DESCRIPTIVE NOTES

The Gander River-Gander Bay region (NTS 2E; east half) spans the junction between oceanic and continental terranes, a first-order tectonic boundary associated with gold and base metal mineralisation. The terrane varies from wet barrens on northern New World, Twillingate and Fogo islands through scrubby boreal forest and muskeg near the sea-coast to coniferous forest in southern parts of the area. Much of the surface is covered by thin, bouldery till deposited from continental glaciers which moved outward from central Newfoundland, that is northerly in the map area. Outcrop, generally excellent along the sea shore, including the multitude of bays and sounds, decreases inland, but inland exposure, and access to it, has vastly increased due to a net of lumber roads constructed in the past 20 years. Access to coastal and island outcrops by small boat is easy because most of the coastal waters are sheltered, with the exception of northern Fogo, Twillingate and Little Fogo islands.

Geologically, the Gander River-Gander Bay region comprises four major, northeast-trending, blocks separated by three major faults (the Red Indian, Dog Bay and GRUB lines). Internal faults separating distinctive stratigraphic assemblages dissect each of these major blocks. The stratigraphy can be summarised as follows. Northwest of the Red Indian Line, lower Ordovician and older rocks of ocean floor and volcanic arc origin comprise three fault slices here termed Moreton's Harbour, Twillingate and Chanceport slices. Between the Red Indian and Dog Bay lines, five fault slices, termed New World Island, Bay of Exploits, Loon Bay, Port Albert and Duder slices, consist of middle Ordovician volcanics, late Ordovician-Silurian clastic rocks and Silurian volcanic and clastic rocks. Between the Dog Bay and GRUB lines (Gander Bay slice), ophiolitic rocks underlain by middle Ordovician clastics which have been over-ridden by an allochthonous fragment of the Loon Bay slice. All are covered by marine Silurian rocks. East of the GRUB Line, rocks consist of Avreig and Cambrian clastic strata with minor mafic flows and dykes. Late Silurian to Devonian plutons and dykes, and sparse Jurassic lamprophyric dykes and plugs occur throughout the map-area.

In a regional overview, Williams et al. (1985) assigned middle Ordovician and older rocks to "zones" and Silurian strata to "belts". In this terminology, Middle Ordovician and older rocks northwest of the Red Indian Line belong to the Notre Dame Subzone of the Dunnage Zone, while those between the Red Indian and GRUB lines belong to the Exploits Subzone. Middle Ordovician and older rocks east of the GRUB line belong to the Gander Zone. Late Ordovician and Silurian rocks of the Loon Bay and Port Albert slices belong to the Botwood Belt, while those of the New World Island slice belong to the Badger Belt. Silurian rocks east of the Dog Bay line belong to the Indian Islands Belt (Williams et al., 1993). This map does not use the zone-belt scheme. Rather it shows stratigraphy in each fault slice and correlations between slices.

The Moreton's Harbour slice is underlain by the Moreton's Harbour Group of northwest-striking, west-facing basaltic pillow lavas (Webber Bight Fm., **COvs**), basaltic volcaniclastic rocks (Little Harbour Fm., **COvc**) and a bimodal basalt-dacite suite (Western Head Fm., **COvw**). The age of these well preserved and virtually unmetamorphosed rocks remains uncertain due to absence of diagnostic minerals, but is greater than 475 Ma, the age of a dyke which intrudes it (Williams and Payne, 1975). The Moreton's Harbour Group may have originally underlain the Avreig Chanceport Group more or less conformably before development of the Chanceport Fault (Dec and Swinden, 1994). A northeast-trending, gently southeast-dipping dyke complex (Hatchet Harbour complex, **COx**) forms more than 80% of the exposure along the southeast side of the Moreton's Harbour Group. This complex may be substantially younger than the Moreton's Harbour Group. A similar fault-bounded sheeted dyke complex cutting the Twillingate Pluton at Salt Harbour is correlated with that in the Moreton's Harbour Group, but may differ in age.

