GEOLOGY OF THE ATIKONAK LAKE AREA, GRENVILLE PROVINCE, WESTERN LABRADOR

by

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Abstract

The map area lies within the Grenville Province in southwestern Labrador and an adjacent part of Quebec. High grade pelitic to semipelitic gneiss is predominant and is intercalated with minor basic paragneiss. The paragneiss is intruded by a basic plutonic suite and a younger acidic plutonic suite. Anorthositic rocks outcrop in the southeast part of the map area; the age and contact relationships of the anorthositic suite are unknown.

Age dating of probably related, and in some cases equivalent, rock units to the north and northeast indicate a polyorogenic history for the map area. The paragneiss was affected by an older event that was separated from a younger orogenic event by the emplacement of the basic and acidic plutonic suites. Probable equivalents of the acidic suite yield ages of circa 1654 Ma. The paragneiss and the plutonic suites were later affected by a series of tectonic episodes, which locally attained granulite facies pressures and temperatures, dated at circa 1646 Ma and termed here the Labradorian orogeny.

The effect of the Grenville Orogeny in this part of the Grenville Province is presumed to consist of low grade thermal features and brittle deformation, possibly with considerably higher grade events in localized ductile shear zones.

Introduction

This report summarizes the results of 1:100,000 scale geological mapping carried out during 1983 in N.T.S. map areas 23A/9, 10, 15 and 16 (Figure 1).

The area centers around Atikonak Lake, which occupies a broad, shallow, drift-blanketed depression at an elevation of 550 to 600 m, from which the land rises to the east and northwest to a better exposed, deeply dissected peneplain at about 770 m. Atikonak Lake and many other large lakes allow float plane access to most of the lowlands, but large tracts of swamp and the mountains are mostly accessible only by helicopter.

Previous Work

Pyke (1956) reported the preliminary results of exploration by BRINEX throughout the area, which included geological reconnaissance in 1953, airborne geophysics in 1954 and ground prospecting in 1956. BRINEX found widespread but minor occurrences of Fe, Ti and Cu mineralization.

Stevenson (1968) mapped the area at 1:250,000 scale and determined it to be largely underlain by quartzofeldspathic, sillimanite-bearing paragneisses with minor amounts of gabbroid, granitoid and anorthositic rocks. He noted the particularly complex structure of the gneisses and the higher grade of those underlying the upland regions in this area. Stevenson's map was incorporated into the regional geological compilation of Labrador at 1:1,000,000 scale by Greene (1972).

The area has traditionally been regarded as lying well south of the Grenville Front zone and, by inference, as underlain by high grade Grenvillian gneisses (Stevenson, 1968; Greene, 1974; Smyth and Greene, 1976; Nunn and Christopher, 1983). Mapping carried out during 1982 established a polydeformational history for the paragneiss in the area to the north (Nunn and Christopher, 1983). Effects of the early episodes, which were tentatively assigned to the Hudsonian Orogeny and are recorded in the paragneiss as a folded gneissosity, are separated from the effects of later orogenies by the

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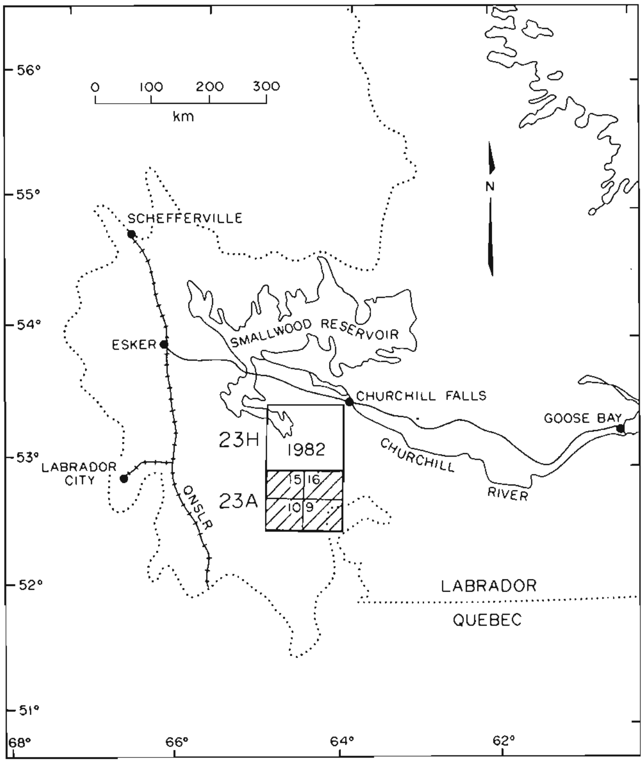

Figure 1. *Location map of the Atikonak Lake area, western Labrador.*

emplacement of granitoid and gabbroid plutonic suites. The later events, which were thought to reflect the Grenvillian Orogeny by Nunn and Christopher (1983), are manifested by further migmatization, a pervasive mineral recrystallization and several deformational episodes. These later events affected all the rock types in the area of Nunn and Christopher (1982 in Figure 1).

