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Tittel

Report: Review of previous magnetic measurements and progress report on 1980 measurements

Forfatter	Dato År	Bedrift (Oppdragsgiver og/eller oppdragstaker)
Carstens, C.W	09.10 1980	Management commitee of FENCO

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Nome	Telemark		17134	Skien

Fagområde	Dokument type	Forekomster (forekomst, gruvefelt, undersøkelsesfelt)
Geofysikk Geologi		Gruvåsen Vipeto Raudhaug Norsjø Damtjern Fenfeltet

Råstoffgruppe	Råstofftype
Malm/metall	RE

Sammendrag, innholdsfortegnelse eller innholdsbeskrivelse

Fenkomplaksets alkaline bergarter har høyere magnetisk signatur enn omliggende gneisser.
Rapporten beskriver gjennomføring av nye magnetiske målinger emd protonmagnetometer, samt noen VLF-målinger for å kartlegge tektoniske soner.
Finner en del avvik fra de tidligere målinger, kanskje mest som følge av at det har vært vanskelig å etablere hvor de gamle målestasjonene var.
Det er registrert en magnetisk struktur ved Vipeto hvor Nb er funnet i Søvitt.
det foreslås nye målinger over hele Fen komplekset.

Elkem a/s
Engineering Division

R E P O R T

TO: MANAGEMENT COMMITTEE OF FENCO

FROM: Elkem a/s
Engineering Division
Nydalsveien 28
P.O.Box 4224
OSLO 4

SUBJECT: REVIEW OF PREVIOUS MAGNETIC MEASUREMENTS AND PROGRESS REPORT ON 1980 MEASUREMENTS

Summary:

In 1949 the major part of the Fen complex was covered with ground magnetic measurements.

The alkaline rocks within the Fen complex seems to be magnetic high compared to the sourrounding gneiss. However, it is generally difficult to correlate the magnetic contour map with Sæter's geological map.

In the Vineto-Raudhaug area and Gruvåsen there were few available data. We have this Summer started following up total magnetic field measurements in these areas. The new magnetic profiles are partly overlapping the old ones.

Unfortunately, it is discrepancies between the old base map (containing the previous magnetic raw data) and new maps. We have transfered the raw data into the new map but still the magnetic stations may be 20-40 m out of the true position. The difference in gradients and magnetic level between the old and the new magnetic data are also greater than it should be between vertical and total field data. Geophysicist Ø.Logn (who is one of the authors of the previous magnetic report) has been consulted concerning the problems of comparing old and new magnetic data. He is now suggesting to cover all the Fen complex with new magnetic ground measurements. We hope that the Management Committee of FENCO shall give us a green light for new magnetic action in the whole Fen complex. If using a similar grid as the previous measurements, the investigations can be carried out within one month this year.

Helicopter measurements are probably not a good alternative to ground magnetic surveys. The resolution will be poorer.

The new magnetic measurements in Vineto-Raudhaug area are revealing clearly north-south magnetic structures. The clearest magnetic high is passing the road cut in Vineto where niobium have been indentified in the søvite. Remembering that the previous niobium crude ore contained about 3% magnetite. We have to pay attention to magnetic structureanomalies with applitudes in the range of 1000-1500 γ

Magnetic measurements in the geochemical grid in Gruvåsen are revealing magnetic anomalies up to 4000 γ The anomalies are indicating that the hematite dikes must contain more magnetite than previously assumed.

Place/Date Oslo, 9.10.1980

C.W.Carstens

C.W. Carstens

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1. Prevoius magnetic investigations.

1.1. Geological/geophysical Correlation of previous work.

The available material was Sæter's geological map and a geophysical contour map from "Geofysisk Malmleting". The Scales were different and the geological map was blown up to the scale of the magnetic contour map to see how the magnetic map corresponded with the geology.

In accordance with the report from "Geofysisk Malmleting" the gneises are magnetic low compared with the Fen complex. Generally speaking the correlation between the rocks within the Fen complex is not too good. The magnetite content seems to vary much within the different alkaline rocks in the Fen complex.

Especially it seems that the magnetic results cannot add much informance concerning the borders between søvite and the raudhaugitt.

Some positive comments can also be added.

In the western part of the complex it sometimes seems to be possible to differ the fenite from the basic silicate rocks and the søvite. In the central part of the area there is a mapped "island" of basic silicate rocks within the søvite. The magnetic contour map seems to differensiate this "island".

Remembering that the niobium concentrations generally occur associated with some magnetite, I think it is worth noticing a magnetic circular high east of Tufte. According to the report from "Geofysisk Malmleting" a few søvite samples have been analyzed showing up to 0,2% Nb_2O_5.

From the raw data it follows that the magnetic high on the road to Skien in "the Fenmyra" is 100 - 150 higher compared with the magnetic level within the gneiss. This may be an indication that the magnetite in the raudhaugitt may extend to south-east toward the "Fenmyra".

1.2. Evaluation of the value of previous measurements.

Unfortunately, there are considerable discrepancies between the old basic map containing the magnetic rawdata and the new economic maps. Woth respect to following up mapping and geophysics it was necessary trying to transfer all the raw data into a new map.

We have spent much time on that work, but still the majority of the magnetic stations may be 30-40 m out of the correct position. It is also worth noticing that the space between the stations were measured in field by paceing. In places where new and old magnetic data are overlapping the gradients and the magnetic level are not satisfying. The discrepancies between old and new magnetic data are greater than it should be for vertical field and total field data. The problems can be studied by looking at the figures 3-12. The old magnetic data are drawn on an overlay which is movable in relation to the new magnetic data.

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Geophysicist Ø.Logn has been consulted concerning the problem of comparing new and old magnetic data. He is now proposing to cover all the Fen-complex with proton-magnetic measurements. The old data can be used to optimize new measurements concerning the may to choose a new grid system. If using a similar grid as the old one, measurements in all the complex can be carried out within one month this year.

2. Progress on 1980-measurements

2.1 Motivations

Knowing that the correlation between the old magnetc map and geological data was not too convincing, the most correct survey step would be to carry out systematically susceptibility measurements to see if this could give motivations for following up investigations with respect to adding informations to geological mapping.

However, we started the measurements without any susceptibility-tests. Traditionally magnetc measurements is the most relevant geophysical method in carbonatites. Knowing that the previous mining for Niobium had been done in søvite dikes with about 3% magnetite in them, we hoped to get indications of potential Niobium-resources.

We utilized a proton magnetometer which measurements normally are 2-3 times faster compared to an old mechanical vertical instrument.

Unfortunately, when starting the measurements, we did not know about the difficulties in positioning the old magnetc stations on new maps. The consequence is that we should have made more overlapping with old magnetic measurements.

So far we have carried out about 15 profiles-km. Generally a 100 m grid has been used. The distance between the stations was 20 m in the profilelines. The survey has mostly been concentrated on the Vipeto-Raudhaug area. Previously there were very few data on that area. But also profiling has been done along the Norsjø, both on shore and on the lake. The geochemical grid in Grubeåsen had been used to do a rapid survey in that part of the area.

2.2 Results from Vipeto-Raudhaug area

So far about 9 km profilelines are measured in Vipeto-Raudhaug area. Contour map of the results is enclosed (See fig. 1). Especially towards north and west there was agricultural land which made investigations impossible.

The contour map is showing a very clear north south structure, and one should notice the high magnetic anomalies running north-south. Especially it is worth noticing the magnetic high running from the southern border of the complex through Kollen, the farms, Vipeto-øvre and Vipeto-nedre towards the main road to Skien.

The magnetic structure is also passing the road cut in the Vipeto area where Niobium has been seen in the søvite.

Enclosed in this report there are some magnetic profiles into which Sæters geology has been plotted. (See fig.2-12) From the profiles it generally follows that it is difficult to correlate the new magnetic results with Sæter's geological map. An exception is profile 4, where the raudhaugitt, the søvite and the damtjernit are revealing different magnetic levels. (See fig.16)

By studying the curves from all the profiles and by ignoring very disturbed curves, some average magnetic values corresponding to different rock-types have been figured out: The result is as follows

Gneiss	Basic silicate rocks	Rødberg and Raudhaugitt
50200 γ	50280 γ	50325 γ

Søvite
50350 γ

Typical for the damtjernit, is that the magnetic results varies from background values to quite high anomalies. The figures may indicate that is is reasonable to expect that magnetic measurements sometimes can be helpful in geological mapping. It will be interesting to compare the results with following up geological mapping.

2.3 Some results from VLF surveys in Vipeto-Raudhaug area

The major part of the magnetic profiles were also measured by VLF. One should notice that the VLF-measurements did not slow down the magnetic measurements. The lines were not marked in the field, and to navigate the profiling it was necessary to be two men with a 20 m rope in between them.

The objective of the VLF measurements was to make a try in mapping tectonized zones. A map of the results are presented in fig. 2. A marked conductor is running north-south from the Damtjern area to the main road. This conductor may represent a continuation of the fault on Sæter's map north of Damtjern. Two other north-south running structures have been detected. It is difficult to say if those represent iron-ore, mineralized dikes or faults.

2.4 Results from Norsjø area

Results from the profile passing close to the Norsjø area are generally indicating a magnetic low ($< 50.000\gamma$). The profile is mainly crossing fenite rocks and one reason for the magnetic low may be that some magnetite has been removed as a result of the fenitization. The magnetic low values indicate also a structural closure towards north of the Fem complex. It is however worth noticing that a small søvite dike at Torsnesodden gave a magnetic high.

