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Tittel Geophysical Exploration of Bruvann Deposit in the Råna Area, Norway				
Forfatter Ahokas, Turo		Dato År 06.08 1993	Bedrift (Oppdragsgiver og/eller oppdragstaker) For Norsulfid AS av Outokumu Finnmines Oy Exploration	
Kommune Sjullangen	Fylke Nordland	Bergdistrikt	1: 50 000 kartblad 1331 1	1: 250 000 kartblad Narvik
Fagområde Geofysikk	Dokument type	Forekomster (forekomst, gruvefelt, undersøkelsesfelt) Bruvannsfelet Råna		
Råstoffgruppe Malm/metall	Råstofftype Cu, Ni			
Sammendrag, innholdsfortegnelse eller innholdsbeskrivelse Det er utført EM Slingram- målinger og magnetiske målinger i et 3,2 km ² stort område. Det følger med en list over bergartens suseptibilitet innen måleområdet. Hele det aktuelle området kunne ikke måles pga topografien. Målingene ga meget god info om strukturene i områder og om mulighetene for mer malm. Magnetiseringen i området er svak, men mineraliserte deler av området har høyere magnetisk suseptibilitet enn omgivende gråberg. Det anbefales mer EM geofysikk før det bores.				

Original

NORSULFID AS

***GEOPHYSICAL EXPLORATION OF BRUVANN
DEPOSIT IN THE RÅNA AREA, NORWAY
1993***

OUTOKUMPU 6.8.1993

OUTOKUMPU FINNMINES OY EXPLORATION

GEOPHYSICAL EXPLORATION OF BRUVANN DEPOSIT IN RÅNA AREA, NORWAY

The magnetic survey shows in the Bruvann area that all rocks of the area are very weakly magnetized but mineralized parts have higher magnetic susceptibilities than the waste rocks. This coincides well with petrophysical determinations carried out from some rock samples. Massive ore is also clearly conductive. The host rocks densities are close 3 g/cm³ and increase according to mineralizations.

Because the magnetic interpretation shows some ore potential areas the work could be continued directly by a few prospecting drill holes. A weak conductor supports the interest of the magnetized area no. 6, too. In the western part where the E-W structures are turning to the south the magnetic survey could be improved by E-W trending profiles. If drilling gives positive results geophysics is recommended to continue by the ground and drill hole EM soundings.

Appendices:

Report: Interpretation of the magnetic and EM surveys at Råna (Arneshesten), Norway, 1993.

List of determined petrophysical parameters of Bruvann deposit, 1993.

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REPORT

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PETROPHYSICS

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INTERPRETATIONS OF THE MAGNETIC AND EM SURVEYS
AT RÅNA (ARNESHESTEN), NORWAY
FOR OUTOKUMPU FINNMINES OY, 1993

Turo Ahokas, GX Consulting

20.07.1993

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1. Introduction

This report describes the geophysical surveys carried out in the Råna area during the spring 1993 and the interpretations of the measured data.

The surveys were planned in cooperation by Aimo Hattula / Outokumpu Finmines Oy and T. Ahokas / GX Consulting. The supervision during the fieldwork as well as the magnetic interpretations were done by T. Ahokas.

The plans of the surveys based on the earlier geophysical data and all the available geological information.

The main purpose of these measurements was to solve the possibilities to find some more ore inside or around the known deposit.

2. Fieldwork

Systematic magnetic and horizontal loop EM surveys (Slingram) were carried out in the area of about 3.2 km². Unfortunately it was not possible to measure the NE part of the planned area because of very steep mountainside and there exists also the dump heap of the mine.

There exist many disturbing sources (iron scrap, etc.) in the area disturbing especially the magnetic data. Those disturbing anomalies are often quite local but their intensities are much higher than the intensities of the anomalies caused by rocks. These "extra" anomalies are mostly very sharp and they can also be negative or positive compared to the base level of the magnetic field in the area.

In the horizontal loop EM survey three different frequencies 110 Hz, 1760 Hz and 7040 Hz were used and the coil separation was 100 m.

The distance between measured points was 10 m in the magnetic survey and 20 m in the EM survey. The line separation was 100 m in both measurements.

In addition to the systematic survey also one long magnetic profile (NNE - SSE) was measured to find out the base level of the magnetic field. Orientating by a map was used to locate the profile but it was also bound to the grid of the systematic survey.

The surveys were carried out by a contractor Suomen Malmi Oy during April 1993.

The location map is shown in the figure 1, the magnetic map in the figure 2 and the EM maps in the figures 8a - 10b.

3. Interpretations

3.1 EM (Horizontal loop, Slingram) interpretations

The EM survey showed a conductive schist zone to the south of the known mafic intrusion. To the north of that, near the boundary of the intrusion there exists another, clearly weaker anomaly. It could be caused by a mineralized part of the intrusion.

There exists also a good conductor near the northern boundary of the intrusion but the interpretation in that area is not very reliable due to too few measured values (the measurements were limited by the dump heap).

In the western part of the area there are many nearly N - S trending conductors causing positive anomalies instead of "normal" negative anomalies. This is due to the direction of the measurements.

The EM interpretations are done by Aimo Hattula and the results are shown in the figure 3.

3.2 Magnetic interpretations

According to the magnetic interpretations there exist only weakly magnetized rocks in the area. Anyhow of these rocks the intrusion and most obviously the mineralized parts of it have the highest susceptibilities.

Because the magnetic anomalies are quite weak and there exist all over the area some small variations in the magnetic data (probably due to heterogeneously magnetized intrusion) it is not possible to make very exact interpretations. Many disturbing sources in the mine area caused also some troubles in the interpretations (anomalies caused clearly by civilization were ignored). In the interpretations discussed in this report it is anyhow tried to determine the boundaries of the intrusion and especially to detect ore potential areas inside the intrusion or near it.

In addition to the measured (N - S direction) profiles also many perpendicular profiles picked up from the measured data were interpreted to create a magnetic interpretation map shown in the figure 4. Also those areas, where quite highly magnetized rocks exist are drawn in this figure. These areas are ore potential. Some of the interpreted profiles are shown in the figures 5a - 6d. Here I would like to point out that in the interpretation profiles the interpreted bodies inside the intrusion are not necessarily separate rock types (and they don't have very sharp boundaries) but they represent mainly the variation of the susceptibility values.

According to the long magnetic profile shown in the figure 7 there exist only very weak anomalies outside the systematically measured area and there are no areal changes in the magnetic base level to take into account in the interpretations.

In the next chapters there are more detailed comments on some parts of the measured area given. These subareas are numbered from 1 to 8 in the magnetic interpretation map in the figure 4 and in the interpretation profiles in the figures 5a - 6d.

In the interpretation map in the figure 4 it is possible to see an anomaly like a tongue pointing to the south in the southwestern corner of the intrusion but unfortunately it is possible to detect it only in the data of one profile (profile 2000E). According to the interpretations this anomaly (number 1 in the figures 4, 5 and 6a) is caused either by a schist around the intrusion or by a part of the intrusion itself. EM survey, carried out earlier, detected at the same site a deep seated conductor so that there could exist a mineralization. In the interpretations in the figures 5a and 6a there are only very rough approximations of the dimensions of that anomalous body shown (about 150 m thick and over 300 m long, almost N - S trending). To get more reliable interpretations I recommend that there should be more magnetic profiles (W - E direction) measured in this limited area.

The ore potential area marked by number 2 in the figure 4 is that part of the intrusion, where the so-called "West ore" is situated deeper ending at the western edge of the intrusion. This western end of the intrusion seems to be very steep. The detected anomalous body number 2 causes the strongest anomaly near the profile 2300E (see the figure 5d) meaning that the centre of the upper surface of this body must be near this profile. This ore lens is situated so deep that it is not possible to interpret its dimensions very exactly but anyhow there is one possible interpretation of it shown in the figure

5d showing also how small the anomaly caused by a deep seated magnetized body really is.

The anomalous area to the NW of the intrusion (number 3 in the figure 4) could mean that the intrusion and the ore potential part of it are dipping to the NW but it is also possible that the anomalies there are caused by pyrrhotite bearing schists around the intrusion.

In the data of the profile 2300E (figure 5d) there is a sharp anomaly at the northern edge of the intrusion and near it there exists also an anomaly in the EM results. It is possible that there exist some disturbing sources on the ground but there may also exist a narrow ore lens near the ground surface. This anomaly is number 4 in the figure 4. On the same profile there is also another narrow anomaly near the southern boundary of the intrusion (number 5 in the figure 4) and according to the EM interpretation it seems to be a medium good conductor.

It would be possible (and partly it is possible) by magnetic interpretations to determine the extent of the so-called "East ore" to the east of the fault (cutting the intrusion into two pieces) because this ore lens is very near the ground surface but unfortunately the measurements are insufficient in that area and already part of the ore is mined off. Anyhow this ore lens is roughly drawn (according to the magnetic data available) in the interpretation map in the figure 4.

Between the profiles 2500E and 2900E the southern boundary of the intrusion is anomalous (number 6 in the figure 4). Partly in the same area there exists a quite weak EM anomaly. This may mean that this part of the intrusion is mineralized.

The anomalous area number 7 in the figure 4 seems to consist of small pieces but it is quite distinguishable (see the interpretation profile 3100E in the figure 5j). This anomaly may continue to the east, outside the measured area.

In addition to the anomalous parts described above there exist some signs of possibilities to have mineralizations in the NE corner of the intrusion (number 8 in the figure 4) but there is not data enough for interpretations.

The schists in the western and NW part of the measured area include also some parts with stronger anomalies but I think that they hardly are ore potential.

4. Conclusions and recommendations

In spite of some small limits caused by the topography and the mine area it was possible to get very good information of the geological structures and the possibilities to have more ore in the area by the magnetic and EM surveys.

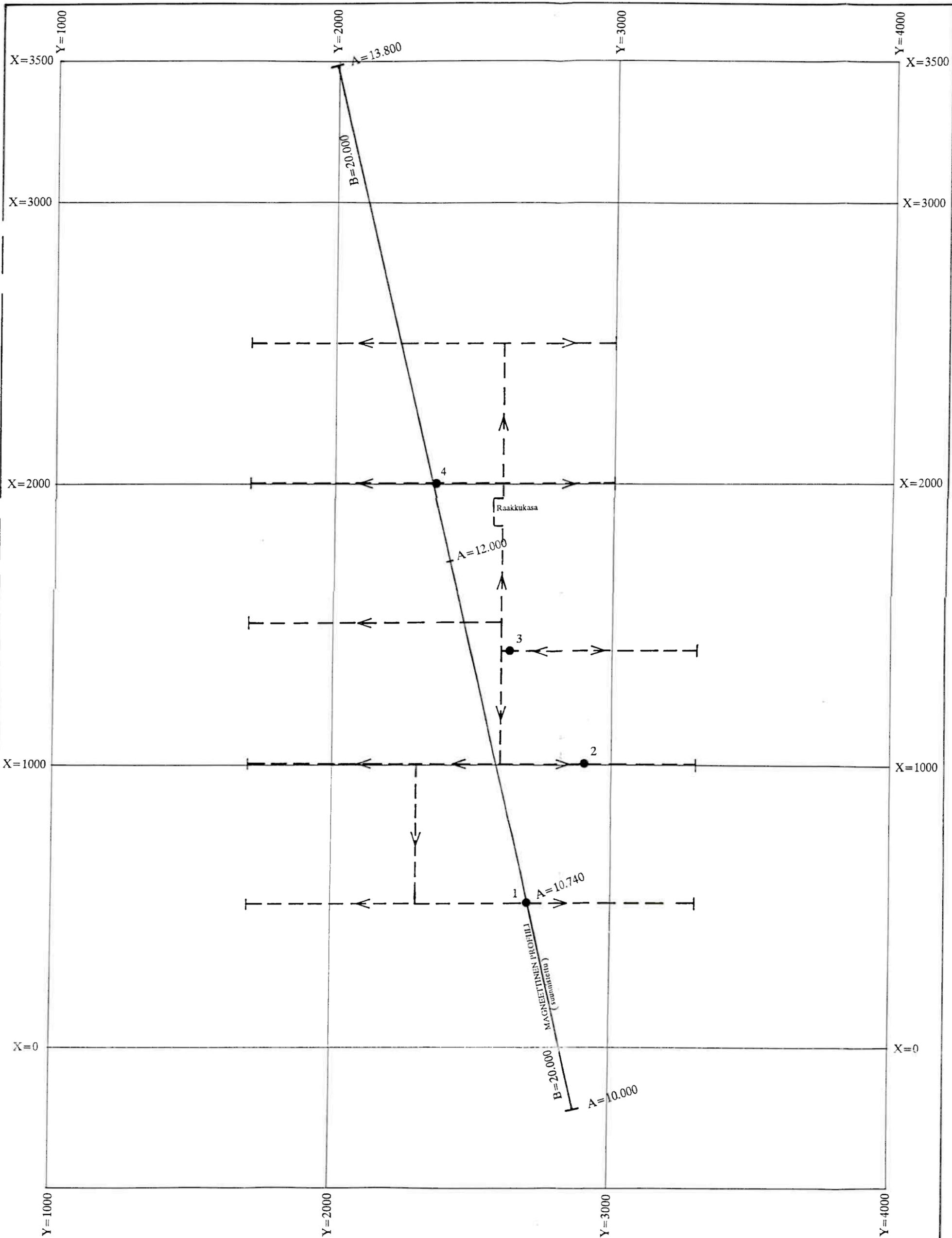
According to the EM measurements there exist very few conductors in the area and of the detected anomalies the strongest ones are caused by earlier known schists.

By magnetic survey it was possible to determine the boundaries of the intrusion quite exactly although it is very weakly magnetized. It also seems to be so that the mineralized parts of the intrusion have higher susceptibility values than the other parts. This is confirmed by some determinations of the petrophysical properties of rock samples. So in the interpretations it is mainly paid attention to the variation of the susceptibility values inside the intrusion (showing the mineralized parts of the intrusion) and to the possibilities to have ore deposits nearby. By this kind of interpretations some ore potential areas discussed above are detected (see the subareas numbered from 1 to 8 in the figure 4).

