L-10 is in the relatively shallower part.

L-5 extends from the shallow part to the depth, connecting to an isolated Low Resistivity Zone to the north.

* Section E-E'

L-4 extends from the shallow part to the depth, including extremely Low Resistivity Zones (lower than 10 Ω·m) in the depth.

L-6 extends from the shallow part to the depth, specially at the survey station No. 223.

* Section F-F'

L-4 extends from the shallow part to the depth, including extremely Low Resistivity Zones (lower than 10 Ω·m) in the southern part.

L-5 extends from the shallow part to the depth.

(3) Results of resistivity measurement of rock samples

Table 5-5 shows the results of resistivity measurement of typical rocks and ores in the area (30 samples). Black ores (B-0) show low resistivity (average 26 Ω·m), and disseminated pyrite ores (Py-diss) show a little higher resistivity (average 325 ·m) than those of Japanese ores. The footwall dacite (Kdc1-b) shows various resistivity ranging 368 to 3,908 Ω·m, depending upon grades of alteration and mineralization. Results of other rocks ranges from 2,320 to 4,802 Ω·m, showing a little differences among them.

5-3-2 Results of Analysis

Results of one dimensional modeling for each survey station are shown in the extra volume of this report.

(1) Plan of Resistivity Structure

P1.18 to Pl.23 and Fig. 5-19 to Fig. 5-24 show plans of resistivity structure, which is derived from the one-dimensional modeling. Characters of each resistivity plan of 100, 200, 400, and 600 meters below the surface, and 400 and 200 meters above the sea level are as follows:

100 meters below the surface

Distribution of Low Resistivity Zones listed in the section (1) Plan of Apparent Resistivity roughly coincides with that of resistivity structures, but several small scale Low Resistivity Zones are weakened in resistivity structures. Therefore they are not listed up here.

* L-1 in the La Trozada Hill is located in a ridge, and coincides with a distribution area of the ore horizon dacitic pyroclastics (Koh-b) unconformably overlying the Jurassic metamorphics (Jsch). Tuffs and shales of ore horizon (Koh-b) are subjected to argillization (kaolinization).

Table 5-5 Resistivity of Ore and Rock Samples

$\rho = (V/I) \cdot (W \cdot D/L)$

No.	Sample Name	(Rock Code)	W (m)	D (m)	L (m)	I (A)	V (V)	ρ (Ω·m)	REM.
1	Shale	(Ksh1)	0.0540	0.0360	0.0785	0.00001	1.3360	3308.51	
2	Shale	(Kdc-sh)	0.0400	0.0290	0.0270	0.00001	0.5231	2247.39	
3	Footwall Dacite	(Kdc1-b)	0.0440	0.0400	0.0630	0.00001	1.3990	3908.32	
4	Phyllite	(Jsch)	0.0620	0.0460	0.0210	0.00001	0.1512	2053.44	
5	Footwall Dacite	(Kdc1-b)	0.0310	0.0390	0.0310	0.00001	0.2020	787.80	
6-1	Ore	(B-O)	0.0440	0.0340	0.0120	0.00001	0.0021	26.02	
6-2	Ore	(Py-diss)	0.0310	0.0430	0.0250	0.00001	0.0610	325.25	
7	Andesite	(Ad)	0.0510	0.0250	0.0480	0.00001	0.6877	1826.70	
8	Shale	(Kdc-sh)	0.0640	0.0470	0.0210	0.00001	0.4624	6623.33	
9	Andesite	(Ad)	0.0550	0.0250	0.0190	0.00001	0.2875	2080.59	
10	Andesite	(Ad)	0.0310	0.0310	0.0260	0.00001	0.6569	2428.00	
11	Andesite	(Ad)	0.0310	0.0480	0.0220	0.00001	0.3279	2217.80	
12	Andesite	(Ad)	0.0400	0.0370	0.0320	0.00001	0.6576	3041.40	
13	Andesite	(Ad)	0.0230	0.0220	0.0230	0.00001	0.6134	1349.48	
14	Porphyrite	(dike)	0.0590	0.0280	0.0320	0.00001	0.5496	2837.31	
15	Fine tuff	(Kdc-sh)	0.0330	0.0470	0.0270	0.00001	0.2278	1308.58	
16	Phyllite	(Jsch)	0.0420	0.0480	0.0180	0.00001	0.3365	3768.80	
17	Sandstone	(Kdc-sh)	0.0600	0.0370	0.0320	0.00001	0.4342	3012.26	
18	Andesite	(Tad2)	0.0750	0.0470	0.0310	0.00001	0.5796	6590.61	
19	Fine tuff	(Kdc-sh)	0.0350	0.0620	0.0280	0.00001	0.2855	2212.63	
20	Andesite	(Ad)	0.0600	0.0300	0.0180	0.00001	0.3049	3049.00	
21	Andesite	(Tad2)	0.0420	0.0400	0.0270	0.00001	1.2120	7541.33	
22	Andesite	(Tad1)	0.0520	0.0430	0.0250	0.00001	0.7210	6448.62	
23	Andesite	(Tad1)	0.0340	0.0450	0.0530	0.00001	0.3547	1023.95	
24	Andesite	(Tad1)	0.0490	0.0360	0.0540	0.00001	1.6000	5226.67	
25	Andesite	(Tad2)	0.0400	0.0390	0.0490	0.00001	0.6400	2037.55	
26	Sandstone	(Koh-b)	0.0500	0.0500	0.0350	0.00001	0.5696	4068.57	
27	Sericite Schist	(Koh-b)	0.0500	0.0480	0.0340	0.00001	0.1896	1338.35	
28	Footwall Dacite	(Kdc1-b)	0.0450	0.0380	0.0270	0.00001	0.1418	898.07	
29	Footwall Dacite	(Kdc1-b)	0.0600	0.0460	0.0230	0.00001	0.0307	368.40	

