LEGEND

POST-METAMORPHIC COVER
LATE MISSISSIPPIAN?
SOUTHWEST COVE SEQUENCE
MS:mc Variably indurated, red and grey sedimentary rocks

MS:mc

Mainly a redbed molasse in its lower part, including polymictic conglomerate distinguished by rounded clasts of plutonic, volcanic, hypabyssal and metamorphic rocks; massive boulder conglomerate beds locally having scoured bases grading to crossbedded pebbly sandstone; in its middle part, red and grey sandstone intercalated with reddish-brown arkose and subordinate conglomerate; in its upper part, reddish-brown siltstone having abundant nodules or concretions and displaying desiccation cracks; dark grey mudstone and light green argillite hosting secondary lenses of podiform carbonate near reduction–oxidation boundaries; in the middle and upper parts of the Southwest Cove sequence, calcrete and silcrete developed as stratabound and transgressive bodies and forming replacement zones on the metre scale and zoned veins on the centimetre scale; silcrete, predominantly grey chalcedony and orange jasper surrounded by a pale green halo of glauconitic clay and reduced mudstone, locally crosscutting calcrete; minor goethite-bearing ferricrete and hematitic clay-rich duricrusts; the outcrop pattern has been modified from Unit Cs on Map 94-226 (Kean and Evans, 1994); outlier possibly equivalent to parts of the Rocky Brook and Humber Falls formations of the Deer Lake Group in the Carboniferous Deer Lake sub-basin or the Little Pond Brook Formation of the Deer Lake Group in the Carboniferous Grand Lake sub-basin

Note 1: Detrital clasts of riebeckite-bearing tuff and syenite are found in polymictic conglomerate near the base of Unit *MS:mc* and are similar to certain Early Silurian magmatic rocks outcropping in the tectonically adjacent King's Point Complex. In the middle part of the Southwest Cove sequence, calcrete and jasper are observed as detrital grains in red and grey sandstone.

Note 2: The lower part of Unit *MS:mc* is probably correlative with redbeds in the Indian Pond–Black Brook area previously assigned to Unit MI:sc (O'Brien, 2011). Although Unit MI:sc has been interpreted as a possible outlier of the Mississippian Deer Lake Group *(ibid)*, Colman-Sadd and Crisby-Whittle (2005) have assigned the strata in Unit *MS:mc* to the Mississippian–Pennsylvanian Barachois Group based on the work of Kean and Evans (1994).

INTRUSIVE ROCKS

POSTTECTONIC INTRUSIVE ROCKS
EARLY TO LATE SILURIAN?
TOPSAILS IGNEOUS SUITE
S:TI Topsails Intrusive Suite

S:TIsy

Mainly red and light pink, medium- to fine-grained, porphyritic to equigranular bodies of isotropic quartz syenite, potassium feldspar-phyric syenite, quartz-phyric granite, quartz–feldspar porphyry and granophyre; maroon, variably jasperitized, biotite-bearing syenite and hematized granophyre crosscut by composite dykes of fresh diabase; light pink, feldspar-phyric stocks and minor intrusions of Unit *S:TIsy* having disseminations of dusty hematite throughout the matrix or having deep red, silicious alteration zones arranged bilaterally about systematic joint surfaces; abundant chlorite–hematite–jasper–quartz veinlets in purplish-red, fine-grained syenite sheets; cataclastite zones in syenite, granite and stratified host rocks injected by minor intrusions, such as pyritic felsic microporphyries, fractured aplite dykes and pinnate quartz veins; widespread conjugate dykes of porphyritic and aphanitic diabase

S:TIdr

Mainly isotropic bodies of light grey, medium-grained equigranular diorite and subordinate, dark grey, coarse-grained quartz gabbro; minor porphyritic diorite having intratelluric plagioclase laths replaced by hematite, carbonate and sericite; pyroxene phenocrysts altered to actinolite and magnetite; rarely, cupriferous diorite porphyry showing uniquitous disseminations of pennitic chlorite, ferroan carbonate, epidote and jasper throughout the diorite matrix; near faults, kink-banded and drag-folded stringers of quartz, calcite and sericite within silicified diorite sheets and adjacent country rocks; jasper-cemented tuffisite pipes intruding ferroan carbonate alteration zones in pyritic bodies of Unit *S:TIdr* diorite

S:TIgm

Mainly light grey, equigranular to slightly porphyritic, hornblende-bearing microgranite and biotite-bearing granophyre; subordinate, light grey, fine-grained, saussuritized quartz–feldspar porphyry and quartz porphyry crosscut by tuffisite pipes, diabase dykes and aplite veins; near the Indian River, buff-weathered graphic granite and associated carbonate-altered microporphyry hosting cataclastite zones and swarms of sigmoidally foliated mafic dykes; chalcopyrite-bearing intrusive breccia composed of variably jasperitized fragments of Unit *S:TIgm* microgranite and Ordovician country rock basalt; composite intrusions made up of silicified granophyre from Unit *S:TIgm* and chloritized diorite from Unit *S:TIdr*, particularly along the faulted margin of the Silurian Springdale Group; Unit *S:TIgm* may include correlatives of Unit eS:TImh of Whalen and Currie (1988)

S:TIgd

Mainly light grey, isotropic hornblende–biotite granodiorite, locally displaying discontinuous glomeracrystic aggregates of very coarse plagioclase; in places, medium-grained equigranular granodiorite hosting diabase intrusions having chilled margins back veined by granite or having zones of partially assimilated mafic dykes; coarse hornblende granodiorite preserving relict trains of cognate xenoliths rich in brown biotite; mafic dykes co-mingled with granodiorite and illustrating folded flow-foliation, particularly around joint abuttments in Unit *S:TIgd* host rocks; silicified granodiorite showing diffuse gradational boundaries with patches of light pink, fine-grained biotite granite or light grey quartz-phyric porphyry bodies; flow-layered intrusive sheets of felsic microporphyry associated with granodiorite-hosted swarms of porphyritic diabase dykes distinguished by a margin-parallel foliation defined by neocrystallized chlorite; near strike-slip faults, highly fractured, light green granodiorite containing a propylitically-altered matrix and illustrating subhorizontal hematite–chlorite slickenlines; epidotized, sericitized or carbonitized granodiorite having a feldspar-depleted sucrose matrix and locally intruded by quartz–pyrite–chalcopyrite veins or, more rarely, molybdenite–chalcocite–bornite veinlets; Unit *S:TIgd* includes locally reddened and jasperitized granodiorite previously assigned to Unit Tg of the Topsails intrusive suite (O'Brien, 2009); may also include K-feldspar porphyritic granite and two-feldspar quartz syenite previously assigned to Unit eS:TIsa of the Topsails intrusive suite (Whalen and Currie, 1988; Coyle, 1992)

Note 1: In the Indian Brook–King's Point map area, plutonic and hypabyssal rocks assigned to the Topsails intrusive suite were locally offset by rectilinear faults before, and after, the presumed Carboniferous deposition of the Southwest Cove sequence. In places, some of these intrusive rock units are hosted by both the Cambro-Ordovician rocks of the Notre Dame Subzone of the Dunnage Zone and the Silurian rocks of the terrestrial overlap sequences.

