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Involvement of a Tertiary Foreland Basin in the Eurekan Foldbelt Deformation, NW Coast of Kane Basin, Ellesmere Island, Canada

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THEME 6: Eurekan Tectonics in Canada, North Greenland, Spitsbergen: Fold Belts Adjacent to Extensional Ocean Basins

Summary: Along the NW coast of Kane Basin (Ellesmere Island), a flatlying conglomerate succession of a Tertiary foreland basin is overthrust by thick Early Paleozoic sediments during the Tertiary Eurekan deformation. In the southern study area between Franklin Pierce Bay and Dobbin Bay, Cambrian to Silurian sediments are thrust over the Tertiary basin along the Parrish Glacier and Cape Hawks thrusts. In front of the Parrish Glacier Thrust, Ordovician/Silurian, Cretaceous and Tertiary deposits are involved into a stack of several thrust sheets along detachments characterized by flat-ramp geometries. Due to erosion, some of the thrust sheets are exposed in klippen and comprise a tectonic inversion of the rock units. The N-dipping Allman Bay Reverse Fault on the peninsula between Franklin Pierce Bay and Allman Bay represents the southernmost exposed Eurekan structure in the Dobbin Bay area. The transport directions are predominantly towards SSE and S.

In the northern study area at Cape Lawrence, Cambrian and younger sediments are thrust over the Tertiary basin along the WNW-dipping Rawlings Bay Thrust Zone. Between the Cambrian of the hanging wall and the Tertiary of the footwall, folded Ordovician evaporites and carbonates are imbricated in the thrust zone. The thick Tertiary conglomerate beds below the Rawlings Bay Thrust Zone are also affected by intense Eurekan shortening which is characterized by flat-lying detachments, folds and triangle structures. Here, the transport directions are to the E and ESE. In the study areas, the Eurekan deformation is characterized by compression with SSE- to E-directed tectonic transport towards the basement blocks of the Greenland-Canadian shield SE of Nares Strait and S of Princess Marie Bay. Only at Cape Lawrence, a large-scale, SE-vergent anticlinal-synclinal pair and a NW-dipping reverse fault in the Tertiary conglomerate could be related to sinistral strike-slip movements along Nares Strait after deposition of the conglomerate and prior to the Eurekan compression along the Rawlings Bay Thrust Zone.

INTRODUCTION

In the study areas at the southeast coast of Ellesmere Island between Franklin Pierce Bay in the west and Cape Lawrence in the northeast, a Tertiary foreland basin (Fig. 1) is exposed which consists of at least 1000 m thick massive, coarse-grained conglomerate and subordinate sandstone (MAYR & DE VRIES 1982). The composition of clasts is dominated by limestone and dolomite derived from the upper part of the Paleozoic succession of the Eurekan foldbelt in the NW (MAYR & DE VRIES 1982). The Tertiary infill of the basin is underlain by Cretaceous clastic sediments and by Ordovician through Silurian limestone and dolomite (DE FREITAS & SWEET 1998)

Several Eurekan thrust faults have been recognized ±parallel to the north coast of Princess Marie Bay and to the northwest coast of Kane Basin (MAYR & DE VRIES 1982, OKULITCH & TRETTIN 1991): along the Parrish Glacier Thrust (KERR 1973a) between Franklin Pierce Bay and Dobbin Bay and the Rawlings Bay Thrust Zone (KERR 1973b) in the Cape Lawrence area, a several km-thick Cambrian to Silurian succession is carried southsoutheast- to eastwards over the Tertiary conglomerate succession (MAYR & DE VRIES 1982) of the foreland basin (Fig. 1). Between Allman Bay and Dobbin Bay, the Tertiary basin is overthrust by Ordovician to Silurian carbonates along the Cape Hawks Thrust. East of Dobbin Bay, the general structural trend of the Eurekan foldbelt changes from ±W-E north of Princess Marie Bay to SSW-NNE at Cape Lawrence (Fig. 1).

The interpretation of transport directions in the study areas is difficult because of the poor outcrop situation especially in the Tertiary clastics. Although numerous sets of joints, shear planes and tectonized horizons can be observed in the massive conglomerate beds, kinematic indicators are rare. The same applies to the competent Paleozoic carbonates which are carried over the Tertiary deposits. Only at some localities, slickensides, conjugate sets of shear planes and small-scale duplex-structures can be used for the interpretation of transport directions.

AREA BETWEEN FRANKLIN PIERCE BAY AND DOBBIN BAY

Lithology

The basal part of the at least 4,5 km thick Cambrian to Early Devonian sediment succession of the hanging wall above the Parrish Glacier Thrust is represented by the Cambrian Ella Bay Formation (KERR 1967) which consists of coarsely crystalline dolostone and is characterized by red and orange weathering. It is overlain by clastic sediments comprising purple and yellow weathering conglomerate and sandstone of the Dallas Bugt For-

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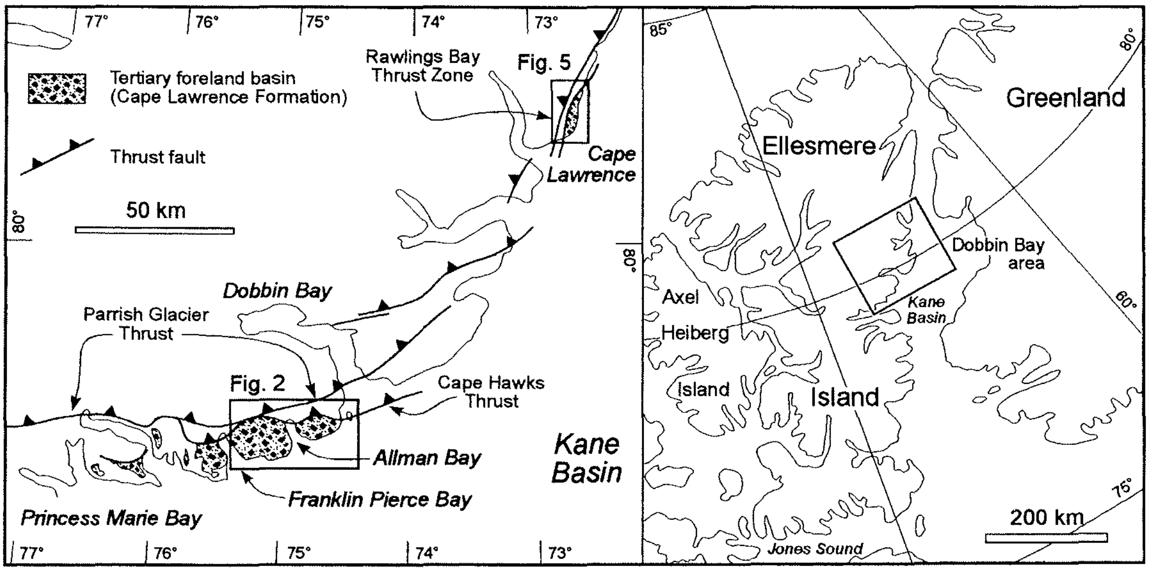


