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GEOLOGY OF THE SNOWSHOE POND (12A/7) MAP AREA

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ABSTRACT

Mapping at a scale of 1:50,000 has been completed in the Snowshoe Pond area. Stratified rocks are placed in two main divisions. Those north of the major tectonic boundary of Noel Paul's Line consist of Ordovician volcanic and sedimentary rocks, and belong in the Dunnage Zone. Those south of the line consist exclusively of quartzitic and pelitic metasedimentary rocks and are placed in the Gander Zone. Granitic plutons range from pre- to posttectonic. Syn- and posttectonic granite and posttectonic mafic intrusions cut across Noel Paul's Line.

Two new units have been identified in the area. These are the syntectonic granite at Wilding Lake and a gabbro that is probably part of the Valentine Lake quartz monzonite intrusive suite. Other units described previously have been traced across the map area, and mafic volcanic rocks occurring at Rodeross Lake in the west and Lake Douglas in the east, appear to be correlative.

Clastic metasedimentary rocks of the Gander Zone show an increase in metamorphism southward from biotite, through andalusite, to sillimanite grade and then pass into migmatite. They form a complex fold interference pattern with pretectonic granite in the west of the area, and are cut by a regionally important postmetamorphic fault.

New occurrences of wolframite have been discovered in quartz veins cutting granite in the south of the area. Volcanic rocks of the Dunnage Zone and the lineaments defined by Noel Paul's Line and the Rogerson Lake Conglomerate are along strike from significant discoveries of gold and base metals at Valentine Lake and Duck Pond. Therefore, they are very promising targets for mineral exploration.

INTRODUCTION

During 1987, the author completed 1:50,000 mapping in the Snowshoe Pond area (Figure 1). The area is located about 40 km south of Buchans in the centre of Newfoundland's Central Mobile Belt (Williams, 1964) and lies astride the boundary between the Dunnage and Gander zones of Williams *et al. (in press)*. It is accessible from Millertown by the hydro-development roads to Granite Lake and Ebbegunbaeg Dam, and by logging roads to Quinn and Rodeross lakes.

Work done during 1987 consisted principally of extending previously defined units across the western one third of the map area. Only two new units were encountered and these were only seen in a total of four exposures. The reader is therefore referred to Colman-Sadd (1987a) for detailed descriptions of most of the units in this report.

Colman-Sadd (1987a) gave a comprehensive summary of previous work within the Snowshoe Pond area, including published studies and unpublished assessment reports. The only new information available since then is a Newfoundland Department of Mines open file 1:50,000 geological map of the entire area (Colman-Sadd, 1987b).

GENERAL GEOLOGY

The Snowshoe Pond area is underlain by two distinct sequences of stratified rocks that are cut by a variety of plutonic intrusions.

In the northwest, volcanic and sedimentary rocks are typical of the Exploits Subzone of the Dunnage Zone (Williams, 1978; Williams *et al., in press)* and the Central Volcanic Belt (Kean *et al.*, 1981). West of Lake Douglas, they consist principally of Ordovician mafic volcanic rocks with extensive volcanogenic sedimentary units (Units 7 to 9), presumed to be unconformably overlain or in fault contact with the Silurian(?) Rogerson Lake Conglomerate (Unit 10) (Kean and Jayasinghe, 1980). The rocks to the northwest of the Rogerson Lake Conglomerate have been traditionally included in the Victoria Lake Group (Kean *et al.*, 1981); the similarity of those to the southeast suggests that they too should be included in the group. East of Lake Douglas, a sequence of felsic volcanic rocks and associated sedimentary rocks (Units 3 to 6) form a fault-bounded wedge. Although distinct from the rocks to the west in volcanic composition, these rocks do have a Dunnage Zone affinity because of their mixed volcanic and sedimentary nature. All of the rocks

