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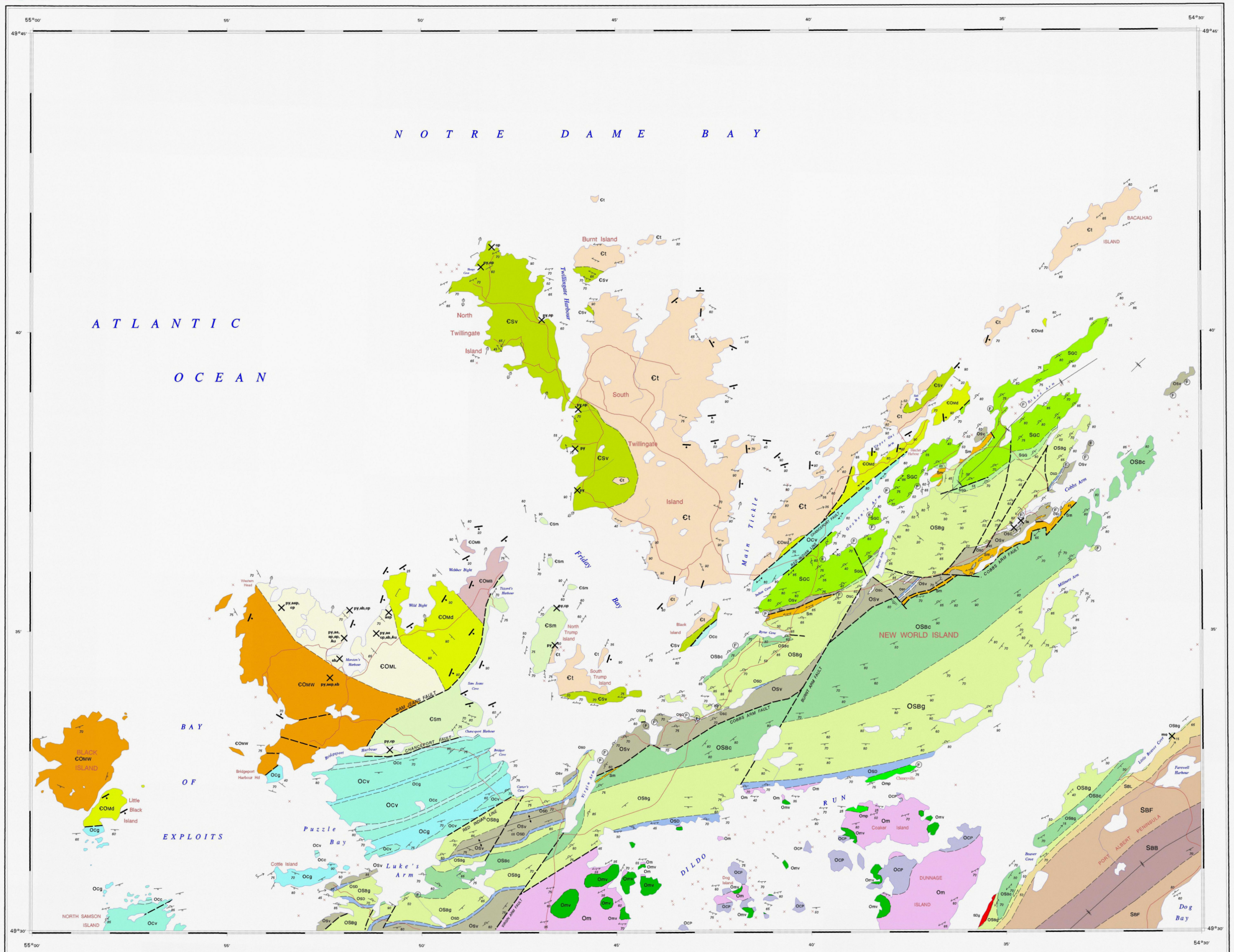

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DESCRIPTIVE NOTES

Twillingate map-area straddles the boundary between the Notre Dame and Exploits subzones of the Dunnage Zone (Williams et al., 1988) in northeastern Notre Dame Bay. The map-area comprises the northern part of New World Island, several other large islands, a multitude of small islands and rocks, and part of the Port Albert Peninsula. Virtually continuous, but very unevenly distributed outcrop along the sea-shore contrasts with sparse to non-existent outcrop in the interior of the islands, which are covered by boggy barrens on the northern islands and by scrubby spruce forest on the more sheltered islands. Glacial polish and scratches occur widely on outcrop, but glacial deposits are rare and sparse. All parts of Twillingate map- area can be easily reached by a combination of small boat and road access.

