Bergvesenet

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Rapportarkivet

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Tittel

Field mapping report Saltdal - Junkerdalen. Berggrunnsgeologi.

Forfatter	Dato	Bedrift
WATLING R J	1968	Sulitjelma Gruber A/S

Kommune	Fylke	Bergdistrikt	1: 50 000 kartblad	1: 250 000 kartblad

Fagområde	Dokument type	Forekomster
Råstofftype	Emneord	

Sammendrag

Feltet mellom Vensmoen og Nestbyfjellet på vestsida av Saltdal er kartlagt i M= 1:50 000. Mektige marmor -enheter er påvist, dels med pyritt-rike amfibolitter. Forskjellige typer glimmerskifre er skildra. Ingen større strukturer er observert, men mikrofolder er svært vanlig. To foldefaser. Ingen økonomisk interessante mineraliseringer observert. Berggrunnsgeologi. Tektonikk.

M/ oversiktskart.

R. J. Watling. 1968

Field Mapping Report.

Area mapped.

The area mapped was between grid lines 74/38 and 74/30 on the Norge 1/50 000 Saltdal (sheet 2129 III) and Junkerdal (sheet 2128 IV) sheets respectively using the Saltelva River as the eastern boundary of the area and the edge of the map as the western boundary.

Introduction.

The area was mapped from 2nd July - 26th August 1968 and is shown on the two maps accompanying this report.

For base maps, Norge 1/50 000 sheets were used and due to each of base maps there were blown up three times to act as "field slips" to enable some observations to be put directly on the map. Apart from one square kilometre in the south west corner the area was entirely wooded and under a thick vegetation cover and this, together with marsh and bog over the majority of the western area and glacial deposits over the east made mapping and correct positioning exceedingly difficult. The base maps originally are inaccurate and the necessity of using a 3x blow up, due to lack of areal photographs also must increase the margin of error when location points are taken in the field.

The area can be said to consist dominantly of marble, in varying degrees of purity, and of calc mica schists, mica schists, and amphibolites, the whole succession being more or less calc throughout and pyrite being a ubiquitous mineral. These points will be discussed in detail later.

The report is divided as follows:

1. Stratigraphy
2. Basis of subdivision of units
3. Subdivided units
4. Structure
5. Metamorphism, related, to black and white marble in particular.
6. List of specimens with locations
7. Economic aspects.

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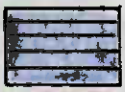
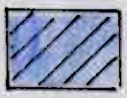
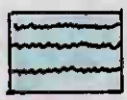
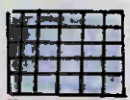
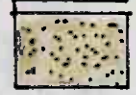
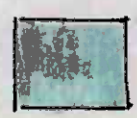
Stratigraphy

Structural succession see 1/50 000 Norge.

101/26		1	Drift
101/140		2	Black and white banded marble
101/140		3	White massive marble with pyrite rich amphibolites.
999/180		4	Actinolite and tremolite schists with mica schists and amphibolite and marble bands.
999/180		5	Biotite schists and biotite rich actinolite amphibolites.
999/180		6	Calc mica schists and mica schists.
101/140		7	Black and white banded marble
101/23		8	Amphibolite with mica schists and marble bands.
(735 ±)		9	Very micaceous calc mica schists and minor amphibolites.
101/140		10	Saccharoidal and pure white marble.
999/10		11	Amphibolite and mica schist.
999/30		12	Marble with minor calc mica schists.
(739)		13	Amphibolite and mica schist
25		14	Garnet mica schist, actinolite garnet mica schist and amphibolite.
999/90		15	Calc mica schist and marble.
101/2		16	Saccharoidal, black and white banded marble and massive marble.
101/9		17	Amphibolite and mica schist.

(740)  18 Large actinolite calc amphibolite

999/110  19 Non calc amphibolite and garnet mica schist.

1. Stratigraphy.

The previous diagram represents the structural succession which is indicated in the area, the numbers to the right of the key will be used in future references to units in the group.

There appears from all the available evidence on this mapping area to be a straight through succession from west to east. That is to say that beds in the west of of the map is structurally lower and lie structurally underneath ensuing beds to the east. Thus in crossing the area from west to east one goes structurally higher.

The equivalence of unit 4 with units 5 and 6 and the possible equivalence of units 2 and 7 will be discussed under their separate headings later.

2. Basis of subdivision of units.

The whole of the area was correct largely by marble predominant and calc rich rocks and this made subdivision of units extremely difficult. Finally it was decided to group rocks of distinctive type in lime-proscenity, together and classify this as a unit. As a result assemblages like biotite schists and biotite rich actinolite amphibolites can be grouped together and distinguished from adjacent calc mica schist and mica schist units. This is the only satisfactory method, which is practicable, for subdividing the area, but even so lateral variations in facies of a particular group necessitated the following of the group along strike and watching this lateral variation to be sure that the unit mapped some five or six kilometers away is the same as the one then being mapped.

Mapping units like this divides a map up into a series of lithologies and gives rise to a structural, not stratigraphic succession. By this it is meant that whereas beds may be stated categorically to be either structurally higher or lower than adjacent beds, they can in no way be said to be stratigraphically higher or lower, and in the age sense no stratigraphical column can be worked out,(except possibly by radiometric dating of the amphibolites), and thus a structural succession is given.

3. The subdivided units.

(1) Drift.

This covered a considerable amount of the area but was most predominant along the main river edge. However it was only of nuisance value and cannot be classed in the same way as all following units. A description of the drift is not included here as it is not deemed necessary.
Suffice it to say that no ore boulders or pebbles were found in it, or where it had been was hid by streams.

(2 and 7) Black and white banded marbles.

The unit contained, black, blush grey and banded marble together with saccharoidal marbles, the latter ranging in colour from grey through reds and whites to greens. The amphibolites which do occassionally occur in the unit are very calcareous and usually contain pyrite, they are, needless to say, of very minor significance in this a marble unit. Schists of mica and calc mica variety are absent in the banded marble unit extending down from around 380/155, but where this unit appears again after the drift at 317/137 they can be seen in small amounts, but none the less they do occur and indicate the incoming of clastic material (necessarily fine grained) from a local scource area during deposition of the original carbonate.

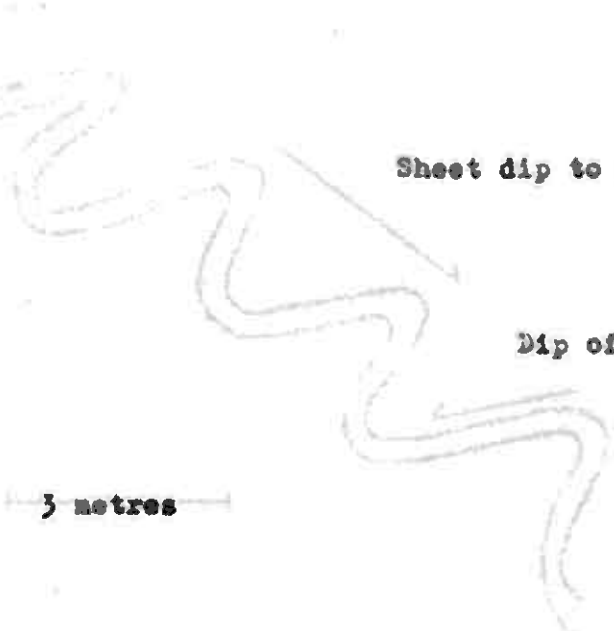
Two separate bands of this so called banded marble unit occur, one, as already stated extending south from 380/155 and the second southwards from 380/140, both bands can be traced with little variation in lithology from north to south of the area.

but both are covered by drift heltoron the 344 grid, upto, in the case of the extreme eastern unit the 320 grid and in that of the western unit the 338 grid. However, both can be picked up south of this again with ease. Spec K is a typical example of this lithology.

Both units are vertically indistinguishable from each other, a fact which poses problems as will be seen later.

So similar are the lithologies of these two units and so distinct and compared to the rest of the rock types, that it was originally thought that bouth could be limites in the same structure, and this indeed could still be a possibility, unfortunately however the bands do not show any swing in strike that is significant in this conclusion, and disappear under the drift in the northeast on the adjacent area where a possible fold closure could have been and thus no conclusive proof could be gained here. In the south west, again in an adjacent area, they go off this map and show no swing in strike either, thus it is considered that there is no structure here, but purely for the negative reason that no proof of its existence can be obtained.

The dip also in both units of this banded marble are mainly easterly although both units are highly crenulated and contorted, also in the south of the area, the banded marble forms the feature outside Rokland and here several westerly dips on bands in this banded marble were recorded but this is anomalous because the sheet dip is to the south east and these anomalous dips represent results taken in minor crenulations. This point is best brought out by reference to the figure below.



Due to lack of proof of a structure involving the two banded marbles it is thus deemed necessary to separate them in the structural succession, the unit in the west being structurally lower than that in the east.

The marble is obviously banded with dark and light bands of vary

very coarse calcite forming the rock, the bands vary in thickness from 1 mm up to ca. 26 cm, but usually show a marked conformity with one another.
Two phases of metamorphism are shown in the marble (discussed under metamorphism at the end) and it was the first of these, presumably during the caledonian orogeny which gave the marble its banded structure.
Thus it is considered that the bands of the banded marble are secondary and due to metamorphic segregation of minerals and not a primary feature set up within the marble at the time of its deposition as a sediment.

Pyrite is ubiquitous throughout these marbles and indeed throughout the succession of the whole area and sometimes may show marked concentration in individual bands within the unit.

This banded marble proved an excellent marked horizon in mapping the area and since it formed features could be traced easily.

(3). White massive marble with pyrite rich amphibolites.

This occurs as a mainly pure white massive and saccharoidal unit, and is probably a lens or just a facies variation of the above banded marble, it does not reappear after the drift and this together with poor exposure leads one to resort to the idea that it is a lens of the banded marble.

This marble starts at 352/148 and has the above characteristics. In addition to this lenses of amphibolite upto 30 cm occur in it and these are crammed full of pyrite enhedra and enhedra sometimes upto 3 cm across, but usually only 0.5 cm cubes.

The unit probably represents a local deposit of alternating very pure calc and muddy calc sediments with organic iron, before metamorphism.

(4). (5 and 6)

(4). Actinolite and tremolite schists with mica schists and amphibolite and marble bands.

(5). Biotite schist and biotite rich actinolite amphibolite.

(6). Calc mica schist and mica schist.

These three units are discussed under the same heading because unit 4 when it reappears after the drift around the 33 grid line is capable of subdivision into two units, 5 and 6 giving rise to two structural columns either side of this 34 grid.

In the following account they are dealt with separately but it must be remembered that on an overall structural succession of the whole area units 5 and 6 would be equivalent to unit 4.

Unit 4 has its medium point at 380/145 and can be traced with small variation upto the 35 grid line.

The unit consists of a variable hotch potch of rocks, tremolite

and actinolite marbles, mica schists, Chlorite schists, red and green marbles, actinolite amphibolites, biotite amphibolites, biotite schists, quartz veins and calc mica schists. Its subdivision as a unit is made possible only because its boundaries are clearly defined as functions with the two banded marbles already discussed.

The unit is essentially composed of amphibolites and actinolite and tremolite on weathered surfaces. The amphibolites are thick, sometimes upto 100 yds. and show much weathering and pyrite crystals, whereas the marbles are void of pyrite in any great quantity. The rocks are highly folded and there is evidence of a series of troughs and culminations on scales upto 0.5 km, both across and along strike, the rocks dip mainly to the east at high angles and exposure is very bad except on the one road crossing the area, because the unit is the site of a valley carved out by glacial and fluvial action between the two banded marbles and has hence thick glacial deposits above it, thus exposure in streams and high points is the only means of identifying the inner parts of the unit, although, as already stated, its boundaries can be mapped with comparative accuracy against the banded marble.
This unit obviously represents more muddy conditions of deposition than those prevailing when the banded marble was laid down.

When the unit emerges from the drift below the 33 grid the increase in amphibolite and schist which was becoming apparent as the original unit was traced south is now even more apparent leading to an easy subdivision into a schist and biotite amphibolite both of which form distinct features.

Unit 5, the amphibolite unit, is the more easterly of the two and occurs in parts as a scarp forming a boundary to a recently made reservar below the 33 grid. The unit consists of very coarse grained biotite schists with biotite amphibolites and amphibolite lenses and units within this main unit. The unit was non calc and thus there was a complete change to muddy deposition in the original site of sedimentation.

Unit 6. The calc mica schist and mica schist unit. The unit also also contains the occassional amphibolite band but the presence on its western boundary of the banded marble and on its eastern boundary of the amphibolite make this assemblage quite easy to distinguish and plot boundaries for.

The schists vary from biotite to muscovite and small amounts of calc indicate possibly an accumulation of carbonate from organic sources. Dips are easterly as indeed they are throughout the area in general. Pyrite again can be seen to be ubiquitous but in nowhere near as large amounts as in the banded marble units.

Both these units can be traced to the extreme south of the area with hardly any change in lithology since their first occurence.

(8). Amphibolite with mica schists and marble bands.

This unit comes in around 345/137 and can be seen to be only a local deposit. It is surrounded on one side by banded marble and on the other by calc mica schists and marble and thus forms a distinct lithology, its boundary however, is quite difficult to trace all the way round the outcrop because it outcrop in several 100 ft. vertical precipices.

Also the amphibolite where best exposed is inaccessible being some half way down a 200 ft. c 70 metre vertical cliff but fortunately occurs enough in isolated outcrops an accessible slopes for its boundary to be marked with reasonable accuracy. It consists essentially of amphibolite but occasional schist bands can be picked out and even small marble bands, but only where the unit is cut through by streams which make detailed study possible. It can be seen to strike out both south and north and does not form an important part of the succession only probably representing a local influxe of muddy material during original deposition prior to metamorphism of a calc rich sediment.

(9). Very micaceous calc mica schist and minor amphibolite.

This unit forms a major subdivision of the largest unit on the map, a marble unit, this unit being separated from the marble on the bases of its extra mica content.

One can say that the subdivision is on the bases of the fact that unit 9 contains both amphibolite and a predominance of calc mica rocks, whereas its sister unit, unit 10, is a pure marble with only occasional amphibolites these latter when they do occur being very thin.

The rocks of unit 9 are very micaceous calc mica schists dipping at high angles to the east the boundary with its sister being marked in several places by a quite distinct break in slope especially in the south. Here the rocks become much more micaceous and it is only possible to identify them as belonging to unit 9 by following them along strike and watching this gradual change take place, this done the subdivision is easily recognised.

(10.) Marble unit, both saccharoidal and massive.

In the north at around 380/135 the unit is entirely massive white and pink marble with very occasional amphibolites and is easily picked up and distinguished from its adjacent calc mica and calc amphibolite partners (the latter will be dealt with later).

Towards the south more mica creeps in although the unit is still recognisable and in the extreme south west quartz pebbles can be seen, this is a meta calc conglomerate, the pebbles are up to 15 cm in long axis and are elongated parallel to the schistosity. The "pebbles" are entirely quartzite.

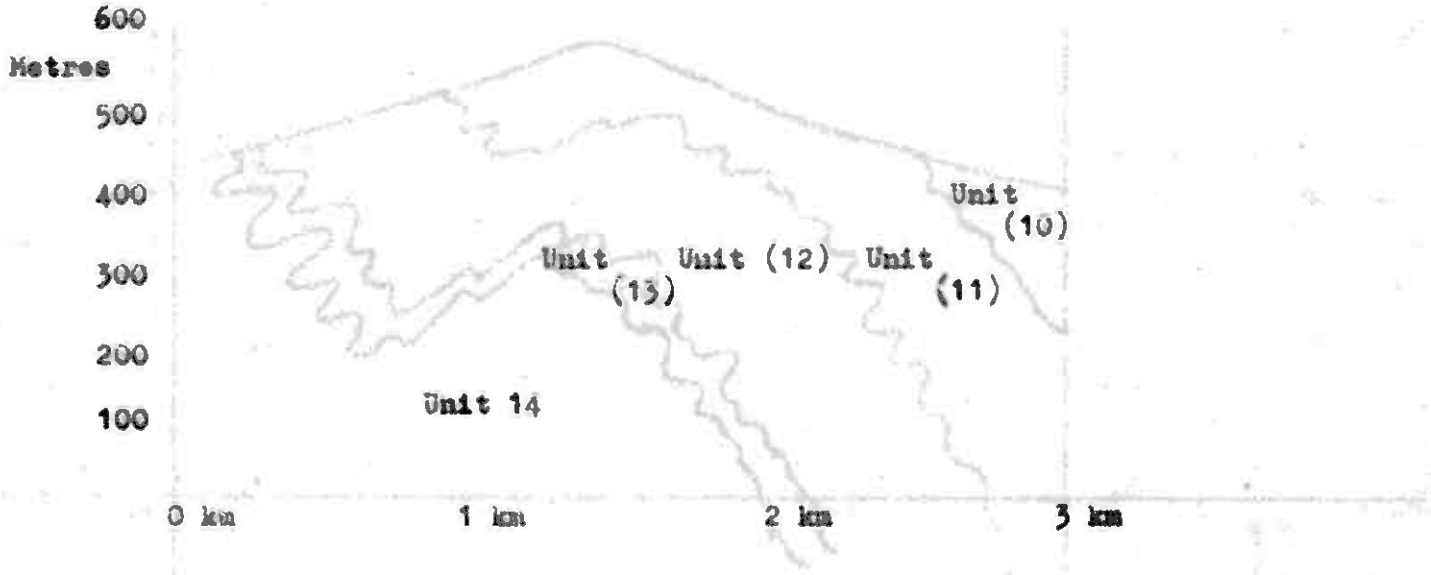
Saccharoidal marble occurs in abundance together with much minor folding and crenulation of beds, and one breached dome at Djun Balet.

The unit is distinctively a marble one and it is possible to see such changes as the incoming of more mica by following the unit along strike as was necessitated in the last unit.

(11). Amphibolite and mica schist unit.

The unit comes in around 370/126 and gets increasingly wider in an E/W sense towards the S.W. Due to the presence of a small dome like structure there.

The sheet dip structure of this fold is given in section EFG. on the scaled cross sections but an indication of the extreme crenulation of the bed is given below.



The unit consists of mica and garnet mica schists in the north forming a sharp contact with the pure marble of the preceeding unit but when traced south west these give place to a calc amphibolite with small red pit marks due possibly to the weathering of some iron rich calcite and probably some feldspar although this latter is not certain.
The rock is quite distinctive of this lithology and forms an easy subdivision being bordered on both sides by pure marbles.

The minor anticline it forms is breached by rivers in the NW of its extent, and where it dies lowground of the same rock type is occupied by lakes.

(12). Marble with minor calc mica schists.

The unit is dominantly one of mica banded pure white marble and in the north a small amount of mica schist. The boundary of the unit is easily distinguished as the unit is sandwiched between two amphibolite and schist units.

The marble grades from pure white to blue grey and is usually very coarse grained, saccharoidal facies is absent except in the south west, in the south west the mica becomes quite abundant and forms bands showing extreme crenulations on scales varying from 6 cm to 10 metres.

Dips and strikes are difficult to take with certainty although in a few good exposures they can be seen to be generally easterly.

Mineralogically the unit is barren, apart from occasional small isolations of pyrite especially in the extreme north and south west.

(13). Amphibolite and mica schist unit.

This unit, up to the 36 grid going south is very similar to its twin, unit 11, being split by marble.

