The Geology of Skjervøy, North Troms, Norway

By

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Abstract

A geological map and section of the island are presented. Despite the lack of sedimentary structures, the meta-sedimentary succession of limestones, overlain by pelite, overlain by a thick series of psammites is thought to be inverted on the basis of its similarity to the succession in the Loppen district and by the sense of vergence of the early minor folds.

Three periods of deformation are distinguished. F_1 predominates and forms a series of tight asymmetric minor folds, associated with a coarse lineation, which retain the same sense of vergence across the island.[1]) F_2 is represented by a single major fold exposed on the higher ground, minor folds, and a fine lineation on micaceous rurfaces. More brittle F_3 structures are also recorded. The tectonic setting of Skjervøy in relation to the major F_1 structures of West Finnmark is briefly discussed.

1. Introduction

Skjervøy, latitude 70° 02′ S and longitude 20° 58′ E, lies at the convergence of Reisafjord and Kvænangen Fjord on the coast of North Troms. It has a total area of about 25 km². The large natural harbour and village is a rapidly growing fishing centre. The topography is mild relative to most of the surrounding islands and divides the island into a southern and a northern half joined by an isthmus of land. The highest point on the island is the summit of Skattefjellet (347 m).

Drainage of most of the island is poor, the many glacial rock basins now holding areas of marshy ground or small lakes. Precipitation is high with considerable snow in winter and run off is rapid once all the natural basins are saturated. A number of the larger basins have been enlarged to form reservoirs providing the island with a self-sufficient water supply.

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[1]) See appendix at end of paper.

Rock exposure is generally good except on sheltered slopes where the arctic vegetation is characterised by the abundance of dwarf birch up to 300 m. Raised beaches lie at 2, 13, 33, and 57 m above present sea level.

The field mapping of the geology of Skjervøy was completed during the summer field season of 1966. The author is greatly indebted to Herr Johansen for his hospitality in Skjervøy and to Dr. P. R. Hooper of the Department of Geology, University College of Swansea, for generous assistance with the work and critical reading of proofs.

2. **General geology**

The island is composed of a meta-sedimentary succession dipping gently to the south-east as illustrated in Pl. V. The lithological units distinguished retain their essential identities over the whole island but more detailed correlation is hampered by rapid lateral changes in thickness and lithology. The thicknesses quoted are average figures based upon field observations and do not make allowance for complex intraformational folding present in most formations. No faunal evidence for the age of the meta-sediments is available. On the 1 : 1,000,000 Geological Map of Norway (Holtedahl and Dons, 1960) the whole Skjervøy succession is marked as Cambro-Silurian. In the Loppen district to the north, however, rocks which are correlated with those on Skjervøy (Hooper and Gronow, in press) are divided by Holtedahl and Dons into Eocambrian, predominantly quartzo-feldspathic rocks, and Cambro-Silurian which are predominantly limestones and pelites. All the lithological units are intruded by numerous basic sheets.

A. The Skattefjellet Psammites

These form a thick series (700 m) of flaggy feldspathic sandstones, with a variable quantity of mica and small red garnets, which are probably derived from greywacke. Their foliation is defined by dark micaceous partings which carry lineations of the first and second generation folds. The typical mineral assemblage for the formation is (Plate II (i))

quartz + biotite + muscovite + plagioclase (An_{30}) + microcline + garnet. The plagioclase rarely shows good lamellar twinning and the microcline is most abundant in the highly deformed psammites, suggesting some degree of feldspathisation. The amunt of biotite is variable but it is usually the most abundant mica. Accessory sphene and iron ore are often present.

The formation has suffered considerable deformation both by F_1 and F_2. A number of F_1 axial planes have been traced on the western flank of Skattefjellet and large F_2 fold closures are found on the summits of Stusnesfjell.

Lailafjell and Trollfjell. Minor folds of both F_1 and F_2 deformations are common and are distinguished by style and axial trend. F_1 drag folds have an axial planar cleavage which is not easily recognized in the quartzo-feldspathic bands but is noted in the preferred orientation of mica plates in the foliation partings. F_2 drag folds have typically monoclinal profiles with a considerable thickening of the short limbs of the folds.

B The Sandøra Augen Gneiss

This formation forms a wedge of gneissic rocks cropping out within the psammites in the south of Skjervøy. To the west the group dips beneath the shallow Skattørsund and is apparently continuous with similar rocks on the island of Kågen. On Skjervøy the wedge passes without any sharp structural or lithological break into highly deformed Skattefjellet psammites. The wedge may represent an intermediate sized F_1 fold closure.[1])

A variety of mineral assemblages are exhibited in this formation but the following are typical (Plate II (ii)):

quartz + microcline + muscovite ± biotite ± garnet

and in feldspathic bands:

microcline + quartz + muscovite.

Microcline is a very prominent mineral in the formation and the numerous feldspathic bands in the psammites suggests the possibility of a progressive feldspathisation of the psammites, reaching a maximum development in the wedge of Sandøra augen gneiss.

The basic intrusions within the gneiss have suffered intense deformation and are only traced with difficulty as schistose bands carrying pink feldspar augen. Their schistosity is defined by the abundance of dark biotite present in greater abundance than hornblende.

