite isolated by the serpentine as described above). Shearing stress at this stage with small movements localized in the less competent serpentine veinlets produced the schisty structure of the serpentinized matrix and perhaps rotated some of the fragments of more solid materials. Carbonatization, where it has affected the breccia, is later that the serpentinization (as seen in this section) and is more intense in the matrix, since the fractured matrix allowed easier

> passage of solutions. The carbonatization therefore follows the same pattern as does the serpentinization: it is seen enroaching on the fragments progressively from their boundaries inward."

Wolosky's description adequately covers this peculiar ultra basic rock. His argument that its breccia form was acquired after the rock was implaced agrees with the author's observations.

Age. The age of the ultra basic breccia is not established. It is younger than the sedimentary rocks to the west and younger than the interbanded schist and quartzite to the east.

Nowhere in Newfoundland has the age of mapped ultra basic rocks been established. Baird (1947) summarizes the available information pertaining to these rocks. Ages suggested by various workers range from Ordovician to Devonian.

Metamorphic Rocks.

Mica gneiss.

Distribution. A mica rich gneiss underlies the southwest corner of the map area. The extent of the gneiss beyond the map area is unknown.

Description. The gneiss is a foliated rock composed of quartz, plagioclase, biotite, muscovite and small amounts of other minerals. The foliation is well developed and is easily seen on a megascopic or microscopic scale. Bands composed of quartz and feldspar are separated from each other by thin layers of mica, mainly dark biotite. The color contrast of the bands of minerals makes the foliation evident. The rock shows little evidence of weathering, except in places rich in mica where outcrops have a rusty hue.

A Rosiwal analysis of a specimen of gneiss taken one half mile from the gradational contact between the gneiss and sedimentary rock is as follows:

Quartz	35.59%
Plagioclase(An_{35}-An_{30})	31.40
Biotite	17.29
Muscovite	10.78
Orthoclase	2.05
Accessories	2.85

Accessory and alteration minerals are secondary white mica, prochlorite, tourmaline, epidote, sillimanite and iron sulphide.

Grain size of the major constituents is about 2 m.m. on the long dimension. The plagioclase has a fairly well developed crystal outline and the quartz is usually allotriomorphic to the feldspar crystals. The quartz grains are strongly elongated in the direction of foliation and they have a pronounced wavy extinction.

Where biotite and muscovite are in contact, the former terminates the muscovite crystals. The muscovite apparently crystallized after the biotite. Usually the platy biotite lies in parallel planes whereas the muscovite has a random orientation.

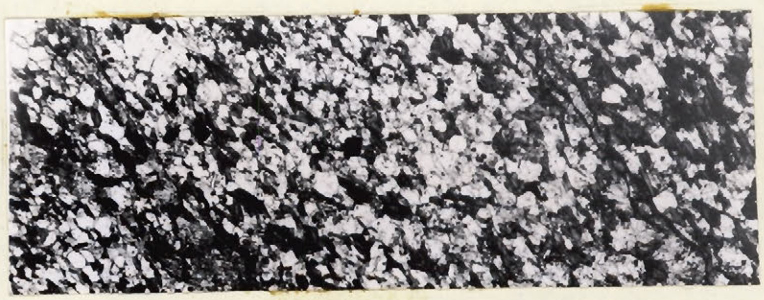
The prochlorite is associated with the biotite. Usually it occurs at the contact between biotite and muscovite.

The sillimanite occurs in very fine fibers in quartz and, to a lesser extent, in muscovite.

<u>Origin.</u> The contact between the gneiss and sedimentary rocks to the north is gradational. Examination of the contact zone shows the main features : (1) the grain size of the schistose sediments increases toward the gneiss (See Figure 13) and (2) the banding in the schistose sediments is parallel to the foliation of the gneiss. Thin sections show that larger grains in the schistose sediments have grown on relict grains. The nearer the specimen is to the gneiss the larger the grain size. However, close to the gneiss the phenonema of grain growth on relict grains is lacking and, at this point in the metamorphic aureole, the sedimentary rocks apparently have been completely recrystallized.

Listed below are the mineralogical compositions and grain size of the main minerals to show variation across the contact zone. Number one is from the schistose sediments, number two is from the intermediate zone where the sediments apparently were recrystallized and number three is from the mica rich gneiss.

A



B

C

Figure 13

Photomicrographs (X27) showing increasing grain sizes in the contact zone of mica gneiss. A-schistose sediments. B-intermediate zone. C-mica gneiss. Plain light.

