The Stratigraphy of the Magerøy Supergroup, Finnmark, North Norway

TORGEIR BJØRGE ANDERSEN

Andersen, T.B. 1984: The stratigraphy of the Magerøy Supergroup, Finnmark, North Norway, *Nor. geol. unders. Bull 395*, 25–37.

The Magerøy Supergroup comprises a sequence of Lower Silurian and possibly Upper Ordovician metasediments with a minimum stratigraphic thickness, uncorrected for tectonic strain, of 5.5 km. These are structurally positioned within the Magerøy Nappe, which was emplaced during the Scandinavian (Scandian) phase of the Caledonian orogeny. The lower part of the sequence, the Kjelvik Group (900 m), represents a basinal assemblage of distal (bottom) to proximal (top) turbidites. These are overlain by sediments of the younger Nordvåg Group (2180 m), which were probably deposited in a shelf environment. The uppermost unit, the Juldagnes Formation (2400 m), comprises flysch-type turbidites. It is likely that these turbiditic sediments developed as a result of increased tectonic activity which preceded the climax of the Scandinavian deformation phase.

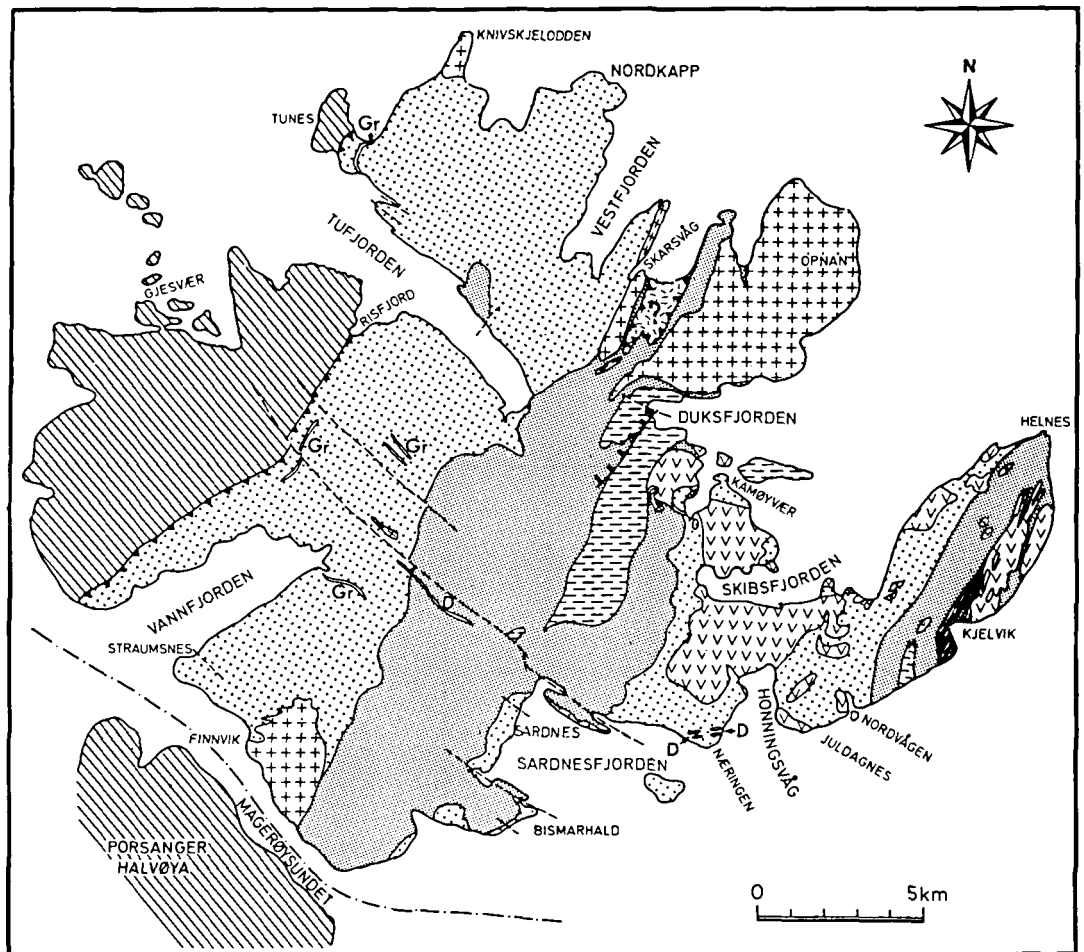
T. B. Andersen, Geologisk Institutt Avd. A, Allégt. 41, Universitetet i Bergen, N–5014 Bergen, Norway

Introduction

The metasediments on the island of Magerøy form a sedimentary sequence with exposed stratigraphic thickness of approximately 5.5 km (Curry 1975). In eastern Magerøy, where this thickness has been estimated, the sequence is not repeated by folding, but the thickness is uncorrected for tectonic strain. The metasediments are structurally positioned in a major allochthonous unit, the Magerøy Nappe, which was emplaced during the Scandinavian phase of the Caledonian orogeny (Ramsay & Sturt 1976, Andersen et al. 1982). Although forming part of the orthotectonic Caledonides, the eastern part of the nappe (Fig. 1) has a relatively low state of deformation and regional metamorphism (Andersen 1979, 1981), and the stratigraphic type section (Fig. 2) has been established in these areas. The middle and upper parts of the Magerøy Supergroup succession are fossiliferous and a Lower Silurian age has been established for these rocks. The fossiliferous strata are, however, underlain by a considerable thickness of sediments where no fossils have been found, and it is therefore possible that this part of the sequence is of Upper Ordovician or older age. The Silurian and possibly Ordovician rocks on Magerøy represent an isolated klippe, and rocks of similar age in northernmost Norway are found only in the Vaddas–Kåfjord area and west of the Lyngen gabbro in Troms approximately 250 to 300 km southwest of Magerøy (Binns & Gayer 1980, Bjørlykke & Olaussen 1981). Both of these areas has a development of Lower Silurian carbonate rocks which may represent time-equivalents of the limestones on Magerøy; however, the age of the limestones in the Magerøy and the Kåfjord areas has not been precisely determined and direct stratigraphic correlation between these areas in Finnmark and north Troms thus awaits further detailed studies.

Prior to the discovery of a Lower Silurian fauna in 1959–60 (Henningsmoen 1961, Føyn 1967), the rocks of Magerøy were lithostratigraphically correlated with the autochthonous Eocambrian (Vendian) rocks of East Finnmark. This was essentially based on the similarity between a lithology known as the 'Duksfjord tillite' on Magerøy and the tillites of East Finnmark (Holtedahl 1944). The finds of fossils both east and west of the major igneous complex, (Fig. 1) however, led Føyn (1967) to conclude that the Duksfjord 'tilloid' represented an intraformational Silurian conglomerate. This conclusion has since been supported by additional finds of fossils, and the establishment of an internal stratigraphy in the metasediments of the Magerøy Nappe (Curry 1975, Andersen 1979).

