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GEOLOGY OF GRENVILLE PROVINCE CRYSTALLINE ROCKS IN THE REGION BETWEEN WILSON AND WINOKAPAU LAKES (NTS 13E/1, 13E/2, 13E/7 AND 13E/8), SOUTH-CENTRAL LABRADOR

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ABSTRACT

The Wilson Lake allochthonous massif in the region of Wilson–Winokapau lakes is characterized by rolling hills of well exposed, granulite facies, quartzofeldspathic paragneiss, marble, gabbronorite and basic orthogneiss. In these highlands, the paragneiss contains the distinctive mineral assemblage hypersthene, sillimanite, biotite, cordierite, garnet and abundant sapphirine. A less well exposed, boggy, drift-covered lowland terrain is underlain by amphibolite-facies paragneiss, granitic orthogneiss, and lesser porphyritic to equigranular granite to granodiorite. Minerals characteristically found within amphibolite-facies paragneiss are sillimanite, muscovite, biotite, garnet, quartz and feldspar.

Together, these rocks define a folded, S-shaped mobile belt of Helikian age, which is part of a more extensive, complex allochthonous terrane in central Labrador. These rocks, and the terrane of which they are a part, have undergone intense metamorphism and tectonism during both the Middle Paleohelikian (ca. 1700 to 1600 Ma) Labradorian orogenic event and again during the Late Paleohelikian (ca. 1000 Ma) Grenvillian event.

INTRODUCTION

This project was initiated as another in a series, of which the long-term objective is, to complete regional scale mapping along the entire Grenville Front Zone in Labrador. The area examined encompasses NTS 13E/1, 13E/2, 13E/7 and 13E/8, located along the Churchill River, 140 km west of Goose Bay, Labrador (Figure 1). Access is either by air or from the Trans-Labrador Highway, a summer gravel-road that transects the central part of the map area. Fieldwork on the Wilson–Winokapau lakes area was carried out during July and August, 1989. Most of the area was covered by helicopter-borne reconnaissance mapping, with ground-traversing parties emplaced where warranted by sufficient bedrock exposure. A limited number of additional ground traverses were dispatched from the Trans-Labrador Highway. In addition, a cursory examination of bedrock exposures along the highway right-of-way was made using a four-wheel drive truck.

The Wilson–Winokapau lakes map area links regional studies carried out to the west and north by Nunn (1981), Nunn and Noel (1982), Nunn and Christopher (1983), Nunn *et al.* (1984), Nunn *et al.* (1986), Thomas (1979, 1981), Thomas and Hibbs (1980), Thomas *et al.* (1981), Thomas and Wood (1983), Thomas *et al.* (1984), Thomas *et al.* (1985), Thomas *et al.* (1986), Wardle and Britton (1981), Wardle (1982, 1985) and Jackson and Finn (1982), with those of Wardle and Ash (1986), Wardle and Crisby (1987) and Wardle *et al.* (1988) to the east. In addition to large-scale reconnaissance geological mapping surveys by Stevenson (1969) and Emslie *et al.* (1978), the area

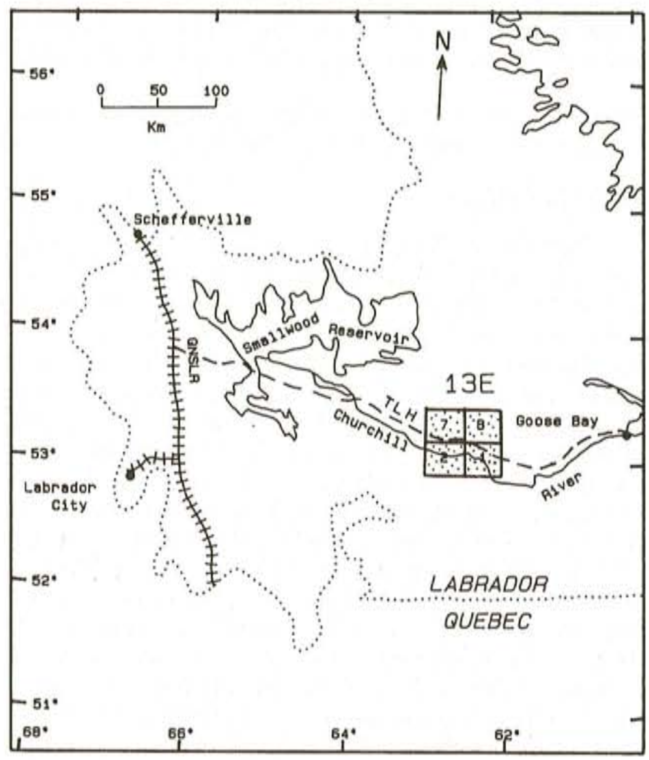


Figure 1. *Location of the Wilson–Winokapau lakes map area.*

was examined during the course of several early mineral exploration programs; see Peters *et al.* (1955), Roderick

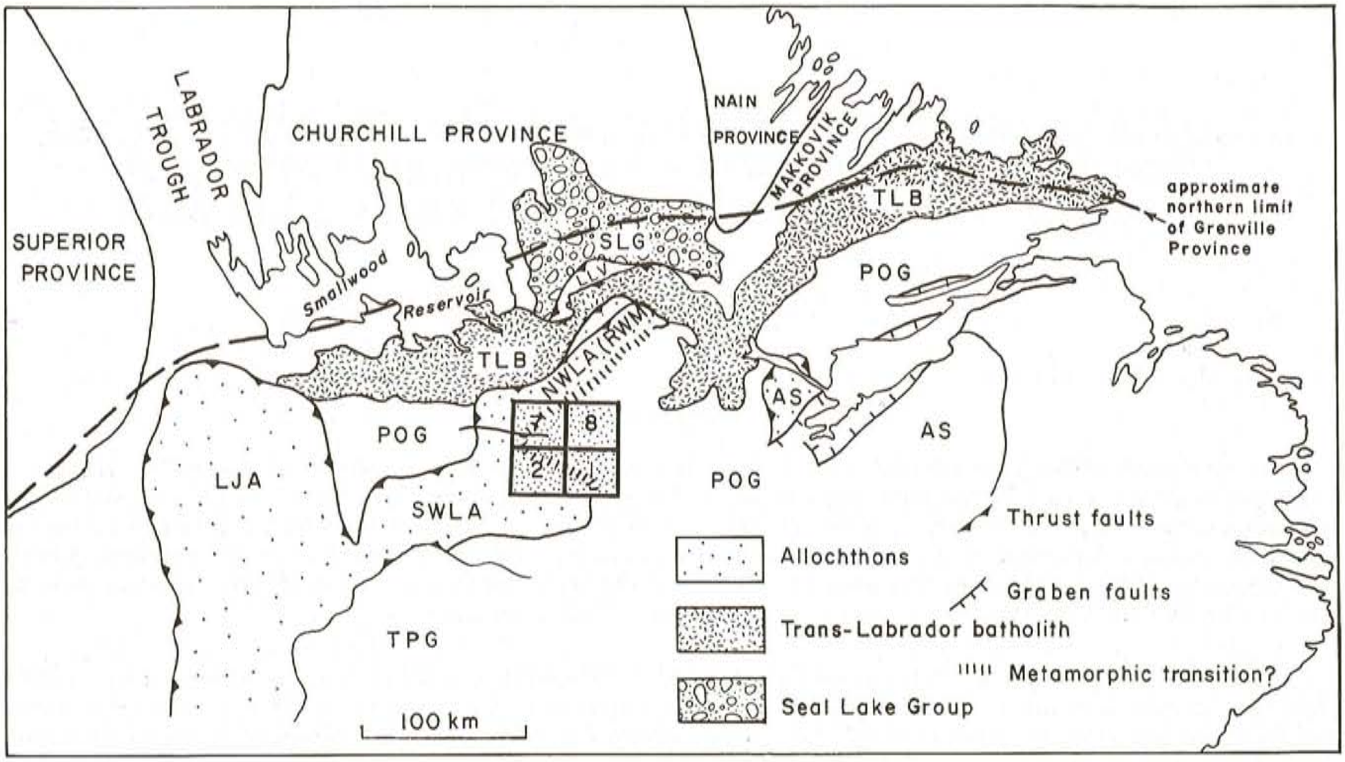


Figure 2. *Simplified regional geology along the northern margin of the northeastern Grenville Province. (SLG = Seal Lake Group; LLV = Letitia Lake volcanic complex; TLB = Trans Labrador batholith; POG = paragneiss, orthogneiss, granitoids; AS = anorthosite suite; LJA = Lac Joseph allochthon; SWLA = southern segment Wilson Lake allochthon; NWLA = northern segment Wilson Lake allochthon (Red Wine mountains massif of Emslie* et al., *1978); TPG = tonalite gneiss, pyroxene granitoids and pyroxene-rich granitic gneisses). Figure modified from Wardle* et al. *(1986).*

(1954), Roderick *et al.* (1955), Piloski (1959), Baldwin (1967), Geiger (1961), Morse (1958) and Goldak (1959).

