

CAMBRIAN MACROFOSSILS FROM THE PHILLIPS BROOK AND NORTH BROOK ANTICLINES, WESTERN NEWFOUNDLAND

W.D. Boyce and I. Knight
Regional Geology Section

ABSTRACT

Sixty-four macrofossil collections have been obtained from newly discovered fossiliferous localities, found in shelf carbonates and lesser shales and siltstones of the Middle to Late Cambrian Port au Port Group, in the Phillips Brook and North Brook anticlines of western Newfoundland. The faunas are dominated by trilobites and inarticulate brachiopods, but also include in some of the younger beds, ostracodes and gastropods.

*The March Point Formation, 50 m of limestone and minor shale and siltstone, has yielded a sparse late Middle Cambrian fauna of small trilobite fragments and inarticulate brachiopods. The conformably overlying Petit Jardin Formation hosts 340 m of limestone, dolostone and shale, divisible into several members. Much of the formation hosts fairly rich early Late Cambrian Dresbachian faunas that are successively dominated by *Arapahoia raymondi* Lochman, 1938b and *Crepicephalus rivus* Kindle, 1948. The presence of *Elvinia roemeri* (Shumard, 1861)? and *Irvingella major* Ulrich and Resser, 1924 in a mound bed, just 90 m below the top of the formation, indicates that the limestones of the formation range at least into the uppermost part of the medial Late Cambrian (Franconian) *Elvinia* Zone. Ostracodes also occur with the Franconian faunas.*

*The Berry Head Formation comprises a lower dolostone member and an upper member of peritidal limestone, dolostone and minor shale. The lower member is barren of fossils except for local inarticulate brachiopods. The upper member contains the trilobites *Calvinella tenuisculpta* Walcott, 1914, *Plethopeltis armatus* (Billings, 1860) and *Stenopilus* sp., plus inarticulate brachiopods, ostracodes and some gastropods (including *Sinuopea*).*

INTRODUCTION

Sixty-four macrofossil collections have been obtained from newly discovered fossiliferous areas/localities, found in shelf carbonates and lesser shale and siltstone of the Middle to Late Cambrian Port au Port Group, in the Phillips Brook and North Brook anticlines of western Newfoundland (Figures 1 and 2). The two anticlines lie east of the type section of the Port au Port Group on the Port au Port Peninsula where the lithology has been studied in detail (Levesque, 1977; Chow, 1986; Chow and James, 1987a, b, 1993; Kennard, 1989; Kennard *et al.*, 1989; Cowan and James, 1989, 1993; James *et al.*, 1989) and to a lesser degree, the palaeontology (Schuchert and Dunbar, 1934; Howell, 1936, 1938; Howell and Mason, 1938; Lochman, 1938a, b; Resser, 1942; Kindle and Whittington, 1965; Whittington and Kindle, 1969; Boyce, 1977; Boyce and Levesque, 1977; Westrop, 1992).

Comparison of the Cambrian carbonate succession in the two anticlines with the Port au Port succession is inevitable (Figure 3). The Port au Port succession, comprises the March Point, Petit Jardin and Berry Head formations.

On the Port au Port Peninsula, the Petit Jardin Formation is divided into five members - in ascending order - the Cape Ann, Campbells, Big Cove, Felix and Man O' War members (Chow and James, 1987a). However, these members have not been easy to map elsewhere in western Newfoundland (*see* Knight and Cawood, 1991); neither have they necessarily been adopted enthusiastically by all workers, even on the Peninsula. Clear anomalies, namely in the definition of the March Point Formation and Berry Head Formation, occur between the classic work on the Peninsula and the studies in the anticlines. Principally, on the Port au Port Peninsula, all dolostones above the Man O' War Member are placed in the Berry Head Formation (Chow and James, 1987a). However, a marker of thick-bedded, chert-rich, dolostone, which serves as the base of the Berry Head Formation throughout the Great Northern Peninsula (GNP) (summarized in Knight and Cawood, 1991) has also been mapped south of the GNP from the Goose Arm thrust stack southwest to the Phillips Brook anticline, (Knight and Boyce, 1991, 2002; Knight, 1994). This marker occurs some 40 m or so above the base of the dolostone in the southern area (*see* Knight and Boyce, 2002).

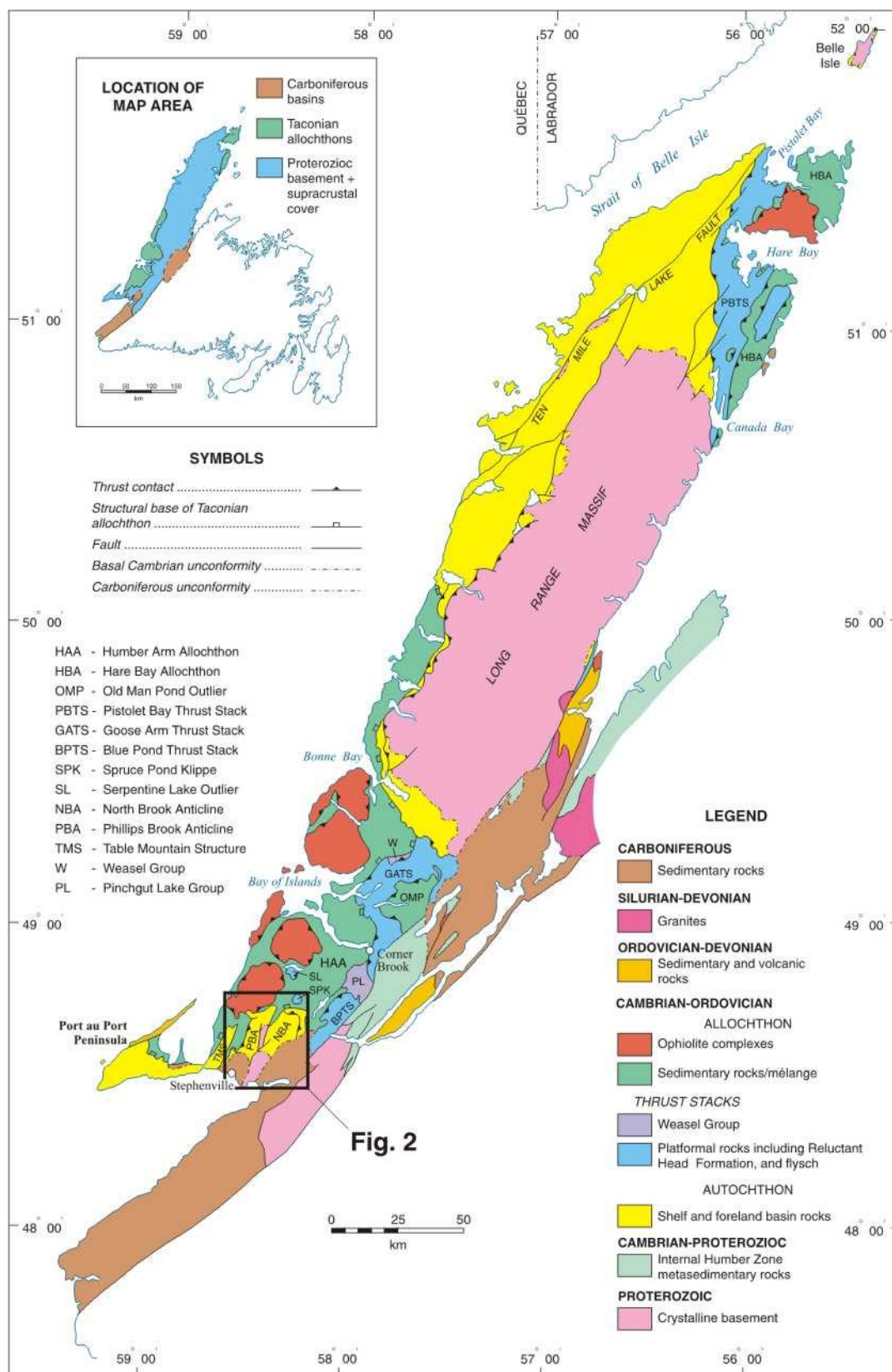


Figure 1. Simplified geological map of western Newfoundland showing the location of the Phillips Brook Anticline (PBA) and the Northern Brook Anticline (NBA).

