Also, density measurements on samples collected east of the orogen will reduce the ambiguity remaining in gravity interpretation. Geophysical and geochronometric studies should also be oriented toward the northern part of the De Pas batholith to verify its continuity with the southern segment and a possible relationship with the evolution of NQO.

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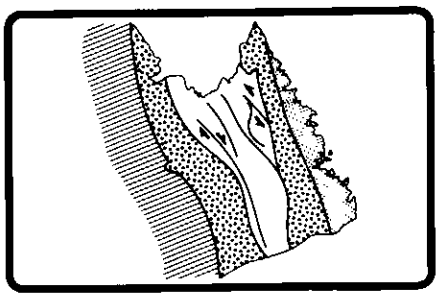

Does the Labrador–Québec border area of the Rae (Churchill) Province preserve vestiges of an Archean history?

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Summary

This paper presents new data from an area of the Rae (eastern Churchill) Province where migmatite and gabbro-anorthosite complexes are intruded by metamorphosed diabase dykes. The pre-dyke rocks are lithologically comparable to Archean components in the Nain Province and may be correlative with them; the dykes may be equivalents of the Early Proterozoic dyke swarms of the Nain Province. It is proposed that this area comprises Archean crust that has escaped pervasive Early Proterozoic structural overprint, but was affected by the prevailing metamorphism. Preservation of these types of relationships may be more widespread in the Rae Province than presently recognized. Some tectonic implications of the data are discussed.

Introduction

Strain partitioning within deeper levels of orogenic belts is such that "islands" of pre-orogenic rocks escape the imprint of younger tectonism and retain a record of their earlier crustal history (*cf.* Kalsbeek *et al.*, 1988). This paper presents some lithostratigraphic data which suggest that some of the gneisses in the Early Proterozoic-deformed Rae Province of Labrador retain their Archean mesoscopic attributes in spite of the younger tectonism. These suggestions are supported by limited preliminary U-Pb zircon dating in progress (U. Schärer, written communication, 1990).

Geological and geochronological framework

Regional mapping (Taylor, 1979; Ryan *et al.*, 1987; Ryan *et al.*, 1988) has provided a basis for subdivision of the Rae (Churchill) Province of central coastal Labrador (see also Wardle *et al.*, 1990). The easternmost subdivision (Figure 1b), in fault contact with Archean (Nain Province) gneisses along the coast, is the Tasiuyak gneiss, a distinctive paragneiss/anatexite unit that can be traced 450 km along the entire eastern margin of the Rae Province (*cf.* Goulet and Ciesielski, 1990; Ryan, 1990; Ermanovics and Van Kranendonk, 1990). This unit is in part co-incident with the Abloviak shear zone (Korstgård *et al.*, 1987).

The Tasiuyak gneiss is succeeded westward by a terrane of granulite- and amphibolite-facies gneisses, herein termed the Kogaluk River complex (Figure 1b). In overall lithological make-up, the Kogaluk River complex is equivalent to the Lac Lomier complex of Ermanovics and Van Kranendonk (1990). The Kogaluk River complex includes migmatite of variable origin, metaplutonic rocks, and metasedimentary and metavolcanic rocks with associated metagabbroic intrusions. The complex can be subdivided into several regional zones determined by metamorphic grade and structural character. The westernmost part of the Kogaluk River complex (Figure 1c) is the focus of this contribution. This specific area is characterized by a metamorphosed, regional mafic dyke swarm that is intrusive into migmatite, foliated tonalite, and gabbroic-anorthositic rocks (Figure 1c). Outside this area, the dykes are rotated into parallelism with the Hudsonian foliation of the gneiss complex.

There are few geochronological constraints at present on the evolution of the Rae Province in Labrador as a whole, and, unfortunately, no age determinations are available from the gneisses in the area described below where the metamorphosed dykes are present. The only control on events in this area comes from two small, foliated granitoid intrusions (not shown on Figure 1c, because of scale) that appear to be late to post-tectonic intrusions; these yield zircon ages in the 1860-1850 Ma range (Krogh and Heaman, 1989). Outside the terrane containing the dykes, however, preliminary data provide strong isotopic indications that reworked Archean crust constitutes an important component of rocks that show a pervasive Hudsonian structural and metamorphic overprint. For example, a suite of samples collected from "Hudsonian" gneisses in the Moonbase Lake–Cabot Lake area (Figure 1b) in 1989 yields upper intercept Archean zircon ages in the 2660–2570 Ma range; monazite from the same suite indicates an Hudsonian metamorphic overprint *ca.* 1830–1800 Ma (Krogh, 1990). It is predicted that the westernmost part of the Kogaluk River complex, the focus of this contribution, will yield similar Archean ages, and that the rocks in this area preserve field relationships that predate the Hudsonian metamorphic and thermal overprint that has affected the major part of the Rae Province.

