Bergvesenet

Postboks 3021, 7002 Trondheim

Rapportarkivet

Bergvesenet rapport nr	Intern Journal nr	Internt arkiv nr	Rapport lokalisering	Gradering
BV 2056				**Fortrolig**
Kommer fra ..arkiv	Ekstern rapport nr	Oversendt fra	Fortrolig pga	Fortrolig fra dato:
Sulitjelma Bergverk A/S	"553240001"			

Tittel

Geologisk kartlegging og VLF mŭling i Steinŭga, Beiardalen, Beiarn kommune.

Forfatter	Dato	Bedrift
SùYLAND-HANSEN T. HARRISON J.	1975	Sulitjelma Gruber A/S

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

Fagområde	Dokument type	Forekomster
Råstofftype	**Emneord**	

Sammendrag

Rapport fra geologisk kartlegging ved Steinŭga i Beiardalen, Beiarn kommune. Tidligere arbeider har pŭvist en del sulfidmineraliseringer med kopperkis og svovelkis. Disse opptrer i massive grönnstein og har trolig sammenheng med intens folding. En del kropper av serpentinitt fins i omrŭdet, uten at disse er petrografisk plassert. Tre profiler ble mŭlt med VLF, uten positivt resultat. Basemetall.

Geologisk kartlegging og
VLF måling i Steinåga
Beiardalen

1975

[redacted]

NR. 668-4

052.020

A/S Sulitjelma Gruber
Prospektering 1975
Prosjekt 7.517/B
Feltrapport

31.10.1975
TSH/JDH/KH

Geologisk kartlegging og VLF måling i Steinåga, Beiardalen.
Reconnaissance mapping and VLF measurement at Steinåga, Beiardalen.

Contents

Abstract

Reconnaissance mapping of an area of sulphide mineralization 20 km south from Tollå in Beiardalen was carried out together with a VLF survey. No positive results were obtained from the VLF work. The mapping has helped to define the problems and outline a basis for further exploration in the area.

1. INTRODUCTION

The Steinåga area lies in the south of Beiardalen, approximately 20 km south of Tollå, on the east side of Storåga (Beiarelven). The area contains some sulphide mineralization. Three claims are held and a shaft has previously been excavated.

The purpose of the present project was to prepare an initial report to act as a basis for later detailed mapping of the area. At the same time a VLF survey was to be carried out in attempt to further locate and define the ore-bodies.

No aerial photographs or detailed maps were available for the area, and the map is based on the grid measured out in the field for the VLF work. If completed this grid will provide ground markers on a rectilinear grid pattern at intervals of 100 m, possibly with 50 m intermediate markers. This cover will be more than adequate for detailed mapping. The numbered markers established to date are shown on the map. It must be noted that the measured intervals are of slope distance and not horizontal distance. As the contours are parallel with the base line overall, the resulting distortion will be at a minimum, and the result will be a slight increase in along-profile scale in the eastern part of the map, but with very little "shear". In addition to the numbered markers, plain markers are present at 50 m intervals between them.

The geological map is the result of 1½ days mapping and is not intended to be comprehensive. The above-mentioned mine-shaft and another mineralized locality with a claim are known in the area of P14/+50, but these were not visited during this work.

The VLF survey was carried out by O.Valla with the assistance of J.D.Harrison, who also did the mapping.

The area lies along the side of Beiardalen, where the floodplain is approx.300 m wide and lies at a height of approx.200 m a.s.l. The valley side slopes up steeply from this floodplain and the highest part mapped in the extreme east lies at approx.500 m a.s.l. The contours run generally parallel with the strike. A tributary of Storåga, Steinåga, crosses the area. This stream has large boulder floodsheets associated, deposited apparently by an annual spring flashflood due to sudden collapse of a snow dam further upstream.

Except for these floodsheets the whole area is forested with a mixture of birch and coniferous woodland, partially as plantation. However, the forest is not thick enough (except in the swamp area), to hinder access to the outcrop, which for a forest area is plentiful. The best outcrop is along Steinåga itself where, as can be seen from the map, a fairly continuous section is exposed.

On a small scale the topography illustrates the geology with the quartzites and serpentinites standing out as ridges, and mineralized levels weathered out as ditches.

2. PETROGRAPHY

The country rock at Steinåga is a vertically dipping Caledonian schist of varying composition. A number of different mineralogies were recognized with gradational boundaries. Thus at one extreme are biotite schists with amphibole-feldspar layers, and at the other extreme muscovite schists with frequent quartz layers. There appears to be a progression from more basic schists in the west to more acid in the east. The muscovite schists often appear homogeneous and finely cleaved while in the centre of the area is a large thickness of colour banded schists.

Towards the east of the succession is a zone of acid pegmatite intrusion associated with a fold belt. These pegmatites, which have distinct margins, are quartz-feldspar-muscovite rocks, the muscovite as large, thick books. In loose blocks of this material xenoliths of prefolded schist were found giving a post folding/schistosity age to these pegmatites. Within the schists at and west of this level, are a number of massive quartzites of varying thickness . It was not established whether these are lenticular or continuous.

Serpentinite bodies occur in the schists. Some of these are clearly of limited lateral extent and take the form of bosses, others appear more continuous. Possible xenoliths of schist are seen here, suggesting a late intrusion date for these ultrabasics. No actual contacts with the country rock were observed. Mineralogically these rocks contain large crystals of fibrous talc minerals, and sometimes olivine in a fine grained black groundmass, which is occasionally slightly rusty. Where olivine phenocrysts were present, there was an associated mineral lineation. One occurrence was as a 10 cm monomineralic layers of a fibrous talc mineral, concordant within the schist (P17/-30).

A number of rocks in the area are classified as greenstones. The mineralogy of all these was not investigated, but they include greenschists and one occurrence of a massive, fine-grained amphibolite. These greenstones appear to be the rock type most directly connected with mineralization. In the mineralized zones they appear as coarse-grained garnet amphibolites. Garnet may constitute up to 50% of the rock and some very large garnets (8 cm) were found. Some olivine and biotite are also present in these rocks.

3. STRUCTURE

The overall structure of the area is very uniform with strikes lying between 006^g and 035^g and dips, with few exceptions, lying in a 30^o interval about the vertical. This structure can be followed to the north and south of the area mapped. The way up of the sequence was not established here, but reference to regional work should establish this. Alternatively there may be sedimentological evidence in the form of graded bedding preserved in the schist. This possibility was not investigated.

Associated with the pegmatites mentioned above are a series of rapid dip changes. No fold closures were seen and this area is considered as a zone of tight, sheared, intruded folds. Some folding is also observed in association with the mineralization. Frequent small refolded early folds are present within the schists.

The area of the fold zone, where Steinåga cuts a gorge through cliffs, contains a number of faults, one of which extends upstream along the line of Steinåga from here. It is also probable that the lowest 300 m of the stream follows a fault, but no evidence was seen for any relative lateral movement on this fault. The previously suggested correlation of the mineralization at P17/+65 with that at P17/+105 is not supported.

4. MINERALIZATION

The mineralization occurs in the massive greenstones in the three mineralized exposures seen in the Steinåga stream section. The locality at P21/+200 is a mineralized greenschist, but a weathered out ditch alongside may have contained a more coarse-grained rock. This ditch continues to run along the boundary of the large serpentinite to the north and this raises the question of whether, as has been suggested, mineralization is associated with these rocks. A similar ditch with non-exposure is present in association with the serpentinites between P4 and P10, but no evidence of any mineralization was seen here. For the moment the only definite association of the mineralization is with the garnet amphibolites.

As can be seen in the sketches of mineralized localities the mineralization appears to be associated with folding. However, these sketches are to an extent interpretive, and the relationship between folding and mineralization must be critically studied. The mineralized zones appear to be markedly discontinuous along strike. The continuation to the north of the outcrop illustrated at P17/105, can be seen outcropping in the canyon wall of Steinåga, some 25 m from the main outcrop. Here, mineralization is considerably weaker and the structure resembles more closely large scale boudinage than folding. Hence we have boudinage within a greenstone band, as an alternative to folding, to describe the

mineralization. Of the three outcrops illustrated, two could conceivably be explained on a boudinage hypothesis. Such a hypothesis would suggest a localization of ore into discrete concentrations, but with a greater probability of limitation to one horizon than in a folded environment. Such a hypothesis would also adequately, for the moment, satisfy the observed lateral variation in mineralization within the greenstones.

