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The different portions of the area have been previously mapped at 1:250 000 scale by Williams (1970), Riley (1957), Neale and Nash (1963), and Baird (1960). The Star Lake (east half) (12A/11E), Buchans 12A/15) and Badger (12A/16) map areas have been mapped at 1:50 000 scale by Kean (1978, 1979) and Kean and Jayasinghe (1982), respectively. The area southwest of Grand Lake (parts of 12A/12,13, 12B/9,16) and the west half of Star Lake have been mapped by Knapp et al. (1979) and Dunning et al. (1982), respectively. Carboniferous rocks bordering Grand Lake have been mapped at 1:50 000 by Hyde and Ware (1981). A preliminary version of this map was published previously at 1:100 000 scale (Whalen and Currie, 1983b). Large scale compilations of Appalachian geology (Williams, 1978) show the central upland region of the

map area to be a Devonian granitic terrane ('Topsails batholith') separating the oceanic and island-arc volcanic sequences of central Newfoundland from the autochthonous continental and miogeoclinal terrane of western Newfoundland, with its local cover of ophiolite-bearing allochthons. The Topsails igneous terrane exhibits a complex sequence of intrusive relations suggesting that it is as old as contiguous terranes, although of quite different character. It appears to be separated from neighbouring terranes by major tectonic breaks which have, in some cases, been affected by later igneous activity. The drift-filled valley of Birchy Lake, thought to contain the Lobster Cove fault, separates the Topsails and Fleur de Lys terranes. To the west, a steeply dipping fault, exposed in Conners Brook and thought to extend the length of Grand Lake (Hyde and Ware, 1981), separates the Topsails terrane from a Carboniferous basin. To the south and east, investigations in the Buchans camp (Thurlow, 1981), and our own observations farther to the southwest, indicate that the Topsails terrane is thrust to the southeast over the central volcanic belt of Newfoundland, and over a gneissic, much more mafic, igneous terrane to the south of Lewaseechjeech Brook. The polydeformed semipelitic to psammitic metasediments of unit HF, have been correlated, based on lithological similarity, with the Fleur de Lys Supergroup of the Burlington Peninsula (Knapp et al., 1979). Unit HF is interpreted as allochthonous and is separated from carbonate rocks of unit Os by major east-

Rocks of mafic to ultramafic composition (unit Om) occur as small to large inclusions in units OHM, Ot, Og and Sa. Southeast of the Topsails terrane, Dunning (1981) and Dunning et al. (1982) identified larger ragments occurring in units Ot and Og as being of ophiolitic affinities, and suggested that the smaller mafic nclusions in these units were also oceanic crustal material. Similar mafic to ultramafic inclusions occur in the Hungry Mountain complex (unit OHM) and younger igneous breccias (unit Sa). Most of these mafic rocks may be of the same early Ordovician age (479-495 Ma) as ophiolitic suites in western Newfoundland Dunning and Krogh, 1985). However, some gabbroic bodies southwest of Buchans, here included in unit Om, may be as young as unit Sd.

In the northern part of the Topsails terrane, the oldest rocks have been grouped together into the Hungry Mountain complex (unit OHM), as described by Thurlow (1981). A foliated hornblende tonalite from this unit on the west side of Hinds Lake yielded U-Pb zircon upper and lower intercept ages of 2090 ± 75 and 467 ± 8 Ma (Whalen et al., 1987b). Even in the type area near Buchans, the Hungry Mountain complex is very heterogeneous on both large and small scales. The rocks consist principally of hornblende gabbro, diorite and tonalite with numerous mafic to ultramafic inclusions (unit OHMa). Significant amounts of various types of younger granodiorite also occur (unit OHMb), together with minor amounts of biotitemuscovite gneiss (unit OHMc). Major portions of unit OHM, based on lithological similarities and U-Pb zircon ages, are probably equivalent to undifferentiated units Om, Ot and Og but unit OHM also contains significantly older components as indicated by the Aphebian age inheritance in zircons. Structurally, the complex varies from massive to strongly foliated, but epidote veins and patches are ubiquitous and

