Table 2-5 Statistical Classification of Geochemical Elements

Classification	Classification Standard	Class (using values of each sample)	Class (using values of three points running mean)
Au-classification (ppm)	1.00	AA-class≥1.00	AA-class≥1.00
		1.00>A-class≥0.23	1.00>A-class≥0.30
	$M + 2\sigma$	0.23	0.30
		0.23>B-class≥0.07	0.30>B-class≥0.09
	$M + \sigma$	0.07	0.09
		0.07>C-class≥0.02	0.09>C-class≥0.03
	Mean	0.02	0.03
Ag-classification (ppm)		A-class≥2.1	A-class≥2.2
	$M + 2\sigma$	2.1	2.2
		2.1>B-class≥0.7	2.2>B-class≥0.8
	$M + \sigma$	0.7	0.8
		0.7>C-class≥0.2	0.8>C-class≥0.3
	Mean	0.2	0.3

In comparison the population consisting of the assay value of each sample with that of the running mean value of the adjacent samples, some slight difference is found. This is because that the values of isolated high content samples distributed scatteringly, contributes to those of the adjacent two samples.

On the contrary of this fact, although the maximum values among the individual assay values are 7.90 ppm Au and 35.4 ppm Ag respectively, they declined to 2.647 ppm and 24.85 ppm respectively in the three-points running mean values (Appendix 9).

2-6-5 Distribution of Geochemically Anomalous Zones

"Geochemical anomaly distribution maps PL 10 and PL 12" were made by the

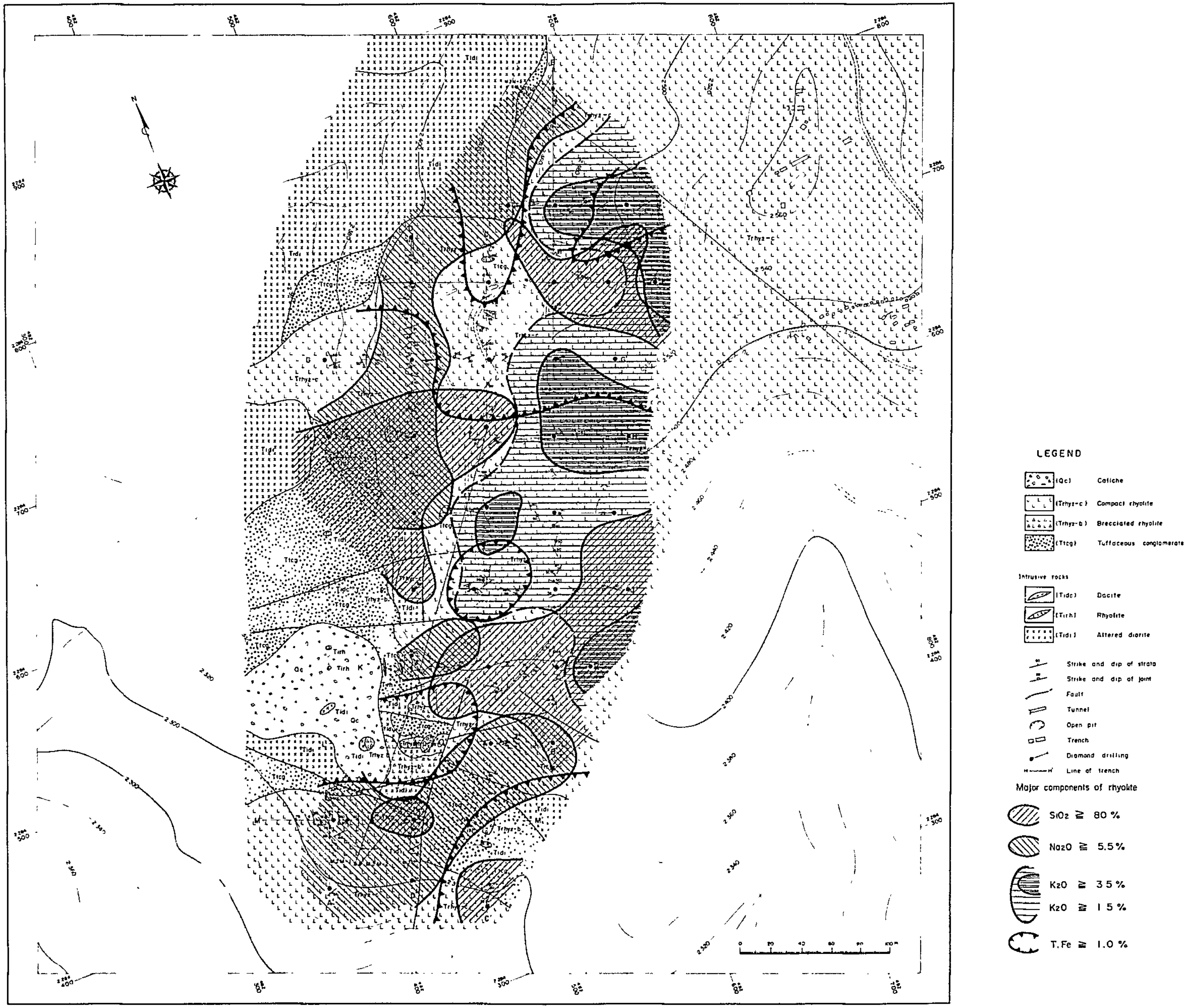


Fig. 2-37 Alteration Zoning of the Surveyed Area

statistical classification of the individual assay values. Moreover, the "geochemically anomalous zone distribution maps (PL 11 and Fig. 13)" were prepared by the statistical classification of the running mean values.

(1) Geochemically anomalous zone of Au component (Fig. 2-33, PL. 14)

The part which contains high anomalous values of two or more B-class anomalies was demarcated as an anomalous zone, and individual names were put for explanation. Those given as the anomalous zones on a large scale are No. 1 and No. 2 anomalous zones distributed in the northeastern part of the area and No. 3 anomalous zone at the southwestern end of the area. Beside these, four anomalous zones on a small scale such as No. 4, 5, 6 and 7 are distributed surrounding the zones of No. 1 and No. 2. Furthermore, small anomalous zones of No. 8 and No. 9 are scattered in the southern part of the area.

The details of these anomalous zones are as follows.

<u>No. 1 Anomalous Zone</u>: The zone is distributed from the eastern-central part to the northwestern part of the area within an approximate extent of 200 meters in extension and 30 to 40 meters in width.

(No. 1 Anomalous Zone)

Class	Sample No.	Au Contents in ppm	Class	Sample No.	Au contents in ppm
AA-class	B-45	2.15	B-class	B-40	0.10
	B-47	2.70		B-42	0.07
	C-80	7.90		B-43	0.10
	H-35	4.35		B-44	0.20
	I-36	1.15		B-50	0.19
				D-84	0.10
A-class	C-72	0.27		D-85	0.13
	G-24	0.40		H-28	0.18
	G-25	0.65		H-31	0.09
	G-34	0.34		H-33	0.09
	H-30	0.75		H-42	0.14
	H-34	0.28		I-30	0.07
	H-36	0.80		I-32	0.16
	I-31	0.38		I-34	0.07
	I-38	0.45		I-35	0.07
	I-41	0.60		I-39	0.14

As shown in the No. 1 Anomalous Zone's table, the zone consists of AA-class anomalies (1.15 - 7.90 ppm) of five samples, A-class anomalies (0.80 - 0.27 ppm) of ten samples and B-class anomalies of sixteen samples. In addition, C-class anomalies are distributed surrounding those of B-class and higher than it. This anomalous zone extends, as a whole, northwestward from the eastern center of the area with trend of N35°W. Regarding the relation between the trend and the distribution of the B Oxidized-Zone consisting of iron oxides contamination, a good consistency is observed on I and H lines, though both intersects obliquely on G and C lines.

Cardinal portions consisting of AA-class and A-class anomalies in the whole No. 1 Anomalous Zone are roughly divided into two subzones such as the one which continues from I-line to H-line and another one distributed from C-line to G-line. The former seems to have a width of 15 meters in average and to extend for more than 100 meters. The average assay value of 11 samples contained in this subzone shows 1.18 g/t Au. The latter has a width of 12 meters in average and extends for about 50 meters. The average value of six samples contained in the subzone shows 1.5 g/t Au. Although the values of anomalies are of those samples from at five meters interval, the distribution of high contents samples is rather scattered.

No. 2 Anomalous Zone: This zone is composed of the anomalies distributed around the intersection of B-line and F-line in the northeastern part of the area, in the eastern part of G-line and at the eastern end of E-line. It has a wide extent though relatively low in grade. The anomalies of AA-class, A-class and B-class in No. 2 Anomalous Zone are shown in the following table.

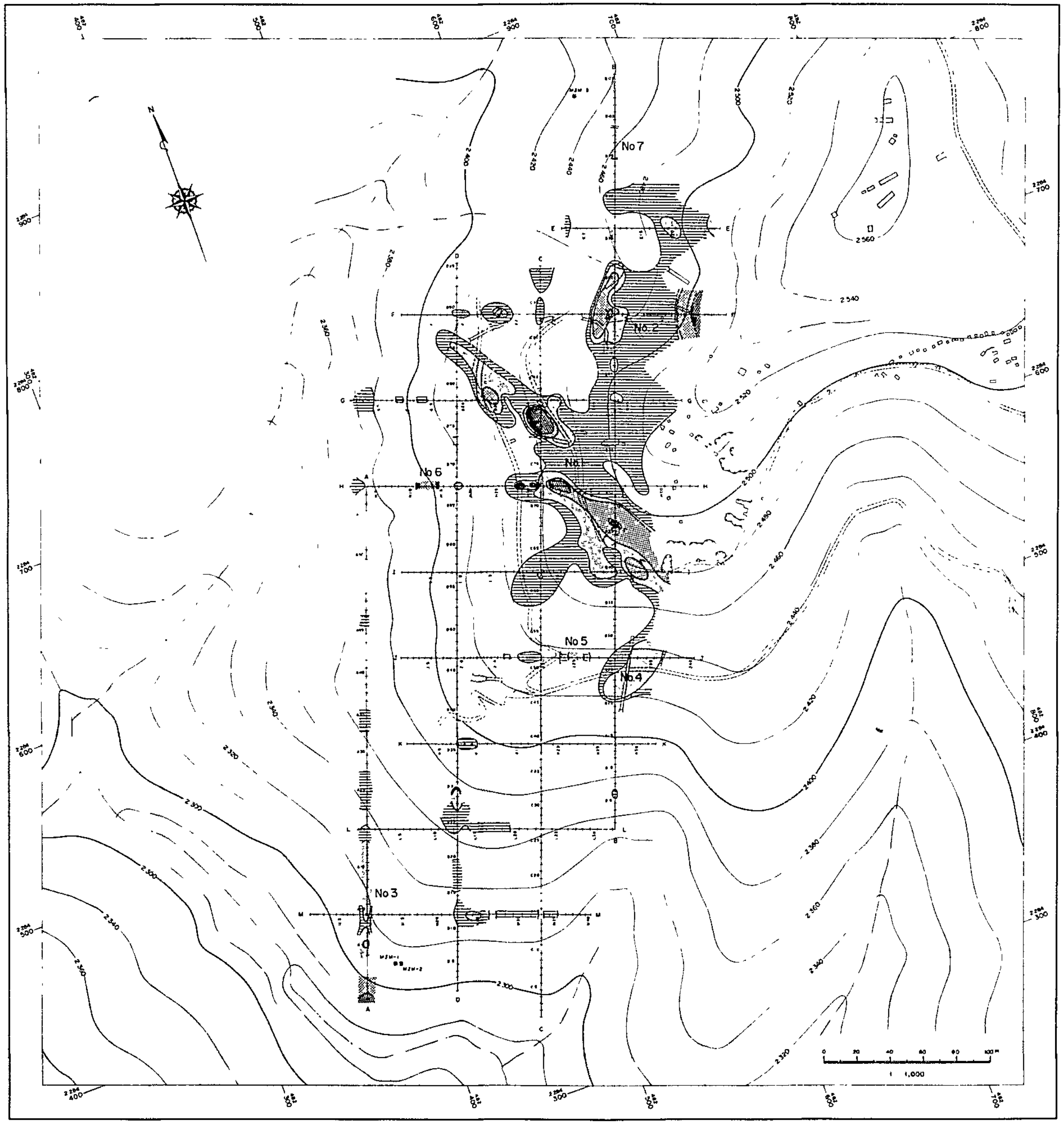
(No. 2 Anomalous Zone)

Class	Sample No.	Au Contents in ppm
AA-class	F-32 F-44 F-46	2.25 1.13 6.60
A-class	B-71 B-79 B-80 E-20 E-27 F-33 F-34	0.45 0.45 0.65 0.30 0.23 0.58 0.60
B-class	B-55 B-57 B-66 B-67 B-73 E-19 E-23 F-38 F-39 F-41	0.09 0.07 0.09 0.16 0.07 0.21 0.10 0.08 0.08 0.07

As shown in the table, the zone consists of AA-class anomalies (1.13 - 6.60 ppm) of three samples, A-class anomalies (0.23 - 0.65 ppm) of seven samples and B-class anomalies (0.07 - 0.21 ppm) of ten samples. Besides these, C-class anomalies of 28 samples are distributed. Generally, the anomalous zone shows a trend of N40°E intersecting with that of the No. 1 Anomalous Zone described in the above. Its distribution is consistent with the trend of the A Oxidized Zone. The nucleuses of the No. 2 Anomalous Zone are divided into two subzones such as the one in the vicinity of the intersection of F-line and B-line, and another at the eastern end of F-line. The former has an extent extending for 30 meters with an width of 10 meters. The average value of five samples contained in the subzone shows 0.91 g/t Au. The latter occupies an interval of 15 meters on F-line, and the average value of three samples of it shows 2.59 g/t Au.

On a wide view, since No. 2 Anomalous Zone and No. 1 Anomalous Zone are distributed continuously in the northeastern part of the area and are open toward the east, it is likely that these zones would continue intermittently to the SAN SEVERIANO mineralized zone situated to the east of the area.

No. 3 Anomalous Zone: The zone shows an isolated distribution on A-line at the southern end of the area.



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Symbol	Class of anomaly	Contents (in ppm)
	AA	Au ≧ 1.00
	A	1.00 > Au ≧ 0.30
	B	0.30 > Au ≧ 0.09
	C	0.09 > Au ≧ 0.027

Fig.2-33 Geochemical Au- Anomalies of the Surveyed Area

The anomalies are arranged almost continuously from A-1 to A-19. Those constituting the zone are shown in the following table.

(No. 3 Anomalous Zone)

Class	Sample No.	Au Contents (ppm)
AA-class	A-1	1.60
A-class	A-2	0.58
	A-4	0.47
	A-5	0.28
	A-6	0.40
	A-10	0.36
	A-12	0.34
	A-13	0.25
	A-17	0.23
B-class	A-9	0.20
	A-11	0.17
	A-14	0.18
	A-15	0.14
	A-16	0.09
C-class	A-18	0.03
	A-19	0.05

As shown in the table, the zone consists of AA-class anomaly of one sample, A-class anomalies of eight samples, B-class anomalies of five samples and C-class anomalies of two samples, 16 in total. The zone is situated on a stock-like rhyolite mass which shows an isolated distribution in the southwestern part of the area, and the relation with other anomalous zones has not been made clear on the trenches. It is, however, well corresponding to the anomalies detected in the drill cores of the hole MJM-1 driven in the vicinity of the zone at the depth from 0 m to 27 m. A remarkable contamination of iron oxides is also observed in the surrounding part.

<u>No. 4 and No. 5 Anomalous Zones</u>: No. 4 Anomalous Zone is found in the vicinity of the intersection of B-line and J-line, and No. 5 Zone on the J-line to the immediate west of the former, both being distributed on a small scale.

No. 4 Zone consists of three A-class anomalies (0.33 - 0.47 ppm), two B-class anomalies and six C-class anomalies. No. 5 Zone consists of each one of A, B and C-class anomalies, the highest value being 0.23 ppm.

These are distributed on the rhyolite body. The brown gossan of iron oxide contamination is observed small in scale.

No. 6 Anomalous Zone: The Zone shows an isolated distribution on H-line in the northeastern part of the area. It is a small-scale anomalous zone consisting of three anomalies including one AA-class anomaly (1.00 ppm) and two C-class anomalies. Although it is a little apart from the main anomalous zone situated to the east of it, it is worthy of note because of the existence of AA-class anomaly. The Zone is underlain by tuffaceous conglomerate which is exposed in rhyolite in a form of window.

No. 7 Anomalous Zone: The Zone consists of two A-class anomalies such as B-96 (0.31 ppm) and B-97 (0.45 ppm). Although it is small in scale, two A-class anomalies are arranged side by side.

No. 8 Anomalous Zone: Two samples of B-class anomaly such as M-24 (0.21 ppm) and M-25 (0.11 ppm) continue in the central part of M-line, and further toward the east, C-class anomalies form a line. Geologically the Zone is located in a part where the rhyolite stock on the southern side is in fault contact with tuffaceous conglomerate.

No. 9 Anomalous Zone: An A-class anomaly (0.33 ppm) and a B-class anomaly (0.16 ppm) are positioned putting a point between them in the southern part of D-line. Many C-class anomalies are continuously arranged on L-line which crosses D-line in the vicinity of No. 9 Zone.

Among the Au anomalous zones described in the above, No. 1 and No.2 are, on a broad survey, distributed continuously on a large scale in the eastern part of the area, showing a tendency to expand toward the east. The anomalous zones from No. 4 to No. 7 seem to be distributed in a form to surround the large-scale anomalous zones.

On the other hand, No. 3 Zone on the rhyolite stock in the southern part of the area shows an isolated distribution together with the adjacent No. 8 and No. 9 zones.

(2) Geochemically anomalous zone of Ag component (PL. 15, Fig. 2-34)

The sections in which each one or more A-class anomaly and B-class anomaly are contained, were demarcated as the anomalous zones, to which the individual numbers were put.

Three anomalous zones including No. 1 in the northern part of the area and No. 2 as well as No. 3 in the southern part of the area are classified into the category of the large-scale anomalous zone. No. 4 and No. 5 are distributed in the western part on a small scale.

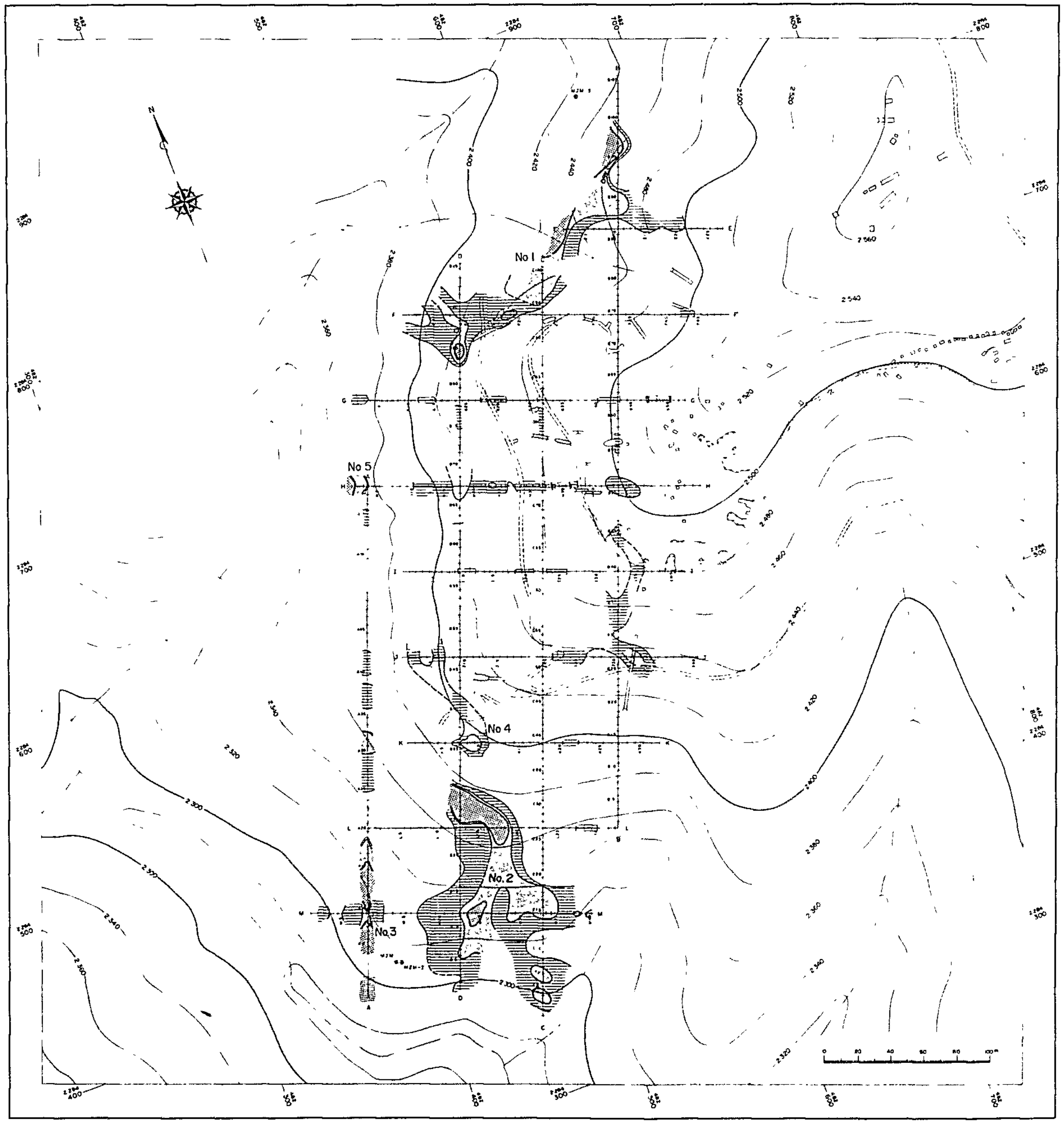
No. 1 Anomalous Zone: The Zone is continuously distributed at the northern end of B, C and D-lines, and E and F-lines which cross the above three lines. Although the exact width can not be determined since the zone shows a form to open toward the north, it roughly extends in the direction of N65°E for about 150 meters from the vicinity of the intersection of F-line and D-line to the northern end of B-line (B-96). The main anomalies which constitute the zone are as follows.

(No. 1 Anomalous Zone)

Class	Sample No.	Ag Contents (ppm)
A	B-88	4.5
	96	6.5
	97	3.2
	C-97	3.0
	D-84	2.7
	85	4.5
	E-1	4.1
	F 2	2.2
	3	2.1
B	C-95	1.3
	96	1.3
	D-86	1.1
	89	1.3
	E-4	1.8
	F-7	1.9
	12	0.7
	15	1.8
	16	0.7
	17	1.9
	18	0.7

No. 1 Anomalous Zone: As shown in the table of No. 1 Anomalous Zone, it consists mainly of nine A-class anomalies and 11 B-class anomalies accompanied with 13 C-class anomalies. It is located at the northern end of the rhyolite terrain, and the northern side of it is underlain by tuffaceous conglomerate or basement rocks underlying the rhyolite.

No. 2 Anomalous Zone: It is distributed continuously on C-line and D-line at the southern end of the area, and also on L-line and M-line both of which



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Symbol	Class of anomaly	Contents (in ppm)
	A	Ag ≧ 2.2
	B	2.2 > Ag ≧ 0.78
	C	0.78 > Ag ≧ 0.28

Fig.2-34 Geochemical Ag-Anomalies of the Surveyed Area

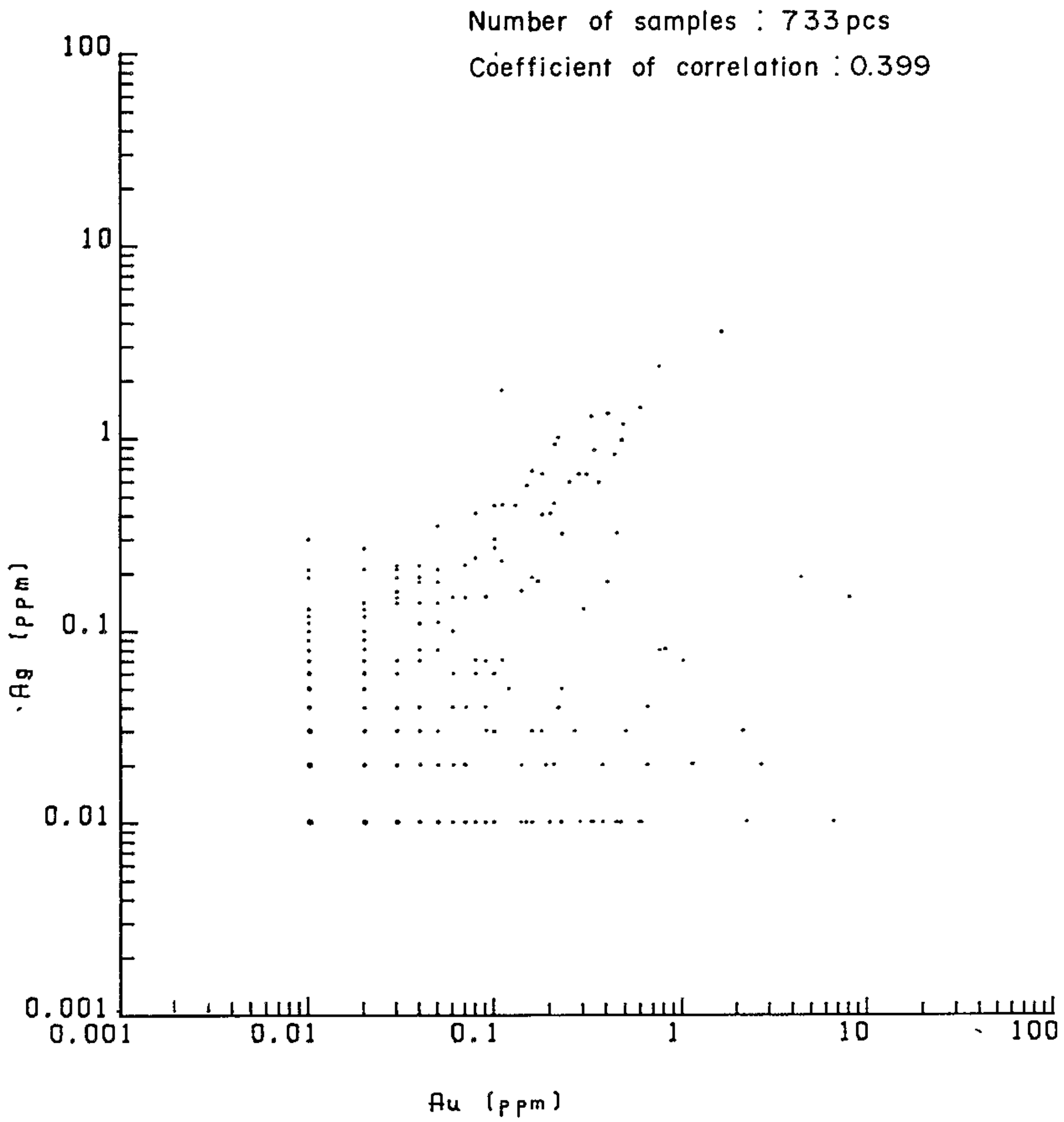


Fig.2-35 Coefficient and Diagram of Correlation for Au and Ag

cross with the aboves. It extends in the direction of N-S for 100 meters with irregular shape, and there is a possibility further to extend southward.

(No. 2 Anomalous Zone)

Class	Sample No.	Ag Contents (ppm)
A	C-3	2.1
	D-18	2.4
	19	2.1
	26	6.8
	28	2.9
	L-18	7.7
	M-24	7.7
	25	2.3
	33	2.2
B	C-5	1.2
	7	1.9
	16	1.9
	17	1.4
	D-6	0.8
	7	0.7
	8	0.9
	13	0.7
	15	0.8
	25	1.0
	M-29	0.8
	30	1.4
	34	1.5
	35	1.1
	37	0.7
	39	1.4

As shown in the table of No. 2 Anomalous Zone, it consists mainly of nine A-class anomalies and 16 B-class anomalies accompanied with 38 C-class anomalies, forming the largest Ag anomalous zone in the area. Geology is composed of tuffaceous conglomerate which is in contact with rhyolite body in the western part of the area.

