GEOLOGICAL SURVEY OF CANADA
COMMISSION GEOLOGIQUE DU CANADA

Open File 537

A STRUCTURAL RECONNAISSANCE OF EASTERN DEVON ISLAND, ARCTIC ARCHIPELAGO

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March 1978

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Abstract

Precambrian gneisses and granitoid gneisses, overlain with profound angular unconformity by flat-lying to gently dipping lower Paleozoic bedded rocks, are widely exposed on the eastern part of Devon Island. Foliation is faint to strong in most of the gneisses, which are mainly quartz-feldspar-biotite rocks, but is weak to absent in the granitoid gneisses. Cataclastic textures are widespread. Dyke-like bodies of diorite and diabasic rock are numerous and widespread; the dykes probably represent several tectonic periods, including post-kinematic. Trends of gneissic foliation and dykes are dominantly eastward. Numerous east- and southeast-trending faults cut both the Precambrian basement rocks and the overlying Paleozoic beds. The Paleozoic rocks are mainly dolomite, limestone, sandstone and intra-formational conglomerate (*see* Christie, 1977).

INTRODUCTION

This report provides an overview of structures of the eastern part of Devon Island east of longitude 87°W, an area of about 26,000 square kilometres (10,000 square miles) (*see* Fig. 1). Data were obtained during a coastal reconnaissance carried out during April and May of 1968 and 1969; dog sleds, motor toboggans, and aircraft were used for transport.

The structural features described here include the 'internal' structures of the Precambrian terrane and the (mainly?) post-lower Paleozoic faults. The Precambrian structures are: gneissic foliation, schlieren, lithological banding, and dykes. Faults that displace the Paleozoic beds provide, with certain geophysical data, clues to probable major tectonic features of the region: the eastern Devon Island horst and the grabens of the adjacent channels.

The Precambrian rocks of eastern Devon Island are mainly grey, granulose quartz-feldspar gneisses of a granitoid aspect. These rocks were described in a general way by Christie (1969, 1970) and in more detail at certain localities by Roots (1963) and by Krupicka (1973).

STRUCTURES OF THE PRECAMBRIAN ROCKS

(Introduction)

Gneissic foliation, usually due to common orientation of flakes or lensoid patches of biotite, is nearly everywhere distinct. Alignment of feldspar grains also contributes to gneissic structure. Banded structure due to variations in composition or texture is present in places, but overall is not a conspicuous feature. Cataclastic textures, on the other hand, are very common and widespread. The gneissic foliation of the Precambrian rocks, observed both on the ground and in air photographs, in most places trends east or easterly. Variable, generally northerly trends occur, locally, such as in the vicinity of Cape Sherard at the southeast extremity of the island and near Cape Newman Smith on the north coast.

Diabasic dykes and dyke-like bodies of dark grey, dioritic rock occur in the gneissic terrane of eastern Devon Island, and many such bodies have been mapped from air photographs. The dark-weathering, dyke-like bodies conform to the pronounced easterly gneissic trends.

Precambrian Rocks of the North Coast

The Precambrian rocks of the north coast of Devon Island are mainly quartz-feldspar-biotite gneisses, the gneissic foliation varying from strong to faint. The foliation and gneissic banding trend generally east, but southeast trends occur between Cape Sparbo and Ward Point, and trends are northerly or northeasternly between Cape Newman Smith and Cape Sparbo. The Precambrian rocks of the north coast may be divided into two broad groups: granitoid gniess with weak foliation, and garnet-bearing banded rocks with stronger foliation. The granitoid rocks are exposed along the coast between Sverdrup Inlet and Belcher Point. The banded rocks occur inland south of Cape Newman Smith and between Belcher Point and Cape Caledon.

Certain rock types, such as dark grey, granulose gneiss with weak foliation or none, occur in both of the groups described above. In addition, sheared or cataclastic textures are common in both groups. The two divisions must, therefore be considered tentative at this stage of reconnaissance study.

Granitoid gneisses

The gneisses between Sverdrup Inlet and Cape Sparbo are grey, medium- to coarse-grained granitoid rocks with weakly developed gneissosity. The quartz is greasy grey and in places bluish; the feldspar typically is dark grey and finely striated; the biotite occurs as small knots or lenses of tiny flakes. Pegmatitic veins cut the gneisses in places. Although the proportions differ, the mineral species of the pegmatite appear nearly identical to those of the host rock; indeed, the pegmatite in places is gradational with and appears to be a massive variation of the granitoid gneiss.

The gneissic structure of the crystalline basement rocks exposed along the lower valley walls of the Sverdrup Inlet region varies from moderately pronounced to indistinct, or nearly massive. The texture in places appears 'smeared' or cataclastic and at some localities schlieren, stretched inclusions, and boudin structures in associated pegmatites suggest mobilization of the gneisses.

Pink- to white-weathering pegmatite veins, anastimosing networks, and amoeboid masses cut the gneisses, in places constituting about one third of the volume of the rock.