The unit is made up of mica schists and garnet mica schists together with actinclite and hornblende amphibolites, but unlike the previous actinolite amphibolite unit 11, the lithologies making up unit 13 continue to the western margin of the area, and do not as they do in the other unit, become very calcic. Mica schists are very common and north of the 35 grid may be said to be the dominant lithology with amphibolites subordinate, whereas a general steady increase in the amphibolite component of the unit towards the s.w. makes the porcentage of schist and amphibolite almost comparable at the west boundary.

Very many microcrenulations makes dips uncertain and this coupled with extremely bad exposure due to marsh and glacial drift makes satisfactory readings in any great quantity impossible to take.
However in the contact exposures with the next unit to be discussed, there is obvious conformity and thus a cross section shows this unit dipping to the east as do the rest.

Microcrenulations on the 20 cm scale give an apparent dip of the unit to the nw along the 34 grid, but as can be seen and as is interpreted on the cross sections, this is anomalous, the sheet dip is to the SE, the minor anticline effecting the unit being to the east.

The rocks west of this unit suffer from extreme crenulation and worse exposure mainly due to bog which from now on is almost ubiquitous, and glacial material which is in abundance and has not been removed by poor depositional erosion, good exposures are found in streams, but often the latter are strike streams and provide only a 2D structure. However there appears to be no marked inconformity with the eastern beds and the few westerly dip readings are only due to the fact that they are taken on western limbs of minor structures, the sheet dip as usual is easterly.

(14). Garnet mica schist, actinolite garnet mica schist and amphibolite unit.

This unit is typified by the assemblage garnet mica schist actinolite garnet mica schist and amphibolite, the main bases of subdivision is on garnets, they are in this unit and in no other in such abundance as to make the unit quite distinguishable.

The unit forms a prominent feature all the way from the 37 grid line to its disappearence off the edge of the map at the 34 grid.

Large actinolite radials in the schists are common and garnets upto 1 cm in diameter are sometimes present although the average is from 2 - 3 mm.

Occasionally a marble band is present, but only found in streams and could come from the adjacent marble unit, although this is by no means certain and from surface exposure cannot be proved.

The amphibolite shows no radiating actinolite but rather long fibrous single crystals of amphibole with some occasional pyrite. In the north the mica schist component becomes less until finally on the 30 grid a very thin unit of garnet mica schist and amphibolite is present.

(15). Calc mica schist and marble unit.

This unit forms a highly calc feature running parallel to the last feature and dissected by a major stream. Exposure, apart from the stream bed and feature top is nonexistent, the slopes being covered by scree and very thick vegetation.

In the extreme north the unit can be seen very clearly on the road which crosses the area from east to west, to is composed of calc mica schists and marbles with the occasional lens of non calc mica schists and even less amphibolite.
The marbles show an extreme variety in colour, reds, yellows, browns, blacks, greys and blues, together with pure white and green occur in the same sample.

Mica, both muscovite and biotite, give clear evidence of the extreme intercrenulation. These west variety of colour end apparently abruptly below the 36 grid and the unit becomes an ordinary mica banded white and dark marble. The calc mica schists show far less spectacular variety but but one unit shows a pitted texture over some 2 km. Schists become very much more common as the unit is traced along the strike to the south west, but large masses of calcite in them make them easily distinguishable from the last unit. The schist itself distinguishing the unit from the next entirely calc unit, which is quite thin in the south west corner and is dealt with next. Much microcrenulation is evident and can be seen clearly even in the poor exposure. Dips to the east are common and the stream section gives an easterly dip.

(16). Saccharoidal, black and white banded marble and massive marble unit.

The unit consists of massive white marble, grey/white and white banded marble, saccharoidal marble and brownish massive marble and is quite readily distinguishable from the next, non calc amphibolite unit. Exceptionally bad exposure of this and the rest of the western units makes the mapping not all that one had hoped for in this area, but the exposures that are present show easterly dips, which is fortunate because if the dips were not conformable it would be impossible to make a detailed examination of the area to find structures and so sent out any complications.

The unit can be traced south west as a feature but thins quite markedly due to a thickening of the adjacent amphibolite.

The unit stays as a marble to the western boundary of the map.

(17). Amphibolite and mica schist unit.

The unit is very poorly exposed due to vast area of bog, marsh and glacial debris.

However the rocks consists of radiating actinolite crystals in a greyish actinolite and mica matrix.

The majority of exposures dip easterly and the unit is mapped almost entirely by using the small feature that it forms as marking boundaries. This, short of digging the whole area up was the only one available to map the unit on.

(18). Large actinolite calc amphibolite unit.

This unit is distinguished from the latter solely on the incoming of marble lenses and the existence of marble bands in the amphibolite.

Actinolite is still the dominant amphibole and the rocks have become much darker and more massive. Over the half kilometer square of suggested exposure of this unit, exposure of the rock is adequate enough to mark farly delmate boundaries, but over a bigger area much better exposure is necessary to mark boundaries with certainty.

(19). Mor calc amphibolite and garnet mica schists.

The unit is marked by the incoming of mica in the amphibolites which gives the actinolite radials a much higher definition being set in a white mica background, the amphibolites are really amphibole mica schists, but there is such a considerable amount of amphibole that the above title of the unit is deemed necessary.

Garnet mica schist forms some 25% of the unit and garnets occur with amphibole in the amphibolites.

Exposure is extremely bad and only two exposures in 20 glacial planed surface occur in the area in the extreme north west corner.

However slightly better exposure in the area to the north of the mapping area enabled convenient boundary to be drawn. However the two stream sections where most of the information on this unit were gathered proved inadequate to formulate dip and strike readings on, because the rocks were far too crenulated and a large enough outcrop to proove sheet dip did not exist. Exposure on the adjacent calc amphibolite unit in three cases gave conclusive easterly dips even though the majority of the microcrenulations dipped west. The sheet dip of this unit is thus deemed the same as the last unit.

Exposure however, is far from good and for the next 4 km west no better and thus exposures and excursions onhide the area proved to be a waste of time due to glacial cover, bog, and surprising increase in lakes. Thus it was not possible to use this adjacent area to sort out the structure in mene, however a general conformity seems in every way to be indicated.

4. Structure

The structure of the area is well seen in the three cross sections. From the first two of these it can be seen that there is a general easterly dip to all the rock units from east to west and no structure, just a straight through sequence as already indicated.

On the last cross section a minor antiform can be seen, but this is in no way large and effects over an area of a few square kilometres only, the rest of the sequence of this section is again straight through with structurally lower beds to the west.

Minor structures in the shape of microcrenulations upto 1 metre in cross sectional area are very common indeed and give anomalous dip readings to the sheet dip in allot of cases. All beds are microcrenulated and the straight lines on the cross sections represent sheet dip, true pictures of the beds would show this microcrenulation but as these latter cannot be put in exactly a far better idea is given of the structure when just using straight lines.

An excellent example of anomalous dip readings due to this microcrenulation has been discussed under the black and white banded marble group.

No major structure can be found in this area on the results of this surface mapping.

A structure involving the two banded marble litheligies has been informed when discussing these units, but no concrete proof of it exists and it is thus deemed to be absent.

5. Metamorphism.

Obviously a discussion of the metamorphism during the Caledonian orogeny is not called for here and is not intended. What is intended under this heading is a description of an occurence of two fold phases in the black and white marble lithology.

The occurence is at 377/158 where a road is being blasted round the bottom of the hill, the black and white marble lithology has been metamorphosed during the caledonian orogeny in a major metamorphic stage during this orogeny and the banded appearance has been imparted to it by the metamorphic effect.

At the above locality secondary calcite veins cut the banded marble as in diagram below.

Marble

Secondary calcite veins

Some 10 yds, (c) 9 metres away from this the secondary veins have themselves been folded.

Marble

Secondary calcite veins

This suggests the following.

(1) Main metamorphism of the sediments imparting banded appearance.

(2) Veining by calcite.

(3) During a period of possible stress relief or equilibration the marble and vein calcite were again folded.

Over a bigger area with better exposure a whole series of the possible F_2 folds could be seen and it is possible that some of the microcrenulations on the highly folded beds in the west are of this phase.

6. List of specimens.

Specimen	Locality	Description
Spec A	380/1445	Actinolite schist with much calcite and small pyrite crystals rock light in colour apart from actinolite which is black.
Spec B	379/144 Strike 224°N	Calc tremolite rock, tremolite fibrous.
Spec C	3785/143	Massive non calc amphibolite.
Spec D	376/142	Slightly calc amphibolite.
Spec E	3765/141	Micaceous amphibolite.
Spec F	373/1335	Amphibolite.
Spec G	373/118	Mica schist with large amphibolite crystals and small veins of biotite running across the rock.
Spec H	366/138	Calc biotite amphibolite.
Spec I	346/139	Banded mica, actinolite calcite pyrite rock, weathering yellow and black.
Spec J	348/136	Black and white speckled amphibolite.
Spec K	370/135	Black and white marble.
Specs L & M	369/134	Massive coarse grained marbles.
Spec N	369/1525	Layered calc biotite rock.
Spec O	3765/1475	Massive actinolite amphibolite rock.
Spec P	3765/147	Calc actinolite amphibolite with pyrite.
Spec Q	377/148	Biotite amphibole quartz schist.
Spec R	382/152	Massive grey amphibolite.
Specs S & T	3435/139	Calc muscovite schists with pyrite.
Spec U	349/136	Calc actinolite mica garnet schist.
Spec V	349/137	Amphibolite with small quartz segregations.
Spec W	350/137	V. similar to spec V.
Spec X	3595/136	Marble with much biotite amphibole and pyrite.
Spec Y	3495/136	Massive quartzy marble.
Spec Z	3495/136	Massive quartzy marble.
Spec 1	3495/137	Calc mica schist with pyrite.

Specimen	Locality	Description
Spec 2	344/1405	Dark grey marble.
Spec 3	363/1325	Slightly calc amphibolite.
Specs 4A & 4B	360/1265	Spotted marble and pure calc marble.
Spec 5	360/126	Another spotted marble, possibly same one with slightly schistose bands.
Spec 6	363/1255	Very micaceous marble, weathering brown.
Spec 7	3675/1164	Amphibolite.
Spec 8	376/113	Quartz mica rock, mica forms plates and layers in the quartz and splits rock into planes.
Spec 9	366/150	Quartz biotite amphibolite.
Spec 10		Null and void.
Spec 11	353/140	Slightly calcic amphibolite with pyrite and possibly chalcopyrite.
Spec 12	358/113	Graphitic calc biotite schist.
Spec 13	348/104	Calc mica schist.
Spec 14	343/106	Calc mica schist.
Spec 15	344/93	Garnet actinolite mica schist.
Spec 16	343/104	Marble
Spec 17	343/104	Same marble with mica.
Spec 18	380/114	Amphibolite.
Spec 19	344/99	Garnet mica schist.
Spec 20	343/98	Mica schist.
Spec 21	377/107	Garnet amphibolite.
Spec 22	372/101	Actinolite amphibolite.
Spec 23	337/138	Calc mica amphibole banded marble.
Spec 24	336/135	Micaceous marble.
Spec 25	335/135	Micaceous marble.
Spec 26	339/134	Grey slightly micaceous marble.
Spec 27	334/134	Same marble with biotite lens.
Spec 28	3325/1325	Appreciable amounts of v dark mica in marble.
Spec 29	300/908	Very calcic actinolite mica garnet schist.

Specimen	Locality	Description
Spec 30	310/1225	Non calcic actinolite mica schist.
Spec 31.	339/970	80°/360°N dip. Calc mica hornblende rock forms feature behind lake at this point.
Spec 32	334/1025	Banded mica, quartz/plagioclase schist.
Spec 33	327/1063	Banded calc mica schist.
Spec 34	310/104	Very calc rock with mica.
Spec 35	308/99	Slightly calcic actinolite mica schist.
Spec 36	301/104	Quartz pebble in calc (very) mica schist meta conglomerate.
Specs 37 and 38	310/98	Calc amphibolite units.
Spec 39	372/97	Actinolite mica schist.
Spec 40	355/134	Actinolite amphibolite.

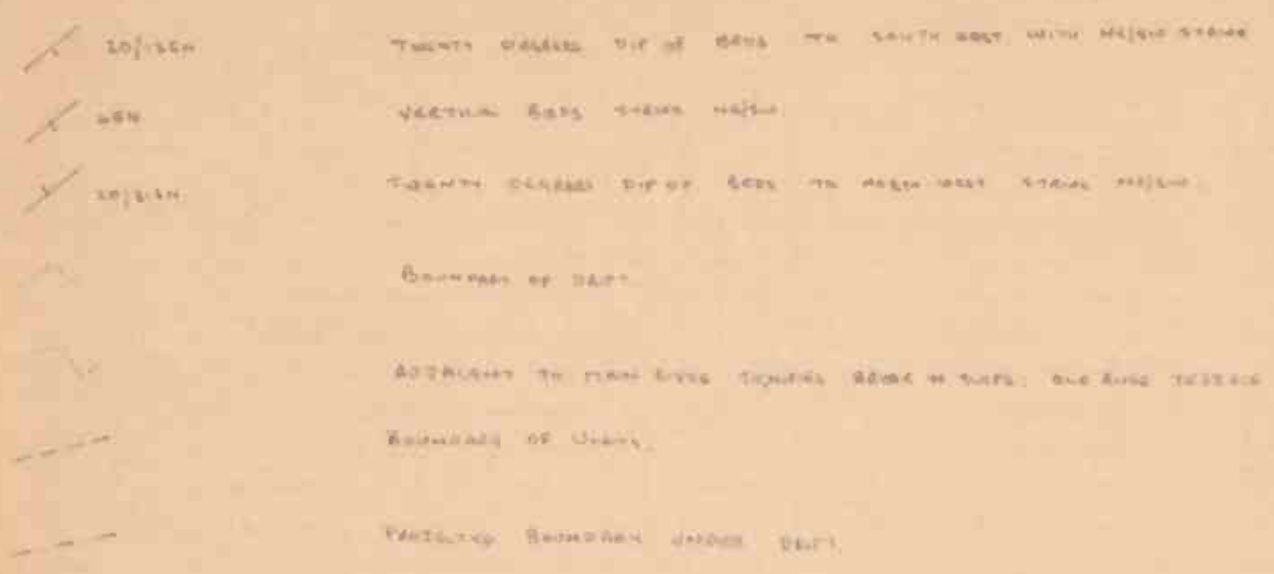
7. Economic aspects.

Apart from the abundance of pyrite the area is barren of minerals and is of no economic importance, as far as a surface schisty can determine.

M711
First Edition-AMS

Prepared by the Army Map Service (AM), Corps of Engineers, U. S. Army, Washington, D. C.
from Norge 1:50,000, Norges Geografiske Oppmåling, Sheet L3 1944. Sheet

Key To Map


20 inch
Twenty degree dip of beds to south east with major strike
dem
Vertical beds strike north
20 inch
Twenty degree dip of beds to north west strike north
Boundary of Draft
Boundary of Draft
Footpath Boundary across Draft