Note 2: Unit *S:TIgm* forms the cupola of several bosses emplaced into Unit *O:CPib* basalt of the Ordovician Catchers Pond Group and older Silurian parts of the Topsails intrusive suite. It also comprises subvertical intrusive sheets near the tectonic boundary that separates the Silurian King's Point Complex from basement rocks of the Catchers Pond and Lushs Bight groups.

Note 3: Unit *S:TIsy* and Unit *S:TIgm* are mapped to crosscut regional fold structures that affect the stratified rocks of the King's Point Complex. Unit *S:TIdr* is mapped to crosscut fault structures that cause tectonic excision of the basal stratigraphy of the Springdale Group.

SYN-TECTONIC TO POSTTECTONIC INTRUSIVE ROCKS
LATE ORDOVICIAN TO EARLY SILURIAN?
BURLINGTON GRANODIORITE
lOS:B Burlington granodiorite

lOS:BU

Mainly light grey to pink, isotropic, coarse-grained, porphyritic, hornblende–biotite granodiorite; light grey to greenish grey, isotropic, medium-grained, equigranular, hornblende–biotite granodiorite transitional to sheeted quartz–feldspar porphyry; epidotized or chloritized granodiorite passing into strongly hematized and silicified granodiorite; massive amphibole-rich granodiorite commingling with the chilled margin of an isotropic gabbro; rectangular boudins of diabase dykes enclosed by granodiorite illustrating a plutonic flow foliation. Unit *lOS:BU* may include subordinate quartz dioritic, monzonitic and granitic rocks assigned to Unit eS: BU by Hibbard (1983)

Note 1: On the Baie Verte Peninsula, various phases of the Burlington granodiorite are known to range in age from the Late Ordovician to the Early Silurian (Skulski et al., 2010). Parts of Unit *lOS:BU* are probably also correlative with the Early Silurian Glovers Island granodiorite (Unit eS:GI of Cawood and van Gool, 1998).

Note 2: North of Kitty's Pond, Unit *lOS:BU* includes younger granodiorite bodies previously assigned to Unit eS:BU of Hibbard (1983) and Unit S:TIgd of O'Brien (2011).

SYN-TECTONIC INTRUSIVE ROCKS
LATE ORDOVICIAN TO EARLY SILURIAN?
RAINY LAKE COMPLEX
lOS:H Harry's Brook gabbro – felsic porphyry

lOS:Hgp

Mainly folded intrusive sheets of medium grained, equigranular to porphyritic gabbro and diorite hosted by Early Ordovician rocks of the Catchers Pond Group; isotropic gabbro transitional to chalcopyrite-bearing greenschist and phyllonite; co-mingling diorite and quartz–feldspar porphyry crosscut by foliated porphyritic gabbro; sheeted quartz–feldspar porphyry bodies containing country rock xenoliths displaying a bed-parallel foliation; sulphidic, silicified and chloritized metagabbro and associated quartz–feldspar porphyry carrying late syntectonic arrays of quartz–chlorite–ferroan carbonate–pyrite–arsenopyrite veins; boudinaged diorite sheets and pinch-and-swell diabase dykes displaying crenulation folding of the country rock schistosity in the boudin neck of the intrusions; openly folded diabase dykes crosscutting penetrative foliation within quartz–feldspar porphyry veins; steeply dipping bodies of quartz–feldspar porphyry intruded into fold hinge zones outlined by a bed-parallel foliation in Ordovician country rocks; nested gabbroic bodies and composite diabase dykes emplaced, in places, across early-formed regional folds and having a foliation parallel to their intrusive margins deformed by later fold structures.

Note 1: Many of the deformed quartz–feldspar porphyries (*cf.* Andrews and Huard, 1991; Gaboury *et al.*, 1996) assigned to Unit *lOS:Hgp* are similar to the Early Silurian (*ca.* 437 Ma) quartz–feldspar porphyry that was dated in an isotopic study of mineralized rocks near the former Hammer Down Gold Mine (Ritcey et al., 1995).

Note 2: Unit *lOS:Hgp* comprises a sheeted intrusive complex–dyke swarm that is possibly correlative with parts of Unit SO:RL of Whalen and Currie (1988) or Unit OS:SR of Colman-Sadd and Crisby-Whittle (2005) in the Topsails igneous terrane. Amphibole-rich mafic intrusions (*ca.* 438 Ma) within Unit SO:RL are hosted by Unit O:GV volcanic rocks of the Early Ordovician Glover Group (Whalen and Currie, 1988).

Note 3: Some of the intrusive rocks assigned to Unit *lOS:Hgp* in the Indian River–King's Point area are possibly older than Late Ordovician–Early Silurian and could thereby document a pre-Rainy Lake Complex phase of tectonism in the Catchers Pond Group. In particular, the Late Middle Ordovician episode of schistosity development that had affected the late kinematic (*ca.* 465 Ma) Coopers Cove granodiorite (and older chlorite schists) in the northerly adjacent Cambrian rocks of the Lushs Bight Group (Szybinski, 1995) may have also affected the Ordovician strata of the Catchers Pond Group.

Ordovician or Silurian?
CATCHERS VALLEY GRANITE
OS:c Catchers Valley granite – felsic porphyry

OS:cg

Mainly fine-grained, equigranular, biotite microgranite and graphic granite; subordinate quartz–feldspar porphyry intruded by aplite veins, diabase dykes and striated quartz veins; zones of secondary jasper, hematite, ferroan carbonate and bornite; in places, microgranite illustrating hematized potassium feldspar phenocrysts set in a carbonate-rich siliceous matrix and showing chlorite pseudomorphs after biotite; possibly related to the granitic phases of the Coopers Cove pluton (Unit Occg of Kean and Evans, 1994)

Note: The granite and felsic porphyry phases of Unit *OS:cg* are generally isotropic but are strongly fractured and regionally altered, particularly in the vicinity of late brittle faults. Pyritic quartz-feldspar porphyry and later diabase dykes are truncated along a major eastnortheast-trending, steeply-dipping fault structure in the type area of the Catchers Valley granite (see also DeGrace, 1971). However, near the south shore of Catchers Pond, a microgranite in the Unit *OS:cg* pluton carries a localized sericite foliation and displays a tectonic alignment of podiform quartz–chlorite–sericite veinlets.