No. 3 Anomalous Zone: A characteristic of the anomalous zone is, as compared with others, that very high anomalies are concentrated on A-line isolated from others. This tendency is also observed in the drill core of the MJM-1 hole driven in the adjacent area. Because of the zone located in the terrain of stock-like ryolite at the southern end of the area, it is probable that such characteristic would be attributed to the nature observed particularly in rhyolite of the area.

(No. 3 Anomalous Zone)

Class	Sample No.	Ag Contents (ppm)
A	A-1	35.4
	2	14.3
	4	9.8
	5	6.5
	6	13.4
	9	4.1

Class	Sample No.	Ag Contents (ppm)
A	A-10	5.9
	12	8.7
	13	5.9
	14	4.0
	17	3.2
B	A-11	1.8
	15	1.6
	16	1.5
	M-2	1.0

No. 4 Anomalous Zone: It extends in the direction of N-S for about 70 meters with the width of about 10 meters in a position to correspond to the northern extension of the No. 2 Anomalous Zone. It is a low-grade anomalous zone on a small scale.

The zone contains three samples (0.8 - 3.0 ppm) on K-line and extends through the points of 2, 6 and 7 on J-line to connect to the points 40 and 41 on D-line. Excepting the high anomalies on K-line, others are weak anomalies of C-class.

The main part of the zone is located on the side of rhyolite in the vicinity of the contact between the rhyolite mass which has a wide distribution on the eastern side of the anomalous zone and underlying tuffaceous conglomerate distributed on the western side.

No. 5 Anomalous Zone: The zone is small in scale consisting of two A-class anomalies (2.2 and 3.5 ppm) at H-1 and H-2 on H-line at the central-western end of the area. The zone is on tuffaceous conglomerate.

As mentioned in the foregoings, the Ag anomalous zones are distributed, taking a broad view of the area, in a form of fringing the northern to the western limits of stock-like rhyolite mass which shows a distribution on a large scale from the central part of the area toward the east.

Excepting for the peculiar behavior of gold and silver in stock-like rhyolite at the southern end of the area, the Au anomalous zones have a concentrated distribution in the eastern part of the area showing a tendency to expand toward the east, though the Ag anomalous zones are distributed in a form to surround the zones of gold, and that place corresponds geologically to an approximate boundary between rhyolite mass and the underlying tuffaceous conglomerate.

2-6-6 Details of the mineralized zone in the depths shown by drill survey

The drill exploration by three horizontal drill holes carried out in this phase, was purposed for investigation of the conditions of mineralization in the depths of the gold and silver anomalous zones obtained by the survey of the third phase.

The MJM-1 hole and the MJM-2 hole were planned to be driven in the direction of N35°E and N50°E respectively from the terrain of rhyolite in the southern part of the surveyed area (2,307 m above sea level), and the MJM-3 hole, in the direction of S35°E from the northwestern end of the area (2,426 m above sea level).

The result showed that in the holes MJM-1 and 2, rhyolite was exposed from the collar to about 50 meters. Further downward in the hole, most of the rocks are of diorite, tuffaceous conglomerate and rhyolitic tuff breccia, and the diorite forms the basement of the rhyolitic rocks.

In the hole MJM-2, it is observed that rhyolite is again intersected at the depth of 240 meters after penetrating tuffaceous conglomerate, rhyolitic tuff breccia and basement rocks. Therefore, it was made clear that the rhyolite body located at the southern end of the area was a different one from that distributed on a large scale from the central part to the northeastern part of the area, and that it was an isolated body showing a stock-like occurrence. On the other hand, the hole MJM-3 cut rhyolite to the bottom after passed through the basement rock and conglomerate from the collar to the depth of about 20 meters.

In the drill cores obtained from the holes, various mineralization and alteration are observed as described in the following.

Details of MJM-1 hole (PL. 21)

Geology of the hole are roughly as follows.

Depth	Geology
0 m – 60	compact rhyolite
60 – 68	tuffaceous conglomerate
68 – 122	mainly diorite (basement)
122 – 206.10	mainly conglomerate, partly rhyolitic breccia and diorite
206.10 – 246.85	diorite (basement)
246.85 – 300.10	brecciated rhyolite intercalated with small amount of diorite and tuffaceous conglomerate

Chloritization and epidotization are both characteristically observed throughout the whole basement diorite, and are hardly observed in rhyolitic rocks and tuffaceous conglomerate.

Silicification is partly observed in rhyolitic rocks and tuffaceous conglomerate only. Argillization is more local and only locally observed along the fracture zones and cracks.

Pyritization is observed throughout the core, which is especially notable in the silicified zone and in the matrix of tuffaceous conglomerate.

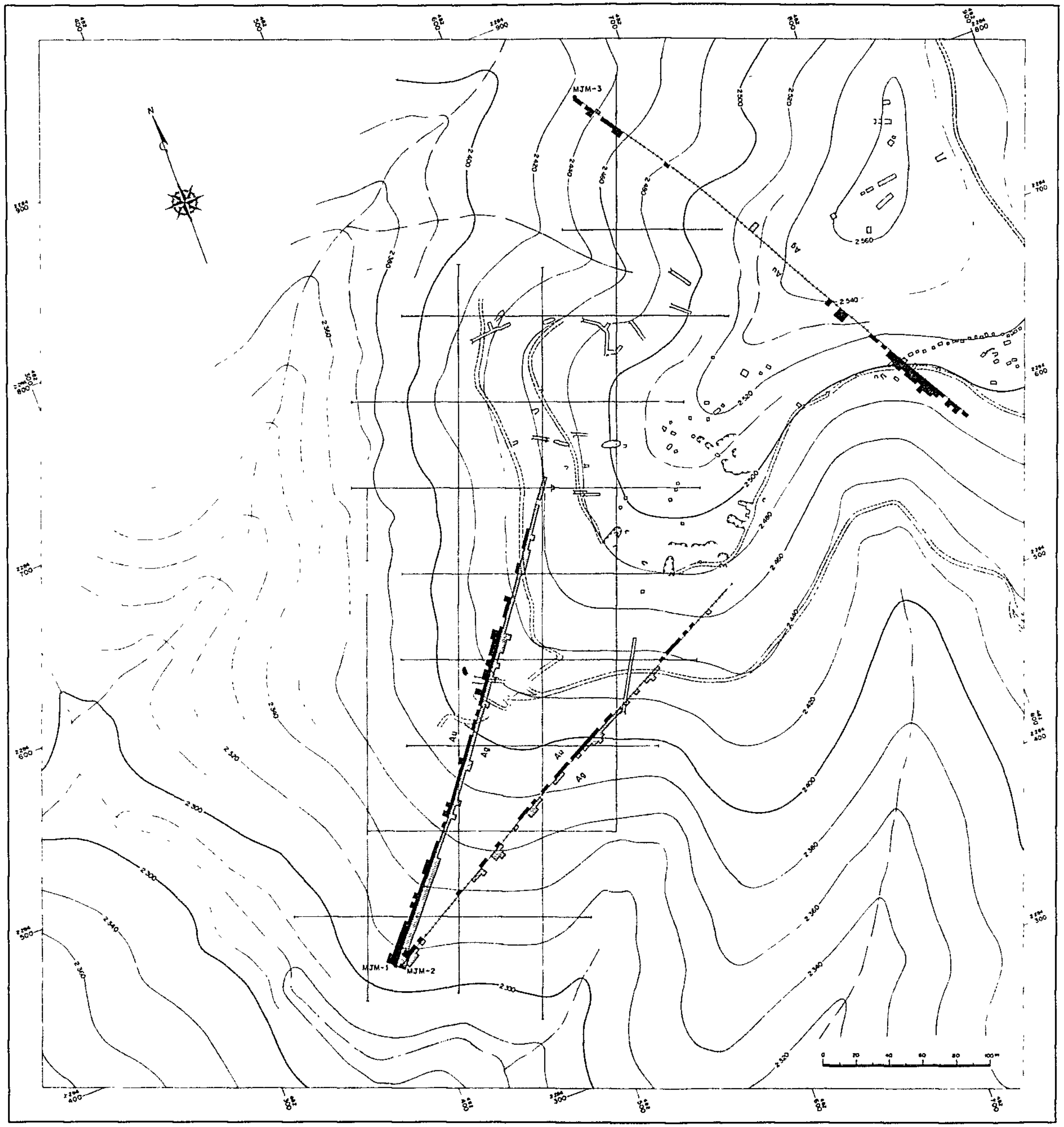
(Copper, lead and zinc mineralization)

The mineralized zones with dissemination of sphalerite and galena accompanied with small amount of chalcopyrite are observed in the following sections.

62.08 m - 65.35 m (3.27 m), 124.30 m - 125.00 m (0.70 m), 189.75 m - 190.30 m (0.55 m), 196.80 m - 196.95 m (0.15 m), 203.60 m - 204.50 m (0.90), 244.80 m - 248.90 m (4.10 m), 298.25 m - 298.75 m (0.50 m).

These are not vein type, but dissemination in the wall rock.

As the result of microscopic observation of the samples of these sections, the ore minerals are composed mainly of pyrite, sphalerite and galena with subordinate amount of chalcopyrite, tetrahedrite, magnetite, hematite and goethite.



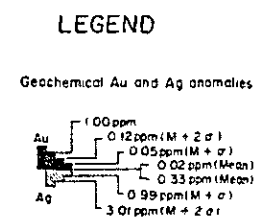


Fig. 2-38 Geochemical Anomalies of the Drilling Holes

The sample (DS1-3P) taken at the depth of 196.85 m contains chalcopyrite, sphalerite and galena disseminated in the matrix of brecciated rhyolite, and spotted chalcopyrite was observed in sphalerite in abundant under the microscope. Exsolution texture in which these spotted chalcpyrite is arranged in a lattice- form is also observed. In some part, galena is included in pyrite.

Quantitative analysis of sphalerite by EPMA showed the components such as 63.3 - 65% Zn, 31.7 - 33.0% S, 0.2 - 0.5% Cu, 0.1 - 2.1% Fe and 0.4 - 0.7% Cd, showing a characteristic that Fe content is very small (Appendix 8).

The assay values of the samples taken from the typical parts in the copper, lead and zinc mineralized zones are as follows:

Section (m)	Ag g/t	Pb %	Zn %	Cu %	Au g/t
62 - 63	4	0.14	0.49	0.04	0.08
63 - 64	3	0.14	0.53	0.01	0.07
244 - 245	3	0.30	0.94	0.08	0.02
298 - 299	3	0.08	0.25	tr	0.01

As shown in the table, zinc and lead mineralization in the drill core, is observed, and it has not been confirmed on the surface, though they are low in grade.

Gold and silver mineralization

The samples were classified based on the classification standard described in Section 2-6-4 as follows. The table shows the main anomalous sections.

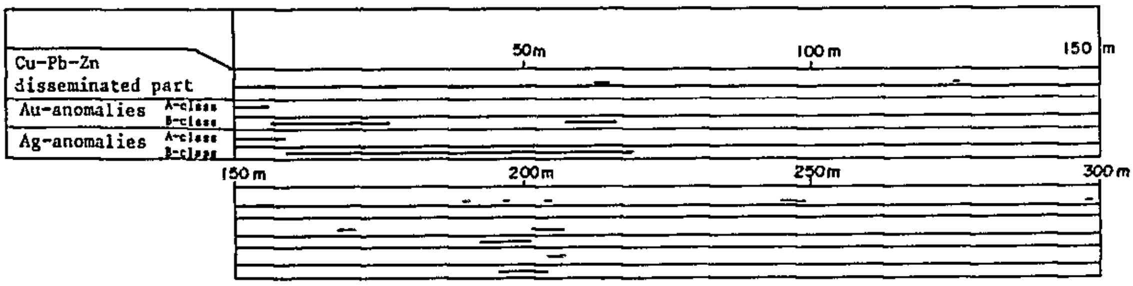
Section	Class of Anomaly	Au Content (g/t) (average of the section)
0.0 m - 6.00 m	A	0.14 - 0.39
6 m - 27 m	B	0.05 - 0.10
57 m - 66 m	B	0.07 - 0.08
168 m - 171 m	A	0.14
192 m - 201 m	B	0.05 - 0.09
201 m - 207 m	A	0.22 - 0.23

Table showing the Ag anomalouw sections

Section	Class of Anomaly	Ag Content (g/t) (average of the section)
0 m - 9 m	A	4.0 - 14.8
9 m - 69 m	B	1.1 - 2.6
195 m - 204 m	B	2.5 - 3.0
204 m - 207 m	A	3.5

The positional relation of these [Pb - Zn - (Cu)] - Au - Ag is show in the following figure.

Fig.2-36 Correlation of Geochemically Anomalous Sections of MJM-1 Drill Hole for [Pb-zn-(Cu)-Au-Ag]



As shown in the figure, the section of the highest Au content of the average core sample for each three-meter interval of the hole MJM-1 is that from 0 m to 6 m in the depth, the highest value being 0.39 g/t Au. The section which shows the highest Ag content is from 0 m to 9 m, which almost overlaps with that of Au. No sulfide minerals of Pb, Zn and Cu, however, has not been observed in these sections. In the section at the depth of about 200 meters, weak dissemination of Pb, Zn and Cu sulfides and Au and Ag anomalous zones almost overlap. In other parts, both groups are distributed independently to each other.

(Details of MJM-2 hole) (PL. 22)

Geology of the drill hole is similar to that of the MJM-1 hole. It is shown, however, to be a little upper than that stratigraphically. In the MJM-1 hole, the basement rock is encountered at two sections, but it is observed

in only very small section. The outline of geology of the hole is as follows.

Depth	Geology
0 m – 51.20	compact rhyolite
51.20 – 232.70	mainly tuffaceous conglomerate interbedded with sandstone, diorite, rhyolite, rhyolitic tuff breccia and rhyolitic breccia
232.70 – 300.20	compact rhyolite

The main hydrothermal alteration observed in the hole is silicification, and argillization, chloritization, epidotization and carbonitization. Silicification is accompanied with pyrite and other sulfide dissemination in many cases and it is repeatedly observed in waves. The main part of it, however, is found in the section from 51.20 m to 232.70 m in depth. Diorite encountered in the section between 108.72 m and 117.65 m has been characteristically subject to chloritization and epidotization. The reason of it will be attributed to that the rock was primarily more basic than others. Chloritization is observed in fracture zones of tuffaceous conglomerate overlapped with argillization. Although pyritization is observed throughout the hole, it is most conspicuous within the range from about 50 meters to 190 meters in depth.

Copper, lead and zinc mineralized zone

Beside pyrite, chalcopyrite - sphalerite - galena-disseminated mineralized zone is observed in the following sections, such as 54.95 - 55.05 m, 70.33 - 79.00 m, 86.80 - 88.00 m, 174.70 - 179.65 m, 181.65 - 182.22 m and 202 m - 204 m.

As the result of microscopic observation of ore samples from these sections, the main ore minerals consist of pyrite, sphalerite, galena and chalcopyrite, containing accessory amount of tetrahedrite, pyrrhotite, hematite and bornite. For example, microscopy of an ore sample (DS2-1P) taken at the depth of 54.90 m shows that coarse crystals of sphalerite and pyrite are of the main ore minerals, and chalcopyrite and galena are found having been

put between them. Magnetite is found at the boundary between sphalerite and chalcopyrite, and micrograins of pyrrhotite are observed in pyrite. Bornite forms lattice-like intergrowth with chalcopyrite.

The result of quantitative analysis of sphalerite by EPMA showed the values such as 61.9 - 66.4% Zn, 32.6 - 33.5% S, 0.2 - 1.6% Cu, 1.1 - 2.8% Fe and 0.06% Cd. (Appendix 8).

The ore grades of the mineralized zone in typical sections are as follows:

Section (m)	Ag (g/t)	Pb (%)	Zn (%)	Cu (%)
70 - 71	3	0.12	0.06	tr
74 - 75	5	0.16	0.59	0.02
174 - 175	3	0.48	0.81	0.01
175 - 176	2	1.48	3.74	tr
176 - 177	2	0.33	0.78	0.01
177 - 178	3	1.63	3.45	0.02
178 - 179	3	1.50	4.68	0.03
202 - 203	1	0.14	0.47	tr
203 - 204	1	0.16	0.12	tr

As shown in the table, the largest mineralized zone is found for five meters in the consecutive sections from 174 meters to 179 meters in a depth, consisting mainly of lead and zinc. The mineralization of these elements in this hole is relatively notable as compared with that of the hole MJM-1, and the maximum values such as 1.63% Pb and 4.68% Zn are shown within the range from 174 meters to 179 meters in a depth. But the mineralization of gold and silver in this hole is very weak as compared with that of lead and zinc.

The maximum value of gold content in this hole was 0.10 g/t, which was shown only in one sample from the section from 90 meters to 93 meters in a depth. The silver content in this part is 4.3 g/t, which is also the highest value of silver in this hole. Beside it, no notable part has not been observed except a tendency of silver that it shows a little higher content in the sections of 174 - 183 meters than other parts, having the values of 2 - 3 g/t Ag.

As described later in Section 2-7, these matters are considered to be due to the vertical zonal arrangement of mineralization in the area, that is, gold and silver mineralization is dominant in the superficial part, which gradually declines toward the depth. On the contrary, it is likely that the lead and zinc mineralization has a tendency to become dominant in the depths. In the hole MJM-1, the sample which showed the highest values of both gold and silver was obtained at the part of collar from 0 meter to 6 meter in rhyolite. On the surface, the two elements show also the same tendency of a little higher content as in the hole MJM-1. From these facts, it is considered that the gold and silver mineralization has been controlled both by country rocks and the depth.

Details of MJM-3 hole (PL. 23)

Geology of the hole consists mainly of rhyolite as shown in the following.

Depth	Geology
0 m – 4.50	altered diorite (basement rock)
4.50 – 16.50	small occurrence of sandy conglomerate, sandy tuff and tuff
16.50 – 252.50	massive and compact rhyolite
252.50 – 300.50 (bottom)	rhyolite lava with flow structure

Hydrothermal alteration observed in the hole is mainly of silicification. Argillization, chloritization and epidotization are also observed in some parts.

Silicification is notably observed in the following sections; 10.65 m - 56.00 m, 80.80 m - 94.60 m, 177 m - 195 m and 237.00 m - 249.10 m. Most of these parts are generally accompanied with pyrite dissemination.

Argillization is observed mainly along the cracks in fracture zones. Chloritization and epidotization are partly observed in the section from the collar to 22.80 meters depth. These are especially notable in diorite exposed in the hole close to the collar. Weak chloritization is observed along the

cracks in rhyolite in the section from 16.50 meters to 22.80 meters, and along the quartz veinlets found in this part.

Copper, lead and zinc mineralization

The ore minerals observed in the mineralized zone consist of chalcopyrite, sphalerite and galena, among which the first one is the main. These ore minerals are found in the range from the collar to the depth of 131.65 meters, and has not been observed beyond that point toward the bottom of the hole.

Most of these ore minerals are found along quartz veinlets and the cracks in the silicified zone, while those of dissemination type have been observed only in one place. Such an occurrence shows a remarkable difference from that observed in the two holes of MJM-1 and 2. The mineralization of the former type is found at the points and in the sections such as 28.20 m - 29 m, 37.15 m - 38.80 m, 51.25 m, 93.60 m and 131.65 m. Dissemination type is observed in the section of 82.45 m - 84.60 m.

The main ore mineral observed in these sections is chalcopyrite. Sphalerite is found in two sections and galena in one section.

Gold and silver mineralization

The main anomalous sections classified on the basis of the classification standard are as follows.

Au Contents Anomalous Section

Section (m)	Class	Au Contents (g/t)	Section (m)	Class	Au Contents (g/t)
12m - 15m	B	0.06	255m - 264m	A	0.14 - 0.28
30m - 36m	B	0.05 - 0.08	264m - 267m	B	0.09
192m -195m	B	0.05	267m - 270m	AA	1.65
201m - 207m	A	0.47 - 0.50	270m - 276m	A	0.16 - 0.25
240m - 249m	B	0.06 - 0.12	276m - 279m	B	0.06
249m - 252m	A	0.33	285m - 288m	B	0.07
252m - 255m	B	0.11	291m - 294m	B	0.08

As shown in the above table, although some anomalous values are observed in the sections from the collar to the depth of 36 meters, anomalous Au contents of the core samples of MJM-3 hole, are concentrated to the depth from 192 meter to 294 meter, being 1.65 g/t Au as a maximum value in the section of 267 m - 270 m. Copper, zinc and lead mineralization is entirely absent in these sections of higher content of gold.

Silver mineralization is extremely weak as compared with that samples of MJM-1 and 2. Except for a point which shows the silver content of 4 g/t at the depth of 129 m - 132 m, any values to be significant are not found. In the part of high silver content, a small vein (2 cm wide) accompanied with chalcopyrite and galena is found at the point of 131.65 m, which is likely to have raised the silver value in relation with its mineralization.

As described in the above, MJM-3 hole shows a tendency of higher contents in inverse proportion to the Cu-Zn-Pb mineralizations as compared with those of other two holes.

The hole was situated at the high place topographically. In the cross section including the hole, the vertical depth of the hole from the surface becomes deeper from the collar toward the depth to the poing 170 m where the maximum height of 120 meters is measured between the ridge and the hole. Beyond that point toward the bottom, the vertical position of the hole gradually become shallow, the bottom of the hole being about 70 meters beneath the surface.

The sections from 192 meters to the bottom where the gold mineralization becomes getting higher, are to correspond to the position 70 to 80 meters beneath the surface.

2-7 Summary and Consideration

(1) Distribution and scale of Au geochemically anomalous zone by trench sampling and the relation with those of the SAN SEVERIANO mine

There are two anomalous zones on a large scale such as those distributed concentratedly on the rhyolite mass exposed from the eastern-central part to the northeastern part of the area and the other in stock-like rhyolite in the southern part of the area. The former group has two cardinal nucleuses of high content. One of these occupies an area of 100 meters long and 15 meters wide in average showing the value of 1.18 g/t Au in average. The other one extends for 50 meters with the average width of 12 meters showing average value of 1.5 g/t Au.

As shown in Fig. 6-1, the high assay values shown in the samples taken so far in the areas between the anomalous zone and the SAN SEVERIANO mine have been confirmed to be scattering, and the zone as a whole, is open toward the SAN SEVERIANO mine. Therefore, an area of 200 m x 400 m intervening between the anomalous zone and the SAN SEVERIANO mine can be positioned to be important as the target for future exploration.

(2) Relation between both the geochemically anomalous zones of Au and Ag

In the survey of this phase, it was made clear that the geochemically anomalous zone of Au and Ag components were not overlapped, but distributed in a form of zonal arrangement. That is, the Au geochemically anomalous zones are distributed in the eastern part of the area and to the east of it. The Ag geochemically anomalous zones, on the other hand, are distributed along the approximate boundary between the rhyolite mass and the underlying tuffaceous conglomerate surrounding the former zones.

Topographically, the former is positioned on the ridge (higher than 2,450 m above sea level) in the eastern part of the area, and the latter in the relatively lower part on the side of the foot of mountain surrounding the ridge.

(3) Comparison of the assay values of drill cores with those of the surface samples

The assay values of Au of drill cores were generally low as compared with those of the surface samples. In the MJM-3 hole, however, the assay values of gold from about 200 meters in depth to the bottom was generally high showing the highest value of 1.65 g/t in a section. This section is positioned about 70 meters below the surface, which is rather shallow part than other position in the drill holes. Whereas, the bottoms of the holes of MJM-1 and 2 are positioned at the depth of about 160 meters below the surface, which is deeper than the above. Furthermore, the two holes were cut through tuffaceous conglomerate near the basement rock underlying the rhyolitic rocks. On the other hand, disseminated mineralized zone of sphalerite, galena and chalcopyrite are observed in many places of the two holes.

From the facts above mentioned, the comprehensive consideration of the relation between the two modes of distribution of the geochemically anomalous zones of gold and silver, the mineralization of copper, lead and zinc observed in the drill cores and the wall rocks of each mineralized zone leads to the conception that the distribution of the mineralized zones of gold and silver and those of copper, lead and zinc suggest a vertical zonal arrangement of the mineralization of the area.

CHAPTER 3

PROVIDENCIA AREA

CHAPTER 3 PROVIDENCIA AREA

3-1 General Remarks

As the result of the survey of the second phase, traces of old open pits and old underground workings were confirmed at several places in the area. In addition, as the result of geochemical prospecting (by stream sediment sampling) conducted in parallel with the above, geochemically anomalous zones were detected along the drainage system in the area and in its surrounding area, which were considered to be a guidance for future exploration.

In the survey of the third phase, detailed geological survey, IP electric survey and geochemical prospecting (by soil sampling) were conducted within the survey area of six square kilometers. As the result, numerous ore outcrops scattered in the area, high chargeability anomalous zone by electric survey and Pb geochemically anomalous zone were detected with mutually close relation, and the area was recommended to be the target area for future exploration.

In this year, detailed geological survey and drill survey were conducted for the area of 0.48 square kilometer on the basis of the conclusion of the third year.

The detailed geological survey was purposed to make clear the relation between the conditions of the numerous ore outcrops scattered in the area and their distribution, and the geologic structure. The drill survey consisting of two vertical holes was purposed to investigate the conditions of ore deposit in the depths of the geochemically anomalous zones and high chargeability anomalous zones detected in the third phase.

All these surveys were directed to obtain the data to evaluate the mineralized zone and to investigate the potentiality of future exploration in the area.

3-2 Location , Village, Topography and Vegetation

The area is situated in the mountainous region about 24 kilometers to the north-northeast of Ixmiquilpan City having an extent of 0.48 square kilometer extending north-northwesterly for 800 meters with 600 meters width.

The nearest settlement is Yonthe situated about five kilometers to the south-southeast of the area, and only several houses are scattered along the road from Yonthe to the area.

The area is positioned on the northeastern slope of the Providencia mountain mass having an altitude between 2,350 meters to 2,580 meters above sea level, showing a relatively steep landform. A dry creek runs down north-northwesterly traversing approximately the center of the area, on both sides of which, on the eastern and the western side, putting the creek between, two ridges stretch north-northeasterly. The vegetation consists mainly of conifers and shrubs, and xelophilous plants including agave are rarely found. Although these plants from thin wood on the steep slope, they grow thick on the gentle slope.

3-3 Geology

Geology of the area including its surroundings consist of sedimentary rocks correlated to early Jurassic to late Cretaceous and small dykes intruded into the former. The Las Trancas Formation to the southwest of the area, the El Doctor Formation in the area and the Mendez Formation to the northeast of the area are distributed respectively in a successive sequence from the lower upward from the southwest toward the northeast. They generally strikes NW and dips SW. Therefore, a reverse stratigraphical relation is shown in the above succession. This is because that the area is positioned at the place where it is put between the two axial planes of a couple of overfold anticline and syncline on a large scale (Fig. 2-1, 3-1 and 3-2).