Rock number	1	2	3
Quartz	38%	36%	36%
Plagioclase	40	37	31
Biotite	10	22	17
Muscovite	4	-	11
Orthoclase	4(?)	4	2
Accessories	2	<1	3
Main accessory	penninite	apatite	sillimanite (&tourmanline)
Grain size	0.15m.m.	0.50m.m.	2.00m.m.

The table above shows that the percentage for the quartz is nearly the same. The biotite and muscovite increase toward the gneiss (3) while the plagioclase decreases. Notable differences are the grain size and accessory minerals.

The mineral compositions listed above are expressed as oxides below and show that there is little difference in bulk composition of the three rocks.

Rock number	1	2	3
SiO_2	74	71	71
Al_2O_3	14	14	15
Fe_2O_3	<1	<1	<1
Fe O	<1	<1	<1
Mg O	3	6	5
Ca O	2	2	1
Na_2O	4	3	3
K_2O	2	3	3
H_2O	<1	<1	<1
	99	99	98

<u>Evidence of Origin.</u> Tabulated below is the evidence indicating that the gneiss may be recrystallized sedimentary rocks.

(1) The bulk composition of the sedimentary rocks to the north and the gneiss are similar.

(2) Persistency of composition throughout individual bands in the gneiss.

(3) Abrupt change in composition across the bands within narrow limits.

(4) Gradation of the gneiss into the sediments to the north.

The evidence, although strong, is not conclusive.

The presence of tourmaline, apatite and zoned plagioclase (See Figure 14) is reason to doubt that the gneiss was formed by, or solely by, the recrystallization of sedimentary rocks.

Tourmaline and apatite are not seen in thin sections of the sedimentary rock adjacent to the gneiss. Their presence must be explained by concentration of minute amounts present in the sediments before gneissification or by metasomatic introduction. If the two minerals were concentrated near the contact, the concentration process might be valid, but both minerals are found inside the area of gneiss. The formation of the tourmaline is especially difficult to explain by a concentration process. Some pelitic sediments contain enough boron to account

Figure 14

Photomicrograph (X27) showing zone plagioclase in mica gneiss. X nicols.

for minor amounts of tourmaline (Turner, 1948) but it is very doubtful if there would be enough in the quartz, feldspar-sediments adjoining the gneiss. The tourmaline must have formed by metasomaticintroduction of boron.

The zoned plagioclase is more calcic at the centre than at the outside. This is the normal order for plagioclase crystallizing from a melt, and strongly suggests that the gneiss is of the magmatic type.

The author offers the opinion that the portion of mica rich gneiss mapped is partly recrystallized sediments and partly introduced material. Similar gneisses studied by the author outside the map area to the northwest show intimate relations with intrusives: one type grades into the other. The mica rich gneiss may change to the south into a plutonic intrusive. Turner (1948) writes that the sillimanite zone of regional metamorphism often undergoes metasomatic modification by synchronous intrusion of granitic magma.

<u>Age.</u> The mica rich gneiss is younger than the Round Pond sedimentary rocks, which may be Ordovician. Possibly the gneiss formed during the Devonian Period when south Newfoundland was intruded by granitic rocks.

Quartz gneiss.

Distribution. Northeast of Round Pond is a prominent ridge underlain by quartz rich gneiss. (Indicated as 2b on the map.) The extent of this gneiss to the east, beyond the map area, is not known. No outcrops were found near the contact between this gneiss and the surrounding sedimentary rocks and for this reason the structural and petrological relations between the two are not well known.

Description. Considerable difficulty arose in selecting a type specimen of this rock because of extreme variation in texture and grain size. A hand specimen judged to be average is whitish grey in color and is faintly foliated. The faint foliation visible is due to biotite and chlorite lenticularly arranged about quartz and feldspar grains. The rock tends to break parallel to the platy minerals.

By microscopic determination the minerals are:

Quartz	50%
Oligoclase	20
Orthoclase	5
Chlorite	10
Biotite	10
Accessory minerals.	

Accessory minerals include apatite, sphene, magnetite and zircon.

Specimens available for thin sections had undergone some weathering and because of clay minerals strongly-developed on the potash and plagioclase feldspars accurate estimation of volume percentages for the two feldspars was not possible. Stain tests (cobalt nitrate and sodium nitrite) were made to aid in establishing the proportions of the two minerals.