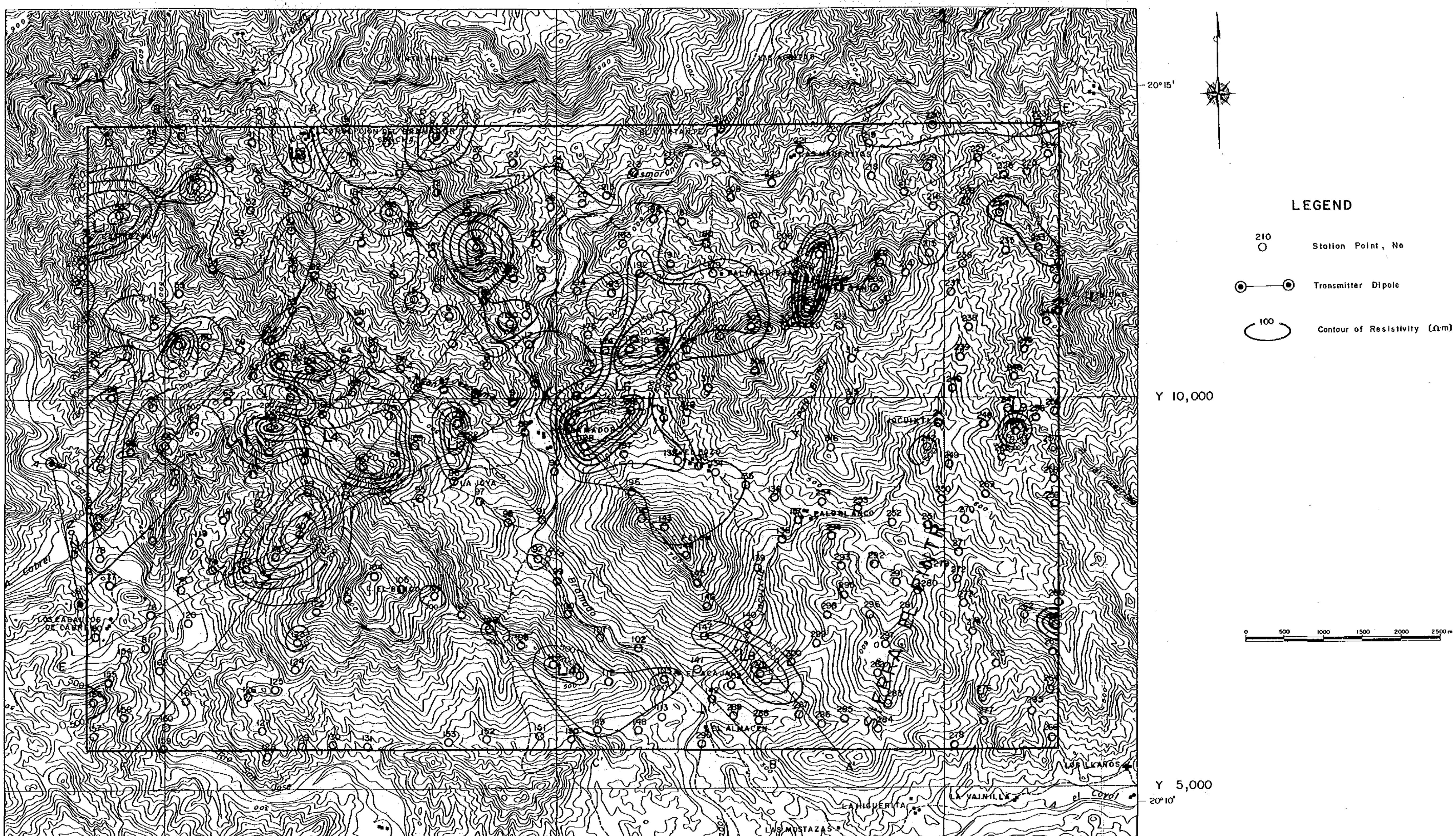

Fig. 5-19

Plan of Resistivity Structure (100 m below the surface)