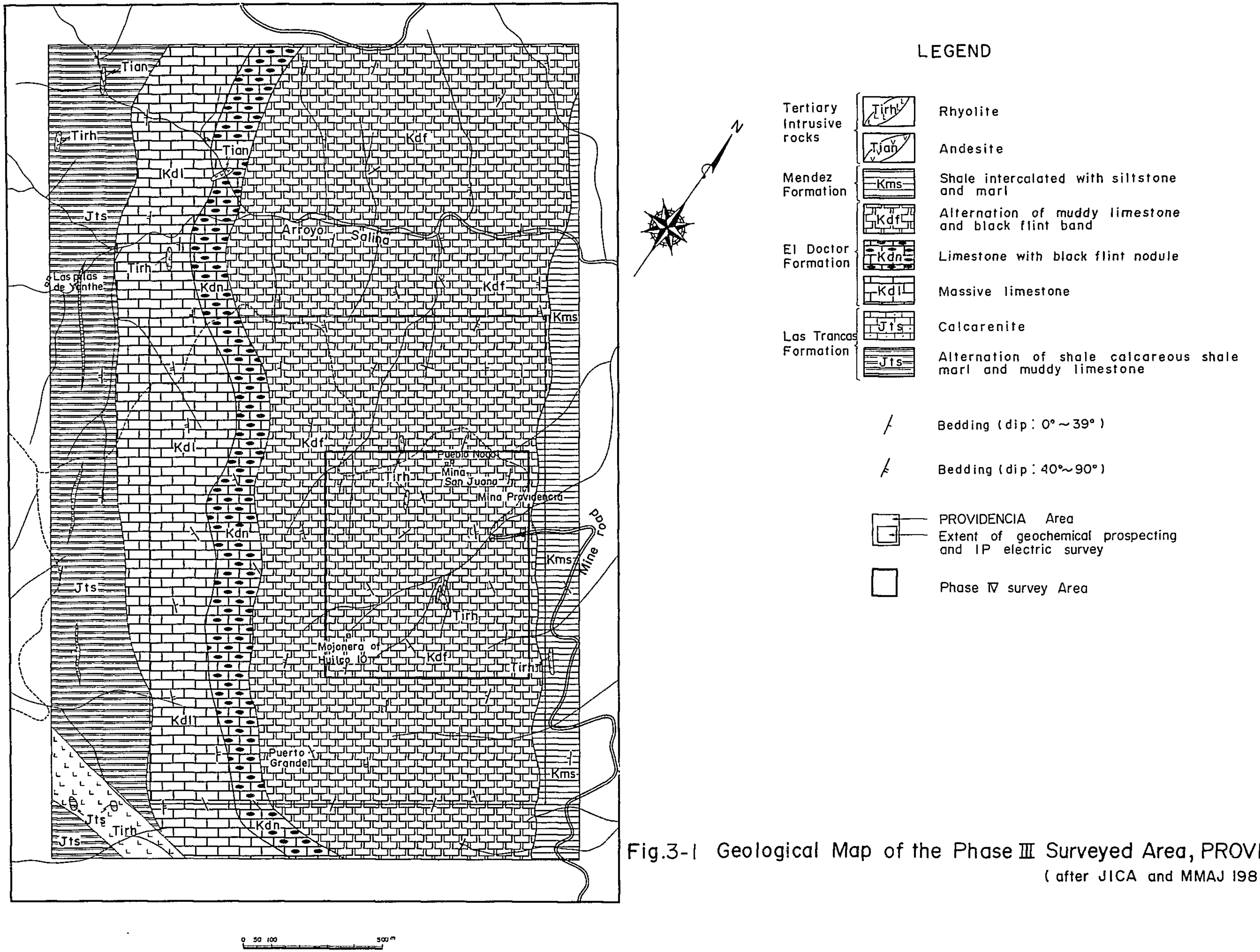
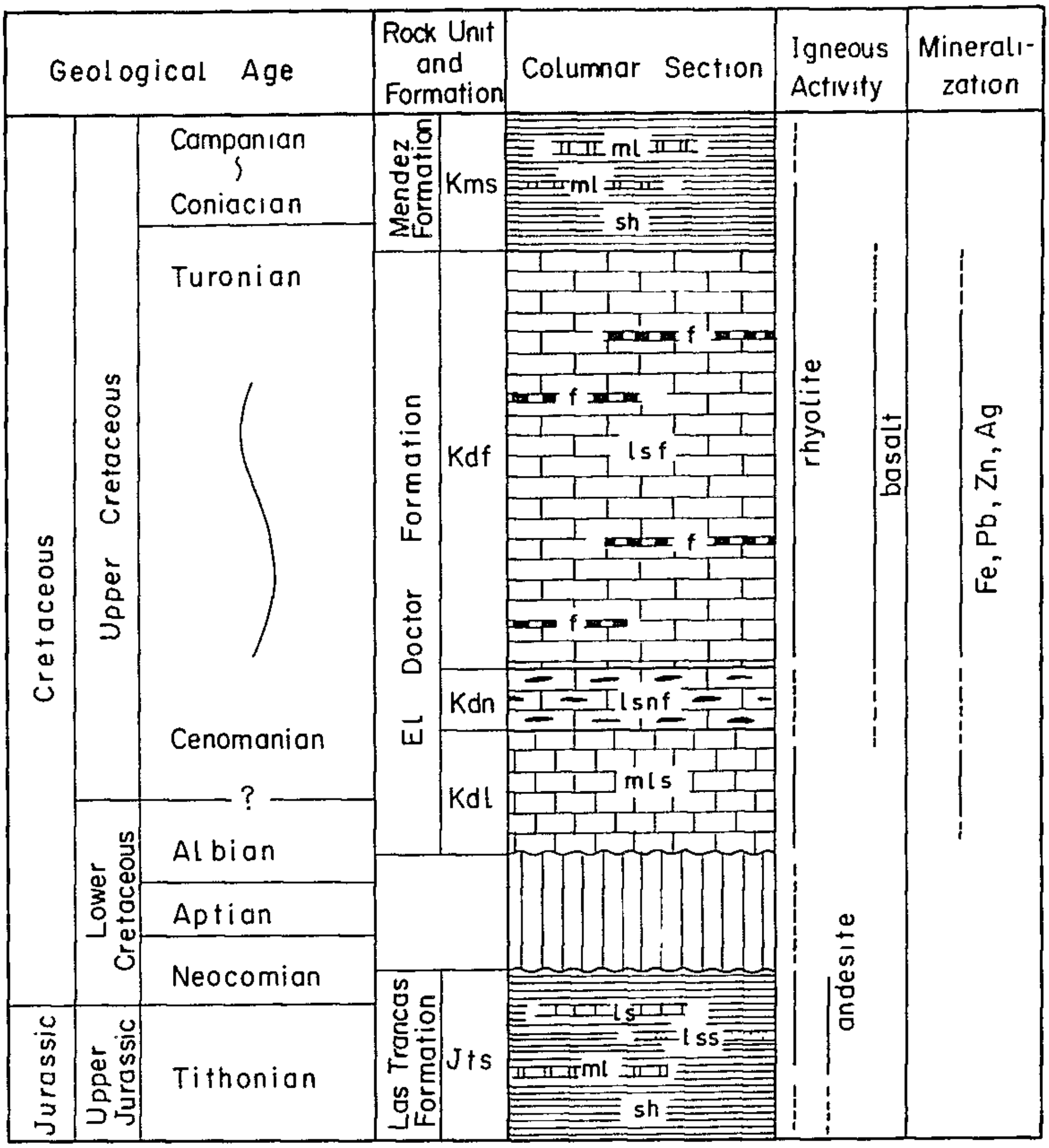


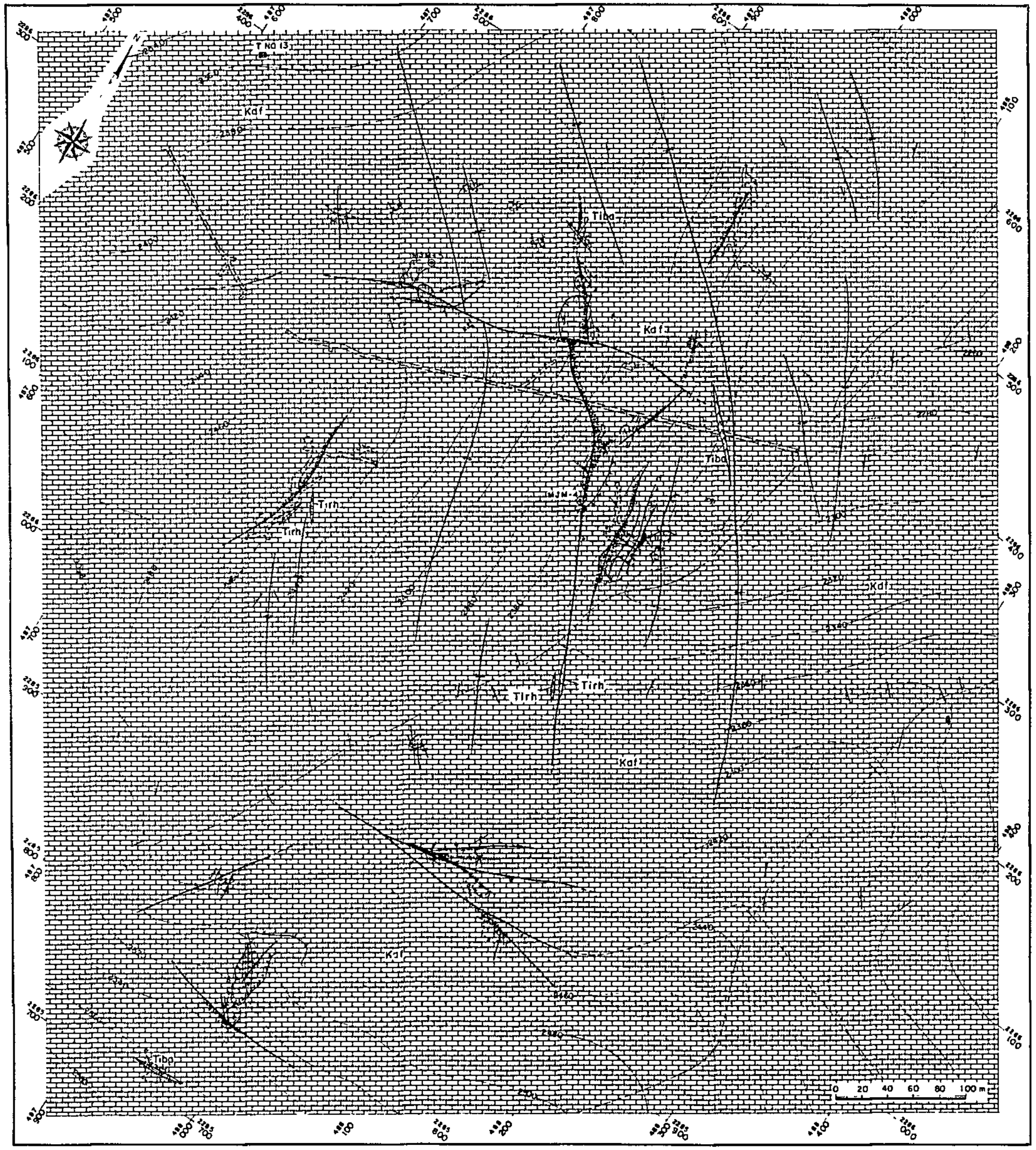
Fig.3-1 Geological Map of the Phase Ⅲ Surveyed Area, PROVIDENCIA
(after JICA and MMAJ 1982)



Abbreviations

ml	marl	Fe	iron
sh	shale	Pb	lead
f	black flint	Zn	zinc
lsf	limestone with black flint band	Ag	silver
lsnf	limestone with black flint nodule		
mls	massive limestone		
ls	limestone		
lss	calcarenite		

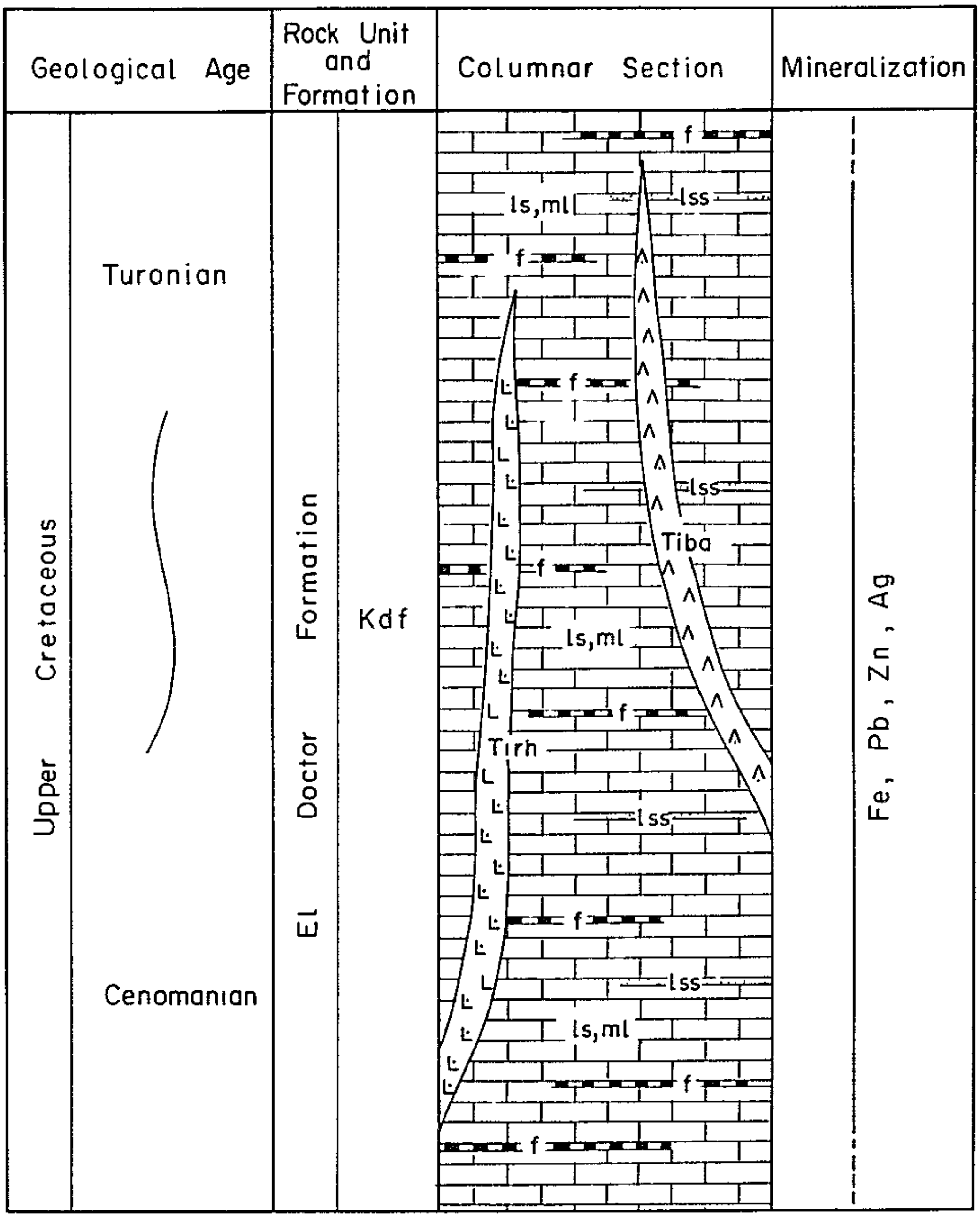
Fig. 3-2 Stratigraphic Column of the Phase III Surveyed Area, PROVIDENCIA (modified from Phase III)



LEGEND

- Tiba — Altered augite basalt
- Tirh — Rhyolite
- Kaf — Alternation of medium bedded limestone, thin bedded calcarenite and black flint band
- Strike and dip of strata
- Fault
- Anticlinal axis
- Synclinal axis
- Overturned anticlinal axis
- Overturned synclinal axis
- Oxide ore
- Tunnel
- Open pit
- ⊙ MJM-4 Diamond drilling site and number

Fig.3-3 Geological Map of the PROVIDENCIA Area



Abbreviations

f	black flint	Tirh	rhyolite
lss	calcarenite	Tiba	basalt
ls	limestone		
ml	marl		

Fig.3-4 Stratigraphic Column of the PROVIDENCIA Area

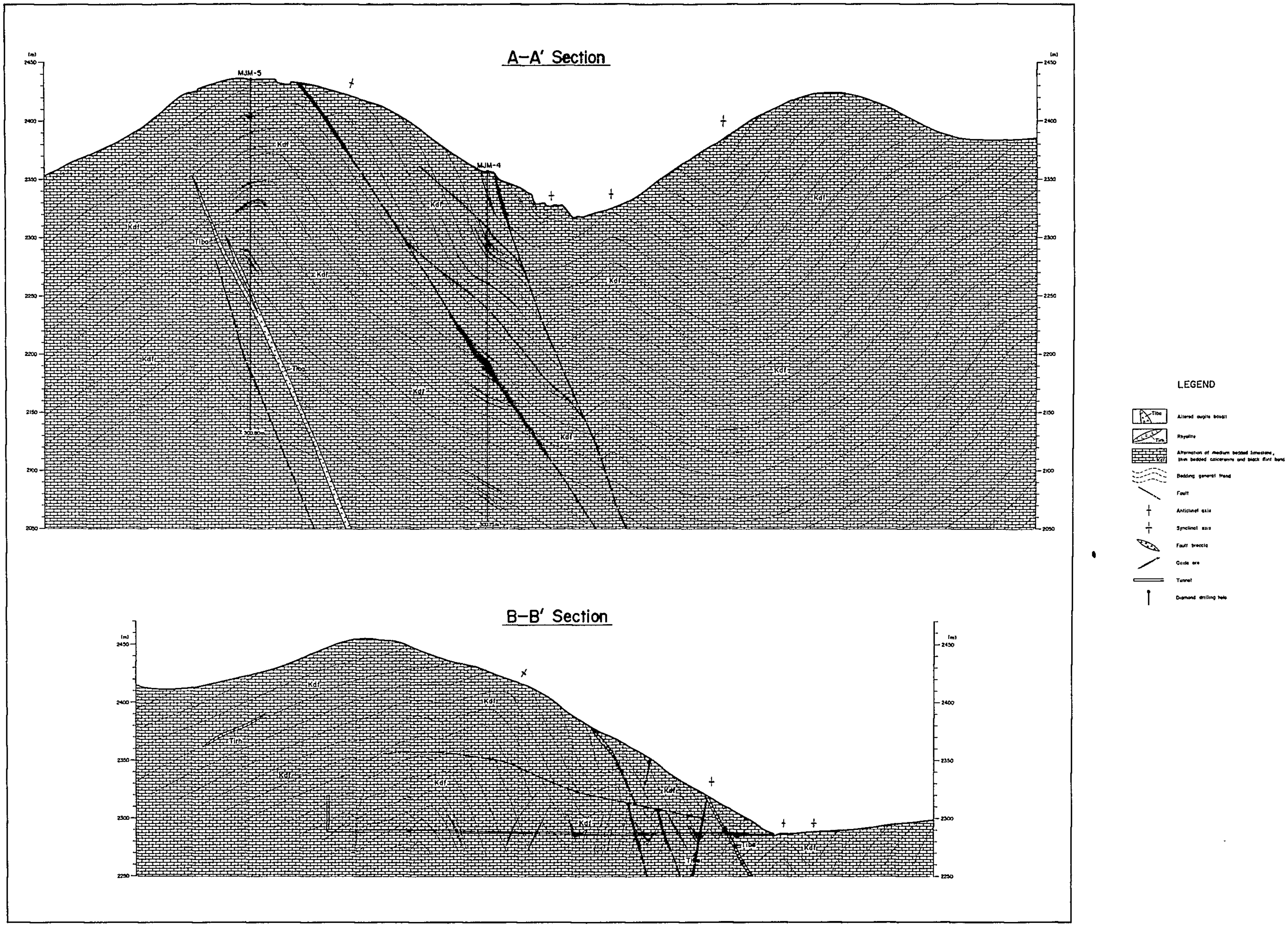


Fig. 3-5 Geological Profiles of the PROVIDENCIA Area

Geology of the area is composed, among these geological environment, of Black Flint Bearing Limestone Member (Kdf) of the El Doctor Formation, which shows a flysh type sequence, and small dykes intruded into them (Fig. 3-3, 3-4).

Black Flint Bearing Limestone Member (Kdf)

The whole area is underlain by the Kdf Member. The member generally consists mainly of alternating beds of dark grey to grey thin-bedded (3 - 10 cm) platy limestone, calcareous sandstone and marl, partly intercalated with medium-bedded (10 - 30 cm) limestone. These alternating beds of limestone and marl are often interbedded with drak grey to grey thin-bedded (1 - 10 cm) calcareous sandstone, sandstone and partly with thin-bedded (less than 1 cm) black shale, which are characteristically intercalated with thin layers (2 - 5 cm) of black to drak grey flint.

Limestone and marl are not recrystallized, but microlitic limestone is observed at the contact with the intercalated calcareous limestone.

Calcareous sandstone, sandstone and black shale are gradationally in contact with each other, and graded bedding and foliated structure are often observed. The unit bed of black flint intercalated in a form of plate is poor in continuity along the strike and generally thins out within the extent of several tens meters. However, since the member is intercalated with abundant black flint beds, the latter locally form alternating beds with other unit beds.

Two vertical drill holes cut through the rocks of the member (Kdf), and the geology of the holes is generally similar to that on the surface. In the drill cores, however, variation of the rock facies is observed in the member, and a dominant presence of platy limestone and calcareous sandstone is observed in some places. That is, platy limestone is dominant in the MJM-4 hole at the sections such a 0 m - 28.40 m and 288.00 m - 296.80 m, and in the MJM-5 hole at 54.70 m - 79.80 m, 219.00 m - 259.50 m and 275.80 m - 281.00 m.

Calcareous snadstone is dominant in the MJM-5 hole at 50.00 m - 54.70 m and at 281.00 m - 300.80 m (bottom of the hole).

The member is considered to be a flysh-type sediment, and the time of sedimentation was determined to be middle Albian to upper Turonian of Cretaceous based on identification of the fossils obtained from the member outside of the area in the second year survey (JICA and MMAJ 1981).

Dyke rocks

The dykes are of rhyolite (Tirh) and basalt (Tiba) in small scale.

Rhyolite is distributed on a small scale at two places in the central part of the area and other two places about 230 meters to the west of the above. Basalt is exposed at two places in the northern center of the area and at one place at the southern end. All these are small-scale dykes intruded into the Black Flint Bearing Limestone Member in the area.

In the MJM-5 hole, basalt dyke is observed at three places in the section between 180.05 m and 195.00 m.

Rhyolite dyke is greyish white to pale brown and has been subjected to weak silicification and argillization.

Basalt dyke has been subjected to strong oxidation to present brown tint.

Under the microscope, the rock presents porphyritic texture. The phenocrysts consist of plagioclase and augite. The matrix is composed of microcrysts of plagioclase and augite, and glass. The rock has been generally altered to produce the secondary minerals such as saponite which fills the amygdaloidal vesicles, and calcite veinlets are observed in addition.

The precise time of intrusion of these dykes has not been made clear.

3-4 Geologic Structure

The area is positioned in the eastern limb of an overfold anticline which was made clear by the geological survey of the second year, having its axis extending in the direction of NW-SE on the southwest of the area and

dipping southwestward. Therefore, the Black Flint Bearing Limestone Member is in the reverse relation stratigraphically.

In the area which constitute a part of a major fold structure, folds and faults are notably observed in the strata in the area.

Fold structure

Among the fold structures observed in the area, a couple of synclinal and anticlinal structures located in the central part of the northern half of the area is the greatest in scale. Beside it, many fold structures on a small scale are observed in the area (Fig. 3-3 and 3-5).

The greatest synclinal structure is found on the northeastern side of the area having its axis extending in the direction of NW-SE, and its axial plane seems to be almost vertical.

The axial part is observed at about 50 meters from the entrance of the T.No. 1 cross-cut (Fig. 3-7) excavated toward the west-southwest, the entrance of which is located in the northeastern part of the area, where the repetition of minor folds is observed around the axial part, forming a major synclinal structure as a whole.

The greatest anticlinal structure is found at about 180 meters to the southwest of the synclinal structure mentioned above. The anticlinal axis extends in the direction of NW-SE, and its axial plane dips steeply southwestward. The axial plane is observed at 310 meters from the entrance of the T.No. 1 cross-cut, where the repetition of minor folds is observed.

Among the minor fold structures observed between these axes of anticline and syncline, overfold syncline and anticline are observed in addition to the common ones at the old pit P. No. 1 and the prospecting tunnel T. No. 3 situated in almost the central part of the area, where the strata have been folded complicatedly (Fig. 3-8).

Besides these, numerous minor folds and micro-folds are observed in the limestone member.

Fault structure

The fault structures of NNW-SSE system, ENE-WSW system and NNE-SSW system are markedly observed in the area, and all these are accompanied with mineralized zones.

A fault of NNW-SSE system is observed at the old pits such as P. No. 2 and P. No. 3 in the central part of the area, which is accompanied with the fault fracture zone more than two meters wide. The fault strikes N20°W and dips 80° northeastward (Fig. 3-9).

The faults of ENE-WSW system are observed at the old pits such as P. No. 3, P. No. 6 and P. No. 7 a little to the north of the center of the area. The general strike of the fault is N70°E dipping 60° southeastward, accompanied with the fault fracture zone 0.5 meter to 1.5 meters wide. This fault cuts the fault of NNW-SSE system mentioned above (Fig. 3-10 and 3-11). It is estimated that the fault would continue to the fracture zone intersected in the drill hole MJM-4 at the depth of 196.60 m - 172.45 m.

A fault of the same system as the above at the old pits such as P. No.11 and P. No. 13 in the southern part of the area, where it is accompanied with the fracture zone 0.4 to 0.5 meter wide. The fault generally strikes E-W and dips 40° - 80° southward, which diverges into three directions on the east. That of the same system is also observed in the old pit P. No. 15 to the south of the above.

The faults of NNE-SSW system are observed in the tunnel T. No. 2 in the northern part, in the tunnel T. No. 15 a little to the west of the center and at the old pit P. No. 17 in the southern part.

3-5 Mineralization and Mineralized Zone

Outline

Many old open pits, old trenches and old prospecting tunnels are observed in the area. These were called in the past Mina Providencia, Mina San Juana,

Mina San Juan and Mojonera of Huilco 10, which seem to have been prospected and mined by hand picking.

The ore produced by the prospecting and mining seems to have been transported by hands to a small-scale smeltry built along the River Salino which flows from the northern outside of the area down northeastward, and smelted there. These are inferred from the remains of partially destroyed smeltry and waterways scattered along the bank of the river.

The mineralization of the area is observed in the Black Flint Bearing Limestone Member (Kdf) of the El Doctor Formation, and the mineralized zone has generally been highly oxidized to form brown gossan. Beside it, many network veinlets of calcite and partly network veins of quartz are observed. The alteration of the country rock of ore deposit, however, is weak, and no recrystallization can not be observed in the member.