A sequence of crystalline rocks was determined from structural and textural evidence at a locality about 4 miles south of the entrance to the west arm of Sverdrup Inlet. There, the apparently oldest rock is medium-grained, quartz-feldspar-biotite gneiss with garnet and with distorted gneissic banding. The banded gneiss is cut by, and occurs as inclusions in, medium-grained, less strongly foliated quartz-feldspar-biotite-garnet rocks with a porphyroblastic texture. The foliation of the porphyroblastic rock is almost, but not quite parallel with that of the included gneiss, and appears to be due to shearing and flowage at a late stage of rock formation. Numerous inclusions resembling the older gneiss are present; some of these appear 'stretched', and dark schlieren may also be related. Intruding the two rocks just described are networks and patches of medium- to coarse-grained, white-weathering quartz-feldspar-biotite pegmatite; the pegmatite structures appear to have been sheared and distorted at a late stage of emplacement. Veins of aplite or finer-grained pegmatite up to 2 inches in width are conspicuously cross-cutting, and are evidently the youngest of the crystalline series.

At Cape Sparbo granitoid gneiss is the youngest of a series of crystalline rocks in which apparently older gneisses occur as inclusions or relicts in younger rocks. The 'older' gneisses are dark to light grey, granulose, quartz-feldspar-biotite rock with 5% to 10% garnet. These rocks occur as small to large inclusions; one body examined measures 200 feet across and is of undetermined length. The 'younger' granitoid rocks are grey to brown quartz-feldspar-biotite rocks that vary in grain size, but generally are medium-grained.

Weak foliation in the granitoid rocks at Cape Sparbo results from orientation of patches or clusters of small biotite flakes. The planar structures of the inclusions in this rock were observed to be randomly oriented where the inclusions are few, but to conform to the general northwesterly gneissic trend where they form 50% or more of the rock. A relationship of this sort might be taken to suggest mobilization of a partially granitized rock mass.

At Cape Hardy, a few miles east of Cape Sparbo, the near-massive, grey-brown granitoid rock is contaminated with or cut by innumerable strings, sheets, and schlieren of darker, fine-grained rock. In places this material is black and fine-grained, and may be crystallized mylonite.

A variety of the rock at Cape Hardy is coarse-grained and porphyroblastic. Inclusions are present, though widely scattered. Very coarse pegmatite veins and masses up to 2 feet wide cut the rock, but form a very small proportion of the rock.

The weakly foliated but rather uniform brown-weathering granitoid gneisses of the Cape Sparbo-Cape Hardy region give way eastward to two varieties of granitoid rock: grey, well-foliated to banded gneiss, and brownish-weathering, relatively little-foliated granitoid rock. The mylonitic and cataclastic structures are more abundant eastward. At a locality near Ward Point, dark grey gneiss with a cataclastic (or 'smeared') texture is cut by an anastimosing network of pink, quartz-feldspar pegmatite and aplite. Bands of grey-black, fine-grained feldspar-biotite rock 2 to 6 inches thick, perhaps recrystallized mylonite zones, occur in the vicinity.

The mixed granitoid gneisses described above prevail in the vicinity of Eastern Glacier and eastward almost to Belcher Point.

Prominent foliation of shear or cataclastic origin is conspicuous in places. This foliation trends easterly, parallel to the regional gneissic trend. Veins of pegmatite and of a rock resembling a pale variety of the host rock cut the gneisses in many directions.

Foliated gneisses

Variable gneisses are exposed in the valley floors south of Cape Newman Smith. These gneisses are in part of granitoid aspect, but include abundant, well-banded garnetiferous gneiss of metasedimentary appearance. Both felsic and mafic rocks are present; at least some of the dark variety appear possibly to have been early mafic dykes or sills. Gneissic trends are easterly to east-southeasterly.

Pale grey, strongly foliated gneisses with interbanded, white-weathering quartz-feldspar rock resembling quartzite appear at the coast west of Belcher Point. The grey gneisses are granitoid, quartz-feldspar rocks with minor mafic minerals but with grey feldspar; garnet strings and knots up to 3 cm wide occur in both the grey- and the paler-weathering gneisses. These rocks continue south and east of Belcher Point, where also a 'smeared-out' or cataclastic texture is common. Garnet is very abundant in some of the cataclasite, where, however, it appears to post-date the cataclasis. A small proportion of the rock west of Cape Caledon is thin pegmatite veins of variable trends.

Precambrian rocks of the east coast

The crystalline rocks of the east coast of Devon Island are variously granitoid quartz-feldspar gneisses, sub-granitoid, foliated gneisses, and foliated and banded garnetiferous quartz-feldspar gneisses.

Such a variety in rock type might be expected where the coastline cuts across the prevailing easterly structural trend.

In contrast to the foliated rocks and quartzitic rocks to the northwest, the gneisses southeast of Cape Caledon are dark grey, granitoid, and mainly garnet-free. A definite gneissic foliation due to lineated quartz and mafic grains is present although the cliffy outcrops appear massive from a distance. Thin, light-weathering feldspathic layers and some amphibolitic layers occur, as do minor bands and wandering veins of pegmatite.