The Twillingate slice, separated from the adjacent Moreton's Harbour slice by a fault along the shore of Sam Jeans Cove, comprises the Sleepy Cove Group and Twillingate Pluton. The age of the arc-related Sleepy Cove Group excedes ≈ 507 Ma, the age of the Twillingate pluton which intrudes it (Elliot et al., 1991). The group includes deformed basaltic pillow lavas and tuff (**Ctvt**), and bimodal basaltic and dacitic rocks (**Ctvv**). Both units are strongly, but variably deformed and metamorphosed to greenschist or higher grade. Twillingate Pluton (**Ct**) comprises variably foliated to mylonitic tonalitic and trondjemite. Deformation is erratic but generally strong. The southeast margin of the pluton around Salt Harbour is cut by a vertical, sheeted, mafic dyke complex (Hatchet Harbour complex, **COx**) tentatively correlated with a similar complex in the Moreton's Harbour Group.

The Chanceport Group comprises spectacular pillowed basalt with interpillow red chert (**COcv**), brightly coloured silicic volcanic and volcanogenic rocks (chert) (**COcc**) and a greywacke/siltstone/conglomerate unit (**COcg**). Like the Moreton's Harbour Group, the Chanceport Group is well preserved and virtually unmetamorphosed. Lafrance and Williams (1992) demonstrated the structural complexity of the Chanceport Group. The Chanceport Group west of the map-area includes both arc-related calc-alkalic and non-arc tholeiitic basaltic rocks (Dec and Swinden, 1994). Based on lithogeochemical correlation, the Chanceport Group is believed to be of middle to late Arenig age (Dec and Swinden, 1994).

Rocks northwest of the Red Indian Line represent oceanic arc and back-arc igneous activity in Arenig and older time. The Red Indian Line and Chanceport Fault are both late, brittle, apparently minor structures at their present level of exposure. Many interpretations of regional geology attach major significance to one or both of these faults (for example Williams et al., 1988; van der Pluijm et al., 1993), assuming that the present late brittle faults excised or conceal older, much larger, ductile features.

The New World Island slice, that is New World Island and adjacent islands, consists mainly of Summerford Group and Badger Group. Summerford Group volcanic rocks (**Ose**) comprise basalt, rarely pillowed, with numerous limestone lenses and a thicker, more continuous, limestone or marble unit toward the top (**Osc**, Cobb's Arm Formation). Tremadoc to Llandeilo fossil ages have been reported from the limestones, with Llanvirn-Llandeilo ages most abundant. Only non-arc chemistry has been documented from the volcanics (Jacobi and Wasowski, 1985). The group is capped by thin but persistent Caradoc black shale and chert (**Osc**, Dark Hole Formation), which is in turn conformably overlain by coarsening-upward turbidific greywacke (**OSbg**) and conglomerate (**OSbs**) of the Badger Group. The Badger Group contains fossiliferous limestone clasts with Caradoc to Llandovery ages. On New World Island the Summerford-Badger sequence is repeated three times in northwest transported nappes separated by thin melange horizons (**SLi**) which locally contain clasts of Silurian fossils. In the structurally lowest nappe, the Golden Arm Group, a sequence of chert-bearing conglomerate (Green Cove Formation, **Sgo**) capped by massive, red, boulder conglomerate (**Sgd**) overlies Badger Group, from which it is distinguished by abundant northerly-derived plutonic boulders in the Golden Group.

A steep, south-dipping reverse fault (Dildo Run Fault) generally separates the New World island slice from the Dunnage Melange. The melange (**DMm**), Chapel Island Formation (**OmC**), and Coaker Porphyry (**OK**, Lorenz, 1984) constitute a unique lithological assemblage here referred to as the Bay of Exploits slice. The melange comprises map-scale blocks of volcanic rocks (**Omv**) and smaller, commonly sheared, commonly shattered, blocks of clastic sedimentary rocks in a chaotic matrix varying from dark shale to greywacke. Remapping by H.Williams (1994) emphasized diversity in lithology and structural style of clasts in the melange, and the unknown provenance of many of them. Significant thicknesses of coherent bedded siltstone-shale rhythmites, olistostrome beds and conglomerate (Chapel Island Formation, **OmC**) occur on the northern and southern hinges of the Dunnage Melange (Williams, 1994). The facings of these sections suggest that they overlie the melange. Melange, bedded sections, cleavage and most small folds are intruded and hornfelsed by the Coaker Porphyry (467 Ma; Elliot et al., 1991), a slightly peraluminous feldspar porphyry containing abundant small inclusions of serpentinised ultramafics and xenomorphic grossydite garnets (Lorenz, 1984), which forms a series of small plugs with features suggestive of intrusion of a batholith into wet mud (Williams, 1994). Caradocian black shale and chert of the Dark Hole Formation stratigraphically overlie the Dunnage Melange on Farmers Island (Williams, 1994) providing a stratigraphic link with the New World island slice.

