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Precambrian Rocks of Cape Breton Island*

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Introduction

Two major Precambrian units, a dominantly metasedimentary unit (George River Group) and a dominantly metavolcanic unit (Fourchu Group), were recognized by Weeks (1954) and many other workers in southern and central Cape Breton. Except for the fact that both units were demonstrably pre-middle Cambrian in age, field data defining their relative ages and structural relations were equivocal.

Two differing interpretations of the relations between these two units were recently presented by Wiebe (1972) and Helmstaedt and Tella (1972). In northern Cape Breton Island, Wiebe (1972) mapped two units which could be identified lithologically with the George River and Fourchu groups. Field relations clearly indicated that the metasedimentary unit (George River Group) had been deformed at least once, metamorphosed, and intruded by mafic to intermediate plutonic rocks prior to the accumulation of the metavolcanic unit (Fourchu Group). Recent workers in southeastern Cape Breton Island (Milligan, 1970, and Helmstaedt and Tella, 1972) have suggested the possibility that the George River and Fourchu groups are contemporaneous. In view of the lithologic similarities and the geographic proximity of the units in northern and southern Cape Breton Island, it is not likely that both views can be valid. If the former view is correct, the George River rocks may well be of Helikian age. The latter view suggests strongly that the oldest rock in Cape Breton Island are Hadrynian. It is the purpose of this paper to consider the correlation of units in northern and southern Cape Breton Island, to review the relations determined in northern Cape Breton Island which demonstrate distinct ages and histories of these units, and to examine briefly the evidence of contemporaneity presented by Milligan (1970) and Helmstaedt and Tella (1972).

Description and Correlation of Lithologic Units

In the Ingonish area of northern Cape Breton Island (Wiebe, 1972, Fig. 1) an older sequence consists of sedimentary rocks which have been metamorphosed within the amphibolite facies. Impure quartzite and marble with variable amounts of calc-silicate bands form prominent members of the sequence which help to define multiple folding on the map scale. Less well exposed are pelitic and semi-pelitic layers with local concentration of sulfides. Deformed dioritic intrusions as well as younger sub-volcanic dikes cut across the earliest recognized folds. None of the igneous or metaigneous material appears intercalated or contemporaneous with the sedimentary sequence. This older sequence resembles very closely the George River Group as reviewed by Weeks (1954). In southern Cape Breton Island, Kelley (1967) encountered some possible volcanic materials within areas of George River rocks but could not decide if they represented younger cross-cutting or contemporaneous bodies. Evidence in northern Cape Breton Island suggests that these volcanic materials are dikes.

The younger unit in northern Cape Breton Island consists dominantly of felsic to intermediate volcanic and volcaniclastic rocks with variable amounts of fine-grained sedimentary materials. Metamorphism, metasomatism, and deformation have hindered attempts to determine the original chemical range of these rocks. The description of the metavolcanic rocks by Wiebe (1972) indicates that they are broadly similar to the Fourchu Group of southeastern Cape Breton Island as described by Weeks (1954). Close association with hypabyssal intrusions in both areas strengthens the correlation. The younger rocks in northern Cape Breton Island and the Fourchu Group in southern Cape Breton Island have similar interbeds of dark fine-grained sediments.

Age Relations Between George River and Fourchu Rocks in Northern Cape Breton Island

In northern Cape Breton Island George River rocks have been strongly deformed at least twice and thoroughly metamorphosed. They are cut by a wide range of intrusive rocks, gneissic diorites, numerous sub-volcanic dikes and younger granitic plutons. Fourchu rocks appear to have been folded only once and show a greater range of metamorphism which appears spatially related to youngest granitic rocks (dated at 410±50 my by Cormier, 1972). Sub-volcanic dikes are extremely scarce and were observed only near the base of the unit. Diorite was nowhere observed to cut Fourchu rocks. Sub-volcanic dikes are abundant in the George River rocks and may have fed flows and tuffs which make up much of the Fourchu Group.

The contact between the two units was mapped as an unconformity (Wiebe, 1972, Fig. 2). N. Rast (personal communication, 1974) suggested that this boundary may be instead a tectonic slide. The minor tectonic disturbance along the boundary was interpreted by Wiebe (1972) as the affect of Acadian deformation on the unconformity. One argument against the slide interpretation is the fact that a hypabyssal pluton (presumably cogenetic with the Fourchu Group volcanics) cuts across the boundary. The slide must therefore have taken place during accumulation of the Fourchu Group and before the emplacement of the pluton. Regardless of the interpretation of the contact, the structural histories of the two units (George River Group and Fourchu Group) are clearly distinctive and suggest that a significant time elapsed between the accumulation of the two units.

