# REPUBLIC OF GUATEMALA

# REPORT ON GEOLOGICAL SURVEY

OF

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PHASE II

[illegible] 1978

METAL MINING AGENCY OF JAPAN
JAPAN INTERNATIONAL COOPERATION AGENCY
GOVERNMENT OF JAPAN

# REPUBLIC OF GUATEMALA
# REPORT ON GEOLOGICAL SURVEY
# OF
# CUCHUMATANES AREA, WESTERN GUATEMALA

PHASE III



FEBRUARY 1979

METAL MINING AGENCY OF JAPAN
JAPAN INTERNATIONAL COOPERATION AGENCY
GOVERNMENT OF JAPAN

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## Preface

The Government of Japan in response of the request of the Government of the Republic of Guatemala, decided to conduct a geological survey for mineral exploration in Huehuetenango and El Quiché Departments, western Guatemala and commissioned its implementation to the Japan international Coorperation Agency.

The Japan International Cooperation Agency, considering its technical characteristics, commissioned the Metal Mining Agency of Japan to accomplish the project within a period of three years (1976∿1978). The survey has been carried out in three phases; the first phase to make regional geological survey and geochemical survey in the whole area (2,000 $km^2$)and the second phase to make semi-detailed survey to select the promising area to carry out the detailed survey in the third phase. The Llano del Coyote prospect was selected as the target area of the third phase, and all the exploration works of the phase were concentrated within the prospect.

Between June 6, 1978 and October 26, 1978 the Metal Mining Agency of Japan dispatched a survey theam headed by Dr. Uchida. During their stay, they could carry out the field work of the third phase very successfully in special collaboration with Direccíon General de Minería e Hidrocarburos and the Embassy of Japan.

This report describes the results of the third phase exploration works carried out in Llano del Coyote, as well as a summary of those previously performed in an area including the prospect. The summary on subjects concerning whole the three phases are described in Summary Report submitted along with this report.

We wish to express our heartfelt gratitude to the Government of the Republic of Guatemala, Direccíon General de Minería e Hidrocarburos and other authorities and the Embassy of Japan for their cooperation and support extended to the Japanese Survey team.

February, 1979

Shinsaku Hogen
President
Japan International Cooperation Agency

Masayuki Nishiie
President
Metal Mining Agency of Japan

Fig. I LOCATION MAP OF LLANO DEL COYOTE PROSPECT

Abstract

This report describes the exploration works carried out in Llano del Coyote prospect in the third phase, as well as summary of geology and mineralization, and all the previous works performed in the area.

3 DDHs totaling 830.7m and 7 DDHs totaling 1,203.0m were carried out in the second and third phases of the present project, respectively.

As a result, a promising sulfide zinc mineralization was intersected between 88.6 and 98.1m in DDH MJ-9 (12.76% Zn for 9.5m).

Mineralization occuring in the prospect is of skarn to hydrothermal replacement type, and comprises a large amount of pyrite, a tolerable amount of magnetite, and locally concentrated sphalerite and chalcopyrite, However, practically no galena is accompanied.

Mineralization is considered to have occurred genetically related with granitic rocks of the Cretaceous, and rhyolite to quartz porphyry of the Paleocene to Eocene. These igneous rocks intruded sedimentary rocks and schists of the Tactic and Chicol Formations of the Paleozoic. At least two phases of mineralization are considered to have occurred, corresponding to the intrusions of the igneous rocks mentioned above. Major stage of Cu and Zn mineralization may belong to a later phase, and the mineralization may be attributed to the post igneous action of the younger intrusives.

Drill results in this prospect very well correlate with geochmical anomalies of rock-chip samples that were collected during surface geological mapping in the third phase; three DDHs of four, which are located in the anomalies delineated by 500 ppm Zn, intersected "%-order Zn-mineralization". This means that halos by primary dispersion of mineralization can be detected on the surface directly above the mineralized loci, as the horizon of the mineralized skarn rarely exposes on the surface .

The anomalies delineated by 500 ppm Zn are located between W12 and E24 lines, having an extent of 3.6 km x 200m. Therefore, possibilities that "mineable" reserves of n x $10^5$ T to n x $10^6$ with economic Zn grade exist underneath the anomalies are considered to be fairly great. Even a deposit of this size may be exploitable, should its Zn-grade be as high as the intersection in MJ-9, as the location of the prospect is very favorable and expenditures for infrastructures can be minimized.

Further exploration by DDHs is warranted, and an extensive drilling program is proposed.

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# 1. Introduction

This report describes the exploration works carried out in the 1978 fiscal year in the Llano del Coyote Prospect, which is located in the western part of the Republic of Guatemala, by the Japan International Co-cperation Agency(JICA) and Metal Mining Agnecy of Japan(MMAJ) in collaboration with the Direccíon General de Mineraía e Hidrocarburos of Guatemala(DGMH).

The present works represent the third phase of a 3-year (1976-1978) program, based on the General Survey Schedule of Mineral Exploration in the Republic of Guatemala (p.      in Summary Report).

In November 1978, DGMH was reorganized to La Secretaría de Estado para Mineraía, Hidrocarburos, y Energía Nuclear. However, in this report DGMH is used for convenience' sake to stand for the above-mentioned new organization.

## 1-1 Purpose of the present phase works

The purpose of the present phase works is as follows: (1) to explore the continuation of the mineralized intersections that were confirmed by the previous DDHs, (2) to reveal the relationship between mineralization and geological elements, (3) to evaluate the exploration potential of the area, and (4) to plan a further exploration program.

## 1-2 Area covered and composition of report

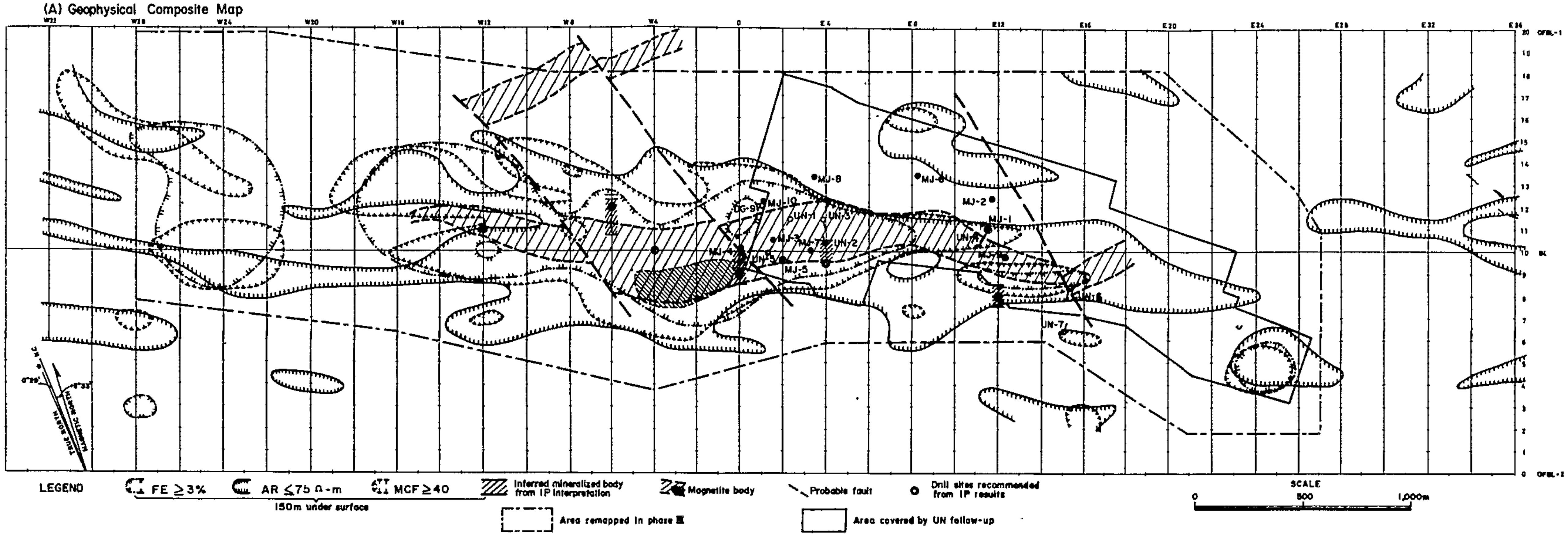
Exploration works of Phase-III have been concentrated within an area of about 5 sq.km in the central part of Area-C of Phase-II(14 sq.km). However, this report describes not only geology and mineralization of the 5-sq.km area, but also those of whole the area, as the exploration works of the two phases composes a single project.

Only brief description will be made on soil geochemistry and geophysical exploration, which were carred out in Phase-II, in regard to the correlation with diamond drill results. Details should be referred to 3-7 and 3-8 in Part-III of the Phase-II report(MMAJ/JICA; 1978).

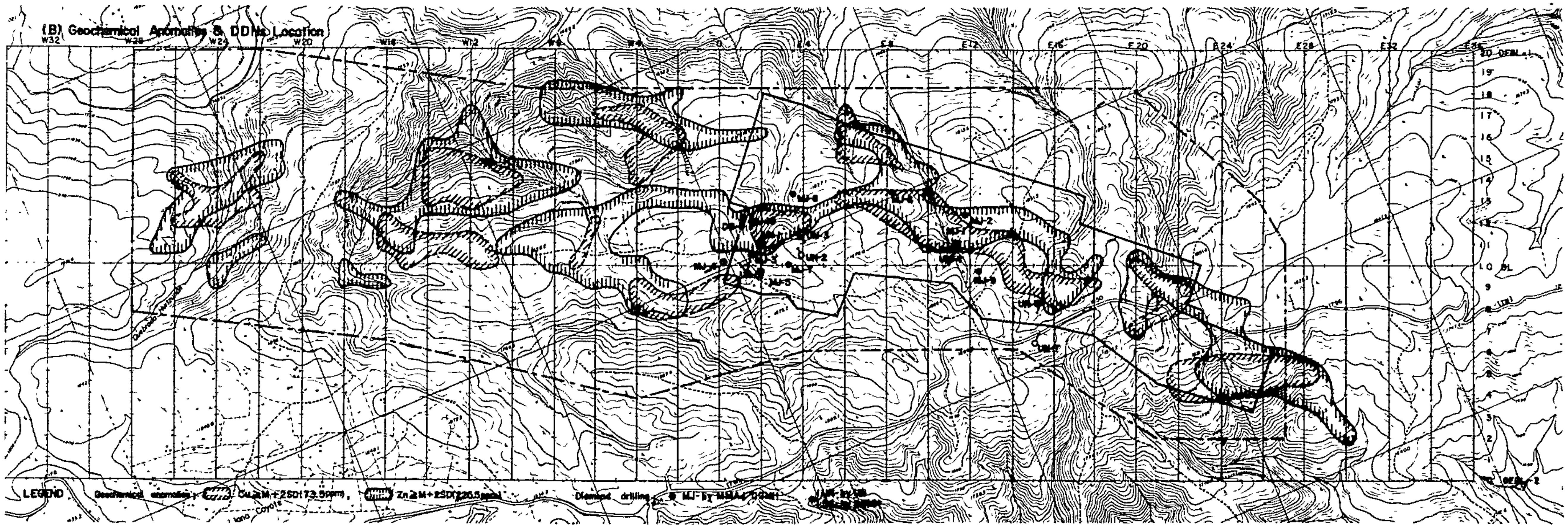
The results of diamond drilling in both Phase-II and -III are described in this report. However, the description on drilling operation is made in the report of each Phase; in 3-9 of Phase-II report, and in Appendix-7 of this report.