Geologically, the Red Indian Line, a major structure related to the closing of the lower Paleozoic Iapetus Ocean, divides the map area. North of this line, which runs from Lukes Arm to Goshen Arm, the rocks comprise lower Ordovician and older suites of oceanic arc-related volcanic rocks and related plutons. This region falls into three parts, namely the Arenig? Chanceport Group of pillow lavas, chert and greywacke (Chanceport slice), bounded to the north by the Chanceport Fault, the lower Ordovician or older Moretons Harbour Group of mafic lavas and volcaniclastic rocks (Moretons Harbour slice), bounded by the Chanceport and Sam Jeans faults, and the Cambrian Sleepy Cove Group of bimodal volcanic rocks intruded by the trondhjemitic Twillingate Pluton (Twillingate slice), bounded by the Sam Jeans, Chanceport and Red Indian Line faults. Rocks south of the Red Indian Line, generally of middle Ordovician to Silurian age, also fall into three divisions. The Badger Belt (Williams et al., 1993), extending south from the Red Indian Line to the Dunnage Mélange, comprises the mainly Llanvirn-Llandeilo Summerford Group of basaltic lavas with abundant carbonate matrix and lenses, overlain by Caradocian black shale, and by Caradoc to Llandovery greywacke and conglomerate of the Badger Group. Along Goldson Arm, the Badger Group is in turn unconformably overlain by distinctive polymict conglomerates of the Llandovery Goldson Group. The Badger Belt is cut into three by south-directed thrusts (Cobbs Arm and Toogood Arm faults) associated with Silurian melange. South of the Badger Belt, the Dunnage Mélange, disrupted shale and siltstone containing kilometre-scale mafic volcanic rafts and intruded by the Coaker Porphyry, forms a lens of Llanvirn and older rocks which in this map-area appear to lie stratigraphically beneath Caradocian black shale and the Badger Group, although the contact is commonly modified by northwest-directed high-angle faulting. The Botwood Belt (Williams et al., 1993) appears only on the Port Albert Peninsula, where the Badger Group is almost conformably overlain by Llandovery subaerial basalt of the Botwood Group. The basalt is in turn overlain by tuff and tuffaceous sandstone. All older units are intruded by late Silurian to Devonian granitoid and gabbroic igneous rocks, mainly in the form of dykes and sills.

Twillingate slice

A triangular, fault-bounded region, open to the northeast, contains metamorphosed volcanic rocks of the Sleepy Cove Group (map-unit **€S**, Williams and Payne, 1975), and tonalitic to trondhjemitic rocks of the Twillingate Pluton (map unit **€t**). The Sleepy Cove Group comprises mainly pillow lavas and mafic dykes (**€Sm**) in its western part, with bimodal volcanics including felsic pyroclastic rocks (**€Sv**) in its eastern part, but its internal stratigraphy remains unknown. Primary volcanic features and bedding can locally be made out within the Sleepy Cove Group, but much of the group is metamorphosed to greenschist or amphibolite facies, and penetrative deformation, locally mylonitic, blots out most primary features. The Twillingate Pluton, which intrudes the Sleepy Cove Group, consists of subequal amounts of quartz and albite or oligoclase, with less than 10 percent of altered amphibole and biotite. Potash feldspar is scarce or absent. Epidote, apatite, magnetite, carbonate, sphene and apatite occur in accessory amount. Elliot et al. (1991) report a precise zircon age of 507+3/-2 Ma for the pluton, lying on the Cambrian-Ordovician boundary. The pluton contains lenses and sinuous dykes of amphibolitic mafic rock, implying comagmatic intrusion, possibly accompanied by shearing. The pluton exhibits a variable and erratically developed tectonic foliation ranging from almost imperceptible to mylonitic. The least deformed varieties form grey to pink, medium to coarse- grained rocks. Fine-grained, mylonitic varieties, locally with strong tectonic lineation and streaky compositional layering can be difficult to distinguish from deformed volcanic rocks of the Sleepy Cove Group, for example on South Trump Island and at Salt Harbour, particularly since the foliation tends to be parallel to the margin of the pluton. Around Salt Harbour the foliation is truncated by northeast-trending mafic dykes one of which returned an Ar40/Ar39 age of 473±9 Ma (Williams et al., 1976).