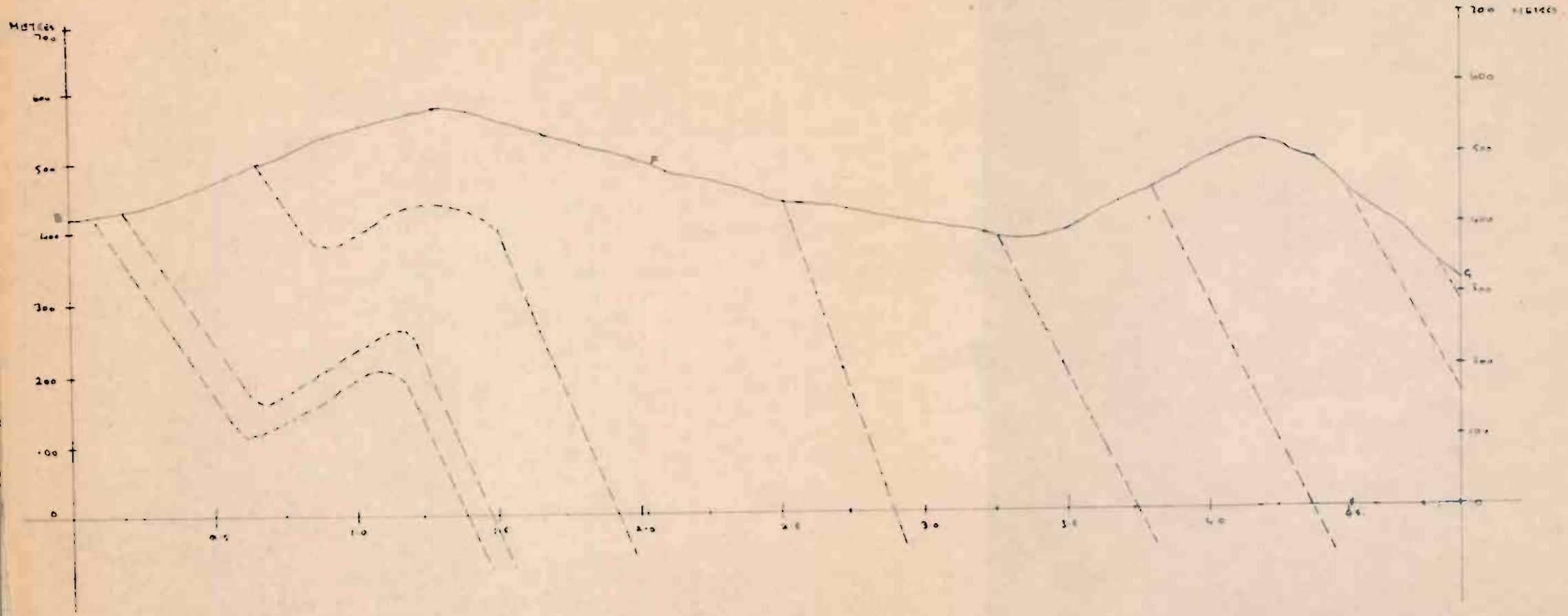
CROSS SECTION 3 EFG

VERTICAL SCALE - 1cm ≡ 1km

HORIZONTAL SCALE - 6cm ≡ 1km

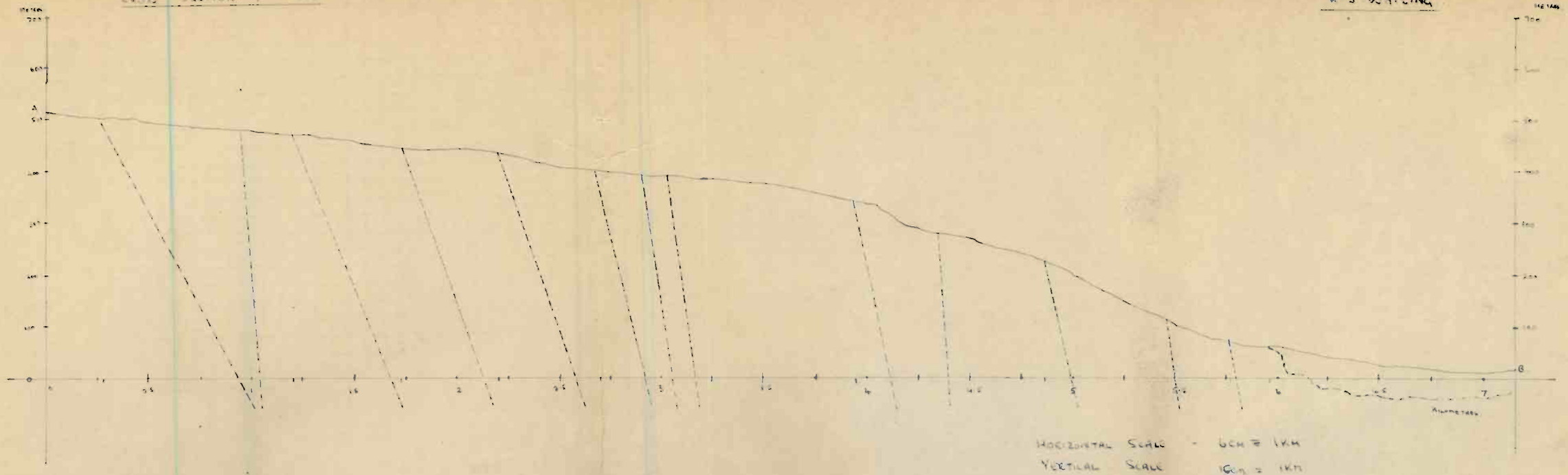
VERTICAL EXAGGERATION 2.5 TIMES

R J WATLING



CROSS SECTION 1 AB

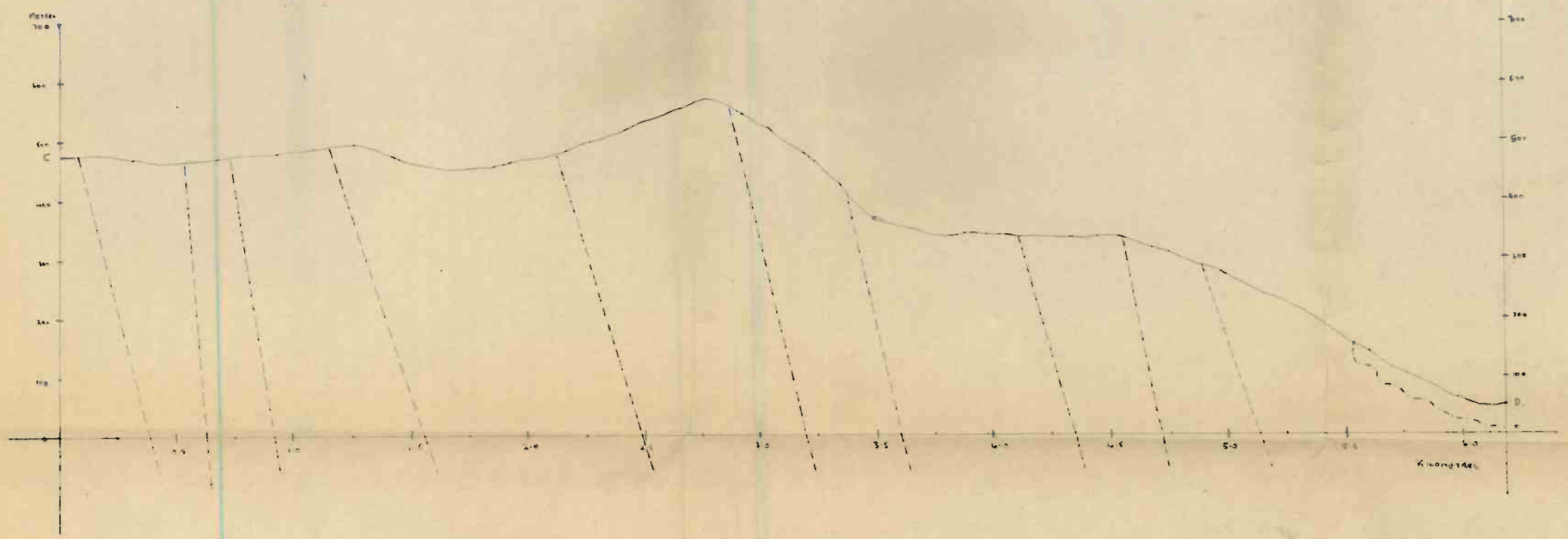
R J WATLING



HORIZONTAL SCALE - 6CM = 1KM
VERTICAL SCALE 15CM = 1KM
VERTICAL EXAGGERATION 2.5 TIMES

R J WATLING

CROSS SECTION 2 C D



HORIZONTAL SCALE - 6CM = 1KM
VERTICAL SCALE - 15CM = 1KM
VERTICAL EXAGGERATION 2.5 TIMES

Map scale 1cm = 1 kilometre

Key to symbols

A

B

C

E

F

G

N

W

E

S

R. J. Watling.

Field Mapping Report.

Area mapped.

The area mapped was between grid lines 74/38 and 74/30 on the Norge 1/50 000 Saltdal (sheet 2129 III) and Junkerdal (sheet 2128 IV) sheets respectively using the Saltelva River as the eastern boundary of the area and the edge of the map as the western boundary.

Introduction.

The area was mapped from 2nd July - 26th August 1966 and is shown on the two maps accompanying this report.

For base maps, Norge 1/50 000 sheets were used and due to each of base maps there were blown up three times to act as "field slips" to enable some observations to be put directly on the map. Apart from one square kilometre in the south west corner the area was entirely wooded and under a thick vegetation cover and this, together with marsh and bog over the majority of the western area and glacial deposits over the east made mapping and correct positioning exceedingly difficult. The base maps originally are inacurate and the necessity of using a 3x blow up, due to lack of areal photographs also must increase the margin of error when location points are taken in the field.

The area can be said to consist dominantly of marble, in varying degrees of purity, and of calc mica schists, mica schists, and amphibolites, the whole succession being more or less calc throughout and pyrite being a ubiquitous mineral. These points will be discussed in detail later.

The report is divided as follows:

1. Stratigraphy
2. Basis of subdivision of units
3. Subdivided units
4. Structure
5. Metamorphism, related, to black and white marble in particular.
6. List of specimens with locations
7. Economic aspects.

052.010

Stratigraphy

Structural succession see 1/50 000 Norge.

101/26	1	Drift
101/140	2	Black and white banded marble
101/140	3	White massive marble with pyrite rich amphibolites.
999/180	4	Actinolite and tremolite schists with mica schists and amphibolite and marble bands.
999/180	5	Biotite schists and biotite rich actinolite amphibolites.
999/180	6	Calc mica schists and mica schists.
101/140	7	Black and white banded marble
101/23	8	Amphibolite with mica schists and marble bands.
(735 ½)	9	Very micaceous calc mica schists and minor amphibolites.
101/140	10	Saccharoidal and pure white marble.
999/10	11	Amphibolite and mica schist.
999/30	12	Marble with minor calc mica schists.
(739)	13	Amphibolite and mica schist
25	14	Garnet mica schist, actinolite garnet mica schist and amphibolite.
999/90	15	Calc mica schist and marble.
101/2	16	Saccharoidal, black and white banded marble and massive marble.
101/9	17	Amphibolite and mica schist.

(740)  18 Large actinolite calc amphibolite

999/110  19 Non calc amphibolite and garnet mica schist.

1. Stratigraphy.

The previous diagram represents the structural succession which is indicated in the area, the numbers to the right of the key will be used in future references to units in the group.

There appears from all the available evidence on this mapping area to be a straight through succession from west to east. That is to say that beds in the west of of the map is structurally lower and lie structurally underneath ensuing beds to the east. Thus in crossing the area from west to east one goes structurally higher.

The equivalence of unit 4 with units 5 and 6 and the possible equivalence of units 2 and 7 will be discussed under their separate headings later.

2. Basis of subdivision of units.

The whole of the area was correct largely by marble predominant and calc rich rocks and this made subdivision of units extremely difficult. Finally it was decided to group rocks of distinctive type in lose-proscenity, together and classify this as a unit. As a result assemblages like biotite schists and biotite rich actinolite amphibolites can be grouped together and distinguished from adjacent calc mica schist and mica schist units. This is the only satisfactory method, which is practicable, for subdividing the area, but even so lateral variations in facies of a particular group necessitated the following of the group along strike and watching this lateral variation to be sure that the unit mapped some five or six kilometers away is the same as the one then being mapped.

Mapping units like this divides a map up into a series of lithologies and gives rise to a structural, not stratigraphic succession. By this it is meant that whereas beds may be stated categorically to be either structurally higher or lower than adjacent beds, they can in no way be said to be stratigraphically higher or lower, and in the age sense no stratigraphical column can be worked out,(except possibly by radiometric dating of the amphibolites), and thus a structural succession is given.

3. The subdivided units.

(1) Drift.

This covered a considerable amount of the area but was most predominant along the main river edge. However it was only of nuisance value and cannot be classed in the same way as all following units. A description of the drift is not included here as it is not deemed necessary.
Suffice it to say that no ore boulders or pebbles were found in it, or where it had been was hid by streams.

(2 and 7) Black and white banded marbles.

The unit contained, black, blush grey and banded marble together with saceharoidal marbles, the latter ranging in colour from grey through reds and whites to greens. The amphibolites which do occassionally occur in the unit are very calcareous and usually contain pyrite, they are, needless to say, of very minor significance in this a marble unit. Schists of mica and calc mica variety are absent in the banded marble unit extending down from around 380/155, but where this unit appears again after the drift at 317/137 they can be seen in small amounts, but none the less they do occur and indicate the incoming of clastic material (necessarily fine grained) from a local scource area during deposition of the original carbonate.

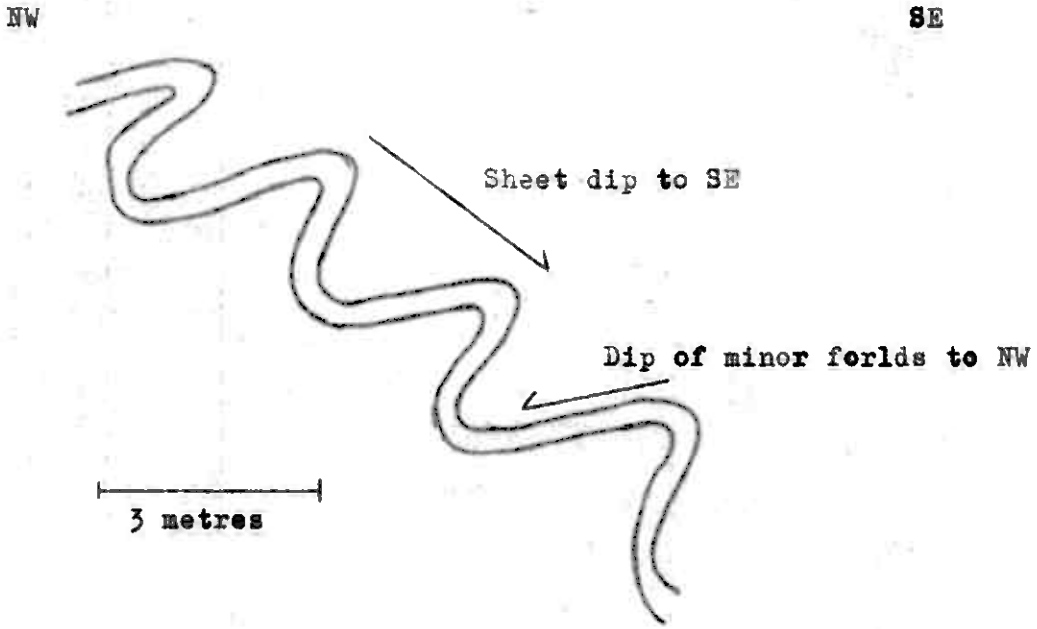
Two separate bands of this so called banded marble unit occur, one, as already stated extending south from 380/155 and the second southwards from 380/140, both bands can be traced with little variationin lithology from north to south of the area,

but both are covered by drift heltoron the 344 grid, upto, in the case of the extreme eastern unit the 320 grid and in that of the western unit the 338 grid. However, both can be picked up south of this again with ease. Spec K is a typical example of this lithology.

Both units are vertically indistinguishable from each other, a fact which poses problems as will be seen later.

So similar are the lithologies of these two units and so distinct and compared to the rest of the rock types, that it was originally thought that bouth could be limites if the same structure, and this indeed could still be a possibility, unfortunately however the bands do not show any swing in strike that is significant in this conclusion, and disappear under the drift in the northeast on the adjacent area where a possible fold closure could have been and thus no conclusive proof could be gained here. In the south west, again in an adjacent area, they go off this map and show no swing in strike either, thus it is considered that there is no structure here, but purely for the negative reason that no proof of its existence can be obtained.

The dip also in both units of this banded marble are mainly easterly although both units are highly crenulated and contorted, also in the south of the area, the banded marble forms the feature outside Røkland and here several westerly dips on bands in this banded marble were recorded but this is anomalous because the sheet dip is to the south east and these anomalous dips represent results taken in minor crenulations. This point is best brought out by reference to the figure below.



Due to lack of proof of a structure involving the two banded marbles it is thus deemed necessary to separate them in the structural succession, the unit in the west being structurally lower than that in the east.

The marble is obviously banded with dark and light bands of vary

very coarse calcite forming the rock, the bands vary in thickness from 1 mm up to ca. 26 cm, but usually show a marked conformity with one another.
Two phases of metamorphism are shown in the marble (discussed under metamorphism at the end) and it was the first of these, presumably during the caledonian orogeny which gave the marble its banded structure.
Thus it is considered that the bands of the banded marble are secondary and due to metamorphic segregation of minerals and not a primary feature set up within the marble at the time of its deposition as a sediment.

Pyrite is ubiquitous throughout these marbles and indeed throughout the succession of the whole area and sometimes may show marked concentration in individual bands within the unit.

This banded marble prooved an excellent marked horizon in mapping the area and since it formed features could be traced easily.

(3). White massive marble with pyrite rich amphibolites.

This occurs as a mainly pure white massive and saccharoidal unit, and is probably a lens or just a facies variation of the above banded marble, it does not reappear after the drift and this together with poor exposure leads one to resort to the idea that it is a lens of the banded marble.

This marble starts at 352/148 and has the above characteristics. In addition to this lenses of amphibolite upto 30 cm occur in it and these are crammed full of pyrite enhedra and anhedra sometimes upto 3 cm across, but usually only 0.5 cm cubes.

The unit probably represents a local deposit of alternating very pure calc and muddy calc sediments with organic iron, before metamorphism.

(4). (5 and 6)

(4). Actinolite and tremolite schists with mica schists and amphibolite and marble bands.

(5). Biotite schist and biotite rich actinolite amphibolite.

(6). Calc mica schist and mica schist.

These three units are discussed under the same heading because unit 4 when it reappears after the drift around the 33 gridline is capable of subdivision into two units, 5 and 6 giving rise to two structural columns either side of this 34 grid.

In the following account they are dealt with separately but it must be remembered that on an overall structural succession of the whole area units 5 and 6 would be equivalent to unit 4.

Unit 4 has its medium point at 380/145 and can be traced with small variation upto the 35 grid line.

The unit consists of a variable hotch potch of rocks, tremolite

and actinolite marbles, mica schists, Chlorite schists, red and green marbles, actinolite amphibolites, biotite amphibolites, biotite schists, quartz veins and calc mica schists. Its subdivision as a unit is made possible only because its boundaries are clearly defined as functions with the two banded marbles already discussed.

The unit is essentially composed of amphibolites and actinolite and tremolite on weathered surfaces. The amphibolites are thick, sometimes upto 100 yds. and show much weathering and pyrite crystals, whereas the marbles are void of pyrite in any great quantity. The rocks are highly folded and there is evidence of a series of throughs and culminations on scales upto 0.5 km, both across and along strike, the rocks dip mainly to the east at high angles and exposure is very bad except on the one road crossing the area, because the unit is the site of a valley carved out by glacial and fluvial action between the two banded marbles and has hence thick glacial deposits above it, thus exposure in streams and high points is the only means of identifying the inner parts of the unit, although, as already stated, its boundaries can be mapped with comparative occuracy against the banded marble.
This unit obviously represents more muddy conditions of deposition than those prevailing when the banded marble was laid down.

When the unit emerges from the drift below the 33 grid the increase in amphibolite and schist which was becoming apparent as the original unit was traced south is now even more apparent leading to an easy subdivision into a schist and biotite amphibolite both of which form distinct features.

Unit 5, the amphibolite unit, is the more easterly of the two and occurs in parts as a scarp forming a boundary to a recently made resevar below the 33 grid. The unit consists of very coarse grained biotite schists with biotite amphibolites and amphibolite lenses and units within this main unit. The unit was non calc and thus there was a complete change to muddy deposition in the original site of sedimentation.

Unit 6. The calc mica schist and mica schist unit. The unit also also contains the occassional amphibolite band but the presence on its western boundary of the banded marble and on its eastern boundary of the amphibolite make this assemblage quite easy to distinguish and plot boundaries for.

The schists vary from biotite to muscovite and small amounts of calc indicate possibly an accumulation of carbonate from organic scources. Dips are easterly as indeed they are throughout the area in general. Pyrite again can be seen to be ubiquitous but in nowhere near as large amounts as in the banded marble units.

Both these units can be traced to the extreme south of the area with hardly any change in lithology since their first occurence.

(8). Amphibolite with mica schists and marble bands.

This unit comes in around 345/137 and can be seen to be only a local deposit. It is surrounded on one side by banded marble and on the other by calc mica schists and marble and thus forms a distinct lithology, its boundary however, is quite difficult to trace all the way round the outcrop because it outcrop in several 100 ft. vertical precipices.

Also the amphibolite where best exposed is inaccessible being some half way down a 200 ft. c 70 metre vertical cliff but fortunately occurs enough in isolated outcrops an accessible slopes for its boundary to be marked with reasonable accuracy. It consists essentially of amphibolite but occasional schist bands can be picked out and even small marble bands, but only where the unit is cut through by streams which make detailed study possible. It can be seen to strike out both south and north and does not form an important part of the succession only probably representing a local influse of muddy material during original deposition prior to metamorphism of a calc rich sediment.

(9). Very micaceous calc mica schist and minor amphibolite.

This unit forms a major subdivision of the largest unit on the map, a marble unit, this unit being separated from the marble on the bases of its extra mica content.

One can say that the subdivision is on the bases of the fact that unit 9 contains both amphibolite and a predominance of calc mica rocks, whereas its sister unit, unit 10, is a pure marble with only occasional amphibolites these latter when they do occur being very thin.

The rocks of unit 9 are very micaceous calc mica schists dipping at high angles to the east the boundary with its sister being marked in several places by a quite distinct break in slope especially in the south. Here the rocks become much more micaceous and it is only possible to identify them as belonging to unit 9 by following them along strike and watching this gradual change take place, this done the subdivision is easily recognized.

(10.) Marble unit, both saccharoidal and massive.

In the north at around 380/135 the unit is entirely massive white and pink marble with very occasional amphibolites and is easily picked up and distinguished from its adjacent calc mica and calc amphibolite partners (the latter will be dealt with later).

Towards the south more mica creeps in although the unit is still recognizable and in the extreme south west quartz pebbles can be seen, this is a meta calc conglomerate, the pebbles are up to 15 cm in long axis and are elongated parallel to the schistosity. The "pebbles" are entirely quartzite.