Fig. 1: Location of the study areas, the outcrops of the Tertiary foreland basin and the main Eurekan thrust faults northwest of Kane Basin (adapted from MAYR & DE VRIES 1982).

mation and dark silt- and sandstone of the Kane Basin Formation (CHRISTIE 1967, KERR 1967, PEEL et al. 1982, LONG 1989). The overlying formations are again dominated by carbonate and consist of yellow to grey weathering limestone and dolostone of the Scoresby Bay and Parrish Glacier formations (THORSTEINSSON 1963, KERR 1967). Towards the north, the Cambrian succession is overlain by Ordovician through Silurian carbonates and Devonian fine-clastic sediments.

East of Allman Bay, mostly thick bedded dolomitic limestone units of the Upper Ordovician and Lower Silurian Thumb Mountain, Irene Bay and Allen Bay formations are exposed between the Parrish Glacier Thrust and the Cape Hawks Thrust. They are overlain by Silurian silty limestone and sandstone of the Cape Storm Formation and fossiliferous limestone with intercalated sandstone of the Goose Fjord and Douro formations (DE FREITAS & SWEET 1998).

South of the Parrish Glacier and Cape Hawks thrusts, thin Cretaceous deposits and a thick, mostly flat-lying Tertiary conglomerate succession overlie Ordovician to Silurian limestone of the Allen Bay Formation (Fig. 2a). The Cretaceous consists of unconsolidated dark mudstone and coal-bearing sandstone as well as numerous intercalated thin coal seams with treetrunks. The mudstone contains large concretions with remnants of coalified wood in the centre. These sediments were assigned to the Cretaceous Isachsen (Aptian), Christopher (Albian) and Kanguk (Turonian) formations by DE FREITAS & SWEET (1998).

The Tertiary conglomerate succession of the Cape Lawrence Formation (MIALL 1986, 1991) has been mapped as Ordovician strata by KERR (1973a, 1973b). MAYR & DE VRIES (1982) first recognized a Paleocene age based on leaf impressions. The Cape Lawrence Formation is part of the Eureka Sound Group (MIALL 1986) and consists of yellowish weathering boulder, cobble and pebble conglomerate which is interpreted as braided stream deposits with a source area in the uplifted lower Paleozoic sediments north of the later Parrish Glacier Thrust (DE FREITAS et al. 1997, DE FREITAS & SWEET 1998). The poorly sorted conglomerate is characterized by m to dm thick, unstratified and massive beds. The pebbles are mostly 5-10 cm in scale with a maximum of 1 m in diametre. The conglomerate is interbedded by thin bands and lenses of gritstone, sandstone and siltstone which often contain well preserved impressions of leaves.

Structure

The main structure formed by Eurekan deformation between Franklin Pierce Bay and Dobbin Bay is represented by the WSW-ENE trending Parrish Glacier Thrust which carries a NNW-dipping, unfolded Cambrian through Devonian succession over Ordovician to Silurian carbonates and Cretaceous and Tertiary clastic sediments (Figs. 2a, 3, profiles A-A', B-B', C-C'). In the northern centre of the peninsula between Franklin Pierce and Allman bays, the E-W trending Cape Hawks Thrust wedges off the Parrish Glacier Thrust (Fig. 2a) carrying S-vergent folded and thrust-faulted Ordovician to Silurian strata on Silurian, Cretaceous and Tertiary sediments (Figs. 2a, 3, profiles C-C', D-D', E-E').

In the footwall of the Parrish Glacier and Cape Hawks thrusts, the Eurekan structures are characterized by tectonic repetitions of the Ordovician to Silurian Allen Bay and Douro formations, Cretaceous mudstone and Tertiary conglomerate (Figs. 2a, 3, profiles A-A', B-B', C-C'). The geometries are dominated by thrust sheets which are carried over Tertiary conglomerate along flat-lying detachments and ramps cutting-up sequence to the SSE. Partly eroded remnants of the thrust sheets form three klippen between Franklin Pierce and Allman bays (Figs. 2a, 3, profiles A-A', B-B', C-C'). It should be noted that the unconsolidated Cretaceous mudstone commonly forms the detachment horizons between Paleozoic carbonates or Tertiary conglomerate of the hanging walls and Tertiary deposits of the footwall. In the centre of the peninsula between Franklin Pierce Bay and Allman Bay, the Tertiary succession is underlain by the Upper Ordovician to Lower Silurian Allen Bay Formation along an unconformable sedimentary contact (DE FREITAS & SWEET 1998) (Fig. 2a).

The western and central klippen south of the Parrish Glacier Thrust represent the remnants of a formerly connected stack of at least three thin thrust sheets. They are characterized by a tectonic inversion of the succession, carrying the Ordovician to Silurian Allen Bay Formation (upper thrust sheet) over the Silurian Douro Formation (middle thrust sheet) over Cretaceous mudstone (lower thrust sheet) over Tertiary conglomerate (footwall). The Douro Formation and the Cretaceous often wedge out laterally, and the Allen Bay Formation overlies directly the Tertiary Cape Lawrence Formation.

The orientation of bedding in the Tertiary and pre-Tertiary sediments which are involved in the thrust sheets is non-uniform (Fig. 2b). This is caused by undulations of the underlying detachment horizons on the one hand and by local folding and tilting in the vicinity of thrust faults on the other hand. In addition, limestones of the Douro and Allen Bay formations in the central klippe are often intensely brecciated and sometimes affected by c1-shear planes which are oriented parallel to the Parrish Glacier Thrust (Fig. 2c).

In the eastern klippe, Tertiary conglomerate units and Cretaceous sediments are thrust over the Tertiary foreland basin along a flat-lying detachment in the NNW and a ramp cutting-up sequence in the SSE (Fig. 3, profile C-C'). The predominantly 25-45° NW dipping conglomerate beds of the klippe above the Cretaceous are affected by numerous brittle shear zones and brecciation. This suggests that the conglomerate of the klippe was originally covered by another thrust sheet of probably Allen Bay carbonate similar to the western klippen and which has been removed by erosion.

