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Structural aspects of the Gaissa thrust belt in the Vestertana - Ruos'tefiel'bma area, Finnmark, N. Norway (Map sheet Smalfjord 2235 I - M711 1:50 000)

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RAPPORT

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The structural geology of the Vestertana - Smalfjord - Tanafjord area was studied. A weak, possible early cleavage (S1) has been found only in the tillite sequences of the Vestertana Group; this is thought to be "bedding" parallel and is thus not observable in the bedded lithologies of the area. D2 produce a fabric penetrative in pelitic rocks (S2) and a high angle fracture cleavage in quartzo-feldspathic rocks. These fabrics developed in association with the close-tight moderately inclined to recumbent folds (F2). On a large scale the region is dominated by SE to ESE facing open steeply inclined to tight, almost recumbent folds, formed in close association with blind thrusting. A later extensional phase of faulting is present in the footwall to the main thrust, the Tarmfjord Thrust.

Emneord	Strukturgeologi	
Berggrunnsgeologi	Bygningsstein	
Prekambrium	Sedimentær bergart	

STRUCTURAL ASPECTS OF THE GAISSA THRUST BELT IN THE VESTERTANA-RUOS'TEFIEL'BMA AREA, FINNMARK, N. NORWAY.

(Map sheet SMALFJORD 2235 I - M711 1:50,000)

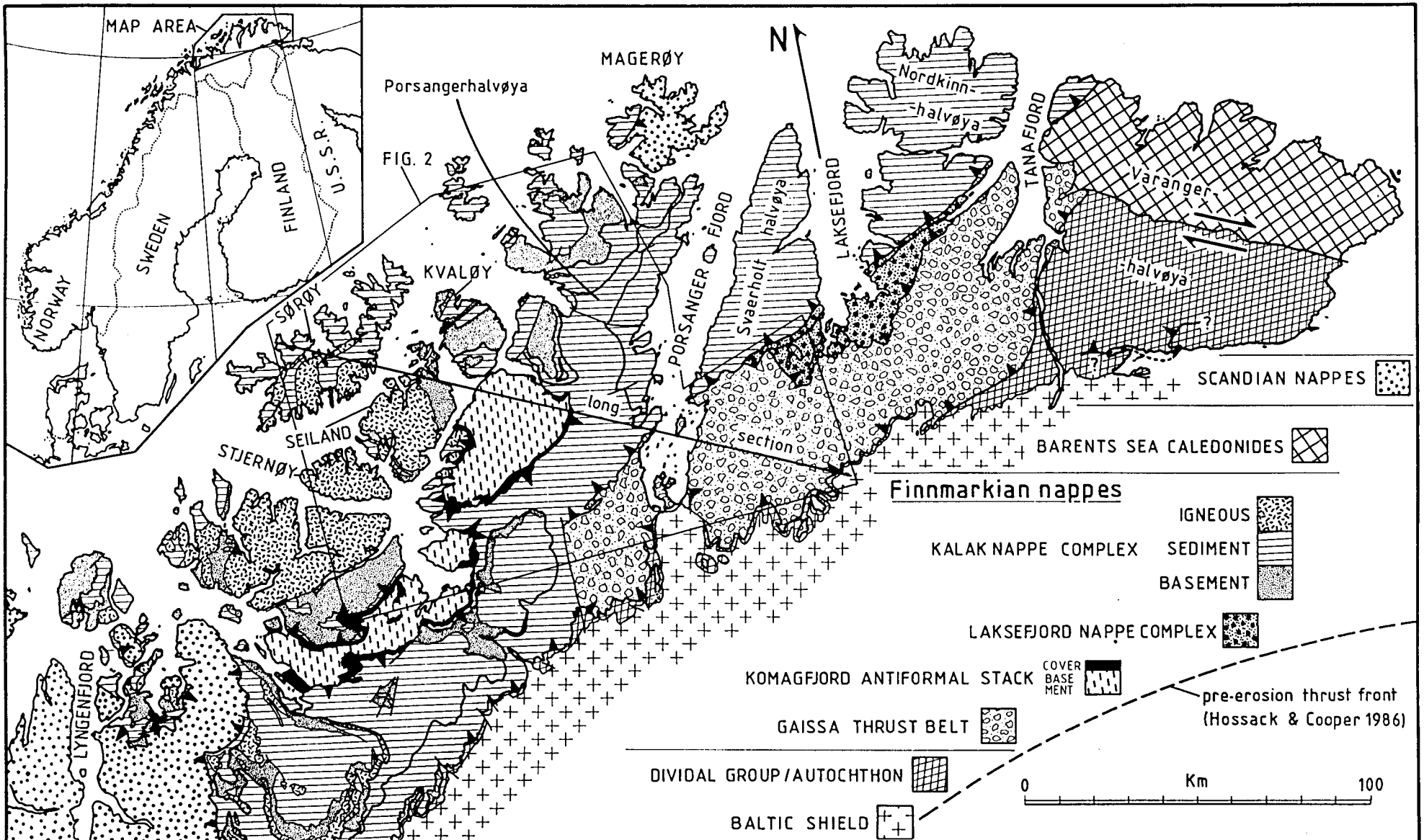
A. H. N. RICE, B. I. THOMASJORD & T. O. ANDREASSON

- 1 - INTRODUCTION -

The field work for this report was undertaken by A. H. N. Rice (between 18.7.88 and 3.8.88) and by B. I. Thomasjord and T. O. Andreasson (between 25.7.88 and 6.8.88). The area covered (the contract area) forms the 180km2 northeastern part of the map sheet SMALFJORD (2235 I, M711 1:50,000). Data obtained from field-slips used in a report by Johnson (1974) were included in parts of the area but has NOT been used in the structural ananlysis. The work was done under the overall control of Dr. A. Siedlecka (NGU) who provided logistical support and valuable discussion throughout the work.

The project aim was to investigate structural aspects of the area as part of a larger study investigating the potential for slate quarrying in Finnmark county. As such, detailed mapping of the contract area was not initially regarded as a priority since the previous work of Edwards (1972) and Johnson (1974), compiled into the 1:100,000 map sheet VESTERTANA (Foyn 1976), was thought to be sufficient. However, it soon became apparent that the work of Johnson (1974) had been of a very preliminary nature in the area south of Torhop (GR 36 19) and immediately west of Ruostefielbma (GR 44 11). Consequently, somewhat more time was spent investigating these areas than other parts of the contract area. Note, however, that although the map presented here is a considerable improvement on the compilation of Foyn (1976), further work is required to confirm some of the proposals outlined here.

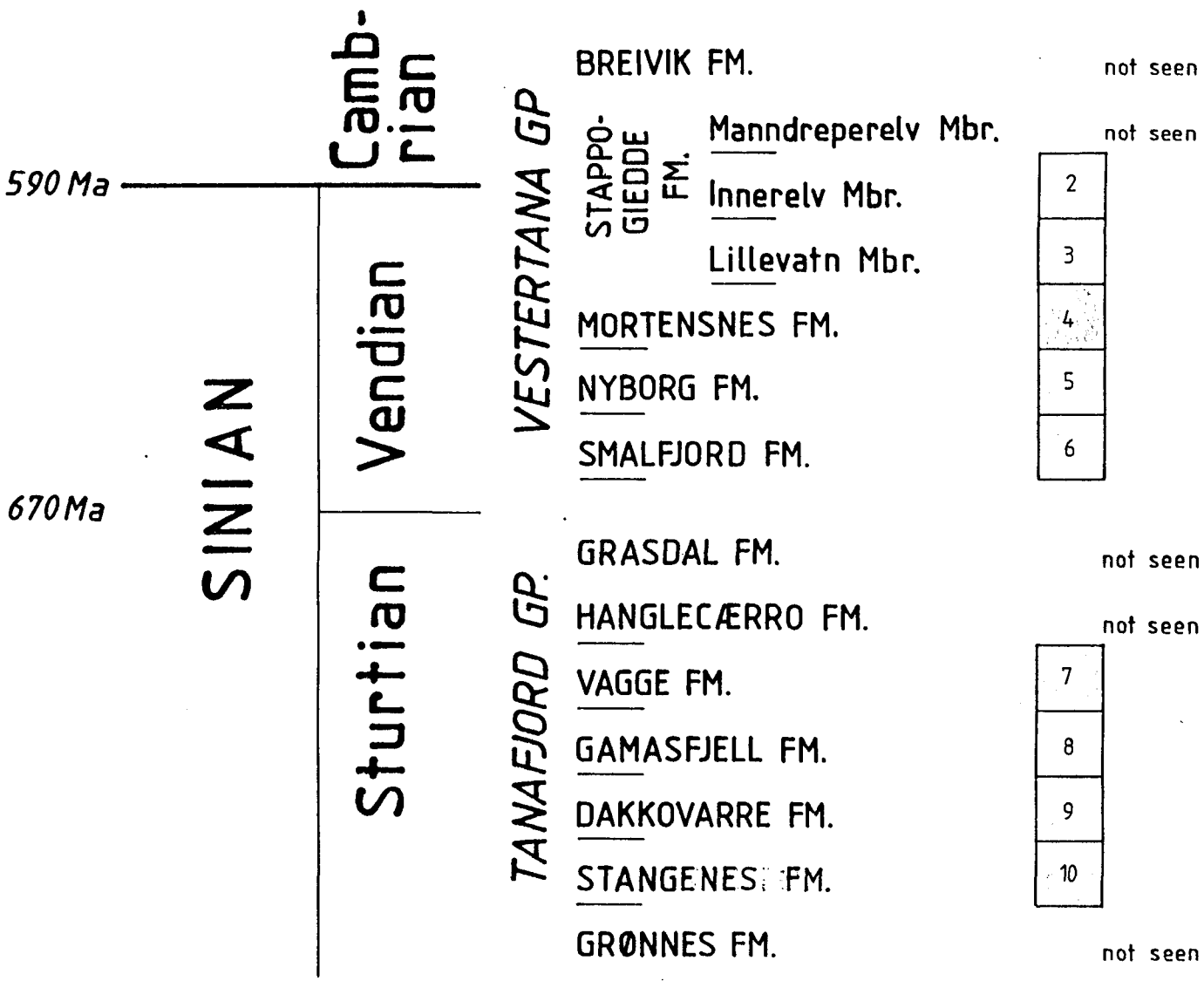
Exposure in the area is generally good. Although exposure in the more wooded regions forming the low ground east of Smalfjord was poor, most major contacts could be constrained reasonably well. The only important exceptions to this


MAP AREA
NORWAY
SWEDEN
FINLAND
U.S.S.R.
MAGERØY
Porsangerhalvøya
FIG. 2
N
Nordkinn-halvøya
TANAFJORD
Varanger-halvøya
LAKSEFJORD
Svaerholt halvøya
PORSANGER FJORD
KVALØY
SØRØY
SEILAND
STJERNØY
long section
LYNGENFJORD
SCANDIAN NAPPES
BARENTS SEA CALEDONIDES
Finnmarkian nappes
KALAK NAPPE COMPLEX
IGNEOUS
SEDIMENT
BASEMENT
LAKSEFJORD NAPPE COMPLEX
KOMAGFJORD ANTIFORMAL STACK
COVER
BASEMENT
GAISSA THRUST BELT
DIVIDAL GROUP/AUTOCHTHON
BALTIC SHIELD
pre-erosion thrust front
(Hossack & Cooper 1986)
0
Km
100

were (1) between indre Torhop (GR37502000) and Saeresgiedde (GR38352035), (2) in the valley south of Vestertana (GR 33 13) and (3) the Ruostefielbma area (GR 44 11). On Map 2 the position of the actual outcrops looked at is indicated by heavy colouring whilst on Map 3 the structure of the area is shown. Map 1 gives the locality numbers, for use with the data. Other areas of outcrop, not studied, have not been shown; such data may be available from Edwards (1972) and Johnson (1974).

Geologically, the contract area lies in the more external part of the Gaissa Thrust Belt (Lower Allochthon; Fig 1), close to the allochthon/autochthon boundary, thought to be a broad (and at present poorly defined) 'parautochthonous' zone lying to the east of Tanaelv (cf Chapman et al. 1985, Townsend et al. 1986, Rice et al. 1988). The rocks were deformed during the late Silurian to early Devonian Scandian event of the Caledonian orogeny (Dallmeyer et al. 1988).

FIG 2


590 Ma
670 Ma
SINIAN
Camb-rian
Vendian
Sturtian
VESTERTANA GP
TANAFJORD GP.
STAPPO-GIEDDE FM.
Manndreperelv Mbr.
Innerelv Mbr.
Lillevatn Mbr.
BREIVIK FM.
MORTENSNES FM.
NYBORG FM.
SMALFJORD FM.
GRASDAL FM.
HANGLECÆRRO FM.
VAGGE FM.
GAMASFJELL FM.
DAKKOVARRE FM.
STANGENES FM.
GRØNNES FM.
not seen
not seen
not seen
not seen
not seen
2
3
4
5
6
7
8
9
10

- 2 - STRATIGRAPHY -

It is NOT the purpose of this section to describe the lithostratigraphy of the contract area in detail; this has been covered in a number of articles (e.g. Siedlecka & Siedlecki 1971, Reading & Walker 1966, Edwards 1984), summarized by Foyn (1985). Rather, the rocks are described to emphasise two features; (1) the effects of lithology on deformation style and (2) the problems which occurred in determining stratigraphic position in areas of poor or complex outcrop.

Two sedimentary groups have been recognized in the contract area; the late Riphean to late Sturtian (pre-Varangian) Tanafjord Group and the early Vendian (Varangian) to early Cambrian Vestertana Group (ages from Vidal 1981; chronostratigraphic nomenclature from Harland et al. 1982 & Cowie & Johnson 1985). Fig 2 summarizes the regional lithostratigraphy and the chronostratigraphic nomenclature.

2.1 Tanafjord Group

Within the contract area as a whole, four of the lower formations of the Tanafjord Group (the Vagge, Gamasfjell, Dakkovarre and Stangenes Formations) crop out, but exposures of the first and last of these lie in the extreme north of the map area and were not covered directly by the present authors.

The DAKKOVARRE FORMATION consists of white weathering medium to dark grey, generally massive, quartzite, locally with 1-3mm rusty spots, and interbedded black shales, pale yellow-green sandstones and thin quartzites. Near the top of the sequence a massive purple sandstone, locally pyritiferous, is present, forming a useful marker for NEAR the top of the Dakkovarre Formation. Overall

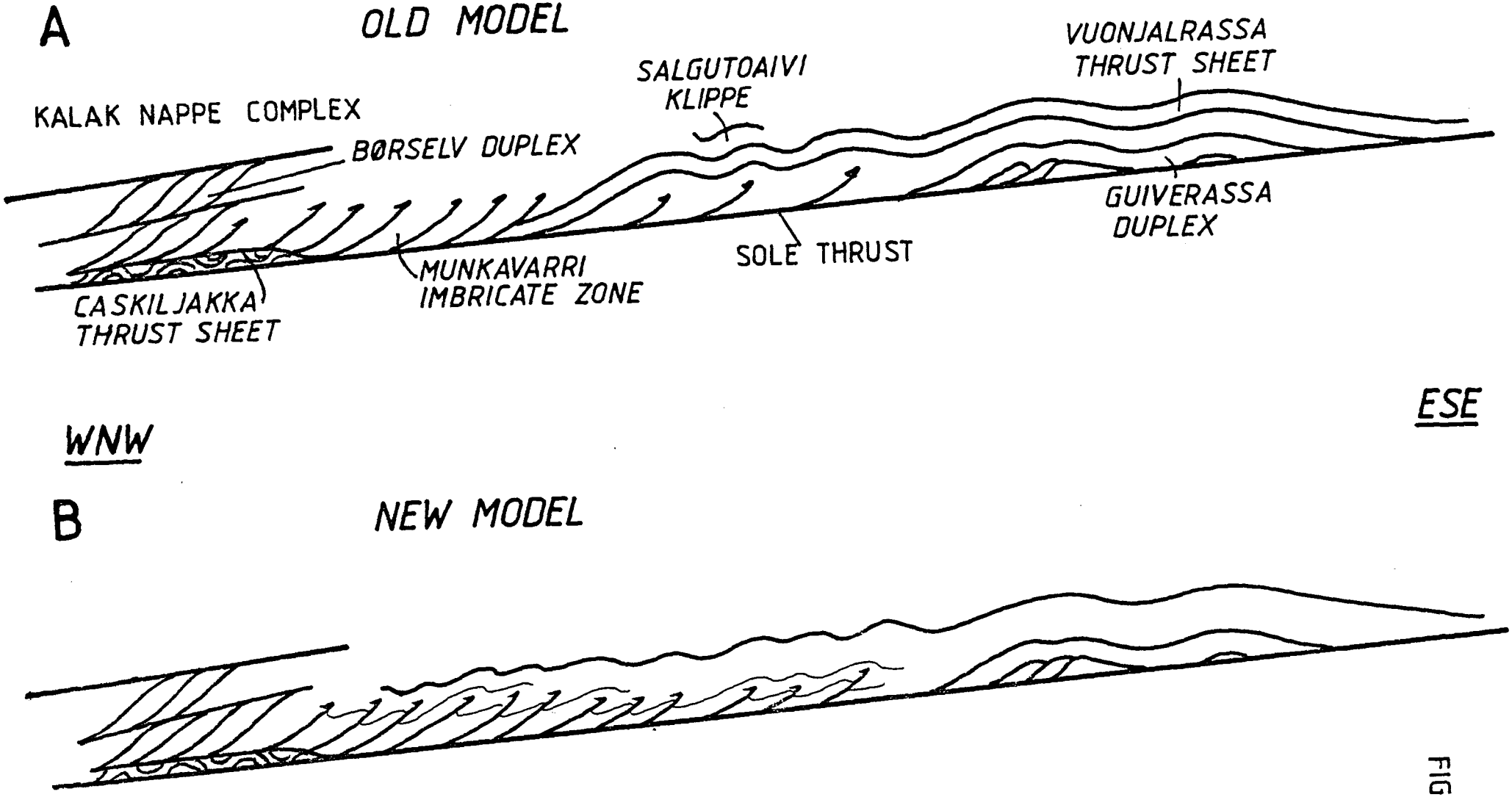

A
OLD MODEL
KALAK NAPPE COMPLEX
BØRSELV DUPLEX
SALGUTOAIVI KLIPPE
VUONJALRASSA THRUST SHEET
GUIVERASSA DUPLEX
SOLE THRUST
MUNKAVARRI IMBRICATE ZONE
CASKILJAKKA THRUST SHEET
WNW
ESE
B
NEW MODEL

FIG 3

lithology bands may be up to several metres thick, but the more competent massive quartzites are better exposed and appear to dominate the succession.

The GAMASFJELL FORMATION is composed almost entirely of a pale grey weathering pink or grey quartzite, although locally yellow-green sandstones, up to 0.75m thick, have been found. In some places the rocks have been stained bright red along joint and bedding surfaces. The massive nature of this formation made it extremely competent.

2.2 Vestertana Group

The Vestertana Group overlies the Tanafjord Group with a slightly angular unconformity. In the north of the contract area the lowest part of the Vestertana Group lies on the Vagge Formation (and still farther north the Hanglecaerro Formation is exposed) whilst in the south the Dakkovarre Formation is the highest part of the Tanafjord Group preserved.

The four lower formations of the Vestertana Group were mapped in the contract area (Smalfjord, Nyborg, Mortensnes and Stappogiedde Formations). The Smalfjord and Mortensnes Formations are both composed of glacial deposits (tillites) and have been described together.

The SMALFJORD and MORTENSNES FORMATIONS (Lower and Upper tillites, respectively). Both of these units are composed of rocks of glacial origin, the former being dominated by continental deposits and the latter containing significant marine tillites (Johnson et al. 1978, but see Edwards 1984 for further details).

In the continental tillites no bedding is present, although there may be considerable variations in rock type and local 'stratigraphies' may be developed. However, there is no certainty that this compositional layering was formed in a horizontal attitude; the absence of reliable bedding posed structural problems in that way-up could not be determined. Two lithologies have been recognized in the continental tillites; (1) golden-brown weathering 'dolomitic tillite', in which the matrix has a high dolomite concentration and in which the clasts were all derived from the dolomites at the top of the Tanafjord Group (Porsanger and Grasdal Formations; Siedlecka & Siedlecki 1971, Bertrand-Sarfarti & Siedlecka 1980, Tucker 1977). In these 'dolomite tillites' clasts up to several metres in size were commonly seen, especially around Stuoroaivi and Ibbagirko (~GR40002100). Clast supported tillites of this type were often seen. (2) grey to blue-grey (brown weathering) generally matrix supported 'ordinary tillite' in which basement derived clasts, generally <1m in size, predominated, although dolomite clasts were also seen. A particularly large clast was found in the roadcut at Loc 5009 (GR42601185).

The upper part of the Mortensnes Formation is composed of sandstones and grits which are not always easily distinguished from the basal part of the overlying Stappogiedde Formation.

In the NYBORG FORMATION three units, corresponding to Members A, B and C of Edwards (1984), were recognized; (1) Member A. This is a basal dolomitic sequence, usually less than 5m thick, although the generally high strains associated with this member make this uncertain. The purer dolomitic layers are a pale brown/buff colour and were generally less than 15cm thick. These are

interbedded with red marls. This rock weathers to a distinctive orangy/red colour which can be recognized from a distance, not least because the rock is somewhat harder than the immediately overlying rocks and so tends to weather proud. (2) Member B. Interbedded pale green to grey and red/purple sand/siltstones and red shales. In low strain areas, where sedimentary structures have been preserved, graded units up to ~0.5m thick were found. Towards the top of this member massive pink weathering grey/pink sandstones/grits become somewhat more abundant in the west, with subordinate red silts and shales. (3) Member C. Green sand/siltstones with shales form the upper part of the Nyborg Formation in the contract area. Beds are typically less than 15cm thick.

The Mortensnes Formation overlies the Nyborg Formation on a slight angular unconformity. In the eastern part of the contract area, around Ruostefielbma the Mortensnes Formation lies on the lower part of Member B whilst to the west of Vestertana it overlies Member C.

The STAPPOGIEDDE FORMATION is comprised of three members, the Lillevatn, Innerelv and Manndreperelv Members, but only the lower two were exposed in the contract area.

The LILLEVATN MEMBER is a dominantly quartzofeldspathic unit, containing a basal conglomerate, overlain by occasional massive sandstones/quartzites and thinner bedded sandstones and dark shales. The overlying INNERELV MEMBER is characterized by interbedded fine sandstones, silts and shales, generally with a

green to greeny grey colour, although red horizons are present. The basal ca. 5m of this member is composed of a distinctive homogeneous red mudstone.

- 3 - STRUCTURE -

3.1 INTRODUCTION

Despite several recent studies, the structural evolution of the Gaissa Thrust Belt (or Gaissa Nappe Complex) is poorly known. Most of the recent work has been done in the Porsangerfjord region, in rocks of the Tanafjord Group in which six main tectonic zones have been identified (Townsend et al. 1986, Gayer et al. 1987). These are the Borselv Duplex, Munkavarri Imbricate Zone, Caskiljakka Thrust Sheet, Salgutaoivi Klippe, Vuonjalrassa Thrust Sheet and Guiverassa Duplex. Figure 3A shows, schematically, the structure proposed by Gayer et al. (1987). The Borselv Duplex lies at the top of the Gaissa Thrust Belt, with the Kalak Thrust as its roof thrust. The duplex is underlain by the Munkavarri Imbricate Zone, for which no roof thrust can be observed except where it underlies the Borselv Duplex. In the model of Townsend et al. (1986) the Munkavarri Imbricate Zone is underlain by a single large thrust sheet (the Vuonjalrassa Thrust Sheet) which forms the roof to the underlying Guiverassa Duplex and which is overlain by the Salgutoaivi Klippe (thought to be an eastern extension of the Munkavarri Imbricate Zone). In restored cross-sections, therefore, the Vuonjalrassa Thrust Sheet lies between the Munkavarri Imbricate Zone and the Guiverasa Duplex.

Recently the field data on which this model was based has been re-appraised (Rice et al. 1989, Roberts et al. 1989) and a more realistic model proposed. In the new model the Munkavarri Imbricate Zone extends considerably further east than previously supposed and underlies rocks formerly ascribed to the Vuonjalrassa Thrust Sheet. These minor imbricates become less abundant further

eastwards and, structurally, the Munkavarri Imbricate Zone appears to merge into the Guiverassa Duplex. Imbricate thrusts within the Munkavarri Imbricate Zone cut into higher parts of the Tanafjord Group stratigraphy further to the west; in the Porsangerfjord coast areas the highest units (Porsangerfjord & Stabbursdal Formations) are imbricated (cf Townsend et al. 1986, Roberts et al. 1989). By comparison, at the Rietkajakskaidi and Munkavarri map sheets boundary only the lower formations are affected (dominantly the Gronnes and Dakkovarre Formations), with the higher formations folded by the underlying blind thrusts. Previously, these overlying folded rocks have been called the Vuonjalrassa Thrust Sheet, but there is no thrust plane separating them 'en masse' from the imbricates of the Munkavarri Imbricate Zone. Further east, where the Guiverassa Duplex is developed in the Gronnes Formation (NOT the Gamasfjell Formation as described by Rice & Harrington 1983), there is a thrust plane at the base of the Vuonjalrassa Thrust Sheet. The new model is illustrated in the schematic cross-section in Fig 3B; note that in this the Salgutoaivi Klippe is no longer present.

