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NEW STRUCTURAL OBSERVATIONS ON THE SOUTHERN BURIN PENINSULA, AVALON ZONE, NEWFOUNDLAND

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ABSTRACT

New bedrock mapping of the southern Burin Peninsula was initiated as part of a multi-year regional mapping project following the recent data acquisition of a high-resolution airborne magnetic radiometric and VLF-EM survey. The area has long been known for its fluorspar deposits, but also has significant potential for high- and low-sulphidation epithermal- and porphyry-related mineralization systems. Previous work has also outlined moderate potential for silica, uranium and rare-earth elements. The first year of bedrock mapping focused on the collection of lithogeochemistry samples of all igneous units in the area, as well as investigations of regional deformation, particularly within the latest Neoproterozoic to lower Paleozoic cover sequence. Across the southern Burin Peninsula, the structural grain is consistent with south- to southeast-directed thrust imbrication post-Cambrian times but before the intrusion of the undeformed Upper Devonian St. Lawrence Granite. Evidence of this deformation includes south- to southeast-directed thrust faults associated with asymmetric folds, slickenlines, repetition of section and overturned beds. A subsequent deformation event is interpreted based on crosscutting thrust faults and local deformation (drag-folding and crosscutting by faults) of the regionally developed penetrative cleavage. Near Burin Inlet, early south-directed thrust faults are truncated by a southeast-directed thrust fault indicating that a south-directed convergent D1 event was followed by a southwest-directed convergent D2 event. Tectonic excision of substantial strata is locally evident across the southern Burin Peninsula. New observations presented here raise the possibility that the Precambrian–Cambrian boundary may also occur at other localities in addition to the Global Boundary Stratotype Section and Point at Fortune Head, owing to implied repetition of section as a result of thrust imbrication.

INTRODUCTION

A new bedrock mapping project on the southern Burin Peninsula (referred to herein as South Burin; *see* Figures 1 and 2 for areal extent) was initiated in 2023 following the release of the recent high-resolution airborne magnetic, radiometric and VLF-EM survey data of the Burin Peninsula (Kilfoil, 2022). Previous regional bedrock mapping in the area (Figure 1) includes works by van Alstine (1948; 1:63 360 scale), Walthier (1948; 1:63 360 scale), O'Brien *et al.* (1977; 1:50 000 scale), and Strong *et al.* (1976, 1978; 1:50 000 scale). Bedrock mapping was also carried out by Williamson (1956; 1:19 200 scale) as part of his investigation into fluorspar mineralization around St. Lawrence, and by Bartlett (1967; 1:12 000 scale) as part of a silica-resource assessment focused on the Random Formation in the western part of South Burin. Each of the previously mentioned regional works also includes brief descriptions of the structural geology, and a schematic tectonic reconstruction was proposed by Strong *et al.* (1978).

Previously, South Burin was interpreted as having been affected by at least one Precambrian and one post-Cambrian orogenic event (van Alstine, 1948). Greene (1974) indicated that the western structure bounding the Cambrian basin south of Mortier Bay (Figure 2) is a thrust fault that carried rocks of the Precambrian Marystown Group to the southeast, over the younger Cambrian units. Strong *et al.* (1978) corroborated Greene's (1974) interpretation and described northeast-striking, northwest-dipping thrust faults within, and bounding, the Cambrian blocks (Figure 2), as well as a penetrative cleavage in parts of the Marystown Group parallel to these structures. These elements are all consistent with southeast-directed thrusting interpreted to have occurred after the Cambrian and before the intrusion of the undeformed, Upper Devonian (377–374 Ma; Kerr *et al.*, 1993; Magyarosi *et al.*, 2019) St. Lawrence Granite (Strong *et al.*, 1976, 1978), possibly related to Siluro-Devonian (Acadian) orogenesis (Strong *et al.*, 1978).

This report provides a review of the stratigraphic framework for the latest Neoproterozoic to lower Paleozoic cover sequence of South Burin, focusing on the varying levels of confidence in (bio- and litho-) stratigraphic constraints across the area, and highlights where further work might improve our current understanding of the geological evolu-

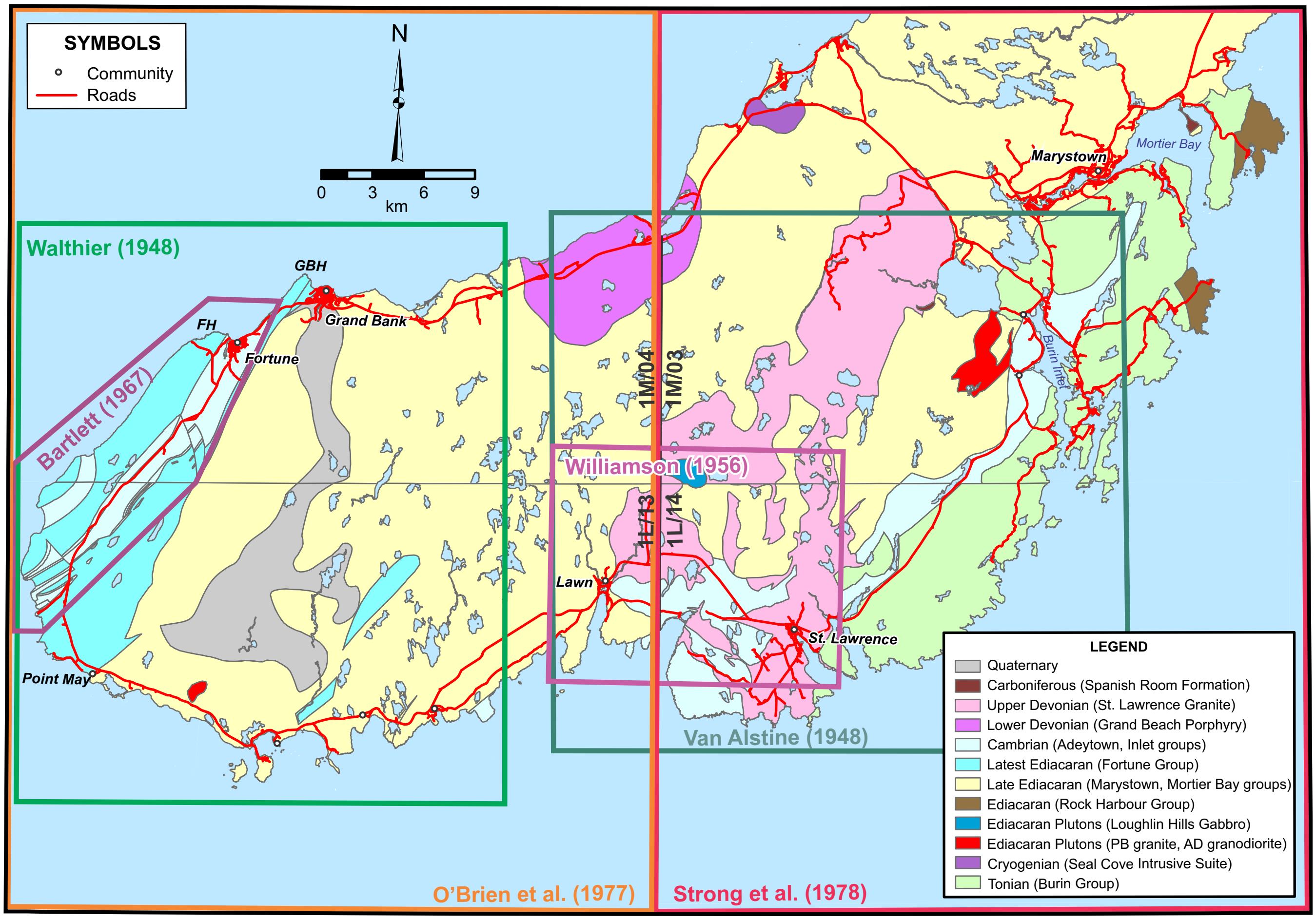


Figure 1. *Index map for previous bedrock mapping in the South Burin area. PB=Peter's Brook granite; AD=Anchor Drogue granodiorite.*

tion. In addition, initial structural interpretations are proposed, as well as suggested avenues for future work to address specific knowledge gaps.

REGIONAL GEOLOGY

South Burin is part of the western Avalon Zone in Newfoundland and is underlain by mainly Neoproterozoic volcanosedimentary sequences that are covered by Avalonia's defining terminal Ediacaran to Ordovician overstep sequence (O'Brien *et al.*, 1990; Landing, 1996; Murphy *et al.*, 2023; Figure 2). The oldest rocks in the area are the primarily mafic volcanic >763 Ma Burin Group (Strong *et al.*, 1978; Krogh *et al.*, 1988; Murphy *et al.*, 2008). Murphy *et al.* (2008) interpreted these as remnants of an intra-oceanic arc that formed within an ocean surrounding Rodinia. The dominantly bimodal volcanic rocks of the Marystown Group occur to the west of the fault-bounded Burin Group and have yielded ages between *ca.* 585 and 574 Ma (Sparkes and Dunning, 2014; Sparkes *et al.*, 2016; Ferguson, 2017). The Marystown Group has been subdivided into six formations in the east (Strong *et al.*, 1978) and six different formations in the west (O'Brien *et al.*, 1977). This group passes upward (to the west) from volcanic flows and pyroclastic rocks to a mixture of pyroclastic rocks and volcanoclastic sediments that are disconformably overlain by the aforementioned terminal Ediacaran to Cambrian (no Ordovician rocks are known on the Burin Peninsula) cover sequence (O'Brien *et al.*, 1977), now collectively called the Dantzic Supergroup (Fletcher, 2006).

CAMBRIAN STRATIGRAPHY AND NOMENCLATURE

The Cambrian stratigraphy of the Avalon Zone in Newfoundland was established by Hutchinson (1962), based primarily on faunal assemblages. The stratigraphic framework and nomenclature have been successively revised over the past 60+ years (*see* Fletcher, 2006 and Landing *et al.*, 2017 for historical summaries), and are briefly reviewed below. Cambrian units in Newfoundland are complex because of discontinuous sedimentation, lateral facies tran-

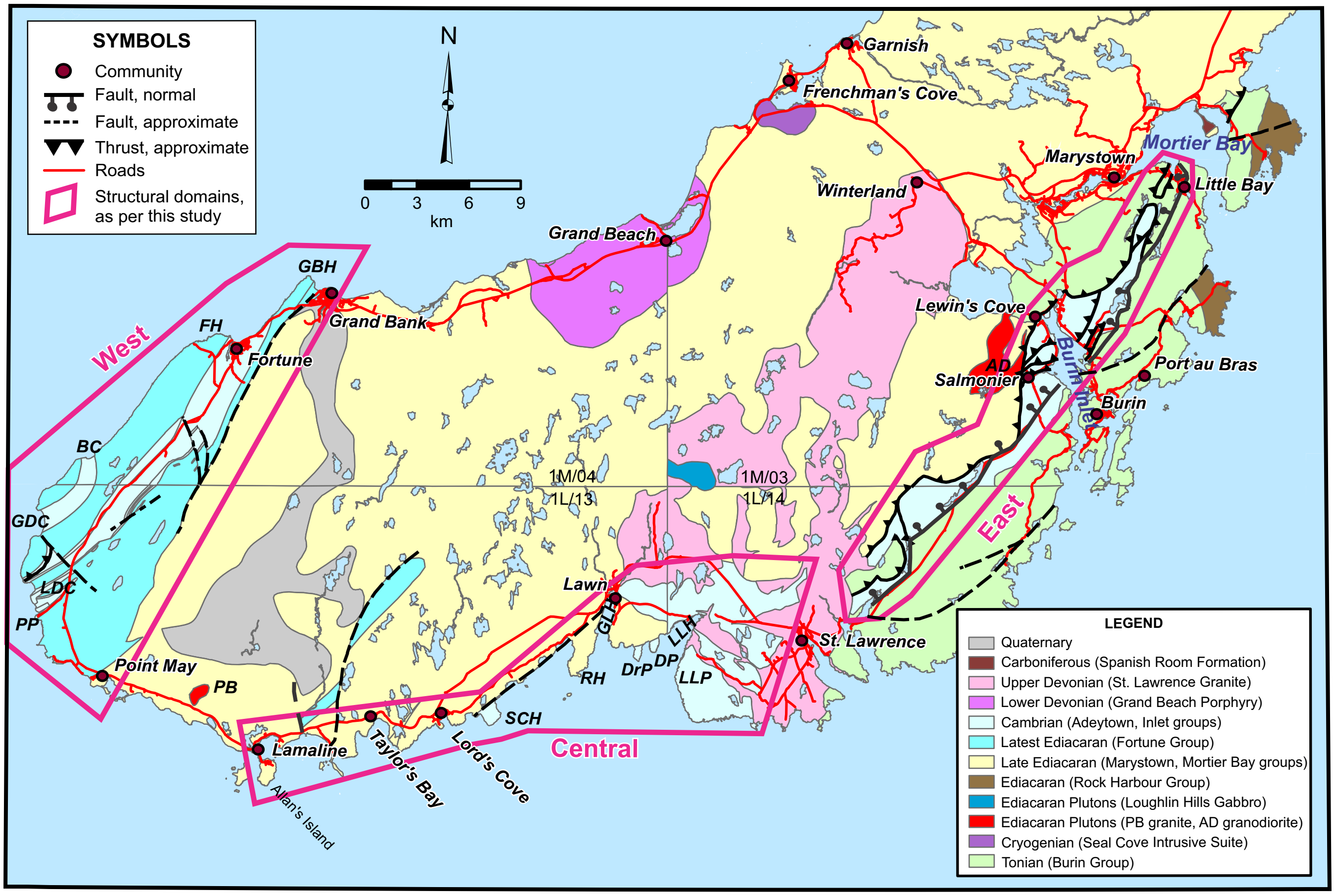


Figure 2. *Simplified bedrock geology map of the South Burin area (modified from O'Brien* et al.*, 1977 and Strong* et al.*, 1978), showing the West, Central and East structural domains, as well as communities and geographic locations referred to in the text. AD=Anchor Drogue granodiorite, BC=Beach Cove, DP=Duck Point, DrP=Drunkard's Point, FH=Fortune Head, GBH=Grand Bank Head, GDC=Great Dantzic Cove, GLH=Great Lawn Harbour, LDC=Little Dantzic Cove, LLH=Little Lawn Harbour, LLP=Little Lawn Point, PB=Peter's Brook granite, PP=Pieduck Point, RH=Ragged Head, SCH=Sand Cove Head.*