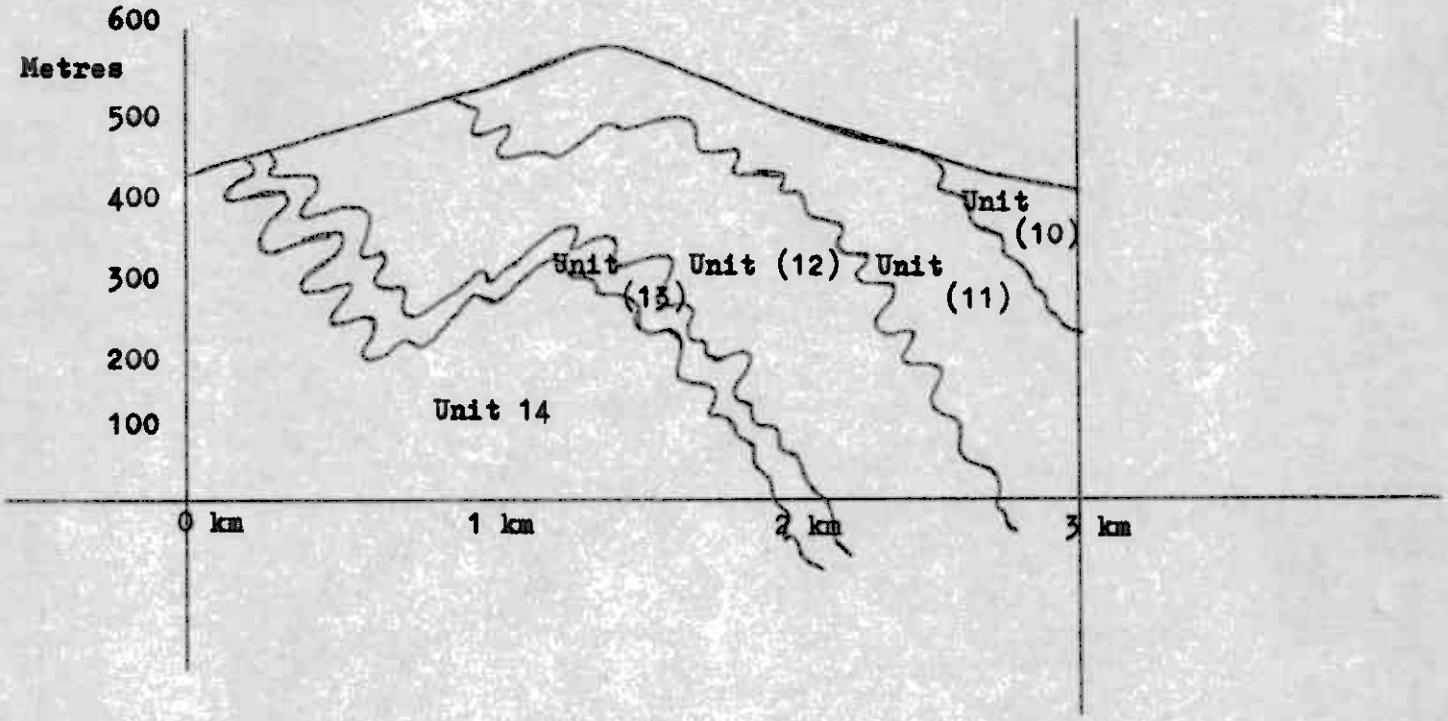
Saccharoidal marble occurs in abundance together with much minor folding and crenulation of beds, and one breached dome at Djun hølet.

The unit is distinctively a marble one and it is possible to see such changes as the incoming of more mica by following the unit along strike as was necessitated in the last unit.

(11). Amphibolite and mica schist unit.

The unit comes in around 370/126 and gets increasingly wider in an E/W sense towards the S.W. Due to the presence of a small dome like structure there.

The sheet dip structure of this fold is given in section EFG. on the scaled cross sections but an indication of the extreme crenulation of the bed is given below.



The unit consists of mica and garnet mica schists in the north forming a sharp contact with the pure marble of the preceeding unit but when traced south west these give place to a calc amphibolite with small red pit marks due possibly to the weathering of some iron rich calcite and probably some feldspar although this latter is not certain.
The rock is quite distinctive of this lithology and forms an easy subdivision being bordered on both sides by pure marbles.

The minor anticline it forms is breached by rivers in the NW of its extent, and where it dies lowground of the same rock type is occupied by lakes.

(12). Marble with minor calc mica schists.

The unit is dominantly one of mica banded pure white marble and in the north a small amount of mica schist. The boundary of the unit is easily distinguished as the unit is sandwiched between two amphibolite and schist units.

The marble grades from pure white to blue grey and is usually very coarse grained, saccharoidal facies is absent except in the south west, in the south west the mica becomes quite abundant and forms bands showing extreme crenulations on scales varying from 6 cm to 10 metres.

Dips and strikes are difficult to take with certainty although in a few good exposures they can be seen to be generally easterly.

Mineralogically the unit is barren, apart from occasional small isolations of pyrite especially in the extreme north and south west.

(13). Amphibolite and mica schist unit.

This unit, up to the 36 grid going south is very similar to its twin, unit 11, being split by marble.

The unit is made up of mica schists and garnet mica schists together with actinolite and hornblende amphibolites, but unlike the previous actinolite amphibolite unit 11, the lithologies making up unit 13 continue to the western margin of the area, and do not as they do in the other unit, become very calcic. Mica schists are very common and north of the 35 grid may be said to be the dominant lithology with amphibolites subordinate, whereas a general steady increase in the amphibolite component of the unit towards the s.w. makes the porcentage of schist and amphibolite almost comparable at the west boundary.

Very many microcrenulations makes dips uncertain and this coupled with extremely bad exposure due to marsh and glacial drift makes satisfactory readings in any great quantity impossible to take.
However in the contact exposures with the next unit to be discussed. There is obvious conformity and thus a cross section shows this unit dipping to the east as do the rest.

Microcrenulations on the 20 cm scale give an apparent dip of the unit to the nw along the 34 grid, but as can be seen and as in interpreted on the cross sections, this is anomalous, the sheet dip is to the SE, the minor anticline effecting the unit being to the east.

The rocks west of this unit suffer from extreme crenulation and worse exposure mainly due to bog which from now on is almost ubiquitous, and glacial material which is in abundance and has not been removed by poor depositional erosion, good exposures are found in streams, but often the latter are strike streams and provide only a 2D structure. However there appears to be no marked inconformity with the eastern beds and the few westerly dip readings are only due to the fact that they are taken on western limbs of minor structures, the sheet dip as usual is easterly.

(14). Garnet mica schist, actinolite garnet mica schist and amphibolite unit.

This unit is typified by the assemblage garnet mica schist actinolite garnet mica schist and amphibolite, the main bases of subdivision is on garnets, they are in this unit and in no other in such abundance as to make the unit quite distinguishable.

The unit forms a prominent feature all the way from the 37 grid line to its disappearence off the edge of the map at the 34 grid.

Large actinolite radial in the schists are common and garnets upto 1 cm in diameter are sometimes present although the average is from 2 - 3 mm.

Occasionally a marble band is present, but only found in streams and could come from the adjacent marble unit, although this is by no means certain and from surface exposure cannot be prooved.

The amphibolite shows no radiating actinolite but rather long fibrous single crystals of amphibole with some occasional pyrite. In the north the mica schist component becomes less until finally on the 38 grid a very thin unit of garnet mica schist and amphibolite is present.

(15). Calc mica schist and marble unit.

This unit forms a highly calc feature running parallel to the last feature and disected by a major stream. Exposure, apart from the stream bed and feature top is nonexistent, the slo being covered by scree and very thick vegetation.

In the extreme north the unit can be seen very clearly on the road which crosses the area from east to west, to is composed of calc mica schists and marbles with the occasional lens of non calc mica schists and even less amphibolite.
The marbles show an extreme variety in colour, reds, yellows, browns, blacks, greys and blues, together with pure white and green occur in the same sample.

Mica, both muscovite and biotite, give clear evidence of the extreme intercrenulation. Thes e wast variety of colour end apparently abruptly below the 36 grid and the unit becomes an ordinary mica banded white and dark marble. The calc mica schists show far less spectacular variety but but one unit shows a pitted texture over some 2 km. Schists become very much more common as the unit is traced along the strike to the south west, but large masses of calcite in them make them easily distinguishable from the last unit. The schist itself distinguishing the unit from the next entirely calc unit, which is quite thin in the south west corner and is dealt with next. Much microcrenulation is evident and can be seen clearly even in the poor exposure. Dips to the east are common and the stream section gives an easterly dip.

(16). Saccharoidal, black and white banded marble and massive marble unit.

The unit consists of massive white marble, grey/white and white banded marble, saccharoidal marble and brownish massive marble and is quite readily distinguishable from the next, non calc amphibolite unit. Exceptionally bad exposure of this and the rest of the western units makes the mapping not all that one had hoped for in this area, but the exposures that are present show easterly dips, which is fortunate because if the dips were not conformable it would be impossible to make a detailed examination of the area to find structures and so sent out any complications.

The unit can be traced south west as a feature but thins quite markedly due to a thickening of the adjacent amphibolite.

The unit stays as a marble to the western boundary of the map.

(17). Amphibolite and mica schist unit.

The unit is very poorly exposed due to vast area of bog, marsh and glacial debris.

However the rocks consists of radiating actinolite crystals in a greyish actinolite and mica matrix.

The majority of exposures dip easterly and the unit is mapped almost entirely by using the small feature that it forms as marking boundaries. This, short of digging the whole area up was the only one available to map the unit on.

(18). Large actinolite calc amphibolite unit.

This unit is distinguished from the latter solely on the incoming of marble lenses and the existence of marble bands in the amphibolite.

Actinolite is still the dominant amphibole and the rocks have become much darker and more massive. Over the half kilometer square of suggested exposure of this unit, exposure of the rock is adequate enough to mark farly delmate boundaries, but over a bigger area much better exposure is necessary to mark boundaries with certainty.

(19). Non calc amphibolite and garnet mica schist.

The unit is marked by the incoming of mica in the amphibolites which gives the actinolite radials a much higher definition being set in a white mica background, the amphibolites are really amphibole mica schists, but there is such a considerable amount of amphibole that the above title of the unit is deemed necessary.

Garnet mica schist forms some 25% of the unit and garnets occur with amphibole in the amphibolites.

Exposure is extremely bad and only two exposures in 20 glacial planed surface occur in the area in the extreme north west corner.

However slightly better exposure in the area to the north of the mapping area enabled convenient boundary to be drawn.
However the two stream sections where most of the information on this unit were gathered prooved inadequate to formulate dip and strike readings on, because the rocks were far too crenulated and a large enough outcrop to proove sheet dip did not exist. Exposure on the adjacent calc amphibolite unit in three cases gave conclusive easterly dips even though the majority of the microcrenulations dipped west. The sheet dip of this unit is thus deemed the same as the last unit.

Exposure however, is far from good and for the next 4 km west no better and thus exposures and excursions onhide the area prooved to be a waste of time due to glacial cover, bog, and surprising increase in lakes. Thus it was not possible to use this adjacent area to sort out the structure in mene, however a general conformity seems in every way to be indicated.

4. Structure

The structure of the area is well seen in the three cross sections. From the first two of these it can be seen that there is a general easterly dip to all the rock units from east to west and no structure, just a straight through sequence as already indicated.

On the last cross section a minor antiform can be seen, but this is in no way large and effects over an area of a few square kilometres only, the rest of the sequence of this section is again straight through with structurally lower beds to the west.

Minor structures in the shape of microcrenulations upto 1 metre in cross sectional area are very common indeed and give anomalous dip readings to the sheet dip in allot of cases. All beds are microcrenulated and the straight lines on the cross sections represent sheet dip, true pictures of the beds would show this microcrenulation but as these latter cannot be put in exactly a far better idea is given of the structure when just using straight lines.

An exellent example of anomalous dip readings due to this microcrenulation has been discussed under the black and white banded marble group.

No major structure can be found in this area on the results of this surface mapping.

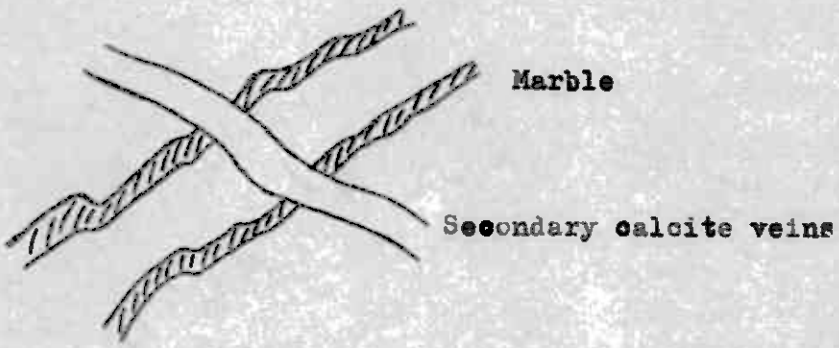
A structure involving the two banded marble litholigies has been informed when discussing these units, but no concrete proof of it exists and it is thus deemed to be absent.

5. Metamorphism.

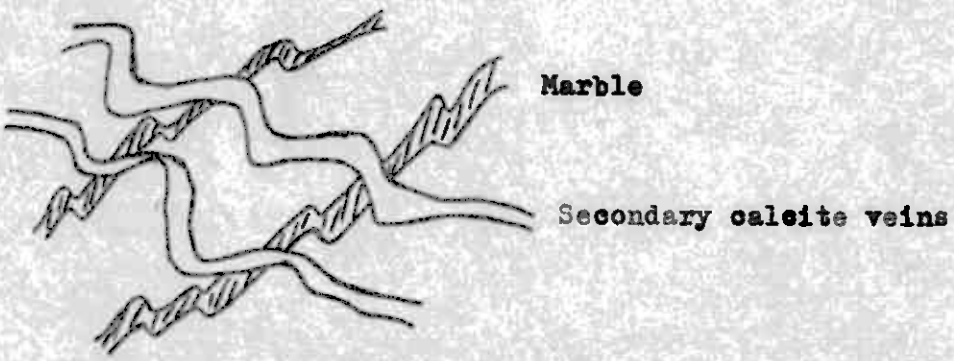
Obviously a discussion of the metamorphism during the Caledonian orogeny is not called for here and is not intended. What is intended under this heading is a description of an occurence of two fold phases in the black and white marble lithology.

The occurence is at 377/158 where a roas is being blasted round the bottom of the hill, the black and white marble lithology has been metamorphosed during the caledonian orogeny in a major metamorphic stage during this orogeny and the banded appearance has been imparted to it by the metamorphic effect.

At the above locality secondary calcite veins cut the banded marble as in diagram below.



Some 10 yds, (c) 9 metres away from this the secondary veins have themselves been folded.



This suggests the following.

(1) Main metamorphism of the sediments imparting banded appearance.

(2) Veining by calcite.

(3) During a period of possible stress relief or equilibration the marble and vein calcite were again folded.

Over a bigger area with better exposure a whole series of the possible F_2 folds could be seen and it is possible that some of the microcrenulations on the highly folded beds in the west are of this phase.

6. List of specimens.

Specimen	Locality	Description
Spec A	380/1445	Actinolite schist with much calcite and small pyrite crystals rock light in colour apart from actinolite which is black.
Spec B	379/144 Strike 224°N	Calc tremolite rock, tremolite fibrous.
Spec C	3785/143	Massive non calc amphibolite.
Spec D	376/142	Slightly calc amphibolite.
Spec E	3765/141	Micaceous amphibolite.
Spec F	373/1335	Amphibolite.
Spec G	373/118	Mica schist with large amphibolite crystals and small veins of biotite running across the rock.
Spec H	366/158	Calc biotite amphibolite.
Spec I	346/139	Banded mica, actinolite calcite pyrite rock, weathering yellow and black.
Spec J	348/136	Black and white speckled amphibolite.
Spec K	370/155	Black and white marble.
Specs L & M	369/154	Massive coarse grained marbles.
Spec N	369/1525	Layered calc biotite rock.
Spec O	3765/1475	Massive actinolite amphibolite rock.
Spec P	3765/147	Calc actinolite amphibolite with pyrite.
Spec Q	377/148	Biotite amphibole quartz schist.
Spec R	382/152	Massive grey amphibolite.
Specs S & T	3433/139	Calc muscovite schists with pyrite.
Spec U	349/136	Calc actinolite mica garnet schist.
Spec V	349/137	Amphibolite with small quartz segregations.
Spec W	350/137	V. similar to spec V.
Spec X	3595/136	Marble with much biotite amphibole and pyrite.
Spec Y	3495/136	Massive quartzy marble.
Spec Z	3495/136	Massive quartzy marble.
Spec 1	3495/137	Calc mica schist with pyrite.

Specimen	Locality	Description
Spec 2	344/1405	Dark grey marble.
Spec 3	365/1325	Slightly calc amphibolite.
Specs 4A & 4B	360/1265	Spotted marble and pure calc marble.
Spec 5	360/126	Another spotted marble, possibly same one with slightly schistose bands.
Spec 6	369/1255	Very micaceous marble, weathering brown.
Spec 7	3675/1164	Amphibolite.
Spec 8	376/113	Quartz mica rock, mica forms plates and layers in the quartz and splits rock into planes.
Spec 9	366/150	Quartz biotite amphibolite.
Spec 10		Null and void.
Spec 11	353/148	Slightly calcic amphibolite with pyrite and possibly chalcopyrite.
Spec 12	358/113	Graphitic calc biotite schist.
Spec 13	348/104	Calc mica schist.
Spec 14	343/106	Calc mica schist.
Spec 15	344/99	Garnet actinolite mica schist.
Spec 16	343/104	Marble
Spec 17	343/104	Same marble with mica.
Spec 18	380/114	Amphibolite.
Spec 19	344/99	Garnet mica schist.
Spec 20	343/98	Mica schist.
Spec 21	377/107	Garnet amphibolite.
Spec 22	372/101	Actinolite amphibolite.
Spec 23	337/138	Calc mica amphibole banded marble.
Spec 24	336/135	Micaceous marble.
Spec 25	335/135	Micaceous marble.
Spec 26	335/134	Grey slightly micaceous marble.
Spec 27	334/134	Same marble with biotite lens.
Spec 28	3325/1325	Appreciable amounts of v dark mica in marble.
Spec 29	300/908	Very calcic actinolite mica garnet schist.

Specimen	Locality	Description
Spec 30	310/1225	Non calcic actinolite mica schist.
Spec 31.	339/970	80°/360°N dip. Calc mica hornblende rock forms feature behind lake at this point.
Spec 32	334/1025	Banded mica, quartz/plagioclase schist.
Spec 33	327/1063	Banded calc mica schist.
Spec 34	310/104	Very calc rock with mica.
Spec 35	308/99	Slightly calcic actinolite mica schist.
Spec 36	301/104	Quartz pebble in calc (very) mica schist meta conglomerate.
Specs 37 and 38	310/98	Calc amphibolite units.
Spec 39	372/97	Actinolite mica schist.
Spec 40	335/134	Actinolite amphibolite.

7. Economic aspects.

Apart from the abundance of pyrite the area is barren of minerals and is of no economic importance, as far as a surface schicly can determine.

