GEOLOGICAL MAPPING OF THE PORT SAUNDERS (12I/11), ST. JOHN ISLAND (12I/14) AND PARTS OF THE TORRENT RIVER (12I/10) AND BELLBURNS (12I/6) MAP SHEETS, NORTHWESTERN NEWFOUNDLAND

by

Ian Knight and W. Douglas Royce[1]
Newfoundland Mapping Section

Abstract

Gently dipping Lower to Middle Ordovician platformal rocks resting unconformably upon Grenvillian basement rocks underlie the map area. The predominantly granitic Grenville rocks formed an early Paleozoic land surface that had marked local relief. The lower Paleozoic successions include 1400 m of generally conformable siliciclastic and carbonate rocks belonging to the Labrador (Lower Cambrian), Port au Port (Middle to Upper Cambrian), St. George (Lower Ordovician) and Table Head (Middle Ordovician) Groups. Two disconformities lie within the St. George Group.

The platform was affected by faulting in the Early Ordovician. Open spaces along northeast trending faults and joints that cut limestones of the Catoche Formation are filled by lithified, dolomitic, chert-quartz sandstone and dolomitic mudstone which resemble lithologies of the youngest rock unit in the St. George Group, the Aguathuna Formation.

A major system of curvilinear northeast trending faults crosses the map area. Vertical throws of large magnitude (100-1500 m) occurred on many of the faults but fold structures and trends, locally inverted bedding, and stratigraphic relationships suggest that the fault system was also affected by strike-slip movements.

The area hosts several small galena-sphalerite showings, including some in petroliferous dolomites that replaced limestones of the Table Head Group.

Introduction

Mapping of lower Paleozoic platformal rocks at 1:50,000 scale was completed in the Port Saunders, St. John Island and Torrent River map areas, and was begun in the northern half of the Bellburns map area during 1983. The gently inclined platformal rocks underlie a generally undulose wooded terrain that is of low elevation (0 to 100 m) in the southwestern and western parts of the map area, but rise to 380 m in the Highlands of St. John, where the hills are capped by resistant sandstone strata of the Labrador Group. Oval to flat-topped, rounded mountains up to 500 m high occur in the east, at the western edge of the Long Range Mountains. The country is dominantly wooded, but large marshes occupy low, flat areas east of Port au Choix and south of Western Brook Pond. Much of the forest is second generation growth after extensive logging operations over the past 20 to 30 years. Low shrub and grasslands cover the rocky mountain top underlain by Grenvillian granites in the Long Range Mountains.

The Northern Peninsula highway (Route 73, also called the Viking Highway) provides access to the area from Deer Lake. Paved roads link the main communities of Hawkes Bay, Port Saunders and Port au Choix. Access to the rest of the map area is facilitated by a network of forest access roads of variable quality. Large lakes such as Western Brook Pond (locally referred to as "Wes Lake"), Eastern Blue Pond (locally known as "Bluey") and River of Ponds Lake provide access to more remote areas by small boat. Helicopter provides the best access to mountainous areas in the east and northeast of the map area.

Geologic maps of the area are included in early studies conducted by Woodard (1957) for the area from Port au Choix north to Castors River and eastward over the Highlands of St. John and by Nelson (1955), who mapped rocks from Port au Choix southward to Portland Creek and eastward to the Long Range Mountains. The geology of the area north and east of Hawkes Bay is illustrated on a recent 1:125,000 compil-

Contribution to Canada-Newfoundland co-operative minerals program 1982-84. Project financed by the Newfoundland Department of Mines and Energy.

[1] 15A Shaw Street, St. John's, Newfoundland A1C 2W7

ation map by L.M. Cumming *in* Bostock et al. (1983). Smyth (1982) also compiled the geology of the area at 1:250,000 scale.

Geologic Setting

The map area contains almost all of the stratigraphy found in the Cambro-Ordovician platformal sequences in western Newfoundland. The generally gently dipping rocks range in age from Early Cambrian to Middle Ordovician and comprise rocks of the Labrador Group (Early Cambrian), Port au Port Group (Middle to Late Cambrian), St. George Group (Early to possibly early Middle Ordovician) and Table Head Group (Middle Ordovician). A mixed nonmarine to marine siliciclastic carbonate sequence in the Labrador Group is succeeded in the map area by an exclusively carbonate succession in the remaining groups.

The basal platformal strata rest with marked unconformity upon Precambrian basement rocks of Grenvillian age. The unconformity is mostly exposed on the western side of the Torrent River map area, where it has topographic relief of approximately 30 m beneath gently dipping outliers of the Labrador Group, south of Pikes Feeder Pond. One topographic high is bounded by two sets of northwest trending lineaments that are truncated by the unconformity.

Precambrian basement rocks are rare west of the Lady Worcester Brook Fault (LWBF). They do, however, occur unconformably overlain by Labrador Group in a fault-bounded wedge near LWB Fault north of Pikes Feeder Pond, as well as slightly east of the Ten Mile Lake Fault (TMLF) near North Summit of the Highlands of St. John.

