GRØNLANDS GEOLOGISKE UNDERSØGELSE
RAPPORT Nr. 72

The Geological Survey of Greenland
Report No. 72

Tension structures related to gliding tectonics in the Caledonian superstructure of Canning Land and Wegener Halvø, central East Greenland

by

R. Caby

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Tension structures related to gliding tectonics in the Caledonian superstructure of Canning Land and Wegener Halvø, central East Greenland

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1976

Abstract

A variety of types of pre-Devonian tension structures observed in the late Precambrian Eleonore Bay Group, Tillite Group and Cambrian strata of Canning Land and Wegener Halvø are described and their mutual relationships discussed. They represent the main Caledonian deformation within the region, and seem to have formed during the westward tectonic transport of gliding units on discontinuity surfaces which lie mostly parallel to bedding.

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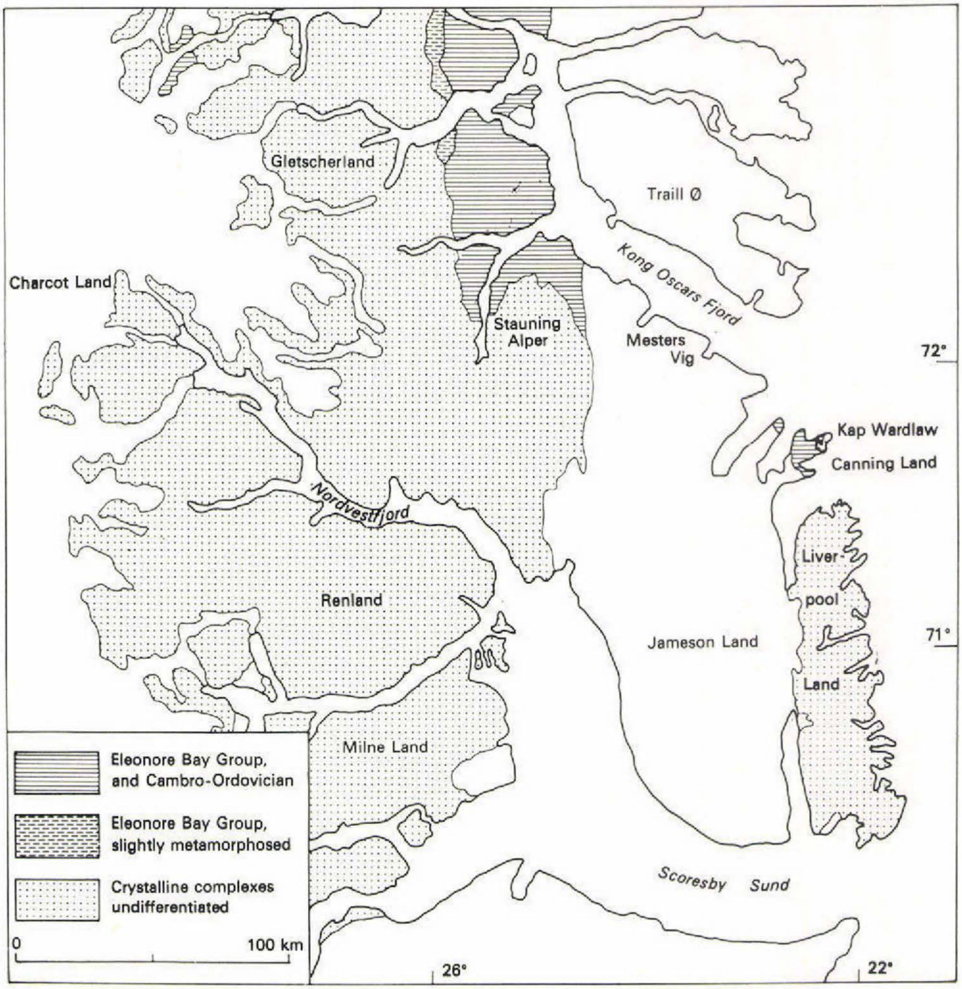

Fig. 1. Outline geological map and geological setting of Canning Land and Wegener Halvø.

Introduction and regional geology

Canning Land and Wegener Halvø include the southernmost outcrops of the non-metamorphic Caledonian superstructure in central East Greenland, comprising the Eleonore Bay Group, Tillite Group and Cambrian strata (map 1 and fig. 1). These outcrops are bounded to the west by a graben of Middle Devonian clastics and the Mesozoic terrain of Jameson Land. According to Bütler (1948), Canning Land forms part of the elevated edge of the Liverpool Land block, but the high grade schists, gneisses and granites comprising Liverpool Land belong to the pre-Caledonian basement (Coe & Cheeney, 1972).

The Canning Land area has previously been investigated by Nordenskjöld (1907), Noe-Nygaard (1937) and Bütler (1948). Recent stratigraphic investigations (Caby, 1972) have shown that the stratigraphic sequence is very similar to the classic sections of Strindberg Land and the Alpefjord region (Katz, 1952; Fränkl, 1953), and the standard nomenclature and numbering (bed groups 1–20) has been applied for the Upper Eleonore Bay Group. The sequence represented on Canning Land reaches a thickness of about 6000 m comprising: monotonous black shales, quartzitic shales and slates of the Lower Eleonore Bay Group ($\geqslant$ 2000 m); quartzites, black and green shales and silty shales, often well banded and with cross-bedding and slump structures, belonging to the Quartzite 'series' (bed groups 1–6: 1500 m); the Multicoloured 'series', a characteristic development of red and purple shales and silty shales, yellow and white dolomites, grey limestones, often with breccia levels, and towards the top with large, branched columnar stromatolite colonies (bed groups 7–13: 900 m); the Limestone–Dolomite 'series' (bed groups 14–19) mainly consisting of various dolomites and limestones rich in ooids, stromatolitic layers, black cherts and intraformational breccias (900 m); the Tillite Group, a banded unit 60 m thick comprising 6 tillitic horizons; and Cambrian strata ($>$ 1000 m) comprising quartzites, siltstones, sandstones, shelly limestones containing small brachiopods and *Obolella congesta*, and banded and massive dolomites and limestones (Caby, 1972).

Along the border of the Devonian graben a folded succession of post-Cambrian rocks crops out, for which a lower–middle Devonian age has been advanced (Caby, 1972). They include pebbly sandstones, shales and dolomites overlain by volcanic tuffs, and slumped and chaotic sediments with olistolites, interpreted as syntectonic deposits formed at the onset of volcanic activity in this zone.

The late-kinematic Kap Wardlaw granite cuts the black shales of the Lower Eleonore Bay Group with sub-vertical contacts and in the roof has irregular convex lobes and apophyses. There is a pronounced contact metamorphic aureole, a zone of spotted slates 250 to 400 m wide surrounding the granite, with adjacent to the contact a narrow zone (0–20 m) of high grade cordierite $\pm$ garnet $\pm$ sillimanite biotite hornfelses.

In the classic outcrops of the Caledonian superstructure found in a broad zone of the central fjord region between latitudes 72°–74°N, the typical structures are large scale disharmonic open folds trending N–S, and numerous faults (Wegmann, 1935; Fränkl, 1953; Eha, 1953). These structures indicate a very low degree of shortening, calculated at about 5% by Eha (1953), and are thought by Haller (1970) to have been generated only by vertical movements. When not faulted, the transition between superstructure and infrastructure has been interpreted as a zone of detachment (Wegmann, 1935; Haller, 1971).

