Energy, Mines and Resources Canada   Énergie, Mines et Ressources Canada

GEOLOGICAL SURVEY OF CANADA   COMMISSION GÉOLOGIQUE DU CANADA

DESCRIPTIVE NOTES

The map area, which is located between 47°00′ and 47°30′ latitude and 66°15′ and 67°00′ longitude (see location map insert), covers an area of approximately 2300 km². It includes portions of NTS sheets 21 O/1, 2, 7, and 8 and all or portions of New Brunswick Mineral Resources 1:15 840 geological map sheets K10 and 11; L8, 9, 10, and 11; M8, 9, 10, and 11; and N9, 10, and 11. Outcrop data from these sheets have been compiled and included on this map. Due to the poor quality of outcrop in the map area, rock debris that was thought to be close to outcrop was mapped. These data plus recent vertical gradient aeromagnetic maps of the area (Geological Survey of Canada, 1988a,b,c,d) were used to outline geological units and locate and extrapolate geological contacts. Many new logging roads, which greatly improve access in this area, have been included on this map; locations of roads plotted using 1985 aerial photographs and those that postdate 1985, which were approximated, were not distinguished. The locations of isotopic age dates and geochemical samples have also been plotted.

The study area is in large part heavily forested, is covered by a variable thickness of glacial drift, and is characterized by relatively poor outcrop. The oldest rocks exposed in the area are part of the lower Tetagouche Group, which comprises a thick sequence of shale, greywacke, and quartzite overlain by bimodal volcanic rocks. An Arenig shallow-water shelly fauna (Fyffe, 1976) and conodonts (Nowlan, 1981) from metasediments just below the felsic volcanics of the Bathurst Camp, to the northeast of the map area, indicate a pre-Middle Ordovician age for the lower Tetagouche Group. Recent U-Pb zircon ages (R.W. Sullivan, pers. comm., 1988) place the top of the lower Tetagouche Group at no younger than 466 Ma (Middle Ordovician). These lower Tetagouche Group rocks were intruded by a suite of granitic rocks of Ordovician age (Bevier, 1988) prior to regional metamorphism and polydeformation. The age of deformation of the Tetagouche Group is still a matter of debate (see Fyffe, 1982; van Staal, 1987). Siluro-Devonian clastic sediments and bimodal volcanics, which underlie the northwestern part of the map area, were subsequently deposited. All of these rocks were intruded by a number of Silurian-age (Bevier, 1988) plutonic suites which range in composition from mafic to felsic.

In the map area, the lowest part of the Tetagouche Group (unit **OT**) consists mainly of dark grey to black shaly siltstone with argillaceous quartzite (**OTs**) and some mafic (**OTm**) and felsic (**OTf**) volcanic rocks occurring locally. Geological data on the volcanic rocks in the eastern part of the map area were mainly compiled from the provincial 1:15 840 geological maps. At the southern end of the map area, probable metamorphic equivalents include amphibolites (**OTa**) and felsic gneisses (**OTg**). In the Tetagouche Group to the north and east of Popple Depot, Helmstaedt (1971) recognized three penetrative generations of folds, at least two of which were interpreted to be pre-Upper Silurian in age. Though clearly defined metamorphic aureoles in Tetagouche Group rocks adjacent to either deformed Ordovician or undeformed Silurian plutons are rare, observed contacts suggest that Silurian granites postdate the main phase (F_1) and probably also later phases of deformation (F_2 and F_3) of the Tetagouche Group.

The older (Ordovician) granites in the area (unit **Og**) have been subdivided into six main units, most of which trend in a northwest to southeast direction, parallel to regional structural trends. Their width to length ratios suggest that they have undergone extensive flattening. Deformation is often quite variable with slightly to moderately foliated granite bordering strongly mylonitized zones. Though muscovite in these granites is concentrated along foliation planes and is probably not primary, its presence plus that of metamorphic garnet does suggest an originally peraluminous character for most of these granites. From north to south the six main bodies are:

(i) Popple Depot granite (**Ogp**): This granite, which forms talus on the slopes north and northeast of Popple Depot, is a reddish-pink to beige, fine grained mafic-poor biotite granite. Its fine grained nature and the presence of abundant granophyric textures and pegmatitic clots suggest that it is a high level intrusive.

