GEOLOGY OF THE BURNT HILL MAP AREA (2D/5), NEWFOUNDLAND

by

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INTRODUCTION

Mapping of the Burnt Hill area at a scale of 1:50,000 was completed during 1980; parts of it had previously been mapped in 1978 and 1979 (Colman-Sadd 1979, 1980a). The Harbour Breton Highway is located just east of the east edge of the area, which can be reached from the highway, either directly or via Little Gull Lake. A woods road which runs from the Harbour Breton Highway near Bishops Falls, along the southeast side of Great Rattling Brook, provides access to part of the northern edge of the area. The southwest corner can be reached by boat from the Long Pond reservoir via Round Pond, and the southern edge by the road from Bay d'Espoir along the Grand Falls transmission line. Access to the rest of the area is by aircraft; mobility is greatly enhanced by the Northwest Gander River, which in wet weather is navigable from its source to the Harbour Breton Highway.

The area was mapped previously by Anderson and Williams (1970) at the 1:250,000 scale. Grady (1953) mapped the ultramafic rocks north of Burnt Hill for the Newfoundland Government, and these were further investigated by Newfoundland and Labrador Corporation (NALCO) geologists (Harrison, 1953; Gates, 1954; Potter, 1955) and Bell Asbestos Mines Ltd. (1963). McCabe (1955) mapped the ultramafic rocks in the southeast quadrant for NALCO. Wolofsky's map of the Sitdown Pond area (Wolofsky, 1951) showed some of the geology around Through Hill, and Slipp (1952) extended his coverage up to the fault zone west of Newfoundland Dog Pond. Butler and Davenport (1978) did a lake sediment geochemistry study through the whole area.

The Burnt Hill area is divided into two parts by the belt of mafic and ultramafic rocks (Units 1-6, 8) that trends from the northeast to the southwest corner. Southeast of this belt are volcanic and volcanogenic rocks of the Middle Ordovician Baie d'Espoir Group (Units 9-11) (Colman-Sadd, 1976, 1980b). Northwest of the belt are unnamed turbidites (Unit 12) which are more mature than those in the Baie d'Espoir Group and which appear to be lateral equivalents of the Silurian Botwood Group (Anderson and Williams, 1970). These turbidites show progressive metamorphism and anatexis towards two centres in the northwest of the area. At Through Hill, the more southerly of the two, there is an intrusion of pegmatitic garnet-muscovite granite (Unit 13); three similar smaller intrusions occur along the sillimanite isograd around the more northerly centre. These granite bodies are considered to be directly related to the anatexis. A large granite body, the Partridgeberry Hills Granite (Unit 14), has intruded the ultramafic belt, the Baie d'Espoir Group, and the turbidites of Unit 12 posttectonically. It consists mainly of chloritized perthitic granite but also contains some muscovite bearing facies. It contrasts with the granite at Through Hill not only in its mineralogy, but also in its poorly developed metamorphic aureole and its almost complete lack of pegmatites. The youngest rocks in the area are represented by a single exposure of conglomerate (Unit 15) that is dominated by ultramafic clasts; although tilted, these rocks have not been penetratively deformed and are thought to be Devonian molasse sediments.

OPHIOLITIC ROCKS (Units 1-8)

North and northwest of Coy Pond, the belt of mafic and ultramafic rocks widens to reveal a structurally intact ophiolite sequence. Peridotite outcrops to the west; it is followed eastwards by sheared serpentinite, banded pyroxenite and peridotite, massive pyroxenite, gabbro grading into diabase with sheeted dikes, and mafic pillow lava. Trondhjemite has intruded the diabase, and a thin layer of sedimentary rock overlies the pillow lava.

The peridotite (Unit 1) is a massive, brown weathering, black rock. The only observed internal structure is a local banding of chromite grains. Most of the rock is formed of olivine which in many places is largely serpentinized. Chromite grains are disseminated throughout and prominent orthopyroxene crystals are visible in hand specimen at many of the exposures. A few veins of dunite have intruded the peridotite. No tectonic fabric is visible in hand specimen although the rock is generally cut by irregular fractures, some of which are filled with asbestos. Close to the exposed fault contact at the north end of the outcrop, an anastomosing fracture cleavage has broken the peridotite into pillowlike lenses; tectonically rounded fragments up to 5 m across can be found in the talc schist within the fault zone.