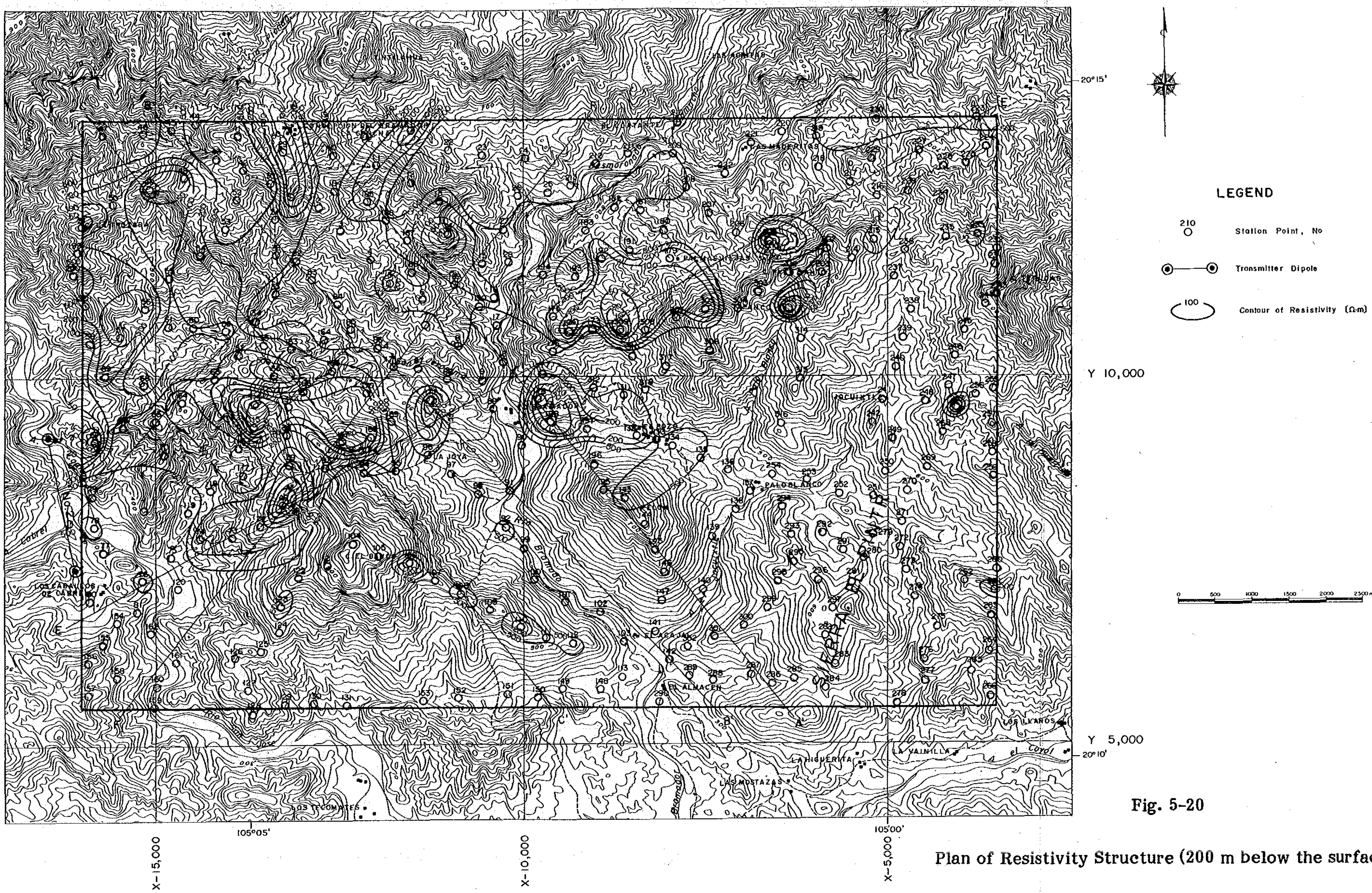

Fig. 5-20

Plan of Resistivity Structure (200 m below the surface)

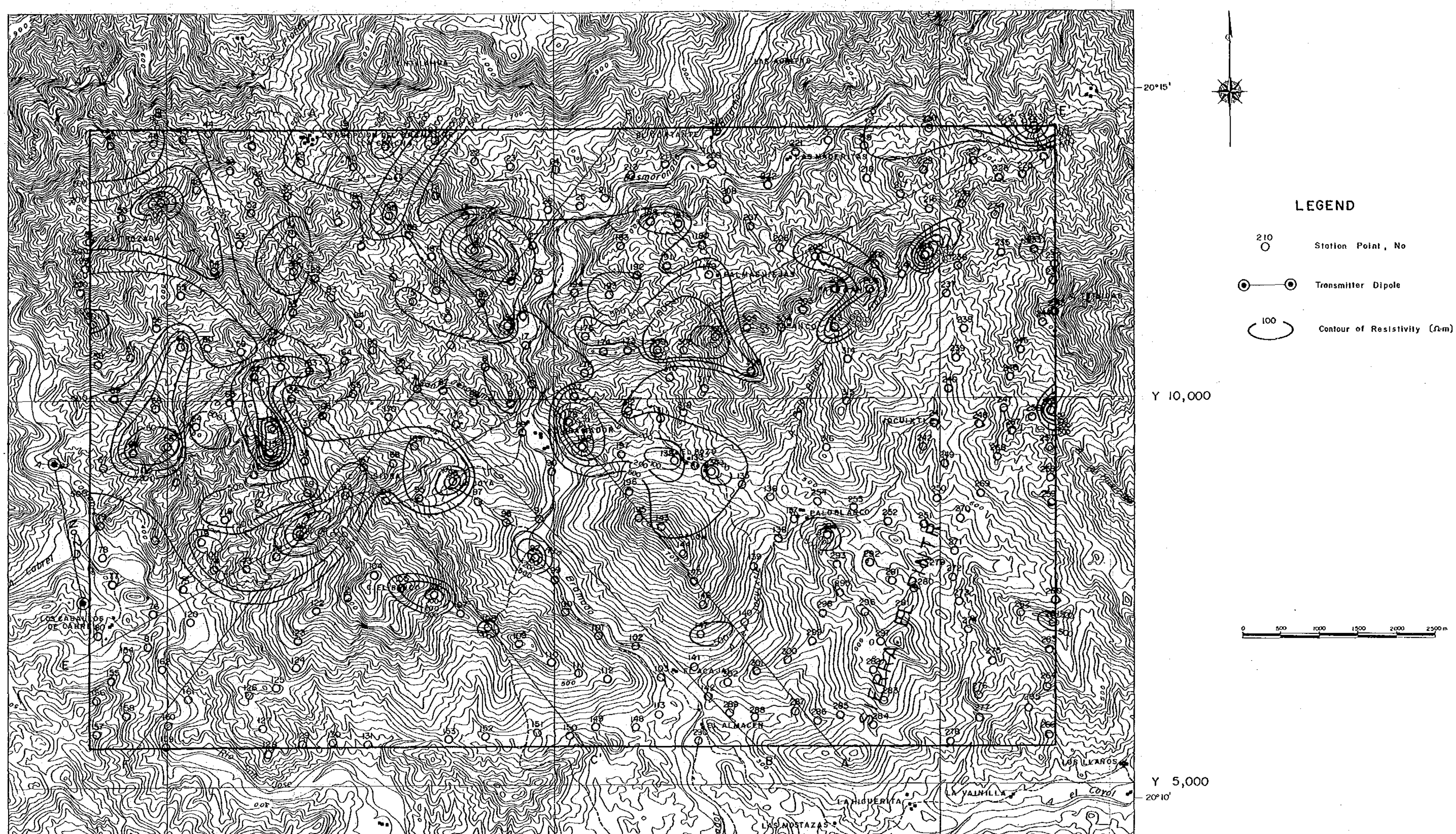

Fig. 5-21

Plan of Resistivity Structure (400 m below the surface)

