Part II Detail Description

Chapter 1 Don Noi area

In this year, the survey of mineral occurrences was carried out in the northwestern part of the Dong Noi area and the MJTM-6 hole was drilled in the center part of the Dong Noi area. Fig. II-1-1 shows the sites of this year's work in the Dong Noi area.

1-1 Mineral occurrence survey

1-1-1 Circumstances of survey

The strong soil geochemical anomaly zones of Zn-Pb-Mn-Cd has been made clear in the Dong Noi area on the basis of Phase I and Phase II geochemical survey.

In Phase II drilling program, two holes of MJTM-1 and MJTM-2 were drilled on the most strong Zn-Pb anomaly of soil geochemistry, but only MJTM-2 intersected weak zinc mineralized zones at the brecciated and sheared parts of skarnized dolomite. Therefore it is concluded that the geological setting was not suitable for forming a minable deposit at these drill sites, in spite of the existence of zinc mineralization.

Another similar geochemical anomaly was detected in Phase II on the limestone in the north-western part of the Dong Noi area, where lead-zinc deposits were also expected. But drilling survey was not executed, because the drill holes on the similar geochemical condition were not successful.

The purpose of this work is to clear the lithofacies and mineralization of the limestone at the surface. The geological mapping and the continuous rock chip sampling were carried out to check the possibility of ore deposits in this area.

1-1-2 Survey method

The survey line of 1.64 km is set on the geochemical anomaly detected by Phase II work, and the continuous sampling and the observation are conducted along and around the line. The mineralized rock such as quartz veins with sulfide minerals were collected as different samples from the continuous samples. The number of rock chip samples is 61 (Fig. II-1-2).

1-1-3 Survey result

1. Situation of geology and mineralization

The northwestern part of Dong Noi area is underlain by massive limestone and banded limestone intercalated with thin argillaceous layers. The limestone generally strikes NNE-SSW and dips 10 to 20° SE. Complex intraformational-foldings are observed in the big outcrop. There is no significant sheared zone or fault, but open joints are common in the northwestern part of the Dong Noi area. The joints have north-south strikes and vertical dips.

Numerous veins are present in the northwestern part of the Dong Noi area, but most of the veins are barren. Only some veins are accompanied by galena, sphalerite and chalcopyrite. No

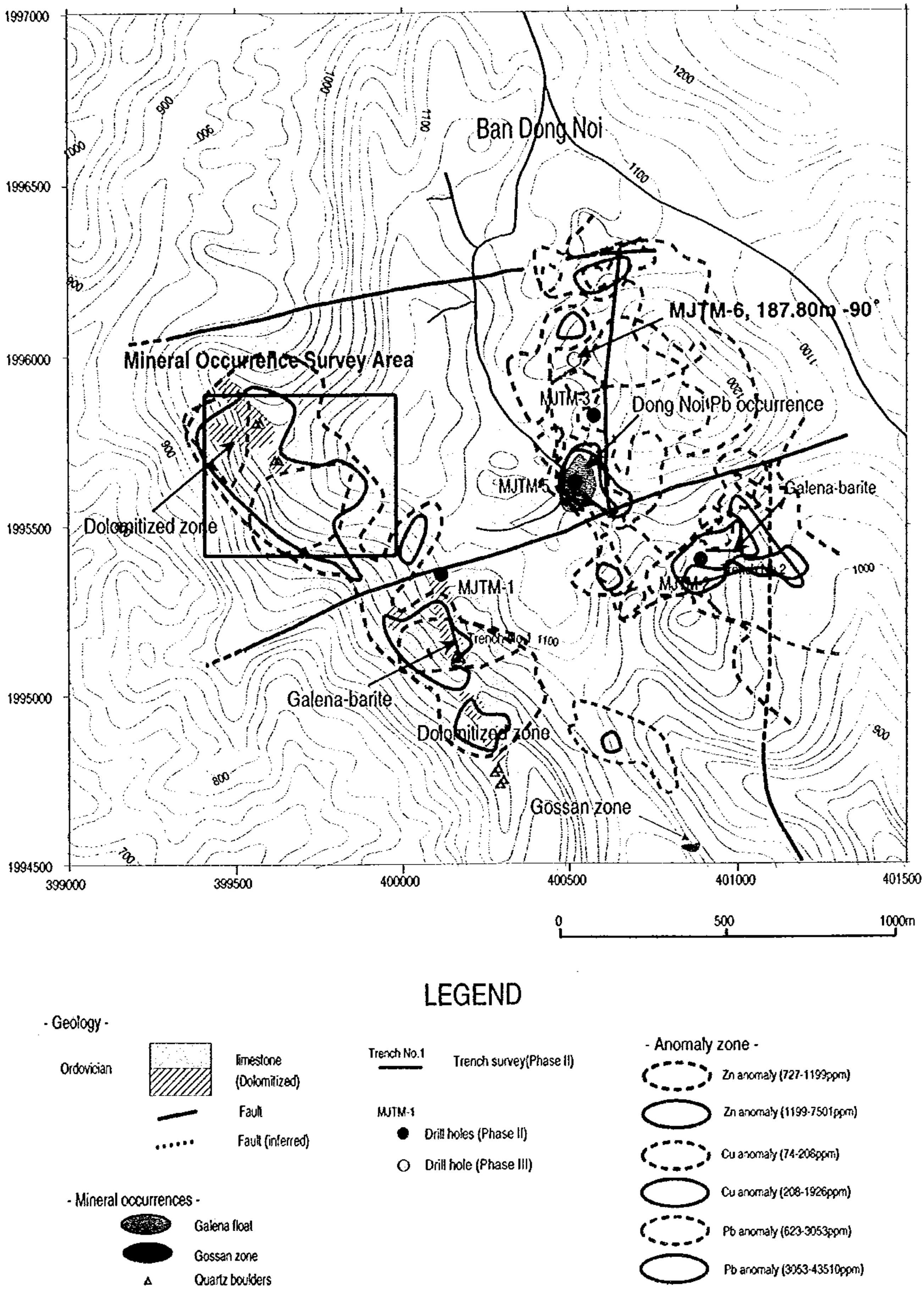


Fig.II-1-1 Location map of third phase survey in the Don Noi Area

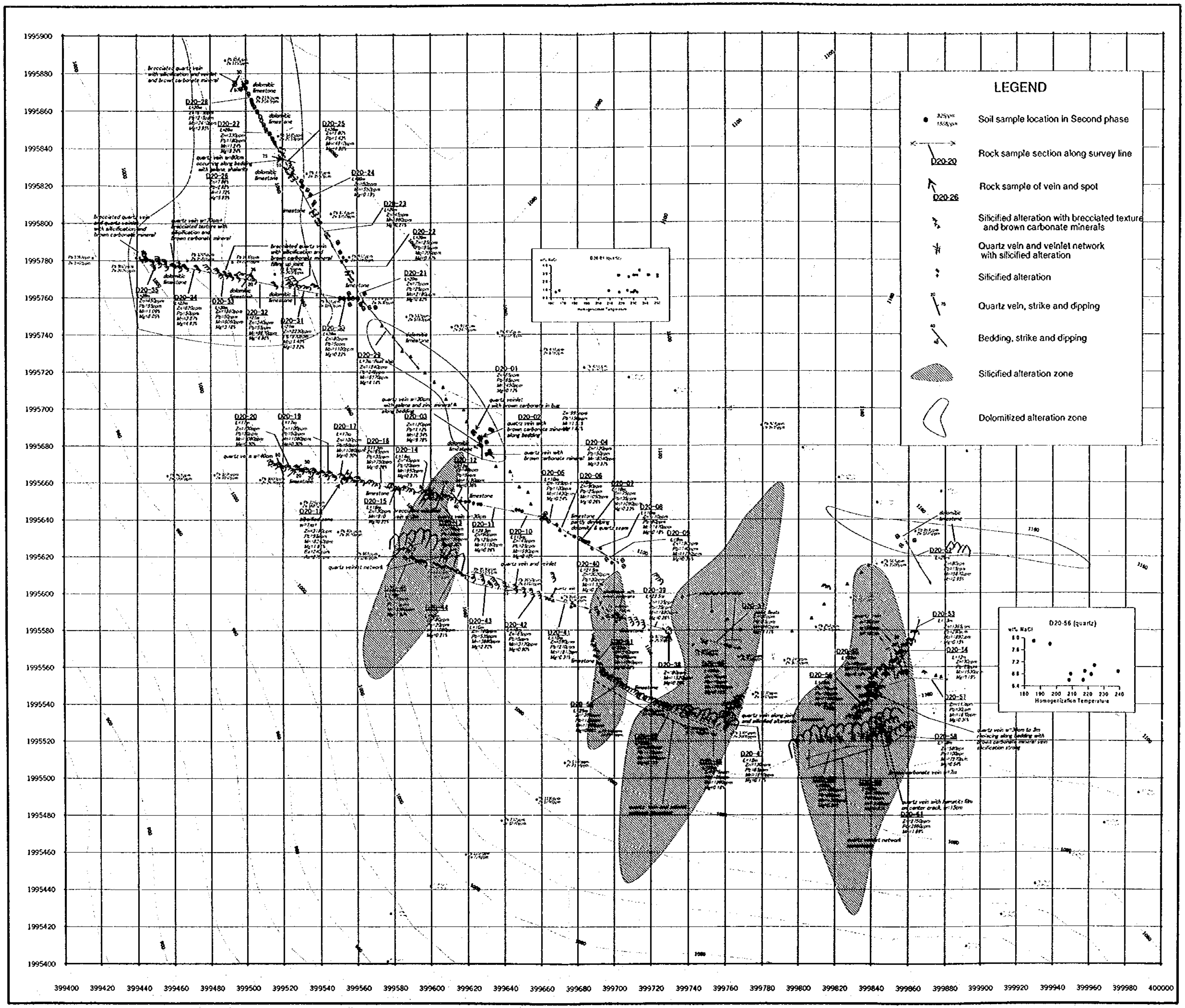


Fig. Ⅱ-1-2 Map showing the result of mineral occurrence survey

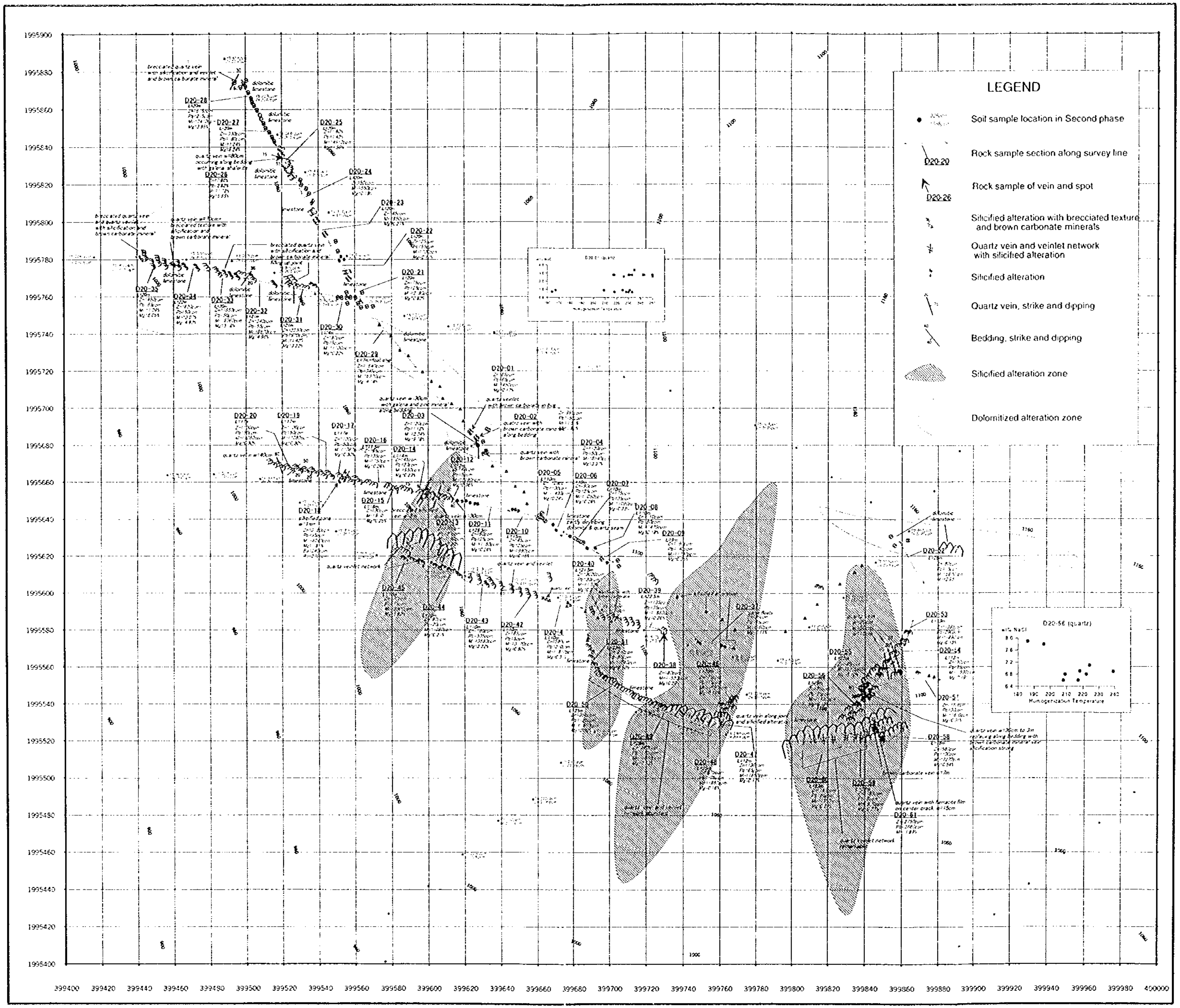


Fig. Ⅱ-1-2 Map showing the result of mineral occurrence survey calc-silicate minerals are observed in this area.

In the southern portion, shear cliffs are composed of the limestone with obvious stratiform structure. There, north-south striking small quartz veins are abundant, and limestone has been silicified. Also the horizontal quartz veins in the range of 0.3 to 3.0 m in width partly replace along bedding plains of limestone, and the limestone around this-type quartz veins is dolomitized. Most of the quartz veins are barren except a quartz vein near the sample of D20-55. The druze of the center part of this vein is filled by brown carbonate mineral that was also observed in Trench No.1 and MJTM-1 hole at Phase II work. The vertical vein of brown carbonate mineral with 7 m wide was found around the D20-58 sample down below the above-mentioned vein, and a quartz vein with hematite films (D20-61 with 15 cm wide) occurs at the boundary between this vein and hosted limestone. The limestone around 1,100 m above sea level in the northeast side is often horizontally dolomitized, but no significant mineralization is found.

In the northwestern portion, strongly dolomitized limestone occurs on the ridge. Two occurrences with quartz veins accompanied by galena and sphalerite, which replace along interlayer of dolomitized limestone, are discovered on the ridge. The quartz veins are small-scale with maximum 80 cm wide and maximum 40 cm wide respectively, and contain silicified limestone, galena, and small breccia of brown carbonate mineral. The limestone around these occurrences shows strong intra-formational folding, and the quartz veins replacing bedding plains have poor continuity.

At the west slope of the ridge, quartz veins occur in places. They fill vertical joints of dolomitized limestone and include silicified breccia and brown carbonate breccia. The veins of brown carbonate mineral are also scattered in the ridge. The widths of these veins range from 20 to 30 cm, and are accompanied by a small-scale silicified zone. The extensions of veins are limited, and most of the veins pinch out approximately 10 m.

2. Result of the chemical analysis

The rock chip sampling sites were arranged at the collected unit of 20 to 25 m along the survey line. The amount of each rock chip sample was about 2 kilograms. Each vein sample was collected from its whole width as different samples from the continuous rock chip samples.

In the silicified zone of the southern portion, most of the samples show low grade ranging from 35 to 590 ppm Zn, from 5 to 535 ppm Pb, and lower than 2,000 ppm Mn, except for two samples rich in brown carbonate veins (D20-40, D20-53). D20-40 and D20-53 show high manganese and zinc contents, 7,270 ppm and 1.32% Mn, 580ppm and 3,020 ppm Zn respectively. The samples rich in quartz veins also show high manganese content.

The quartz veins in this silicified zone contain high zinc and lead: D20-18 is 3,180ppm Zn and 95 ppm Pb, and D20-61 is 2,750 ppm Zn and 2,680 ppm Pb. These content levels are almost equivalent to the values of the soil samples analyzed in Phase II work. Magnesium content of the rock chip sample, which indicates the degree of dolomitization of limestone, is commonly less than 0.3%. Therefore dolomitization is not so strong in this area.

The samples collected from weak dolomitized portion (Mg≦1.0%) show several tens ppm Zn and Pb, whereas those from strong dolomitized portion show 330 ppm to 1.6% Zn, and 50 to 970 ppm Pb.

Two occurrences with quartz veins containing galena and sphalerite are detected in the strongly dolomitized ridge. The analysis value of D20-2 quartz vein with 30 cm wide is 995 ppm Zn and 150 ppm Pb, D20-3 with 30 cm wide is 120 ppm Zn and 1.12 % Pb, a small vein of D20-4 is 120 ppm Zn and 50ppm Pb, and D20-26 with 80 cm wide is 7.86 % Zn and 2.82 % Pb. All samples contain highly manganese and magnesium in the range of 6,540 ppm to 1.72 % Mn, and 1.81 % to 9.78 % Mg.

The D20-25 rock chip sample with 20 m interval, including D20-26 vein, presents 1.60 % Zn and 1.43 % Pb, but ore mineral has not been determined in the outcrop.

1-2 Drilling Survey

1-2-1 Outline of the drilling survey

1.Outline of the work

The drilling survey is made in the Dong Noi and the Mae Kanai area, which were selected as the promising regions based on the result of the Phase II exploration. The purpose is to check for the detail geology and to confirm and grasp an ore deposit and its mineralization type in the room for IP, geochemical anomaly area that grasped the copper/lead mineral occurrences of the Mae Kanai and Dong Noi area.

