Lithostratigraphy of the Storvann Group, East Hinnøy, North Norway and its Regional Implications

JOHN M. BARTLEY

Bartley, John M. 1981: Lithostratigraphy of the Storvann Group, east Hinnøy, North Norway, and its regional implications. *Norges geol. Unders. 370*, 11–24.

The Storvann Group is a sequence of metasedimentary rocks which constitutes the autochthonous Cambrian(?) sedimentary cover of the Precambrian Lofoten terrane on east Hinnøy, North Norway. The Storvann Group is composed of impure quartzite overlain by progressively more aluminous quartz-rich schists, with subordinate calcite marbles, comprising a transgressive sequence. The general stratigraphic similarity of the Storvann Group to autochthonous, unmetamorphosed sedimentary rocks of the Scandinavian platform supports a recent hypothesis that the Lofoten terrane was part of the Baltoscandian continental block prior to Caledonian orogenesis.

The composition of the Storvann Group suggests a platformal or miogeoclinal environment of deposition. However, without some means of determining the original thickness and stratigraphic continuity of this sequence, the position it represents relative to the pre-Caledonian Baltoscandian continental edge remains unknown.

John M. Bartley, Department of Earth & Planetary Sciences, Massachusetts Institute og Technology, Cambridge, Massachusetts, U.S.A.
Present address: Department of Geology, Mitchell Hall 029A, University of North Carolina, Chapel Hill, North Carolina 27514, U.S.A.

Introduction

The island of Hinnøy is located in North Norway at 68° to 69°N latitude (Fig. 1). The author's objective on Hinnøy was to examine the contact relationships and structural geology of the boundary between the Lofoten–Vesterålen Precambrian terrane to the west (hereafter called the Lofoten terrane) studied by Griffin et al. (1978), and the Caledonian nappe terrane lying to the east (Gustavson 1966, 1972, Binns 1978). Three tectonically distinct rock associations were recognized: (1) pre-Caledonian crystalline basement rocks, which are considered to be an eastward extension of the Lofoten terrane; (2) the Storvann Group, a sequence of metasedimentary rocks in depositional or modified depositional contact with the pre-Caledonian basement, and which is believed to be its Cambrian or Vendian sedimentary cover; and (3) Caledonian allochthons, which in the study area include at least three distinct associations of metasedimentary and lesser meta-igneous rocks. This report focuses on the lithostratigraphy and significance of the Storvann Group.

The Caledonian structural position of the Lofoten terrane, and the pre-Caledonian relationship to the Baltoscandian craton, have been uncertain. In general, the exposures of Precambrian gneiss along the west coast of Norway have been interpreted to represent pre-Caledonian Baltoscandian basement under-

