Chapter 4 Geophysical survey

4-1 Selection of the Area for Geophysical Survey

The geophysical survey area was determined to the WS area where the distribution of the P1 layer and sulphide mineralization was confirmed by the analysis of the existing data and the field geological survey.

The Location of geophysical survey area is shown in Fig II-4-1.

4-2 Method of the survey

4-2-1 Content of the survey

An electric prospecting had been carried out using IP method on survey lines.

Specification of geophysical survey is shown in Table II-4-1.

Table II-4-1 Specification of the geophysical survey

Method	Induced polarization method (IP method)
Detection method	Time domain method
Electrode arrangement	Dipole-Dipole
Separation of electrode arrangement	a=100m
Coefficient of electrodes separation	n=1~5
Number of survey line	16
Total length of survey line	32.0km
Tests of physical property of rocks and ores (laboratory test)	35 specimens for chargeability and resistivity

4-2-2 Method of the measurement

1. Determination of survey line and survey

Survey lines established crossing the P1 layer in the WS area. Lines were surveyed using the pocket compass, measuring esron tape and GPS. The base point of survey was set up to the C-23 where is the cross point of the road and line C.

The location of survey lines are shown in Fig II-4-2.

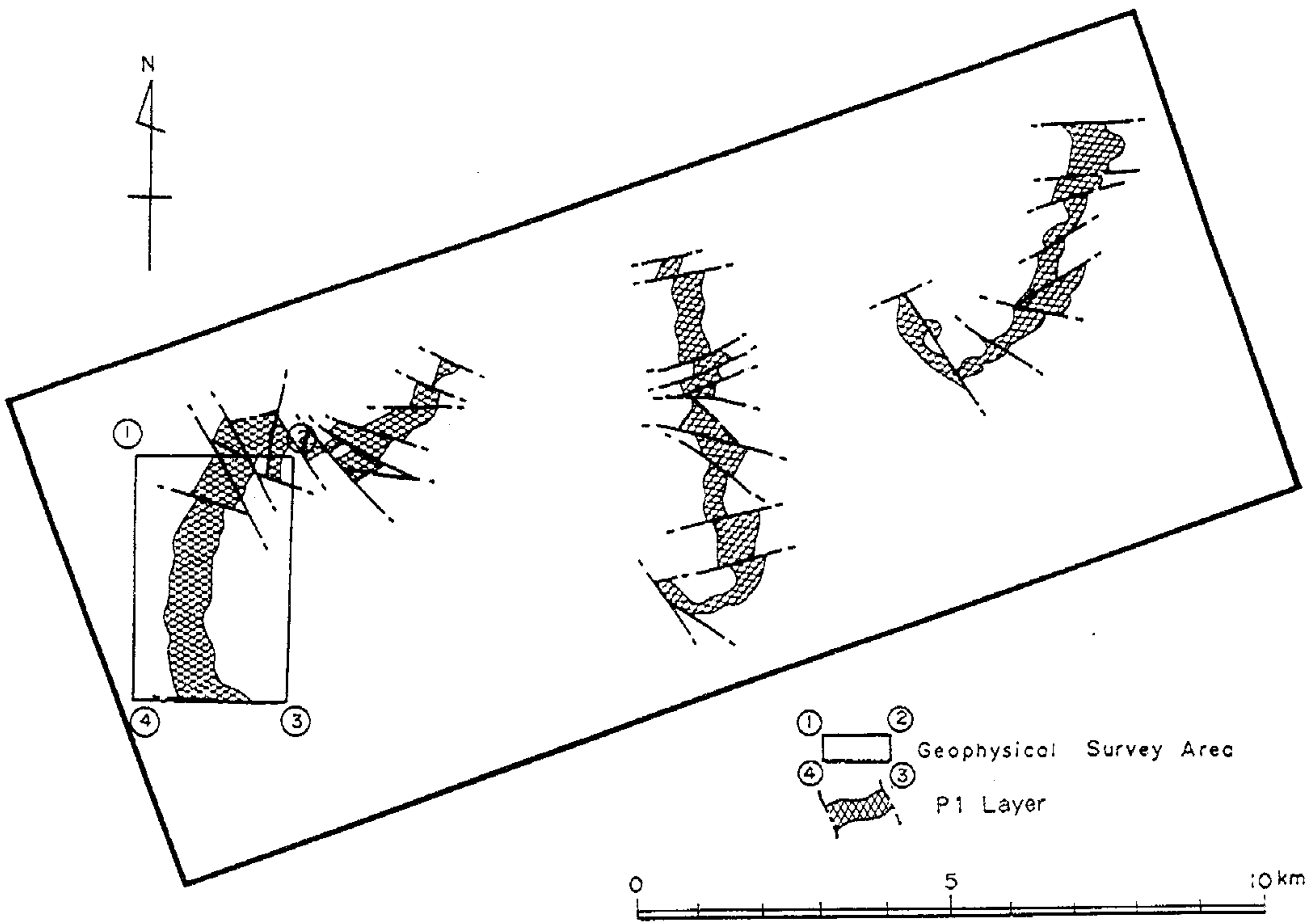


Fig.II-4-1 Locality of the geophysical survey area

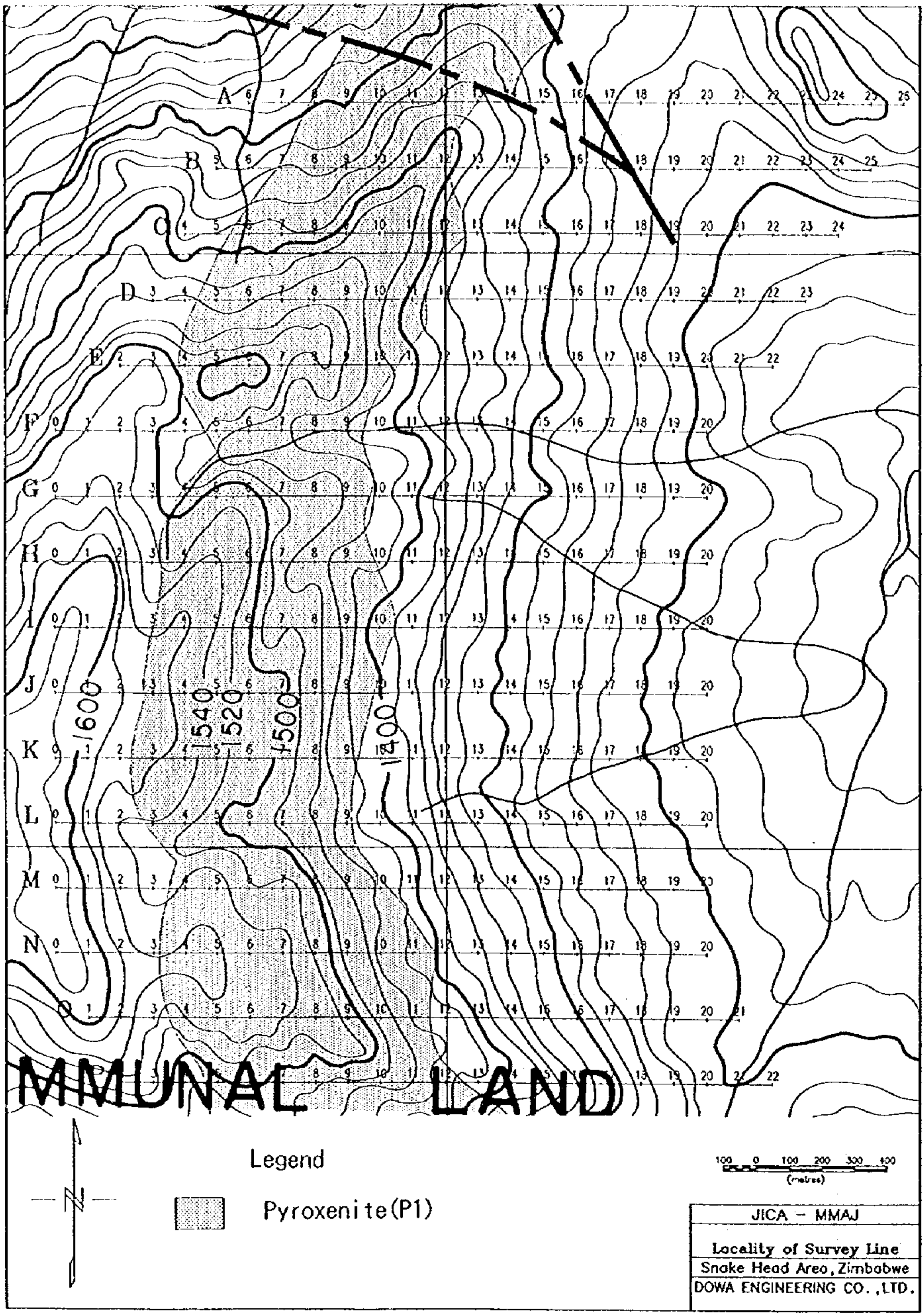


Fig.II-4-2 Locality of the geophysical IP survey line

2. Electric prospecting (IP method)

The concept of operation is shown in Fig II-4-3. The measurement had been carried out by the time-domain method. This method (abbreviation symbol T.D. method, transient IP method) sends an intermittent direct current (on/off 2.0sec) into the ground through a couple of current electrode C1,C2. Then two data are measured through the couple of potential electrodes P1,P2. One is the primary voltage(Vp) just before switching off an electric current, the other is the secondary voltage(Vs) during the time(t_4 ~t_{14}) after switching off an electric current.

The concept of the method of measurement is shown in Fig II-4-4 and the list of sampling time is shown in Table II-4-2.

The measurement value of IP effect is generally termed with chargeability, shown as $Vs(t_n)/Vp$[mV/V].

The data of secondary potential difference in this survey has not received an influence of the effect of electromagnetic coupling. At this investigation, we adopted the chargeability in mid-point 935msec data. 1% of chargeability by frequency domain method correspond to 5mV/V of time-domain method respectively.

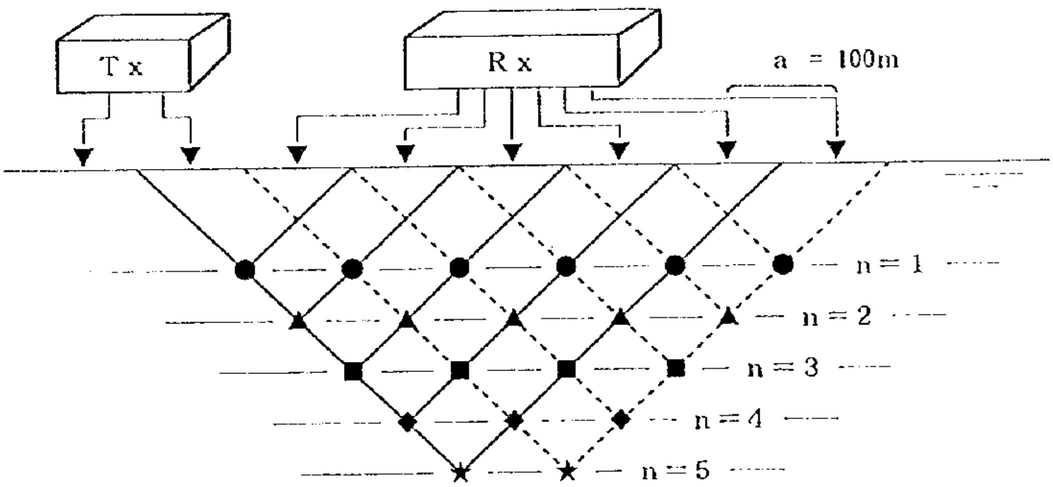


Fig II-4-3 Concept of operation

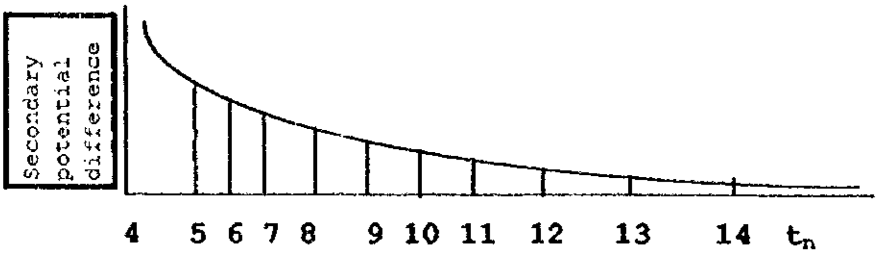


Fig II-4-4 Concept of the method of measurement

Table II-4-2 List of sampling time

Slice #	4	5	6	7	8	9	10	11	12	13	14
Width (msec)	20	40	40	80	80	140	140	230	230	360	360
Mid-point(")	60	90	130	190	270	380	520	705	935	1230	1590

3. Physical property tests

IP measurement of physical property of 35 specimens that represent rocks and ores in this area has been carried out in order to collect the fundamental data of the electrical characteristics of this area.

These specimens were measured by the time-domain method after cutting them into four faces and soaking in tap water for one day using the same receiver in the field.

Statistics of physical properties are presented in Table II-4-3. Relationship between chargeability and resistivity of the rock and ore samples are shown in Fig II-4-5.

These samples range in resistivity from 657 (Serpentinite) to 48,974 Ω·m (dolerite) and range in chargeability from maximum 49.5mV/V(Serpentinite) to 0.6mV/V(Dolerite).

Anisotropy of physical property in rocks was not recognized both in resistivity and in chargeability.

Gabbro shows slightly higher chargeability (3.4 - 7.3mV/V) compare to other rocks and range in resistivity from 5,000 to 10,000 Ω·m.

Pyroxenite which has sulphide content shows low chargeability (2mV/V) and high resistivity (15,000Ω·m). It is interpreted that the sulphide content is too low.

Serpentinite which has chromite($FeCr_2O_4$) content shows high chargeability(approximately 50mV/V). But Serpentinite which has no chromite content shows low chargeability. Serpentinite range in resistivity from 600 to 35,000 Ω·m. Serpentinite which shows high

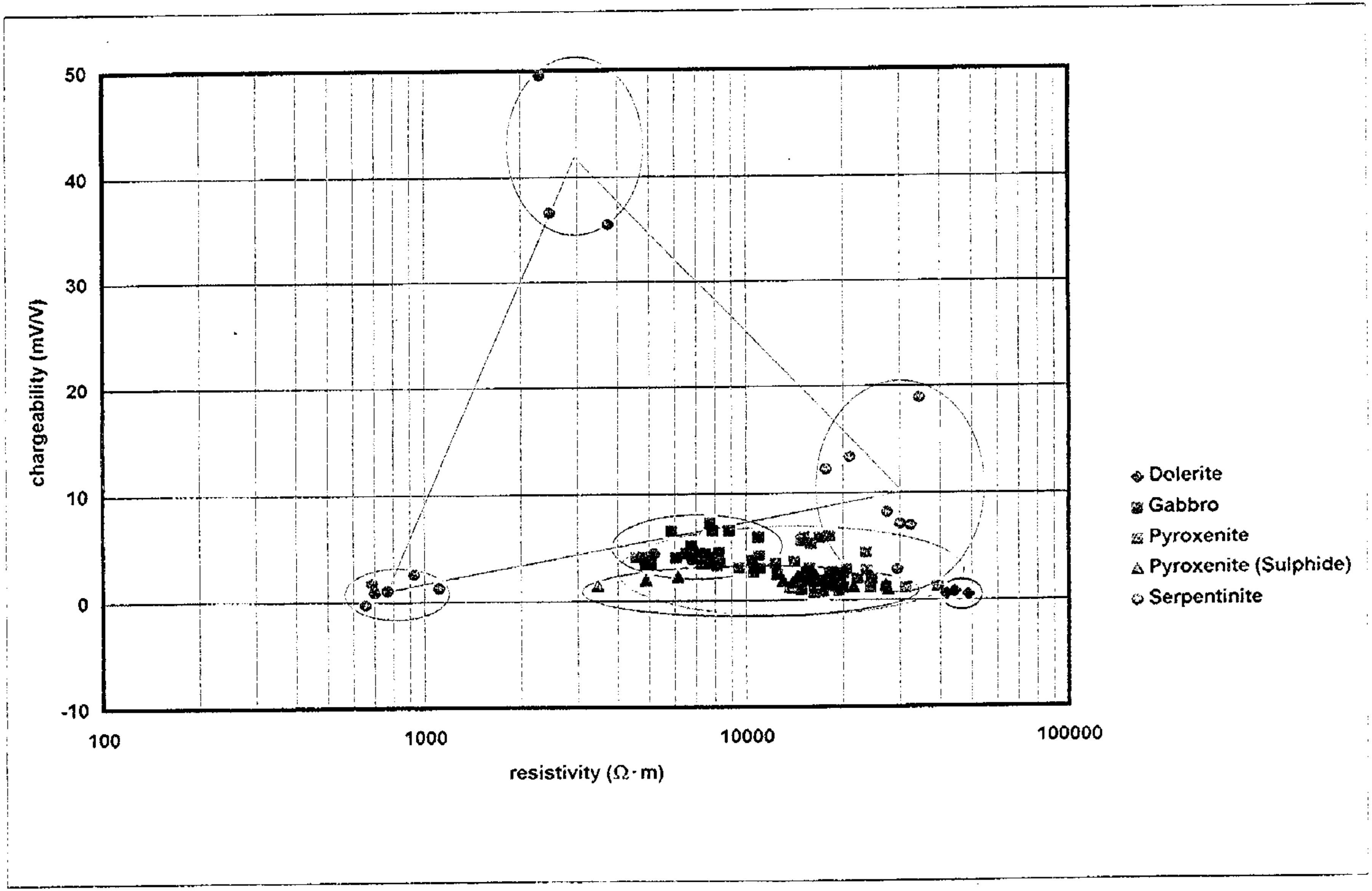


Fig.II-4-5 Relationshop between IP and apparent resistivity of rock samples

chargeability indicates high resistivity (2,000 - 3,000 Ω·m). Low resistivity of Serpentinite results from weathering.

Table II-4-3. Statistics of physical properties

ROCK TYPE	REM.	Resistivity(ohm-m)			chargeability(mV/V)		
		average	max	min	average	max	min
ALL SAMPLE		14,897	48,974	657	4.4	49.5	-0.3
Dolelite		45,020	48,974	41,799	0.7	0.8	0.6
Gabbro		7,275	10,941	4,885	4.9	7.3	3.4
Pyroxenite	Sulphide	15,398	27,634	3,462	1.8	2.5	1.0
Pyroxenite		16,456	39,328	4,570	2.8	6.0	0.7
Serpentinite		11,745	34,485	657	11.1	49.5	-0.3

4-3 Results of Survey

4-3-1 Section of apparent resistivity and chargeability

Panel diagram of apparent resistivity and chargeability section are shown in Fig II-4-6 to Fig II-4-7.

A summary of interpretation for distribution of apparent resistivity and chargeability of each section is following.

1. Background value of chargeability was estimated less than 2 mV/V approximately.
2. Chargeability anomaly corresponded to the distribution with Serpentinite is found in the western end of line B~P.
3. Anomalies located in the deep place between stations No.6 to No.10 of E,H,I,J,K,L,M lines suggest the existence of deep anomaly source.
4. Distribution of apparent resistivity shows low resistivity in shallow place and have tendency to increase resistivity in deeper place.
5. The distribution area of Gabbro shows slightly apparent low resistivity. Classification depending on a resistivity between Pyroxenite and Serpentinite is not clear.
6. Chargeability anomaly is not found at the week Sulphide dissemination zone.

Distributions of resistivity and chargeability and relationship in each section were summarized as follows.