sitions, discordances, paraconformities and post-depositional, redox-related colour changes (*e.g.*, Bengston and Fletcher, 1983; Normore, 2010; Álvaro, 2021). In particular, the stratigraphic position and degree of diachroneity of the Random Formation (variably referred to Precambrian, Eocambrian and Cambrian by previous workers) has long been controversial (Hutchinson, 1962; Greene and Williams, 1974; Butler and Greene, 1976; Anderson, 1981; Bengston and Fletcher, 1983). Bengston and Fletcher (1983; *see* Fletcher, 2006) proposed that deposition of the Random Formation was restricted to the Terreneuvian (earliest Cambrian; Tommotian Siberian Stage; *cf.* Greene and Williams, 1974), based on the presence of the Aldanella attleborensis assemblage in the units bounding the Random Formation at several locations across the Avalon Zone. Its variable thickness, and locally its absence, such as in the central and eastern parts of South Burin (Bengston and Fletcher, 1983), may be the result of erosion after deposition of the Random Formation (Hiscott, 1982). However, the stratigraphy of these isolated outliers would likely differ from each other and elsewhere if they are remnants of separate basins with differing basements and depositional histories. Stratigraphic details, including basin analysis with control on unit thicknesses to allow for correlation across South Burin, are lacking.

The stratigraphic nomenclature for the cover sequence in western South Burin differs from that used in central and eastern South Burin (*see* below). This is largely owing to the level of biostratigraphic constraints, in select localities (*e.g.*, Fortune Head, Great Dantzic Cove), permitting correlation of units on western South Burin with units elsewhere in the

Avalon Zone (*e.g.*, Landing, 1996; Landing and Westrop, 1998; Landing *et al.*, 2017). However, if such correlation is attempted in the absence of such constraints (*e.g.*, based on lithostratigraphy alone), then an oversimplified and erroneous picture may emerge. For this reason, we follow a cautious approach and apply regional stratigraphic nomenclature to western South Burin, where such correlations based on faunal content have been previously applied (*e.g.*, Hutchinson, 1962), and use the local framework of Strong *et al.* (1978) for central and eastern South Burin (*see* also Bengston and Fletcher, 1983), where such detailed research is currently lacking.

LATEST EDIACARAN TO MIAOLINGIAN COVER SEQUENCE: THE DANTZIC SUPERGROUP

The Dantzic Supergroup (Fletcher, 2006), named after Great and Little Dantzic coves on western South Burin, is divided into a lower Fortune Group and an upper Adeyton Group (Fletcher, 2006; redefined from Jenness, 1963; Figure 3). The former includes a lower Rencontre Formation (White, 1939; Williams, 1971; Smith and Hiscott, 1984; Doten Cove Formation of Hutchinson, 1962 and Bengston and Fletcher, 1983) and an upper Chapel Island Formation (Widmer, 1950; *see* also O'Brien *et al.*, 1977; Smith and Hiscott, 1984; Crimes and Anderson, 1985; Narbonne *et al.*, 1987; Myrow and Hiscott, 1993). The Rencontre Formation, >600 m in thickness (Hutchinson, 1962 and references therein), comprises terrestrial to shallow-marine conglomerate, sandstone and shale (Smith and Hiscott, 1984), is named for an island in northern Fortune Bay, and includes mainly micaceous (muscovite-bearing) sandstone in South Burin, with a thin basal conglomerate that is only locally exposed (O'Brien *et al.*, 1977). It is gradationally and conformably overlain by green, purple and red siltstone, fine sandstone, mudstone and lesser limestone of the Chapel Island Formation (Hutchinson, 1962; Smith and Hiscott, 1984; Bengston and Fletcher, 1983; Myrow and Hiscott, 1993). Significantly, this 900–1000-m thick formation includes the Precambrian–Cambrian Global Boundary Stratotype Section and Point, located at Fortune Head (Bengston and Fletcher, 1983; Crimes and Anderson, 1985; Narbonne *et al.*, 1987; Landing *et al.*, 1989; Myrow and Hiscott, 1993; Landing, 1994). The overlying quartz-rich Random Formation (Walcott, 1900; Hayes, 1948; Christie, 1950; Anderson, 1981; Hiscott, 1982) is now included as the basal unit of the Adeyton Group (Fletcher, 2006). The Adeyton Group (as redefined by Fletcher, 2006, modified from Jenness, 1963) now includes (in ascending order): the Random, Bonavista, Smith Point, Brigus and Chamberlain's Brook formations. All formations of the Adeyton Group are Early Cambrian (Terreneuvian to Cambrian Series 2) in age,

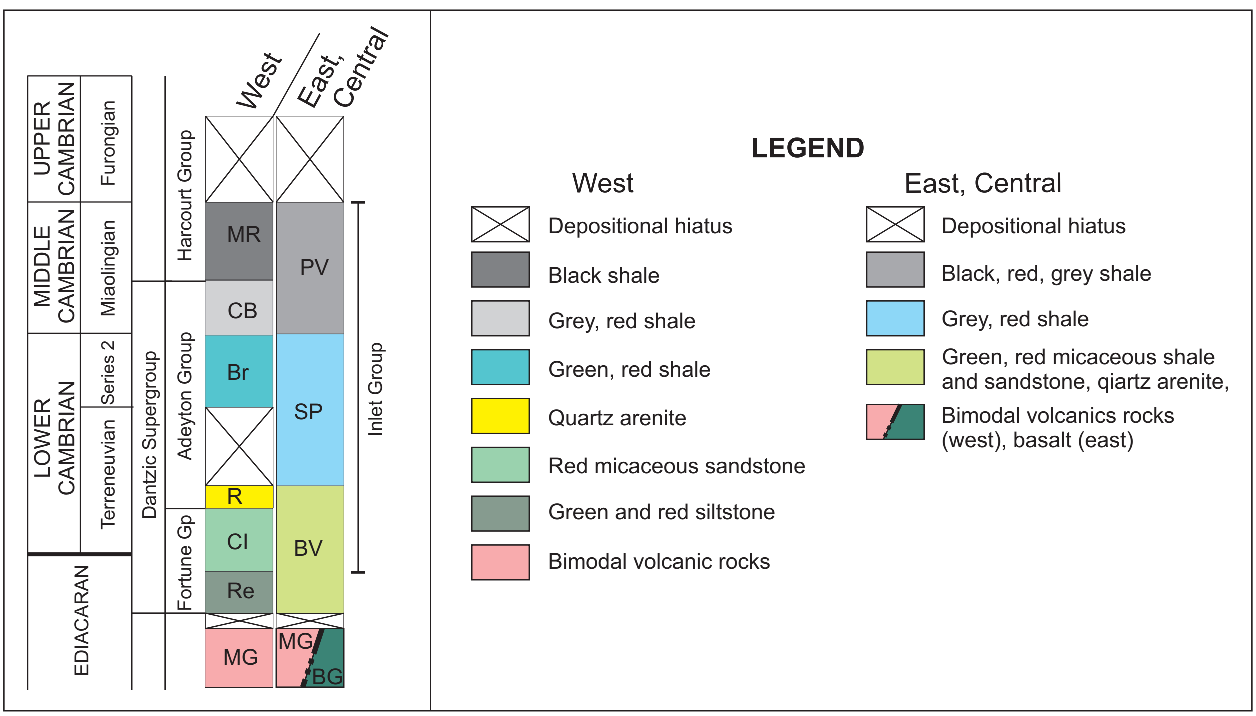


Figure 3. *Generalized stratigraphic column for South Burin area (modified after Strong* et al.*, 1978; Landing* et al.*, 2017; Álvaro, 2021). BG=Burin Group, Br=Brigus Formation, BV=Bay View Formation, CB=Chamberlain's Brook Formation, CI=Chapel Island Formation, MG=Marystown Group, MR=Manuels River Formation, PV=Pleasant View Formation, R=Random Formation, Re=Rencontre Formation, SP=Salt Pond Formation.*

with the exception of the uppermost Chamberlain's Brook Formation, which is Middle Cambrian (Miaolingian; *see* Figure 3; Mills and Álvaro, 2023 and references therein). Shales of the Bonavista and Brigus formations range in colour from green to red, whereas those of the Chamberlain's Brook Formation range from dark grey to red. The Adeyton Group is overlain by the black shale-dominant Harcourt Group, which includes the trilobite-rich Manuels River Formation at its base. The Manuels River Formation is the youngest Cambro-Ordovician formation in the area; no younger formations of the Harcourt Group occur in South Burin (*e.g.*, Hutchinson, 1962; O'Brien *et al.*, 1977; Strong *et al.*, 1978).

WESTERN SOUTH BURIN COVER ROCKS

In the western part of South Burin, the lower units of the cover sequence were correlated with rocks in the northern Fortune Bay area, as, in both areas, the Rencontre Formation is transitional into the overlying Chapel Island, and the upper contact of the latter is sharp but conformable with the overlying Random Formation (Smith and Hiscott, 1984). Elsewhere in Newfoundland's Avalon Zone, the Random Formation is disconformable or unconformable on varying Precambrian units (*e.g.*, Hutchinson, 1953; McCartney, 1967; Jenness, 1963; Anderson, 1981; Hiscott, 1982; Fletcher, 2006). In western South Burin, the Random Formation comprises two quartz-rich members, separated by a siltstone–sandstone member (Bartlett, 1967). A third, upper quartz-rich member, present elsewhere in the Avalon Zone, is absent in western South Burin (Bartlett, 1967; Butler and Greene, 1976). The overlying red and green shale and nodular limestone in western South Burin (*e.g.*, Little Dantzic Cove) are part of the Brigus Formation, based on fossil content (Hutchinson, 1962). A sub-Brigus Formation unconformity and omission of the Bonavista and Smith Point formations is implied (*ibid.*; *see* Figure 3). The Brigus Formation is conformably overlain by Chamberlain's Brook Formation, followed by black shale hosting Paradoxides davidus (Dale, 1927) and Eodiscus punctalus (Potter, 1949) trilobites correlative to the Paradoxides hicksi and Paradoxides davidus zones of the Manuels River Formation of the Harcourt Group on the Avalon Peninsula (*see* also Walthier, 1948 and O'Brien *et al.*, 1977).

CENTRAL AND EASTERN SOUTH BURIN COVER ROCKS

Strong *et al.* (1978) proposed the name Inlet Group for the latest Precambrian to Miaolingian (formerly Middle Cambrian) sedimentary sequence that overlies the Marystown and Burin groups in the central and eastern parts of South Burin (Figures 2 and 3). In ascending order, it comprises the Bay View, Salt Pond and Pleasant View formations. The micaceous, sandy to silty, Bay View Formation, estimated at 600-m thick near its type locality (Strong *et al.*, 1978), is lithologically similar to the Rencontre and Chapel Island formations but contains some quartz arenite beds in its upper part that are similar to those of the Random Formation (*see* also facies descriptions of Hiscott, 1982). The only fossils reported in the Bay View Formation within central and eastern South Burin are worm burrows (endichnia and hypichnia; *see* Strong *et al.*, 1978). The overlying Salt Pond Formation has a maximum thickness of 450 m and comprises various colours of shale, commonly mottled or variegated, and minor limestone nodules and thin beds that increase in thickness and frequency up-section. Its lithology and small shelly fossil content (*see* Bengston and Fletcher (1983) for fossil details at Duck Point) are consistent with parts of the Bonavista, Smith Point and Brigus formations. The Bonavista and Brigus formations are lithologically similar and are distinguished by faunal content, mainly the presence of trilobites in the latter but not the former; the first appearance of trilobites occurs within the intervening Smith Point Formation (Hutchinson, 1962). The red, grey and black shale of the Pleasant View Formation, with a 100 m maximum thickness, contains "Middle Cambrian" (now Miaolingian) trilobites, and is likely correlative with the Chamberlain's Brook and Manuels River formations (Strong *et al.*, 1978).

The Inlet Group in both the central and eastern South Burin areas has not benefitted from the level of paleontological, biostratigraphic, nor lithostratigraphic study as correlative rocks of western Burin and other parts of the Avalon Zone in Newfoundland. Owing to the lack of biostratigraphic constraints and structural complexities, the stratigraphic framework remains poorly constrained for central and eastern Burin. Despite the stronger structural deformation that has affected South Burin's Cambrian units, the rocks here are generally lower metamorphic grade relative to those on the Avalon Peninsula (Hutchinson, 1962), except where they have been contact metamorphosed by intrusions related to the Upper Devonian St. Lawrence Granite (van Alstine, 1948).