Although it is difficult to prioritize the interpreted ore potential areas the western and SW parts near the southern boundary of the intrusion are perhaps the most interesting ones (numbers 1, 5 and 6 in the figure 4). The possible mineralizations in the NW part of the intrusion are quite deep so that there must be used some other geophysical methods to solve this problem (for instance EM-37 or Gefinex 400).

There exist many interesting anomalies near the eastern edge of the measured area but unfortunately it was not possible to get data enough of that area due to very steep and slippery mountainside.

As the follow up work before drilling there should be some EM surveys using equipments with better depth penetration carried out both on the ground surface and in the drill holes, especially in the northern or NW part of the area, where the possible mineralizations can be deeper. I also recommend that there should be some W - E trending magnetic profiles measured to the SW of the intrusion around the anomaly number 1 in the figure 4. Also by gravity survey it would be possible to separate mafic rocks from the other rock types but the survey must be more detailed than done by NGU earlier in this area.



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Arneshesten Råna
1331
1: 10 000
Linjastokartta
OUTOKUMPU NORGE A/S
03.05.1993 SMOY / LMJ / ami

Figure 1

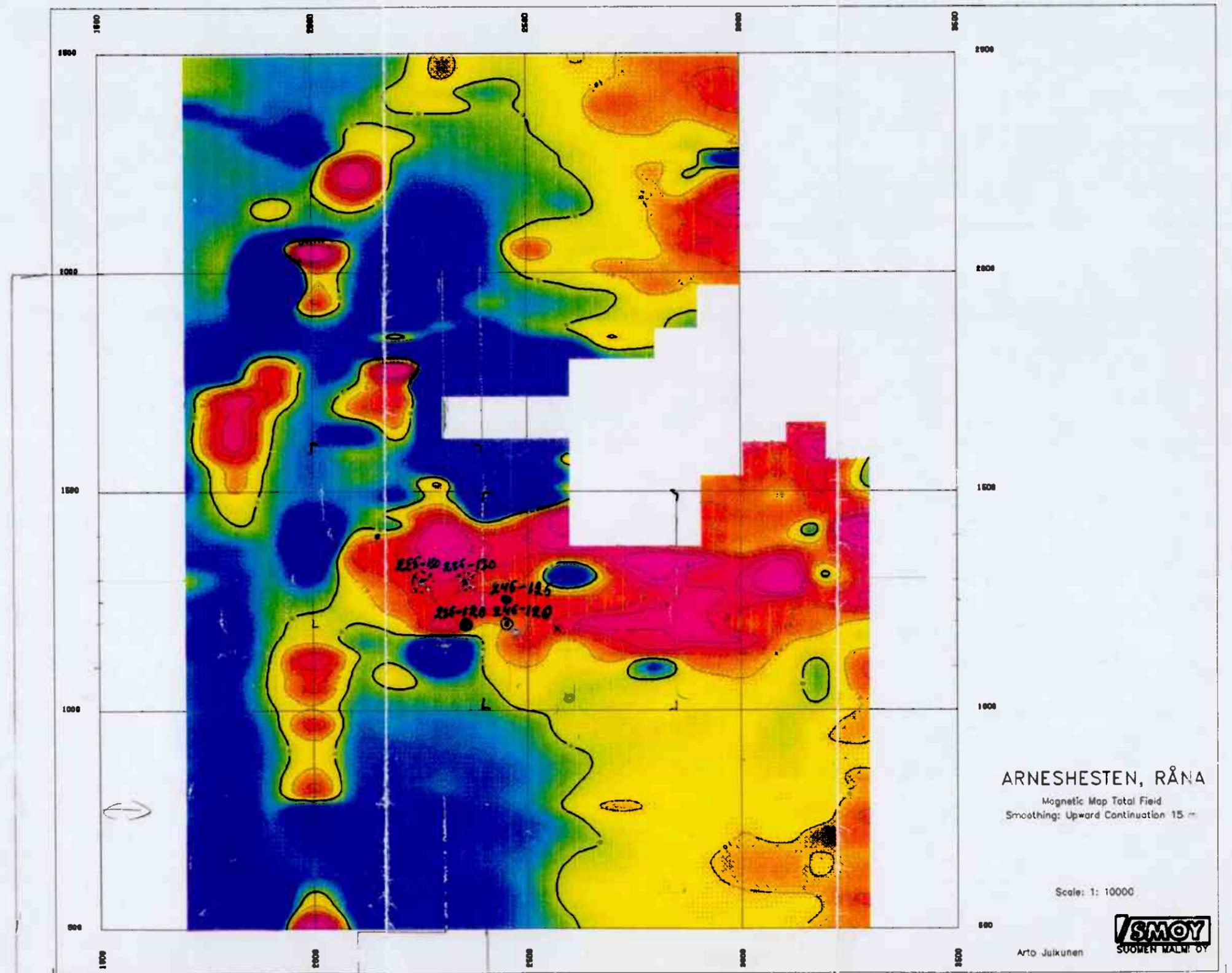
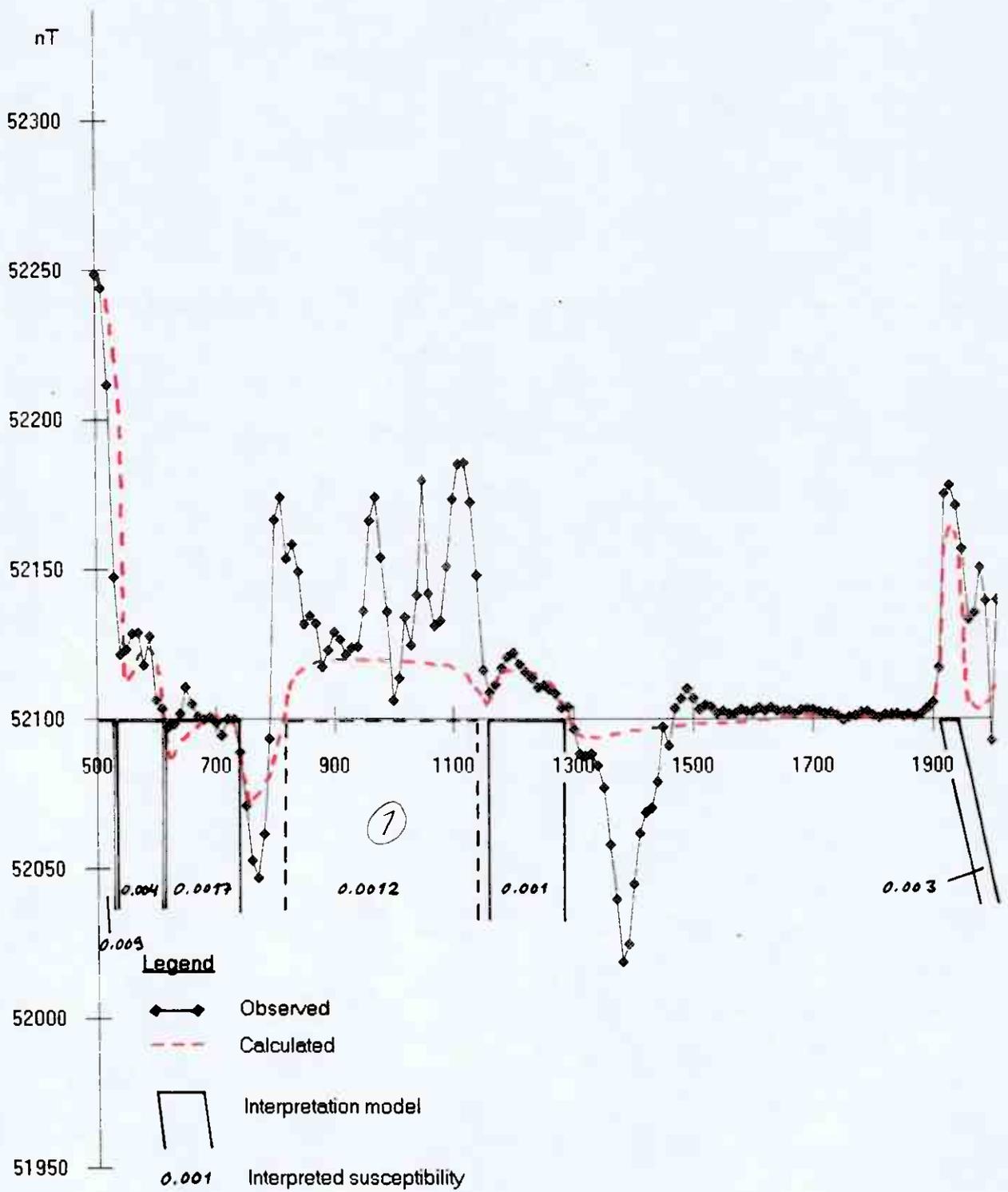