The peridotite is bounded on the east by a narrow continuous band of sheared serpentinite and talc schist (Unit 2). A few peridotite exposures occur on the east side of the band and one banded pyroxenite and peridotite exposure occurs to the west; in general, however, the sheared serpentinite marks the boundary between the two. It weathers a bright orange color and forms a readily mappable horizon not only in the ophiolitic sequence at Coy Pond, but also in those at Great Bend and Pipestone Pond outside the map area (Anderson and Williams, 1970; Williams, 1970). The best asbestos occurrences are associated with the sheared sepentinite.

Banded pyroxenite and peridotite form the western part of Unit 3. The bands are 2 cm to 1 m thick and are defined by variations in composition and pyroxene grain size. Peridotite forms dismembered blocks and intrusive veins as well as conformable bands. Preliminary petrography indicates that the pyroxenite is dominated by clinopyroxene. The proportion of peridotite decreases towards the east so that the eastern part of Unit 3 consists essentially of massive, medium to coarse grained pyroxenite, with only rare veins and xenoliths of peridotite.

Bands of gabbro are present in the central part of Unit 3 and increase in number towards the east, so that the boundary between the dominantly ultramafic rocks of Unit 3 and the gabbro of Unit 4 is irregular and in places gradational. The gabbro is medium to coarse grained in the west, where it contains xenoliths of pyroxenite and is cut by rare gabbro pegmatite veins. It becomes progressively finer grained towards the east, passing imperceptibly into diabase. The gabbro is generally massive; banding was found in only one location, and then in a loose boulder. In many outcrops, the rock is altered and brecciated; a tectonic fabric is present locally. In the eastern part of Unit 4, where the rock is diabase, most exposures are small and structureless. Sheeted dikes were seen in only one exposure, where dike width varies from 10 cm to 1 m; the dike boundaries show evidence of shearing and no chilled margins were identified.

An intrusion of trondhjemite (Unit 5) is present within the outcrop area of Unit 4 and is itself intruded by diabase dikes. Many of its contacts, where it has intruded gabbro and diabase, are gradational zones of silicified mafic rock. The contacts with the dikes that intruded the trondhjemite, however, are sharp, although the dikes have in most cases been affected by the strong foliation in the trondhjemite, and are sheared or boudinaged. This foliation is poorly developed in the surrounding gabbroic rocks of Unit 4.

LEGEND

DEVONIAN (?) OR LATER

15 Fluviatile conglomerate formed of ultramafic clasts

SILURIAN ?

14 **Partridgeberry Hills Granite:** 14a, Chloritized biotite-perthite granite; 14b, muscovite granite.

13 Muscovite granite.

12 **Botwood Group equivalents?:** Interbedded sandstone and semipelite forming turbidite cycles; gs, greenschist facies; a, with andalusite porphyroblasts; s, with probable sillimanite porphyroblasts; m, migmatitic; bg, banded granitoid gneiss; ug, unbanded granitoid rock.

ORDOVICIAN

BAIE D'ESPOIR GROUP (NORTH STEADY POND FORMATION)