Probable Archean elements

Granulite- and amphibolite-facies quartzofeldspathic migmatite containing intercalated units of gabbro-anorthosite forms a distinctive association in the westernmost Kogaluk River complex, north of the Middle Proterozoic Mistastin Batholith (Ryan *et al.*, 1988; Figure 1c). This association has been intruded by a swarm of diabase dykes, now metamorphosed to amphibolite and mafic granulite (Figure 2).

The pre-dyke migmatites are well-layered to somewhat diffusely layered rocks derived from tonalitic to granodioritic protoliths. Some of the granitoid rocks originally intruded the gabbro-anorthosite suite. Both the granitoid and gabbroid rocks were subsequently deformed, metamorphosed and migmatized, prior to emplacement of the mafic dyke swarm.

The gabbro-anorthosite components of this terrane tend to occur as trains of abundant fragments within the quartzofeldspathic migmatites and are the remnants of originally layered intrusive bodies. They comprise a varied suite ranging from white saccharoidal anorthosite containing relicts of gray igneous plagioclase, to hornblende-bearing gabbroic anorthosite, to "snowball"-textured gabbros in which ovoid plagioclase up to 10 cm in diameter is surrounded by a hornblende-rich groundmass (Figure 3).

The mafic dykes reflect the metamorphic grade (amphibolite to granulite facies) of their host rocks, regardless of their structural state. They vary from a few centimetres to over 25 m in width and are largely recrystallized, though well-preserved plagioclase phenocrysts and coarse ophitic textures are still locally visible.

Other components of the Kogaluk River complex

Outside the area described above, the gneisses of the Kogaluk River complex are, for the most part, parallel-layered migmatitic rocks in which former dykes form concordant mafic layers. Dykes appear to be absent from the supracrustal rocks.

The dominant rock-type of the Kogaluk River complex within the region shown on Figure 1b is an amphibolite-facies migmatite in which a gray tonalitic to dioritic paleosome alternates with a white to pink aplitic to pegmatitic granitic neosome; thin layers of mafic rock are locally abundant. Younger less-deformed felsic metaplutonic rocks (not shown separately on Figure 1) are commonly non-migmatitic and contain a simple single penetrative foliation. They retain megacrystic and hypidiomorphic textures, and locally contain screens and schlieren of the migmatite. Similar rocks to these within the Lac Lomier complex have yielded U-Pb zircon ages indicating Early Proterozoic emplacement (Bertrand *et al.*, 1990); one such unit from the Kogaluk River complex has, however, yielded an Archean age (Krogh, 1990).

The supracrustal metasedimentary packages (Figure 1b) are dominated by pelitic and semipelitic gneiss. They also include marble, calcareous meta-arkose, and quartzite. By comparison with cover sequences on the Archean cratons bounding the Rae Province (*cf.* Wardle and Bailey, 1981), these are considered to be largely of Early Proterozoic age. Mafic rocks associated with the paragneisses include massive to layered metaplutonic types and laminated to fine-grained massive rocks presumably derived from volcanic rocks. Supracrustal rocks decrease in abundance from east to west.

The Kogaluk River complex also contains massive to mildly deformed granitic pegmatites and fine- to medium-grained, weakly deformed to undeformed, pink and white granites (shown as units 3, 5 and various cross patterns in Figure 1c); rocks of this type have yielded the 1860–1850 Ma ages noted above. The area transected by the Labrador–Québec border is underlain by a massive to gneissose, layered metagabbronorite (Figure 1c), that, in places, retains its original coarse subophitic texture. This gabbronorite grades into a monzonitic variant, the whole suite being akin to members of the *ca.* 2300 Ma Pallatin intrusive suite that occurs 50 km to the west in Québec (Girard *et al.*, 1988; Girard, 1990; J. van der Leeden, personal communication, 1990). This gabbronorite unit may have been emplaced coevally with the mafic dyke swarm.

Mylonite zones in the Kogaluk River complex

Two broad (kilometre-scale) zones of mylonitic rocks have been identified in the central part of the Kogaluk River complex. The rocks in these zones are characterized by porphyroclastic features, elongate quartz, and a fine mylonitic layering. Both zones are characterized by horizontal to gently plunging (both north and south) lineations, a style similar to that of the Abloviak shear zone (*cf.* Korstgård *et al.*, 1987). All these zones may be part of a series of contemporaneous anastomosing crustal scale shears (*cf.* Girard *et al.*, 1990).