C. The Pelites

There are three principal outcrops of pelitic rocks. Those occurring around Trollfjell and those forming a belt around the bottom slopes of Skattefjellet are clearly in the same stratigraphic positions separated only by faulting through the centre of the island. The third outcrop, the Vågen pelite, forms a narrow wedge within the Skattefjellet psammites which is widest at the southern shore of Skjervøy harbour, narrowing south-westwards.

The maximum thickness of the Vågen pelite wedge is in excess of 50 m. Both the lower and the upper contacts with psammitic rocks are abrupt litho-

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[1]) See appendix at end of paper.

logical changes and are at least in part tectonic. The rocks are massive in character forming a prominent shoulder on the northern flank of Skattefjellet. Intraformational folding is suspected but can seldom be demonstrated. An exception to this is illustrated in Fig. 2. The typical mineral assemblage is:

muscovite + garnet + quartz ± plagioclase (An_{30})

Mica is represented almost exclusively by muscovite. Small red garnets are numerous in all specimens of the group with diameters of one to two millimetres only.

The northern edge of the wedge is occupied by an impersistent semipelitic unit which has a maximum development of 20m. It is distinguished from the pelite by the presence of quartzo-feldspathic ribs about 1.5 cm thick which exhibit numerous F_1 folds intruded by basic sheets. It appears probable that Vågen pelite is of tectonic origin, forming the core to a large F_1 drag fold.

The two main outcrops of pelite form a massive formation with only limited jointing and steep brown-weathering outcrops. The maximum thickness seen is in the south where over 70m occurs on the lower slopes of Skattefjellet. Mineralogically these pelites are very similar to the Vågen pelite although the latter is slightly more quartz rich. The garnets are usually small, pink and idioblastic except where the formation passes into the large F_2 fold closure around the summit of Trollfjell. Garnets from this locality are larger and poorly formed, indicating extended or renewed metamorphism related to the F_2 deformation.

The junction of the pelites with the Skattefjellet psammites is very abrupt and usually intruded by basic sheets. The original relation between the supposed Eo-cambrian and Cambro-Silurian members of the succession is therefore obscure. Approaching the other side of the pelites the junction is marked by a passage into semi-pelitic rocks and a great increase in the number of basic sheets.

Along the summit of Trollfjell a persistent slice of psammitic rocks is found in the pelites. These psammites are not represented along the west coast of the island, for example in the area around Isakeidet, where the pelitic succession is uninterrupted. The band is therefore regarded as a tectonic feature resulting from the severe F_1 deformation and recorded as Skattefjellet psammite on the map. (Plate V.)

D. The Lysthus Semi-pelites

This is a large and variable formation separating the true pelites from the more calcareous formations. The junctions with the pelites on the one side and the calcareous formation on the other are transitional. The maximum thickness of the unit is seen in a broad outcrop to the south of Finneidet where it is in excess of 100m.

The typical semi-pelitic mineral assemblage is:

biotite + quartz + muscovite + plagioclase (An_{30}) ± garnet

The quartz content of some bands may exceed that of mica, but several pelitic bands of a light rusty appearance also occur within the group. These more schistose divisions are composed of:

muscovite + biotite + small garnets + a little quartz.

In contrast to the pelites the abundant mica in the Lysthus semi-pelites is biotite. This stands out even in the hand specimens by the very dark coloration of the micaceous partings.

Within the quartzo-feldspathic bands micas are also abundant but muscovite and biotite are in approximately equal proportions. The muscovite micas form much larger plates than do the biotites and from the textural relation of the muscovite plates to other minerals it appears that muscovite continued to crystallise later than the other minerals.

F_1 drag fold structures are very well developed in parts of the Lysthus semi-pelites and the axial plane cleavage is again best represented by the preferred orientation of the mica plates. Another distinctive feature of this formation is the abundance of basic sheets.

An important horizon within the formation is the Eyrie Limestone. This is a pure meta-limestone with associated calc-silicate and calcareous-pelitic rocks which may be traced from just north of the summit of Trollfjell to the coast 200 m south-west of Ramneset. Near Isakeidet on the west coast of the island the 10 m of Eyrie Limestone appears to be represented only by a band of green and purple calc-silicate slates with a maximum development of 3 m. To the south of Finneidet there is no trace of a calcareous band within the semi-pelites. The transition to the Prestberget formation begins with the appearance of zoisite in the biotite-rich partings of the semi-pelite assemblage.

E. The Prestberget Formation

Defining the boundary betweet the Lysthus semi-pelites and the Prestberget formation is difficult as it depends on the first appearance of a distinctly calcareous lithology. The boundary drawn on the map (Plate V) may therefore be diachronous in part.

The complete formation is exposed on the coast west of Trollfjell where it has an average thickness of 80—100 m. On the eastern slopes of Trollfjell the formation is highly deformed and considerably increased in thickness by the F_2 fold. In contrast, where the formation crops out on the western side of the island and around the northern part of Skjervøy harbour the foliation is almost flat and F_1 folds are never developed. The thin, often slaty foliation of the formation is the axial plane cleavage of the F_1 deformation and the abundant basic sheets which intrude this plane carry the same cleavage.

