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Tittel

Geological report on the Hopen-copper-mine area. Hopen Kopper

Forfatter	Dato	Bedrift
MASON H.	1967	Sulitjelma Gruber A/S

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

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Råstofftype	**Emneord**	

Sammendrag

Undersokelse med tanke pa dannelsen, stratigrafisk og strukturell situasjon til koppermalmene i Hopen - omradet, kartblad Bodo og Loding. Stratigrafien er delt i Saura -gruppen nederst, sa Bodô -gruppen og intrusiver. Mellom Saura- og Bodo-gruppen er det en strukturell grense. Utgaende av malmsonen er svaert spredt og uregelmessig pga.hog tektonisk pavirkning. Trolig er malmene av hydrotermal intrusiv opprinnelse og har trengt inn i Bodo-gruppens bergarter langs eksisterende strukturer.

Geological report on the Hopen copper mine area.

H. Mason
1967

GEOLOGICAL REPORT ON THE HOPEN COPPER MINE AREA

H. MASON, Sulitjelma, 25th of September 1967.

A.M.S. Maps - Bodø - Løding (486 E - 490 E/ 7473 N - 7467 N approx.)

INTRODUCTION:

The work was undertaken from September 5th to 23rd on A.M.S. 1:50 000 maps. There were roughly enlarged to 1:25 000 to make room for additional structural data. Positioning was found to be difficult, as the terrain is physically difficult (Pine forrest and Mountain) and the map is not too correct.

Aerial photographs were not available until the work was finished, and therefore the exact positioning of fold closures and outcrop and the correct representation of their geometry was not possible. The structural overlay and cross-sections are therefore meant to be approximatious and are not drawn for exact drilling measurements to be taken. The map was copied on to 1:16 666' enlargements to the A.M.S. 1:50 000 purely for representations purposes.

The main problem was the mode of formation of, the stratigraphic level of, and the structural position of the copper ore units. It is hoped that this is in part fulfilled.

STRATIGRAPHY:

The stratigraphy is as in fig. I namely:

Intrusives	Granite Gneiss	(White feldspar - mica - quartz + garnets)
	Copper Ore unit	(Chalcopyrite?)
	Quartz vein units	(White quartz - pure?)
Bodø Group	Marble units	(White marbles - pure)
	Garnet schist units	(Red garnet + grey schistore matric)
	Quartzite units	(Dull grey colour + occasional garnets)
	Hornblende/Mica schist units	(Green-black schist) + gtz eyes in lower part.

---------- structural disconformity - slide?

Saura group { Hornblende/Mica schist units (Green-black schist) +gtz eyes.
Impure units (Blue marbles.)

I SAURA GROUP:

Structurally this group is the lowest and it is therefore convenient to take it as the lowest in a atratigraphic sense in the oldest, but since it is separated from the upper Bodø group by a structural disconformity it could be younger or equal in age to that group.

The group consists of impure marbles with thin semi-pelitic bands cut by semi bo dened granitic veins (1 cm - 10 cm) width. Contained within these marbles are two units of Hornblende/Mica schists, the upper unit containing subordinate phyllites. The general strike is so that these units cut into the Upper Bodø Group and it is therefore concluded that there is a structural disconformity between the two groups. It is possible, however, that the group as a whole thins towards the North.

The junction Saura Marble/Bodø hornblende/Mica schists is visible in one place and shows a prominant schistosity-bedding interection although no grat dislocation signs are visible, the junction being quite "clean" and sharp. Drag? folds are visible in the lower marble unit and the actual junction appears folded.(Below Bratfjeld (I) Mine.)

The schistosity in the Saura Group appeares to be parallel to bedding, minor folds of schistosity are rare in the marble, but comon in the schist units - the marble appearing to have flowed rather than folded. The sudden appearance of large thickness of schist within the marble units suggests folding but careful examination of the "rore" areas gives no evidence of it, although exposure is not good.

Quartz veins (very large) cut the schist units in the north. Granitic veins as mentioned cut both marble + schist - in a general NE,SW direction.

II BODØ GROUP

This group structurally overlies the Saura Group and is separated from it by the structural disconformity. (The Hopen slide of Nicholsen + Rutland). The main rock unit is the green-black Hornblende/Mica schist unit, which contains within it a subordinate quartzite and several garnet schists with garnets varying from 1 - 2 mm up to 1 cm in size. Above these included units lies a very pure marble unit which lies below another marble unit (less pure).

The junction H/M schist and garnet schist is quite sharp in all cases and it is therefore concluded that they represent an original chemical difference in the rock units prior to metamorphism.

The H/M schist also contains a few very thin discontinous buff-yellow coloured marbles (1-3 cm wide, 2 m long) and quartz eye - both folded.

The rock show a prominant schistosity -bedding interection in several places, but in others, notably the H/M schist - pure marble junction on Hopsfjell, the schistosity is parallel to the bedding. The reason for this is probably that several sets of conflicting schistosities have developed during the deformation history of this unit. (F_1 + F_{2a} + F_3 according to Rutland and Nicholsen) the main schistosity, however , is not parallel to bedding and it is this (F_{2a}?) schistosity which has been mapped (see structural overlay). However, the folding is complex abd it is possible that one of the other schistosities has been picked up here and there. Minor schistosity folds are very common in the garnet schist and in the H/M schist. The junction of these two units is also completely folded. Minor folds (of schistosity) are not common in the marble which appears to have flowed - as in the case of the Saura Marble. The junction of the marble and H/M schists is in general not comlete.

The Bodø Group is cut by granitic veins (30 m width and in the north a large off of the granite gneiss (50 m thick approx.) gives rise to smaller feeder veinlets of granitic material. Several larger 30 m dykes appear to be cut by this larger unit.

These relations are thought to represent a complex intrusive history of the granite gneiss.