South of the Topsails terrane, an extensive mafic to tonalitic terrane (map unit Ot) has been described by Herd and Dunning (1979), Dunning (1981) and Dunning et al. (1982). This terrane consists of moderately to strongly foliated hornblende-biotite tonalite to diorite with numerous small to large mafic to ultramafic inclusions of unit Om. Unit Ot tonalite from Southwest Brook yielded U-Pb zircon upper and lower intercept ages of 1430 \pm 18 and 456 \pm 3 Ma (Dunning, pers. comm. 1983). A massive to moderately foliated granodioritic to granite terrane (unit Og) separates this mafic terrane from the Topsails. Unit Ogd contains arge inclusions of quartz, obviously derived from older veins, and locally appears to be a remobilized igmatite complex. Contact relationships between the tonalite terrane (unit Ot) and the granodiorite terrane unit Og) are very poorly exposed, but the granodiorites appear to be younger. latformal sedimentary rocks (unit **Os**) consist of phyllitic schist and phyllite of the Grand Lake Brook Group at the base of the succession and grade upward into phyllite and marble. The Grand Lake Brook marbles locally grade into thickly bedded, calcitic and dolomitic marbles of the overlying St. George Group, which in turn is locally disconformably overlain to the west by Table Head Formation limestone, shaly limestone and shale. The Glover Group (unit OG) consists mainly of pillowed basalts (unit OGv), but there are minor areas of

tuffaceous clastic sediments (unit OGs). A fossil locality at the southwest margin of the mapped area

yielded a mid- to late Arenig fauna (G.S. Nowlan, pers. comm., 1982). Close to contacts with younger granitic rocks, the Glover Group loses primary features and becomes massive, fine grained rock, presumably due to

contact metamorphism. Knapp et al. (1979) found the Glover Group on Glover Island to rest on ultramafic The Buchans Group (unit OBv), which borders the central part of the Topsails terrane, has been recently mapped in detail by Kean (1979), described by Thurlow (1981) and Thurlow and Swanson (1981), and dated by U-Pb zircon geochronology at 475 ± 3.5/-2 Ma (Dunning et al., 1987). The Buchans Group consists of a sequence of pillowed basalts, dacites, rhyolites, fragmental tuffs and breccias, with minor conglomerate of subaqueous origin. Thurlow (1981) showed that the Hungry Mountain complex (unit OHM) as thrust over the Buchans Group, and that younger granites (units Ssy and Sp) intrude the group. The uchans Group is intruded by diabase and gabbro (unit OBi) which may, in part, be as young as unit Sd. Rather diverse granitoid rocks (units Oi) outcropping at various places in the Topsails terrane, appear to be somewhat younger than the Glover Group and the Buchans Group. These rocks are generally near massive, or weakly foliated, and lack the small scale heterogeneity characteristic of units Ot and Og. Some of the granitic portion of the Hungry Mountain complex (unit OHM) may be equivalent to these units. All of these units exhibit fracture-related chlorite and epidote alteration. The Feeder Granodiorite (unit Oia), and the Buchans Group, and dykes of this body cut the Buchans Group. The pink, two-feldspar, biotiteamphibole granitic rock is characterized by 5 to 10 mm, rounded to subhedral, quartz grains. Bell and Blenkinsop (1981) obtained a Rb-Sr whole-rock isochron of 410 \pm 80 Ma from this rock. Thurlow (1981) has suggested the Feeder Granodiorite may be genetically related to the Buchans Group acid volcanics. The Hinds Brook granite (unit Oib), which outcrops mainly to the west of Hinds Lake, yielded a U-Pb zircon age of 460 \pm 10 Ma (Whalen et al., 1987b). Granite of unit Oic contains aplitic zones with coarse grained muscovite rosettes and patchy, greisen-like, muscovite alteration. Contact relations between units Oib and Oic were not observed, but they are thought to be of similar age. In Blue Grass Brook, volcanics and sediments of unit Ss unconformably overlie the granite. The basal conglomerate contains rounded cobbles of locally derived granite, red rhyolite and oxidized basalt, and is in turn overlain by flows of similar rhyolite