11 Felsic and intermediate volcanic rocks, mainly pyroclastic but including some flows.

10 Conglomerate, probably resedimented.

9 Volcanogenic sandstone and semipelite forming tubidite cycles.

MIDDLE ORDOVICIAN OR EARLIER

8 Brecciated and sheared serpentinite, mainly derived from Unit 3.

7 Thinly bedded black argillite and sandstone.

6 Mafic pillow lava.

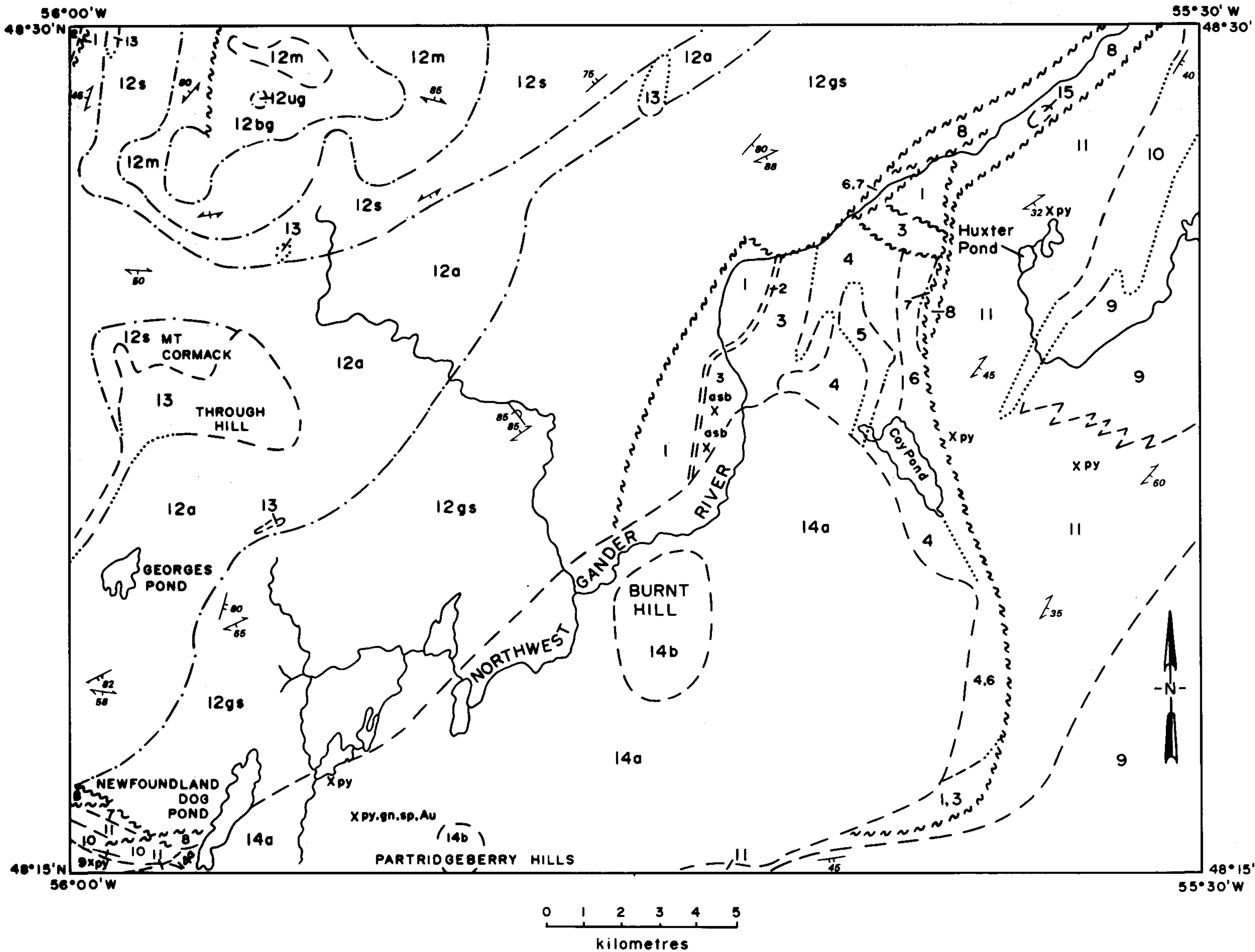
5 Trondhjemite.

4 Gabbro and diabase.

3 Pyroxenite, and banded pyroxenite and peridotite.

2 Sheared serpentinite.

1 Peridotite.



56°00'W
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12m
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CORMACK
THROUGH
HILL
GEORGES
POND
NEWFOUNDLAND
DOG
POND
14a
14b
PARTRIDGEBERRY HILLS
Xpy.gn.sp.Au
Xpy
NORTHWEST
GANDER
RIVER
BURNT
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asb
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4,6
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15
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0 1 2 3 4 5
kilometres

The boundary between the diabase of Unit 4 and mafic pillow lava of Unit 6 is fairly sharp and easily mapped north of Coy Pond. The pillow lava has variolitic texture and is extensively epidotized. In the fault block exposed along the Northwest Gander River, pillow lava grades into pillow breccia.

North of Coy Pond, pillow lava is overlain with apparent conformity by Unit 7. At the base of the unit is black argillite with 1 mm to 1 cm thick siltstone and sandstone beds. The beds are commonly channelled and have load casts, and parallel and cross laminations. They are overlain by poorly sorted conglomerate, which is also well exposed in a fault block on the Northwest Gander River, where it sits directly on pillow lava. The clasts in the conglomerate are angular to subrounded and principally of mafic volcanic composition. Clasts of felsic volcanic and plutonic rocks are also common and quartz grains occur in the matrix.