(ii) Meridian Brook granite (**Ogm**): Extending east-west for about 33 km across the middle of the map area, this is an orange to beige, medium to coarse grained, equigranular biotite-muscovite granite. South of Tilley Ridge and east of Mount Mitchell, unit **Ogm** includes a reddish-brown to grey, fine grained, in places amphibole-bearing phase and also some exposures of deformed inclusion-rich tonalite. A U-Pb zircon age of 470 ± 1 Ma has been obtained from this body (Bevier, 1988).

(iii) Sweat Hill granite (unit **Ogs**): Separated from the Meridian Brook granite by a sequence of metasediments, the Sweat Hill granite is a similar-size body of quartz and feldspar porphyritic biotite-muscovite granite. Portions of this granite have patches of tourmaline. At its western end, this intrusive unit varies from coarse grained nearly equigranular granite to high level porphyritic granite. In contrast, a gradational change from a nearly massive coarse grained granite to a chloritic feldspar-augen schist occurs along a 5 km road that transects the eastern end of the body.

(iv) Serpentine River granite (unit **Oge**): The Serpentine River granite is a fine to coarse grained, dark pink to beige biotite-muscovite granite. Along a north-south road that transects the western end of the body, this granite changes, from north to south, from being weakly to strongly foliated, increases in grain size, and changes from being equigranular into a feldspar-porphyroblastic phase (subunit **Ogeb**). The texture of the southern portion of this granite varies from medium to fine grained (aplitic). A U-Pb zircon age of 455 + 12/ − 9 Ma has been obtained from this unit (Bevier, 1988).

(v) Mullin Stream Lake granite (unit **Ogu**): This granite, which extends northeast (not shown) and northwest of Mullin Stream Lake parallel to the regional structure, is a pink to orange, medium to coarse grained, weakly to strongly foliated biotite-muscovite granite. The northeastern portion of the body, which is outside the map area, varies from granitic to quartz monzonitic in composition, and has finer grained portions and is more strongly deformed than the northwestern portion of the body. Adjacent to the North Pole Stream granite, unit **Ogu** is cut by quartz veins and displays fracture-related alteration. A U-Pb zircon age of 458 + 16/ − 1 Ma has been obtained from this unit (Bevier, 1988).

(vi) Fox Ridge granite (unit **Ogf**): This biotite-muscovite granite is characterized by feldspar augen up to 4 cm in diameter that commonly exhibit rapakivi mantling. The type section of this granite, which is described by Fyffe and Pronk (1985), is located outside the map area to the southeast of Trousers Lake. A U-Pb zircon age of 452 + 15/ − 1 Ma has been obtained from this area (Bevier, 1988).

All of these granites are very felsic. Units **Ogp**, **Ogm**, **Oge**, and **Ogu** are lithologically very similar. Some additional bodies of Ordovician granites (**Og**) have not been given individual names. The small bodies north and northwest of Mullin Stream Lake closely resemble unit **Ogu**. Another small body to the west of Mullin Stream Lake at the edge of the North Pole Stream granite, is a dark grey fine grained unit which has small feldspar phenocrysts. It is thought to represent a high level intrusion.

The western portion of the map area is underlain by a sequence of northeast- to southwest-striking sedimentary and bimodal volcanic rocks of Siluro-Devonian age. The sediments (unit **Ss**) include quartzites, fine to coarse, poorly sorted conglomerates, siltstones, and shales. The basalts (unit **Sm**) are amygdaloidal with epidote-filled vesicles and fractures. The felsic volcanics (unit **Sf**) include flow-banded to massive beige, brown, and red rhyolites and fragmental tuffs. The Mount Elizabeth and Redstone Mountain intrusive complexes, both of which have given Silurian ages, clearly intrude this sequence. However, granite grades to high level subvolcanic porphyry adjacent to rhyolites on Mount Charnisay, and there are rhyolites in the area that look like possible volcanic equivalents of this granite. Based on fossil evidence, higher stratigraphic levels of this sequence are of Devonian age.