The Dunnage Melange is separated from the Loon Bay slice to the south by a major north-vergent thrust (Campbellton Fault, O'Brien, 1993) which was sealed by the early Devonian Loon Bay batholith (408 Ma, Elliot et al., 1991). To the east the melange is separated from the Port Albert slice by the sinistral Reach Fault. In both Loon Bay and Port Albert slices, Badger Group is overlain by the Silurian Botwood Group (Williams et al. 1993).

The Loon Bay slice lies mainly west of the map-area, but outcrops as a series of northwest-vergent thrust sheets. The oldest rocks comprise sheets of the middle Ordovician Exploits Group. A single sheet of the late Arenig? New Bay Formation (** Obs**) comprises psammite, siltstone and pelite with abundant thick olistostromes and debris flows (Hughes and O'Brien, 1994). The Loon Harbor Formation (**Obl**), a broad breccia and agglomerate, also occur in a single thrust slice. The chemistry of these rocks resembles Llandeilo-Llanvirn volcanics further to the west (Hughes and O'Brien, 1994). Rhyolitic tuff and mullicoloured chert conformably overlie the mafic volcanic rocks around Loon Harbour and are in turn overlain by thick-bedded black chert with shale interbeds. To the west, the mullicoloured chert is of Llanvirn age (S.H.Williams, 1993), while the overlying black shale and chert is of Caradoc age. However contact metamorphism around the Loon Bay batholith has blackened all of the chert, making distinction of the two chert-rich units impracticable. The two units are therefore combined into a single unit, the Baytona Formation (**Obs**). A coarsening-upward turbidific sequence (Badger Group, the "Sansom-Goldson" association of the older literature) conformably overlies the Baytona Formation. The Badger Group comprises greywacke (**OSbg**) and conglomerate (**OSbs**) which contains limestone clasts with late Caradoc to Llandovery fossils. Two klippe of the Llandovery Botwood Group occur near Michaels Harbour, one of basalt of the Lawrencetown Formation (**SSsL**), the other of reddish, mudcracked micaceous sandstone (Wigwam Formation, **SSsw**).

The Port Albert slice forms a wedge between the Reach and Stoneville faults which extend to Fogo Island. All of the region between the Dog Bay and Reach faults was included by Williams et al. (1993) in their Botwood Belt on the grounds that both Badger and Botwood groups, typical of that belt, were exposed northwest of Stoneville. However the region south of Stoneville exhibits a very different stratigraphy, dominated by melange and overlying redbeds. The contact between different stratigraphic sequences is marked by a steep, dextral ductile shear zone up to a kilometer wide (Stoneville Fault) which truncates the Badger Group and separates the Port Albert slice from the Duder slice. Northeast of Stoneville this fault merges with the Dog Bay Line. Stratigraphy of the Badger Group in the Port Albert slice resembles that in the Loon Bay slice. Basalt of the Lawrencetown Formation (**SSsL**) of the Botwood Group lies paraconformably on the Badger Group at Port Albert (Williams, 1993), capped by thin ignimbrites. Botwood strata above the volcanics differ between the two slices. Fogo Harbour Formation (**SSsf**) comprises micaceous sandstone with numerous tuff beds. On Fogo Island this formation is conformably overlain by a thick sequence of ignimbrites and welded tuff (Brimstone Head Formation, **SSs**). The contact of the Brimstone Head and Fogo Harbour formations is less well-marked west of Fogo Island, but the presence of abundant sheets of porphyry and possible ignimbrites suggests that Brimstone Head Formation was deposited on Fogo Island and the Port Albert Peninsula. A small rhyolite outlier of Baytona Formation occurs beneath the Badger Group on Change Islands.