The basement rocks that directly underlie the Labrador Group consist mainly of red to pink, fine to coarse grained granite which is composed of quartz, microcline, perthite, oligoclase and accessory biotite, chlorite and magnetite. Enclosed within the granite are rafts of banded quartzo-feldspathic gneiss. Locally, the granite exhibits an indistinct foliation and, in the area north of Pikes Feeder Pond, is cut by prominent sets of northeast trending, southeast dipping joints.

Stratigraphy of the Cambro-Ordovician Platformal Rocks

The subdivisions of the lower Paleozoic sedimentary rocks of the Northern Peninsula are similar to those used by Knight (1978, 1980, 1983).

Labrador Group

The Labrador Group, which is approximately 400 m thick, consists of, in ascending order, the Bradore, Forteau and Hawke Bay Formations, which are dominantly siliciclastic but contain minor carbonate rocks.

The basal Bradore Formation (Unit B, Figure 1) consists of red arkosic and gray to pink glauconitic sandstones, grits and minor conglomerate. The map area appears to contain two contrasting successions. In the west along Frenchman's Brook, Doctors Brook and the foot of the western scarp of the Highlands of St. John, the succession is typified by red, cross-stratified, arkosic sandstone with only minor gray sandstone. Pebble beds and grit are common towards the base of the formation; well sorted, *Skolithus* - bearing red and white sandstone is common at the top of the formation. Green-gray, glauconitic, very fine sandstone (some of which was mistaken for a massive diabase sill *in* Knight, 1983) is only a few metres thick and is apparently near the base of the formation. To the east of Lady Worcester Brook Fault, the Bradore Formation consists of a few metres of crossbedded, pebbly brown sandstone and conglomerate, overlain by approximately 50 m of gray and pink, glauconitic, cross-laminated and laminated, very fine sandstone and coarse siltstone, locally intercalated with gray shale. The top of the formation consists of approximately 30 m of red crossbedded sandstone and minor gray sandstone.

The overlying Forteau Formation (Unit F, Figure 1) consists of a lower shale-dominated section overlain by grainy limestone and sandstone. In the lower section, gray and black shales which are manganiferous, fossiliferous and contain calcareous concretions, are intercalated with thin, intensely bioturbated, brown weathering sandstones and fossiliferous limestones. A gray to pink, fossiliferous, dolomitic limestone several metres thick occurs near the base of the formation. The upper grainy succession is typified by black fossiliferous and oncolitic, oolitic lime grainstone, gray, fossiliferous, lime grainstone, crossbedded sandy limestone and minor bioturbated sandstone and gray shale. Archeocyathid bioherms and skeletal grainstones and rudstones derived from the bioherms occur in this upper sequence and have been located in outcrops southwest of Frenchman's Brook and near Hawkes Bay at the mouth of Long Steady, Torrent River.

The Hawke Bay Formation forms the upper part of the Labrador Group and consists mostly of white, flinty, quartzose sandstone that displays large scale trough and planar-tabular cross-stratification. Interbedded at scattered intervals in the white sandstone are red, gray and green sandstones and shales. These lithologies