Redstone Mountain intrusive complex: Granite (unit **SRg**) of this complex is a pink to scarlet, medium grained biotite-amphibole granite which is very similar to map unit **SEag**, and in the area south of Trousers Lake has been described by Fyffe and Pronk (1985). Associated with it are dykes and bodies of diabase and gabbro (unit **SRd**). Based on alteration of this granite in close proximity to the North Pole Stream granite, unit **SRg** is thought to slightly predate unit **SNg**. A Rb-Sr whole rock isochron age of 409 ± 25 Ma for this granite is reported by Fyffe and Pronk (1985).

Based on this study, it seems appropriate to rename the Mount Elizabeth granite (Fyffe et al., 1981), the Mount Elizabeth intrusive complex, for it includes a number of apparently contemporaneous igneous suites. These have been grouped into a mafic suite (unit **SEm**), an eastern peraluminous suite (unit **SEpg**), and a western alkaline (unit **SEa**) granite suite.

(i) Mafic suite (unit **SEm**): The mafic suite includes a diverse group of rocks. One substantial medium to coarse grained troctolite body, the Portage Brook troctolite (unit **SEmP**), contains plagioclase, olivine, two pyroxenes, brown amphibole, opaques, and apatite, and has locally well developed banding. Contact relationships between this gabbro and other mafic and felsic intrusive phases have not been observed. The Goodwin Lake gabbroic rocks (unit **SEmG**), located on the southeastern side of the complex, consists entirely of cumulate rocks ranging from norite and gabbro to peridotite (Paktunc, 1988b). The other mafic intrusive rocks (unit **SEmd**) include fine to medium grained plagioclase porphyritic and equigranular ophitic textured diabase, medium to coarse grained amphibole-clinopyroxene biotite gabbro, and minor areas of diorite to quartz diorite adjacent to granitic intrusions. A small area of medium grained biotite quartz diorite around Blue Ledge Lake, southeast of Popple Depot, has been included in unit **SEmd**.

Field relationships between younger granitic rocks (unit **SEpg** and **SEa**) and mafic intrusive rocks suggest that they are contemporaneous. Such features as cuspate, irregular contacts with chilled margins of mafic against felsic rocks, pillowed mafic rock in granitic rock, and evidence of interaction between the two different composition melts to produce intermediate or hybrid composition rocks are interpreted to reflect magma mixing. A few felsic dykes have been noted cutting gabbroic rocks, but no mafic dykes have been observed to cut granitic rocks.

(ii) Peraluminous granitic suite (unit **SEpg**): The eastern portion of the Mount Elizabeth intrusive complex consists of a compositionally and texturally homogeneous, pink and white, equigranular fine to coarse grained biotite granite which contains traces of muscovite. A small body of K-feldspar porphyritic biotite granite occurring to the southeast of Mount Mitchell is compositionally similar. Also, there is a restricted area adjacent to Mount Elizabeth where the granite is more biotite-rich (granodiorite). A U-Pb monazite age of 418 ± 1 Ma has been obtained from this granite (Bevier, 1988).

Though it did not prove possible to locate contacts between the eastern (peraluminous) and western (alkaline) granitic suites, contacts between both granite suites and mafic intrusive rocks suggest they are contemporaneous. If there is only one age of mafic intrusion, then both the granitic suites are of a similar age, a conclusion which is supported by U-Pb ages.

(iii) Alkaline granitic suite (unit **SEa**): The western portion of the Mount Elizabeth intrusive complex contains a spectrum of compositions and is characterized by an apparent close genetic relationship between mafic and felsic intrusive rocks. Though some areas are quite homogeneous, it appears, from both restricted outcrop and rock debris, that portions of this suite are remarkably heterogeneous. Contacts between the various phases have not been observed but they are all tentatively considered to be of similar age. The intrusive phases will be discussed in order of increasing silica content.

