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TECTONOSTRATIGRAPHY OF THE BAIE VERTE OCEANIC TRACT AND ITS OPHIOLITE COVER SEQUENCE ON THE BAIE VERTE PENINSULA

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ABSTRACT

The Baie Verte Peninsula is a centre for mining in insular Newfoundland, and comprises Early Ordovician ophiolite volcanic sequences that contain volcanogenic massive sulphide ± gold deposits, and several types of epigenetic gold mineralization. The excellent preservation and relatively simple structural history of the 489 Ma Betts Cove Complex and its cover sequence, the Snooks Arm Group, makes it an ideal template to test stratigraphic correlations across the Baie Verte Peninsula. Each major ophiolite sequence on the Baie Verte Peninsula can be correlated with the Betts Cove Complex. Correlative units include, boninites, 487 Ma felsic volcanic rocks (Rambler rhyolite) and overlying island-arc tholeiitic basalts of the lower Pacquet Harbour Group; the layered cumulates, gabbro, 489 Ma trondhjemite dykes, sheeted dykes, boninite and island-arc tholeiitic basalts of the Point Rousse Complex; and layered similar rocks of the Advocate Complex and lower Flatwater Pond Group. Distinctive marker units recognized in the ophiolite cover rocks of the Snooks Arm Group (basal conglomerate, iron formation, tholeiitic basalts, 470 Ma clinopyroxene-phyric calc-alkaline tuffs, and 467 Ma rhyolite) can all be found, in the same sequence, in equivalent cover rocks of the upper Pacquet Harbour Group, the Point Rousse cover sequence, and the Flatwater Pond Group. Thicker sequences of coarse-grained conglomerates in the Flatwater Pond and Shark Point groups are interpreted to reflect proximity to an ophiolitic basement that was thrust higher up the continental margin, relative to the thin units of finer grained conglomerate and thick iron formation that characterize the distal facies of the Snooks Arm Group. The recognition of correlations and marker units across the Baie Verte Peninsula suggests that existing stratigraphic nomenclature now merits revision and simplification.

INTRODUCTION

The Baie Verte Peninsula (Figure 1) is host to a rich mineral endowment and has long been the focus of mining and exploration for copper, gold, asbestos and other commodities. These diverse mineral resources are mostly hosted by Early Ordovician submarine volcanic rocks that constitute the Baie Verte oceanic tract (BVOT) of the Notre Dame Subzone, Dunnage Zone (Williams *et al.*, 1988; van Staal *et al.*, 2007). Until recently, understanding the metallogeny of the Baie Verte Peninsula was hampered by uncertainties in the age of volcanic units, their subdivision into individual and potentially unrelated ophiolite complexes, and uncertainties in the tectonic setting of the cover sequences. Further complexity arises from the large contrast in structural style and geometry across the peninsula (Hibbard, 1983; Castonguay *et al.*, 2009).

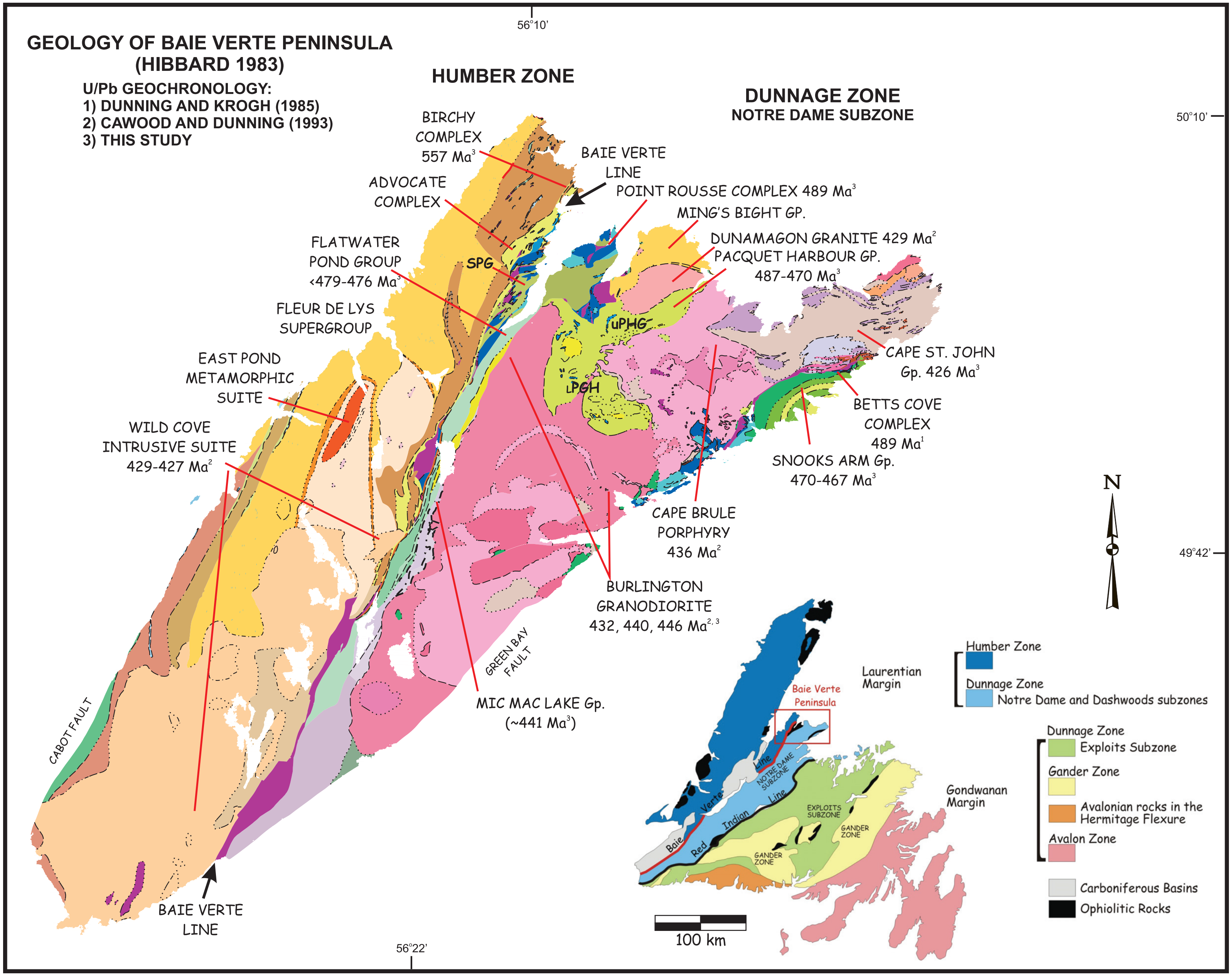

Figure 1. *Regional geological map of Baie Verte Peninsula adapted from Hibbard (1983), Bédard* et al. *(1999) and Colman-Sadd and Crisby-Whittle (2002; and references therein). lPHG - lower Pacquet Harbour Group; uPHG - upper Pacquet Harbour Group; SPG - Shark Point Group.*

The Baie Verte Peninsula has an extensive history of mineral exploration dating back to the 1850s, and has been the focus of numerous lithological and structural studies summarized, in part, in Hibbard (1983), Waldron *et al.* (1998), Bédard *et al.* (1999, 2000a) and Evans (2004). As part of the Geological Survey of Canada's Appalachian TGI-3 Program, an integrated geoscience study of the Baie Verte Peninsula was initiated in 2006 to aid in the search for base-metal mineralization by resolving problems in the tectonostratigraphy and structural history of the peninsula. This was approached by combining the extensive body of literature and mapping in this area with new focused bedrock mapping in key areas. In conjunction with regional geophysics, geochronology, lithogeochemistry and remote sensing data, this approach has now identified key stratigraphic markers and structural relationships. Key stratigraphic units have been traced across poorly exposed areas with the aid of a high-resolution regional aeromagnetic survey (*e.g.*, Coyle and Oneschuk, 2008), locally augmented by detailed aeromagnetic surveys flown for mineral exploration companies. Detailed petrology and geochemistry, coupled with precise geochronology, was used to ascertain if the ophiolite and cover sequence defined from the relatively well-exposed and least-deformed Betts Cove area, as described by Bédard *et al.* (1999, 2000a, b), can be extrapolated westward across the peninsula. The initial results from this work indicate that both the ophiolite and its various cover sequences can be correlated at various scales.

GEOLOGICAL SETTING

The Baie Verte Peninsula straddles the boundary of the Humber Zone (representing the ancient continental margin of Laurentia) with the diverse oceanic rocks of the Dunnage Zone. The eastern part of the peninsula forms part of the Notre Dame Subzone of the Dunnage Zone (Figure 1; Williams *et al.*, 1988) representing peri-Laurentian arc systems and related environments. The Baie Verte oceanic tract (BVOT) is interpreted to represent the vestiges of the presumably narrow 'Humber Seaway' that developed between Laurentia proper and ribbon-like zones of continental crust of Laurentian affinity, that collectively form the 'Dashwoods microcontinent' (Waldron and van Staal, 2001). This rifted ribbon of continental crust eventually formed the substrate for island-arc terranes represented by younger volcanic sequences now preserved within the Buchans–Roberts Arm Belt. The tectonic boundary between the Humber Zone and Notre Dame Subzone is the Baie Verte Line (BVL), a complex zone of reactivated shear zones and faults that separate obducted ophiolite crust and underlying mantle from the Laurentian continental margin.

West of the BVL, the Humber Zone comprises migmatitic gneisses of the East Pond metamorphic suite (interpreted to represent Grenvillian basement) and the overlying Fleur de Lys Supergroup comprising psammites, pelite, marble, graphitic schist and amphibolite derived from continental margin sedimentary rocks (Figure 1; Hibbard, 1983). The Ming's Bight Group comprises pelite, psammite, conglomerate and amphibolite that lie to the east of the BVL, and is correlated with the Fleur de Lys Supergroup.

The Fleur de Lys Supergroup is separated from the BVL by a narrow, tectonically disrupted zone of graphitic schist, quartzite, pelite, metabasalt, metagabbro and serpentinite melange comprising the Birchy Complex (Hibbard, 1983; Winchester *et al.*, 1992; Figure 1). A metagabbro in the lower part of the Birchy Complex from Coachman's Cove has yielded a U–Pb zircon age of *ca.* 558 Ma (V. McNicoll, unpublished data, 2007) and is interpreted to record the opening of the Humber Seaway. Faults along the BVL separate serpentinite melange and pelitic (locally graphitic) schists of the Birchy Complex from the Advocate Complex to the east.