Mineral assemblages within the formation show considerable variation but a number of generalisations can be made. Biotite is the most abundant mica and is present in almost all the assemblages examined. (Plate III (ii)). Amphiboles are common, usually in the form of hornblende but occasionally in the form of tremolite-actinolite with a much weaker pleochroism. Plagioclase feldspars are represented by andesine in the range An_{30-40}. The mineral assemblage of the green calcareous schists is:

tremolite-actinolite + biotite + carbonate + quartz + zoisite + andesine

In the purple calcareous schists it is:

biotite + hornblende + carbonate + quartz + andesine + zoisite

and in the metamorphosed marls:

clinopyroxene + biotite + andesine + quartz ± hornblende

In some more quartz-rich bands the typical calcareous schist lithology is developed as partings between quartzo-feldspathic bands:

biotite + quartz + zoisite + andesine + hornblende

Thus the Prestberget formation is the metamorphosed derivative of a series of impure calcareous sediments with occasional more magnesia-rich members in the form of marls.

As the next formation, the Engnes Limestone, is approached along the track to Engnes, several lenses of pure meta-limestone are developed which reflect an increasing proportion of carbonate leading eventually to a passage into almost pure meta-limestone. The junction between the Prestberget formation and the Engnes Limestone is poorly exposed along the entire outcrop from Mortevågen to Ramneset and it is necessarily defined only by an arbitrary line (Plate V) which places all the calcareous schists within the Prestberget formation.

F. The Engnes Limestone

The limestone occurs in three separate outcrops, in two of which the complete formation appears to be exposed. In the third, near the playing field north of the village only the lower part is exposed in the form of impure limestone.

In the north of the island a continuous coastal section from Engnes west to Mortevågen and south to Ramneset exposes a total thickness of about 140 m of pure limestone considerably deformed by folding. The numerous F_1 minor folds indicate the probability of a number of intraformational F_1 folds. In contrast to this thick development, the limestones at Finneidet have a total thickness of only 20 m. No F_1 folds are developed at this locality and it would appear that the limestones are here attenuated on the limb of an F_1 fold.

The basic intrusions within the limestones have suffered considerable boudinage as a result of the F_1 deformation. At Finneidet the intrusions are small and often completely pinched out by the boudins. Boudinage in the Engnes area is no less severe but many of the intrusions reach considerable dimensions. Boudins exceeding 5 m in thickness which can be traced for less than 20 m along the strike are indicative of the serverity of this effect.

The original limestone has been completely recrystallised during the metamorphism to a white granular or saccharoidal marble composed of a mosaic of carbonate crystals. Close to the junction with the Bratteidet formation at Mortevågen a number of pelitic and calc-silicate bands appear. Similar lithologies occur again on the southern side of Engnesbukta but none of these bands persist for more than a limited distance owing to the F_1 deformation.

G. The Bratteidet Formation.

This formation is represented by isolated outcrops. The larger is at Bratteidet where 20 m is exposed beneath the Engnes Limestone. It is limited to the north by a large fault which runs through Bratteidet. This fault has a downthrow to the north which brings the topmost Skattefjellet psammite against the Bratteidet Formation. To the south where the Bratteidet Formation succeeds the Engnes Limestone there is an abrupt tectonic contact at which pure limestone is succeeded by biotite schist.

At Bratteidet the lower half of the formation is largely composed of pelitic rocks with varied lithologies including such minerals as zoisite, hornblende and garnet (Plate III (i)). The purest pelitic rocks of the Skjervøy succession are developed here. The upper half of the formation is mainly composed of massive quartzites. Shear zones between quartzite bands have a more foliated quartz + muscovite + microcline lithology. Much of the formation has an appreciable calcium content which is represented by the occurrence of zoisite in the biotite schists and in impure pelitic bands associated with the quartzites.

Impure pelitic bands exposed at Mortevågen and south of Engnesbukta are somewhat similar in appearance to the pelites at Bratteidet, but are succeeded by the topmost Engnes Limestone and are included within the latter formation. While it is possible that these pelites have been intimately folded into the Engnes Limestone by the F_1 deformation no conclusive evidence is available.

At Engnes only the quartzite members of the formation are represented. In the small bay immediately to the east of Engnes they appear in a single small outcrop in which the massive foliation is dissected by numerous joints. About 20 m south of the Engnes light a single lens of quartzite 5 m in length has been sheared into the limestones and subsequently cut by a basic intrusion.

Substanial F_1 deformation also occured at Bratteidet resulting in the cleavage and attenuation of basic intrusions within the formation, and a tendency towards the rodding of quartzitic members in the F_1 axial direction. In addition the pelitic members exhibit the strain-slip cleavage of the F_2 deformation.

H. The Basic Sheets

Numerous basic sheets varying in width from 20 cm to 5 m cut all the meta-sedimentary formations on the island. All those examined are amphibolites with an essential hornblende-andesine (An_{30}-An_{40}) assemblage and are of igneous origin (Plate IV (i)). Some have finer grained margins which might be due in part to chilling during intrusion.

Variations in the mineralogy of the sheets appear to be a result of metamorphism. Zoisite frequently develops in sheets intruded into the calcareous formations (with the exeption of the pure limestones) while the biotite content increases with the degree of shear to which they have been subjected. Pink garnets may be numerous or absent within different parts of the same sheet tending to occur in the finer phases of the sheets or where cleavage and shearing are most intense. They frequently develop rhombdodecahedral form.

The mineral assemblage from a massive amphibolite with relict ophitic texture is.

hornblende + andesine + biotite + iron ore.