Quartz veins, up to 2 m thick cut the H/M schist and garnet schist units. The quartz and granitic veins are virtually unfolded.

The copper ore unit cuts the H/M schist unit in the Storfjell Mine, in the Tusvann mine it is approximately parallell to the general schistosity ($F_{2a?}$) but shows complex relations with a pegmatitic fraction (Chlorite-garnet-feldspar?) the Cu ore unit is folded in several outcrops and in the Hopsflell Mine and Bratfjell (I) Mine, The intrusion of copper into the Bodø group is therefore thought to have been prior to (F_{2a}) or main schistosity folding.
NB. For more detailed discussion of Copper Ore Unit see copper ore unit IV.

INTRUSIVES.

III QUARTZ.

The major quartz veins are intruded into both Saura and Bodø groups. They are virtually unfolded and are usually parallell to the general schistosity direction. The large vein body near Bratfjell II Mine is of economic proportions, it dips to the west at about 60° with no sign of thining.

The quartz is in all cases a white massive crystalline unit, the veins vary in size from 10 cm to several metres width, they are confined to the schist units in both group but this is probably due to case of penetrations rather than petrogenesis, since the large vein near Bratfjell II Mine is probably too large to have been "Sweated out" of the host rock.

The quartz veins are always cut by granitic veins and are older than the granitic intrusives.

IV COPPER ORE UNIT.

For outcrop - mines see Map 3 1:25 000.

The Copper Ore outcrop is sporadic and liable to rapid thickening and thinning with total disappearance in several cases.

In Storfjell Mine it cross-cuts the schistosity at a small angle.

In Tussvann Mine it shows intrusive relations with a concordant pegmatitic (since metamorphosed to a Chlorite-garnet-feldspar rock) but is approximately parallel to the local schistosity. In the Hopsfjell Mine the Copper Ore is folded by a SW plunging (70°) fold, it is also tightly folded in several outcrops on the Fjeld. In Bratfjell (I) the ore is present in several parallel veinlets - (see Mine Plan and Diagram.)

The general trend Storfjell Tussvann— Hopsfjell + Hopen— Brattfjell (II)— Brattfjell (I) indicates an approximate single zone at one structural level for the ore unit. This is borne out by the outcrop pattern on Hopsfjell and further to the north. However, several small minor outcrops occur to the south around Hill 351 7467-8N/487-4E approx., and one outside Hopen Mine (in the south of the tunnel). These may represent one intrusion broken by the complex folding in the area, or several smaller intrusions.

In the several areas there are schists with the copper-sulphur yellow-brown colour but no visible copper. These outcrops are fairly numerous but are all at different structural levels and are extremely discontinous.

A syntheris of the above information:

1. Hydrothermal intrusion of copper, after F, folding into Bodø group along general structural trend but crosscutting in certain places the primary schistosity. Associated contact metamorphism at Tussvann Gruber, _(see Diagram).

2. Copper Folded along F2A folds (in the SW axis plunging steeply to SW).

3. Either associated with above or latter metamorphism of rocks giving rise to minor mobilisation of Copper Ore body.

It would therefore appear that the Brattfjell (I)—Hopsfjell—Tussvann—Storfjell Ore body allthough sporadic and tightly folded is probably at one structural level and may be located by electro-resistivity geophysical measurements considering the structural trend as given on the structural overlay (map 2).

The area to the south of Hopsfjell is, however, very complex, and therefore the ore body is liable to be "pinched out" by the foldings

as surface outcrop suggests. It would therefore seem that this southern continuation of the ore is probably not worth considering at the present time.

This discription of the copper is not helpful since it appears that the ore may sometimes be related to the F2A structural trend and in other cases may not, and that in all cases it is liable to be sporadic and tightly folded - as shown by the original mine working inability to continue.

Whether the ore mounts to 1,000,000 tons or not, it's maximum thickness would appear to be 1-2 metres and a large amount of overburden would have to be removed when extracting the ore and also in following its structural trend. Therefore even considering the high Copper content, it would not appear to be economic at present to work this particular area.

V Granite Gneiss.

The granite gneiss would appear to be the youngest unit present since it shows definite intrusive relations to both Saura and Bodø group. Several contorted xeholiths of H/M schist are found within it near the actual contact of gneiss with schist. The contact is folded but not violently, and the gneiss in general crosscuts the major schistosity within the two groups.

The granitic veins within both groups crosscut the quartz and copper units and are themselves virtually unfolded. Those in the Saura Marbles are boundined, however, in a straight line.

Several pegmatitic fractions are found within the granite gneiss with large 3 cm white feldspar crystals and 2 - 3 cm square "books" of Muscovite. Garnet is present in subordinate amounts.

The gneiss unit represent the northern extremity of the Hopen "slide" since it is intrusive into both upper and lower group. It is therefore after the "sliding" but would appear to be slightly folded and is involved in the F_3 deformation phase. This is born out by its appearing to form the case of the portulated major Antiform (Heian Antiform) see tectonic Section.

TECTONICS.

The Saura Group contains few minor folds in relation to the Bodø Group, although this is partially to be expected as the Saura group's mainly Marble. As already stated the schistosity in the Saura group is parallel to bedding and its general strike suggest a structural disconformity between it and the upper Bodø group.

Plots of the fold axix azimuth for both groups (see diagrams) show no marked difference in axis trends or plunge trends, but the data for the Saura group is scare and no conclusions may be drawn from this.

If the disconformity is a alide (or nappe?) the littological similarity between the schist in both group and their similar fœd styles and fold axis trends suggest a short travel distance for the upper unit.