General Geology

Most of the map area (Figure 2) is underlain by sillimanite-bearing, quartzofeldspathic, pelitic to semipelitic paragneiss (unit 1) of three main subfacies. The differences between the subfacies are structural and textural, not compositional, and are considered to reflect a relationship between the structural development of the paragneiss and the grade and timing of peak metamorphism. The metamorphic grade is determined from the associated plutonic suites (units 2 and 3) in each subfacies area. The central and southwestern lowland areas are underlain by upper amphibolite facies rocks (subfacies 1a) whereas the eastern and northwestern upland areas are underlain by granulite facies rocks (subfacies 1b and 1c, respectively). The boundaries between the subfacies are approximate and appear transitional. In previous work to the north, the boundaries were inferred to be thrust zones (Nunn and Christopher, 1983). The northwestern granulite facies paragneiss is structurally more like the amphibolite facies rocks than its eastern counterpart, and appears to have undergone peak metamorphism at a later stage than the eastern granulites.

Banded, supracrustal metabasic rocks and minor quartzite (unit 1d) form widespread but minor intercalations in the paragneiss. They are particularly abundant in the northwestern map area (23A/10). Throughout the Atikonak Lake area, these basic gneisses contain both orthopyroxene and clinopyroxene, and appear to consist of granulite facies assemblages even in the parts of the map area believed to be in the amphibolite facies.

The paragneiss is intruded by a gabbroid suite (unit 2) and a predominantly K-feldspar megacrystic granitoid suite (unit 3). The former is more abundant in the granulite facies parts of the map area, and the latter is more abundant in the poorly exposed amphibolite facies terrane. To the west of the area in map sheet 13D/12 (Thomas et al., 1984 (this volume)), charnockitic varieties of the granitoid unit (3b) are associated with and intrusive into noritic rocks (unit 2). This relationship has also been recognized to the northeast of this area in the Red Wine Mountains (Emslie et al., 1978). It is not known whether the generally weaker fabric development in the charnockitic rocks (unit 3b), in contrast to the basic plutonic suite (unit 2), reflects a different response to deformation or a structural event separating the two plutonic suites.

A rock equivalent to the unit 3b granitoid rocks from just north of the western part of the map area has given a U-Pb zircon core age of 1672 Ma (Krogh, written communication, 1983). Based upon continuity (Thomas et al., 1981; Wardle and Britton, 1981; Nunn and Christopher, 1983) and mineralogical composition and texture (Nunn and Christopher, 1983), the dated rock has been correlated by Nunn and Christopher (1983) with units to the north and northeast of the map area (e.g. North Pole Brook Intrusive Suite, Thomas and Hibbs, 1980; Michikamau plutonic suite, Nunn and Noel, 1982). These units have yielded ages ranging from circa 1700 Ma to 1576 Ma with a distinct cluster at approximately 1650 ± 20 Ma (e.g. Fryer, 1983; Krogh et al., in preparation). These data suggest an age of about 1670 Ma for the emplacement of the plutonic granitoid suite, and freezing of the U-Pb and Rb-Sr geochronological systems due to regional cooling following low grade to granulite grade metamorphism at around 1650 Ma.

