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Reports

Basement and Cover Rocks at Cape North, Cape Breton Island, Nova Scotia

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Introduction

Recent field studies by Wiebe (1972) and isotopic dating by Cormier (1972) suggests that the pre-Mississipian history of northern Cape Breton Island is more complex than was previously recognized by Neale (1963, 1964) and McLaren (1956). The recent work partly bears out the suggestion by Williams *et al* (1972) that the sinuous belt of basement, polydeformed cover rocks and granitic intrusions of several ages that extends from the vicinity of Gander to the southwestern part of Newfoundland also continues through northern Cape Breton Island.

Interest in these relationships prompted a visit (a revisit for E.R.W.N.) to several localities in northern Cape Breton. At one of them, Cape North, we found basement/cover relationships somewhat similar to those described by Wiebe (1972). As Wiebe's evidence comes from east of a major zone of dislocation, the Aspy Fault, and as the Cape North section lies west of this fault we feel that it merits the brief description provided in this note.

Geological Setting

Wiebe's (1972) study of the pre-Carboniferous rocks, particularly in the Ingonish and Black Brook regions (Fig. 1), distinguished two metamorphic terranes separated by an unconformity. The older of these consists of marble, quartzite and pelitic rocks possibly equivalent to the Precambrian (Helikian?) George River Group. The younger, overlying unit is described as a less deformed sequence of felsic to intermediate metavolcanic rocks and related metasedimentary rocks, which is possibly correlative with the Hadrynian Fourchu Group of the southeastern part of the Island. Two plutonic assemblages were also distinguished: an older, compositionally varied granitic series which in part may be older than and in part contemporaneous with the Fourchu (?) Group; and a younger leucocratic granodiorite which intrudes the metavolcanic rocks. Wiebe relates deformation of the older granitic series and the Fourchu Group (?) rocks to Devonian (Acadian) orogeny and the younger granodiorite is interpreted as a post-tectonic Acadian intrusion.

