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Résumé de l'article

Les roches volcaniques et sddimentaires du neoproterozoique III dans les hautes-terres d'Antigonish et de Cobequid prlsentent de grandes similarites aux points de vue lithostratigraphie, age de deposition, glochimie volcanique et histoires structurale et m£tamorphique. Les deux regions sont d£coup£es en plusieurs blocs de faille; ils sont nomm6s, du nord au sud: Georgeville, crete Maple, Clydesdale et Keppoch dans les hautes-terres d'Antigonish et Jeffers et riviere Bass dans les hautes-terres de Cobequid. Les variations de facies du nord au sud permettent des correlations lithostratigraphiques entre les blocs de Keppoch et de Jeffers et entre ceux de Clydesdale et de la riviere Bass. L'age de deposition maximal de ces roches est donn6 par les datations U-Pb sur les zircons d£triliques a 613 ± 5 Ma et 605 ± 5 Ma. Trois types gdochimiques distincts de volcanites se retrouvent dans les deux regions: des tholeiites continentales, des andesites basaltiques calco-alcalines et des rhyolites d'arc volcaniques. La deformation neoproterozoique III va d'intense (plissements et chevauchemenls multiples) dans les hautes-terres de Cobequid et le nord des hautes-terres d'Antigonish a faible et d'une seule phase dans le sud des hautes-terres d'Antigonish. Les roches plutoniques post-tectoniques communes aux deux regions comprennent les gabbros riches en hornblende et les granodiorites d'arc volcanique avec des ages entre 620 ± 5 et 609 ± 4 Ma. Ceux-ci limitent etroitement les age de deposition, de deformation et d'intrusion entre 618 et 615 Ma dans les hautes-terres d'Antigonish et entre 610 et 608 Ma dans les hautes-terres de Cobequid.

Les donnees stratigraphiques et la g6ochimie des volcanites indiquent une deposition dans un arc volcanique ensialique. La deformation neoproterozoique III est attribute a la fermeture du bassin. Les correlations entre les hautes-terres de Cobequid ct cclles d'Antigonish suggercnt qu'elles font partie d'un meme terrain neoproterozoique et que les mouvements de failles pal6ozoi'ques etaicnt restreints.

Correlation of Neoproterozoic III sequences in the Avalon Composite Terrane of mainland Nova Scotia: tectonic implications

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Neoproterozoic III volcanic and sedimentary rocks in the Antigonish and Cobequid Highlands have very similar lithostratigraphy, depositional age, volcanic geochemistry, and structural and metamorphic histories. Both regions are cut into several fault blocks; from north to south these are termed Georgeville, Maple Ridge, Clydesdale and Keppoch in the Antigonish Highlands, and Jeffers and Bass River in the Cobequid Highlands. North to south facies variations allow lithostratigraphic correlation between the Keppoch and Jeffers blocks, and the Clydesdale and Bass River blocks. The maximum depositional age of these rocks is provided by U-Pb detrital zircon ages of 613 ± 5 and 605 ± 5 Ma. Three geochemically distinct types of volcanic rocks occur in both regions: continental tholeiites, calc-alkalic basaltic andesites, and volcanic arc rhyolites. Neoproterozoic III deformation varies from intense (polyphase folding and thrusting) in the Cobequid Highlands and northern Antigonish Highlands to mild and single phase in the southern Antigonish Highlands. Post-tectonic plutonic rocks common to both regions include volcanic-arc granodiorite and hornblende-rich gabbro with ages between 620 ± 5 and 609 ± 4 Ma. These closely constrain the time of deposition, deformation and intrusion to between 618 and 615 Ma in the Antigonish Highlands and 610 and 608 Ma in the Cobequid Highlands.

The stratigraphic record and the volcanic geochemistry indicate deposition in an ensialic volcanic arc rift. The Neoproterozoic III deformation is attributed to basin closure. The correlations between the Cobequid and Antigonish Highlands suggest that they form part of one Neoproterozoic III terrane and that Paleozoic fault movement was limited.

Les roches volcaniques et sédimentaires du néoprotérozoïque III dans les hautes-terres d'Antigonish et de Cobequid présentent de grandes similarités aux points de vue lithostratigraphie, âge de déposition, géochimie volcanique et histoires structurale et métamorphique. Les deux régions sont découpées en plusieurs blocs de faille; ils sont nommés, du nord au sud: Georgeville, crête Maple, Clydesdale et Keppoch dans les hautes-terres d'Antigonish et Jeffers et rivière Bass dans les hautes-terres de Cobequid. Les variations de faciès du nord au sud permettent des corrélations lithostratigraphiques entre les blocs de Keppoch et de Jeffers et entre ceux de Clydesdale et de la rivière Bass. L'âge de déposition maximal de ces roches est donné par les datations U-Pb sur les zircons détritiques à 613 ± 5 Ma et 605 ± 5 Ma. Trois types géochimiques distincts de volcanites se retrouvent dans les deux régions: des tholéiites continentales, des andésites basaltiques calco-alcalines et des rhyolites d'arc volcaniques. La déformation néoprotérozoïque III va d'intense (plissements et chevauchements multiples) dans les hautes-terres de Cobequid et le nord des hautes-terres d'Antigonish à faible et d'une seule phase dans le sud des hautes-terres d'Antigonish. Les roches plutoniques post-tectoniques communes aux deux régions comprennent les gabbros riches en hornblende et les granodiorites d'arc volcanique avec des âges entre 620 ± 5 et 609 ± 4 Ma. Ceux-ci limitent étroitement les âge de déposition, de déformation et d'intrusion entre 618 et 615 Ma dans les hautes-terres d'Antigonish et entre 610 et 608 Ma dans les hautes-terres de Cobequid.