The richest ores seen in the field contained 5% sulphide consisting of chalcopyrite and pyrite. These were in loose blocks at P17/+25 and an outcrop at P17/+40. However, samples have previously been taken and thick sections made for reflected light study. Details of these sections are given at Appendix A. The sections were only studied as hand specimens. Microscopic study has not been made and the descriptions given in the appendix are therefore not wholly reliable.

5. VLF SURVEY

VLF measurement was carried out along Profiles 17, 23 and 25, but the work was then abandoned due to the poor results obtained. The transmitter used was Bodø (Station JXZ) and no difficulties were experienced in reading the values. The minimum intensity points were clearly defined. However, the anomalies obtained in these profiles were not significant and did not relate to the known geology. Therefore VLF could not be used as an aid to locating ore-zones. As previous CP measurements in this terrain also failed to produce any positive results, it must be assumed that the mineralized zones are not significantly better conductors than the country rock. The results obtained from the profiles are shown at Appendix B.

6. EXPLORATION

It is intended to follow up this project with more detailed work at Steinåga. The following problems should be solved by detailed mapping.

1. The structural associations of the mineralized zones.
2. The petrographical associations of these zones, with special reference to the significance of the serpentinites.
3. The role of faults in the displacement of ore zones.
4. The lateral continuity or otherwise of the ore zones.
5. The richness and persistence of ore-concentrations.

From a practical viewpoint it is recommended that mapping should commence with detailed recording along successive profiles. This can be followed by study along strike in zones of interest. Due to the limited exposure some geochemical sampling may be advantageous, especially in the area of the ditches mentioned above, which are associated with the serpentinites and possibly with the mineralized levels.

It appears that in terms of geophysical prospecting electrical methods are unusable. Discussion of drilling programmes must await the completion of detailed mapping and an earth sampling programme.

APPENDIX A

THICK SECTIONS

SECTION	LOCALITY	TYPE OF ORE	SULPHIDE CONTENT	SULPHIDE MINERALS
S1	P17/+65	Disseminated brecciated	5 %	Pyrrhotite 80 % Chalcopyrite 20 % (Pentlandite ?)
S2	P17/+65	Finely banded	15 %	Pyrrhotite 65 % Magnetite 25 % Chalcopyrite 10 %
S3	P17/+105	Banded disseminated	25 %	Pyrrhotite 85 % Chalcopyrite 15 %
S4	P21/+200	SECTION	NOT	AVAILABLE
S5	P15/+100	Coarse disseminated	3 %	Pyrrhotite 40 % Zincblende (?) 45 % Chalcopyrite 15 %
S6	P14/+65	Massive	25 %	Pyrrhotite 70 % Chalcopyrite 25 % Pyrite 5 %
S7	P14-50/+65	SECTION	NOT	AVAILABLE

APPENDIX B

VLF RESULTS

DISTANCE	PROFILE 17 IN PHASE COMPONENT	PROFILE 17 OUT OF PHASE COMPONENT	PROFILE 23 IN PHASE COMPONENT	PROFILE 23 OUT OF PHASE COMPONENT	PROFILE 25 IN PHASE COMPONENT	PROFILE 25 OUT OF PHASE COMPONENT
0	+14	−2	+11	−2	+16	−2
+25	+15	−3	+11	−2	+12	−2
+50	+13	−2	+16	−2	+8	−1
+75	+16	−2	+16	−2	+8	−1
+100	+15	−2	+14	−2	+10	−2
+125	+18	−2	+13	−2	+12	−2
+150	+13	−2	+13	−2	+11	−2
+175	+12	−2	+12	−2	+19	−3
+200	+14	−2	+11	−2	+18	−2
+225	+16	−1	+10	−1	+15	−2
+250	+13	−1	+14	−1	+17	−2
+275	+14	−1	+15	−1	+17	−2
+300	+15	−1	+15	−1	+18	−2
+325	+16	−1	+13	−1	+16	−2
+350	+14	−1	+13	−1	+15	−2
+375	+13	−1	+12	−1	+15	−2
+400	+15	−1	+12	−1	+15	−1

APPENDIX C

HAND SPECIMENS

SPECIMEN	LOCALITY	ROCK TYPE
2	P17/+65	Garnet - Amphibolite
3	P21/+200	Mineralized greenstone
4	P9/+250	Serpentinite
5	P17/-100	Serpentinite
6 A	P17/+25	Garnet - Amphibolite
6 B	P17/+25	Mineralized garnet - amphibolite
7	P17/+40	Mineralized greenstone

STEINÅGA Beiardalen GEOLOGISK KART	Målestokk 1:5000
	Tegn. J.D.H. 29/10-75 Trac. J.D.H. Kfr. T.S.H. 1/11-75
	Erstatning for:
A/S SULITJELMA GRUBER Prospektering 1975 Prosjekt 7.517/B	Erstattet av:

Quartzite

Undifferentiated Schist

Muscovite - quartz schist

" " " with acid pegmatites

Muscovite - garnet (- biotite) schist

Biotite (- garnet - amphibole) schist

Greenstone

Mineralized greenstone

Serpentinite

Drift :— swamp

" boulder fan

" alluvial plain

P 13 Profile number

+100 Distance along profiles in metres

Grid point marked on the ground

River

Road

Drift boundary

Dip and strike of schistosity

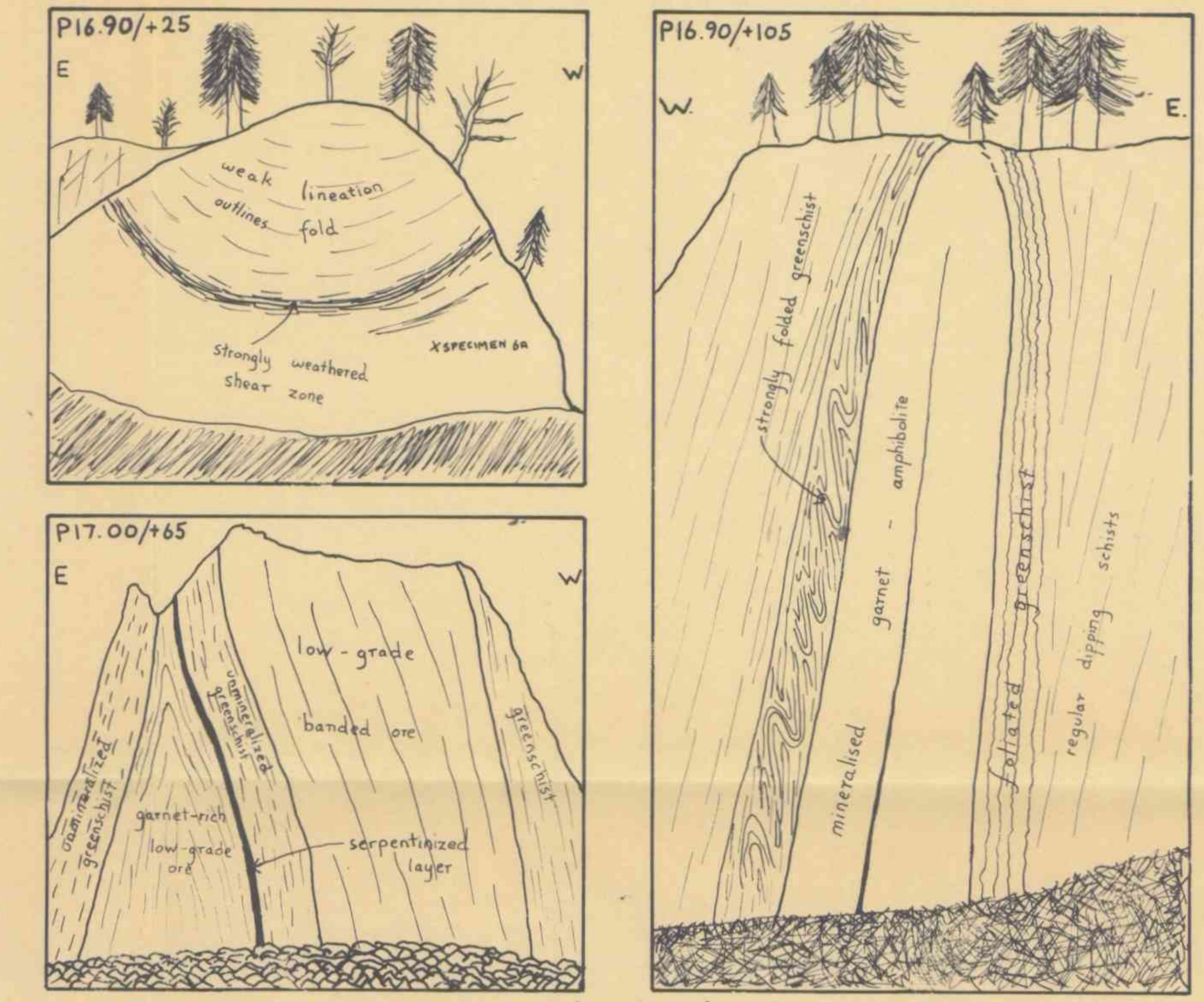
Claim

Fold belt axis

Geological boundary observed

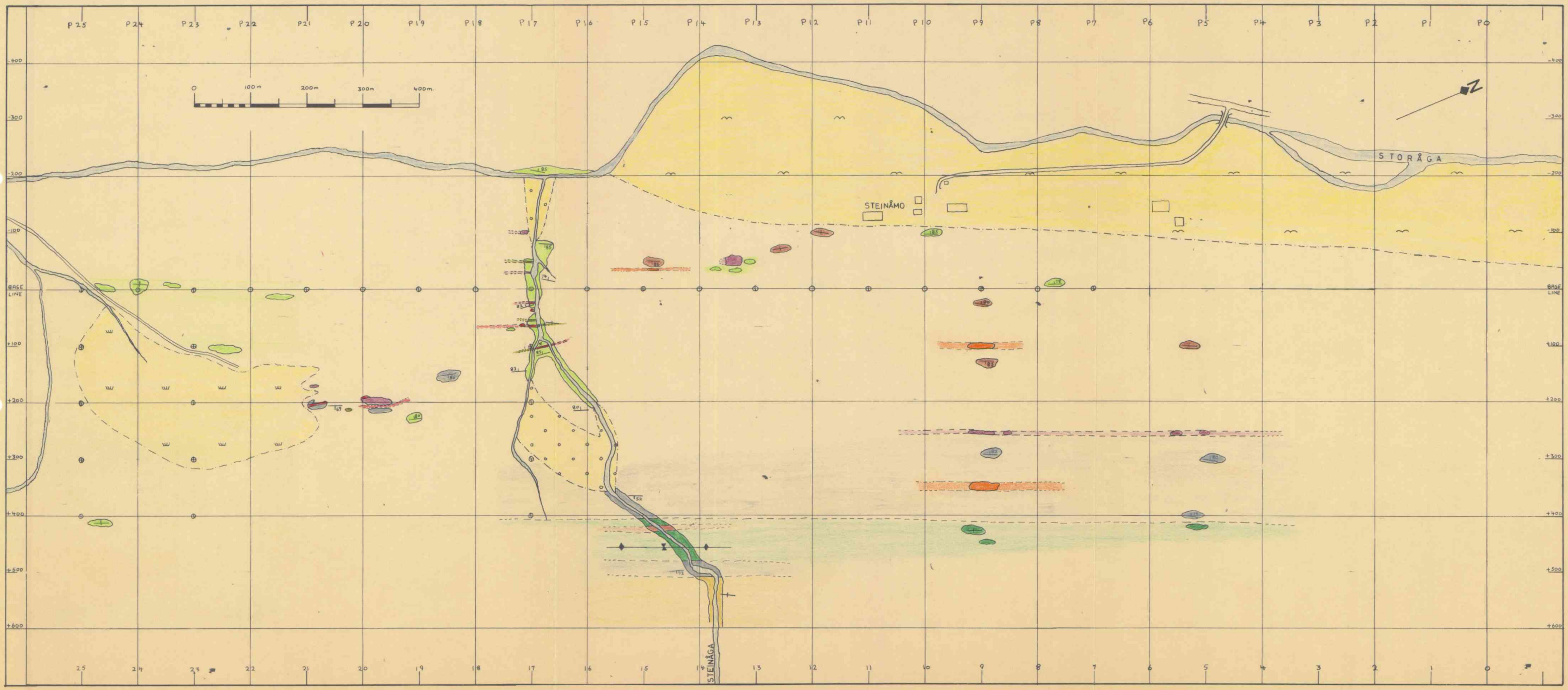
" " inferred

" " assumed



MINERALIZED LOCALITIES

SCALE. 1:100



052-020

A/S Sulitjelma Gruber
Prospektering 1975
Prosjekt 7.517/B
Feltrapport

31.10.1975
TSH/JDH/KH

Geologisk kartlegging og VLF måling i Steinåga, Beiardalen.
Reconnaissance mapping and VLF measurement at Steinåga, Beiardalen.

Contents

Abstract

Reconnaissance mapping of an area of sulphide mineralization 20 km south from Tollå in Beiardalen was carried out together with a VLF survey. No positive results were obtained from the VLF work. The mapping has helped to define the problems and outline a basis for further exploration in the area.

1. INTRODUCTION

The Steinåga area lies in the south of Beiardalen, approximately 20 km south of Tollå, on the east side of Storåga (Beiarelven). The area contains some sulphide mineralization. Three claims are held and a shaft has previously been excavated.

The purpose of the present project was to prepare an initial report to act as a basis for later detailed mapping of the area. At the same time a VLF survey was to be carried out in attempt to further locate and define the ore-bodies.

No aerial photographs or detailed maps were available for the area, and the map is based on the grid measured out in the field for the VLF work. If completed this grid will provide ground markers on a rectilinear grid pattern at intervals of 100 m, possibly with 50 m intermediate markers. This cover will be more than adequate for detailed mapping. The numbered markers established to date are shown on the map. It must be noted that the measured intervals are of slope distance and not horizontal distance. As the contours are parallel with the base line overall, the resulting distortion will be at a minimum, and the result will be a slight increase in along-profile scale in the eastern part of the map, but with very little "shear". In addition to the numbered markers, plain markers are present at 50 m intervals between them.

The geological map is the result of 1½ days mapping and is not intended to be comprehensive. The above-mentioned mine-shaft and another mineralized locality with a claim are known in the area of P14/+50, but these were not visited during this work.

The VLF survey was carried out by O.Valla with the assistance of J.D.Harrison, who also did the mapping.

The area lies along the side of Beiardalen, where the floodplain is approx.300 m wide and lies at a height of approx.200 m a.s.l. The valley side slopes up steeply from this floodplain and the highest part mapped in the extreme east lies at approx.500 m a.s.l. The contours run generally parallel with the strike. A tributary of Storåga, Steinåga, crosses the area. This stream has large boulder floodsheets associated, deposited apparently by an annual spring flashflood due to sudden collapse of a snow dam further upstream.

Except for these floodsheets the whole area is forested with a mixture of birch and coniferous woodland, partially as plantation. However, the forest is not thick enough (except in the swamp area), to hinder access to the outcrop, which for a forest area is plentiful. The best outcrop is along Steinåga itself where, as can be seen from the map, a fairly continuous section is exposed.

On a small scale the topography illustrates the geology with the quartzites and serpentinites standing out as ridges, and mineralized levels weathered out as ditches.

2. PETROGRAPHY

The country rock at Steinåga is a vertically dipping Caledonian schist of varying composition. A number of different mineralogies were recognized with gradational boundaries. Thus at one extreme are biotite schists with amphibole-feldspar layers, and at the other extreme muscovite schists with frequent quartz layers. There appears to be a progression from more basic schists in the west to more acid in the east. The muscovite schists often appear homogeneous and finely cleaved while in the centre of the area is a large thickness of colour banded schists.

Towards the east of the succession is a zone of acid pegmatite intrusion associated with a fold belt. These pegmatites, which have distinct margins, are quartz-feldspar-muscovite rocks, the muscovite as large, thick books. In loose blocks of this material xenoliths of prefolded schist were found giving a post folding/schistosity age to these pegmatites. Within the schists at and west of this level, are a number of massive quartzites of varying thickness . It was not established whether these are lenticular or continuous.

