



# Bergvesenet

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## Rapportarkivet

|  |  |   |  |   |
|--|--|---|--|---|
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| Tittel<br><b>Magnetic and electromagnetic measurement in the Otta -Raphamen area</b> |  |   |  |   |
| Forfatter<br><b>Mikkola, Pekka</b>   |  | Dato<br><b>17/2 1977</b>                        | Bedrift<br><b>Soumen Malmi OY</b>        |   |
| Kommune<br><b>Sel</b>  | Fylke<br><b>Oppland</b>                    | Bergdistrikt<br><b>Østlandske</b>               | 1: 50 000 kartblad<br><b>17184</b>       | 1: 250 000 kartblad<br><b>Lillehammer</b> |
| Fagområde<br><b>Geofysikk</b>  | Dokument type<br><b>Rapport</b>            | Forekomster<br><b>Raphamen gamle Sel gruver</b> |  |   |
| Råstofftype<br><b>Malm/metall</b>  | Emneord<br><b>Cu</b>                       |   |  |   |
| Sammendrag   |  |   |  |   |

23-14/77

ELECTROMAGNETIC AND MAGNETIC MEASUREMENTS IN THE  
OTTA-RAPHAMN AREA IN DECEMBER 1976

**SUOMEN MALMI OY**

1977-02-17



ELECTROMAGNETIC AND MAGNETIC MEASUREMENTS IN THE OTTA-RAPHAM AREA  
IN DECEMBER 1976

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ELECTROMAGNETIC AND MAGNETIC MEASUREMENTS IN THE OTTA-RAPHAMN AREA IN  
DECEMBER 1976

According to the contract between Otta Malm A/S and Geobor A/S, Suomen Malmi Oy carried out geophysical measurements and staking near Otta in Rapnammn area during the period 1976-11-23...12-10. The VLF-, shootback- and magnetic measurements, altogether appr. 20 profilekilometers and staked out lines, altogether 4.8 km covered an area of appr. 1.8 km<sup>2</sup>. These measurements (except shootback-method) were similar to those made by Suomen Malmi Oy in February 1975 in Aasoren (Report 23-51, 1975-06-12) and in September 1975 in Myrum (Report 23-113, 1975-12-12). The used co-ordinate system is the official XY-system and tying has been done with the aid of economical maps on scale 1 : 5000.

The aim of the investigations was to locate possible massive sulfides in the area with the help of shootback-method. Judging from the test measurements made over known mineralizations it was expected that the mineralizations would be poor conductors and also VLF-measurements were included. Magnetic measurements were made to support the electromagnetic interpretations and to give a better picture of the bedrock structure.

The results of the measurements are portrayed in the form of contour maps on scale 1 : 5000. The VLF- and shootback-profiles on the test-lines are on scale 1 : 2000 in profile form. The qualitative interpretation of the VLF anomalies has been chiefly based on the relation of the real component to the imaginary component. The shootback results didn't show any anomalies that would have exceeded the general noise level. In the interpretation of the magnetic anomalies a curve-fitting technique and two-dimensional platelike models were used. The most important VLF-anomalies are described in the form of a list in appendix 1. The results of the interpretations are given in appendix 2 as an interpretation map and as magnetic interpretation profiles in appendices 6 - 19.

The field crew consisted of a foreman and two observers. The point spacing along lines was 20 meters in the case of VLF and shootback measurements and 10 meters in the case of magnetic measurements. Coil separation of 60 meters was used in shootback measurements.

## 2. VLF MEASUREMENTS

The receiving apparatus was a Ronka EM 16 made by Geonics Ltd (Canada). The radiostation GBR (16.0 kHz) in Rugby, Great Britain served as the transmitter. The apparatus measures the inclination of the magnetic component of the electromagnetic field (real component) and a quantity that is proportional to the phase difference between the primary and the secondary fields (imaginary component). The results have been fraser-filtered with a filtering interval of 20 meters, which means that the points of inflection of the original data have been transformed to anomaly peaks. The filtered data is easy to visualize as contour maps and at the same time the effect to topography and regional anomalies is diminished. The filtered data has been contoured on scale 1 : 2000 and optically reduced to scale 1 : 5000 and further appended on the topographic maps (appendices 3a and 3b). The results of the test lines are in profile form both as original and filtered data on scale 1 : 2000 (appendices 20 and 24).

The VLF-method was tested over two known mineralizations which both caused small anomalies indicating conductivity from moderate to poor (zones 3 and 4 on the interpretation map). The power lines running through the northern and western parts of the area disturbed the measurements in their neighbourhood (also on the test line).

The VLF map indicates numerous VLF conductors in the area of which most are poorly conducting. The relatively broad line spacing makes the connecting of anomalies difficult and even uncertain in some cases. Thus the contour map and the interpretation map contain somewhat different interpretations in connecting anomalies in few cases. The general strike seems to be between east-west and N 45°E. The interpretation map is based on detailed study of the data in profile form and the east-west strike has been favoured. It would have been possible to connect some anomalies also in NE-direction (e.g. parts of numbers 9, 14, 10 and 11).

None of the VLF-anomalies indicate good conductivity and are likely to be caused by electrolyte containing shear zones or sulfide impregnations. Anomalies 3 and 4 (and perhaps 5) must be regarded as the most interesting ones because of the known mineralizations which are near to them.

### 3. SHOOTBACK MEASUREMENTS

The shootback measurements were made using CEM-units made by Crone Geophysics (Canada) with the so called horizontal shootback method. In this configuration the transmitter coil is horizontal and receiver coil vertical in zeroposition. The inclination of the total field is measured at the receiver in degrees (360 div). Both units are identical and can serve both as the transmitter and as the receiver. Two readings per station are taken and the functioning of the units is reversed in between. The two readings are summed together to the final reading which is zero in non-conducting environment inspite of differences of elevations. The systematic measurements were made with 60 meters coil separation and 1830 Hz (medium) and 5010 Hz (high) frequencies. The shootback results of both frequencies have been contoured on scale 1 : 2000 and optically reduced to scale 1 : 5000 and appended to topographic maps (appendices 4a and 4b).

In order to choose proper frequencies and coil separation test measurements were made on the same lines as with the VLF (appendix 20a). The results are shown in profile form on scale 1 : 2000 (appendices 21-23 and 25-27). In general no clear anomalies were noticed. In test line 1 with the medium frequency and with coil separations of 60 and 80 meters there exist very weak indications of a conductor at appr. 160 m. But other frequencies or coil separations do not confirm this interpretation.

The shootback contour maps don't show any clear anomalies, which would rise above the noise level in the area. This means that there are no good conductors (e.g. massive sulfides) in the area near the surface. With 60 meters coil separation the depth penetration is appr. from 20 to 40 meters. This conclusion is confirmed by the VLF results which also indicated that there are no good conductors in the area.

#### 4. MAGNETIC MEASUREMENTS

The magnetic survey was made using a Scintrex (Canada) MP2 proton magnetometer, which measures the total component of the flux density of the geomagnetic field and which has a reading accuracy of 1 nT (1 nanotesla equals to 1 gamma). The diurnal variations of the geomagnetic field (less than 15 nT) were eliminated by means of base line measurements. The smoothed values have been contoured on scale 1 : 2000 and optically reduced to scale 1 : 5000 and appended to topographic map (appendix 5).

The area is very weakly magnetized and no dominant magnetic zones appear in the results. The anomalies are all very little in amplitude and length. The strongest anomalies are only about 1000 nT and usually less than 400 nT even though the overburden is expected to be thin and thus the attenuation of the anomalies little. However, a routine curvefitting interpretation for the anomalies in the area was carried out using two dimensional plates as models. The values  $T_0 = 50270$  nT,  $I_0 = 81^\circ$  and  $A_0 = 100^\circ$  have been used in the calculations. The interpreted profiles and the results are shown in appendices 6 - 19. The interpretation parameters which were possible to vary are: the horizontal location of the upper left corner of the plate  $X_0$  (m), the dip  $FII$  ( $1^\circ$ ), the depth to the upper surface  $Z$  (m), the depth to the lower surface  $H$  (m) (marked with 0 if it is very deep), the width of the plate  $D$  (m) and the effective susceptibility  $K$  ( $10^{-6}$  cgs). The reliability of the interpretation is diminished by simplicity of the models. E.g. the effect of possible remanent magnetism has been overlooked.

The general strike in the area is quite uniformly east-west. The interpreted dips are nearly vertical but slightly towards south in the southern part of the area and towards north in the northern part. The western part is more strongly magnetized compared to the eastern part of the area.

There is no evident correlation between the VLF conductors and the magnetic zones. The strongest magnetic anomalies seem to be between conductors or intersect them. This is the case at conductors 1 and 2, 7 and 10 and 4 and 5.

## 5. SUMMARY


Technically the undertaking succeeded well except the effect of the power lines, which disturbed specially VLF measurements. The measurements carried out gave no direct indications of possible ore formations. On the contrary it can be concluded that there are only poor conductors and no massive sulfides in the area at least at shallow depths. Also magnetically the area is quite barren.

VLF measurements pointed out some conductors (numbers 3, 4 and 5) which might be considered interesting because of their relations to known mineralizations. It is probable that the mineralizations in the area are not good conductors but disseminated when the suitable method to be used would be IP-measurements.

Espoo 1977-02-17

SUOMEN MALMI OY

Geophysical Department



Pekka Mikkola

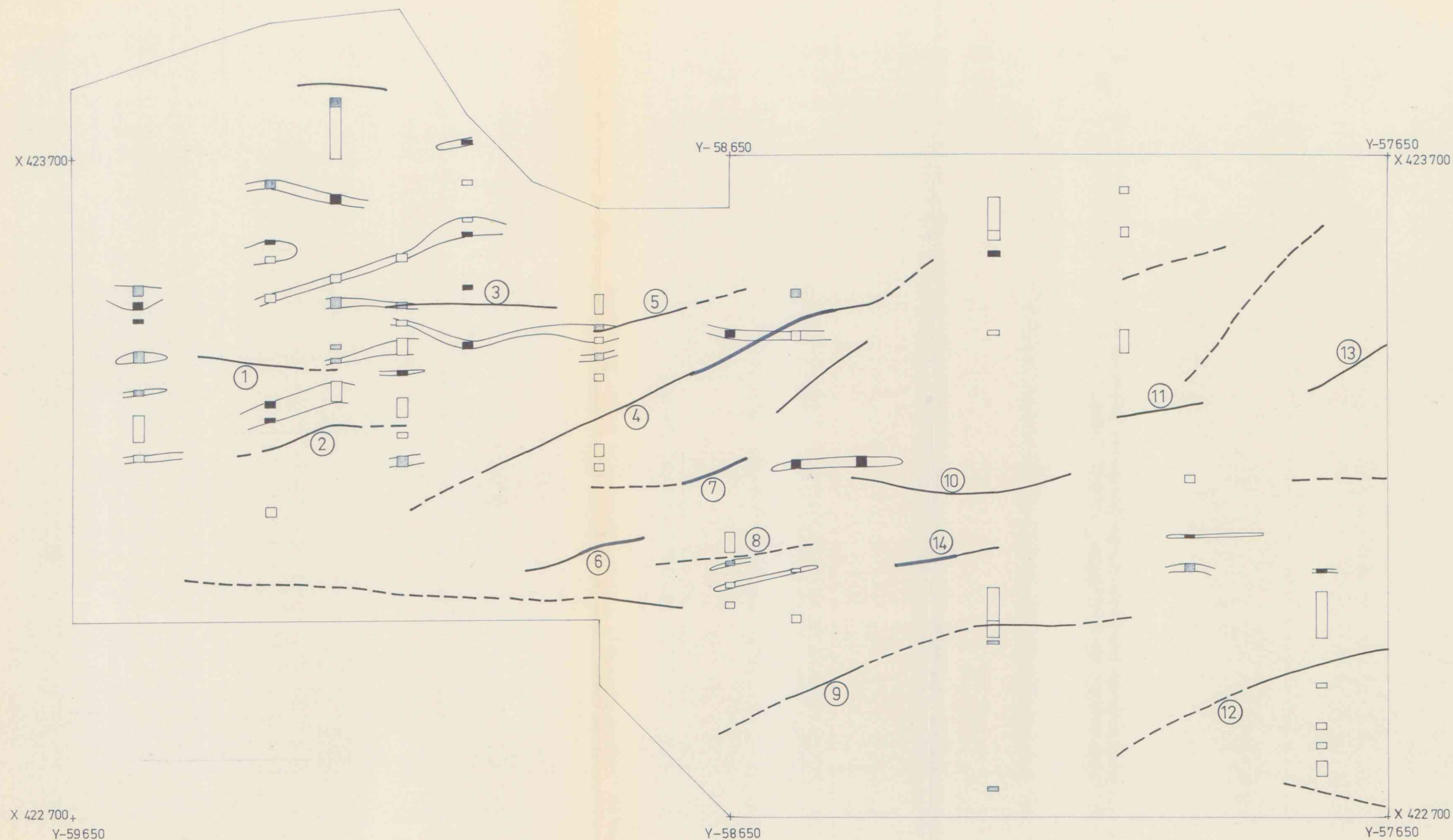
Geophysicist



## LIST OF VLF ANOMALIES

| no./y-co. | R (f %) | I (f %) | T (nT) | length<br>(m) |   |
|-----------|---------|---------|--------|---------------|---|
| 1/-59.35  | + 32    | + 24    | - 169  | 200           | Poor conductor  |
| 2/-59.25  | + 8     | - 1     | + 7    | 200           | Poor conductor  |
| 3/-59.05  | + 37    | + 19    | + 14   | 200           | Poor conductor which is connected with a weakly magnetized zone. Might belong to the same horizon as anomaly 5. Begins from the Botthangen mineralization and continues east from it. |
| 4/-58.85  | + 7     | - 5     | + 19   | > 900         | Conductivity varies between very poor and moderate. The NE end is connected with a magnetic zone. Runs near the mineralization at Nedre Rapphamn-tjern.                               |
| -58.55    | + 62    | + 30    | - 72   |               |   |
| 5/-58.85  | + 31    | + 19    | + 52   | > 200         | Conductivity varies from poor to very poor.   |
| 6/-58.85  | + 28    | - 45    | - 22   | 200           | Conductivity varies from poor to moderate. Might belong to the same horizon as anomaly 8.   |
| 7/-58.65  | + 110   | + 45    | + 4    | > 200         | Conductivity between very poor and moderate. Strongest anomaly in the area.   |
| 8/-58.65  | + 5     | - 1     | + 7    | 200           | Very poor conductor which is correlated with a weakly magnetized zone.  |

| no./y-co. | R (f %) | I (f %) | T (nT) | length<br>(m) |   |
|-----------|---------|---------|--------|---------------|---|
| 9/-58.45  | + 24    | + 13    | - 15   | > 700         | Conductivity varies from very poor to poor. The eastern end is connected with a magnetic zone.  |
| 10/-58.45 | + 21    | + 17    | + 3    | 300           | Poor conductor which might belong to the same horizon as anomaly 7. The western end is connected with a magnetic zone, which lies between nos 7 and 10 appr. in the same horizon. |
| 11/-58.05 | + 23    | + 16    | - 10   | 200           | Poor conductor which might belong to the same horizon as anomaly 13 or continues to the NE.   |
| 12/-57.85 | + 13    | 0       | - 9    | > 400         | Weak anomaly at the border of the area. Could be even a good conductor.   |
| 13/-57.75 | + 18    | + 13    | - 31   | 200           | Poor wide conductor. Overburden is a possible cause.  |
| 14/-58.35 | + 80    | + 23    | 0      | < 200         | Moderate conductor. Might be connected also to nos 9 and 10 in the NE-direction.  |



Magnetic zones

- $K \geq 2500 \times 10^{-6} \text{ cgs}$
- $1000 \leq K < 2500 \times 10^{-6} \text{ cgs}$
- $K < 1000 \times 10^{-6} \text{ cgs}$