A zone of strongly foliated, garnetiferous quartz-feldspar gneiss appears at the coast south of Cape Fitz Roy and underlies the north shore of the deep inlet there. The south shore of the inlet, however, is relatively uniform quartz-feldspar gneiss with weak foliation and a granitoid aspect. The granitoid rocks weather dark grey, in contrast to the lighter, brown colours of the foliated rocks to the north.

The coast between the inlet south of Cape Fitz Roy and Cape Parker is characterized by monotonous grey, granitoid gneisses with relatively sparse dark minerals and weak foliation. Amphibolitic dark bands or large inclusions are present and conspicuous; the bands range from a few inches to several hundreds of feet in width. The darker bands are generally less than 10% of the rock, but locally form 30% or more. South of Cape Parker, the gneisses are well-banded and mainly leucocratic, with garnet present. Near Hodgson Head, the dark minerals are amphibole-pyroxene, but these give way northward to biotite. Bluish quartz is common throughout this belt. At Hodgson Head and nearby to the south the banded garnetiferous gneiss is quartzitic, with very small grains of dark mineral. The banding is nearly flat-lying and is accentuated by thin, light-weathering leucocratic layers. Pegmatite intrusions and ptygmatic segregations in small amounts are widespread.

The gneisses of Philpotts Island are variable. Strongly foliated to banded gneisses, usually quartzitic, dominate in the north (the region of conspicuous, flat-topped hills) while grey, near-massive granitoid gneisses underlie the southern part of the island. Coarse, biotitic gneiss with garnet occurs locally on the north coast. This rock contrasts markedly with strongly banded, garnetiferous quartzitic gneisses with tiny flakes of mafic mineral that form most of the peculiar, monadnock-like hills of the northeast part corner of the island. The presence of bands of white-weathering, garnetiferous quartz-feldspar rock of quartzitic aspect with moderate or nearly flat dips gives a bedded appearance to the hills. The southern end of the south-most hill is biotitic, schistose gneiss, perhaps a transition phase to near-massive, granitoid gneisses of the south coast of the island.

A 'stretched'-appearing pink weathering feldspar-augen gneiss outcrops on the western extremity of the south coast of Philpotts Island. To the east occurs finer-grained, pale-weathering, biotitic quartz-feldspar gneiss of quartzitic aspect, this rock interlayered with darker-weathering banded grey, but mafic-poor quartz-feldspar gneiss. Pink garnet occurs throughout these rocks.

The southeastern coast of Philpots Island is underlain by dark grey, biotitic quartz-feldspar gneiss of granitoid character. Foliation or gneissosity is usually conspicuous. 'Smeared' feldspar augen texture was noted to the west, and darker, dioritic lensoid layers and inclusion-like bodies were observed at several localities. The darker bodies are cut by aplite veins and by ptygmatic layers of light-weathering quartz-feldspar rock.

Light to dark grey and brown biotitic, granulose quartz-feldspar gneisses of sub-granitic aspect outcrop between Philpotts Island and Cape Sherard. The trend of the well-developed gneissosity changes from easterly near the island to northeasterly at Cape Sherard.

Precambrian rocks of the south coast

Gneissic rocks are well exposed along the south coast of Devon Island between Cape Sherard and Croker Bay, and on a headland west of Croker Bay. They also form the floors of Cuming, Powell, and Burnett Inlets, and of some valleys tributary to Croker Bay.

The south-coastal gneisses are variously foliated, banded, or nearly uniform and granitoid in texture. Almost everywhere the textures appear to be those of a 'stretched' or cataclastic rock.

Gneisses of two aspects are present and intimately mixed along the south coast: light brown-weathering quartz-feldspar gneiss; and dark grey, variegated gneisses, often sub-granitoid in texture. The paler gneisses, which tend to dominate in the region of Dundas Harbour and to the west, are foliated or banded, and many are feldspathic with lensy patches of biotite and abundant garnet. The darker gneisses, to the east of Dundas Harbour, contain numerous structures such as dark bands, boudins, inclusion-like patches, breccia zones, and ptygmatic folds. Many of the gneisses appear to have been generated by mobilization of older rocks: augen texture, apparently due to cataclasis, is widespread. Included in the dark gneisses are abundant dark grey, sub-granitoid, sheared-appearing quartz-feldspar gneisses.

The gneissic banding and foliation trend easterly to northeasterly and the planar structures dip northward east of Croker Bay. Structural trends are variable toward Cape Sherard, with some southeasterly trends apparent among dominantly north-northeast and northeast trends. Great variation in gneissic attitude on a local scale also was noted along about 10 miles of the coastline west of Cape Sherard. The variability and northerly structural directions are the only observed anomalous features of the southeastern extremity of Devon Island that might be related to a substantial positive gravity anomaly lying just offshore (*see* Earth Physics Branch, Ottawa, Gravity Map Series No. 87, 1968).