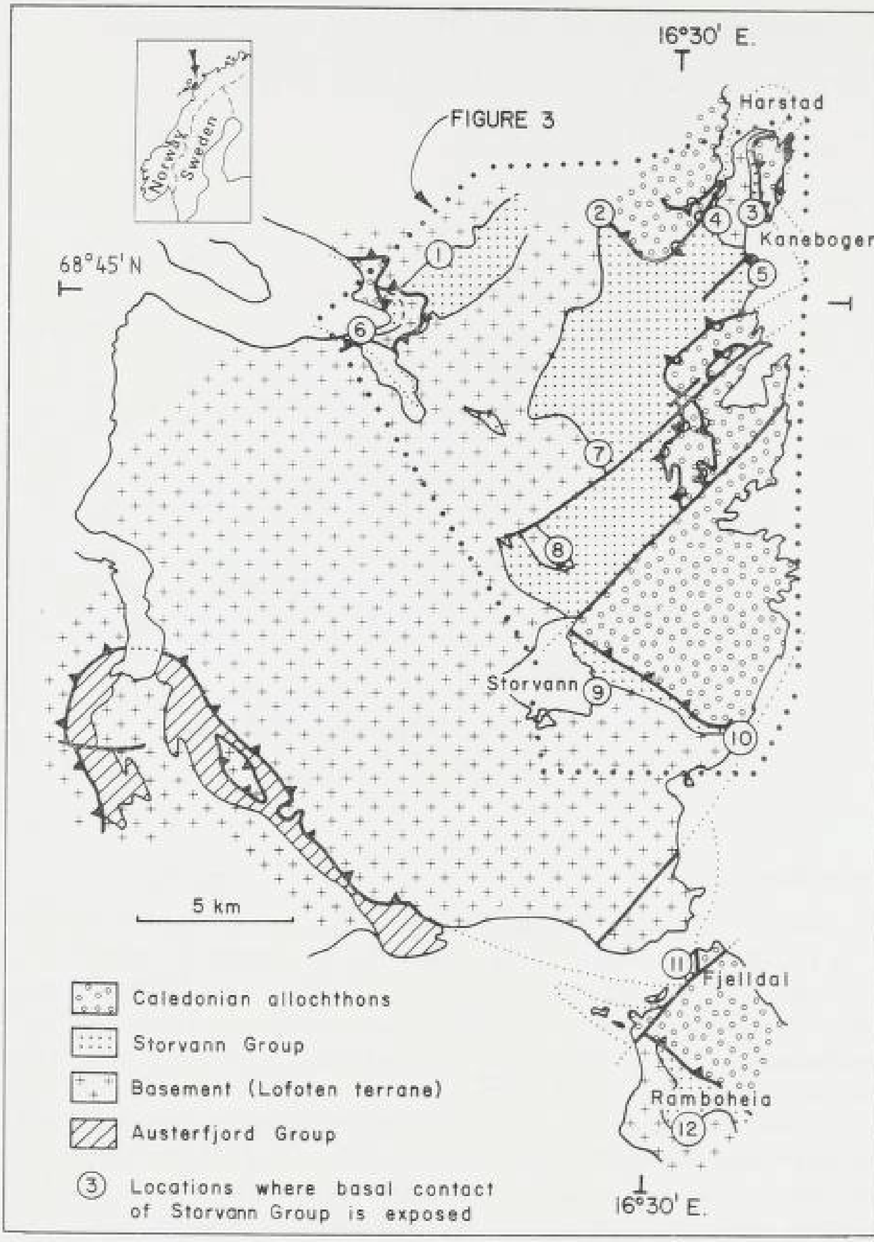

Fig. 1. Simplified geologic map of East Hinnøy, North Norway, showing distribution of Storvann Group and locations of exposed basal contact.

lying the nappes (Wilson & Nicholson 1973, Gee 1975, Binns 1978). However, Brueckner (1971) and Griffin et al. (1978) inferred a shallow structural level for the Lofoten terrane on the basis of a lack of petrological and geochronological evidence for Caledonian metamorphism or deformation. Tull (1977) and Hakkinen (1977) presented structural evidence for the absence of Caledonian penetrative deformation in most of the Lofoten terrane (but cf. Griffin & Taylor 1978). To explain the lack of Caledonian effects, Hakkinen (1977) proposed that the Lofoten block was a far-travelled, high-level nappe. Griffin et al. (1978) considered the Lofoten terrane to underlie the nappes, but nonetheless to have remained at a shallow crustal level (3–9 km).

A shallow structural level for the Lofoten terrane is precluded by the fact that the (meta)sedimentary cover of the block experienced amphibolite facies (kyanite grade) metamorphism synchronous with emplacement of the Caledonian nappes. The lack of Caledonian effects in the Lofoten basement terrane is considered in a separate paper (Bartley, in prep., see also Bartley 1979). The lithostratigraphic similarities of the Storvann Group to the autochthonous Cambrian cover of the Caledonian foreland to the east (Vogt 1967) support the hypothesis of Griffin et al. (1978) that the Lofoten terrane was a part of the Baltoscandian craton in pre-Caledonian time. This also favors a position beneath the nappes for the Lofoten block, consistent with structural observations on and near Hinnøy (Bartley 1980, in prep.).

The Storvann Group consists of a sequence of kyanite- to sillimanite-grade metasedimentary rocks of mainly quartz-rich terrigenous protoliths. It is exposed extensively in the eastern half of the study area from the southern outskirts of Harstad to Storvann, and in the extreme southeast of the study area near Fjelldal and on Ramboheia (Fig. 1). Outcrops along the eastern shore of Storvann are proposed as a type section (location 9, Fig. 1), where a relatively complete and coherent (though still strongly deformed) sequence of rock is exposed, from the basal contact with pre-Caledonian basement to the thrust-truncated top (Fig. 2). Another excellent set of exposures, tectonically thinned but essentially complete, is present along the shoreline and in road-cuts east of Kanebogen to the Harstad NAF campground (location 3, Fig. 1). The name Storvann Group is here considered as an informal designation. It has been divided into 5 unnamed formations (see below).

Lithostratigraphy

CONTACT RELATIONSHIPS

The basal contact of the Storvann Group is exposed at several places (Fig. 1). In all cases, the compositional layering of the basal quartzite is parallel to the contact. Although the rocks are tectonized, there is no suggestion of concentrated strain at the contact. On the map scale, lithologic units of the Storvann Group carry through parallel to the basal contact. Three of the exposures of the basal contact (2, 11, and 12) are anomalous in that little or none of the basal quartzite unit is present, and the quartz–garnet schist (Fig. 2 and below) is in direct contact with the basement or separated from it by only 10 centimetres to a metre of quartzite. At these places, it is suggested that the contact may have been sheared early during the penetrative deformation and thrusting so that no mylonitic fabric was preserved, or perhaps mylonites were never formed. Rocks at the base of the Storvann Group would have been removed