The eastern klippe is underlain by an undisturbed, gently SSE-dipping succession of Tertiary and Cretaceous clastics and probably Silurian carbonates. In the northeast, the klippe and its footwall are overthrust by the Douro, Cape Storm and Allen Bay formations along the E-W trending Cape Hawks Thrust (Figs. 2a, 3, profile C-C'). Between the central and eastern klippen, a flat-lying detachment is situated within the conglomerate of the Tertiary Cape Lawrence Formation. Although it is difficult to recognize bedding-parallel thrust faults in the massive and monotonous conglomerate beds, several slices of Cretaceous dark mudstone within the Tertiary conglomerate indicate the occurrence of a detachment horizon. Additionally, the bedding of the Tertiary is almost horizontal in the hanging wall of the detachment but dips gently to the N and NE in the footwall (Fig. 2a). Here, conjugate sets of NW-SE trending dextral and NNE-SSW trending sinistral shear planes indicate a general NNW-SSE compression (Fig. 2c).

In the area between Allman Bay and Dobbin Bay, folded Ordovician to Silurian strata are thrust over the Tertiary conglomerate along the Cape Hawks Thrust (Figs. 2a, 3, profiles D-D', E-E'). At Cape Hawks, flat-lying carbonates and clastics of the Allen Bay, Cape Storm, Goose Bay and Douro formations are overthrust by a 300 m thick succession of folded and thrust-faulted Allen Bay and Cape Storm formations probably prior to the activation of the Cape Hawks Thrust (Fig. 4a).

In this area, the Cape Hawks Thrust dips 30° to the NNW. The Tertiary conglomerate directly below the thrust fault is affected by a poorly preserved, steeply N-dipping cleavage s1 and steeply NNW-dipping or flat-lying c1 shear planes which cut through the pebbles of the Cape Lawrence Formation. Slickenside lineations indicate a SSE-transport of the hanging wall (Fig. 4b). Additionally, c1 shear planes in the Paleozoic of the hanging wall are oriented parallel to the Cape Hawks Thrust.

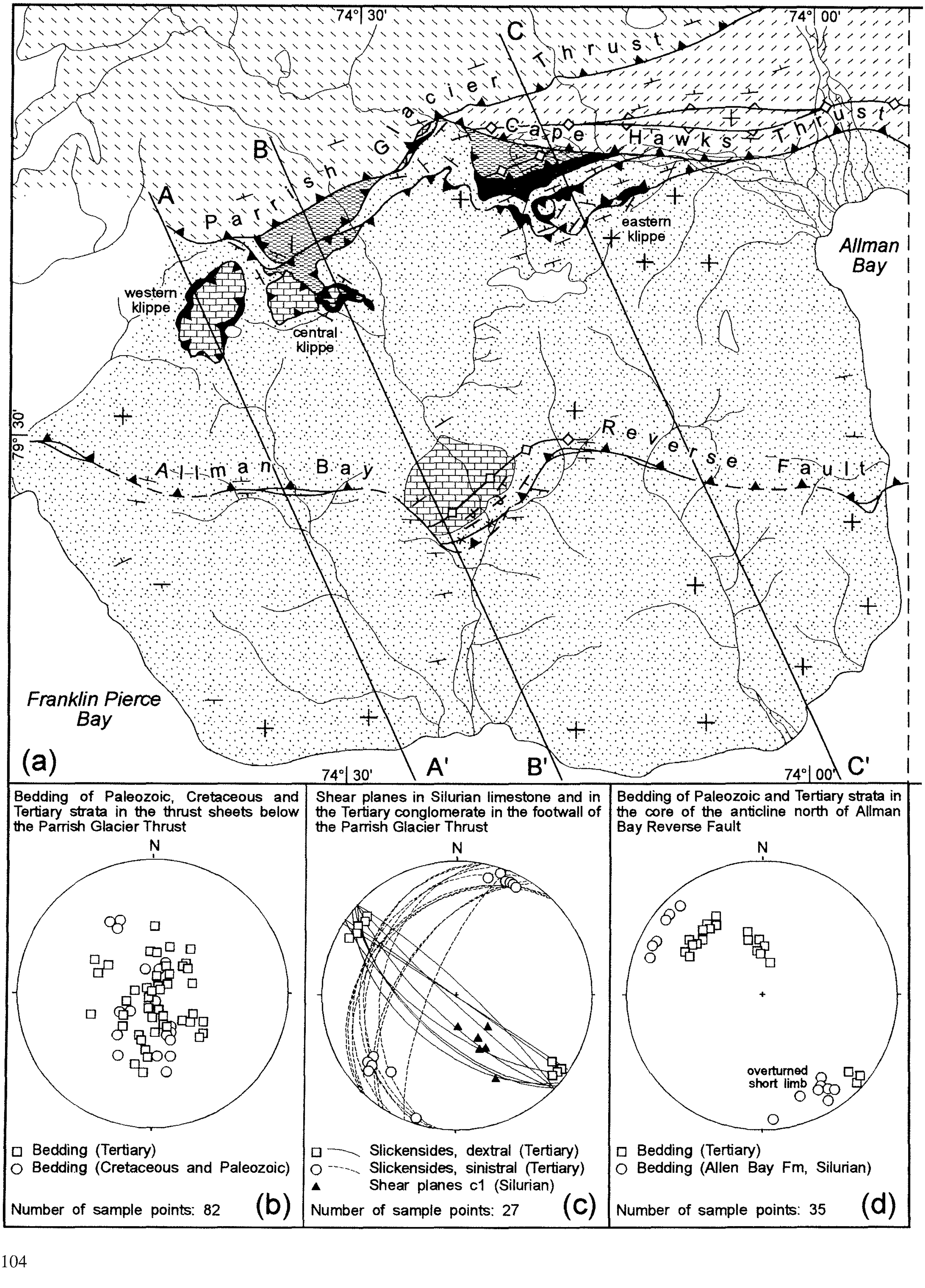
The southernmost structure of the Eurekan deformation between Franklin Pierce and Dobbin bays is represented by the E-W trending, steeply N-dipping Allman Bay Reverse Fault (Fig. 2a). In the centre of the peninsula between Franklin Pierce Bay and Allman Bay, a large-scale, SE-vergent fold structure is exposed. In the core of the anticline, Ordovician to Silurian limestone of the Allen Bay Formation crop out within an erosional window and are overlain by Tertiary conglomerate along an unconformable sedimentary contact (Figs. 2a, 3, profile B-B').