DYKES

Dykes and dyke-like bodies are abundant in some regions: especially on and north of Philpotts Island and south of Cape Sparbo. These structures trend generally easterly to southeasterly, parallel with or slightly discordant to the regional foliation. Some dykes are distinctly cross-cutting. Two sorts of dykes or dyke-like bodies were observed during field work: a) pre- or syn-kinematic, dioritic dykes (?) and b) post-kinematic, diabase intrusions. The two types were not distinguishable in air photos, however, and are shown on the map by a single symbol. The few younger dykes visited and identified are marked by the symbol 'dy'.

Pre- and syn-kinematic dykes and dyke-like bodies

The dykes and dyke-like bodies are more or less tabular, usually with straight, parallel walls but in places swelling or pinching and discontinuous. They are typically 2 to 20 feet thick and occur both singly and in swarms. The contacts with the country rock are sharp, in places irregular, and with apophyses of dyke-rock intruding the country rock. Porphyroblastic texture suggests recrystallization and crystal growth, and the dykes probably pre-date the latest period of regional metamorphism. The number of ages of dyke intrusion is unknown; one or more intrusive episodes of pre- or early orogenic age, as well as synkinematic, or relatively late-stage (late orogenic?) episodes may be represented. A wide range of ages of dyke intrusion in South Greenland has been described by Allaart (1967), whose terminology has been followed here, and similar relationships appear to exist on eastern Devon Island.

Post-kinematic dykes

Post-kinematic diabase dykes, in contrast with the bodies described above, are characteristically dark green-grey, brown-weathering rock with diabasic texture. The borders show evidence of chilling during crystallization, and the contacts with the country rocks are marked by a distinct joint. These dykes are 20 or more feet thick.

The post-kinematic dykes evidently are not numerous on eastern Devon Island. They have been identified, generally with an eastern or southeastern trend, at scattered localities on the coasts (*see* map). One of the younger dykes crosses the point forming the east side of Johnson Bay, on the south coast of the island. Others, west of the bay and on the west side of Dundas Harbour, were mapped by Kurtz, McNair, and Wales (1952).

FAULTS AND LINEAMENTS

Fault lines are conspicuous throughout the area underlain by Paleozoic beds, and lineaments, presumed to be faults, are also present in the Precambrian terrane. The dominant trend is approximately east, or perhaps slightly south of east, with several important fault lines trending 120° azimuth. The fault lines are commonly sinuous, some bifurcate, and a few apparently are straight in short segments, with abrupt changes in direction.

Certain prominent topographic features, such as the east arm of Sverdrup Inlet, conform to or are continuous with east-trending lineaments.

It seems probable that the location and direction of such features are due to faulting, the erosive forces tending to excavate more deeply along fault-weakened zones in the rocks. Long, straight or slightly curving valleys occur on the east coast of Devon Island, and these also may be considered lineaments.

A few prominent topographic features such as the south coastal fiords trend northerly, and it seems probable that these are related to a secondary direction of faulting. One such fault is observable along the east wall of Powell Inlet, where about 2,000 feet of vertical (stratigraphic) displacement has occurred.

A lineament of unknown origin forms a long, curving line from the west arm of Sverdrup Inlet on the north coast to the vicinity of Graham Inlet on the south coast of Devon Island.

The coastal cliffs and headlands of the south coast are remarkably uniform and in places straight, and the south coast of the island may be described as a major lineament. It seems probable that the south coast of Devon Island is fault-controlled: the coastal trend conforms very nearly to the dominant fault-lines to the north. A fault near and parallel to the coast is evident in air photographs of the headland east of Burnett Inlet and may be part of a coastal fault zone. A regional basement fault trending westerly along the south coast of Devon Island was postulated from an abrupt discontinuity in a reconnaissance magnetic profile flown over the southeastern tip of Devon Island (Gregory, Bower, and Morley, 1961, p. 6-140) and recent data confirm the postulation. All these data tend to support the suggested fault origin of the Parry Channel lineament (Viscount Melville Sound-Barrow Strait-Lancaster Sound) of Fortier (Fortier *et al.*, 1963, p. 159 *and see* Fig. 1).

No evidence was obtained to date the faults described above, except that they are younger than the highest beds in the Paleozoic section -- thus, probably post-Silurian. A Cretaceous or later age has been assigned to a northerly-trending fault on an arm of Viks Fiord on western Devon Island (Fortier, *et al.*, 1963, p. 159).

The stratigraphic displacement and sense of movement on many of the faults can be determined from air photographs. The net stratigraphic displacement of most faults is small -- up to a hundred feet. However, 600 feet (180 m) and 1,400 feet (400 m), with north sides down, can be calculated respectively for the fault zones at Cape Skogn and Cape Newman Smith, and 1400 feet of displacement is evident for both the northwest-trending, north-side-down fault crossing Burnett Inlet and the valley-wall, west-side-down fault of Powell Inlet.

In general terms eastern Devon Island may be described as a horst-like rise of basement rocks partially capped by a nearly undisturbed veneer of Paleozoic sedimentary rocks. The basement surface is exposed near sea level at about the longitude of Sverdrup and Burnett Inlets, and rises eastward, reaching about 2,000 feet (600 m) elevation south of Cape Sparbo and east of Dundas Harbour. The eastward rise is more or less gradual on the north coast, attaining 2,000 feet in 40 miles (600 m in 64 km). The Precambrian surface of the south coast, however, appears broken along an east-west profile, with a relatively steep rise to 2,000 feet elevation occurring east of Croker Bay in a distance of about 20 miles (32 km).

