19. GEOLOGY OF PART OF FOXE FOLD BELT, CENTRAL BAFFIN ISLAND, DISTRICT OF FRANKLIN

Project 740020

J.R. Henderson, David Shaw[1], Marcia Mazurski[2], Mariette Henderson, Ron Green[3], and Dan Brisbin[2]
Regional and Economic Geology Division

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Abstract

Aphebian Piling Group supracrustal rocks overlying Archean basement gneiss comprise a lower, miogeoclinal quartzite-pelite assemblage with minor amphibolite and calcium-silicate gneiss, and an upper, thicker eugeoclinal metagreywacke assemblage. Both basement gneiss and supracrustal rocks were involved in at least two early deformations (D_1 and D_2) which produced isoclinal, recumbent folds, and a final major deformation (D_3) which produced the characteristic subhorizontal normal folds of the Foxe Fold Belt. Metamorphism culminated before D_3 and increased from northwest to southeast across the map area. The significant metamorphic changes produced in the rocks are a progressive increase in the volume of neosome in migmatitic metagreywacke, and an abrupt disappearance of muscovite from lower Piling quartzite. Ubiquitous graphite in Piling Group paragneiss causes characteristic rusty-weathering, but no mineral occurrences of economic interest were found.

Introduction

During the 1978 field season nine-sixteenths of the Ekalugad Fiord map area (27B) and about one-sixteenth of the Home Bay map area (27A) at a scale of 1:250 000 were mapped (Fig. 19.1). This was the third year of a continuing study of Foxe Fold Belt on Baffin Island; other work in relation to this study has been done by Morgan et al. (1975, 1976) and Tippett (1978).

Preliminary geological maps of the work done in 1978 are being prepared. Future field work is planned on map sheets 27A,B,C, and D.

General Geology

The Hudsonian Foxe Fold Belt (Jackson and Taylor, 1972) extends from southwest of Melville Peninsula to the east coast of Baffin Island (Fig. 19.2). On Baffin Island the belt contains metamorphosed and polydeformed Aphebian Piling Group (Jackson, 1971) supracrustal rocks overlying Archean granitoid basement gneiss. Metamorphic grade is lowest in the centre of the fold belt on Baffin Island where the Piling Group appears thickest; both grade of metamorphism and abundance of Hudsonian granitic material increase outward from the central Piling Basin (Jackson and Taylor, 1972; Morgan et al., 1975, 1976).

Piling Group comprises a lower, thinner miogeoclinal quartzite-pelite-carbonate assemblage, and an upper, thicker eugeoclinal mafic volcanic-distal turbidite succession. Along the north margin of the belt carbonate and quartzite make up the bulk of the miogeoclinal assemblage, whereas in the centre of the belt and farther south, calcareous rocks are rare or absent. Iron formation occurs near the base of the eugeoclinal sequence along the north and south margins of the belt, but is absent from the Piling Group in the centre and east end of the fold belt (Morgan et al., 1975, 1976; Tippett, 1978).

Posttectonic Helikian or Hadrynian diabase dykes intrude most rocks in the region. Near Foxe Basin and in Davis Strait Ordovician platform carbonate rocks occur. Most areas above 900 m elevation in eastern Baffin Island are covered by permanent ice or snow fields. In the area mapped bedrock exposure is excellent except in the northwest corner where ground moraine is extensive, and tundra polygons occur.

No mineral deposits of economic interest were found, but some malachite stain occurs in quartzite near the base of the Piling Group, and some pegmatites cutting basement rocks in Ekalugad Fiord exhibit higher-than-background uranium radioactivity.

Stratigraphy

Basement Gneiss

Rocks believed to be Archean underlie Piling Group. They are exposed in elliptical domes and concordant sheets along the east margin of the map area (Fig. 19.3). Basement gneiss also occurs near the centre of the area in several stratiform lenses on the limbs of a southeast-plunging normal synform. In the fiord country concordant sheets of basement gneiss appear in cores and limbs of early isoclines (F_1, F_2) as well as late normal folds (F_3).