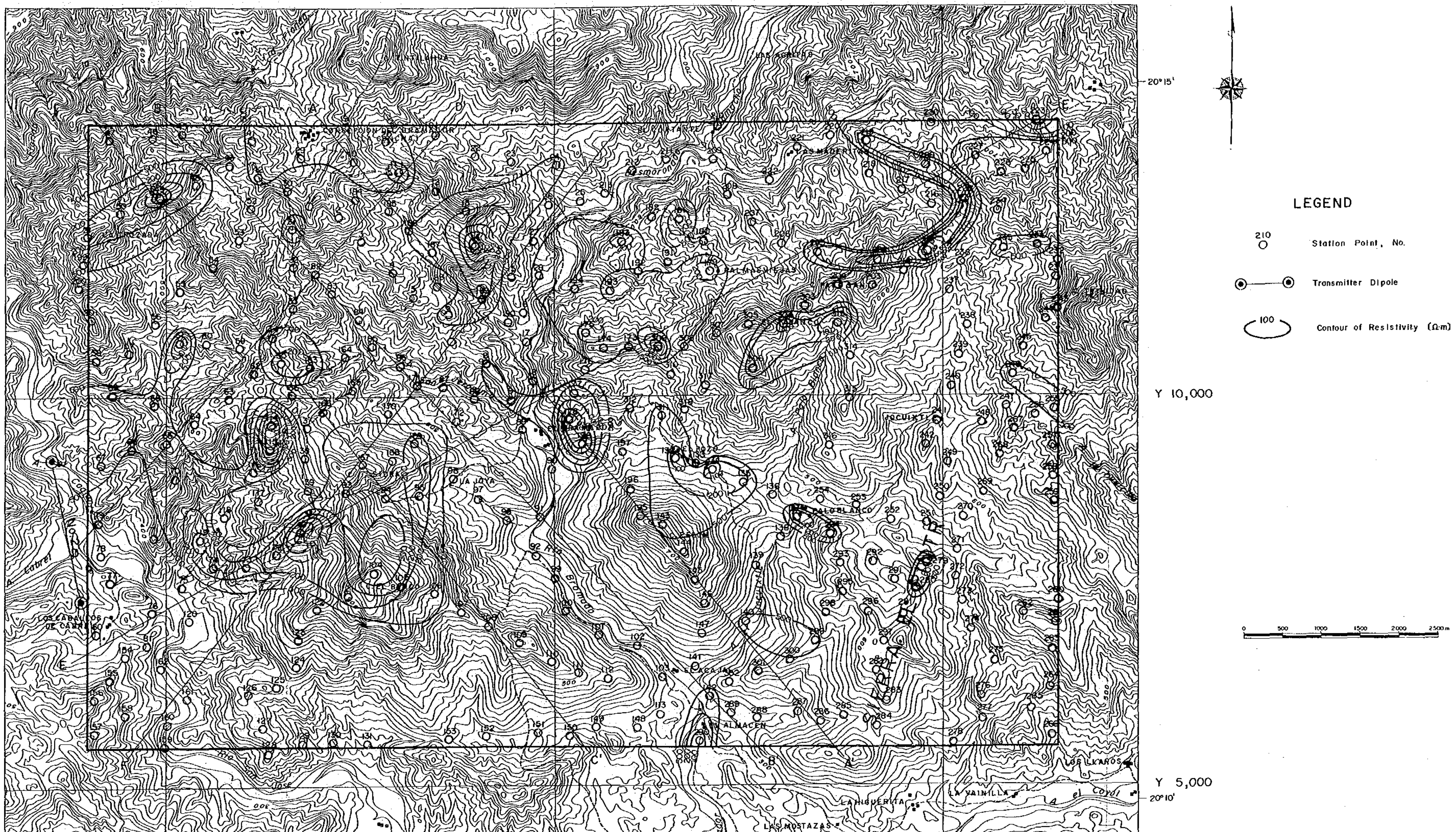

Fig. 5-22

Plan of Resistivity Structure (600 m below the surface)

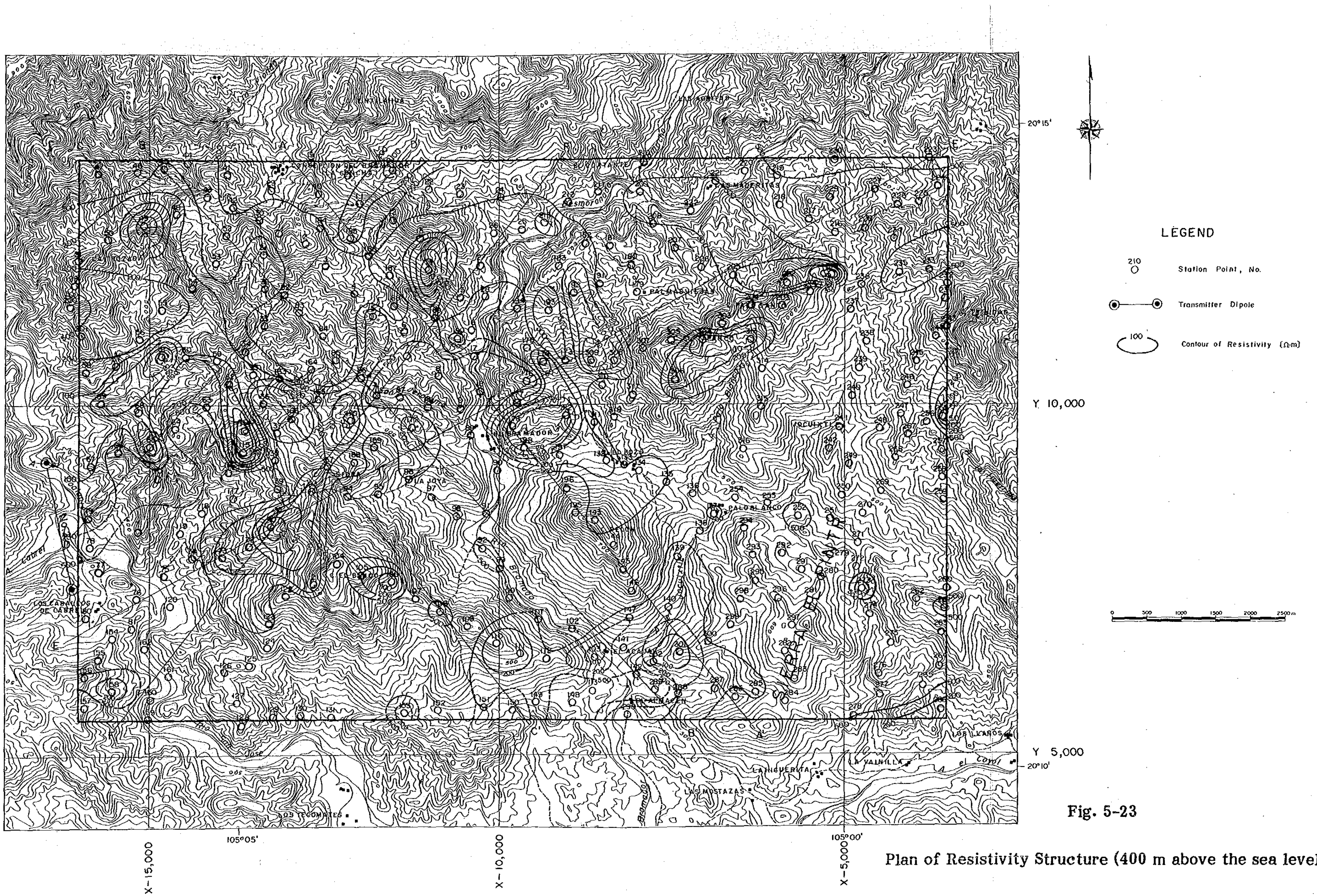

Fig. 5-23

Plan of Resistivity Structure (400 m above the sea level)

