NAIN - CHURCHILL PROVINCE CROSS-SECTION; RIVIERE BAUDANCOURT - NACHVAK LAKE

by

R.J. Wardle
Labrador Mapping Section

Abstract

This paper reports on the western transect of a project designed to provide a cross-section of the Nain-Churchill Province boundary. The eastern transect was completed in 1982.

The predominant rock type in the transect area is a tonalite-granodiorite gneiss, largely at amphibolite facies, but locally preserving relict granulite facies assemblages. The gneiss contains numerous mafic enclaves, including metagabbro and anorthosite, and may be broadly compared, although not directly correlated, with the Nachvak gneiss of the eastern transect. Also present within the granodiorite-tonalite gneiss are bands of supracrustal gneiss dominated by garnetiferous psammitic gneiss, but also including rusty sillimanite-bearing pelitic gneiss, quartzite, marble and ultramafic rocks. These bear close resemblance to the Archean Upernavik supracrustals of the Nain Province.

The eastern end of the transect is underlain by an extensive unit of mylonitic, garnet-rich tonalite gneiss (Tasiuyak gneiss) interpreted to have developed by massive melting and wholesale injection of leucogranite (sensu lato) *into Archean, Upernavik-type supracrustals.*

The extreme western end of the transect is underlain by psammitic-pelitic gneisses which appear structurally younger than adjacent units and which are confirmed as belonging to the lower Proterozoic Lake Harbour Group.

The western transect lies entirely within the inner Churchill Province and was strongly reworked and metamorphosed, probably at upper amphibolite facies conditions during the Hudsonian orogeny. Structures formed during this event are largely west verging, east dipping and steepen towards the eastern end of the transect.

The overall structural picture produced by combination of western and eastern transects is of a structural fan centered on the Tasiuyak gneiss. The fan may have developed either in response to upward ramping of a major east directed intracrustal thrust fault or in response to collision of two crustal blocks. The Tasiuyak gneiss appears to represent the deepest levels of Archean crust which have been exposed in the core of the fan.

A prominent subhorizontal quartz lineation is associated with mylonitic fabrics in the axial part of the fan and is probably related to syn- or post-thrust, strike-slip faulting and associated lateral shearing.

Introduction

Work this year completed the field component of a two year project on the boundary of the Nain and Churchill structural provinces, begun in 1982 in the Nachvak Fiord area (Figure 1).

The project has now provided a 100 km long cross-section across this poorly known structural boundary. The cross-section can be conveniently divided into: an eastern transect, which is the area completed in 1982 (Wardle, 1983) in the Nachvak Fiord area; and a western transect which is the area reported on here.

The results of the 1982 eastern transect may be summarized as follows.

The Nain-Churchill boundary was found to be a broad zone within which Archean crust of the Nain Province was progressively reworked during the Hudsonian Orogeny circa 1.8 Ga. The boundary area was divided, from east to west, into three structural zones: the Nain Province, Churchill Border (or Foreland) Zone and Churchill Inner Zone.

The Nain Province was found to consist of Archean crust for which the following history was recognized:

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[1] Department of Earth Sciences, Memorial University of Newfoundland, St. John's, Newfoundland A1B 3X5