The Duder slice, between the Stoneville Fault and the Dog Bay Line, consists of melange of the Duder Complex, and the overlying Ten Mile Lake Formation (**St**). The Duder Complex (Currie, 1993), includes a northwestern belt of rocks 2.5 km wide of intensely cleaved, dark grey shale and siltstone (**Sdp**, "paper schist") containing rare blocks of volcanic rocks and limestone up to a meter across. To the southeast, tectonic melange (**Sbx**) comprises blocks of gabbro and bimodal volcanics, meters to tens of meters across enveloped in sheared, homogenised siltstone and shale. The melange can be topographically recognized because the mafic igneous blocks stand up as prominent hillocks. Southeast of this spectacular melange, relatively little strained, east-facing conglomerate, grey or greenish psammite and siltstone -shale rhythmites with olistostrome beds up to a meter thick (**Sbs**) contain dekameter scale blocks of volcanic rocks and complexly boudined and fractured mafic dykes. Clasts within the complex include black chert (Exploits Group?), fossiliferous (Halysites) limestone blocks (Indian Islands Group?), mafic volcanics, gabbro and deformed granite. No local source is known for the last. The complex is cut by undeformed gabbro of the Mount Peyton igneous suite (424 Ma, Dickson, 1994). Latest deformation is therefore of Silurian age, although older deformation may be present.

The Duder Complex is overlain by red shale, siltstone and sandstone of the Ten Mile Lake Formation (**St**). The actual contact is not exposed, but the generally low dips and lack of cleavage in the Ten Mile Lake Formation, compared to the steep dips and intense cleavage in the Duder Complex, suggest a major unconformity. The Ten Mile Lake Formation crosses the Dog Bay Line with minor displacement, and conformably overlies Wenlock or younger strata of the Indian Islands Group. Both the Ten Mile Lake formation and the Duder Complex are truncated by the Reach Fault, along which the Ten Mile Lake Formation is strongly cleaved. Lithologically the Ten Mile Lake Formation differs from typical "Botwood sandstone" (**SSw**) in a higher proportion of pelite and lack of associated volcanic rocks. Gabbro dykes, probably related to the Mount Peyton igneous suite cut the Ten Mile Lake Formation.

The Gander Bay slice consists of four major units, namely the Gander River Complex, the Davidsville Group, the Hamilton Sound Group and the Indian Islands Group. The Gander River Complex, (renamed by O'Neill (1991) from the former Gander River Ultramafic Belt or GRUB), comprises variably altered pyroxenite, serpentinite, gabbro, and mafic volcanic rocks, pervasively brecciated trondhjemite and plagioclase porphyry assembled in an intricate series of fault slivers. Fault slivers of diverse sedimentary assemblages are also imbricated with the complex, which is generally agreed to represent disrupted ophiolite, although no coherent stratigraphy has yet been reconstructed. The Avreig age of emplacement (≥ 475 Ma) for ophiolitic rocks further to the southwest (Colman-Sadd et al., 1992) probably also dates original emplacement of the Gander River Complex.

Sedimentary rocks unconformably overlying and imbricated with the Gander River Complex have traditionally been lumped together as the Davidsville Group (Kennedy and McDonald, 1972), which includes three diverse, tectonically assembled, parts: (i) limy shale and calcareous sandstone (Weirs Pond Formation)(ii) a fining-upward turbidite sequence (Duffow and Hunts Cove formations), and (iii) Caradocian black shale. There is little evidence of original close spatial or sedimentological relationships among these components.

"Weirs Pond Formation" as defined by O'Neill and Blackwood (1989) included both coarse breccia and conglomerate at the base of the turbidite sequence overlying the Gander River Complex and a limy assemblage structurally underlying parts of the complex. The name is here restricted to the limy assemblage. Two types of fossiliferous calcareous rocks occur in the Weirs Pond Formation (**ODw**). Calcareous sandstone with millet-seed quartz grains, containing a late Arenig-early Llanvirn peri-Gondwanan assemblage occurs just south of Weirs Pond (and also south of the map-area on Gander Lake (McKenzie and Cocks, 1978) and the Trans-Canada Highway (Blackmore and Cocks, 1982)). This lithology and assemblage strongly resembles the Indian Bay Big Pond Formation (**ODo**), assigned by O'Neill (1991) to the Gander Group. On Weirs Pond and to the north, part of the Gander River Complex is unconformably overlain by calcareous shale with thin limestone bands bearing conodonts of late Arenig to Llandeilo age and Laurentian affinity (Bruge, 1980; Pickerill et al., 1979; Blackwood, 1982). The tops of both types of sections are faulted against structurally overlying Gander River Complex. In general the Weirs Pond Formation is less deformed than the turbidite sequence, and indicates a more stable, shelf-like environment of sedimentation.