The little paleontological work conducted in the area has led to the suggestion that the stratigraphy may differ slightly from that of western Burin. In the St. Lawrence–Lawn area (central South Burin; *see* Figure 2), the Bay View Formation disconformably overlies the Marystown Group (O'Brien *et al.*, 1977). At Duck Point, it includes units recognized as members 1–3 and the lower part of member 4 of the Chapel Island Formation (Bengston and Fletcher, 1983). A stromatolitic unit above Chapel Island member 4 contains a pre-Random Formation faunal assemblage (*ibid.*). The succeeding red, purple and green mudstone and nodules and beds of limestone contain a post-Random Formation, pretrilobitic assemblage similar to that of the Bonavista Formation at Smith Sound, southern Bonavista Peninsula (ibid.). The conclusion is that much of Chapel Island member 4, all of member 5 and the entire Random Formation are missing in the central South Burin area (Bengston and Fletcher, 1983), indicating a depositional hiatus or condensed sequence here (*see* Figure 1 *in* Hiscott, 1982). The sub-trilobitic Bonavista Formation, absent in western South Burin, is present and at least 17 m (50 feet) thick near St. Lawrence and Lawn (Hutchinson, 1962). The salient point is that the Bonavista and Smith Point formations are missing in western South Burin; however, they are both present, at least locally, in central South Burin. Similarly, parts of Chapel Island and possibly all of the Random, present at western South Burin, are missing at central South Burin.

CAMBRIAN GEODYNAMIC MODELS

Fletcher and Greene (2013) proposed an early to mid-Cambrian depositional model that involves the eastward migration of depocentres from the Fortune Bay area to the Avalon Peninsula, based on thicknesses of faunal assemblage-defined units. Landing and Westrop (1998) proposed a similar model and suggested that the distribution, thickness and continuity of the cover sequence, as well as the location and timing of volcanism throughout disparate Avalonian blocks, were largely controlled by contemporaneous transtensional movements. Álvaro (2021) suggested that the onlapping geometries and depositional gaps within the latest Ediacaran to Ordovician units were related to episodic syn-rift movements and thus a cautionary approach to lithological correlation is implied. Murphy *et al.* (2018) suggested that a San Andreas-type transform fault controlled the Ediacaran to Cambrian transition from subduction to extension. These various models highlight some of the stratigraphic complexities of Avalonia's cover sequence, which is further complicated by the poorly understood post-depositional deformational history.

MINERAL POTENTIAL

The South Burin area is known for its fluorspar deposits that have been intermittently mined since 1933 (Magyarosi, 2018). The fluorspar deposits are related to magmatic-hydrothermal veins that are mainly associated with alkaline–peralkaline phases of the Devonian St. Lawrence Granite (*ibid.*). The area was also previously considered for its silica endowment within the quartz-rich sandstone units of the Random Formation (Bartlett, 1967; Butler and Greene, 1976). The precious-metal potential of the South Burin, including high- and low-sulphidation epithermal- and porphyry-related systems, has also been long recognized (*see* reviews by Sparkes, 2012; Sparkes and Dunning, 2014; Sparkes *et al.*, 2016). Preliminary investigations into uranium (Davenport, 1978) and rare-earth elements (Miller, 1994) suggest moderate potential for these commodities as well, likely associated with the younger Devonian igneous events.

METHODOLOGY

Strike and dip measurements are all consistent with right-hand-rule convention, where dip-direction is 90° clockwise from the strike. The software, Stereonet (*see* Allmendinger *et al.*, 2013), was utilized to project primary and deformation structures on equal-area stereonets and to calculate girdles and associated fold axes based on populations of planar structures. Location data were collected using the internal GPS in a Panasonic Toughpad FZ-G1.

NEW STRUCTURAL OBSERVATIONS

Aspects of deformation are variable across South Burin. Deformation in "basement units" (*i.e.*, the Neoproterozoic sequences below the terminal Ediacaran to Middle Cambrian cover sequence), particularly in the Tonian Burin Group, is not everywhere obvious. The group is a submarine mafic volcano-plutonic assemblage that generally lacks a penetrative fabric, as much of its constituent remnants are rheologically rigid relative to the sparse sedimentary rocks with which they are interbedded. Rare instances of rootless folds are preserved in domains between highly attenuated and strongly foliated limbs (Plate 1). These are consistent with the structural transposition of more competent units in a ductile regime. Rocks of the Marystown Group include mainly volcanic products (flows and pyroclastic deposits) which, like the Burin Group, typically lack a regionally developed penetrative fabric. Local high-strain zones do occur within the Marystown Group, and these are generally characterized by strongly schistose fabrics, mainly in rocks having a probable pyroclastic protolith. An excellent example of compressional crenulation cleavage is exposed in a roadcut north of Lord's Cove (Plate 2; *see* Figure 2 for location).

By contrast, the terminal Ediacaran–Cambrian cover sequence exhibits regional but variably developed tectonic deformation features, including a penetrative cleavage and local fold development commonly spatially associated with brittle faults or fault zones. Below, we focus on deformation within rocks of the latest Ediacaran to Miaolingian cover strata. For simplicity, South Burin is subdivided into West, Central and East Burin structural domains for cover sequences occurring in the western, central and eastern parts of South Burin, respectively (Figure 2).

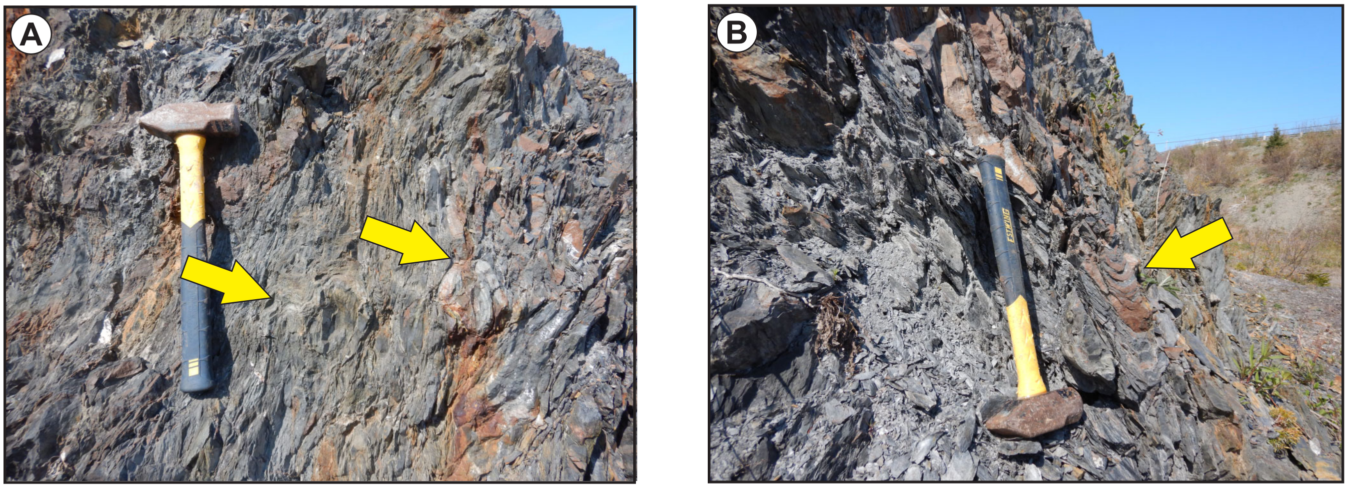


Plate 1. *A) Antiformal; B) synformal rootless folds (yellow arrows) in interbedded sandstone and shale of the Burin Group near Little Bay.*

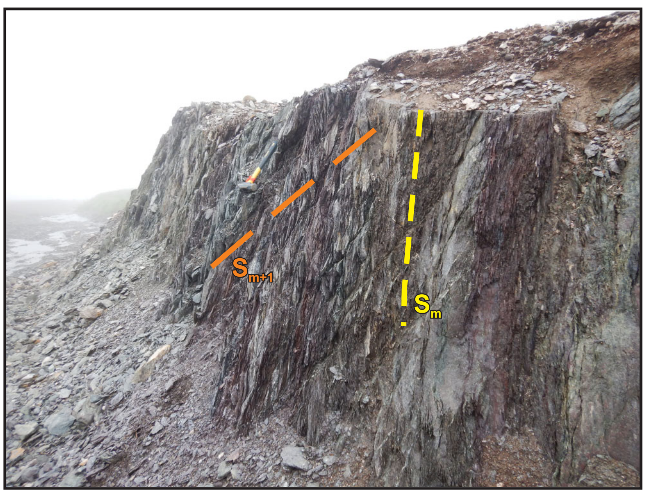


Plate 2. *Compressional crenulation cleavage in schistose mafic pyroclastic rocks of the Marystown Group, from road-cut on the Burin Highway ~1.5 km north of Roundabout (46.93051°N, 55.590442°W). View is to the east; the main cleavage (yellow dashed line), S_m, is oriented 264°/74°; the later crenulation cleavage (orange dashed line), S_{m+1}, is oriented 312°/49°.*

WEST BURIN DOMAIN

Nature and Distribution of Basal Cover Sequence

The base of the Dantzic Supergroup crops out in only a few locations within the West Burin structural domain (Figure 2). Basal conglomerate of the Rencontre Formation, ~7–10 m in thickness, unconformably overlies welded tuff of the Marystown Group on the east side of Admiral's Cove, immediately west of Grand Bank (Potter, 1949; O'Brien *et al.*, 1977; *see* Figure 2 for location). The base of the Rencontre Formation is not exposed on the south side of the peninsula, owing to the modern beach deposits at Point May. O'Brien *et al.* (1977) indicate that the Rencontre Formation disconformably overlies amygdaloidal basalt of the Marystown Group in the section exposed along Salmonier Brook (northeast of Lamaline). Its position above differing lithologies is consistent with a disconformable to unconformable basal contact.

Structural Observations

Shale and sandstone of the Adeyton Group commonly exhibit a variably developed penetrative cleavage. Typically, bedding is shallowly dipping, whereas the cleavage is subvertical (Plate 3A). The cleavage ranges from discrete to spaced (*sensu* Price and Cosgrove, 1990); the latter are evidenced by the occurrence of microlithons, and the cleavage domains are best developed near subtle lateral changes in bedding thickness (Plate 3B). On fold limbs, cleavage is strongly penetrative and incompetent layers are extremely attenuated to absent (Plate 3B, 3C). In plan view, the cleavage is anastomosing in outcrops of sandstone; thus, the original bedding surfaces resemble a series of boudinaged lenses (Plate 3C). In narrow zones where cleavage is well developed, a small component of slip is evident along some cleavage planes, indicating local and incipient fault development (Plate 3D). The complexity of the interplay between bedding, cleavage and fault development is only locally evident at outcrop-scale (*e.g.*, Plate 3D). Transposition of bedding is more common in rocks of higher metamorphic grade, such as in the Burin Group in western South Burin, rather than in lower greenschist facies rocks of West Burin.

Bedding from the West structural domain (Figure 2) strikes most commonly to the southwest and dips to the