Further east from the Rietkajakskaidi map sheet (i.e. south of Laksefjord and eastwards) the rocks are relatively flat lying and undeformed, with only a few small to intermediate scale folds (cf Foyn et al. 1983, Foyn & Siedlecki 1980). No major thrusts have been described between Rietkajakskaidi and the Tana river, except in the present contract area and to the northwest, in the Digermul peninsula region, in the footwall to the Laksefjord and Kalak Nappe Complexes.

This model suggests that the the Vuonjalrassa Thrust Sheet may extend from the Rietkajakskaidi map sheet eastwards to the contract area. This is discussed at the end of the structural section.

3.2 MINOR STRUCTURES

Numerous minor structures were found within the area; the type of structure, however, depended to some degree of the lithology. Due to the limited time available some aspects of this work are still uncertain, but a broad appreciation of the structural history is possible. The contract area has been divided into three structural subareas (separated by the blue lines on the maps); a NORTHEASTERN subarea, forming the region northeast of a line from indre Torhop to Ruostefielbma (GR 36 20 to GR 42 11), a WESTERN subarea, lying to the west of Vestertana and a CENTRAL subarea, lying between the northeastern and western subareas. Tables 1 & 2 summarize the data. The k parameter is a measure of the distribution of the data; for clusters $k>0$ and for girdled (great circle) distributions $k<0$ (Woodcock 1977). Figs 4 to 8 show the data plotted and Fig 9 shows the mean orientations of the data from the three subareas.

3.2.1 S0 - bedding

All the rocks except the bulk of the tillite sequences exhibit a bedding, termed S0. In most of the Smalfjord and Mortensnes Formations compositional variation could not be assumed to be bedding (i.e. to have been deposited in an essentially horizontal position. This has resulted in problems in elucidating the large-scale structures of the contract area. The mean orientation of S0 swings from NNE-SSW trending (207/33) in the northeastern subarea to N-S

trending in the central subarea (185/23). The mean orientation of data from the western subareas (187/28) lies between that of the two other subareas (Fig 9).

3.2.2 S1 - early spaced cleavage

In some parts of the unbedded tillites of the Smalfjord Formations, especially in the east, along the road section near Ruostefielbma (GR 42 11) two cleavages were seen in the rocks. One of these is a penetrative cleavage whilst the other is a spaced cleavage. This latter is thought to be an early cleavage developed by flattening during both sedimentary burial and diagenesis and subsequent tectonic burial and early metamorphism.

The cleavage is spaced at 1-10cm, producing flagstones, and is gently wrapped around clasts. The status of this cleavage is not entirely certain; although, as stated, it may be an early, 'bedding parallel' fabric, no suitable localities were found (with the Nyborg Fm. in direct contact) where this hypothesis could be checked. At no localS1y was S1 seen to be folded. The apparent presence of S1 in only the tillites is a consequence of its lack of bedding; rocks with bedding also cleave along S0, so the presence of a weak S1 component in the fabric is masked.

3.2.3 S2 - penetrative cleavage

All the pelitic rocks contain a penetrative fabric (S2) which, except in areas of very high strain, lies at an angle to the bedding. In those cases where strains were high the bedding had been considerably thinned and was essentially parallel to S2, and should properly be called compositional banding.

Direct observation of folds, especially those in the Nyborg Formation (see below), indicates that the S2 fabric in pelitic lithologies is fanned in a normal fashion around fold hinges (Fig 10A) and thus bedding/cleavage relationships can be used to determine way-up in areas of poor exposure or high strain, where sedimentary details have been obscured.

In the thicker sandstone units within the Nyborg and Innerelv Members, as well as in the massive quartzites of the Dakkovarre and Gamasfjell Formations, a high angle fracture cleavage has developed. Within these fractures free-standing quartz crystals, sometimes up to 1cm long, were found. In other cases these quartz crystals had grown with a syn- or antitaxial form (Durney & Ramsay 1973) and could be used to determine the direction of movement.

In the central subarea S2 trends approximately N-S (185/39) whilst in the northeast subarea the dominant trend is NNE-SSW (202/47). In the western subarea the mean trend is 191/47, between that in the northeast and central subareas.

3.2.4 F2 - folds

Small to intermediate scale folds have been found in most of the stratigraphic units. They are, however, absent in the unbedded parts of the Smalfjord and Mortensnes Formations and in the massive quartzites of the Gamasfjell Formation.

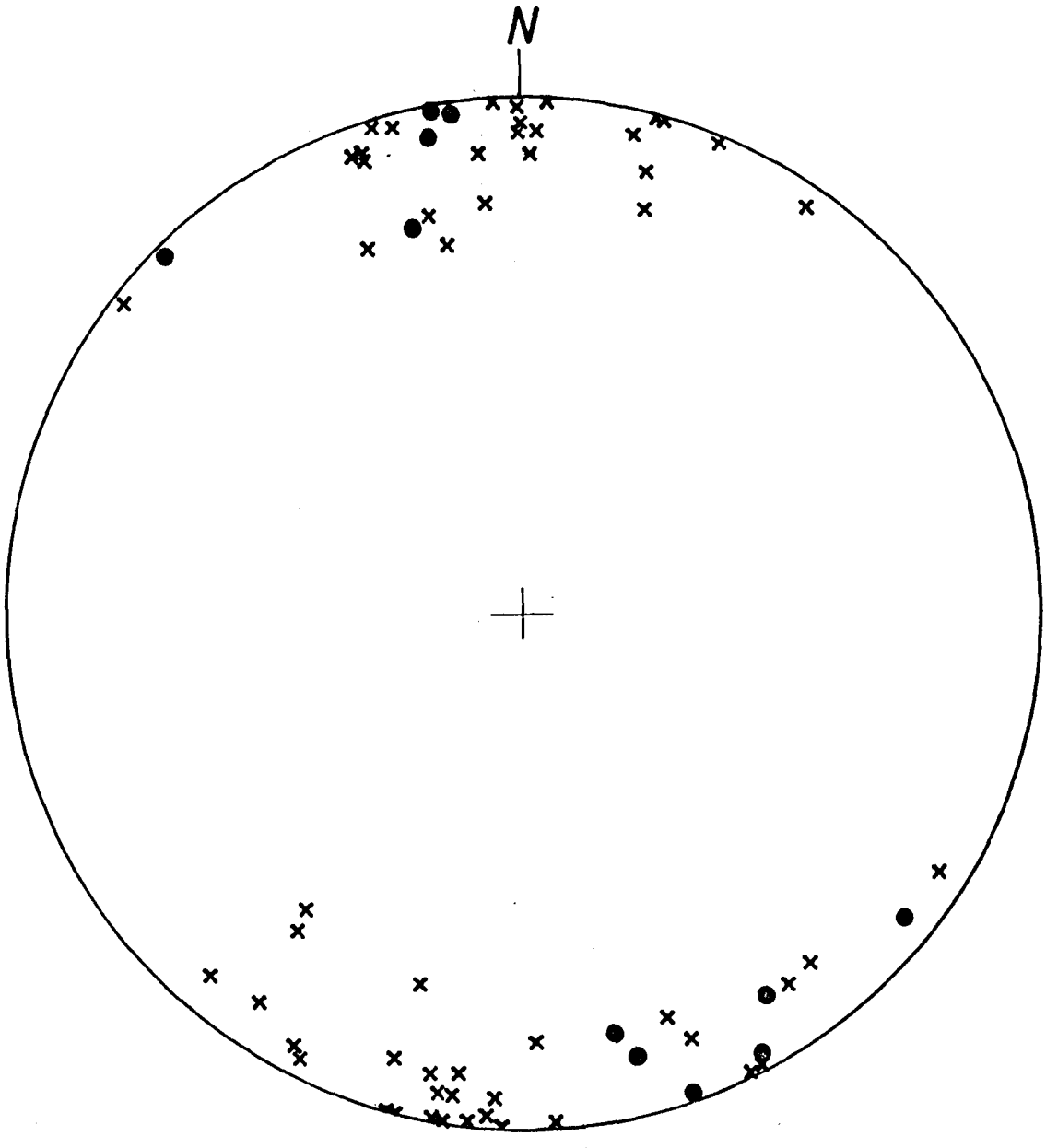
In the Nyborg Formation and Innerelv Member of the Stappogiedde Formation small to intermediate scale folds are ubiquitous; aerial photographs of the Vardoaivi area (GR 13 37) show clearly the ridges formed by the fold axes spaced at ca.

34 per kilometre (wavelength of either ca. 30m or ca. 60m, depending on whether the ridges are either both syn- and antiforms or only syn- or antiforms). The fold style is directly related to the finite strain in the rock which, to a considerable degree is related to the proximity to a thrust, with lower fold interlimb angles and axial plane dips in areas of higher strain. In general folds are open to close, moderately inclined to almost upright structures, with sub-horizon axes and only slightly overturned middle limbs; non cylindrilism was not seen on outcrop scale and is not shown in aerial photographs. Except in a few well exposed road cuts and river sections the asymmetry of the folds was not determinable; in those folds seen in secion, facing and vergence was towards the east. In the northeastern subarea the mean F2 axial trend is 04-210, in the central subarea it is 10-189 whilst in the central subarea the mean direction is 00-014 (Fig 4).

Mean axial planes are similar in orientation to the mean S0 and S2 orientations. However, they are generally steeper dipping than both S0 and S2 (Fig 5; Table 1).

In the interbedded black shale/thin bedded quartzite of the Dakkovarre Formation near the Tarmfjord Thrust (see below) pervasive small-scale (amplitude <20cm) upright to gently inclined, close to tight markedly non-cylindrical folds were found (especially on Cakkalas; Locs 5173 & 5184). These have an oblique trend (mean 02-158; axial plane 165/63), close to, but not parallel to, the thrusting direction in those rocks (12-291; see below). These folds probably formed by rotation of early F2 structures during movement along the Tarmfjord Thrust.

FIG 4

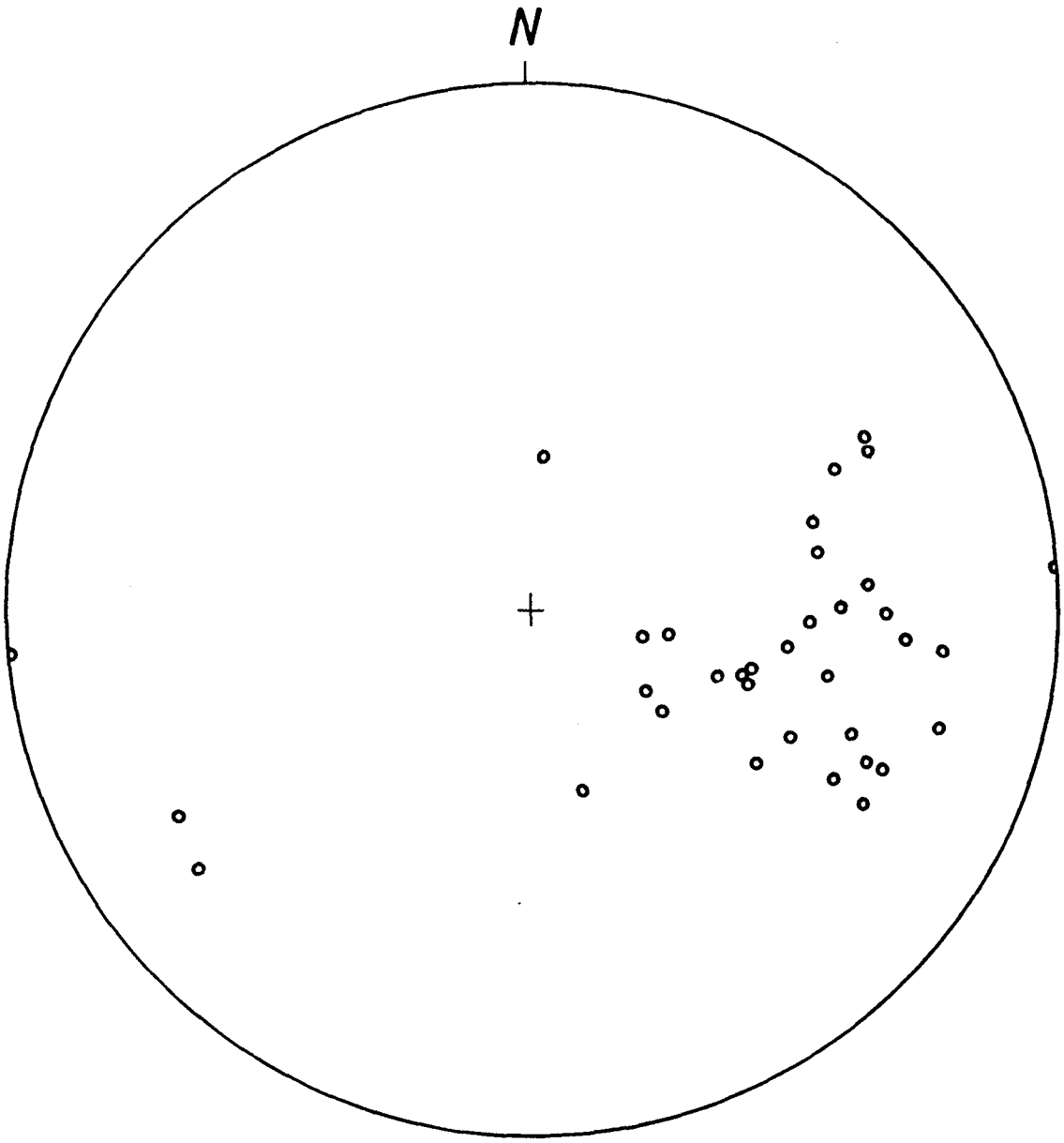


F2 AXES

× GENERAL

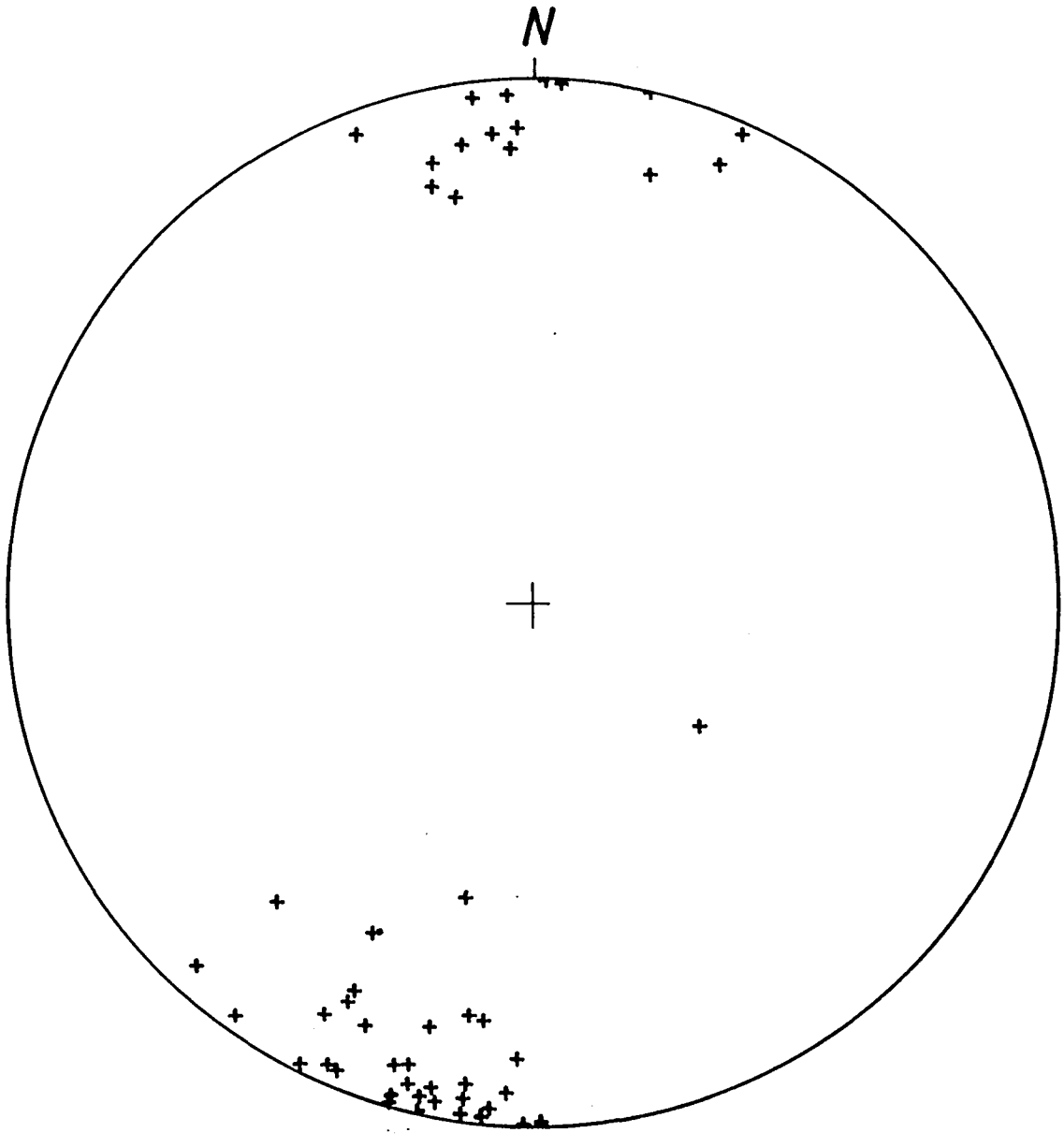
● TARMFJORD THRUST HANGINGWALL

FIG 5



F2 AXIAL PLANES (poles)

FIG 6



L2a LINEATIONS

3.2.5 L2a - intersection lineation

The intersection of S2 with S0 produced an intersection lineation (L2a). This lineation was observed most often in the Innerelv Member (Stappogiedde Formation); in the Nyborg Formation slickensides were more common and obscured the L2a intersection lineation.

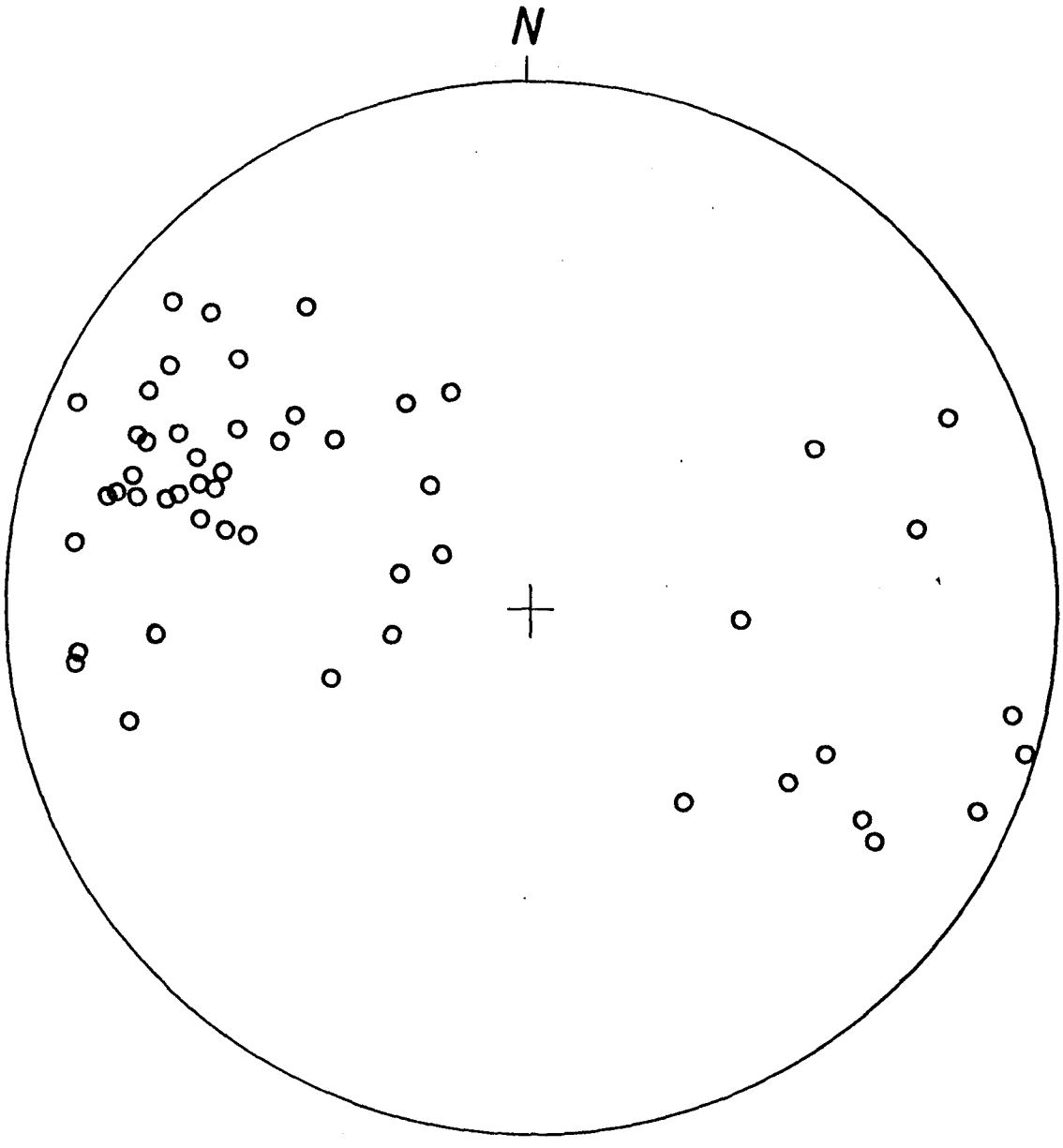
The limited amount of data suggests that the L2a lineation parallels the F2 fold axis direction, having a less than 5' difference in mean orientation (cf Table 2).

3.2.6 L2b - slickenside & mineral lineations

Slickensides were often developed on cleavage and bedding planes, especially in the Nyborg Formation. Slickensides were also seen on joint faces, but the orientation of these striae was not recorded since they would yield only a localized slip direction, rather than the regional slip vector. Mineral lineations were much less commonly observed, being restricted to quartz fibres developed in S2 fracture cleavage voids in folded massive sandstones, particularly in the Nyborg Formation. In general, however, it was not possible to obtain an accurate measurement of the fibre growth direction.

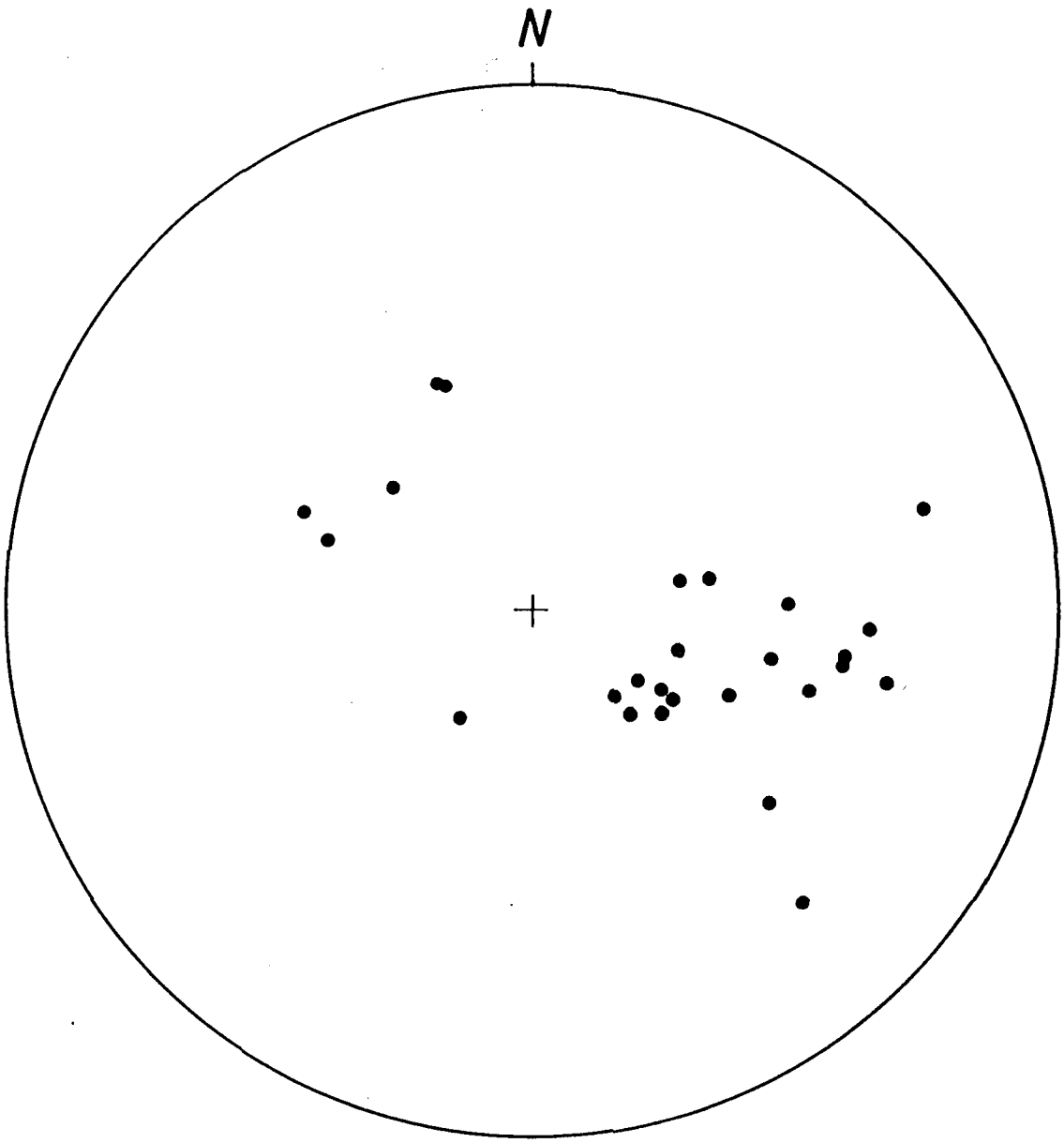
Mean slickenside/mineral lineation orientations (Figs 7 & 9) vary as the other linear structural elements do, with the data from the northeast subarea having a more northerly direction (14-310) whilst the data from the central subarea having a more westerly direction (19-291). Again, the data from the western subarea has an intermediate mean orientation (18-309). These directions all have a more N-S orientation (by up to 25') than the 'a' direction (the direction

FIG 7



L2b LINEATIONS

FIG 8



THRUST PLANES (poles)

normal to the fold hinge) of the F2 fold axes in the same subarea. Overall, they indicate a typical ESE (113') displacement direction (X direction) for the southern part of the Gaissa Thrust Belt. This swings to a SE direction (135') in the northern part of the belt.