The structure of Canning Land and Wegener Halvø has previously been interpreted as a large E–W trending anticline plunging westwards with some minor folds and thrust planes in its core, and cut up into several segments by faults (Bütler, 1948, p. 28). In 1971 the region was remapped and a preliminary report of the stratigraphy and structure has been given by Caby (1972). The general structure, summarized in map 1 and fig. 2, implies that the rocks of the Caledonian superstructure have undergone westward translation during which tension features were formed, while N–S trending compressive folds simultaneously formed in zones of local contraction. The compressive folds occur either within the Kap Tyrrell thrust zone, or in the deepest exposed zone of black shales which are affected by a sub-vertical slaty cleavage. The Kap Tyrrell overthrust sheet may have covered the whole of northern Canning Land, as is suggested by the reappearance of black shales of the Lower Eleonore Bay Group above the Multicoloured 'series' by normal faulting, south-east of Porfyrbjerg (fig. 2 c). Numerous post-Devonian and Tertiary normal and strike-slip faults tend to complicate and obscure the general structure of the area.

The aim of this paper is to describe the different types of pre-Devonian tension structures observed and their mutual relations in selected areas. The tension features characterize different structural levels which lie sub-parallel to the pile of sediments.

Faults and related structures

Pre-Devonian low-angle faults are ubiquitous (fig. 2). They are especially conspicuous in the limestones and dolomitic rocks of the Multicoloured 'series' and Limestone-Dolomite 'series' south-west of Ålborg Fjord (fig. 3 a–f). The main faults generally dip at angles of 30° either to the WSW or ENE, and make an angle of 30° to 50° with the bedding. Other lower angle faults pass into décollement zones parallel to the bedding, and are outlined by a marked boudinage of the more compact layers (fig. 3a, c, f). The horizontal extension measured on such faults is of the order of some tens or hundreds of metres.

A large fault, well exposed in the southern flank of the mountain above Kap Fletcher, is responsible for the preservation of Cambrian strata (Caby, 1972). The fault plane has a constant dip of 30° towards the east and is delineated by the presence of some large dolomitic blocks, boudinage structures and shear zones (fig. 2 e). The amount of horizontal displacement measured is 1.3 km. Whereas a multitude of sub-vertical fractures and minor faults occur in the massive Cambrian dolomites, the shaly flysch-like Cambrian succession (Ella Ø Formation?) shows a surprising devel-

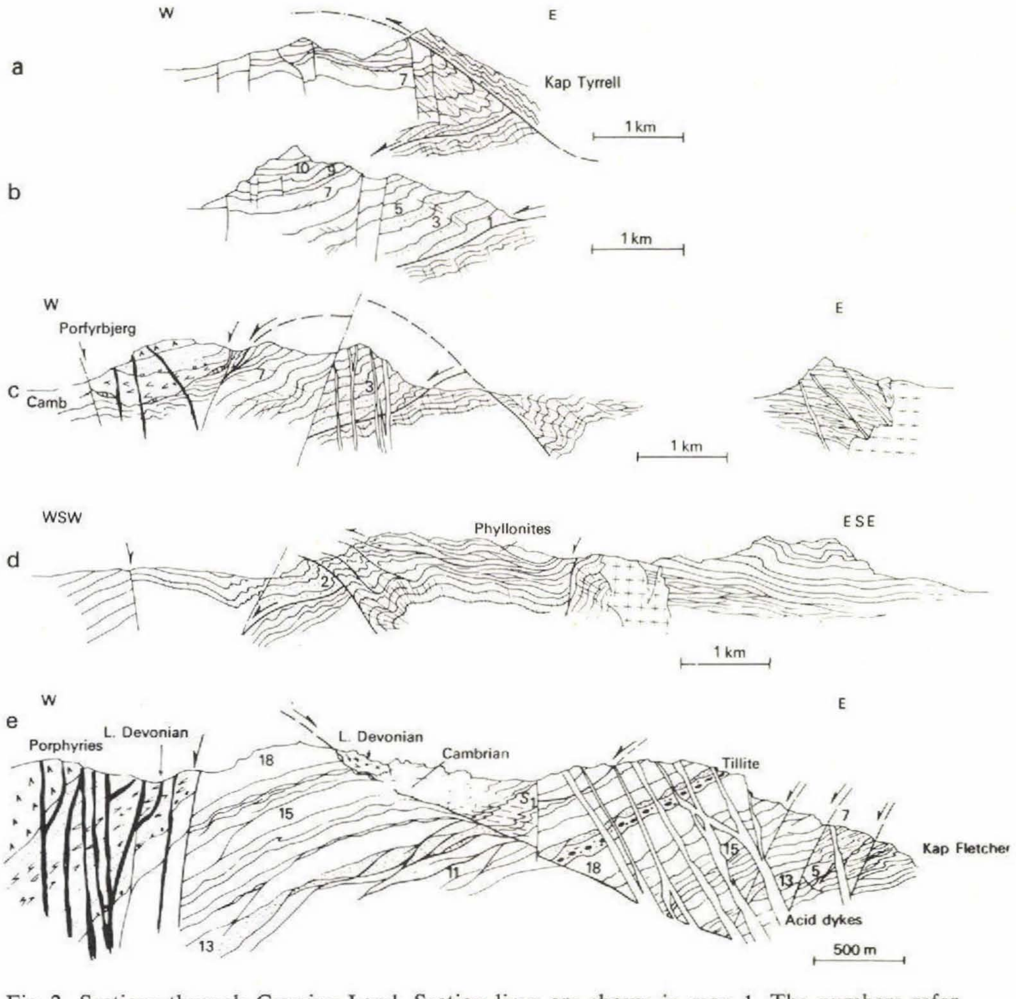

Fig. 2. Sections through Canning Land. Section lines are shown in map 1. The numbers refer to the bed groups of the Upper Eleonore Bay Group. Note on section *e* how the axial plane cleavage (S_1) of folds are related to the low angle fault.

opment of tight to isoclinal folds with amplitudes of a metre to a decametre. Parasitic minor folds with curved axes trending from 010° to 080° show in their hinges a slight thickening of limestone bands, and an incipient slaty cleavage is seen in the black shales (fig. 4). Such recumbent folds appear to have formed under a local vertical stress generated during the main movement along the fault. Rocks of assumed Lower Devonian age are preserved at the highest level of the down-faulted block (fig. 2 e). These rocks are probably the most deformed rocks in Canning Land, and are affected by a multitude of recumbent to isoclinal folds and shear planes. The presence of cherts in the axial planes of folds and the very ductile behaviour of the dolomites, necessarily implies that the sediments were deformed while still unconsolidated and water-rich.