Relations Between Fourchu and George River Groups in Southern Cape Breton Island

In 1954 Weeks summarized much of what was then known or believed about Cape Breton geology on the basis of his extensive mapping and the reports of earlier workers. At that time (and even at present) there was little systematic

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knowledge of the stratigraphy of either the George River Group or the Fourchu Group. There was however, an obvious lithologic contrast between initial descriptions of the two units which led workers to assume different ages for the two units. Further, because the George River Group contained prominent marble and quartzite, there was a tendency to correlate it with "Grenville" sedimentary rocks.

Clear structural relations between Fourchu and George River rocks were not determined in southern Cape Breton Island. Weeks (1954, p. 13) stated that an unconformity "of considerable magnitude" exists between Middle Cambrian rocks and the George River Group and indicated that at least one deformation and metamorphism affected George River rocks prior to deposition of Middle Cambrian rocks. Weeks (1954, p. 25) emphasized the apparent depositional continuity between the Fourchu Group volcanic rocks and fossiliferous Middle Cambrian sedimentary rocks. If both of his statements are correct, then there must be at least one episode of deformation and metamorphism between the times of accumulation of the George River and Fourchu groups. This inferred relationship for southern Cape Breton Island matches that demonstrated for northern Cape Breton Island by Wiebe (1972).

On the basis of more recent mapping, Milligan (1970) and Helmstaedt and Tella (1972) have suggested that the Fourchu and George River groups may be contemporaneous and represent different depositional environments. It is this writer's opinion that the data upon which such an interpretation has been made are inadequate and may be more simply interpreted in other ways.

In the report by Milligan (1970), the main evidence for contemporaneity of the Fourchu and George River Groups is the occurrence of volcanic material in areas mapped as dominantly marble or quartzite. Maps accompanying his report show considerable detail and record locations of all outcrops encountered. Small outcrops of volcanics have been interpreted as interbedded lavas and the extrapolated distribution on the map has been influenced by that assumption. Milligan (1974, personal communication) has expressed uncertainty as to whether the volcanic material was extrusive or intrusive. On the basis of outcrop distribution, it seems as likely that the volcanic rocks are dikes and that the relations are similar to those observed in northern Cape Breton Island.

The evidence put forward by Helmstaedt and Tella (1972) for a facies interpretation consists entirely of the occurrence of "andesitic fragments in a limestone breccia". The age and structural setting of the breccia is not known, and Helmstaedt (1974, personal communication) expressed uncertainty as to whether the breccia was of sedimentary or tectonic origin.

Summary

It is this writer's view that the evidence presented by Milligan (1970) and Helmstaedt and Tella (1972) in favor of a facies interpretation of the George River and Fourchu Group is inadequate and unconvincing. It seems much more probable that the relations suggested by Weeks (1954) for southern Cape Breton Island and demonstrated by Wiebe (1972) for northern Cape Breton Island are in general terms applicable throughout Cape Breton Island: the George River Group is probably Helikian in age and was deformed, metamorphosed and intruded by igneous rocks prior to accumulation of the Hadrynian Fourchu Group.

References

CORMIER, R.F., 1972, Radiometric ages of granitic rocks, Cape Breton Island, Nova Scotia. Can. J. Earth Sci., vol. 9, pp. 1074-1086.

HELMSTAEDT, H. and TELLA, S., 1972, Structural history of pre-Carboniferous rocks in parts of eastern Cape Breton Island in Geol. Surv. Canada Paper 71-1, Part A, pp. 7-10.

KELLEY, D.G., 1967, Baddeck and Whycocomagh map-areas. Geol. Surv. Canada, Memoir 351, pp. 65.

MILLIGAN, G.C., 1970, Geology of the George River series, Cape Breton. Province of Nova Scotia, Department of Mines, Memoir 7, pp. 111.

WEEKS, L.J., 1954, Southeast Cape Breton Island, Nova Scotia. Geol. Surv. Canada, Memoir 277, pp. 112.

WIEBE, R.A., 1972, Igneous and tectonic events in northeastern Cape Breton Island, Nova Scotia. Can. J. Earth Sci., vol. 9, pp. 1262-1277.