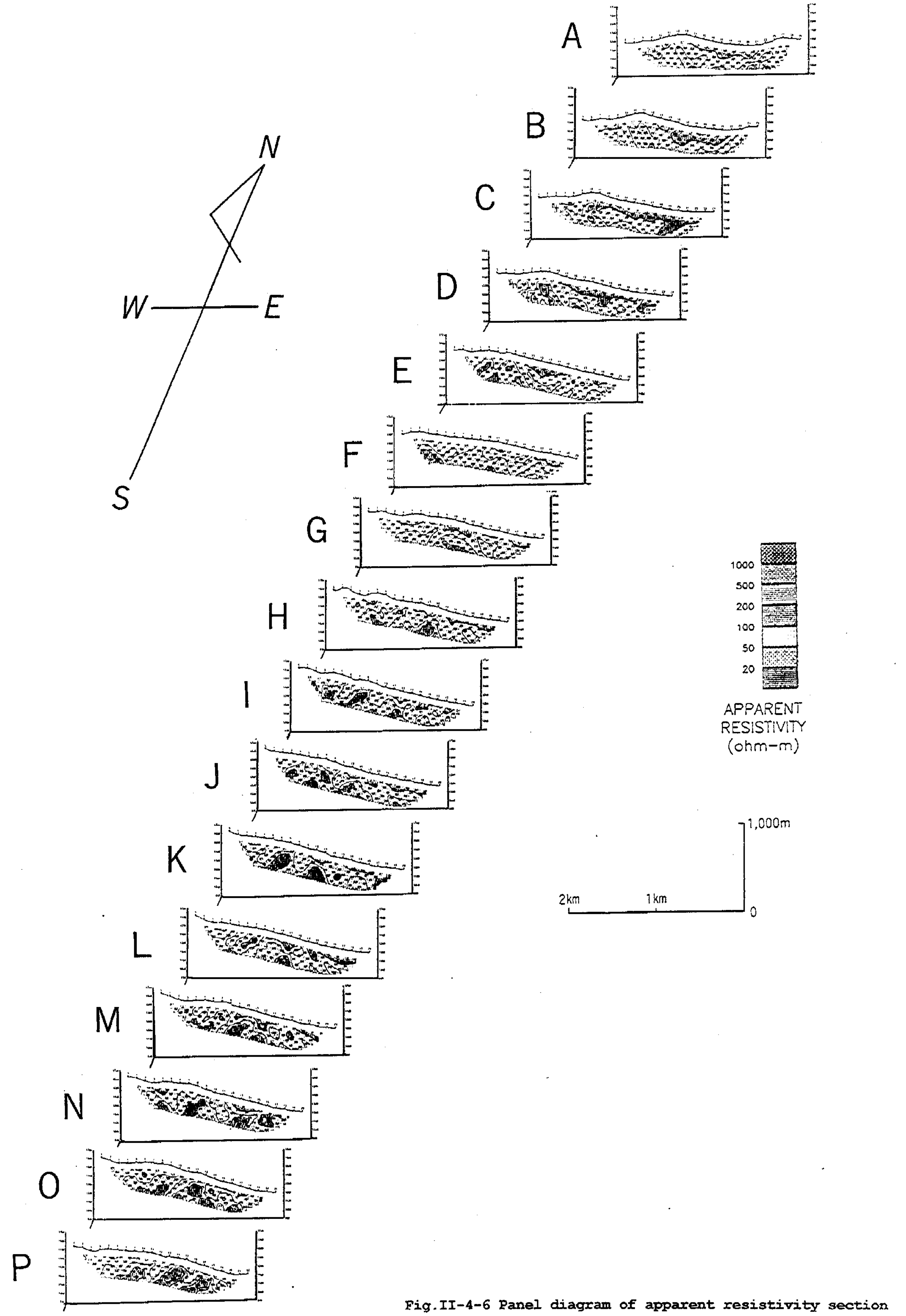


Fig.II-4-6 Panel diagram of apparent resistivity section

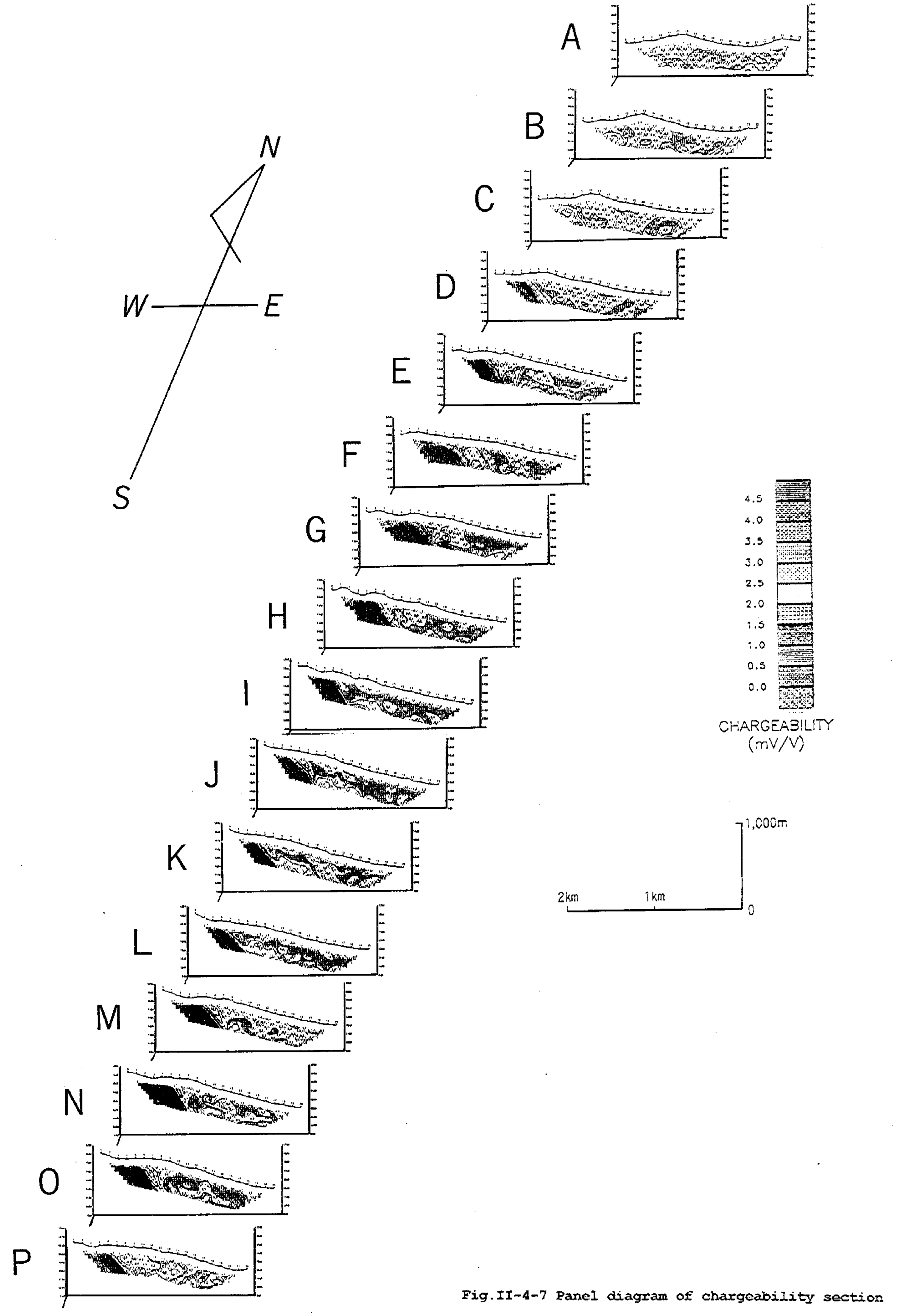


Fig.II-4-7 Panel diagram of chargeability section

Line A

Resistivity shows less than 100 Ω·m in shallow part at the station No.8,15,16,19, and have tendency to shows high resistivity in deep part. It is considered that the low resistivity at the shallow part results from the weathering, argillization, alteration, slightly crack and moisture condition.

Chargeability shows monotonous distribution less than 2.5 mV/V, and remarkable anomaly pattern isn't admitted.

Line B

Resistivity shows less than 100Ω·m in shallow part in the western side of station No.9 and between stations No.17 and No.20, and have tendency to show high resistivity in deep part.

Chargeability shows a weak anomaly with 3.7mV/V in deep part , between stations No8 and No.9. Pyroxenite distributes on the surface of this area, but it is estimated that lower Serpentinite layer may be distributes around the anomaly. The other chargeability anomaly with maximum 3.5mV/V recognized in shallow part between stations No.22 and No.24, but low resistivity anomaly is not recognized at same place. This place corresponds to the Gabbro.

Line C

Resistivity shows less than 100 Ω·m in shallow part at station No.11, between stations No.14 and No.16 and the eastern side from the station No.20.

Chargeability shows anomaly with maximum 4.3mV/V around the western end of the line, between stations No.6 and No.9. This area corresponds to the Serpentinite. Other weak anomaly with 2.6mV/V is recognized in shallow part between stations No.20 and No.23.

Line D

Resistivity shows less than 100 Ω·m in shallow part between stations No.12 and No.14.

Chargeability shows anomaly pattern with maximum 19.5mV/V between stations No.4 and No.8. An anomaly distribution form, suggest to exist an anomaly source in shallow part. This position of anomaly corresponds to Serpentinite.

Line E

Resistivity almost shows 200~1500 Ω·m except for the shallow part between stations No.11 and No.15. General view of the resistivity distribution shows 200~500 Ω·m in the distribution area of Gabbro, and shows 500~1000 Ω·m in the lower Pyroxenite area.

Chargeability shows an apparent anomaly pattern around the station No.3 and No.5. This position corresponds to distribution area of Serpentinite. At east side of this anomaly pattern the other anomaly with the maximum 5.1mV/V is recognized in the deep part at the satiation No.9.

Line F

Resistivity generally shows 200~2000 Ω·m. High resistivity can be found in the deep part.

Chargeability shows an apparent pants leg pattern with maximum 9.3mV/V in the deep part between stations No.2 and No.7. An anomaly distribution form suggest to exist an anomaly source in deep depth. The position of an anomaly source corresponds to the extension of Serpentinite.

Line G

Resistivity generally shows 200~1300. Ω·m. This line has a tendency to be higher resistivity in the deep part.

Chargeability shows an apparent pants leg pattern around the station No.4,5. An anomaly distribution form suggest to exist an anomaly source in subsurface. A minus chargeability below the stations No.6~9 consider to be a result depending on IP anomaly influence of above-mentioned No.4,5. Chargeability shows a background value less than 2mV/V in the eastern side from station No.11.

Line H

Resistivity distribution almost similar to the line H.

Chargeability shows an apparent pants leg pattern around the station No.3~4. An anomaly distribution form suggest to exist an anomaly source in subsurface. This anomaly source corresponds to the distribution area of Serpentinite. The other weak anomaly with 3mV/V is recognized in deep part below the stations No.7 and No.8. But accompanied with low resistivity anomaly.

Line I

Resistivity generally shows 200~1500 Ω·m.

Chargeability shows an apparent pants leg pattern around the station No.2,3. An anomaly distribution form suggest to exist an anomaly source in comparatively deep place. In the east side of this anomaly pattern, an weak anomaly with maximum 3.6mV/V is recognized in the deep part . Chargeability shows a background value less than 2mV/V in the eastern side from the station No.10.

Line J

Resistivity distribution almost similar to the line I.

Chargeability shows an apparent pants leg pattern around the station No.1,2. An anomaly distribution form suggest to exist an anomaly source in subsurface. Other weak anomaly with maximum 3.9mV/V is recognized in deep part between stations No.6 and No.11. This anomaly suggests a deep anomaly source continued from the line I.

Line K

Resistivity distribution almost similar to the line J.

Chargeability shows an apparent half of pants leg pattern around the station No.1~3. An anomaly distribution form suggest to exist an anomaly source in subsurface. Other weak but an apparent anomaly with maximum 3.7mV/V is recognized in deep part between stations No.6 and No.11. This anomaly shows similar form to the line I,J and may be caused by same continuous anomaly source.

Line L

Resistivity distribution almost similar to that of the line K. Remarkable anomaly is not recognized.

Chargeability shows an apparent half of pants leg pattern around the station No.1,2. This position of anomaly corresponds to the distribution area of Serpentinite. Other weak anomaly similar to the line I,J,K is recognized in deep part between stations No.6 and No.9. Chargeability in eastern side from the station No.9 shows a background value with 2mV/V.

Line M

Resistivity distribution almost similar to the line L. Remarkable anomaly is recognized.

Chargeability shows an apparent half of pants leg pattern around the station No.2,3. An anomaly distribution form suggest to exist an anomaly source in subsurface. This position of anomaly corresponds to the distribution area of Serpentinite. Other weak anomaly with maximum 2.3mV/V is recognized in deep part between stations No.8 and No.10.

Line N

Resistivity generally shows 200~3000 Ω·m except for the distribution area of Gabbro.

Chargeability shows an apparent half of pants leg pattern around the station No.2~3. An anomaly distribution form suggest to exist an anomaly source in subsurface. This position of anomaly corresponds to the distribution area of Serpentinite. An independent weak anomaly in shallow to deep part between stations No9 and No.10. may be reflected very sectional anomaly source located in subsurface.

Line O

Resistivity generally shows 200~2000 Ω·m. High resistivity excels in deep part.

Chargeability shows an apparent half of pants leg pattern around the station No.3,4. An anomaly distribution form suggest to exist an anomaly source in subsurface. This position of anomaly corresponds to the distribution area of Serpentinite.

Line P

Resistivity generally shows 200~2000 Ω·m. High resistivity excels in deep part.

Chargeability shows an apparent half of pants leg pattern around the station No.5,6. An anomaly distribution form suggest to exist an anomaly source in subsurface.

4-3-2 Plan of apparent resistivity and chargeability

The plan of apparent resistivity and chargeability for this survey are shown in Fig II-4-8 and Fig II-4-9. In the section, Chargeability anomaly pattern by dipole-dipole electrode arrangement can be displayed the pants leg pattern. This pattern cutting "n" level of the coefficient of electrodes separation, appear both side of expected anomaly source on the plan. An anomaly pattern changes it's distribution increasing "n" level and not become correspond to anomaly source. Therefore, the relationship between geophysical anomalies, expected anomaly source and geological situation were discussed using plan of n=1 level in the case of shallow place, and n=4,5 level in the case of deeper place.