The easternmost zone (Figure 1b), 12 km wide, is at amphibolite facies and is marked by an abundance of foliated pink granitoid sheets. The granitoids appear to have been injected syn- to late-tectonically with respect to the mylonitization of the enclosing gray migmatitic hornblende-blastic gneisses. The overall character of this zone suggests that it is a counterpart of the NNW-trending Falcoz zone (Girard *et al.*, 1990) 120 km to the north.

The westernmost zone, near Moonbase Lake (Figure 1b), is 6 km wide and at granulite facies. It has a pronounced aeromagnetic

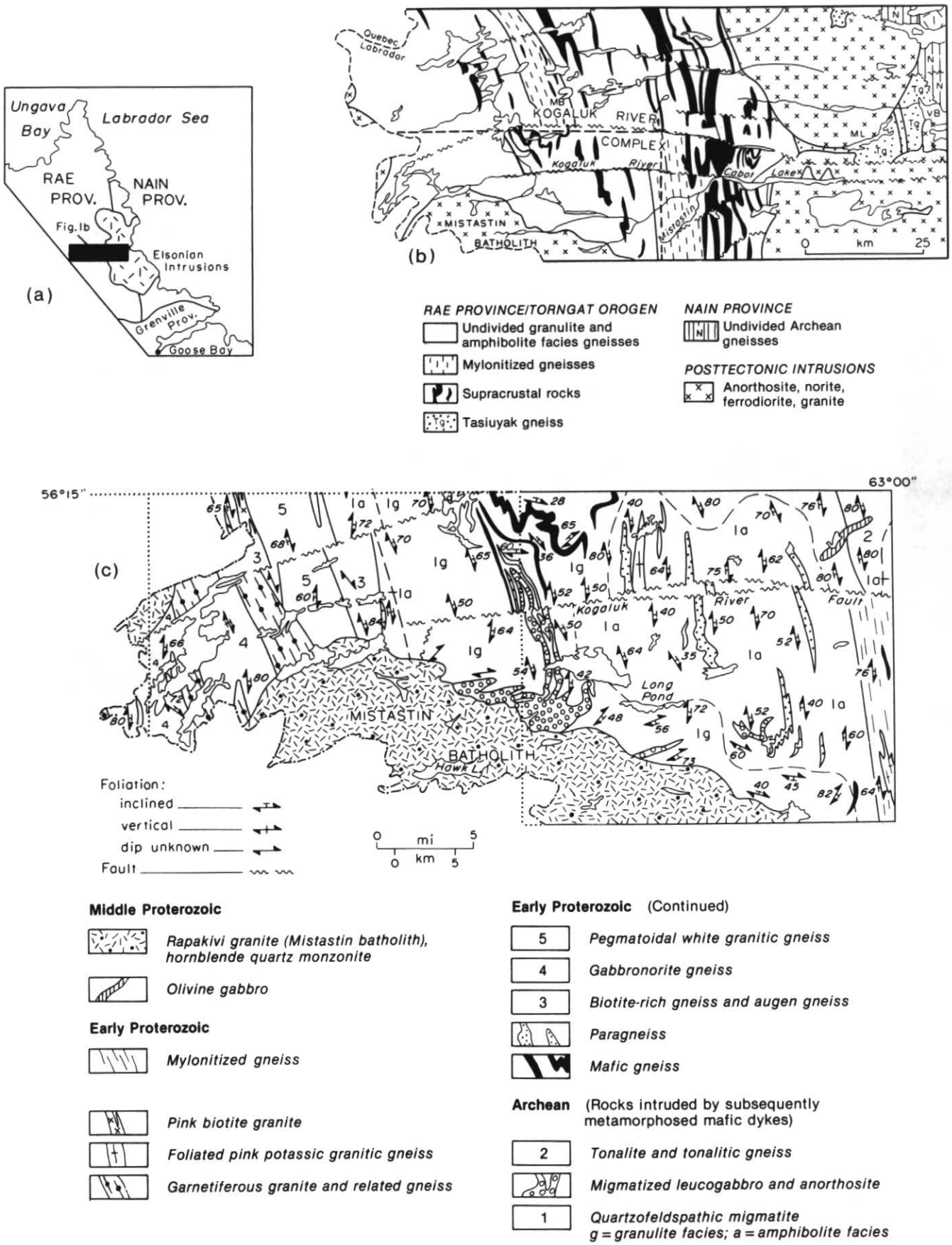

Figure 1 (**a**) *Major lithotectonic elements of northern Labrador and adjacent Québec.* (**b**) *Fundamental geological subdivisions of the corridor shown in Figure 1a.* ***VB****, Voisey Bay;* ***ML****, Makhavinekh Lake;* ***MB****, Moonbase Lake.* (**c**) *Detail of part of the Kogaluk River complex outlined in Figure 1b. Note that gneissic units 1 and 2 and the leucogabbro-anorthosite association are the only rock units in which metamorphosed basic dykes have been definitely recognized. The dashed lines mark the approximate boundary between granulite- (1g) and amphibolite- (1a) facies rocks.*