Serpentinite bodies occur in the schists. Some of these are clearly of limited lateral extent and take the form of bosses, others appear more continuous. Possible xenoliths of schist are seen here, suggesting a late intrusion date for these ultrabasics. No actual contacts with the country rock were observed. Mineralogically these rocks contain large crystals of fibrous talc minerals, and sometimes olivine in a fine grained black groundmass, which is occasionally slightly rusty. Where olivine phenocrysts were present, there was an associated mineral lineation. One occurrence was as a 10 cm monomineralic layers of a fibrous talc mineral, concordant within the schist (P17/-30).

A number of rocks in the area are classified as greenstones. The mineralogy of all these was not investigated, but they include greenschists and one occurrence of a massive, fine-grained amphibolite. These greenstones appear to be the rock type most directly connected with mineralization. In the mineralized zones they appear as coarse-grained garnet amphibolites. Garnet may constitute up to 50% of the rock and some very large garnets (8 cm) were found. Some olivine and biotite are also present in these rocks.

3. STRUCTURE

The overall structure of the area is very uniform with strikes lying between 006^g and 035^g and dips, with few exceptions, lying in a 30^{o} interval about the vertical. This structure can be followed to the north and south of the area mapped. The way up of the sequence was not established here, but reference to regional work should establish this. Alternatively there may be sedimentological evidence in the form of graded bedding preserved in the schist. This possibility was not investigated.

Associated with the pegmatites mentioned above are a series of rapid dip changes. No fold closures were seen and this area is considered as a zone of tight, sheared, intruded folds. Some folding is also observed in association with the mineralization. Frequent small refolded early folds are present within the schists.

The area of the fold zone, where Steinåga cuts a gorge through cliffs, contains a number of faults, one of which extends upstream along the line of Steinåga from here. It is also probable that the lowest 300 m of the stream follows a fault, but no evidence was seen for any relative lateral movement on this fault. The previously suggested correlation of the mineralization at P17/+65 with that at P17/+105 is not supported.

4. MINERALIZATION

The mineralization occurs in the massive greenstones in the three mineralized exposures seen in the Steinåga stream section. The locality at P21/+200 is a mineralized greenschist, but a weathered out ditch alongside may have contained a more coarse-grained rock. This ditch continues to run along the boundary of the large serpentinite to the north and this raises the question of whether, as has been suggested, mineralization is associated with these rocks. A similar ditch with non-exposure is present in association with the serpentinites between P4 and P10, but no evidence of any mineralization was seen here. For the moment the only definite association of the mineralization is with the garnet amphibolites.

As can be seen in the sketches of mineralized localities the mineralization appears to be associated with folding. However, these sketches are to an extent interpretive, and the relationship between folding and mineralization must be critically studied. The mineralized zones appear to be markedly discontinuous along strike. The continuation to the north of the outcrop illustrated at P17/105, can be seen outcropping in the canyon wall of Steinåga, some 25 m from the main outcrop. Here, mineralization is considerably weaker and the structure resembles more closely large scale boudinage than folding. Hence we have boudinage within a greenstone band, as an alternative to folding, to describe the

mineralization. Of the three outcrops illustrated, two could conceivably be explained on a boudinage hypothesis. Such a hypothesis would suggest a localization of ore into discrete concentrations, but with a greater probability of limitation to one horizon than in a folded environment. Such a hypothesis would also adequately, for the moment, satisfy the observed lateral variation in mineralization within the greenstones.

The richest ores seen in the field contained 5% sulphide consisting of chalcopyrite and pyrite. These were in loose blocks at P17/+25 and an outcrop at P17/+40. However, samples have previously been taken and thick sections made for reflected light study. Details of these sections are given at Appendix A. The sections were only studied as hand specimens. Microscopic study has not been made and the descriptions given in the appendix are therefore not wholly reliable.

5. VLF SURVEY

VLF measurement was carried out along Profiles 17, 23 and 25, but the work was then abandoned due to the poor results obtained. The transmitter used was Bodø (Station JXZ) and no difficulties were experienced in reading the values. The minimum intensity points were clearly defined. However, the anomalies obtained in these profiles were not significant and did not relate to the known geology. Therefore VLF could not be used as an aid to locating ore-zones. As previous CP measurements in this terrain also failed to produce any positive results, it must be assumed that the mineralized zones are not significantly better conductors than the country rock. The results obtained from the profiles are shown at Appendix B.

6. EXPLORATION

It is intended to follow up this project with more detailed work at Steinåga. The following problems should be solved by detailed mapping.

1. The structural associations of the mineralized zones.
2. The petrographical associations of these zones, with special reference to the significance of the serpentinites.
3. The role of faults in the displacement of ore zones.
4. The lateral continuity or otherwise of the ore zones.
5. The richness and persistence of ore-concentrations.

From a practical viewpoint it is recommended that mapping should commence with detailed recording along successive profiles. This can be followed by study along strike in zones of interest. Due to the limited exposure some geochemical sampling may be advantageous, especially in the area of the ditches mentioned above, which are associated with the serpentinites and possibly with the mineralized levels.

It appears that in terms of geophysical prospecting electrical methods are unusable. Discussion of drilling programmes must await the completion of detailed mapping and an earth sampling programme.

APPENDIX A

THICK SECTIONS

SECTION	LOCALITY	TYPE OF ORE	SULPHIDE CONTENT	SULPHIDE MINERALS
S1	P17/+65	Disseminated brecciated	5 %	Pyrrhotite 80 % Chalcopyrite 20 % (Pentlandite ?)
S2	P17/+65	Finely banded	15 %	Pyrrhotite 65 % Magnetite 25 % chalcopyrite 10 %
S3	P17/+105	Banded disseminated	25 %	Pyrrhotite 85 % Chalcopyrite 15 %
S4	P21/+200	SECTION	NOT	AVAILABLE
S5	P15/+100	Coarse disseminated	3 %	Pyrrhotite 40 % zincblende (?) 45 % Chalcopyrite 15 %
S6	P14/+65	Massive	25 %	Pyrrhotite 70 % Chalcopyrite 25 % Pyrite 5 %
S7	P14·50/+65	SECTION	NOT	AVAILABLE