On its southeastern side, the Twillingate Pluton and Sleepy Cove Group are clearly truncated by brittle shearing on the Chanceport Fault and Red Indian Line. On the west side the situation remains ambiguous. Between Tizzards Harbour and Sam Jeans Cove the contact with the Moretons Harbour Group has been interpreted as stratigraphic with the Sleepy Cove Group underlying the Moretons Harbour Group (Strong and Payne, 1973) and as a fault masked by dike intrusion (Williams and Payne, 1975). The following features suggest the contact is faulted. (i) The supposedly overlying Moretons Harbour group strikes almost at right angles to the contact (and to the dykes). (ii) The metamorphic grade and degree of deformation of the Sleepy Cove Group is much higher than that of the Moretons Harbour Group, and these features change abruptly, not gradationally at the contact, here termed the Sam Jeans fault. The map therefore interprets the Sleepy Cove Group and Twillingate Pluton as a distinct terrane relative to the Moretons Harbour and Chanceport groups. The model of Williams and Payne (1975), wherein the pluton formed the roots of a volcanic arc which was slightly later tectonically juxtaposed to and invaded by a related arc, remains plausible.

Moretons Harbour slice

The Moretons Harbour Group (Strong and Payne, 1973) forms a northwest-trending, southwest-facing sequence of pillow lavas, aquagene tuffs, salic tuffs and sills, and minor sedimentary rocks more than 8 km thick, which is invaded by very abundant cognate mafic dykes. Layered rocks and dykes of the Moretons Harbour Group lack minor folds and penetrative cleavage, and metamorphism is below greenschist grade. The base of the group is here adjusted from the original definition of Strong and Payne (1973) to the stratigraphically lowest exposures of sedimentary rocks (**€MB**) in the vicinity of Webber Bight. The uppermost part of the group at Bridgeport Head is faulted against north-facing greywacke and volcanic rocks of the Chanceport Group (**OC**). The map follows Strong and Payne (1973) in dividing the Moretons Harbour Group into a lower unit of pillow lavas and minor sediments (Webber Bight Formation, **€OMB**), a middle unit of spectacular aquagene basaltic tuff, (Little Harbour Formation, **€OML**) and an upper unit of basalt with intercalated felsitic sills and dykes (Western Head Formation, **€OMW**). Mafic dykes (**€OMd**) form northeast-trending, southeast-dipping, sheeted sets which increase in abundance from less than 30 percent of exposure near Valley Pond to more than 90 percent of exposure between Wild Bight and Sam Jeans Fault. Near the fault the dykes dip southeast at angles of 20-30°, perpendicular to the attitude of the supracrustal rock. Similar, but vertical, sheeted dykes appear along the southern margin of the Twillingate Pluton at Hatchet Harbour and northeastward, and are presumed to be correlative. Strong and Payne (1973) showed that the Moretons Harbour Group, including the dykes, exhibit island-arc chemical signatures.

The age of the Moretons Harbour Group is not directly known since several attempts to date it radiometrically have failed. According to Dec and Swinden (1994), correlatives of the Moretons Harbour Group to the southwest underlie equivalents of the Chanceport Group, which on the basis of correlation with the dated Roberts Arm Group is considered to be of Arenig age. The Moretons Harbour Group according to these correlations would be of early Arenig or older age. Elliot et al. (1991) have demonstrated that at least some of the felsite dykes in the Moretons Harbour Group are of early Devonian age (409±3, U-Pb zircon).

Chanceport slice

The Chanceport Group (**OC**, Strong and Payne, 1973) comprises a narrow slice of mainly north-facing volcanogenic rocks between the Red Indian Line and Chanceport Fault. This slice is truncated by the merger of these faults near Hatchet Harbour. The lower part of the unit (**OCv**) consists of pillowed and massive basaltic lavas with horizons of volcanic breccia, conglomerate and sandstone, and numerous lenses of red and black chert and siliceous sandstone (**OCc**), while the upper part (**OCg**) comprises green and red siltstones, shales and turbiditic sandstones with pillowed basalt containing thin chert beds, felsic agglomerate, bedded tuff and chert toward the top. The Chanceport Group exhibits island arc chemical signatures (Strong and Payne, 1973, Dec and Swinden, 1994).