STRATIFIED ROCKS

POST-ORDOVICIAN AND PRE-CARBONIFEROUS TERRESTRIAL OVERLAP SEQUENCES
MIDDLE SILURIAN AND OLDER?
S:K KING'S POINT COMPLEX
S:KV Volcanic rocks of the King's Point Complex

S:KV4

Mainly red, pink and greyish-pink, flow-layered porphyritic rhyolite and hematized welded tuff ; massive, crystal-lithic felsic tuff passing upward into compacted flow-layered tuff; partially welded tuff containing fragments of aphanitic rhyolite, quartz–feldspar porphyry and resorbed quartz crystals set in a maroon vitric matrix; crystal-rich felsic tuff locally displaying thin bedding, internal lamination, fine-grained banding and chaotic flow folding; conchoidally fractured black obsidian having concentric perlitic cracks; dark red, hematized flows of feldspar-phyric rhyolite intercalated with ignimbrite; selective epidote replacement along flow bands within layered ash tuffs and adjacent ignimbrite; tuffaceous strata illustrating a jasper-rich sucrose matrix, particularly where well-stratified and preferentially altered; rare, well-bedded red sandstone grading upward from size-graded sedimentary breccia and underlying massive debrite marked by a large textural variety of felsic volcanic clasts; probably in part correlative with the Upper Volcanic Rocks of the King's Point Complex and possibly equivalent to Unit 6B of Miller and Abdel-Rahman (2003) or Unit eS:KVue (Colman-Sadd and Crisby-Whittle, 2005)

S:KV3

Mainly light pink, generally massive, felsic lapilli tuff, felsic ash tuff and felsic crystal tuff; in places, thickly stratified intervals of medium-grained lithic tuff and coarse-grained volcanic breccia preferentially hosting pyritic gossan zones; minor, light grey and light pink interbeds of well-layered but variably hematized potassium feldspar–quartz tuff; pyrolusite–graphite films on folded and striated systematic joints in felsic lapilli tuff; where heavily fractured, dark grey pseudomorphs of chlorite, sericite and pyrite after primary feldspar crystals; disseminated hematite, arsenopyrite and pyrite cubes near quartz vein arrays; probably in part correlative with the Upper Volcanic Rocks of the King's Point Complex and possibly equivalent to Unit 6A of Miller and Abdel-Rahman (2003) or Unit eS:KVup (Colman-Sadd and Crisby-Whittle, 2005)

S:KV2

Mainly light grey to reddish-grey ash flow tuff, crystal-poor ignimbrite and minor aphanitic rhyolite; conspicuous flow-banded aphyric rhyolite blocks within an eutaxitically foliated matrix; probably, in part, correlative with the Middle Volcanic Rocks of the King's Point Complex and possibly equivalent to Unit 4 of Miller and Abdel-Rahman (2003) or Unit eS:KVm (Colman-Sadd and Crisby-Whittle, 2005)

S:KV1

Unseparated felsic volcanic strata, including subcroppings of purplish-red and red crystal tuff and fine-grained, lithic ash tuff having outsized fragments of aphyric rhyolite; relative stratigraphic position unknown due to lack of exposure

Note 1: In the northwestern part of the Indian Brook–King's Point area, intrusive rock units of presumed Silurian age have been previously included in the Early Silurian King's Point Complex. Many of these rocks are herein removed from the King's Point Complex and assigned to the Topsails intrusive suite because they are contiguous with posttectonic plutonic rocks assigned to the S:TI divisions of this suite in the Sheppardville map area (O'Brien, 2011).

Note 2: North of the map area, and southeast of Strugglers Pond on the Baie Verte Peninsula, a basal sedimentary breccia in the oldest known stratified rock unit of the King's Point Complex (Miller and Abdel-Rahman, 2003) may lie above a nonconformity separating the breccia and overlying felsic volcanic strata from an earliest Silurian or older granodiorite within Unit *lOS: BU*.

TOPSAILS IGNEOUS SUITE
EARLY TO MIDDLE SILURIAN
S:S SPRINGDALE GROUP
Sedimentary (S:Ss) and volcanic (S:Sv) rocks

S:Su

Unseparated sedimentary, volcanic and hypabyssal rocks previously assigned to the Springdale Group (Coyle, 1992), including felsic volcanic flows and pyroclastic strata, red cobble conglomerate and crossbedded sandstone, and quartz–feldspar porphyry

S:Sv6

Mainly a massive to thick stratified sequence of dark grey basalt flows; dark green aphanitic basalt marked by a regional chlorite–epidote alteration

S:Svs5

Mainly purplish-red mafic volcanic strata enriched in hematite or jasper; commonly, porphyritic basalt displaying a flow-top breccia infilled by fine-grained red sandstone and grey laminated argillite; discontinuous lenticle of cobble conglomerate rich in locally derived intraclasts of purplish-red basalt and succeeded by purplish-red basalt intruded by gabbro sills; sequential chlorite-chalcedonic quartz-ferroan carbonate-pyrite alteration in strongly amygdaloidal basalt flows

S:Ss4

Mainly red, crossbedded granular sandstone and minor pebbly sandstone; sandstone beds containing rip-up clasts of red argillite and being locally scoured by size-graded conglomerate; conglomeratic sandstone having detrital clasts of quartz–feldspar porphyry; pebbly sandstone within Unit *S:Ss4* illustrating rounded clasts of mafic and felsic volcanic rocks similar to those found in lower parts of the local Springdale Group sequence; Unit *S:Ss4* supersedes Unit S:Ss of O'Brien, 2011; Unit *S:Ss4* is possibly partially correlative with certain redbeds in Unit 9 of Coyle (1992) or Unit S:SS (Colman-Sadd and Crisby-Whittle, 2005)