The quartz crystals have wavy extinction and are allotriomorphic to the feldspar crystals. Much of the chlorite appears to be an alteration produced after biotite. Iron released in the alteration is in the chlorite as trains of small magnetite crystals. The biotite contains small inclusions of zircon with pleochroic haleos.

Origin. Few positive statements may be made as to the origin of this gneiss. Its apparently uninterrupted trend into the grit to the west suggests it was formed from the grit. The grit is more altered near the gneiss, than it is further west. However, the alteration of the grit is chiefly manifested in the presence of epidote which may be laid to causes other than those which produced the gneiss. The structural and textural features of the gneiss are such as might be imposed when a layered rock recrystallized.

Within a few inches across the foliation the mineral assemblage changes rapidly; a band composed primarily of subhedral quartz and feldspar lies adjacent to a band richer in mica and chlorite than is normal for the gneiss. The banding in this gneiss is not as persistent along strike as is the mica rich gneiss. However, it is suggestive of structure inherited from a layered rock, and, if the transformed rock was grit similar to that found to the west, variations along strike would be expected because such are found in the grit.

The quartz rich gneiss will have to be studied along its continuation to the east beyond the map area to obtain the information necessary to establish its origin.

Age. The quartz rich gneiss was probably formed at the same time as the mica gneiss previously discussed.

Schist.

Distribution. Highly schistose rocks occupy the northeast corner of the map area. These rocks extend at least six miles north of the Round Pond sheet (Wolosky, 1951). Their distribution east of the Round Pond area is unknown.

Description. Interbanded mica schist, micaceous quartzite and andalusite schist are present. Individual beds average ten inches in thickness but vary from less than an inch to several feet. Mica schist is the most abundant type.

Mica schist. The mica schist is a fine grained, dark green, well foliated rock. Biotite and sericite are the main components together with variable amounts of fine quartz and possibly feldspar.

Andalusite schist. Many of the bands of schist have randomly orientated porphyroblasts. The porphyroblasts are as much as one inch in length and have a rectangular outline. Generally the micaceous foliation of the schist flows around the metacrysts and when the rock is broken it shows curved parting planes around them. The andalusite porphyroblasts contain large amounts of mica. Some of the porphyroblasts have been granulated on their corners by post-crystallization movement in the schist.

Quartzite. The quartzite is rarely present as pure quartz and bands of quartzite often grade into adjoining schist beds. The purer quartzites are light grey in color and are composed of fine interlocking quartz grains. Accessory minerals are biotite, sericite, chlorite and magnetite. Some bands of the quartzite contain sufficient magnetite to impart a rust stain to the rock on the weathered surface.

Amphibolite. Near the west boundary of the schist area one outcrop was, in part, a fine grained amphibolite. Wolosky (1951), found lenses of a similar rock to the north and he considers it was formed by thermal metamorphism related to the introduction of the ultra basic rocks.

Origin. The interbanded schist and quartzite are metamorphosed sedimentary rocks. The presence of Al_2SiO_5 in the form andalusite, rather than kyanite, suggests that temperature, rather than pressure (or stress), effected the metamorphism (Harker, 1950). The grade of metamorphism was not sufficiently high to allow the andalusite to expel included mica. The known extent of the schist-quartzite indicates metamorphism on a regional scale. These rocks are believed to have been faulted into their present relationship with the relatively unaltered sedimentary rocks to the west (cf. p.71).

Age. Until the regional distribution of this metamorphic rock unit is known, no statement is possible regarding its age relationship with the sedimentary rocks of the Round Pond Area.

Structural Geology.

Sedimentary Rocks.

Folds. The Round Pond series of sedimentary rocks have been intensely folded throughout the area. Scarcity of attitudes of bedding planes and no definite recognition of bed repetition prevent locatition of major folds.

Minor folds, probably drag folds, in outcrops along the north shore of Round Pond have horizontal axial lines which strike easterly. Attitudes of minor folds indicate the major folds to have horizontal, or nearly horizontal, axial lines.

Throughout the area the bedding, observed in a limited number of outcrops, is usually parallel to cleavage. This relationship indicates isoclinal folding on a broad scale. The minor folds, mentioned above, developed in the incompetent members during the folding.

A few observations of primary structures, including cut and fill relationships and grain gradation show that tops of beds face north and south. The number pointing north slightly exceeds the number pointing south but total observations (10) are too few to be significant.