The first attempt to subdivide and interpret the Magerøy succession was made by Curry (1975), who divided the metasediments into three groups; the Kjelvik Group, the Nordvågen Group and the Juldagnes Group. In the re-investigation



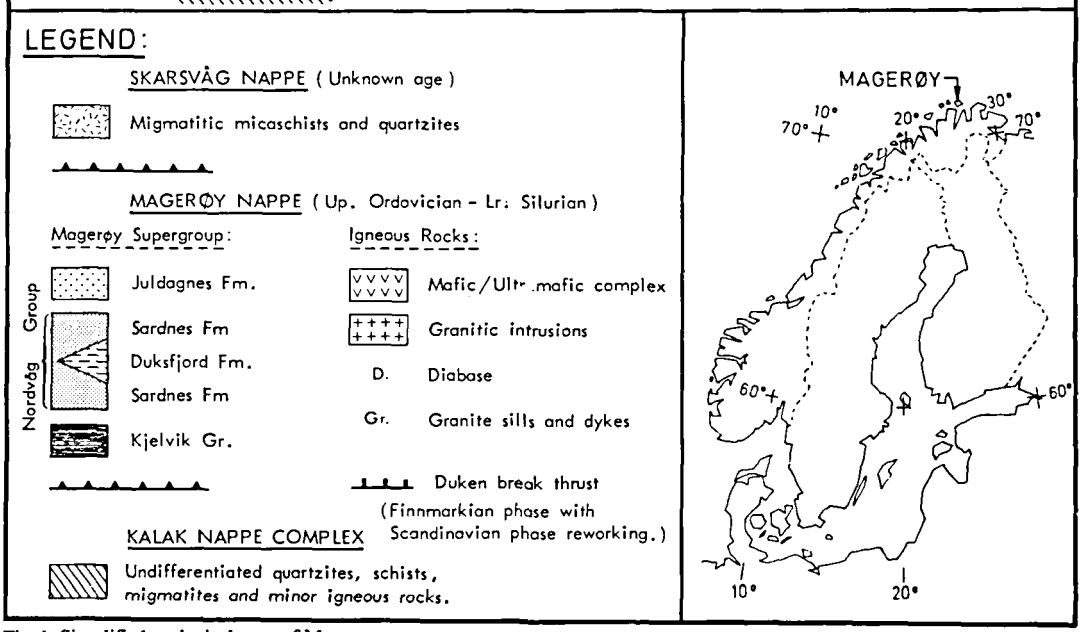


Fig. 1. Simplified geological map of Magerøy.

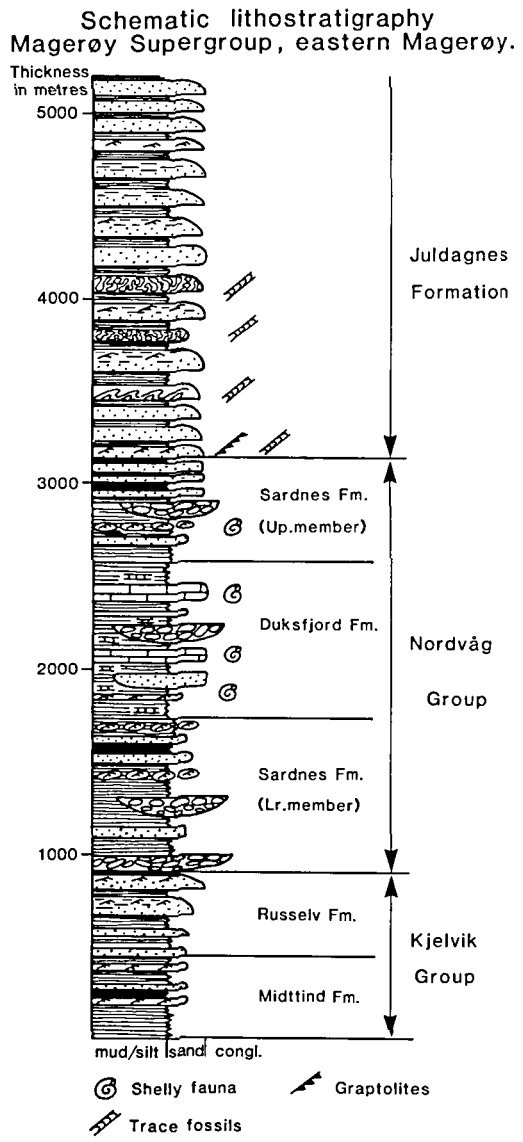


Fig. 2. General stratigraphic section of the Magerøy Supergroup showing the types of sediments within each stratigraphic unit. The stratigraphic thicknesses shown are from eastern Magerøy. The individual beds shown are not to scale thickness.

by the present author, which has been particularly concerned with the two upper units, the main stratigraphical boundaries of Curry (1975) have been maintained, but the units have been subdivided further and a revised interpretation, particularly for the Nordvåg Group (ex-Nordvågen Group) is presented. This stratigraphic scheme has also been adopted on the published 1:250,000 map-sheet 'Nordkapp' (Roberts 1981).

The main object of this paper is to report on the general characteristics of the sedimentary rocks of the Magerøy Supergroup and define the lithostratigraphy. The evolutionary model which is described towards the end is a provisional interpretation based on a limited amount of detailed logging in this very thick sedimentary sequence.

Lithostratigraphy of the Magerøy Supergroup

The component units which constitute the Magerøy Supergroup are shown in Figs. 1 and 2 and are described in a more formal manner in the appendix (p. 36).

The Kjelvik Group

Only reconnaissance work has been carried out by the present author in this unit. The observations cited here are therefore essentially based on the descriptions given by Curry (1975).

The Kjelvik Group crops out in a limited are around the village of Kjelvik on eastern Magerøy (Fig. 1) where it is exposed in the hinge of a major recumbent anticline (Andersen 1981). The minimum thickness is 900 m and the base of the unit is not exposed. The group shows an overall coarsening-upward sequence, reflected by increasing amounts of coarser and thicker beds of greywacke towards the top of the unit. Curry's subdivision into three formations was based essentially on the amount of greywacke in relation to pelitic material. The two upper units of Curry (1975) are, however, very similar in the type of sedimentation, and have been grouped together into one formation, the Russelv Formation. The *Midttind Formation,* which constitutes the lower 470 m of the Kjelvik Group, consists mainly of laminated mudstones and siltstones interbedded with rippled and laminated fine-grained sandstones. The *Russelv Formation,* formerly called the Transition and Kjelvik formations, comprises typical turbidite deposits characterized by more frequent and thicker beds of greywacke towards the top. Approximately 40% of the lower 200 m of the Russelv Formation comprises greywackes, while the upper 220 m is dominated by greywackes and other psammitic lithologies (Curry 1975).