The northwestern long limb of the fold structure gently dips to the NW, and the southwestern short limb dips steeply to the SE and is partly overturned (Figs. 2d, 3, profile B-B'). To the SE, the anticline and syncline are carried over gently S-dipping Tertiary conglomerate along the Allman Bay Reverse Fault. In the SW, the Allen Bay Formation in the core of the anticline, the long limb and the overturned short limb are separated from gently S-dipping Tertiary conglomerate by a steep fault which is related to the Allman Bay Reverse Fault as a dextral oblique tear fault (Fig. 2a). To the east, the carbonates of the Allen Bay Formation plunge below Tertiary deposits and both the core of the anticline and the Allman Bay Reverse Fault change their local SW-NE trend in the vicinity of the fold structure into the general W-E trend (Fig. 2a). This fold structure, on the scale of 100's of metres, is probably related to a blind thrust in the Paleozoic strata below the Tertiary basin (Fig. 3, profile B-B').

CAPE LAWRENCE AREA

Lithology

At Cape Lawrence (Fig. 5), the basal exposed deposits of the Paleozoic succession are represented by dark grey to black unstratified limestone and intercalated oolithic beds of the Cambrian Kennedy Channel Formation (KERR 1967). It is overlain by red-weathering dolostone and limestone of the Ella Bay Formation (KERR 1967). The equivalent to the Dallas Bugt Formation in the southern study area is represented here by red


74°30'
74°00'
79°30'
A
A'
B
B'
C
C'
Parrish Glacier Thrust
Cape Hawks Thrust
Allman Bay Reverse Fault
western klippe
central klippe
eastern klippe
Allman Bay
Franklin Pierce Bay
(a)
Bedding of Paleozoic, Cretaceous and Tertiary strata in the thrust sheets below the Parrish Glacier Thrust
N
Bedding (Tertiary)
Bedding (Cretaceous and Paleozoic)
Number of sample points: 82
(b)
Shear planes in Silurian limestone and in the Tertiary conglomerate in the footwall of the Parrish Glacier Thrust
N
Slickensides, dextral (Tertiary)
Slickensides, sinistral (Tertiary)
Shear planes c1 (Silurian)
Number of sample points: 27
(c)
Bedding of Paleozoic and Tertiary strata in the core of the anticline north of Allman Bay Reverse Fault
N
overturned short limb
Bedding (Tertiary)
Bedding (Allen Bay Fm, Silurian)
Number of sample points: 35
(d)

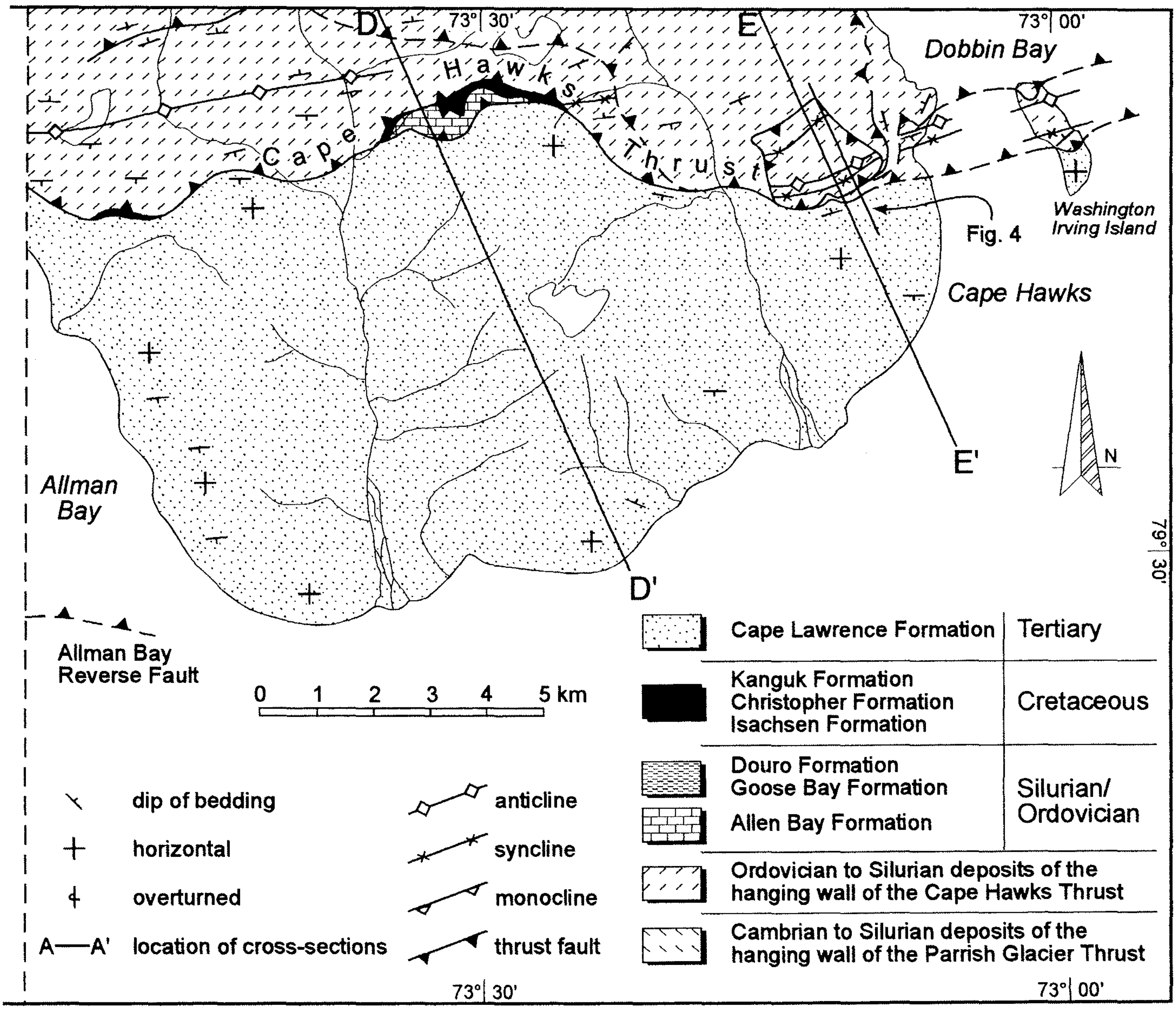


Fig. 2: Geological map and Schmidt nets of the southern study area. (a) Geological map of the Tertiary foreland basin between Franklin Pierce Bay and Dobbin Bay. (b) Bedding s0 of Paleozoic, Cretaceous and Tertiary deposits and (c) shear planes in Silurian and Tertiary deposits below the Parrish Glacier Thrust. (d) Bedding s0 of Paleozoic and Tertiary deposits north of the Allman Bay Reverse Fault.

sandstone and conglomerate of the Archer Fjord, Carl Ritter Bay and Rawlings Bay formations overlain by sandstone of the Kane Basin Formation and younger units (Fig. 5) (KERR 1967).