Figure 2

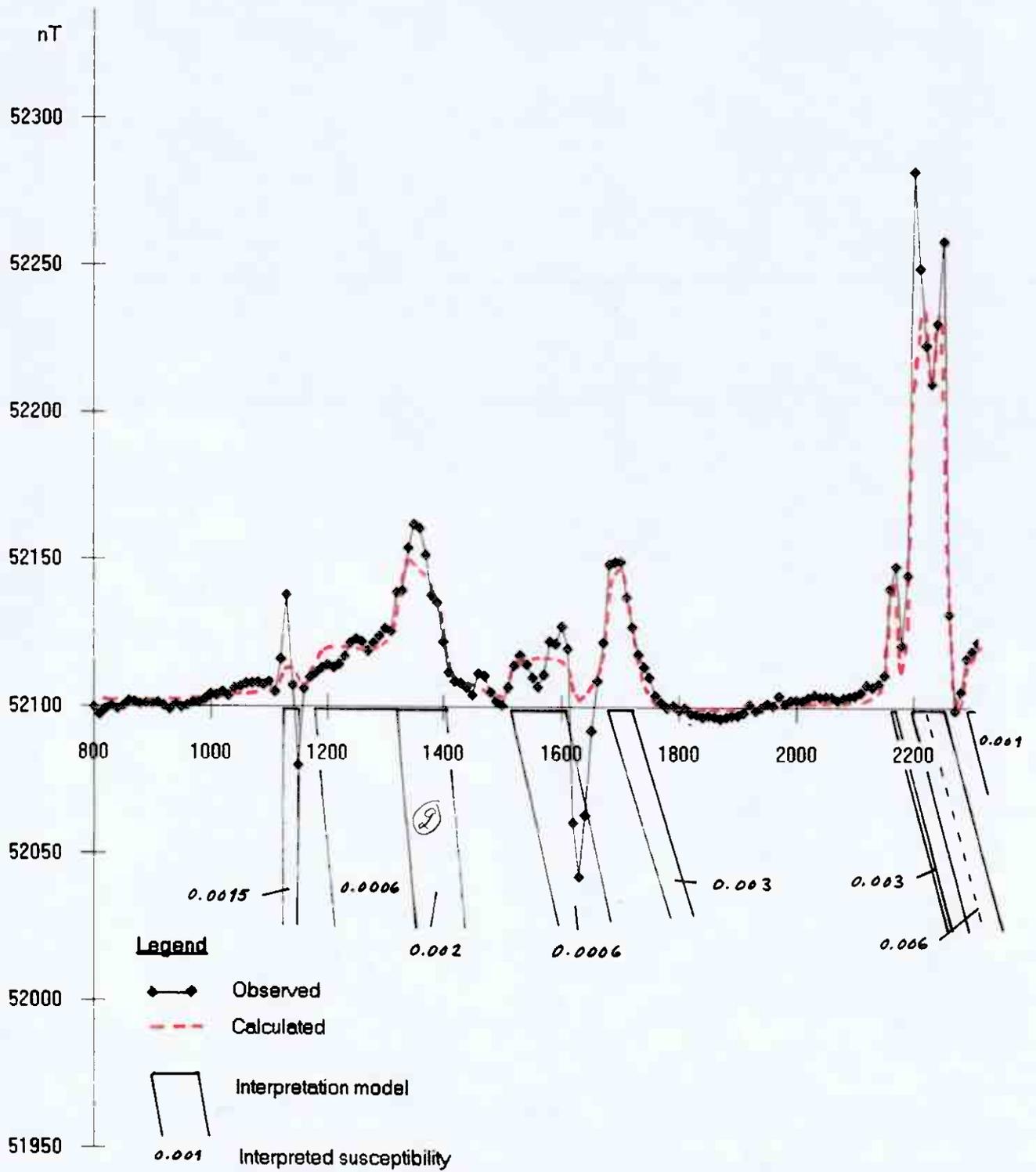
Râna, Magnetic profile 2000E



Scale 1 : 10 000

Figure 5a

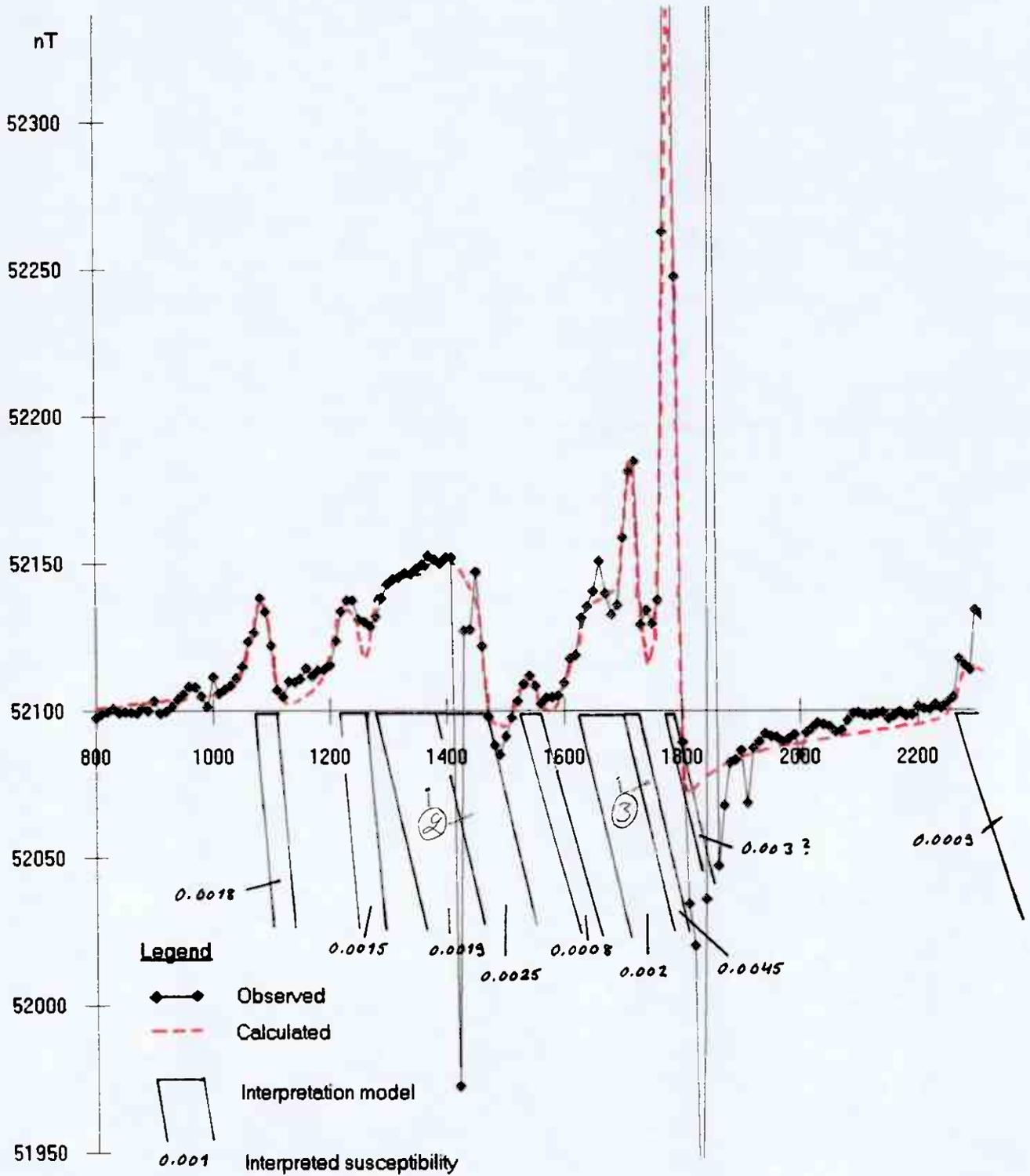
Råna, Magnetic profile 2100E



Scale 1 : 10 000

Figure 5b

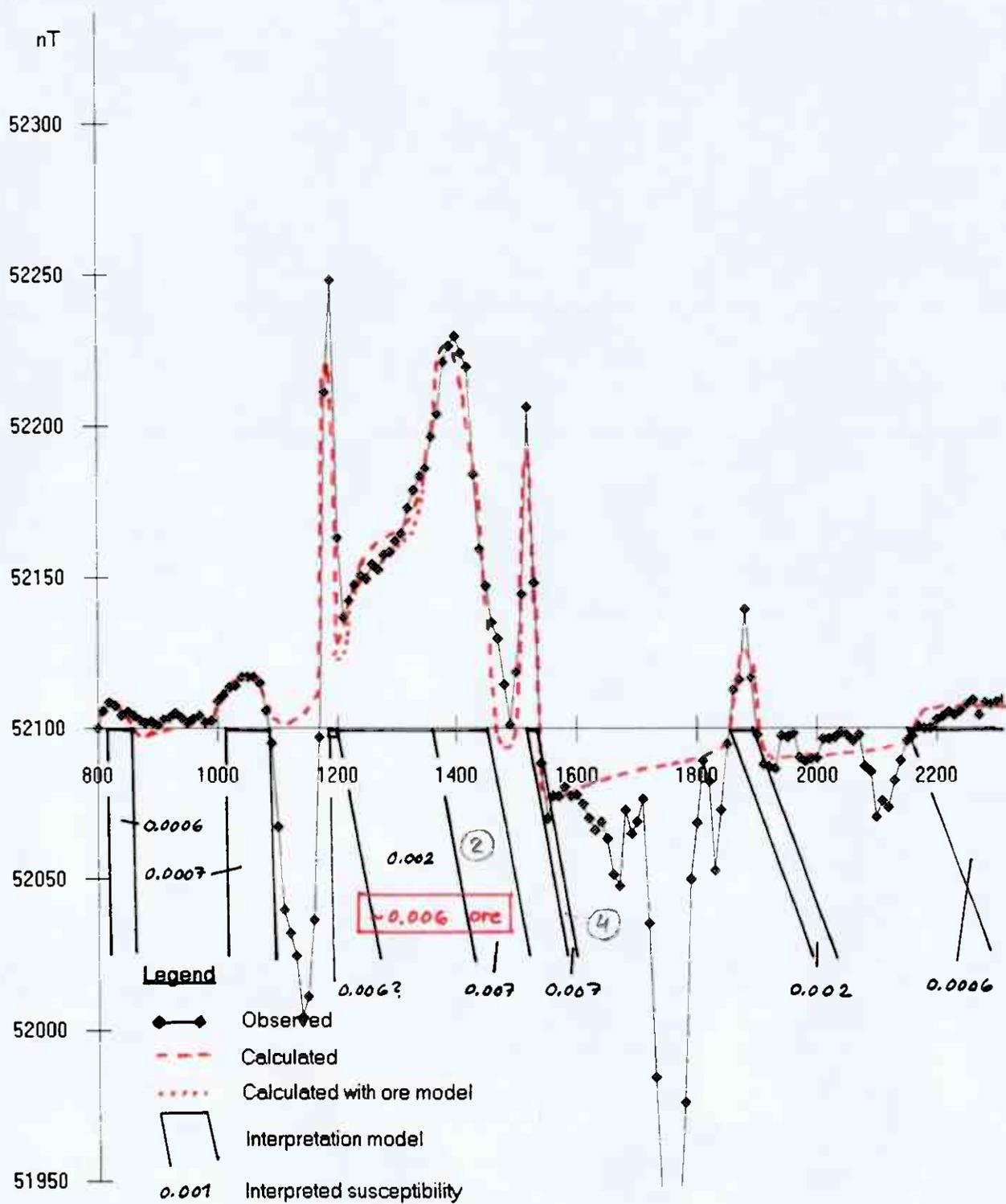
Râna, Magnetic profile 2200E



Scale 1 : 10 000

Figure 5c

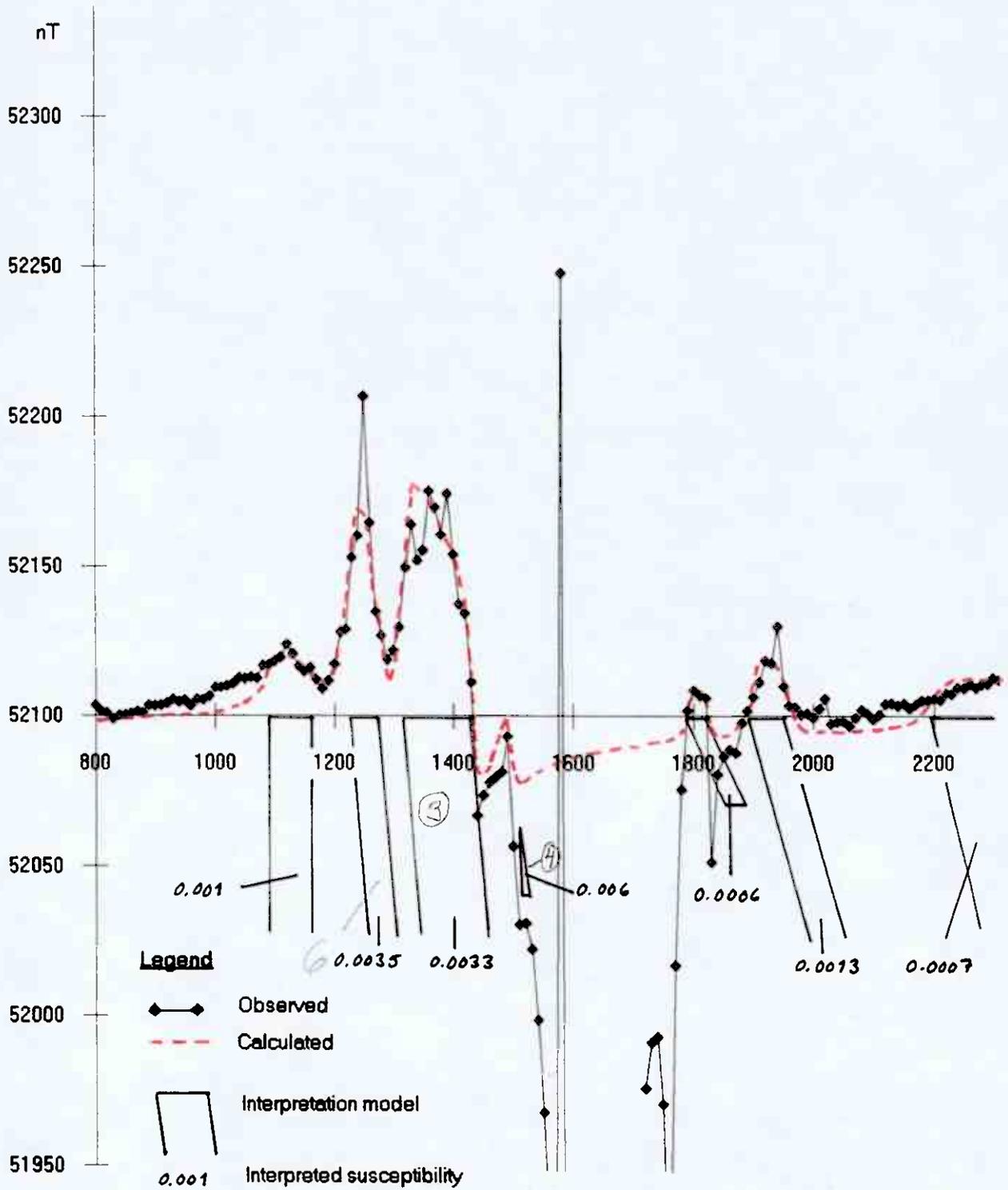
Râna, Magnetic profile 2300E



Scale 1 : 10 000

Figure 5d

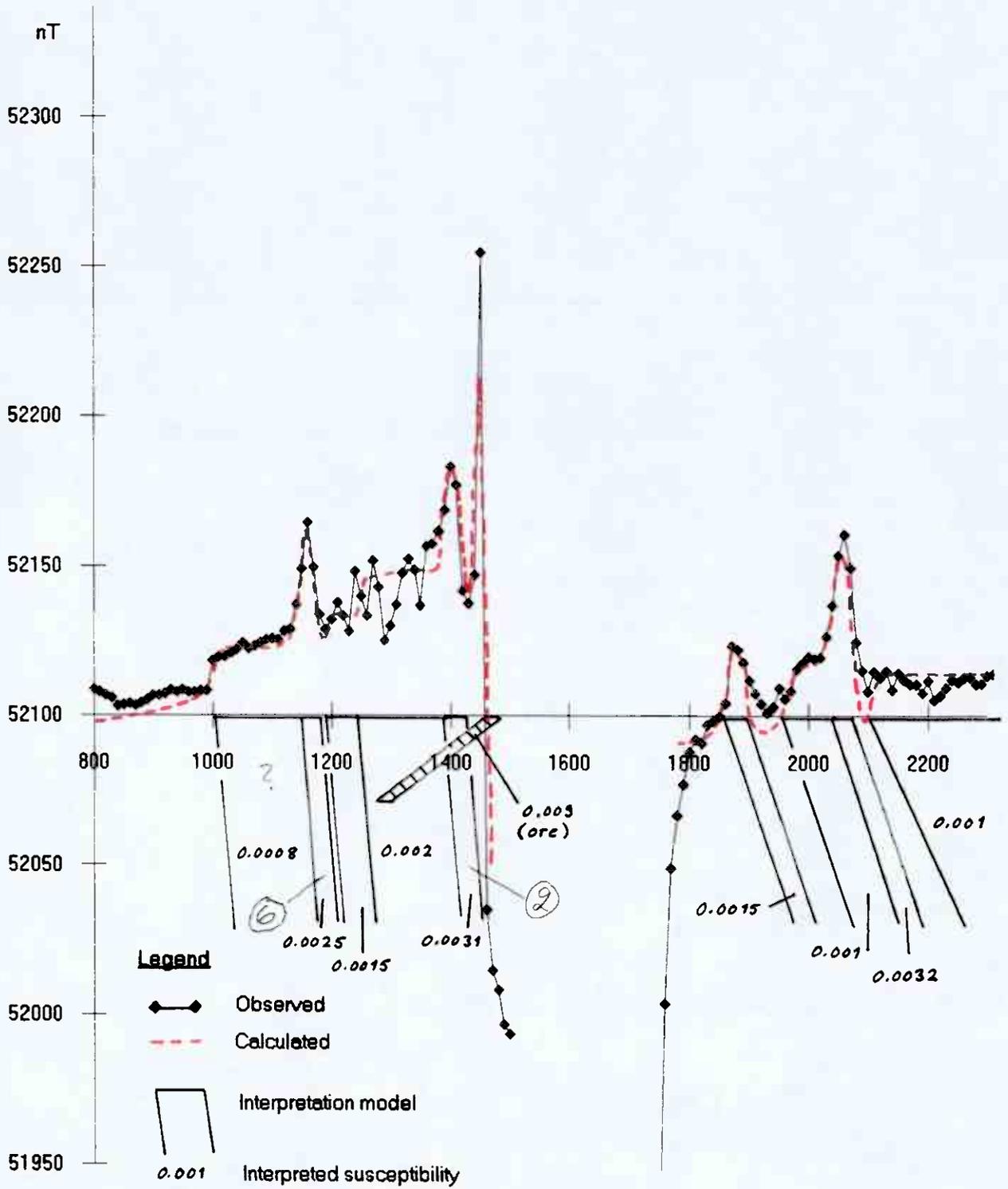