The change in facies from laminated and rippled fine-grained sandstones in a succession dominated by pelites, to a facies with coarser greywackes with virtually complete Bouma sequences

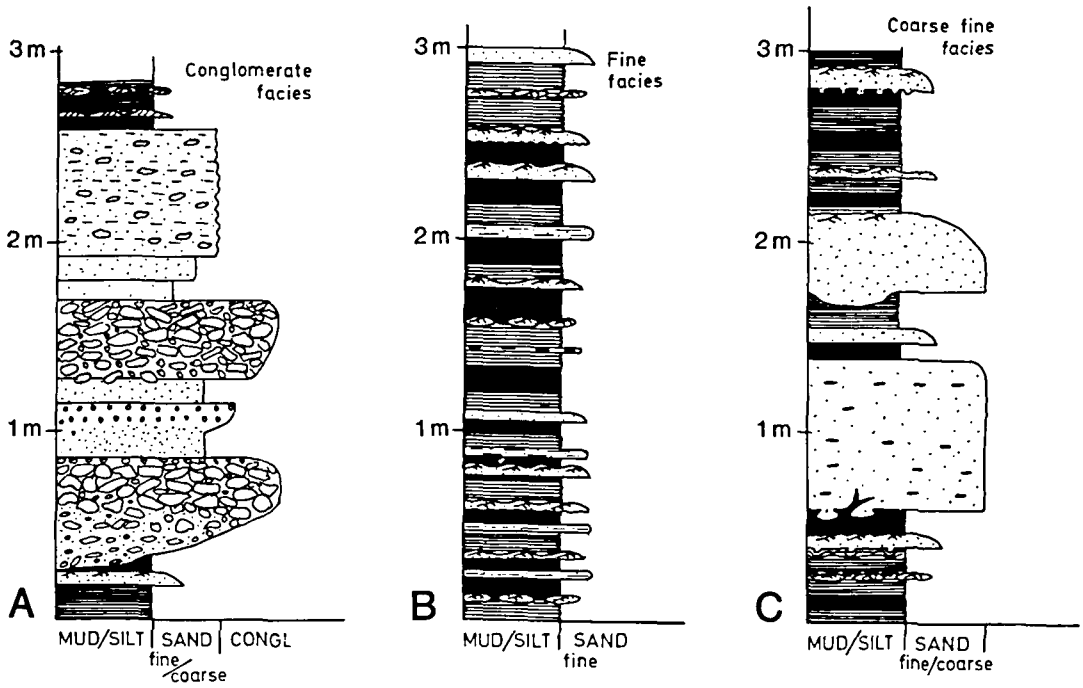


Fig. 3. Typical profiles of (A) conglomerate facies (Locality UTM 512741), (B) fine facies (Locality UTM 537768) and (C) coarse-fine facies (Locality UTM 504723) in the Sardnes formation; map-sheet Magerøysundet 2036 I.

	Facies A	*Facies B*	*Facies C*
Grain size	Pebbles max. 50 cm. Matrix silt/sst.	Very fine to fine sst. Interbedded mud/siltst. Coarser material rare.	Med. to coarse sst. Intraform.mud. clasts <5 cm. Fine material as in B.
Internal structure	Congl. often rev. graded, sst. homogeneous.	Sst graded, cross and parallel lam. Mud/siltst. homogeneous or parallel lam.	Sst homogeneous, sometimes graded, and with cross- and parallel lam. Fine material as in B.
Bed thickness	Congl. 0.15–2.5 m Sst 0.05–2 m.	Sst 0.01–0.30 m Silt/mudst. <0.50 m.	Sst. 0.15–1.5 m Fine material as in B.
Nature of bed surface	Congl. up. flat, lr. wavy or erosional Sst parallel bedded.	Sst parallel, wavy or lenticular. Mud/siltst. parallel bedded.	Sst lr. wavy often erosional, loading common. Up. flat or transitional.
Lateral persistence	Lensoid.	Thicker sst persistent.	Sst persistent.

is taken to represent a transition from distal to proximal turbidite deposits. This change in depositional environment could represent a progressive shallowing of the basin. A model of this kind to explain the coarsening-upward sequence of the Kjelvik Group is in accordance with the depositional environment suggested for the younger Nordvåg Group which overlies the Kjelvik Group without any visible stratigraphic break, and which below is suggested to have been deposited in a shelf-type environment.

THE NORDVÅG GROUP

The metasediments within the Nordvåg Group show marked lithological variation and their precise interpretation and mutual relationships are not fully understood. The group is divided into two units, the Sardnes Formation and the Duksfjord Formation. The stratigraphy of the Nordvåg Group is somewhat complicated as the Duksfjord Formation appears to form a discontinuous wedge within the Sardnes Formation. Thus, where the Duksfjord Formation is developed, the Sardnes Formation comprises a lower and an upper member (Fig. 2).

The Sardnes Formation comprises almost entirely epiclastic material, with only a few thin limestone horizons found in the area 2–3 km

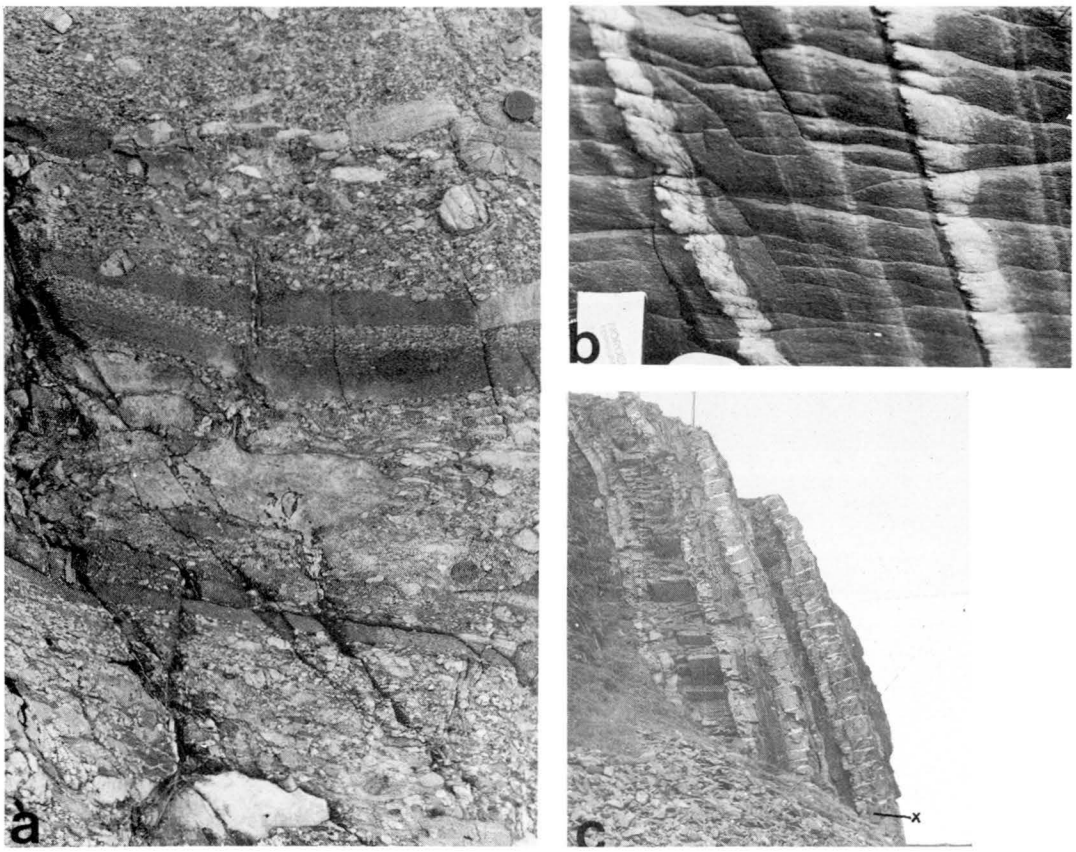


Fig. 4. a) Conglomerate and coarse sandstones from the Nordvåg Group, younging upwards. The limestone fragment in the centre is 45 cm long. Some of the intraformational pebbles have their internal bedding preserved (top right). Locality northeast of Nordvågen. The conglomerate unit are frequently graded, with the larger fragments concentrated in the central or upper parts of the beds. Note also pressure-solution and crystallization phenomena associated with the limestone fragments.
b) Laminated mudstones/siltstones interlayered with thin, graded and rippled sandstones, possibly representing storm-sand deposits in the fine facies of the Sardnes Formation. The sediments are younging to the right, and the lower bed surfaces of the sandstones are disturbed by loading. The flat-lying planar structure is the S1 cleavage. Locality west of Sardnes.
c) Interlayering of coarse sandstones and mudstones/siltstones of the coarse-fine facies of the uppermost part of the Sardnes Formation. The sequence is younging towards the right; for scale, person marked X. Locality west of Sardnes.