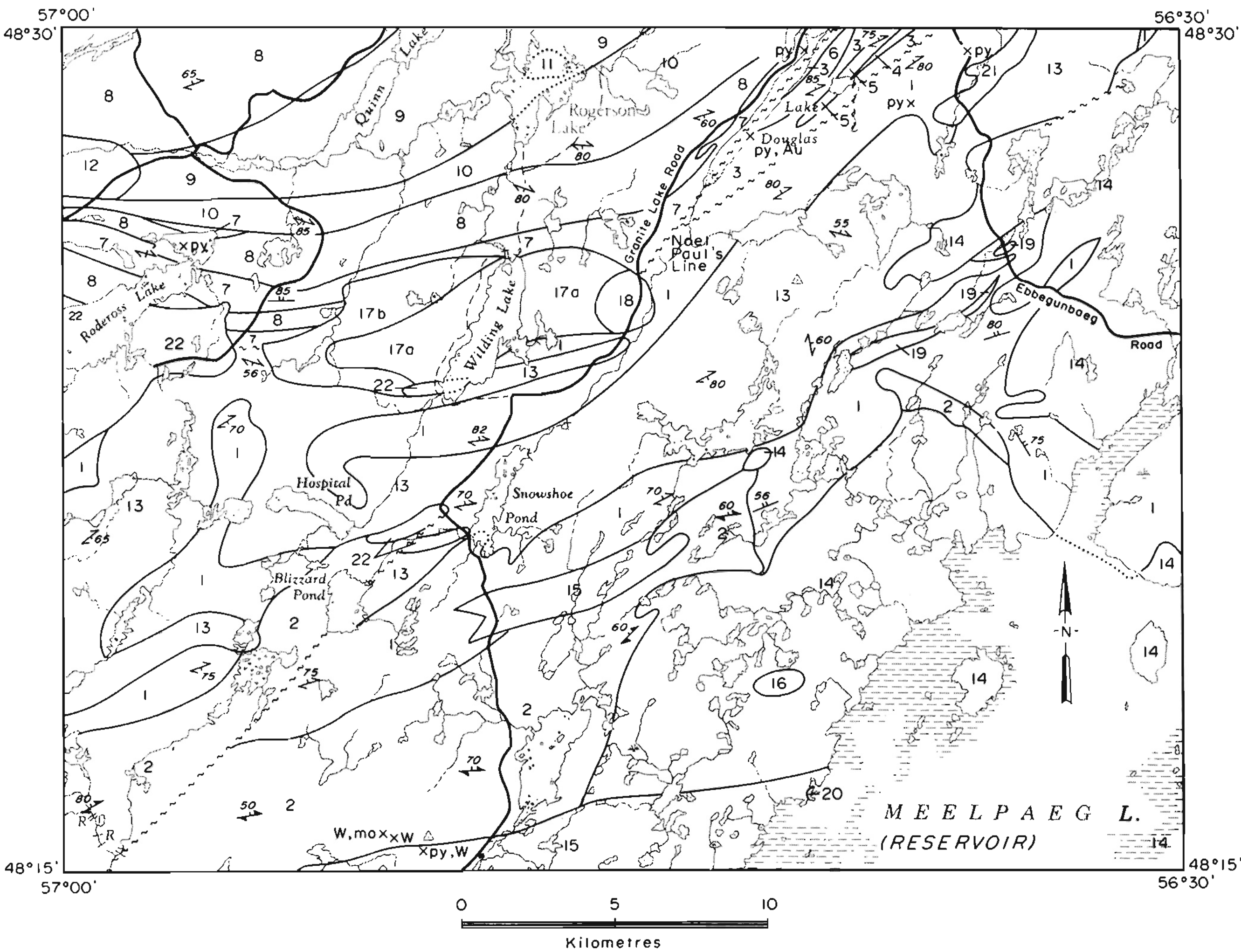

Figure 1. *Geological sketch map of the Snowshoe Pond (12A/7) map area.*

included in the Dunnage Zone within the map area are only slightly to moderately deformed by one principal deformation, and are metamorphosed to the greenschist facies.

