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REPORT ON GEOLOGICAL MAPPING AND GROUND MAGNETOMETER SURVEY AREA EAST OF ORBODY, SKOROVAS

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Innhold:

REPORT

ON GEOLOGICAL MAPPING
AND GROUND MAGNETOMETER SURVEY
AREA EAST OF OREBODY, SKOROVAS

TO ELKEM-SPIGERVERKET A/S, SKOROVAS GRUBER

OCTOBER 29, 1974

1. INTRODUCTION

Geological mapping at a scale of 1:5.000, based on aerial photograph B5-841, was carried out in an area east of the mine orebody, Skorovas, between the 4.th and 14.th october 1974. The area mapped is generally of low relief, topographically a broad gentle-sloped valley-head falling from the reservedam (~ 610 m) in the north; Vestre Overste Nesåvatn and the lower north-west slopes of Nesåklumpen in the south (650 m); the mass of Grubefjell to the west (650 m); and open to the east where lies lake 545.

Substantial and often critical parts of the area have little or no exposure due to bogs in depressions or to relatively rich vegetation cover, the 'tree-line' running through the area. Over the majority of the area, however, exposure is adequate to yield the principal geology and structure.

2. LITHOLOGIES AND MINERALISATION

a) Greenstones

It is not possible to determine the correct sequence of greenstones in the area mapped with certianty. However, evidence from the attitude of exhalite horizons and sporadically well-developed pillow structures suggests that the oldest greenstones are massive, characteristically with a siliceous or silica-epidote box-vein structure and horizons rich in quartz amygdales. At some horizons it is evident that relatively siliceous variations of this greenstone occur. The massive greenstones are not found to contain exhalite horizons, although they may be locally weakly magnetic, apparently often in or near fracture zones, due to very fine, evenly dispersed magnetite. In many respects these greenstones resemble the "massive epidote-rich greenstones" of the south Olatjönna area, which are the oldest greenstones in the section Olatjönn - Svartberget, and which are described in a report on South-East Skorovas. It is possible that the greenstones are lateral equivalents, the massive greenstones of Olatjönna being relatively calc-rich with abundant epidote-filled amygdales, the massive greenstones of the present mapping area bein relatively siliceous with abundant quartz-filled amygdales.

The massive greenstones are followed by crudely-schistose or tabular greenstones of variable thickness, containing horizons which are quartz-amygdaloidal and probable equivalents of the massive greenstones. These greenstones are, however, on the whole relatively calc-rich, containing abundant epidote, while pillow structures are occasionally well-developed. The greenstones are associated with the occurrence of exhalite horizons, notably at or near their contact with relatively good schistose greenstones, and are most likely the lateral equivalents of the lower members of the Lower Pillow Unit of South-East Skorovas. In the immediate vicinity of the Skorovas orebody, similar greenstones are exposed at (Y. 5440 X. 70140; Y. 5350 X. 69340).

Apparently contained within this greensone pillow sequence are relatively good to high-schistose greenstones of variable thickness evidently intimately associated with relatively acid, explosive volcanism. The schistose greenstones attain their maximum thickness in the southern parts of the area, reaching at least 100 m; while thinning-out occurs to the north where a maximum thickness of 25-30 m. apparently occurs. The relatively good schistose greenstones are relatively chlorite-epidote rich greenstones with rich in vesicles and amygdales, predominantly epidote-filled. These greenstones occur in the cores of DBH. 10.034 and DBH. 10.037 and act as a host horizon for the relatively highly-schistose greenstones.

The highly-schistose greenstones characteristically have a strongly developed lenticular texture, where exposed are clearly ferruginous; and together with the good schistose greenstones are characteristic indicators of possible exhalative mineralisation. This has been establiched in the mapping of South-East Skorovas, and while no jaspers are actually exposed in the vicinity of the boreholes or near exposed sulphide mineralisation 160 m to the north of DBH. 10.034, there is a high proportion of jasper/jasperoid fragments and boulders in overburden directly above projections of the mineralised horizons. One may dismiss this as the result of drift-transport from elsewhere, however in the mapping of South-East Skorovas it was almost universally found that where high proportions of exhalative chert occurred in overburden, a source exhalite horizon occurred within ~ 50 m.

Also, 250 m south of DBH. 10.037, along the most likely projection of the structurally uppermost mineralised horizon, a definite exhalite-mineralised horizon is exposed including magnetite-chert, stratiform sulphide mineralisation and thin compact chert.

In both borehole cores, mineralisation is found intimately associated with an evidently more acid, strongly lenticular or tuffaceous rock, fine-grained pyrite being concentrated along the margins of lenticles. A greenstone containing chloritic clumps, termed chlorite-fleck greenstone, is found within the mineralised horizons in the cores; and also in the exhalite horizons to the south and south-west. In South-East Skorovas, this greenstone is often found associated with exhalite mineralisation e.g. south of Vestre Overste Nesåvatn. Horizons rich in magnetite occur in the mineralised horizons of the borehole cores, notably in DBH. 10.034 where magnetite occurs in clumps 6 m above the potential ore horizon and also in the lowermost parts of the ore horizon with coarse copper-rich pyrite in veinlike form.

To the east of the mineralised horizons, clearly acid effusives, locally with a quartz-porphyritic greenstone, are exposed, having a relatively well-developed planar fabric. This horizon, lying structurally below the mineralised horizons is thin and locally discontinous, but is traceable at a reasonably consistent horizon parallel to the whole length of outcrop of the good schistose greenstones in the east of the area. In the north and north-west of the area, where the good schistose greenstones are most thin, occur realtively acid agglomerates containing angular acid fragments to ~ 15 cm across. It appears that where this rock is thickly developed, the good schistose greenstones are thin while the tuffaceous, potentially mineralised horizons are absent; the acid agglomerates evidently being laterally continuous with the good schistose, mineralised horizons and acid effusives to the south and south-east. The agglomerate can be traced out of tha area mapped to the Vann-Ledning at Y. 5330 X. 69740.

A basic agglomerate outcrops in the south-east of the area near the western shore of lake 545. This lies structurally below pillow lavas.

Acid rocks of probable keratophyric composition, being of a massive nature with cherty fracture occur as thin, near-stratiform bodies locally, these probably being dyke-rocks. Where they occur, minor pyritic impregnation may occur.

Occuring sporadically throughout the greenstone sequence are small irregular bodies of metagabbro. As in South-East Skorovas, limited replacement of host greenstone occurs locally in the contact zone.

3. STRUCTURE

It is clear that f_2 folding has resulted in the formation of a boat-like depression structure, elongated north-south, in the area. Profiles across the area demonstrate this.

Lithological mapping also demonstrates the area to consist of a refolded f_1 fold, having a nose facing upward and eastward. From surface observation on profile A-B, of course, it is not possible to determine what direction the lower limb of the fold would take. On profile C-D however it is apparent that the reverse of the A-B sequence occurs near the f_2 axis i.e. that the lower limb of the fold is exposed in the north. If then the lower limb is inserted in A-B and the change in topographic height of the fold hinge between A-B, C-D noted, a theoretical plunge for the northern half of the structure can be obtained. This is 3 - 4° south, corresponding to the observed plunge of the northern half of the structure, confirming the structure to be that shown in the geological profiles.

Within the f_1 fold structure, the proximity of the fold hinge and overturned limb on a west-to east traverse is well indicated by the rapid increase in westerly dip, from angles of 4° - 15° on the upper limb to 20° - 40° in the east.

The low dip valves on the western shore of lake 545 can only be explained by a structural break being concealed beneath the large drift-filled depression to the west. This is also suggested by the local common occurrence of thick vein quartz and by the strong deformation observed within the highly schistose rocks at the surface and of the lowermost sulphides in DBH. 10.034.

A stereogram plot of f_1 surfaces in the area gives a near-symmetrical grouping about a long axis trending ~025° for the actual orientation of the axis of f_2 folding.