To the east of the BVL, there are several ophiolite sequences. These include the *ca.* 489 Ma (Dunning and Krogh, 1985) Betts Cove Complex (Upadhyay, 1973; Bédard *et al.*, 2000a), rocks within the southern (lower) Pacquet Harbour Group (Hibbard, 1983), the Point Rousse Complex (Norman and Srong, 1975), and the Advocate Complex (Bursnall, 1975). These are each overlain by volcano-sedimentary cover sequences including the Snooks Arm Group (cover to the Betts Cove Complex), the upper Pacquet Harbour Group, the Point Rousse cover sequence, the Flatwater Pond Group, and the Shark Point Group (Figure 1). These ophiolite sequences and their volcanic cover sequence are discussed in detail below.

The BVOT and Humber Zone are intruded by several large Late Ordovician to Early Silurian granitoid plutons including the *ca.* 446–432 Ma Burlington granodiorite, *ca.* 436 Ma Cape Brulé porphyry, *ca.* 429 Ma Dunamagon granite (Hibbard, 1983; Cawood *et al.*, 1993, and V. McNicoll, unpublished data, 2009), and *ca.* 429 Ma Wild Cove intrusive suite (Cawood *et al.*, 1993). These plutons appear to be early synvolcanic with respect to Late Ordovician to Early Silurian, continental volcanic and sedimentary cover sequences on the peninsula. The Burlington granodiorite is unconformably overlain by bimodal, continental tholeiitic volcanic rocks of the Mic Mac Lake Group. A welded felsic tuff near the base of the Mic Mac Lake Group is of *ca.* 441 Ma age (V. McNicoll, unpublished data, 2009). Mafic tuff breccia in a fault-bounded outlier of the Mic Mac Lake Group north of Flatwater Pond is *ca.* 430 Ma (V. McNicoll, unpublished data, 2008) and similar in age to late phases of the Burlington granodiorite and the Dunamagon granite. The Cape St. John Group lies unconformably on the Snooks

Arm Group (Neale *et al.*, 1975) and comprises continental-derived sedimentary rocks and bimodal volcanic rocks including tholeiitic massive basalt and *ca.* 426 Ma felsic volcanic rocks (V. McNicoll, unpublished data, 2008). Silurian volcanic rocks and their shallow intrusive equivalents are also present within the Kings Point Complex in the south-central part of the peninsula; these include a prominent ridge-forming, ring-dyke (Figure 1).

STRUCTURAL EVOLUTION

At least three phases of regional deformation have affected the rocks of the Baie Verte Peninsula (Hibbard, 1983; Castonguay *et al.*, 2009). Most deformation phases are domainal and fabrics vary in orientation, style and in intensity. In addition, structural correlations across BVL are rendered difficult due to intense and long-lived strain along the complex fault zone, which has juxtaposed rock units of different origins and structural levels.

Structures related to D_1 (D_E of Hibbard, 1983) have been strongly overprinted in the Fleur de Lys Supergroup, and are poorly developed east of the BVL. The D_1 age constraints from the Humber Zone range from 468 to 459 Ma ($^{40}Ar/^{39}Ar$; S. Castonguay *et al.*, unpublished data, 2009), and are interpreted to be related to obduction of the ophiolite complexes and arc collision of the BVOT during the main stages of the Taconic Orogeny (Waldron *et al.*, 1998; van Staal *et al.*, 2007).

The D_2 event (Dm of Hibbard, 1983) represents the main tectonometamorphic phase of most of the Baie Verte Peninsula. In the central part of the peninsula, S_2 is an east-striking cleavage to a penetrative schistosity, locally characterized by a strong L>S fabric, and axial-planar to megascopic F_2 folds. The D_2 fabrics are associated with south-directed shear zones, such as the Scrape fault, reverse faults and large-scale, east-trending folds that are open in the south, and tight in the north (Figure 2; Kidd *et al.*, 1978; Hibbard, 1983; Tremblay *et al.*, 1997; Castonguay *et al.*, 2009). The D_3 open, upright cross folds (F_4 of Castonguay *et al.*, 2009) have axial planes trending to the north-northeast in the Pacquet Harbour Group, and trend to north-northwest in Cape St. John Group. The doubly plunging synclinal form of the Betts Cove Complex is a result of F_3 refolding of an F_2 syncline (Figure 2; Spicer, 2008). Along the BVL, D_2 fabrics are overprinted by a south-southwest-trending S_3 fabric and east-directed shear zones (Kidd, 1974; Hibbard, 1983). The D_2 and D_3 structural phases are interpreted to be penecontemporaneous and associated with an overall Silurian sinistral transpressional regime localized along the BVL and subsidiary faults (Waldron *et al.*, 1998). This composite deformation was responsible for exhumation of the Fleur de Lys Supergroup (429–417 Ma; $^{40}Ar/^{39}Ar$; Jamieson, 1990; Castonguay *et al.*, unpublished data, 2010), and contributed to burial and metamorphism of ophiolite and cover rocks east of the BVL (425–405 Ma; U–Pb and $^{40}Ar/^{39}Ar$; Anderson *et al.*, 2001).

East of the BVL, D_4 structures (*i.e.*, D_3 of Castonguay *et al.*, 2009, Pacquet Harbour area D_2 of Anderson, 1998, and D_L of Hibbard, 1983) are mainly recognized in the northern part of the peninsula as shallowly inclined to recumbent, open to tight southeast-plunging F_4 folds, cogenetic with northwest- and southeast-dipping ductile–brittle extensional shear zones (Anderson, 1998; Anderson *et al.*, 2001). D_4 is well developed in, and along, contacts of the Ming's Bight Group, where it is associated with an amphibolite-facies assemblage (405–370 Ma; U–Pb and $^{40}Ar/^{39}Ar$; Anderson, 1998; Anderson *et al.*, 2001). In the Point Rousse Complex, reactivations of D_2 high-strain zones suggest north-side down, normal motion (Kidd *et al.*, 1978; Castonguay *et al.*, 2009). The D_4 regional deformation is associated with an overall dextral strike-slip (transpressional to transtensional) regime during the Acadian Orogeny (Waldron *et al.*, 1998; Anderson *et al.*, 2001).

EARLY TO MIDDLE ORDOVICIAN ROCKS OF THE EASTERN BAIE VERTE PENINSULA

BETTS COVE COMPLEX

The Betts Cove Complex (Hibbard, 1983; Betts Cove Ophiolite of Bédard *et al.*, 2000a; Figures 2 and 3) comprises a lower ultramafic cumulate section, overlain by layered gabbros, massive gabbro (transitional to sheeted dykes), sheeted dykes, and pillowed boninites of the Betts Head Formation (Bédard *et al.*, 2000a). Boninites in the Betts Head Formation are subdivided into low-Ti (0.1–0.3%; Figure 4a) boninite and overlying, intermediate-Ti boninite (0.3–0.5%; Coish and Church, 1979; Bédard *et al.*, 2000a). The low-Ti boninites are aphyric or contain small phenocrysts of olivine, orthopyroxene, chromite ± clinopyroxene. The pillows are generally small (10 cm to 1 m) and have wide, diffuse pillow margins containing small (0.5 to 3 mm) varioles, with partly coalesced, larger varioles in pillow interiors. The intermediate-Ti boninites are either aphyric or contain small phenocrysts of clinopyroxene and plagioclase (Bédard *et al.*, 2000a). Rare, thin felsic (trondhjemite) hypabyssal rocks occur within the sheeted dyke units and within the contact zone with the overlying lower Betts Head Formation (Upadhyay, 1973). Underlying layered cumulates include dunite, harzburgite and their serpentinized equivalents, overlain by pyroxenite and gabbro. These have compositions that are calculated to have equilibrated with low-Ti boninitic magmas (Bédard *et al.*, 2000a). The Late Intrusive Suite is the plutonic equivalent of inter-

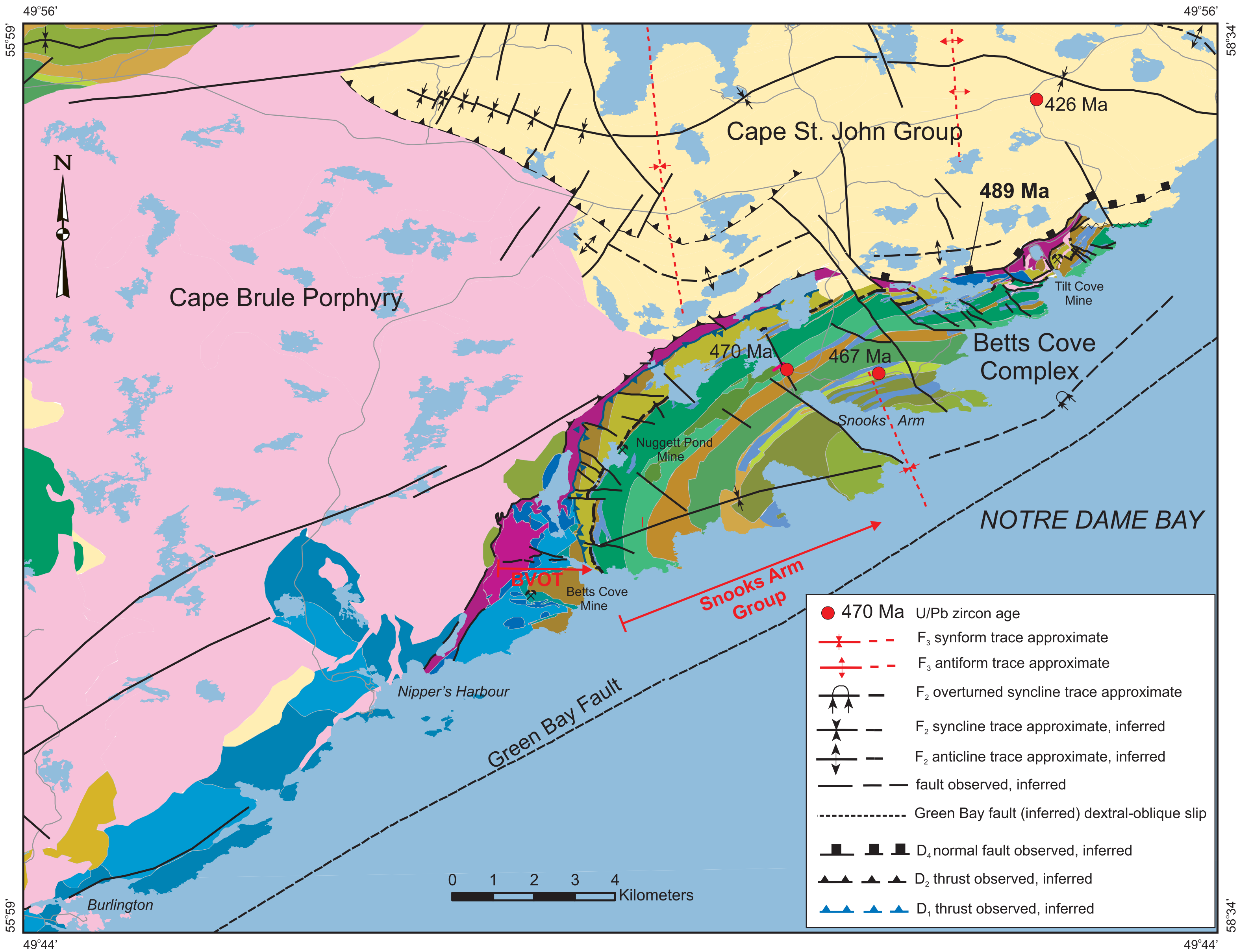

Figure 2. *Geology of eastern Baie Verte Peninsula. Based on data from this study and compiled data from Bédard* et al. *(2000a, b) and Colman-Sadd and Crisby-Whittle (2002; and references therein).* See *legend in Figure 3.*

Figure 3. *Legend to accompany Figures 2, 5, 6 and 7 with emphasis on the Ordovician.*

mediate-Ti boninites and is composed of predominantly massive to layered gabbro and gabbro norite with subordinate hornblende diorite and trondhjemite found as sheets in the dyke section and cutting layered gabbros (Bédard *et al.*, 2000a). A Late Intrusive Suite gabbro on Long Pond yielded a U–Pb age of *ca.* 489 Ma (Dunning and Krogh, 1985) and dates the formation of the Betts Cove Complex.