and basalt. The intrusive rocks of units Oib and Oic thus appear to form a basement for the volcanic and

sedimentary rocks of the Springdale Group (unit Ss). A number of bodies of granite, which occur outside the area mapped by the authors, have been grouped together into unit Oid. These granites intrude units OHM and Ot in the south and units HF and Om in the north and are thought to be older than the Topsails intrusive suite (units Sa through Sq). The Rainy Lake complex (unit SORL) consists of distinctive, mildly saussuritized gabbro with clots of pyroxene, biotite and amphibole, which is cut by various mesocratic diorites, leucocratic tonalites and granodiorites. Unit SORL has striking similarities to recent island arc plutonic rocks (Whalen, 1985, 1986). A quartz diorite from unit SORL yielded a U-Pb zircon age of 438 ± 8 Ma (Whalen et al., 1987b). These more mafic intrusive rocks are cut by fine- to medium-grained red two-feldspar biotite-amphibole granite which may be significantly younger. The western part of the complex in Harry's Brook contains basaltic enclaves, and the sequence is bounded to the west by west-facing pillow lavas with minor interstitial red chert. A thick volcanic section (unit Ss) younger than the Glover Group and Rainy Lake complex outcrops in the central part of the Topsails terrane. We have observed unconformable contacts with the Glover Group (unit OG) and older granitic rocks (unit Oic). The lithological composition and stratigraphic position of this volcanic section strongly suggest that it is equivalent to the Springdale Group. Neale and Nash (1963) mapped the Springdale Group from its type area southwest to the vicinity of Sheffield Lake, where they truncated it by a rather arbitrary boundary, possibly because they recognized the presence of subvolcanic porphyries (unit Sq) in this area. However, we have been able to separate the Springdale-type lithologies from these younger rocks. A unit Ss rhyolite sample collected to the west of Hinds Lake yielded an U-Pb zircon age of 429 \pm 4 Ma (Whalen et al., 1987b), essentially identical to the 430 \pm 5 Ma zircon age obtained from the type Springdale area by Chandler et al. (1987). Near-massive red rhyolite, with little layering or flow banding, forms the lowest part of the section, overlain by reddened basalt flows, with frothy vesicular tops indicating subaerial extrusion. The upper part of the section consists of brightly coloured, orange to red rhyolites with sparse, small phenocrysts. Spectacular rhyolite-basalt mixtures occur, including a flow composed of globules of basalt and rhyolite, and composite dykes grading from rhyolite cores to basalt edges. he upper part of the section also contains rhyolite breccias with well sized, angular fragments, and laharic breccias with both rhyolitic and basaltic boulders in a chaotic rhyolitic matrix. We interpret a small area of similar volcanics at the southeast edge of the Topsails terrane (Caribou Lakes) to be part of the Springdale Group, since they exhibit unconformable relations to the older granodiorite (unit Ogc) and are associated with flow-banded rhyolite dykes. The félsic volcanics are mainly subalkaline to alkaline high-silica rhyolites which bear a close chemical resemblance to some of the A-type granites in map unit Sm, whereas the mafic