4. CONCLUSIONS

a) The structure of the area is that of an f_1 fold having an axis trending north-south, which has been refolded on $\sim 025^{\circ}$ by f_2 to preduce a basin structure of boat-like form having it's long axis trending north-south.

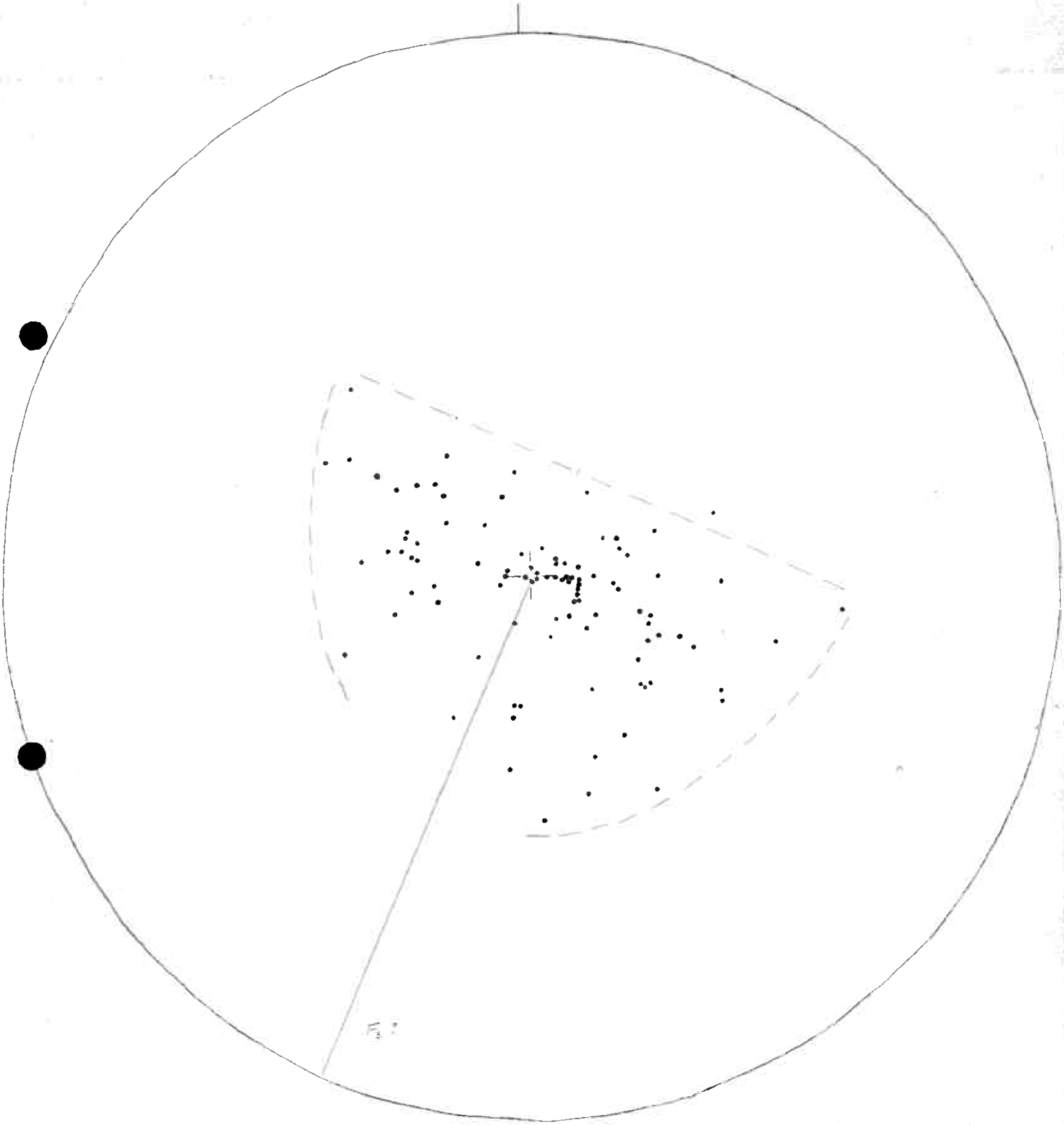
b) The mineralised horizons including the potential ore horizons are genetically linked with volcanism of exhalative type which includes relatively acid material as a strong component, including acid tuffs, keratophyre and acid agglomerates.

c) The mineralised horizons show few indications of strong metamorphic remobilisation, although deformation of a high degree is locally evident, and the occurrence of anomalovsly high copper content is thought to be the result of concentration in the stages of diagenesis, possibly steam-silica solutions from underlying lava flows acting as a transporting medium.

d) The exhalite-mineralised horizon containing potential ore-grade mineralisation is continuous at least as far south on strike projection as X. 69120, the displacement of the extensive fracture traceable from south-west of Vestre Overste Nesåvatn to the southern edge of the area being no more than 2 - 3 m locally. It isevident that the extent and grade of mineralisation varies significantly laterally.

e) Greenstones which are potential hosts to mineralised horizons are more thickly developed to the south. North of X. 69900, the greenstones most likely to contain mineralised horizons become thin and barren, on the western side of the f_2 structure their horizon being occupied by acid agglomerates.

f) The two distinct mineralised horizons in DBH 10.037, 10.034 are evidently not one folded horizon but two lenticular bodies.



AREA EAST OF OREBODY, SKOROVAS.

POLES TO PRIMARY
CLEAVAGE, 106 READINGS.

GROUND MAGNETOMETER SURVEY

1. Methods

A ground magnetic survey was carried out between October 18 - 23, 1974 using a vertical magnetometer type GM-59A, the survey being limited to the outcrop and extrapolated outcrop of the potential mineralised horizon. The limits of the survey area are as follows; Y. 4430 - Y. 4660, X. 6910 - X. 7050. The net set up by earlier geophysical workers in 1974 was used, the area on this net being defined by 300N - 1000S, 9500 - 12200.

In the mid-section of the survey area, traverses were spaced at 50 m, reading points being 6·25 m apart, except for the limits of traverses where the points were 12·5 m apart after the barren background gamma valves had been reached.

A Continual check was made on possible drift, while daily drift was found to be negligible at 250 gamma over 7 - 8 traverses. A check was also carried out on the effects of taking readings on the sides of steep slopes. The effects of nearby bank-like features were found not to noticeably distort the trends of anomalies where these were traced both over flat ground and beneath steep slopes.

A total of 19 traverses were completed, comprising 612 point readings.

2. Discussion of Results.

The results, as plotted on profiles and contoured at 1:2.500 scale indicate two stratiform anomalous horizons, defined by anomalous valves greather than 3750 gamma. Where very high anomalies occur, it is common for these anomalous areas to be flanked by very low anomalies.

The more easterly anomalous body is undoubtedly the outcrop of the potential ore-grade mineralised horizon cut at a depth of approximately 29 - 36·5 m
D.10.038 by borehole DBH. 10.034 A. This is clearly seen where the mineralised
horizonis exposed around 400 - 450 S, 1150 0, and also in the borehole correlation section.

The westerly anomalous body is more difficult to interpret. As a correlation between DBH. 10.034, 10.037 SHOWS, THIS cannot outcrop and thus it is probably unlikely that this horizon is represented by the clear and continuous western anomaly.

In the furthest south of the area however, two exhalite-mineralised horizons outcrop. The more easterly of these is continuous along strike with the easterly anomaly and with the structurally lowest mineralised horizon to the north. It is also apparent that the western exhalite-mineralised horizon (Y. 4670, X. 69180) is continuous with a mineralised horizon structurally above that intersected by DBH. 10.034 A. Whether this horizon is that represented by the anomaly or that occurring in the mid-section of DBH. 10.037 is undeterminable.