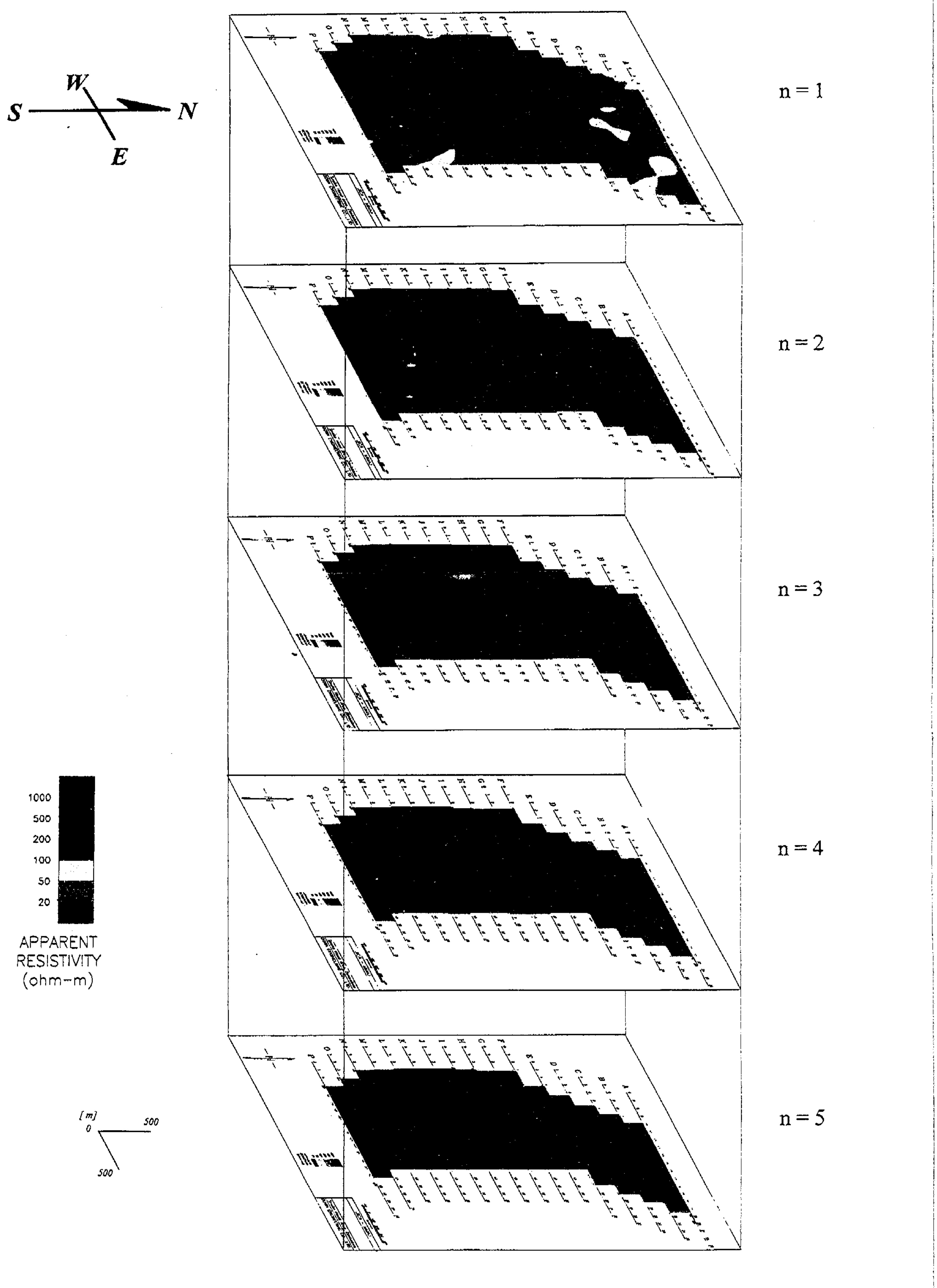


Fig.II-4-8 Panel diagram of apparent resistivity plane

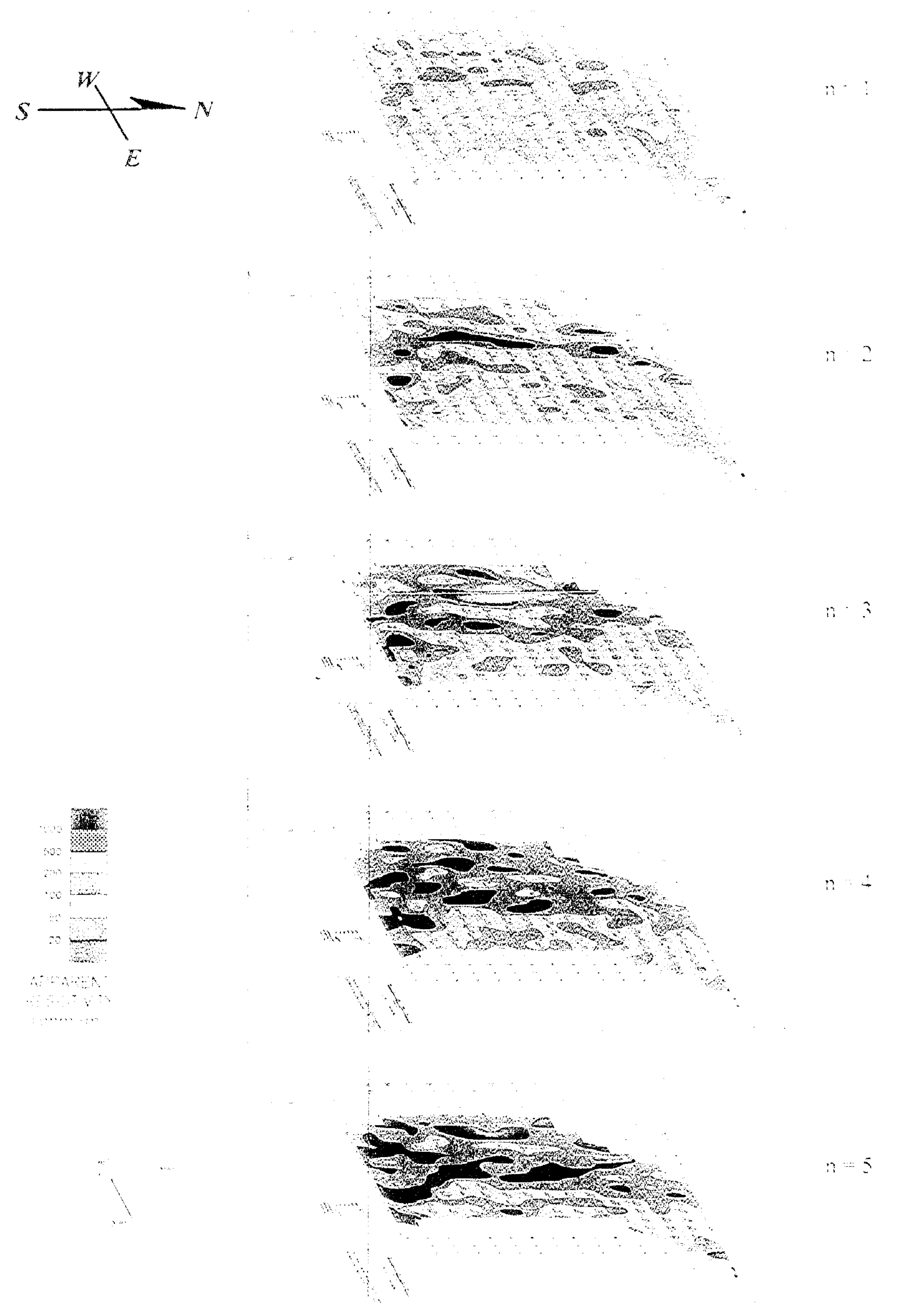


Fig.II-4-8 Panel diagram of apparent resistivity plane

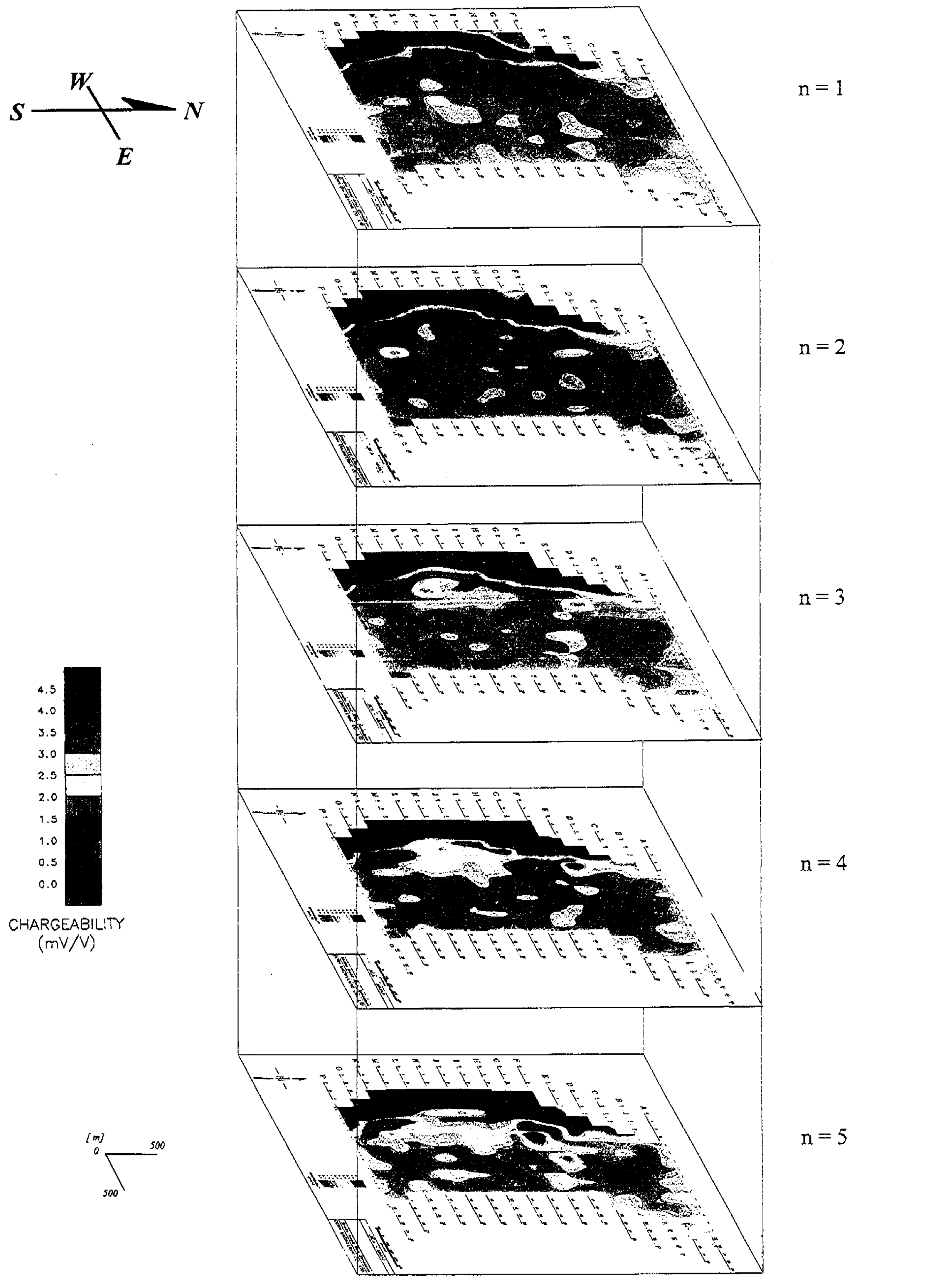


Fig.II-4-9 Panel diagram of chageability plane

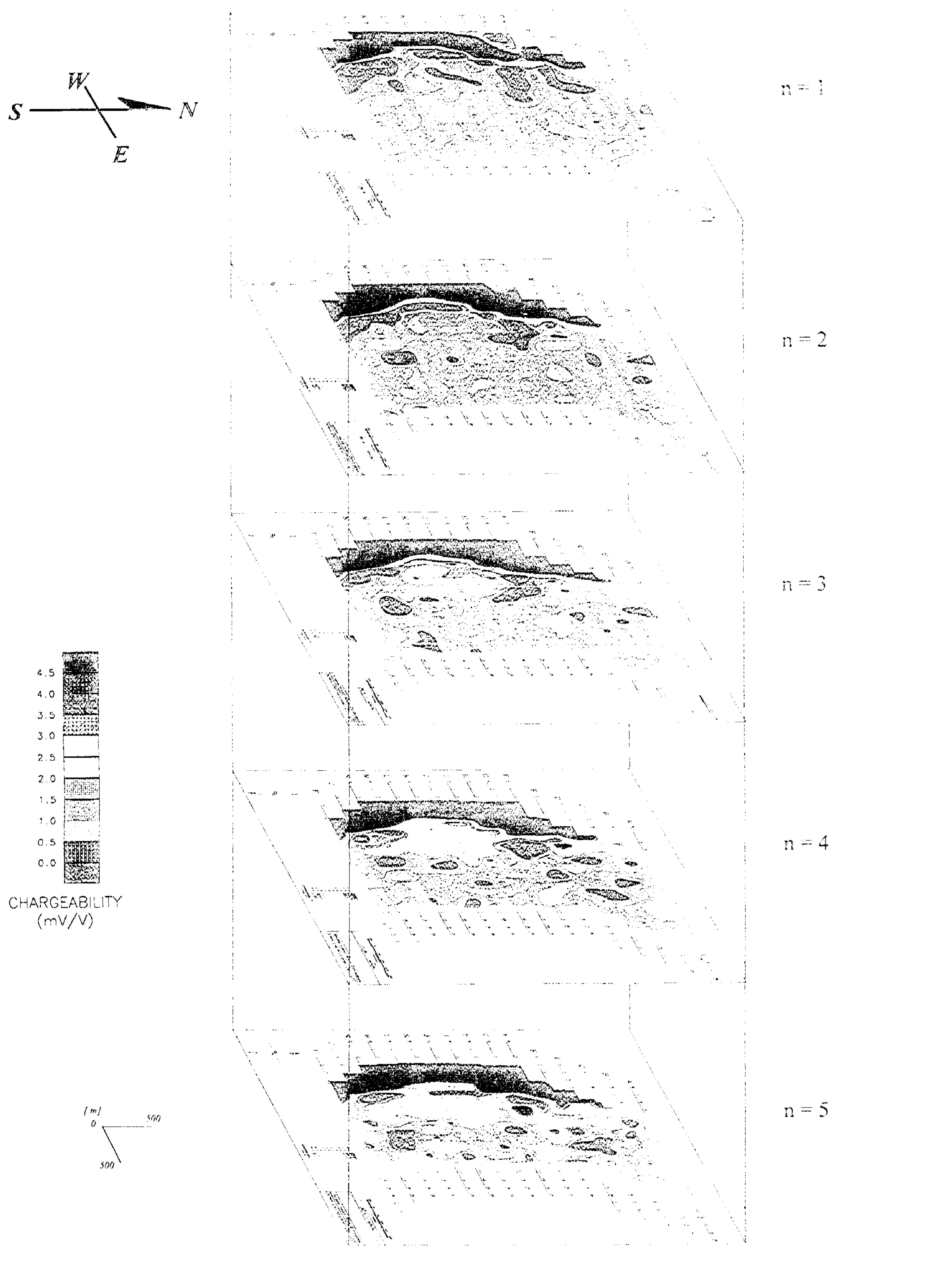


Fig.II-4-9 Panel diagram of chageability plane

The distribution of apparent resistivity

n=1

Plan of n=1 level shows resistivity situation in subsurface. This figure shows low resistivity zone less than 100 Ω·m in the north and east area. The area where generally shows less than 200 Ω·m corresponds to the distribution area of Gabbro.

n=2,3,4,5

The distribution of apparent resistivity deeper than n=2 level shows more than 200 Ω·m and high resistivity predominate in the deep part. Remarkable low resistivity anomaly can not be recognized.

The distribution of chargeability

n=1

At the west side of survey area, a chargeability anomaly is continuously admitted from the line C to the line P. This anomaly shows chargeability with maximum 26.5mV/V, that position corresponds to the distribution area of Serpentinite with chromite. We are thought that chargeability anomaly of n=1 level may be reflected by anomaly source near the subsurface. This anomaly source is consider to have high resistivity and high chargeability, because of low resistivity anomaly isn't admitted with same position.

n=4,5

Weak chargeability anomaly (2~5mV/V) is continuously recognized between stations No.6 and No.10 on the line E, and from line H to N.

4-3-3 Summary

Characteristics of chargeability distribution are summarised in Table II-4-4.

4-4 Analysis of Geophysical Data

4-4-1 Method of 2-D Analysis

2-D simulation analysis of resistivity and chargeability pseudosection was carried out with finite element method forward program by Coggon(1971) and Rijo(1977). In these analyses, several ten times of repetition were made by forward mode of computation and amendment until the completion of approximation to pseudosection.

Table II-4-4 Summary of geophysical survey

Line	Resistivity [Ω·m]	Chargeability [mV/V]	Characteristic of distribution
A	67~1,277	0.1~ 2.4	Monotonous distribution less than 2.4mV/V.
B	52~1,196	0.1~ 3.7	Deep and weak anomaly 3.7mV/V between stations No.8 and No.9.
C	63~1,533	0.3~ 4.3	Maximum 4.3mV/V between stations No.6 and No.9.
D	86~1,704	-0.9~11.2	Anomaly between stations No.4 and No.8.
E	150~1,284	-0.1~16.4	Anomaly between stations No.3 and No.5. Deep and weak anomaly between stations No8 and No.10.
F	127~1,955	-0.7~ 9.3	Anomaly between stations No.2 and No.7.
G	110~1,264	-1.8~11.2	Anomaly in the station No.4,5.
H	134~1,462	-0.5~12.4	Anomaly between stations No.3 and No.4. Deep and week anomaly in the station No.7,8.
I	110~1,934	-0.4~11.5	Anomaly in the station No.2,3. Deep and week anomaly between stations No.6 and No.10.
J	19~1,815	-0.6~12.0	Anomaly in the station No.1,2. Deep and week anomaly between stations No.6 and No.11.
K	113~2,167	0.0~16.6	IP anomaly with half of pants leg pattern between stations No.1~3. deep and week anomaly between stations No.6~9.
L	98~2,448	-0.1~13.1	IP anomaly with half of pants leg pattern in the station No.1,2. deep and week anomaly between stations No.6~9.
M	75~1,594	-0.8~14.1	IP anomaly with half of pants leg pattern in the station No.2,3. deep and week anomaly between stations No.8 and No.10.
N	80~3,447	-1.4~26.5	IP anomaly half of pants leg pattern between stations No.2~3. deep and week anomaly in the station No.9,10.
O	154~2,102	-1.2~16.0	IP anomaly half of pants leg pattern in the station No.3,4.
P	60~3,709	-1.9~ 9.8	IP anomaly half of pants leg pattern in the station No.5,6.

4-4-2 Results of 2-D Analysis

2-D simulation analysis was carried out for apparent resistivity/chargeability of provisional sections of 3 survey lines of E, I, L which were selected within deep chargeability anomalous zones. Data of physical properties of rocks and ore samples are used for this analyses as a reference. Geological sections of these 3 survey lines are shown in Fig.II-4-10.

The results of 2-D simulation analysis are shown in Fig.II-4-11 ~ Fig.II-4-13.

<Line E>

Resistivity: The low resistivity zone in the eastern part of station No.9 was generally matched with calculation by assuming the middle-resistivity body(200 ~ 500Ω·m).

Chargeability: The chargeability anomalous pattern of the subsurface between stations No.4 and No.5 generally matched with calculation by assuming the polarizable body of 20 ~ 25mV/V in the surface area. The chargeability anomalous pattern at the deep part between stations No.8 and No.10 generally matched with calculation by assuming the small polarizable body (180 ~ 250 meters in depth, 100 meters in wide, 50 meters in thick, 120mV/V).

<Line I>

Resistivity: The low resistivity layer was estimated in the subsurface of the east part of station No.7. Gabbro predominate in this area.

Chargeability: The polarizable body of 25mV/V was estimated in the area of Serpentinite. The anomalous pattern of the deep part between stations No.6 and No.10 generally matched with calculation by assuming the polarizable body of 30mV/V in the depth of approximately 170 meters. and approximately 100 meters thickness.

<Line L>

Resistivity: The low resistivity layer was estimated in the subsurface of the east of station No.9. Gabbro predominate in this area.

Chargeability: The polarizable body of 10 ~ 30mV/V was estimated in the subsurface between stations No.0 and No.2. The anomaly of the deep part between stations No.6 and No.7 generally matched with calculation by assuming the polarizable body(10 ~ 30mV/V, approximately 150 meters in thick) which