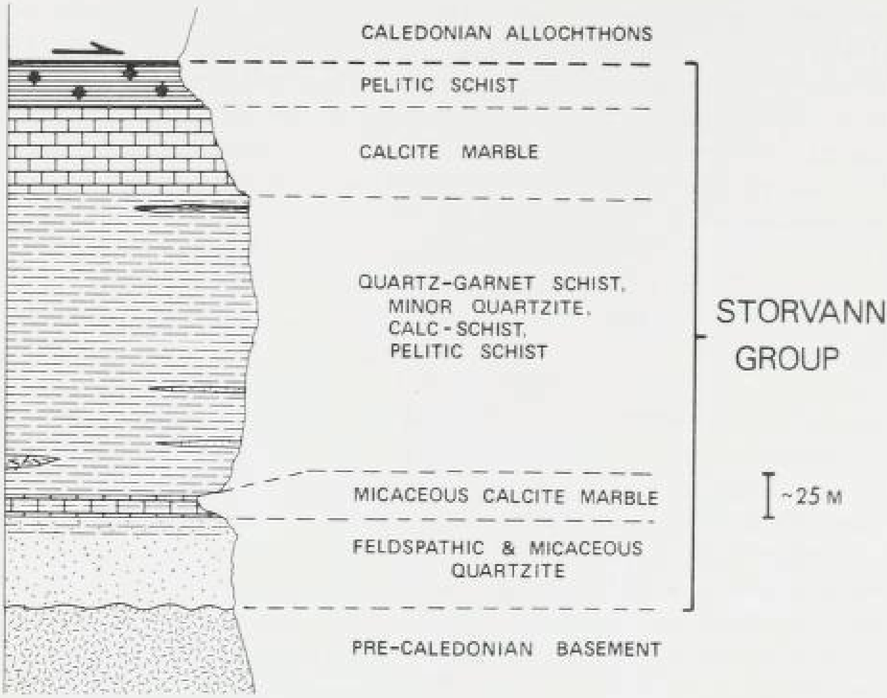

Fig. 2. Stratigraphic column for the Storvann Group. Absolute thicknesses, and to a lesser extent relative thicknesses, of the lithologic units are highly variable due to complex strain patterns. In this figure, approximate typical thicknesses are indicated.

in the process; these contacts are thus considered tectonic slides in the sense of Fleuty (1964). Strictly speaking, it might be preferable to consider the Storvann Group rocks at these places, at Ramboheia (location 12) in particular, as parautochthonous rather than autochthonous.

The Storvann Group constitutes a transgressive sequence. At the base is an impure quartzite which is overlain by progressively more aluminous (though still quartz-rich) rocks, interrupted by two marble horizons. This compositional change is inferred to reflect fining upward of the terrigenous clastic input to the sedimentary basin, consistent with a transgressive setting. How much of the sequence has actually been preserved is unclear, because the stratigraphically upper contact is everywhere a thrust fault.

The combination of the above relations, that is, (1) lack of discordance of lithological units at the map and outcrop scales, (2) consistency of rock sequence above the pre-Caledonian basement, (3) lack of evidence of concentrated strain at the basal contact, and (4) the transgressive nature of the sequence, is taken to indicate that the basal contact of the Storvann Group is an unconformity.

The upper contact of the Storvann Group is always marked by a thrust fault, but this is not necessarily the same thrust everywhere. On the Stangnes peninsula (Fig. 3), the Storvann Group is overlain by amphibolite with an intervening zone of complex tectonic mixing of schist, marble, and amphibolite. On the east shore of Storvann, as entirely different assemblage of rock overlies the Storvann Group. Above the highest schist unit (Pelitic Schist below) of the Storvann Group is an assemblage of mixed lithologies similar to that on the Stangnes peninsula, which is in turn overlain by a slice of Narvik Group (Strand 1960) pelitic gneiss and schist. The Narvik Group slice is overlain by gray calcite marble of the Salangen Group (Gustavson 1966). The significance of these relationships for the geometry of the nappe stack will be considered in a separate paper (Bartley in prep., see also Bartley 1980).

LITHOLOGIES

The distribution of Storvann Group lithologies mapped on east Hinnøy is shown in Fig. 3. The structural complexity of the rocks is striking. However, despite polyphase folding and high-angle faults, a consistent sequence of five formations is recognizable away from the contact with the Precambrian basement.

1. Quartzite

The basal unit of the Storvann Group is a heterogeneous mixture of micaceous quartzite, vitreous quartzite, and quartz–feldspar–biotite schist, with local occurrences of quartz–biotite schist and garnet–mica schist. A separate upper member consisting of the latter lithologies was mapped separately in one area (center of Fig. 3).

The vitreous quartzite is usually present as compositional bands 2–10 centimetres thick, separated by more micaceous layers 1–20 cm thick. The vitreous layers are fine-grained and range in color from white to bluish gray and rarely dark gray. The miceceous quartzite is similar, but contains mica in discontinuous films and as disseminated grains defining the schistosity. The compositional banding on a mesoscopic scale has been transposed by isoclinal folding and in general has little primary significance.

Rocks with higher feldspar contents than the vitreous quartzite are present in this unit, especially in its lower parts, on the north side of Finnslettheia in particular (Fig. 3). It is locally difficult to locate the basement/cover contact here because of the compositional similarity of the feldspathic cover (here a meta-arkose) to the granitic basement. In such cases, the contact was drawn on the basis of: (1) the appearance of vitreous or micaceous quartzite interlayers, and (2) the better layering and finer grain-size of the metasedimentary rocks (in most cases). In the northwestern part of the map area, the basement is dominated by metasedimentary rocks and the identification of the basal contact can become difficult. However, in general the basal contact can be traced into areas where the lithologies are more distinctive and the contact more easily located, so that its geometry can be determined with confidence.

In thin-section, the feldspathic quartzites contain both microcline and plagioclase in subequal amounts, forming from a few percent up to perhaps 25% of the rock. In general, microcline is dominant in less feldspathic rocks, while plagioclase is more important in the meta-arkoses. A change from muscovite to