(a) Hybrid intrusive rocks (unit **SEah**): There are areas adjacent to mafic intrusive rocks where probable interaction between coexisting mafic and felsic magmas has produced hybrid or intermediate compositions. Most of these are truly mixed rocks in that they are characterized by partially digested mafic igneous inclusions in a dioritic to granitic composition matrix.

(b) Syenite (unit **SEas**): A dark blue-green, red-brown-weathering syenite defines a small body in the middle of the complex and occurs as a marginal phase of the alkaline granite on Mount La Tour. It contains quartz, plagioclase, alkali feldspar, fayalite, hedenbergite, zircon, apatite, and opaque minerals.

(c) Quartz monzonite (unit **SEaq**): A beige-grey to orange, fine to medium grained biotite-amphibole quartz monzonite is a major intrusive phase of the western suite. A notable feature of this rock is euhedral white plagioclase grains which are prominent on weathered surfaces. On the northwestern slope of Tilley Ridge, there are a number of zones or dykes of glassy flow-banded, grey to beige rhyolitic intrusive rocks which appear to be late offshoots of the quartz monzonite.

(d) Aplite (unit **SEaa**): Closely associated with the quartz monzonite are a number of areas of dark pink to red, very felsic aplite. Some portions have spherulitic textures and contain texturally-late interstitial blue amphibole but no biotite. Other portions consist of equigranular biotite-bearing aplite which lacks amphibole.

(e) Alkaline granite (unit **SEag**): The most abundant phase of the western suite is a scarlet red, medium to coarse grained, equigranular granite. Much of this phase contains only one feldspar (i.e. hypersolvus granite) and is amphibole bearing. However, there are two-feldspar-bearing portions east of Mount Marie. Red-brown biotite aggregates in some samples may be pseudomorphs after fayalite rather than amphibole. On Mount Charnisay, this granite varies to fine grained miarolitic granite and rhyolitic porphyry. Some felsic dykes, which cut units **SEmP** and **Ss**, are thought to be equivalents of the alkaline granite. A sample of this granite gave a U-Pb zircon age of 414 + 11/ − 1 Ma (Bevier, 1988)

One of the largest intrusive bodies in the Central Plutonic Belt, the North Pole Stream granite (unit **SN**), is more appropriately called an intrusive suite. The main intrusive phase is a medium to coarse grained, equigranular to K-feldspar porphyritic, white and pink biotite granite (unit **SNg**). In the region of Big Bald Mountain, this phase is very deeply weathered. To the south of Big Bald Mountain, there is a body of grey and black biotite granodiorite (unit **SNgd**) that contains abundant highly digested metasedimentary inclusions. It is cut by white felsic dykes which may be offshoots of the biotite granite (**SNg**). A similar granodiorite south of Long Lake is actually the northern end of the Squaw Lake granodiorite of Fyffe and Pronk (1985). For simplicity this granodiorite has been included in unit **SNgd**. Contact relationships, like those in the Mount Elizabeth suite, between amphibole-bearing diorite and diabase (unit **SNd**) and the granite (**SNg**) suggest that they are contemporaneous. Cutting the biotite granite (**SNg**) are bodies of fine to medium grained, white muscovite-biotite granite (unit **SNm**), reddish biotite granite (unit **SNb**), and dark red-brown quartz-feldspar porphyry (unit **SNp**). Some samples of unit **SNm** contain muscovite pseudomorphs after, and some relict, cordierite. A U-Pb monazite age of 417 ± 1 Ma was obtained from a sample of unit **SNg** collected just about a half a kilometre off the edge of the map area (Bevier, 1988). Muscovite from a sample of unit **SNm** gave a K-Ar age of 414 ± 5 Ma and a Rb-Sr age of 381 ± 4 Ma. Another sample of **SNm** gave a Rb-Sr muscovite age of 425 ± 4 Ma and a biotite age of 397 ± 4 Ma. These ages indicate that the various phases of the North Pole Stream suite are of similar age.

The Miramichi granite (unit **SM**) is located on the eastern side of the map area. It exhibits considerable textural variation, from medium grained equigranular to seriate and K-feldspar porphyritic. This biotite granite bears a very close resemblance to adjacent granite units **SNg** and **SEpg**. All of these compositionally similar granites are thought to be of the same age and to constitute a consanguineous "supersuite".