Râna, Magnetic profile 2400E



Scale 1 : 10 000

Figure 5e

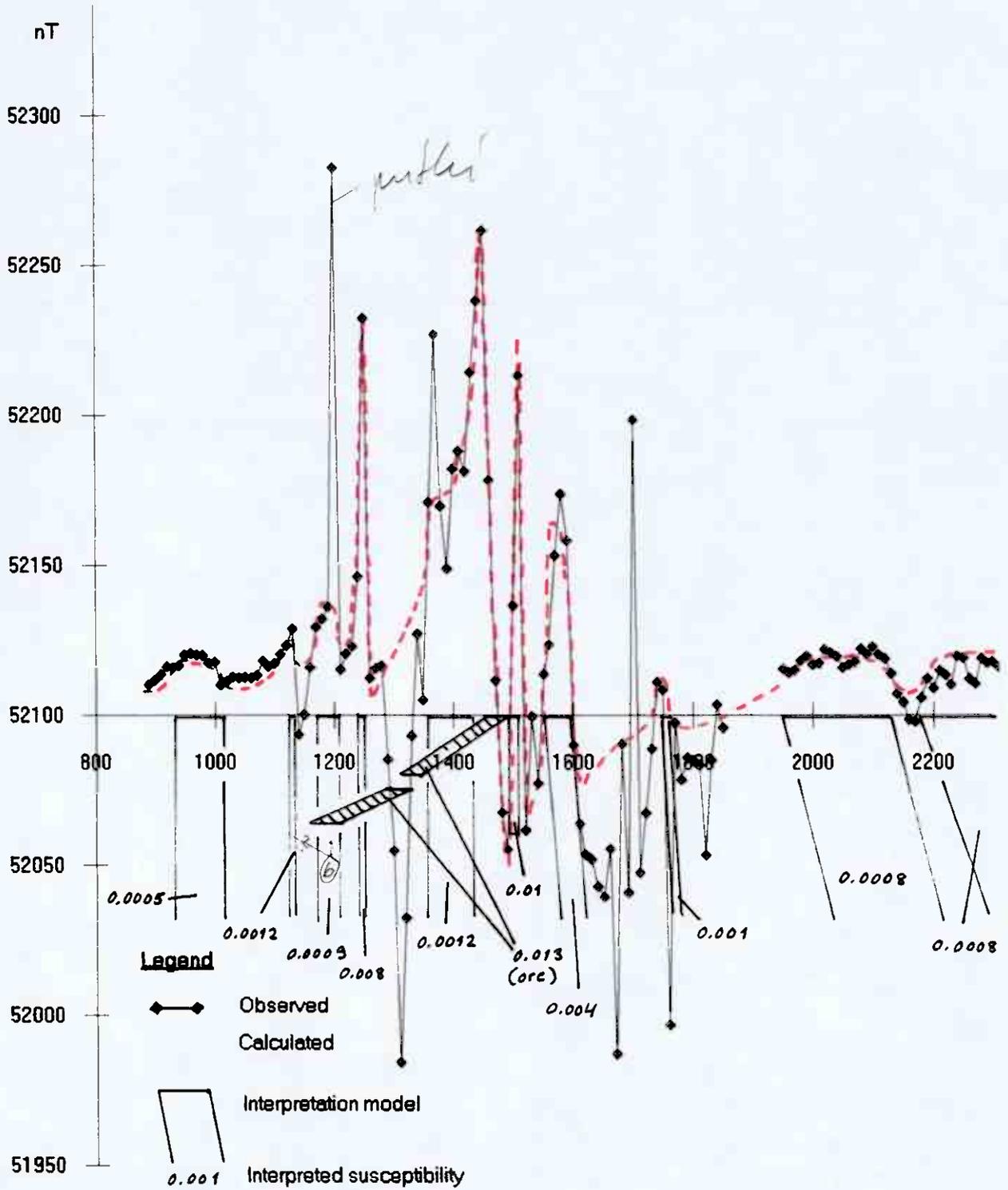
Råna. Magnetic profile 2500E



Scale 1 : 10 000

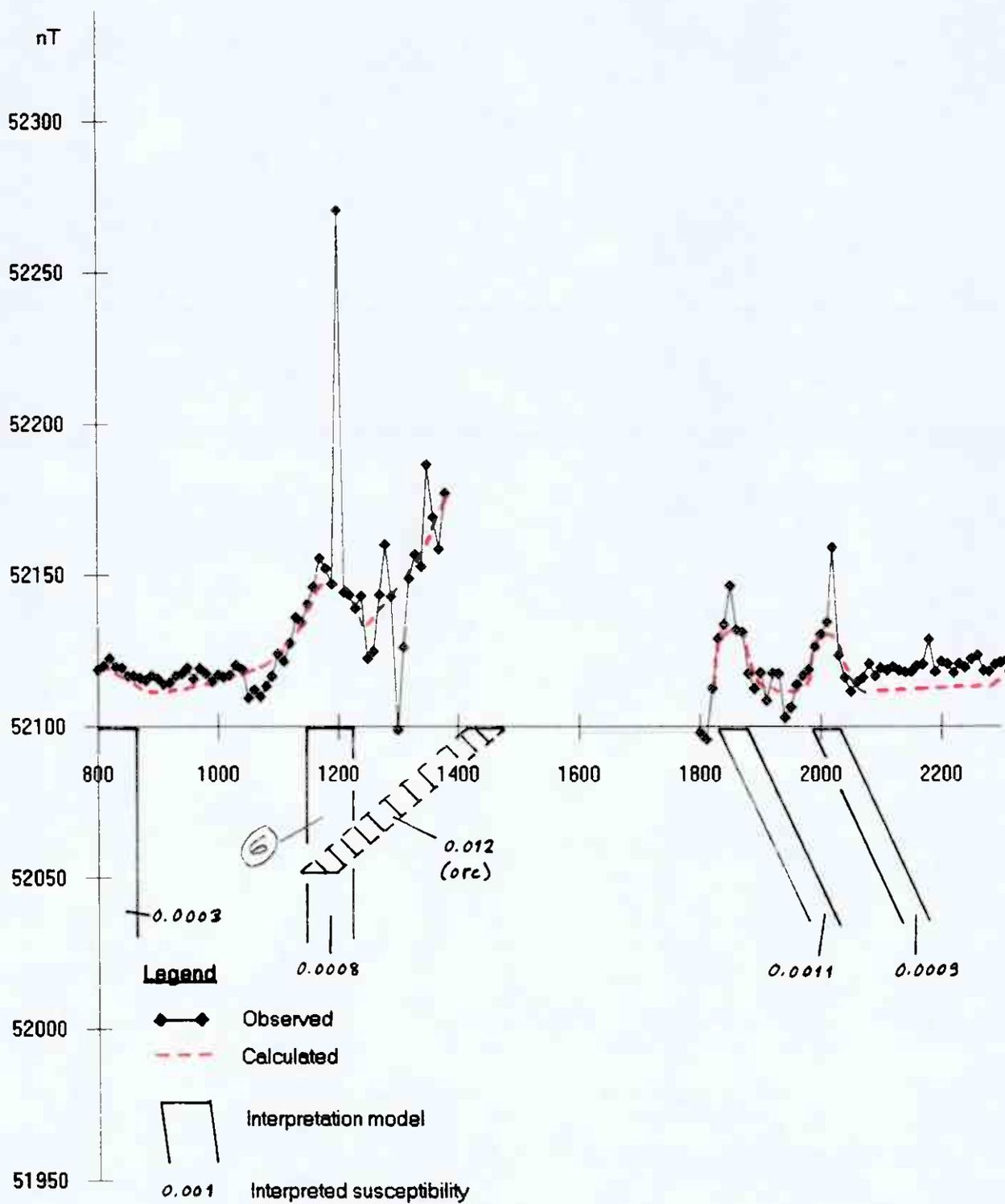
Figure 5f

Råna. Magnetic profile 2600E



Scale 1 : 10 000

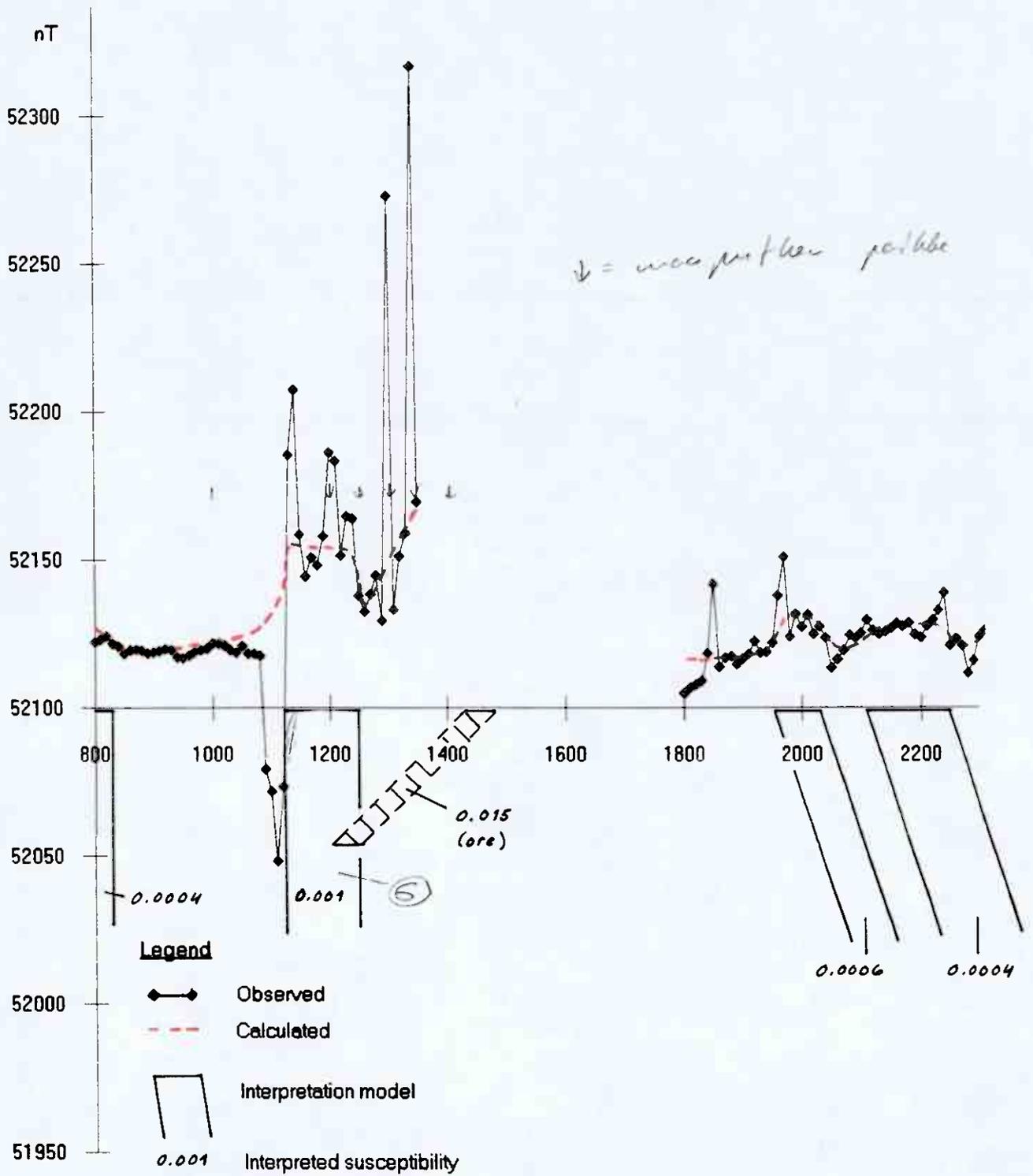
Råna, Magnetic profile 2700E



Scale 1 : 10 000

Figure 5 h

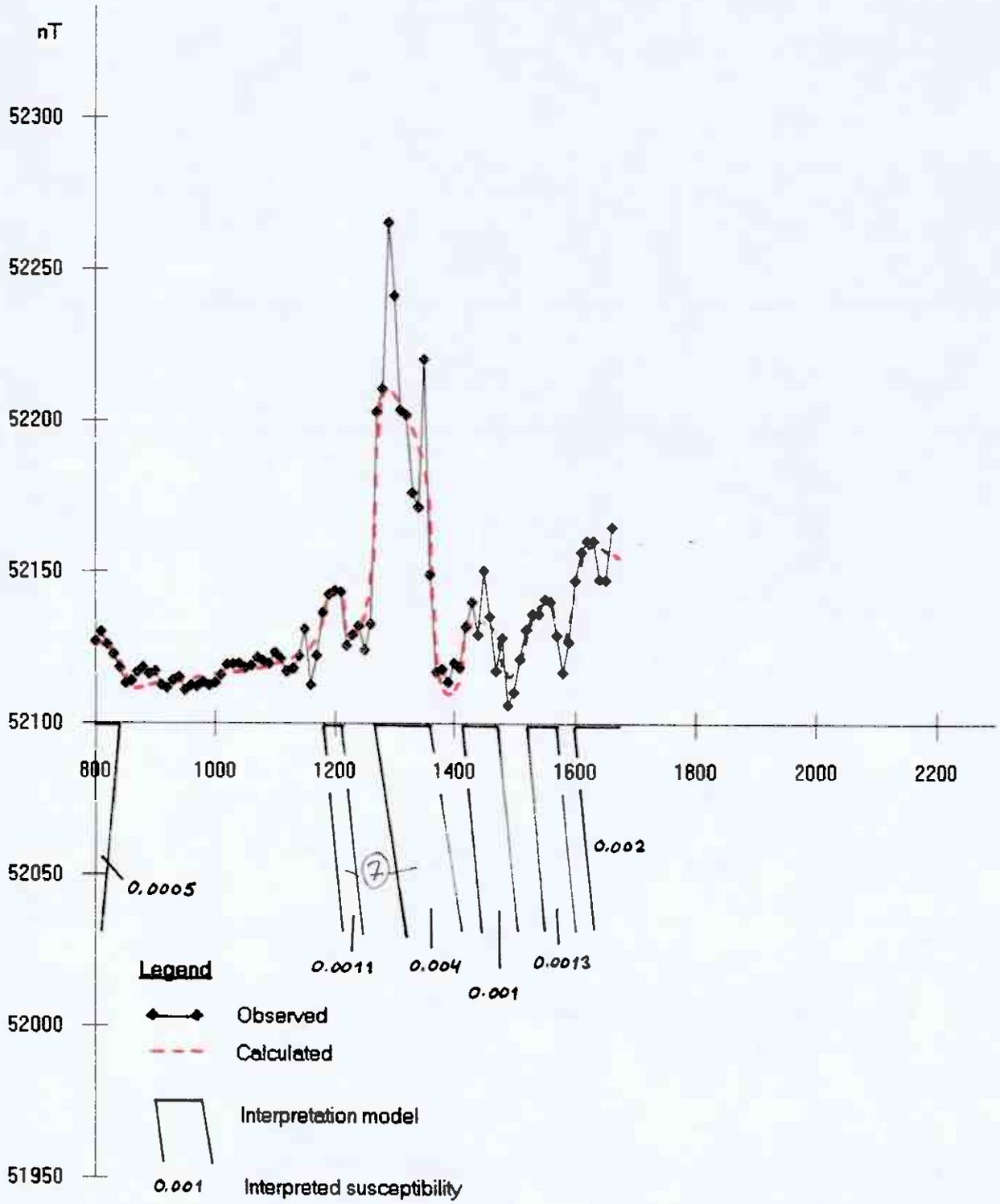
Råna, Magnetic profile 2800E



Scale 1 : 10 000

Figure 5;