Slices of Ordovician and Silurian evaporite and carbonate of the Bauman Fjord, Irene Bay and Allen Bay formations lie in the Rawlings Bay Thrust Zone between the Kennedy Channel carbonates in the hanging wall and the Tertiary basin in the footwall (Fig. 5). The latter consists of approximately 1000 m thick conglomerates of Paleocene age (MAYR & DE VRIES 1982) which were assigned to the Cape Lawrence Formation (MIALL 1986, 1991). The base of the Tertiary basin in the Cape Lawrence area is unknown.

Structure

In the Cape Lawrence area, the Rawlings Bay Thrust Zone consists of two major reverse faults which steeply dip to the WNW (Fig. 5). The upper, minor thrust fault cuts through Cambrian sediments carrying dark limestone of the Kennedy Channel Formation over dolostone and limestone of the Ella Bay and Kennedy Channel formations. The lower Rawlings Bay Thrust is a complex structure. Below the Kennedy Channel Formation of the hanging wall and the Tertiary conglomerate of the footwall, slices of Early Paleozoic carbonates (mostly Irene Bay and Allen Bay formations) and extremely folded evaporite of the Bauman Fjord Formation are intercalated (Fig. 5).

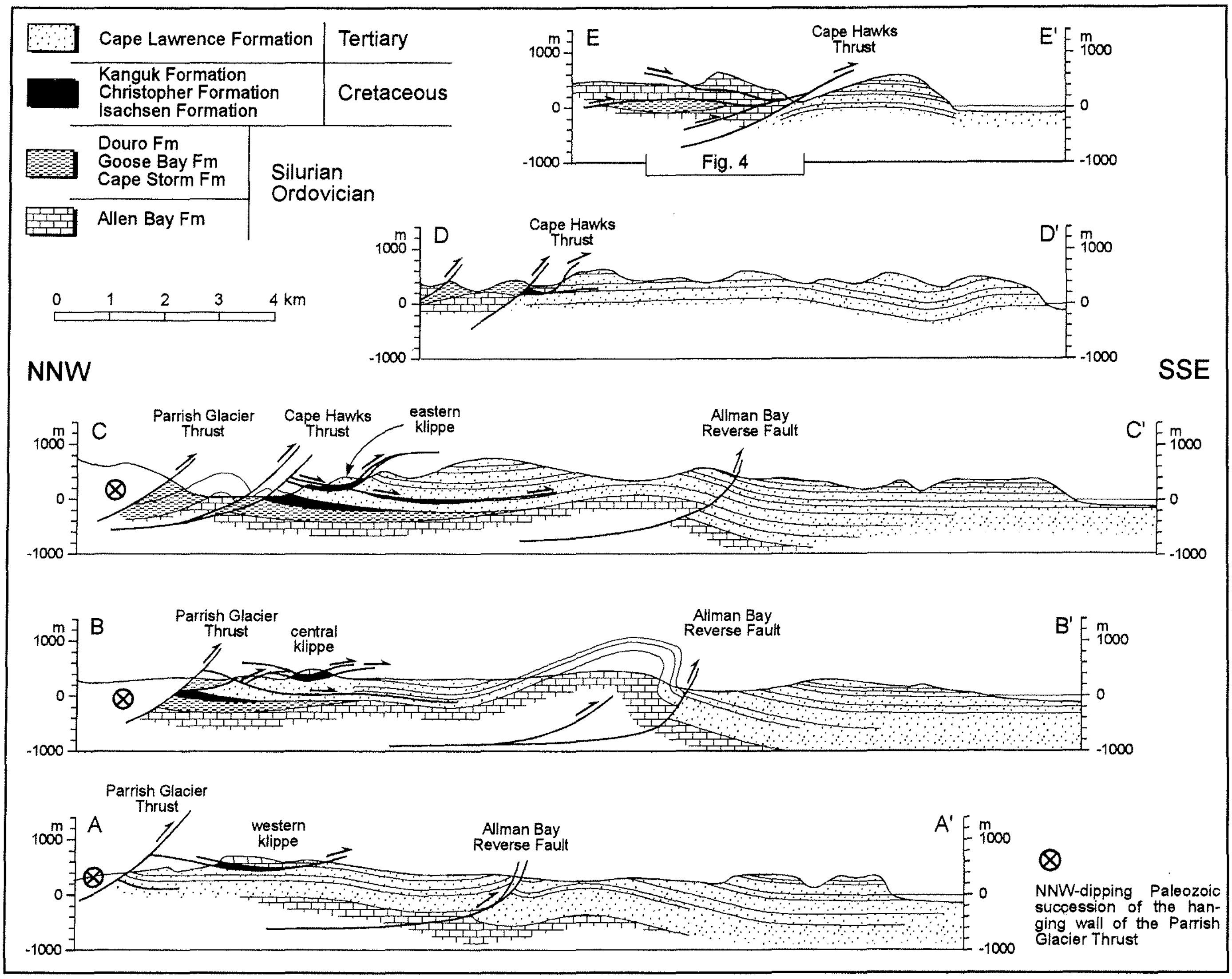


Fig. 3: NNW-SSE cross sections through the Tertiary foreland basin between Franklin Pierce Bay and Dobbin Bay (for location of cross sections see Fig. 2).

The dark limestones of the Kennedy Channel Formation in the hanging walls of the upper and lower Rawlings Bay thrusts are affected ESE-vergent anticline and syncline pairs on the scale of 100's of metres which strike almost parallel to the NNE-SSE trending main thrust faults (Fig. 5). Apart from these fold structures, the km-thick Paleozoic succession overlying the Kennedy Channel Formation is unfolded and dips steeply to the WNW. Directly above the lower Rawlings Bay Thrust, the dark limestone is partly brecciated and truncated by numerous c1-shear planes. Small-scale duplex structures within the basal Kennedy Channel Formation indicate transport directions to the ESE (Fig. 6a).

In the southern exposures of the Cape Lawrence area, the thick beds of the Tertiary conglomerate of the footwall are almost horizontal. Approaching the lower Rawlings Bay Thrust, the Tertiary deposits are increasingly affected by Eurekan deformation. Below the main thrust plane, steeply ESE-dipping beds of the Cape Lawrence Formation are displaced by gently WNW-dipping thrust faults with transports of the hanging walls towards the ESE (Fig. 6b). Especially 100 m-scale, ESE-vergent thrust-related folds, triangle structures and gently WNW-dipping thrust faults (Fig. 7, profile F-F') demonstrate the significant involvement of Tertiary units in the ESE-directed compression. Within the triangle structures slices of Paleozoic limestones are likely intercalated. To the ESE, these structures run into bedding-parallel detachments which are characterized by tectonized horizons up to 10 metres thick between unaffected conglomerate beds and which are hardly to identify in the cliffs facing the coast of Kane Basin.