In the Dong Noi area, the north to south trending geochemical anomaly of Zn, Pb and Cd and the same trending IP anomaly that were recognized. In this anomaly, two drill holes carried out in the Phase II that grasped the existence of Cu-Zn mineral occurrences hosted by skarn. In this year, one drill hole was planed to confirm underground geological information and mineral occurrence on this anomaly north extension. The site of drill hole is shown in Fig.II-1-1. The length of drill hole is 187.50 meters.

A drilling team consists of one operator and 3 to 4 workers per shift and the drilling is 24 hours by three shifts as a rule except movement, assembling, dismantlement and withdrawal.

The schedule of location work started on 11 February 2000 in the work of Mae Kanai area that describes later, which was maintenance of unpaved road from Dong Noi village to MJTM-5 site of Phase II.

The establishment of the access road from MJTM-5 hole to MJTM-6 hole was decided the course that makes a detour the mountainside of Doi Dong Luang to avoid the source of water.

The water for drilling was transported by two trucks attached 10m^3 capacity of a water tank from the water supply of Ban Huai Pla Khan, 8km apart from the Dong Noi area.

At first, they transported directly to the drilling site. But after the rainfall, they could not climb the slope because of the establishment road turned mud, so the transportation changed to pump up near the junction of toward MJTM-3 hole in the Phase II.

The program and the summary of the drilling survey were shown in Table II-1-1 and Table II-1-2 including 4 holes of the Mae Kanai area.

2. Drilling method and used drilling machines

The drilling is carried out by a wire-line method using two size bits of HQ, NQ. The drilling was planed to that NQ is final bottom bit size, but the truth is that it was used properly by the rock condition and rock quality.

For protection of loss circulation and wall sloughing, we prepared sufficient casing pipes and cased off it to drilling hole.

The type of drilling machine was the VK-600 that made of the Australian Vilkens Keo Ltd. The drilling machines and wear parts used in the drilling work including those in the Mae Kanai area are shown in Appendix 5.

3. Drilling work

(1) Setup works

[Road Preparation]

The unpaved road connecting between the national highway through Ban Mae Kanai and Ban Dong Noi was maintained quite a lot parts by local government of Amphoe Mae Sariang, because of survey opening time passed the January middle of a month.

The access road from Ban Dong Noi to MJTM-5 site occurred the small-scale collapse in the shoulder of a road. It got finished with slight repair because of the repair was soundness in last year.

The access road from MJTM-5 to MJTM-6 was decided the course that makes a detour the mountainside of Mt. Don Rouen to avoid the water source area and woods.

[Mobilization and Setup of Equipment]

The drilling machine VK-600 was a mounted on truck type, and was driven to MJTM-6 site by itself.

(2) Drilling Water

Although the lack of drilling water was anxious from the experience in phase II, The water for drilling was transported by two trucks attached 10m^3 capacity of a water tank from the water supply of Ban Huai Pla Khan apart 8km from the Dong Noi area in this year. At first, they transported directly to the drilling site. But after start of drilling, it was unusual heavy rain in this season. Therefore the truck could not climb the slope because of the new establishment road turned mud and drilling stopped, so the water transportation changed to pump up near the junction of toward MJTM-3 in the Phase II.

(3) Drilling Operation

Drilling work in Dong Noi area is described below.

Table II-1-1 Program of drilling survey

Items	2000 January													2000 Febraury																						
	19	20	21	22	23	24	25	26	27	28	29	30	31	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Road & Site Preparation	to MJTM-7		to MJTM-9								to MJTM-10					to MJTM-8								to MJTM-6												
Rig-1Mobilization, Set up, Break down																																				
Rig-1Drilling				MJTM-7																			MJTM-8													
Rig-2 Mobilization, Set up, Break down																																				
Rig-2 Drilling					MJTM-9																															
Rig-3 Mobilization, Set up, Break down																																				
Rig-3 Drilling																				MJTM-10																
Demobilization																																				

Items							2000 March																													
	24	25	26	27	28	29	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Road & Site Preparation																																				
Rig-1Mobilization, Set up, Break down																																				
Rig-1Drilling work																																				
Rig-2 Mobilization, Set up, Break down																																				
Rig-2 Drilling work	MJTM-6																																			
Rig-3 Mobilization, Set up, Break down																																				
Rig-3 Drilling work																																				
Demobilization																																				

Table II-1-2 Summary of drilling activity

MJTM-6	Period	Total Turns	Working Turns	Day Off Turns	Turn Worker	Days
Road, Site Prepia	02/11～02/21	18	9	5	23	9
Mobilization	02/25	2	1	1	10	1
Drilling	02/26～03/08	32	30	2	127	12
Demobilization	03/09～03/10	4	2	2	24	2
total	02/11～03/10	56	42	10	184	24
Depth Planned	200.00 (m)		Drilling Speed	15.65 (m/ drilling day)		
Depth Drilled	187.80 (m)			7.83 (m / total working day)		
Core Length	183.80 (m)		Casing	15.00 (m)HW		
Core Recovery	97.87 (%)			(m) NW		
Water Carting	84.00 hours		560 m^3			

MJTM-7	Period	Total Turns	Working Turns	Day Off Turns	Turn Worker	Days
Road, Site Prepia	01/19～01/20	4	2	2	6	2
Mobilization	01/21～01/23	6	3	3	14	3
Drilling	01/24～02/08	26	21	5	136	16
Demobilization	02/09～02/10	4	2	2	20	2
total	01/19～02/10	40	28	12	176	23
Depth Planned	250.00 (m)		Drilling Speed	16.88 (m/ drilling day)		
Depth Drilled	270.00 (m)			11.74 (m / total working day)		
Core Length	267.10 (m)		Casing	8.70 (m) HW		
Core Recovery	98.93 (%)			260.10 (m) NW		
Water Carting	57.00 hours		190 m^3			

MJTM-8	Period	Total Turns	Working Turns	Day Off Turns	Turn Worker	Days
Road, Site Prepia	02/03～02/09	14	7	7	15	7
Mobilization	02/10～02/11	4	2	2	12	2
Drilling	02/12～03/05	46	40	6	134	23
Demobilization	03/06～03/08	4	2	2	10	2
total	02/03～03/08	68	51	17	171	34
Depth Planned	250.00 (m)		Drilling Speed	9.69 (m/ drilling day)		
Depth Drilled	222.90 (m)			6.56 (m / total working day)		
Core Length	198.55 (m)		Casing	5.80 (m) HW		
Core Recovery	89.08 (%)			188.00 (m) NW		
Water Carting	33.00 hours		110 m^3			

MJTM-9	Period	Total Turns	Working Turns	Day Off Turns	Turn Worker	Days
Road, Site Prepia	01/21～01/22	2	2	2	3	2
Mobilization	01/23～01/24	4	2	2	18	2
Drilling	01/25～02/05	24	20	4	93	12
Demobilization	02/06～02/08	6	3	3	16	3
total	01/22～ 02/08	36	27	11	130	19
Depth Planned	200.00 (m)		Drilling Speed	16.67 (m/ drilling day)		
Depth Drilled	200.00 (m)			10.53 (m / total working day)		
Core Length	188.03 (m)		Casing	35.00 (m) HW		
Core Recovery	94.02 (%)			180.25 (m) NW		
Water Carting	78.00 hours		260 m^3			

MJTM-10	Period	Total Turns	Working Turns	Day Off Turns	Turn Worker	Days
Road, Site Prepia	01/29～02/02	10	5	5	13	5
Mobilization	02/07～02/08	6	3	3	15	2
Drilling	02/09～02/18	20	19	1	134	10
Demobilization	02/19～02/21	6	3	3	15	3
total	01/29～02/21	42	30	12	177	20
Depth Planned	200.00 (m)		Drilling Speed	20.00 (m/ drilling day)		
Depth Drilled	200.00 (m)			10.00 (m / total working day)		
Core Length	190.85 (m)		Casing	12.00 (m) HW CP		
Core Recovery	95.43 (%)			105.00 (m) NW		
Water Carting	114.00 hours		380 m^3			

MJTM-6: Drilling was performed using by HQ bit from surface to bottom. From surface to 5.70m in the alluvium deposits was bored by no water. Tricone bit(4 1/2") was used for non-core drilling through the surface to 15.00m. PQ rods as casing pipe were going down to 15.00m. There is an intense rainfall in the 2nd day when started drilling and the drilling stopped for almost a day from that the water truck could not reach to the drilling site. After this, the drilling water was sent directly by using the pump to avoid such a trouble as shown above.

(4) Withdraw of equipment

This drilling was the last drilling point, was broken down immediately after drilling, and its equipment were carried by 10 tons of trucks and VK-600 that were used in the Mae Kanai area. Drilling sites was cleaned up after withdraw of equipment rapidly.

The cores were observed and taken samples for analysis in Mae Sariang town and were stored in the core warehouse of the Chiang Mai Branch of the Department of Mineral Resources.

1-2-2 geology of drilling hole

MJTM-6 was planed to clear the feature of mineralization corresponding with north extension area of IP anomaly because of MJTM-3 and MJTM-5 carried out in the Phase II that grasped the Cu-Pb mineralization relate well with IP anomaly.

Drilling log of scale 1: 200 is shown in Appendix 7.

MJTM-6: 187.80 m in depth

0.00-8.70m: Dark brown lateritic topsoil and tuffaceous mudstone that undergo argillization.

8.70-14.60m: Dolomitic limestone presents the light gray to the gray color, the dip of bedding mainly exhibits about 10 degree. It was undergone strong sheared that occur brecciation and/or argillization and oxidization is recognized conspicuously along the cracks from 13.50 to 14.40m and from 12.40 to 12.60m.

14.60-167.90m: This is composed of green skarn and magnetite skarn that present dark green gray to light green color, that mainly consist of magnetite, calc-amphibole, chlorite, epidote. It was undergone that green argillization(chlorite, talc) with quartz vein from 20.20 to 21.00m, silicification from 21.00 to 22.40m, brecciation from 22.40 to 22.90m. Magnetite is abundant from 27.80m to bottom. The calcite-quartz hairline is accompanied with the weak mineralization of galena and sphalerite that is recognized from 49.85 to 50.25m. Ore assay in this part shows 3,440ppmPb, 2,220ppmZn. Milky white quartz-calcite vein accompanied with pyrite dissemination and weak chalcopyrite mineralization is observed from 63.25 to 64.20m. Fluid inclusion homogenization temperature in a calcite vein at 63.50m are between 262℃ and 331℃. Salinity ranges from 4.3 to 5.2 wt.% of NaCl equivalent. Network quartz veins are accompanied with strong pyrite dissemination that is recognized remarkably from

69.30 to70.40m. However, ore assay data is not high content of Cu, Pb, and Zn. Pyrite mineralization with galena is observed from 84.70 to 84.80m. Ore assay in this part shows 3.9%Pb. Network quartz veins are accompanied with the strong pyrite dissemination, sphalerite and a little mineralization of chalcopyrite that is recognized from 88.50 to 89.70m. Ore assay in this part shows 1.1%Zn. The strong sheared and argillized zone accompanied with abundant pyrite dissemination and a little chalcopyrite mineralization is recognized from 91.70 to 94.00m and from 98.90 to 99.30m. A strong pyritization with fine-grained chalcopyrite mineralization is recognized from 102.60 to 109.60m, ore assay shows 0.2%Cu in the width of 2.8 m from 106.80 to 109.60 m. Magnetite and pyrite mineralization accompanied with garnet is recognized from 109.60 to 140.80m. Network quartz veins accompanied with strong pyrite dissemination and chalcopyrite mineralization are observed from 129.60 to 130.50m. Fluid inclusions in quartz are divided into normal type and CO_2 rich type at 129.60m. Normal type homogenization temperature is between 149℃ and 240℃ and temperature of CO_2 rich type is between 308℃ and 335℃. Salinity of both types ranges from 1.2 to 1.7 wt.%. It was undergone shearing, chlorite argillization and silicification are recognized from 140.80 to 144.40m. Network quartz veins are accompanied with fine-grained chalcopyrite from 144.40 to 150.80m. Ore assay is 0.42%Cu in the width of 0.5m from 144.40 to 144.90m, 0.57% Cu in the width of 0.65 m from 147.40 to 148.05m. The pyrrhotite is abundant in more depth of 148.30m. Pyrrhotite and pyrite dissemination with galena and a little chalcopyrite is recognized from 150.80 to 165.00m. Ore assay shows 0.56%Pb in the width of 3.8 m from 153.90 to 157.70m.

167.90～168.95m: There is light green aplitic dike with fine grained biotite. This rock is composed of quartz, potash feldspar, plagioclase, biotite, muscovite, and chlorite and is holocrystalline texture.

168.95～181.05m: There is dark green to the dark gray colored magnetite skarn (chlorite, amphibole) with a large amount of magnetite. Network quartz veins are abundant, pyrrhotite and pyrite disseminated is accompanied with chalcopyrite and galena that is recognized from 173.10 to 181.05m. Ore assay shows 0.42%Cu in the width of 3.9m from 177.10 to 181.00m, and especially 3.3%Cu, 0.2%Pb, 0.3%Zn in the width of 0.3m from 178.55 to 178.85m. Fluid inclusion homogenization temperature in quartz from 178.70 to 178.80m are between 149℃ and 195℃. Salinity ranges from 7.8 to 23.3 wt.%.

181.05～187.80m: It is composed of Potash feldspar porphyritic biotite granite. Mineralization is not remarkable , only there is a little pyrite dissemination along the crack from 181.30 to181.50m.

1-3 Consideration

1-3-1 Mineral Occurrence Survey

In the relevant northwestern part of the Dong Noi area, geochemical anomaly in lead, zinc, manganese and cadmium was observed along the district where limestone was distributed just as in the central to southern part of the Dong Noi area. Anomalies in lead (500-3,600 ppm) and zinc (500-3,400 ppm) were widely spread. Similar geochemical anomalies had been observed also around Trench No. 1 and MJTM-1 Hole during our survey of last year. However, no mineralized part was found in our boring and trench surveys.

On the other hand, out of rock samples gathered this time, although sectional samples extracted from strongly dolomitized part in the northwestern end and from quartz vein indicated high anomalies of over 1,000 ppm, most of their values were 200 ppm or less. As a result of our outcrop observation, in brown carbonate mineral vein, thread-lace quartz vein, quartz veins including quartz veinlets and granule of silicified breccia were assumed to have been formed through rise of ore solution along fissures and joint systems in limestone vertically, and later through their replacement and spread along joints in intra-layer directions and partly along specific horizon (lithofacies).

Also, from the result of outdoor observation, a well-developed silicificated zone consisting of quartz vein and brown carbonate mineral vein was found developed under a lower part of the dolomitized zone, and above it dolomitized zone was widely formed. In a dolomitized zone, with increase of zinc and lead concentrations also in host rocks, a quartz vein containing galena and sphalerite was considered to have been formed to be replaced with a specific horizon of the dolomite folded intraformationally, showing an accordion-like structure. These relationships are consistent with the result of our observation at Trench No.1. Few samples were seemingly included in the rock samples extracted from these sections that might show high geochemical anomalies.

Our measurement of homogenization temperatures and Salinity of fluid inclusion revealed no remarkable difference in homogenization temperatures between the sample from lower silicificated zone (D20-56) and quartz vein replaced with upper dolomite layer (D20-1). However, a large difference in Salinity was observed. Homogenization temperatures of the former and the latter were 180-240℃ and 160-250℃ respectively. Salinity as converted into NaCl of the former showed high values of 6.5-8.0wt%, while the latter showed lower values of around 1.0 wt% and 3wt%.

It is difficult to explain only from the results of rock sample analyses possible reasons for the wide-ranged and intensified geochemical anomalies in soil samples. However, it may be possible that lead and zinc contained in quartz vein and dolomitized zone formed widely along the joint fissures in limestone were absorbed into manganese oxide during the time when manganese similarly contained in them was changed to oxide in the weathering process and stayed on the land surface.

In the northwestern ridge carefully investigated this time, a certain amount of lead and zinc ore body might have occurred. A detailed investigation into geological structures will be necessary to decide the points of their occurrence.

1-3-2 Drilling Survey

The survey on MJTM-6 Hole was planned to grasp in particular the state of copper and lead mineralization in the district where anomaly was found on the basis of the results of MJTM-3 and MJTM-5 Holes which had been excavated in the districts where IP and geochemical anomalies in copper, lead and zinc were observed in the initial year.

Like the case of MJTM-3 Hole, in MJTM-6 Hole dolomitic limestone was distributed under land surface which was non-mineralized but argillized in part. In a deeper layer of 14.60 m or lower, magnetite skarn and green skarn were distributed. Existence of potassium feldspar porphyritic biotite granite which had been identified in MJTM-3 Hole was confirmed in the depth of 181.05 m.

The state of mineralization in the hole is summarized below from upper to lower layers. Around the depth of 50 m, existence of weak mineralization of galena and sphalerite accompanied by quartz-calcite vein was confirmed, and around the depth of 64 m, mineralization of chalcopyrite was identified together with quartz vein. Both in the depths of 85 m and 89-101m, disseminated mineralization of galena and chalcopyrite/sphalerite was identified respectively. Pb of the former was 3.9%, and Zn of the latter was 1.1%. From the depth of around 100 m, more dissemination of pyrite was found accompanying scattered chalcopyrite. In the depth of 140 m and lower, not only pyrite but also pyrrhotite, chalcopyrite and galena increased. In the depths of 176 m to 181 m as the bottom of the hole, pyrite mineralization was the most intensified. The average copper grade in this section was 0.42%. Copper mineralization had a tendency to become larger toward the part in contact with granite, which suggests that such mineralization occurred simultaneously with skarn formation. However, in view of the low fluid inclusion homogenization temperature of 150-200℃ in the quartz existing in the depth of 178.80 m where copper mineralization was the most intensive, it is difficult to think that such mineralization occurred at the time when it was in contact with granite. On the other hand, the extremely high Salinity of 8-24 wt%, it might have been possible that the mineralization was directly caused by residual magma of the granite.