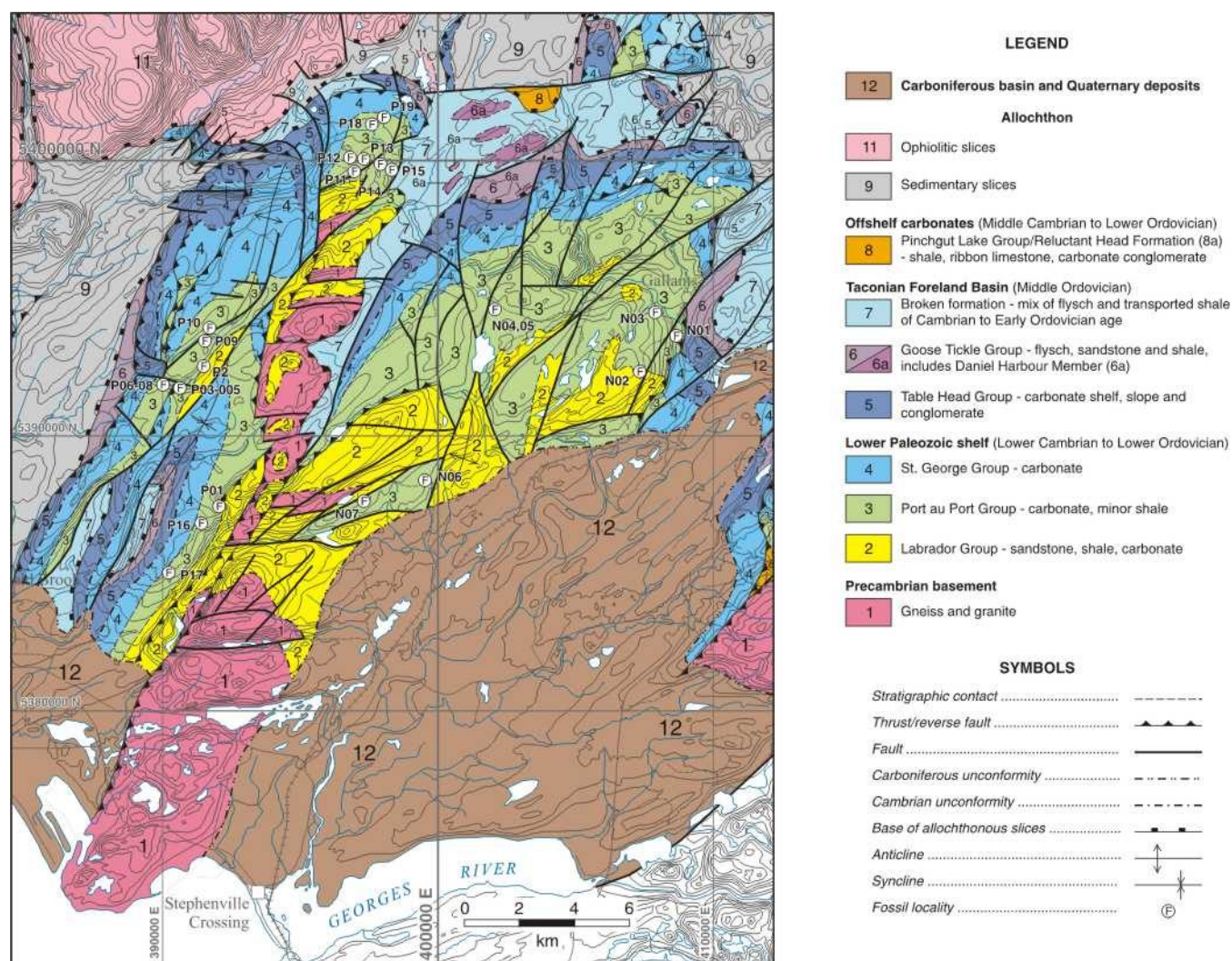


Figure 2. Simplified geology of the Phillips Brook Anticline and the Northern Brook Anticline. Fossiliferous areas/localities within the Phillips Brook Anticline are designated P01 to P19 (see Appendix 1); those of the Northern Brook Anticline are designated N01 to N07 (see Appendix 2).

Of greater concern, however, are apparent discrepancies between the formation definitions used by Cowan and James (1993) and those originally proposed by Chow and James (1987a). Although Cowan and James (1993, page 1578, Figure 3) used the same member names as Chow and James (1987a), basal strata of the Cape Ann Member appear to have been assigned to the upper March Point Formation. In addition, some strata included in the Man O' War Member by Chow and James (1987a) appear now to reside in the Berry Head Formation (Cowan and James, 1993, page 1578, Figure 3).

The Cape Ann Member is continued to be used in this brief report for reasons outlined below and will also correlate other parts of the succession in the anticlines with the type section and its members. An excellent section is

exposed along the middle reaches of Romaines Brook; it cuts the entire Port au Port Group in the core of the Phillips Brook Anticline (see Figure 2 and Appendix 1). This section has only been logged in the simplest fashion, and requires a future detailed bed-by-bed examination and description. However, it provides the first evidence that the members of the Petit Jardin Formation can be logged outside of the Port au Port Peninsula (Figure 3). In particular, strata comparable to the Cape Ann Member lie above March Point Formation limestones and below a thick unit of oölitic grainstone, stromatolitic limestone and dolostone. The latter is a good fit with the thick bedded, oölitic dolostone and limestone of the Campbells Member of Chow and James (1987a). The Romaines Brook section also allows the numerous disparate fossil collections elsewhere in the anticlines to be placed in their proper stratigraphic context.

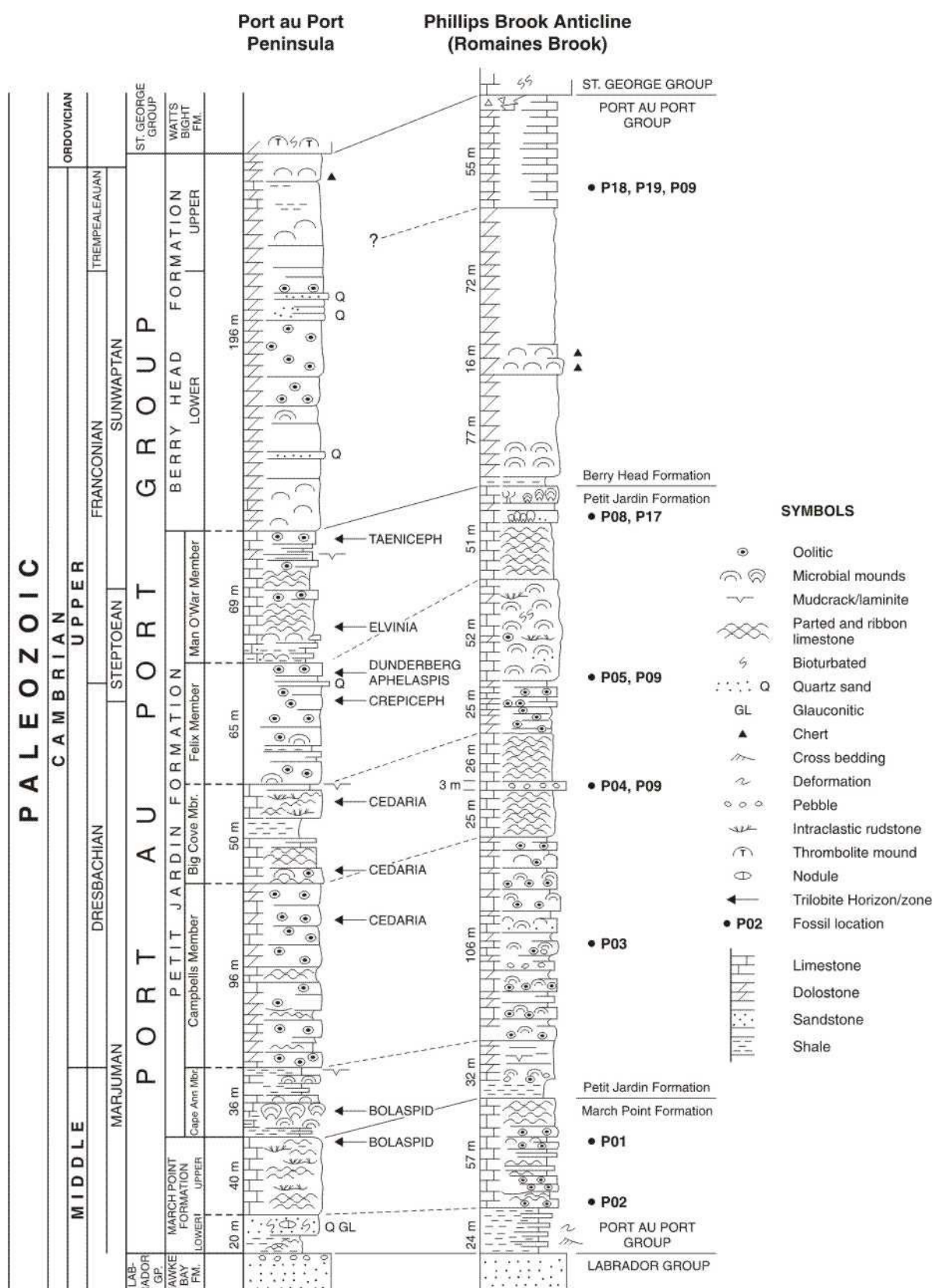


Figure 3. Correlation of Phillips Brook Anticline Cambrian sequences with that of the Port au Port Peninsula. BOLASPID = Bolaspidella. CREPICEPH = Crepicephalus. DUNDERBERG = Dunderbergia. TAENICEPH = Taenicephalus.

SUMMARY OF CAMBRIAN PALEONTOLOGICAL WORK ON THE PORT AU PORT PENINSULA

The history of paleontological work of the Port au Port Peninsula is treated in detail below because the Cambrian faunas of the Phillips Brook and Northern Brook anticlines are correlated with those of the Port au Port Peninsula (see Figure 3).