The Chanceport Group is undated within the map-area, but correlative rocks to the west have yielded late Arenig-early Llanvirn fossils, and isotopic ages of 473 Ma (see Lafrance and Williams, 1992 for summary). Lafrance and Williams (1992) have shown that the Chanceport Group, unlike the Moretons Harbour Group is complexly internally deformed. The relations of the Chanceport Group to the Moretons Harbour Group across the Chanceport Fault remain controversial. Dec and Swinden (1994) found that west of the map-area the Chanceport Fault was a minor feature within an essentially continuous section from Moretons Harbour to Chanceport equivalents. However van der Pluijm et al. (1993) found a difference of more than 20° of latitude in paleopole positions for the two units, and concluded that the Chanceport Fault marked the boundary between Notre Dame and Exploits subzones. Within Twillingate map-area the fault is marked only by minor, late brittle, deformation, and its position can be fixed within 3 meters at Chanceport Harbour and Bridgeport Harbour.

Badger Belt

The Badger Belt, defined by Williams et al. (1993), forms a strip across southern New World Island and adjacent islands characterised by the Summerford, Badger and Goldson Groups as well as Silurian melange. The Summerford Group (Horne, 1970), a heterogeneous assemblage of Ordovician volcanic and sedimentary rocks, forms a narrow, fault-dissected, but essentially continuous strip extending from Cobbs Arm and offshore islands across the map-area. The base of the group is unexposed, but the lower parts consist of basalt pillow lava and volcanic breccia (**OSv**) with numerous intercalations of limestone. Tremadoc and Arenig fossil ages have been reported south of the map area (Kay, 1967, Bergstrom et al., 1974), but at Cobbs Arm fossil ages are Llanvirn-Llandeilo, implying an originally much thicker, possibly composite, volcanic sequence than the few hundred meters preserved now. At Cobbs Arm the lavas are overlain by discontinuous limestone, limy shale and limy tuff of the Cobbs Arm Limestone (**OSC**), which is in turn overlain by Caradoc black graptolitic shale with numerous chert lenses and layers (Dark Hole Formation, Horne, 1969; map unit **OSD**). The Cobbs Arm Limestone and Dark Hole Formation occur to the southwest of Cobbs Arm as narrow discontinuous lenses. Much of the Cobbs Arm Limestone now consists of deformed marble.

The Badger Group (Williams et al., 1993) comprises of thick marine turbiditic greywacke (**OSBg**) and overlying polymict conglomerate (**OSBc**). These rocks were formerly loosely termed "Sansom greywacke" and "Goldson conglomerate" respectively, but the usage of these terms has become so vague and inconsistent that "Sansome" is here abandoned entirely, and "Goldson" is reserved for the formally defined Goldson Group (Twenhofel and Schrock, 1937). Thin to medium-bedded greywackes of the Badger Group locally contain siltstone and conglomerate interbeds, and display sole marks convolute bedding and grading. The conglomerates are thick- bedded with some beds exceeding a metre in thickness. Clasts include chert, siltstone, mafic and siliceous volcanic rocks, quartz-feldspar porphyry, granite and limestone. On eastern New World Island the Badger Group conformably overlies the Dark Hole Formation, but west of Burnt Arm there is locally an erosional unconformity between volcanic rocks of the Summerford Group and the Badger Group, suggesting rapid lateral changes in stratigraphy, as noted by Horne (1970) and Arnott (1983). Graptolites and shelly faunas from the Badger Group suggest a range of ages from late Caradoc to early Llandovery.

Mélange (**SB**) with a disrupted, homogenized dark shale and siltstone matrix which locally contains Llandovery fossils, and rafts of Summerford Group up to several tens of metres across, can be traced as a discontinuous belt 30 km long and up to 300 m wide across New World Island for 30 kilometres from Cobbs Arm to Virgin Arm. A similar, but much narrower discontinuous, belt extends from Byrne Cove to Pikes Arm. These mélange belts mark complex thrust faults which imbricate the Badger Group (Lafrance and Williams, 1992), and contain blocks from the (northern) hanging wall. The mélange is continuous with its foot wall whose fossils indicate a Llandovery age of thrusting.

The Goldson Group (Twenhofel and Schrock, 1937; Arnott, 1983, map-unit **SG**) forms a distinctive sequence of conglomerates occupying a syncline along Goshen Arm. The lower unit (Green Cove Formation, **SGG**, Arnott, 1983) consists of a distinctive association of late Llandovery fossiliferous shales, conglomerate with clasts up to a meter across of the underlying Summerford Group, and beds and lenses of an unusual pebble conglomerate with black chert clasts. The unit is mainly shaly where it overlies Badger Group, but conglomeratic where it overlies the Summerford Group. The upper unit of the Goldson Group (**SGc**) consist of coarse buff, brown or red conglomerate with sub-angular to well rounded pebbles, cobbles and boulders of sedimentary, volcanic and plutonic rocks. Polymict conglomerates predominate, but red conglomerate at Pikes Arm contains mostly diorite boulders, while a nearby conglomerate contains mainly granite and metamorphic fragments (Helwig and Sarpi, 1969). Angular shale clasts and large limestone boulders are locally prominent, and a serpentinite clast occurs at Pikes Arm. The conglomerates are commonly graded, with scouring and channelling at the base of some units. About 100 meters of red sandstone occurs associated with conglomerate on Burnt Island, at or near the top of the group.