In 1972, Canadian Occidental Petroleum Ltd. undertook mapping and lithogeochemical work to investigate the source of Mo, Cu, and Zn geochemical stream anomalies in the area of Bear Lake, 4 km east of Serpentine Lake. Mapping by the author in this area indicated the presence of fracture-related sulphide mineralization with associated alteration cutting foliated felsic granite (unit **Oge**).

In the area of Long Lake, various exploration programs, the most recent and extensive being that of Canadian Occidental Petroleum Ltd. between 1971-1974 and 1979-1982, have been carried out to evaluate the economic potential of sphalerite, chalcopyrite, and galena in fractured and silicified granite and adjacent sedimentary host rocks. Also, U and Mo mineralization occurs associated with silicified granite breccia on the southeastern end of Long Lake. This mineralization is associated with high level, highly fractionated phases of the North Pole Stream suite. Geological mapping suggests that this area represents the upper level or roof zone of the body whereas deeper levels are exposed to the northeast and east.

Two mafic intrusive bodies in the map area have been the object of past and current exploration interest for Ni, Cu, and Pt+Pd. The Portage Brook troctolite (unit **SEmP**), which is located around Popple Depot at the northern end of the map area, contains probable magmatic-derived sulphide concentrations (pyrrhotite, pentlandite, and chalcopyrite) of around 3-5% in some thin anorthosite layers with limited lateral continuity (Paktunc, 1988a). Platinum group elements are mainly below detection limits. The Goodwin Lake intrusion, which is located on the northeastern side of the map area, consists of cumulate rocks in which pyrrhotite with subordinate pentlandite and chalcopyrite are widespread. Drilling has outlined in excess of 5 million tonnes with 0.34% Cu, 0.28% Ni, 0.03% Co, and low platinum group element concentrations (Paktunc, 1988b).

A number of areas with potential for gold mineralization has been recognized. (1) Zones of extensive quartz veining and dyking occur in Tetagouche Group rocks incorporated in roof pendants in the Mount Elizabeth intrusive complex. (2) Along their contact with the alkaline granite suite (unit **SEa**), Devonian felsic volcanic rocks (unit **Sf**) contain disseminated and fracture-filling pyritic zones. (3) Deformed granites north and east of Serpentine Lake (unit **Oge**) are cut by sulphide-bearing veins with associated alteration haloes. (4) All of the deformed granites are cut by major shear zones which could have acted as conduits for gold-bearing fluids. A small area of greisen alteration containing traces of molybdenite was recognized in biotite granite (unit **SEpg**) of the Mount Elizabeth complex and a brecciated and silicified zone was identified in alkaline granite (unit **SEag**) south of Mount Edward.