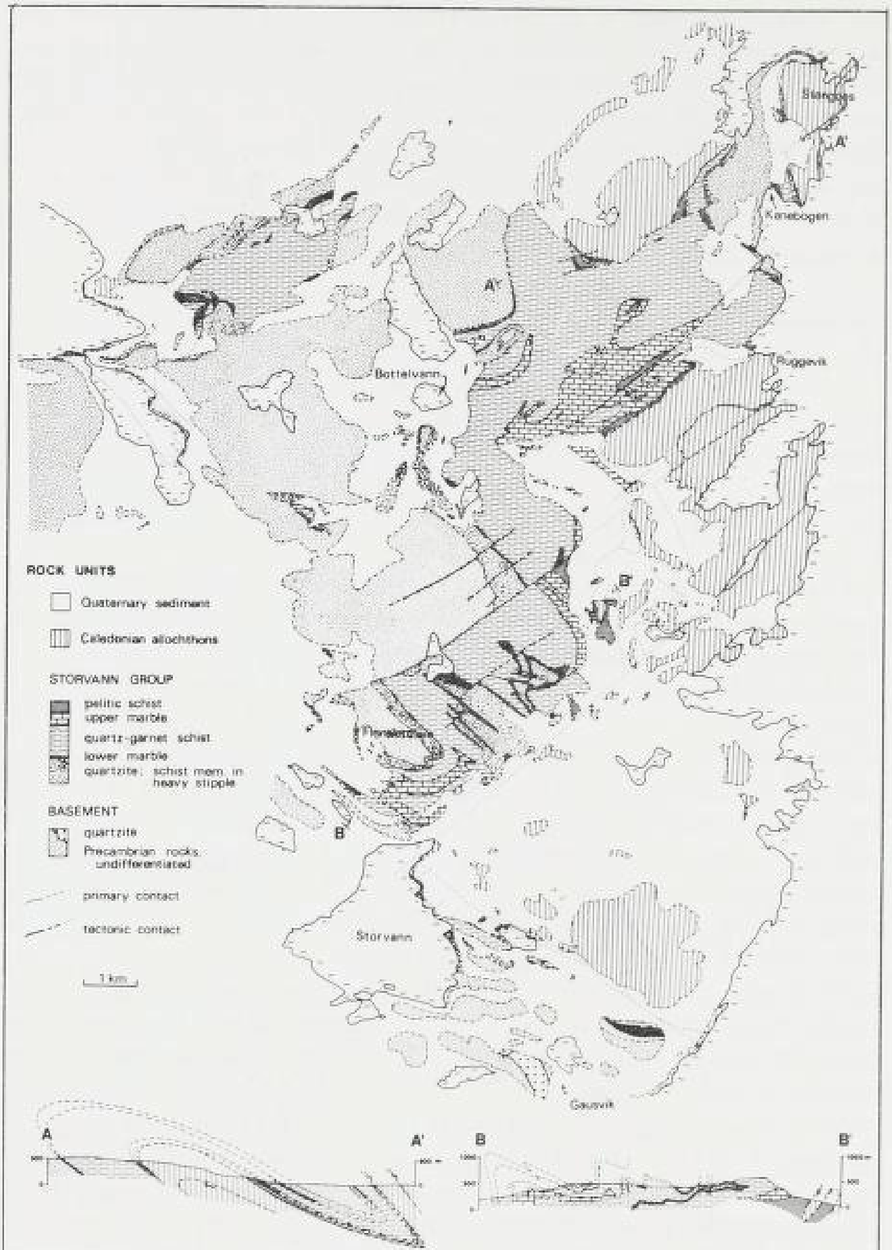

Fig. 3. Distribution of Storvann Group lithologies on East Hinnøy, with illustrative geologic cross-sections.

biotite as the dominant mica also accompanies the transition from less to more feldspathic compositions. The micas, though concentrated along compositional bands, are commonly individually rotated into an orientation parallel to axial planes of late folds. The rotation of micas and the resulting intersection lineation are commonly present even in outcrops which show no mesoscopic late folding.

The basal 2–20 metres of the quartzite unit usually consist of vitreous quartzite or meta-arkose, but on the east shore of Storvann and at the north end of the Stangnes peninsula, about 5 m of quartz–biotite schist with 5 mm feldspar porphyroblasts is present at the base. This is considered to be a local facies of the basal Storvann Group. It is equally possible that these are lenses of Precambrian metasedimentary rock, preserved locally below the basal unconformity of the Storvann Group. Volumetrically, these rocks represent a minor element of the sequence, so the resolution of this question is of modest importance.

A layer of quartz–biotite–garnet schist is locally present at the top of the quartzite unit. On the east shore of Storvann, about 5 m of a schist very similar to the quartz–garnet schist unit (see below) is present at the top of the quartzite. Further north, 50 m or more of this unit occurs as part of a separate, upper member of the quartzite unit (Fig. 3). This lithology is in a sense transitional to the quartz–garnet schist present higher in the sequence, although generally separated from it by the lower marble unit.

The other lithology present in the upper member of the quartzite unit is a quartz–biotite schist. This dark brown or gray, fissile schist is an atypical rock type in the Storvann Group, but clearly occurs stratigraphically above vitreous and feldspathic quartzite more typical of the quartzite unit and below the lower calcite marble. It is thus considered a member of the basal quartzite formation.

The thickness of the quartzite formation varies, probably mainly due to variations in finite strains, from zero to about 250 m northwest of Sørvikfjell. A typical thickness for the unit would be about 50 m. The possibility that some of the thickness variations in the quartzite, including its absence in some areas, may be due to facies variations (for instance, due to infilling of topography) cannot be ruled out.

The protolith of the quartzite unit was of variable composition, but was generally a moderately mature sandstone with subordinate shaly facies. The absence of a basal conglomerate is notable, and unfortunate because the presence of locally-derived pebbles would reinforce the interpretation that the basal contact is an unconformity. It is important that the Storvann Group basal quartzite is readily distinguished from quartzites of the basement complex, on the basis of lithology and associated rock types, as well as structural position.