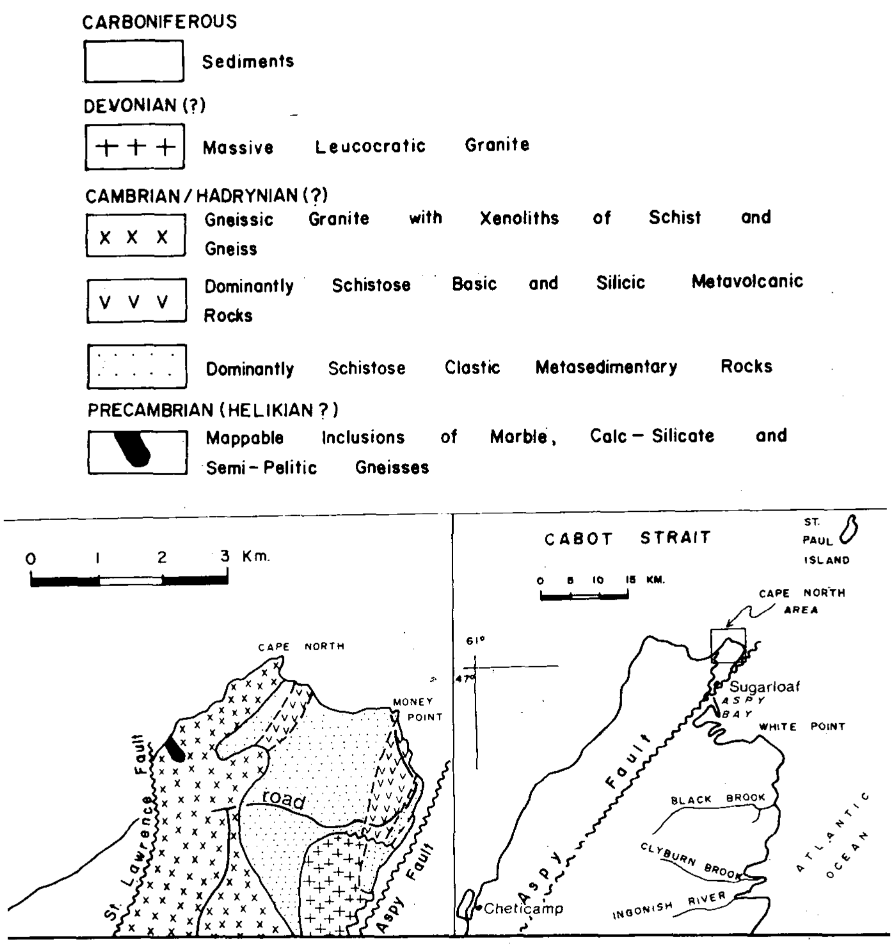

FIG. 1. Maps showing the position of the Cape North area and its general geology.

Cormier's Rb/Sr isochrons (1972) suggest that the older granitic rocks are ca. 560 m.y. old and the younger granites ca. 400 m.y. Biotite K/AR ages from the older granites yield dates roughly similar to that of the younger granites and suggest updating during Acadian orogenesis.

THE CAPE NORTH SECTION

Cape North at the northernmost tip of Cape Breton Island offers good coastal exposures of a variety of metasedimentary and metavolcanic rocks that increase in metamorphic grade westward and pass into intrusive gneissic granite. The gneissic granite contains inclusions of schists, gneisses and, in one locality, marble. These rocks and a very similar sequence on St. Paul's Island, 15 miles to the northeast have been mapped and described by Neale (1964) and Phinney (1963). The entire sequence was interpreted as a Devonian metamorphic progression. The presence of crystalline limestone led Neale to correlate the sequence with the Precambrian George River Group of southeastern Cape Breton Island (Weeks, 1954).

Our revisit to Cape North suggests, on the basis of intrusive relationships and structures in the granitic rocks, that the marble and associated rocks are remnants of an older complex that possibly formed the basement to the less deformed metasedimentary and metavolcanic cover rocks that lie east of them.

The marble and intercalated calc-silicate gneisses, garnet-kyanite gneisses and amphibolitic gneisses occur as a septum surrounded by gneissic granite 2.1 km southwest of the tip of Cape North (Fig. 1). The calc-silicate gneisses consist chiefly of quartz, epidote and plagioclase. Foliation in the garnet-kyanite gneisses is imparted by biotite and kyanite layers which form augen around garnet prophyroblasts.

Granitic and aplitic dykes that belong to the complex mapped as hybrid rocks by Neale (1964) truncate the steep foliation of the gneisses but themselves contain a strong schistosity which is locally associated with tight folds within them. These pink to grey biotite and muscovite-biotite foliated granites are commonly garnetiferous and their aplitic phases are particularly rich in garnet. Traced northeastward along the coast they intrude the metasedimentary/metavolcanic sequence and the foliation of the granites can be clearly traced into the S_2 fabric of this sequence, particularly where dykes of granite cut the metasediments. The foliated granite was thus emplaced after the development of the major fabric in the marble and associated gneisses and prior to deformation of the metasedimentary and metavolcanic cover rocks.

The cover rocks consist of a sequence of north-northeast striking mafic and silicic metavolcanic rocks, black pleitic schists, semi-pelites, psammites and some metaconglomerates. Foliation is steeply inclined. The metavolcanic rocks, exposed chiefly to the southeast of Money Point, include silicic prophyritic flows and/or sills, crystal tuff units from 30 cm to 2 m thick and silicic agglomerates with stretched and flattened fragments. Mafic flows and a few possible tuff beds have been almost totally recrystallized to actinolite-biotite-chlorite schists in which the feldspar is almost all highly sericitized although a few igneous placioclases are preserved. Metamorphism is biotite grade but

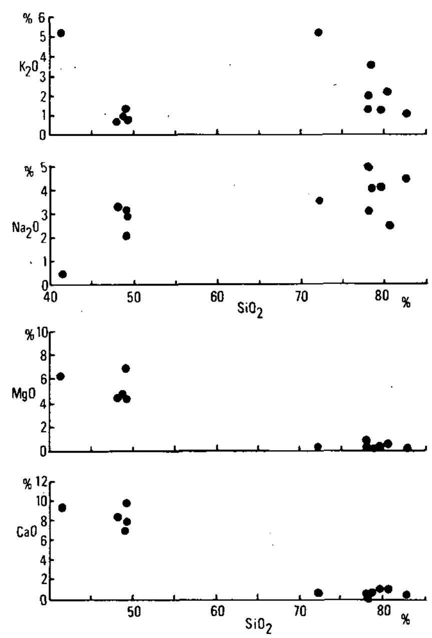

FIG. 2. Partial analyses of metavolcanic rocks from the Cape North Section.

