EM SURVEY IN THE BIDJOVAGGE REGION IN 1986

Summary

Data acquisition by EM37 in Area 43 was successfully completed in April 1986. 3 km long zone was covered by 18.1 line-km or 346 occupied stations measured. A skidoo was very useful and regardless of long distance from the road the survey was carried out quickly. No power lines or any other man-made sources existed here. Data processing and interpretation were straightforward using available programs. There were many good conductive zones already known causing high anomalies. The most interesting zone could be followed only partly, because of another close shallow parallel conductor masking its continuation to moderate depths.

EM31 measurement in Suovrarappat can be regarded successful, because a larger area with homogeneous conductivity could be delineated. Some magnetic data analyses and drilling are recommended followed by mise-à-la-masse measurements in the both areas. Spectral-IP would be interesting to test in Suovrarappat.

Introduction

Transient or time domain EM (TDEM) method has been noticed suitable for fast deep reconnaissance sounding and profiling in prospecting of massive sulfide orebodies, which are good conductors. The depth penetration of the method depends on the resistivity of the ground, the size of the energizing loop and the current intensity flowing in the loop. In quite resistive ground (> 1000 ohmmeters) and with a reasonably large loop and portable power source, the depth range to detect middle sized orebodies is down to 500 m. The method is geometry dependent, which means that profitably situated bodies, i.e. as large projection as possible is parallel to the loop and below it, produce multifold anomaly intensities compared to perpendicular position. So the system is sensitive to horizontal bodies below the loop, and vertical ones outside the loop. Therefore quite resistive halfspace below the loop produces anomaly level that limits the detectability of a deep target. Also a suitably situated conductive host rock layer or dike with a large parallel projection causes a marked anomaly threshold. It is self-evident that power grid lines can also have harmful effects to this kind of sensitive system.

April, a total of 13 working days. Geophysicist Ensio Lakanen attended from 14th to 17th of April and carried out EM31 and Gefinex 200 surveys.

EM37 Equipment

The ground transient EM device EM37-3 is manufactured by Geonics Ltd., Canada. This instrument was first introduced in 1980, but has been updated so that this unit is the latest No. 3 version delivered in 1984.

Transmitter consists of a console weighing 20 kg and power unit with 5 HP Honda gasoline engine coupled to 120 V, 3-phase, 400 Hz alternator weighing 60 kg. Output power is 2.8 kW, maximum current 30 A and voltage 150 V. The transmitter loop was built up with 4 mm^2 isolated copper wire; 9 reels with 400 m, 20 kg each were available. The current waveform in the transmitter consists of alternating bipolar current pulses with a slow exponential turn-on and a rapid linear shut-off (turn-off) time depending on the loop size and current, normally less than 0.5 ms. The repetition rate can be set at 2.5 or low, 6.25 or medium, and 25 Hz or high.

Receiver consists of a console weighing 22 kg and air-cored 100 cm dia. coil weighing 8 kg. A coil holder is supplied to facilitate measurement along three axes. The measured quantity is the time rate of decay of magnetic flux at 20 logarithmically spaced time channels covering range from 0.08 at high to 80 ms at low repetition rate. 4 digits plus sign LED display is used and integration time can be selected from 2^n (n = 4, 6, 8, 10, 12, 14) cycles at 25 Hz. The effective area of the coil is about 100 m^2. Synchronization of receiver to transmitter can be maintained with oven controlled high stability quartz crystals. Receiver energy is taken from 12 V rechargeable NiCd batteries of 20 Ah.

At the receiver the induced voltage in the coil is measured in millivolts. The reading is normalized by dividing with the effective area of the coil and the current in the transmitter loop and is written in nanovolts per A x $meter^2$ (nV/Am^2).

KTP-84 is a data logger or digitizer and recorder, also called a field computer manufactured by Rautaruukki Oy, Finland. EM37 interface KTP-EMI and software were made during 1985 and was introduced in January 1986. The interface is built in EM37

X-component, channel No. 15, app. 9/4, seems to give the best overall picture of the surveyed area. The projections of the interpreted conductors are included in this appendix. Here is also something new, almost perpendicular, negative anomaly zone cuts both WC and EC in profiles 900 and 1000 S respectively. EC is totally finished here. This may be caused by a magnetized dike, and not just a fracture zone, because it is so clear in the later channels. This feature is also seen in the Z-component, app. 9/3.

To investigate more thoroughly the southern plunge of MZ a small 200 x 200 m^2 transmitter loop was laid down, the centre at 275 S, 125 E, and five profiles from 200 S to 400 S with 50 m spacing were occupied, app. 8. P 200 S, app. 8/5, is clearly caused by two good conductors as with the larger loop. Well separated two anomalies are still visible in P 250 S, app. 8/4. In the P 300 S the earlier channels indicate one thick plate while the later channels separate the two plates, and so does DIT-plot, app. 8/8 (note that the appendix numbers are mixed here and getting smaller to north). The same widening of the anomaly is seen in P 350 S, app. 8/2, but only one in P 400 S, app. 8/1, can be observed. DIT-plot, app. 8/10, however, has a conductor indication at point O.

When compared to slingram results measured from 500 S to 200 N over MZ and partly EC are in good correlation with EM 37 results just discussed. The most intense anomaly is in P 50 N (not measured by EM 37), and broadside configuration delineates the conductor accurately to 60 W and is about 15 m thick. Anomaly continues to south getting smaller and wider. The zero level is so much on positive side that the minimum does not go to negative after 250 S, but can be interpreted as well after normalizing the readings. Even P 500 S can be interpreted with a conductive plate at a depth more than 60 m (not accurate due to lack of model results with a ratio more than 0.6 - depth to coil separation). In P 350 S plate is at a depth of 60 m. EM37 would give a distinct anomaly from that depth, if there would not be other conductors so close. A large
8 loop TDEM has a poor resolution when there are more than one parallel conductor in question.

There are also three slingram profiles in the south, 1400, 1500 and 1600 S indicating many parallel conductors, just as EM37, but better.

Magnetic high correlates with diabase and MZ and EC are on its flanks. Diabase ends in the north in

P 150 N. More exact comparison is best to be made after having magnetic data processed.

Airborne data by Dighem correlate well regarding the accuracy of locating the anomalies. Magnetic high seems to be broken where TDEM anomalies were cut, too, c. P 1000 S.

Transient curves and time constants, app. 10/1, indicate relatively high values, even 12 ms at 600 N, 100 W, for instance. Unfortunately they are mainly due to graphite. App. 10/2 is to show one normal interpretation, P 500 S channel no. 10, as an example.

In Suovrarappat EM31 result was a nice surprise. It was hoped for that this instrument would give homogeneous conductivity readings above the known mineralization. The wish seems to be fulfilled, when looking at the data, app. 11/1. The intersection of the mineralization is in the western side of the space having very homogeneous conductivity of 7.4 to 7.7 mS/m. It is about 100 m long in E-W direction and 30 m in S-N direction. This is two or three times the area estimated for the outcrop earlier. The conductivity increases to three different directions to south, north and northeast getting the highest value 22 in north, where the zone is also narrowing. This is very probably caused by graphite, but where it changes from sulfides to graphite is impossible to say. A test was made in Bidjovagge mine on an open pit of the orebody B. The conductivity above the known ore was from 7 to 9 mS/m and graphite gave even 40.

Gefinex 200, still smaller EM instrument were also used, but the overburden thickness must be too much for it in order to behave as homogeneously as EM31, app. 11/2. What seems to be seen from the data are a zone with thinner overburden probably and a couple of outcrops or large boulders causing the highest readings. Interpreted overburden thicknesses vary from 0.5 to 5 m.

These data show no marks of really good conductors, (as in Area 43), and therefore the slingram anomalies are only moderate. Profiles with 50 m spacing is not enough to produce discriminating information. The width of the anomalies are the same as with EM31, when the coil separation is not subtracted. It is possible that the conductive zone has very little depth extension and even less on the outskirts of the zone.

Conclusions and recommendations

In Area 43 it is clearly evidenced that MZ is a good conductor for at least 300 m long. It seems to plunge toward south and it may also be possible that there are more than one conductive body in succession underneath as might be the case with a weak indication in P 200 N. Quite likely the conductor continues at least to 500 S the upper surface less than 100 m deep. Because of so close other shallow parallel conductor, EC, the anomaly of MZ is masked and cannot be better followed by TDEM. EC continues to 900 S bending rather sharply toward west in 600 - 700 S, and to 1000 N, starting again in about 1500 N. WC is quite continuous, only broken by the negative almost perpendicular zone in 900 S. WC is getting wider toward south or having a parallel conductor.

Magnetic data of a larger area should be interpreted for structural information and mise-à-la-masse method used to follow the intersected mineralized conductors in more detailed fashion. That is all geophysics can offer for this case; more knowledge must be gained from drilling.

Suovrarappat gave more than a hoped for result. EM31 delineated an extraordinarily homogeneous conductive area. It will be highly recommended to expose the bedrock to see, what it means. Magnetic data will be analyzed later. This might be a good test ground for spectral-IP.

Outokumpu Oy
Exploration
Ensio Lakanen
Ensio Lakanen
Research geophysicist

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Abbreviations

TDEM	=	time domain electromagnetic method
	=	transient electromagnetic method
EM 37	=	Geonics Ltd.'s transient electromagnetic equipment
HI	=	High frequency = 25 Hz pulse frequency
MD	=	Medium frequency = 6.25 Hz pulse frequency
Z	=	Z- or vertical component of electromagnetic field (time derivative)
X	=	X horizontal " "
Y	=	Y " " "

(X is the direction of survey line, Y is perpendicular to it, note that X and Y are used as coordinate axes as well)

nV/Am^2	=	unit of the time derivative of the electromagnetic field normalized by the transmitter loop current (nanovolts per Ampermeter squared)
TR = Tx	=	transmitter
ch.	=	channel
DIT	=	depth inversion techniques = apparent resistivity versus depth inversion
Ra	=	apparent resistivity
mean	=	mean of apparent resistivity at one station
± dec.	=	one order of magnitude more or less than mean
Rx	=	receiver

APPENDICES

1/1	Overall survey layout c. 1:80000
1/2	Area 43 TDEM survey layout 1:20000
1/3	Suovrarappat EM31 survey area 1:20000
2/1	Area 43, TDEM-profile 1500 S, Z- and X-components 1:5000
2/2	" " 1400 S " "
2/3	" " 1300 S " "
2/4	" " 1200 S " "
2/5	" " 1100 S " "
2/6	" DIT-plot 1500 S 1:5000
2/7	" " 1400 S "
2/8	" " 1300 S "
2/9	" " 1200 S "
2/10	" " 1100 S "
3/1	Area 43, TDEM-profile 1000 S, Z- and X-components 1:5000
3/2	" " 900 S " " and interpreted plate model
3/3	" " 800 S " " and interpreted plate model
3/4	" " 700 S " " and interpreted plate model
3/5	" " 600 S " " and interpreted plate model
3/6	" DIT-plot 1000 S 1:5000
3/7	" " 900 S "
3/8	" " 800 S "
3/9	" " 700 S "
3/10	" " 600 S "
4/1	Area 43, TDEM-profile 500 S, Z- and X-components 1:5000 and interpreted plate model
4/2	" " 400 S, " " and interpreted plate model
4/3	" " 300 S " " and interpreted plate model
4/4	" " 200 S, " " and interpreted plate models
4/5	" " 100 S " " and interpreted plate models
4/6	" DIT-plot 500 S 1:5000
4/7	" " 400 S "
4/8	" " 300 S "
4/9	" " 200 S "
4/10	" " 100 S "

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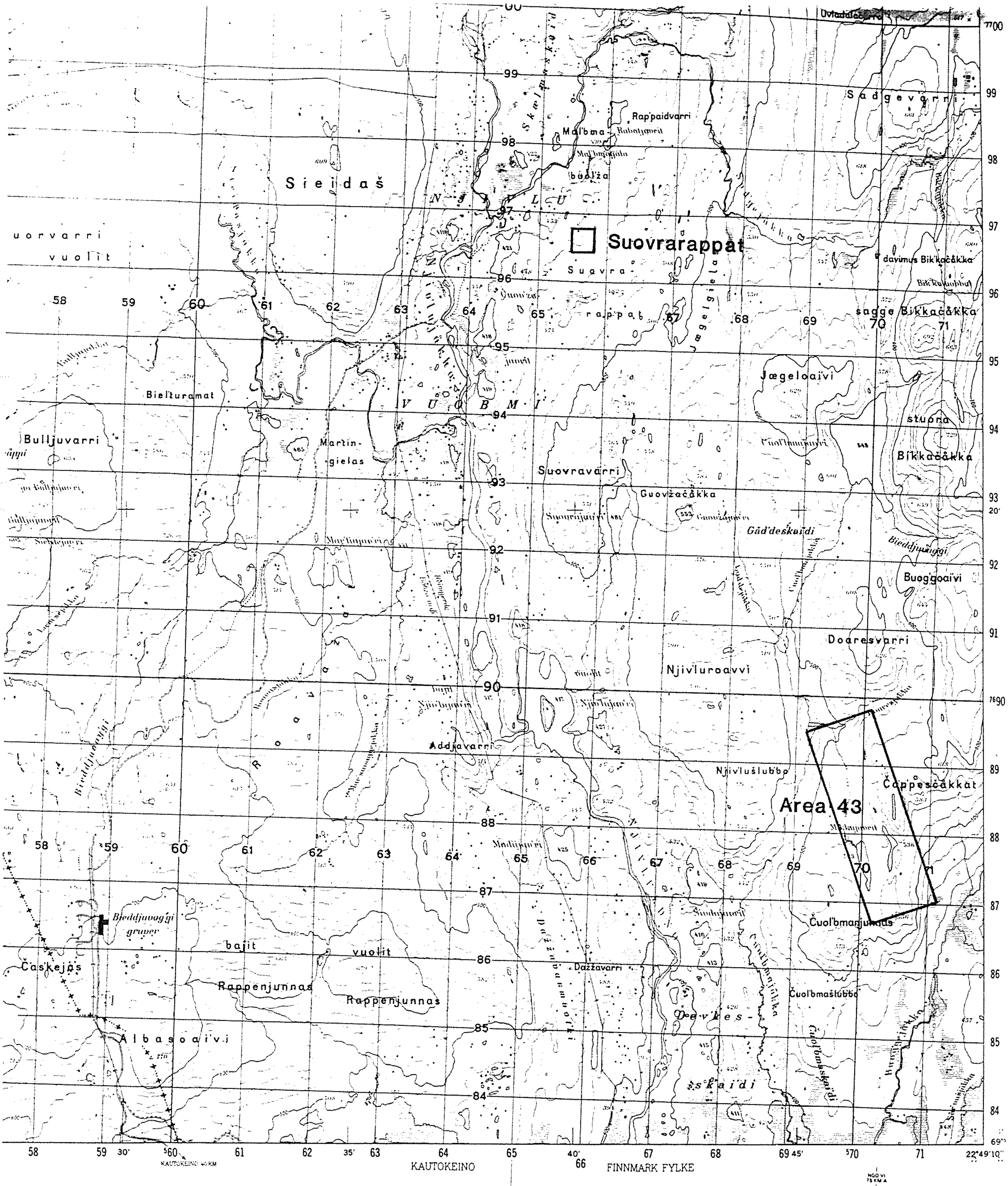
5/1	Area 43,	TDEM-profile	0,	Z- and X-components	1:5000
		and interpreted plate models			
5/2	"	"	100 N,	"	"
		and interpreted plate model			
5/3	"	"	200 N,	"	"
		and interpreted plate model			
5/4	"	"	300 N,	"	"
		and interpreted plate model			
5/5	"	"	400 N,	"	"
		and interpreted plate model			
5/6		DIT-plot	0	1:5000	
5/7	"	"	100 N	"	
5/8	"	"	200 N	"	
5/9	"	"	300 N	"	
5/10	"	"	400 N	"	
6/1	Area 43,	TDEM-profile	500 N,	Z- and X-components	1:5000
		and interpreted plate model			
6/2	"	"	600 N	"	"
		and interpreted plate model			
6/3	"	"	700 N	"	"
		and interpreted plate model			
6/4	"	"	800 N	"	"
		and interpreted plate model			
6/5	"	"	900 N	"	"
		and interpreted plate model			
6/6	"	DIT-plot	500 N	1:5000	
6/7	"	"	600 N	"	
6/8	"	"	700 N	"	
6/9	"	"	800 N	"	
6/10	"	"	900 N	"	
7/1	Area 43,	TDEM-profile	1000 N,	Z- and X-components	1:5000
7/2	"	"	1100 N	"	"
7/3	"	"	1300 N	"	"
7/4	"	"	1500 N	"	"
7/5	"	DIT-plot	1000 N	1:5000	
7/6	"	"	1100 N	"	
7/7	"	"	1300 N	"	
7/8	"	"	1500 N	"	
	200 x 200 m^2 transmitter loop:				
8/1	Area 43,	TDEM-profile	400 S,	Z- and X-components	1:5000
		and interpreted plate model			
8/2	"	"	350 S	"	"
		and interpreted plate model			
8/3	"	"	300 S	"	"
		and interpreted plate model			
8/4	"	"	250 S	"	"
		and interpreted plate models			
8/5	"	"	200 S	"	"
		and interpreted plate models			
8/6	"	DIT-plot	200 S	1:5000	
8/7	"	"	250 S	"	
8/8	"	"	300 S	"	
8/9	"	"	350 S	"	
8/10	"	"	400 S	"	

8

9/1	Area 43, TDEM contoured map 1:5000, channel No. 5, Z-comp.	
9/2	" " " " " 5, X- "	
9/3	" " " " " 15, Z- "	
9/4	" " " " " 15, X- "	
	and projections of interpreted plate models	
10/1	TDEM transient decay curves, 12 stations	
10/2	An example of plate modeling, profile 500 S channel No. 10, 1:5000	
11/1	Suovrarappat EM31 contoured map 1:1000 in mS/m	
11/2	" Gefinex 200 contoured map 1:1000 in-phase in percents	

1



5 Kilometers

5000 Yards

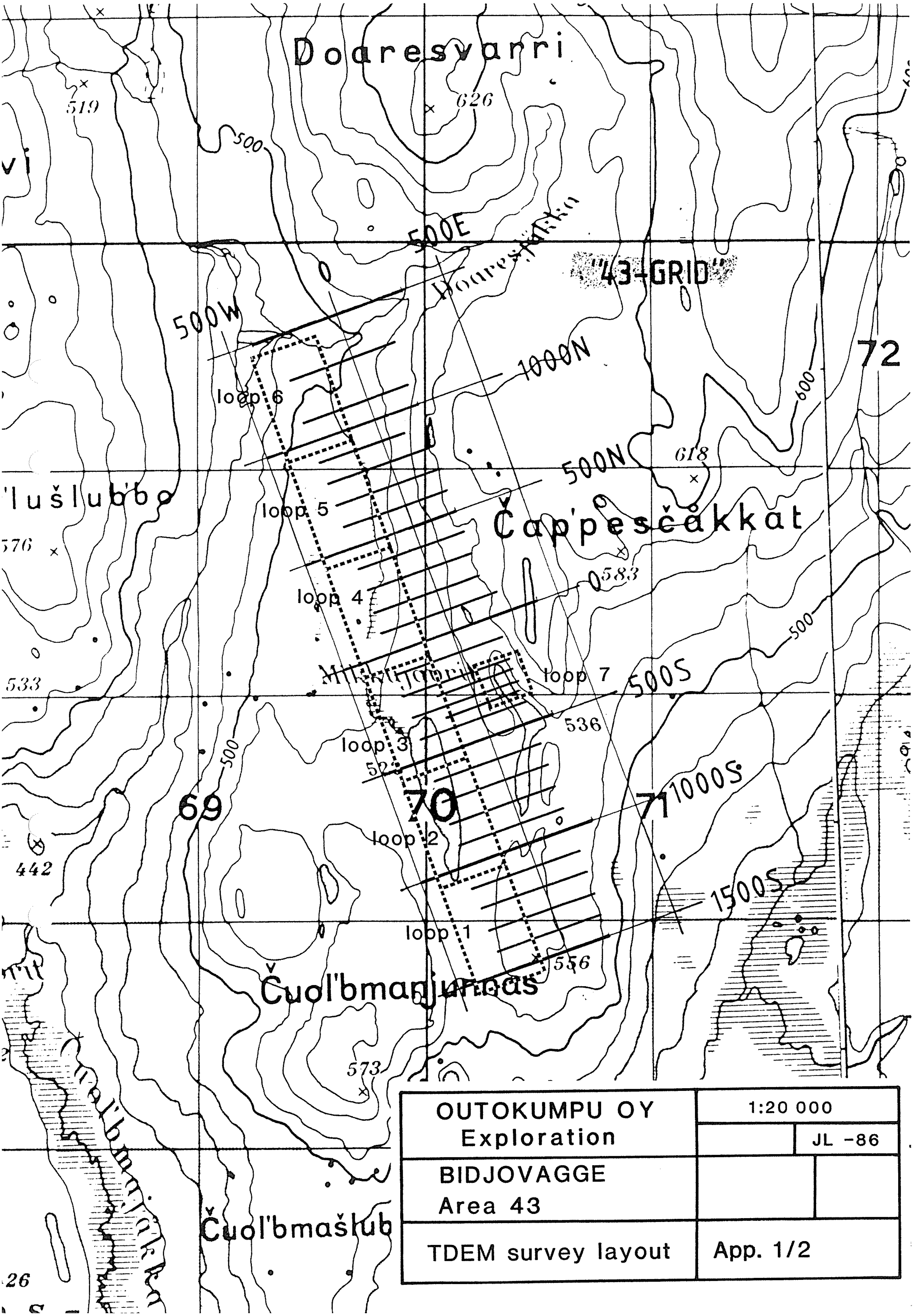
3 Statute Mil

TRYKT I NORGES GEOGRAFISKE OPPMÅLING 8 - 79.
ETTERTRYKK ULOVLIG. NGO HAR ALL RETT ETTER LOV OM ÅNDSVERK.

EKVIDISTANSE 20 METER
Tellekurver 100 m
Mellomkurver 10 m
Høgd i meter over gjennomsnitts sjønivå
Djupn i meter under springfjære
EUROPEISK DATUM
KONFORM SYLINDERPROJEKSJON
Tal i SVART for rutelinje i UTM sone 34

CONTOUR INTERVAL 20 METERS
Index contours: 100 meters
Supplementary contours: 10 meters
Vertical Datum: Mean Sea Level
Soundings in meters below Spring Low Water
EUROPEAN DATUM
TRANSVERSE MERCATOR PROJECTION
BLACK numbered lines indicate the UTM grid, zone 34

OUTOKUMPU OY Exploration	
BIDJOVAGGE	
survey areas	App. 1/1


Doaresvarri
626
519
500
500E
0
Doaresjokka
"43-GRID"
500W
1000N
72
loop 6
600
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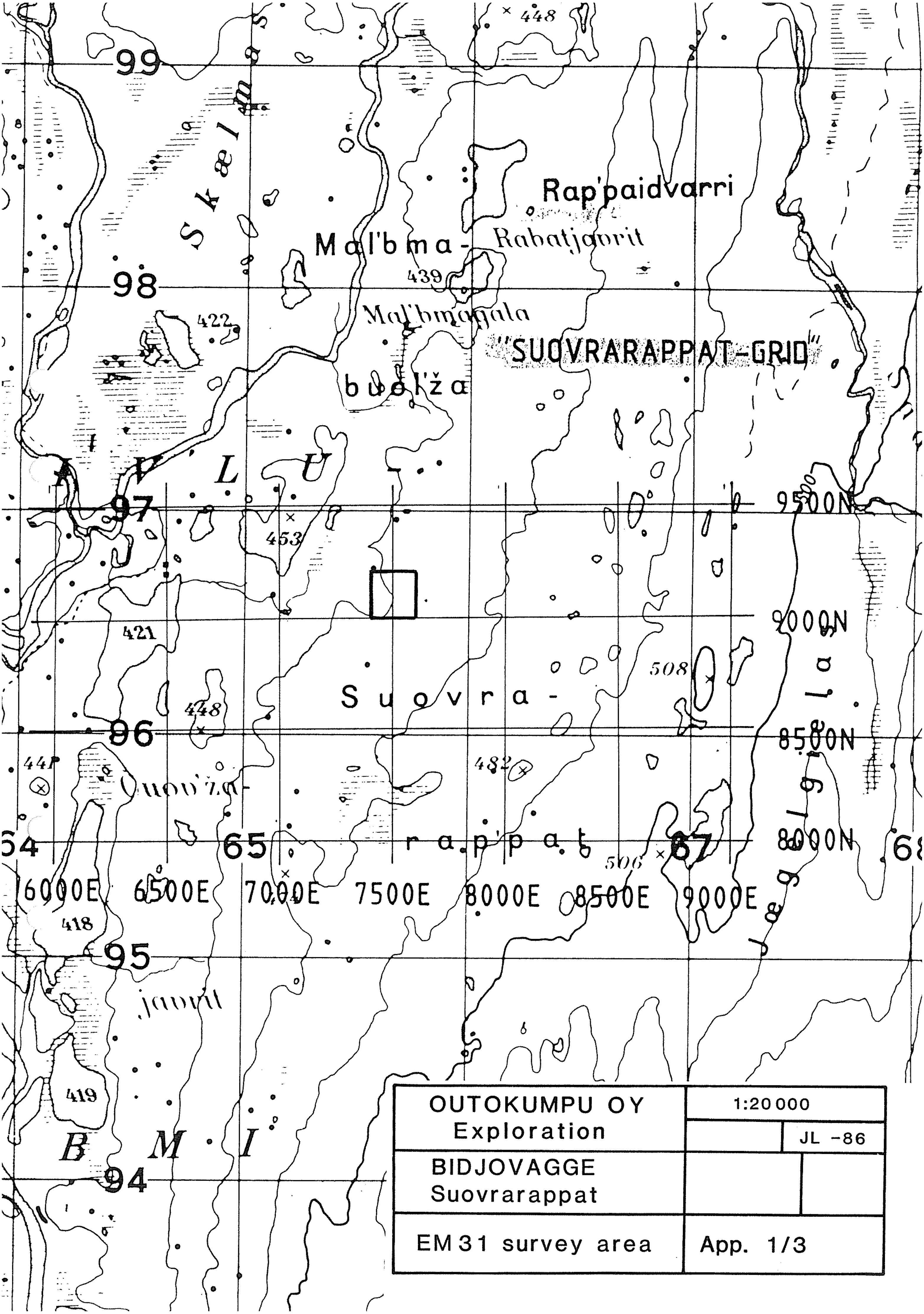
500N
lušlubbo
loop 5
Čappesčakkat
576
583
loop 4
500
533
Mihttjávri
loop 7
500S
536
loop 3
500
52
1000S
69
70
71
442
loop 2
1500S
loop 1
556
Čuol'bmanjunnas
573
Čuol'bmašlub
26
OUTOKUMPU OY
Exploration
1:20 000
JL -86
BIDJOVAGGE
Area 43
TDEM survey layout
App. 1/2



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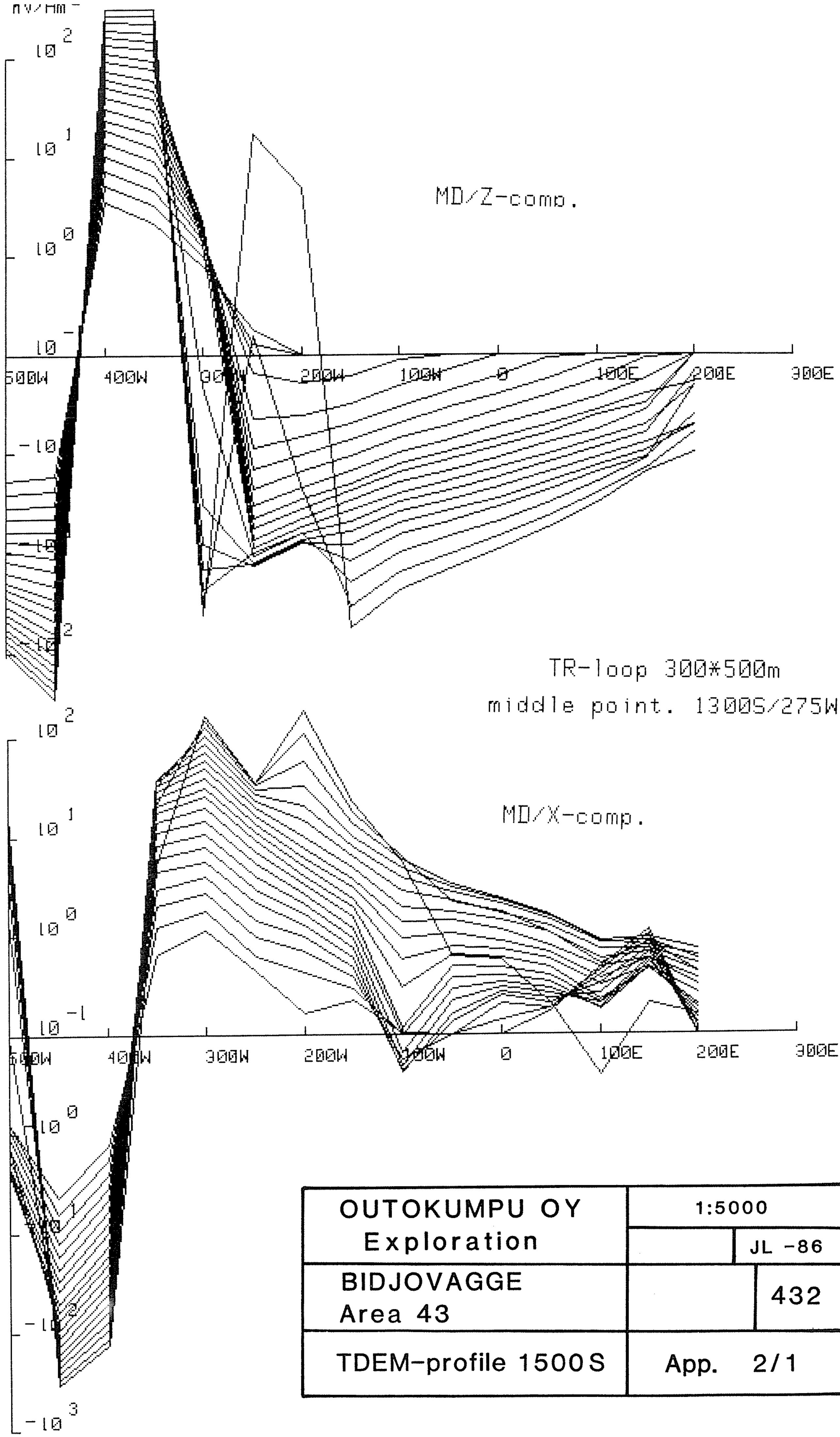
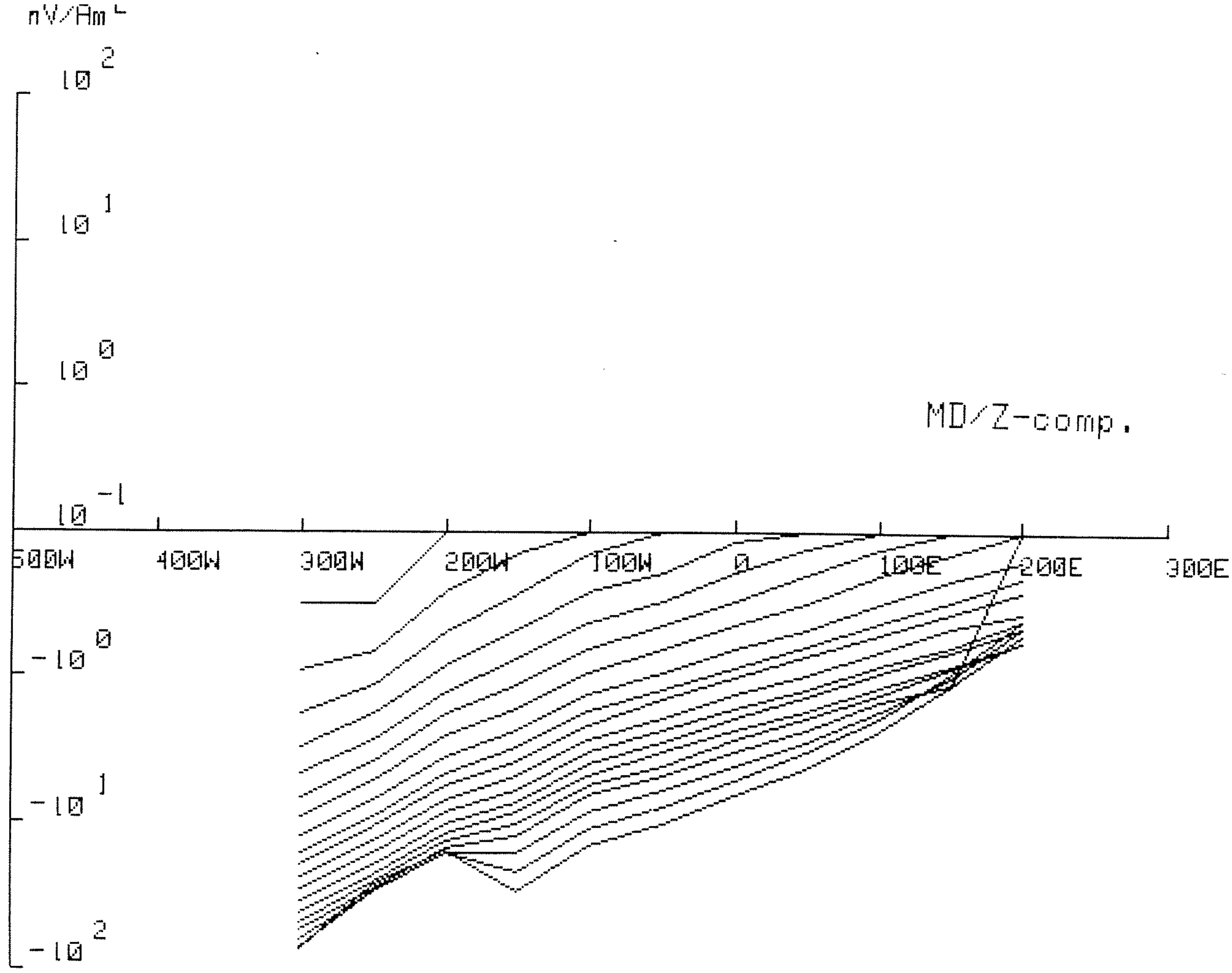
BIDJOVAGGE Suovrarappat		
EM 31 survey area	App. 1/3	

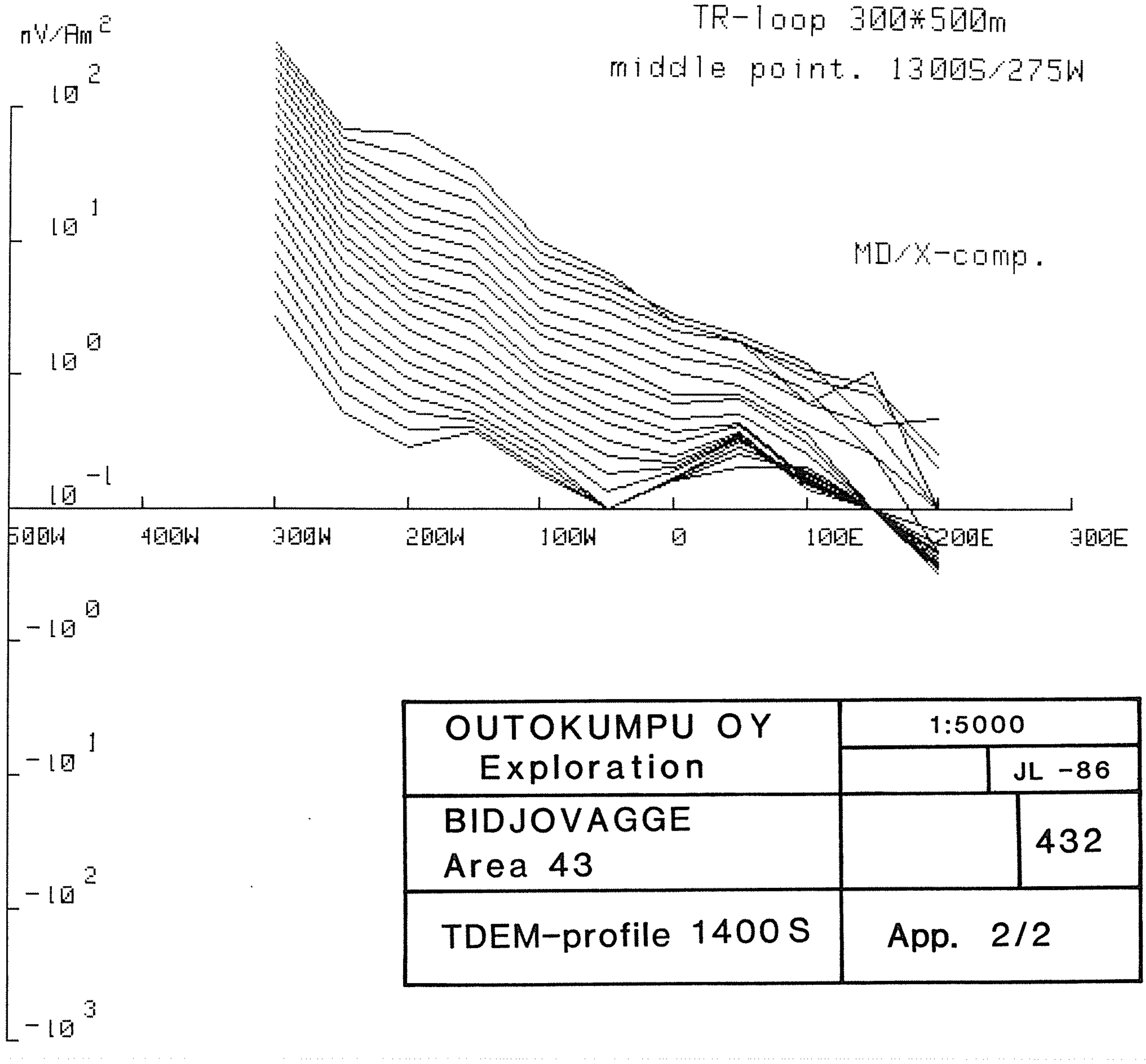
2



OUTOKUMPU OY Exploration	1:5000	
		JL -86
BIDJOVAGGE Area 43		432
TDEM-profile 1500 S	App. 2/1	



TR-loop 300*500m
middle point. 1300S/275W



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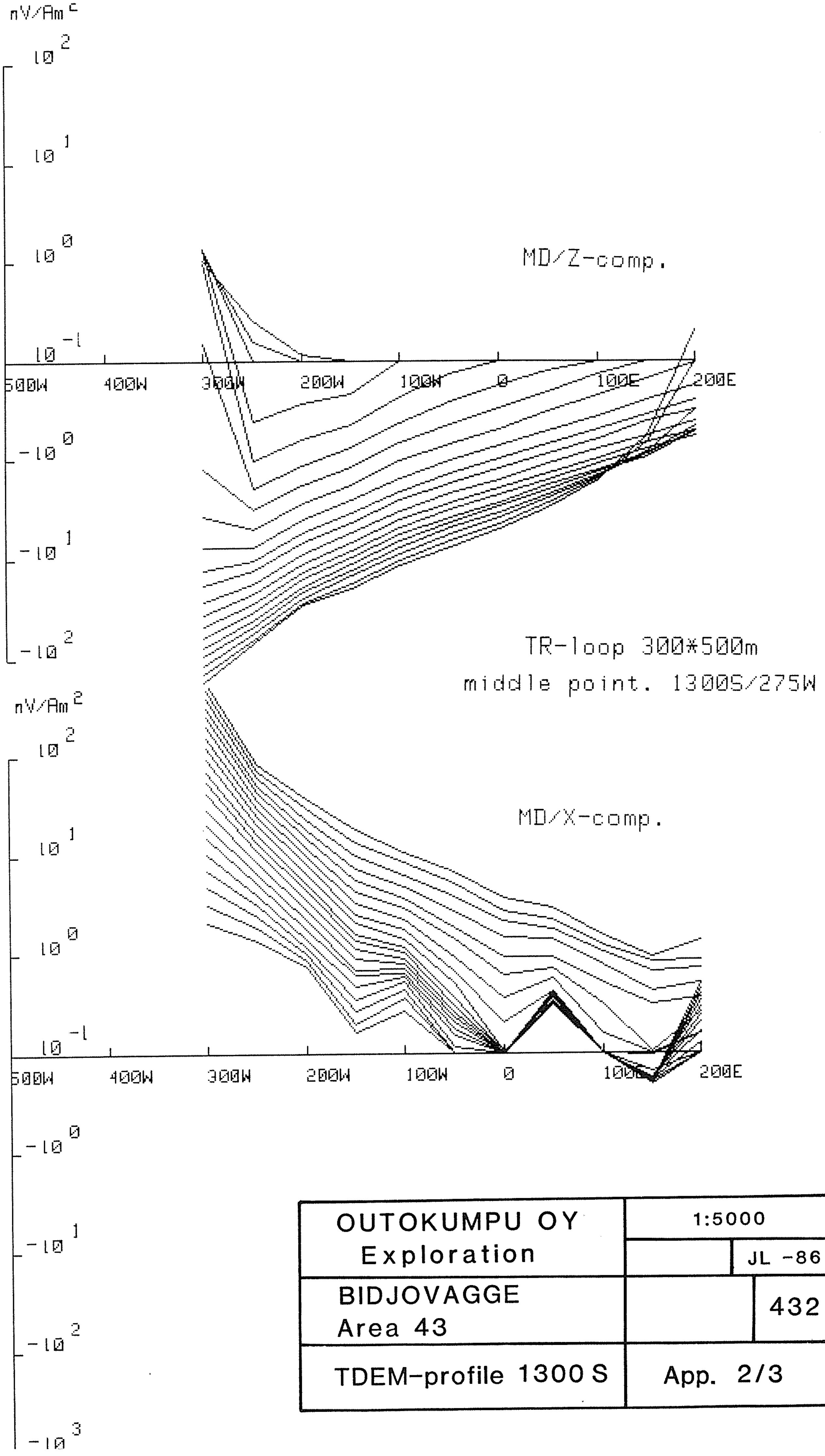
TDEM-profile 1400 S	App. 2/2	



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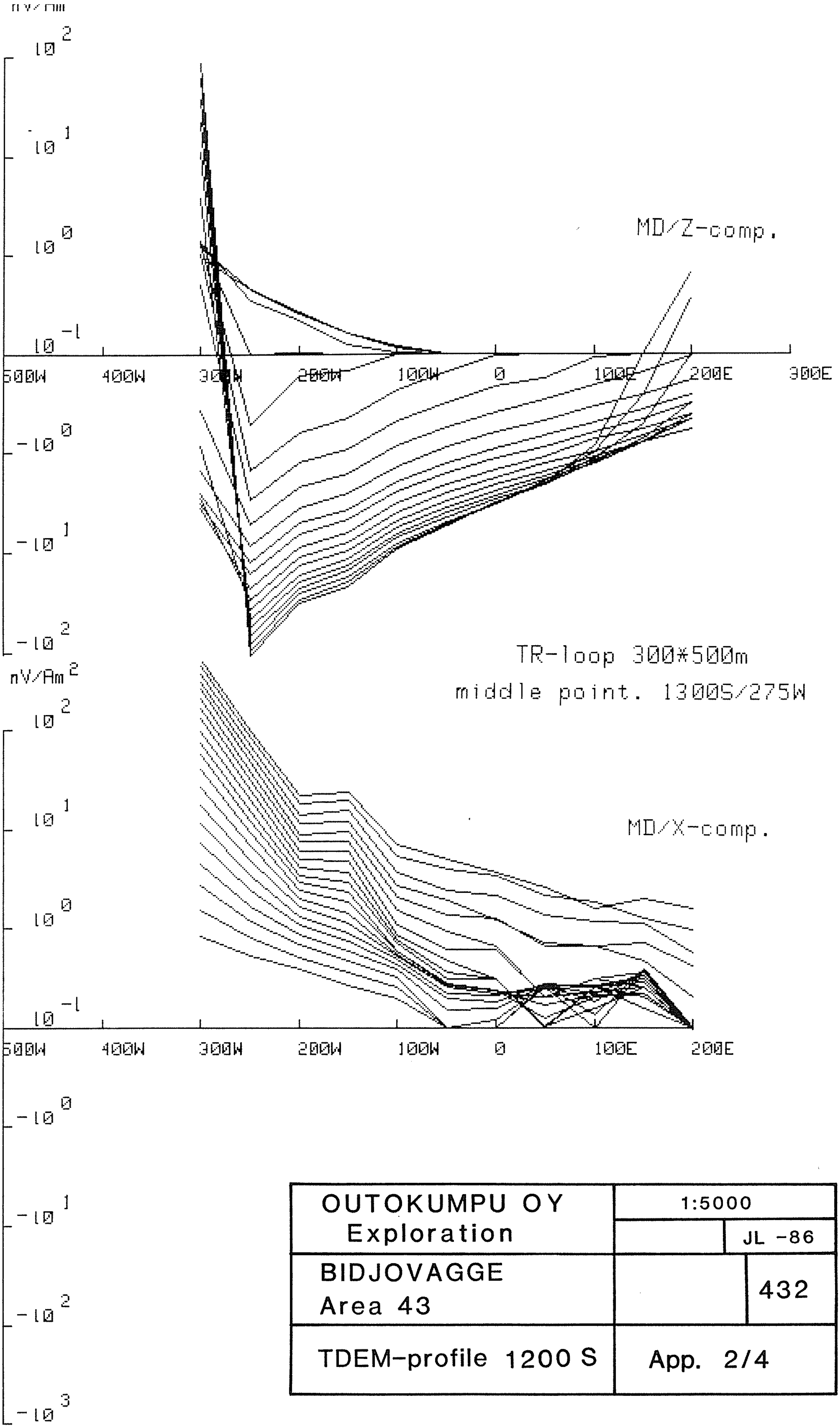
TDEM-profile 1300 S	App. 2/3	



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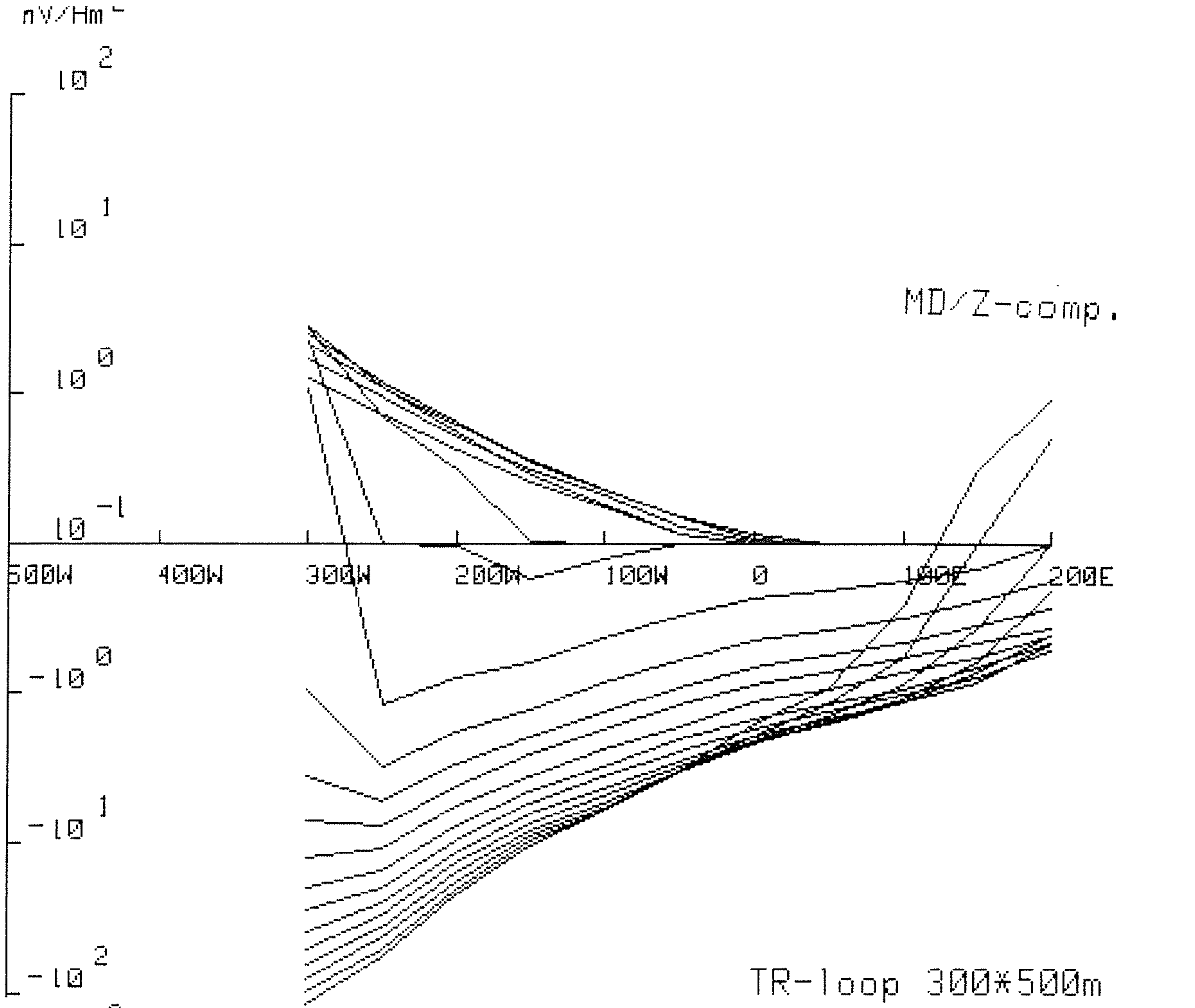
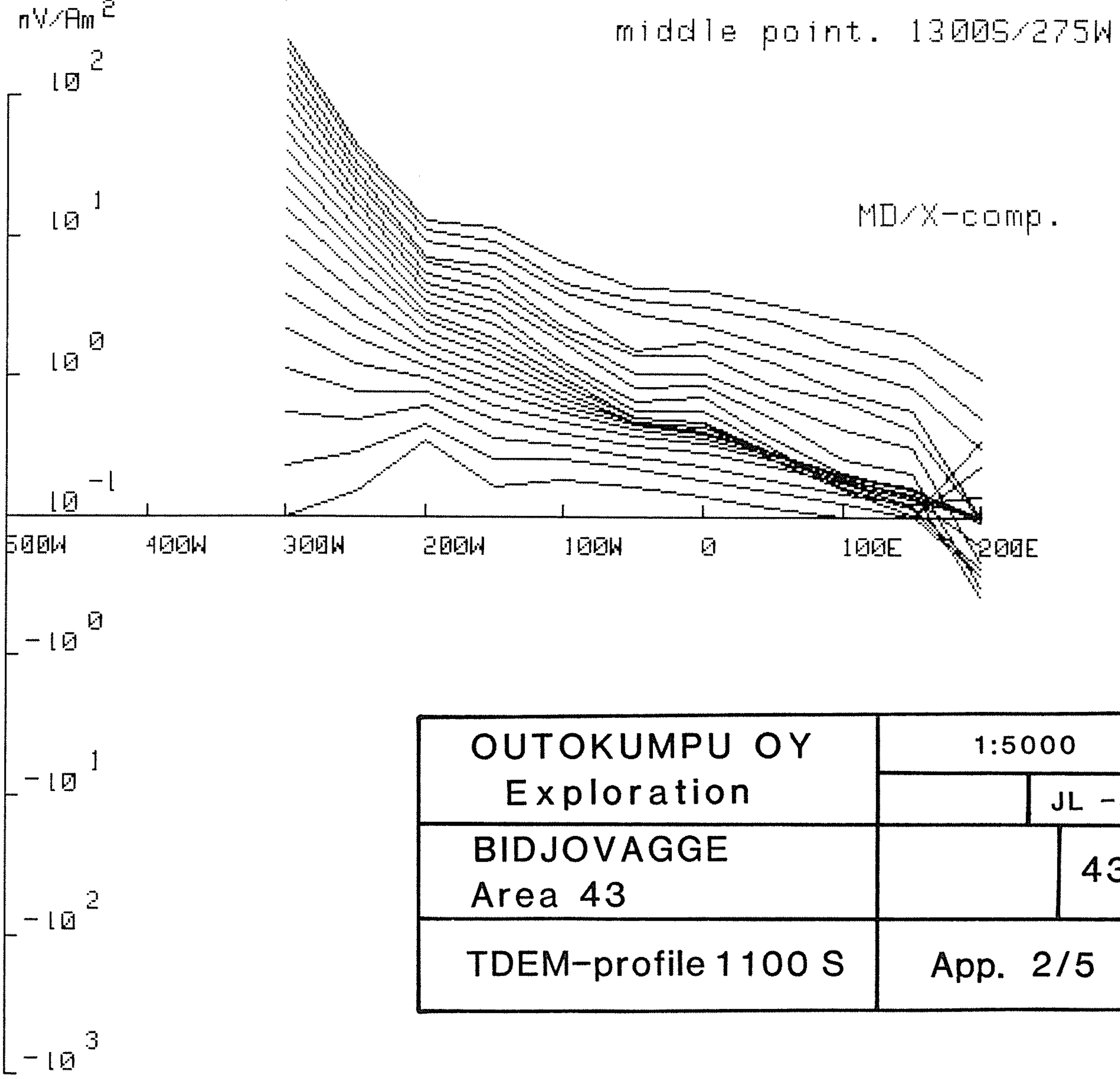
TDEM-profile 1200 S	App. 2/4	





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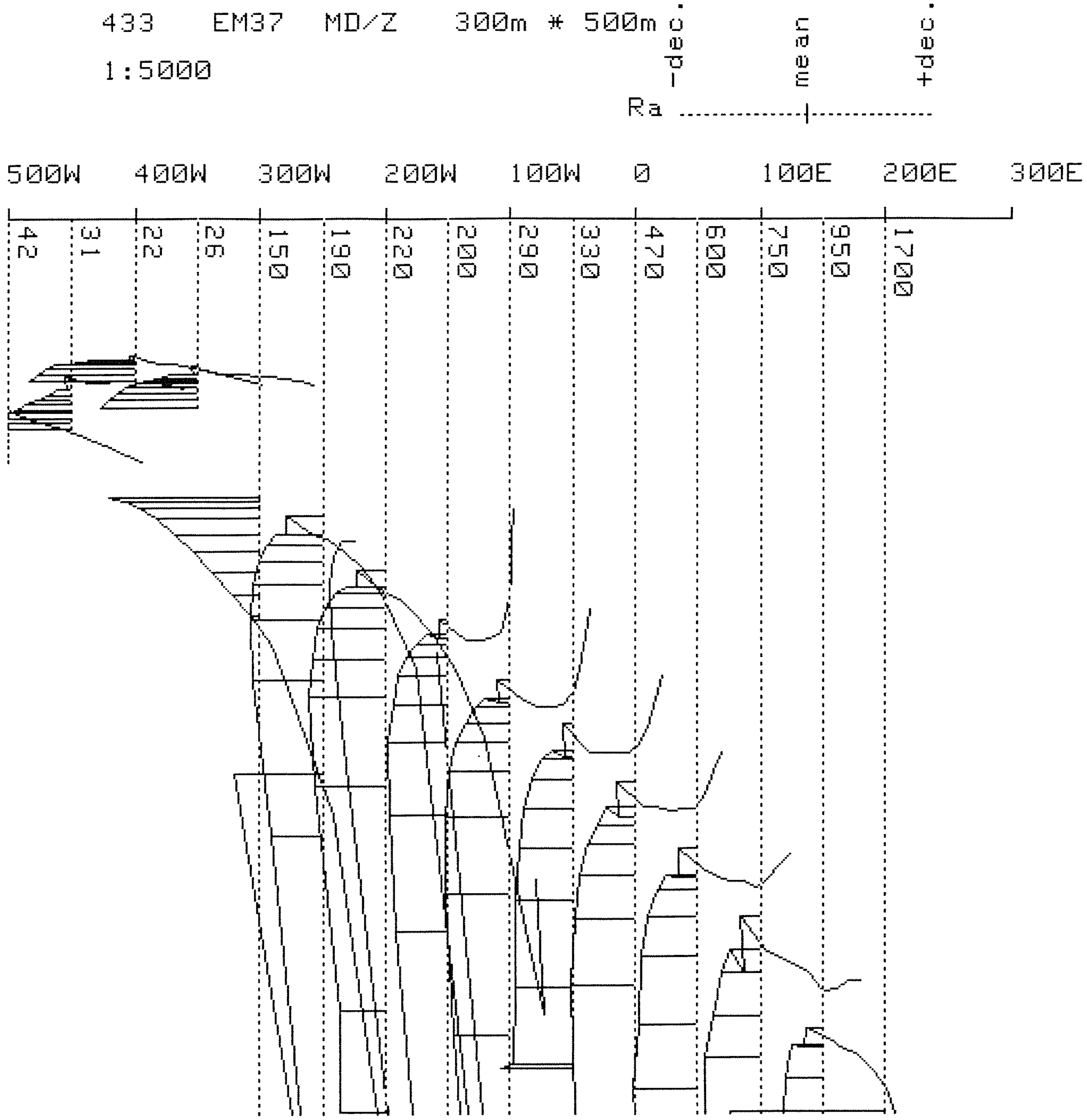
BIDJOVAGGE Area 43		432
TDEM-profile 1100 S	App. 2/5	

Area 43   MIKKUJAURE 1   Prof.1500S

433   EM37   MD/Z   300m * 500m

1:5000

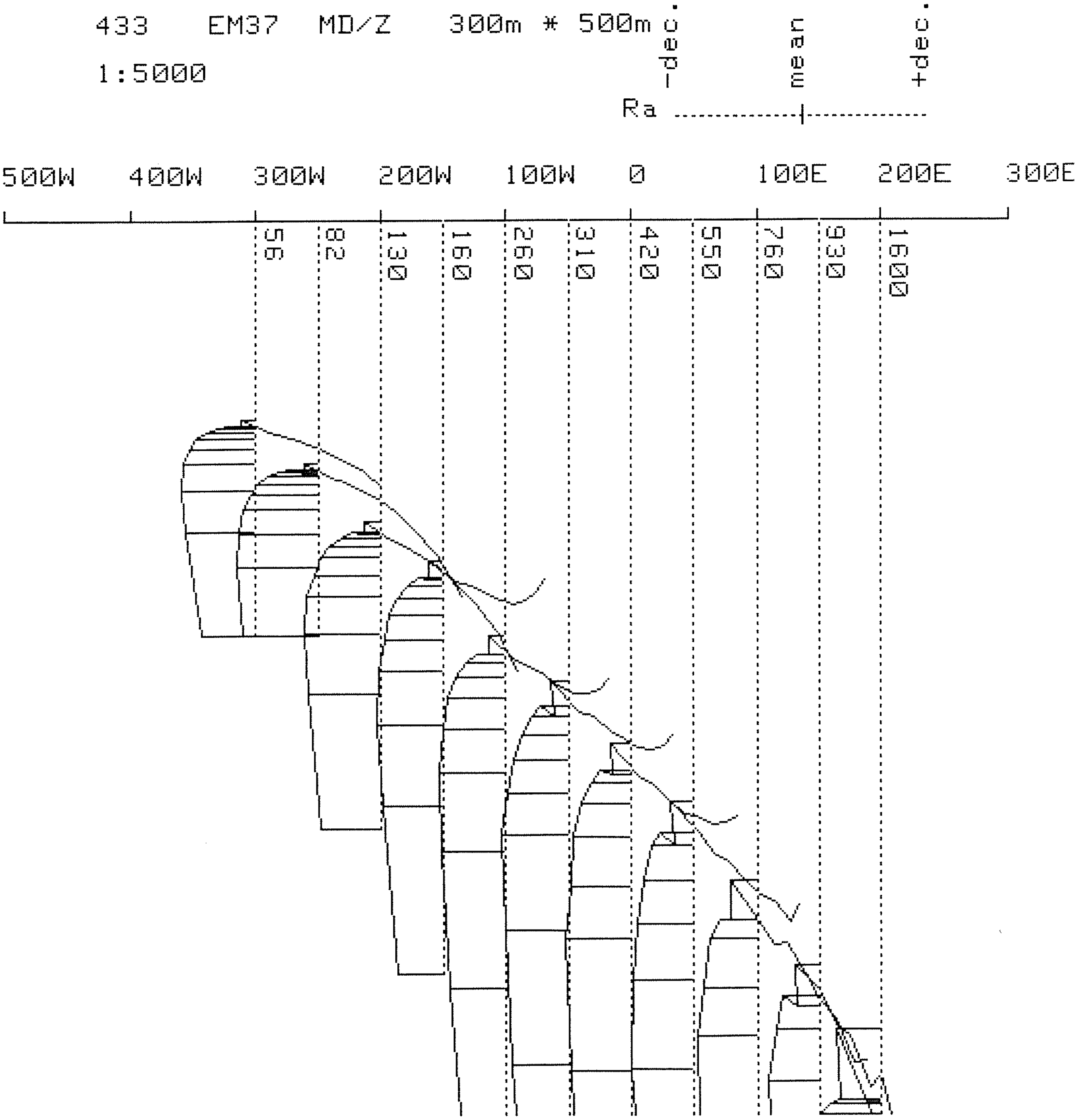


OUTOKUMPU OY Exploration	1:5000	
		JL -86
BIDJOVAGGE Area 43		433
DIT-plot	App. 2/6	

Area 43 MIKKUJAURE 1 Prof.1400S

433 EM37 MD/Z 300m * 500m

1:5000



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BIDJOVAGGE Area 43		433
DIT-plot	App. 2/7	

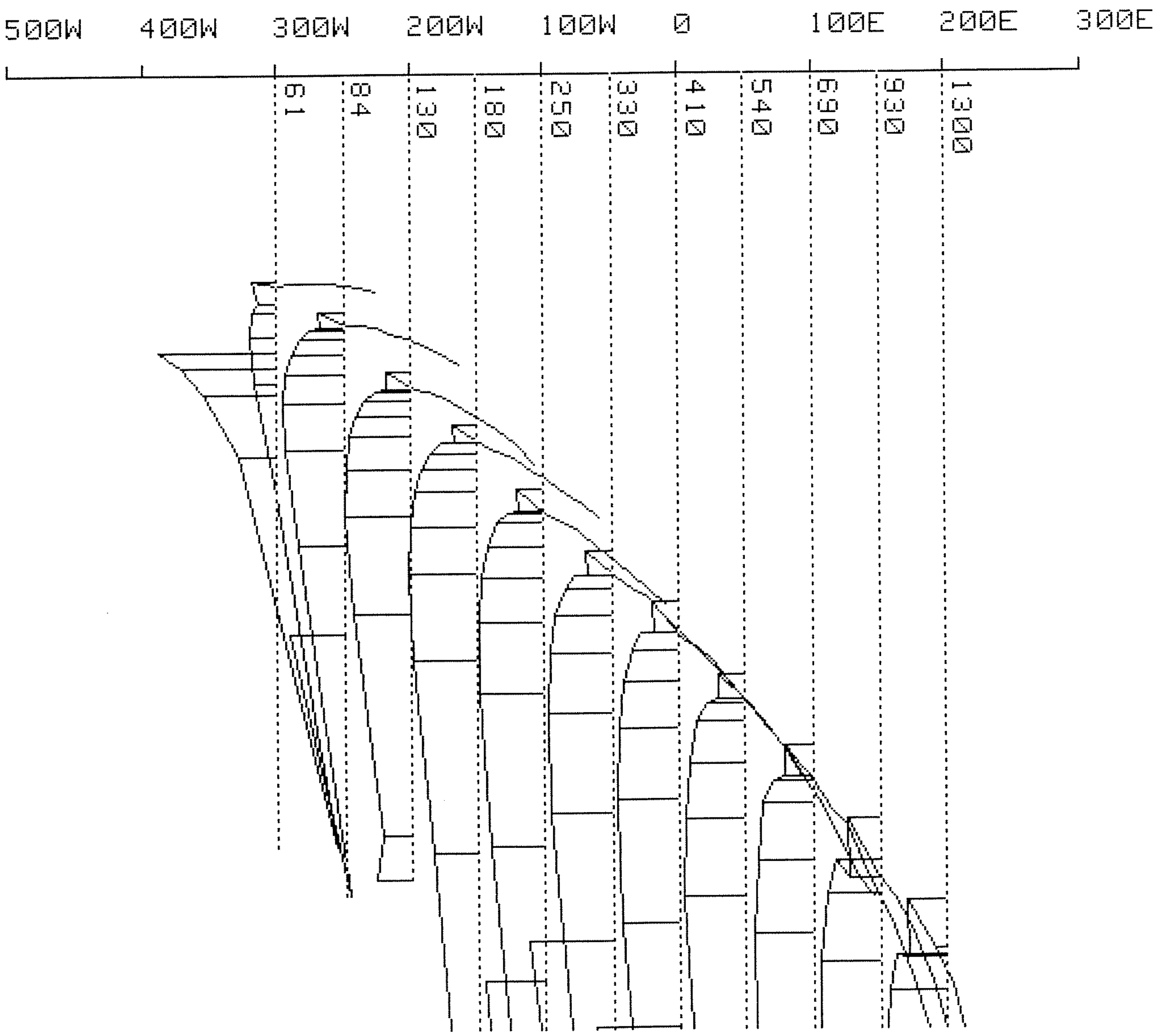
Area 43 MIKKUJAURE 1 Prof.1300S

433 EM37 MD/Z 300m * 500m

1:5000

-dec. mean +dec.

Ra



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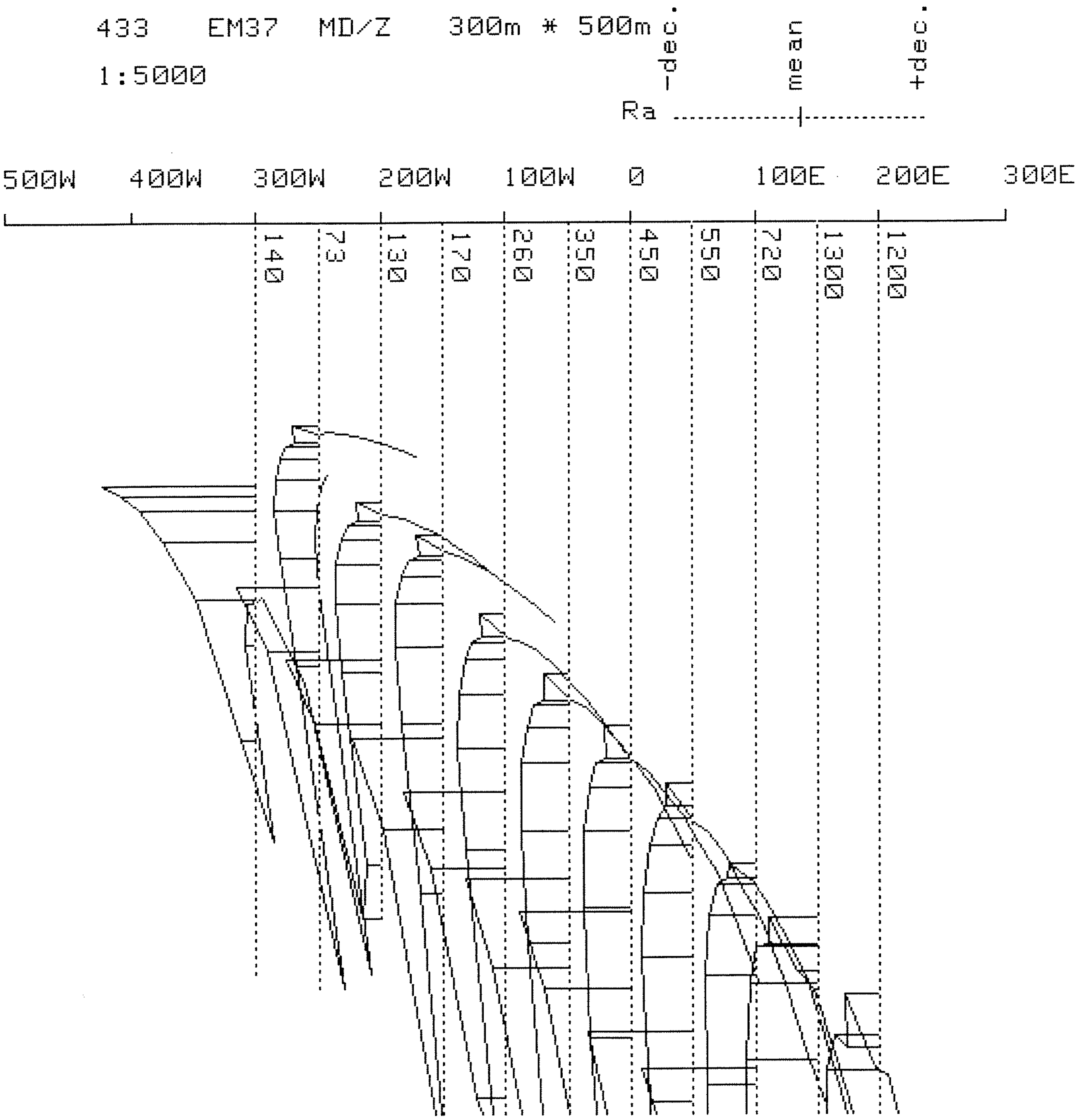
		JL -86
BIDJOVAGGE Area 43		433
DIT-plot	App. 2/8	

Area 43   MIKKUJAURE 1   Prof.1200S

433   EM37   MD/Z   300m * 500m

1:5000



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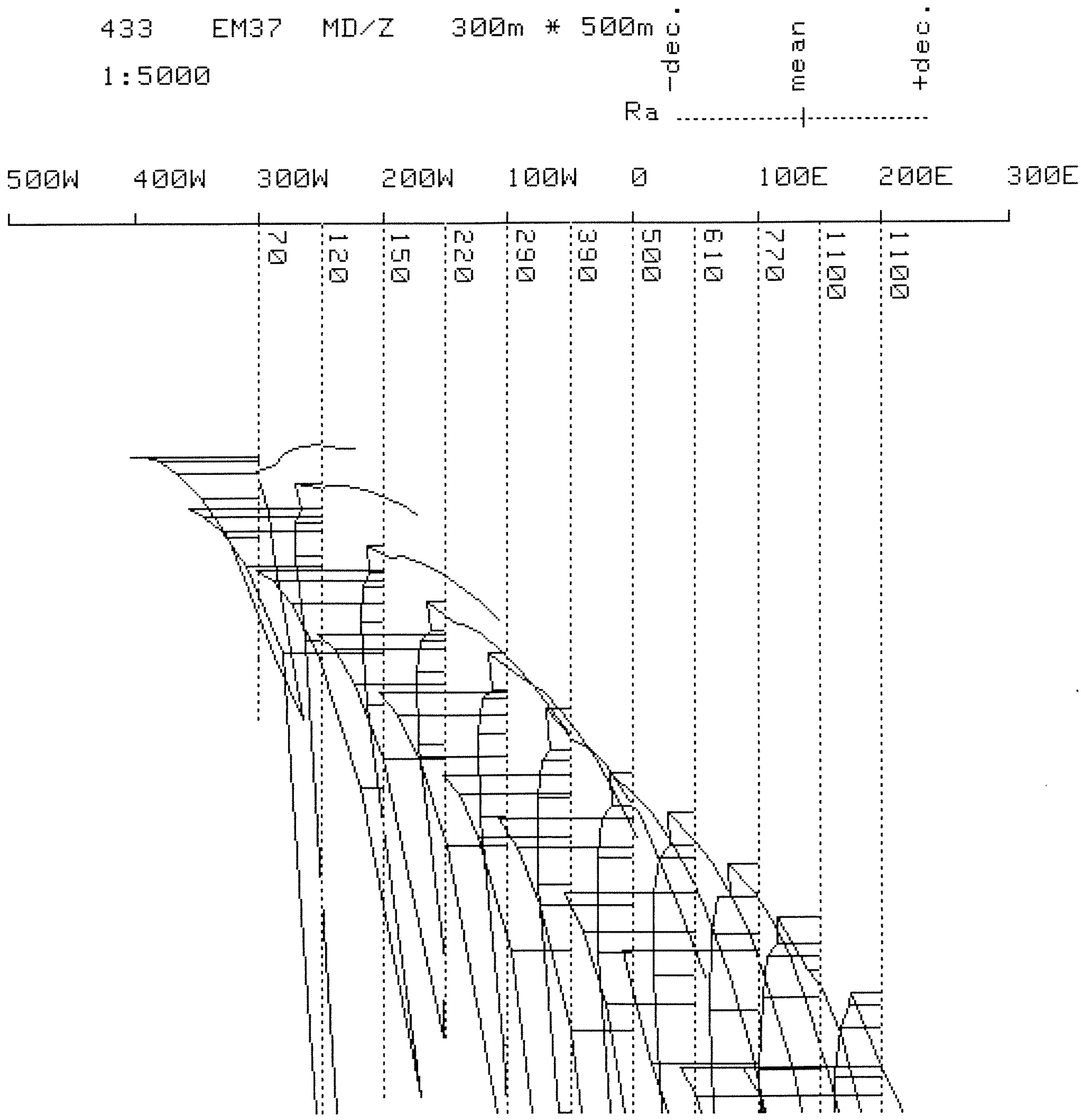
BIDJOVAGGE Area 43		433
DIT-plot	App. 2/9	

Area 43 MIKKUJAURE 1 Prof.1100S

433 EM37 MD/Z 300m * 500m

1:5000



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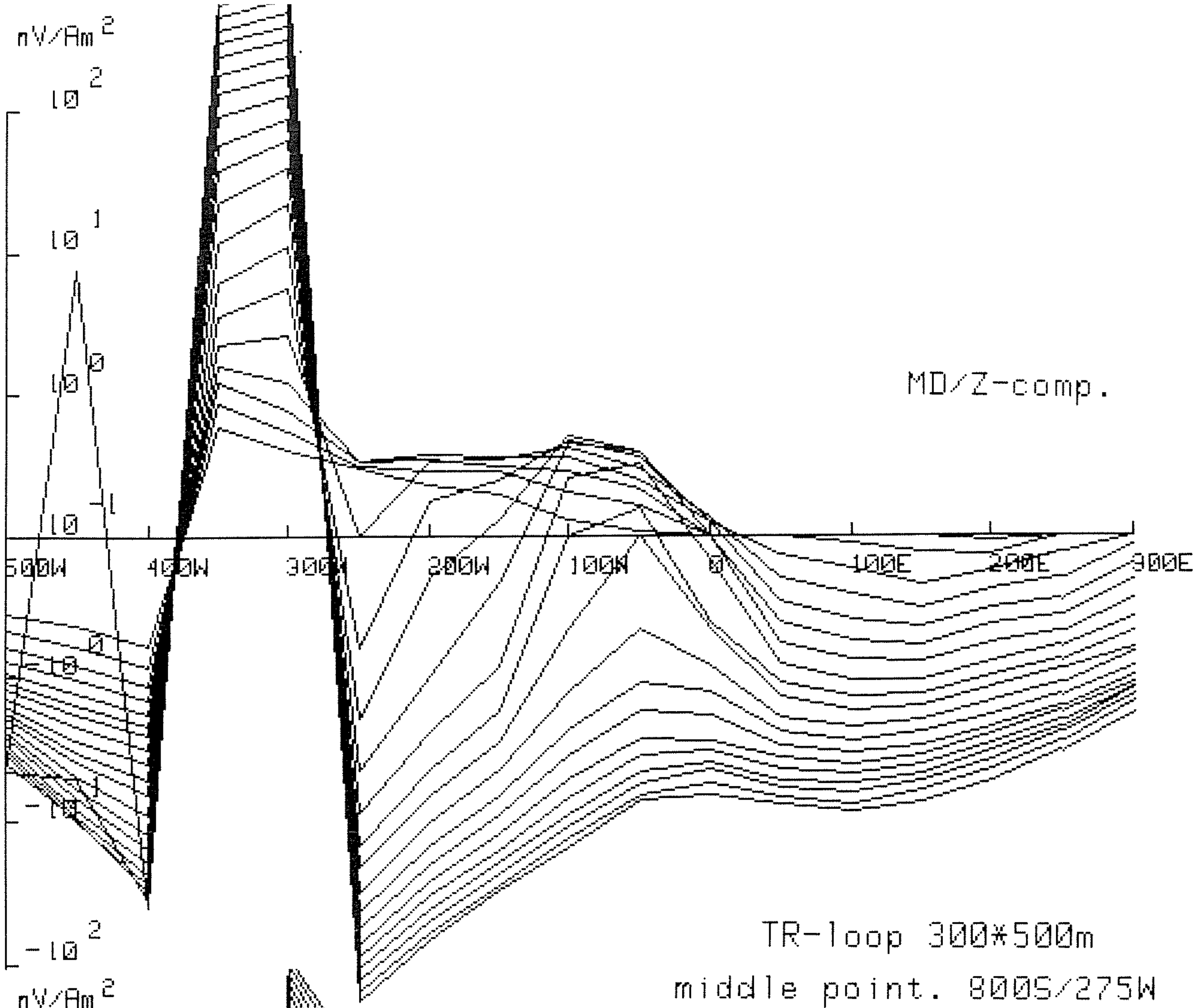
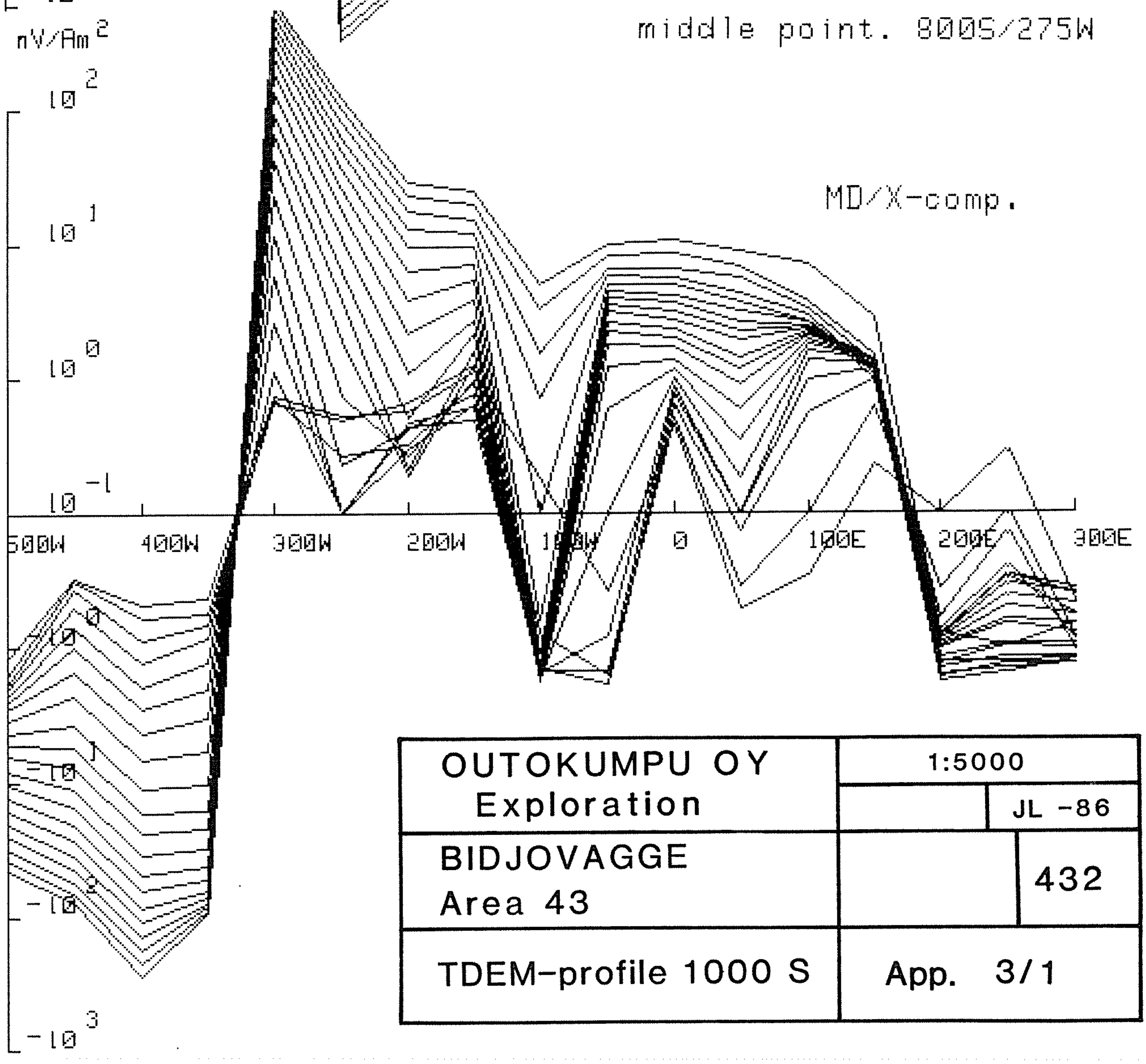
BIDJOVAGGE Area 43		433
DIT-plot	App. 2/10	

3

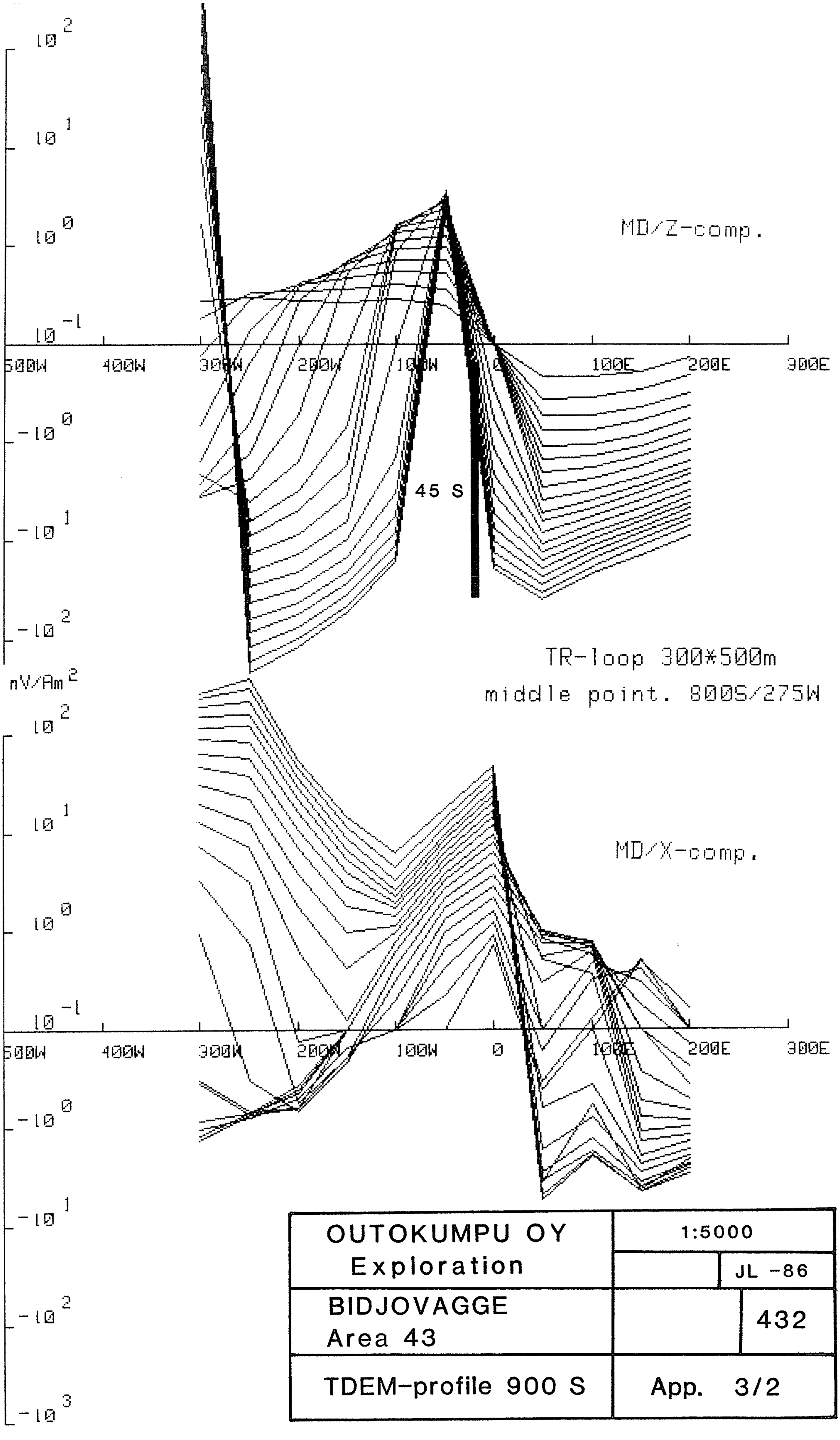


TR-loop 300*500m

middle point. 800S/275W



OUTOKUMPU OY Exploration	1:5000 JL -86	
BIDJOVAGGE Area 43		432
TDEM-profile 1000 S	App. 3/1	



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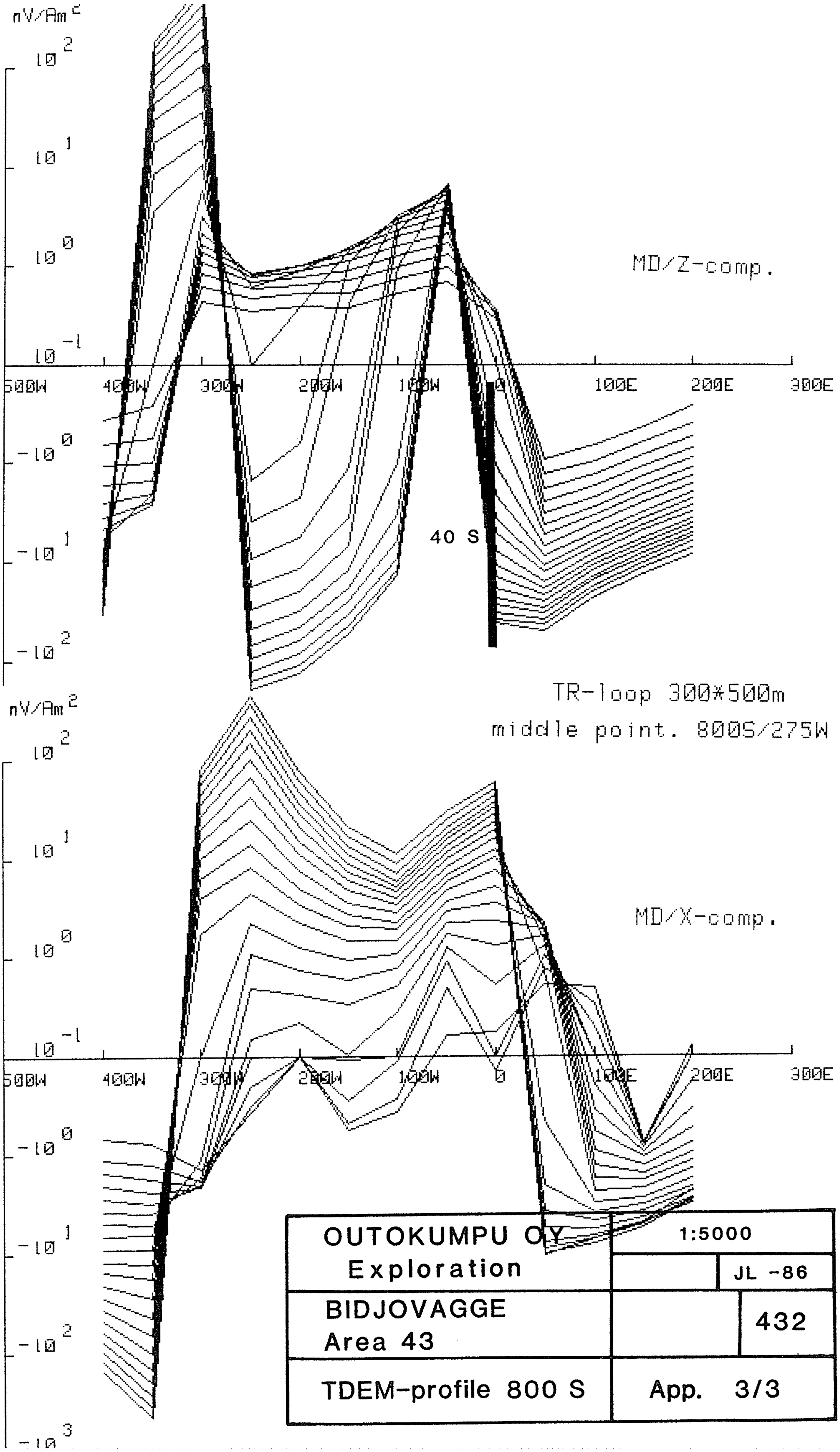
BIDJOVAGGE Area 43		432
TDEM-profile 900 S	App. 3/2	



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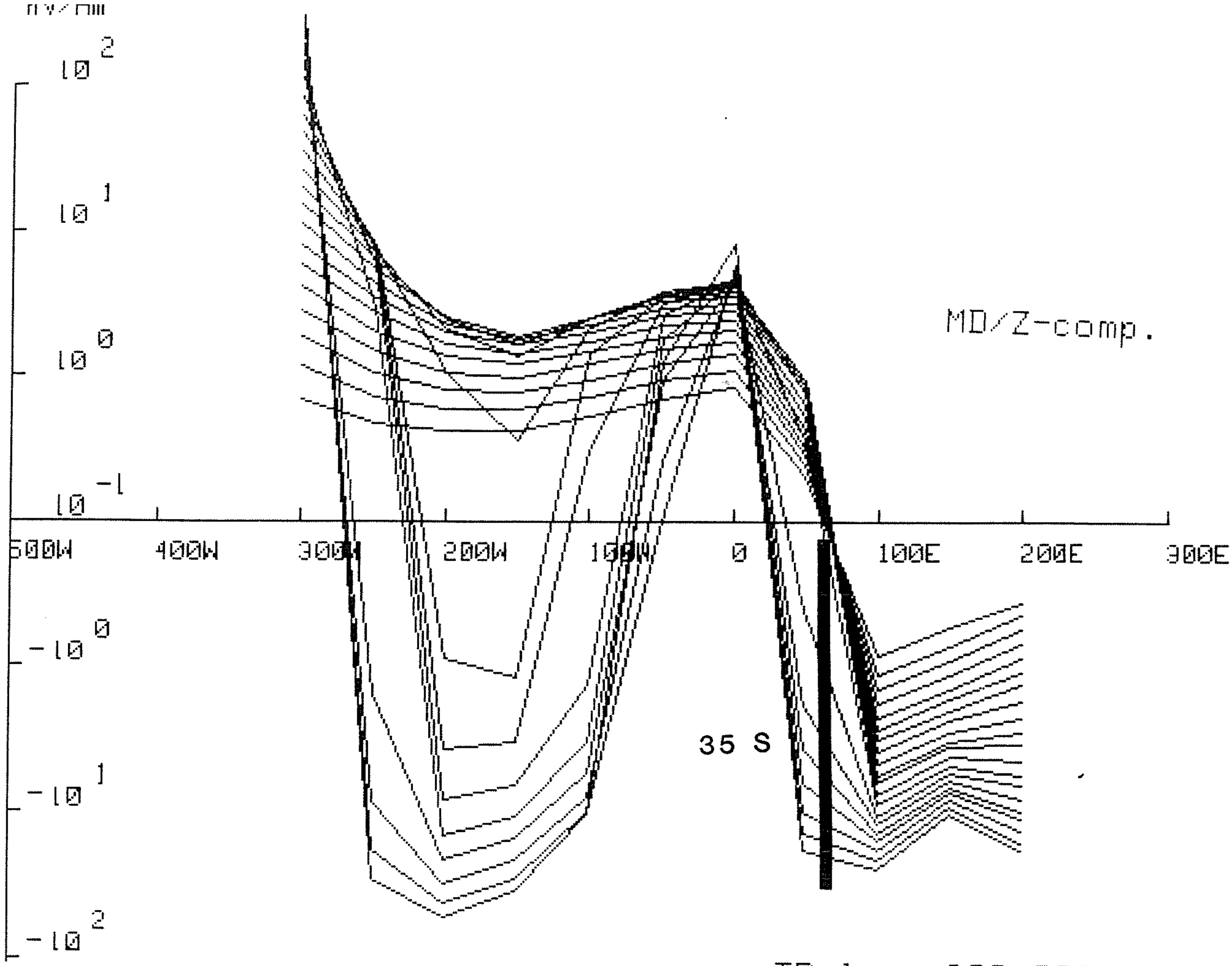
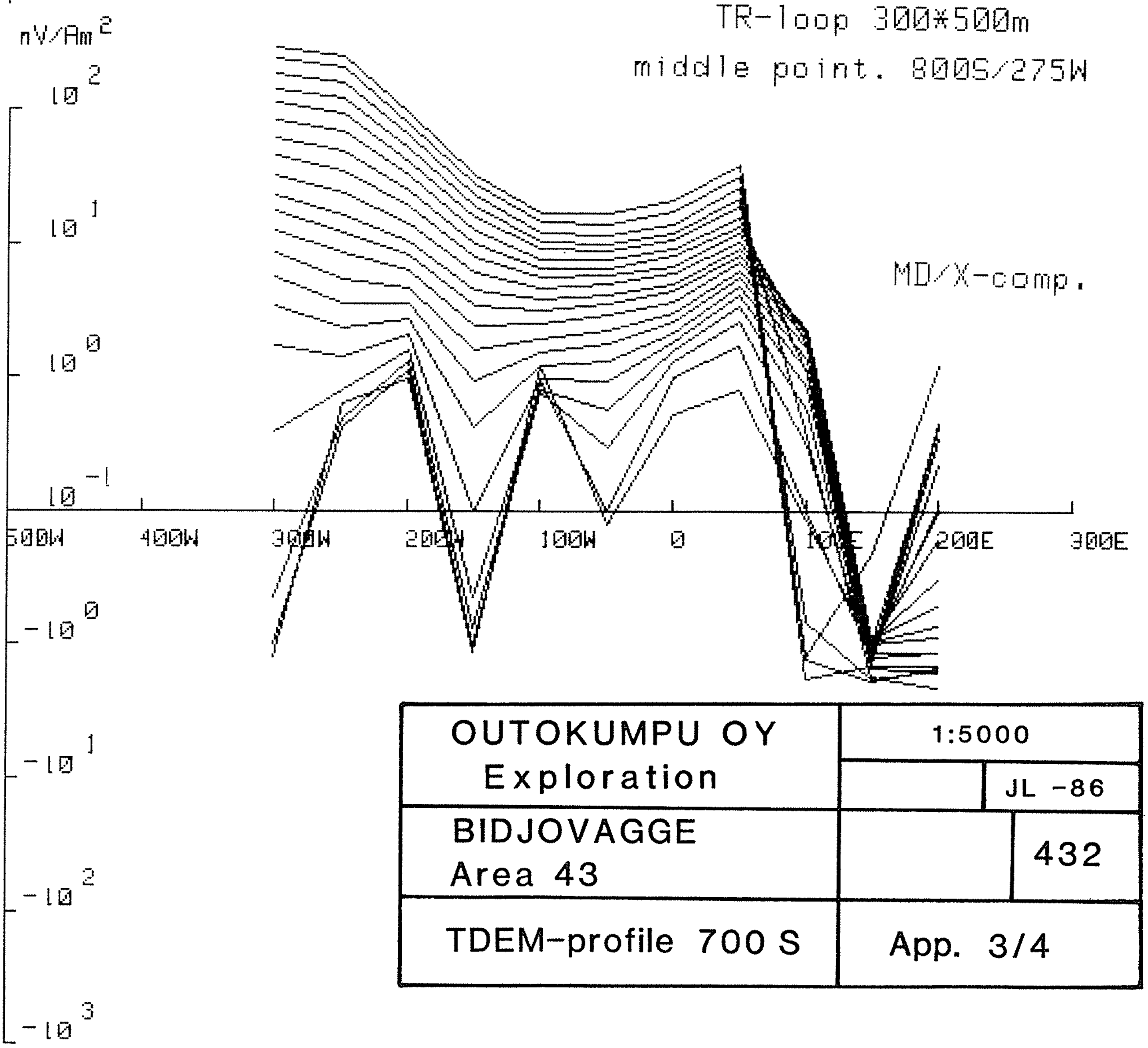
		JL -86
BIDJOVAGGE Area 43		432
TDEM-profile 800 S	App. 3/3	



TR-loop 300*500m
middle point. 800S/275W



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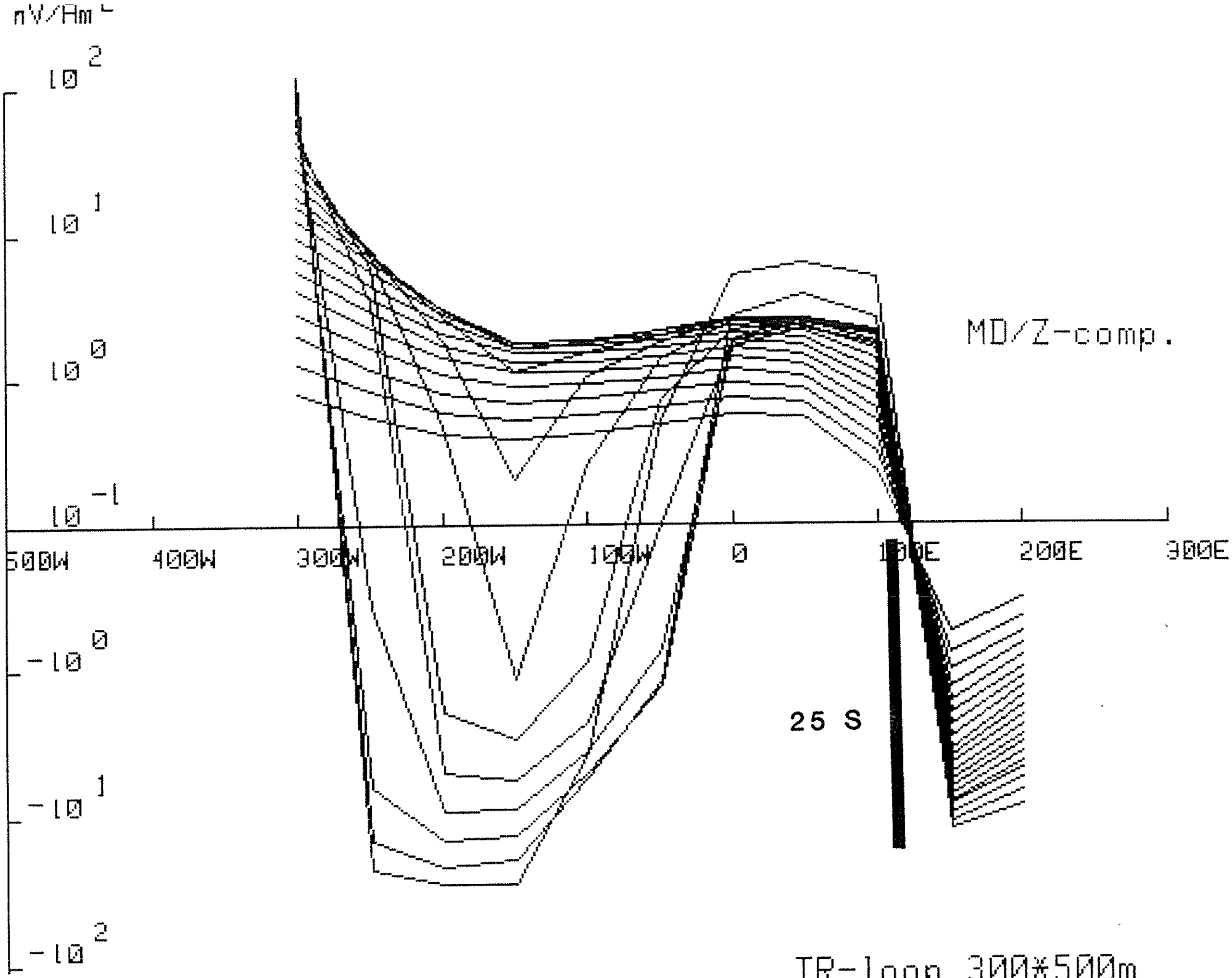
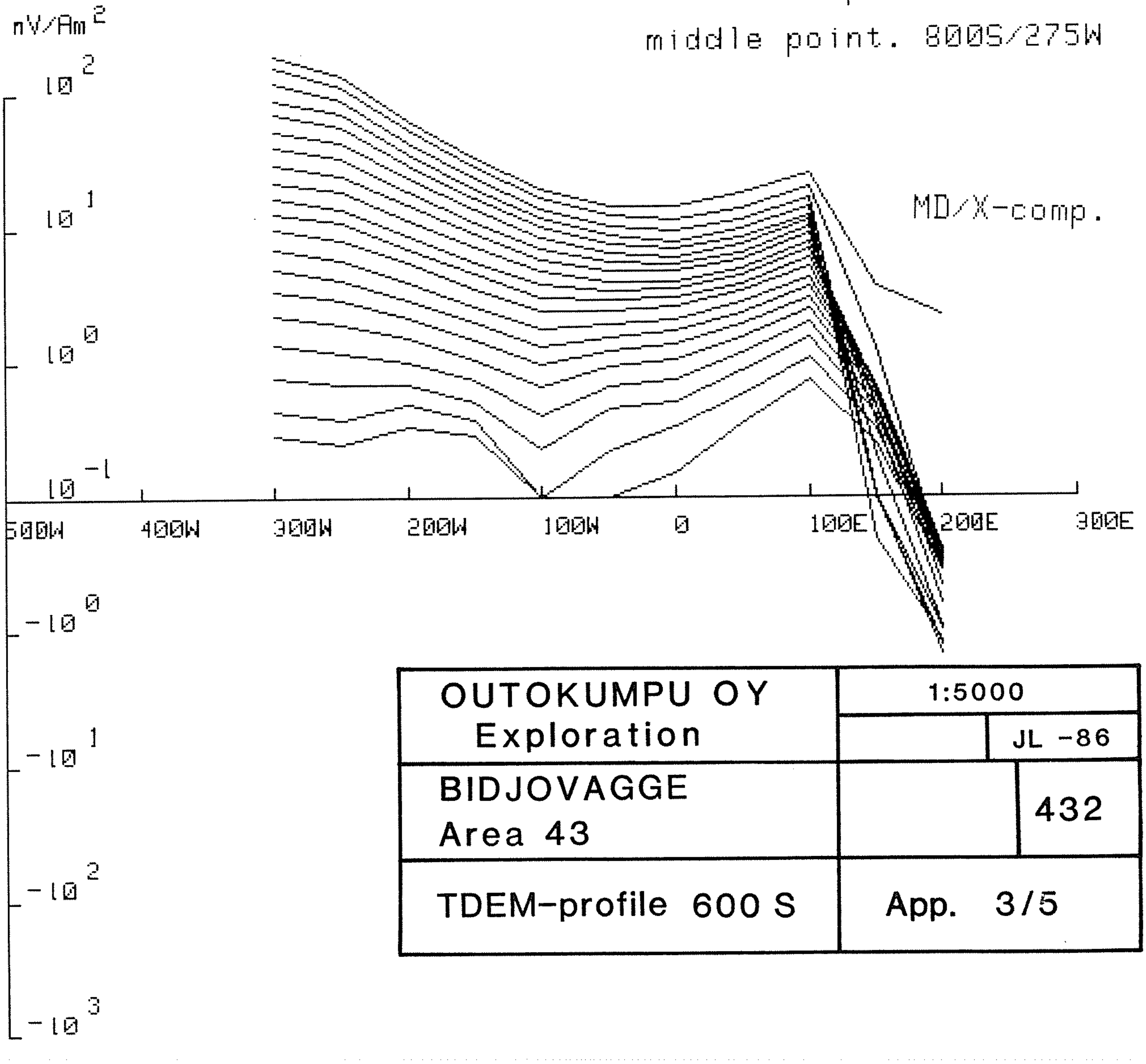
		JL -86
BIDJOVAGGE Area 43		432
TDEM-profile 700 S	App. 3/4	



TR-loop 300*500m
middle point. 800S/275W

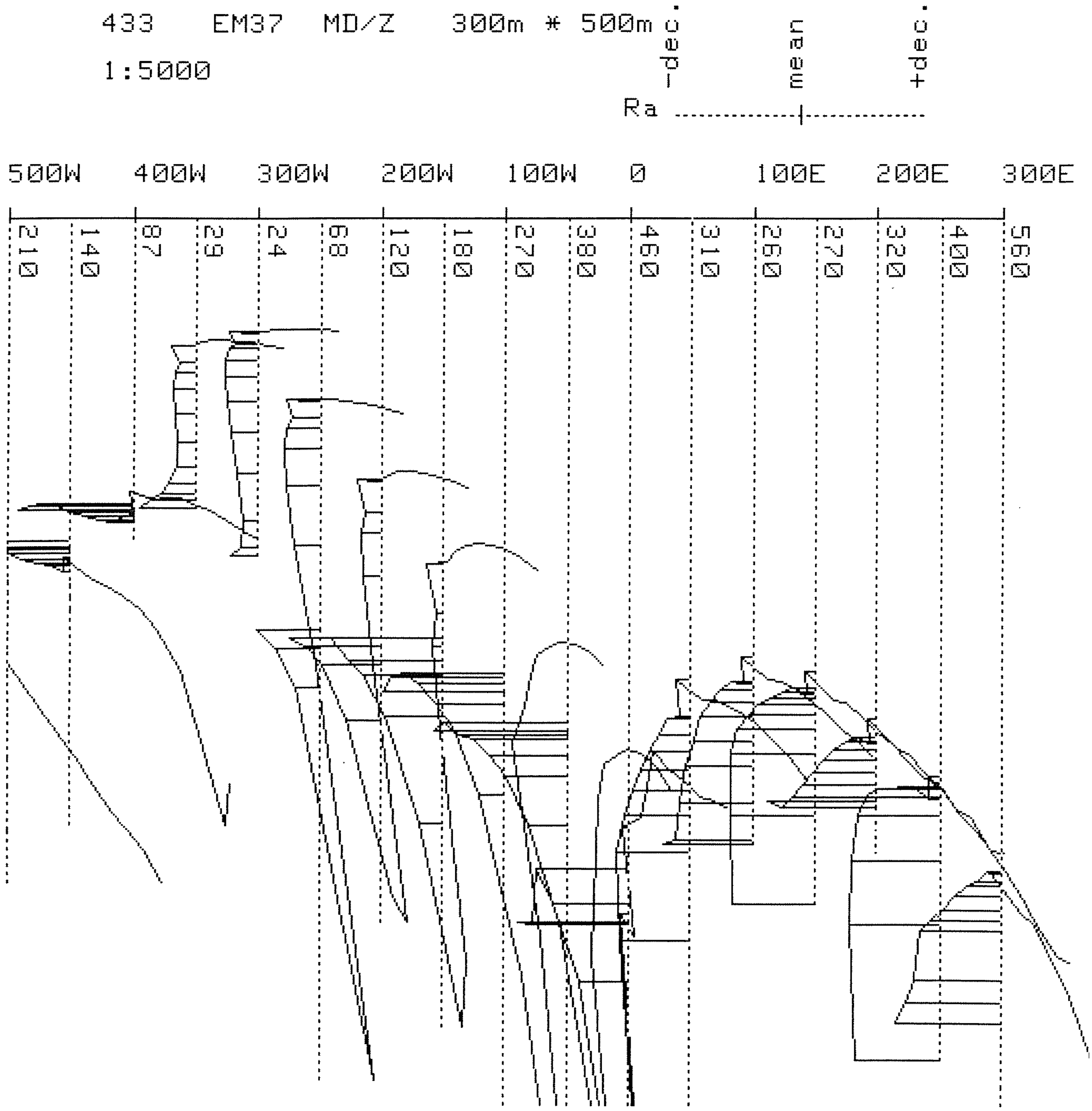


OUTOKUMPU OY Exploration	1:5000	
		JL -86
BIDJOVAGGE Area 43		432
TDEM-profile 600 S	App. 3/5	

Area 43 MIKKUJAURE 2 Prof.1000S

433 EM37 MD/Z 300m * 500m

1:5000



OUTOKUMPU OY Exploration	1:5000	
		JL -86
BIDJOVAGGE Area 43		433
DIT-plot	App. 3/6	

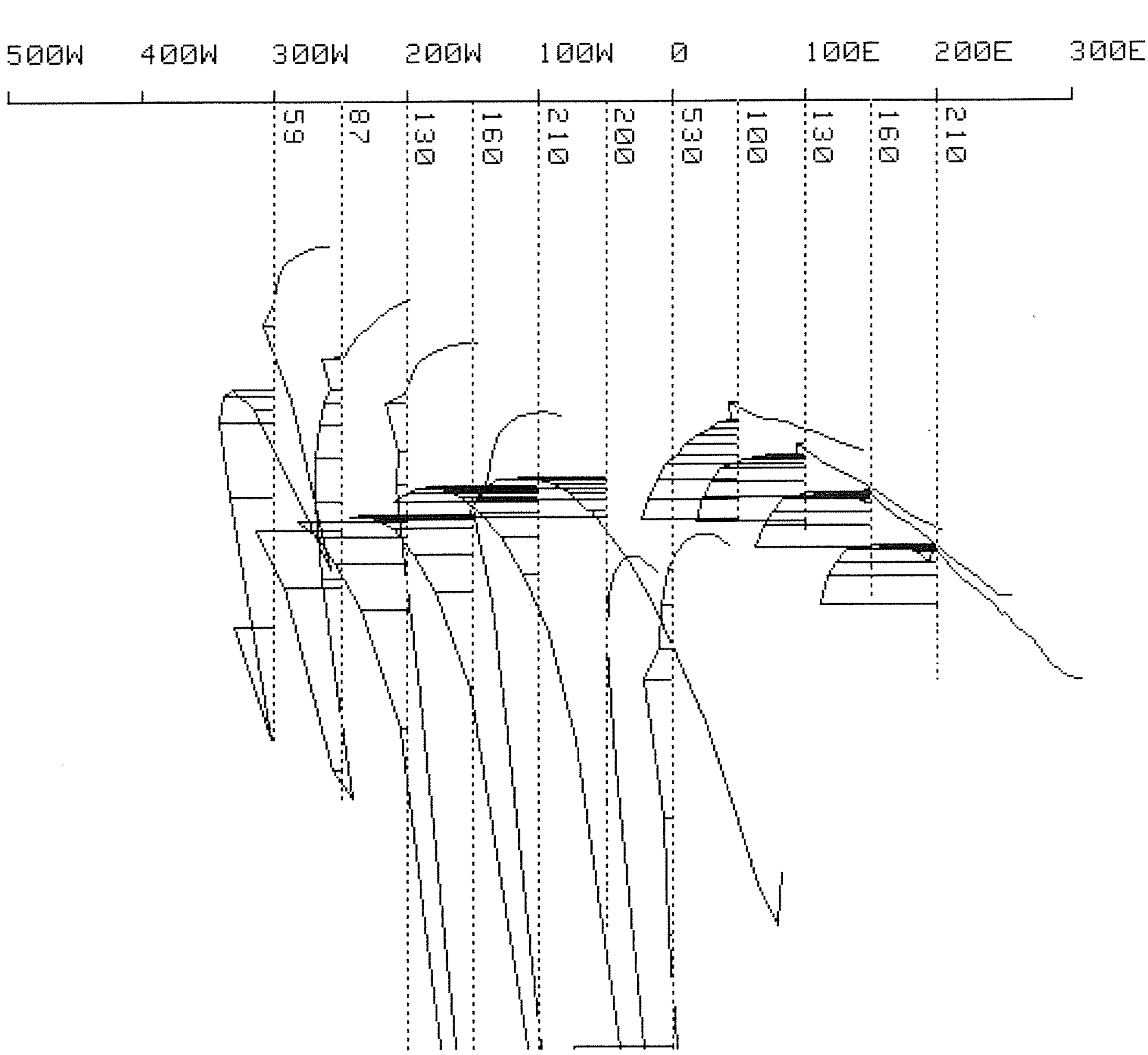
Area 43   MIKKUJAURE 2   Prof.900S

433   EM37   MD/Z   300m * 500m

1:5000

-dec.   mean   +dec.

Ra

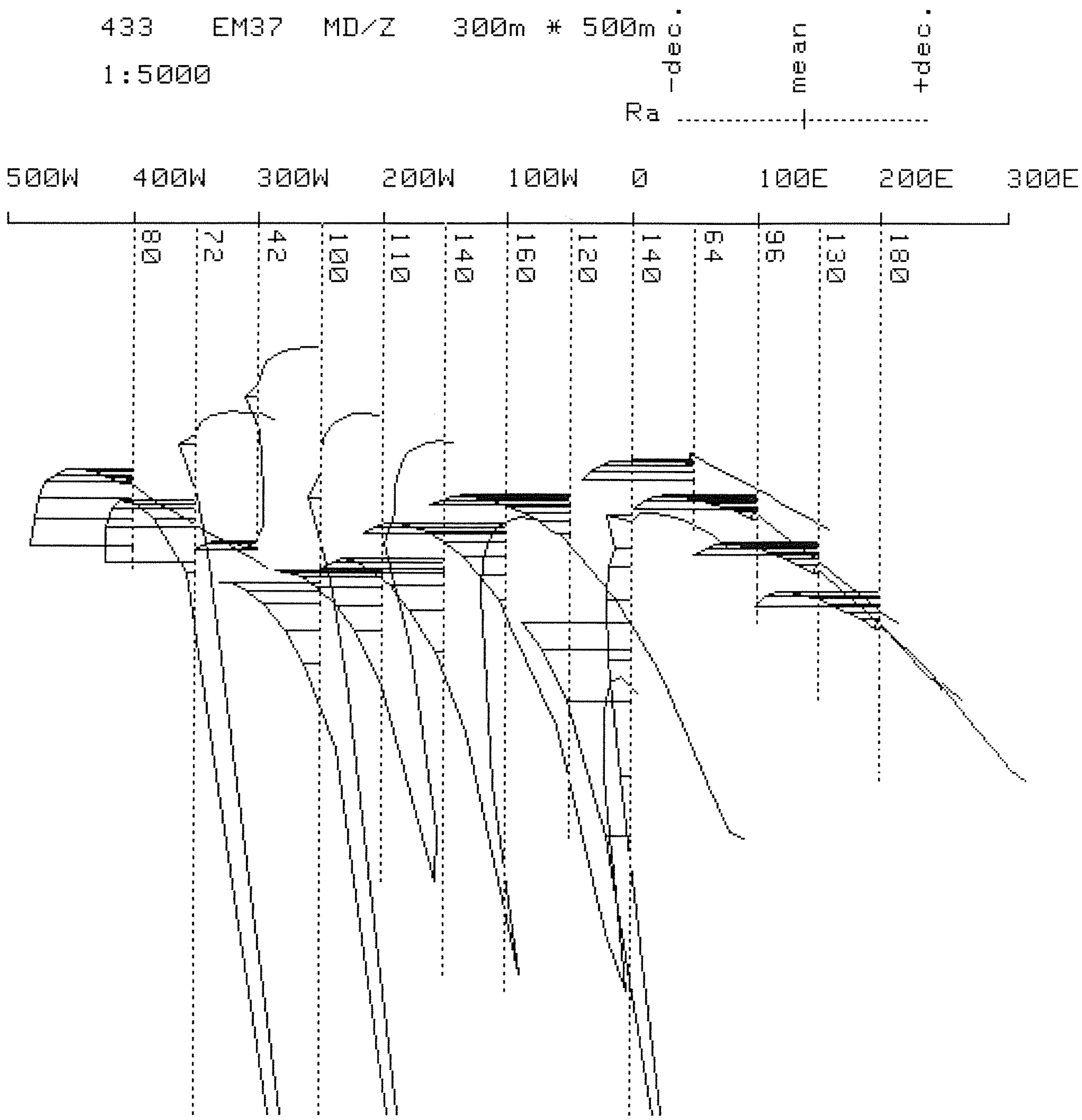


OUTOKUMPU OY Exploration	1:5000	
		JL -86
BIDJOVAGGE Area 43		433
DIT-plot	App. 3/7	

Area 43   MIKKUJAURE 2   Prof.800S

433   EM37   MD/Z   300m * 500m

1:5000

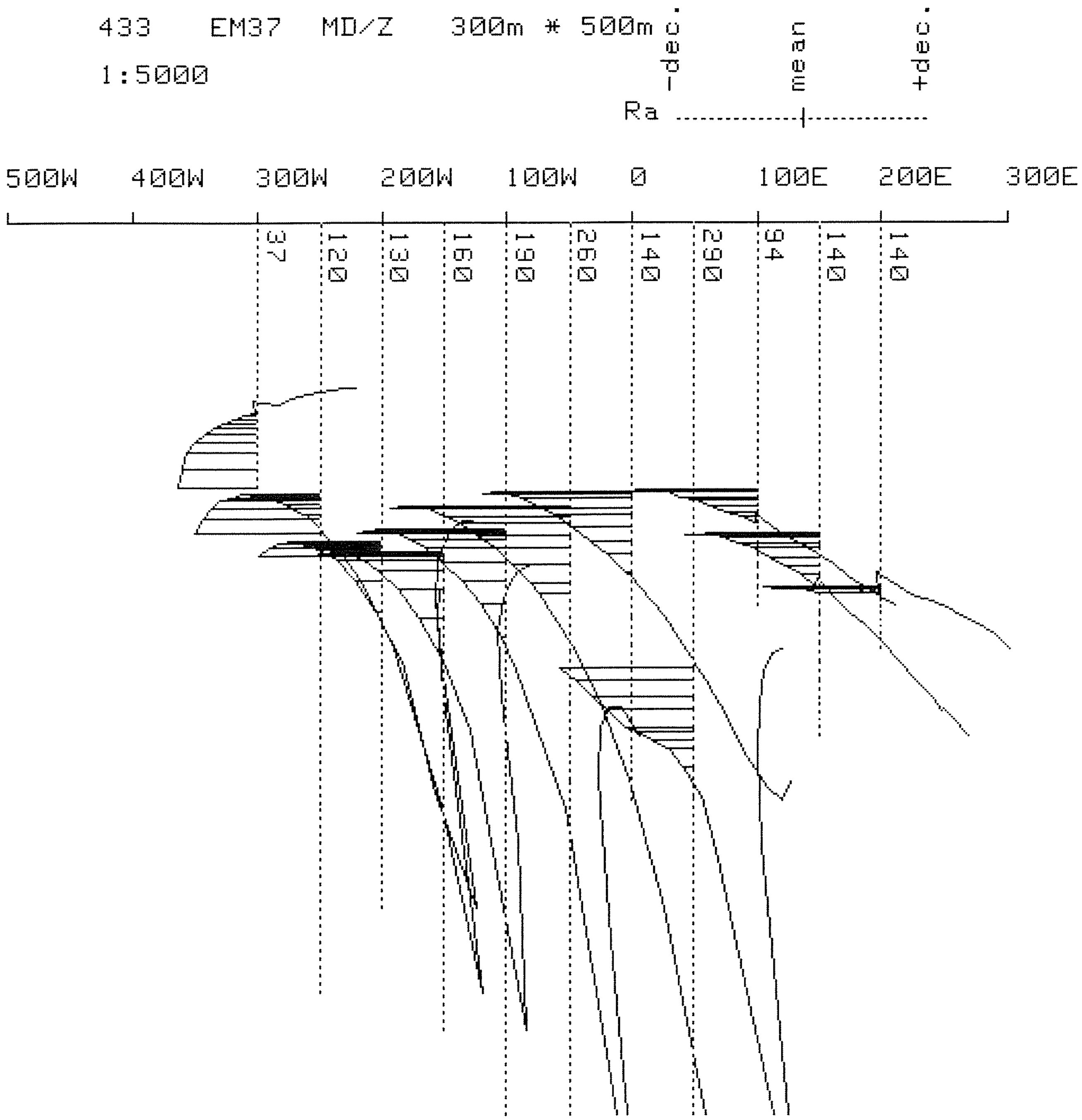


OUTOKUMPU OY Exploration	1:5000	
		JL -86
BIDJOVAGGE Area 43		433
DIT-plot	App. 3/8	

Area 43 MIKKUJAURE 2 Prof.700S

433 EM37 MD/Z 300m * 500m

1:5000

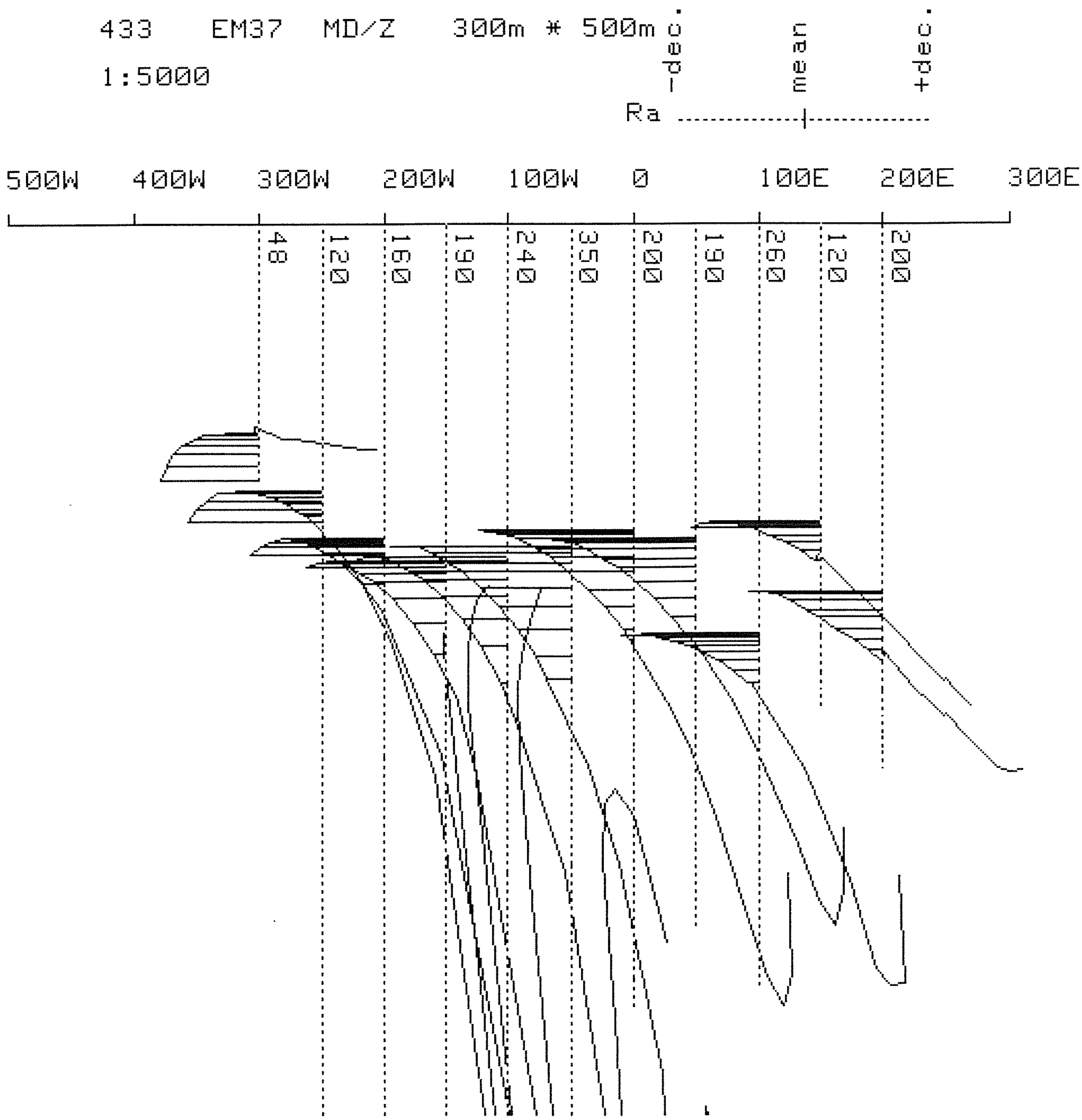


OUTOKUMPU OY Exploration	1:5000	
		JL -86
BIDJOVAGGE Area 43		433
DIT-plot	App. 3/9	

Area 43 MIKKUJAURE 2 Prof.600S

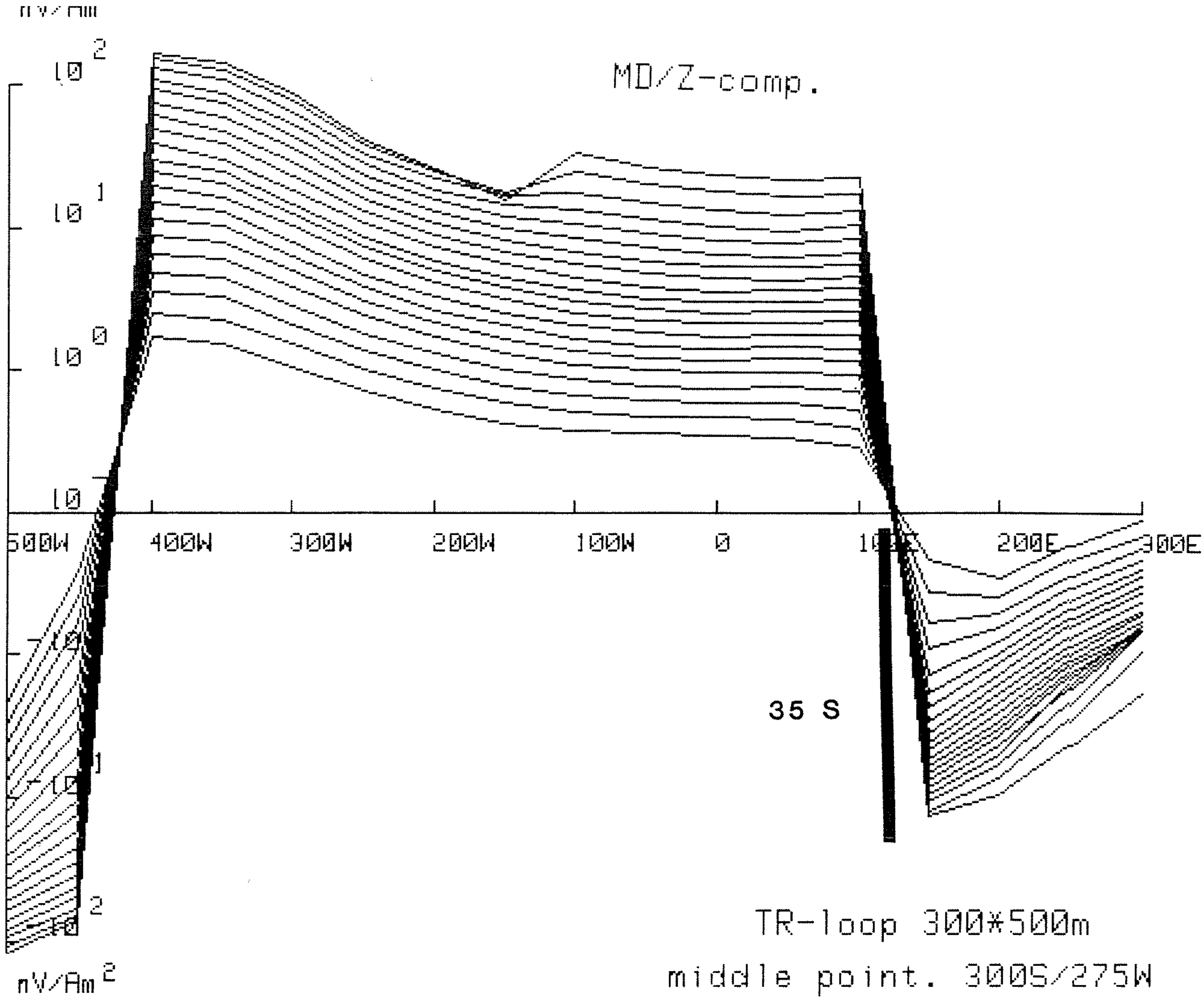
433 EM37 MD/Z 300m * 500m

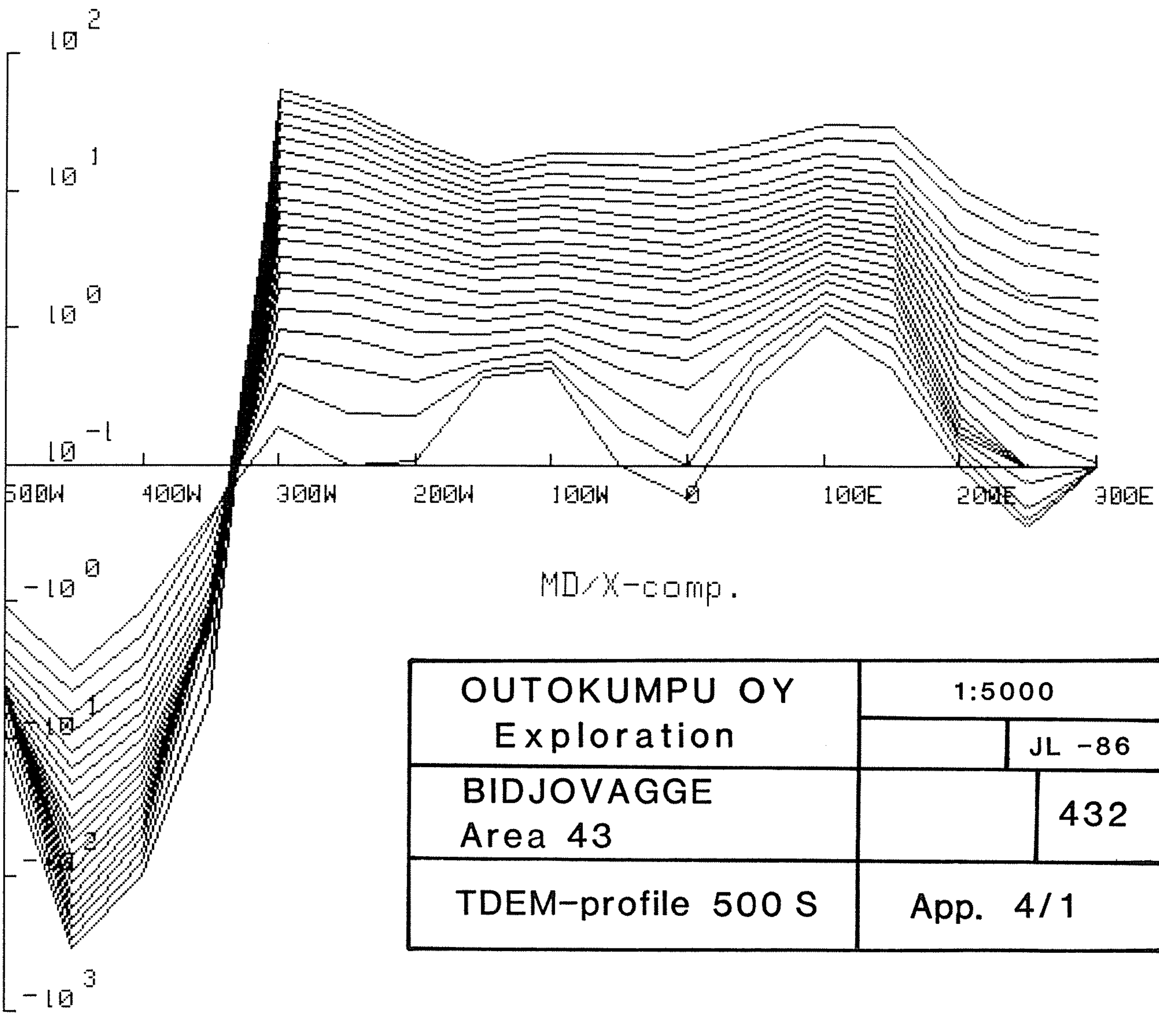
1:5000



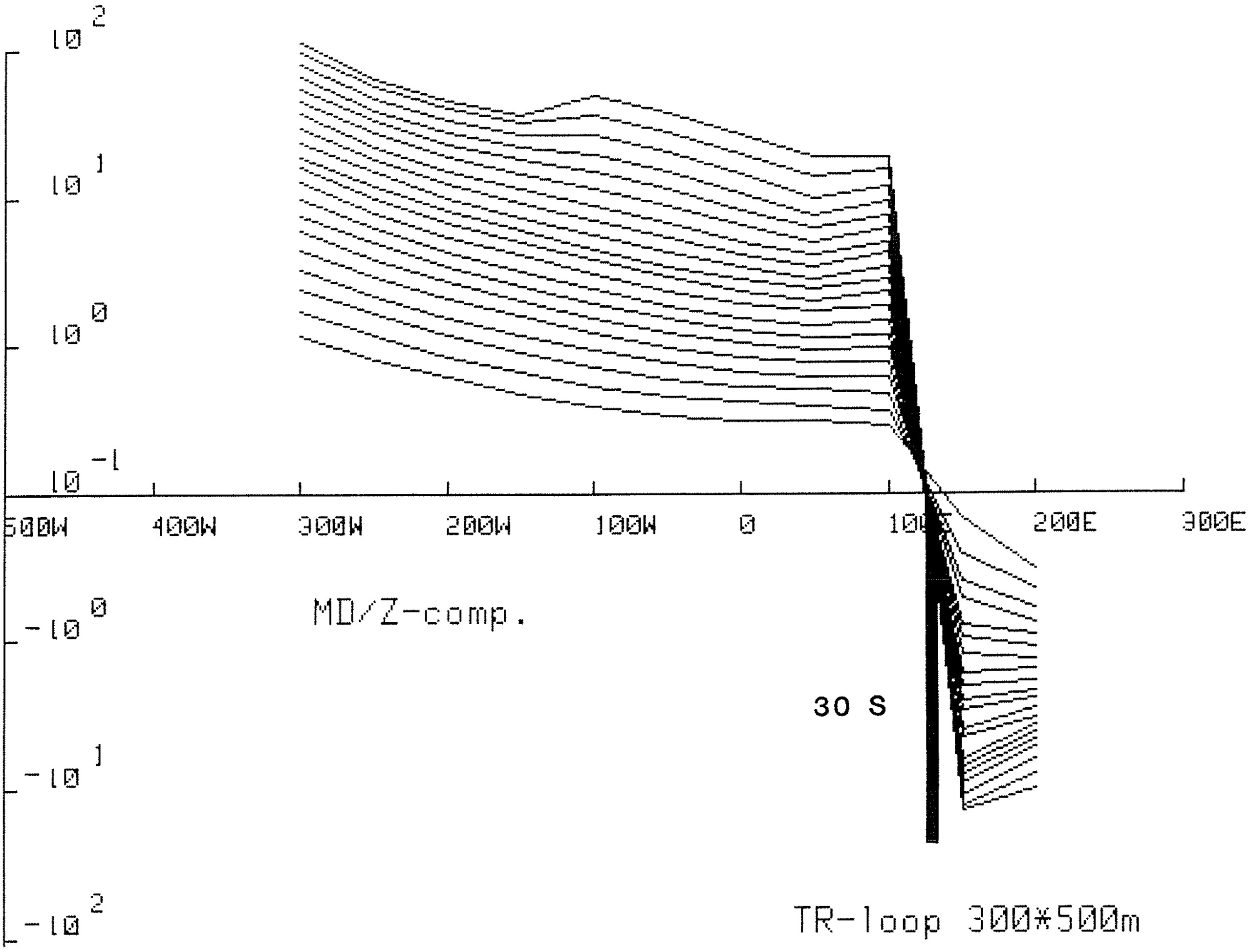
OUTOKUMPU OY Exploration	1:5000
	JL -86
BIDJOVAGGE Area 43	433
DIT-plot	App. 3/10

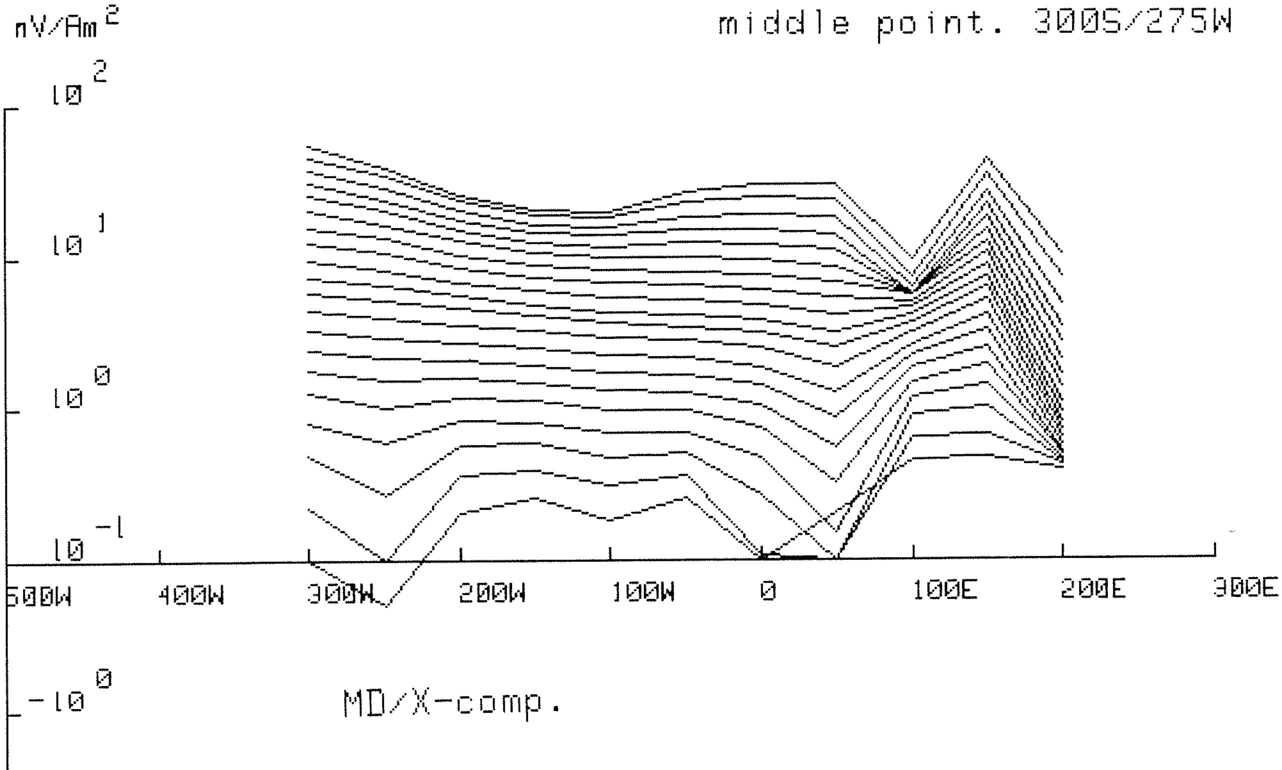
4



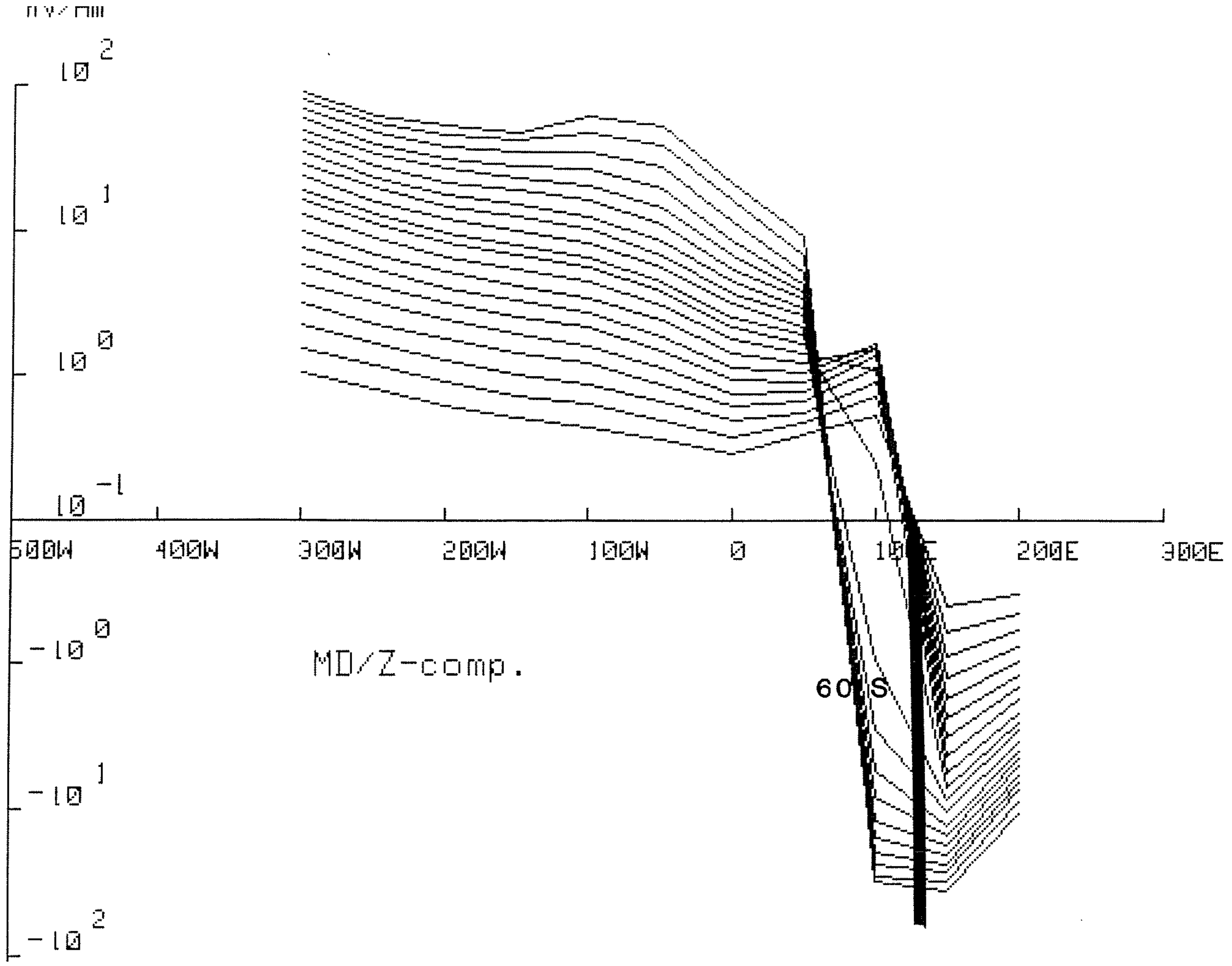


OUTOKUMPU OY Exploration	1:5000	JL -86
BIDJOVAGGE Area 43		432
TDEM-profile 500 S	App. 4/1	

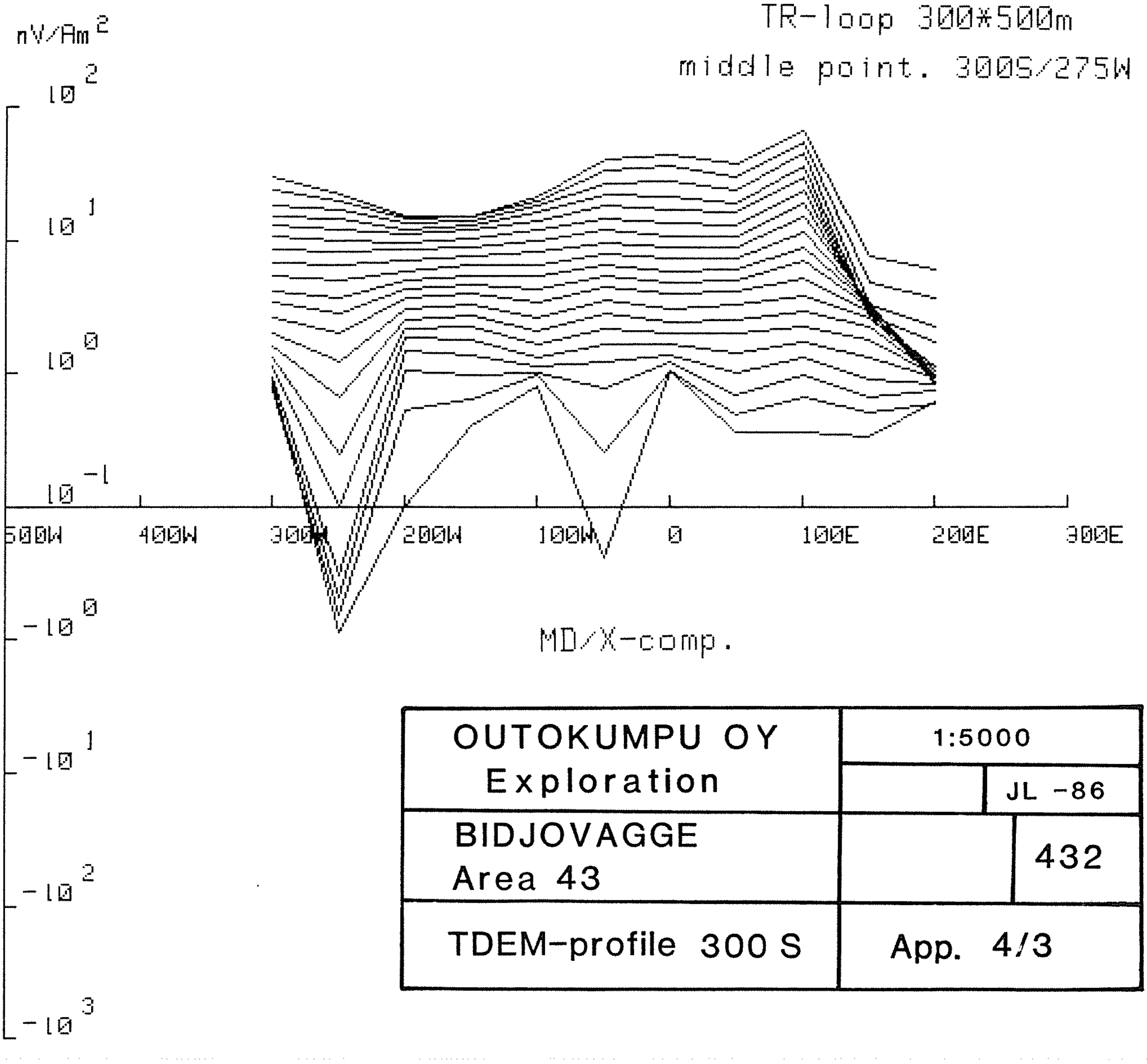




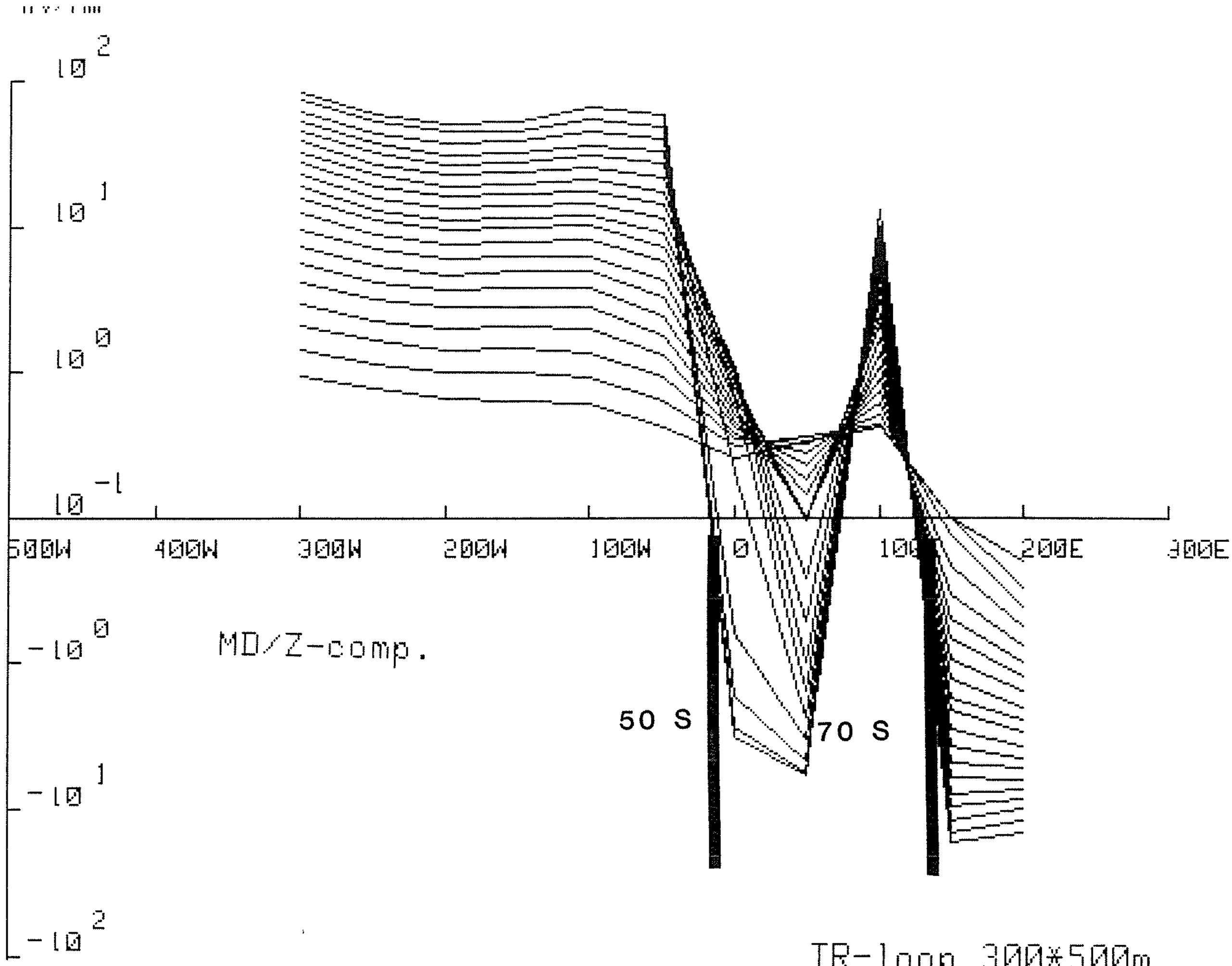
OUTOKUMPU OY Exploration	1:5000 JL -86	
BIDJOVAGGE Area 43		432
TDEM-profile 400 S	App. 4/2	



TR-loop 300*500m
middle point. 300S/275W

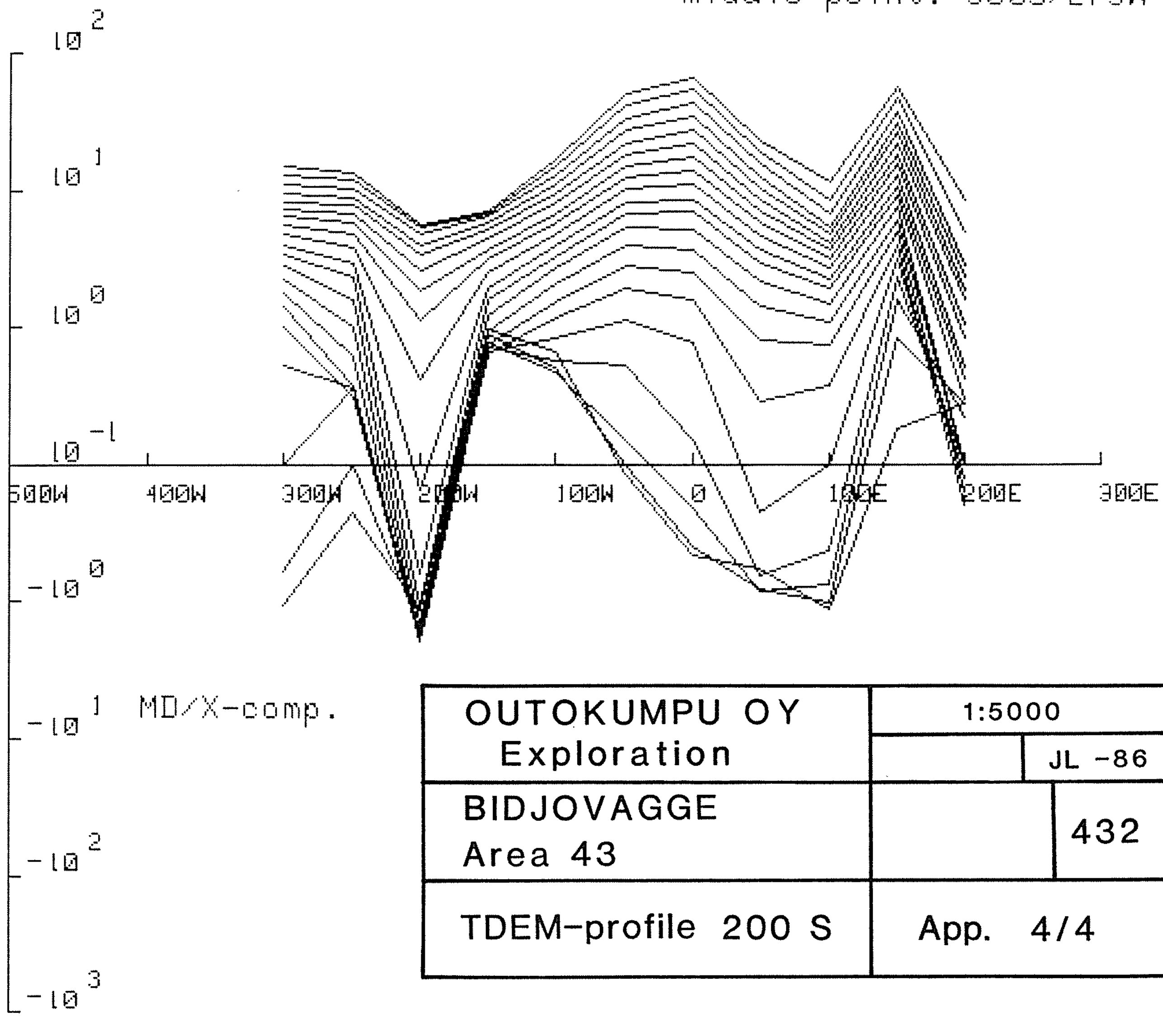


OUTOKUMPU OY Exploration	1:5000 JL -86	
BIDJOVAGGE Area 43		432
TDEM-profile 300 S	App. 4/3	

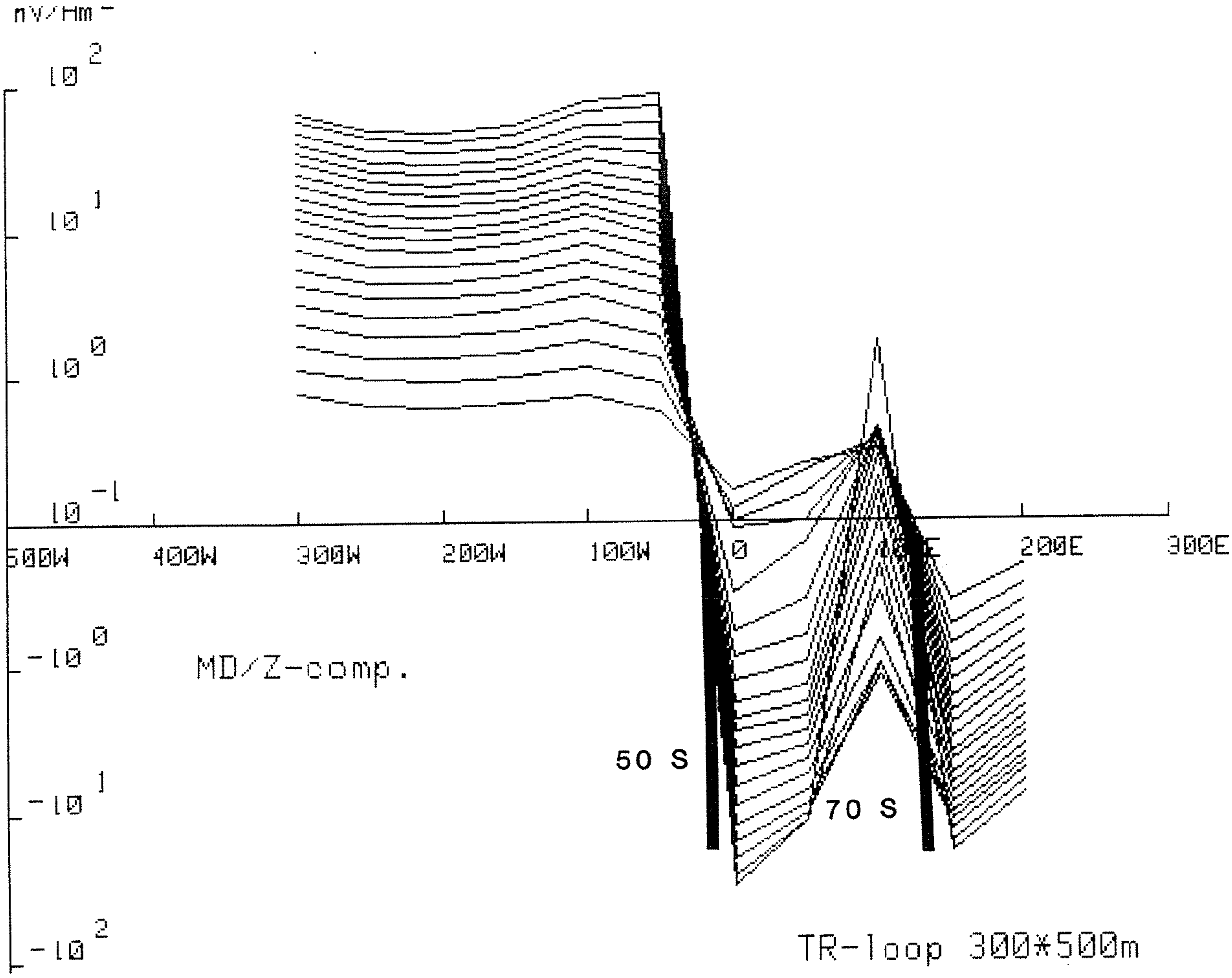


TR-loop 300*500m

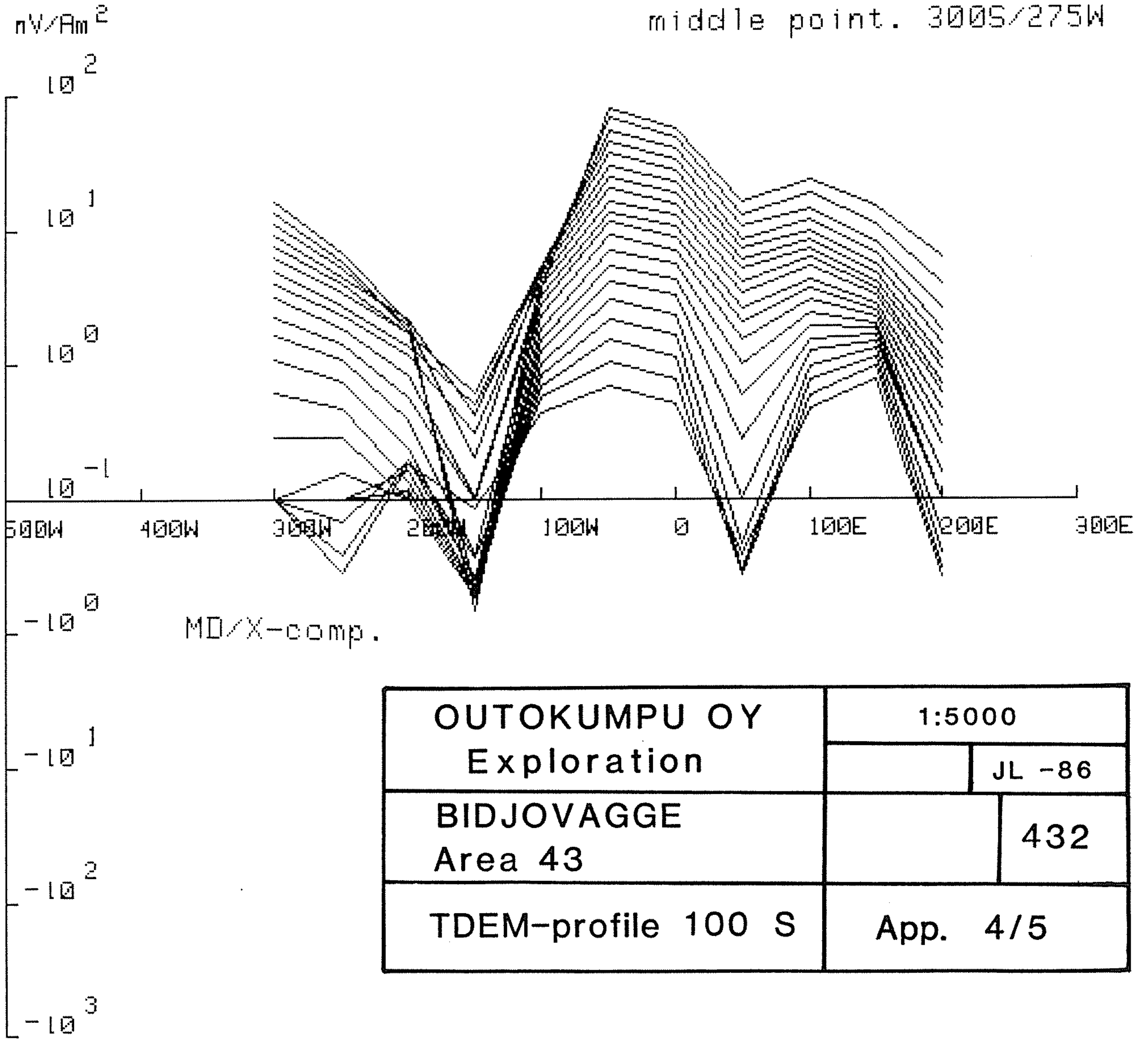
middle point. 300S/275W



OUTOKUMPU OY Exploration	1:5000	
		JL -86
BIDJOVAGGE Area 43		432
TDEM-profile 200 S	App. 4/4	



TR-loop 300*500m
middle point. 300S/275W



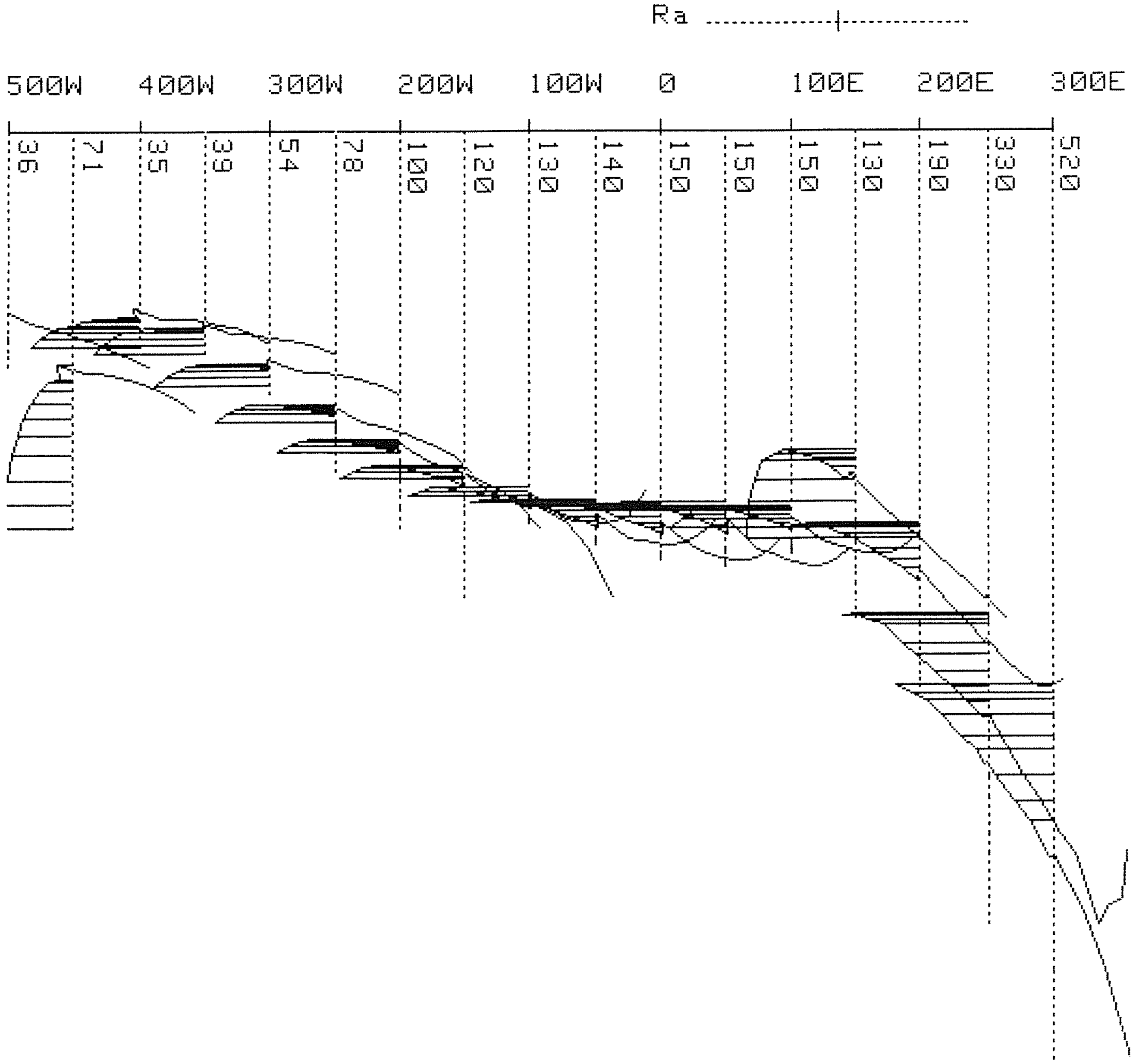
OUTOKUMPU OY Exploration	1:5000	
		JL -86
BIDJOVAGGE Area 43		432
TDEM-profile 100 S	App. 4/5	

Area 43   MIKKUJAURE 3   Prof.500S

433   EM37   MD/Z   300m * 500m   -dec.   mean   +dec.

1:5000

Ra

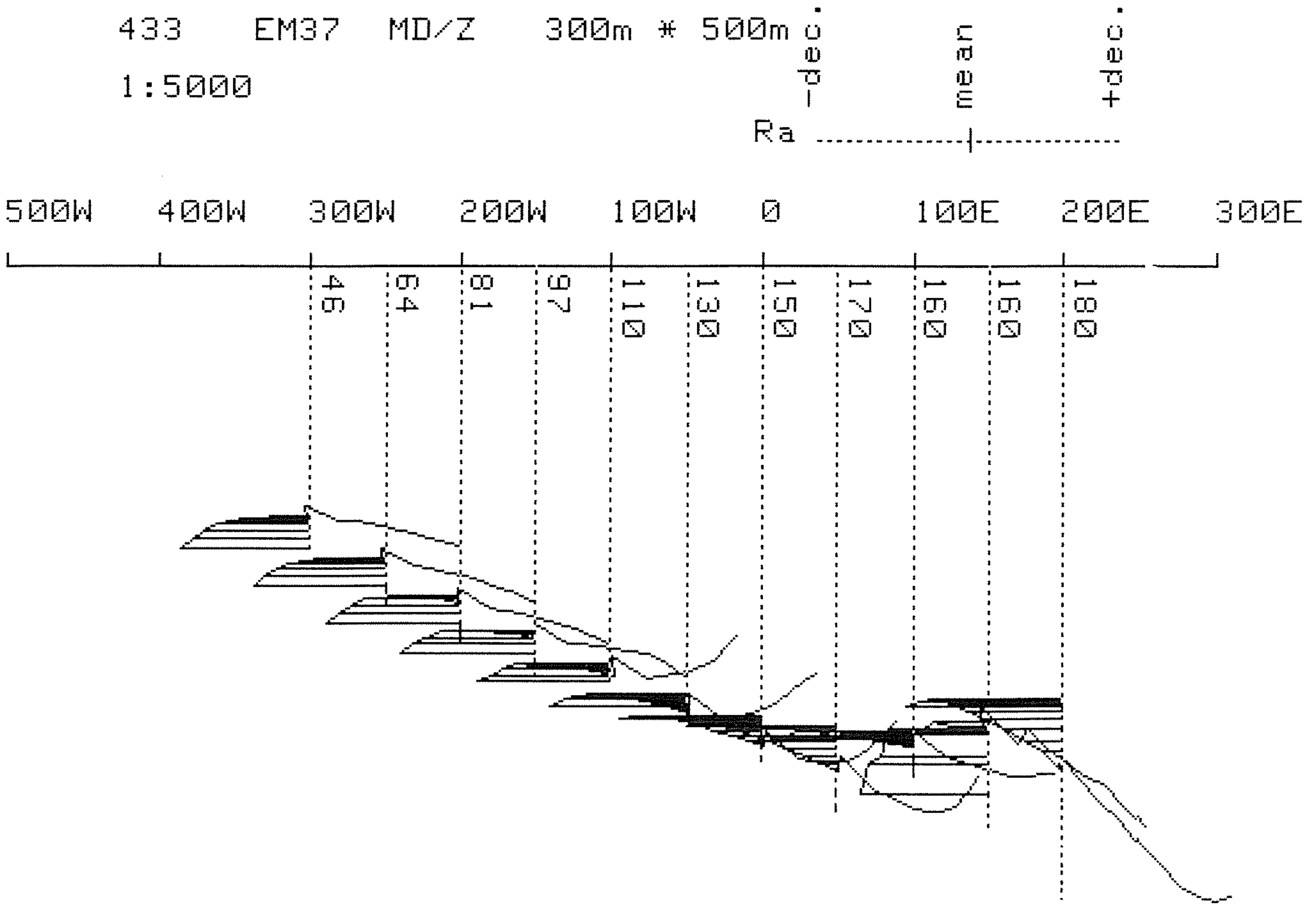


OUTOKUMPU OY Exploration	1:5000	
		JL -86
BIDJOVAGGE Area 43		433
DIT-plot	App. 4/6	

Area 43   MIKKUJAURE 3   Prof.400S

433   EM37   MD/Z   300m * 500m

1:5000

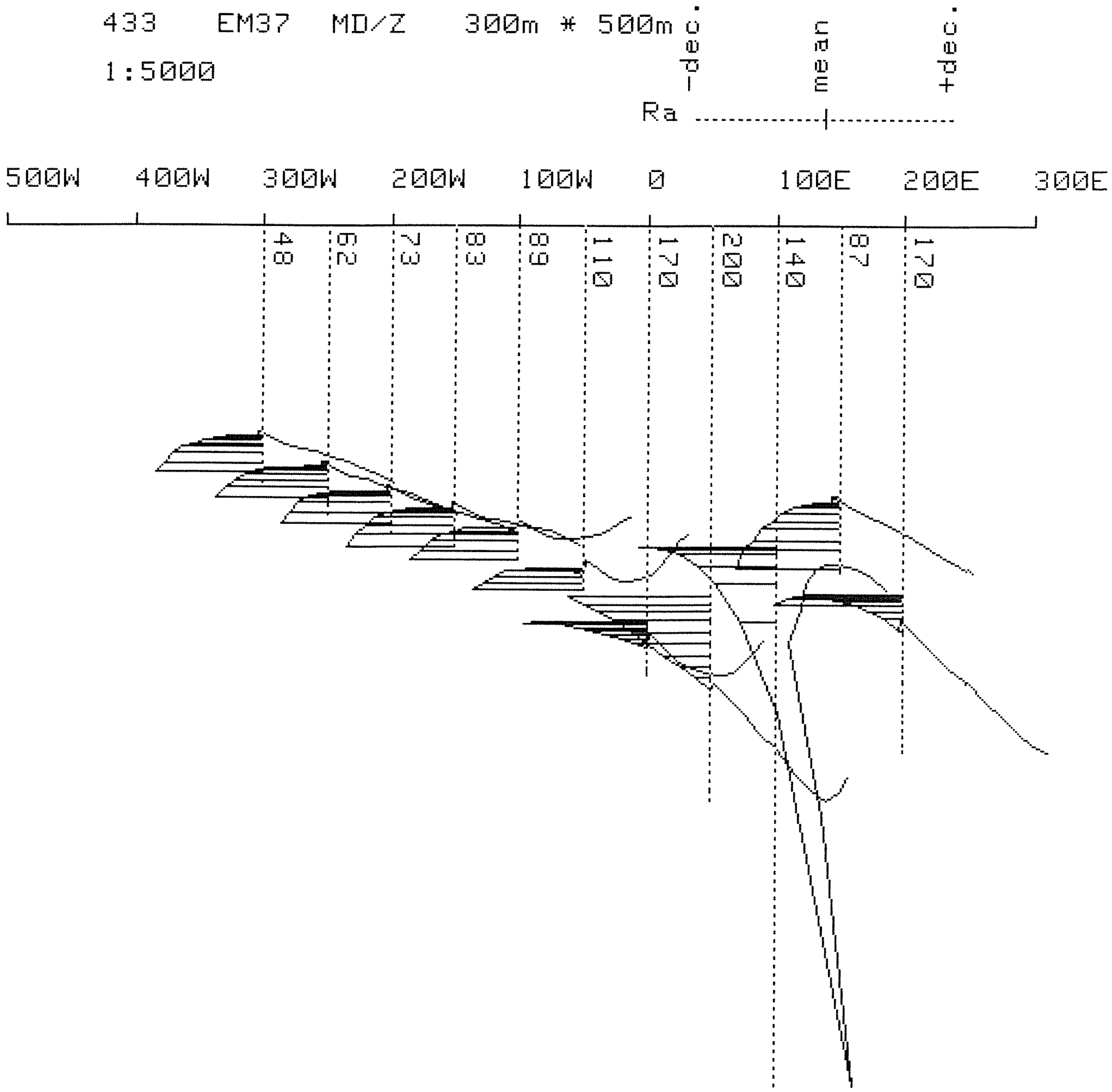


OUTOKUMPU OY Exploration	1:5000	
		JL -86
BIDJOVAGGE Area 43		433
DIT-plot	App. 4/7	

Area 43 MIKKUJAURE 3 Prof.300S

433 EM37 MD/Z 300m * 500m

1:5000

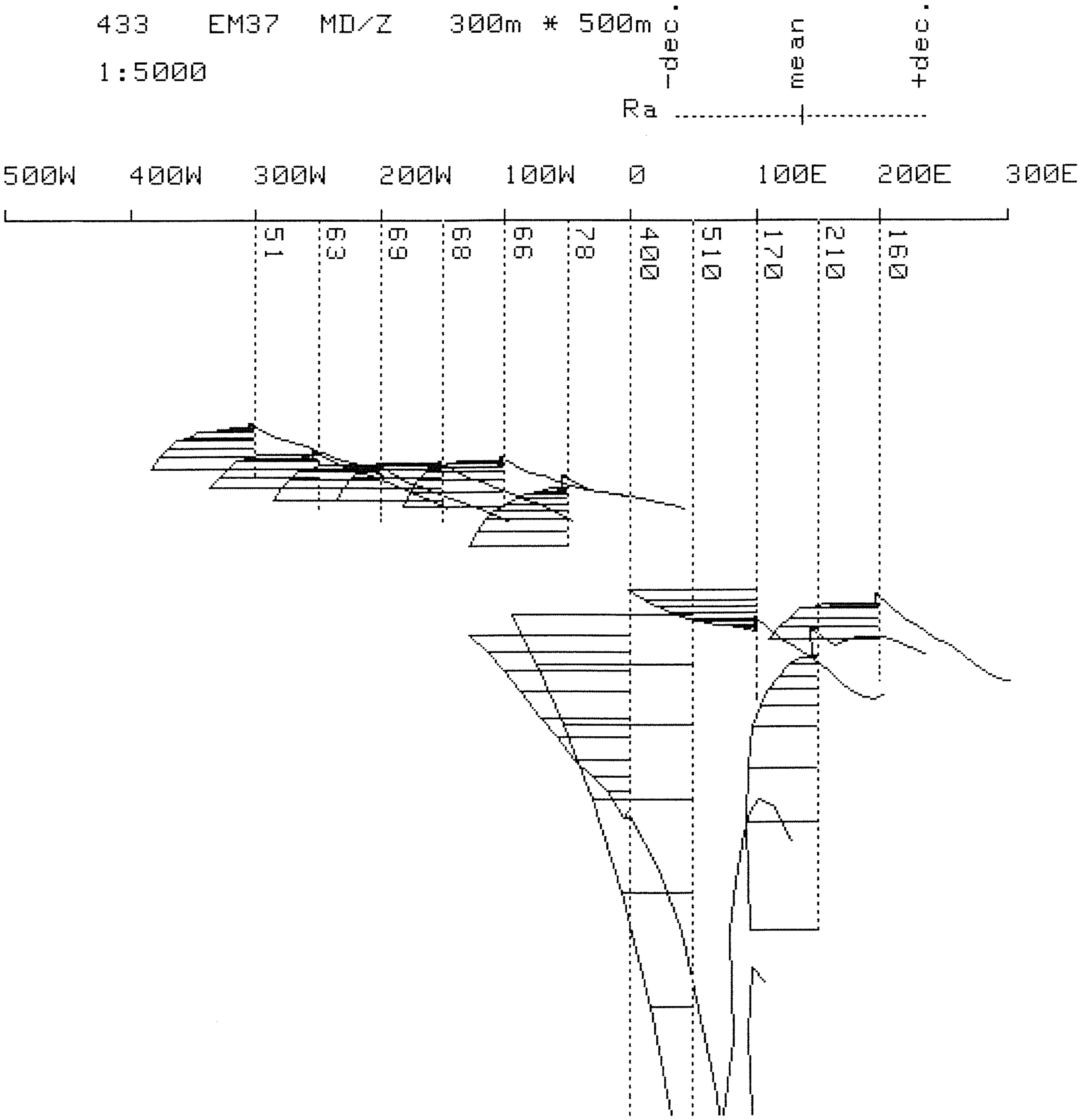


OUTOKUMPU OY Exploration	1:5000	
		JL -86
BIDJOVAGGE Area 43		433
DIT-plot	App. 4/8	

Area 43 MIKKUJAURE 3 Prof.200S

433 EM37 MD/Z 300m * 500m

1:5000

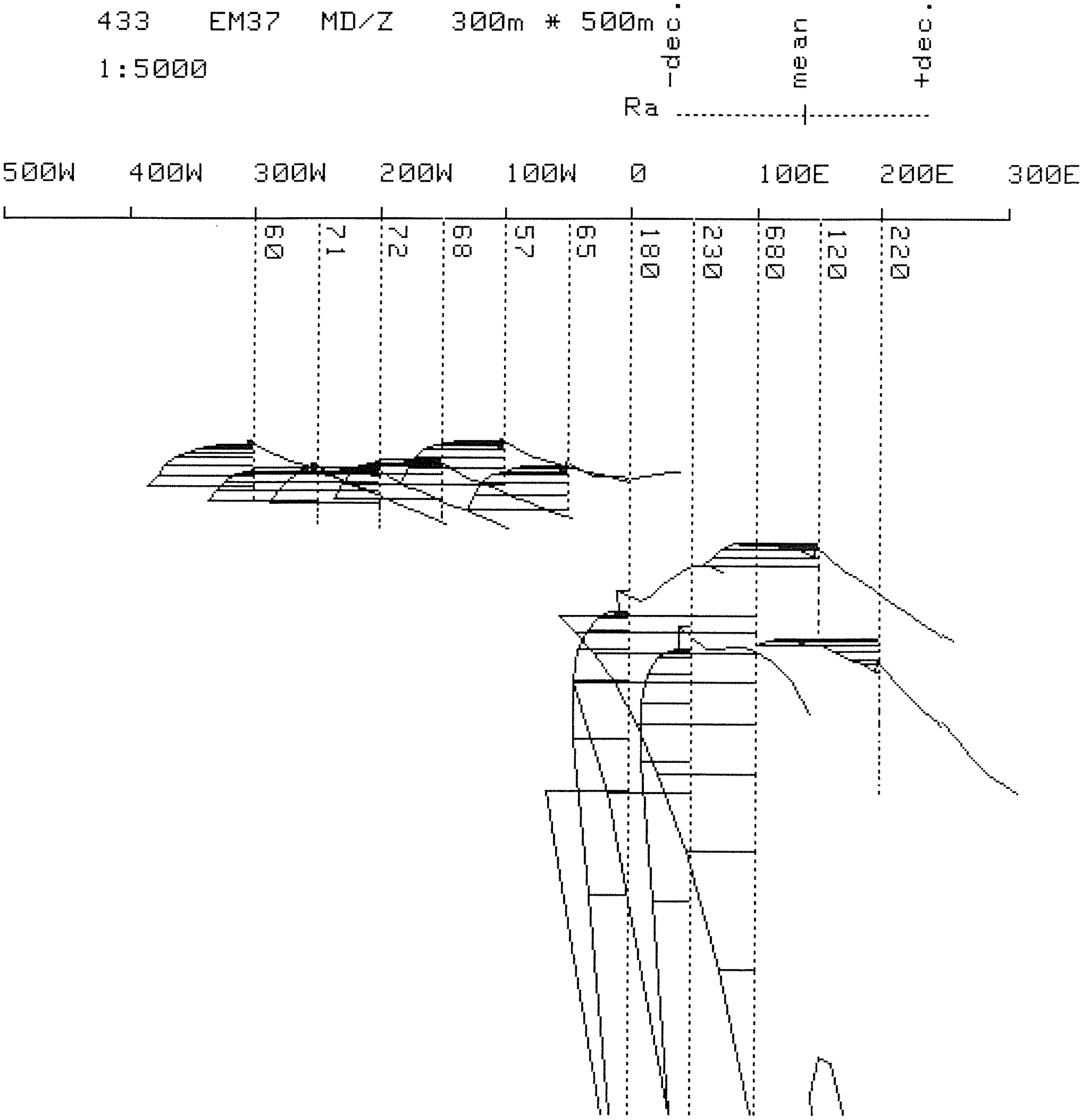


OUTOKUMPU OY Exploration	1:5000 JL -86	
BIDJOVAGGE Area 43		433
DIT-plot	App. 4/9	

Area 43 MIKKUJAURE 3 Prof.100S

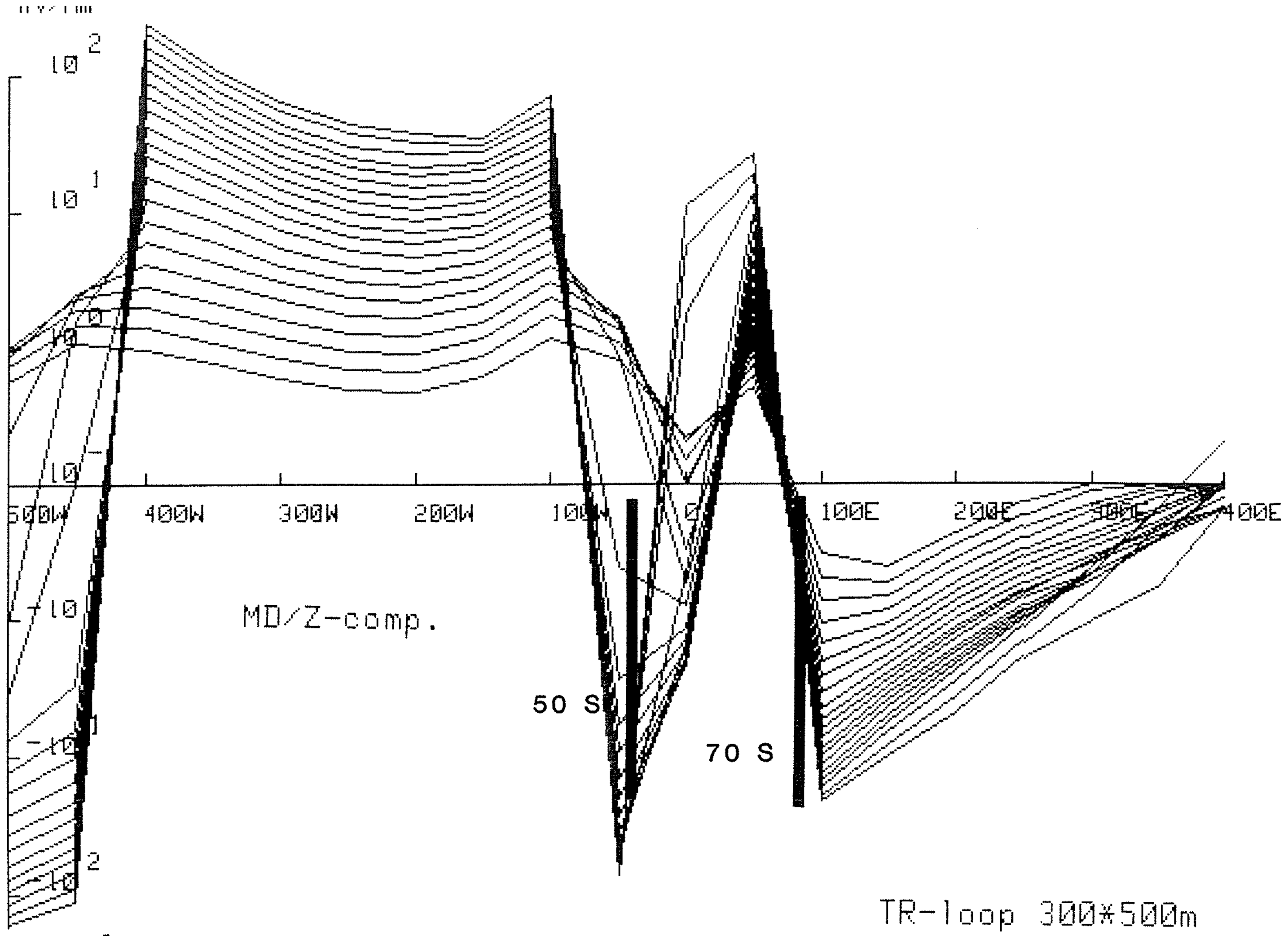
433 EM37 MD/Z 300m * 500m

1:5000

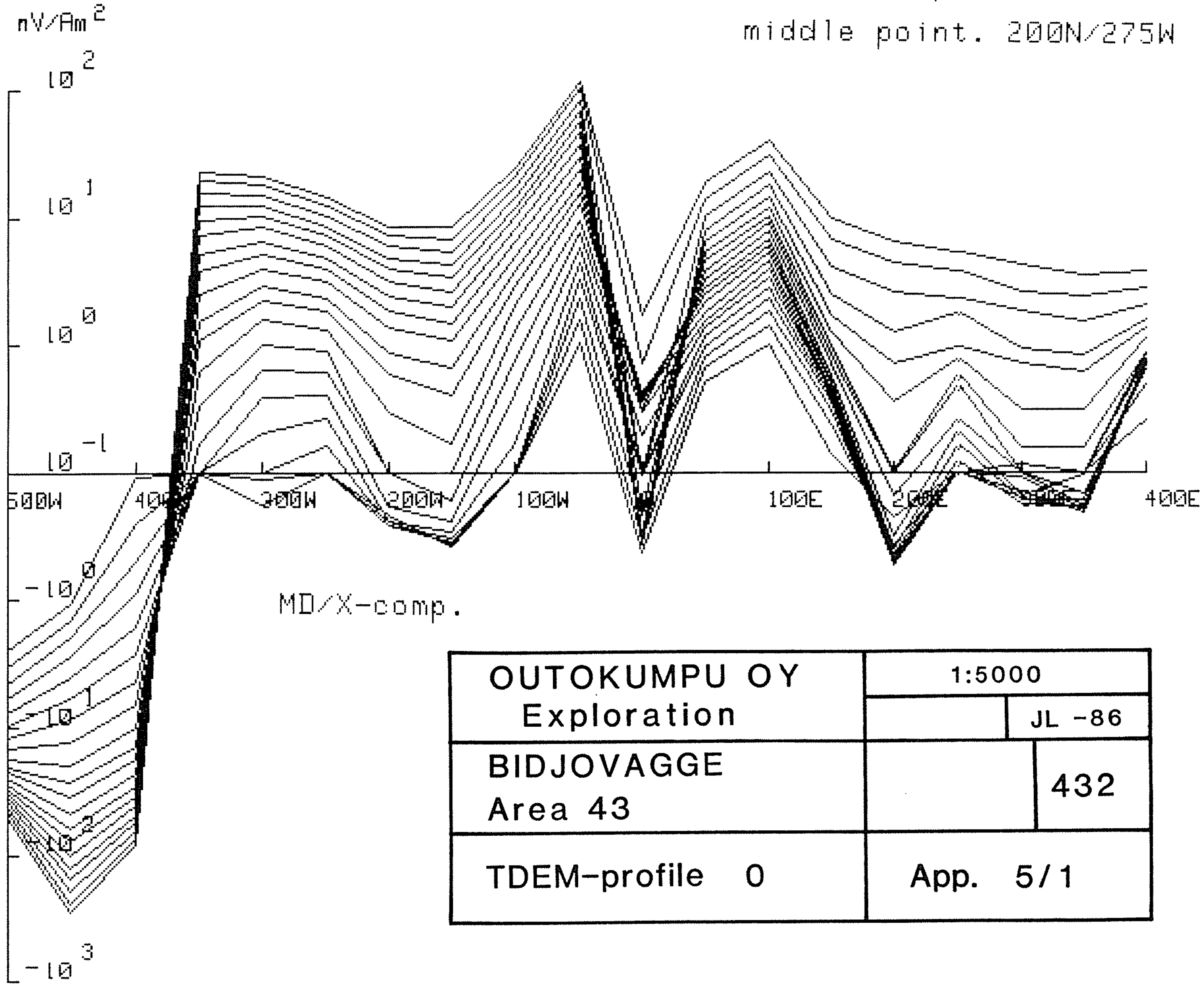


OUTOKUMPU OY Exploration	1:5000	
		JL -86
BIDJOVAGGE Area 43		433
DIT-plot	App. 4/10	

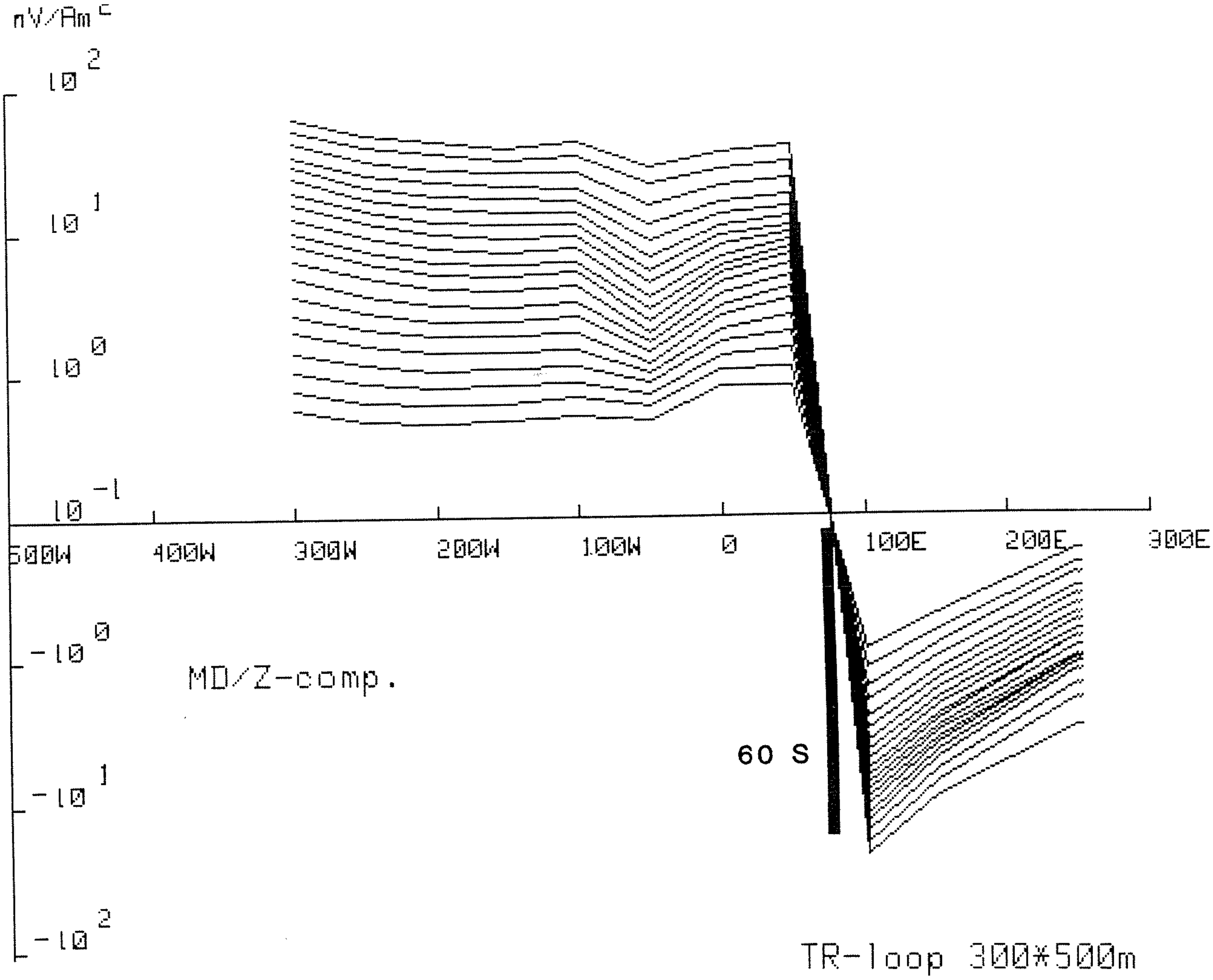
5



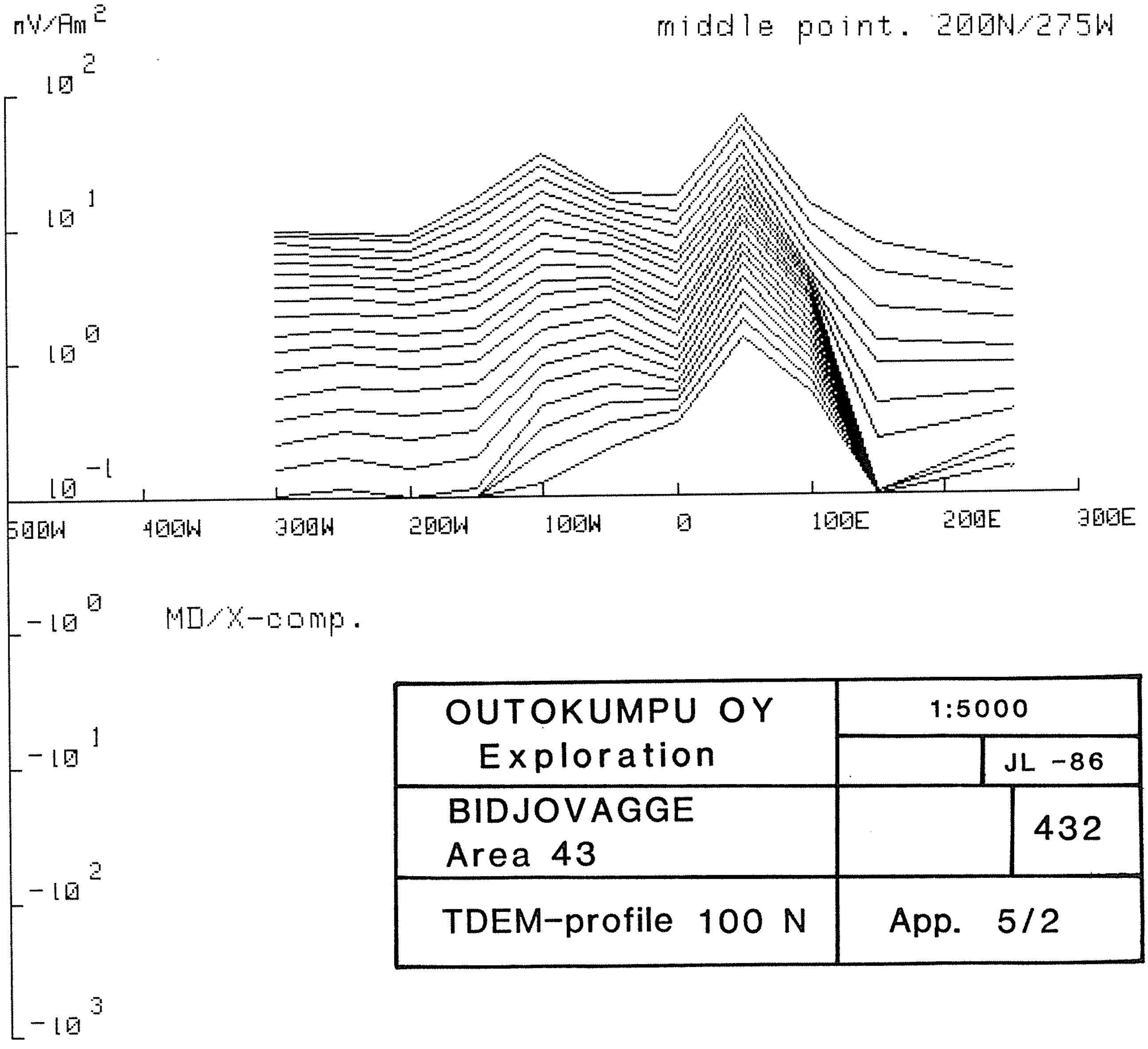
TR-loop 300*500m
middle point. 200N/275W



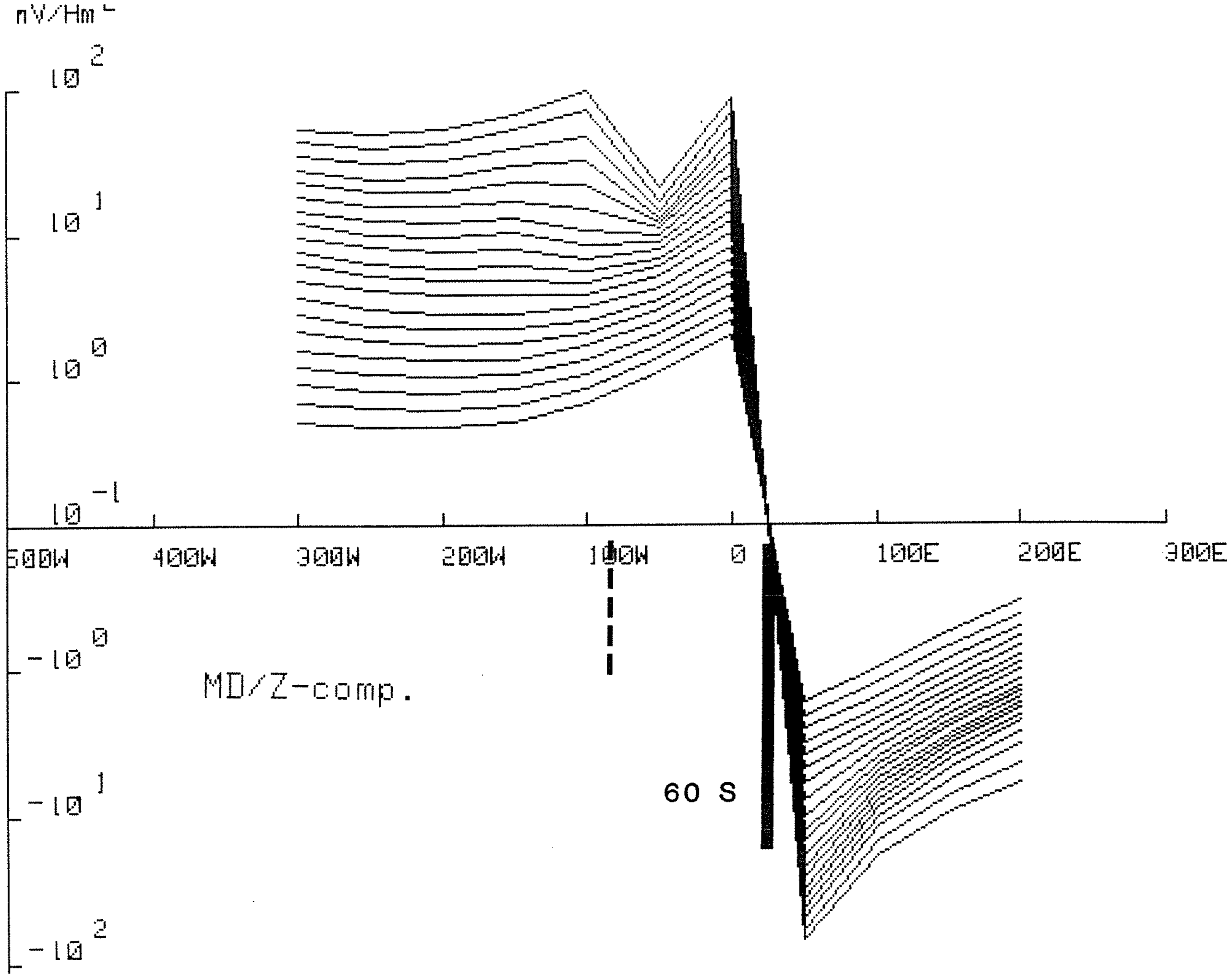
OUTOKUMPU OY Exploration	1:5000	JL -86
BIDJOVAGGE Area 43		432
TDEM-profile 0	App. 5/1	



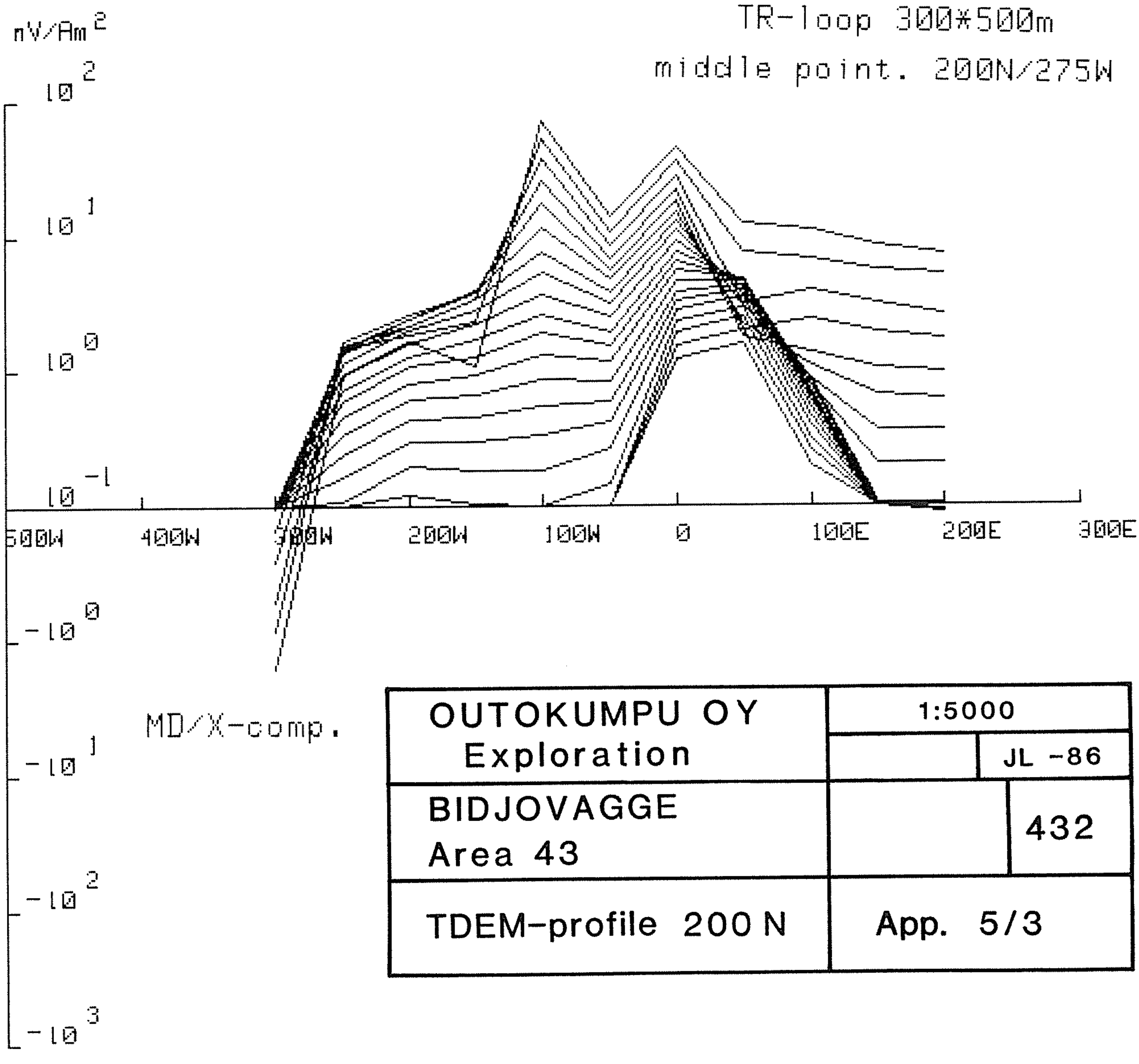
TR-loop 300*500m
middle point. 200N/275W



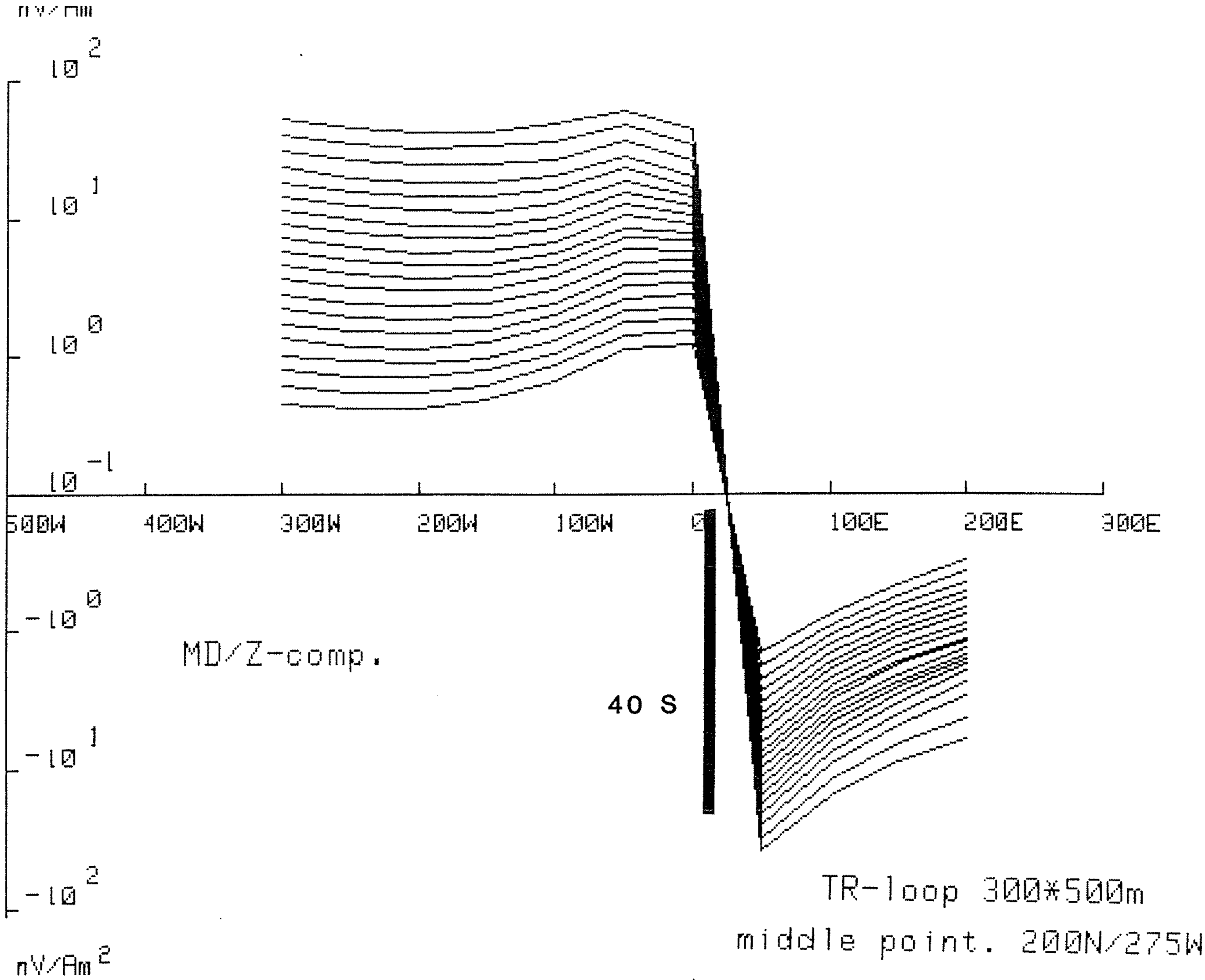
OUTOKUMPU OY Exploration	1:5000 JL -86	
BIDJOVAGGE Area 43		432
TDEM-profile 100 N	App. 5/2	

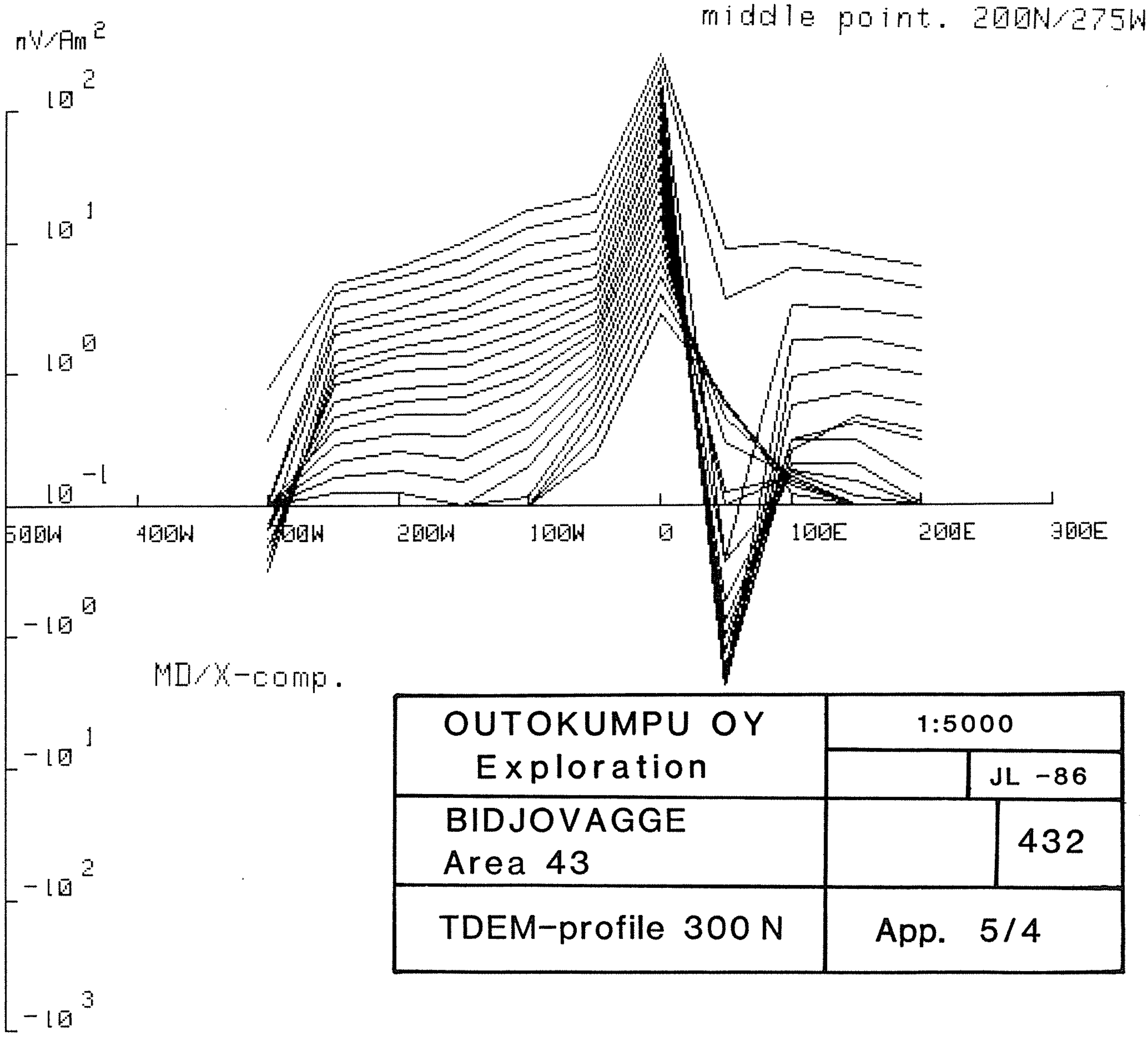


TR-loop 300*500m
middle point. 200N/275W

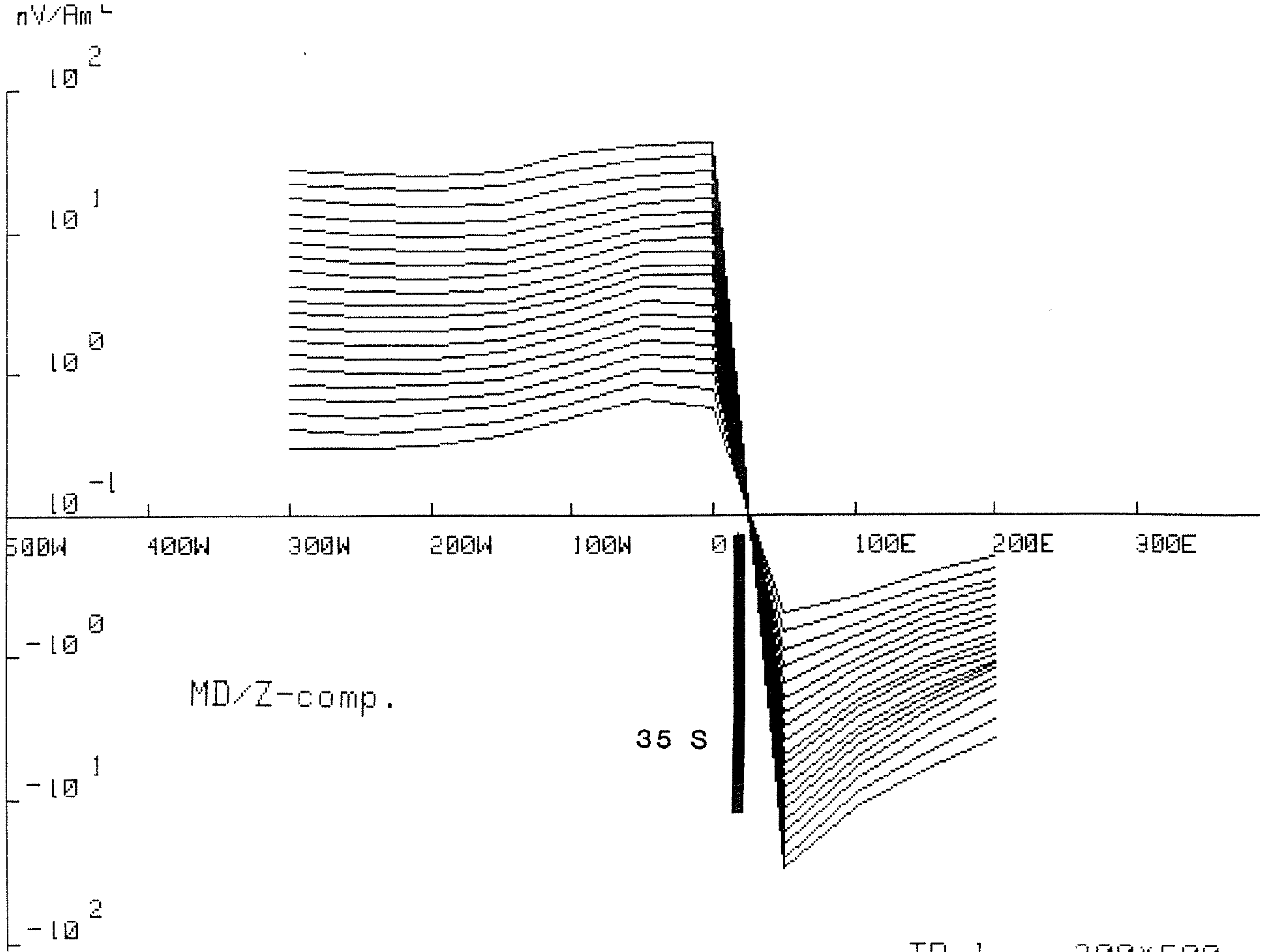


OUTOKUMPU OY Exploration	1:5000	
		JL -86
BIDJOVAGGE Area 43		432
TDEM-profile 200 N	App. 5/3	

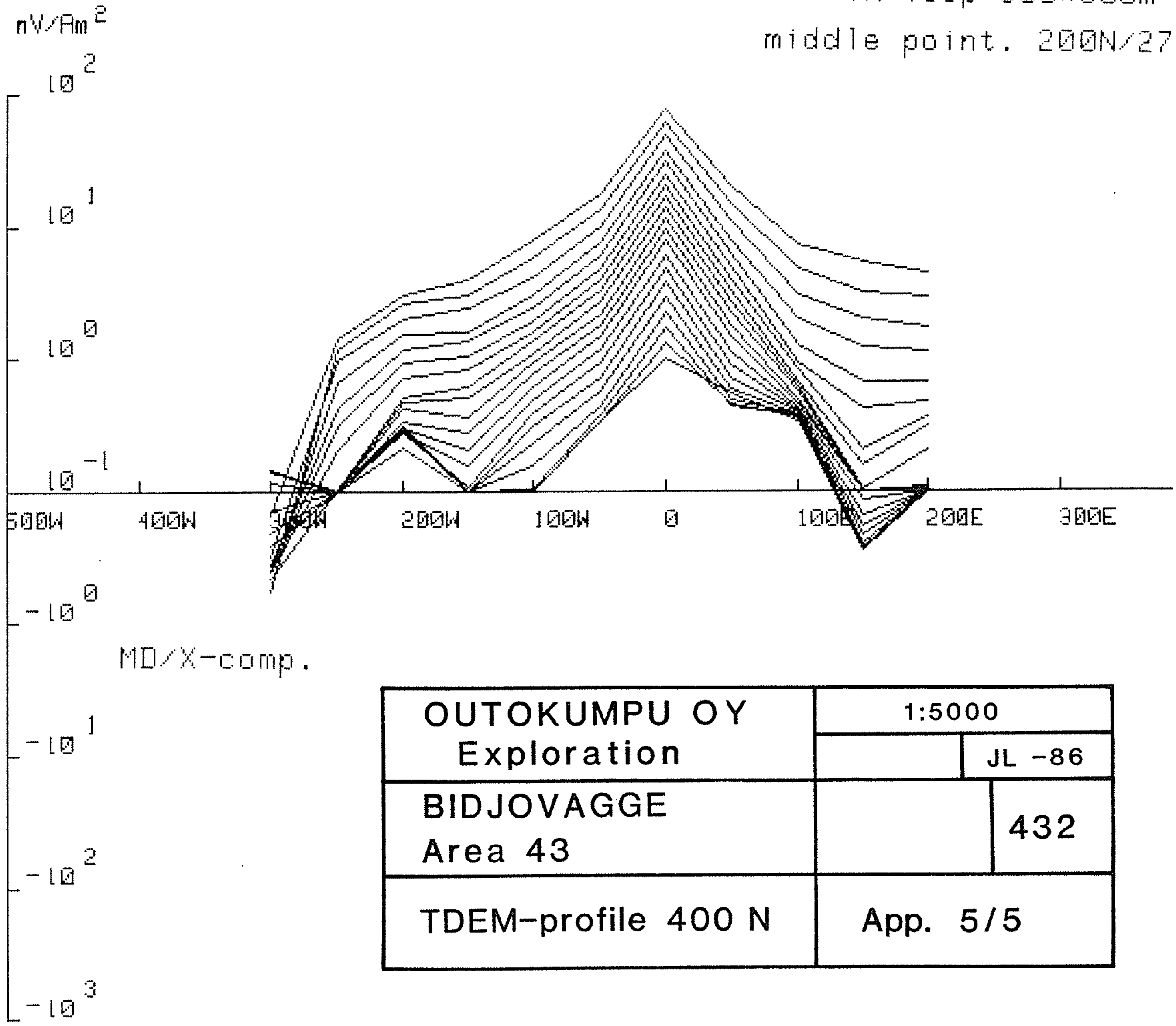




OUTOKUMPU OY Exploration	1:5000	
		JL -86
BIDJOVAGGE Area 43		432
TDEM-profile 300 N	App. 5/4	



TR-loop 300*500m
middle point. 200N/27

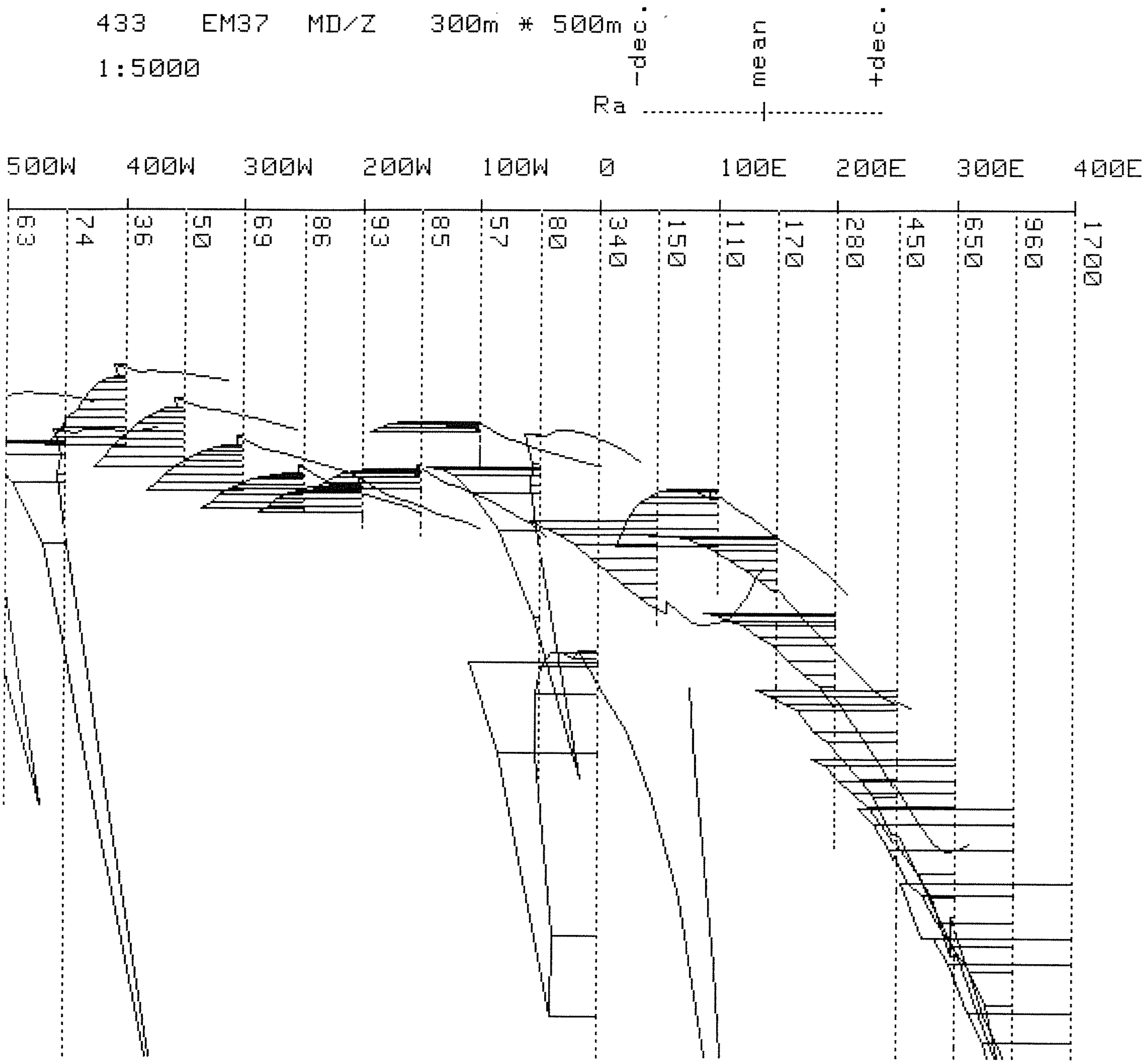


OUTOKUMPU OY Exploration	1:5000	
		JL -86
BIDJOVAGGE Area 43		432
TDEM-profile 400 N	App. 5/5	

Area 43 MIKKUJAURE 4 Prof.0

433 EM37 MD/Z 300m * 500m

1:5000

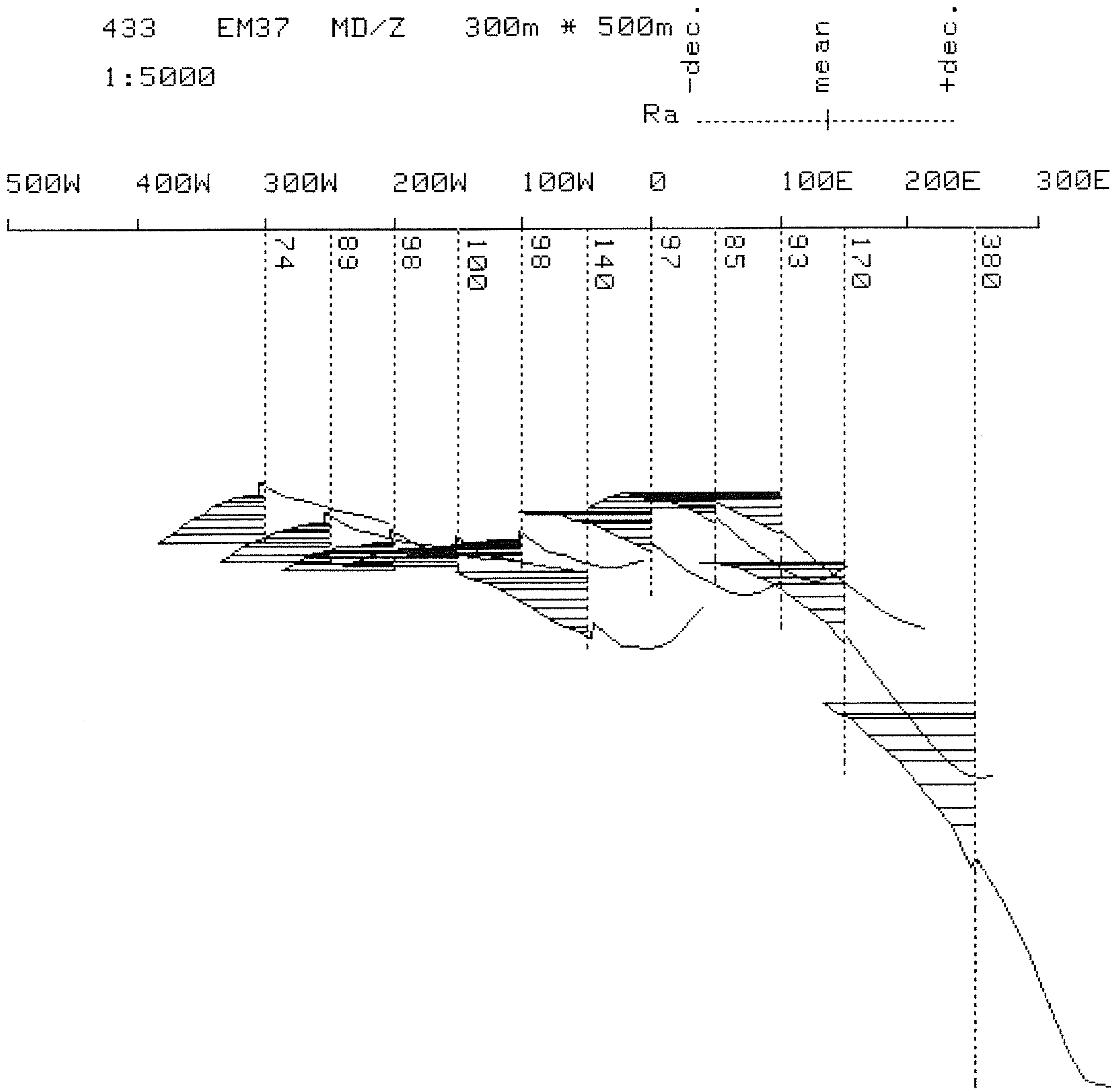


OUTOKUMPU OY Exploration	1:5000	
		JL -86
BIDJOVAGGE Area 43		433
DIT-plot	App. 5/6	

Area 43 MIKKUJAURE 4 Prof.100N

433 EM37 MD/Z 300m * 500m

1:5000

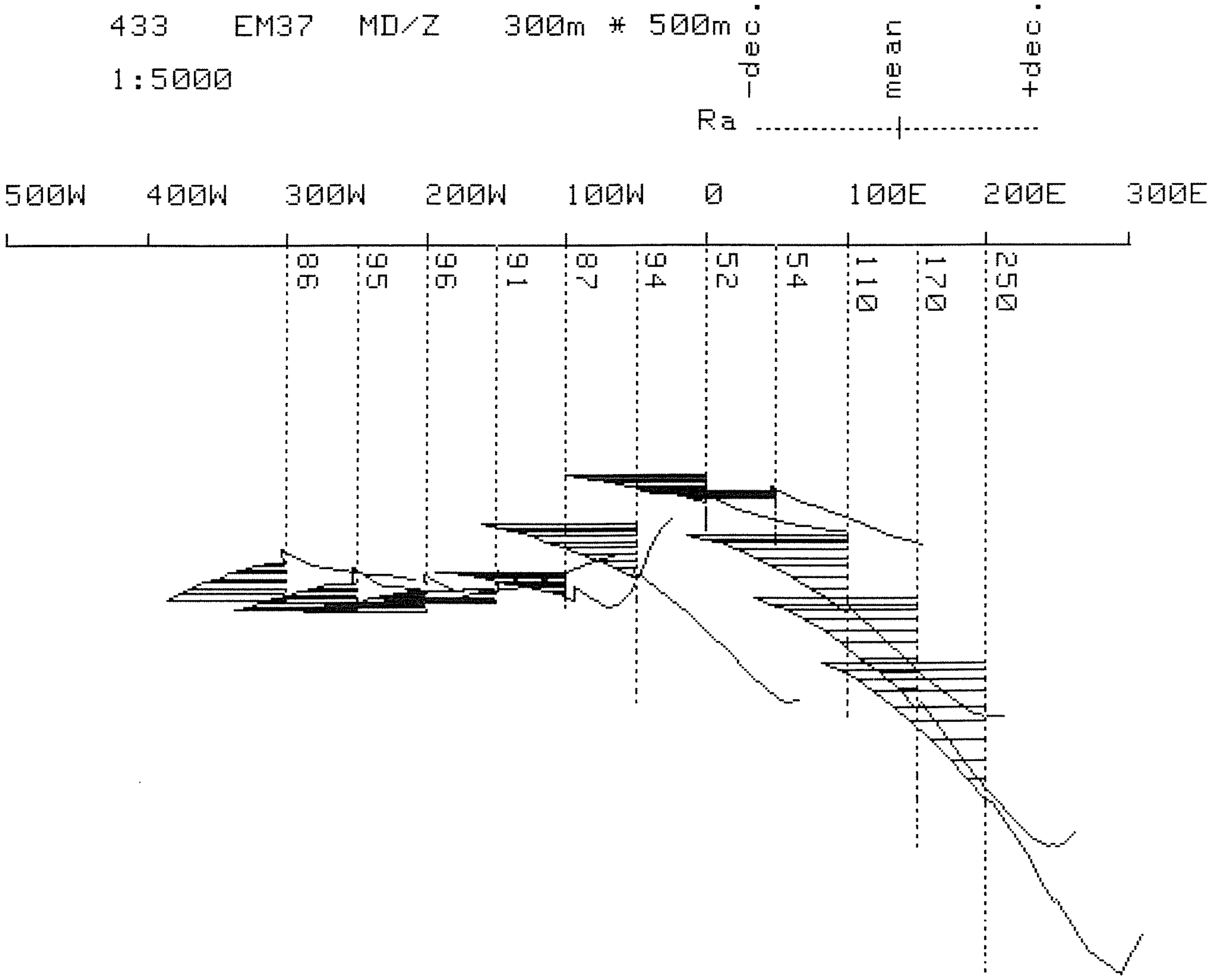


OUTOKUMPU OY Exploration	1:5000	
		JL -86
BIDJOVAGGE Area 43		433
DIT-plot	App. 5/7	

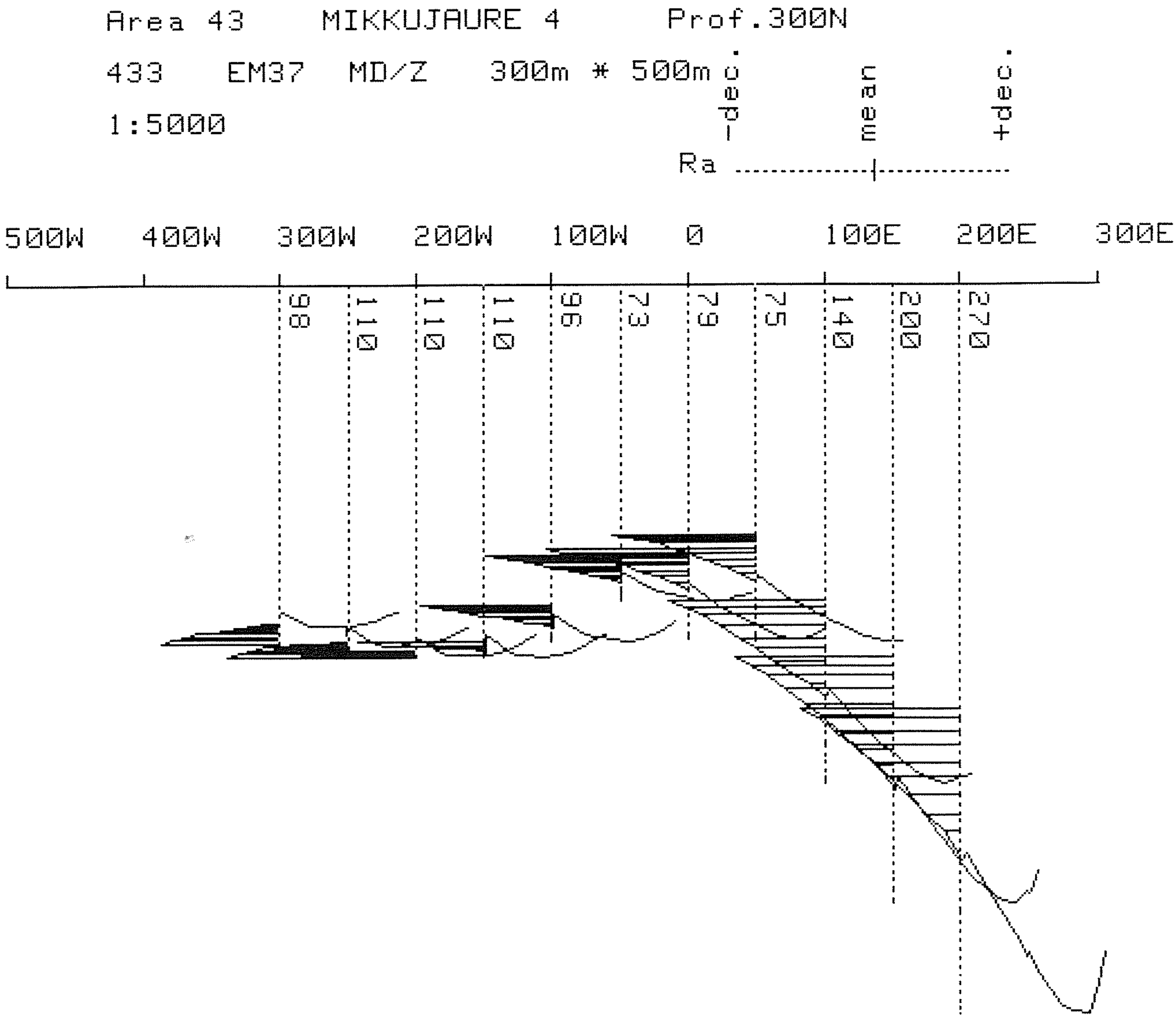
Area 43   MIKKUJAURE 4   Prof.200N

433   EM37   MD/Z   300m * 500m

1:5000



OUTOKUMPU OY Exploration	1:5000	
		JL -86
BIDJOVAGGE Area 43		433
DIT-plot	App. 5/8	

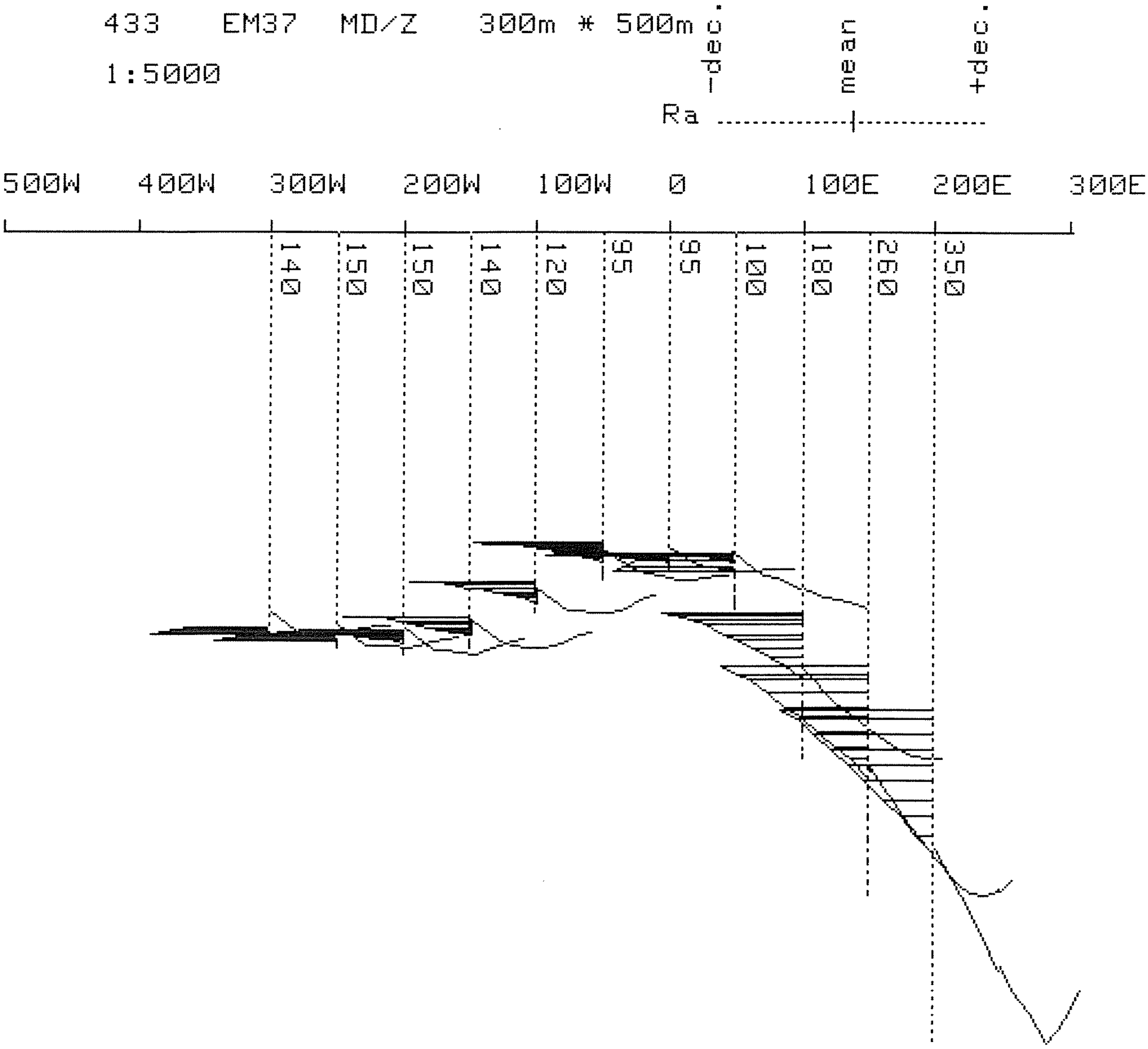


OUTOKUMPU OY Exploration	1:5000	JL -86
BIDJOVAGGE Area 43		433
DIT-plot	App. 5/9	

Area 43 MIKKUJAURE 4 Prof.400N

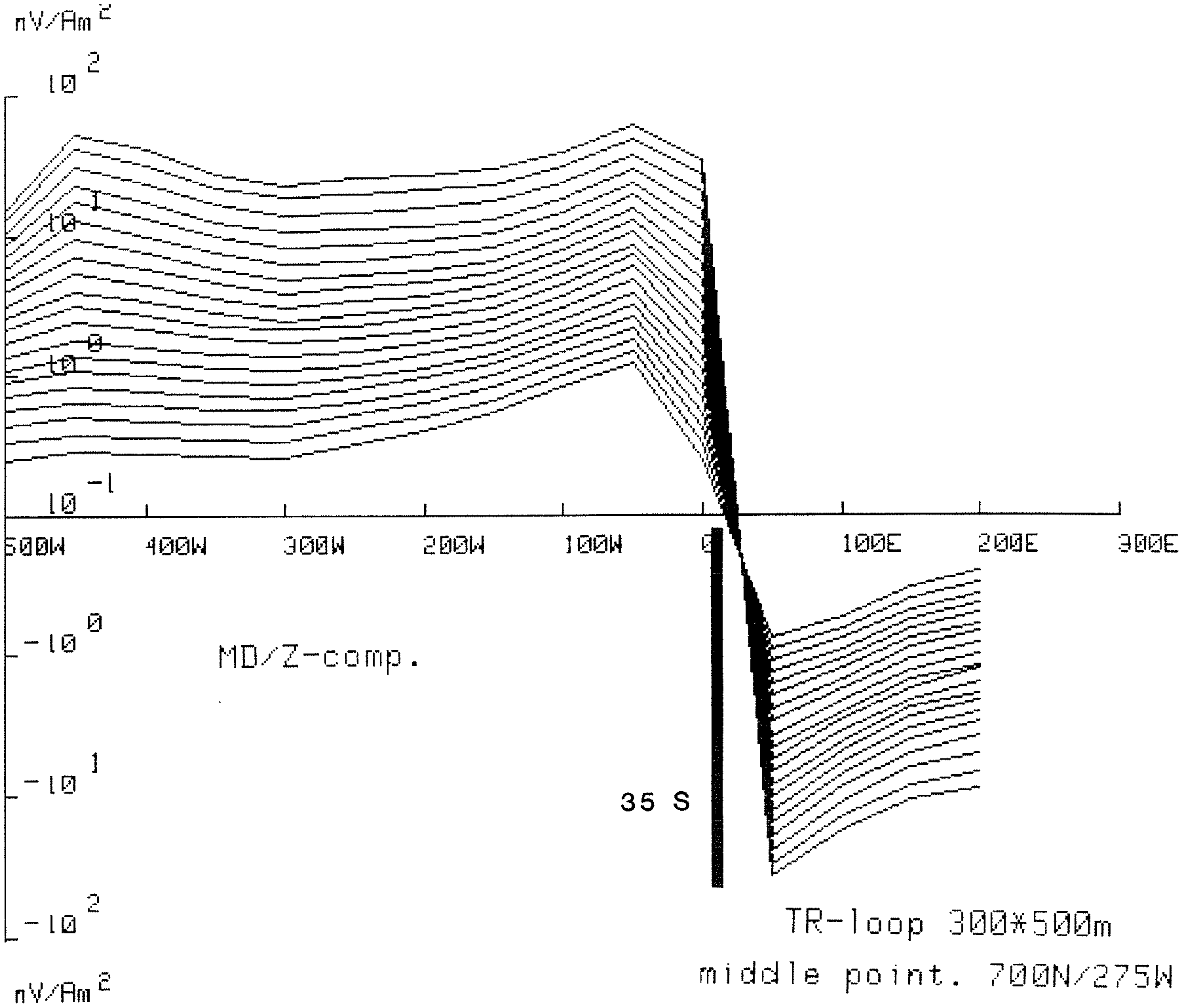
433 EM37 MD/Z 300m * 500m

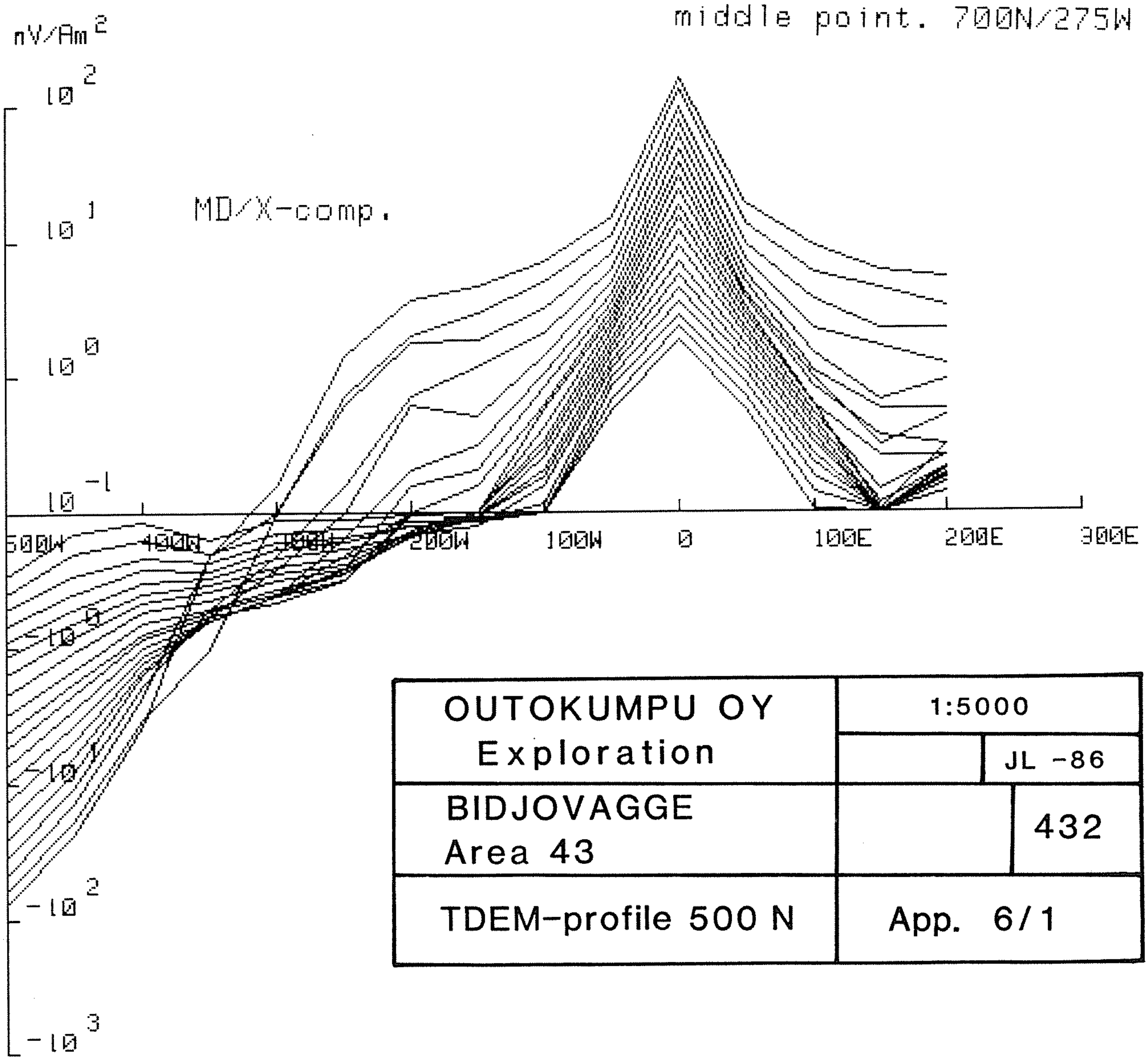
1:5000



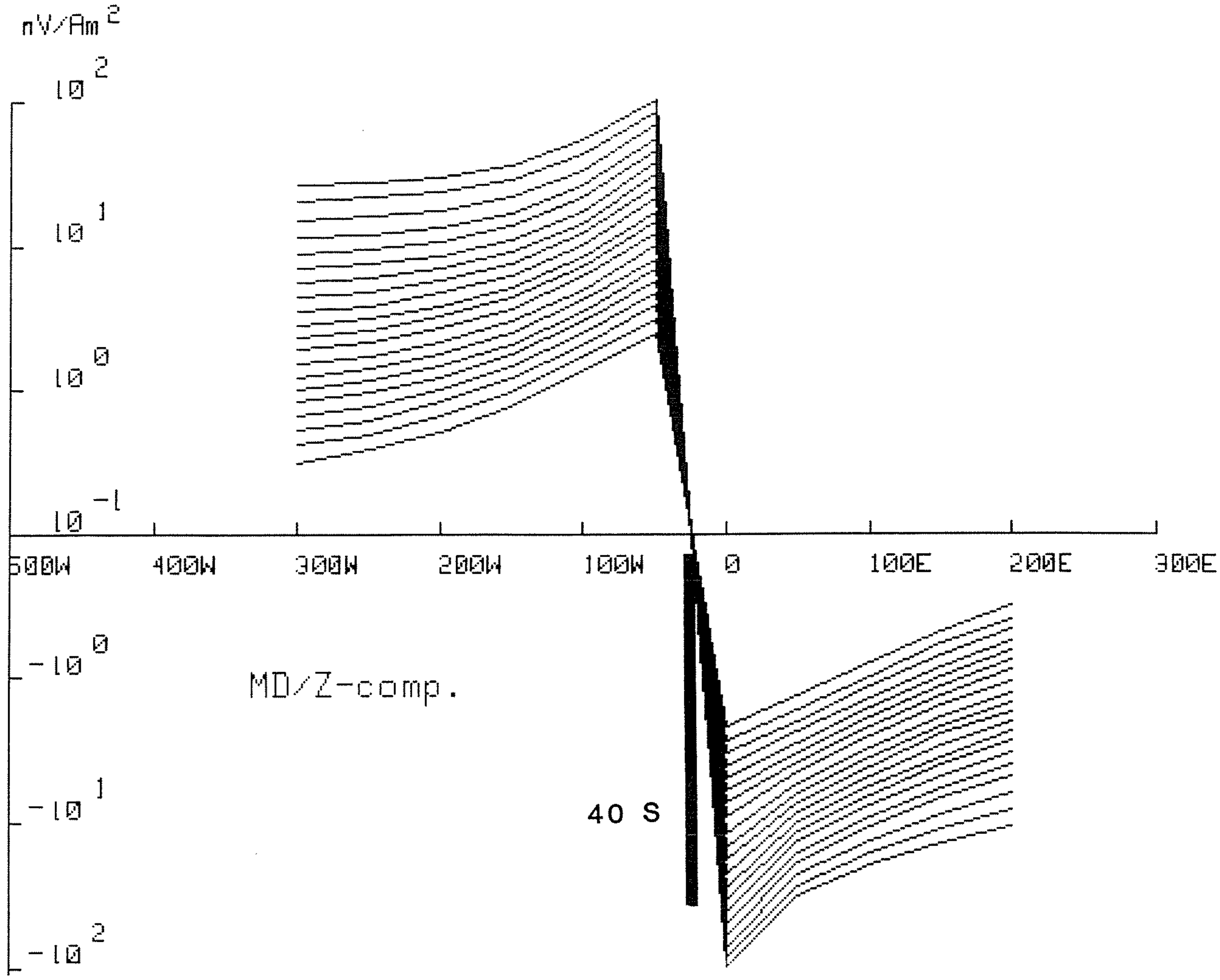
OUTOKUMPU OY Exploration	1:5000	
		JL -86
BIDJOVAGGE Area 43		433
DIT-plot	App. 5/10	

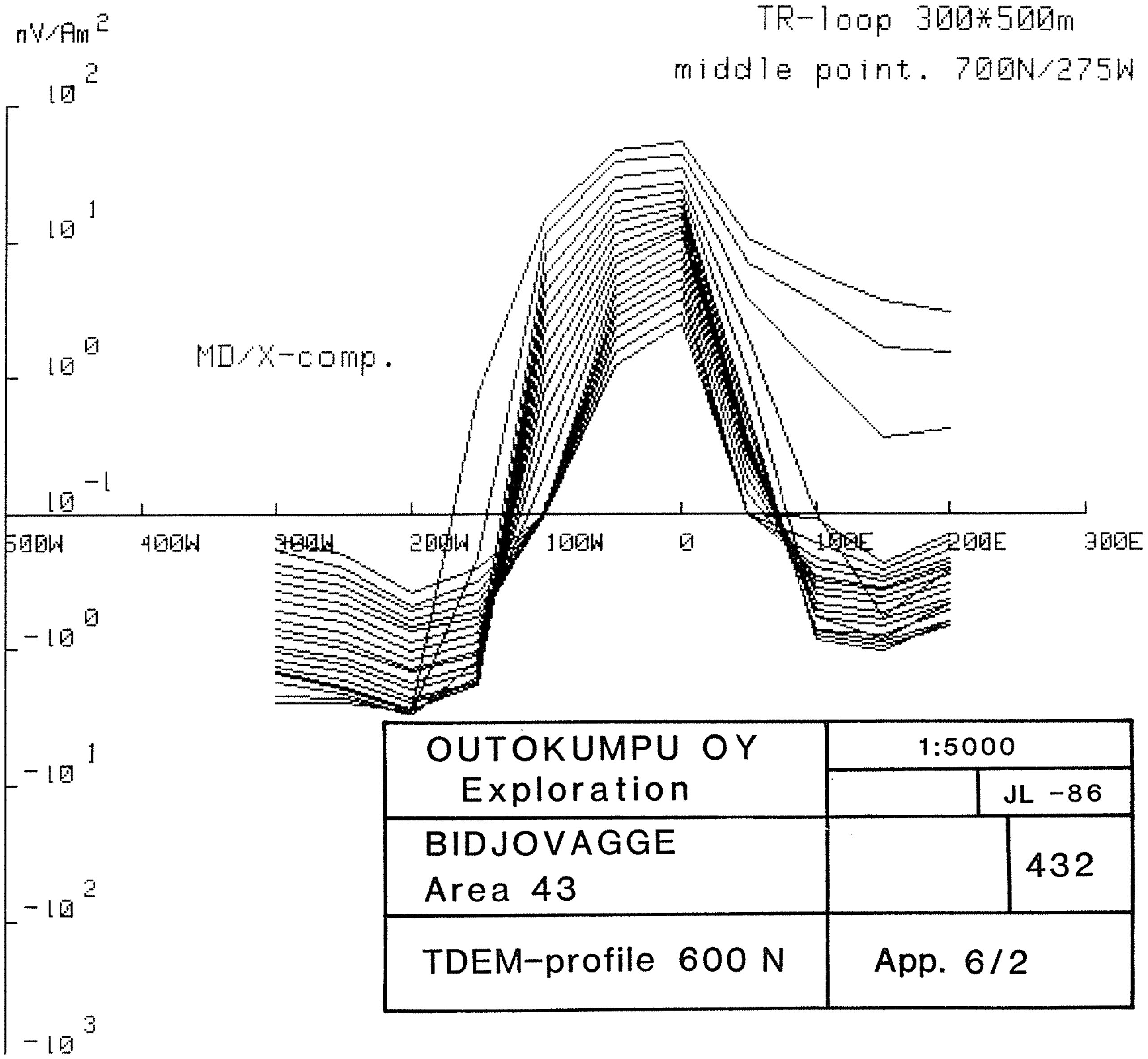
6



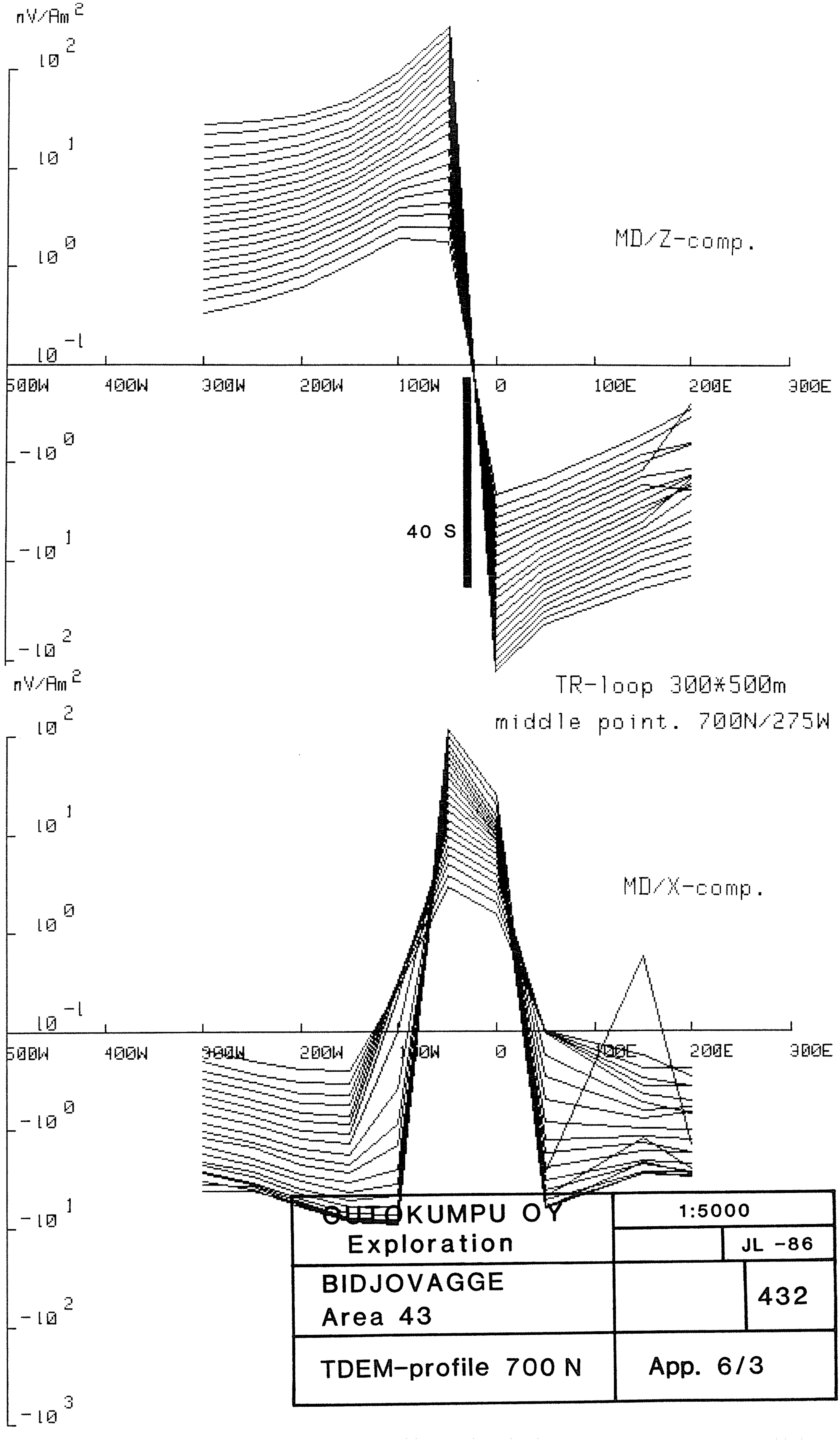


OUTOKUMPU OY Exploration	1:5000	
		JL -86
BIDJOVAGGE Area 43		432
TDEM-profile 500 N	App. 6/1	

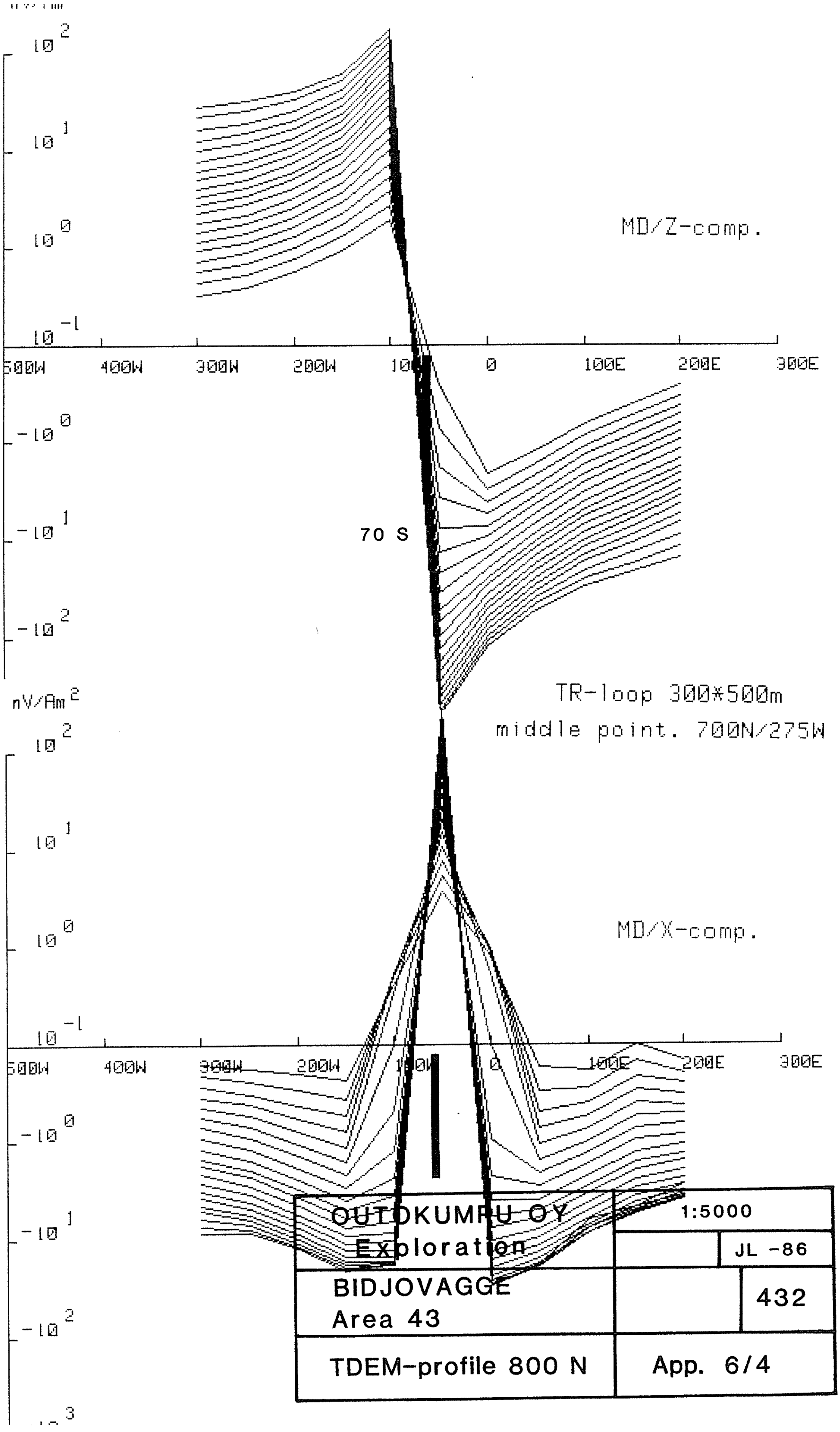




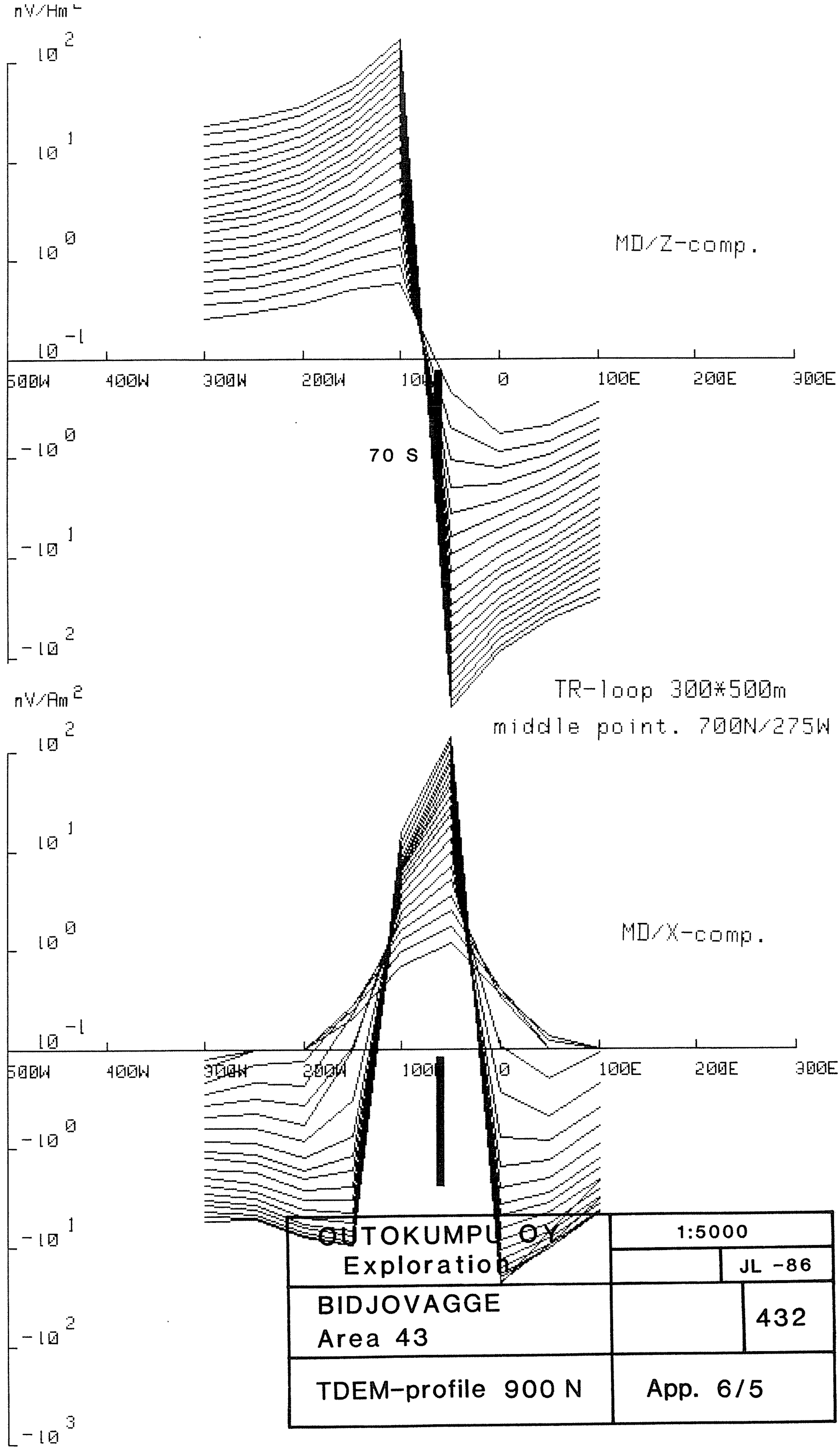
OUTOKUMPU OY Exploration	1:5000	
		JL -86
BIDJOVAGGE Area 43		432
TDEM-profile 600 N	App. 6/2	



OUTOKUMPU OY Exploration	1:5000	
		JL -86
BIDJOVAGGE Area 43		432
TDEM-profile 700 N	App. 6/3	



MD/Z-comp.
500W
400W
300W
200W
100W
0
100E
200E
300E
70 S
nV/Am 2
TR-loop 300*500m
middle point. 700N/275W
MD/X-comp.
OUTOKUMPU OY
Exploration
1:5000
JL -86
BIDJOVAGGE
Area 43
432
TDEM-profile 800 N
App. 6/4

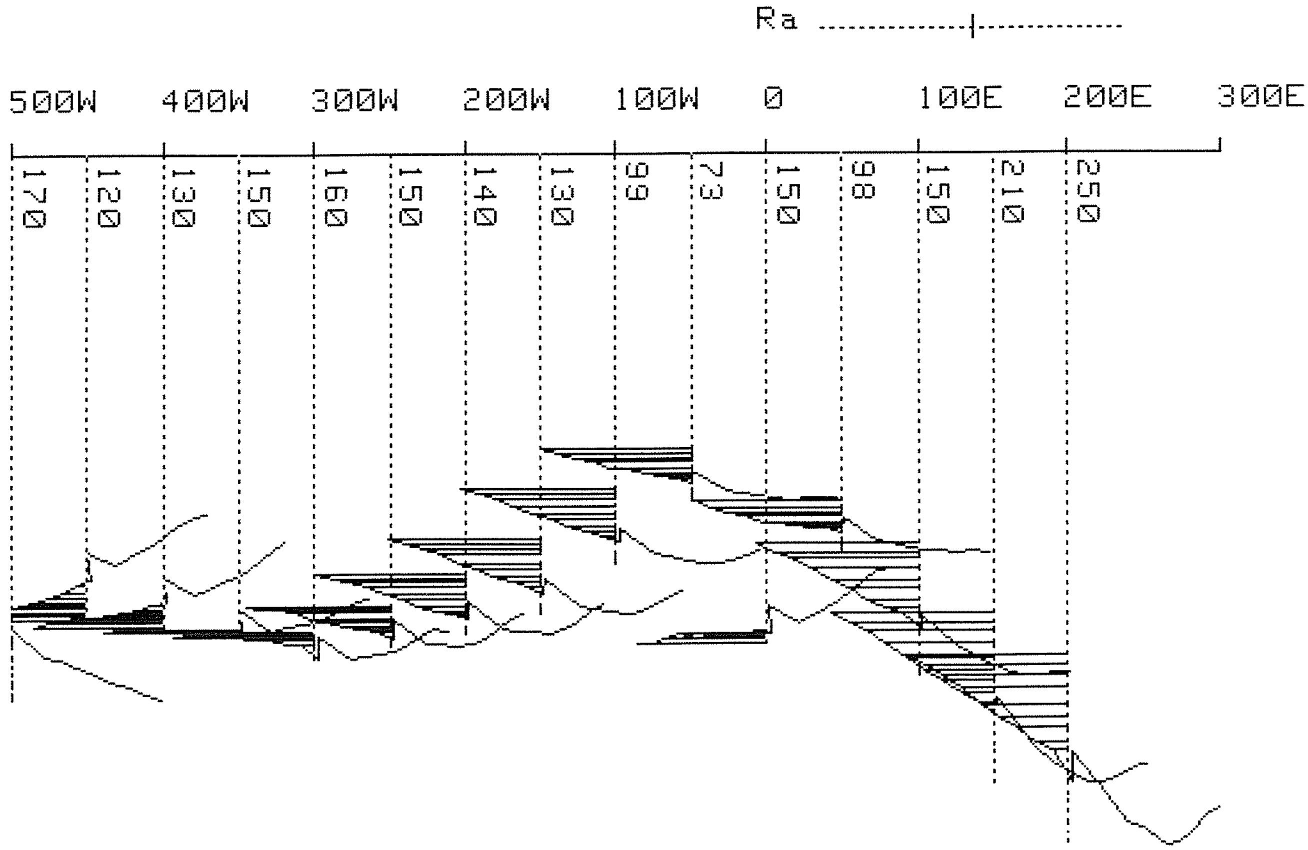


OUTOKUMPU OY Exploration	1:5000	
		JL -86
BIDJOVAGGE Area 43		432
TDEM-profile 900 N	App. 6/5	

Area 43   MIKKUJAURE 5   Prof.500N

433   EM37   MD/Z   300m * 500m   -dec.   mean   +dec.

1:5000

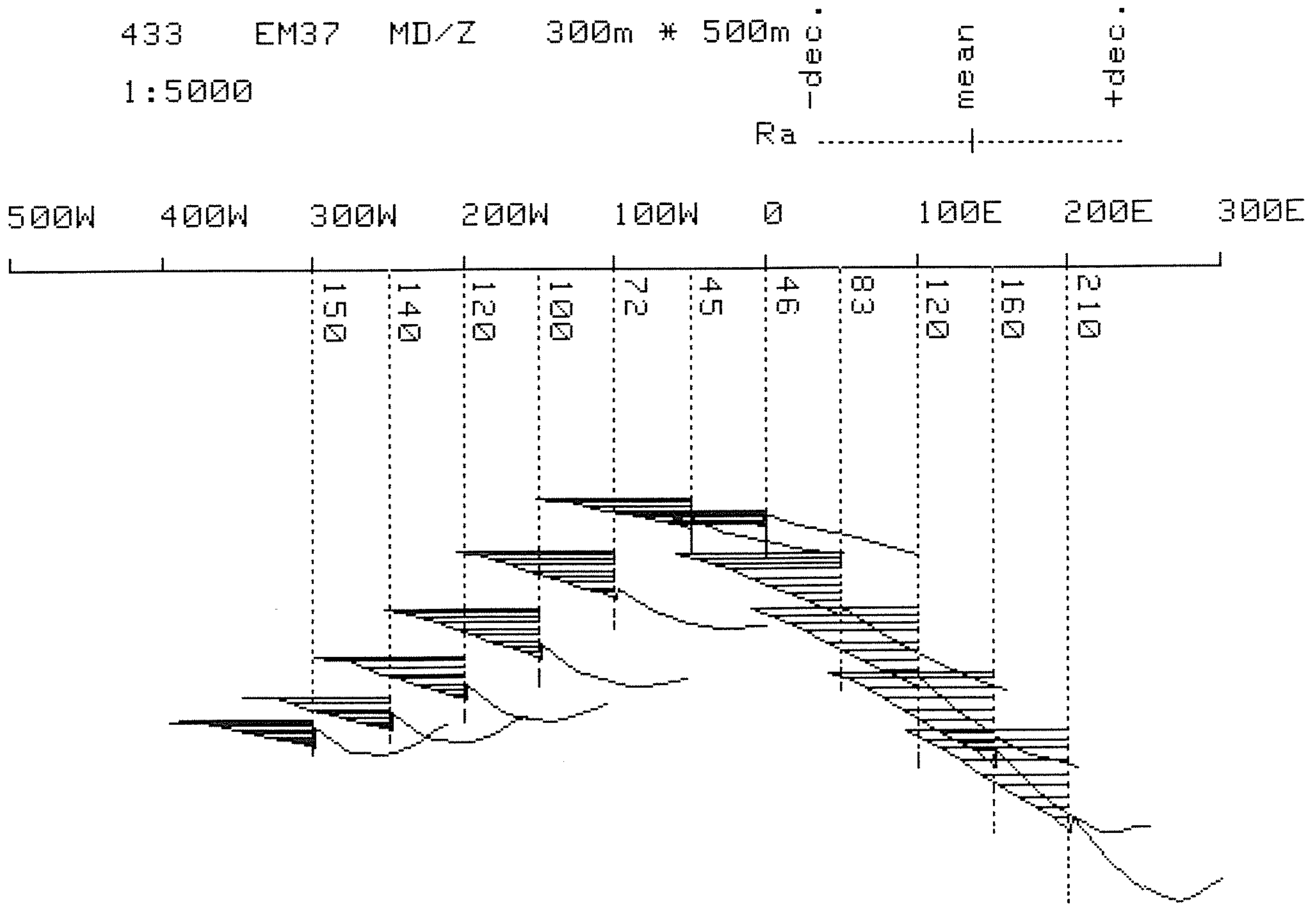


OUTOKUMPU OY Exploration	1:5000	
		JL -86
BIDJOVAGGE Area 43		433
DIT-plot	App. 6/6	

Area 43 MIKKUJAURE 5 Prof.600N

433 EM37 MD/Z 300m * 500m

1:5000



OUTOKUMPU OY Exploration	1:5000 JL -86
BIDJOVAGGE Area 43	433
DIT-plot	App. 6/7

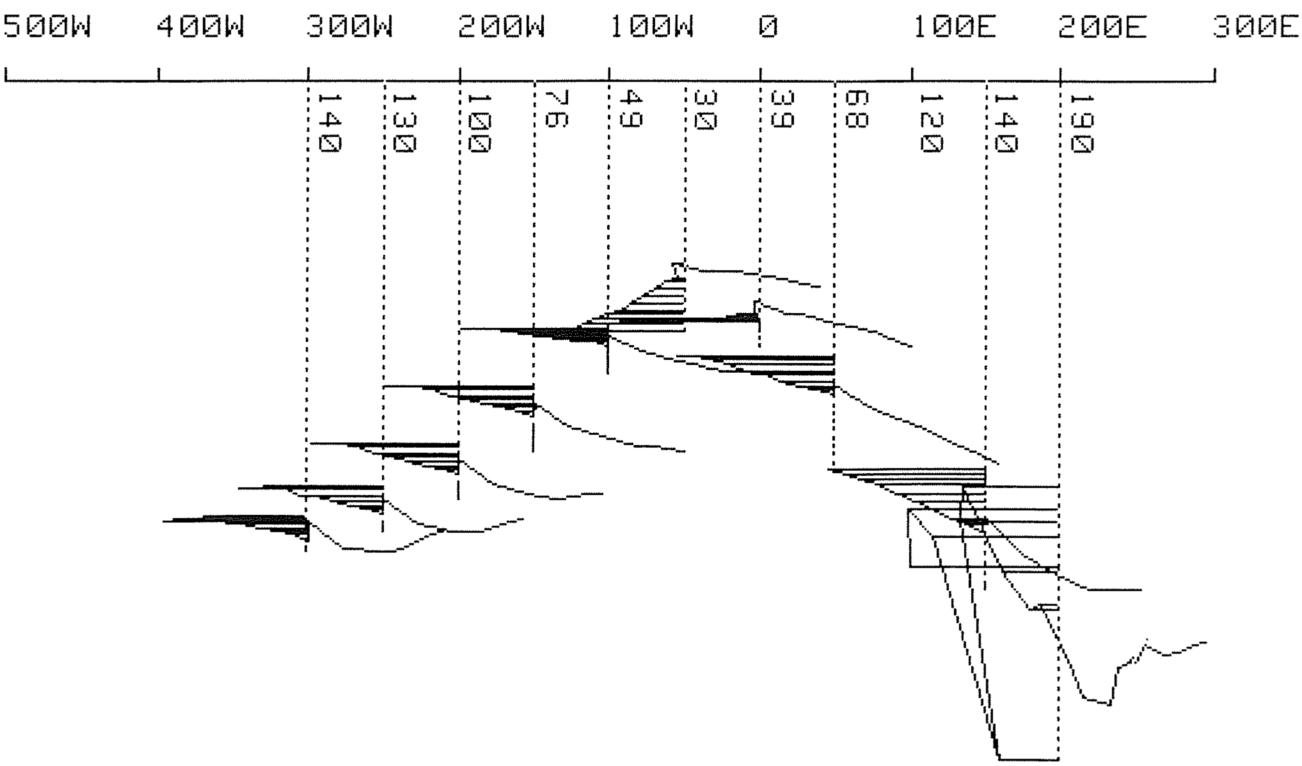
Area 43 MIKKUJAURE 5 Prof.700N

433 EM37 MD/Z 300m * 500m

1:5000

-dec. mean +dec.

Ra

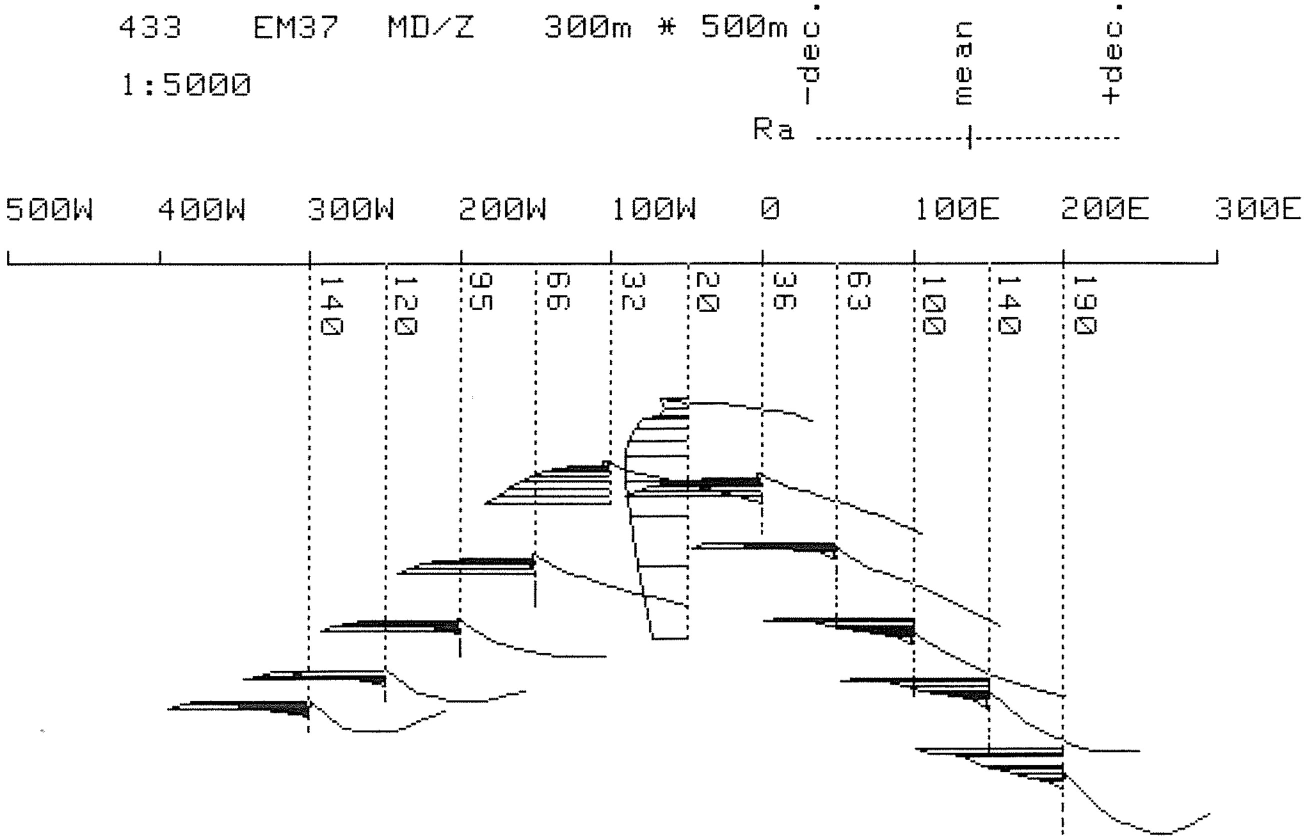


OUTOKUMPU OY Exploration	1:5000	
		JL -86
BIDJOVAGGE Area 43		433
DIT-plot	App. 6/8	

Area 43 MIKKUJAURE 5 Prof.800N

433 EM37 MD/Z 300m * 500m

1:5000



OUTOKUMPU OY Exploration	1:5000	
		JL -86
BIDJOVAGGE Area 43		433
DIT-plot	App. 6/9	

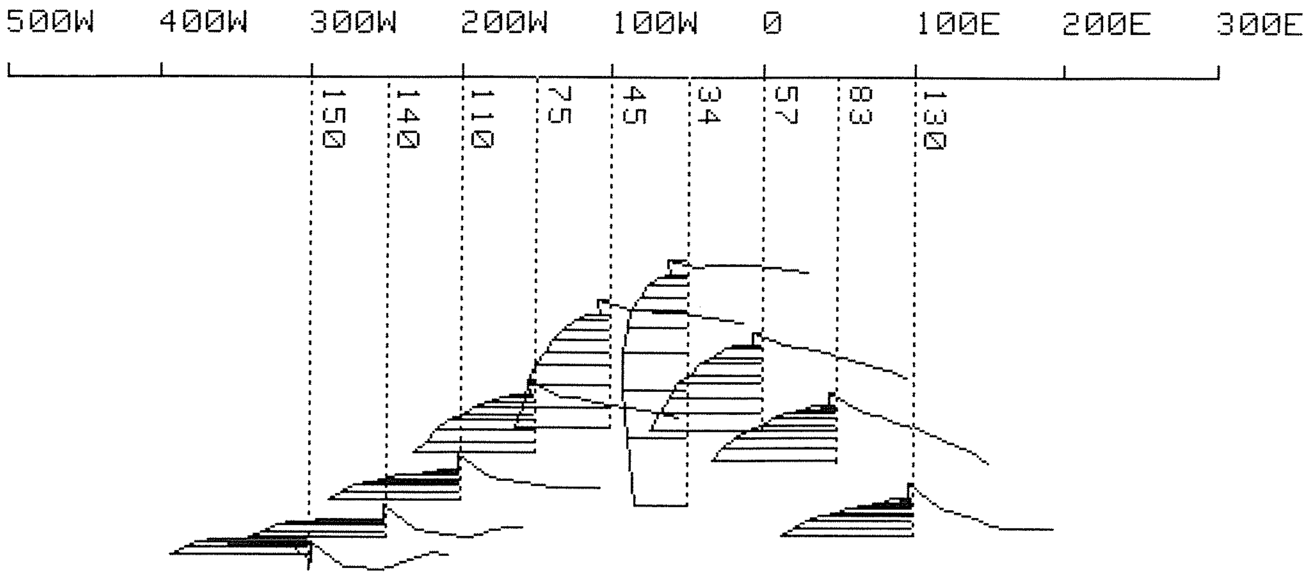
Area 43 MIKKUJAURE 5 Prof.900N

433 EM37 MD/Z 300m * 500m

1:5000

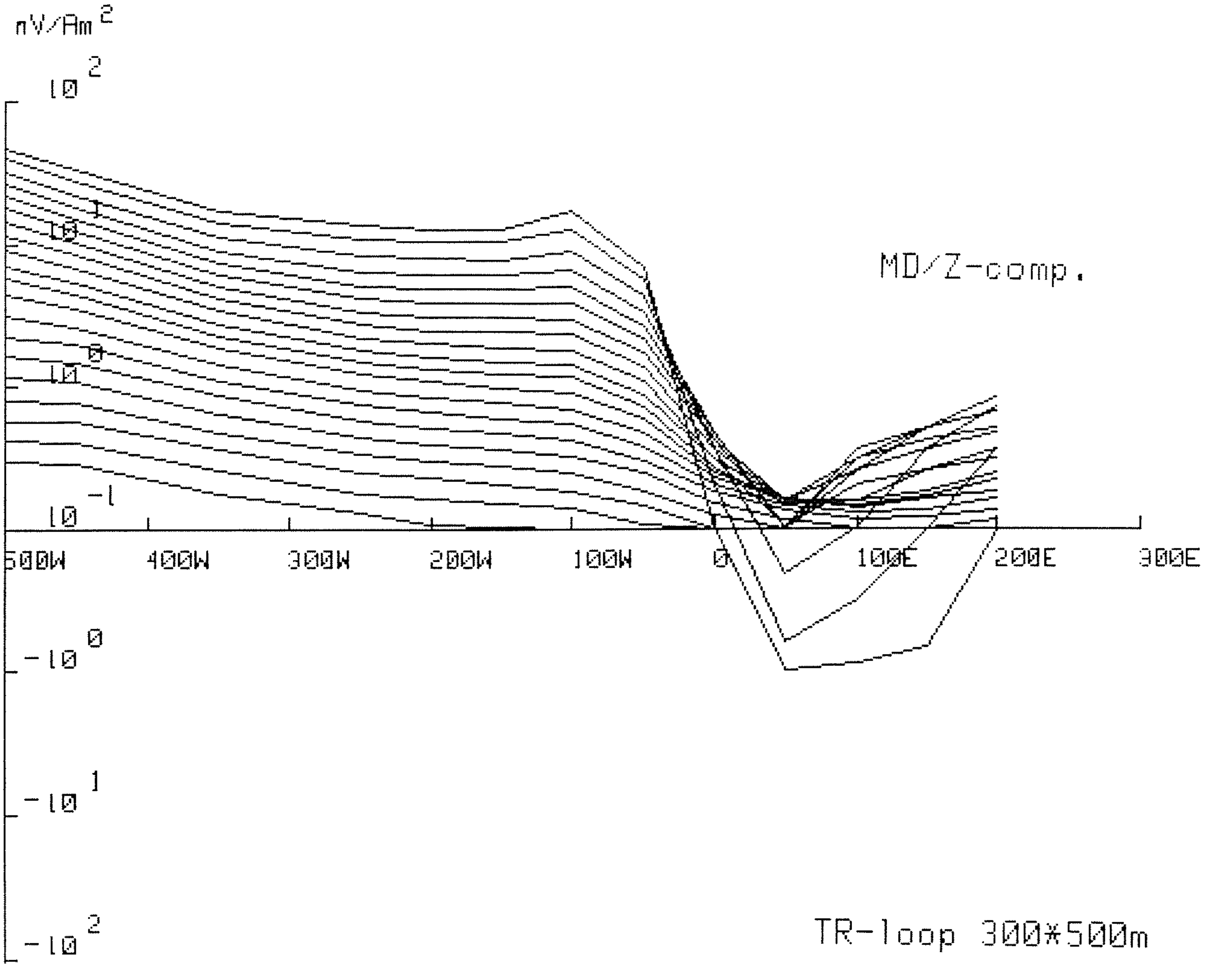
-dec. mean +dec.