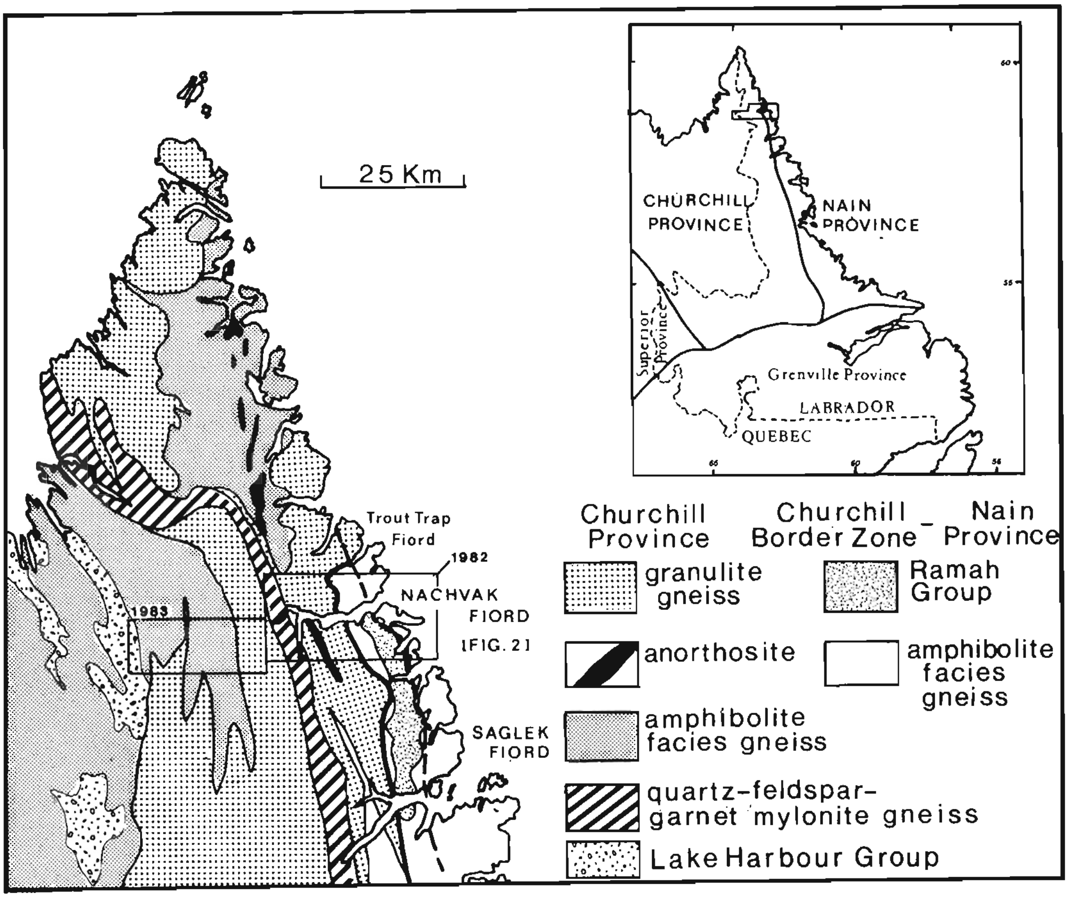


Figure 1: *Regional geological setting of project area in northern Labrador.*

1. formation of early mafic gneisses, locally associated with supracrustal gneisses;
2. widespread intrusion of granitoid plutons incorporating early mafic gneisses as inclusions;
3. regional deformation, migmatization and granulite grade metamorphism of those plutons circa 2.8 Ga resulting in formation of Nachvak gneiss;
4. intrusion of Kammarsuit granite circa 2.7 Ga;
5. zonal mylonitization and retrogression circa 2.6 to 2.5 Ga;
6. intrusion of regional post-tectonic mafic dike swarm circa 2.4 Ga.

The predominant rock type in the Nain Province is the Nachvak gneiss which was subjected to static amphibolite-greenschist facies retrogression during late Archean and Hudsonian metamorphic events.

The Churchill Border, or Foreland, Zone is underlain predominantly by the granitoid Nachvak gneiss but also contains lower Proterozoic sediments of the Ramah Group deformed in the Hudsonian Orogeny. Hudsonian deformation in the gneiss is restricted to zonal reworking in shear zones which change in character from brittle fracture zones in the east to ductile shear zones in the west. The border zone also contains a granulite facies - amphibolite/greenschist facies retrograde isograd, previously thought to be the Nain-Churchill boundary, which marks the western limit of combined Late Archean - Hudsonian retrograde alteration. Structural style is that of vertical tectonics and easterly directed overthrusting.

The Churchill Inner Zone contains a westerly extension of the Nachvak gneiss which encloses a linear belt of Archean anorthosite. Nachvak gneiss is bounded to the west by a major belt of quartz + feldspar + garnet mylonitic gneiss (Tasiuyak gneiss) of enigmatic origin. Hudsonian straightening and mylonitic fabrics are pervasive in the inner zone and the late 2.4 Ga dikes have been transposed into the regional fabric. Both western Nachvak and Tasiuyak gneiss were intensely mylonitized in what was thought to be a major transcurrent shear zone.

The geology of the eastern transect is summarized in the tectonostratigraphic chart (Figure 2) and cross-section (Figure 3).

The geology of the western transect was previously known only from the regional reconnaissance mapping of Taylor (1979). In general the transect area was proposed to be underlain by granitoid gneisses, differentiated into amphibolite and granulite facies map units (Figure 1), and migmatitic paragneisses. The paragneisses were divided into biotite-quartz-feldspar paragneisses