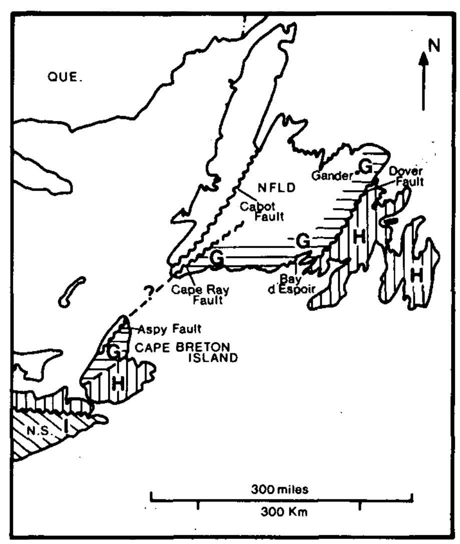

FIG. 3. Distribution of rocks of the Gander (G) and Avalon (H) tectonostratigraphic zones in Newfoundland and eastern Nova Scotia.

increases westward. A few interbeds of graphitic pelite and muscovite-albite schist are intercalated with the volcanic rocks. A dozen samples of the volcanic rocks were collected for age determinations. They were unsuitable because of their alteration and Rb/Sr ratios, but all were partially analyzed chemically. The silicic rocks contained 72 to 82 percent SiO_2 and the basic rocks 40 to 49 percent silica (Fig. 2), a decidedly bimodal aspect.

The muscovite-biotite pelites, semi-pelites and psammites occur in beds 10 to 40 cm thick. Many beds are pebbly and at Money Point and a few places immediately west of it the rock is a conglomerate with stretched, dominantly quartzitic pebbles and cobbles. The sediments are biotite grade in the east, garnet becomes common near Money Point and staurolite appears in these sediments about 0.6 km west of the CNT relay station and 1.5 km west of Money Point, where kyanite also occurs.

The strong schistosity of this sequence is associated with tight minor folds and has been crenulated by a later deformation. The minor folds plunge gently to moderately north and south. Intersection of bedding and schistosity and the geometry of the folds suggests that the entire sequence might form the western limits of an antiform. Microscopic studies of the metasedimentary rocks shows that the strong schistosity recognized in the field is a second fabric (S_2). It is a composite structure, generally defined by muscovite and biotite that forms augen around the garnet and staurolite porphyroblasts and the kyanite aggregates. The garnet and staurolite contain straight muscovite-biotite inclusion trails of an earlier (S_1) fabric. A few garnet crystals contain slightly curved inclusion trails near their margins which suggest that the growth of these prophyroblasts continued into the early part of the second deformation. Crenulations of the S_2 cleavage represent the third stage of polyphase deformation of this cover sequence which we suggest was deposited upon an earlier deformed basement represented by the marble gneiss septa and other country rock components in the "hybrid gneiss."

Medium-grained red, massive leucocratic biotite granite exposed south of the Money Point sequence cuts this sequence and also cuts the gneissic granite ("hybrid rocks") farther south along the coast. In places it is involved in minor open folds presumably equivalent to late flexures (F_3) in the metasedimentary/volcanic sequence.

Discussion

The presence of basement and cover rocks and granitic rocks of two ages at Cape North strongly resemble the relationships described by Wiebe (1972) in northeastern Cape Breton Island. We have visited several of Wiebe's localities, particularly his Clyburn Brook section, and noted strong lithological and metamorphic similarities to those at Cape North. The Cape North volcanic rocks differ from Wiebe's classification of the volcanic rocks of the Forchu Group(?) as ranging from rhyolite to andesite. Both deformed cover sequences superficially resemble the less metamorphosed rocks of the Hadrynian Fourchu Group (Weeks, 1954) in their type section of southeastern Cape Breton.