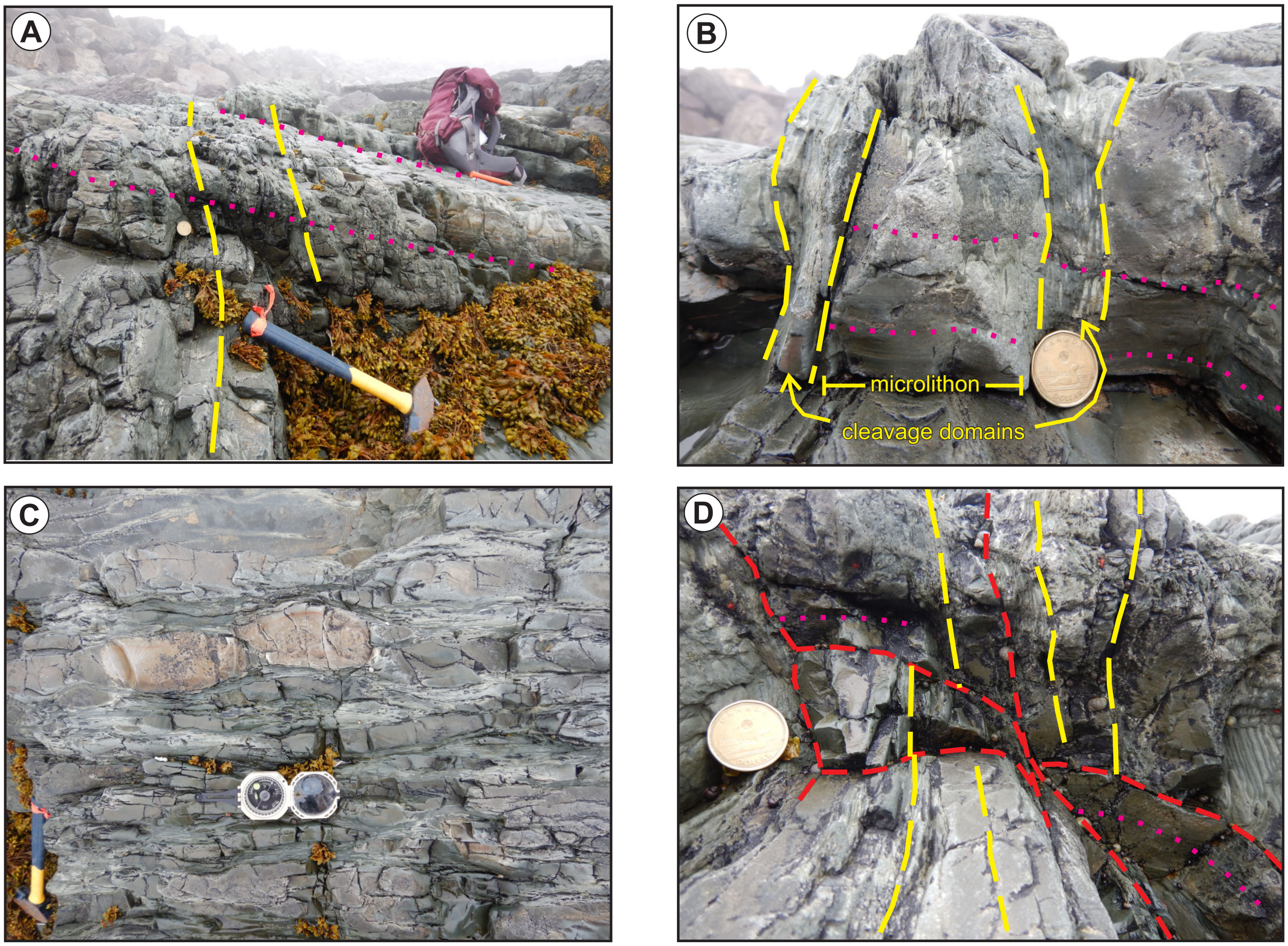


Plate 3. *Cleavage in green-grey shale and fine-grained sandstone of the Adeyton Group (Brigus Formation) near Point May (46.907442°N, 55.951625 W). A) Cross-sectional view of shallowly dipping bedding and subvertical cleavage; B) Sectional view of bedding showing narrow zones where cleavage development is strong, obscuring primary layering (bedding), and locally showing offset along some cleavage planes; C) Plan view of a bedding surface strongly disrupted by cleavage; D) Close-up of a highly disrupted zone where intense cleavage has developed into small local faults which offset primary layering. Bedding=pink dotted line, cleavage=yellow dashed line, fault=red dashed line.*

northwest, with fewer beds striking to the northeast and dipping to the southeast. A plot of all bedding surfaces, projected as poles, from the West Burin Domain defines a π girdle that gives a fold axis plunging 6° towards 229° (Figure 4A). Long, shallowly northwest-dipping limbs and short, steeply southeast-dipping limbs characterize several of the asymmetrical anticlines. Rare overturned bedding, commonly on the southern limbs, was also noted. The cleavage is mainly steep, with dips to the northwest more common than those to the southeast (Figure 4D).

At Point May (Figure 2), a local low-angle, northeast-directed thrust fault was observed, along with a minor southwest-directed component in the overriding block (Figure 5A). However, as this example is confined within a few beds, displacement here was evidently local. Several examples of asymmetric folds and associated faults occur near Pieduck Point (Figure 5B–D). Axial planes of anticline-syncline pairs dip to the northwest and appear to steepen downward (Figure 5B). A nearby faulted antiform shows clear vertical offset along an axial plane, with a tight, east-northeast and west-southwest doubly-plunging fold in the footwall of the fault (Figure 5C–F). Bedding on the southern limb of the tight fold is locally overturned. About 50 m south of this fold, a steeply south-southeast-dipping fault (measuring 170°/85°) cuts through steeply north-northwest-dipping shales (bedding oriented 250°/69°). A 1-m-thick carbonate bed in the shale succession shows about 5 m of dextral offset across the south-southeast-dipping fault.

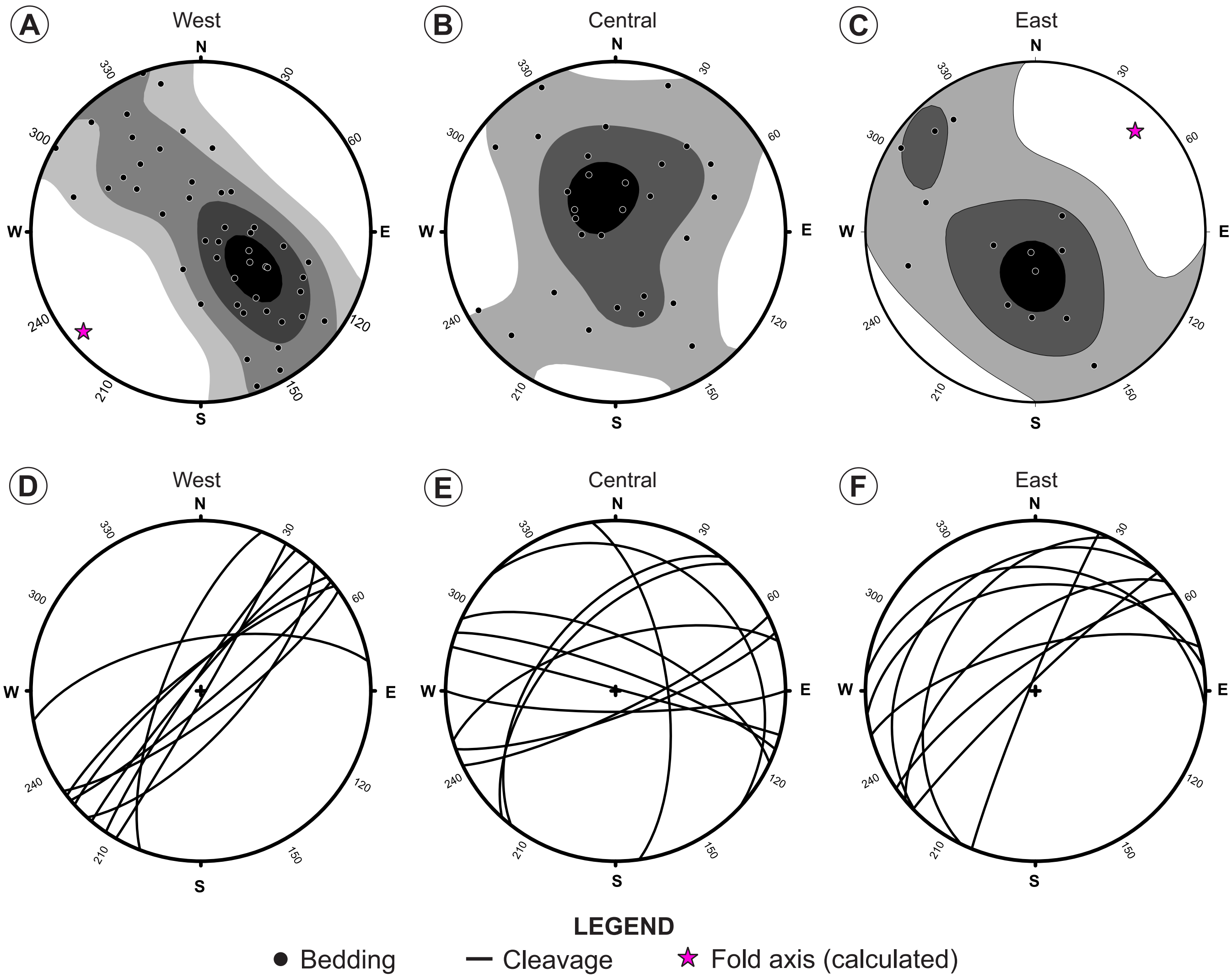


Figure 4. *Equal area stereographic projection plots for bedding (A–C) and cleavage (D–F) from West, Central and East Burin domains (*see *Figure 2 for the areal extent of each domain). Bedding is plotted as poles to planes, contoured, and a fold axis (pink dot) is calculated from the girdle for the West (a: 6°→229°) and East (c: 19°→045°) domains.*

Farther north, at Beach Cove (Figure 2), strongly tectonized, white quartz arenite of the Random Formation is thrust over highly disrupted black shale of the Manuels River Formation (Plate 4A, B). The attitude of the fault between the two lithologies is approximately 320°/70° but is slightly variable even within this small coastal exposure. Fragments of black shale (likely Manuels River Formation) and red shale (Brigus or Chamberlain's Brook Formation) occur within the tectonized quartz arenite unit (Plate 4C, D). Both bedding and penetrative cleavage are variable in the black shale, both are locally folded and crenulated. The confluence of outcrop-scale faults of varying orientation is characteristic of this fault zone (Plate 4B). Detailed fault measurements and analysis are required to resolve the sequence of faulting and the magnitude and sense of displacement across the zone.

At Fortune Head (Figure 2), broad open folds are immediately evident in the medium-bedded shale and fine-grained sandstone of the Chapel Island Formation. Closer inspection, however, reveals complexities including cuspate/lobate fold geometry owing to competency contrast, and distinct, short ramp segments that demonstrate important brittle faulting here (Plate 5). In accordance with the competency contrast in layers, this style of faulting is likely syngenetic with folding. Although the short ramp segments are obvious, the flat-on-flat fault segments here are subtle to cryptic. Fold vergence was not determined at this locality. Steep, down-dip slickenlines occur on both bedding-parallel quartz veins and, rarely, on bedding surfaces elsewhere in the area, but were too poorly preserved for the sense of displacement to be determined. The slickenlines are either related faulting, or to flexural slip between beds during folding.

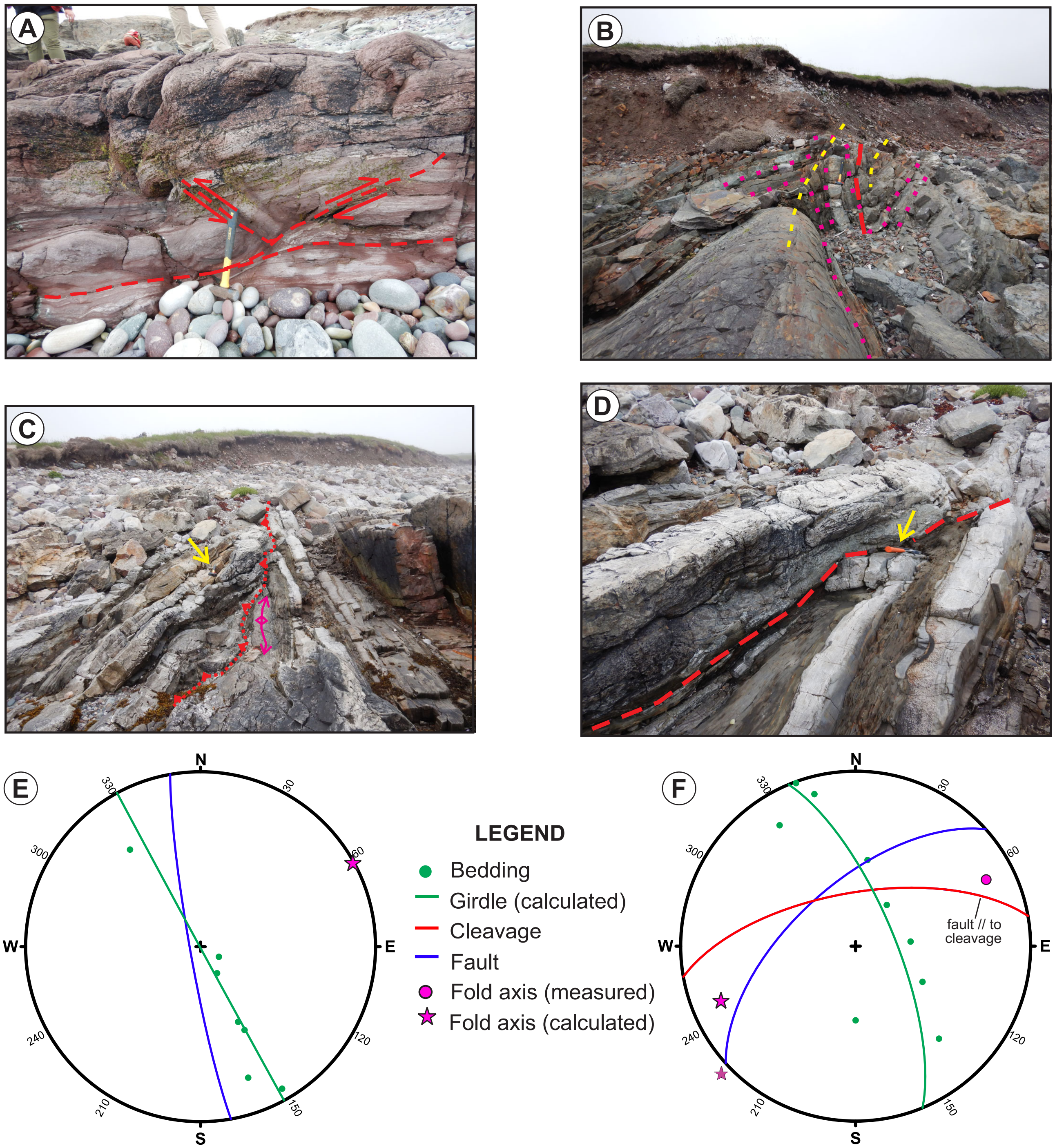


Figure 5. *Structural observations from Point May (A; 46.90569°N, 55.948079°W) and Pieduck Point (B–D; 46.933323°N, 55.97669°W and 46.936853°N, 55.978436°W). A) Low-angle thrust fault (to the right) and associated back-thrust (to the left) in red sandstone and shale of the Rencontre Formation; view is to the northwest; bedding is 230°/36°; the main fault plane (on right-hand-side) trends 208°/38°; B) Asymmetric anticline–syncline pair and associated fault (red dashed line); view northeast; bedding and fault orientations are depicted in Figure 5A; C) Thrust-faulted anticline in interbedded quartz sandstone and shale of the Random Formation; hinge of doubly-plunging anticline in the footwall indicated by the pink arrowed line; the red dashed line traces the main thrust fault; view northeast; D) Detail of (C). Bedding (in B only)=pink dotted line, Fault=red dashed line, axial plane (in B only)=yellow dashed line, fold axis (in C only)= arrowed pink line, yellow arrows point to hammer for scale. Equal area stereographic projection plots of structural elements at Pieduck Point; E) Anticline–syncline pair (shown in B); the girdle to bedding defines a nearly horizontal calculated fold axis of 0.3° towards 061.5°; F) Broken thrust-ramp-anticline (shown in C and D); bedding measurements about a small, parasitic fold define a girdle with a fold axis plunging 18° towards 248°; the axis of the fold shown in Plate 4C plunges 24° towards 065°.*