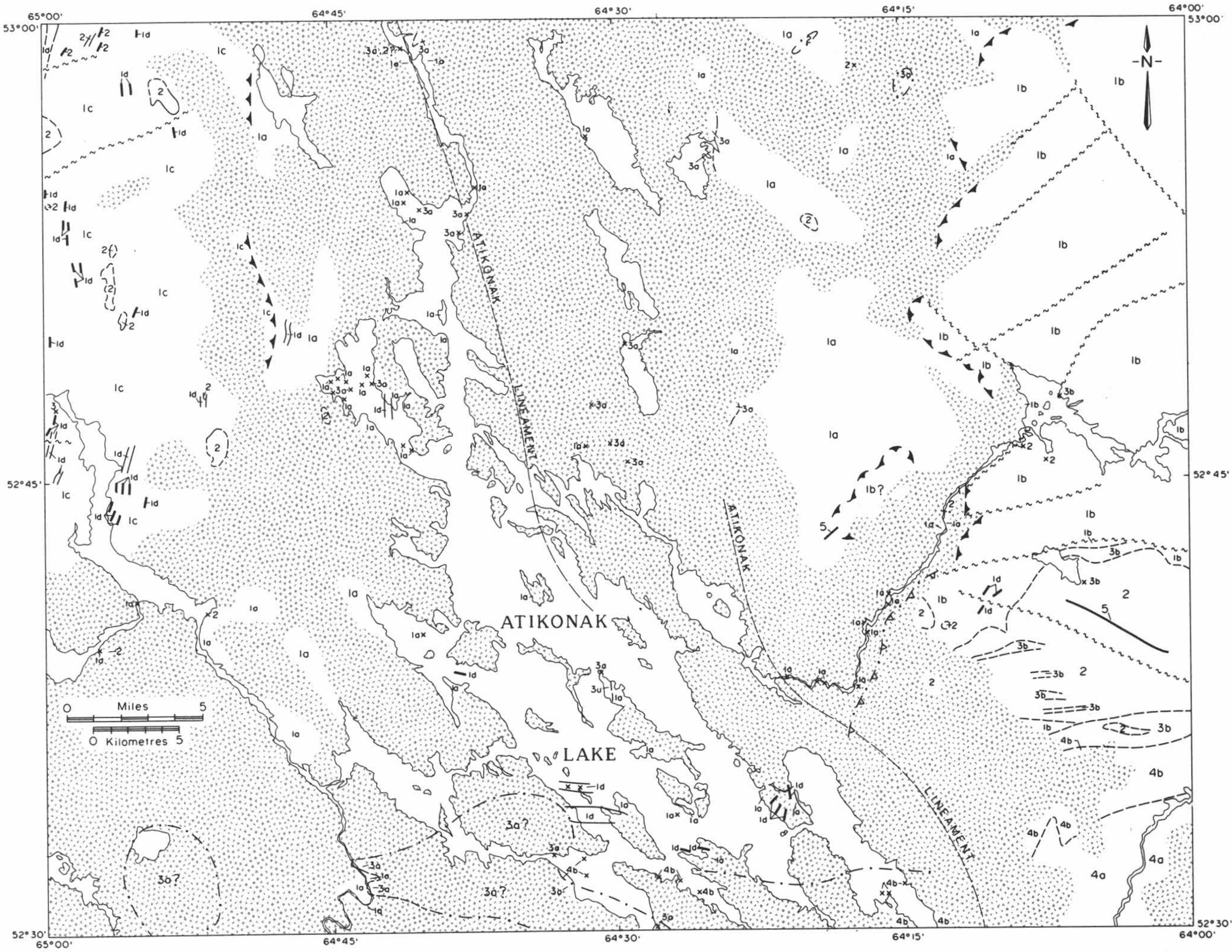

Figure 2: *Geology of the Atikonak Lake area.*

SYMBOLS

Thin layers and sheets, schematic (exaggerated). . . . .

Isolated outcrops or outcrop groups . . . . ×

Geological boundary (approximate, inferred) . . . .

Interpretative aeromagnetic boundary (geological, thrust) . . . .

Faults and lineaments (inferred). . . . .

Thrust, teeth on upthrust block (inferred) . . . .

Atikonak lineament. . . . .

Legend for Figure 2

LEGEND

HELIKIAN or younger

5 *Diabase dykes.*

HELIKIAN

4 **Anorthosite suite:** *possibly approximately synchronous with Unit 2.*
4a - *anorthosite and noritic anorthosite.*
4b - *leuconorite.*

PALEOHELIKIAN

3 **Orthogneiss and foliated granitoid rocks:** *possible equivalents of the North Pole Brook Intrusive Suite (Thomas and Hibbs, 1980).*
3a - *K-feldspar megacrystic granodiorite and quartz monzonite and strongly deformed porphyroclastic equivalents; minor non-megacrystic granodiorite.*
3b - *opdalite and farsundite equivalents of* **3a**.

2 **Basic plutonic suite:** *possible equivalents of the Ptarmigan Complex (Emslie et al., 1978). Primary or metamorphic textured gabbro to norite; partial to complete plagioclase-hornblende-biotite replacement in amphibolite facies areas.*

APHEBIAN

1 **Paragneiss:**
1a - *migmatite-banded pelitic to semipelitic amphibolite facies metasedimentary gneisses in central lowlands.*
1b - *granulite grade equivalents of* **1a** *in the east.*
1c - *granulite grade equivalents of* **1a** *in the west.*
1d - *metabasic gneisses with minor metasedimentary paragneiss layers and rare quartzite.*

The major metamorphic events which affected units 2 and 3 have been dated. The granulite facies metamorphism recorded in the same equivalent of the unit 3b granitoid rock (see above) has yielded U-Pb zircon concordia ages of 1645 and 1647 Ma (Krogh, written communication, 1983). Furthermore, U-Pb dating on sphene (Krogh et al., in preparation) from granitoid units throughout the Grenville Front Tectonic Zone to the north and the northeast of the map area has demonstrated fairly conclusively that the main upper amphibolite to granulite facies metamorphism occurred around or before 1650 Ma rather than during the Grenville Orogeny as previously thought. Tectonic features attributed to this Paleohelikian event, though not necessarily assigned thus by the authors at the time, are widespread in central Labrador and range from greenschist facies foliations to migmatites and gneissic fabrics. These structures are not confined to the high grade gneisses and migmatites of previous mapping (Thomas and Wood, 1983; Nunn and Christopher, 1983) and the Red Wine Mountains (Emslie et al., 1978) but extend farther north into lower grade rocks of the Trans-Labrador batholith (Ryan, 1980; Thomas and Hibbs, 1980; Nunn, 1981; Thomas et al., 1981; Nunn and Noel, 1982; Ryan et al., 1982). We have tentatively termed these events the Labradorian orogeny.

Equivalents of the plutonic suites yielding similar ages are known from a long belt subparallel to the northern margin of the Grenville Province, stretching from Scandinavia through Labrador to Mexico. In Labrador, these have been collectively termed the Trans-Labrador batholith (Wardle and staff, 1982); elsewhere, they include the Smaland-Varmland granitoid terrane in Sweden (Gower and Owen, in preparation) and the Mazatzal Belt in the United States (Van Schmus and Bickford, 1981). The only tectonic events of this age known to the authors are from the Mazatzal orogeny in the southwestern United States and from the American midwest (Van Schmus and Bickford, 1981). Along the southeastern margin of Laurentia the Labradorian orogeny may be only one of a series of localized to extensive "... repeated overprinting or overlapping of successive tectonic events ..." (Baragar, 1981). However, as more dates become available, in particular those from methods capable of seeing through the Grenvillian resetting, the orogeny may take on more than local significance.

