A POSSIBLE EQUIVALENT OF THE LAKSEFJORD NAPPE, SOUTH WEST OF PORSANGERFJORDEN, FINNMARK, NORWAY

D. MICHAEL WILLIAMS

Williams, D. M.: A possible equivalent of the Laksefjord Nappe, south west of Porsangerfjorden, Finnmark, Norway. *Norsk Geologisk Tidsskrift,* Vol. 56, pp. 7–13, Oslo 1976.

A hitherto unrecorded sequence of rocks from the west Stabbursdalen area, south west of Porsangerfjorden, is briefly described. The minimum thickness of this unit, which is considered to be allochthonous and provisionally named the Betusordda Nappe, is in the order of 600 m. The unit consists of quartzites, phyllites, and metasiltstones affected by lower greenschist facies metamorphism. The nappe exhibits a history of polyphase deformation. The first folds, of a flattened buckle type, have an associated axial planar foliation which is crenulated by later small scale folds. Both these fold types have axial directions trending approximately N–S. Later folds include N–S buckling and open E–W warps with some associated faulting.

In a brief discussion of the position of the nappe in the tectono-stratigraphy of the Finnmark Caledonides, it is proposed that the nappe probably represents part of the Laksefjord Nappe of mid-Finnmark.

D. M. Williams, Department of Geology, University College, Galway, Ireland.

The Betusordda Nappe

The Laksefjord Nappe (Føyn 1969) occupies the position of middle thrust unit in the Caledonides of central Finnmark. First described by Føyn (1960) as the Laksefjord Group, it comprises the Ifjord, Landersfjord, and Friarfjord Formations. The original unconformable relationship of this group with the underlying Precambrian crystalline basement is occasionally preserved above the basal thrust of the nappe. The rocks of the group, up to 6 kms thick, are metamorphosed to low greenschist facies grade and have undergone polyphase deformation (Føyn 1960, Gayer & Roberts 1971). Fig. 1 shows the position of the Laksefjord Nappe in Finnmark.

Reconnaissance field mapping in 1973 by the author revealed the presence of a hitherto unrecorded rock sequence in the west Stabbursdalen area, about half way between Altafjorden and Lakselv (Fig. 1). Although it was expected that the Kolvik, or Kalak, Nappe, a sequence of medium to high grade metasediments (Gayer 1971, 1973), would be seen to lie directly above the Gaissa Nappe (Rosendahl 1945, Roberts 1974), it was found that a tectonically intermediate unit outcropped in the upper western part of the Stabbursdalen valley (Fig. 2). The name Betusordda Nappe is suggested for this unit pending any further work, the name being taken from the area which it partly underlies in western Stabbursdalen.