Contrary to the stratigraphy defined by Bédard *et al.* (2000a), we also include the volcanic rocks of the Mount Misery Formation in the Betts Cove Complex, rather than in the Snooks Arm Group (Figures 2 and 3). The Mount Misery Formation is composed of plagioclase-phyric, pillowed island-arc tholeiitic basalts that are chemically transitional to, and interbedded with, intermediate-Ti boninites (Figure 4a). The top of the Mount Misery Formation locally contains mafic- and ultramafic-derived breccia and conglomerate. Pillow breccias of the Mount Misery Formation host Cyprus-style gold-rich volcanogenic massive sulphide (VMS) copper deposits at the Tilt Cove Mine (Sangster *et al.*, 2008).

SNOOKS ARM GROUP

The Snooks Arm Group (Figure 2; Bédard *et al.*, 1999) represents the cover sequence to the Betts Cove ophiolite. However, as outlined above, the Mount Misery Formation is herein included within the upper part of the ophiolitic

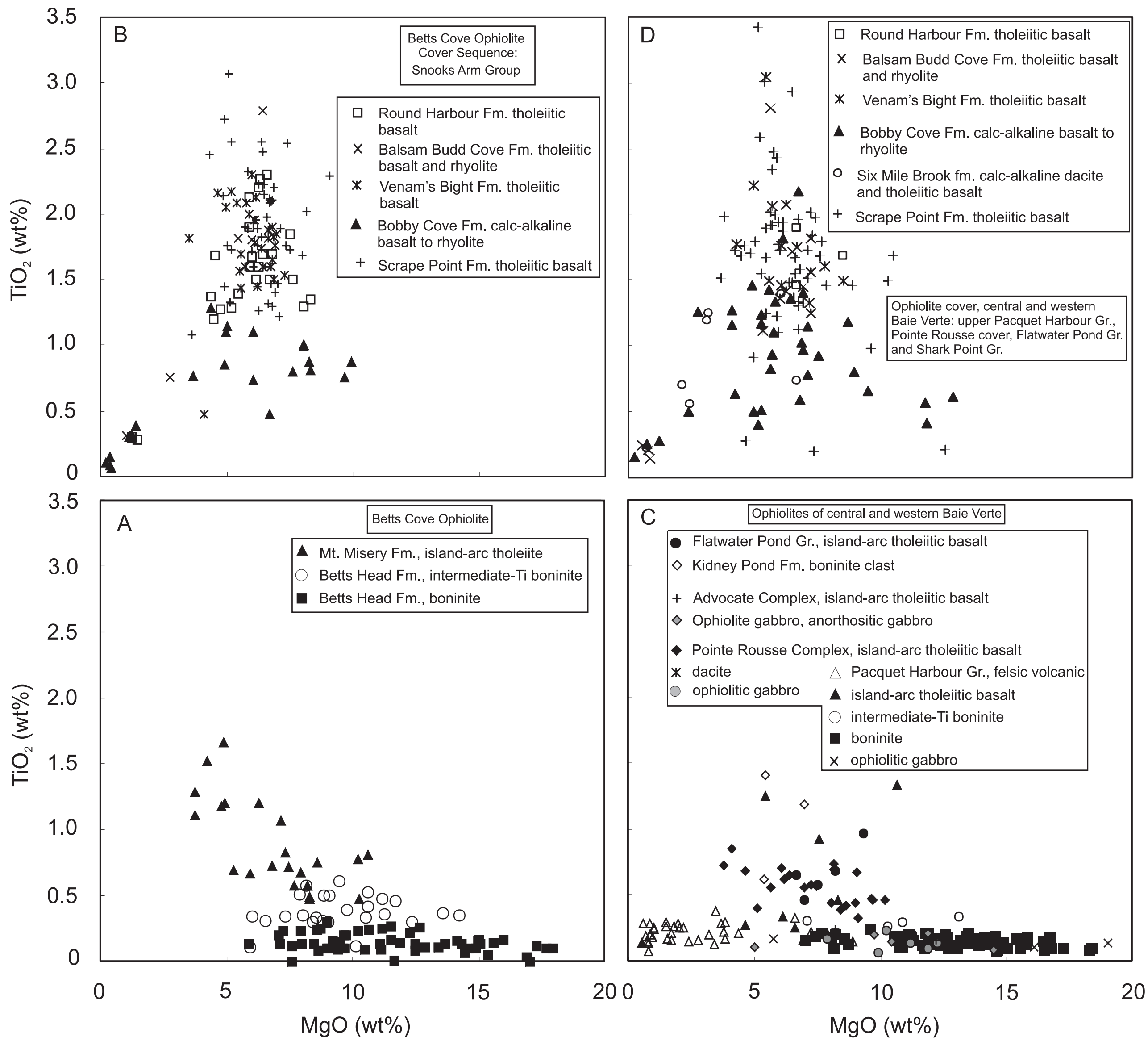

Figure 4. *TiO_2 versus MgO diagram. A) Volcanic rocks of the Betts Head and Mount Misery formations, Betts Cove Complex. Data from Bédard (2000b) and references therein. B) Volcanic rocks of the Snooks Arm Group (*see *A for data sources). C) Ophiolite-related, boninites and island-arc tholeiitic rocks of the southern Pacquet Harbour Group, Point Rousse Complex, Flatwater Pond Group and Advocate Complex. Data from this study, Gale (1971), Kambampati (1984) and Piercey (1996). D) Ophiolite volcanic cover of the Pacquet Harbour Group, Point Rousse cover sequence, Flatwater Pond Group and Shark Point Group (*see *data sources from C above).*

sequence, rather than with the cover sequence. Consequently, the Scrape Point Formation becomes the stratigraphically lowest part of the Snooks Arm Group (Figure 3).

The lowermost part of the Scrape Point Formation is called the Nugget Pond horizon, which is composed of a local basal conglomerate or breccia of basalt clasts cemented by jasper (*cf.*, Sangster *et al.*, 2008), overlain by red siltstones and shale, and jasper–magnetite iron formation (Plate 1a). These rocks host the Nugget Pond gold deposit, where they are affected by an epigenetic albite–carbonate–quartz–pyrite alteration that contains gold associated with pyrite (Sangster *et al.*, 2008). These rocks are overlain by, (and interbedded with), coarser, green siltstone and tuffaceous greywacke. These clastic rocks are, in turn, overlain by, and locally interbedded with, mafic tuffs and tholeiitic, high-Ti (1.5–3.0%; Figure 4b), plagioclase-phyric pillow basalts.

The Bobby Cove Formation overlies the Scrape Point Formation and includes a distinctive, lower, calc-alkalic