On top of the conglomerate units in the southern Cape Lawrence area, a Paleozoic thrust sheet with a horizontal base is exposed (Fig. 7, profile F-F') (Mayr & de Vries 1982). This situation is similar to the klippen between Franklin Pierce and Allman bays.

The trend of the Rawlings Bay Thrust Zone and related fold structures is almost parallel to the Wegener Fault in Nares Strait. But there are two major structures which are different to the NNE-SSW orientation of the main Eurekan structures: in the footwall of the lower Rawlings Bay Thrust, the Tertiary beds in the northern exposures of the Cape Lawrence area are affected by a SE-vergent anticlinal-synclinal pair several hundred metres in scale and a steeply WNW-dipping reverse fault (Fig. 5, profile G-G'). Although the outcrop situation is poor, it can clearly be observed that these large-scale structures do not affect the flat-lying Tertiary succession in the SSE but are obliquely overthrust by the lower Rawlings Bay Thrust (Fig. 5).

AGE OF DEFORMATION

The age of the compressive Eurekan orogeny (THORSTEINSSON & TOZER 1970) is interpreted to be in the range from Late Campanian to Late Eocene or Early Oligocene (TRETTIN 1991, OKULITCH & TRETTIN 1991). In the study areas between Franklin Pierce Bay and Dobbin Bay and at Cape Lawrence, the Tertiary conglomerate is clearly involved into several stages of Eurekan deformation. Concerning the Paleocene age of the Cape Lawrence Formation (MAYR & DE VRIES 1982, DE FREITAS & SWEET 1998), the onset of deformation started during post-Paleocene times. 200 km southeast of Franklin Pierce Bay, the continuation of the Parrish Glacier Thrust affects Middle Eocene sediments of the Eureka Sound Group (WEST & DAWSON 1977, 1980, MAYR & DE VRIES 1982). This suggests that the main stage of thrust-faulting in the study areas took place during post-Middle Eocene times.

CONCLUSIONS

The Eurekan deformation in the study areas is dominated by thrust-faulting. All in all, three main structural elements can be observed. The formation of thin thrust sheets along flat-lying detachments and ramps cutting-up sequence is a characteristic feature in the Silurian/Ordovician and Cretaceous/Tertiary deposits in the footwall of the Parrish Glacier and lower Rawlings Bay thrusts. Between Franklin Pierce and Allman bays and at Cape Lawrence, some of these thrust sheets are exposed in klippen in front of the main thrusts.

Another structural element is represented by SSE- to ESE-vergent fold-structures on a scale of 100's of metres. They are exposed in the area between the Cape Hawks and Parrish Glacier thrusts west of Dobbin Bay, in the hanging wall and footwall of the Rawlings Bay Thrust Zone and on the peninsula between Franklin Pierce and Allman bays. At Cape Hawks, some of the detachments are involved in the folding.

The main structures of the Eurekan deformation are represented

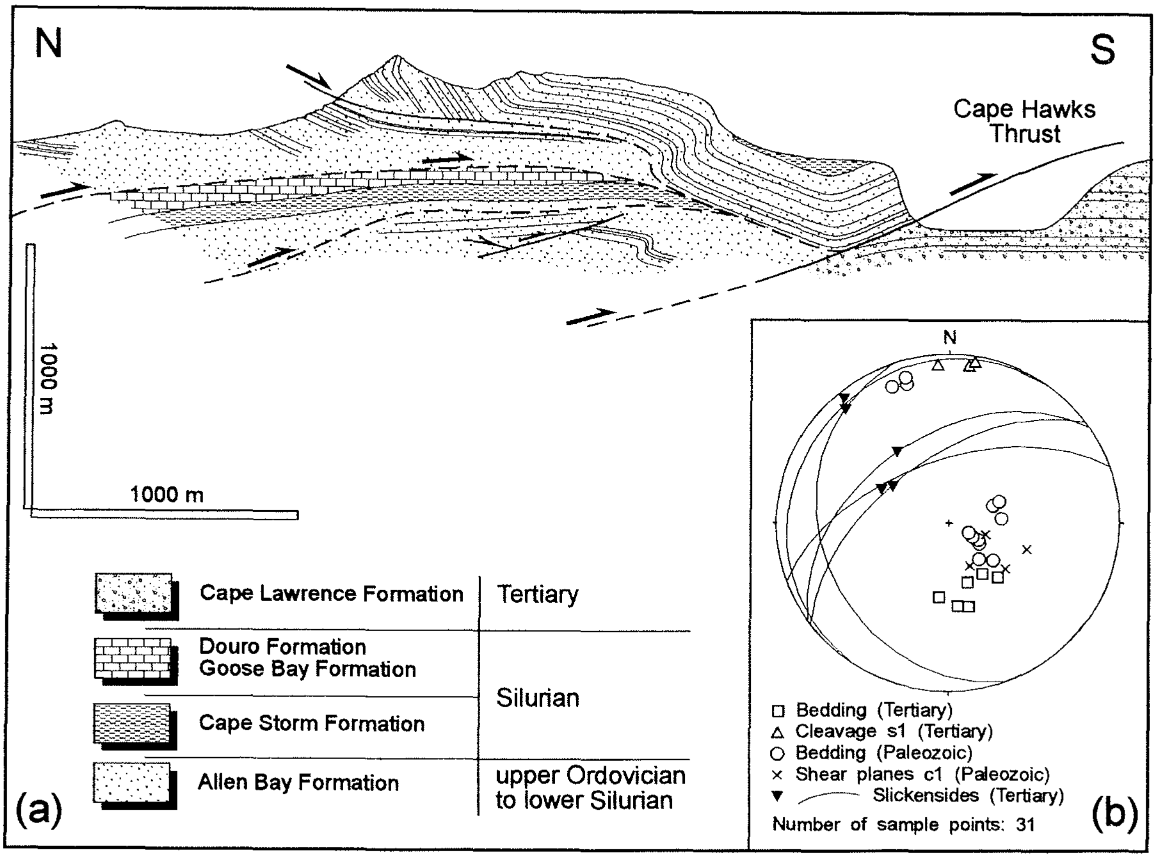


Fig. 4: (a) N-S-profile through the folded and thrust-faulted upper Ordovician to Silurian succession in the hanging wall and the flat-lying Tertiary conglomerate succession in the footwall of the Cape Hawks Thrust west of Cape Hawks (for location see Fig. 2a). (b) Schmidt net of tectonic elements in Paleozoic and Tertiary deposits above and below the Cape Hawks Thrust.