3.2.7 Minor thrust planes

Minor thrust planes were not commonly seen in this part of the Gaissa Thrust Belt. In areas further west (especially the Munkavarri Imbricate Zone, see above) minor thrusts are abundant (cf Townsend et al. 1986, 1988). The thrust planes observed were sometimes related to small-scale fold development. This is reflected in the similar mean orientations of thrust planes and fold axial surfaces (3' difference; Fig 9), suggesting a close genetic link and thus an F2 (D2) thrusting age. Modern models of thrust development (e.g. Eisenstadt & de Paor 1987) suggests that such minor thrusts need not necessarily root down dip into a major subhorizontal decollement (such as either the Gaissa or Tarmfjord Thrusts).

3.2.8 Extensional structures

Evidence of extensional strains has been found in a belt trending south from the Auskarnes area (Locs 5120-5127; GR 20 38 to GR 21 39) through Saeresgiedde (Loc 5252 (GR38052015) to the Cakkalas area (Locs 5173 GR35401640; 5208-5211 GR 14 36; 5221 GR35251575; 5249 GR35921592). Most of the exposures with extensional fractures are in the lower, dolomitic part of the Nyborg Formation (Member A of Edwards 1984). Whether the competence contrast between the hard dolomitic rocks and the adjacent relatively soft, more foliated rocks of the rest of the Nyborg

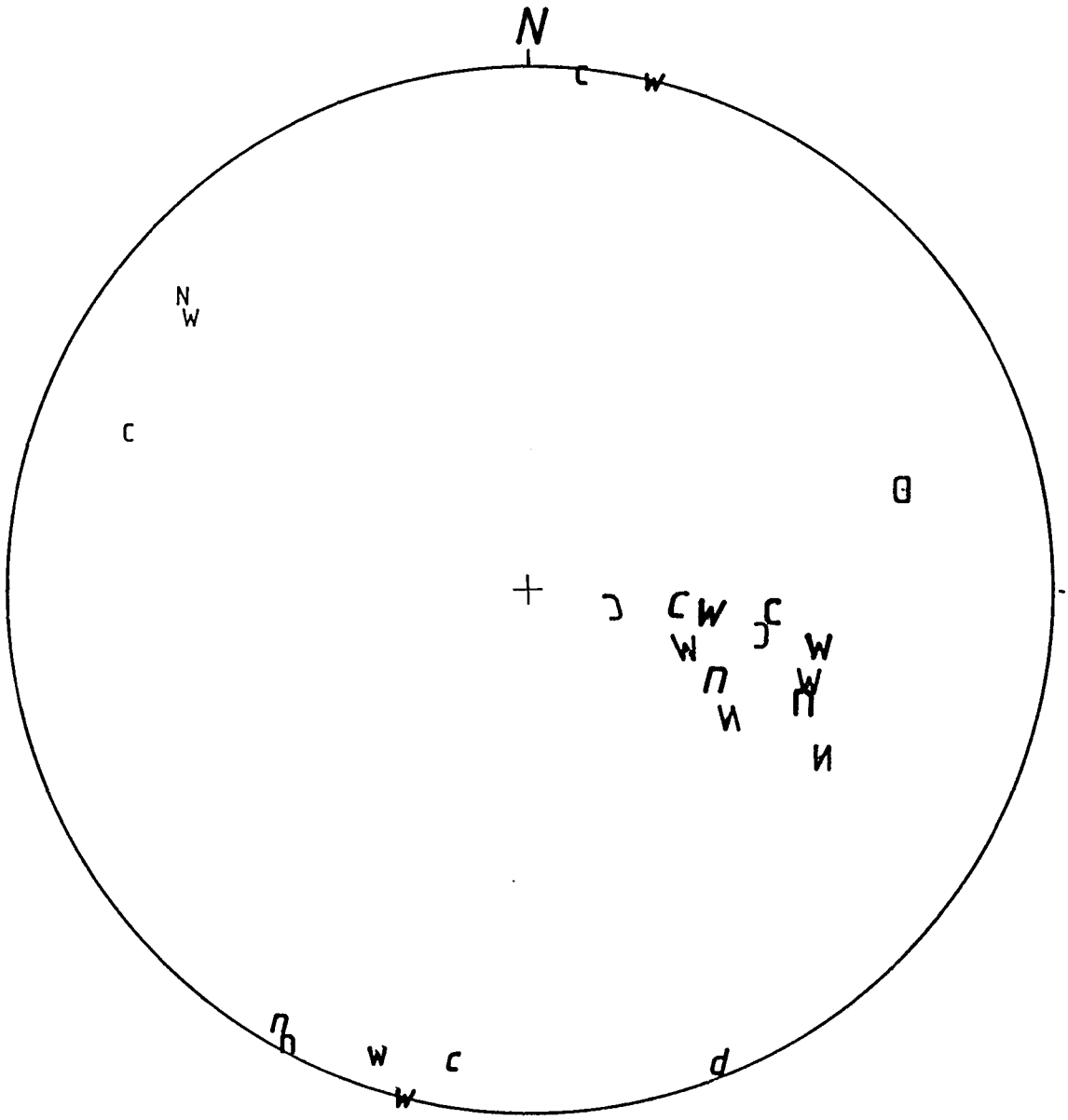
Formation and the underlying Smalfjord Formation is in some way related to the development of these extensional fractures, is unknown.

These extensional structures, taking the form of conjugate shears, often with markedly curved fault planes, definately developed AFTER D2, since F2 structures have been affected (Fig 10B). Associated with the extensional faults are quartz fibres up to 8cm long (Fig 10C).

Figs 11 & 12 show the mean fault plane and quartz fibre orientations (for west and east dipping faults). Fig 13 shows the mean orientations; the squares are the mean mineral (quartz fibre) orientation and the large circles the poles to mean fault planes. The orientation of the maximum compressive stress ( ) bisects the two fault orientations and lies on a great circle through the poles to the fault planes. The minimum compressive stress ( ) also lies on this great circle, but at 90' to the maximum compressive stress. Construction of these positions indicates that the maximum compressive stress was oriented atr 80-126 and the minimum compressive stress at 320-315. Both of these directions are close to the X direction (thrusting direction) for the northeastern subarea. Not enough data were collected from the central subarea (although it was extensively developed at the localities listed above - time was a limiting factor) to determine whether the direction of extension swings to a more ENE-WSW direction in the central subarea.

MEAN ORIENTATIONS

FIG 9



n, c, w F2 axes *d Tarmfjord thrust folds*

n, c, w L2a intersection lin

N C W L2b slickenside/mineral lineation

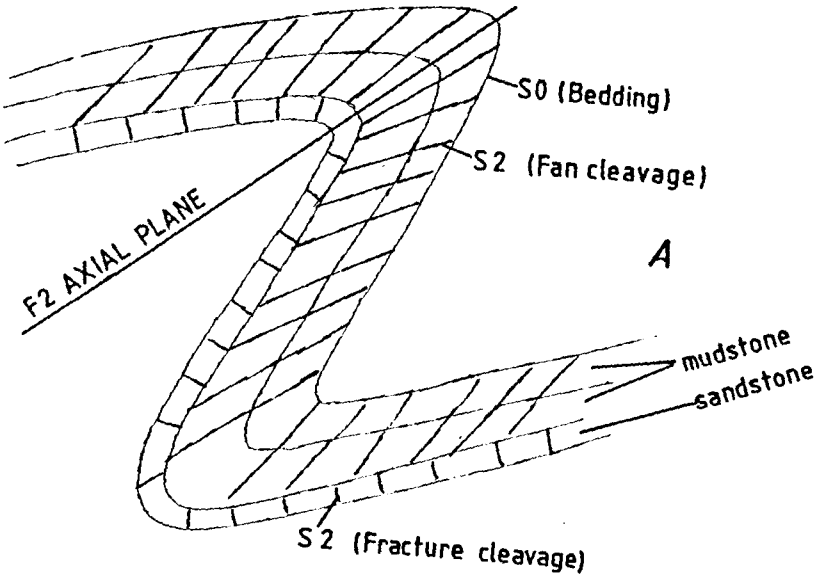
n c w S0 (pole)

n c w S2 (pole)

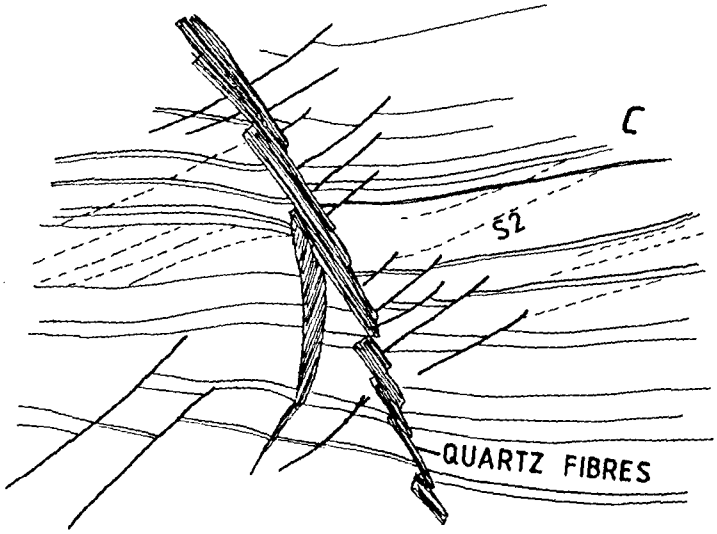
N ɔ W F2 axial plane (pole)

N ɔ W THRUST PLANE (pole)

FIG 10


S0 (Bedding)
S2 (Fan cleavage)
F2 AXIAL PLANE
A
mudstone
sandstone
S2 (Fracture cleavage)


F2 AXIAL PLANE
B


C
S2
QUARTZ FIBRES

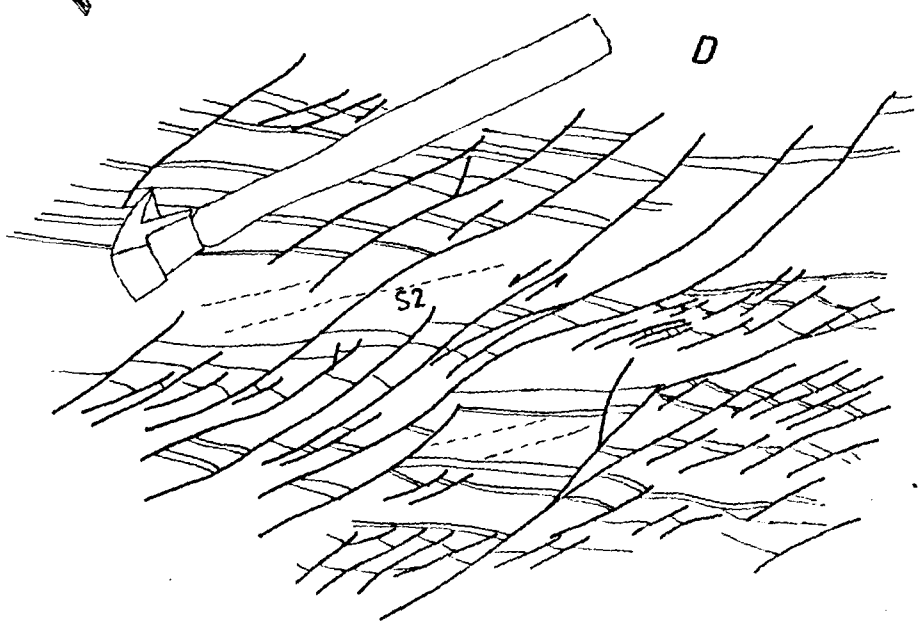
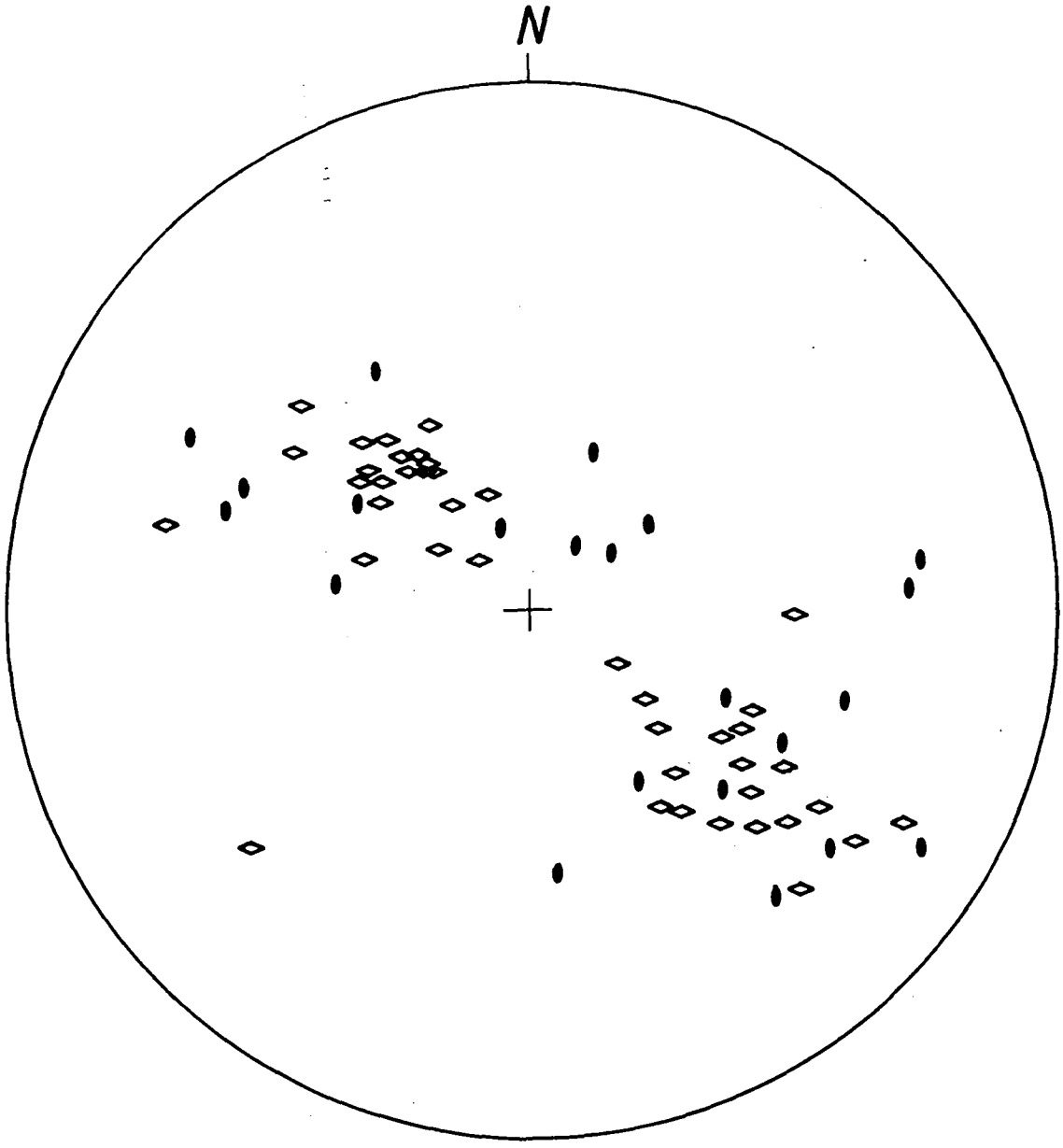