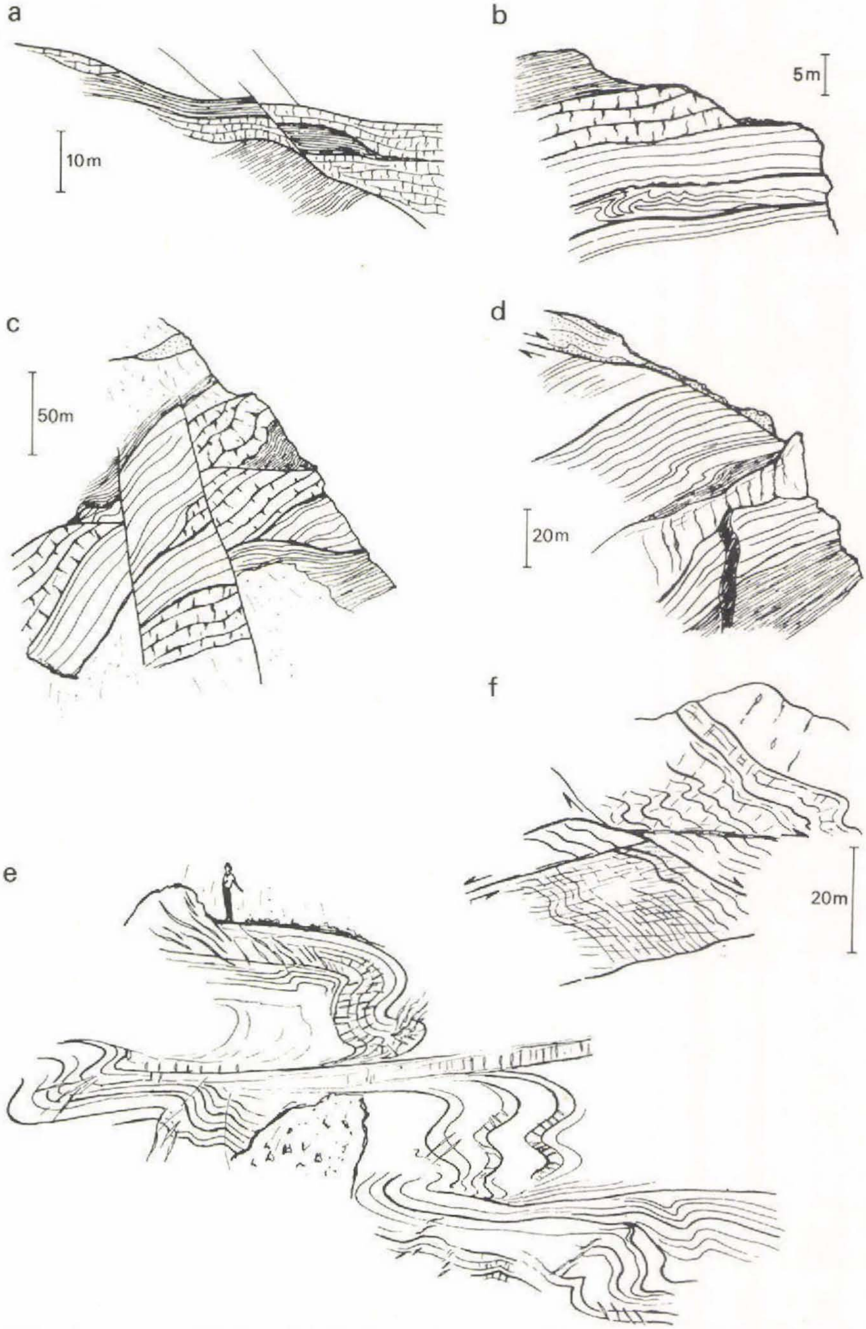

Fig. 3. (a–d) Low-angle faults and décollement zones in the Multicoloured 'series' (bed groups 9 to 11), west of Ålborg Fjord. (e) Plastically folded banded limestones of bed group 9 in a large scale boudin: fold axes are curved, with a mean E–W trend. (f) N–S trending recumbent folds and low-angle faults in a large scale boudin of bed groups 8 and 9 west of Ålborg Fjord; note the well developed axial plane slaty cleavage in bed group 7.

Fig. 4. Tight to isoclinal fold in Cambrian slates along the Kap Fletcher low-angle fault.

Boudinage in the limestones, dolomitic rocks and the Quartzite 'series'

Most outcrops of the Quartzite 'series', Multicoloured 'series', and Limestone-Dolomite 'series' in Canning Land show to varying degrees the development of boudinage structure. Such structures were also reported in the same series from the fjord region further north by Wegmann (1935).

South of Ålborg Fjord large scale boudinage, particularly in bed groups 7 to 13, is responsible for the local disappearance of numerous layers and implies a considerable extension in a WSW–ENE direction. The beds are cut at a low angle by a multitude of flat planes which with a progressive boudinage of the competent layers of dolomite and quartzite become parallel to the bedding (fig. 3 a, d, f). Seen in section, the decametric to plurihectometric boudins seem to be rectangular or rhomboidal in shape with a weak lengthwise orientation in an E–W direction. Spheroidal boudins of the stromatolitic biostromes of bed groups 14 to 17 are also spectacular. Large scale boudins of white quartzite also occur at Kap Brown (fig. 5a, b).

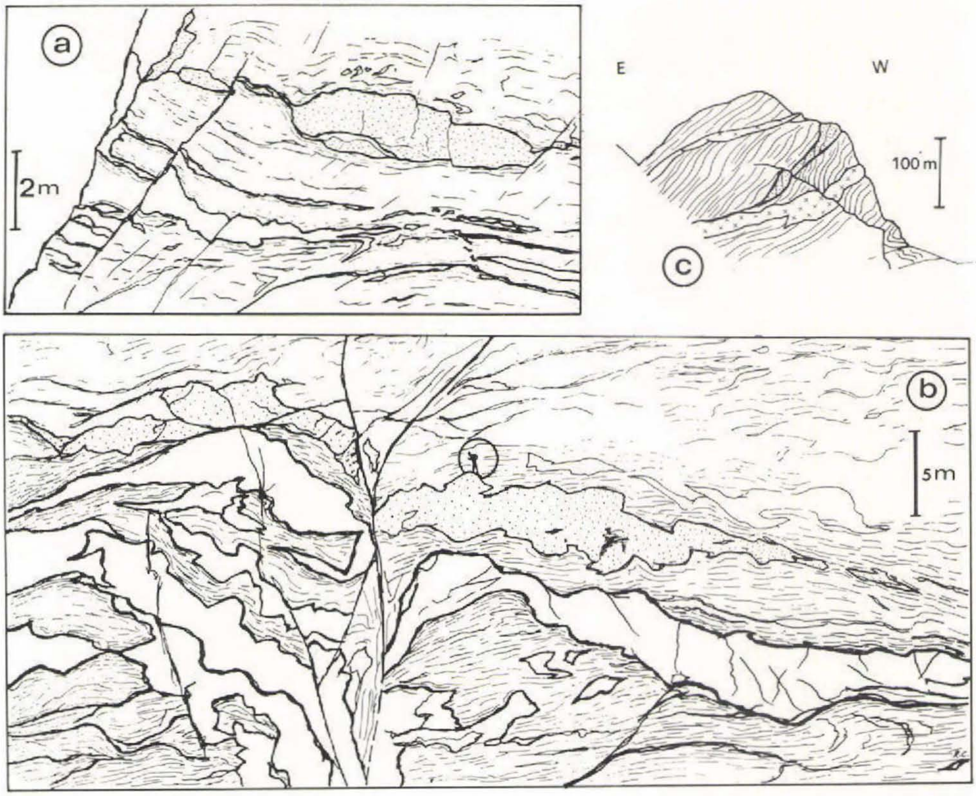

Fig. 5. (a–b) Large scale boudinage of white quartzite (dotted) in phyllonitic black shales in the cliff of Kap Brown; numerous irregular apophyses of calc-alkaline microgranite (in white) are also boudinaged. (Drawn after photographs). (c) Section of the eastern cliff of Kap Brown.

In the limestones and dolomitic rocks, plastic deformation occurs in some lenses of banded, marly limestones of bed groups 9 and 11 (fig. 3 e). The recumbent folds of decametre amplitude have irregularly oriented curved axes with a mean E–W trend parallel to the long axes of the boudins and lenses. The presence of a great number of sigmoidal veins, subperpendicular to the bedding suggests that the folds were formed by flexural flow (Ramsay, 1967, p. 394). The limbs of the folds contain X-shaped conjugate veins trending N–S.

In the Quartzite 'series' large scale boudins of white quartzite embedded in phyllonitic shales are exposed at Kap Brown (fig. 5 a–c). Lenses of plastically folded rocks were also observed in the varicoloured shales of the Quartzite 'series' (bed groups 3–6). Near Kap Fletcher (fig. 6) hectometre size lenses of plastically folded red and green quartzitic shales, bounded by decametre size boudins of white quartzite and boudinaged lamprophyric sills, occur within undeformed rocks of the same series in which only slickensides on bedding planes are to be seen. Within the lenses, isoclinal irregular folds with a well-developed axial plane flow-cleavage have a mean E–W axial trend.

Fig. 6. Recumbent folds trending E–W in red and green shales of the Upper Quartzite 'series', Kap Fletcher. Numerous shear planes outlined by lamprophyric foliated sills (in grey) are parallel to axial planes of folds. Large boudins of white quartzite in the foreground. These structures appear in lenses overlying and underlying unfolded rocks of the same formation. (Drawn after a photograph).