S:Ssv3

Mainly clast-supported polymictic conglomerate interstratified with subordinate matrix-supported pebble conglomerate and succeeded by vesicular grey basalt and minor andesite; purplish-red, plagioclase-rich basalts intercalated with basaltic breccia and mafic tuff; in places, basalt breccias being made up entirely of red hematized blocks of vesicular lava and also containing isolated fragments of mafic tuff completely replaced by jasper; mafic pyroclastic strata having angular grey clasts of flow-layered rhyolite present in addition to the more common clasts of dark green scoraceous basalt; near the base of the subunit, very thick stratified, red and grey conglomerate containing rare, well-rounded extrabasinal clasts of granite and gabbro, minor cobbles of grey ignimbrite and orange rhyolite, and ubiquitous purplish-red boulders of variably hematized basalt; massive to thick stratified sedimentary breccia characterized by basalt clasts displaying internal hematite-rich spherical bands and having concentric leached zones in the granular matrix surrounding them; medium-bedded red sandstone and grey pebbly sandstone showing irregular zones of hematite locally replacing the sedimentary matrix; in other localities, pre-incorporation liesegang rings and randomly oriented redox bands within basalt boulders; yellowish-grey, parallel laminated interbeds of fine-grained palagonitic sandstone within a fining-upward succession of red sandstone; open-spaced veins of chlorite–hematite–calcite–quartz near joint sets in conglomerate and sandstone; crosscutting epidote–carbonate–chlorite alteration zones in light green vesicular basalt and amygdaloidal gabbro sills, especially near faults; prominent jasper–hematite–pyrite–quartz veinlets along feathered joints in reddish-grey basalt; *Unit S:Ssv3* supersedes Unit S:Sm of O'Brien (2011); possibly correlative, in part, with Unit S:SVm4 (Colman-Sadd and Crisby-Whittle, 2005); possibly also equivalent to the volcanic-derived conglomerate in Unit 9 of Coyle (1992) or Unit S:SSc (Colman-Sadd and Crisby-Whittle, 2005)

S:Svs2

Mainly light grey and pink, felsic volcanic and pyroclastic strata, including welded ash flow tuff, crystal-lithic lapilli tuff, pumiceous vitric tuff and felsic agglomerate having large blocks of flow-banded rhyolite; in the lowest exposed part of the subunit, massive flows of porphyritic rhyolite having quartz and potassium feldspar phenocrysts set in a microlite-rich matrix; intercalated with light pink, feldspar-porphyritic and aphanitic rhyolite showing flow banding and flow folding; coarse volcanic breccia marked by jasper-rimmed fragments of emerald green pumice and pink spherulitic rhyolite; succeeded by a size-graded polylithic breccia containing ubiquitous felsic ash tuff, minor basalt and rare laminated argillite; thick-bedded tuff and lithic breccia having abundant outsized blocks of potassium-feldspar-bearing orange rhyolite and dark red aphyric rhyolite; volcanic conglomerate and fanglomerate having outsized felsic and mafic volcanic clasts; minor sand-matrix debrite, parallel-laminated grey sandstone and slump-folded argillite; light grey, felsic lithic-crystal tuff distinguished by the presence of rare mafic lapilli; massive crystal tuff dominantly composed of resorbed quartz grains and euhedral feldspar prisms set in a purplish-red ash matrix; in correlative units elsewhere in the Springdale Group, reports of exotic clasts of the local Ordovician basement (cf. Coyle, 1992); Unit *S:Svs2* supersedes Unit S:Sf of O'Brien (2011); possibly correlative, in part, with units 2 and 6 of Coyle (1992) or units S:SVx and S:SVf2 (usage of Colman-Sadd and Crisby-Whittle, 2005)

S:Ssv1

Mainly red boulder conglomerate and purplish-red silicified andesite comprising several interstratified lenticles of volcanic and sedimentary rocks (monomictic conglomerate in lowest preserved lenticle); clast-supported conglomerate marked by variably hematized boulders of plagioclase porphyritic and glomeracrystic andesite; red conglomerate illustrating well-rounded cobbles of parallel-laminated quartzose sandstone; intraformational grey sandstone showing jasper concretions and containing distinctive pebbles of hematitic andesite and jasper; dark grey, light green and purplish-red amygdaloidal basalt flows and mafic pyroclastic rocks comprising two lenticles of Unit *S:Ssv1* volcanic strata; massive amygdaloidal andesite flows intercalated with coarse volcanic breccia displaying bombs selectively replaced by jasper; polylithic mafic tuff having a chloritic matrix replaced by hematite and quartz; Unit *S:Ssv1* is possibly correlative with unit 3 and 5 of Coyle (1992) or units S:SVif and S:SVm2 (Colman-Sadd and Crisby-Whittle, 2005)

Note 1: North of the intersection of routes 390 and 391, red boulder conglomerate overlying felsic pyroclastic strata in the lower part of Unit *S:Ssv3* of the Springdale Group contains granite and gabbro extraclasts together with ignimbrite and basalt intraclasts, all set in a sandstone matrix locally enriched in yellowish-green palagonite. The sub-Springdale Group nonconformity documented by McGonigal (1970) may possibly relate to this episode of basement uplift.

Note 2: The terrestrial volcanosedimentary strata that have been assigned to Unit S:Su probably represent rocks that are generally younger than those observed within the anticline–syncline pair located immediately northwest of the Indian River.

EARLY SILURIAN?
eS:M MICMAC LAKE GROUP
eS:MU Volcanic rocks of the Upper Sequence?

eS:MUm

Mainly dark grey to purplish-red basalt breccia, reddish-grey, plagioclase-porphyritic magnetic andesite, and purplish-red, very coarse-grained, highly amygdaloidal basalt in subcrop near Kitty's Pond; locally, very large blocks of red scoraceous basalt and hematitic vesicular basalt in glacial till

ROCKS FORMED IN THE IAPETUS OCEAN (NOTRE DAME SUBZONE OF THE DUNNAGE ZONE)
EARLY ORDOVICIAN
CATCHERS POND GROUP
O:CP Volcanic and sedimentary rocks

O:CPsp Silver Pond Formation

O:CPspf

Upper felsic volcanic member: Mainly light grey to light pink volcanic breccia and quartz-rich crystal tuff; at the base of the member, felsic breccia lying in sharp contact with a basaltic andesite flow from Unit *O:CPspb*; thin-bedded volcanic breccia gradational to felsic lapilli tuff and felsic ash tuff; succeeded by medium-grained, thick-bedded felsic crystal tuff, having abundant resorbed quartz prisms and displaying small bombs of quartz-phyric porphyry and quartz–feldspar porphyry; overlain by a polymictic felsic volcanic breccia distinguished by large volcanic fragments derived from older formations of the Catchers Pond Group; capped by fine-grained felsic, lithic>crystal tuff

O:CPspb

Lower mafic volcanic and chert member: Mainly mafic volcanic flows, hemipelagic chert and epiclastic turbidites; at the base of the member, a relatively thin, well stratified sequence of vesicular pillow lava illustrating interstitial red chert passing gradationally upwards into highly vitric pillow breccia; succeeding light grey beds of graded pebbly wacke, massive feldspathic sandstone and laminated siltstone turbidite fining upward into dark grey siliceous argillite; dark green ferruginous chert bands intercalated with subordinate lava flows; overlying basalt breccia interbedded with aquagene tuff; vesicular basalt and basaltic andesite characterized by chlorite–quartz–jasper–carbonate alteration

Note 1: Lithic wackes scoured into Unit *O:CPspb* siltstone typically display detrital clasts of intraformational chert and basalt, and they are commonly observed to have rip-up clasts of laminated argillite, particularly in the lower part of the member. In contrast, some coarse-grained granular wackes in the upper part of Unit *O:CPspb* begin to show felsic volcanic extraclasts derived from strata other than within the Silver Pond formation.