East of the outlet of Round Pond is a syncline. This structure was traced in the field by attitudes of quartzite members that showed cross bedding. The syncline plunges to the northeast at 35°and apparently terminates in the diorite underlying Round Pond. The attitude of this structure is different from the general attitude of the folds of the area and may be explained in one of two ways. First, that the fold was formed and faulted into its present position (see faults) or second that the fold was formed during faulting. The latter explanation seems improbable because of the large size of the fold. Folding in conjunction with faulting is usually limited to small scale drag folds.

Minor folds and top determinations show that an anticlinal axis parallels the north shore of Round Pond. North of this position other folds are undoubtedly present but available data are insufficient to locate them.

A minor secondary structure of interest is shown in figure 15. This structure occurs locally in slaty phases of the green slaty shale north of Round Pond. The secondary horizontal fractures are developed on the vertical cleavage planes. The horizontal fractures are alternately open

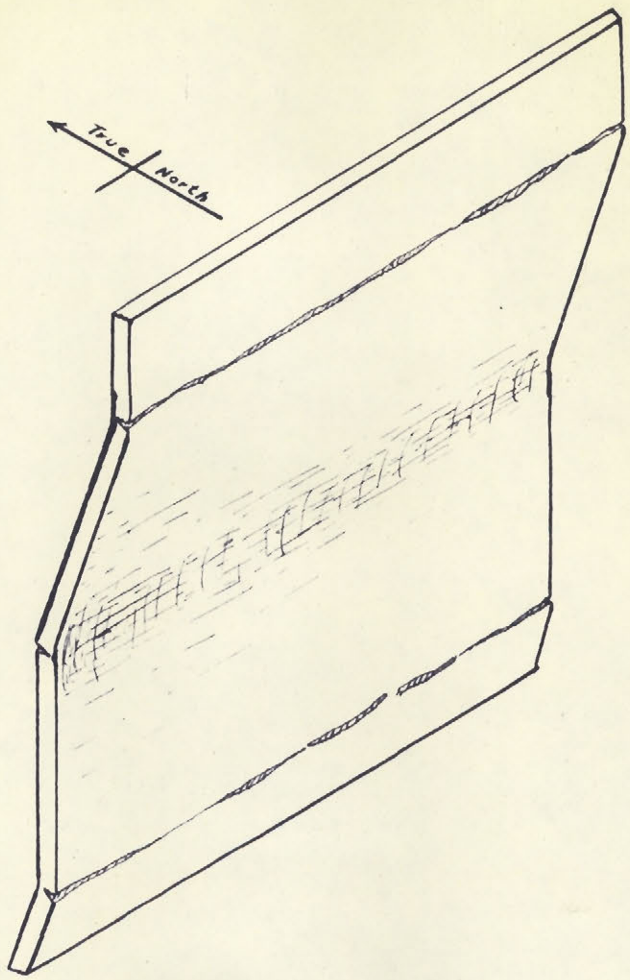


Figure 15

Isometric drawing showing a portion of a cleavage (flow) plate. One half natural size. Note the horizontal fractures. Dihedral angle between alternate planes is 162°.

toward north and south. Their formation appears to represent the buckling of an incompetent member enclosed by stronger rock. This would necessitate a force acting vertically. No source of the force is postulated. The The open nature of the fractures shows that they were formed above the zone of flow.

<u>Faults.</u> One fault in the area is known; two are postulated. (See Figure 16)

North of Kikupegh Pond, between the two bodies of diorite, a fault zone strikes east. The sedimentary rocks are fractured and intruded by diorite. The dip of the fault zone is obscure because of the irregular nature of the fault surfaces seen in the field. Local observations show the diorite and sediments in a nearly vertical contact and probably the fault zone has a similar attitude.

Movement on this fault is not known. The trend of the sediments north of the fault zone is northeasterly and south of the fault zone the trend is southeast. If the sediments were faulted into this relative position, rather than the southern fold being due to the faulting, a movement of fairly large scale is indicated.