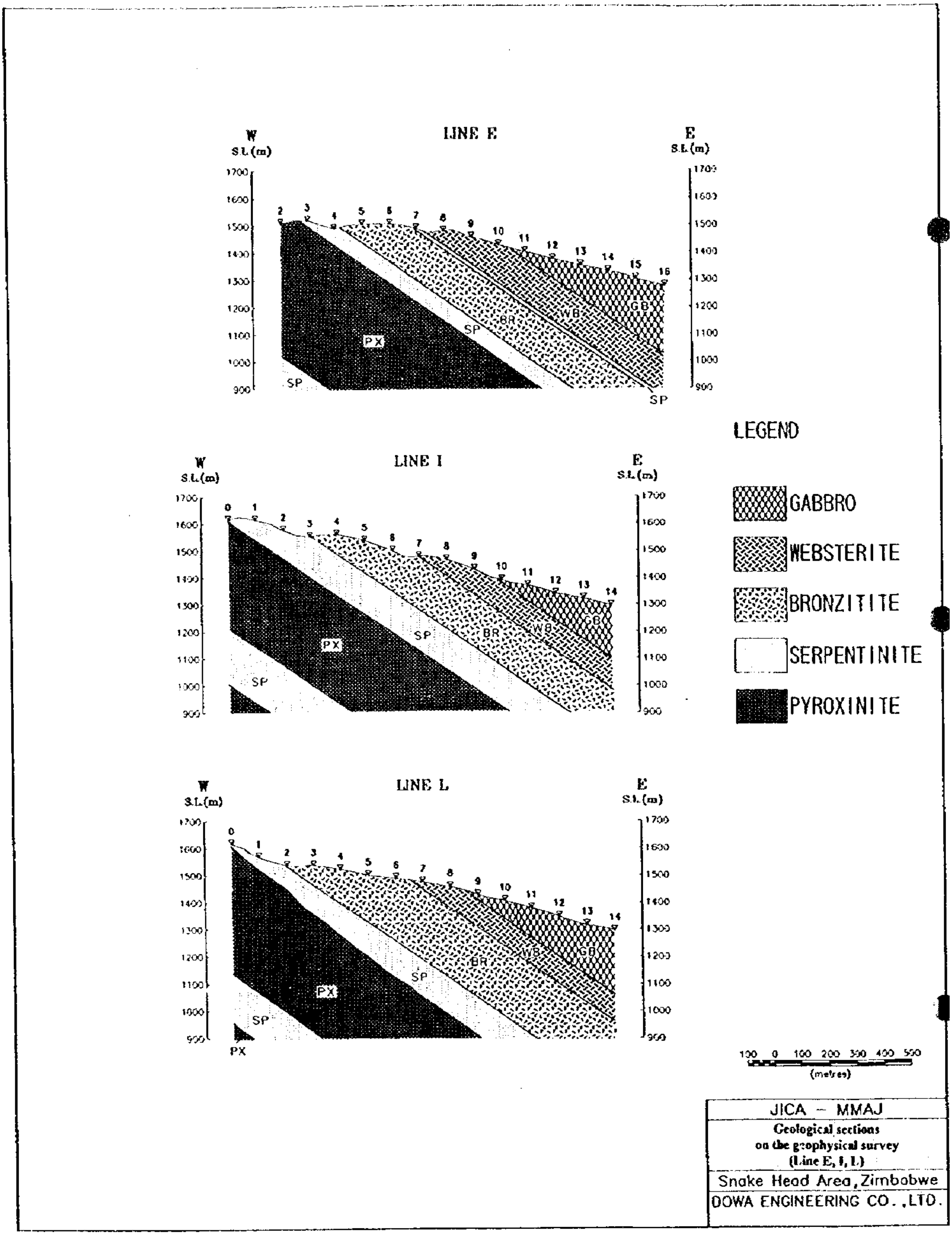


Fig.II-4-10 Geological section of geophysical survey line

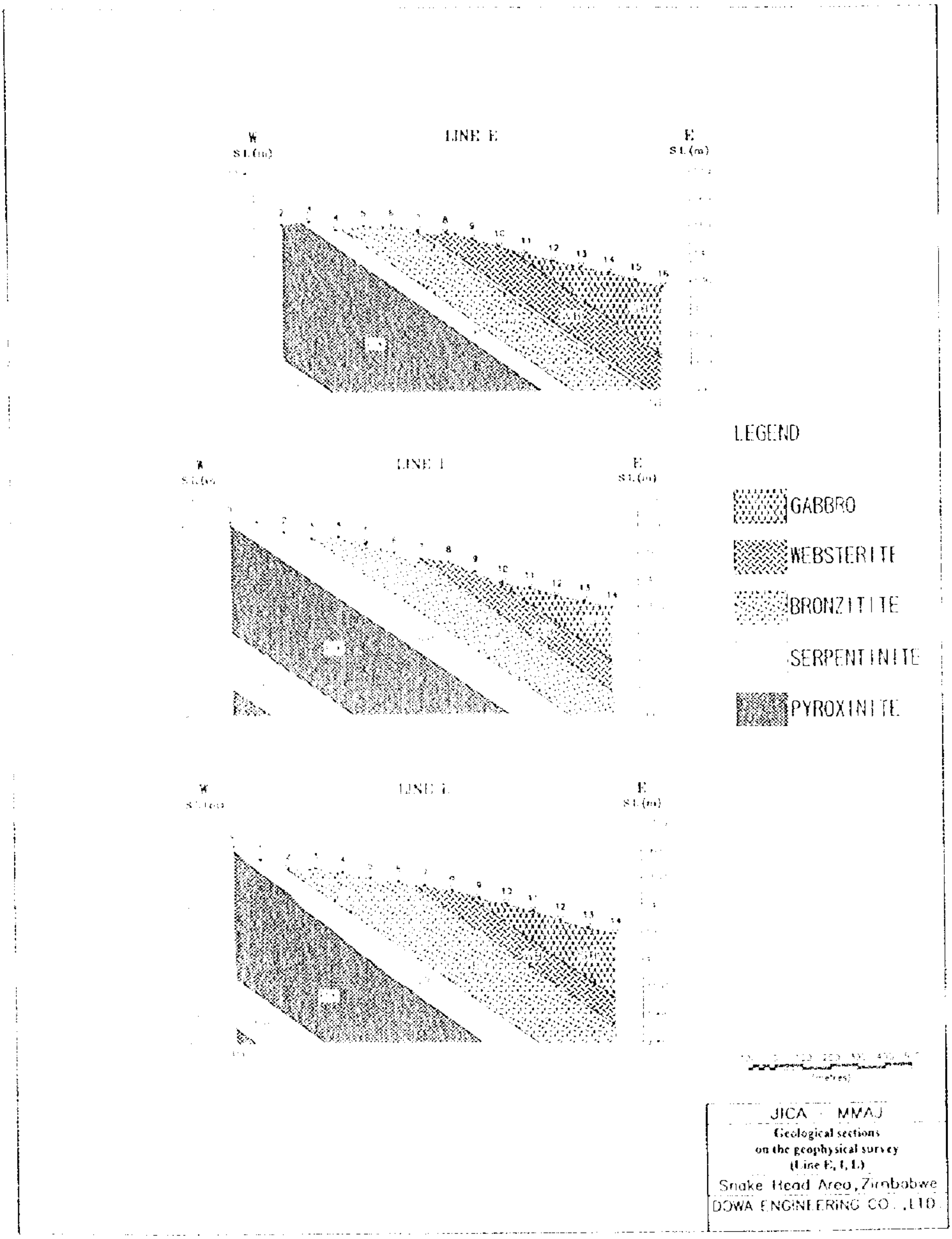


Fig.II-4-10 Geological section of geophysical survey line

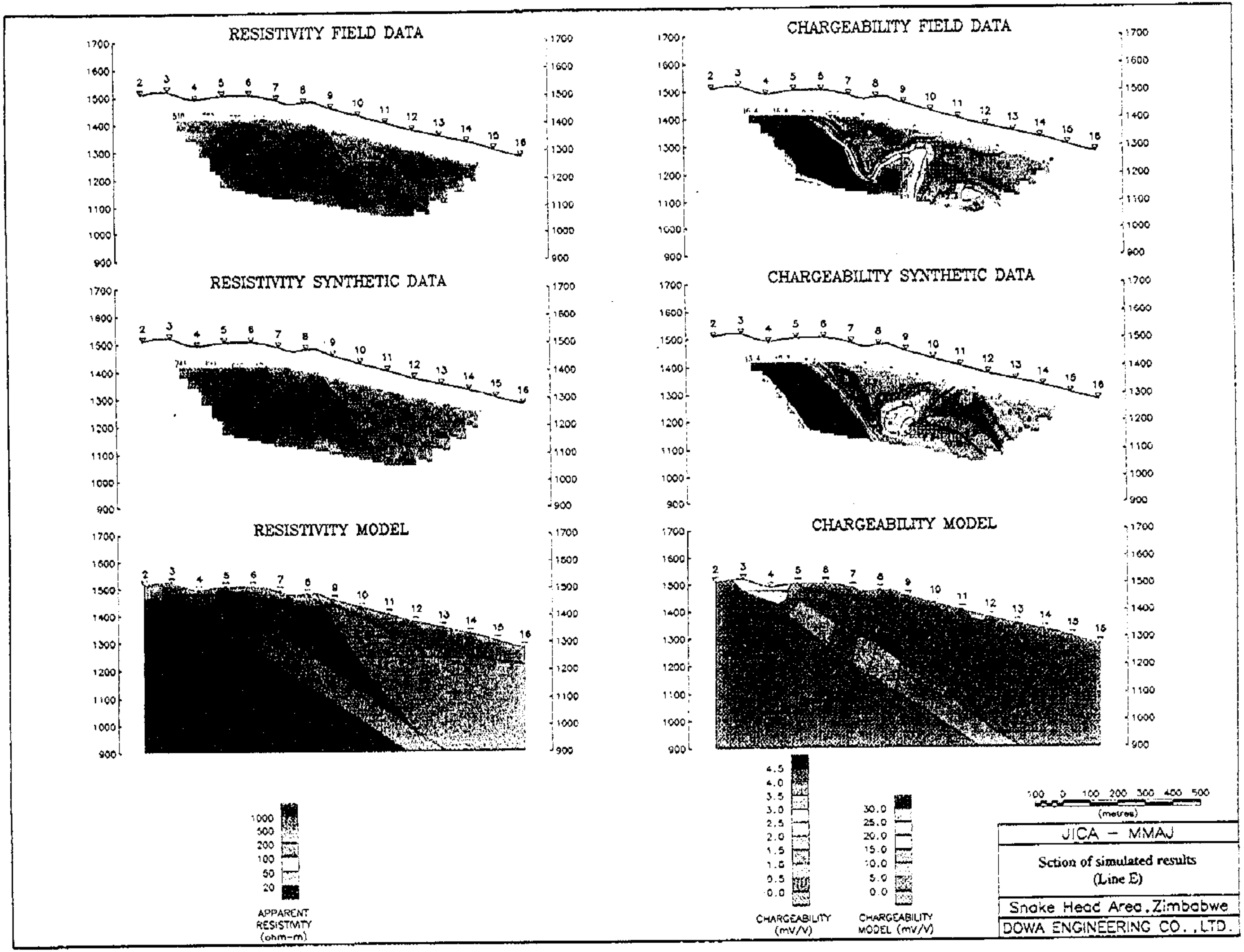


Fig.II-4-11 Section of simulated results (E line)

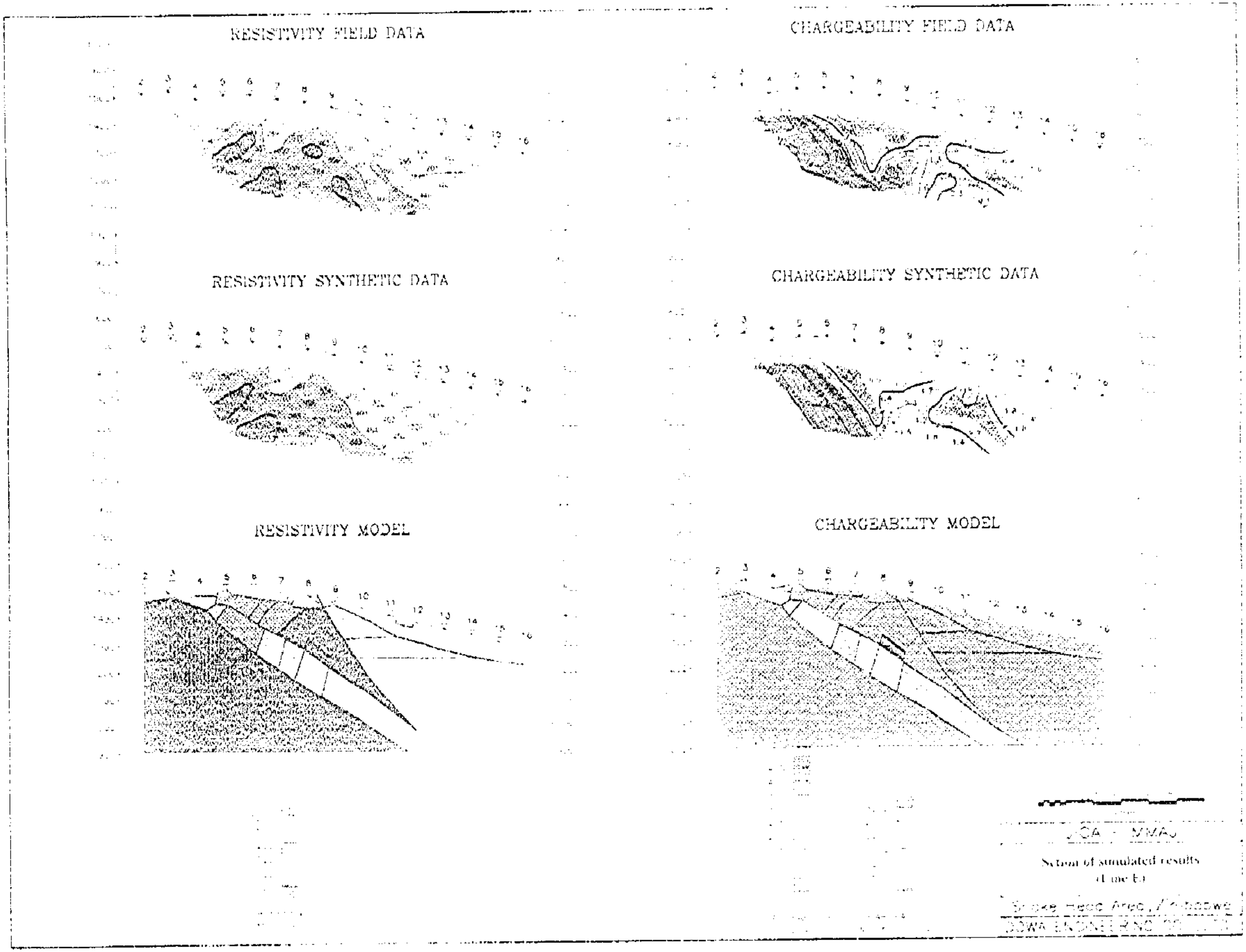


Fig.II- -11 Section of simulated result (E line)

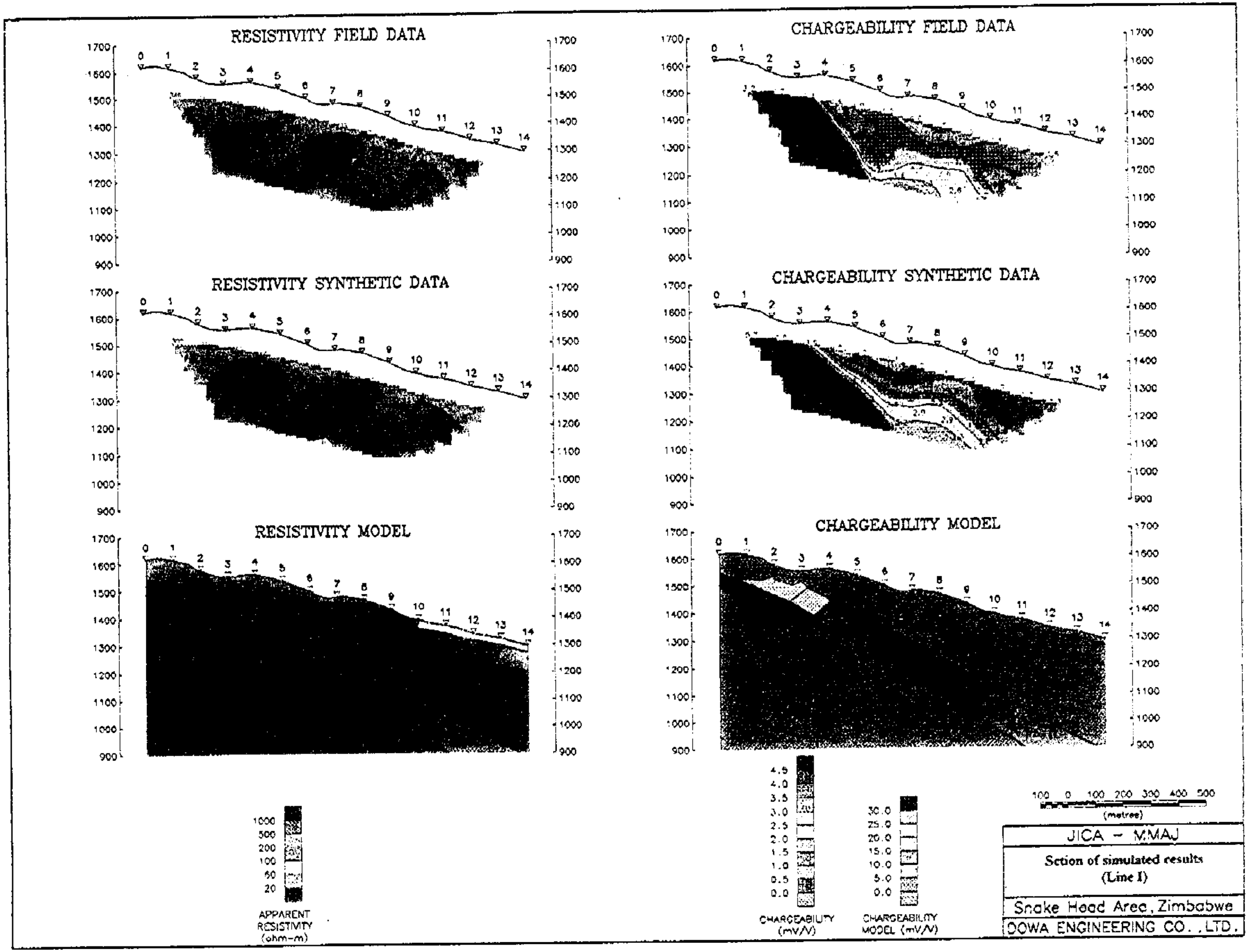


Fig.II-4-12 Section of simulated results (I line)

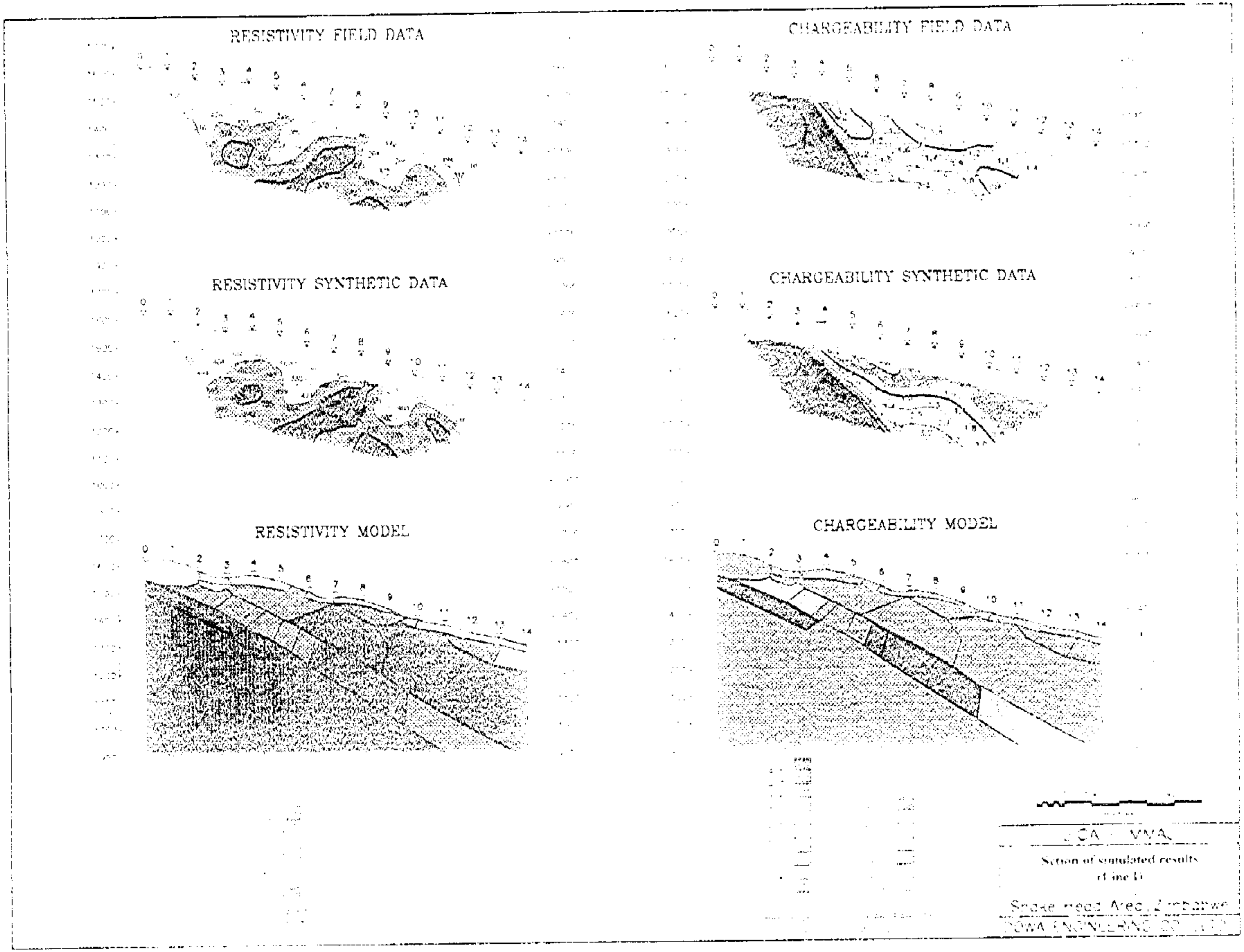
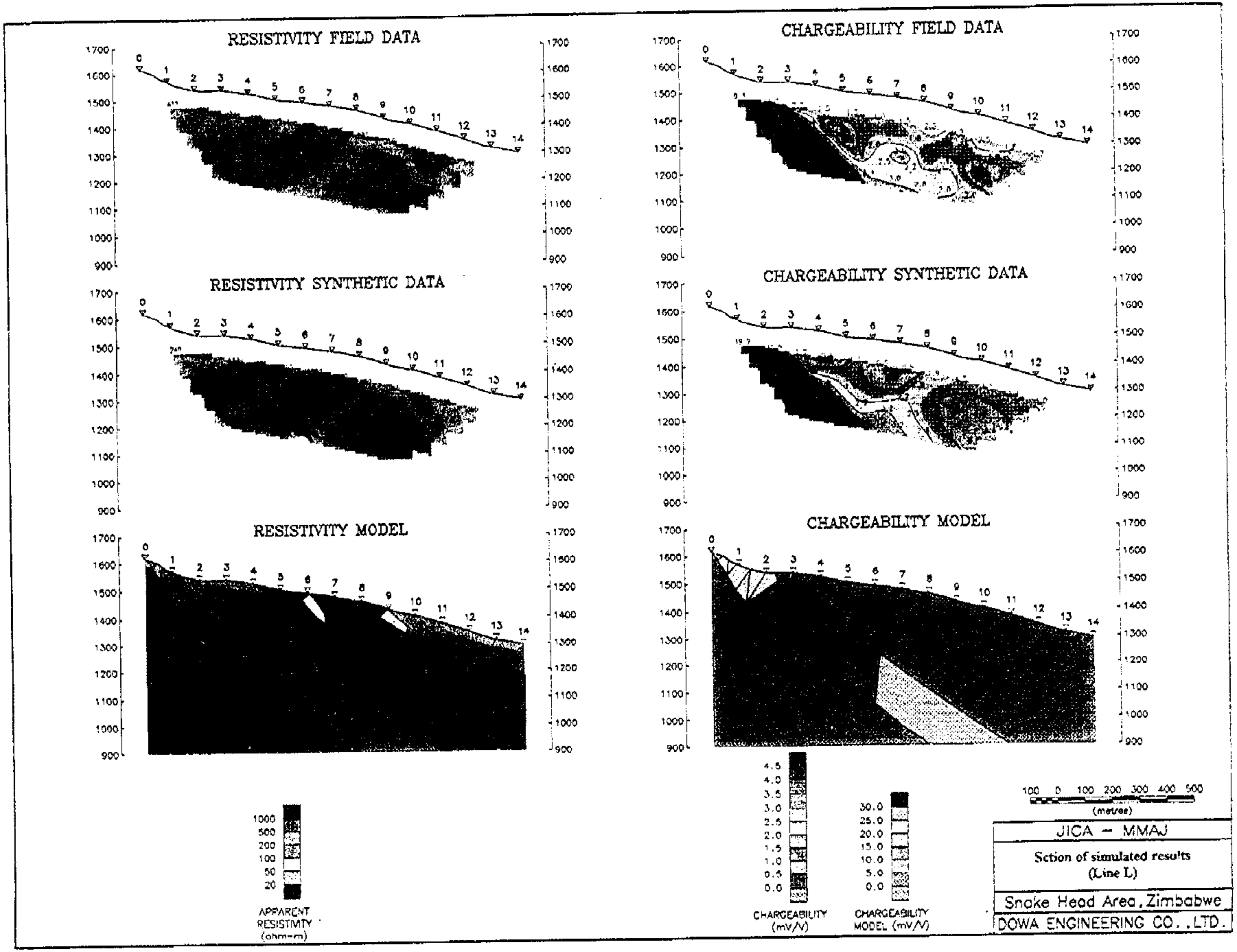


Fig.II-4-12 Section of simulated results (I line)



... Section of simulated results (L line)

