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Postboks 3021, 7002 Trondheim

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Tittel

Detailed geological mapping of the Gudrun area. Geologi. Kartlegging.

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HARRISON J D.	1975	Sulitjelma Gruber A/S

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Fagområde	Dokument type	Forekomster
Råstofftype	Emneord	

Sammendrag

Detaljgeologisk kartlegging i området Gudrun. Bergartene som er skildra er Furulundskifrene, Sulitjelma-amfibolitten som er delt inn i skifrig ,bandet, metaporfyrisk, nodular og kalkholdig amfibolitt, glimmerskifer og flaser-gabbro. Strukturgeologi og sulfidmineralisering er kort omtalt, beste mineralisering ved Dualdagop. Blotningskart uten farger (feltdagbok ?). Geologi. Kartlegging.

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012.026

A/S Sulitjelma Gruber
Prospektering 1975
Prosjekt 7.504/A
Feltrapport

TSH/JDH/HE
21/10-1975

Detailed geological mapping of the Gudrun area (EJ 212, EJ 213 and EH 213)

Contents

Abstract

An area of 8 sq.km in the Sulitjelma Amphibolite between Fjeld Grube and Otervann was mapped with special emphasis on all mineralized layers. The possibility of the presence of ore in economic quantity near the surface is considered to be poor.

1. INTRODUCTION

The project was carried out in the summer of 1975. Originally commencing with detailed mapping of the continuation of the Fjeld Grube ore horizon, it was later extended to include the area to the east as far as Otervann. The purpose of the extension was to map that part of the Sulitjelma Amphibolite, which may be affected by the tunnelling for the Lomi hydro-electric scheme.

The mapping was carried out by J.D.Harrison with some assistance from M.Chambers (University College, London), who mapped lithological boundaries in the Otervann area.

The boundaries of the Sulitjelma Amphibolite were taken as northern and southern limits of the area to be mapped.

Due to the size of the area mapped (over 8 sq.km), it was not practicable to record all outcrops, and work was concentrated along those levels showing evidence of mineralization. However, the vast majority of outcrops within the area were examined.

Air photos were available for most of the area and, with overlays, these were used as field maps.

Work was hampered by fresh snow in the later part of the season, while at the same time mapping in October permitted access to many outcrops still snow covered in the summer.

The area has previously been studied in the Ph.D. works of Mason (1966) and Wilson (1968), and their work was found helpful in this project.

2. TOPOGRAPHY

The area is covered by parts of sheets EJ 212, EJ 213 and EH 213 of the 1:10 000 series. It lies between eastings Y 26600 and Y 32500 and between northings X 1016 400 and X 1020 400. The area lies in the height interval 550 m.o.h. and 1200 m.o.h.

The sharpest relief is in the south of the area, where cliffs marking the base of the Sulitjelma Amphibolite fall steeply to Lomi elv. A steep wall also bounds the cwm* in the west of the area into which Giken elv falls from Duoldagop. Elsewhere the topography is relatively gentle. Softer bands of schist are commonly weathered out to form shallow NW-SE valleys running through the central plateau area, which is itself divided into a NW facing and a steeper SE facing slope by the watershed of the Giken and Otervann drainage basins. The area terminates in the north-east against the cliffs of Vardetoppen.

*en kort dal

There are no trees in the area and vegetation is very sparse above 750 m. Exposure is therefore generally good. However, there are considerable areas of drift and scree which make it difficult to map complete units, especially in the west of the area where the structure is evidently folded and faulted.

3. PETROGRAPHY

The bulk of the rocks mapped lie within the Sulitjelma Amphibolite, but there is doubt in this area over the placement of the boundaries. For convenience the questionable units are here included within the Sulitjelma Amphibolite. Hence the base of the formation is taken at the base of the lowest amphibolite band, even though this is possibly discontinuous to the west. The alternative would be to place the boundary above the succeeding schist band. At the top of the formation lies the controversial flaser gabbro (or dioritic gneiss as Mason called it). This has been considered as a junction unit marking the base of a major nappe. Its character and thickness varies, but in the west it looks exactly like other coarse-grained members of the formation.