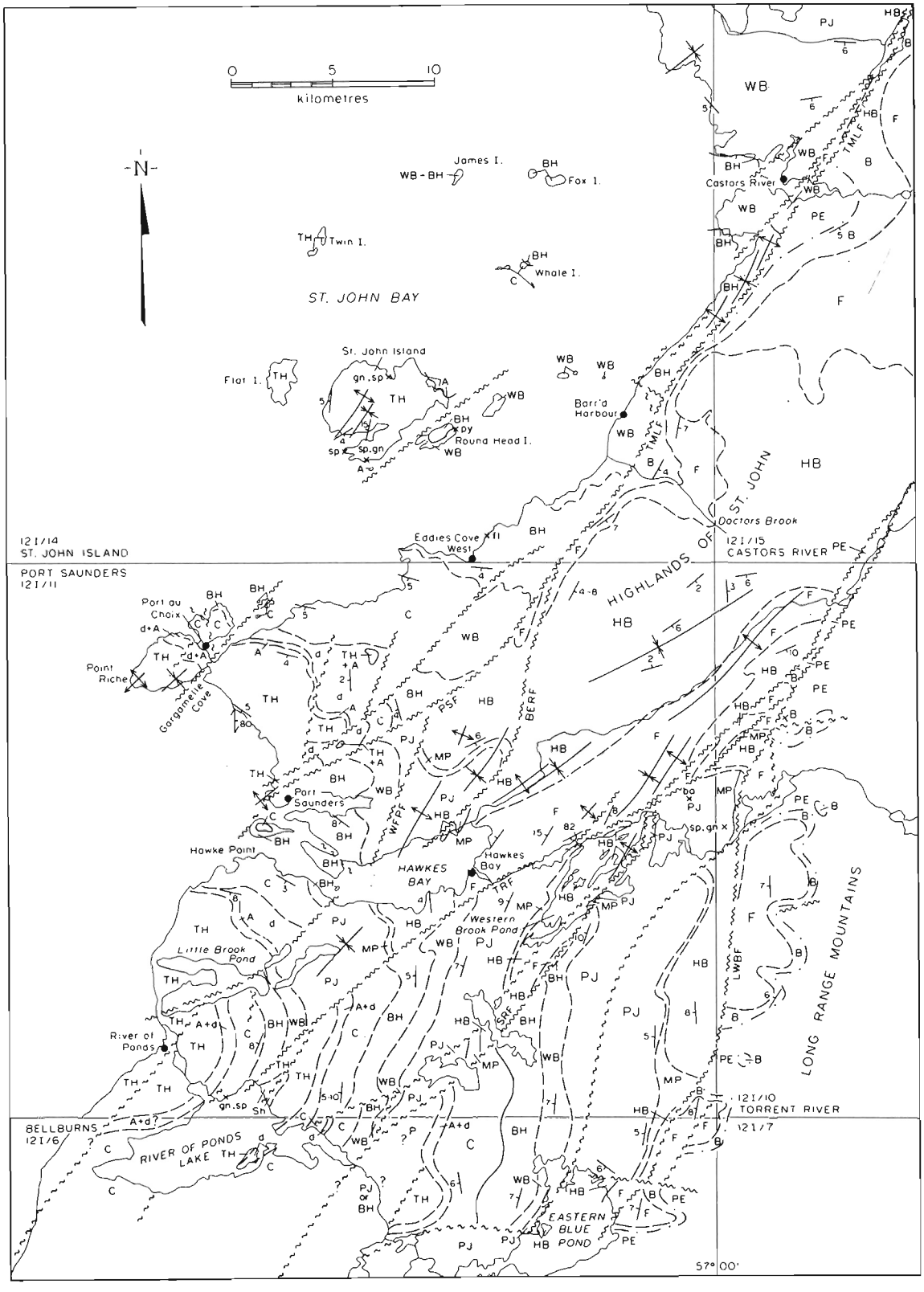


Figure 1: *Sketch map of the geology of the St. John Island, Port Saunders and parts of the Castor River, Bellburns and Torrent River map areas.*

LEGEND

MIDDLE ORDOVICIAN

TH **Table Head Group** - *Limestone, minor dolomitic limestone, dolostone and shale.*

LOWER ORDOVICIAN

St. George Group (WB, BH, C, A)

A Aguathuna Formation - *Dolostone, dolomitic shale.*

C Catoche Formation - *Limestone, top extensively replaced by diagenetic dolostone (d).*

BH Boat Harbour Formation - *Limestone, dolomitic limestone, dolostone, diagenetic dolostones.*

WB Watts Bight Formation - *Diagenetic dolostones, minor limestone.*

MIDDLE TO UPPER CAMBRIAN

Port au Port Group (MP, PJ)

PJ Petit Jardin Formation - *Dolostone, minor shale and limestone.*

MP March Point Formation - *Dolostone, minor shale, sandstone.*

LOWER CAMBRIAN

Labrador Group (B, F, HB)

HB Hawke Bay Formation - *White sandstone, minor shale.*

F Forteau Formation - *Limestone, shale, sandstone.*

B Bradore Formation - *Red and gray sandstone, minor conglomerate.*

PRECAMBRIAN

PE Grenville Basement - *Granite, gneiss.*

SYMBOLS

Unconformity
Geologic contact
Fault (approximate, assumed)
Bedding
Cleavage
Folds
Mineral showing

gn galena
sp sphalerite
ba barite
fl fluorite
py pyrite

TMLF Ten Mile Lake Fault
PSF Port Saunders Fault
WFPF Whale Factory Pond Fault
BERF Big East River Fault
TRF Torrent River Fault
SRF Starvation Ridge Fault
LWBF Lady Worcester Brook Fault

are phosphatic and glauconitic, and exhibit trace fossils, ripple marks and mudcracks.

The Forteau Formation within the map area contains inarticulate brachiopods and the problematic mollusc *Salterella*, as well as trilobites including *Wanneria logani* Walcott, *Olenellus* (= *Paedumis*) *transitans* Walcott, *O. lapworthi* Peach and Horne, *O. brevoculus* Resser and Howell, *Bonnia senecta* (Billings) and *Kootenia* sp. nov.. *Olenellus fremonti* occurs in shales in the lower part of the Hawke Bay Formation.

Port au Port Group

The Port au Port Group, which is probably >400 m thick in the map area, rests conformably upon the Hawke Bay Formation. It comprises two units, the March Point and Petit Jardin Formations (MP and PJ, Figure 1), both composed of recessively weathering dolostones and lesser shales. The March Point Formation is approximately 25 m thick on the south shore of Hawkes Bay but is probably approximately 50 m thick in the area east of Western Brook Pond. It consists of rusty to brown weathering, dark gray to gray, argillaceous dolostone, gray and black shale and minor glauconitic sandstone. Interbedded shale, siltstone and rusty weathering, bioturbated, very fine sandstone occur in the basal 3 m of the formation. Phosphatic intraclasts and quartz pebbles occur in the sandstone, which is mostly planar laminated and flaser bedded.