Our study supports Wiebe's evidence of an unconformity between gneissic basement (George River Group?) and deformed cover sequence (Fourchu Group?). This relationship differs from that in the type area of southeastern Cape Breton Island where Helmstaedt and Tella (1973) interpret Fourchu volcanism as approximately coeval with the final period of George River deposition. Also, Helmstaedt and Tella report that the Fourchu Group suite represents a complete calc-alkaline suite in contrast to the bimodal assemblages at Clyburn Brook and Cape North.

A major northeast striking fault in northern Cape Breton, the Aspy Fault, is commonly considered to separate basement rocks of very different character (Neale, 1963; Wiebe, 1972; Currie, 1975). For example, lenticular masses of anorthosite and sheared and chloritized mafic rocks are common in the intensely retrogressed gneisses west of the fault, but are not known to the east, whereas marble is known east of the fault but not to the west, except in the Cape North region. These differences led Brown (1973) to correlate the Aspy Fault with the Cape Ray Fault of southwest Newfoundland which he has interpreted as a cryptic suture along which two former continental margins of a pre-Ordovician, Proto-Atlantic Ocean (Iapetus) were brought together.

Our observations at Cape North, which is west of Aspy Fault, suggest strong similarity of basement and cover rocks with those east of the fault. We conclude that if the Cape Ray Fault does actually extend to Cape Breton Island, then it may be hidden beneath the Carboniferous rocks west of Cape North and joins with the Aspy Fault farther to the south near the town of Sugarloaf on Aspy Bay.

Although basement rocks differ on either side of the Aspy Fault, there is a remarkable resemblance in the deformed cover sequences. Currie (1975) has described the Trout Brook complex from the west coast area immediately north of Cheticamp (Fig. 1) as a sequence which consists of basaltic and rhyolitic rocks near the base grading upward into slate and then a monotonous series of greywackes. Metamorphic grade ranges from sub greenschist to amphibolite and locally the sequence grades into migmatite. It rests unconformably on an older gneissic complex. These rocks strongly resemble the Cape North sequence and also the deformed cover rocks of the Clyburn Brook section. The ages of all these cover sequences are unknown and this resemblance of lithological sequences on either side of the Aspy Fault may be fortuitous. However, if they are old (e.g., Hadrynian) and formed prior to the closing of the proto-Atlantic Ocean, they would reflect similar environments of origin on either side of the ocean.

Wiebe (1972) concludes that the cover rocks of northeastern Cape Breton and the ca. 560-m.y. old granitic rocks (Cormier, 1972) which intrude them were not deformed until the Devonian, about the time of emplacement of the younger granites of the area, i.e., ca 400 m.y. (Cormier, 1972; Phinney, 1963). We suggest that this age is too restrictive and draw attention to the relationships in the Gander Belt of Newfoundland which Williams and others (1970, 1974) have projected into northern Cape Breton (Fig. 3). Deformation of cover rocks and the older garnetiferous granites intrusive into them is dated stratigraphically as pre-Middle Ordovician near the town of Gander (Kennedy and McGonigal, 1972). Elsewhere in the Gander Zone, near Baie d/Espoir in southern Newfoundland, a similar granite has yielded a Rb/Sr whole rock isochron of 573 ± 40 m.y. (Cormier, personal communication, 1974). For this reason some of the metamorphism and granitic intrusion of the Gander Zone is interpreted as Hadrynian and referred to as the Ganderian orogenic episode (Kennedy, 1975). However, in the southwestward extension of the Gander Zone is has long been recognized that there is also evidence of Devonian deformation, metamorphism and intrusion (Cooper, 1954). It still seems probable to us that Cormier's 560 m.y. event which was chiefly an igneous event in southeastern Cape Breton (Cormier, 1972; Helmstaedt and Tella, 1973) and southeasternmost Newfoundland (Williams *et al.*, 1972, 1974) may have been an important tectonic event in northern Cape Breton - certainly east of the Aspy Fault and possibly on both sides of it.

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