The Furulund Schist

The upper part of the Furulund Schist forms a steep cliff to the north of Lomi elv. The schists are of variable character, but characteristically micaceous and strongly cleaved. Lower down at the base of the cliff grain size becomes coarser, and the rocks may be described as phyllitic with frequent late folds. In contrast, refolded early folds are typical in the finer grained levels of the formation. Boudinage is not such a common feature here as it is further west by Langvann. Occasional discontinuous pure quartzite bands occur. There is a continuous band of graphite schist about 60 m from the top of the Furulund Schist, which is responsible for the marked anomaly recorded on the VLF trace at this level. These graphitic paper shales have a maximum thickness of 8 m, and contain somewhat less than 1% pyrite in finely disseminated form along the cleavage surfaces. No other sulphides were present. The band, which has been preferentially weathered out, forms a well defined feature and can be traced along the length of the cliff, although it is frequently unexposed. It can be seen to continue to the east although no studies were made east of Oter elv.

Marking the top of the Furulund Schist is a band of breccia which in the east is a mineralized chlorite breccia (see under "Mineralization"), and in the west is a calcareous rock with minor chlorite and no sulphides. In Oter elv a very thin marble band is seen just below the breccia. It is white and dies out to the west. Marble bands have been reported from the cliffs to the east under Otertind and beyond.

The Sulitjelma Amphibolite

The Sulitjelma Amphibolite includes many different rock types and, in part, the boundaries of these lithologies were mapped. It must be noted, however, that many of these boundaries are arbitary, as in reality the petrography is infinitely variable and also much small-scale alternation in lithology occurs. Hence boundaries often indicate a predominant rather than absolute lithology. The basic lithology, which is rarely seen, appears to be a fine, even-grained, massive, non-schistose rock which possibly represents lava flows. However, the amphibolite can usually be grouped under one of the following headings:

A. Schistose amphibolite

A common occurrence is as a fine-grained homogeneous schist. Typically it is a dark grey-green with a strong penetrative cleavage and uniform grain size. Elsewhere the cleavage is less well developed and grain size more variable.

B. Banded amphibolite

This is another common lithology and is also frequently schistose. It is characterized by a fine colour banding on a 1-5 mm scale. Sometimes slight folding is seen in the banding. This type is relatively more resistant to weathering than the schistose type, although it is more commonly strongly jointed. In places the colour banding represents thin bands of pure hornblende. It is conceivable that some of the colour banding reflects primary compositional layering in tuff deposits or volcanogenic sediments.

C. Metaporphyritic amphibolite

This name was used by Mason and Wilson to describe a massive, fine-grained amphibolite containing white porphyroblasts of feldspar. These are up to 1 cm in length and occasionally euhedral, but more often sub-rounded. They may constitute up to 40% of the rock. No preferred orientation or banding was seen in the distribution of the porphyroblasts. The metaporphyritic amphibolite does not appear in the west of the area, but appears in connection with a thickening downwards of the flaser gabbro. The lower boundary is well defined here, but to the east it becomes more gradational with bands of metaporphyritic rock alternating with bands of schistose amphibolite. In fact metaporphyritic bands occur as low as the top of the upper schist band at the western tip of Øvre Otervann. Hence the boundary here is drawn to show the lower limit of the predominance of the type. At the base of the unit in the north-west, a rock type was seen with small diffuse rod-shaped concentrations of feldspar with approximate dimensions of 4 mm x 1 mm in a fine grained groundmass. This type may be transitional between a fine-grained amphibolite and the metaporphyritic amphibolite. The unit itself is notable for its lack of any sign of mineralization, although some of the schist bands within it under Vardetoppen showed some minor, rusty weathering.