northwest of Sardnes. From these limestones crinoid fragments have been recorded (Føyn 1967). Three main facies have been distinguished in the Sardnes Formation, of which two probably represent a relatively shallow-marine environment. Most distinctive is the *conglomerate facies* (Fig. 3a) which can occur at several stratigraphic levels throughout the formation, and invariably as lensoid bodies. The lenses commonly comprise several conglomerate beds interlayered with medium-to coarse-grained sandstones (Fig. 4a). The conglomerate beds frequently show reverse grading. Pebbles belong to two main groups; 1) extraformational and 2) intraformational derived material. The former, comprising several different lithologies, is dominated by well rounded pebbles of metamorphic quartzites and vein quartz. The maximum observed size of the extraformational pebbles is 20 cm. Less common pebbles of this group are of granites, granitic gneiss and rarely also gabbroic rocks. More than 50% of the pebbles consist of intraformational rocks and include sandstones, shales and also limestones similar to those of the Duksfjord Formation. Internal structures such as bedding and lamination are commonly preserved in the pebbles showing that some of the material was partly lithified prior to erosion and redeposition. The intraformational pebbles are variably rounded indicating a non-uniform distance of transport and resistance to rounding. The clasts of this group commonly have sizes up to 30 cm.

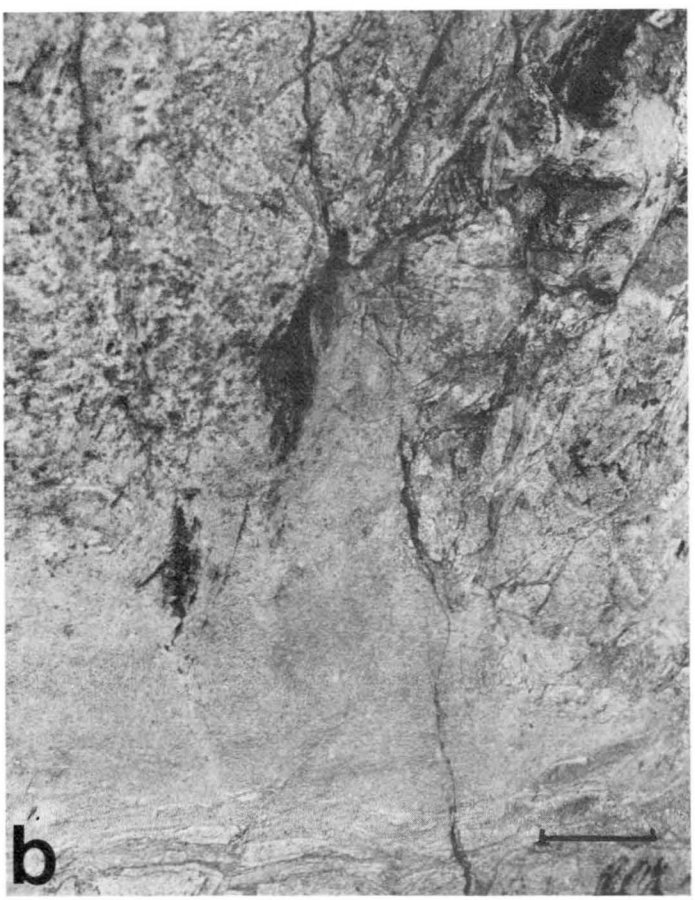


Fig. 5. a) Tillite-like Duksfjord conglomerate probably representing a submarine scree or mass-flow deposit. The limestone and sporadic quartzite fragments rest in a matrix of homogeneous brown pelitic material, and no internal stratification can be discerned.
b) Base of the Duksfjord conglomerate showing deformation of the underlying sediments, and a diapir of the silty material intruding the base of the conglomerate. Scale bar 5 cm.

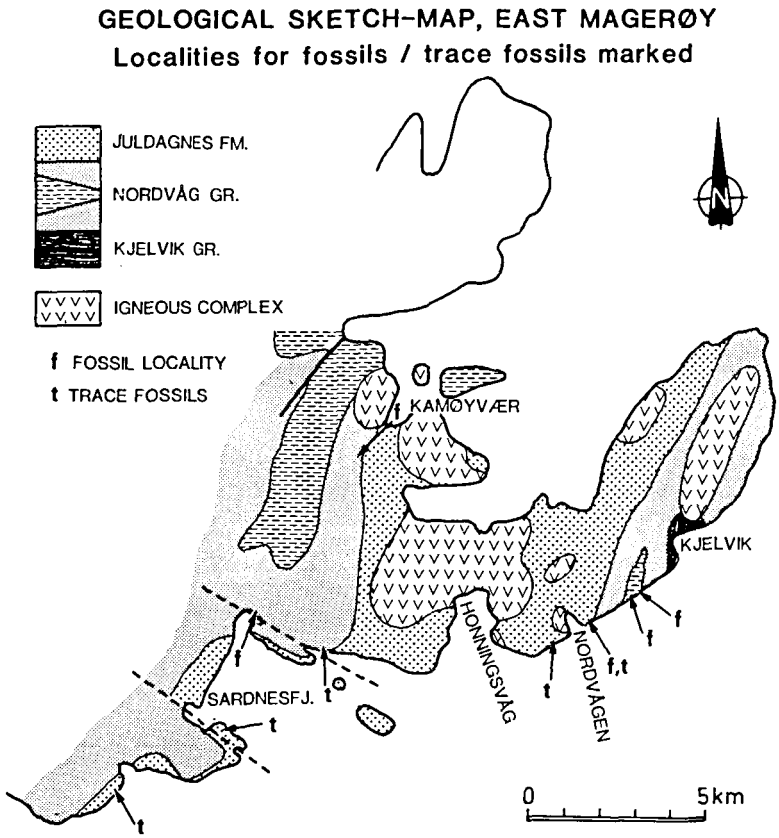


Fig. 6. Sketch map of eastern Magerøy showing fossil and trace fossil localities.

Conglomerates of this type also occur within the Duksfjord Formation, and these contain abundant limestone fragments which have sometimes preserved crinoid fragments.

The *fine facies* constitutes approximately 90% of the Sardnes Formation (Fig. 3b). It consists of lenticular and laterally persistent layers of fine-grained to very fine-grained sandstones which are rippled or parallel-laminated. Bed thicknesses vary between 1 cm and 30 cm, and the thicker sandstones are laterally persistent. The lower surfaces of these are commonly disturbed by loading (Fig. 4b). The lenticular sandstones are formed by isolated ripples, and the sandstones are interbedded with brown and black mudstones (now largely phyllites and mica schists) and with grey siltstones which are often parallel-laminated.