The Paleozoic beds of eastern Devon Island almost everywhere appear essentially flat-lying. A westward regional dip proposed in earlier descriptions of the region: (*see* Fortier *et al.*, 1963, p. 157, 154, 159) may be present, but the dip is so small that it is effectively masked by vertical movement and tilting of blocks in this basin-margin region. Thus, beds in the vicinity of Sverdrup Inlet may have a westward regional dip of about 20 feet per mile (4 m per km), but beds of the south coast from west of Stratton Inlet to Croker Bay, a distance of about 75 miles (120 km), are regionally flat-lying.

Devon Island is criss-crossed by faults and broken into numerous elongate blocks. Relative movement appears to have been vertical only in the central part of the island, whereas many of the blocks of the northern margin are tilted, the tilting more extreme near the coast. The tilting is invariably 'inward' so that the Paleozoic unconformity is higher at the coastward edge of fault blocks. This produces the appearance that the north coast, or edge, of a horst-form Devon Island stands slightly higher tectonically than the interior (*see* Fig. 3). The island may be described as an east-trending, horst-like rise rather than basement arch. Faults offshore probably parallel the north and south coasts as suggested by Gregory, Bower and Morley (1961, p. 24) from geophysical and hydrographic data. The rise now stands as a steep-sided, positive structure with a tectonically flat upper surface.

A REVIEW OF TECTONIC FEATURES OF EASTERN DEVON ISLAND AND ADJACENT CHANNELS

Structural features of eastern Devon Island, as noted in the Introduction, include 'internal' structures of the Precambrian terrane and the younger (mainly? post-lower Paleozoic) faults, movement on which has produced the horst-and-graben geomorphic form that dominates this region of the Arctic Islands.

The 'internal' structures of the Precambrian, crystalline terrane described here presumably record more than one tectonic episode, and they probably represent a very long geological history. From their general conformity and uniformity of trend, the internal structures of the Precambrian rocks may represent a major Precambrian tectonic event in which older structures were overwhelmed or converged to form the existing pattern.

Similar rocks of the crystalline basement of southeastern Ellesmere Island have been assigned to the granulite facies of regional metamorphism (Frisch *et al.*, 1978). Rocks that in the field appear to be of amphibolite grade were interpreted by these authors as having been downgraded from the higher grade facies.

A single radiometric (K-Ar) age determination of 1760 m.y. on southeastern Ellesmere Island has been obtained. As elsewhere in the Churchill province of the Canadian Shield, the age determination may represent a Hudsonian orogeny that affected both Aphebian and older, Archean rocks.

The remarkably uniform, mainly easterly trends of the Precambrian rocks of Devon Island do not appear to conform with structures on southeastern Ellesmere, Coburg, or northern Baffin Island, where trends are northeasterly, northerly, and northwesterly, respectively. The possible reasons for these variations in structural trends will not be explored here.

Geophysical data have been obtained in the channels north and south of Devon Island, and some of the results from these data are reviewed in the following paragraphs in order to evaluate and extend structural conclusions arrived at from the reconnaissance field work.

Marine geophysical data recently obtained confirm the suggested faults noted by Gregory, Bower, and Morley (1961; noted earlier) for the south coast of Devon Island. Manchester (as reported by Barrett, 1966, p. 223) found, from total magnetic field measurements, that a fault following the north side of Lancaster Sound extends into Baffin Bay as far east as longitude 75°W. From the bottom topography of Lancaster Sound and from magnetic data, Barrett (1966) concluded that a major fault lies immediately south of Devon Island and that the sound itself is a half-graben with a hinge north of Baffin Island and a fault with a vertical slip of 8 km (25,000 feet) south of Devon Island. The possibility of Lancaster Sound being a graben bounded by faults along both Devon and Baffin Islands also was considered (*op. cit.* p. 227) from the steepness of the walls of the trough of the sound and from the presence of distinct, scarp-like, linear topographic features within the sound. Anomalous, northwesterly trends and increased magnetic relief in the total magnetic field southeast of Devon Island were taken to represent structures in basement rocks.

Seismic and magnetic data obtained by M.J. Keen and others (1972, p. 702-706) have allowed some refinement of the model for Lancaster Sound. Seismic profiles show that the sound is underlain by some 7 km (23,000 feet) of sedimentary material, partly folded and faulted, and bounded both to the north and the south by structural features that appear to be faults. The sedimentary section in Lancaster Sound and adjacent parts of Baffin Bay is considered to consist of sedimentary formations in three structural styles: in Lancaster Sound, sediments dipping a few degrees northward and gently folded about north-trending axes; to the east in the sound, overlying, easterly-dipping sediments deformed mainly by faults; and overlying these in turn, undeformed sediments also dipping easterly. Changes in the magnetic and gravity fields at the eastern entrance to Lancaster Sound are attributed to a change from continental to oceanic crust.