Regional Geology

The Wilson–Winokapau lakes area lies within a Mid to Late Precambrian mixed gneiss and granitoid crystalline terrane (Figure 2), which forms part of the northern Grenville Province in central Labrador. To the north and northwest of the map area, the Red Wine Mountains highland massif of Emslie *et al.* (1978) is part of a more extensive regional gneiss salient, termed by Thomas *et al.* (1986) the Wilson Lake allochthon. The allochthon consists of granulite-facies quartzofeldspathic paragneiss, charnockitic rocks and pyroxene-bearing mafic intrusive bodies. Paragneiss is the oldest rock type present and has been dated using U–Pb and Rb–Sr methods at ca. 1680 to 1650 Ma. Rocks of the Red Wine Mountains massif (north Wilson Lake allochthon) have been thrust in a northwesterly direction over monzonitic, granitic and granodioritic rocks of the ca. 1650 Ma Trans Labrador batholith. Part of the batholith has in turn been thrust both against metasedimentary, metavolcanic and basic intrusive rocks of the ca. 1323 Ma Seal Lake Group and felsic volcanic rocks of the Letitia Lake volcanic complex. The batholith–supracrustal rock juxtaposition approximates the centre of the northern boundary zone of the Grenville Orogen.

West of the Wilson–Winokapau lakes area, middle to upper amphibolite quartzofeldspathic paragneiss intermixed with granitic orthogneiss (Thomas *et al.*, 1986) form a re-entrant into the Red Wine Mountains highland massif, itself still the predominant unit. The boundary between these two terranes remains a thrust or high-angle reverse fault. The massif continues to the south and southwest of the map area where it becomes the south Wilson Lake allochthon, but the nature of the contact between it and the surrounding gneissic and granitoid rocks is more obscure. The boundary appears in some places to be a fault, whereas in others, it is either a metamorphic transition or deformed intrusive contact. Beyond the southern edge of the massif, a younger (ca. 1250 to 1200 Ma) distinctly different, lowland granulite-facies terrane, consisting of tonalitic gneisses, pyroxene granitoids and pyroxene-bearing granitic gneisses, predominates. To the east of the map area, lies a complex sequence of highly deformed rocks consisting mainly of amphibolite-facies paragneiss, orthogneiss and felsic granitoids of mixed ages and origins, intruded by a ca. 1650 Ma anorthosite suite. All lithological units surrounding the map area are within the confines of the Grenville Orogen, and therefore exhibit complex polymetamorphic and polydeformational characteristics.

GENERAL GEOLOGY OF THE WILSON–WINOKAPAU LAKES AREA

Nine bedrock units are recognized in the Wilson–Winokapau lakes area (Figure 3), the oldest of which is the amphibolite to granulite-facies Disappointment Lake paragneiss (Unit 1). Granulite-facies paragneiss (subunit 1a) belongs to the Red Wine Mountains highland massif of Emslie *et al.* (1978), part of which passes through the western half of the map area. Amphibolite-facies paragneiss (subunit 1b) is in apparent conformable contact with granulite-facies paragneiss, along what is primarily a metamorphic boundary, where muscovite-rich assemblages give way to muscovite-poor or absent assemblages. Amphibolite-facies paragneiss is exposed in a narrow, 10-km-wide, northeast-trending belt in the eastern part of the map area. It is also exposed in the western and central parts of the area, south of Wilson Lake, within a basinal structure, as well as in a 5-km-wide westerly trending belt.

Several outcrops of marble (Unit 2), which occur within granulite-facies paragneiss southeast of Winokapau Lake, probably represent original carbonate-rich interbeds. These marble outcrops are aligned in a discontinuous (boudinaged?), folded band up to 0.5-km wide and 20-km long.

Massive, igneous to gneissic textured bodies of gabbronoritic to leuconoritic composition (Unit 3), intrude the granulite-facies paragneiss around Wilson Lake. They were probably originally sills and feeder dykes, which have been boudinaged during subsequent deformation. Numerous intrusive contacts exist between rocks of this unit and those of subunit 1a. Beaver River basic orthogneiss (Unit 4), is similar in composition to the gabbronoritic rocks of Unit 3 and at one locality, northeast of Wilson Lake, the two units may be in gradational contact. The Beaver River gneiss is an extensive regional unit found along the eastern edge of the Red Wine Mountains massif and is most widely exposed north of the map area.

Several small ultramafic bodies (Unit 5) of unknown origin, are found within both granulite- and amphibolite-facies paragneiss. No contacts were observed, but the bodies are similar to pyroxenites and dunites found in the adjacent areas to the west (Thomas and Wood, 1983) and southwest, (Thomas *et al.*, 1984).

Orthogneiss derived from porphyritic granite–granodiorite (Unit 6), is present in the eastern part of the map area and is correlated with similar equivalents to the southeast (see Wardle *et al.*, *this volume*), east (Wardle *et al.*, 1988), and northeast (Thomas *et al.*, 1981). It intrudes, and in places is interbanded with, amphibolite paragneiss of subunit 1b.

Although deformed and metamorphosed, isolated bodies of the boudinaged Mouni Rapids pluton (Unit 7), which occur along, and southwest of, the Churchill River, still exhibit core zones of primary igneous texture. Rocks belonging to the pluton are intrusive into subunit 1a granulite-facies paragneiss.

An arcuate body of granodioritic to granitic composition, located southeast of Wilson Lake and termed the Wilson Lake granodiorite (Unit 8), may be time-stratigraphic equivalent or even genetically related to the Mouni Rapids pluton. Together these constitute the youngest, least deformed granitoids in the map area. Relict megacrystic texture is present in the core of the Wilson Lake body, and intrusive contacts between granodiorite and amphibolite-facies paragneiss were observed. A small foliated body of gabbro to quartz gabbro (Unit 9) occurs in Unit 6 granitoid gneiss in the east-central part of the map area. Since no contacts were observed, its relationship to the host gneiss is unknown.

Based on correlation and comparison with previously mapped and dated units in adjacent study areas, all rocks within the Wilson–Winokapau lakes area have undergone both the Labradorian (ca. 1700 to 1600 Ma) and Grenvillian (ca. 1000 Ma) orogenies. They are polydeformed and polymetamorphosed, their distribution and outcrop patterns being strongly influenced by complex regional fold interference structures, probably of several ages. Rocks within the area form what is now an approximately 65-km-wide S-shaped crustal belt, derived from an allochthonous thrust sheet(?s). This sheet(s) has been emplaced from the south or southeast, and its deepest level is exposed in the northwestern part of the map area as a granulite massif, with progressively shallower levels occurring in a southeasterly direction. The boundaries of the thrust sheet extend well beyond the confines of the Wilson–Winokapau lakes area.