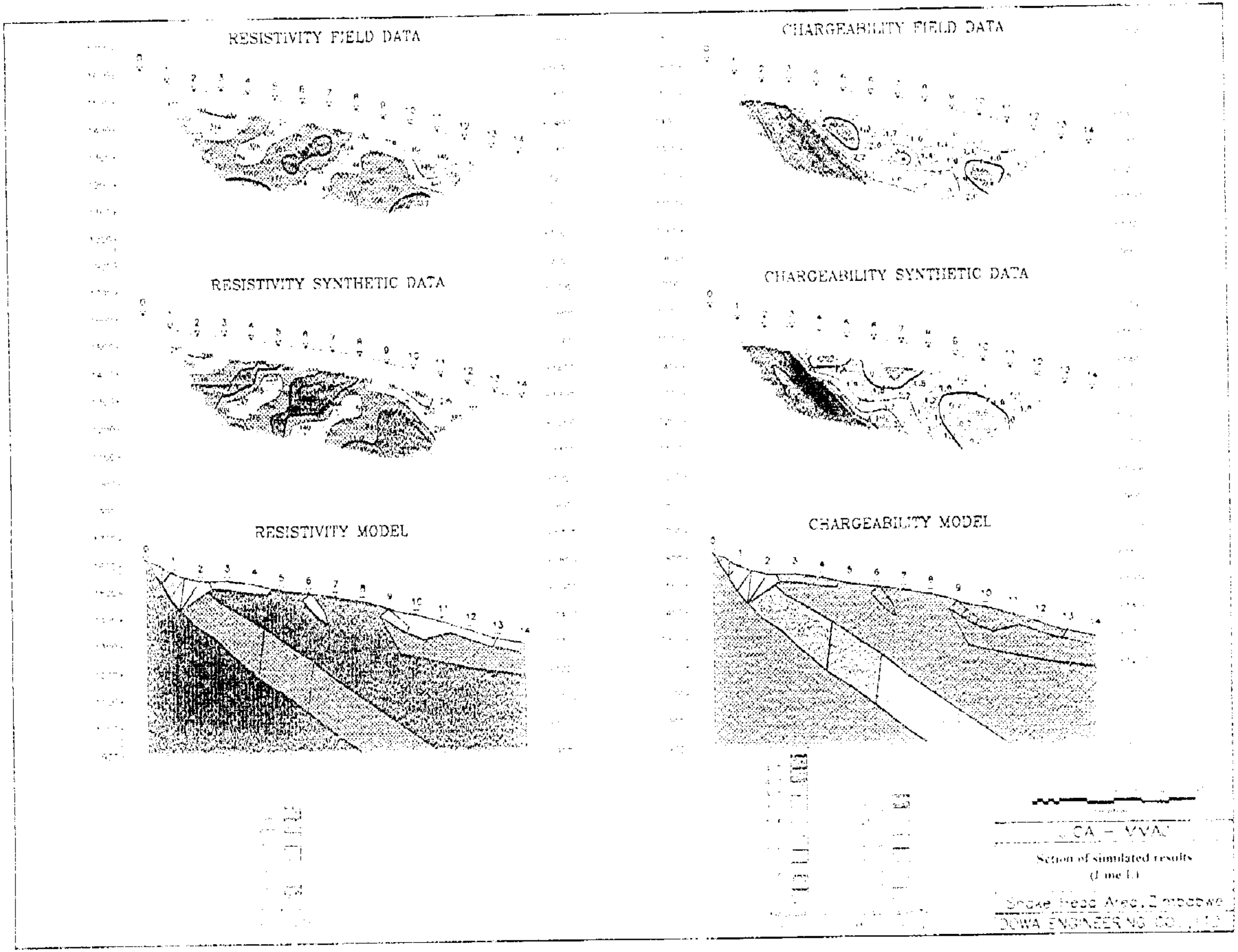


Fig II-4-13 Section of simulated result (L line)

is tilted to the east at an angle of 35 degree to the horizontal.

4-5 Evaluation of the Geophysical Survey

Results of comprehensive analysis of geophysical survey are shown in Fig II-4-14.

The distinctive chargeability anomalies were detected in the western part of Line D~P, and the weak distinctive anomalies were detected at deep part of Line E, and Line H~N between stations No.6 and No.10. These anomalies are not accompanied with low-resistivity anomalies.

As a result of physical property tests, it was proved that the sample which has sulphide content are in the order of 1.0mV/V to 2.5mV/V and do not show a great deal of contrast with the host rock. This probably results from minor quantities of sulphide. On the other hand, Serpentinite with chromite($FeCr_2O_4$) shows high chargeability(50mV/V), and also shows high resistivity(over 500 Ω·m). Difference was found between this sample and other rocks in chargeability.

As a result of 2-D simulation analysis, it was estimated that the anomaly in the western part of area result from polarizable body which correspond to Serpentinite. And it was also estimated that the anomaly at the deep part between stations No.6 and No.10 result from polarizable body which correspond to the extension of Serpentinite or the basal part of Pyroxenite(P1).

According to EPO654(1992), drilling has succeeded in finding the two zones of disseminated sulphide mineralization. These zones are termed the main sulphide zone(MSZ; 85 ~ 95 meters in depth) and the lower sulphide zone(LSZ; 145 ~ 155 meters in depth), and it has been made clear that the two zones are 10m thick and contain 0.1 ~ 0.12 % Cu + Ni.

On the basis of above results, it can be stated that the anomalies at shallow part in western part of Line D ~ Line P result from Serpentinite with chromite. On the other hand, It can be stated that the anomalies at deep part of Line E and Line H ~ N between stations No.6 and No.10 result from the extension of Serpentinite or the basal part of Pyroxenite(P1). It may be inferred that the source of these anomalies are situated approximately 150 meters below LSZ.

The relationship between grade of sulphide and chargeability can not be decided because of the variety of resistivity of host

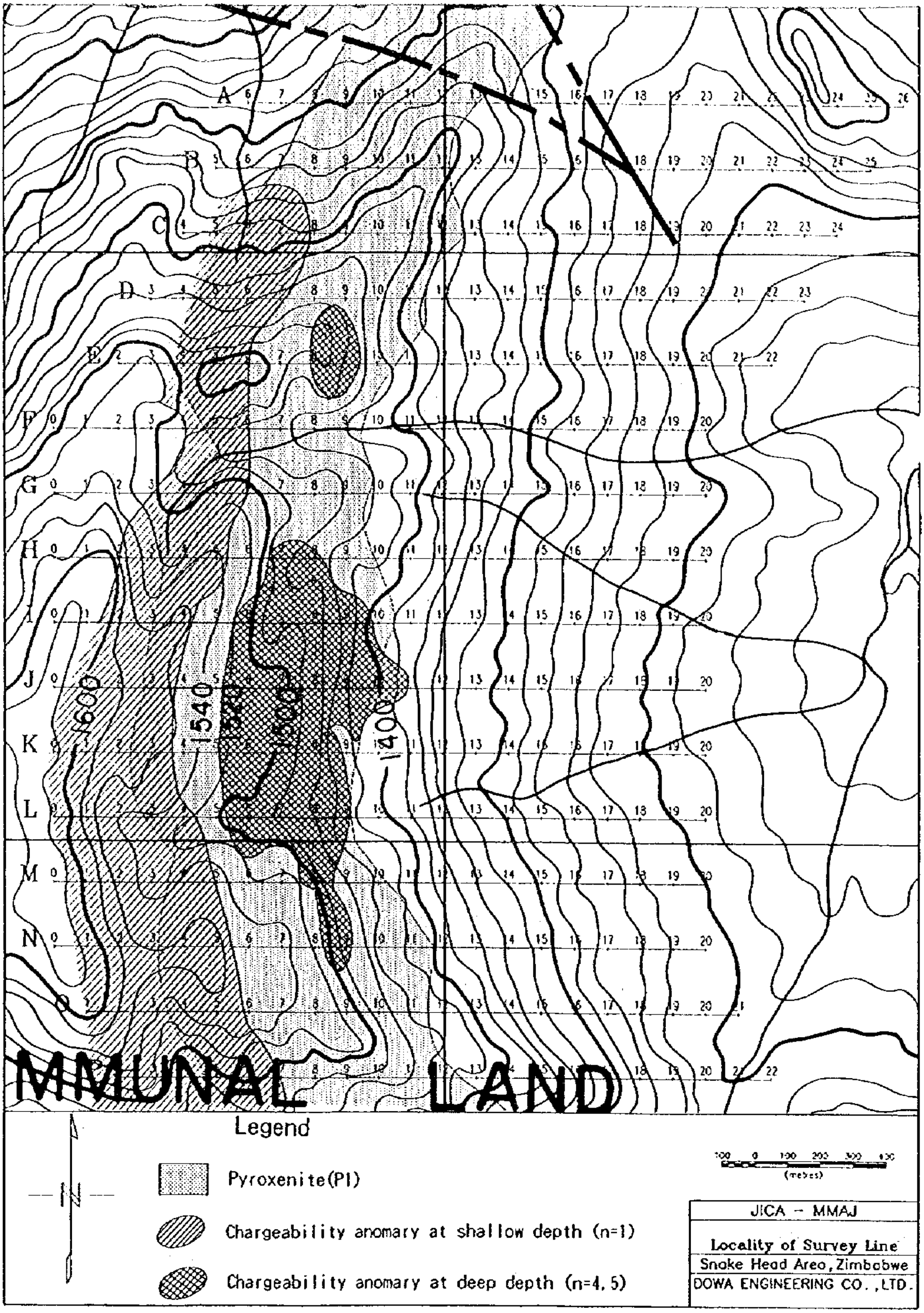


Fig.II-4-14 Summary of the geophysical survey

rock or connection between each sulphide minerals. But it can be stated that it is difficult to find out low-grade sulphide target(under %-order) by IP survey.
Data from 2-D simulation analysis and physical property tests, as well as field data, indicate that the boundary between Pyroxenite(P1) and Serpentinite has been made clear.

Chapter 5 Drilling survey

5-1 Method of the survey

5-1-1 Purpose and outline of the survey

Based on results of Phase I surveys, drilling was carried out in order to find mineralized zone. The drilling survey consisted of 10 drill holes, total length of 4,500.74 meters.

The target sites are in the WS area where the geochemical and geophysical anomalies were obtained by Phase I survey.

Each drilling site is shown in Fig.II-5-1, and details of drilling is shown in Table II-5-1.

The drilling work was contracted to R. A. Longstaff (Pvt) Ltd., based in Harare.

Table II-5-1 List of drilling

Specification	Amount	
Drilling survey	MJZS-1(W,-60°)	400.00m
	MJZS-2(W,-60°)	500.00m
	MJZS-3(W,-60°)	500.30m
	MJZS-4(W,-60°)	300.00m
	MJZS-5(W,-60°)	400.44m
	MJZS-6(W,-60°)	450.00m
	MJZS-7(W,-60°)	500.00m
	MJZS-8(-90°)	650.00m
	MJZS-9(W,-70°)	400.00m
	MJZS-10(W,-60°)	400.00m
	Total(10 holes)	4,500.74m

5-2 Result of the survey

5-2-1 Lithology of holes

Geologic section are shown in Fig.II-5-2 to Fig.II-5-9.

Summary of each hole is as follows :

(1) MJZS-1 (400.00m)

The bed rock appears after the red and white soil portion of 8.90 meters.

8.90m--162.80m Gabbro

It is green to dark green color, and fine grain, minute , hard. Texture is holocrystalline and equigranular. Mineral assemblage is mainly composed of plagioclase and approximately same quantity of orthopyroxene and clinopyroxene. White and pale green, coarse grain part is recognized in some part, a white spot of plagioclase becomes remarkable. A small vein of calcite,

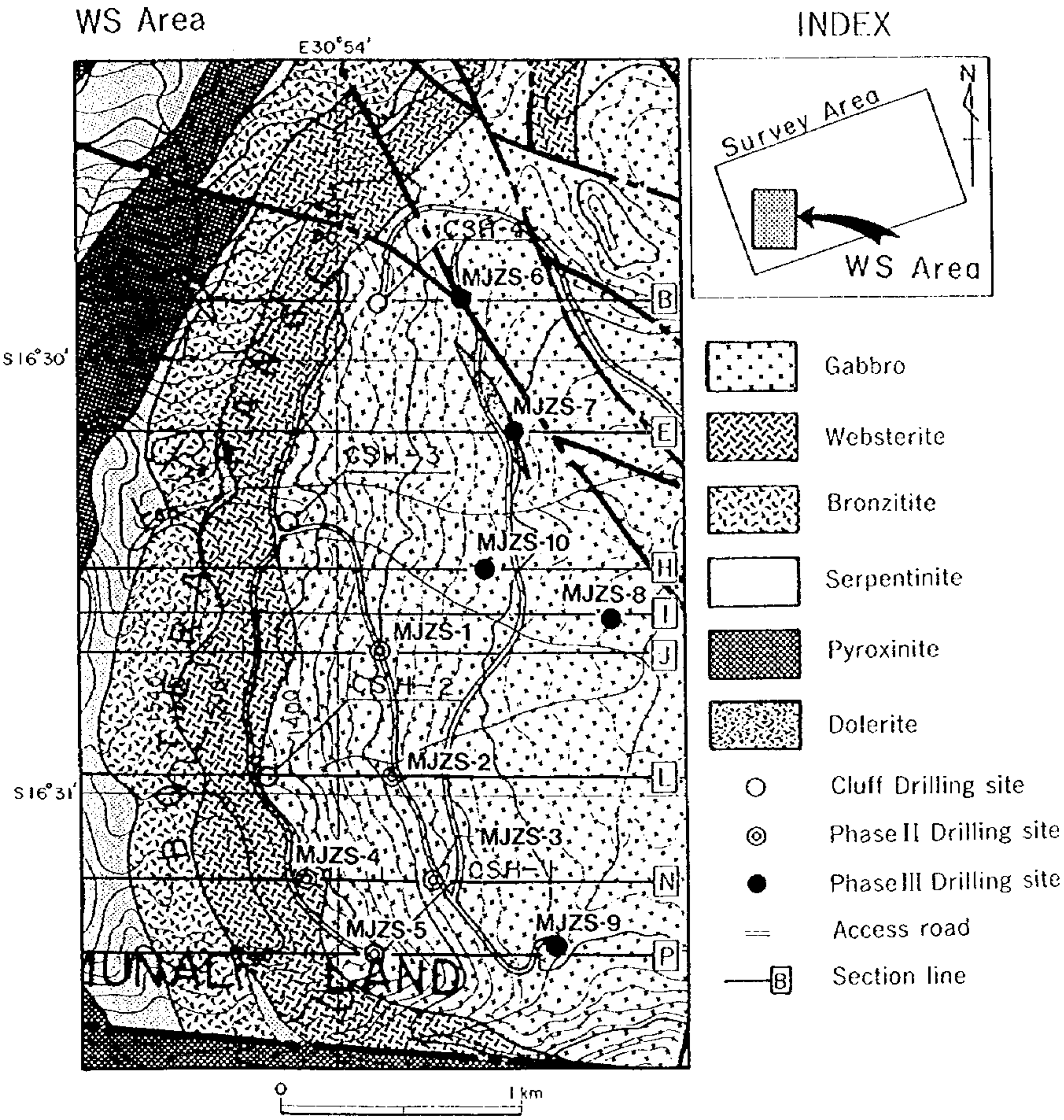


Fig.II-5-1 Locality of drilling sites

chlorite and serpentine was admitted along the brecciated zone.

162.80m--222.70m Websterite

It shows green to dark green color, and medium to coarse grain, Texture is holocrystalline and equigranular. Mineral assemblage is composed of approximately same quantity of orthopyroxene and clinopyroxene. Extremely fine grain and small quantity of sulphide dissemination mainly composed of pyrite, pyrrhotite and chalcopyrite accompanied. Small vein of chlorite and serpentine is admitted in websterite layer.

222.70m--232.00m Serpentinite

It shows pale green to yellow green color. Mineral assemblage is mainly composed of olivine. Rock facies shows fine grain and soapy, and characteristically show banding and stripe form with dark and clear color.

232.00m--283.50 Bronzitite

It shows a dark green to dark gray color. Texture is a fine grain, holocrystalline and equigranular. Mineral assemblage is composed of almost all orthopyroxene and includes a small to an extremely small quantity of clinopyroxene. The uppermost of this layer includes sulphide dissemination which is mainly composed of pyrite, pyrrhotite and chalcopyrite.

283.50m--293.00m Serpentinite (~Harzbergite)

The contact part shows a pale green color. Rock facies shows fine grain, soapy, and stripe form. Center part shows black color, fine grain minute and hard. Mineral assemblage is almost all composed of olivine.

293.00m--357.30 Bronzitite

Mineral assemblage and rock facies is similar to the upper bronzitite. Grain size becomes coarse and increase a quantity of clinopyroxene towards the lower potion.

357.30m--390.10m Serpentinite (~Harzbergite)

Contact part shows gray, pale green to olive green color. Rock facies shows fine grain, soapy, and stripe form. Center part shows black color, fine grain minute and hard. Mineral assemblage is almost all composed of olivine.

390.10m--400.00 Bronzitite

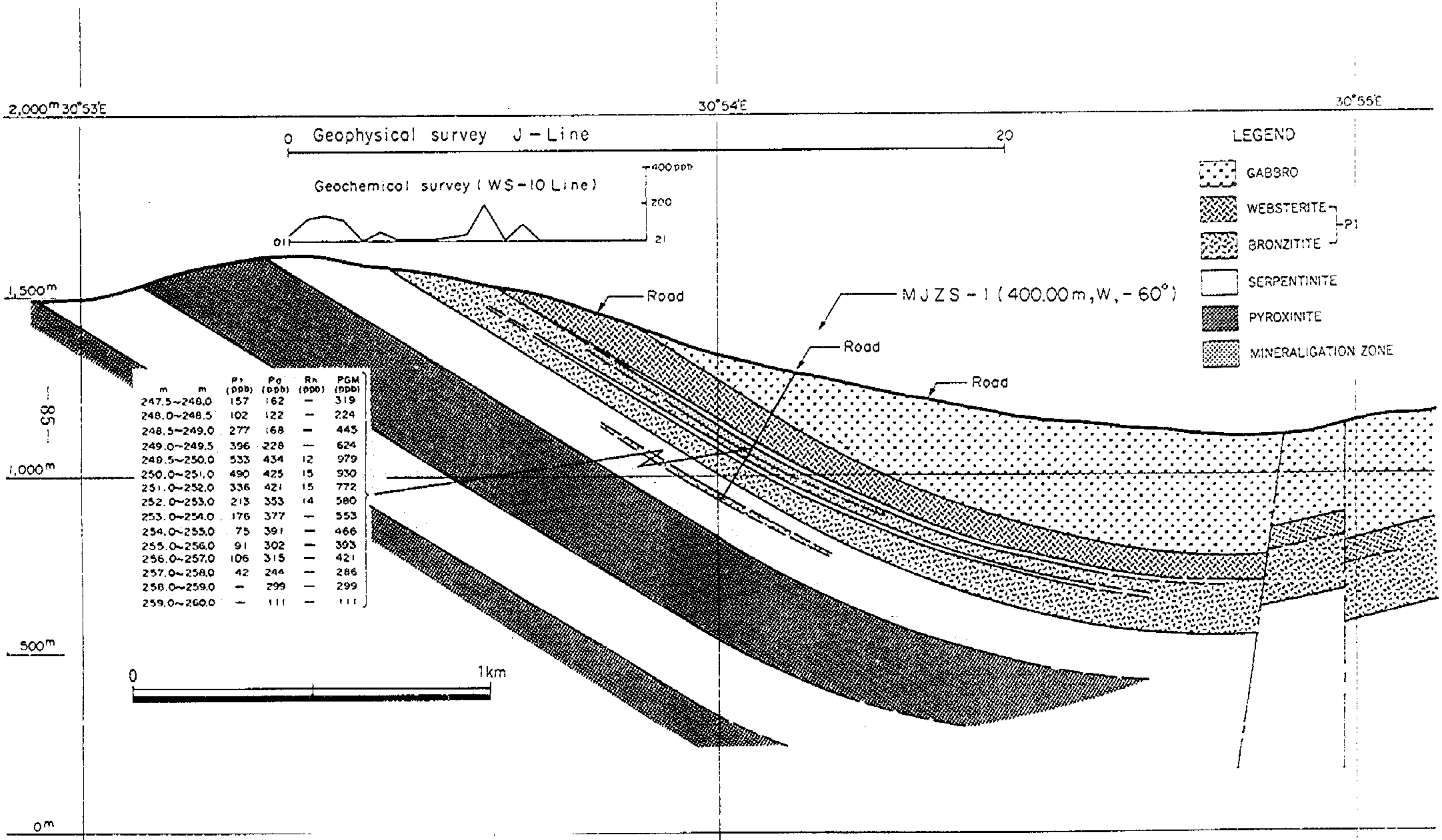
Mineral assemblage and rock facies is similar to the upper bronzitite. Small veins of calcite and clay were observed.