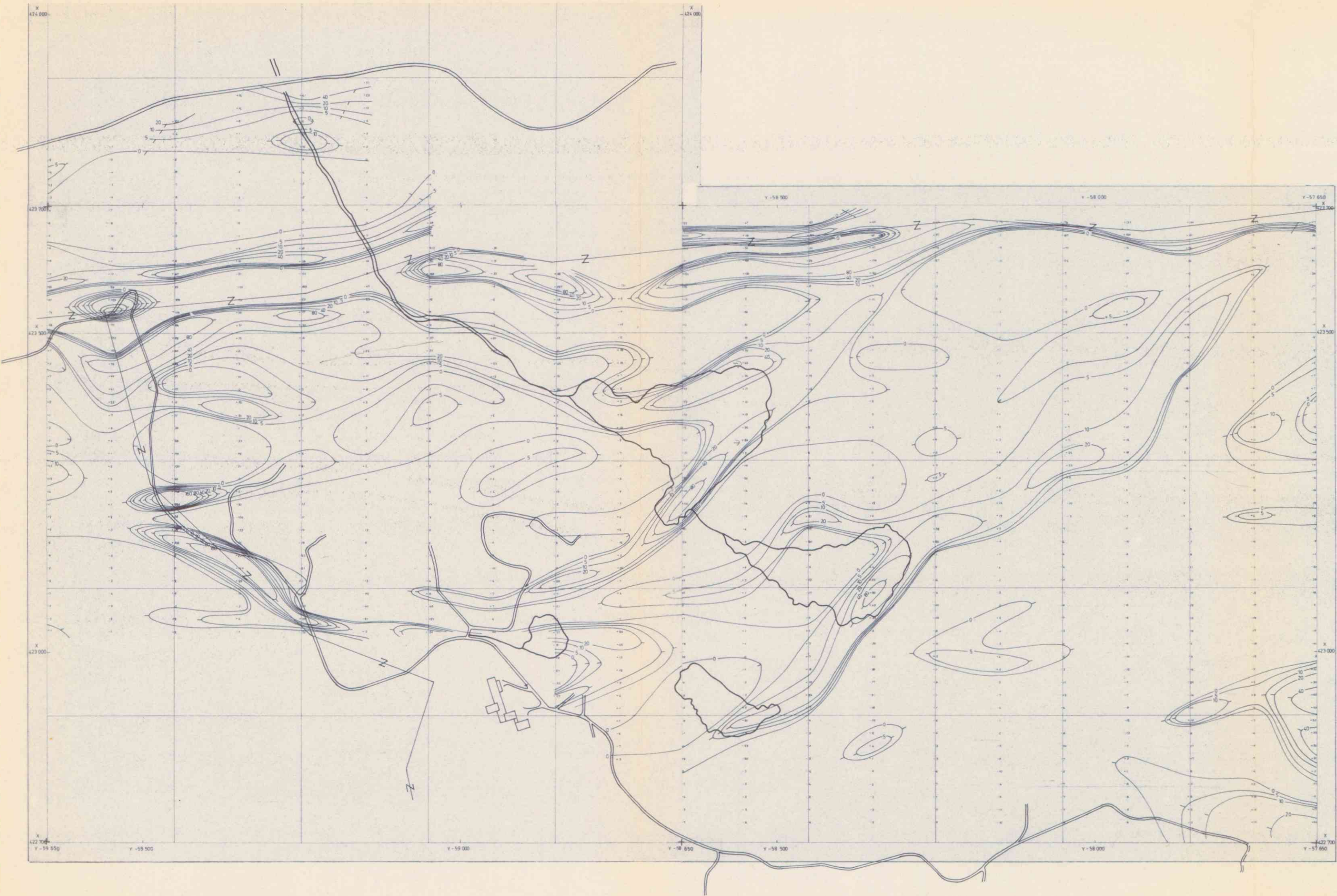
Conductive zones

- moderate conductivity
- poor — " —
- very poor — " —

⑫ etc anomalies referred in the text and App.1

|                    |        |         |    |     |
|--------------------|--------|---------|----|-----|
| SUOMEN MALMI OY    | 1:5000 | interp. | TK | 2.7 |
|                    |        | draw    | AS | 2.7 |
|                    |        | insp.   | PM | 2.7 |
| Interpretation map |        |         |    |     |
| OTTA, Raphamn      |        |         |    |     |





Contours: 0, +5, +10, +20, +40, +80 etc %

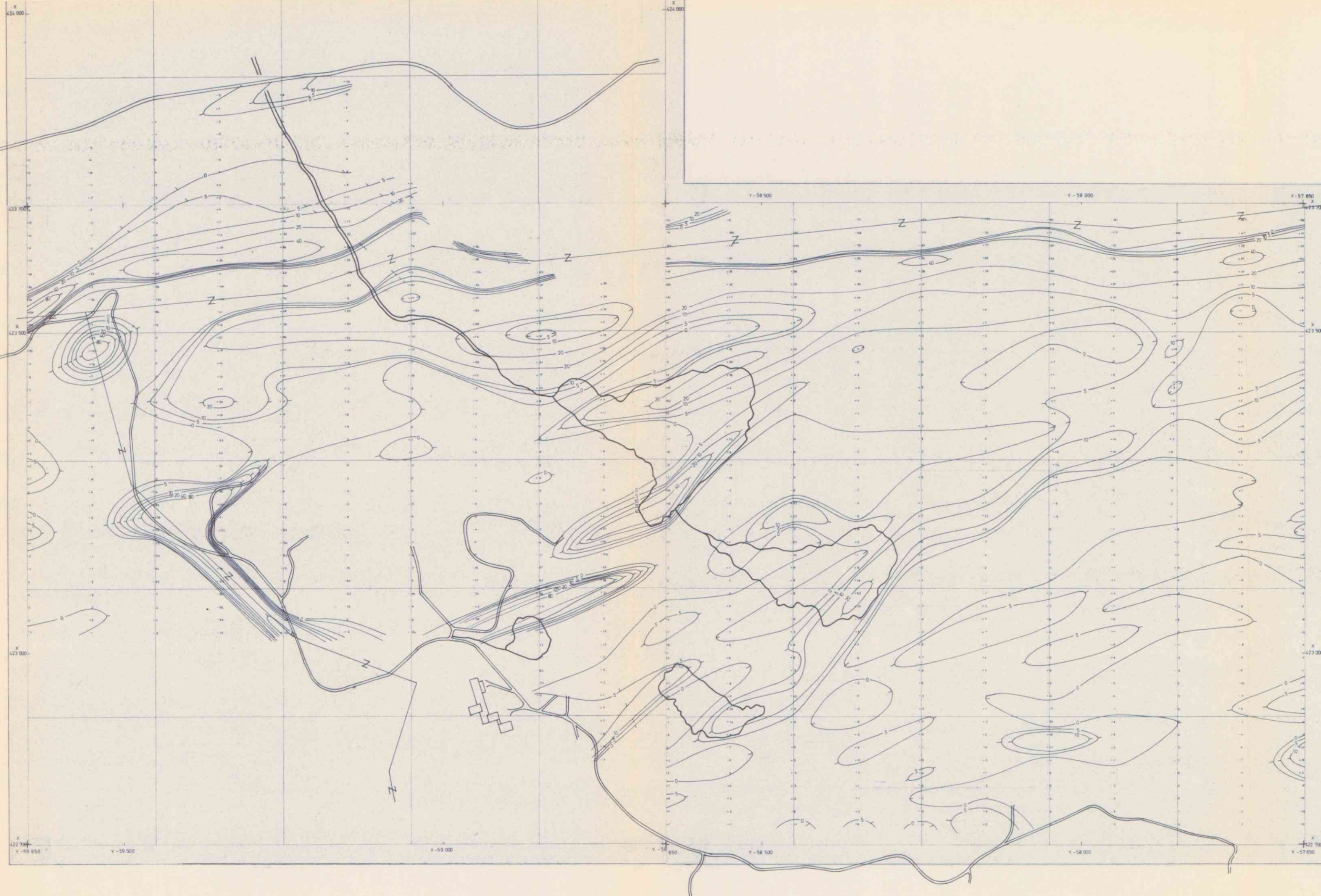
Transmitter: GBR 16,0 kHz

Instrument: Geonics EM-16

Fraser-filtered

|                             |        |      |    |       |
|-----------------------------|--------|------|----|-------|
| SUOMEN MALMI OY             | 1:5000 | meas | TK | 12,76 |
|                             |        | draw | AS | 1,77  |
|                             |        | insp | PM | 1,77  |
| VLF – map<br>Real component |        |      |    |       |
| OTTA, Raphamn               |        |      |    |       |

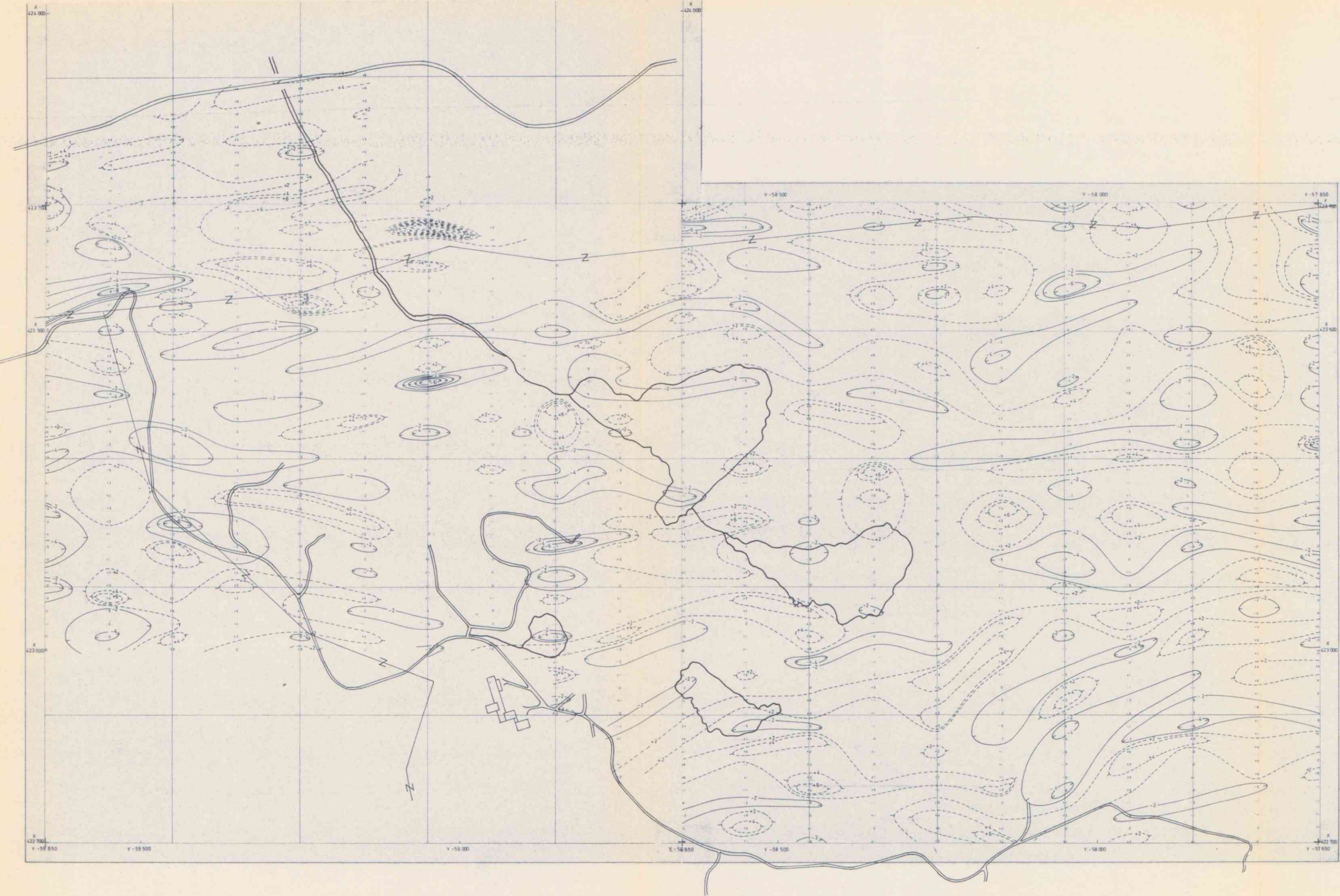




Contours: 0, +5, +10, +20, +40, +80 etc %  
Transmitter: GBR 16,0 kHz  
Instrument: Geonics EM-16  
Fraser-filtered

|                                  |        |      |    |       |
|----------------------------------|--------|------|----|-------|
| SUOMEN MALMI OY                  | 1:5000 | meas | TK | 12.76 |
|                                  |        | draw | AS | 1.77  |
|                                  |        | insp | PM | 1.77  |
| VLF - map<br>Imaginary component |        |      |    |       |
| OTTA, Raphamn                    |        |      |    |       |

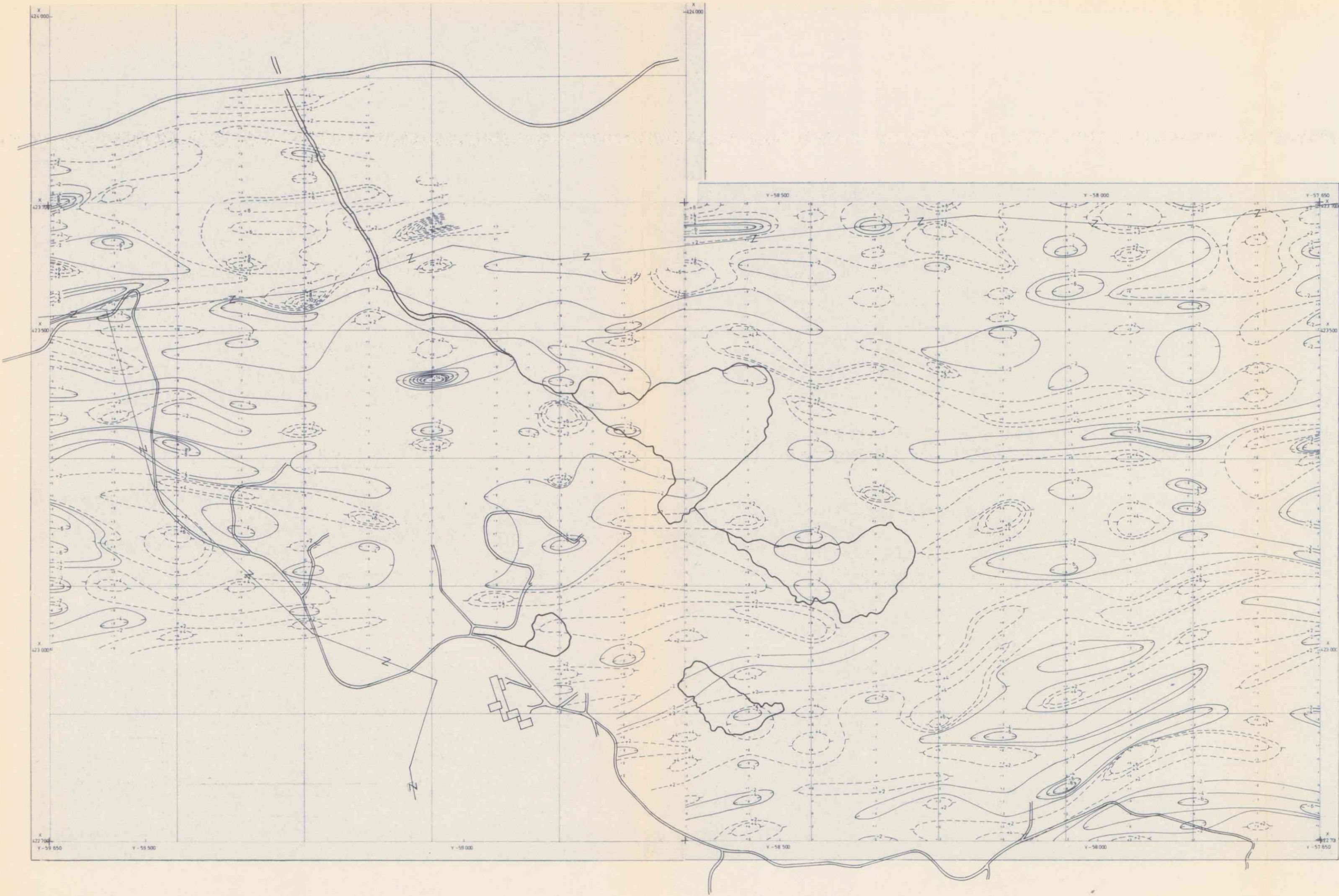




Contours:  $\pm 2, 4, 6, 8, 10, 12^\circ$  etc  
Instrument: Crone CEM  
Method: Horizontal shootback  
Frequency: 1830 Hz  
Coil separation: 60 m

|                                   |        |      |     |       |
|-----------------------------------|--------|------|-----|-------|
| SUOMEN MALMI OY                   | 1:5000 | meas | T J | 12.76 |
|                                   |        | draw | SM  | 1.77  |
|                                   |        | insp | PM  | 1.77  |
| Shootback-map<br>Medium frequency |        |      |     |       |
| OTTA, Raphamn                     |        |      |     |       |