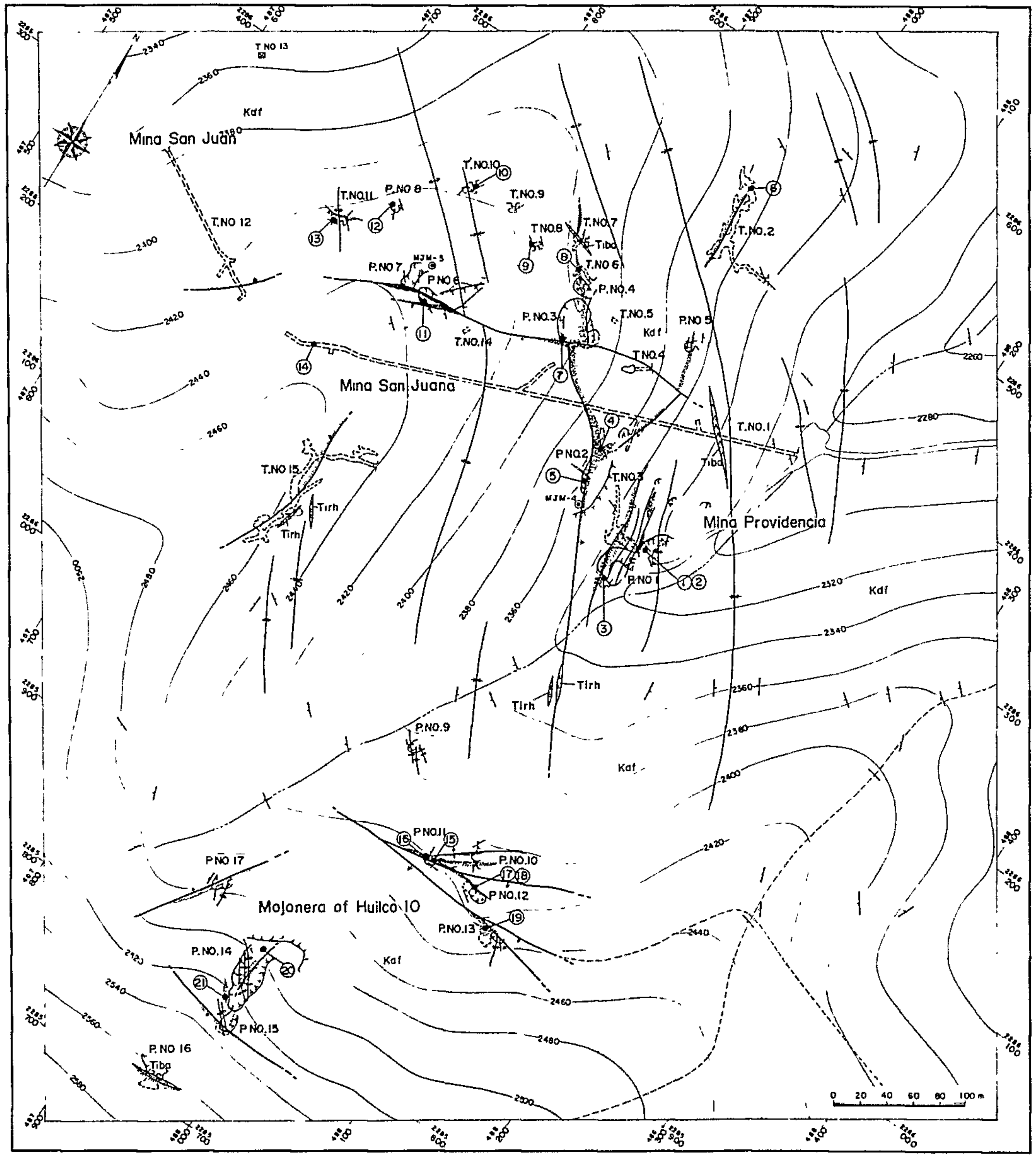
Ore deposits consist of irregular massive, brecciated and partly disseminated ore bodies emplaced along the fault fractures and the fracture zones in the vicinity of the fold axial planes occurring in the member, and disseminated ore bodies emplaced along the bedding plane of the member.

Among these, the ore bodies of the former types are superior to the latter both in scale and grade.

These deposits are considered to be hydrothermal type fissure filling deposit or vein type deposit.

Itemized description of ore deposits

The mineralized zones in the area are of Mina Providencia, Mina San Juana and Mina San Juan situated on the northwestern side of a dry creek flowing down in the central part from the southwest toward the northeast and Mojonera of Huilco 10 on the southern side of the upstream of the creek. These names of mines and location of the old prospecting and mining works are shown in PL. 19 and Fig. 3-6. The occurrence and scale of these mineralized zones are shown in Table 3-1, and the assay grades of the ore sampled in the Appendix 7 and Fig. 3-6.



LEGEND

- Altered augite basalt
- Rhyolite
- Kdf Alternation of medium bedded limestone, thin bedded calcarenite and black flint band
- Strike and dip of strata
- Fault
- Anticlinal axis
- Synclinal axis
- Overturned anticlinal axis
- Overturned synclinal axis
- Oxide ore
- Tunnel
- Open pit
- MJM-4 Diamond drilling site and number
- Sample Location and number

Chemical Analysis of Ore Samples

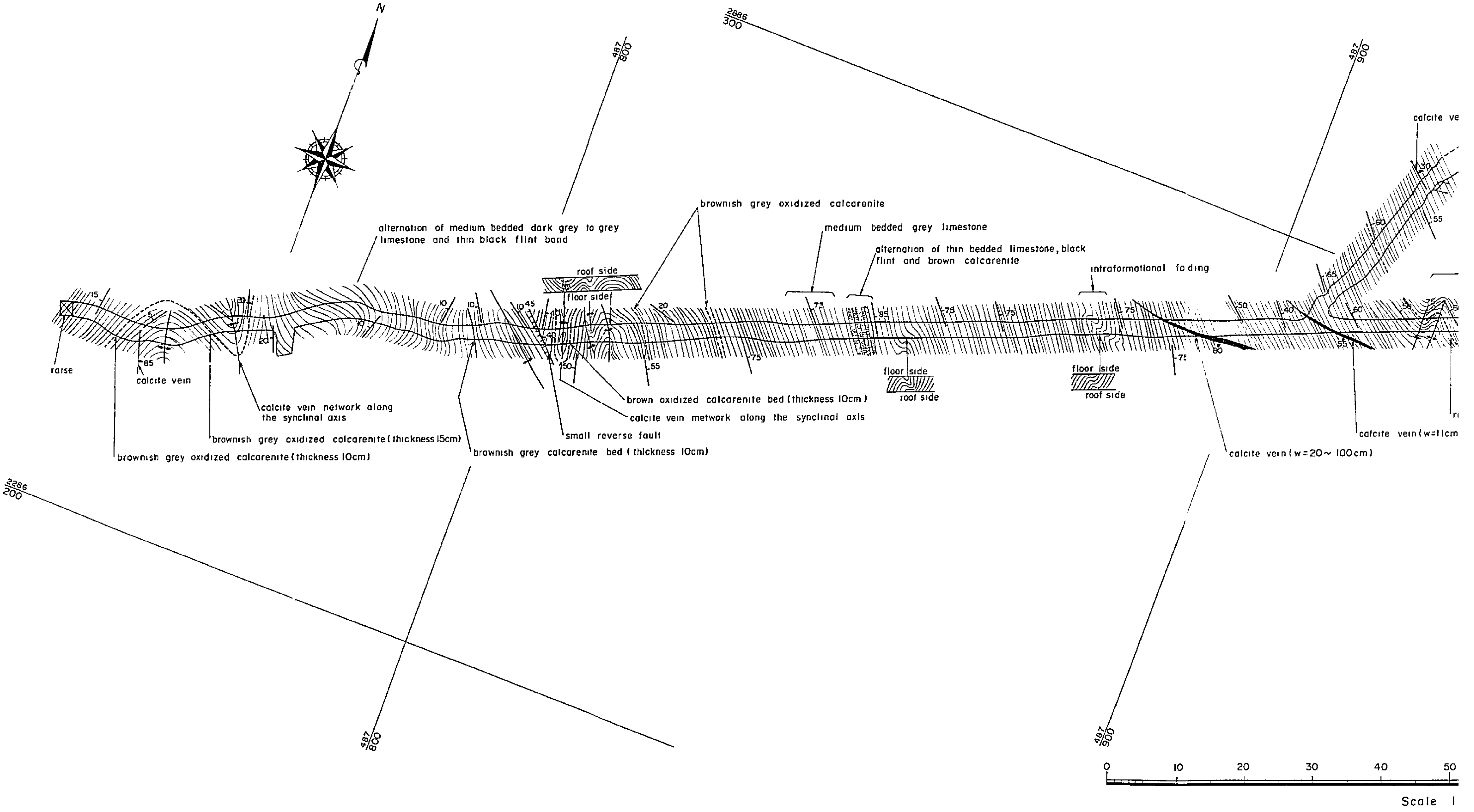
Ser No	Sample No.	Metal Contents				
		Au g/t	Ag g/t	Cu %	Pb %	Zn %
1	KP-1PM	0 01	11	0 01	6 06	0 52
2	KP-2PM	—	10	0 03	2 56	2 63
3	KP-3PM	—	13	0.08	1 38	41.78
4	KP-4 M	0.01	19	0 01	0 94	32 87
5	VL-aPM	<0 01	12	0 02	1.18	7 61
6	VL-11PM	—	7	Tr	7.90	1 91
7	KP-6 M	0 03	21	0.05	8.80	33 39
8	VL-8PM	—	10	0.01	6.66	0.90
9	VL-3PM	<0.01	14	0.02	0.55	44.78
10	KP-8PM	—	18	0.01	10 28	25 71
11	KP-9PM	—	8	0.04	0.24	43 25
12	VL-2PM	0.03	3	0.01	0.06	0 72
13	VL-5PM	—	4	Tr	0.04	37 77
14	O14-1 M	—	3	0.01	0 01	0 22
15	NP-5 M	<0.01	6	0.02	1 98	4 65
16	NP-7 M	—	7	0.02	1.93	3 97
17	NP-9 M	—	5	Tr	0 93	23 76
18	NP-10PM	<0 01	3	Tr	0.91	6.41
19	NP-8 M	—	4	0 02	1.33	2.62
20	NP-3PM	0 01	8	0.01	1 63	4 08
21	NP-2 M	0 05	15	0.01	2 34	18 96

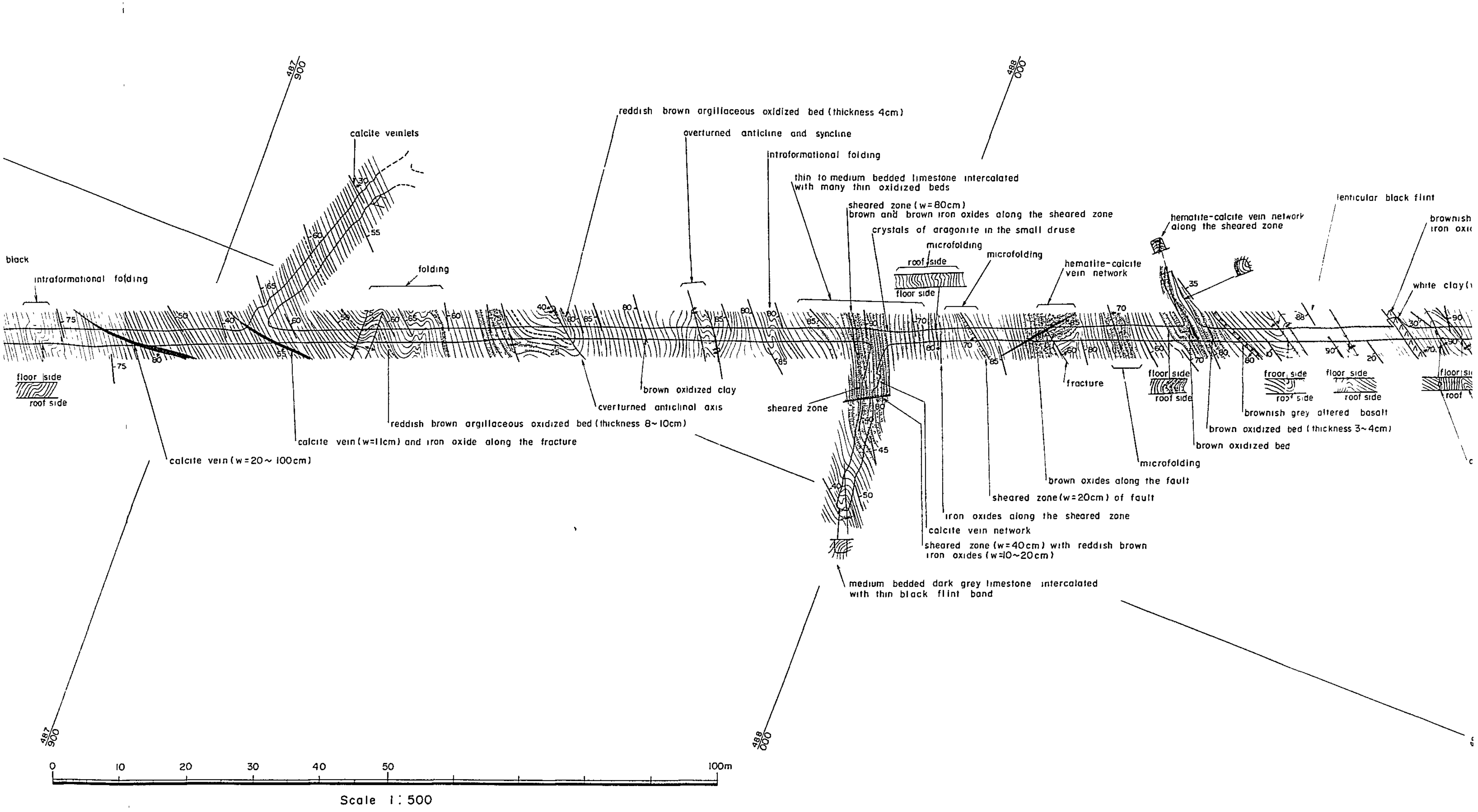
Tr . Trace — . Not assayed

Fig. 3-6 Geological Sketch of the PROVIDENCIA Mineralized Area

Table 3-1 List of Mines, Prospects and Ore Showings in the PROVIDENCIA Area

Name of Mine	Pit and Tunnel No.	Mode of occurence	Principal ore mineral	Scale of ore body width, length	General trend of ore body	Reference Sample
Mina Providencia	P No.1	massive and dissemination	hematite, goethite	4m± , 25m±	N20°W	KP-1PM, KP-2M
	P No.1 T No.3	massive and dissemination	goethite	1m± , 45m±	N10°W	KP-3PM
	T No.2	brecciated ore and dissemination	hematite, cerussite	0.7± 60m±	NS	VL-11P
	T No.5	dissemination	goethite	1m- , 5±	N40°W	
	P No.2	brecciated ore, dissemination and partly massive ore along the fault	hematite, goethite	2m±, 200m±	N30°W	KP-4M, KP-5P, VL-aM
	P No.3					KP-6M, KP-7T,
	P No.4					VL-8PM
	T No.6					KP-11T
	T No.7					KP-11T
	T No.8	massive and dissemination	Mn-mineral, hemimorphite	0.3m±, 15m±	N30°E	VL-3PM
	T No.9	calcite vein network	goethite	0.5m±, –	–	
	P No.5	dissemination	goethite	0.5m±, 15m±	N20°W	
Mina San Juana	P No.6	massive and dissemination ore along the fault	hemimorphite, hematite	1.5m-, 60m±	N80°E	KP-9PM, KP-10T
	P No.7					
	P No.8	dissemination	hematite, goethite	1m- , 10m±	N10°E	VL-2PM
	T NO.10	dissemination	hemimorphite, goethite, hematite	1m- . 10m-	N50°E	KP-8PM
	T No.11	massive and dissemination	Mn-mineral	0.5m±, 15m±	N70°E	VL-5PM
	T No.14	dissemination	goethite, hematite	0.3m±, 3m±	N10°E	
	T No.15	brecciated ore and dissemination	goethite, hematite	1.5m±, 70m±	NS	
Mina San Juan	T No.12	calcite vein with iron oxides	goethite, hematite	0.3m, 2m±	N35°E	
Mojonera of Huilco 10	P No.10	massive and brecciated ore	goethite, hematite	0.3m-, 15m±	N45°W	
	P No.11	massive and brecciated ore	goethite, hematite	1.0m±, 30m±	N70°E	NP-5M, NP-6P, NP-7M
	P No.12	massive and dissemination	goethite, hematite	0.85m-, 10m±	N60°W	NP-9M, NP-10PM
	P No.13	brecciated ore and massive	goethite, hematite	0.75m, 10m±	N80°E	NP-8M
	P No.14	massive (stocked ore)	hematite, goethite, barite	? ?	?	NP-2M, NP-3PM, NP-4P
	P No.15	massive	goethite, hematite	2m±, 10m±	N80°W	
	P No.16	massive	goethite, hematite	1m± 10m±	N80°E	
	P No.17	brecciated ore	goethite, hematite	1m±, 30m±	N35°E	


N
2886
300
2286
200
487
800
487
900
alternation of medium bedded dark grey to grey limestone and thin black flint band
brownish grey oxidized calcarenite
medium bedded grey limestone
alternation of thin bedded limestone, black flint and brown calcarenite
intraformational folding
roof side
floor side
raise
calcite vein
calcite vein network along the synclinal axis
brownish grey oxidized calcarenite (thickness 15cm)
brownish grey oxidized calcarenite (thickness 10cm)
brownish grey calcarenite bed (thickness 10cm)
small reverse fault
brown oxidized calcarenite bed (thickness 10cm)
calcite vein metwork along the synclinal axis
calcite vein (w=20 ~ 100cm)
calcite vein (w=11cm
0
10
20
30
40
50
Scale



black
intraformational folding
floor side
roof side
calcite veinlets
folding
reddish brown argillaceous oxidized bed (thickness 4cm)
overturned anticline and syncline
introformational folding
thin to medium bedded limestone intercalated with many thin oxidized beds
sheared zone (w=80cm)
brown and brown iron oxides along the sheared zone
crystals of aragonite in the small druse
microfolding
roof side
floor side
microfolding
hematite-calcite vein network
hematite-calcite vein network along the sheared zone
lenticular black flint
brownish iron oxi
white clay (
fracture
brown oxidized clay
overturned anticlinal axis
sheared zone
reddish brown argillaceous oxidized bed (thickness 8~10cm)
calcite vein (w=11cm) and iron oxide along the fracture
calcite vein (w=20~100cm)
microfolding
brown oxides along the fault
sheared zone (w=20cm) of fault
iron oxides along the sheared zone
calcite vein network
sheared zone (w=40cm) with reddish brown iron oxides (w=10~20cm)
medium bedded dark grey limestone intercalated with thin black flint band
brownish grey altered basalt
brown oxidized bed (thickness 3~4cm)
brown oxidized bed
487 900
488 000
0 10 20 30 40 50 100m
Scale 1:500

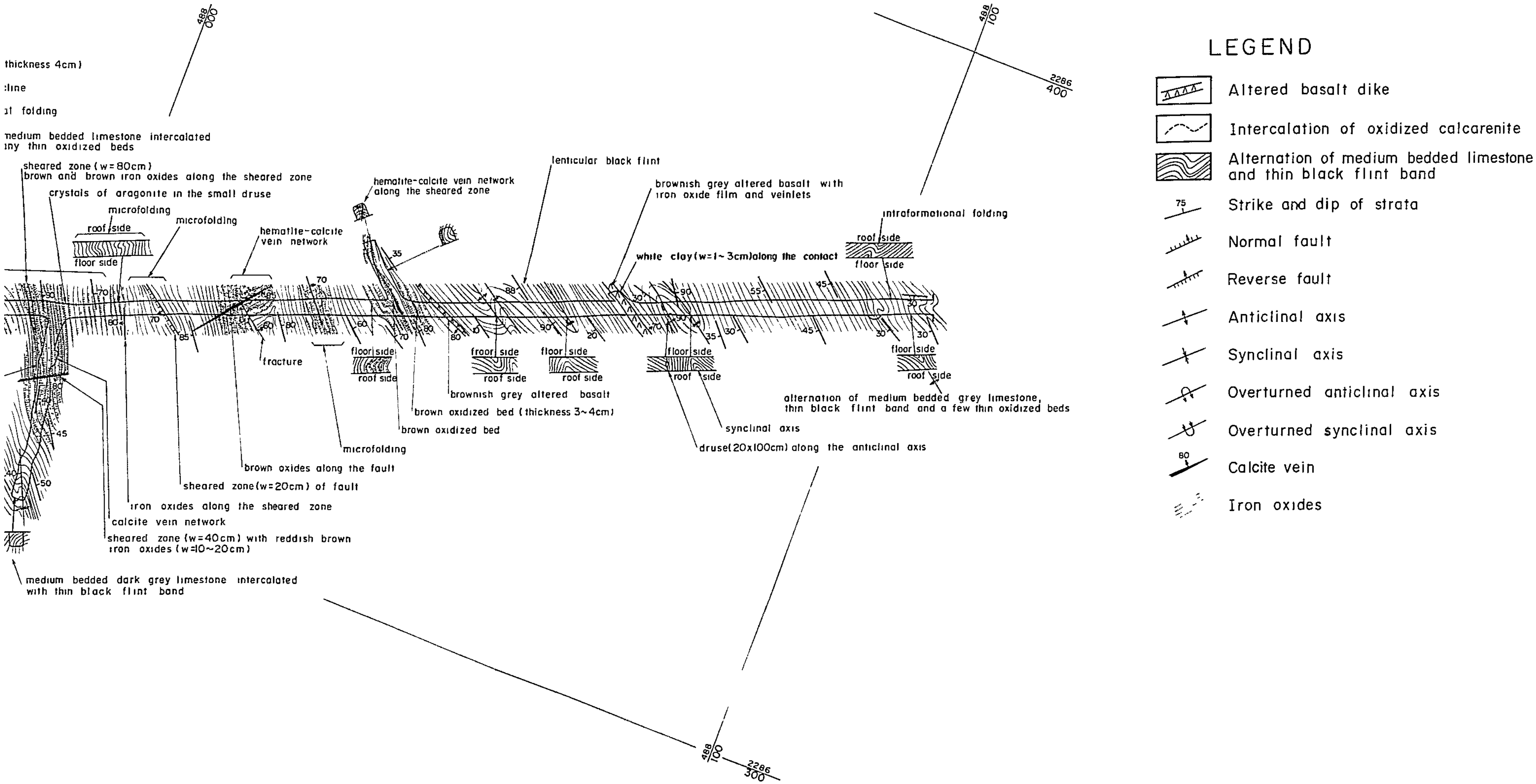


Fig.3-7 Geological Sketch of No.1 Cross Cut Tunnel of the PROVIDENCIA Area

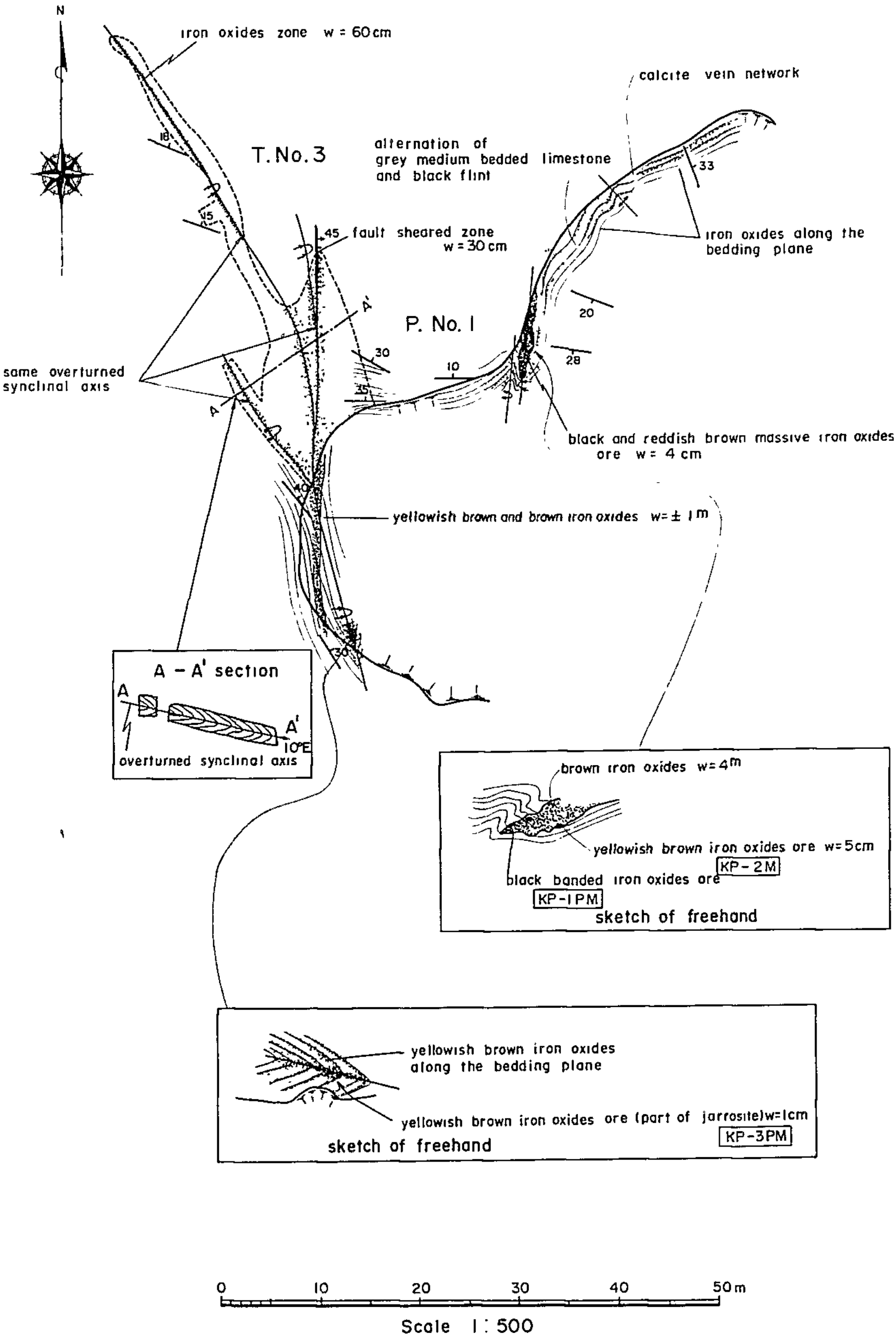


Fig. 3-8 Geological Sketch of No.1 Open Pit and No.3 Tunnel of the PROVIDENCIA Area