KEY TO MAP

20/130	TWENTY DEGREE DIP OF BEDS TO SOUTH EAST WITH NE/SW STRIKE
90°	VERTICAL BEDS STRIKE NE/SW
20/310	TWENTY DEGREE DIP OF BEDS TO NORTH WEST STRIKE NE/SW
	BOUNDARY OF DRIFT
	ESCARPMENT TO RIVER BANK SHOWING BREAK IN SLOPE AND RIVER TERRACE
	BOUNDARY OF UNITS
	PROBABLE BOUNDARY UNDER DRIFT

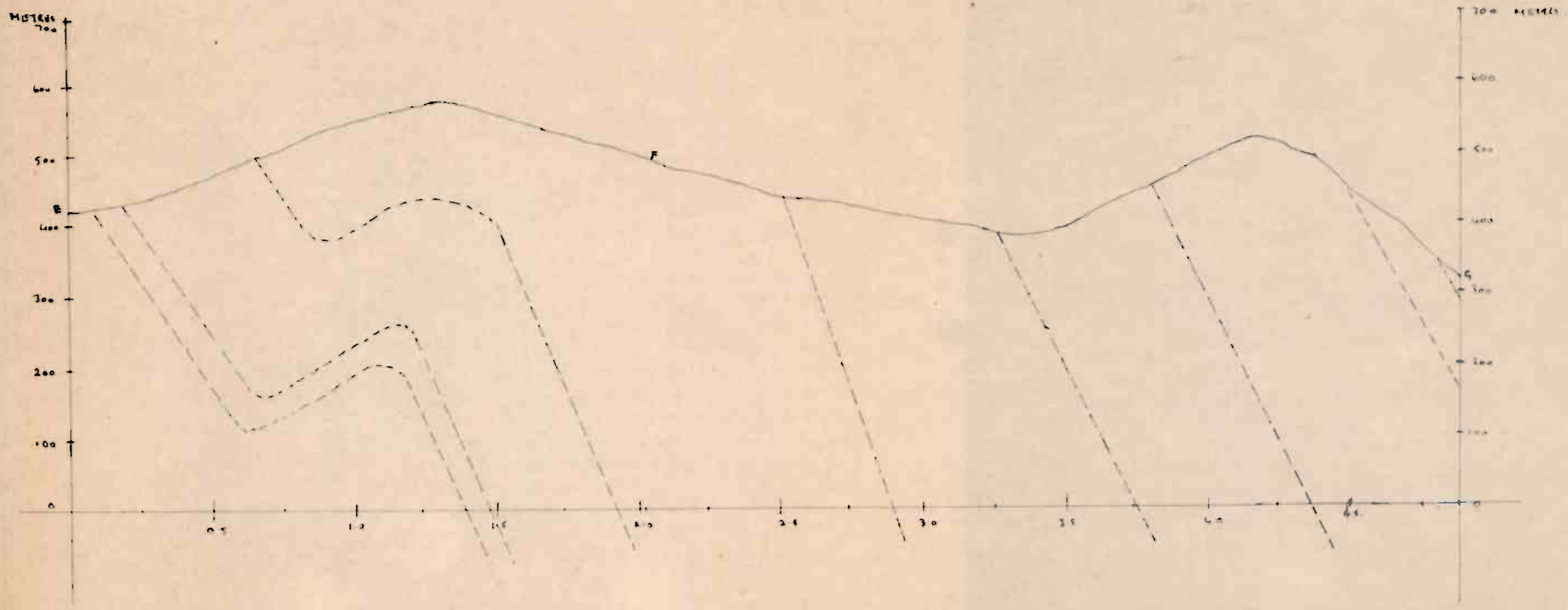
CROSS SECTION B EFG

VERTICAL SCALE - 1cm ≡ 1km

HORIZONTAL SCALE - 6cm ≡ 1km

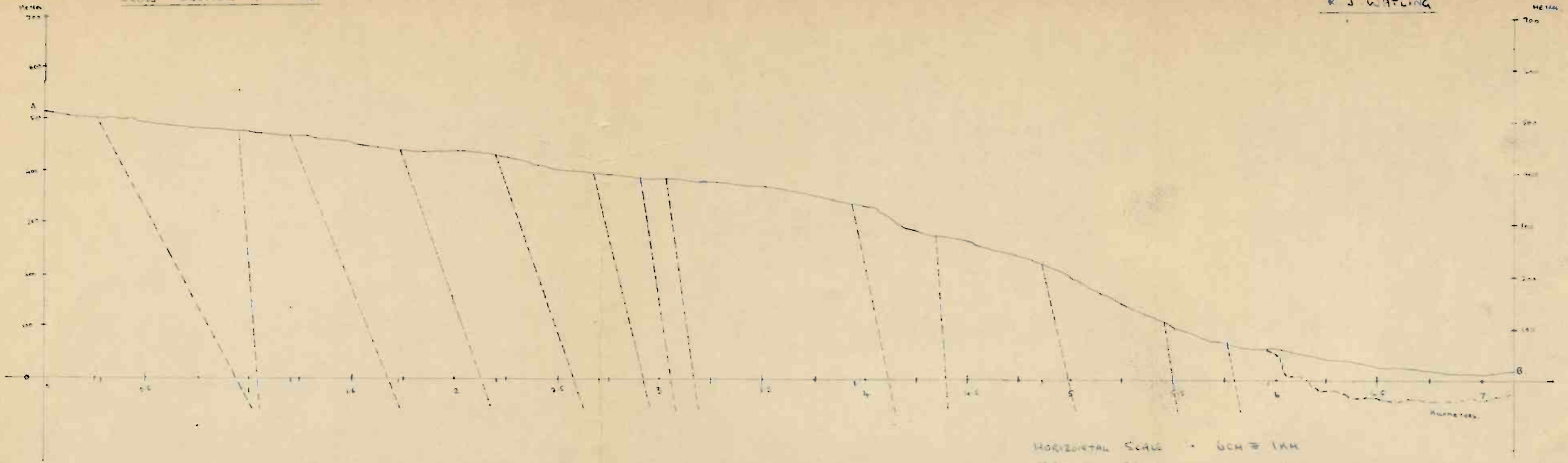
VERTICAL EXAGGERATION 2.5 TIMES

R J WATLING



CROSS SECTION : AB

R J WATLING

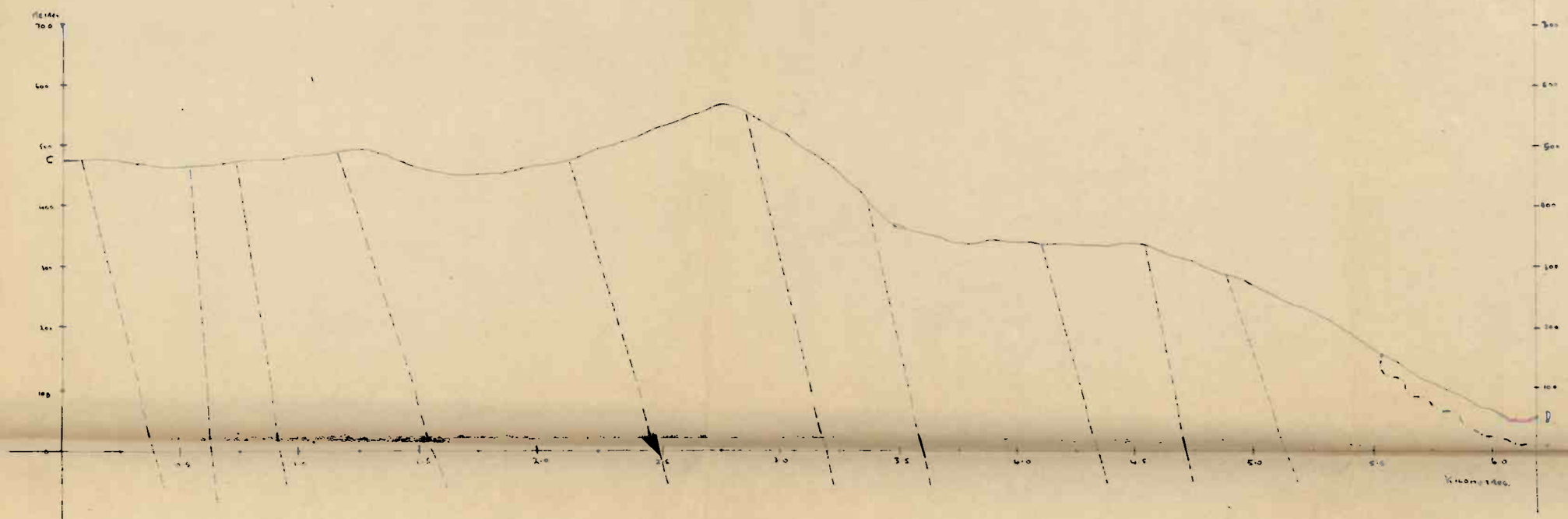


HORIZONTAL SCALE - 6CM = 1KM
VERTICAL SCALE 1CM = 1KM
VERTICAL EXAGGERATION 2.5 TIMES

R J WATLING

CROSS SECTION 2 C D

HORIZONTAL SCALE :- 6CM = 1KM
VERTICAL SCALE - 1CM = 1KM
VERTICAL EXAGGERATION 2.5 TIMES



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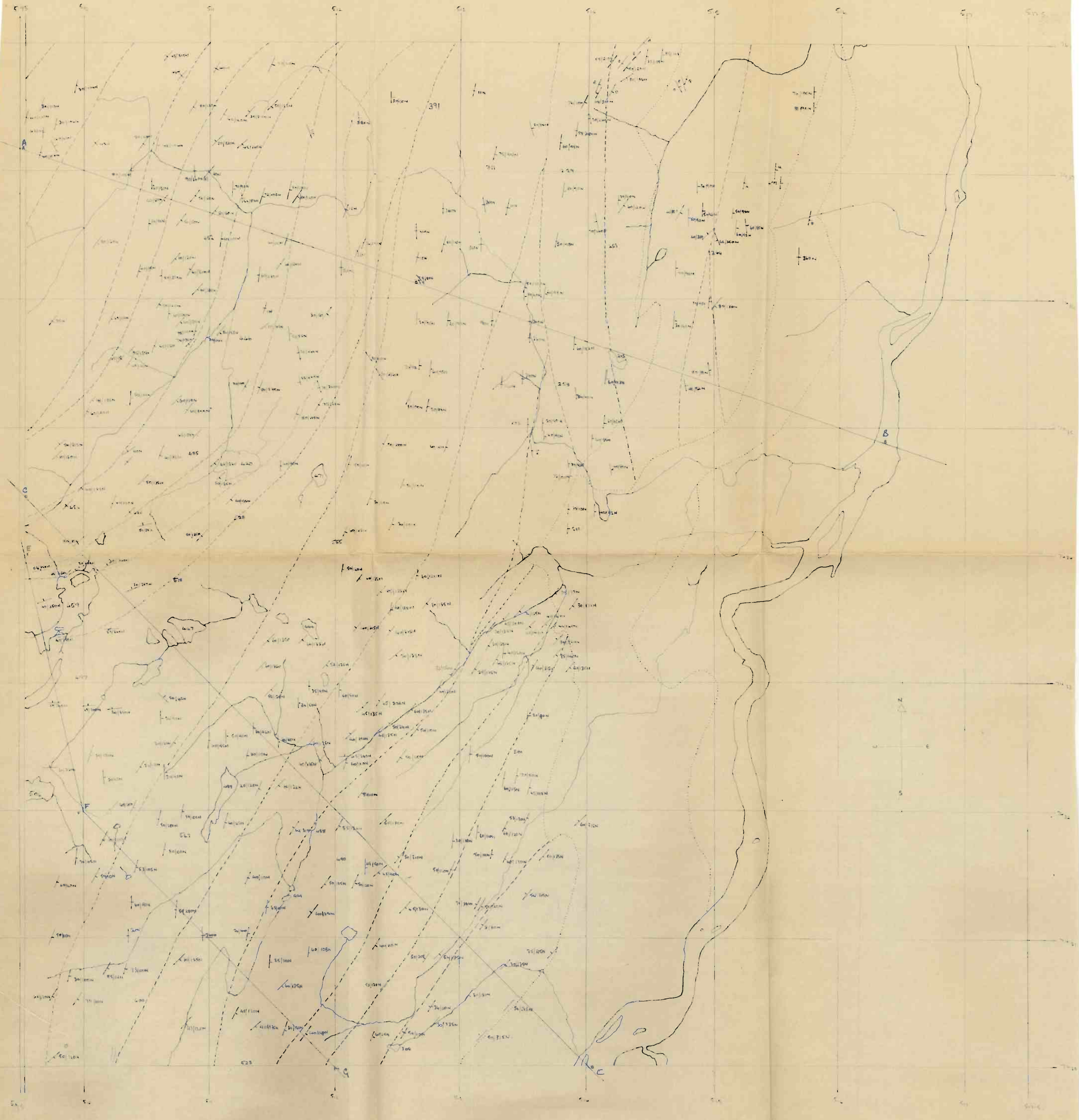


WATLING

R. J. Watling.

Field Mapping Report.

Area mapped.

The area mapped was between grid lines 74/38 and 74/30 on the Norge 1/50 000 Saltdal (sheet 2129 III) and Junkerdal (sheet 2128 IV) sheets respectively using the Saltelva River as the eastern boundary of the area and the edge of the map as the western boundary.

Introduction.

The area was mapped from 2nd July - 26th August 1968 and is shown on the two maps accompanying this report.

For base maps, Norge 1/50 000 sheets were used and due to each of base maps there were blown up three times to act as "field slips" to enable some observations to be put directly on the map. Apart from one square kilometre in the south west corner the area was entirely wooded and under a thick vegetation cover and this, together with marsh and bog over the majority of the western area and glacial deposits over the east made mapping and correct positioning exceedingly difficult. The base maps originally are inacurate and the necessity of using a 3x blow up, due to lack of areal photographs also must increase the margin of error when location points are taken in the field.

The area can be said to consist dominantly of marble, in varying degrees of purity, and of calc mica schists, mica schists, and amphibolites, the whole succession being more or less calc throughout and pyrite being a ubiquitous mineral. These points will be discussed in detail later.

The report is divided as follows:

1. Stratigraphy
2. Basis of subdivision of units
3. Subdivided units
4. Structure
5. Metamorphism, related, to black and white marble in particular.
6. List of specimens with locations
7. Economic aspects.

Stratigraphy

Structural succession see 1/50 000 Norge.

101/26	1	Drift
101/140	2	Black and white banded marble
101/140	3	White massive marble with pyrite rich amphibolites.
999/180	4	Actinolite and tremolite schists with mica schists and amphibolite and marble bands.
999/180	5	Biotite schists and biotite rich actinolite amphibolites.
999/180	6	Calc mica schists and mica schists.
101/140	7	Black and white banded marble
101/23	8	Amphibolite with mica schists and marble bands.
(735 ½)	9	Very micaceous calc mica schists and minor amphibolites.
101/140	10	Saccharoidal and pure white marble.
999/10	11	Amphibolite and mica schist.
999/30	12	Marble with minor calc mica schists.
(739)	13	Amphibolite and mica schist
25	14	Garnet mica schist, actinolite garnet mica schist and amphibolite.
999/90	15	Calc mica schist and marble.
101/2	16	Saccharoidal, black and white banded marble and massive marble.
101/9	17	Amphibolite and mica schist.

(740)  18 Large actinolite calc amphibolite

999/110  19 Non calc amphibolite and garnet mica schist.

1. Stratigraphy.

The previous diagram represents the structural succession which is indicated in the area, the numbers to the right of the key will be used in future references to units in the group.

There appears from all the available evidence on this mapping area to be a straight through succession from west to east. That is to say that beds in the west of of the map is structurally lower and lie structurally underneath ensuing beds to the east. Thus in crossing the area from west to east one goes structurally higher.

The equivalence of unit 4 with units 5 and 6 and the possible equivalence of units 2 and 7 will be discussed under their separate headings later.

2. Basis of subdivision of units.

The whole of the area was correct largely by marble predominant and calc rich rocks and this made subdivision of units extremely difficult. Finally it was decided to group rocks of distinctive type in lose-proscenity, together and classify this as a unit. As a result assemblages like biotite schists and biotite rich actinolite amphibolites can be grouped together and distinguished from adjacent calc mica schist and mica schist units. This is the only satisfactory method, which is practicable, for subdividing the area, but even so lateral variations in facies of a particular group necessitated the following of the group along strike and watching this lateral variation to be sure that the unit mapped some five or six kilometers away is the same as the one then being mapped.

Mapping units like this divides a map up into a series of lithologies and gives rise to a structural, not stratigraphic succession. By this it is meant that whereas beds may be stated categorically to be either structurally higher or lower than adjacent beds, they can in no way be said to be stratigraphically higher or lower, and in the age sense no stratigraphical column can be worked out,(except possibly by radiometric dating of the amphibolites), and thus a structural succession is given.

3. The subdivided units.

(1) Drift.

This covered a considerable amount of the area but was most predominant along the main river edge. However it was only of nuisance value and cannot be classed in the same way as all following units. A description of the drift is not included here as it is not deemed necessary.
Suffice it to say that no ore boulders or pebbles were found in it, or where it had been was hid by streams.

(2 and 7) Black and white banded marbles.

The unit contained, black, blush grey and banded marble together with saceharoidal marbles, the latter ranging in colour from grey through reds and whites to greens. The amphibolites which do occassionally occur in the unit are very calcareous and usually contain pyrite, they are, needless to say, of very minor significance in this a marble unit. Schists of mica and calc mica variety are absent in the banded marble unit extending down from around 380/155, but where this unit appears again after the drift at 317/137 they can be seen in small amounts, but none the less they do occur and indicate the incoming of clastic material (necessarily fine grained) from a local scource area during deposition of the original carbonate.

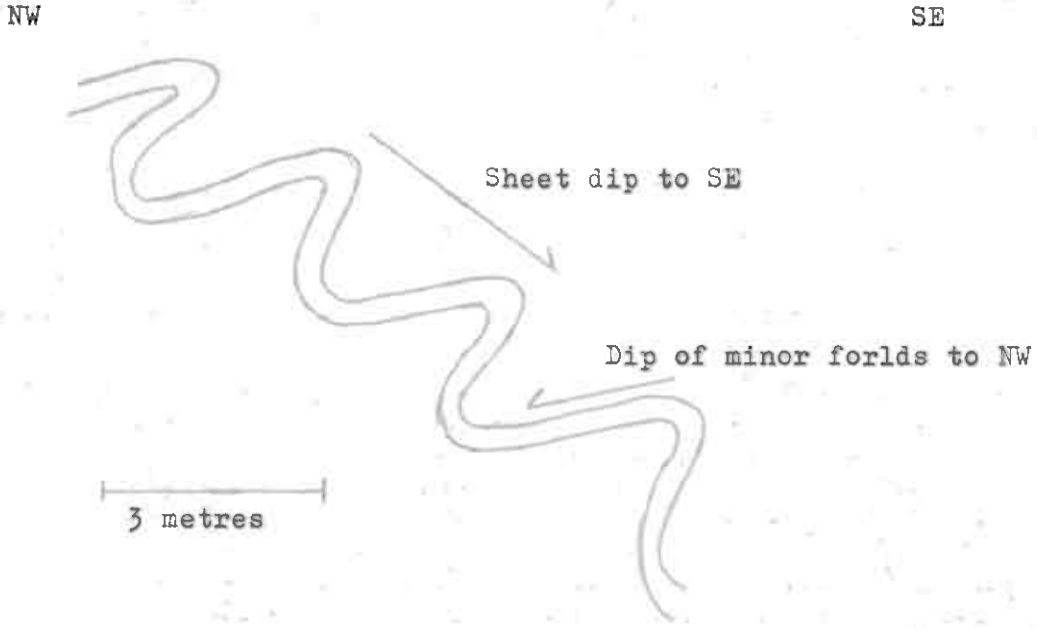
Two separate bands of this so called banded marble unit occur, one, as already stated extending south from 380/155 and the second southwards from 380/140, both bands can be traced with little variation in lithology from north to south of the area,

but both are covered by drift heltoron the 344 grid, upto, in the case of the extreme eastern unit the 320 grid and in that of the western unit the 338 grid. However, both can be picked up south of this again with ease. Spec K is a typical example of this lithology.