The *coarse-fine facies* of the Sardnes Formation is particularly common in the upper 60 m of the formation. It is characterized by the interbedding of laterally persistent medium-to coarse-grained sandstones and siltstones/mudstones with subordinate fine-grained sandstones (Fig. 3c, 4c). The coarse sandstones are dominantly of arkosic composition, and sometimes contain intraformational mud clasts. The normal thickness of the beds is between 15 cm and 1.50 m. The lower bed surfaces are often erosional and disturbed by loading. The sandstones are commonly homogeneous, although grading and an ill-defined parallel lamination and in some rare cases ripple cross-lamination have been identified. The interbedded finer material is similar to that of the fine facies already described.

The depositional environment of the Sardnes Formation cannot be precisely identified from our present knowledge of these rocks. However, it is suggested that it was a marine shelf environment, where the fine facies was representative of shelf mud and storm sand deposits (Reinech & Singh 1975). The conglomerate facies was probably formed by transport and deposition of mass-flows in channels, and these might have represented feeders to a deep-water fan system (Walker 1978). The coarse-fine facies is found in the upper 60 m of the formation and probably represents a transitional facies to the turbidites of the Juldagnes Formation described below.

The Duksfjord Formation is laterally disconti-

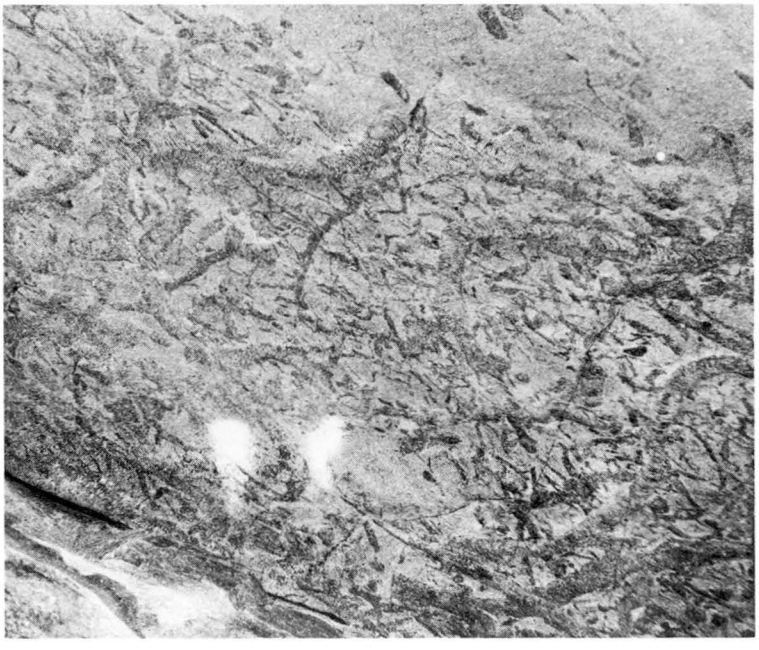


Fig. 7. Bed surface with trace fossils, including *Scolitia plana* and *Chondrites sp.* from the lower part of the Juldagnes Formation, northeast of Sardnes. Scale 5 cm long.

nuous, and lies as a wedge within the Sardnes Formation. The most characteristic feature of the Duksfjord Formation is the abundance of calcareous rocks. A large portion of the formation comprises originally calcareous mudstones and siltstones which as a result of the strong metamorphism and deformation now occur as calcareous phyllites and mica schists. Relatively pure limestones, now marbles, are developed in some places, and in the Sardnes-Duksfjord region in central Magerøy these have considerable thicknesses. In this area 4 major limestone (marble) horizons occur, one of which can be traced 6 km along strike. Some of the limestones pass laterally into mudstones and siltstones, now mica schists, and this lateral facies change takes place by interfingering over distances of 20 to 30 m. Such features might originally have represented mound-shaped bioherms, but the limestones in central Magerøy are usually too deformed and recrystallized to have allowed the preservation of fossils or other primary structures. Locally, however, crinoid fragments and ill-preserved colonial corals have been observed (Curry 1975).

Interbedded with the calcareous facies are abundant epiclastic rocks which range from grey mica schists, metasandstones and orthoquartzites to conglomerates. The conglomerates contain abundant intraformational angular clasts, often dominated by limestones, thus indicating their local derivation. A dramatic example of locally derived material is found in the lensoid conglomerate previously known as the Duksfjord tillite (Holtedahl 1944). This conglomerate is apparently internally structureless, matrix-supported and has a maximum thickness of approximately 20 m. The angular pebbles consists of limestones up to 40 cm across, and they rest in an originally unsorted, calcareous mud-rich matrix (Fig. 5a). The conglomerate has severely disturbed the underlying sediments during deposition, and clastic dykes derived from these intrude the base of the conglomerate indicating the soft-sediment origin of the distortion (Fig. 5b). The earlier interpretation of this unit as a tillite seeks no support in structures observed within or associated with this lithology, and as suggested by Føyn (1967) it represents an intraformational Silurian conglomerate. The most likely explanation is that it represents a submarine scree deposit, possibly reef talus, or slumped material on a tectonically unstable shelf which during a short transport and deposition liquified its substrate of unconsolidated marine sediments (Andersen 1979).

The Duksfjord Formation is a very important part of the Magerøy Supergroup as it has the most diagnostic shallow-water facies and contains a relatively diverse faunal assemblage. Fossils are known from several localities (Fig. 6), and a variable shelly fauna has been recognised. Unfortunately, no systematic collection or detailed

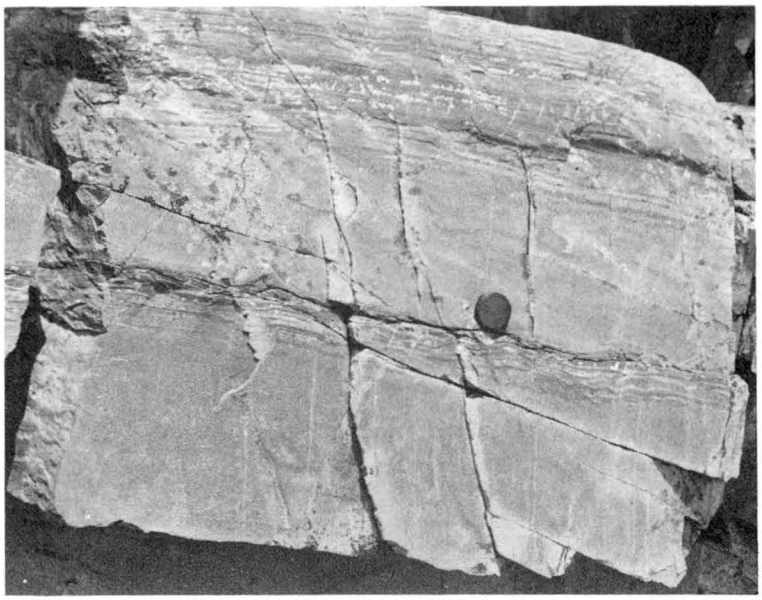


Fig. 8. Typical turbidites of the Juldagnes Formation with divisions a, b, c and d of the Bouma sequence developed. Way-up towards the top. Locality between Juldagnes and Nordvågen. Scale, 6 cm.

palaeontological work has been carried out, but the fauna presently recognised includes crinoids, favositids, halysitids, rugose corals and brachiopods. An early examination of material from Magerøy (Henningsmoen 1961) indicated a Lower Silurian age, but no definite stratigraphic age has yet been determined for this part of the sequence.