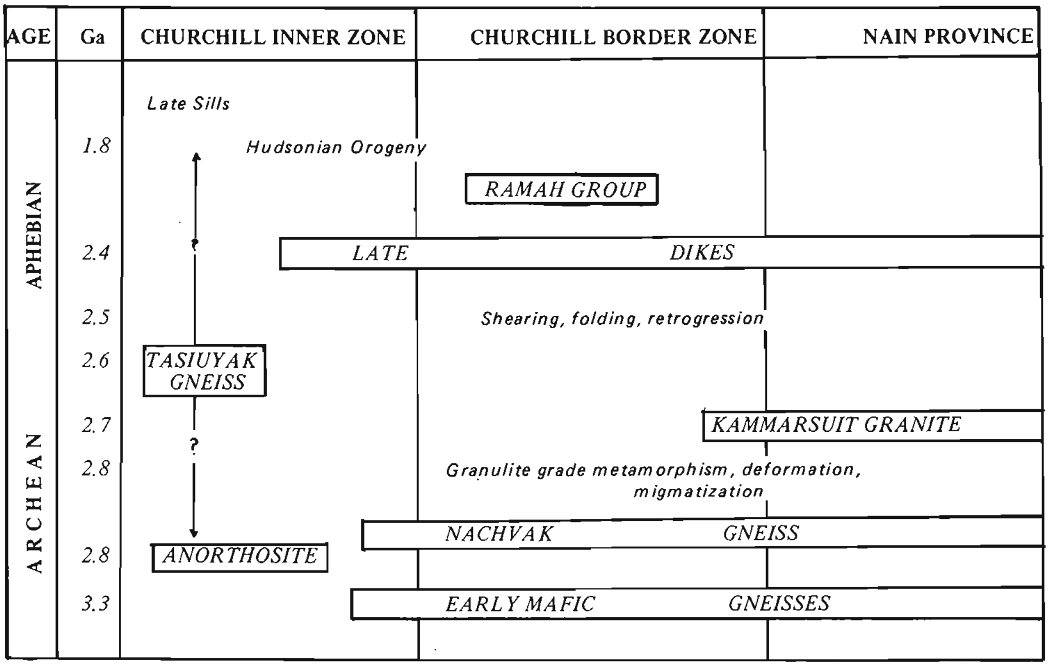


Figure 2: *Tectonostratigraphic summary of geology of eastern transect area (after Wardle, 1983).*

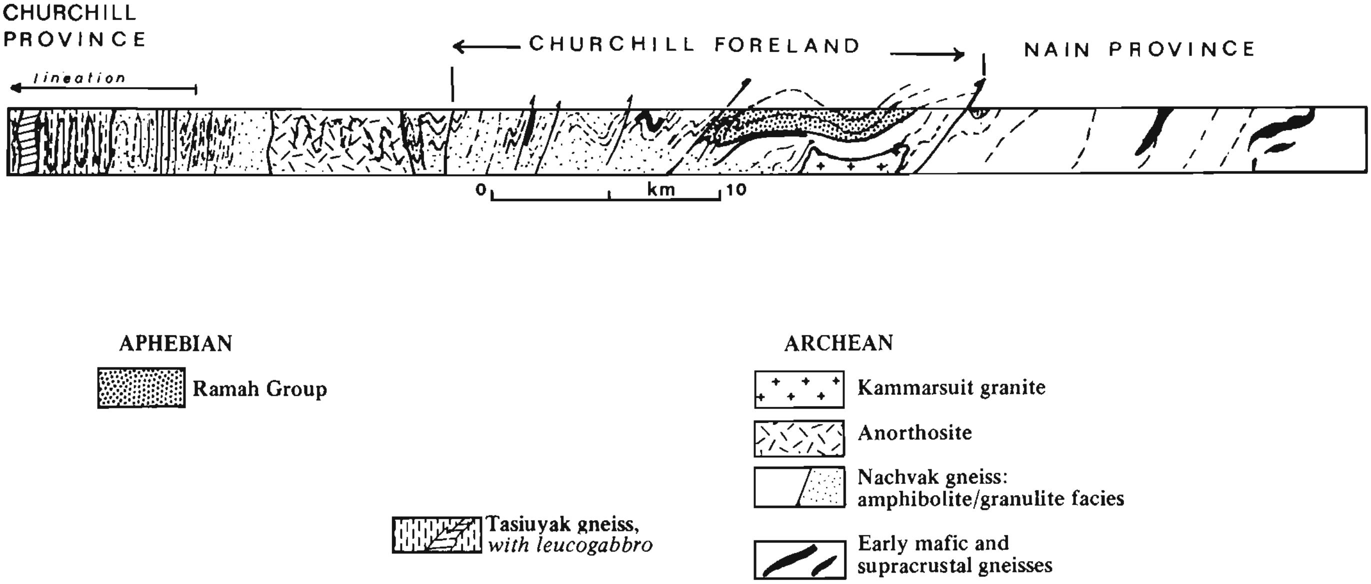


Figure 3: *Cross-section of eastern transect (after Wardle, 1983).*

(ALpg - Taylor, 1979) and rusty graphite-bearing paragneisses (ALrc), both of which were assigned to the lower Proterozoic Lake Harbour Group (Jackson and Taylor, 1972; Taylor, 1979). For reasons discussed below, only the rusty gneisses are now included within the Lake Harbour Group as shown in Figure 1.

The western and eastern transects are conveniently divided by the important and regionally extensive unit of quartz + feldspar + garnet mylonite gneiss (Afg - Taylor, 1979) which was recognized by Taylor *(op. cit.)* as a fundamental feature of the eastern Churchill Province (Figure 1) and which was later referred to as the Tasiuyak gneiss by Wardle (1983).

Field work in the western transect was accomplished largely by a series of ground traverses following the river system which flows from the Quebec-Labrador border, near the west flowing Rivière Baudancourt (Figure 4), east to Nachvak Lake. The area around Nachvak Lake, which lies in the heart of the Torngat Mountains (relief 0.5 to 2 km) and is not easily covered on foot, was completed by helicopter mapping. However, this work was hampered by bad weather with the result that ground coverage in the Nachvak Lake area is not as complete as elsewhere in the transect.

The geology of the western transect is shown in Figure 4 which has been modified from the regional maps of Taylor (1979).

Geology

The transect area is predominantly underlain by granitoid gneisses (Unit 1) which are interbanded with a variety of migmatitic supracrustal gneisses (Unit 2). In the east these were strongly migmatized and injected by leucotonalite-granite and were subsequently intensely mylonitized (Unit 3). A younger series of supracrustal gneisses, belonging to the Lake Harbour Group, is differentiated in the western part of the transect (Unit 4) and is the only unit for which a lower Proterozoic age is reasonably assured.