Les données stratigraphiques et la géochimie des volcanites indiquent une déposition dans un arc volcanique ensialique. La déformation néoprotérozoïque III est attribuée à la fermeture du bassin. Les corrélations entre les hautes-terres de Cobequid et celles d'Antigonish suggèrent qu'elles font partie d'un même terrain néoprotérozoïque et que les mouvements de failles paléozoïques étaient restreints.

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INTRODUCTION

The Avalon Composite Terrane of the northern Appalachian Orogen extends from Newfoundland to southern New England (Keppie and Dallmeyer, 1989). It is defined by the presence of a lithostratigraphically correlative, subaerial to shallow marine, Cambrian-Ordovician overstep sequence containing an Acado-Baltic (Atlantic realm) fauna (Keppie, 1985). Where the Cambrian-Ordovician rocks have been removed by erosion, the presence of a lithostratigraphically correlative Silurian-Lochkovian overstep sequence containing the distinctive Rhenish-Bohemian fauna (Boucot, 1975) may also be used to define the composite terrane (Keppie *et al.*, 1991). Neoproterozoic III (i.e., 650-540 Ma; Plumb, 1991) sequences characterized by diverse volcano-sedimentary sequences that overlie a mid/late Proterozoic basement are intruded by gabbroic, dioritic and granitic plutons. Contrasts in Proterozoic stratigraphy led to the division of the Avalon Composite Terrane into several Neoproterozoic III terranes, including the Antigonish and Cobequid terranes, that were assembled during the Neoproterozoic III Avalonian-Cadomian orogeny to form the "Avalon Composite Terrane" (Keppie, 1985, 1989). One of the major problems in deciphering the evolution of the Neoproterozoic III Avalonian rocks is the difficulty in confidently correlating among the various Neoproterozoic III sequences. Detailed correlations between Avalonian successions in Newfoundland have been proposed (e.g., King, 1988). No equivalent analysis is available for Avalonian rocks in Nova Scotia. The purpose of this paper is to review the geology of the late Proterozoic rocks of the Antigonish and Cobequid Highlands in order to draw attention to the very strong lithostratigraphic, geochemical and geochronological similarities between these two areas. These data suggest that northern Nova Scotia belonged to a single terrane in the Neoproterozoic III.

Detailed descriptions of the sequences in the Antigonish and Cobequid Highlands may be found elsewhere (Pe-Piper, 1987; Pe-Piper and Piper, 1987, 1989; Murphy and Keppie, 1987; Murphy *et al.*, 1990) and are summarized below.

GEOLOGICAL SETTING AND STRATIGRAPHY

Antigonish Highlands

Neoproterozoic III rocks of the Georgeville Group in the Antigonish Highlands occur in several fault blocks: (from north to south) the Georgeville, Maple Ridge, Clydesdale and Keppoch blocks (Fig. 1B; Murphy and Keppie, 1987). Although the stratigraphy of the Georgeville Group in the Antigonish Highlands changes across fault blocks (Fig. 2), gross similarities enable correlation across the bounding faults (Murphy and Keppie, 1987).

In the southernmost Keppoch block, the Keppoch Formation consists of at least 3000 m of subaerial to submarine, interlayered felsic volcanic rocks, basaltic andesites and basalts, overlain by thick turbiditic greywackes and mudstones (Murphy and Keppie, 1987). In the Clydesdale block the sequence is dominated by at least 1500 m of proximal and distal turbidites with thin interlayered mafic volcanic rocks (Fig. 2). The Maple Ridge block consists of at least 1200 m of turbiditic mudstones, slates and minor conglomerates. In the northernmost Georgeville block, plagioclase-phyric basaltic andesites and interlayered marbles are overlain by distal turbidites and channel-fill conglomerates (Murphy and Keppie, 1987). Clasts within the conglomerates include granite, andesite, rhyolite, mudstone, quartz and feldspar.

A maximum depositional age for the Georgeville Group is given by the 613 ± 5 Ma age of the youngest detrital zircons from one of these conglomerates (Keppie and Krogh, 1990). $^{40}Ar/^{39}Ar$ analyses of hornblende from a post-tectonic appin-