The younger and most characteristic rocks of the map area form a rather diverse A-type granite suite (Whalen et al., 1987a) of gabbros, syenites, granodiorites and granites (units Sa to Sq) which we have called the Topsails intrusive suite (Whalen and Currie, 1983). Based on U-Pb zircon ages (Whalen et al., 1987b), all these intrusive phases may be essentially contemporaneous with the maximum age span between oldest and youngest phases being 8 Ma (432-424 Ma). The Topsails intrusive suite includes several elongate belts of agmatite (unit Sa) consisting of extraordinarily complex mixtures of diverse mafic fragments and variously hybridized granitoid rocks. The mafic fragments range from fine grained but featureless basalt, through various gabbroic rock types, to ultramafic blocks. Fragments range in size from a few millimetres to more than 10 m, and shapes range from extremely angular to almost spherical. The whole unit is cut by mafic dykes which are themselves sinuous, and locally broken up, suggesting that they were emplaced into a still plastic mass. The mafic fragments could be, in part, derived from unit Om, whereas the felsic matrix appears more likely equivalent to units Sg and Sp. Although one poorly exposed example northeast of Buchans fringes syenite (unit Ssy), the others appear to form screens separating plutons of hornblende-bearing granite.

Based on intrusive relationships and degree of alteration, both quartz syenite-bearing suites in the map

volcanics resemble transitional or early rift basalts (Whalen, 1986).

area (units Ssya and Ssyb) appear older than unit Sp, however there is no evidence to indicate the two suites are genetically related. The gabbro-quartz syenite suite outcrops as three small bodies in the central to southern part of the map area, one of which, just west of Shanadithit Brook, may represent a large fragment in an agmatite zone. A large body of this intrusive rock, the Skull Hill syenite, in the northeast part of the map area, gave a zircon age of 415 ± 2 Ma (Kean and Jayasinghe, 1982). Based on constraints imposed by field relationships and the zircon ages of Whalen et al. (1987b), this age appears too young by at least 5 Ma. The gabbros contain elongate clinopyroxenes with amphibole rims, euhedral plagioclase and interstitial K-feldspar. The more felsic parts of the unit are deep orange with minor acicular amphibole. The quartz syenite-granite suite (unit Ssya) around Sheffield Lake exhibits an apparent continuum of ompositions from red, two-feldspar, biotite-amphibole-clinopyroxene quartz syenite to biotite-amphibole granite. The syenite contains abundant, small, partially disaggregated mafic inclusions, which decrease in bundance with increasing quartz content. Granite of unit Sm clearly intrudes the syenite. Northeast of Suchans, the poorly exposed quartz syenite to granite sequence appears to belong to a different suite than the Sheffield Lake occurrences, although it is also older than units Sp and Sm. Pink two-feldspar biotite-amphibole granite (unit Sg) southeast of Hinds Lake, is considered to be older than unit Sp, for it is cut by fine grained peralkaline granite dykes, probably equivalent to unit Sp, and exhibits chlorite alteration of mafic minerals adjacent to granite of unit Sp. Unit Sg east of Glover Island

exhibits both intrusive and apparently gradational contacts with unit Sm, and the two units are separated

by a zone of finer grained intrusive rock, Granite of unit Sq does not closely resemble the different

intrusive phases belonging to unit Sp for it is coarse grained and contains distinctive clotty mafic Peralkaline coarse grained, white to red, hypersolvus, amphibole granite with prominent quartz grains and a distinctive interstitial habit to the mafic minerals (unit Sp) is quite lithologically and nemically homogeneous over a very large area of the Topsails terrane extending from Lewaseechjeech Brook more than 100 km to the northeast to the vicinity of Sheffield Lake. A sample from Gaff Topsail, at the northeast end of the map area, yielded a concordant U-Pb zircon age of 429 \pm 3 Ma (Whalen et al., .987b). This granite contains spongy mafic clots of aegirine and arfvedsonite with occasional aenigmatite and 'exotic' sodium titanium silicates and phosphates. Closely associated with unit Sp. is a spectrum of fineto medium-grained granitic to granodioritic phases (unit Sm) which have been subdivided mainly on the basis of feldspar and mafic minerals. These phases occur mainly at the margins of the coarse grained amphibole granite, and vary from amphibole-poor to amphibole-free biotite-granite to peralkaline amphibole aggiring granite. Both one-feldspar and two-feldspar types occur. Contact relationships, where observed, show that these phases are younger than unit Sp, although in many areas the contacts appear to be gradational. Marginal rocks of dioritic or granodioritic composition (unit Smc) occur adjacent to agmatite zones (unit Sa). Field observations and chemistry indicate that these compositions result from mixing between granitic (unit Sp) and basaltic magmas (Whalen and Currie, 1984). Closely associated with felsic volcanics of unit Ss is a subvolcanic, red, altered, granophyric and miarolitic aplite (unit Smh). Since