## Fig. 2 AREAL RELATIONSHIP : PRESENT PROJECT vs PREVIOUS UN PROJECT

(A) Geophysical Composite Map




(B) Geochemical Anomalies & DDHs Location



## 1-3 Chronology and summary of the previous works

The chronology of whole the present 3-year project is omitted here, as it is described in p-1 and -2 in Summary Report (MMAJ/JICA; 1979). Here only the chronology and summary of the previous works carried out within the Llano del Coyote prospect are briefly reviewed.

Exploration works by UN: The mineralization in this area was first localized by UN, through their reconnaissance geochemical sampling of stream sediments, which was carried out from 1966 to 1967. The anomaly was called "No.10 Anomaly Llano del Coyote, Area-II" (UN, 1968).

Subsequently, from 1969 to 1970, UN undertook a follow-up work program in an area about 2.5km (WNW-ESE) by 0.6 to 1.3km(NNE-SSW) that included the above-mentioned anomaly. The program comprised geological mapping in an area of 2.5km x 0.7km at a scale of 1/2,000, grid sampling of geochemical soil and rock chip samples (Cu,Pb,Zn, and Mo analysed), IP survey for 24 lines totaling 17.13 line·km (33.9 line·km including the re-measurement for check), EM and ground magnetic survey for 12.65 line·km, and 7 short diamond drill holes to the IP anomalies, totaling 751.44m. As a result, it was revealed that mineralization covered almost all the investigated area (2.5 to 3 km long), and the sub-economical sulfide mineralization was intersected in their DDH No.4 (a prefix UN- is assigned hereafter in this report, to denote the DDHs by UN: 124.1m-129.6m, for 5.5m interval; Cu 0.38%, Zn 2.96%). Nevertheless, most of other drills terminated in the oxidized zone, as they were of short length. UN consequently recommended several additional diamond drills, and detailed geological mapping, geochemical sampling, and IP survey for the possible extension of the anomaly.

Exploration works by DGMH: Succeeding to UN, DGMH carried out two drills totaling 189,7m (a prefix DG- is assigned hereafter in this report, to denote the DDHs by DGMH). A massive Pb-Zn sulfide ore was intersected near the bottom of DG-9, though the recovery is extremely poor and it seems not to have been assayed. DGMH gave up to continue the drilling plan due to the change of its policy.

Phase-I of the present project: During our field work of the 1st phase exploration(from November to December in 1976), the report by UN(1973) was reviewed, the ground was visited for investigation, and all the cores of

9 holes totaling 941m (including 2 holes by DGMH) were relogged. As a result of this review, we judged that the area was worth exploration from the reasons mentioned below, consequently we recommended to commence exploration again: (1) The mineralization observed on the surface is pervasive, and both the geochemical and geophysical anomalies by UN are still open. Therefore, further outward extension of the anomaly is quite within bounds of possibility. (2) The Zn values of geochemical anomalies themselves are worth exploration. The Cu values are not so high, but they are neither very much reliable, nor can be a negative factor, as there occurs the leached capping some 50 to 70 m deep. (3) No DDH has been carried out to a geochemical anomaly, but almost all the DDHs were to the IP anomalies. Furthermore, almost all the terminated within the oxidized zone, before reaching the target zone. (4) The mineralized intersection in DDH UN-4 has not been traced by other drills. (MMAJ/JICA; 1976)

Phase-II of the present project: Based on the proposal mentioned above, this prospect was selected one of the target areas in the Phase-II program, and was designated as Area-C Llano del Coyote.

Following works were carried out in an area of about 14 sq.km (7 km x 2 km): (1) Preparation of 1/10,000 photogrammetrical topographic map from IGN air photographs. (2) Geological mapping at a scale of 1/10,000 for the routes and picket lines,totaling 88.1 km. (3) A grid sampling of 861 geochemical soil samples and chemical analysis of four elements (Cu, Pb, Zn, and Ag for each sample). (4) IP survey for 42 line·km and ground magnetic survey for 72 line·km. (5) 3 diamond drill holes totaling 830.7m.

As a result of the exploration works of the phase, following facts were revealed(Fig.2):(1) There exists a west-northwesterly trending mineralization-alteration zone that has a surface extension of 5 to 6 km by 0.4 to 0.6km within the target area. (2) Geochemical and geophysical anomalies exist approximately coinciding with this zone (the extent of the anomalies is about twice as large as that localized by UN). (3) Indication of mineralization was intersected in almost all the DDHs, though the intersections are of far from economic grade (Table-4).

An exploration program for the 3rd phase was planned, based on the result of this second phase, and was recommended. The program included 7 additional DDHs totaling 1,200m, and supplemental geological mapping in the vicinity of DDH sites. (Table-28, 3-10 in Phase-II Report).

Geographical relationship among the areas covered by exploration works of various projects or phases mentioned above is shown in Fig.2.

### 1-4 Works carried out in present phase

This area was selected as the only target area for the Phase-III program, as it was judged the most prospective,after having been compared with other six follow-up areas ( Area-C is included in B-2). Field works of the Phase-III program were concentrated within the centeral part of Area-C; 7 DDHs totaling 1,203m, supplemental geological mapping in an area of 5 sq·km, and geological logging of drill cores were carried out. Microscopic observation, X-ray diffractometry, and chemical analysis were performed for handspecimens collected from the surface and core samples. Breakdown of the works are as follows.

Diamond drilling

| No. | Proposed No* | Length(m) |
|---|---|---|
| MJ-4 | (MJ-1) | 150.2 |
| MJ-5 | (MJ-3) | 151.3 |
| MJ-6 | (MJ-6) | 150.8 |
| MJ-7 | (MJ-5) | 300.1 |
| MJ-8 | (MJ-4) | 150.2 |
| MJ-9 | (MJ-7) | 150.2 |
| MJ-10 | (MJ-2) | 150.2 |
| Total | | 1,203.0 |

*Proposed Nos. corresponding to those in Table-28 in the Phase-II Report.

Geological mapping

5 sq·km between W-28 and -27. Mapped at a scale of 1/2,000 and compiled in geologic maps and sections at scales of both 1/2,000 (local) and 1/5,000.

Geological logging of DDH cores

Total length of drill holes logged; 1,203.0m

Graphic geologic log; compiled at a scale of 1/500

Number of samples tested

| Sort of test | Microscopic observation | X-ray diffractometry | Chemical analysis | |
|---|---|---|---|---|
| | Number of sections | Number of samples | Number of samples | Elements assayed |
| Handspecimens from surface | 15 | 160 | 129(15) | (Au),Ag, Cu,Pb,Zn,S, Fe,Mn 2,169(83) |
| Handspecimens drill core | 30 | 78 | 169(68) | |
| Total | 45 | 238 | 298(83) | 2,169 |

*Number in parenthesis indicates the number of gold assay.

Geological mapping was performed based on 1/2,000 topographic maps that had been photographically enlarged from an 1/10,000-photogrametric topographic map. This was prepared from IGM air photos in the Phase-II.

Traverses were sometimes chained with a pocket compass and a 50m-ethlone chain, when required. Results of the mapping are compiled in 1/5,000-scale geologic maps and sections(PL-1-1, 1-2, and -2). A detailed geologic map and sections are further presented at a scale of 1/2,000 for the center al part of the area (W12-E12), where diamond drill sites are located(PL-3,-4).

Diamond drilling was performed by two wire-line drill rigs. Results of drilling are described in Chapter-5 of this report, and the detail of the drilling operation is given in Appendix-7 of the same, respectively.

The result of the logging is compiled in graphical geologic logs at a scale of 1/500 (PL-6-1 through 6-7 inclusive).

The results of the tests of rock and core samples are shown in Appendices (Appendix-1 through 4 inclusive), and sample locations are plotted in PL-7.

As a result of the exploration works mentioned above, a favourable mineralization was ihntersected by MH-9 (88.60m to 98.10m 12.76% Zn), on which description will be made in detail in later chapers.

Drilling operation as well as geological logging of drill cores was carried out during a 112-day period from June to October, while surface geological mapping was performed during a 31-day period from September to October, 1978.

## 1-5 Personnel

The personnel engaged in the present phase are listed below:

General maganement and project coordination

| | |
|---|---|
| Takeo Kuroko | Leader, Metal Mining Agency of Japan (MMAJ) |
| Yukio Harada | MMAJ (representative of Mexico office) |
| Kenji Sawada | MMAJ |
| Sadayuki Nagahata | Japan International Cooperation Agency (JICA) |
| Tadao Hamachi | MMAJ Special adviser |

Field party from MMAJ

| | |
|---|---|
| Kinsuke Uchida | Leader |
| Masakazu Kawai | Sub-leader; in charge of the Geological Survey Group |
| Hideo Janome | Geological Survey Group member |
| Tadayoshi Seino | - ditto - |
| Akio Chida | Drilling superviser |
| Soji Kannari | Drilling Group member |
| Yasuo Kanemitsu | - ditto - |
| Sakae Hirono | - ditto - |
| Katsuei Narita | - ditto - |

Guatemalan Counterpart from Dirección General de Minería e Hidrocarburos (DGMH)

| | |
|---|---|
| Fernando R. Santiago M. | Leader, Chief of Metal Mining Section |
| J. Antonio Gonzalez C. | Sub-leader, Chief Dept. Investigation & Technical Services |
| Hugo Lucero | Geological Survey Group |
| Armando Castellanos | - ditto - |
| Armand Rivera | Drilling Group |

| | |
|---|---|
| Felipe Galvéz | Drilling Group |
| Obdulio Calderón | - ditto - |
| Julio Valdéz | - ditto - |
| Gonzalo Morataya | - ditto - |
| Fredy D. Recinos B. | - ditto - |
| Carlos Medrano | Surveyor |
| Marco Antonio Kopp M. | Assay Laboratory |
| Jorge Mario Ruano | - ditto - |
| Flor de María Cintora R. | - ditto - |
| Pedro Valencia | - ditto - |

## 1-6 Acknowledgment

We heartily wish to express our thanks to His Excellency Lic. Jorge Luis Monzón Juárez, Secretary of La Secretaría de Estado para Minería, Hidrocarburos, y Energía Nuclear, Lic. Mario Escobar Carrera, Sub-director of La Direccion de Minería e Hidrocarburos, Ing$^{o}$. Luis Specher, Chief of Department of the Promotion of Mining, and all the personnel of the Secretaria(Ex-DGMH) who have been engaged in the present operation for their cordial assistance and cooperation.

