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GEOLOGY OF THE EASTERN CHURCHILL PROVINCE BETWEEN ANAKTALIK BROOK AND CABOT LAKE (NTS 14D/2, 6, 7), LABRADOR

B. Ryan, D. Lee[1], and L. Corriveau[2]
Labrador Mapping Section

ABSTRACT

Metamorphosed sedimentary and volcanic rocks form a significant component in the Early Proterozoic Churchill Province of north-central Labrador. The supracrustal rocks are predominantly in the granulite facies and are interlayered with quartzofeldspathic gneisses, many of which are younger rocks of plutonic origin. The quartzofeldspathic rocks vary from megacrystic charnockite to potassic granite. Rusty sulfide-rich zones are common in the supracrustal rocks, and white granite sheets within one paragneiss belt are characterized by high radioactivity. The gneisses have been posttectonically intruded by olivine gabbro, hornblende quartz monzonite and rapakivi granite of the Middle Proterozoic Nain Plutonic Suite.

INTRODUCTION

The 1.75–1.8 Ga Churchill Province (Trans-Hudson Orogen) in Labrador comprises a poorly known region. Mapping at 1:250,000 scale by Taylor (1979) has outlined broad subdivisions to the orogen, showing it to be a terrane of high-grade metamorphic rocks of diverse origin, including lesser synkinematic plutonic rocks; little detailed work has been done with respect to defining the variations or components within these subdivisions. The eastern margin has been examined in the Nachvak–Hebron sector of northern Labrador (Wardle, 1983; Ryan *et al.*, 1984), and the western margin has been examined in the Wabush–Schefferville area of western Labrador (Wardle, 1982), but the intervening interior has received little attention. A project was begun in 1985 (Ryan and Lee, 1986) aimed at mapping a 60-km-wide corridor across the central part of the orogen from Voisey Bay near Nain on the Labrador coast, westward to Strange Lake at the Quebec border (Figure 1). The mapping of the Churchill Province is part of a program to evaluate the potential of granitoid intrusions associated with the 1.4–1.5 Ga Nain Plutonic Suite, and any unknown felsic plutons that may be present, to determine whether any of these intrusions are peralkaline and therefore akin to that at Strange Lake, which hosts a rich deposit of Zr and rare-earth elements (Miller, 1986).

Churchill Province gneisses are subordinate to the post-Hudsonian plutons in the eastern part of the corridor mapped in 1985 (Ryan and Lee, 1985, 1986), but comprise nearly 80 percent of the area studied in 1986 (Figures 1, 2). One of the most significant results from the 1986 mapping has been the delineation of extensive belts of supracrustal rocks within the eastern Churchill Province gneisses. Rusty, sulfide-rich zones are areally distributed in the supracrustals, and, economically, are the most interesting rocks discovered to date.

An outline map of the major geological components of the 1986 project area, covering NTS sheets 14D/2, 6 and 7, is presented in Figure 2; the ordering of gneissic units in the legend does not imply stratigraphic order. The eastern part of the map area (14D/2, 7), from Cabot Lake to Anaktalik Brook, is a well exposed, variably dissected plateau underlain chiefly by granulite-facies gneisses and posttectonic igneous rocks. The western third of the study area (14D/6) between the headwaters of Konrad Brook and Anaktalik Brook is very poorly exposed, the topography being that of a very gently rolling plateau covered with glacial droppings. Mapping was carried out from two base-camps (an initial camp at Makhavinekh Lake approximately 10 km east of the study area, and a second one on the plateau at 'Moon-base' lake) as well as from three two-man fly-camps.

CHURCHILL PROVINCE

The Churchill Province is characterized by a generally north to northwest-striking layered complex of supracrustal and metaplutonic rocks; some of the plutonic rocks intrude the supracrustals. Metamorphic facies of the gneisses is upper amphibolite or granulite; in some instances the amphibolite-facies rocks are retrogressed equivalents of those in the granulite facies. Evidence for polyphase deformation is present in many outcrops, but only one regional refolded structure was identified. This is a refolded isoclinal fold, which occurs between Cabot Lake and Konrad Brook.

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

[2] Department of Geology, University of Toronto, Toronto, Ontario, M5S 1A1.