The southern and eastern three quarters of the map area contain only one unit of stratified rocks, consisting of interbedded quartzite, psammite and pelite (Unit 1), and a unit of migmatite (Unit 2) derived from them. These rocks are placed in the Meelpaeg Subzone of the Gander Zone (Williams *et al., in press).* The contact between the Exploits and Meelpaeg subzones (Noel Paul's Line) is a ductile shear zone where it is exposed, but is obscured by later intrusions along about half of its length within the Snowshoe Pond area. It has a southwest trend near Lake Douglas, but then swings westward to Rodeross Lake. The metasedimentary rocks of the Meelpaeg Subzone, tentatively correlated with the Ordovician Spruce Brook Formation of Colman-Sadd and Swinden (1984), were intruded pretectonically by mafic dykes, and have undergone two pervasive periods of deformation. Metamorphism varies from greenschist facies in the northwest to upper-amphibolite facies in the south, where an extensive area of sillimanite-grade metasedimentary rocks passes into migmatite.

Plutonic intrusions fall into three categories: 1) those that are restricted to the Exploits Subzone, 2) those that are restricted to the Meelpaeg Subzone, and 3) those that are common to both subzones. In the first category are several small gabbro intrusions, an intrusion of gabbro that is probably related to the Valentine Lake quartz monzonite (Unit 12), and one intrusion of granite (Unit 11). All of these are intruded by mafic dykes that are likely to be of about the same age as the mafic volcanism (Ordovician). In the second category are several granitoid bodies that probably range in age from Silurian to Devonian. Of these, the highly deformed biotite granite of Unit 13 appears to be terminated by the fault defining Noel Paul's Line between Rodeross and Wilding lakes, and so may predate movement on this fault; it has been affected by all the structural events that deformed the metasediments of the Meelpaeg Subzone. The other granitoid rocks restricted to the subzone (Units 14 to 16, 19 to 21) are considerably less deformed and are mostly related to the North Bay Granite. They are not physically terminated by Noel Paul's Line, and their general similarity to the granites at Wilding Lake (Units 17 and 18), which cut Noel Paul's Line, suggests that their restriction to the Meelpaeg Subzone is fortuitous. Apart from the granites at Wilding Lake, which

LEGEND

PLUTONIC INTRUSIONS

SILURIAN AND/OR DEVONIAN

22 *Equigranular, medium- to fine-grained, grey, biotite–pyroxene–hornblende gabbro; includes unseparated pyroxenite, and gabbroic and granitic pegmatite*

21 *Equigranular, medium grained, white, muscovite–biotite granite*

20 *Equigranular, medium grained pink syenite(?)*

19 *Garnet–tourmaline–muscovite granite pegmatite*

18 *Feldspar-porphyritic to equigranular, medium grained, grey to pink, biotite granodiorite; unfoliated or locally slightly foliated*

17 *Moderately foliated and locally lineated medium grained, grey biotite granite;* 17a, *K-feldspar porphyritic;* 17b, *equigranular*

NORTH BAY GRANITE (Units 14 to 16)

16 *Equigranular, medium grained, white, muscovite–garnet granite (not exposed* in situ)

15 *Equigranular, medium grained, grey to buff, biotite–muscovite granodiorite; locally slightly foliated*

14 *Feldspar-porphyritic to equigranular, medium grained, grey to pink, biotite granodiorite; locally slightly foliated*

13 *Equigranular to feldspar-megacrystic, medium grained, grey to pink, biotite granite; foliated, commonly mylonitic and commonly polydeformed*

ORDOVICIAN(?)

12 *Equigranular, medium grained, hornblende gabbro; slightly foliated; probably part of Valentine Lake intrusive suite*

11 *Equigranular, medium grained, grey to pink, chlorite–biotite granite*

DUNNAGE ZONE

SILURIAN(?)