Ra

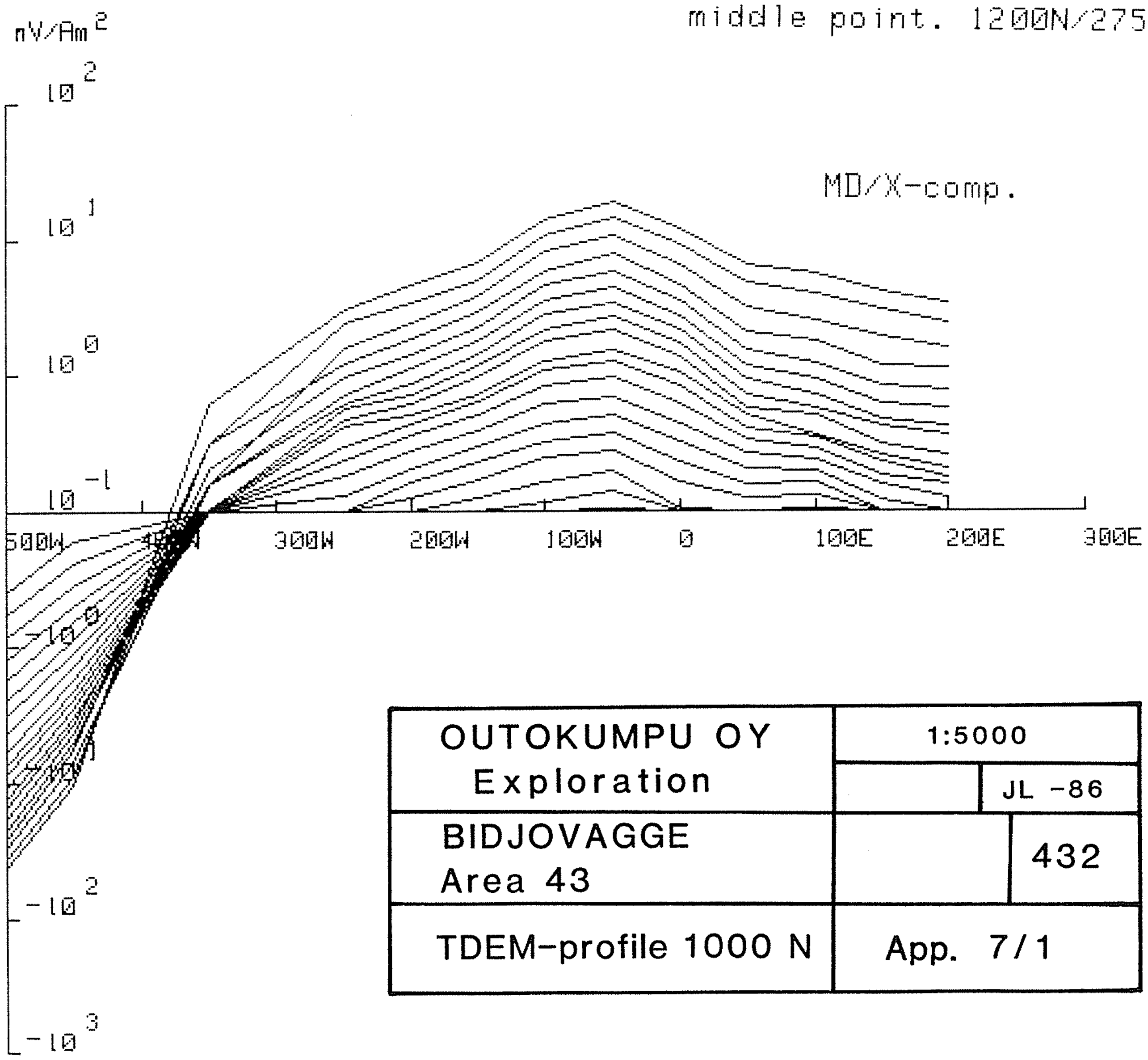


OUTOKUMPU OY Exploration	1:5000	JL -86
BIDJOVAGGE Area 43		433
DIT-plot	App. 6/10	

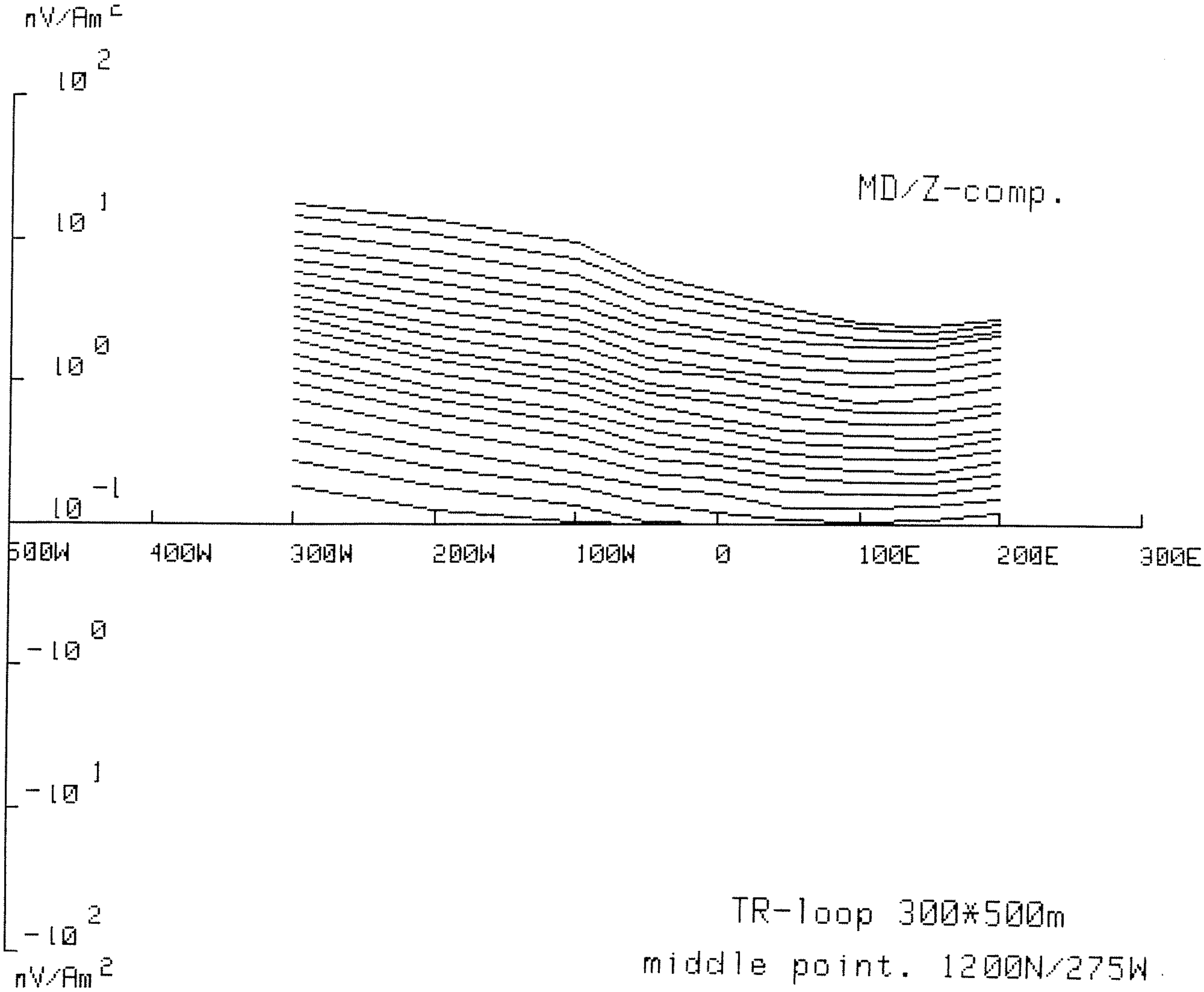
7

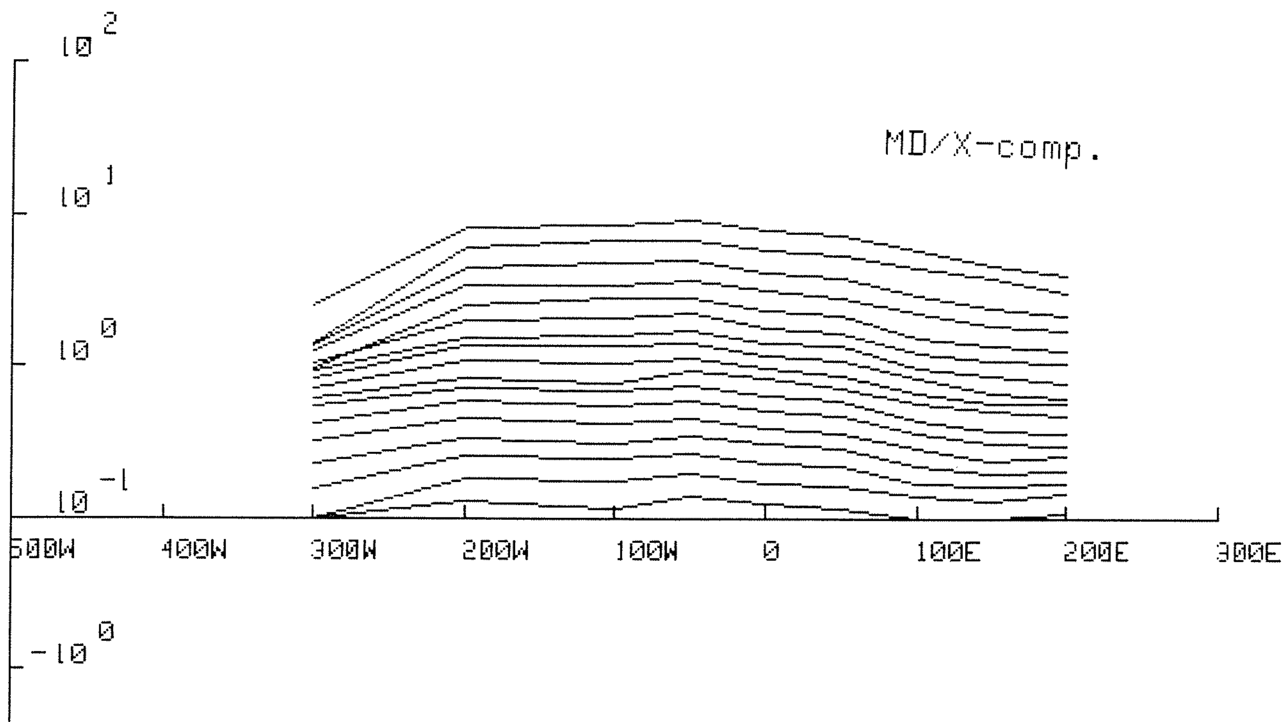


TR-loop 300*500m
middle point. 1200N/275W

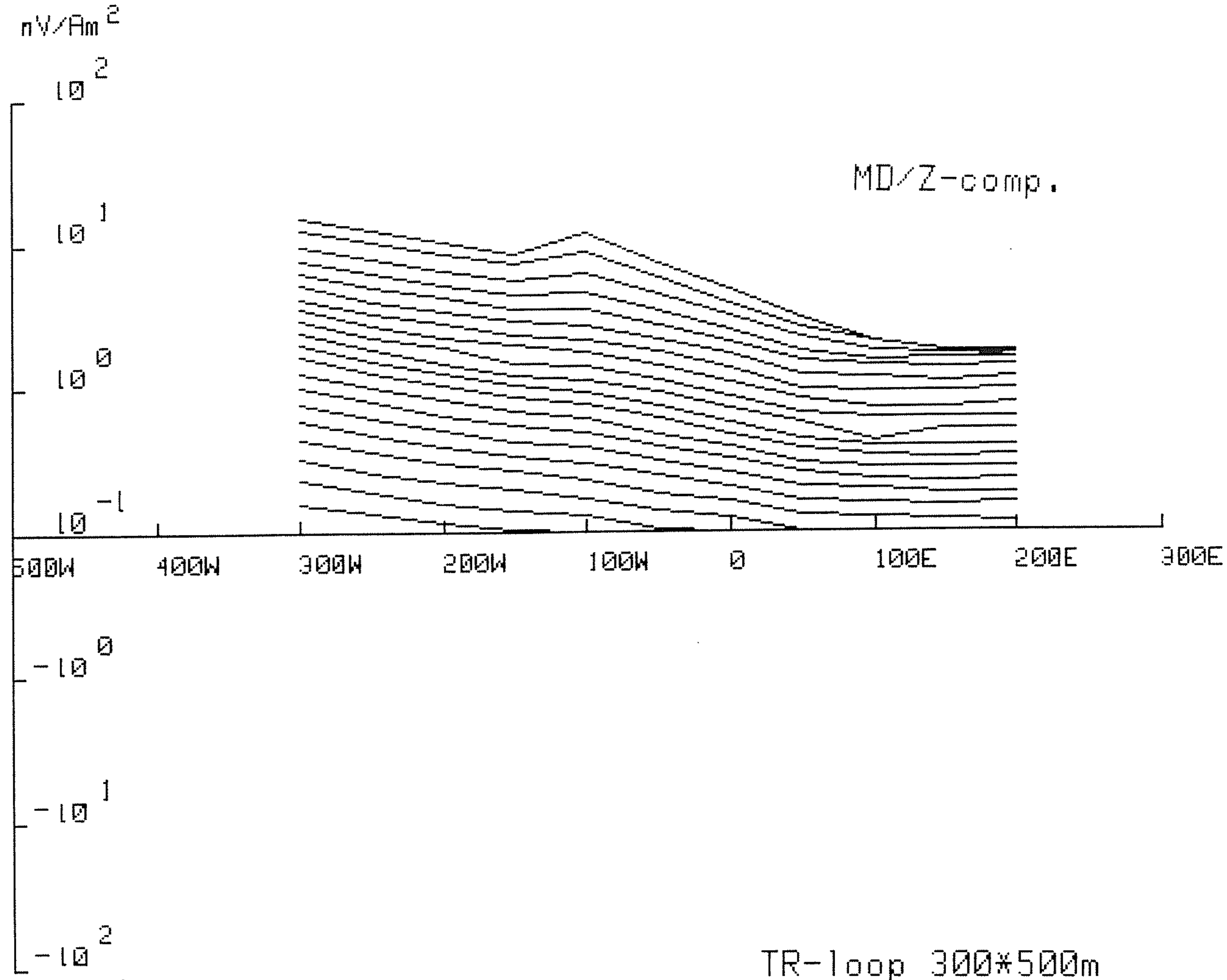


OUTOKUMPU OY Exploration	1:5000	
		JL -86
BIDJOVAGGE Area 43		432
TDEM-profile 1000 N	App. 7/1	

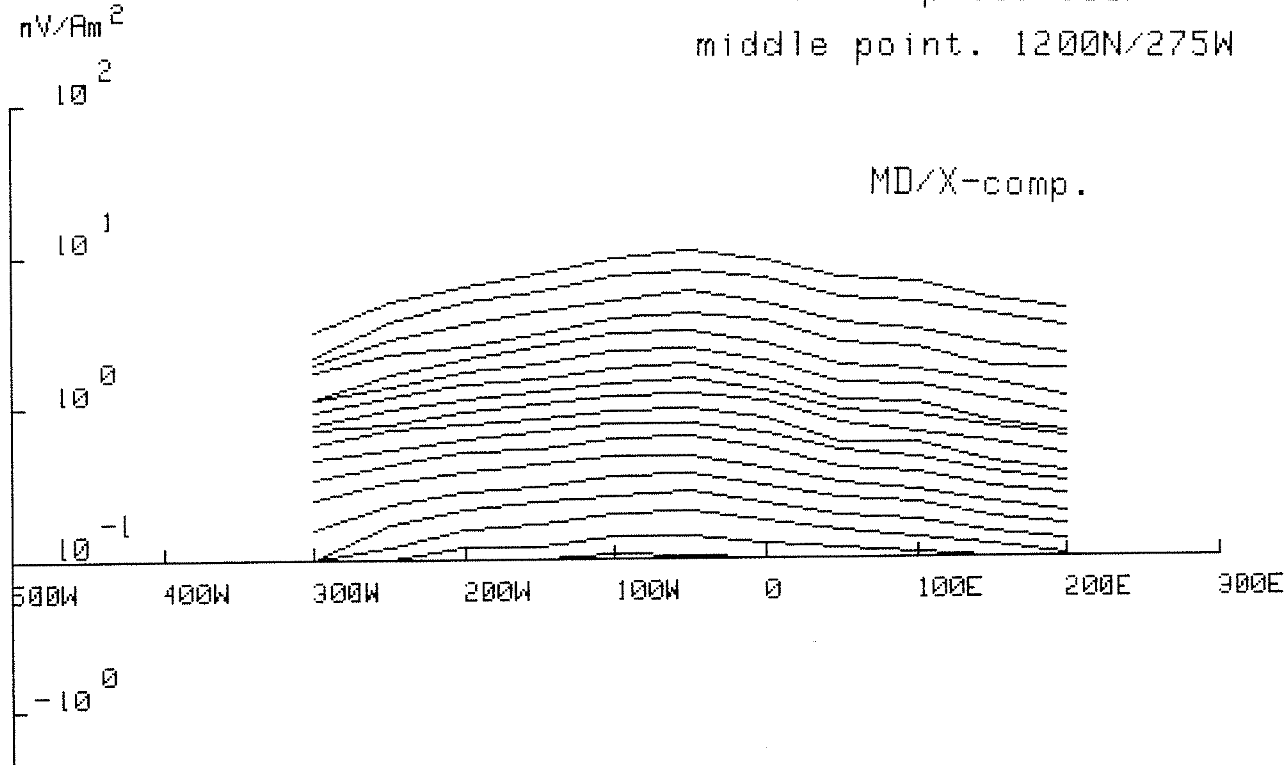




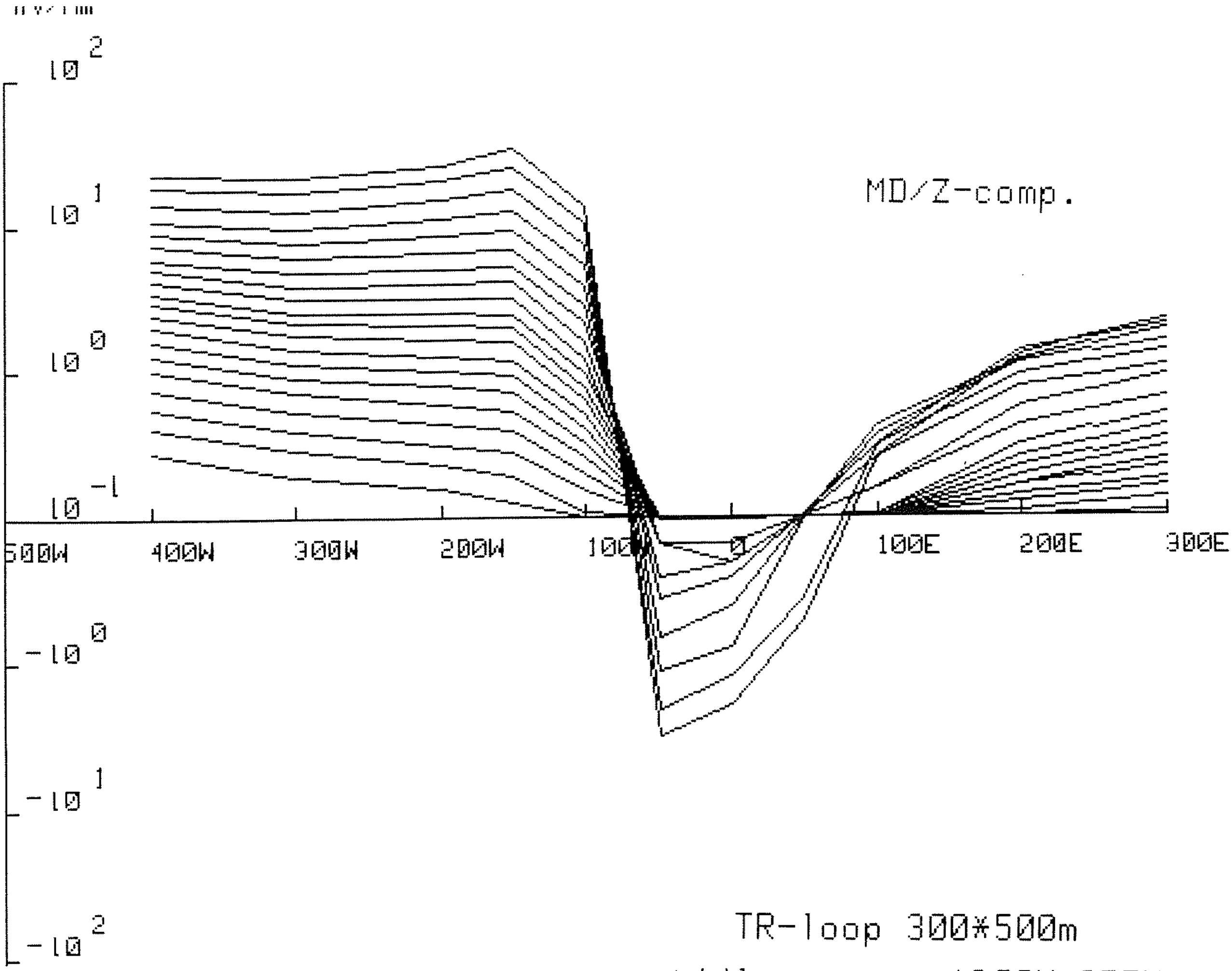
OUTOKUMPU OY Exploration	1:5000 JL -86
BIDJOVAGGE Area 43	432
TDEM-profile 1300 N	App. 7/3

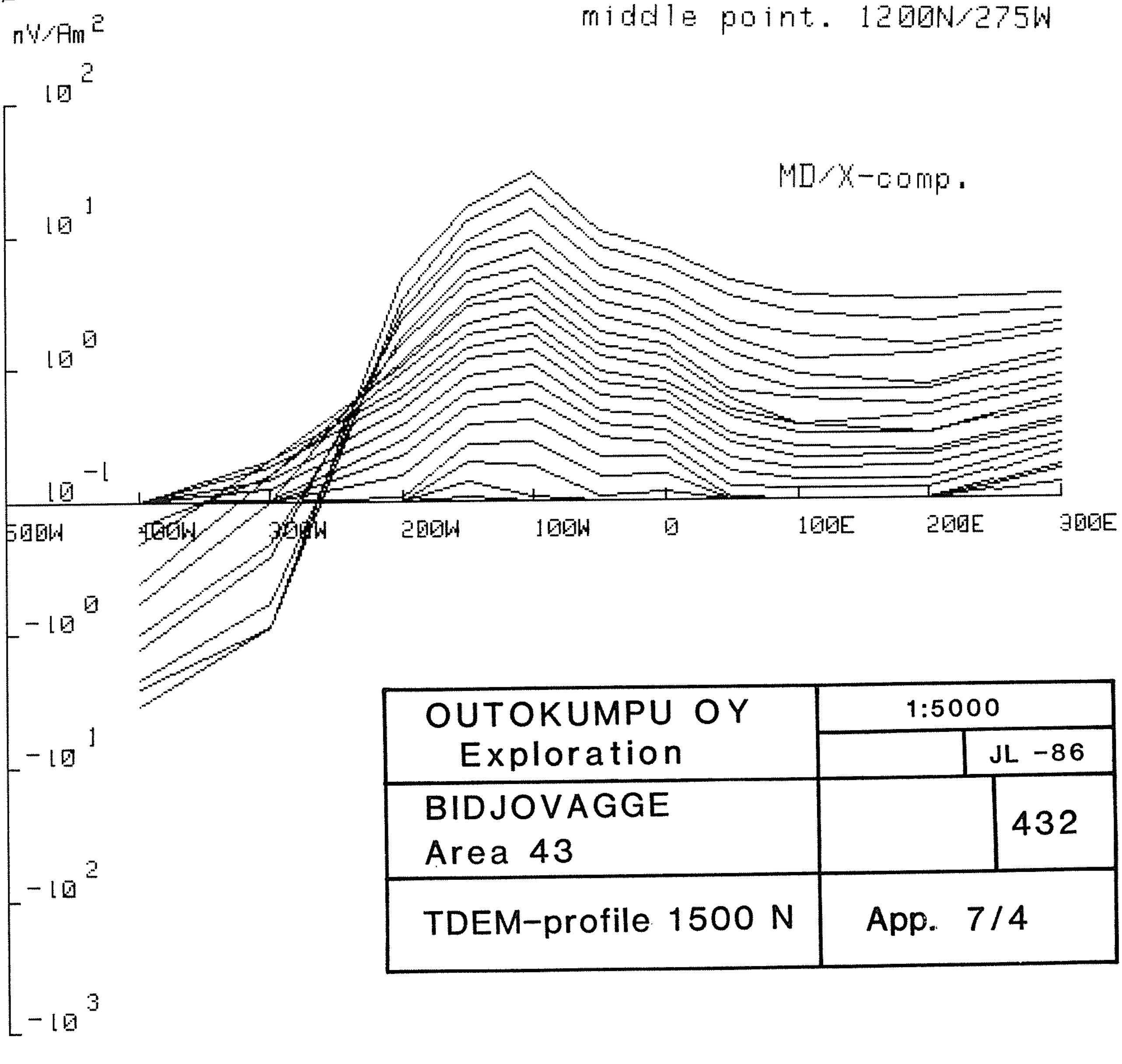


TR-loop 300*500m
middle point. 1200N/275W



OUTOKUMPU OY Exploration	1:5000 JL -86	
BIDJOVAGGE Area 43		432
TDEM-profile 1100 N	App. 7/2	



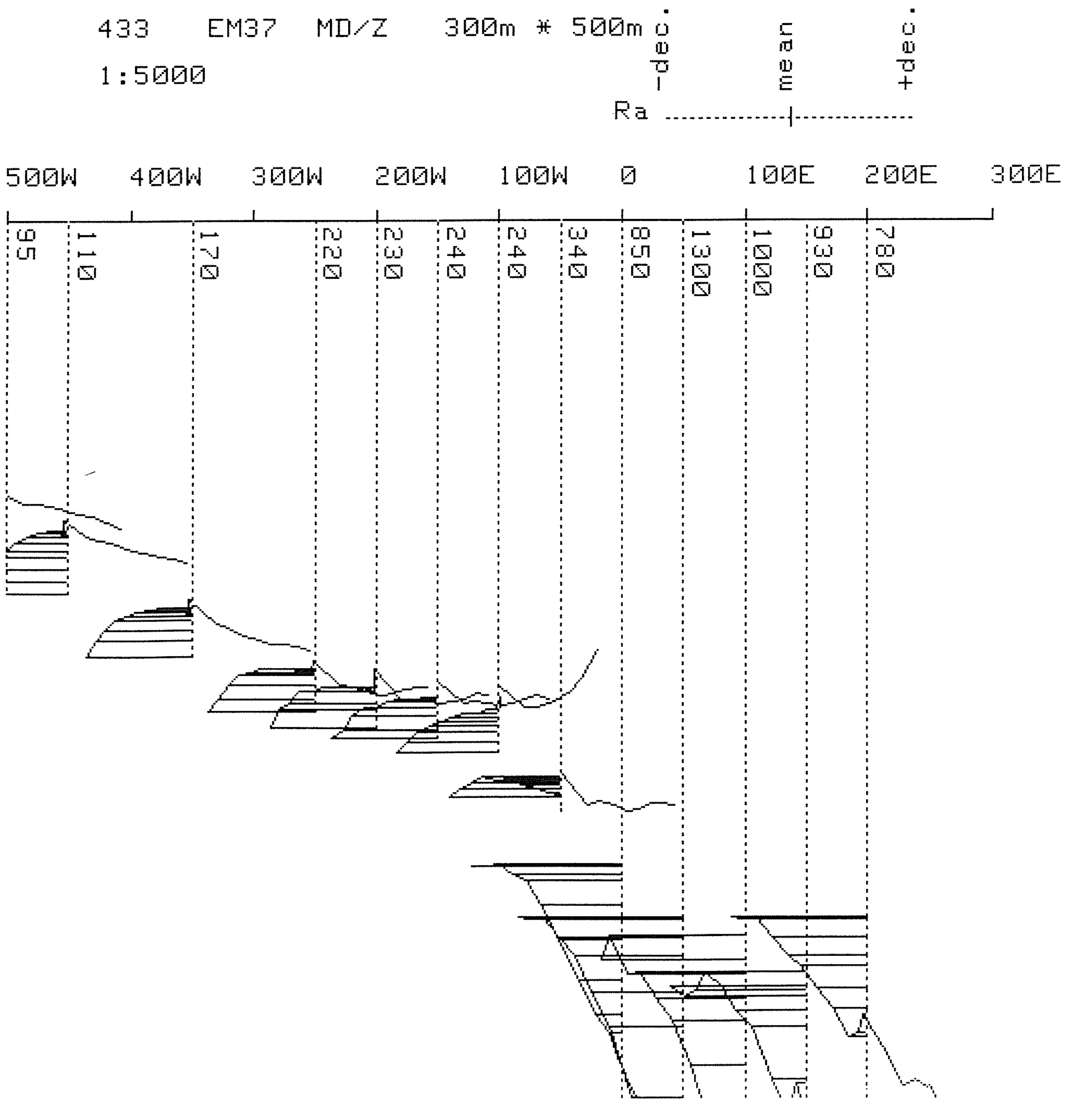


OUTOKUMPU OY Exploration	1:5000	
		JL -86
BIDJOVAGGE Area 43		432
TDEM-profile 1500 N	App. 7/4	

Area 43 MIKKUJAURE 6 Prof.1000N

433 EM37 MD/Z 300m * 500m

1:5000



OUTOKUMPU OY Exploration	1:5000	
		JL -86
BIDJOVAGGE Area 43		433
DIT-plot	App. 7/5	

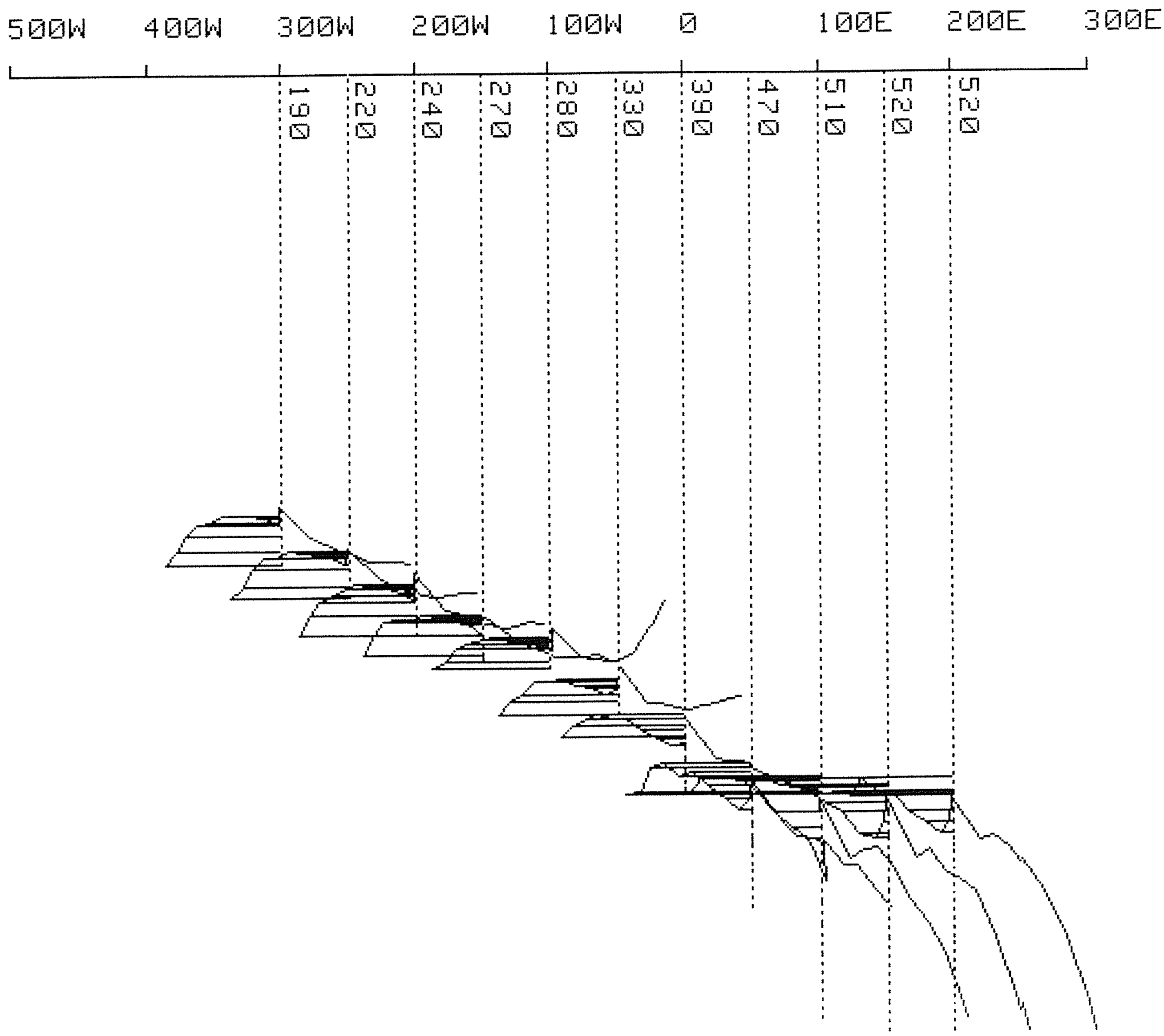
Area 43 MIKKUJAURE 6 Prof.1100N

433 EM37 MD/Z 300m * 500m

1:5000

-dec. mean +dec.

Ra

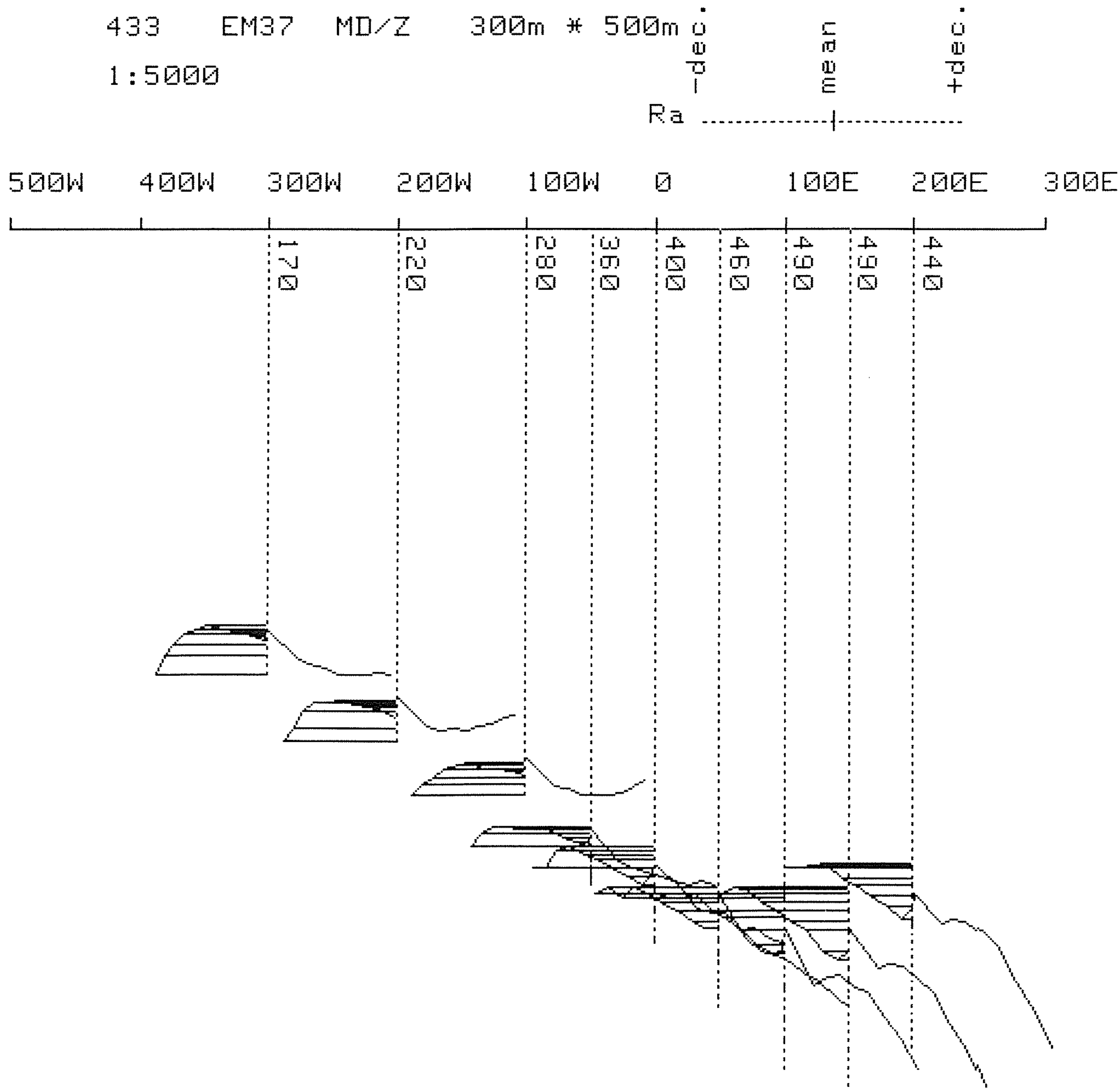


OUTOKUMPU OY Exploration	1:5000	
		JL -86
BIDJOVAGGE Area 43		433
DIT-plot	App. 7/6	

Area 43   MIKKUJAURE 6   Prof.1300N

433   EM37   MD/Z   300m * 500m

1:5000

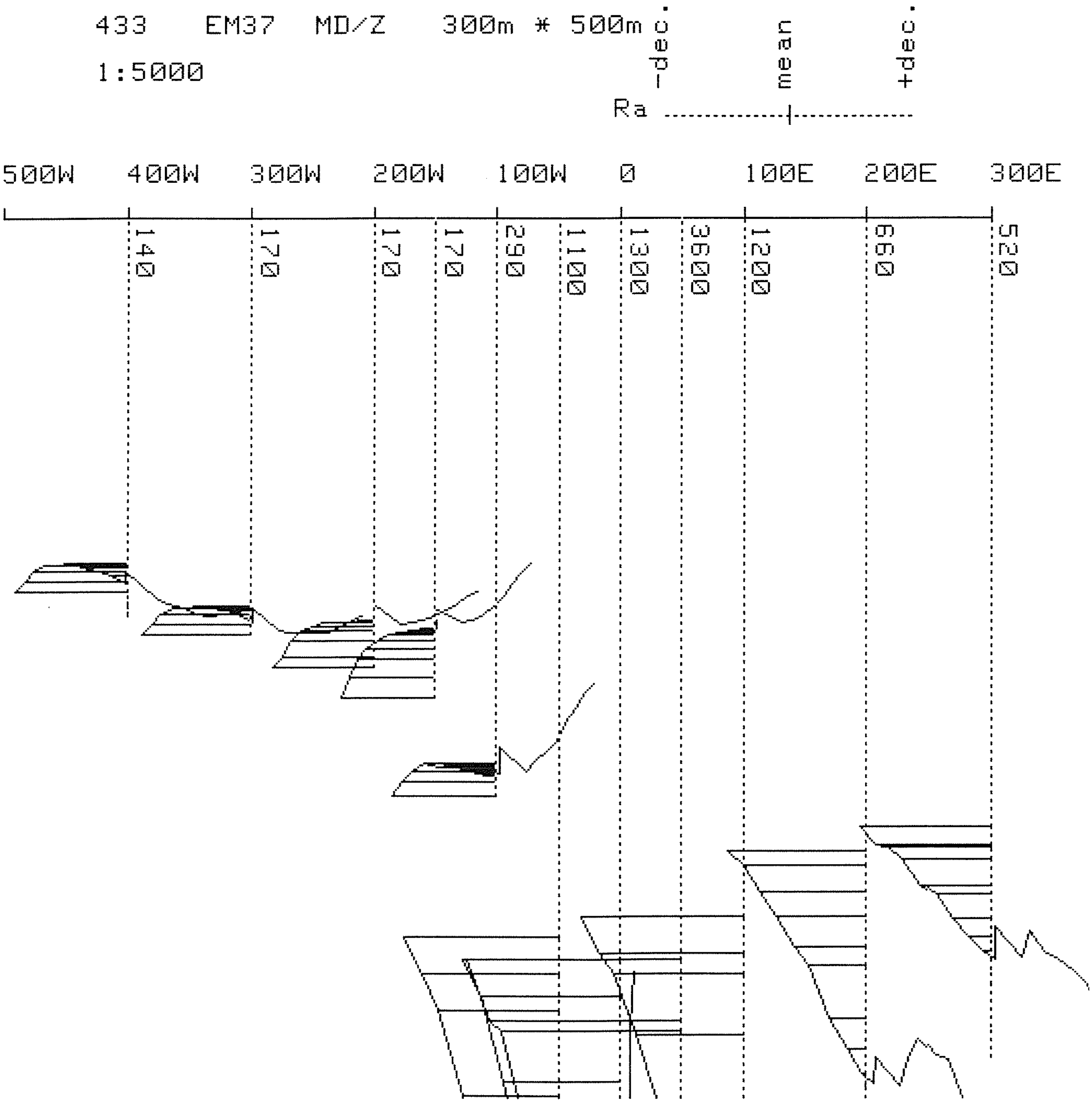


OUTOKUMPU OY Exploration	1:5000	
		JL -86
BIDJOVAGGE Area 43		433
DIT-plot	App. 7/7	

Area 43   MIKKUJAURE 6   Prof.1500N

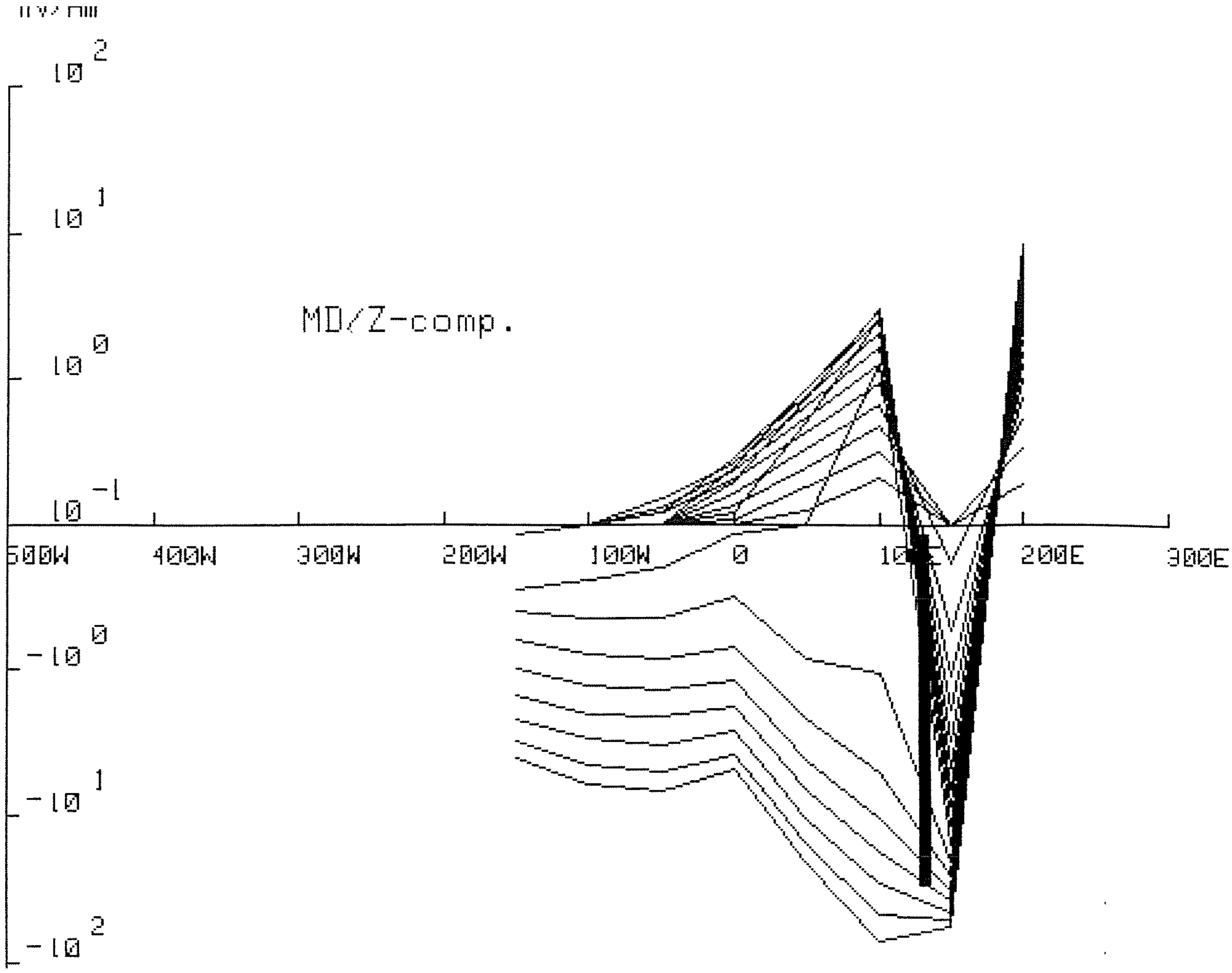
433   EM37   MD/Z   300m * 500m

1:5000



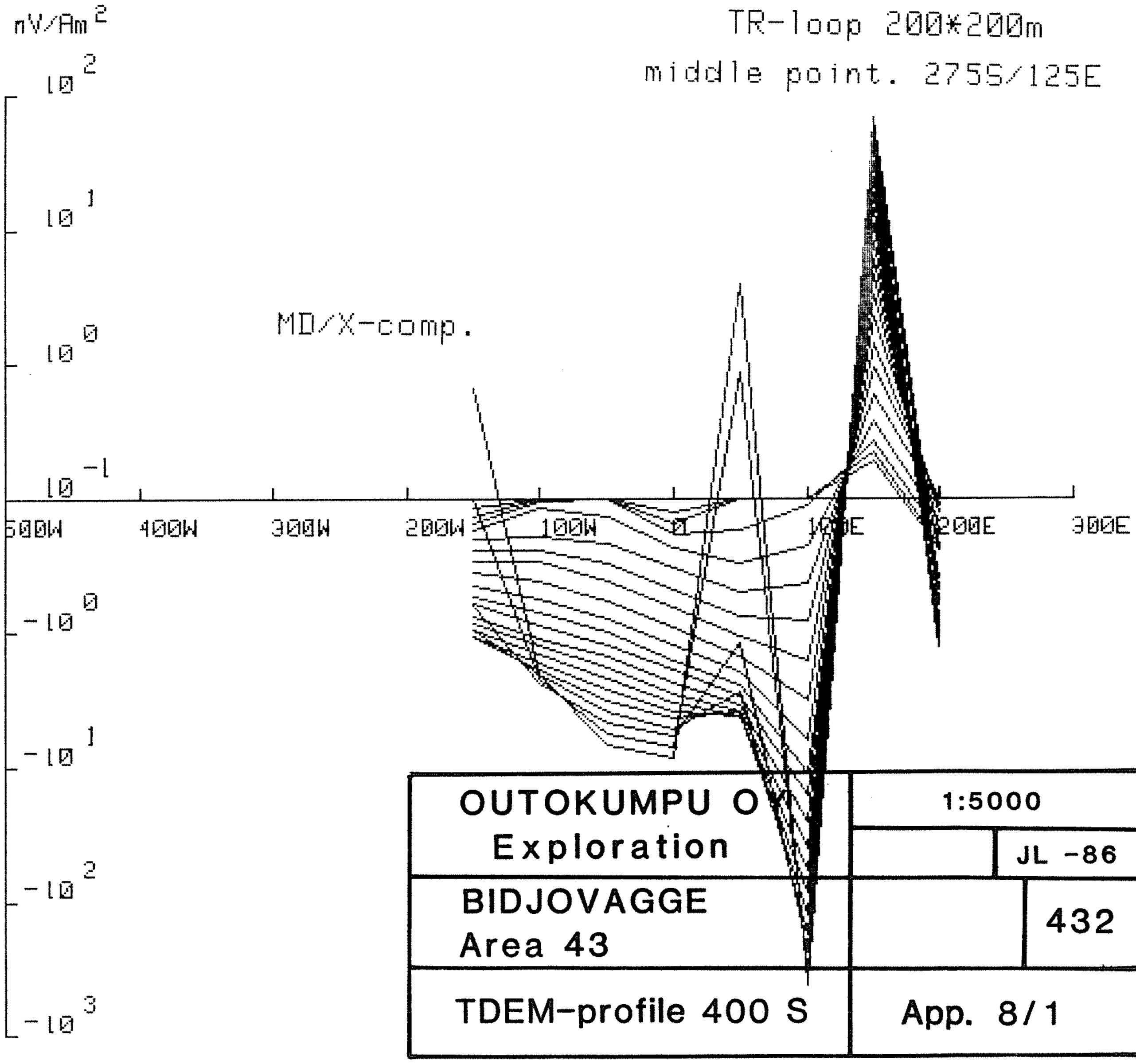
OUTOKUMPU OY Exploration	1:5000	
		JL -86
BIDJOVAGGE Area 43		433
DIT-plot	App. 7/8	

8

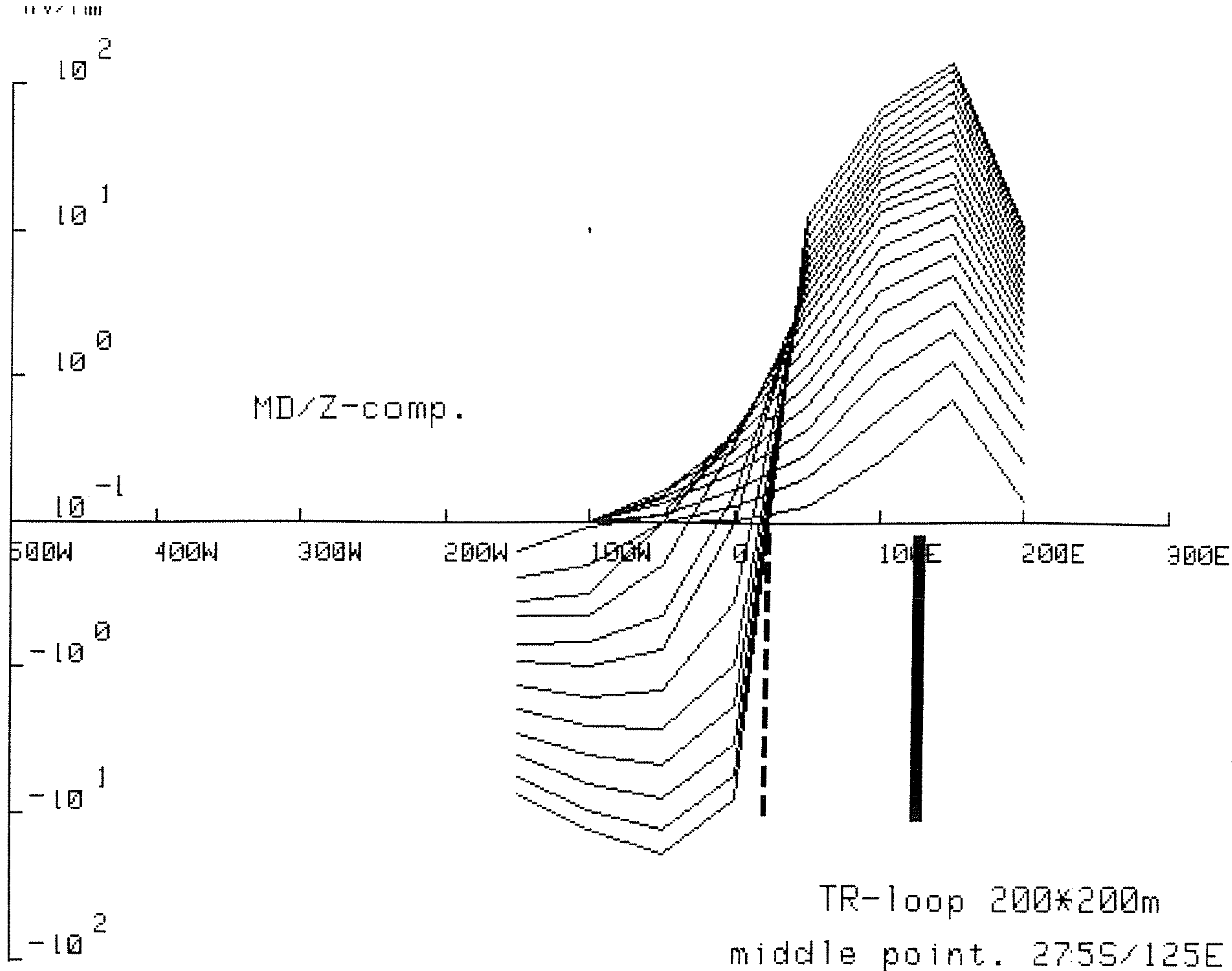


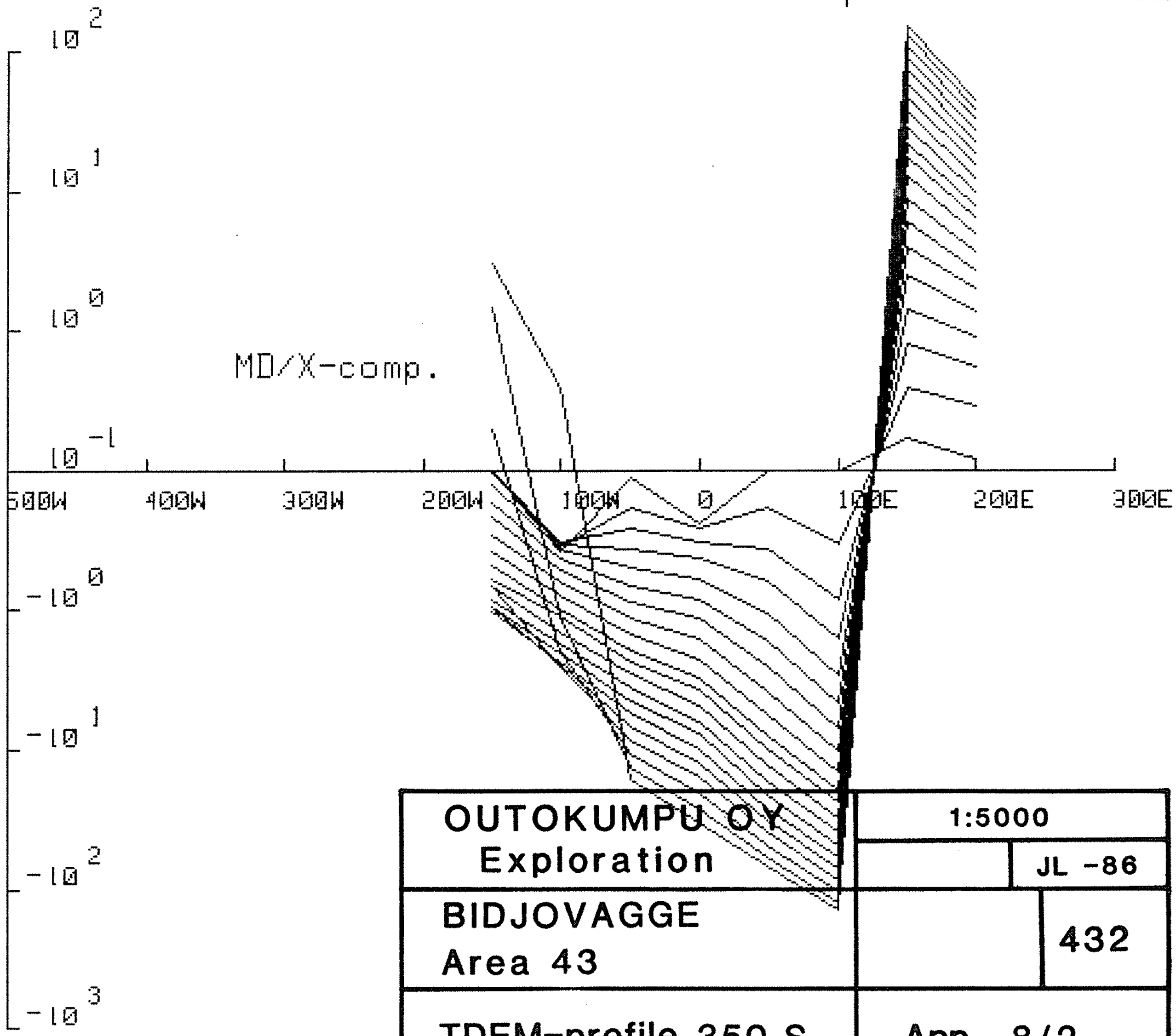
TR-loop 200*200m

middle point. 275S/125E

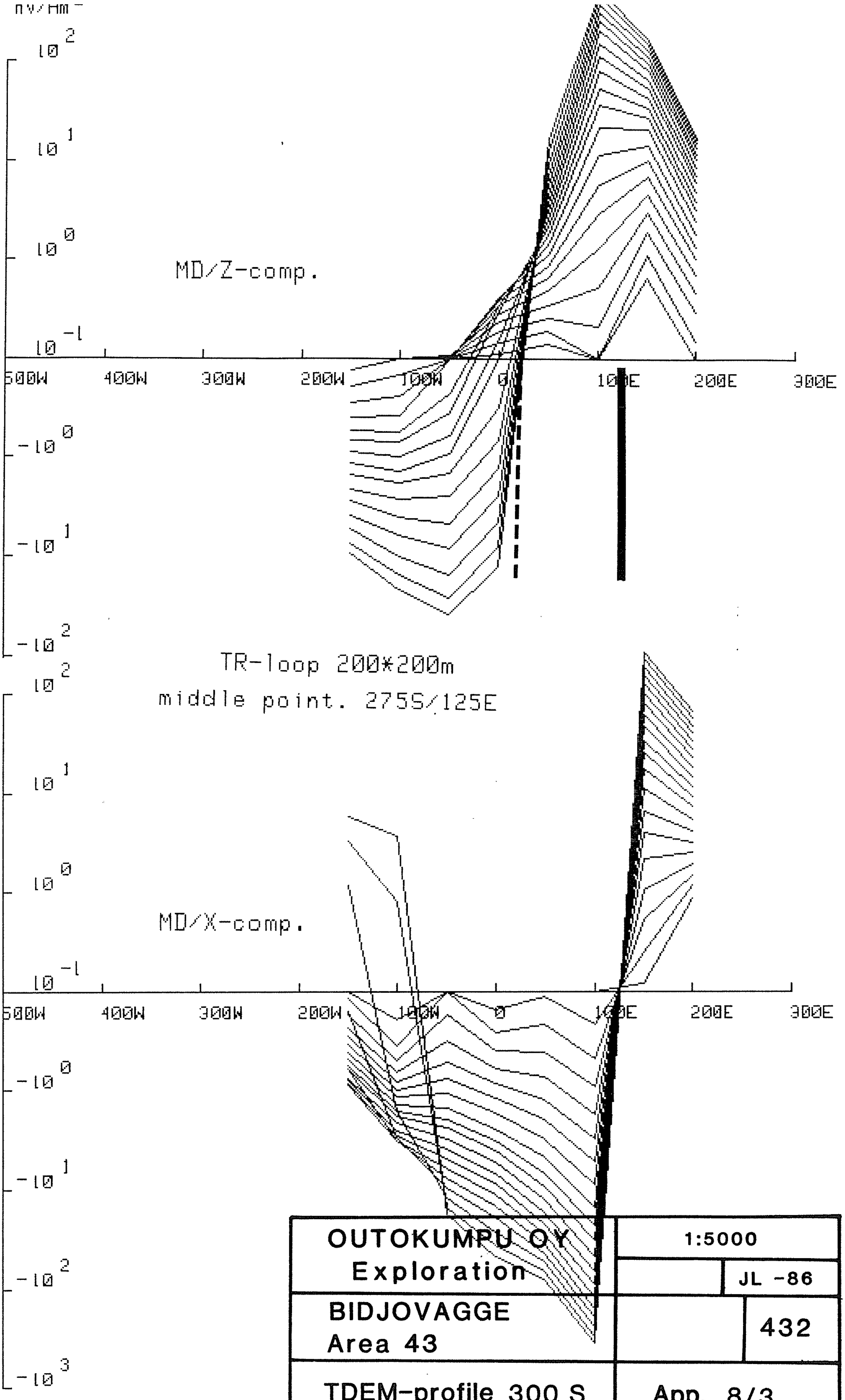


OUTOKUMPU OY Exploration	1:5000 JL -86
BIDJOVAGGE Area 43	432
TDEM-profile 400 S	App. 8/1