Disappointment Lake Paragneiss (Unit 1)

This unit is subdivided into granulite facies paragneiss (subunit 1a) and middle to upper amphibolite facies paragneiss (subunit 1b). Granulite facies paragneiss is quartzofeldspathic, rusty pink to buff coloured on weathered surfaces, medium to fine grained (1 to 4 mm), dense and extremely resistant to weathering. It is banded on a scale of 0.5 to 5 cm, having prismatic to fibrous sillimanite, fine grained hypersthene, magnetite, and locally abundant sapphirine and/or cordierite, in addition to minor biotite in melanocratic, anastomosing restite layers. Rare muscovite and garnet are also present. Melanocratic restite bands vary in width up to 2 cm, and commonly contain lenticular clots of densely packed aggregates of fibrolitic sillimanite, pyroxene and magnetite, as well as ubiquitous fine grained magnetite, which imparts to the rocks a unique and intensive magnetic signature. On an aeromagnetic map, the anomaly patterns reflect bedrock structural trends and can be used to delineate the areal extent of the gneiss. Leucosome mobilizate bands consist of dense, fine- to medium-grained granoblastic polygonal aggregates of quartz, K-feldspar and plagioclase. These are tightly folded, pinch and swell, and vary up to 5 cm in width, although they are more normally in the 1- to 2-cm-size range. Evidence is present for partial melting under anhydrous conditions at high temperatures in granulite facies paragneiss. Occurrences of both layer parallel and crosscutting quartz-feldspar sweats and veinlets, containing subhedral to euhedral hypersthene crystals up to 1-cm long are found, although as a rule, hypersthene-free mobilizate bands and veinlets predominate in the paragneiss. Granulite facies Disappointment Lake paragneiss contains numerous boudinaged mafic dykes and inclusions that may be related to the gabbronoritic sills of Unit 3. These are especially prevalent around the west end of Wilson Lake.

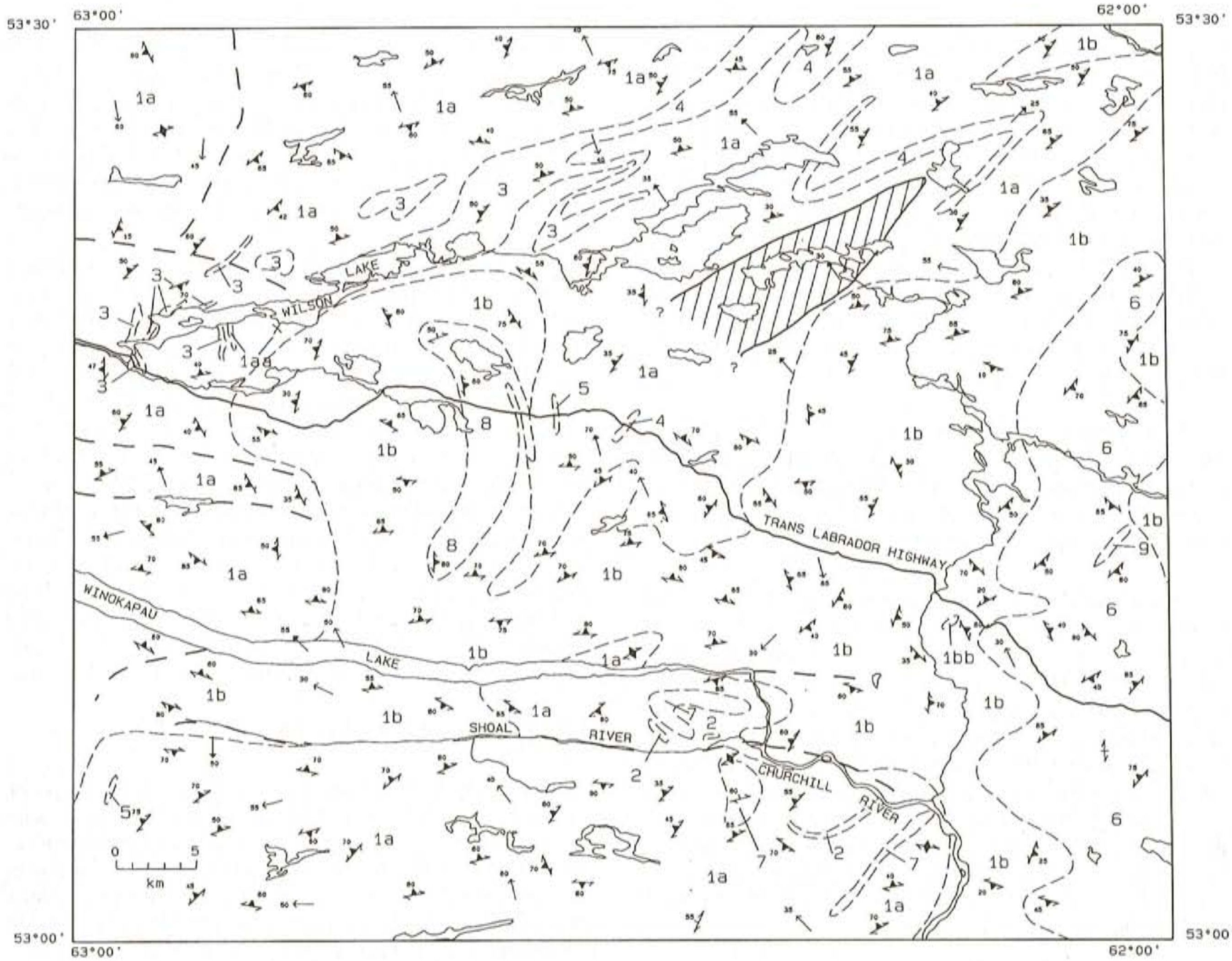


Figure 3. *Geology of the region between Wilson and Winokapau lakes.*

Also found in close proximity to the mafic rocks at this locality, are several sizeable oxide zones (subunit laa), locally comprising massive magnetite–ilmenite layers within the paragneiss. The mafic dykes and oxide zones at this end of the lake are in the nose of a major regional fold and may have been emplaced in low-stress dilation zones in this structure. Although not common, pegmatite dykes were also observed within granulite paragneiss.

Middle to upper amphibolite-facies quartzofeldspathic paragneiss (subunit lb) is less dense, and much more fissile than its granulite facies counterpart. It is also pink to buff white on weathered surfaces and comprises quartz, K-feldspar, plagioclase, sillimanite, biotite, muscovite, garnet, and magnetite–ilmenite as well as rare cordierite. Unlike its granulite facies equivalent, amphibolite facies paragneiss contains abundant muscovite and is also richer in biotite and garnet. The abundance of phyllosilicate minerals imparts to this unit a strong planar anisotropy. Metamorphic differentiation is well developed with mafic minerals in melanocratic restite bands 0.5- to 1-cm-wide, separated by 2- to 3-cm-wide quartz–feldspar mobilizate bands. Sillimanite may be prismatic or fibrolitic, and has a tendency to form radiating clusters with biotite and muscovite along restite mobilizate band boundaries. Garnet occurs in restite bands as subhedral to euhedral porphyroblasts. Fine- to medium-grained granoblastic polygonal texture predominates in mobilizate bands. Diabase dykes and boudins are also present within amphibolite facies paragneiss, as are zones of banded diorite or quartz diorite gneiss (subunit lbb). One large hill in the southeastern part of the map area, is completely underlain by diorite gneiss interlayered with pegmatite and quartzofeldspathic paragneiss. At least three generations of pegmatite are observed in large quantities within amphibolite facies paragneiss. The two earliest generations form dykes and bodies that are highly deformed. The dykes are contorted and/or ptygmatically folded, and the bodies sheared and cataclasized. Southwest of Winokapau Lake and northeast of the outlet from the lake (of the Churchill River), amphibolite facies paragneiss is completely inundated with pegmatite. The former locality in particular contains dykes (?sills) of extremely coarse grained material having sheared, euhedral

LEGEND (Figure 3)

PALEOHELIKIAN or OLDER

9 *Foliated gabbro and/or quartz gabbro*

8 Wilson Lake granodiorite: *foliated porphyritic to megacrystic granite–granodiorite, massive pink granodiorite, augen gneiss after porphyritic granite–granodiorite, biotite orthogneiss, aplite. Intrusive into middle to upper amphibolite Disappointment Lake paragneiss*

7 Mouni Rapids pluton: *foliated porphyritic to megacrystic granite–granodiorite and/or augen gneiss after megacrystic granite–granodiorite; minor quartz-diorite, diorite and hornblende granite. Intrusive into granulite facies Disappointment Lake paragneiss*