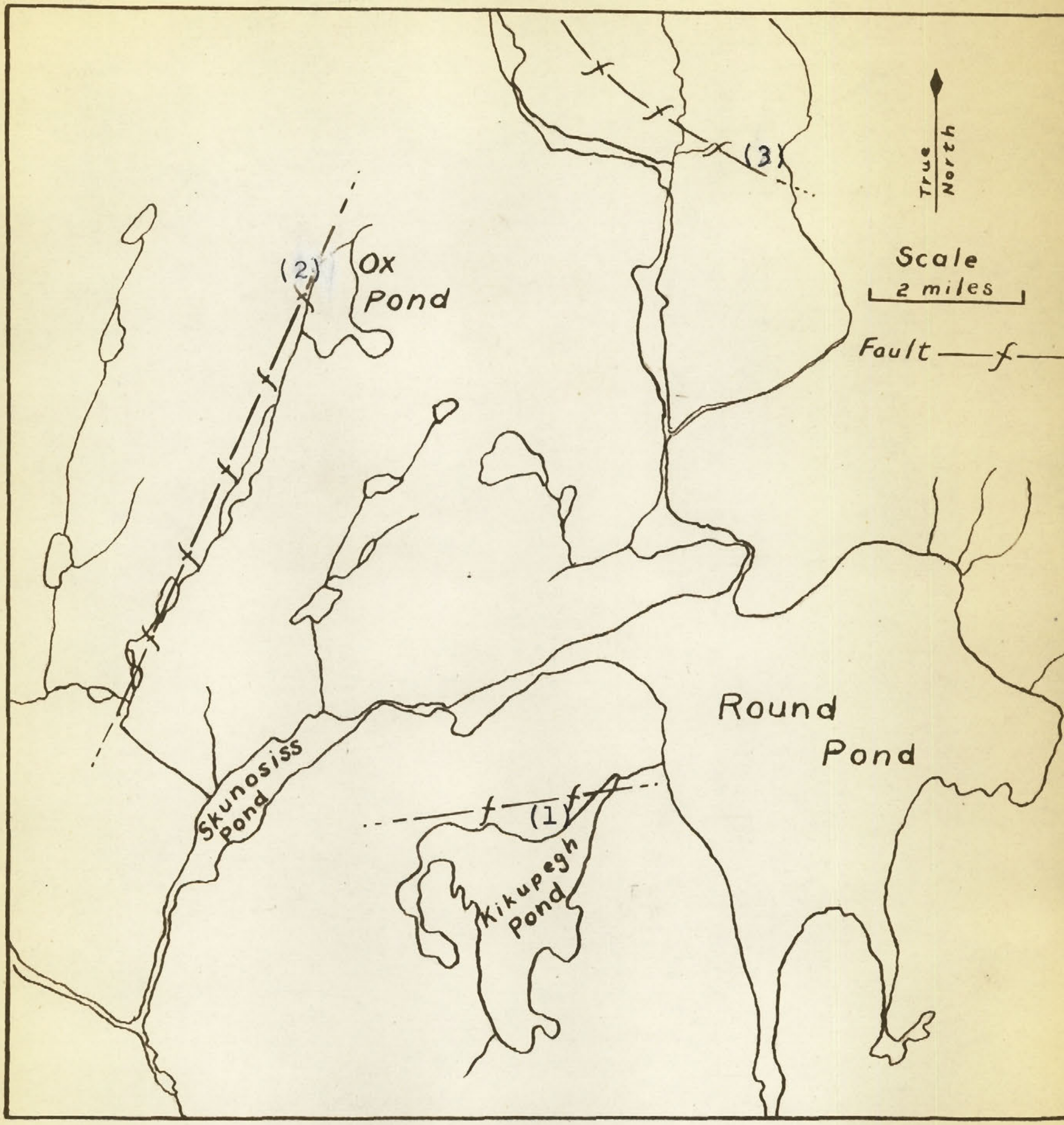


Figure 16

Location map showing faults. Number (1) is known. Numbers (2) and (3) are postulated.

A topographic depression, at a slight angle to the regional trend, runs from Ox Pond southwest along the drainage of Ox Pond. No disruption of the sediments was observed in the limited number of outcrops of this area but the depression may mark a fault line.

A fault contact is postulated between the schist and sedimentary rock at the northwest of the map area. Evidence for this relationship is:

(1) The schist represents a degree of metamorphism not recorded in the sediments to the west.

(2) The coarse clastic sediments on the west, if metamorphosed, would not produce the interbanded schist and quartzite.

(3) Granulation of the andalusite porphyroblasts in the schist indicates movement after their formation.

The possibility that the sediments were laid down on the schist cannot be ruled out.

Faulting brought the schist into its present position with the sediments. Later ultra basics were intruded along the fault.