The transition from Gander River complex to the turbidite sequence is exposed in roadcuts west of Weirs Pond where a diffuse zone of Gander River Complex several meters wide is broken up into meter- scale blocks with interstices filled with angular clasts. This material grades upward into matrix-supported conglomerate, and then to turbidific pebble conglomerate and granule sandstone (Duffow Formation, **ODd**). (Currie, 1995a) which commonly contains pebbles of serpentinite, chromite grains and blue quartz granules all derived from the Gander River Complex. These strata contain meter-scale green or purple siltstone-shale rhythmite intercalations, and grade upward into dark grey shale (Hunts Cove Formation, **ODH**). The maximum thickness of the turbidite sequence is about 1300 m, all of which appears to be unfossiliferous. This sequence contains no materials, such as chert or coticules, related to contemporary volcanism.

A fault-bounded sliver of sheared Caradoc black shale, too small to show on the map, but typical of the Exploits Subzone, occurs on Weirs Pond (O'Neill, 1991), and a similar, unfossiliferous, sliver occurs in a roadcut southwest of Weirs Pond. The Weirs Pond Formation and Caradocian black shale exhibit only faulted contacts with strata of the turbidite sequence.

The Davidsville Group is truncated to the north by the Hamilton Sound Group. Along the contact, and dissecting the other units of the Hamilton Sound Group, narrow, sinuous belts of Carmanville Melange (**OHc**) consist of blocks meters to tens of metres across floating in rusty black shale matrix. West of Gander Bay and around Carmanville the large blocks are predominantly of volcanic origin but the eastern part of the melange contains large ultramafic blocks, suggesting a link to the Gander River Complex or correlative rocks. A variety of other sedimentary and igneous clasts, many of them of unknown provenance, also occur in the melange. Melange surrounds an ovoid region of non-arc basalts of the Noggin Cove Formation (**OHn**, Johnston (1992)), mainly coarse volcanic breccia and conglomerate which formed on the slope/apron of a volcano. Caradocian black graptolitic shale and bedded manganiferous chert of the Main Point Formation (**OHm**) fringe the volcanic rocks on the south side. This sulphide-rich black shale provided much of the material for the melange matrix, demonstrating that the melange is of Caradocian or younger age. The volcanic-chert/black shale sequence strongly resembles in lithology and age the Exploits Group to the west.

Most islands in Hamilton Sound are underlain by thinly laminated, turbiditic, coticule-bearing rhythmites (Woody Island Formation, **OHw**) which contain numerous olistostrome beds up to 1 meter thick. These strata somewhat resemble bedded sections found within the Dunnage Melange to the west, for example on Chapel and Camel Islands (Williams, 1994). Small areas of other sedimentary units of unknown age and affinity on islands at the mouth of Gander Bay are here included in the Woody Island formation. The correct stratigraphic ordering of units of the Hamilton Sound Group cannot be determined from outcrop observation due to inadequate outcrop and structural complexity, but comparison with contemporary, lithologically similar units in the Botwood Belt suggests that the coticule-bearing siltstone is the oldest, and the graptolitic shale and chert the youngest unit. No contacts between the Hamilton Sound and Davidsville groups have been found, but within a km of the contact the former is intensely sheared along steeply dipping planes, and exhibits downward-facing folds (Karlstrom et al., 1982). Karlstrom et al. (1982) suggested that the Hamilton Sound Group sheared a structural history with rocks west of the Dog Bay Line, consistent with the proposed lithological correlations.

The Llandovery and younger Indian Islands Group unconformably overlies the Hamilton Sound Group. Exposures of the contact on and near Seal Islands in Gander Bay exhibit only a small divergence in attitude (Williams, 1993), but on a regional scale the Indian Islands Group truncates the trend of the Hamilton Sound Group at about a 45° angle. Small east-over-west high angle faults everywhere obscure the Indian Islands-Davidsville contact. However structural relations between the Hamilton Sound and Davidsville groups imply that the Indian Islands-Davidsville contact must also be an unconformity or major fault. The Indian Islands Group consists of discontinuous basal limestone and limy shale (Seal Island Formation, **SIc**), commonly reduced to a breccia of large slabs of Halysites-bearing limestone, conformably overlain by monotonous calcareous siltstone (Charles Cove Formation, **SIc**) with limestone lentices from which a Wenlock brachiopod has been recovered (Wu, 1978). The siltstone is in turn overlain by gray shale with thin buff siltstone beds (Horwood Formation, **SIs**). South of Horwood the Indian Islands Group is conformably overlain by red shale and siltstone of the Ten Mile Lake Formation (Currie, 1993).

