



BERGVESENET

MED BERGMESTEREN FOR SVALBARD

Postboks 3021, N-7441 Trondheim

Rapportarkivet 2001

Bergvesenet rapport nr BV 5715	Intern Journal nr	Gammelt internt rapp. nr.	Rapport lokalisering	Gradering
Kommer fra ..arkiv Grong Gruber AS	Ekstern rapport nr	Oversendt fra Grong Gruber a.s.	Fortrolig pga	Fortrolig fra dato:
Tittel Synopsis of the geology of the Sandøla - Nesåvatnn area				
Forfatter G. H. Gale		Dato År 1. 3. 1974	Bedrift NGU	
Kommune Røyvik	Fylke Nord-Trøndelag	Bergdistrikt	1: 50 000 kartblad 19231	1: 250 000 kartblad Grong
Fagområde Geologi	Dokument type		Forekomster Grongfeltet	
Råstoffgruppe Malm/metall	Råstofftype Cu Zn			
Sammendrag / innholdsfortegnelse Rapporten er et sammendrag av geologiske undersøkelser utført i 1973 i de kambro- ordovisiske bergartene fra Sandøla øst for Trangen og forsettelsen NØ-over så langt som til Gaizervann og Blåmurvann. Rapporten er ikke en endelig geologisk oppsummering , for ikke alle strukturdata er blitt sammenlignet, den er først og fremst skrevet som et diskusjonsgrunnlag og tolkning av det geologiske kartet over området.				

Synopsis of the Geology of the Sanddøla-Nesåvann area:

A. INTRODUCTION

This report is a summary of geological investigations carried out in 1973 in the Cambro-Ordovician rocks of Sanddøla east of Trangen and extending northeastwards as far as Gaziervann and Blåmurvann. This report is not a final account of the geology, since not all of the structural data has been synthesised, and is designed primarily as a basis for discussion and interpretation of the accompanying geological maps.

The description is organized on the basis of individual map sheets and detailed descriptions of each unit on a map sheet are avoided when the unit has been discussed in a previous section.

B. MØKLEVANN. Map 1189-01.

Gneiss: The oldest rock in the area appear to be the acidic gneisses of the "Grong Culmination" which occur south of Sanddøla river. There have been investigated in three traverses from which it appears that the gneisses are dominantly acidic with only thin, widely scattered horizons of amphibolite. The fine grained layered gneisses immediately south of the river grade southwards into medium-grained gneisses with small (< 1 cm) feldspar porphyroblasts in some exposures which become progressively more abundant southwards. At (0330 1100) there is a 8-10 meter thick unit of quartz-biotite schist which was probably a pelitic sediment originally. The medium grained porphyroblastic gneiss becomes more porphyroblastic south of (0310 1100) in that the size and proportion of feldspar metacrysts increases to such an extent that the rock is a porphyroblastic feldspar gneiss with up to 50 % of the rock consisting of feldspar porphyroblasts up to 2 cm in length set in a fine to medium grained quartz-feldspar-biotite matrix.

The presence of quartzitic layers in the fine grained, medium grained and porphyroblastic gneiss (outside the Møklevann sheet) and the quartz-biotitic schist layer mentioned above as well as layering/bedding in the fine grained gneiss indicate that the gneisses are metamorphosed arkosic sediments rather than metamorphosed granitic intrusives.

Acidic Intrusive rocks: The largest intrusive mass in the map area forms part of the Sanddøla trondhemite. The trondhemite is medium grained and often pinkish coloured with large areas that are pale greenish due to strong epidotization. The latter is well exposed in road cuts between Møklevann and Stortjern. At the extreme eastern end of Møklevann there is a small lense of fine grained trondhemite several tens of meters in width.

An elongated body of trondhemite extending from Langtjern to west of Stamtjern is considered to be an apophysis of the main trondhemite mass. Contacts with the surrounding rocks are only rarely exposed, the best example being along the road to Stamtjern. This is a fine to medium grained holocrystalline mass with a pronounced schistosity which is well developed in some places so that the rock resembles a quartz-rich schist. Along the Stamtjern road the northern contact is diffuse and consists of lenses of the trondhemite intruded into basic volcanic /diabase. The contact at Langtjern and west of it appears to be strongly cleaved and is marked by a sharp escarpment which is probably a fault zone.