We are all indebted very much to His Excellency Mr. Fujio Hara, Japanese Ambassador to the Republic of Guatemala, Mr. Takehiko Shigemitsu, First Secretary, and other members of the Japanese Embassy in Guatemala for assistance extended to us during our stay in Guatemala.

## 2. General Information

### 2-1 Location

The mapped area of the present phase is located about 110 air·km northwest of Guatemala City, the capital of the Republic, and is within Area-C Llano del Coyote of Phase-II. The mapped area is within jurisdiction of Municipality of Aguacatán, Department of Huehuetenango (Fig.1). The major part of the area is covered by an IGN quadrangle map Sacapulas (1961 - 1, 1/50,000).

Area-C of Phase-II is a rectangular area bounded by two N66°30'W -S66°30'E lines (7km) and two N23°30'E-S23°30'W lines(2km), covering a 14 sq·km area. The coordinates of its four corners are listed below:

| | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| North latitude | 15°20'15" | 15°18'46" | 15°17'45" | 15°19'15" |
| West longitude | 91°15'00" | 91°11'47" | 91°12'14" | 91°15'49" |

The area is covered by 4 sheets of the IGN quadrangle maps (1/50,000); Sacapulas(1961-1), Nebáj(1962-2), Huehuetenango(1961-4), and Chiantla (1962-3).

### 2-2 Access

The mapped area is easily accessed from the capital via Huehuetenango city (the departmental capital of the department of the same name ) through national highways Routes CA-1, 9N and 7W. The road distance between the prospect and the capital is about 291 to 297km, and the required time by car is about 5 to 7 hours. The area is favourably located, as Route-7W passes through near the southwestern border of Area-C (Fig.1), and the drill site of MJ-9 in which promissing mineralization- was intersected, is situated only about 280m off the route. Description on the road condition of major intervals is made below.

Guatemala-Huehuetenango: Access from Guatemala city, the capital, up to Huehuetenango, which is the base to project areas, is fiarly convenient (261 road km). A 2-lane asphalted national highway CA-1(Pan American HWY) passes about 4km southwest of the city center of Huehuetenango, which can be reached by 4 to 6 hours' drive from the capital. Several bus services are daily available between the two cities, and it takes about 6 to 8 hours. No regular commercial flight is available, though there is a small air strip in Huehuetenango.(Fig.1,2)

## Fig. 3 ACCESS TO LLANO DEL COYOTE PROSPECT

Huehuetenango-Llano del Coyote

Aguacatán, where the camp was established during the field operation, is located about 18km east-northeast of Huehuetenango (21km along road), and can be reached by 50 minutes' drive from the latter via the Routes 9N and 7W.

The southwestern corner of the area, where the Route 7W passes nearby, is located about 6.8 km and in S67°E direction from the municipality center of Aguacatán. From this corner east-southeastward, the Route 7W runs along the southern border of the mapped area, in and outside of the area. The Route 7W is nearly parallel to the border and only 500m apart at most from it, so that the area can easily be accessed by car; the road distance from the center of Aguacatán up to the area ranges from 9.5km to 15km, and it takes only 15 to 25 minutes by car.

The Route 7W is an all-weather road, and is about 3.5m wide. It is fairly well maintained in the section between the area and Huehuetenango, though it is unpaved. However, the road may be closed for certain days in the rainy season at the section of about 5 km near La Baranca between Aguacatán and Huehuetenango, as the road passes along the fault scarp of the Chixoy-Polochic in this section. It is also quite within bounds of possibility that this part of the road might be closed for a long time, should an earthquake take place. It may be necessary to strengthen the bridge within this section, when the heavy goods more than 10T are to be transported. (Fig.1,2)

On Huehuetenango city

Huehuetenango city is the departmental capital of the department of the same name, and is the entrance to the Altos Cuchumatanes. In our reports, the description on location and access to the project areas was often made, taking the city as a starting point.

The population of the city is said some 50 to 100 thousand, and is ranked the fourth or the fifth in the Republic. Huehuetenango city tolerably provides the urban functions, though it is small: There are various offices of departmental and federal governments. There also are a Guatel office, a post office, three banks, two radio stations, a hospital, several repair shops and hotels, and two supermarkets in the city.

Our field office was established in the city during the field works of the 1st and 2nd phase programs. Most of our supplies for the field works such as food, fuel, and so on were purchased in the city except special goods.

## 2-3 Available ports and transportation routes

Ports that can probably be utilized for shipping of concentrates or importing equipments are Champerico, San José, and Acajutla (El Salvador) on the Pacific coast, and Puerto Barrios on the Atlantic. However, the former two have no pier that can berth ships, so that cargoes are loaded and discharged only by lighters. Therefore, it may be necessary to use the latter two, depending on sorts of equipments, and to prepare special containers if the former two are utilized for shipping concentrates. Data of these ports are summarized in Table-1.

Routes between the ports and the prospect are summarized in Table-2, and shown in Fig.2. Transportation distances are as follows; to Champerico about 220km, to San José 340 to 350km, to Acajutla 440 to 450km, and to Puerto Barrios 460 to 480 km. The route from Puerto Barrios listed in Table-2 includes a very rough 85km-section between San Cristóbal Verapáz and Cunén. Therefore, the alternative route via the capital and CA-1 might be more realistic.

Further investigation on the routes and ports will be necessary, when it is justified to carry on feasibility study.

## 2-4 Communication

No telephone cable for public use is extended to Aguacatán as yet. Telephone call from Huehuetenango to Guatemala city can be made only from the telephone booth in Guatel office, as little extension has so far been made to individual houses in Huehuetenango.

Telegram can be sent from the post office which is in the center of the municipality, and is delivered to each house in Aguacatán.

Both foreign and domestic mails are safely delivered to and from the Aguacatán area. It takes about 2 to 3 days between Aguacatán and the capital, and 8 to 10 days by air mail between the former and Japan.

Telex can be sent from the Guatel office in Quetzaltenango city that can be reached from Aguacatán by about two hours' drive.

## 2-5 Physiography, vegetation, and climate

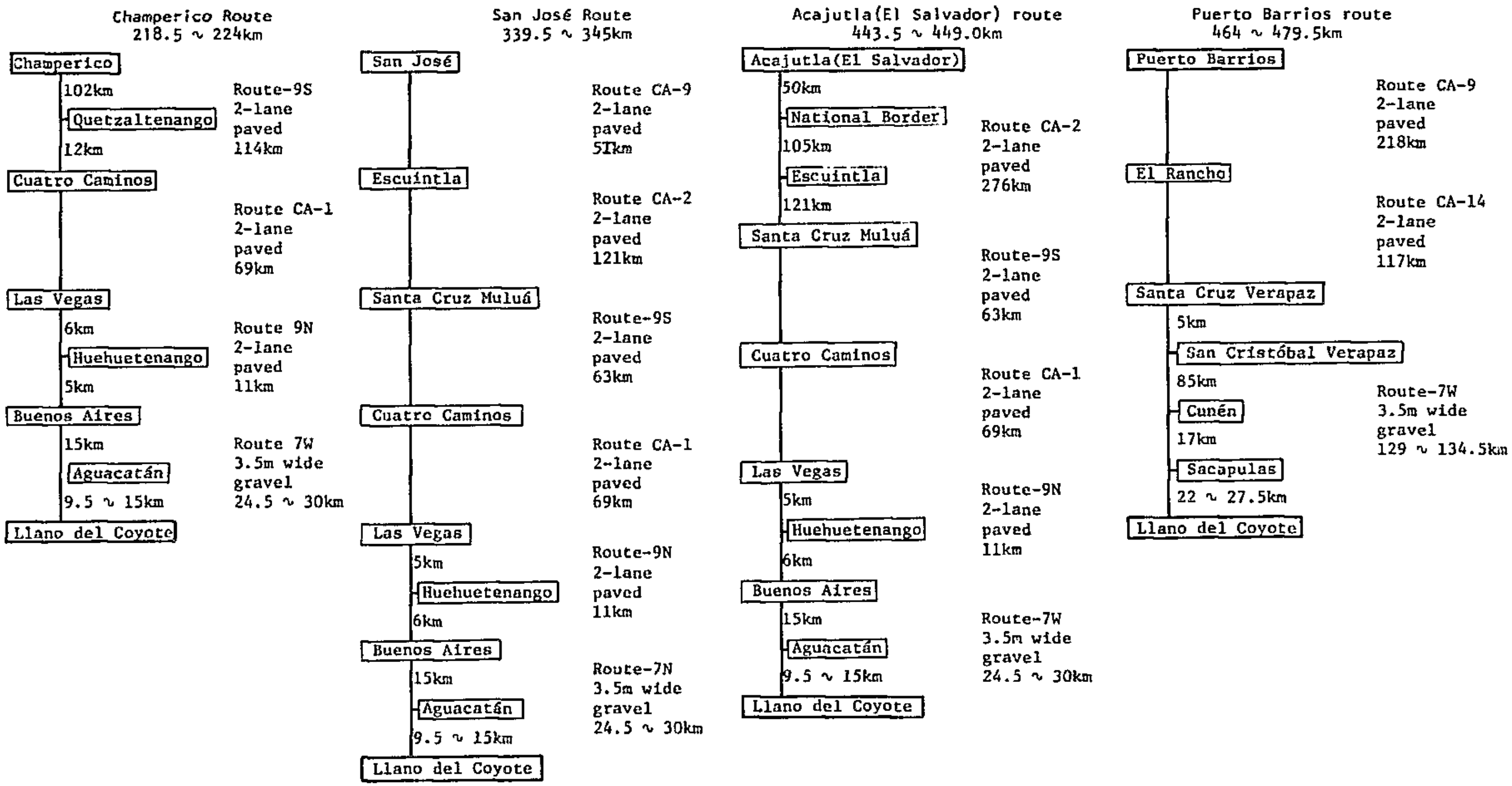
### Physiography (PL 1-1,1-2,and 2)

The mapped area is located almost on top of a ridge which extends in WNW-ESE direction and is situated between two easterly running rivers Río Blanco and Río Negro. Elevation varies from 1,460m above sea level (at the southeastern corner) to 1,890m within the mapped area. In general,