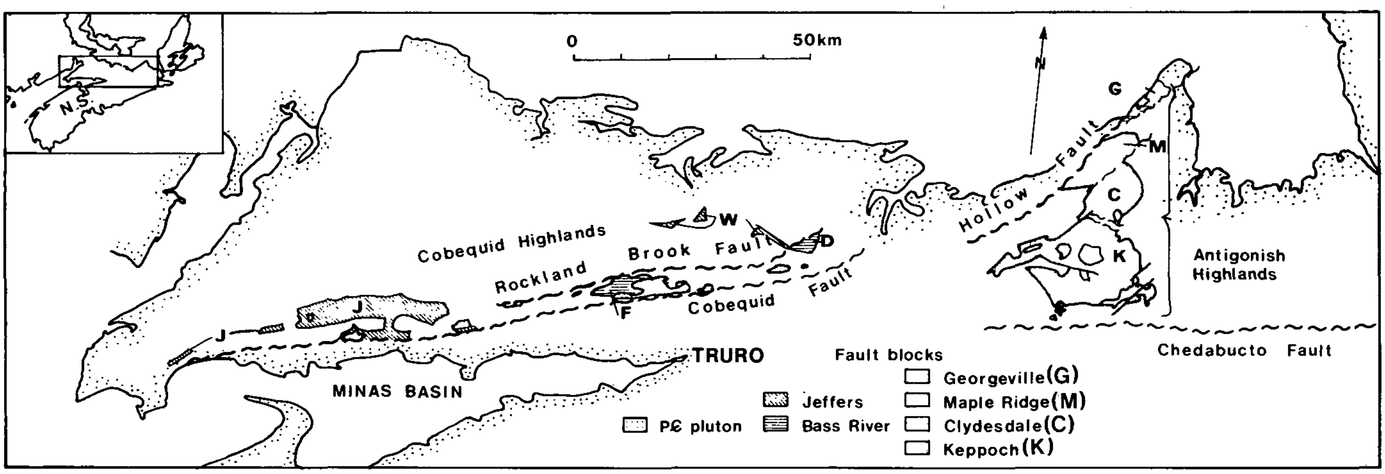

Fig. 1. Generalized geological map of the Precambrian rocks of northern mainland Nova Scotia (modified from Williams, 1979; Donohoe and Wallace, 1982; Murphy *et al.*, 1991; Pe-Piper and Piper, 1987). Rocks of the Antigonish Highlands (the Georgeville Group) consist of C - Clydesdale Formation, CB - Chisholm Brook Formation, K - Keppoch Formation, M - Maple Ridge Formation. Rocks of the Cobequid Highlands consist of D - Dalhousie Mountain volcanic unit, F - Folly River Formation, J - Jeffers Group, and W - Warwick Mountain Formation.