D
S2

FIG 11

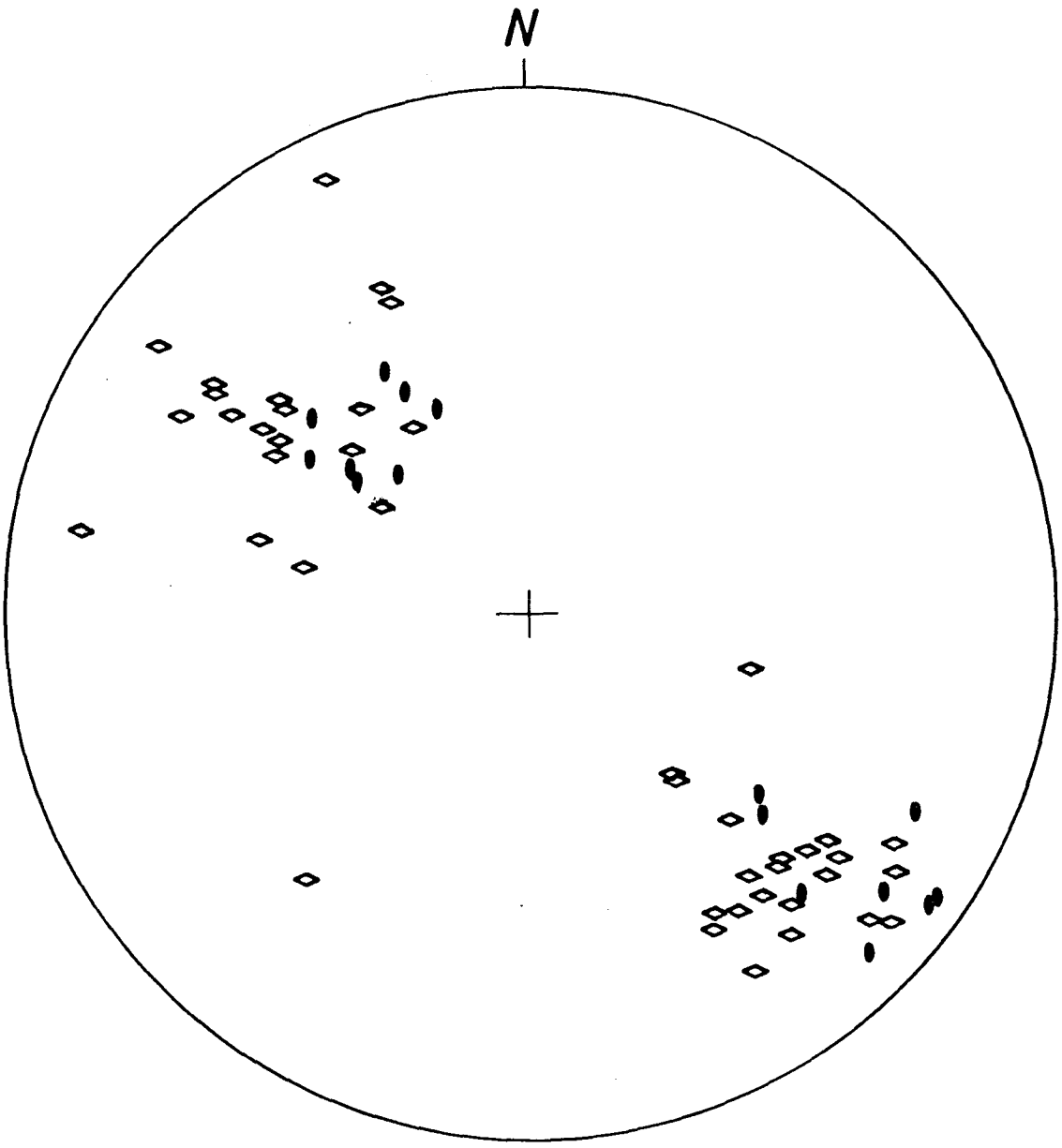


EXTENSIONAL FAULTS

◇ AUSKARNES

• OTHER AREAS

FIG 12

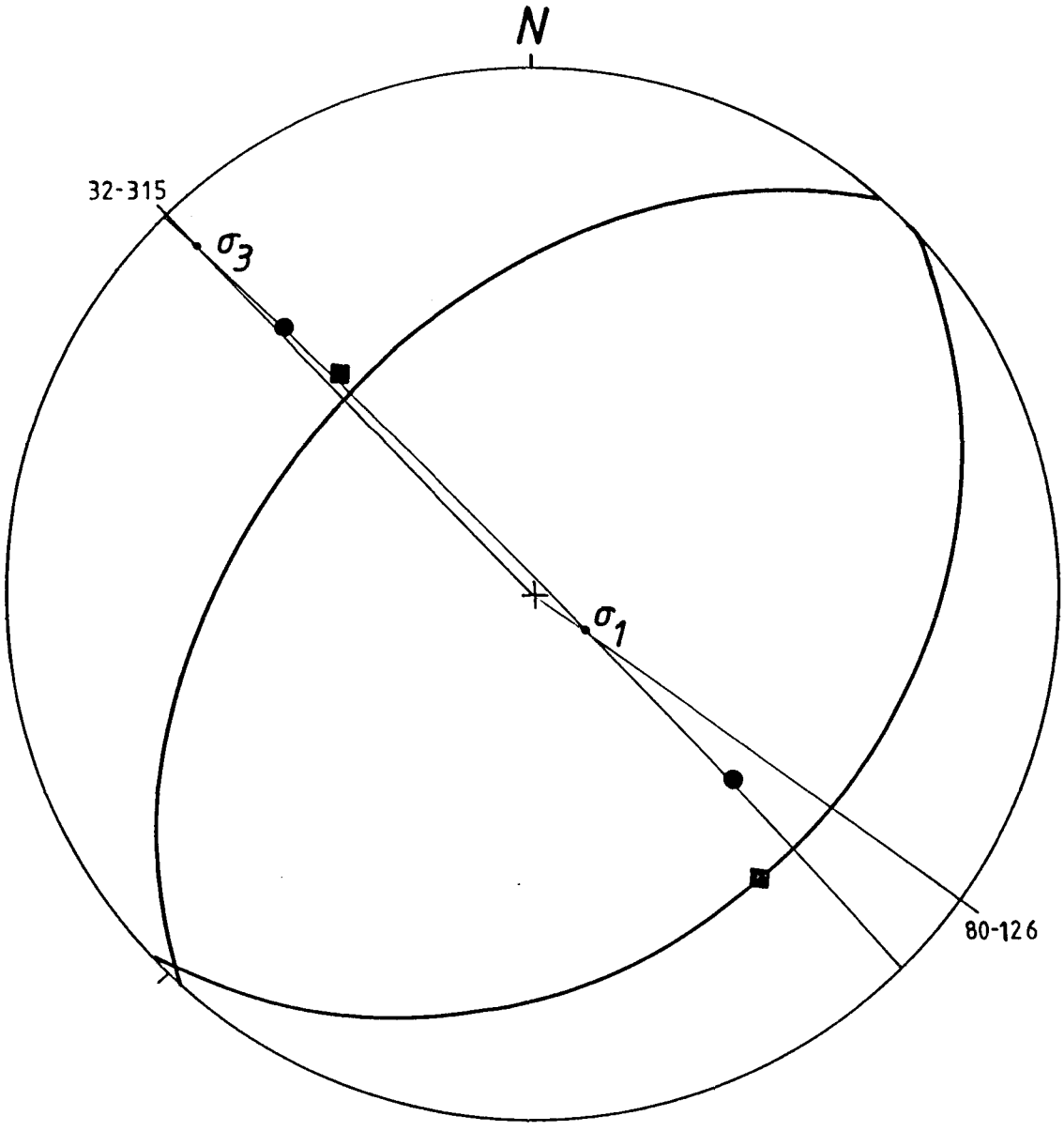


QUARTZ FIBRES

◇ *AUSKARNES*

● *OTHER AREAS*

FIG 13



Summary of extensional data showing orientation of σ_1 and σ_3

- *POLE TO MEAN FAULT PLANE*
- *QUARTZ FIBRE MEAN ORIENTATION*

3.3 REGIONAL STRUCTURE

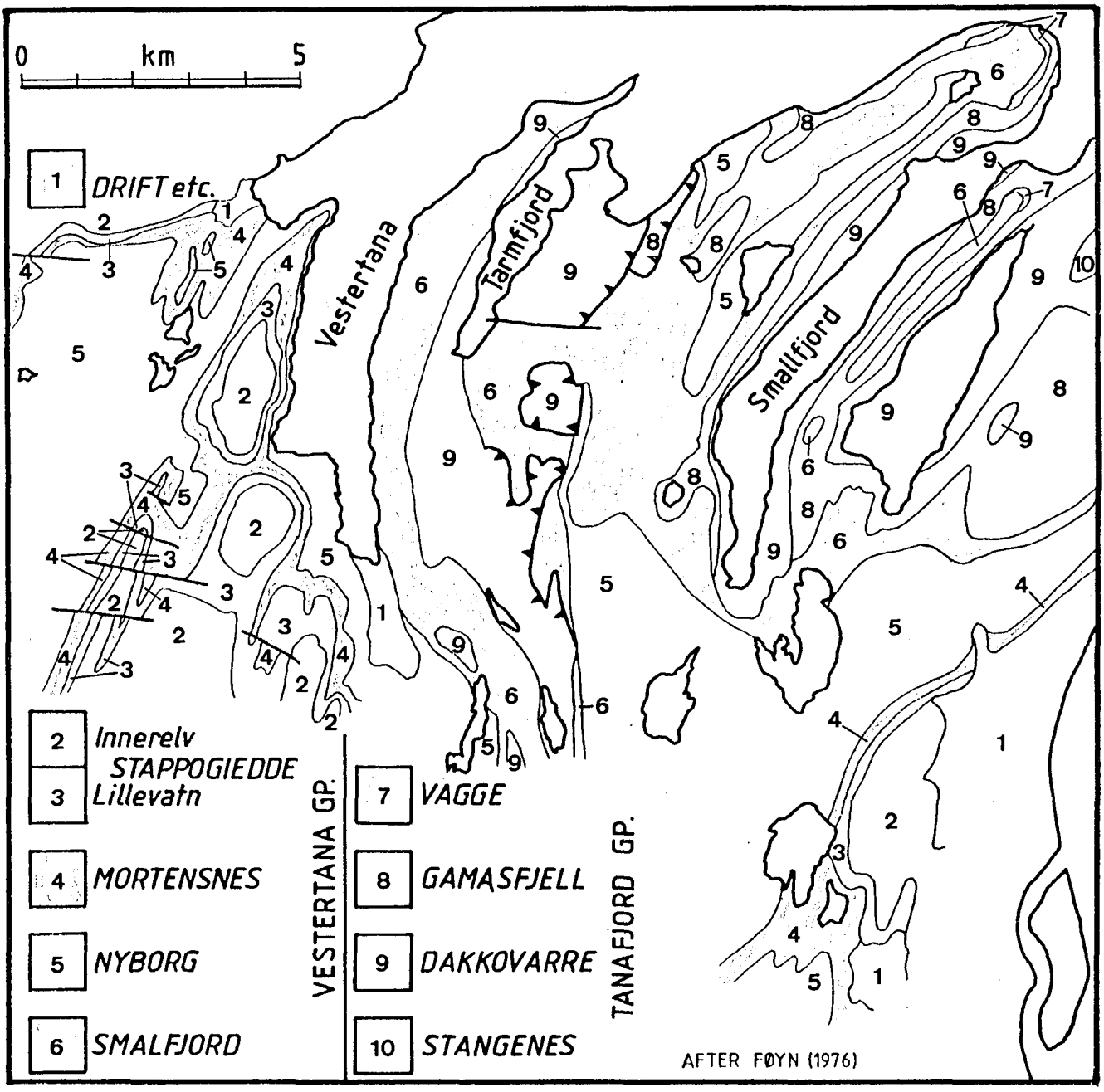
3.3.1 The Map

As stated, the primary aim of the field-work was not mapping. Improvements to the published maps (Foyn 1976, Sigmond et al. 1984; Fig 14) are thus patchy. The relatively limited amount of work done in the area west and southwest of Vestertana (6 days between us) did not reveal any significant differences between our work and that of Edwards 1972. Note, however, that the map of Edwards (1972) shows a more complex structure than illustrated by Foyn (1976). To the east of Vestertana, however, significant changes have been made in five main areas;

(1) between Langorotto (GR 43 11) & Hoergavarri (GR 45 14).
(2) Rittavarri (GR 40 16).
(3) between indre Torhop (GR 37 20) & Gappevarri (GR 38 19).
(4) between Jametsbavtgappi (GR 34 17) & Rassakkar (GR 36 13).
(5) Loeibusvuovdi (GR 33 12).

(1) Langarotto to Hoergavarri (GR43001145 to GR45001415). Along the road from Ruostefielbma to Smalfjord the first outcrop of the Mortensnes Formation lies at GR 43 11 (Loc 5007), ca. 0.5 km east of the position marked by Foyn (1976). The track immediately east of this outcrop leads northeastwards to a quarry in ordinary tillite (Mortensnes Formation). Further west along the main road another track heading northeastwards (off one of the loops in the old road) leads to a small clearing where the base of the Stappogeidde Formation is exposed. Further uphill the lower, red shale, part of the Innerelv Member is

FIG 14


0 km 5
1 DRIFT etc.
2 Innerelv
3 STAPPOGIEDDE Lillevatn
4 MORTENSNES
5 NYBORG
6 SMALFJORD
VESTERTANA GP.
7 VAGGE
8 GAMASFJELL
9 DAKKOVARRE
10 STANGENES
TANAFJORD GP.
Vestertana
Tarmfjord
Smallfjord
AFTER FØYN (1976)

exposed whilst further northeast along the track ordinary tillite crops out. Further west, along the road to Smalfjord, outcrops of the Nyborg and Mortensnes Formations can be seen in medium scale folds. Note that the Nyborg Formation is also exposed in the small cliffs ca. 15m above the road (Loc 5001), directly above exposures of the Mortensnes Formation.

To the northeast (GR44401300) at the base of the steep hill slope, red shales are exposed (Loc 5040). Although possibly these rocks are part of the Nyborg Formation, it seems more likely that they are part of the Innerelv Member (Stappogiedde Formation) and it is probable that the Mortensnes Formation and Lillevatn Member of the Stappogiedde Formation lie further uphill, dipping steeply to the east.

(2) Rittavarri (GR40351650). On the summit with the trig point (not the highest point) massive quartzites of the Gamasfjell Formation were found overlying strongly cleaved tillite containing many very small clasts (Loc 5113). In neither unit was it possible to determine the 'way-up', but the regional fold pattern implies that these rocks are inverted, since ~150m to the east cleaved tillite overlies the Gamasfjell Formation. Between the two outcrops of quartzite, and lying within the cleaved tillite (presumed to be the Smalfjord Formation) is a thin sequence of red siltstones/shales and thin green sandstones, interpreted to be the Nyborg Formation tightly squeezed into the fold hinge. Fine sedimentary details were not preserved, but, assuming that the thin compositional layering (1-5mm) represents a highly deformed bedding, then its relationship to the very prominent cleavage indicates that in the western part the sequence is inverted.

It is uncertain whether the Nyborg Formation crops out within the folded Smalfjord Formation to the northeast, on Alduloegvarri (GR41751825); although not seen by the authors or by Johnson (1974) (and thus not indicated on the map), it is likely to be present.

(3) Indre Torhop to Gappevarri (GR 37 20 to GR 38 17). From a structural viewpoint, this is one of the more crucial regions within the contract area. Along a WNW-ESE oriented cross-section Foyn (1976) showed the Dakkovarre Formation thrust over the Gamasfjell Formation, which in turn was shown to be tectonically emplaced onto the Smalfjord Formation. No major inversion of the stratigraphy was shown. Our mapping has shown that the small imbricate of the Gamasfjell Formation is overlain by dolomitic tillite, folded into a broad upright open synform. Although the contact was not seen, the tillite is not strongly cleaved and contains large clasts with relatively few quartz veins; this suggests a low strain and thus an unconformable contact between the Gamasfjell Formation and the tillite, the Smalfjord Formation.

Within the underlying tillite succession two outcrops of strongly cleaved red silts/shales were found; at both localities the sequences are thin (GR38101945, Loc 5409, ca. 10m thick and GR37731985, Loc 5444, ca. 2m thick). In both cases the overlying tillite is extremely well cleaved and contains many small clasts, whilst the tillite below has somewhat larger clasts and is somewhat less well cleaved. These sequences have been interpreted as extensively thinned Nyborg Formation, overlain by sheared Smalfjord Formation.

(4) Jametsbavtgappi to Rassakar (GR 34 17 to GR 36 13). Foyn (1976) showed a major upright (?late) fault separating the southern margin of the Dakkovarre Formation on Urravarri (GR 36 19) from the Smalfjord Formation. Although this fault is in line with a fault lying to the southwest of Tarmfjord (GR 33 17), exposures of the Dakkovarre Formation close to the contact with the tillite show features typical of the tectonic base of this formation where it is known to be tectonicly placed (see below). This suggests that only minor faulting occurred.

Immediately south of Tarmfjord Foyn (1976) showed a normal, unconformable relationship between the Dakkovarre and Smalfjord Formations. To the southeast this uncoformable relationship was shown to become a tectonic junction, with the Dakkovarre Formation thrust over the Smalfjord Formation. This apparent anomaly was resolved by observing that south of Tarmfjord the Dakkovarre Formation has a tectonic contact with the underlying tillite.

At the northern end of the Cakkalas summit Foyn (1976) showed a single large klippe of the Dakkovarre Formation, directly overlying the Nyborg Formation to the east and the Smalfjord Formation elsewhere. Our somewhat more detailed work has revealed that there are at least three klippen and probably four (it is not wholly certain that the northwestern klippe is distinct from the central klippe; air photo analysis and the general topographic relationships suggest that they are). The easternmost klippe clearly overlies a thin sequence of tillite, of dolomitic type in parts, which in turn overlies a thinned sequence of the Nyborg Formation. Siedlecka (pers. comm. 1988) noted that both the upper and lower contacts of Nyborg Formation were composed of Member A (dolomites and marls), generally taken to indicate the base of this formation.

South of these klippen the geology illustrated by Foyn (1976) is substantially correct, given the relatively poor 1:100,000 topographic maps available. Note, however, that in several places outcrops of Member A of the Nyborg Formation have been found within the tillites, in one case directly underlying the Dakkovarre Formation.

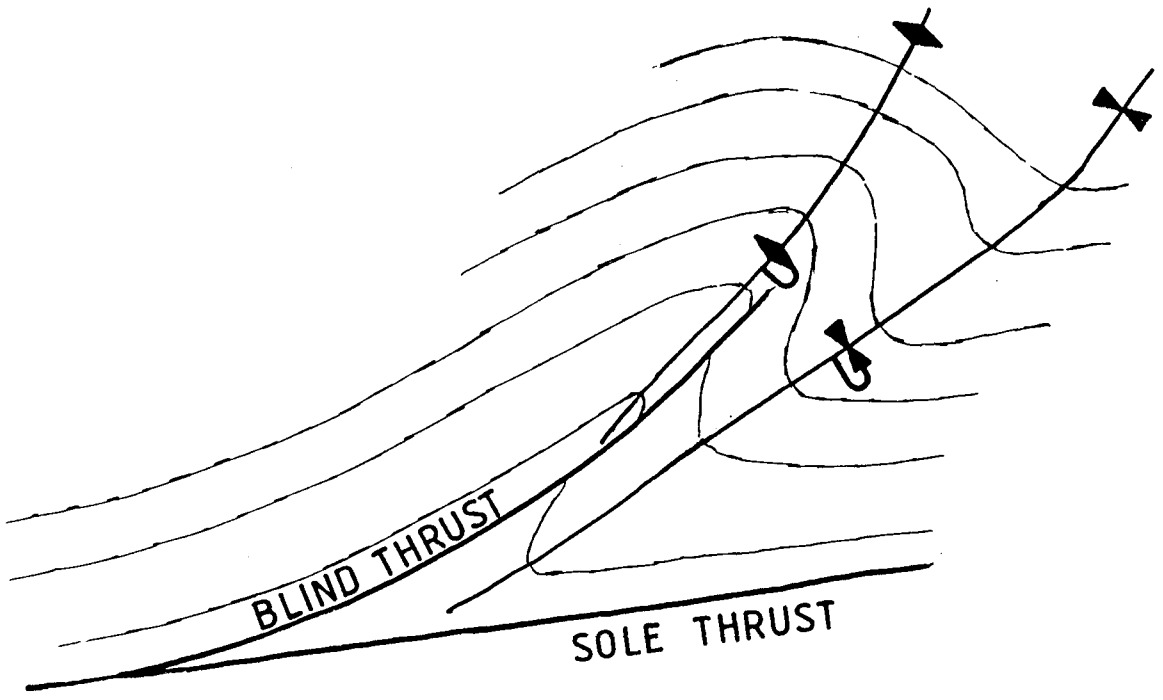
(5) Loeibusvuovdi (GR 33 12). Revision to Foyn's (1976) map in this region is very sketchy, being based on only one days work. However, it was found that massive quartzites (presumed to be part of the Dakkovarre Formation) cropped out immediately southeast of the farms in the Loeibusvuovdi area, and that this was overlain by tillite, passing up to the Nyborg Formation. Note that the area of Dakkovarre Formation southwest of Baktejavri (at GR34401250) has not been seen by us and is copied from the work of Foyn.

3.3.2 Major Structures

As stated in the Introduction, the contract area forms part of the more external region of the Gaissa Thrust Belt (Lower Allochthon). As such, the outcrop pattern has been dictated by one relatively major thrust and several large-scale folds, three of which are of greater significance than the rest. The two cross-sections (see Maps) summarizes the large-scale structure of the contract area.

The only major thrust, the Tarmfjord Thrust, imbricated rocks of the Tarnafjord Group onto the Vestertana Group in the area between indre Torhop (GR 37 20) and Cakkalas (GR 36 13). Generally the thrust plane separates rocks of the Dakkovarre Formation from the Smalfjord Formation, but in the north the thrust

FIG 15



Showing the variation in fold style associated with blind thrusts

lies beneath rocks of the Gamasfjell Formation (which is itself overlain tectonically by the Dakkovarre Formation) whilst in the south and extreme north it has cut down into the inverted rocks of the Nyborg Formation. So far as is known the Tarmfjord Thrust always overlies inverted rocks.

Although the Tarmfjord Thrust is exposed now, there is no certainty that it was not originally a blind structure (i.e. it did not join a roof thrust). Indeed, its relatively short displacement (restoration suggests a minimum of only 2.5km displacement) suggests that it is similar to many of the other thrusts presumed to lie below, and be related to, many of the folds in the area (cf Fig 15).

Deformation along the Tarmfjord Thrust resulted in locally high strains developing in both the footwall and hanging wall. In the footwall cataclasis resulted in a major reduction in the size of clasts within the tillite and the formation of a ?cataclastic foliation (especially below the imbricate of the Gamasfjell Formation (Loc 5416 GR3?281895). In the hangingwall minor folds in the Dakkovarre Formation have been rotated towards the X direction (see above).

Three major synclinal folds have been identified in the area. In the west a major fold affects the rocks in the Laddebakti (GR 30 13) and Suossjakharjas (GR 27 12) area. Edwards (1972) showed a thrust sheet overlying this fold, but this was not covered by our work, A second major fold lies between Smalfjord and Sundvatnet, trending NE along Alduloegavarri (GR 41 18), curving to a more N-S orientation south of Rittavarri (GR 40 16). South of Rittavarri this fold appears to die out rapidly. Both of these major synformal folds have steeply dipping to slightly overturned western limbs with rlatively open fold profiles.

The most important fold in the area is the footwall synform to the Tarmfjord Thrust. The trace of the axial surface is shown on the maps and its curvilinear form indicates a low angle of dip. The position of the trace of the axial surface can be well constrained between Loc 5120, 5122 and 5121, 5123 (GR 38 21). Further south it is thought to lie within the thin and highly deformed Nyborg Formation at Locs 5409 and 5444 (GR38101945 and GR37731985). Similarly, in the Cakkalas region (GR 36 16) the axial surface is thought to lie within the thinned Nyborg Formation under the Tarmfjord Thrust, where the basal dolomitic lithologies of the Nyborg Formation have been found at both the lower and upper contacts (Siedlecka, pers. comm. 1988). Between these two areas, however, the axial surface must lie within the Smalfjord Formation but its precise location cannot be established due to the lack of bedding in the tillites; the position shown on the map is conjectural.

The footwall synform to the Tarmfjord Thrust is the only fold which significantly affects both cross-sections. Since it is almost certain that the other essentially upright open large-scale folds are related to minor blind thrusting at depth, the lack of along strike continuity of structures suggests small thrust displacements (similar to the thrust at Langarotto; GR 42 11).

3.4 STRUCTURAL SUMMARY

Structurally the area is relatively simple. An early bedding (S0) parallel fabric (S1) formed, probably as a result of mimetic growth during pre-orogenic diagenesis and early orogenic burial metamorphism. This fabric is observable only in unbedded rocks since elsewhere S0 has masked the relatively weak S1

component in the S0/S1 fabric. Superimposed on this was a tectonic fabric (S2) which was penetrative in the more pelitic rocks. In quartzofelspathic lithologies an S2 fracture cleavage developed at a high angle to S0. S2 formed in association with large- and small-scale folds, associated with minor and major thrusting

The direction of transport of these folds/thrust and the associated S2/L2a/L2b directions swings from being related to ESE directed compression in the central subarea to SE directed in the northeastern subarea. There is not a sharp boundary between the two zones of direction of thrust movement, rather there is a gradual swing; the western subarea lies within this transition zone and has transitional structural orientations.

Overall, large-scale structures suggest that little orogenic contraction has taken place in this area (compared to the ca. 50% shortening in the Munkavarri Imbricate Zone in the Porsangerfjord area ; cf Gayer et al. 1987). Thrusts are widely spaced, probably all blind, and with displacements in the order of a few kilometres only. This blind thrusting has caused large-scale folding of varying styles, the fold shape depending on the proximity to the thrust tip. That these fold/thrust structures are more common in the northern part of the Gaissa Thrust Belt is certain (Siedlecka & Siedlecki 1971, Chapman et al. 1985) although the significance is unclear.

The minor F2 structures at the base of the Nyborg Formation in the Auskarnes to Cakkalas area have been affected by post-D2 extensional strains. These

structures cut both the right-way-up and inverted limb of the footwall synform to the Tarmfjord Thrust. A more precise age of extension cannot be established.

The swing in thrusting/folding directions (and associated structural elements) has been described across much of Varangerhalvoya to the east and has been related to strike-slip movements along the Trollfjord-Komagelv Fault (Williams 1979, Rice et al. 1989). However, the parallelism of L2a and F2 axes and of the F2 axial surfaces and S2 cleavage demonstrates that S2 is not a transecting cleavage and thus was probably not developed in a strain field affected significantly by strike-slip fault movements (cf Soper 1986). That these structures were subsequently affected by movements along the Trollfjord-Komagelv Fault is, however, probable.

The overall style of deformation in this region is similar to that observed in the Porsangerfjord region, with blind thrusts cutting up-section by variable amounts causing folding in the overlying rocks. The major difference is that the spacing of the thrusts in the east is much greater and the associated folding is much more intense, being locally recumbent and isoclinal. This suggests that a strain localization occurred in the east, with a relatively few weak zones exploited more fully during shortening. There seems, therefore, to be no problem in correlating, structurally, these rocks with those of the Vuonjalrassa Thrust Sheet in the Rietkajakskaidi and Ullugaisa areas.

- 4 - SLATE QUARRYING POTENTIAL -

At the outset of this section it must be stated that we have no expertise in slate quarrying. These comments, therefore, are of a general and rather speculative nature.

The requirement for slate production would appear to be (1) a relatively high strain, to increase fissility and thus the thinness of the slates, and reduce unevenness in the bedding planes, (2) a suitable rock type - not too psammitic and not to pelitic and (3) a large body of rock with this suitable composition.

Within the contract area no single unit satisfies these requirements. Only the Nyborg Formation and Innerelv Member (Stappogiedde Formation) come close to satisfying requirement (2), but both these units do have considerable variations in composition and the strain may vary considerably over a short distance.

This conclusion seems rather negative; in the field we rarely came across what appeared to be good naturally formed slates. Having said that, the most promising areas for further exploration would seem to be in the west of the contract area, where the exposures of the suitable rocks are more extensive and are not covered by trees. The Nyborg Formation exposed in the Auskarnes area is certainly unsuitable, due to the abundance of extensional fault structures seen cutting the bedding and cleavage.

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TABLE 1

Table of mean orientation of planar structural elements, with pole to mean plane orientation given in brackets. Data refer to a 360° compass.

Data	Subarea	N	Mean Orientation	Cone of Confidence	k parameter
S0	Northeast	111	207/33(57-117)	6.36	0.23
	West	89	187/28(62-097)	6.69	0.26
	Central	213	185/23(67-095)	4.87	0.98
S2	Northeast	121	202/47(43-112)	4.32	4.45
	West	97	191/47(43-101)	4.53	4.05
	Central	197	185/39(51-095)	3.16	7.61
F2 ax.pl.	Northeast	8	210/54(36-120)	9.05	4.60
	West	9	198/47(43-108)	10.60	4.39
	Central	5	191/37(53-101)	21.48	3.36
on Tarmf. Thrust		9	165/63(27-075	25.66	0.29
Thrust pl.	Northeast	13	213/38(52-123)	15.59	1.33
	West	5	201/26(64-111)	46.00	0.06
	Central	11	194/13(77-104)	21.74	0.76

TABLE 2

Table of mean orientation of linear structural elements and extensional structures. Pole to mean planes given in brackets. Data refer to a 360° compass.

Data	Subarea	N	Mean Orientation	Cone of Confidence	k parameter
F2	Northeast	8	04-210	14.29	2.08
	West	18	00-014	8.80	4.21
	Central	14	10-189	13.46	10.15
on Tarmf. Thrust		11	02-158	10.77	21.30
Int lin.	Northeast	4	01-209	25.30	19.22
(L2a)	West	32	07-198	6.72	15.75
	Central	10	01-006	13.83	0.73
Slicken.	Northeast	24	14-310	13.83	0.26
& min lin.	West	11	18-309	24.06	0.71
(L2b)	Central	29	19-291	14.62	0.54
Extensional Structures					
West dipping					
Fault plane		28	222/47(43-132)	6.02	12.37
Quartz fibre		28	43-319	5.68	30.25

East dipping				
Fault plane	28	047/31(59-317)	4.86	10.19
Quartz fibre	27	30-141	5.12	14.15

FIELDBOOK NOTES:

RICE: 48 p.

THOMASJORD 2 p.

ANDREASSON 2 p.

JOHNSON 4 p.

Strike and plunge orientations taken on a 360' compass
Magnetic variation NOT INCLUDED IN THIS DATA
Dip direction is 90 degrees clockwise from strike direction

Monday, 18th July, 1988

5001. Boundary of red/purple shales with tillite. Shales overlie tillite

Bedding in shales 210/24
Cleavage in tillite 218/54
Intersection lin 01-207

Good sedimenatry structures preserved - low strain. Beds up to 0.5m thick. Medium scale monocline - Ze

Steep limb bedding 197/81
Steep limb cleavage 209/60

Fold cut by minor thrust. Cleavage more pronounced in axial zone. Thrusts parallel to bedding in shallow fold limbs

Thrust plane 212/23
Slickenside on thrust 18-285
Minor fractures (proto thrusts?) 207/26
Quartz veining (with free standing crystals) along thrust.

Closer to tillite (downhill a bit) - more minor thrust planes - better cleavage. Bedding hard to discern - some parts much broken, a protocataclasite with chlorite infill.

Minor thrusts 219/25, 213/27
Cleavage 180/75

Nyborg Fm. thrust over Mortensnes Fm.

Tillite contains large granitic blocks.

Cleavage in tillite 186/70
Quartz filled fractures 050/46 - with free quartz crystals

5002. Up hill ca. 10m. - above Nyborg Fm. Tillite - Mortensnes Fm. with large clasts.

Cleavage (penetrative) 185/53

5003. Tillite at top of cliff visited at loc. 5001.
Cleavage - appears to be TWO cleavages - a spaced cleavage at 1-10cm intervals and a fine, penetrative cleavage. The former may be related to bedding ? - an early bedding parallel compaction cleavage?

Cleavage (spaced) 208/41
Cleavage (penetrative) 203/57

5004. Tillite - many small clasts

Cleavage (penetrative) 224/37

Cleavage (weak) 201/13
The penetrative cleavage is parallel to (& forms?) the low strain zones/augens around the clasts.