The western edge of the ophiolite sequence is unexposed but is presumed to be faulted against sedimentary rocks of Unit 12. Peridotite close to the assumed fault is more fractured than elsewhere. The fault that cuts across the strike of the sequence at its northern end is exposed in a cliff beside the Northwest Gander River; black argillite and sandstone of Unit 12 overlie a breccia of serpentinized peridotite in a talc schist matrix. Farther east, just south of the river, the same fault zone is exposed with gabbro overlying the talc schist. The fault is assumed to continue northeastwards down the valley of the Northwest Gander River to the Great Bend ultramafic complex in the Miguels Lake map area (2D/12) (Kean, 1974); preliminary observations show that this complex contains the same three ultramafic units (1-3) as the sequence at Coy Pond. The protolith of the serpentinite schist and breccia (Unit 8) in this northeasterly part of the fault zone appears to have been banded pyroxenite and peridotite of Unit 3. A similar protolith is indicated for the serpentinite breccia that marks the fault zone along the east side of the ophiolite sequence, separating sediments of Unit 7 from felsic volcanic rocks of Unit 11.

The ophiolite sequence at Coy Pond was intruded by the Partridgeberry Hills Granite and good exposures of the intrusive contact are exposed just east of the Northwest Gander River. Units 4 and 6 can be traced southwards along the edge of the granite pluton, but poor exposure and disruption by the pluton make it difficult to separate diabase from pillow lava. Banded pyroxenite and peridotite of Unit 3, and peridotite of Unit 1 reappear at the southeast corner of the granite; they are presumed to have been contiguous with the ultramafic rocks to the north before the granite was intruded.

The ultramafic belt continues at the southwest end of the Partridgeberry Hills Granite as a series of blocks in the fault zone west of Newfoundland Dog Pond. This zone continues northwestwards to connect with the north trending Pipestone Pond ultramafic complex (Slipp, 1952). Part of this complex outcrops in the northwest corner of the map area, where peridotite with a west dipping fracture cleavage has been thrust over sediments of Unit 12. The ultramafic units (1, 2 and 3) defined in the ophiolite at Coy Pond were also observed in the Pipestone Pond complex, but with opposite polarity. They pass westwards into gabbro, diabase and pillow lava (Wolofsky, 1951; Kean, 1974).

BAIE D'ESPOIR GROUP (Units 9-11)

Within the Burnt Hill map area, the Baie d'Espoir Group is represented by rocks presently assigned to the North Steady Pond Formation (Colman-Sadd, 1980b). It is possible that the volcanic rocks will be separated at a later date when presumed on-strike equivalents have been mapped near Great Burnt Lake. Three units are recognized in this report; sandstone and phyllite (Unit 9), conglomerate (Unit 10) and volcanic rocks (Unit 11). The relative stratigraphic positions of these units are unknown.

The dominant rock type of Unit 9 is volcanogenic, arkosic sandstone. It is medium to fine grained and beds are commonly graded; bed thickness is generally 10 to 60 cm, although locally beds are less than 5 cm thick. The sandstone is interbedded with green-gray phyllite containing siltstone laminations.

Conglomerate of Unit 10 is well exposed on Little Gull River in the northeast corner of the map area, and in the brook flowing out of Newfoundland Dog Pond in the southwest corner. In between, the mapping of this unit is based on limited exposure and boulder distributions. The clasts in the conglomerate are argillite, siltstone, psammite, fine to medium grained felsic and mafic igneous rocks, chert, calcite, feldspar and vein quartz. They vary in size from 0.02 mm to 15 cm, are subangular to rounded, and are set in a mudstone matrix. Near Newfoundland Dog Pond, the conglomerate beds are 30 cm to 1 m thick and are interbedded with coarse sandstone; bed contacts are gradational. In the northeast corner of the area, the conglomerate beds are much thicker (10 m or more); they are associated with black argillite and volcanogenic sandstone beds similar to those found in Unit 9.