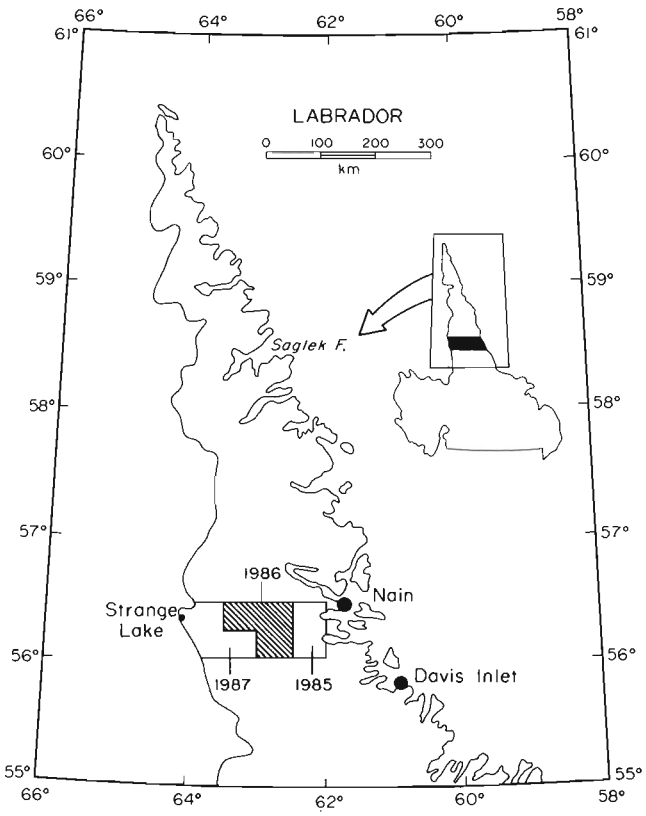

Figure 1: *Location of the Nain–Strange Lake corridor showing the 1986 map area in relation to that completed in 1985 and proposed for completion in 1987.*

Mylonitic fabrics are locally well developed, especially in the area southwest of Cabot Lake, and rare zones of ultramylonite and pseudotachylite veins are present.

Garnet–Quartz–Feldspar Mylonitic Gneiss

This unit, which is 30 km wide in the area east of Konrad Brook lake (Ryan and Lee, 1985, 1986), occupies only a small sliver along the southern edge of the rapakivi granite and another small sliver along the granite's northern margin. There has been some transformation of garnet to cordierite + hypersthene directly adjacent to the granite, but otherwise the unit is a mylonitic white-weathering rock containing abundant red to lavender garnet; locally knots of sillimanite and biotite are molded around the garnet.

Quartzofeldspathic Granulite Gneiss

Rocks grouped into this unit range from compositionally well layered varieties to more homogeneous augen gneisses (deformed porphyritic charnockite) and diffusely layered metaplutonic rocks. They commonly weather in shades of pale brown to buff, and generally form topographically higher areas than the lower grade rocks. Migmatitic structures are absent from the granulites, but locally a *lit-par-lit* network of quartzofeldspathic veins is present, and pegmatite dikes occur peripheral to the younger granitic rocks. The quartzofeldspathic granulites south of Cabot Lake and north of Konrad Brook tend to be well layered rocks, containing lenses of mafic granulite and sillimanite paragneiss. More diffusely layered to homogeneous felsic granulite between Cabot Lake and Konrad Brook intrudes the mafic and metasedimentary gneisses interlayered with it, and commonly contains rafts of the older rocks. Porphyritic charnockite and derived mylonitic augen gneiss interdigitate with supracrustal rocks north of Khongnekh Lake; similar rocks occur west of the rapakivi granite near Anaktalik Brook and in the belt west of 'Moon-base' lake. Although inclusions of adjacent rocks in the quartzofeldspathic gneiss and its local porphyritic texture suggest derivation from igneous protoliths, there are few indications of the origin of the felsic granulites throughout most of the area.