Note 2: Felsic volcanic breccia in the middle–upper part of the younger member of the Silver Pond formation illustrates outsized blocks of very coarse, quartz>feldspar crystal tuff similar to those seen within the limestone block-bearing marker horizon in the underlying New Water Pond formation. This *O:CPspf* breccia also contains angular blocks of aphanitic and porphyric rhyolite similar to those found in the older West Waters Pond formation.

O:CPnw New Waters Pond Formation

O:CPnwf

Upper argillite and felsic volcanic member: Mainly thin-bedded argillaceous jasperite, felsic pyroclastic strata (associated with rhyolite flows and intrusions), and a marker horizon of subaqueous quartz–feldspar tuff; at the base of the member, red to pink, hematized felsic crystal tuff, jasperitized siltstone turbidite, and ferruginous replacement chert comprising laterally continuous beds draped on the tops of mafic lava flows distinguished by limestone inclusions; succeeded by interbedded red laminated argillite, green siliceous argillite and maroon graded siltstone and by minor sandstone turbidite displaying abundant rip-up clasts of dark grey laminated argillite; sharply overlain by a fining-upward interval of felsic pyroclastic strata, including course volcanic breccia composed of angular fragments of aphanitic rhyolite, potassium feldspar-phyric rhyolite, flow-banded rhyolite and eutaxitically foliated ignimbrite, and capped by lithic tuff made up of microlitic or vitric felsite bombs and clast-rotated bedded blocks; a very coarse-grained crystal tuff forming a marker horizon in Unit *O:CPnwf* and being characterized by large blocks of fossil-bearing clastic limestone together with angular fragments made up of size-graded beds of crystal tuff; near the bottom of the marker unit, smaller subangular clasts of hematized felsic crystal tuff, ferruginous chert and jasper supported by large fractured phenocrysts of resorbed quartz; locally, at the top of the member, massive feldspathic wacke, rhyolite-derived wacke and basalt-derived wacke

O:CPnwl

Limestone member: Mainly well-bedded fossiliferous limestone yielding a trilobite, brachiopod and conodont fauna (Dean, 1970; O'Brien and Szybinski, 1989) and comprising a relatively thin sequence directly above coherent andesitic sheet flows; laterally discontinuous lenses of bioclastic carbonate interstratified with smooth-surface autobreccias of basaltic andesite

O:CPnwb

Lower mafic volcanic member: Mainly a localized and variably thick sequence of marine mafic to intermediate volcanic rocks and subordinate subvolcanic sills; dominantly highly vesicular calc-alkaline basalt, transitional calc-alkaline basalt–island-arc tholeiite, basaltic andesite and andesite (Moore et al., 2002); comprising sheet flows or autobreccias intercalated with biogenic carbonate or, more rarely, fine-grained, thin-bedded quartz-feldspar crystal tuff; in places, carbonate-altered pillow lavas transitional to silicified pillow breccias

Note: Primary coherent rhyolite extrusions have not been observed within the stratigraphical succession of the New Waters Pond formation. It is unknown if they occur in the subsurface.

O:CPww West Waters Pond Formation

O:CPwwfu

Unseparated felsic volcanic strata: Mainly thin-bedded chloritic lithic tuff, fine-grained quartz-feldspar crystal tuff, subordinate silicified volcanic breccia, and pyritic gossan; all transitional to quartz-sericite schist; minor phyllite and dark grey argillite

Note: Unit *O:CPwwfu* may include rocks that are elsewhere assigned to Unit *O:CPwwf1* and possibly Unit *O:CPwwf2*. The felsic volcanic rocks at the Lochinvar prospect (Froude et al., 1996) are included in Unit *O:CPwwfu*.

O:CPwwf2

Upper rhyolite and mudstone member: Mainly rhyolite flows, rhyolite breccias and felsic volcanic-derived sedimentary rocks; at the base of the member, a coherent rhyolite lava showing synvolcanic folds of flow layering crosscut by marginally banded or massive dykes of quartz–feldspar porphyry; flow-banded rhyolite forming laterally discontinuous *in situ* lobes gradational with jigsaw-fit hyaloclastite; succeeded by felsic volcanic breccia made up of fragments of porphyritic, aphyric and spherulitic rhyolite; overlying stratiform rhyolite bodies display aphyric, quartz-phyric, pumiceous or scoriaceous textures and are capped by feldspar-phyric crystal tuff; at the top of the member, tuffaceous wacke gradational to laminated mudstone

Note: Based on their lateral extent and thickness, the rhyolite lavas in the upper member of the West Waters Pond formation probably comprise parts of kilometre-scale coulée-type extrusive bodies. Some of the overlying coarse pyroclastic strata possibly represent autoclastic breccias that are locally augened by a eutaxitic flow foliation.

O:CPwwm2

Upper pillowed basalt member: Mainly a very localized but notably thick sequence of basalt and andesite; throughout most of the member, vesicular basalt flows having abundant matrix-disseminated carbonate and vein carbonate; near the structural top of the unit, pillow lava and pillow breccia transitional to chlorite schist; near its faulted contact with the Springdale Group, sucrose basalt from Unit *O:CPwwm2* hosting open-spaced, fibred and slickenlined veins of quartz, calcite, hematite, ferroan carbonate, chlorite, clinozoisite, epidote, chalcopyrite and pyrite.

Note: Restricted to the east of the map area, Unit *O:CPwwm2* may be, in part, a lateral facies variant of Unit *O:CPwwm1*, although the former is significantly thicker than the latter. The stratigraphical base of the upper pillowed basalt member is not exposed.