Above the basal member, the formation is dominated by some 15 m of argillaceous dolostone that is typified by planar to undulose thin bedding, bioturbation and lenses and beds of intraformational breccias. Gutter casts, small ripple marks and dolomite- and quartz-lined vugs also occur in the dolostone. Above this member, the succession becomes somewhat more variable with dark gray shale and mudstone and yellow weathering, thinly bedded and stromatolitic, pale gray shaly dolostone intercalated with the bioturbated and intraclastic dolostone already described. Desiccation cracks, lamination, flaser bedding, tepee structures and some cryptalgal structures occur in these beds. The stromatolitic structures consist of cryptalgal laminites and broad, low elevation mounds composed of closely spaced, laterally linked hemispheroids. Inarticulate brachiopods including *Lingulella* are common in the formation but so far the March Point Formation in the map area has not yielded any trilobites.

The conformably overlying Petit Jardin Formation is generally poorly exposed in the map area although it underlies much of the area south of Port Saunders Fault. It contains yellow to buff weathering, pale gray dolostone, minor limestone and red, green and gray shales and mudstones. A section on the south shore of Hawkes Bay reveals a 32 m thick basal member of red, green and gray shales intercalated with thinly bedded dolostone. Lamination, ripple marks, fenestrae, thin layers of intraclastic breccia and abundant desiccation cracks are common sedimentary structures. Cryptalgal structures in the member are generally irregular and oval shaped, broad, flat to centrally depressed, and surrounded by deep desiccation cracks.

Above the basal member, the succession includes thick beds of intraformational breccia, large stromatolite mounds, and cross-stratified oolitic grainstone as well as thinly bedded, shaly dolostone that exhibits flaser bedding, mudcracks and ripple marks. Limestone occurs within the dolostone in this member and has yielded the trilobite genera *Arapahoia* and *Blountia* and inarticulate brachiopods, possibly *Dicellomus*. These faunae confirm that the rocks are of early Late Cambrian age, and the trilobites indicate the Cedaria-Crepicephalus Zones.

The rest of the formation is poorly known but appears to include a member of yellow weathering, thick and thin bedded, pale gray dolostone which exhibits attributes of intertidal deposition, and includes some beds of cross-stratified, sandy dolostone with mudcracked dolostone drapes. Black chert nodules are common in the upper 180 m of the formation where thick beds of dark gray, finely crystalline dolostone exhibit stromatolite structures and bioturbation, and are interbedded with pale gray dolostone similar to that in the rest of the formation.

St. George Group

Sitting conformably above the Cambrian rocks are limestones, dolostones and diagenetic dolostones of the St. George Group; this group is divided into the Watts Bight, Boat Harbour, Catoche and Aguathuna Formations.

The basal Watts Bight Formation (WB, Figure 1) is approximately 100 m thick. It tends to form ridges and is fairly well exposed. The dark gray to black, fine to medium crystalline, diagenetic dolostone of the formation is generally cherty and characterized by light gray to creamy white mottling. The dolostone forms thick beds that exhibit large boundstone mounds including stromatolite structures that are intercalated with and surrounded by moderately to intensely bioturbated, generally thinly stratified carbonate. Thin (10 cm) interbeds of laminated and flaser bedded, dark gray dolostone with desiccation cracks

occur locally. Intercrystal and cavity porosity lined by dolomite spar and frequently filled by pink to buff colored, geopetal dolomite mudstone also occurs. Ghosts of planispiral gastropods and straight ellesmeroceratid cephalopods indicate an Early Ordovician age for the formation.

A succession of partly dolomitized limestones on James Island in St. John Bay may belong to the Watts Bight Formation. The succession exhibits cryptalgal mounds and extensively developed, bioturbated, sparsely fossiliferous, well bedded limestones of subtidal origin. The presence of some trilobite fragments, possibly *Hystricurus oculilunatus* Ross, suggests that the succession may be equivalent to the Boat Harbour Formation.

The overlying Boat Harbour Formation (BH, Figure 1) is generally recessively weathering and not well exposed except along shoreline sections. The formation is approximately 150 m thick and is best exposed near Eddies Cove West and on Fox Islands in St. John Bay. The base of the formation is well exposed on Round Head Island where thick, mounded beds of white weathering, gray dolostone that are locally brecciated rest sharply upon burrow-mottled, dark gray dolostone of the Watts Bight Formation. Similar stratigraphic relationships occur elsewhere in the map area (see Knight, 1983).

The formation, which is characterized by deposits of peritidal settings, contains cyclically intercalated subtidal limestone, stromatolitic and thrombolitic lime boundstone and intertidal-supratidal limestone and dolostone. A disconformity is believed to interrupt the sequence close to the top of the formation. Diagenetic dolostone has replaced limestones in the lower 50 m of the formation where stratiform breccias also occur. These breccias occur in this same stratigraphic interval throughout the area but it is presently unclear if they are of sedimentary collapse (after the dissolution of limestone?) or of tectonic origin. The formation and its fauna in the area are described more fully in previous reports (Knight, 1983; Boyce, 1983).

Well bedded, fossiliferous, bioturbated, gray limestone which displays extensive, dolomitic burrow-mottling comprises the Catoche Formation (C, Figure 1). This distinctive and fairly well exposed unit, which is approximately 160 m thick, rests conformably upon the Boat Harbour Formation and commonly forms ridges in the area. Several beds of thrombolitic boundstone mounds also occur in the formation which was deposited generally in an open subtidal shelf environment. Bituminous, vuggy, light to dark gray diagenetic dolostone (d, Figure 1) extensively replaced limestone (though depositional fabrics are still preserved) of the upper 34 to 50 m of the Catoche Formation. It locally possesses high porosity and is rich in sparry dolomite within open spaces (pseudobreccia). Mapping suggests that the diagenetic dolostone passes laterally into insignificantly altered dolomitic limestone in the area north of River of Ponds Lake. A more detailed description of the Catoche Formation in the area is given by Knight (1977, 1983).