10 ROGERSON LAKE CONGLOMERATE: *purple, clast-supported, polymictic conglomerate and minor sandstone*

CAMBRIAN AND ORDOVICIAN

VICTORIA LAKE GROUP (Unit 9 and part of Unit 8, north of Rogerson Lake Conglomerate)

9 *Mafic volcanic rocks, diabase dykes and small gabbro intrusions*

8 *Sedimentary rocks composed mainly of sandstone, siltstone and shale, but also including conglomerate; minor unseparated felsic crystal tuff, mafic volcanic rocks and small gabbroic intrusions.*

7 *Mafic pillow lava, pillow breccia, massive flows, and small gabbro intrusions*

6 *Crystal–lithic felsic tuff, and rhyolite flows and/or subvolcanic intrusive rocks*

5 *Clast-supported conglomerate composed mainly of felsic volcanic clasts*

4 *Grey quartz–feldspar, crystal–lithic felsic tuff*

3 *Grey parallel- and cross-laminated shale, siltstone and sandstone; includes strongly deformed rocks on Noel Paul's Brook that contain bands of limestone and mafic volcanic and/or intrusive rocks*

GANDER ZONE

ORDOVICIAN

2 *Migmatite, rich in biotite schlieren and metasedimentary fragments; derived from Unit 1 by Silurian(?) metamorphism and gradational into Unit 14 of North Bay Granite*

1 *Interbedded quartzite, psammite, semipelite and pelite, intruded by unseparated mafic dykes (probably equivalent to Spruce Brook Formation)*

Mineral Occurrences

Pyrite .... *py*
Gold .... *Au*
Molybdenite .... *mo*
Tungsten .... *W*

Symbols

Bedding, tops unknown (inclined) ....
Cleavage (inclined, vertical) ....
Gneissosity (inclined) ....

vary from moderately deformed to completely posttectonic, the third category consists of the Rodeross Lake mafic–ultramafic intrusion (Unit 22). This appears fresh and undeformed, but has steeply dipping cumulate layering, indicating that it has been tilted. It has yielded a preliminary K/Ar date of 405 Ma (A. Hayatsu, personal communication, 1988).

PREVIOUSLY UNDESCRIBED UNITS

Unit 12

Logging operations during 1987 have created a new exposure on a northwesterly branch of the Quinn Lake–Victoria Lake road, near the western edge of the map area. The exposure consists of medium grained, equigranular, slightly pyritiferous, hornblende gabbro, containing inclusions of dark-green, fine grained, mafic volcanic rock. Both the gabbro and the volcanic rock have a slight inhomogeneous tectonic fabric. The gabbro has been cut by an east-southeast-trending mafic dyke, and by a few narrow quartz veins.

The new exposure is located about 2 km along strike from occurrences of quartz monzonite and gabbro that form an intrusive suite around Valentine Lake in the Victoria Lake area (Kean, 1977, 1982). The suite was referred to in the report of Colman-Sadd (1987a), but not shown on his map because at that time no exposures had been located in the Snowshoe Pond area.

Unit 17

Colman-Sadd (1987a) showed two granitoid units around Wilding Lake. The oldest of these is the strongly deformed biotite granite of Unit 13. The younger is an equigranular, medium grained, grey or pink, biotite granodiorite of Unit 18, which locally has a slight fabric and which is exposed principally on the Granite Lake road. It was formerly thought to extend to Wilding Lake (Colman-Sadd, 1987a) but is now considered to be restricted to an area well east of the lake. The newly defined granite intrusion of Unit 17 crops out at only three places, but it is the source of extensive boulder fields that have been used to estimate its areal extent.

The granite of Unit 17 is medium grained, grey or pink, and in most places contains biotite as the only primary mica. Its eastern variety (subunit 17a; Plate 1) is porphyritic, containing euhedral lath-shaped phenocrysts of potassium feldspar up to 4 cm long, but the variety (subunit 17b) that is dominant in the west is equigranular. Veins of the distinctive porphyritic variety and of possibly associated garnet–tourmaline–muscovite granite cut metasedimentary rocks of Unit 8 and granite of Unit 13 between Rodeross and Wilding lakes. An intrusive contact of subunit 17b into mafic volcanic rocks of Unit 7 is also exposed in this area.