The Bodø group schists exhibit a marked schistosity/bedding interection as stated in section (II) Minor folding is largely semi-harmonic with small overturned folds common. The major fold axis azimuth trend would appear to be (from diagram)

(1) 345° plunge 70° north
(2) 045° " 50° west

These are probably the F_2 and F_3 of Nicholson and Rutland.
The folding within the Bodø group is therefore complex involving two or more periods of the deformation. The folds are all schistosity folds as mapped, the only nonschistosity fold being that in Bratfjell (I) Mine. Dips are usually high and it is very easy to follow a secondary schistosity due to intence folding. Therefore those folds shows may be only in part correct and several may have been missed altogether. For a correct tectonic synthesis it would be necessary to spend 6 weeks using 1:50 000 scale aerial photographs.

As stated the Copper Ore unit follows in part the major schistosity folds. The Saura group in general dips to the west under the Bodø group which itself is highly folded. See Cross-sections X-4 and A-B.

As indicated on the map it would appear (from the top of Hopsfjell) ~~that~~

that the general trend is from Storfjell around to Tussvann and then as known to Bratfjell in an Antiform.

Conclusions.

1. The only sure way of locating the ore is by geophysics, however, some predictions may be made as to the ore horizon position in the north.

2. The ground is probably too difficult for geophysical measurements to be carried out easily and therefore diamond drilling would be necessary but a compentant geologist must be present as the structure is very complex locally over the entire area.

3. The ore unit is sporadic due to its mode of intrusions (in long weak structural lines) and due to latter folding, and is therefore going to be difficult to follow when mining.

4. Although difficult the full structural picture, (for a slightly larger area is desirable in more to the west) could be accurately predicted using larger scale aerial photographs and spending at least 6 weeks on the area.

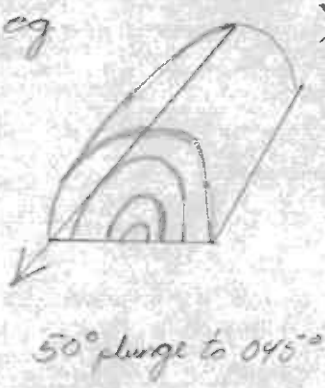
FOLD AXES.

Location No.	Rock Type	Azimuth/plunge.	Notes.
(4)	Saura schist	340/55 NW	
	"	288/48 W	crenulation fold of schistosity.
	"	270/38 W	
(8)	H/M schist	341/45 N	
(9)	"	240/27 W	
(10)	"	221/38 S	
(12)	"	046/51 S	
(13)	"	031/52 S	
	"	350/71 S	
	"	162/67 S	minor folds
	"	140/90 S	
(20)	H/M schist - Saura Marble	196/26 S	possible drag folds at Saura Marble - H/M schist contact.
		170/20 S	
(21)	Copper Ore unit	021/245 W	
	H/M schist -Saura Marble	120/30 W	
(23)	Copper Ore unit	098/20 W	
(28)	H/M schist	340/50 N	
	"	348/39 N	
	"	339/60 N	
	"	310/25 N	
(31)	"	166/46 N	
(32)	"	255/48 W	laye 3 m Amplitude fold (5 m fl.)
(37)	Garnet schist	325/15 N	
(39)	Saura Marble	163/36 S	
		050/70 W	
(40)	"	074/56 W	
(43)	Saura schist	026/32 S	
		057/39 S	

(45)	Saura Marble	345/20 S	large 3 m amplitude fold (Smfl)
(52)	"	311/31 N	
(53)	"	290/50 N	
(57)	Garnet schist	218/50 W	
(58)	"	216/57 W	
	"	286/67 W	
	"	217/68 W	
(59)	"	224/43 W	
	"	222/65 W	
	"	227/63 W	
(62)	H/M schist	214/68 SW	
	"	221/54 SW	
(65)	"	235/57 W	
(68)	Garnet schist	225/47 W	
(69)	"	354/61 N	
(71)	H/M schist	235/52 W	
(72)	"	252/55 W	
(73)	"	225/60 W	
	"	231/61 W	
(75)	"	202/61 SW	
(76)	"	225/64 SW	
	"	228/60 SW	
(82)	"	220/58 SW	
	"	234/68 SW	
	"	352/53 N	
	Copper ore unit	230/70 SW	
(83)	H/M schist	196/54 W	
	"	215/53 W	
(84)	"	200/52 SW	
(86)	"	232/30 SW	

(88)	H/M schist	243/46 SW
(93)	"	247/51 SW
(96)	"	280/60 W
(99)	"	256/65 W
(103)	"	223/47 SW
(109)	"	088/35 W
	"	085/40 W
(112)	"	265/62 W
(113)	"	240/62 W
(117)	"	260/65 W
(121)	"	240/50 SW
(122)	"	280/40 W
	"	260/50 W
(127)	"	010/55 S
(128)	Saura Marble	000/40 S

Azimuth is taken to be the crest of the fold:



NB! Unless otherwise stated the folds are minor folds with amplitudes < 2m but > 10 cm.
All folds are schistosity folds, except where otherwise stated eg. Marble schist sunction folds.
(Folds in marbles are inclusion particle folds.)

Specimen list

No.	Position	Type.
HCu 1	7470N/488.4E	Bodø group-marble.
HCu 2	7489.7N/488.5 E	Copper ore (Hopsfjell)
HCu 3	7472 N/489.5E	Granite gneiss.
HCu 4	7468N/487E	Garnet schist Bodø group.
HCu 5	7471N/489.3E	Garnet (large 10 mm) schist.
HCu 6	7468N/488 E	Hornblende/Mica schist. (Bodø group)
HCu 7	7467N/488.5 E	Saura Marble Group Marble.
HCu 8	7472N/48 9.3 E	Quartzite (Bratfjell Mine)

HCu 9	7468.7N/486.7E	Copper Ore Tussvann Mine.
HCu 10	7468.7N/486.7E	Pegmatite " "

Name	Copper Mine + Workings Position	Positions See map (3)