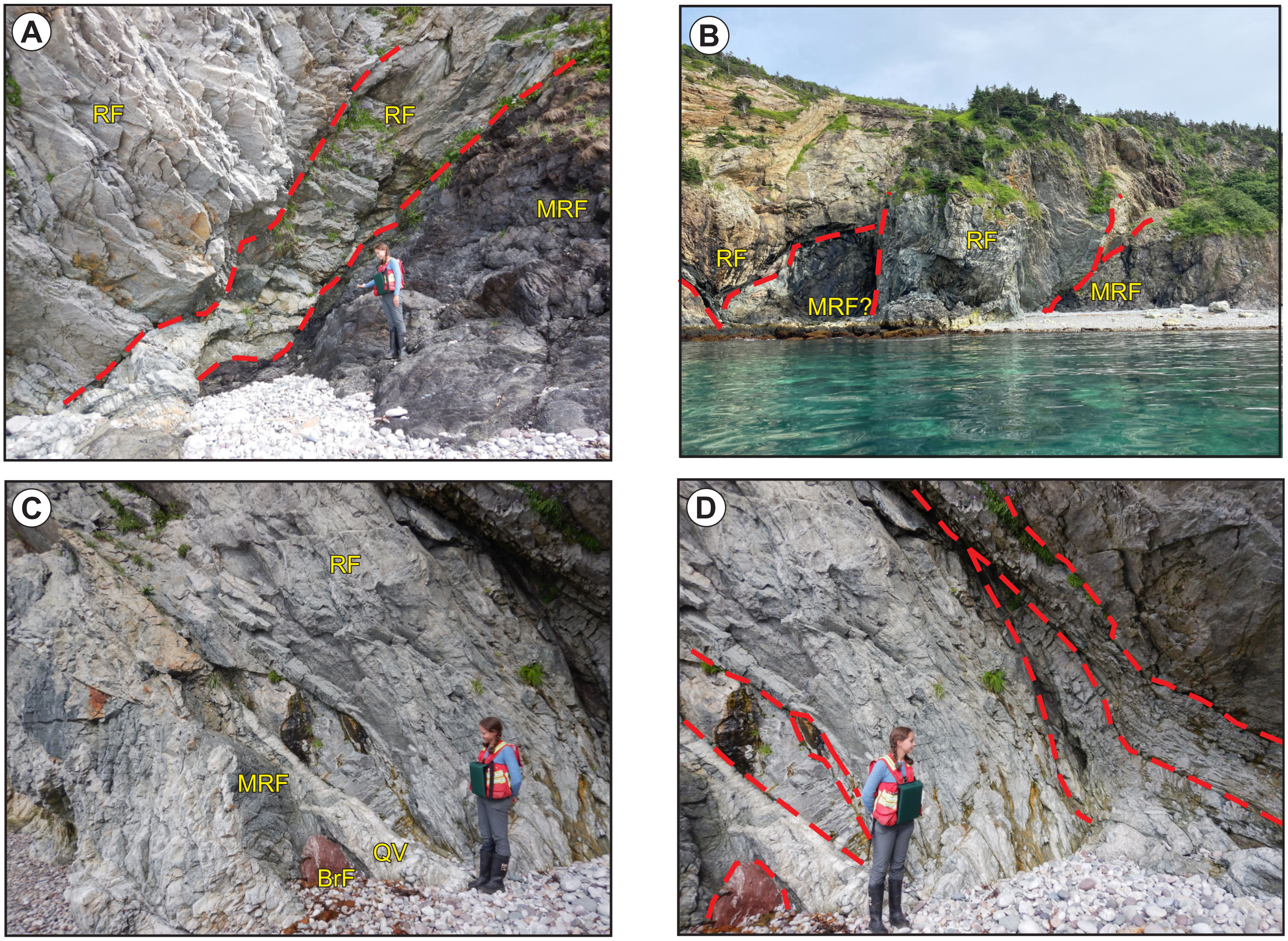


Plate 4. *Structural observations from Beach Cove (47.015004°N, 55.933048°W). A) Quartz arenite of the Random Formation fault-juxtaposed against black shale of the Manuels Formation; fault trends 320°/70°; view is to the southeast; B) View to the east from offshore showing complex faulting at Beach Cove; C) Blocks of black (MRF) and red (BrF) shale incorporated in fault zone; D) Fault imbrication within tectonized quartz arenite of the Random Formation. C and D are viewed to the northeast. Fault=red dashed line, BrF=Brigus Formation, MRF=Manuels River Formation, QV=quartz vein, RF=Random Formation.*

At Grand Bank Head (Figure 2), the outcrops are equally structurally complex. At one locality, a subvertical fault plane appears to truncate a steeply northwest-dipping fault plane (Figure 6). The orientation of the older, truncated fault and the fold geometry in its hangingwall are consistent with southeast-directed thrust imbrication. The measured and calculated fold axes between the faults (Figure 6B, C) both plunge gently to the southwest (02°→210° and 08°→215°, respectively). About 2 km to the southwest, in a steeply east-dipping (S_0 = 015°/66°) package of red and grey shale, conjugate fractures were noted with average orientations of 335°/40° and 030°/75°. The cleavage here is slightly oblique to the fracture set (S_{main}= 040°/70°). Based on the orientation of the conjugate fractures, the maximum compressional stress was approximately north–south, bisecting the acute angle defined by the conjugate fractures.

CENTRAL BURIN DOMAIN

Nature and Distribution of Basal Cover Sequence

The cover sequence (Dantzic Supergroup) crops out in the Central structural domain (Figure 2) on the peninsula between St. Lawrence and Little Lawn Harbour, on Duck Point, Drunkards Point, north of Ragged Head, on Sandy Cove Head, on the northern half of Allan's Island, and north of the Lamaline–Taylor's Bay area (O'Brien *et al.*, 1977). Lamaline basalts (Marystown Group; O'Brien *et al.*, 1977) north of Taylor's Bay are disconformably overlain by micaceous sandstone assigned to the Rencontre Formation (O'Brien *et al.*, 1977). At Allan's Island (Figure 2), basalt is overlain by a thin basal conglomerate of the Rencontre Formation. The volcaniclastic pebble conglomerate, ~2 m

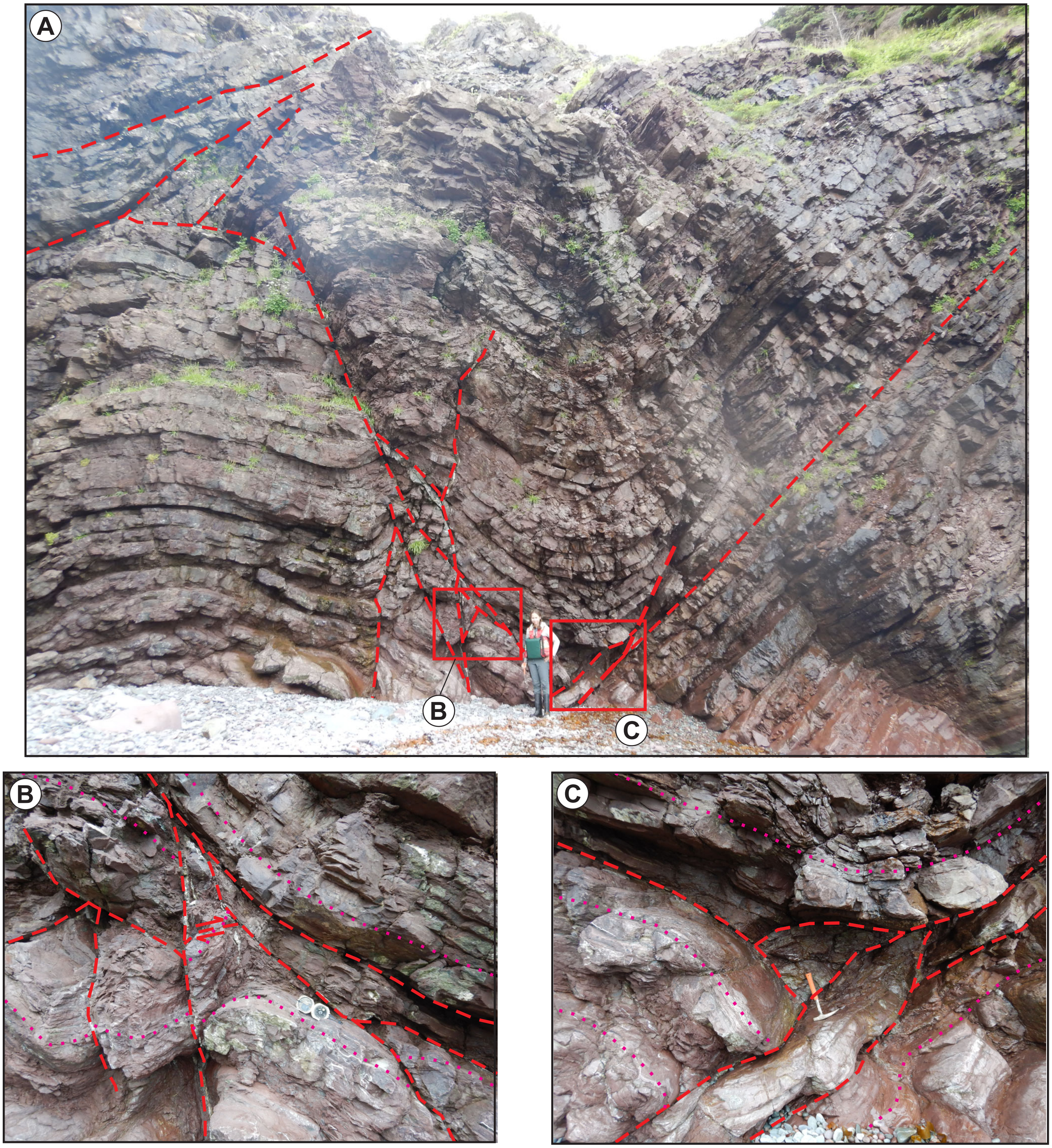


Plate 5. *Open folds and subtle faults at Fortune Head (47.075851°N, 55.849463°W). A) Folded beds of Chapel Island Formation showing the position of details highlighted in (B); B) Cuspate geometry of incompetent shale at the juncture between faulted competent sandstone beds; C) Truncation of bedding at base of large-scale syncline. Bedding=pink dotted line, Fault=red dashed line.*