D. Nodular amphibolite

This name was given by Wilson to a rock type found in Giken elv in association with a mineralized horizon. The rock consists of lens and bands of amphibolite of widely differing composition and grain size, between 1 mm and 3 cm thick, with very little or no matrix material. Where present, the matrix appears slightly calcareous. Nodular amphibolite also occurs immediately below, and also above, the calcareous conglomerate on the opposite side of the cwm.

E. Calcareous amphibolite and calcareous conglomerate

The calcareous amphibolite consists of elongate lenses of fine-grained amphibolite, 10-20 cm long set in an orange-brown calcareous matrix. Frequently the calcareous content is lower, and it merely forms lenses and partings in an otherwise massive or schistose fine-grained amphibolite. The calcareous material is invariably preferentially weathered out. In two cases such a calcareous amphibolite occurs as the continuation of a mineralized horizon, viz. the eastward extension of the Børgestol level (studied under Project 7.402/E), and the westward continuation of the mineralized level at the base of the amphibolite in the Oter elv section. An extreme variety of this rock type is the calcareous conglomerate observed at two localities below the upper schist band. This rock itself is possibly related to the nodular amphibolite, judging by the field relations observed. It is uniformly brown in clour and is a paraconglomerate with clast size ranging from 5 mm to 20 cm.

F. Mica schist

Two thick and persistent schist bands occur within the Sulitjelma Amphibolite. The composition of the schist is variable, but a light grey mica shist is typical. Mason reports a sheared pegmatite in the lower band near Otervann. Exposure is poor in this southern band, which was partly mapped under Project 7.402/E, due to considerable drift and permanent snow. Parts of the northern band are better exposed, but again preferential weathering has led to a drift-filled valley. At the western end of the upper band a persistent strongly folded psammite band occurs. Also in this band are two thin rust-weathered garnet-biotite-graphite schist, which can be traced in part to Otervann. Although graphite is not abundant in these bands, it has been adequate to create a notable anomaly on the VLF trace. The upper schist band appears to thin considerably to the west, while the lower one runs out into the Furulund Schist, where the lower amphibolite band dies out. In fact, the petrography of the schist within the amphibolite is indistinguishable in the field from parts of the Furulund Schist.

G. Flaser gabbro

Mason used the field term "dioritic gneiss" for this unit, which he considered to be a tectonised junction unit between two major nappes. The unit thickens eastwards from the waterfall zone, and its upper limit was not mapped in the east where Mason reports complex relations with Purulund Granite, the Sulitjelma Gabbro and other rock types. Typically, this rock type contains large, irregular sub-rounded blocks of coarse-grained amphibolite up to 2 m in size, in a matrix of fine-grained banded amphibolite, in which the banding is very irregular and tends to follow the outline of the clasts. This matrix often shows, in part, a rusty orange weathering colour. The feldspar content of the blocks is generally higher than in other coarse-grained amphibolites lower in the formation. Sometimes a mineral lineation may be seen, but the texture is fairly equigranular.

In the west the breccia texture is not so evident and the flaser gabbro here was mapped in the field as a massive coarse grained amphibolite. The change to the east is a gradational one with the presence of a matrix becoming increasingly apparent, and there is no question of there being two distinct units. The lower contact of the main body of the flaser gabbro is marked by a persistent chlorite breccia band which is up to 4 m thick and mineralized in the west, reducing to 10 cm without mineralization in the east, where it fades out at the junction with the metaporphyritic amphibolite. In this area a large lens of flaser gabbro occurs below the main body, separated by discontinuous bands of schistose amphibolite and a band of fine-textured flaser gabbro (i.e. without large blocks), which latter continues to the east as a clear marker at the base of the flaser gabbro. In contrast, the lens itself has large blocks with a grain size as coarse as any seen in the unit. The western end of this lens is obscured by drift, but to the east it ends abruptly as a series of short interdigitations with the metaporphyritic amphibolite. Within the main body of the flaser gabbro a marker band of rodded amphibolite occurs. This is a coarse-grained amphibolite, not brecciated, with a strong mineral lineation in the amphiboles producing parallel elongate crystals aligned parallel with the maximum dip.