Fossil studies on the Cambrian carbonate shelf succession of the Port au Port Peninsula have been restricted to Schuchert and Dunbar (1934), Howell (1936, 1938), Howell and Mason (1938), Lochman (1938a, b), Resser (1942), Kindle and Whittington (1965), Boyce (1977, and unpublished data, 1978-2005), Boyce and Levesque (1977) and Westrop (1992).

On the southwestern coast, between March Point and Big Cove, Schuchert and Dunbar (1934, pages 33-35) measured a stratigraphic section. They reported trilobites from several levels, but the taxa were not identified. These were subsequently identified and described by Lochman (1938a, b). Howell (1936, page 3) found fossils at some of the same horizons as Schuchert and Dunbar (1934) as well as lower and higher horizons.

MARCH POINT FORMATION

Bed 10 of Schuchert and Dunbar (1934) is 13 feet (~ 4 m) thick. Lochman (1938b, page 462) reported the following from slabs of thin-bedded, fine-grained, dark-grey knob-bly limestone having shaly partings:

Arthropoda—Trilobita

Eldoradia dunbari Lochman, 1938b

Marjumiella newfoundlandensis Lochman, 1938b

Brachiopoda—Inarticulata

Obolus sp. undet.

Howell (1938) and Howell in Howell and Mason (1938, page 296) reported a Middle Cambrian trilobite fauna, comprising undescribed species of *Ehmania*, *Elrathiella* and *Glyphaspis*.

During the summer of 1976, significant trilobite collections were made by R. Levesque and Dr. R.K. Stevens, as part of Levesque's M. Sc. thesis project (Levesque, 1977). Four of these collections were sent to Dr. W.H. Fritz for identification (Fritz, 1977). Two (RL-76-209 & RL-76-210) are discussed here; the other two are treated under the Petit Jardin Formation.

Collection RL-76-209 (1/3 of a pygidium) and collection RL-76-210 (1/2 of a cranidium) were obtained from the

same locality, approximately 1500 m east of Campbell's Cove (Fritz, 1977, pages 1, 3). The collections were made from "thin fossil hash beds (up to 20 cm. thick) in blue-grey weathering, fine grained, grey, massive, medium bedded (5 to 10 cm), lime mudstone, in places with trace fossils on bedding surfaces" (Fritz, 1977, page 2) — in an upfaulted block which was previously considered part of the St. George Group (Boyce, 1977, page 14). Fritz (1977, page 1) questionably assigned the material to *Coosella* sp., and tentatively assigned it to the early Late Cambrian (Dresbachian) *Crepicephalus* Zone. This identification was disputed by Boyce (1977), who subsequently described and illustrated the material. The pygidium from collection RL-76-209 was described as *Glyphaspis* sp. (Boyce, 1977, page 31; Plate 6, figure 1) and assigned an older, late Middle Cambrian *Bathyriscus-Elrathina* Zone age (Boyce, 1977, page 18; Boyce and Levesque, 1977).

On July 9, 1978, Dr. R.K. Stevens led Boyce to a number of localities within the Port au Port Group. West of Marches Point, three reconnaissance collections were made from the March Point Formation. Near the base of the formation, collection 1978F005 yielded the following (Boyce, unpublished, 1978):

Arthropoda—Trilobita

Ehmania sp. cf. *E. borealis* Howell, 1943

Brachiopoda—Inarticulata

Gen. et sp. undet.

From an unknown distance stratigraphically above 1978F005, the following were identified from collection 1978F006 (Boyce, unpublished, 1978):

Arthropoda—Trilobita

Bolaspidella? sp. undet.

Marjumiella? sp. undet.

The highest collection (1978F007) was obtained an unknown distance stratigraphically above 1978F006, and yielded (Boyce, unpublished, 1978):

Arthropoda—Trilobita

Marjumiella? sp. undet.

Three collections obtained by Dr. N. Chow during her Ph.D. thesis fieldwork (Chow, 1986) were examined by Boyce on November 9, 1984. Collections NC-1983-147 (1984F136) and NC-1983-157 (1984F137) were made from the Petit Jardin Formation, and are discussed below. Collection NC-1983-006 (1984F135) was obtained from the March Point Formation. The following trilobites are present:

Ehmania borealis Howell, 1943

Ehmaniella sp. cf. *E. burgessensis* Rasetti, 1951

Elrathia sp. cf. *E. quebecensis* Rasetti, 1963

This fauna correlates with those of the upper part of the *Ehmaniella cloudensis* Zone at Eddies Cove East and Canada Bay (Knight and Boyce, 1987).

Westrop (1992) did some reconnaissance sampling in the March Point Formation. According to Westrop (1992, page 230; Figure 3), the March Point Formation is about 54 m thick. From a horizon approximately 48.5 m above the base of the formation (or 5.5 m below its top), at Degras he obtained *Elrathia* sp. indet. (Westrop, 1992, page 252; Figures 18.3, 18.4, 18.6-18.9).

During the summer of 1998, additional macrofossil collections were made from the March Point Formation (Boyce, unpublished, 1998; Knight, unpublished, 1998). Collection 1998F052 from the basal limestone beds of the formation yielded:

Arthropoda—Trilobita

Elrathia quebecensis Rasetti, 1963

Brachiopoda—Inarticulata

Gen. et sp. undet.

This fauna correlates with those of the upper part of the *Ehmaniella cloudensis* Zone at Eddies Cove East and Canada Bay (Knight and Boyce, 1987). Collection 1998F042 (K-1998-012A) yielded *Ehmaniella*? sp. undet., indicating a similar correlation. Collections 1998F043 (K-1998-012B), 1998F044 (K-1998-012C) and 1998F046 (K-1998-013B) contain undetermined trilobites, yet to be identified, and collection 1998F045 (K-1998-013A) comprises unidentified inarticulate brachiopods.

In summary, two distinct trilobite faunas occur in the March Point Formation. The lower of the two is characterized by:

Ehmania borealis Howell, 1943

Ehmaniella sp. cf. *E. burgessensis* Rasetti, 1951

Ehmaniella? sp. undet.

Elrathia quebecensis Rasetti, 1963

Glyphaspis sp.

The upper fauna comprises:

Bolaspidea? sp. undet.

Eldoradia dunbari Lochman, 1938b

Elrathia sp. indet. of Westrop (1992)

Marjumiella newfoundlandensis Lochman, 1938b

Detailed biostratigraphic sampling of the formation is long overdue.

PETIT JARDIN FORMATION

Beds 23 and 24 of Schuchert and Dunbar (1934) occur in the Big Cove Member. According to Schuchert and Dun-

bar (1934, page 34), Bed 23 is 55 feet (~ 17 m) thick, comprising: “dark-gray siltstone and silty shale, with occasional more solid layers of oölite or intraformational conglomerate”. From Bed 23, Lochman (1938b, page 462) identified:

Arthropoda—Trilobita

Arapahoia raymondi Lochman, 1938b

Brachiopoda—Inarticulata

Lingulella sp. cf. *L. quadrilateralis* (Walcott, 1905)

According to Schuchert and Dunbar (1934, page 34), Bed 24 is 20 feet (6.10 m) thick, comprising: “limy siltstone in thin knobby layers, grading upward into more calcareous strata and culminating in a 20-inch (51 cm) layer of oölite, the upper surface covered with glauconite”. According to Lochman (1938b, page 462), the fossil collection is from a dark-gray crystalline limestone near the top of the bed and contains:

Arthropoda—Trilobita

Arapahoia raymondi Lochman, 1938b

Coosella helena Lochman, 1938b

Coosia sp.²

Maryvillia arion Walcott, 1916³

Millardia avitas Walcott, 1916⁴

Talbotina degreasensis Lochman, 1938b

Talbotina solitaria Lochman, 1938b

Welleraspis newfoundlandensis Lochman, 1938b

Brachiopoda—Inarticulata

Dicellomus nanus (Meek and Hayden, 1862)

According to Robison (1988, page 71), *Welleraspis newfoundlandensis* Lochman, 1938b also ranges through the lower 111 m of the Holm Dal Formation (Tavsen's Iskappe Group) of central North Greenland.

Lochman (1938b, page 462) also investigated a collection obtained from dark grey limestones exposed at Little Green Gardens. The following were reported:

Arthropoda—Trilobita

Arapahoia raymondi Lochman, 1938b

Kingstonia ara (Walcott, 1924)⁵

Talbotina sp. undet.

Brachiopoda—Inarticulata

Lingulella sp. undet.

Resser (1942, page 8) indicated that the pygidium of *Maryvillia arion* Walcott, 1916 — described and illustrated by Lochman (1938b, page 169; Plate 57, figure 4) — was incorrectly attributed. He assigned it to *Blountia terranovica*, new species.