The region east of the GRUB Line consists of the Cambrian Jonathon's Pond Formation, the Arenig Indian Bay Big Pond Formation and Cuff Pond Pelite, metamorphosed, migmatised and dyked equivalents of these units (Flinn's Tickle Complex), and various Siluro-Devonian intrusive rocks. The Jonathon's Pond Formation (**COcJ**), comprises monotonous feldspathic psammites with rare pebbly beds derived from a continental source, thought to be part of Gondwana on the basis of detrital U-Pb zircon ages of 510-650 Ma (O'Neill, 1991). Southeast of Hangedman Harbour, near the structural top of the formation, iron-rich tholeiitic amphibolites locally form up to 10 percent of the outcrop. Some of the amphibolite represents dykes, now boudinaed and converted to schistose or gneissic material, but relics of deformed tuffs and pillow lava also occur. The Indian Bay Big Pond Formation (**Ooi**) comprises calcareous psammites and pelites which contain a late Arenig Celtic fauna (Wonderly and Neuman, 1984) and conformably overlie the Jonathon's Pond Formation. O'Neill (1991) considered the Indian Bay Big Pond Formation to be the youngest part of the Gander Group, but van Staal and Williams (1991) noted that the formation strongly resembles rocks of the Exploits Subzone, and suggested that part of the Exploits Subzone originally conformably overlay the Gander Zone as an overlap assemblage. The structural top of the Gander Group along the GRUB Line contains a large proportion of calcareous pelite (Currie, 1992) which locally contains coticules, and is commonly mylonitised into parallel centimetre-scale black and white layers (Cuff Pond Pelite, **Ooc**). This material is here correlated with the Indian Bay Big Pond Formation and the Weirs Pond Formation of the Davidsville Group.

All zones and sub-zones of the map-area are intruded by diverse intrusive rocks which largely postdate assembly of the fault blocks. West of the GRUB Line, igneous activity was strongly bimodal. Gabbro and more mafic igneous rocks (**SDm**) occur in the Mount Peyton igneous suite as a large body (**SDmp**) and in the Fogo Batholith as small pods of gabbro, norite and layered mafic rocks (**SDm**). Mafic dykes, presumed to be correlative to the gabbros, are ubiquitous, but rather sparse. Dykes up to 150 m wide occur north of the Mount Peyton complex. Large amounts of heterogeneous dioritic rocks with patchy pegmatoid texture and abundant biotite (**SDd**) occur in the Fogo Batholith and in the core of the Loon Bay Batholith. Textures suggest that these rocks result from repeated mixing of salic and mafic magmas. Felsic igneous plutons (**SDg**) include the Long Island, Loon Bay and Fogo batholiths, and the Freshwater, Rocky Bay and Aspen Cove plutons. With the exception of the Fogo Batholith, the oldest phases of these plutons are tonalitic, with distinctive poikilitic biotite, while younger phases, commonly marginal, are more leucocratic but not very enriched in potassium. The salic part of the Fogo Batholith comprises potassic, alkaline hornblende-biotite granite (Sandeman and Malpas, 1995). Dykes of dacitic to rhyolitic composition are ubiquitous in all zones and subzones. Igneous breccias, some misidentified in the past as conglomerates, and small plugs are ubiquitous in sedimentary rocks of the Gander Bay slice.

Reliable dates for this igneous activity range from the 424 Ma Ar-Ar age obtained by Dickson (1994) for the Mount Peyton igneous suite to 408 Ma (U-Pb zircon) for the Loon Bay Batholith (Elliot et al., 1991). The complex, multiphase character of the magmatism suggests that this range of ages (late Silurian to early Devonian) is probably real and not an artefact of inadequate dating.