It is evident from the anomaly map that a relatively strongly mineralised horizon should outcrop along a line dividing the two borehole positions, trending approximately north,south. Unfortunately much of the ground covered by this anomaly is of marsh or boulder drift, however it is perhaps significant that in several localities,on the anomaly, a high proportion of sulphide-impregnated boulder-material occur, possibly indicating a buried exposure. However, on the borehole correlation section it is clear that no mineralised horizon is cut by DBH. 10.037 in its upper sections as would be expected if a mineralised horizon had an outcrop to the east. Thus, if the western anomaly does represent outcropping sulphide mineralisation, this horizon would be, at least locally, of shallow extent.

One factor which is potentially significant in this problem is the exposure of greenstones barren of sulphides but containing influential amounts of very finely disseminated magnetite. For instance, the high anomaly at 200 S, 1110 0 is due to the exposed outcrop of such greenstone. However, where greenstones are exposed in the immediate vicinity of the western anomaly, these are found not to contain magnetite in sufficiently influential amounts, and tis is proposed that the mineralised horizon represented by the western anomaly is as potentially rich in sulphide as that represented by the eastern anomaly.

The exhalite mineralised horisons exposed in the south of the area, and also that outcropping in the south-west which is well exposed on the Vann Ledning at Y. 4920, X. 69170 are in no doubt continuous with the sulphide and cupriferous sulphide horizons of north and north-east Vestre Overste Nesåvatn. This is indicated both structurally and texturally, the former relationship being relatively complex due to the combined effects of topography and a change in plunge direction of dominantly north-south oriented structures at the northernmost tip of Vestre Øverste Nesåvatn. In this area, the plunge of f_2 structures changes from that to the north and into the basin-like structure of the area of this report, to the south and into the evidently basin-like structure beneath Vestre Overste Nesåvatn, discussed in the report of South-East Skorovas.

CONCLUSIONS

The horizon of strongly schistose greenstones contains at least two stratiform mineralised horizons which are continuous from 250S and 450S to at least 1000S. These horizons, together with the host greenstone horizons are continuous with those of north and north-west Vestre Overste Nesåvatn in a complex structural manner, the nature and extent of mineralisation varying significantly both along strike and dip, it being evident that the most strongly mineralised bodies are near-stratiform but essentially podiform or lenticular.

The potentially mineralised greenstone horizon extends westward beneath the refolded f_1 fold structure from the outcrop along Y. 45530., having a thickness of at least 100 m from the mid-part of the area southward, thinning out considerably to the north.

Other geophysical methods of deeper penetration should indicate the extent of mineralisation further west beneath the structure.

On the geological evidence and data discussed in this report the following exploratory diamond drilling targets are suggested;

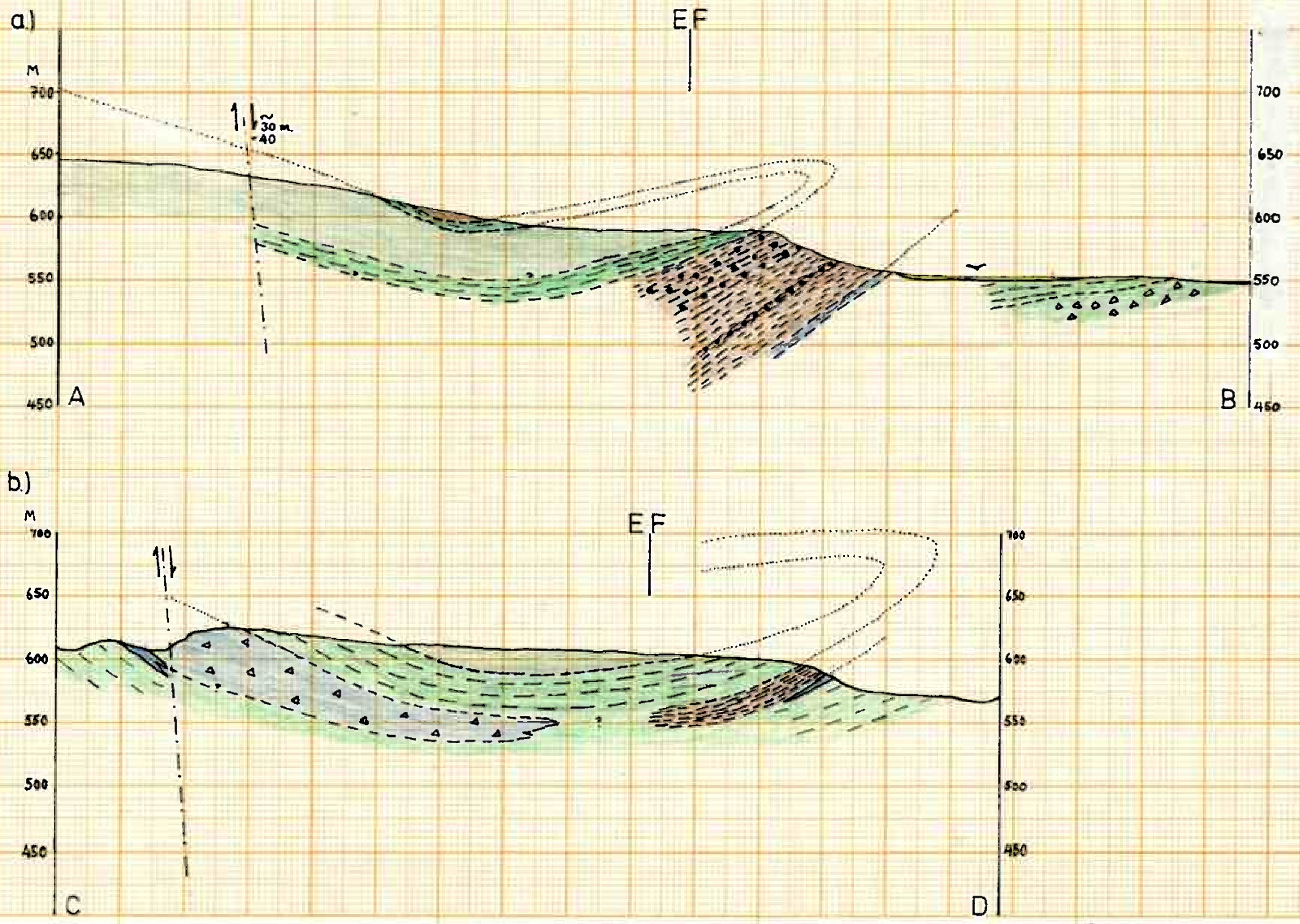
a) 500 S , 1100 Ø, 70 m 65° due east
b) 810 S, 1050 Ø, 75 m 65° due 108°.
c) 400 S, 1125 Ø, 75 m 65° due east.