The state of the depth around 64 m in MJTM-6 Hole where chalcopyrite occurred was almost consistent with that of the upper limit to the abnormal area whose value of 16m V-sec/V or more grasped as a result of IP exploration. The state of the depths of 140 m or deeper where mineral showing including chalcopyrite dissemination was intensive in general was consistent with the state of area with IP anomaly of 20 m V-sec/V or more. Fig. II-1-4 shows the cross section in the south to north direction including MJTM-3 and MJTM-5 Holes. As having been presumed from the result of the investigation conducted in the second year, the area with anomaly in IP is con-

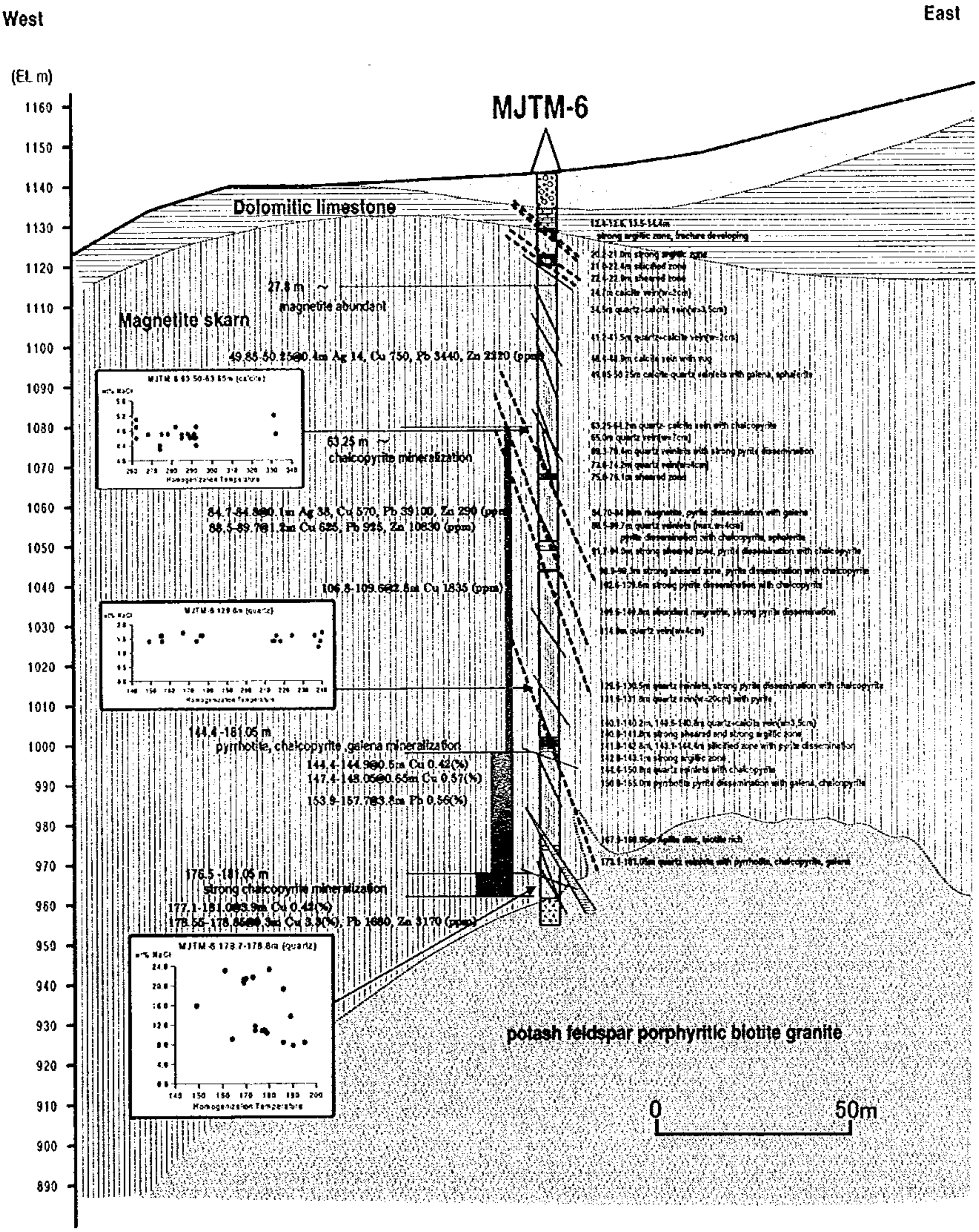


Fig. II-1-3 Geologic profile of MJTM-6

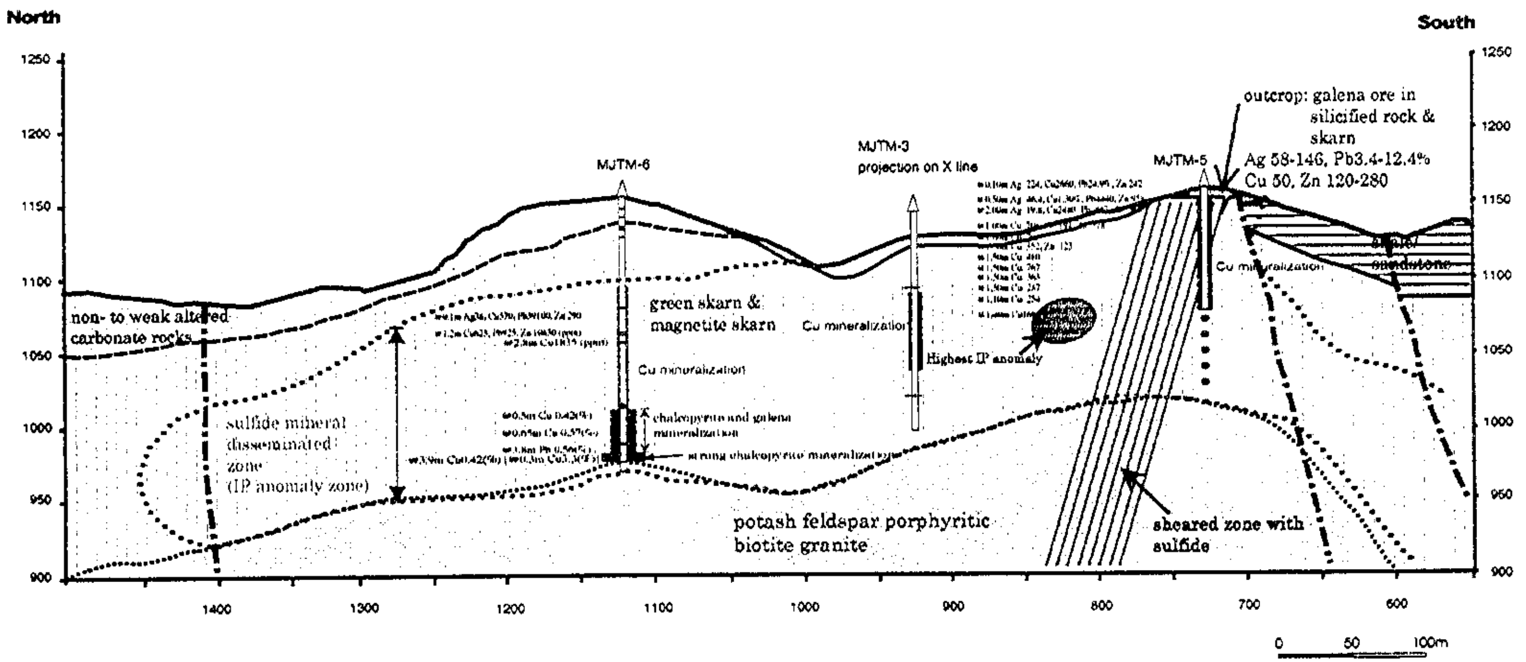


Fig.II-1-4 Geologic profile along IP anomaly zone at the center of the Dong Noi area sidered to represent the range where copper mineralization occurred. MJTM-5 Hole was excavated up to the depth of 100 m and it is not in touch with granite. However, around the hole bottom corresponding to 20m V-sec/V or more, copper grade had a tendency to become higher, i.e. Cu = 1,600 ppm or more, and from this we see a possibility of its grade becoming higher toward the place of granite existence. In view of the tendency of copper mineralization skarns to be distributed scatteredly, although it was difficult to definitely decide the specific location of ore shoots, existence of ore shoots might be possible in the area where anomaly in IP was observed. However, the highest grade was only CU = 3.3% in the 30 cm interval and Cu = 0.42% in the 5 m interval including the above 30 cm interval, and at present the place is not considered as an object of the intended operation.

Chapter 2 Mae Kanai area

Four drilling surveys were carried out in the Mae Kanai area. The sites of four drill holes are shown in Fig.II-2-1

2-1 Drilling survey

2-1-1 Outline of drilling survey

In the Mae Kanai area, MJTM-7 hole was planed to grasp an ore deposit and its mineralization type in the high IP anomaly area based on the result of the Phase II IP exploration. MJTM-8, MJTM-9 and MJTM-10 were planed to clear beneath the gossan zone of 0.3~0.8% Zn content and beneath the geochemical anomaly zones of Zn, Pb surrounding the gossan zone.

A drilling team consists of one operator and 3 to 4 workers per shift and the drilling is 24 hours by two shifts as a rule except mobilization, assembling, dismantlement and withdrawal.

The schedule of location work is described below. Each drilling site was permitted and applied by the attendance of the Forest Bureau of Mae Sariang branch and also the Forest Department of Amphoe Mae Sariang on 18 January 2000. Road preparation from the main road to MJTM-7 site started on 19 January. MJTM-7 site prepared and maintained on 20 January. An access road to MJTM-9 was repaired from 21 January. MJTM-9 site prepared on 22 January. A drilling machine was carried in and set up at MJTM-7 site on 20 January, at MJTM-9 site on 23 January. A water supply tank of 40m^3 was settled beside MJTM-9, water supply pipelines were instituted to each hole.

Drilling water was transported from a sluice by two carting trucks, it placed 1 km Mae Sariang town side from Ban Mae Ho. It is 6km apart from a tank.

Road preparation carried out in order of MJTM-10, MJTM-8. A road construction work to MJTM-8 needed 7 days before construction of drilling site, because slope is steep and it was a

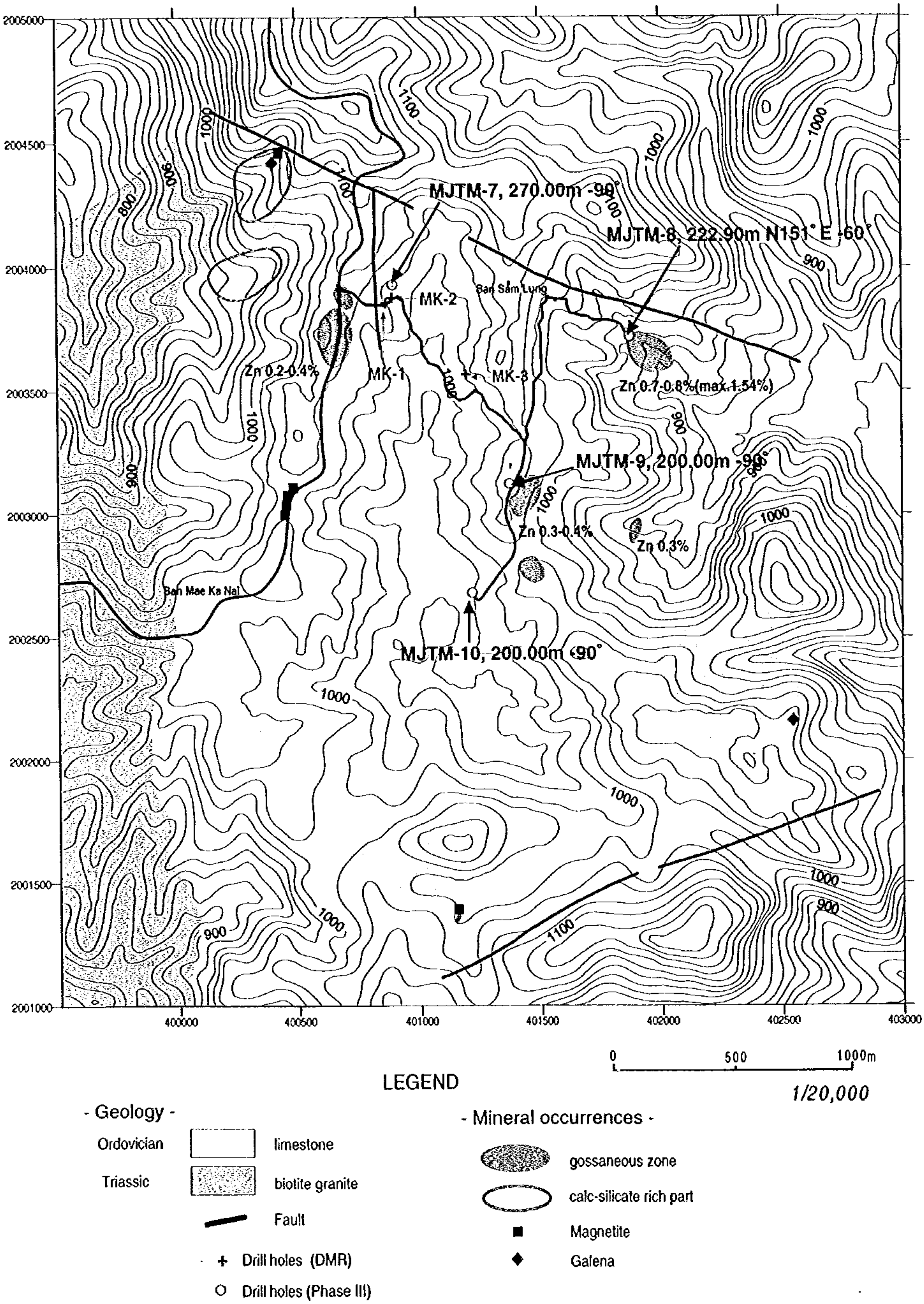


Fig.II-2-1 Location map of the drill holes in the Mae Ka Nai Area little difficult to cut a road for much growing bamboo forest.

Drilling work was smooth almost except for MJTM-8. Drilling work of MJTM-8 was difficult for the rushing water is about 200 liter per a minute deeper 185m, in addition to the rock was hard and broken into small piece at the lower part.

The program and the summary of the drilling survey were shown in Table II-1-1 and Table II-1-2.

2-1-2 Drilling method and used drilling machines

The drilling is carried out by a wire-line method using two size bits of HQ, NQ. The drilling was planed to that NQ is final bottom bit size, but the truth is that it was used properly by the rock condition and rock quality.

For protection of loss circulation and wall sloughing, we prepared sufficient casing pipes and cased off it to drilling hole.

Three using drilling machines were the VK-600 of the Australian Vilkens Keo Ltd., the MPR-3 of the Drillcorp South East Asia Ltd, and the LY-44 of the Longyear Corporation.

The drilling machines and wear parts used in drilling work including those in the Mae Kanai area are shown in Appendix 5.

2-1-3 Drilling work

(1) Setup works

[Road Preparation]

The unpaved road connecting between the national highway through Mae Kanai and Bang Dong Noi was maintained quite a lot part by Amphoe Mae Sariang, because of survey opening time passed in the middle of January.

The access road from the main road to MJTM-9 and also Ban Sam Lung was the narrow width and had bad damage by rain. Therefore, it needed slight repair.

It was easy to connect from existing road to near road of MJTM-7.

About MJTM-8, road preparation was easy extended the width until Ban Sam Lung. The access road was planed on the small ridge was underlain by hard shale from Ban Sam Lung to drilling site. Road construction work needed 6 days before construction of drilling site, because slope is steep and it was difficult to except the bamboo root.

MJTM-9 adjoins the established road and the maintenance of site was easy.

MJTM-10 was in the gentle slope of only miscellaneous small trees. Therefore, it was easy to prepare the access road and the development of drilling site.

[Bringing and Setup of Equipment]

VK-600 was a mounted on truck type and MPR-3 was a caterpillar mounted type. They were driven to MJTM-7 site and MJTM-9 site by itself. LY-44 was carried in site of MJTM-10 by ten-ton truck.

(2) Drilling water

A water tank of $40m^3$ was settled up beside the site of MJTM-9, some water supply pipelines were established to each drilling hole. About MJTM-8, mainly drilling water was used stream water beside the drilling site because that the stream had the much volume of water and lost circulation point was only few.

(3) Drilling operation

Drilling work in Mae Kanai area is described below.

MJTM-7: Drilling was performed using by HQ bit from surface to 260m, and NQ bit from 260m to 270m. Dry blocking was worked from surface to reached weathering zone at 8.70m. Tricone bit(4 1/2") was used for non-core drilling through the surface to 8.70m and PQ rods as casing pipe were going down. Drilling work almost proceeded smoothly to the plan depth of 250m. Pyrite disseminated zone occurred nearly 245m. Therefore the drilling was continued until plan depth of 300m to confirm this mineralization, but it was ended at 270m because pyrite dissemination and silicification weakened at 264.6m. HQ size drilling was bored from 250.0m to 260.0m. NQ size drilling was bored from 260.0m to 270.0m. The casing pipe of HQ rod was insert to 260m.

MJTM-8: Drilling was performed using a HQ diamond bite from surface to 185.70m, NQ size bit from 185.70m to 222.90m. Dry drilling was worked from surface to under first gossan zone at 5.95m. Tricone bit(4 1/2") was used for non-core drilling through the surface to 4.80m and PQ rods as casing pipe were going down. Drilling work almost proceeded smoothly to nearly 130m. The rod stuck was caused in the brecciated zone of skarnized limestone. The drilling condition returned smoothly after accident recovery. The rushing water was about 200 liter a minute at brecciated part of 184.50m. To change NQ bit was at 187.50 m and even the casing pipe inserted, but water rushing did not decrease. More than 200m, the block was happened many times by drilling wall collapse because that hard silicified rock and chart distributed, shear-brecciated was remarkable, and underground water was abundant and its pressure was strong. Also, some bit were consumed and broken for the hard gravel dropped to bottom hole. To try cement work for keeping drilling wall was unsuccessful by high-pressure water. Therefore, drilling deepen was conducted by using NW bit for casing pipe go down bottom. But two bits were consumed and rod was stacked. For this reason, HQ rod was drawn up for bit change. After changing NQ bit, rods were gone down again. Drilling wall collapse might occur at sheared and brecciated zone near 120min depth. On-off rods were repeated, and drilling wall collapse more advanced. Drilling work was canceled at 222.90m under the apprehension that the drill hole accident happened.