expression (GSC, 1983) indicating a north-northwesterly continuation of at least 100 km into Québec.

Discussion: Possible correlatives of the pre-dyke terrane and implications for evolution of the Rae Province

It is proposed that the part of the Kogaluk River complex containing the discordant metadiabase dykes is an Archean relict within the Rae Province that has largely escaped Early Proterozoic structural reworking. This proposal is based on two observations: (i) The rock types, especially the gabbroic and anorthositic rocks, resemble to a large degree those of the Nain Province to the east. Though not unique to the Nain Province, or the greater North Atlantic Archean craton, metamorphosed gabbroic and anorthositic rocks of the type described here are common, as exemplified by the Fiskenaesset Complex and other dismembered layered intrusions in West Greenland (*cf.* Myers, 1985). Identical gabbroic and anorthosite rocks are known to occur along the Labrador coast at Okak (Ermanovics *et al.*, 1988), Tasiuyak Bay (Wiener, 1981) and Hopedale (Ermanovics *et al.*, 1982). (ii) Also characteristic of the Nain Province in Labrador is a swarm of diabase dykes of Early Proterozoic age, which may correlate with the dykes of the Kogaluk River complex.

It is clear that the westernmost part of the Kogaluk River complex has escaped most of the regionally pervasive Early Proterozoic deformation and has preserved its pre-udsonian relationships. Granulite-facies metamorphic assemblages in the dykes and their host gneisses indicate, however, that thermal equilibration did occur. Fragments of snowball-textured metagabbro, along with massive amphibolite and mafic granulite layers (metadykes) in otherwise migmatitic parallel-layered gneisses, have been documented from other parts of the Kogaluk River complex as far east as the Tasiuyak gneiss (Ryan *et al.*, 1988), and imply a considerable extent for the Archean(?) crust.

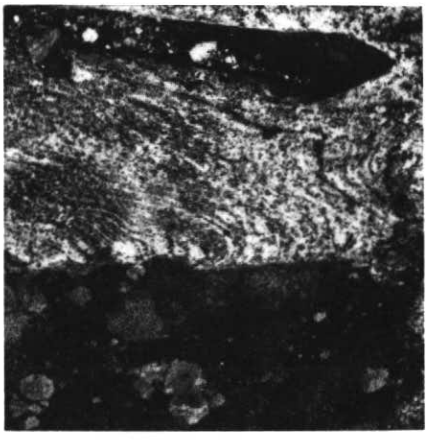

Figure 2 *Contact between metamorphosed basic dyke and a folded layering. Field of view is 0.5 m wide.*

Evidence for the existence of Archean crust within the Rae Province supports earlier notions (*cf.* Korstgård *et al.*, 1987; Hoffman, 1988) that this area is probably largely underlain by reworked Archean crust; isotopic data from Middle Proterozoic intrusions also imply this (Ashwal *et al.*, 1988). The recognition of metagabbro-anorthosite and discordant metadiabase provides a key to delineation of older crust in the Kogaluk River complex. This technique may also prove useful in distinguishing Archean from Proterozoic crust elsewhere in the Rae Province. Extrapolation eastward from the Québec border implies that over 50% of the quartzofeldspathic gneisses are probably pre-Hudsonian. The supracrustal rocks are interpreted to be largely Early Proterozoic and to have been originally unconformable on the Archean gneiss. The possibility exists that there are compositionally similar Archean supracrustal belts preserved within the Kogaluk River complex; these, however, would be difficult to recognize without the presence of dykes.