APPENDIX B

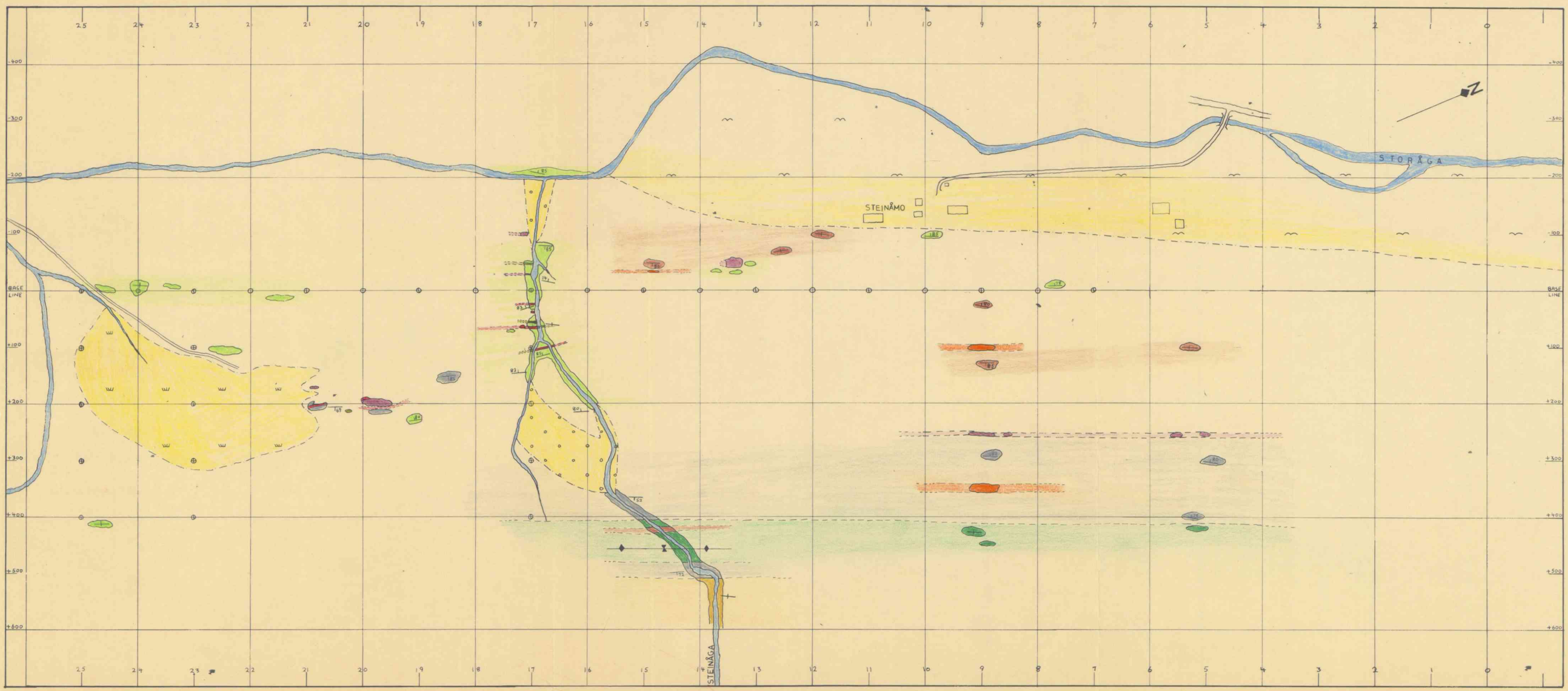
VLF RESULTS

	PROFILE 17		PROFILE 23		PROFILE 25	
DISTANCE	IN PHASE COMPONENT	OUT OF PHASE COMPONENT	IN PHASE COMPONENT	OUT OF PHASE COMPONENT	IN PHASE COMPONENT	OUT OF PHASE COMPONENT
0	+ 14	− 2	+ 11	− 2	+ 16	− 2
+ 25	+ 15	− 3	+ 11	− 2	+ 12	− 2
+ 50	+ 13	− 2	+ 16	− 2	+ 8	− 1
+ 75	+ 16	− 2	+ 16	− 2	+ 8	− 1
+ 100	+ 15	− 2	+ 14	− 2	+ 10	− 2
+ 125	+ 18	− 2	+ 13	− 2	+ 12	− 2
+ 150	+ 13	− 2	+ 13	− 2	+ 11	− 2
+ 175	+ 12	− 2	+ 12	− 2	+ 19	− 3
+ 200	+ 14	− 2	+ 11	− 2	+ 18	− 2
+ 225	+ 16	− 1	+ 10	− 1	+ 15	− 2
+ 250	+ 13	− 1	+ 14	− 1	+ 17	− 2
+ 275	+ 14	− 1	+ 15	− 1	+ 17	− 2
+ 300	+ 15	− 1	+ 15	− 1	+ 18	− 2
+ 325	+ 16	− 1	+ 13	− 1	+ 16	− 2
+ 350	+ 14	− 1	+ 13	− 1	+ 15	− 2
+ 375	+ 13	− 1	+ 12	− 1	+ 15	− 2
+ 400	+ 15	− 1	+ 12	− 1	+ 15	− 1

APPENDIX C

HAND SPECIMENS

SPECIMEN	LOCALITY	ROCK TYPE
2	P17/+65	Garnet - Amphibolite
3	P21/+200	Mineralized greenstone
4	P9/+250	Serpentinite
5	P17/-100	Serpentinite
6 A	P17/+25	Garnet - Amphibolite
6 B	P17/+25	Mineralized garnet - amphibolite
7	P17/+40	Mineralized greenstone



STEINÅMO
STORÅGA
STEINÅGA
BASE LINE
N

052-020

A/S Sulitjelma Gruber
Prospektering 1975
Prosjekt 7.517/B
Feltrapport

31.10.1975
TSH/JDH/KH

Geologisk kartlegging og VLF måling i Steinåga, Beiardalen.

Reconnaissance mapping and VLF measurement at Steinåga, Beiardalen.

Contents

Abstract

Reconnaissance mapping of an area of sulphide mineralization 20 km south from Tollå in Beiardalen was carried out together with a VLF survey. No positive results were obtained from the VLF work. The mapping has helped to define the problems and outline a basis for further exploration in the area.

1. INTRODUCTION

The Steinåga area lies in the south of Beiardalen, approximately 20 km south of Tollå, on the east side of Storåga (Beiarelven). The area contains some sulphide mineralization. Three claims are held and a shaft has previously been excavated.

The purpose of the present project was to prepare an initial report to act as a basis for later detailed mapping of the area. At the same time a VLF survey was to be carried out in attempt to further locate and define the ore-bodies.

No aerial photographs or detailed maps were available for the area, and the map is based on the grid measured out in the field for the VLF work. If completed this grid will provide ground markers on a rectilinear grid pattern at intervals of 100 m, possibly with 50 m intermediate markers. This cover will be more than adequate for detailed mapping. The numbered markers established to date are shown on the map. It must be noted that the measured intervals are of slope distance and not horizontal distance. As the contours are parallel with the base line overall, the resulting distortion will be at a minimum, and the result will be a slight increase in along-profile scale in the eastern part of the map, but with very little "shear". In addition to the numbered markers, plain markers are present at 50 m intervals between them.

The geological map is the result of 1½ days mapping and is not intended to be comprehensive. The above-mentioned mine-shaft and another mineralized locality with a claim are known in the area of P14/+50, but these were not visited during this work.

The VLF survey was carried out by O.Valla with the assistance of J.D.Harrison, who also did the mapping.

The area lies along the side of Beiardalen, where the floodplain is approx.300 m wide and lies at a height of approx.200 m a.s.l. The valley side slopes up steeply from this floodplain and the highest part mapped in the extreme east lies at approx.500 m a.s.l. The contours run generally parallel with the strike. A tributary of Storåga, Steinåga, crosses the area. This stream has large boulder floodsheets associated, deposited apparently by an annual spring flashflood due to sudden collapse of a snow dam further upstream.

Except for these floodsheets the whole area is forested with a mixture of birch and coniferous woodland, partially as plantation. However, the forest is not thick enough (except in the swamp area), to hinder access to the outcrop, which for a forest area is plentiful. The best outcrop is along Steinåga itself where, as can be seen from the map, a fairly continuous section is exposed.

On a small scale the topography illustrates the geology with the quartzites and serpentinites standing out as ridges, and mineralized levels weathered out as ditches.

2. PETROGRAPHY

The country rock at Steinåga is a vertically dipping Caledonian schist of varying composition. A number of different mineralogies were recognized with gradational boundaries. Thus at one extreme are biotite schists with amphibole-feldspar layers, and at the other extreme muscovite schists with frequent quartz layers. There appears to be a progression from more basic schists in the west to more acid in the east. The muscovite schists often appear homogeneous and finely cleaved while in the centre of the area is a large thickness of colour banded schists.

Towards the east of the succession is a zone of acid pegmatite intrusion associated with a fold belt. These pegmatites, which have distinct margins, are quartz-feldspar-muscovite rocks, the muscovite as large, thick books. In loose blocks of this material xenoliths of prefolded schist were found giving a post folding/schistosity age to these pegmatites. Within the schists at and west of this level, are a number of massive quartzites of varying thickness . It was not established whether these are lenticular or continuous.

Serpentinite bodies occur in the schists. Some of these are clearly of limited lateral extent and take the form of bosses, others appear more continuous. Possible xenoliths of schist are seen here, suggesting a late intrusion date for these ultrabasics. No actual contacts with the country rock were observed. Mineralogically these rocks contain large crystals of fibrous talc minerals, and sometimes olivine in a fine grained black groundmass, which is occasionally slightly rusty. Where olivine phenocrysts were present, there was an associated mineral lineation. One occurrence was as a 10 cm monomineralic layers of a fibrous talc mineral, concordant within the schist (P17/-30).