Granitoid Gneisses (Unit 1)

These are generally gray gneisses of overall tonalitic composition, although pink granitic varieties are locally present. They are strongly migmatitic and often well banded with a stromatic migmatite texture. The gneisses in the western half of the transect show the association biotite + hornblende ± garnet and also contain biotite clots, probably pseudomorphs after pyroxene. Orthopyroxene is increasingly more prevalent along the eastern part of the transect where the granitoid gneisses alternate between gray, predominantly hornblende-bearing rocks, and buff granulite facies gneisses. It was not possible to substantiate the manner in which Taylor (1979) divided the area into amphibolite and granulite facies map units. The western part of the area (generally that part west of the dashed line marking the limit of lineation development on Figure 4) is largely at amphibolite facies, whereas the eastern part of this area consists of a mixture of amphibolite and granulite facies assemblages.

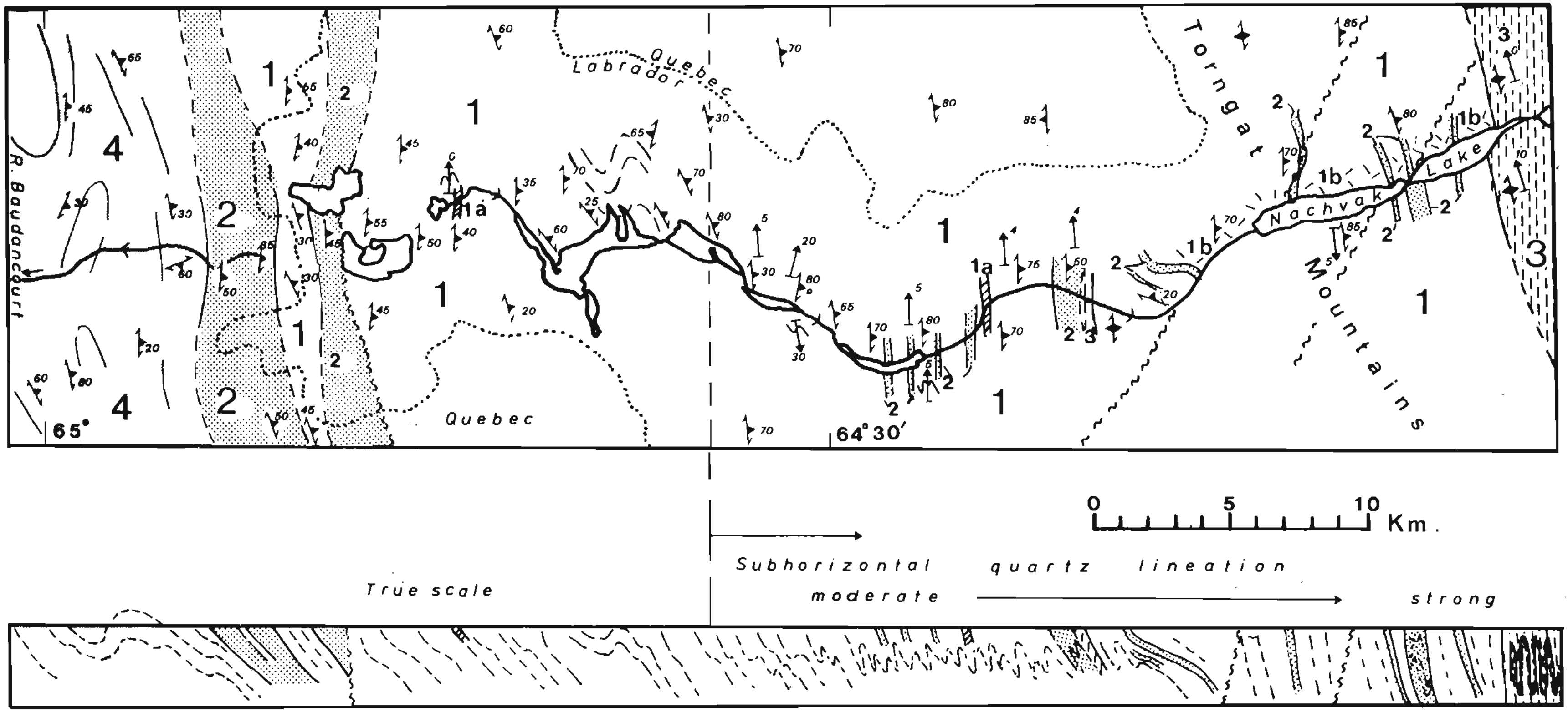
The granitoid gneisses are also characterized by numerous zones of elongate amphibolite and amphibolite gneiss inclusions which may occur either in thin trains or as extensive zones tens of metres wide. The inclusions appear to have been derived by intense migmatization, injection and tectonic disruption of amphibolite layers within the granitoid gneisses. Their protolith is generally unrecognizable; however, some of the zones contain leucogabbroic-anorthositic compositions (1a) which were probably derived from layered mafic bodies either intruded into the granitoid gneiss protolith, or incorporated as inclusions within it.

