TERRENCEVILLE (1M/10) AND GISBORNE LAKE (1M/15) MAP AREAS, NEWFOUNDLAND

by

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INTRODUCTION

Geological mapping of the Terrenceville (1M/10) and Gisborne Lake (1M/15) map areas was carried out during the 1979 field season. The area has been mapped previously on a scale of 1:63,360 by Bradley (1962). Revision of this earlier work was deemed necessary in the light of results from recent mapping elsewhere in the Burin-Merasheen project area; *ie.* O'Driscoll, 1977; O'Brien, 1978; Strong *et. al.* 1978; O'Brien and Taylor, 1979; O'Driscoll and Muggridge, 1979 and in the adjacent Belleoram (1M/11) map area (Williams, 1971).

The study area forms a part of the much larger Avalon Zone of the Newfoundland Appalachians (Williams *et. al,* 1974) that consists of Late Precambrian volcanic, sedimentary and plutonic rocks locally overlain by Lower to Mid-Paleozoic sedimentary rocks.

The geological evolution of the area can be tentatively outlined by way of several rudimentary tectonic stages. The earliest is characterized by dominantly subaerial, felsic to mafic volcanism and associated granitoid plutonism with minor contemporaneous sedimentation. Cessation of volcanism coincided with the onset of shallow water, non-calcareous, terrigenous clastic sedimentation. Renewed, localized, silicic volcanism gave way to terrestrial sedimentation in the uppermost Precambrian.

The region was subjected to deformation and dynamothermal metamorphism during the Acadian orogeny. Syn- to postorogenic molasse was deposited in restricted basins during the Devonian. Widespread granitoid emplacement constitutes one of the later tectonic stages recognized in the region.

Formation names in this report are not meant to be used formally although some of them have been used by Bradley (1962).

STRATIGRAPHY

Unit 1

The oldest exposed rocks in the Terrenceville-Gisborne Lake area are a succession of dominantly subaerial, silicic and subordinate mafic volcanics with minor clastic sediments. They are exposed in three, broad northeast-trending belts which underlie approximately 60% of the Terrenceville map area.

Bradley (1962) concluded that the volcanic rocks in these three outcrop belts constituted separate stratigraphic units including from east to west, the Precambrian Deer Park Pond (Unit 1a) and underlying Southern Hills (Unit 1b) Formations and the Ordovician Belle Bay and Grand Le Pierre Formations (Unit 1c). Our mapping, however, suggests that these units represent stratigraphically equivalent facies variants within a single major Precambrian volcanic field.

Unit 1a (Deer Park Pond Facies)

The easternmost volcanic belt consists of mafic and felsic massive flows and related volcaniclastic deposits of mafic to felsic composition. The dominant silicic volcanic lithotypes are ash flow tuffs and spatially

associated tuffaceous deposits of uncertain origin. Strongly foliated and unstratified lithic and crystal-lithic air-fall(?) tuffaceous rocks are volumetrically only slightly less significant. Massive and flow banded rhyolite flows are a minor constituent of this belt.

Mafic flows and hypabyssal rocks are less extensive and constitute approximately 5-10% of the outcrop area east of the Cape Roger Mountain Batholith. Fine to medium grained mafic and intermediate crystal tuffs are most common in the western part of the belt, where they have been thermally metamorphosed by the Cape Roger Mountain Batholith.

Epiclastic sediments are rare in the lowest stratigraphic levels of unit 1a and are limited to individual beds or thin intraformational units. Several major clastic units occur in the upper levels of unit 1a. These are discussed below (see section 1d).

The base of unit 1a is not exposed in the map area. A small synclinal keel of unit 2 directly overlies the volcanics near the western margin of the belt. As these sediments also overlie unit 1b, it is suggested that unit 1a is stratigraphically equivalent to the adjacent central belt and that the facies boundary between these units is steep. The possibility exists, however, that at least the lower parts of unit 1a represent the lowest level of unit 1 and stratigraphically underlie the adjacent Southern Hills Facies.

Unit 1b (Southern Hills Facies)

The central volcanic belt is underlain by a succession of ash flow tuffs and rhyolite flows which are locally intercalated with very minor epiclastic sedimentary lenses.

Most of unit 1b consists of densely welded and moderately to strongly flattened ash-flow deposits. These include red, gray and black, very fine grained vitrophyres, ash tuffs, lithic and pumice-rich lapillistones and vitric or crystal-vitric tuffs. Coarse grained lapillistones and gray felsic tuff-breccias are of minor volumetric importance and epiclastic volcanic breccias are absent.