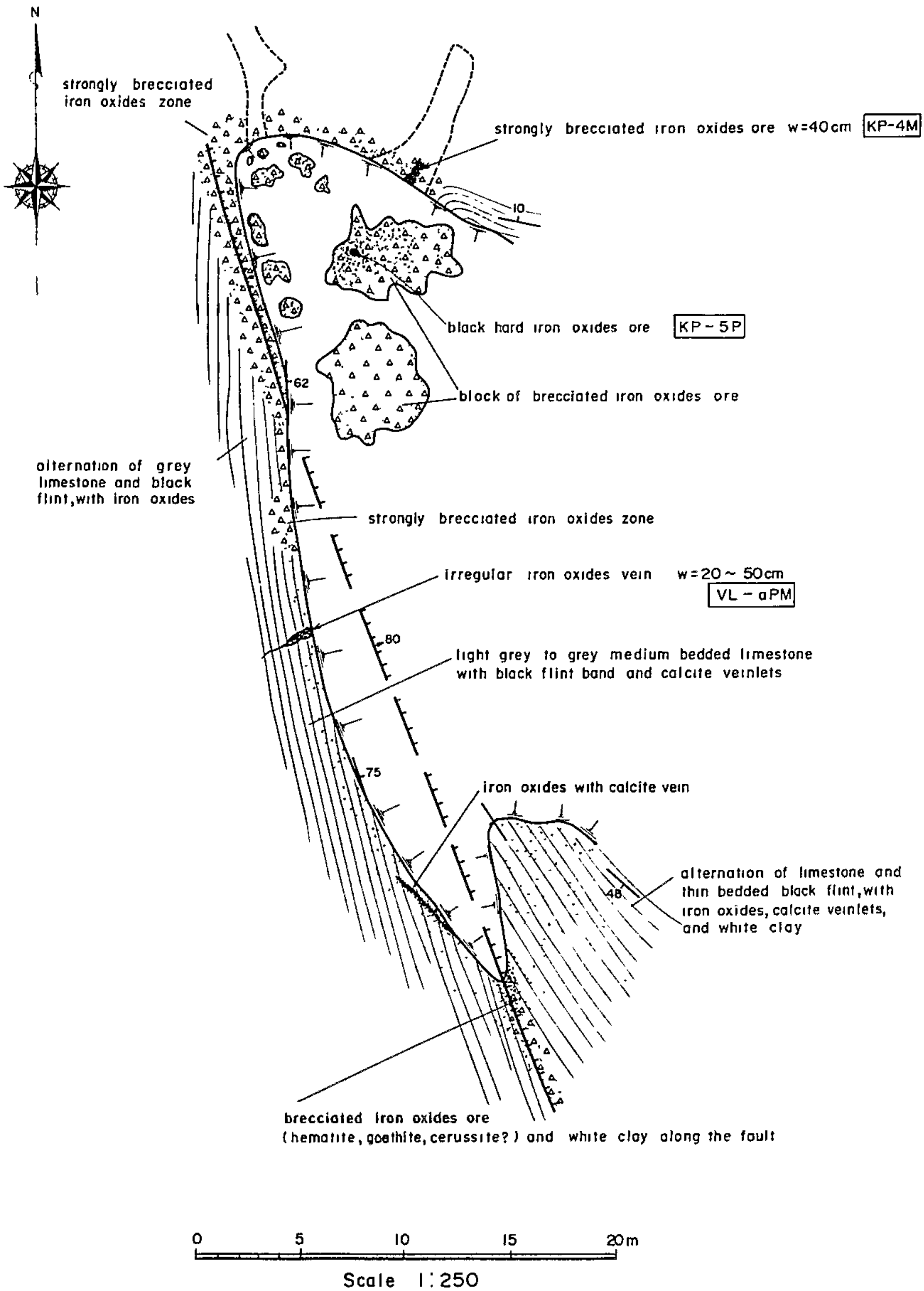


Fig.3-9 Geological Sketch of No.2 Open Pit of the PROVIDENCIA Area

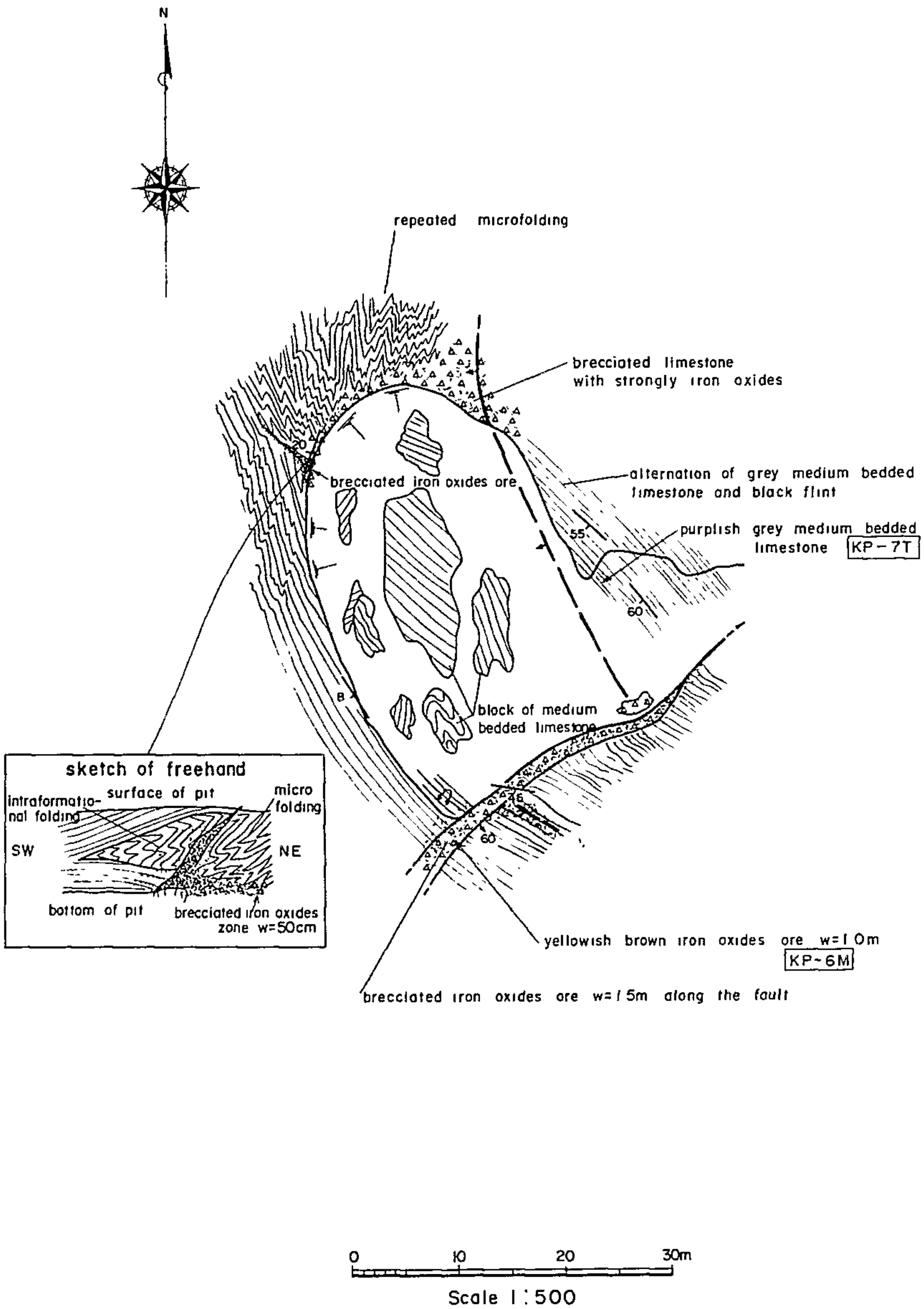


Fig. 3-10 Geological Sketch of No. 3 Open Pit of the PROVIDENCIA Area

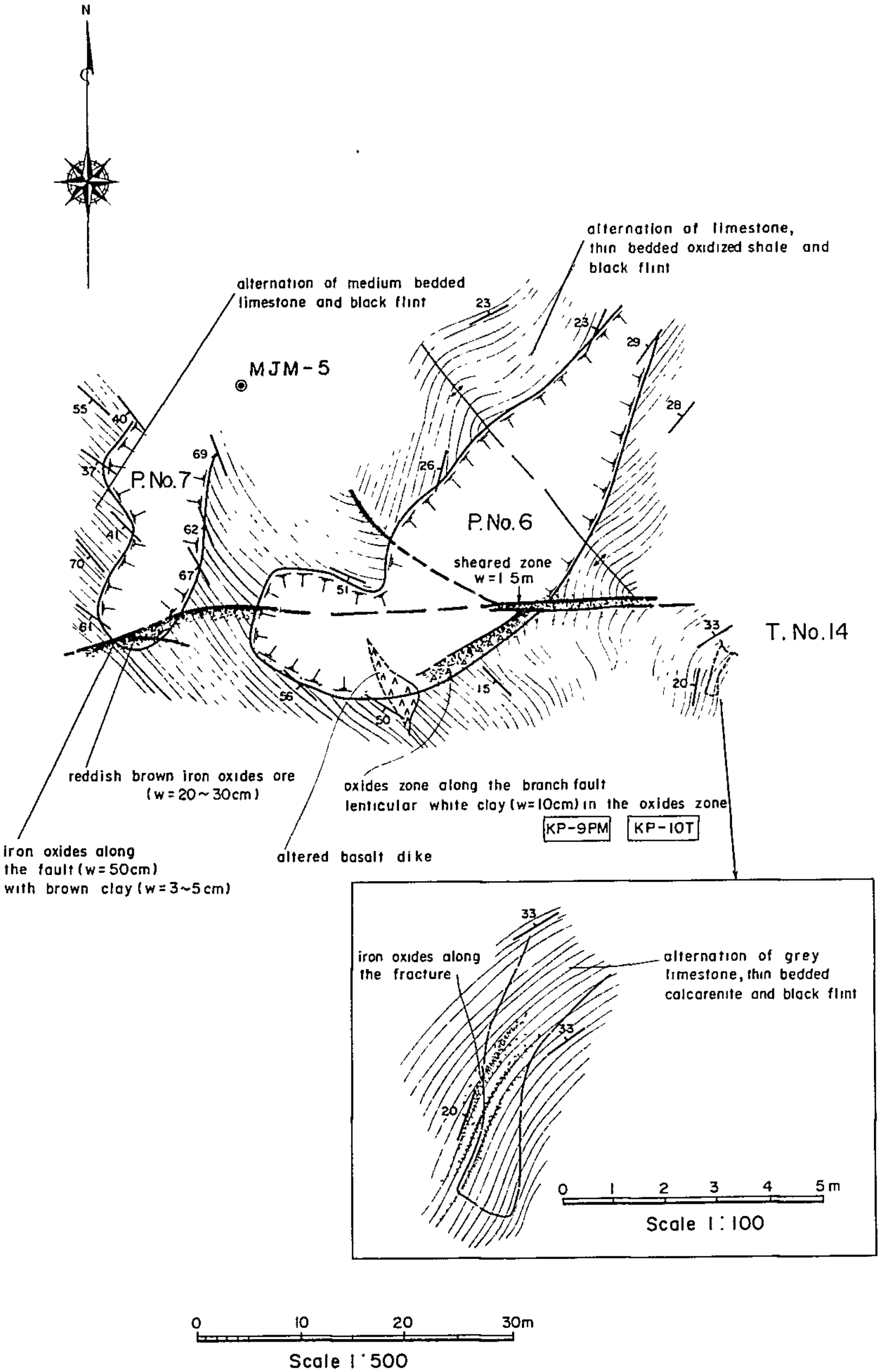


Fig.3-11 Geological Sketch of No.6 and No.7 Open Pits and No.14 Tunnel of the PROVIDENCIA Area

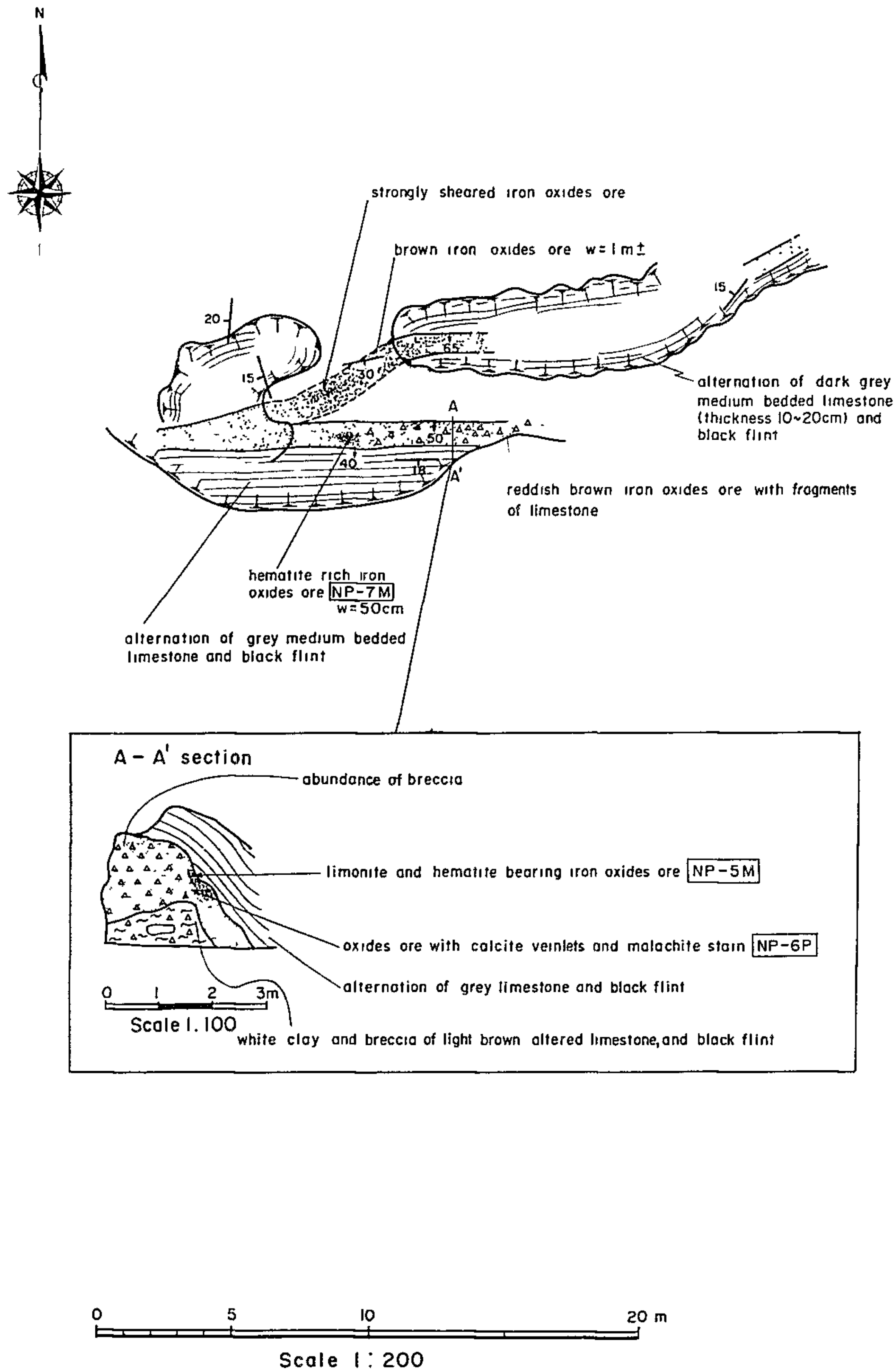


Fig. 3-12 Geological Sketch of No.11 Open Pit of the PROVIDENCIA Area

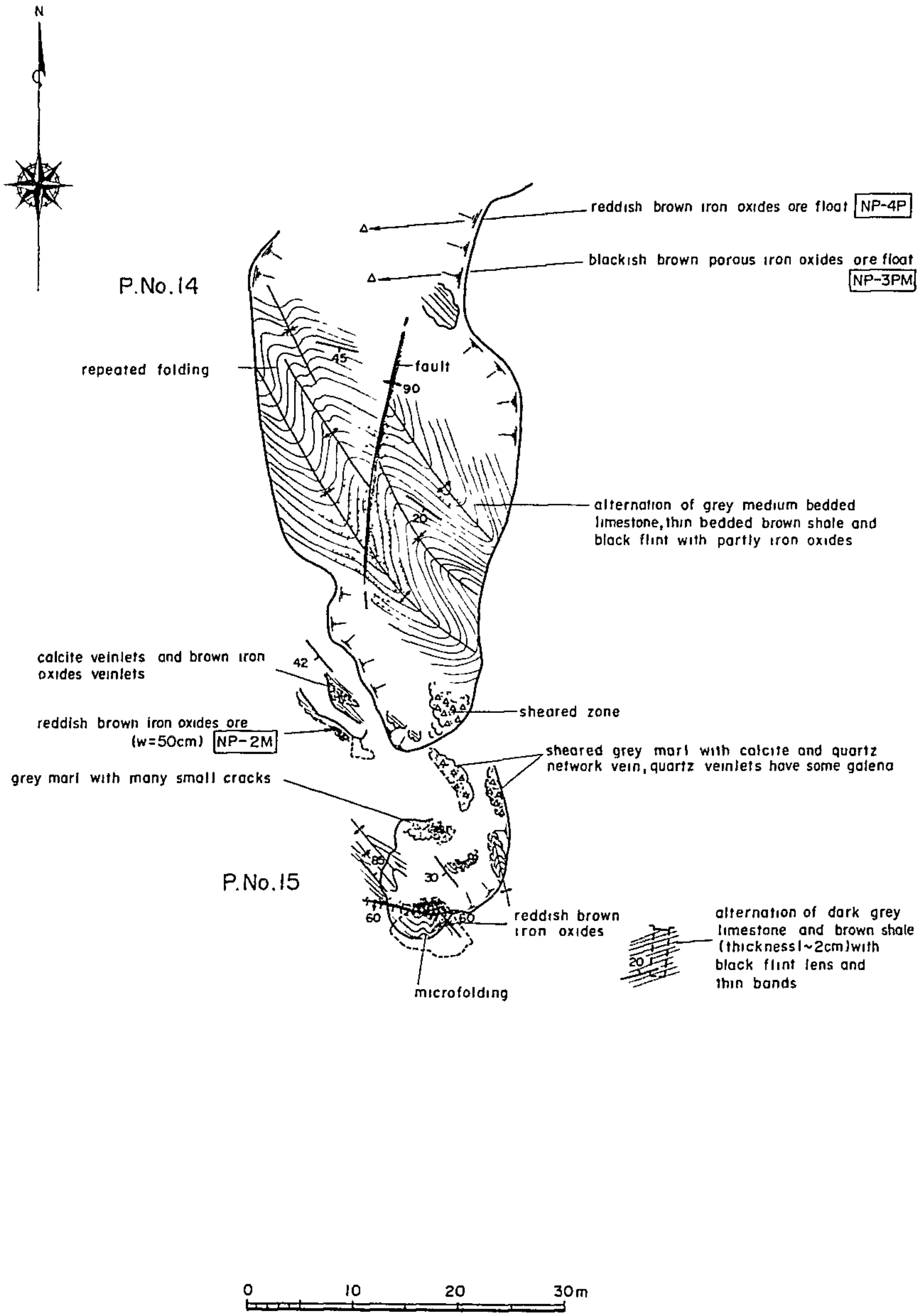


Fig.3-13 Geological Sketch of No.14 and No.15 Open Pits of the PROVIDENCIA Area

(1) Mina Providencia mineralized zone

The mineralized zone is situated a little north of the central part of the area, and it contains five old pits, nine old tunnels for prospecting and mining and small-scale traces of prospecting in the surrounding area.

While the ore bodies are distributed at eight places in the zone, four bodies are the relatively significant ones. These are the East ore body in the P. No. 1 pit at the southern end of the mineralized zone, the ore body which continues from P. No. 1 to T. No. 3 on the west of the above, the one extending from P. No. 2 toward the north-northwest through P. No. 3, P. No. 4 and T. No. 6 to T. No. 7 on the northwest of the above and the other one in the T. No. 2 at the northern end of the mineralized zone.

The East ore body at P. No. 1 (Fig. 3-8) is a lenticular massive oxide ore body emplaced along the axial part of a small-scale overfold syncline having a steep westerly-dipping axial plane which strikes in the N-S direction, and it is about four meters wide. The ore consists of black to blackish brown, partly brown oxides ore. Under the microscope, the main minerals are of hematite filling the surrounding part of quartz grains and goethite showing a spherulitic texture, and minute pyrite in quartz as accessory.

The assay result of a local sample (KP-1PM) taken from the ore body showed 6.06% Pb and 0.52% Zn.

The ore body which continues from P. No. 1 to T. No. 3 (Fig. 3-8) is a disseminated oxides ore body emplaced along the axial plane of an overfold syncline having the axial plane striking approximately in the N-S direction and gently dipping westward.

The ore is concentrated in small-scale fracture zone formed in the vicinity of overfold axial plane and along the bedding planes of the country rock adjacent to the above. Another one is the concentration along a small fault slightly oblique to the overfold axial plane.

The ore body continues for about 70 meters with the width of about one meter.

The ore is generally consists of blackish brown to brown goethite and hematite. The assay result of an ore sample (KP3-PM) along overfold axial plane showed 1.38% Pb and 41.78% Zn.

The ore body which continues north-northwestward from P. No. 2 to T. No. 7 (Fig. 3-6, 3-9 and 3-10) is an oxides ore body composed of brecciated, disseminated and massive ore emplaced along the fault fracture zone of NNW-SSE system.

The ore body is the largest in scale among the ore bodies in the area and continues for about 200 meters along the fault with the width of about two meters. On the southern side of P. No. 3, approximately at the center of the ore body, it is cut by a fault of ENE-WSW system, where the northern part of the ore body has been dislocated eastward relatively with reference to the southern part. A brecciated ore body about 1.5 meters wide was formed along the fault fracture zone of ENE-WSW system running nearby the pit P. No. 3, and the ore shoots have been formed at the intersections of these two faults.

The ore body has been cut by a small basalt dyke one meter wide intruded in the direction of N85° W in the tunnel T. No. 7 found at the northern end of the ore body.

The result of microscopic observation of an ore sample (KP-5P) taken from a huge float ore at P. No. 2 showed spherulitic texture of goethite and hematite, and calamine accompanied by silicate minerals contained in the above.

A vein offsets north-northeastward from the main ore body at the northern side of P. No. 2, which forms an ore shoot at the part of offshoot with swell of the vein width. A sample (KP-4M) taken from the branch vein showed the assay values such as 0.94% Pb and 32.87% Zn. An ore sample (VL-8PM) taken in the tunnel T. No. 6 in the northern part of the main ore body showed the values such as 6.66% Pb and 0.90% Zn.

Although the outcrop of the ore body exposed in the tunnel T. No. 2 (PL. 19) has not been confirmed on the surface, prospecting and mining has been carried out in the underground. The ore body was emplaced along the fracture zone of a small fault of the N-S trend and the crack caused by micro-fold, and it is about 70 centimeters in width. It consists of brecciated oxides ore accompanied with calcite veinlets. A part considered to be the ore shoot of the ore body is about 35 meters along the strike, the both ends of which change to low-grade oxides ore disseminated in the brecciated wall rock. It continues for about 60 meters as a whole.

As the result of microscopy of an ore sample (VL-119M) taken at the northern end of the ore body, a texture in which hematite surrounded the nucleus of silicate minerals and cerussite was observed. The assay result of the ore showed 7.90% Pb and 1.19% Zn.

A crosscut was driven in the past toward the west-southwest for the purpose of prospecting the lower part of the Minas Providencia mineralized zone. Although any mineralized zone to warrant the ore grade can not be observed in the tunnel, some oxidized zones are observed in the cracks and the folded parts at 75 m, 95 m and 110 m - 130 m from the entrance, and in addition, calcite veins are observed cutting the wall rock at 215 m and 235 m from the entrance (Fig. 3-7).

(2) Mina San Juana mineralized zone

The mineralized zone is adjacent to the southwestern side of the Mina Providencia mineralized zone, and situated on the ridge stretched out north-northeastward. Three old open pits and four tunnels for prospecting and mining are found in the zone. Among these, most of the old mining works are located on the northern side of the mineralized zone, while the tunnel T. No. 15 has been excavated independently at about 150 meters to the south of the aboves.

The main ore bodies contained in the zone are the one extending from P. No. 6 to P. No. 7 and the other one exposed in the tunnel T. No. 15, and others are all small in scale (PL. 19, Fig. 3-11).

The ore body extending from P. No. 6 to P. No. 7 is the brecciated or massive oxides ore body. It is about 1.5 meters wide and has been confirmed for about 40 meters along strike. It seems, however, that the vein will further continue beyond the both ends of it confirmed so far.

On the eastern side of the old open pit P. No. 6, a fault of NE-SW system is found to have offset from the fault of ENE-WSW system toward the southwest, along which brecciated oxide ores is observed. The oxide ore is intercalated with irregularly lenticular pale brown part accompanied with white clay and calcite. Microscopy of a sample (KP-9M) taken from the above revealed that the pale brown part was a complicated mixture of calamine with calcite and other siliciate minerals, in which small amount of Pb-Mn minerals, hematite and goethite were contained. The assay result of the smaple showed 0.24% Pb and 43.25% Zn. Barite was observed in the ore thin section of the sample (KP-10T) taken from the same place.

The ore body found in the tunnel T. No. 15 is a brecciated or disseminated oxides ore body emplaced along the fault fracture zone of N-S system and the small faults branched off from it. The ore body continues for about 70 meters along the strike, and many complicated offsets are found. Therefore, the part which can be said to be a ore shoot is found for the interval of 25 meters approximately in the center of the ore body, which is about 1.5 meters wide. The extension on both sides present low-grade ore.

(3) Mina San Juan mineralized zone

The mineralized zone is situated in the western part of the area, and has been prospected by the crosscut T. No. 12. However, any mineralization to be as good as ore can not be observed. In the underground, network calcite veins at 38 meters from the entrance and a calcite vein at 105 meters, 30 centimeters wide and accompanied with oxides ore, are observed.

(4) Mojonera of Huilco 10 mineralized zone

The mineralized zone is situated in the southern part of the area. The old open pits are found at four places on the northeastern side and at four places on the southwestern side (PL. 19, Fig. 3-6).

The main ore body is the one found from the old open pit P. No. 10 to P. No. 13. The ore body is emplaced along the fault of E-W system and faults and cracks offset from the former, and consists of oxides ore body which contains brecciated, massive and partly disseminated ore.

The characteristics of the ore body is observed at P. No. 11 (Fig. 3-12), where an ore body emplaced along the fault fracture zone of E-W system and the veins offset from the former are observed. Although the width of the ore body is about one meter in general, it thickens at the crossing of the two veins. In respect of the eastern extension of the ore body, it diverges into two veins, and it is likely that the southern one continues to the ore outcrop of P. No. 12, and the northern branch to the ore body of P. No. 10. The one found at P. No. 13 is a small-scale oxides ore body formed along a branch fault of E-W system.

The result of microscopy of the oxides ore sampled at P. No. 11 revealed that it was oxides ore showing spherulitic texture of goethite and hematite.

Although the assay values of the ore body are generally low, those of a sample (NP-9M) taken from the ore outcrop of P. No. 12 showed relatively high grade such as 0.93% Pb and 23.76% Zn.

The ore once occurred in the old pit of P. No. 14 in the southwestern part of the mineralized zone is surmised to have been a massive ore body emplaced along the fault of NNE-SSW system and the complicated fold structure. The ore has been, however, all mined out, with no outcrop except for the float ore. A small ore body emplaced along the fault of E-W system is found in the cold pit P. No. 15 to the south of the above. On the northern side of it, network veinlets of quartz and calcite cut the brecciated wall rock, and small grains of galena is observed in quartz veinlets.

In the old pit P. No. 17, a brecciated oxides ore body accompanied with quartz veinlets is observed along the fault of NE-SW system, but the ore is low in grade.

3-6 Details of the Mineralized Zone Shown by Drill Survey

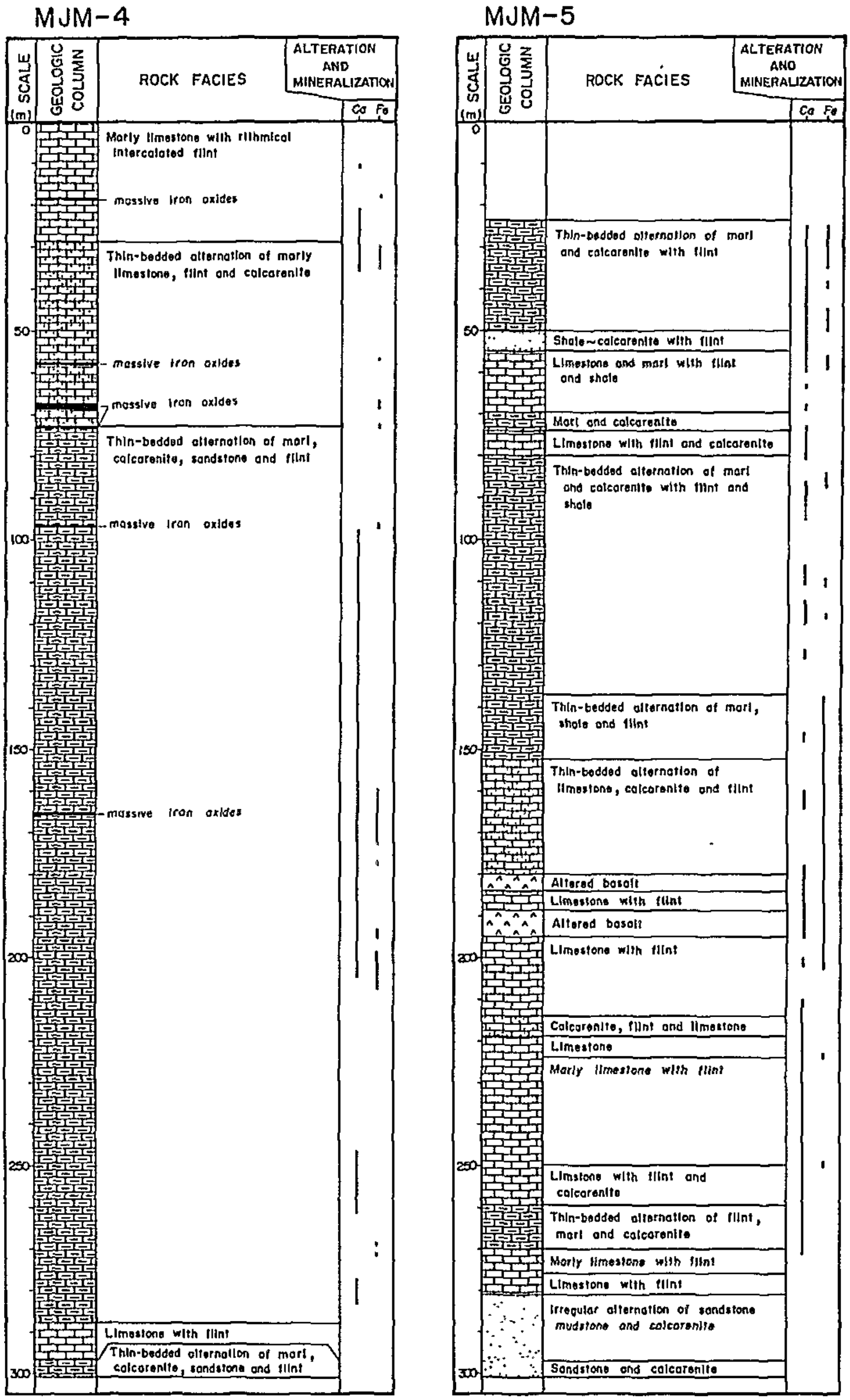
Two vertical drill holes driven in the survey of this year was planned to carry out at the places where the high chargeability anomaly and geochemical anomaly of lead were overlapped. Accordingly, the hole MJM-4 was driven on the southern side of the old open pit P. No. 2 in the Mina Providencia mineralized zone, and the Hole MJM-5 on the northern side of the old open pit P. No. 7 in the San Juana mineralized zone.