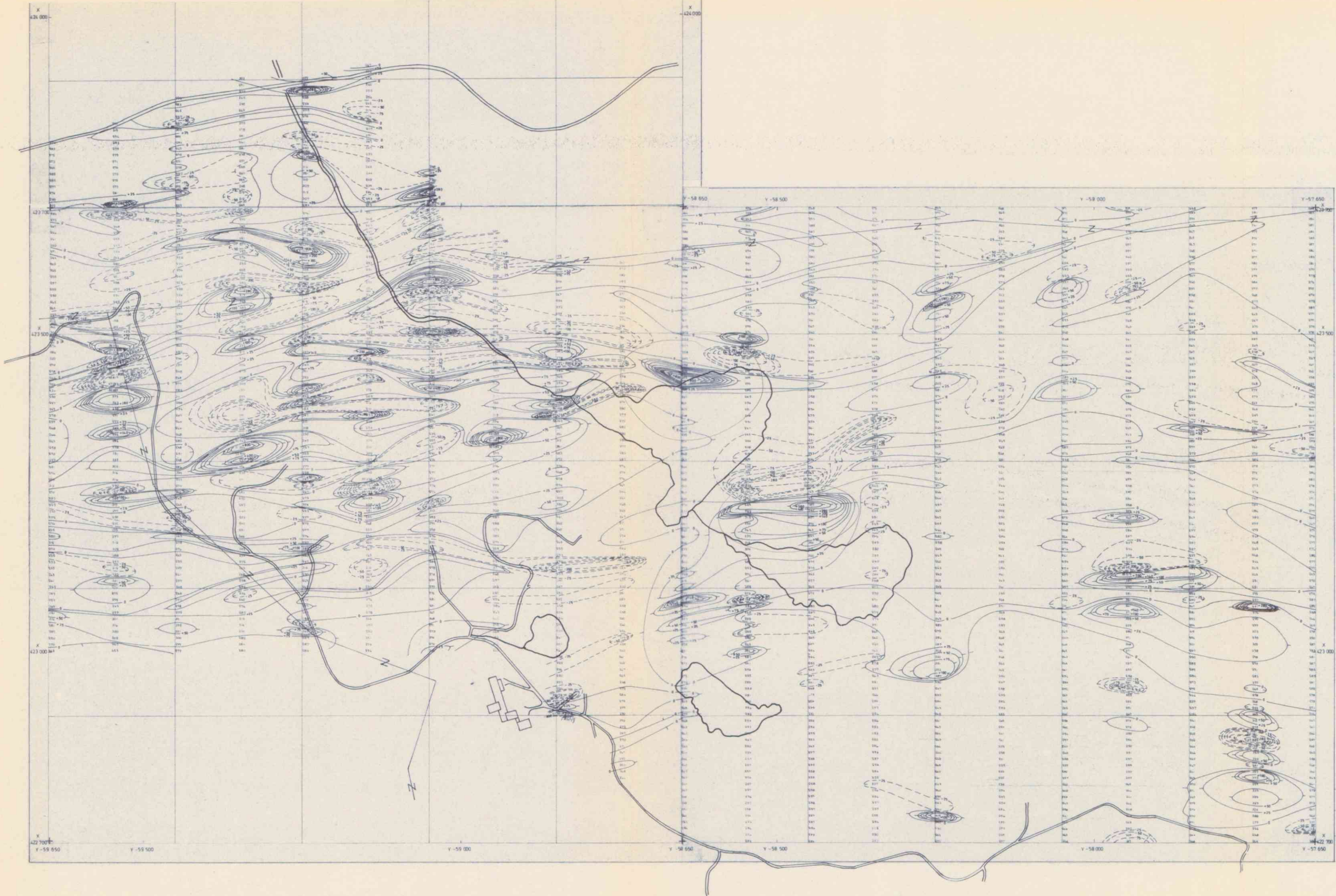




Contours:  $\pm 2, 4, 6, 8, 10, 12^\circ$  etc  
Instrument: Crone CEM  
Method: Horizontal shootback  
Frequency: 5010 Hz  
Coil separation: 60 m

|                                 |        |      |    |       |
|---------------------------------|--------|------|----|-------|
| SUOMEN MALMI OY                 | 1:5000 | meas | TJ | 12.76 |
|                                 |        | draw | SM | 1.77  |
|                                 |        | insp | PM | 1.77  |
| Shootback-map<br>High frequency |        |      |    |       |
| OTTA, Raphamn                   |        |      |    |       |





Contours: 0,  $\pm$  25, 50, 75, 100, 140, 200, 280, 400 etc nT

Instrument: Proton magnetometer MP 2

Zero-level: 50270 nT

|                 |        |      |    |       |
|-----------------|--------|------|----|-------|
| SUOMEN MALMI OY | 1:5000 | meas | TK | 11.76 |
|                 |        | draw | SM | 12.76 |
|                 |        | insp | PM | 1.77  |
| Magnetic map    |        |      |    |       |
| OTTA, Raphamn   |        |      |    |       |



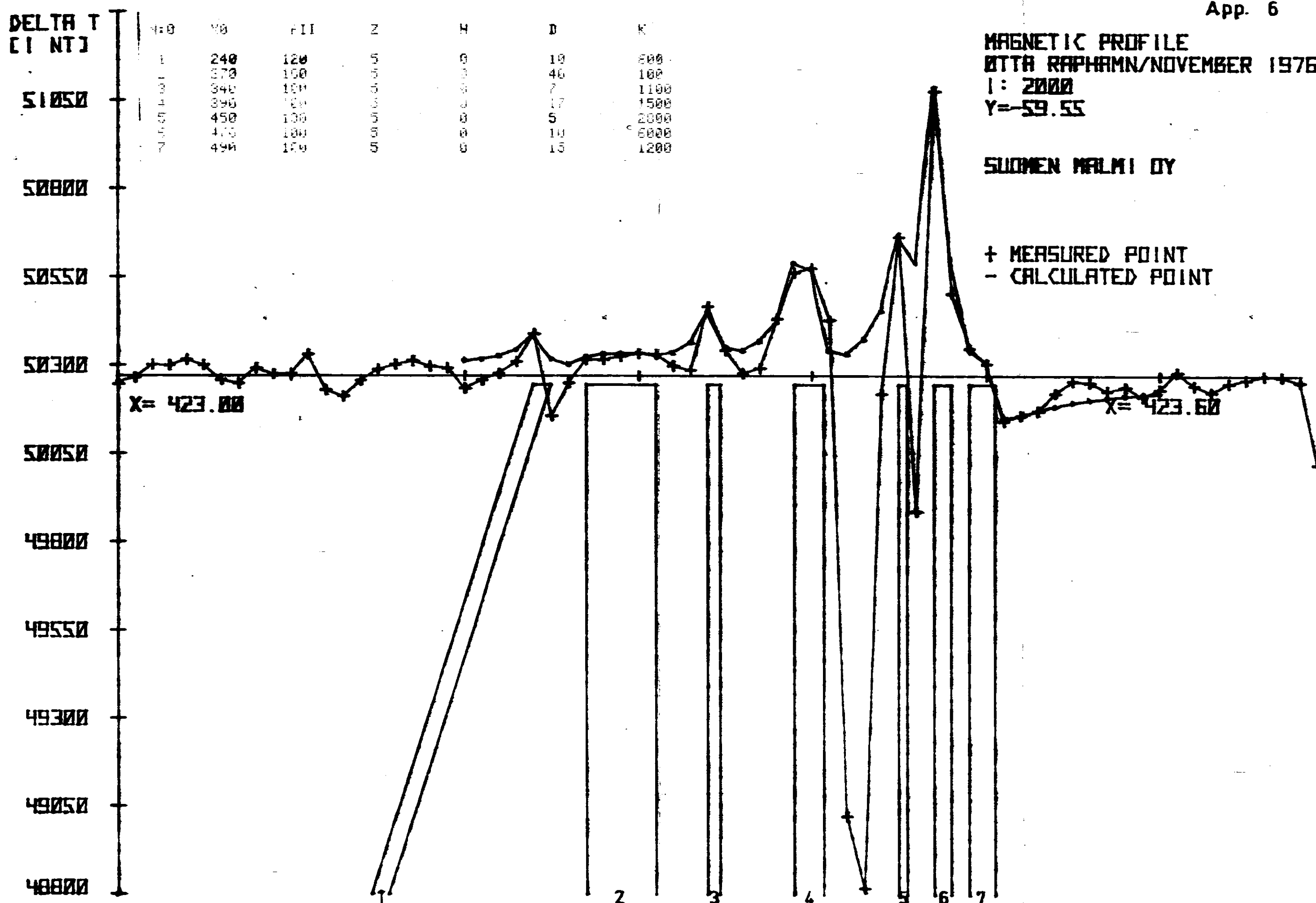
DELTA T  
[INT]

| Y | X   | Y   | Z | H | D  | K    |
|---|-----|-----|---|---|----|------|
| 1 | 240 | 120 | 5 | 0 | 10 | 500  |
| 2 | 370 | 100 | 5 | 0 | 40 | 100  |
| 3 | 340 | 100 | 5 | 0 | 7  | 1100 |
| 4 | 390 | 100 | 5 | 0 | 17 | 1500 |
| 5 | 450 | 100 | 5 | 0 | 5  | 2000 |
| 6 | 470 | 100 | 5 | 0 | 10 | 6000 |
| 7 | 490 | 100 | 5 | 0 | 15 | 1200 |

MAGNETIC PROFILE  
 OTTA RAPHAMN/NOVEMBER 1976  
 I: 2000  
 Y=-59.55

SUOMEN MALLI OY

+ MEASURED POINT  
 - CALCULATED POINT



DELTA T  
[INT]

| N:0 | X0  | FII | Z | H | D  | K    |
|-----|-----|-----|---|---|----|------|
| 1   | 105 | 100 | 5 | 0 | 15 | 200  |
| 2   | 053 | 100 | 5 | 0 | 5  | 3600 |
| 3   | 273 | 100 | 5 | 0 | 10 | 8000 |
| 4   | 450 | 120 | 5 | 0 | 12 | 750  |
| 5   | 490 | 120 | 5 | 0 | 10 | 600  |
| 6   | 512 | 120 | 5 | 0 | 10 | 1000 |
| 7   | 602 | 100 | 5 | 0 | 12 | 1700 |

MAGNETIC PROFILE  
OTTA RAPHAMN/NOVEMBER 1976  
I: 2000  
Y=-59.35

SUDMEN MALMI OY

+ MEASURED POINT  
- CALCULATED POINT

51350

51200

51050

50900

50750

50600

50450

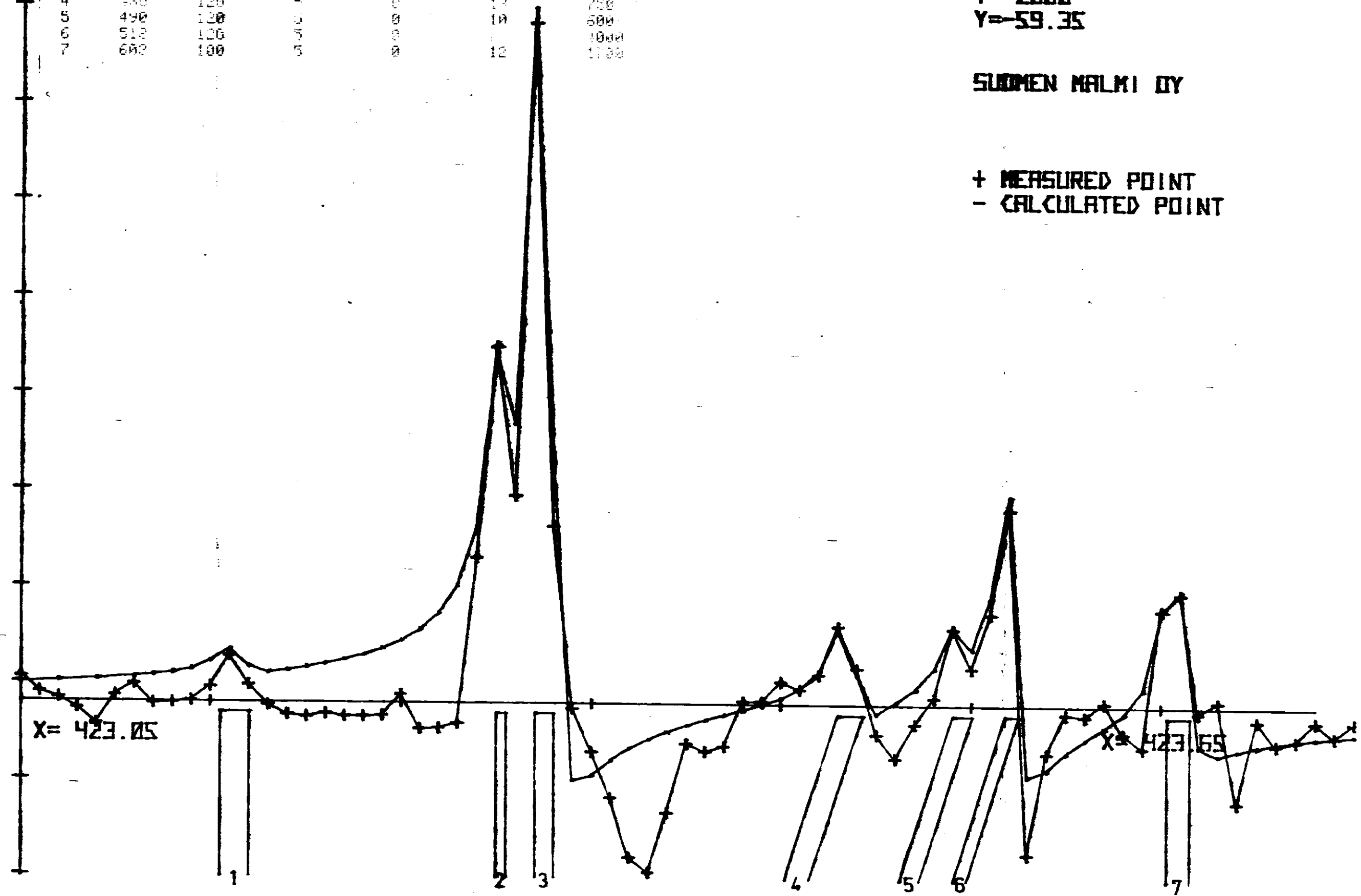
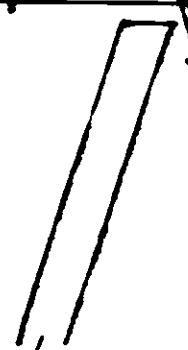
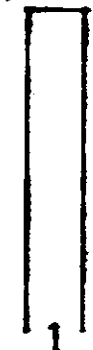
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50150

50000

X= 423.05

X= 423.65

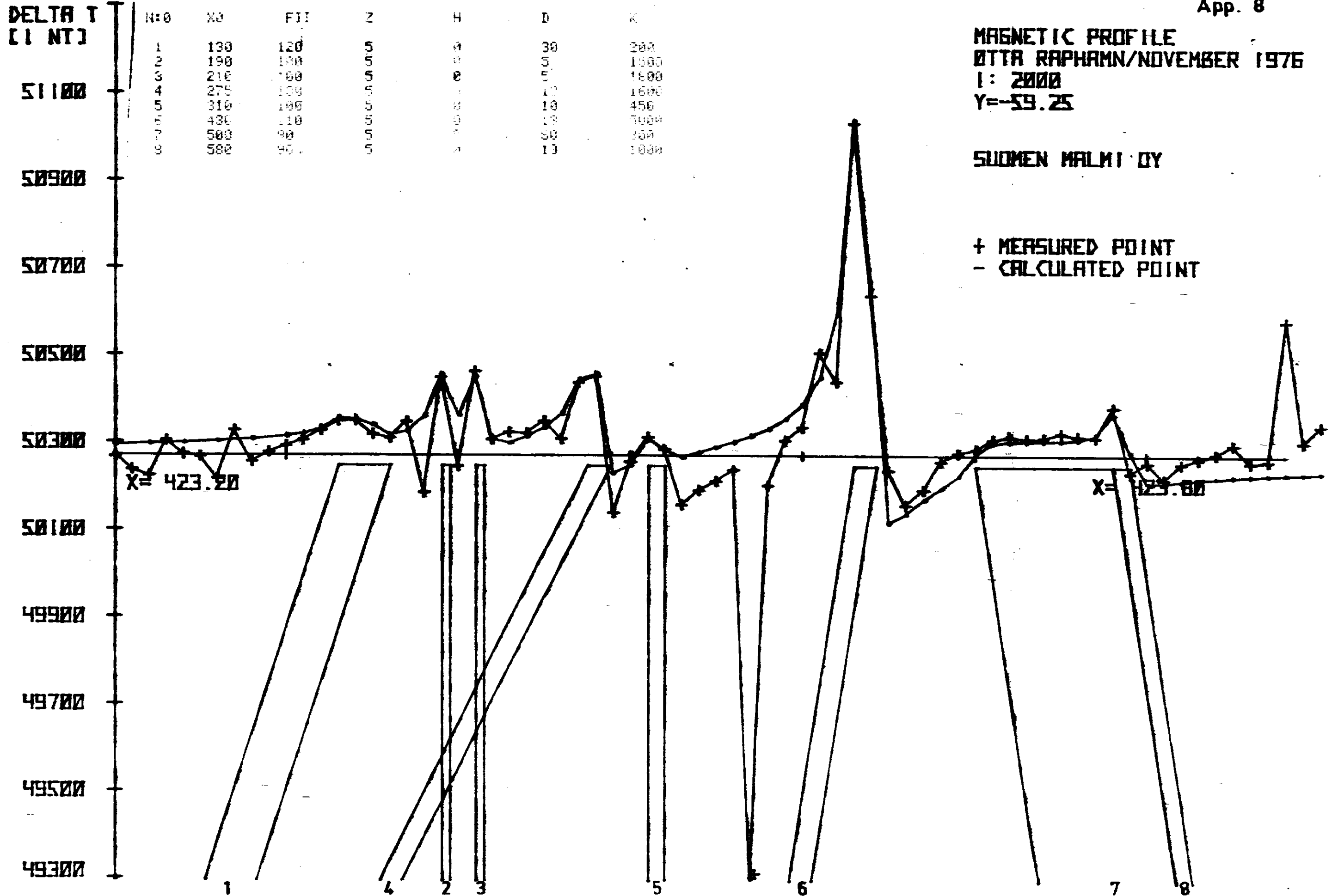


DELTA T  
[1 NT]