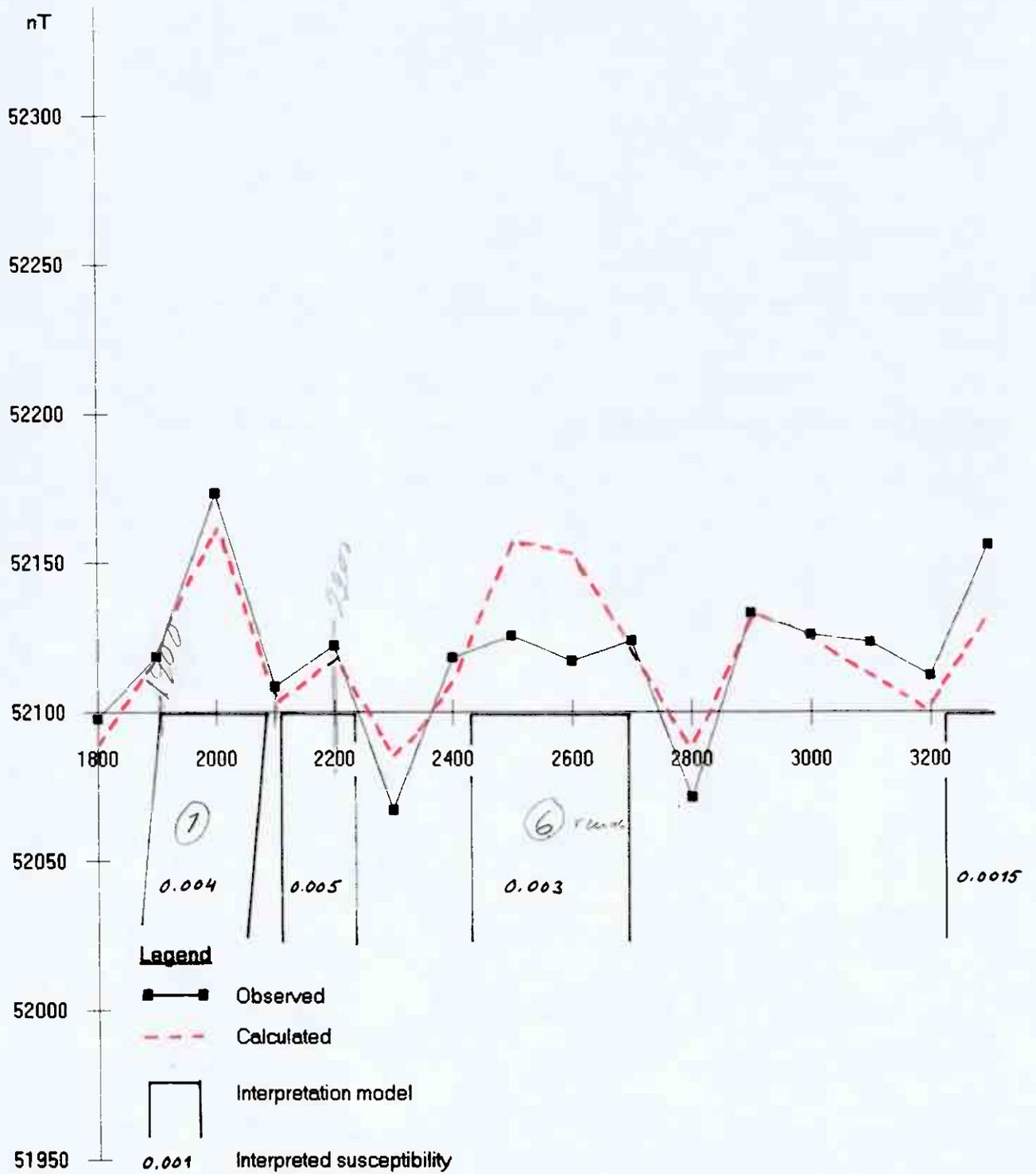
Râna, Magnetic profile 3100E



Scale 1 : 10 000

Figure 5j

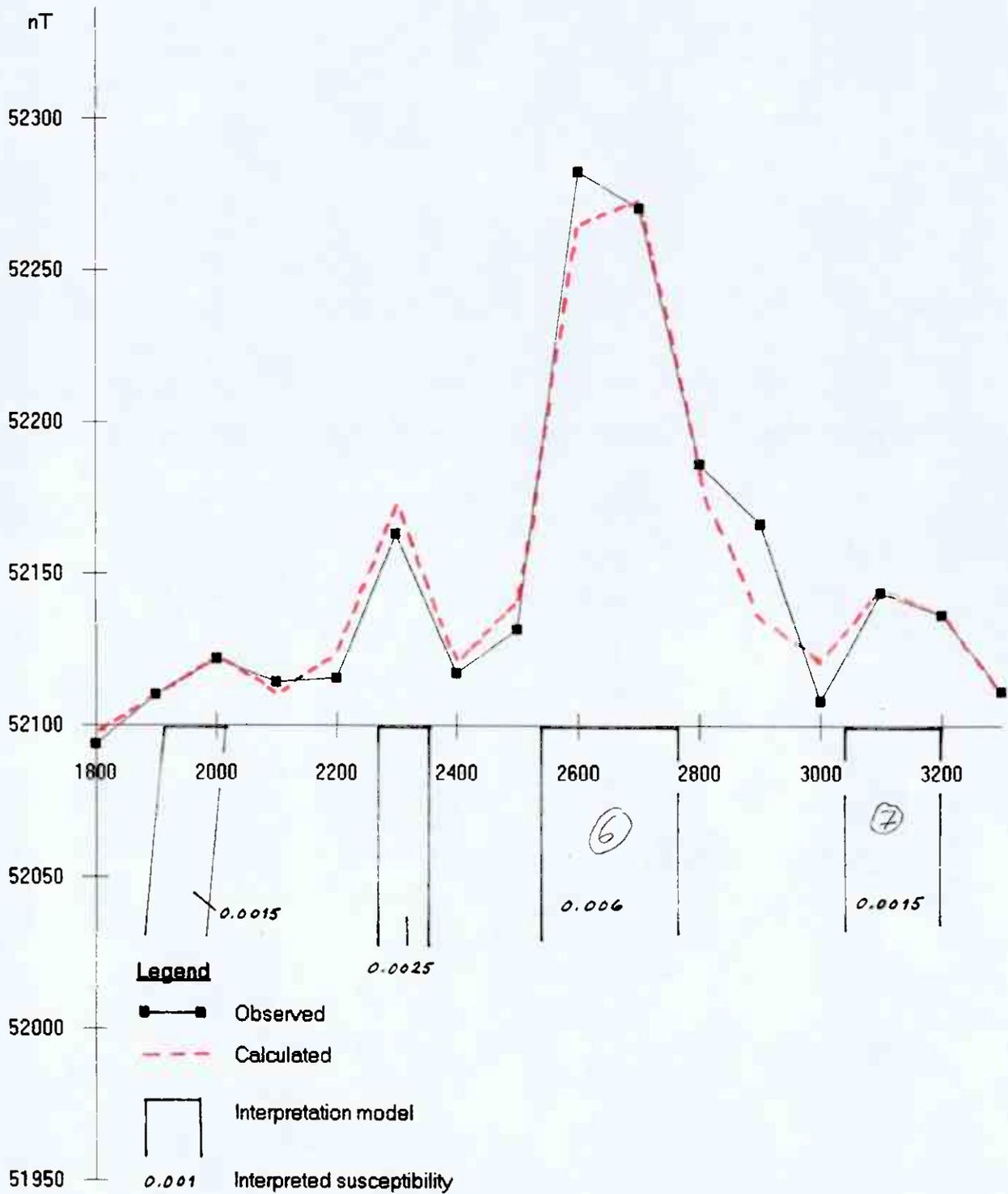
Råna, Magnetic profile 1100N



Scale 1 : 10 000

Figure 6 a

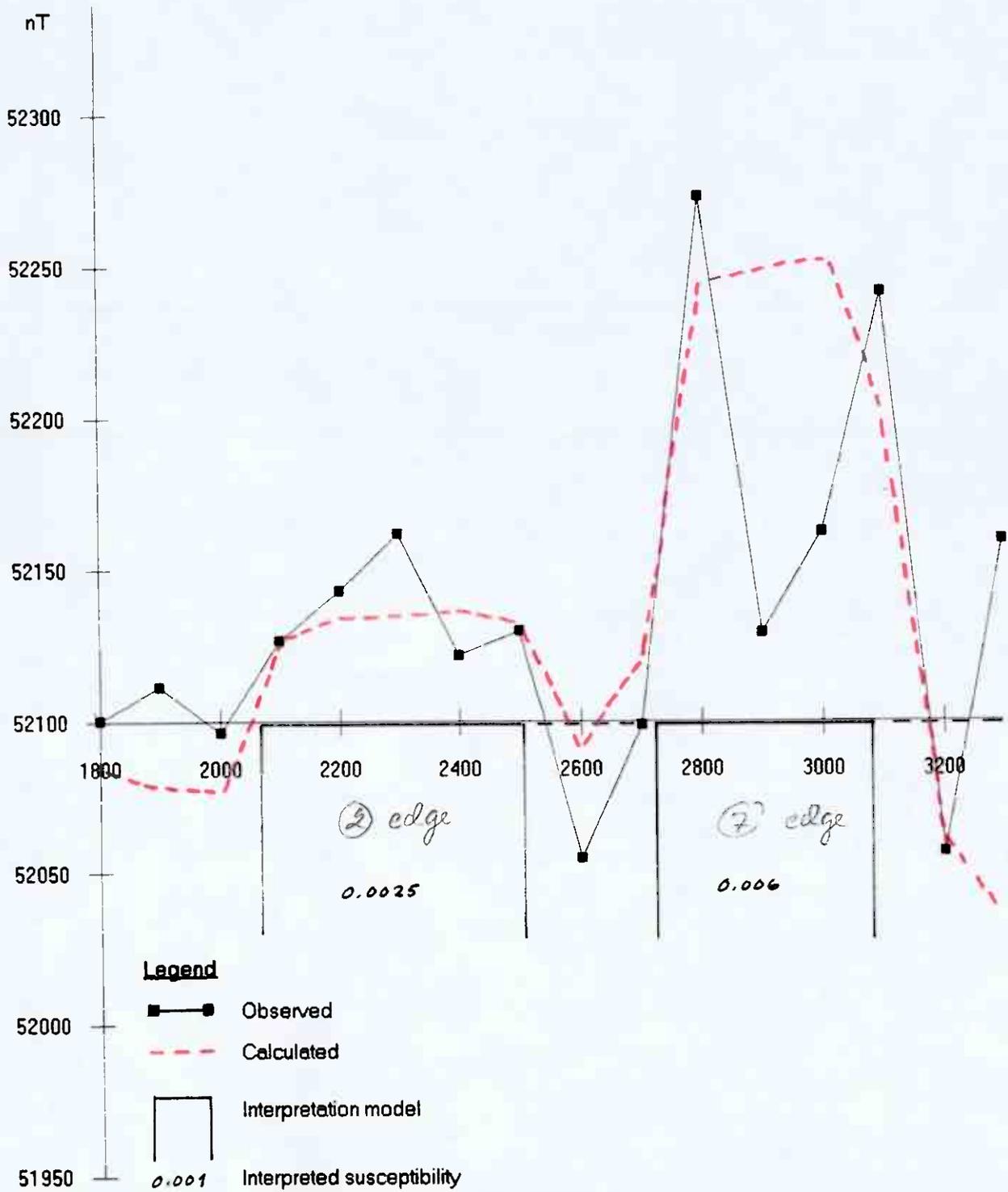
Râna, Magnetic profile 1200N



Scale 1 : 10 000

Figure 6 b

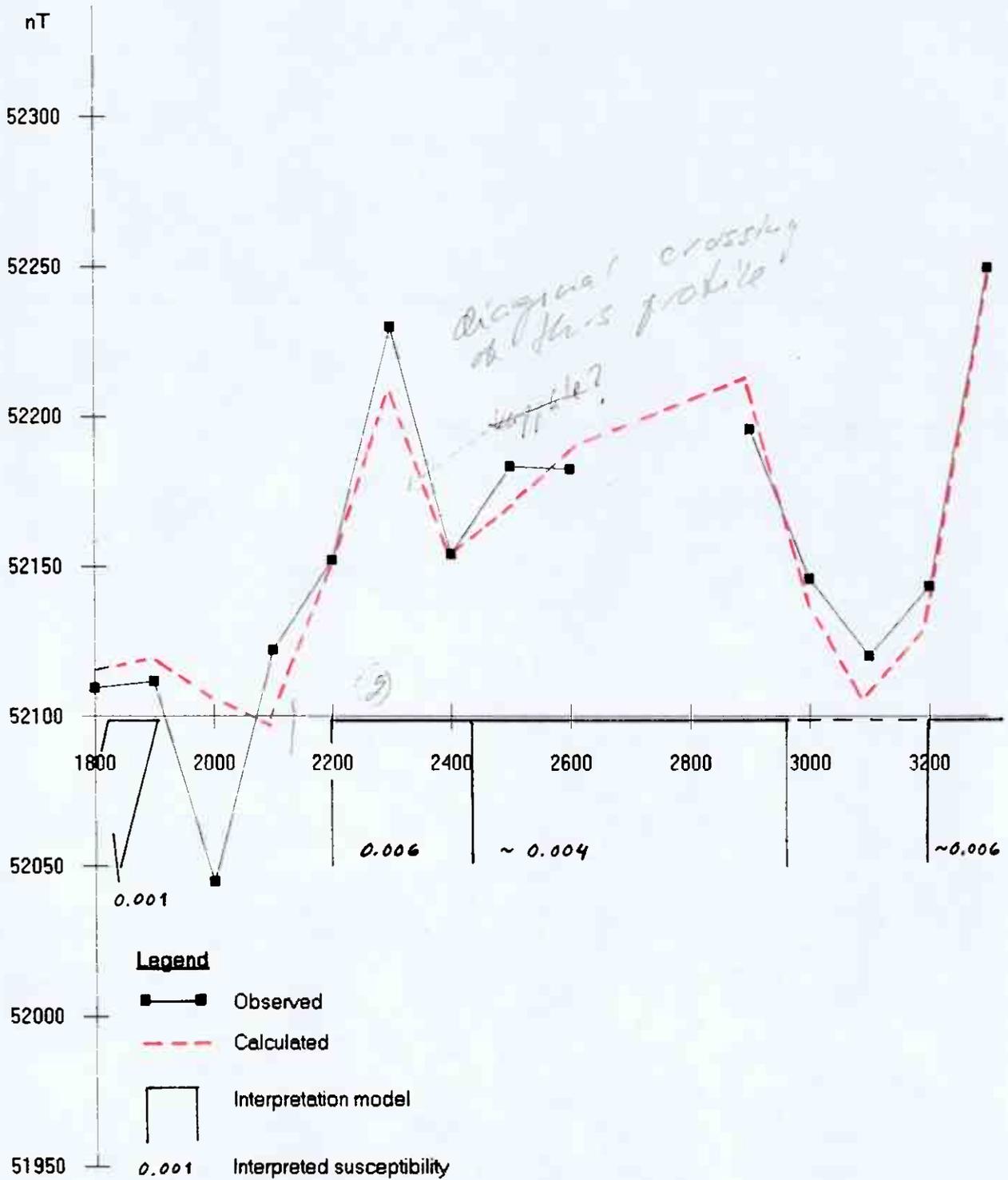
Råna, Magnetic profile 1300N



Scale 1 : 10 000

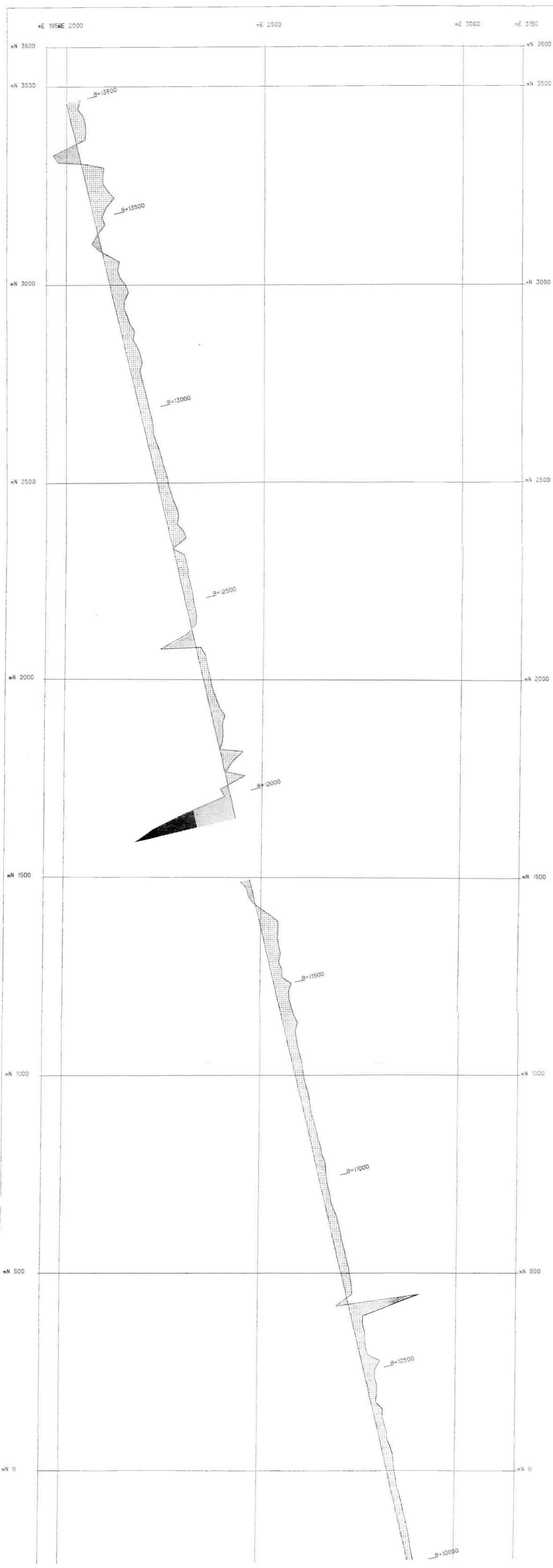
Figure 6 c

Råna, Magnetic profile 1400N



Scale 1 : 10 000

Figure 6 d



GEDPHYSICS
SHEET ARNESHESTEN

422 Magnetic
Grid 100*20 m
1993

7.5.1993
BACKGROUND: 52090.0
Z-SCALE: 100.00 nT/cm

SCALE 1:5000
0 250.0
m

█	>	52490.0	nT
▨	-	52290.0	
▩	-	52090.0	
▧	-	51890.0	
▦	-	51690.0	
█	<	51490.0	

FIGURE 7

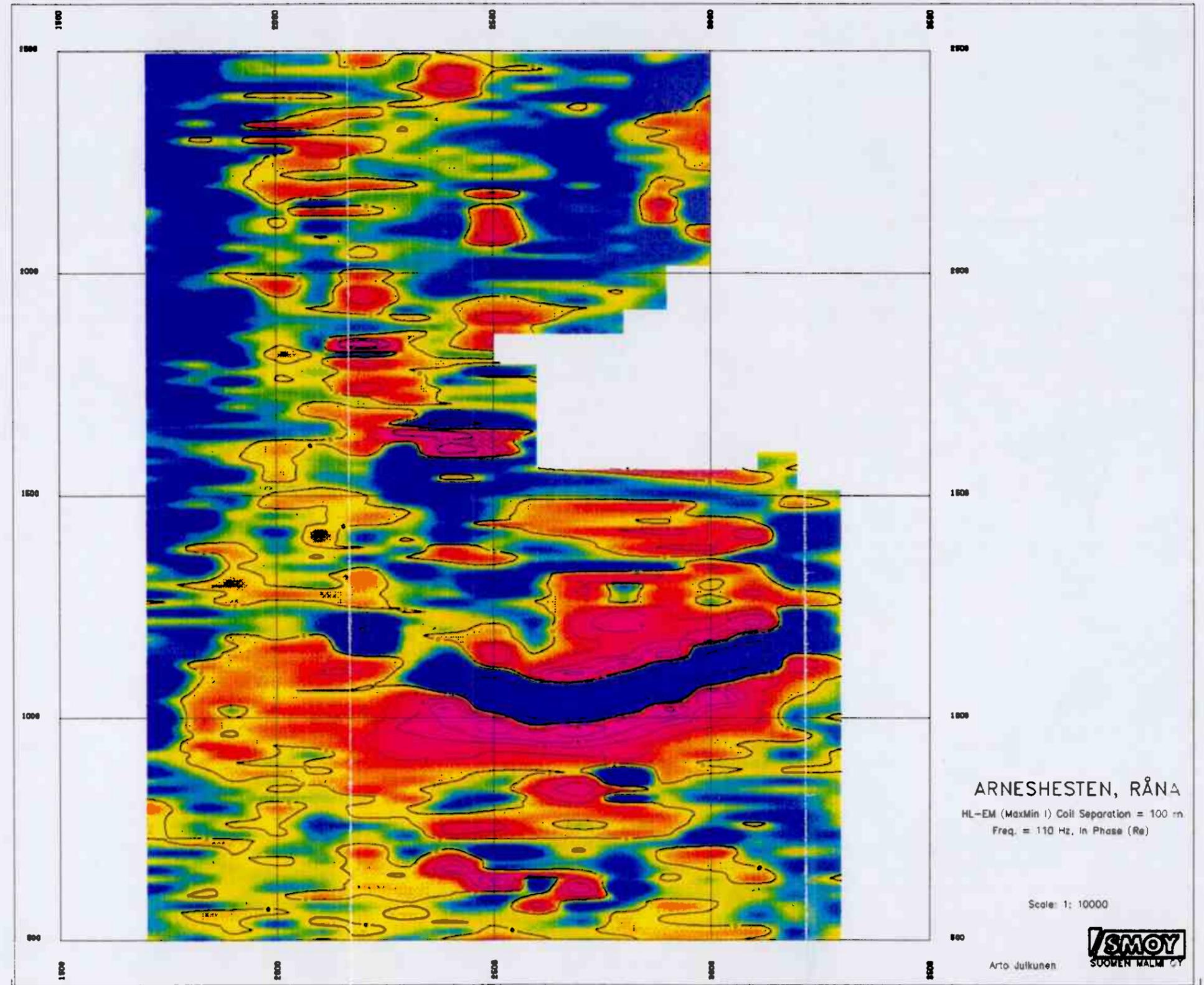


Figure 8 a

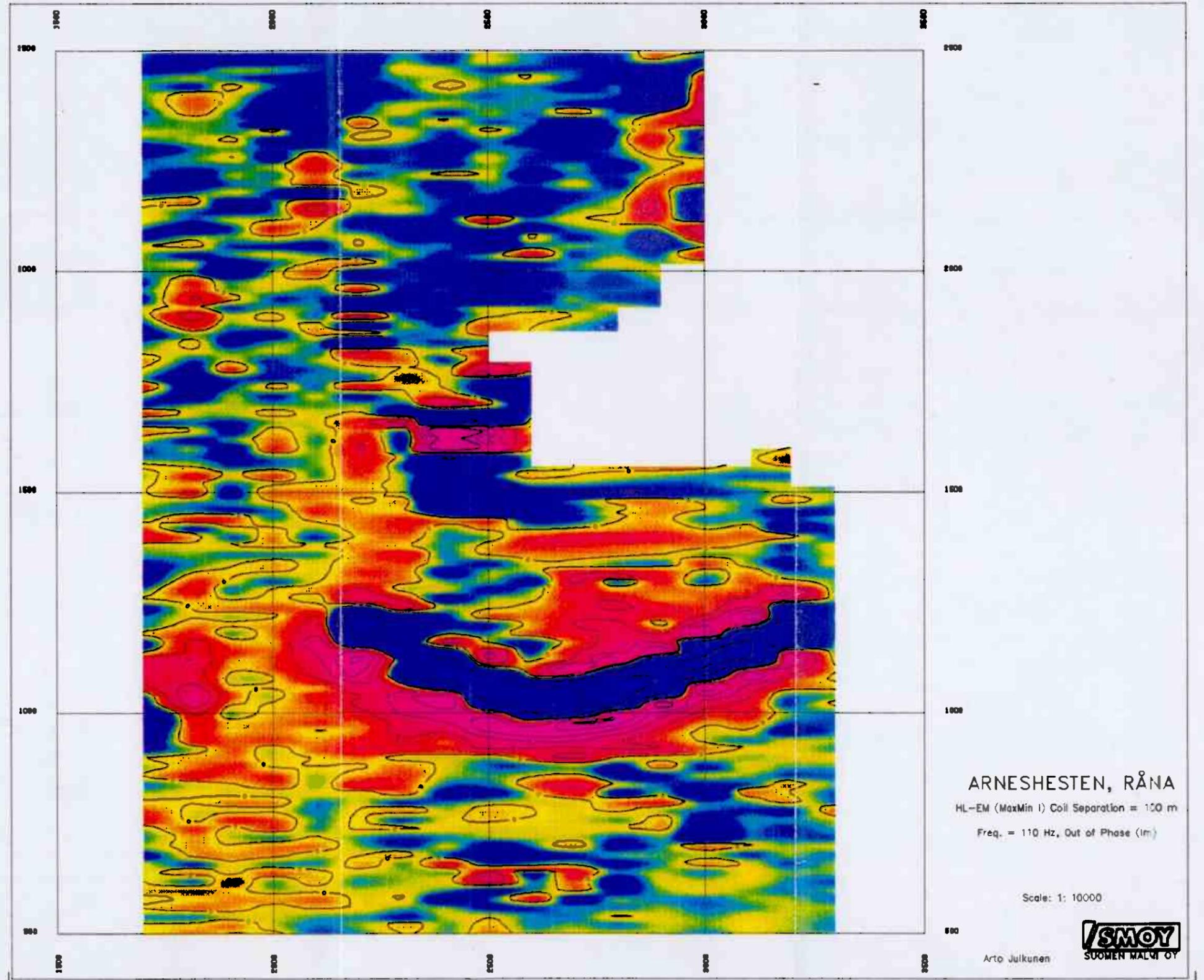


Figure 8 b