6 *Banded- to augen-textured pink, migmatitic, biotite, quartz, feldspar orthogneiss after possible equigranular to porphyritic granite–granodiorite. Commonly intruded by coarsely crystalline pegmatite dykes*

APHEBIAN or OLDER

5 *Pyroxene, magnetite-bearing ultramafic rocks of unknown affinity*

4 Beaver River gneiss: *well banded basic orthogneiss containing orthopyroxene, clinopyroxene, amphibole, garnet, feldspar and minor quartz*

3 Gabbronorite: *massive igneous to metamorphic textured gabbro, quartz gabbro, norite and leuconorite. Intrusive into granulite facies Disappointment Lake paragneiss*

2 *Talc, tremolite, diopside and wollastonite(?)-bearing white marble*

1 Disappointment Lake paragneiss: **1a;** *granulite facies quartzofeldspathic paragneiss containing sillimanite, biotite, hypersthene, magnetite and rare garnet with or without sapphirine, cordierite and minor muscovite. Contains numerous boudinaged mafic dykes and inclusions, rare oxide zones (1aa) and small intrusive bodies of charnockite and charnockite gneiss:* **1b;** *middle to upper amphibolite facies quartzofeldspathic paragneiss containing sillimanite, abundant muscovite, biotite and garnet with or without kyanite and rare cordierite. Intruded by abundant deformed and undeformed, coarsely crystalline pegmatite dykes. Also contains zones of banded diorite to quartz diorite gneiss (1bb) and granodiorite melt*

SYMBOLS

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

Gneissic banding/foliation (horizontal, inclined, vertical)........

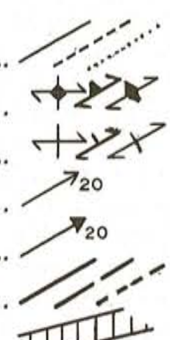
Foliation (horizontal, inclined, vertical)........

Mineral lineation with plunge........

Tectonic lineation with plunge........

Fault (defined, approximate, assumed)........

Fault zone, shear zone (width indicated)........



K-feldspar crystals ranging up to 15 cm in length, and muscovite books 8 to 10 cm in width. Several small pegmatite boulders containing amazonite were found along the Trans-Labrador Highway in the region of the latter locality but could not be traced to their source. The last generation of pegmatite occurs as underformed dykes and dykelets, which crosscut gneissic banding and generally range in width from 5 to 10 cm.

Both amphibolite and granulite grade paragneiss are extensively tectonized, exhibiting well developed, linear and planar fabrics (Figures 3 and 4) as well as complex, major and minor fold patterns including mushroom, dome and basin structures, isoclinal, chevron and hook folds. Small-scale fold patterns mimic regional fold geometries. Mineralogical and chemical studies on extensions of the Wilson–Winokopau lakes paragneiss terrane into adjacent areas (Thomas and Wood, 1983; Thomas *et al.*, 1984; Thomas *et al.*, 1986) suggest derivation from an aluminous (?argillaceous) sedimentary protolith. Geochronological studies in these same areas yield Rb–Sr and U–Pb dates of 1666 Ma and 1676 Ma respectively, for the paragneiss (Thomas *et al.*, 1986), indicating that the protolith is at least Aphebian in age.

Marble (Unit 2)

Several outcrops of coarse grained, white marble (Unit 2) occur in an irregular, sinuous band 15- to 20-km long by 0.5-km wide, south of the Churchill River. In defining the limits of the marble band, scattered outcrops of marble not examined during the present study, but reported by Stevenson (1969) north of the east end of the Shoal River and in the valley of the Churchill River east of its confluence with the Shoal River, have been included in Figure 3. The marble has a dull grey surface that weathers in relief; however, fresh surfaces are bright white. It is coarsely recrystallized and dominated by polygonal granoblastic calcite crystals of up to 1-cm diagonal length. Unit 2 rocks are impure, well banded, with prominent silica-rich layers generally less than 1 cm in width, separated by up to 10-cm-wide layers of carbonate. In addition to calcite and dolomite, talc, tremolite, diopside, siderite, microcline, muscovite and chlorite are present. Calcite, constitutes up to 80 percent of the rock, whereas talc and diopside are present either as fine grained crystals within silica-rich layers, or as coarser crystal aggregates forming irregular, layer parallel lenticles. Tremolite is present in minor amounts. Although the marble belt itself has been folded, the layers within this unit are regular and unfolded at outcrop scale. The layering may be either bedding or transposed bedding.

The marble is completely surrounded by banded to augen-textured Disappointment Lake granulite-facies paragneiss (subunit 1a) and although no contacts with this unit were observed, the former is interpreted to represent original impure siliceous limestone interbeds in the latter. The marble, in common with its granulite-facies paragneiss host, would therefore also have an Aphebian age protolith.

Gabbronorite (Unit 3)

Several bodies of noritic to gabbroic composition (Unit 3) intrude granulite-facies paragneiss of subunit 1a, north and northeast of Wilson Lake (Figure 3). These bodies are deformed and elongated and are probably derived, originally, from sills and dykes. They consist mainly of norite, pyroxene gabbro, and to a lesser degree along the margins of the bodies, gneissic equivalents of these rock types. Norite is generally massive, medium grained and exhibits ophitic to subophitic textures in the central parts of the bodies, and recrystallized polygonal granoblastic textures along the margins. Sharp, intrusive contacts marked by chilled margins of gabbronorite against granulite paragneiss are exposed in the highlands north of Wilson Lake. Gabbronoritic rocks around Wilson Lake contain hypersthene, augite, hornblende, brown biotite, plagioclase, magnetite–ilmenite and rare olivine or garnet. Lithotypes in the gabbronorite unit are correlated with identical rocks found to the north of the Wilson–Winokapau lakes area by Emslie *et al.* (1978) and Thomas *et al.* (1981).

Beaver River Gneiss (Unit 4)

Emslie *et al.* (1978) mapped a banded mafic gneiss along the eastern side of the Red Wine Mountains massif that they called the Beaver gneiss. Thomas *et al.* (1986) traced the unit into the region north of the Wilson–Winokapau lakes area, and renamed it Beaver River gneiss. During the present study, the main exposures of Beaver River gneiss (Unit 4) were found in the northern part of the map area, with one local area of outcrop in the centre of the map area along the Trans Labrador Highway. The principal exposures are confined to two separate northeast-trending folded belts, 3-km and 1.5-km wide respectively (Figure 3). Beaver River gneiss in the northernmost belt appears to grade gradually southwestward into gabbronorite belonging to Unit 3.

Beaver River gneiss is melanocratic, dark green to grey black on weathered surfaces and dark green on fresh surfaces. It is medium to coarse grained and contains white to grey, garnet, feldspar, magnetite-rich leucocratic mobilizate bands, alternating with melanocratic restite bands containing hypersthene, augite, hornblende, biotite, lesser garnet, magnetite and rare pyrite. Minor chlorite and green spinel (gahnite?) are also present. The banding is poorly to moderately well developed on a centimetre scale but locally may be much wider. These rocks exhibit a polygonal granoblastic texture with subordinate augen texture, developed locally where euhedral to subhedral garnets up to 1 or 2 cm in diameter are present. Where the gneiss is most highly deformed, a linear fabric is present. Emslie (personal communication, 1980) believes that Beaver River gneiss was derived from an original thick succession of calcareous metasedimentary rocks, however, the close compositional and mineralogical similarities and gradational contact relationship with Unit 3 gabbronorite, suggest derivation from a mafic igneous protolith. If the latter case is true, then that protolith has been emplaced into granulite facies paragneiss and therefore is likely Aphebian or younger in age.