I. Ferriday.

October 29 1974 I. L. Ferriday

12.11.74
ILF/ØB

GEOLOGICAL PROFILES—AREA EAST OF OREBODY, SKOROVAS



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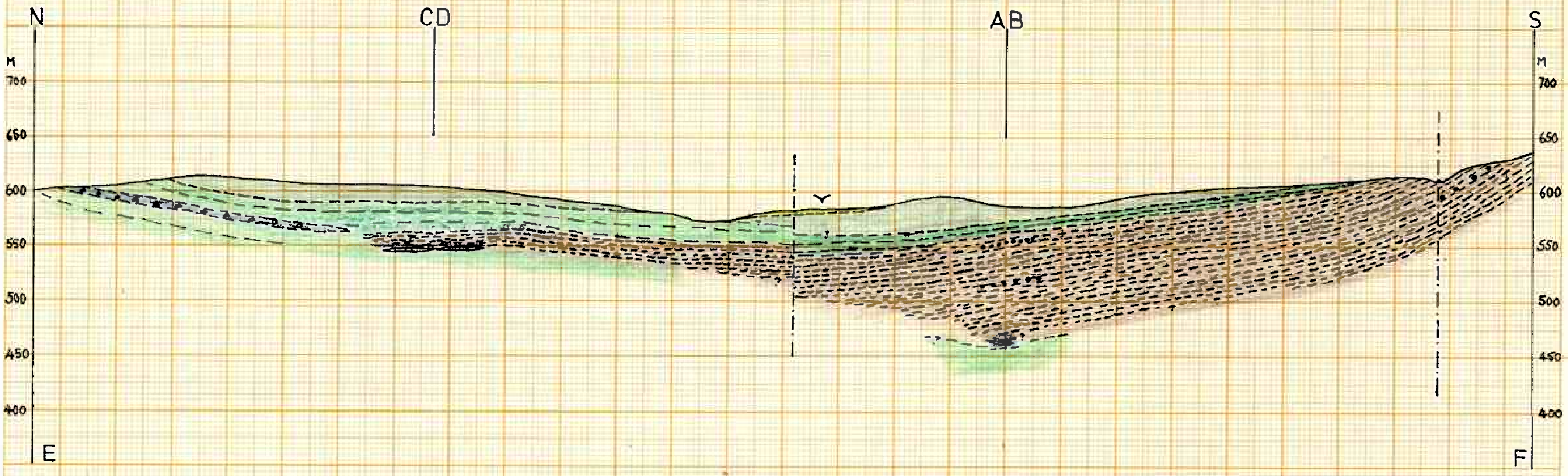


I.L. FERRIDAY OCT. 1974.

N.B. Preliminary number — now 10,038

BOREHOLE LOG B.H. 10.034 A, VERT. 38m.

FINE SILICEOUS BOX-VEINING.

PTYGMATIC FOLDING OF FINE EPIDOTE STREAKS COMMON.

s.a.g: schistose-epidote dark greenstone with quartz-amygdaloidal horizons.

FINE BEDDING LAMINATION.

DECREASING EPIDOTE.

INCREASING SILICA + CHLORITE + SCHISTOSITY.

VEIN QUARTZ

s.a.g. + FINE GRAINED STRATIFORM PYRITE.

relatively light green lenticular-structure pyroclastic with fine felsic flecks and lenticles.
schistose, fine grained.
fine grained pyrite concentrated around margins of felsic material.
↓↑ : direction of increasing pyrite content.

INCREASING CHLORITE.

VERY FINE LENTICULAR-FLECK STRUCTURE.

INCREASING SILICA.

s.a.g.

DECREASING CHLORITE.

DECREASING CHLORITE.

s.a.g.

MAGNETITE CLUMPS.

HORIZON CLEARLY LITHIC TUFFACEOUS.

MAGNETITE IN FINE CLUMPS.

LOCAL ANOMALOUS HIGH PYRITE, Cu Py
ASSOCIATED WITH FELSIC.
SOME REMOBILISATION ASSOCIATED WITH VEIN QUARTZ

LENTICULAR-STRUCTURE
APPARENT KERATOPHYRIC
WITH FINE-GRAINED Py, CuPy.

FINE, WELL-DEFINED Py, Cu.Py VEINLIKE FORM.

COARSE-GRAIN SUB-ROUNDED-SUB-ANGULAR Cu.Py. 'High' magnetite CONTENT.

CHLORITIC LENTICULAR GREENSTONE

PREDOMINANTLY FINE-MEDIUM GRAINED Py + CuPy in stratiFORM TO LENTICULAR FORM.
NON-MAGNETIC.

Horizon of potential ore. Lenticular stratiform fine to coarse grained pyrite + Cu-pyrite (Cu ≃ 4-5%?) in dark grey siliceous matrix. Also in very coarse veinlike form.

s.a.g

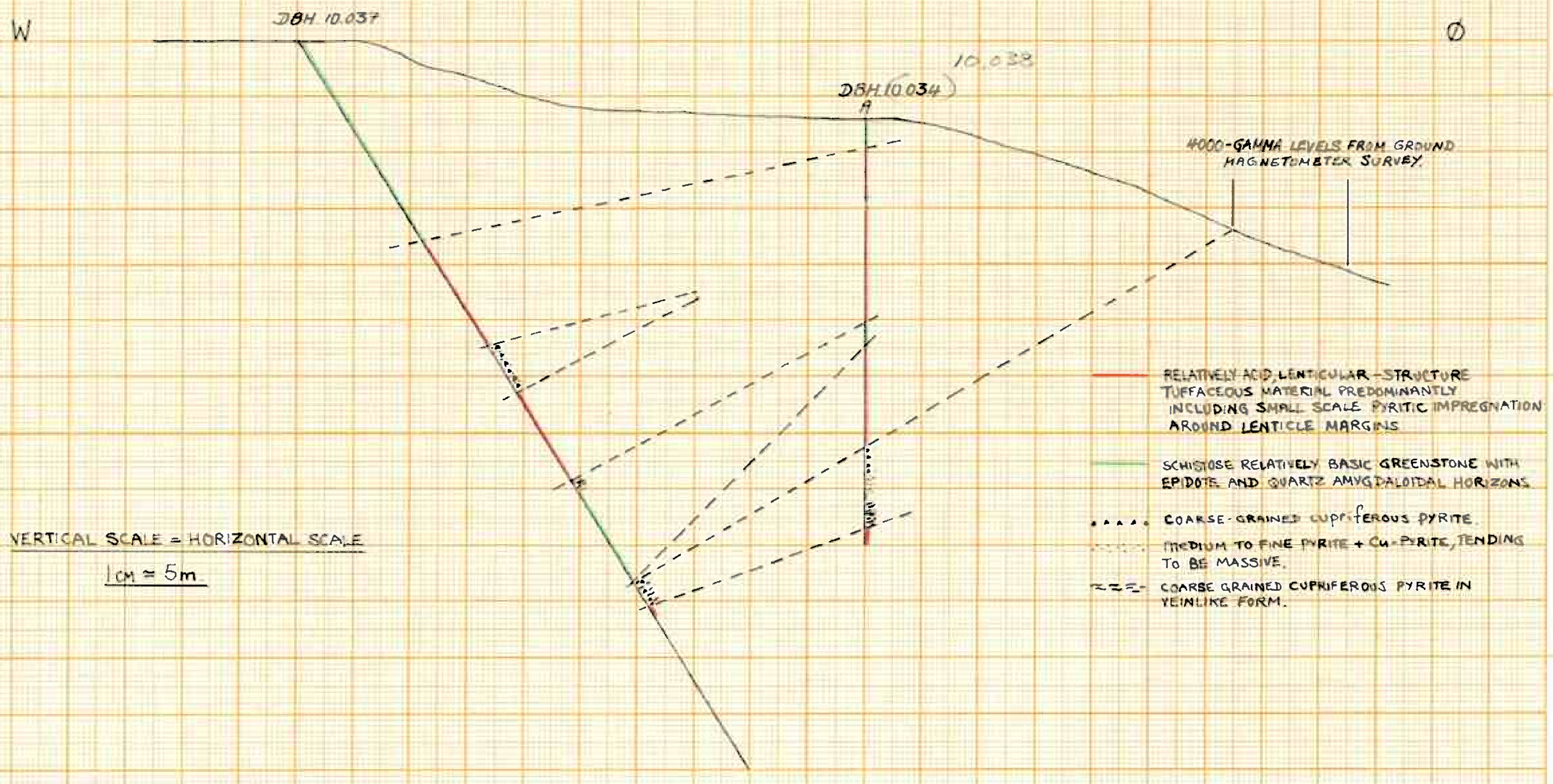
IRREGULAR LENTICLES AND CLOTS OF V. COARSE GRAIN OF Cu.Py (Cu-RICH) IN FINE CHLORITE GREENSTONE OF 'AMYGDALE' TYPE.

STRATIFORM BANDED Py, CuPy, FINE-GRAINED IN DARK SILICEOUS MATRIX.

'VEIN-STRUCTURE' Cu-RICH py IN GREENSTONE
HIGH DEFORMATION EVIDENT. LITTLE OBVIOUS METAMORPHIC REMOBILISATION.