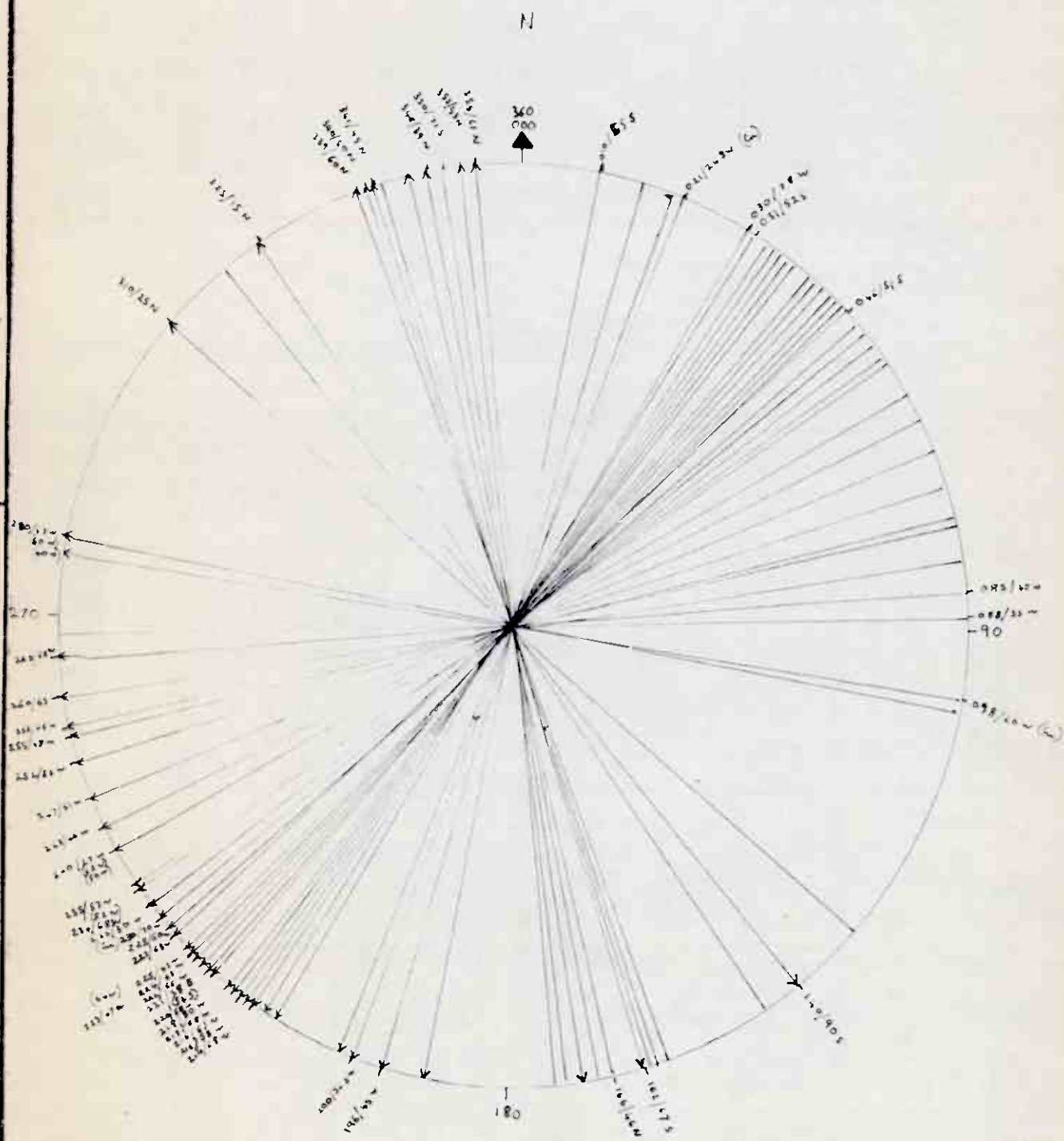
A/S SULITJELMA GRUBER

FOLD AXIS AZIMUTH PLOTS FOR: —

Bodø Group.

F. MASON

(6)