The position of the mineralized sections of these drill holes are as follows.

<u>MJM-4 Hole (PL. 24)</u>

The mineralized sections observed in the cores of the hole MJM-4 were intersected at six places such as those shown in the following, including the massive and disseminated ores.

Mineralized section	Massive ore	Thickness
18.05 m 18.20	18.05 m 18.20	15 cm
57.85 72.62	57.85 58.10	25 cm
	67.00 68.70	170 cm
	72.35 72.62	27 cm
96.72 97.12	96.72 97.12	40 cm
159.25 172.45	165.65 165.90	25 cm
193.10 198.35	-	-
268.70 283.20	-	-



ABBREVIATIONS

Ca : Calcite veinlets

Fe : Iron oxides

Fig. 3-14 Summary of Geological Core Logs of the MJM-4 and MJM-5 Drilling Holes, PROVIDENCIA

The result of microscopy of the samples of massive oxides ore taken from the cores at the depths of 58.00 m, 67.50 m and 97.00 m showed that the ores consist mainly of goethite including hematite.

The mean values of assay result of the most dominant oxides ore at the depeth of 67.00 m - 68.70 m (170 cm) are 1.87% Pb and 0.68% Zn. The grades of oxides ore at 96.72 m - 97.12 m are 0.13% Pb and 29.16% Zn, and those at 57.85 m - 58.10 m are 1.69% Pb and 1.84% Zn. Those of other oxides ores are less than one percent in both lead and zinc showing a low grade.

In respect to the relation between these mineralized zones and those on the surface, the fault fracture zone accompanied with disseminated oxides ore and calcite veinlets encountered at the depth of 169.60 m - 172.45 m corresponds to the lower extension of the fault of ENE-WSW system found in the old pits (P. No. 6 and P. No. 7) on the south of the hole MJJ-5. Accordingly, the mineralized zone at the depth of 159.25 m - 172.45 m is correlated to the lower extension of the mineralized zone along the fault of ENE-SWS system on the surface (Fig. 3-5). The other mineralized zones have not been confirmed to be correlated directly to those on the surface.

The calcite veins penetrate the platy limestone and marl in a form of network at the depths such as 10.65 m - 12.00 m, 97.12 m - 98.10 m, 169.90 m - 172.45 m, 278.00 m - 279.10 m and 281.00 m - 281.50 m.

Although these calcite veins are partly accompanied with oxides ore, most of them are not accompanied with it.

<u>MJM-5 Hole (PL. 25)</u>

The mineralized sections observed in the cores of the hole MJM-5 are inferior to those of the hole MJM-4, and these are oxides stain along the cracks of wall rock, oxide ore accompanied with calcite vein and thin disseminated mineralized zone along the bedding plane of wall rock.

The oxides ore consists of brown to reddish brown or dark brown goethite and hematite. Those along the cracks are thin, one to five milimeters wide, having been disseminated in the rock adjacent to the crack.

Calcite veinlets often penetrate the platy limestone and marl, and the concentration of them are sometimes observed.

The depths of the sections belonging to categories such as (I) oxidation along cracks, (II) oxidized sections accompanied with calcite and (III) concentration of calcite veinlets are shown in the following.

(I)	(II)	(III)
28.00 m 33.10		26.45 m 33.10
44.30 48.55 55.55 56.95		45.06 57.35
87.20 88.00		87.20 93.50
155.42 156.30	155.42 155.52	155.42 155.52
		183.95 188.05
224.10 224.28	224.10 224.28	224.10 224.28
249.70 250.20	249.70 250.20	249.70 250.20

In some part of the hole, platy limestone and marl have been leached to become white in the adjacent part of the calcite veins. These are observed along the network calcite veinlets and cracks at the depths such as 26.45 m - 33.10 m, 44.20 m - 48.72 m and 55.55 m - 56.95 m, especially bleaching is conspicuous in the section from 44.20 m to 45.06 m.

The mineralization in this hole is weak, and any section to be correlated to the mineralized zone on the surface, can not be observed.

3-7 Consideration

Geology of the area consists of Black Flint Bearing Limestone Member (Kdf) of the Cretaceous sedimentary rocks, and the member shows a stratigraphically reverse geologic structure.

The member is mainly composed of thin bedded platy limestone and marl interbedded with thin bedded calcareous sandstone, sandstone and shale, which is characteristically intercalated with thin layers of black flint.

The ore deposits are the hydrothermal type deposit emplaced under the control of the fault structures and fold structures distributed in the member, showing the forms of lenticular, vein type and partly dissemination type.

In relation to the dimension of ore deposit, the ore body emplaced along the fault of NNW-SSE system in the Mina Providencia mineralized zone is the greatest, having the width of about two meters and lateral extension of about 200 meters. Other many ore bodies confirmed are rather small in scale.

The ore is an oxides ore showing massive, brecciated and disseminated forms, and consists mainly of goethite and hematite containing calamine and cerussite.

While the assay result showed that gold, silver and copper are low in grade, the values of lead and zinc are high, and their maximum values were 10.28% Pb and 43.25% Zn.

As the result of the drill survey, massive oxides ore was intersected at six sections in the hole MJM-4. Among these, the thickest one is the section between 67.00 m and 68.70 m (170 cm). No notable mineralized zone was encountered in the hole MJM-5.

The relation between the drill survey and the geochemically anomalous zones is considered as follows.

When the mineralized zones confirmed by the drill hole MJM-4 are correlated to those on the surface based on the geologic structure, all these are contained within the geochemically anomalous zones of lead. Therefore, the intersections in the drill hole is well consistent with the result of geochemical prospecting.

While the drill hole MJM-5 is located at the western end of the Pb-geochemically anomalous zone, the projection of the geology of the drill hole on

the basis of the geologic structure proved that the actual position was outside of the geochemically anomalous zone.

Therefore, the fact that no remarkable mineralized zone was confirmed by the drill survey of this phase, is concordant with the result of geochemical prospecting. On the other hand, however, any indication has not been shown that was to be correlated to the high chargeability anomalous zone obtained by the geophysical survey.

The occurrence of igneous rocks which is considered to have a close relation with the mineralized zone of the area has not been confirmed by the survey of this phase, and this fact leads to the assumption that there might be any possibility remained that the high chargeability anomalous zone has reflected some latent igneous body which might occur more in the depth or any potential mineralization corresponding to the mineralized zones distributed in the area.

As described in the above, both of the two vertical drill holes were driven through the oxidation zone or leached zone, which resulted in to make clear that the oxidation zone of the area was far deeper beyond our expectations. Furthermore, not a few samples taken on the surface outcrops showed high contents of base metals, whereas most of the drill core samples showed much less values, showing that the holes were within the oxidation to leached zone.

On the basis of these facts, it is concluded that the future exploration should be directed to the main themes of investigating the conditions of sulfide mineralization in the depths. For this purpose, it is recommended to excavate two drill holes for confirmation of the mineralization in the depth below the main mineralized zone (Providencia mineralized zone).

CHAPTER 4

DIAMOND DRILLINGS IN THE SAN CLEMENTE AREA

CHAPTER 4 DIAMOND DRILLINGS IN THE SAN CLEMENTE AREA

4-1 Outline

Diamond drillings of three horizontal holes (MJM-1, MJM-2 and MJM-3) were excavated in order to make clear the relation between the geology and the geologic structure in the depths of the gold and silver anomalous zones detected by the geochemical prospecting conducted in the third phase.

The drilling operation was conducted by the El Consejo de Recursos Minerales (CRM) in technical cooperation with two Japanese drill engineers, during a period of 175 days from July 18, 1982 to January 8, 1983. The whole period of the drilling works at the site was 154 days, among which those for actual excavation work were 106, and the remain was devoted for the restoration of mechanical troubles and accidents in the holes and for holiday, the last ones being about 31 percent of the days of actual excavation works.

The camp for the members of drill team was established at the Cardonal settlement lying halfway between the SAN CLEMENTE area and the PROVIDENCIA area. It required to drive for about 30 minutes from the camp to reach the San Clemente settlement and another walking of 15 to 20 minutes to each site of MJM-1 or MJM-2, and 40 minutes to MJM-3.

The drill team was organized by two to four crews, each crew consisting of an operator and three workers, under the supervision of a Mexican engineer.

The drilling works were carried out by two to four shifts per day.

4-2 Drilling Method and Machines

The main rocks to be excavated were massive rhyolite, tuffaceous conglomerate and brecciated rhyolite, in which the existence of some cracks and clay beds nearby the mineralized zones were predicted to be encountered. Accordingly, the wireline coring tools with two stages of NQ (0 - 180 m) and BQ (180 - 300 m) were prepared. Longyear L-38 type was selected for the drill machine..

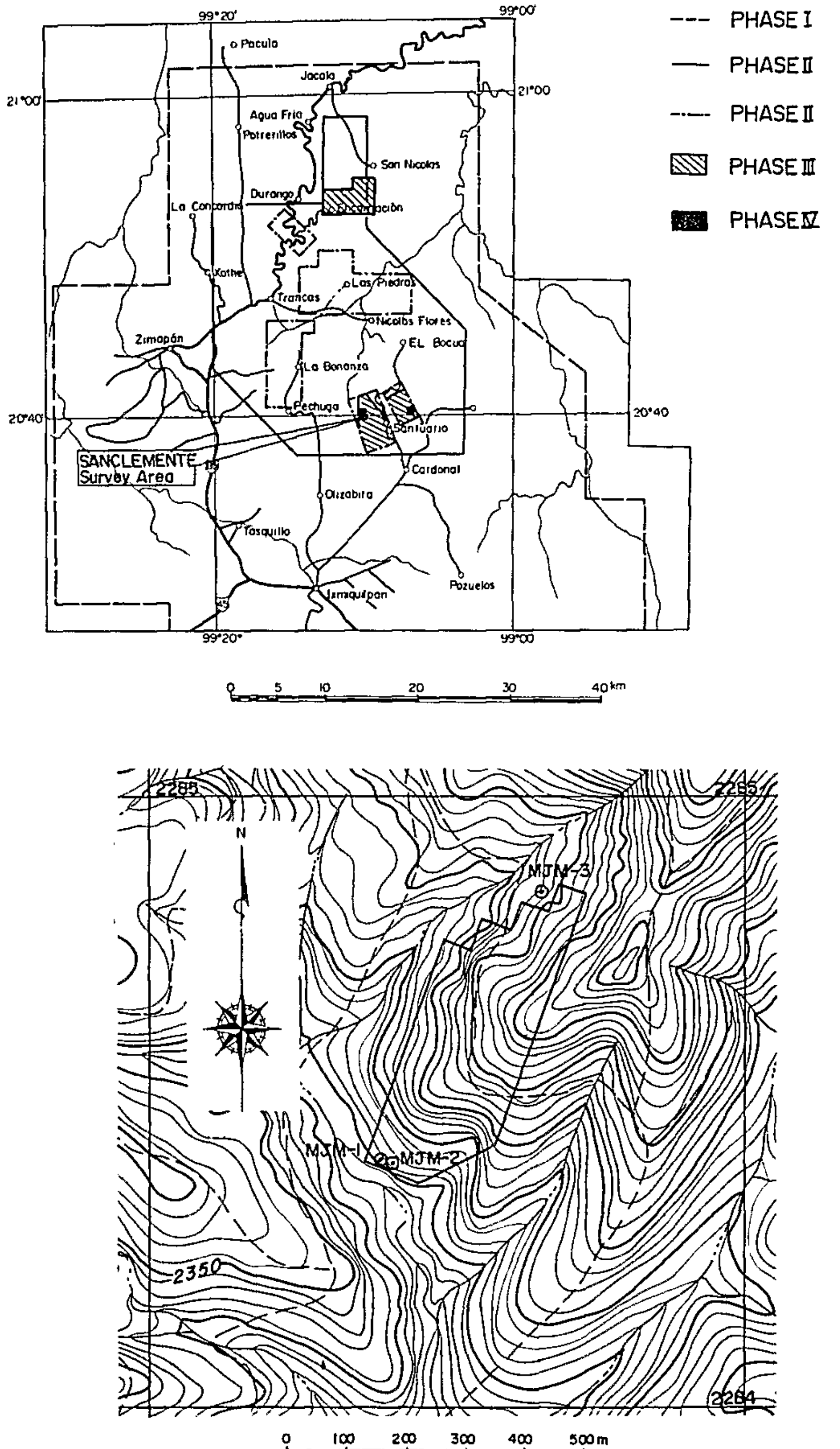


Fig. 4-1 Drilling Sites of the SAN CLEMENTE Area

Because of excavation of the horizontal drill holes, cutting oil was added to circulating water at a rate of 0.2 to 0.3 percent to minimize the effect of friction of the rod, to protect the wall of the hole and to improve the bit life.

The drill machine used and other machinery and tools are shown in Table 4-1, the details of supplies used are in Table 4-2 and the diamond bits used in Table 4-3 respectively.

4-3 Drilling Works

4-3-1 Maneuvering, arrangement, move and removal

For the transportation of tools and equipment, the trucks were used from Mexico City to the terminal of the road in the adjacent area of the drill site. Then a helicopter and self-propelling of the machine were used to reach the site.

At the first station, two holes of MJM-1 and MJM-2 were drilled. After completion of the works there, the machinery was moved to the second station for the hole MJM-3 by helicopter. The Helicopter was again used for removal after completion of the whole works at the site.

The circulating water was obtained at first by flowing it from the upstream of the creek by the head. During the digging of the hole MJM-1, however, a flush of groundwater of 60 - 120 l/min was encountered in the section between 160 meters to 180 meters from the collar, and it was used for digging the hole MJM-2.

Two pumps were set at the nearby creek to pump up water for the drilling of the MJM-3 hole. The water from the hole MJM-1 was together used to save the time for repairing when the pumps were out of order.

4-3-2 Drilling operation

The details of drilling are as shown in the following tables and figures: The summary of works (Table 4-4, 4-5 and 4-6), the figures showing the progress

of works (Fig. 4-2, 4-3 and 4-4), the result of drilling (Table 4-7), the result of survey of the deviation of drill holes (Table 4-8, 4-9 and 4-10) and the cross sections through the drill holes (Fig. 4-5, 4-6 and 4-7).

(1) MJM-1 Hole

The NQ-wireline method was used as scheduled since a stable bedrock was exposed from the collar. Because a higher silicification of the rocks than the forecast resulted in to lower the bit life and the speed of digging, cutting oil was added to the circulating water at the rate of 0.2 - 0.3 percent beyond the point of 100 meters from the collar. As the result, the friction between the rod and the wall of hole was minimized, the speed of rotation of the rod was increased and at the same time the bit life was improved.

When digging at 191.45 meters, BW-casing was inserted to the bottom and NQ-wireline diamond bit was replaced by BQ type and the hole was completed at 300 meters as scheduled.

(2) MJM-2 Hole

The hole was started to drill by NQ-wireline method at the same station as that of the MJM-1 hole only changing the direction. Flush water from the MJM-1 hole was used for the circulating water. Although some caving was met during excavation, no significant trouble was found. After BQ-casing pipe was inserted, NQ-wireline method was replaced to BQ type, and the hole was completed at 300.20 meters as scheduled.

(3) MJM-3 Hole

Digging was started by NQ-wireline method because the rock at the collar was unconsolidated and loose. After run down to 12 meters, the hole was expanded by NW-casing pipe shoe bit, which was placed there to protect the collar. Digging was continued to 161.65 meters by NQ-wireline method, then it became difficult to continue excavation due to caving caused by the cracks of the wall of hole, and thus the BW-casing

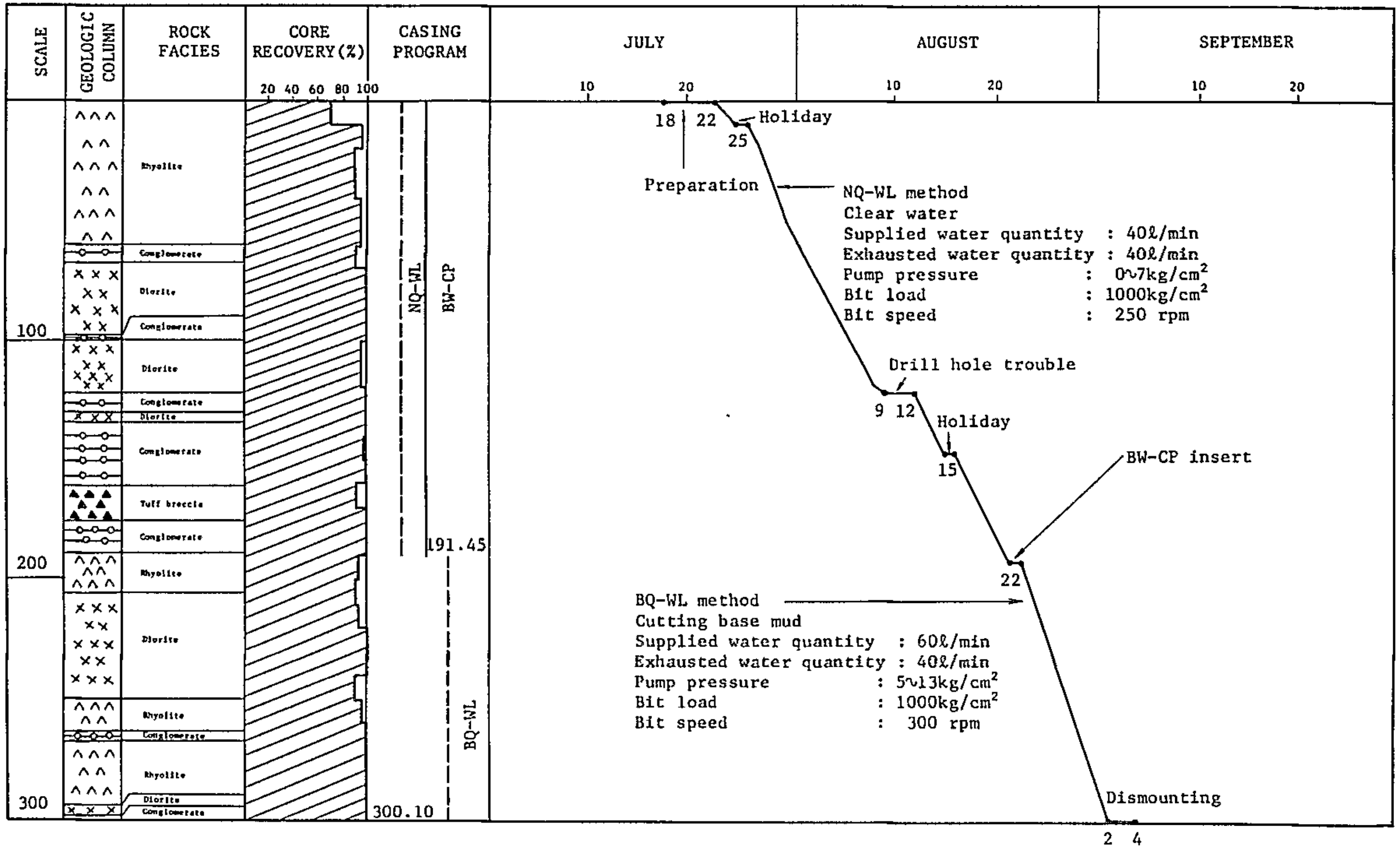


Fig. 4-2 Drilling Progress of the SAN CLEMENTE Area (MJM-1)

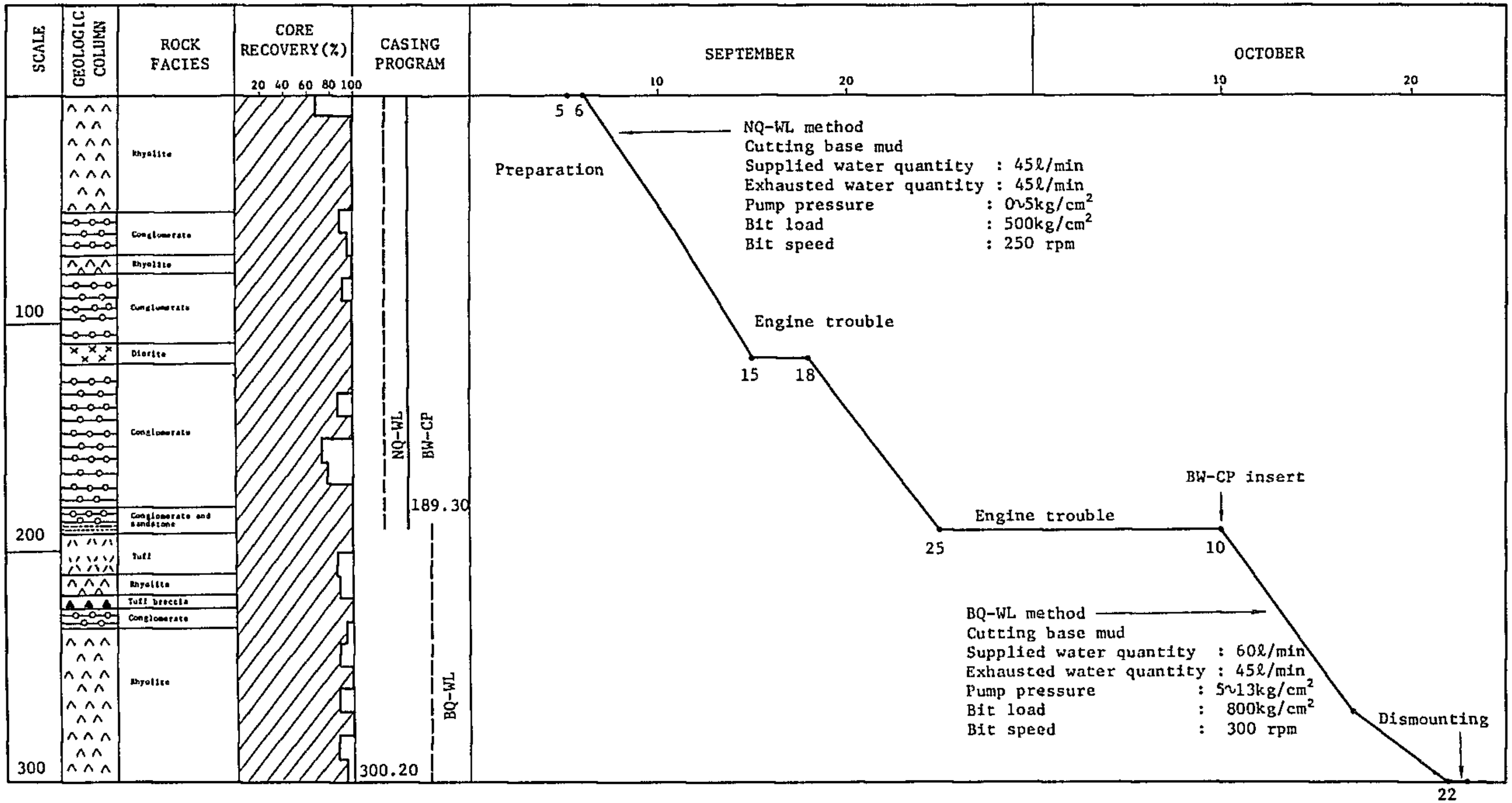


Fig. 4-3 Drilling Progress of the SAN CLEMENTE Area (MJM-2)

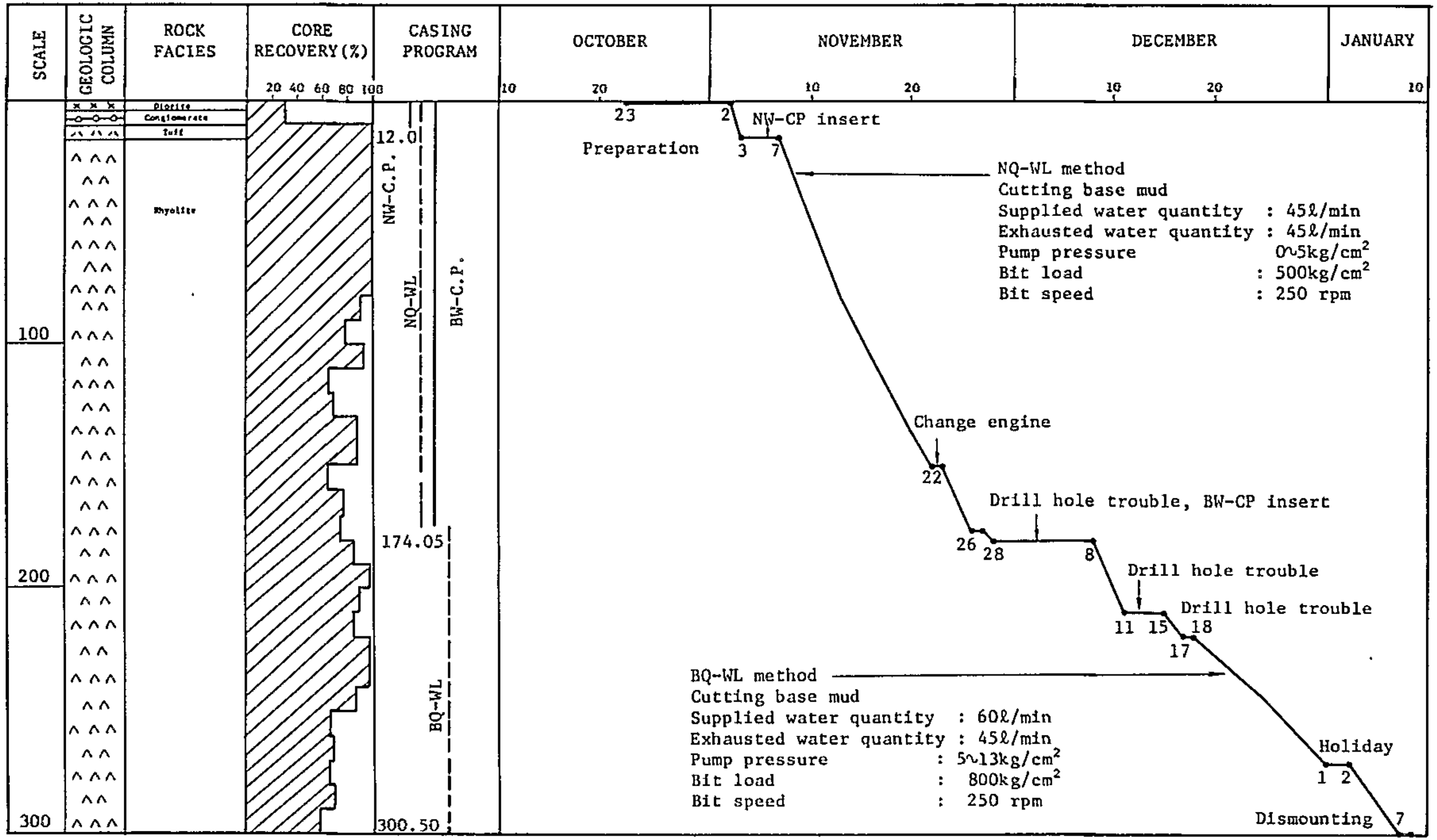


Fig. 4-4 Drilling Progress of the SAN CLEMENTE Area (MJM-3)