Massive, nonpyroclastic felsic flows may constitute up to 10% of the outcrop area of this belt and are spatially and genetically related to the ash-flow volcanism. They include very fine grained glassy or slightly porphyritic rhyolites, pink and orange saccharoidal textured rhyolites or felsites and flow-banded rhyolites.

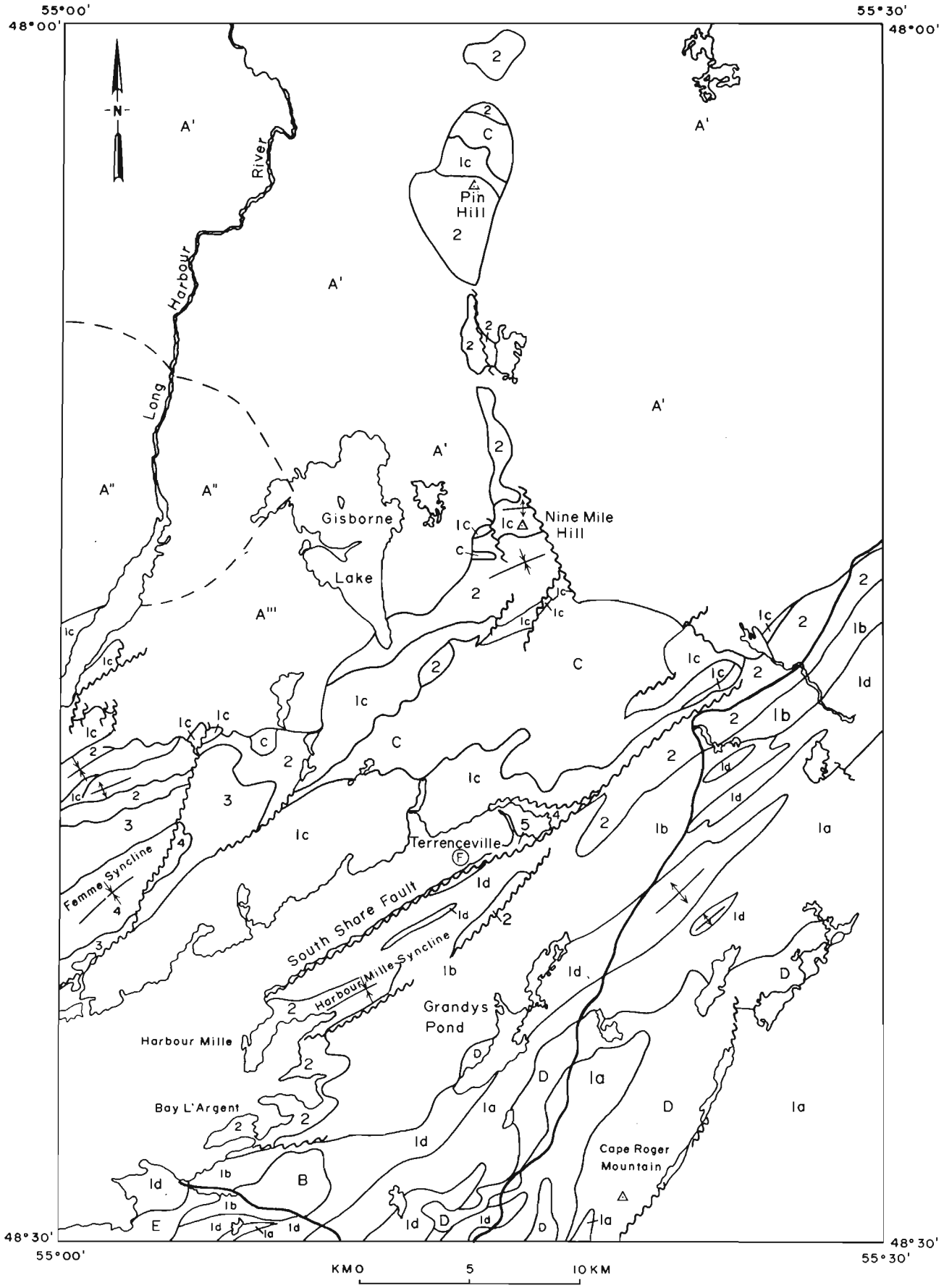
Cleaved, vitric-crystal and lithic tuffs of probable air-fall origin are interleaved with welded ash-flow deposits mostly in the eastern part of the belt.