South of Langtjern the rocks are largely silicic and resemble a medium grained keratophyre more than the trondhemite. On the basis of the evidence at Stamtjern this unit is considered to be an intrusive phase related to the main trondhemite mass.

The relationship between the main trondhemite mass and the other rocks is difficult to establish due to the absence of observed contact relationships. Southeast of Bryntjern the diabase appears to be intruded by trondhemite which contains rafts of basic volcanics which have a well developed schistosity. This suggests that the trondhemite may have been intruded into greenstones after the development of the regional schistosity.

The contact between Møklevann and the eastern boundary of the map is poorly exposed and east of Setertjern it runs along a small steep valley. Several small exposures of strongly tectonized greenstone near the contact where it crosses the Møklevann road suggests that faulting has occurred along the contact in some places.

Basic intrusives: Two large bodies of basic intrusives occur at Bryntjern and Møklevann. In addition small basic dikes occur near Angeltjern and scattered throughout the volcano-sedimentary sequence at Møklevann. In addition there are several small exposures of a medium grained basic rock

resembling gabbro along the northern contact of the trondhjemite body at Stamtjern. This area is shown on the map as a single mass, however, since the exposure is sparse in this area it ^{is} just a feasible to consider it as an area of basic volcanics with scattered medium grained dikes.

The basic intrusive at Bryntjern is mainly fine grained and holocrystalline. The rocks are metamorphosed and the original minerals have been intensely altered and is therefore classified as a diabase. The interior of the body has zones that are medium grained and is best classified as a meta-gabbro. This basic mass is considered to be a high level synvolcanic intrusive which was sufficiently large to permit coarse crystallization of its center. The contact with the metasedimentary rocks in the northwest corner of the map is not exposed but appears to be a fault boundary running along a topographic depression. The southeastern contact is shown as a fault since there is a strong scarp at the approximate location of the contact (It should be noted that some of the rocks at (0460 0590) mapped as massive lava are similar to the fine grained diabases so that placement of the contact along the fault zone may not be valid in detail).

The diabase body at Møklevann is fine grained and contains a number of 1-2 m wide lenses of basic and acidic volcanics and several small dikes of fine to medium grained trondhjemite. Small diabase dikes intruding the volcano-sedimentary rocks in the area mapped by K. Langley indicate that the diabase is later than the regional fabric in this area

Although age relationships of the intrusives to the other rocks in the area has not been definitely established, several features point toward a post greenstone age for the diabase and trondhjemite: (1) dikes of diabase cut the foliation in the volcanics; (2) apophyses of trondhjemite occur in the diabase; (3) xenoliths of basic rocks considered to be volcanic in origin occurs within the trondhjemite; and (4) the Stamtjern trondhjemite body intrudes the basic volcanics.

Volcanic rocks: The volcanic rocks of this map area can be separated into three major divisions: (1) massive lavas; (2) Greenschists; and (3) the volcano-sedimentary sequence north of Langtjern.

The fine grained massive lavas are basaltic flows in which lava boundaries are only rarely visible. The lavas have been intruded by basaltic dikes, up to 1.5 m thick, which are well exposed along the electricity transmission line at (0430 0735). In places, notably east of Stamtjern, the map unit contains minor pyroclastic material. West and northwest of Stamtjern the lavas, pyroclastics and tuffaceous sediments are intimately intermixed

and no attempt has been made to separate them into lithological units.

The greenschist unit is a sequence consisting mainly of strongly foliated basic pyroclastics, layered tuffs and clastic basic sediments. Massive basaltic units several meters in thickness, and thin keratophyric tuffs and lavas are scattered throughout this unit. In addition, several quartzite horizons, the largest of which occurs at Stortjern, occur throughout the unit.

Strongly deformed pyroclastics are most common adjacent to the massive lava unit. These consist of basic volcanic fragments, generally less than 10 cm in length, that have been strongly flattened within the plane of the regional foliation which is generally parallel to the layering when it can be determined. Several fine grained layered basic rocks, considered to be tuffs, west of Angeltjern have scattered pyroclastic fragments.

The tuffaceous units are dark green, fine grained basic rocks consisting mainly of amphibole crystals. Occasionally lapilli tuff fragments can be detected. The rocks have a strong schistosity and often exhibit a well developed layering which indicates that they were waterlain. Tuffaceous greenschist is most abundant adjacent to the massive lavas.