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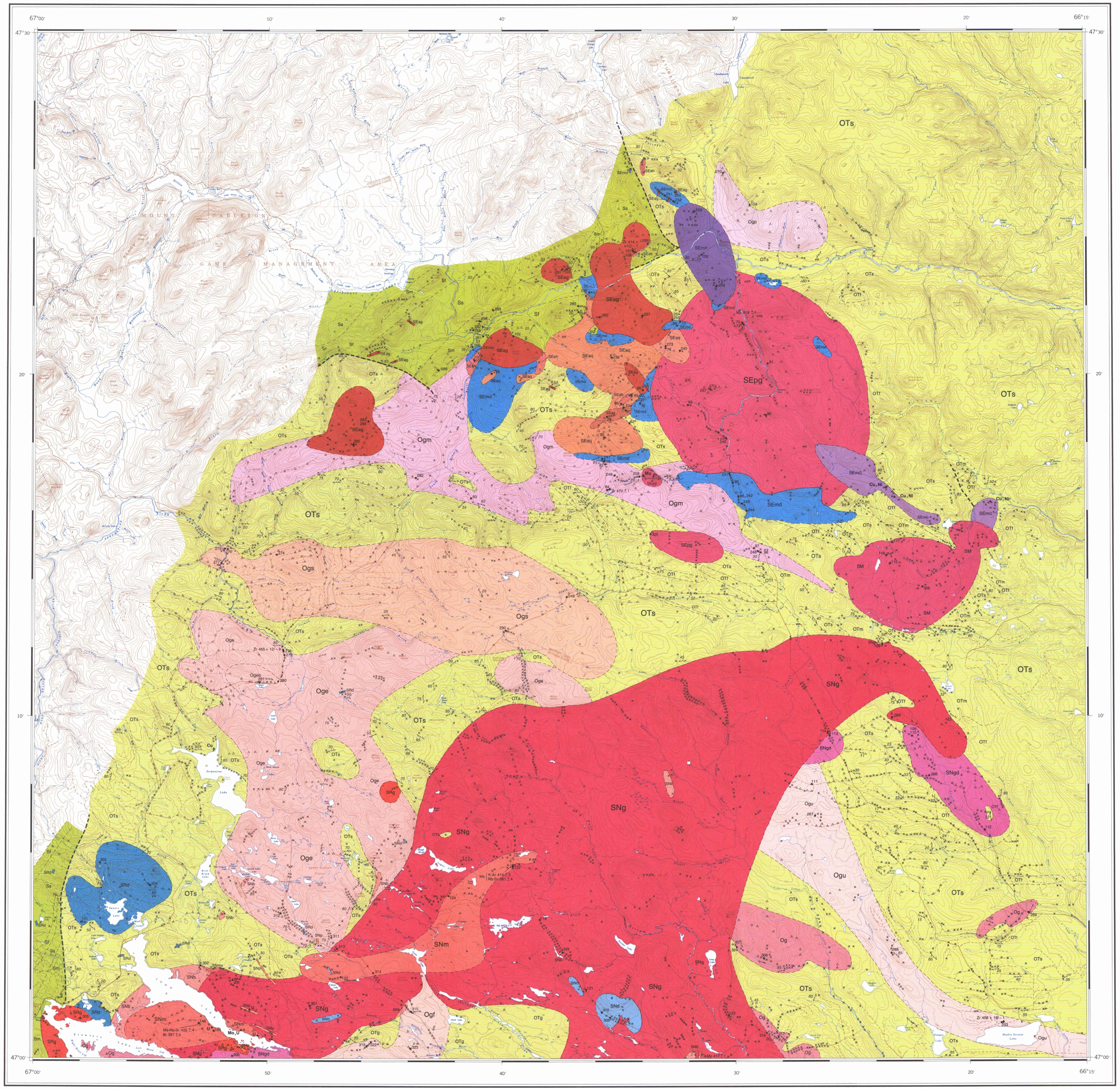
Canada



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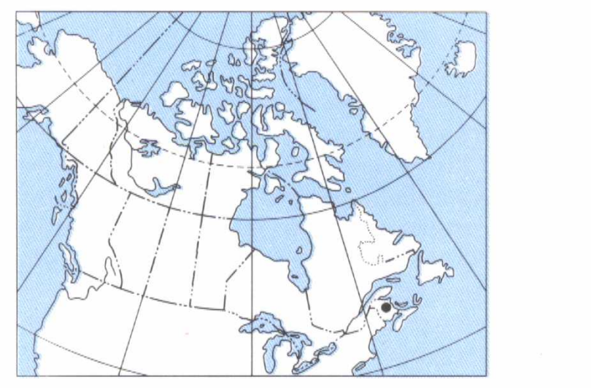

INDEX MAP

LEGEND

PALEOZOIC
SILURIAN TO EARLY DEVONIAN *(units **SRg** to **SM** are of similar age)*