Table 4-1 Drilling Equipment: MJM-1, 2, 3

Item	Type	Quantity	Specification
Drilling machine	L-38 (Long year, Co.)	1 set	Capacity: NQ 575m, BQ 725m Inner diameter of spindle: 148m/m Spindle speed: 300 rpm Weight (except engine): 1300kg
Wireline hoist		1 set	Attached to drilling machine
Engine for drill	(Ford, Co.)	1 set	Diesel engine: 4 cycle Revolution: 1800 rpm Related Power: 20 PS
Drilling pump	F.M.C. (Long year, co.)	1 set	Type: 3 cylinders-single acting Capacity (max.): 140 ℓ/min. Pressure (max.): 56 kg/cm^2
Engine for pump	No. C106SP5 (TWIN DISC, Co.)	1 set	Diesel engine Revolution: 1800 rpm Related power: 18 PS
Mud mixer			
Engine for mixer			
Derrick			
Generator			
Engine for generator			
Water tank		2 sets	Plastic tank (3 m^3)

Table 4-2 Consumed Materials: MJM-1, 2, 3

Article	Specification	Unit	Quantity			
			MJM-1	MJM-2	MJM-3	Total
Diesel fuel	Drilling machine & Drilling Pump Water Pump	ℓ	1,500	1,040	2,000	4,540
Gasoline	Jeep	ℓ	1,200	750	1,500	3,450
Engine oil	Drilling machine & Drilling Pump	ℓ	40	80	80	200
Cylinder oil	Drilling machine	ℓ	100	40		140
Grease		kg	48	48		96
Bentonite						
Cement		sx	20	11	23	54
Cutting oil		ℓ	65	140	210	415
Diamond bit	NQ	pcs	12	21	11	44
	BQ	pcs	6	5	24	35
Diamond reaming shell	NQ	pcs	3	3	5	11
	BQ	pcs	2	2	9	13
Core barrel	NQ	pcs	2	2	2	6
	BQ	pcs	1	1	1	3
Drill rod	NQ	m	200	200	200	600
	BQ	m	300	300	300	900
Core lifter	NQ	pcs	4	4	4	12
	BQ	pcs	4	4	4	12
Core lifter case	NQ	pcs	2	2	2	6
	BQ	pcs	2	2	2	6
Chuck piece	NQ	pcs	3	3	2	8
	BQ	pcs	2	3	1	6
Wire	1/2"m/m	m	200			200
	6 m/m	m	1,000	700	700	2,400
Lost circulation materials						

Table 4-3 Results of Bit Works: MJM-1, 2, 3

MJM-1

Item \ Depth (m)		0~106.30	106.30~202.60	202.60~300.10
Circulating water		Clear water	Cutting base mud	Cutting base mud
Change bit		NQ-WL D.B. 7 times	NQ-WL D.B. 5 times BQ-WL D.B. 1 time	BQ-WL D.B. 5 times
Pump	Pressure (kg/cm^2)	0~7	5~10	5~13
	Supplied water quantity (ℓ/min)	40	60	60
	Exhausted water quantity (ℓ/min)	40	40	40
Bit	Load (kg/cm^2)	300~1000	500~1200	500~1000
	Speed (rpm)	150~280	250~300	300
Core recovery (%)		92	97	97

MJM-2

Item \ Depth (m)		0~103.00	103.00~198.10	198.10~300.20
Circulating water		Cutting base mud	Cutting base mud	Cutting base mud
Change bit		NQ-WL D.B. 15 times	NQ-WL D.B. 6 times	BQ-WL D.B. 5 times
Pump	Pressure (kg/cm^2)	0~5	5~10	5~13
	Supplied water quantity (ℓ/min)	45	60	60
	Exhausted water quantity (ℓ/min)	45	45	45
Bit	Load (kg/cm^2)	300~500	300~700	500~800
	Speed (rpm)	250~300	250~300	250~300
Core recovery (%)		95	96	93

MJM-3

Item \ Depth (m)		0~99.50	99.50~200.60	200.60~300.50
Circulating water		Cutting base mud	Cutting base mud	Cutting base mud
Change bit		NQ-WL D.B. 8 times	NQ-WL D.B. 3 times BQ-WL D.B. 8 times	BQ-WL D.B. 16 times
Pump	Pressure (kg/cm^2)	0~5	5~10	5~13
	Supplied water quantity (ℓ/min)	45	60	60
	Exhausted water quantity (ℓ/min)	45	45	45
Bit	Load (kg/cm^2)	300~500	300~700	500~800
	Speed (rpm)	200~250	200~250	200~250
Core recovery (%)		90	75	78

Note : D.B. means Diamond Bit.

Table 4-4 Summary of Drilling Results: MJM-1

Item	Working period	Number of days	Actual working days	Re-pairing days	No working days	Total number of workers
Preparation	18th Jul. '82∿22nd Jul. '82	5	5	—	—	48
Drilling	23rd Jul. '82∿ 1st Sep. '82	41	34.5	3.5	3	301
Dismounting	2th Sep. '82∿ 4th Sep. '82	3	3	—	—	24
Total	18nd Jul. '82∿ 4th Sep. '82	49	42.5	3.5	3	373

Drilling length, etc.			
Planned length	300m	Over burden	0m
Increase or decrease in length	0.10m	Core length	286.40m
Length drilled	300.10m	Core recovery	95%

Core recovery for each 100m section		
Depth of hole	Section	Total
0∿106.30	92%	92%
106.30∿202.60	97%	94%
202.60∿300.10	97%	95%

Working time				
Drilling	Drilling	217°35'	42.1%	37.1%
Drilling	Hoisting & lowering rod, casing	243°25'	47.1%	41.5%
Drilling	Repairing	56°00'	10.8%	9.5%
Drilling	Sub total	517°00'	100.0%	88.1%
Preparation		40°00'		6.8%
Dismounting		30°00'		5.1%
Others				
Total		587°00'		100.0%

Drilling efficiency	
Total drilling length / Working period	7.32 m/day
Total drilling length / Net working days	7.90 m/day
Total drilling length / Net drilling days	8.70 m/day
Total drilling workers / Total drilling length	1.00 man/m

Inserting casing pipe		
Pipe size & inserted length (m)	inserted length / Drilling length ×100(%)	Recovery of casing pipe (%)
BW.C.P. 191.45m	63.8%	100%

Drilling length by each size (m)		
Bit size	NQ	BQ
Drilling length	191.45	108.65
Core length	180.70	105.70

Remarks:

Table 4-5 Summary of Drilling Results: MJM-2

Item	Working period	Number of days	Actual working days	Re-pairing days	No working days	Total number of workers
Preparation	5th Sep. '82	1	1	—	—	8
Drilling	6th Sep. '82∿21st Oct. '82	46	28	18	—	287
Dismounting	22nd Oct. '82	1	1	—	—	8
Total	5th Sep. '82∿22nd Oct. '82	48	30	18	—	303

Drilling length, etc.			
Planned length	300m	Over burden	0m
Increase or decrease in length	0.20m	Core length	284.45m
Length drilled	300.20m	Core recovery	95%

Core recovery for each 100m section		
Depth of hole	Section	Total
0∿103.0	95%	95%
103.0 ∿205.15	96%	96%
205.15∿300.20	93%	95%

Working time				
Drilling	Drilling	185°45'	25.8%	25.2%
Drilling	Hoisting & lowering rod, casing	238°15'	33.1%	32.4%
Drilling	Repairing	296°00'	41.1%	40.2%
Drilling	Sub total	720°00'	100.0%	97.8%
Preparation		8°00'		1.1%
Dismounting		8°00'		1.1%
Others				
Total		736°00'		100.0%

Drilling efficiency	
Total drilling length / Working period	6.53 m/day
Total drilling length / Net working days	6.53 m/day
Total drilling length / Net drilling days	10.72 m/day
Total drilling workers / Total drilling length	0.96 man/m

Inserting casing pipe: Pipe size & inserted length (m)	Inserted length / Drilling length ×100(%)	Recovery of casing pipe (%)
BW.C.P. 189.30m	63.1%	100%

Drilling length by each size (m)		
Bit size	NQ	BQ
Drilling length	189.30	110.90
Core length	180.50	103.95

Remarks:

Table 4-6 Summary of Drilling Results: MJM-3

Item	Working period	Number of days	Actual working days	Re-pairing days	No working days	Total number of workers
Preparation	23rd Oct. '82∿ 1st Nov. '82	9	8	—	1	136
Drilling	2nd Nov. '82∿ 7th Jan. '83	67	44	21	2	751
Dismounting	8th Jan. '83∿	1	1	—	—	7
Total	23rd Oct. '82∿	77	53	21	3	894

Drilling length, etc.			
Planned length	300m	Over burden	0m
Increase or decrease in length	0.50m	Core length	243.50m
Length drilled	300.50m	Core recovery	81%

Core recovery for each 100m section: Depth of hole	Section	Total
0∿ 99.50	90%	90%
99.50∿200.60	75%	82.5%
200.60∿300.50	78%	81%

Working time				
Drilling	Drilling	507°50'	37.2%	
	Hoisting & lowering rod, casing	390°20'	28.6%	
	Repairing	468°00'	34.2%	
	Sub total	1366°10'	100.0%	
Preparation		168°00'		
Dismounting				
Others				
Total				

Drilling efficiency	
Total drilling length / Working period	4.49 m/day
Total drilling length / Net working days	4.62 m/day
Total Drilling length / Net drilling days	6.83 m/day
Total drilling workers / Total drilling length	2.50 man/m

Inserting casing pipe: Pipe size & inserted length (m)	Inserted length / Drilling length ×100 (%)	Recovery of casing pipe (%)
NW.C.P. 12.0 m	4.0%	100%
BW.C.P. 174.05m	57.9%	100%

Drilling length by each size (m): Bit size	NQ	BQ
Drilling length	161.65	138.85
Core length	131.70	111.80

Remarks:

Table 4-7 Generalized Drilling Results

Drill Hole No.	Machine Type	Drilling Period	Drilled Length (m)	Core		Number of Drilling Shift				Drilling Speed	
				Length (m)	Recovery (%)	Drilling	Casing, etc.	Accident	Total	m/shift *	m/shift **
MJM-1	L-38	23th Jul. '82 ~ 1st Sep. '82	300.10	286.40	95	56	1	7	64	4.69	5.36
MJM-2	L-38	6th Sep. '82 ~ 21th Oct. '82	300.20	284.45	95	52	1	37	90	3.34	5.77
MJM-3	L-38	2nd Nov. '82 ~ 7th Jan. '83	300.50	243.50	81	113	1	76	190	1.58	2.66
Total			900.80	814.35	90.4	221	3	120	344	2.62	4.08

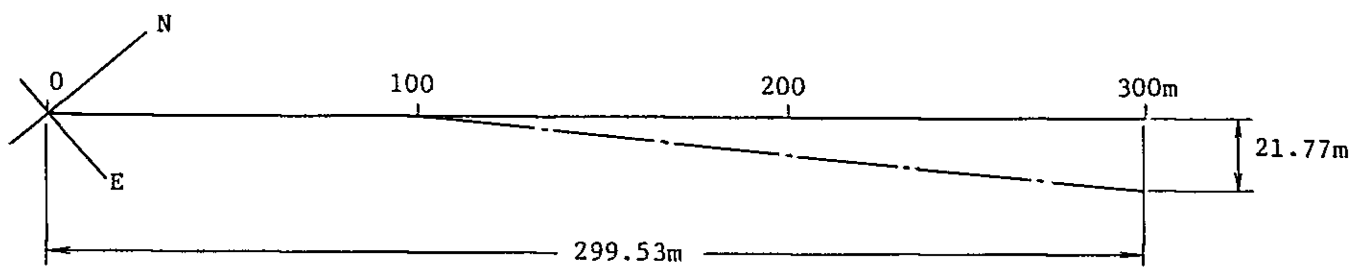
Notes * Drilling Length per one shift covering total works operated.

** Drilling Length per one shift covering net drilling operations.

Table 4-8 Surveying Results of Drill Hole : MJM-1

MJM-1

Depth (m)	Apparent Angle	True Angle	Dip	Holizontal Deviation		Holizontal Deviation		Vertical Deviation	
				Cos	Total	Sin	Total	Sin	Total
0	N32°00'E	N40°00'E	±0	100.00	100.00		0		0
200	N28°30'E	N36°30'E	-6°	149.72	249.72	9.16	9.16	15.68	15.68
300	N27°00'E	N33°00'E	-7°	49.81	299.53	4.36	13.52	6.09	21.77

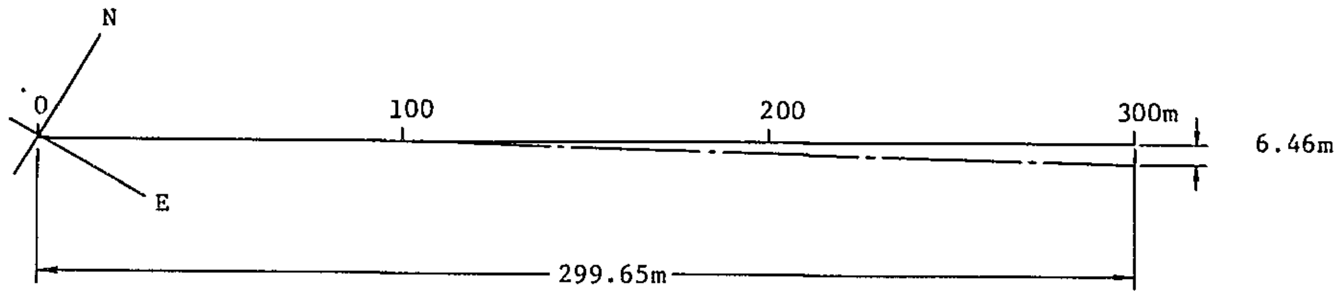


Section of Drill Hole
S = 1:2000

Table 4-9 Surveying Results of Drill Hole : MJM-2

MJM-2

Depth (m)	Apparent Angle	True Angle	Dip	Holizontal Deviation		Holizontal Deviation		Vertical Deviation	
				Cos	Total	Sin	Total	Sin	Total
0	N52°00'E	N60°00'E	±0	115.00	115.00		0		
230	N55°30'E	N63°30'E	-2°						
				184.65	299.65	11.29	11.29	6.46	6.46



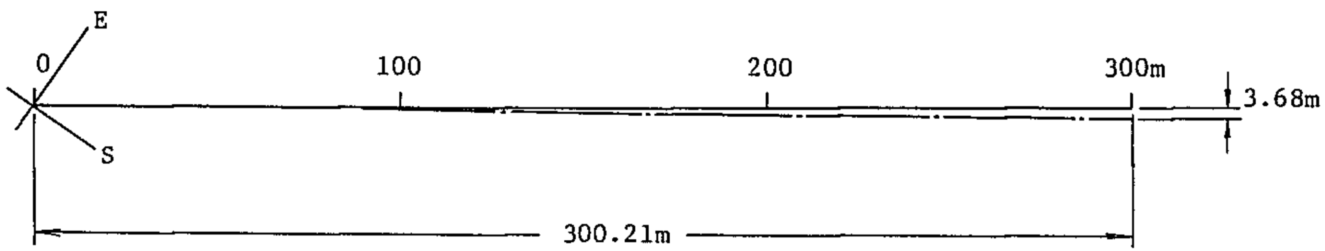
Section of Drill Hole

S = 1:2000

Table 4-10 Surveying Results of Drill Hole : MJM-3

MJM-3

Depth (m)	Apparent Angle	True Angle	Dip	Holizontal Deviation		Holizontal Deviation		Vertical Deviation	
				Cos	Total	Sin	Total	Sin	Total
0	S43°00'E	S35°00'E	±0		89.5		0		0
141.0									
179.0	S40°00'E	S32°00'E	-1°	210.71	300.21	11.0	11.0	3.68	3.68



Section of Drill Hole
S = 1:2000

pipe was inserted. During the work of replaing the bit when the bottom was at 174.10 meters, the tool was caught in the hole resulting in to fail to return to the bottom. Then the work of replacing the casing was repeated, and finally the BW-casing was additionally inserted to the point of 174.05 meters. The hole was completed at 300 meters. The reason of a great delay of the work of this hole is firstly attributed to that the BW-casing had not been inserted to the depth schedule, which resulted in to cause caving below the lower end of the casing and the time was required for additional insertion of casing. In addition, falling off of bit due to the use of inferior bit and reamer of non-standard and the jamming trouble would have been the cases.

4-4 Geology of the Drill Holes

The geology of the three horizontal drill holes driven in the area is as follows.

<u>MJM-1 Hole</u> (PL. 21)

0.00 m	@	White-pale brown massive and compact rhyolite. Vesicules at several places, which are filled with microcrystals of quartz, iron oxide and black mineral (Mn?). Fracture zones are observed at 11 places. Partly filled with white clay and iron oxide.
55.30–59.65	*	Silicified zone with pyrite dissemination.
59.65	@	Pale grey tuffaceous conglomerate. Pyrite dissemination in the matrix of conglomerate.
62.80–62.82	*	A quartz vein, accompanied by dissemination of sphalerite and chalcopyrite.
62.82–63.35	*	Dissemination of sphalerite in the matrix of conglomerate.
66.90–67.50	*	Fracture zone
67.50	@	Green to dark green altered diorite.
68.57–68.60	*	Quartz vein, accompanied by sphalerite, chalcopyrite and pyrite.

92.35 m

* Highly silicified zone

94.55

97.20

* Pale green quartz vein, accompanied by lenticular epidote.

98.20

@ Pale green tuffaceous conglomerate. Pyrite dissemination in the matrix

100.40 * Chalcopyrite dissemination along crack.

101.50

@ Green to dark green altered diorite.

122.20

@ Alternating beds of tuffaceous granule conglomerate and tuffaceous pebble conglomerate.

126.20

* Highly silicified zone, with dissemination of pyrite, and small amount of galena.

126.80

131.45

@ Dark green altered diorite.

134.00

@ Grey to dark grey tuffaceous pebble conglomerate

148.10

* Pale green network quartz vein

149.07

@ Highly silicified altered diorite.

150.05

@ Dark greenish-grey tuffaceous conglomerate.

161.00

@ Green altered diorite.

161.90

@ Pale grey rhyolitic tuff breccia.

171.60

171.70

* Dissemination of fine-grained chalcopyrite along the crack

174.70

@ Dark grey to grey tuffaceous pebble conglomerate.

188.68

@ Greenish white to white brecciated rhyolite and massive rhyolite

189.85 * Pyrite and chalcopyrite dissemination in network quartz vein.

193.05

* Pyrite, galena and sphalerite dissemination in the matrix of brecciated rhyolite.

199.45

@ Grey tuffaceous pebble conglomerate.

201.55

@ Grey to greenish grey highly altered diorite.

202.60

@ Grey to greenish grey highly altered rhyolite.

203.60

204.50

* Dissemination of pyrite and small amount of galena.

206.10

@ Green to dark green altered diorite.

243.20

@ Tuffaceous conglomerate.

243.52

@ Green altered diorite.

245.35 m
* Network calcite vein.

245.60
246.85
* Fracture zone.

@ Pale grey rhyolitic tuff breccia.

248.90 * Galena dissemination in the matrix of conglomerate.

249.75
@ Pale green to dark grey altered diorite.

252.30
@ Pale grey rhyolite, massive and brecciated.

259.85
260.50
* Cracks filled with iron oxides.

263.30
@ Grey tuffaceous pebble conglomerate.

264.80
* Stratified.

267.65
@ White brecciated rhyolite. The matrix consists of siliceous material accompanied by chalcopyrite.

281.50
284.50
286.00
287.00
* Dissemination of black mineral (Mn?) in the matrix.

290.30
@ Tuffaceous conglomerate.

291.20
@ White rhyolite. Generally fractured. Argillized along the crack.

291.65
293.00
* Network veinlets of black mineral (Mn?).

294.50
@ Green altered diorite.

295.95
296.15
* Silicified.

298.25
298.75
* Dissemination of pyrite and small amount of galena.

@ Tuffaceous conglomerate.

300.10

MJM-2 Hole (PL. 22)

0.00 m – 51.20	@	Pale grey to grey massive and compact rhyolite. Several vesicules are found filled with microcrystals of quartz and iron oxides along crack.
42.00 – 44.00, 46.70 – 47.50	*	Highly silicified zone with pyrite dissemination.
51.20 – 70.33	@	White to whitish grey tuffaceous pebble conglomerate.
51.20 – 55.05	*	Highly silicified zone with abundant pyrite dissemination.
54.95 – 55.05	*	Dissemination of sphalerite and chalcopyrite.
70.00 – 70.30	*	Fracture zone accompanied by white clay.
70.33 – 78.00	@	White massive rhyolite. Highly silicified zone penetrated by many quartz veinlets.
70.50 – 70.55, 74.25 – 74.65	*	Dissemination of sphalerite, galena and chalcopyrite.
75.45	*	Galena dissemination.
76.95	*	Dissemination of sphalerite and chalcopyrite.
78.00 – 108.72	@	Pale grey to grey tuffaceous conglomerate.
85.30 – 86.80	*	Concentration of carbonaceous matter.
86.80 – 88.00	*	Dissemination of sphalerite, galena and chalcopyrite.
88.00 – 91.00	*	Highly altered to become white rock.
97.30 – 98.92	*	Well sorted coarse (1-2 mm diameter) sandstone.
108.72 – 117.65	@	Green medium to coarse-grained altered diorite.
117.65 – 159.50	@	Pale grey to grey tuffaceous conglomerate.
137.70 – 147.00	*	Silicified.
138.70 – 143.25	*	Dissemination of small amount of chalcopyrite.
153.05 – 157.14	*	Fracture zone with clay.
159.50 – 160.35	@	Pale green altered diorite.
160.35 – 181.10	@	Pale grey to grey tuffaceous conglomerate
164.65 – 179.65	*	Silicification and argillization.
174.70 – 179.65	*	Dissemination of sphalerite, galena and small amount of chalcopyrite.

(MJM-2 continued)

181.10
@ Pale green altered diorite.
181.65
@ Alternating beds of tuffaceous conglomerate and tuffaceous sandstone.
193.00
@ Rhyolitic pyroclastic rock.
202.00
* Small amount of disseminated sphalerite and galena in the matrix.
204.00
209.55
@ White massive rhyolite.
213.60
@ White rhyolitic tuff breccia. Small amount of fragments of shale in the matrix.
216.45
@ White massive rhyolite.
219.10
@ White to grey rhyolitic tuff breccia.
221.60
* Matrix is a little sandy.
224.20
@ Tuffaceous conglomerate.
232.70
@ White massive rhyolite.
241.00
243.00
* Fracture zone accompanied with clay.
260.00
* Fracture zone. Iron oxide along the crack.
266.15
300.20

<u>MJM-3 Hole</u> (PL. 23)

0.00 m
@ Brownish green fine-grained altered diorite.
4.50
@ Pale brown sandy tuff. Pebbles consist mainly of altered diorite and shale.
10.65
@ Sandy tuff breccia. Silicified. Pyrite dissemination.
13.80
@ Greenish gray highly silicified tuff. Network vein of chlorite and epidote.
16.50
@ Pale grey to pale brown massive and compact rhyolite. Fracture zones are observed at eight places.
* Highly silicified. Pyrite dissemination in abundant.
17.85
* Hematite fills the cracks.
22.80
* Hematite, pyrite and veinlets accompanied with clay along crack.
28.20
* Dissemination of sphalerite and chalcopyrite in quartz veinlets.
29.00
30.80
* Highly silicified. Abundant pyrite dissemination.
37.15
38.80
* Chalcopyrite dissemination along the cracks.
42.80

51.25 m – 51.45	*	Chalcopyrite dissemination along the cracks.
81.45 – 84.60	*	Chalcopyrite dissemination.
87.70 – 92.00	*	Fracture zone.
93.60	*	Chalcopyrite dissemination
92.00 – 94.60	*	Highly silicified zone with pyrite dissemination.
103.00 – 110.35	*	Pyrite and scorodite are observed along the cracks.
110.35 – 122.85	*	Manganese oxide dissemination along the cracks.
122.85 – 132.40	*	Iron oxides dissemination along the cracks.
131.65	*	Chalcopyrite, galena and malachite vein (2 cm wide)
147.00 – 154.85	*	Fracture zone.
177.00 – 184.10	*	Fracture zone.
195.00 – 206.60	*	Iron oxides dissemination.
219.10 – 228.50	*	Iron oxides dissemination along the cracks.
242.00 – 249.10	*	Highly silicified zone. Manganese oxide dissemination along the cracks.
249.10 – 252.50	*	Fracture zone.
252.50 – 300.50	@	Pale pinkish grey compact rhyolite with flow structure. Fracture zones are observed at five places. Iron oxides dissemination along the cracks.
260.80 – 266.50	*	Notable fracture zone.
300.50		

CHAPTER 5

DIAMOND DRILLINGS IN THE PROVIDENCIA AREA

CHAPTER 5 DIAMOND DRILLINGS IN THE PROVIDENCIA AREA

5-1 Outline

Diamond drillings of two vertical holes (MJM-4 Hole and MJM-5 Hole) were excavated in order to make clear the geology, the geologic structure and mineralization in the depths of the area where the high chargeability anomalous zone by IP method and the geochemically anomalous zone were overlapped.

The MJM-4 hole was digged vertically to the depth of 300.75 meters at the station on the southern side of the old pit (P. No. 2) 2,357 meters high above sea level in a little north of the center of the surveyed area.

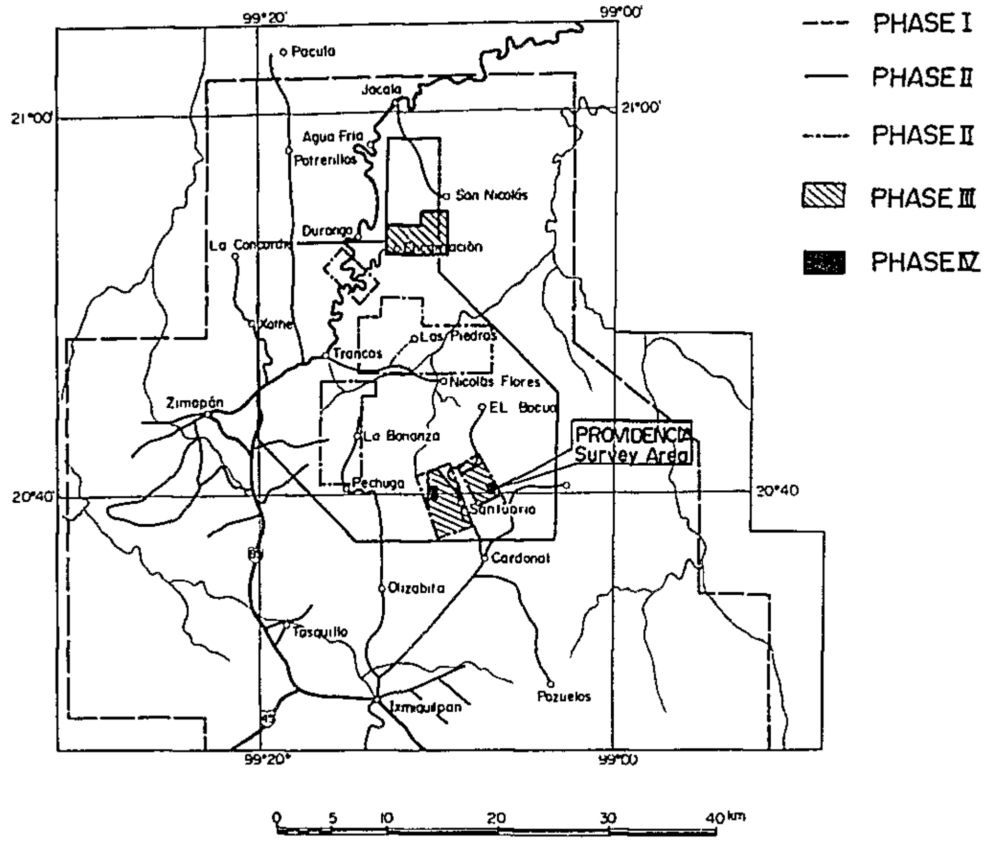
The MJM-5 holes was digged vertically to the depth of 300.80 meters at the station on the northeastern side of the old pit (P. No. 7) situated close to the ridge 2,435 meters high above sea level in the northwestern part of the surveyed area.