The basic sediments often contain metacrysts of calcite and have up to 50 % clastic quartz. Layering is well developed in many places and is generally bedding although in many places the compositional layering appears to be a foliation and sedimentary layering is difficult to prove e.g., along the road to Møklevann at (0450 1080). Rocks with sedimentary layering and containing clastic quartz become more prominent southwards from the massive lava unit so that the rocks immediately north of the limestone unit consist almost entirely of basic sediments in contrast to the dominantly tuffaceous and pyroclastic rocks immediately south of the massive lavas. No contact has been placed between the pyroclastic and tuffaceous greenschist and the basic sediments since the writer considers them to be both gradational and intermixed. The basic sediments are best exposed in road cuts along the Stamtjern road where they are phyllitic and in the vicinity of Stortjern where they are a mixture of phyllites and medium grained clastic basic sediments.

A Quartzite layer at Stortjern has a thickness of 3 - 5 m and can be traced along strike for a distance of 1.5 km. This is a greyish coloured rock consisting mainly of quartz with 5-15 % magnetite and traces of feldspars.

Several thin layers at (0406 0730) (0434 0775) and (0400 0740) could not be traced beyond the immediate outcropping. A quartzite lense, 10 x 0.5 m, at (0393 0707) appears to be a continuation of the horizon at the Godejord mineral occurrence.

Isolated outcrops of massive greenstone, interpreted as lava, occur within the dominantly tuffaceous and pyroclastic parts of the greenschists unit. Poorly developed pillow-like structures were observed in one small outcrop northwest of Fiskløsa.

Thin horizons of keratophyric rocks were observed at (0399 0722) (0399 0747), (0430 0997 - not shown on the map), 600 m northwest of Stamtjern and (0455 0600). Several of these e.g., that at (0455 0600), are massive and have only a weak schistosity whereas others are strongly schistose and are best described as quartz-sericite schists. Primary volcanic structures have not been observed in the keratophyric rocks. The schistose keratophyres maintain their thickness along strike and were probably of tuffaceous origin. The massive keratophyres are either lavas or dikes related to the trondhjemitic intrusive.

The volcano-sedimentary unit north of Langtjern has not been mapped in detail. The unit is similar to that of the greenschists in many respects and differs mainly in the greater abundance of keratophyre in this area. Some of the sediments observed north of Langtjern appear to be more quartz rich than those occurring in the Greenschist unit to the south.

A limestone horizon 5-10 meters in thickness can be traced across the map area. Isolated blocks above Trangen has enabled the writer to extend the unit beyond the Stamtjern road to the western edge of the map area. The limestone horizon separates basic sediments of the Greenschist unit from the pelitic and psammitic rocks to the south, Map Unit 15. The pelitic and psammitic rocks are generally brownish in colour due to presence of biotite being the chief mica present. Isolated thin horizons have a pale green colour indicating the presence of minor material derived from basic rocks. Locally this unit has garnet porphyroblasts (2-3 cm) but these do not indicate an age difference with the greenschist and greenstones since small garnets (1-2 mm) have been observed at Stortjern and at Godejorde.

The contact between the sediments and the gneisses to the south has not been observed. Several small outcrops near the contact in the woods at (0322 0631) on the south side of the Sanddøla river have a strong vertical

cleavage and are intensely mylonitized which indicate that at least locally the contact is a fault. In addition the narrow, steep walled and straight character of the Sanddøla river channel supports a fault contact however more observations of structural discordance are needed before a faulted contact can be accepted.

C. FINNBV. Map 1139-02.

The rock units described on the Møklevann map sheet continue into the Finnbu sheet.

At the eastern margin of the map the medium grained trondhjemite is intruded into basic volcanics. Veins and lenses of medium grained trondhjemite cut the greenstones and rafts of greenstone occur in the Trondhjemite. This area of the trondhjemite is considered to represent its roof. The general absence of inclusions of greenstone in the trondhjemite to the west is thought to represent progressively deeper erosional levels.

Small bodies of fine grained trondhjemite and porphyritic trondhjemite are exposed in the northeastern corner of the map. The fine grained trondhjemite is schistose and pyritic (1-5 % pyrite) and contains rafts of greenstone. A Mo-Cu mineralization occurs in fine grained trondhjemite at (0610 1660).