The results from the east-west profile on the Norsjø, east of Labukta, are also indicating low magnetic values. So far the magnetic curve seems to reflect the depth to and the slope of the bottom, instead of indicating any extension of søvite dikes or any niobium placer deposit.

2.5 Results from Gruveåsen area

In Gruveåsen area the magnetic result is reflecting the dikes of iron ore. Previously it was assumed that the major part of the dikes represented hemalite ore. We have however obtained magnetic anomalies from 1000-4000 γ which also must indicate a lot of magnetite.

3. Conclusions

Mainly because of bad discrepancies between the old base map (containing the old magnetic rawdata) and the new map, it is a problem to utilize the old magnetic data for following up measurements. At areas where new and old measurements can be compared, the gradients and magnetic level are not in too good accordance. The discrepancies are geater than they should be for vertical and total field magnetic results.

The problems have been discussed with geophysicist Ø.Logn, who is the author of the old geophysical report. We hope that the management committee shall give us a green light for covering the Fen complex by proton-magnetic measurements. If using a grid of 100 x 20 m about 2000 stations have to be measured. Within one month it is possible to carry out a magnetic program like that. The best time for field work in Fen area is the months October and November.

The new magnetic data seem to give detailed information of the magnetic structure. It is worth noticing that a magnetic hihg structure is passing over the road cut in Vipeto where som Niobium has been found in the søvite.

In Gruveåsen there are some magnetic anomalies rising up to 4000 which indicate the existence of more magnetite than previously assumed.

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4. Appendix.

4.1. Audio magnetotelluric (A.M.T.) surveys-premiminary results.

During 3 days 1 km A.M.T. tests were carried out. The objective was to try to map some deep structures of the complex.

The investigations were limited to the Gruvåsen area to avoid too much influence from powerlines.

It is difficult to interpretate the data. So far resistivity contrasts have been interpretated from 800 m to 1,5 km below the ground level.

The measurements are few in numbers and it may be dangerous to explain the results. The most relevant explanation is perhaps a contact of two different rock types at the above mentioned level. Perhaps we cannot look away from a possible deep seated iron ore.

To carry out further investigations we have to stop all current in the areas and I do not think we at this stage have motivations for doing that.

4.2. Gravimetric interpretation.

It is worth noticing the gravimetric high above the Fen complex. The anomaly is so considerable that it is difficult to explain it from the known density contrast within the alkaline rocks. The geophysical department on the Norwegian geological Survey (NGU) have promised to carry out some modeling purpose based on Ramberg's raw data taking into consideration the known mineralizations of iron ore. We will try to give them more information concerning the extension of iron ore and give them more density data of the different rock units.

4.3. Vertical Seismic prospecting (VSP) - A pobsible future investigation method.

From Dr. T.S.Hansen (project supervisor for ore seismic in Norway) we have learnt that vertical seismic prospecting (VSP) has been carried out at Sokli to map the deep structures of the carbonatite plugg. By that method good results were obtained.

By the VSP method geophones are placed into the bottom of a deep drillhole. The explosives are placed on the ground on different places at each side of the drillhole. By a set up like that the conditions for mapping deep structures are optimized compared to ordinary reflection seismic on the ground.

As far as we know nothing has been published about the VSP investigations in Sokli. The method is sold by Technoexport which is a company in USSR.

It is worth considering to try the VSP-method in Fen.

51 000

52 600

Klokkerhavna

Vipeto øvre

Fensmyra

Main road to Skien

141500

141 000

Hårtvedt

51500

52 000

Clear conductor

Weaker conductor

Faults (from Sæther's map)

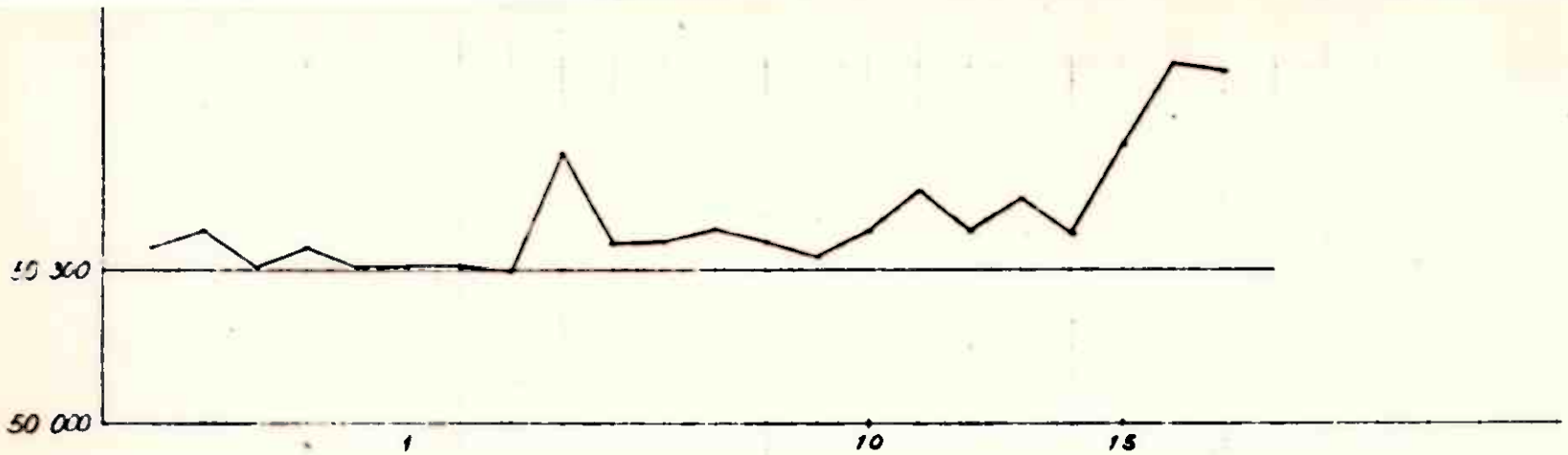
Magnetite

Hematite

CONDUCTORS FROM VLF MEASUREMENTS

(GBR)

Målestokk 1:5000	Tegn. C.W.C.
	Trac. GB9
	Kfr. C.W.C.
Erstatning for:	
fig 2	
Erstattet av:	



Magnetic vertical field measurements

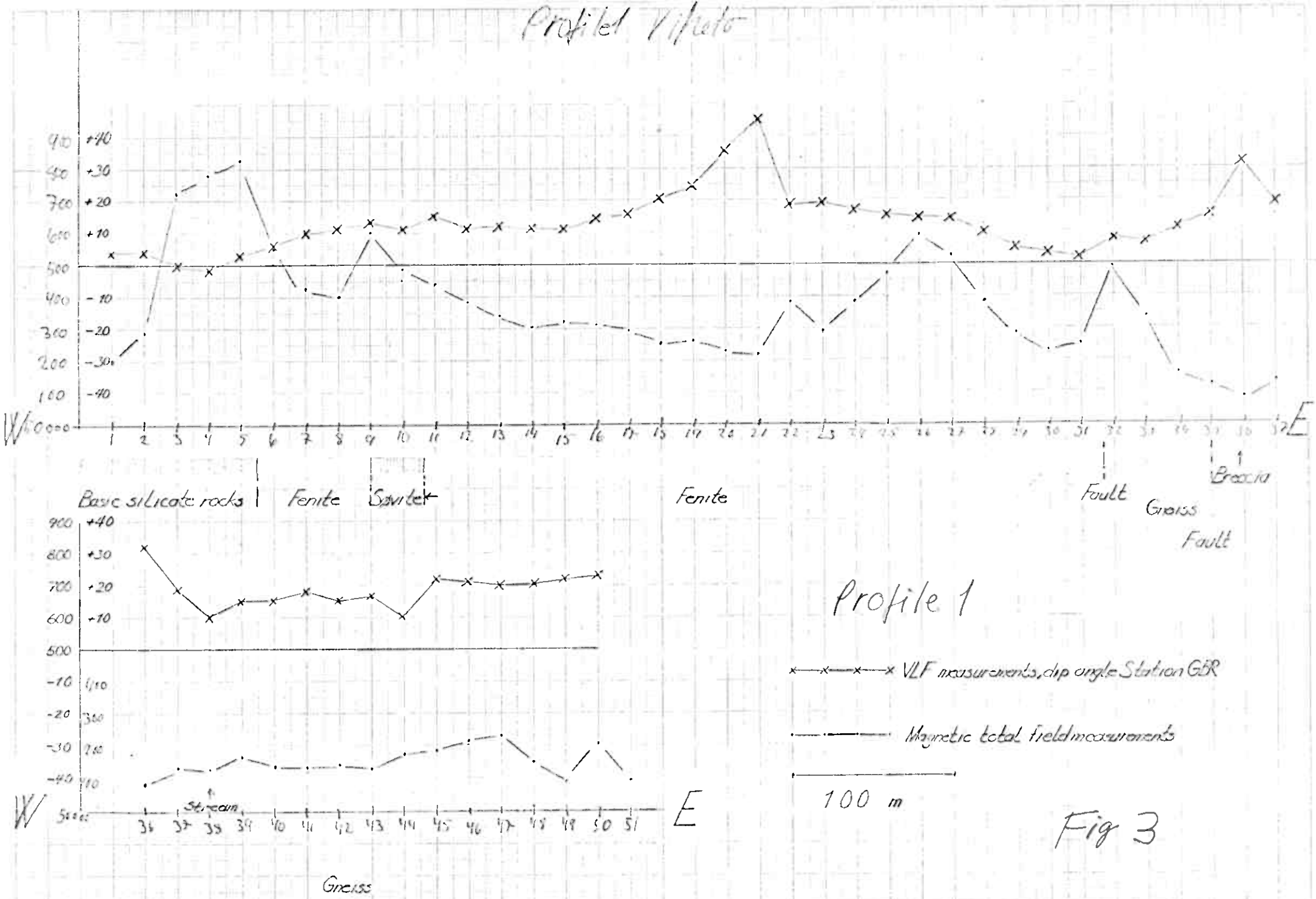
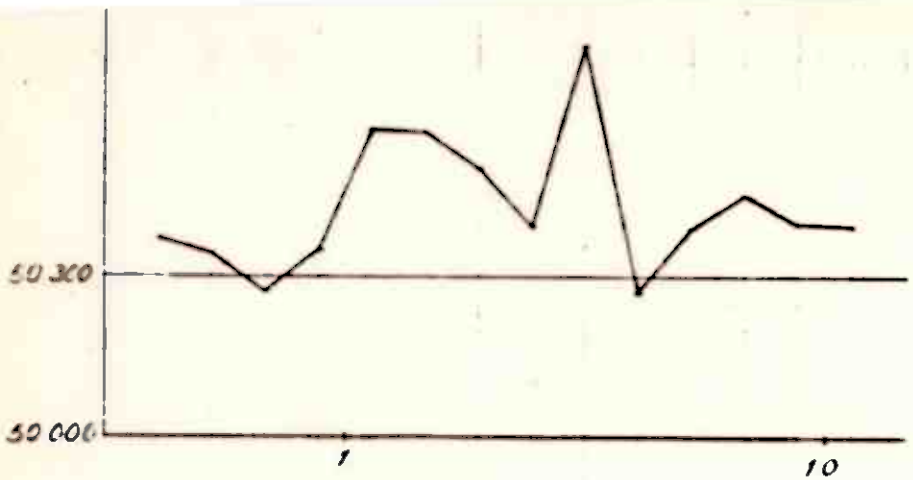