Unit 4 consists of anorthosite (unit 4a) and leuconorite (unit 4b), and occurs only in the southeastern corner of the map area. The age of the anorthositic rocks is unknown, as is their position in the chronological sequence. The major shear zone which affects the northern margin of unit 4 could be Labradorian or Grenvillian in age.

Unit 1: Supracrustal Gneisses

Unit 1a consists of upper amphibolite facies metasedimentary paragneiss, and units 1b and 1c consist of equivalent granulite facies paragneiss. The hand specimen mineralogy of these paragneisses is typical of both facies, and their distinction relies on the mineralogy of the spatially associated plutonic rocks and their neosomes, and the structural morphology of the paragneisses.

The paragneisses are predominantly a monotonous sequence of pelitic to semi-pelitic migmatites. They consist of quartz + feldspar + biotite ± magnetite ± garnet migmatitic neosomes and sillimanite + biotite + opaque oxides ± plagioclase ± garnet restites. The early neosomes form a concordant layering which is cut across by later generations of similar material. Either the restite or the neosome may form disrupted layers within the other. Patches and dikes, up to 5 m thick, of diatexite containing small patches of restite indicate coalescing melt and local mobility of the neosome phase.

Homogeneous, nonmigmatitic, paleosome layers and thin, psammitic layers are uncommon relicts of the primary layering.

The quartzofeldspathic minerals commonly display a mineral fabric or static recrystallization textures. The restites always contain a mineral fabric, though this may be dynamic or mimetic.

Despite the monotonous compositional character of unit 1, it can commonly be subdivided on a structural basis. Unit 1a is composed mostly of tight, straight belttype structures. Unit 1b is characterized by more areas of irregular fabric, thicker, wavy layering and open folding and, in contrast to unit 1a, fewer zones of regular, attenuated, straight fabrics and tight folds. Structures in unit 1c are like those of 1a but the melt layering in the straight zones commonly exhibits porphyroclastic textures whereas that in units 1a and 1b is commonly annealed.

The basic gneisses (unit 1d) intercalated with the paragneiss are homogeneous to layered, plagioclase - two-pyroxene rocks with minor biotite and a quartz segregation banding. The basic gneisses appear to retain a granulite facies mineralogy in the lowlands around Atikonak Lake where other lithologies suggest amphibolite facies conditions. The granulite facies assemblages may be metastable and inherited from earlier, possibly more widespread, granulite facies metamorphism. The basic gneisses are intimately associated with tonalitic to granodioritic, concordant and discordant sheets and net veins which do not occur in the paragneiss sequence. Garnet ± biotite are common in these granitoid sheets and at metabasite/paragneiss contacts; an alternative ferromagnesian mineralogy in these sheets at granulite facies is orthopyroxene ± biotite. Rare, quartzite layers also occur with the metabasites. They are clean, medium grained, recrystallized, thin to medium bedded rocks with up to 10 percent diopside or garnet + magnetite ± biotite. The thinner bedded quartzites usually contain the diopside or have a calcareous matrix. A large boulder of interlayered quartzite, granulite facies metabasite and pink marble was found and is believed to have been locally derived. The rocks of unit 1d are believed to represent a basic volcanic - quartzite or chert - carbonate association, and the metasedimentary paragneiss to have a graywacke protolith.

Unit 2: Basic Plutonic Suite

Members of this suite range from noritic through gabbronoritic to gabbroic, and are dominated by leucocratic lithologies. They vary from massive, medium to very coarse grained, seriate intergranular rocks preserving primary or pseudomorphed igneous textures, to isotropic to foliated (rarely gneissic) fine to medium grained granoblastic metamorphic rocks with coarser grained sweats. In the first type, primary pyroxene phenocrysts and groundmass plates are abundant whereas plagioclase is usually recrystallized, but may contain rare relict cores. Olivine and biotite may be present and Fe-Ti oxides are abundant. Compositional variations are common but layering is rare. With increased recrystallization and deformation, these rocks grade into the metamorphic members of the suite in which they are locally preserved as strain augen. Olivine is absent in the recrystallized rocks, but biotite is more abundant and the clinopyroxene may be diopside rather than augite. These rocks are generally massive with weak pyroxene and plagioclase mineral fabrics, and they may contain coarser grained noritic or granitic material in irregular patches and net veins or as an incipient layering. A strong fabric is present in the granitic veins. Rare, folded layering in the basic plutonic rocks may represent an earlier metamorphic fabric or relict primary layering.

In the areas metamorphosed to amphibolite facies, there is partial replacement of the pyroxenes by hornblende and biotite. Corona textures were not noted in any of the basic plutonic suite lithologies (*cf.* unit 3, Nunn and Christopher, 1983).