Granite of Unit 17 has a moderate, planar, or locally linear, penetrative fabric. It is distinctly more deformed than granodiorite of Unit 18, and distinctly less deformed than

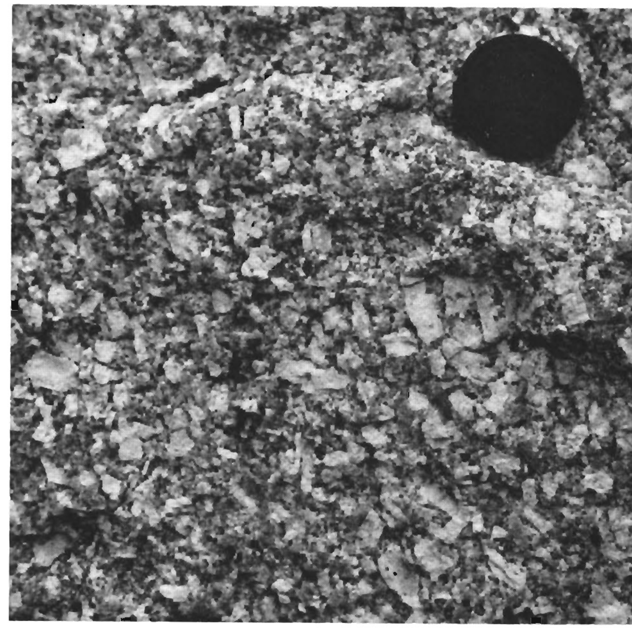

Plate 1. *Moderately foliated, porphyritic biotite granite of subunit 17a, west of Wilding Lake.*

granite of Unit 13. The latter relationship is demonstrated in the exposure of Unit 13 adjacent to Noel Paul's Line between the Rodeross Lake intrusion and the granite of Unit 17. Here mylonitic granite (Unit 13) is crosscut by deformed, but nonmylonitic, veins of porphyritic and equigranular granite (Unit 17; Plate 2).

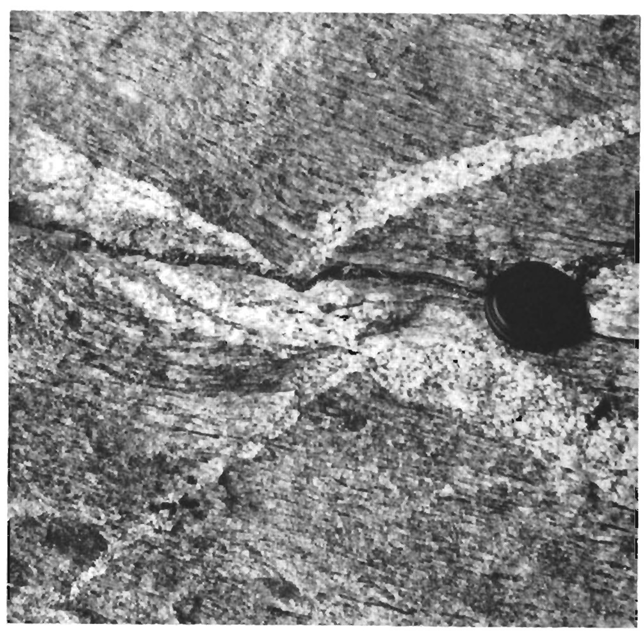

Plate 2. *Slightly deformed granite veins of Unit 17 cutting mylonitic granite of Unit 13, adjacent to Noel Paul's Line, southeast of Rodeross Lake.*

CONTINUATION OF PREVIOUSLY DESCRIBED UNITS

Most of the area mapped during 1987 is underlain by units described by Colman-Sadd (1987a) from other parts of the area.

North of the Rogerson Lake Conglomerate, mapping during 1987 failed to yield any new exposure (except in Unit 12, see above). The nonplutonic rocks in this area are divided into Units 8 and 9. The mafic volcanic rocks, dykes and gabbro intrusions at Rogerson Lake are placed in a single unit (Unit 9) because the absence of exposure does not justify separating them anywhere beyond the west shore of Rogerson Lake.

The Rogerson Lake Conglomerate (Unit 10) can be traced by scattered exposures southwest from Rogerson Lake to the Rodeross Lake road. Beyond that there is an exposure gap extending to the east edge of the Victoria Lake area (Kean, 1982). Constraint by exposures of other units indicates a considerably narrower outcrop than was envisaged by Colman-Sadd (1987a), and more in keeping with the 200-m width shown by Kean (1982).