MAGNETIC PROFILE  
OTTA RAPHAMN/NOVEMBER 1976  
I: 2000  
Y=-59.25

SUOMEN MALMI OY

+ MEASURED POINT  
- CALCULATED POINT



DELTA T  
[1 NT]

50600

50500

50400

50300

50200

50100

50000

49900

49800

49700

| N:0 | M0  | F11 | 2 | H | D  | A    |
|-----|-----|-----|---|---|----|------|
| 1   | 233 | 120 | 5 | 0 | 13 | 1150 |
| 2   | 273 | 130 | 5 | 0 | 10 | 550  |
| 3   | 365 | 100 | 5 | 0 | 30 | 100  |
| 4   | 370 | 100 | 5 | 0 | 5  | 3250 |
| 5   | 400 | 100 | 5 | 0 | 25 | 150  |
| 6   | 440 | 100 | 5 | 0 | 0  | 400  |
| 7   | 470 | 100 | 5 | 0 | 5  | 2000 |
| 8   | 540 | 90  | 5 | 0 | 10 | 500  |

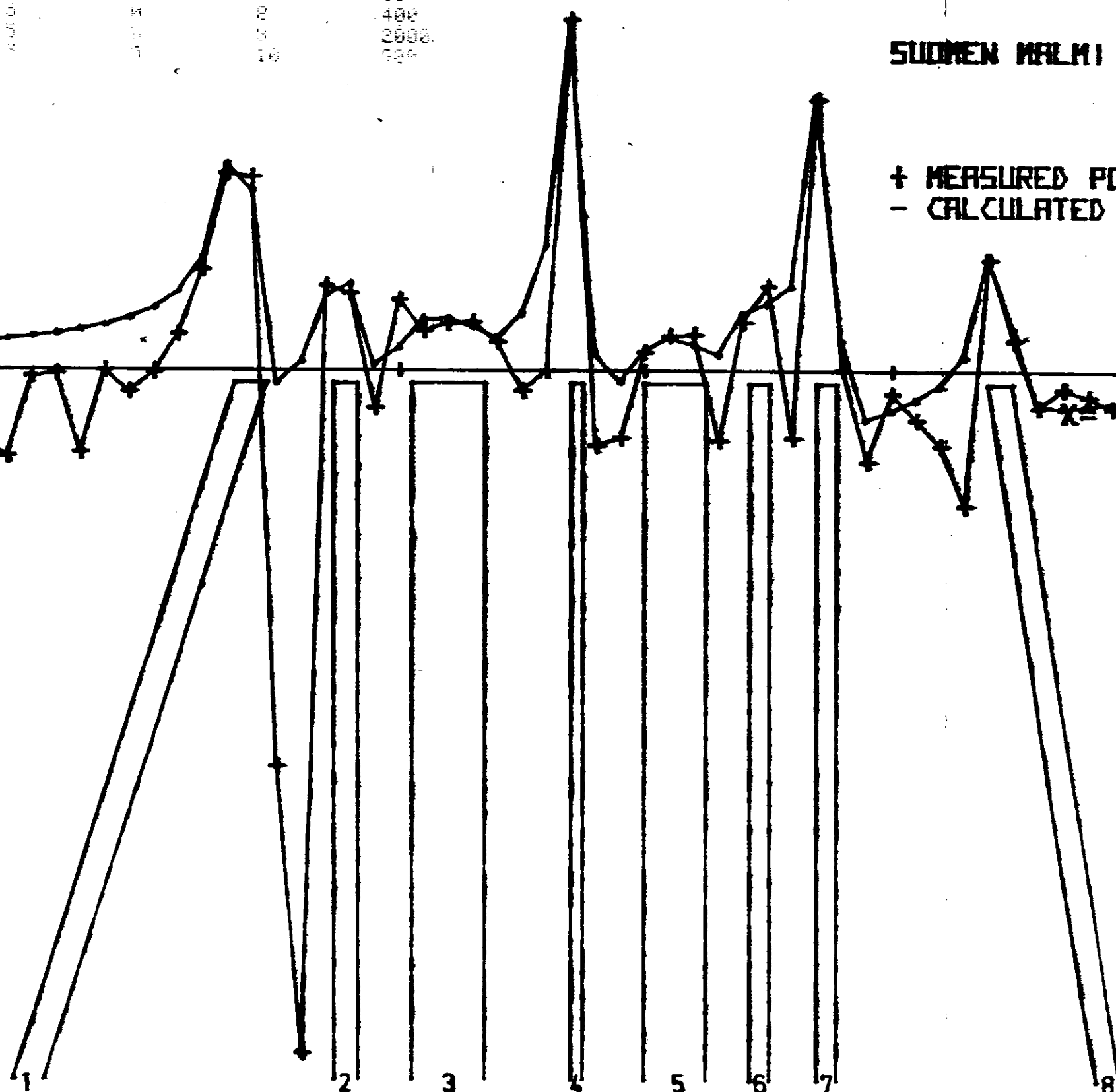
MAGNETIC PROFILE  
OTTA RAPHAMN/NOVEMBER 1976  
I: 2000  
Y=-59.15

SUDHEN MALHI DY

+ MEASURED POINT  
- CALCULATED POINT

X=423.00

X=423.00



DELTA T  
[INT]

| N:0 | X0  | FII | Z | H | D  | K    |
|-----|-----|-----|---|---|----|------|
| 1   | 310 | 100 | 5 | 0 | 10 | 3100 |
| 2   | 400 | 100 | 5 | 0 | 5  | 3300 |
| 3   | 480 | 30  | 5 | 0 | 5  | 3700 |
| 4   | 500 | 60  | 5 | 0 | 5  | 3900 |
| 5   | 557 | 90  | 5 | 0 | 5  | 3900 |
| 6   | 610 | 60  | 5 | 0 | 5  | 3700 |

MAGNETIC PROFILE  
ØTTA RAPHAMN/NOVEMBER 1976  
I: 2000  
Y=-59.05

SUOMEN MALMI OY

+ MEASURED POINT  
- CALCULATED POINT

51100

50900

50700

50500

50300

X= 423.40

50100

49900

49700

49500

49300

X= 423.70

1

2

3

4

5

6

DELTA T  
[ I NT ]

| N:0 | X0  | FII | Z | H | D  | K    |
|-----|-----|-----|---|---|----|------|
| 1   | 125 | 100 | 5 | 0 | 10 | 200  |
| 2   | 135 | 100 | 5 | 0 | 20 | 20   |
| 3   | 150 | 140 | 5 | 0 | 10 | 350  |
| 4   | 190 | 100 | 5 | 0 | 10 | 1650 |
| 5   | 215 | 120 | 5 | 0 | 15 | 800  |
| 6   | 295 | 120 | 5 | 0 | 10 | 1100 |
| 7   | 350 | 90  | 5 | 0 | 30 | 700  |

MAGNETIC PROFILE  
OTTA RAPHAMN/NOVEMBER 1976  
I: 2000  
Y=-58.85

SUOMEN MALMI OY

50500

50400

50300

50200

50100

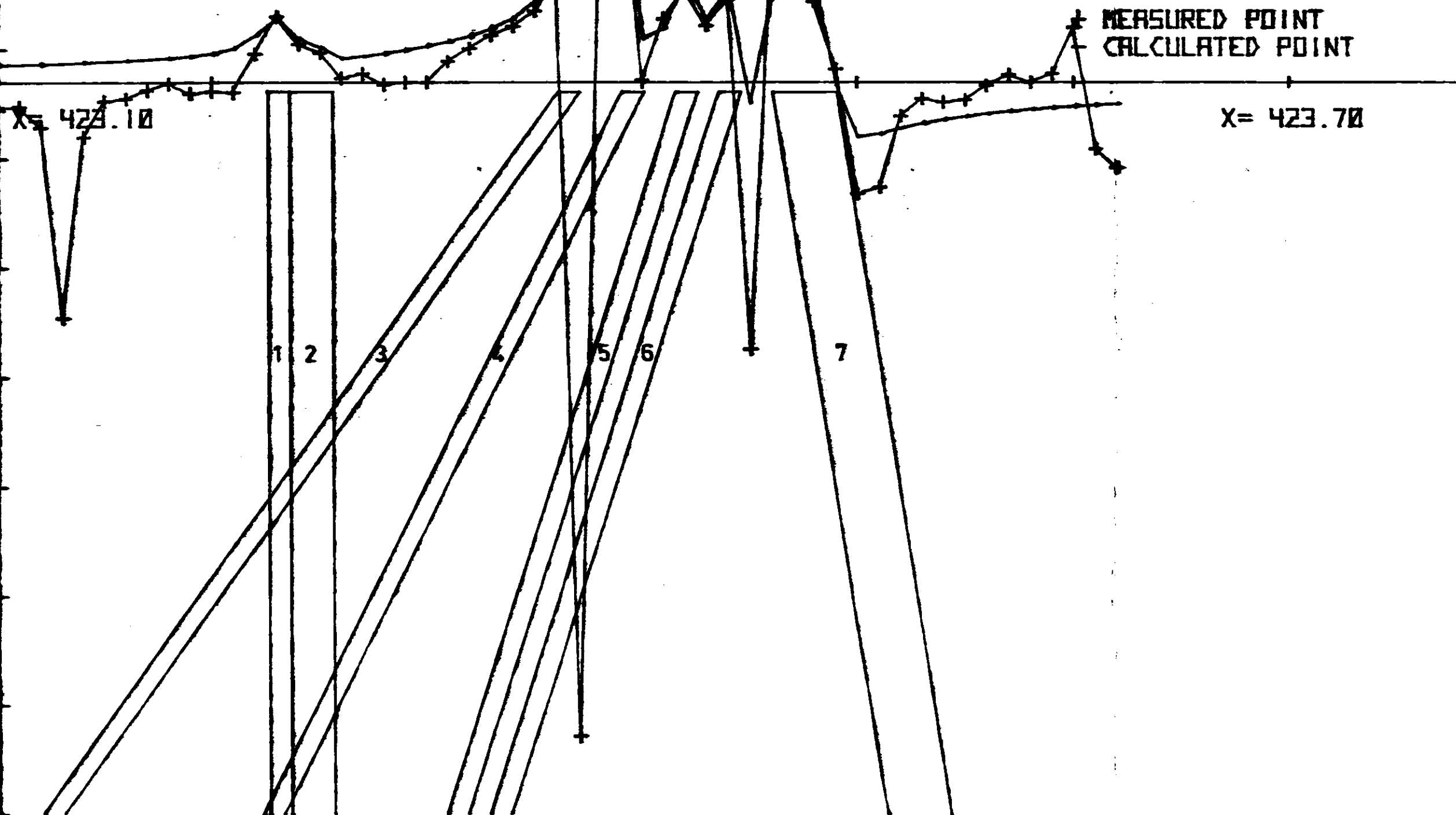
50000

49900

49800

49700

49600



MEASURED POINT  
CALCULATED POINT

X= 423.70

DELTA T  
[INT]

51350

51200

51050

50900

50750

50600

50450

50300

50150

50000

N:0

X0

FII

Z

H

D

K

|   |     |     |   |   |    |      |
|---|-----|-----|---|---|----|------|
| 1 | 115 | 100 | 5 | 0 | 10 | 180  |
| 2 | 145 | 100 | 5 | 3 | 10 | 300  |
| 3 | 180 | 100 | 5 | 0 | 5  | 1500 |
| 4 | 200 | 100 | 5 | 4 | 30 | 280  |
| 5 | 525 | 75  | 5 | 0 | 10 | 7600 |

MAGNETIC PROFILE

OTTA RAPHAMN/NOVEMBER 1976

I: 2000

Y=-58.65

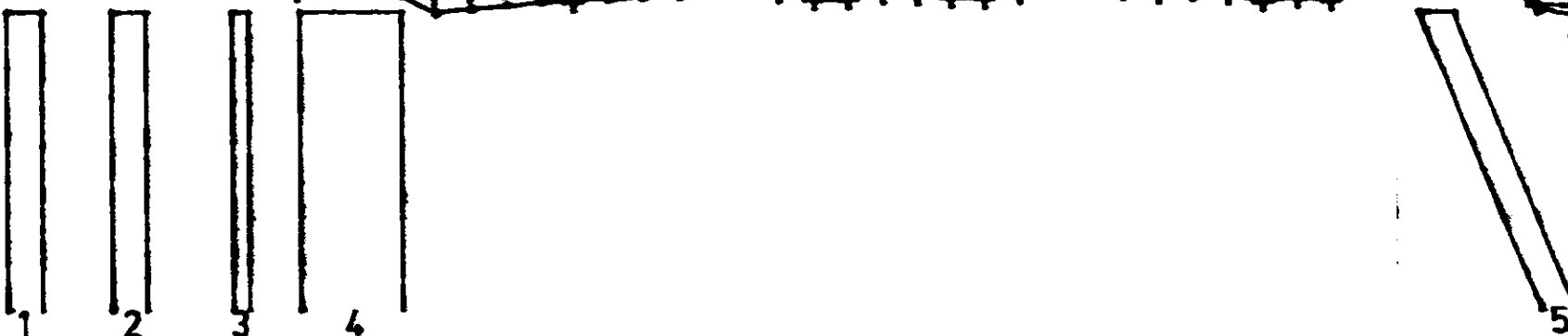
SUDON MALMI DY

+ MEASURED POINT

- CALCULATED POINT

X= 422.90

X= 423.50



App. 13

DELTA T  
[INT]

| N:0 | X0  | FII | Z | H | D  | K    |
|-----|-----|-----|---|---|----|------|
| 1   | 95  | 100 | 5 | 0 | 10 | 250  |
| 2   | 170 | 130 | 5 | 0 | 5  | 900  |
| 3   | 328 | 100 | 5 | 0 | 12 | 3200 |
| 4   | 520 | 100 | 5 | 0 | 15 | 300  |
| 5   | 565 | 80  | 5 | 0 | 10 | 1000 |