4. STRUCTURE

The structure of the whole area dips to the north-east at varying angles. The strike swings from 050^{g} in the south-west corner of the area through to a general trend of around 130^{g} in the east. The change is concentrated in two main areas, in the waterfall fault zone immediately to the east of Giken elv, and further east where the outcrop of metaporphyritic amphibolite begins. It is not clear, due to poor exposure, whether the change in strike in the first area is due to folding or faulting.

Otherwise there are no major folds in the area. Late minor flexures are present, and in places (for example in psammitic layers in the upper schist band), pre-schistosity folding is excellently displayed. Over the area the dip varies from 20° to 60°, but generally values are notably consistent with an average of 35°.

The only significant structures observed are faults. Most important are those of Wilson's "Waterfall Zone", which cross the area with a general trend of 165G. The faults observed in this work do not all coincide with those recorded by Wilson, who mapped one of these faults as extending to the SE to cut the Ny-Sulitjelma ore-body, on the basis of evidence from underground maps. No surface expression of this fault was seen. Wilson recorded movement on a number of these faults, but rust layers in the back of the gorge cut by the waterfall, were seen to be continuous across the faults, and the only fault with any significant movement lies to the west. The movement on this is apparently of the order of 100 m in a dextral sense. However, a similar surface outcrop would be obtained from a vertical throw with the eastern block showing relative downward movement. Unfortunately outcrop in the floor of the cwm is insufficient to prove or disprove fault displacement, and it is not possible to correlate with any degree of confidence the rust levels across the fault zone.

The fault which cuts the Furulund Schist/Sulitjelma Amphibolite boundary in the south, and marks the western extremity of the lowest body of amphibolite, has previously been mapped to indicate a sinistral movement. However, both above and below the amphibolite body, marker horizons (e.g. the graphite schist below) were found to be undisplaced by the fault. Moreover, the large overhanging outcrop where displacements have been recorded, shows a considerable degree of tectonism and minor mineralization, and is quite in contrast to the main amphibolite body to the east. Also a clear structural unconformity is observed beneath the overhang. This outcrop is here interpreted as a thrust block.

A series of minor faults or joints, cross the flaser gabbro in the central part of its exposure. They are aligned in parallel, with a strike of 030G and a dip of 60° to the SE. Movement was recorded on the largest of these, and this is recorded on the map. Generally these faults are clearly defined on the ground, with the western faces of the fault planes providing excellent exposure of the flaser gabbro.

5. MINERALISATION

The original purpose of the project was to investigate the eastward extension of the ore levels present at and below Fjeld Grube. However, various other levels of rust were observed and recorded. The main Fjeld Grube level was identified as the mineralized chlorite schist, which underlies the main body of the flaser gabbro. As mentioned previously, this level thins out to the east and ore minerals disappear. Lying under this chlorite breccia, but normally separated from it by a band of banded amphibolite, is a rusty and weakly mineralized band of schistose amphibolite, which also dies out to the east.

A study of the Giken elv section downstream of the waterfall, showed three more layers of rusty weathering. The first of these is a rust band within the schistose amphibolite with a little chlorite and pyrite present. There is a little amphibolite breccia in association with this band.

The second rust level is also in schistose amphibolite, but here it immediately overlies a 5 m band of nodular amphibolite, which is itself devoid of mineralization and shows no rust.

The third level is a thick (10 m) band of mixed amphibolites with considerable quantities of chlorite present in varying concentrations. Minor pyrite mineralization is present throughout as scattered crystal aggregates and small single crystals.

In the schistose amphibolite bands within the metaporphyritic amphibolite, some rusty weathering was observed on the lower slopes of Vardetoppen. However, this was very weak and impersistent and no sulphides were seen.

A chlorite breccia occurs along the lower margin of the basal amphibolite in the Oter elv section. It changes character to the west to become a calcareous breccia with minor chlorite and no sulphides. Some pyrite is present in the Oter elv section, and at a locality further west where the breccia appears to be tectonically thickened (possibly in asscciation with a fault), the following minerals were observed: magnetite, pyrite, chalcopyrite, chlorite and fibrous actinolite (asbestos). Mason reports that this level continues to the east past Oter elv as a double layer of pyrite impregnation.