¹ the “grey-green shale with rounded phosphate pellets” of Lochman (1938b, page 462)

² *Coosina kindlei* Westrop, 1992, see Westrop (1992, page 239) for updated synonymy

³ *Blountia terranovica* Resser, 1942 (see Westrop, 1992, page 246)

⁴ *Menomonion* sp. cf. *M. semele* (Walcott, 1916), see Westrop (1992, page 250) for updated synonymy

⁵ *Kingstonia peltata* Palmer in Palmer and Peel, 1981 (see Westrop, 1992, page 245)

Kindle and Whittington (1965, page 685) demonstrated the existence of additional Cambrian strata farther east along the south coast of the Port au Port Peninsula, from “at least 1 mile (1.6 km) west of Campbells Cove to a point east of Felix Cove”. They obtained trilobites⁶ from the following localities:

1. 0.7 mile (~ 1.1 km) east of the tip of Cape St. George, from algal mounds:

Arapahoia raymondi Lochman, 1938b

Coosella helenae Lochman, 1938b

2. east of Marches Point, about 250 yards (~ 229 m) east of Young's Brook, approximately 20 feet (~ 6.1 m) above the base of Bed 28 of Schuchert and Dunbar (1934) and Lochman (1938b, page 461; Figure 1), from algal mounds:

Arapahoia raymondi Lochman, 1938b

Kingstonia peltata Palmer in Palmer and Peel, 1981

Terranovella arcuata Palmer in Palmer and Peel, 1981

3. Campbells Cove — about 12 miles (~ 19 km) east of Marches Point, from algal mounds:

Bynumia sp.

Talbotina degrasensis Lochman, 1938b

4a. east of Campbells Cove, from limestones roughly 300 feet (~ 91 m) below the *Talbotina*-bearing beds:

Dicellomus sp. (inarticulate brachiopod)

4b. east of Campbells Cove, one third of a mile (~ 0.5 km) east of Felix Cove, from algal mounds:

Kingstonia peltata Palmer in Palmer and Peel, 1981

As mentioned above, significant trilobite collections were made by R. Levesque and Dr. R.K. Stevens, as part of Levesque's M.Sc. thesis project (Levesque, 1977). Four of these collections (RL-76-209, RL-76-210, RL-76-220 and RL-76-228) were sent to Dr. W.H. Fritz for identification (Fritz, 1977). Collections RL-76-209, RL-76-210 were discussed above, under the March Point Formation.

Collection RL-76-220 was obtained approximately 1000 metres east of Felix Cove (Fritz, 1977, pages 1, 3), from “a thin fossil hash bed (up to 10 cm thick) on top of (a) distinctive arborescent limestone stromatolite bed” (Fritz, 1977, page 2) in the Petit Jardin Formation. Fritz (1977, page 1) identified *Dytremacephalus* sp. from this collection and correctly indicated a range of *Aphelaspis* Zone to *Dunderbergia* Zone for the genus.

Collection RL-76-228 was made approximately 1750 metres east of Felix Cove (Fritz, 1977, pages 1, 3), from an oölitic limestone in the Petit Jardin Formation. Fritz (1977, page 2) identified a cranidium as “cf. *Coosina* sp.” and tentatively referred the collection to the *Crepicephalus* Zone.

Also in 1976, Dr. R.K. Stevens and Ms C. Gallagher collected several trilobite cranidia from a siliceous dolostone about 1000 m east of Man O' War Cove (Boyce, 1977, page 15).

Boyce was given access to all the above collections during the course of his B.Sc. (Honours) thesis (Boyce, 1977). Although Boyce agreed with the identification of *Dytremacephalus* sp. (RL-76-220) by Fritz (1977), he questioned the identification of “cf. *Coosina* sp.” (RL-76-228).

In early 1977, the Department of Mines and Energy (courtesy of I. Knight) arranged for Boyce to visit Dr. A.R. (Pete) Palmer at the Department of Earth and Space Sciences in Stony Brook, New York; Dr. Palmer in turn arranged for Boyce to visit Dr. C.H. Kindle in Nyack, New York. Much of the 1976 Port au Port Peninsula material was taken along for identification. Palmer (personal communication, 1977) confirmed the identifications of *Dytremacephalus* sp. from RL-76-220. However, the cranidium from RL-76-228 was identified as *Camaraspis* and those from the locality of Stevens and Gallagher were identified as *Taenicephalus* (Palmer, personal communications, 1977).

Boyce (1977) subsequently described and illustrated the material. The material from RL-76-220 was described as *Dytremacephalus* sp. (Boyce, 1977, pages 39-40; Plate 9, figures 1-8), and assigned a (middle to late Dresbachian) *Aphelaspis* Zone to *Dunderbergia* Zone age (Boyce, 1977, pages 20-21; Boyce and Levesque, 1977). The cranidium from RL-76-228 was described as *Camaraspis* sp. (Boyce, 1977, pages 37-39; Plate 8, figures 8-10), and assigned an early Franconian *Elvinia* Zone age (Boyce, 1977, page 21; Boyce and Levesque, 1977). The three cranidia of Stevens and Gallagher were assigned to *Taenicephalus* sp. (Boyce, 1977, pages 35-36; Plate 7, figures 3-5), indicative of a middle Franconian *Conaspis* Zone, now *Taenicephalus* Zone age (Boyce, 1977, page 22; Boyce and Levesque, 1977). Boyce (unpublished, 1988) subsequently identified these trilobites as *Dytremacephalus strictus* Rasetti, 1965, *Camaraspis convexa* (Whitfield, 1878) and *Taenicephalus shumardi* (Hall, 1863). As Boyce and Levesque (1977) pointed out, these trilobites represented the first late Dresbachian, early Franconian and middle Franconian faunas found in the autochthonous sequence of western Newfoundland. See Palmer (1977) for Dresbachian, Franconian and Trempealeauan trilobite zonations.

⁶ identifications after Westrop (1992)

On July 9, 1978, Dr. R.K. Stevens took Boyce to Felix Cove, where *Dunderbergia* sp. and inarticulate brachiopods were obtained from pebbly oölitic dolomite grainstone.

Previously, on July 6, 1978, Boyce examined the Petit Jardin Formation in Campbells Cove and Felix Cove. On the east side of Campbells Cove, from a stromatolite bed — probably locality 3 of Kindle and Whittington (1965) — the following were obtained (1978F001 — Boyce, unpublished):

Arthropoda—Trilobita

Talbotina? sp. undet.

Brachiopoda—Inarticulata

Gen. et sp. undet.

At Felix Cove, fragments of the trilobite *Crepicephalus rivus* Kindle, 1948 were collected from a 30 cm thick oölitic lime grainstone (1978F002 — Boyce, unpublished).

Boyce measured Section 1978DB-01 in Felix Cove on July 11 & 12, 1978 (Boyce, unpublished). Five macrofossil samples were taken from the 23.07 metre-thick section. *Crepicephalus rivus* Kindle, 1948 was obtained from oölitic lime grainstones at four intervals: 0.00-0.30 m (1978F002); 3.95-4.10 m (1978F008); 7.48-7.52 m (1978F009); and 7.92-8.02 m (1978F010 — originally discovered by Dr. R.K. Stevens).

A 0.50 m-thick bed of aborescent stromatolite mounds (capped by lime? grainstone) was identified 13.13-13.63 m above the base of Section 1978DB-01. This probably is equivalent to the bed containing *Dytremacephalus strictus* Rasetti, 1965, approximately 1000 m east of Felix Cove (RL-76-220 — Fritz, 1977).

Dunderbergia sp. and inarticulate brachiopods were obtained 20.52-20.65 m above the base of Section 1978DB-01, from pebbly oölitic dolomite grainstone (1978F003). The interval subsequently was resampled by Boyce and J.S. Ash on August 29, 1992 (1992F096 — Boyce, unpublished, 1992); they also obtained inarticulate brachiopods 21.25-21.45 m above the base of the section (1992F097 — Boyce, unpublished, 1992).

Three collections obtained by Dr. N. Chow during her Ph.D. thesis fieldwork (Chow, 1986) were examined by Boyce on November 9, 1984. As mentioned above, collection NC-1983-006 (1984F135) was made from the March Point Formation. Collections NC-1983-147 (1984F136) and NC-1983-157 (1984F137) were both obtained from the Petit Jardin Formation. *Blountia* sp. cf. *B. mimula* Walcott, 1916 occurs in the former; the latter contains *Blountia terranovica* Resser, 1942 and *Terranovella* sp.

Chow (1986, page 22) and Chow and James (1987a, page 419; Figure 2) showed *Dytremacephalus* as occurring near the top of the Felix Cove Member. *Dunderbergia* was shown as occurring in the basal part of the overlying Man O' War Cove Member, with *Camaraspis* and *Taenicephalus* in the middle and upper parts of the member, respectively (Chow, 1986, page 22; Chow and James, 1987a, page 419; Figure 2). F.H.C. O'Brien in Chow (1986, page 27) indicated the presence of latest Cambrian conodonts in the uppermost beds of the Berry Head Formation.

Westrop (1992) did some reconnaissance sampling, substantially revising the taxa of Lochman (1938b). He also restudied and re-illustrated some of the material of Kindle and Whittington (1965), Fritz (1977) and Boyce (1977) and Boyce and Levesque (1977), housed at the Geological Survey of Canada. Westrop (1992, page 237; Figure 11) applied the trilobite-based chronostratigraphic stages defined by Ludvigsen and Westrop (1985) in the Rocky Mountains to the Cambrian shelf carbonates (see Figure 3) and loosely defined some trilobite associations with lithofacies in parts of the formation.