Profile 1 Photo
W
E
Basic silicate rocks
Fenite
Syenite
Fenite
Fault
Gneiss
Fault
Breccia
Stream
Gneiss
Profile 1
VLF measurements, dip angle Station GBR
Magnetic total field measurements
100 m

Fig 3



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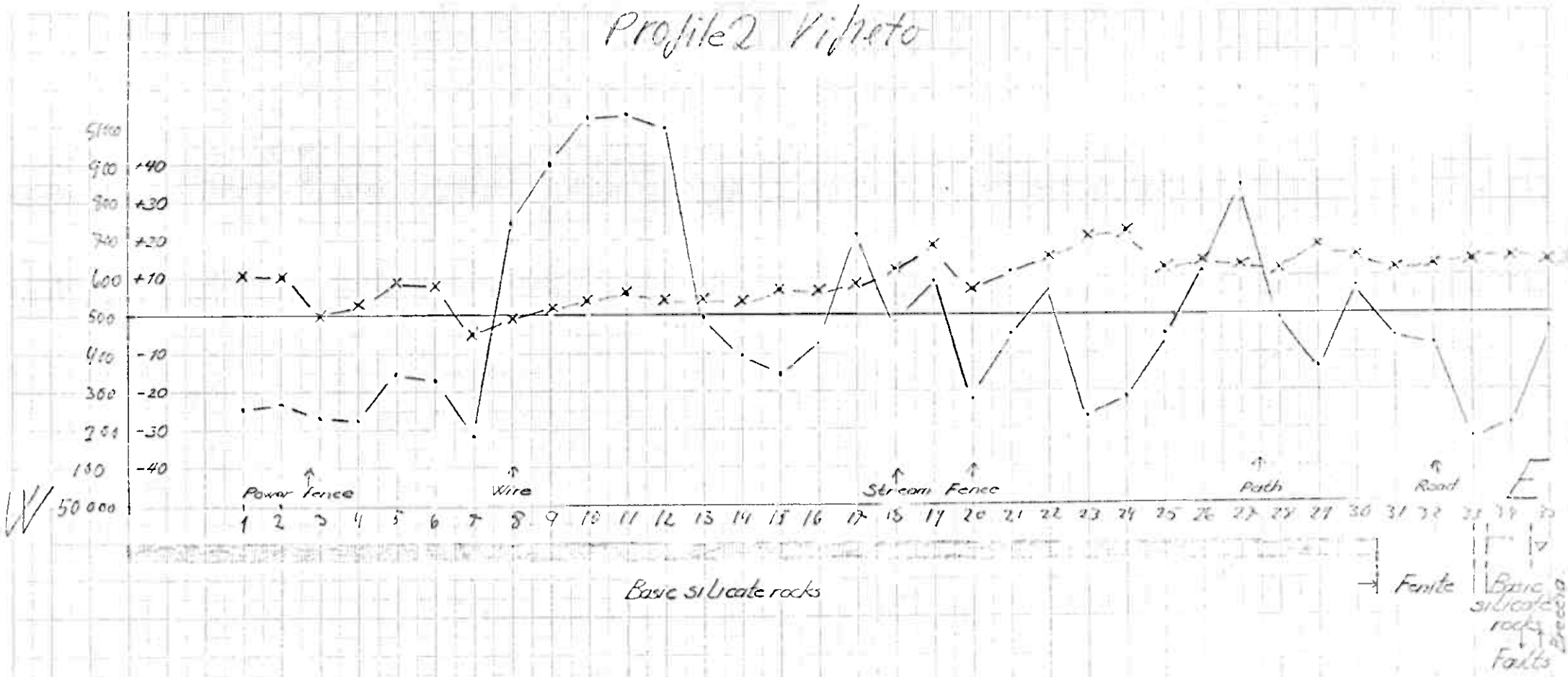