Sheets of penetrative deformation in the black shales of the Lower Eleonore Bay Group

Flattening can be deduced in the black shales from ptygmatically folded shrinkage-cracks or sun-cracks, from the apparent rotation of channels and from the development of a fine slaty cleavage.

Tectonic lenses and elongate pseudo-boudins occur as intercalations within less deformed rocks. The layers are intersected at a very low angle by a profusion of small scale shear planes and slides which cut up the rocks into tectonic lenses (fig. 7) or elongate pseudo-boudins (fig. 8) on a metre to centimetre scale. The displacements appear mainly to be of the order of some tens of centimetres, although their amplitude when parallel to the bedding is unknown. The external surfaces of the lenses and the elongate boudins bear conspicuous slickensides with a mean E–W trend, subparallel with an intersection lineation involving bedding and shear planes. The elongate pseudo-boudins exhibit an internal fold structure in transverse sections (fig. 8). The folds are irregular and disharmonic, with axes subparallel to the lengths of the lenses (fig. 9) and show an irregular axial plane slaty cleavage outlined by minute chlorite and white mica, or by minute biotite in the spotted slates around the Kap Wardlaw granite.

When such structures are present on a centimetre or millimetre scale, sedimentary structures become completely obliterated. The rocks become phyllonites with a laminated structure of tectonic origin subparallel to bedding (figs 10 & 11). Such rocks are more flaggy than the non-phyllonitic rocks, and exhibit a conspicuous development of slickensides on the flaggy surfaces, implying ductile behaviour during the westward tectonic transport. In the same zones phyllonites with breccia structure also occur, the angular or round shaped nodules being fragments of more quartzitic brittle beds.

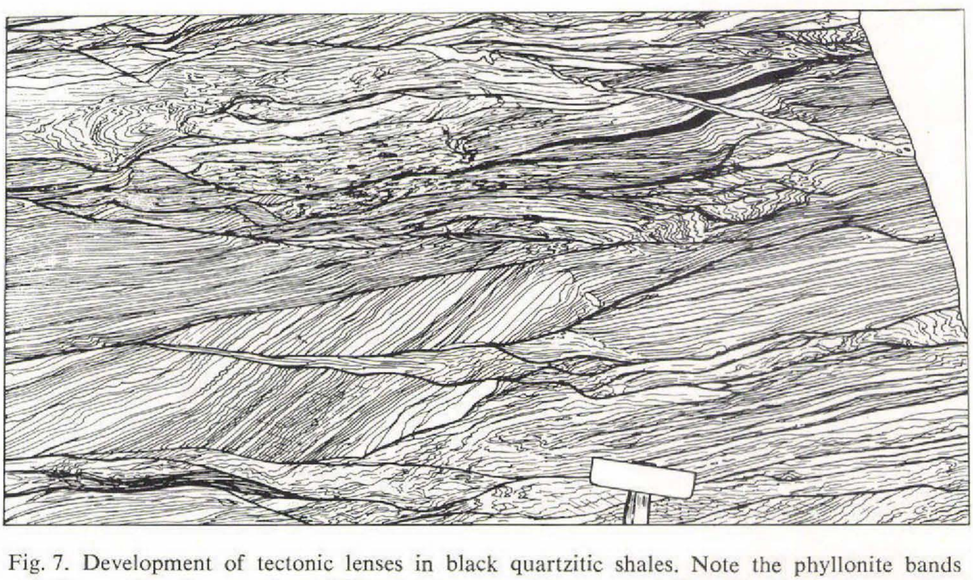

Fig. 7. Development of tectonic lenses in black quartzitic shales. Note the phyllonite bands and the small scale recumbent folds. At the coast 3 km west of Kap Wardlaw. (Drawn after a photograph).

Fig. 8. Decimetre scale tectonic lenses and elongate pseudo-boudins with an internal fold structure in black quartzitic shales, 6 km south-west of Kap Wardlaw. The view is perpendicular to the direction of movement, which is clearly indicated by abundant slickensides on the flaggy surfaces of the rocks. (Retouched photograph).

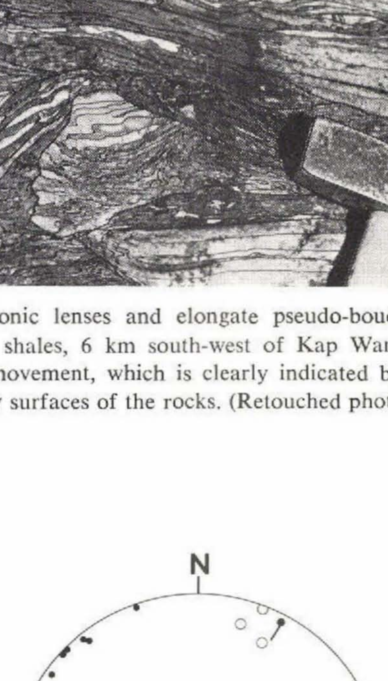

Fig. 9. Upper hemisphere projections of: axes of elongate pseudo-boudins in the black shales (solid symbols); intersections of S_1/S_0 planes (solid dots); poles to late vertical quartz veins (open circles). Locality at the coast of Århus Bugt 6 km south-west of Kap Wardlaw.

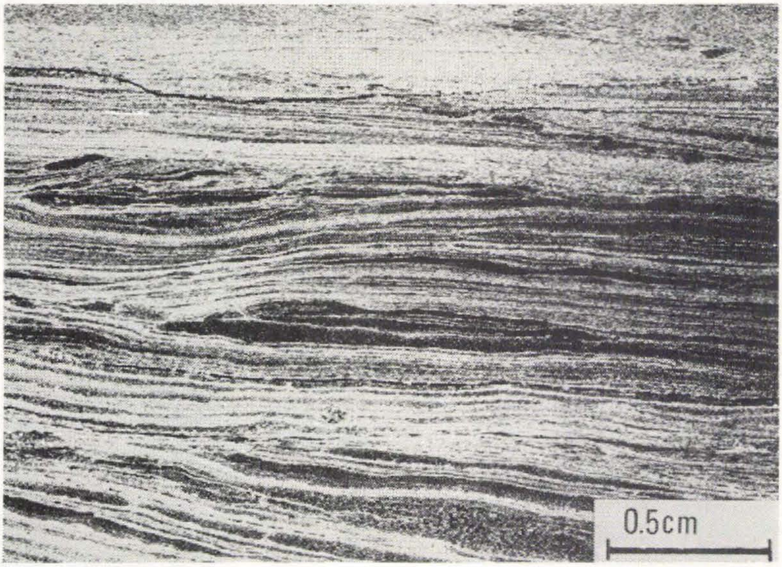

Fig. 10. Section of phyllonitic shale parallel to the length of elongate pseudo-boudins. (Negative print).

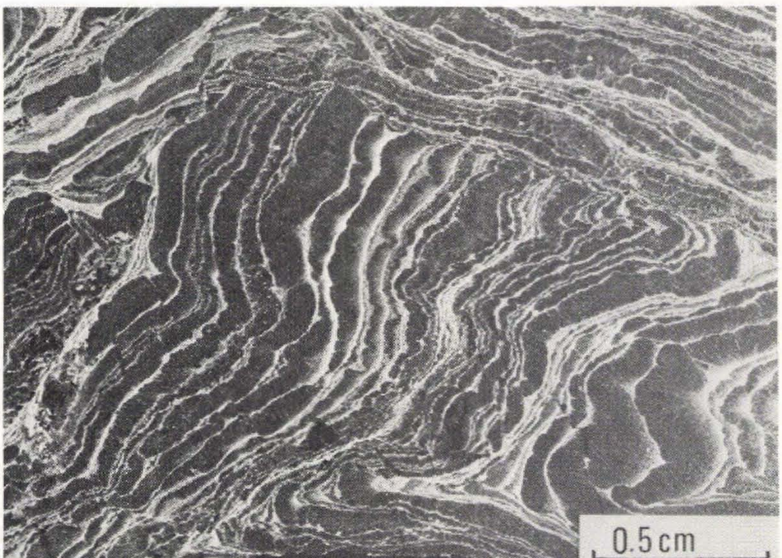

Fig. 11. Transverse section showing the internal folded structure of an elongate pseudo-boudin. (Negative print).