Westrop (1992, page 252; Figures 18.10-18.12, 18.15-18.17) described and illustrated "*Ptychoparina* gen. et sp. indet." from the Campbells Member.

From four fossiliferous levels within an interval 30 to 41.2 m above the base of the Big Cove Member (see Westrop, 1992, page 231; Figure 4), Westrop (1992) described and illustrated the following taxa:

Arapahoia raymondi Lochman, 1938b

Blountia terranovica Resser, 1942

Coosella helena Lochman, 1938b

Coosina kindlei Westrop, 1992

Kingstonia peltata Palmer in Palmer and Peel, 1981

Menomonion sp. cf. *M. semele* (Walcott, 1916)

Talbotina degrasensis Lochman, 1938b

Terranovella arcuata Palmer in Palmer and Peel, 1981.

Robison (1988, page 67) identified *Kingstonia peltata* Palmer in Palmer and Peel, 1981 from the "basal few metres" of the Holm Dal Formation of central North Greenland.

According to Westrop (1992, page 232; Figure 5), the Felix Member is approximately 78 m thick. Three collections within an interval from 49 to 53 m above the base of the member yielded:

Crepicephalus rivus Kindle, 1948⁹

Komaspidella sp. cf. *K. laevis* Rasetti, 1961

Terranovella dorsalis (Hall, 1863)

This Upper Marjuman faunal assemblage he termed the *Terranovella dorsalis* Fauna.

⁹ *Crepicephalus* sp. cf. *C. iowensis* (Owen, 1852) of Westrop (1992, pages 236-238; Figures 12.3, 12.4, 12.9)

Westrop (1992, page 232; Figure 5) shows *Dytremacephalus strictus* Rasetti, 1965 as occurring about 58 m above the base of the Felix Member and *Camaraspis convexa* (Whitfield, 1878) as about 10 m above the base of the Man O' War Member.

LITHOSTRATIGRAPHY OF THE PHILLIPS BROOK AND NORTH BROOK ANTICLINES

The March Point Formation as exposed in the anticlines is a 50-m thick succession. It comprises a lower member of shale, siltstone and fine grained sandstone and only minor carbonates. This is overlain by an upper member of bioturbated dolomitic limestone, oölitic grainstone, nodular and parted dolomitic limestone, intraclastic and oncolitic rudstone, shale and rare stromatolitic boundstone. Oölitic units are dolomitized extensively in the North Brook Anticline.

The conformably overlying Petit Jardin Formation is a 340-m thick succession comprising dolomitic and argillaceous ribbon limestone, intraclastic and skeletal rudstone and floatstone, stromatolitic boundstone, oölitic, intraclastic and skeletal grainstone and thick units of dolostone. The dolostones range from featureless, thick-bedded units (commonly assumed to be dolomitized grainstones), domal stromatolites and dololaminite. Red, green and grey shales having intercalated siltstones and fine sandstones also occur. Quartz sand and chert are present locally in the higher parts of the formation. This succession is arranged into several lithological members that are correlated here, with the formal members on the Port au Port Peninsula (Figure 2).

The Berry Head Formation conformably overlies the Petit Jardin Formation. It comprises a lower dolostone member and an upper member of interbedded peritidal limestone, dolostone and rare shale. The dolostones are mostly thick bedded and often featureless, but some beds exhibit stromatolites, dololaminite and other shallow-water features. Chert is locally common. Limestones of the upper member include stylonodular and parted, burrowed, stromatolitic, oölitic and laminated types. Collapse breccias cross cut the strata locally close to the top of the upper member.

BIOSTRATIGRAPHY OF THE PHILLIPS BROOK AND NORTH BROOK ANTICLINES

MARCH POINT FORMATION

The March Point Formation is well exposed in the middle reaches of Romaines Brook in the Phillips Brook Anticline and in the core of, as well as along Harrys River, in the North Brook Anticline. Fossils were found in both these

areas but are generally of small, scattered and obscure, unidentifiable fragments. They include ptychopariid trilobites and some inarticulate brachiopods.

PETIT JARDIN FORMATION

Trilobites have been collected from a number of sections and scattered localities through the Phillips Brook Anticline and in scattered localities in the North Brook Anticline (Knight and Boyce, 2000; Knight, 2003). The well-exposed, largely complete, but previously unvisited, section through the formation in the incised gully along the middle reaches of Romaines Brook (Figure 2) provides both new stratigraphic and biostratigraphic baselines to integrate these fossil collections into the regional stratigraphic picture. Not only has the section yielded a number of new fossil localities, but it also provides a good reference section to stratigraphically locate the earlier obtained fossil collections. Two collections of fossils were also made in limestones, just below barren dolostone that were placed in the top of the Petit Jardin Formation by Knight and Boyce (2000), but would be defined as Berry Head Formation by Chow and James (1987a) and Cowan and James (1993). Previous scrutiny of these limestones in the northern part of the Phillips Brook Anticline for trilobites proved fruitless (Knight and Boyce, 2000). To date, three definitive trilobite faunas have been found in the limestones of the Petit Jardin Formation in the anticlines. A fourth trilobite fauna has been found but it is small and yet to be identified.

The oldest trilobite fauna is dominated by *Arapahoia raymondi* Lochman, 1938b. It occurs predominantly in thin solitary beds of skeletal intraclastic lime packstone, grainstone and rudstone, some of which are associated with stromatolitic boundstone, within a succession of dolomitic ribbon limestones. In the Phillips Brook Anticline, the key trilobite occurs with

Blountia sp. undet.

Gen. et s. undet.

Kingstonia sp. undet.

Talbotina/Welleraspis sp. undet.

In the North Brook Anticline, only *Blountia* sp. undet. and *Kingstonia* sp. undet. occur with *Arapahoia raymondi* Lochman, 1938b. The *Arapahoia raymondi* fauna is found in a member dominated by ribbon limestone supporting the correlation of this unit with the Big Cove Member of Chow and James (1987a). The best collections of this fauna are found from P09-001 to P09-005 in Section K-1999-003M in the Phillips Brook Anticline (see Appendix 1), although the base of this section is faulted. In this section the *Arapahoia raymondi* fauna is immediately overlain by a small but abundant as yet unidentified trilobite fauna still within the Big Cove Member. A single, fossil collection has also been found underlying the ribbon limestones in the oölitic and

stromatolitic member which is correlated with the Campbells Member. The fossils are poorly preserved and additional work will be needed to define this fauna.

The second fauna is dominated by *Crepicephalus rivus* Kindle, 1948 and is hosted by beds of intraclastic oölitic grainstone where it is associated with other shallow peritidal lithofacies. It is accompanied by *Terranovella* sp. undet., in both anticlines and by *Komaspidella* sp. undet. in the North Brook Anticline. *Arapahoia* sp. undet. is also known with *Crepicephalus rivus* Kindle, 1948, in some other localities in the Phillips Brook Anticline. Trilobites are less abundant than in the older *Arapahoia raymondi* fauna. The fauna is hosted by carbonate rocks that correlate with the lower and middle part of the Felix Member. The best collections are P09-011 to P09-013B from the upper part of Section K-1999-003M (see Appendix 1). In the North Brook Anticline, *Komaspidella* sp. undet. and *Terranovella* sp. undet. both occur abundantly but only as monospecific assemblages (N07 and N05, respectively - see Appendix 2).

The third fauna has, so far, only been found in place in the southern part of the Phillips Brook Anticline, where it is hosted by intraclastic and oölitic grainstones and rudstones associated with boundstone mounds, that interrupt a succession of ribbon limestones. The mounds display striking arborescent and digitate stromatolites. It has also been found in a large boulder in the river bed of Romaines Brook, west of the measured section illustrated in Figure 3. There, the trilobites occur in a basal pebbly grainstone that is overlain by impressive, long thin columnar stromatolites. The fauna includes:

Elvinia roemeri (Shumard, 1861)? – incomplete cranidium (+, -)

Iringella major Ulrich and Resser, 1924 – cranidium (+, -)

Sulcocephalus sp. undet – cranidia (+, -)

Inarticulate brachiopods and indeterminate ostracodes are also present in the fauna.

The youngest fauna occurs in rocks that compare lithologically to those of the Man O' War Member of the Port au Port Peninsula and appear to lie within about 20 m of the base of the dolostones that mark the upper part of the Petit Jardin Formation as previously mapped and defined in the Phillips Brook Anticline (Knight and Boyce, 2001). The same dolostones, however, would be placed in the base of the Berry Head Formation by Chow and James (1987a). A unit of grey shale that occurs at the base of this dolostone in the northern part of the Phillips Brook Anticline contains an abundant fauna of inarticulate brachiopods.