Both units are vertically indistinguishable from each other, a fact which poses problems as will be seen later.

So similar are the lithologies of these two units and so distinct and compared to the rest of the rock types, that it was originally thought that bouth could be limites if the same structure, and this indeed could still be a possibility, unfortunately however the bands do not show any swing in strike that is significant in this conclusion, and disappear under the drift in the northeast on the adjacent area where a possible fold closure could have been and thus no conclusive proof could be gained here. In the south west, again in an adjacent area, they go off this map and show no swing in strike either, thus it is considered that there is no structure here, but purely for the negative reason that no proof of its existence can be obtained.

The dip also in both units of this banded marble are mainly easterly although both units are highly crenulated and contorted, also in the south of the area, the banded marble forms the feature outside Røkland and here several westerly dips on bands in this banded marble were recorded but this is anomalous because the sheet dip is to the south east and these anomalous dips represent results taken in minor crenulations. This point is best brought out by reference to the figure below.



Due to lack of proof of a structure involving the two banded marbles it is thus deemed necessary to separate them in the structural succession, the unit in the west being structurally lower than that in the east.

The marble is obviously banded with dark and light bands of

very coarse calcite forming the rock, the bands vary in thickness from 1 mm up to ca. 26 cm, but usually show a marked conformity with one another.
Two phases of metamorphism are shown in the marble (discussed under metamorphism at the end) and it was the first of these, presumably during the caledonian orogeny which gave the marble its banded structure.
Thus it is considered that the bands of the banded marble are secondary and due to metamorphic segregation of minerals and not a primary feature set up within the marble at the time of its deposition as a sediment.

Pyrite is ubiquitous throughout these marbles and indeed throughout the succession of the whole area and sometimes may show marked concentration in individual bands within the unit.

This banded marble prooved an excellent marked horizon in mapping the area and since it formed features could be traced easily.

(3). White massive marble with pyrite rich amphibolites.

This occurs as a mainly pure white massive and saccharoidal unit, and is probably a lens or just a facies variation of the above banded marble, it does not reappear after the drift and this together with poor exposure leads one to resort to the idea that it is a lens of the banded marble.

This marble starts at 352/148 and has the above characteristics. In addition to this lenses of amphibolite upto 30 cm occur in it and these are crammed full of pyrite enhedra and anhedra sometimes upto 3 cm across, but usually only 0.5 cm cubes.

The unit probably represents a local deposit of alternating very pure calc and muddy calc sediments with organic iron, before metamorphism.

(4). (5 and 6)

(4). Actinolite and tremolite schists with mica schists and amphibolite and marble bands.

(5). Biotite schist and biotite rich actinolite amphibolite.

(6). Calc mica schist and mica schist.

These three units are discussed under the same heading because unit 4 when it reappears after the drift around the 33 gridline is capable of subdivision into two units, 5 and 6 giving rise to two structural columns either side of this 34 grid.

In the following account they are dealt with separately but it must be remembered that on an overall structural succession of the whole area units 5 and 6 would be equivalent to unit 4.

Unit 4 has its medium point at 380/145 and can be traced with small variation upto the 35 grid line.

The unit consists of a variable hotch potch of rocks, tremolite

and actinolite marbles, mica schists, Chlorite schists, red and green marbles, actinolite amphibolites, biotite amphibolites, biotite schists, quartz veins and calc mica schists. Its subdivision as a unit is made possible only because its boundaries are clearly defined as functions with the two banded marbles already discussed.

The unit is essentially composed of amphibolites and actinolite and tremolite on weathered surfaces. The amphibolites are thick, sometimes upto 100 yds. and show much weathering and pyrite crystals, whereas the marbles are void of pyrite in any great quantity. The rocks are highly folded and there is evidence of a series of throughs and culminations on scales upto 0.5 km, both across and along strike, the rocks dip mainly to the east at high angles and exposure is very bad except on the one road crossing the area, because the unit is the site of a valley carved out by glacial and fluvial action between the two banded marbles and has hence thick glacial deposits above it, thus exposure in streams and high points is the only means of identifying the inner parts of the unit, although, as already stated, its boundaries can be mapped with comparative occuracy against the banded marble.
This unit obviously represents more muddy conditions of deposition than those prevailing when the banded marble was laid down.

When the unit emerges from the drift below the 33 grid the increase in amphibolite and schist which was becoming apparent as the original unit was traced south is now even more apparent leading to an easy subdivision into a schist and biotite amphibolite both of which form distinct features.

Unit 5, the amphibolite unit, is the more easterly of the two and occurs in parts as a scarp forming a boundary to a recently made resevar below the 33 grid. The unit consists of very coarse grained biotite schists with biotite amphibolites and amphibolite lenses and units within this main unit. The unit was non calc and thus there was a complete change to muddy deposition in the original site of sedimentation.

Unit 6. The calc mica schist and mica schist unit. The unit also also contains the occassional amphibolite band but the presence on its western boundary of the banded marble and on its eastern boundary of the amphibolite make this assemblage quite easy to distinguish and plot boundaries for.

The schists vary from biotite to muscovite and small amounts of calc indicate possibly an accumulation of carbonate from organic scources. Dips are easterly as indeed they are throughout the area in general. Pyrite again can be seen to be ubiquitous but in nowhere near as large amounts as in the banded marble units.

Both these units can be traced to the extreme south of the area with hardly any change in lithology since their first occurence.

(8). Amphibolite with mica schists and marble bands.

This unit comes in around 345/137 and can be seen to be only a local deposit. It is surrounded on one side by banded marble and on the other by calc mica schists and marble and thus forms a distinct lithology, its boundary however, is quite difficult to trace all the way round the outcrop because it outcrop in several 100 ft. vertical precipices.

Also the amphibolite where best exposed is inaccessible being some half way down a 200 ft. c 70 metre vertical cliff but fortunately occurs enough in isolated outcrops an accessible slopes for its boundary to be marked with reasonable accuracy. It consists essentially of amphibolite but occasional schist bands can be picked out and even small marble bands, but only where the unit is cut through by streams which make detailed study possible. It can be seen to strike out both south and north and does not form an important part of the succession only probably representing a local influse of muddy material during original deposition prior to metamorphism of a calc rich sediment.

(9). Very micaceous calc mica schist and minor amphibolite.

This unit forms a major subdivision of the largest unit on the map, a marble unit, this unit being separated from the marble on the bases of its extra mica content.

One can say that the subdivision is on the bases of the fact that unit 9 contains both amphibolite and a predominance of calc mica rocks, whereas its sister unit, unit 10, is a pure marble with only occasional amphibolites these latter when they do occur being very thin.

The rocks of unit 9 are very micaceous calc mica schists dipping at high angles to the east the boundary with its sister being marked in several places by a quite distinct break in slope especially in the south. Here the rocks become much more micaceous and it is only possible to identify them as belonging to unit 9 by following them along strike and watching this gradual change take place, this done the subdivision is easily recognized.

(10.) Marble unit, both saccharoidal and massive.

In the north at around 380/135 the unit is entirely massive white and pink marble with very occasional amphibolites and is easily picked up and distinguished from its adjacent calc mica and calc amphibolite partners (the latter will be dealt with later).

Towards the south more mica creeps in although the unit is still recognizable and in the extreme south west quartz pebbles can be seen, this is a meta calc conglomerate, the pebbles are up to 15 cm in long axis and are elongated parallel to the schistosity. The "pebbles" are entirely quartzite.

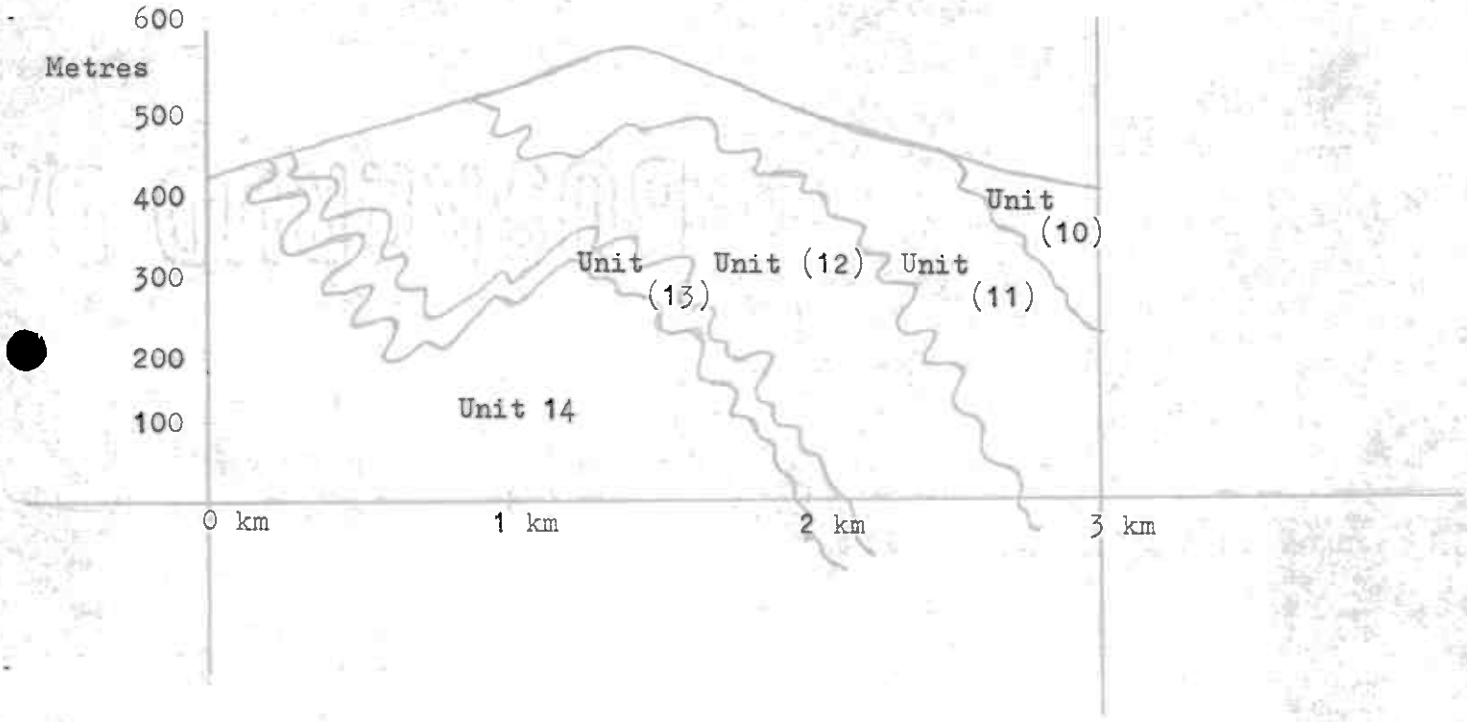
Saccharoidal marble occurs in abundance together with much minor folding and crenulation of beds, and one breached dome at Djun hølet.

The unit is distinctively a marble one and it is possible to see such changes as the incoming of more mica by following the unit along strike as was necessitated in the last unit.

(11). Amphibolite and mica schist unit.

The unit comes in around 370/126 and gets increasingly wider in an E/W sense towards the S.W. Due to the presence of a small dome like structure there.

The sheet dip structure of this fold is given in section EFG. on the scaled cross sections but an indication of the extreme crenulation of the bed is given below.



The unit consists of mica and garnet mica schists in the north forming a sharp contact with the pure marble of the preceeding unit but when traced south west these give place to a calc amphibolite with small red pit marks due possibly to the weathering of some iron rich calcite and probably some feldspar although this latter is not certain.
The rock is quite distinctive of this lithology and forms an easy subdivision being bordered on both sides by pure marbles.

The minor anticline it forms is breached by rivers in the NW of its extent, and where it dies lowground of the same rock type is occupied by lakes.

(12). Marble with minor calc mica schists.

The unit is dominantly one of mica banded pure white marble and in the north a small amount of mica schist. The boundary of the unit is easily distinguished as the unit is sandwiched between two amphibolite and schist units.

The marble grades from pure white to blue grey and is usually very coarse grained, saccharoidal facies is absent except in the south west, in the south west the mica becomes quite abundant and forms bands showing extreme crenulations on scales varying from 6 cm to 10 metres.

Dips and strikes are difficult to take with certainty although in a few good exposures they can be seen to be generally easterly.

Minerallogically the unit is barren, apart from occasional small isolations of pyrite especially in the extreme north and south west.

(13). Amphibolite and mica schist unit.

This unit, up to the 36 grid going south is very similar to its twin, unit 11, being split by marble.

The unit is made up of mica schists and garnet mica schists together with actinolite and hornblende amphibolites, but unlike the previous actinolite amphibolite unit 11, the lithologies making up unit 13 continue to the western margin of the area, and do not as they do in the other unit, become very calcic. Mica schists are very common and north of the 35 grid may be said to be the dominant lithology with amphibolites subordinate, whereas a general steady increase in the amphibolite component of the unit towards the s.w. makes the porcentage of schist and amphibolite almost comparable at the west boundary.

Very many microcrenulations makes dips uncertain and this coupled with extremely bad exposure due to marsh and glacial drift makes satisfactory readings in any great quantity impossible to take.
However in the contact exposures with the next unit to be discussed. There is obvious conformity and thus a cross section shows this unit dipping to the east as do the rest.

Microcrenulations on the 20 cm scale give an apparent dip of the unit to the nw along the 34 grid, but as can be seen and as in interpreted on the cross sections, this is anomalous, the sheet dip is to the SE, the minor anticline effecting the unit being to the east.

The rocks west of this unit suffer from extreme crenulation and worse exposure mainly due to bog which from now on is almost ubiquitous, and glacial material which is in abundance and has not been removed by poor depositional erosion, good exposures are found in streams, but often the latter are strike streams and provide only a 2D structure. However there appears to be no marked inconformity with the eastern beds and the few westerly dip readings are only due to the fact that they are taken on western limbs of minor structures, the sheet dip as usual is easterly.

(14). Garnet mica schist, actinolite garnet mica schist and amphibolite unit.

This unit is typified by the assemblage garnet mica schist actinolite garnet mica schist and amphibolite, the main bases of subdivision is on garnets, they are in this unit and in no other in such abundance as to make the unit quite distinguishable.

The unit forms a prominent feature all the way from the 37 grid line to its disappearence off the edge of the map at the 34 grid.

Large actinolite radial in the schists are common and garnets upto 1 cm in diameter are sometimes present although the average is from 2 - 3 mm.

Occasionally a marble band is present, but only found in streams and could come from the adjacent marble unit, although this is by no means certain and from surface exposure cannot be prooved.

The amphibolite shows no radiating actinolite but rather long fibrous single crystals of amphibole with some occasional pyrite. In the north the mica schist component becomes less until finally on the 38 grid a very thin unit of garnet mica schist and amphibolite is present.

(15). Calc mica schist and marble unit.

This unit forms a highly calc feature running parallel to the last feature and disected by a major stream. Exposure, apart from the stream bed and feature top is nonexistent, the slo being covered by scree and very thick vegetation.

In the extreme north the unit can be seen very clearly on the road which crosses the area from east to west, to is composed of calc mica schists and marbles with the occasional lens of non calc mica schists and even less amphibolite.
The marbles show an extreme variety in colour, reds, yellows, browns, blacks, greys and blues, together with pure white and green occur in the same sample.

Mica, both muscovite and biotite, give clear evidence of the extreme intercrenulation. These wast variety of colour end apparently abruptly below the 36 grid and the unit becomes an ordinary mica banded white and dark marble. The calc mica schists show far less spectacular variety but but one unit shows a pitted texture over some 2 km. Schists become very much more common as the unit is traced along the strike to the south west, but large masses of calcite in them make them easily distinguishable from the last unit. The schist itself distinguishing the unit from the next entirely calc unit, which is quite thin in the south west corner and is dealt with next. Much microcrenulation is evident and can be seen clearly even in the poor exposure. Dips to the east are common and the stream section gives an easterly dip.

(16). Saccharoidal, black and white banded marble and massive marble unit.

The unit consists of massive white marble, grey/white and white banded marble, saccharoidal marble and brownish massive marble and is quite readily distinguishable from the next, non calc amphibolite unit. Exceptionally bad exposure of this and the rest of the western units makes the mapping not all that one had hoped for in this area, but the exposures that are present show easterly dips, which is fortunate because if the dips were not conformable it would be impossible to make a detailed examination of the area to find structures and so sent out any complications.

The unit can be traced south west as a feature but thins quite markedly due to a thickening of the adjacent amphibolite.

The unit stays as a marble to the western boundary of the map.

(17). Amphibolite and mica schist unit.

The unit is very poorly exposed due to vast area of bog, marsh and glacial debris.

However the rocks consists of radiating actinolite crystals in a greyish actinolite and mica matrix.

The majority of exposures dip easterly and the unit is mapped almost entirely by using the small feature that it forms as marking boundaries. This, short of digging the whole area up was the only one available to map the unit on.

(18). Large actinolite calc amphibolite unit.

This unit is distinguished from the latter solely on the incoming of marble lenses and the existence of marble bands in the amphibolite.

Actinolite is still the dominant amphibole and the rocks have become much darker and more massive. Over the half kilometer square of suggested exposure of this unit, exposure of the rock is adequate enough to mark farly delmate boundaries, but over a bigger area much better exposure is necessary to mark boundaries with certainty.

(19). Non calc amphibolite and garnet mica schist.

The unit is marked by the incoming of mica in the amphibolites which gives the actinolite radials a much higher definition being set in a white mica background, the amphibolites are really amphibole mica schists, but there is such a considerable amount of amphibole that the above title of the unit is deemed necessary.

Garnet mica schist forms some 25% of the unit and garnets occur with amphibole in the amphibolites.

Exposure is extremely bad and only two exposures in 20 glacial planed surface occur in the area in the extreme north west corner.

However slightly better exposure in the area to the north of the mapping area enabled convenient boundary to be drawn.
However the two stream sections where most of the information on this unit were gathered prooved inadequate to formulate dip and strike readings on, because the rocks were far too crenulated and a large enough outcrop to proove sheet dip did not exist. Exposure on the adjacent calc amphibolite unit in three cases gave conclusive easterly dips even though the majority of the microcrenulations dipped west. The sheet dip of this unit is thus deemed the same as the last unit.

Exposure however, is far from good and for the next 4 km west no better and thus exposures and excursions onhide the area prooved to be a waste of time due to glacial cover, bog, and surprising increase in lakes. Thus it was not possible to use this adjacent area to sort out the structure in mene, however a general conformity seems in every way to be indicated.

4. Structure

The structure of the area is well seen in the three cross sections. From the first two of these it can be seen that there is a general easterly dip to all the rock units from east to west and no structure, just a straight through sequence as already indicated.

On the last cross section a minor antiform can be seen, but this is in no way large and effects over an area of a few square kilometres only, the rest of the sequence of this section is again straight through with structurally lower beds to the west.

Minor structures in the shape of microcrenulations upto 1 metre in cross sectional area are very common indeed and give anomalous dip readings to the sheet dip in allot of cases. All beds are microcrenulated and the straight lines on the cross sections represent sheet dip, true pictures of the beds would show this microcrenulation but as these latter cannot be put in exactly a far better idea is given of the structure when just using straight lines.

An exellent example of anomalous dip readings due to this microcrenulation has been discussed under the black and white banded marble group.

No major structure can be found in this area on the results of this surface mapping.