2. Lower calcite marble

Above the basal quartzite unit in many areas is a thin (5–10 m) gray calcite marble. It is commonly impure, containing several percent white mica, minor quartz, and occasional accessory pyrite and/or graphite. Compositional banding is defined by varying concentrations of mica and by a subtle shading of color from light to medium gray. Intrafolial isoclinal fold hinges are moderately common, indicating transposition of bedding by folding to produce the present compositional banding. Texturally, the calcite is granoblastic, with lepidoblastic mica films. Quartz occurs as disseminated equant grains. Calcite is generally intensely twinned, indicating late to post-metamorphic strain.

A somewhat different facies of this unit is present on the west flank of Finnslettheia. Outcrop is moderate to poor, but normal marble appears to pass laterally into a calc-silicate rock composed of tremolite, calcite, plagioclase, quartz, epidote, and sphene. Phlogopite occurs in trace amounts in one sample.

The lower marble formation is not present everywhere. This is at least in part due to tectonic slides between the quartzite and quartz–garnet schist units. In the inverted section on top of Finnslettheia (Fig. 3), only three lenses of this marble occur, while the intervening areas where the marble is absent commonly show more intense foliaton. This could result from either large-scale boudinage of the marble or tectonic sliding. From what is known of the relative ductility of calcite- and quartz-rich rocks at amphibolite facies conditions, it seems unlikely that marble would be the boudin-forming lithology. Hence, a tectonic sliding interpretation is preferred.

The protolith of the calcite marble was presumably a shallow-water biogenic limestone with some terrigenous component. The reducing conditions which produced the pyrite and graphite may have resulted from incomplete oxidation of organic carbon. The calc-silicate facies was in part dolomitic (as evidence by Mg-bearing phases such as tremolte), and bears no mineral indicating low f_{O_2}. It is possible that local secondary dolomitization occurred under oxidizing conditions to form the protolith of the calc-silicate facies, at the same time oxidizing all remaining carbon in the rocks.

3. Quartz–garnet schist

The quartz–garnet schist is the areally most extensive unit of the Storvann Group, and one of the most distinctive lithologies. In outcrop it is a massive, resistant light gray rock with foliation defined by lensoidal or sigmoidal clots of mica one centimetre or less in length. Quartz veins a few mm to a few cm thick, and several cm to several tens of cm long, are common. Easily confused with, but distinct from, these veins are bands of quartzite on the same scale. The quartzite bands are more laterally continuous and contain mm-scale color bands parallel to the schistosity.

Quartz generally constitutes 70 to 80% of the rock, occasionally ranging up to more than 90% (forming essentially a garnetiferous quartzite). Quartz generally shows only weak dimensional preferred orientation, mainly appearing as granoblastic aggregates. Sutured grain boundaries are not uncommon. Undulatory extinction is locally present. The textures suggest an annealing recrystallization after schistosity formation, followed by late to post-metamorphic strain.

Garnet is ubiquitous as small, subhedral porphyroblasts (1–3 mm, occasionally up to 5 mm), composing up to 10% of the rock. The garnets are randomly dispersed throughout the rock. Where late spaced-cleavage planes intersect garnet, rims of chlorite ± epidote are developed. Although the garnet is commonly sieved with equant blebs of quartz, trails of aligned inclusions have not been observed within this unit.

Both biotite and muscovite are present, but in relative minor amounts, together comprising no more than 10–15% of the rock as a rule. Proportions of the two micas vary, biotite usually dominating. Continuous mica-films are seldom present, making the schistosity often abscure in outcrop. A late spaced-cleavage defined by mica concentrations is often more prominent than the earlier foliation. In one specimen, random-oriented, interkinematic biotite porphyroblasts were observed.

Green tourmaline is an ubiquitous accessory phase, occurring as small (<1 mm) euhedral or subhedral grains. Other accessory minerals include zircon, sphene, and apatite.

Three rock types with somewhat different compositions occur locally in this formation. On Finnslettheia, 10 m of plagioclase–porphyroblastic, graphitic schist is interlayered with more typical quartz–garnet schist at the base of the formation. The prominent foliation is marked by lepidoblastic intergrowths of muscovite and graphite, with subordinate biotite. Sparse, albite-twinned plagioclase porphyroblasts are a few mm across, anhedral, and randomly oriented.

A hornblende–porphyroblastic facies of this formation is present near its base in the area 1 km south of Bottelvann (Fig. 3). Hornblende occurs as stubby, randomly-oriented porphyroblasts up to 1 cm across. In the shoreline exposures at Fjelldal (Fig. 1), the stratigraphically higher part of the quartz–garnet schist unit becomes more pelitic, with the minerals kyanite and staurolite appearing. The rocks here are more strongly retrograded in late events, developing much secondary white mica, biotite, and chlorite. Coexistence of kyanite, staurolite, and garnet can be documented petrographically. Due to the intense retrogression, it cannot be demonstrated that biotite coexisted with these other phases, though this seems likely.

The thickness of this unit ranges from about 150 to more than 700 m. To what extent these thicknesses relate to original stratigraphic thickness is not certain, but it is clear that this was and is the thickest formation within the Storvann Group.

The protolith of this unit was probably a chemically mature siltstone with some intermixed sand. The presence of abundant garnet in a relatively mica-poor rock suggests high alumina relative to alkalis, and hence a clay-rich, feldspar-poor protolith. The feldspar- and amphibole-bearing lithologies may reflect a variation in provenance, or a moderate amount of carbonate (as cement?) which reacted with the silicate phases to form Ca-bearing silicates during metamorphism.