MAGNETIC PROFILE  
OTTA RAPHAMN/NOVEMBER 1976  
I: 2000  
Y=-58.55

SUDHEN MALHI DY

+ MEASURED POINT  
- CALCULATED POINT

50850

50700

50550

50400

50250

X= 422.90

50100

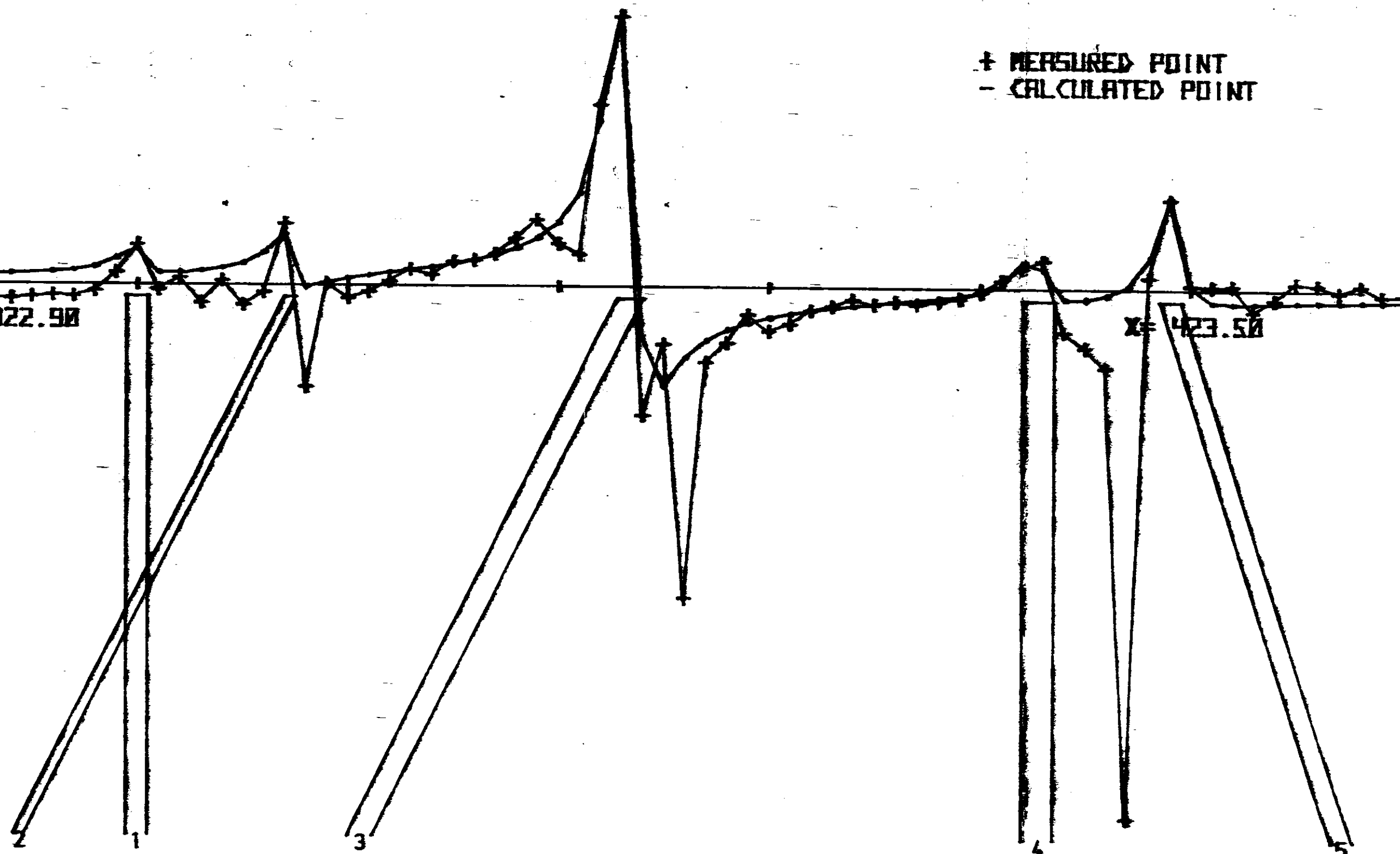
49950

49800

49650

49500

X= 423.50





App. 14

DELTA T  
[INT]

| N:0 | X0  | FII | Z | H | D  | K    |
|-----|-----|-----|---|---|----|------|
| 1   | 330 | 130 | 5 | 0 | 15 | 5000 |

MAGNETIC PROFILE  
OTTA RAPHAMN/NOVEMBER 1976  
I: 2000  
Y=-58.45

SUDMEN MALMI DY

+ MEASURED POINT  
- CALCULATED POINT

50850

50700

50550

50400

50250

X= 422.90

50100

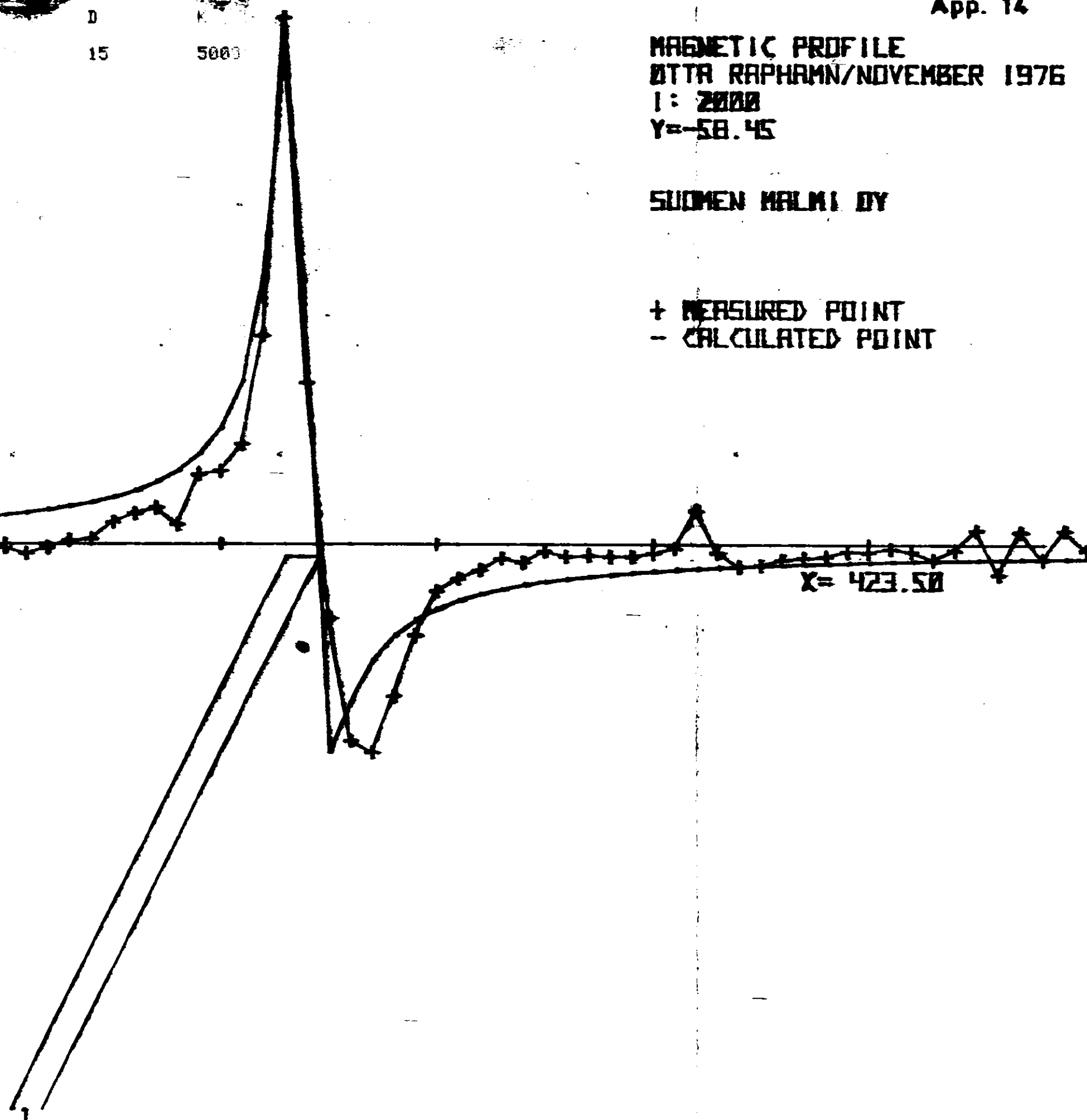
49950

49800

49650

49500

X= 423.50



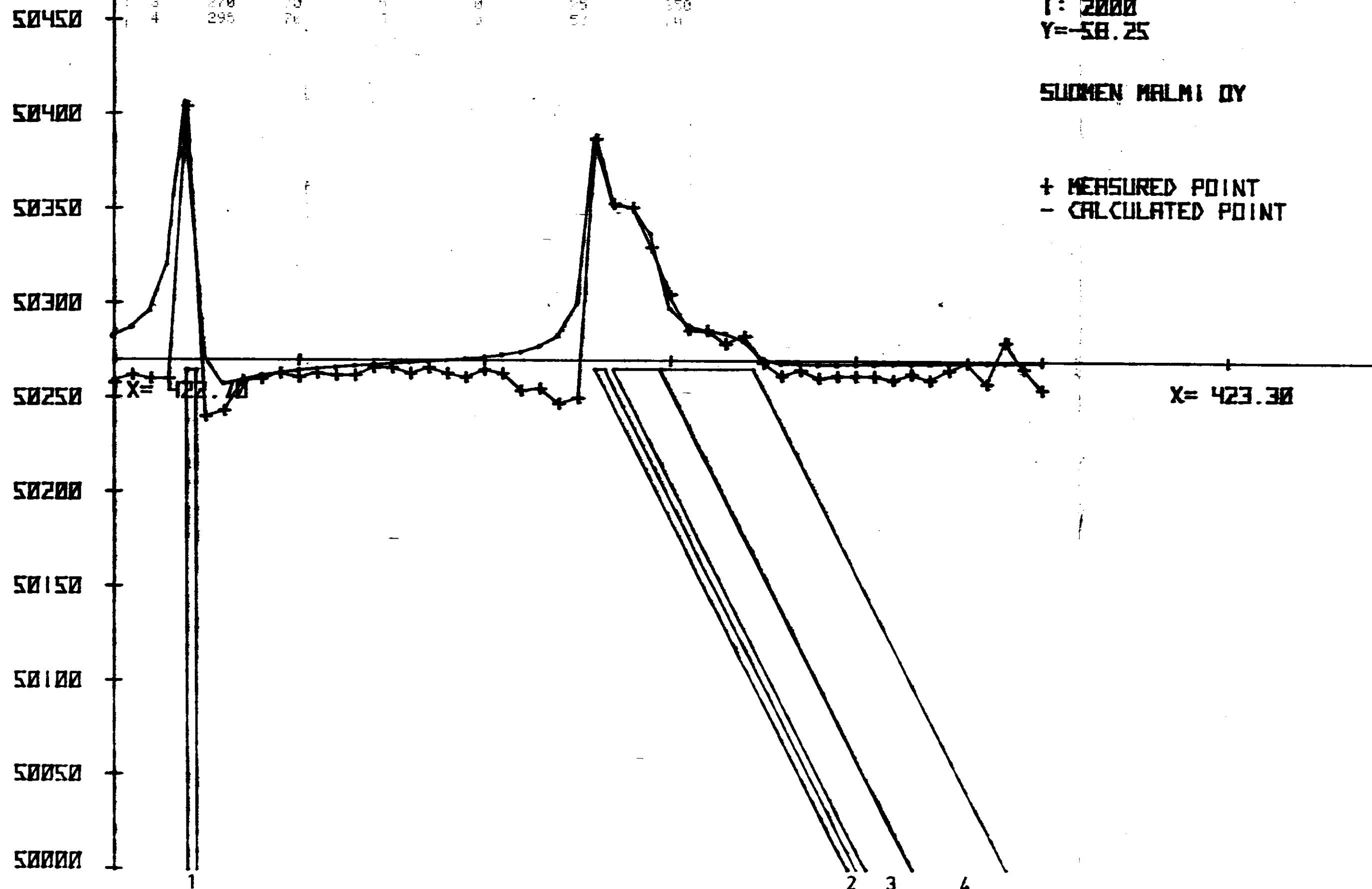
DELTA T  
[INT]

| N:0 | X0  | F11 | Z | H | D  | K    |
|-----|-----|-----|---|---|----|------|
| 1   | 40  | 100 | 5 | 0 | 5  | 1600 |
| 2   | 265 | 70  | 0 | 0 | 5  | 400  |
| 3   | 270 | 70  | 5 | 0 | 25 | 350  |
| 4   | 295 | 70  | 0 | 0 | 50 | 14   |

MAGNETIC PROFILE  
OTTA RAPHAMN/NOVEMBER 1976  
I: 2000  
Y=-58.25

SUOMEN MALMI OY

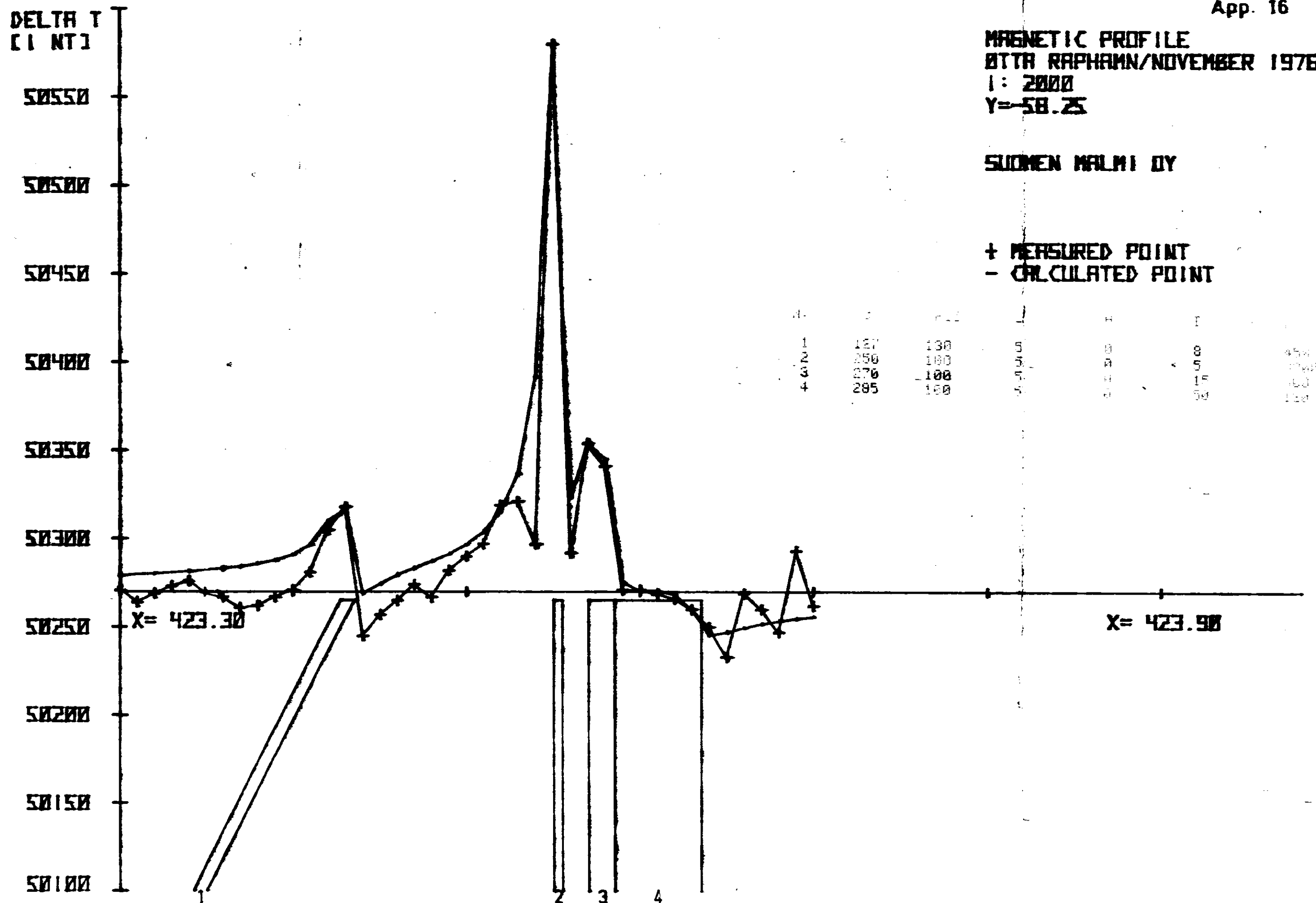
+ MEASURED POINT  
- CALCULATED POINT



MAGNETIC PROFILE  
 OTTA RAPHAH/NOVEMBER 1976  
 I: 2000  
 Y=-58.25

SUOMEN MALMI OY

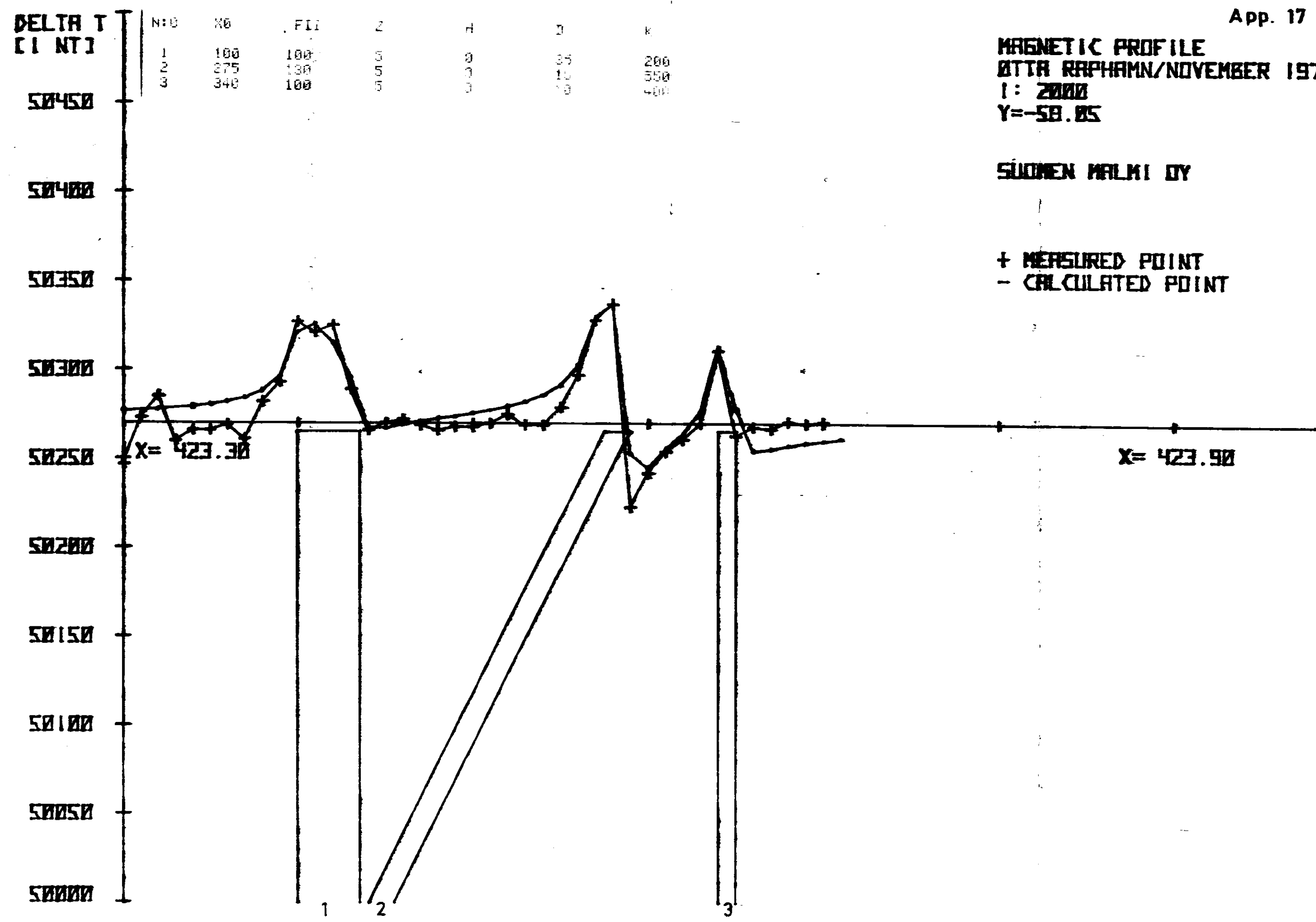
+ MEASURED POINT  
 - CALCULATED POINT



MAGNETIC PROFILE  
 OTTA RAPHAMN/NOVEMBER 1976  
 I: 2000  
 Y=-58.85

SUOMEN HALKI OY

+ MEASURED POINT  
 - CALCULATED POINT



App. 18

DELTA T  
[INT]