As noted previously, the graphite schist towards the top of the Furulund schist contains minor pyrite.

Some minor rust and chloritization were observed at a level above the upper schist band.

Quantitative details of mineralized localities are given in the Appendix.

6. CONCLUSION

Much has been said by Wilson and Mason on the origin and history of the Sulitjelma Amphibolite and associated rocks, and little can be added here. The equivalent rocks to the east into Sweden are reported as pillow lavas. No convincing pillow structures were seen within the area covered by this work, but at one or two localities in the east, possible pillow structures were observed in fine-grained massive amphibolites.

Economically the area is not promising. The only previously known mineralized horizon dies out rapidly to the east, and the new levels found do not appear to have any value.

The work was carried out in conjunction with a reconnaissance VLF Survey (Project 7.504/C) and a detailed geochemical sampling programme (Project 7.504/B) in the NW of the area. Also a detailed VLF Survey was carried out to the SW in areas previously mapped in detail along the Gudrun and Holmsen ore levels (Project 7.504/D). Only the results of the reconnaissance VLF work are available at the time of writing, and these are generally in good accord with the results of the mapping.

The only occurrence of ore in economic quantities at present thought possible, is in the down-dip extension of the upper chlorite breccia (the base of the flaser gabbro) under Duoldagop. This possibility can only be tested by drilling and deep geophysical work.

A study is also recommended of the continuation to the east of the lower chlorite breccia at the base of the Sulitjelma Amphibolite.

LOCALITY	THICKNESS	ORIENTATION	TOTAL ORE MINERALS	ORE MINERAL PROPORTIONS		OXIDATION VALUE 04R48	NOTES
A	3 m	110°/30° NE	5 %	pyrite chalcopyrite	80 % 20 %	R6	chlorite breccia underlain by R3 schistose amphibolite with minor pyrite
B	1.5 m	105°/40° NE	2 %	pyrite	100 %	R4	same horizon as A
C	20 cm	088°/40° NE	<1 %	pyrite	100 %	R3	same horizon as A
D	2 m	060°/42° NE	3 %	pyrite	100 %	R4	some chlorite present
E	3m	060°/50° NE	2 %	pyrite	100 %	R5	schistose amphibolite overlying a 5m nodular amphibolite.
F	10m	080°/30° NE	1 %	pyrite	100 %	R4	10% chlorite
G	4 m	120°/45° NE	10%	pyrite chalcopyrite magnetite actinolite	40% 10 % 45% 5 %	R5	chlorite breccia . malachite staining seen at this locality only.
H	4m	137°/43° NE	1%	pyrite chalcopyrite	90 % 10 %	R3	same horizon ar G, but here more diffuse and with lesr chlorite.

Y 34000 Y 32000 Y 30000 Y 28000

X1019000

X1017500

X 1016 000

X 1014 000

EG 214	EH 214	EJ 214
EG 213	EH 213	EJ 213
EG 212	EH 212	EJ 212

Tegn. JOH	15/10 -75	
Trac. "	"	
Ktr. TSH		

A/S SULITJELMA GRUBER
PROSPEKTERING 1975
PROSJEKT 7.504/A

SULITJELMA M 1:10000 EKV. 10 M
FJELD GRUBE ÖST
geologisk kart

KEY

- 999.5 Lapphelleren Schists
- 999.180 Flaser Gabbro (coarse texture)
- 999.180 Flaser Gabbro (rodded texture)
- 101.9 Flaser Gabbro (fine texture)
- 999.245 undifferentiated Sulitjelma Amphibolite
- 999.245 metaporphyritic Sulitjelma Amphibolite
- 999.245 nodular Sulitjelma Amphibolite
- 999.230 schistose Sulitjelma Amphibolite
- 999.25 banded Sulitjelma Amphibolite
- geological boundary (with outcrop)
- geological boundary (without outcrop)
- geological boundary (inferred)
- geological boundary (gradational)
- drift boundary
- VLF baseline (Prosjekt 7.504/c)