A quite different granite suite occurs along the GRUB Line where peraluminous leucocratic biotite-muscovite plutons occur (**SDp**), one of which (Replegable Harbour) contains tabular, clean-cut, pegmatitic granite in foliated and mylonitic, along the line. These plutons commonly contain garnet, particularly in abundant pegmatitic phases, as well as variously digested enclaves of country rock, and appear to be mainly derived by melting of Davidville and Gander Groups (Currie and Pajari, 1978). A small part of the Deadman's Bay Pluton (**DMm**), a megacrystic biotite granite appears on the eastern edge of the map-sheet. This fluorite-bearing body, apparently the youngest granite pluton in the region, is surrounded by a broad, migmatitic aureole with abundant amphibolitic boudins (Flinn's Tickle complex, **SDFT**) developed from Gander Group rocks. The youngest rocks in the map-area are a sparse suite of alkali feldspar porphyry dykes and the Dildo Pond pluton (**JD**), both largely composed of titanaugite, barkevikitic amphibole and biotite, and thought to be of Jurassic age (Foster (~140 Ma, Strong and Harris, 1974).

STRUCTURAL GEOLOGY

South of the map-area, Colman-Sadd et al. (1992) showed that the equivalents of the Gander River Complex were obducted eastward onto the Gander Group in early Arenig time (~475 Ma). This event is here termed D_1. East-verged recumbent folds characteristic of the Gander Group (Williams, 1967) may be of this age, and Paleozoic (1990) noted four periods of deformation along the GRUB Line, the youngest of which affects the late Silurian Ragged Harbour pluton.

The Coaker Porphyry (467 Ma, Elliot et al., 1991) truncates a strong cleavage and numerous folds of cleavage in the Dunnage Melange. Since the Dunnage Melange includes within it fragments of late Arenig strata of the Exploits Group (Hibbard and Williams, 1979; H.Williams and O'Brien, 1994), emplacement and initial deformation of the melange are restricted to late Arenig to earliest Llanvirn time. This event must therefore be younger than D_1 and is here termed D_2. No deformation of this age was noted by Lafrance and Williams (1992) in the Tremadoc to Llanvirn Summerford Group of New World Island.

Karlstrom et al.(1982), Elliot et al.(1991) and Lafrance and Williams (1992) showed that structural elements of late Ordovician and Silurian age can be recognized from one end of the Gander Zone to the other. In New World Island to the GRUB Line, Lafrance and Williams (1992) recognized three periods of deformation. The oldest (here termed D_3), a pervasive thrusting to the southeast, formed small scale thrusts and folds in the Badger Group which locally contains blocks with Llandovery fossils. However O'Brien (1993) has shown that much of the Badger Group is of Ashgill age. D_3 probably began in Ashgill time but persisted locally into Llandovery time. Southeast of the Dog Bay Line, emplacement of the Hamilton Sound Group over the Davidsville Group is constrained to post-Caradoc and pre-Llandovery time by presence of Caradocian strata in the melange and Llandovery strata unconformably overlying the melange. Imbrication of sedimentary strata into the Gander River Complex is likewise constrained to post-Caradoc time by the presence of Caradocian strata within the imbricates, and to easterly vergence by ramps and flats within the Gander River Complex. Both of these large scale events have the timing and kinematics of D_3. The oldest kinematic indicators along the GRUB Line are sinistral (Piasecki, 1992), suggesting that the thrusting may have had a sinistral component.

Lafrance and Williams (1992) described their second deformation event (D_4) as a progressive event characterised by ductile dextral shear and formation of large, gently-plunging folds, and deduced it to be of late Silurian age. West of the Dog Bay Line, D_4 folds are moderately overturned toward the west (Williams, 1993), and accompanied by high angle reverse faults. East of the Dog Bay Line, the folds are close, upright, gently-plunging structures which affect the Wenlock and younger Indian Islands Group as well as the older Davidsville Group. Small-scale, steeply-plunging dextrally asymetric folds, as well as narrow (< 5 meters) dextral mylonites and numerous dextral kinematic indicators associated with this deformation occur in a broad zone extending from the Stoneville Fault to several kilometers east of the Dog Bay Line. The Dog Bay Line and Stoneville Fault appear to have formed and moved during this episode.