The geophysical results discussed above can be summarized as follows: a) a substantial thickness of sedimentary rocks lies beneath Lancaster Sound and the margin of Baffin Bay; b) a variety of structural styles occurs in the sedimentary fill; c) a substantial vertical displacement separates the basement rocks of southern Devon Island from those of Lancaster Sound; d) longitudinal linear topographic features occur in Lancaster Sound; and e) a change in magnetic trends takes place south-east of Devon Island. The probable significance of these features will be considered in the following paragraphs.

Thickness of sediment above magnetic and seismic basement in Lancaster Sound, evidently in the order of 25 000 feet (7 km) at least near the eastern entrance, is about 6 times greater than the measured Paleozoic section on eastern Devon Island. Not only the thickness, but also the unity of the seismic 'formations', with their distinctive structural styles, is significant: the folded, north-dipping beds appear to form a thick and unbroken succession at the eastern end of Lancaster Sound (*see* M.J. Keen *et al.*, 1972, Fig. 15b). Here, however, one is presumably closer to a former margin of the Franklinian platform depositional region, and it is here that one might expect, therefore, an even thinner Paleozoic section that to the west. While one could expect some younger Paleozoic beds (e.g. Silurian, Devonian) to be preserved in a Lancaster Sound graben, it seems certain that the bulk of this substantial submerged sedimentary column is younger than early and middle Paleozoic. The section probably is Mesozoic or younger, as was suspected by C.E. Keen and others (1972, p. 249) from seismic velocities. Sedimentary rocks of the Eclipse Group on Bylot Island are assigned Lower Cretaceous to Eocene ages (Jackson, *et al.*, 1975; Jackson and Davidson, 1975); these beds probably are related to at least one of the seismic units in Lancaster Sound.

The great vertical displacement of the 'basement' in Lancaster Sound suggests a major tectonic event such as might be associated with continental rifting. A major graben structure, rather than crustal warping, would better accommodate the substantial bedded deposits that have been determined by geophysical means: 7 km (23 000 feet) thick in a channel less than 75 km (45 miles) wide. The normal faults associated with the coasts (*see* Fig. 4) of Devon Island may be secondary breaks related to the major rift; the faults, both parallel and oblique to the coast, may be conjugate sets that provided for adjustment following rifting.

The 'trough within a trough' shape of Lancaster Sound suggested by Barrett (1966, Fig. A) to be possibly the remnants of a broad, drowned river valley, might also be a glacial feature. That is, the linear ridges may be moraines. A fluvial origin followed by glacial modification was proposed for Lancaster Sound and its tributary valleys by Pelletier (1966, p. 91) from the 'hanging' relationship of the tributary to the trunk valleys and to the broad U-shape of Lancaster Sound itself. A glacial origin also has been proposed for certain submarine features elsewhere in the archipelago (*see* Horn, 1963, p. 4; Pelletier, 1965, 1966, p. 81-85; Vilks, 1965).

The tectonic setting of Jones Sound appears, from both surface and marine geophysical data, to be similar to that of Lancaster Sound (*see* Fig. 5). C.E. Keen and Barrett (1973), in reporting on and interpreting seismic reflection and magnetic data from both a transverse and a longitudinal line in eastern Jones Sound, conclude that a sedimentary basin exists in which the magnetic basement is in general shallower and where older sedimentary rocks (of higher seismic velocity than the bulk of the sediment fill) lie closer to the surface than in Lancaster Sound. As in Lancaster Sound, there is little deformation in the low-velocity sediment, which appears to have been deposited in basins on either side of a basement high. No faults were observed along the north-south crossing of Jones Sound, but major faults with substantial vertical displacement were found in Lady Ann Strait, at the eastern entrance to the sound. A large, apparently upthrust basement block is taken to mark the eastern termination of the Jones Sound sedimentary basin.

The data from Jones Sound are as yet few, so that the interpretation of submarine structure must remain even more speculative than for Lancaster Sound. However, from surface data from Devon Island and southeastern Ellesmere Island (Christie, in prep.), a strong symmetry across Jones Sound seems probable, with seaward-dropping fault blocks of the south coast of Ellesmere matching those of the north coast of Devon Island (Fig. 5). Thus, Jones Sound may be a graben structure.

The submarine topography of Jones Sound is relatively complex (*see* Pelletier, 1966, Fig. 9) and the shorelines are irregular compared to Lancaster Sound. Numerous features can be ascribed to glacial activity proposed by Pelletier (*op. cit.* p. 88). A broad, submerged bench flanks much of the south coast of Ellesmere Island; the south-facing scarp marking the edge of this bench aligns approximately with the basement high of the geophysical traverse to the east. The presence of a submerged fault block similar to those exposed on land could account for the features noted; resistant Paleozoic beds and/or Pre-cambrian rocks would tend to divert Recent trough development south-ward, and the up-tilted southern edge of the Precambrian basement would result in a linear basement 'high' with sedimentary basins on either flank. If a graben structure exists, it may occupy the southern part of Jones Sound where soft, younger sediment fill presumably was eroded to form the main trough of the sound.