Profile 2

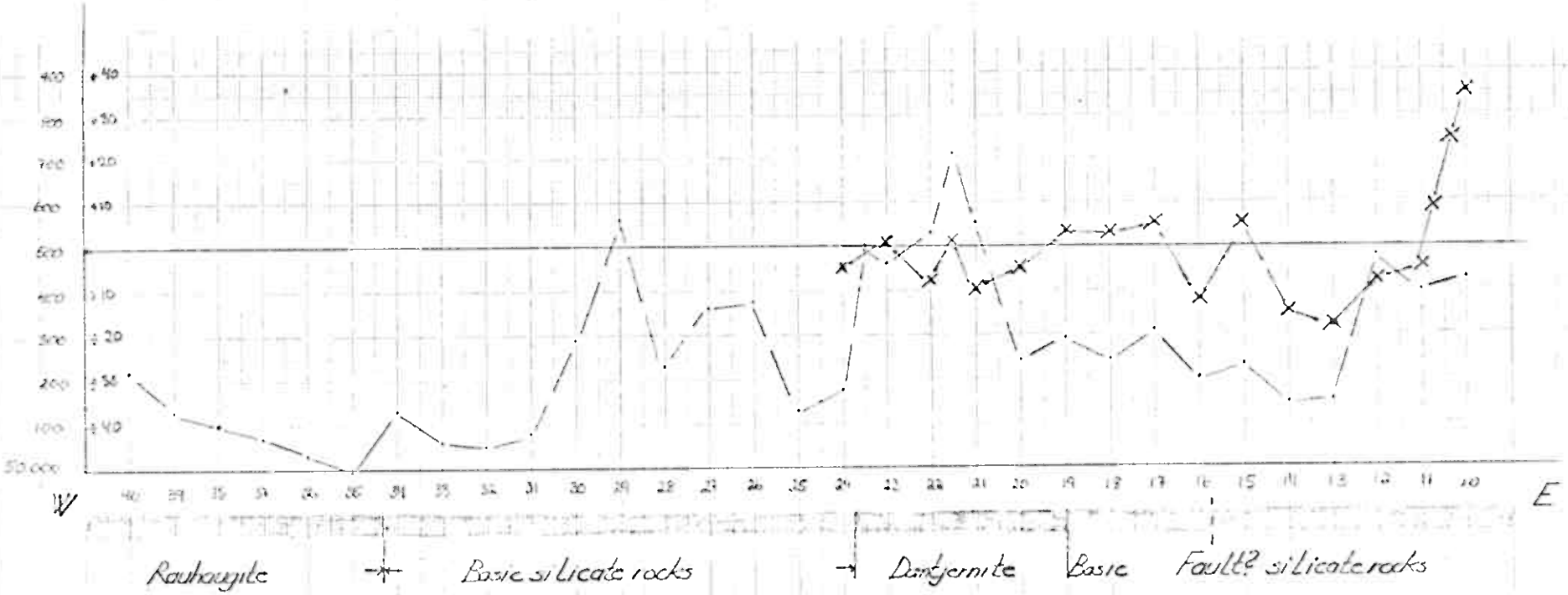
VLF measurements, dip angle Station GBR

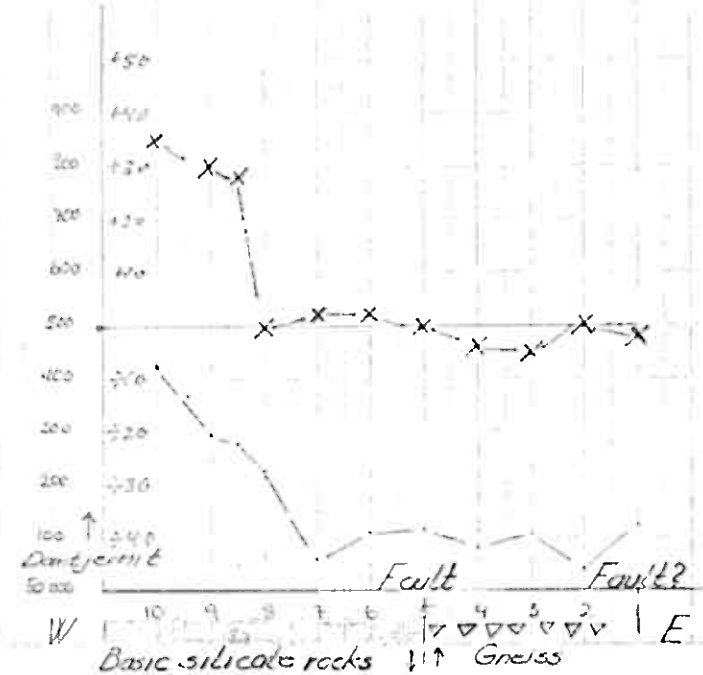
Magnetic total field measurements

100 m

Fig. 4

PROFILE 3 Vibefo





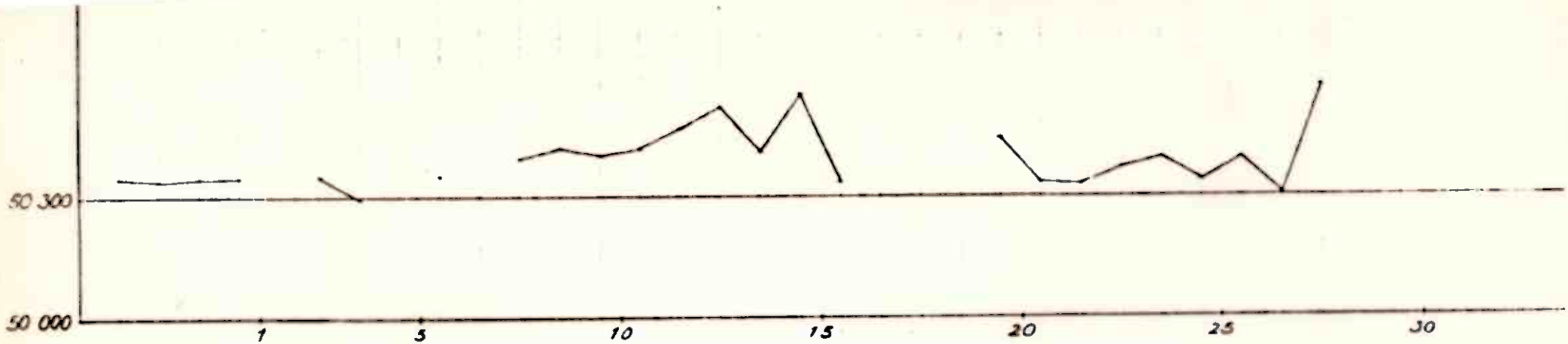
Profile 3

VLF measurements, dip angle Station GSR

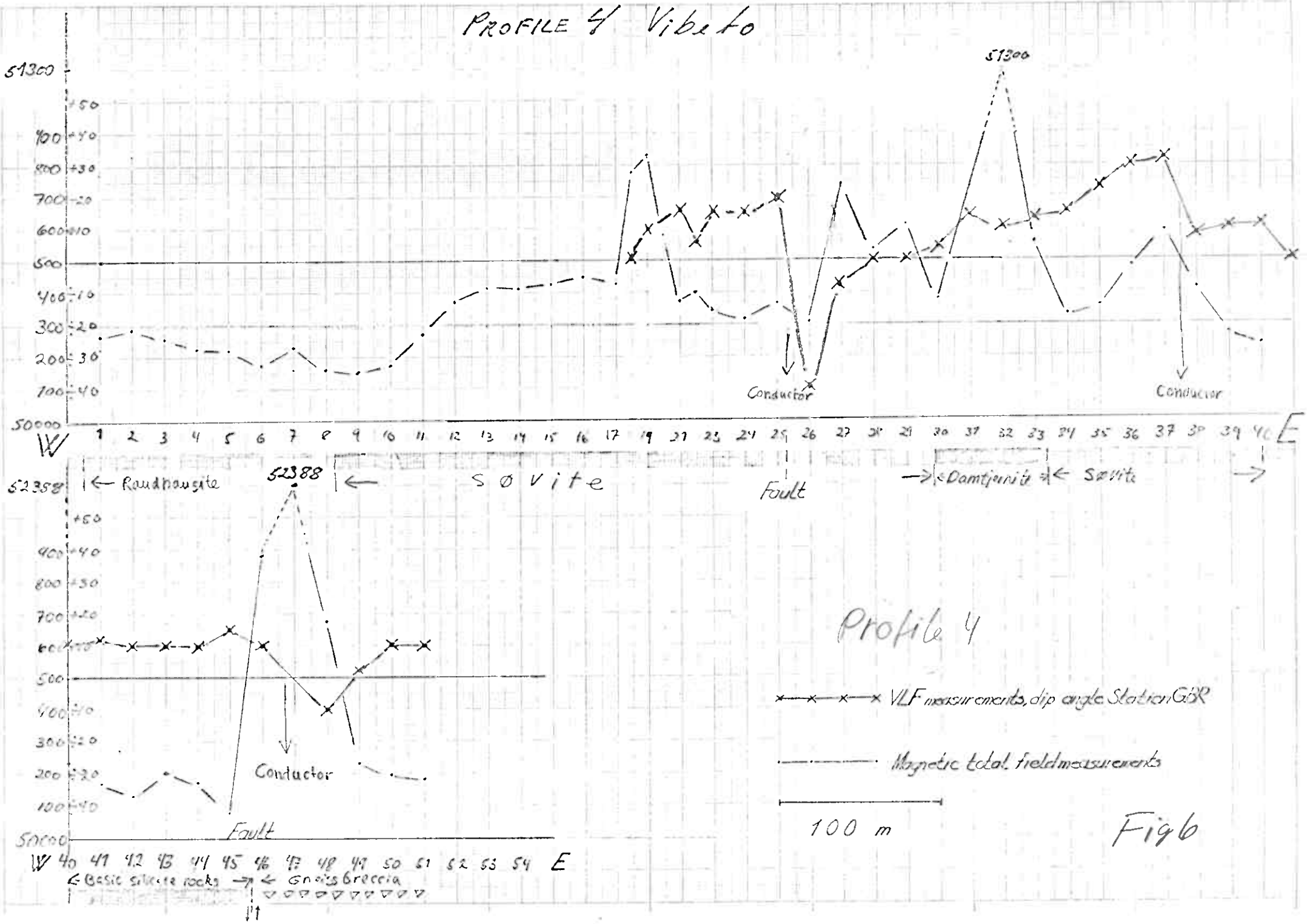
Magnetic total field measurements

100 m

fig 5



Magnetic vertical field measurements


PROFILE 4 Vibeto
51300
+50
+40
+30
+20
+10
500
-10
-20
-30
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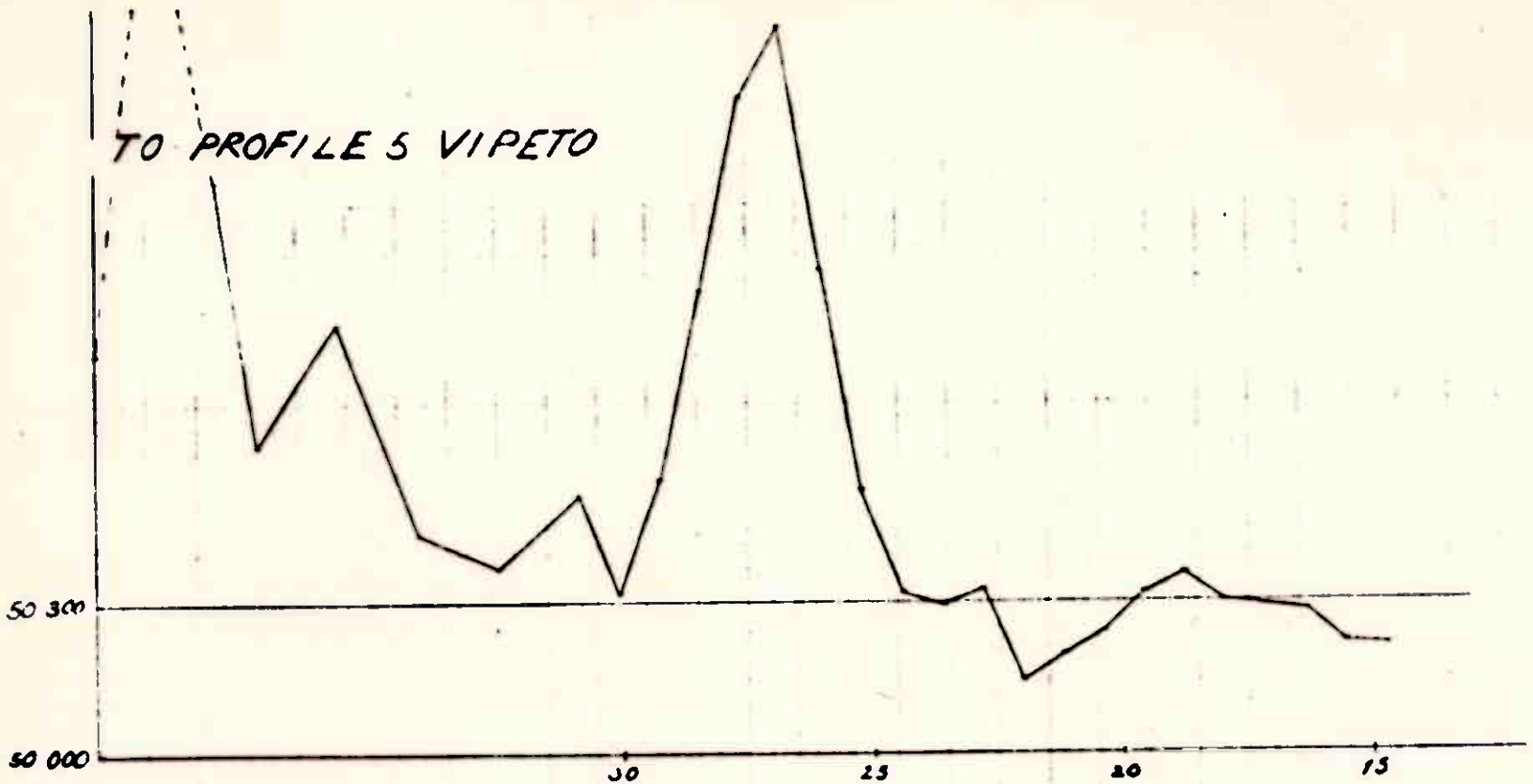