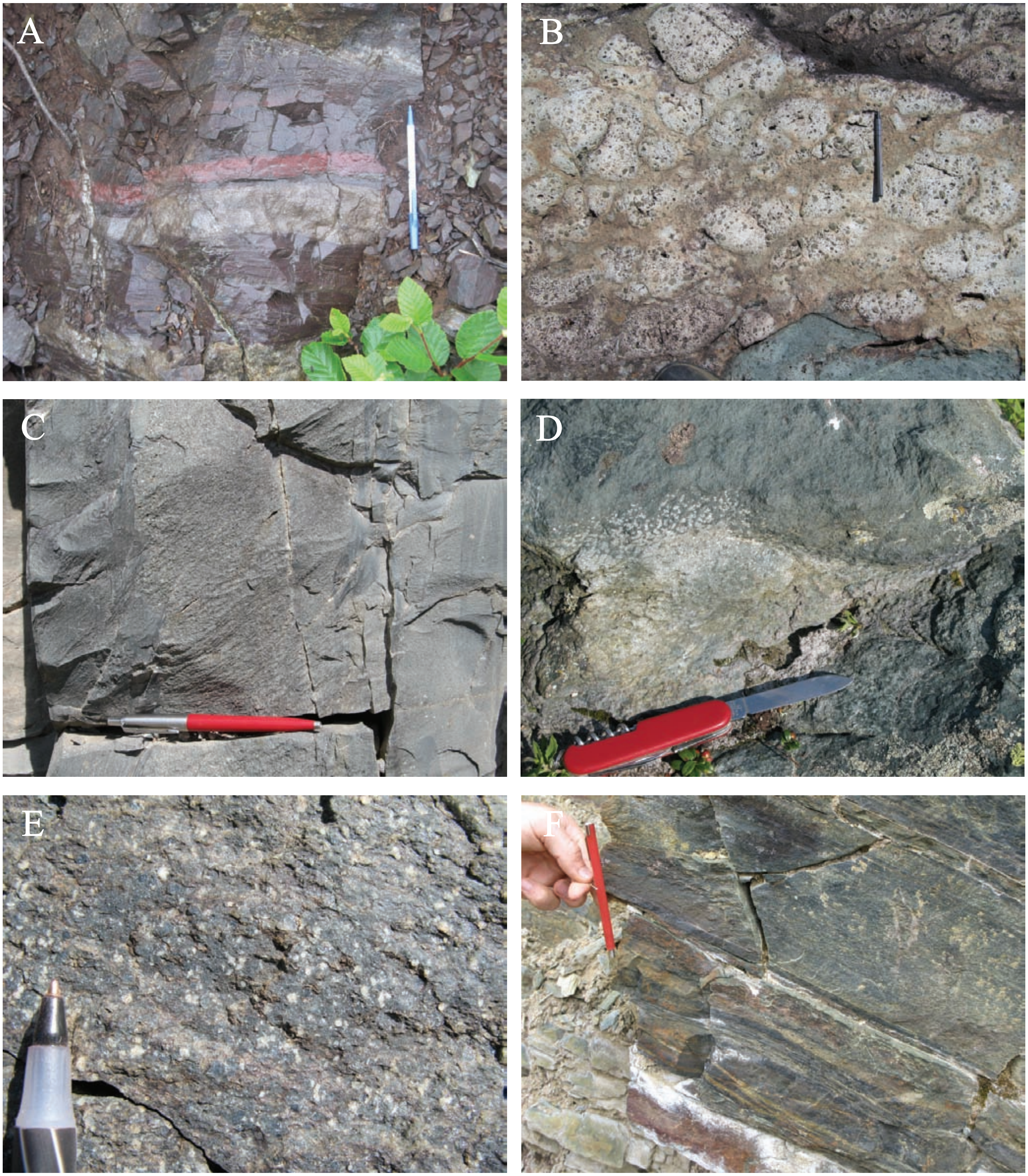

Plate 1. *A) Nugget Pond horizon, Scrape Point Formation with jasper, chert and red argillite beds. B) Photo of East Pond member, lower Bobby Cove Formation, Snooks Arm Group showing clinopyroxene-phyric andesitic tuff breccia. C) Photo of upper Bobby Cove Formation, turbiditic wacke, (Snooks Arm Group) showing younging to the southeast (right). D) Variolitic low-Ti boninite, southern Pacquet Harbour Group. E) Quartz and feldspar-phyric,* ca. *487 Ma Rambler rhyolite, southern Pacquet Harbour Group. F) Photo of magnetite iron formation and overlying normal-graded wacke overlying massive sulphide mineralization in Rambler Rhyolite formation, base of cover sequence at the Ming mine pit.*

marker unit, herein named the East Pond member, which is composed of green-grey, clinopyroxene megaphyric-tuff breccia (Plate 1b), -lapilli tuff and volcanic conglomerate. These are overlain by felsic crystal tuff (locally a lapilli tuff) that yielded a U–Pb zircon age of *ca.* 470 Ma (V. McNicoll, unpublished data, 2007; Figure 2). The mafic-dominated volcaniclastic rocks, including the East Pond member, occur as large lenses (up to 2 km wide) associated with calc-alkaline basaltic to andesitic lava flows, pillows and dykes (Figure 2). The upper Bobby Cove Formation is composed of green volcaniclastic greywacke and siltstone (Plate 1c), interbedded with purplish pelagic mudstone and rare, thin felsic tuff beds. Polymict conglomerate occurs locally and includes volcanic-derived clasts, as well as felsic plutonic and metamorphic schist clasts (Upadhyay, 1973; Church, 1977). Locally, a thin jasper iron formation and red argillite defines the top of the Bobby Cove Formation.

The overlying Venam's Bight Formation is composed of pillowed, amygdaloidal, tholeiitic, high-Ti (>1.5%; Figure 4b) basalts. The basalts are plagioclase-phyric, to glomerophyric, and rare aphyric flows. The pillowed basalts are locally interbedded with pillow breccia, hyaloclastite and mafic volcanic breccia, and layers of red siliceous mudstone or ironstone.

The Balsam Bud Cove Formation includes a Basal Member (Bédard *et al.*, 1999) consisting of interbedded red and green siltstone, shale and sandstone, turbiditic volcaniclastic rocks, tuffaceous sandstone and basaltic lavas similar to the underlying Venam's Bight Formation basalts (Figure 4b). These are succeeded by a sequence of quartz- and feldspar-phyric felsic tuffs, crystal tuffs and black sulphidic shale. The shales contain Laurentian graptolite fossils belonging to the lower *Didymograptus bifidus* Zone (early Llanvirn; Snelgrove, 1931). A sample of felsic tuff overlying the graptolitic shale yielded a U–Pb zircon age of *ca.* 467 Ma (V. McNicoll, unpublished data, 2007; Figure 2). The upper member consists of thick-bedded debris-flow deposits containing large fragments (up to 20 m) of massive and pillowed basalt, and smaller clasts of felsic tuff, pyroxenite, tuffaceous sandstone and microgabbro (Bédard *et al.*, 2000a).

The top of the Snooks Arm Group is the Round Harbour Formation. This is dominated by sheet and pillowed flows of tholeiitic basalt (Figure 4b) similar to the Venam's Bight basalts, interbedded with thin chert units. Pillows are large (up to 2 m in diameter), and are typically well preserved.

EARLY TO MIDDLE ORDOVICIAN ROCKS OF THE CENTRAL BAIE VERTE PENINSULA

PACQUET HARBOUR GROUP

Deformed and metamorphosed volcanic and sedimentary rocks of Ordovician age in the north central portion of the Baie Verte Peninsula have been assigned to the Pacquet Harbour Group (*e.g.*, Hibbard, 1983; Figures 1 and 5). These are spatially separated from the Betts Cove Complex and the Snooks Arm Group by the Silurian Cape Brulé Porphyry and Cape St. John Group. The lower Pacquet Harbour Group is a partial ophiolite sequence that includes boninites, associated felsic volcanic rocks and thin units of island-arc tholeiitic basalt. The upper Pacquet Harbour Group is an ophiolite cover sequence that includes tholeiitic mafic volcanic rocks, volcaniclastic and epiclastic fragmental rocks and calc-alkaline flows and fragmental rocks.

South of the Rambler mining camp, the lower Pacquet Harbour Group, consists of low-Ti boninites (Figure 4c and Plate 1d) with rare, thin (<50 m) cogenetic felsic tuffs and rhyodacitic flows (Hibbard, 1983; Piercey, 1996; Figure 5). These are cut by tholeiitic gabbro dykes that potentially feed overlying tholeiitic pillow basalts similar to those of the Scrape Point Formation in the Snooks Arm Group (Piercey, 1996). This sequence hosts the Big Rambler Pond stringer massive sulphide deposit and is overlain by interbedded lapilli tuff, tuff breccia and pillowed plagioclase-phyric, intermediate Ti boninite (Figures 4c and 5), island-arc tholeiitic basalt and a thin felsic tuff. The upper part of this sequence is repeated in the hanging wall of the Rambler Brook fault where it hosts the Rambler rhyolite. In this area, boninites are overlain by the 2.5 km wide sequence of quartz-phyric, rhyodacite, felsic tuff and tuff breccia named here, the Rambler Rhyolite formation (Figure 5 and Plate 1e). The upper parts of the Rambler Rhyolite formation host the volcanogenic massive sulphide deposits of the Rambler and Ming mines. These are locally overlain by thin lenses of island-arc basalt, similar to those found in the Mount Misery Formation. A sample of rhyolite immediately below the mineralization yielded a U–Pb zircon age of *ca.* 487 Ma (V. McNicoll, unpublished data, 2008; Figure 5).

The base of the upper Pacquet Harbour Group is a thin (<1 m) sequence of black chert and magnetite iron formation overlain by a thick (*ca.* 450 m) sequence of volcanic

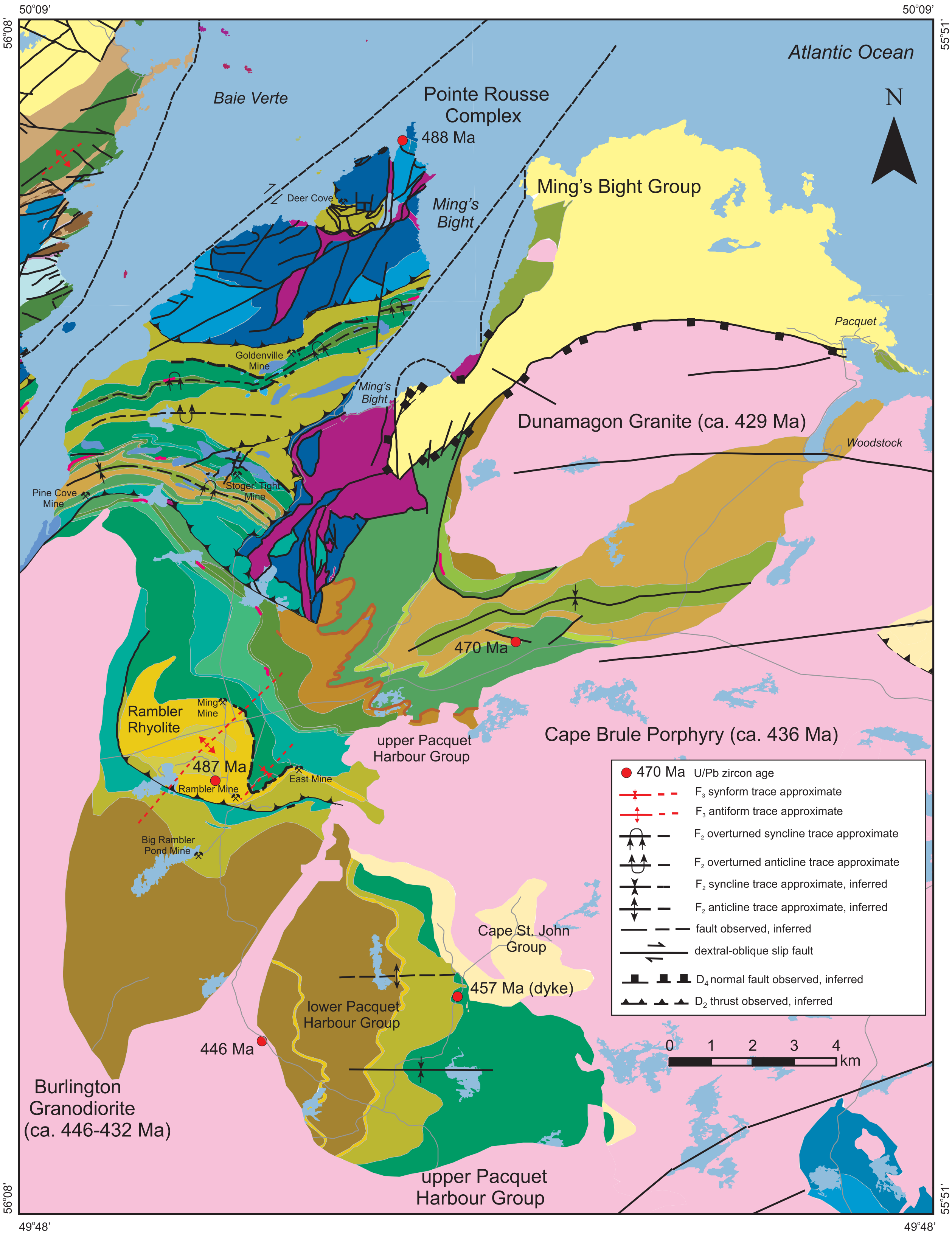

Figure 5. *Geology of north-central Baie Verte Peninsula. Based on data from this study and compiled from Gale (1971), Tuach and Kennedy (1978), Hibbard (1983 and personal communication 2006), Kambampati (1984), Christie and Dearin (1986), Huard (1990), and Piercey (1996).* See *legend in Figure 3.*