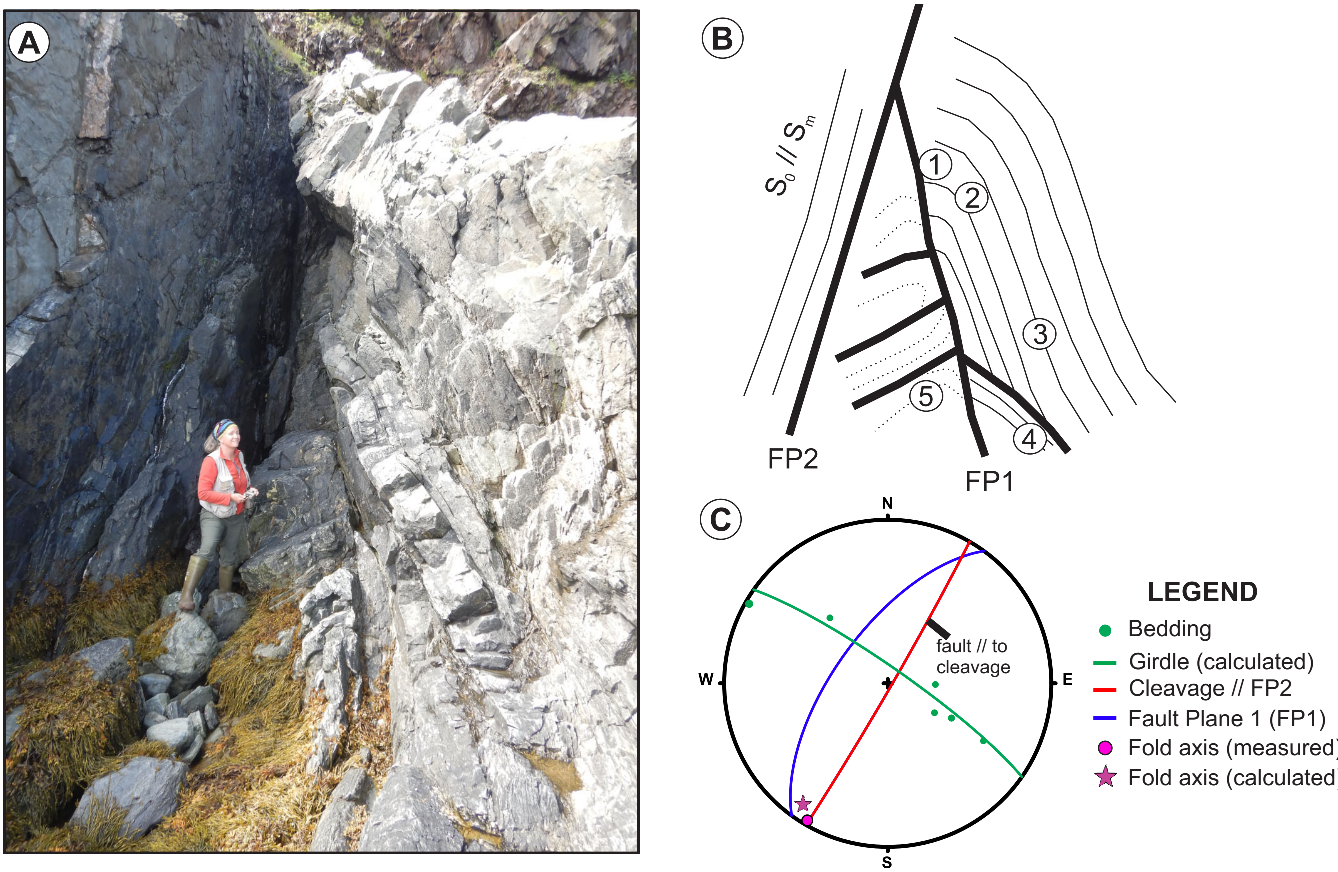


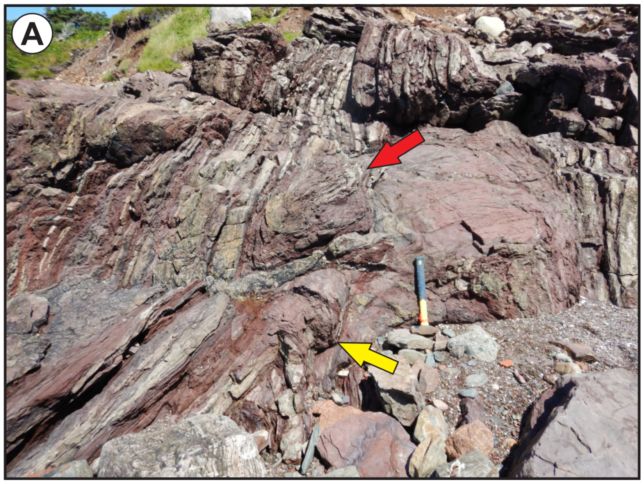
Figure 6. *Structural elements from Grand Bank Head (47.108273°N, 55.769982°W). A) Interbedded sandstone and shale of the Chapel Island Formation, view to south-southwest; B) Sketch of fold/fault geometry illustrating where structures were measured (Fault Plane 1, FP1 = 216°/64°; Fault Plane 2, FP2 = 030°/88°; S_0 at 1 = 212°/28°; S_0 at 2 = 208°/37°; S_0 at 3 = 211°/58°; S_0 at 4 = 182°/24°; S_0 at 5 = 048°/44°); C) Equal area stereographic projection plot of all structural elements from this location.*

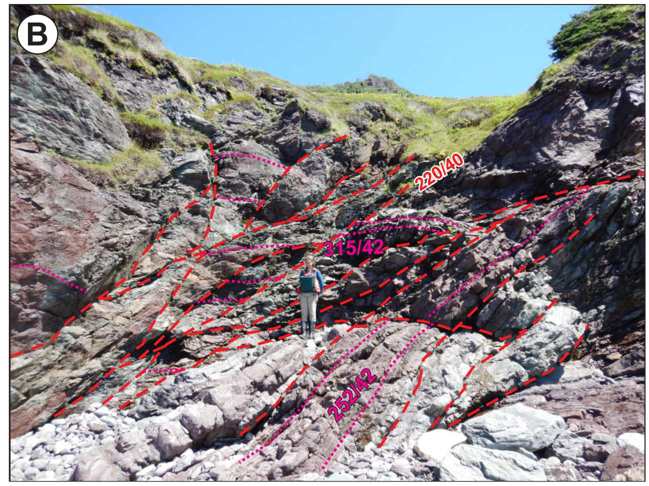
thick, fines upwards to interbedded, mainly red, sandstone and shale containing detrital muscovite. Basal conglomerate of the Rencontre Formation unconformably overlies felsic pyroclastic rocks of the Marystown Group at Duck Point, and these two units are fault juxtaposed at Drunkards Point and in the Ragged Head section (van Alstine, 1948; Williamson, 1956; O'Brien *et al.*, 1977). At these localities, red, micaceous sandstone and shale (Bay View Formation; likely correlative to Rencontre Formation) overlie a basal conglomerate and are, in turn, overlain by red, green and grey shales of the Inlet Group. The sandstones and shales are locally tight to isoclinally folded and overturned (O'Brien *et al.*, 1977). Parts of the succession, particularly north of Ragged Head, are apparently fault-bounded due to thrust imbrication (O'Brien *et al.*, 1977), but detailed structural studies have never been conducted in this area.

Structural Observations

The Central structural domain (Figure 2) has the most variable bedding and cleavage orientations of all three structural domains on South Burin (Figure 4B, E). It is also, arguably, the most strongly and complexly deformed domain. At Duck Cove, north of Duck Point (Figure 2), interbedded red and grey sandstone and shale (Bay View Formation) exhibit tight to isoclinal folds with complex geometries ranging from cylindrical, to conical, to box folds (Plate 6A). A conjugate joint set (300°/60°; 340°/50°) crosscuts the folds at this location. At Ragged Head, ~4.5 km to the west, intense deformation has similarly affected micaceous sandstones of the Bay View Formation, and abundant faults are focused within a ~10 m-wide fault zone (Plate 6B). Immediately north of this fault zone on Ragged Head, carbonaceous sandstone layers in steeply southeast-dipping beds of the Salt Pond Formation exhibit cuspate-lobate folding with axial planes subparallel to the moderately northwest-dipping cleavage (Plate 6C). A plot of poles to bedding surfaces from the Ragged Head area defines a π girdle with a calculated fold axis that plunges 14° towards 045° (Figure 7A).

Interbedded black and grey shales on the northwest side of Little Lawn Harbour locally exhibit offset along discrete





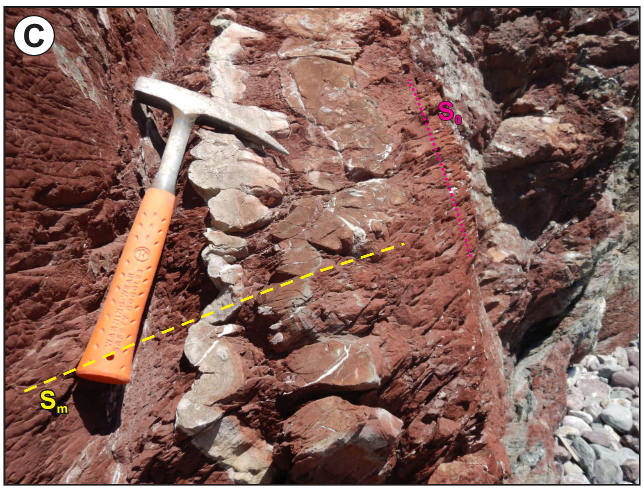


Plate 6. *Structural observations from Duck Cove (46.916572°N, 55.511565°W) and Ragged Head (46.905197°N, 55.572507°W) areas. A) Folded grey sandstone and red shale of the Bay View Formation (Rencontre Formation equivalent) at Duck Cove, showing a synformal box fold (red arrow) along strike from a cylindrical to conical antiform (yellow arrow); B) Fault zone in grey sandstone and red shale of the Bay View Formation at Ragged Head; select fault (red) and bedding (pink) measurements given; C) Folded carbonaceous layer (white-weathering bed) in red shale of the Salt Pond Formation at Ragged Head; S_0 = 035°/75°; Sm = 218°/52°. All views are to the northeast. Bedding=pink dotted line, cleavage=yellow dashed line, fault=red dashed line.*

faults developed slightly oblique to bedding (Plate 7A, B). Apparent up-throw is to the south or southeast. Elsewhere along this coastal section, a subhorizontal cleavage is evident within a succession of subvertical grey and black shale (Plate 7C). The shale here is highly siliceous and fractures conchoidally, but the cleavage is tightly spaced and penetrative. Small vertical displacements cut across some cleavage planes (Plate 7D), indicating that deformation may be partitioned across a broader zone. A plot of all poles to bedding surfaces from this area within Little Lawn Harbour defines a π girdle with a calculated fold axis that plunges 19° towards 133° (Figure 7B). At Little Lawn Point, 1.5 km to the southeast (Figure 2), bedding defines a π girdle with a calculated fold axis that plunges 14° towards 080° (Figure 7C).

On the Sand Cove Head peninsula, white quartzitic and red shaley members of the Bay View and Salt Pond formations structurally overlie black shale of the Pleasant View Formation (Plate 8A). The fault plane, interpreted as a thrust, dips moderately to the northwest and is subparallel to a well-developed cleavage (Plate 8B). The cleavage is locally crenulated near irregularities in the fault surface (Plate 8C) and locally shows a drag-fold geometry (Plate 8D). Farther south, outcrop-scale folding is evident, and an antiform shows an asymmetry defined by a short and steep, south-dipping forelimb and a long, shallowly northwest-dipping trailing back limb (Plate 8E). Close inspection of the outcrop-scale fold reveals strongly tectonized blocks separated by small-scale faults within the overall fold structure (Plate 8F). Bedding measurements from this area define a π girdle with a calculated fold axis that plunges 35° towards 250° (Figure 7D).

Farther west at Allan's Island, micaceous red sandstone and shale overlie red-weathering Lamaline basalts of the Marystown Group, with a 2-m-thick basal conglomerate at the contact. Above (north of) the basalt, the sandstone and shale is locally strongly folded and contorted, and primary flame structures indicate locally overturned bedding. A short, moderately south-dipping south limb and a long, shallowly north-dipping north limb define a mesoscopic asymmetrical anticline in the well-cleaved sandstone and shale of

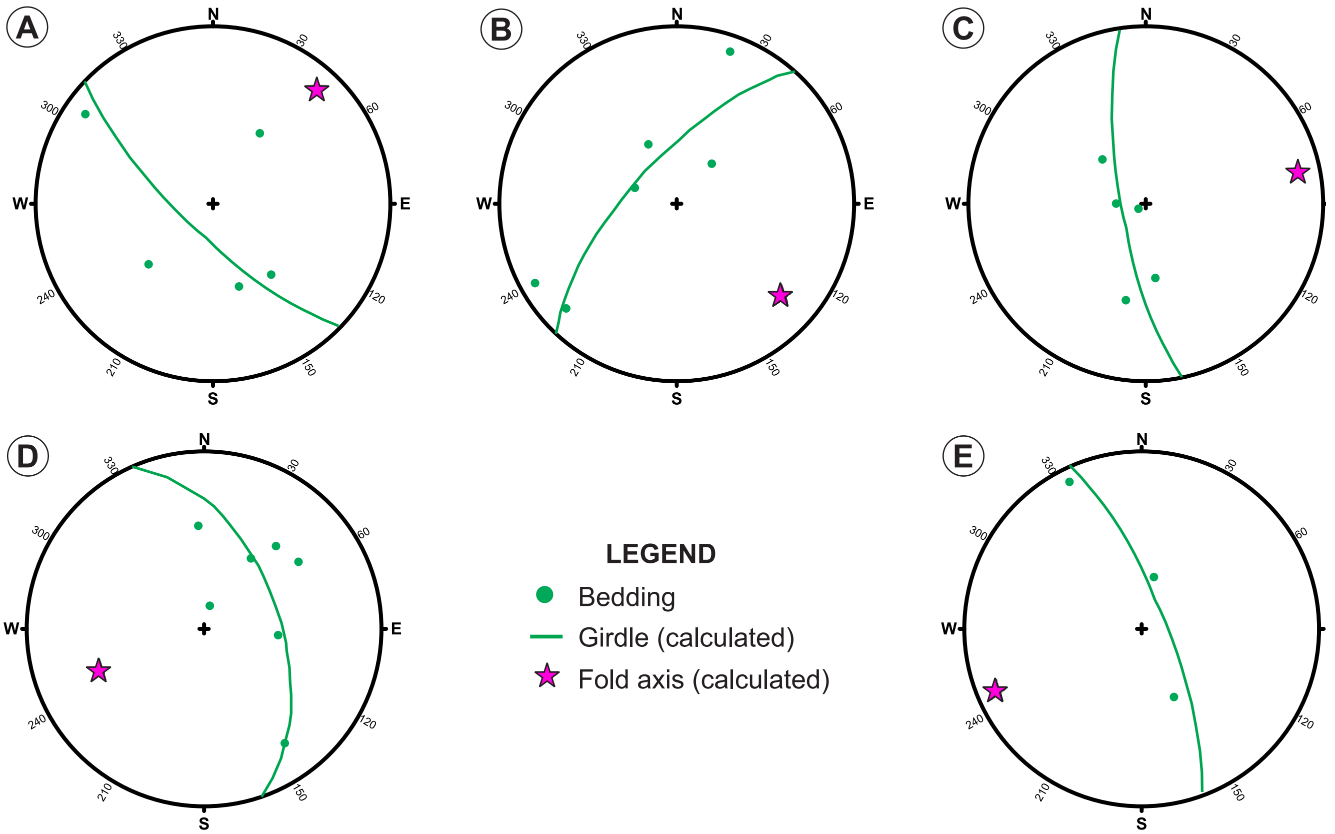


Figure 7. *Equal area stereographic projection plots for bedding measurements from: A) Ragged Head (fold axis = 14°→045°); B) Little Lawn Harbour (fold axis = 19°→133°); C) Little Lawn Point (fold axis = 14°→080°); D) Sand Cove Head (fold axis = 35°→250°); E) Allan's Island (fold axis = 08°→248°).* See *Figure 2 for geographic locations.*

the Bay View Formation. The calculated fold axis plunges 08° towards 248° (Figure 7E).