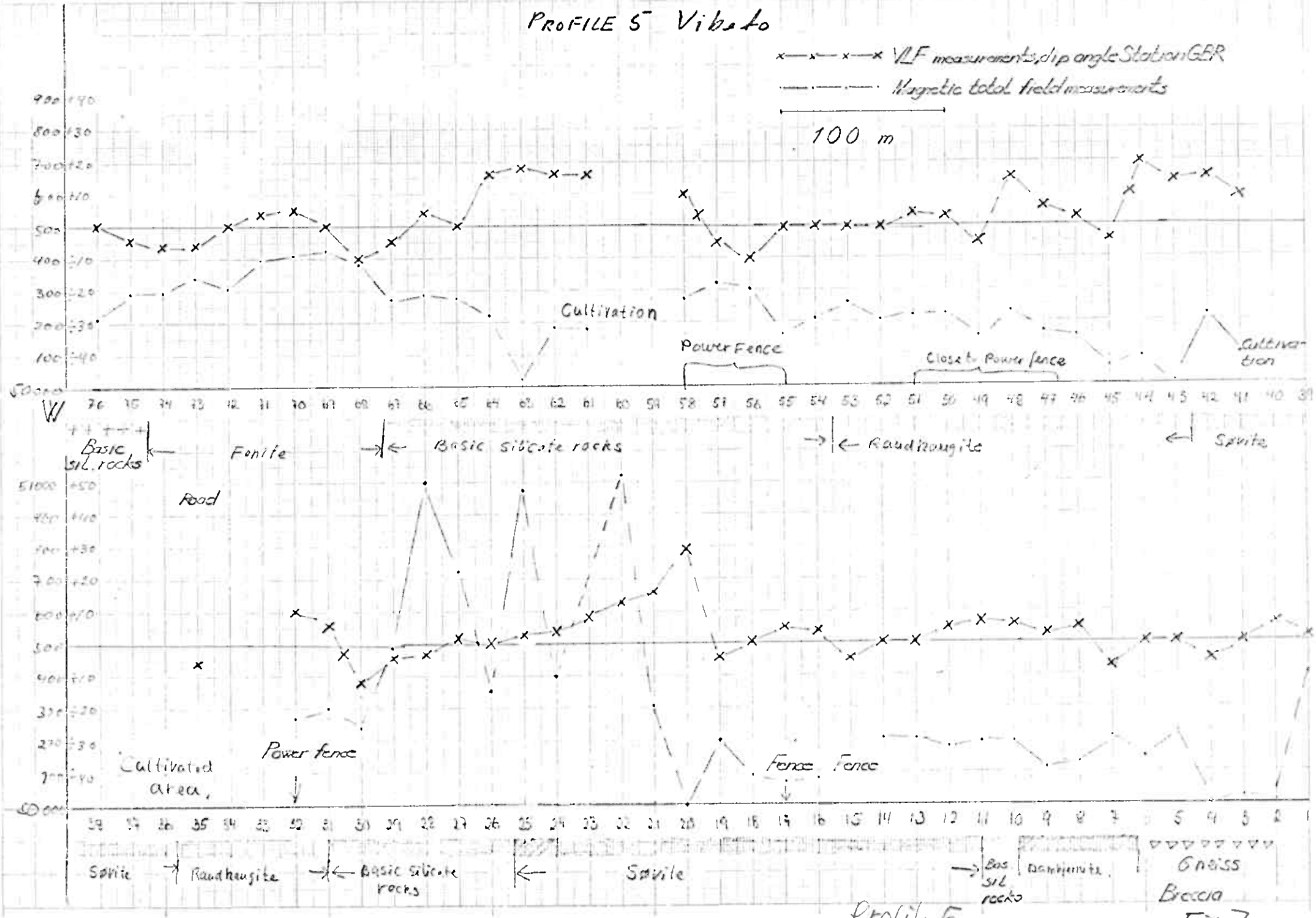
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 19 21 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 E
Conductor
Conductor
52388
52358
← Rondhaugsite
← Sø v i t e
Fault
→ ← Damtjernit ← Sø vite →
+50
+40
+30
+20
+10
500
-10
-20
-30
-40
50000
Conductor
Fault
W 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 E
← Basic silicate rocks → ← Gneiss breccia
Profile 4
VLF measurements, dip angle Station GSR
Magnetic total field measurements
100 m
Fig 6