4. Upper calcite marble

The upper gray calcite marble formation is generally similar to the lower, but may usually be distinguished by its purer composition and more prominent color banding. A few percent white mica and minor quartz are present, but graphite and sulfides are absent and the rock is generally more than 95%

calcite. While the lower marble unit is generally homogeneous in color, the upper marble is commonly banded gray and buff on a scale of 1–5 cm. Textures are granoblastic; early tectonic foliation can be recognized by the color bands and by sparse micaceous layers.

The thickness of the upper marble is difficult to estimate because the upper contact is generally poorly exposed or tectonic. Only 5 metres of marble are present in the Kanebogen shoreline section (Fig. 3), while its apparent thickness is considerably increased by late folds in most other areas of favorable exposure. Perhaps the most representative thickness is encountered southwestward along strike from Ruggevik, where the marble is about 100 metres thick.

5. Pelitic shrist

This highly garnetiferous schist is the stratigraphically/structurally highest unit assigned to the Storvann Group. It probably constituted a mechanically favorable level for detachment, since it commonly occurs as a thin (10–20 m) layer immediately beneath the lowest allochthonous rocks of the area. In some areas it appears to be involved in the zone for tectonic mixing mentioned above (p. 14–15). The consistent presence of a pelitic schist, often rusty-weathering and bearing coarse garnet porphyroblasts, at the top of the Storvann Group section, regardless of the overlying units, leads the author to believe that this schist forms an integral part of the Storvann Group.

The rock has a well-developed schistosity with the foliation defined by mica films which anastomose and wrap around the subhedral and euhedral garnets. The garnets range in size from 0.5 to 2 cm in diameter. In thin-section, major minerals include quartz, muscovite, biotite, garnet, and often kyanite. One specimen contains fibrolitic sillimanite. Accessory minerals include green tourmaline, zircon, and sphene.

The garnet porphyroblasts include trails of elongate quartz grains, recording a two-stage growth history. The inner portion includes abundant linear trails, suggesting growth post-dating formation of an early schistosity. These inclusion trails continue into the outer zone where inclusions are more sparse, and curve into a sigmoidal pattern, indicating synkinematic growth. Where late spaced-cleavage intersects the garnets, truncating the internal fabrics, retrograde chlorite is developed.

Biotite occurs as two growths. It is present as 1–3 mm, randomly-oriented porphyroblasts which are bent and truncated by the late cleavage, and also in secondary quantities to muscovite within the mica films which define that cleavage.

Muscovite forms both the through-going mica films and also locally remains in the matrix preserving an earlier foliation in short segments. It is not clear how this older matrix foliation relates to the internal foliation of the garnet, because of strong disruption by the late cleavage. However, these older fabrics are assumed to be related.

Kyanite occurs as anhedral relics, replaced in part by white mica, quartz, and chlorite. This retrogression (?) is interpreted to be related to late cleavage-forming events, although it is not as clearly related to cleavage traces as in the case of garnet retrogression.

Sillimanite occurs as fine-grained intergrowths with muscovite in one kyanite-bearing thin-section. Since the kyanite is replaced in part by muscovite, it may be that the kyanite to sillimanite reaction ocurred by two coupled reactions involving muscovite, similar to the relationships described by Carmichael (1969). This is the first occurrence of sillimanite grade Caledonian metamorphism to be described from the Scandinavian Caledonides of southern Troms and northern Nordland.

On the east shore of Storvann, the pelitic schist unit is partly calcareous. Calcite occurs as discontinuous lensoid interlayers a few mm thick, composed of fine-grained granoblastic aggregates. No calc-silicate minerals were observed.

The structural thickness of this unit is highly variably, and in most areas very uncertain. It is very non-resistant to weathering so that exposures tend to be rare except along shorelines. Areas of the map showing apparently large thicknesses of the pelitic schist unit are largely the result of generalization from a few outcrops which were impossible to represent individually on the scale of the study. It is probable that in these wooded areas of poor exposure, the structure is far more complex than that shown in the map. However, the data do not permit a more sophisticated interpretation.

The protolith of the pelitic schist unit was a shale, deposited in part under reducing conditions, and in part in environments of some carbonate deposition. It appears to be an expression of continued transgression of the Scandinavian continental margin in early Paleozoic time.

Correlation

The impure, often feldspathic composition of the basal quartzite, the dominantly terrigenous character of the section, and the gross sequence of lithologies encourage correlation with the autochthonous Vendian/Cambrian rocks of the foreland of the Caledonian mountain belt (Dividal Group of Pettersen 1878, see Fig. 4). At this latitude, the autochthonous sequence has been described by Moberg (1908) and Vogt (1918, 1967). Gustavson (1966) has described autochthonous sequences from tectonic windows through the nappe stack. The sections are all largely sandstone and shale, overall fining upwards, with thin calcareous horizons (Fig. 4). Vendian and early Cambrian faunas are reported from several of the foreland sections (Moberg 1908, Vogt 1967, Ahlberg & Bergström 1978, Ahlberg 1979, 1980). Gustavson's section from the Dividalen window is similarly dominated by sandstone and shale. Other sections from windows are too incomplete for reasonable comparison, and in some cases (e.g., Rombak window) are structurally dismembered (K. V. Hodges, pers. comm. 1980).