Table - 1 Summary of Available Ports

| | Pacific Coast | | | Atlantic Coast |
|---|---|---|---|---|
| Port | Champerico | San José | Acajutla (El Salvador) | Puerto Barrios |
| Location | Lat. 14°18'N.; long. 91°56'W. | Lat. 12°55'10"N.; long.90°50'W.107 kms.S.of Guatemala C.on the Pacific | Lat.13°35'N.;Long.89°50"W.Port for western part of Salvador. | Lat.15°43'N.; long.88°36'W. |
| Distance * | 220 ∿ 250km | 340 ∿ 350km | 440 ∿ 450km | 460 ∿ 480km |
| Accommodation | Open roadstead subject temporarily to heavy swells. Anchorage in approx. 43 ft., one mile from wharf. Cargo loaded and discharged by lighters. Pier, length 1,132 ft., width 80 ft., head 82 ft., bridge 27 ft., two 10-ton, two 15-ton and one 25-ton which (max capacity 40-tons). Four tugs and 11 30-ton lighters. 2,000m. railway, four locomotives, 150 car platforms, 15 truck lifts and 7 cranes of different tonnage. 23 covered warehouses, 35,100 cu. m. Total port area, 52,000 sq.m., concrete paved. Open and paved warehouses with total area of 30,000 sq.m. Port rail tracks, 6,000 lineal feet. Container Handling Facilities: Available. Working Hours: Saturday work from 07.00 to 12.00. Overtime rates at any time(double pay). | Open roadstead; ships anchor about 1/4 mile from pierhead in about 8 to 9 fms.;sand, not very good holding ground;infrequent heavy swells; from the middle of June until October, violent wind and rain storms of short duration, called "Chubascos", may occur, particularly at night. Steel pier owned by Ferrocarriles de Guatemala(FEGUA), but operated by Agencia Maritima S.A., serves lighters loading/discharging vessels in the roads. Three 5-ton winches and one heavy-duty winch of 20 tons, but capable of handling up to 22 short tons, with previous notice. Nine lighters of 35 tons cap. each; four tugs and one dispatch boat. San Jose has now been declared a National Port. | Open bay. The Port consists of a breakwater mole, 763m. long. The access mole runs for approx.400m. and has a free width of 7m. Pierhead 37m wide. The Port has recently been expanded and improved with the utmost in port installation. Ships dock directly to the mole thus eliminating lighterage operations.Pier has two berths, both of which are well protected and usable at all times. Overall height of pier at M.L.W.,7m.-well fendered and made of reinforced concrete. Draft alongsode,30 to 44 ft. Bulk unloading possible at rate of up to 100tons/hr. One transit shed on pier of t,000sq.m. CEPA has built four warehouses with total covered space of 22,000sq.m.,enabling 400,000tons cargo to be handled yearly. Two open storage yards-total area 15,000sq.m. Two travelling cranes with boom of 16m. long and capacity 3 metric tons. Port fully equipped for handling all types of cargo, with automotive cranes, fork lift trucks up to 20,000 In.,tractors, trailers,etc. | Depth in channel approach 28 ft. Good anchorage S.W. of the peir with rearly 5 fms. of water. R.of T. less than 12 in. One pier 2,112 ft. long, property of Ferrocarriles de Guatemala, with one outer berth alongside shed on north side (27 ft. outer end, 25ft. inner end) and one inner berth on N. side alongside U.F.C. banana conveyors (25 ft.). On south side of pier alongside sheds, one outer berth with 27 ft. at outer end and 25 ft. at inner end.one middle berth with 25 ft. and one inner berth with 23 ft. at outer end and 21 ft. at inner end. On the south side of the approach to the pierhead, one outer berth with 21 ft. and one inner berth with 16 ft. Pier sheds of 400 ft. by 80 ft. and 580 ft. by 41 ft. No cranes on pier but 15-ton mobile crane and 5-ton crawler crane available in yards. Water available. Vessels must fly Guatemalan flag at foremast in order to receive pratique. |
| Bunkers | Not available. | Crude oil available. | Available. | Petrol and diesel oil from tank cars possible in emergency. |
| Pilotage | N.C. and not necessary. | | Available and compulsory. | Compulsory. Launch available for handling lines $10.00. |
| Remarks | The Government has plans for the construction of a new port with two berths for accommodating 10,000-tons ships. | The best on the Pacific coast, but custom clearance is required. | Depth alongside of 32 to 39 ft. Facilities for handling containers will be available on completion of ner pier. | |
| Information Source | Clyde Port Authority(1972); Ports of the World | ditto | ditto? | ditto |

Table - 2 Proposed Route to Ports



the part lower than 1,750m forms steep topography, while the part higher than this forms the flat topped mesa-like topography. Probably the silicified zone along the sedimentary-granite contact may have caused this prominent physiographical feature.

In the northern part of the area (Río Blanco side), where non-altered metamorphic rocks of the Sacapulas or the Chicol Formation occur, very steep slopes averaging 30° to 35° are usualy formed and quite often steep cliffs of conglomerate schist are developed. There are several tributaries flowing to the north on this slope, which are deeply dissected, and accompanied with steep side walls and falls.

To the south of the area mentioned above, topography becomes suddenly gentle in the area underlain by the alternation of the shale and sandstone of the Tactic Formation. This flat topography extends further to the south, forming a mesa-like hill which is underlain by the mineralization-alteration zone. The zone covers the granite contact. The mineralization-alteration zone (about 5.6km in WNW-ESE) is located between 1,800m and 1,865m above sea level on this mesa, except in a section of 1.3km between W-26 and W-13 in the western part.

In the southeastern part (Río Negro side) of the area, where granitic rocks underlie, topography changes steep again.

These topographical characteristics mentioned above are considered to be fairly fabourable for underground mining: Anywhere between W-16 and B-14, the mineralized zone can be reached by an adit from 400 to 1,000m long, providing that its portal is opened at an elevation of 1,600m. It can also be reached by an 1,300m adit at longest, even if the portal were lowered down to 1,500m above sea level. An inclined shaft can, of course, shorten the distance.

There are many places topographically suitable for waste and tailing disposals in the vicinity of the mapped area, so far as no human factors such as environmental polution, and acquisition or compensation of lands are concerned. Further study will essentially be required on these factors, should it be justified to carry on feasibility study in future.

Vegetation and others

The flat lands on the mesa are mostly utilized as pasture, corn fields, and cultivated lands for potatoes and wheat. This part is inhabited fairly thick. Therefore, there may be some trouble, though not very serious perphaps, for the acquisition of the surfacr right or land,

and/or compensation of the crops. On the contrary, there remains some natural vegetation along tributaries and on the steep slope; two kinds of pine trees and broad-leaved evergreen trees including some sort of oaks, and so on are observed.

Climate

This area, as well B-2, can be said rather drier than other areas of the present project's. Annual precipitation is inferred between 1,200 and 1,500 mm, most of which fall during the six months in the rainy season. The dry season is from November to April of the next year. However, it is said that it sometimes showers in December and January. They say that the maximum temperature in the day time rises even up to 30°C in March and April, the months just before the rainy season begins. Nevertheless, even this time it is rather cool and fresh at night.

2-6 Water supply and electricity

All the tributaries in the area become dried up in the dry season so that even drilling water can not sufficiently be supplied from them. However, the Río Blanco, which flows easterly in the north of the area, seems to have abundant water even during the dry season, though we have no hydrological data at present. Therefore, the required industrial water for, say up to a 500 TPD production rate, will probably be supplied sufficiently, if a small dam is built. The pumping head would be around 300 to 400m at most, even assuming the mill site on top of the mesa: The river bed is located between 1,430m and 1,520m above sea level, while the surface elevation of the mineralized zone is between 1,800m and 1,890m above sea level. For the reference, the horizontal distance between the river course and the mineralized zone ranges from 700m to 1,300m.

A 33 KV power line of INDE passes through the southern part of the mapped area along the Route 7W. Therefore, electricity will be utilized, only by installing the receiving and distributing facilities. On this viewpoint, this area is extraordinarily well located for a place in Guatemala.

# 3 Geology

## 3-1 Regional geological setting

The mapped area is geologically located at the northern periphery of a granitic batholith. The southernmost fault plane of the Chixoy-Polochic fault system's is inferred to run parallel to the long side of the area, about 0.7 to 1.1 km apart from this (PL-28 in Phase-II Report).

The granitic batholith occurs from Huehuetenango eastward for about 65 km with a width between 10 and 15 km. The result of the K-Ar dating of two samples taken from the batholith indicates 117 and 135 m.y. ages. (early Cretaceous)(Table-7 and Fig.3 in Summary Report).

The mineralization-alteration zone, which is the target of our project, occurs within a roof-pendant of the Paleozoic sequence in the batholith. The roof-pendant extends westward from the vicinity of Sacapulas in a shape of wedge, thinning out at a point about 1km west of the northwestern corner of the area (PL-28 in Phase-II Report).

In the vicinity of the mineralization-alteration zone, seventeen or more small (mostly dykes) intrusive bodies of rhyolite-quartz porphyry occur. They trend in N40° 45°W direction,arranging in "en echelon". This is very much interesting with relation to geological structure and mineralization (Fig.6, PL-1-1, 1-2).

The result of the K-Ar dating of the rocks, which can be inferred equivalent to these acidic intrusives, indicates 58 and 62 m.y. ages. (Table-7 and Fig.11 in Summary Report).

Stratigraphically, the roof-pendant comprises the sequences that may be correlated to the Chicol Formation of pre-Permian, and the Tactic Formation of the Permian or older (Fig.4, and Fig.6,7 in Summary Report).

From the viewpoint of metallogenic province, the area belongs to the Pb-Zn-Ag mineralization zone that extends from Chiapas in Mexico, as other areas of this project do. However, more locally, it can be said that the area belongs to a Cu-Zn zone which coincides with the acidic intrusives (Fig.5 in Summary Report).

## 3-2 Local geology

### 3-2-1 General features

Definition and distribution of major geological units

The mapped area mainly comprises three geological units; (1) granitic rocks, (2) sedimentary and metamorphic rocks of the Paleozoic (hereafter, the term "sediments" may be used when to denote the both), and (3) intrusive bodies of rhyolite to quartz porphyry (hereafter, the term "acidic intrusives" may be used when to denote the both).

The area includes another unit of different category the "mineralization-alteration zone" that is mainly derived from the "sediments". Recent volcanic ash and welded tuff overlie the older rocks here and there on the mesa.

The granitic rocks occur in two separated parts in the vicinity of this area; one is the part south to the base line within the area, and another is north to the area. The northern body enters the mapped area in the western part than W-3 line.

The"sediments" which occur as roof-pendant between the two bodies of granitic rocks, show an apparent width more than 2 km on the surface at the eastern limit (E-36), but decrease it on going westward. The width becomes about 1 km near the central part of the mapped area (O-line), and further decreases down to 200m around the western limit (W-34). The sediments disappear in the granitic rocks at about 1 km west of the western limit.