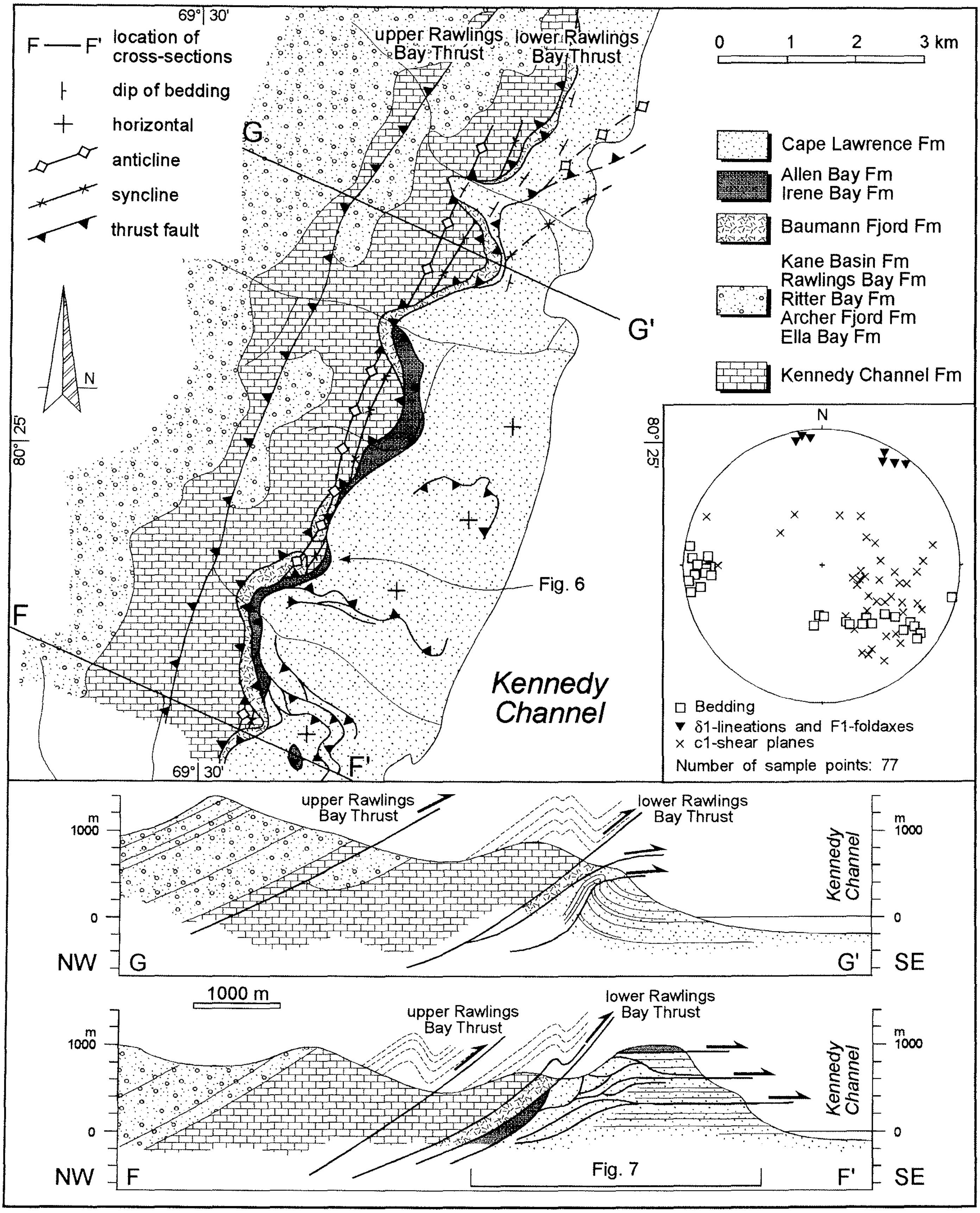


Fig. 5: Geological map and cross sections of the Rawlings Bay Thrust Zone and the Tertiary foreland basin in the Cape Lawrence area.

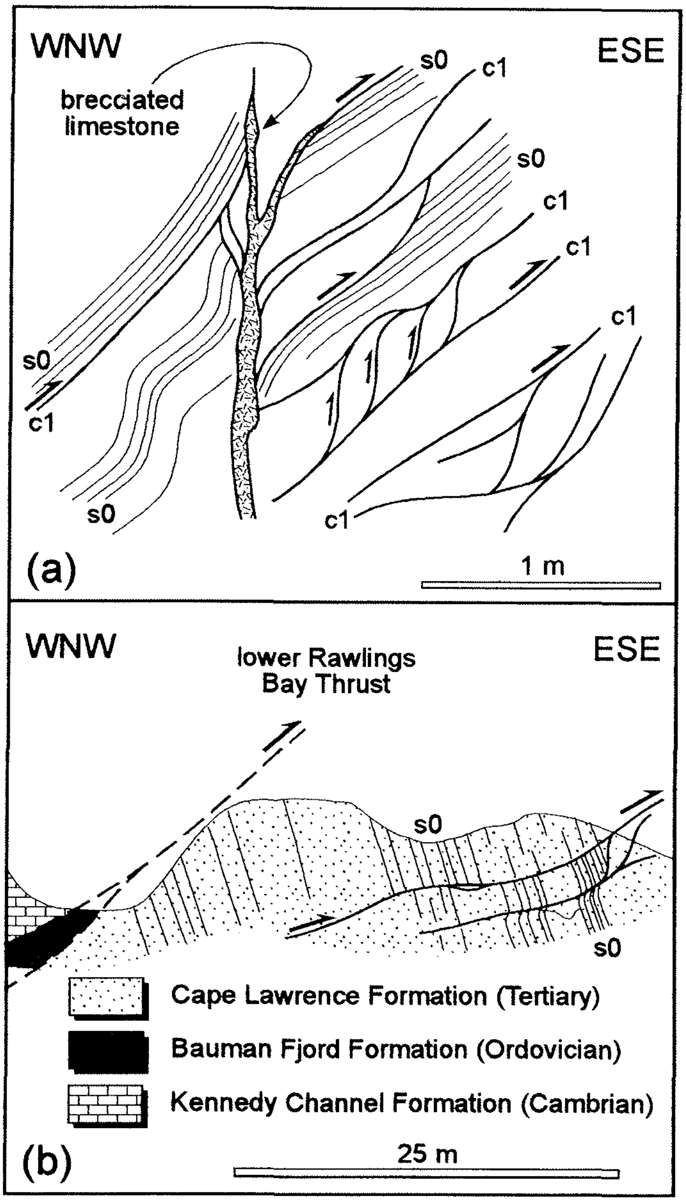


Fig. 6: Schematic sketches of (a) c1-shear planes in dark limestone of the Cambrian Kennedy Channel Formation in the hanging wall and (b) small-scale thrust faults in steeply ESE-dipping conglomerate of the Tertiary Cape Lawrence Fm in the footwall of the lower Rawlings Bay Thrust. For location see Fig. 5.

by the Parrish Glacier, Cape Hawks and Rawlings Bay thrusts. The main thrust faults and the overlying Paleozoic succession dip 30-50° to the N, NNW and WNW.