Dunnage Zone units south of the Rogerson Lake Conglomerate appear on the gradiometer map (Geological Survey of Canada, 1985) to maintain continuity from Lake Douglas to Rodeross Lake. The sparse geological evidence supports this conclusion. Mafic volcanic rocks (Unit 7), including pillow lava, can be traced eastward from Rodeross Lake to 2 km northwest of Wilding Lake (Plate 3). They are then projected across an exposure gap of about 7 km to correlate with the northeast-trending pillow lavas that form the northwest shore of Lake Douglas. Outcrop areas of mafic volcanic rocks, without definite pillow lava, occur at the north end of Rodeross Lake and adjacent to Noel Paul's Line to the east of the lake. They are separated from the main part of Unit 7 by belts of clastic sedimentary rocks (Unit 8; Plate 4). A particularly prominent horizon of complexly folded pelite occurs immediately to the north of the main mafic volcanic outcrop at Rodeross Lake. This horizon is tentatively correlated with similar rocks extending from the west edge of the area almost to the Granite Lake road. Metasedimentary rocks that are poorly exposed in the brook between Wilding and Rogerson lakes were equated on a preliminary basis with Unit 1 by Colman-Sadd (1987a,b); they are now thought more likely to be part of the sedimentary sequence of Unit 8.

Plate 3. *Mafic pillow lava of Unit 7, northwest of Wilding Lake.*

Plate 4. *Interbedded sandstone and shale of Unit 8, southeast of Rodeross lake.*

South of Noel Paul's Line, the only metasedimentary unit is the interbedded quartzite and pelite of Unit 1 (Plate 5). The northern outcrop area extends southwest from Lake Douglas to the Granite Lake road where it is thought to bifurcate; one branch is projected across an area of no exposure to Wilding Lake, and the other can be traced to north of Hospital Pond. It is uncertain whether the latter branch is continuous with the main outcrop area to the northeast, or whether they are in fact separated by foliated granite of Unit 13.

The southern outcrop area of Unit 1 can be traced southwestward from Meelpaeg Lake to Blizzard Pond, where it is faulted against migmatite (Unit 2; Plate 6). The migmatite grades into metasediments of Unit 1, and forms outcrop areas separated by foliated granite (Unit 13). The map pattern west of Snowshoe Pond has been determined by sparse bedrock

Plate 5. *Quartzite interbedded with sillimanite schist, Unit 1 in southwest corner of map area.*

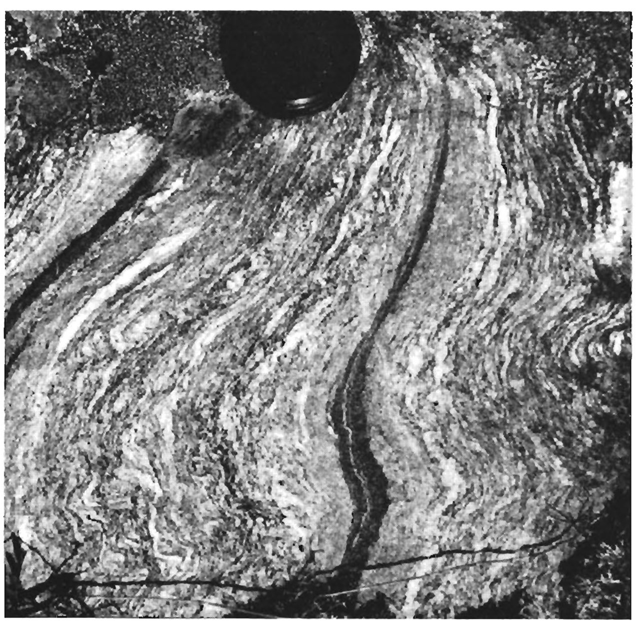

Plate 6. *Migmatite (Unit 2), just west of Blizzard Pond.*

exposure, supplemented by gradiometer data (Geological Survey of Canada, 1985).