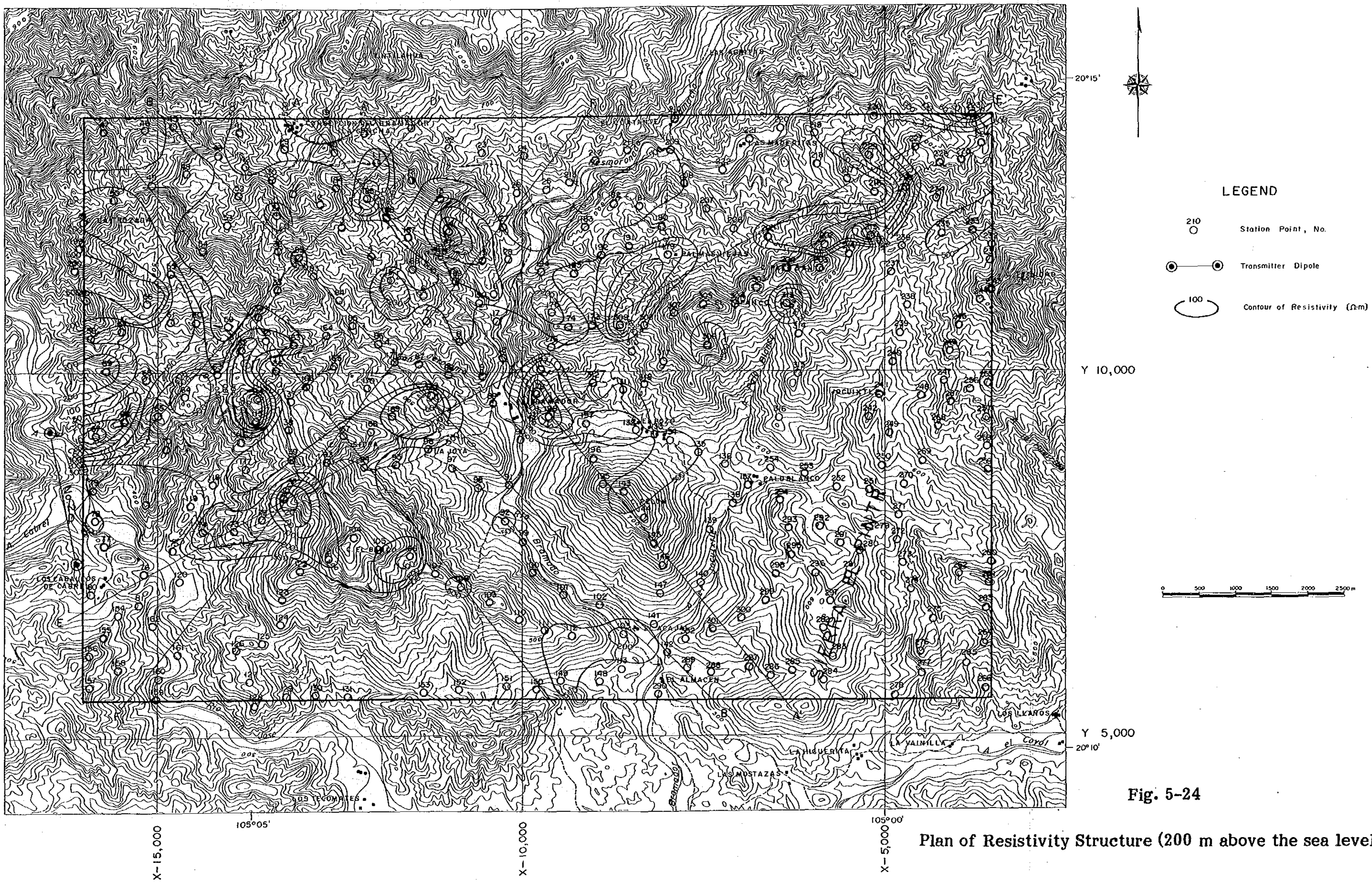

Fig. 5-24

Plan of Resistivity Structure (200 m above the sea level)

* L-2 in an area north of Los Caballos widely extends northeast to southwest, and coincides with a distribution area of the footwall dacite (Kdc1-b). The rocks are subjected to argillization (Potash feldspar, sericite, chlorite). The zone is in a multi-element geochemical anomaly zone of Ag-Cu-Pb-Zn.

* L-3 in La Concha is in a distribution area of the shale-sandstone formation (Kshl) and the footwall dacite (Kdc1-b), being subjected to argillization (potash feldspar, sericite, chlorite).

* L-4 in an area north of the Sidra Hill shows a complicated pattern controlled by intrusive rocks around there, separating into two parts. Northeast to southwest and northwest to southeast trends are generally dominant. They are in a distribution area of the hanging wall dacite and pyroclastics-shale alternation (kdc-sh), being subjected to significant argillization (potash feldspar, sericite, chlorite), and coincides with a multi-element geochemical anomaly zone of Ag-Cu-Pb-Zn.

* L-5 in an area southeast of La Concha shows an irregular distribution pattern, roughly trending two directions, northwest to southeast and northeast to southwest. At the Survey Station 5, a small scale Low Resistivity Zone is accompanied. This zone is in a distribution area of the shale-sandstone formation (Kshl), footwall dacite (Kdc1-b), ore horizon dacitic pyroclastics (Koh-b), and hanging wall dacite and pyroclastics-shale alternation (Kdc-sh), being subjected to argillization (kaolinization).

* L-6 in an area east to northeast of El Bramador is extensively distributed, trending northeast to southwest and northwest to southeast. L-6' is situated in an area northeast of L-6 trends further northeast. These zones are in a distribution area of the hanging wall dacite and pyroclastics-shale alternation (Kdc-sh), being subjected to argillization (potash feldspar, sericite, chlorite). They also are in an southeastern extension zone of the San Jeronimo Valley old working area. Therefore it is evaluated that this zone is one of the potential areas for mineralization.

* L-8 in an area east of El Acajal is of small scale, and in a distribution area of the I-stage andesites (Tad1) and the andesite (Ad).

* L-9 in an area south of the Trinidad Hill is of small scale, and in a distribution area of the II-stage andesites (Tad2) and I-stage dacites (Tdc1).