LIGHT GREEN, CHERTY, RELATIVELY HIGHER [SILICA] GREENSTONES. No sulphide EVIDENT.

CORRELATION OF BOREHOLES, EAST SKOROVAS



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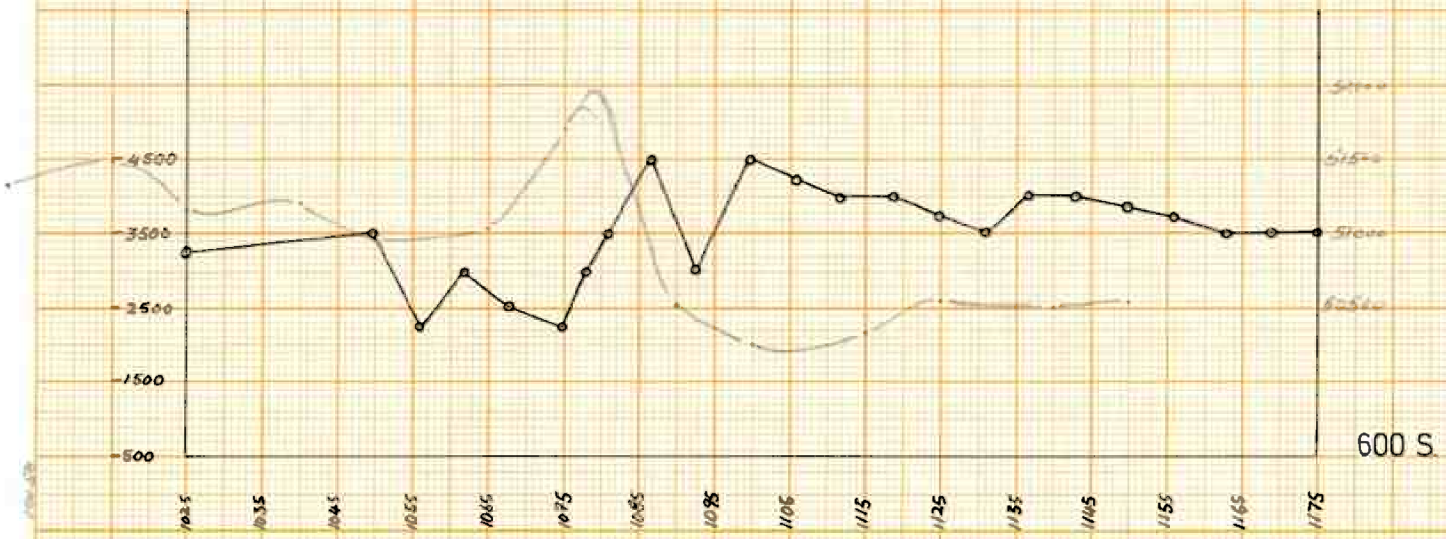


600 S.

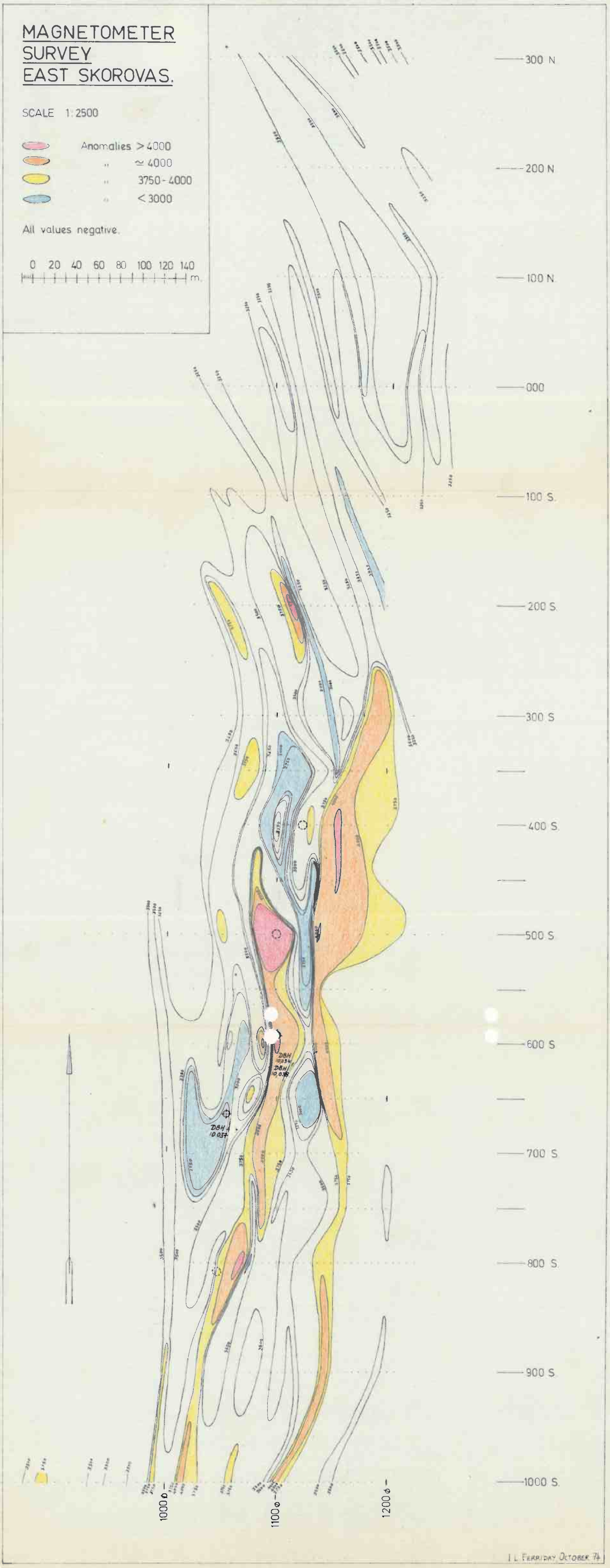
650 S.

MAGNETOMETER SURVEY EAST SKOROVAS.

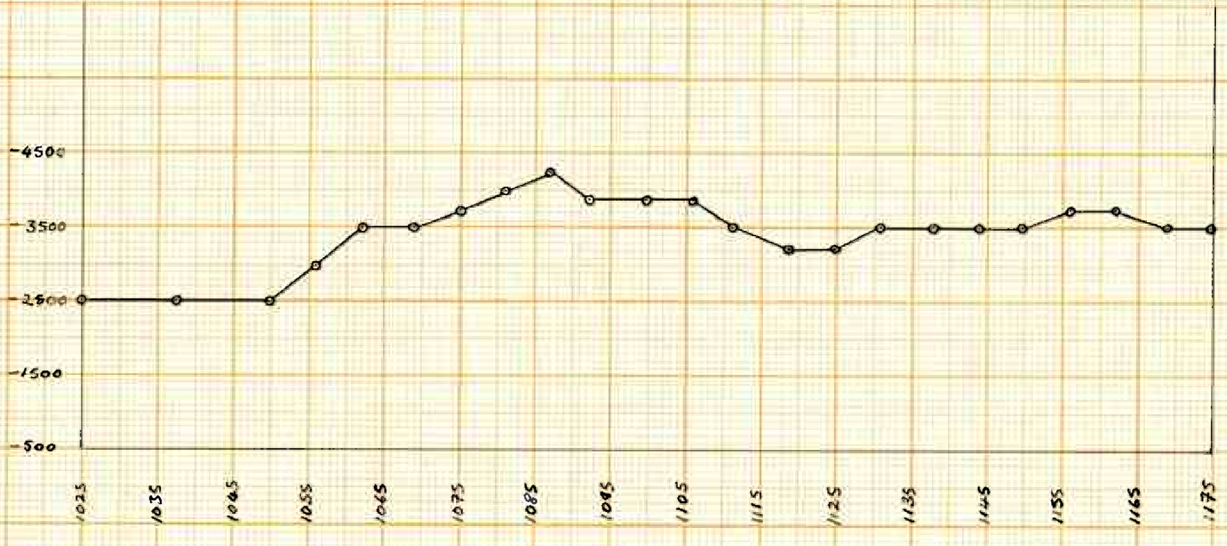
SCALE 1:2500

🟥	Anomalies > 4000
🟧	" ≃ 4000
🟨	" 3750-4000
🟦	" < 3000

All values negative.