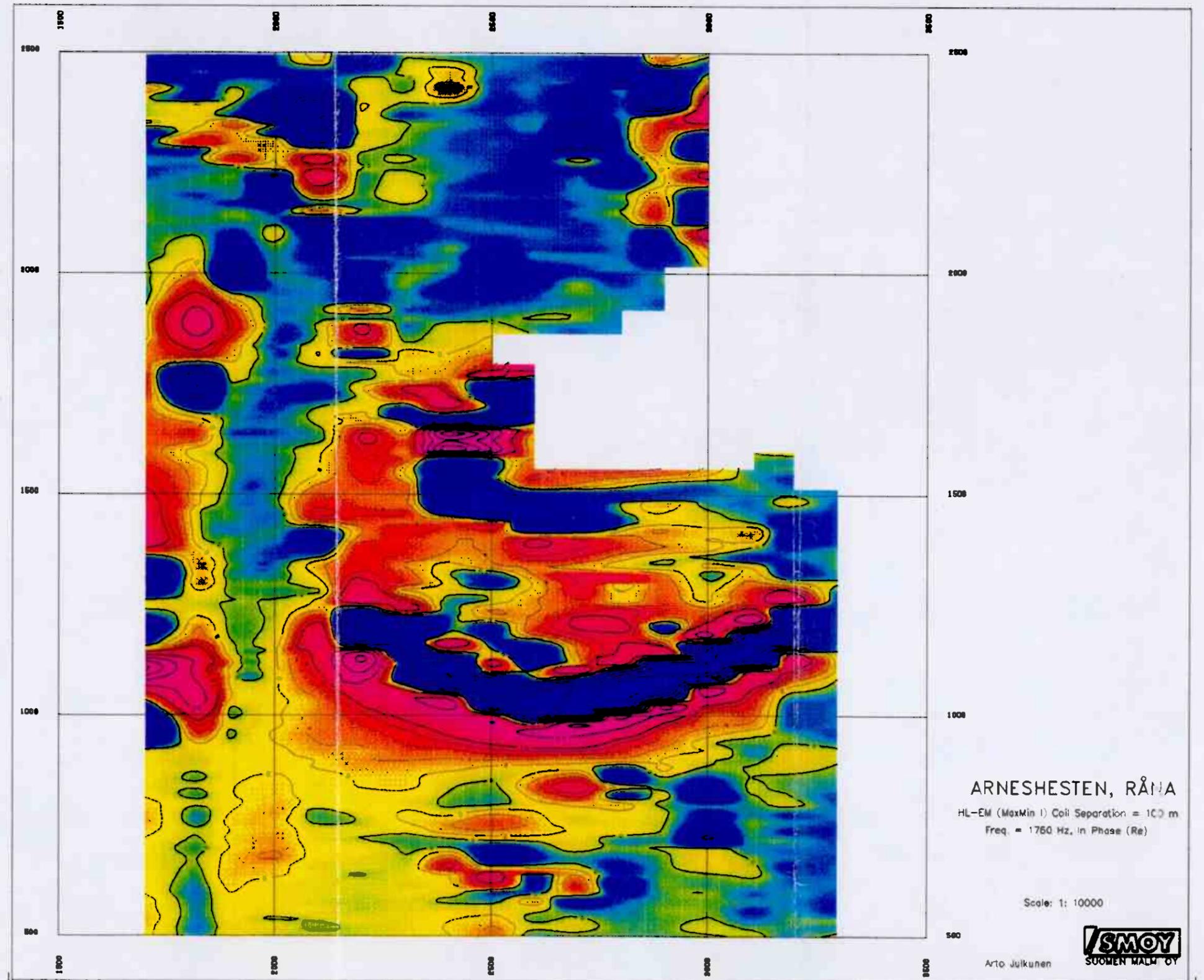


Figure 9a

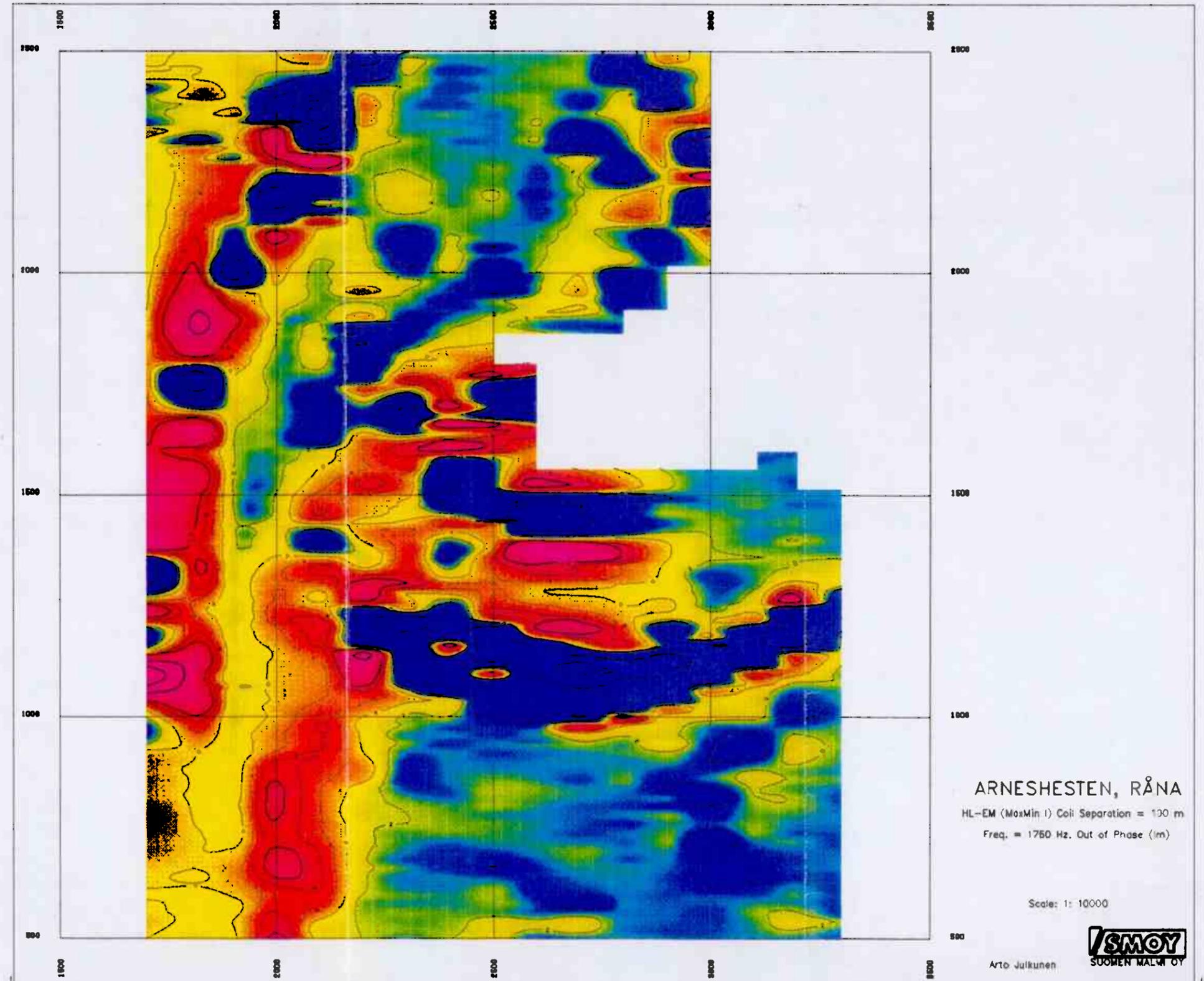


Figure 9b

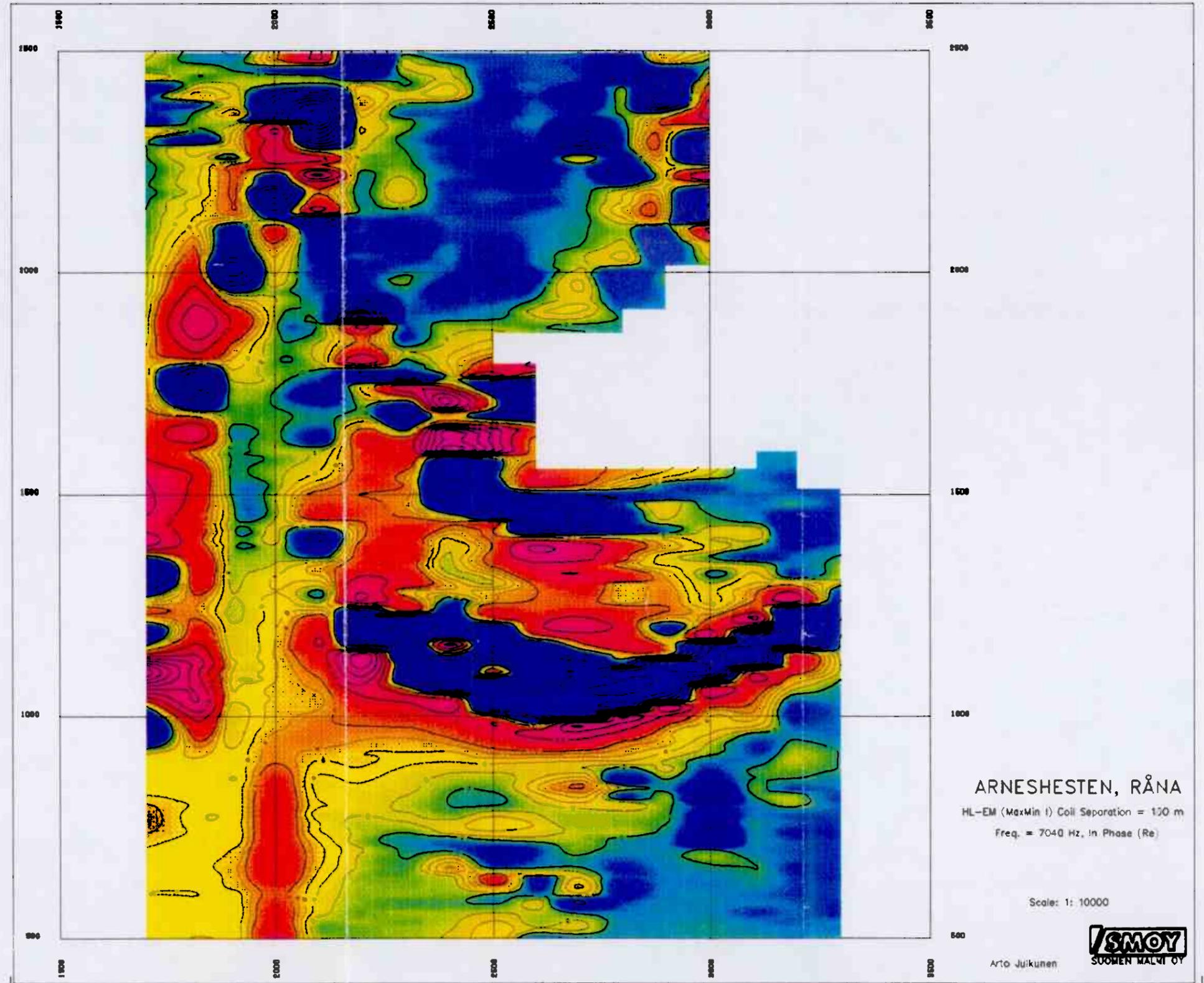


Figure 10a

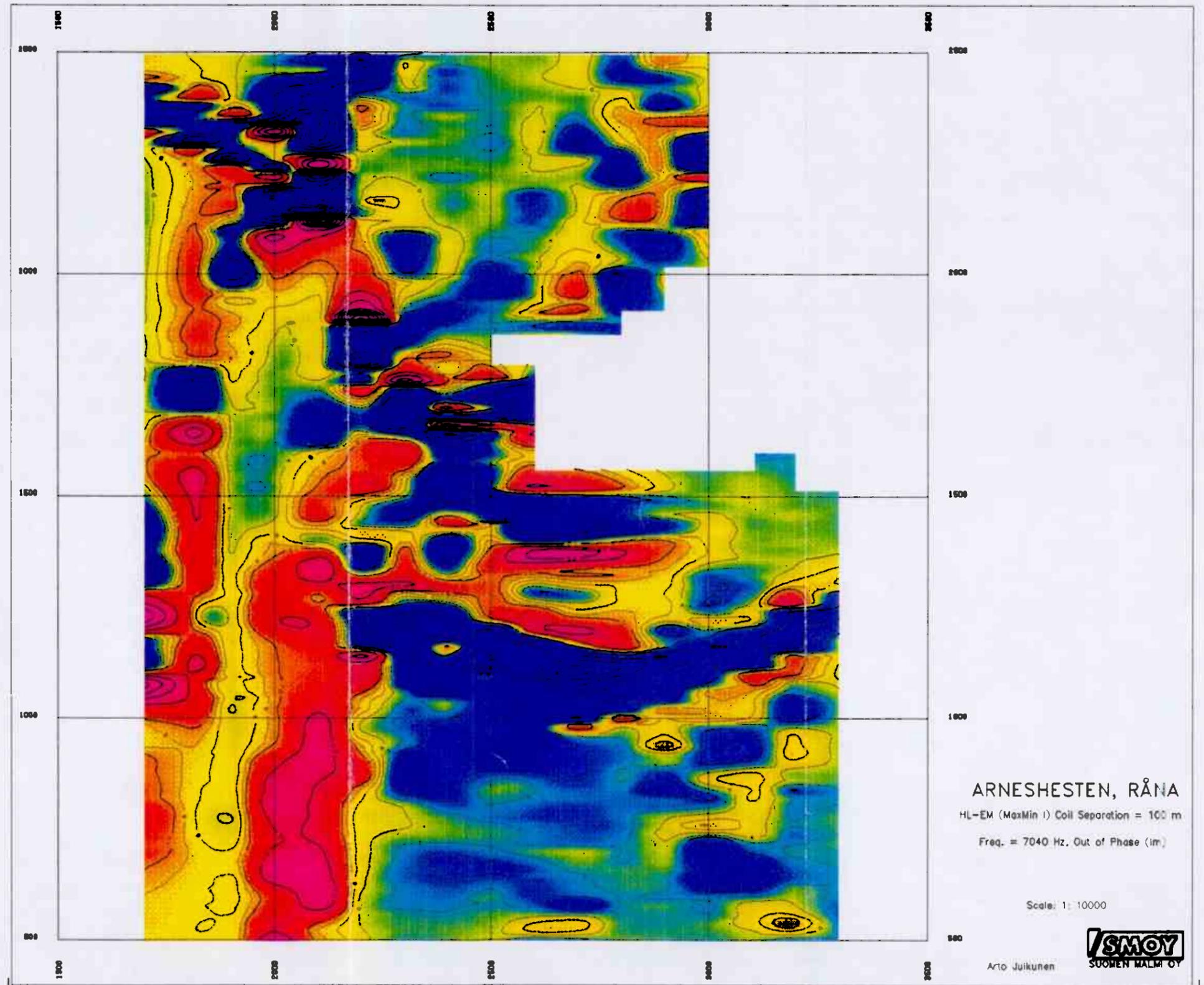


Figure 10b

PETROPHYSICAL DETERMINATIONS BRUVANN DEPOSIT IN RÅNA AREA, NORWAY
1993

SAMPLE	depth	legend	SUSC. SI/10E-5	DENSITY g/cm ³	RESISTIVITY ohm-m
B173	12.60	perid./good diss.	247	3.58	1.0E-03
B183	33.10	perid./med. diss.	120	3.38	2.0E-01
B183	39.35	perid./garnet	128	3.35	2.0E-02
B183	41.20	pyroxenite	103	3.20	3.0E+05
B183	44.80	gneiss	231	3.04	1.0E+05
B184	2.40	perid./med. diss.	266	3.34	4.0E+05
B184	8.00	gneiss/garnet	188	3.05	6.0E+04
B184	9.90	hbl gneiss	197	2.97	3.0E+05
B184	25.80	green pyroxenite	206	3.18	3.0E+05
Massive ore			474	4.63	1.0E-03
Leopard ore			723	3.70	1.0E-03
Norit, coarse			185	2.95	1.0E+06
B192	0.90		214	3.29	1.0E+06
B192	23.00		746	3.37	1.0E+01