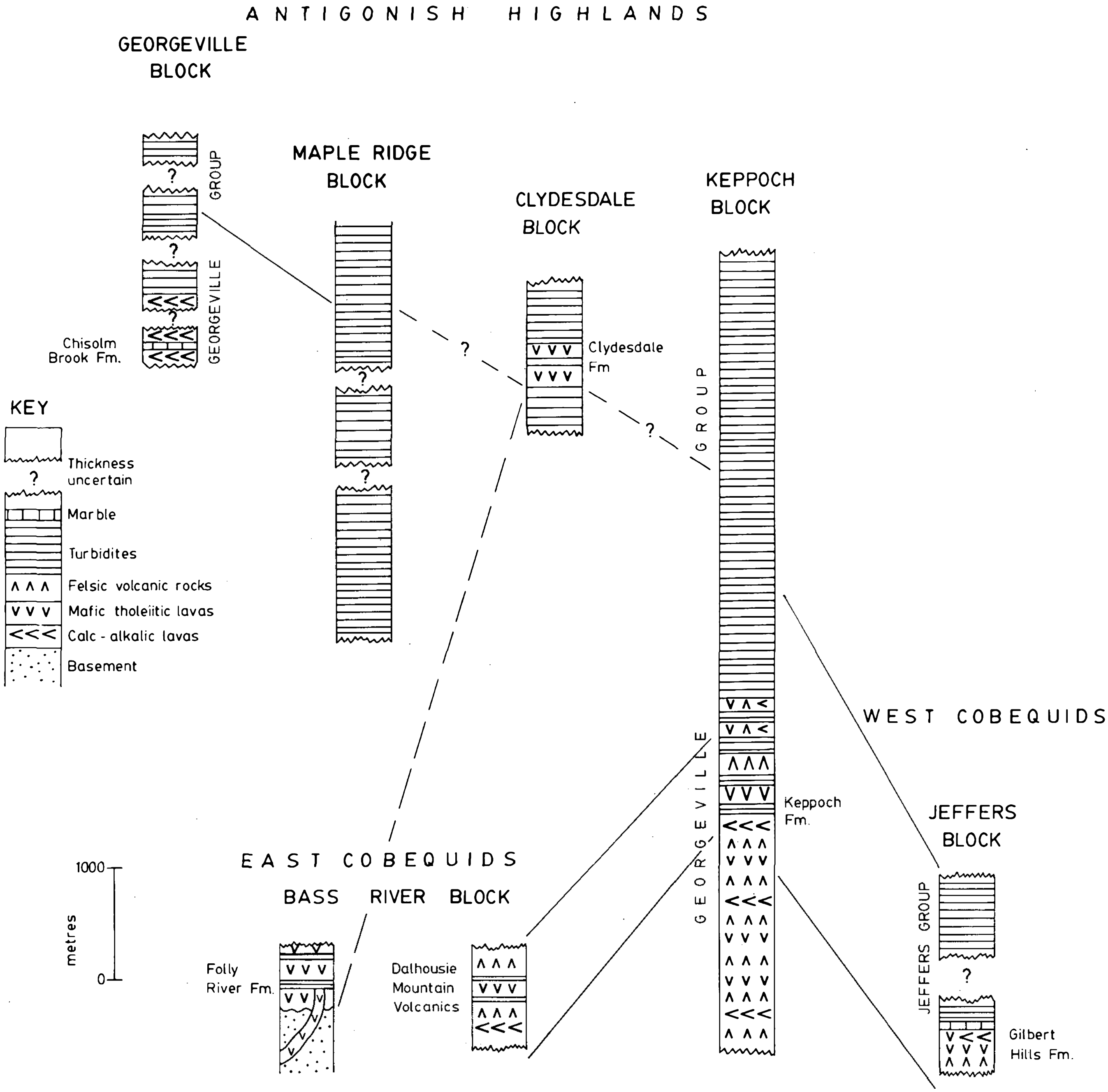

Fig. 2. Schematic stratigraphy of the Neoproterozoic III rocks of northern mainland Nova Scotia. Only the names of formations with volcanic rocks are given. Stratigraphic details given by Murphy and Keppie (1987), Pe-Piper (1987) and Pe-Piper and Piper (1987, 1989). Correlation within the Antigonish Highlands is based on recognition of large-scale fining and coarsening upward cycles (see text and Murphy and Keppie, 1987). Other correlations are discussed in text.

itic pluton in the northern highlands yield plateau ages of 620 ± 5 Ma and 611 ± 4 Ma (Keppie *et al.*, 1990). The above data imply that the Georgeville Group in the Georgeville block was deposited and deformed between 618 and 615 Ma.

The correlation of formations across fault blocks shown in Figure 2 is based on (a) correlation of the conglomerates in the Georgeville, Maple Ridge and Clydesdale blocks, (b) similarity between thin plane-laminated mudstones in the Georgeville and Maple Ridge blocks, and (c) large-scale upward-coarsening and upward-fining trends in different fault blocks. The limited thickness and fine-grained nature of the sedimentary rocks of the Clydesdale Formation indicate that the depositional site was sediment starved, but on the basis of stratigraphic position, it probably correlates with the upper part of the thick sequence of turbidites in the Maple Ridge block to the north (Murphy and Keppie, 1987, see also Fig. 2). Generally, the turbidites fine southward, suggesting that there was a source of volcanic detritus to the north of the basin. The stratigraphic succession probably represents the progressive development of a marine basin (Murphy and Keppie, 1987).

Cobequid Highlands

The Cobequid Highlands are divided by the Rockland Brook Fault into the Jeffers and Bass River blocks (Fig. 1). Neoproterozoic III rocks of the Jeffers Group and the Warwick Mountain Formation outcrop in the Jeffers block in the central and western highlands, whereas the Folly River Formation and the informally named Dalhousie Mountain volcanic unit are found in the Bass River block in the eastern highlands (Fig. 1; Donohoe and Wallace, 1982, 1985; Pe-Piper and Piper, 1987, 1989; Murphy *et al.*, 1988). In the Jeffers block, the stratigraphy of Jeffers Group (Pe-Piper and Piper, 1987, 1989) is complicated by thrusting. Thick, interlayered felsic flows and tuffs, basaltic andesites and basalts of the Gilbert Hills Formation are conformably overlain by argillites and pass upward into sandy turbidites (Fig. 2). A minimum depositional age for the Jeffers Group is given by the $^{40}Ar/^{39}Ar$ hornblende plateau ages of 607 ± 3 Ma and 605 ± 4 Ma for the post-tectonic Jeffers diorite (Keppie *et al.*, 1990). In the northeastern part of the Jeffers block, the Warwick Mountain Formation consists of strongly cleaved turbidites and mafic to felsic volcanic rocks that have been correlated with the Jeffers Group (Donohoe and Wallace, 1982, 1985).

In the eastern end of the Bass River block of the Cobequid Highlands, the Dalhousie Mountain volcanic unit consists of interlayered felsic to mafic flows and pyroclastic rocks and interlayered turbidites (Murphy *et al.*, 1988). In the central part of the Bass River block, the Folly River Formation consists of basalts, abundant feeder dykes and interbedded distal turbidites and cherts (Pe-Piper and Murphy, 1989). The Folly River Formation is interpreted to unconformably overlie quartzites and pelitic schists of the Gamble Brook Formation (Murphy *et al.*, 1988). The basal contact of the Folly River Formation truncates a mylonitic fabric in the Gamble Brook Formation. A granite, thought to have intruded in the latest stages of the development of this mylonitic fabric (Nance and Murphy, 1990), yielded a U-Pb zircon age of 605 ± 5 Ma (Doig *et al.*, 1991). Nance and Murphy (1990) attributed the fabric development in the Gamble Brook Formation to sinistral, strike-slip movements during development of the basin into which the Folly River Formation was deposited. A minimum age for the deposition of the Folly River Formation is given by the 612 ± 4 Ma and 609 ± 4 Ma ages of the post-tectonic Debert River Formation (Doig *et al.*, 1991, U-Pb, zircon). Taken together, the above geochronological data constrain deposition and deformation of the Folly River Formation to between 610 and 608 Ma.