conglomerate, epiclastic wacke and high-Ti tholeiitic basalts (Figure 4d) that occur in the hanging-wall sequence of the Big Rambler Pond deposit, and overlie massive sulphide lenses at the top of the Rambler Rhyolite formation in the Ming and Rambler mines area (*cf.*, Gale, 1971; Tuach and Kennedy, 1978; Plate 1f). The conglomerates are polymict and contain angular clasts of boninite, felsic volcanic and diorite clasts in a green, chloritic matrix. This sequence is overlain by pillowed calc-alkaline (Figure 4d) basalt and clinopyroxene (replaced by actinolite) -phyric tuff breccia, overlain by mafic turbiditic wacke (Plate 2a), siltstone and an upper magnetite iron formation. These rocks are overlain by tholeiitic pillow basalts that are geochemically similar to the Venam's Bight Formation (Figure 4d), which are in turn overlain by shale, wacke, felsic tuff and lapilli tuff. This part of the sequence includes a felsic tuff that gave a U–Pb age of *ca.* 470 Ma (V. McNicoll, unpublished data, 2008; Figure 5 and Plate 2b). The top of the volcanic sequence comprises pillowed tholeiitic basalts and mafic epiclastic rocks that are similar to those of the Round Harbour Formation (Figure 5; Plate 2c).

POINT ROUSSE COMPLEX

The Point Rousse Complex is composed of a dismembered ophiolite complex and a volcanic cover sequence (Figure 5). The lower ophiolite comprises mantle harzburgite (in Ming's Bight; Figure 5) boninitic ultramafic cumulates, pyroxenite, layered gabbro (Figure 2d), anorthosite gabbro, and thin segregations of trondhjemite. A sample of trondhjemite, hosted by layered gabbro, yielded a U–Pb zircon age of *ca.* 489 Ma (V. McNicoll, unpublished data, 2009; Figure 5, Plate 2e). Although the sheeted dyke unit (Plate 2f) includes numerous low-Ti boninite dykes, only a thin unit of boninite is exposed in the ophiolite (Figures 4c and 5). Late diabase dykes of island-arc tholeiitic basalt affinity cut the sheeted dyke complex. The core of an anticline in the southern half of the Point Rousse Peninsula exposes intermediate boninite andesite associated with nearby sulphide mineralization (Gillard Pond in Figure 5; *cf.*, Hibbard 1983). However, there are thick, structurally imbricated (and folded) panels of pillowed basalts of island-arc tholeiitic affinity (Figure 4c) that are petrographically and chemically similar to those of the Mount Misery Formation rocks in the Betts Cove area. These tholeiitic volcanic rocks are present throughout the Point Rousse Peninsula.

The cover sequence to the ophiolitic rocks on Point Rousse (Figure 5) are composed of a lower banded magnetite and jasper iron formation (termed the Goldenville horizon; Plate 3a), overlain by mafic tuffs and high-Ti tholeiitic basalts that are geochemically similar to basalts in the Scrape Point Formation (Figure 4d). A minimum age estimate for the lower cover sequence is provided by the Stog'er Tight gabbro sill (Figure 7). Examination of detailed geological mapping (1:2500 scale; Huard, 1990), geochronological and geochemical data (Ramezani, 1992) reveal that the Stog'er Tight gabbro sill intrudes the lower cover sequence between a basal oxide iron formation that overlies island-arc tholeiitic basalt, and overlying high-Ti tholeiitic basalts. The gabbro has an imprecise U–Pb age of 483 +8.7/-4.8 Ma (Ramezani, 1992), which is interpreted here as an estimate of the crystallization age of the gabbro, and is a minimum age estimate (albeit with large errors) of the lower cover sequence. The high-Ti tholeiitic basalts are overlain by calc-alkaline basalt (Figure 4d), clinopyroxene-phyric tuff and tuff-breccia (Plate 3b), and mafic epiclastic wackes and conglomerates capped by iron formation. These rocks are overlain by high-Ti tholeiitic basalts that are similar to the Venam's Bight Formation, followed by mafic epiclastic and volcaniclastic rocks, and a sequence of tholeiitic pillow basalts similar to those of the Round Harbour Formation (Figure 4d).

FLATWATER POND GROUP

The ophiolite cover sequence that extends along the east side of the BVL from Baie Verte to MicMac Lake was named the Flatwater Pond Group by Hibbard (1983; Figure 6). The Flatwater Pond Group was distinguished from other cover sequences by the presence of conglomerate. Although undated, granitoid clasts in the conglomerate that resemble the Burlington granodiorite, led Hibbard (1983) and subsequent workers to suggest that this sequence may be Silurian.

Island-arc tholeiitic basalts, associated with felsic tuffs and VMS mineralization, are chemically indistinguishable from the Mount Misery Formation (Figure 4c), and constitute a local ophiolitic basement to the Flatwater Pond Group north of Flatwater Pond (Figure 6). These basalts are overlain by oxide-facies banded iron formation (Dunsworth, 2004; Figure 6a). South of Flatwater Pond, the base of the sequence is not exposed due to faulting associated with the BVL; however, abundant coarse-grained conglomerate and megabreccia occur at the lowest observed stratigraphic position (Kidd, 1974). A unit informally named the 'Boudin Pond conglomerate' by Kidd (1974), and informally renamed Fox Pond formation here, contains clasts of ophiolitic gabbro (Plate 3c), up to 100 m in diameter, surrounded by a dark-grey-green chloritic matrix. South of Flatwater Pond, this unit is either in fault contact, or, locally conformable, with overlying mafic volcaniclastic rocks, and subordinate green and grey, and minor black and maroon, banded argillite, cherty argillite, thin limestone beds and shaly intraformational conglomerate that Kidd (1974) informally called the Teardrop Pond formation.

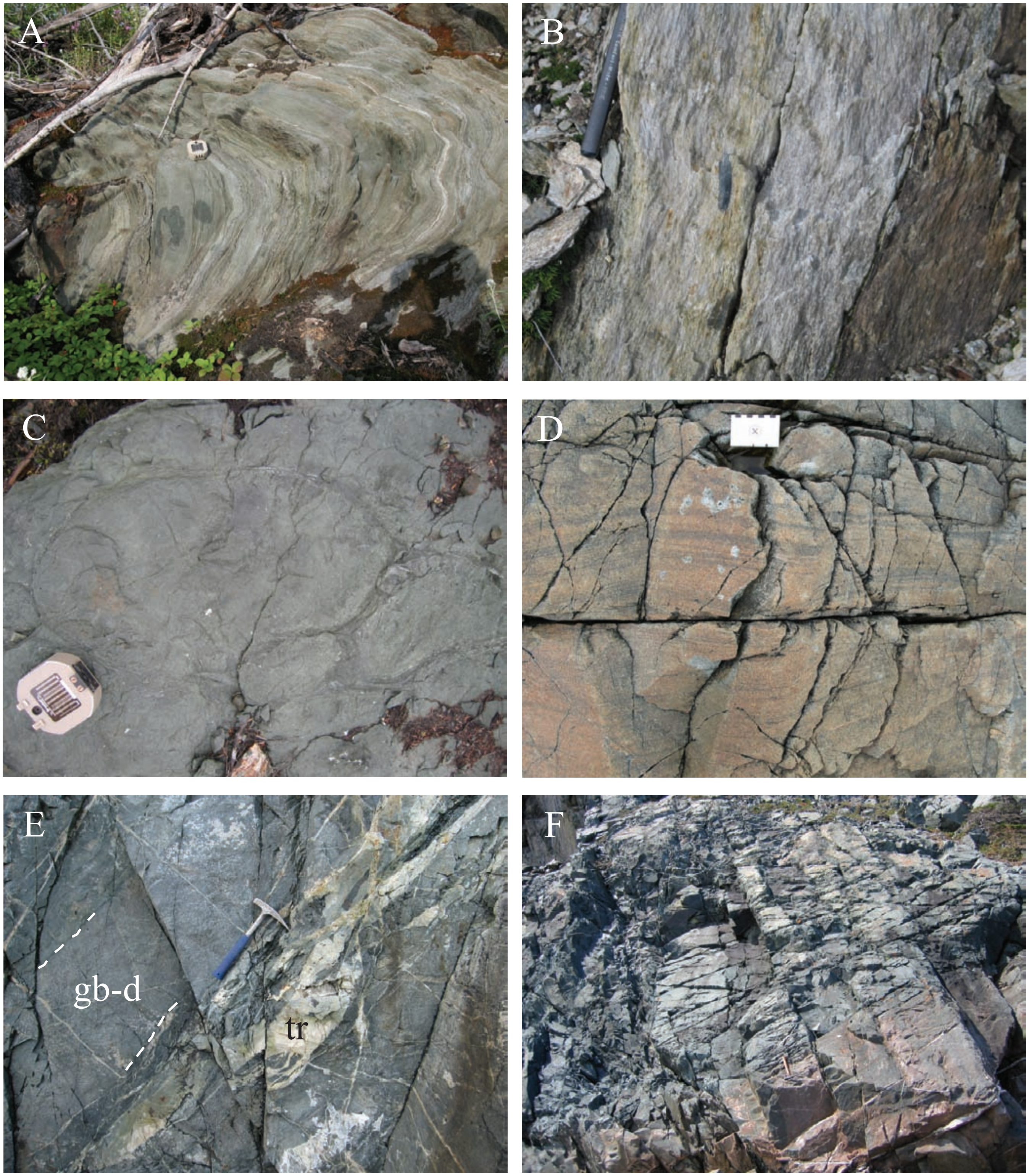

Plate 2. *A) Volcanic-derived, turbiditc wacke and metasiltstone, cover sequence, upper Pacquet Harbour Group. B) Photo of felsic lapilli tuff dated at* ca. *470 Ma, with lithic clast, upper Pacquet Harbour Group. C) Plagioclase-phyric, tholeiitic basalt, upper Pacquet Harbour Group. D) Layered pyroxenite, melagabbro cumulate, Point Rousse ophiolite complex. E) Trondhjemite dykes dated at* ca. *489 Ma, cutting sheeted gabbro dykes, Point Rousse ophiolite complex; gb-d -gabbro dyke; tr - trondhjemite. F) Sheeted boninitic gabbro dykes, Point Rousse ophiolite complex.*