A/S SULITJELMA GRUBER

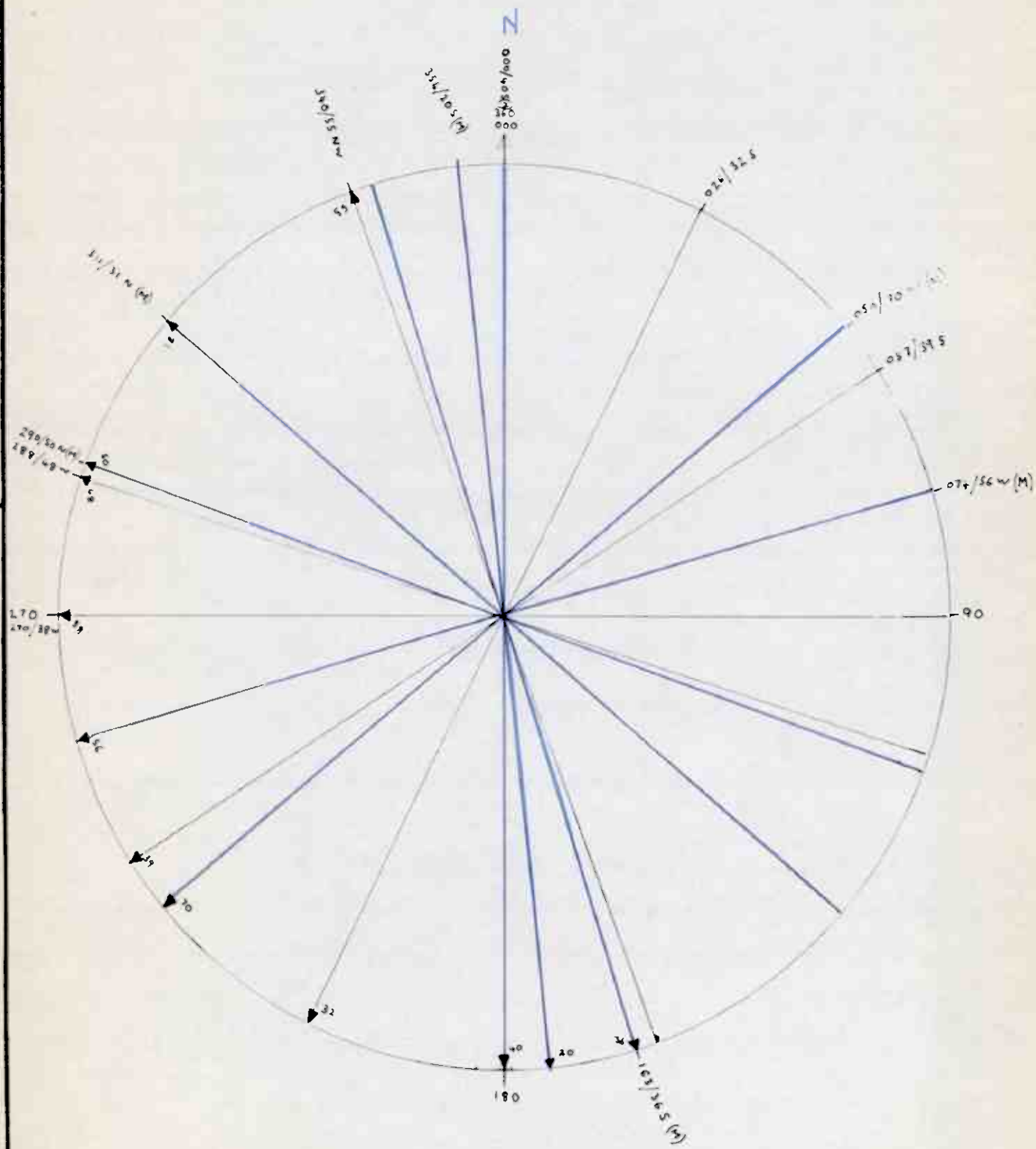
FOLD AXIS AZIMUTH PLOTS FOR :-

SAURA MARBLE GROUP

(MARBLE IN BLUE)

H. MASON

(5)



A/S SULITJELMA GRUBER

SEQUENCE OF ROCK UNITS HOPEN AREA.

H. MASON.

FIG I (8)

SEQUENCE

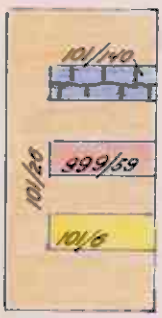
GRANITE GNEISS

INTRUSIVES

COPPER ORE UNIT

QUARTZ (MAJOR VEINS)

BODÖ GROUP



MARBLE UNITS

GARNET SCHIST UNITS

QUARTZITE UNITS

HORNBLENDE/MICA SCHIST UNIT

SALURA GROUP

HORNBLENDE/MICA SCHIST UNITS

IMPURE MARBLE UNIT

MAP (3)