Bay of Exploits slice

On its southern side the Badger Belt lies against a distinct assemblage of older rocks termed the Bay of Exploits slice (Currie, 1995) comprising the Dunnage Mélange (Hibbard and Williams, 1979, map-unit **Om**), bedded greywacke and conglomerate (**Omp**), and the Coaker Porphyry (**OCP**), intrusive into the mélange. The mélange consists of a matrix of black, grey, green or locally red shale and pebbly shale mixed with disaggregated greywacke. Streaky layers suggestive of former beds, and recumbent folding of bedding and cleavage occur within this homogenised matrix. The most obvious clasts are mafic volcanic rafts (**Omv**) up to kilometer across. Quartz greywackes, commonly disaggregated, and locally exhibiting spectacular herring- bone folding, are the second most common lithology. Other important components include silicic volcanic rocks, limestone, conglomerate, chert and psammitic schists. A large number of more exotic fragments occur including fragmental mafic volcanics with cobbles and boulders of gabbro, mixtite with sparse boulders of quartzite and limestone, volcanics containing fossiliferous Middle Cambrian limestone (Kay and Eldridge, 1968) and massive ferruginous manganiferous chert. Distinctly ophiolitic assemblages such as serpentinite are absent. Many of the fragments can be matched from the Summerford Group or the Exploits Group to the south, but many others cannot, and the proportions of lithologies differ from those in surrounding rocks (Williams, 1994).

Along its northeastern margin near Cheneyville the Dark Hole Formation and Badger Group dip southeast and face away from the Dunnage Mélange. At Cheneyville a celebrated section of conglomerate and black shale resembles the base of the Dark Hole-Badger sequence. However volcanic blocks in black shale occur north of Cheneyville, exposed at low tide on the south side of the cove west of Cheneyville The Cheneyville section is therefore within the mélange, forming part of a conformable northwest-facing stratigraphic section (**Omp**), or a structural repetition of such a section with cover rocks. This map therefore shows this much disputed contact (Horne, 1969, 1970; Kay, 1976; Hibbard and Williams, 1979; Lorenz, 1984; van der Pluijm, 1986; Elliot et al., 1991; Lafrance and Williams, 1992) as a fault-modified stratigraphic contact similar to that observed by Williams (1994) on Farmers Island to the southwest of the map area.

The Dunnage Mélange is cut by a myriad of quartz-plagioclase porphyry sills and plugs (Coaker Porphyry, **OCP**) exhibiting billowy, fluted contacts with hornfelsed mélange, suggesting intrusion into a soft host. Many or all of these bodies appear to represent apices of an underlying pluton. Biotite is the predominant mafic mineral, but muscovite phenocrysts occur locally. Rounded, serpentinised mafic to ultramafic nodules 1-30 cm in diameter, and garnet xenocrysts rich in pyrope and grossular form a sparse but persistent component of the porphyry. The Coaker Porphyry has been dated by U-Pb zircon as 467±5 Ma (Elliot et al., 1991). Since it cuts the mélange, original mélange formation must be of Llanvirn or older age, although subsequent tectonic reworking is probable. Kay (1976) reported clasts of Coaker Porphyry in the conglomerate at Cheneyville, but re-examination of these clasts suggests that most are of unknown provenance and none are indubitably from the Coaker Porphyry.

Botwood Belt

A small part of the Botwood Belt (Williams et al., 1993), defined by presence of the Silurian Botwood Group overlying the Badger Group, is exposed on Port Albert Peninsula. The greywacke of the Badger Group is here near massive with rare pebbly beds, and substantial amounts of homogeneous fine-grained green turbiditic siltstone and dark grey mudstone. The conglomerate forms a thick lens within greywacke, very well exposed at Port Albert and south along the coast. Clasts are commonly moderately to well rounded and consist predominantly of siltstone, granitoid plutonic rocks, some of them gneissic, subordinate epidotised mafic volcanics, and small but highly visible components of red chert and fossiliferous (Caradoc to Llandovery) limestone. Greenish siltstone and dark-grey mudstone and shale beds up to a metre thick occur within the conglomerate.