Although characterized by the calcareous lithologies, the Duksfjord Formation contains a large portion of epiclastic material which shows that an influx of clastics periodically dominated over carbonate sedimentation. The interlayering of calcareous and clastic material indicates that the depositional environment was unstable, possibly as a result of tectonic instability on the shelf itself as indicated by the Duksfjord conglomerate.

THE JULDAGNES FORMATION

The uppermost stratigraphic unit of the Magerøy Supergroup, the Juldagnes Formation, is a flysch-type sequence with a minimum stratigraphical thickness of 2400 m. The faunal control of this formation is limited, and is represented only by one locality where *Monograptus sandersoni* have been identified (D. Skevington pers. comm. in Sturt et al. 1975). This occurs at the base of the Juldagnes Formation, and indicates a Lower Llandovery age. In addition to this single locality with body fossils, trace fossils are relatively common and are found at several stratigraphic levels (Fig. 6). The ichnofauna includes *Chondrites*, *Scolitia plana* and *Protopalaeodictyon* (Fig. 7).

The entire Juldagnes Formation is characterized by a rhythmic interlayering of graded grey-green greywackes and black-brown pelites. The turbidites exhibit well preserved Bouma sequences, frequently with several divisions of the Bouma sequence present (Fig. 8). The graded units are mainly classical turbidites (Walker 1978), although both proximal and distal varieties occur. However, no systematic variation in the type of sedimentation in the Juldagnes Formation has been recorded, and it appears to have a uniform development throughout its total stratigraphic thickness. A section measured in a road-section between Juldagnes and Nordvågen illustrates this monotonous development (Fig. 9). The lack of marker horizons has also made further stratigraphic subdivision difficult.

In the type area between Nordvågen and Sardnes a number of sedimentary structures are well preserved (Fig. 10). These include soft sediment deformation structures, channel structures and sole markings. The erosive nature of some of the thicker turbidites is shown both by the locally developed intraformational conglomerates and by the channels.

When unfolded around the F1 and F2 fold axes (Andersen 1981) the palaeocurrent directions recorded from the turbidites indicate a northeasterly derivation of the sediments. The exact significance of this result, however, is uncertain as the possibility of rotational movements during

the emplacement of the Magerøy Nappe cannot be ruled out.

AN EVOLUTIONARY MODEL

Although detailed sedimentological studies remain to ble completed and even though the orogenic deformation during the late Silurian Scandinavian (Scandian) phase partly destroyed the primary sedimentary structures, it appears that enough data are now available to suggest a provinsional model for the evolution of the Magerøy Supergroup. The general pattern of the sedimentological development in the Magerøy Nappe appears to be the result of two large-scale cycles of sedimentation. The first is represented by the Kjelvik and Nordvåg Groups, and indicates a change in depositional environment from basinal in the Midttind Formation to a shelf facies in the Nordvåg Group. The shelf facies which has been suggested for the Nordvåg Group prograded across the basinal and transitional facies, and is dominated by fine-grained sediments interpreted as shelf mud and storm sand deposits. These sediments are cut at irregular intervals, both laterally and vertically, by channel deposits which consist of conglomerates and coarse-grained sandstones. The frequency of intraformational material in the conglomerates shows that these represent deposits from strongly erosive currents, and that the channels can possibly have represented feeders to deeper water fan systems.

Periods of quiescence in tectonic activity in the provenance area resulted in a reduced influx of epiclastic material, and the development of the limestones of the Duksfjord Formation. The three-dimensional distribution of the Duksfjord sediments indicates that the formation constitutes a lense-shaped body which has its maximum thickness in central Magerøy. It is possible that this is a result of it being developed on a structurally elevated area on the shelf where carbonate sedimentation could dominate. Local developments of submarine scree deposits, such as the tillite-like conglomerate in Duksfjord, and the periodic influx of clastic material have been taken as an indication of tectonic instability during sedimentation, and possibly with syn-depositional faulting in the shelf area.

In the upper part of the Sardnes Formation the coarse-grained sandstones of the coarse-fine facies indicate an increased tectonic activity which presumably accompanied the terminal stage of the shelf environment and a deepening to a new basinal environment. This constitutes the second, large-scale, sedimentary cycle and is represented by the thick development (2.4 km) of the flysch-type turbidites of the Juldagnes Formation. It is likely that these represent the sedimentary respons to the onset of the tectonic activity which culminated in Middle to Upper Silurian times in the orogenic deformation and metamorphism marking the Scandinavian phase of the Caledonian orogeny.

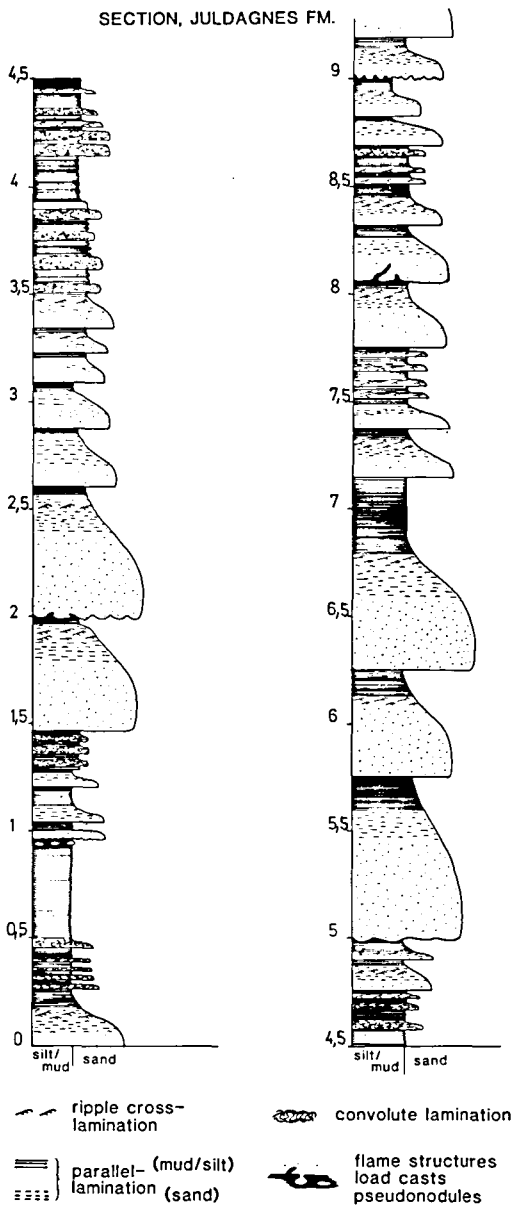


Fig. 9. Measured profile in the Juldagnes Formation from road-section (UTM 637750 map-sheet 2136 IV) along the coast between Juldagnes and Nordvågen. Thickness in metres.