Should this hypothesis of a fault be true, it is possible that the fault is of regional extent. Murray (1870) reports serpentine to the east of the Round Pond area. His location for the serpentine falls in line with the extension of the arc of ultra basic outcrops at the northeast of the Round Pond area.

<u>Joints.</u> The joints of the sedimentary rocks are variable in attitude. At the north, a system approximates to 070°; 70N° and 040°T, 70°W. These joints appear to be contemporaneous.

South of the diorite and in the sedimentary rocks a system of joints differs in attitudes from those of the north. Their attitudes are: 070° to 085°T, 60° to 80°N. and 135° to 160°T, 50° to 80°S.W. A second set of parallel joints cuts the above joints and their strike is 360°T, dip 85°W.

Intrusive Rocks.

The diorite appears to be a concordant intrusive (cf. p.47). Its shape in plan and relation to the surrounding sedimentary rocks is similar to a phacolith. However, as the sediments south of the Kikupegh Pond fault appear to to be faulted into their present position, the diorite bodies are not termed phacoliths.

The diorite is free of secondary structures except for a set of joints. These joints strike at 350°T. and they dip vertically. They are believed to be shrinkage cracks.

Ultra Basic Rocks.

The ultra basic rocks are believed to be intruded along a fault. One outcrop shows a vague foliation which indicates a small fold plunging northwest (?). The folding in the ultra basic rock suggests that it is older than the diorite to the south, because the diorite has but one type of secondary structure (see above).

Internal structures of the ultra basic are described above(cf. p.48).

Gneisses.

The foliation of the two gneisses of the Round Pond area is nearly vertical and is parallel to that of the regional trend of the sedimentary rocks.

Schist.

The limited number of outcrops of the interbanded schist and quartzite are insufficient to establish the structure. To the north, Wolosky (1951) suggests the area to be the south flank of a plunging anticlinal nose, or perhaps part of a dome.

Economic Considerations.

The only minerals of possible economic interest that were found are sulphides. The sulphide occurrences are small and of no commercial value.

North of Kikupegh Pond pyrite, pyrrhotite and chalcopyrite occur in an outcrop of mixed diorite and graywacke. The best samples of this mineralization gave assay results of less than 1% nickel and a trace of copper.[1]

The small blebs of sulphides are few in number and the occurrence is of no value. Careful search of the immediate area failed to find sulphide-bearing drift which suggests that the occurrence is small.

Small amounts of pyrite are present in the silicified rocks at the north of the map area. The presence of the pyrite suggests that some mineralization accompanied the alteration of the country rock and for this reason the silicified rocks may have a potential as ore bearing horizons.

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1 Oral communication from the late Dr. H. J. MacLean Buchans Mining Company.

Search failed to locate any massive pyrite in the silicified bedrock or associated drift. Should further investigation be undertaken geophysical methods of prospecting will have to be employed.

Summary and Conclusions

The Round Pond sedimentary rocks are of the eugeosyncline type. The sediments are isoclinally folded. The folds trend northeast to east, and they are generally upright. The folds have no plunge. Younger than the sedimentary rocks are the ultra basic rocks and diorite. Granitic gneisses are younger than the sedimentary rocks, and they are probably the youngest rocks of the area. The schist is older than the ultra basic rocks.

The sedimentary rocks were derived from a land mass to the north and it is possible that they were laid down during the Ordovician Period. They are coarsest at the north because, (1) their source lay in that direction and (2) it may be that their source was rising which caused more rapid deposition. Volcanism added appreciable amounts of material to the sediments at the north of the area.

Subsequent to deposition the sedimentary rocks were folded. Until their position in the geological time scale is known, it is impossible to state what orogeny or orogenies affected them. If they are Ordovician probably they were folded by the Taconic orogeny and later by the Acadian disturbance.

Faulting (postulated) broug ht the schist into contact with the sedimentary rocks, and ultra basic material was intruded along the contact. Movements sheared and foliated the ultra basic rocks into a breccia form. It is impossible to say whether these movements were contemporaneous with the faulting north of Kikupegh Pond.

Diorite was intruded into the folded and faulted sedimentary rocks under and adjacent to the Round and Kikupegh Ponds. The intrusion of the diorite probably marks the beginning of the Acadian disturbance during which Newfoundland was intruded by granitic magmas. The granitic gneisses presumably were formed at this time.

The sequence of events outlined above may cover a time span from Ordovician to Devonian or a part thereof.