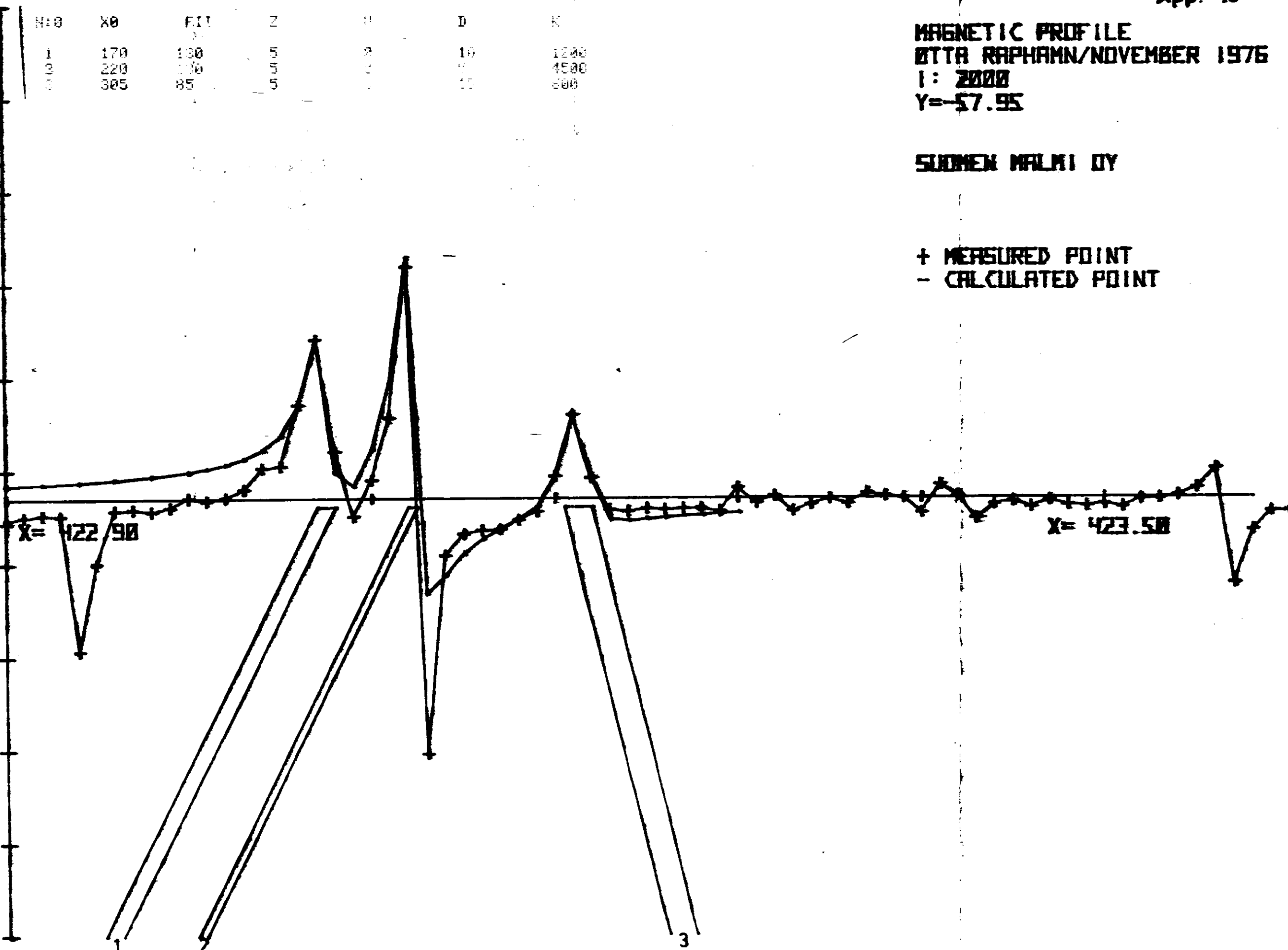
| N#0 | X0  | FIT | Z | H | D  | K    |
|-----|-----|-----|---|---|----|------|
| 1   | 170 | 100 | 5 | 2 | 10 | 1200 |
| 2   | 220 | 100 | 5 | 2 | 10 | 1500 |
| 3   | 305 | 85  | 5 | 2 | 10 | 2000 |

MAGNETIC PROFILE  
OTTA RAPHAMN/NOVEMBER 1976  
I: 2000  
Y=-57.95

SUOMEN MALKI OY

+ MEASURED POINT  
- CALCULATED POINT

50700  
50600  
50500  
50400  
50300  
50200  
50100  
50000  
49900  
49800



DELTA T  
[INT]

MAGNETIC PROFILE  
ØTTA RAPHAMN/NOVEMBER 1976  
I: 2000  
Y=-57.75

SUOMEN MALMI OY

+ MEASURED POINT  
- CALCULATED POINT

50700

50600

50500

50400

50300

50200

50100

50000

49900

49800

| N:0 | X0  | FII | Z | H | D  | K    |
|-----|-----|-----|---|---|----|------|
| 1   | 60  | 100 | 5 | 0 | 23 | 150  |
| 2   | 102 | 110 | 5 | 0 | 10 | 200  |
| 3   | 132 | 110 | 5 | 0 | 10 | 650  |
| 4   | 195 | 100 | 5 | 0 | 8  | 750  |
| 5   | 270 | 100 | 5 | 0 | 70 | 100  |
| 6   | 370 | 90  | 5 | 0 | 5  | 4500 |