Unit 11 consists of a variety of felsic and intermediate volcanic rocks. The dominant lithology is felsic crystal tuff with a fine grained matrix and crystals of quartz and feldspar up to 3 mm across. Probable rhyolite flows with quartz and feldspar phenocrysts have been found southwest of Newfoundland Dog Pond, and west of Huxter Pond adjacent to the faulted contact with serpentinite. Fine grained intermediate volcanic rocks which probably include both flows and pyroclastics occur due east of Coy Pond. Zones of sericitic alteration and pyrite mineralization have been found at several localities in Unit 11 and are indicated on the map; no other sulphide minerals were observed, although assays of samples have given slightly anomalous values of base metals and silver (Colman-Sadd, 1980a).

The rocks of the Baie d'Espoir Group within the map area were regionally metamorphosed in the greenschist facies. They have been deformed twice. The first deformation formed tight to isoclinal folds and a foliation that is generally subparallel to bedding. The second deformation is most obvious near the contact with the Partridgeberry Hills Granite at the southern edge of the area. It formed open to close recumbent folds and a nearly horizontal crenulation cleavage.

SANDSTONE AND SHALE (Unit 12)

Unit 12 occupies the northwest half of the map area. It is similar in rock type to units containing Silurian fossils farther east (Anderson and Williams, 1970), but there is not yet sufficient detailed map coverage to make a definite correlation. The unit is therefore only tentatively assigned to the Silurian.

Good exposures, displaying the original sedimentary character of the unit, are present in the southeast flowing tributaries of the Northwest Gander River. Sandstone beds, 10 cm to several metres thick, are interbedded with shale beds varying from 1 cm to 1 m thick. The sandstone is medium to fine grained and rich in quartz; graded bedding, load structures, and ripple-drift lamination are common, suggesting rapid deposition by turbidity currents. The shale beds contain numerous siltstone laminations and are commonly channeled by sandstone beds.

Unit 12 shows progressive low pressure regional metamorphism towards two centres in the western part of the map area. The andalusite and sillimanite isograds shown on the map are drawn where porphyroblasts of these minerals become clearly visible in the field. Future microscopy may require them to be redrawn. In the migmatitic zone (12m), the shale beds with their siltstone laminations show evidence of having melted to form a granitoid liquid, but the sandstone beds have remained intact. In the banded gneiss zone (12 bg), sandstone beds are represented by a few disjointed slabs, but generally the sedimentary features of the rock have been destroyed. The gneiss itself is of semipelitic composition with biotite-rich and quartzofeldspathic layers interbanded on a 1 mm to 1 cm scale; garnet is a common accessory mineral. In one location the banding has gradually faded out and the gneiss has become massive (12 ug). Other than the presence of a few amphibolite blocks in the banded gneisses, there is no evidence to suggest that any rocks other than those belonging to Unit 12 have been involved in the metamorphism.

Metamorphism of Unit 12 near the Partridgeberry Hills Granite is quite different in character from the regional metamorphism to the northwest. A very narrow aureole, which probably nowhere exceeds 100 m in width, has been formed. Within the aureole, the sediments have been metamorphosed to hornfels and spotty slate.

The rocks of Unit 12 have been tightly folded around axes that plunge vertically or steeply to the southwest. A well developed axial planar cleavage strikes southwest and, in general, is nearly vertical. These structures represent the main deformation. An earlier deformation is indicated by reversed facing directions of bedding on the main cleavage, and by an early cleavage which is only really apparent near the ultramafic belt. In parts of the migmatitic and gneissic zones, a later deformation has formed tight folds and has transposed bedding and the main cleavage to form a gneissic banding. The north trending fault along the western margin of the banded gneiss is marked by mylonite.

MUSCOVITE GRANITE (Unit 13)

Five granitic bodies are included in Unit 13. All except the one east of Georges Pond are pegmatitic muscovite granite with prominent garnet and tourmaline crystals. The small granite body east of Georges Pond is medium grained and no garnet or tourmaline have been recognized in it. Biotite occurs in the intrusions where the country rocks have been assimilated.

The granites are undeformed and the one at Through Hill truncates large scale folds formed during the main deformatin of Unit 12 (Colman-Sadd, 1980a). This granite also truncates the sillimanite isograd, indicating that the metamorphism was not caused directly by the granite.