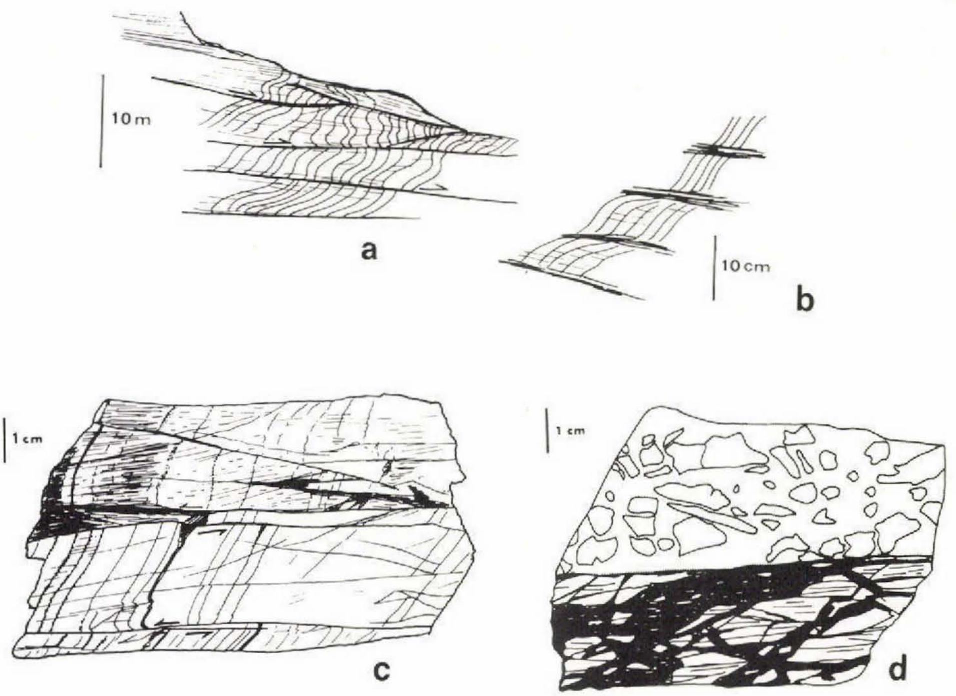

Fig. 12. Structures observed at Kap Brown in green shales. (a & b) Shear planes parallel to the slaty cleavage, axial plane of decametre scale recumbent folds trending N–S (see fig. 5 c). (c) Small scale shear planes subparallel to slaty cleavage; dark zones correspond to partly recrystallized shale with destruction of sedimentary structures. (d) Phyllonitic rock due to pure flattening in dark, completely recrystallized shale with angular relics preserving bedding; no preferential elongation can be observed in this brittle texture.

Another type of phyllonitic fabric has also been observed at Kap Brown in the green quartzitic shales possibly belonging to the Quartzite 'series'. There the rocks are affected by recumbent folds trending N–S and by shear planes. These phyllonites were formed apparently by pure flattening in the S_1 plane without preferential elongation. All transitions exist between schistose rocks with preserved bedding and intersection lineation, and phyllonites with flat nodules disposed without apparent preferential orientation (fig. 12 a–d).

The cleavage

In the red and green shales of the Quartzite 'series' and Multicoloured 'series' zones of both west and east dipping cleavage occur, even in a single exposure (fig. 13), as for example 2 km south-west of Kap Tyrrell along the coast; it is a fracture cleavage in the siltstones, but may be a slaty cleavage in the shales. Sometimes quartz veinlets developed parallel to the cleavage during a late stage of deformation. The cleavage cuts in this zone subhorizontal beds with an angle of 20° to 40°, and corresponds to the axial plane of local assymetric, metre sized recumbent folds which face either west or east.

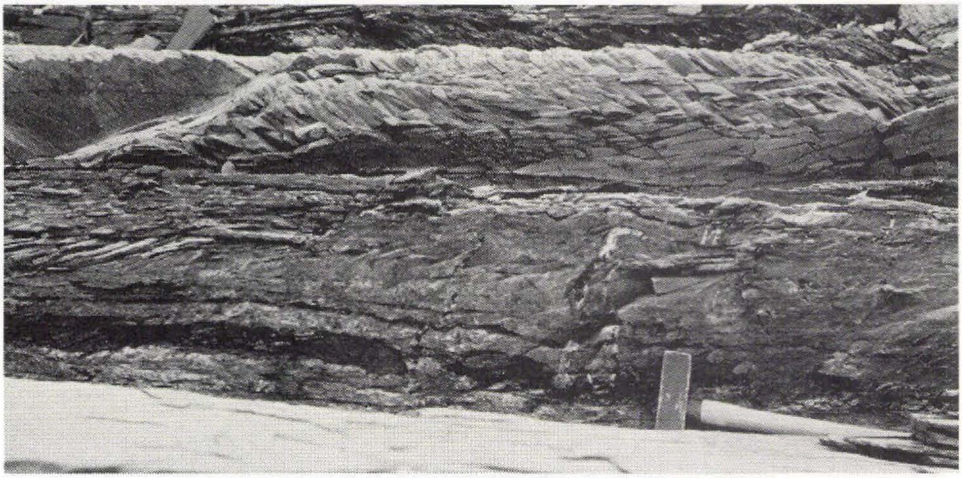

Fig. 13. Fracture cleavage in green silty shales at the base of the Multicoloured 'series'. Two families of cleavage can be seen. Numerous slickensides on bedding planes imply longitudinal strains acting parallel to layering. 2 km south-west of Kap Tyrrell along the coast.

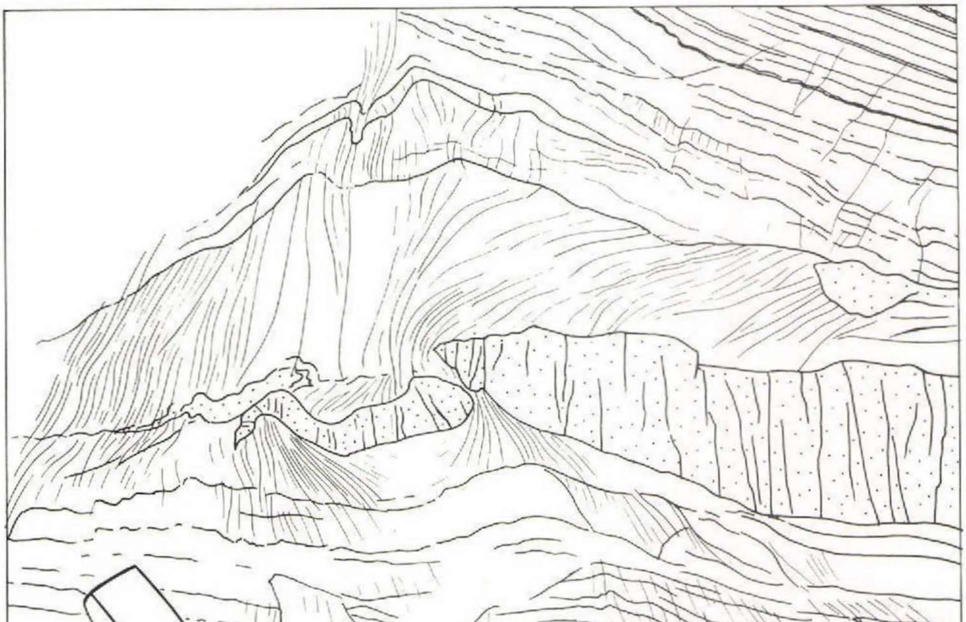

Fig. 14. Rotation fracture cleavage around a quartzitic lensoid layer in green shales of the Quartzite 'series', Kap Tyrrell.