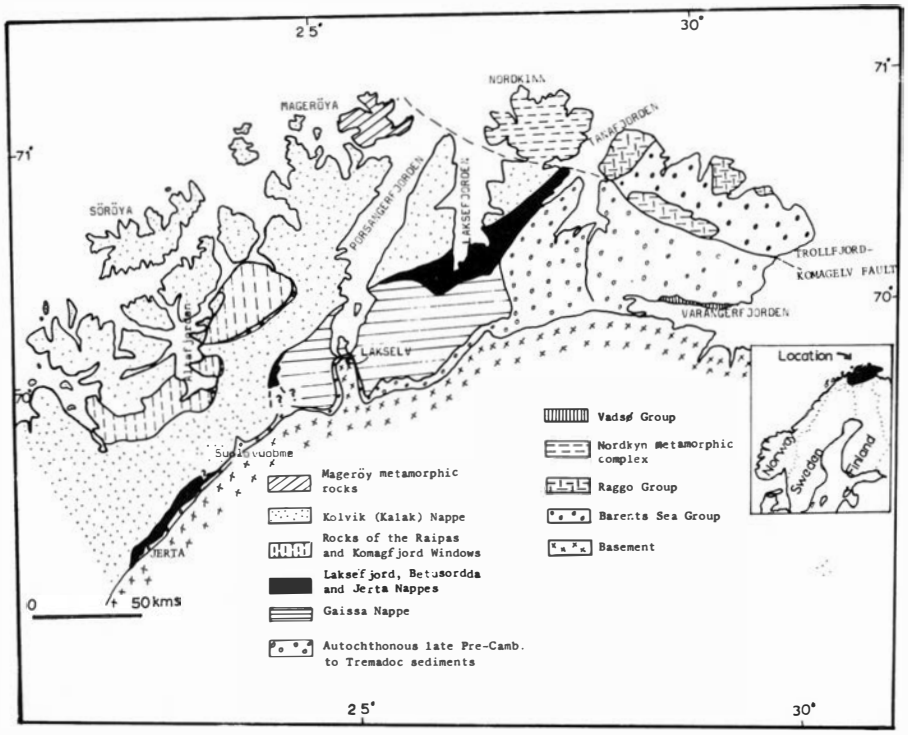

Fig. 1. The geology of the Finnmark Caledonides, showing the position of the Laksefjord Nappe and its suggested correlatives.

Stratigraphy and lithologies

No formal stratigraphy can be established at the moment due to tectonic complexity and the reconnaissance nature of the mapping. The succession so far examined has a minimum thickness of about 600 m, and consists of quartzites, conglomerates, phyllites, metasiltstones and grits. The rocks have been subject to lower greenschist facies metamorphism.

The stratigraphically lowest exposed rocks seen in the southwest corner (Unit A) of the mapped area comprise interbedded cream quartzites, metasiltstones, and phyllites; the base is not seen. Some of these dark siltstones are finely graded with small quartzite granules up to 5 mm across at the base grading up through dark siltstone to slaty pelite. The grading occurs in units measuring 15–20 cms in thickness. Some of the quartzites exhibit tabular cross bedding. In the extreme west of the mapped area, this interbedded unit with a minimum thickness of 200 m is overlain (?conformably) by a thick white quartzite (Unit B) with thin conglomerates (< 2 m) containing quartzite and jasper pebbles up to 10 cms in diameter. The thickness of this quartzite unit is unknown, although with a minimum of 300 m it is a very extensive lithology in the area. The relationship between the succession to the south (Units A and B) and that to the north (Unit X) is uncertain. However, it is suggested that they are partly equivalent (Table 1).

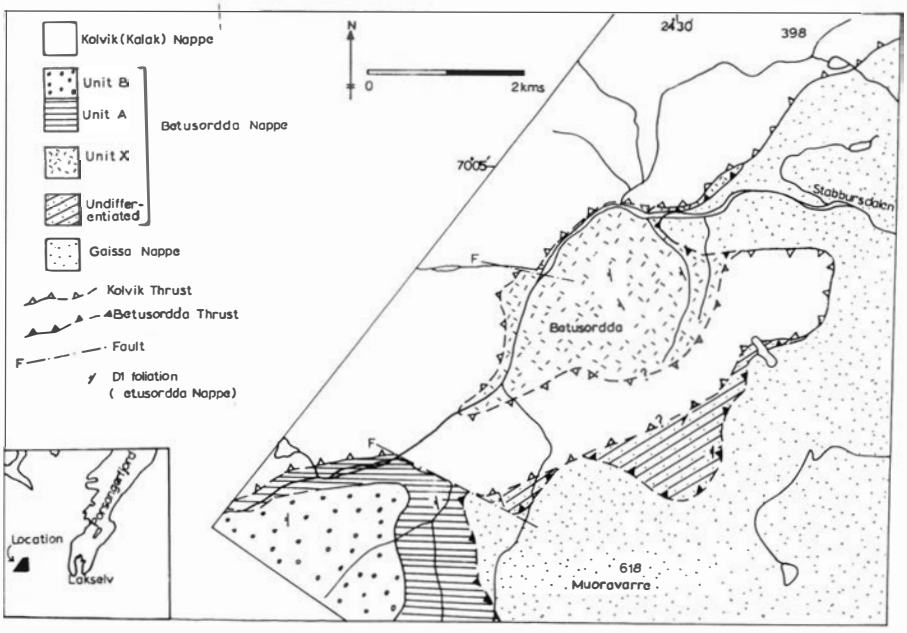

Fig. 2. Geological reconnaissance map of the western Stabbursdalen area.