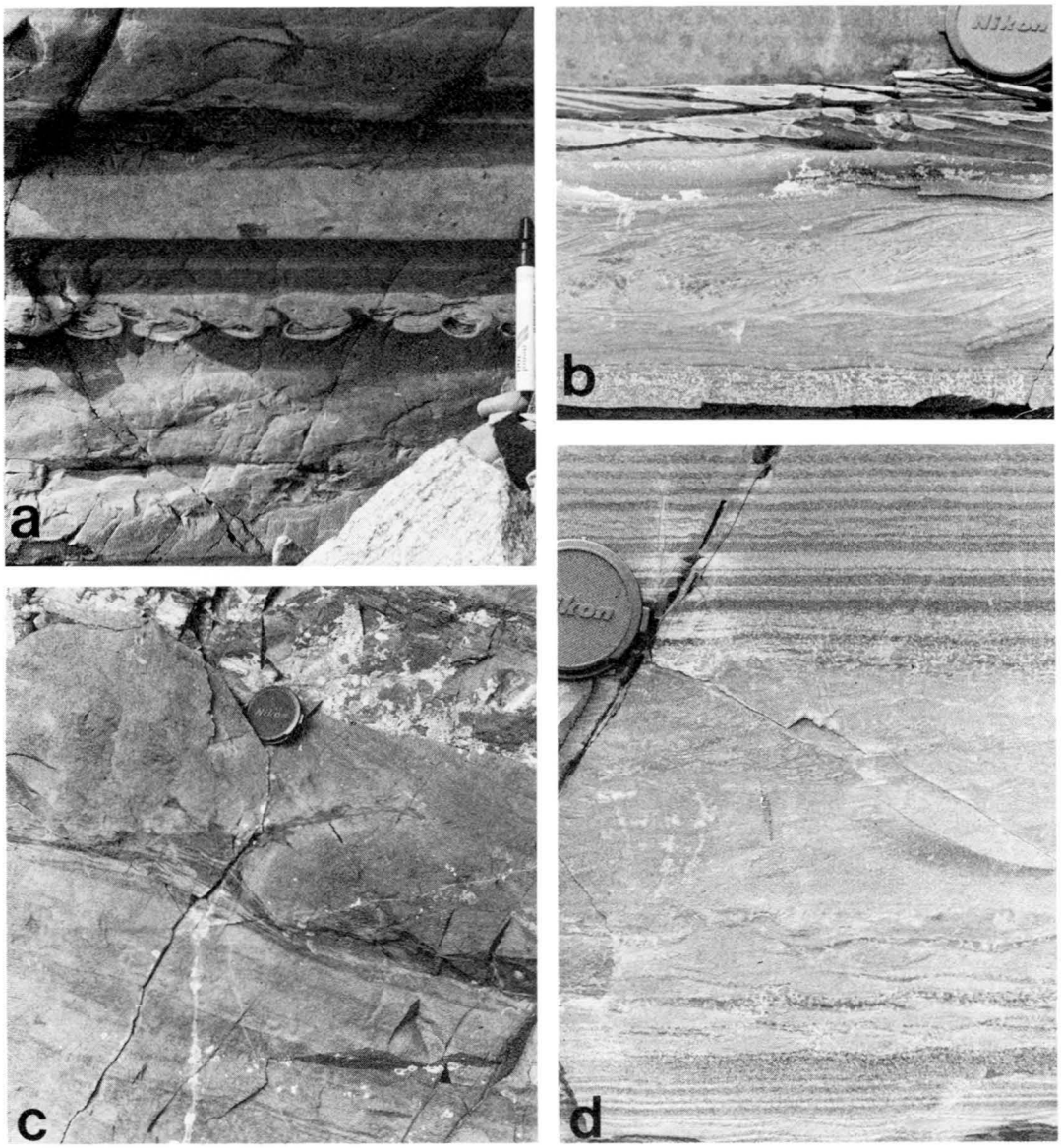


Fig. 10. Details of sedimentary structures preserved in the Juldagnes Formation in localities between Juldagnes and Nordvågen showing:
a) Load casts and climbing ripples (younging upwards).
b) Climbing ripples in the finer grained material between the greywacke beds. Note also the S1 cleavage dipping towards the right (younging upwards).
c) Flame structure (younging upwards).
d) Flaser bedding, lenticular bedding and parallel lamination in the finer grained material between greywacke beds (younging upwards).

Acknowledgements. – The author wishes to thank Dr. R.J. Steel and Prof. B.A. Sturt for helpful discussion and criticism, and Dr. D. Roberts and two anonymous referees for improving an early manuscript. E. Irgens and J. Ellingsen are thanked for preparing the illustrations. The stratigraphic terminology has been approved by the Committee for Norwegian Stratigraphy.
Norwegian contribution No. 57 to IGCP project 27 'The Caledonide Orogeny'.

References

Andersen, T.B. 1979: *The geology of south-western Magerøy: with special reference to the tectono-metamorphic development.* Unpubl. Cand.real. thesis. Univ. of Bergen. 338 pp.

Andersen, T.B. 1981: The structure of the Magerøy Nappe, Finnmark, North Norway. *Nor. geol. unders. 363,* 1–23.

Andersen, T.B., Austrheim, H., Sturt, B.A., Pedersen, S. and Kjærsrud, K. 1982: Rb-Sr whole rock ages from Magerøy, North Norwegian Caledonides. *Nor. Geol. Tidsskr. 62,* 79–85.

Binns, R.E. & Gayer, R.A. 1980: Silurian or Upper Ordovician fossils at Guolasjav'ri Troms, Norway. *Nature 284,* 53–55.

Bjørlykke, A. & Olaussen, S. 1981: Silurian sediments, volcanics and mineral deposits in the Sagelvvatn area, Troms, North Norway. *Nor. geol. unders. 365,* 1–38.

Curry, C.J. 1975: *A regional study of the Magerøy basic igneous complex and its envelope.* Unpubl. Ph.D. thesis. Univ. of Dundee. 244 pp.

Føyn, S. 1967: Stratigraphical consequences of the discovery of Silurian fossils on Magerøy, the island of North Cape. *Nor. geol. unders. 347,* 208–222.

Henningsmoen, G. 1961: Cambro-Silurian fossils in Finnmark, northern Norway. *Nor. geol. unders. 213,* 93–95.

Holtedahl, O. 1944: On the Caledonides of Norway. *Skr. Norske Vidensk. Akad. i Oslo, Mat-Naturv.* Kl. 4, no. 1.

Ramsay, D.M. & Sturt, B.A. 1976: The syn-metamorphic emplacement of the Magerøy Nappe. *Nor. Geol. Tidsskr. 56,* 291–307.

Reineck, H.F. & Singh, I.B. 1975: *Depositional sedimentary environments.* Springer Verlag. New York–Heidelberg–Berlin. 439 pp.

Roberts, D. 1981: *Kartblad 'Nordkapp', Berggrunnsgeologisk kart 1:250000.* Nor. geol. unders.

Sturt, B.A., Pringle, I.R. & Roberts, D. 1975: Caledonian nappe sequence in Finnmark, northern Norway, and timing of orogenic deformation. *Geol. Soc. Am. Bull. 86,* 710–718.

Walker, R.G. 1978: Deep-water sandstone facies and ancient submarine fans: models for exploration and stratigraphic traps. *Amer. Assoc. Petrol. Geol. Bull 62,* 932–966.