5005. Nearly at top of hill. Slight ridge of tillite exposed - only 0.5m high; ridge trends 025'

Cleavage (spaced) 208/39

5006. ca. 60m above road. Walked SW from loc. 5005. This is first scree (no exposure) of redshales of Nyborg Fm.

5007. Down at road outcrop - first outcrop travelling west from Ruostefielbma. Tillite - Mortensnes Fm. Quite clearly two cleavages.

Cleavage (spaced) 1-5cm 203/79
Cleavage (penetrative) 204/49

The penetrative fabric is definately wrapped around the clasts. The spaced fabric appears to be also, but not so strongly

Quartz fracture 048/39
Quartz fibre lineation 41-125

Tillite contains pyrite cubes - small

Tuesday, 19th July, 1988

5008. Tillite - outcrop just in trees above gully slope by road.

Cleavage (spaced) 1-10cm 217/41

10 cm thick zone of intense cleavage (?thrust)

zone 210/05
Cleavage (?fine) 186/59

5009. Down in gully to N of road - ace exposure although much covered at this end by mud/soil.
ca. 15m west of blue painted boulder. Directly below loc 5008 is a small exposure of tillite.

Cleavage (spaced) 198/62

3m west red/green shales/silts of Nyborg Fm.
Folded into monocline Ze. Good graded bedding in steep limb - low strain & younging to east.

Fold axis 12-016
Axial plane 205/59

Continuing to west see a dodgy outcrop of Nyborg Fm. - pretty certain it is not in situ.

First good outcrop is just below tree level - tillite. This continues west to the small roadcut cliffs.

Cleavage (spaced) 201/66
Cleavage (fine) 216/48

Towards the west end of tillite outcrop is a 3m diameter boulder of massive sandstone. Can follow tillite for ca.30m along road but contact with Nyborg Fm. is obscured by 1m of cover. In Nyborg Fm.;

Bedding 217/82
Cleavage 209/59

Series of superb folds in Nyborg Fm.

Fold axis 26-216
Axial plane 211/62
Slickenside 29-287
Steep fault 188/Vertical - cannot match beds across fault
Fold axis 30-217
Axial plane 202/54
Slickenside 36-294

In steeply dipping Nyborg Fm.;

Bedding 205/73
Cleavage 209/69

Series of minor thrusts/shear zones

Thrust	226/22	slicken of quartz fibres	18-304
	196/45		42-304
	201/33		33-291

These quartz veins are up to 2cm thick but only <2m long - thin and die out.

Fold axis 04-207
Axial Plane 210/55

Series of minor accommodation faults in fold hinge zone

Fault	213/18	slicken of quartz fibres	17-300
	227/64		66-321

At last major fold. Inter limb angle ca. 55'. Good sedimentary structures - low strain.
Fold axis 01-023
Axial plane 197/69

Fold axis 04-035
Axial plane 205/62

Fracture cleavage in steep limb 051/27

5010. Nyborg Fm. red and blue green shales & silts. Good sedimentary structures - low strain.

Bedding 197/67
Cleavage 207/45

5011. Top of hill. Nyborg Fm. - long outcrop trending 015'
Bedding 190/59
Cleavage 023/57

These readings taken in first place I looked - rock much folded.

5012. Just in trees. Spot height 196m. Nyborg Fm. - red/purply shales.

Bedding 029/88
Cleavage 208/81

5013. Scattered outcrops of Nyborg Fm. all over summit.

Bedding 211/82
Cleavage 206/56

5014. Hill 208m. Scattered outcrops of Nyborg Fm.

Bedding 175/22
Cleavage 141/60

5015. Nyborg Fm. Strongly developed cleavage - bedding is hard to see - more pelitic overall? ?Highly strained/

Bedding 171/20
Cleavage 181/23

5016. About to go down steep slope at edge of trees. Nyborg Fm. - red shale & silt/sandstone. Sed structures indicate inverted sequence.

Bedding 191/52
Cleavage 196/45
Slickenside 23-288

5017. Nyborg Fm. - red shale. Bedding very fine - suspect high strain.

Bedding 190/54
Cleavage 193/61
Quartz vein 180/61
Slickenside in quartz 54-340

5018. Nyborg Fm. In car tracks near minor river.

Bedding 203/60
Cleavage 201/46

5019. Walked east along track - pretty well 100% exposure but all weathered. By west end of lake due to dam.
Nyborg Fm. Thick red sandstones - up to 15cm. Graded bedding indicates right way up.

Bedding 191/44
Cleavage 198/56

5020. Nyborg Fm. Mostly sandstones - no obvious cleavage.

Bedding 053/80

5021. Nyborg Fm. Blocks of tillite (ex situ) a few metres away.

Bedding 018/17
Cleavage 220/56

5022. On ridge - all Nyborg Fm. Graded bedding indicates right way up.

Bedding 028/79
Cleavage 186/46

5023. Nyborg Fm. Graded bedding indicates younging to east.

Bedding 034/82
Cleavage 181/40

5024. Nyborg Fm. between lakes.

5025. Nyborg Fm. Good cliff exposure.

Bedding 187/37
Cleavage 186/56

5026. Nyborg Fm.

Bedding 189/72
Cleavage 191/41

5027. Nyborg Fm. Mostly red sandstones. Bedding finely laminated - high strain?

Bedding 198/10

5028. About to go down steep slope of hill. Greeny grey sandstones - not 100% sure in situ. Probably tillite.

Cleavage (spaced) 171/25

Few metres down definately tillite in situ. Only 15m above vally floor.

Cleavage (spaced) 194/06 // to a crude bedding
Cleavage (penetrative) 136/35

Large (0.5m) cobble

5029. Blue grey sandstone - Mortensnes Fm. No obvious clasts.

Cleavage (spaced) 149/37
Cleavage (penetrative) 197/43

5030. Mortensnes Fm. Greeny blue sstns - some small rounded grains up to 1mm diameter. Some <20cm cobbles

Cleavage (1-20cm spaced) 170/64
Cleavage (penetrative) 144/86

5031. Down steep part of hill to west. Lots of ex situ blocks of pink massive quartzite - Gamasfjell Fm.

5032. Gamasfjell Fm. Massive pinkish quartzite. Beds up to 1.5m thick Slightly gritty at base of some beds.

Bedding 126/11

5033. 50m on, all scree is Mortensned Fm. None in situ.

5034. Mortensnes Fm. - lots of small (<3cm) clasts.

Cleavage (spaced) 140/34
Cleavage (penetrative) 140/20

5035. Mortensnes Fm. Many small clasts.

Cleavage (spaced) 208/33

Wednesday, 20th July, 1988

5036. From track walked uphill through 4-8m of fairly massive white sandstone. Overlying finer banded silts and sstns - darker, greeny. Beds up to 0.75m thick.

Bedding 206/46

Cannot see any obvious sedimentary structures - possible graded bedding suggests inverted - but not certain.

Overlain in a good cliff section by 3-4m of green-brown silt/sandstones Very flaggy - 1cm flags parallel to bedding. Some pockets/lenses of white to grey sandstone up to 12cm thick.

Bedding 195/47
Cleavage 200/57

This is capped by red silts/shales - little green in it. This forms the flat part of the hill. Red shales continue westwards as far as the valley to the west.

5037. On west side of hill - still red shale

Bedding 200/80
Cleavage 205/41

Graded bedding indicates inverted

5038. Quartzites again and as previously, underlain by fine grained silts and sandstones. Here can see a 4cm conglomerate overlying sandstones and then 7-12cm of conglomerate - base of Stappogiedde Fm. This is in the NW corner of a small cleared area west of the track.

5039. U. tillite, with cobbles up to 10cm diameter

Cleavage (spaced) 194/60

5040. First outcrop up hill - red shales & greeny grey sandstones. Either Nyborg Fm. or Stappogiedde Fm. Not much of the greeny sandstones typical of the Nyborg Nyborg - prefer Stappogiedde Fm.

Bedding 209/37
Cleavage 196/44

5041. Red and blue/green shales and silt/sandstones of the Nyborg Fm.

Bedding 195/40
Cleavage 217/51
Intersection lin 04-209
Slickenside lin 36-291

5042. Exposure on road corner - NyborG Fm. many large/intermediate scale folds. Folds all face east

Fold axis 00-195
Axial plane 195/35
Slickenside lin 02-107

Fold axis 10-215
Axial plane 219-25

5043. Nyborg Fm. Massive sandstones (<0.5m thick) overlying shales

Bedding 174/11
Cleavage 204/47
Slickenside lin on bedding 05-295
Slickenside lin on cleavage 44-285

Slickenside lin on cleavage suggests extension from the steps on the fibres.

5044. Nothing 100% in situ - lots of Nyborg Fm. large blocks

Thursday, 21 July, 1988

5045. In a quarry in tillite - lots of large blocks. Outcrop all along path to the quarry.

Cleavage (spaced) 186/55
Cleavage (penetrative) 188/40

5046. Tillite. Opposite lay-by formed when road straightened.

Cleavage (spaced) 193/21
Cleavage (fine) dips to east??
Slickenside on spaced cleavage 19-294 - extensional??
Bedding?? 320/17

5047. Top of hill - all scree to here was of Nyborg Fm. shales. Here Nyborg Fm. in situ.

Bedding 190/80
Cleavage 181/72

5048. Nyborg Fm. - lots of minor outcrops on slope

Bedding 202/73
Cleavage 206/70

5049. Nyborg Fm. Some pale grey/white sandstone lenses up to 3cm thick

Bedding 182/41
Cleavage 193/61

Down at lake level

Bedding 141/05
Cleavage 192/54

5050. Nyborg Fm. 50m N of stream, by lake outflow. Graded bedding indicates right way up - sandstone-shale units up to 15cm thick

Bedding 148/15
Cleavage 152/24

5051. Nyborg Fm. - good outcrop

5052. Summit of hill 173m. Very poor exposure of Nyborg Fm

Bedding 186/79
Cleavage 180/45

5053. Nyborg Fm.

Bedding 185/47
Cleavage 183/57

5054. Nyborg Fm. just N of bog at valley bottom

Bedding 075/13
Cleavage 135/32
Slickenside 1in on bedding 07-103

5055. Tillite - small clasts

Cleavage 105/26

5056. Tillite

Cleavage (spaced) 173/32

5057.
Tillite

Cleavage (spaced) 176/24
Cleavage (penetrative) 160/78

5058. Scattered outcrops of tillite to here. Still in tillite here but many blocks of Nyborg Fm about.

Bedding 196/47
Cleavage 206/77

5059. Summit of hill. Tillite
- strongly cleaved.

Cleavage (spaced) 203/71

5060. All tillite scree - no outcrop.

5061. Hill top. All scree to here was of tillite. Can see white quartzites on opposite hill top dipping under tillite.

Cleavage (spaced) 007/69
Cleavage 009/50

5062. In valley - a mere 3m NW of last outcrop seen since 5061 - just across stream. Quartzites - massive white weathering - slightly pinkish. Gamasfjell Fm.

Bedding 046/23

5063. Summit. Gamasfjell Fm. Bedding up to 0.75m thick.

Bedding 044/16

Foresets indicate right way up.

5064. Gamasfjell quartzite

Bedding 018/23

5065. 10m down hill from summit - thin bedded sandstones - reddish/yellow colour - probably Dakkovarre Fm.

Bedding 023/17

5066. Massive pinkish Gamasfjell Fm quartzites - in a small cliff.

Bedding 032/13
Shear joint 090 dextral

5067. Scattered outcrops of Gamasfjell Fm. quartzite. Very pink.

Bedding 035/23

5068. At edge of trees. Gam,asfjell Fm. quartzites.

Bedding 031/25

5069. Gamasfjell Fm. white quartzite.

Bedding 041/19

5070. Gamasfjell Fm. Beds < 0.75m thick.

Bedding 063/13
Shear joint 110. Sinistral.

5071. Tillite - slightly ex situ.

5072. Tillite - well exposed by side of lake. Cannot see any bedding

Cleavage 180/44

5073. Immediately south of small grassy area of west side of lake. Superb outcrop of tillite - bedded & spaced cleavage (1-10cm) and a steeper, fine, penetrative cleavage.

Cleavage (spaced) & bedding 042/21
Cleavage (penetrative) 158/20
Slickenside on bedding 22-125

5074. Knoll between two lakes. Well exposed Gamasfjell Fm. quartzites.

Bedding 042/21

5075. Gamasfjell Fm. quartzites. Pink. Beds up to 1.5/2m thick.

Bedding 025/18

5076. Massive quartzites - Gamasfjell Fm. ~50m up hill.

Bedding 195/08

5077. Break in slope and then tillite

Cleavage (spaced) 193/60
Cleavage (penetrative) 196/40

5078. All tillite - strongly cleaved - no obvious bedding.

Cleavage 194/88

5079. White sandstone - much sheared & flaggy. ?Gamasfjell Fm. thrust over tillite?
Outcrop trends 003'

Cleavage in sandstone 184/46

5080. 100-75m NW of 5079. Low bluffs - tillite - 40cm granite cobbles. Overlies fine grained greeny grey silts & red sstn/shales. No clasts but still part of Smalfjord Fm.

Bedding 152/26
Cleavage 171/48

5081. Many large blocks of Nyborg Fm. here - none in situ.
At summit in tillite.

Cleavage 179/64

A few metres on and slightly downhill - white quartzites - Gamasfjell Fm?

Thrust plane in quartzites 023/39
Slickenside lin on thrust plane 26-079

5082. 15m down hill & structurally under last - tillite.

Cleavage 176/69

5083. Massive tillite

Cleavage (spaced) 179/07
Fractures 048/14
Slickensides on fractures 08-115

5084. Tillite.

Cleavage (spaced) 174/45
Cleavage (penetrative) 142/61

5085. Tillite.

Cleavage (spaced) 181/41
Slickenside 28-311

Slickenside fibre steps suggest extension down dip to WNW

Friday, 22 July, 1988

5086. Massive blue-grey glassy quartzite. In a quarry ? for a new houses foundations. Dakkovarre Fm.

Bedding 358/16

5087. Massive quartzite and thin black shales - some as foresets.

Bedding 352/83
Shear joint 071; down to south - ie if bedding rotated to horiz then sinistral

5088. Not more than 20-25m up hill. Ferruginous red sandstone typical of near the top of the Dakkovarre Fm. Bedding not developed.

5089. Massive pink/grey quartzite - Gamasfjell Fm. Beds up to 2m thick. Hard to be sure what actually IS bedding.

Bedding?? 004/81

Rocks here are brecciated locally along bedding planes, with haemetite infill. Probably related to large scale folding.

5090. Trees thinning out - becoming scrubbier. Gamasfjell Fm. quartzites.

Bedding 172/69
Slickenside lin on bedding 68-260

5091. Up to flat part of hill all Gamasfjell Fm.

Bedding 189/72
Slickenside lin on bedding 69-285

5092. From ~100m after 5091 to here all Gamasfjell dipping as here.

Bedding 183/66
Fracture cleavage 359/52

5093. Gamasfjell Fm. quartzites.

Bedding 011/33
Ripple axis 30-279

5094. Quartzite - seen from a distance.

5095. Hill top at S end.
White Gamasfjell Fm. quartzites. Bedding locally greenish.

Bedding 324/38
Slickenside 38-061

5096. All hill summit ridge is Gamasfjell Fm.

Bedding 203/45

5097. Gamasfjell Fm. quartzite.

Bedding 192/34

5098. Gamasfjell Fm. quartzite - white

Bedding 197/21

5099. In valley floor. Gamasfjell Fm. white quartzite.

Bedding 216/26

Beds up to 1.5m thick.

5100. Gamasfjell Fm. white quartzite. Very massive. Bedding uncertain.

Bedding 201/26

Ridge to west is all quartzite.

5101. Gamasfjell Fm. quartzites - bedding uncertain.

Bedding?? 206/40

5102. Massive pink/grey quartzite - Gamasfjell Fm.

Bedding 219/60

Foresets indicate right way up.

5103. Ferruginous red sandstones of upper part of Dakkovarre Fm.
Bedding uncertain.

Bedding 231/28

5104. Pink/grey quartzite - Gamasfjell Fm. Beds up to 1m thick.

Bedding 209/26
Ripple axis 10-340 - symmetric ripples

Each bed is a series of graded units from coarse sstn (grains <3mm) to fine sandstone. Some thin yellow sandstone lenses as well.

5105. Still Gamasfjell Fm. - pinkish sandstones. Beds up to 0.5m thick.

Bedding 194/48

5106. Rose quartz coloured Gamasfjell Fm. quartzites.

Bedding 211/40

5107. Top of hill. Raining to west. Pinkish Gamasfjell Fm. quartzites.

Bedding 185/82

5108. Tillite here - VERY strongly cleaved - papery shales.

Cleavage 008/86

5109. Gamasfjell Fm. Pink quartzites.

Bedding 210/27

If tillite extends southwards to here then it must pass to west of this lake - or it pinches out.

5110. To east of a 50-70m wide zone of heather - fertile area ?= tillite? Here still in Gamasfjell Fm. quartzites.

Bedding 036/37

5111. Hill 207m. Tillite lies on west slope of hill. Close to base of tillite ~ 2m exposure missing.

Below - Gamasfjell Fm. quartzites - beds up to 1m thick - not highly strained

Bedding 198/34

Above - tillite - very strongly cleaved

Cleavage 197/85

5112. Previous location was on a ridge ~100m east of cairn on hill top. 25m NNE of cairn is a narrow exposure of red/green shales. Very strongly cleaved. Thin green sandstone? bands in the sequence give compositional banding - thought to be the bedding. The sequence is only 10m thick and represents the Nyborg Fm.

Bedding 198/88
Cleavage 199/56

To west of Nyborg Fm. 5m of tillite, again highly strained, & then next location.

5113. At cairn (trig point). Gamasfjell Fm. quartzites - beds up to 0.5m thick & definately overlies tillite.

Bedding 187/64

5114. About to enter trees. Fine bedded greeny/grey sandstones and quartzites and some very thin black shales. Dakkovarre Fm.

Bedding 197/84

5115. Massive quartzites - 5m down in purple sandstones of upper part of Dakkovarre Fm.

Bedding 193/64

5116. Black shales & thin quartzites - Dakkovarre Fm.

Bedding 198/72

5117. Dakkovarre Fm.

Bedding 193/69

5118. Dakkovarre Fm.

Bedding 335/20

Graded bedding indicates right way up.

5119. Massive quartzites and thin black shales and yellow sandstones. Dakkovarre Fm.

Bedding 027/80
Cleavage (in mudstones) 204/82
Slickenside lin 80-117

Graded bedding youngs to east.

Saturday, 23 July, 1988

5120. Knoll to west of road. Nyborg Fm. overlain by massive grey quartzites of Gamasfjell Fm. Beds of quartzite up to 1m thick.

Bedding (qtzite) 161/60
Fracture cleavage (qtzite) 339/37

Minor thrust plane 165/65 ~ parallel to bedding

Nyborg Fm. is strongly cleaved - compositional bands <1cm thick with planar boundaries.

Bedding 207/50
Cleavage 203/31
Fracture cleavage 022/69 (in sandstones)
Chlorite slickenside 27-123

Between Gamasfjell & Nyborg Fms. are pockets of greeny grey shale/silt - very strongly cleaved. Locally contains relatively small clasts - tillite, probably lower (Smalfjord Fm.). Not exposed everywhere - ie in some places Gamasfjell Fm. lies directly on Nyborg Fm.

On N. side of knoll tillite better and thicker exposed.

Some evidence of extensional faulting here.

5121. Nyborg Fm. Sstn beds up to 15cm thick - low strain.

Bedding 191/26
Cleavage 182/44
Cleavage (fracture) 039/86
Slickinside lin on bedding 26-297

Graded bedding indicates right way up.

5122. Nyborg Fm. Relatively low strain.

Bedding 176/53
Cleavage 189/39

Graded bedding clearly indicates inverted.

5123. To east of road (5m) Nyborg Fm clearly right way up.

Bedding 191/34
Cleavage 193/41

5124. Nyborg Fm. Nyborg Fm. By sea at north end of grassy area with houses.

Bedding 157/90
Cleavage 176/51

Few metres away,
Bedding 188/33
Cleavage 183/44

Graded bedding clearly indicates right way up.

Minor extensional fault, ~30cm displacement
Fault plane 007/31 slickenside 16-129

Minor fold axis 04-194 Ze
Axial plane 189/40
Extensional fault cutting fold 212/75
Tensional gashes - also indicate down to west extension

5125. Nyborg Fm. all the way to here
Now at N end of small pebbly beach.

Fold axis 12-001
Axial plane 197/34

Extensional structures seen
Fault plane cutting fold 219/61
Slickenside on fault 55-336

Cleavage 215/31
Slickenside on cleavage 31-295

Extensional structures
Fault plane 018/51 slickenside qtz fibre 43-132
037/45 44-129

5126. Nyborg Fm. still.

Bedding 197/08
Cleavage 202/25

Extensional structures
Fault plane 031/32
Slickenside 27-137

5127. Near east side & top of cliff at northern end of Nyborg Fm. outcrop. Whole outcrop is cut by conjugate extensional faults - superb minor recumbent fold cut by these faults.

Intersection lin (fold axis) 17-015
Fault plane 069/13 slickenside lin 07-126
222/41

5128. Down at sea level - excellent outcrop of contact between Nyborg Fm. and underlying Smalfjord Fm. Dolomite is present at base of Nyborg Fm. No obvious unconformity here - suggests very low angle. Several sandstone lenses in tillite - bedding?

Bedding in tillite? 204/28
Cleavage in tillite 212/36

Many extensional structures in Nyborg Fm. - see later large data set of extensional faults.

5129. Close to base of Nyborg Fm. - no dolomite seen.

Bedding 215/22
Cleavage 166/39

5130. Top of steep part of hill.
Tillite - still strongly cleaved

Cleavage 204/41

5131. Tillite - Smalfjord Fm.

Cleavage 199/41

5132. Seen a few red sandstone blocks typical of base Smalfjord Fm. here according to Johnsons field slips - none in situ. Here is massive grey quartzite - some pinkish parts - Gamasfjell Fm.

Bedding 235/15

5133. Gamasfjell Fm. quartzites.

Bedding 220/13

5134. In obvious gully east of south end of lake. Smalfjord Fm. - several obvious lithological types - bedding?

Bedding 184/06
Cleavage 213/20

Superb strain shadows around clasts - preserved as darker brown areas. Long axis of clasts lie // to cleavage - ?rotated

Quartzite forms a ledge around the lake ~ 30m above water level

5135. At summit nearly. 4 metre x 2 metre boulder of dolomite within the Smalfjord Fm. - huge!!!
Most of the clasts here are of dolomite

Cleavage 156/52

5136. Summit of 252m Ibbargirko. Dolomitic tillite - Smalfjord Fm.

Cleavage 188/47

5137. Several very large blocks of Nyborg Fm. here. In situ is Smalfjord Fm. - not dolomitic.
~20m above trees here

Spaced cleavage 185/41

In nearby outcrop can see thin snadstone bands - ?bedding

Bedding 210/51
Cleavage 189/44
Fracture cleavage 025/31

5138. 4m above trees and round to north a bit at base of 'cliff'
All tillite except for a thin scab of the Nyborg Fm. ~1m thick stuck on in one small area.

Bedding in Nyborg Fm. 025/82
Cleavage in Nyborg Fm. 205/40

5139. In trees - down 10m or more.
Nyborg Fm.

Bedding ~ horizontal
Cleavage 219/47

5140. Nyborg Fm. Sandstone bed thin - < 1cm and planar, suggesting high strain

Bedding 192/88
Cleavage 209/49

5141. Came out of trees by small peat cuttings. Nyborg Fm.

Bedding 216/71
Cleavage - poorly developed

Graded bedding indicates right way up

Few metres on

Bedding 214/54
Cleavage 211/62

5142. Nyborg Fm. bedding very thin - high strain

Bedding // to cleavage
Cleavage 220/44

5143. At south end of lake. Just a bit of red (<1m) of Nyborg Fm. on east side of gully.
To east is Smalfjord Fm. tillite - not many clasts.

Cleavage 032/31

5144. Gamasfjell Fm. Tillite either very thin or faulted out.

Bedding 032/34

5145. Gamasfjell Fm. to here. No sigh of Dakkovarre Fm.

Bedding 204/26

5146. Down cliff a bit - yellow sandstones - very thin - part of Gamasfjell Fm.

Bedding 181/25

Sandstones < 2m thick and pass downwards into massive quartzites.

5147. At sea level. Dark grey sandstones/quartzite. Massive beds - up to 1m thick. Dakkovarre Fm.

Bedding 229/45

Merges downwards into massive purple sandstones
and then quartzites and darke shales with mudcracks.

5148. Dark sandstones & thin (<1mm) black shales. Dakkovarre Fm.

Bedding 216/26
Slickenside lin 29-324

5149. Dakkovarre Fm. Sandstones with abundant ferruginous spots up to 1.5mm diameter. Also dark grey sandstones with 1-2cm ?carbonate cemented sandstone nodules.

Bedding 227/18

5150. Finely interbedded black shales and thin sandstones. Dakkovarre Fm.

Bedding 217/29
Cleavage 213/44
Intersection lineation 06-223

5151. Up slope from beach now. All Dakkovarre Fm. Here on flat ground.
Massive white quartzites - ?Gamasfjell (but could be Dakkovarre Fm.)