X= 422.70

X= 423.30

1

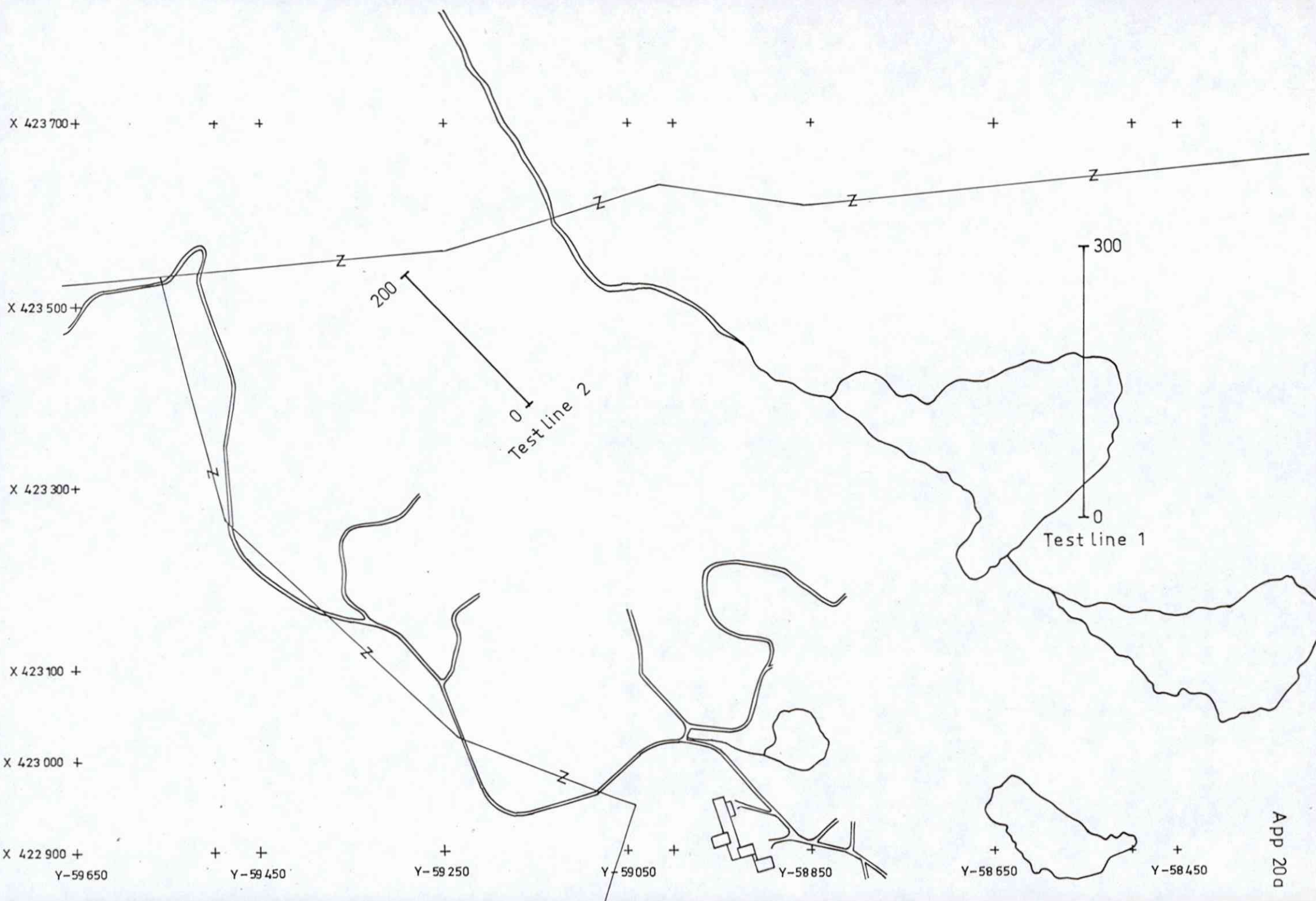
2

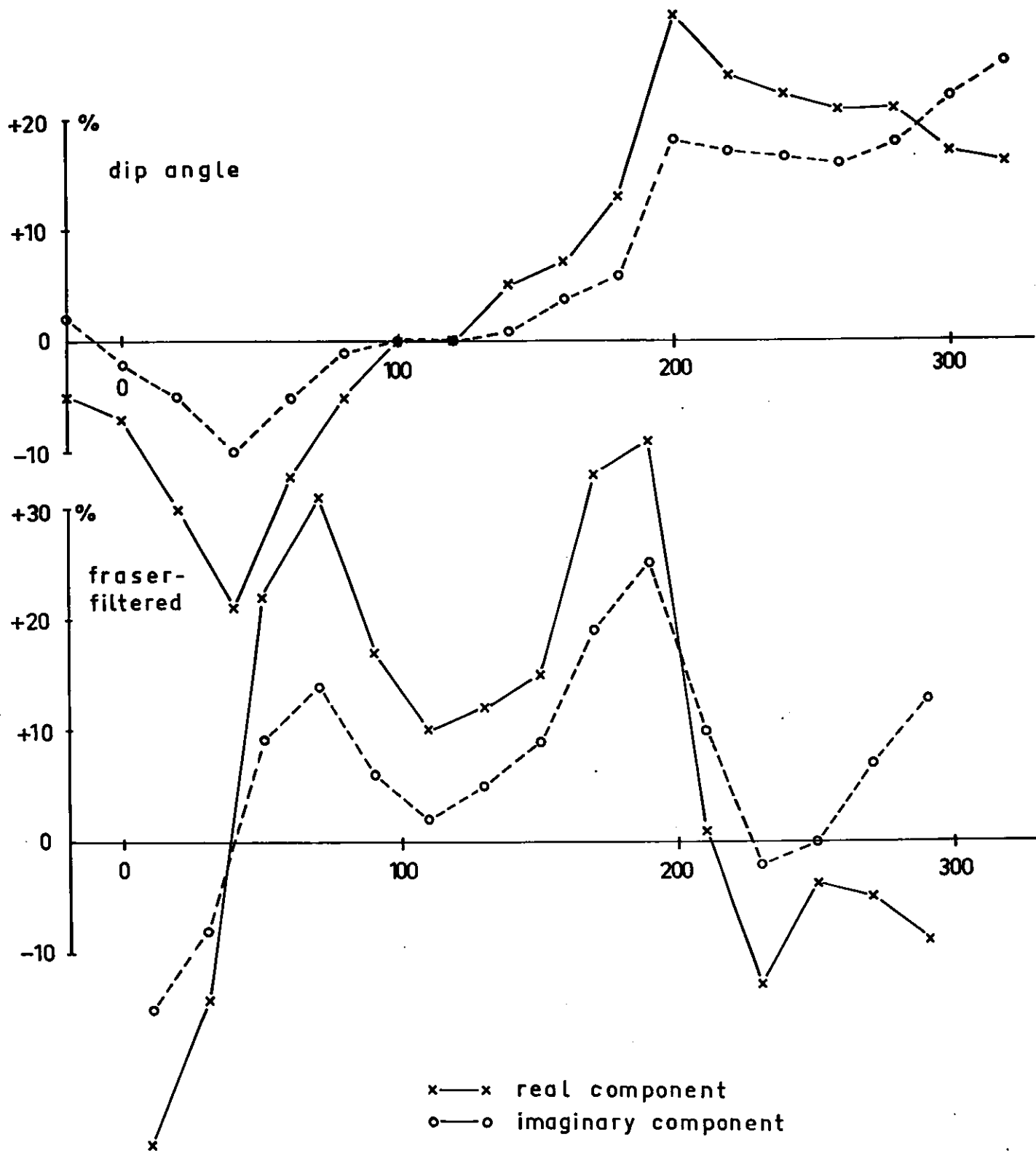
3

4

5

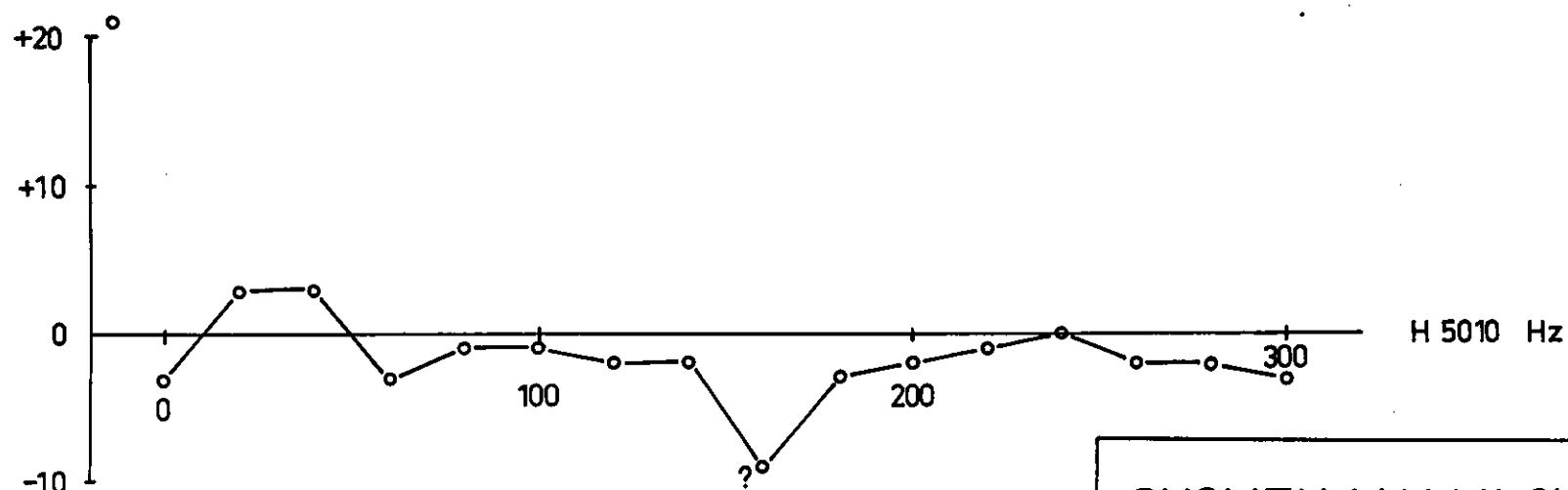
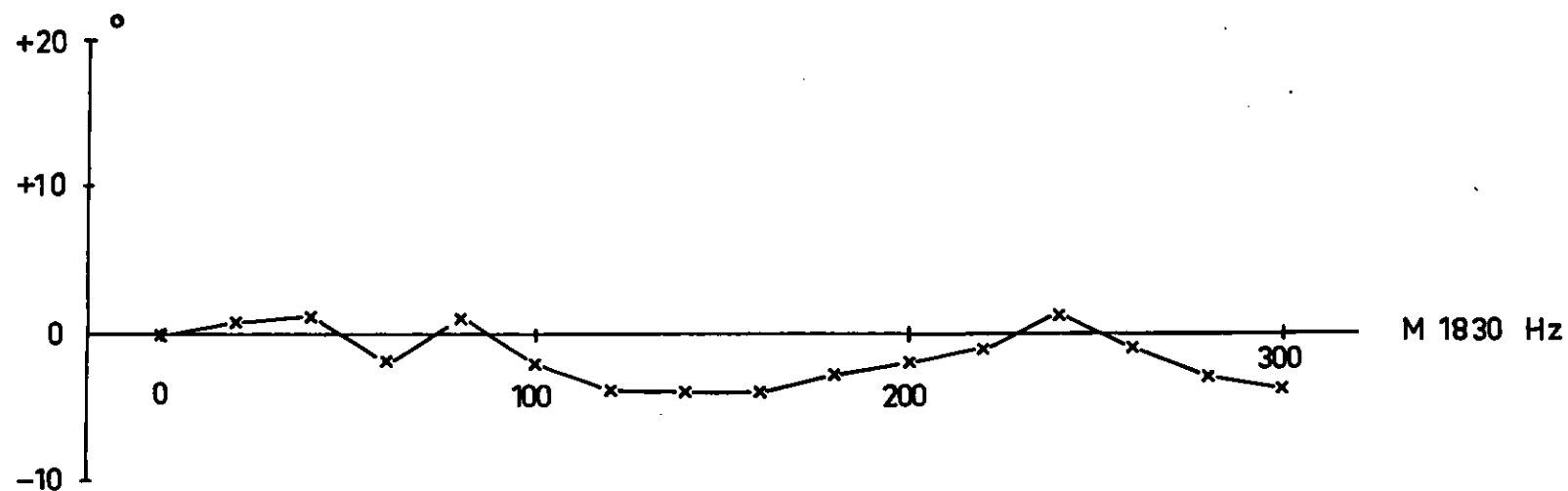
6



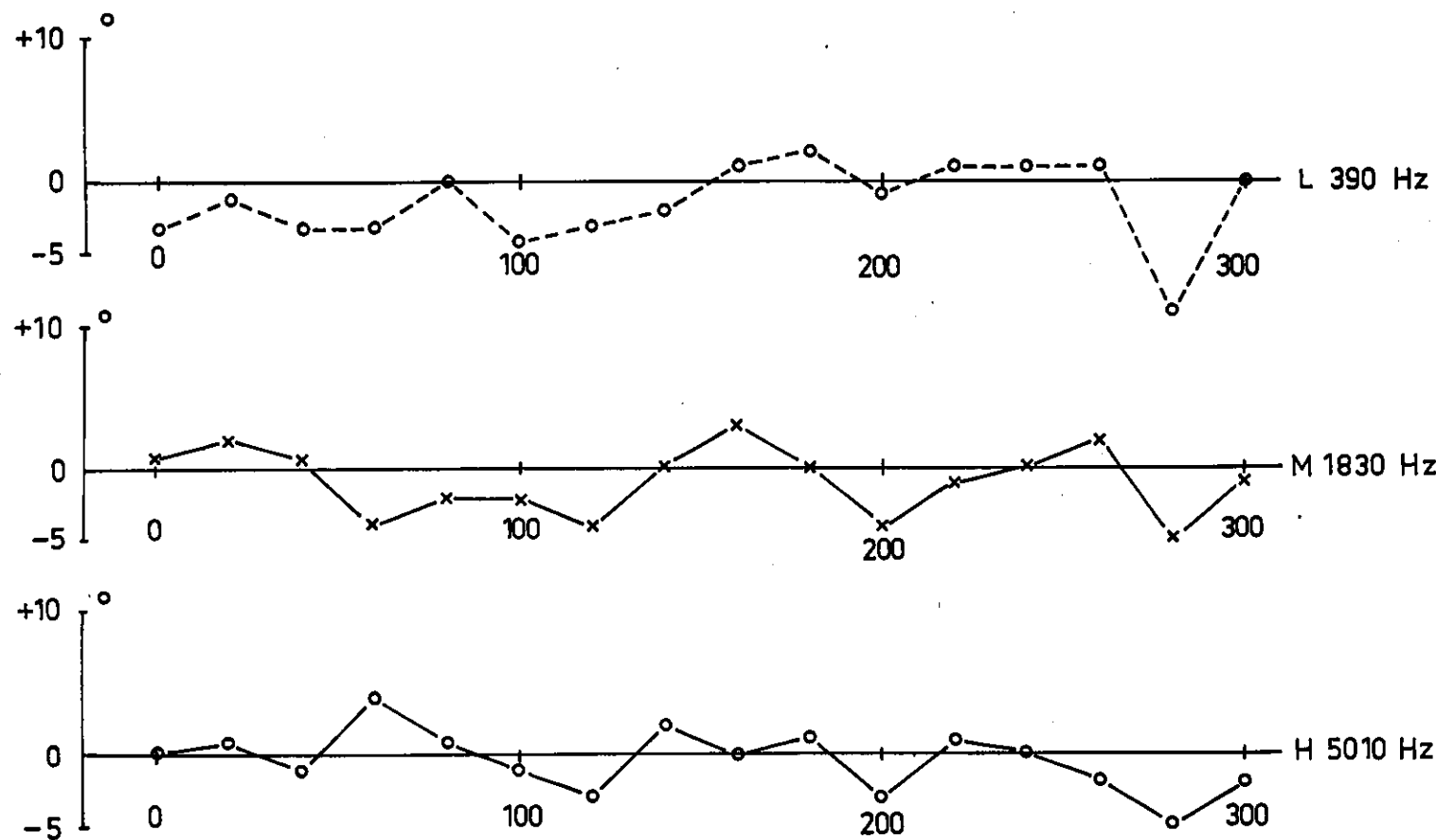


|                             |             |       |    |       |
|-----------------------------|-------------|-------|----|-------|
| SUOMEN MALMI OY             | 1:2000      | meas. | TJ | 11.76 |
|                             |             | draw. | AS | 2.77  |
|                             |             | insp. | PM | 2.77  |
| VLF-profile<br>GBR 16,0 kHz | Test line 1 |       |    |       |
| OTTA, Raphamn               |             |       |    |       |

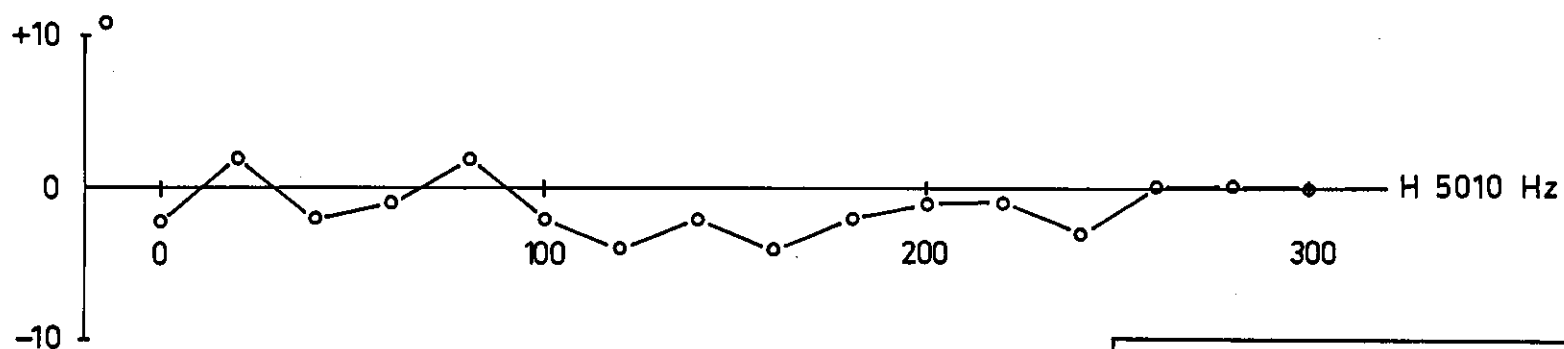
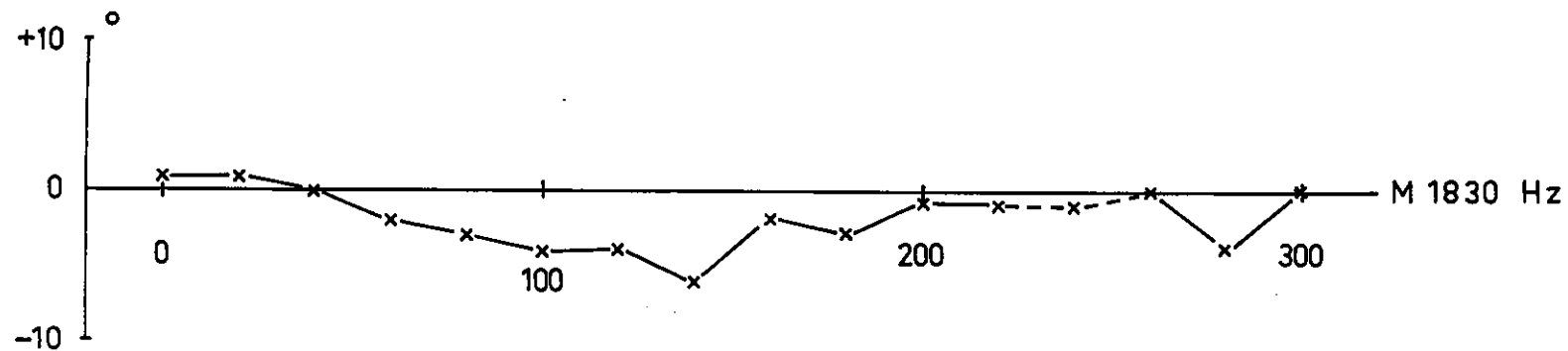




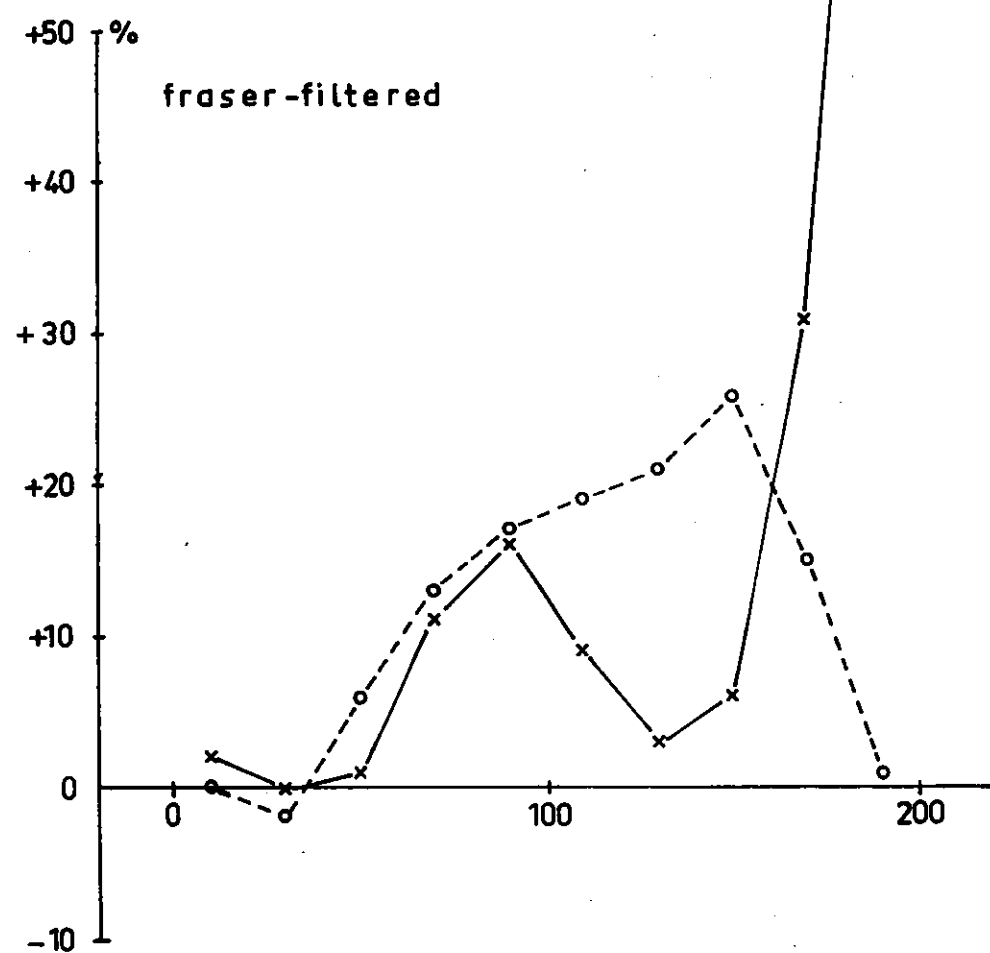
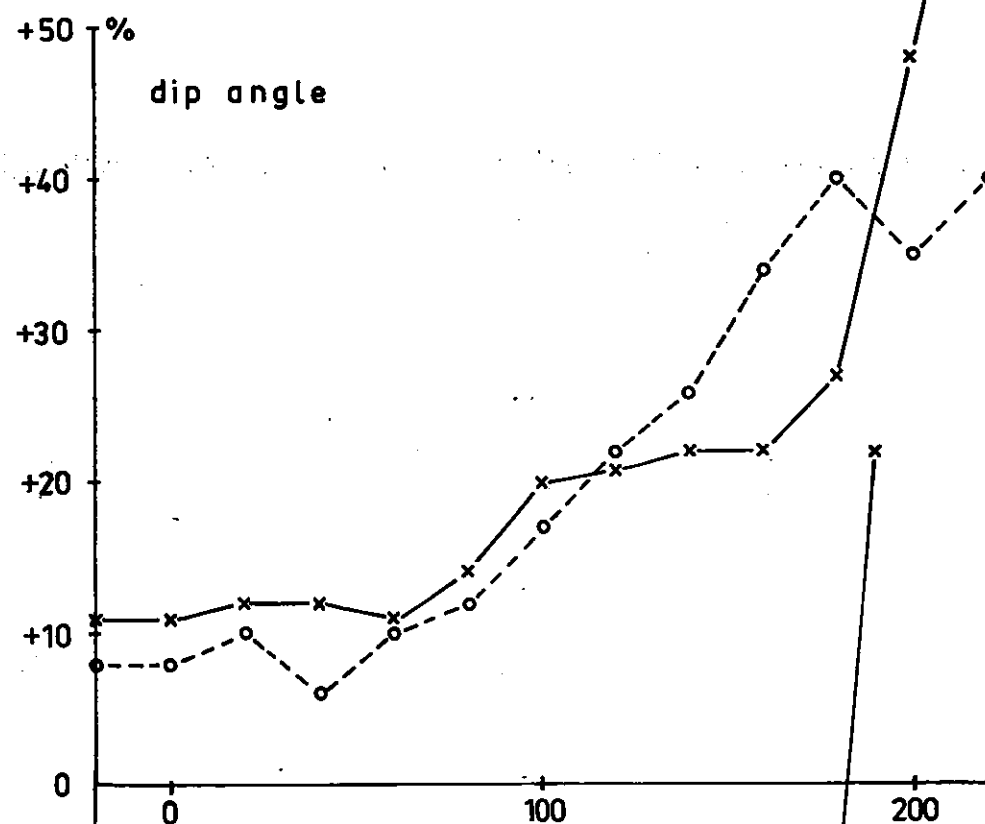
|   |             |       |    |       |
|---|-------------|-------|----|-------|
| SUOMEN MALMI OY                             | 1:2000      | meas. | TJ | 11.76 |
|   |             | draw. | AS | 2.77  |
|   |             | insp. | PM | 2.77  |
| Shootback-profile<br>Coil separation a=60 m | Test line 1 |       |    |       |
| OTTA , Raphamn                              |             |       |    |       |



|   |             |          |       |
|---|-------------|----------|-------|
| SUOMEN MALMI OY                             | 1:2000      | meas. TJ | 11.76 |
|   |             | draw. AS | 2.77  |
|   |             | insp. PM | 2.77  |
| Shootback-profile<br>Coil separation a=80 m | Test line 1 |          |       |
| OTTA, Raphamn                               |             |          |       |