SM	*Miramichi granite*
	NORTH POLE STREAM GRANITIC SUITE (**SNp**-**SNgd**)
SNgd	*Medium to coarse grained biotite granodiorite*
SNd	*Gabbro, diabase, and diorite*
SNg	*Medium to coarse grained biotite granite*
SNm	*Fine to medium grained muscovite-biotite granite*
SNb	*Fine to medium grained biotite granite*
SNp	*Quartz-feldspar porphyry*
	MOUNT ELIZABETH INTRUSIVE COMPLEX (**SEmd**-**SEah**) ALKALINE GRANITIC SUITE (**SEag**-**SEah**)
SEah	*Hybrid intrusive rock*
SEas	*Syenite*
SEaq	*Quartz monzonite*
SEaa	*Aplite*
SEag	*Alkaline granite*
	PERALUMINUS GRANITIC SUITE
SEpg	*Fine to coarse grained biotite granite and granodiorite*
	MAFIC SUITE (**SEmd**-**SEmP**)
SEmP	*Portage Brook troctolite*
SEmG	*Goodwin Lake gabbroic rocks*
SEmd	*Diabase and gabbro*
	REDSTONE MOUNTAIN INTRUSIVE COMPLEX (**SRd** and **SRg**)
SRg	*Granite*
SRd	*Diabase and gabbro*
	*(Units **Sf** to **Ss** may include Devonian rocks)*
Ss	*Clastic sedimentary rocks*
Sm	*Mafic volcanic rocks*
Sf	*Felsic volcanic rocks*

ORDOVICIAN

Og	*Undivided deformed granite*
Ogp	*Popple Depot granite*
Ogm	*Meridian Brook granite*
Ogs	*Sweat Hill granite*
Oge	*Serpentine River granite; coarse-grained porphyritic variant (**Ogeb**)*
Ogu	*Mullin Stream Lake granite*
Ogf	*Fox Ridge granite*
	TETAGOUCHE GROUP
OT	*Clastic sedimentary (**OTs**), mafic (**OTm**), and felsic (**OTf**) volcanic rocks, amphibolites (**OTa**), and gneisses (**OTg**)*

Rock outcrop, area of outcrop	× ×××
Rock debris or float	△
Geological boundary (defined, approximate, assumed)	
Bedding (inclined, overturned)	80 80
Cleavage or regional foliation (inclined, vertical, dip unknown)	75
Fault (inferred)	- - - - -
Showings: **Cu**-*copper,* **Ni**-*nickel,* **Zn**-*zinc,* **U**-*uranium,* **Mo**-*molybdenum*	▲
Geochemical sample site (WXNB prefix omitted)	245 ●
U-Pb *age (Ma ± 2 SD)* **Zr**-*zircon;* **Mz**-*monazite*	♦
K-Ar *and* **Rb-Sr** *mineral age (Ma ± 2 SD);* **Ms**-*muscovite,* **Bt**-*biotite*	◊

Geology by J.B. Whalen 1985-1988, assisted by P. Neelands 1986; additional outcrop data compiled from McNutt 1961, Fyffe 1971, 1972 a, b, c, Irrinki 1972 a, b, 1977 a, b, Constable 1974, Crouse 1977, 1979

Geological cartography by the Geological Survey of Canada

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

Base map assembled by the Geological Survey of Canada from maps published at 1:50 000 scale, 21-O/7, 21-O/8, 21-O/2, 21-O/1 by the Surveys and Mapping Branch 1957, 1981. Roads were revised by the Geological Survey of Canada for this edition

Copies of the topographical editions covering this map area may be obtained from the Canada Map Office, Department of Energy, Mines and Resources, Ottawa, Ontario, K1A 0E9

Mean magnetic declination 1989, 21°04′ West, decreasing 2.8′ annually. Readings vary from 20°43′ W in the SW corner to 21°26′ W in the NE corner of the map

Elevations in feet above mean sea level

MAP 1751A

GEOLOGY

GEOLOGY OF A NORTHERN PORTION OF THE CENTRAL PLUTONIC BELT

NEW BRUNSWICK

Scale 1:100 000 - Échelle 1/100 000

Kilometres 2 0 2 4 6 8 Kilomètres

Universal Transverse Mercator Projection   Projection transverse universelle de Mercator

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21-O/NW	21-O/NE	21P/NW
21-O/SW	21-O/SE 1751A	21P/SW
21J/NW	21J/NE	21-I/NW

NATIONAL TOPOGRAPHIC SYSTEM REFERENCE

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