Ultramafic Rocks (Unit 5)

Several small isolated bodies of peridotitic ultramafic rocks (Unit 5) occur within granulite-facies paragneiss. Most can only be measured in metres, whereas two map-scale bodies in the size range 1-km long by 0.5-km wide were found. One occurs along the Trans-Labrador Highway in the centre of, and the other in the southwestern corner, of the map area. The ultramafic rocks are dark green to black on both weathered and fresh surfaces, medium to coarse grained and massive. They contain variable quantities of olivine, ortho- and clinopyroxene, brown biotite, serpentine and magnetite–ilmenite. Both bodies are deformed, the one near the southwestern map boundary exhibiting a peculiar texture of bent, crushed pyroxene laths, ranging up to 4-cm long, within a groundmass consisting of intensely serpentinized olivine, and abundant magnetite–ilmenite along veinlets and fractures. On cursory examination, it has the appearance of a coarse spinifex quench texture. The ultramafic rocks are probably intrusive bodies within the paragneiss, however, due to poor exposure, no contacts were observed. Their age and origin is unknown, but they appear to be confined only to granulite-facies paragneiss and it is possible that they are genetically related to the Unit 3 gabbronorite suite.

Orthogneiss (Unit 6)

A north–south-trending body of orthogneiss (Unit 6) is exposed along three quarters of the eastern border of the Wilson–Winokapau lakes map area (Figure 3). The gneiss is pink, migmatitic, and exhibits well developed banding and/or augen texture. Quartz-, orthoclase- and microcline-rich leucocratic mobilizate bands up to 2-cm wide, alternate regularly with melanocratic restite bands containing biotite, hornblende, muscovite, chlorite, minor sillimanite and rare epidote. Orthoclase augen, after megacrysts, range up to 4 by 3 cm in a groundmass of inequigranular polygonal to interlobate granoblastic textured quartz and feldspar. Exposures of both pyroxene–hornblende gabbro and muscovite–sillimanite paragneiss are present within the orthogneiss terrain, probably as xenoliths. Although the rocks in Unit 6 are highly deformed, part of a core zone of original porphyritic to megacrystic plutonic igneous textured granite or granodiorite is exposed along the Trans-Labrador Highway, northeast of the Churchill River. This original igneous protolith has intruded, and is therefore younger than, amphibolite facies paragneiss of subunit 1b, however, its absolute age is presently unknown.

Mouni Rapids Pluton (Unit 7)

The Mouni Rapids pluton (Unit 7) comprises three separate bodies resulting from the tectonic disruption and large-scale boudinaging of a single, originally diapiric(?) mass. These bodies are hosted by subunit 1a granulite facies paragneiss, south of both the eastern end of Winokapau Lake and the Churchill River. The two northerly bodies (Figure 3) are lenticular in shape and appear to occupy the cores of two major regional folds. The southernmost body is stretched into an elongate northeast-trending mass approximately 8-km long by 1-km wide. Rocks of the pluton are pink to buff white on weathered surfaces and moderately to intensely foliated, exhibiting for the most part porphyritic to megacrystic textures. Equigranular banded- to augen-textured gneissic equivalents are also present where the rocks are most intensely deformed. Composition of rocks within the pluton is generally granitic to granodioritic, with local dioritic, quartz dioritic and hornblende granite variants. Mineral constituents comprise variable proportions of clinopyroxene, hornblende, biotite, garnet, muscovite, chlorite, minor sillimanite, quartz, orthoclase, microcline and magnetite–ilmenite. The Mouni Rapids pluton intrudes granulite-facies paragneiss and may be as recent as Paleohelikian in age.

Wilson Lake Granodiorite (Unit 8)

An arcuate, north-trending body of granitic to granodioritic composition termed the Wilson Lake granodiorite (Unit 8), is approximately 20-km long by 4-km wide and occurs just west of the centre of the map area (Figure 3). Rocks within the body are pink to white on weathered surfaces, and textures range from porphyritic or megacrystic to aplitic. The core of the body is generally massive and megacrystic, whereas the borders are gneissic having developed polygonal granoblastic or augen textures. The northwestern and sections of the western edge of the Wilson Lake granodiorite are dominated by white to pink aplite intermixed with pegmatite-rich material. Pegmatite veins and dykes are common throughout Unit 8, the rocks of which have been metamorphosed at least to amphibolite grade. The Wilson Lake granodiorite contains quartz, orthoclase, microcline, biotite, muscovite, chlorite and magnetite–ilmenite. Intrusive contacts are observed between Unit 8 granitoid rocks and amphibolite paragneiss of subunit 1b, the relatively fresh character of the granitoids suggesting a fairly recent (Paleohelikian?) age of emplacement. Mineralogical and textural similarities common to the granitic rocks of Units 6, 7 and 8, may indicate a time/stratigraphic and/or genetic link. Whether or not this possibility is tenable will have to await chemical and geochronological studies of these units.

Foliated Gabbro–Quartz Gabbro (Unit 9)

Several outcrops of foliated gabbroic rock (Unit 9) occur within gneissic granitoids near the east-central boundary of the map area (Figure 3). The gabbro is a minor rock type and consists of plagioclase, pyroxene, hornblende, biotite and magnetite–ilmenite containing rare quartz crystals. It is deformed and metamorphosed and its age and affinity are unknown.

STRUCTURE

Rocks within the Wilson–Winokapau lakes area have been subjected to both the Labradorian (ca. 1700 to 1600 Ma) and Grenvillian (ca. 1000 Ma) orogenies. Complex, polyphase structural patterns have resulted at all scales from microscopic to megascopic, and no attempt at present is made to correlate these with individual orogenic events. Generally, in the Wilson–Winokapau lakes area, bedrock structural

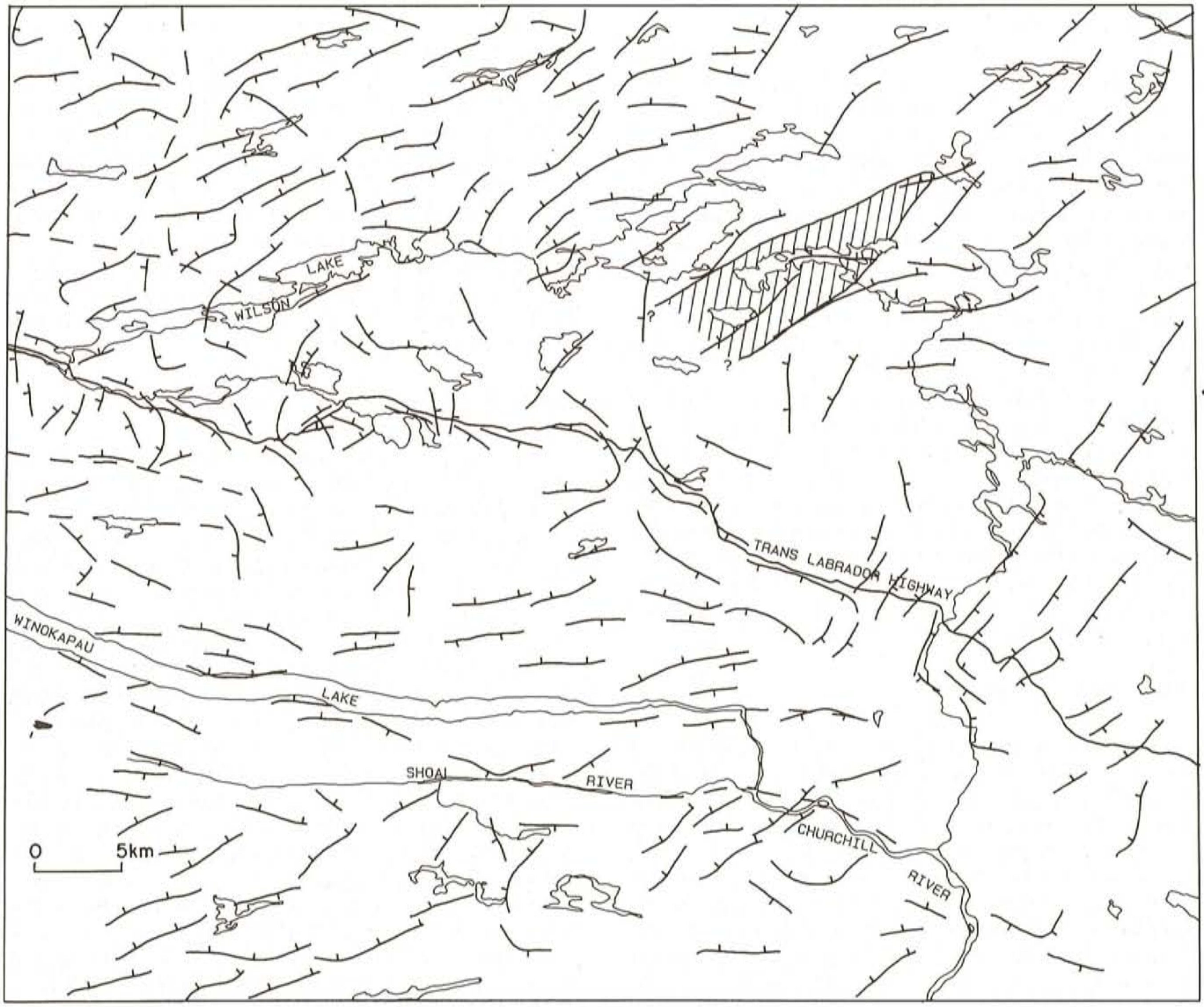


Figure 4. *Bedrock structural trends in the region between Wilson and Winokapau lakes.*