The undifferentiated unit comprises rocks which are so poorly exposed as to make their relationship with other units impossible to ascertain. The northern exposures reveal rocks which appear to have been originally shales and silty sandstones; these have been transported to quartzose phyllites. The tectonic thickness of these rocks is in the order of 100–150 m. In the plateau area south of the Stabbursdalen valley, exposure in the undifferentiated unit is very limited, especially near the Betusordda-Gaissa Nappe contact. One exposure here, which may be of some importance, shows 5 m of quartzose conglomerate containing angular clasts of green and dark grey shale up to 20 cm in diameter. This conglomerate is set

Table 1. Provisional stratigraphy for parts of the Betusordda Nappe. Unit A may be the equivalent of Unit X.

Southern outcrops			*Northern outcrops*		
Quartzites (and conglomerates)	−300 m+	UNIT B	Kolvik (Kalak) Nappe		
			Kolvik Thrust		
			Metasiltstones and phyllites.	−70 m	
Interbedded graded metasiltstones and quartzites with phyllites. Base not seen	−200 m+	UNIT A	Phyllites with some sandstones and thin grits	−50 m	UNIT X
			Grits and conglomerates	−20 m?	
			Basal Thrust		
			Gaissa Nappe.		

in a (?)20 m thick sequence of gritty iron-rich sandstones. These sandstones are also found near the basal thrust of the nappe at the western end of the Stabbursdalen valley, where they overlie the Stabbursdal Interbedded Member of the Gaissa Nappe (i. e. the penultimate stratigraphical member of the Gaissa Nappe sequence, Williams 1974).

Structures of the nappe

The earliest structures recognized are recumbent folds on scales from microscopic to wavelengths of 5 m, with westerly dipping (5°–30°) axial planes. These are flattened buckle folds which show a well-developed pervasive foliation which becomes more obvious towards the base of the nappe. The axial trend of these early (D1) folds varies from 340° to 020°. Small scale thrusting is also associated with the folding.

The D1 foliation (S1) is seen in thin section to be axial planar to small attenuated flat-lying folds. Phyllites have a good fabric defined by small elongate quartz grains, aligned white mica, and iron minerals. Quartzite – pelite lithologies are seen to contain augened lenses of crushed quartz surrounding larger, strained quartz porphyroclasts. The S1 chlorite-quartz fabric is often emphasised by quartz grains with a preferred lattice and dimensional orientation. Calcite and epidote growth post-dates the formation of the S1 fabric.

A later phase of deformation, D2, is seen to have crenulated the early foliation. The crenulation, which sometimes forms a poor cleavage, occurs about conjugate axes, 330° and 040°, the NW axial trend being the more prevalent. Where present, the crenulation cleavage is high angled, usually dipping at around 50°. In thin section this cleavage, S2, has an associated growth of chlorite. Growth of hematite is seen to have occurred in two phases, one pre-D1 and one post-D1. Open buckle folds, with sub-vertical axial planes, deform the D1 foliation. These have wavelengths of about 10 m and trend approximately N–S. They affect all lithologies, and in view of their style it is likely that they represent a different phase of deformation to that which produced the S2 crenulation fabric.

A late stage feature is the formation of E–W open warps which fold S1 and the D1 thrusts. Associated with these late folds are small scale E–W normal faults and possibly E–W striking tension gashes. The scale of these folds varies from wavelengths of 2 m up to 500 m.

Correlation of the Betusordda Nappe

The Betusordda Nappe is distinguished from the underlying Gaissa Nappe by its stratigraphy, lithological associations, metamorphic grade and style of deformation. It is distinguished from the overlying Kolvik, or Kalak, Nappe by its lower metamorphic grade (of lower greenschist facies to the Kolvik's minimum of upper greenschist facies), differences in tectonic

style, chronology, and trends of folds, and its occurrence beneath the Kolvik Thrust. At the exposures closest to the thrust plane itself (within 1 m) the Kolvik rocks are virtually featureless dark mylonites. This mylonitisation does not extend to the immediately underlying rocks of the Betusordda Nappe. The basal thrust of the Betusordda Nappe is nowhere exposed but the lithologies and structures involved are so distinct from those of the Gaissa Nappe that its position can be traced with a fair degree of accuracy.