B192	26.50		223	3.15	6.0E+05
B192	27.70		163	2.96	8.0E+05
B192	32.80		146	3.04	6.0E+05
B192	375.00		20	2.81	1.0E+06
B192	385.00		144	2.95	3.0E+05

SUOMEN MALMI OY

FINNEXPLORATION

SAATE

Päivämäärä Date

4.5.93

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For your attentionHyväksyttäväksenne
For your approvalLausuntonne varten
For your commentsAllekirjoitettäväksenne
Please signPalautamme
We returnPyydämme palauttamaasi
Please return

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LATAKSESSA JOTEN OTIN VEROKOPION. LÄHETIN PA-
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JATKUU
A-13,800
SARKEA

SUUNNITETTU
MAGN PROFIILI

A-10,800

Y: 2650

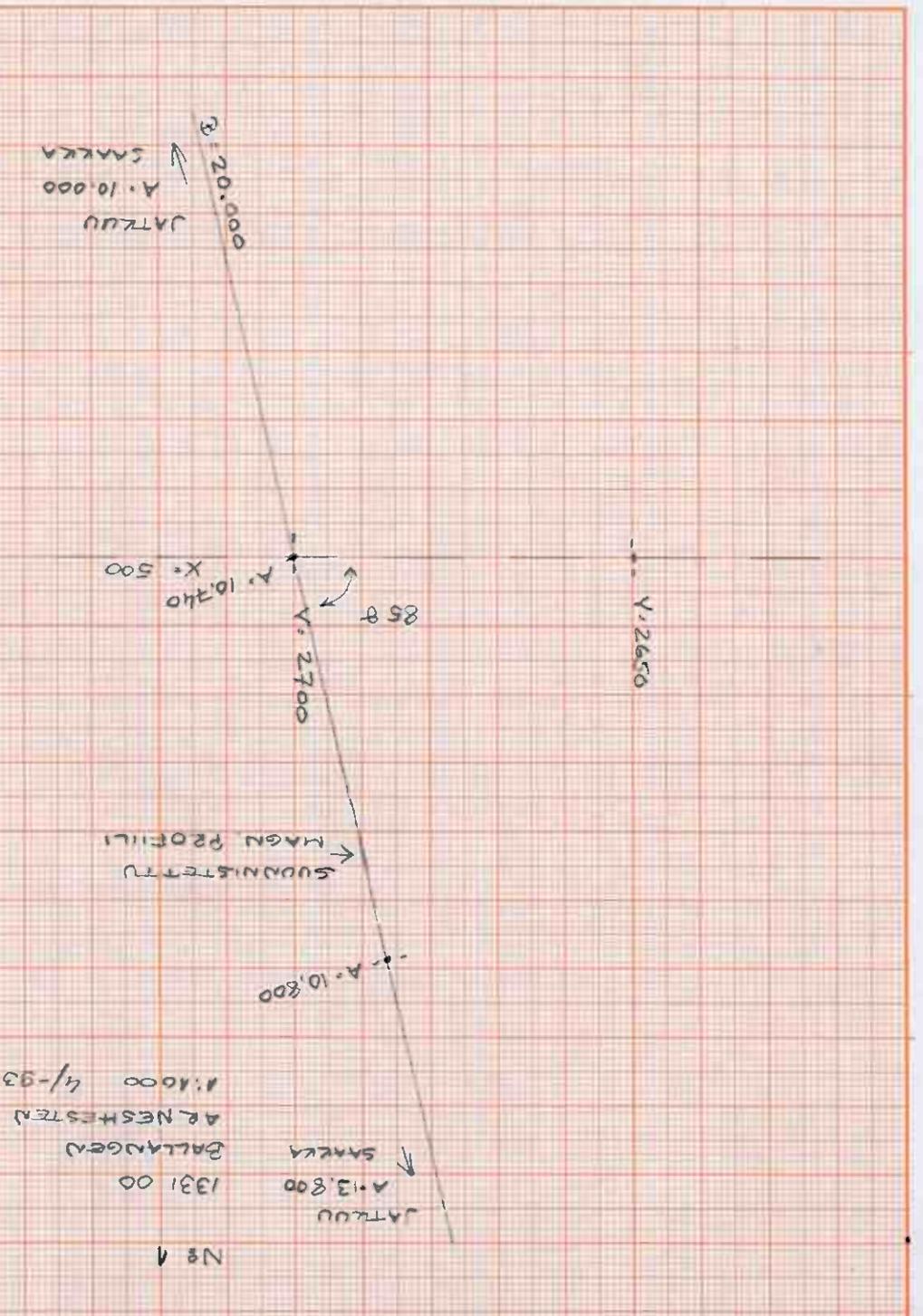
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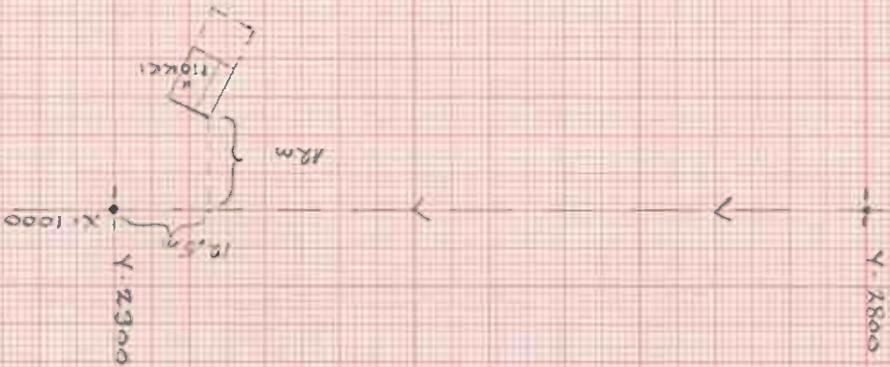
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X: 500

JATKUU
A-10,000