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LEGEND

CENOZOIC

PLEISTOCENE AND RECENT

[ ] Ice, snowfields

[Q] Surficial deposits; sand, gravel, till; glacial, beach and fluviatile deposits

PALEOZOIC

CAMBRIAN, ORDOVICIAN

[P] Dolomite, limestone, lime-dolomite breccia and conglomerate, sandstone, gypsum.

PRECAMBRIAN

[PЄ] Gneiss, granitoid gneiss, migmatite, and related rocks.

dy - Diabase (younger diabase dykes)
d - Diabasic, dioritic rocks; dykes and sills; probably includes some 'younger' diabase dykes.
am - Amphibolite.

Devon I.
RLC Dec/73

LEGEND

Geological boundary (approximate, assumed) ....

Limit of geological mapping ....

Foliation (horizontal, inclined, dip unknown)

Foliation (airphoto or binocular interpretation;
g, m, s; dip gentle, moderate, steep) ......

Fault (in part assumed, from lineaments;
solid circle indicates downthrow side) ......

Lineament ....

Elevated marine beaches .... b.

Dyke-like dark body .... d., dy
dy: 'younger' diabase dykes.

Line of structural cross-section;
Fig. 3 of O.F. report .... A —— D

Geology by R.L. Christie, 1968, 1969

Building ....

Devon I.
RLC / Dec '73

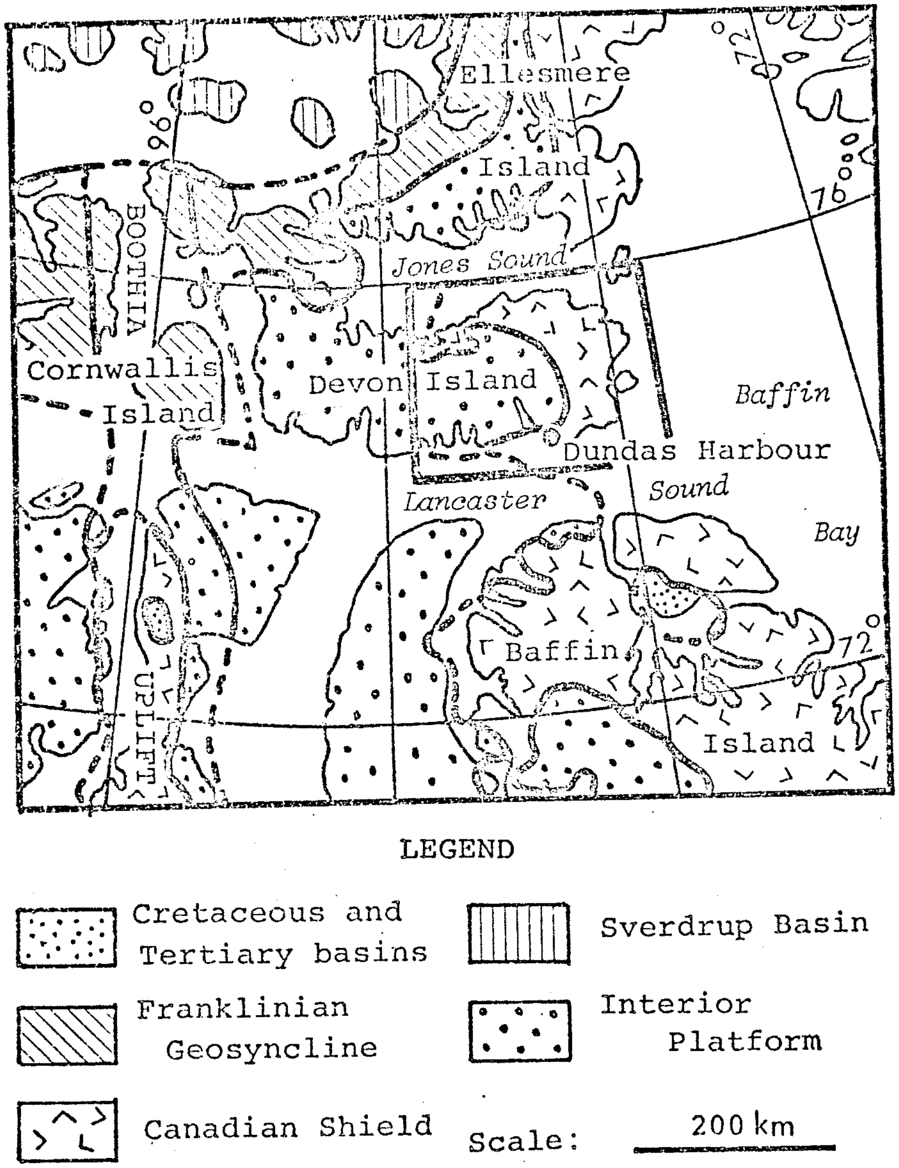
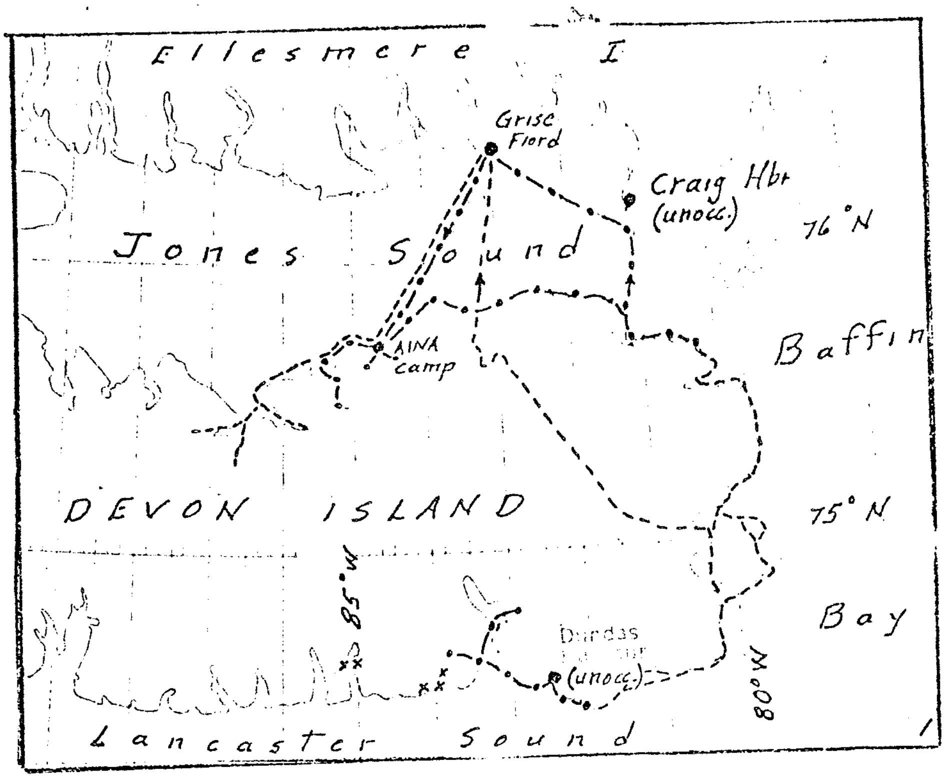