VOLCANIC GEOCHEMISTRY

Geochemical studies have distinguished three distinct magma types in the Neoproterozoic III volcanic and hypabyssal rocks in the Antigonish and Cobequid Highlands (Pe-Piper and Piper, 1989; Pe-Piper and Murphy, 1989; Murphy *et al.*, 1990):

(a) Fe-Ti rich within-plate continental tholeiitic basalts which generally plot as subalkali basalts on a SiO_2 versus Zr/TiO_2 plot (Fig. 3a) and contain up to 19.0 wt. % FeO^T (Fig. 3b). On many tectonic discrimination plots (e.g., Fig. 3c), they plot as within-plate basalts. In the Antigonish Highlands, these basalts occur in the Clydesdale and Keppoch formations. In the Cobequid Highlands, these rocks comprise the basalts and dykes of the Jeffers Group, Folly River and Warwick Mountain formations.

(b) Calc-alkalic basaltic andesites, with less abundant andesites and dacites (Fig. 3a), fall mostly within the calc-alkaline field on many tectonic discrimination plots (e.g., Fig. 3c) and near the tholeiitic-calc-alkaline boundary of Miyashiro (1974) in terms of iron enrichment (Fig. 3b). In the Antigonish Highlands this is the predominant magma type in the Keppoch Formation and the only volcanic rock type represented in the Chisholm Brook Formation. In the Cobequid Highlands, this is the predominant component in the Jeffers Group and Dalhousie Mountain volcanics, and it is also represented in the Warwick Mountain Formation.

(c) Rhyolites which have geochemical features indicating a volcanic arc origin. Murphy *et al.* (1990) summarized the evidence to suggest that these resulted from crustal anatexis. Such rhyolites are found in the Keppoch Formation of the Antigonish Highlands and in the Jeffers Group, Warwick Mountain Formation and Dalhousie Mountain unit of the Cobequid Highlands (Fig. 3a).

The geochemistry of the volcanic rocks of both the Antigonish and Cobequid Highlands has been interpreted to represent a rifted volcanic arc (Murphy *et al.*, 1990; Pe-Piper and Piper, 1989).

STRUCTURE

In the northern Antigonish Highlands, the Georgeville Group has been polydeformed, firstly by N-S isoclinal folds and thrusts and refolded by E-W, followed by N-S, upright folds. The deformation is attributed to Neoproterozoic III dextral closure of the sedimentary basin (Murphy *et al.*, 1991). This deformation dies out southward and is only locally developed in the Keppoch block. Cleaved fragments derived from the Georgeville Group occur in unconformably overlying Cambrian-Ordovician rocks (Murphy and Keppie, 1987). The time of deformation in the Antigonish Highlands is constrained to 618 to 615 Ma by the ca. 613 ± 5 Ma detrital zircons in the Georgeville Group (Keppie and Krogh, 1990) and by the 620 ± 5 to 611 ± 4 Ma (Keppie *et al.*, 1990) post-tectonic appinitic plutons that intruded the group.

In the Cobequid Highlands, isoclinal folds and N-verging thrusts in the Jeffers Group have been cut by post-tectonic gabbroic to granitic plutons with $^{40}Ar/^{39}Ar$ plateau ages for hornblende of 605 ± 4 and 607 ± 3 Ma (Pe-Piper and Piper, 1987; Keppie *et al.*, 1990). These ages provide a minimum age for the deformation. The Folly River Formation was deformed by variably plunging, tight, asymmetric folds with an axial planar schistosity containing a gently ESE plunging mineral stretching lineation refolded by broadly coplanar and coaxial folds with a spaced axial planar fracture cleavage (Nance and Murphy, 1990). All of the structures in the Jeffers Group and Folly River Formation were attributed to dextral basin closure by Nance and Murphy (1990). The age of deformation of the Folly River Formation is constrained to between 610 and 608 Ma by the post-tectonic Debert River Pluton (dated at ca. 612 ± 4 Ma and 609 ± 4 Ma, Doig *et al.*, 1991, U-Pb zircon) and the pre-Folly River mylonitic granite dated at 605 ± 5 Ma.

Correlations

The lithostratigraphic, geochemical and geochronological data support a correlation of the Keppoch Formation of the Antigonish Highlands with the Jeffers Group, Warwick Mountain Formation and Dalhousie Mountain volcanic unit of the Cobequid Highlands. Both contain interlayered continental tholeiitic basalt, calc-alkaline basaltic andesite and volcanic-arc rhyolite overlain by a thick sequence of greywacke. The Clydesdale Formation (Antigonish Highlands) strongly resembles the Folly River Formation (Cobequid Highlands) in that they both consist of continental tholeiitic basalt and interlayered greywacke. Although the Folly River Formation is geochemically and lithologically similar to the Clydesdale Formation, the lack of proximal turbidites in the Folly River Formation suggests a more distal environment of deposition. The Folly River Formation lies within the same fault block as the Dalhousie Mountain volcanic unit (i.e., Bass River block), suggesting a facies transition between them similar to that proposed between the Keppoch and Clydesdale blocks. Geochronological constraints suggest that the northern Georgeville Group was deposited between 618 and 615 Ma, whereas deposition of the Folly River Formation occurred between 610 and 608 Ma. Given the errors between different geochronological methods and different laboratories, these sequences are interpreted as penecontemporaneous. The data also indicate that deposition occurred in a short time interval. The short time interval between deposition and deformation in both the Antigonish and Cobequid Highlands is consistent with the strike-slip tectonic regime proposed on the basis of kinematic data by Nance and Murphy, (1990). Neoproterozoic III deformation in both areas is attributed to telescoping of the volcanic-arc basin.