In the context of the Finnmark Caledonides the Betusordda Nappe would appear to be tectonically equivalent to the Laksefjord Nappe. Føyn (1960) described the stratigraphy of the Laksefjord Group in the Laksefjorden area. It comprises three formations here:

(Top) Friarfjord Formation – black phyllite with quartzite layers in the lower part. (Variable thickness).

Landersfjord Formation – light quartzite with horizons of quartzite and jasper pebble conglomerates. (Variable thickness).

(Base) Ifjord Formation – light conglomerate, dark greenish phylite, and dark conglomerate. (Variable thickness).

The total estimated thickness is in the order of 6000 m. All units of the group are laterally variable both in thickness and lithology.

Starting from the highest lithostratigraphic unit so far recognised in the Betusordda Nappe certain lithological comparisons may be made. The Landersfjord quartzite, a thick (over 1000 m) quartzite sequence contains conglomerate horizons, the clasts being in part of red jasper. Red jasper clasts have also been noted from the conglomerates of unit B of the Betusordda Nappe. Underlying this, unit A may be, by implication, equivalent to the Ifjord Formation. No tillites have been identified near the base of the Betusordda Nappe, but gritty sandstones are common and in one locality a grit containing a localised conglomerate horizon with large (20 cm diameter) clasts of green shale has been noted. The facies variation in the Ifjord Formation is marked (Føyn 1960, Laird 1972) and certain similarities can be seen between unit A and the finer conglomerate facies of Laird (op. cit.). The thicker (5–10 m) quartzites of unit A appear to have no equivalents in the lithologies of the Ifjord Formation. However, in view of the significant facies variation within the sediments, such differences cannot be held to preclude any future detailed stratigraphic correlation.

The structures of the Laksefjord Nappe around the head of Laksefjorden are summarised in Table 2. Sequence and style of deformation can be seen to bear marked similarities to that of the Betusordda Nappe.

Thus, a correlation between the Laksefjord and Betusordda Nappes is attractive for the following reasons:

The structural position of both nappes in the Finnmark Caledonides is identical, i.e. both lie structurally below the Kolvik Nappe and above the Gaissa Nappe.

Table 2. Comparison of deformation in the Laksefjord and Betusordda Nappes. Laksefjord structures after G. D. Williams (pers. comm.) and J. S. Noake (1974).

	Laksefjord Nappe		*Betusordda Nappe*
D1	N–S asymmetric flattened folds		N–S asymmetric flattened folds
D2	000°–050° crenulation and folding	Metamorphism	330°–040° crenulation (? and folding)
D3	N–S crenulation and chevron folds		Not distinguished
D4	Open N–S or 070° conjugate folds		Open N–S buckles
D5	Approx. E–W large warps and faulting		Approx. E–W large warps and faulting

Lithologically the nappes are not impossibly different, especially when the significant facies variation within the Laksefjord Group is borne in mind.

The structural events and styles in both nappes are comparable, as is the metamorphism.

The Jerta Nappe, occurring some 40–70 km to the south-west of the Stabbursdalen area, has been described by Skjerlie & Tan (1961). It is possible that the north-east part of this nappe, which includes a tillite horizon, could be equivalent to the Laksefjord Nappe (K. B. Zwaan, pers. comm.). The position of the Jerta Nappe in Finnmark (Fig. 1) is in close proximity to the outcrops of the Betusordda Nappe. A tectonic equivalence seems likely but the stratigraphy of the Jerta and Betusordda Nappes is not yet well enough understood to make correlation any more positive.