I. L. Ferriday October 74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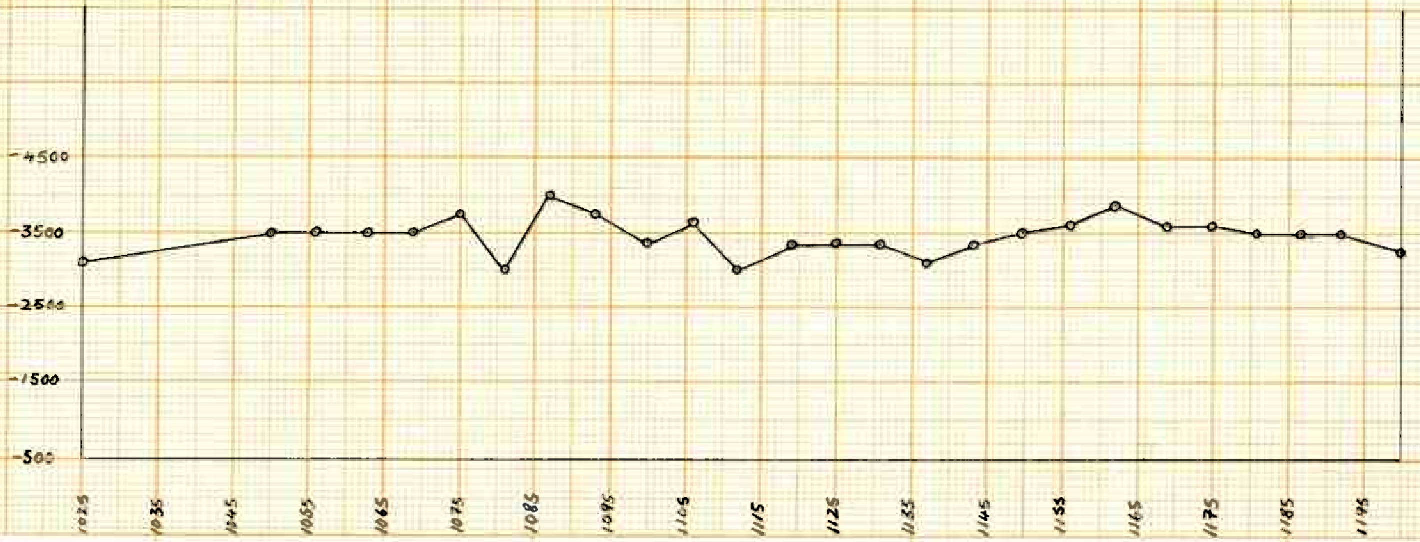
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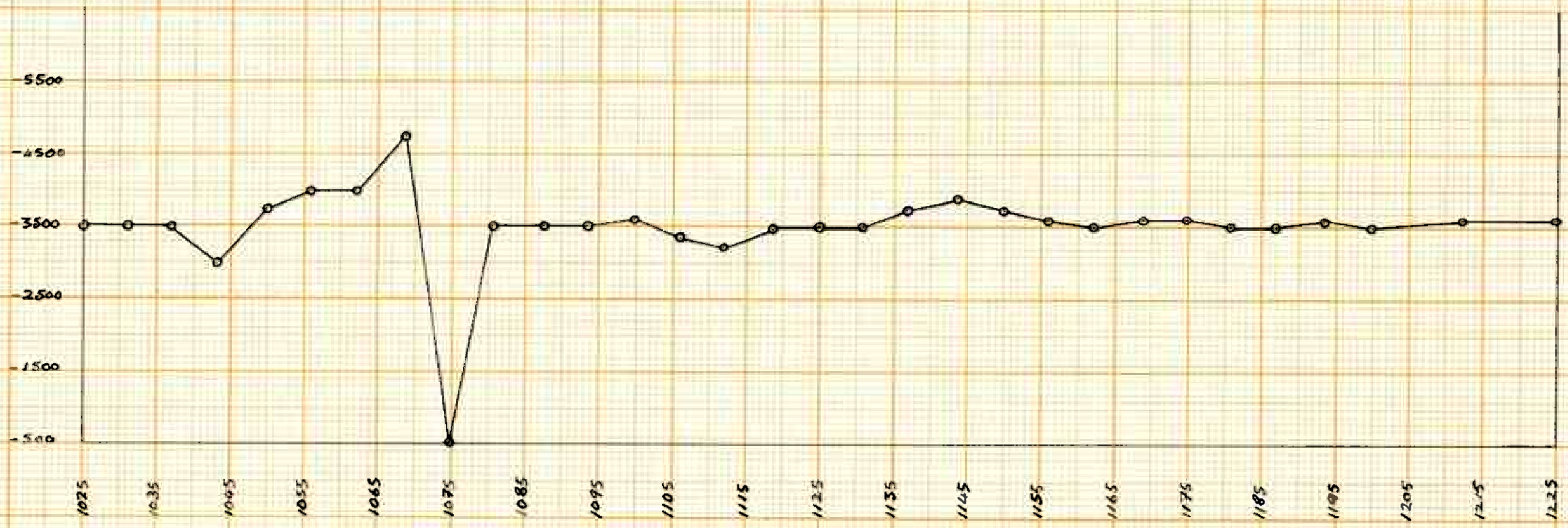
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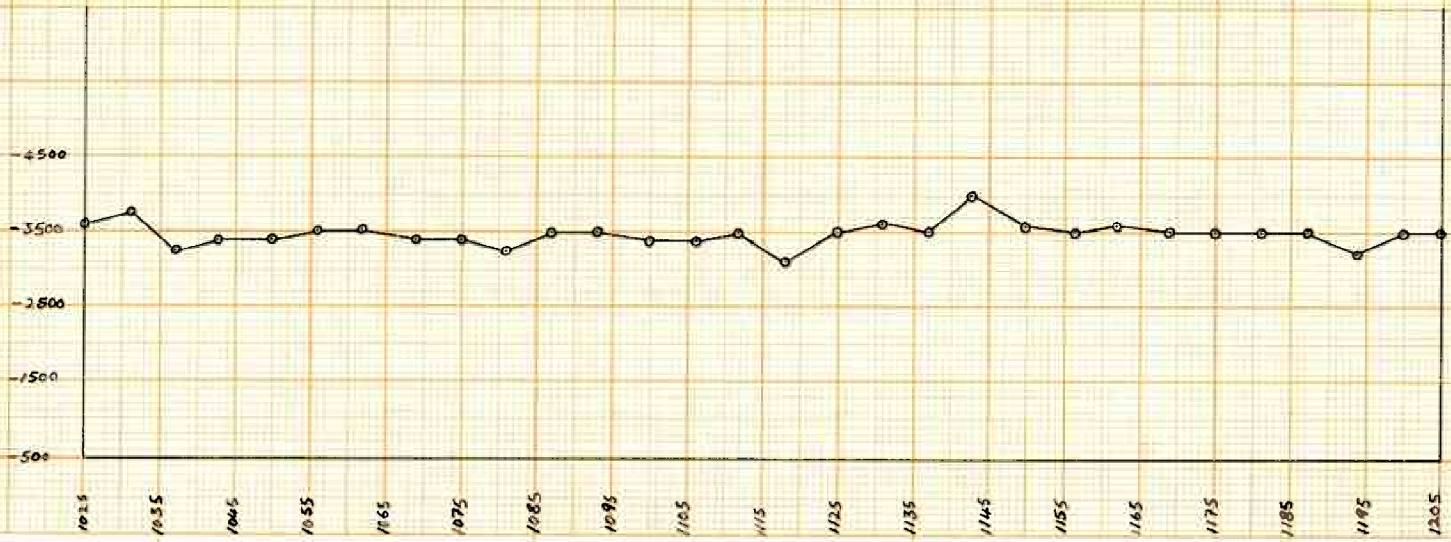
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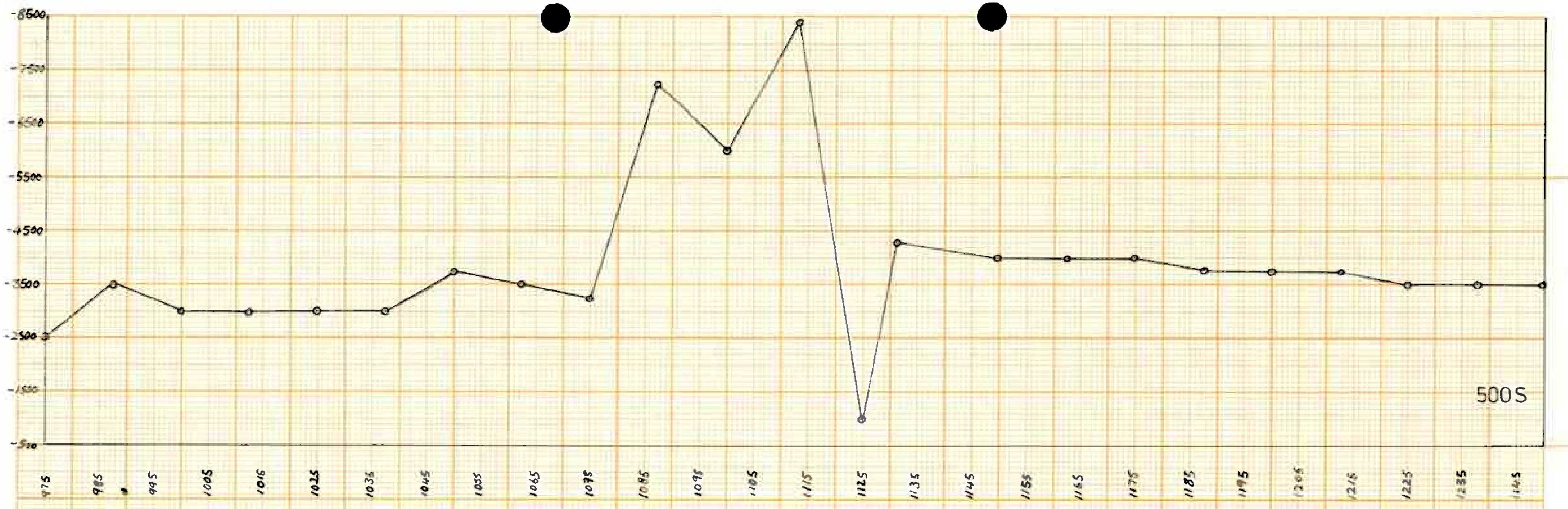
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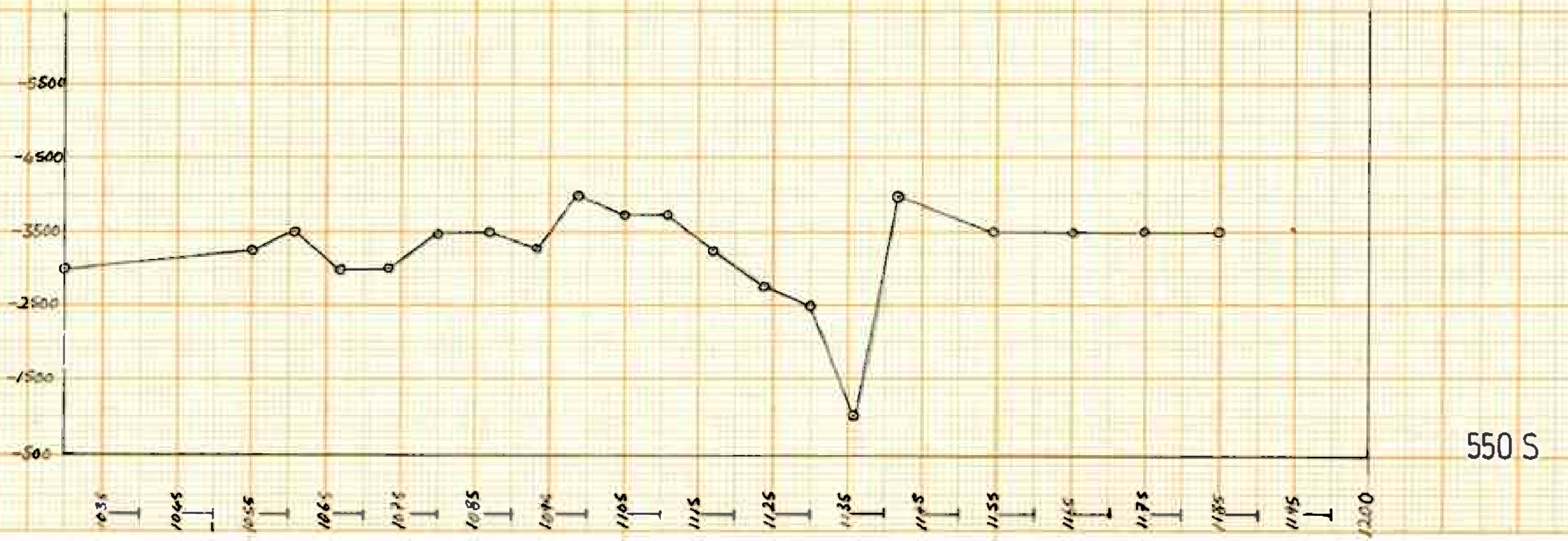
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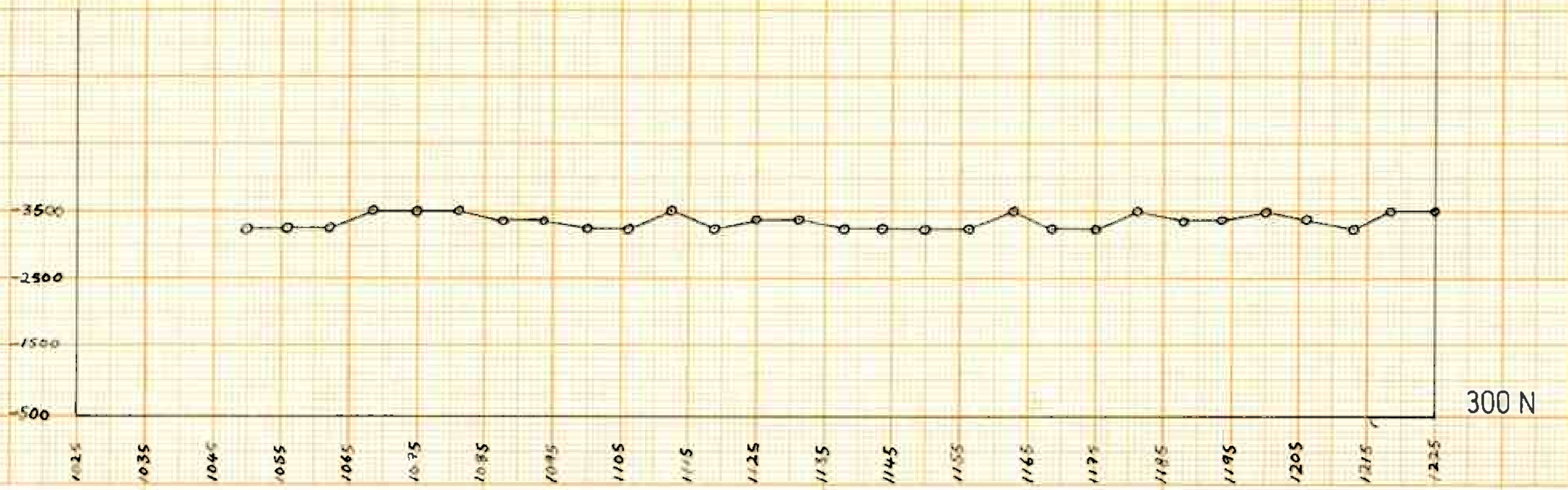
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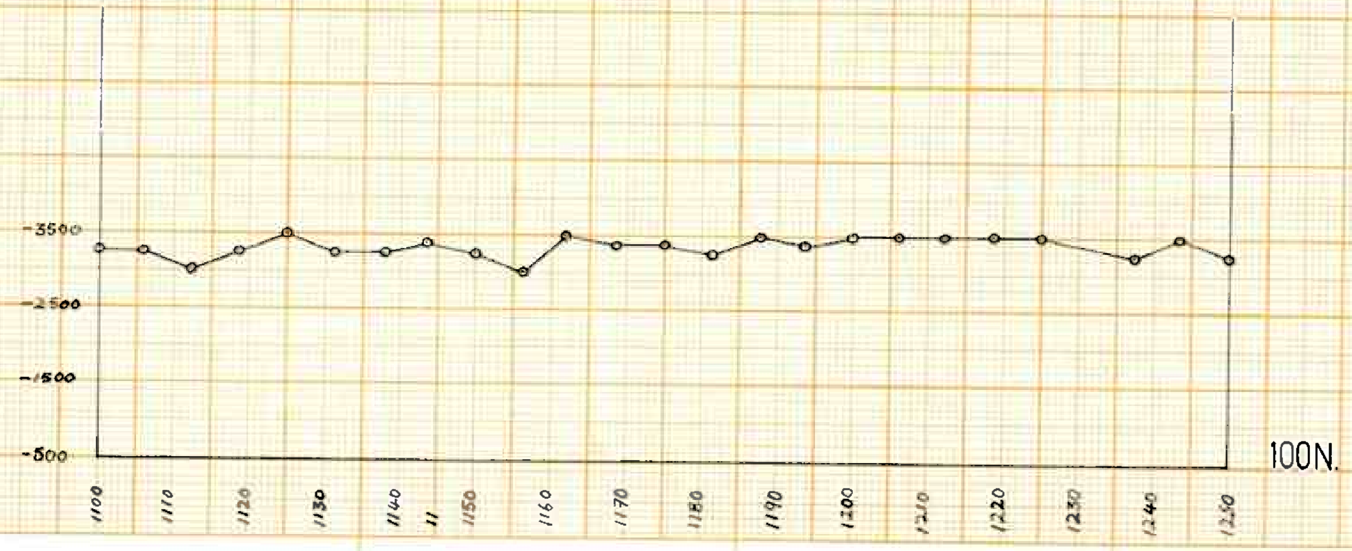