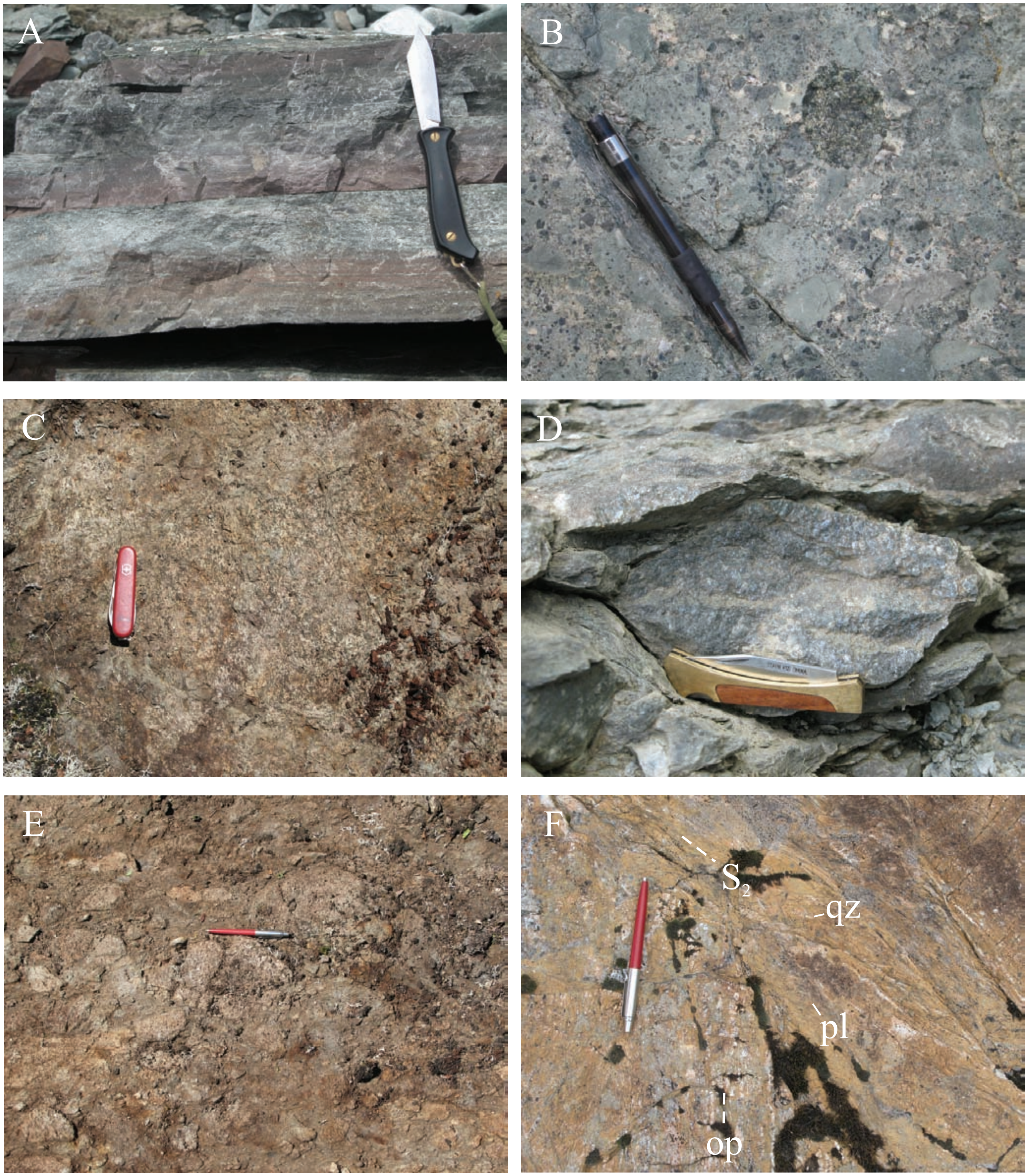

Plate 3. *A) Photo of Goldenville horizon, base of Point Rousse cover sequence showing magnetite iron formation, red argillite and green wacke beds. B) Photo of clinopyroxene-phyric tuff breccia with clinopyroxenite cognate xenoliths, Point Rousse cover sequence. C) Photo of ophilolite-derived, flaser gabbro boulder clast, lower Flatwater Pond Group. D) Photo of a quartzite clast, Kidney Pond formation, Flatwater Pond Group. E) Photo of granodiorite pebbles (dated at 479 Ma nearby) in polymict conglomerate, Kidney Pond formation. F) Photo of mantle harzburgite, Advocate Complex west of Flatwater Pond showing primary orthopyroxene fabric (op) and crosscutting S_2 shear zone; qz - quartz; pl - plagioclase.*

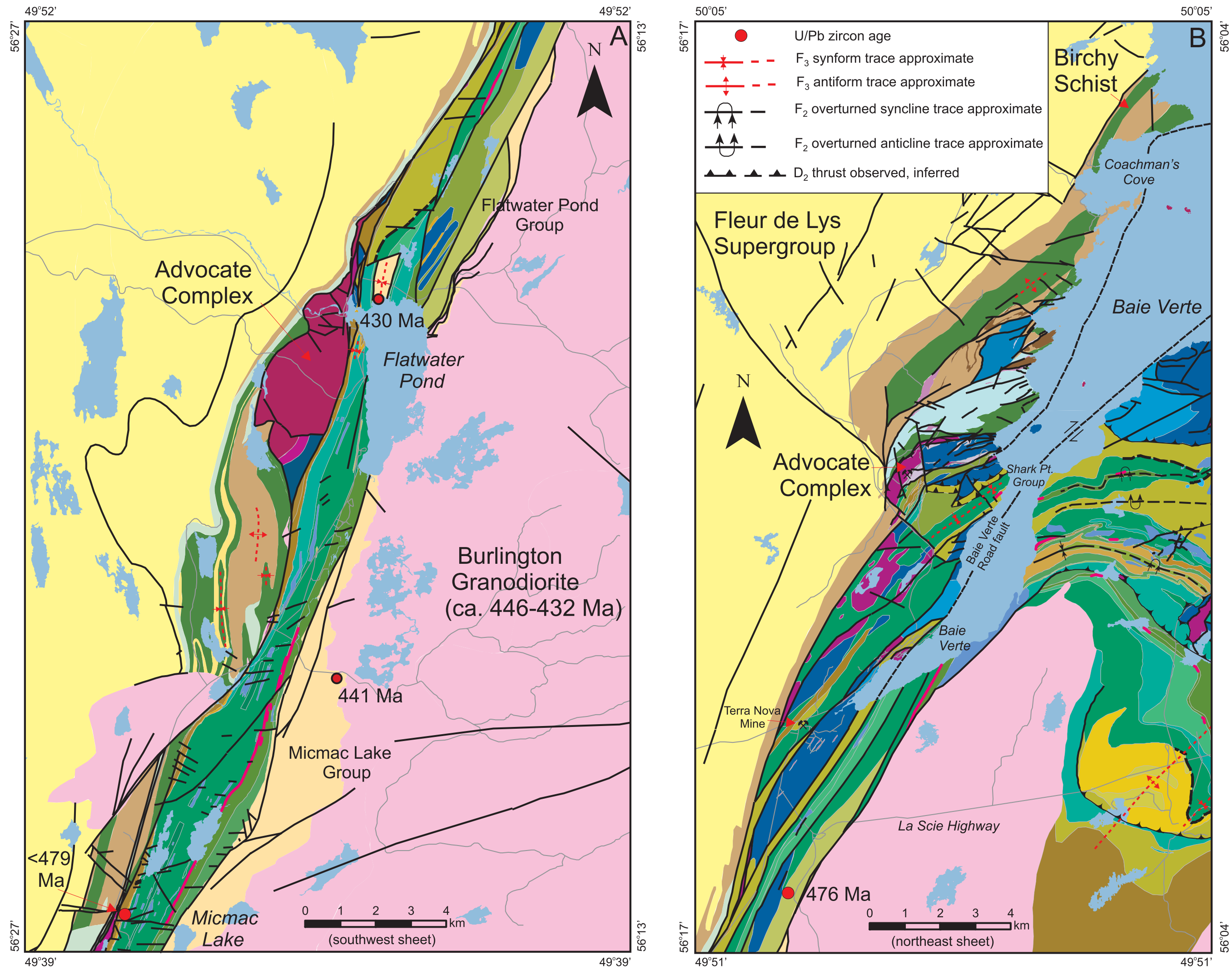

Figure 6. *Geology of western Baie Verte Peninsula. Based on data from this study and compiled data from Kidd (1974), Bursnall (1975), Hibbard (1983) and Dunsworth (2004). A) Southern part, North of Mic Mac Lake to Flatwater Pond area. B) Northern part, Baie Verte area. Note small duplication where cut.* See *legend in Figure 3.*

Lenses of conglomerate comprising the Kidney Pond formation (Kidd, 1974; later Kidney Pond conglomerate of Hibbard, 1983) locally overlie the Fox Pond formation. These polymict conglomerates have a mud- to sand-size grey–black matrix and contain pebble- to boulder-size clasts of ophiolite-derived gabbro, flaser gabbro, boninite (rare) and basalt, as well as quartzite (Plate 3d) and limestone (rare). Granite (Plate 3e), jasper and felsic volcanic clasts also occur. Two samples of Kidney Pond conglomerate were dated. A sample containing abundant felsic volcanic clasts yielded detrital zircon ages ranging from *ca.* 2550 to 550 Ma likely reflecting sediment input from the adjacent continental margin (V. McNicoll, unpublished data, 2009). A second sample collected north of Mic Mac Lake, contained large granitoid clasts and these yielded an age of *ca.* 479 Ma (V. McNicoll, unpublished data, 2009; Figure 6a) that provides a maximum age for deposition of the conglomerate. The source of granitoid clasts in the Kidney Pond conglomerate is uncertain as they are significantly older than any dated part of the Burlington granodiorite (oldest phase is *ca.* 446 Ma). The Kidney Pond formation is overlain by high-Ti tholeiitic basalts that are geochemically similar to basalts in the Scrape Point Formation (Figures 4d and 6a). Thin (<50 m) units of pink sericitized felsic tuff southwest of Flatwater Pond occur within tholeiitic pillow basalts that overlie the Kidney Pond formation. These felsic rocks are correlated with calc-alkaline dacite, felsic lapilli tuff and pink sericitized tuff that are included here in the Six Mile Brook formation and exposed in a fault-bounded panel along the northeastern margin of the Flatwater Pond Group (Figure 6). Dacite within the Six Mile Brook formation unit has a U–Pb zircon age of *ca.* 476 Ma and contains inherited grains up to