BERRY HEAD FORMATION

Apart from scattered gastropods found in burrowed limestone beds in the upper member of the Berry Head Formation, the unit is generally devoid of easily found macrofossils. The best recovery, to date, comes from the section at Goose Arm (Knight and Boyce, 1991). However, a number of fossiliferous limestones that host trilobites were found at the base of the upper member in the northern part of the Phillips Brook Anticline (P18, P19 - see Appendix 1). The trilobites plus scattered gastropods (including *Sinuopea*) and ostracodes occur in interbedded skeletal-intraclastic packstone, bioturbated skeletal wackestone and stromatolitic boundstone that form the lower part of metre-scale shallowing-upward cycles. The trilobites include *Calvinella tenuisculpta* Walcott, 1914, *Plethopeltis armatus* (Billings, 1860) and *Stenopilus* sp. undet., correlative with the latest Cambrian (Trempealeauan) *Plethopeltis*-bearing strata Zone of Goose Arm.

DISCUSSION

Mapping of the Cambrian carbonate shelf succession in the Phillips Brook and North Brook anticlines coupled with documentation of increasing numbers of fossil collections provides increasing assurance that the lithostratigraphy of the Port au Port Group type section can be extended regionally outside of the Port au Port Peninsula in the southern part of the Humber Zone of western Newfoundland.

MARCH POINT FORMATION

Only unidentified trilobites have so far been recovered from the March Point Formation in the Phillips Brook and North Brook anticlines. Trilobites from the top of this unit and the overlying Cape Ann Member on Port au Port Peninsula have been shown to be part of the *Bolaspidella* Zone (Chow and James, 1987a) and *Elrathia* sp. indet. was reported from the top of the formation by Westrop (1992; page 252). Previously, however, Boyce (1977; unpublished, 1978, 1984, 1998) identified the following from the lower part of the March Point Formation:

Ehmania borealis Howell, 1943

Ehmaniella sp. cf. *E. burgessensis* Rasetti, 1951

Ehmaniella? sp. undet.

Elrathia quebecensis Rasetti, 1963

Glyphaspis sp.

From higher levels Boyce (unpublished, 1978) identified:

Bolaspidella? sp. undet.

Marjumi? sp. undet.

The best trilobite faunas collected to date in the March Point Formation in western Newfoundland are those of Eddies Cove East and other nearby localities on the St Barbe coast, GNP (Whittington and Kindle, 1966, 1969; Boyce, 1977; Boyce and Levesque, 1977; Knight, 1977; Stouge and Boyce, 1983) and at Chimney Arm and Cloud Rapids in Canada Bay (Howell, 1937, 1938, 1943; Knight and Boyce, 1987; Knight, 1987). There, the faunas are interpreted to range through the *Bathuriscus-Elrathina* and *Bolaspidea* zones at the St. Barbe coast and through the *Polyleptaspis*, *Olenoides longispinus* and *Ehmaniella claudensis* zones (equivalent to the *Bathuriscus-Elrathina* zone) at Canada Bay. *Zacanthoides gilberti* Young and Ludvigsen, 1989 (*Zacanthoides* sp. of Knight and Boyce, 1987, page 361; Figure 4) is present in the *Olenoides longispinus* Zone at Canada Bay. This allows a firm correlation with the late Middle Cambrian *Ptychagnostus gibbus* (agnostid trilobite) Zone = uppermost *Oryctocephalus* (polymeroid trilobite) Zone of the Great Basin (see Young and Ludvigsen, 1989, page 8; Figure 3).

PETIT JARDIN FORMATION

Two faunas collected in the anticlines belong to the Dresbachian Stage (or the middle and upper parts of the Marjuman Stage) and one is Franconian, correlating with the Steptoean Stage.

The oldest fauna dominated by *Arapahoa raymondi* Lochman, 1938b compares with the *Arapahoa raymondi* fauna of Westrop (1992) from the Big Cove Member of Port au Port Peninsula. Associated with this species, Westrop (1992) also described *Blountia terranova* Resser, 1942, *Coosella helena* Lochman, 1938b, *Coosina kindlei* Westrop, 1992, *Kingstonia peltata* Palmer in Palmer and Peel, 1981, *Menomonina* sp. cf. *M. semele* (Walcott, 1916), *Talbotina degreasensis* Lochman, 1938b and *Terranovella arcuata* Palmer in Palmer and Peel, 1981. This fauna allows correlation with the *Lejopyge laevigata* Zone of North Greenland and the *Cedaria* Zone of the Rocky Mountains (Westrop, 1992). Westrop (1992) defined loosely three trilobite-lithofacies associations from this fauna. *Arapahoa raymondi* occurs as the only species in parted limestone host, *Kingstonia-Terranovella* were found within a thrombolitic boundstone, and *Coosella-Coosina-Talbotina* association was hosted by bio-intraclastic packstones.

The fauna collected in the anticlines, are hosted by skeletal-intraclastic and oölitic grainstone, packstone and rudstone and the only fossil found in ribbon and parted limestone is an inarticulate brachiopod. Boundstone mounds

were searched but yielded no fauna. No petrography has so far been done to see if there may be a link of faunas and allochem composition. A trilobite fauna collected from the middle limestone member of the Petit Jardin Formation at Goose Arm (Knight and Boyce, 1991) has genera that overlap the Port au Port fauna of Westrop (1992) and the fauna in the anticlines.

The middle fauna is dominated by *Crepicephalus rivus* Kindle, 1948, accompanied by *Arapahoa* sp(p). undet, *Komaspidella* sp. undet. and *Terranovella* sp. undet. The fauna is hosted by beds of intraclastic oölitic grainstone that are associated with other shallow-peritidal lithofacies in strata correlated with the Felix Member and is believed to mark the upper part of the Dresbachian Stage. Westrop (1992) described an Upper Marjuman faunal assemblage of *Crepicephalus rivus* Kindle, 1948⁹, *Komaspidella* sp. cf. *K. laevis* Rasetti, 1961 and *Terranovella dorsalis* (Hall, 1863), which he called the *Terranovella dorsalis* Fauna from the upper half of the Felix Member. At Goose Arm *Crepicephalus rivus* Kindle, 1948 – together with *Kingstonia* sp. undet. and *Tricrepicephalus texanus* (Shumard, 1861) – occur in a single limestone horizon within the thick upper dolostone member of the formation (Knight and Boyce, 1991). This probably correlates with the *Terranovella dorsalis* fauna of the Felix Member.

Westrop (1992, page 232, Figure 5) indicated the presence of *Dytremacephalus strictus* Rasetti, 1965 high in the Felix Member. According to Rasetti (1965, page 36, Figure 1), the species is restricted to the middle *Aphelaspis* Zone of northeastern Tennessee. However, it has not been found in the anticlines.

The uppermost fauna recovered from the anticlines consists of Franconian trilobites led by *Elvinia roemeri* (Shumard, 1861)?, *Irvingella major* Ulrich and Resser, 1924 and *Sulcocephalus* sp. undet. This fauna is best correlated with the uppermost *Elvinia* Zone (*Irvingella major* Subzone), i.e., basal Sunwaptan Stage (see Westrop, 1986, page 14. Text-figure 21; page 15, Text - figure 22) and is placed in the Man O' War Member. It is found within a grainstone-arborescent stromatolite facies association together with ostracodes and inarticulate brachiopods. It lies within a few 10's of metres of the base of a thick dolostone sequence, traditionally placed in the Berry Head Formation. On the Port au Port Peninsula, however, Chow and James (1987a) showed the *Elvinia* fauna in the lower part of the Man O' War Member and *Taenicephalus* marking the uppermost beds of the member. This same fauna, according to Cowan and James (1993) indicates the base of the Berry Head Formation.

⁹ *Crepicephalus* sp. cf. *C. iowensis* (Owen, 1852) of Westrop (1992, pages 236-238; Figures 12.3, 12.4, 12.9)

BERRY HEAD FORMATION

Poverty of fossils in the Berry Head Formation is its bane. However, low in the upper member, a sparse trilobite fauna correlated with the *Saukia* Zone has been recovered in the Philips Brook Anticline. It comprises *Calvinella tenuisculpta* Walcott, 1914, *Plethopeltis armatus* (Billings, 1860) and *Stenopilus* sp. undet. This Trempealeauan/Sunwaptan fauna is also found low in the member at Goose Arm (Boyce in Wilkinson, 1983; Knight and Boyce, 1991, page 146, Figure 3). There, the fauna is richer and more diverse, found in more than one horizon, and consists of *Calvinella? tenuisculpta* Walcott, 1914, *Heterocaryon* sp. undet., *Leiocoryphe* sp. undet., *Peracheilus spinosus* (Rasetti, 1945), *Plethopeltis* spp. *Stenopilus longispinus* (Rasetti, 1963), and *Stenopilus* sp. cf. *S. pronus* Raymond, 1924. The Goose Arm and Phillips Brook Anticline faunas correlate with the latest Sunwaptan *Keithia schucherti* Fauna of Ludvigsen *et al.* (1989) in the Cow Head Group, correlative with the Trempealeauan *Saukia* Zone. The study of the upper member in Goose Arm also recorded faunas of the *Mississquoia* and *Symphysurina* subzones (Knight and Boyce, 1991) but neither fauna has so far been found in the anticlines.

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APPENDIX 1: Phillips Brook Anticline Faunas

Unless otherwise indicated, the datum for the fossil sites is NAD27 and the UTM Zone is 21. Samples with 2005F numbers were not examined until January, 2005.