(2) MJZS-2 (500.00m)

The bed rock appears after the red soil portion of 1.69 meters.

1.69m--184.18m Gabbro

It shows multi-color of green, dark green and white, and fine grain, minute , hard. Texture is holocrystalline and



m ~ m	Pt (ppb)	Pd (ppb)	Rh (ppb)	PGM (ppb)
247.5~248.0	157	162	—	319
248.0~248.5	102	122	—	224
248.5~249.0	277	168	—	445
249.0~249.5	396	228	—	624
249.5~250.0	533	434	12	979
250.0~251.0	490	425	15	930
251.0~252.0	336	421	15	772
252.0~253.0	213	353	14	580
253.0~254.0	176	377	—	553
254.0~255.0	75	391	—	466
255.0~256.0	91	302	—	393
256.0~257.0	106	315	—	421
257.0~258.0	42	244	—	286
258.0~259.0	—	299	—	299
259.0~260.0	—	111	—	111

Fig.II-5-2 Drilling section (J-Line)

equigranular. Mineral assemblage is mainly composed of plenty plagioclase, and orthopyroxene, a small quantity of clinopyroxene. White and pale green, coarse grain part is recognized in some parts, weak weathered zone is admitted along to crushed zone. Mineral assemblages change in the direction towards the lower portion. The center potion is composed of about same quantity of plagioclase and orthopyroxene, and is accompanied by a small quantity of clinopyroxene. Lower portion is composed of a small quantity of plagioclase, and about equal quantity of orthopyroxene and clinopyroxene.

184.18m--266.00m Websterite

It shows dark green color, and medium to coarse grain, Texture is holocrystalline and equigranular. Mineral assemblage is mainly composed of orthopyroxene and clinopyroxene, these two pyroxenes are about equal quantity, or quantity of orthopyroxene is little more than clinopyroxene. A small quantity of sulphide dissemination which mainly composed of pyrite, pyrrhotite and chalcopyrite accompanied. Small vein of chlorite, serpentine and epidote is admitted in websterite layer.

266.00m--302.40 Bronzitite

Contact of websterite and bronzitite change gradually. It shows dark green to dark gray color. Texture is a fine grain, holocrystalline and equigranular. Mineral assemblage is almost all composed of orthopyroxene and includes an extremely small quantity of clinopyroxene. Uppermost layer includes sulphide dissemination which is mainly composed of pyrite, pyrrhotite and chalcopyrite.

302.40m--307.98m Serpentinite (~Harzbergite)

It shows pale gray, pale green and olive green color. Rock facies shows fine grain, soapy, soft and stripe form. Mineral assemblage is almost all composed of olivine.

307.98m--384.08 Bronzitite

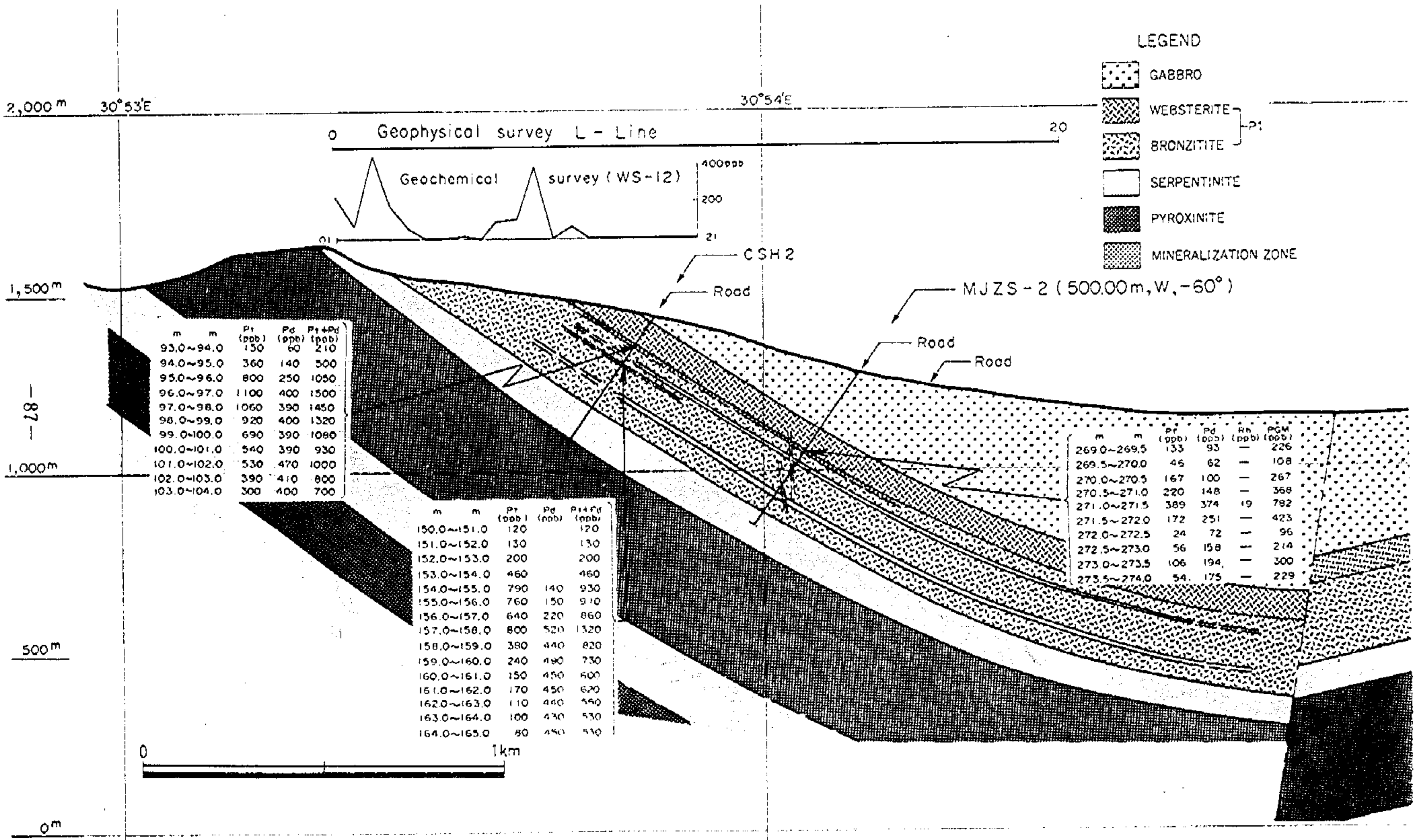
Mineral assemblage and rock facies is similar to the upper bronzitite. Grain size becomes coarse and includes a comparatively large quantity of clinopyroxene. Dolerite dyke which shows olive green color and cross to the hole about 70 degree is admitted from 351.50m to 354.00m in depth.

384.08m--394.70m Serpentinite (~Harzbergite)

It shows black color. Rock facies show fine grain, soapy, and stripe form. Center part shows gray, pale green and olive green color. Mineral assemblage is almost all composed of olivine.

394.70m--472.38 Bronzitite

Rock facies is similar to the upper bronzitite. It shows a green to pale green color, medium grain, holocrystalline and



m m	Pt (ppb)	Pd (ppb)	Pt+Pd (ppb)
93.0~94.0	150	60	210
94.0~95.0	360	140	500
95.0~96.0	800	250	1050
96.0~97.0	1100	400	1500
97.0~98.0	1060	390	1450
98.0~99.0	920	400	1320
99.0~100.0	690	390	1080
100.0~101.0	540	390	930
101.0~102.0	530	470	1000
102.0~103.0	390	410	800
103.0~104.0	300	400	700

m m	Pt (ppb)	Pd (ppb)	Pt+Pd (ppb)
150.0~151.0	120		120
151.0~152.0	130		130
152.0~153.0	200		200
153.0~154.0	460		460
154.0~155.0	790	140	930
155.0~156.0	760	150	910
156.0~157.0	640	220	860
157.0~158.0	800	520	1320
158.0~159.0	380	440	820
159.0~160.0	240	490	730
160.0~161.0	150	450	600
161.0~162.0	170	450	620
162.0~163.0	110	440	550
163.0~164.0	100	430	530
164.0~165.0	80	450	530

m m	Pt (ppb)	Pd (ppb)	Rh (ppb)	PGM (ppb)
269.0~269.5	133	93	—	226
269.5~270.0	46	62	—	108
270.0~270.5	167	100	—	267
270.5~271.0	220	148	—	368
271.0~271.5	389	374	19	782
271.5~272.0	172	251	—	423
272.0~272.5	24	72	—	96
272.5~273.0	56	158	—	214
273.0~273.5	106	194	—	300
273.5~274.0	54	175	—	229

Fig.II-5-3 Drilling section (L-line)

equigranular texture. Mineral assemblage is almost all composed of orthopyroxene and includes a small quantity of clinopyroxene.

472.38m--500.00m Serpentinite (~Harzbergite)

It shows black color. Rock facies of upper contact zone show gray, pale green and olive green color, fine grain, soapy, and stripe form. Mineral assemblage is almost all composed of olivine. Center part characteristically shows a white mottled pattern of 3 to 5cm diameter concentrating a large crystal of plagioclase, olivine and etc.

(3) MJZS-3 (500.30m)

The bed rock appears after the red soil portion of 3 meters.

3.00m--188.49m Gabbro

It shows green to dark green color, and medium to coarse grain, minute, hard. Texture is holocrystalline and equigranular. Mineral assemblage is mainly composed of plenty plagioclase, and orthopyroxene with green to pale green color, clinopyroxene with light purple color. White and pale green part is recognized in some parts, weak weathered zone with small vein of calcite, chlorite and quartz is admitted along to crushed zone.

188.49m--263.58m Websterite

It shows green to dark green color, and medium to coarse grain, Texture is holocrystalline and equigranular. Mineral assemblage is mainly composed of orthopyroxene and clinopyroxene, these two pyroxenes are about equal quantity, or quantity of orthopyroxene is little more than clinopyroxene. Some parts become fine grained, clinopyroxene with light purple in color is observed clearly as s spot.

263.58m--393.50 Bronzitite

It shows green to dark green color. Texture is a medium to coarse grain, holocrystalline and equigranular. Mineral assemblage is almost all composed of orthopyroxene (green to dark green in color) and include an extremely small quantity of clinopyroxene (light purple in color). Uppermost and middle of this layer include two layer of sulphide dissemination zone which mainly composed of pyrite, pyrrhotite and chalcopyrite and small calcite vein. Sulphide generally shows euhedral and extremely small grain or film shape, anhedral sulphide which filled in grain boundary is admitted in comparatively high concentrate part of sulphide.

398.50m--400.00m Serpentinite (~Harzbergite)

Both contacts change gradually. It shows a black to light gray color. Rock facies shows fine grain, soapy, soft and stripe form. Mineral assemblage is mainly composed of olivine, magnetite and chromite.

400.00m--475.88 Bronzitite

Mineral assemblage and rock facies is similar to the upper bronzitite. a comparatively large quantity of clinopyroxene is included. There is almost no dissemination of sulphide and a small vein of chlorite is admitted.

475.88m--487.64m Serpentinite (~Harzbergite)

Both contacts change gradually. It shows a black color. Rock facies shows fine grain, soapy, and stripe form. Some part shows gray, pale green, olive green color, and strongly serpentinized. Mineral assemblage is almost all composed of olivine and magnetite.

487.64m--500.30 Bronzitite

Rock facies is similar to the upper bronzitite. It shows green to olive green color, medium grain, holocrystalline and equigranular texture. Mineral assemblage is composed of about equal quantity of orthopyroxene and clinopyroxene.

(4) MJZS-4 (300.00m)

The bed rock appears after the red and gray soil portion of 12.70 meters.

12.70m--56.70m Websterite

It shows green to dark green color, and medium to coarse grain. Texture is holocrystalline and equigranular. Mineral assemblage is mainly composed of orthopyroxene and clinopyroxene, these two pyroxenes are about equal quantity. An extremely small quantity of sulphide dissemination is admitted.

56.70m--130.70m Bronzitite

It shows green to olive green color. Texture is a coarse grain, holocrystalline and equigranular. Mineral assemblage is almost all composed of orthopyroxene (green to dark green in color) and include a small quantity of columnar clinopyroxene. Small vein of calcite is admitted and sulphide dissemination zone which is mainly composed of pyrite, pyrrhotite and chalcopyrite is recognized from 70.00m to 87.00m. Dolerite dyke is also admitted from 110.60m to 111.20m.

130.70m--136.00m Serpentinite (~Harzbergite)

It shows black to light gray and partly green color. Rock facies shows fine grain, soapy and stripe form.

136.00m--216.00 Bronzitite

Mineral assemblage and rock facies is similar to the upper bronzitite. Sulphide dissemination zone is recognized from 143.00m to 153.00m. Dolerite dyke is also admitted from 163.00m to 166.00m, 176.50m to 178.30m, and 190.00m to 190.80m. Many small veins of chlorite are admitted.

216.00m--222.00m Serpentinite (~Harzbergite)

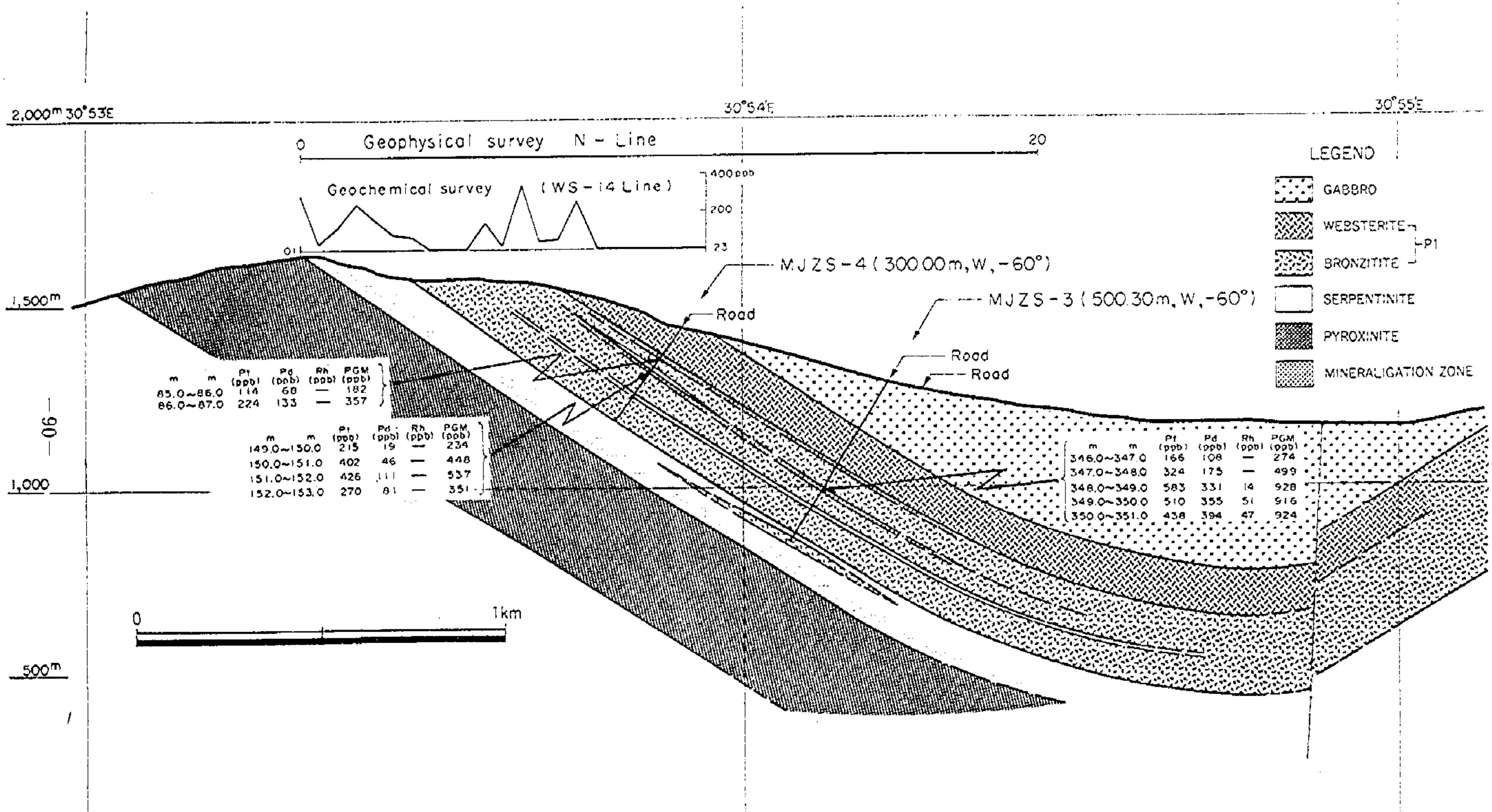


Fig.II-5-4 Drilling section (N-line)

It shows black, gray and olive green color. Rock facies shows fine grain, soapy, minute, soft, and stripe form. Mineral assemblage is almost all composed of olivine. Lower portion of this layer shows coarse grain and white mottled pattern.

222.00m--300.00 Bronzitite

Rock facies is similar to upper the bronzitite. It shows green to olive green color, coarse grain, holocrystalline and equigranular texture. Mineral assemblage is composed of almost all of orthopyroxene and include a small quantity of clinopyroxene. Many small vein of calcite and chlorite is admitted, Felsic rock dyke is also admitted from 237.50m to 238.00m, 251.00m to 251.60m, and 256.50m to 257.00m.

(5) MJZS-5 (400.44m)

The bed rock appears after the red soil portion of 6.89 meters.

6.89m--25.07m Gabbro

It shows green to dark green color, and fine grain, minute , hard. Texture is holocrystalline and equigranular. White and pale green color, weathered clay zone is recognized in some parts.

25.07m--148.34m Websterite

It shows green to dark green color, and medium grain. Texture is holocrystalline and equigranular. Mineral assemblage is mainly composed of orthopyroxene and clinopyroxene, these two pyroxenes are about equal quantity. A small quantity of sulphide dissemination is admitted in upper and center portion of websterite layer.

184.34m--159.00m Serpentinite (~Harzbergite)

Both contact change gradually. It shows black, dark green, pale green color. Rock facies shows fine grain, soapy, and stripe or mesh form. Mineral assemblage is almost all composed of olivine.

159.00m--229.50 Bronzitite

It shows green to dark green color. Texture is a medium grain, holocrystalline and equigranular. Mineral assemblage is almost all composed of orthopyroxene. Uppermost of this layer (160.00m to 172.50m) include sulphide dissemination which mainly composed of pyrite, pyrrhotite and chalcopyrite.

229.50m--243.04m Serpentinite (~Harzbergite)

It shows black to olive green color. Rock facies shows fine grain, soapy, soft. Both boundary portion shows stripe form and center portion shows mesh like pattern. Mineral assemblage is composed of olivine and serpentine.