In summary, geochronological data indicate that the stratigraphic succession in both areas is penecontemporaneous. The stratigraphy in both the Cobequid and Antigonish Highlands records a progressive change from subaerial through shallow to deep submarine environments indicating the progressive development of a marine basin. The geochemistry of the volcanic rocks indicates that the basins were formed within a volcanic-arc rift. The presence of continental tholeiites and the lack of MORB affinities indicates that this basin did not reach a stage of oceanization and was probably floored by continental crust. The geochemistry of the penecontemporaneous plutons is consistent with a volcanic arc regime (Pe-Piper, 1988).

Palinspastic Reconstructions

The proposed correlations between the Cobequid Highlands and Antigonish Highlands make it possible to place constraints on a Neoproterozoic III and Paleozoic fault motions in northern Nova Scotia. Two major sets of faults that experienced strike-slip motion in the Paleozoic bound the Neoproterozoic III blocks (Fig. 1). The Cobequid and Chedabucto and related faults of the Minas Fault Zone trend east-west. The Hollow Fault trends north-east, as do the eastern ends of the Cobequid and Rockland Brook faults. Miller *et al.* (1989) proposed that the southwestern ends of these latter faults have been rotated clockwise by the latest dextral motion on the Minas Fault Zone. The Antigonish and Cobequid Highlands are separated by the Stellarton Basin, which is a northeasterly trending Upper Carboniferous trough that was affected by 20 to 35 km of Late Carboniferous dextral displacement on the Cobequid and Hollow Fault systems (Yeo and Gao, 1986, 1987). Restoring this motion suggests that the Cobequid and Antigonish Highlands were juxtaposed in Early Carboniferous time. Depending upon which set of major faults is used, two possible Neoproterozoic III palinspastic reconstructions place the Cobequid Highlands either south or north of the Antigonish Highlands (Fig. 4). The depositional paleogeography consists of the Keppoch Formation, Dalhousie Mountain volcanic unit and Gilbert Hills Formation (Jeffers Group) deposited on one side of a subsiding basin, with the Clydesdale and Folly River formations within the basin and the Chisholm Brook Formation on the opposite side of the basin.

Thus two palinspastic models can accommodate the proposed correlations depending on whether the Cobequid Highlands originally lay to the south (model A, Fig. 4) or north (model B, Fig. 4) of the Antigonish Highlands. If the blocks of the Cobequid Highlands originally lay south of the Antigonish Highlands (model A, Fig. 4) then most of the motion required to achieve their present configuration would be east-west dextral motion on the east-west Minas Fault Zone. This implies penecontemporaneous or subsequent dextral motion on northeast-trending faults (as suggested by Keppie, 1982; Yeo and Gao, 1986) and penecontemporaneous northerly-directed thrusting in the Cobequid Highlands (Waldron *et al.*, 1989). There is abundant evidence for dextral movements on the Minas Fault Zone during the Devonian-Carboniferous (Eisbacher, 1969; Yeo and Gao, 1986; Keppie and Dallmeyer, 1987; Mawer and White, 1987; Waldron *et al.*, 1989). Restoring northern Nova Scotia to its Early Carboniferous position yields a configuration (shown in model A, Fig. 4) consistent with the stratigraphic correlations proposed above.

On the other hand, if the Cobequid blocks initially lay north of the Antigonish Highlands (model B, Fig. 4), then major sinistral motion on the Rockland Brook and Hollow faults (and its continuation in the Cobequid Fault) would be required to achieve the present configuration. This would have been followed by minor dextral motions on the Cobequid Fault (Fig. 4). East-west faults bounding the blocks in