A number of rocks in the area are classified as greenstones. The mineralogy of all these was not investigated, but they include greenschists and one occurrence of a massive, fine-grained amphibolite. These greenstones appear to be the rock type most directly connected with mineralization. In the mineralized zones they appear as coarse-grained garnet amphibolites. Garnet may constitute up to 50% of the rock and some very large garnets (8 cm) were found. Some olivine and biotite are also present in these rocks.

3. STRUCTURE

The overall structure of the area is very uniform with strikes lying between 006^g and 035^g and dips, with few exceptions, lying in a 30^o interval about the vertical. This structure can be followed to the north and south of the area mapped. The way up of the sequence was not established here, but reference to regional work should establish this. Alternatively there may be sedimentological evidence in the form of graded bedding preserved in the schist. This possibility was not investigated.

Associated with the pegmatites mentioned above are a series of rapid dip changes. No fold closures were seen and this area is considered as a zone of tight, sheared, intruded folds. Some folding is also observed in association with the mineralization. Frequent small refolded early folds are present within the schists.

The area of the fold zone, where Steinåga cuts a gorge through cliffs, contains a number of faults, one of which extends upstream along the line of Steinåga from here. It is also probable that the lowest 300 m of the stream follows a fault, but no evidence was seen for any relative lateral movement on this fault. The previously suggested correlation of the mineralization at P17/+65 with that at P17/+105 is not supported.

4. MINERALIZATION

The mineralization occurs in the massive greenstones in the three mineralized exposures seen in the Steinåga stream section. The locality at P21/+200 is a mineralized greenschist, but a weathered out ditch alongside may have contained a more coarse-grained rock. This ditch continues to run along the boundary of the large serpentinite to the north and this raises the question of whether, as has been suggested, mineralization is associated with these rocks. A similar ditch with non-exposure is present in association with the serpentinites between P4 and P10, but no evidence of any mineralization was seen here. For the moment the only definite association of the mineralization is with the garnet amphibolites.

As can be seen in the sketches of mineralized localities the mineralization appears to be associated with folding. However, these sketches are to an extent interpretive, and the relationship between folding and mineralization must be critically studied. The mineralized zones appear to be markedly discontinuous along strike. The continuation to the north of the outcrop illustrated at P17/105, can be seen outcropping in the canyon wall of Steinåga, some 25 m from the main outcrop. Here, mineralization is considerably weaker and the structure resembles more closely large scale boudinage than folding. Hence we have boudinage within a greenstone band, as an alternative to folding, to describe the

mineralization. Of the three outcrops illustrated, two could conceivably be explained on a boudinage hypothesis. Such a hypothesis would suggest a localization of ore into discrete concentrations, but with a greater probability of limitation to one horizon than in a folded environment. Such a hypothesis would also adequately, for the moment, satisfy the observed lateral variation in mineralization within the greenstones.

The richest ores seen in the field contained 5% sulphide consisting of chalcopyrite and pyrite. These were in loose blocks at P17/+25 and an outcrop at P17/+40. However, samples have previously been taken and thick sections made for reflected light study. Details of these sections are given at Appendix A. The sections were only studied as hand specimens. Microscopic study has not been made and the descriptions given in the appendix are therefore not wholly reliable.

5. VLF SURVEY

VLF measurement was carried out along Profiles 17, 23 and 25, but the work was then abandoned due to the poor results obtained. The transmitter used was Bodø (Station JXZ) and no difficulties were experienced in reading the values. The minimum intensity points were clearly defined. However, the anomalies obtained in these profiles were not significant and did not relate to the known geology. Therefore VLF could not be used as an aid to locating ore-zones. As previous CP measurements in this terrain also failed to produce any positive results, it must be assumed that the mineralized zones are not significantly better conductors than the country rock. The results obtained from the profiles are shown at Appendix B.

6. EXPLORATION

It is intended to follow up this project with more detailed work at Steinåga. The following problems should be solved by detailed mapping.

1. The structural associations of the mineralized zones.
2. The petrographical associations of these zones, with special reference to the significance of the serpentinites.
3. The role of faults in the displacement of ore zones.
4. The lateral continuity or otherwise of the ore zones.
5. The richness and persistence of ore-concentrations.

From a practical viewpoint it is recommended that mapping should commence with detailed recording along successive profiles. This can be followed by study along strike in zones of interest. Due to the limited exposure some geochemical sampling may be advantageous, especially in the area of the ditches mentioned above, which are associated with the serpentinites and possibly with the mineralized levels.

It appears that in terms of geophysical prospecting electrical methods are unusable. Discussion of drilling programmes must await the completion of detailed mapping and an earth sampling programme.

APPENDIX A

THICK SECTIONS

SECTION	LOCALITY	TYPE OF ORE	SULPHIDE CONTENT	SULPHIDE MINERALS
S1	P17/+65	Disseminated brecciated	5 %	Pyrrhotite 80% Chalcopyrite 20% (Pentlandite ?)
S2	P17/+65	Finely banded	15 %	Pyrrhotite 65% Magnetite 25% Chalcopyrite 10%
S3	P17/+105	Banded disseminated	25 %	Pyrrhotite 85% Chalcopyrite 15%
S4	P21/+200	SECTION	NOT	AVAILABLE
S5	P15/+100	Coarse disseminated	3 %	Pyrrhotite 40% Zincblende (?) 45% Chalcopyrite 15%
S6	P14/+65	Massive	25 %	Pyrrhotite 70% Chalcopyrite 25% Pyrite 5%
S7	P14·50/+65	SECTION	NOT	AVAILABLE

APPENDIX B

VLF RESULTS

DISTANCE	PROFILE 17		PROFILE 23		PROFILE 25	
	IN PHASE COMPONENT	OUT OF PHASE COMPONENT	IN PHASE COMPONENT	OUT OF PHASE COMPONENT	IN PHASE COMPONENT	OUT OF PHASE COMPONENT
0	+ 14	− 2	+ 11	− 2	+ 16	− 2
+ 25	+ 15	− 3	+ 11	− 2	+ 12	− 2
+ 50	+ 13	− 2	+ 16	− 2	+ 8	− 1
+ 75	+ 16	− 2	+ 16	− 2	+ 8	− 1
+ 100	+ 15	− 2	+ 14	− 2	+ 10	− 2
+ 125	+ 18	− 2	+ 13	− 2	+ 12	− 2
+ 150	+ 13	− 2	+ 13	− 2	+ 11	− 2
+ 175	+ 12	− 2	+ 12	− 2	+ 19	− 3
+ 200	+ 14	− 2	+ 11	− 2	+ 18	− 2
+ 225	+ 16	− 1	+ 10	− 1	+ 15	− 2
+ 250	+ 13	− 1	+ 14	− 1	+ 17	− 2
+ 275	+ 14	− 1	+ 15	− 1	+ 17	− 2
+ 300	+ 15	− 1	+ 15	− 1	+ 18	− 2
+ 325	+ 16	− 1	+ 13	− 1	+ 16	− 2
+ 350	+ 14	− 1	+ 13	− 1	+ 15	− 2
+ 375	+ 13	− 1	+ 12	− 1	+ 15	− 2
+ 400	+ 15	− 1	+ 12	− 1	+ 15	− 1

APPENDIX C

HAND SPECIMENS

SPECIMEN	LOCALITY	ROCK TYPE
2	P17/+65	Garnet - Amphibolite
3	P21/+200	Mineralized greenstone
4	P9/+250	Serpentinite
5	P17/-100	Serpentinite
6 A	P17/+25	Garnet - Amphibolite
6 B	P17/+25	Mineralized garnet-amphibolite
7	P17/+40	Mineralized greenstone

STEINÅGA

Beiardalen

GEOLOGISK KART

A/S SULITJELMA GRUBER
Prospektering 1975
Prosjekt 7.517/B

Målestokk			
1:5000	Tegn.	J.D.H.	29/10-75
	Trac.	J.D.H.	
	Kfr.	T.S.H.	1/11-75

Erstatning for:

Erstattet av:

Quartzite

Undifferentiated Schist

Muscovite - quartz schist

" " " with acid pegmatites

Muscovite - garnet (- biotite) schist

Biotite (- garnet - amphibole) schist

Greenstone

Mineralized greenstone

Serpentinite

Drift: — swamp

" boulder fan

" alluvial plain

P 13 Profile number

+100 Distance along profiles in metres

Grid point marked on the ground

River

Road

Drift boundary

Dip and strike of schistosity

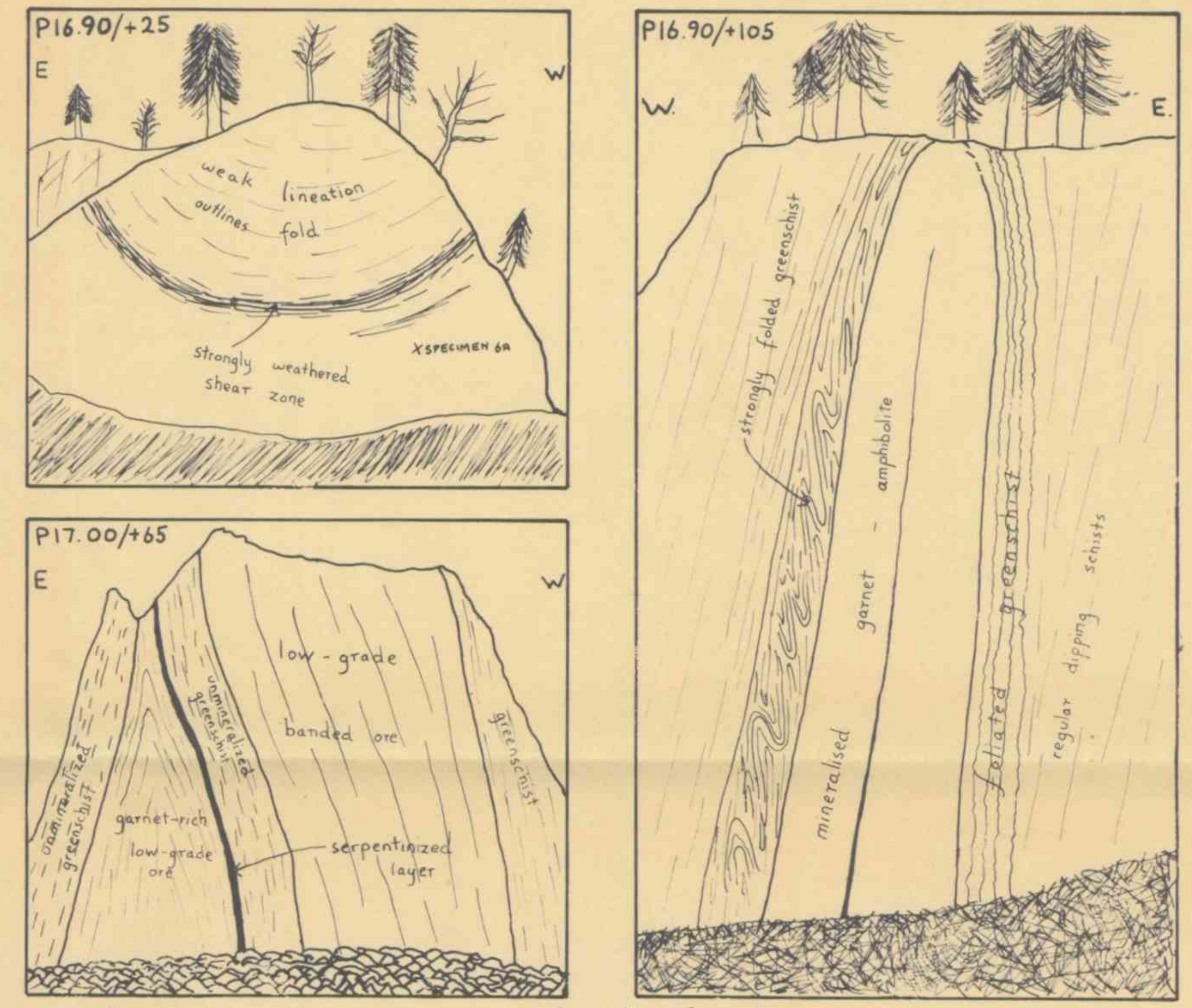
Claim

Fold belt axis

Geological boundary observed

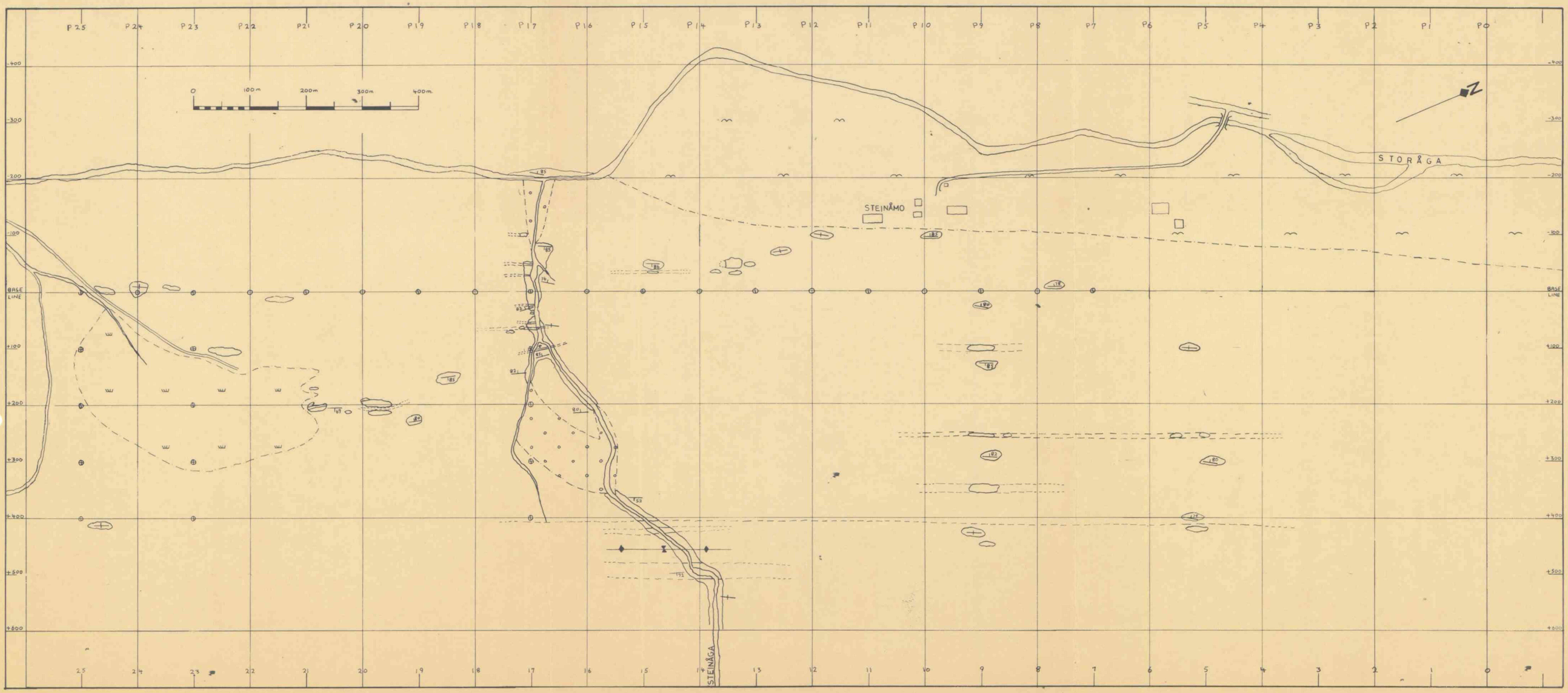
" " inferred

" " assumed



MINERALIZED LOCALITIES

SCALE 1:100



052.020

A/S Sulitjelma Gruber
Prospektering 1975
Prosjekt 7.517/B
Feltrapport

31.10.1975
TSH/JDH/KH

Geologisk kartlegging og VLF måling i Steinåga, Beiardalen.
Reconnaissance mapping and VLF measurement at Steinåga, Beiardalen.

Contents

Abstract

Reconnaissance mapping of an area of sulphide mineralization 20 km south from Tollå in Beiardalen was carried out together with a VLF survey. No positive results were obtained from the VLF work. The mapping has helped to define the problems and outline a basis for further exploration in the area.