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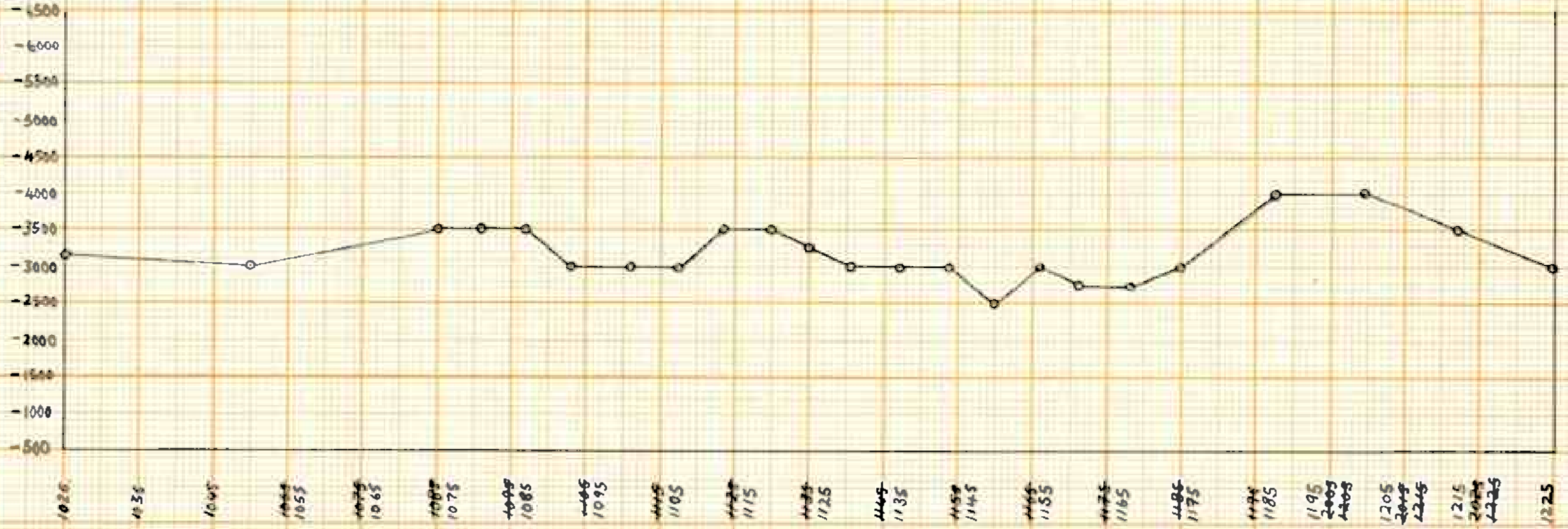