In the area around Nachvak Lake the migmatitic granitoid gneisses give way to massive, buff weathering granodiorite to tonalite gneisses (1b) which, whilst strongly foliated and lineated, lack the complex textures and structures typical of the gneisses to the west. These gneisses contain abundant fresh orthopyroxene and are clearly at granulite facies. They also contain abundant inclusions of amphibolite - mafic granulite and lesser ones of leucogabbro - anorthosite gneiss. The nature of the contact between these massive granulite gneisses and the remainder of the Unit 1 granitoid gneisses has not been observed, largely due to the extremely rugged nature of the Nachvak Lake area. Pending examination of this contact it appears likely that the massive gneisses are structurally younger than the bulk of the tonalite gneisses and may represent pre- to synkinematic intrusive sheets.

Supracrustal Gneisses (Unit 2)

These were recognized by Taylor (1979; his unit ALpg) although their confirmed extent is considerably less than indicated by his reconnaissance mapping.

They occur as numerous bands, varying in width from less than a metre to 3 km, and are interspersed within the granitoid gneisses. The most extensive bands occur in the west where they consist largely of



APHEBIAN

4 — **Lake Harbour Group.** *Pelitic to psammitic gneisses.*

ARCHEAN (?)

3 — *Mylonitic interbanded garnet leucogranite and garnet metasedimentary gneisses.* Tasiuak gneiss

2 — **Supracrustal gneisses** *including: garnet psammite and rusty sillimanite gneiss, with minor quartzite marble and ultramafic rocks.*

1 — **Granitoid gneisses.** *Largely migmatitic tonalite to granodiorite gneisses with abundant amphibolite inclusions. Largely retrogressed granulite grade rocks.*

1a - *metagabbroic to anorthositic gneisses.*

1b - *massive foliated to lineated buff, granulite grade tonalite.*

Figure 4: *Geology of the western transect between Rivière Baudancourt and Nachvak Lake. Geology in part modified from Taylor, 1979.*

garnet-rich quartz + feldspar + biotite psammitic gneiss, with thin interbands of rusty sillimanite + biotite pelitic gneiss and rare bands and pods of ultramafic rocks. Garnet in these rocks typically has a mauve color. These gneisses are generally strongly migmatitic with a white, quartz-rich, leucotonalite-granodiorite-granite leucosome component, in many cases of pegmatitic character.

In the central part of the transect the supracrustal gneisses form much narrower bands, the width of which is locally exaggerated in Figure 4. These bands again consist largely of garnetiferous psammitic gneiss but are also associated with impure, garnetiferous gray quartzite, rusty sillimanite + biotite + graphite gneiss, pods of gray marble and calc-silicate, and ultramafics and amphibolite - mafic granulite. These gneisses are also strongly migmatitic with a white leucotonalite-leucogranite leucosome; in the eastern part of the transect they are overprinted by mylonitic fabrics and resemble the Tasiuyak gneiss (Unit 3) described below.

Supracrustal gneisses are well exposed as prominent rusty bands on the fiord walls around Nachvak Lake, but are generally difficult to reach. Where examined they consist of mylonitic, garnetiferous gneisses which in most respects are transitional between the clearly recognizable supracrustal gneisses to the west and the Tasiuyak gneiss.

Contact relationships of supracrustal gneiss and granitoid gneiss are generally obscured by intense migmatization and pegmatite sheeting which seems concentrated in contact regions. Premetamorphic relationships of the supracrustal and granitoid gneisses are, therefore, unknown.

Tasiuyak Gneiss (Unit 3) - *mylonitic, interbanded garnet leucotonalite-leucogranite and garnet metasedimentary gneiss*

This unit, which divides the eastern and western transects, was examined mainly during the 1982 field season and found to consist of a monotonous, homogeneous, leucocratic quartz + plagioclase + garnet gneiss. On washed surfaces the gneiss is highly distinctive, being finely banded with mauve garnet-rich bands alternating on a 2 to 10 cm scale with white, quartz + plagioclase leucocratic bands containing 1 to 3 cm garnet porphyroblasts. The garnet-rich bands also contain biotite, sillimanite and locally graphite. On weathered surfaces the gneiss is a rusty brown color and fine structures are obscured. Staining of polished slabs shows the gneiss to comprise a fine centimetric scale alternation of leucogranitic and leucotonalitic compositions. The garnet-rich bands are generally of granitic composition.

The central part of the unit also contains a pretectonic leucogabbroic body (Wardle, 1983).

The eastern part of the unit is dominated by an intense mylonitic fabric. However, in the central and western parts of the unit this fabric is less intense and is locally seen to be discordant to an isoclinally folded compositional banding.