From sheets in the calcareous formation it is:

hornblende + andesine + zoisite + almandine or

hornblende + andesine + zoisite + biotite + almandine.

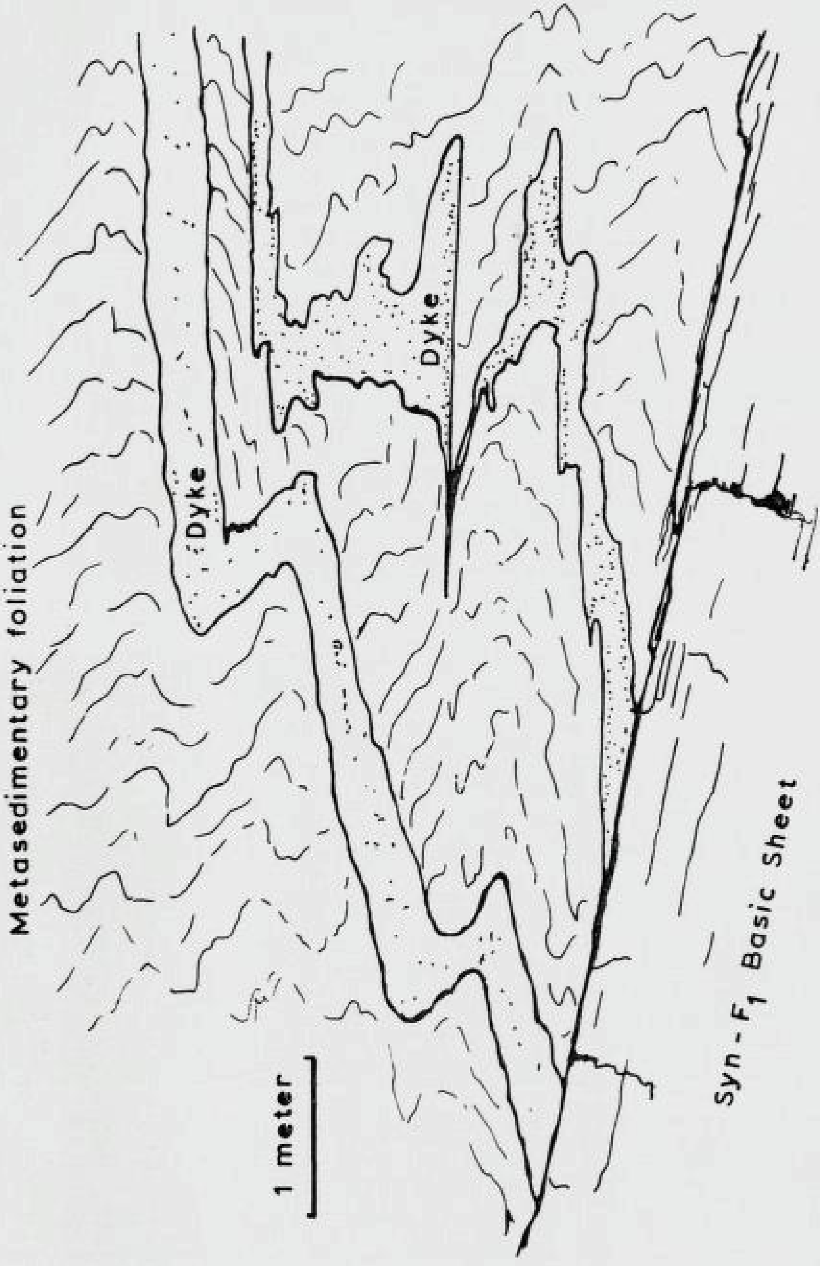
From severly sheared sheets it is:

hornblende + biotite + andesine + epidote + almandine (Plate IV (ii))

while "ghost" amphibolites from the Sandøre augen gneiss have the assemblage:

biotite + hornblende + microcline + andesine.

Fig. 1. F_1 structures in the Lysthus Formation south of Sjøburdneset. The two smaller amphibolites are deformed by the typical F_1 "drag" folds. The larger later amphibolite is parallel to the axial planes of the F_1 folds, but contains the F_1 axial plane cleavage (S_2).


Metasedimentary foliation
Dyke
Dyke
1 meter
Syn-F_1 Basic Sheet

Two generations of intrusions are demonstrated. The earlier are few in number and do not exceed about 50 cm in width. They are fine grained with abundant biotite and may also be rich in almandine. South of Sjøburdneset sheets of this earlier suite are deformed by an F_1 drag fold and cut by a larger dyke of the later suite (Fig. 1). Clearly the earlier suite was emplaced prior to the F_1 deformation.

Amphibolites of the second and main suite were intruded with remarkable concordance to the axial plane of F_1 (Plate I (i)). They often lie in the limbs of the F_1 minor folds parallel to but not along the axial planes of the folds. They carry the axial plane cleavage of F_1 and must therefore be regarded as syn-F_1 intrusions. Similar basic sheets with a similar relation to the F_1 folds have been described from all parts of the Loppen district north of Kvænangen Fjord (Mr. D. Lewis, personal communication, Hooper and Gronow, in press). They constitute an important piece of evidence in the correlation of the F_1 folds of the two areas. In the Loppen district Hooper and Gronow have shown that they were intruded after the formation of the F_1 folds but prior to late F_1 axial plane shear which was concentrated in the F_1 fold limbs.