Conclusion

The correlation of the Betusordda and Laksefjord Nappes cannot be proven by tectonic or lithological similarities. However, their similar position in the Finnmark Caledonides, together with their similarity in metamorphic grade and structural histories, invites the tentative conclusion that they may be derived from similar zones of the Caledonian orogen. The apparent absence of a middle thrust unit around Suolovuobme (Fig. 1) and its possible reappearance further south-west as the Jerta Nappe suggest either deposition of the sediments in distinct basins, or the presence of syn-thrusting tectonic highs, or both. The autochthononous tillite-bearing sediments of the Alta and Komagfjorden windows (Føyn 1964, Roberts & Fareth 1974) are in close proximity to the Betusordda Nappe. If the Ifjord conglomerate is the equivalent of the Vendian tillites of Finnmark (Laird 1972) and the Laksefjord Group is not the lowest unit of the so-called Finnmark Supergroup (Siedlecka 1973), then these autochthonous sediments are equi-

valent in age to the sediments of the Betusordda Nappe. This suggests that they were deposited nearer the continental margin than the Betusordda Nappe sediments and possibly overridden by the Laksefjord-Betusordda-Jerta Nappe(s) during orogeny.

Acknowledgements. – I am indebted to all members of the Cardiff Arctic Norway Expedition 1971–1973, financial support for which was provided by a N.E.R.C. grant to R.A. Gayer (U. C. Cardiff). I also thank Mr. A. Gwynn, who first drew my attention to these rocks and provided information concerning them. I am grateful to Mr. G. D. Williams and Dr. J. S. Noake for all the structural information pertaining to the Laksefjord Nappe. My thanks are extended to Drs. R. A. Gayer and D. Roberts for critical reading of the manuscript.

The author's financial support was provided by a N. E. R. C. research studentship.

May 1975

REFERENCES

Føyn, S. 1960: Tanafjord to Laksefjord. In *Aspects of the Geology of Northern Norway*. Ed. J. A. Dons, Guide to excursion A3, 21st. Intern. Geol. Congress, Norden, 1960, 45–55. Oslo.

Føyn, S. 1964: Den tillittførende formasjongruppe i Alta – en jevnføring med Øst-Finnmark og med indre Finnmark. *Nor. Geol. Unders. 228,* 139–150.

Føyn, S. 1969: Laksefjord-gruppen ved Tanafjorden. *Nor. Geol. Unders. 258,* 5–16.

Gayer, R. A. 1971: The stratigraphy of the Kolvik Nappe of west Porsanger. *Nor. Geol. Unders. 269,* 295–306.

Gayer, R. A. 1973: Caledonian geology of Arctic Norway. *Am. Assoc. Pet. Geol. Memoir 19* (Arctic Geology), 453–468.

Laird, M. G. 1972: The stratigraphy and sedimentology of the Laksefjord Group, Finnmark. *Nor. Geol. Unders. 278,* 13–41.

Noake, J. S. 1974: The geology of inner Sværholthalvøya, Finnmark, north Norway. Unpub. Ph. D. thesis, Cardiff Univ. Coll.

Roberts, D. & Fareth, E. 1974: Correlation of autochthonous stratigraphical sequences in the Alta-Repparfjord region, west Finnmark. *Nor. Geol. Tidsskr. 54,* 123–129.

Roberts, J. D. 1974: Stratigraphy and correlation of Gaissa Sandstone Formation and Børselv Subgroup (Porsangerfjord Group), south Porsanger, Finnmark. *Nor. Geol. Unders. 303,* 57–118.

Rosendahl, H. 1945: Prekambrium-Eokambrium i Finnmark. *Nor. Geol. Tidsskr. 25,* 327–349.

Siedlecka, A. 1973: The late Precambrian Øst Finnmark Supergroup – a new lithostratigraphic unit of high rank. *Nor. Geol. Unders. 289,* 55–60.

Skjerlie, F. J. & Tan, T. H. 1961: The geology of the Caledonides of the Reisa valley area, Troms, Finnmark, northern Norway. *Nor. Geol. Unders. 213,* 175–196.

Williams, D. M. 1974: The geology of the northern parts of the Gaissa Nappe, Finnmark, north Norway, Unpub. Ph. D. thesis, Cardiff Univ. Coll.