1. INTRODUCTION

The Steinåga area lies in the south of Beiardalen, approximately 20 km south of Tollå, on the east side of Storåga (Beiarelven). The area contains some sulphide mineralization. Three claims are held and a shaft has previously been excavated.

The purpose of the present project was to prepare an initial report to act as a basis for later detailed mapping of the area. At the same time a VLF survey was to be carried out in attempt to further locate and define the ore-bodies.

No aerial photographs or detailed maps were available for the area, and the map is based on the grid measured out in the field for the VLF work. If completed this grid will provide ground markers on a rectilinear grid pattern at intervals of 100 m, possibly with 50 m intermediate markers. This cover will be more than adequate for detailed mapping. The numbered markers established to date are shown on the map. It must be noted that the measured intervals are of slope distance and not horizontal distance. As the contours are parallel with the base line overall, the resulting distortion will be at a minimum, and the result will be a slight increase in along-profile scale in the eastern part of the map, but with very little "shear". In addition to the numbered markers, plain markers are present at 50 m intervals between them.

The geological map is the result of 1½ days mapping and is not intended to be comprehensive. The above-mentioned mine-shaft and another mineralized locality with a claim are known in the area of P14/+50, but these were not visited during this work.

The VLF survey was carried out by O.Valla with the assistance of J.D.Harrison, who also did the mapping.

The area lies along the side of Beiardalen, where the floodplain is approx.300 m wide and lies at a height of approx.200 m a.s.l. The valley side slopes up steeply from this floodplain and the highest part mapped in the extreme east lies at approx.500 m a.s.l. The contours run generally parallel with the strike. A tributary of Storåga, Steinåga, crosses the area. This stream has large boulder floodsheets associated, deposited apparently by an annual spring flashflood due to sudden collapse of a snow dam further upstream.

Except for these floodsheets the whole area is forested with a mixture of birch and coniferous woodland, partially as plantation. However, the forest is not thick enough (except in the swamp area), to hinder access to the outcrop, which for a forest area is plentiful. The best outcrop is along Steinåga itself where, as can be seen from the map, a fairly continuous section is exposed.

On a small scale the topography illustrates the geology with the quartzites and serpentinites standing out as ridges, and mineralized levels weathered out as ditches.

2. PETROGRAPHY

The country rock at Steinåga is a vertically dipping Caledonian schist of varying composition. A number of different mineralogies were recognized with gradational boundaries. Thus at one extreme are biotite schists with amphibole-feldspar layers, and at the other extreme muscovite schists with frequent quartz layers. There appears to be a progression from more basic schists in the west to more acid in the east. The muscovite schists often appear homogeneous and finely cleaved while in the centre of the area is a large thickness of colour banded schists.

Towards the east of the succession is a zone of acid pegmatite intrusion associated with a fold belt. These pegmatites, which have distinct margins, are quartz-feldspar-muscovite rocks, the muscovite as large, thick books. In loose blocks of this material xenoliths of prefolded schist were found giving a post folding/schistosity age to these pegmatites. Within the schists at and west of this level, are a number of massive quartzites of varying thickness . It was not established whether these are lenticular or continuous.

Serpentinite bodies occur in the schists. Some of these are clearly of limited lateral extent and take the form of bosses, others appear more continuous. Possible xenoliths of schist are seen here, suggesting a late intrusion date for these ultrabasics. No actual contacts with the country rock were observed. Mineralogically these rocks contain large crystals of fibrous talc minerals, and sometimes olivine in a fine grained black groundmass, which is occasionally slightly rusty. Where olivine phenocrysts were present, there was an associated mineral lineation. One occurrence was as a 10 cm monomineralic layers of a fibrous talc mineral, concordant within the schist (P17/-30).

A number of rocks in the area are classified as greenstones. The mineralogy of all these was not investigated, but they include greenschists and one occurrence of a massive, fine-grained amphibolite. These greenstones appear to be the rock type most directly connected with mineralization. In the mineralized zones they appear as coarse-grained garnet amphibolites. Garnet may constitute up to 50% of the rock and some very large garnets (8 cm) were found. Some olivine and biotite are also present in these rocks.

3. STRUCTURE

The overall structure of the area is very uniform with strikes lying between 006^g and 035^g and dips, with few exceptions, lying in a 30^o interval about the vertical. This structure can be followed to the north and south of the area mapped. The way up of the sequence was not established here, but reference to regional work should establish this. Alternatively there may be sedimentological evidence in the form of graded bedding preserved in the schist. This possibility was not investigated.

Associated with the pegmatites mentioned above are a series of rapid dip changes. No fold closures were seen and this area is considered as a zone of tight, sheared, intruded folds. Some folding is also observed in association with the mineralization. Frequent small refolded early folds are present within the schists.

The area of the fold zone, where Steinåga cuts a gorge through cliffs, contains a number of faults, one of which extends upstream along the line of Steinåga from here. It is also probable that the lowest 300 m of the stream follows a fault, but no evidence was seen for any relative lateral movement on this fault. The previously suggested correlation of the mineralization at P17/+65 with that at P17/+105 is not supported.

4. MINERALIZATION

The mineralization occurs in the massive greenstones in the three mineralized exposures seen in the Steinåga stream section. The locality at P21/+200 is a mineralized greenschist, but a weathered out ditch alongside may have contained a more coarse-grained rock. This ditch continues to run along the boundary of the large serpentinite to the north and this raises the question of whether, as has been suggested, mineralization is associated with these rocks. A similar ditch with non-exposure is present in association with the serpentinites between P4 and P10, but no evidence of any mineralization was seen here. For the moment the only definite association of the mineralization is with the garnet amphibolites.

As can be seen in the sketches of mineralized localities the mineralization appears to be associated with folding. However, these sketches are to an extent interpretive, and the relationship between folding and mineralization must be critically studied. The mineralized zones appear to be markedly discontinuous along strike. The continuation to the north of the outcrop illustrated at P17/105, can be seen outcropping in the canyon wall of Steinåga, some 25 m from the main outcrop. Here, mineralization is considerably weaker and the structure resembles more closely large scale boudinage than folding. Hence we have boudinage within a greenstone band, as an alternative to folding, to describe the

mineralization. Of the three outcrops illustrated, two could conceivably be explained on a boudinage hypothesis. Such a hypothesis would suggest a localization of ore into discrete concentrations, but with a greater probability of limitation to one horizon than in a folded environment. Such a hypothesis would also adequately, for the moment, satisfy the observed lateral variation in mineralization within the greenstones.

The richest ores seen in the field contained 5% sulphide consisting of chalcopyrite and pyrite. These were in loose blocks at P17/+25 and an outcrop at P17/+40. However, samples have previously been taken and thick sections made for reflected light study. Details of these sections are given at Appendix A. The sections were only studied as hand specimens. Microscopic study has not been made and the descriptions given in the appendix are therefore not wholly reliable.

5. VLF SURVEY

VLF measurement was carried out along Profiles 17, 23 and 25, but the work was then abandoned due to the poor results obtained. The transmitter used was Bodø (Station JXZ) and no difficulties were experienced in reading the values. The minimum intensity points were clearly defined. However, the anomalies obtained in these profiles were not significant and did not relate to the known geology. Therefore VLF could not be used as an aid to locating ore-zones. As previous CP measurements in this terrain also failed to produce any positive results, it must be assumed that the mineralized zones are not significantly better conductors than the country rock. The results obtained from the profiles are shown at Appendix B.

6. EXPLORATION

It is intended to follow up this project with more detailed work at Steinåga. The following problems should be solved by detailed mapping.

1. The structural associations of the mineralized zones.
2. The petrographical associations of these zones, with special reference to the significance of the serpentinites.
3. The role of faults in the displacement of ore zones.
4. The lateral continuity or otherwise of the ore zones.
5. The richness and persistence of ore-concentrations.

From a practical viewpoint it is recommended that mapping should commence with detailed recording along successive profiles. This can be followed by study along strike in zones of interest. Due to the limited exposure some geochemical sampling may be advantageous, especially in the area of the ditches mentioned above, which are associated with the serpentinites and possibly with the mineralized levels.

It appears that in terms of geophysical prospecting electrical methods are unusable. Discussion of drilling programmes must await the completion of detailed mapping and an earth sampling programme.