petrography and chemistry demonstrate that many phases of unit Sm are subalkaline to alkaline. they

cannot all simply be chilled marginal zones of the peralkaline granite (unit Sp).

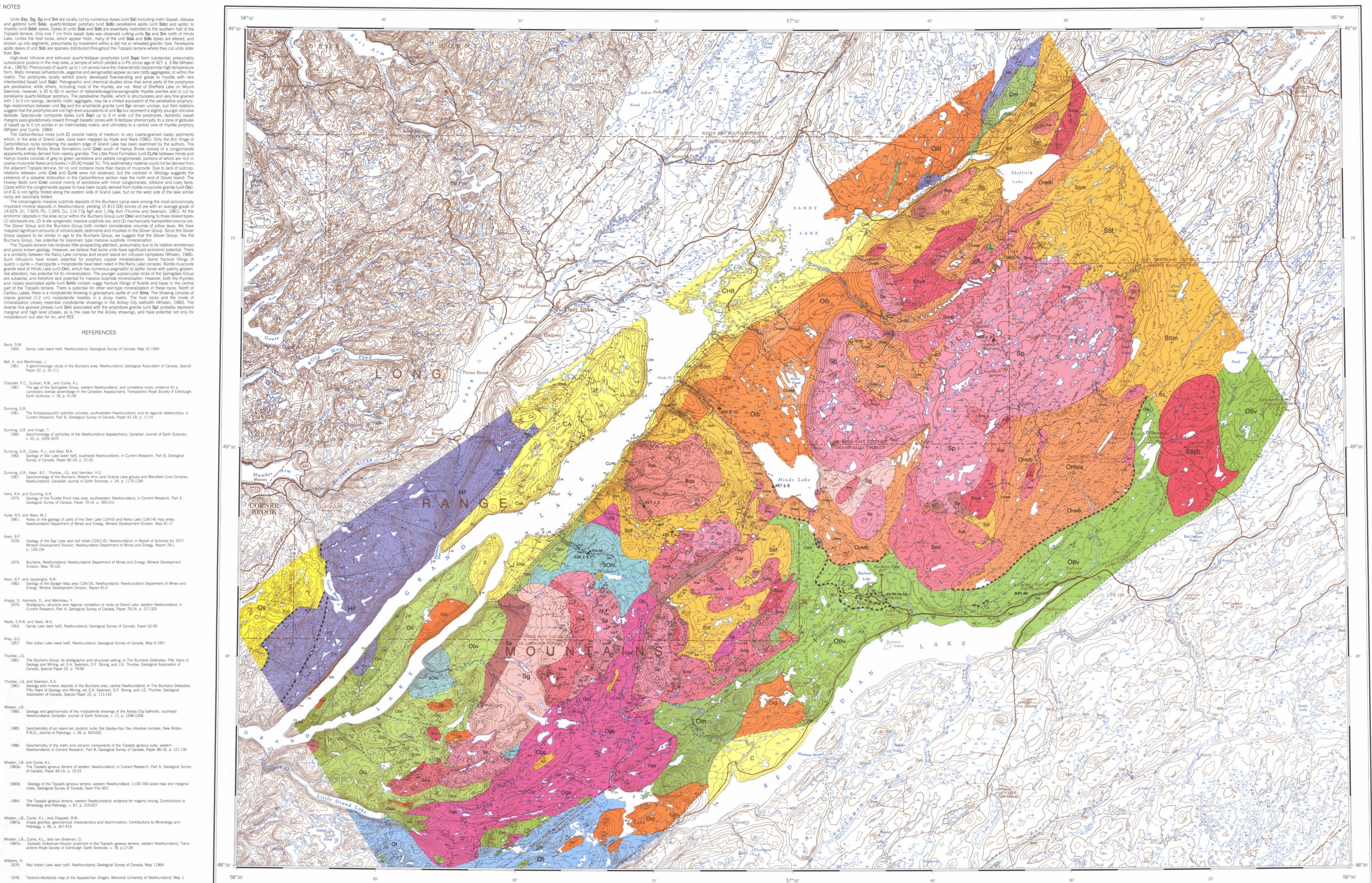
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TOPSAILS IGNEOUS TERRANE