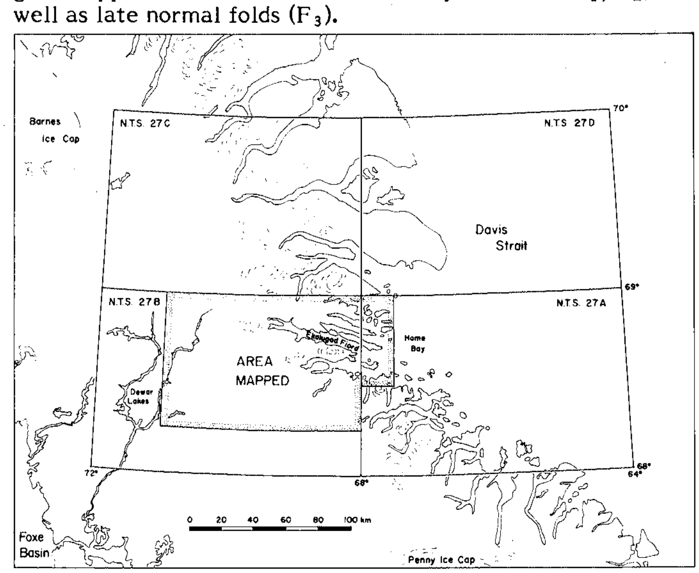

Figure 19.1. *Index map of areas referred to in central Baffin Island.*

[1] Department of Geology, Carleton University, Ottawa, Ontario K1S 5V6

[2] Department of Geology, Queen's University, Kingston, Ontario K7L 3N6

[3] Department of Geology and Geophysics, University of Utah, Salt Lake City, Utah 84112, U.S.A.

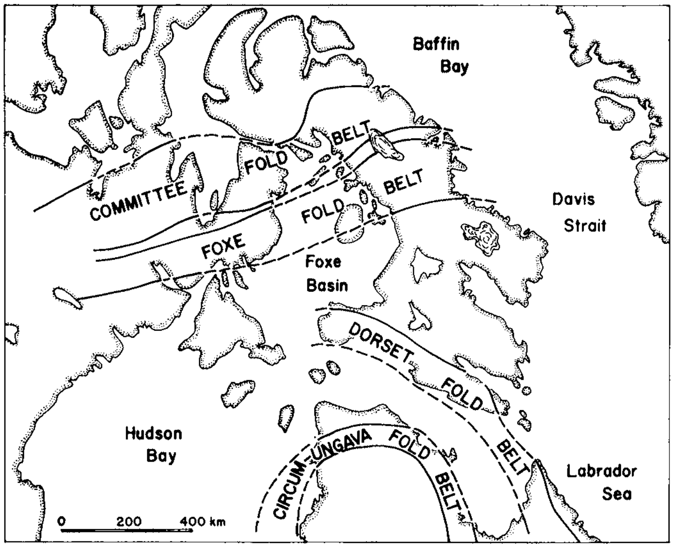

Figure 19.2. *Tectonic setting of Foxe Fold Belt in relation to other areas of Hudsonian folding in northeastern Canada (after Jackson and Taylor, 1972).*

Texture and composition of basement gneiss are variable; along the east margin of the area, mainly medium grained laminated orange or pink weathering biotite quartz monzonite occurs; in the centre of the region, coarse microcline-augen gneiss forms a large part of the exposed basement, and in the fiords, grey, granodiorite gneiss with abundant folded amphibolite boudins (Fig. 19.4) is common. In contrast to Piling Group rocks, basement gneiss does not weather rusty.

Wherever observed, the contact between basement rocks and Piling Group is sheared and foliations are concordant.

Lower Piling Group

A variety of lithologies appear in the lower Piling Group; quartzite is most common, but pelitic interbeds and concordant amphibolite layers are abundant locally. Marble and calcium-silicate gneiss outcrops in a few thin layers near the basement contact in Ekalugad and Kangok fiords (Fig. 19.3). Generally, quartzite occurs at the base of the group, but pelite or amphibolite are in contact with basement gneiss in many places.