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1135
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1165
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1185
1195
1205
1215
1225

300 S.

-6500
-6000
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-4500
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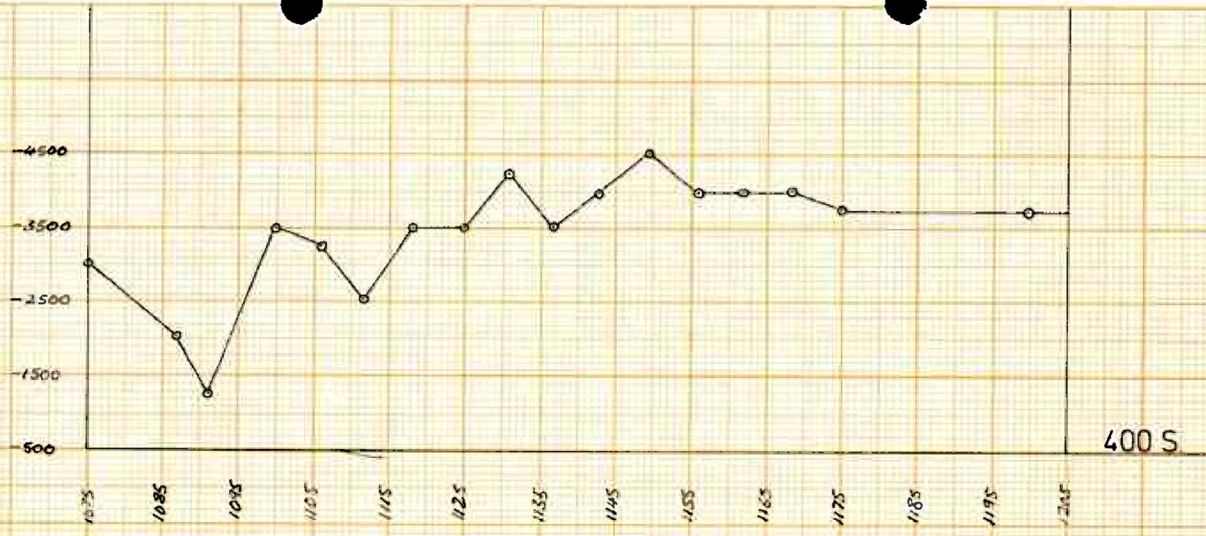

Proton-magnetometer