MJTM-9: Drilling was performed using a HQ diamond bite from surface to 180.00m, NQ size bit from 180.00m to 200.0m. Dry drilling was worked from surface to 9.60m. The lost circulation occurred at 34m, casing pipe were going down to 35m. After that drilling work almost proceeded smoothly.

MJTM-10: Drilling was performed using a HQ diamond bite from surface to 104.85m, NQ size bit from 104.85m to 200.00m. Dry drilling was worked from surface to reached rock at 11.80m. PQ rods as casing pipe were going down to 11.80m. Drilling work almost proceeded smoothly.

(4) Withdraw of equipment

MPR-3 ran to MJTM-8 by itself after finished MJTM-7. After MJTM-8 hole, this machine installed all the equipment that was carried by a trailer truck.

VK-600 was once transported for repairing to Chiang Mai after MJTM-9 drilling, it removed to MJTM-6 hole in the Dong Noi area after completion of repairing.

LY-44 and its all the equipment were carried by 10-ton truck after MJTM- drilling.

2-1-4 Geology of Drill hole

Four drilling holes were carried out in the Mae Kanai area. Drilling log of scale 1: 200 are shown in Appendix 7.

MJTM-7: to 270.00m

0.00~3.70m It consists of the light brown lateritic top soil including limestone gravel.

3.70~4.20m It is composed of the rework sediment distributing in low ground along stream.

4.20~8.60m It consists of strong weathering sandstone with yellow gray to light-brown colored.

8.60~119.40m It is composed of carbonate rock showing weak skarnized that is undergone chlorite, epidote alteration, silicification zone is observed partly.

8.60~9.90m This zone presents the light yellow to the light orange colored is altered from by the weathering.

9.90~18.00m Fine to coarse grained pyrite dissemination with a little magnetite is abundant.

19.70~25.00m Weak pyrite dissemination is observed.

21.20~30.40m Calcite veins (the vein width of about 1 cm) are greatly recognized.

31.00~33.00m Fine to coarse grained pyrite disseminated with a little magnetite are observed.

33.00~34.40m Light green gray to white colored silicification is recognized.

42.30~42.50m Calcite network veins are abundant.

43.70~44.00m Calcite network veins are abundant.

55.00~55.80m Calcite-quartz veins with chalcopyrite film is observed. Ore assay from 55.20 to 55.50m shows 0.1%Cu.

70.00~71.00m Chalcopyrite is observed. Ore assay at 70.75 m~70.85m shows 0.6%Cu.

87.20～91.30m Strong coarse grained pyrite dissemination with magnetite is recognized..

91.30～119.40m This zone is undergone strong silicification with light gray to gray color. Quartz-calcite vein (the width of 2 cm) at the depth of 94.75 m is accompanied with sphalerite, a little chalcopyrite, galena, pyrite. Fluid inclusion homogenization temperature in sphalerite are between 180℃ and 240℃. The salinity ranges from 6.6 to 7.8 wt.% of NaCl equivalent. Ore assay in this part shows 1.16% Zn.

119.40～122.40m Fine alternation of white limestone and black shale. Slickenside along bedding is remarkable, and graphite is recognized.

122.40～124.30m It is composed of massive white limestone.

124.30～125.00m Light green limestone is undergone weak skarnized.

125.00～127.40m Alternating beds of carbonaceous black shale and white limestone. Schistose slickensides are abundant and graphite is recognized conspicuously. Ore assay from 127.00 to 127.40m shows 0.2%Zn, 0.1%Pb.

127.40～129.10m It is consists of sheared skarn that presents light gray to light green gray color. Strong sheared zone is undergone argillization(sericite, chlorite, saponite) with pyrite dissemination and weak chalcopyrite mineralization.

129.10～129.20m Quartz-calcite vein accompanied with a large amount of chalcopyrite mineralization is developing. Fluid inclusion homogenization temperature in the quartz are between 299℃ and 309℃. The salinity ranges from 7.2 to 8.5 wt.%. Ore assay with 10 cm in width shows 18.5%Cu.

129.20～129.60m It is composed of the sheared chlorite skarn. Chalcopyrite mineralization is observed in argillization zone(sericite, chlorite). Ore assay from 129.20 to 129.50 m shows 1.35%Cu and from 129.10 to 129.50m is 5.5%Cu.

129.60～131.10m Alternation of black shale and white limestone shows strong foliation, and graphite is much.

131.10～161.10m It is mainly consists of chlorite skarn that presents light gray to light green gray color and include carbon-rich shale thin layer in part. This zone is undergone strongly shearing causing rock fragmentation, brecciation, and argillization with quartz-calcite vein. Pyrite dissemination with very fine-grained chalcopyrite is observed from 135.20 to 136.70m. Ore assay from 135.00 to 137.00m in width of 2 m shows 0.2%Cu.

161.10～239.00m It consists of chlorite skarn with silicification, and argillization(chlorite, sericite, saponite) and intercalate thin shale layer partly. Quartz-calcite veins with pyrites-chalcopyrite is recognized from 176.90 to 179.90m. Ore assay from 177.00 to 177.10m in width of 0.1 m shows 0.3%Cu.

239.00～264.60m It consist of the sheared skarn that presents dark gray to light gray color. Fluid inclusion homogenization temperature in the quartz vein at 245.70m are between 194℃ and 197℃. The salinity ranges from 6.9 to 7.2 wt.% of NaCl equivalent.

The anomaly of copper/lead/zinc is not recognized from 245.50 to 248.50m.. It is undergone argillization(saponite, chlorite) with light green to white color, strong fine to coarse grained pyrite dissemination is recognized from 248.50 to 264.00m. It is accompanied with strong silicification and abundant pyritization from 264.00 to 264.60m.

264.60～270,00m It consist of the green skarn zone that presents dark green to green color with pyrite dissemination.

MJTM-8 :to 222.90 m(N151E, -60°)

0.00～1.30m It consists of the filled -up soil by construction of drilling site.

1.30～1.50m It consists of the lateritic top soil that presents darkness brown color and includes small gravel of gossan.

1.50～5.95m Gossan presents darkness brown to the light yellow brown color. Gossan shows wavy or banded structure and is mostly consist of limonite with pyrite relic in part. Also it include white clay(chlorite, sericite?) from 4.25 to 4.30m and 4.80m. Ore assay from 1.60 to 6.0m in width of 4.4 m shows 1.3%Zn.

5.95～10.25m Shale, sandstone, alternation of shale and sandstone are distributed and argillization(chlorite, sericite, talc) are remarkable to the whole.

10.25～11.95m Gossan shows brown to yellowish brown color. Gossan is rich limonite and is accompanied with white clay (chlorite, sericite). Ore assay from 10.25 to 11.95min width of 1.75 m shows 0.5%Zn.

11.95～17.80m It mainly consists of fine grained sandstone with light yellow color. Bluish gray colored clay(chlorite) seams by hydrothermal alteration were intercalated from 13.45 to 14.25m.

14.25～14.30m Gossan is darkness brown color, ore assay shows 0.4%Pb, 0.3% Zn.

17.80～21.40m Yellow colored shale is undergone hydrothermal alteration. Some vertical cracks are developing accompanied with manganese oxide film abundantly.

21.40～27.70m It consists of dolomite with purple to the light gray color. Many veins of quartz-calcite-chlorite are accompanied with pyrite dissemination, a little chalcopyrite, sphalerite, and galena.

27.70～30.90m It consists of the shale with orange to the yellow brown color. Hydrothermal alteration with a large amount of limonite is recognized.

30.90～37.95m It consists of dolomite with darkness green gray color. Network calcite-quartz veins are abundant. Fluid inclusion homogenization temperature in the quartz vein at the depth of 32.80m are between 106℃ and 183℃. The salinity ranges from 1.9 to 8.3 wt.%.

37.95～40.60m Dark gray colored shale is undergone silicification. Quartz-calcite veins with a little pyrite dissemination are abundant.

40.60~41.20m It consists of the dark gray colored dolomite with the calcite-quartz vein. Pyrite-chalcopyrite dissemination are recognized from 40.60 to 40.80m. Ore assay at this part shows 0.8%Cu.

41.20~43.00m It consists of the dark gray silicified shale with weak pyrite dissemination.

43.00~46.00m It consists of alternation of dolomite and siliceous shale with pyrite dissemination.

46.00~57.40m Light green dolomite distributes and that is undergone weak skarnization(chlorite, pyrite). Calcite-quartz veins with several centimeter widths are observed with interval of 1 m each between 40.60 and 40.80m and between 50.50 and 56.00m.

57.40~67.50m There is muddy dolomite showing light gray to gray color with weak pyrite dissemination.

67.50~68.50m Dark green dolomite is undergone a little skarnization and is accompanied with fine grained pyrite dissemination.

68.50~76.30m It is consist of gray siliceous shale .Cracks with weak pyrite disseminated are abundant.

76.30~79.70m It consists of the light-brown chart with weak pyrite dissemination.

79.70~102.20m Alternation of shale and limestone is black to the gray color with width of 40 to 100cm in each. Both rock facies show strong cataclastic texture. Small breccia of limestone with boudinage shape are included in the clayey shale layer. Slickenside is greatly recognized in clayey shale.

102.20~104.20m Light gray colored siliceous shale with a little pyrite.

104.20~109.40m It is alternated beds of shale and limestone that present black to white color. Interval of alternation is from 40 to 100cm in width. Strong sheared texture is remarkable.

109.40~115.30m It is dolomite with green color undergoing skarnization.

115.30~125.60m Alternation of limestone, shale, and green skarn strongly sheared is developing. Pyrite dissemination are observed from 117.90 to 120.30m.

125.60~133.90m It consists of the green skarn undergoing strongly sheared. Silicification and fine grained pyrite dissemination are observed from 131.40 to 132.00m.

133.90~138.20m It composed of the green skarn with banded structure and dark green color.

138.20~159.90m It consists of the silicified skarn with light green to green color. Network quartz-calcite vein occurs. Hornfelsic dark gray massive sandstone is intercalated from 139.40 to 140.10m.

159.90~165.70m It is an alternation of skarnized green limestone and light brown to green colored chart.

165.70~173.70m It consists of the dark green to green colored green skarn.

173.70～188.00m Alternating beds of light brown to green colored chart and green skarn.

188.00～197.60m Purplish gray to light green hornfelsic sandstone is distributed with pyrite dissemination and weak chlorite-epidote alteration.

197.60～199.00m It consists of massive green skarn.

199.00～204.00m It is purplish gray to light green hornfelsic sandstone accompanied with weak chlorite-epidote-pyrite dissemination.

204.00～209.20m Light green to green massive green skarn is distributed accompanied with pyrite dissemination.

209.20～222.90m This part is undergone strong silicification. There are extremely abundant cracks and much brecciation, and it is also occurred fine cracks with pyrite at this part.

MJTM-9 : to 200.00 m

0.00～20.20m. Weathered reddish-brown lateritic soil is distributed. Shale and/or sandstone gravel has been undergone weathering argillization, and silicified limestone gravel and/or thin layer is observed from 11.00 to 11.30m.

20.20～28.70m Orange to light-brown weathered fine-grained sandstone is developed partly with argillization.

28.70～29.70m It is light yellow brown shale with clear thin lamina.

29.70～34.35m Alternation of shale and sandstone. It is undergone strong argillization with breccia of limestone and quartz vein from 29.70 to 31.60m. Strong white argillization(talc, smectite, chlorite) with limonite occurs from 31.60 to 34.35m and it includes abundant breccias of quartz vein from 34.30 to 34.35m.

34.35～35.10m This matrix is reddish-brown mudstone. Small veins of limonite fill up in grain gap of brecciated texture. It might be as a halo of the gossan zone.

35.10～39.50m It consists of remarkable laminated and light gray to gray dolomite. From 38.00 to 39.50m, network quartz veins occur abundantly with silicification in part.

39.50～42.70m Original rock is unknown by argillic alteration(talc, smectite, sericite, chlorite). Thin layers of dolomitic limestone are intercalated from 41.40 to 41.50m.

42.70～43.40m It is thin laminated limestone partly dolomitic. Hematite vein occurs along bedding-plane at 43.38 m.

43.40～44.05m Mudstone with argillization and shearing brecciation.

44.05～50.00m It consists of gray dolomitic limestone with thin bedding of 1 to 10mm in width. There is partly weak pyrite dissemination and the quartz-calcite veins in parallel of bedding-plane.

50.00～64.00m It is dark gray to gray muddy dolomite with parallel bedding texture with 1 to 10mm in width. There are several hematite veins occurring along parallel bedding-plane. The oxidization is remarkable from 51.60 to 52.00m. Weak pyrite dissemination is seen from 52.00 to 64.00m.

64.00～80.00m Parallel bedded with 1 to 10 mm in width of dark gray to gray dolomite. There has weak pyrite and hematite dissemination. There is abundant calcite vein from 67.90 to 68.10m. Oxidization is remarkable from 79.00 to 79.20m and from 71.00 to 73.00m. Hematite is abundant from 76.20 to 78.00 m.

80.00～98.70m Wavy bedded tuffaceous and/or muddy dolomite and light gray to gray dolomite are alternatively. Weak dissemination occurs from 82.00 to 83.70m, from 89.10 to 92.90mandfrom 92.90 to 98.70m.

98.70～200.00m Parallel bedded gray to dark gray dolomite. Partly oxidization with pyrite dissemination and hematite/limonite are recognized.

137.50～138.20m It is accompanied with argillization(talc, smectite, chlorite) with remarkable brecciated texture and pyrite dissemination.

139.80～139.90m Calcite-quartz vein is with width of 10 cm accompanied with strong pyrite dissemination.

157.00～160.00m It is light green gray color and is undergone weak argillization and pyritization. This part is undergoing strong argillic alteration (talc, smectite, sericite, and chlorite) from 158.30 to 158.50m and from 159.20 to 159.30m.

165.60～166.80m It presents gray to light gray color and massive and compact. Pyrite dissemination is moderately.

178.30～178.60m Network calcite vein is abundant with orange to light brown alteration.

178.90～183.90m It is undergone weak silicification. Calcite veins with abundant pyrite dissemination and argillization(smectite, green mud stones) occur from 183.90to 184.10m.

184.50～185.50m It is undergone light brown to orange oxidization.

187.50～188.70m It is undergone light brown to orange oxidization.

188.70～188.85m Calcite vein with fine grained pyrite dissemination.

199.00～199.20m Calcite vein with oxidization is abundant.

199.40～199.70m Calcite vein with the oxidization is abundant.

MJTM-10 : to 200.00 m

0.00～11.40m Brown to orange lateritic weathered soil. Light brown to yellow colored strong weathered fine sandy soil dominates from 10.00 to 11.40m.

11.40～20.70m Light gray to gray limestone with clear brecciated texture. Brecciated part shows light brown to orange color and network calcite-quartz veins are abundant. Strong argillization occurs from 15.00 to 15.60m. From 15.60 to 17.00m it is brecciated limestone and network calcite-quartz vein is abundant. Light gray to gray hard limestone distributes and network quartz-calcite vein is abundant from 17.00 to

20.70m.

20.70~27.50m It consists of light gray to gray limestone with gentle dip bedding. Silicification occurs from 23.70 to 24.00m. Light brown carbonate mineral veins occur from 24.60 to 25.00m. Weak pyrite dissemination is recognized from 25.00 to 25.70m.

27.50~30.50m Brown to orange dolomitic limestone is undergone porous alteration, and network calcite-quartz vein is abundant.

30.50~35.00m Light green limestone distributes. Reddish-brown porous alteration occurs from 31.80 to 32.70m. Network calcite vein is observed from 32.70 to 35.00m.

35.00~45.00m Gray to light gray colored dolomitic limestone and dolomite alternation. There shows parallel lamination.

45.00~56.20m Light gray to gray colored limestone. It is well bedding and is accompanied with weak pyrite dissemination. Brown porous alteration with brecciated texture occurs and calcite veins fill up among breccias from 51.20 to 51.90m. Milky white quartz-calcite veins of 10 cm width with pyrite develops from 55.00 to 55.10m. Ore assay of this part was examined, but anomaly of the copper/lead/zinc was not detected.

56.20~56.50m Dark gray colored mudstone. Network quartz veins well develop and silicification with pyrite and galena are recognized at the contact of vein. Ore assay from 56.25 to 56.30m in width of 0.05m shows 0.9%Pb and from 56.40 to 56.50m in width of 0.1 m shows 7.29%Pb and 0.3%Zn.

56.50~58.50m Light gray to gray colored massive dolomitic limestone. It is accompanied with weak pyrite dissemination.

58.50~65.00m Light gray to light gray colored limestone with well parallel bedding. Quartz-calcite vein is accompanied with pyrites and galena from 59.25 to 59.28m. Ore assay at this part is 1.3%Pb. Crack develops from 60.00 to 65.00m. Strong reddish-brown colored porous alteration occur from 62.30 to 62.60m and from 63.30 to 63.50m.

65.00~78.00m Gray to dark gray colored dolomitic limestone with parallel bedding. Brown carbonate mineral veins occur from 65.00 to 66.00m. Yellow to orange colored porous alteration are observed from 67.10 to 68.10m. Banded green alteration(chlorite) develops with alteration vein of brown carbonate mineral from 69.80 to 70.20m. Ore assay of this part was examined but the anomaly of the copper/lead/zinc was not detected. Silicification and milky white quartz vein with pyrite are alternatively developing from 73.50 to 78.00m. Ore assay from 76.35 to 76.60m and from 77.40 to 77.55m did not show anomaly of copper/lead/zinc.

78.00~81.40m It consists of dark gray calcareous shale. Reddish-brown to yellow colored porous alteration and network quartz-calcite veins occur from 78.00 to 81.40m. Ore assay from 79.75 to 81.00m was examined but copper/lead/zinc anomaly was not detected.

81.40~85.00m It consists of light gray to light green colored dolomite. Milky white quartz veins are abundant from 81.80 to 83.00m. Strong pyrite dissemination occurs from 82.00 to 82.50m. Ore assay at this part did not detected anomaly of copper/lead/zinc. Milky white quartz-calcite veins are abundant from 84.10 to 84.30m. Weak pyrite dissemination occurs from 84.30 to 85.00m.