In the northwest quarter of the map area (Fig. 19.3), where the metamorphic grade is lower, quartzite is medium grained, light grey, quartz-muscovite schist. To the east and

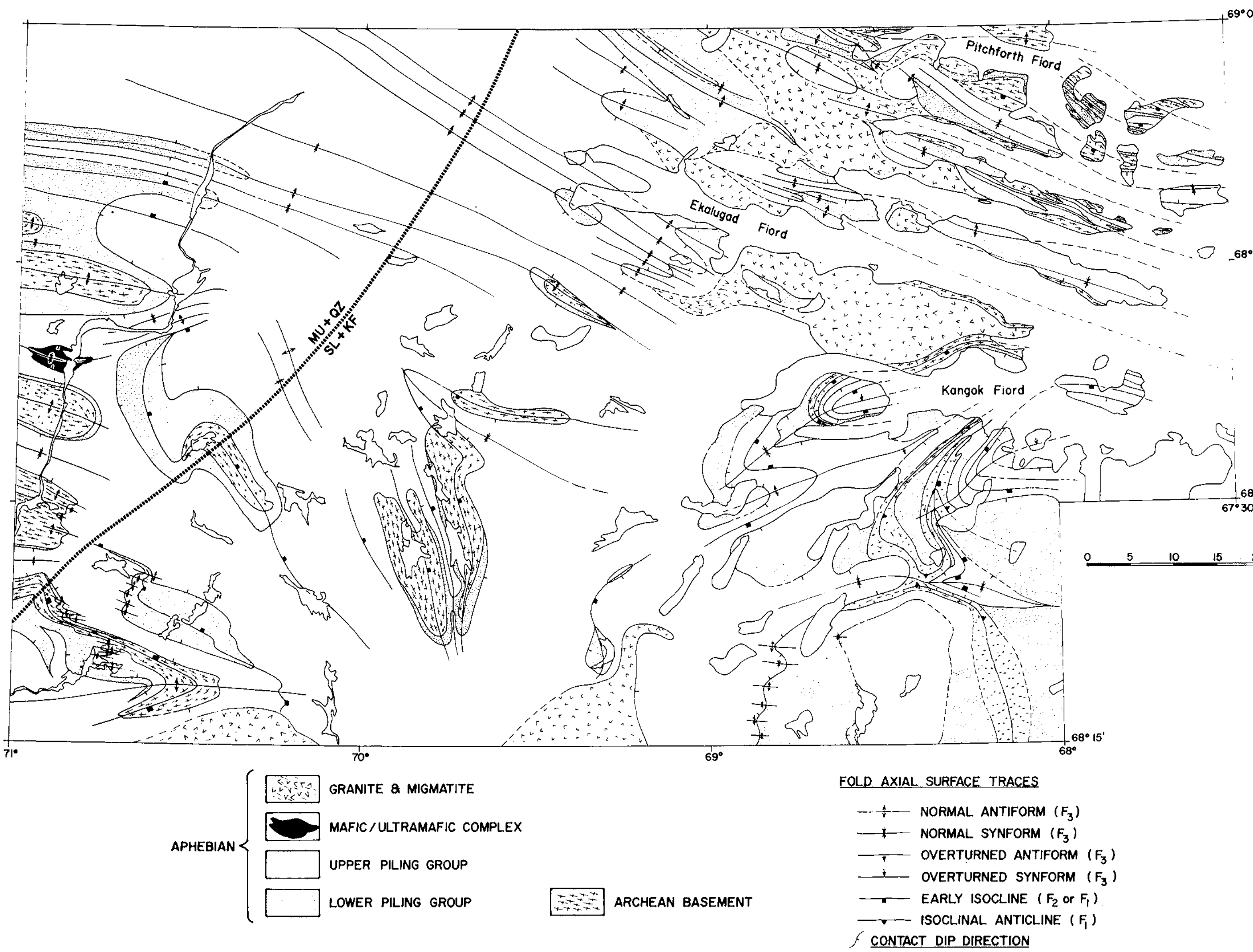

Figure 19.3. *Geological map of part of Foxe Fold Belt, central Baffin Island.*

Figure 19.4

Folded amphibolite boudins in granodiorite basement gneiss (north of Ekalugad Fiord).