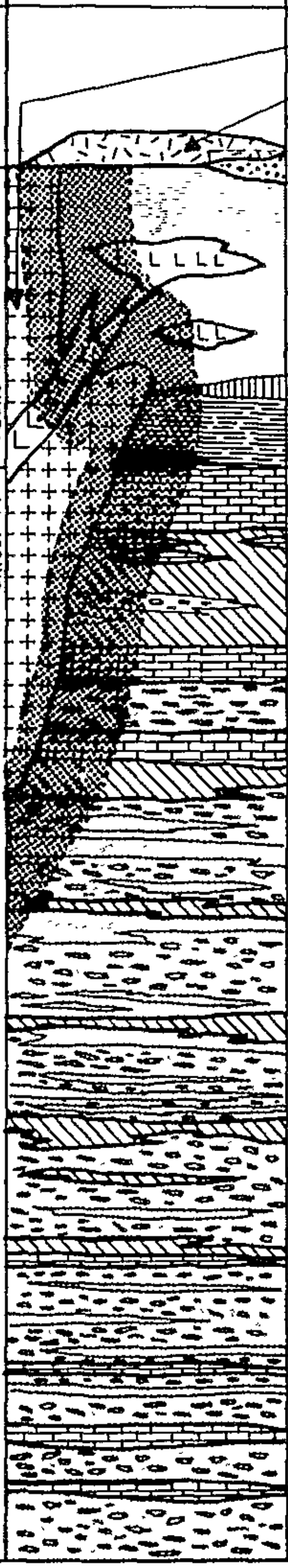
The"acidic intrusives"occur as more than 17 small bodies in the central part(about 5.2km in WNW-ESE between W-26 and E-26) of the "sedimentary" terrain within about 600m from the granitic contact. The individual bodies strike in N40°-45°W, arranging in en echelon, as if they were the dykes that had intruded in the "echelon faults" or the sills that repeatedly exposed by "echelon folding".

The"sediments" which approximately occur in the area where there is a swarm of the acidic intrusives, and are situated within 400m to 500m from the granitic contact, are suffered from skarnization and hydrothermal alteration to form the"mineralization-alteration zone" (Fig. C-3,Pl.-63)

Relationships mentioned above are shown in Fig.6, PL 1-1,and 1-2.

## Fig.4 Generalized Stratigraphic Section of Area-C

### ( Llano del Coyote )

| Geological Age & Formation or Group | | | Graphic Columnar Section | Lithological Unit | Thickness in M | Note |
|---|---|---|---|---|---|---|
| Cenozoic | Quaternary | |  | Granitic Rocks<br>Volcanic Ashes & Welded tuff | | Alteration halo is observed for some 400m from contact |
| | | | | Alluvium | | |
| Palaeozoic | Permian and/or Pre-Permian | Santa Rosa Group | | Alternation of tuffaceous shale & fine sandstone<br>Quartz Porphyry*1 | 150 ± | *1 Quartz porphyry seems to occur mostly as sills concordant to bedding of host rocks |
| | | | | Black chert*2 | 0–30 | *2 Black chert thins out from central part westward |
| | | | | Black slate | 50 ±20 | |
| | | | | Alternation of limestone*3, green schist, conglomerate-schist*4 & pelitic schist | 200± 50 | *3 Limestone is mostly dark colored & phyllitic to schistose<br>*4 Conglomerate schist includes sericite-quartz-(chlorite)-schist which may originally be acidic volcanics |
| | | | | Alternation of conglomerate-schist*4, green schist,& pelitic schist | 340± 40 | |
| | | | | Alternation of limestone, conglomerate-schist , green schist, & pelitic schist | 150 + | |

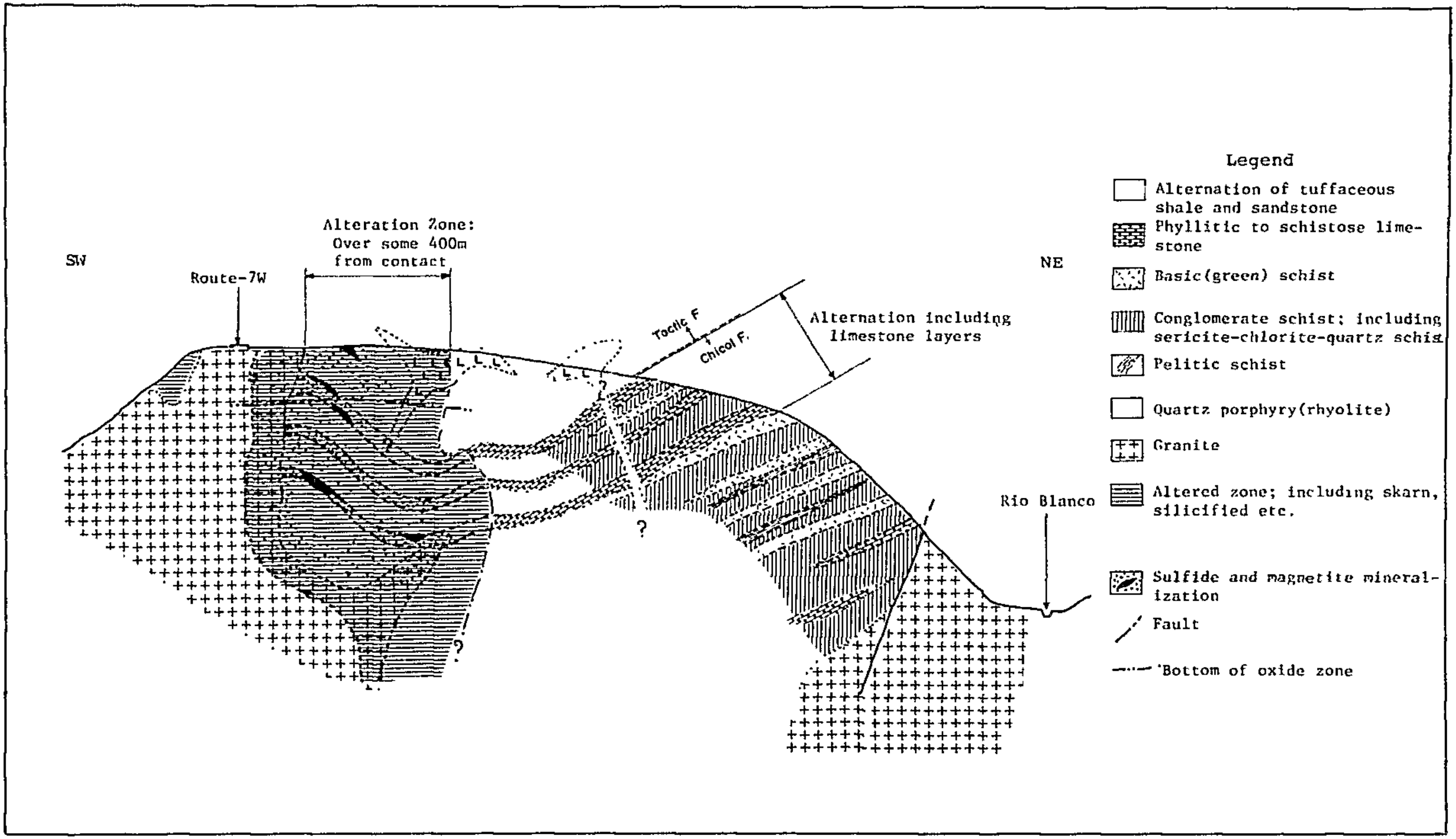
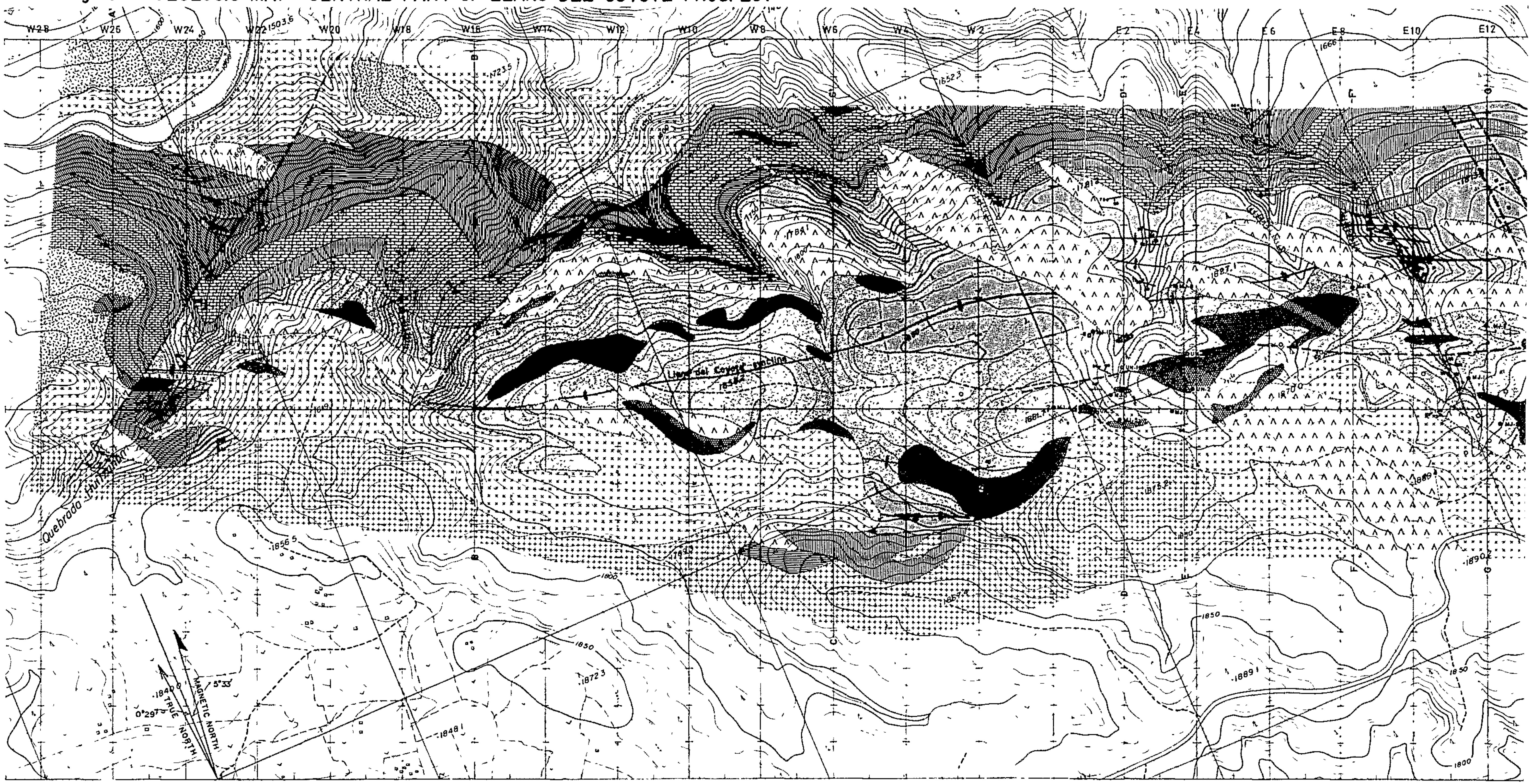