Mafic Gneiss and Metasedimentary Gneiss

These two units comprise the supracrustal belts of the map area, and are commonly spatially associated. They occur in both the granulite- and amphibolite-facies terranes, although they are volumetrically more abundant in the higher grade rocks between Cabot Lake and Anaktalik Brook. The mafic gneiss varies mineralogically from garnetiferous amphibolite to two-pyroxene granulite, and texturally from massive and homogeneous to well layered. Some retain compositional banding and relic igneous textures, which indicate derivation from a layered intrusion, whereas others lack banding and contain lenses of associated metasedimentary rocks, suggesting a homogeneous lava-flow or sill-like origin. They are locally characterized by areas rich in disseminated pyrite, which give rise to rusty zones several metres wide and several tens to several hundreds of metres in length. Many of the mafic-gneiss belts are disrupted tectonically and/or 'exploded' by younger granitoid gneisses such that they pinch out along strike or disappear into a train of isolated inclusions.

The metasedimentary gneiss comprises a diverse assemblage of rocks. The most abundant is rusty, biotite–garnet–sillimanite gneiss, commonly intruded by white garnetiferous granite sheets, which locally form 50 percent of some outcrops. This pelitic to semipelitic gneiss is easily recognized from the air by its orange-brown rusty weathering, which in many cases is a function of disseminated sulfides; locally the sulfides are quite abundant and form prominent gossan zones. Other paragneisses include pink-weathering clinopyroxene ± grossularite-bearing meta-arkose and associated gray, nodular, forsterite–diopside marble, pale-green, laminated, calc-silicate gneiss, and gray, banded, garnetiferous psammitic gneiss. These rocks are intercalated with the rusty biotite-rich paragneiss, and also constitute the major rock types in a braided belt between Ikadlivik and Anaktalik brooks. Marble and calc-silicate rocks also form a significant part of a folded supracrustal sequence partly outlined by Taylor (1979) southwest of Cabot Lake. A narrow metasedimentary belt 12 km north-northeast of 'Moon-base' lake is composed nearly entirely of white sillimanite ± muscovite quartzite.

The lithological composition of the metasedimentary rocks in the supracrustal sequences strongly suggests a correlation with other Early Proterozoic rocks in the eastern Churchill Province, e.g., the Labrador Trough, Ramah