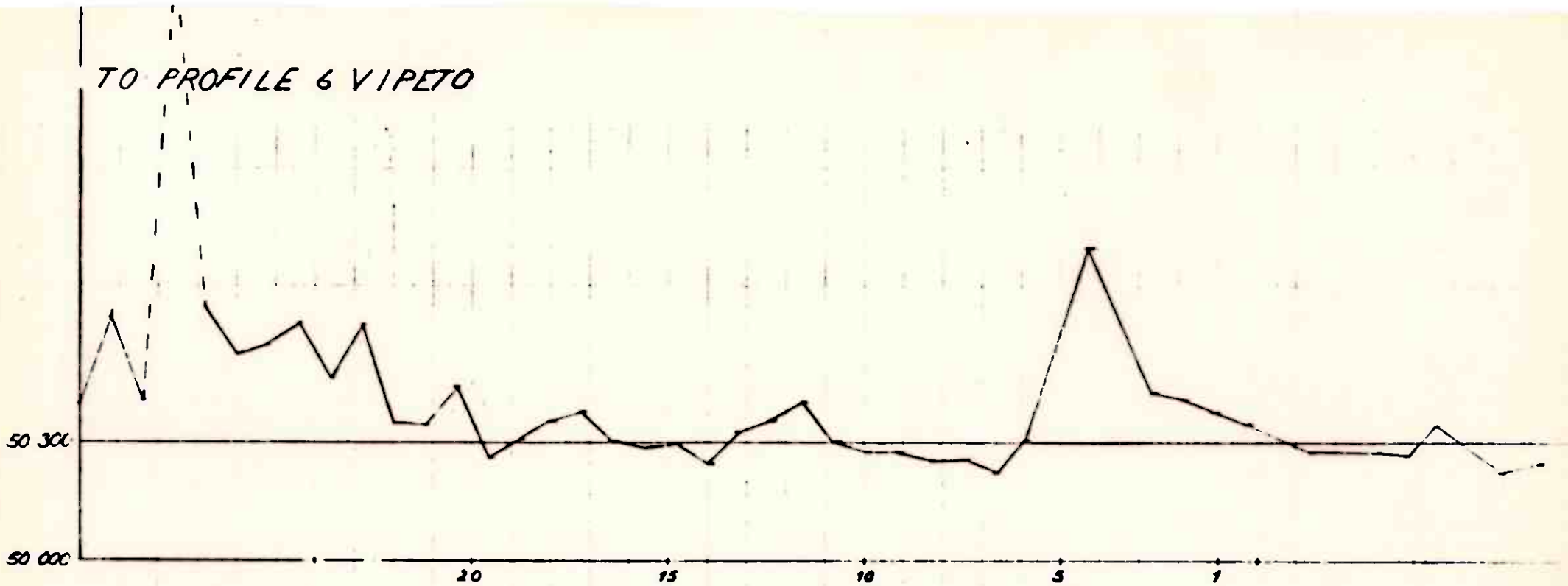


Magnetic vertical field measurements

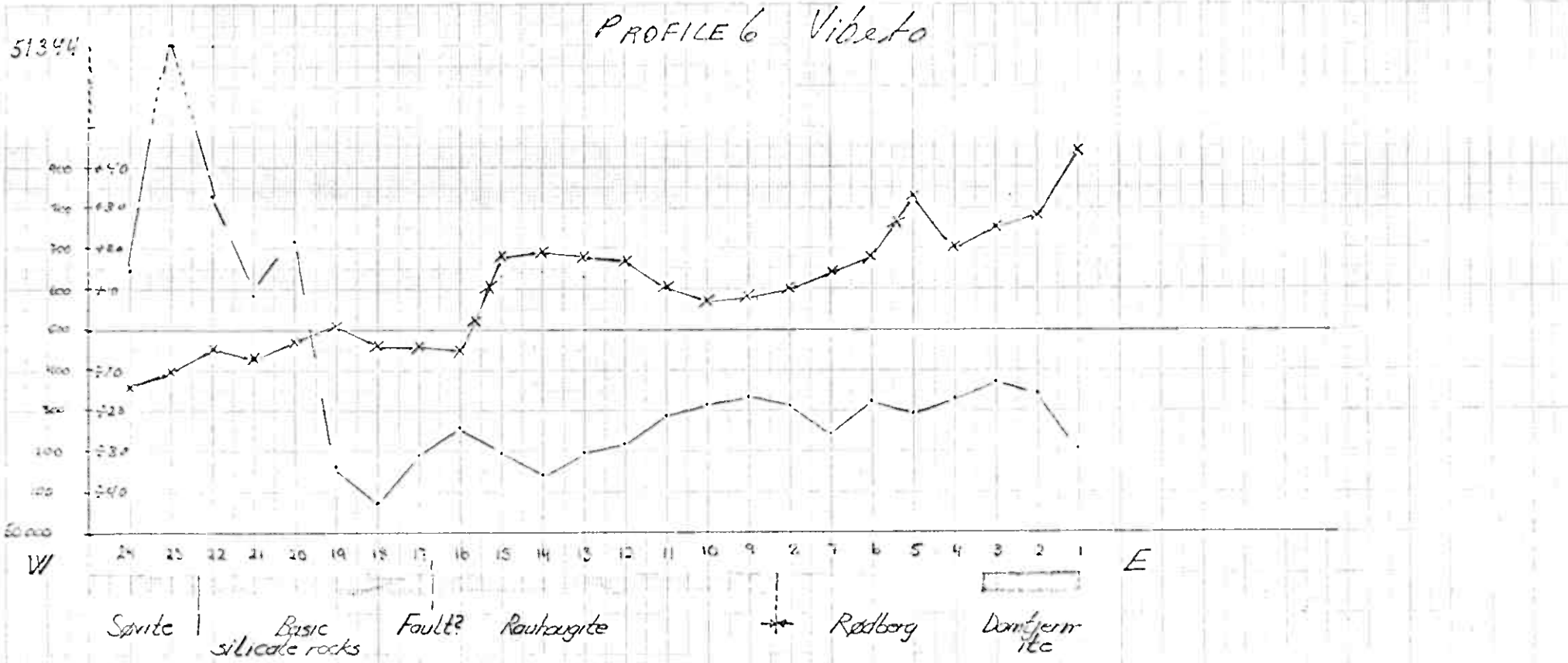


Profil 6

Fig 7



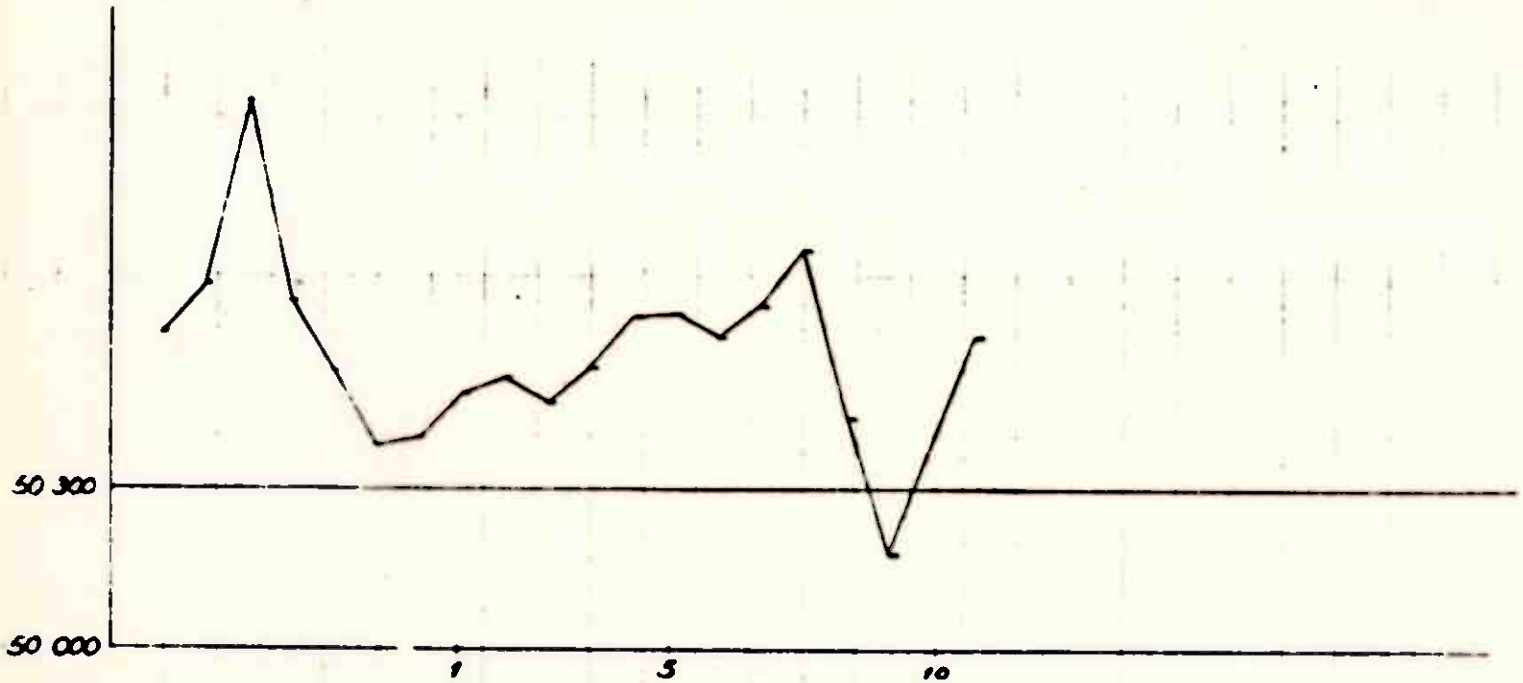
Magnetic vertical field measurements



Profile 6

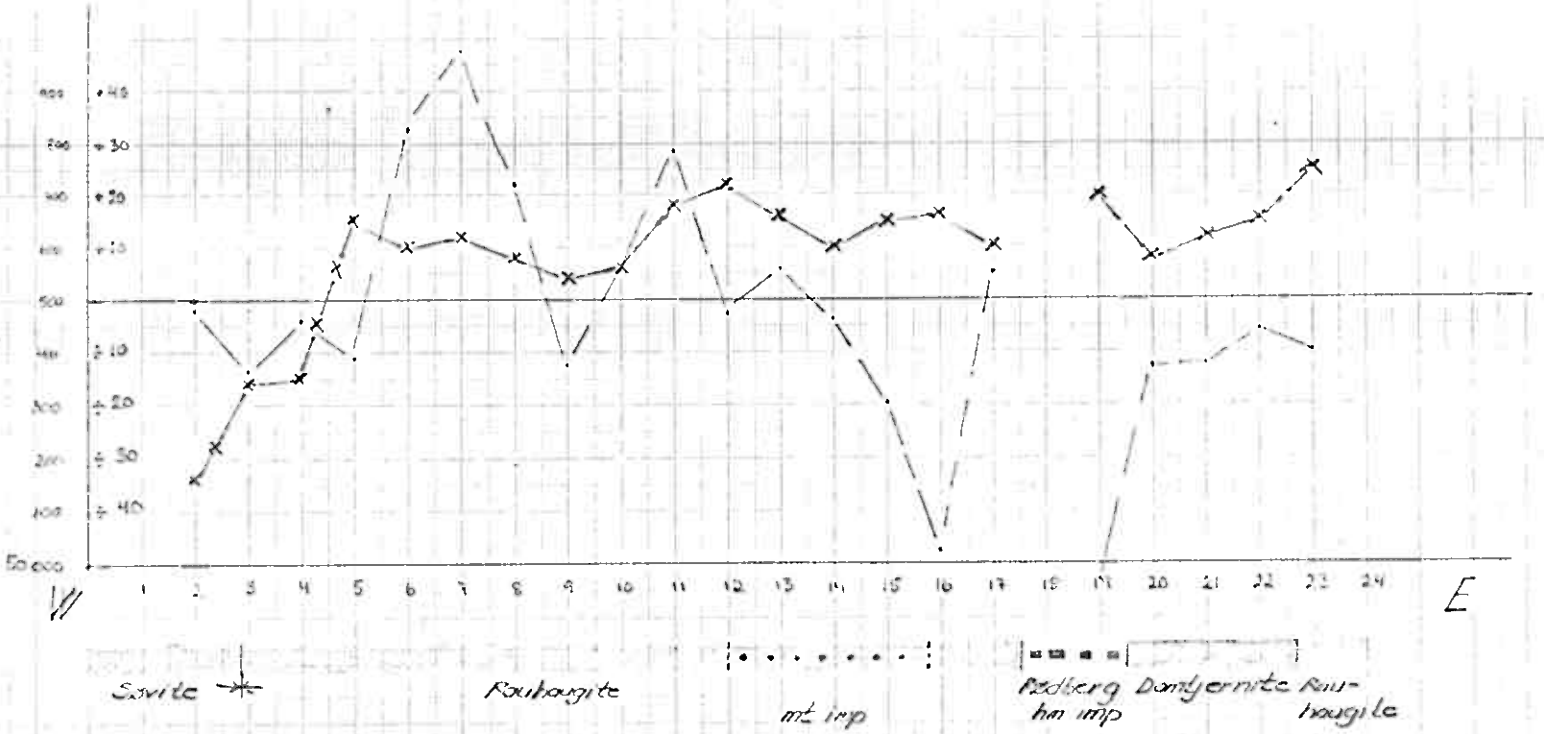
Fig 8

TO PROFILE 7 VIPETO



Magnetic vertical field measurements