Unit 1b is conformably overlain by clastic sediments of the Anderson's Cove Formation (unit 2) in the Harbour Mille Syncline and east of the South Shore Fault System in the east-central part of the map area.

Unit 1c (English Harbour East Facies)

The rocks of the western volcanic belt, which includes the Belle Bay and Grand Le Pierre Formations of Bradley (1962), are products of dominantly felsic ash-flow volcanism with associated coarse grained epiclastic deposition and relatively minor mafic volcanism.

Felsic volcanic lithotypes include moderately to strongly welded and flattened pumice-rich ash-flows, unwelded lithic lapillistones and associated air-fall tuffs, rhyolitic to basic tuff-breccias and agglomerates. Massive flows of rhyolitic and rhyodacitic(?) composition are volumetrically less important.



LEGEND

VOLCANIC AND SEDIMENTARY ROCKS

DEVONIAN

5 Predominantly red sandstones and fine to medium grained conglomerate with subordinate siltstones (Terrenceville Formation)

PRECAMBRIAN

4 Predominantly maroon, fine to coarse grained conglomerates with minor sandstones and subordinate rhyolite volcanics. (Rencontre Formation)

3 Predominantly ash flow tuffs and rhyolites with minor basic rocks. (Mooring Cove Formation)

2 Fine to very coarse grained clastic sediments and thermally metamorphosed equivalents with subordinate basic sills and flows. (Anderson's Cove Formation)

1 Subaerial felsic and mafic volcanics with minor sediments, flows and hypabyssal intrusions.

1a, Predominantly mafic and felsic tuffs with subordinate basic rocks and minor ash flows, rhyolites (Deer Park Pond Facies) and clastic sediments.

1b, Predominantly ash flow tuffs, rhyolites and felsic tuffs with subordinate clastic sediments and basic rocks (Southern Hills Facies).

1c, Predominantly ash flow tuffs and volcanic breccias with minor rhyolitic and basaltic flows and red and green clastic sediments (English Harbour East Facies).

1d, Predominantly medium to coarse grained sandstones and fine grained conglomerates with finer grained clastics.

NOTE: Formation names in this report are not meant to be used formally although some of them have been used by Bradley (1962).

IGNEOUS ROCKS

DEVONIAN

A Ackley City Batholith

- A^{1} Coarse grained, massive, K-spar porphyritic biotite granite
- A^{11} Coarse grained, massive, uniform textured biotite granite.
- A^{111} Fine and medium grained, massive, uniform textured biotite granite.

B Berry Hill Stock: Medium grained adamellite with minor granite and aplite.

C Cross Hills Batholith: Medium grained hornblende granodiorite and fine grained alaskite, with subordinate diorite, recrystallized fine grained granitoid and foliated or unfoliated diabase, volcanic, sedimentary and minor gabbro xenoliths.

PRECAMBRIAN

D Cape Roger Mountain Batholith: Fine to medium grained foliated hornblende biotite granodiorite with subordinate gabbro and minor aplite and diabase dikes.

E Deepwater Point Pluton: Medium grained foliated hornblende biotite granodiorite with minor aplite.

Mafic volcanics include massive, amygdaloidal and blocky, finely vesicular aa basalt flows. Very coarse grained laharic deposits are unique to the western volcanic belt and constitute a significant proportion of it. Fine to coarse grained epiclastic sedimentary rocks are spatially related to the lahars.

Volcanism in the western belt can be tentatively subdivided into three stages. An initial period of felsic pyroclastic volcanism resulted in the deposition of partially welded,medium grained, feldspathic and quartzofeldspathic crystal and crystal-lithic tuffs of Bradley's (1962) Grand Le Pierre Formation. The ash-flow volcanism is superseded by deposition of coarse grained laharic breccias and related epiclastic rocks of the lower parts of Bradley's (1962) Belle Bay Formation. Bradley (1962) suggested that the contact of these formations was an angular unconformity. However, our mapping indicates that the contact is conformable and represents the transition from pyroclastic to epiclastic deposition. The epiclastic deposits consist of fine to very coarse grained crudely stratified or chaotic laharic breccias and interstratified fine to coarse grained, red and green, siliceous clastic sediments. Silicic pyroclastic activity is continuous throughout this stage, but the deposits are restricted in volume. A resurgence of volcanicity marks the latest stage and resulted in the deposition of voluminous welded ash-flow tuffs and less extensive massive rhyolitic and basaltic flows.