The most relevant observations from this season's work come not from the main body of the Tasiuyak gneiss but from the previously described belts of supracrustal gneiss (Unit 2). As described above, these consist predominantly of migmatitic garnet-bearing psammitic gneiss. The leucosome veins vary from centimetres to metres in width, from microgranite to pegmatite in texture, and are generally subparallel to foliation. In composition they range from leucogranite to leucotonalite and contain 10 to 30% mauve garnet porphyroblasts. Where these rocks have been strongly straightened and mylonitized, as for example in the band located 7.5 km west of Nachvak Lake, the result is a banded, mylonitic gneiss composed of alternating mauve garnet + biotite + sillimanite bands and garnet leucotonalite-leucogranite bands, which is in most respects identical to the main body of Tasiuyak gneiss.

It is proposed, therefore, that the Tasiuyak gneiss is a two-component gneiss in which the dark purple fraction represents relict (restite) supracrustal material, and the pale gray to white fraction the migmatitic leucotonalitic-leucogranite material. Leucogranite *(sensu lato)* forms a much larger component of the Tasiuyak gneiss (60 to 70 percent) than in the Unit 2 supracrustal gneisses and this is taken to indicate that the metasedimentary protolith of Unit 3 was subject to either massive melting or wholesale injection of leucogranite *(sensu lato)*, probably during granulite facies metamorphism.

The present homogeneous, finely banded character of the gneiss was imposed during mylonitization and tends to obscure the earlier and more significant compositional variation within the unit.

Pelitic-psammitic gneiss - Lake Harbour Group (Unit 4)

The western end of the transect is underlain by a sequence of metasedimentary gneisses initially recognized by Taylor (1979; his unit ALrc) and assigned to the Lake Harbour Group.

During the past season's work these gneisses were examined only within the valley of the tributary flowing west into Riviere Baudancourt. They consist of well banded (3 to 20 cm), rusty weathering pelitic to psammitic gneisses. The pelitic gneisses are biotite-rich and also bear sillimanite. The psammitic ones are usually gray quartz + feldspar + garnet gneisses varying to gray, impure quartzite. Locally the gneisses display a rhythmic alternation of pelitic and psammitic bands suggestive of derivation from a bedded, shale-sandstone sequence.

The pelitic-psammitic gneisses are in general much less migmatitic than the adjacent supracrustal gneisses of Unit 2 and have a very different field appearance. In particular their red garnet contrasts with the mauve garnet of Unit 2. The pelitic-psammitic gneisses are also generally much rustier and have more clearly defined air-photo structural trends than adjacent units.

The contact of the pelitic-psammitic gneisses and the supracrustal gneisses of Unit 2 is unexposed in the transect section. However, the pelitic-psammitic gneisses become more quartz-rich towards the contact and contain bands of coarse feldspathic quartzite, possibly derived from granule conglomerate. It is strongly suspected, therefore, that the contact is a tectonized unconformity.

Structure and Metamorphism

The overall structural style of the western transect is illustrated in cross-section in Figure 4.

Structural style in the western half of this section is dominated by gentle east dipping gneissic fabrics refolded into west verging F_2 folds. These folds are seen as both minor outcrop scale structures and major map scale features.

In the central part of the cross-section the overall attitude of gneissic foliation steepens, and F_2 folds become more prevalent and assume a tight to isoclinal style. F_2 folding is also associated with the development of S_2 transposition fabrics, east dipping ductile shear zones, and a shallow, north plunging quartz lineation. The lineation is apparently colinear with F_2 fold hinges, although coincidence of the two structures can be reliably demonstrated in relatively few outcrops.

The eastern part of the cross-section is dominated by a vertical to steep, east dipping gneissosity which is largely a composite fabric produced by transposition of early gneissic and migmatitic banding with the S_2 fabric. There is no discernible megascopic folding; however, the supracrustal gneisses contain abundant, minor, isoclinal folds. Steep, east dipping, ductile shear zones are present throughout this part of the transect but are concentrated within the supracrustal units, and in particular the Tasiuyak gneiss which marks the most pronounced development of mylonitization in the area. Development of a strong subhorizontal quartz lineation is associated with ductile shear and mylonite zones.

The granitoid gneisses, particularly the massive granulite facies tonalite gneisses (subunit 1b), are relatively free of ductile shear fabrics; however, they do possess the same strong, subhorizontal quartz lineations as the other units.

Metamorphic assemblages in the western part of the transect area are predominantly of the upper amphibolite facies, as indicated by sillimanite-bearing assemblages in the supracrustal rocks of Units 2 and 4. However, the presence of probable biotite pseudomorphs of pyroxene within the granitoid gneisses of Unit 1 indicates the early attainment of granulite facies conditions in that unit.

The amphibolite facies alteration varies from static replacement of granulite assemblages to dynamic recrystallization within shear zones and is correlated with the period of F_2 folding and ductile shearing.

Granulite facies assemblages become increasingly prevalent in the eastern half of the transect area and are characterized by the general paragenesis: quartz + feldspar + biotite + orthopyroxene + hornblende ± clinopyroxene. Pyroxene, in particular orthopyroxene, is clearly unstable with respect to hornblende and is an early metamorphic phase.

Orthopyroxene has been observed at only one locality within the metasedimentary gneisses of Unit 2. However, mafic bands within the metasedimentary gneisses record the assemblage: plagioclase + orthopyroxene + clinopyroxene (minor) + biotite indicating ambient granulite grade conditions. Development of orthopyroxene within the metasedimentary gneisses may have been suppressed by relatively high internal $P\ H_2O$, high $f\ O_2$, or unsuitable composition.