Fig.5 Schematic Geologic Profile of Area-C Llanc del Coyote

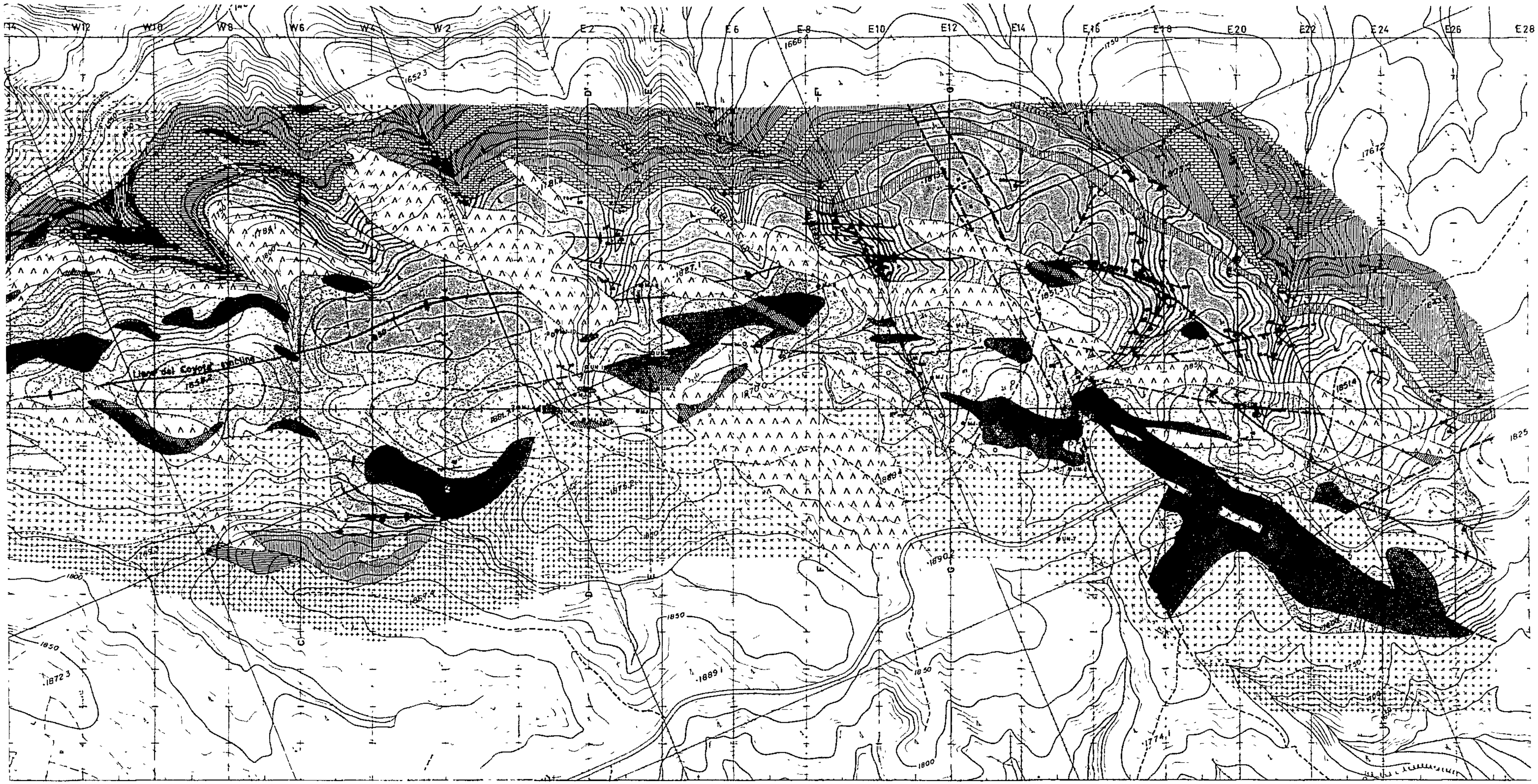
Fig. 6  GEOLOGIC MAP: CENTRAL PART OF LLANO DEL COYOTE PROSPECT




LEGEND

- Alluvium
- Volcanic ash, pumice & welded tuff
- Tuffaceous shale & fine sandstone with occasional black slate
- Black cherty rock
- Mainly limestone (schistose & phyl
- Mainly conglomerate schist & sericite chlorite quartz schist
- Mainly basic (green) schist
- Pelitic schist
- Rhyolite & quartz porphyry
- Quartz diorite & Granodiorite
- Granite
- Serpentine
- Altered tuffaceous shale & fine sandstone (skarn & silicified rock etc.)
- Limonite gossan
- Strike & dip of beds or foliation
- Anticline
- Syncline
- Fault
- Geologic boundary
- Geologic section line

) DEL COYOTE PROSPECT




tuff | Tuffaceous shale & fine sandstone with occasional black slate | Black cherty rock | Mainly limestone (schistose & phyllitic)

artz schist | Mainly basic (green) schist | Pelitic schist | Rhyolite & quartz porphyry | Quartz diorite & Granodiorite

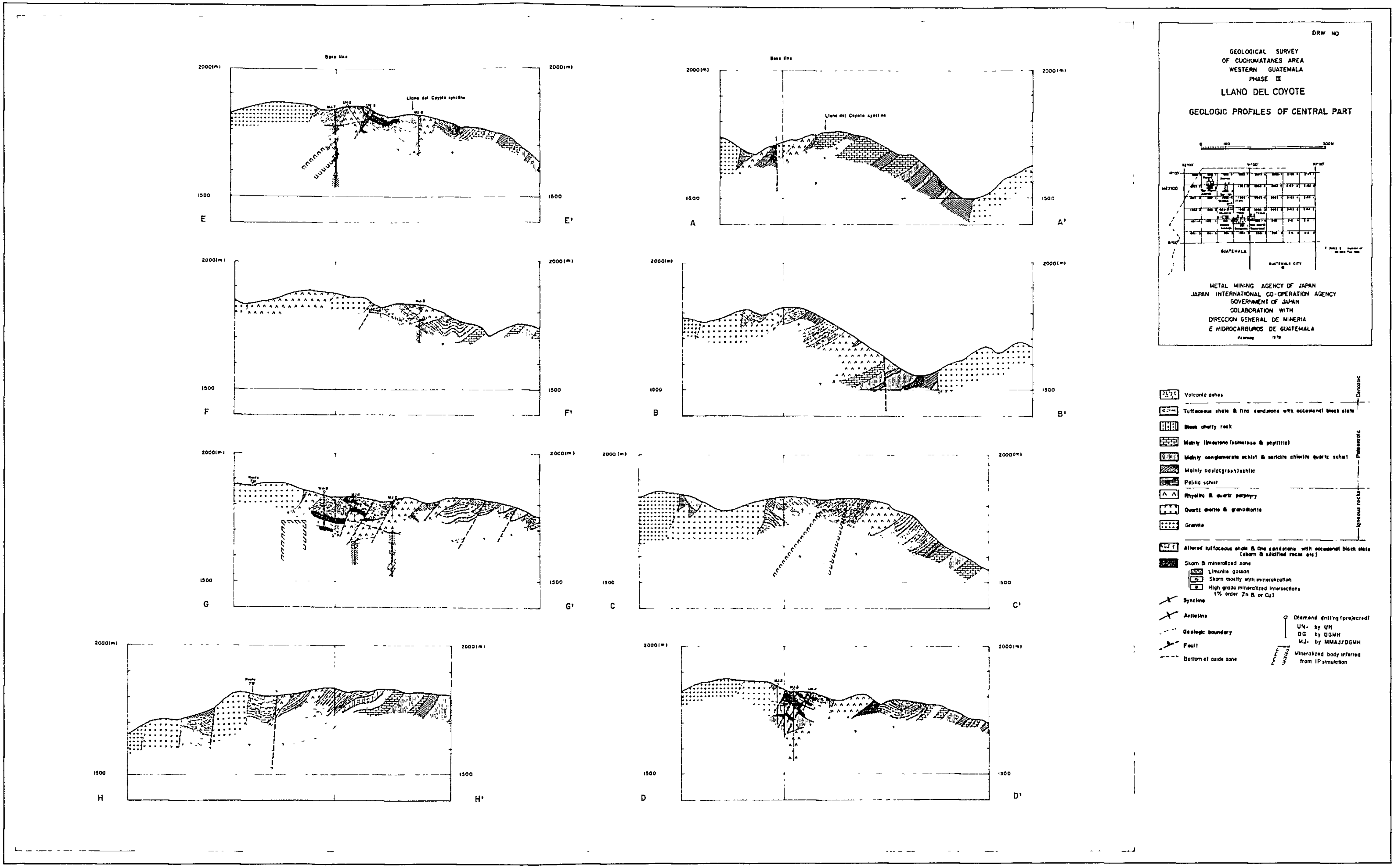
ffaceous shale & fine sandstone (skarn & silicified rock etc.) | Limonite gossan

e | Syncline | Fault | Geologic boundary | Geologic section line

Diamond drilling
- UN = by UN
- DG = by DGMH
- MJ = by MMAJ/DGMH
- —— Proposed drill site

0 500m

Fig. 7 GEOLOGIC PROFILES: CENTRAL PART OF LLANO DEL COYOTE



### Relationship between major structures and major units

The "sediments" in Area-C are interpreted to form a syncline (in the north) and an anticline (near granitic contact in the southern part), both of which have the axes almost parallel to the long side of the mapped area. The former is denoted hereafter as Llano del Coyote Syncline. The above-mentioned "acidic intrusives" occur coincidently in the axial area of this syncline, and the mineralization-alteration zone is likely located between the granitic rocks and the axial plane of the syncline. (Fig.5,6,7; PL-1-1, 1-2, and 2)

### Stratigraphical correlation

The stratigraphical column can rather easily be constructed on the northern limb of the Llano del Coyote syncline, especially on the north-looking steep slope that faces to the Río Blanco, as rocks here are not altered and well exposed. The stratigraphical column constructed from the mapping on this part, is schematically shown in Fig.4. The "sediments" that expose in this area may be correlated to the upper part of the Chicol Formation, and the lower part of the Tactic Formation of the Santa Rosa Group, from lithostratigraphical similarities. In Fig.4, the Chicol is assigned to the uppermost part of the alternation of "conglomerate schist-green schist-pelitic schist" that intercalates limestone, while the Tactic is assigned from the black slate upward. (Fig.4 vs. Fig.6,7 of Summary Report).

On the contrary, in the "mineralization-alteration zone", it is fairly difficult "to infer the original rocks", "to construct the stratigraphic column", and "to correlate it to that of the northern limb", because the exposure is extremely bad here due to the flat topography, and because the rocks are strongly leached out and stained with limonite in this part. However, we have been able to reveal at last, that the altered rocks other than the acidic intrusives can probably be correlated to shale, sandstone, and slate of the Tactic. Skarns are attributed to the calcareous part of the Tactic and the limestone of the Chicol, repectively, based on the studies of geology on the surface and drill cores. As to the green schists, they are not very much suffered from alteration even in the zone.

Integrating these data, we have correlated the sequence on the southern limb of the syncline to that on the northern limb, especially based on the boundary between the Tactic and the Chicol.