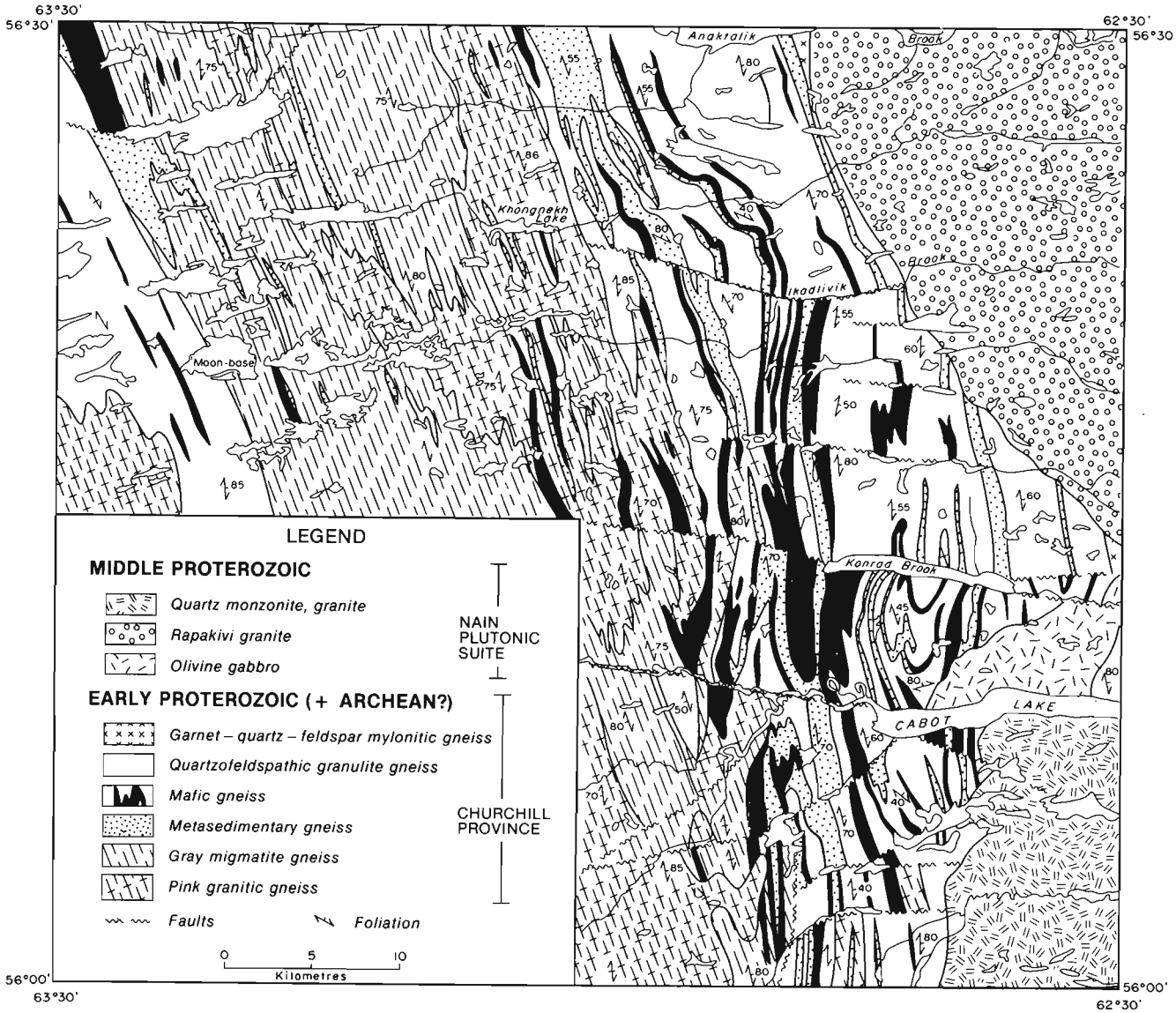

Figure 2: *Geological map showing major subdivisions of the Churchill Province defined by this study in the Cabot Lake–Anaktalik Brook area.*

Group, and Lake Harbour Formation, and we agree with Taylor (1979) that supracrustal gneisses in this area are vestiges of Early Proterozoic sedimentary and volcanic rocks metamorphosed during the Hudsonian Orogeny.

Gray Migmatite Gneiss

Well layered, leucocratic to melanocratic hornblende–biotite gneiss containing amphibolite lenses predominate in the central part of the study area. The gneiss is characterized by a pervasive, but variably developed, quartzofeldspathic vein network generally subparallel to the gneissosity. It appears for the most part to be in the amphibolite facies, but relic orthopyroxene was recognized in several widely scattered outcrops suggesting a possible retrogression from granulite facies. The migmatite gneiss, because of its weathering characteristics, displays the best field evidence for polyphase deformation; many outcrops show early isoclinal folds and associated linear fabrics, refolded by later more open folds. The paleosome to the migmatite gneiss varies in texture from a foliated, equigranular granodioritic rock to an augen gneiss containing white feldspar grains 1.5 cm in maximum dimension. In a few outcrops it can be shown that some narrow mafic units are dikes that had cross-cut early migmatite veins prior to a later deformational event; this later deformation transposed all elements into near-parallelism. This unit may contain rocks of Archean age, since locally it seems to be more migmatitic and more structurally complex than the other gneissic rocks in the area. Some of these structures predate intrusion of the basic dikes, which may be correlative with the Early Proterozoic dike swarm in the Archean gneisses of the Nain Province to the east (Taylor, 1979).

Pink Granitic Gneiss

Gneiss that constitutes this unit is, in many cases, simply variably deformed granitoids lacking a strong compositional layering or migmatization. It is interbanded with surrounding gneisses on all scales from several metres to several kilometres but has its greatest concentration in a zone in the central part of the area. It is of plutonic origin, commonly containing isolated rafts of older rocks or forming a *lit-par-lit* network within them. Map patterns southwest of Cabot Lake suggest a folded plutonic contact between the granitic gneiss and an older association of gray migmatite and supracrustals. However, outcrop is poor in this area and this interpretation of rock distribution is subject to change. A similar deformed intrusive contact appears to be present northwest of Cabot Lake where pink, mylonitized, porphyritic (augen), granitic gneiss interfingers with gray, mylonitized, migmatitic gneiss. Although in a few areas gneisses grouped into this unit are migmatized and appear to display composite fabrics, in many areas the rock contains a single anastomosing foliation, and is quite clearly a late tectonic intrusion. One such deformed potassic granite southwest of Cabot Lake was collected for U–Pb zircon dating. It is likely that deformed and metamorphosed granitic rocks of more than one age are included in this unit.