Appendix

The name Magerøy Supergroup is proposed in the main text of the paper for the Lower Palaeozoic metasedimentary rocks which constitute the bulk of the Magerøy Nappe. Body fossils, including a shelly fauna and graptolites in the middle and upper parts of the succession, indicate a Lower Silurian age for these particular sediments, but as the fossiliferous strata are underlain by a considerable thickness of older sediments where no fossils have yet been found it is likely that the lowermost parts of the Magerøy Supergroup are of Upper Ordovician or older age. All thicknesses referred to below are stratigraphic thicknesses in profiles which are not repeated by folding, but are otherwise uncorrected for tectonic strain. Approval for the stratigraphic subdivisions and nomenclature has been given by the Norsk Stratigrafisk Komite (Committee for Norwegian Stratigraphy).

1) THE KJELVIK GROUP

The description of the Kjelvik Group is based almost entirely on the work of Curry (1975). Definitions of type localities can therefore only be presented with the precision given by this author (UTM coordinates have not been given). The changes suggested in the stratigraphic subdivision of the Kjelvik Group have been made in order to bring this into line with modern stratigraphic usage and nomenclature.

Name: Kjelvik is a small village on the east coast of Magerøy northeast of Honningsvåg. The name Kjelvik Group was introduced by Curry (1975).

Stratigraphic subdivisjon: The Kjelvik Group was divided into 3 formtions by Curry (1975). The nomenclature in this subdivision, where the formations were named the Midttind pelite formation, the Transition formation and the Kjelvik psammite formation, is not in accordance with modern stratigraphic nomenclature. Although little detailed work has been carried out by the present author on the Kjelvik Group, the two upper formations (Curry 1975) appear to be very similar in sedimentological development. It is therefore suggested that they are grouped together to constitute one formation, the Russelv Formation. The lowermost unit of Curry (1975) is called the Middtind Formation, with the term pelite omitted from the original subdivision.

a) Midttind Formation

Name: Midttind pelite formation suggested by Curry (1975). Midttind (or Medtind) is a mountain 1 km south of Kjelvik. The present author has omitted the term pelite from the name.
Type area: Coast section in the southern and central parts of Kjelvik bay.
Thickness: Minimum 470 m, base not exposed. Estimated by Curry (1975).
Lithology: Laminated mudstones and siltstones with interbedded rippled and laminated fine-grained sandstones.
Boundaries: Lower boundary not exposed. Upper boundary transitional.

b) Russelv Formation

Name: Russelv is a little river east of Kjelvik. This is the only geographical name given on map-sheet Skarsvåg (M711) which can be used as a formation name in the area, even though Russelva is situated 500 m to the east of the actual outcrop area of this formation. Russelv Formation is proposed as a new name and includes the Transition formation and the Kjelvik psammite formation of Curry (1975).
Type area: Coast section in the central and northern parts of Kjelvik bay.
Thickness: Approximately 430 m. (The sum of the two formations of Curry's original subdivision.)
Lithology: Greywackes with interbedded mudstones and siltstones. Thicker and more frequent greywackes towards the top of the formation. In the uppermost parts also light-coloured psammites.
Boundaries: Lower boundary transitional to the Midttind Formation, but taken at the beginning of regular development of greywackes. Upper boundary taken at the level of the lowermost conglomerate assigned to the Nordvåg Group (Curry 1975).

2) NORDVÅG GROUP:

Name: Nordvågen is a village approximately 3 km northeast of Honningsvåg. The name Nordvågen Group was introduced by Curry (1975), but this has been shortened to Nordvåg Group to comply with modern Norwegian stratigraphic nomenclature (see also Roberts 1981).
Stratigraphic subdivision: The Nordvåg Group contains two formations, the Sardnes Formation and the Duksfjord Formation. The Duksfjord Formation however, is laterally discontinuous and occurs as a wedge within the Sardnes Formation. Thus, where the former is developed the Sardnes Formation comprises a lower and an upper member. Where the Duksfjord Formation is not developed it is not possible to distinguish between these two members of the Sardnes Formation on the basis of lithology.

a) Sardnes Formation:

Name: Sardnes is an abandoned village in southeastern Magerøy. The name was introduced by Andersen (1981).
Type area: Coast profile between Nordvågen and Kjelvik (UTM, Lower member 675768–668764, Upper member 663763–656759 map sheet 2136 IV), and the hills north of Sardnes.
Thickness: Approximately 1280 m, including the 825m-thick lower member and 500m-thick upper member. These thicknesses were estimated along the coastal section between Nordvågen and Kjelvik. In central Magerøy thicknesses are uncertain.
Lithology: Mudstones, siltstones and fine- to medium-grained sandstone dominate. Channel conglomerates may occur at any

stratigraphic level. Thin bands of limestones occur in an area 1.7 km northwest of Sardnes. The uppermost part of the Sardnes Formation comprises dark shales with interbedded medium- to coarse-grained sandstones. The metamorphic grade is middel greenschist facies in eastern Magerøy and upper greenschist to amphibolite facies in central and western Magerøy.
Boundaries: Lower boundary transitional to the Kjelvik Group, but taken at the level of the first occurrence of channel conglomerate. Upper boundary to the Juldagnes Formation transitional, but placed at the first occurrence of regular flysch-type turbidites of the Juldagnes Formation. The boundaries to the Duksfjord Formation are transitional.
Fossils: Crinoid ossicles occur in the thin limestones northwest of Sardnes (Føyn 1967). Trace fossils in the uppermost part of the Sardnes Formation.

b) Duksfjord Formation:
Name: Duksfjord is a fjord in north-central Magerøy. The name was introduced by Andersen (1979) in an unpublished thesis.
Type area: The coast section approximately 1.5 to 2 km northeast of Nordvågen (UTM 675768–656759 map-sheet 2136 IV). In the area around Duksfjord, however, this formation has a considerably thicker development, but due to deformation and metamorphism the sedimentary structures are less well preserved.
Thickness: Approximately 850 m in the coast section northeast of Nordvågen.
Lithology: Dominantly calcareous mudstones and siltstones interbedded and interfingering with limestone horizons. Slump and channel conglomerates and occasional lensoid orthoquartzites occur in minor amounts. Metamorphism is of middle greenschist facies grade in eastern Magerøy and upper greenschist to amphibolite facies in central Magerøy.
Boundaries: Transitional with a gradual increase of calcareous material into the Duksfjord Formation.
Fossils: A shelly fauna of Lower Silurian age in limestones and calcareous phyllites in eastern Magerøy. Poorly preserved crinoid ossicles and colonial corals in south-central Magerøy.

3) JULDAGNES FORMATION:
Name: Juldagnes is the area in the easternmost part of the town of Honningsvåg. The name Juldagnes Group was applied to this unit by Curry (1975). As no further stratigraphic subdivision has been made within this unit, the present author has given it the status of a formation (Andersen 1979, 1981).
Type area: Shoreline sections from the village of Nordvågen to Næringen west of Honningsvåg (Base UTM 656769, map-sheet 2136 IV, top not seen).
Thickness: Approximately 2400 m, which is a minimum thickness as the top of the sequence is not seen.
Lithology: Turbidites of flysch-type; greywacke and pelite. Middle to upper greenschist facies metamorphism in eastern and southeastern Magerøy. The sequence is also locally strongly hornfelsed in this area. Amphibolite facies metamorphism in western and northern Magerøy.
Fossils: Lower Silurian graptolites in the lowermost part of the formation. Trace fossils common in eastern and southern Magerøy.