In nearly all the metasedimentary formations on Skjervøy the sheets have suffered some bouodinage during the F_1 deformation although the phenome-

Fig. 2. Small F_1 "ghost" fold in the Vågen pelite (Photo P.R.H.).

non is most fully developed in the meta-limestones. In the areas of F_2 folding all the sheets become folded and may ultimately be deformed into large rods with the trend and plunge of the F_2 axes. Several small sheets south of Tenn-skjerneset are not deformed by the F_1 shear.

I. Discussion

No sedimentary structures have been found on Skjervøy, due perhaps to the intense late F_1 shearing. The succession does show very marked similarities to that established for the Loppen district (Hooper and Gronow, in press) and indeed with that established on Sørøy (Sturt and Ramsay 1965). In both these areas sedimentary structures have shown the quartzo-feldspathic formations to lie at the bottom, overlain successively by a pelitic group and then a limestone group. If the obvious correlation of these successions with that of Skjervøy is accepted, then the Skjervøy succession is inverted. This conclusion is convincingly supported by the structural evidence recorded below.

The mineral assemblages indicate that the Skjervøy succession has been regionally metamorphosed to the almandine-amphibolite facies of the Barrovian type facies series. The presence of zoisite in stable paragenesis with oligoclase-andesine (An_{30}) implies that the sillimanite-almandine-orthoclase sub-facies has not been reached. As neither staurolite nor kyanite has yet been identified a further sub-division between the staurolite-almandine sub-facies and the kyanite-almandine-muscovite sub-facies is not possible.

The schistosity of the meta-sediments is produced by the preferred orientation of mica plates while the cleavage of the amphibolite sheets and of the Prestberget formation is similarly produced by the preferred orientation of biotite and hornblende. There is no reason to suppose that the foliation of the psammites results from any process other than the accentuation of the original bedding (S_1) by metamorphic differentiation and shearing. While this may also be true for the semi-pelites it is doubtful whether the foliation of the pelitic and calcareous formations bears any relation to the original bedding. In the Vågen pelite isolated quartzite stringers may be observed making an angle of up to 40° with the foliation, but it cannot be proved that these represent the original bedding.

Zoisite prisms developed in the sheared amphibolites to the north of Finneidet have a preferred orientation of their long (b-crystallographic) axes in the direction of the F_1 fold axes.

Inclusions in the idioblastic garnets do not indicate rotation during the F_1 deformation even in the highly cleaved margins of the basic sheets. It is therefore believed that the main genesis of garnet was of post-F_1 age. Where the garnet-mica schists have been folded by F_2, the garnets become xenoblastic and larger, indicating continued or renewed crystallisation during the F_2 deformation. Here also zoisite aggregates have a preferred orientation parallel to the F_2 fold axes. There does not, therefore, appear to have been any lowering of the metamorphic grade until after the F_2 deformation.

An anomalous assemblage is found in a small outcrop at Isakeidet. It is a chlorite-almandine-biotite schist well developed adjacent to the calc-silicate band representing the Eyrie limestone at this locality.

3. Structure

Two major generations of folds, F_1 and F_2, are recognised on Skjervøy and a third deformation, F_3, is represented by joint sets and locally developed strain-slip cleavage. F_1 predominates in the south-west of the island from Sjøburdneset to Sandøra where it is beautifully developed and, to a lesser extent, in the Mortevågen, Engnes, Engnesbukta area in the north. F_2 structures predominate on the summits Lailafjell and Stusnesfjell and even more strongly the Trollfjell-Ramneset area where a large F_2 fold closure can be seen.

A. The F_1 Deformation

The earliest folds are small, tight asymmetric drag folds, reclined with their axes approximating to the angle and direction of dip of the foliation. When plotted on a stereogram those from the south-west coast form a single maximum plunging 20° in the direction 145° (Fig. 3a). They are associated with a characteristic coarse lineation and basic sheets which lie parallel to their axial planes, dipping south-south-east at approximately 25° (Fig. 3b), virtually parallel to the foliation plane (Fig. 3c).

The predominant sense of vergence implied by the asymmetry of the F_1 minor folds indicates that the whole Skjervøy succession lies on a single major F_1 fold limb. If the succession is inverted, as lithological correlation with the Loppen and Sørøy districts suggests, then Skjervøy lies on the inverted limb of an F_1 anticline facing west. This is the same direction of facing as the F_1 folds in the Loppen district. If it is assumed, on the other hand, that the succession is not inverted, not only are the lithological units in the opposite order to that established over a wide area to the north, but the F_1 folds must be supposed to face eastwards in a direction opposite to that of the Loppen district. While the second possibility cannot be ruled out entirely in the absence of sedimentary structures, it may be considered most unlikely.

A strong cleavage is developed parallel to the F_1 axial plane (S_2) which also affects the axial planar basic sheets and forms the schistosity in the pelitic and calcareous formations. The implication is that after the development of the F_1 folds and the intrusion of the basic sheets parallel to their axial planes, the same stress field produced further shearing which developed more especially along the limbs of the F_1 folds and within the basic sheets. The degree of movement in the S_2 cleavage plane is demonstrated by the non-affine deformation of quartz stringers in amphibolite sheets (Plate 1 (ii)).