trends (Figure 4) exhibit a preferred easterly to northeasterly strike having moderate northwest or southeast dips (Figure 3). These are further illustrated on stereonet diagrams of poles to gneissic banding planes (Figure 5). A contoured plot of these poles for all four map sheets contains a distinct maximum, indicative of the preponderance of northwest dips, in particular within granulite facies paragneiss of Unit 1. This structural geometry results from a number of early, closed to isoclinal folds, whose axial planes trend northeast, and have dips that fan from southeast to northwest. In the northeastern part of the area (NTS 13/E8), these folds are overturned to the southeast, and axial planes along with gneissic banding (Figure 5) have shallow to moderate northwest dips. Elsewhere, folds may be upright or overturned to either the northwest or the southeast. Later, major cross-folds have refolded the earlier regional folds around westerly trending axes. Associated with these later folds are predominantly northwest-plunging tectonic and/or mineral lineations (Figure 3); their trend is well illustrated in a contoured sterographic diagram representing data from all four map sheets (Figure 5), which contains a distinct maxima in the northwest quadrant. This has resulted in the creation of complex regional dome and basin fold interference patterns (Figure 3). The S-shaped geometry of the entire belt of rocks exposed in the field area is controlled by two late megascopic regional folds; one having its nose in the vicinity of west Wilson Lake, the other in the Cache River area northeast of the east end of Winokapau Lake. The latter fold closure is particularly well illustrated in the field by both a swing of over 270° in the gneissic banding, and the folding of an earlier tectonic lineation around the nose (Figure 3).

The later east-west trending folds have been faulted and sheared out along limbs by relatively recent east–west faults. The two best exposed examples of these extend along (and control the topography of) the valleys of both Winokapau Lake and the Shoal River. Exposures of sheared, mylonitic and fault brecciated rocks are present at the western terminus of the Shoal River valley, and also in parts of the Winokapau Lake gorge. Other faults and lineaments occur in the more well exposed northwestern part (NTS 13E/7) of the map area.

An approximately 8-km-wide northeasterly trending zone of sheared and mylonitized granulite-facies paragneiss occurs east of Wilson Lake on NTS 13/E8. Its southwestern limits are unknown due to poor exposure, but where observed it extends over a strike length of at least 15 km. It may represent a fault zone, however, the lack of marker horizons or contrasting lithological units, combined with exceedingly poor exposure, does not allow for the determination of degree of relative displacement across the zone.

METAMORPHISM

With the exception of the cores of some plutonic igneous bodies, all rocks within the Wilson–Winokapau lakes area have been intensely metamorphosed. Paragneiss, orthogneiss and gabbroids in both the northwestern and southern parts of the map area have been metamorphosed to the granulite facies. The northwestern paragneiss is rich in the high pressure and temperature magnesium and iron silicate mineral sapphirine, whereas in the southern paragneiss cordierite predominates (Figure 6). A mineral assemblage consisting of hypersthene, sillimanite, biotite, sapphirine, cordierite, quartz, feldspar and garnet typifies these rocks (Figures 6 and 7). Evidence of retrogression is present in the northwest, by the retrograde reaction:

$$\text{sapphirine} + \text{quartz} \rightarrow \text{hypersthene} + \text{sillimanite}$$

supported by textures in which coarse sapphirine crystals are surrounded by hypersthene and sillimanite rims.

The conclusion that rocks within the central and eastern parts of the map area have undergone middle to upper amphibolite-facies metamorphism, is supported by the presence in paragneiss of the assemblage sillimanite, biotite, muscovite, quartz, feldspar and garnet (Figure 7). Much or all of the muscovite may be retrograde, the central and eastern (subunit 1b) paragneiss being an amphibolite retrogressed equivalent of granulite facies (subunit 1a) paragneiss, but textures are inconclusive. Much of the area has undergone late retrograde greenschist facies metamorphism indicated by the presence of chlorite, epidote, secondary biotite and calcite. Although widespread, the effects of this event are discontinuous and patchy.

Geochronological and metamorphic studies in adjacent map areas suggest that the metamorphism that produced both the sapphirine-bearing granulite and muscovite-bearing amphibolite rocks, occurred during the ca. 1700 to 1600 Ma Labradorian Orogeny. The studies also suggest that these rocks were affected by an intense ca. 1000 Ma Grenvillian metamorphism, but due to their anhydrous character the effects of this latter event are difficult to identify.

ECONOMIC GEOLOGY

Three rock types present within the Wilson–Winokapau lakes area may have economic significance. Although relatively small and local in extent, the ultramafic bodies (Unit 5) are mineralized with magnetite–ilmenite, serpentine and possibly chromite. Chrysotile was not observed but might be found under closer scrutiny on surface or possibly underground. The ultramafic body near the southwest corner of the area is particularly rich in opaque minerals, especially magnetite, which occurs in sufficient quantities to cause a magnet to stick to parts of the outcrop. This body in particular, should be investigated further for its chromite potential.

Wide expanses of the area are underlain by pegmatite or muscovite paragneiss profusely injected with pegmatite dykes and bodies. On the plateau south of central Winokapau Lake, outcrops of pegmatite are found containing orthoclase crystals over 10 cm in length and width, having muscovite books of similar size. Although not observed anywhere in outcrop, coarse crystals of blue-green amazonite were found in boulders at several localities along the Trans-Labrador Highway. Pegmatites should be investigated in more detail to find the source of these boulders. Economically important complex zoned pegmatites occur in the Grenville Province of southeastern Ontario, and it is possible that some of those in the Wilson–Winokapau lakes area may be similar, potentially containing Be, Nb, Li, Ce and W mineralization.

The third rock type of possible economic interest, which should be examined in more detail, is the marble of Unit 2. An investigation of its industrial mineral potential for use as dimension stone, ceramics or paint filler may be warranted. At least one exposure of this rock type occurs on the slopes of the Churchill River gorge and as such, would be easily accessible by boat.

DISCUSSION

Disappointment Lake amphibolite and granulite grade paragneiss within the Wilson–Winokapau lakes area, can be traced both to the north and south into equivalent rocks belonging to the Wilson Lake allochthon (Figure 2). The paragneiss unit has been dated by various methods (see Thomas *et al.*, 1986), all of which yield Paleohelikian ages, however, the emplacement of the allochthon itself probably occurred during the Neohelikian Grenvillian Orogeny. The allochthon's exact geometry and the nature of its boundaries are still unclear. Thomas *et al.* (1986) originally placed a thrust fault completely around the margin of the allochthon, effectively defining it as a klippe. Shearing in the Beaver River gneiss was the only evidence for that part of this fault along the eastern edge of the allochthon. No strong evidence for such a fault exists in the Wilson–Winokapau lakes area, apart from the shear zone on NTS map sheet 13/E8, and instead, the geometry of the allochthon seems to be influenced mainly by folding. It is therefore suggested that at least the northern segment of the allochthon may in fact be a folded nappe structure, which has been emplaced from the southeast. A northerly to northwesterly tectonic transport direction is still indicated for the Wilson Lake allochthon as a whole, on the