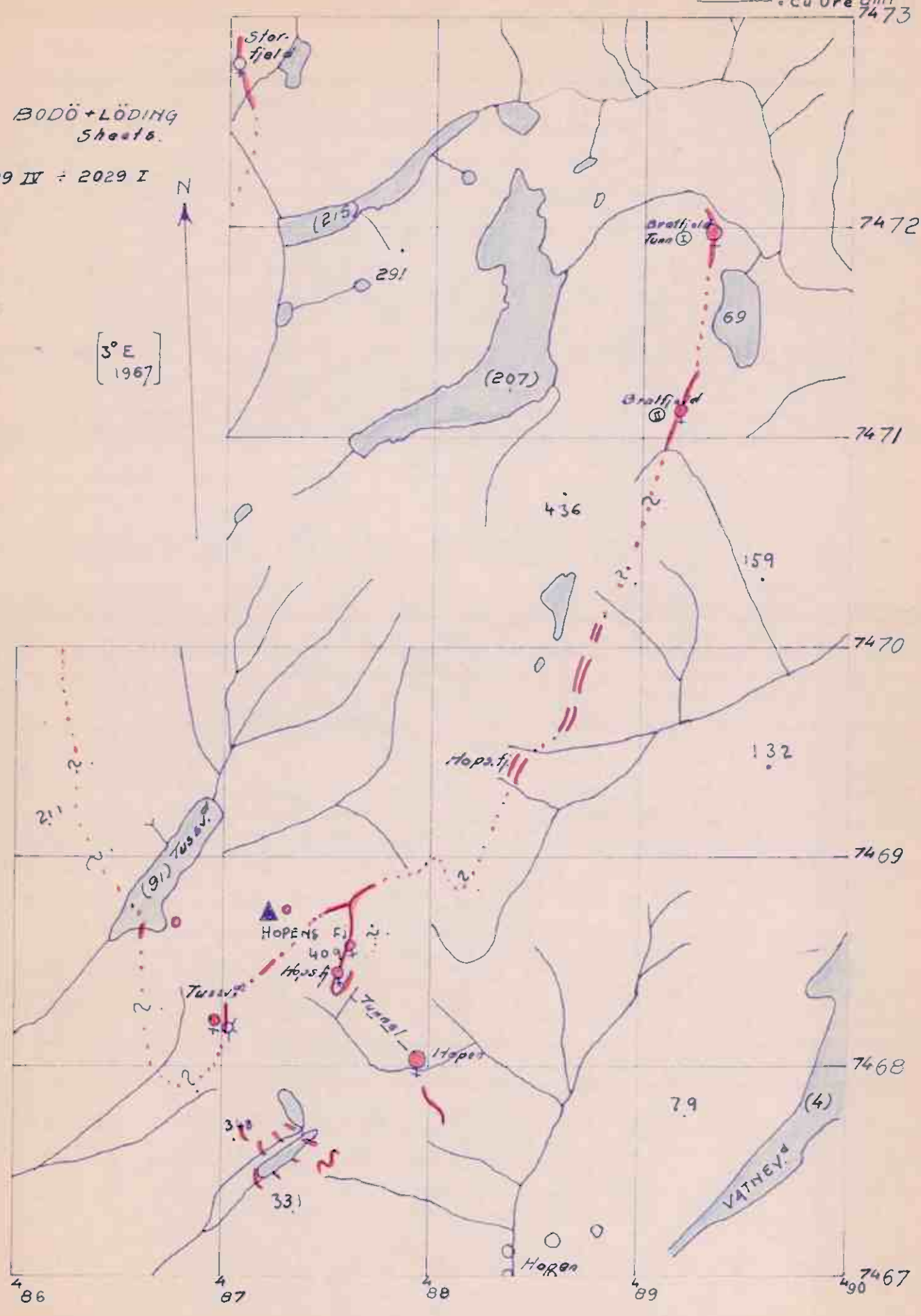
HOPEN Cu. MINES COPPER OUTCROPS

Cu Ore Unit

BODÖ + LÖDING Sheets.

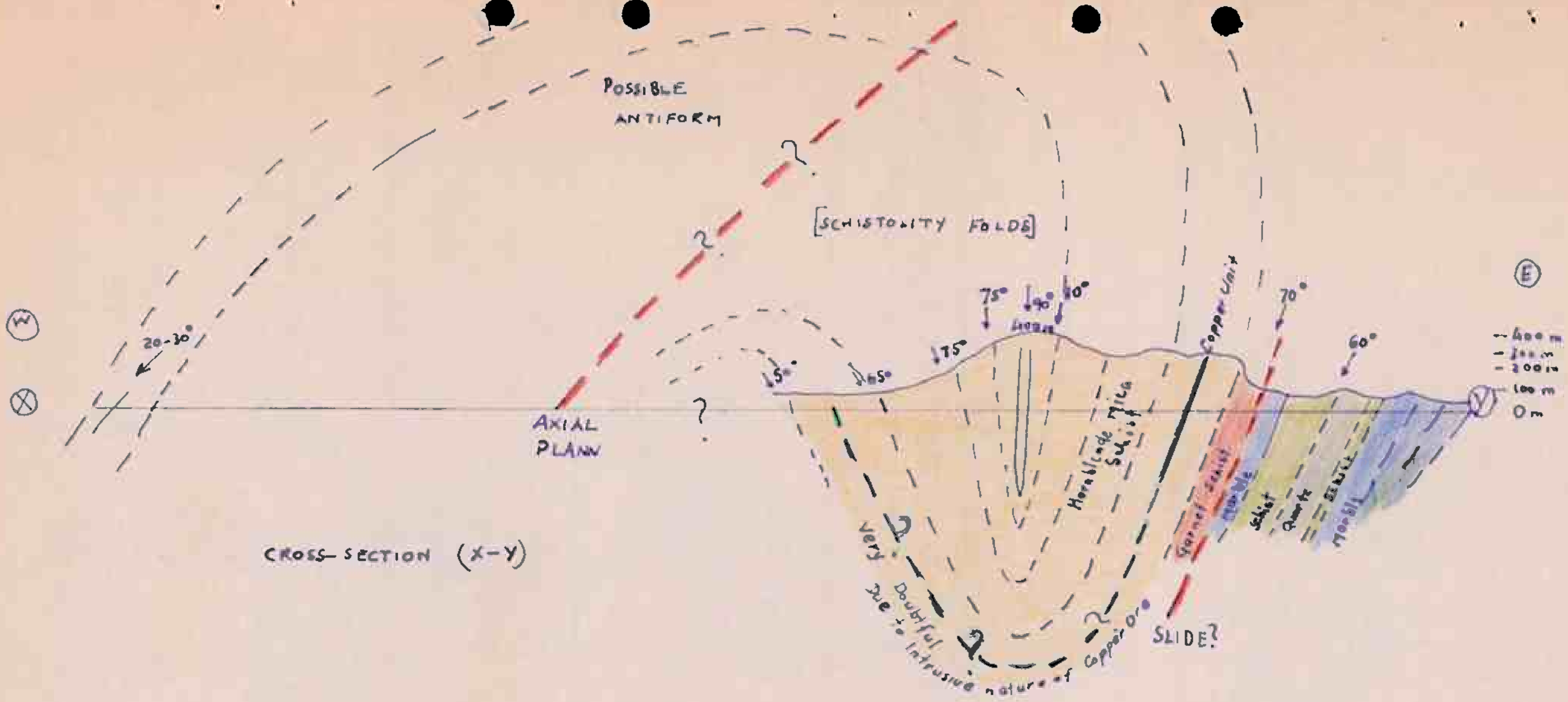
2029 IV + 2029 I

[3° E 1967]