PROFILE 7 Vibeto

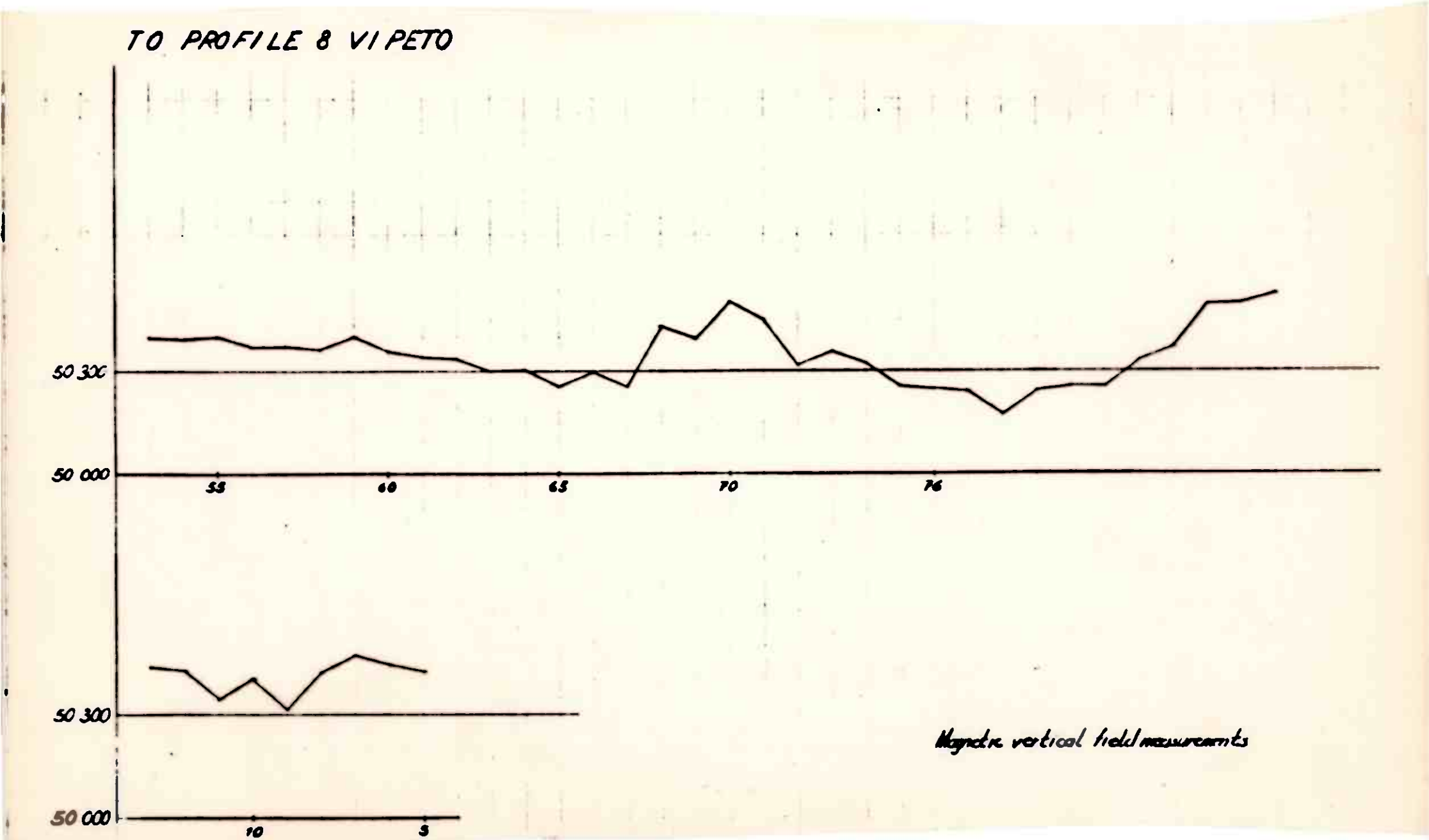


VLF measurements, dip angle, Station GBR

Mystic total field measurements

100 m

Fig. 9


TO PROFILE 8 VI PETO
50 300
50 000
55
60
65
70
75
50 300
50 000
10
5
Magnetic vertical field measurements

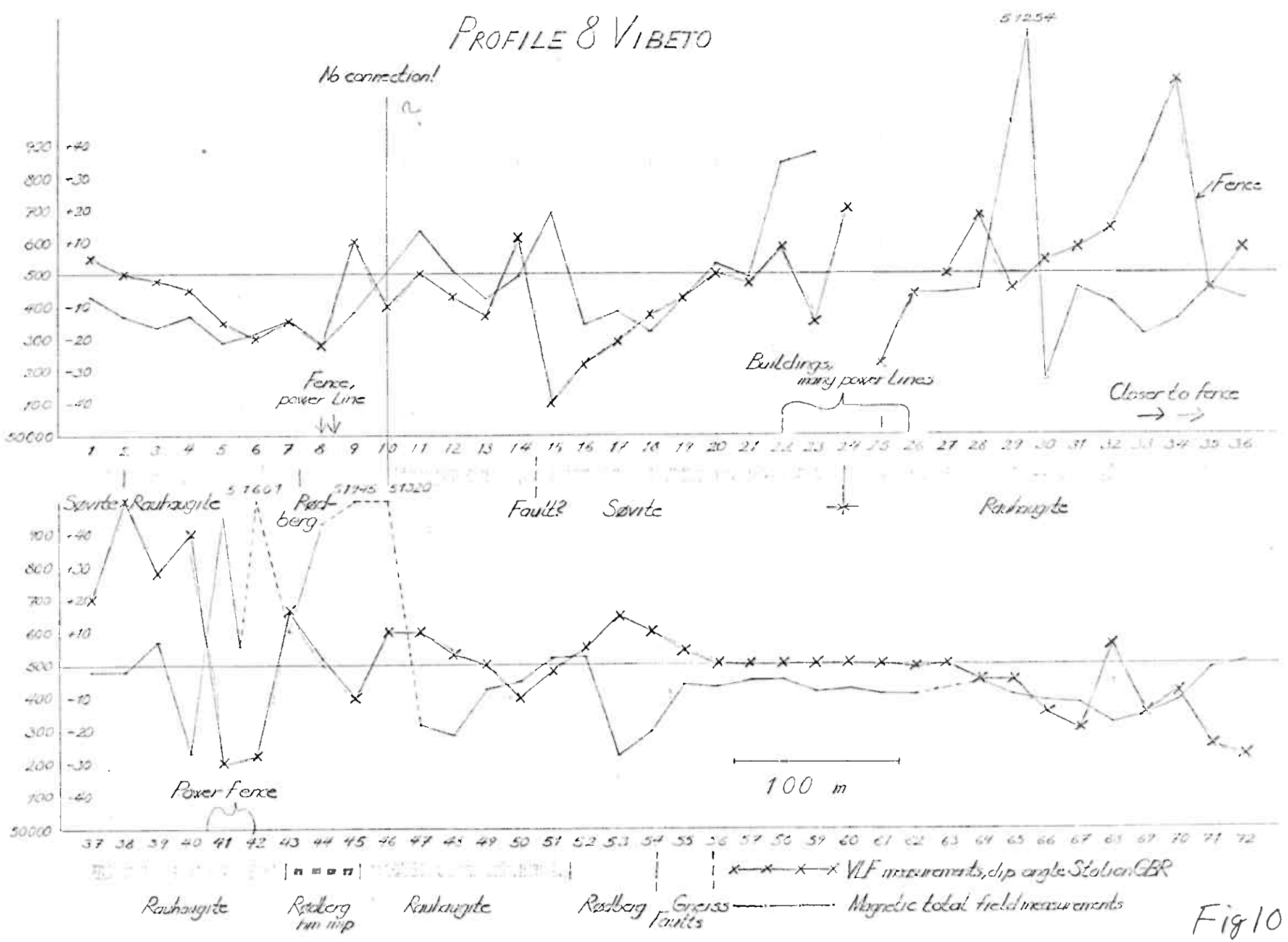
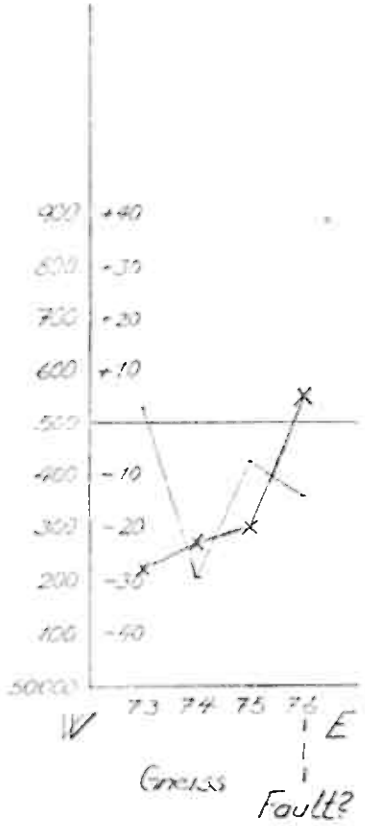