As mentioned above, non-altered "sediments" and altered "sediments" in the "alteration-mineralization zone" can obviously be separated in their distribution areas, whereas intrusive rocks, both granitic rocks and the "acidic intrusives", are almost always suffered from alteration. Therefore, geological units are tentatively grouped into three for the description below: (1) "sediments" in non-altered zone, (2) intrusive rocks, and (3) "sediments" in the "alteration-mineralization zone".

Alteration zoning will be discussed later in 6-3.

### 3-2-2 Sedimentary and metamorphic rocks("sediments") in non-altered zone

The metamorphic rocks of the Chicol Formation in this area mainly consist of a sequence of "conglomerate schist∿sandstone schist∿pelitic schist", and that of "chlorite-quartz schist∿green schist". They intercalate some thin layers of the phyllitic to schistose limestone. The thickness of the Formation within the mapped area is roughly estimated from 600 to 780m (lower limit open). The Formation exposes within the area may be stratigraphically subdivided into three, based on the exsistence of limestone interlayers; the lower part that contains limestone layers (150m+), the middle part without any limestone layers (340m±), and the upper part with limestone (200 ± 50m).

The Tactic Formation consists of an alternation of sandstone and shale with lesser amount of slate. The thickness within the area is inferred from 180 to 250m (upper limit open).

These are schematically illustrated in Fig. 4 and 5.

Conglomerate schist, sandstone (psammitic) schist, and pelitic schist:

In this report, a schistose rock which contains pebble-like materials is widely called as "conglomerate schist". However, it includes many varieties, depending on the abundance and sorts of the pebbles, nature of the matrix, and the degree of the development of the schistosity. Corresponding with these change, the conglomerate schist grades transitionally into sandstone schist, pelitic schist, and muscovite-chlorite-quartz schist. Furthermore, the muscovite-chlorite-quartz schist changes into green schist via siliceous green schist. These changes seem to occur both laterally and vertically.

From other veiwpoint, "pebbles" are sometimes difficult to distiguish in field, especially in a small weathered float on a ridge, though they can more distinctly or even easily be distinguished in a lager float or in an outcrop along the tributaries where they are washed by running water.

From these two points, it is difficult to identify these varieties by unit of a single layer, and to trace or to correlate them. Therefore, in the geologic maps and geological sections of this report, the presentation of lithofacies is done rather idealized.

A typical conglomerate schist as well as a typical sandstone schist is olive gray to moderate gray in color, but it changes the color to grayish green - greenish gray in accordance with the increase of chlorite, making it difficult to distinguish it from muscovite-chlorite-quartz schist.

The"pebbles"mostly comprise "flattened" black slate and black schist (n cm x n m/m), which are arranged parallel to the schistosity, and angular to subangular white pebbles (up to 10cm) of quartzite or chert, quartz prophyry, rhyolite,and fragments of quartz and feldspar.

The matrix mostly consists of the materials that could be originally arenaceous or argillaceous, comprising mainly quartz, feldspar, and opaque minerals, with accessory chlorite, muscovite, and biotite. Also calcite and calcite veinlets are often accompanied to form a calcareous rocks. A variety that contains less"pebbles"grades into psammitic and/or pelitic schists, while a variety that has more siliceous matrix with comparatively abundant chlorite and muscovite grades into muscovite-chlorite-quartz schist.

The microscopical observation is summarized in Appendix 2-1 of Phase-II Report (RA-20, RA-31, RA-65. and RA-72). The reason why some of the samples are described as sandstone, phyllite, and shale in the Appendix, is because their thin sections were prepared only from the parts where few pebble were included.

Muscovite-chlorite-quartz schist: In the attached geologic maps and geologic sections, the rock is not distinguished from the conglomerate schist, as there are many intermediate and transitional varieties such as mentioned above. However, there are sometimes rocks that can be inferred originally to be acidic tuff breccia or tuff, from the presence of the pebbles and/or matrix of volcanic origin.

As a special variety of this, "(Garnet)-muscovite-quartz schist" is observed, though this is not separately marked in the maps. At least a layer of this rock occurs near the boundary between the Chicol and Tactic in the western half of the area, and was utilized as a key bed. This is white in color, and shows weakly developed schistosity on which comparatively large muscovite flakes are observed. Porphyroclastic phenocrysts of rounded quartz (less than 3mm) and subangular feldspar are observed in the matrix. Limonitized pseudomorphs of idiomorphic garnet are often scattered. The rock is microscopically described as altered dacite (RA-116, in which some mafic sites are observed to have changed to secondary biotite. We infer that a quartz schist derived from acidic volcanic has been suffered from the granitic intrusion to upgrade the metamorphic grade to form the rock presently observed.

Green schist: There are many varieties in color such as grayish green, dusky green, dusky grayish green, grayish olive green, and dusky yellow green. There are also abundant varieties in mesoscopical structures: (a) Schistosity is well developed. (b) Compositional banding of epidote is obvious. (c) So-called "agglomeratic" or "pillow structure" is observed (RA-63, Appendix 2-1)*. (d) The one that appears to be porphyrite or andesite origin, with abundant porphyroclastic feldspar (RA-16, and RA-23 in Appendix 2-1). (e) The one that seems to be andesitic tuff with so-called "green patch" (RA-63 and RA-74 in Appendix 2-1)*. (f) The one that is more siliceous and more similar to chlorite-quartz schist, etc.
*Appendix is of Phase-II Report.

Schistose to phyllitic limestone: Three to five thin limestone layers occur within 200±50m of the uppermost horizon of the Chicol, and three to four within the lowermost 150m of the same Formation in the area. The rock is black in color and usually shows schistose to phyllitic structure, so that it is apt to be mistaken for pelitic schist or black slate. It consists principally of calcite aggregates, and sometimes accompanies quartz. In the pelitic bands of the rock, muscovite and quartz are main constituents (RA-28, Appendix 2-1). This rock is considered to form skarn in the mineralization-alteration zone.

Black slate and "black cherty rock": Black slate is observed in the lower most horizon of the Tactic, and its thickness is inferred around 50m(Fig. C-1). East to E-8 line, a black, fine-grained, hard, and compact rock(About 30m thick)occurs at the uppermost part of this black slate. It was utilized as a key bed on mapping. Therefore a field term "cherty rock" is tentatively given to the rock and it is separately described in the fact maps. This comprises microscopically both slaty and sandy bands (RA-119, Appendix 2-1)*. A slaty band consists of an aggregate of sericite, chlorite, epidote and albite, while in a sandy band, clastic materials of subangular quartz, fragments of chert, and zircon are cemented in an altered matrix that comprises sericite, quartz, and reddish brown opaque minerals.

Sandstone, shale, and tuffaceous shale: An altenation of these rocks occurs in the stratigraphically uppermost part in the mapped area, and has thickness of more than 150m(open to the upper). This may be correlated to the lower part of the Tactic Formation. The rocks are usually very much weathered and stained with limonite, as they occur near and in the alteration zone and as they occur on the mesa where erosion is not advanced. Therefore, a fresh rock can hardly be observed.

"Shale" has comparatively obvious bedding. The colors of the relatively fresh and less stained parts are dusky yellow, dusky yellowish brown, moderate brown and pale greenish yellow. The rock was classified as "shale" in the field, from the facts that it has obvious bedding, and finer than "sandstone" in grain size. Nevertheless, the rock that has been microscopied is rather of sandstone size's (RA-34, Appeidix 2-1)*.

On the other hand, the rocks, which are massive, coarser grained, and without bedding, are classified "sandstone". The color at the weathered surface, shows dusky yellow, dusky yellowish brown, moderate brown, and pale greenish yellow. Microscopically, the rock consists of clastic fragments of subangular to rounded grains of quartz, with lesser amounts of muscovite, biotite, feldspar, zircon etc.. These fragments are cemented in quartzose matrix(RA-35, Appendix 2-1)*. *Appendix is of Phase-II Report.

### 3-2-3 Igneous rocks

The most important igneous rocks that occur in the mapped area can be grouped in to two;. (1)granitic rocks, and (2)the "acidic intrusives" that include varieties from quartz porphyry to rhyolote. Aside from these, intermediate to basic dykes are observed here and there in granitic rocks,

and sometimes in schists, However, description on them are omitted.

Granitic rocks were tentatively classified into two facies on sufface mapping (granite and quartzdiorite ∿ granodiorite), based on the difference in appearance(Fig.6, PL 2-1,2-2). However, it is still not obvious either whether the classification is appropriate or not, or what the mutual relation is even the classification is appropriate.

Novage dating has been carried out directly on igneous rocks in the mapped area. However, the age dating made on ingneous rocks in the adjacent areas indicates that the apparent sequence of the igneous activity around this area can be interpreted as follows: (1)Intrusion of quartz monzonitic rocks in the early Cretaceous(135-117m.y.). This may represent the main phase of the batholith. (2)Intrusion of gronodiorite in the later Cretaceous(85-74 m.y.). (3)Intrusion of dykes and sills of rhyòlite-quartz porphyries in the Paleocene-Ecocene (62-58m.y.). However, there still remains a possibility that (2) might be equivalent to (1) rejuvenated by the alteration accompanied with the intrusion of (3)(3-6-1 in Summary Report). It is,however, not incompatible with other geological observations that the three rock types in the mapped area correspond to (1) to (3),respectively.

Metallic mineralization in the mapped area is considered to have occurred at least over two phases. There is a possibility that the main phase of Cu-Pb-Zn-Ag mineralization may be attributed to post-igneous activity of the "acidic intrusives", and the formation of skarn and some of magnetite and pyrite may have been brought by the main phase intrusion of the batholith. This will be discussed later.

Granitic rocks

Comparatively fresh granitic rocks within the mapped area are medium to coarse grained biotite granite to granodiorite. They mainly consist of plagioclase, quartz, K-feldspar, and biotite, and accompany small amounts of zircon, magnetite, apatite as accessory minerals. However, there are very little fresh rocks in the area, as most of the rocks are almost always suffered from hydrothermal and/or supergene alterations.

As alteration types, the prophylitic and argillic alterations are widely observed, but some may be classified as the phyllic. The first and the third are considered to have been caused by hydrothermal alteration, while the second was probably formed by the superimposition of supergene alteration on the former two.

In the propylitic alteration, the primary biotite sites are changed to "clorite and epidote", "chlorite and sericite", or "chlorite alone", while the plagioclase sites are changed to kaolinite and/or sericite, being accompanied with epidote in some occasions. Some K-feldspar sites are altered to sericite, but some others remain unaltered.

Apparent argillic alteration is often observed near the contact with the sediments where the granitic rocks are suffered from leaching and stained with limonite. Here, almost all the mafic sites are leached out, and the feldspar sites often change into the aggregates of very pale bluish green colored clay minerals (montmorillonite or kaolinite?). In the part such this, the rock is very often penetrated with reticular quartz veinlets to show a "green patch tuff-like" appearance. This "argillic" assemblage is considered to have been formed by the superimposition of the supergene alteration (that must have been caused by the leaching of the disseminated pyrite) on a hydrothermal alteration assemblage (probably propylitic or phyllic).