EAST BURIN DOMAIN

Characteristics and Distribution of Basal Cover Sequence

The Inlet Group unconformably overlies pillow basalt of the Burin Group northeast of St. Lawrence, but elsewhere the contact is not exposed or fault-modified (Strong *et al.*, 1978).

Structural Observations

In the East structural domain, rocks of the Dantzic Supergroup cover sequence extend from Little St. Lawrence north-northeasterly through Burin Inlet to Mortier Bay (Figure 2). Poles to bedding from the East Burin Domain define a π girdle with a calculated fold axis that plunges 19° towards 045° (Figure 4C), roughly parallel to the strike of previously identified thrust faults in the area (*see* Strong *et al.*, 1978).

At Lewin's Cove on the north end of Burin Inlet, felsic pyroclastic rocks of the Mount Lucy Anne Formation, Marystown Group, are thrust over red and green shale of the Salt Pond Formation of the Inlet Group (Plate 9A; Strong *et al.*, 1978). The fault plane dips moderately to the northwest and southeast-directed thrusting is inferred. Slickenlines in the area are locally folded (Plate 9B).

At Salmonier (Figure 2), on the highway west of Burin Inlet, red shale of the Salt Pond Formation sits structurally above black shale of the Pleasant View Formation. Given the stratigraphic framework (Figure 3), a thrust contact is inferred. Although some of the slickenlines may have formed during flexural slip related to folding, abundant and variably preserved slickenlines (*e.g.*, 31°→005°) on shallowly north-dipping fault and bedding surfaces are consistent with south-directed thrust imbrication as previously proposed by Strong *et al.* (1978).

Primary layering is commonly obscured by intense cleavage development and also by intense reddening of some rocks of the Inlet Group. In red shale of the Salt Pond Formation north of Little Salmonier (east of Salmonier, on

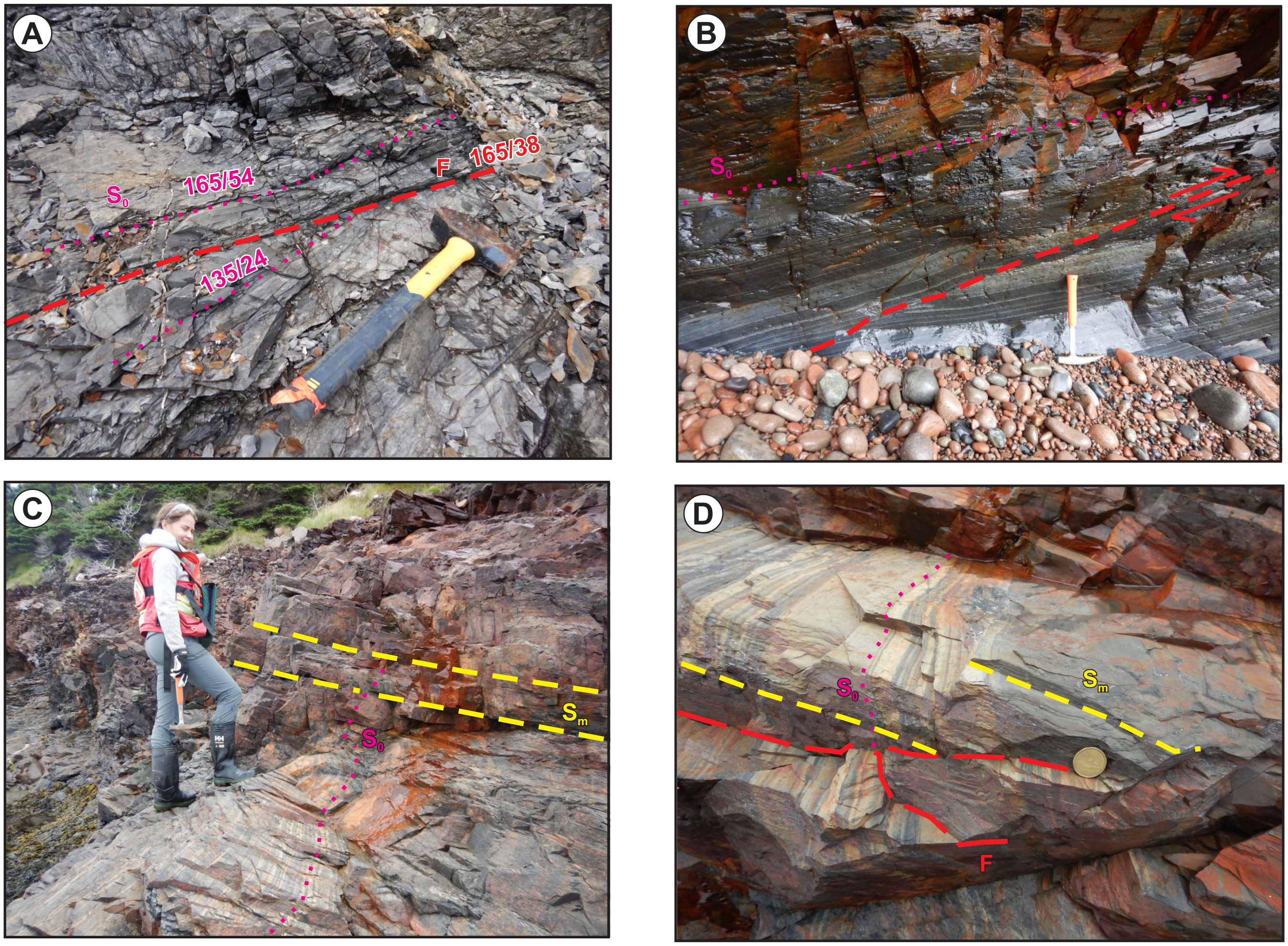


Plate 7. *Structural elements at Little Lawn Harbour (46.92896°N, 55.491881°W). A) Slight obliquity of bedding across a discrete fault (F) in highly cleaved dark-grey shale; select bedding (pink) and fault (red) orientations shown; top of photograph is to the northwest; B) Offset of a marker horizon in dark-grey laminated shale, indicating minor reverse displacement to the southeast (view to northeast); C) Subhorizontal cleavage (S_m = 313°/21°) in steeply dipping (S_0 = 330°/82°) siliceous slate (Pleasant View Formation?); view to the northwest; D) Offset primary layering highlighting displacement across discrete fault subparallel to cleavage. Bedding=pink dotted line, cleavage=yellow dashed line, fault=red dashed line.*

east shore of Burin Inlet; Figure 2), bedding is nearly impossible to discern, but the cleavage appears deformed and truncated by two generations of faulting. With proximity to an early, shallowly north-dipping fault, the steeply northwest-dipping cleavage is deflected subparallel to that fault (Plate 9C). The apparent drag on the cleavage in the footwall of the fault is consistent with reverse or thrust displacement across the fault. This shallowly north-dipping fault is offset by a later, steeply northwest-dipping fault. Both faults appear to postdate the cleavage, and the steep fault clearly offsets the shallow one.

DISCUSSION

This report is based on reconnaissance geological investigation and presents preliminary structural interpretations of the Dantzic Supergroup cover sequence of the southern Burin Peninsula. Below are summarized some critical field, lithostratigraphic and paleontological knowledge gaps, as well as the implications of the new structural data presented above. These observations may have important implications for: 1) the Global Boundary Stratotype Section and Points (GSSP) for the Precambrian–Cambrian boundary at Fortune Head; 2) the late, rift–drift history of Ediacaran to Ordovician Avalonia; and 3) the post-Cambrian deformation history of the area.

Within the West structural domain, new structural data are consistent with southeast-directed thrust imbrication, complicated by subsequent, possibly north–south oriented shortening. Asymmetric folds and associated faults at Pieduck Point and Grand Bank Head indicate southeast-

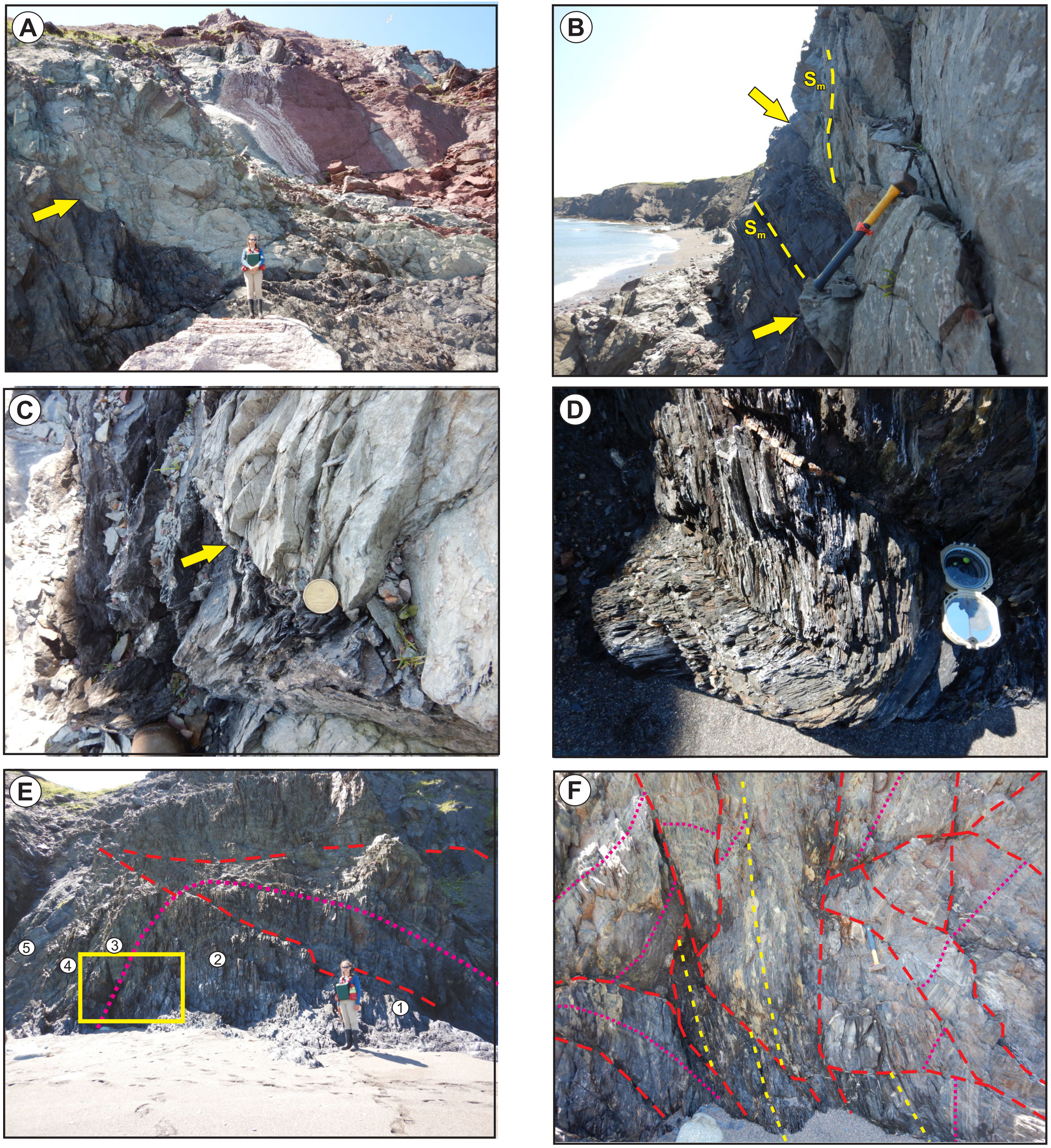
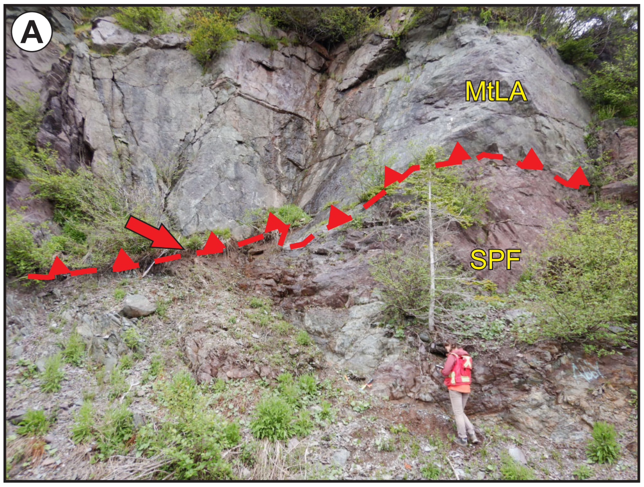