Unit 3: Orthogneiss and Foliated Granitoid Rocks

Unit 3a consists of moderately to strongly foliated, weakly migmatitic, megacrystic granodiorite, adamellite and quartz monzonite with minor nonmegacrystic lithotypes. The megacrysts are up to 5 cm across and the groundmass is composed of recrystallized quartz, feldspar, biotite and magnetite. The megacrysts are usually partially rounded and variably replaced by polygonal microcline. A strongly deformed variety of this rock contains rounded and oval, medium to coarse grained (less than 1.5 cm across) K-feldspar relicts in a fine grained groundmass. The megacrystic rocks are weakly migmatitic and contain an incipient layering or patchy development of granitic melt which is in contrast to the less abundant nonmegacrystic rocks that are generally well layered.

Unit 3b consists of orthopyroxene-bearing varieties, chiefly farsundite (quartz monzonite to adamellite) and opdalite (granodiorite), and is closely associated with the eastern occurrences of the gabbronorite suite. These rocks of charnockitic affinity are weakly foliated and megacrystic, weathering to a rusty buff color. About half of the feldspar fraction consists of centimetric K-feldspar megacrysts in a matrix of medium grained, recrystallized plagioclase and quartz. Orthopyroxene, opaque oxides, and fine felted biotite possibly replacing orthopyroxene, comprise up to 10 percent of the rock.

Unit 4: Anorthosite Suite

This unit consists of massive anorthosite and noritic anorthosite (4a) with a northern (?marginal) anorthositic norite phase (4b). The plagioclase in both units is a dark gray or reddish color and varies from coarse to very coarse grained. The color index ranges from 5 to 20 in unit 4a and from 20 to 35 in unit 4b. The matrix is composed of orthopyroxene and Fe-Ti oxides ± olivine, and pyrite is a common accessory. The pyroxene and olivine are commonly partly or completely replaced by corona minerals. The overall texture appears intergranular to subophitic, but layering and igneous lamination observed in rocks to the south of the map area suggest that the body is of cumulate origin.

Parts of this unit have been strongly deformed and the plagioclase has recrystallized to form polygonal white aggregates with or without relicts of the gray and red feldspar. In the eastern part of the unit 4 outcrop area, the mafic minerals are recrystallized to fine grained, equigranular orthopyroxene, whereas farther west they are replaced by polygonal hornblende aggregates. Locally, the rocks become fine grained, flaggy white gneisses. Corona textures generally have been destroyed wherever deformation and recrystallization are well developed.

Unit 5: Diabase dikes

Diabase dikes are widespread and are most common in the western uplands. They are very variable in orientation and seem post-tectonic, although one dike was observed to contain a fabric. The dikes are fine grained and generally less than 50 cm wide; two coarser grained dikes, approximately 40 m and more than 100 m wide, are shown in map sheet 23A/9. The former is traceable for more than 6 km.

Mineralization

The intercalated metabasic volcanic rocks and paragneisses contain numerous rusty weathering zones whereas the paragneisses away from this association are not known to contain such zones. Malachite showings are present in all the major rock types in the northwestern part of the map area (23A/15) and may be associated with north trending ductile structures or lineaments, or the basic rocks (units 1d and 2). The granitoid, gabbroid and paragneiss units are all rich in magnetite and poor in sulfides. No gemstone quality laboradorite occurrences were found in the anorthositic suite, but these rocks contain abundant magnetite and disseminated pyrite, and similar anorthosites in nearby Quebec are a major source of titanium.

Lake sediment geochemistry is now available for the area (Geological Survey of Canada, 1982).

Structure and Metamorphism

The structural and metamorphic history of the area has been summarized in Table 1, and a structural and metamorphic facies map has been reproduced in Figure 3.

The oldest structures in the area are the migmatitic layering in the metasedimentary units (1a,b,c), and a quartz segregation fabric in the metabasic unit (1d) of the paragneisses. The former structure occurs in very rare inclusions of paragneiss within unit 3 and elsewhere is cut across by dikes of unit 2. Folding of the layering in the inclusions is not necessarily a record of polydeformation prior to inclusion (*cf.* Nunn and Christopher, 1983). However, the inclusions are evidence of a gneiss-forming event prior to the emplacement of the plutonic suites (units 2 and 3) in the Paleohelikian, and this event is assumed to be Hudsonian or early Paleohelikian (HPD) in age.

The deformation sequence is divided by the emplacement of units 2 and 3 in this map area. Regionally, either intrusion of unit 3 or the younger Labradorian events might be diachronous, or a part of unit 3 might be syntectonic, since there is such close agreement between the ages of emplacement of the North Pole Brook Intru-