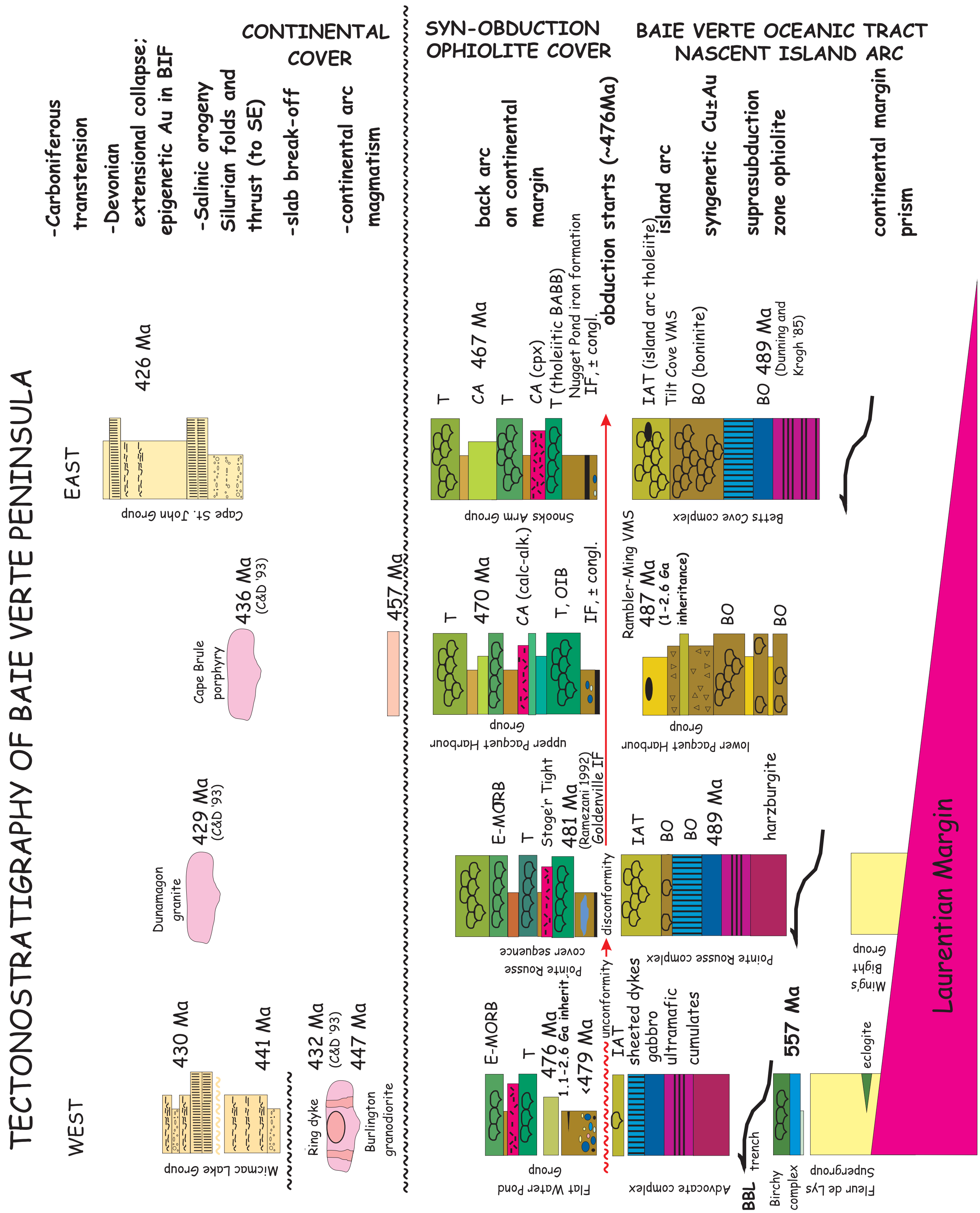

Figure 7. *Tectonostratigraphy of Baie Verte Peninsula.*

2600 Ma (V. McNicoll, unpublished data, 2007; Figure 6b). Overlying the tholeiitic basalts and Six Mile Brook formation is a laterally persistent, thin sequence of calc-alkaline clinopyroxene-phyric lapilli tuff and crystal tuff (Prairie Hat I member of Kidd 1974). These rocks are overlain by calc-alkaline basalt, mafic volcaniclastic rocks and an uppermost unit of high-Ti, tholeiitic pillow basalts that are similar to those of the Venam's Bight Formation (Figure 4d).

ADVOCATE COMPLEX

The Advocate Complex is the westernmost fragment of ophiolite crust on the Baie Verte Peninsula (Figure 6) and is separated from the ancient continental margin rocks by the Birchy Complex (Bursnall, 1975; Hibbard, 1983). The Advocate Complex includes serpentinized mantle harzburgite with discordant dunite pods and dykes (Plate 3f), in mostly tectonic contact with boninitic, serpentinized ultramafic cumulates, layered gabbro, boninitic anorthositic gabbro (clinozoisite-quartz rock), gabbro, sheeted dykes and rare, tectonic slices of mafic volcanic rocks. Most of the pillowed volcanic section of the ophiolite is missing either through faulting or erosion. Pillowed island-arc tholeiitic basalts similar to those of the Mount Misery Formation (Figure 4c) occur in tectonic slivers along the Baie Verte Highway and are locally associated with massive sulphide mineralization (*e.g.*, at the old Terra Nova Mine; Figure 6b). Gabbro dykes of island-arc tholeiitic affinity cut ophiolitic gabbro in the town of Baie Verte, and may represent feeders to these volcanic rocks.

The Advocate volcanic cover sequence was named the Shark Point group by Bursnall (1975). Stratigraphic younging is rare and numerous faults disrupt the stratigraphy along the BVL; these factors complicate subdivision and interpretation. The ophiolite southeast of the Advocate pit is adjacent to ophiolite-derived conglomerate, megabreccia containing gabbro rafts and argillite. These units are now covered in mine tailings, but are described by Bursnall (1975). They appear to be similar to the Fox Pond formation and shales found within the Flatwater Pond Group (*see* above). At Shark Point itself, located southeast of the old Advocate wharf, island-arc tholeiitic basalt lies structurally beneath high-Ti, tholeiitic basalt (Figures 4c and 6b).

INTEGRATED STRATIGRAPHY AND IMPLICATIONS

Previous studies of the BVOT on the Baie Verte Peninsula, have tended to highlight the differences between the various packages of Early to Middle Ordovician volcanic and sedimentary rocks, that occur between the Betts Cove Complex and Snooks Arm Group in the east, and the Flatwater Pond Group in the west (*i.e.*, Hibbard, 1983). New and compiled geochemical and geochronological data, in combination with detailed mapping and geophysical studies, now enable correlations between these different packages, despite the different styles and intensity of superimposed deformation (Figure 7). As the sequence at Betts Cove is the least deformed and best exposed example of the BVOT in the Baie Verte Peninsula, the stratigraphic sequence developed by Bédard *et al.* (1999, 2000a) is used as the template to anchor the correlations.

STRATIGRAPHIC TEMPLATE OF THE BETTS COVE AREA

Bédard *et al.* (1999, 2000a) defined the Betts Cove ophiolite (Betts Cove Complex of Hibbard, 1983) as consisting of a lower ultramafic cumulate section, overlain by layered gabbros, massive gabbro (transitional to sheeted dykes), late gabbro sheets related to intermediate-Ti boninites and dated at *ca.* 489 (Dunning and Krogh, 1985), sheeted dykes, and pillowed boninites of the Betts Head Formation. It is here suggested that volcanic rocks of the Mount Misery Formation be included in the Betts Cove Complex, rather than in the overlying Snooks Arm Group. The Mount Misery Formation contains plagioclase-phyric, pillowed island-arc tholeiitic basalts that are chemically transitional to, and interbedded with, intermediate-Ti boninites (Figure 4a) like those found in the underlying Betts Head Formation. Furthermore, the overlying Scrape Point Formation is locally separated from the Mount Misery Formation by an angular unconformity (Bédard *et al.*, 1999) and is marked at its base by conglomerate or breccia and iron formation. In light of these factors, it seems reasonable to redefine the base of the Snooks Arm Group as the boundary between the Mt. Misery and Scrape Point Formations (Figures 3 and 7), rather than at the base of the Mount Misery Formation (Bédard *et al.*, 2000a).

The Snooks Arm Group as defined represents the ophiolitic cover sequence to the Betts Cove Complex. The Scrape Point Formation is now defined as the stratigraphically lowest part of the Snooks Arm Group. The stratigraphy of the Scrape Point and Bobby Cove Formations are important in understanding proposed correlations amongst the cover sequences to the ophiolites. Its lowermost unit (the Nugget Pond horizon) comprises a local basal conglomerate or breccia of basalt clasts cemented by jasper, overlain by red siltstones and jasper–magnetite iron formation. Mixed volcanic and ultramafic breccia at the top of the Mount Misery Formation on Long Pond (Bédard *et al.*, 2000a), may also be interpreted as a breccia at the base of the overlying Scrape Point Formation.

The Bobby Cove Formation overlies the Scrape Point Formation and includes a very distinctive, green-grey, clinopyroxene-phyric tuff-breccia that is informally referred to herein as the East Pond member. This unit is very similar to the 'Prairie Hat member' described by Kidd (1974) within the Flatwater Pond Group and Point Rousse Complex, and also to similar clinopyroxene-phyric tuffs described by Hibbard (1983; and personal communication, 2006) in the upper Pacquet Harbour Group (Figures 2, 5, 6 and 7). The East Pond member is overlain by by felsic crystal tuff dated at *ca.* 470 Ma (V. McNicoll, unpublished data, 2007), followed by calc-alkaline basaltic to andesitic lava flows that are in turn overlain by turbiditic, volcaniclastic greywacke and conglomerate. Locally, a thin jasper iron formation and red shale defines the top of the Bobby Cove Formation.

These rocks, and also the sequence of mafic and felsic rocks in the overlying Venam's Bight, Balsam Bud and Round Harbour Formations, represent potential marker horizons. These distinctive marker horizons and related age determinations were used to anchor the stratigraphic sequences across the peninsula (Figure 7). Once such linkages are established, correlations can be extended into the underlying and overlying rock units. In some cases, these rock units are lithologically identical to those from the Betts Cove area. However, elsewhere there are clear differences in the rock types, which we sugget can be explained by different paleogeographic settings (Figure 7).