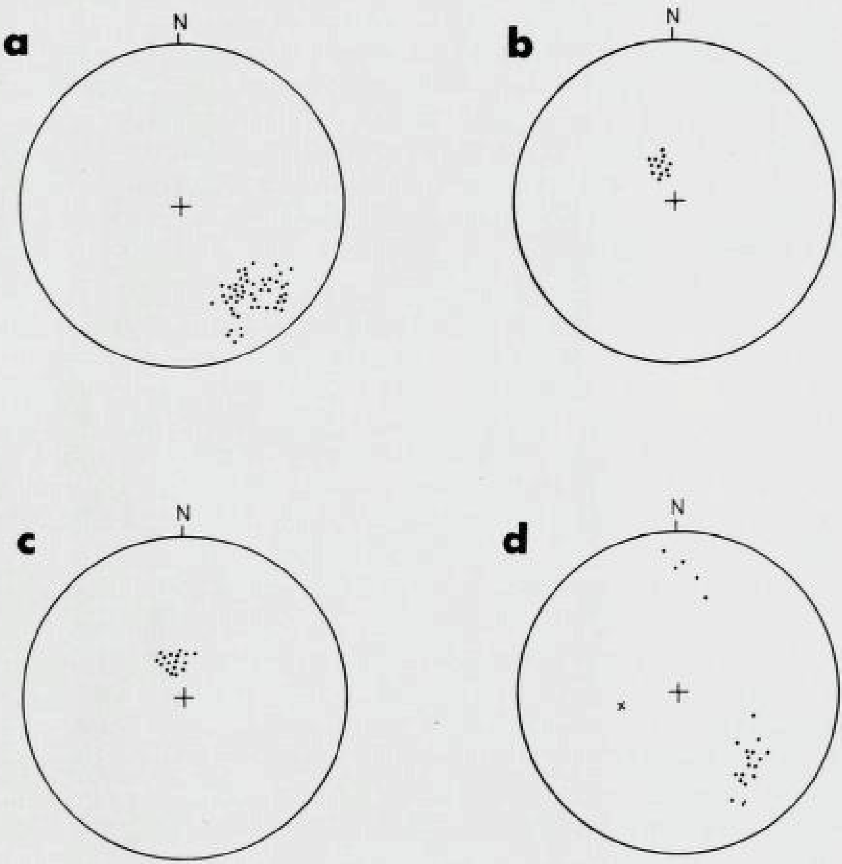


Fig. 3. Stereograms illustrating the principal features of the F_1 and F_2 deformations. (a) F_1 fold axes from the Finneidet - Stusneset - Sandøra area, southern Skjervøy. (b) Poles to the axial planes of the F_1 "drag" folds in the Skattefjellet and Finneidet-Sjøburdneset areas. (c) Poles to the foliation planes in the psammitic rocks of the Tennskjerneset - Skattøra area. (d) F_2 lineations forming a great circle distribution around F_1 folds. The cross indicates the derived pole to the F_2 axial plane, Stusneset.

The F_1 minor folds have a similar fold profile with thickened hinge zones and attenuated limbs. The interlimb angle varies up to 30° but subsequent shearing has frequently caused the folds to become isoclinal so that in areas of very intense deformation, the poles to the foliation planes form a single maximum, despite the presence of some quite large F_1 drag folds.

B. The F_2 Deformation.

On the summit of Trollfjell a major F_2 fold causes the foliation to swing from its normal gentle south-easterly dip through a synformal closure with an axis plunging 10° in direction 142° and an axial plane dipping 15° in direction 110° - into a vertical easterly limb. This vertical limb, with associated minor F_2 folds, may be traced parallel to the F_2 axis from the summit of Trollfjell to the coast near Ramnneset. The F_1 axial plane present as the S_2 cleavage in the basic sheets and in the minor F_1 folds, is folded around the F_2 synform, but the F_1 lineation has been obliterated in the axial region and the pattern of deformation of the F_1 linear structures cannot therefore be used to demonstrate the mechanism of the F_2 folding.

Little of the overturned limb of the F_2 fold can be seen as the land surface has been lowered by erosion to expose only the fold closure over most of the area. F_2 drag folds indicate that, like F_1, the F_2 deformation has a similar style and monoclinic symmetry. In contrast with F_1, however, these folds are more open and there is no great development of cleavage and shearing parallel to the axial planes. None of the amphibolite sheets can be shown to post-date F_2.

Over much of the island an F_2 strain-slip cleavage is developed within the pelitic partings of the psammitic and semi-pelitic formations. It forms a microfold lineation in those mica plates orientated parallel to the axial planes of the F_1 structures. Its orientation is remarkably constant over much of the island. At Stusneset it is found superimposed upon a number of minor F_1 folds to form a great circle on a stereographic projection (Fig. 3d). In the pelitic rocks exposed between Finneidet and Bratteidet a typical F_2 strain-slip cleavage is developed with a south-westerly dipping axial plane. North of Isakeidet, however, an F_2 drag fold has an axial plane similar in attitude to that of the major fold on Trollfjell.

If a correction is made for the major faulting which crosses the island of Skjervøy on the northern side of the village, it is apparent that the three areas of F_2 folding lie on a single axial plane. As they also have the same axial plunge they are regarded as the now isolated fragments of a single fold, the Trollfjell synform.