* L-12 in Santa Edwiges is of small scale, and in a distribution area of the hanging wall dacite and pyroclastics-shale alternation (Kdc-sh), being subjected to argillization (potash feldspar, sericite, chlorite), this zone is in a multi-element geochemical anomaly zone of Ag-Pb. The Santa Edwiges old working is near by the zone. Therefore it is evaluated that this zone is one of the potential areas for mineralization.

* L-14 in an area west of El Acajal trends northwest to southeast, and in a distribution area of the I-stage andesites (Tad1), II-stage andesites (Tad2), and andesite (Ad).

200 meters below the surface

* L-1 is connected with L-2 and L-4, extending widely, and possibly correlated with an argillization zone.

* L-3 is possibly connected with L-1, L-2, and L-4, extending north to south.

* L-5 is separated into two medium scale zones.

* L-6 is separated into four parts, still being significant Low Resistivity Zones. It is possibly correlated with a postulated mineralization-argillization zone.

* L-8 and L-14 decrease their scales in this level.

400 meters below the surface

* L-1, L-2, L-4, L-5, and L-6 show significant low resistivities, and they are mutually connected.

* L-10 is of small scale, and located in an area southeast of L-5. It is possibly correlated with a postulated mineralization-alteration zone.

600 meters below the surface

* L-1 decreases its scale to the northeast and southwest.

* L-4 is separated into three parts, surrounding a high resistivity zone.

* L-5 trends northeast to southwest.

* L-6 is separated into six parts, trending two directions, northeast to southwest and northwest to southeast.

400 meters above the sea level

In a plan showing the resistivity of the level, contours for lower levels are lacking.

* L-1, L-2, and L-4 show a continuous extensive Low Resistivity Zone.

* L-5 and L-6 show complicated distribution patterns, widely extending.

* L-8, L-9, L-12, L-13, and L-14 are of small scale, and concentrated in a same position in the plan of apparent resistivity of 2,048 Hz.

200 meters above the sea level

* L-1 and L-2 are connected, showing extensive distribution.

* L-4 is separated into three parts, trending northeast to southwest.

* L-5 and L-6 are separated into several parts, but it seems that they tend to be connected·each other.

* L-12 and L-14 are of small scale, same as that in the 400 meters above the sea level.

(2) Structural Resistivity Section

P1.24 to P1.29 and Fig. 5-13 to Fig. 5-18 show resistivity distribution, obtained from the one dimensional modeling, of the A-A', B-B', C-C', D-D', E-E', and F-F' sections. Characters of resistivity distributions for each section are as follows.

A-A' Section

The basement granodiorite (Gd) is exposed in the northeastern end of the section, gently deepening to the southeast. The shale-sandstone formation (Kshl), footwall dacite (Kdc1-b), ore horizon dacitic pyroclastics (Koh-b), and hanging wall dacite and pyroclastics-shale alternation (Kdc-sh) gently overlie the basement.

In the central part, a small stock of the granophyre (Gph) possibly exists in the subsurface. From the central part to the southwest side, an andesite intrusive body occupies the main body of the Pelon Hill. In the southwest side, the I-stage andesites (Tad1) and II-stage andesites (Tad2) are distributed.

* L-5 is separated into two parts. A Low Resistivity Zone showing 50 to 170 Ω·m is distributed near the intersection of the A-A' and D-D' sections, from the shallow part to the deeper. Specially the deeper part is in a distribution area of the footwall dacite (Kdc1-b) or the ore horizon dacitic pyroclastics (Koh-b), and possibly being subjected to alteration.

* A Low Resistivity Zone near the intersection of the A-A' and F-F' sections shows 70 to 80 Ω·m in the shallow part and 50 Ω·m in the deeper. It coincides with a marginal zone of a granophyre dyke, possibly a faulting zone.

* L-6 in the central part shows very low resistivity (8 to 17 Ω·m) in the shallow part, but moderate (140 to 180 Ω·m) in the deeper, in the southeast side. This zone coincides with a contact zone between the ore horizon dacitic pyroclastics (Koh-b), and granophyre (Gph) or andesite (Ad) intrusives, possibly being subjected to alteration.

* L-8 in the southwestern side shows 60 Ω·m in the shallow part. This zone coincides with a contract zone between the andesite (Ad) and I-stage andesite (Tad1), possibly resulting in shearing or cracking around there.

B-B' Section

This section is parallel to the A-A' section, and its geological setting is same as that of the A-A' section.

* L-10 shows 140 to 200 Ω·m in the shallow part, being correlated with a distribution area of the ore horizon dacitic pyroclastics (Koh-b). The La Castellana, Los Alpes, and San Jose old workings are located along this section line, and their alteration zones could affect their resistivity structures. A low resistivity zone of 100 Ω·m is in the deeper part, therefore another mineralization-alteration zone is possibly there.

* L-11 shows 130 Ω ·m in the shallow part. The Delicias, El Rosario, and La Colorada old workings are there, and they could affect their resistivity structures. A granophyre (Gph) intrusive body is possibly near the intersection of the B-B' and F-F' sections.

* L-12 shows 40 to 120 Ω ·m in the shallow part, and is located in an extension area of the Santa Edwiges old workings. Therefore this zone is subjected to mineralization-alteration, and should be investigated more carefully.

* L-13 shows 50 Ω ·m in the deeper part, and is in a distribution area of the andesite (Ad). It is presumed that this zone is caused by some faults or cracks around there.

* L-14 shows 70 to 180 Ω ·m in the shallow part, and is in a distribution area of the contact zone between the andesite (Ad) and I-stage andesites (Tad1). Therefore it is presumed that this zone is caused by some sheared zones or faults.

C-C' Section

This section is parallel to the A-A' and B-B' sections, and its geological setting is similar to those of them. The metamorphic rocks (Jsch) are distributed in the northwestern end of this section.

* L-1 shows 1 to 150 Ω ·m in the shallow part, and is in a distribution area of the footwall dacite (Kdc1-b) and ore horizon dacitic pyroclastics (Koh-b), being subjected to argillization.

* L-4 is separated into two parts. The middle part, near the Survey Station 36, shows high resistivity (higher than 600 Ω ·m), therefore it is presumed that a dyke exists there. The Low Resistivity Zones show 10 to 140 Ω ·m, and are in a distribution area of the ore horizon dacitic pyroclastics (Koh-b) and hanging wall dacite and pyroclastics-shale alternation (Kdc-sh). There it is presumed that this zone is in a mineralization-alteration zone.