A contact between the Badger Group and overlying Botwood Group (**SB**) is exposed just north of Port Albert. Although attitudes above and below the contact are almost parallel, a weak cleavage in the Badger Group may be truncated along the contact suggesting an unconformity. The basal unit of the Botwood Group, the Lawrenceton Formation (**SBL**), comprises subaerial basalt, commonly amygdaloidal and columnar, with distinctive red or green patchy colouration, and thin lenses of red, interflow siltstone. A 10 meter-thick ignimbrite sheet overlies the basalt just east of Port Albert. The Lawrenceton Formation is overlain by fine-grained greenish, micaceous sandstone with numerous tuff beds (Farewell sandstone, **SBF**), but the contact with underlying rocks is nowhere exposed. A poorly exposed region in central Port Albert Peninsula is rich in tuff, dykes and minor plutons, and has been assigned to the Brimstone Head formation (**SBB**), a unit consisting predominantly of tuff and ignimbrite with subordinate tuffaceous sandstone. These rocks are well exposed in roadcuts on the way to Farewell Harbour. The Farewell sandstone must be older than the 422±2 Ma age obtained from a composite dyke cutting the unit on Dog Bay (Elliot et al., 1991), although this Ludlow age may approximate the age of salic igneous rocks in the Brimstone Head Formation. Much of the Botwood Group is of Llandovery-Wenlock age (Williams, 1972).

A thin screen of quartz-eye granodiorite (unit **SDg**) petrographically identical to the early Devonian Loon Bay batholith (Currie, 1995) occurs east of Dunnage Island intruding the Badger Group. Dykes of similar age (Elliot et al., 1991) intrude the Chanceport and Moretons Harbour groups, and numerous felsitic dykes intruding all older units are assumed to be of similar age.

Structure

The structure of Twillingate map area has been examined in detail (Karlstrom et al., 1982; Williams et al., 1988; B. Lafrance and P.F. Williams, 1992). Pre-Caradoc folding and cleavage of the Dunnage Mélange can be demonstrated by ubiquitous truncation and hornfelsing of cleavage and folds of cleavage by the Llanvirn (467 Ma) Coaker Porphyry. Some of the truncated structures may be of olistostromal origin, but the pervasive cleavage and folding of cleavage must represent pre-Caradoc hard-rock deformation. Mylonitic foliation cut by 473 Ma mafic dykes in the Twillingate slice may be of similar age. The earliest deformation observed throughout the map-area (D_1 of Lafrance and Williams, 1992) comprises small scale thrusts ramps and flats. which are ubiquitous in the Badger Group, together with larger thrusts and associated folds (Toogood, Cobbs Arm and Milliners Arm nappes of Lafrance and Williams, 1992). Lafrance and Williams (1992) deduce the sense of thrust motion associated with D_1 to be northwest-over-southeast. Some D_1 deformation is demonstrably of Llandovery age on Cobbs Arm (Lafrance and Williams, 1992), but much of the deformation could be of latest Ordovician age, since the Badger Group ranges in age from Caradoc to Llandovery. D_2 is treated by Lafrance and Williams (1992) as a single progressive event dominated by regional dextral ductile faulting, and including development of the regional cleavage, formation of the large gently plunging folds which dominate the outcrop pattern, small dextral folds, and abundant dextral movement indicators closely associated with faults. Gently northeast-plunging, kilometre-scale folds, for example on the Port Albert Peninsula, formed with the steep regional cleavage approximately axial planar to the folds. The regional cleavage dips steeply east, and the folds are slightly overturned toward the west. Several generations of small-scale steeply plunging dextral folds locally overprint the shallowly plunging folds, for example on Cottle Island. Dextral ductile shear can be observed in the Chanceport and Badger groups on opposite sides of Goshen Arm, suggesting dextral motion of D_2 age on the Red Indian Line. D_2 structures affect the Llandovery-Wenlock Botwood and Goldson groups, but are truncated by the latest Silurian Loon Bay batholith. Deformation is therefore of mid- to late Silurian age. Youngest deformation in the map area comprises a set of north-northeast trending sinistral brittle faults which post-date the late Silurian igneous rocks. Offsets on the Virgin Arm and Burnt Arm faults are 1 to 2 kilometres. Lafrance and Williams (1992) have shown that these faults curve into the Red Indian Line, and suggest significant sinistral movement on this feature at this time. Lafrance and Williams (1992) have suggested northwest-trending normal faults of Mesozoic age between North Samson Island and New World Island, but no outcrop evidence of such faults has been found.