In general, the main foliation in exposures of Unit 1 in the west part of the map area is the first deformation cleavage. This is commonly folded into tight, second-deformation folds and a second cleavage is developed in some places. Metamorphism increases from biotite grade, southeast of Lake Douglas, to andalusite grade, north and northwest of Hospital Pond, and to sillimanite grade, south and west of Blizzard Pond. The sillimanite-grade metasediments of Unit 1, grade southward into schlieren migmatite of Unit 2. The sedimentary protolith of the migmatite is clearly indicated by ubiquitous quartzitic and pelitic inclusions; occasional amphibolitic inclusions probably represent the mafic dykes that cut rocks of Unit 1. The migmatite front is excellently exposed about 1 km east of the fault that cuts through Blizzard Pond.

The oldest of the plutonic intrusions south of Noel Paul's Line is the foliated biotite granite of Unit 13. The main outcrop areas previously defined east of Snowshoe Pond can be traced westward to the western edge of the map area. The granite becomes especially mylonitic between Hospital Pond and Rodeross Lake. The main fabric appears to correspond with the first-deformation fabric recognized elsewhere in the granite and with the first-deformation fabric of the Unit 1 metasediments. Tight second-deformation folds are common in exposures of the granite southeast of Rodeross Lake (Plate 7).

Plate 7. *Second-deformation folds in mylonitic granite of Unit 13 between Rodeross Lake and Hospital Pond.*

The largely posttectonic granitoid rocks, grouped with the North Bay Granite, are represented in the south-central part of the map area by equigranular, medium grained, biotite and biotite–muscovite granodiorite (Unit 15). The granodiorite is exposed along the south edge of the map area. Its contact with the migmatite (Unit 2) to the north has a marked topographic expression, but is not exposed. It is probably either a fault or sharp intrusive contact. The granite is cut by pyritic, muscovite–garnet pegmatite veins and by quartz veins that carry pyrite and wolframite.

The youngest rocks in the map area belong to the mafic–ultramafic Rodeross Lake intrusion and similar smaller bodies at Wilding Lake and Snowshoe Pond (Unit 22). Work done during 1987 has helped to define the extent and age of these rocks, but has added no other new information. Where exposure is particularly bad, e.g., west of Snowshoe Pond, the map pattern is based principally on gradiometer data (Geological Survey of Canada, 1985).

PRINCIPAL TECTONIC STRUCTURES

The map pattern in the western half of the Snowshoe Pond area is controlled by three main tectonic features, Noel Paul's Line, the Blizzard Pond fault and the complex interference of two generations of folds west of Snowshoe Pond.

Noel Paul's Line

The line marks the contact between rocks of the Dunnage and Gander zones. East of Lake Douglas, it is marked by a fault that separates a sequence of felsic metavolcanic and metasedimentary rocks (Units 3 to 6) from quartzites and pelites of Unit 1. This fault converges, southwest of the lake, with another fault marking the southeast boundary of the pillow lavas of Unit 7, and these faults are then presumed to be cut by the granitoid intrusions at Wilding Lake. The line is drawn as a continuation of the trend of the Lake Douglas fault, but it could equally well have been drawn as a continuation of the fault southeast of Lake Douglas, since there is no exposure between the point of convergence and the posttectonic granodiorite of Unit 18.

Most of Noel Paul's Line is obscured in the western half of the area by the Wilding Lake and Rodeross Lake intrusions. The only place where the line reappears (but is not exposed) is for about 1 km southeast of the Rodeross Lake road. Here, there is an exposure gap of 700 m (or 300 m perpendicular to strike) between mylonitic granite of Unit 13 (Plate 2) and mafic, possibly pillowed, volcanic rock (Unit 7) with a slight tectonic fabric. Both exposures have been intruded by veins of Unit 17 granite, with a moderately developed planar fabric.

Blizzard Pond Fault

The effects of the fault are most clearly seen southwest of Blizzard Pond where the fault displaces the migmatitic front separating Unit 1 metasedimentary rocks from Unit 2 migmatites. This segment of the fault gives rise to a strong topographic lineament, and exposures of migmatite close to the fault trace are strongly sheared; pegmatite veins that are generally posttectonic have been isoclinally folded and cleaved. Farther to the southwest, where migmatite occurs on both sides, there is little evidence for the fault, but in the Wolf Mountain (12A/2) area to the south, it shows up again as the prominent lineament forming the west shore of the northern arm of Granite Lake.