Poorly developed tectonic ripples, similar to those described by Warren *et al.* (1970) have also been observed in compact red shales.

The black shales of the Lower Eleonore Bay Group contain generally a poorly developed slaty cleavage. In the less deformed zones the cleavage cuts the bedding at an angle of 20° to 50° and is the axial plane of centimetre scale asymmetric folds. In the phyllonitic rocks a similar cleavage is developed inside the elongated pseudo-boudins and in the lenses of folded rocks described above. Complete rotation of cleavage through a single layer has been observed (figs 14 & 15). This phenomenon implies the existence of local compressive stress acting along selected beds.

A zone of subvertical slaty cleavage trending NNE is exposed west of Bowen Bjerg. The cleavage is the axial plane of disharmonic NNE–trending open folds. Possibly belonging to the deepest structural level exposed in Canning Land, this area suffered an homogeneous subhorizontal shortening which contrasts with the overlying phyllonitic sheets. In thin section the cleavage is outlined by the preferential orientation of chlorite or white mica. In the spotted slates around the Kap Wardlaw granite, the poorly developed cleavage is outlined by flattened crystals of andalusite and tiny grains of pale brown biotite; in the garnet-cordierite zone adjacent to the granite, the cleavage is delineated by flakes of brown biotite.

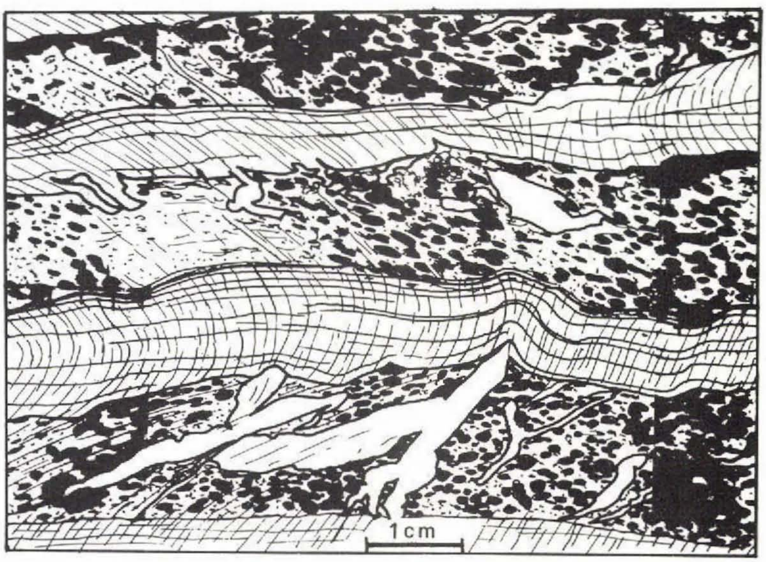

Fig. 15. Buckled quartzitic layers in spotted black shale. The quartzitic cracks (sun-cracks?) show differential rotations on both sides of the buckled layer. Note the complete rotation of cleavage (outlined by minute biotite) that cuts the buckled layer at right angles.

Disharmonic folds with N–S to NE–SW trend

Different fold types occur at different structural levels. These include:

(a) asymmetric metre to hectometre scale knee-folds observed in the black shales of the Lower Eleonore Bay Group and in the Quartzite 'series';

(b) symmetric open folds in the black shales, in local contraction zones near phyllonitic rocks (fig. 16) – such disharmonic folds occur near the boundary between the zone of subvertical slaty cleavage and overlying phyllonitic rocks;

(c) recumbent folds on a metre scale, alternately facing either west or east, in the red shales of the Quartzite 'series' and Multicoloured 'series' (fig. 3 f);

(d) tightened asymmetric folds, in close association with shear planes, locally observed in the black shales of the Lower Eleonore Bay Group (fig. 17).

These different types of folds are thought to have formed in local contraction zones related both to thrusts, like the major Kap Tyrrell thrust (fig. 2 a), and to low angle faults such as the Kap Fletcher fault (fig. 2 e).

It must be pointed out that no superimposed deformation, such as refolded phyllonites, has been observed, which strongly suggests that phyllonites and folds formed during the same episode of deformation. The importance of flexural-slip in the development of these different types of folds is everywhere evident in the ubiquitous presence of slickensides on the limbs of the folds.

Fig. 16. Disharmonic fold underlying phyllonitic black shales, south of Århus Bugt. Note the numerous dilation quartz veins in the hinge and the décollement zones which imply a pure flexural-slip type fold mechanism.

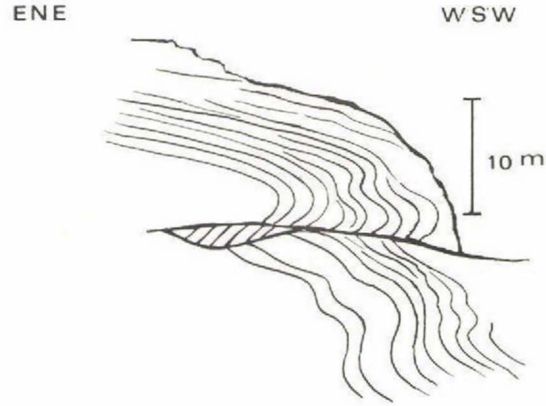

Fig. 17. N–S trending disharmonious recumbent fold above a décollement plane, overlying phyllonitic black shales, 3 km WSW from Kap Wardlaw.

Tension fissures

In the limestones and dolomitic rocks tension fissures are particularly frequent. The limestones of bed group 9 and many other limestone or dolomite layers are streaked by a dense system of calcitic or dolomite veinlets. The veins have a mean N–S direction, with many cases of çonjugate arrangement in X-shaped and sigmoidal veins. In many areas the veinlets and fissures in bed group 9 permit calculation of an extension of the order of 10%. Near the mountain above Kap Tyrrell veins and subvertical normal faults may reduce progressively bed group 9 from 100 to 50 m in thickness (fig. 2 b). At a millimetre scale, veining and small displacements are particularly spectacular in the stromatolitic biostromes, and considerably obscure their original shape.

In the black shales of the Lower Eleonore Bay Group subvertical N–S trending quartz-carbonate veins are frequently present. In the deformed units the veins appear

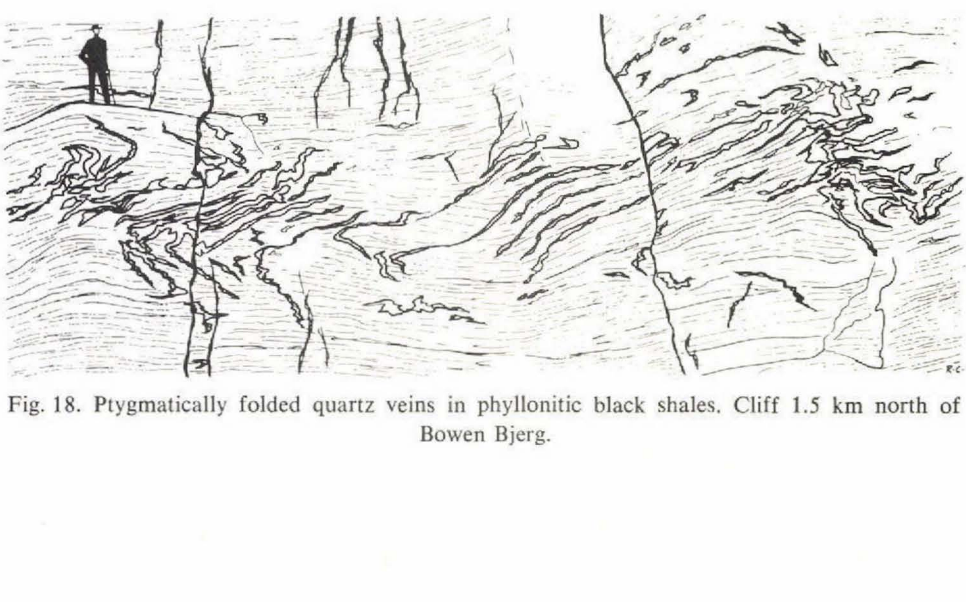

Fig. 18. Ptygmatically folded quartz veins in phyllonitic black shales. Cliff 1.5 km north of Bowen Bjerg.