Table 1: *Summary of structural and metamorphic events.* *

UNIT	EVENTS	FOLDING, FAULTING	FABRICS	MIGMATIZATION	METAMORPHIC GRADE
1	*Deposition* *Basic dykes* HPD_1	–	HPS_1, *Location fabric*** *in (1)*	HPM_1, *major*	*uA+*
	HPD_2	HPF_2, *rare isoclines in (1a)*	–		?
2	*Intrusion*				
3	*Intrusion*				
	LD_1	–	LS_1, *rare location fabric in (3)*	LM_1, *possible range in (1)*	*uA(1a, 1c), G(1b)*
	LD_2 *- early*	LF_2, *tight to isoclinal in (1, 3)*	LS_2, *major, mineral and shape fabrics in (1, 2, 3)*	LM_2, *minor + late to post-tectonic sweats*	*uA(1a,), G(1b, 1c)*
	- late	*Thrusting, possible range or regeneration*	*Mylonite, shear zones and straight belts*		*uA*
	LD_3 ***	LF_3, *moderate to tight in (1)*	–	–	*A*
	Basic dykes			*2-mica and muscovite-bearing granite dykes*	*mA?*
	LD_4	LF_4, *open to tight, regional map scale*	–	–	*mA?*
				2-mica and muscovite-bearing granite dykes	*mA?*
4	*Intrusion*				
	GD_1, *or* LD_2 *- late to pre-*LD_4	*Major ductile shear zone*	*transposition in (1b), mineral fabric in (2, 3), mineral and shape fabrics in (4)*	–	*mA?*
	GD_2, *or* LD_4, *or later*	*Atikonak lineament*	–	–	?
	D	*Faulting*			*Gs*

* *Adapted from Nunn and Christopher, 1983. Numbers in parentheses refer to legend and text. A, amphibolite facies; u, upper; m, middle; G, granulite facies; Gs, greenschist facies; + denotes "or higher".*
** *Arrangement of fabric elements in layers (three dimensional).*
*** *This event is not equivalent to that labelled* GD_3 *in the table of Nunn and Christopher (1983); an equivalent of this event should be inserted between* GD_3 *and* GD_4 *of their table.*

sive Suite and ages of the peak metamorphism of the Labradorian events.

Structures that postdate the granitoid and gabbroid plutonic suites are assigned to the Labradorian deformation (LD). Early Labradorian deformation (LD_1) is represented by a major discordant migmatization in unit 1 and by a migmatitic layering in parts of unit 3. Its effect on units 2 and 4 is unknown. In order to account for the subsequently more rigid behavior of the paragneisses of subfacies 1b, we suggest that this domain was metamorphosed to granulite facies at LD_1 time, and thence behaved as a relatively dehydrated block, whereas the other paragneiss areas reached only upper amphibolite grade (*cf*. units 1b to 1a and 1c). However, we cannot exclude possibilities of older (HPD) or younger Labradorian ages of granulite facies metamorphism.

LD_2 was the peak metamorphic event of the Labradorian orogeny. Earlier migmatite or primary fabrics were tightly to isoclinally folded, major recrystallization occurred, and axial planar fabrics were developed in units 1, 2 and 3. Further migmatization was restricted to the formation of isolated axial-plane-parallel pegmatites and diatexites. Metamorphism reached upper amphibolite facies in the lowland regions and granulite facies in the areas underlain by subfacies 1b and 1c, the two upland portions of the map area. Late LD_2 events include the thrusting of the western upland granulite terrane into its present position overlying amphibolite facies paragneiss, and a posttectonic, static recrystallization which destroyed many of the LS_2 mineral fabrics. The eastern upland granulite block may also have been thrust into place at that time.