Relatively pristine granulite facies assemblages are prevalent in the Nachvak Lake area, at the eastern end of the transect. The granulite facies mineralogy in this area has been cataclastically deformed within shear zones but has suffered relatively little hydrous alteration, a feature which was also noted in adjacent parts of the eastern transect (Wardle, 1983).

Age and Correlation of Units

In the preceding description little mention has been made of the age of the various lithological units. Taylor (1979) inferred all rocks in the transect region to be of Aphebian age; in particular, the supracrustal rocks were all assigned to the Lower Proterozoic Lake Harbour Group. There is, however, little isotopic age support for this inference; available data is restricted to scattered K-Ar mineral ages which fall mostly in the 1.6 to 1.7 Ga range (Taylor, 1979) and are presumably related to uplift and cooling.

The granitoid gneisses show clear evidence of a complex and prolonged crustal evolution. The most important events in this history appear to have been an early widespread granulite facies metamorphism, of unknown age, and an amphibolite facies reworking associated with F_2 folding and ductile shearing. This latter event is presumed to have been the Hudsonian Orogeny. The granitoid gneisses are broadly comparable with the Nachvak gneiss of the eastern transect, in terms of both overall composition and their abundance of mafic to anorthositic inclusions (Wardle, 1983). The Nachvak gneiss underwent a granulite event circa 2.8 Ga, which is the typical timing of granulite metamorphism in the North Atlantic craton (Bridgwater et al., 1978), and was zonally retrogressed and reworked in the Hudsonian. It is accordingly strongly suspected, although not proven, that the granitoid gneisses of the western transect are broadly time-equivalent to the Nachvak gneiss, and underwent a similar Archean granulite event which produced pervasive migmatization. Some support is given to this interpretation by a K-Ar hornblende age of 2050 Ma on granulite gneiss 15 km south of Nachvak Lake (Taylor, 1979). This age is too old for the Hudsonian and may reflect partial resetting of an Archean age. Additional support is also given by Rb-Sr determinations from granulites of the northeastern Churchill Province of Labrador in general (Taylor, 1978), which have yielded mixed isochrons with both Archean (2.64 Ga) and Hudsonian (1.86 Ga) components. Anantha Iyer (1980) demonstrated close chemical and petrographic similarities between granulite grade rocks of the interior Churchill Province and those of the Nain Province, south of the transect area.

A major uncertainty remains concerning the age of the massive granulites (1b) around Nachvak Lake. These obviously have a very fresh stable granulite mineralogy, and there is some uncertainty as to whether this is a relict Archean assemblage which has been reworked under anhydrous conditions in the Hudsonian, or it is a prograde Hudsonian assemblage. The former interpretation was favored by Wardle (1983) for granulite gneisses immediately east of the Tasiuyak gneiss; however, the issue remains open pending isotopic dating.

The supracrustal rocks of the western transect are divided here into two units, the pelitic-psammitic gneisses (Unit 4) and the garnetiferous psammitic gneisses (Unit 2).

The garnet psammitic gneisses of Unit 2 bear very close similarities to the Archean Upernavik Supracrustals (3.3 to 2.8 Ga) of the Nain Province. These have been extensively described by Bridgwater et al. (1975) and Ryan et al. (1983; 1984) from the Saglek Fiord area (Figure 1), and consist predominantly of mauve-garnet-rich psammitic gneisses, rusty sillimanite-bearing pelitic gneisses, impure quartzite and minor marble and calc-silicates, together with variable amounts of ultramafic, and amphibolite - mafic granulite. The latter units are thought to have been derived from mixed high level mafic intrusions and mafic volcanic sequences.

The Upernavik supracrustals are also intimately interbanded with surrounding granitoid gneisses on a scale varying from metres to kilometres. The only major difference between the supracrustals of the Saglek area and the western transect is that in the Saglek area the supracrustals commonly contain much larger proportions of mafic material.

At present it is impossible to assign unequivocally an Archean age to the supracrustal rocks of Unit 2; however, on the basis of lithologic and structural similarity they bear more resemblance to the Upernavik supracrustals than to any of the known lower Proterozoic sequences in the interior Churchill Province.

The supracrustal protolith for the Tasiuyak gneiss (Unit 3) is also proposed to have been an Upernavik-type, Archean supracrustal sequence which was subject to massive melting and leucogranite *(sensu lato)* leucosome formation in what was probably the 2.8 Ga granulite event, although in the absence of isotopic age data a Hudsonian age cannot be ruled out.

The pelitic-psammitic gneisses of Unit 4 (Lake Harbour Group) appear to be structurally younger than the adjacent Archean (?) gneisses, and an early Proterozoic age is highly probable. The Lake Harbour Group is a major component of the interior Churchill Province and consists of a thick, clearly differentiated sequence of marble, rusty pelitic gneiss, quartzite and amphibolite which is reasonably established as being of Lower Proterozoic age (Jackson and Taylor, 1972). The group may be broadly equivalent to the Ramah Group of the eastern transect area.