- 101.6 calcareous Sulitjelma Amphibolite
- 999.89 mica schist
- 999.21 garnet - biotite - graphite schist
- 999.160 calcareous conglomerate
- 999.70 chlorite breccia
- 101.7 mineralized schist
- 101.35 Furulund schist
- 999.9 graphite schist
- 101.5 drift
- fault
- thrust
- strike and dip of bedding
- mineralized locality (see appendix)
- planned tunnel (Sulitjelma Kraft)

012.024

A/S Sulitjelma Gruber
Prospektering 1975
Prosjekt 7.504/A
Feltrapport

TSH/JBH/KH
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This name was given by Wilson to a rock type found in Ciken elv in association with a mineralized horizon. The rock consists of lens and bands of amphibolite of widely differing composition and grain size, between 1 mm and 3 cm thick, with very little or no matrix material. Where present, the matrix appears slightly calcareous. Nodular amphibolite also occurs immediately below, and also above, the calcareous conglomerate on the opposite side of the cwm.

E. Calcareous amphibolite and calcareous conglomerate

The calcareous amphibolite consists of elongate lenses of fine-grained amphibolite, 10-20 cm long set in an orange-brown calcareous matrix. Frequently the calcareous content is lower, and it merely forms lenses and partings in an otherwise massive or schistose fine-grained amphibolite. The calcareous material is invariably preferentially weathered out. In two cases such a calcareous amphibolite occurs as the continuation of a mineralized horizon, viz. the eastward extension of the Børgestol level (studied under Project 7.402/E), and the westward continuation of the mineralized level at the base of the amphibolite in the Oter elv section. An extreme variety of this rock type is the calcareous conglomerate observed at two localities below the upper schist band. This rock itself is possibly related to the nodular amphibolite, judging by the field relations observed. It is uniformly brown in clour and is a paraconglomerate with clast size ranging from 5 mm to 20 cm.

F. Mica schist

Two thick and persistent schist bands occur within the Sulitjelma Amphibolite. The composition of the schist is variable, but a light grey mica shist is typical. Mason reports a sheared pegmatite in the lower band near Otervann. Exposure is poor in this southern band, which was partly mapped under Project 7.402/E, due to considerable drift and permanent snow. Parts of the northern band are better exposed, but again preferential weathering has led to a drift-filled valley. At the western end of the upper band a persistent strongly folded psammite band occurs. Also in this band are two thin rust-weathered garnet-biotite-graphite schist, which can be traced in part to Otervann. Although graphite is not abundant in these bands, it has been adequate to create a notable anomaly on the VLF trace. The upper schist band appears to thin considerably to the west, while the lower one runs out into the Furulund Schist, where the lower amphibolite band dies out. In fact, the petrography of the schist within the amphibolite is indistinguishable in the field from parts of the Furulund Schist.

C. Flaser gabbro

Mason used the field term "dioritic gneiss" for this unit, which he considered to be a tectonised junction unit between two major nappes. The unit thickens eastwards from the waterfall zone, and its upper limit was not mapped in the east where Mason reports complex relations with Furulund Granite, the Sulitjelma Gabbro and other rock types. Typically, this rock type contains large, irregular sub-rounded blocks of coarse-grained amphibolite up to 2 m in size, in a matrix of fine-grained banded amphibolite, in which the banding is very irregular and tends to follow the outline of the clasts. This matrix often shows, in part, a rusty orange weathering colour. The feldspar content of the blocks is generally higher than in other coarse-grained amphibolites lower in the formation. Sometimes a mineral lineation may be seen, but the texture is fairly equigranular.