Erosion, for the interval following the formation of the gneisses and up to Recent time, played the dominant role in the history of the area. No evidence of post-Acadian uplift or faulting is found within the limited area of the Round Pond map sheet.

The area was extensively glaciated during the Pleistocene by an ice sheet moving to the south.

Further work in adjoining areas may establish the age of the sedimentary formations which will permit more exact statements pertaining to the history of the area.

REFERENCES

Baird, D.	1947	Geology of the Burlington Peninsula, Newfoundland. Doctorate Thesis, McGill University. p 196.
Berman, H.	1934	see Larsen.
Conquergood, G. [1]	1952	Personal Communication.
Cooke, H.C.	1937	Thetford, Desraeli, and the eastern half of Warwick map-areas, Quebec. G.S.C.Mem. 211,p 127.
Cooper, J.R. (Dorf, Erling)	1943	Early Devonian Plants from Newfoundland. Journal of Paleontogoly. Vol. 17, p 263-264.
Dorf, Erling	1943	see Cooper.
Harker, A.	1950	Metamorphism. 3rd edition Methuen & Co.,London p 150.
Jewell, W.B.	1939	Geology and mineral deposits of the Baie d' Espoir area. Newfoundland Geological Survey Bull. 17. p 7. p 7.
Kay, Marshall	1943	Development of the Allegheny Synclinorium and adjoining regions. Bull. G.S.A. Vol.53 p 1601 - 1658.
" "	1951	North American Geosynclines G.S.A. Mem. 48 p 70-85.
Larsen, E.S. (Berman, H.)	1934	Microscopic Determination of Nonapaque minerals. U.S.G.S. Bull. 848, 2nd edition. p 151,158,161,163.
Lobeck, A.K.	1939	Geomorphology. McGraw-Hill Book Co., New York. p 175.
MacClintock, P.	1940	see Twenhofel.

Murray, Alex.	1870	Report for 1870. Geological Survey of Newfoundland p 229.
Newhouse, W. H.	1931	Geology and ore deposits of Buchans, Newfoundland. Economic Geology. Vol. 26 p 401-402.
Schurchert, C.	1930	Orogenic times of the northern Appalachian. Bull. G.S.A. Vol. 41, p 721-723.
Shand, S.J.	1949	Eruptive Rocks. John Wiley & Sons, New York. p 233. p 169.
Snelgrove, A.K.	1938	Information Circular 4. Newfoundland Geological Survey. p 20. p 13.
Turner, F.J.	1948	Evolution of the Metamorphic Rocks. G.S.A. Mem. 30,p 127 p 86.
Twenhofel, W.H. (MacClintock, P.)	1940	The surface of Newfoundland. Bull. G.S.A. Vol. 51, p 1720-1721. p 1703-1704. p 1747.
Twenhofel	1947	Data relating to Physiography and Wisconsin Glaciation of Newfoundland. Amer. Jour. Sc. Vol. 245. p 119.
Van Alstine, R.E.	1948	Geology and Mineral Deposits of the St. Lawrence Area, Burin Peninsula, Newfoundland. Newfoundland Geological Survey. Bull. 23. p 10.
Weeks, J.L. [2]	1952	Personal communication.
Wolosky, L.	1951	Unpublished Honours Thesis. B.A. degree, Queens University. p 42-44. p 14. p 18.