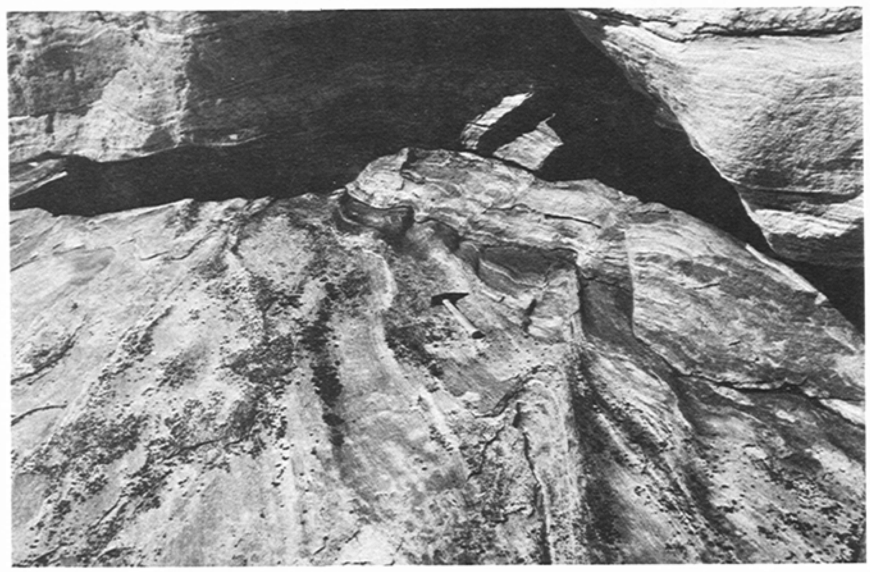

Figure 19.5

Gently curving linear aggregates of quartz and feldspar (L_1) parallel to F_3 hinges in basement gneiss (north of Ekalugad Fiord).

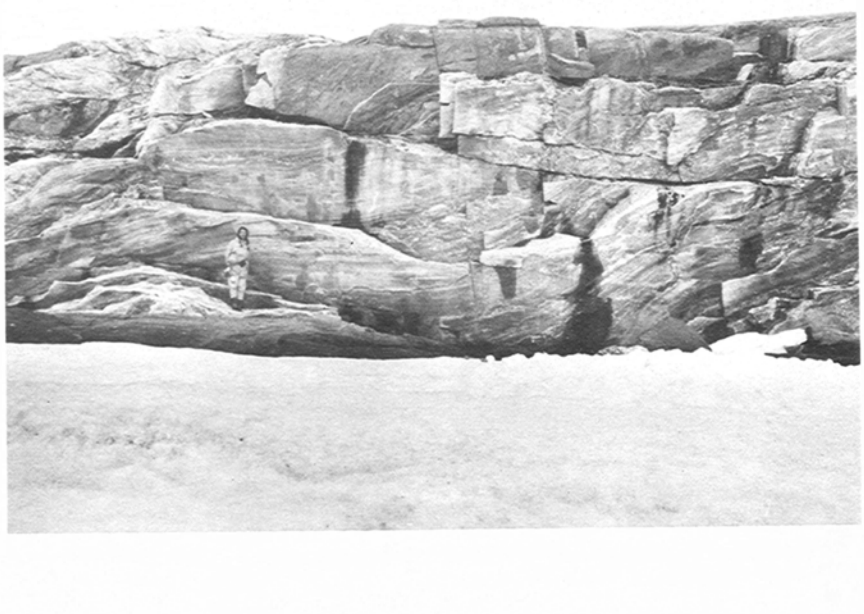

Figure 19.6

Linear aggregates of quartz, feldspar and sillimanite (L_1) transverse to mesoscopic F_3 fold hinges in lower Piling quartzite (island at mouth of Pitchforth Fiord).