O:CPwwm1

Lower mafic volcanic member: Mainly mafic volcanic flows and mafic intrusions; at the base of the member, spectacular intervals of dark grey pillow lava having variolitic glassy rims, radial structure and interstitial green chert; extensively altered pillow breccia net-veined by iron carbonate; succeeded by vesicular basalt flows intruded by coarse-grained gabbro sills, both locally displaying a completely silicified matrix; at the top of the member, highly amygdaloidal andesite flows progressively replaced by chlorite, hematite and jasper ascending the volcanic sequence

Note: Relatively thin but laterally persistent, Unit *O:CPwwm1* is well developed in the type area of the West Waters Pond formation and farther west. However, it is also interpreted to be present to the north of Unit *O:CPwwm2* near the Indian Brook copper prospects.

O:CPwwf1

Lower felsic volcanic member: Mainly fine-grained felsic pyroclastic strata forming the most widespread unit of felsic volcanic rocks in the Catchers Pond Group; at the base of the member, thin-bedded to laminated, very fine-grained, crystal-lithic tuff; succeeded by finely laminated ash tuff and lapilli tuff intercalated, in places, with banded siliceous argillite; overlying quartz-phyric tuff and quartz–feldspar crystal tuff commonly altered by ferroan carbonate and weathered to pitted limonite; locally, chalcopyrite-bearing tuff having disseminated sulphide grains rimmed by secondary hematite or extensively replaced by jasper; pretectonic sills of pyritic gabbro and multiple diabase dykes

Note: In places, the lowest member of the West Waters Pond formation contains outsized blocks of dacitic tuff typical of those that characterize the underlying Long Pond formation as well as ferruginous chert and jasper clasts similar to those occurring in the uppermost part of the Indian Brook formation.

O:CPlp Long Pond Formation

Mainly mafic extrusive and intermediate pyroclastic strata; at the base of the formation, thin sulphidic or jasperitized interbeds of dark to light green, fine-grained, highly vitric, plagioclase-phyric dacitic crystal tuff and light grey, size-graded, felsic lithic-crystal tuff distinguished by rounded quartz eyes set in a lapilli-rich chloritic matrix; amygdaloidal dykes and sills of porphyritic diabase and equigranular gabbro; dark green, carbonate-altered basalt and epidotized pillow breccia (having conspicuous fragments of red chert and orange jasper) interstratified with buff-weathered, plagioclase- and/or quartz-phyric crystal tuff; light green, silicified, mafic–felsic breccia containing plagioclase-porphyritic mafic bombs (displaying vesicular chloritic cores and leached sericitized rims) and minor outsized blocks of felsic lapillistone (illustrating notched or hot-indented margins adjacent to mafic clasts and preserving a eutaxitically foliated or spherulitic matrix)

In the middle part of the Long Pond formation, a well stratified interval of polylithic tuff having conspicuous fragments of light-green dacitic vitroclasts (perlitically fractured, obsidian-rich pumice and quench-textured ejecta characterized by compacted chilled selvages and minute chloritic amygdules) together with clasts of light-pink rhyolitic glass (porphyritic ash composed of embayed quartz phenocrysts set in a dark-grey matrix of contorted shards); minor, flow-layered welded tuff passing gradationally into devitrified bands made up of isolated spherulites and agate-bearing lithophysae; light-grey, coarse-grained, clast-rotated felsic breccias displaying sharp boundaries with interstratified horizons of fine-grained, medium-bedded mafic tuff

At the top of the Long Pond formation, extensively carbonate-altered and highly silicified basalt flows capping glassy intermediate tuff and jasperitized felsic tuff; the above-mentioned bimodal pyroclastic strata hosting laterally discontinuous stratabound zones of massive jasper and crosscutting zones of hematite-bearing quartz veinlets

Unit *O:CPlp* tuff is locally transitional to sericitic, chloritic or carbonaceous schist; in places, the subdivision is host to zones of disseminated chalcopyrite and sphalerite in volcanic schist, to arrays of chlorite–quartz–pyrite–hematite veins, to stringers made up of jasper, hematite, sericite and feldspar, and to spotted aggregates composed of ferroan carbonate and pyrite grains

O:CPib Indian Brook Formation

Mainly pillowed basalt, pillow breccia, interflow chert and subvolcanic intrusions; throughout most of Unit *O:CPib*, dark green, well stratified, medium- to fine-grained pillowed basalt intercalated with massive, medium-to coarse-grained flows of plagioclase-porphyritic andesite; abundant gabbroic sills and multiple diabase dykes having variolitic edges or chilled margins; pillow lava intervals displaying pipe vesicles, glassy selvages, interstitial grey-green chert, monomictic mafic breccia and hyaloclastite; in places, polylithic basaltic breccia and grey mafic tuff made up of thoroughly silicified and relatively pristine volcanic fragments; minor pyrite–chalcopyrite mineralization in gossans present along contacts between mafic breccia and massive flows; widespread propylitically altered basalt illustrating chlorite pseudomorphs after clinopyroxene, having ubiquitous amygdules filled by chlorite and carbonate, and being crosscut by numerous chlorite–epidote–titanite–quartz stringers; in places, folded pyrite–sericite–quartz veinlets in silicified basalt; in the upper part of the Indian Brook formation, and especially near its boundary with the Long Pond Formation, red jasperitized basalt having abundant matrix-disseminated carbonate, and displaying purple-red interbeds of parallel-laminated chert, and hosting transgressive sheets of quartz–feldspar porphyry

CAMBRIAN TO EARLY ORDOVICIAN?
C:E WESTERN ARM GROUP?

C:Ecb

Maroon and red, hematitic, ribboned chert; dark green, siliceous, parallel-laminated argillite; light grey, thin-bedded sandstone turbidite; dark grey, magnetic basalt flows, tholeiitic pillow lava and porphyritic gabbro sills; locally, hematized jasper-rich basalt, black chlorite schist and light green epidosite; possibly correlative with Early Ordovician parts of the upper Skeleton Pond Tuff and the overlying Big Hill Basalt [Unit wOs and Unit wOb of Kean and Evans, (1994)] or, alternatively, Unit LCOpb at the stratigraphical top of the Cambro-Ordovician Lushs Bight Group (cf. Kean and Evans, 1994)

C:Eat

Banded argillite, ferruginous chert and mafic crystal tuff in subcrop and drill core; possibly correlative with strata found in the upper part of the Skeleton Pond Tuff (Marten, 1971) of the basal Western Arm Group (cf. Kean *et al.*, 1995)