At Cape Lawrence, some of the detachments in the Tertiary conglomerate were re-activated during the formation of triangle-structures below the lower Rawlings Bay Thrust. It should be noted that the detachments are restricted to the footwall of the Parrish Glacier and Rawlings Bay thrusts. In addition, the km-thick Paleozoic succession in the hanging walls of both thrust zones is unfolded except for some probably thrust-related folds in the Kennedy Channel Formation at Cape Lawrence.

To the NNW and WNW, the Paleozoic succession flattens out. 20 km NNW of the Parrish Glacier Thrust and WNW of the Rawlings Bay Thrust Zone, a foldbelt with km-scale folds is developed in pre-Middle Devonian deposits. Due to the absence of younger sediments it is difficult to assign this folding to the Devonian to Early Carboniferous Ellesmerian orogeny or to the Tertiary Eurekan deformation.

Although the outcrop situation is poor, the observations in the study areas suggest that the Eurekan deformation is dominated by compression which is supported MAYR & DE VRIES (1982) and DE FREITAS & SWEET (1998). The fold-vergences and transport-directions of thrusts are to the SSE between Franklin Pierce Bay and Dobbin Bay and to the ESE at Cape Lawrence towards the basement blocks of the Greenland-Canadian shield SE of Nares Strait and S of Princess Marie Bay.

There is one exception in the northern part of the Tertiary exposures at Cape Lawrence: the orientation of the NE-SW trending large-scale fold-structure and the NW-dipping reverse fault is oblique to the NNE-SSW trending Nares Strait. During fieldwork in summer 1999 it is planned to prove whether they represent transpressional structures which could be related to sinistral displacements along Nares Strait after deposition of the Cape Lawrence Formation. However, MAYR & DE VRIES (1982) described evidence for lateral movements on Darling Peninsula east of Dobbin Bay and sinistral strike-slip faulting on Judge Daily Promontory north of Cape Lawrence.

The studies in the Dobbin Bay and Cape Lawrence areas suggest several stages of deformation:

(1) The onset of deformation can be related to uplift and erosion of Silurian and Ordovician carbonate in the northwest during the deposition of the Cape Lawrence Formation in Paleocene times (MAYR & DE VRIES 1982).

(2) Probably sinistral strike-slip movement along Wegener Fault (Nares Strait) after the deposition of the Cape Lawrence Formation. The spreading in Labrador Sea and Baffin Bay (SRIVASTAVA 1978, HINZ et al. 1979, MENZIES 1982) could be the cause of this post-Paleocene left-lateral motion before anomaly 24 (55 m.y.). This corresponds to the motion of the Greenland plate to the NE between anomalies 25 and 24 (SRIVASTAVA 1985).

(3) Development of detachment faults and ramps in the footwalls of Parrish Glacier and Rawlings Bay thrusts.

(4) Main stage of the Eurekan deformation and development of the Parrish Glacier, Cape Hawks and Rawlings Bay thrusts and thrust-related folding. The steeply inclined main thrust faults represent the youngest Eurekan structures and cut through the Tertiary foreland basin, the probable transpressional structures at Cape Lawrence and the detachments in both study areas. Provided that the NE-SW trending fold and thrust fault at Cape Lawrence represent transpressional structures of a sinistral motion between Greenland and Ellesmere Island between anomalies 25 and 24, the compressional Eurekan main thrust faults could be Eocene in age. In this case, they could be related to a relative northwestern motion of Greenland with respect to Ellesmere Island between anomalies 24 (55 m.y.) and 13 (36 m.y.) (SRIVASTAVA 1985).

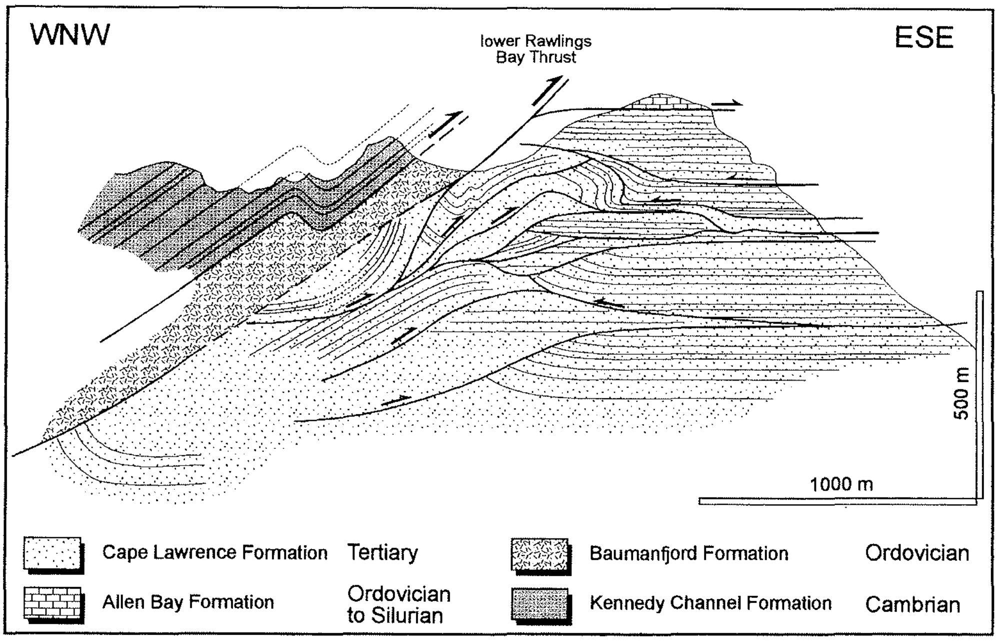


Fig. 7: WNW-ESE-profile through the southernmost exposures of the Tertiary basin below the lower Rawlings Bay Thrust at Cape Lawrence illustrating the intense involvement of the Cape Lawrence Formation in the Eurekan deformation. Location of profile is situated in the ESE-part of cross section F-F' (see Fig. 5).

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