Bedding 190/21

5152. Since 5151 mostly quartzites but some silts - ie still Dakkovarre Fm.?

5153. All up slope from 5152 has been massive quartzite - Gamasfjell Fm.

Bedding 207/27

5154. Pink quartzite of Gamasfjell Fm.

Bedding 211/36

5155. On east flank of hill 137. Massive quartzite - Gamasfjell Fm.

Minor thrust plane 219/48
Bedding (above thrust) 212/58

5156. Few metres up from last - in tillite of Smalfjord Fm. Contact is to east of summit ridge. Not many clasts.

Cleavage 185/70

5157. Just to west of bog. Nyborg Fm

Cleavage 212/28

5158. Nyborg Fm. Medium strain

Bedding 210/36
Cleavage 206/28
Fracture cleavage 001/32
Intersection lineation 14-182

5159. Tillite - many small clasts.

Cleavage 203/51

5160. Tillite with lots of carbonate clasts - blocks up to 1m diameter.

Cleavage (spaced) 227/45
Cleavage (penetrative?) 176/12

5161. All Stuoroaivi is dolomitic tillite.

Cleavage 117/22

5162. Strongly cleaved tillite.

Cleavage 229/21

5163. Dolomitic type tillite. Many clasts - difficult to get true cleavage orientation.

Cleavage? 211/40

On east side of major N-S trending gully.

5164. On west side of gully. Nyborg Fm.

Bedding 212/36
Cleavage 201/48

Sunday, 24th July, 1988

5165. Quite greeny coloured tillite - not many pebbles. Massive - low strain

Cleavage 185/44
Possible fault plane 209/64

5166. Tillite

Cleavage 171/42

5167. Tillite. Definately two cleavages

Cleavage (spaced) 223/34
Cleavage (penetrative) 207/28
Slickenside lin 21-255

5168. Tillite with a few large dolomite clasts

Cleavage 196/20

5169. Tillite - grey. Nearly up steep part of slope.

Cleavage 172/26

5170. To SE of lakes. Tillite -quite well foliated.

Cleavage 178/49

At cliffs to east - form a prominant ridge. Dakkovarre Fm. Mostly thin bedded quartzite and very thin shales.

Bedding 195/14

5171. Tillite. To N of river. Boulders <10cm. Not many boulders.

Cleavage 187/21

To ENE is Dakkovarre Fm.

Bedding 200/12

5172. Tillite - greeny coloured - only a few small clasts.

Cleavage 186/32
Slickenside lin 19-286

5173. Nyborg Fm. Interbedded dolomite & red shales. Low strain.

Bedding 204/13
Cleavage 203/21

Extensional structures
Fault plane 265/42
Quartz fibre 14-281

Nyborg Fm. is 15m thick here. Overlain by Dakkovarre Fm. with a gap in the expsoure of ~5m.
Dakkovarre Fm. is thin bedded quartzites (beds <3cm)- smooth bedding planes suggest high strain.

Fold axis 02-154 axial plane 169/46
13-159 331/67

24-337 324/69
19-161 166/90 slickenside 58-093

5174. Nyborg Fm. less dolomitic and less deformed.

Bedding 152/74
Cleavage 191/23

5175. Tillite

Cleavage 203/40

At same height as 5174

5176. Since previous have walked due east. All exposure has been of tillite - Smalfjord Fm.

Cleavage 182/28

5177. Tillite to here.

Cleavage 187/26

5178. Tillite

Cleavage 208/13

5179. In gully at N end of lake. Nyborg Fm. - not dolomitic

Bedding 203/21
Cleavage 217/33

Green sandstones - thin and planar - ? high strain.

Slickenside lineation 21-294

5180. On east side of gully - tillite - not many clasts

Cleavage 194/26

5181. Nyborg Fm. To east can see tillite - contact not exposed. Strain relatively high here.

Bedding 209/24
Cleavage 192/43

5182. Nyborg Fm. ca 20m above inferred base of this Fm.

Bedding 210/61
Cleavage 187/49

5183. Above Nyborg Fm., at top of steep slope is tillite, including 1-1.5m of dolomitic tillite.

Cleavage in tillite 194/50

Cleavage in tillite very good - papery - high strain.

Overlain by quartzites - Gamasfjell Fm.?? or Dakkovarre Fm.

Bedding in quartzite 212/44

5184. Whole hill top is Dakkovarre Fm.

Bedding 159/63

30m south of summit in tillite

Cleavage 178/37

Folds in base of Dakkovarre Fm.

Fold axis 02-345	axial plane 153/60
01-343	155/60
04-331	173/45
Slickenside lin 14-066	

No Nyborg Fm. seen immediately below Dakkovarre Fm.

5185. Half way up cliff of Dakkovarre Fm.

Bedding 201/48

Underlain at ~one third of the way up by tillite

Cleavage 202/25

Underlain at base of slope by Nyborg Fm. Strongly cleaved - no fine sedimentary details preseved.

Bedding 183/16
Cleavage 176/25

Further to east is tillite again. In tillite over Nyborg Fm. dolomitic tillite observed.

5186. Tillite.

Cleavage 169/40

To north is Nyborg Fm. Cannot see any obvious Nyborg Fm. outcrops to north of here.

Bedding 198/63
Cleavage 198/63

High strain

5187. Tillite - band of dolomitic tillite.

Cleavage 174/32

5188. Dakkovarre Fm. forms top of hill - but basal quarter of steep scree slope is in tillite.

Cleavage (tillite) 175/51
Bedding (Dakkovarre Fm.) 235/30

5189. Dakkovarre Fm.

Bedding 167/46

5190. Down slope to west of the two small lakes. Layer of very fine grained greeny coloured rock - up to 8m thick. Could be deformed tillite or Dakkovarre Fm.

Cleavage 181/51

5191. Tillite - suspect last outcrop was highly sheared (cataclased) tillite.

Cleavage 188/23

5192. Above large unmarked lake. Dakkovarre Fm.

Bedding 176/43
Cleavage 204/62

5193. Tillite

Cleavage 197/42

5194. Tillite - almost 100% certain that it fills the valley bottom - ie the Dakkovarre to the north is another klippe.

Cleavage 193/34

Monday, 25th July, 1988

Back at Nyborg Fm. between locations 5124 and 5128. Walked south from 5128, recording extensional fault data. First set collected by B-I Thomasjord, second by T O Andreasson.

Fault plane	220/45	Slickenside 32-304
	218/22	26-306
	054/30	32-151
	052/27	27-132
	041/33	34-135
	034/17	17-126
	042/49	45-137
	220/53	53-282
	050/31	32-131
	237/37	42-302
	017/27	20-123
	234/40	37-310
	047/29	57-140
	212/47	57-140
	036/33	34-149
	225/50	48-320
	320/59	55-328
	054/20	22-149
	181/41	09-335
Fault Plane	210/38	Slickenside 38-305
	214/26	34-222
	224/27	24-300

045/37	27-139
045/11	11-131
217/41	41-305
070/19	15-133
229/34	36-305
034/45	34-136
227/63	45-286
041/31	27-129
229/45	37-310
014/61	55-105
205/38	35-336
053/26	30-129
211/15	13-306
061/33	33-146
216/65	61-305
035/29	36-141
054/27	23-142
215/26	51-313
210/70	32-335
049/35	32-141

Intersection lin (Fold axis) 00-016 axial plane 202/30
00-357 191/17

Fold axis 21-355 axial plane 256/29

Tuesday, 26th July, 1988

5195. Grey quartzitic sandstone - beds up to 1m thick. Dakkovarre Fm.

Bedding 211/37

5196. Thick bedded quartzites - up to 0.75m thick beds. Grey in some areas. Probably Dakkovarre Fm.

Bedding 192/17

5197. Orangy weathering rock - no clasts but looks like tillite.

Bedding 287/10
Cleavage 197/49

First outcrop uphill (6m up) clasts seen - tillite.

5198. Top of Abmir. Grey tillite - Smmalfjord Fm.

Cleavage 177/73

5199. Since previous llocation all tillite - quartzite clasts

Cleavage 195/57

5200. Thick bedded quartzitic sandstone -Gamasfjell Fm.
Beds up to 1m thick.

Bedding 156/04

5201. Massive quartzites/sandstones. Faintly pink. Beds up to 1.5m thick Gamasfjell Fm.

Bedding 140/07

5202. Gamasfjell Fm. - approx same bed as last location.

Bedding 130/19
Foreset 172/28

5203. Tillite - grey , not many clasts.

Cleavage (spaced) 240/73
Cleavage (penetrative) 181/31

5204. Tillite - poorly cleaved

Cleavage 176/49

5205. Tillite - some dolomite clasts

Cleavage 133/06

5206. Tillite - not 100% sure this is in situ

Cleavage 169/64

5207. Nyborg Fm. - with dolomite beds up to 10cm thick - folded

Fold axis 02-153
Cleavage 190/21

5208. Nyborg Fm. with dolomite

Cleavage 123/06
Extensional fault 145/22
Intersection lin 196/02

5209. Nyborg Fm. No dolomite beds, but rock feels hard like dolomite - probably marl. No obvious bedding - high strain??

Cleavage 160/08

5210. Nyborg Fm. No dolomite. Thin bedded sandstones.

Cleavage 175/29
Extensional fault 145/15

5211. Nyborg Fm. With creamy coloured dolomite.

Bedding 183/82
Extensional fault 125/12

5212. Tillite - dolomitic clasts and matrix. Clasts very large. Forms a 5m thick band, over and underlain by ordinary tillite.

Cleavage 161/34
Bedding?? 118/09

5213. Tillite. No dolomite

Cleavage 185/21
Bedding 138/09

5214. Nyborg Fm. Lowest part exposed is not dolomitic but a few metres up there is dolomite - band <10cm thick.

Bedding 133/16

5215. Cliff of Dakkovarre Fm. No sign of tillite between Dakkovarre and Nyborg Fms. but exposure not 100%.

Bedding 146/27
Minor thrust plane 169/28

5216. Top of hill. Dakkovarre Fm.

Bedding 127/33

5217. Dakkovarre Fm. - Not much pelitic stuff here.

Bedding 164/12

5218. At west edge of Dakkovarre Fm. exposure.

Bedding 001/36

5219. First outcrop of tillite since moving west from last location.

Cleavage 189/41

5220. Tillite. Cleavage quite well developed.

Cleavage 163/38

5221. Red, dolomitic Nyborg Fm. - shows up on air photo as white spot. Underlain and overlain all around by tillite.

Bedding 159/57
Cleavage 161/30
Extensional fault 161/39

5222. To north Nyborg exposed for less than 100m. Along strike is tillite.

Cleavage 170/26

5223. Corner of lake - contact of Dakkovarre Fm. and tillite. Dakkovarre Fm. is quite pelitic.

Bedding 201/21

5224. On an E to W section; 2m of red, dolomitic Nyborg Fm. overlain by 4-5m of tillite, becoming more cleaved upwards, overlain by 1m of dolomitic Nyborg Fm. overlain by papery green shales - equivalent to the thrust at the base of the Dakkovarre Fm.

Cleavage 171/32

5225. Tillite - Smalfjord Fm. Not exceptionally cleaved.

Cleavage 112/36

5226. Dakkovarre Fm. Finely bedded silt and sandstones.

Bedding 355/23

5227. Between 5226 and here passed over red dolomitic Nyborg Fm. in the scree - NOT seen in situ. Here typical Smalfjord Fm.

Cleavage 156/23

5228. Gone downhill to west a bit. Tillite here with a good cleavage.

Cleavage 153/28

5229. At cliffs of Dakkovarre Fm. - no folding on small-scale although within 2m of the contact.

Bedding 057/09

5230. Massive pale grey quartzite - may be the Gamasfjell of Dakkovarre Fms. - pinkish in places.

Bedding 183/13

5231. This outcrop probably overlies last one. Here in Dakkovarre Fm.

Bedding 221/39

5232. Dakkovarre Fm. Just above scree slope. Massive quartzites and finer banded lithologies.

Fold axis 06-340
Bedding (massive) 209/08

5233. Since previous outcrop no exposure - none here - all boggy.

5234. Dakkovarre Fm. - quartzite in beds up to 15cm thick.

Bedding 309/67

5235. Dakkovarre Fm. - sandstones - this is lowest outcrop on hillside.

Bedding 119/26

5236. Dakkovarre Fm. bedding hard to determine in massive quartzite.

Bedding? 161/17

5237. Massive quartzites again - Dakkovarre Fm.

Bedding 063/17

5238. Dakkovarre Fm. - shale/siltstone.

Bedding 142/34

5239. Tillite - well cleaved, but clasts still clearly visible and up to 30cm diameter. Approximately 5m. below Dakkovarre.

5240. Dakkovarre Fm. - quartzite and thin sandstones.

Bedding 119/31

5241. Tillite - large clasts up to 30cm diameter.

Cleavage 166/38

5242. Tillite

Cleavage 028/32

5243. Dakkovarre Fm. - thin bedded sandstones etc.

Fold axis 14-141

5244. North side of same lake as loc 5243. Dakkovarre Fm. - thin shales again. Immediately to west is tillite.

Fold axis 04-145
Axial plane 163/44

5245. Dakkovarre Fm. - amssive quartzites - white weathering.
Bedding uncertain

5246. All scree by lake and since river has been of tillite. Here on a small knoll of Dakkovarre Fm. Poor outcrop.

5247. East side of lake. Tillite - definately in situ.

Cleavage 211/14

No sign of the Nyborg Fm. here.

5248. Here in Nyborg Fm. Good graded bedding indicates low strain.

Bedding 197/27
Cleavage 222/27
Intersection lin 01-179

5249. At east end of lake. Dolomitic Nyborg Fm.

Bedding 180/13
Extensional fault plane 205/33

Wednesday, 27 July, 1988

5250. Dakkovarre Fm.

Minor thrust plane 195/23
Groove lineation 13-005

Minor thrust plane 168/23

Minor thrust plane 228/18
Slickenside lin 57-251

Minor thrust plane 191/38
Slickenside lin 29-267

5251. Tillite - dolomitic type with 0.75m diameter clasts.

Cleavage 166/58

5252. Dolomitic type Smalfjord Fm. tillite - imbricated??

Extensional fault	215/56	slickenside	56-307
	217/63		60-317
	209/45		43-312
	177/61		45-329
	230/61		50-330
	214/57		54-309
	112/26		07-126
	041/29		19-118

5253. Dolomitic type tillite.

Cleavage 223/40

5254. Tillite - band with a red matrix - has clasts in it.

Cleavage 219/36
Slickenside lin 35-286

5255. Dolomitic type tillite.

Cleavage (spaced) 209/50
Cleavage (penetrative) 195/73

5256. Dolomitic type tillite - Smalfjord Fm.

Bedding 195/33
Cleavage 194/59
Minor thrust plane 190/51

At east margin of exposure is massive pink quartzites - Gamasfjell Fm.

Bedding 190/27

Some green sandstones n the Gamasfjell Fm.

5257. Pink/purple Gamasfjell Fm. quartzite with green sandstones in bands up to 10cm thick.

Bedding 171/24

5258. Pink/red quartzites of the Gamasfjell Formation.

Bedding 211/22

5259. Nyborg Fm. Good spaced cleavage - green, upper part of the Nyborg Fm. - Member C of Edwards?

Bedding 033/86
Cleavage 187/46

5260. Near corner of road. Contact of Mortensnes Fm. and Nyborg Fm.

Bedding 216/26
Cleavage 264/33

5261. Tillite.

Cleavage 189/83

5262. South side of road - upper part of Nyborg Fm. - thick green sandstones and thinner shales.

Bedding 174/23
Cleavage 171/32
Intersection lin 08-188

North side of road - Mortensnes Fm. tillite

Cleavage 187/69

Fault on road line

5263. Very finely interbedded siltsones and sandstones - Lillevatn Mbr

Bedding 196/41
Cleavage 214/56
Intersection lin 13-207
Fold axis 19-017
Axial plane 186/67

5264. South side of road. Tillite

Cleavage (spaced) 190/63
Cleavage (penetrative) 191/70

Few metres down road, boundary with Nyborg Fm.

Bedding 023/70
Cleavage 017/82

Slickenside lin on contact 58-126.

Graded bedding indicates right way up.

Underlain by more tillite - possibly the Nyborg Fm. described is actually a red band within the tillite

Intersection lin 21-189

5265. Nyborg Fm. - Member C.

Bedding //cleavage
Cleavage 188/74
Intersection lin 42-203

Overturned according to graded bedding

Slickenside lin 74-301
Fracture cleavage 317/33

5266. Nyborg Fm. Member B of Edwards. Relatively low strain

Bedding 179/30
Cleavage 185/42
Intersection lin 01-186

5267. Pink sandstone - massive with some red shales.

Bedding 120/36
Cleavage 153/43

5268. Purple and green pelitic Nyborg Fm. with massive pink sandstones up to 1m thick.

Bedding 186/41
Cleavage 181/57
Slickenside 40-285

Graded bedding indicates right way up.

5269. Nyborg Fm. Green and red sandstn and shale.

Bedding 177/31
Cleavage 185/54
Fracture cleavage 013/07

Graded bedding indicates right way up.

Fold axis 05-013
Axial plane 181/57
Slickenside lin 34-302

Fold is tight, moderately inclined.

5270. Nyborg Fm.

Bedding 200/79
Cleavage 183/69

5271. Gully - cant get down into it directly. However, can see whole section of superb folds - amplitude 10-30m, tight, moderately inclined. All in Nyborg Fm. Member B.

5272. Nyborg Fm. Member B.

Bedding 194/32
Cleavage 179/15

Graded bedding indicates right way up

5273. Nyborg Fm. - pink sandstones and red shales.

Bedding 184/62
Cleavage 179/53

5274. Nyborg Fm. red and green siltsones.

Bedding 193/54
Cleavage 182/44

Graded bedding indicates inverted.

5275. Nyborg Fm. as above.

Bedding 178/13
Cleavage 183/25

5276. Nyborg Fm. as above - fine red sandstones

Bedding 193/69
Cleavage 187/40

5277. Nyborg Fm. Red silts/shales and greeny fine silt/sands and pale grey sandstone beds. Graded bedding indicates most of rock is right way up

Fold axis 02-190
Axial plane 207/45

5278. Nyborg Fm. Low strain in red shales and pink sandstones

Bedding 183/77
Cleavage 181/46
Intersection lin 03-185

5279. Nyborg Fm. Red shale and green sandstone

Bedding 341/09
Cleavage 191/40
Intersection lin 14-357

5280. Nyborg Fm. - superb fold on south side of gully. Verges east.

Fold axis 08-209
Axial plane 215/42
Slickenside 52-143

Fold is tight, moderately inclined.

5281. Nyborg Fm. - red shale and sandstone

Bedding 186/19
Cleavage 185/30
Intersection lin 00-193

5282. Nyborg Fm. - massive white (white weathering??) sandstone and red silts/shales.

Bedding 191/64
Cleavage 177/53

5283. Red and green Nyborg Fm.

Bedding 175/10
Cleavage 189/25
Kink band 06-202

5284. For last 50m or so mostly massive pink sandstones.

Bedding 229/09
Fracture cleavage 080/26

Fractures are quartz filled

5285. Mostly Nyborg Fm. - pale pink sandstones.

Bedding 201/37
Fracture Cleavage 061/56
Quartz fibre lin 22-316

5286. Across river - Nyborg Fm. much more pelitic

Bedding 125/05
Cleavage 185/30
Intersection lin 04-203

5287. Nyborg Fm. - mostly red silt and shales.

Bedding 019/41
Slickenside lin 38-117

20m up slope - greny grey finely laminated siltstones and shales - Member C of Nyborg Fm.

Bedding 091/07
Cleavage 027/35

5288. Nyborg Fm? Well bedded green silt and sandstone with some white sandstones. Beds up to 20cm thick.

Bedding 178/11
Cleavage 181/27
Intersection lin 04-203

5289. Bluffs forming cliffs at top of hill - tillite - Mortensnes Fm.

Cleaveg 203/44

5290. Tillite - can see many discrete bands of dolomitic tillite in the surrounding hillsides.

Cleavage 179/71

5291. Tillite - well cleaved

Cleavage 189/64

5292. Top of Mortensnes Fm. - finely bedded sandstones/mudstones with a green hue.

Bedding 166/15
Cleavage 196/50
Intersection lin 10-195

Thursday, 28th July, 1988

5293. Mortensnes Fm. JUST possible (but unlikely) that there is a thin band of Nyborg Fm. between here and the sea.

Cleavage 169/62

Cleavage not well developed in some places

5294. Lillevatn Mbr of Stappogiedde Fm.

Bedding 177/57
Fracture cleavage 153/82

Graded bedding shows right way up.

Few metres north in shales of upper part of Mortensnes Fm.

5295. 8m up. Finely interbedded black shales and quartzitic sandstones.

Bedding 193/22
Cleavage 179/40

5296. Red shales - very soft - base of Innerelv Mbr of Mortensnes Fm. Bedding uncertain - cannot see lithological variations well.

Bedding? 021/37
Cleavage 171/25

5297. More red silts etc

Bedding? 359/03
Cleavage 167/49
Intersection lin 02-180

5297. Since previous outcrop walked across bog and then up relatively steep slope. Still in trees. Here green/purple Innerelv Mbr.

Bedding shallower than cleavage by ca. 30'
Cleavage 159/40
Intersection lin 07-183

5298. Innerelv Mbr.

Bedding 022/29
Cleavage 181/42
Intersection lin 04-192

5299. Innerelv Mbr.

Bedding 191/86
Cleavage 153/17
Intersection lin 09-197

5300. Innerelv Mbr. - all greeny blue coloured.

Cleavage 182/47

5301. Since previous all grey/blue Innerelv Mbr.

Bedding 013/20
Cleavage 181/55
Intersection lin 00-181

Interbedded purple and green shales up to 3cm thick

5302. Purple, green and grey shales of Innerelv Mbr.

Bedding 182/70
Cleavage 183/65
Intersection lin 12 -351

5303. White weathering sandstone/grit - Lillevatn Mbr.

Bedding 183/89
Cleavage 175/32

5304. Mortensnes Fm. - finely interbanded shales.

Bedding 181/84

5305. Tillite - proper here, with clasts.

Cleavage 177/51

5306. Massive pink sandstone of Nyborg Fm. - Member B. No Member C here?

Bedding 190/58

5307. No outcrop - many Nyborg Fm. blocks about.

5308. No exposure along lake side. Here red shales and green sandstones of Nyborg Fm.

Bedding 218/29
Cleavage 193/37
Slickenside 21-289

5309. On little island in river at lake outlet. Nyborg Fm. - red and green shales and sandstones. Superb folds.

Fold axis 28-349
Axial plane 180/49

Fold axis 22-347
Axial plane 193/48

5310. In gully - superb folds in Member B of Nyborg Fm.

Minor thrust plane 188/50
Fold axis 08-341
Axial plane very variable
Bedding above thrust 198/38
Cleavage above thrust 197/47

5311. Nyborg Fm. Good cleavage - red shales etc.

Bedding 184/38
Cleavage 178/46
Intersection lin 01-003

5312. Member C of Nyborg Fm. - green sandstones/shales

Bedding parallel cleavage
Cleavage 187/82

Pelitic parts weathered/strained to a paper shale.

5313. Still in upper part of Nyborg Fm. More psammitic here.

Bedding 331/20
Cleavage 172/54

Few metres up

Bedding 189/64
Cleavage 193/45

5314. All the main cliff is Mortensnes Fm. - tillite.

Cleavage 174/69

5315. Tillite - just below a band of dolomitic tillite.

Bedding? horizontal
Cleavage 181/65
Intersection lin 03/353

5316. Lower boundary of dolomitic tillite

Cleavage 175/49

5317. 5m down east side - sandstones silts of the upper part of the Mortensnes Fm. and junction with Lillevatn Mbr. Boundary slightly overturned.

Bedding 185/52
Cleavage 205/09
Intersection lin 02-188
Fracture cleavage 357/36

Sandstones <5m thick.

5318. Quartzites again - Lillevatn Mbr.

Bedding 179/49
Mullion 15-209

5319. Innerelv Mbr. - mostly red shales - cant see any defimate bedding.

Cleavage 187/48

5320. Still red shales of base of Innerelv Mbr.

Bedding 180/26
Cleavage 185/59
Intersection lin 00-186

5321. Same as above - basal Innerelv Mbr.

Bedding 045/17
Cleavage 189/57

5322. Green Innerelv Mbr. - forms cliffs to west of lake

Bedding 190/15
Cleavage 191/47
Intersection lin 03-357

5323. Lillevatn Mbr.

Bedding 203/24

5324. Upper part of Mortensnes Fm. No clasts - pelitic

Cleavage 184/49

5325. Boundary of lower quartzites and upper finely interbedded sandstones and black shales of Lillevatn Mbr.
Upright open folds.