On the north side of Fremsttjern a fine grained trondhjemite or keratophyre occurrence occurs adjacent to the main trondhjemite mass. It contains small lenses with disseminated pyrite. Immediately east of Fremsttjern there is a small body of mixed schistose silicic and basic rocks which appear to be deformed volcanics. This body is in thrust contact with the trondhjemite. (The actual extent and origin of these rocks is not known since the area between the Koltjern brook and Fremsttjern has not been mapped.

Between Rognhaugtjern and Piperudtjern there is a fine grained laminated silicic rock, which resembles a silicic volcanic, lying between the trondhjemite and the greenstone. Thin sections of this rock show it to be strongly mylonitic with highly strained quartz which suggests that movement along this zone has been later than the regional metamorphism. An attempt was made to find this zone at the trondhjemite contact in Koltjern brook however here the contact zone is a mixture of dense basic volcanics and medium grained trondhjemite.

The pelitic and psammite sediments (Unit 15) on this map sheet have not been investigated.

The limestone horizon pinches out somewhere south and east of Bergtjern.

The greenschist horizon on this map sheet is dominantly sedimentary west of Tverrelven and consists mainly of green phyllites and well layered greenschists some of which are probably waterlain tuffs since they consist entirely of basic material. East of Tverrelven this unit consists mainly of layered tuffaceous rocks and massive greenstones ^{which/} become more dominant eastwards.

The massive greenstones and pyroclastic greenschists north of Finnbuvann thin out rapidly in the unmapped area west of Kolitjern brook since they are represented by only a very thin basic volcanic unit in Kolitjern brook. This is considered to be due to thrusting along the trondhjemite margin.

Metasediments (other than Unit 15).

A thin horizon of calcareous phyllite can be traced across the map area and for a short distance into map 1189-02. West of Finnbuvann the horizon becomes very thin and is found as scattered small exposures in brooks. The lithology is highly variable from the calcareous phyllites to siltstone and sandstone. In several places it resembles a phyllitic limestone. The rock is strongly tectonized with a penetrative cleavage and original layering can be seen between the cleavage phases in several places where the rocks have been folded. East of Fremsttjern both contacts of this unit are delineated by steep near vertical scarps and are considered to be fault controlled. The southern fault boundary can be traced westwards as far as (0500 1380).

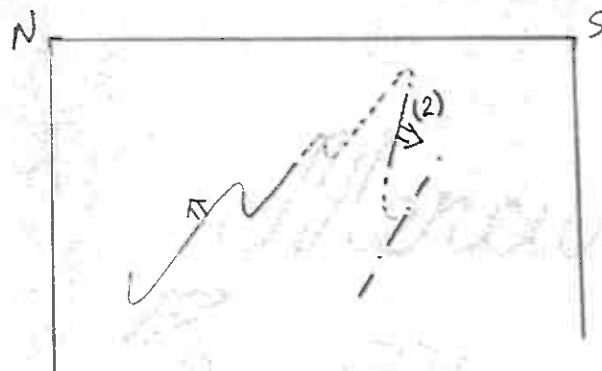
Southeast of Tjernrøle and along Kolitjern brook there is 200 meters of medium grained calcareous psammite which are quite similar to unit 18 of the Nesåvann mapsheet. The relationship of the calcareous psammites and calcareous phyllites is not known since both contacts run along small steep valleys.

The rocks immediately south of the greenstone occurrence in Kolitjern brook and for 400 meters southward are well layered sediments consisting of semipelite and psammite. This unit has not been outlined but is thought to have much the same configuration as the unit of calcareous tuff (LKT) shown on Foslies map.

Two occurrences of graded bedding were found close to section B - B¹.

The best exposure occurs in slightly overturned metasandstones near the faulted southern boundary of unit 19. The other occurs in interbedded sandstone and siltstones about 50 m north. The latter is not as well

preserved but indicate that the sequence is right way up since the folds (F_2) here have the style shown in the diagram below.



(2) position of way up criteria at the southern locality in relation to folds 50 meters north.

A Polymict conglomerate horizon (unit 23) is unconformably overlying an eroded trondhjemite surface in the eastern part of the map area. The conglomerates are interbanded with gritty and pebbly arkoses. The conglomerate consists of larger rounded blocks of medium grained trondhjemite, keratophyre/or fine grained trondhjemite, and minor greenstone and jasper in a chloritic sandy matrix.