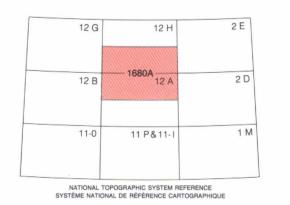
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LEGEND

Carboniferous clastic sedimentary rocks; CA, Anguille Group, sandstone, siltstone,

arkose and mudstone; CNB, North Brook and Rocky Brook formations, pink to

orange conglomerate and sandstone, granite wash; CLPB, Little Pond Brook

Quartz-feldspar porphyry, rhyolite, minor basalt; Sqa, orange to green quartz-

Dyke rocks; Sda, fine- to medium-grained diabase and plagioclase-porphyritic

diabase; Sdb, orange quartz-K-feldspar porphyry; Sdc, white to beige amphibole-

White to red, fine- to medium-grained equigranular granite; minor quartz-feldspar

amphibole two-feldspar granite; Smc, amphibole-biotite two-feldspar granite and

porphyritic granite and aplite; Sma, biotite two feldspar granite; Smb, biotite-

granodiorite; Smd, biotite one-feldspar granite; Sme, biotite-amphibole one-

sodic pyroxene one-feldspar granite; Smh, red epidotized and chloritized

one-feldspar granite, may include minor unit Sm, in large part peralkaline

White to pink medium- to coarse-grained biotite-amphibole two-feldspar granite,

quartz syenite to granite; Ssyb, grey to orange medium- to coarse-grained

Ssya, red medium grained K-feldspar porphyritic amphibole-biotite two-feldspar

Agmatite of mafic to ultramafic blocks in granitic to granodioritic matrix, blocks

Ssf, red flow banded rhyolite, rhyolite breccia, laharic breccia and silicic tuff;

Fine- to coarse-grained amphibole-clinopyroxene gabbro, diorite and quartz diorite

and amphibole-biotite granodiorite, also includes younger red fine grained biotite-

Massive to slightly foliated granite to granodiorite; Oia, FEEDER GRANODIORITE;

pink to red, biotite-amphibole two-feldspar granite; Oib, HINDS BROOK GRANITE;

white to pink medium- to coarse-grained biotite-amphibole K-feldspar porphyritic

and aplite; Oid, undivided medium- to coarse-grained, white to pink, biotite,

amphibole and/or muscovite granite, may include areas of hybrid gneisses

coarse-grained diabase and gabbro, may be as young as unit Sda in part

Pillow basalt, agglomerate, diabase, tuff and conglomerate; OGv, pillow basalt,

Platformal sedimentary rocks; includes Table Head Formation, St. George Group,

Massive to moderately foliated granodiorite and minor tonalite, with many small

mafic to ultramafic fragments, relations between subunits uncertain; Oga, grey to

granodiorite, minor amphibole granodiorite; Ogb, white coarse grained amphibole granodiorite; Ogc, white to pink coarse grained amphibole-biotite quartz-eye