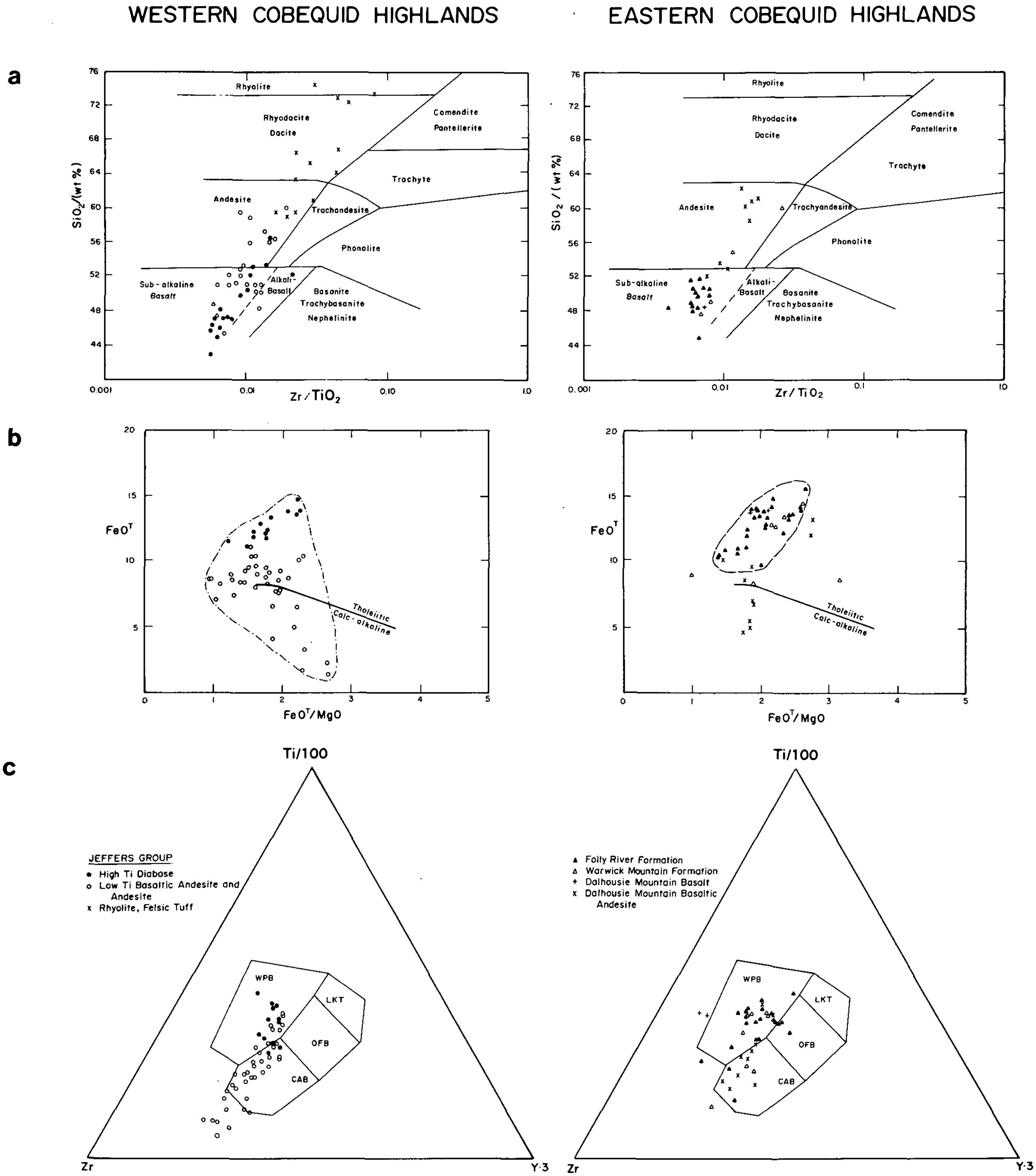

Fig. 3. Plots of selected elements from Neoproterozoic III volcanic rocks of northern mainland Nova Scotia to illustrate their geochemical character. Open symbols indicate calc-alkaline basaltic andesites; solid symbols, within-plate continental tholeiitic basalts.
(a) SiO_2 versus Zr/TiO_2
(b) FeO^T/MgO versus FeO^T for mafic rocks (tholeiitic - calc-alkalic boundary after Miyashiro, 1974)
(c) Ti-Zr-Y ternary diagram. Fields after Pearce and Cann (1973): WPB - within plate basalt, LKT - low K tholeiite, OFB - ocean floor basalt, CAB - calc-alkaline basalt.