C. The F_3 Deformation.

At Engnes and Mortevågen small horizontal crenulations and pinches in limestone and pelitic bands have a trend of 060°. In pelites at Bratteidet a very inconsistent strain-slip cleavage is developed at a small angle to the foliation and apparently post-dating the prominent F_2 strain-slip cleavage. Further evidence for an F_3 deformation is presented by a conjugate joint set which is occasionally developed in the meta-limestones and pelites at Mortevågen. These are approximately vertical with trends of 315° and 345°.

D. Faults.

The major faults appear to be developed along two principal directions of 055° and 080° and are either vertical or have a steep hade to the north. All the major jointing in the north end of the island is also in these planes. Within the Trollfjell synform faults with these trends have horizontal displacements and it is possible that this set is associated with the F_2 deformation.

The majority of faults have downthrows towards the north but do not normally show drag features, even when the movement has been substantial. The largest single fault trends at about 080° through Bratteidet and has an estimated downthrow to the north of 350 m. This is sufficient to bring the Skattefjellet psammites of Lailafjell against the quartzites of the Bratteidet formation. Eastwards this large throw is dispersed among a series of faults which cross the island to reach the sea less than half a mile south-west of Ramnneset. Here a fault throws F_2 folded psammites, pelites and semi-pelites on the north against the Prestberget formation to the south which is undisturbed by F_2. The faults which reach the sea immediately north of Ramnneset have downthrows to the south which may total 30 to 40 m.

Numerous small strike faults trending 060° to 070° with hades to the north of about 10° cut the psammites of Stusnesfjell and are well exposed at Stusneset. Many of these faults have small downthrows to the south but the trend is representative of the major joint set in the south of the island.

4. Discussion

A detailed correlation of stratigraphic units is hampered by rapid lateral changes in lithology and thickness, due mainly to the severe deformation suffered by these rocks. It follows that a detailed correlation with successions from other areas is unlikely to prove fruitful. On the larger scale, however, the broad divisions with a pelite group lying between a thick series of feldspathic sandstones on the one side and a calcareous group on the other corresponds with the successions established in the Loppen district (Hooper and Gronow, in press) and Sørøy (Sturt and Ramsay, 1965). In both these more northerly areas sedimentary structures prove the limestones to be the youngest of the three groups, and if correlation of the Skjervøy succession with these successions is accepted, then the former must be inverted. Unfortunately sedimentary structures are not available to confirm or disprove this.

The structures, too, bear a close comparison with those of the Loppen district. The earliest (F_1) is a set of tight asymmetric folds with axial planar basic sheets bearing the late-F_1 axial plane cleavage. These are the specific and rather unusual features of the F_1 in the Loppen district (Hooper and Gronow, in press). In both areas F_2 is a more open folding associated with a faint lineation caused by a crenulation of mica surfaces, while F_3 is mainly represented by faults and joint sets.

In the Loppen district the F_1 minor asymmetric folds are strictly congruous to the major F_1 closures. With this in mind the sense of vergence of the minor folds on Skjervøy implies that the whole island is on the inverted limb of a large overturned F_1 anticline facing west. Thus the F_1 structures provide strong independent support for believing the Skjervøy succession to be inverted and for its correlation with the successions of the Loppen district and Sørøy. The significance of Skjervøy in the regional pattern of the F_1 deformation has been discussed by Hooper and Gronow (in press).

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Appendix

Recent observations on the southern shore of Skjervøy and the opposite coast of Kågen

P. R. Hooper, D. E. Pearson and D. Lewis.

In the summer of 1967 brief visits were made to the shores of the low lying peninsula extending eastwards from the main mass of Kågen by P.R.H. and D.E.P., while D.L. independently spent a day on the good exposures on the southern shore of Skjervøy in a search for primary sedimentary structures.

Sedimentary structures were not found owing to the severe F_1 tectonism. However, while confirming the persistent sense of vergence of the F_1 minor folds over the greater part of the island as recorded by Ash, D.L. noted many clear and persistent examples of these folds verging in the opposite sense south of a line running through the centre of the lens of augen gneiss. He was thus able to confirm Ash's suggestion that the augen gneiss represents an F_1 fold closure.

On Kågen, to the south, the foliation is similar to that on Skjervøy (dipping gently south-east) with psammites in the north overlain to the south by a thin band of pelite and then limestone. Strongly developed minor F_1 folds have a sense of vergence similar to that recorded by D.L. south of the augen gneiss on Skjervøy. On the basis of the correlation suggested by Ash (above) and by Hooper and Gronow (in press) the major isoclinal F_1 fold thus identified crossing the southern end of Skjervøy is an anticline facing and closing westwards with an axial plane trace trending ENE-WSW and with a southerly overlying limb in the correct stratigraphic position. The apparent closure east-