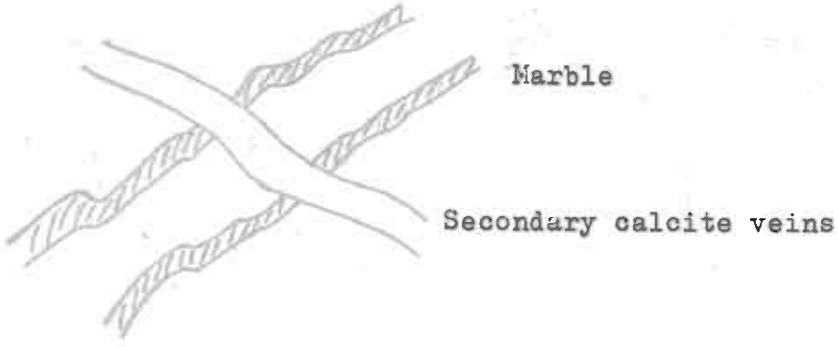
A structure involving the two banded marble litholigies has been informed when discussing these units, but no concrete proof of it exists and it is thus deemed to be absent.

5. Metamorphism.

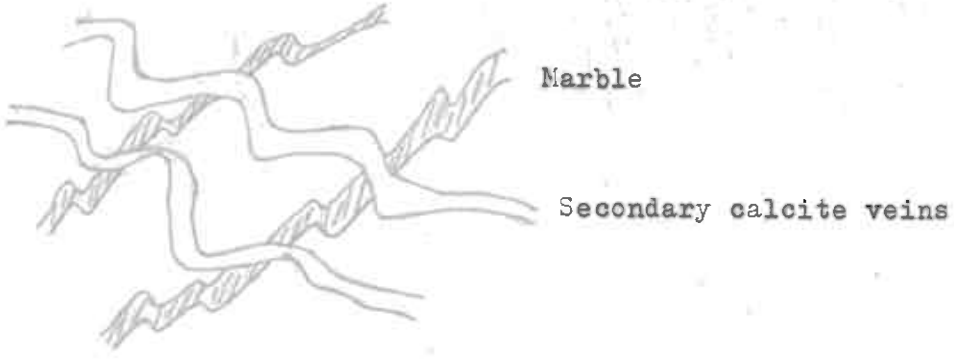
Obviously a discussion of the metamorphism during the Caledonian orogeny is not called for here and is not intended. What is intended under this heading is a description of an occurence of two fold phases in the black and white marble lithology.

The occurence is at 377/158 where a roas is being blasted round the bottom of the hill, the black and white marble lithology has been metamorphosed during the caledonian orogeny in a major metamorphic stage during this orogeny and the banded appearance has been imparted to it by the metamorphic effect.

At the above locality secondary calcite veins cut the banded marble as in diagram below.



Some 10 yds, (c) 9 metres away from this the secondary veins have themselves been folded.



This suggests the following.

(1) Main metamorphism of the sediments imparting banded appearance.

(2) Veining by calcite.

(3) During a period of possible stress relief or equilibration the marble and vein calcite were again folded.

Over a bigger area with better exposure a whole series of the possible F_2 folds could be seen and it is possible that some of the microcrenulations on the highly folded beds in the west are of this phase.

6. List of specimens.

Specimen	Locality	Description
Spec A	380/1445	Actinolite schist with much calcite and small pyrite crystals rock light in colour apart from actinolite which is black.
Spec B	379/144 Strike 224°N	Calc tremolite rock, tremolite fibrous.
Spec C	3785/143	Massive non calc amphibolite.
Spec D	376/142	Slightly calc amphibolite.
Spec E	3765/141	Micaceous amphibolite.
Spec F	373/1335	Amphibolite.
Spec G	373/118	Mica schist with large amphibolite crystals and small veins of biotite running across the rock.
Spec H	366/158	Calc biotite amphibolite.
Spec I	346/139	Banded mica, actinolite calcite pyrite rock, weathering yellow and black.
Spec J	348/136	Black and white speckled amphibolite.
Spec K	370/155	Black and white marble.
Specs L & M	369/154	Massive coarse grained marbles.
Spec N	369/1525	Layered calc biotite rock.
Spec O	3765/1475	Massive actinolite amphibolite rock.
Spec P	3765/147	Calc actinolite amphibolite with pyrite.
Spec Q	377/148	Biotite amphibole quartz schist.
Spec R	382/152	Massive grey amphibolite.
Specs S & T	3433/139	Calc muscovite schists with pyrite.
Spec U	349/136	Calc actinolite mica garnet schist.
Spec V	349/137	Amphibolite with small quartz segregations.
Spec W	350/137	V. similar to spec V.
Spec X	3595/136	Marble with much biotite amphibole and pyrite.
Spec Y	3495/136	Massive quartzy marble.
Spec Z	3495/136	Massive quartzy marble.
Spec 1	3495/137	Calc mica schist with pyrite.

Specimen	Locality	Description
Spec 2	344/1405	Dark grey marble.
Spec 3	363/1325	Slightly calc amphibolite.
Specs 4A & 4B	360/1265	Spotted marble and pure calc marble.
Spec 5	360/126	Another spotted marble, possibly same one with slightly schistose bands.
Spec 6	369/1255	Very micaceous marble, weathering brown.
Spec 7	3675/1164	Amphibolite.
Spec 8	376/113	Quartz mica rock, mica forms plates and layers in the quartz and splits rock into planes.
Spec 9	366/150	Quartz biotite amphibolite.
Spec 10		Null and void.
Spec 11	353/148	Slightly calcic amphibolite with pyrite and possibly chalcopyrite.
Spec 12	358/113	Graphitic calc biotite schist.
Spec 13	348/104	Calc mica schist.
Spec 14	343/106	Calc mica schist.
Spec 15	344/99	Garnet actinolite mica schist.
Spec 16	343/104	Marble
Spec 17	343/104	Same marble with mica.
Spec 18	380/114	Amphibolite.
Spec 19	344/99	Garnet mica schist.
Spec 20	343/98	Mica schist.
Spec 21	377/107	Garnet amphibolite.
Spec 22	372/101	Actinolite amphibolite.
Spec 23	337/138	Calc mica amphibole banded marble.
Spec 24	336/135	Micaceous marble.
Spec 25	335/135	Micaceous marble.
Spec 26	335/134	Grey slightly micaceous marble.
Spec 27	334/134	Same marble with biotite lens.
Spec 28	3325/1325	Appreciable amounts of v dark mica in marble.
Spec 29	300/908	Very calcic actinolite mica garnet schist.

Specimen	Locality	Description
Spec 30	310/1225	Non calcic actinolite mica schist.
Spec 31.	339/970	80°/360°N dip. Calc mica hornblende rock forms feature behind lake at this point.
Spec 32	334/1025	Banded mica, quartz/plagioclase schist.
Spec 33	327/1063	Banded calc mica schist.
Spec 34	310/104	Very calc rock with mica.
Spec 35	308/99	Slightly calcic actinolite mica schist.
Spec 36	301/104	Quartz pebble in calc (very) mica schist meta conglomerate.
Specs 37 and 38	310/98	Calc amphibolite units.
Spec 39	372/97	Actinolite mica schist.
Spec 40	335/134	Actinolite amphibolite.

7. Economic aspects.

Apart from the abundance of pyrite the area is barren of minerals and is of no economic importance, as far as a surface schicly can determine.

Key To Map

/ 20/150N — Thirty degree dip of beds to south east with higher ground

/ dip — Vertical beds strike north/south.

/ 20/150N. — Twenty degree dip of beds to north west. strike north/south.

Boundary of Peat

Boundary to river basin including beds of rivers, and some tributaries

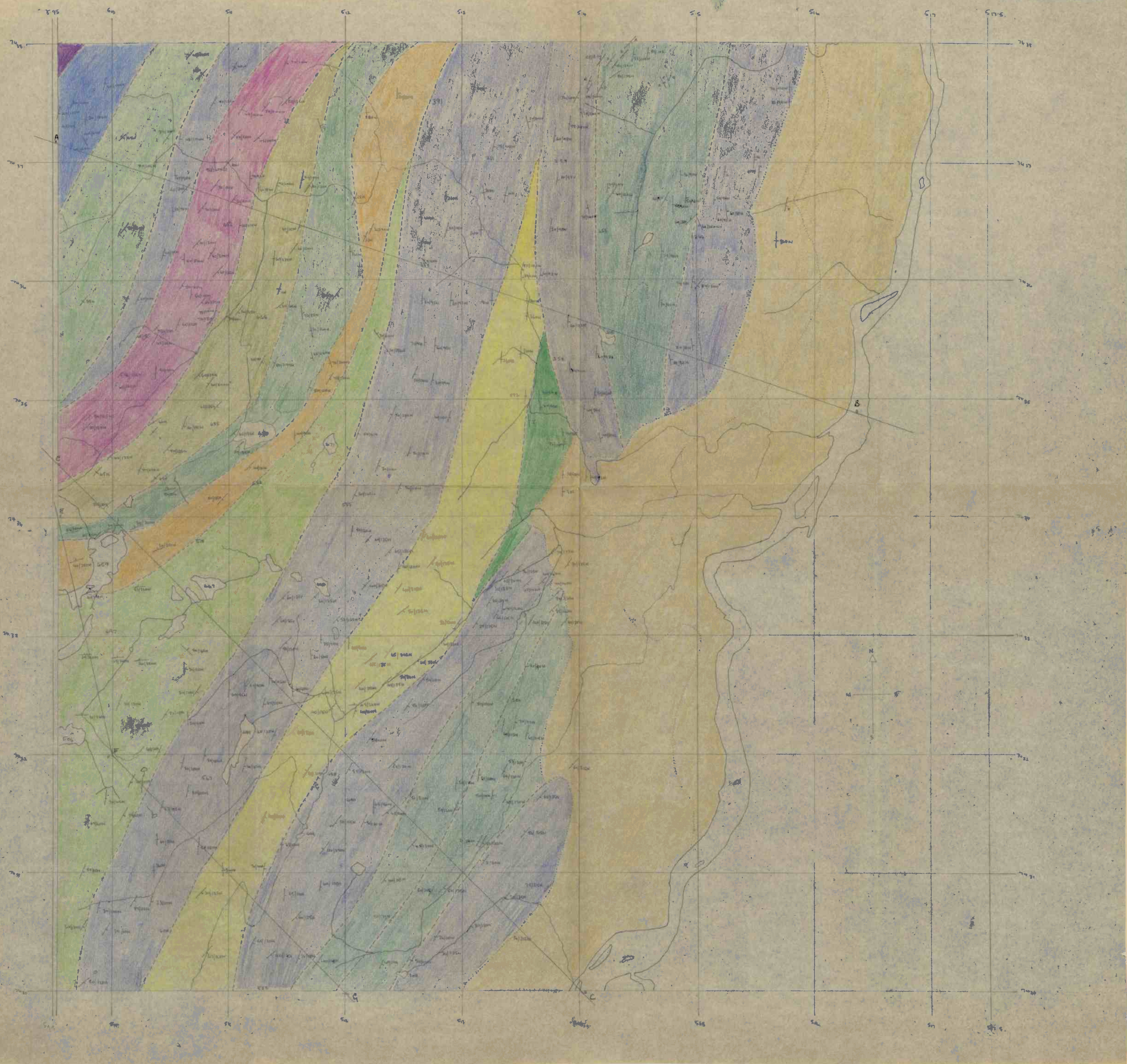
Boundary of Moors.

Protected Boundary under Ramsar

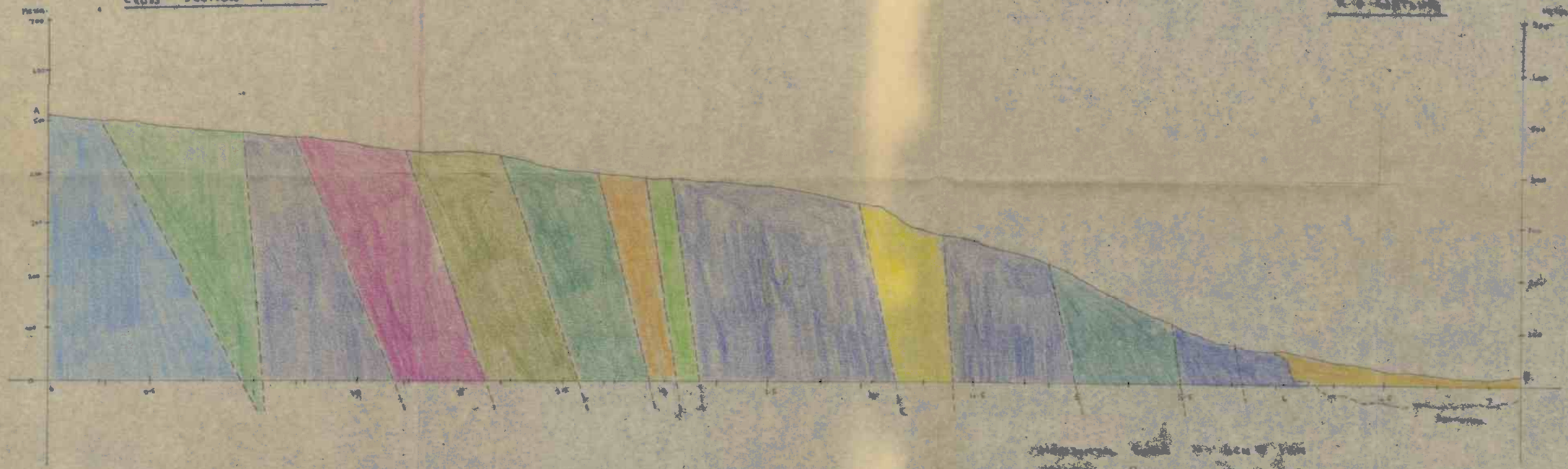
R.J. WATLING

MAP SCALE 6cm = 1 KILOMETRE

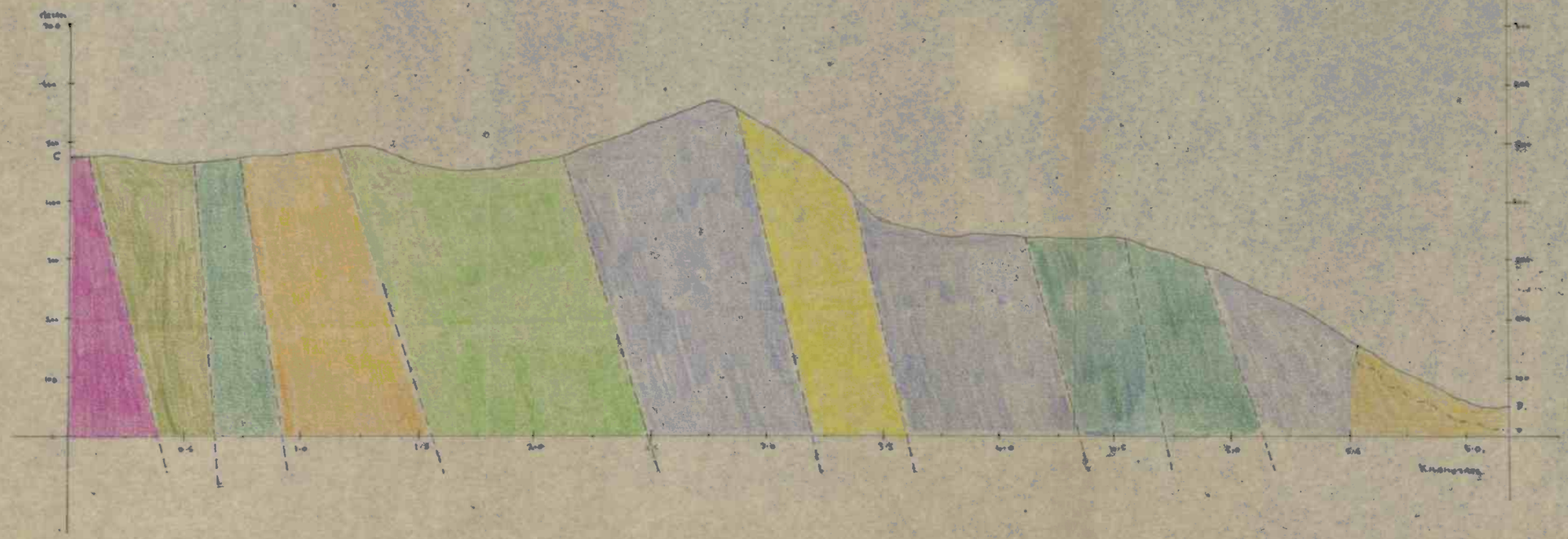
KEY ALONGBANKMOL CROSS SECTIONS



CROSS SECTION 1 AB



CROSS SECTION 2 C.D.



Scale :- 6cm = 1km

Scale - 16cm = 1km

EXAGGERATION 2.5 times.

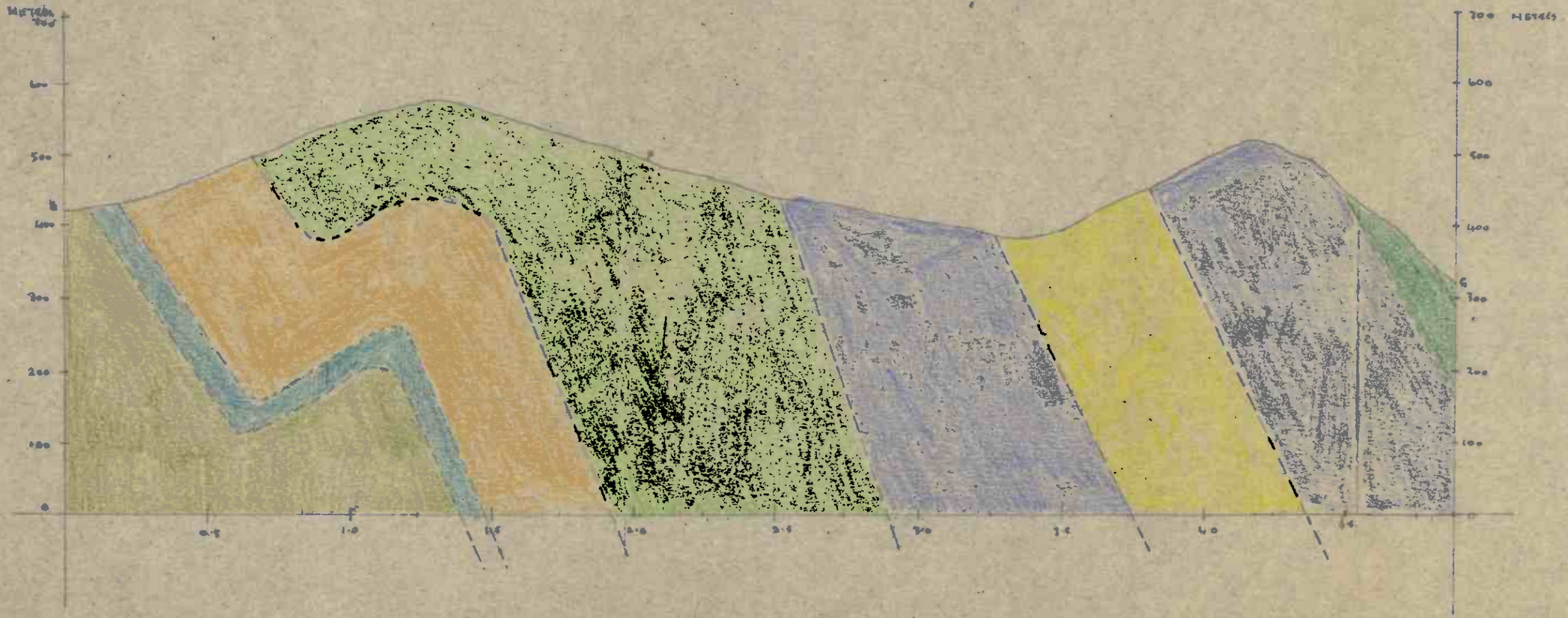
CROSS SECTION B EFG

VERTICAL SCALE - 1cm = 1km

HORIZONTAL SCALE - 6cm = 1km

VERTICAL EXAGGERATION 2.5 TIMES

R J WATLING



NORWAY-NORGE 1:50,000

FIRST EDITION–AMS

JUNKERDAL

SHEET 2128 IV

AMS SERIES M711

Watkins 4/55

AMS M711
First Edition–AMS

Prepared by the Army Map Service (PV), Corps of Engineers, U. S. Army, Washington, D. C. Copied in 1952 from Norge 1:50,000, Norges Geografiske Oppmåling, Sheet L 14, 1943. Sheet size changed and planimetric detail partially revised.