In the west the breccia texture is not so evident and the flaser gabbro here was mapped in the field as a massive coarse grained amphibolite. The change to the east is a gradational one with the presence of a matrix becoming increasingly apparent, and there is no question of there being two distinct units. The lower contact of the main body of the flaser gabbro is marked by a persistent chlorite breccia band which is up to 4 m thick and mineralized in the west, reducing to 10 cm without mineralization in the east, where it fades out at the junction with the metaporphyritic amphibolite. In this area a large lens of flaser gabbro occurs below the main body, separated by discontinuous bands of schistose amphibolite and a band of fine-textured flaser gabbro (i.e. without large blocks), which latter continues to the east as a clear marker at the base of the flaser gabbro. In contrast, the lens itself has large blocks with a grain size as coarse as any seen in the unit. The western end of this lens is obscured by drift, but to the east it ends abruptly as a series of short interdigitations with the metaporphyritic amphibolite. Within the main body of the flaser gabbro a marker band of rodded amphibolite occurs. This is a coarse-grained amphibolite, not brecciated, with a strong mineral lineation in the amphiboles producing parallel elongate crystals aligned parallel with the maximum dip.

4. STRUCTURE

The structure of the whole area dips to the north-east at varying angles. The strike swings from 050^{g} in the south-west corner of the area through to a general trend of around 130^{g} in the east. The change is concentrated in two main areas, in the waterfall fault zone immediately to the east of Giken elv, and further east where the outcrop of metaporphyritic amphibolite begins. It is not clear, due to poor exposure, whether the change in strike in the first area is due to folding or faulting.

Otherwise there are no major folds in the area. Late minor flexures are present, and in places (for example in psammitic layers in the upper schist band), pre-schistosity folding is excellently displayed. Over the area the dip varies from 20° to 60°, but generally values are notably consistent with an average of 35°.

The only significant structures observed are faults. Most important are those of Wilson's "Waterfall Zone", which cross the area with a general trend of 165g. The faults observed in this work do not all coincide with those recorded by Wilson, who mapped one of these faults as extending to the SE to cut the Ny-Sulitjelma ore-body, on the basis of evidence from underground maps. No surface expression of this fault was seen. Wilson recorded movement on a number of these faults, but rust layers in the back of the gorge cut by the waterfall, were seen to be continuous across the faults, and the only fault with any significant movement lies to the west. The movement on this is apparently of the order of 100 m in a dextral sense. However, a similar surface outcrop would be obtained from a vertical throw with the eastern block showing relative downward movement. Unfortunately outcrop in the floor of the cwm is insufficient to prove or disprove fault displacement, and it is not possible to correlate with any degree of confidence the rust levels across the fault zone.

The fault which cuts the Furulund Schist/Sulitjelma Amphibolite boundary in the south, and marks the western extremity of the lowest body of amphibolite, has previously been mapped to indicate a sinistral movement. However, both above and below the amphibolite body, marker horizons (e.g. the graphite schist below) were found to be undisplaced by the fault. Moreover, the large overhanging outcrop where displacements have been recorded, shows a considerable degree of tectonism and minor mineralization, and is quite in contrast to the main amphibolite body to the east. Also a clear structural unconformity is observed beneath the overhang. This outcrop is here interpreted as a thrust block.

A series of minor faults or joints, cross the flaser gabbro in the central part of its exposure. They are aligned in parallel, with a strike of 030g and a dip of 60° to the SE. Movement was recorded on the largest of these, and this is recorded on the map. Generally these faults are clearly defined on the ground, with the western faces of the fault planes providing excellent exposure of the flaser gabbro.

5. MINERALISATION

The original purpose of the project was to investigate the eastward extension of the ore levels present at and below Fjeld Grube. However, various other levels of rust were observed and recorded. The main Fjeld Grube level was identified as the mineralized chlorite schist, which underlies the main body of the flaser gabbro. As mentioned previously, this level thins out to the east and ore minerals disappear. Lying under this chlorite breccia, but normally separated from it by a band of banded amphibolite, is a rusty and weakly mineralized band of schistose amphibolite, which also dies out to the east.