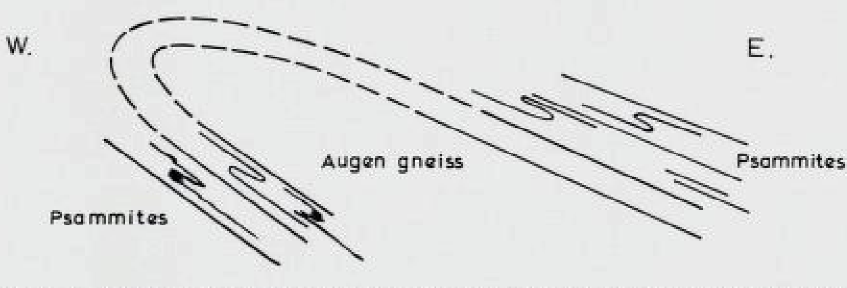

Fig. 1. Section of the F_1 anticline on the south of Skjervøy. The sense of vergence of the minor folds indicates that the anticline closes and faces west. The axis plunges gently to the south-east.

wards of the augen gneiss on Ash's map appears to be fortuitous. Augen gneiss typically develops as impersistent lenses in the Loppen District. The drag folds in fact indicate a closure westwards as indicated in Fig. 1. The apparent incongruous nature of the minor folds on Plate V of Ash's paper is not real. It is a consequence of recording "drag sense" as if the observer were looking north, when in fact the folds are plunging gently south. The "drag sense" should always be recorded on a map looking down plunge.

It is of particular importance to note that this major fold is not accompanied by a significant change in the foliation on a regional scale and can only be identified by repetition of lithological units and the sense of vergence of the minor F_1 folds. It would be surprising if other examples of major isoclinal F_1 folds, capable of repeating the succession on a regional scale, were not present in North Troms.

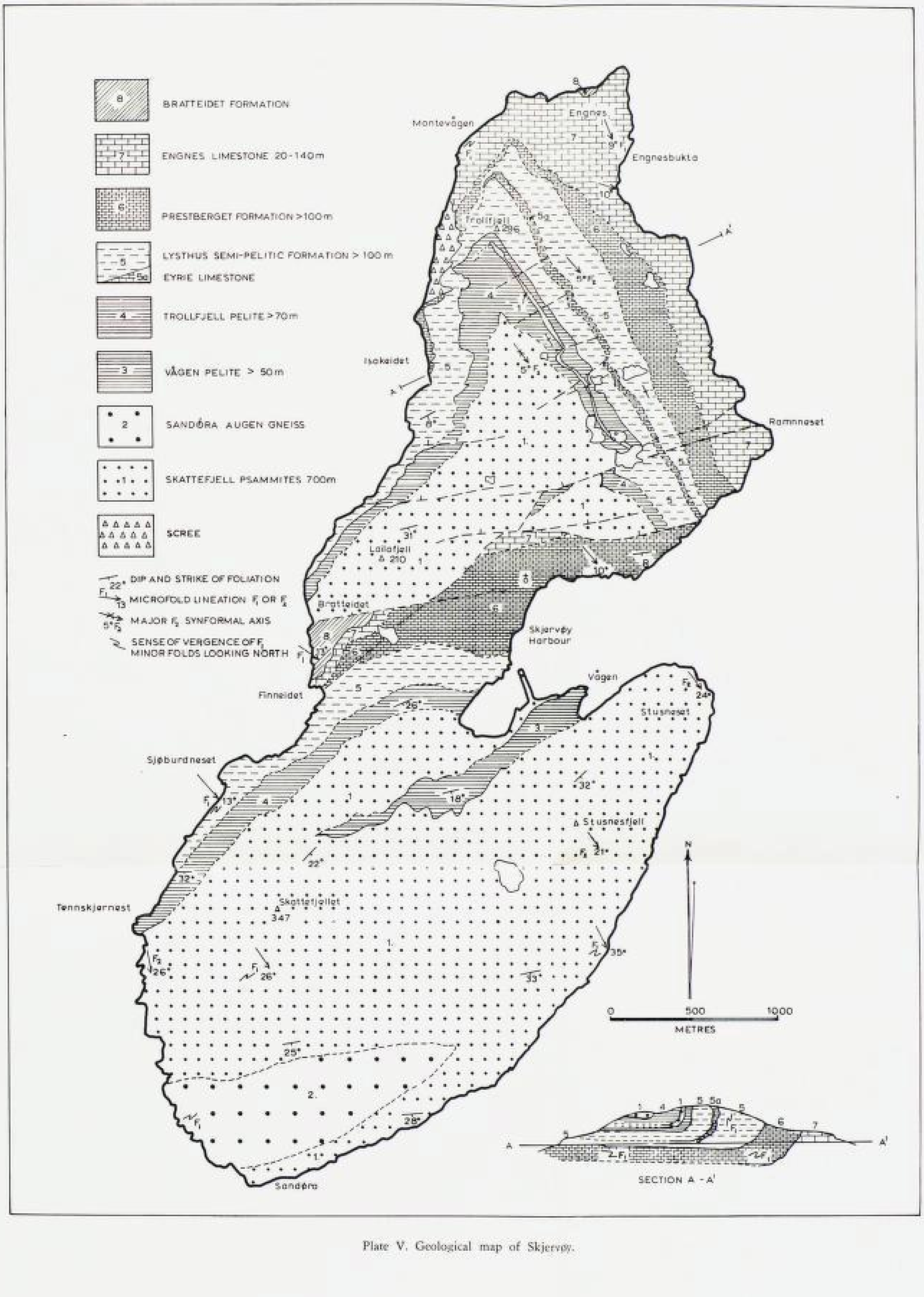

Plate V. Geological map of Skjervøy.