85.00～99.20m Light green gray colored limestone is well bedding. Milky white calcite-quartz vein with brown oxide mineral are recognized from 90.80 to 93.50m.

99.20～148.60m It is consist of the dark gray to black colored shale and that dip of bedding is gentle. Chloritoid porphyroblasts are observed from 136.10 to 136.30m and from 137.15 to 137.30m. Overall milky white quartz-calcite veins are abundant with pyrite dissemination. Also, pyrite dissemination occur abundantly along bedding plane. There are many cases that pyrite oxidizes and turn into hematite often from 128.20 to 129.00m and from 137.80 to 148.60m.

148.60～161.00m It is consist of light gray to white colored dolomitic limestone. Weak pyrite dissemination occurs with orange colored porous alteration at the part of crack developing. Mottled coarsely pyrite dissemination is recognized from 156.40 to 156.90m.

161.00～176.00m Interbedded dolomite and calcareous shale shows light gray to gray colored. Brecciated texture is observed locally. Network veins of calcite and/or quartz accompanied with fine grained pyrite dissemination are abundant.

176.00～178.70m It consists of black shale. It undergoes silicification and is observed strong pyrite dissemination with quartz vein.

178.70～190.40m It is composed of light gray to white colored dolomitic limestone that shows parallel bedding dominantly. It partly intercalates black shale layers and is accompanied with weak fine grain pyrite dissemination.

190.40～200.00m It consists of light gray to light green gray colored dolomitic limestone and dolomite. Weak silicification and light green to white colored weak argillization occurs from 195.60 to 196.80m.

2-2 Consideration

MJTM-7 Hole was excavated as a target of the highest IP anomaly in the Mae Kanai area (Fig.II-2-2). In this hole, surface soil and rework sediment along stream were distributed from the surface to the depth of 4.20 m, and Ordovician fine-grained sandstone was distributed up to the depth of 8.60m. In the depths of 8.60 m or deeper, green or light green slightly skarnized limestone under the influence of chloritization and epidotization was distributed, and in the depths of around 120 to 140 m it existed surrounding mudstone and white unaltered limestone. Silicificated zone was developed in the depths of 91-120 m and 161-239 m. In the depths of 10-50 m, pyrite dissemination was universally confirmed and small amounts of magnetite were accompanied in four sections. Also, chalcopyrite films were observed along cracks. In the depths of 50-91 m, a lot of calcite (-quartz) veins were developed in general, but their mineralization seemed

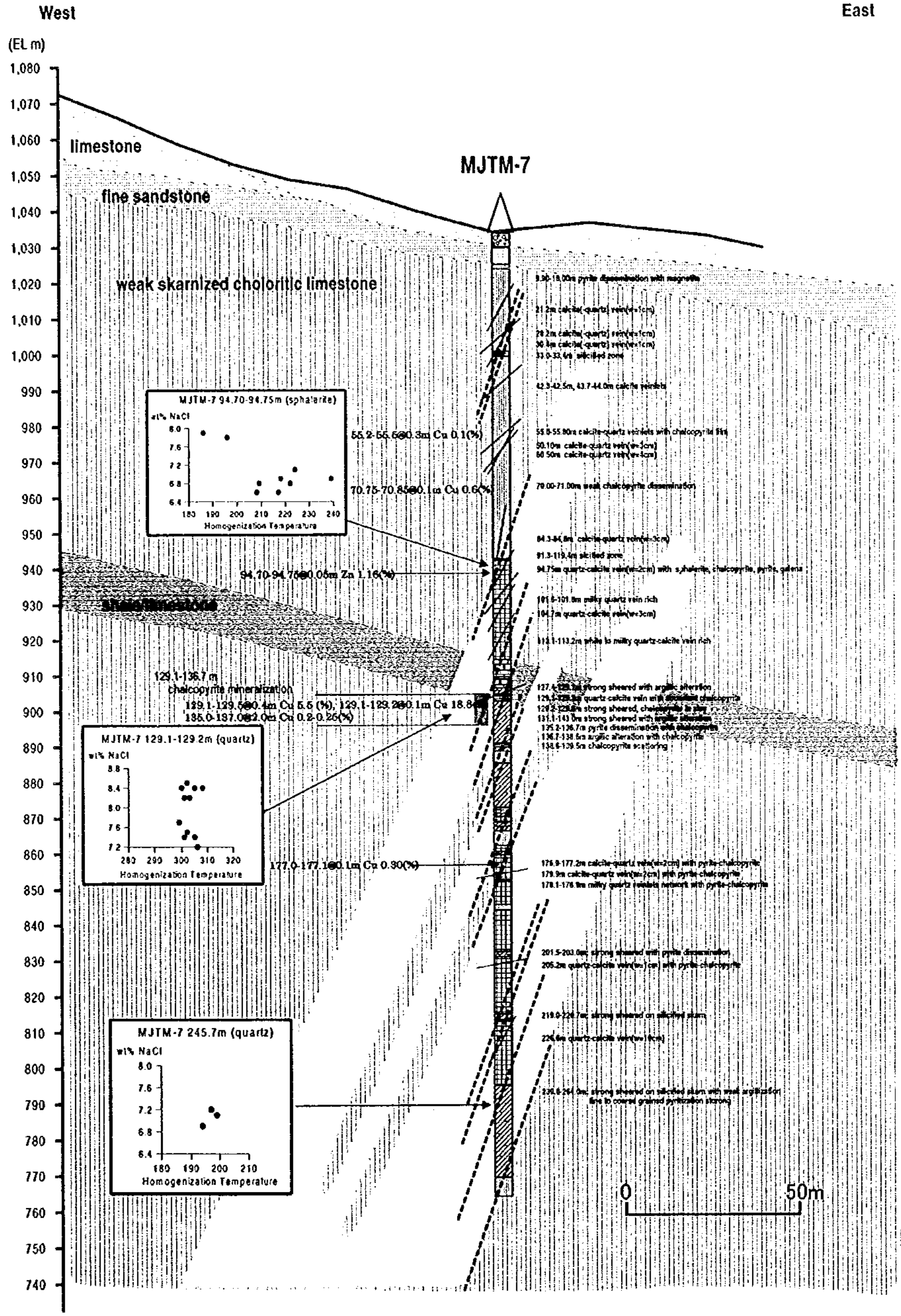


Fig. II-2-2 Geologic profile of MJTM-7

weak. In the depth of 87.20 m or deeper toward silicified skarn in a lower layer, pyrite and magnetite increased accompanying small amounts of chalcopyrite. Generally, mineralization of pyrite dissemination seemed weak in silicified zones, and in the depths of around 94 m existence of quartz vein was confirmed accompanying sphalerite. In the crashed skarn limestone distributed in the depths of 127.40-143.00 m, existence of a relatively large amount of pyrite dissemination was identified accompanying chalcopyrite. In the depth of 129 m, chalcopyrite-quartz vein existed in a width of 10 cm and 18.5%Cu was obtained as its grade. Also in the silicified zone at the depth of 174-200 m, existence of spotted chalcopyrite mineralization was confirmed. The most intensified mineralization in MJTM-7 Hole was pyrite dissemination zone existing from the depth of 239 m. However, no significant mineral showing was identifiable in this section. Near MJTM-7 Hole, there were two holes (MK-1 and MK-2) excavated for adjustment in the investigation conducted by DMR. Having examined the state of mineralization near MJTM-7 Hole including these data, we found that silicification was intensified in the nearby layer in the depth of 100 m or lower and that quartz vein was developed accompanying pyrite dissemination and chalcopyrite. From the result of IP investigation conducted in the second year, we observed a high possibility that the area with high IP anomaly near MJTM-7 Hole might have been distributed extending in the north-northeastern to south-southwestern direction and that the state of the above distribution might have been in conformity with the state of distribution of the silicified zone and pyrite dissemination zone. In other words, the area with high IP anomaly is presumed to represent the pyrite-chalcopyrite mineralized zone accompanied by the silicified zone and quartz vein. From the result of fluid inclusion test conducted in MJTM-7 Hole, the homogenized temperature near copper mineralization zone developed in the center of the said hole was 300-310℃, and mineralization of sphalerite existed in an upper layer is assumed to have been generated in temperatures of 180-230℃. Salinity of ore solution was constantly high, i.e. 6.8-8.4 wt% at times of both high and low temperatures.

MJTM-8 Hole and MJTM-9 Hole were excavated to grasp the state of mineralization of the lower gossan zone with high zinc content which was distributed on the land surface.

In MJTM-8 Hole, gossan was distributed in three thick and thin layers in alternation strata of sandstone and shale (Fig.II-2-3). Gossan mostly consisted of limonite, but relic mineral of pyrite was observed in part. Zinc contents of gossan obtained were 1.3% in the depths of 1.60-6.00 m and 0.5% in the depths of 10.25-11.95 m. The sedimentary rocks near the gossan toward the depth of 20 m were under strong hydrothermal alteration, and generation of chlorite, sericite and talc was observed. In the depths of 20-80 m, alternate layers of dolomite and siliceous shale were distributed. In this section, in addition to pyrite dissemination in general, only slight chalcopyrite dissemination was observed in brecciated and pulverized dolomite in the depths of 40.60-40.80 m. In the depth of 80-134 m, intensified foliated brecciation and disintegration were observed, and this was considered as a new fault zone and no mineral showing was accompanied. In the depth of 134 m or lower, two silicified zones existed, but no remarkable mineral showing

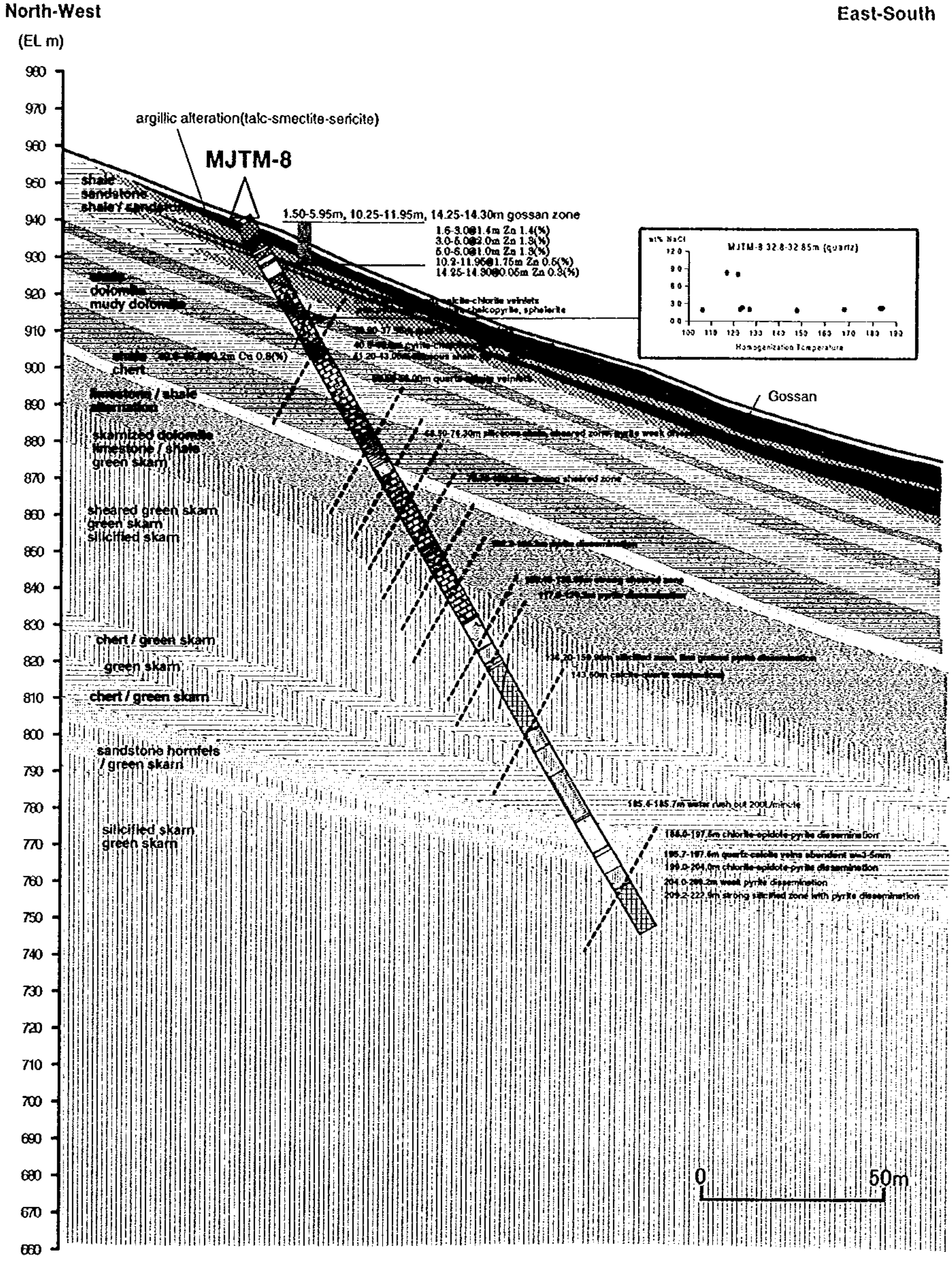


Fig.II-2-3 Geologic profile of MJTM-8

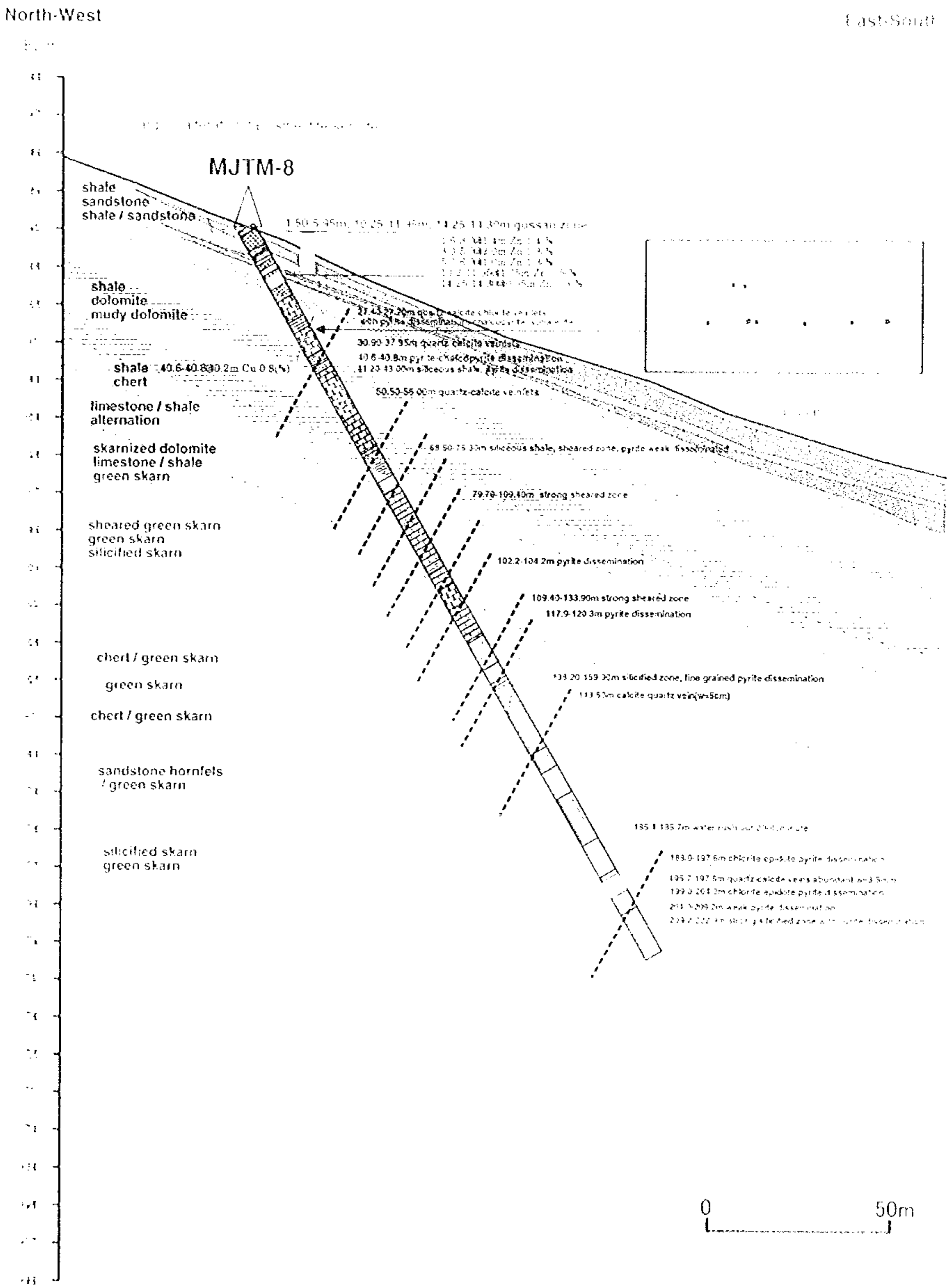


Fig.II-2-3 Geologic profile of MJTM-8

was observed. However, small cracks in vertical directions were well developed in general, and pyrite and limonite were generated along the cracks. This indicates that ore solution that generated gossan may have risen in a lower part of gossan. From the liquid inclusion test conducted near copper showing in MJTM-8 Hole, low homogenization temperatures of 100-190℃ was obtained, and salinity were divided into two groups of 2.5% and around 8%.

In MJTM-9 Hole, thick layer of weathered soil was distributed and reaching the rock in the depth of 20.20 m (Fig.II-2-4). In the depths of 20.20-40.05 m, sandstone and shale were dominants, both being argilized because of hydrothermal alteration. In the depths of 34.35-35.10 m, gossan zone was distributed where cracks in brecciated mudstone were filled with limonite. Silicification, quartz vein and slight argillization were observed in the upper part of the gossan zone consisting of alternate layers of sandstone and mudstone. In its lower part, altered clay was distributed consisting of talc, smectite, sericite and chlorite. In the depths of 44 m and lower, no conspicuous alteration or mineral showing was observed except distribution of dolomitic limestone, argillaceous dolomite and dolomite as well as some portion of pyrite dissemination. In the areas surrounding quartz-galena vein and porous alteration under intensified alteration of oxidized shear zone accompanying a lot of gravels, tendency of intensified pyritization was observed.