243.04m--310.30 Bronzitite

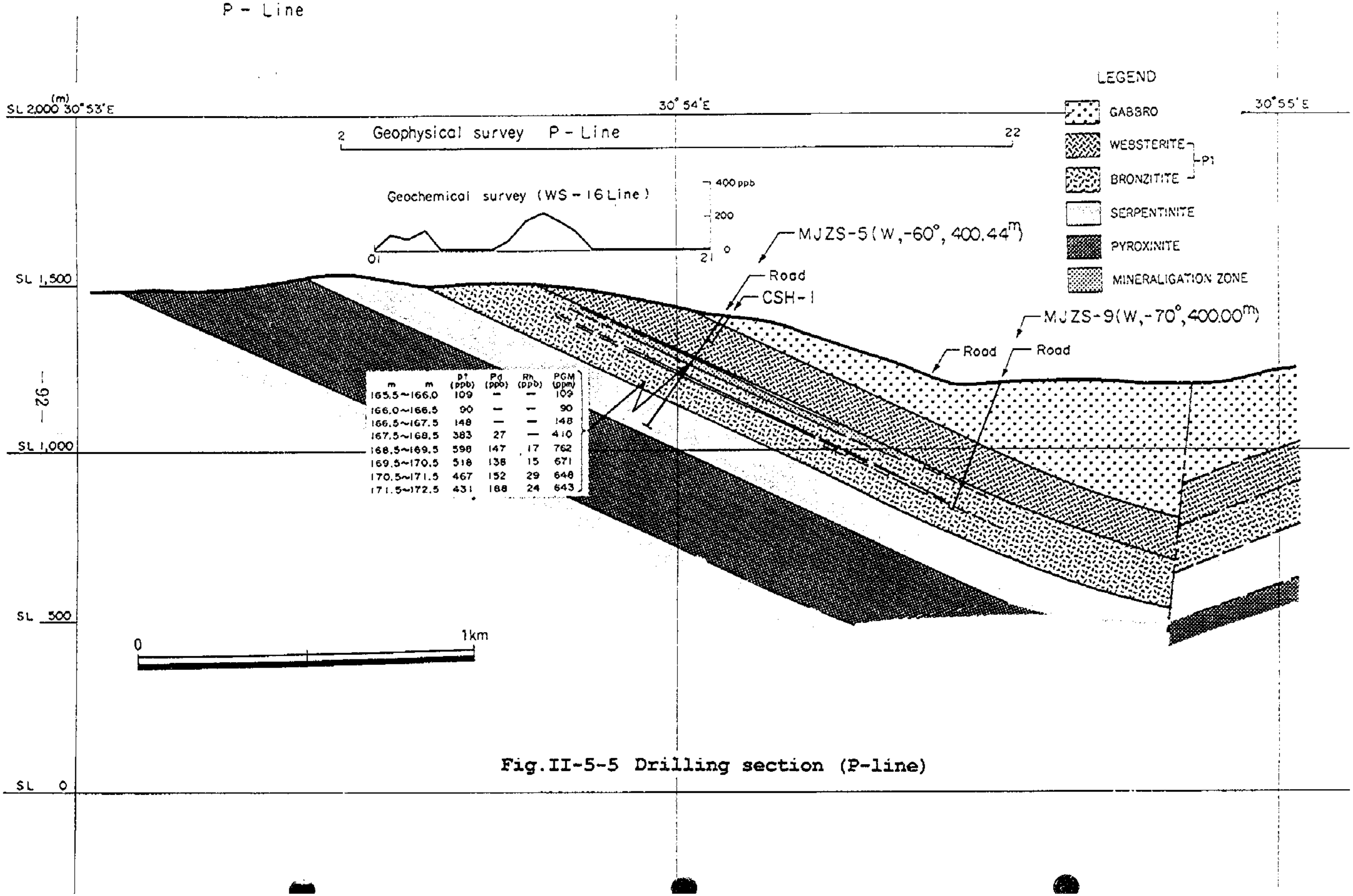


Fig.II-5-5 Drilling section (P-line)

Mineral assemblage and rock facies is similar to the upper bronzitite. A comparatively large quantity of clinopyroxene is accompanied. there is no sulphide dissemination, A small vein of calcite is admitted.

310.30m--400.00m Serpentinite (~Harzbergite)

Upper portion of this layer shows multi-color of white, pale green, green and dark green. Rock facies shows fine grain, soapy, soft and stripe form. Dolerite dyke is admitted from 326.76m to 337.74m. Lower portion under the dolerite dyke shows dark green to black color and becomes comparatively fresh. Coarse grain white mottled pattern, white spot of calcite and pale green stripe pattern is recognized in some place.

(6) MJZS-6 (450.00m)

The bed rock appears after the red and white soil with gabbro boulder portion of 16.69 meters.

16.69m--156.10m Gabbro

It is pale green color, medium grain, and soft. Texture is holocrystalline and equigranular. Mineral assemblage is mainly composed of plenty of plagioclase, orthopyroxene and small quantity of clinopyroxene. White and pale green part is recognized in some part, a white spot of plagioclase becomes remarkable. The brecciated zone with strongly silicified is observed between 51.00m and 61.00m, the shear zone with green clay is observed between 64.96m and 68.90m, 75.00m and 76.60m.

156.10m--285.00m Websterite

It shows green color and purple spot of clinopyroxene, and medium to fine grain, Texture is holocrystalline and equigranular. Mineral assemblage is composed of approximately same quantity of orthopyroxene and clinopyroxene. Small vein of calcite, chlorite and serpentine is admitted in websterite layer. Fault zone with strong brecciation and silicification is observed between 200.70m and 210.94m, shear zone with green clay and silicification is observed between 263.50m and 268.00m, 275.00m and 281.50m.

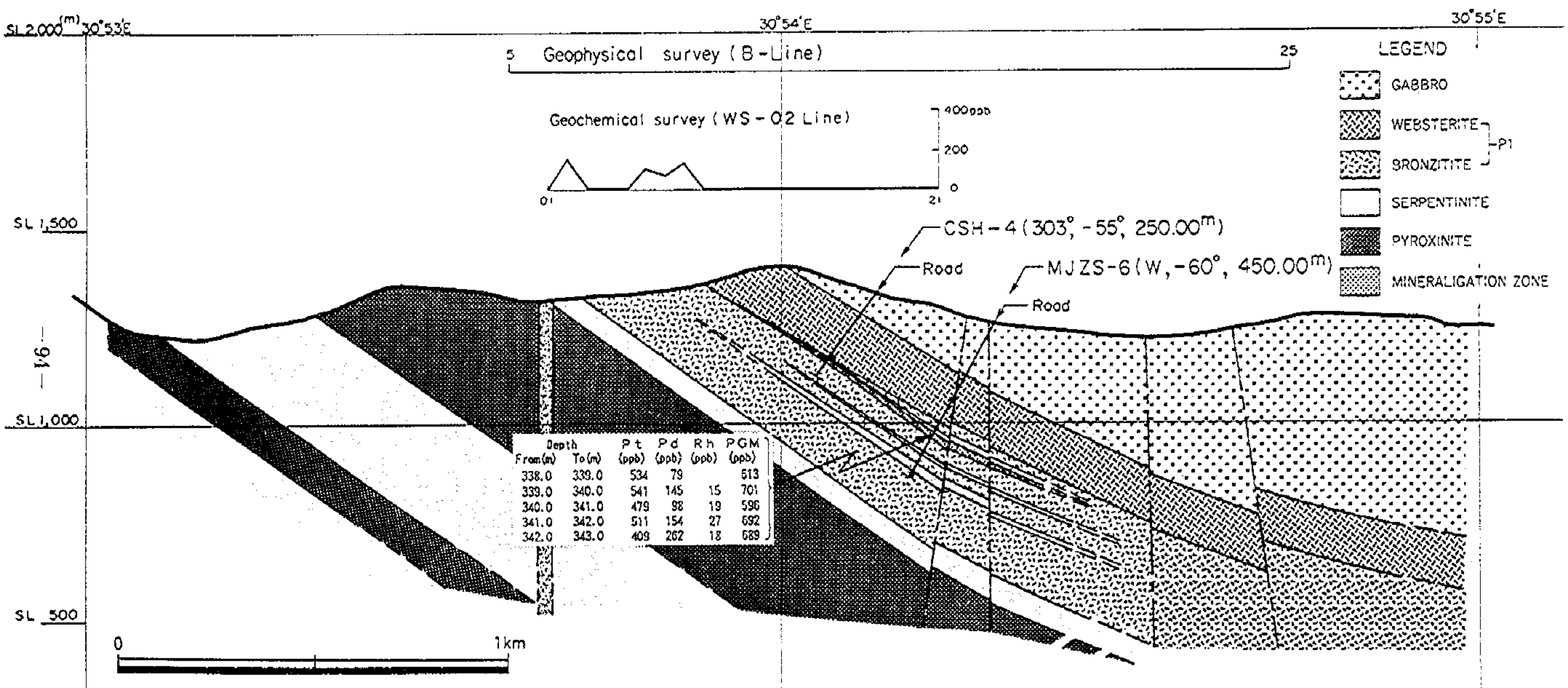
285.00m--307.50 Bronzitite

Boundary changes gradually from websterite to bronzitite. It shows a green to dark green color. Texture is rather coarse grain, holocrystalline and equigranular. Mineral assemblage is composed of almost all orthopyroxene and includes a small to an extremely small quantity of clinopyroxene. Fault zone with strong brecciation is observed between 296.00m and 300.00m.

307.50m--322.80m Serpentinite

It shows gray to dark gray color. Rock facies shows fine grain and soapy, and characteristically show banding and stripe

B Line



Depth From(m)	Depth To(m)	Pt (ppb)	Pd (ppb)	Rh (ppb)	PGM (ppb)
338.0	339.0	534	79		613
339.0	340.0	541	145	15	701
340.0	341.0	479	98	19	596
341.0	342.0	511	154	27	692
342.0	343.0	409	262	18	689

Fig.II-5-6 Drilling section (B-Line)

form with dark and clear color. Center part shows black color, fine grain and include a olivine. Thin layer of chromite is accompanied in center part.

322.80m--371.34m Bronzitite

Mineral assemblage and rock facies is similar to the upper bronzitite. The uppermost of this layer includes sulphide dissemination between around 322m and 340m. Sulphide is mainly composed of pyrite, pyrrhotite and chalcopyrite.

371.34m--374.00m Dunite

Rock facies shows black color, fine grain, and stripe form. Mineral assemblage is almost all composed of olivine.

374.00m--404.00m Bronzitite

Mineral assemblage and rock facies is similar to the upper bronzitite. Brecciated zone including pale green to white chlorite and serpentine is observed between 392.00m to 395.50m.

404.00m--436.00m Serpentinite

Contact part shows gray to dark gray color. Rock facies shows fine grain, soapy, and stripe form. Center part(423.00m to 426.30m) shows black color, fine grain minute and hard. Mineral assemblage is almost all composed of olivine.

436.00m--450.00 Bronzitite

Mineral assemblage and rock facies is similar to the upper bronzitite.

(7) MJZS-7 (500.00m)

The bed rock appears after the red and green soil with gabbro boulder portion of 18.00 meters.

18.00m--223.70m Gabbro

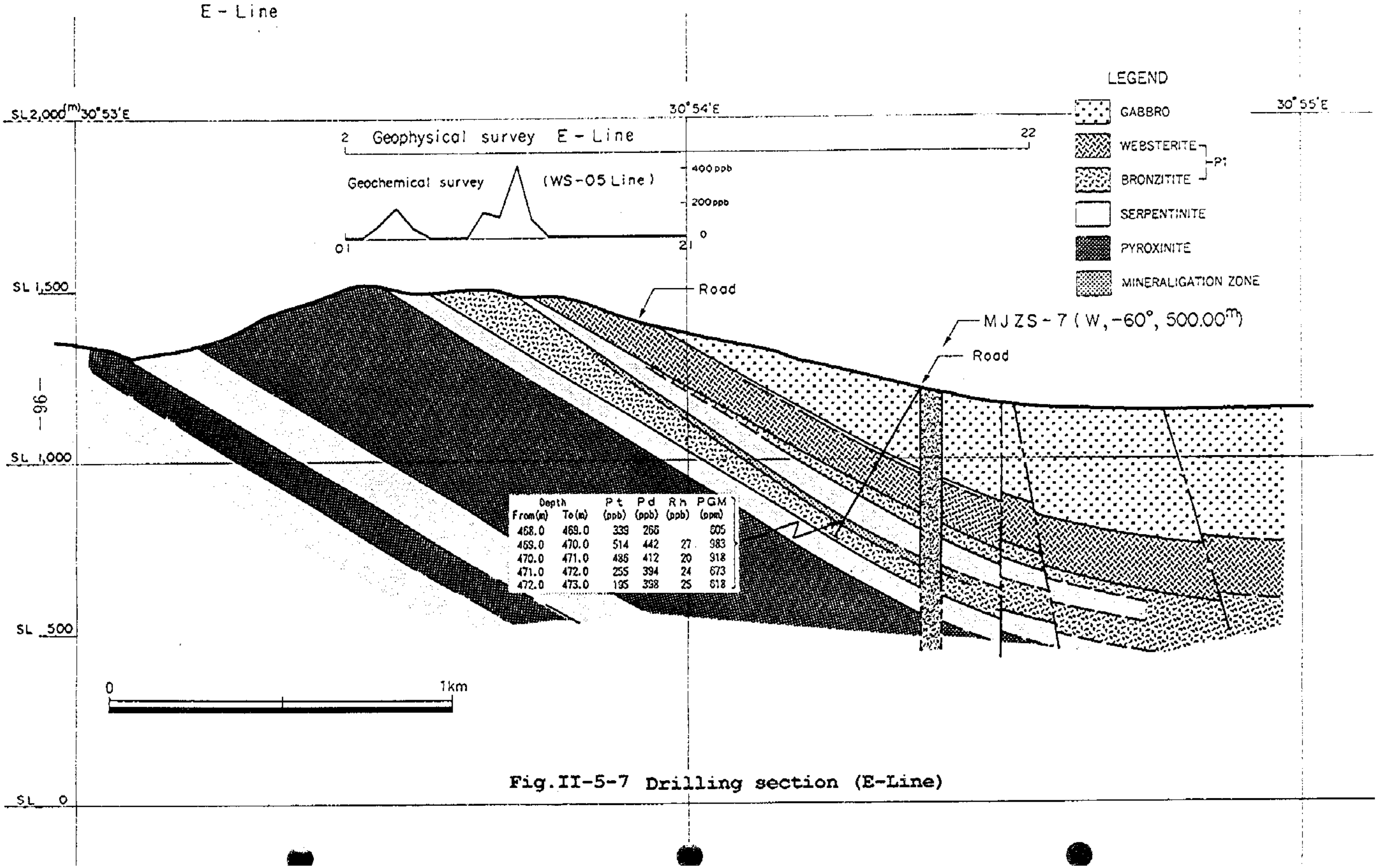
It shows green to dark green color, and fine grain, minute , hard. Texture is holocrystalline and equigranular. Mineral assemblage is mainly composed of plenty plagioclase, and orthopyroxene, a small quantity of clinopyroxene. Plagioclase is recognized clearly in white and pale green part. Mineral assemblages has a tendency to increase the amount of clinopyroxene in the direction towards the lower portion. Small vein of calcite and chlorite is observed in lower portion.

223.70m--233.00m Serpentinite

It shows dark green and olive green color. Rock facies shows fine grain, soapy, soft and stripe form. Center portion becomes black color and mineral assemblage is almost all composed of olivine.

233.00m--340.38m Websterite

It shows purple spot in dark green color, and medium grain. Texture is holocrystalline and equigranular. Mineral assemblage is mainly composed of about equal quantity of orthopyroxene and



Depth From(m)	Depth To(m)	Pt (ppb)	Pd (ppb)	Rh (ppb)	PGM (ppm)
468.0	469.0	339	266		605
469.0	470.0	514	442	27	983
470.0	471.0	486	412	20	918
471.0	472.0	255	394	24	673
472.0	473.0	195	398	25	618

Fig.II-5-7 Drilling section (E-Line)

clinopyroxene. Small vein of calcite and chlorite is observed.

340.36m--375.00 Bronzitite

It shows dark green to dark gray color. Texture is a coarse grain, holocrystalline and equigranular. Mineral assemblage is almost all composed of orthopyroxene and includes an extremely small quantity of clinopyroxene. Small calcite vein is observed between 358m and 370m and sulphide dissemination which is mainly composed of pyrite, pyrrhotite and chalcopyrite recognized along to this vein.

375.00m--450.00m Serpentinite

Boundary changes gradually from bronzitite to serpentinite. It shows pale green and olive green color. Rock facies shows mottled pattern. Mineral assemblage is almost all composed of serpentine and olivine, a small quantity of orthopyroxene is included. Many small calcite vein is observed, and sulphide dissemination which is mainly composed of pyrite, pyrrhotite and chalcopyrite recognized from around 395m.

450.00m--500.00m Bronzitite

Mineral assemblage and rock facies is similar to the upper bronzitite. Rather strong sulphide dissemination is observed continue from upper serpentinite to around 475m.

(8) MJZS-8 (650.00m)

The bed rock appears after the red soil with gabbro boulder portion of 12.50 meters.

12.50m--350.00m Gabbro

It shows pale green, green to dark green color, and medium grain, minute, hard. Texture is holocrystalline and equigranular. Mineral assemblage is mainly composed of plenty plagioclase, and orthopyroxene with green to pale green color, clinopyroxene with light purple color. Weak brecciated zone and small vein of chlorite are recognized in some parts.

350.00m--527.60m Websterite

It shows green to dark green color, and medium to coarse grain, Texture is holocrystalline and equigranular. Mineral assemblage is mainly composed of orthopyroxene and clinopyroxene, these two pyroxenes are about equal quantity, or quantity of orthopyroxene is little more than clinopyroxene. Clinopyroxene with light purple color is observed clearly as s spot.

527.60m--574.19 Bronzitite

It shows green to dark green color. Texture is a coarse grain, holocrystalline and equigranular. Mineral assemblage is almost all composed of orthopyroxene (green to dark green color) and include an extremely small quantity of clinopyroxene (light purple color). Very weak sulphide dissemination zone is observed

I - Line

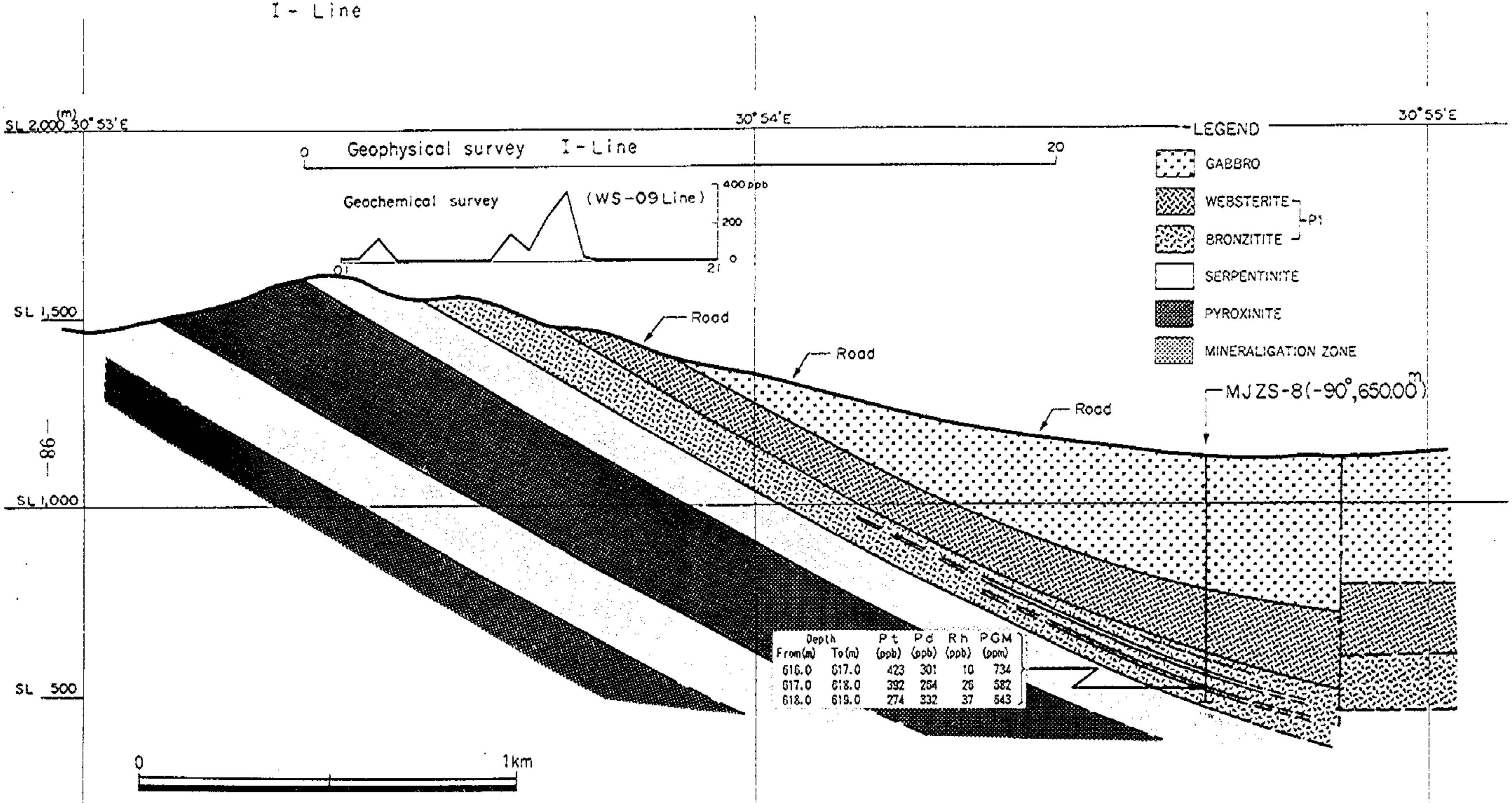


Fig.II-5-8 Drilling section (I-Line)

between 554m and 562m.