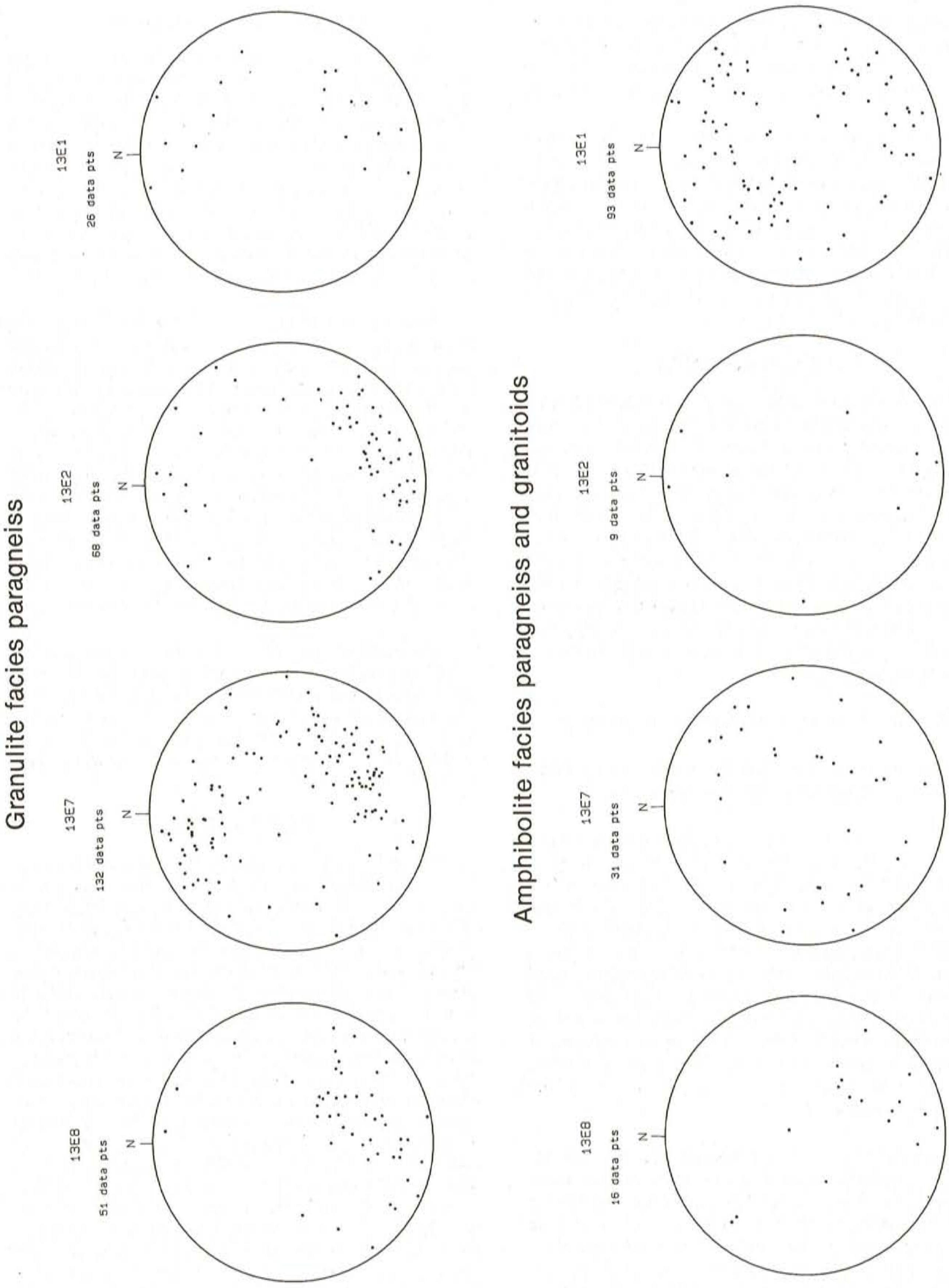


Figure 5. *Equal area, lower hemisphere Schmidt net stereographic plots of poles to gneissic banding/foliation planes and of lineation data for the region between Wilson and Winokapau lakes.*