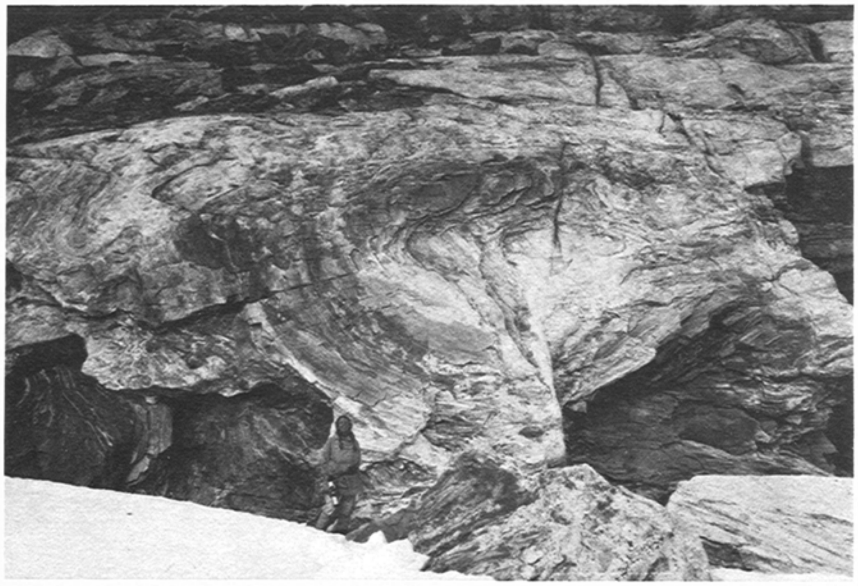

Figure 19.7

Linear aggregates of quartz and feldspar (L_1) folded 180 on subvertical S_0 surfaces in basement gneiss (sea coast north side of Ekalugad Fiord).

south, quartzite is coarse grained, cream-coloured quartz-microcline-sillimanite-(garnet) gneiss. Low grade pelite is rusty weathering homogeneous fine grained mica-graphite-quartz schist, but in the higher grade terrain it is rusty weathering, coarse grained biotite-garnet-feldspar-quartz-graphite-sillimanite gneiss. Amphibolite varies from homogeneous fine grained hornblende-plagioclase biotite schist in the northwest of the map area to coarser grained garnet amphibolite gneiss in the fiord region.

No primary structures except parallel bedding are preserved in lower Piling Group rocks in the map area. Secondary mesoscopic structural elements are well-developed: mica foliation is ubiquitous and commonly is crenulated; quartz grains exhibit plate and rod habits; garnet and feldspar are flattened and elongated. Mesoscopic folds are developed locally in layered or foliated rocks; commonly they are boudined or have their limbs sheared-off. In some quartzitic paragneiss, intersecting sets of isoclinal folds produce anastomosing gneissosity bands on outcrop surfaces resembling pinch-and-swell structure.

Upper Piling Group

Characteristically, upper Piling Group rocks are a monotonous sequence of thin- to thick-layered (0.1 to 1.0 m), fine- to medium-grained, rusty weathering, dark grey metagreywacke. The principal minerals are quartz, feldspar, biotite, and graphite; in places, dark green calcium-silicate minerals are present and scattered small garnets appear in higher grade rocks. With increasing metamorphic grade, the proportion of white granite neosome progressively increases. The granite appears initially as discrete white laminae that pinch and swell parallel to foliation in the metagreywacke; with increasing volume of granitic component, the rock becomes a migmatite with scattered biotite-graphite schist schlieren. Garnets commonly occur in both paleosome and neosome.

Generally, upper Piling metagreywacke stratigraphically overlies lower Piling quartzite, but in places quartzite is absent and metagreywacke lies directly against basement gneiss.

Mafic-Ultramafic Complex

A mixed sequence of amphibolite, hornblendite, metagreywacke, and quartzite, occurs along the west margin of the map area (Fig. 19.3). The complex is synformal and structurally overlies upper Piling metagreywacke. However, the rocks previously were isoclinally folded (Chernis, 1976) and the true stratigraphic position of the complex is unknown. The succession of lithologies composing the complex resembles the transitional sequence of rocks separating Tippett's (1978) quartzite-schist unit (lower Piling of this paper) from his metagreywacke-siltstone unit (upper Piling of this paper).

Granite and Migmatite

In the south and east parts of the map area (Fig. 19.3) where the metamorphic grade is highest, extensive bodies of foliated granite, pegmatite, and granite-metagreywacke migmatite occur. The neosome in the migmatite varies from coarse grained or pegmatitic, light grey biotite-(garnet)-(cordierite) granite to pink biotite quartz monzonite with microcline augen. The proportion of rusty weathering biotite-graphite-(garnet)-(sillimanite) paleosome varies from about 5 to 50 per cent. Contacts with adjacent metagreywacke, quartzite, or basement gneiss, may be abrupt or gradational. The migmatization occurred before the late folding (F_3), and probably was coincident with the metamorphic culmination in the region.