Unit 1c conformably underlies clastic rocks of unit 2 in the Long Harbour Syncline and in anticlinal cores near Gisborne Lake and Nine Mile Hill.

Rocks underlying the Rencontre Formation (unit 4) in the Femme Syncline, which Bradley (1962) included in the Belle Bay Formation, stratigraphically overlie adjacent clastic sediments of unit 2. This relationship indicates that these volcanics are correlative with the Mooring Cove Formation of Williams (1971) and should not be included in the Belle Bay Formation.

Unit 1d (Clastic sediments)

Sedimentary rocks occur as intercalations throughout the eastern, central and western volcanic belts. In the stratigraphically lower levels of unit 1a they are limited to a few individual beds or thin units of gray to purple granule sandstones and conglomerates. Within unit 1b, periodic clastic units form from 5 to 10% of the succession in bands usually tens of metres thick but locally attaining thicknesses up to 350 m. A similar distribution of clastics occurs in unit 1c where the thickest units are most common in the lower stratigraphic levels. The major lithotypes are gray-green litharenites and fine grained conglomerates and represent intraformational epiclastic deposits.

Several major clastic intercalations occur towards the top of unit 1a. They occur in an anticlinal belt northeast and southwest of Grandy's Pond, at higher levels in a synclinal keel southeast of this zone and in several minor synclines between the two larger structures. The largest of these forms the Grandy's Pond Anticline and is a succession of dirty and immature arenites and interbedded granule to pebble sandstones and conglomerates. Interbedding of tuffs and arenites is present in the uppermost stratigraphic level of the sediments. Structural studies suggest that this unit should outcrop again to the southeast, above the lower levels of unit 1a, or be laterally replaced by the volcanics. Patches of clastic sediment in the area of the Cape Roger Mountain Batholith may represent this repetition.

The sedimentary sequences of unit 1d are characterized by generally very

immature, poorly sorted sandstones with subordinate, similarly textured, polymictic conglomerates. The former are predominantly medium to coarse grained, massive, ungraded feldspathic litharenites. Other diagnostic features include the presence of magnetite laminae and moderate to large scale crossbedding. The conglomerates, though polymictic, contain almost exclusively acid volcanic clasts.

The only significant facies variations occur in sediments in the Grandy's Pond Anticline. In the south, near St. Bernards, granule to pebble sandstones and conglomerates are predominant and are locally interbedded with thin pyroclastic units. Northeast of Grandy's Pond the main facies of the belt is a succession of cleaner, better sorted arenites with relatively few conglomerate layers.

The clastic deposits of unit 1d are characteristic of shallow water, moderate to high energy shelf sedimentation.

Unit 2 (Anderson's Cove Formation)

Unit 2 occurs in two main belts northwest of the unit 1 volcanics which they directly overlie. The southern belt extends from Bay L'Argent northeastwards to the Paradise River. The northern belt extends from the entrance of Long Harbour, on the adjacent Belleoram (1M/11) sheet, northeast to Nine Mile Hill and thence northwards through a line of roof pendants in the Ackley Granite to the northern edge of the map area.

This formation is in both stratigraphic conformity and tectonic contact with the underlying volcanics with two possible exceptions east of Gisborne Lake (see below). A coarse clastic basal unit, varying from tens to hundreds of metres in thickness, generally occurs at this contact. In some places, an otherwise conformable relationship is interrupted by basic sills or flows. The boundary is always sharp and generally represents a cessation of acidic volcanic activity except for rare felsic tuffs in unit 2. Contemporaneous basic volcanicity is discussed below. The formation varies considerably in sedimentary evolution throughout its outcrop. Nearly all the sediments of unit 2 are gray or dark green in color.

Southern Belt

In the Bay L'Argent area basic flows overlying unit 1b volcanics are followed by a thin basal conglomerate and then a well bedded succession of conglomerates, sandstones and laminated siltstones. The latter lithotype is dominant with thin interbedded muddy sandstones, fine grained conglomerates and a few aquagene vitric and crystal-vitric tuffs. It contains 2-20 m cycles in which the dirty, poorly sorted, coarser clastics are dominant. 2 km southwest of Bay L'Argent the sediments are sharply interrupted by a gradually fining upwards 300-400 m thick boulder conglomerate unit and 1 km northeast of Harbour Mille sandy cycles pass up into an homogeneous sandstone wedge representing a local coarsening up of the sequence. At Harbour Mille, a general coarsening and reddening characterizes the top of the exposed succession. Light colored sandstones with minor red mudstones are overlain by coarser, partly pebbly, sandstones with red siltstones.