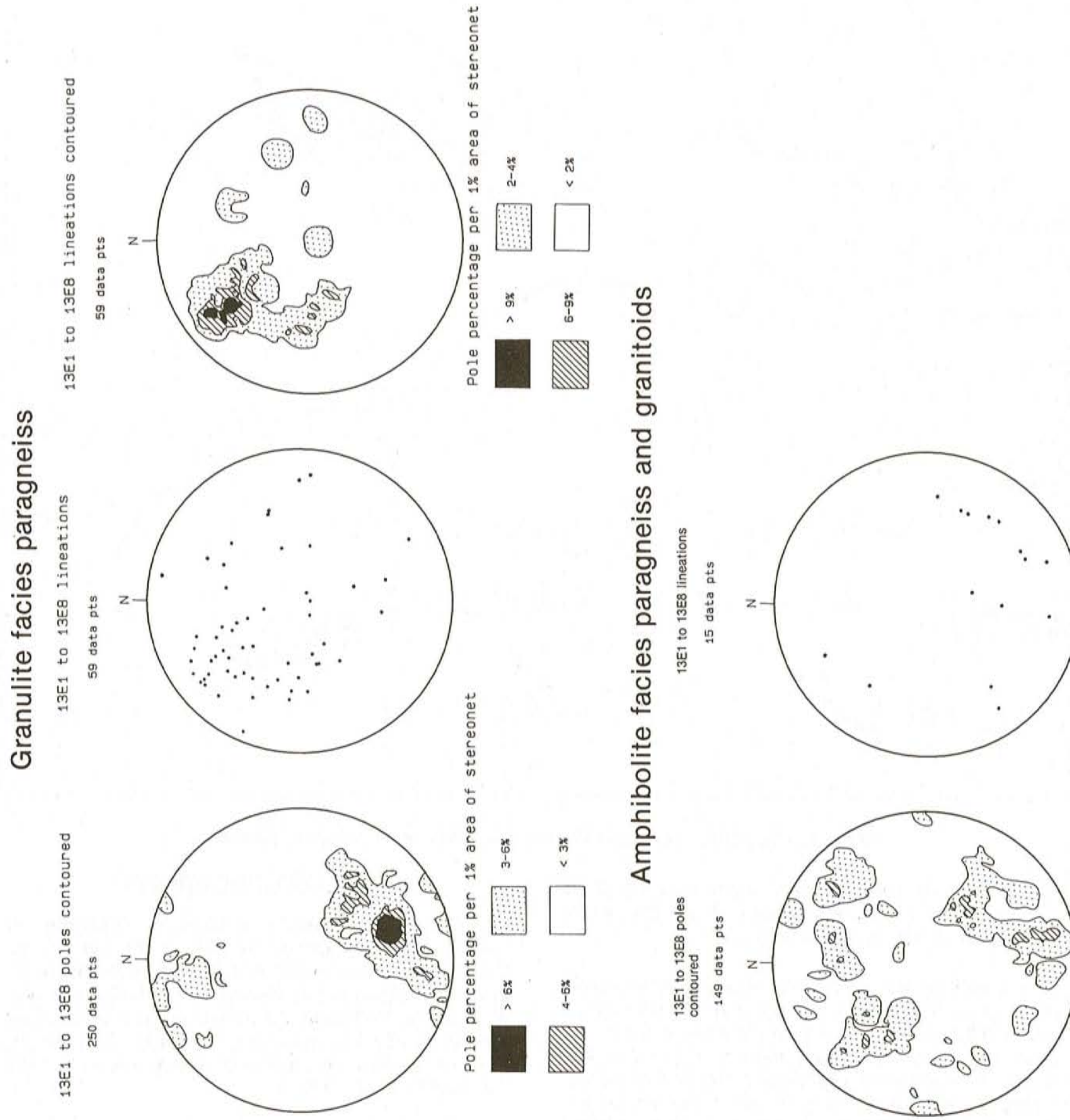


Figure 5. *(Continued)*

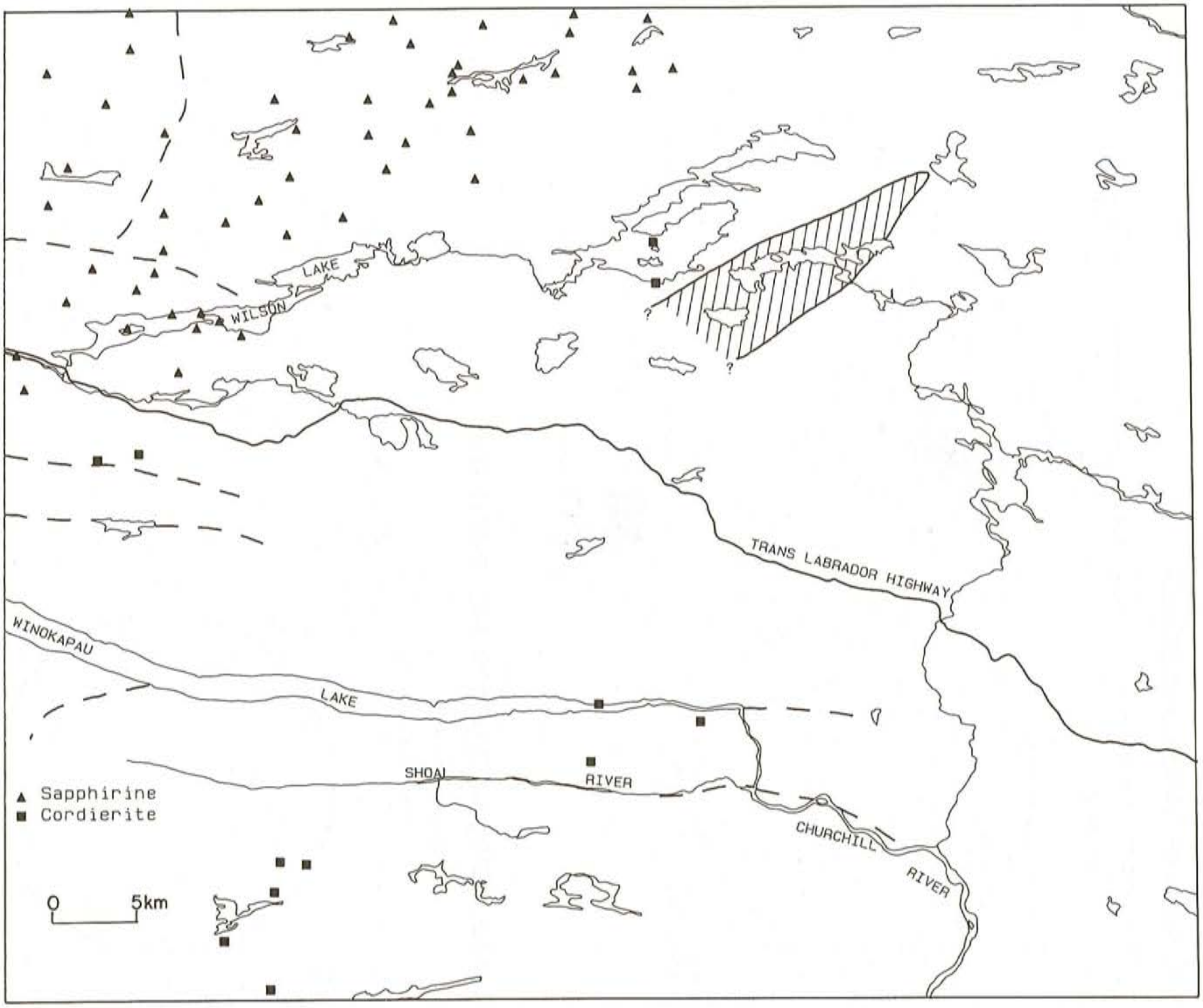


Figure 6. *Sapphirine and cordierite localities, Wilson—Winokapau lakes area.*

basis of lineation data; the northwestern boundary of the structure remains a thrust or high-angle reverse fault and the folding is in all likelihood Grenvillian in age.

It is unlikely that the complex structural/metamorphic history of the Wilson Lake allochthon and its surrounding rocks will be unravelled, until further detailed studies are carried out on selected critical segments of the structure. Required is the identification of some form of marker horizon, or sequence of unique lithological units whose relative age relationships are clearly demonstrated and which are suited to detailed geochronological study.

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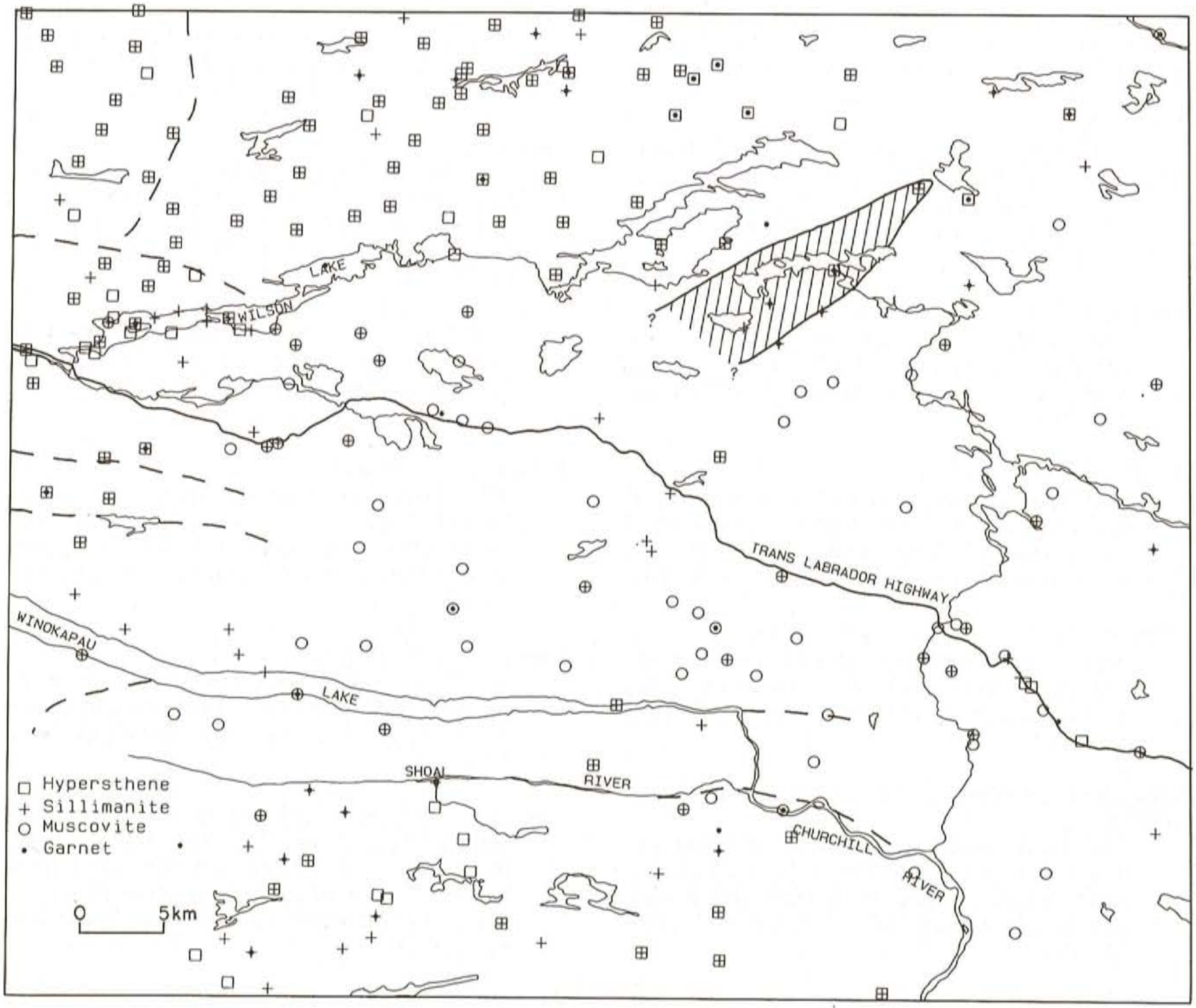

Figure 7. *Hypersthene, sillimanite, muscovite, garnet localities, Wilson–Winokapau lakes area. Note that biotite is also found throughout the area.*

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