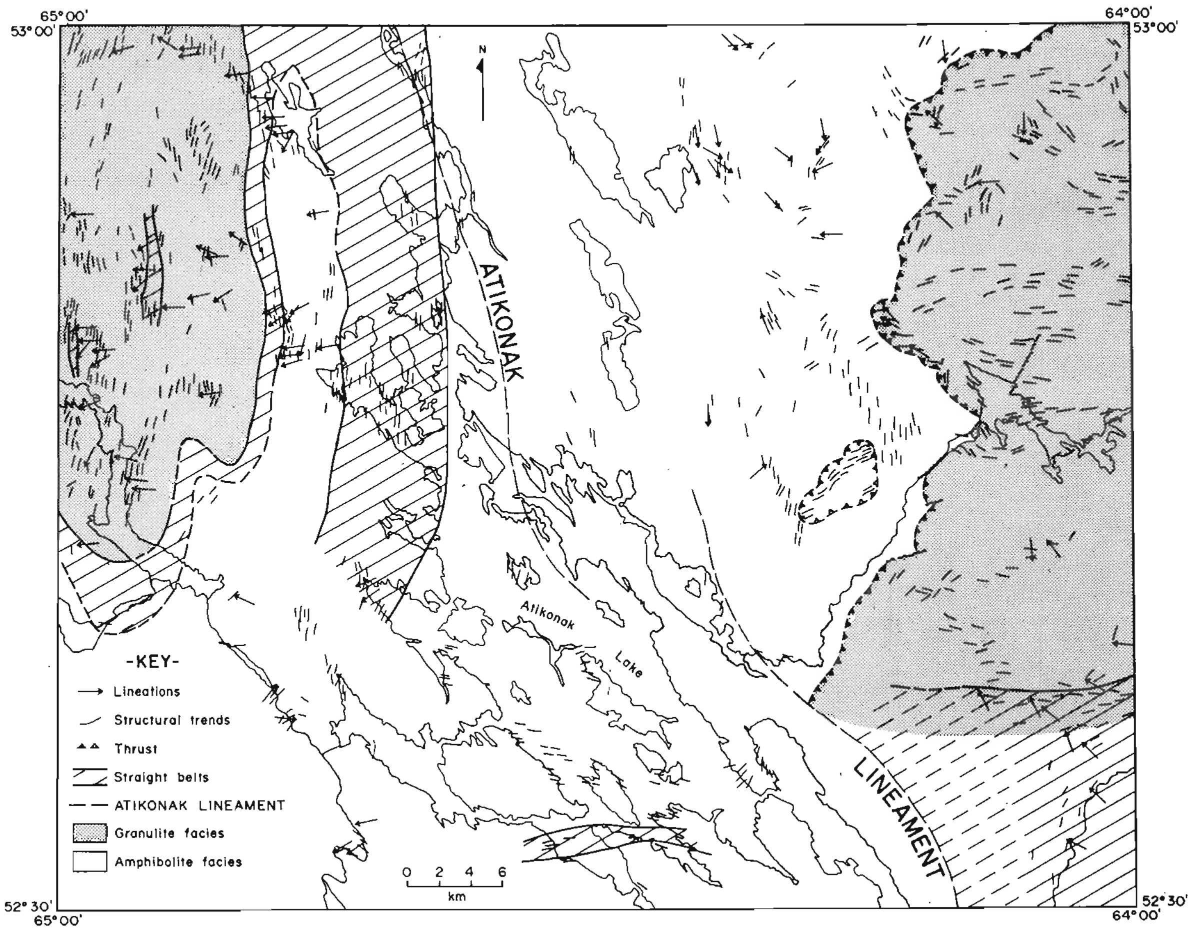

Figure 3: *Structural and metamorphic facies map.*

The mineral and migmatite fabrics were moderately to tightly folded during LD_3 and openly to tightly folded during LD_4. No new mineral fabrics were developed with these deformations.

LD_1, 2 and 3 structures have an overall easterly but variable strike in the eastern upland region of the map area, and the lineations are variable except along the southern margin of the granulite facies area where a high strain zone (late LD_2?) tightens all the earlier structures and the lineation becomes consistently steeply plunging to the north-northwest. In the other regions of the map area, these structures are oriented with a northerly strike controlled by the limbs of LD_4 folds. In the western uplands where the LD_4 deformation is tight, and apparently colinear with LD_2, the northerly strike is very consistent and the lineations are strong and moderately plunging to the west. Throughout the lowland regions, the structures are less regular and LD_4 hinge zones are common perturbations on the regional strike pattern. The lineation is still fairly consistently toward the west. Most of the lineations are more or less down-dip regardless of the strike of the LS_2 fabric.

The high strain zones and metamorphic facies boundaries are principally late LD_2 events. The one surrounding the eastern upland has not been seen except in the south where it appears to be truncated by the Atikonak lineament. There is, however, a strong discordance of fabric at the base of the small inferred klippe in the southern part of map sheet 23A/16. The western boundary is a transition zone marked by a number of straight belts. Fabrics within these straight belts may be glassy and submylonitic and are conformable with the "normal" LD_2 structures outside the shear zones, a feature that is also common north of the map area (Nunn and Christopher, 1983). The substitution of biotite-rich restites for the more common sillimanite - Fe-Ti oxide - biotite restite is best developed in these straight belts and is clearly related to deformation.

These high strain zone fabrics are also moderately to tightly folded by LD_4 folds in the western areas.

The LF_4 axial traces in the map area and related fold axes to the north and northeast (Figure 4) form a divergent fan in the less competent upper amphibolite facies gneisses around the northwestern corner of the eastern granulite terrane which appears to be acting as a rigid block. This fanning of the fold axes indicates that the eastern upland thrust block was in place at that time and that thrust-emplacement occurred at a time similar to that of the western granulite terrane (i.e. late LD_2).* The last generation of granitic intrusion consists of dikes of muscovite granite, commonly tourmaline-bearing, which were emplaced both before and after the LD_4 folding. The LD_4 folding is responsible for the regional map pattern.

Though the sequence of events from LD_2 to LD_4 apparently represents the waning stages of an orogenic cycle, there are no age constraints on post-LD_2 structures, and subsequent events might be Grenvillian.

In the southeastern part of the map area, a major shear zone occurs principally in the anorthositic rocks (unit 4). The zone strikes approximately 090°, dips steeply to the north and has a down-dip lineation. The sense of movement on the shear zone is not known.