Overlying the Catoche Formation in the area mapped is the poorly exposed and recessively weathering Aguathuna Formation (A, Figure 1). This unit is composed of yellow weathering, siliceous and argillaceous dolostone which was deposited in restricted intertidal and supratidal flat settings. Collapse breccias were noted locally in the map area. The Aguathuna Formation as defined here is somewhat different from that described by Knight (1983), who combined a lower dolostone sequence with an overlying sequence of interbedded limestone and dolomitic limestone or dolostone in the formation. Rather, the formation is now confined to Knight's lower dolostone sequence only and the overlying strata are now placed in the Table Head Group.

At Port au Choix and Horn Island, St. John Bay, the dolostones appear to overlie diagenetic dolostones of the Catoche Formation conformably. The Aguathuna Formation in each locality is only 3.5 to 4 m thick; this thin sequence is in marked contrast to the approximately 57 m that occur in the formation at Table Point (Bellburns map area), 40 km to the south. Preliminary studies suggest that only the topmost beds in the Table Point section occur at Port au Choix. These facts combine to indicate that there may be a major facies change from northwest to southeast involving limestone of the top of the Catoche Formation passing southward into dolostone of the Aguathuna Formation. Alternatively, the same features suggest that a disconformity separates the Catoche and Aguathuna Formations at Port au Choix and that the disconformity occurs somewhere within the Aguathuna Formation in the Table Point section. If a disconformity is present, the lower Paleozoic platform in western Newfoundland was topographically uneven when the Aguathuna Formation was deposited.

Although no evidence of erosion occurs at the contact of the two formations in the map area, there is evidence that the plat-

form was then being dissected by high angle northeast trending faults. In the Port Saunders map area, near Hawke Point, minor northeast trending faults and fractures cut the Catoche Formation. Buff weathering, dolomite-cemented sandstones which are composed of chert and vug-quartz sand grains and which exhibit good stratification and cross-stratification fill open spaces along the faults. These cemented sandstones are cut by shears indicating later fault movements (Figures 2 and 3). In the same area at Hawke Flat, eastward dipping fractures (Figure 4) were dilated by stresses or solution and are now filled by buff weathering, silty dolomite mudstone. Although there is no conclusive evidence that the fracture-fills are of Early Ordovician age, they nonetheless appear to be lithologically very similar to argillaceous dolostones and sandy dolarenites that contain vug- and chert-quartz sand grains in the Table Point section of the Aguathuna Formation. This interpretation of the fracture-fills as late Early Ordovician in age supports the hypothesis that the Early Paleozoic platform was deformed by a phase of block-faulting during the depositional time interval of the Aguathuna Formation and that a disconformity must lie between the diagenetic dolostones of the Catoche Formation and the overlying thin sequence of dolostones of the Aguathuna Formation at Port au Choix.