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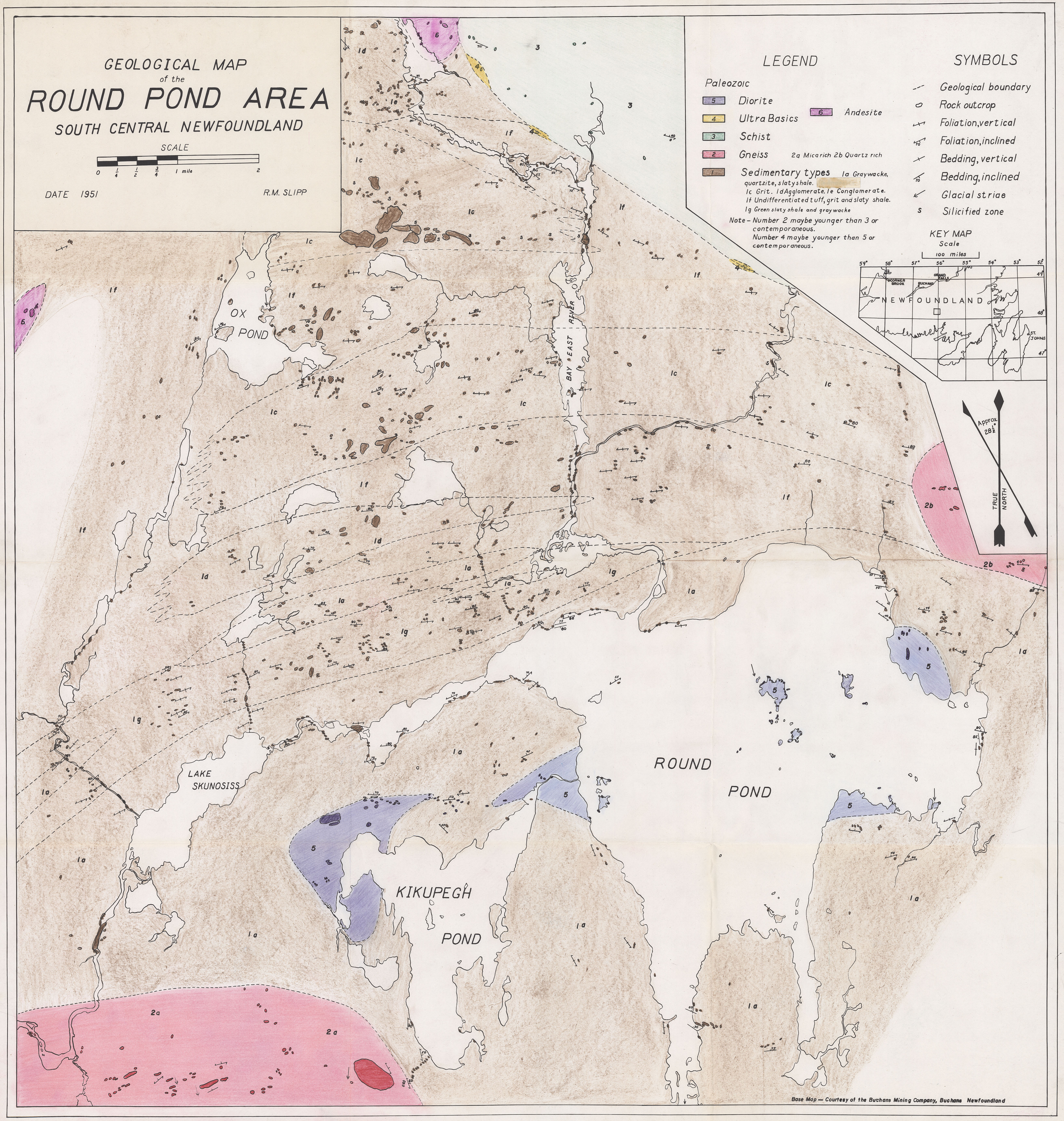
1 Power Corporation of Canada, Montreal.
2 Geological Survey of Canada, Ottawa.


GEOLOGICAL MAP
of the
ROUND POND AREA
SOUTH CENTRAL NEWFOUNDLAND
SCALE
0 1/4 1/2 3/4 1 mile 2
DATE 1951
R.M. SLIPP
LEGEND
Paleozoic
5 Diorite
4 Ultra Basics
3 Schist
2 Gneiss 2a Micarich 2b Quartz rich
1 Sedimentary types 1a Graywacke, quartzite, slatyshale.
1c Grit. 1d Agglomerate. 1e Conglomerate.
1f Undifferentiated tuff, grit and slaty shale.
1g Green slaty shale and graywacke
6 Andesite
Note - Number 2 maybe younger than 3 or contemporaneous.
Number 4 maybe younger than 5 or contemporaneous.
SYMBOLS
Geological boundary
Rock outcrop
Foliation, vertical
Foliation, inclined
Bedding, vertical
Bedding, inclined
Glacial striae
s Silicified zone
KEY MAP
Scale
100 miles
59° 58° 57° 56° 55° 54° 53° 52°
49° 48° 47°
CORNER BROOK
BUCHANS
GRAND FALLS
NEWFOUNDLAND
ST. JOHNS
Approx. 28°
TRUE NORTH
OX POND
BAY EAST RIVER
LAKE SKUNOSISS
KIKUPEGH POND
ROUND POND
Base Map — Courtesy of the Buchans Mining Company, Buchans Newfoundland