Unlike the Lac Lomier complex to the north (Ermanovics and Van Kranendonk, 1990) and the George River area to the west (van der Leeden *et al.*, 1990), there is no convincing evidence of significant crustal growth in the Rae Province of this area by the formation and amalgamation of magmatic arc terranes. The mylonite zones that transect the area are not major structural boundaries between radically different terranes since common rock units, including anorthositic gabbro and discordant dykes, occur on both sides of the zones and are re-oriented into them (Ryan *et al.*, 1987; Ryan *et al.*, 1988). Therefore, if the Rae (Churchill) – Nain junction is a major collisional zone (Torngat Orogen of Hoffman, 1988), it does not, at least in this area, represent the suture along which an amalgamated Early Proterozoic arc complex was accreted to the Archean craton. Rather, if the Rae Province Archean rocks described here are "Nain-type", the Rae–Nain junction must either mark a zone along which the Nain Province splintered and was later re-joined, or, as Hoffman (1990) suggests, it must represent a contact along which two similar Archean crustal blocks have been juxtaposed.

If the conclusion based on field relationships and comparative correlations is correct, then the westernmost Kogaluk River complex exhibits the first indications of rocks preserved within the Rae Province of this part of Labrador in which field evidence for an Archean history is preserved. However, Archean elements have been identified within the southern part of the Rae Province near Churchill Falls (Nunn *et al.*, 1990), and there is evidence of pre-Hudsonian intrusive components in the Rae Province west of the study area (van der Leeden *et al.*, 1990). If there are, in fact, well-preserved remnants of Archean crust in the interior of the Rae Province in Labrador–Québec, then the contention that the area comprises largely a reworked Archean substrate with infolded and metamorphosed cover (Korstgård *et al.*, 1987) seems to be valid.

Conclusions

Leucogabbro-anorthosite associations and migmatitic gneisses crosscut by metadiabase dykes have been discovered within the Rae Province near the Labrador–Québec border. The leucogabbro-migmatite complex resembles parts of the Nain Province, and may represent an Archean element which has escaped the intense Hudsonian deformation characteristic of the greater part of the Rae Province. The Archean rocks have, however, been subjected to the prevailing Hudsonian granulite-facies metamorphism. These Archean rocks are either a westward extension of Nain crust or perhaps an accreted terrane of closely comparable character. The extent of the probable Archean terrane is not readily apparent due to the intensity of the Hudsonian overprint and the paucity of radiometric ages throughout most of the interior of the Rae Province.

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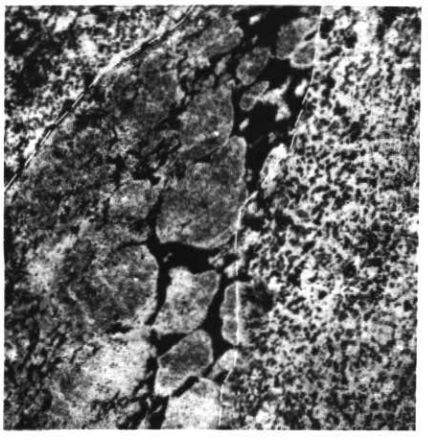

Figure 3 *"Snowball"-textured metagabbro (outlined by white dashed line) engulfed by younger granitoid; both predate the intrusion of the metamorphosed dykes of Figure 2. Largest "snowball" is approximately 10 cm in maximum dimension.*

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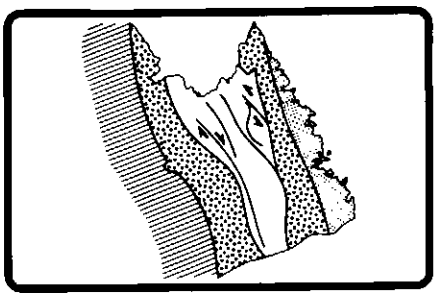

U-Pb geochronological evidence for Archean crust in the continuation of the Rae Province (eastern Churchill Province), Grenville Front Tectonic Zone, Labrador

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Summary

In Labrador, the northerly-trending zones of the Churchill Province are truncated at their southern margin by rocks of the Labrador Orogen within the Grenville Province. Churchill Province rocks locally extend into the Grenville Province where they are gradationally reworked. This paper describes the geology of the central part of the Churchill Province (the Rae Province) in a 3700 km² area lying astride the Grenville Front.

The eastern part of the area, the Orma domain, consists of supracrustal rocks intruded by, and infolded into, orthogneiss. The supracrustal unit is dominated by mafic volcanic and pelitic rocks with subordinate psammite, felsic volcanic rocks, quartzite and conglomerate. The orthogneiss unit consists of foliated to gneissic tonalite and granodiorite. Both units are intruded by a plutonic suite of granite, diorite and gabbro. U-Pb zircon geochronology of four tonalite samples indicates that the majority of orthogneiss in the Orma domain was emplaced in the Late Archean (2682–2675 Ma). These data confirm earlier ideas that parts of the Rae Province consist of reworked Archean crust. U-Pb results of both zircon and titanite analyses from the same samples indicate a