The drilling works was conducted by El Consejo de Recursos Minerales (CRM) in technical cooperation with two Japanese drill engineers during the period from July 18, 1982 to November 20, 1982.

Sixty one days were spent for the drilling works of the MJM-4 hole at the site and 82 days for those of the MJM-5 hole. The days for the actual drilling work were 35 days in the former and 45 days in the latter, and the remain was devoted for waiting time due to the shortage of circulating water supply and for restoring the mechanical troubles and the accident in the holes, corresponding to about 44 percent of those of the whole drilling works.

The camp for the members of drill team was established at the Cardonal settlement lying halfway between the SAN CLEMENTE area and the PROVIDENCIA area. It required about 30 minutes to drive from the camp to reach the end of mining road and another walking of 15 to 20 minutes to the site.

The drill team was organized by two to three crews, each crew consisting of an operator and three wokers, under the supervision of a Mexican engineer.



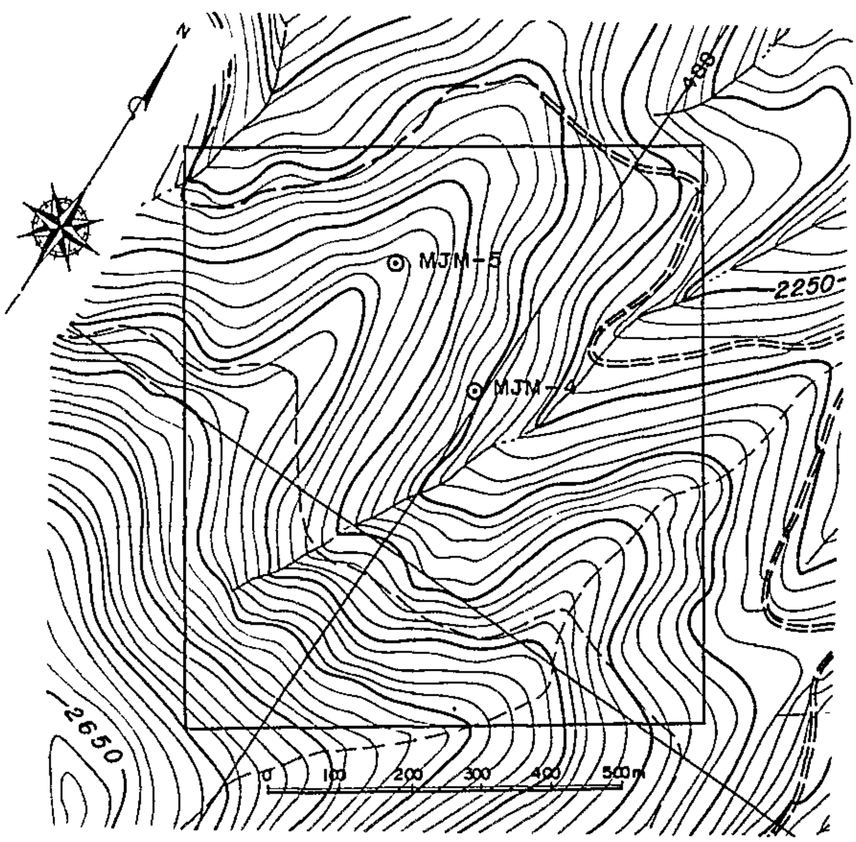


Fig. 5-1 Drilling Sites of the PROVIDENCIA Area

The works were carried out by two to three shifts a day.

5-2 Drilling Method and Machines

The geology consists mainly of platy limestone, and it was judged that a large scale caving would not occur although it was predicted that many cracks would be encoutered, which might cause a loss of the whole quantity of circulating water.

Accordingly, the wireline coring tools with two stages of NQ and BQ were prepared. Materials for preventing loss of circulating water such as bentonite, telstop (both powder and grain), and Portland cement were prepared, and cutting oil was also prepared to minimize the effect of friction between the rod and the wall of hole.

The drill machine used and other machinery and tools are shown in Table 5-1, the details of supplies used are in Table 5-2 and the diamond bits used in Table 5-3.

5-3 Drilling Works

5-3-1 Maneuvering, arrangement, move and removal

Similar to the SAN CLEMENTE area, trucks were used for transportation of tools and equipment from Mexico to the terminal of the road in the adjacent area of the drill site. Then a helicopter was used to carry them to the site of the MJM-5 hole. The move from the site of MJM-5 to that of MJM-4 and the removal of that station were done by self-propelling of the machine. The water was transported by the 10-ton tank lorry (for a distance of one way of 10 to 40 kilometers) to the terminal of the road, then pumped up by two pumps to the site (head was about 180 meters).

5-3-2 Drilling operation

The details of drilling are shown in the tables and figures such as the summary of works (Table 5-4 and 5-5), the figures showing the progress of works (Fig. 5-2 and 5-3) and the result of drilling (Table 5-6).

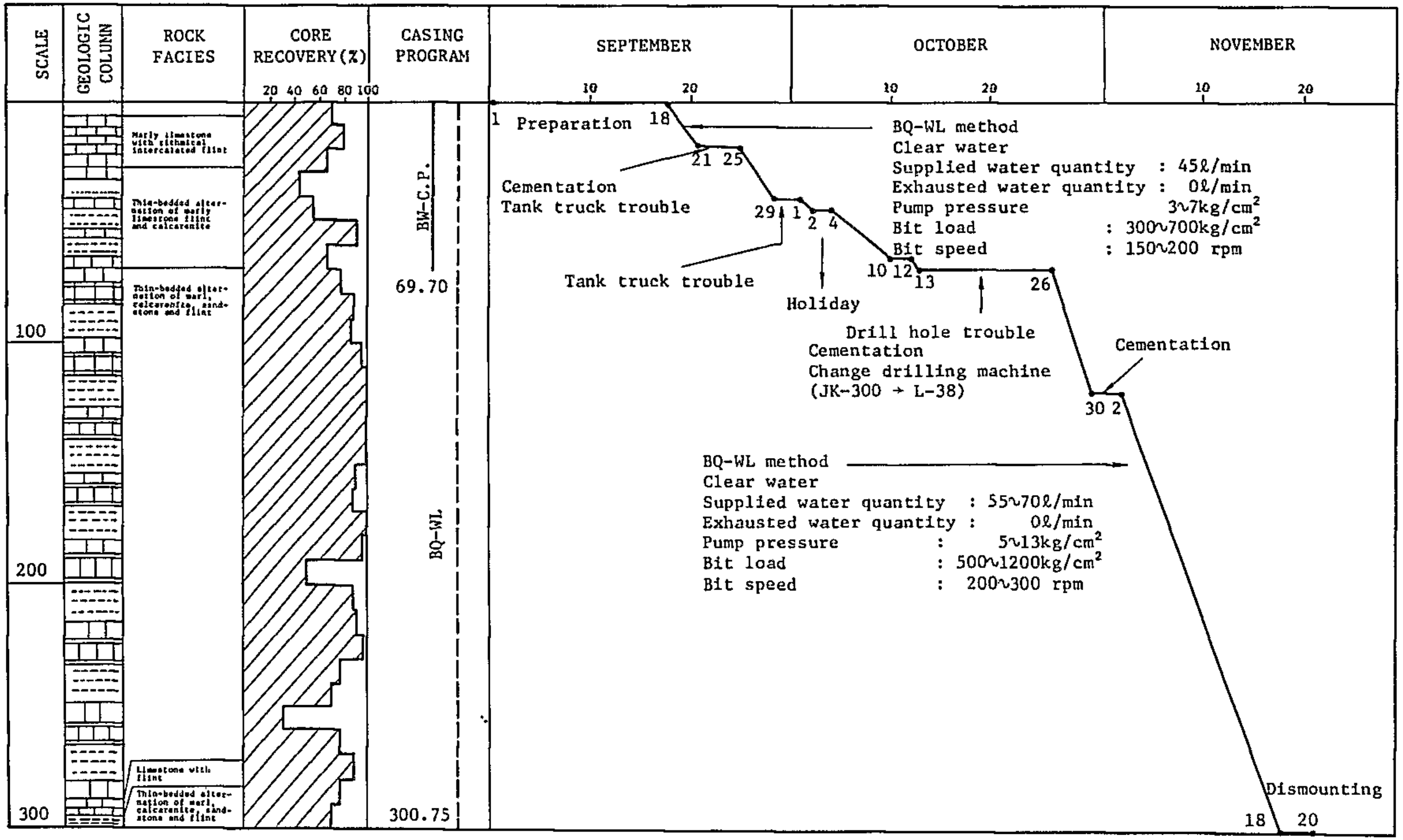


Fig. 5-2 Drilling Progress of the PROVIDENCIA Area (MJM-4)

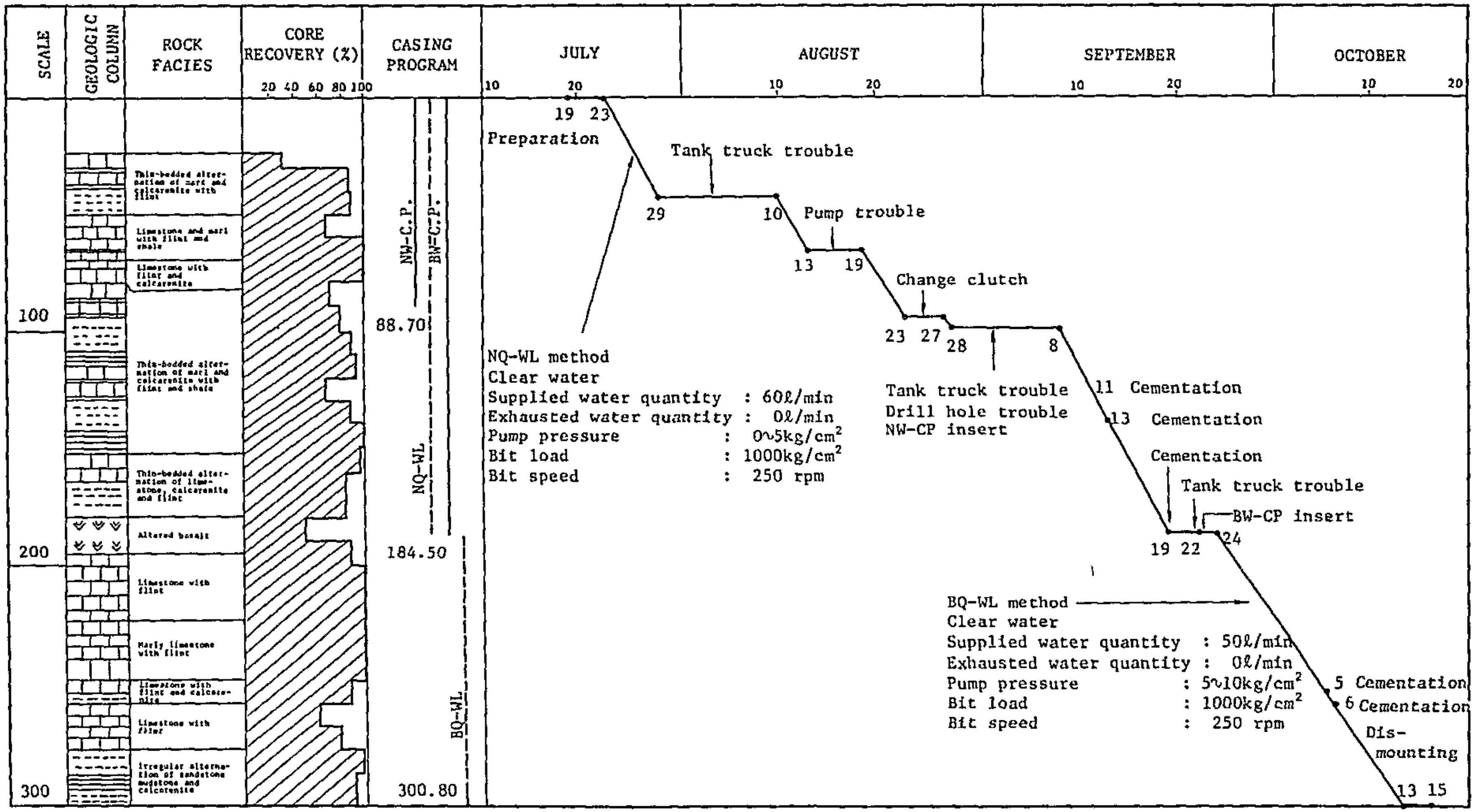


Fig. 5-3 Drilling Progress of the PROVIDENCIA Area (MJN-5)

Table 5-1 Drilling Equipment: MJM-4, 5

Item	Type	Quantity	Specification
Drilling machine	L-38 (Long year, Co.)	1 set	Capacity: NQ 575m, BQ 725m Inner diameter of spindle: 148 m/m Spindle speed: 300 rpm Weight (except engine): 1300 kg
Wireline hoist		1 set	Attached to drilling machine
Engine for drill	F4L 912 (Mitui DEUTZ)	1 set	Diesel engine: 4 cycle Revolution: 1500 rpm Related power: 43 ps
Drilling pump	F.M.C. (Long year, Co.)	1 set	Type: 3 cylinders-single acting Capacity (max.): 140 ℓ/min. Pressure (max.): 56 kg/cm^2
Engine for pump	No. C106SP5 (TWIN DISC, Co.)	1 set	Diesel engine Revolution: 1800 rpm Related power: 18 ps
Mud mixer			
Engine for mixer			
Derrick	BV-3820 mast	1 set	Steel structural derrick (vertical) Maximum load capacity: 6t Effective length of pull rod: 6 m
Generator			
Engine for generator			
Water tank	5 m^3 3 m^3	2 sets 1 set	Plastic tank

Table 5-2 Consumed Materials: MJM-4, 5

Article	Specification	Unit	Quantity			
			MJM-4	MJM-5		Total
Diesel fuel	Drilling machine & Drilling Pump Water Pump	ℓ	4,450	4,000		8,450
Gasoline	Jeep	ℓ	1,500	1,500		3,000
Engine oil	Drilling machine & Drilling Pump	ℓ	100	60		160
Cylinder oil	Drilling machine	ℓ	120	100		220
Grease		kg	64	50		114
Bentonite		t	0.5			0.5
Cement		sx	45	35		80
Cutting oil		ℓ	400			400
Diamond bit	NQ	pcs		10		10
	BQ	pcs	15	5		20
Diamond reaming shell	NQ	pcs		5		5
	BQ	pcs	5	3		8
Core barrel	NQ	pcs		2		2
	BQ	pcs	2	2		4
Drill rod	NQ	m		200		200
	BQ	m	300	300		600
Core lifter	NQ	pcs	4	4		8
	BQ	pcs	4	4		8
Core lifter case	NQ	pcs	2	2		4
	BQ	pcs	2	2		4
Chuck piece	NQ	pcs	3	2		5
	BQ	pcs	3	1		4
Wire	6 m/m	m	700	300		1,000
	16 m/m	m	25			25
Lost circulation materials		kg	275			275

Table 5-3 Results of Bit Works: MJM-4, 5

MJM-4

Item \ Depth (m)		0~99.45	99.45~200.50	200.50~300.75
Circulating water		Clear water	Clear water	Clear water
Change bit		BQ-WL D.B. 8 times	BQ-WL D.B. 5 times	BQ-WL D.B. 2 times
Pump	Pressure (kg/cm^2)	3~7	5~10	5~13
	Supplied water quantity (ℓ/min)	45	55~70	55~70
	Exhausted water quantity (ℓ/min)	0	0	0
Bit	Load (kg/cm^2)	300~700	500~1000	500~1200
	Speed (rpm)	150~200	200~300	200~300
Core recovery (%)		72	93	75

MJM-5

Item \ Depth (m)		0~102.65	102.65~200.30	200.30~300.80
Circulating water		Clear water	Clear water	Clear water
Change bit		NQ-WL D.B. 5 times	NQ-WL D.B. 5 times	BQ-WL D.B. 5 times
Pump	Pressure (kg/cm^2)	0~5	5~10	5~10
	Supplied water quantity (ℓ/min)	60	60	50
	Exhausted water quantity (ℓ/min)	0	0	0
Bit	Load (kg/cm^2)	500~1000	500~1000	500~1000
	Speed (rpm)	250	250	250
Core recovery (%)		66.2	85.2	92.5

Note : D.B. means Diamond Bit

Table 5-4 Summary of Drilling Results: MJM-4

Item	Working period	Number of days	Actual working days	Re-pairing days	No working days	Total number of workers
Preparation	1st Sep. '82∿17th Sep. '82	17	17	—	—	92
Drilling	18th Sep. '82∿17th Nov. '82	61	35	24	2	337
Dismounting	18th Nov. '82∿20th Nov. '82	3	3	—	—	33
Total	1st Sep. '82∿20th Nov. '82	81	55	24	2	462

Drilling length, etc.			
Planned length	300m	Over burden and weathering zone	2.55m
Increase or decrease in length	0.75m	Core length	240.15m
Length drilled	300.75m	Core recovery	80%

Core recovery for each 100m section: Depth of hole	Section	Total
0∿ 99.45	72%	72%
99.45∿200.50	93%	82.5%
200.50∿300.75	75%	80%

Working time				
Drilling	Drilling	302°40'	42.5%	34.5%
Drilling	Hoisting & lowering rod, casing	217°20'	30.5%	24.7%
Drilling	Repairing	192°00'	27.0%	21.9%
Drilling	Sub total	712°00'	100.0%	81.1%
Preparation		136°00'		15.5%
Dismounting		30°00'		3.4%
Others				
Total		878°00'		100.0%

Drilling efficiency	
Total drilling length / Working period	4.93 m/day
Total drilling length / Net working days	5.10 m/day
Total rilling length / Net drilling days	8.59 m/day
Total drilling workers / Total drilling length	1.12 man/m

Inserting casing pipe: Pipe size & inserted length (m)	Inserted length / Drilling length ×100(%)	Recovery of casing pipe (%)
BW.C.P. 69.70m	23.2%	100%

Drilling length by each size (m): Bit size	NQ	BQ
Drilling length		300.75
Core length		240.15

Remarks:

Table 5-5 Summary of Drilling Results: MJM-5

Item	Working period	Number of days	Actual working days	Re-pairing days	No working days	Total number of workers
Preparation	19th Jul. '82∿22nd Jul. '82	4	4	—	—	48
Drilling	23rd Jul. '82∿12th Oct. '82	82	45	33	4	539
Dismounting	13th Oct. '82∿15th Oct. '82	3	3	—	—	24
Total	19th Jul. '82∿15th Oct. '82	89	52	33	4	611

Drilling length, etc.			
Planned length	300m	Over burden and weathering zone	22.80m
Increase or decrease in length	0.80m	Core length	244.10m
Length drilled	300.80m	Core recovery	81.2%

Core recovery for each 100m section		
Depth of hole	Section	Total
0∿102.65	66.2%	66.2%
102.65∿200.30	85.2%	75.5%
200.30∿300.80	92.5%	81.2%

Working time				
Drilling	Drilling	282°20'	29.3%	27.9%
Drilling	Hoisting & lowering rod, casing	341°40'	35.4%	33.7%
Drilling	Repairing	341°00'	35.3%	33.7%
Drilling	Sub total	965°00'	100.0%	95.3%
Preparation		32°00'		3.2%
Dismounting		16°00'		1.5%
Others				
Total		1013°00'		100.0%

Drilling efficiency	
Total drilling length / Working period	3.67 m/day
Total drilling length / Net working days	3.86 m/day
Total drilling length / Net drilling days	6.68 m/day
Total drilling workers / Total drilling length	1.79 man/m

Inserting casing pipe		
Pipe size & inserted length (m)	Inserted length / Drilling length ×100(%)	Recovery of casing pipe (%)
NW.C.P. 88.70m	29.5%	100%
BW.C.P. 184.50m	61.3%	100%

Drilling length by each size (m)		
Bit size	NQ	BQ
Drilling length	184.50	116.30
Core length	140.25	103.85

Remarks:

Table 5-6 Generalized Drilling Results

Drill Hole No.	Machine Type	Drilling Period	Drilled Length (m)	Core		Number of Drilling Shift				Drilling Speed	
				Length (m)	Recovery (%)	Drilling	Casing, etc.	Accident	Total	m/shift *	m/shift **
MJM-4	JK-300 L-38	18th Sep. '82 ∿ 17th Nov. '82	300.75	240.15	80.0	65	1	23	89	3.38	4.63
MJM-5	L-38	23th Jul. '82 ∿ 12th Oct. '82	300.80	244.10	81.2	76	2	42	120	2.51	3.96
Total			601.55	484.25	80.5	141	3	65	209	2.88	4.27

Notes

* Drilling Length per one shift covering total works operated.

** Drilling Length per one shift covering net drilling operations.

(1) MJM-4 Hole (Vertical)

Although it was initially scheduled to drill the hole MJM-4 after completion of the MJM-5 hole, another machine (JK-300 type) was brought in to the site of the MJM-4 having forecast a considerable delay of completion of the work of the MJM-5 hole, and the work was started on September 18 by BQ wireline method.

Jamming was caused when the drilling was in progress at 65 meters depth. By judging that the work of restoration would be difficult by that machine because of the small capacity, the machine which had been operated at MJM-5 were moved to the MJM-4 site and the both machines were replaced. The trouble was restored and digging was restarted after 14 days since the generation of jamming. BW casing pipe was inserted to the depth of 69.70 meters, and the work was completed as scheduled by the continual use of BQ-wireline method.

(2) MJM-5 Hole (Vertical)

Overburden was deeper than the initial forecast, which together with the weathering of limestone led to lower the core recovery. The measure to expand the hole by NW- casing shoe bit after running down every several meters by NQ-wireline tools, was repeated.

Although the hole was excavated by NQ-wireline method to the depth of 184.50 meters, BQ-casing pipe was inserted to that point because of increase of the resistance by caving in the hole. After that, BQ-wireline method was used and the hole was completed at the depth as initially planned.

The causes of a large delay of the work of this hole are those such as the failure of the clutch of the drill machine, a gross break down of the tank lorry, failure of the water pump and the troubles in the hole.

5-4 Geology of the Drill Holes

The geology of the two vertical holes excavated in the area is as follows.

<u>MJM-4 Hole (PL. 24)</u>

0.00 m	@ Mainly platy grey limestone intercalated with thin layers of black flint.
18.05 18.20	* Massive iron oxides.
21.90 28.40	* Fracture zone. Calcite veins along the cracks.
	@ Alternating beds of grey thin-bedded marly limestone, calcarenite and black flint.
57.85 58.10	* Fracture zone. Iron oxides dissemination along the cracks and the bedding plnes.
67.00 68.70	* Massive iron oxides is observed.
72.35 72.62	* Average assay values: 1.87% Pb, 0.68% Zn.
	@ Alternating beds of dark grey thin-bedded marl, thin-bedded calcarenite sandstone and black flint. Fracture zones are observed at more than a dozen places. Iron oxides is disseminated along the cracks, sometimes along the bedding planes.
96.72 97.12	* Reddish brown iron oxides penetrated by calcite veinlets. The average assay values: 0.13% Pb, 29.16% Zn.
159.25 159.55	* Dissemination of iron oxides along the bedding plane.
163.30 165.65	* Iron oxides dissemination.
165.90 168.00	* Massive iron oxides along the bedding plane.
169.60 172.45	* Fracture zone. Iron oxides and calcite veinlets along the cracks.
193.10 195.10	* Fracture zone accompanied with iron oxides.
214.00 214.75	* Intensely fractured zone accompanied with network quartz veins.
247.00 261.35	* Fracture zone. A small dissemination of iron oxides.
268.70 268.90 271.10 271.30	* Brown basalt dykes (20 cm wide)
278.00 279.10	* Calcite vein
288.00	@ Pale grey limestone interbedded with small amount of black flint.
296.80	@ Alternating beds of thin-bedded marl, calcareous sandstone and black flint.
300.75	

MJM-5 Hole (PL. 24)

0.00 m

@ Highly weathered. None core recovered.

23.40

@ Alternating beds of dark grey thin-bedded marl and grey calcarenite intercalated with thin layers of black flint

26.45, 33.10 * Thin concentration of iron oxides along the bedding plane. Calcite veins (3-5 cm wide) penetrate at eight places.

38.95 * Calcite vein (7 cm wide) accompanied with iron oxides.

44.20, 48.72 * Network calcite veins. The wall rock is bleached.

50.00

@ Alternating beds of dark grey calcarenite and calcareous shale interbedded with thin layers of black flint.

50.85 * Network calcite veins

54.70

@ Alternating beds of pale grey to grey thin-bedded limestone and marl intercalated with thin bedded black flint and calcareous shale.

55.55, 56.95 * Iron oxides fills the cracks.

57.35 * Network calcite veins.

69.33

@ Alternating beds of dark grey thin-bedded marl and calcarenite intercalated with black flint

74.00

@ Pale grey to grey limestone intercalated with black flint and black calcarenite.

79.80

@ Alternating beds of dark grey thin-bedded marl and calcarenite intercalated with black flint and brown shale. Reverse graded bedding in calcarenite.

82.00, 88.25 * Fracture zone. The cracks are partly filled with iron oxides.

91.00, 93.50 * Network quartz vein.

120.70

136.90

@ Whitish grey limestone intercalated with thin-bedded marl

138.80

@ Alternating beds of blackish grey thin-bedded marl, brown shale and black flint.

141.80, 144.50 * Iron oxides fills the cracks.

148.35

@ Alternating beds of calcarenite and black flint. Iron oxides is disseminated along the bedding plane.

150.00

@ Dark grey massive limestone intercalated with black flint

152.35

@ Alternating beds of marly limestone, calcarenite and sandy black flint.

(MJM-5 continued)

155.42 m
155.52 ---* Veinlets of iron oxides.
156.30
161.00 ---* Dissemination of iron oxides along the bedding plane.
@ Alternating beds of pale grey limestone and black flint.
163.00
@ Alternating beds of thin-beded calcarenite, sandy limestone and black flint. Small amount of iron oxides is disseminated along the bedding plane.
174.00
174.40 @ Pale grey marly limestone.
174.45 --* Dissemination of iron oxides.
176.00
@ Pale grey calcareous sandstone.
177.00
@ Alternating beds of calcarenite and marl.
180.05
@ Limestone intercalated with black flint. Greenish grey to pale brown *altered basalt dykes* penetrate at three places.
188.75
195.00 ---* Largest basalt dyke, cut by hematite veinlets and network calcite vines.
@ Alternating beds of marly limestone and black flint.
200.30
200.50 ---* Iron oxides is concentrated in calcarenite.
214.00
@ Alternating beds of thin-bedded calcarenite, marly limestone and black flint.
219.00
@ Grey massive limestone partly intercalated with calcarenite.
224.10
224.28 ---* Network calcite vein accompanied with iron oxides.
@ Mainly brownish grey marly limestone intercalated with black flint.
242.55
@ Brownish grey calcarenite intercalated with black flint. Many calcite veinlets.
244.10
@ Pale grey massive limestone.
245.00
@ Brownish grey marly limestone intercalated with dark grey calcarenite and black flint.
249.70
250.20 ---* Fracture zone. Calcite veins accompanied with iron oxides.
@ Pale grey limestone intercalated with calcarenite and black flint.
259.80
@ Alternating beds of thin-bedded marl, calcarenite and calcareous sandstone.
270.30
@ Brownish marly limestone intercalated with black flint and calcarenite
273.95
@ Alternating beds of thin-bedded calcarenite and sandstone.
275.80
@ Irregularly alternating beds of pale brown sandstone, shale and calcarenite intercalated with black flint.
281.00
@ Alternating beds of brownish grey calcarenite and sandstone.
300.80