Two correlation schemes seem possible: (1) the two marble formations of the Storvann Group correlate with the two calcareous horizons of the foreland sequence, with the quartz–garnet schist equivalent to the green shale; or (2)

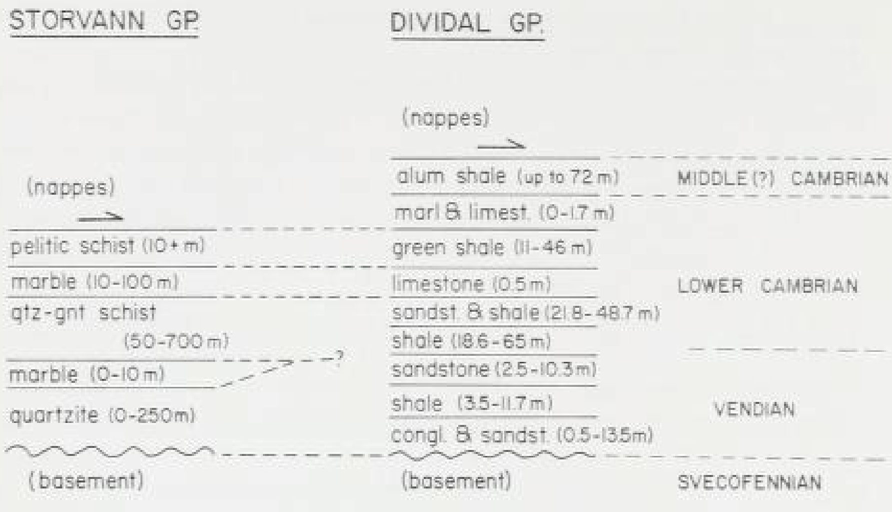

Fig. 4. Comparison and speculative correlations of formations of the Storvann Group to the autochthonous Vendian/Cambrian formations (Dividal Group) of the Caledonian foreland in Norway. Foreland section generalized from Vogt (1967) and Ahlberg (1980).

the upper marble formation of the Storvann Group correlates with the lower limestone horizon of the foreland section, and the quartzite, lower marble, and quartz–garnet schist formations are together equivalent to the basal sandstone and shale formations of the foreland. The latter is preferred for the following reasons: (1) the presence of metasandstone layers in the quartz–garnet schist seems incompatible with the lithology of the green shale, which Vogt (1967) describes as a pure shale, containing no sandstone; (2) the thinness and discontinuity of the lower marble of the Storvann Group suggest that no equivalent need appear in other sections; and (3) the thickness and purity of the upper marble appears inconsistent with correlation to a discontinuous thin, marly horizon.

The correlations shown on Fig. 4 are admittedly speculative, especially considering (1) geographical separation (more than 100 km), and (2) the difference in metamorphic grade (unmetamorphosed versus amphibolite facies). Nevertheless, the author considers a correlation of the Storvann Group with the autochthonous sequence of the Caledonian foreland very likely. This is consistent with the view of Griffin et al. (1978) that the Lofoten terrane was indeed part of the Baltoscandian craton in pre-Caledonian time. It is also consistent with structural arguments (Bartley 1979, in prep.) that the Lofoten block does not constitute a far-travelled nappe (cf. Tull 1977, Hakkinen 1977).

Discussion

The Caledonian cover rocks of east Hinnoy were described by Gustavson (1972) as a single stratigraphic succession. The present study concludes that these cover rocks include elements of at least four distinct stratigraphic sequences, including both autochthonous and allochthonous units. The Storvann Group as defined here is the autochthonous portion of the cover rocks. Allochthonous rocks include parts of: (1) the Narvik Group (Strand 1960, Gustavson 1966), consisting mainly of pelitic schists and gneisses with minor intrusions of granitoids and amphibolites, and in the study area present only in two tectonic slivers at the base of the nappe pile; (2) the Stangnes Group, a newly-distinguished, thrust-bounded slab of layered amphibolite intruded by a semi-concordant tonalite gneiss pluton, the Ruggevik Tonalite Gneiss (these units will be described in detail in a future paper, pending completion of work in progress; see also Bartley 1980); and (3) the Salangen Group (Gustavson 1966), a sequence of marbles and mica schists which comprise the highest unit of the nappe stack exposed on east Hinnøy. All of the above have been metamorphosed at amphibolite facies conditions during the Caledonian orogeny. Juxtaposition of the allochthons and the autochthon occurred prior or to synchronous with metamorphism, so that no abrupt breaks in metamorphic grade are observed (Bartley 1980, and in prep).

The lithostratigraphy of Hinnøy is thus far more complex than previously recognized. Furthermore, the rocks considered autochthonous in this study are not those considered to be autochthonous cover by Gustavson (1972). One of the quartzite units considered autochthonous by Gustavson (west of Gausvik, see Fig. 3) has proven to be intruded by a granite which has given a Rb/Sr whole-rock intrusive age of 1559 ± 155 Ma (Bartley 1980), indicating that this quartzite is different from the basal quartzite of the Storvann Group and lies within the Precambrian basement. This is consistent with the observation that this Precambrian quartzite is associated with amphibolite and calc-silicate marble rather than the schists and calcite marbles of the Storvann Group. Further, this eliminates the principal evidence which Gustavson (1972, p. 12) used to infer that the rocks here termed the Storvann Group, and their subjacent basement, are allochthonous. The structural repetition of lithologic units north from Gausvik reported by Gustavson (1972) has not been confirmed during the present study. A full discussion of the structural geology of this area, and an account of the evidence bearing on the differences in mapping and structural interpretation shown by the present investigation in relation to Gustavson's work, will be presented in a subsequent paper (Bartley, in prep.).