Discussion

Comparisons between the western and eastern transects are of critical importance to the understanding of the tectonic evolution of the Nain-Churchill boundary region in the area of the established cross-section.

The granitoid gneisses of the western transect bear overall resemblance to the circa 2.8 Ga Nachvak gneiss. Both are of similar composition and contain abundant zones of mafic inclusions, locally recognizable as metagabbroic bodies, including meta-anorthosite. However, there are also major differences. The most obvious difference, and one which would be expected, is that the gneisses of the western transect have been much more pervasively reworked during the Hudsonian Orogeny. However, much of the migmatization and granulite grade metamorphism is believed to be an inherited Archean effect. A second and more fundamental difference is that the Archean(?) supracrustal rocks of the western transect bear little resemblance to those present within the Nachvak gneiss of the eastern transect. Supracrustal associations in the Nachvak gneiss are dominated by the mafic gneisses described above, probably derived from igneous intrusions, and similar in many respects to the mafic component of the Upernavik supracrustals (Wardle, 1983). However, metasedimentary material is rare and is limited to thin bands of garnetiferous quartzite or metachert. In contrast the supracrustals of the western transect are more extensive and are dominated by metasedimentary material. Thus, whilst the Archean(?) gneisses of the western transect may be broadly time-equivalent to those in the east, they cannot be directly correlated.

There are also important differences in Hudsonian structural style between the two transects which are summarized in the cross-sections of Figures 3 and 4. The western transect is dominated by west verging structures whereas the eastern transect contains mainly east verging folds and associated thrusts. When put together the two transects form an overall fan structure, the core of which is formed by the Tasiuyak gneiss with its generally vertical structures.

The east verging structures are clearly related to overthrusting onto the Nain Province craton. This is a well known and expected feature of the Churchill Foreland Zone. What is less clear is the significance of the west verging structures. These are not obviously related to overthrusting but the structural style would suggest that this is to be expected. Also the structures (F_2 folds and ductile shear zones) are clearly second generation ones, even in the Lake Harbour Group, and indicate only late Hudsonian tectonic style. The regional geological maps of the northern Churchill Province (Taylor, 1979) in the transect region indicate that shallow, east dipping foliations are widespread and that westerly structural vergence may be a regionally important feature of this part of the interior Churchill Province.

A detailed discussion of models for the tectonic evolution of the Nain-Churchill boundary is beyond the scope of this paper. However, some provisional ideas are proposed which will be more fully considered in a future publication.

The development of structural fans is not an unusual feature of foreland fold and thrust belts, and is usually related to thrusting and in particular the development of thrust ramps. Deformation over the thrust ramp produces progressive folding and imbrication which may eventually lock the thrust and then produce back thrusting and back folding. This may be viewed as a single stage process (e.g. Price et al., 1981 - Porcupine Creek Fan) or a multistage process (e.g. Brown and Read, 1983 - Shuswap terrane). Following this model the Nain-Churchill boundary fan might be interpreted to have developed over a major intracrustal thrust ramp. The most likely locus for this would be the eastern contact of the Tasiuyak gneiss, although this contact was severely modified during later lateral shearing. The scale of the Nain-Churchill fan, however, is very large and would likely have to be related to a ramp of major crustal proportions.

An alternative model for production of large scale fans is collision of crustal blocks (e.g. Price, 1981 - Kootenay Arc; Coward, 1983 - western Himalayas). In this interpretation it is conceivable that the western half of the fan represents a crustal block which collided against the Nain craton producing both easterly and westerly directed thrust structures.

In either model the core of the fan is likely to be occupied by the rocks of deepest crustal level, in this case the Tasiuyak gneiss. All the features of this gneiss are commensurate with deep crustal evolution; however, the most significant part of this evolution, the massive melting and leucogranite *(sensu lato)* formation, appears to have occurred in the Archean and to have simply been exhumed in the Hudsonian.

The structural picture is also complicated by the presence of a strong subhorizontal lineation associated with mylonitization and folding in the central and west-central parts of the fan. This implies a subhorizontal, north-south trending attitude for the principal axis of the finite strain ellipsoid and obviously indicates a lateral shear rather than an overthrust regime. Field evidence indicates colinearity of F_2 fold hinges and the lineation, suggesting a coeval relationship. It is also conceivable that the lineation is superimposed, although if this is the case it is surprising that there is no record of an earlier, east plunging lineation more obviously related to fold and thrust development.

Regardless of the problems of timing of lineation development, it is apparent that the axial regions of the fan were modified by lateral shear, either during or subsequent to folding and thrusting. The most likely cause of the lateral shear would be a major strike-slip fault zone located along the fan axis.

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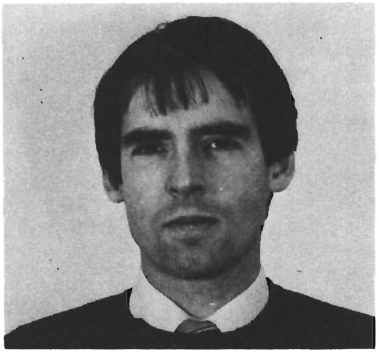

R.J. Wardle