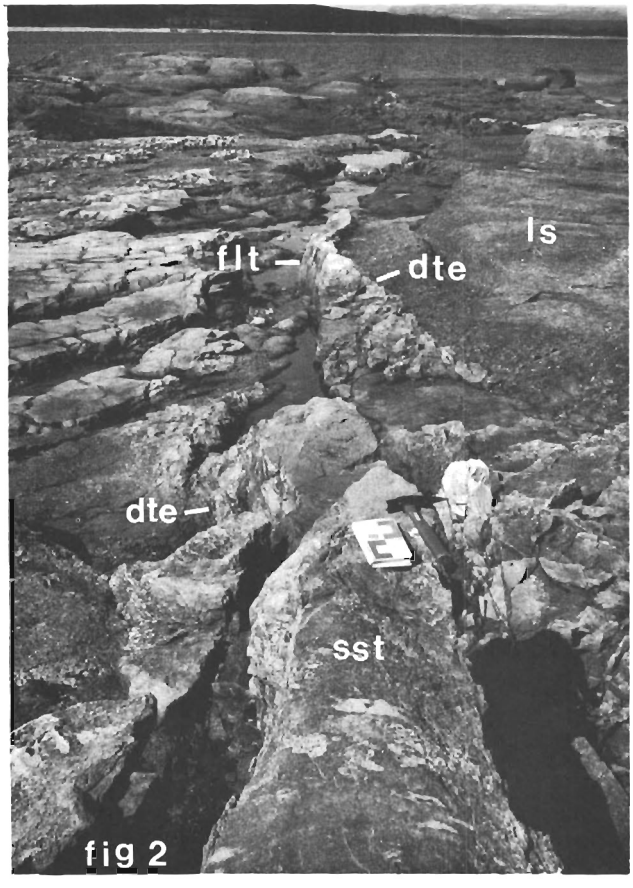
Table Head Group

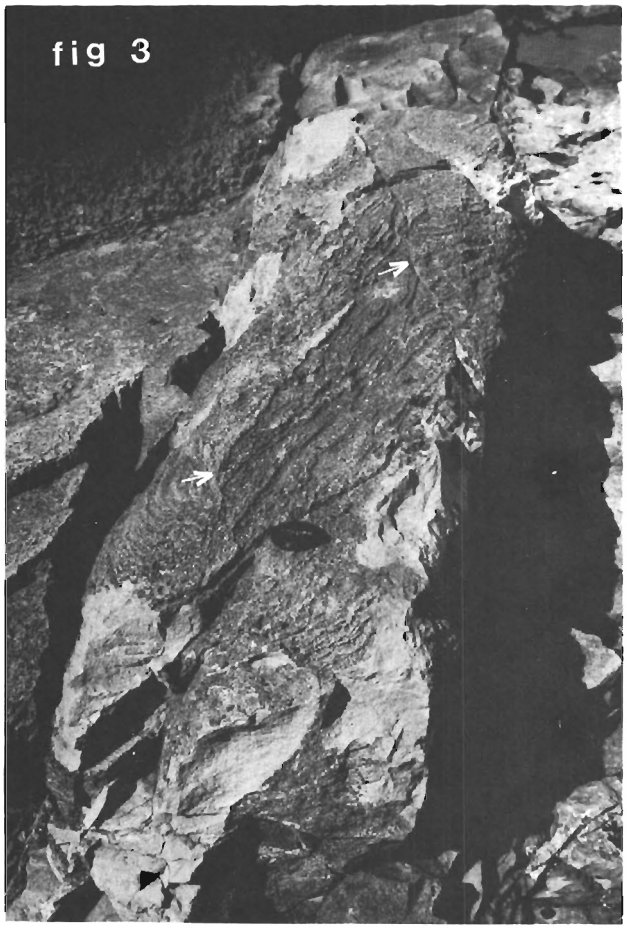
Shoreline to subtidal shelf limestones of the Table Head Group (TH, figure 1) rest conformably upon the dolostones of the Aguathuna Formation in the map area. In the Port au Choix area, the basal 12 m of the formation consists of cyclically developed, burrow-mottled, fossiliferous lime mudstone and laminated, commonly mudcracked, fenestral dolostone or dolomitic lime mudstone previously assigned to the Aguathuna Formation by Knight (1983). Similar strata, approximately 9 m thick, were noted by Knight (1977) at the base of the Table Head Group at its type section at Table Point. Cross-stratified limestone occurs in the member at Gargamelle Cove. In the River of Ponds area, thickly bedded (1-2 m), white to light gray weathering, gray fenestral limestone occurs in which laminar and tubular fenestrae of variable dimensions are filled by geopetal muds and dolomite and calcite. These beds underlie a wide area to the north of River of Ponds and may be of substantial thickness. They may be in part equivalent to and/or overlie the basal member. Both cyclical and fenestral carbonates are overlain by the well bedded, blue gray fossiliferous, rubbly weathering limestone which is so characteristic of much of the Table Point type section. Slump breccias are common in this limestone near Port au Choix. Surprisingly, diagenetic dolostone described earlier by Knight (1983) has a wide distribution within the limestones of the Table Head Group. Some of the dolostone is sparry dolomite-rich pseudobreccia generally claimed to be restricted to the St. George Group.