South of Terrenceville a thin slice of the Anderson's Cove Formation consists of gray, mafic, vitric-lithic tuffs overlain by granule to pebble conglomerates which conformably overlie unit 1b. Other outcrops of more typical laminated facies occur within the area of unit 1b and as a synclinal keel in unit 1a.

In the area around Paradise River and extending southwest towards Terrenceville, the Anderson's Cove Formation typically consists of medium

to coarse grained, feldspathic litharenites with granule and pebble clast-bearing beds. Here, light gray, cleaner and better sorted sandstones predominate over the gray and green dirty types which are associated with minor laminated siltstones (cf. Bay L'Argent area). The uppermost light colored sandstones are interbedded with minor red siltstones (*cf.* Harbour Mille section). Mafic, vitric-lithic lapilli tuffs are also present in this area.

Northern Belt

The northern belt, excluding that part north of Nine Mile Hill, is characterized by very coarse clastics. Thick wedges of conglomerate occur at its western and eastern ends. The conglomerates thin to the north and fine both northwards and up sequence. Their thicknesses vary from approximately 850 m to 0 m in the west and from about 850 m to 300-400 m in the east. Along the northern edges of this belt both of these sequences pass up into a laminated siltstone facies with thin sandstone interbeds. In the west, however, the formation is conformably overlain on its southern margin by another acidic volcanic sequence (unit 3) and the conglomeratic beds comprise the complete succession. Between the conglomerate wedges dirty sandstones predominate while conglomerates are subordinate and fine grained clastics minor. The sandstones contain a few clean, light gray sublitharenites; a lithotype which is otherwise only found north of Nine Mile Hill.

1.2 km north of Nine Mile Hill the boundary between Units 1c and 2 is discordant to the bedding in both and the latter may be unconformable on the volcanics. In the roof pendant zone, clean, light gray sublitharenites become interbedded upwards with subordinate gray and purple siltstones before giving way to laminated siltstones with thin sandstone beds. West of Mary Ann Pond, the arenite units are thicker and coarser, with local granule sandstone or conglomerate beds, and exclude the finer clastics. At Pin Hill the strike of the sediments and underlying volcanics is parallel but the contact is not exposed. Within the sediments the sequence is the same except that the siltstones are dark gray and at the top are very slaty.

The northernmost pendant consists of a well rounded, generally clast supported polymictic conglomerate. This type of conglomerate is atypical for the rest of the map area where they are matrix supported and poorly sorted.

Mafic Rocks

Contemporaneous basic volcanicity occurs in much of the Anderson's Cove Formation. In the west of the northern belt and in the Bay L'Argent region compound diabase sills and basalt flows, up to 200 m thick and comprising as much as 40% of the sequence, interrupt the clastic sequence. They are generally massive and homogeneous or banded parallel to the strike. Variations in grain size, cleavage, epidotization, porphyroblasts and in type, concentration and size of phenocrysts and/or amygdules occur. Local erosion supplied an important clast component to overlying conglomerates. Thick concordant bodies also occur in the roof pendant zone. South and northeast of Terrenceville the basic volcanic activity is represented by mafic tuffs.

Environments of Deposition

Two contrasting environments of deposition are recognized within unit 2. Around Bay L'Argent and in the northern belt, exclusive of the roof pendants, the sediments indicate mass flow deposition into a periodically subsiding basin from local, actively rejuvenating sources. In contrast, the cleaner, predominantly sandy, crossbedded sequences at Harbour Mille, around and southwestwards from Paradise River and in the roof pendants to the north are characteristic of a shallow water shelf environment. Facies variations and

current directions, consistently from a southerly quarter, show that if their formation is approximately chronostratigraphic, the two belts must have been separate basins of deposition.

Throughout the deposition of unit 2, the area lay within an active epeirogenic tectonic regime with fault controlled source supply and basins of sedimentation.

Unit 3 (Mooring Cove Formation)

Silicic volcanic rocks conformably overlie the Anderson's Cove Formation (unit 2) in the western part of the Terrenceville map sheet. This contact relationship indicates that the volcanics are stratigraphically equivalent to the Mooring Cove Formation in the westerly adjacent Belleoram sheet (Williams, 1971).

The main lithotypes of this unit are flow banded rhyolites and massive felsites. Metabasic flows or hypabyssal rocks constitute a minor proportion of this unit and are exposed only on the north limb and core of the Femme Syncline.