Structural Geology

The structural features characterizing Foxe Fold Belt are normal antiforms and synforms (F_3) produced during the last penetrative deformation (D_3) of the region. The F_3 folds developed on a terrane of subhorizontal gneisses that had been deformed by at least two periods (D_1 and D_2) of isoclinal folding (F_1 and F_2). Macroscopic F_1 and F_2 isoclines are common in the region mapped; they can be differentiated only where F_2 overprints F_1, e.g. near the southeast corner of the map area (Fig. 19.3) where the limbs of a basement-cored F_1 isoclinal anticline are folded into an F_2 isocline and two F_3 synforms. In the southwest corner of the map area, the limbs of a basement-cored F_1 or F_2 isoclinal anticline are folded into and east-plunging F_3 normal antiform. F_3 folds in the region generally are readily distinguished as low-amplitude normal antiforms and synforms with subhorizontal hinges. In the map area the dominant trend of F_3 folds is east-southeast. South of Kangok Fiord (Fig. 19.3), however, a pair of northeast-trending F_3(?) normal folds become progressively overturned and isoclinal as they are followed northeast along their axial-surface traces.

Mineral foliation (S_1 schistosity) parallels differentiated layered (S_0 bedding or gneissosity) around the hinges of all mesoscopic folds observed in the map area, suggesting that a pre-D_1 penetrative deformation was obscured by later events.

Mineral lineation (L_1) is pronounced in some rocks of the map area; linear grains and grain aggregates commonly parallel axes of pre-D_3 boudined granitic laminae in metagreywacke and basement gneiss. Mineral lineations (L_1) commonly parallel hinges of F_3 folds (Fig. 19.5), but in some exposures L_1 is transverse to F_3 hinges (Fig. 19.6), and in one remarkable exposure L_1 is rotated 180° on planar S_0 surfaces striking parallel to local F_3 hinges (Fig. 19.7).

Metamorphic Geology

Metamorphism of the rocks in the map area apparently culminated when the gneisses were subhorizontal before D_3. The grade of metamorphism increases from northwest to southeast, as shown by the progressive increase in the volume of neosome in migmatitic metagreywacke, and the abrupt disappearance of muscovite from the rocks. The apparent trace of the surface of the reaction: muscovite + quartz $\leftrightharpoons$ sillimanite + K feldspar + vapour is drawn on the geologic map (Fig. 19.3). This reaction is strikingly apparent in lower Piling quartzite which is a quartz-muscovite-(sillimanite) schist northwest of the reaction boundary and a quartz-K feldspar-sillimanite gneiss to the southeast. Dark blue cordierite was observed in neosome of migmatite near the southeast corner of the area.

References

Chernis, P.J.
1976: Stratigraphy, structure and metamorphism of the Piling Group at Dewar Lakes, Baffin Island, N.W.T.; unpublished B.Sc. Thesis, Carleton University, Ottawa, 64 p.

Jackson, G.D.
1971: Operation Penny Highlands, south central Baffin Island; Geological Survey of Canada, Paper 71-1, Part A.

Jackson, G.D. and Taylor, F.C.
1972: Correlation of Major Aphebian rock units in the northeastern Canadian Shield; Canadian Journal of Earth Sciences, v. 9, p. 1650-1669.

Morgan, W.C., Bourne, J., Herd, R.K., Pickett, J.W., and Tippett, C.R.
1975: Geology of the Foxe Fold Belt, Baffin Island, District of Franklin; in Report of Activities, Part A, Geological Survey of Canada, Paper 75-1A, p. 343-347.

Morgan, W.C., Okulitch, A.V., and Thompson, P.H.
1976: Stratigraphy, structure and metamorphism of the west half of the Foxe Fold Belt, Baffin Island; in Report of Activities, Part A, Geological Survey of Canada, Paper 76-1A, p. 387-391.

Tippett, C.R.
1978: A detailed cross-section through the southern margin of the Foxe Fold Belt in the vicinity of Dewar Lakes, Baffin Island, District of Franklin; in Current Research, Part A, Geological Survey of Canada, Paper 78-1A, p. 169-173.