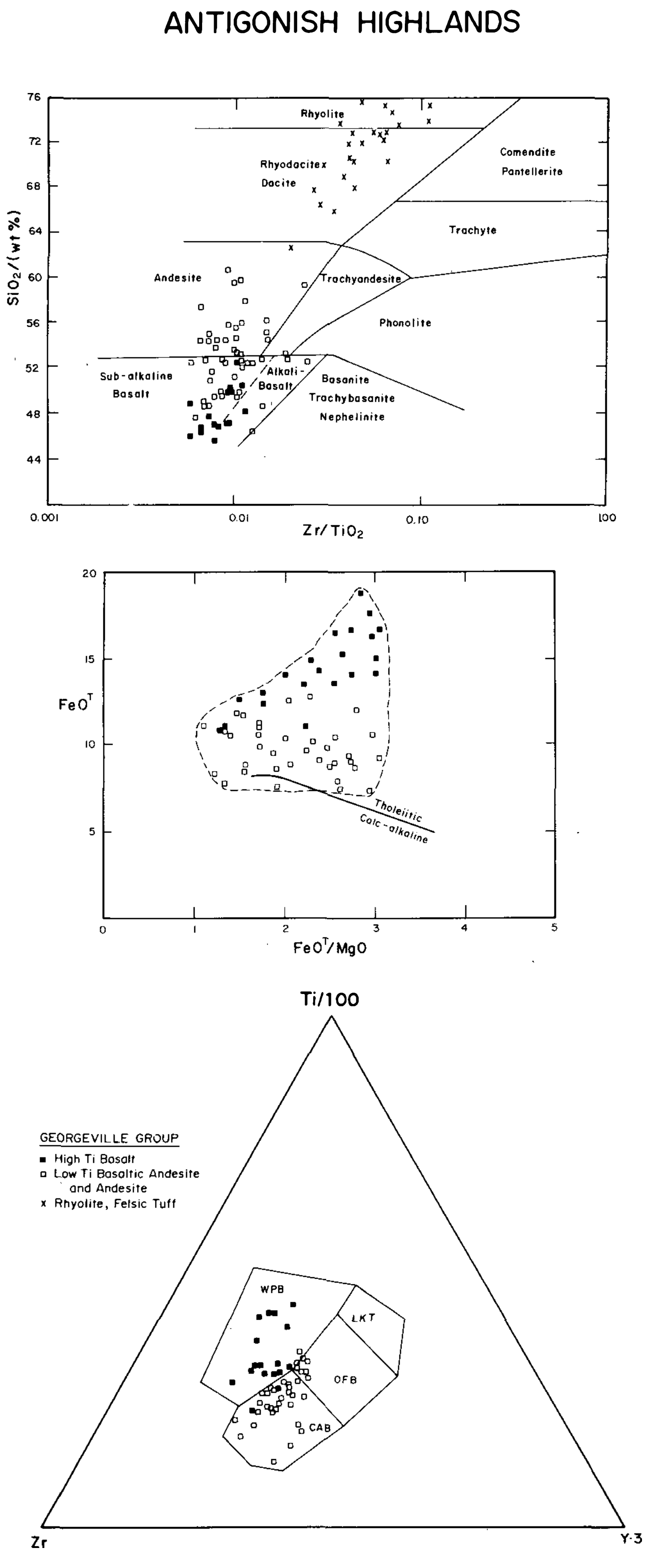

Fig. 3 Cont.

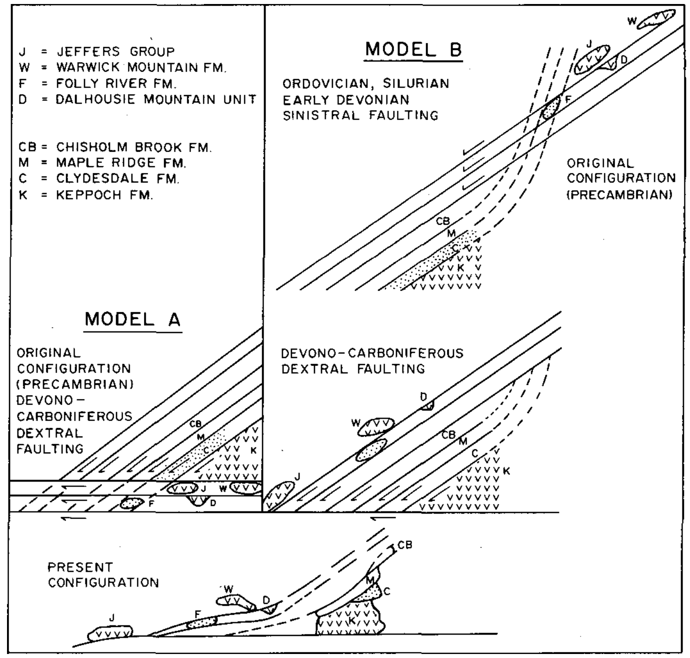

Fig. 4. Schematic palinspastic reconstructions for the late Precambrian volcanic rocks of northern mainland Nova Scotia, showing possible dispersion resulting from movement on the Cobequid, Hollow and Rockland Brook faults. Model A: Cobequid rocks originally lying to south of Antigonish rocks and emplaced principally by dextral slip on the Minas Geofracture, followed by dextral slip on the Minas Fault Zone. Model B: Cobequid rocks originally lying to northeast of Antigonish rocks and emplaced principally by sinistral slip along the Rockland Brook and Hollow faults. Abbreviations as in Figure 1.

the Cobequid Highlands swing northeast of the Antigonish Highlands, suggesting that the blocks originated to the north. Keppie and Murphy (1988) have proposed sinistral movements on the Hollow Fault during the Ordovician, which would be consistent with model B. Furthermore, paleomagnetic data suggest major sinistral movements during the Silurian and Early Devonian accretion of the Avalon Composite Terrane with Laurentia (Kent and Keppie, 1988). Transpressive deformation in the Neoproterozoic III was both sinistral and dextral on northeast-southwest faults (Murphy *et al.*, 1991; Nance and Murphy, 1990). The current database does not permit a clear preference to be made between the two models. Kinematic and geochronological studies of these fault zones may distinguish between these models.

Summary

The correlations proposed here imply that the Cobequid and Antigonish Highlands were part of the same rift basin within a volcanic arc during the Neoproterozoic III. The limited nature of the rifting is indicated by the presence of continental crust beneath the basin and suggests that the Antigonish and Cobequid Highlands formed part of one terrane during the Neoproterozoic III (Keppie *et al.*, 1991). Murphy and Keppie (1987) and Nance and Murphy (1988, 1990) propose that this rifting was produced by strike-slip movements, suggesting that the rift basin represents a pull-apart basin. This model is supported by the close temporal association between deposition, deformation and plutonism of the Neoproterozoic III sequences in both the Antigonish and Cobequid Highlands. Keppie (1982, 1985) and Nance (1987) have suggested that oblique subduction and translation along faults in the volcanic arc were associated with Neoproterozoic III tectonothermal events. This could result in the opening and closing of strike slip basins and would explain the anomalous intensity of Neoproterozoic III deformation in northern Nova Scotia relative to other parts of the Avalon Composite Terrane.

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