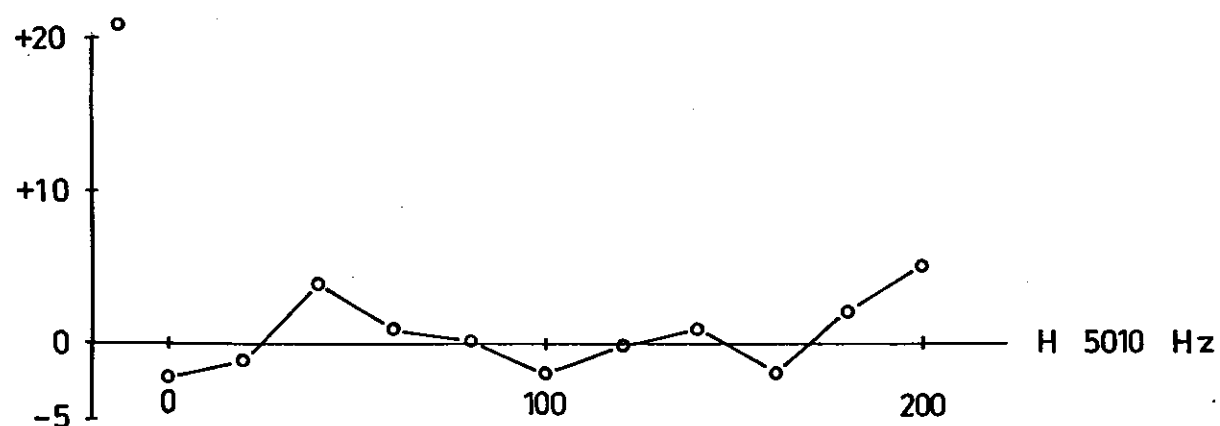
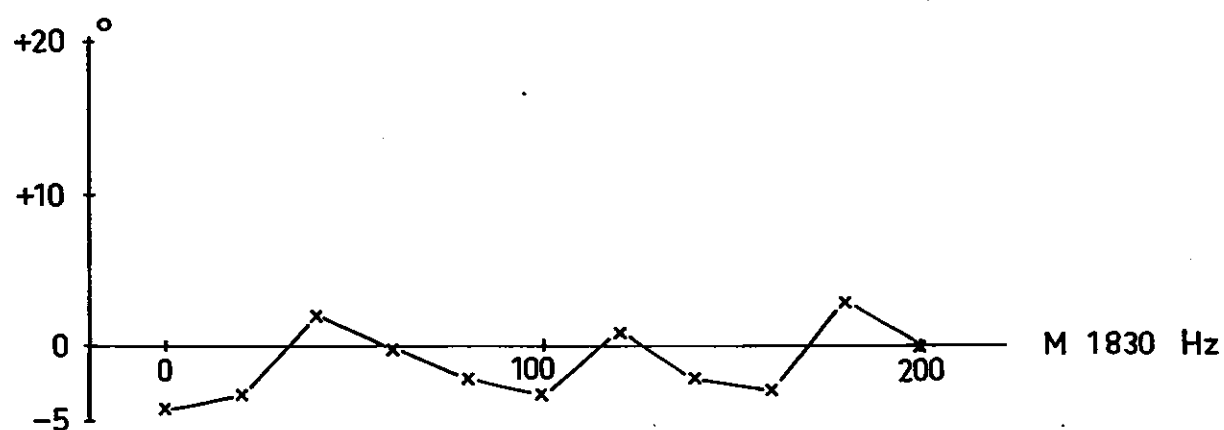
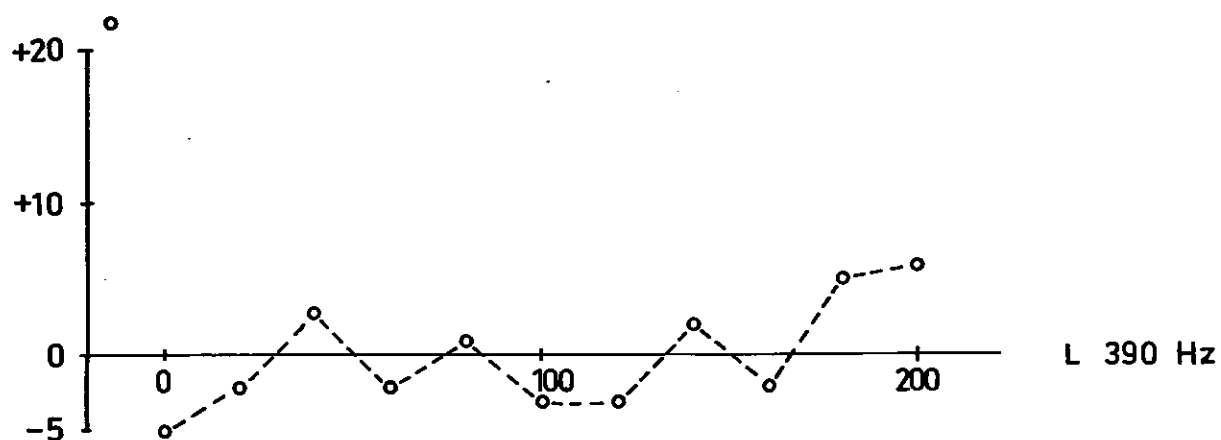


|  |             |       |    |       |
|--|-------------|-------|----|-------|
| SUOMEN MALMI OY                              | 1:2000      | meas  | TJ | 11.76 |
|  |             | draw. | AS | 2.77  |
|  |             | insp. | PM | 2.77  |
| Shootback-profile<br>Coil separation a=100 m | Test line 1 |       |    |       |
| OTTA , Raphamn                               |             |       |    |       |

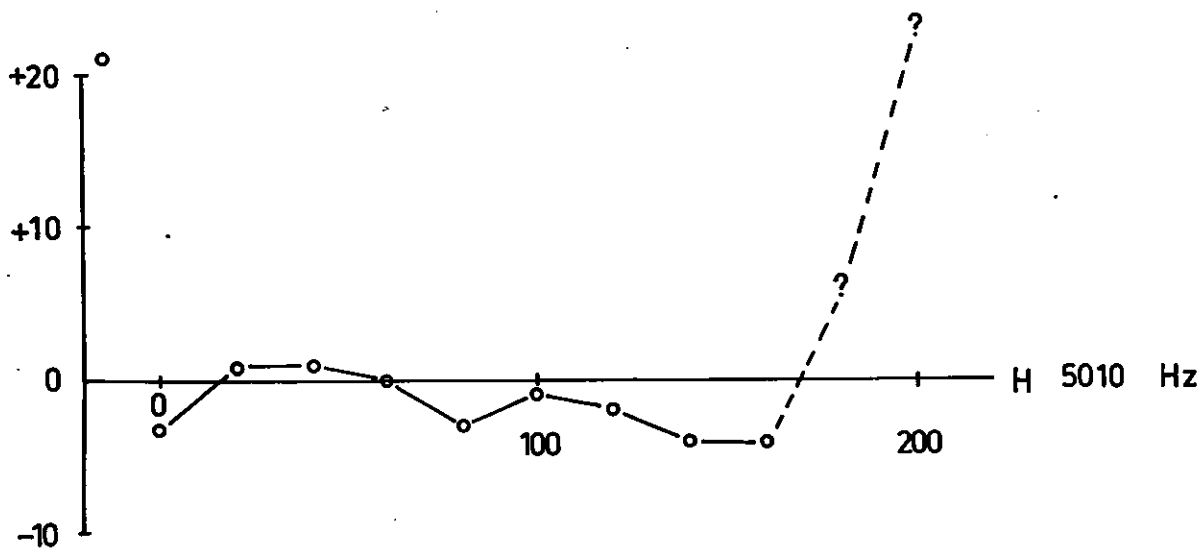
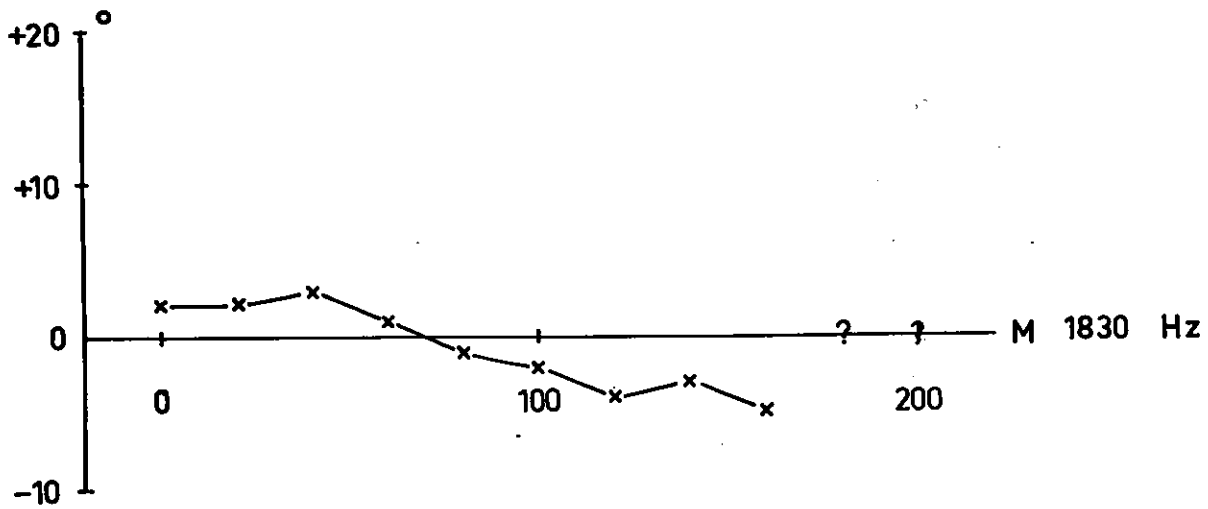


x—x real component  
o—o imaginary component

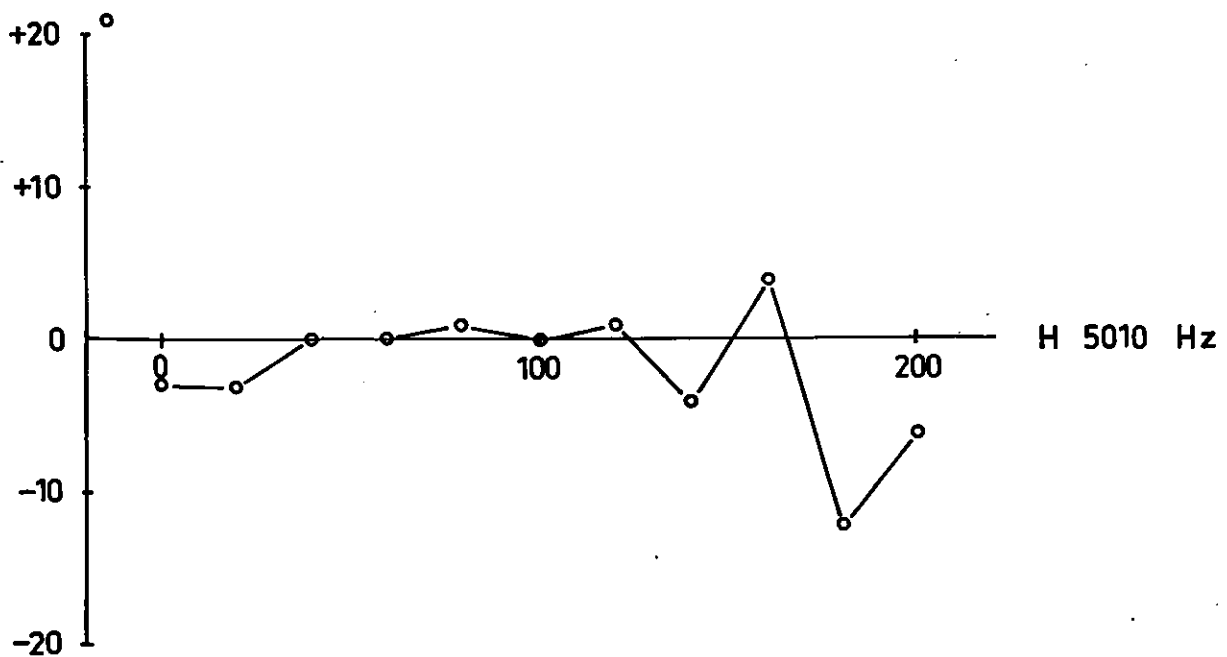
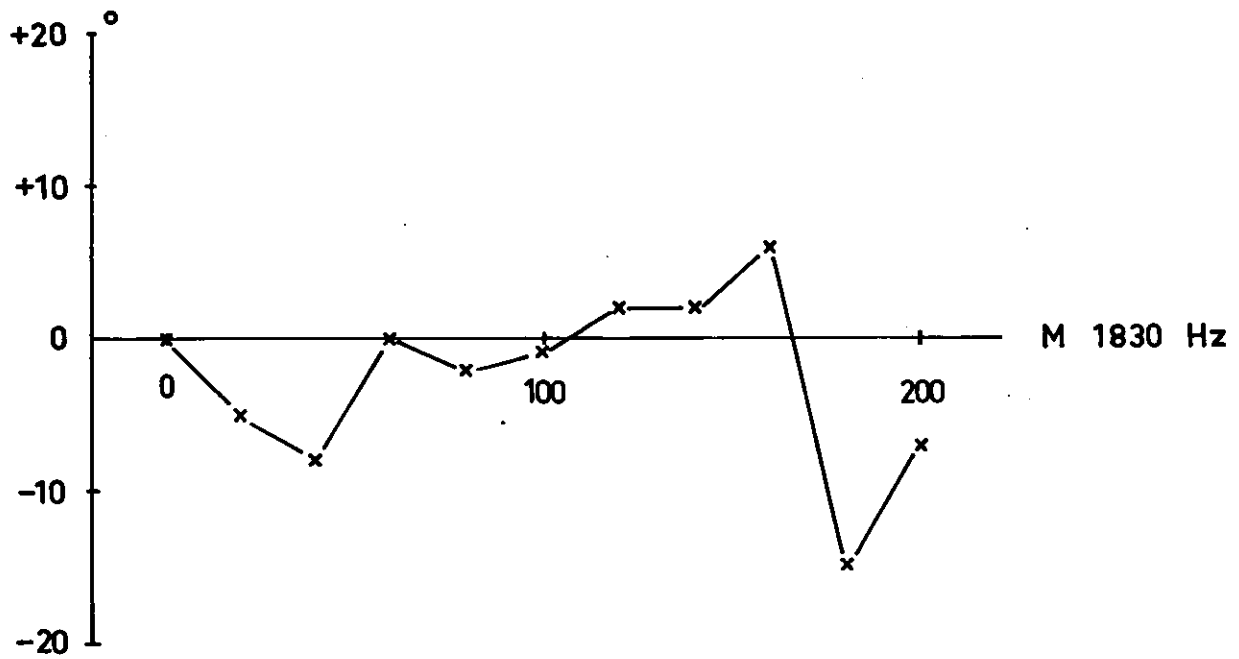
|                             |             |       |    |       |
|-----------------------------|-------------|-------|----|-------|
| SUOMEN MALMI OY             | 1:2000      | meas  | TJ | 11.76 |
|                             |             | draw. | AS | 2.77  |
|                             |             | insp. | PM | 2.77  |
| VLF-profile<br>GBR 16,0 kHz | Test line 2 |       |    |       |
| OTTA, Raphamn               |             |       |    |       |



|   |             |       |    |       |
|---|-------------|-------|----|-------|
| SUOMEN MALMI OY                               | 1: 2000     | meas. | TJ | 11.76 |
|   |             | draw  | AS | 2.77  |
|   |             | insp. | PM | 2.77  |
| Shootback-profile<br>Coil separation $a=60$ m | Test line 2 |       |    |       |
| OTTA, Raphamn                                 |             |       |    |       |



|   |             |       |    |       |
|---|-------------|-------|----|-------|
| SUOMEN MALMI OY                             | 1:2000      | meas. | TJ | 11.76 |
|   |             | draw. | AS | 2.77  |
|   |             | insp. | PM | 2.77  |
| Shootback-profile<br>Coil separation a=80 m | Test line 2 |       |    |       |
| OTTA, Raphamn                               |             |       |    |       |



|  |             |       |    |       |
|--|-------------|-------|----|-------|
| SUOMEN MALMI OY                              | 1:2000      | meas. | TJ | 11.76 |
|  |             | draw. | AS | 2.77  |
|  |             | insp. | PM | 2.77  |
| Shootback-profile<br>Coil separation a=100 m | Test line 2 |       |    |       |
| OTTA , Raphamn                               |             |       |    |       |