MJTM-10 Hole was excavated to identify the state of mineralization in the lower part of geochemical anomaly in zinc through soil geochemical exploration (of conventional method, MMI methods). In MJTM-10 Hole, limestone, alternate layers of limestone and dolomite, mudstone, and dolomite were distributed from upper to lower parts (Fig.II-2-5). Mineralization was weak in general. In front of and behind the shale in the depth of around 56.2 m, galena dissemination and quartz containing galena were observed. The grade obtained were 0.9%Pb in the 50 cm section and 1.3%Zn in the 30 cm section. Concerning the quartz vein in the section of 10 cm, 5.0%Pb and 0.3%Zn were obtained. Further, large-scaled pyrite dissemination was observed in the intermediate mudstone. In MJTM-10 Hole, on the other hand, a lot of alteration zones were seen not accompanying metallic ore but considered to have been a passage for ore solution. They were either porous alteration accompanying oxidation or brown carbonate mineral vein, which are often seen in the western part of Dong Noi area. Also, quartz-galena veins were frequently developed. Surrounding these alterations and vein, conspicuous graveling was observed indicating a proof that strong hydrothermal activities took place.

Chapter 3 Homogenization Temperature and Salinity of Fluid Inclusion

Homogenized temperature and salinity of fluid inclusions were tested to estimate a temperature of mineralization and a characteristic of hydrothermal solution. The data are shown in Appendix 8.

Samples are collected from outcrops and drilling cores in the Dong Noi area and the Mae

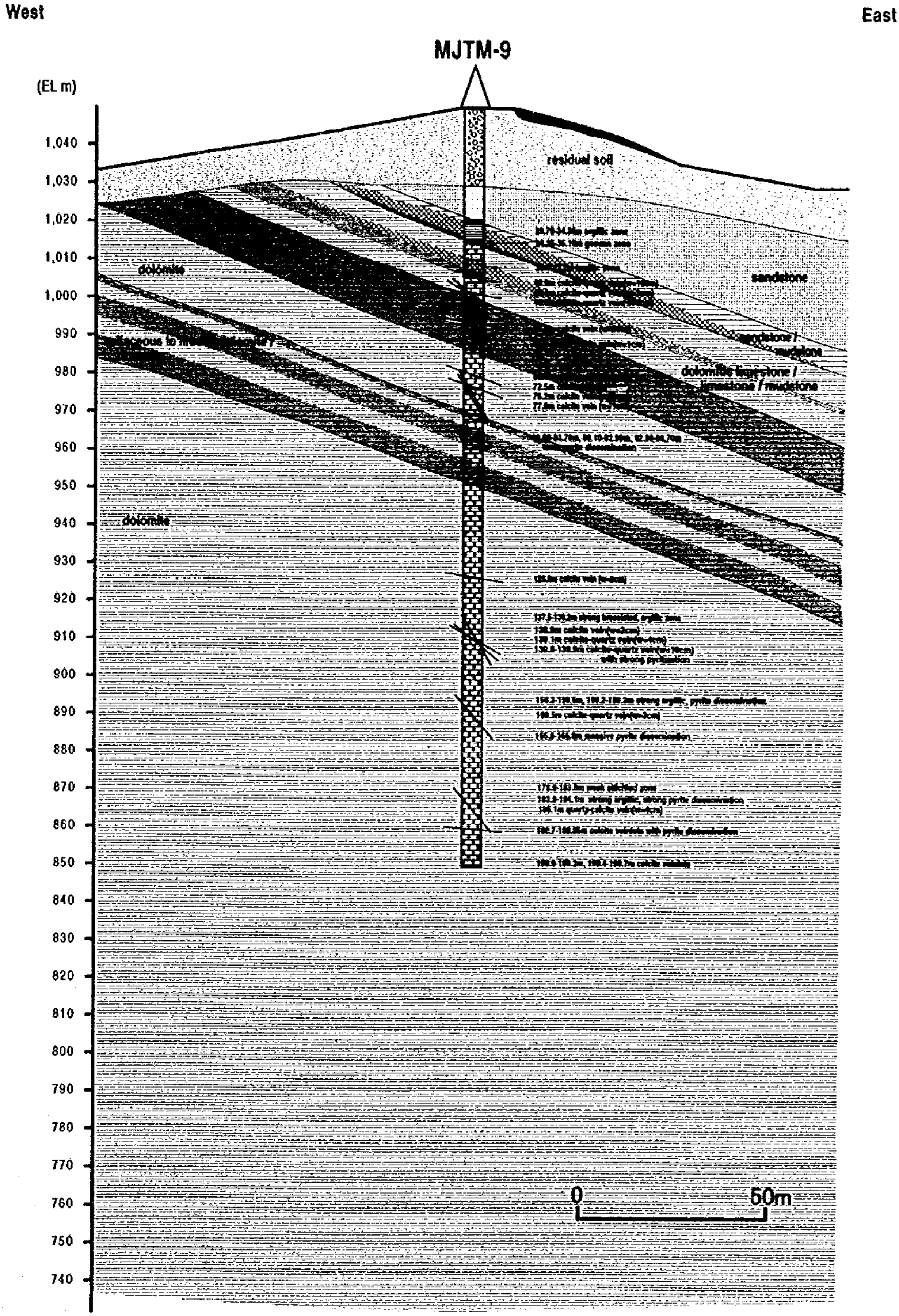


Fig.II-2-4 Geologic profile of the MJTM-9

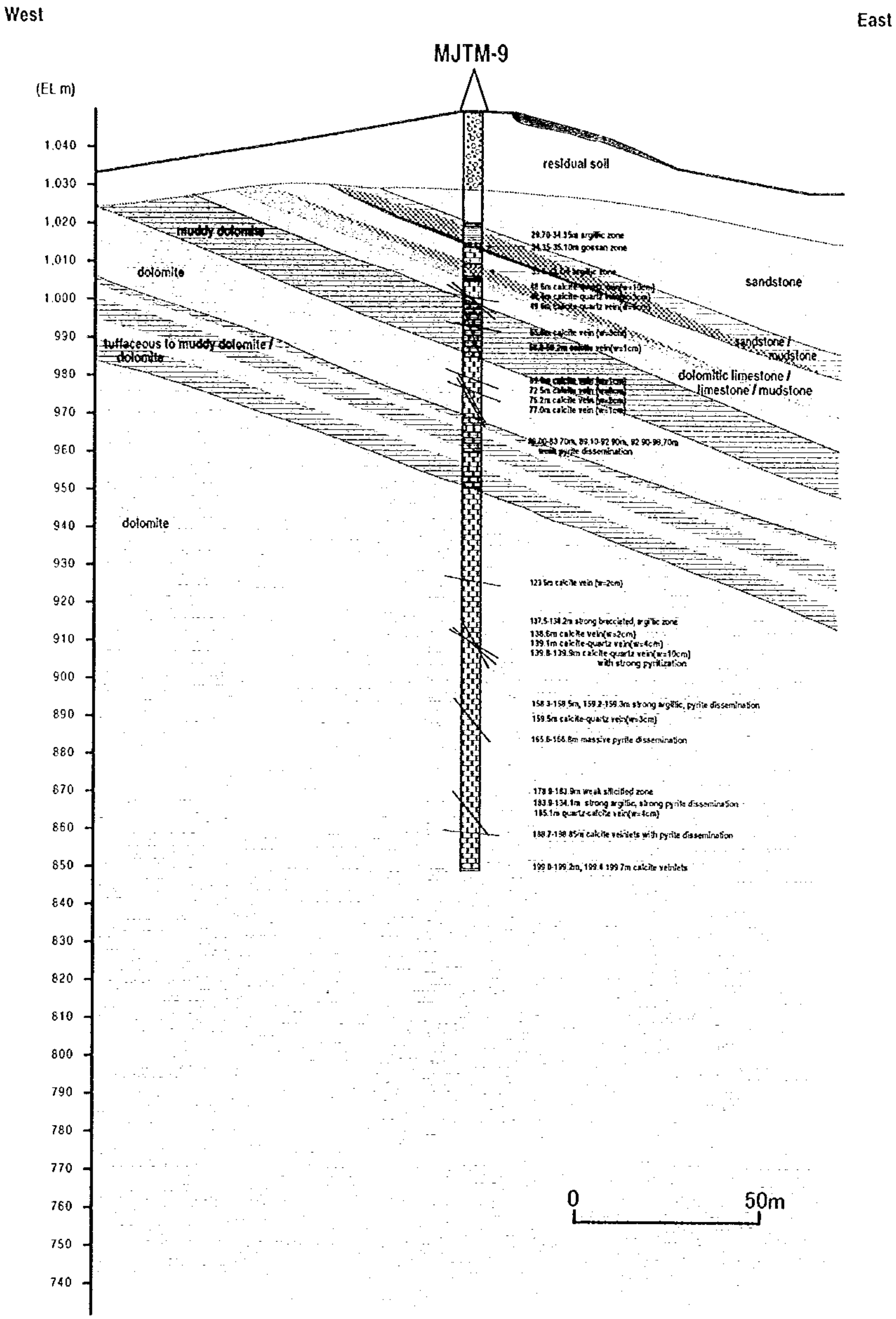


Fig.II-2-4 Geologic profile of the MJTM-9

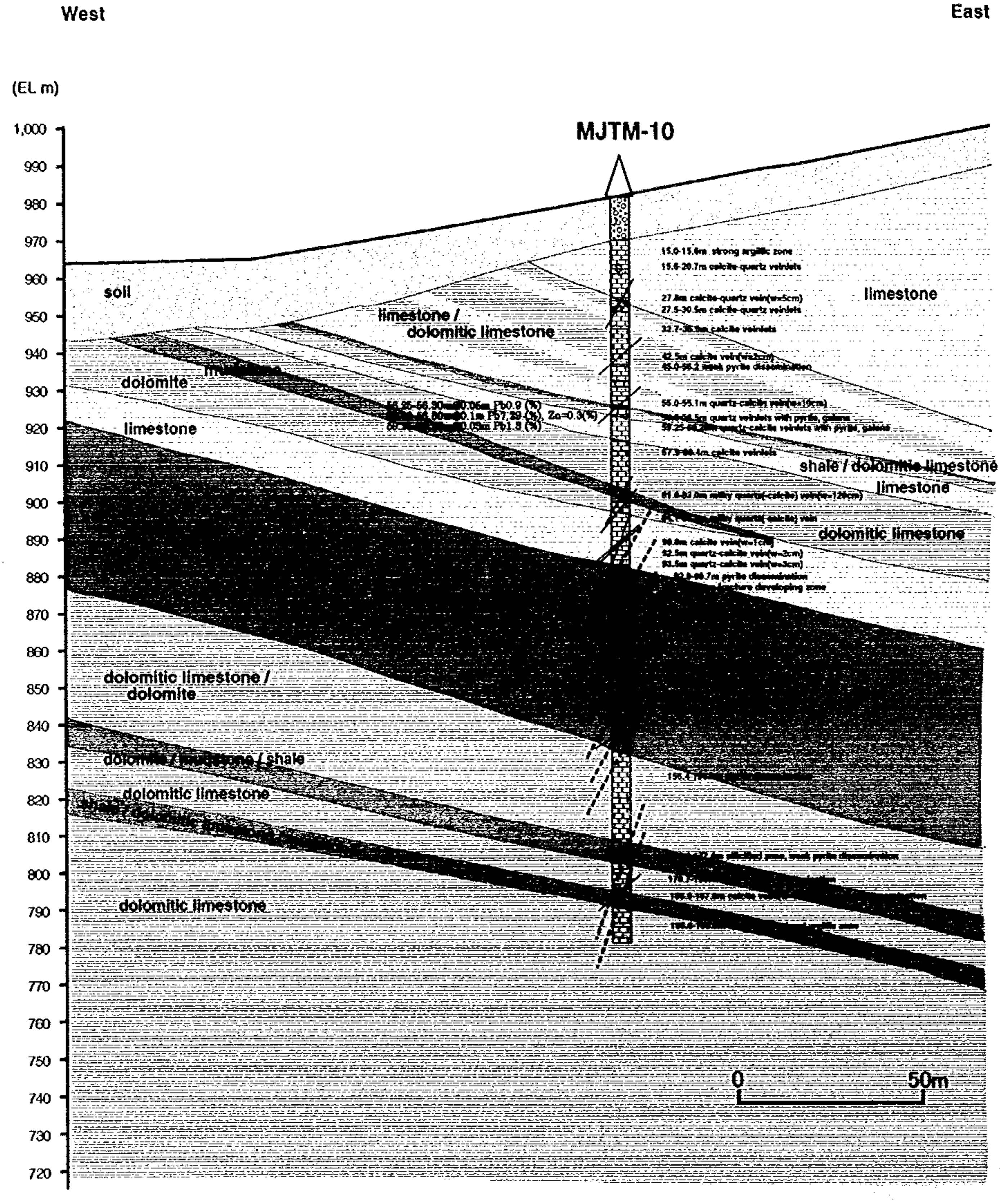


Fig.II-2-5 Geologic profile of MJTM-10

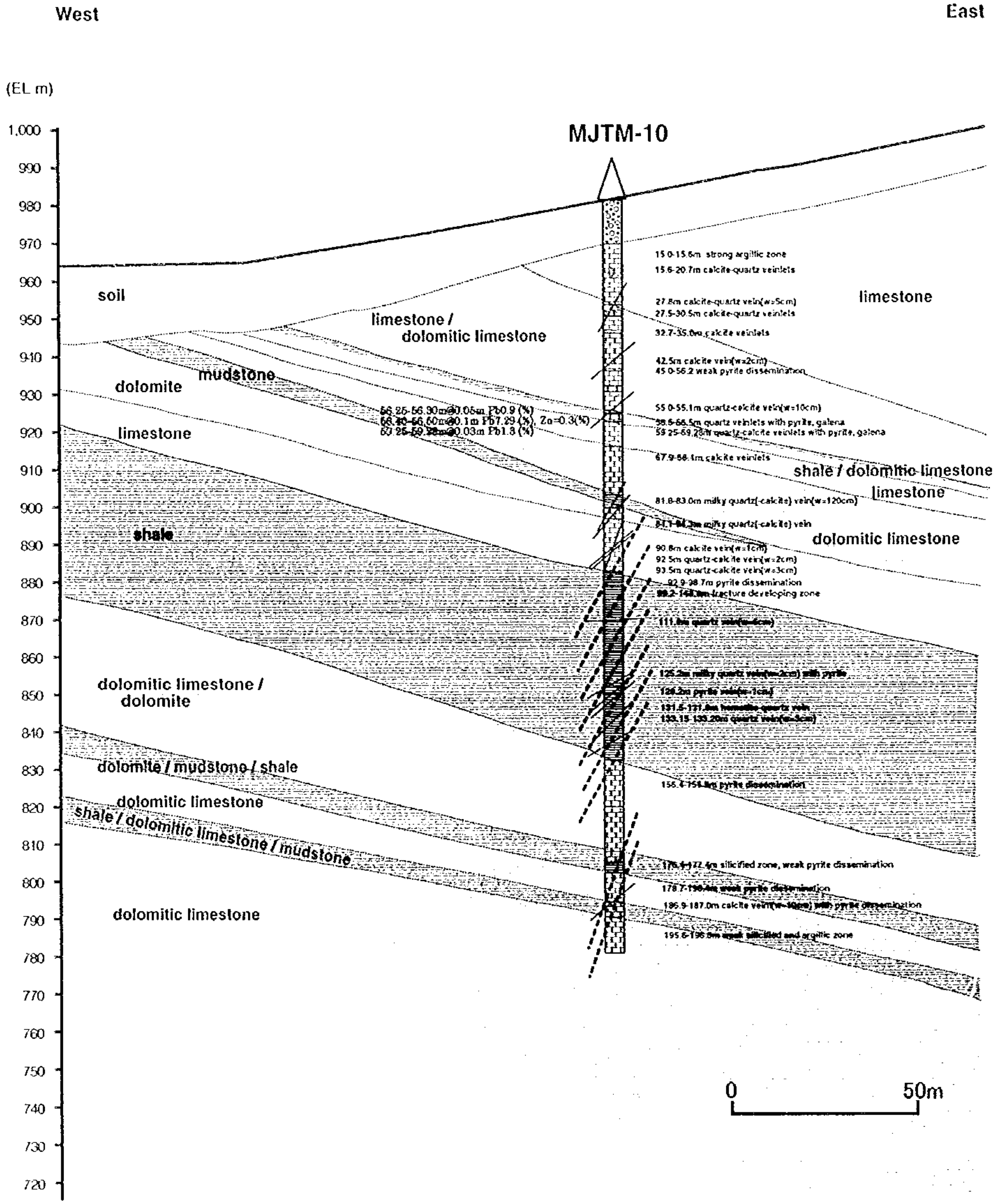


Fig.II-2-5 Geologic profile of MJTM-10

Kanai area. Measured minerals are quartz, calcite, and sphalerite, which are distributed in quartz-calcite veins. Fig.II-3-1, II-3-2 and II-3-3 show the result of measurement.

Two outcrop samples (D20-01 and D20-56) are tested in the Dong Noi area. Both samples are collected from quartz veins confirmed by mineral occurrence survey in Phase III.

The D20-01 sample is a quartz vein. Its homogenization temperatures show among 164 and 250℃ and salinity ranges from 0.7 to 3.4 wt.% NaCl eq. The limestone around the D20-01 vein is dolomitized and accompanied by many quartz-calcite veins with the dark brown carbonate mineral. Quartz-calcite veins of the D20-03 sample to the several meters south of D20-01 contain galena.

The quartz vein of D20-56 is 30 cm to 3 m wide, and replaces limestone along a bedding-plane. Limestone around the vein is strongly silicified and accompanied by many quartz-calcite veins with the dark brown carbonate mineral. Strong dolomitization also occurs in the boundary between limestone and the vein. Its homogenization temperatures are among 201 and 374℃ and salinity ranges from 4.4 to 7.7 wt.% NaCl eq.