PROFILE 8 VIBETO
No connection!
Fence,
power Line
Buildings,
many power lines
Closer to fence
Fence
Fault?
Søvite
Rauhaugite
Rødberg
Poor fence
100 m
Rauhaugite
Rødberg
thin imp
Rauhaugite
Rødberg
Gneiss
Faults
VLF measurements, dip angle Station GBR
Magnetic total field measurements

Fig 10

PROFILE 8 VIBETO



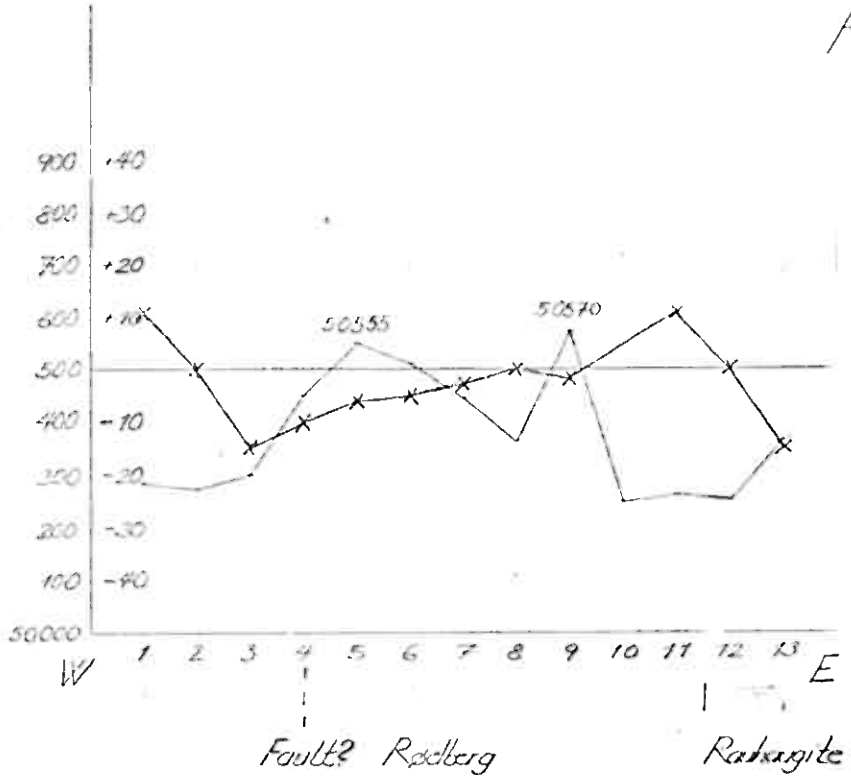
×—×—×—× VLF measurements, dip angle Station GBR

——·—— Magnetic total field measurements

100 m

Fig 10

PROFILE 9 VIBETO



Profil 9

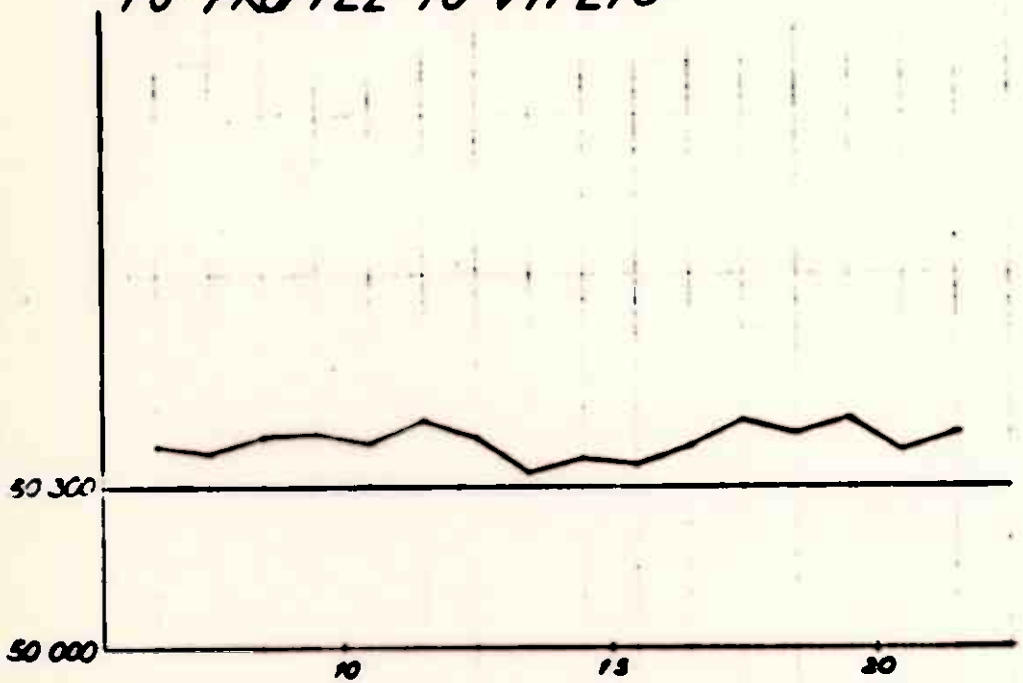
×—×—×—× VLF measurements, dip angle Station GBR

———— Magnetic total field measurements

100 m

Fig 11

TO PROFILE 10 VIPETO



Magnetic vertical field measurements

PROFILE 10 VIBETO

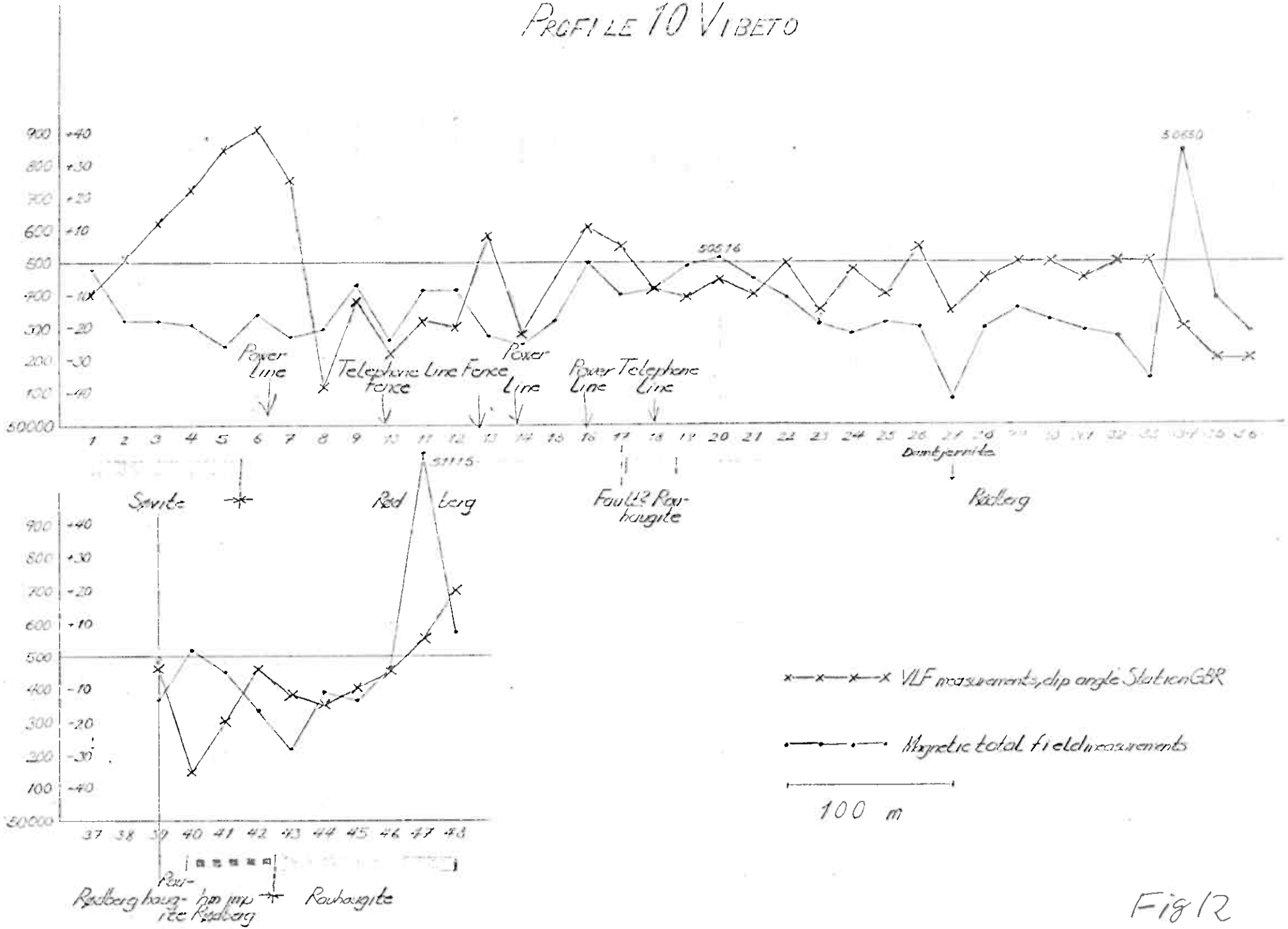


Fig 12