Port au Port Group Berry Head Formation

P19 = 2005F005 (K-2004-003)

Plethopeltis Zone. 397754E, 5401606N, 301 m.

Mollusca–Gastropoda

Gen. et sp. undet. – cross-sections

P18 = 2004F074 (K-2004-057A₂)

Plethopeltis Zone. Boundstone and intraclastic grainstone. 397758E, 5401526N, 351 m. Probably close to or equivalent to 2005 (K-2004-002A).

Arthropoda–Trilobita

Gen. et sp. undet.

Stenopilus sp. undet. – cranidium

P18 = 2005F004 (K-2004-002A)

Plethopeltis Zone. 397753E, 5401540N, 361 m. Probably recollected at the end of the 2004 field season as 2004F074 (K-2004-057A₂).

Arthropoda–Trilobita

Calvinella tenuisculpta Walcott, 1914 – cranidium (+), librigena(+), and pygidium (-)

Plethopeltis armatus (Billings, 1860) – pygidium (-)

ptychopariid gen. et sp(p). undet. – librigenae (+, -)

P18 = 2004F073 (K-2004-057A₁)

Plethopeltis Zone. Interbedded boundstone and skeletal intraclastic packstone/wackestone. 397743E, 5401522N, 353 m. Probably close to or equivalent to 2005F2003 (K-2004-002).

Arthropoda–Trilobita

Gen. et sp. undet.

Stenopilus sp. undet. – cranidium

P18 = 2005F003 (K-2004-002)

Plethopeltis Zone. Lime mudstone/wackestone. 397747E, 5401525N, 358 m. Probably recollected at the end of the field season as 2004F073 (K-2004-057A₁).

Arthropoda–Trilobita

Stenopilus sp. undet. – convex cross-sections

Petit Jardin Formation Man O' War Member

P17 = 2004F070 (K-2004-045B)

Elvinia Zone (*Irvingella major* Subzone). Stromatolitic boundstone mounds associated with ribbon limestone, oölitic grainstone, intraclastic edgewise rudstone, dololaminite, argillaceous dololaminite, shales. 390779E, 5386033N, 405 m.

Arthropoda–Ostracoda

Gen. et sp. undet.

Arthropoda–Trilobita

Elvinia roemeri (Shumard, 1861)? - incomplete cranidium (+, -)

Gen. et sp. undet.

Irvingella major Ulrich and Resser, 1924 – cranidium (+, -)

Sulcocephalus sp. undet. – cranidia (+, -)

Brachiopoda–Inarticulata

Gen. et sp. undet.

Felix Member

P16 = 2004F067 (K-2004-041B₁)

Crepicephalus rivus Zone. Lumpy looking lime mudstone rich in skeletal remains. 391466E, 5387006N, 373 m.

Arthropoda–Trilobita

Arapahoia sp. undet. – cranidium (-)

Crepicephalus rivus Kindle, 1948 – cranidia, pygidia (+, -)

Terranovella – 2 cranidia (+)

P16 = 2004F066 (K-2004-041B)

Crepicephalus rivus Zone. Intraclastic, skeletal oölitic grainstone. 391466E, 5387006N, 373 m.

Arthropoda–Trilobita

Crepicephalus rivus Kindle, 1948

Brachiopoda–Inarticulata

Gen. et sp. undet.

P15 = 1999F109 (K-1999-025H₂)

Crepicephalus rivus Zone. Timber landing. Intraclastic oölitic lime grainstone. 398550E, 5399700N.

Arthropoda–Trilobita

Crepicephalus rivus Kindle, 1948 – pygidium (+)

Coosina kindlei Westrop, 1992 – pygidium

P14 = 1999F108 (K-1999-025H₁)

Crepicephalus rivus Zone. Lime wackestone? 398250E, 5399700N.

Arthropoda–Trilobita

Gen. et sp. undet. – fragments

Big Cove Member

P13 = 1999F100 (K-1999-025E)

Arapahoia raymondi Zone. Dolomitic lime mudstone/wackestone. 397150E, 5400000N.

Arthropoda–Trilobita

Gen. et sp. undet. – small, convex

P13 = 1999F054A to 1999F054D (K-1999-025E?)

Arapahoia raymondi Zone. Loose blocks in abandoned quarry. Lime packstone/grainstone.

Arthropoda–Trilobita

Talbotina / *Welleraspis* sp.

P12 = 1999F107A to 1999F107D (K-1999-025D₂)

Arapahoia raymondi Zone. Pyritiferous intraclastic skeletal lime packstone, dolomitic lime mudstone and intraclastic lime packstone. 396688E, 5399843N, 378 m.

Arthropoda–Trilobita (in lime packstone)

Gen. et sp. undet. – librigena (+)

Talbotina sp. undet. – pygidium (+)

Brachiopoda–Inarticulata (in lime mudstone)

Gen. et sp. undet.

P11 = 1999F104A (K-1999-025C_x)

Intraclastic lime packstone/grainstone. 396625E, 5399475N.

Brachiopoda–Inarticulata

Gen. et sp. undet.

P11 = 1999F104 (K-1999-025C₄)

Lime wackestone? 396625E, 5399475N.

Arthropoda–Trilobita

Gen. et sp. undet. – fragment

P10 = Section K-1999-003J

391575E, 5393725N.

P10-004 = 1999F036

Laminated red/purple shale.

Brachiopoda—Inarticulata

Gen. et sp(p). undet. — comminuted debris

P10-003 = 1999F035

Green shale.

Brachiopoda—Inarticulata

Gen. et sp. undet.

P10-002 = 1999F034B

Outcrop. Ribbon limestone and shale.

Brachiopoda—Inarticulata

?*Lingulella* sp. undet.

P10-001 = 1999F034A

Loose block.

Arthropoda—Trilobita

Gen. et sp. undet. — possible free cheek

**Port au Port Group
Berry Head Formation**

P09 = 1999F005 (K-1999-003Q₁)

Plethopeltis Zone. Tributary of Romaines Brook. Small gully along a skidder trail. 391230E, 5393400N.

Mollusca–Gastropoda

Sinuopea - see Rohr *et al.* (2000, page 245, Plate 2)

P09 = Section K-1999-003M

Petit Jardin Formation

Felix Member

P09-013B = 1999F103B (K-1999-003M-006B)

Crepicephalus rivus Zone. Oölitic lime grainstone. 391075E, 5393315N.

Arthropoda–Trilobita

Gen. et sp(p). undet. – cross-sections, fragments

P09-013A = 1999F103A (K-1999-003M-006A)

Crepicephalus rivus Zone. Oölitic lime grainstone. 391075E, 5393315N.

Arthropoda–Trilobita

Crepicephalus rivus Kindle, 1948 – pygidial doublure

P09-013 = 1999F103

Crepicephalus rivus Zone. Large block of oölitic lime grainstone. 391075E, 5393315N.

Arthropoda–Trilobita

Gen. et sp(p). undet. – fragments

P09-012 = 1999F102

Crepicephalus rivus Zone. 391075E, 5393315N.

Arthropoda–Trilobita

Gen. et sp. undet.

P09-011A = 1999F101(FLOAT)

Crepicephalus rivus Zone. Oölitic lime grainstone. 391075E, 5393315N.

Arthropoda–Trilobita

Gen. et sp(p). undet.

P09-011 = 1999F101

Crepicephalus rivus Zone. Oölitic lime grainstone. 391075E, 5393315N.

Arthropoda–Trilobita

Crepicephalus rivus Kindle, 1948

Terranovella sp.

Big Cove Member

P09-010A = 1999F043

Loose block. Lime packstone/grainstone. 391125E, 5393275N.

Arthropoda–Trilobita

Gen. et spp. undet.

P09-010 = 1999F042 (K-1999-003M-P)

Lime packstone/grainstone. 391125E, 5393275N. Stratigraphically above 1999F041A.

Arthropoda–Trilobita
Gen. et spp. undet.

P09-009 = 1999F041A

Intraclastic, skeletal and laminated lime packstone/grainstone. 391125E, 5393275N. Immediately stratigraphically above 1999F041, below 1999F042.

Arthropoda–Trilobita
Gen. et spp. undet.

P09-008 = 1999F041

Lime packstone/grainstone. 391125E, 5393275N. Stratigraphically above 1999F040, immediately below 1999F041A.

Arthropoda–Trilobita
Gen. et spp. undet.

P09-007 = 1999F040

Lime packstone/grainstone. 391125E, 5393275N. Stratigraphically above 1999F061, below 1999F041.

Arthropoda–Trilobita
Gen. et spp. undet.

P09-006 = 1999F061

Lime packstone/grainstone. 391125E, 5393275N. Stratigraphically above 1999F060, below 1999F040.

Arthropoda–Trilobita
Gen. et sp(p). undet.

P09-005 = 1999F060

Arapahoia raymondi Zone. Lens of intraclastic, skeletal lime packstone/grainstone. 391125E, 5393275N. Stratigraphically above 1999F059, below 1999F061.

Arthropoda–Trilobita
Arapahoia raymondi Lochman, 1938b

P09-005 = 1999F044

Arapahoia raymondi Zone. Subcrop?, probably equivalent to 1999F060. Lime packstone/grainstone. 391125E, 5393275N.