Fig. 19. (a) Upper hemisphere projections of slickensides (solid symbols) on the limbs of decimetre scale knee folds (axes shown by dots) in black shales. Measured in an area 100 × 100 m 2 km south of Porfyrbjerg. (b) Upper hemisphere projections of slickensides (solid symbols) on subhorizontal S_1 surfaces, which are the axial planes of recumbent shear folds shown on fig. 12. Dots indicate axes of the folds. In green shales of possibly the Quartzite 'series' at the coast of Kap Brown.

to have formed at a late stage of the boudinage and the phyllonitic deformation, and they trend perpendicular to the elongate pseudo-boudins (fig. 9). In other phyllonitic zones where ptygmatically folded they appear to be synkinematic (fig. 18).

Around the Kap Wardlaw granite, many tension gashes within the narrow cordierite metamorphic zone are filled by diopside, Ca-amphibole, epidote and sphene, and have also been encountered in Ca-Mg rich competent layers and lenses representing channels of ankeritic sandstone.

Slickensides

Conspicuous slickensides are found on bedding planes in many areas. In the Quartzite 'series' and Multicoloured 'series', the streaks are outlined by fibrous quartz and chlorite, and in the black shales by a fine crenulation. Strong divergence of up to 30° has been measured in the trend of slickensides between two layers 50 cm apart, and in folded rocks the direction of the slickensides is also strongly dispersed (fig. 19 a). These variations may be the result of disturbances in gliding processes due to lithological heterogenuities related to the development of tectonic lenses and pseudo-boudins.

Relations between tension structures and magmatic intrusions

Dykes and sills of lamprophyric composition occur in many areas and measure from 0.5 up to 30 m in thickness (Caby, 1972). Most of them are emplaced along faults and shear-planes and sometimes along the axial planes of recumbent folds (fig. 6). A planar texture parallel or at a low angle to the contacts is often developed within the intrusions. This texture is possibly mimetically inherited from a magmatic flow structure, but in most cases the planar texture appears to be due to a late to post-magmatic flattening. The intrusions which occur adjacent to the Kap Wardlaw granite are gneissose, with a foliation outlined by brown secondary biotite and by elongated and broken phenocrysts with pressure shadows filled by biotite. In the lamprophyres exposed very close to the granite, pyroxene is mostly replaced by cummingtonite. Outside the contact aureole, the lamprophyres are compact or schistose rocks showing complete chloritization of biotite.

'Cold boudinage' of sills is frequent, as for example in lamprophyric sills located within the axial planes of recumbent folds at Kap Fletcher (fig. 6).

'Hot boudinage' of a lamprophyric sill subparallel to phyllonitic rocks of the andalusite zone around the Kap Wardlaw granite has been observed in the north face of Bowen Bjerg (fig. 20). There the sill is fragmented into rectangular boudins, and in the pressure shadows aplitic-granodioritic veinlets cement small fragments of the lamprophyric rock.

The Kap Wardlaw granite cuts sharply through the black shales of the Lower Eleonore Bay Group and also the early lamprophyric dykes. In the contact aureole the same elongate pseudo-boudins and phyllonitic rocks occur as those described above, and they contain both syn- and post-kinematic growths of biotite, andalusite or garnet. It therefore seems likely that the *mise en place* of the early dykes and the granite took place during different stages of the same deformation.

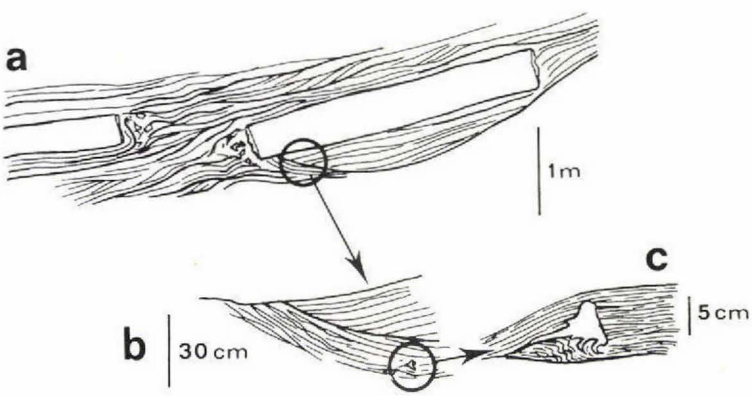

Fig. 20. (a–b) Boudinaged lamprophyric sill in phyllonitic shales of the andalusite zone in the north face of Bowen Bjerg. The pressure shadows are filled up by an agmatitic breccia cemented by aplitic material. Aplitic pods were also formed in the shales (c).

Concluding remarks

Very different types of structures due to tension, summarized in fig. 21, are widely developed in many areas of the Caledonian superstructure exposed in Canning Land and Wegener Halvø, and these structures represent the main Caledonian deformation in this region.