porphyritic granite to granodiorite; Ogd, grey medium grained biotite-muscovite

White to grey medium- to coarse-grained hornblende ± biotite tonalite to diorite,

moderately to strongly foliated, with many small to large mafic to ultramafic

HM ultramafic inclusions; OHMa, fine- to coarse-grained hornblende gabbro,

granodiorite and migmatite; Oge, pink medium- to coarse-grained biotite granite

Moderately to strongly foliated gabbro to granite with many small to large mafic to

amphibolite, diorite and quartz diorite; OHMb, medium- to coarse-grained white to

porphyritic biotite-amphibole granite, and tonalite; OHMC, medium grained white to

25,4

pink amphibole-biotite quartz-eye porphyritic granite to granodiorite, K-feldspar

Mafic to ultramafic rocks; basalt, gabbro, hornblendite, pyroxenite, ophiolitic

pink medium- to coarse-grained biotite and biotite-amphibole granite to

massive basalt and minor rhyolite; OGs, tuff, tuffaceous sediments and

two-feldspar granite; Oic, pink fine- to medium-grained biotite ± muscovite granite

OBv, basalt, rhyolite, tuff, breccia, minor subaqueous conglomerate; OBi, fine- to

Ssm, amygdaloidal and massive subaerial basalt, minor andesite; Sss, arkose,

Sg contains pink fine- to medium-grained granite with pegmatitic patches

may be as old as unit Om, matrix may be as young as unit Sm

amphibole ± clinopyroxene gabbro to quartz syenite

feldspar granite; Smf, amphibole-biotite one-feldspar granite; Smg, amphibole-

White to red medium- to coarse-grained equigranular amphibole ± sodic pyroxene

clinopyroxene aplite and quartz-K-feldspar porphyritic peralkaline aplite; Sdd, red

K-feldspar porphyry, in large part peralkaline; Sqb, orange to red quartz-K-feldspar

porphyritic rhyolite and minor amygdaloidal basalt flows, felsic volcanics in large

CHB, Howley Beds, grey sandstone, minor conglomerate and siltstone

TOPSAILS INTRUSIVE SUITE (Sa-Sq)

granophyric aplite

SPRINGDALE GROUP

conglomerate and siltstone

RAINY LAKE COMPLEX

amphibole two-feldspar granite

and Grand Lake Brook Group

HUNGRY MOUNTAIN COMPLEX

pink biotite-muscovite gneiss

FLEUR DE LYS SUPERGROUP

Geological boundary (defined, approximate, assumed) . . .

Schistosity, foliation (inclined, vertical, dip unknown)

numbers indicate relative age, 1 being the oldest ...

Bedding, tops known (inclined, overturned)

Glacial striae (direction of ice flow known);

HADRYNIAN TO LOWER PALEOZOIC

Rock outcrop (area of outcrop)

Fault (assumed) ...

suites; some may be as young as Sda

Semipelitic schist and psammitic gneiss

MINERALS

Geology by J.B. Whalen 1981, 1982, K.L. Currie 1981, 1982, J.G. Graves 1981, and P. Barrette 1982;

some areas compiled from Dunning et al. 1982, Hyde and Ware 1981, Kean 1978, 1979, Kean and

Jayasinghe 1982, Knapp et al. 1979, and Neale and Nash 1963

Geological cartography by M. Sigouin, Geological Survey of Canada

Any revisions or additional geological information known to the user would be

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vary from 24°32'W in the SW corner to 25°12'W in the NE corner of the map

Elevation in feet above mean sea level

Energy, Mines and Resources, Ottawa, Ontario, K1A 0E9

Molybdenite .

Native silver and argentite Ag

SILURIAN OR ORDOVICIAN

part subalkaline; Sqc, composite rhyolite-basalt dyke

Formation, grey to green muscovitic sandstone, quartz-pebble conglomerate;

PALEOZOIC

CARBONIFEROUS

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