Unit 4 (Rencontre Formation)

The volcanics of unit 3 are overlain unconformably by a fining-upward sequence of coarse clastics in a broad syncline around Femme Pond. Most of the sequence is gray weathering but basal beds and the finer clastics in the core of the syncline weather maroon. They overstep the lowest volcanic horizons of unit 3 in the east where thick subangular, matrix supported boulder conglomerates are dominantly massive and unbedded. These conglomerates fine westwards and northwards across the syncline. Boulders are much smaller westwards on the south flank of the syncline and absent on the north side where cobble to pebble and pebble to granule conglomerates predominate. Up sequence they become interbedded with sandstones and siltstones which are the major rock types in the core of the syncline. Towards the top of the sequence a thick felsite lava flow has been documented by Bradley, (1962).

Similar fine to medium grained red conglomerates which outcrop at the head of Fortune Bay and extend up the Terrenceville Brook valley have been tentatively correlated with the Rencontre Formation following Bradley (1962). They are interpreted to be in fault contact with the surrounding lithotypes in a graben-like structure.

Unit 5 (Terrenceville Formation)

This formation outcrops only at the community of Terrenceville and consists of well bedded brown conglomerates, red sandstones and red and pale green mudstones. The conglomerates are polymictic, matrix supported, up to cobble size with scattered boulders, rounded to subangular and commonly lensoid. Channelling is abundant, both of conglomerate into sandstone and vice versa, and more planar beds are irregular in thickness. The mudstones and sandstones bear plant remains which have been dated as Upper Devonian (Bradley, 1962). The rocks are interpreted as a fluviatile mixture of channel sandstones and conglomerates and overbank alluvial deposits.

INTRUSIVE ROCKS

Two main periods of plutonic activity can be recognized in the study area. Precambrian intrusive rocks, occurring only on the southeast side of Fortune Bay, include the pretectonic Cape Roger Mountain Batholith (Bradley, 1962) and the Deepwater Point Pluton. Paleozoic intrusions include the Ackley Granite (White, 1939) the Berry Hill Stock and the Cross Hills Batholith (Bradley, 1962). Hornblende separates from the former have been dated isotopically by the $^{40}Ar/^{39}Ar$ method at 356 ± 10 Ma. (Geochronology report, this volume).

Precambrian granitoids

The Cape Roger Mountain Batholith is a pretectonic, metamorphosed and locally strongly foliated granitoid intrusion which underlies approximately 150 km^2 of the southeastern part of the Terrenceville map area. The batholith is intrusive into volcanic rocks of unit 1a and sediments of unit 1d, and a thermal aureole of epidotization is developed.

The main phase of the batholith is a pink, medium grained biotite and hornblende granodiorite with hypidiomorphic granular to slightly porphyritic texture. Two subphases have been tentatively identified. The first is characterized by a finer grain size and a lower color index than the main phase whereas the second subphase contains mainly microgranitic to aplitic textured granitoids. Aplite dikes and gabbroic dikes and bosses constitute a minor proportion of the batholith.

The Cape Roger Mountain Batholith is strongly foliated along its eastern margin; elsewhere only weak fabrics are developed. All phases of the batholith have been metamorphosed under lower greenschist facies conditions. Biotites and amphiboles are altered to chlorite, quartz is cloudy and plagioclase is partially or completely replaced by epidote.

The Deepwater Point Pluton is a new name to be proposed for the St. Jacques Pluton of Strong *et al.*, 1974 (see O'Brien *et al.*, in prep.). It forms a 5 km^2 intrusive body which outcrops in the southeasternmost part of the Terrenceville map area. The pluton is pretectonic, containing a pervasive, inhomogeneous foliation which is strongest at its margins and in adjacent dikes.

The main intrusive phase is pink, medium grained biotite granodiorite. Fine grained granodiorite and microgranite occur near the northern contact of the body. Stringers and veins of coarse grained, muscovite-bearing granite are locally developed at the contact near Deepwater Point.

The Deepwater Point Pluton is intrusive into lithic arenites and pebble conglomerates of unit 1d south of St. Bernards. Sediments adjacent to the intrusion have been strongly epidotized in zones subparallel to the intrusive contact. The zoning in thermal metamorphic effects seen in the contact aureole may be a result of lithological control or an irregular subsurface contact between the pluton and the country rocks.