A speculative synthesis of the structure assumes an ophiolite and arc-volcanic suite obducted southeast onto the margin of Gondwana in early Ordovician time (Colman-Sadd et al., 1992), followed by formation of a back-arc basin formed by rifting of a post-obduction, west- facing volcanic arc in late Arenig time. The Notre Dame Subzone comprises remnants of the early Ordovician (pre-early Arenig) and older ocean floor. The Dunnage Mélange may represent (a) a relict of a pre-Arenig accretionary wedge complex exposed in a window, or (b) a relict of Arenig and later accretionary wedge complexes trapped by slab-rollback of old, dense ocean floor which triggered arc-rifting. The Summerford Group, which contains fossils ranging from Tremadoc to Llanvirn, should contain both post-obduction arc volcanics and back-arc basin, non- arc volcanics. Only the latter have so far been documented (Jacobi and Wasowski, 1985). The Dark Hole Formation indicates cessation of activity in the back-arc basin while the Caradoc- Llandovery Badger Group resulted from rapid filling of the basin after cessation of volcanism due to arrival of Laurentia at the subduction zone, which resulted in post-Caradoc sinistral southeast thrusting (D_1). Subsequent shortening was accomodated by early Silurian westward dextral subduction of the floor of the basin (Currie 1995), with the Botwood Group accumulating on the western (active) margin of the closing basin. The pervasive dextral transpressive regime (D_2) commenced following closure of the back-arc basin in Wenlock or Ludlow time. Late sinistral transcurrent faulting (D_3) could represent a continuation of northwest-southeast compression into a brittle regime which post-dated some Silurian to Devonian pluton emplacement.

Numerous occurrences of pyrite with associated chalcopyrite, massive, disseminated, or associated with quartz veins have been reported from the Sleepy Cove Group (see Dean and Strong, 1975 for compilation), most from mafic units in bimodal volcanics. The occurrence at Sleepy Cove itself had a small production in the late 19 th century but is now only of historic interest. A considerable number of occurrences of pyrite, chalcopyrite, arsenopyrite, stibnite and gold have been reported from basaltic pillow breccia agglomerate and tuff of the Moretons Harbour Group as stringers, disseminations, or associated with quartz veins and felsite dykes. A small production was reported from the east side of Moretons Harbour (Stewart Mine) early in the century. At Cobbs Arm, lime was produced from several quarries in a marble unit 30 to 40 metres thick. Pyrite occurs in layers up to 3 metres thick in volcanics of the Summerford Group in the same region. A few flecks of molybdenite occur along the Badger-Botwood contact north of Port Albert.

Acknowledgments

During compilation we have made use of an unpublished geological map of Twillingate map-area compiled by P.F. Williams from the work of himself and his students.

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TABLE OF FORMATIONS

SILURO-DEVONIAN

- **SDg** — *Trondhjemite, granodiorite, porphyry, salic dykes, igneous breccia*

NOTRE DAME SUBZONE | EXPLOITS SUBZONE

Ages (left column): SILURIAN (Wenlock-Llandovery); SILURIAN-ORDOVICIAN (Ashgill-Llandovery); ORDOVICIAN (Caradoc); Llandvirn-Llandeilo; Arenig; Tremadoc

MORETONS HARBOUR SLICE

MORETONS HARBOUR GP. (€OMB-€OMd)
- **€OMd** — *Sheeted mafic dykes; minor volcanic screens*
- **€OMW** — *WESTERN HEAD FORMATION; pillow lava, salic tuff, chert*
- **€OML** — *LITTLE HARBOUR FORMATION; basaltic and salic tuff*
- **€OMB** — *WEBBER BIGHT FORMATION; pillows, amygdaloidal basalt; minor argillite*

SAM JEANS FAULT

TWILLINGATE SLICE

TWILLINGATE PLUTON (€t)
- **€t** — *Foliated to mylonitic tonalite, trondjhemite*

intrusive contact

SLEEPY COVE GROUP (€Sm-€Sv)
- **€Sv** — *Bimodal volcanics, basalt, rhyolite*
- **€Sm** — *Deformed pillow lava, tuff; greenschist*

CHANCEPORT FAULT

CHANCEPORT SLICE

CHANCEPORT GROUP (OCv-OCc)
- **OCc** — *White, red and green chert, tuff, greywacke*
- **OCg** — *Greywacke, argillite, salic agglomerate, chert*
- **OCv** — *Pillow lava with inter-pillow chert*