It appears from the result of both samples that weak silicification, dolomitization and Zn-Pb mineralization are associate with low salinity fluid, whereas strong silicification and Pb mineralization is associate with relatively high salinity fluid. It suggests that Zn-Pb minerals precipitated by decreasing salinity in ascending ore fluid through fractures of rocks.

The core samples are collected for fluid inclusion test from MJTM-6 hole in the Dong Nói area. The 63.50～63.60 m sample in green skarn contains calcite-quartz veins accompanied by a small amount of chalcopyrite. Its homogenization temperatures from calcite show among 262 and 332℃, and salinity ranges from 4.3 to 5.2wt.% NaCl eq. 129.60m sample in brecciated green skarn consists of network quartz veins accompanied by a small amount of chalcopyrite. Its homogenization temperatures show among 149 and 240℃, and salinity range from 1.2 to 1.7wt% NaCl eq. Some fluid inclusions of this sample contain liquidus CO_2. Its homogenization temperatures show among 308 and 335℃ but the salinity data could not be obtained, thereby the data does not show in the chart. The 178.70～178.80 m sample in green skarn contains quartz veins accompanied by the dissemination of a large amount of pyrites-pyrrhotite-chalcopyrite and a small amount of galena. Its homogenization temperatures are among 149 and 195℃, and salinity range from 7.8 to 23.3wt% NaCl eq. The solid phase is observed in some fluid inclusions. The disappearance temperatures of the solid phase are 97 and 107℃, and also salinity are 27.9 and 28.2wt.%.

Therefore, it can be stated that Cu-mineralization in green skarn relates to ore fluid of very high salinity and relatively low temperature, which was produced on a cooling process following skarnization of potash feldspar porphyritic biotite granite.

The core samples are collected for fluid inclusion test from MJTM-7 and MJTM-8 hole in the Mae Kanai area.

The 94.90～94.95 sample of MJTM-7 contains quartz-calcite veins accompanied by a large

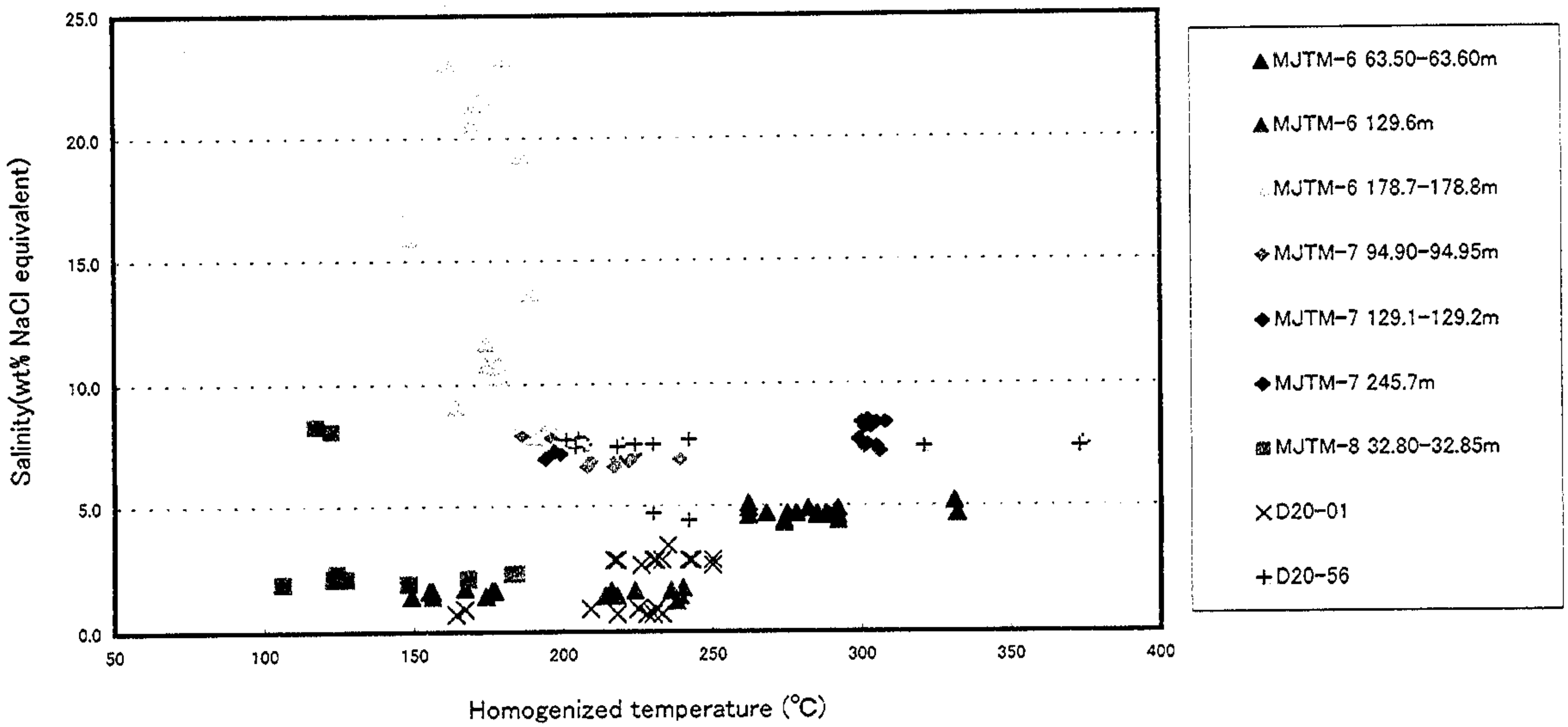


Fig. II-3-1 Diagram between homogenized temperature and salinity in Phase III

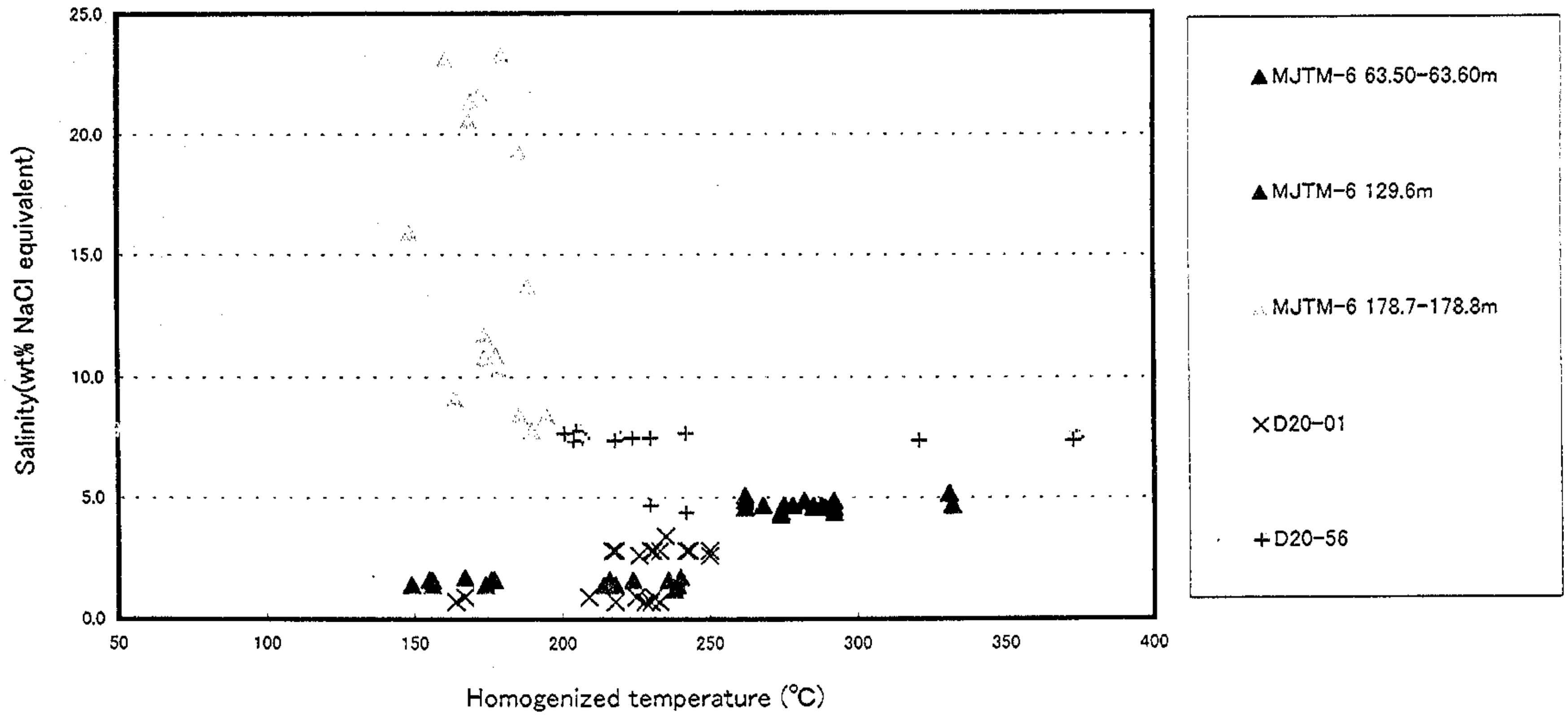


Fig.II-3-2 Diagram between homogenized temperature and salinity in Don Noi area

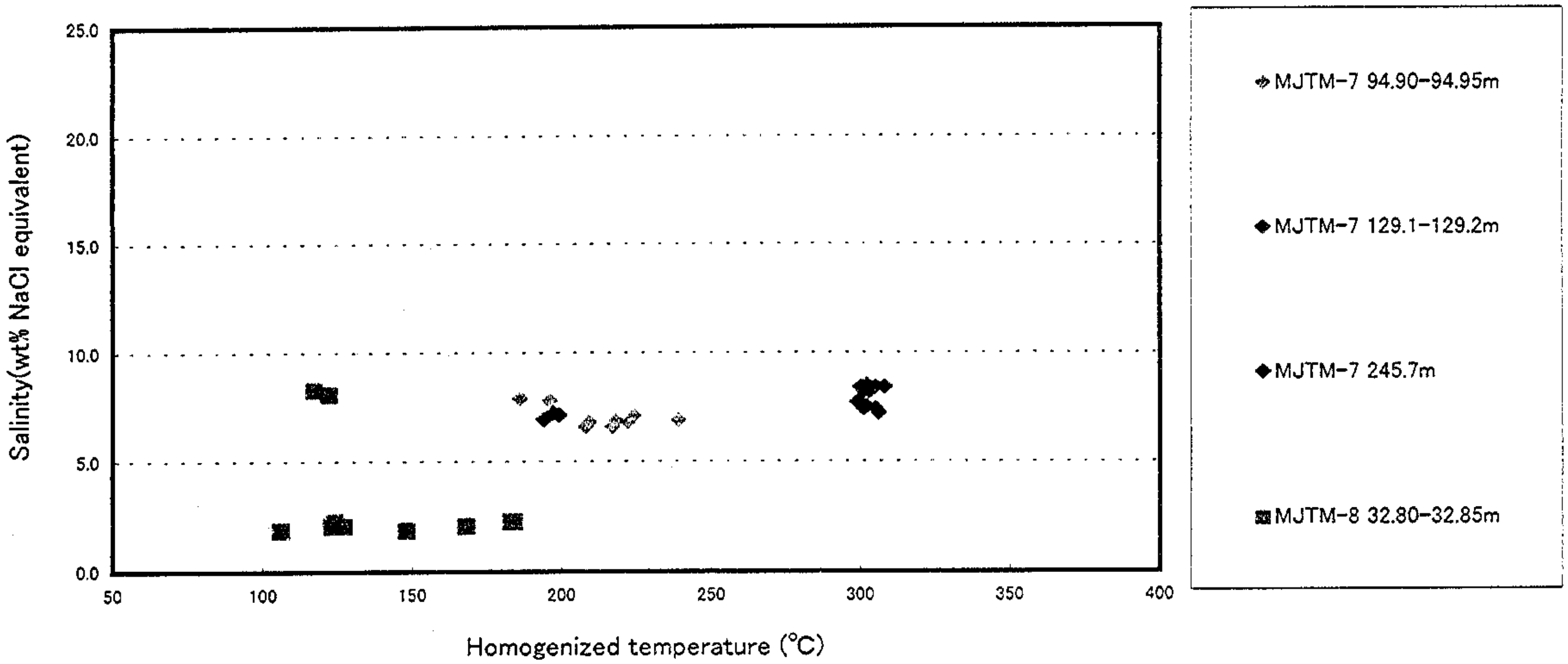


Fig.II-3-3 Diagram between homogenized temperature and salinity in Mae Kanai area amount of sphalerite (1.16% Zn). The homogenization temperatures from sphalerite show among 186 and 239℃, and salinity range from 6.6 to 7.9wt% NaCl eq. The 129.10～129.20 m quartz vein is accompanied by strong chalcopyrite mineralization (18.45% Cu). Its homogenization temperatures are among 299 and 308℃, and salinity range from 7.2 to 8.5wt% NaCl eq. The 245.70m sample is quartz vein with strong pyrite dissemination. Its homogenization temperatures are among 194 and 197℃, and salinity range from 6.9 to 7.1wt.% NaCl eq.

The location of 32.80～32.85m sample of MJTM-8 is situated underneath the gossan with high Zn soil anomaly. It contains a quartz-calcite vein with hematite and dark brown carbonate mineral. Its homogenization temperatures are among 106 and 184℃, and salinity range from 1.9 to 8.3wt.% NaCl eq.

It can be stated from the above results in the Mae Kanai area that, after skarnization, a vein-type Cu mineralization is produced due to ore fluid of high temperature and relatively high salinity, whereas a stratiform-type or vein-type Zn mineralization is produced by ore fluid of low to middle temperature and relatively high salinity. Thereby it suggests that Cu mineral mainly precipitated in veins by falling temperature of ore fluid, whereas Zn mineral deposited as stratiform in sedimentary rocks by decreasing salinity of ore fluid.

Chapter 4 General discussion

4-1 Dong Noi area

In the Dong Noi area, the state of mineral showing was investigated in its northwestern part, and additional boring survey was conducted in the spare part of the area with IP anomaly.

The Dong Noi area consists of siliceous sandstone of Cambrian period, mudstone/sandstone and carbonate base of Ordovician period, and granite of Triassic Period that has intruded into them. As pointed out in the report of our investigation conducted in the second year, conditions of the eastern and western parts of the district were quite different from each other as divided by a border in almost the center of the district. In other words, in the eastern side, granitic stocks had been intruded into a shallow part. Being influenced by this, most of the carbonate was replaced with magnetite skarn or hornblende skarn. In the western side, on the other hand, although a lot of quartz-calcite veins and calcite veins deriving from dolomitization and hydrothermal activities were developed, no skarnization was identified.

Through our geochemical survey, we observed a wide-ranged distribution of anomalies in lead, zinc, manganese and cadmium in both eastern and western sides. With regard to the eastern side, we reached a conclusion from the state of MJTM-1 Hole and Trench No.2 that the area with such anomalies was caused by zinc/lead mineralization, which was formed along small fractures accompanying loose brecciation having been developed like a network in the upper part of the skarnized zone.

With respect to the area with anomalies in the western side, we only observed slight galena dissemination in dolomite existed in MJTM-1 Hole and Trench No. 1 and no definite cause of anomalies was found. Through our investigation into mineral showings conducted this year on the district with geochemical anomalies in the northwestern part, it was clarified that ore solution rose up along joints, fractures or beddings in the limestone seams and formed quartz veins and silicificated zones in a relatively lower part. Around 1,000 ppm of zinc was contained in these quartz veins, but no dolomitization or high anomalies in zinc or lead values were observed in the surrounding limestone. However, when brown calcite veins containing large amounts of iron oxide and manganese were accompanied, then zinc contents of the sectional samples were increased.

In the upper part of this silicificated zone, a wide range of dolomitized zone was formed in the limestone, and the host rock itself was under the influence of mineralization as indicated in the values of Zn = 330 ppm – 1.6% and Pb = 50-970 ppm. In the area where this dolomitized zone was developed, quartz veins containing silicificated small breccia and silicificated zone were distributed along joints and galena-sphalerite and a certain bedding replaced galena-sphalerite veins. Out of the samples representing these quartz veins, those of the highest grade was in a width of 80 cm with values of Zn = 7.86% and Pb = 2.82%. The sample from the 20 m section in the periphery also showed high values of Zn = 1.60% and Pb = 1.43%.

As a characteristic of this mineralized zone, sulfide mineral was scarcely found in it except veins.

As characteristics of mineralization observed through our fluid inclusion test, although homogenized temperatures were 140-250 ℃ and there was scarcely any difference in their homogenized temperature between the silicificated and dolomitized zones, salinity of the former was 6-8% and that of the latter was 1-3%. From this we may guess that there seems to be some relationships between zinc/lead mineralization and reduction in salinity.

While our geochemical survey revealed a large-range of lead/zinc anomalies, such values of rock samples extracted from outcrops in the lower silicificated zone showed considerably low quality, and those from dolomitized zone were a little lower than the data of geochemical anomalies. On the other hand, their values obtained from the samples of quartz veins and silicificated rocks were on the same level or higher than the data of geochemical anomalies. However, because the amount of quartz veins and silicificated zone with high concentration and the portions with high concentration in dolomitized zone account for only a little percentage to the entire zones concerned, it is difficult to explain only from these data the range and intensification of the entire areas having geochemical anomalies.

From the results of our observation of this time, we consider that lead and zinc contained in quartz veins and dolomitized zones developed widely along joints and fissures in the limestone may probably have been absorbed into manganese oxide and remained on the land surface during the process of weathering when manganese contained in a similar manner as above changed to oxide.

In view of the fact that quartz veins containing sphalerite and galena were actually extracted from the northwestern part of the Dong Noi area, the possibility may be the highest in the Dong Noi area for determining lead/zinc ore exist in this part. On the other hand, since the structure of forming quartz veins may cause replacements in open joints and along bedding of specific horizon, assumption of the position of their existence will require more detailed explanation of the rock faces and geological structures.