Lafrance and Williams (1992) distinguished a late period of deformation (D_5) characterised by sinistral rectilinear brittle faults, such as the Reach Fault and other small faults on New World Island. On the grounds that one of these faults displaced a Jurassic? lamprophyre dyke, Lafrance and Williams (1992) tentatively suggested that displacement was of Mesozoic age. However the Reach Fault and associated parallel faults are cut by the Mount Peyton igneous suite of late Silurian age. Earliest fault movements therefore predated late Silurian time, but movement locally continued through early Devonian time: the Reach Fault truncates the early Devonian (408 Ma) Loon Bay Batholith. The GRUB and Red Indian lines also display late sinistral movement, which in the case of the GRUB Line cuts the late Silurian or Devonian Ragged Harbour pluton.

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TECTONIC INTERPRETATION

According to the interpretation of Currie (1995b), initial southeast obduction of oceanic rocks (Gander River Complex) occurred prior to 475 Ma. Subsequent southeast-dipping subduction near the Red Indian Line consumed the oldest Avreig and older oceanic crust to the northwest and built a west-facing volcanic arc, which split in late Arenig to Llanvirn time, forming a back-arc basin in which Summerford and Exploits groups were deposited. The Summerford Group contains fossils as old as Tremadoc and should contain the transition from arc-type to non-arc volcanics. The Dunnage Melange probably formed during late Arenig, east-dipping subduction, with subsequent migration of the volcanic arc over the accretionary wedge complex due to slab roll-back, resulting from subduction of relatively old, dense sea-floor northward of the Red Indian Line. Igneous activity in the back-arc basin, including the Coaker Porphyry, lasted from late Arenig time to mid-Caradoc time when the basin became inactive and was blanketed by black shale and chert forming in a starved basin. Middle Ordovician strata of the Davidsville Group and Indian Bay Big Pond Formation were deposited east of the basin on a passive margin of Gondwana, possibly during a non-volcanic interval marking reversal in subduction direction. In Ashgill to early Llandovery time, arrival of a large fragment of Laurentia at the east-dipping subduction zone led to rapid uplift and dumping of westerly-derived, coarsening-upward clastics (Badger Group), and pervasive northwest-over-southeast sinistral thrusting (imbrication of Davidsville Group and Gander River Complex, emplacement of the Hamilton Sound Group). The present narrow width of remnants of the back-arc basin together with strong contrasts between Llandovery strata of the Botwood and Indian Islands groups implies major loss of oceanic basin floor in Llandovery and younger time, presumably due to subduction. Currie (1995b) assumed westward dextral subduction leaving relics of an accretionary wedge complex (Duder Group). In this model the Indian Islands Group formed a passive margin sequence, while the Exploits Group formed on the actively-rifting Laurentian margin. Sense of motion reversed from dextral to sinistral in mid-Silurian, and final "hard" continent-continent collision occurred at the end of the Silurian, marked by plutonism and metamorphism. Minor reactivation of faults marked Mesozoic opening of the modern Atlantic Ocean.

ECONOMIC GEOLOGY

Mineral exploration in the map-area has concentrated on rocks of the Gander River Complex and along the Dog Bay Line. In the Gander River Complex, ultramafic rocks around Shoal Pond contain thin layers and pods of chromite, but no economic deposits have been found. Traces of asbestos occur in the same region, although the amounts are much too small to be of commercial significance. Occurrences of nickel and copper mineralisation have been reported (Blackwood, 1982). Recent exploration of the Gander River Complex has concentrated on gold mineralisation in quartz veins occupying Riedel shears, commonly in gabbro but also found in other rocks. Evans (1993) has discussed current knowledge of these occurrences. Gold occurs in similar settings along the Dog Bay Line, namely in and around allochthonous gabbro masses of the Duder Complex and in dykes thought to be correlative to the Duder Complex, and ubiquitous, but rather sparse. Dykes up to 150 m wide occur north of the Mount Peyton complex. Large amounts of heterogeneous dioritic rocks with patchy pegmatoid texture and abundant biotite (**SDd**) occur in the Fogo Batholith and in the core of the Loon Bay Batholith. Textures suggest that these rocks result from repeated mixing of salic and mafic magmas. Felsic igneous plutons (**SDg**) include the Long Island, Loon Bay and Fogo batholiths, and the Freshwater, Rocky Bay and Aspen Cove plutons. With the