A study of the Giken elv section downstream of the waterfall, showed three more layers of rusty weathering. The first of these is a rust band within the schistose amphibolite with a little chlorite and pyrite present. There is a little amphibolite breccia in association with this band.

The second rust level is also in schistose amphibolite, but here it immediately overlies a 5 m band of nodular amphibolite, which is itself devoid of mineralization and shows no rust.

The third level is a thick (10 m) band of mixed amphibolites with considerable quantities of chlorite present in varying concentrations. Minor pyrite mineralization is present throughout as scattered crystal aggregates and small single crystals.

In the schistose amphibolite bands within the metaporphyritic amphibolite, some rusty weathering was observed on the lower slopes of Vardetoppen. However, this was very weak and impersistent and no sulphides were seen.

A chlorite breccia occurs along the lower margin of the basal amphibolite in the Oter elv section. It changes character to the west to become a calcareous breccia with minor chlorite and no sulphides. Some pyrite is present in the Oter elv section, and at a locality further west where the breccia appears to be tectonically thickened (possibly in association with a fault), the following minerals were observed: magnetite, pyrite, chalcopyrite, chlorite and fibrous actinolite (asbestos). Mason reports that this level continues to the east past Oter elv as a double layer of pyrite impregnation.

As noted previously, the graphite schist towards the top of the Furulund schist contains minor pyrite.

Some minor rust and chloritization were observed at a level above the upper schist band.

Quantitative details of mineralized localities are given in the Appendix.

6. CONCLUSION

Much has been said by Wilson and Mason on the origin and history of the Sulitjelma Amphibolite and associated rocks, and little can be added here. The equivalent rocks to the east into Sweden are reported as pillow lavas. No convincing pillow structures were seen within the area covered by this work, but at one or two localities in the east, possible pillow structures were observed in fine-grained massive amphibolites.

Economically the area is not promising. The only previously known mineralized horizon dies out rapidly to the east, and the new levels found do not appear to have any value.

The work was carried out in conjunction with a reconnaissance VLF Survey (Project 7.504/C) and a detailed geochemical sampling programme (Project 7.504/B) in the NW of the area. Also a detailed VLF Survey was carried out to the SW in areas previously mapped in detail along the Gudrun and Holmsen ore levels (Project 7.504/D). Only the results of the reconnaissance VLF work are available at the time of writing, and these are generally in good accord with the results of the mapping.

The only occurrence of ore in economic quantities at present thought possible, is in the down-dip extension of the upper chlorite breccia (the base of the flaser gabbro) under Duoldagop. This possibility can only be tested by drilling and deep geophysical work.

A study is also recommended of the continuation to the east of the lower chlorite breccia at the base of the Sulitjelma Amphibolite.

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KEY

- 999.5 Lapphelleren Schists
- 999.180 Flaser Gabbro (coarse texture)
- 999.180 Flaser Gabbro (rodded texture)
- 101.9 Flaser Gabbro (fine texture)
- 999.245 undifferentiated Sulitjelma Amphibolite
- 999.245 metaporphyritic Sulitjelma Amphibolite
- 999.245 nodular Sulitjelma Amphibolite
- 999.230 schistose Sulitjelma Amphibolite
- 999.25 banded Sulitjelma Amphibolite
- geological boundary (with outcrop)
- geological boundary (without outcrop)
- geological boundary (inferred)
- geological boundary (gradational)
- drift boundary
- VLF baseline (Prosjekt 7.504/c)

- 101.6 calcareous Sulitjelma Amphibolite
- 999.59 mica schist
- 999.21 garnet - biotite - graphite schist
- 999.160 calcareous conglomerate
- 999.70 chlorite breccia
- 101.7 mineralized schist
- 101.55 Furulund schist
- 999.9 graphite schist
- 101.5 drift
- fault
- thrust
- strike and dip of bedding
- mineralized locality (see appendix)
- planned tunnel (Sulitjelma Kraft)


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X 1017 500
X 1016 000
X 1014 000
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H-0
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