SARKEA
B: 20,000





1331 00
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 ARNESHESTEN
 1:1000 4/-93
 N82

N: 3

1331 00

BALLANGEN

ARNESTESTEN

1:1000 4/-93

LINJOITUKSEN ALOITUS

PULTTI KALLIOSSA

↓ X=1420.66 Y=2626.18

→ MATKA MITATTU JA SUUNNATTU TEODOLIITILLA

SUUNTA PAALUJA →

X=1400 Y=2850 →

--- Y=2875 →

--- Y=2900 →

--- Y=2925 →

X=1400

X=1350

Y=2600

WATER 1000 FEET
(SANDSTONE)

X=2000

13m

Y=2350

X=1200

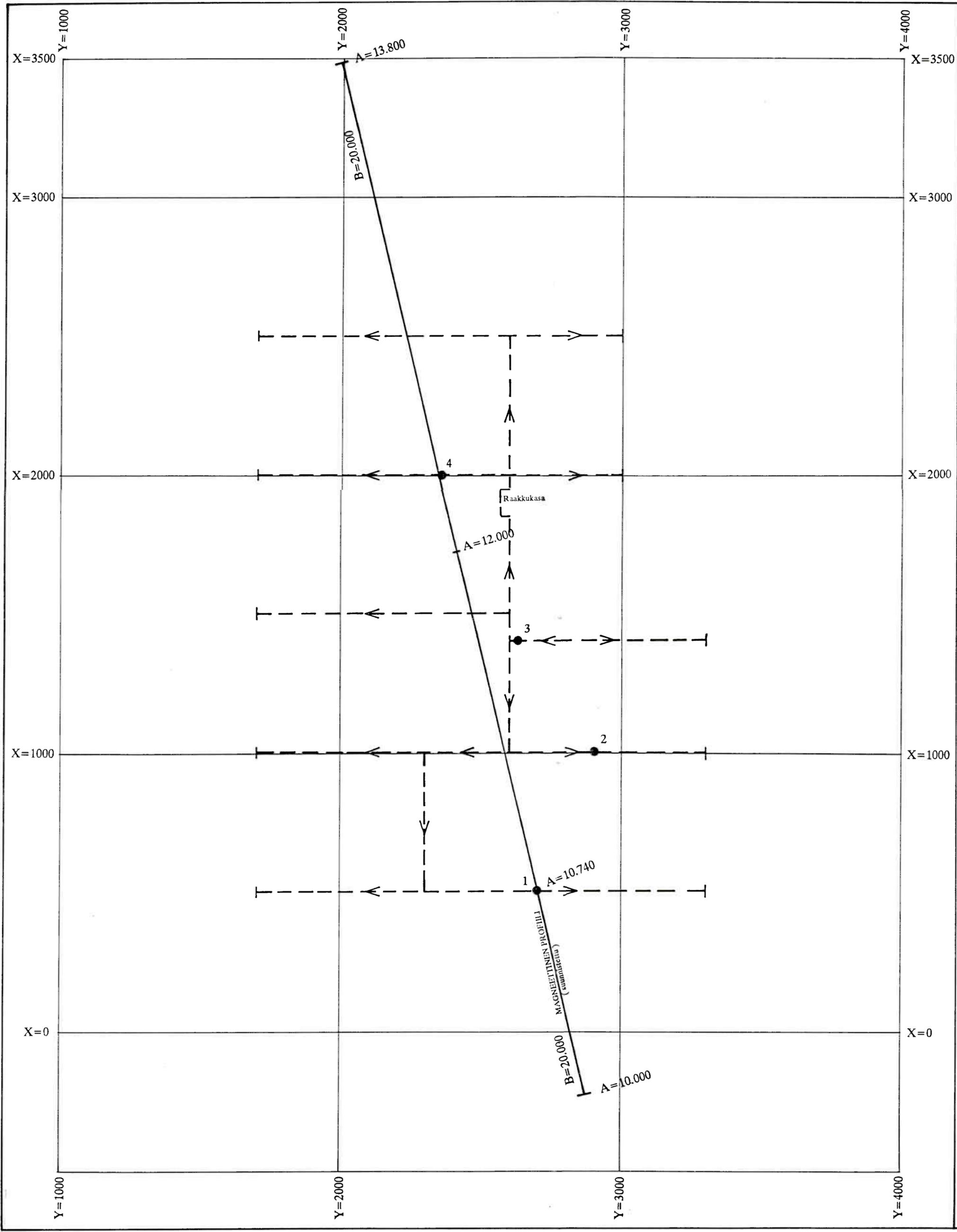
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BALANCE
KENSINGTON
11000 4/93

1331 00

N 4

X=1200



SUOMEN MALM

NORJA
 Arneshesten Råna
 1331
 1 : 10 000
 Linjastokartta
 OUTOKUMPU NORGE A/S
 03.05.1993 SMOY / LMJ / aml

Peridotitt

Nikkel og Olivin

1:2000

4:2000

4:2000

γ = 1400

Zsmalm

Forkværling

Noritt

Per

Pyr

itt

ortskifer

Kalkskifer

Svartskifer

Bruvann

Gneis

421.3