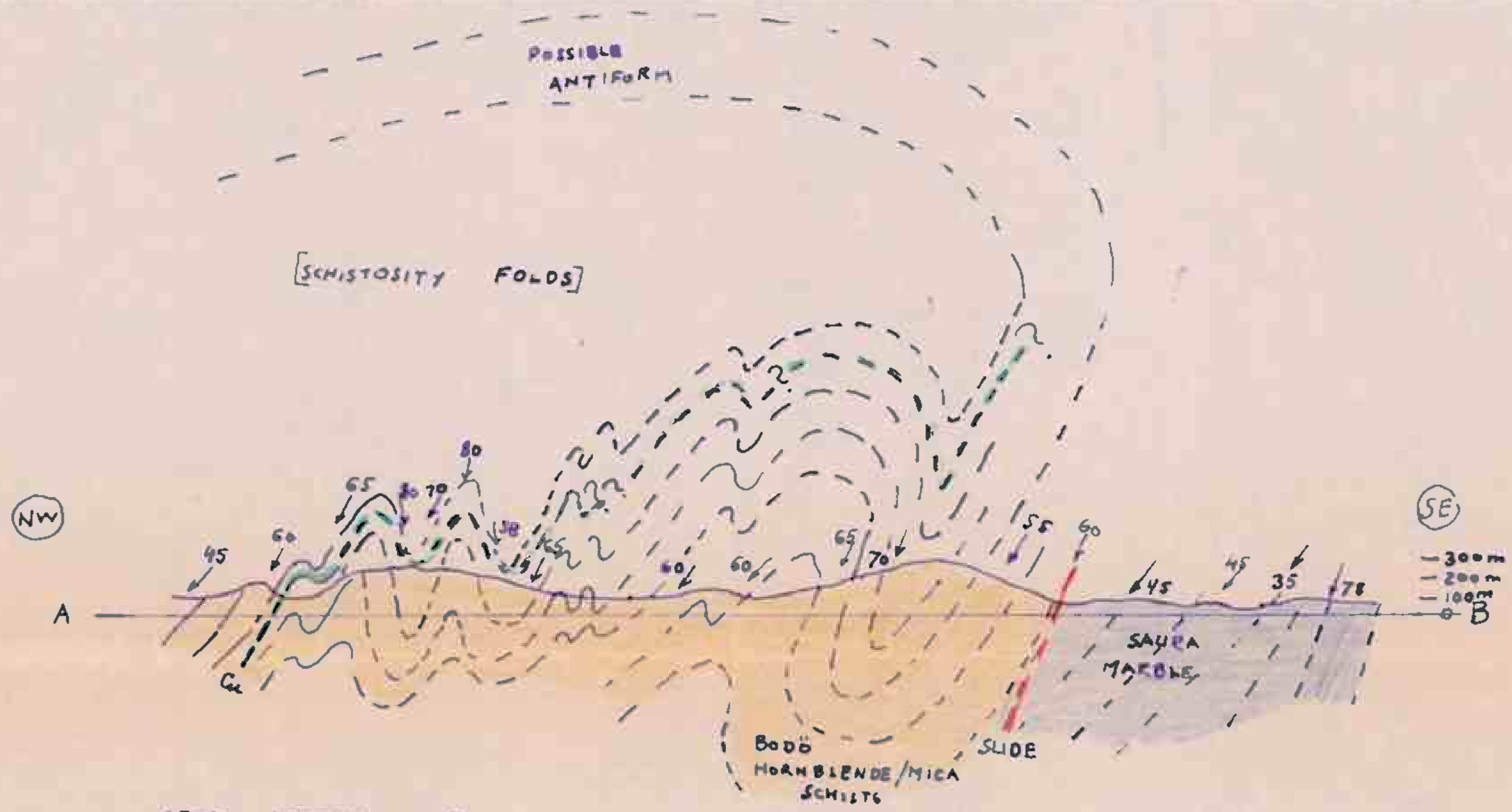


Km. SQUARES

Mason

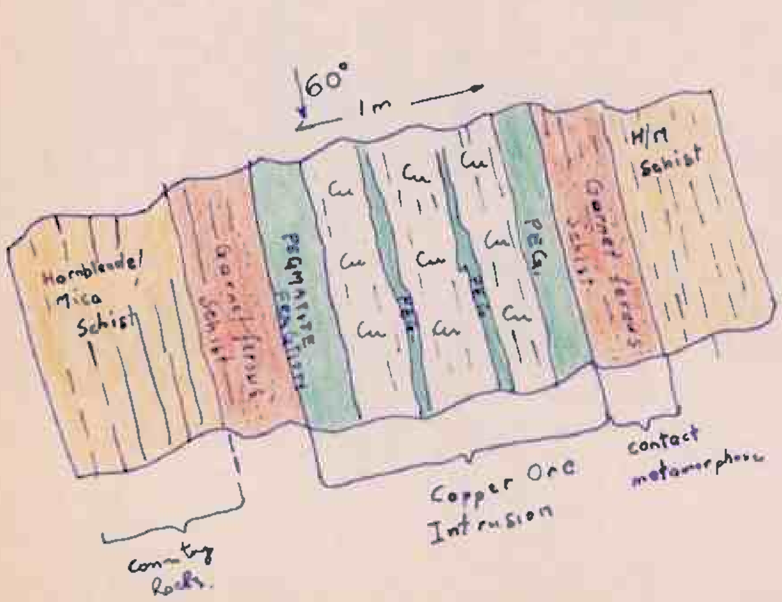


CROSS-SECTION (X-Y)



CROSS SECTION A-B

SKETCH PROFILES [SCALE 1:16,666']



Copper Ore Relations in Tassv^d MINE
(a) Outcrop.

MASON 1967

A/S SULITJELMA GRUBER

APPROXIMATE Plans of COPPER MINES (NOT TO SAME SCALE)

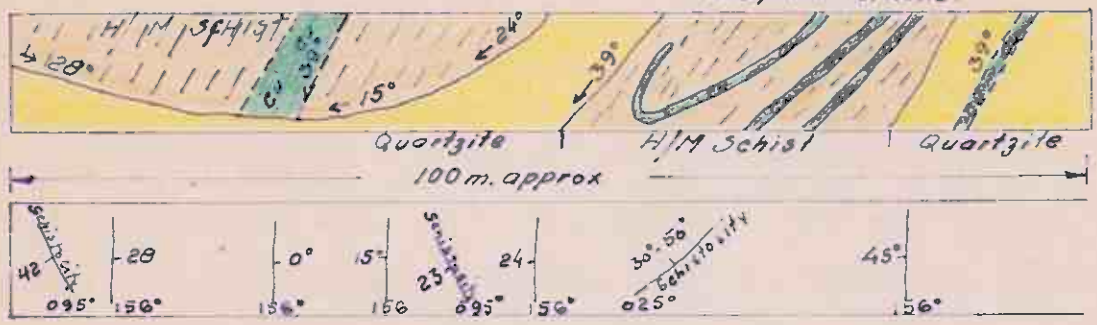
(9)