* L-13 shows 85 to 150 Ω ·m, and L-15 shows 50 to 150 Ω ·m, in their shallow parts. They are in distribution areas of the andesite (Ad). It is presumed that they are caused by faults accompanies by cracks.

D-D' Section

The basement granodiorite (Gd) is distributed in the northeastern end of the section, gently deepening to the southwest. The shale-sandstone formation (Ksh1), footwall dacite (Kdc1-b), ore horizon dacitic pyroclastics (Koh-b), and hanging wall dacite and pyroclastics-shale alternation (Kdc-sh) unconformably overlie the basement. On the other side, the metamorphic rocks (Jsch) and intrusive dacite (Dc) are exposed in the southwestern end of the section.

* L-2 shows 1 to 200 Ω ·m from the shallow part to the depth, extending about 1,500 meters from the southeast to the northwest. A small but significant low resistivity zone (35 Ω ·m) is located in the deeper part.

* L-10 shows 90 to 200 Ω·m from the shallow part to the depth, also extending horizontally. This anomalous zone is caused by the San Jose old working mineralization-alteration zone.

* L-5 shows 70 to 100 Ω·m, and is extensively distributed in a distribution area of the shale-sandstone formation (Kshl) and footwall dacite (Kdcl-b).

E-E' Section

The basement granodiorite (Gd) and metamorphic rocks (Jsch) are distributed in the southwestern end of the section. From the footwall dacite (Kdcl-b) to the hanging wall dacite and pyroclastics-shale alternation (Kdc-sh) unconformably overlie the basement.

* L-4 shows 1 to 125 Ω·m, widely extending from the shallow part to the depth. It is deepened to the northeast, and shows 40 to 180 Ω·m in the deeper part. An argillization zone is distributed in the surface, and it is presumed that a mineralization-alteration zone exists there.

* L-6 shows 4 to 150 Ω·m, widely extending in the shallow part. A small high resistivity zone (300 to 700 Ω·m) at the Survey Station 176 is within the Low Resistivity Zone. This zone is in a distribution area of the hanging wall dacite and pyroclastics-shale alternation (Kdc-sh), being subjected to argillization. A small low resistivity zone (10 Ω·m) is in the deeper part of the northeastern end of the section, and is in a distribution area of the shale-sandstone formation (Kshl).

F-F' Section

The basement granodiorite (Gd) is exposed in the northeastern end of the section. The formations from (Kdcl-b) to (Kdc-sh) gently overlie the basement. The metamorphic rocks (Jsch) are distributed in the southwestern end, and the shale-sandstone formation (Kshl) overlies them. An andesite (Ad) dyke is located in the central part of the section. A very high resistivity zone (1,000 to 10,000 Ω·m) is distributed around the intersection of the F-F' and B-B' sections, presumably indicating existence of a granophyre (Gph) dyke in the very shallow part.

* L-4 shows a complicated pattern probably due to the distribution of an andesite (Ad) dyke, 1 to 125 Ω·m around the intersection of the F-F' and E-E' sections, 10 to 150 Ω·m in the northeastern side of the Sidra Hill. A argillization zone is there, and it is presumed that a mineralization-alteration zone exists in the subsurface.

* L-5 shows 70 to 100 Ω·m from the shallow part to the depth, and is in a distribution area of the shale-sandstone formation (Kshl) and footwall dacite (Kdcl-b). This zone is in an intersection zone of two dominant resistivity distribution trends, northeast to southwest and northwest to southeast, and it is possibly caused by faults trending same directions.

5-4 Discussion

An integrated interpretation of the geological, geochemical, and geophysical survey results was done, and its result is as follows.

* The total geomagnetic intensity map is shown in Fig. 5-25, and its outline is as follows.

  A significant, high intensity anomaly zone is in La Concha, showing 43,000 gamma. This is well correlated with a distribution of the granodiorite. The contour map shows that the magnetic intensity is weakened to the south. A trend northwest to southeast is dominant, and it coincides with a trend of the geological structure noted in the area. A disturbance of the contours is noted in the southeastern side of the surveyed area, and several small scale magnetic anomaly zones are distributed in the disturbance zone. They are correlated with a distribution area of the andesite (Ad), dacite (Dc), I-stage andesite (Tad1), II-stage andesite (Tad2), and I-stage dacite (Tdc1). The trend northwest to southeast suggests that a same trend geological tectonic line exists there. The granodiorite (Gd) in Cabrel is distributed from the southern edge of the area to the south, showing rather low resistivity different from that of the granodiorite in an area north of La Concha.

* An electromagnetic survey (Turam) was conducted in the San Jeronimo Valley area (2.6km x 0.6km) by C.R.M. in 1980. Electromagnetic anomalies trend along the valley east-northeast to west-southwest, and the largest one extends about 1.5 kilometers long. These anomaly zones represent information of the subsurface several ten meters below the surface, and possibly are correlated with the Low Resistivity Zones of L-10 and L-11 detected by the CSAMT survey.

* Low Resistivity Zones from L-1 to L-14 detected by the CSAMT survey were integratively interpreted as shown in Table 5-4, and L-4, L-5, L-6, L-10, and L-12 were appraised as preferable anomalies.

(1) L-4 in the northern side of the Sidra Hill is separated into two parts, showing a complicated pattern due to an intrusive body. But it generally trends northeast to southwest and northwest to southeast. The zone is in a distribution area of the hanging wall dacite and pyroclastics-shale alternation (Kdc-sh), being subjected to argillization (potash feldspar, sericite, chlorite) in the surface, and coincides with a multi-element geochemical anomaly zone of Ag-Cu-Pb-Zn. A Low Resistivity Zone is detected in the very shallow part in the zone, and a lower resistivity zone is detected in the deeper part. The latter is possibly in a distribution area of the ore horizon formation, but there is also a possibility that it is caused by an argillization zone in the surface.

(2) L-5 in an area southeast of La Concha shows a complicated pattern, trending two directions, northwest to southeast and northeast to southwest.