Plate 8. *Structural observations at Sand Head Cove (46.885283°N, 55.628863°W). A) View west of members of Bay View and Salt Pond formations thrust onto black shale of the Pleasant View Formation; the fault plane (yellow arrow) was measured at 215°/32° but varies to more steeply dipping; B) View south of fault (yellow arrows) between Bay View black shale (footwall) and Salt Pond quartz arenite (hangingwall); cleavage (S_m) in the former is parallel to the fault, but oblique to the fault in the latter; C) Cleavage subparallel to the fault (arrow) is crenulated near irregularities in the fault surface; D) The cleavage locally shows a drag-fold geometry consistent with a dextral shear component; E) View west of outcrop-scale antiform showing an asymmetry consistent with south-directed thrusting; numbers correspond to bedding measurements: 1 = 236°/70°; 2= 185°/35°; 3 = 145°/58°; 4 = 130°/55°; 5 = 085°/52° (yellow box = detail shown in F); F) Highly tectonized blocks separated by small-scale faults within the overall fold structure. Bedding=pink dotted line, cleavage=yellow dashed line, fault=red dashed line.*



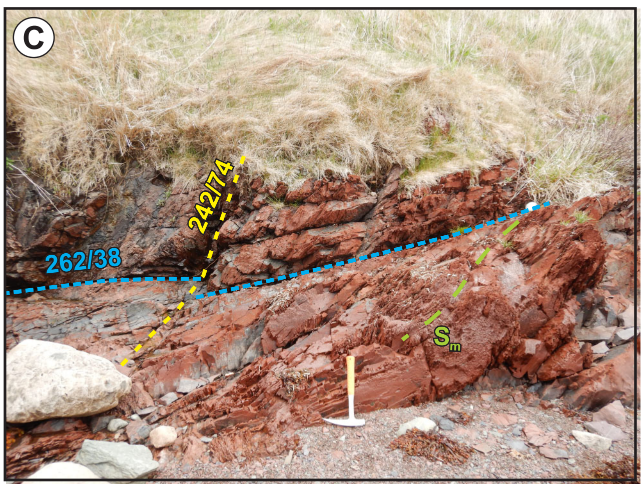


Plate 9. *Structural elements from the East Burin domain. A) Felsic pyroclastic rocks of the Mount Lucy Anne Formation (Marystown Group) thrust upon red shale of the Salt Pond Formation (Inlet Group) at Lewin's Cove (47.094366°N, 55.208494°W); view is to the northwest, the thrust plane is oriented 235°/50°, ornaments are on the hangingwall side; MtLA=Mount Lucy Anne Formation, SPF=Salt Pond Formation; B) Folded slickenlines on subcrop below the Marystown–Inlet Group thrust contact, at Lewin's Cove; C) View northeast of highly cleaved and faulted red shale of the Salt Pond Formation at Little Salmonier (47.073596°N, 55.184125°W). Trends of early (blue) and late (yellow) faults are shown. The cleavage, S_m (green dashed line), is deflected from 226°/86° distal from the shallowly north-dipping, early fault (blue dashed line) to 262°/38° proximal to the fault.*

directed thrust imbrication. At Beach Cove, the northwest-striking, northeast-dipping fault transports quartz arenite of the Random Formation in the hangingwall over possible Manuels River black shale in the footwall. This fault geometry indicates thrust imbrication placing Terreneuvian rocks over Miaolingian rocks, and further implies that the intervening units (Brigus and Chamberlain's Brook formations) have been tectonically excised (Figure 8). The orientation of this fault is similar to one set of the conjugate fractures described from 2 km southwest of Grand Bank Head. North–south compression is compatible with the development of north-northwest- and north-northeast-striking fractures and rare brittle faults. The geometry of the low-angle fault at Point May (Figure 5A) is consistent with at least a small component of north-directed compression. Walthier (1948) notes abundant northwest-trending faults having nominal or undetermined displacement, and a smaller set of north-northeasterly faults that are commonly bedding-parallel. Measured and calculated fold axes from Pieduck Point (Figure 5F) highlight the doubly-plunging fold axes. However, the fold axes are notably rotated slightly counter-clockwise relative to the main fault and cleavage (red line in Figure 5F), compatible with a small component of subsequent deformation. Alternatively, the main master fault may be slightly oblique to the direction of maximum compression, and thereby act as more of a lateral-oblique ramp. Structural observations presented herein raise the possibility that the Precambrian–Cambrian boundary may also occur at other localities in addition to the GSSP at Fortune Head, owing to implied repetition of section as a result of thrust imbrication.

The Central structural domain exhibits the most intense and complex deformation of the three structural domains discussed. Stereographic projections of structural elements from this domain exhibit considerable variation (Figure 4B, E) that is not readily resolved in the context of a single post-Cambrian deformation event. The complex fold geometry at Duck Cove (Plate 6A) and fault zone north of Ragged Head (Plate 6B) could both result from a single, progressive event rather than polyphase deformation. The cuspate-lobate folded carbonate layer in red shale near Ragged Head likely

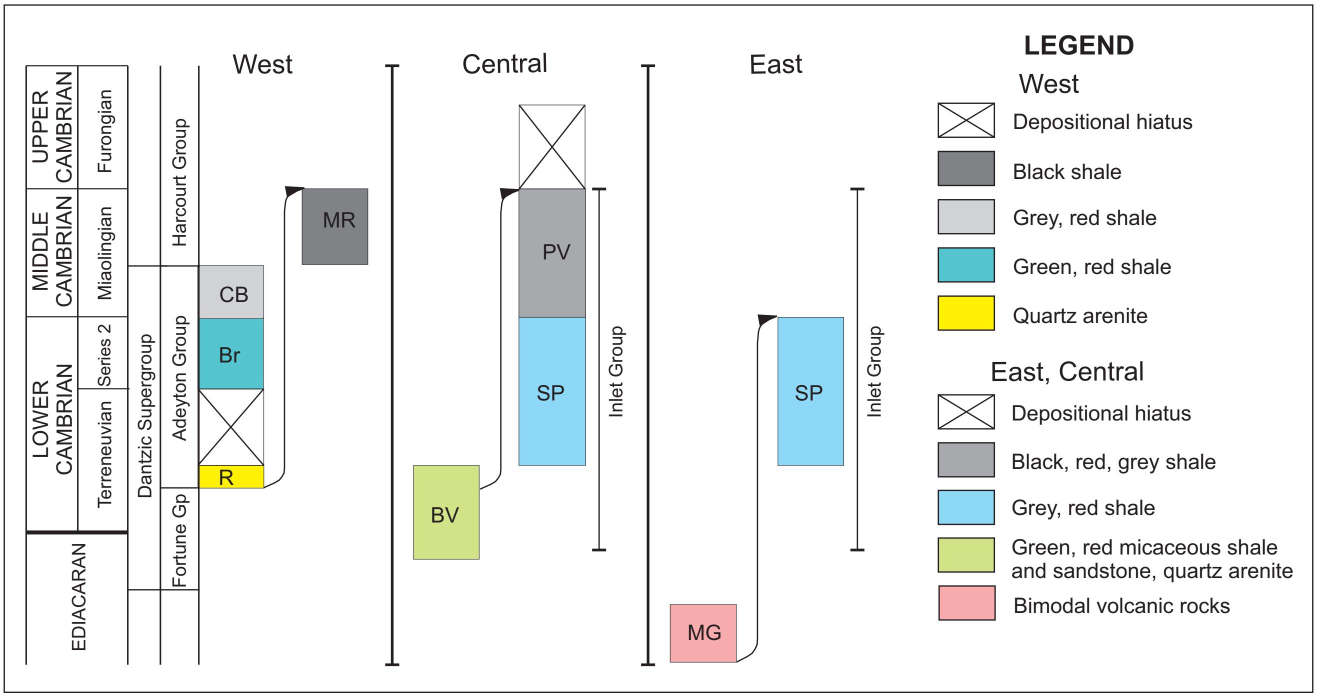


Figure 8. *Summary of thrust imbrication observations across South Burin. Br=Brigus Formation, BV=Bay View Formation, CB=Chamberlain's Brook Formation, MG=Marystown Group, MR=Manuels River Formation, PV=Pleasant View Formation, R=Random Formation, SP=Salt Pond Formation.*

developed coeval with the near-axial planar penetrative cleavage development in the enveloping shale (Plate 6C). However, the penetrative cleavage, now more shallowly dipping than the subvertical beds in which it occurs, likely originated in a compressional tectonic regime, wherein the principal compressional stress axis was subhorizontal, thereby producing a subvertical cleavage. Subsequent deformation tilted the deformed beds to near vertical, re-orienting the originally steep cleavage to its current moderate to shallow dips. The offset of both primary layering and cleavage across discrete faults at Little Lawn Harbour (Plate 7D) indicates brittle deformation subsequent to a D1 cleavage-forming event, and may be the best evidence for polyphase deformation in this area. The conjugate shears that transect folded beds at Duck Cove also indicate a subsequent, post-folding, deformation event. The calculated fold axes from the areas described above vary considerably: shallow to the southeast and east at Little Lawn Harbour and Little Lawn Point, respectively; shallow to the northeast at Ragged Head; and shallow to moderate to the west-southwest at Sand Cove Head and Allan's Island. This degree of variability is best explained by the modification of an early, initially more consistent structural pattern by a later deformation event, resulting in the re-orientation of early structural elements. The first event is consistent with folding related to south- to southeast-directed thrust imbrication. The later event does not appear to be associated with any penetrative fabric development but resulted in local brittle faulting, and tilting and warping of small blocks and their constituent structural elements. The spacing of structural elements related to this second, post-Cambrian deformation event is not clear, as the distribution of its constituent structural elements appears patchy.

Deformation in the East structural domain is also characterized by south- to southeast-directed thrust imbrication, as proposed by Greene (1974) and Strong *et al.* (1978). Parts of the Marystown Group are thrust to the southeast onto Cambrian shales (Plate 9A). The stratigraphy along the west side of Burin Inlet is consistent with south-directed thrust imbrication involving at least three structural panels (Figure 2; *see* also Strong *et al.*, 1978). Polyphase deformation is evident on the east side of Burin Inlet, east of Salmonier, where an early, shallowly north-dipping fault, interpreted to result from south-directed thrusting, is crosscut by a steeper, northwest-dipping fault. This fault geometry is consistent with south-directed followed by southeast-directed thrusting. This simple scenario is consistent with the structural history inferred from the map pattern, whereby the south-directed thrust sheets within the Inlet Group are truncated by southeast-directed thrusting inferred along the Lewin's Cove Fault.

FUTURE WORK

The terminal Ediacaran to Miaolingian Dantzic Supergroup in South Burin has evidently been subjected to polyphase deformation. Evidence is currently sparse, and further work should include detailed structural studies where exposure, and suitable (multilayered, sedimentary) rocks permit. Coastal sections of western and central South Burin offer a level of exposure and contrast in lithology ideal for future structural investigations. The regional high-resolution airborne magnetic radiometric and VLF-EM survey data might augment such research, and allow for remote predictive mapping in advance of detailed studies. Age constraints, either *via* radiometric or biostratigraphic means, would provide indispensable complementary data. In addition, use of isotopic analyses in a chemostratigraphic approach would further strengthen such investigations, as comparison with the global record of isotopic excursions may help to constrain the age of the units and facilitate correlation (*e.g.*, Brasier *et al.*, 1992; Strauss *et al.*, 1992; Macdonald *et al.*, 2013; Canfield *et al.*, 2020; Sperling *et al.*, 2021; Kozik *et al.*, 2023).

New structural observations presented here indicate potential repetition of section as a result of thrust imbrication along the west coast of South Burin, raising the possibility that the Precambrian–Cambrian boundary may also occur at other localities, in addition to the GSSP at Fortune Head. Future investigations into this possibility should include detailed structural studies, supported by biostratigraphic constraints based on acritarchs, microfossils and ichnofossils, and radiometric analysis of any tuff horizons identified within the targeted strata.

Further investigation into the origin and isotopic characteristics of the basement to each of the three structural domains defined herein is also necessary. The microcontinent of Avalonia is a composite terrane comprising distinct basement blocks that were amalgamated prior to the deposition of its cover sequence (Landing, 1996; Beranek *et al.*, 2023). Current age constraints contrast the Tonian Burin Group with the Ediacaran Marystown Group, with few intervening Cryogenian rocks known (*see* van Staal *et al.*, 2021). That the Burin and Marystown groups evolved separately and independently is implicit from their known ages, but the magnitude of their separation and the timing of their juxtaposition remains to be explored. Basement studies should include geochemical, isotopic and geochronological investigations to better understand the pre-cover evolution of this part of Avalonia.

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