Fold axes 02-187
01-000
07-000
11-355

6-7m up grassy slope - in sandstones again

Bedding 189/13

5326. Very pelitic green shales of Innerelv Mbr. - near base??

Bedding 181/17
Cleavage 179/59

5327. Very soft and pelitic grey mudstone - basal Innerelv Mbr.

Bedding - not visible
Cleavage 196/28
Intersection lin 04-193

5328. Innerelv Mbr. Red and green soft shales.

Bedding 061/10
Cleavage 180/41
Intersection lin 06-192

5329. Since previous outcrop, mostly green Innerelv Mbr.

Bedding 109/17
Cleavage 181/29
Intersection lin 03-191

5330. Red pelitic Innerelv Mbr. Very poor exposure.

Bedding 158/52

5331. Silts and pelite of Lillevatn Mbr. - upper part?

Bedding 175/50
Cleavage 169/45

5332. Massive quartzites of base of Lillevatn Mbr.

Bedding 287/04

Beds up to 1.5m thick.

5333. Tillite

Cleavage 191/53

5334. Nyborg Fm.? - fine banded green sandstones and shale.

Bedding // cleavage
Cleavage 178/24

5335. Tillite

Cleavage 183/70

5336. Tillite. Clasts small - some carbonate clasts.

Cleavage 130/28

Saturday, 30th July, 1988

5337. Just passed through gate in SE corner of farm field. All to left is massive quartzite - Gamasfjell Fm.

Bedding 331/20

This aint on Foyn's map at all.?

5338. Small gorge. Massive gery quartzite - beds up to 1.5m thick. Some 10cm thick sandstones/shale.

Bedding 331/26
Cleavage 237/17
Intersection lin 05-339

5339. Very fine clasts - almost looks brecciated.

Cleavage 168/52

5340. In a pothole in the path - Nyborg Fm. this fits in with the good vegetation in this area.

Bedding 075/68?? hard to be sure

All red silts and shales.

5341. In SSE trending straight gully - still in Nyborg Fm.

Bedding 194/56

5342. Nearly at top of hill. Gully dying out. 10m east of path tillite

Cleavage 053/37

West side of gully - Nyborg Fm. - Member B.

Bedding 188/23
Cleavage 204/36
Fold axis 07-184 kink style

5343. Tillite - at end of gully

Cleavage 149/39

5344. Tillite

Cleavage 161/30

5345. Tillite

Cleavage 159/24
Slickensides 10-136

5346. Tillite - good cleavage

Cleavage 161/32

5347. Tillite - scattered outcrops of tillite since previous

Cleavage 168/37

5348. Dakkovarre Fm. - massive quartzite - first outcrop seen down hill.

Bedding 167/31

5349. Dakkovarre Fm. - quartzites in beds up to 1m thick

Bedding 122/18

5350. Dakkovarre Fm. - thinner bedded quartzites - some shales probably but weathered out

Bedding 177/28

5351. Dakkovarre Fm. - quartzite in beds up to 0.5m thick with thin sandstones and shales.

Bedding 356/71

Bedding has dipped east since small lakes.

5352. Dakkovarre Fm. - quartzite

Bedding 189/65?

5353. Dakkovarre Fm. - quartzite in 0.5m thick beds

Bedding 163/70

5354. No outcrop since previous location. Here massive pink sandstones and thin red shales - Nyborg Fm. No tillite SEEN between Nyborg and Gamasfjell Fms.

Bedding 142/05
Cleavage 153/60

5355. Nyborg Fm. still.

Bedding 171/48
Cleavage 143/20
Intersection lin 20-205
Slickenside lin 13-279

5356. Nyborg Fm. Massive pink sandstones and fine red shales

Bedding 178/67
Cleavage 179/58

5357. Can see folds as valleys and ridges in Nyborg Fm. to south. Here massive pink sandstones of Nyborg Fm.

Bedding 175/51

5358. Massive sandstones - probably same bed as loc 5357.

Bedding 163/49
Quartz fibre lineation 33-299

5359. 20 metres east of prominent cliff - see air photographs. Nyborg Fm.

Bedding 175/83
Cleavage 166/45

Graded bedding suggests inverted

5360. Ridge mentioned in 5359 was of Nyborg Fm. Here in tillite - well cleaved - dolomitic type.

Cleavage 151/53

5361. Massive - beds up to 2m thicks - quartzites of Dakkovarre Fm. Mostly grey - slightly pink in places.

Bedding 332/26

5362. Tillite

Cleavage 176/48

5363. Massive white quartzite - Dakkovarre Fm. Tillite outcrops to southeast.

Bedding 358/12

Beds up to 1.5m thick.

5364. Dakkovarre Fm. quartzites.

Bedding 219/08

5365. In gully to west of 5364. Cliffs to west of lake to south are of Dakkovarre Fm. but just to west of here is cliff of tillite.

5366. Tillite.

Cleavage 160/48

5367. Walked up to natural amphitheatre on hill top. No tillite up here - all Dakkovarre Fm. - quartzites and shales.

Bedding 251/26

5368. Tillite

Cleavage 200/15

5369. Massive quartzites of Dakkovarre Fm. Boundary with tillite lies in the lake.

Bedding 222/21

5370. Dakkovarre Fm. Massive white quartzites - some iron rust spots.

Bedding 175/17

5371. Dakkovarre Fm. - massive sandstones and thinner siltstones.

Bedding 021/20

5372. Massive grey quartzites - weather white - Dakkovarre Fm.

Bedding 191/32

5373. Dolomitic type tillite - very well foliated. No large clasts ?high strain

Cleavage 161/67

5374. Tillite.

Cleavage 155/45

5375. Dakkovarre Fm. quartzites. To east of gully ca 10m toeast is tillite.

Bedding 171/51

Poor graded bedding suggests rock are right way up.

Cleavage (tillite) 143/40

5376. In gully - tillite to east, Dakkovarre Fm. to west.

Bedding (Dak) 115/24

5377. Dakkovarre Fm. Massive grey quartzites

Bedding 131/29

Large ripple 30cm wavelength; axis 04-175

5378. Massive quartzite - Dakkovarre Fm.

Bedding 335/18

5379. Dakkovarre Fm. - quartzites and sandstones

Bedding 017/77

5380. This hill slope is roughly bedding parallel. Here in quartzites of Dakkovarre Fm.

Bedding 176/18
Small ripple 05-189

5381. Dakkovarre Fm.

Bedding 183/24

5382. Dakkovarre Fm. - in stream. Grey quartzite and thin sandstone and siltsones.

Bedding 177/46

5383. Tillite. No tillite scree seen until hill top.

Cleavage 151/54

5384. Tillite

Cleavage 147/59

Sunday, 31 July, 1988

5385. Fine grained tilite - no clasts at all.

Cleavage 184/52

5386. Tillite with small clasts . Quite a range of lithologies seen in tillite here.

Cleavage 204/72

5387. Tillite

Cleavage 197/61

5388. Tillite. No sign of Nyborg Fm.

Cleavage 009/83

5389. Tillite - some carbonate clasts up to 20cm diameter

Cleavage 198/59

5390. Just out of trees. Tillite.

Cleavage 219/69

5391. Lower part of slope is dolomitic tillite.

Cleavage 182/11

5392. Tillite

Cleavage 178/21

5393. No outcrop on hill top. No sign of any Nyborg Fm. scree.

5394. Tillite

Cleavage 200/39

5395. Tillite -dolomitic type

Cleavage 223/10

5396. Since previousall outcrop is dolomitic tillite.

Cleavage 168/37

5397. Dolomitic type tillite

Cleavage 213/41

5398. Tillite - not dolomitic

Cleavage 204/25

5399. Tillite - with pinkish sandstones (NOT Nyborg Fm.)

Cleavage 229/18

5400. Tillite - ordinary type but with lots of dolomite clasts up to 0.5m diameter.

Cleavage 197/24

5401. Golden dolomitic tillite

Cleavage 164/31

5402. Dolomitic tillite

Cleavage 112/23
Quartz fibre lineation 00-122

5403. Ordinary tillite

Cleavage 186/40

5404. Dolomitic tillite

Cleavage 184/22

5405. Dolomitic tillite - clasts up to 0.5m diameter.

Cleavage 178/51

5406. Just before power lines - in trees. Nyborg Fm.

Bedding horizontal
Cleavage 199/49

Monday, 1 August, 1988

5407. Massive grey quartzite - not pinkish - Gamasfjell Fm

Bedding 107/07

Beds up to 2m thick

5408. Quartzite scree all the way up the hill. Here tillite.

Cleavage 180/32

Only a few clasts

5409. Purple and green shales - looks vaguely like the Nyborg Fm. but has 2cm clasts. Few metres up hill definately in Nyborg Fm.

Bedding 180/25
Cleavage 189/35

Nyborg Fm. highly strained - verythin compositional bands, no fine sedimentary detail.

5410. Close to top of knoll. Tillite - strongly cleaved - small clasts

Cleavage 195/48

Nyborg Fm. probably less than 10m thick.

5411. Doubtfull in situ. Tillite - not very strained

Cleavage 140/38

5412. Tillite - seen many blocks of golden tillite but in situ is pale green tillite - finely cleaved - high strain.

Cleavage 193/26

5413. Since previous location tillite has appeared fairly typical

Cleavege 208/35

Tillite here more strongly cleaved than just before - near a thrust?

5414. Massive pale quartzite - Gamasfjell Fm.

Bedding 177/37
Fold axis 00-183
Axial plane 185/60

5415. At south end of Gamasfjell Fm. outcrop. Purple-pink quartzite. No sedimentary structures seen.

Bedding 176/43
Minor thrust plane 178/40
Shear joints 281 dextral
261 dextral

5416. Tillite to east of Gamasfjell Fm. is very finely laminated with small clasts - very high strain

Cleavage 206/57

Some 3cm diameter clasts

5417. Gamasfjell Fm. quartzites - massive and pink.

Bedding 199/22

Suspect that this slope is parallel to the Gamasfjell bedding.

5418. Massive pink quartzite - Gamasfjell Fm.

Bedding 221/34

Knoll to north is dolomitic type tillite. Clasts up to 20cm diameter. Well cleaved but clasts are not veined - low strain. Presume this lies unconformably on the Gamasfjell Fm.

Cleavage 159/40

5419. On east side of gully - massive quartzites of Gamnasfjell Fm. Very fractured.

Bedding (uncertain) 239/17

5420. So far all this hill is quartzite - pink/purple

Bedding 321/65

Thus tillite is in a syynform

5421. On northeast end of ridge. Pinky Gamasfjell Fm. quartzites.

Bedding 315/64

5422. Gamasfjell Fm. - quartzites.

Bedding 176/54

5423. Dakkovarre Fm. - interbedded black shales and quartzites

Bedding 175/46
Cleavage 179/25
Extension cleavage 173/63
Intersection lineation 11-335

5424. Since previous location poor outcrop. All grey quartzite probably of Dakkovarre Fm.

Bedding 185/22

5425. Black shales and fine sandstones. Well laminated

Bedding 238/32
Intersection lin 22-349

5426. Dakkovarre Fm. - shales

Bedding 000/77
Cleavage 185/22

5427. Cairn at hill top. Black and dark grey sandstones and shales. Dakkovarre Fm.

Bedding 279/20
Intersection lin 15-347

5428. Massive grey quartzite - Dakkovarre Fm.

Bedding 304/11
Ripple axis 01-292

5429. Dakkovarre Fm. quartzite.

Bedding 177/36

5430. Dakkovarre Fm. sandstones. Just crossed a small bog.

Bedding 233/18
Ripple axis 12-289

10m further on

Bedding 321/78

5431. Thin bedded sandstones and shales of Dakkovarre Fm. Folded as seen on Cakkalas near base of Dakkovarre Fm.

Fold axis 07-122
Axial plane 094/24

5432. West side of small bog. Contorted Dakkovarre Fm. - finely interbedded sandstones and dark shales.

Fold axis 07-341
Axial plane 199/35

5433. Dolomitic type tillite

Cleavage 225/21

No need here for Foyn's (1976) fault.

5434. Contorted Dakkovarre Fm. in finely interbedded lithologies.

Fold axis 02-308

On south side of this river are massive quartzites.

5435. Tillite

Cleavage 177/41

Couple of metres up hill contact between quartzites (below) and tillite
Contact is a 7cm thick fault gouge.

5436. Purple coloured tillite - with small clasts

Bedding 202/48
Cleavage 201/65

5437. Near Sjursjok. Nyborg Fm. - very little folding here.

Bedding 201/16
Cleavage 209/29
Intersection lin 03-206
Slickenside lin 18-313

5438. In quarry of Nyborg Fm. Massive sandstones with not much shales.

Bedding 192/10
Cleavage 186/27
Intersection lin 01-196
Fracture cleavage 089/75
Quartz fibre lin 03-327

5439. Nyborg Fm. green sandstones and shales of Member C.

Bedding 152/22

5440. Nyborg Fm. - on road section - under tillite.

Fold axis 03-185 axial plane 183/43
11-192 176/54
07-191
27-196
Minor thrust planes 183/54
191/58
Intersection lin 05-188

Tuesday, 2 August, 1988

5441. Purple sandstone typical of near the top of the Dakkovarre Fm.
some pyrite. Beds up to 3m thick.

Bedding 001/16

5442. Massive quartzites and shales - Dakkovarre Fm.

Bedding 217/24
Cleavage 199/40

5443. Massive quartzites and shales of Dakkovarre Fm.

Bedding 213/19

Quartzites have abundant rust spots.

5444. Tillite overlying a very thin sequence of the Nyborg Fm.
Contact exposed by ripping up vegetation.

Cleavage 198/40

Overlying tillite is highly strained - no or very few clasts.

Cleavage 172/34

Tillite below is less strained - clast bigger. Nyborg Fm. probably only 2m thick.

5445. Tillite - dolomitic

Cleavage 181/38

5446. Tillite - dolomitic - clasts up to 30cm diameter

Cleavage 148/29

5447. Quartzite - with rust spots - Dakkovarre Fm.

Bedding 178/21

No sign of the Gamasfjell Fm. between location 5446 and here.

This is the structural data collected by B.-I. Thomasjord. Further details of the lithologies observed at the localities can be obtained from the NGU archives.

DATA REFERS TO A 360' COMPASS
DIP DIRECTION IS 90' CLOCKWISE FROM THE STRIKE DIRECTION
MAGNETIC VARIATION NOT INCLUDED IN THIS DATA

T13			Cl	166/45	
T14			Cl	172/53	
T15	Bed	180/69	Cl	059/26	
T16	Bed	034/54			
T17	Bed	135/25	Cl	152/39	
T18	Bed	026/39	Cl	126/73	Inters lin 18-194
T19	Bed	165/55	Cl	171/66	Inters lin 19-346
			Cl	171/45	
T20	Bed	045/42	Cl	162/64	Inters lin 22-189
T21	Bed	162/28			
T22	Bed	187/15			
T23					
T24	Bed	189/21			
T25	Bed	166/30			
T26					
T27	Bed	166/27			
T28	Bed	173/51			
T29	Bed	205/90	Cl	207/44	Inters lin 02-204
T30			Cl	180/49	Inters lin 31-206
T31					Fold 12-189
T32	Bed	166/49	Cl	004/90	Inters lin 10-358
T33	(none)				
T34	Bed	009/75	Cl	185/43	Inters lin 06-195
T35	Bed	156/18			Inters lin 18-205
T36	Bed	282/10	Cl	192/20	Inters lin 15-202 Slicken 14-265
T37	Bed	216/46	Cl	224/33	Inters lin 20-023 Slicken 41-310
T38	Bed	182/40	Cl	194/54	Inters lin 221/26
T39			Cl	205/83	
T40	Bed	180/47			
T41	Bed	173/48			
T42	Bed	155/22	Cl	164/73	
T43	Bed	186/57			
T44	Bed	016/48			
T45	Bed	063/21	Cl	178/72	
T46	Bed	158/17			
T47	Bed	185/11	Cl	187/32	
T48			Cl	191/50	
T49	Bed	180/32			
T50	Bed	191/28			
T51	Bed	171/23			
T52	Bed	180/30	Cl	171/38	
T53	Bed	159/29			Fract Cl 104/18
T54	Bed	149/23			
T55	Bed	128/79	Cl	169/30	
T56	Bed	203/36			
T57	Bed	175/11			
T58	Bed	202/43			
T59	Bed	358/62			
T60	Bed	018/19	Cl	349/77	
T61	Bed	165/61			

T62	Bed	179/29			
T63	Bed	162/38	Cl	188/45	
T64	Bed	176/45	Cl	169/51	
T65	Bed	149/26	Cl	158/68	
T66	(none)				
T67	Bed	176/39	Cl	225/25	
T68			Cl	180/28	
T69	Bed	023/55	Cl	177/18	
T70	Bed	189/50	Cl	197/39	
T71			Cl	011/82	
T72	Bed	212/30			
T73	Bed	203/25			
T74	Bed	184/39			
T75	Bed	211/34			
T76			Cl	171/76	
T77	Bed	209/19	Cl	180/18	
T78	Bed	194/79			
T79	Bed	198/13			
T80	Bed	176/14			
T81	Bed	184/21			
T82	Bed	187/22			
T83	Bed	184/14	Cl	188/34	
T84	Bed	187/12	Cl	162/52	
T85	Bed	182/50	Cl	170/47	
T86			Cl	170/42	
T87	Bed	357/19	Cl	347/71	Fract Cl 050/55
T88	Bed	157/29	Cl	184/42	
T89	Bed	346/31			
T90	Bed	184/17			
T91	Bed	198/32			
T92	Bed	189/31			
T93	(none)				
T94	Bed	184/26			
T95	Bed	162/12			
T96	Bed	167/06			
T97	Bed	162/16			
T98	Bed	167/26			Thrust plane 244/73
T99	Bed	095/60			
T100	Bed	141/26			
T101	Bed	015/63			
T102	Bed	056/57			
T103	Bed	181/90			
T104			Cl	194/69	
T105			Cl	202/48	
T106			Cl	202/48	
T107			Cl	184/40	
T108			Cl	185/48	
T109					
T110	Bed	059/37	Cl	195/55	
T111	Bed	056/90	Cl	205/86	
T112	Bed	224/48	Cl	205/45	
T113	Bed	199/90			
T114			Cl	165/35	
T115	Bed	173/20			
T116			Cl	197/60?	
T117			Cl	185/47	

This is the structural data collected by T. O. Andreasson. Further details of the lithologies observed at the localities can be obtained from the NGU archives.

DATA REFERS TO A 360' COMPASS
DIP DIRECTION IS 90' CLOCKWISE FROM THE STRIKE DIRECTION
MAGNETIC VARIATION NOT INCLUDED IN THIS DATA

A169	Bed	169/61				
A170	Bed	141/39				
A171			Cl	133/29		
			Cl	175/39		
A172	Bed	121/60	Cl	175/73		
A173			Cl	162/46		
A174	Bed	238/09				
A175			Cl	153/49		
A176			Cl	151/47		
A177	Bed	161/29				
A178	Bed	339/19				
A179			Cl	136/81		
A180			Cl	166/11		
			Cl	198/64	Slicken 52-329	
A181	Bed	163/70				
A182	Bed	145/35				
A183			Cl	165/62		
A184	Bed	040/30			Fract Cl 276/72	
A185	Bed	177/54				
A186	Bed	145/52	Cl	153/61		
A187			Cl	157/53	Fold 19-179	Ax pl 155/53
A188	Bed	191/45	Cl	168/82		
A189	Bed	231/08	Cl	200/10		
A190	Bed	151/24	Cl	180/50		
A191	Bed	191/42	Cl	181/58		
A192	Bed	193/79				
A193					Fold 12-197	
					Fold 07-002	
A194						
A195	Bed	180/23			Fold 07-000	Slicken 11-311
	Bed	176/23				Slicken 13-264
A196			Cl	191/45		
A197	Bed	340/31	Cl	323/15		
A198	Bed	019/35	Cl	199/05		
A199	Bed	040/17			Thrust plane 306/20	
A200	Bed	196/04				
A201					Fold 08-222	Ax pl 216/21
A202			Cl	008/06		
A203	Bed	170/24			Fold 07-189	
A204	Bed	155/25	Cl	193/63		
A205	Bed	183/33	Cl	183/53		
A206			Cl	183/51		
A207			Cl	191/54		
			Cl	169/45		
A208			Cl	190/61		
A209			Cl	170/74		
A210			Cl	173/69		
A211	Bed	182/38	Cl	116/55		
A212	Bed	046/02	Cl	143/48		
A213	Bed	164/82	Cl	229/27		
A214	Bed	125/18				

A215	Bed	035/07	Cl	173/81	
A216	Bed	189/33	Cl	176/68	
A217	Bed	070/53	Cl	177/87	
A218	Bed	195/76			
A219	Bed	141/20	Cl	173/57	
A220	Bed	345/25	Cl	198/46	
A221	Bed	343/21	Cl	172/31	
A222	Bed	353/12	Cl	175/31	
A223	Bed	326/05	Cl	186/43	
A224	Bed	231/36			
A225	Bed	190/40	Cl	018/87	Fold 05/203 Ax pl 204/71 Fold 02-192
A226	Bed	207/16	Cl	181/66	
A227	Bed	335/13	Cl	166/68	
A228	Bed	313/06	Cl	174/41	
A229	Bed	058/06	Cl	183/61	
A230	Bed	307/09	Cl	177/46	Intersect lin 07-196
A231	Bed	169/13	Cl	185/61	
A232					
A233	Bed	171/29	Cl	183/70	
A234			Cl	188/79	
A235			Cl	199/82	
A236			Cl	191/51	Fold 05-195
A237	Bed	189/58	Cl	178/81	
A238	Bed	257/17			Slicken 34-282 Thrust plane 234/20
	Bed	245/20			
A239	Bed	283/09			
A240	Bed	201/26			
A241	Bed	001/02			
A242	Bed	009/73			Fold 07-004 Slicken 79-340
A243	Bed	262/69			Fold 52-124 Slicken 12 132
A244	Bed	017/38	Cl	202/61	Fold 40-175
A245	Bed	002/33	Cl	187/54	
A246	Bed	203/59			
A247			Cl	180/37	
A248	Bed	194/55			Slicken 81-029
A249	Bed	195/79	Cl	196/59	
A250	Bed	187/89	Cl	185/58	
A251			Cl	164/25	

This data has been obtained from airphoto overlays used by Johnson in his report (Johnson 1974). It is not all the data available from this source. Note that at many outcrops the strike of the bedding and cleavage was shown to be the same; our experience suggests that this is most unlikely, implying a horizontal regional fold axis. It has been assumed that the magnetic variation was included in the data on the fieldslips. Due to these uncertainties, none of these data have been used on the stereonets shown in this report.