NAIN PLUTONIC SUITE

Posttectonic intrusions that outcrop along the eastern margin of the study area are extensions of those mapped previously to the east (Ryan and Lee, 1985, 1986). Chocolate-brown, deeply weathered, iron-rich, olivine gabbro occurs as a gently northwest-dipping sheet between Konrad Brook and Cabot Lake, and equigranular fayalite-bearing, hornblende quartz monzonite to granite occurs south of the lake. Rapakivi granite occupies the northeast quadrant of the study area.

The *olivine gabbro* sheet displays many of the features described previously by Ryan and Lee (1986), such as a local hornblende- and plagioclase-porphyritic texture, a diffuse layering and a lower chilled contact. However, unlike its eastern extension, no large dikes emanate from it.

The *quartz monzonite–granite* unit south of Cabot Lake is relatively homogeneous and medium grained; rafts of country rock gneiss and gabbro are present locally, and a fine grained quartz-porphyry phase and an acicular-hornblende phase occur sporadically along the southern extremity of the body.

The gently curving western contact between the *rapakivi granite* and gneisses centred on Ikadlivik Brook marks the western extent of an ovoidal, coarse grained pluton that extends 25 km eastward (Ryan and Lee, 1986). It is remarkably homogeneous in texture and grain size, and, except for a few widely scattered gneissic rafts and late aplitic dikes, the interior part of the pluton is composed of monotonous, hornblende-bearing, rapakivi granite with mantled ovoidal potash feldspar. In many places in the northeast corner of the study area, the pluton comprises a rusty, friable, olivine-bearing phase that is deeply weathered and easily eroded, producing a rolling topography with distinctive orange-brown cliff faces.

ECONOMIC GEOLOGY

The abundance of supracrustal rocks (of presumed early Proterozoic age) characterized by locally extensive sulfide-rich zones presents new targets of economic interest. Only pyrite and magnetite were identified in hand specimens from these zones, but Cu, Zn, and Co anamolies in nearby lakes (Geological Survey of Canada, 1978) suggest that there is potential for other mineralization. Several prominent gossan zones within the supracrustals were sampled for assay, but results are not available at this time.

Data from airborne gamma-ray spectrometry collected by the Geological Survey of Canada in 1983 showed the presence of anamolous U and Th along Anaktalik Brook in the vicinity of the contact between rapakivi granite and gneisses (Geological Survey of Canada, 1986). We were successful in isolating the source of one of the two anamolies defined by that survey. A narrow metasedimentary belt bordering rapakivi granite just south of Anaktalik Brook is intruded by narrow (1 to 2 m wide) dikes and sills of white garnetiferous granite that have 6-times-background radioactivity. They also contain abundant disseminated grains (up to several millimetres in size) of a yellowish- to reddish-brown mineral tentatively identified in hand specimen as monazite. The dikes are very similar to white synmetamorphic granite sheets in other metasedimentary rocks of the area, but are only radioactive at this one locality. The source of the second anomaly in the Anaktalik Brook area was not located. It corresponds to an area of rapakivi granite, but a scintillometer survey over outcrops in question revealed no anamolous radioactivity. McConnell (1986), following up a regional lake water fluorine anamoly (Geological Survey of Canada, 1978) in the same area, noted the presence of fluorite in some outcrops, but also did not detect any abnormal radioactivity values (J. McConnell, personal communication, 1986).

SUMMARY

Supracrustal rocks of presumed early Proterozoic age underlie a significant component of the eastern part of the interior Churchill Province in Labrador. They are interlayered with (and intruded by) quartzofeldspathic gneisses considered to be derived from syn- to late-kinematic plutonic rocks, and with migmatite gneiss of uncertain origin, which may contain elements of the Archean basement to the supracrustals. Metamorphism in the area reached granulite facies during the Hudsonian Orogeny, but the central part of the area exhibits amphibolite-facies assemblages, in part derived from retrogression of granulite-facies rocks. Rusty, sulfide-rich zones in the supracrustal rocks may hold potential for Cu, Zn and Au, and constitute hitherto unknown exploration targets.

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