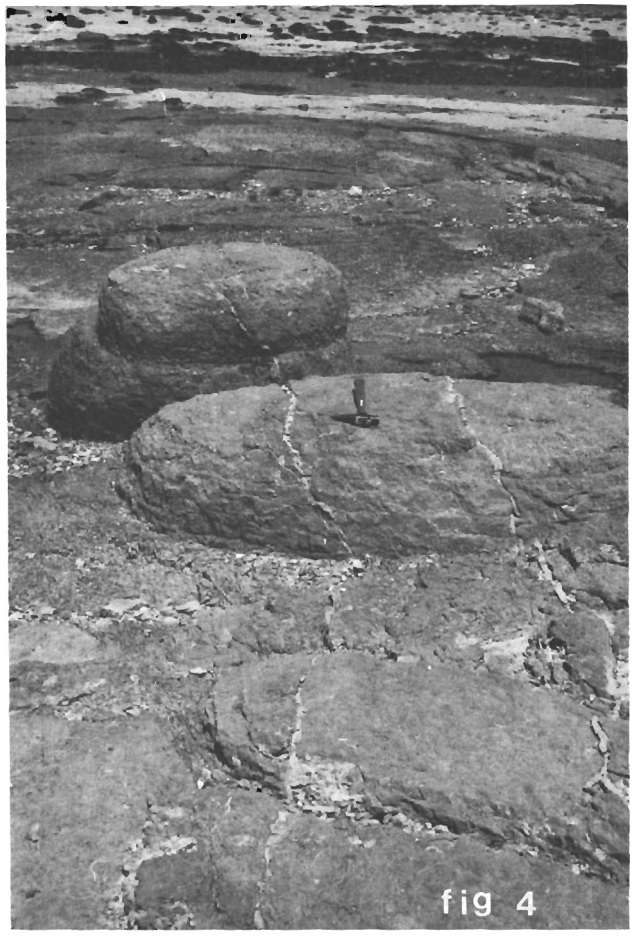
Structure

Long, curvilinear, frequently braided and anastomosing, northeast to north trending faults transect the map area. The faults offset the stratigraphic boundaries to the northwest of the faults by many kilometres both southwestward and northeastward. Vertical throws of 100 to 1500 m occur across several of the faults. Grenvillian basement rocks of the Long Range Mountains are uplifted upon the north trending, eastward dipping Lady Worcester Brook Fault (LWBF). Dip of the fault planes varies from 55° to 90° and changes direction along the trace of the faults. Sense of vertical displacement varies across the map area. Rocks are downthrown to the northwest on the Ten Mile Lake (TMLF), Port Saunders (PSF) and Big East River (BERF) Faults but to the southeast on the Torrent River (TRF) and Starvation Ridge (SRF) Faults.

The faults are sharp, smooth planar surfaces in many outcrops but fault breccias a few metres wide are locally developed and carbonate rocks are extensively dolomitized close to faults. Strata between faults are either gently inclined and consistent in strike or gently warped about northeast trending, generally southwest plunging fold axes. However, close to faults, beds may dip steeply and be overturned; tight, locally recumbent, folds also occur, for example, the Big East River Fault on the north shore of Hawkes Bay. Stratigraphically exotic, structurally emplaced blocks of strata that are discordant to the structural grain, occur locally along the Torrent River and Starvation Ridge Faults. Axes of tight, northeast-trending folds close to the Whale Factory Pond, Big East River, Torrent River, and Starvation Ridge Faults strike obliquely at an angle of 25° into the faults. At several localities, for example, Two Hills Point near Port Saunders and the eastern shore of Western Brook Pond, drag folds within the downthrown, younger rock unit adjacent to the faults suggest the sense of displacement upon the faults is opposite to that normally associated with simple vertical movements. A north trending cleavage is locally developed in limestones of the Table Head Group and Catoche Formation within the braided fault system.







Figures 2, 3 and 4: Northeast trending fault (flt) cutting limestones (ls) of the Catoche Formation at Hawke Point, Hawkes Harbour. Preserved along the fault are pockets of cemented quartz sandstone (sst, Figure 2) which displays depositional layering (Figure 3). Two fractures obliquely crosscut and displace this layering (arrows). Dolostone (dte) replaces the limestone in a narrow zone close to the fault plane. Three kilometres to the east at Hawke Flat, Hawkes Bay, dolomite mudstones fill easterly dipping joints that also cut rubbly weathering, well bedded limestones of the Catoche Formation (Figure 4). These structures and sedimentary fills are believed to support the hypothesis of a phase of block faulting on the carbonate platform during the late Early Ordovician.

Although large vertical displacements have occurred on the faults and reverse faulting likely occurred on the Lady Worcester Brook Fault, variable bedding attitudes and fold styles, fold trends oblique to faults, anomalous senses of displacement upon the faults suggested by the folds, and the presence of exotic structural blocks along the trace of some faults all suggest that a major strike-slip component of movement occurred upon the faults. The orientation of drag folds close to the Big East River, Port Saunders and Torrent River Faults suggests right lateral movements occurred. No structural evidence has been found to date, however, to suggest that a phase of sinistral strike-slip movement also affected the platformal strata even though left lateral offset of stratigraphic markers occurs across the Torrent River and Starvation Ridge Faults.

Mineralization

Minor sphalerite, galena, chalcopyrite, barite and fluorite showings occur in the map area.

Sphalerite, galena and barite occur in rocks of the Port au Port Group. Traces of an earlier presence of disseminated sphalerite in dolostone of the March Point Formation was revealed using a zinc reactive solution. Weathered sphalerite crystals were subsequently noted in outcrops west of Otter Pond and on a woods road 6 km north of Eastern Blue Pond.

The best known Cambrian showing in the area is that near Pikes Feeder Pond (Beckett, 1966) where galena, sphalerite and associated chalcopyrite and pyrite occur in gray, massive dolostone of the lower Petit Jardin Formation. The mineralization is mostly in open spaces along an irregular fracture network so that galena, the dominant mineral, occurs as fine streaks, and as coarse, 5 mm crystals and massive clots within fracture porosity. However, coarse crystalline galena also appears to concentrate in layers parallel to bedding, locally disseminated in intercrystal porosity, and as small clots and laminae associated with green and yellow sphalerite within and possibly replacing the depositional fabric of the original dolostones. Beckett (1966) suggested that the mineralization is essentially strata-bound although related to a north trending, steeply eastward-dipping fracture zone. Mineralization was traced over a strike length of 1200 m by trenching and soil and stream geochemistry. Trenching showed that galena is distributed over a thickness of 60 cm and Beckett (1966) estimated that this width contained an average of less than 2% galena although locally galena is more concentrated.

Barite occurs in dolostones of the Petit Jardin Formation at the upper end of Indian Steady, near Middle Pond. The long, bladed, white crystals were precipitated in open cavities that had previously been lined by sparsely developed crystals of rhombic dolomite.