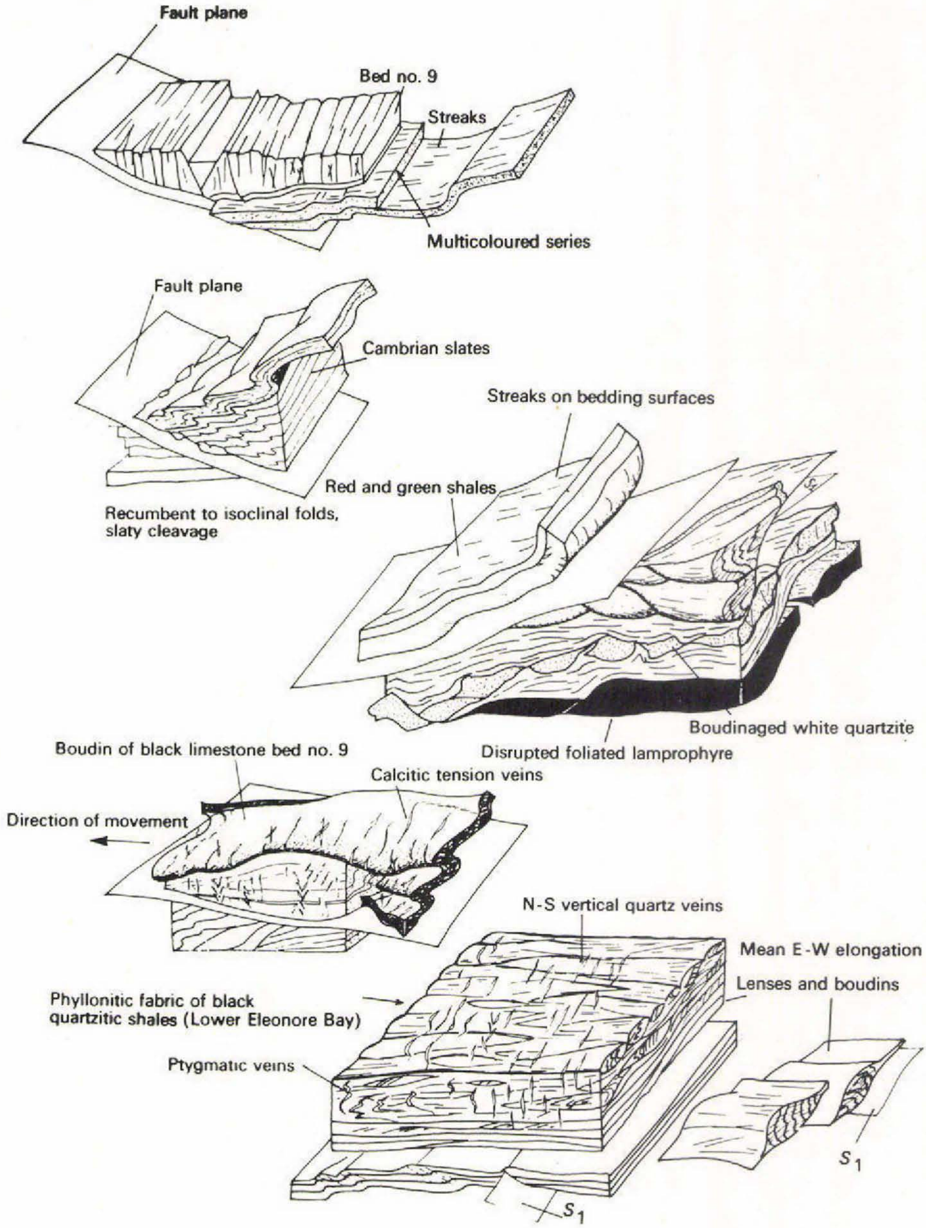

Fig. 21. Different types of structures related to extension observed in Canning Land.

It is concluded that these tension structures were formed during westward tectonic transport of gliding units on discontinuity surfaces which lie mostly parallel to bedding. In the different types of structures the direction of tectonic transport is everywhere evident from the abundance of streaks and slickensides on bedding planes, both in flat-lying and in folded beds.

An unexpected connection between a major low-angle fault and local development of tight folds has been demonstrated.

The E–W trending recumbent to isoclinal folds, recorded at different scales, formed within stratiform units and lenses undergoing penetrative deformation with a vertical flattening and an extension parallel to the direction of tectonic transport. These deformed zones, in which phyllonites were also formed, occur both below and above subhorizontal strata largely devoid of folds in which only slickensides are to be seen. Nowhere have polyphase structures, such as refolded phyllonites, been recognized. The stratoid zones of phyllonites in the Lower Eleonore Bay Group possibly outline slides and overthrust sheets in which only tension structures have been noted. Their widespread occurrence points to the important role of gravity in the kinematics of the belt, possibly in connection with the uplift and deformation described from the central metamorphic complex of the inner fjord region (Haller, 1970). N–S to NE–SW trending compressive folds of different shapes formed during the same tectonic episode by flexural-slip in local contraction zones.

The recumbent to isoclinal E–W trending folds observed in sheets and lenses of the limestones and red shales of the Quartzite 'series' and Multicoloured 'series', as well as the small scale folds which characterize the elongate pseudo-boudins found in the black shales of the Lower Eleonore Bay Group, were formed parallel to the direction of tectonic transport. This is demonstrated by the widespread occurrence of slickensides parallel to the lengths of the boudins in the whole area. Following the initial stages of deformation, gliding processes produced mullions parallel to slickensides, comparable to those recorded by Warren *et al.* (1970). Boudins formed simultaneously, where later low-angle faults cut the mullions. The bulk of deformation is a vertical shortening concomitant with an extension parallel to the direction of movement. At this stage local stresses generated by different speeds of displacement along each discontinuity surface caused constriction of the more ductile rocks, inducing the formation of recumbent folds on different scales, the axes of which are roughly parallel to the direction of tectonic transport; the vergence of these folds has no signification. It must be emphasized that such folds lie transverse to the general trend of the Caledonian fold belt of East Greenland. However, transverse folds are also conspicuous at deeper structural levels of the central metamorphic complex in the inner fjord region (Haller, 1957, 1970; Henriksen & Higgins, 1970), and a similar origin is possible.

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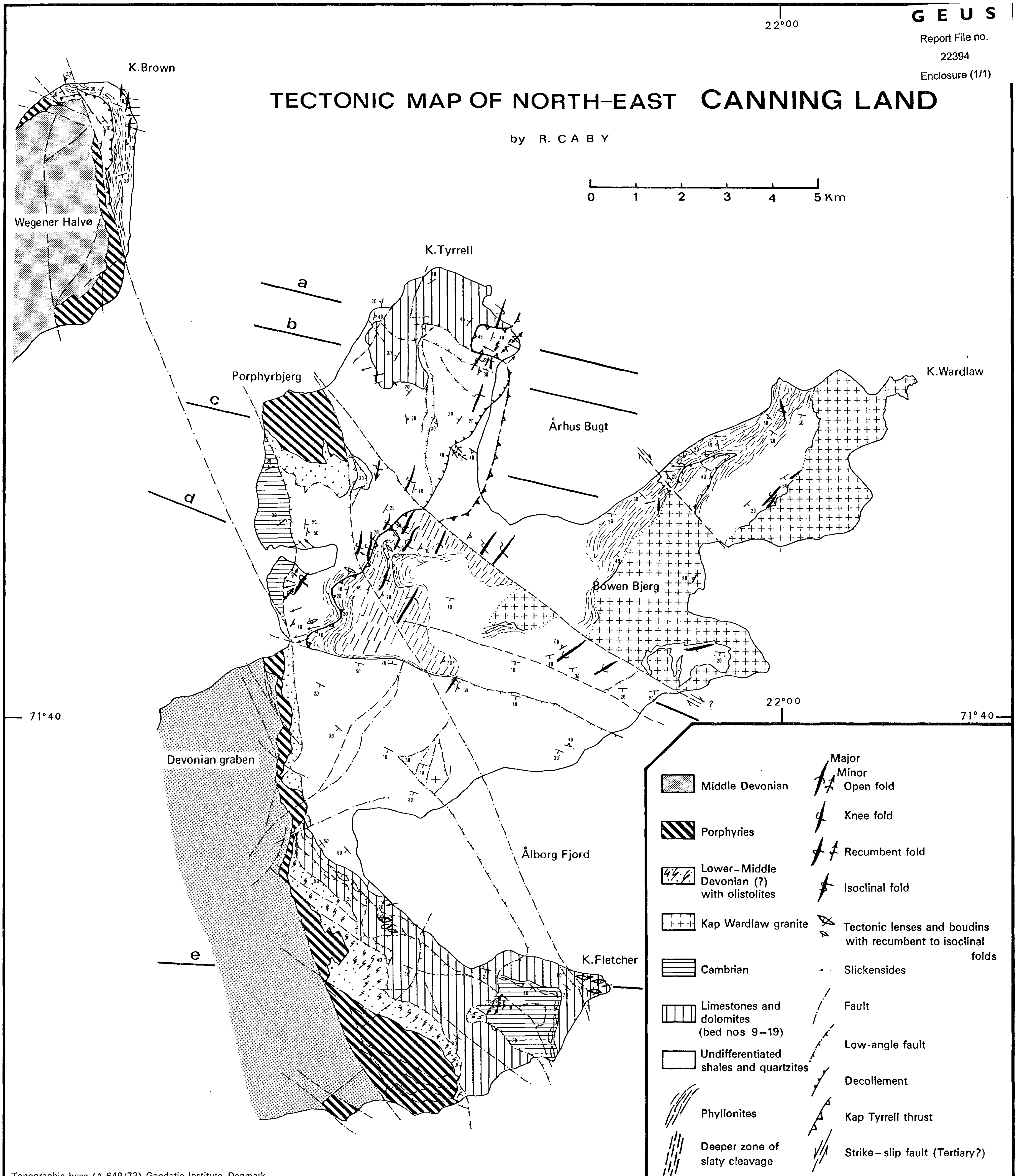
TECTONIC MAP OF NORTH-EAST CANNING LAND

by R. CABY



Topographic base (A 649/72) Geodetic Institute, Denmark.