The composition of the Storvann Group metasedimentary sequence, i.e., quartzose terrigenous clastic rocks with laterally continuous carbonate horizons, implies a platformal or miogeoclinal depositional environment. However, without fossil control or some other means of estimating the original thickness and stratigraphic continuity of the Storvann Group, one cannot distinguish between these two possibilities. As a consequence, no inferences can be made about the position of east Hinnøy relative to the pre-Caledonian continental edge. One can only say that the edge of the continent was located somewhere to the west of the modern limits of the Lofoten terrane, roughly 60 km northwest of the present study area.

Acknowledgements. – The interpretations presented here benefitted from discussions with B. C. Burchfiel, K. V. Hodges, F. S. Spear, and J. F Tull. B C. Burchfiel, J. R. Butler and two anonymous reviewers critically read an earlier version of this paper, which thereby benefitted in both presentation and content. The author acknowledges support for field investigations from grants to B. C. Burchfiel from M.I.T. and the U.S. National Science Foundation, and from grants to the author from the Geological Society of America Penrose Fund and the American—Scandinavian Foundation Crown Princess Märtha Friendship Fund. Thin-sections were ably prepared by the technical staff of the Geological Museum of the University of Oslo.

REFERENCES

Ahlberg, P. 1979: Early Cambrian trilobites from Mount Luopakte, northern Eweden. *Sver. geol. Unders. C 765*, 12 pp.

Ahlberg, P. 1980: Early Cambrian trilobites from northern Scandinavia. *Norsk geol. Tidsskr. 60*, 153–159.

Ahlberg, P. & Bergström, J. 1978: Lower Cambrian ptychopariid trilobites from Scandinavia. *Sver. geol. Unders. Ca 49*, 41 pp.

Bartley, J. M. 1979: Autochthonous cover sequence of the Lofotenblock, North Norway. Implications for controls of basement involvement in orogenesis. *Geol. Soc. Am. Abstr. Programs 11*, 385.

Bartley, J. M. 1980: *Structural geology, metamorphism and Rb/Sr geochronology of east Hinnøy, North Norway.* Unpubl. Ph.D. thesis, M.I.T., Cambridge, MA, U.S.A.

Binns, R. E. 1978: Caledonian nappe correlation and orogenic history in Scandinavia north of lat 67°N. *Bull. geol. Soc. Am. 89*, 1475–1490.

Brueckner, H. K. 1971: The age of the Torset granite, Langøy, northern Norway. *Norsk geol. Tidsskr. 51*, 85–88.

Carmichael, D. M. 1969: On the mechanism of prograde metamorphic reactions in quartz-bearing pelitic rocks. *Contr. Miner. Petrol. 20*, 244–267.

Fleuty, M. J. 1964: Tectonic slides. *Geol. Mag. 101*, 452–456.

Gee, D. G. 1975: A tectonic model for the central Scandinavian Caledonides. *Am. Jour. Sci. 275–A*, 468–515.

Griffin, W. L. & Taylor, P. N. 1978: Geology and age relations on Værøy, Lofoten, north Norway. *Norges geol. Unders. 338*, 71–82.

Griffin, W. L., Taylor, P. N., Hakkinen, J. W., Heier, K. S., Iden, I. K., Krogh, E., Malm, O., Olsen, K. I., Ormaasen, D. E. & Tveten, E. 1978: Archean and Proterozoic crustal evolution in Lofoten–Vesteraalen, North Norway. *Jl. geol. Soc. Lond. 135*, 629–647.

Gustavson, M. 1966: The Caledonian mountain chain of the southern Troms and Ofoten areas. Part I. Basement rocks and Caldeonian metasediments. *Norges geol. Unders. 239.*

Gustavson, M. 1972: The Caledonian mountain chain of the southern Troms and Ofoten areas. Part III. Structures and structural history. *Norges geol. Unders. 283.*

Gustavson, M. 1974: Berggrunnskart M8: Harstad, 1:100 000. *Norges geol. Unders.*, Trondheim.

Hakkinen, J. W. 1977: *Structural geology and metamorphic history of western Hinnøy and adjacent parts of east Hinnøy, north Norway.* Ph.D. dissert., Rice Univ., Houston.

Moberg, J. C. 1908: Bidrag till Kännedomen av de Kambriska Lagren Vid Torneträsk. *Sver. geol. Unders.*, Ser. C, No. 212.

Pettersen, K. 1878: Schematisk oversigt over det nordlige Sveriges og Norges geologi. *Geol. Fören. Stockholm Förh. 4*, 16–32.

Strand, T. 1960: Cambro–Silurian stratigraphy. *In* Holtedahl, O. (ed.): Geology of Norway. *Norges geol. Unders. 208*, 163–165.

Tull, J. F. 1977: Geology and structure of Vestvågøy, Lofoten, north Norway. *Norges geol. Unders. 333*, 59 pp.

Vogt, T. 1918: Geologiske tudier Langs den Østlige Del av Fjellkjeden i Tromsø amt. *Norsk geol. Tidsskr. 4*, 260.

Vogt, Th. 1967: Fjellkjedestudier i den østlige del av Troms. *Norges geol. Unders. 248*, 60 pp.

Wilson, M. R. & Nicholson, R. 1973: The structural setting and geochronology of basal granitic gneisses in the Caledonides of part of Nordland, Norway. *Jour. geol. Soc. London 129*, 365–387.