The conglomerate has been folded together with the trondhjemite by open F_2 folds with a near vertical axial plane. The south contact of the conglomerate-arkose unit is faulted against calcareous phyllites.

D. LANGTJERN SHEET- map 1189-03

Greenstone and trondhjemite. The area of greenstone on Skarfjell shown on Foslie's 100.000 map sheet Sanddøla is a complex interfingering of greenstone with minor keratophyre and medium grained trondhjemite. Small bases of fine-grained trondhjemite and keratophyre, too small and irregular to be shown on the 1:20 000 map, are present in the trondhjemite and greenstone units.

The greenstone is generally massive, fine grained and generally lack primary volcanic structures. Locally, epidotized subrounded blocks (knots) are considered to be tectonic breccia fragments.

The greenstone body lying between arkose and phyllite near the top of the map contain pyroclastics at (0642 1775) and several tuffaceous horizons in the immediate vicinity. Although this block of greenstones has not been investigated in detail it resembles the Blåmuren greenstone unit on the Nesåvann map sheet rather than massive lavas of nearby Skarfjell and the layered greenstones to the south.

The intrusion of the trondhjemite into the greenstones can easily be demonstrated in this area: medium grained trondhjemite lenses and veins cut the greenstone and small stocks of trondhjemite contain xenoliths of basic volcanics.

The layered greenschists, map unit 12, are a continuation of the rocks on the Finnbu map. This unit is poorly exposed and small outcrops of pyroclastics and lava appear to be more abundant than on the Finnbu sheet to the west.

In the brook running from Langtjern at (0559, 1700) there is a short section of calcareous sedimentary rocks which are similar to the calcareous phyllites at Langtjern (unit 19). These rocks are however considered to represent minor calcareous sedimentation within the greenschist unit (because of the sparcity of exposure a correlation with unit 19 or unit 17 is equally plausible).

The greenschists are in direct contact with unit 17 at (0639 1863) and although foliations are parallel in both rock units the actual contact shows evidence of late shearing. The contact with unit 15 is not exposed in the brook draining Langtjern and the rocks of unit 12 nearest the contact are lavas. Several small bodies of trondhjemitic rocks occur in layered greenschists in the eastern part of the map.

Metasediments: Map unit 15, observed only in a short section the brook running from Langtjern, is mainly psammite with interlayered semi-pelite. The highly calcareous siltstones and phyllites of unit 19 are a continuation of the rocks on the Finnbu sheet. The relationship between the thin horizon of these rocks at the west end of Langtjern and the faulted block northeast of Langtjern is best explained as a pre-faulting isocline although evidence for such a fold has not been found in the area. The south contact is strongly mylonitized at (0662 1827).

Arkose and conglomeratic arkose of unit 23 are definitely in fault contact with the greenschist and calcareous phyllites along the south boundary and are also faulted against greenstone and trondhjemitic to the north. At (0588 1702) local movements have sheared and mylonitized conglomerate at the north contact. Conglomerates are most common in the western part of this unit and have been cut out by late faulting in the northeast.

A small body of a calcareous silicic rock occurs in the eastern part of the map area (unit 9). This rock has a strong foliation and abundant quartz phenocrysts/porphyroblasts. The unit is in fault contact with the calcareous phyllites. The north contact with greenstone is a zone of thrusting and is marked by remobilized carbonate with about 20 % quartz and mica. A small body of this carbonate has been outlined at (0663 1836). This rock was probably a volcanic however it is difficult to account for the high carbonate content other than by remobilization from elsewhere.

E. NESÅVANN - map 1189-04

Trondhjemite: A medium to coarse grained massif with small lenses of fine grained trondhjemite occupies the south western corner of the map. Small bodies of gabbro have been observed within the massif at vann 630 and on Nesåpiggen.

Veins and lenses of medium grained trondhjemites intrude greenstone south-west og northeast of Gaiz-javre.

Fine grained trondhjemite, often porphyritic, is the dominant rock type in several places southwest of Gaiz-javre (unit 11). These have been intruded by medium grained trondhjemite and the small bodies of unit 11 are a mixture of both rock types.

A small body of silicic volcanics (unit 10) occurs in the southern part of the map. These are fine grained and fine grained quartz porphyritic rocks in which individual units, probably flows, can be followed for short distances. Along the south boundary they are interlayered with thin greenstone horizons while the north boundary is unconformably overlain by and folded together with the arkoses and conglomerate of unit 23. Part of the south boundary is faulted/thrusted against the greenstones.