Måleståkk, Scale 1:50,000

1 ½ 0 1 2 3 Miles

1000 500 0 1000 2000 3000 4000 Meters

1000 500 0 1000 2000 3000 4000 Yards

EKVIDISTANSE, CONTOUR INTERVAL 30 METERS

TRANSVERSE MERCATOR PROJECTION

HORIZONTAL DATUM: EUROPEAN DATUM

BLACK NUMBERED LINES INDICATE THE 1,000 METER UNIVERSAL TRANSVERSE MERCATOR GRID ZONE 33. INTERNATIONAL SPHEROID

RUTENETT UTM SONE 33. SORTE TALL.

THE LAST THREE DIGITS OF THE GRID NUMBERS ARE OMITTED

TALLENE ANGIR KM.

HEIGHTS IN METERS

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LEGEND—TEIKNTYDING

- International boundary with marker — *Riksgrense, grenseøys, - merke*
- Fylke boundary — *Fylkesgrense*
- Herad, town boundary — *Heradsgrense, bygrense*
- Sokn boundary — *Soknegrense*
- Crown lands boundary — *Statsålmenningsgrense*
- Main road; Route number—*Hovudveg, vegnummer* — 50
- Secondary road—*Bygdeveg*
- Private road—*God privat køyreveg*
- Cart road—*Kjerreveg*
- Winter road; Track—*Vinterveg. Lite synleg stig (ferdaveg)*
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- Power transmission line; Power station, transformer station — *Elektrisk leidning, kraft el. transformatorst.*
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- Deciduous woods—*Lauvskog*
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- Streetcar line — *Trallebane, hestejarnveg*
- Aerial cableway—*Togbane (taubane)*
- Church; Parish, chapel—*Hovudkyrkje. Soknekyrkje. Kapell*
- Cemeteries—*Kyrkjegard*
- Factory, power station, etc.; Mill — *Større fabrikk, drift, kraftverk, mylne o.l.*
- Brickworks; Small mill; Sawmill — *Teglverk, Mylne (mølle), kvern, Sag*
- Mine, mining claim; Quarry—*Gruve, skjerp, Steinbrot*
- Wireless telegraph station—*Trådlaus stasjon*
- Airfield; Parade ground—*Flyplass. Eksismo*
- Horizontal control points—*Trigonometrisk punkt*
- Lighthouse, light; Beacon; Air navigation light — *Fyr, lykt Sjømerke. Luftfyr*
- Fishers or hunters cabin, cattle camp, etc. — *Fiskarbu, skyttarbu, felæger o.l.*
- Farms; Farm, mountain pasture—*Gard, småbruk, plass, sæter*
- Cottage, school, hotel, meetinghouse, tourist shelter, inn, sports-hunters cabin, small farm, small power station, mill, etc. — *Villa, skole, hotell, bedehus, turisthytte, gjestgjevarhus, sports-jakthytte, mindre bruk, lite kraftverk, mølle o.l.*

RUTETILVISING (KARTREFERENSE); NÆRMESTE 100 m.		SONEOMRÅDE GRID ZONE DESIGNATION: 33W; 100 KM RUTE 100,000 M. SQUARE IDENTIFICATION	TO GIVE A STANDARD REFERENCE ON THIS SHEET TO NEAREST 100 METERS	
Eksempel: TRIGONOMETRISK PUNKT 1625			SAMPLE POINT: HORIZONTAL CONTROL POINT 1625	
km aust	24,6		1. Locate first VERTICAL grid line to LEFT of point and read LARGE figures labeling the line either in the top or bottom margin, or on the line itself:	24
km nord	20,3		Estimate tenths from grid line to point:	6
TRIGONOMETRISK PUNKT	246203		2. Locate first HORIZONTAL grid line BELOW point and read LARGE figures labeling the line either in the left or right margin, or on the line itself:	20
Merk at komma skøyfes og at 100 km tallene de små tallene 5 a isteg 24 nord-IKKE skal tas med.		WQ	Estimate tenths from grid line to point:	3
Ved meldinger utover 100 km eller hvis mere enn ett rutenett er merket på kartet, skal også 100 km ruten angis:			SAMPLE REFERENCE:	246203
TRIGONOMETRISK PUNKT	WQ246203	IGNORE the SMALLER figures of any grid number; these are for finding the full coordinates. Use ONLY the LARGER figures of the grid number; example: 7404000	If reporting beyond 100,000 meters or if sheet bears an overlapping grid, prefix 100,000 Meter Square Identification, as:	WQ246203
Ved meldinger utover 9° nord, syd eller 18° aust, vest, skal også soneområde angis:			If reporting beyond 9°N-S or 18°E-W, prefix Grid Zone Designation, as:	33WWQ246203
TRIGONOMETRISK PUNKT	33WWQ246203			

INDEX TO ADJOINING SHEETS
ISOGONIC INFORMATION 1951

2029 II	2129 III	2129 II
2028 I	2128 IV	2128 I
2028 II	2128 III	2128 II

GN
1°00' OR 18 MILS
0°26' OR 8 MILS

APPROXIMATE MEAN DECLINATION 1952
FOR CENTER OF SHEET
ANNUAL MAGNETIC CHANGE 8' EASTERLY

Use diagram only to obtain numerical values. To determine magnetic north line, connect the pivot point "P" on the south edge of the map with the value of the angle between GRID NORTH and MAGNETIC NORTH, as plotted on the degree scale at the north edge of the map.

MISVISING 1952 I GRADER OG MINUTTER
OG I STREKER
ÅRLIG FORANDRING 8' ELLER 2.4 ' AUST

Diagrammet gir bare tallverdiene. Retningen for Magnetisk Nord bestemmes ved å forbinde pivotpunktet "P" i søndre rammekant, med det punkt på skalaen i nordre rammekant, som svarer til misvisningen regnet i forhold til RUTENETT NORD (GN).

GLOSSARY–FORKORTELSER

Bh	bedehus	meetinghouse	ned	nedre	lower
bg	berg	mountain, rock	n	nordre	northern
Bvs	brannvaktstasjon	fire station	nt	nut	peak
bk	bekk	brook, creek	PA	postapneri	post office
DS	dampskipsstoppested	port	Pgd	prestegard	vicarage
Elektr Vk	elektrisitetsverk	power station	RS	redningsstasjon	rescue station
ev	elv	river	San	sanatorium	sanatorium
Fbr	fabrikk	factory	Sph	sportshytte	sports cabin
Fb	fiskarbu	fishers cabin	skj	skjær	rock, skerry
fj	fjell	mountain	Sk	skole	schoolhouse
fd	fjord	fiord	Sb	skyttarbu	hunters hut
fs	foss	waterfall	st	store	great
Fl	felæger	cattle camp	str	straum	stream, current
gd, gd	gard	farm	sd	sund	sound
hlr	haug	hill, hillock	sæ	sæter	mountain-pasture
hd	høyde, högd, hovd	hill	sl	stöl	shieling
hmr	hamar	crag	s	søndre	southern
hl	holme	islet	TS	telegrafstasjon	telegraph station
in, ind	indre	inner	td	tind	peak, pinnacle
Jh	jakthytte	hunters cabin	tj	tjern, tjörn	lakelet, pool
KP	kamp	hill, hilltop	Th	turisthytte	tourists shelter
Kpl	kapell	chapel	Tk	tömmerkoie	lumber shanty
Knp	knapp	peak	UH	Ungdomshus	meetinghouse
Knt	knatt	peak	vn	vann, vatn	lake (lakelet)
Kl	kolle	knoll	v	vestre	western
L	lade, låe	barn	vk	verk	factory, works
ld	land	land	vb	vokterbolig	caretakers house
Ldh	landhandleri	shop	vl	voll	plain, meadow
l	lille, litle, listle	little	yt	ytre	outer
LS	lodsstasjon	pilot station	ö	östre, austre	eastern
M	meieri	dairy	øv	øvre	upper
m	mellem, midtre	middle			

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JUNKERDAL
NORWAY

NORWAY-NORGE 1:50,000 | FIRST EDITION—AMS | # SALTDAL | SHEET 2129 III
SERIES M711

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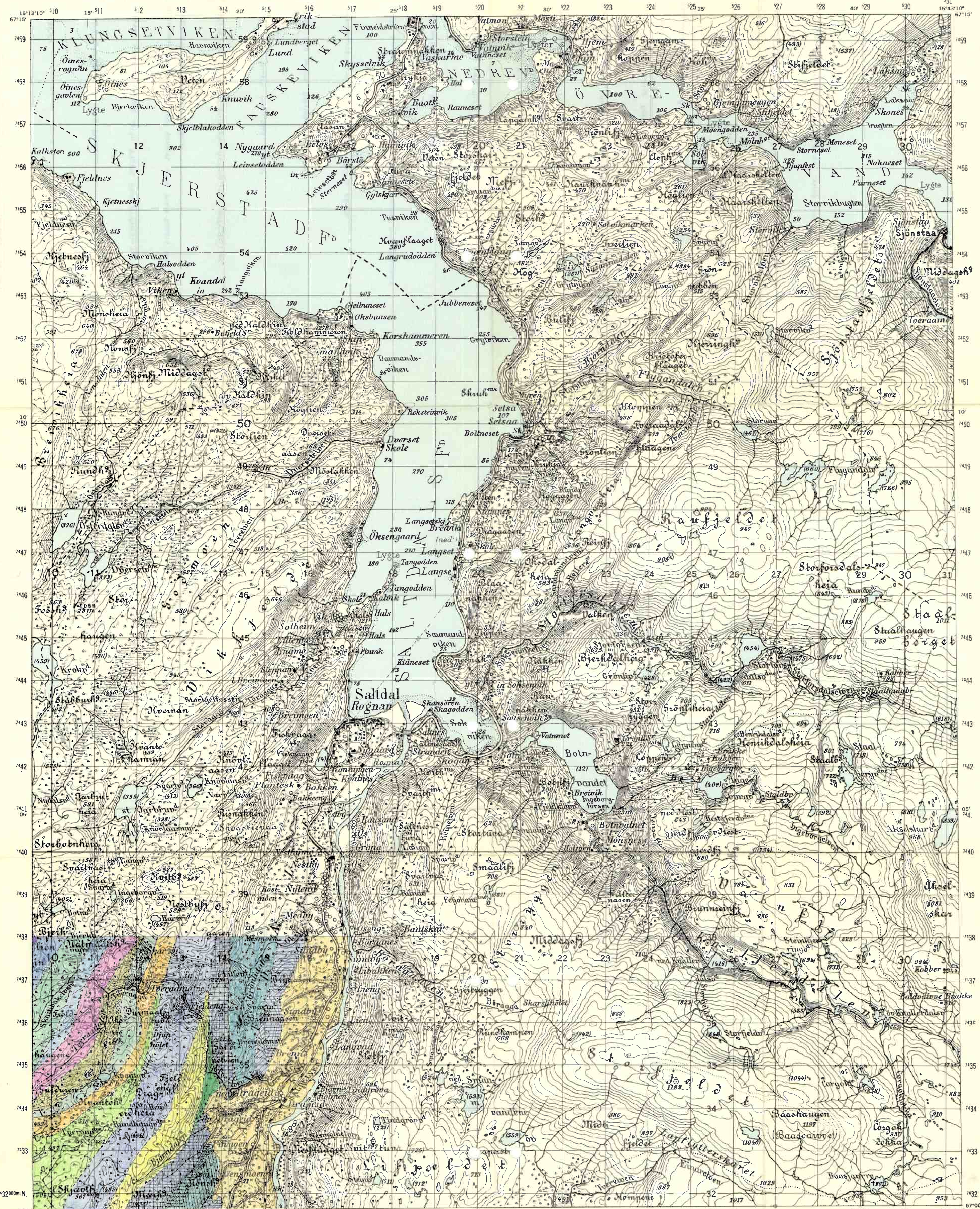

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TRYKT I OFFSET EMIL MOESTUE A/S, OSLO. 12-63.

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Fishers or hunters cabin, cattle camp, etc. — Fiskarbu, skyttarbu, felægerr o.l.
Farms; Farm, mountain pasture—Gard, småbruk, plass, sæter
Cottage, school, hotel, meetinghouse, tourist shelter, inn, sports-hunters cabin, small farm, small power station, mill, etc. — Villa, skole, hotell, bedehus, turisthytte, gjestgjevarhus, sports-jakthytte, mindre bruk, lite kraftverk, mölle o.l.

RUTETILVISING (KARTREFERENSE) NAERMESTE 100 m.		
Eksempel: SK		
km aust	20,3	
km nord		43,6
SK	203436	

Merk at komma sloyfes og at 100 km tallene de små tallene 5 aust og 67 nord IKKE skal tas med.
Ved meldinger utover 100 km eller hvis mere enn ett rutenett er merket på kartet, skal også 100 km ruten angis:
SK WQ203436
Ved meldinger utover 9° nord, syd eller 18° aust, vest, skal også soneområde angris:
SK 33WWQ203436

SONEOMRÅDE GRID ZONE DESIGNATION 33W
100 KM RUTE 100,000 M. SQUARE IDENTIFICATION
WQ

IGNORE the SMALLER figures of any grid number; these are for finding the full coordinates. Use ONLY the LARGER figures of the grid number. example: 7432000

TO GIVE A STANDARD REFERENCE ON THIS SHEET TO NEAREST 100 METERS
SAMPLE POINT: SK
1. Locate first VERTICAL grid line to LEFT of point and read LARGE figures labeling the line either in the top or bottom margin, or on the line itself: 20. Estimate tenths from grid line to point: 3
2. Locate first HORIZONTAL grid line BELOW point and read LARGE figures labeling the line either in the left or right margin, or on the line itself: 43. Estimate tenths from grid line to point: 6
SAMPLE REFERENCE: 203436
If reporting beyond 100,000 meters or if sheet bears an overlapping grid, prefix 100,000 Meter Square Identification, as: WQ203436
If reporting beyond 9°N S or 18°E W, prefix Grid Zone Designation, as: 33WWQ203436

INDEX TO ADJOINING SHEETS
ISOGONIC INFORMATION 1951

2029 I	2129 IV	2129 I
2029 II	2129 III	2129 II
2028 I	2128 IV	2128 I

GN
0°26' OR 8 MILS
1°00' OR 18 MILS

APPROXIMATE MEAN DECLINATION 1952 FOR CENTER OF SHEET
ANNUAL MAGNETIC CHANGE 8' EASTERLY
Use diagram only to obtain numerical values. To determine magnetic north line, connect the pivot point "P" on the south edge of the map with the value of the angle between GRID NORTH and MAGNETIC NORTH, as plotted on the degree scale at the north edge of the map.

MISVISING 1952 I GRADER OG MINUTTER OG I STREKER
ÅRLIG FORANDRING 8' ELLER 2,4 · AUST
Diagrammet gir bare tallverdiene. Retningen for Magnetisk Nord bestemmes ved å forbinde pivotpunktet "P" i söndre rammekant, med det punkt på skalaen i nordre rammekant, som svarer til misvisingen regnet i forhold til RUTENETT NORD (GN).

GLOSSARY—FORKORTELSER

Abbr.	Norwegian	English	Abbr.	Norwegian	English
Bh	bedehus	meetinghouse	ned	nedre	lower
bg	berg	mountain, rock	n	nordre	northern
Bvs	brannvaktstasjon	fire station	nt	nut	peak
bk	bekk	brook, creek	PÅ	postapneri	post office
DS	dampskipsstoppested	port	Pgd	prestegard	vicarage
Elektr Vk	elektrisitetsverk	power station	RS	redningsstasjon	rescue station
ev	elv	river	San	sanatorium	sanatorium
Fbr	fabrikk	factory	Sph	sportshytte	sports cabin
Fb	fiskarbu	fishers cabin	skj	skjær	rock, skerry
fj	fjell	mountain	Sk	skole	schoolhouse
fd	fjord	fiord	Sb	skytterbu	hunters hut
fs	foss	waterfall	st	store	great
Fl	felæger	cattle camp	str	straum	stream, current
gd, gd	gard	farm	sd	sund	sound
hg	haug	hill, hillock	sr	sæter	mountain-pasture
hd	höyde, högd, hovd	hill	sl	stöl	shieling
hmr	hamar	crag	s	söndre	southern
hl	holme	islet	TS	telegrafstasjon	telegraph station
in, ind	indre	inner	td	tind	peak, pinnacle
Jh	jakthytte	hunters cabin	tj	tjern, tjörn	lakelet, pool
KP	kamp	hill, hilltop	Th	turisthytte	tourists shelter
Kpl	kapell	chapel	Tk	tömmerkoie	lumber shanty
KnP	knapp	peak	UH	Ungdomshus	meetinghouse
Knt	knatt	peak	vn	vann, vatn	lake (lakelet)
Kl	kolle	knoll	v	vestre	western
L	låde, löe	barn	Vk	verk	factory, works
ld	land	land	Vb	vokterbolig	caretakers house
Ldh	landhandleri	shop	Vl	voll	plain, meadow
l	lille, litla, lisle	little	Yt	ytre	outer
LS	lodsstasjon	pilot station	ö	östre, austre	eastern
M	meieri	dairy	öv	övre	upper
m	mellem, midtre	middle			

SALTDAL, NORWAY

Key and Lithological | Structural Successions Metamorphic Retrogressive Episodes

In Text

Structurally Highly Rigid Mobile Layers in Key

(1) Water

(2) Black and white Banded Marble

(3) White Massive Marble with Pyrite Rich Amphibolites

(4) Actinolite and Tremolite Schists with Mica Schists and Amphibolite and Marble Bands

(5) Biotite Schists and Biotite Rich Actinolite Amphibolites

(6) Calc Mica Schists and Mica Schists

(7) Black and white Banded Marble

(8) Amphibolite with Mica Schists and Marble Bands

(9) Very Thickness Calc Mica Schists and Thin Amphibolites

(10) Saccharoidal and Pure White Marble

(11) Amphibolite and Mica Schist

(12) Marble with Thin Calc Mica Schists

(13) Amphibolite and Mica Schist

(14) Garnet Mica Schist, Actinolite Garnet Mica Schist and Amphibolite

(15) Calc Mica Schist and Marble

(16) Saccharoidal, Black and White Banded Marble and Massive Marble

(17) Amphibolite and Mica Schist

(18) Large Actinolite Calc Amphibolite

(19) Non Calc Amphibolite and Garnet Mica Schist

R. J. Watts Map

NORWAY-NORGE 1:50,000

FIRST EDITION—AMS

JUNE