The Atikonak lineament (Figure 3) is based primarily on aeromagnetic interpret-

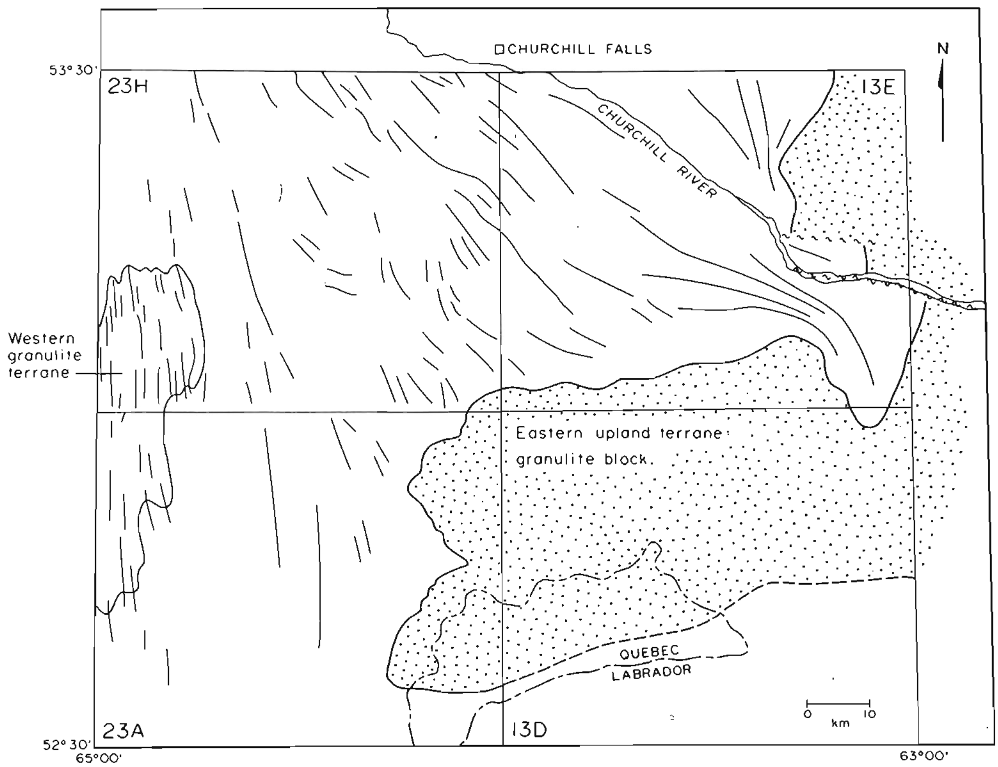

Figure 4: *Schematic representation of late fold traces, mostly LF_4 and equivalents, to show fanning of LD_4 structures around the eastern granulite facies block. Data from the present study (23A), and adapted from Nunn and Christopher, 1983 (23H), Thomas and Wood, 1983 (13E) and Thomas et al., 1984 (this volume) (13D).*

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* *In the Wabush area of western Labrador, 140 km to the west-northwest, northwesterly trending structures similar to, and possibly synchronous with, the LD_4 folds occurred late in a Grenvillian deformation sequence that was initially characterized by northwesterly directed thrusting (T. Rivers, 1983). The LD_4 folds, therefore, might be Grenvillian structures and the thrust-emplacement of the eastern upland terrane might be late Labradorian or early Grenvillian.*

ation. The feature truncates other trends on the aeromagnetic map (Geological Survey of Canada, 1978), appears to deflect the shear zone fabric in unit 4, and may have a sinistral displacement. The lineament may have reactivated older strain zones in the northern part of the map area. The post-unit 4 structures may be Labradorian or Grenvillian in age.

Summary

Field mapping undertaken during 1983, combined with recent geochronological results (Krogh, written communications, 1983) on the whole project area, suggests, in agreement with previous work, that:

(i) the paragneisses were derived from a slope or basinal sequence, probably largely of graywacke-shale composition, with minor intercalations of basic volcanic rocks and either quartzite or chert horizons. In previous work (e.g. Nunn and Christopher, 1983; Rivers and Nunn, 1983), this sequence has been tentatively proposed as an equivalent to the deeper water parts of the Labrador Trough succession, located 100 km northwest of the area. However, reconnaissance mapping conducted in 1983 indicates that these paragneisses and the metasediments of the Labrador Trough are probably separated by major thrusts, and it may be premature or invalid to correlate the two;

(ii) the paragneisses record a polyorogenic history with a preplutonic and a postplutonic component. The early component was probably pre-1670 Ma but is otherwise constrained only by the probable Aphebian age of the sedimentary protolith. Units 2 and 3 comprise the plutonic interval;

(iii) a major granitoid plutonic event probably occurred within the time interval 1670-1650 Ma, possibly in association with the intrusion of the gabbroid suite. Pregranitoid gabbroid suites are spatially and complexly associated with the granitoid rocks throughout the Trans-Labrador batholith (Emslie et al., 1978; Wardle and Britton, 1981; Nunn and Noel, 1982; Gower and Owen, in preparation).

However, contrary to previous work, it is concluded that:

(i) the main dynamothermal events in the area were mid-Paleohelikian (circa 1650 Ma), not Grenvillian, and are here termed the Labradorian orogeny;

(ii) the basic plutonic suite predates the granitoid plutonic suite and the correlation by Nunn and Christopher (1983) with the Shabogamo Intrusive Suite of western Labrador (Rivers, 1980) is probably no longer valid;

(iii) structures of apparent Grenville age consist of shear and thrust zones which in places separate huge tracts of older gneisses;

(iv) the Grenvillian metamorphic grade probably does not exceed lower amphibolite facies throughout the northern 120 km of the Grenville Province.

The structural history of the Labradorian orogeny is complex and its effects were heterogeneous. Because of this structural heterogeneity, separation of younger (post-LD_2) Labradorian from Grenvillian structures is locally difficult, and considerable uncertainty still exists regarding the effects of the Grenvillian Orogeny versus those of earlier events. The uncertainty is presently most marked for the anorthosite suite, since the ages of both the anorthosite suite and the structures in it are not known.

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