The location of the granite bodies, in each case close to the sillimanite isograd, implies a relationship between granite origin and metamorphism. It is suggested that the granites represent the melt fraction from the sediments of Unit 12, and that the banded and unbanded gneisses (12bg, 12ug) are the residue. The granites are located along the sillimanite isograd because this formed at pressure and temperature conditions corresponding to the solidus of the melt. The granites and the metamorphism are, therefore, the results of the same heat sources, but are not in themselves cause and effect. The Through Hill metamorphic centre is regarded as less deeply eroded than the centre to the north. In the former case, erosion has reached the apex of the sillimanite isograd and corresponding granite solidus, so that these occupy the middle of the outcrop. In the latter case, erosion has cut deeper and exposed the high temperature gneissic rocks around which the sillimanite isograd and granite solidus form a perimeter.

The granite at Through Hill has been dated by the Rb/Sr method at 432±5 Ma (initial ratio 0.721) by P. Elias (personal communication).

PARTRIDGEBERRY HILLS GRANITE (Unit 14)

This granite forms a large intrusion, elongated in a west-southwest direction parallel to the regional structural trend. The main part of the granite (14a) is medium to coarse grained, gray or pink, locally vuggy, and pervasively altered. The feldspars are plagioclase (An_{33}) and perthitic microcline, the latter indicating a high level of intrusion. The mica is biotite which has been partially or completely altered to chlorite.

At two localities, a separate muscovite-rich facies (14b) is developed. This rock is fine to medium grained, and equigranular. Analyses show that it is distinctly richer in silica than the biotite granite. The contact relationships between the two granites are unknown.

Pegmatite and aplite veins are very scarce in both facies of the granite, but quartz veins are common. Two particularly large quartz veins cut the southwestern end of the granite and are responsible for the two mineral occurrences shown in that part of the map area. Assays from these veins were reported by Colman-Sadd (1980a).

Most of the Partridgeberry Hills Granite is undeformed. In the southeastern part of the intrusion, a fairly well defined fabric has been attributed to partial assimilation of previously foliated metasedimentary rocks (Colman-Sadd, 1980b). There are, however, parts of the granite, notably the muscovite bearing facies in the southwest, that clearly have been deformed and have a cataclastic fabric.

DEVONIAN(?) CONGLOMERATE (Unit 15)

The conglomerate is exposed at one locality in the Northwest Gander River valley. It is presumed to overlie unconformably sheared serpentinite of Unit 8, but this relationship is uncertain because of poor exposure.

The clasts consist mainly of brown weathering peridotite (Unit 1) and orange weathering, sheared serpentinite (Units 2 and 8). There are also some clasts of gabbro, mafic and felsic volcanic rock, and argillite. Grain size varies from 0.2 mm to over 30 cm; there is no clay or silt fraction and the rock is clast supported. Clasts are subangular to subrounded. Sorting is poor, except in a few sandstone lenses which may be up to 10 cm thick.

The conglomerate dips 50° to the east, but otherwise shows no evidence of deformation. In particular, it contrasts with conglomerate of Unit 10 in that it has no foliation. Individual clasts, and particularly serpentinite clasts, were deformed prior to deposition.

The age of the conglomerate is thought to be Devonian because it apparently postdates Acadian deformation and emplacement of the ultramafic belt (Colman-Sadd, in press). No distinction has been made between possible fluviatile or turbidite modes of sedimentation. However, given the probable tectonic environment in the Devonian, it is considered that fluviatile deposition is more likely.

MINERALIZATION

The most obvious potential for mineral deposits in the Burnt Hill area lies in the felsic and intermediate volcanic rocks (Unit 11) of the North Steady Pond Formation. These rocks are on strike with and probably laterally equivalent to the mineralized Great Burnt Lake volcanic belt. They are interpreted as forming the southeastern flank of the pre-Caradocian island arc of Dean (1977). Four occurrences of disseminated pyrite in these rocks are shown on the map.

The mafic pillow lavas (Unit 6) and diabase dikes (Unit 4) at the top of the Coy Pond ophiolitic sequence contain ubiquitous, but minor, amounts of disseminated pyrite. Their geologic association suggests the possibility of economic concentrations of sulphide minerals to form Cyprus-type deposits.

The mineral potential of the ultramafic part of the Coy Pond sequence (Units 1 to 3), the muscovite granites (Unit 13), and the Partridgeberry Hills Granite (Unit 14) was discussed by Colman-Sadd (1980a). It is considered to be less than that of the volcanic rocks.

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