The greenstones between Skarfjell and Gaiz-javre are massive, fine grained basaltic volcanics which rarely exhibit primary volcanic structures. Thin horizons of chloritic silicic lavas occurs in several places throughout this unit.

The Blåmurvann greenstone unit is probably a continuation of the layered greenschist and greenstones on the Langtjern map. These greenstones have been investigated only briefly. There appears to be an abundance of fragmental and tuffaceous basaltic volcanics in this unit however there is too much basic lava to warrant describing it as 'basic tuffs' since it is a

mixture of lava, pyroclastics and tuff. A thin horizon of keratophyre agglomerate in a basic matrix occurs just off the southwestern corner of this unit on the Langtjern map.

Metasediments: A thin unit of calcareous phyllite marks the thrust/fault boundary between the arkoses (unit 23) and the Blåmurvann greenstones. This unit is strongly tectonized and appears to be massive dirty limestone at (0700 1888) and (0878 2105).

Less tectonized phyllites occurs southwest of Gaziervann. The rocks consist of calcareous phyllite, siltstone and several beds of arkosic sandstones up to 10 m thick. The contact, if any, with the limestone conglomerate unit, 20, has not been delineated. A small body of calcareous phyllite occurring within the greenstones at (0840 1935) is fault bounded on both contacts.

The limestone conglomerate, unit 20, is westward dipping to vertical west of Gaziervann. Thin horizons of greenstone conglomerate occur throughout the unit in addition to thin arkosic sandstone beds. In several places the rock is obviously a pseudo-conglomerate since only the limestone 'fragments' have a rounded form and the siltstone and phyllite fragments have definitely angular and elongated shapes. Unit 20 is thrust upon and over the arkoses of unit 23 at (0991 2028) but appears to be faulted against unit 23 in the northeast at (1135 2187).

Map unit 21 is quite similar to unit 19 and differs mainly in the presence of a basal conglomerate horizon underlying the calcareous siltstones and phyllites and lying unconformably upon the greenstones. This unit has been preserved in late downfaulted blocks in the Blåmurvann antiform. Several small bodies of this rock, without the basal conglomerate, less than 10 meters in thickness occur at the contact between the greenstones and unit 17 northeast of Holmtjern.

Greenstone conglomerate with a steep westerly dip occur west of Gaiz-javre and northeast of øvre Nesåvann. The unit has been mapped on only one traverse and is not greatly dissimilar to the basal conglomerate of unit 23 in that it is a layered pebble to boulder conglomerate with basic and acidic rock fragments in a basic matrix. Definite stratigraphic correlation between the two units cannot be attempted at this time due to lack of detailed tectonic observations in this area.

Arkose and conglomerates of unit 23 are a thick sequence of sedimentary rocks with abundant cut and fill structures, graded bedding in the arkosic layers and an absence of layering in conglomerate units that are up to several hundred meters thick. The well-rounded fragments range in size from pebbles up to boulders one meter in length and have been derived largely from a medium grained trondhjemite similar to the massif to the west. Basic fragments are rare in the conglomerate although jasper fragments are commonly present.

Cut and fill structures and graded bedding in arkosic sandstones indicate that both parts of this unit are right way up.

A small body of this unit northeast of Blåmurvann can be shown to be folded about the greenstones on the basis of the intermediate axes of deformed pebbles. It is quite obvious from the map that unit 23 has been cut out by faulting along its contact with unit 18 in the area north of Holmtjern.

All of the boundaries of unit 23 are controlled by a late brittle tectonic deformation. A traverse was made over the entire width of the arkose-conglomerate unit where the two parts are in contact (between Gaiz-javre and Håvdalsvann in an effort to study the contact relationships between them. A brief examination of the area where the two bodies should meet did not reveal any obvious structural discontinuity.

The calcareous psammities of unit 18 are a thick sequence of uniform highly calcareous sediments. In many places in this unit bedding has been destroyed by a regional schistosity along which carbonate weathers out to give an impression of layering, however, when fold hinges can be discerned it is possible to recognize the original layering when it is at a high angle to the schistosity. The bedding becomes indiscipherable from the schistosity where there is an angle of less than 30 degrees between the two.

G. H. Gale 1/3/74