Northeast of Blizzard Pond, sheared migmatite occurs along Noel Paul's Brook and there is an apparent offset of an anomaly on the gradiometer map (Geological Survey of Canada, 1985). The anomaly is thought to be caused by a small mafic intrusion (Unit 22). The fault cannot be traced any farther northeast than this. Mylonitic granite occurs at Snowshoe Pond, but this is widespread in Unit 13 and there is no reason to attribute it to relatively late faulting. Northeast of Snowshoe Pond, the regional strike has the same trend as the fault, which may be undetected as a layer parallel structure. The fault's projection is exactly in line with the contact between metasediments of Unit 1 and foliated granite of Unit 13, south of Lake Douglas.

Polyphase Folding

West of Showshoe Pond, a complex map pattern in Units 1 and 13 shows significant divergence from the regional strike, as defined by the linear trend of Dunnage Zone units to the north and the strike of foliation in migmatites (Unit 2) to the south. The map pattern can be discerned to a limited extent from bedrock exposures. It has also been interpreted in areas of poor exposure using gradiometer data (Geological Survey of Canada, 1985), since metasedimentary rocks of Unit 1 have an anomalously high magnetic vertical gradient when compared with the foliated granite of Unit 13.

The map pattern west of Snowshoe Pond is attributed to interference of first and second deformation folds, with the added complication that originally, the metasediments and the granite may not have been interlayered in a regular way. Measured fold axes of both generations generally plunge at more than 45° in a variety of directions. The outcrop pattern of Unit 1, north of Hospital Pond, is suggestive of a type 3 interference pattern (Ramsay, 1967), in which the two sets of fold axes are about parallel, but the axial planes are at a high angle.

MINERAL POTENTIAL

Colman-Sadd (1987a) described six potentially mineralized exploration targets in the Snowshoe Pond area. They are:

1. tungsten–molybdenum mineralization associated with the younger granitoid intrusions (Units 14 to 19);
2. base- and precious-metal potential in mafic volcanic rocks (Units 7 to 9);
3. base- and precious-metal potential in felsic volcanic rocks (Units 4, 6 and 8);
4. potential for lineament-related gold mineralization along Noel Paul's Line;
5. similar mineralization in intensely deformed, pyritiferous quartzite and pelite (Unit 1), southeast of Noel Paul's Line, and
6. potential for platinum-group-element concentrations in the mafic–ultramafic Rodeross Lake intrusion (Unit 22).

Mapping during 1987 has further defined the extent of these targets and has located new occurrences of wolframite near the southern edge of the area. This mineralization occurs in pyritiferous quartz and greisen veins about 10 to 30 cm wide that cut biotite granodiorite of Unit 15. The veins are probably related to those carrying molybdenite and wolframite in migmatites (Unit 2) to the north (Tuach and Delaney, 1986).

The mineral potential of volcanic rocks in the area has been emphasized by the discovery of anomalous gold values in altered felsic volcanic rocks a few kilometres to the north, between Rogerson Lake and Lake Ambrose, and by the major Duck Pond massive sulphide discovery by Noranda. The latter deposit occurs farther north and approximately along strike in the Victoria Lake Group (Kean and Evans, *this volume).*

BP-Selco's gold find at Valentine Lake is in a mainly quartz monzonite intrusive suite (Kean and Evans, *this volume)* that is probably represented in the Snowshoe Pond area by the single gabbro exposure in Unit 15. The showing is adjacent to the long, narrow belt of Rogerson Lake Conglomerate (Unit 10) which appears to be the molasse infill of a substantial Silurian(?) topographic lineament. The control on mineralization at Valentine Lake is at present uncertain, but if it is related to tectonism or fluid movement along this lineament, potential for similar occurrences exists adjacent to the Rogerson Lake Conglomerate in the Snowshoe Pond area (see also Kean and Evans, *this volume).*

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