Figure 1. Stratigraphic-structural provinces of part of the Canadian Arctic Archipelago.



0 50 100

Scale in miles

Route of 1968: •—•—• 1969: - - - x x - - -

Fig. 2. MAP OF EASTERN DEVON ISLAND AND SOUTHERN ELLESMERE ISLAND SHOWING LOCATIONS OF EXISTING AND FORMER HABITATIONS AND RECONNAISSANCE EXPLORATION ROUTES OF 1968 AND 1969.

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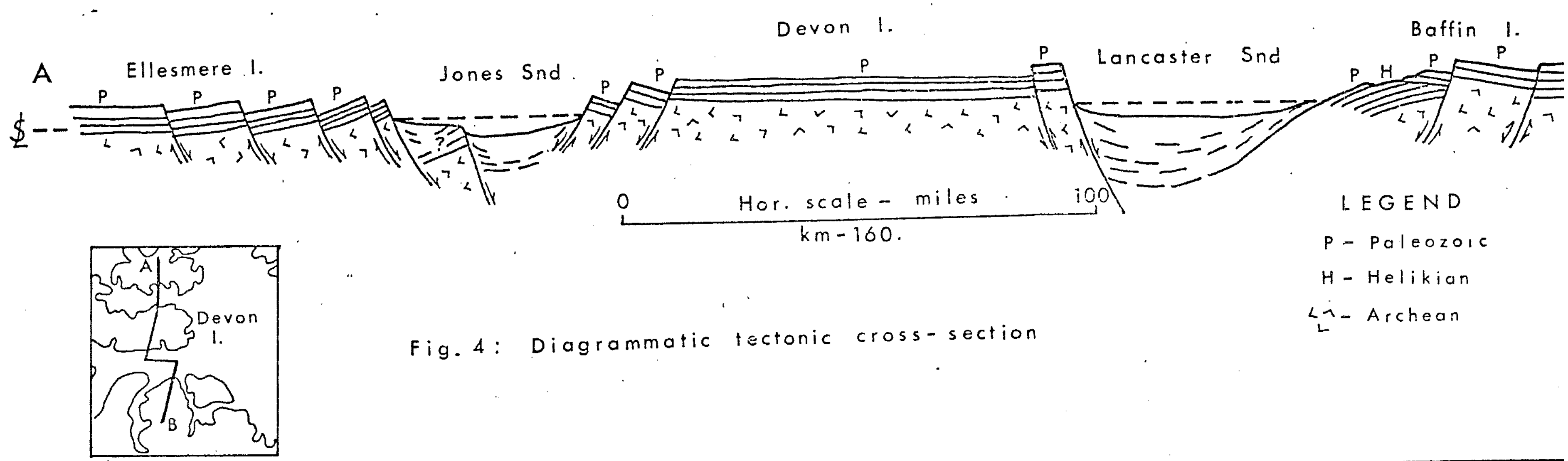

Fig. 4: Diagrammatic tectonic cross-section