MASON

Bratfield (I) Copper Mine 125m. 7472-0N, 489-4E

Minor Fold 021/24 (SW)

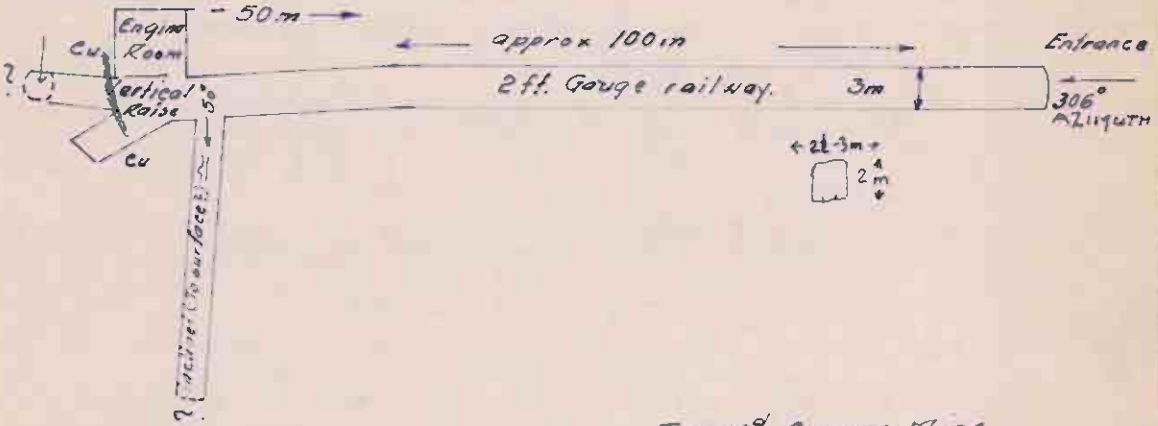
Irregular Cu. Zone.



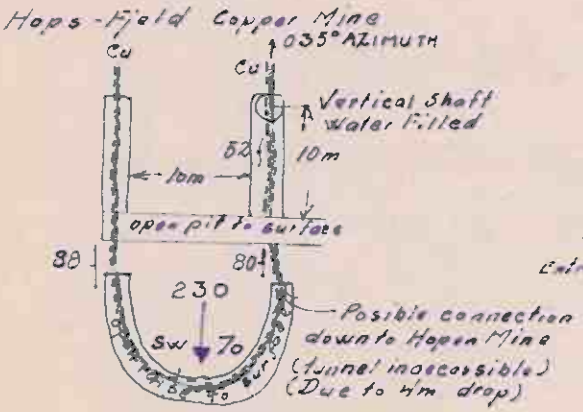
Bratfield II is inaccessible Due to Position in cliff Face

Hopen Copper Mine

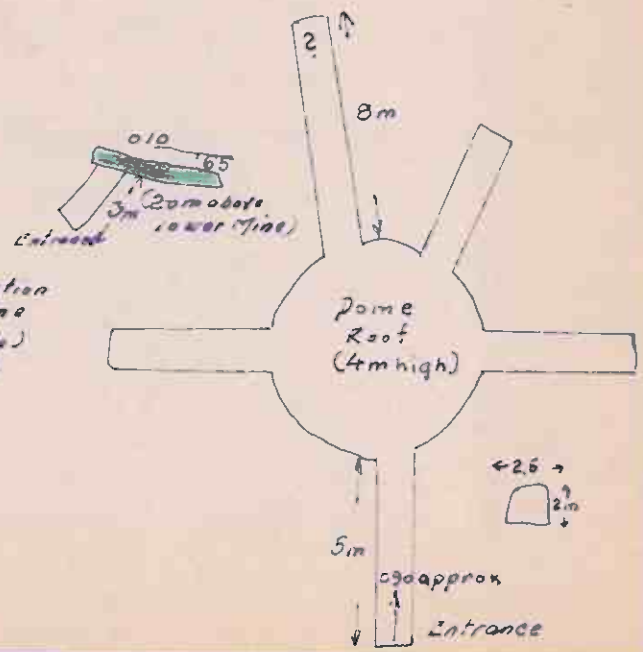
vertical shaft (waterfilled)



Hops-Field Copper Mine



Tussvd Copper Mine



2 other vertical shafts are found 100m to North along Copper Ore Outcrop (Both Waterfilled)

STRUKTURAL TREND AS SEEN FROM HOPS FIELD

POSSIBLE MAJOR ANTIFORM

MARBLE

HORN BLENDE/MICA SCHIST (Bodö Group)

GARNET SCHIST

GARNET QUARTZITE

HCL 5

HCL 2

SAURA MARBLE

GRANITE GNEISS

A

B

X

Y

MASOR FOLD AXIAL TRACE [* = SYNCLINE ⊕ = ANTICLINE]

MINOR FOLD AXIAL AZIMUTH + PLUNGE (50°)

SCHISTOSITY STRIKE + DIP (70°)

CU. ORE OUTCROP

SUGGESTED STRUCTURAL TREND OF ORE

FORM LINE [DEMONSTRATES SCHISTOSITY FOLDING]

HOPEN SLIDE ?

1 Km

SCALE 1:16,666'

[BODÖ + LÖDING SHEETS]

1:50000

TECTONIC OVERLAY FOR GEOLOGIAL MAP OF HOPEN

Målestokk

Tegn. MASON

Trac.

Klr.

Erstatning for:

Erstattet av: