quartz vein coincide with each other, but location is not correspond to each other.

3. Physical property test

In order to grasp the features of rock resistivity, the resistivity of surface samples (45 samples) and drill core (23 samples) are measured. The results are presented in Tables II-5-3 and Fig.II-5-13. Measured values vary from 664 Ω.m of granodiorite (surface sample) to 17,126 Ω.m of quartz vein (surface sample).

Surface samples of granodiorite range in resistivity from 664 to 6,912 Ω.m. Compared with surface samples, resistivity of drill core is relatively high ranging from 6,229 to 11,907 Ω.m. This may be attributable to the fact that surface samples are under the influence of weathering to some extent, whereas resistivity of drill core represented the resistivity of relatively fresh granodiorite in the deep underground. Also, it is assumed that the resistivity of granodiorite which was under the influence of weathering and alteration might have been lowered to around 2,000 Ω.m.

Quartz vein range in resistivity from 4,250 to 17,126 Ω.m. These resistivity values are higher than those of surface samples of granodiorite, while they are similar to or slightly higher than those of granodiorite of drill core with high resistivity.

With regard to the other kinds of rocks, resistivity values of gneiss and diorite are high; the resistivity of gneiss is ranging from 2,308 to 13,394 Ω.m and that of diorite is 7,199 Ω.m. Among the surface samples and drill core gathered this time there was no sample of quartz vein containing gold particles. However, since the amounts of gold particles contained were extremely small, it may be judged that gold particles do not constitute a factor to reduce resistivity. In fact no alteration related to the vein is noted.

From the above results, the resistivity of the rocks distributed in the area surveyed this time is found high, showing similar degrees each other and, consequently, it is difficult to classify geological characteristics according to the values of resistivity. However, since resistivity of quartz vein are slightly higher than those of other rocks, in case the width of quartz vein is broad or in case several veins are gathered together, high resistivity may be revealed in the resistivity distribution obtained through CSAMT Method measurement.

5-3 Analysis

1. Analysis method

(1-D analysis)

In order to obtain underground resistivity models, 1-D analysis was made on the assumption that the underground resistivity structure was of a horizontal multi-layered structure.

Table II-5-3 Results of Physical Property Test

No.	Sample No.	Location	Depth(m)	Rock Name	Resistivity (ohm-m)	Rem.
1		Area I	-	Granodiorite	2,847	
2		〃	-	Andesite dyke	2,752	
3		〃	-	Granodiorite	6,912	
4		〃	-	Granodiorite	2,200	
5		〃	-	Pegmatite	5,015	
6		〃	-	Psammytic gneiss	5,933	
7		〃	-	Granodiorite	1,376	
8		〃	-	Granodiorite	1,944	
9		〃	-	Psammytic gneiss	4,095	
10		〃	-	Amphibole gneiss	3,002	
11		〃	-	Quartz vein(No.10)	12,502	
12		〃	-	Granodiorite	2,227	
13		〃	-	Granodiorite	2,341	
14		〃	-	Granodiorite	1,490	
15		〃	-	Granodiorite	1,645	
16		〃	-	Granodiorite	2,054	
17		〃	-	Granodiorite	5,163	
18		〃	-	Granodiorite	3,968	
19		〃	-	Granodiorite	664	
20		〃	-	Psammytic gneiss	3,681	
21		〃	-	Granodiorite	4,262	
22		〃	-	Granodiorite	1,752	
23		〃	-	Granodiorite(Pb,Zn vein)	3,150	
24		〃	-	Granodiorite	3,907	
25		〃	-	Granodiorite	2,547	
26		〃	-	Diorite	7,199	
27		Area II	-	Felsite	1,416	
28		〃	-	Granodiorite	1,940	
29		〃	-	Quartz vein	4,639	
30		〃	-	Quartz vein	11,909	
31		〃	-	Granodiorite	1,486	
32		〃	-	Granodiorite	1,431	
33		〃	-	Quartz vein	12,782	
34		〃	-	Granodiorite	2,673	
35		〃	-	Quartz vein	4,250	
36		〃	-	Granodiorite	2,384	
37		〃	-	Quartz vein	16,718	
38		〃	-	Quartz vein	17,126	
39		〃	-	Granodiorite	3,718	
40		〃	-	Granodiorite	2,678	
41		〃	-	Granodiorite	4,400	
42		〃	-	Granodiorite	3,019	
43		〃	-	Psammytic gneiss	2,308	pumice
44		〃	-	Quartz vein	8,341	
45		〃	-	Granodiorite	2,096	
46		MJMT-1	44.60	Anmbl Gn	1,510	
47		〃	56.00	Granodiorite	11,907	
48		〃	68.50	Ss-Gn	3,158	
49		〃	75.25	Granodiorite	7,571	
50		〃	77.90	Ss-Gn	4,441	
51		〃	87.20	Granodiorite	6,229	
52		〃	115.00	Ss-Gn	9,648	
53		〃	120.40	Granodiorite	9,765	
54		〃	127.00	Ss-Gn	10,751	
55		〃	140.00	Anmbl Gn	4,224	
56		〃	146.10	Pegmatite	6,156	
57		〃	164.50	Granodiorite	6,689	
58		〃	175.90	Ss-Gn	8,852	
59		〃	203.60	Ss-Gn	6,277	
60		〃	245.37	Ss-Gn	13,394	
61		〃	273.00	Granodiorite	8,880	
62		〃	296.00	Ss-Gn	8,413	
63		MJMT-2	40.53	Granodiorite	7,226	
64		〃	141.60	Granodiorite	2,117	
65		〃	181.00	Granodiorite	3,417	
66		〃	216.40	Granodiorite	9,090	
67		〃	255.56	Granodiorite	7,695	
68		〃	299.36	Granodiorite	7,623	

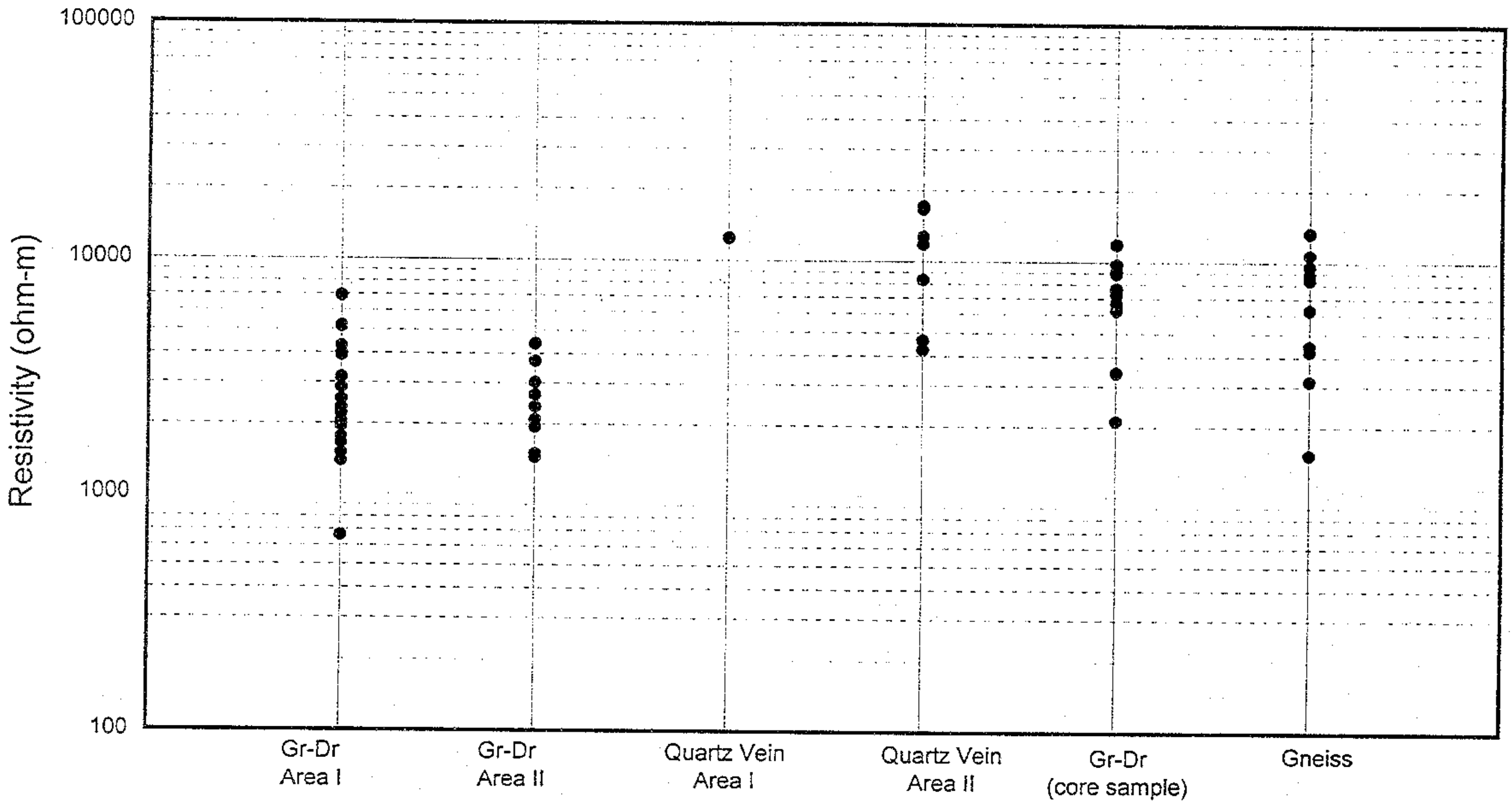

Fig.II-5-13 Resistivity Property of Rock and Core Sample

In the analysis, the data which had been obviously under the influence of noise were excluded. Apparent resistivity value was calculated for initial models of each frequency with parameters of the number of layers of horizontal multi-layered structure, thickness of layers and resistivity values. Then simulation technique was used to correct the parameters of the models so that they might become near to the values of actual measurement (the values obtained after near field correction based on the method of Yamashita and Hallof (1985). The analysis program "EMIXMT" of Interpex was used.

(2-D analysis)

2-D analysis was conducted using 2-D inversion analysis program of Uchida and Ogawa (1993). In the analysis, the data under the influence of near field were excluded.

2. Section of 1-D resistivity structure

Section of 1-D Resistivity Structure was prepared by arranging the resistivity structure of each survey line obtained as a result of 1-D analysis (See Figs. II-5-14 to II-5-29).

As geological features of the survey area, this area is underlain by granodiorite, adamellite, diorite and gneiss. From the results of resistivity measurement of samples, they had similar resistivity values and it is difficult to identify the types of these rocks by comparing their resistivity values. Here, it is considered that difference between the values of resistivity obtained through our field survey reflected the degree of alteration caused by weathering, existence of fracture zones, and distribution of quartz vein. Noting in particular the existence of high resistivity layer revealed as a result of our analysis, the outline of its correspondence with the distribution of quartz vein outcrops is stated as follows:

1) Area I

(line A)

Resistivity of the surface layer is ranging from 500 to 2,000 Ω·m (Layer thickness: around 200 m). Beneath the surface layer the high resistivity layer of 2,000 to 10,000 Ω·m is noted to exist toward the depth. In the eastern region of station No.19, the resistivity value of the second layer is 5,000 Ω·m or more which is slightly higher than that of the west side. In particular, high resistivity value of 10,000 Ω·m or more is analyzed at stations No.20 and 24. Outcrop of quartz vein is noted in the position between stations No.19 and 20.

(line B)

The resistivity value of the surface layer is ranging from 500 to 2,000 Ω·m (layer

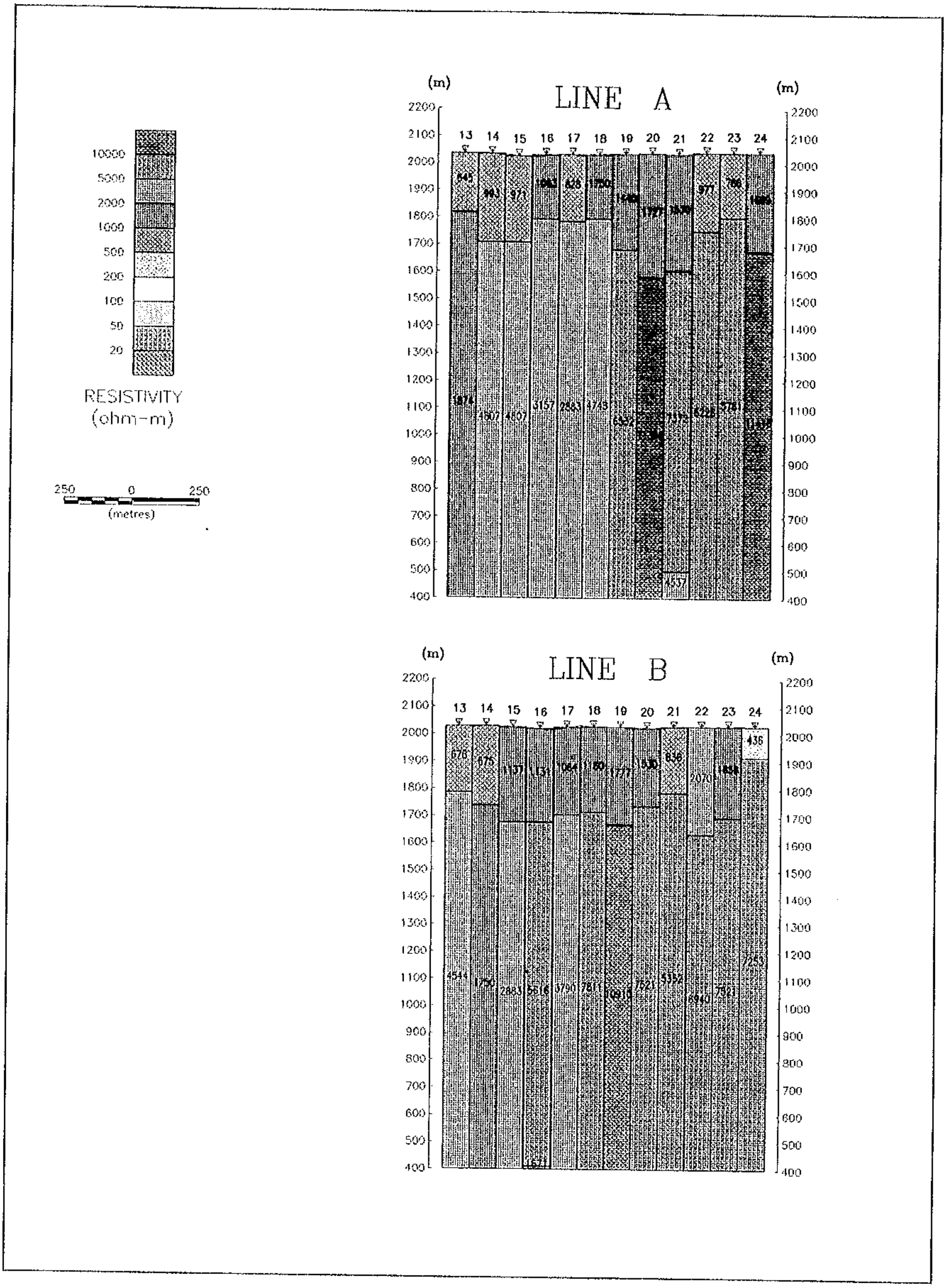

Fig. II-5-14 Section of 1-D Resistivity Structure (Area I ,Line A, B)

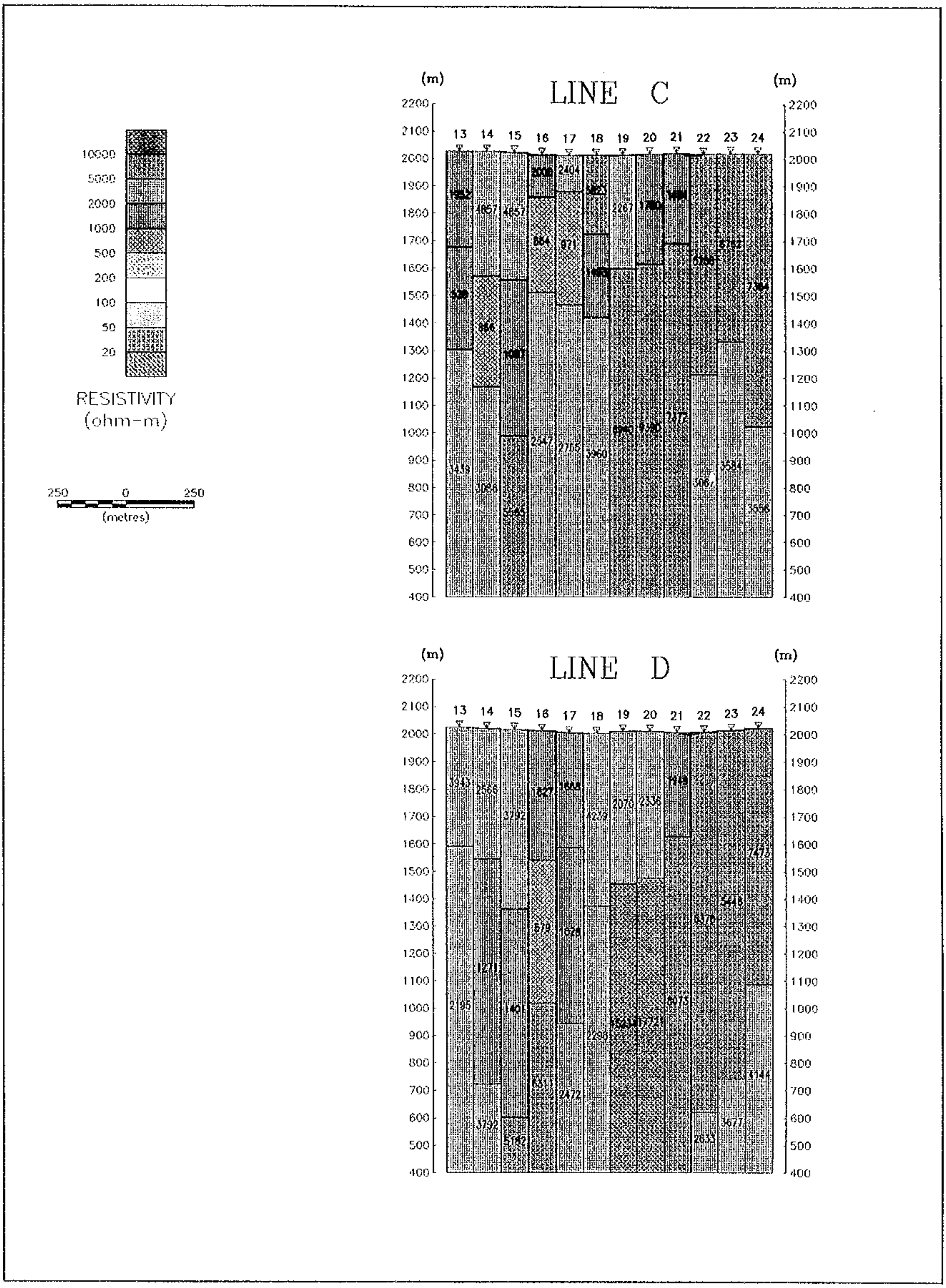

Fig. II-5-15　　Section of 1-D Resistivity Structure (Area I, Line C, D)

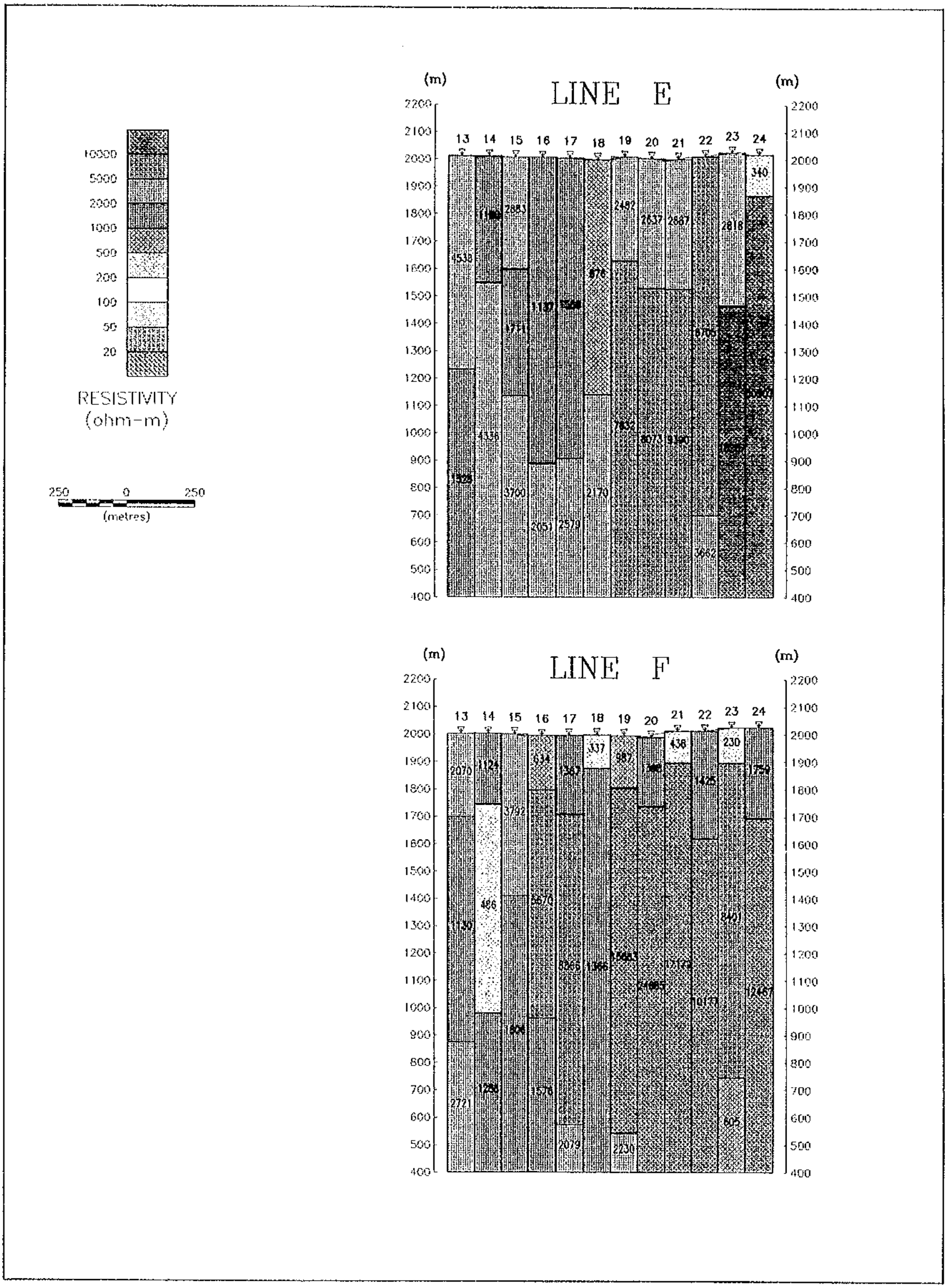

Fig. II -5-16 Section of 1-D Resistivity Structure (Area I ,Line E, F)

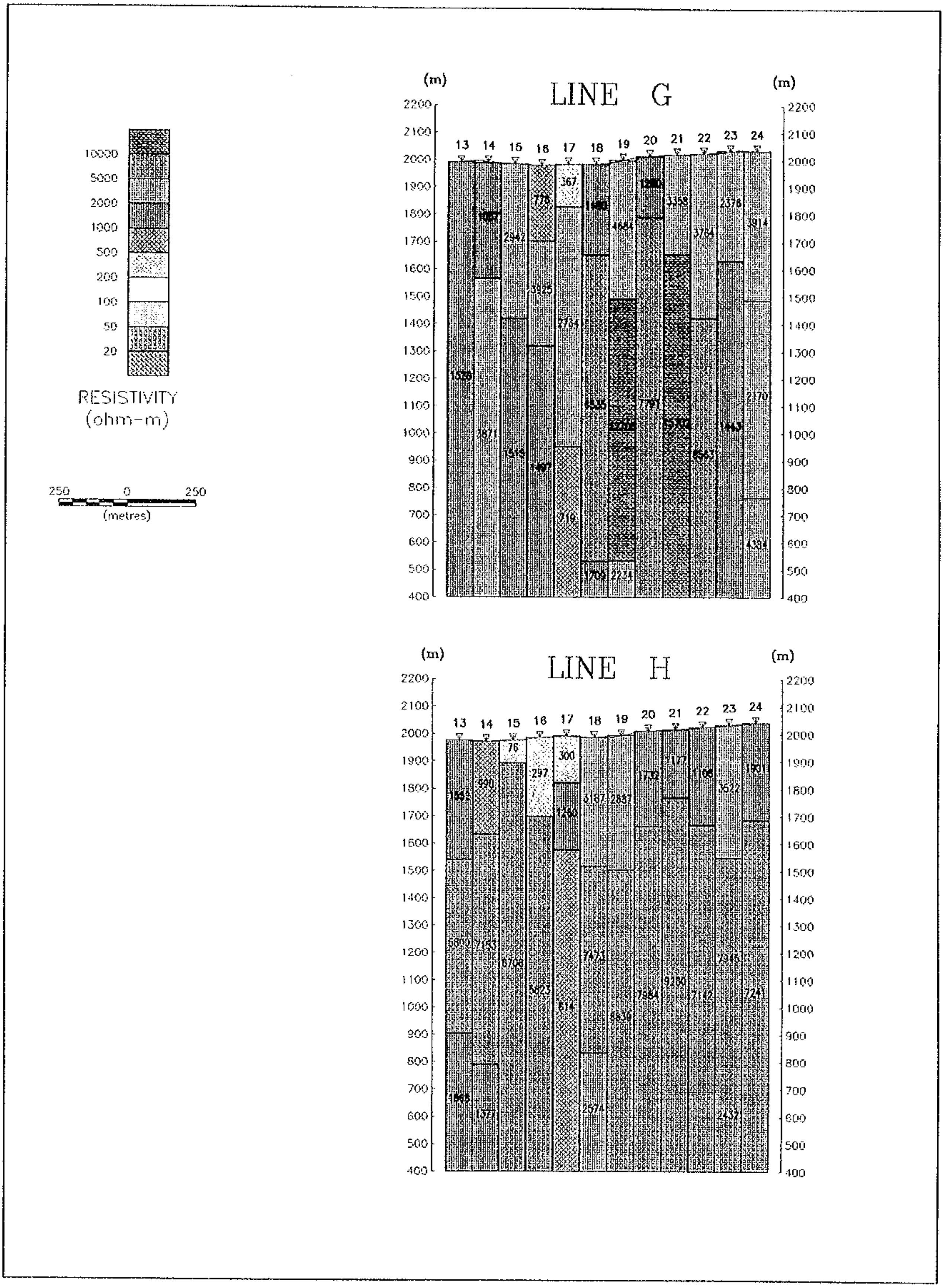

Fig. II-5-17 Section of 1-D Resistivity Structure (Area 1 ,Line G, H)

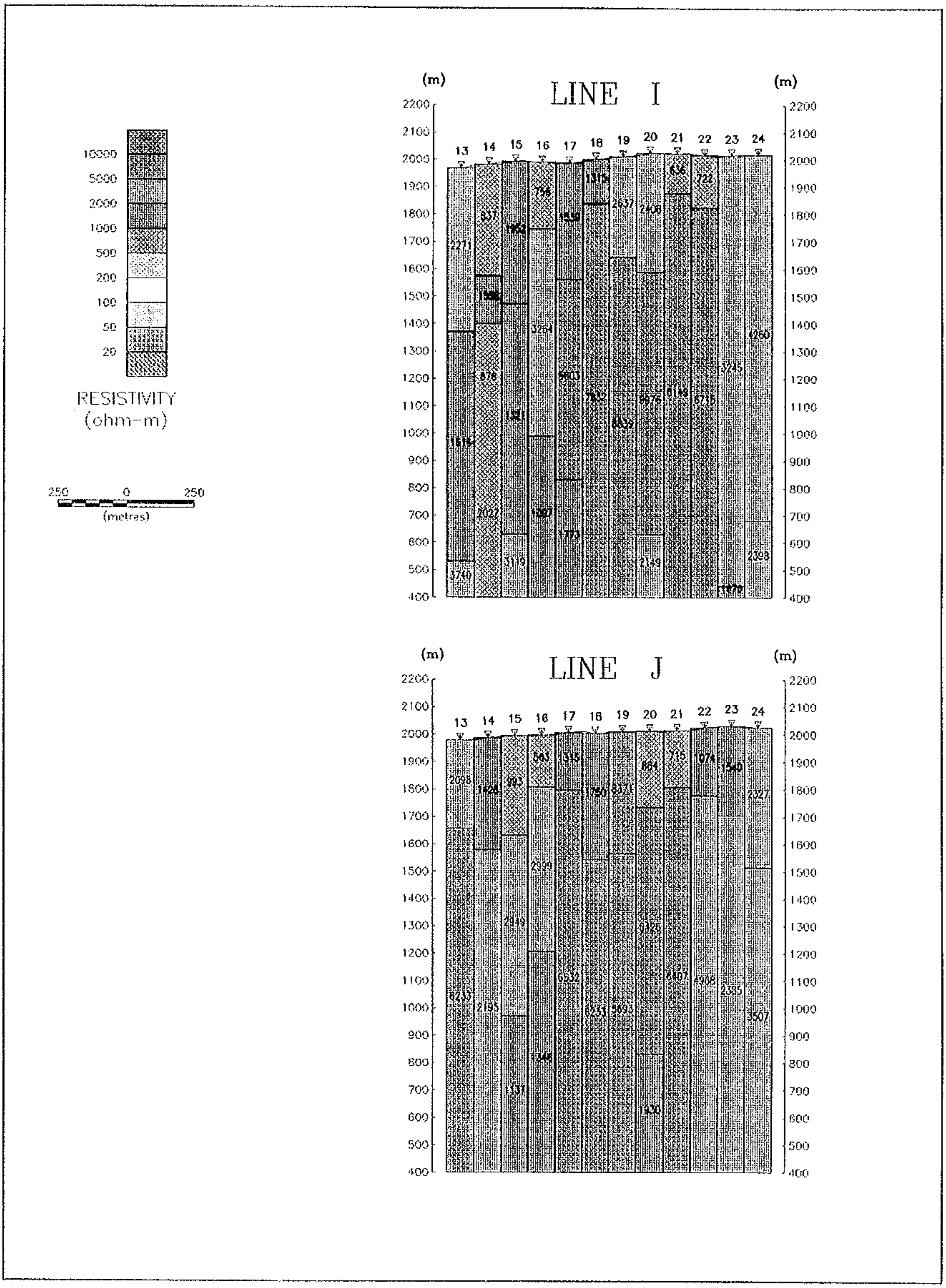

Fig. II-5-18 Section of 1-D Resistivity Structure (Area I ,Line I, J)

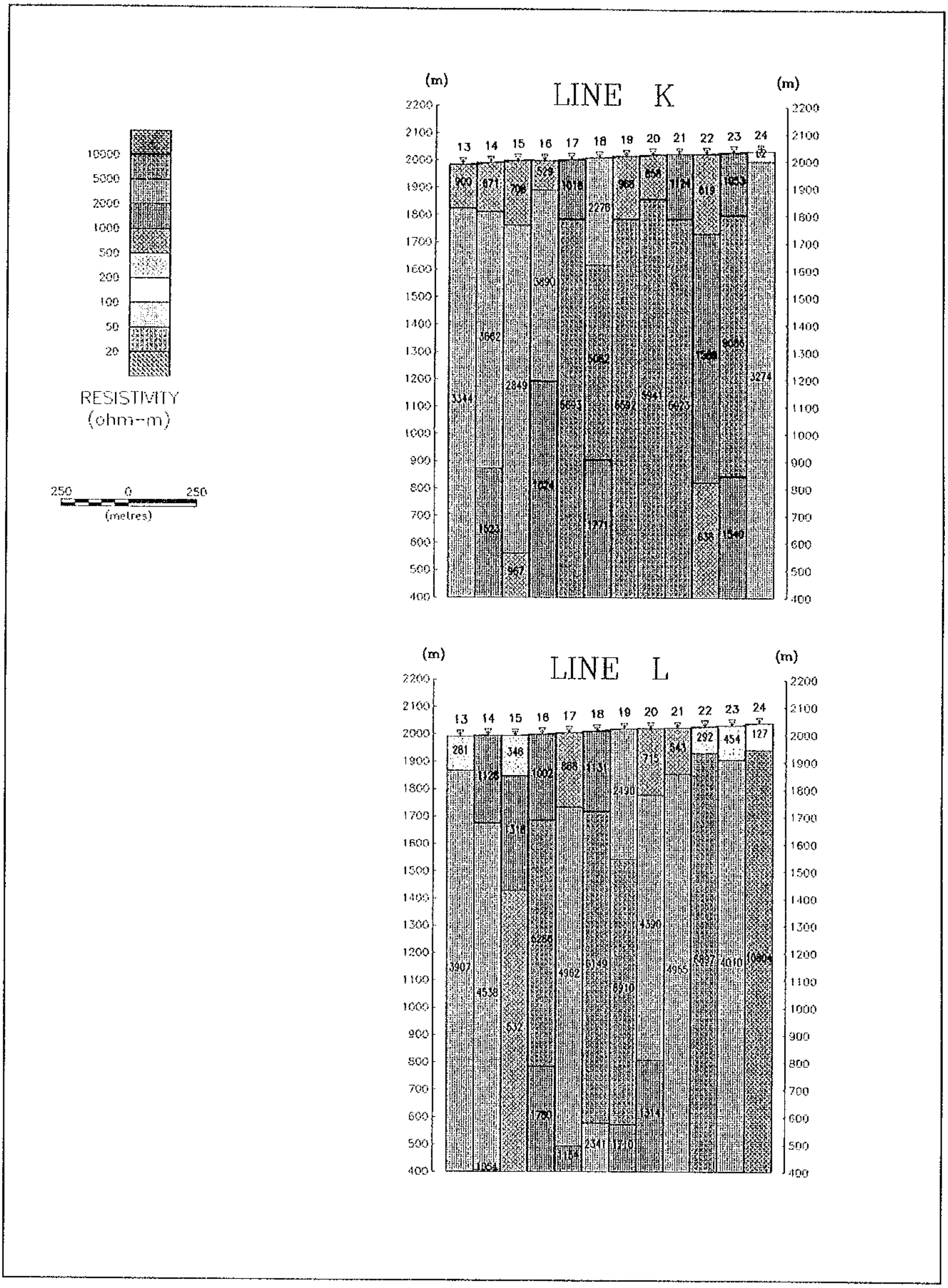

Fig. II-5-19 Section of 1-D Resistivity Structure (Area I ,Line K, L)

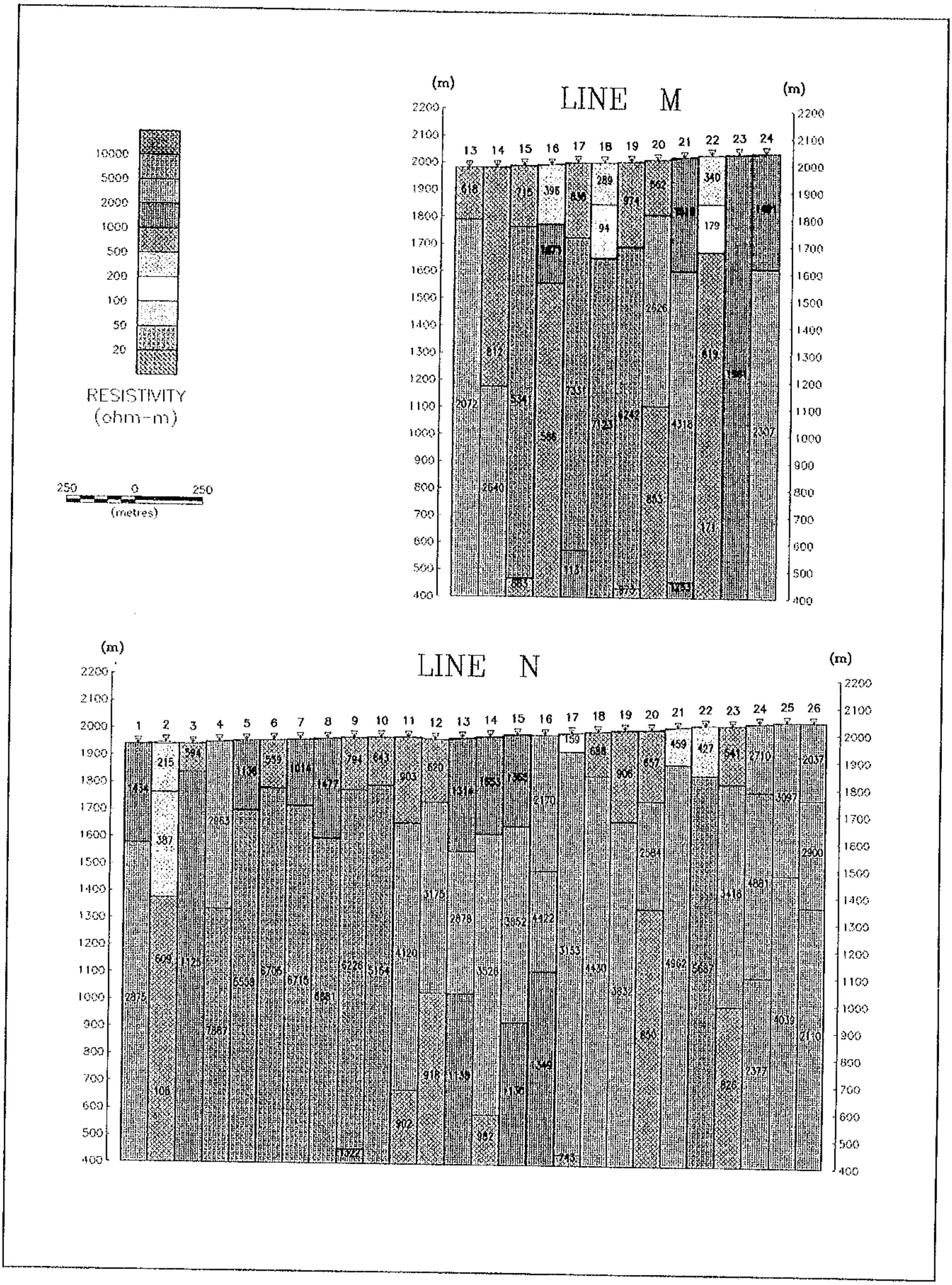

Fig. II -5-20 Section of 1-D Resistivity Structure (Area I ,Line M, N)

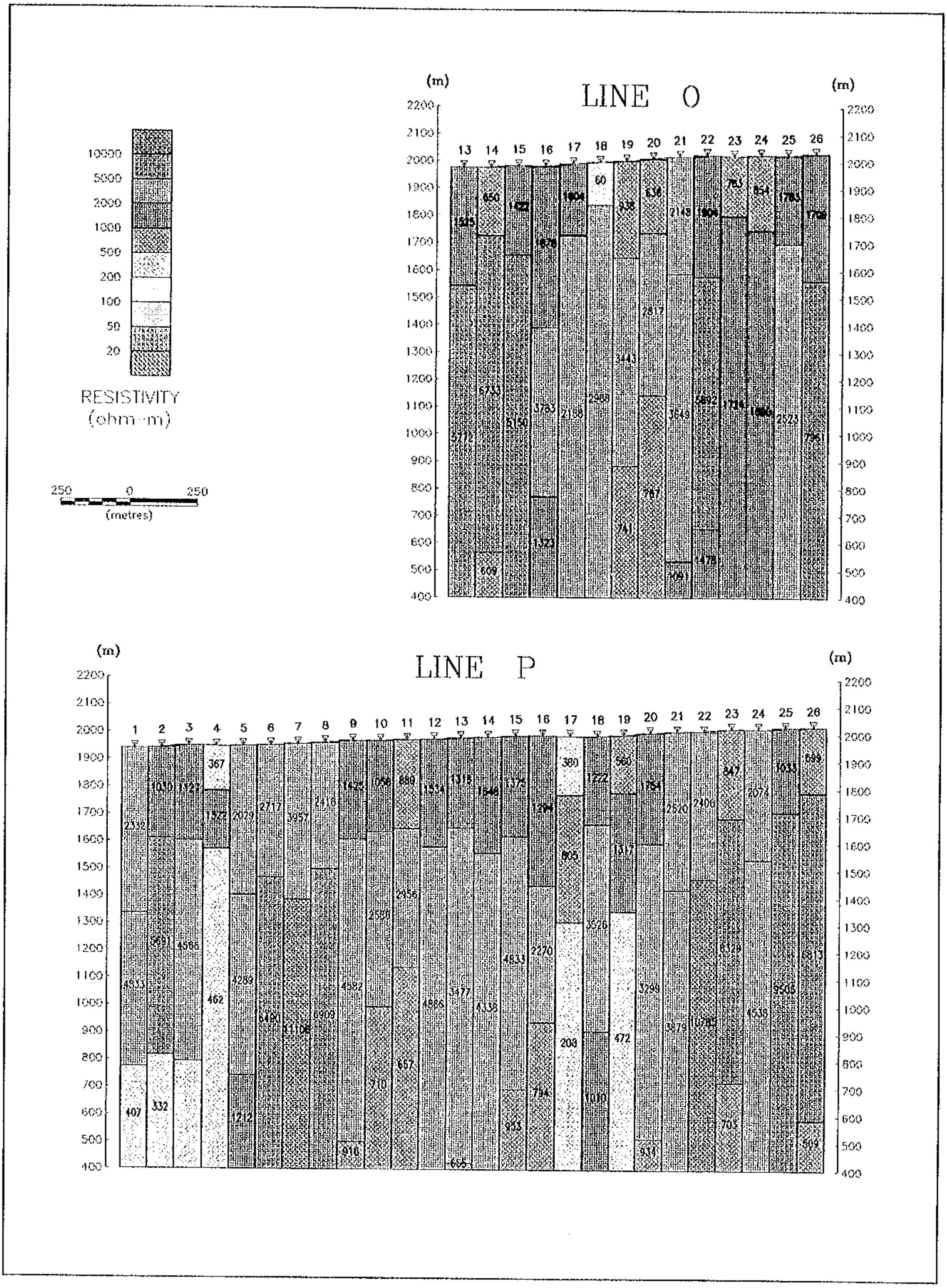

Fig. II-5-21　　Section of 1-D Resistivity Structure (Area I, Line O, P)

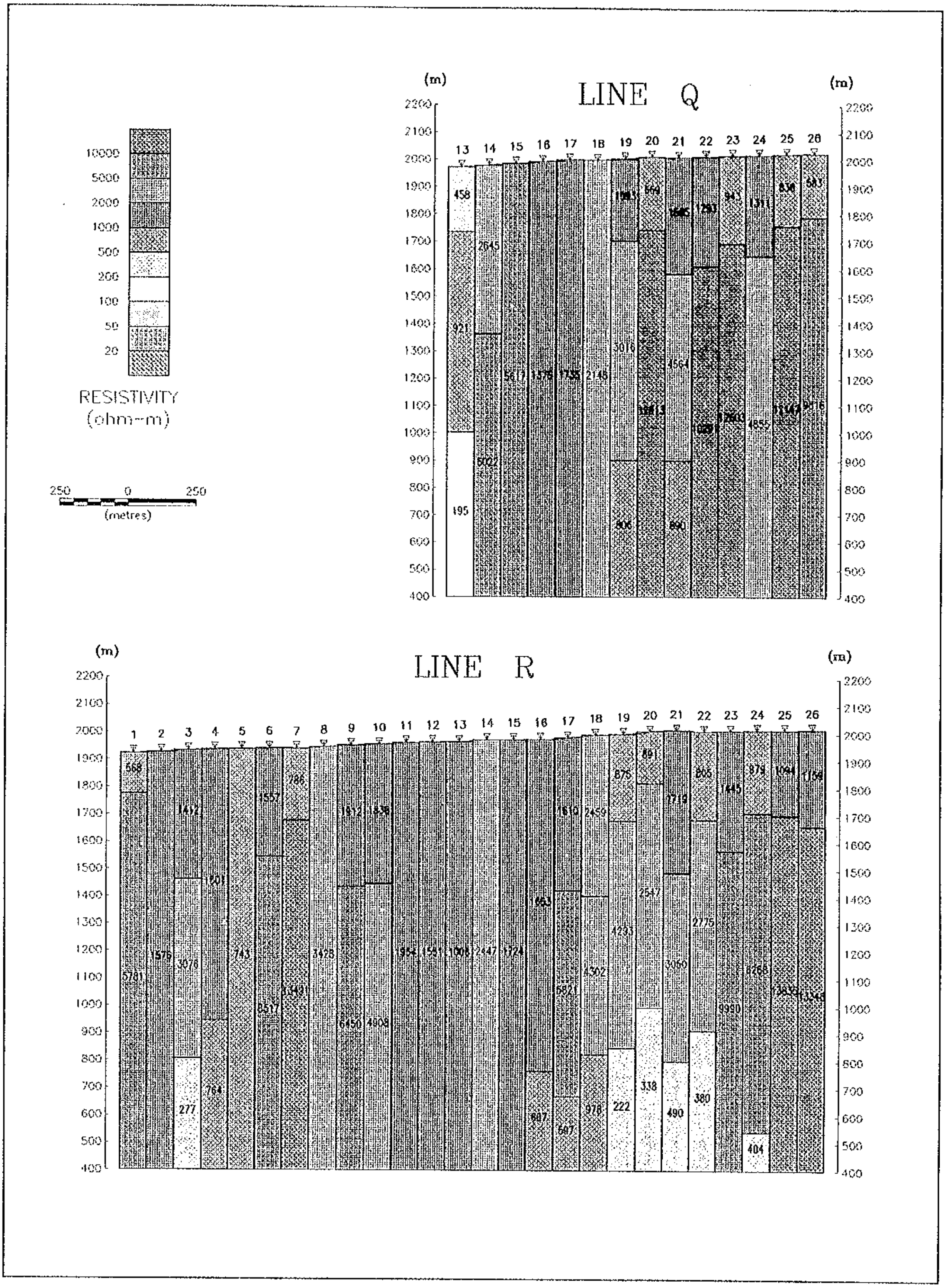

Fig. II-5-22 Section of 1-D Resistivity Structure (Area I ,Line Q, R)

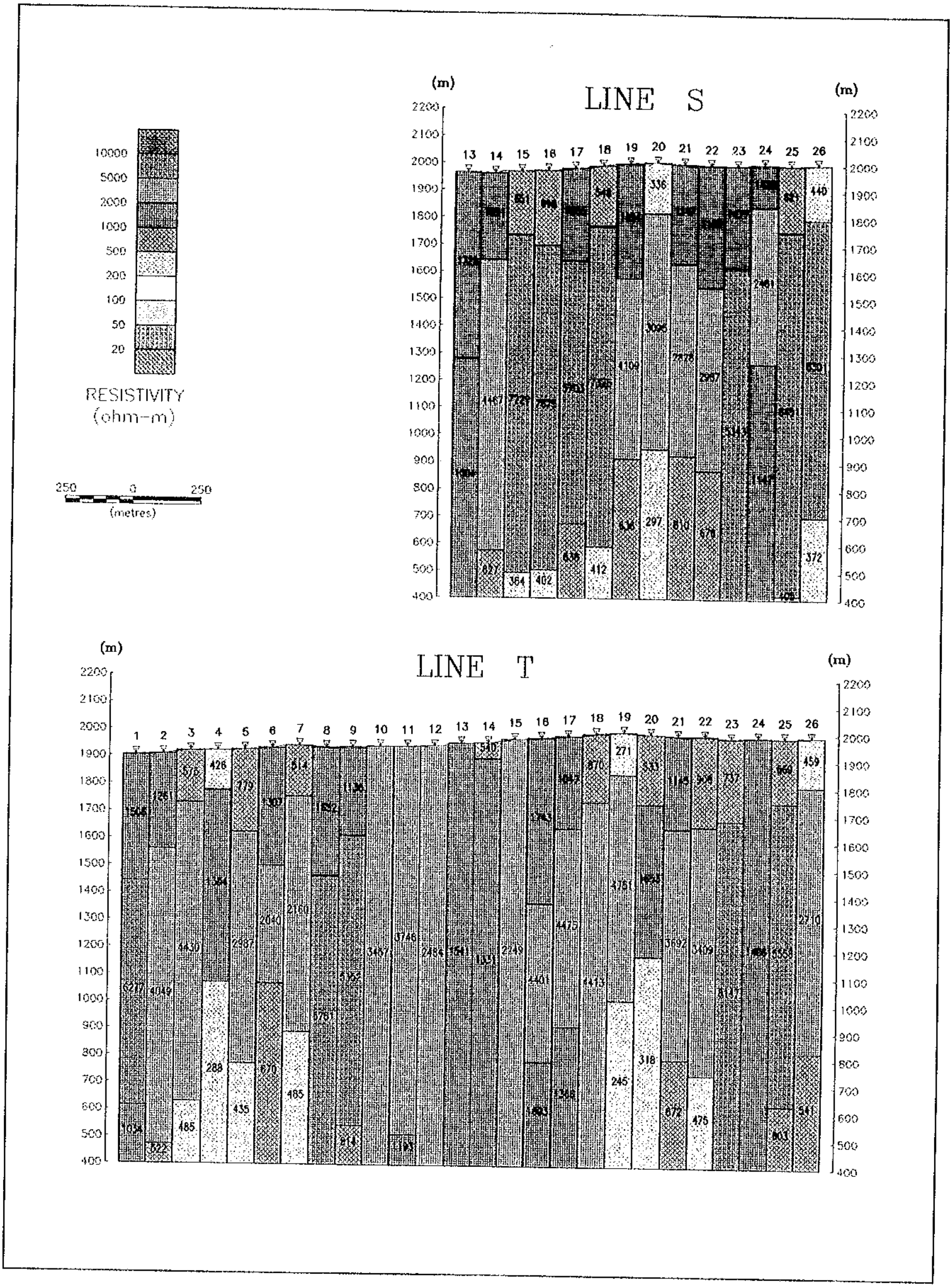

Fig. II-5-23 Section of 1-D Resistivity Structure (Area I, Line S, T)

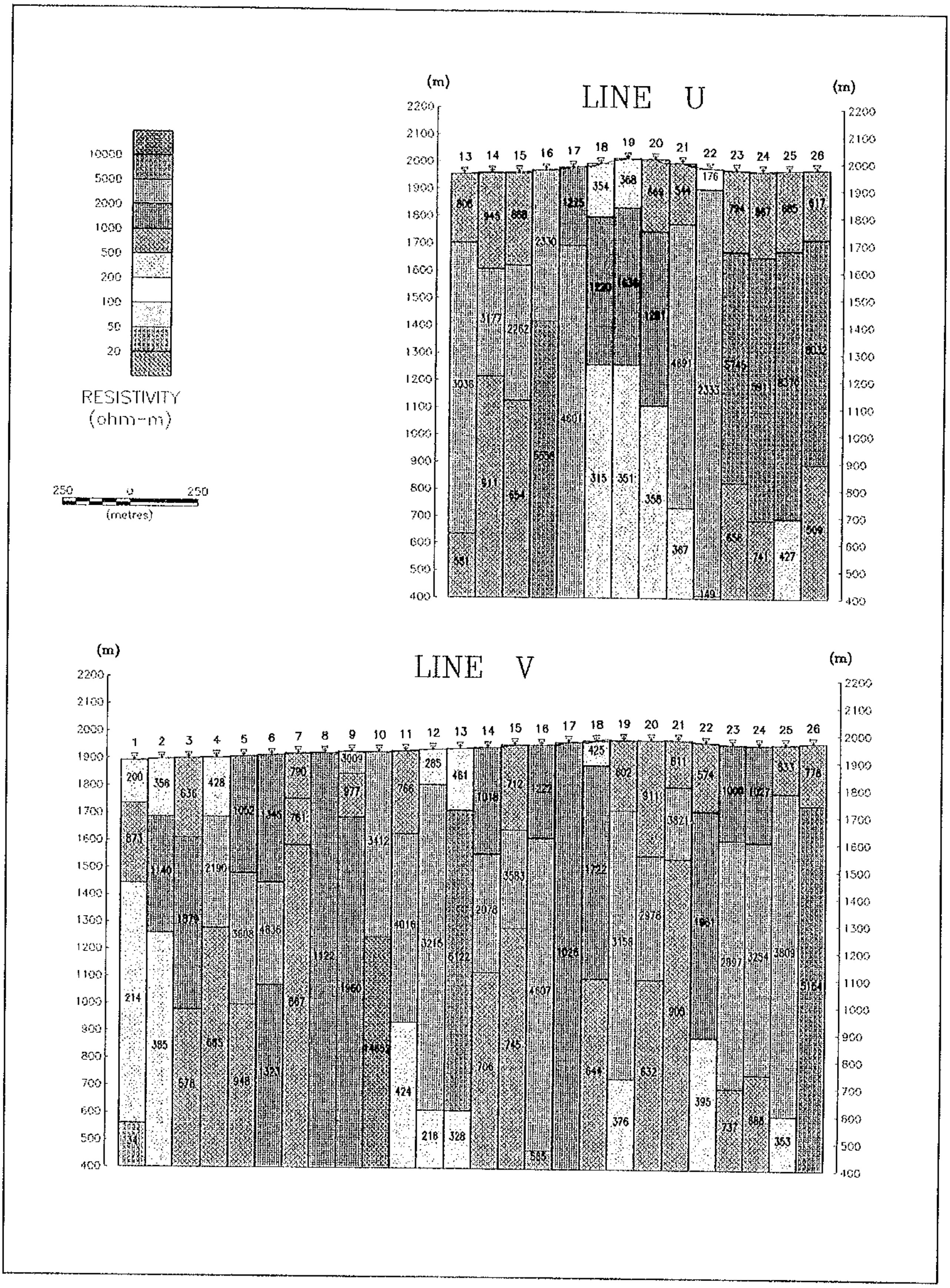

Fig. II-5-24 Section of 1-D Resistivity Structure (Area I, Line U, V)

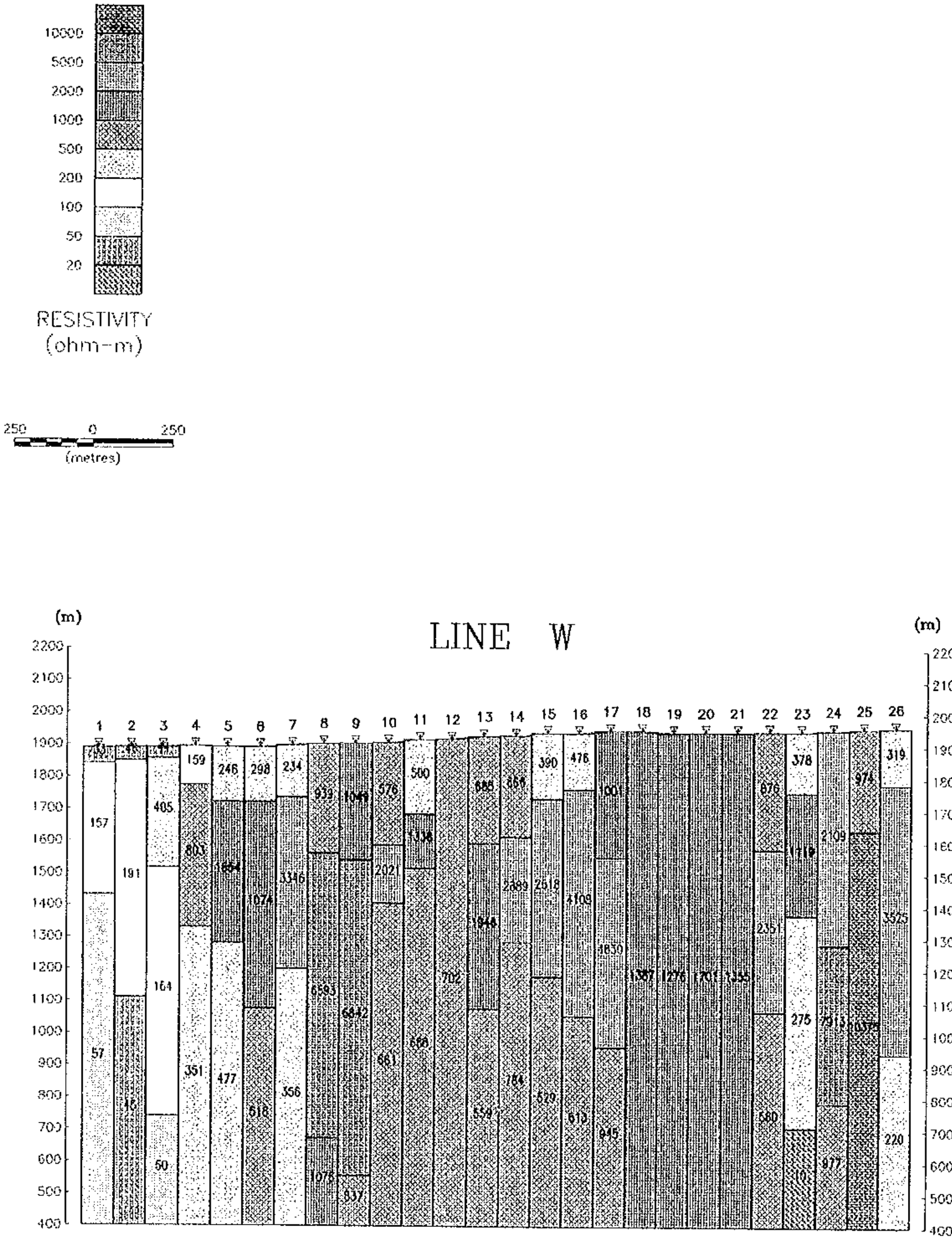

Fig. II-5-25 Section of 1-D Resistivity Structure (Area I ,Line W)

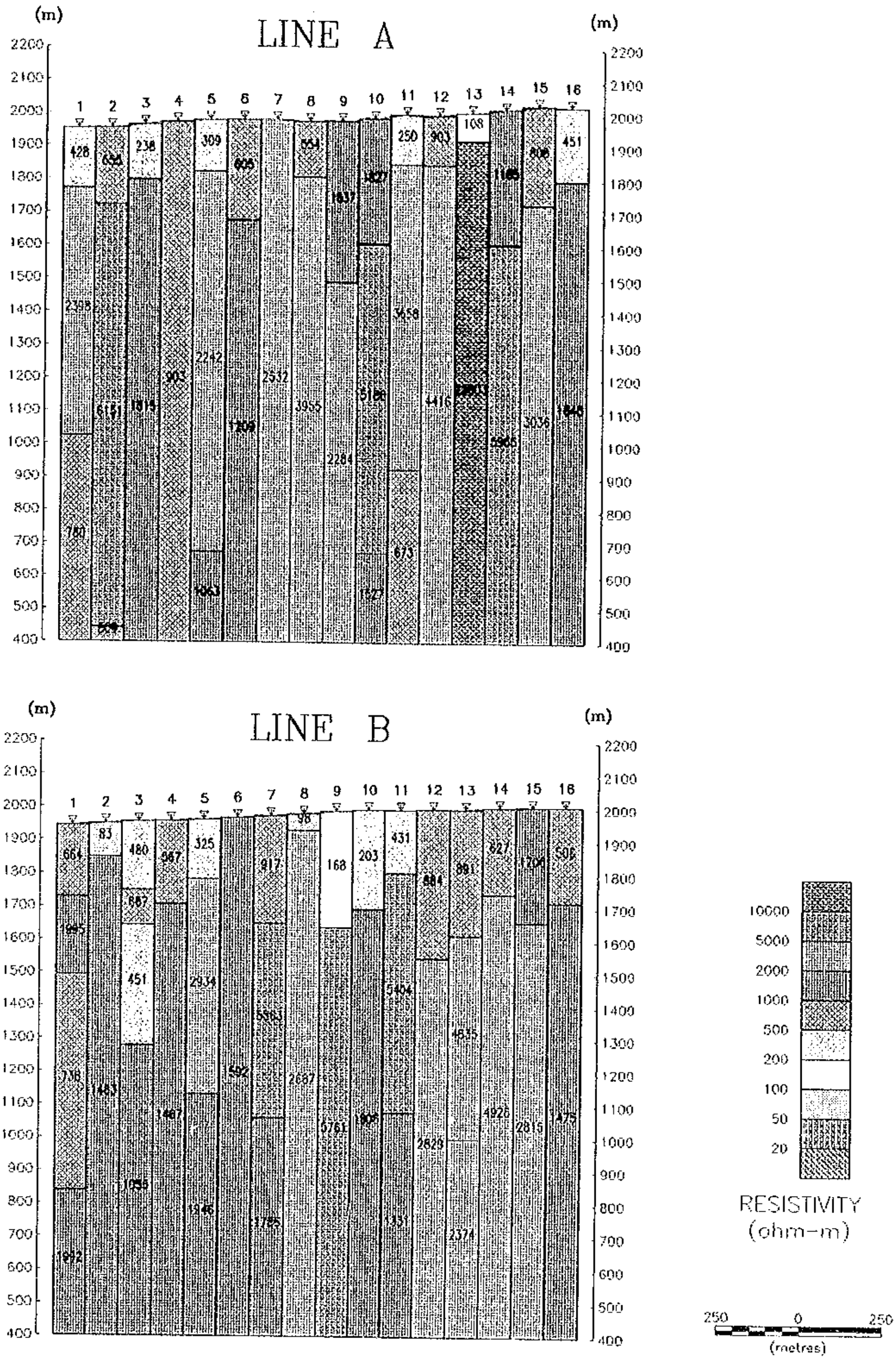

Fig. II-5-26 Section of 1-D Resistivity Structure (Area II, Line A, B)

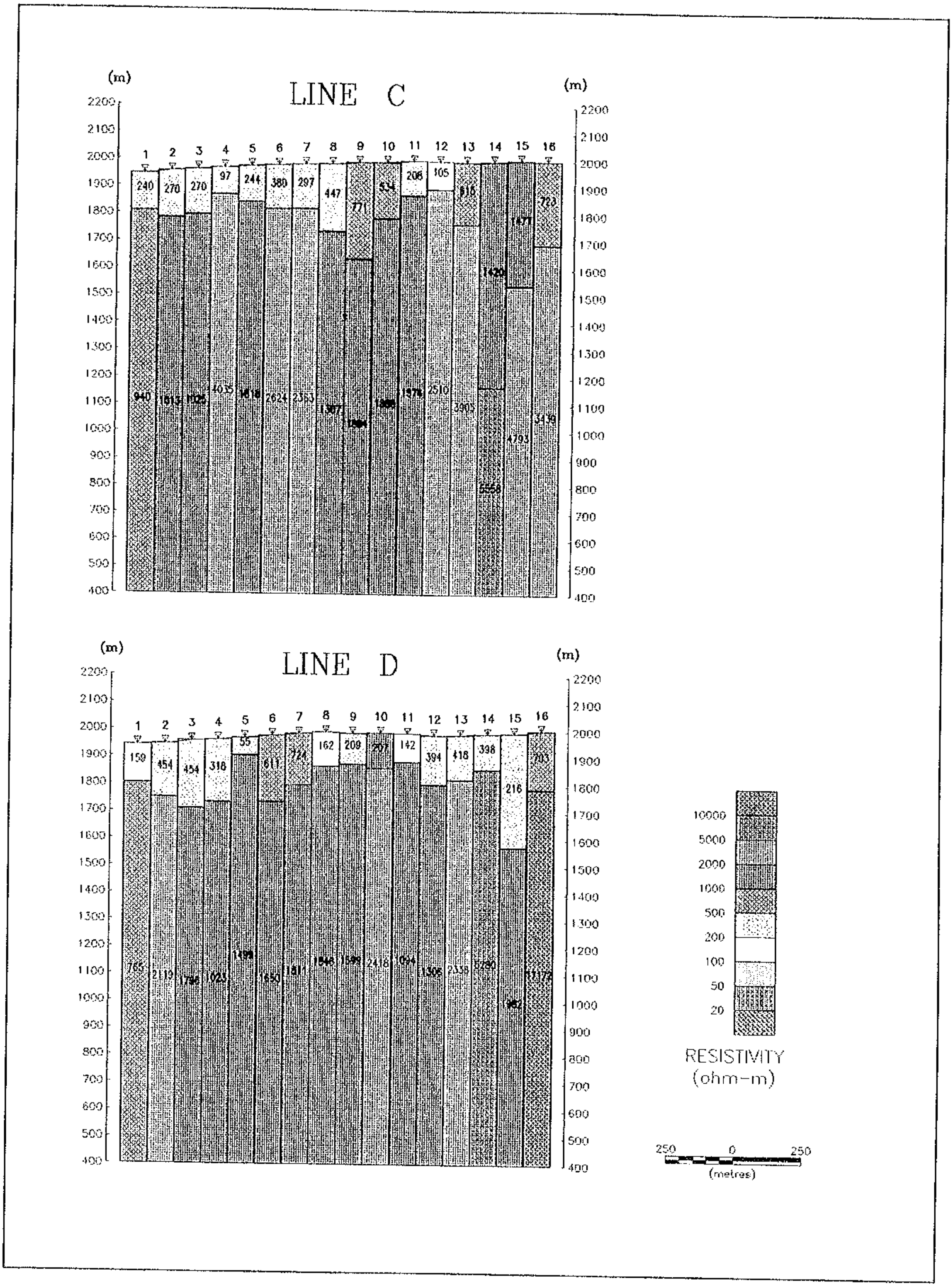

Fig. II-5-27 Section of 1-D Resistivity Structure (Area II, Line C, D)

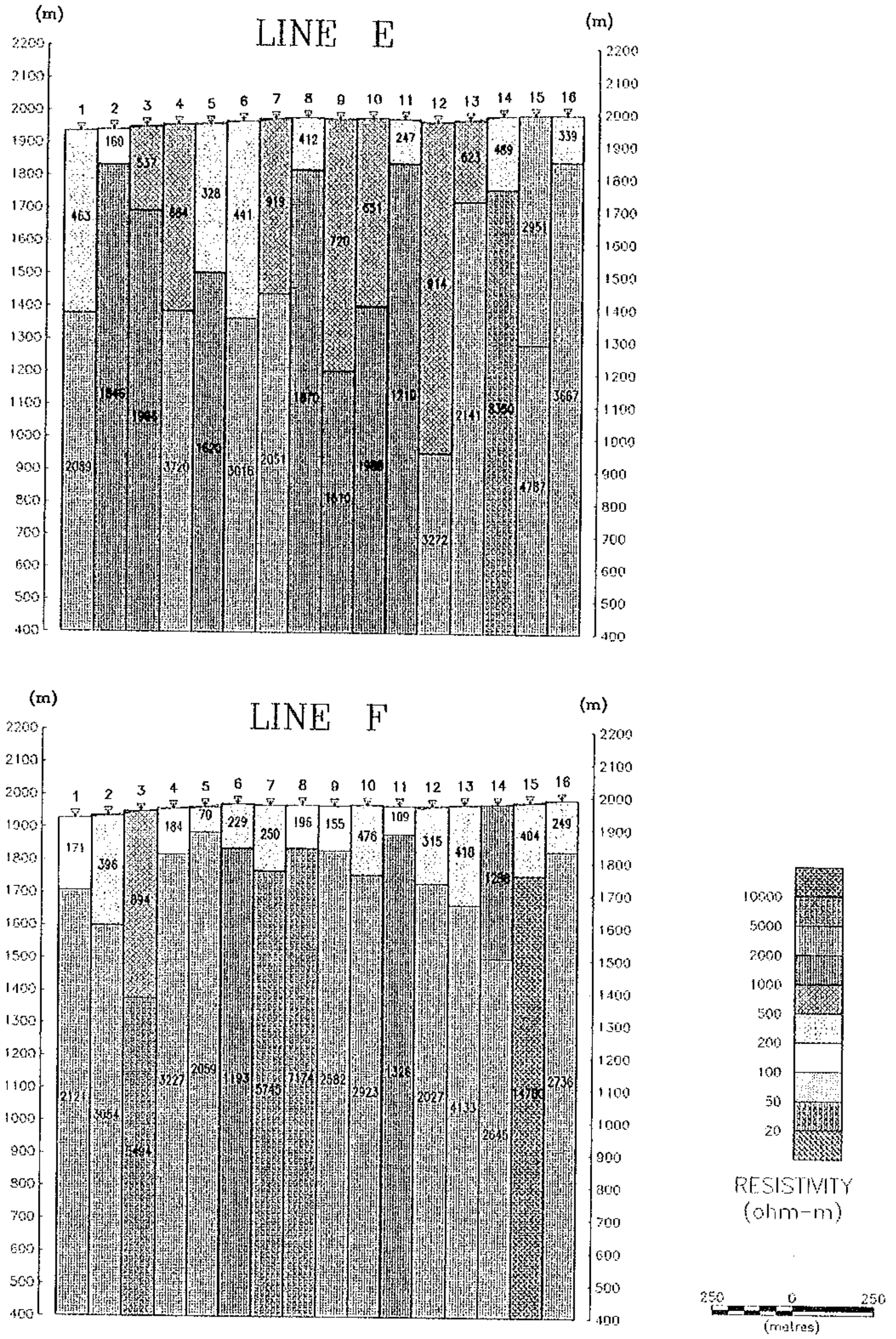

Fig. II-5-28 Section of 1-D Resistivity Structure (Area II, Line E, F)

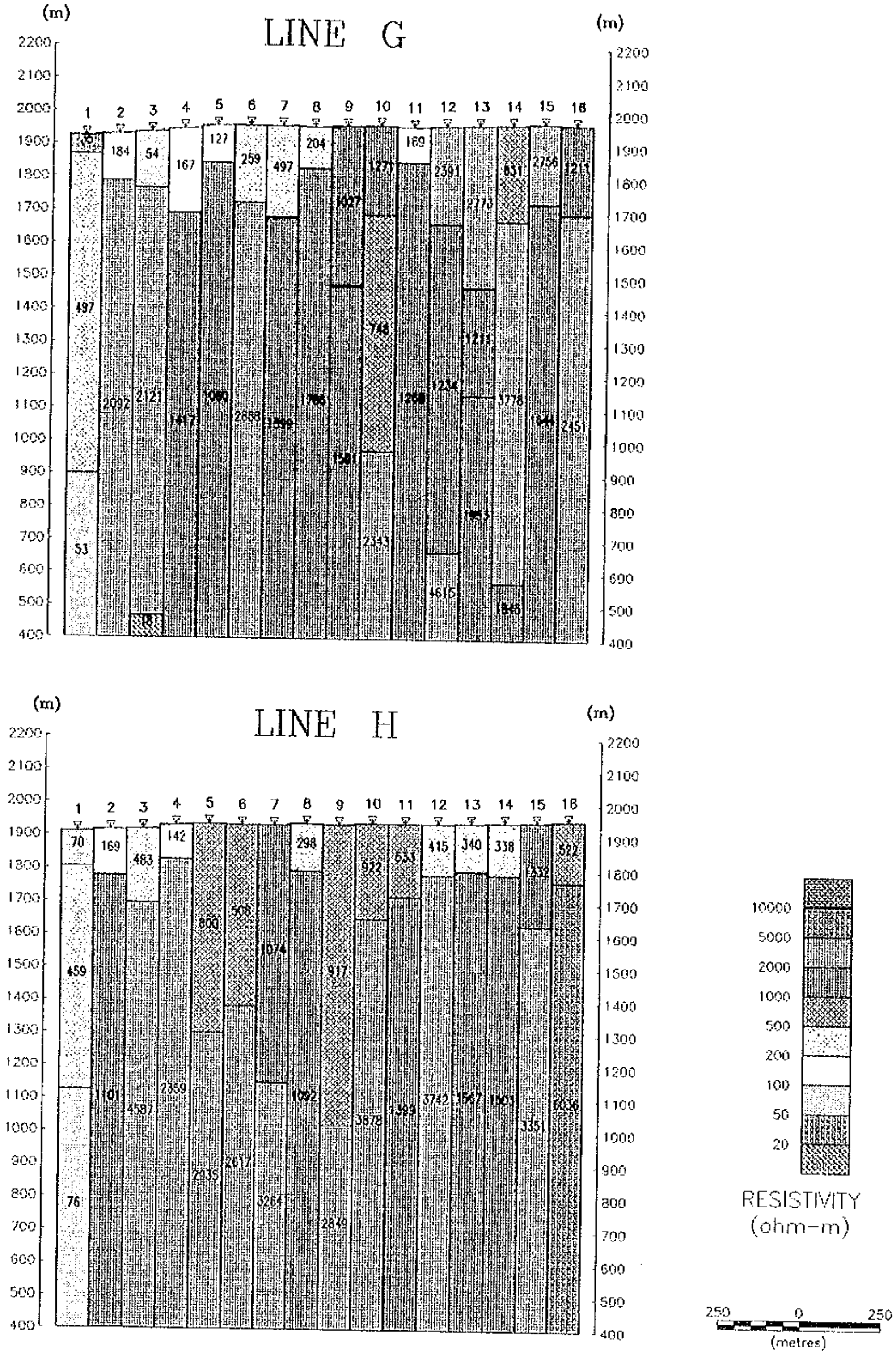

Fig. II-5-29 Section of 1-D Resistivity Structure (Area II, Line G, H)