C:Ebi

Massive flows of light grey plagioclase-porphyritic basalt; light green, non-magnetic basalt enriched in disseminated epidote; arsenopyrite-bearing quartz veins in silicified basalt; porphyroblastic chalcopyrite in mafic greenschist; thin horizons of sulphide-bearing banded iron formation; possibly correlative with Cambrian strata located near the Sugar Loaves Basalt–Skeleton Pond formation transition (cf. Szybinski, 1995)

C:Etg

Highly magnetic tholeiitic basalt and tholeiitic gabbro sills (Jenner and Szybinski, 1987; Szybinski, 1995), including island-arc tholeiite (Gaboury et al, 1996); massive aphyric mafic flows, minor pillow breccia and aquagene tuff, particularly in the klippe made up of Unit *C:Etg* rocks; dark grey, plagioclase-porphyritic vesicular basalt and variolitic pillowed basalt transitional to sulphide-bearing, black chlorite schist; equigranular to schistose gabbro carrying folded quartz–chlorite–carbonate veins displaying bilateral pyrite–arsenopyrite mineralization; along the southern margin of Unit C:Ebg, banded mylonite, talc schist and chlorite schist; possibly correlative with the Late Cambrian or older Sugar Loaves Basalt (cf. Szybinski, 1995) or, alternatively, the Big Hill Basalt (cf. Szybinski, 1995) within the pre-Ordovician part of the Western Arm Group (Colman-Sadd and Crisby-Whittle, 2005)

Note 1: A brachiopod-bearing argillite within the type area of the Skeleton Pond Tuff of the Western Arm Group has been previously determined to be Early Ordovician (MacLean, 1947).

Note 2: According to Szybinski (1995), the Sugar Loaves Basalt of the Western Arm Group is Late Cambrian or older on the basis of a crosscutting *ca.* 493 Ma (Furongian) lamprophyric dyke. Equivalent to Kean and Evans' (1994) Unit LCOpb in the uppermost Lushs Bight Group, the Sugar Loaves Basalt has been interpreted by Szybinski (1995) as being Cambrian and comprising the basal formation of the Cambro-Ordovician Western Arm Group.

Note 3: The banded siliceous argillite and magnetite-rich mafic tuff herein assigned to Unit *C:Eat* of the Western Arm Group had been previously placed in Unit C1T (Andrews, 1991) or Unit Ot (Kean and Evans, 1994) and included in the Catchers Pond Group rather than the Lushs Bight Group. They have been tentatively correlated with similar strata in the Ordovician Skeleton Pond Tuff in the type area of the Western Arm Group (Kean et al., 1995).

Note 4: In the vicinity of Spar Pond, the basalt flows, gabbro sills and mafic mylonite herein assigned to Unit *C:Etg* of the Western Arm Group were previously included in Unit C1F of the Catchers Pond Group (Andrews, 1991). If correct, they are possibly partial equivalents of some of the Ordovician mafic volcanic strata observed in Unit O:CPib of the Catchers Pond Group rather than being Cambrian and correlative with the Sugar Loves Basalt or the Big Hill Basalt of Szybinski (1995).

LATE CAMBRIAN OR OLDER?
C:L LUSHS BIGHT GROUP

C:Lu

Unseparated mafic volcanic rocks and associated subvolcanic intrusions belonging to the southwestern part of the Lushs Bight Group (cf. DeGrace, 1971); includes the basaltic pillow lava, pillow breccia, hyaloclastite, chlorite schist, gabbro sills and sheeted diabase dykes of the Cambrian and/or Early Ordovician Lushs Bight Group (cf. Kean and Evans, 1994); non-magnetic extrusive and intrusive rocks having numerous chalcopyrite-rich gossans and hosting alteration zones marked by polymineralic veins

C:Liu

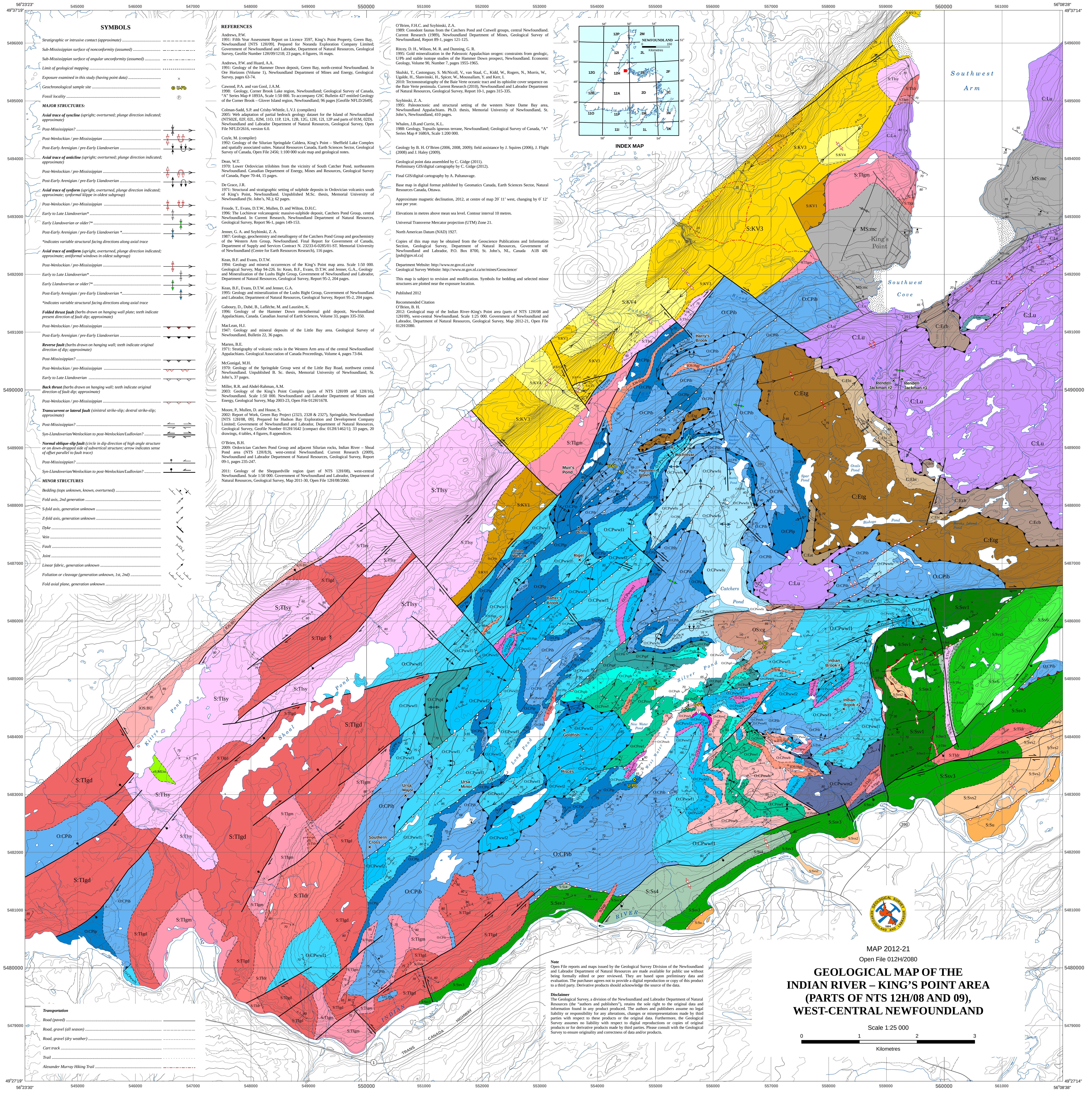
Altered ultramafic rocks, including ophiolitic peridotite, serpentinite and talc schist [part of Unit LCOu (Colman-Sadd and Crisby-Whittle, 2005)] and thus representing the oldest exposed part of the Lushs Bight Group as defined by Kean and Evans (1994); possibly correlative with part of the Cambrian Indian Head–Indian Beach complex (Szybinski, 1995)