DATA REFER TO A 360' COMPASS
DIP DIRECTION IS 90' CLOCKWISE FROM STRIKE DIRECTION
MAGNETIC VARIATION ASSUMED TO BE INCLUDED

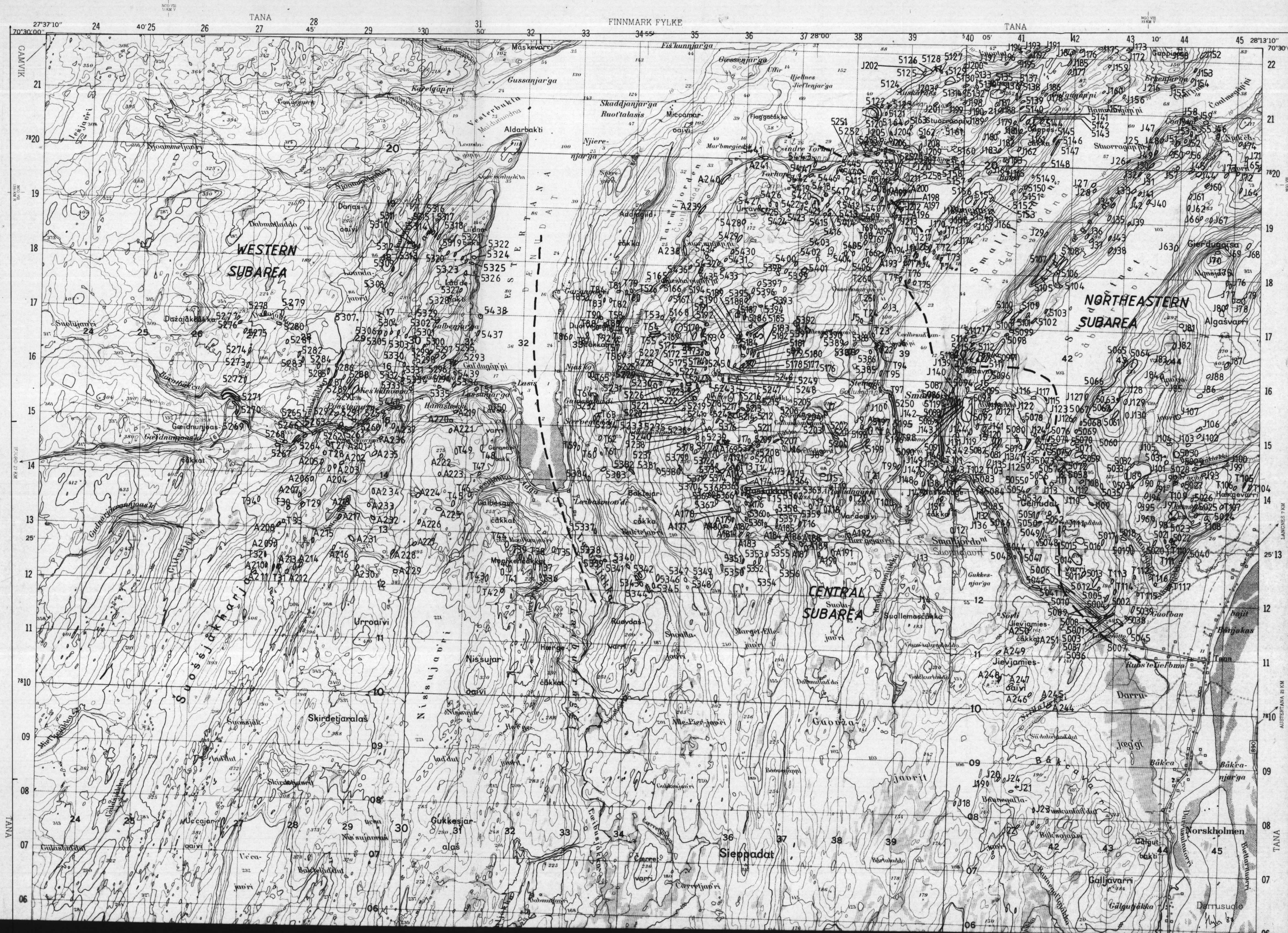
Bed = Bedding (S0); Cl = Cleavage

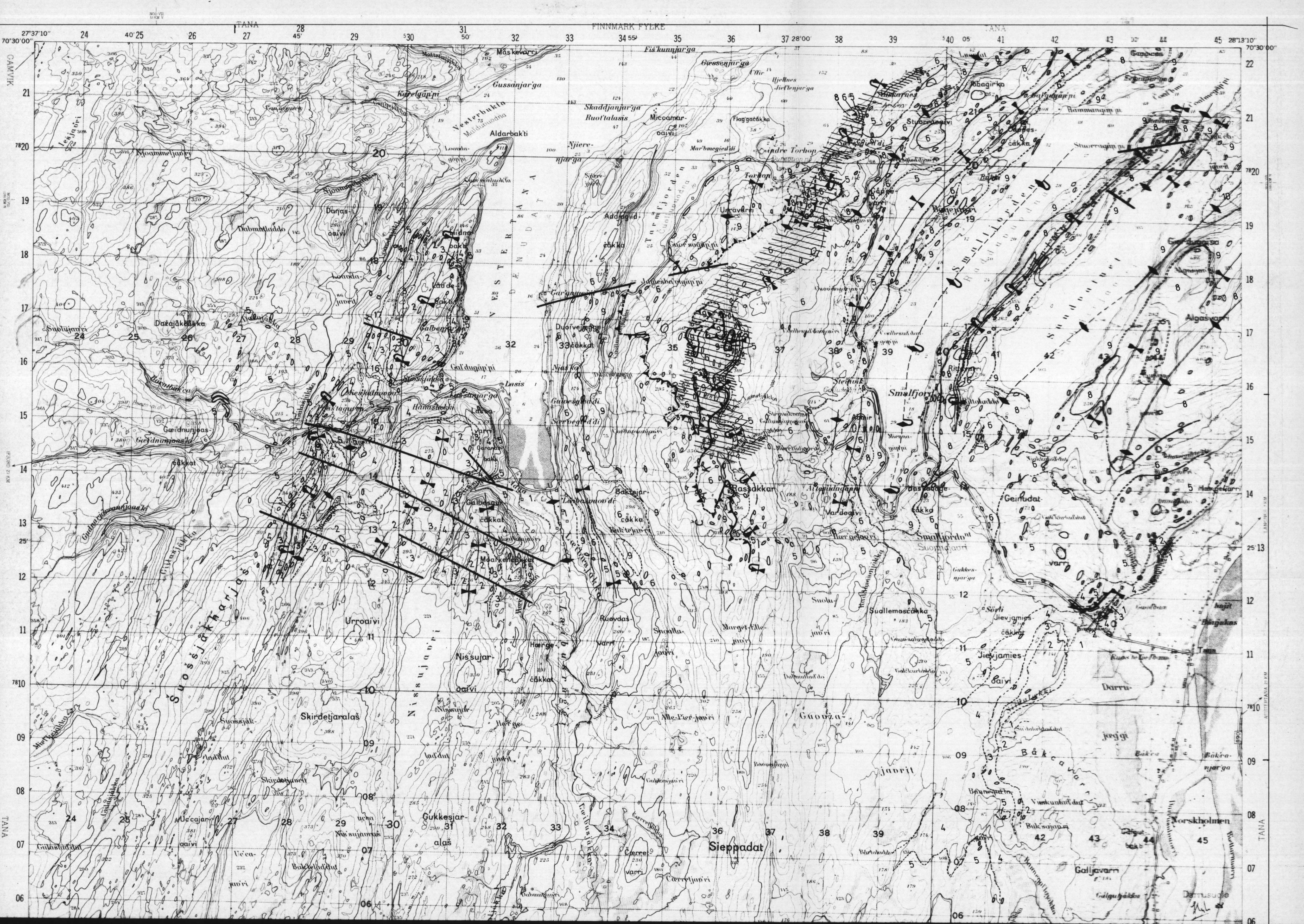
J1	Nyborg Fm.	Bed	180/60	Cl	190/60
J2	Nyborg Fm.			Cl	190/30
J3	Smalfjord Fm.			Cl	190/30
J4	Gamasfjell Fm.	Bed	210/30		
J5	Smalfjord Fm.	Bed	010/45	Cl	190/40
J6	Dakkovarre Fm.	Bed	205/15		
J7	Gamasfjell Fm.	Bed	240/60		
J8	Nyborg Fm.			Cl	185/58
J9	Gamasfjell Fm.	Bed	332/06		
J10	Gamasfjell Fm.	Bed	162/09		
J11	Smalfjord Fm.			Cl	160/40
J12	Smalfjord Fm.			Cl	162/40
J13	Nyborg Fm. (dol)	Bed	180/06		
J14	Nyborg Fm.	Bed	040/44		
J15	Nyborg Fm.				
J16	Nyborg Fm. (dol)	Bed	172/16		
J17	Nyborg Fm.			Cl	230/25
J18	Mortensnes Fm.			Cl	192/52
J19	Mortensnes Fm.			Cl	200/64
J20	Lillevatn Mbr.	Bed	014/72		
J21	Lillevatn Mbr.	Bed	220/24		
J22	Nyborg Fm.			Cl	234/18
J23	Lillevatn Mbr.	Bed	345/28		
J24	Lillevatn Mbr.	Bed	036/90		
J25	Gamasfjell Fm.	Bed	042/70		
J26	Dakkovarre Fm.	Bed	048/81		
J27	Dakkovarre Fm.	Bed	042/66		
J28	Dakkovarre Fm.			Cl	265/35
J29	Dakkovarre Fm.	Bed	038/63		
J30	Smalfjord Fm.			Cl	046/78
J31	Gamasfjell Fm.	Bed	225/46		
J32	Smalfjord Fm.			Cl	041/78
J33	Gamasfjell Fm.	Bed	234/48		
J34	Smalfjord Fm.			Cl	215/82
J35	Gamasfjell Fm.	Bed	210/30		
J36	Smalfjord Fm.			Cl	206/36
J37	Gamasfell Fm.	Bed	232/32		
J38	Dakkovarre Fm.	Bed	230/48		
J39	Dakkovarre Fm.	Bed	225/48		
J40	Dakkovarre Fm.	Bed	236/20		
J41	Gamasfjell Fm.	Bed	240/27		
J42	Gamasfjell Fm.	Bed	237/52		
J43	Gamasfjell Fm.	Bed	224/22		
J44	Dakkovarre Fm.			Cl	241/21
J45	Dakkovarre Fm.	Bed	060/04		Fold axis 05-209

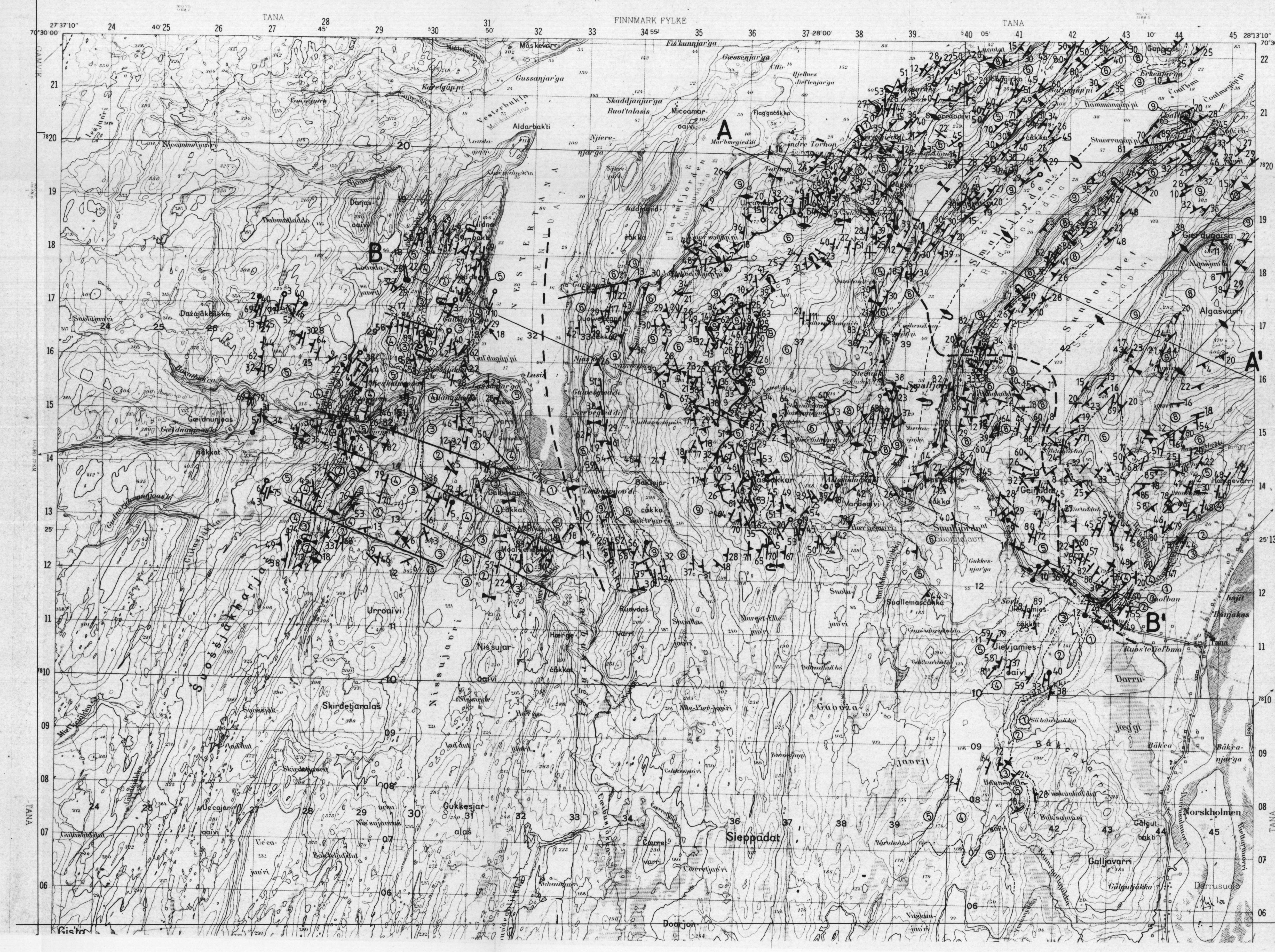
J46	Gamasfjell Fm.	Bed	050/45		
J47	Dakkovarre Fm.	Bed	040/65		
J48	Gamasfjell Fm.	Bed	047/85		
J49	Gamasfjell Fm.	Bed	050/80		
J50	Smalfjord Fm.			Cl 045/80 & 053/78	
J51	Smalfjord Fm.			Cl 220/82	
J52	Smalfjord Fm.			Cl 062/82	
J53	Smalfjord Fm.			Cl 070/77	
J54	Vagge Fm.				Fold axis 05-240
J55	Vagge Fm.				Slicken 26-276
J56	Gamasfjell Fm.	Bed	240/30		
J57	Gamasfjell Fm.	Bed	244/32		
J58	Gamasfjell Fm.	Bed	065/70		
J59	Gamasfjell Fm.	Bed	240/28		
J60	Dakkovarre Fm.	Bed	231/32		
J61	Dakkovarre Fm.	Bed	238/28		
J62	Dakkovarre Fm.				Fold axis 10-238
J63	Dakkovarre Fm.	Bed	236/38		
J64	Stangnes Fm.	Bed	210/15		
J65	Stangnes Fm.	Bed	230/29		
J66	Dakkovarre Fm.	Bed	238/32		
J67	Dakkovarre Fm.	Bed	217/35		
J68	Dakkovarre Fm.	Bed	098/22		
J69	Dakkovarre Fm.	Bed	082/16		
J70	Gamasfjell Fm.	Bed	024/11		
J71	Dakkovarre Fm.	Bed	224/27		
J72	Dakkovarre Fm.	Bed	226/27		
J73	Dakkovarre Fm.	Bed	230/46		
J74	Dakkovarre Fm.	Bed	228/33		
J75	Gamasfjell Fm.	Bed	080/08		
J76	Gamasfjell Fm.	Bed	090/05		
J77	Gamasfjell Fm.	Bed	198/18		
J78	Gamasfjell Fm.	Bed	225/28		
J79	Gamasfjell Fm.	Bed	222/29		
J80	Gamasfjell Fm.	Bed	300/04		
J81	Dakkovarre Fm.	Bed	200/20		
J82	Dakkovarre Fm.	Bed	220/24		
J83	Dakkovarre Fm.	Bed	201/21		
J84	Dakkovarre Fm.	Bed	190/04		
J85	Dakkovarre Fm.	Bed	200/24		
J86	Gamasfjell Fm.	Bed	066/22		
J87	Gamasfjell Fm.	Bed	065/20		
J88	Gamasfjell Fm.	Bed	063/04		
J89	Smalfjord Fm.			Cl 184/50	
J90	Smalfjord Fm.			Cl 193/68	
J91	Nyborg Fm.	Bed	090/85		
J92	Nyborg Fm.	Bed	056/05		
J93	Nyborg Fm.	Bed	030/22		
J94	Nyborg Fm.	Bed	090/18		
J95	Nyborg Fm.	Bed	053/85		
J96	Nyborg Fm.	Bed	054/58		
J97	Nyborg Fm.	Bed	030/78		
J98	Nyborg Fm.	Bed	055/90		
J99	Smalfjord Fm.			Cl 200/22	
J100	Smalfjord Fm.			Cl 184/26	
J101	Smalfjord Fm.			Cl 192/51	
J102	Smalfjord Fm.			Cl 176/54	
J103	Smalfjord Fm.			Cl 201/80	
J104	Gamasfjell Fm.	Bed	090/14		

J105	Gamasfjell Fm.	Bed	066/12	
J106	Gamasfjell Fm.	Bed	070/18	
J107	Gamasfjell Fm.	Bed	082/16	
J108	Smalfjord Fm.		Cl	219/32
J109	Nyborg Fm.	Bed	221/25	
J110	Nyborg Fm.	Bed	062/10	
J111	Smalfjord Fm.		Cl	175/17
J112	Nyborg Fm.	Bed	152/19	
J113	Nyborg Fm.	Bed	052/08	
J114	Nyborg Fm.	Bed	162/27	
J115	Dakkovarre Fm.	Bed	109/11	
J116	Gamasfjell Fm.	Bed	138/10	
J117	Gamasfjell Fm.	Bed	067/15	
J118	Gamasfjell Fm.	Bed	162/06	
J119	Gamasfjell Fm.	Bed	092/12	
J120	Gamasfjell Fm.	Bed	074/12	
J121	Gamasfjell Fm.	Bed	102/12	
J122	Gamasfjell Fm.	Bed	087/18	
J123	Gamasfjell Fm.	Bed	199/23	
J124	Smalfjord Fm.		Cl	203/86
J125	Gamasfjell Fm.		Cl	136/60
J126	Gamasfjell Fm.	Bed	087/20	
J127	Dakkovarre Fm.	Bed	030/15	
J128	Gamasfjell Fm.	Bed	047/22	
J129	Gamasfjell Fm.	Bed	159/14	
J130	Gamasfjell Fm.	Bed	212/20	
J131	Gamasfjell Fm.	Bed	010/29	
J132	Gamasfjell Fm.	Bed	219/66	
J133	Gamasfjell Fm.	Bed	123/05	
J134	Smalfjord Fm.		Cl	203/74
J135	Smalfjord Fm.		Cl	195/60
J136	Smalfjord Fm.		Cl	170/64
J137	Smalfjord Fm.		Cl	178/36
J138	Dakkovarre Fm.	Bed	045/27	
J139	Gamasfjell Fm.	Bed	175/75	overturned
J140	Dakkovarre Fm.	Bed	180/67	overturned
J141	Gamasfjell Fm.	Bed	042/16	
J142	Gam & Dak Fms.	Bed	187/87	overturned
J143	Dakkovarre Fm.	Bed	189/70	overturned
J144	Gamasfjell Fm.	Bed	177/82	overturned
J145	Dakkovarre Fm.	Bed	357/40	
J146	Dakkovarre Fm.	Bed	358/83	
J147	Dakkovarre Fm.	Bed	062/14	
J148	Dakkovarre Fm.	Bed	078/11	
J149	Dakkovarre Fm.	Bed	098/31	
J150	Dakkovarre Fm.	Bed	096/18	
J151	Smalfjord Fm.		Cl	151/71
J152	Dakkovarre Fm.	Bed	230/25	
J153	Dakkovarre Fm.	Bed	235/25	
J154	Dakkovarre Fm.	Bed	254/30	
J155	Dakkovarre Fm.	Bed	260/10	
J156	Dakkovarre Fm.	Bed	245/20	
J157	Dakkovarre Fm.	Bed	240/35	
J158	Gamasfjell Fm.	Bed	220/35	
J159	Gamasfjell Fm.	Bed	235/40	
J160	Gamasfjell Fm.	Bed	230/30	
J161	Gamasfjell Fm.	Bed	225/30	
J162	Gamasfjell Fm.	Bed	220/40	
J163	Gamasfjell Fm.	Bed	220/30	

J164	Gamasfjell Fm.	Bed 220/30	
J165	Dakkovarre Fm.	Bed 230/30	
J166	Dakkovarre Fm.	Bed 220/20	
J167	Dakkovarre Fm.	Bed 220/20	
J168	Dakkovarre Fm.	Bed 230/15	
J169	Gamasfjell Fm.	Bed 220/30	
J170	Gamasfjell Fm.	Bed 215/30	
J171	Gamasfjell Fm.	Bed 210/30	
J172	Vagge Fm.	Bed 240/40	
J173	Smalfjord Fm.		Cl 315/30
J174	Smalfjord Fm.	Bed 210/20	
J175	Nyborg Fm.	Bed 240/50	
J176	Nyborg Fm.		Cl 210/50
J177	Nyborg Fm.		Cl 215/80
J178	Nyborg Fm.	Bed 240/60	
J179	Nyborg Fm.		Cl 220/16
J180	Nyborg Fm.	Bed 225/70	Cl 225/40
J181	Nyborg Fm.		Cl 210/45
J182	Nyborg Fm.	Bed 220/30	
J183	Nyborg Fm.	Bed 240/30	
J184	Smalfjord Fm.		Cl 220/50
J185	Smalfjord Fm.		Cl 215/80
J186	Smalfjord Fm.		Cl 210/45
J187	Smalfjord Fm.		Cl 210/50
J188	Smalfjord Fm.		Cl 215/40
J189	Smalfjord Fm.		Cl 210/50
J190	Smalfjord Fm.		Cl 205/40
J191	Smalfjord Fm.		Cl 210/45
J192	Gamasfjell Fm.	Bed 035/30	
J193	Gamasfjell Fm.	Bed 040/30	
J194	Gamasfjell Fm.	Bed 040/15	
J195	Gamasfjell Fm.	Bed 040/15	
J196	Gamasfjell Fm.	Bed 000/05	
J197	Gamasfjell Fm.	Bed 250/20	
J198	Gamasfjell Fm.	Bed 000/05	
J199	Gamasfjell Fm.	Bed 270/05	
J200	Smalfjord Fm.		Cl 220/50
J201	Smalfjord Fm.		Cl 200/40
J202	Nyborg Fm.	Bed 230/20	
J203	Nyborg Fm.	Bed 220/20	
J204	Nyborg Fm.	Bed 220/15	
J205	Smalfjord Fm.		Cl 210/35
J206	Smalfjord Fm.		Cl 210/35
J207	Gamasfjell Fm.	Bed 210/25	
J208	Gamasfjell Fm.	Bed 020/10	
J209	Gamasfjell Fm.	Bed 020/35	
J210	Gamasfjell Fm.	Bed 020/05	
J211	Gamasfjell Fm.	Bed 040/25	
J212	Nyborg Fm.		Cl 210/60
J213	Nyborg Fm.	Bed 030/30	
J214	Smalfjord Fm.		Cl 235/40
J215	Smalfjord Fm.		Cl 210/50

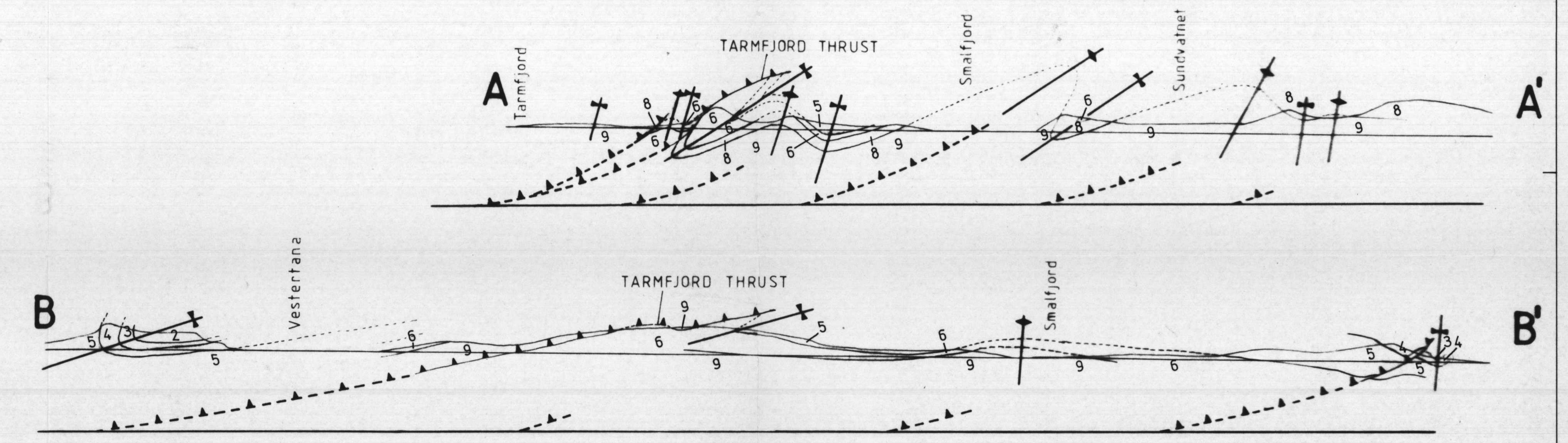






- 5001 — 5447 localities of RICE (this report)
- A169 — A251 ANDREASSEN (this report)
- T13 — T117 THOMASJORD (this report)
- J1 — J216 JOHNSON (1974)

MAP 1 LOCALITIES	MAP 2 OUTCROP
MAP 3 STRUCTURE	KEY



schematic cross-sections

(showing blind thrusts off a sole thrust at an unknown depth)

- - - - - - boundaries of structural subareas

S0 - bedding

S2 - cleavage

F2 - fold axis

L2a - intersection lineation of S0 & S2

L2b - mineral lineation

L2b - slickenside

minor thrust plane

major thrust

lithological contact

UPRIGHT — *major F2 synform* / *major F2 antiform* — *trace of axial surface*

OVERTURNED

inverted limb

inferred zone of faults

post-D2 extensional faulting (SEE MAP 2)

faults observed

DRIFT etc. [1]

VESTERTANA GROUP

Stappogiedde Fm.
- INNERELV MBR. [2]
- LILLEVATN MBR. [3]

Mortensnes Fm. [4]

Nyborg Fm. [5]

Smalfjord Fm. [6]

UNCONFORMITY

TANAFJORD GROUP

Vagge Fm. [7]

Gamasfjell Fm. [8]

Dakkovarre Fm. [9]

Stangenes Fm. [10]

STRUCTURAL GEOLOGY OF THE N.W. PART OF MAP SHEET

SMALFJORD

(M711 1:50,000 2235-I)

by

A. H. N. RICE, B. I. THOMASJORD & T. O. ANDREASSEN

1988