RED INDIAN LINE

BADGER BELT

GOLDSON GROUP (SGG-SGc)
- **SGc** — *Polymict conglomerate with mafic clasts; sandstone, shale*
- **SGG** — *GREEN COVE FORMATION; polymict conglomerate, argillite pebbles*

unconformity
- **Sm** — *Mélange; grey shale and siltstone with blocks of OSv, OSc and OSD*

tectonic contact

BADGER GROUP (OSBg-OSBc)
- **OSBc** — *Grey conglomerate, chert clasts ("Goldson type")*
- **OSBg** — *Greywacke/siltstone turbidites ("Sansome type")*

conformable contact

SUMMERFORD GROUP (OSv-OSD)
- **OSD** — *DARK HOLE FORMATION; black shale with graptolites; chert*
- **OSC** — *COBBS ARM LIMESTONE; marble, silty limestone, limy tuff and shale*
- **OSv** — *Pillow lava, plagioclase-porphyritic basalt, tuff; numerous marble lenses*

DUNNAGE SLICE
- **OSD** — *DARK HOLE FORMATION; black shale with graptolites; chert*
- **OCP** — *COAKER PORPHYRY; quartz-feldspar porphyry, ultramafic nodules, garnet xenocrysts*
- **Omp** — *Polymict conglomerate siltstone, shale with coticules*
- **Om** — *DUNNAGE MÉLANGE; olistostromes, tectonised olistostromes; chaotic shale and siltstone, pebbly mudstone*
- **Omv** — *Mafic volcanic and gabbro rafts in mélange*

BOTWOOD BELT

BOTWOOD GROUP (SBL-SBB)
- **SBB** — *BRIMSTONE HEAD FORMATION; ignimbrite, tuff sandstone*
- **SBF** — *FAREWELL FORMATION; green mica sandstone, tuff*
- **SBL** — *LAWRENCETON FORMATION; basalt, rhyolite, red siltstone*

unconformity

BADGER GROUP (OSBg-OSBc)
- **OSBc** — *Grey conglomerate, chert clasts ("Goldson type")*
- **OSBg** — *Greywacke/siltstone turbidites ("Sansome type")*

Symbols

- Geological boundary (approximate)
- Bedding, top known (inclined, overturned)
- Bedding, top unknown (inclined)
- Pillow lava, top known (inclined)
- Cleavage (inclined)
- Azimuth and plunge of stretching lineation
- Azimuth and axial plunge of small folds (vergence; sinistral, dextral, unknown)
- Fault (position approximate)
- Strike and dip of shear or mylonite zone; (sinistral, dextral, reverse)
- Strike of dyke (dip known, unknown)
- Strike and dip of vein, joint
- Trace of axis of major anticline; syncline
- Glacial striae (direction of ice movement known, unknown)
- Fossil locality
- Mineral occurrence

MINERALS

- Arsenopyrite .... asp
- Chalcopyrite .... cp
- Gold .... Au
- Limestone .... ls
- Molybdenite .... mo
- Pyrite .... py
- Stibnite .... sb

Geology by H. Williams, 1992, 1993, and K.L. Currie, 1993, Geological Survey of Canada

Geological compilation and interpretation by H. Williams, 1994

Marginal notes by K.L. Currie, 1995

Digital cartography by P. Corrigan, Geological Survey of Canada

Electrostatic plot produced by the Geological Survey of Canada

Any revisions or additional geological information known to the user would be welcomed by the Geological Survey of Canada

OPEN FILE 3151

GEOLOGY

TWILLINGATE

NEWFOUNDLAND

Scale 1:50 000 - Échelle 1/50 000

Kilometres 1 0 1 2 3 4 Kilomètres

Transverse Mercator Projection
CM 54°45', Scale Factor 1

Projection transverse de Mercator
MC 54°45', facteur d'échelle 1

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Copies of the topographical edition of this map may be obtained from the Canada Map Office, Department of Natural Resources Canada, Ottawa, Ontario, K1A 0E9

Geographical names subject to revision

Mean magnetic declination 1995, 24°07' W, decreasing 8.0' annually. Readings vary from 24°02' W in the SE corner to 24°13' W in the NW corner of the map

2 E/14		2 E/16
2 E/11	2 E/10 OF 3151	2 E/9
2 E/6	2 E/7 OF 3161	2 E/8 OF 3147

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