    A small Low Resistivity Zone nearby the Survey Station 5 is located in an area north of the San Pedro ore deposit. Therefore this zone should be paid attention. The zone is in a distribution area of the shale-sandstone formation (Ksh1), footwall dacite (Kdc1-b), ore horizon dacitic pyroclastics (Koh-b), and hanging wall dacite and pyroclastics-shale alternation (Kdc-sh), being subjected to argillization (kaolinization). The main body of the zone is in the lower formations than the ore horizon, therefore it seems that it is not favourable for further exploration activity. However as a result of the interpretation, following facts were made clear; a moderate resistivity zone is in the shallow part (down to 100 meters depth), and a thick Low Resistivity Zone (100 $\Omega\cdot$m) underlies below it. This Low Resistivity Zone corresponds to a distribution area of the footwall dacite (Kdc1-b) and ore horizon pyroclastics (Koh-b), it is not negligible from the list of favourable anomaly zones.

(3) L-6 in an area east to northeast of El Bramador shows 4 to 150 Ω·m from the shallow part to the depth, widely extending. The zone extends to two directions, northeast to southwest and northwest to southeast, especially to the northeast, and tends to connect with L-6 and L-7. The low resistivity zone group is in a distribution area of the hanging wall dacite and pyroclastics-shale alternation (Kdc-sh), being subjected to argillization (potash feldspar, sericite, chlorite). A Low Resistivity Zone in an area east of El Bramador is located in a southeastern extension zone of the San Jeronimo Valley being old workings and it is expected that the ore horizon extends to this area.

(4) L-10 in San Jose shows 140 to 200 Ω·m in the shallow part, 250 Ω·m in the middle, and 100 Ω·m in the depth, forming three layers resistivity structure. The zone is of small scale, but coincides with a part of an electromagnetic anomaly zone. It is in a distribution area of the ore horizon dacitic pyroclastics (Koh-b), and hanging wall dacite and pyroclastics-shale alternation (Kdc-sh), being subjected to argillization (potash feldspar, sericite, chlorite), and coincides with a multi-element geochemical anomaly zone of Ag-Cu-Pb-Zn. Therefore it should be paid attention for Kuroko exploration. It is possible that the zone is caused by a postulated mineralization-alteration zone extending from the La Castellana, Los Alpes, and San Jose ore deposits.

(5) L-12 in Santa Edwiges shows 40 to 120 Ω·m from the shallow part to the depth. It is of small scale, but extends to the south. It is in a distribution area of the hanging wall dacite and pyroclastics-shale alteration (Kdc-sh), being subjected to argillization (potash feldspar, sericite, chlorite), and coincides with a multi-element geochemical anomaly zone of Ag-Pb. In addition an extension of mineralization zones from the Santa Edwiges ore deposit is expected there, therefore this zone is one of the most promising area for Kuroko exploration.

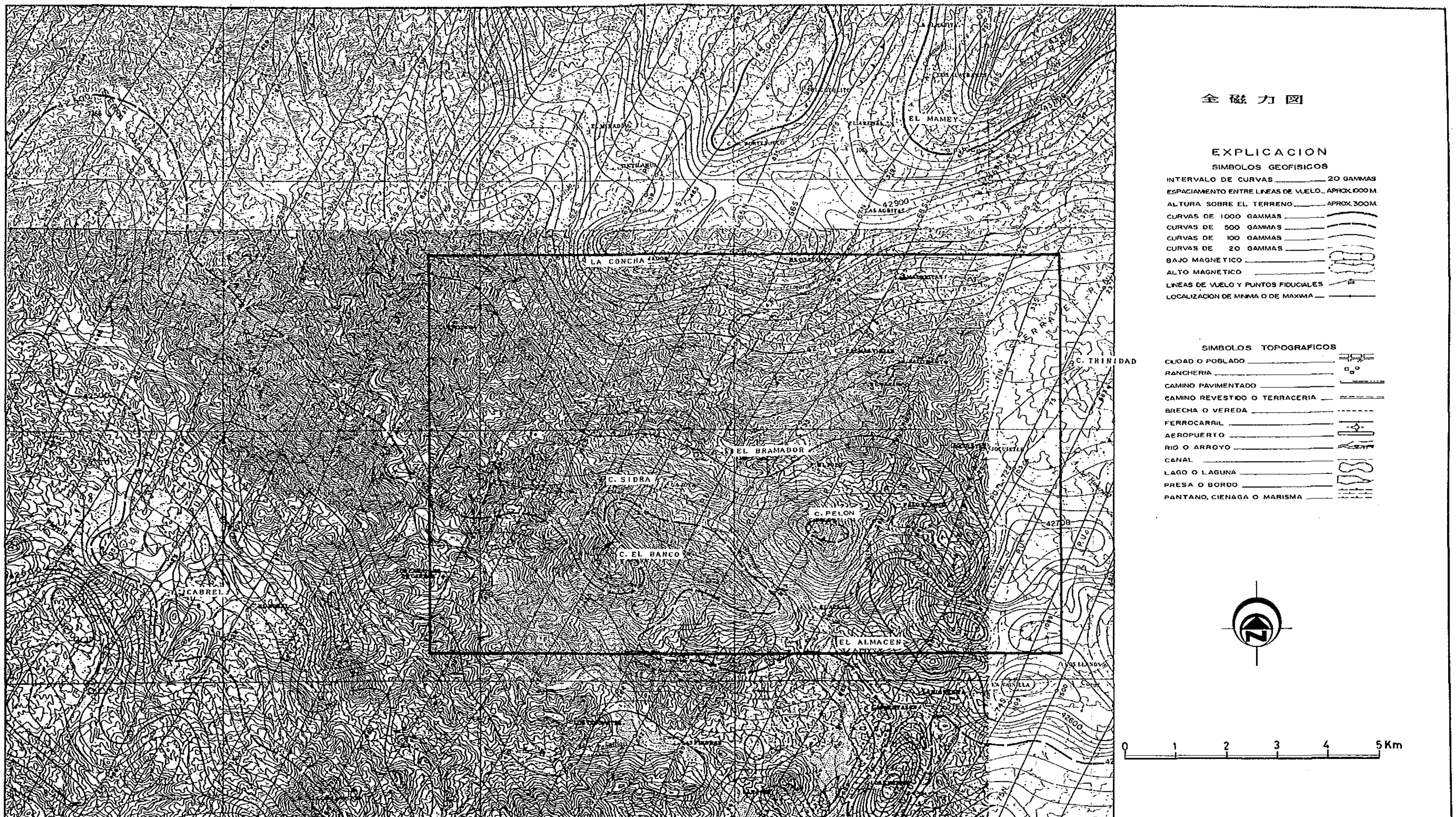

Fig. 5-25

Total Intensity, Aeromagnetic Map