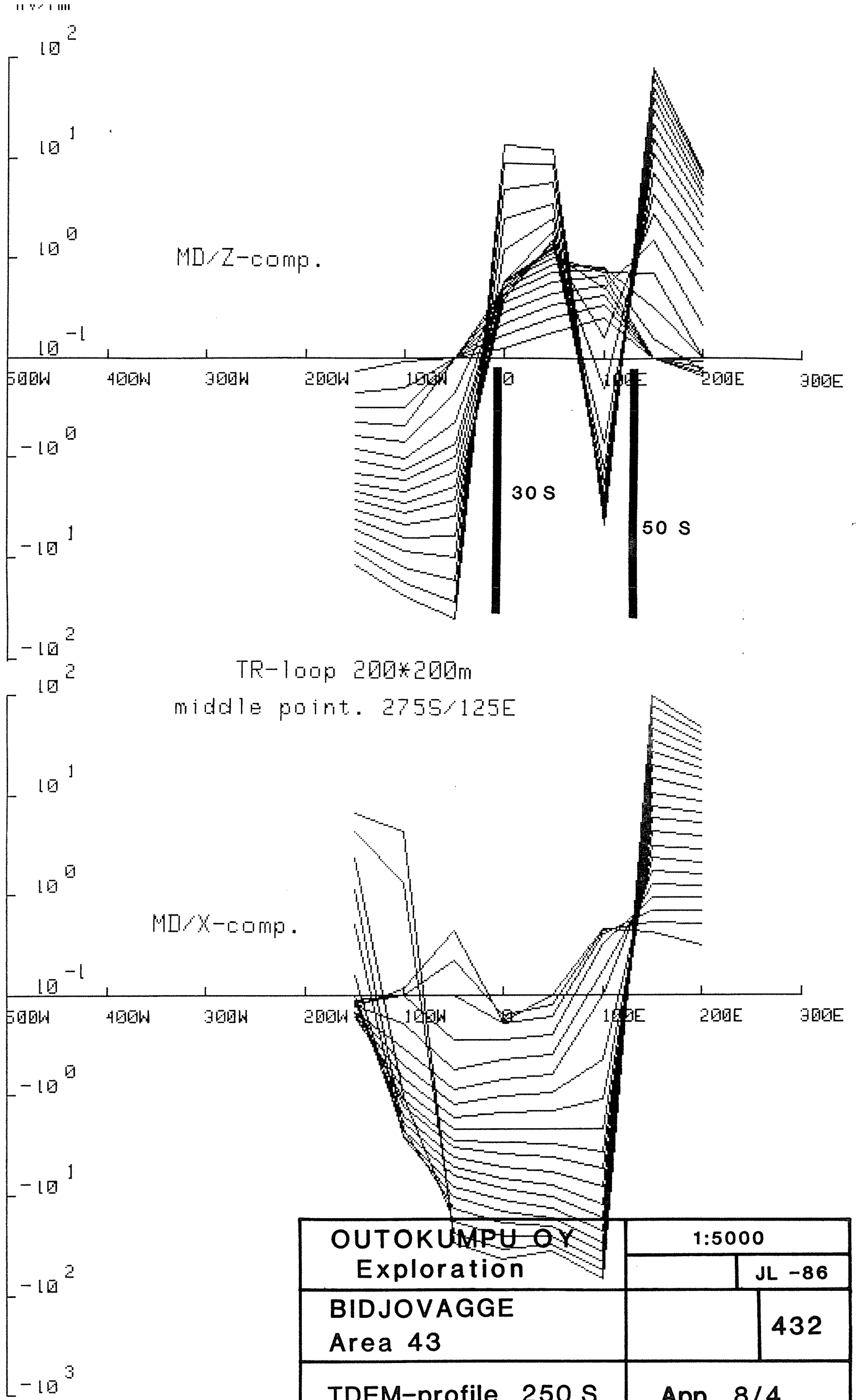




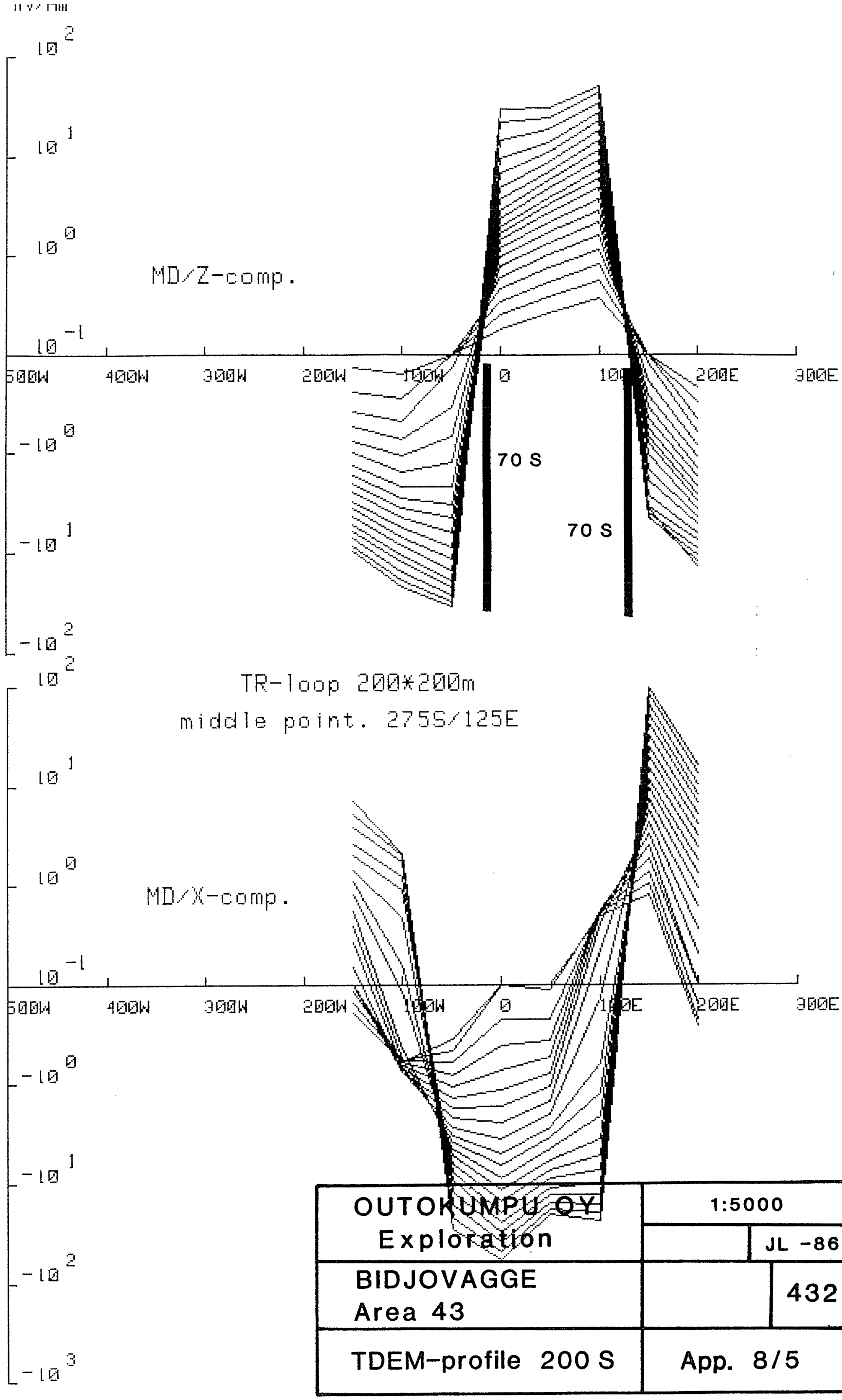
OUTOKUMPU OY Exploration	1:5000	
		JL -86
BIDJOVAGGE Area 43		432
TDEM-profile 350 S	App. 8/2	



OUTOKUMPU OY Exploration	1:5000	
		JL -86
BIDJOVAGGE Area 43		432
TDEM-profile 300 S	App. 8/3	



OUTOKUMPU OY Exploration	1:5000	JL -86
BIDJOVAGGE Area 43		432
TDEM-profile 250 S	App. 8/4	

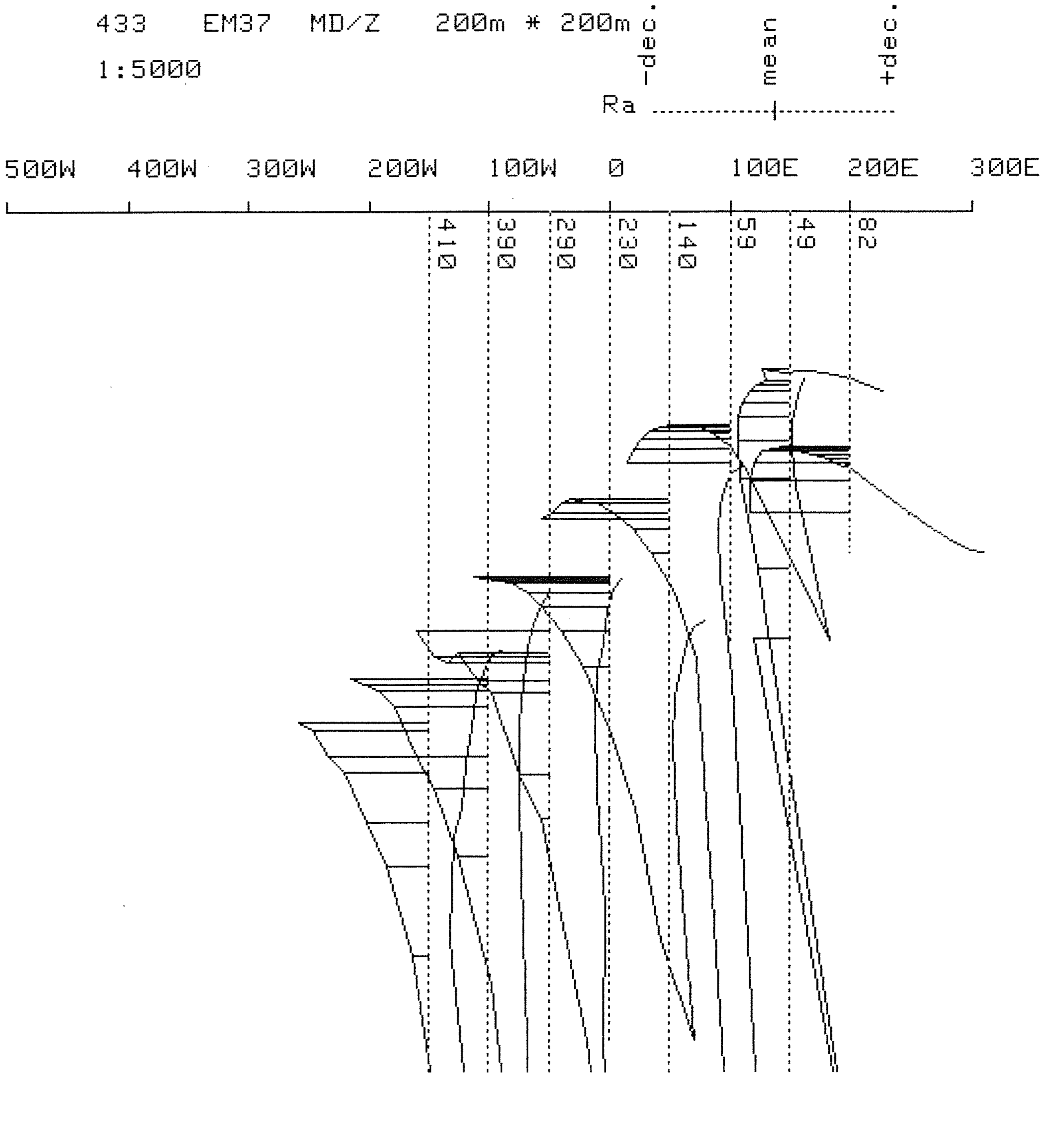


OUTOKUMPU OY Exploration	1:5000	
		JL -86
BIDJOVAGGE Area 43		432
TDEM-profile 200 S	App. 8/5	

Area 43 MIKKUJAURE 7 Prof.400S

433 EM37 MD/Z 200m * 200m

1:5000

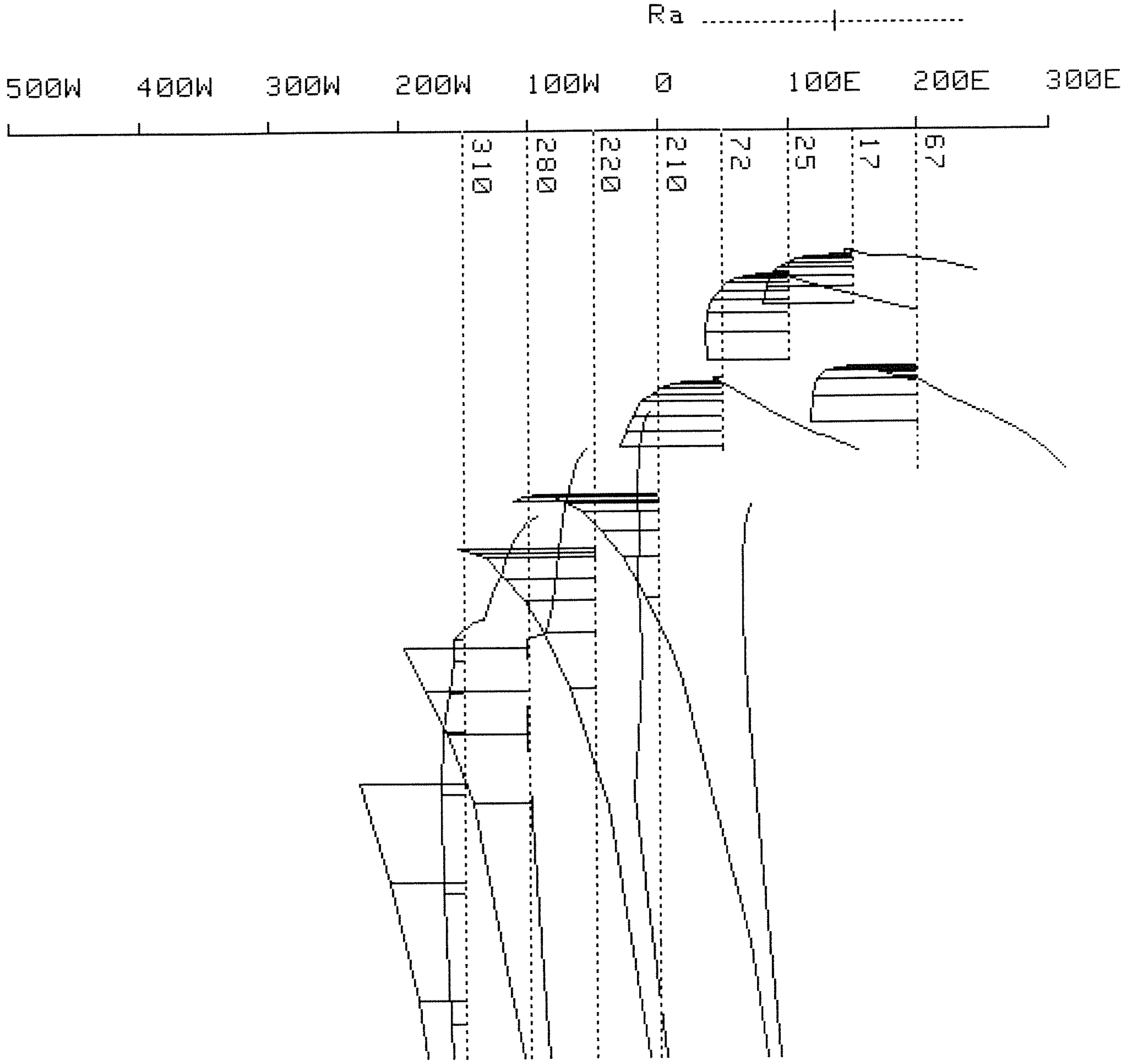


OUTOKUMPU OY Exploration	1:5000	
		JL -86
BIDJOVAGGE Area 43		433
DIT-plot	App. 8/10	

Area 43 MIKKUJAURE 7 Prof.350S

433 EM37 MD/Z 200m * 200m -dec. mean +dec.

1:5000

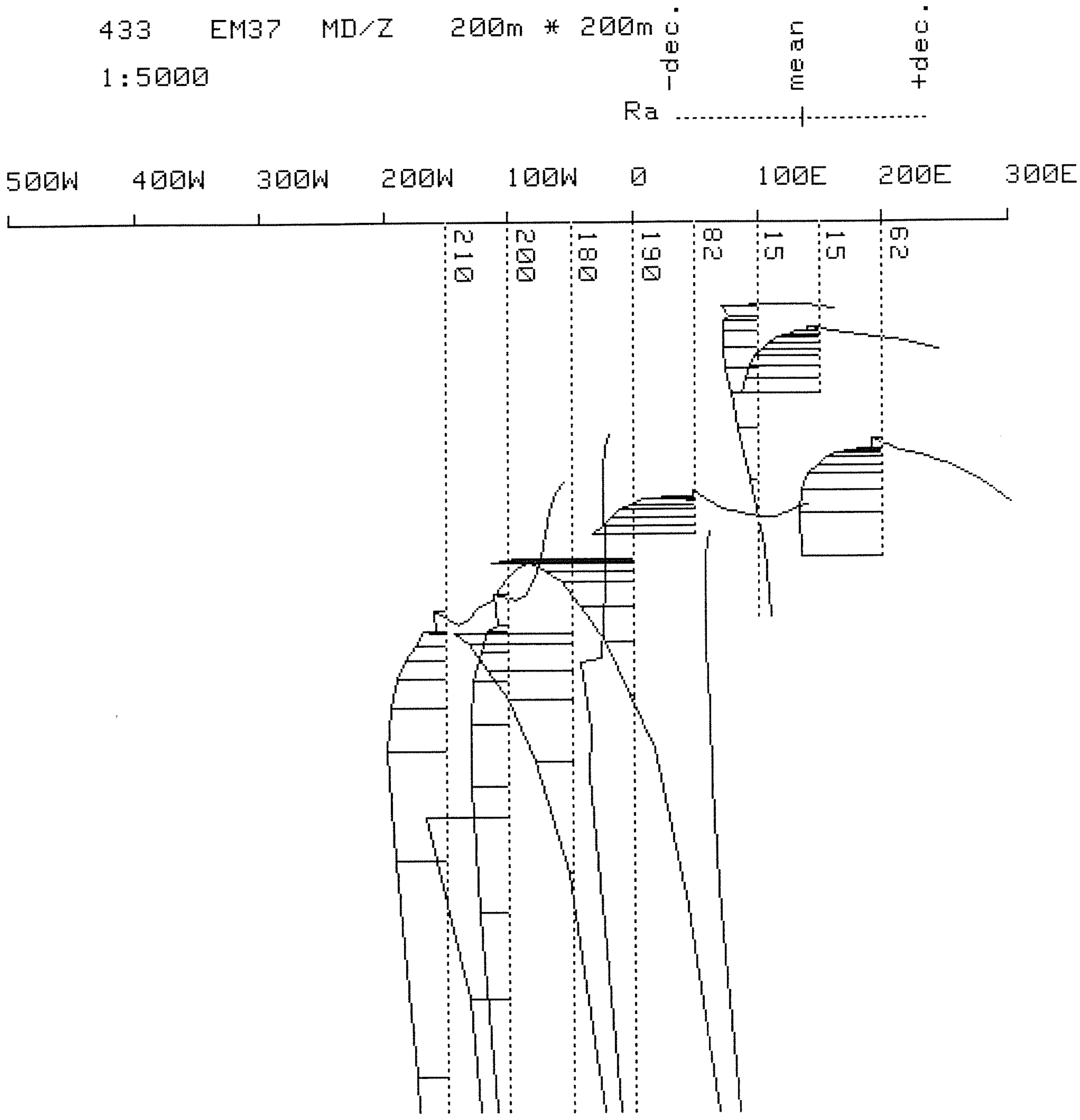


OUTOKUMPU OY Exploration	1:5000	
		JL -86
BIDJOVAGGE Area 43		433
DIT-plot	App. 8/9	

Area 43   MIKKUJAURE 7   Prof.300S

433   EM37   MD/Z   200m * 200m

1:5000

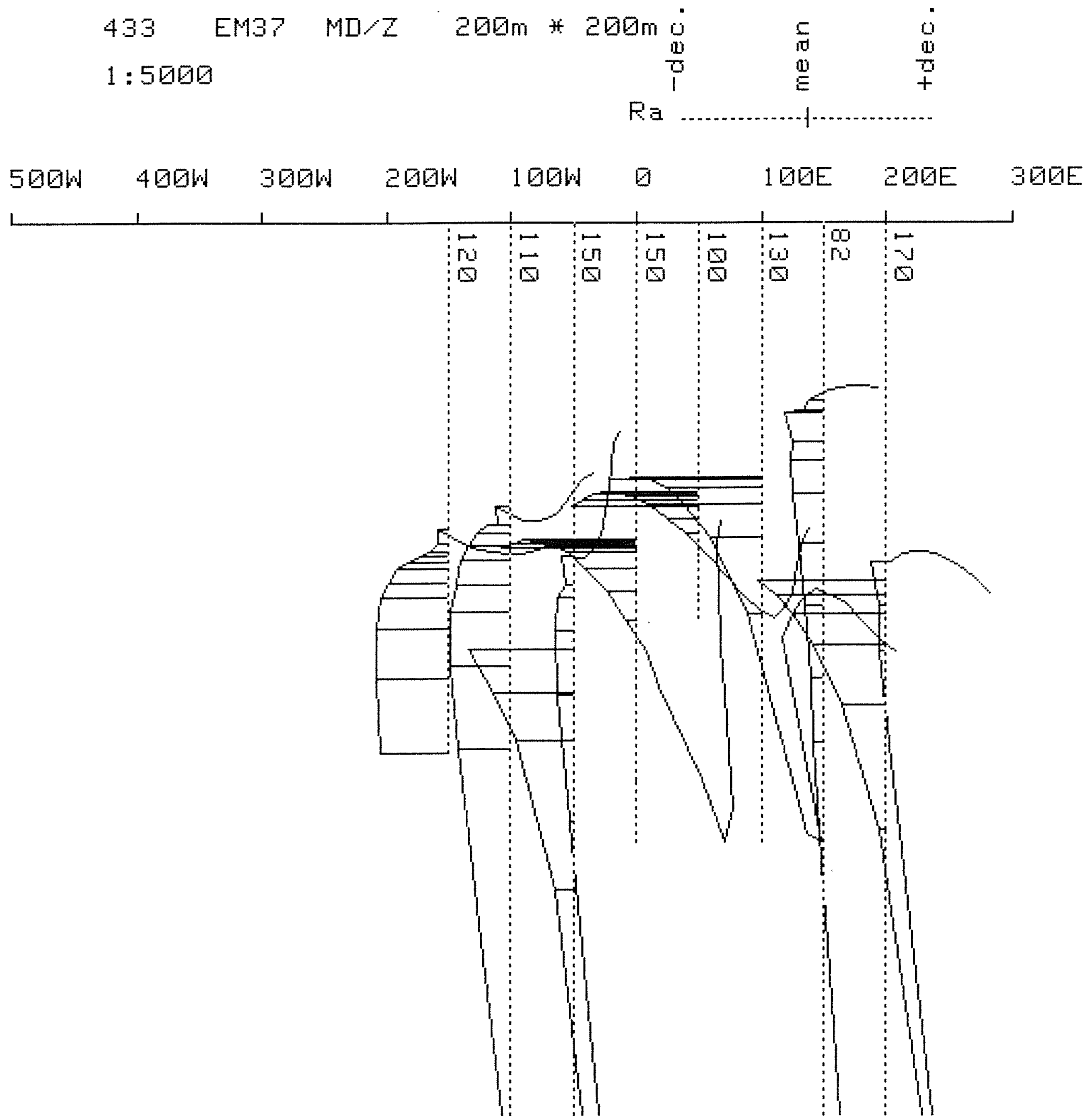


OUTOKUMPU OY Exploration	1:5000	
		JL -86
BIDJOVAGGE Area 43		433
DIT-plot	App. 8/8	

Area 43 MIKKUJAURE 7 Prof.250S

433 EM37 MD/Z 200m * 200m

1:5000

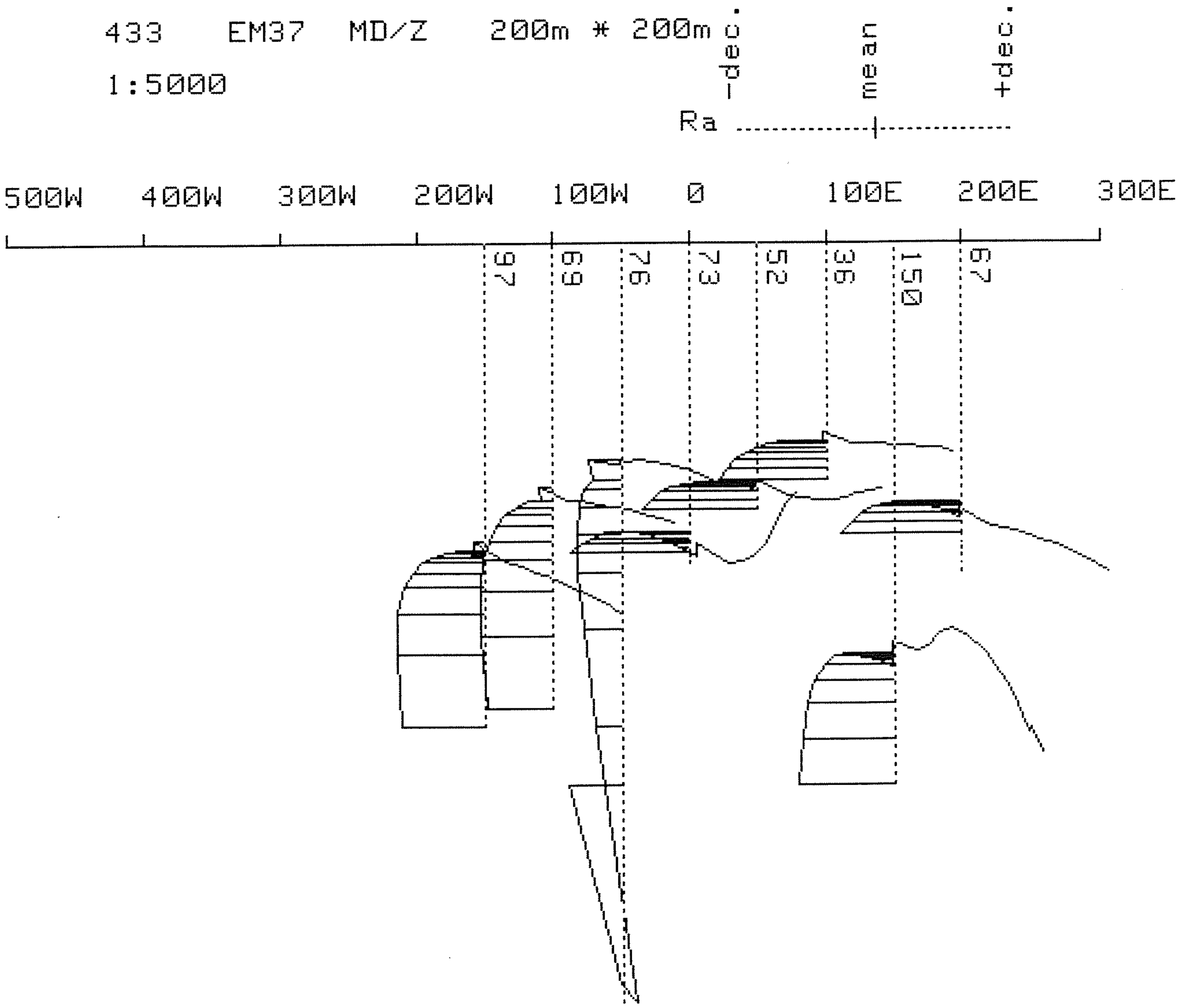


OUTOKUMPU OY Exploration	1:5000	
		JL -86
BIDJOVAGGE Area 43		433
DIT-plot	App. 8/7	

Area 43   MIKKUJAURE 7   Prof.200S

433   EM37   MD/Z   200m * 200m

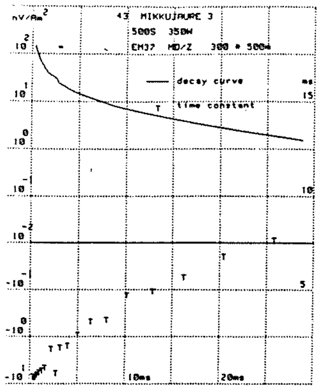
1:5000

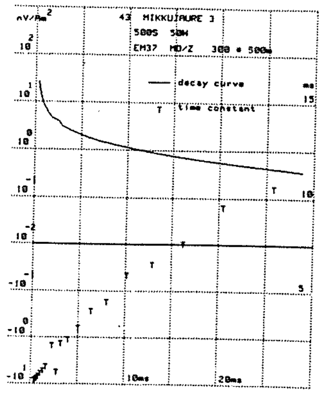


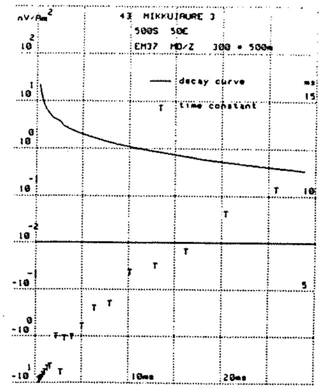
OUTOKUMPU OY Exploration	1:5000	
		JL -86
BIDJOVAGGE Area 43		433
DIT-plot	App. 8/6	

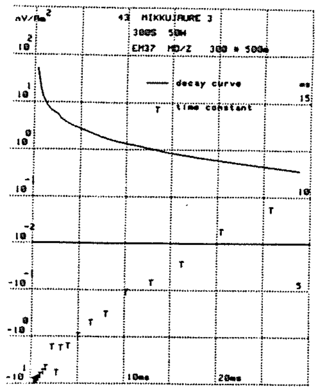
9

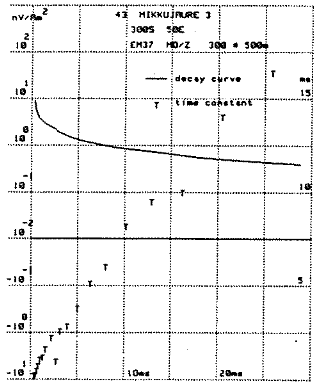
10

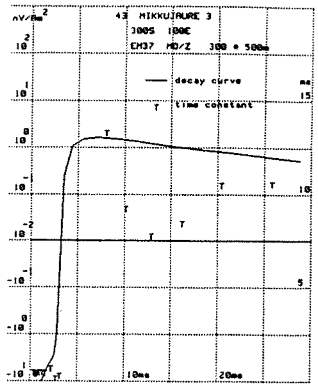


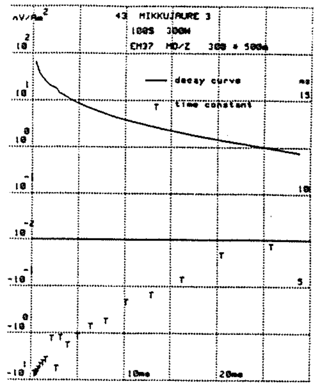


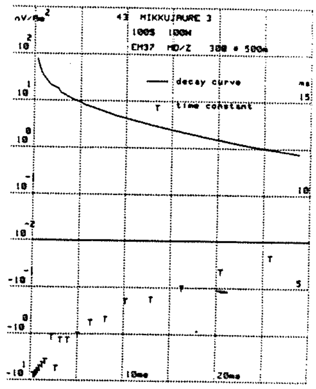


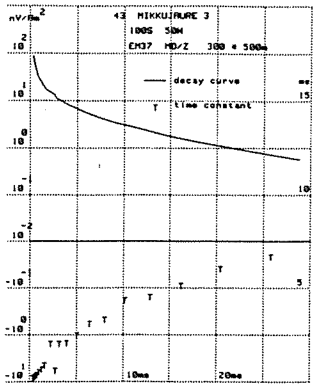


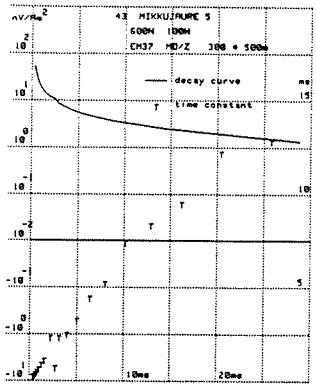


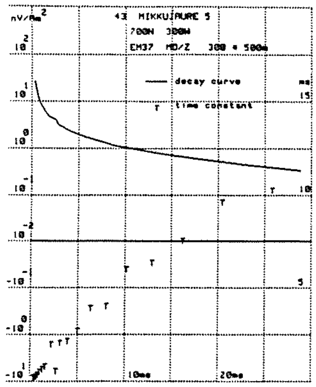


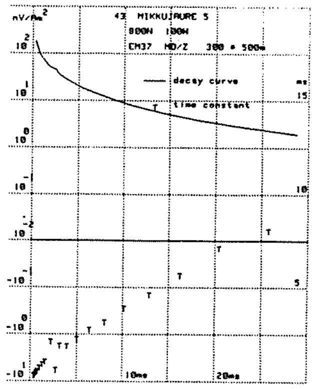








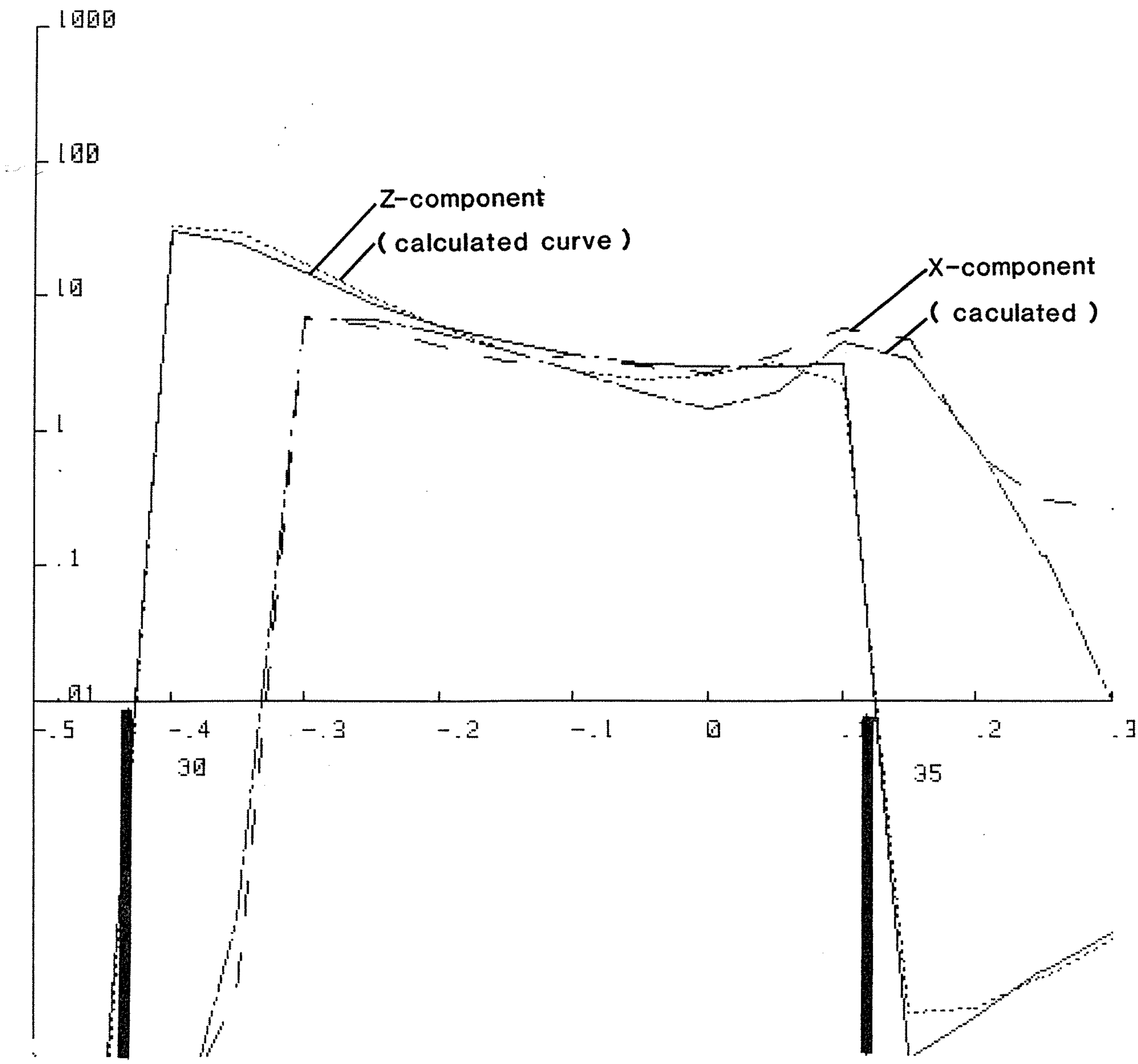




OUTOKUMPU OY Exploration	1:5000 JL -86	
BIDJOVAGGE Area 43		432
TDEM decay curves time constants	App. 10/1	

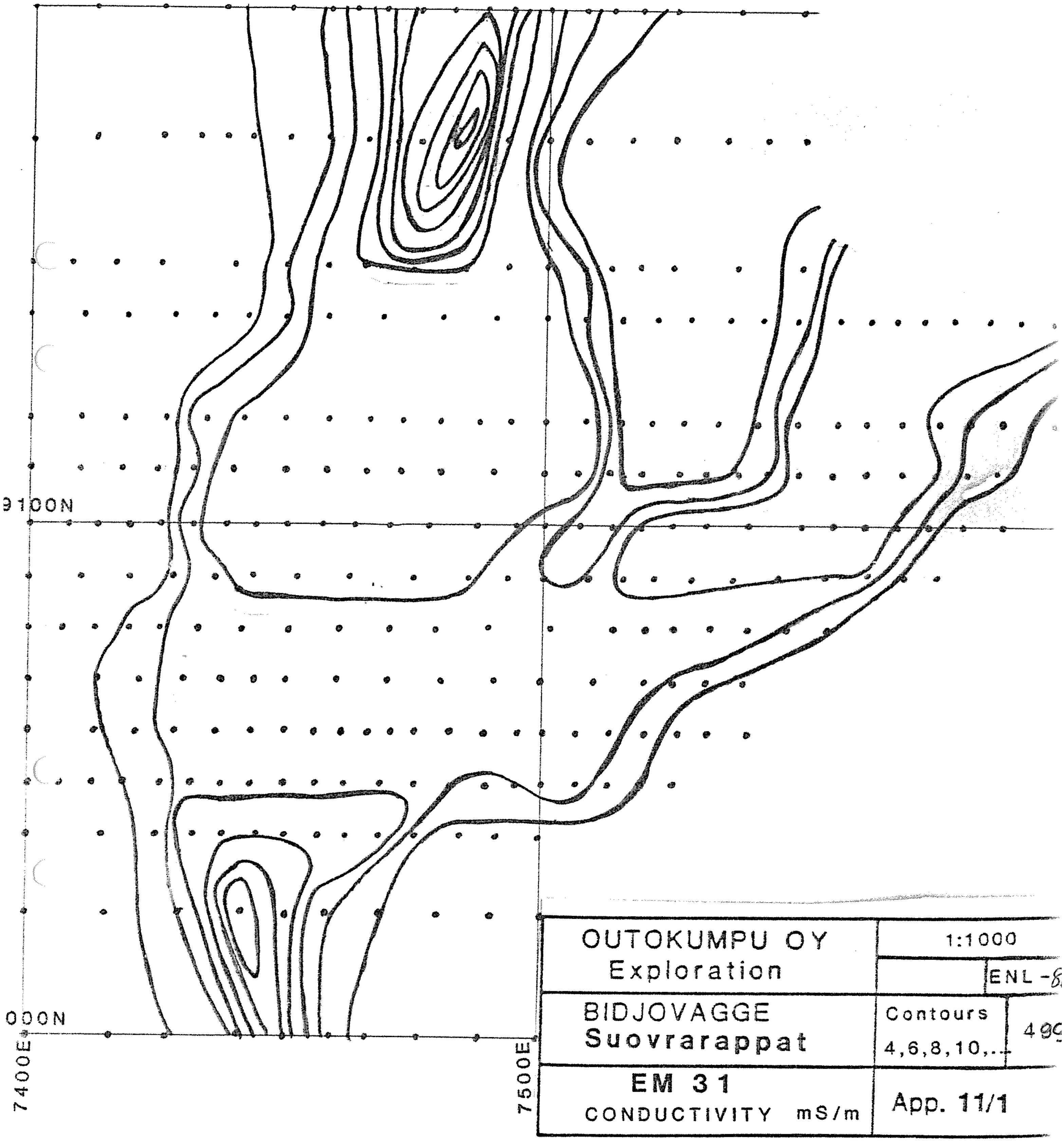
43/MIKKUJAURE 3/Prof A=-.5 -Komp.

415/432 1:5000 Pvm nV/Am^2

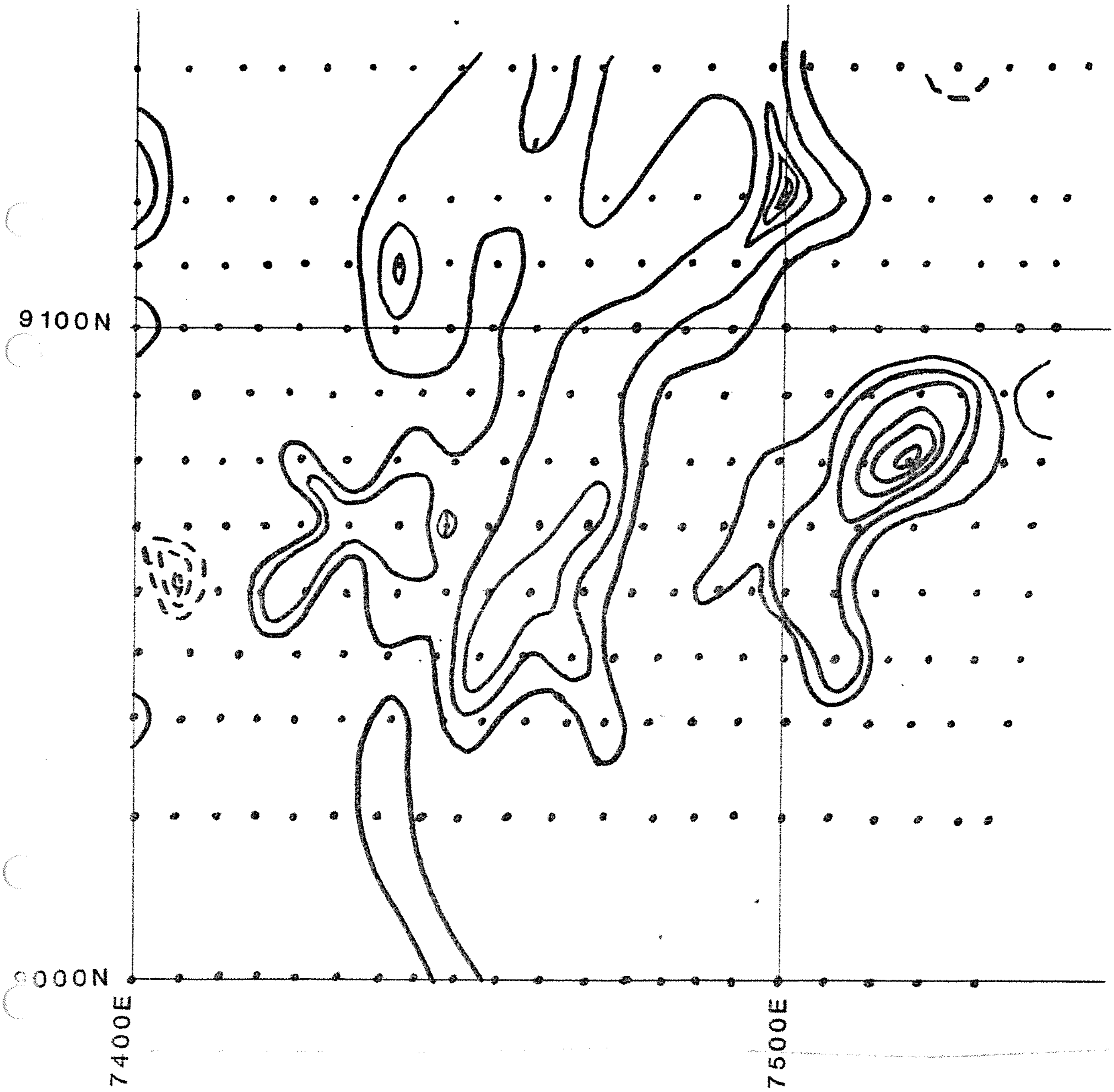


OUTOKUMPU OY Exploration	1:5000	
		JL -86
BIDJOVAGGE Area 43		
TDEM interpretation	App. 10/2	

11



OUTOKUMPU OY Exploration	1:1000 ENL -8	
BIDJOVAGGE Suovrarappat	Contours 4,6,8,10,...	499
EM 31 CONDUCTIVITY mS/m	App. 11/1	



OUTOKUMPU OY Exploration	1:1000	
		ENL -86
BIDJOVAGGE Suovrarappat	Contours ±20,40,60,...	499
Gefinex 200 IN-PHASE %	App. 11/2	