Arthropoda–Trilobita
Gen. et spp. undet.

P09-004 = 1999F059

Arapahoia raymondi Zone. Skeletal lime rudstone. 391125E, 5393275N. Stratigraphically above 1999F007A, below 1999F060.

Arthropoda–Trilobita
Arapahoia raymondi Lochman, 1938b

P09-003A = 1999F007B

Arapahoia raymondi Zone. Loose blocks. Intraclastic, skeletal lime packstone/grainstone. 391200E, 5393225N.

Arthropoda–Trilobita

Arapahoia raymondi Lochman, 1938b

P09-003 = 1999F007A (K-1999-003M-A)

Arapahoia raymondi Zone. Outcrop. Intraclastic, skeletal lime packstone/grainstone. 391200E, 5393225N. Stratigraphically above 1999F038A (and its lateral equivalent, 1999F006), below 1999F059.

Arthropoda–Trilobita

Arapahoia raymondi Lochman, 1938b¹⁰

Gen. et sp(p). undet.

P09-002B = 1999F039

Arapahoia raymondi Zone. Loose block. Intraclastic, skeletal lime packstone/grainstone. 391125E, 5393275N.

Arthropoda–Trilobita

Arapahoia raymondi Lochman, 1938b

P09-002A = 1999F038B

Arapahoia raymondi Zone. Loose block, from 1999F037A or 1999F007A. Intraclastic, skeletal lime packstone/grainstone. 391125E, 5393275N.

Arthropoda–Trilobita

Arapahoia raymondi Lochman, 1938b

P09-002 = 1999F038A

Arapahoia raymondi Zone. Outcrop. Intraclastic, skeletal lime packstone/grainstone. Stratigraphically above 1999F037A, below 1999F007A. 391125E, 5393275N. Lateral equivalent of 1999F006.

Arthropoda–Trilobita

Arapahoia raymondi Lochman, 1938b

P09-002 = 1999F006 (K-1999-003M-A₁)

Arapahoia raymondi Zone. Outcrop. Intraclastic, skeletal lime packstone/grainstone. 391125E, 5399391N, 366 m. Lateral equivalent of 1999F038A.

Arthropoda–Trilobita

Arapahoia raymondi Lochman, 1938b

P09-001A = 1999F037B

Arapahoia raymondi Zone. Subcrop/loose block. Intraclastic, skeletal lime packstone/grainstone. 391125E, 5393275N.

Arthropoda–Trilobita

Arapahoia raymondi Lochman, 1938b

P09-001 = 1999F037A

Arapahoia raymondi Zone. Outcrop. Intraclastic, skeletal lime packstone/grainstone. 391125E, 5393275N. Stratigraphically below 1999F038A (and its lateral equivalent, 1999F006).

Arthropoda–Trilobita

Arapahoia raymondi Lochman, 1938b

¹⁰ Originally identified as ?*Lonchocephalus* - Boyce (unpublished, 1999)

**Port au Port Group
Petit Jardin Formation
Man O' War Member**

P08 = 2004F063 (K-2004-035G)

Base of columnar stromatolite in large, loose boulder. 389553E, 5392081N, 269 m.

Arthropoda–Trilobita
Gen. et sp(p). undet.

P07 = 2004F062 (K-2004-035E)

Rare oölitic lime grainstone- in intraclastic lime rudstone. 389900E, 5391777N, 264 m.

Arthropoda–Trilobita
Gen. et sp(p). undet.

Felix Member

P06 = 2004F061 (K-2004-035D)

Oölitic grainstone. Top of bed. 389806E, 5391829N, 286 or 290 m.

Arthropoda–Trilobita
Gen. et sp(p). undet.

P05 = 2004F060 (K-2004-034E)

Crepicephalus rivus Zone. Top of oölitic grainstone. 390343E, 5391673N, 283 m. Possible repeat of lower Petit Jardin Formation.

Arthropoda–Trilobita
Crepicephalus rivus Kindle, 1948 – librigena (+, -)
Terranovella – 2 cranidia (+), pygidium (+)

Big Cove Member

P04 = 2004F059 (K-2004-034D)

Arapahoia raymondi Zone. Probable equivalent of Section K-1999-003M11. In top 60 cm of bioturbated stylobedded wacke-stone/packstone. 390390E, 5391685N.

Arthropoda–Trilobita
Arapahoia raymondi Lochman, 1938b? – cranidium (+), librigena (+)
Brachiopoda–Inarticulata
Gen. et sp. undet. – tiny

Campbells Member

P03 = 2004F058 (K-2004-034B)

Domal stromatolite and oncolitic-oölitic-intraclastic grainstone/rudstone plus dololaminite. 390507E, 5391692N, 307 m.

Arthropoda–Trilobita
Gen. et sp. undet. – two very good cranidia (+)

March Point Formation

P01 = 2004F068 (K-2004-041D)

Oölitic grainstone and bioturbated limestone. 391925E, 5387045N, 410 m.

Arthropoda–Trilobita

Gen. et sp. undet. – cranidium (+), pygidium (+)

P02 = 2004F050 (K-2004-025F)

Oncolitic oölitic limestone. 390628E, 5391635N, 292 m.

Arthropoda–Trilobita?

Gen. et sp(p). undet.

P02 = 2005F017 (K-2004-024E)

Dolomitic lime mudstone and cross-laminated dolomitic lime packstone. 391749E, 5392805N, 392 m.

Arthropoda–Trilobita

ptychopariid en. et sp. undet. – cranidia (-), librigenae (+, -) thoraxes (+), pygidium (+)

P02 = 2004F050 (K-2004-024D)

Oölitic? limestone. 391752E, 5392849N, 422 m.

Arthropoda–Trilobita?

Gen. et sp(p). undet.

APPENDIX 2: North Brook Anticline Faunas

Unless otherwise indicated the datum for the fossil sites is NAD27 and the UTM Zone is 21.

Port au Port Group Petit Jardin Formation Felix Member

N07 = 2002F024 (K-2002-032F)

Crepicephalus rivus Zone. Roberts Brook, Trilobite-rich, skeletal oölitic grainstone, very coarse concentric-radial oöids. 39726E, 5387684N, 271 m.

Arthropoda–Trilobita

?*Komaspidella* sp. undet. – pygidia (+, -)

N06 = K-2002-032

Crepicephalus rivus Zone. 399457E, 5388280N. 186 m. No data.

N05 = 2002F011 (K-2002-018B₁)

Crepicephalus rivus Zone. Old road. Intraclastic-oölitic grainstone and edwise conglomerate. Trilobites occur in grainstone; inarticulate and possibly articulate brachiopods in conglomerate. 402200E, 5394600N, 299 m.

Arthropoda–Trilobita

Terranovella sp. undet. – cranidia (+, -), pygidia (+, -)

Brachiopoda–Inarticulata

Gen. et sp. undet.

Big Cove Member

N04 = 2002F010 (K-2002-018B)

Arapahoia raymondi Zone. Old road. Intraclastic-oölitic-skeletal packstone interbedded with oölitic limestone and overlain by stromatolitic limestone. 402317E, 5394462N, 293 m.

Arthropoda–Trilobita

?*Kingstonia* sp. undet. – cranidia (+, -), pygidium (+)

N03 = 2002F023B (K-2002-029A₄)

Arapahoia raymondi Zone. Old road north of Gallants. Skeletal grainstone intercalated at base of an oncolitic intraclastic oölitic grainstone that overlies ribbon limestone with edgewise conglomerate. 408675E, 5396550N.

Arthropoda–Trilobita

ptychopariid gen. et. sp. undet. - librigenae (+, -)

Brachiopoda–Inarticulata

Gen. et sp. undet. (+, -)

N03 = 2002F023A (K-2002-029A)

Arapahoia raymondi Zone. Old road north of Gallants. Skeletal grainstone intercalated at base of an oncolitic intraclastic oölitic grainstone that overlies ribbon limestone with edgewise conglomerate. 408675E, 5396550N.

Arthropoda–Trilobita

Arapahoia raymondi Lochman, 1938b – librigenae (+, -)

?*Kingstonia* sp. undet. – cranidia (+, -)

N02 = 2002F021 (K-2002-027B)

Arapahoia raymondi Zone. Gallants - Don's Brook. Thinly bedded coarse grained siltstone and black shale with some black limestone. 407497E, 5392126N, 261 m.

Arthropoda–Trilobita

Blountia sp. undet. – cranidium (+), pygidia (+, -)

?*Kingstonia* sp. undet. – cranidium (+, -)

Brachiopoda–Inarticulata

Gen. et sp. undet. (+)

Cape Ann Member

N01 = 2002F022 (K-2002-027F₈)

Harry's River, southwest of Gallants. Dark brown-weathering, dark grey mudstone with lumpy lenses and beds of intraclastic and skeletal wackestone and packstone. 408517E, 5393116N. Very base of Petit Jardin Formation, above exposed March Point Formation.

Arthropoda–Trilobita

ptychopariid gen. et sp. undet. – librigenae (+, -), pygidium (-)

Brachiopoda–Inarticulata

Gen. et sp. undet. (+)