574.19m--581.30m Serpentinite

It shows a dark gray color. Rock facies shows fine grain and stripe form. Mineral assemblage is mainly composed of olivine and serpentine.

581.30m--650.00 Bronzitite

Mineral assemblage and rock facies is similar to the upper bronzitite. a comparatively large quantity of clinopyroxene is included. Sulphide dissemination zone is observed between 584.00m and 626.00m.

(9) MJZS-9 (400.00m)

The bed rock appears after the green and pale green soil with gabbro boulder portion of 8.00 meters.

8.00m--190.50m Gabbro

It shows pale green, green to dark green color, and medium to coarse grain, minute, hard. Texture is holocrystalline and equigranular. Mineral assemblage is mainly composed of plenty plagioclase, and orthopyroxene with green to pale green color, clinopyroxene with light purple color. Plagioclase shows a white spot characteristically. Weak and small vein of chlorite is recognized in some parts.

190.50m--328.54m Websterite

It shows dark green color, and medium grain. Texture is holocrystalline and equigranular. Mineral assemblage is mainly composed of about equal quantity of orthopyroxene and clinopyroxene, clinopyroxene shows light purple color and scattered pattern. Weak brecciated zone is observed between 246.00m and 251.00m.

328.54m--400.00m Bronzitite

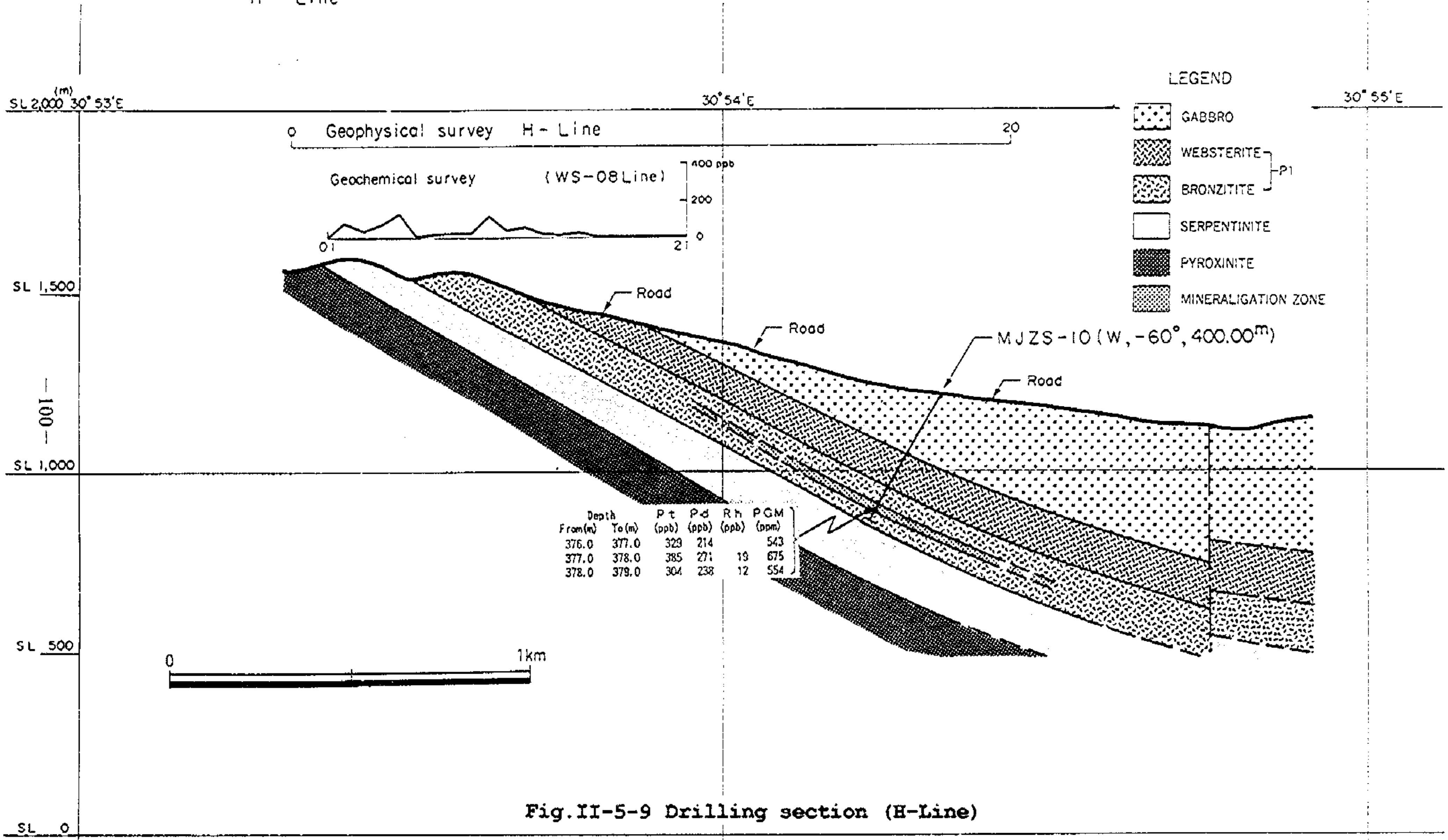
It shows dark green color. Texture is a coarse grain, holocrystalline and equigranular. Mineral assemblage is almost all composed of orthopyroxene (green to dark green in color) and include a small quantity of clinopyroxene in some parts. Small vein of calcite is observed between 328.54m and 342.90m, sulphide dissemination zone which is mainly composed of pyrite, pyrrhotite and chalcopyrite is recognized along to the vein. Weak sulphide mineralization is also observed near the bottom of the drill hole.

(10) MJZS-10 (400.00m)

The bed rock appears after the white soil with gabbro boulder portion of 24.89 meters.

24.89m--196.50m Gabbro

It shows green to dark green color, and medium grain, H - Line



Depth From(m)	Depth To(m)	Pt (ppb)	Pd (ppb)	Rh (ppb)	PGM (ppm)
376.0	377.0	329	214		543
377.0	378.0	385	271	19	675
378.0	379.0	304	238	12	554

Fig.II-5-9 Drilling section (H-Line)

minute , hard. Texture is holocrystalline and equigranular. Mineral assemblage is mainly composed of plenty plagioclase, a small quantity of orthopyroxene and clinopyroxene. Weak and small vein of chlorite is recognized in some parts. Weak brecciated zone(fault?) is observed between 135.00m and 148.00m, 156.50m and 157.00m, 184.00m and 187.00m.

196.50m--301.50m Websterite

It shows green color and light purple scattered pattern, and medium to coarse grain. Texture is holocrystalline and equigranular. Mineral assemblage is mainly composed of orthopyroxene and clinopyroxene, clinopyroxene shows a clear light purple spots. Fault breccia zone is observed between 204.00m and 208.00m, 231.00m and 237.00m.

301.50m--400.00m Bronzitite

It shows dark green color. Texture is a coarse grain, holocrystalline and equigranular. Mineral assemblage is almost all composed of orthopyroxene. Brecciated zone is observed between 351.50m and 355.50m, 373.00m and 373.50m, 379.00m and 381.00m, and 386.8m. In the uppermost of this layer an extremely small quantity of olivin is included and becomes extinct gradually from 323m. On the other hand sulphide dissemination which mainly composed of pyrite, pyrrhotite and chalcopyrite increase. Sulphide dissemination becomes rich around 370m to 379m, and then becomes extinct.

The results of microscopic observations of thin sections of rocks are shown in Table II-5-2.

Gabbro which situated upper most of this area is Gabbro-norite. Texture is medium grain and equigranular, average grain size is 1.5mm. Mineral assemblage is composed of plagioclase, clinopyroxene and orthopyroxene from abundant to rare, and include an extremely small quantity of opaque minerals. Plagioclase shows less than 3.5mm of grain size, columnar to long-columnar, euhedral to subhedral shape, and shows polysynthetic twin shape. Orthopyroxene shows less than 3mm of grain size, and shows a very weak pleochroism. Clinopyroxene shows less than 2mm of grain size, columnar and subhedral shape. these two pyroxenes show clear exsolution texture. Pigionite is not admitted. An Extremely small quantity of chlorite is grown along to the outer rim of grain and cleavage by alteration.

Websterite is coarse grain equigranular, average grain size is 2 to 3mm. Mineral assemblage is mainly composed of clinopyroxene and orthopyroxene (more than 98%) and include a small to an extremely small quantity of anhedral plagioclase and opaque minerals. Orthopyroxene shows less than 3.5mm of grain

Table II-5-2 Results of the microscopic observations of thin section of rock samples

Number	Sample name	Rock name	Rock name defined by microscopic obervation	Location		Mineral assemblages														Texture
						Phenocrysts								Alteration minerals						
				Drill number	Depth(m)	Plagioclase	Biotite	Hornblende	Clinopyroxene	Orthopyroxene	Augite	Olivine	Opaque mineral	Tremolite	Calcite	Chlorite	Serpentine	Phlogopite	Talc	
1	T-1	Websterite	Websterite	MJZS-1	170.00	△			◎	◎			△			·				Coarse grain, equigranular
2	T-2	Serpentinite	Iron ore-calcite-amphibole rock	MJZS-1	229.50								△	◎	○					
3	T-3	Bronzitite	Bronzitite	MJZS-1	249.50	·	·	·	·	◎			△							Coarse grain, equigranular
4	T-4	Gabbro	Gabbro-norite	MJZS-2	115.88	◎				○	◎		·			·				Medium grain, equigranular
5	T-5	Websterite	Websterite	MJZS-2	190.18	△			◎	◎			△			·				Coarse grain, equigranular
6	T-6	Bronzitite	Bronzitite	MJZS-2	274.00	△	·	·		◎			·			·				Coarse grain, equigranular
7	T-7	Pyroxinite	Bronzitite	MJZS-2	401.50					◎			·						·	Coarse grain, equigranular
8	T-8	Harzbergite	Dunite	MJZS-2	486.00							◎	·				·		·	Coarse grain, equigranular
9	T-9	Harzbergite	Talc rock	MJZS-5	317.20				·				△						◎	Coarse grain, equigranular
10	T-10	Harzbergite	Serpentinite	MJZS-5	340.25								△		△		◎		○	Coarse grain, equigranular
11	TS-1	Bronzitite	Olivin-Websterite	MJZS-7	448.50	·			○	◎		△	·							Coarse grain, equigranular
12	TS-2	Bronzitite	Olivin-Websterite	MJZS-7	462.50	△			◎	◎		○	·					△		Coarse grain, equigranular
13	TS-3	Bronzitite	Websterite	MJZS-7	464.50	△			◎	◎		△	·					·		Coarse grain, equigranular
14	TS-4	Bronzitite	Olivin-Websterite	MJZS-6	334.50	·			◎	◎		○	△							Coarse grain, equigranular
15	TS-5	Bronzitite	Olivin-Websterite	MJZS-8	614.50	△			○	○		◎	·					·		Coarse grain, equigranular
16	TS-6	Bronzitite	Websterite	MJZS-10	371.50	△			◎	◎			△					△		Coarse grain, equigranular
17	TS-7	Bronzitite	Olivin-Websterite	MJZS-10	394.50	·			○	○		○	·					△		Coarse grain, equigranular

※ ◎ : abundance ○ : common △ : minor · : rare size, columnar, subhedral shape and shows a very weak pleochroism. Clinopyroxene shows less than 6.5mm of grain size, columnar to long-columnar and subhedral shape. these two pyroxene shows clear exsolution texture each other. A quantity of clinopyroxene is more than orthopyroxene. An extremely small quantity of plagioclase is admitted as an anhedral Crystal which filled a grain boundary of these two pyroxenes. Alteration is very weak.

Bronzitite is coarse grain equigranular, average grain size is 2 to 3mm. Mineral assemblage is mainly composed of orthopyroxene (more than 98%) and includes a small quantity of plagioclase, An extremely small quantity of opaque mineral, negligible small quantity of biotite and amphibole. Orthopyroxene shows less than 7mm of grain size, columnar to long-columnar, euhedral to subhedral shape. and shows a pleochroism (X=light purple brown, Z=pale green). Exsolution texture of clinopyroxene is developed. Plagioclase is admitted as an anhedral Crystal which filled a grain boundary of these two pyroxene, grain size is less than 1mm. Amphibole shows an anhedral shape with pleochroism (X=light yellow, Z=pale green), and grain size is less than 0.7mm. Biotite shows an anhedral shape, and grain size is less than 0.4mm. Negligible weak alteration is admitted.

Dunite is coarse grain equigranular, average grain size is 2mm. Mineral assemblage is mainly composed of olivine (more than 99%) and include a small quantity of euhedral to subhedral opaque mineral(chromite). Olivine shows less than 6mm of grain size, subhedral shape. and serpentinization increases along the outer rim of crystal and crack. In some case, a plenty of serpentine, middle quantity of talc, a small quantity of calcite and opaque minerals are produced by almost complete alteration.

5-2-2 Mineralization

Geologic cross section by drilling were shown in Fig.II-5-2 to Fig.II-5-9. Log showing of chemical analysis of each holes are shown in Fig.II-5-10 to Fig.II-5-19.

Summary of mineralization in each hole are as follows :

(1) MJZS-1

Sulphide dissemination was observed from serpentinite layer which exist in contact zone between websterite and bronzitite layer to uppermost of the bronzitite layer (226m-260m). This mineralization is mainly composed of pyrrhotite, pyrite and accompany an extremely small quantity of chalcopyrite. Grain size is maximum 2mm, generally less than 1mm and around 0.5mm. these minerals show euhedral usually and irregular anhedral mineral that fills a grain boundary is also recognized. The sulphide content is estimated maximum about 3%.

Though platinum group minerals can't be observed by naked eye, by the result of chemical analysis these minerals concentrate in the lowest portion of sulphide disseminate zone and show maximum platinum group elements content 979ppb.

(2) MJZS-2

Sulphide dissemination is observed in the uppermost portion of the bronzitite layer and shows about 10m of thickness(226m-274m). A kind of minerals, grain size and form of minerals are similar to MJZS-1 drilling. Sulphide content is estimated maximum approximately 5%.

Results of chemical analysis show platinum group element to be maximum 782 ppb. and concentrate in the lowest portion(269.00m-273.50m) of sulphide disseminated zone.

(3) MJZS-3

2 layers of sulphide dissemination zones are observed in this drilling. The upper one situated on the uppermost part of the bronzitite layer and shows a width of about 10m(263.50m-273.50m), another is situated approximately 70m lower than the upper one and shows about 16m(335m-351m) width. The kind of minerals, grain size and form of minerals are similar to MJZS-1. Sulphide content is estimated maximum approximately from 1 to 2%.

Upper sulphide dissemination zone corresponds to MSZ and lower zone corresponds to LSZ.

The results of chemical analysis show platinum group element content reaching a maximum of 928 ppb and concentrate in the lowest portion(346m-351m) of sulphide disseminated zone.

(4) MJZS-4

2 layers of sulphide dissemination zone are observed also in this drill hole. The upper one is situated on the uppermost part of the bronzitite layer and shows about 17m(70m-87m) width, another is situated approximately 60m lower than the upper one and shows about 10m(143m-153m) width. The minerals, grain size and form of minerals are similar to MJZS-1 and 2 drill holes. Sulphide content is estimated maximum approximately from 1 to 2%.

Each sulphide disseminated zone corresponds to MSZ and LSZ same to MJZS-3.

Results of chemical analysis show platinum group elements with maximum 357 ppb (85m-87m) in MSZ and 537 ppb (149m-153m) in

LSZ, and concentrated in the lowest portion of each sulphide disseminated zone.

(5) MJZS-5

Sulphide dissemination was observed in the uppermost of the bronzitite layer (162m-172.50m) just under the serpentinite layer which exist in contact zone between websterite and bronzitite layer. This mineralization is mainly composed of pyrrhotite, pyrite and accompanies an extremely small quantity of chalcopyrite similar to that of other drill holes observed by the naked eye. Grain size is maximum 2mm, generally less than 1mm and around 0.5mm. these minerals show euhedral usually and irregular anhedral minerals that filled a grain boundary. The sulphide content is estimated maximum to be about 3%.

The results of chemical analysis show that these minerals concentrate in the lowest portion of sulphide disseminated zone and show maximum platinum group elements content 762 ppb.

(6) MJZS-6

Sulphide dissemination is observed in the depth between 327m and 348m in the bronzitite layer which exist just under the serpentinite layer. This mineralization is mainly composed of pyrrhotite, chalcopyrite and accompany an extremely small quantity of pyrite. Grain size is maximum 2mm, generally less than 1mm and around 0.5mm. these minerals show euhedral usually and irregular anhedral mineral that fills a grain boundary is also recognized. The sulphide content is estimated maximum about 2%.

Though platinum group minerals can't be observed by naked eye, by the result of chemical analysis these minerals concentrate in the lowest portion (338m to 343m) of sulphide disseminate zone and show maximum platinum group elements content 692ppb.

(7) MJZS-7

Sulphide dissemination is observed from middle portion of the serpentinite to the bronzitite layer. Sulphide minerlization is not so strong in the serpentinite layer but becomes rather strong in the bronzitite layer. A kind of minerals, grain size and form of minerals are similar to MJZS-6 drilling. Sulphide content is estimated maximum approximately 5%.

Results of chemical analysis show platinum group element to be maximum 983 ppb. and concentrate in the lowest portion(468.00m-473.00m) of sulphide disseminated zone.

(8) MJZS-8

2 layers of sulphide dissemination zones are observed in this drilling. The upper one situated on the uppermost part (556.00m to 564.00m) of the bronzitite layer, another is situated in the depth of 610.00m to 626.00m. Platinum group elements are not accompanied in the upper sulphide zone, included in the lower sulphide zone. The kind of minerals, grain size and form of minerals are similar to MJZS-6 and 7. Sulphide content is estimated maximum approximately from 1 to 2%.

The results of chemical analysis show platinum group element content reaching a maximum of 682 ppb and concentrate in the lowest portion(616m-619m) of sulphide disseminated zone.

(9) MJZS-9

2 sulphide small vein and dissemination zone are observed in this drill hole. The upper one is situated on the uppermost part of the bronzitite layer and shows about 18m(328.00m-343.00m) width, another is situated near the bottom of hole.

These sulphide mineralization are accompanied with small vein of calcite or sulphide dissemination around the calcite vein, by the results of chemical analysis, almost no platinum group elements are included in these two zone.

(10) MJZS-10

Sulphide dissemination is observed generally in the bronzitite layer, rather strong dissemination is recognized from 370m to around the bottom of hole.
This mineralization is same to MJZS-7 and mainly composed of pyrrhotite, chalcopyrite and accompanies an extremely small quantity of pyrite. Grain size is maximum 2mm, generally less than 1mm and around 0.5mm. these minerals show euhedral usually and irregular anhedral minerals that filled a grain boundary. The sulphide content is estimated maximum to be about 3 to 4%.

The results of chemical analysis show that platinum group elements concentrate in the lowest portion of sulphide disseminated zone and show maximum content 675 ppb.

Distribution of ore elements in each hole is shown in Fig.II-5-10 to Fig.II-5-19. Distribution peak of 3 platinum group elements (platinum, palladium, rhodium) situate approximately at the same place and palladium has comparatively wide distribution to lower direction. Gold has a similar distribution form to platinum group elements and its peak is situated just on the upper part of platinum group elements. Silver doesn't show a characteristic distribution form against