Paleozoic granitoids

The Ackley Granite is an extensive, essentially posttectonic, high level Devonian intrusion which underlies approximately 1000 km^2 of the study area, including most of the Gisbourne Lake area but only the northwestern margin of the Terrenceville area. The geology of the entire batholith is discussed by Dickson *et. al.* (this volume). A brief summary is given here.

The Ackley Granite east and north of Gisborne Lake is composed mainly of coarse to very coarse grained, porphyritic biotite granite with associated aplitic and alaskitic veins. Exposures of the batholith in the area southwest of Gisborne Lake consist mainly of coarse grained, nonporphyritic, biotite granite. Grain size decreases with proximity to the southern margin of the batholith where the major phase is pink, fine to medium grained, sparsely porphyritic, biotite granite.

The batholith is unlike other posttectonic intrusions in the map area in that it is essentially unmetamorphosed. (see Dickson *et al.*, this volume). Intrusive contacts between the batholith and thermally metamorphosed volcanics of unit 1c, sediments of the Anderson's Cove Formation and intrusives of the Cross Hills Batholith are exposed in the map area.

The Berry Hill Stock is a small granitoid body, less than 6 km^2 in area, which intrudes units 1b and 1d in the southwestern part of the Terrenceville sheet. The contact is sharp and appears to be polygonal. The stock is post-tectonic with respect to the main regional deformation and truncates earlier structures in the adjacent country rocks. It is mildly metamorphosed, however, with chlorite locally replacing ferromagnesian phases and epidote forming after plagioclase. The major intrusive phase is medium grained adamellite with subordinate amounts of granite, aplite and diabase. The stock is cut by narrow fracture zones and joints, along which fluorite mineralization locally occurs.

The Cross Hills Batholith forms an approximately 250 km^2 body north of the head of Fortune Bay. Another pluton of 30 km^2 occurs 17 km west-northwest of Terrenceville with a 4 km^2 subsidiary just to the east of it. Two smaller bodies emplaced into the Anderson's Cove Formation, 2.5 km southwest of Nine Mile Hill and 3 km north of Pin Hill respectively, are assumed to be part of the complex.

The main body is a complicated mixture of roof pendants, xenoliths, and intrusive rocks. The pendants and accidental xenoliths consist of well bedded sandstones with some siltstones, conglomerates, feldspar porphyritic or glassy rhyolitic volcanics, and diabase with rare gabbro. The intrusive xenolith assemblage is dominant. The sedimentary and volcanic xenoliths are cut by diabase dikes with chilled margins. Diabases are commonly the only rock type seen in many of the xenoliths. They are usually medium grained ophitic textured rocks but fine grained aphyric and plagioclase or plagioclase-pyroxene porphyritic varieties are also present. Locally the dikes are multiple with diabase chilled against diabase. The pendants and xenoliths are intruded, diked and net-veined by a fine to medium grained, locally foliated, granitoid which may form a separate early phase in the centre of the complex. This rock has been recrystallized (thermally metamorphosed by later phases?) destroying obvious record of the composition, grain size and foliation in many places. The gabbros are commonly foliated whereas the diabases and volcanics show little effect of the deformation or thermal metamorphism. The sediments are hornfelses and were folded prior to the thermal event which largely healed the cleavage.

The above rocks are intruded by the major granitoid phases; a medium grained hornblende granodiorite and a fine grained pink alaskite granite. The age relationship between these is not known. The hornblende granodiorite is metamorphosed, with chloritization of the ferromagnesian minerals and widespread saussuritization of feldspar. Of the accidental xenoliths diabase and volcanics are abundant in the granodiorite but small cognate(?) diorite and quartz diorite xenoliths are also common. The fine grained granite occurs along the western margin of the complex. In its northernmost part it is free of xenoliths but everywhere north and northwest of Grand Le Pierre it contains abundant diabase inclusions.

To the northwest of the main body an earlier diorite phase with country rock xenoliths is diked by a later fine-grained, pink, alaskitic granite with miarolitic cavities. Bradley (1962) referred to this body as the Bakers Pond sill. To its east the smaller body is a massive gabbro and the other intrusions are types of diorite.

STRUCTURES

The area was deformed and metamorphosed during the Acadian orogeny. The first of two ductile phases of deformation was accompanied by regional metamorphism in the greenschist facies and is largely responsible for the regional strike. It was a major inhomogeneous deformation producing a

set of noncylindrical moderate to tight upright folds. Most folds occur at outcrop scale and are parasitic on map scale structures. Minor folds may be isoclinal. Axial planes are subvertical and strike approximately northeast and the folds plunge gently northeast through the horizontal to moderately southwest. A strong axial planar cleavage is developed, and folds approximate to round hinged class II structures (Ramsay, 1967).