As a result of excavation of MJTM-6 Hole in the remaining part of the area with IP anomalies, we came to judge more clearly that the district with high IP anomalies may have represented an area where copper/lead mineralized zones overlapped with skarn. We understood from our investigation in MJTM-6 Hole that copper mineralization started in the depth of around 60 m, extended scatteredly to lower layers and was most intensified in the position where it became in contact with granite. It might be considered from the fact that mineralization became more intensified as it extended to lower parts that mineralization may have been closely related with the time of skarn formation. However, from our examination of fluid inclusion, the homogenized temperatures of 149-195℃ were far lower than the temperature for skarn formation. On the other hand, extremely high salinity of 7.8-23% indicates a possibility of copper mineralization having been derived from the final solution of granite. From the state of copper mineralization in MJTM-5 Hole, we note that mineralization along the shear was developed by cutting a skarn. Consequently, we think it was caused by a mineralization, which occurred far later than the time of mineralization of skarn.

From the state of mineralization in the three holes of MJTM-3, MJTM-5 and MJTM-6, no grade or reserve was found so far which may become an object of a possible operation. However, since copper grade in skarn tends to be unevenly distributed, it may be considered that there may be some room for further exploration in this district having abnormal IP values (16 mV-sec/V or more).

By generalizing the data obtained through our survey on the Dong Noi area conducted for a period of three years, we prepared a mineralization model of the Dong Noi area (see Fig. II-4-1). In the eastern half of the district, a wide-range skarn zone was formed because granitic rocks in the form of a stock had intruded into the Ordovician limestone. Later, accompanying the rise of mineralization solution that was deeply associated with the final solution of granite, a mineralized zone in the form of a tube was formed mainly consisting of pyrite-pyrrhotite that extended in the south-to-north direction, and copper/lead precipitation took place simultaneously. A part of the ore solution rose along shears, precipitating copper and lead in part, and formed an ore body mainly consisting of galena in a border between skarn and mudstone. In the place away from the stock, ore solution moved along narrow cracks developed as a network, precipitating sphalerite in part along the cracks. However, no large ore body was formed because there was little porous part in skarn that was massive and compact. In the western half, on the other hand, no large-scaled skarn zone was contained in the upper part of batholith. The mudstone and sandstone in direct touch with it became hornfels, and slight skarnization was observed in the lower part of

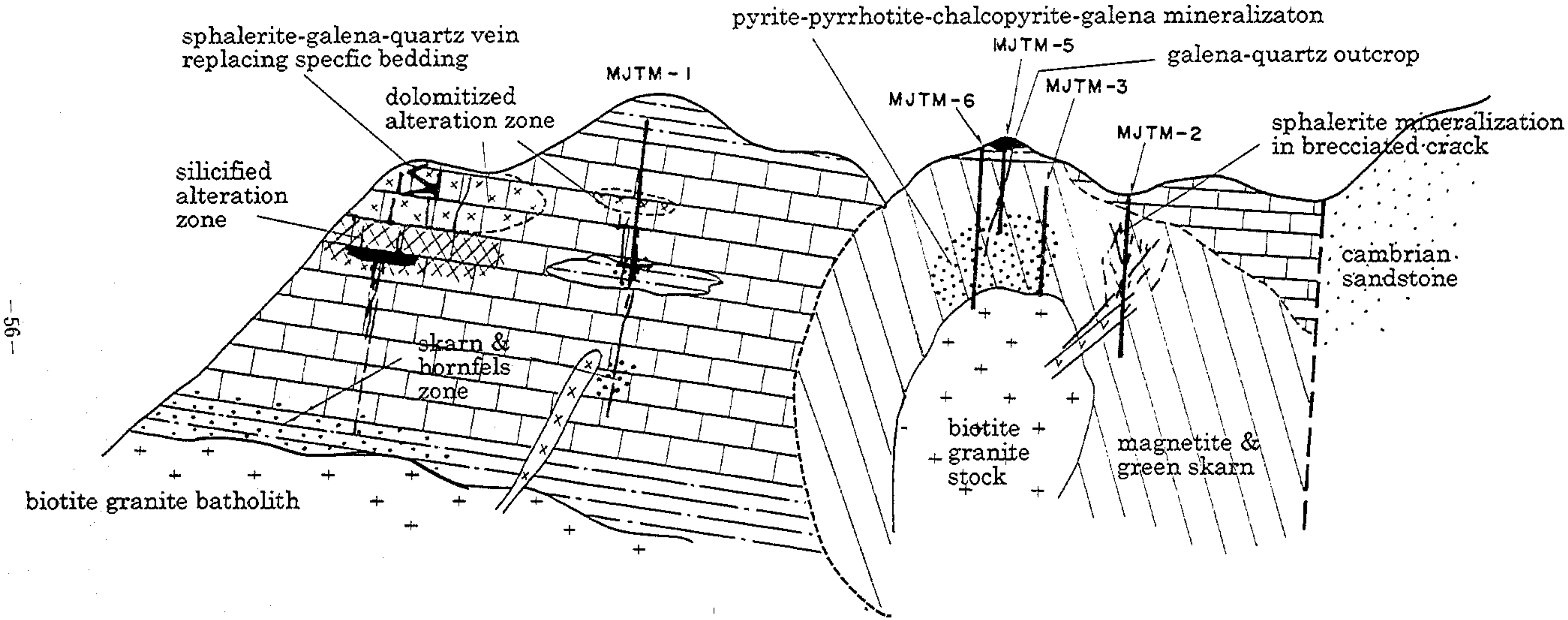


Fig. II-4-1 Schematic mineralization model in the Dong Noi area the limestone. Ore solution in low to medium temperatures and with high salinity rose through joints and cracks of limestone, formed a silicificated zone on a certain level, and the limestone was dolomitized in a wide range in the upper part, and at the same time lead/zinc dissemination took place. In the dolomitized zone, a specific single layer was replaced and sphalerite-galena-quartz veins were formed.

4-2 Mae Kanai area

MJTM-7 Hole in the Mae Kanai area was excavated to check and confirm the state of mineralization associated with the highest IP anomaly, which was found in the district. In MJTM-7 Hole, remarkable pyrite dissemination and silicification were observed in the middle part, accompanying chalcopyrite showing. Chalcopyrite was the most prevailing in the depth of around 129 m. By referring to the results of DMR's surveys conducted in the past on MK-1 and MK-2 which were located near MTJM-7 Hole, the silicificated zone in MTJM-7 Hole accompanying pyrite was assumed to be extended in the NE-SW direction which was the same as the plane direction of IP anomaly extension, and we presumed that the silicificated zone represented a mineralized zone of hydrothermal type which had been formed along fractures running in the same direction as referred to above.

Based on the result of our survey conducted in the second year, we presumed that the gossan zone in the Mae Kanai area might have been extended in a vertical direction. Consequently, MJTM-8 Hole and MJTM-9 Hole were excavated to check and confirm the state of mineralization occurred in lower layers of the gossan zone. As a result of our investigation on the two holes, we found that the gossan zone was distributed almost along the land surface in thickness of more than 10 meters, and we confirmed that no remarkable mineral showing existed in the lower layers. The gossan zone was distributed between argilized mudstone and/or sandstone. Originally it was a massive sulfide mineral, abundant with pyrite and accompanying sphalerite. However, pyrite may have been oxidized and changed to limonite through weathering, while sphalerite may have been dissolved and flew out. The sedimentary rocks near the gossan were under intensified argillization of talc-sericite-chlorite-smectite especially on its lower wall. In MJTM-9 Hole, silicificated zone in the form of hydrothermal breccia and quartz veins were observed accompanying white argillization on the wall above the gossan zone.

The present gossan zone was distributed only along the surface ridge and on a slow eastern slope. Based on the fact that the bedding plane of this district was a slow slope inclined to the east as well as on the result of our drilling, the gossan zone is considered to have been formed a few to fifteen meters away from the border between limestone and general sedimentary rocks toward sedimentary rocks or on the border in some part and that the upper phase of the zone was almost in conformity with the land surface. No clear sign of mineralization was observed except for the quartz-calcite veins and slight dissemination of pyrite in lower layers of the gossan zone. In MJTM-9 Hole, the degree of dolomitization was very low. In view of the fact that

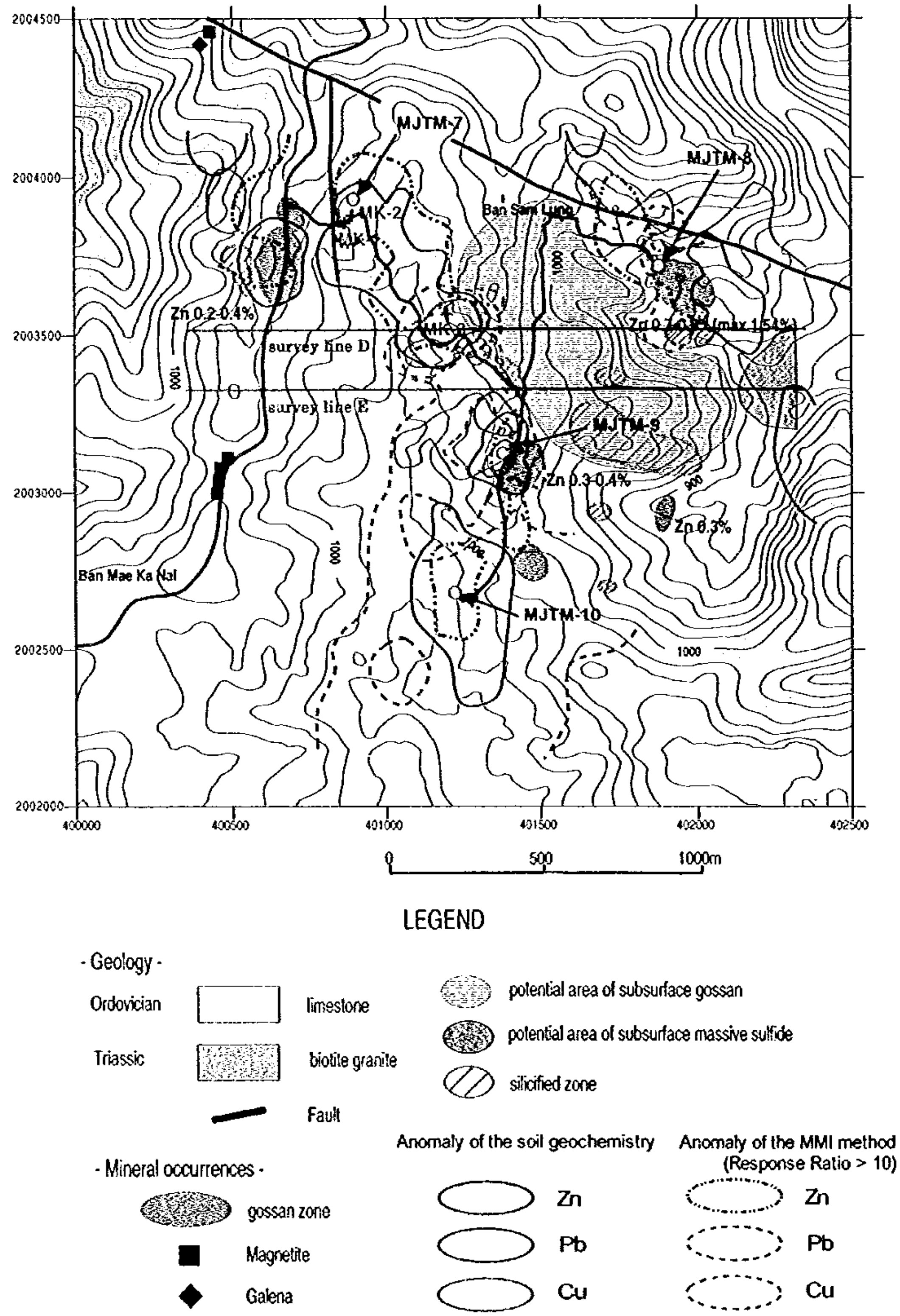
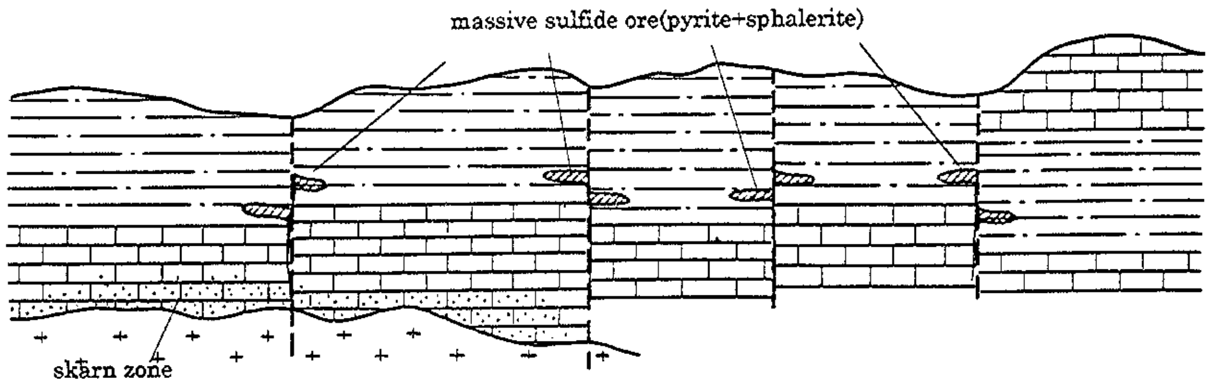


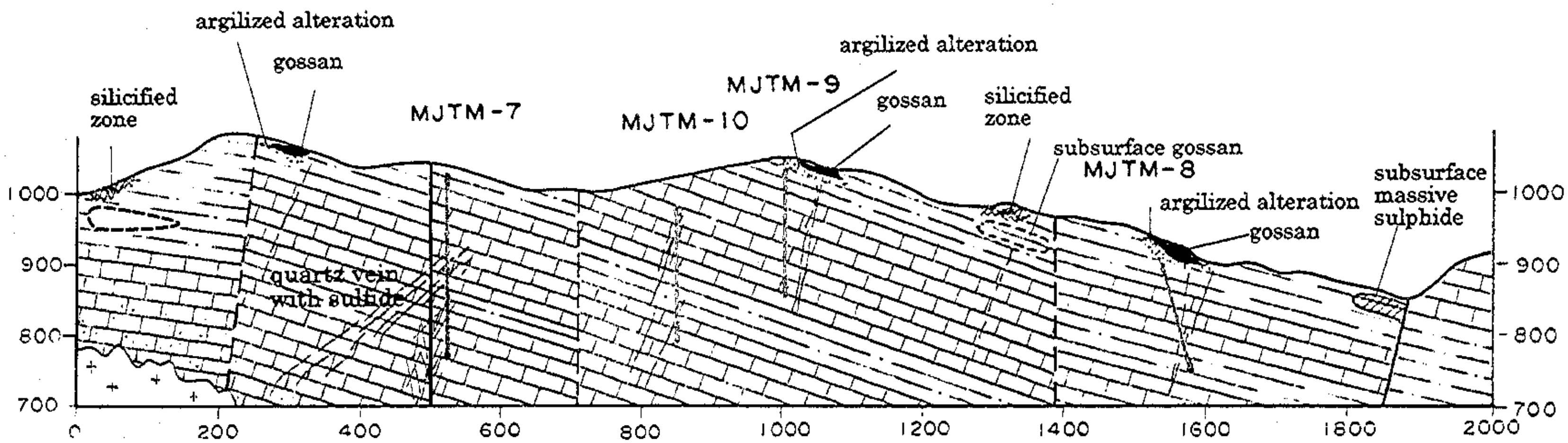
Fig.II-4-2 Potential area for subsurface gossan and massive sulfide ore gossan zones occur almost on the same level, we judge that the gossan, which occurred in sedimentary rocks, has been formed along a specific horizon of sedimentary rocks. From this we consider that in the district surrounded by MJTM-8 Hole, MJTM-9 Hole and MK-3 Hole, the horizon on which gossan occurred is under the land surface. Therefore, we note a high possibility of the gossan zone being hidden under the land surface. In the eastern side of MJTM-9 Hole especially in the area where silicificated zone was extended, it is quite possible that that gossan should exist underneath the silicificated zone. However, since no IP anomaly was grasped, there is little possibility of its being sulfide mineral. Further, in the east end of the profile lines E and D for geophysical exploration, the district with IP anomaly was distributed inclining to the east right beneath the land surface. Since this district corresponds to the extension of the gossan zone which was distributed in MJTM-8 Hole, we presume that massive sulfide mineral may possibly exist under the land surface (see Fig. II-4-2).

MJTM-10 Hole and MK-3 Hole of DMR were excavated to grasp the state of mineralization in lower layers of the district with geochemical anomalies of zinc, lead and copper. In both holes, existence of mineral showing such as galena and galena dissemination accompanied by quartz vein was observed. Further, strong oxidization was observed in MJTM-9 Hole, and a lot of porous and coarse silicificated zones in light brown to orange colors were identified. Since they frequently show brecciated texture, there is a high possibility of their having been the passage for predominant hydrothermal ore solution.

Fig. II-4-3 shows a mineralization model of the Mae Kanai area. From the results of our fluid inclusion tests in MJTM-7 Hole and MJTM-8 Hole, it was clarified that ore solution with high salinity was involved in mineralization also in the Mae Kanai area. A rather high value of 300℃ was obtained as the homogenized temperature of chalcopyrite-quartz vein in MJTM-7 Hole. The homogenized temperature of sphalerite-quartz vein observed in upper layers was 190-240 ℃, while that of lower layers of the gossan zone in MJTM-8 Hole was 105-185℃ which was near the homogenized temperatures of epithermal to mesothermal deposits. Based on the fact that the original sulfide ore body had been formed in replacement with a specific stratification which was nearer to the general sedimentary rocks from the border between limestone and mudstone/sandstone, we presume that these hydrothermal ore solutions rose along old fractures and fissures of silicificated zones and quartz veins identified in MJTM-7 Hole and porous silicificated zones in MJTM-10 Hole, and formed sulfide minerals by replacement only the specific horizon. Then, upon tilting, resumption of fault processes and land surface deprivation in the Mae Kanai area, the present space layout may have been established.



(a) primary mineralization of pyrite-sphalerite ore body



(b) mineral occurrence in the Mae Kanai area at the pesent

Fig.II-4-3 Schematic mineralization model in the Mae Kanai area