PACQUET HARBOUR GROUP AND POINT ROUSSE COMPLEX

Stratigraphic, geochemical and geochronological data reveal that the southern portion of the Pacquet Harbour Group contains low-Ti boninites and overlying intermediate-Ti boninites and less abundant island-arc tholeiitic basalts that are correlative, respectively, with the Betts Head and Mount Misery Formations of the Betts Cove Complex as defined by Bédard *et al.* (2000a; Figures 4c, 5 and 7; *cf.*, Hibbard, 1983). However, only the volcanic part of the ophiolite section is exposed (Hibbard, 1983) and it is overlain by upper Pacquet Harbour Group volcanic and sedimentary cover rocks that are equivalent to the Snooks Arm Group. Although there is no direct extrusive equivalent of the Rambler Rhyolite formation at Betts Cove, its *ca.* 487 Ma age is within error of the *ca.* 489 Ma of the Late Intrusive Suite gabbro related to intermediate-Ti boninite magmas in the Betts Cove Complex, indicating temporal equivalence. Thin flows of altered island-arc tholeiitic basalt that overlie the *ca.* 487 Ma Rambler Rhyolite formation, and are interbedded with intermediate-Ti boninites at Big Rambler Pond, are correlated with similar rocks in the Mount Misery Formation that host the Tilt Cove VMS deposit. Rare trondhjemitic hypabyssal rocks in the Betts Cove Complex associated with the Late Intrusive Suite occur in the sheeted dyke sequence (albite–quartz aplite of Upadhyay, 1973), are locally transitional with diabase gabbro and may represent shallow intrusive analogues of the Rambler Rhyolite formation.

The lower part of the Point Rousse Complex contains a dismembered intrusive section (Figures 5 and 7) that can be correlated with the lower Betts Cove Complex. It includes boninitic-layered cumulates, massive gabbro and sheeted dykes, locally cut by fine-grained gabbro dykes of both intermediate-Ti boninite and island-arc tholeiitic basalt affinity (*this study* and Norman and Strong, 1975). Rare, thin (<50 cm) dykes of trondhjemite cut the sheeted dyke section and occur as pegmatitic segregations in massive gabbros. A trondjhemite dyke yielded a zircon U–Pb age of *ca.* 489 Ma (V. McNicoll, unpublished data, 2009) and is within error of both the Late Intrusive Suite at Betts Cove (*ca.* 489 Ma), and the *ca.* 487 Rambler Rhyolite formation. The volcanic section of the Point Rousse Complex comprises fault-bound panels and axial culminations (Figure 5) of island-arc tholeiitic basalts that are correlative with the Mount Misery Formation. Low-Ti boninites are not preserved and intermediate Ti-boninites are rare and are interbedded with island-arc tholeiitic basalts in the lower part of the central thrust sheet on Ming's Bight, and as thin, siliceous flows northeast of Gillard Pond (Figure 5).

The upper Pacquet Harbour Group and Point Rousse cover sequences can be correlated with the Snooks Arm Group. Magnetite iron formation and black chert (Plate 1f) situated above the massive sulphide horizon in the Ming and Rambler mines area is considered to correlate with the Nugget Pond horizon of the Scrape Point Formation in the Betts Cove area (Figure 7). This sequence is also developed in the Point Rousse Complex where the lower iron formation and red argillites of the Goldenville horizon occupy the same position as the Nugget Pond horizon in the Scrape Point Formation (Figure 7). These rocks are also logically correlated as a member within the Scrape Point Formation.

Another key marker unit is the distinctive clinopyroxene-phyric tuff of the East Pond member that is recognized within the lower Bobby Cove Formation in the Betts Cove area (Figures 2 and 7). Calc-alkaline pyroxene-phyric tuff and tuff breccia present in the Point Rousse Complex and upper Pacquet Harbour Group is interpreted as the East Pond member marker horizon near the base of the Bobby Cove Formation, forming a direct connection to the stratigraphy of the Snooks Arm Group (Figures 5, 6 and 7). Interbedded calc-alkaline basalts and overlying turbiditic wackes and upper iron formation that resemble the lower and upper Bobby Cove Formation are found in the upper Pacquet Harbour Group and on Point Rousse.

The stratigraphically higher units within the upper Pacquet Harbour Group and Point Rousse Complex, although not as distinctive as those of the Nugget Pond horizon and East Pond member, are petrographically, geochemically and geochronologically consistent with the sequence of rocks in the Snooks Arm Group (Figures 3, 4d, 5 and 7). Thus it is expected that these sequences will be formally stratigraphically linked in the near future.

ADVOCATE COMPLEX AND ITS COVER SEQUENCES: FLATWATER POND, AND SHARK POINT POND GROUPS

The Advocate Complex includes a tectonized section of mantle harzburgite and dismembered crustal section that can be correlated with the Betts Cove and Point Rousse Complexes (Figures 6 and 7). However, as in the case of the Point Rousse Complex, a thick boninite section similar to the Betts Head Formation is absent and may have been tectonically removed and/or eroded. The latter seems likely in light of the boninitic affinities of its intrusive rocks; the structurally deeper ophiolite section exposed; and the presence of thick, ophiolite-derived (including boninitic gabbro and pillowed boninite clasts) megabreccia and conglomerate in the adjacent lower Flatwater Pond and Shark Point groups (Figure 7). The base of the ophiolite is exposed along the BVL and includes a thick mantle harzburgite section east of Flatwater Pond (Figure 6a). The Advocate Mine section includes boninitic-layered ultramafic cumulates, layered and massive gabbro, anorthositic gabbro and hydrothermally altered trondhjemite, and sheeted dykes of island-arc tholeiitic basalt affinity. Part of the missing extrusive sequence of the Advocate Complex is now recognized as fault-bound slivers within the Flatwater Pond and Shark Point groups. Island-arc tholeiitic basalts occur in the Flatwater Pond and Shark Point groups (Figure 4c) and resemble those of the Mount Misery Formation, and significantly, locally host massive sulphide mineralization at the Terra Nova Mine (Figure 6b) and at scattered showings near the Baie Verte Highway. These form ophiolite basement to cover rocks that include many of the stratigraphic elements of the lower to middle Snooks Arm Group.

Although previous studies suggested that the Flatwater Pond Group was a younger (Silurian) cover sequence (Hibbard, 1983), unpublished stratigraphic, lithogeochemical and geochronological data now indicate that its lower section (above the island-arc tholeiitic basalts) is approximately coeval with the lower part of the Snooks Arm Group. The age of the lower Flatwater Pond Group is constrained to be <479 Ma (age of granodiorite clast in Kidney Pond formation) and *ca.* 476 Ma (age of Six Mile Brook formation). These ages are consistent with the age range of the Scrape Point Formation at Betts Cove (<489 Ma >470 Ma; Figure 2), in the upper Pacquet Harbour Group (<487 Ma >470 Ma; Figure 5), and overlying the Point Rousse Complex (<488 Ma and *ca.* 483 +8.7/-4.8 Ma; Figure 5). However, there are some significant lithological and textural contrasts between the Flatwater Pond and Shark Point groups and these sequences. The base of the Snooks Arm Group is marked by chert and iron formation overlying conglomerate and breccia, whereas the lower Flatwater Pond and Shark Point groups contains ophiolite-derived, megaconglomerate of the Fox Pond formation, and are overlain by black and red argillites that may be correlative with the Nugget Pond horizon. The Fox Pond formation is not laterally persistent, and north of Flatwater Pond, island-arc tholeiitc basalts (correlated with the Mount Misery Formation) are overlain by a thick-banded iron formation that is likely equivalent to the Nugget Pond horizon. The lower Scrape Point conglomerates at Betts Cove may be distal, basinal equivalents of the Fox Pond formation (Figure 7). Polymict conglomerates are present in the lower Scrape Point Formation and include clasts of basalt and peridotite, as well as in sedimentary rocks of the upper Bobby Cove Formation where they include clasts of granodiorite, amphibolite, pelitic schist, actinolite schist and rhyolite in a wacke matrix containing detrital chromite (Church, 1969). The correlation of the clinopyroxene-phyric tuff-breccia of the East Pond member with similar units in the Flatwater Pond Group provides a stronger lithological link.

TIMING OF DEFORMATION AND DEPOSITION OF OPHIIOLITE COVER

Deposition of the ophiolite cover sequence between *ca.* 476 and 467 Ma overlaps in time with $^{40}Ar/^{39}Ar$ hornblende age estimates for D_1 deformation at *ca.* 468–459 Ma (*see* above). The argon data likely record cooling ages and therefore represent minimum age estimates on D_1 deformation. The deposition of the submarine ophiolite cover sequence is interpreted to have occurred contemporaneously with D_1 deformation responsible for ophiolite emplacement. Erosion of locally uplifted ophiolite thrust sheets on the continental margin can account for the presence of ophiolite-derived conglomerates at the base of the cover sequence (Figure 7). Thicker sequences of coarse-grained conglomerates in the Flatwater Pond Group reflect proximity to an ophiolitic basement that was thrust higher up the continental margin relative to the thin units of finer grained conglomerate and thick iron formation that characterize the distal facies of the Snooks Arm Group.

CONCLUSIONS

Although there are differences amongst the Lower to Middle Ordovician volcano-sedimentary sequences that are developed on the Baie Verte Peninsula from its eastern edge to the BVL, this study clearly demonstrates that they are all related. The identification of several distinct marker horizons and of a consistent stratigraphic sequence supports a direct relationship between units and assists greatly in developing a new regional geological map for the peninsula. The stratigraphy developed by Bédard *et al.* (1999, 2000a, b) for the least deformed and best exposed sequence at Betts Cove provides a stratigraphic template for both the BVOT and it's cover sequences. A formal resolution of the stratigraphic nomenclature of Baie Verte Peninsula is required by the data presented here and is now in preparation.

Results of the current study reveal that the Notre Dame Subzone on the Baie Verte Peninsula comprises two major sequences. The Early Ordovician BVOT includes low-Ti and intermediate-Ti boninitic and younger island-arc tholeiitic mafic crust formed between *ca.* 489 and 487 Ma. It is overlain by an ophiolite cover sequence comprising the *ca.* 476–467 Ma Snooks Arm Group and its equivalents in the Pacquet Harbour Group, Point Rousse Complex and Flatwater Pond Group. One possibility for revision of the stratigraphic nomenclature in this area could involve a new group-level name for the ophiolite succession, extension of the Snooks Arm Group to all ophiolite cover sequences, and retiring group-level names that, as previously defined, include parts of both sequences. The development of a consistent and acceptable stratigraphic framework is the next step in this project.

The current work has important implications for the regional metallogeny of the Baie Verte Peninsula. Most of massive sulphide mineralization in Baie Verte is associated with the BVOT, and in particular within its volcanic section. The recognition of island-arc tholeiitic basalt, and locally andesite of boninitic affinity on Point Rousse within thrust-repeated panels, and in the core of map-scale anticlines, has important implications for the massive sulphide and related gold potential of these areas. Similarly, island-arc tholeiitic basalt associated with the BVOT is found along the BVL from Flatwater Pond to Baie Verte. Finally, correlation of the Nugget Pond iron formation across the Baie Verte Peninsula opens up new potential targets for gold-related mineralization.

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