In fine grained rocks (including unwelded vitric tuffs) alignment of phyllosilicates is completely penetrative and the cleavage is slaty. In sandy and clast-bearing rocks (including crystal and crystal-lithic tuffs) this mineral fabric is confined to the matrix components and wraps around grains and clasts, elongated in the same direction, in an anastomosing fashion. Single crystal grains (eg. quartz and feldspar) show flattening by pressure solution or lattice deformation while aggregates (eg. lithic grains and conglomerate clasts) are stretched as well as flattened. However, quartz eyes and epidotized clasts remain relatively undeformed. On a hand specimen scale these anastomosing mineral and aggregate shape fabrics are penetrative. Close slaty partings and spaced fracture cleavages always seem to parallel the penetrative fabrics. Qualitative strain studies on elongated clasts and a well developed stretching lineation, generally pitching steeply southwest in the cleavage plane, indicate a tectonic regime producing LS tectonites.

In the massive or strongly welded rhyolitic rocks deformation is only shown by spherulite flattening, feldspar tails and shard and clast fabric rotation. In places clasts in lithic pyroclastics or conglomerates with strong initial preferred orientation fail to rotate or deform enough and remain oblique to the cleavage.

The coarser grained basic rocks and the most massive conglomerates commonly resist deformation too. The Cape Roger Mountain Batholith displays only a weak fabric internally but is more strongly deformed in linear belts at or near its margins. The Deepwater Point Pluton is similarly affected. All other granitoid massifs in the area are essentially posttectonic.

Subsequent deformations were insignificant and effected only minor variations on the regional structure. The second ductile phase (folds of the cleavage) is rare, approximately coplanar with the first, occurs in fold pairs and was only seen on outcrop scale. The development of a succession of crenulations, kinks and brittle structures followed. Many of the major fault directions are sub-parallel to and enhance the regional tectonic trend.

METAMORPHISM

Dynamothermal metamorphic mineralogy is only developed during the main first phase deformation and reaches chlorite grade. Fine grained matrix and detritus in the sediments recrystallize but the coarser detrital grains and clasts are generally unaffected. Fine grained basic rocks are recrystallized to well cleaved fine grained meshes. Coarser grained varieties retain relict igneous textures with alteration to chlorite-plagioclase assemblages $\pm$ epidote and amphibole pseudomorphs of pyroxene. Metamorphism of tuffaceous rocks and clasts produces chlorite in mafic tuffs and quartz-sericite in felsic types. Alteration in massive felsic volcanics may only show as recrystallized spherulites.

Thermal metamorphism around the Precambrian intrusives occurs as various forms of epidotization. This can be either pervasive, or selectively affecting lithic grains, plagioclase crystals and the matrix, or restricted to veins and patches and rounded nodules. Epidotized rocks, clasts and nodules are resistant to the later deformation.

No aureole occurs around the Berry Hill Stock and thermal metamorphism in the Cross Hills Batholith is confined to xenoliths and alteration of some of the earlier intrusive phases. A well developed contact metamorphic aureole, locally reaching hornblende hornfels facies,is developed around the Ackley Granite.

MINERALIZATION AND EXPLORATION POTENTIAL

Chalcopyrite, galena, malachite, azurite and bornite are present in quartz veins and fractures in unit 1b volcanics along the South Shore Fault System. Very minor base metal indications are present in several other parts of unit 1 and appear to be related to the regional metamorphism of the area. Little indication of massive sulfide mineralization was found during the course of the study; however, a potential prospecting environment for such deposits might be in the interbedded volcanic and sedimentary sections of units 1a and 1d. (see Taylor *et. al.*, 1979).

Quartz veins are widespread throughout the study area, with the greatest concentration occuring in units 1b and 2. Visible mineralization is restricted to specular hematite. The possibility of gold mineralization in some of the larger veins is worthy of investigation.

Minor fluorite occurrences are related to posttectonic plutonism and are present on joint surfaces in and adjacent to the Berry Hill Stock. Fluorite occurs in float approximately 2 km south of the Ackley Granite contact at Eastern Lookout. The host rock is thermally metamorphosed rhyolite of unit 1c. The presence of molybdenite float from the same area was reported by Bradley (1962); however, *in situ* mineralization was not found.

A reconnaissance spectrometer survey of the region failed to outline any areas of significantly anomalous radioactivity.

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