thickness: approx. 200 m). Beneath the surface layer, a high resistivity layer of 2,000 to 10,000 Ω・m exist toward depth. In the depth of station No.19, a high resistivity layer of 10,910 Ω・m which is slightly higher than the resistivity value of surrounding points is analyzed. Quartz vein outcrop is noted in this position.

(line C)

At stations No.14, 15, 17, 18, 19 and 22 to 24, the first layer is analyzed as a layer with high resistivity value of 2,000 Ω・m or more. In the vicinity of station No.19, outcrop of quartz vein is noted. At stations No.22 to 24 , a high resistivity value of 5,000 Ω・m or more was analyzed. However, no outcrop of quartz vein is noted in this position.

(line D)

In the depth of stations No.19 and 20, with high resistivity layer of 10,000 Ω・m or more which is a higher than those of surrounding points was analyzed. Outcrop of quartz vein is noted in these positions.

(line E)

In the second layer of stations No.19 to 24, a high resistivity layer of 5,000 Ω・m or more was analyzed. Outcrops of quartz vein exist in the middle of stations No.18 and 19.

(line F)

No outcrop of quartz vein is noted on this line. At stations No.19 to 24 , a high resistivity layer of 10,000 Ω・m or more was analyzed.

(line G)

In the depth of stations No.18 to 22, a high resistivity layer of 5,000 Ω・m or more was analyzed. More than one outcrop of quartz vein exist in these positions.

(line H)

While a resistivity layer of 2,000 Ω・m or less was analyzed as the first layer of many measuring points, the first layer of stations No.18 and 19 was analyzed as a high resistivity layer of 2,000 Ω・m or more. This condition is interpreted to reflect the existence of quartz vein in the vicinity. In the second layer, a high resistivity layer of 5,000 Ω・m or more was analyzed on the entire survey line.

(line I)

The first layer of stations No.19 and 20 was analyzed as a resistivity layer of 2,000 Ω·m or more which is higher than that of surrounding points. The second layer of stations No.17 to 22 was analyzed as a high resistivity layer of 5,000 Ω·m or more. Outcrop of quartz vein is distributed in the vicinity of these positions.

(line J)

A resistivity layer of 5,000 Ω·m or more which is higher than that of surrounding points was analyzed as the first layer of station No.19. A high resistivity layer of 5,000 Ω·m or more was analyzed as the second layer of stations No.17 to 21. Quartz veins are distributed in these positions.

(line K)

The first layer at station No.18 was analyzed as a resistivity layer of 2,000 Ω·m or more which is higher than that of surrounding points. The second layer of stations No.17 to 21 was analyzed as a high resistivity layer of 5,000 Ω·m or more. Quartz veins are distributed in this position.

(line L)

The first layer of station No.19 was analyzed as a resistivity layer with 2,000 Ω·m or more which is higher than that of surrounding points. The second layer of stations No.6, 18 to 19, and 22 was analyzed as a high resistivity layer of 5,000 Ω·m or more. These conditions are interpreted to reflect the existence of quartz vein in this position.

(line M)

The first layer of the entire survey line was analyzed as a resistivity layer of 2,000 Ω·m or less. Among them the layer at station No.21 where outcrop of quartz vein is noted, a high resistivity layer of 1,519 Ω·m, which is slightly higher than that of surrounding points, was analyzed. The second layer of stations No.15, and 17 to 19 was analyzed as a high resistivity layer of 5,000 Ω·m or more.

(line N)

In most of the entire range of this survey line, the first layer was analyzed as a resistivity layer of 2,000 Ω·m or less. The second layer at stations No.4 to 10 was analyzed as a high resistivity layer of 5,000 Ω·m or more. In the vicinity of station No. 8, outcrop of quartz vein is noted.

(line O)

The first layer at station No.21 was analyzed as a resistivity layer of 2,000 Ω·m or more which is slightly higher than that of surrounding points. Outcrop of quartz vein is noted in this position. The second layer at stations No.13 to 15, 22, and 26 was analyzed as a high resistivity layer of 5,000 Ω·m or more.

(line P)

The first layer of stations No.1, 5 to 8, 21 to 22, and 24 was analyzed as a resistivity layer of 2,000 Ω·m or more which is slightly higher than that of surrounding points. The second layer of stations No.2, 6 to 8, 22, 23, and 25 to 26 was analyzed as a high resistivity layer of 5,000 Ω·m or more. At stations No.1 to 5, and 21 on this survey line outcrops of quartz vein are confirmed.

(line Q)

The first layer of stations No.14, 15, and 18 was analyzed as a resistivity layer of 2,000 Ω·m or more which is higher than that of surrounding points. The second layer at stations No.14, 20, 22 to 23, and 25 was analyzed as a high resistivity layer of 10,000 Ω·m or more. No outcrop of quartz vein is confirmed on this survey line.

(line R)

The first layer at stations No.8 and 18 was analyzed as a resistivity layer of 2,000 Ω·m or more which is higher than that of surrounding points. The second layer at stations No.1, 6 to 7, 9, 17, and 23 to 26 was analyzed as a high resistivity layer of 5,000 Ω·m or more. Outcrops of quartz vein are noted at stations No.1 to 3, 9 to 10, and 20 to 22.

(line S)

The first layer of the entire survey line was analyzed as a resistivity layer of 2,000 Ω·m or less. The second layer at stations No.15 to 18, 23, and 25 to 26 was analyzed as a high resistivity layer of 5,000 Ω·m or more. Outcrop of quartz vein is noted only at station No.23, but not in other positions.

(line T)

At stations No.10 to 12 the layers from the surface to the depth were analyzed as high resistivity layers of 2,000 Ω·m or more. The second layers at stations No.1, 8 to 9, 23, and 25 was analyzed as a high resistivity layer of 5,000 Ω·m or more. The high resistivity layer in the vicinity of stations No.10 to 12 was on the northern extension of the quartz vein which is on the south side of these points. Outcrop of quartz vein is distributed in the vicinity of station No.23.

(line U)

The first layer at station No.16 was analyzed as a resistivity layer of 2,000 Ω·m or more which is higher than that of surrounding points. The second layer of stations No.16, and 23 to 26 was analyzed as a high resistivity layer of 5,000 Ω·m or more. The area in the vicinity of stations No.23 to 26 is on the southern extension of quartz vein outcrop which was noted on the north side of these points.

(line V)

The first layer at stations No.9 and 10 was analyzed as a resistivity layer of 2,000 Ω·m which is higher than that of surrounding points. Outcrops of quartz vein are noted at these positions. The second layer of stations No.10 to 13 was analyzed as a high resistivity layer ranging from 3,000 to 15,000 Ω·m. In these positions more than one outcrop of quartz vein are noted.

(line W)

The second layer of stations No.8 to 9 was analyzed as a high resistivity layer of 5,000 Ω·m or more. These positions are on the south-western extension of quartz vein existing on the north-west side. The layer from the surface to the depth at stations No.24 to 26 was analyzed as a high resistivity layer.

2) Area II

(line A)

The second layer at stations No.2, 10, 13, and 14 was analyzed as a high resistivity layer of 5,000 Ω·m or more. No distinctive high resistivity layer is noted to correspond with the quartz vein existed in the vicinity of station No.15.

(line B)

The second layer at stations No.7, 9, and 11 was analyzed as a high resistivity layer of

5,000 Ω·m or more. No outcrop of quartz vein is noted on the land surface.

(line C)

The second layer at stations No.4, 6 to 7 on the extension of quartz vein (2) and (3) was analyzed as a resistivity layer of 2,000 Ω·m or more which is higher than that of surrounding points. Also, the second layer at stations No.12 to 16 was analyzed as a resistivity layer of 2,000 Ω·m or more which is slightly higher than that of surrounding points.

(line D)

The second layer at stations No.14 and 16 was analyzed as a high resistivity layer of 5,000 Ω·m or more. Station No.16 exist on the northern extension of quartz vein (6). No high resistivity layer is noted to correspond with the quartz vein exist in the vicinity of stations No.4 and 6.

(line E)

The second layer of stations No.4, and 5 to 6 was analyzed as a resistivity layer of 2,000 Ω·m or more. Outcrops of quartz vein are noted in the vicinity of these positions. No high resistivity layer is noted to correspond to quartz vein outcrop which is noted in the vicinity of Measuring Point 9. The first layer at station No.15 where outcrop of quartz vein is noted was analyzed as a resistivity layer of 2,000 Ω·m or more.

(line F)

The second layer at stations No.3, 7 to 8, and 15 was analyzed as a resistivity layer of 5,000 Ω·m or more. Outcrops of quartz vein are noted at Measuring Points 3, 7, and 14.

(line G)

In the entire area a resistivity layer of 5,000 Ω·m or less was analyzed. No high resistivity layer exist to correspond with the outcrop of quartz vein which is noted on the land surface.

(line H)

The layers other than the resistivity layer of 8,036 Ω·m in the second layer at station No.16 were analyzed as high resistivity layers of 5,000 Ω·m or less. No outcrop of quartz vein is noted on the land surface.