Note 1: In the area immediately northeast of Catchers Pond, rocks herein assigned to Unit *C:Lu* include massive basaltic flows, subordinate pillow lava and a gabbro sill complex, all of which are thought to be older than the adjacent faulted body of quartz–feldspar porphyry. They are possibly correlative with Unit LCOpd in the lower sequence of the Lushs Bight Group (Kean and Evans, 1994) or they may represent part of the Cambrian Little Bay Basalt (Szybinski, 1995).

Note 2: Most of the rocks shown within the main tract of Unit *C:Lu* were presumed to have comprised the northern and central units of a local south-facing Early Ordovician succession of the Lushs Bight Group, and to have occupied the inverted limb of a southerly-overturned fold nappe (DeGrace, 1971).

Note 3: In the southwesternmost tectonic panel of Unit *C:Lu*, certain extrusive rocks have been excluded from DeGrace's (1971) Lushs Bight Group and, in an alternative interpretation by Andrews (1991), were included in the Ordovician Catchers Pond Group. These comprise part of Unit C1T of Andrews (1991).

Newfoundland Labrador
NATURAL RESOURCES



SYMBOLS

Stratigraphic or intrusive contact (approximate)
Sub-Mississippian surface of nonconformity (assumed)
Sub-Mississippian surface of angular unconformity (assumed)
Limit of geological mapping
Exposure examined in this study (having point data) ×
Geochronological sample site U-Pb
Fossil locality Ⓕ

MAJOR STRUCTURES:

***Axial trace of syncline** (upright; overturned; plunge direction indicated; approximate)*
Post-Mississippian?
Post-Wenlockian / pre-Mississippian
Post-Early Arenigian / pre-Early Llandoverian

***Axial trace of anticline** (upright; overturned; plunge direction indicated; approximate)*
Post-Wenlockian / pre-Mississippian
Post-Early Arenigian / pre-Early Llandoverian

***Axial trace of synform** (upright, overturned, plunge direction indicated; approximate; synformal klippe in oldest subgroup)*
Post-Wenlockian / pre-Mississippian
*Early to Late Llandoverian**
*Early Llandoverian or older?**
*Post-Early Arenigian / pre-Early Llandoverian **
**indicates variable structural facing directions along axial trace*

***Axial trace of antiform** (upright, overturned, plunge direction indicated; approximate; antiformal windows in oldest subgroup)*
Post-Wenlockian / pre-Mississippian
*Early to Late Llandoverian**
*Early Llandoverian or older?**
*Post-Early Arenigian / pre-Early Llandoverian **
**indicates variable structural facing directions along axial trace*

***Folded thrust fault** (barbs drawn on hanging wall plate; teeth indicate present direction of fault dip; approximate)*
Post-Wenlockian / pre-Mississippian
Post-Early Arenigian / pre-Early Llandoverian

***Reverse fault** (barbs drawn on hanging wall; teeth indicate original direction of dip; approximate)*
Post-Mississippian?
Post-Wenlockian / pre-Mississippian
Early to Late Llandoverian

***Back thrust** (barbs drawn on hanging wall; teeth indicate original direction of fault dip; approximate)*
Post-Wenlockian / pre-Mississippian

***Transcurrent or lateral fault** (sinistral strike-slip; dextral strike-slip; approximate)*
Post-Mississippian?
Syn-Llandoverian/Wenlockian to post-Wenlockian/Ludlovian?

***Normal oblique-slip fault** (circle in dip direction of high angle structure or on down-dropped side of subvertical structure; arrow indicates sense of offset parallel to fault trace)*
Post-Mississippian?
Syn-Llandoverian/Wenlockian to post-Wenlockian/Ludlovian?

MINOR STRUCTURES

Bedding (tops unknown, known, overturned)
Fold axis, 2nd generation
S-fold axis, generation unknown
Z-fold axis, generation unknown
Dyke
Vein
Fault
Joint
Linear fabric, generation unknown
Foliation or cleavage (generation unknown, 1st, 2nd)
Fold axial plane, generation unknown

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Geological point data assembled by C. Gidge (2011).
Preliminary GIS/digital cartography by C. Gidge (2012).

Final GIS/digital cartography by A. Paltanavage.

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Approximate magnetic declination, 2012, at centre of map 20˚ 11' west, changing by 0˚ 12' east per year.

Elevations in metres above mean sea level. Contour interval 10 metres.

Universal Transverse Mercator projection (UTM) Zone 21.

North American Datum (NAD) 1927.

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Geological Survey Website: http://www.nr.gov.nl.ca/nr/mines/Geoscience/

This map is subject to revision and modification. Symbols for bedding and selected minor structures are plotted near the exposure location.

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Transportation
Road (paved)
Road, gravel (all season)
Road, gravel (dry weather)
Cart track
Trail
Alexander Murray Hiking Trail

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MAP 2012-21

Open File 012H/2080

GEOLOGICAL MAP OF THE INDIAN RIVER – KING'S POINT AREA (PARTS OF NTS 12H/08 AND 09), WEST-CENTRAL NEWFOUNDLAND

Scale 1:25 000

0 1 2 3
Kilometres