In the St. George Group, mineralization occurs in the Boat Harbour and Catoche Formations. Fluorite occurs as disseminated crystals and in spherical vugs in limestone and dolostone of the Boat Harbour Formation just north of Eddies Cove West. Shearer (1964) and Beckett (1966) reported sphalerite, pyrite and marcasite towards the base of the Boat Harbour Formation on the shore, 3 km north of the same community. The showing has not been located. Beckett (1966) describes black and pale brown sphalerite surrounding marcasite in nodules in a north-trending, steeply dipping vein up to 6 inches (15 cm) in width. A marcasite-pyrite showing occurs in possible collapse breccias at the base of the Boat Harbour Formation on Round Head Island, St. John Bay. The pyrite fills fracture porosity in the breccia, surrounding dolostone fragments. Locally, massive and nodular marcasite is developed in the breccia.

A galena, sphalerite and pyrite showing (called the Rice Pudding Showing) with a strike length of several metres occurs in calcite, dolomite and quartz veins that cut dolomitized limestone of the Catoche Formation on the northwest shore of River of Ponds Lake. The galena and sphalerite, forming streaks in fine fractures and locally fist-sized clots, occur with aggregates of crystalline black sphalerite that grew upon sparry dolomite that had already lined the fracture walls. A minor, north trending, vertical fault cuts the carbonates along the shore to the north of the showing. Secondary, crystalline dolostone, associated with the showing, replaces, fossiliferous limestone and cryptalgal mounds. It is white and pink in color, equigranular in texture and highly porous. The pink dolostone contains unseen zinc mineralization since the rock reacts to the application of zinc reactive solution.

Three sphalerite-galena showings were found in epigenetic? dolostone that replaces limestone low in the Table Head Group on St. John Island. The mineralization, which is locally associated with pyrite and barite, occurs in large tabular bodies to irregular stockworks of gray, crystalline dolostone that replace the limestone where the limestone is gently warped and cut by minor faults. Sparry dolomite lines open spaces. Dark brown, very coarse crystals of sphalerite and dis-

seminated and aggregated crystals of galena occur along the margins, in shear zones, and as open space fillings along bedding planes and within beds of the dolostone. The dolostone is strongly petroliferous and black hydrocarbon residues fill some open spaces in the mineralized dolostone.

Acknowledgements

Kevin Austin, Mike Basha and Ashley Phillips provided able assistance throughout the mapping program; Kevin Austin also contributed significantly by sharing mapping responsibilities during the summer. The people of Hawke Bay are thanked for their thoughtfulness and kindness; the home comforts were much appreciated. Mary *Driscoll typed earlier drafts of the* manuscript.

References

Beckett, R.J.
1966: Report on the southern portion of the Grandroy Concession, Newfoundland. Part I, Hawke Bay area; Part II, North of Eddies Cove West. Unpublished Report, New Jersey Zinc Exploration Company.

Bostock, H.H., Cumming, L.M., Williams, H. and Smyth, W.R.
1983: Geology of the Strait of Belle Isle area, northwestern insular Newfoundland, southern Labrador and adjacent Quebec. Geological Survey of Canada, Memoir 400, 145 pages, Map 1495A.

Boyce, W.D.
1983: Preliminary Ordovician trilobite biostratigraphy of the Eddies Cove West - Port au Choix area, Western Newfoundland. *In* Current Research. *Edited by* M.J. Murray, P.D. Saunders, W.D. Boyce and R.V. Gibbons. Newfoundland Department of Mines and Energy, Mineral Development Division, Report 83-1, pages 11-15.

Knight, I.
1977: Cambro-Ordovician platformal rocks of the Northern Peninsula, Newfoundland. Newfoundland Department of Mines and Energy, Mineral Development Division, Report 77-6, 27 pages.

1978: Platformal sediments on the Great Northern Peninsula: Stratigraphic studies and geological mapping of the north St. Barbe District. *In* Report of Activities for 1977. *Edited by* R.V. Gibbons. Newfoundland Department of Mines and Energy, Mineral Development Division, Report 78-1, pages 140-150.

1980: Cambro-Ordovician carbonate stratigraphy of western Newfoundland; sedimentation, diagenesis and zinc-lead mineralization. Newfoundland Department of Mines and Energy, Mineral Development Division, Open File Nfld. 1154, 43 pages.

1983: Geology of Cambro-Ordovician rocks in parts of the Castor River, St. John Island and Port Saunders map sheets. *In* Current Research. *Edited by* M.J. Murray, P.D. Saunders, W.D. Boyce and R.V. Gibbons. Newfoundland Department of Mines and Energy, Mineral Development Division, Report 83-1, pages 1-10.

Nelson, S.J.
1955: Geology of the Portland Creek - Port Saunders area, west coast. Newfoundland Department of Mines and Resources, Report No. 7, 58 pages.

Shearer, J.
1964: Report on investigations on Grandroy Concession, Great Northern Peninsula. Unpublished Report, New Jersey Zinc Exploration Company Limited.

Smyth, W.R.
1982: Geology Map - Port Saunders. Newfoundland Department of Mines and Energy, Mineral Development Division, Map 82-53, 1:250,000.

Woodard, H.
1957: Geology of the Port Saunders - Castor River area, Newfoundland. Newfoundland Department of Mines and Resources, Report No. 10, 45 pages.

Ian Knight