It is fiarly difficult, sometimes, to distinguish such limonitized and argillized granitic rocks from other rock - types by naked-eye in the field. This is either difficult even microscopically, as a thin section usually covers only a very narrow area (RA-60 , Appendix 2-1). However, this may rather be safely achieved with a hand lens, if a comparatively wide plane cut by a diamond saw, is carefully observed.

Acidic intrusives

More than 17 small bodies of the "acidic intrusives" are observed in the area, occurring apparently in en echelon. There are few places where the contacts with host "sediments" can be observed, as there are few good outcrops. However, it is inferred that most of them occur as dykes gently dipping to the southwest, from correlation between the surface distribution and positions in drill holes, though some may occur concordantly to the host "sediments".

The rocks are generally affected by hydrothermal alteration and mineralization. On the surface, they are usually suffered from supergene alteration and stained with iron oxides, often showing chocolate color. They are white, light gray, pale greenish gray, pinkish gray, where not stained.

They range petrographically from quartz porphyry to rhyolite, showing varieties in appearance described below.

*Phenocrysts*

Following varieties are distinguished as to the abundance of phenocrysts; (1) one that contains quartz phenocrysts with few feldspar and mafic ones, (2) one that contains abundant phenocrysts of quartz, feldspar, mafic minerals (latter two are usually altered completely), and (3) one that is rather aphyric.

Quartz phenocrysts range from 2m/m up to 5m/m in diameter, and show idiomorphic to corroded or rounded forms. Plagioclase phenocrysts are usually less than 2.5m/m long, and usually show idiomorphic lath shape. Albite and Carlsbad twinning are often observed. They are mostly altered and replaced mainly by sericite, kaolinite, and montmorillonite. However, replacement of plagioclase sites by epidote or chlorite is rarely observed. Mafic phenocrysts are almost always altered and replaced completely by chlorite, epidote, and limonite. Nevertheless, relict hornblende less than 2m/m long is observed in the core at 117m of MJ-9.

*Groundmass*

There are also some varieties in groundmass; some are holocrystalline and rather can be called quartz porphyry, but some others show an appearance of devitrified glass.

It is usually suffered from alteration extremely. It consists of microcrystals of quartz, sericite, chlorite, epidote, zoisite, and clay matters. The groundmass is often penetrated by veinlets of quartz, pyrite, magnetite. Veinlets that comprise K-feldspar, chlorite, quartz, and epidote are observed, though they are rare (MJ-1 48.5m, MJ-2 94.8m Appendix 2-1).

As to the alteration assemblages, following varieties are observed; (1) One that resembles the potassic, accompanying secondary biotite (RA-38, Appendix* 2-1), (2) one that resembles the phyllic (RA-125, of Appendix* 2-1 and RA-44 in Appeidix*3-1), (3) One that resembles the prophlitic (97-152m in DDH MJ-2), (4) one that resembles the argillic, having kaolinite and montmorillonite (RA-46, RA-48, RA-91, and RA-129 in Appendix* 3-1). (4) is possibly attributed to superimposition of supergene alteration on hydrothermal alteration assemblages (from (1) through (3) ). *Appendices with asterisk are of Phase-II Report.

It is fairly difficult sometimes to distinguish these acidic intrusives from others by naked-eye in the field, especially when a strongly altered variety that contains less phenocryst is encountered. However, even this is the case, small plagioclase laths (less than 1 mm long) may usually be observed in white siliceous groundmass, if a sample is carefully observed with a handlens on a plane cut by diamond saw. Also this is one of the field identification criteria that a white massive rock which accompanies "wine-red colored in situ limonite-hematite" along the fractures is very probably the acidic intrusives.

### 3-2-4 Sedimentary and metamorphic rocks("sediments") in altered zone

The mineralization-alteration zone, which is the main target of our project, occurs over about 5.2 km (W26-E26) on the surface, approximately along the base line (N66°30'W-S66°30'E). The aureole of the alteration is over the granite-"sediments" contact, and covers for some 400m toward the "sediments" at maximum (Fig.5,6,7). It is inferred that the zone seemingly dips to the south concordantly to the granite-sediments contact, although it is not very certain as yet. The granite-"sediments" contact appears to dip to the south, at least in the part from the center eastward, being judged from the results of DDHs UN-6, MJ-5,and the geophysical survey.

On the surface, the rocks in the zone are extremely suffered from leaching and weathering, and are mostly stained with the oxides of iron and manganese of both "in situ" and "transported". Therefore, it is often very difficult to identify the original rock types.

The depth of the leached capping ranges from 50 to 100m at least in the eastern part of the mapped area, being judged from the result of the DDHs. The bottom of the capping is considered approximately parallel to the present topography (PL.-2,-4).

In drill holes, the boundary between the Chicol and Tactic can rather easily be distinguished, from the lithological difference and the fact that skarn often occurs at this part (Fig.4,5,7, and PL-4).

The rocks in this zone stratigraphically correspond to the altered equivalent of the rocks described in 3-2-2, and are structurally situated on the southwestern limb of the Llano del Coyote syncline(Fig.4,5).

The rocks in the zone are classified into three units, (1)"altered shale-tuffaceous shale-sandstone", (2)"skarn", and (3)"schists" and are described below. Description on igneous rocks in the zone is included in the previous section 3-2-2.

Altered shale, tuffaceous shale, and sandstone

These rocks are often massive, hard, and compact, and sometimes show a cherty appearance. However, there is also another variety that has a banded structure. The latter may have been derived from shale, tuffaceous shale, or clay slate of the Tactic Formation, while the former from the sandstone of the same Formation.

Color of these rocks are various, depending on their constituent minerals; pink to orange in pink zoisite(?)* - rich part, dusky grayish green in chlorite-rich part, and light gray to brownish gray in muscovite-rich part. These parts form in some places compositional banding, but in some other places, veinlets, and irregular shapes intermingled each other.
*We tried to identify the pink mineral by X-ray and microscope, however no special mineral has been identified other than zoisite. It may be a manganiferous pink variety of zoisite.

The rocks mainly consists of quartz with lesser amounts of epidote, zoisite, sericite, and chlorite. They are of both rock-forming and alteration minerals. Microscopical observation is described in Appendix 2-1 of Phase-I Report (RA-16,17,21, DDH Core-36, and -46), Phase-II Report (MA-1-4,1-5,RA-53, and RA-122), and Phase-III Report (MJ-7 36.2m, 76.55m; MJ-8 6.05m).

In the leached capping, the rocks are often difficult to distinguish from acidic intrusives and/or granitic rocks. However, according to our experience, a siliceous rock, in which dendritic manganese oxide occurs, and/or which is stained with the latter, is very possibly the silicified shale or sandstone. On the contrary, most of the siliceous rocks with "wine-red stain" appear to be acidic intrusives as mentioned already.

Skarn

Skarn is the most important rock as the host of mineralization, but it distributes only in very limited areas on the surface, from the geological structure and its stratigraphical horizons (Fig.7, PL-2,PL-4).

In the oxidized zone, it occurs as gossan or etremely stained rocks with iron oxides, due to limonitization of sulfide minerals, magnetite, and garnet.

Principal skarn minerals that have been recognized are, in descending order; epidote, garnet, chlorite, and tremolite ∿ actinolite. Tremolite ∿ actinolite is observed in UN-4(360 UN;1973), Samples S-28c, MJ-7 126.3m, MJ-9 138.9m, etc.(Appendix 2-1). Other than these following skarn minerals have so far been observed; altered (weatherd?) rhombic pyroxene(?) at 89' of DG-8, cummingtonitic amphibole at 296' of UN-6 (Appendix 2-1 Phase-I Report), and wollastonite(UN;1973).

A tolerable correlation is observed between types of skarn minerals and those of metallic minerals; pyrite prevails in epidote-rich skarns, garnet predominates in garnet-rich skarns, and high zinc mineralization almost always occurs in amphibole-chlorite-rich skarns. These relationship will be discussed later in 4-2, and 6-3.

The stratigraphic positions or horizons of the skarns that have been recognized are interpreted as below, of which (2) is the only horizon in which"%-order Zn mineralization"has so far been intersected by drilling (MJ-9,12.76%Zn for 9.5m intersection, MJ-1 1.42% Zn for 5.9m(oxide zone), and UN-4 2.96% for 5.5m): (1) two to three skarn layers (each one is 3 to 20m thick) in the Tactic, within a 60 to 70m-stratigraphical interval from the upper limit of the Chicol, (2) a 7 to-20m thick skarn around the boundary between the Tactic and Chicol, and (3) a skarn horizon in the Chicol, at stratigraphically lower position about 50 to 70m from the boundary.

Skarns of (1) might be attributed to calcareous parts in the shale-sandstone alternation of the Tactic, however, no clacareous equivalents have been confirmed in the non-altered facies as yet. Skarns of (2), and (3) are considered to have been derived from interlayers of limestone in the Chicol Formation, which are observed in the non-altered facies. Apart from those mentioned above, two or more horizons might be expected in the lower poisition than (3), though they have not been confirmed as yet, as limestone interlayers are observed in the non-altered sequence.

*Regional metamorphic rocks(schists)*

Schists of the Chicol Formation include conglomerate schist, muscovite-chlorite-quartz schist, green schists and so forth.

The difference between altered and non-altered facies is not so large in the schists, as in other rocks described above. Only the change in color (becomes lighter or paler in the altered zone) and increase in abundance of veinlets (quartz, quartz-calcite, epidote-chlorite, etc.) are the major discernibele differences in lithology other than mineralization.

Pyrite and/or magnetite often occurs disseminated and/or as veinlets. Pyrite often replaces magnetite here and there, and resembles a banded ore of the "stratiform pyritic deposits" when it replaces magnetite seams occurring parallel to schistosity.

Conglomerate schists are more difficult to distinguish in core than in surface mapping, as the diameter of cores is small, and the fresh surface of cores is less appropriate to distinguish pebbles than pertly washed -out surface of the outcrops. However, presence of lithic fragments are clearly discernible by microscope in some samples(Appendix 2-1; MJ-1 235.1m, MJ-2 232.7m). The pebbles comprise rounded to lenticular sandstone, quartzite, and quartz porphyries.

### 3-2-5 Structure

The most prominent structural elements observed in this area are the Llano del Coyote syncline, and an anticline, both of which extend nearly parallel to the elongation of the mapped area, and fault systems that trend in NE ∿ ENE and NNW. These faults seemingly crosscut and displace all the other structures; and are interpreted to represent the last structural epidote in the area.

Northwesterly trending faults or fissures that occur in en echelon may be implied to exist from the arrangement of the "acidic intrusives".

These are shown in Fig.5,6,7, PL-1-1,1-2, and -2.

#### Folds

The Llano del Coyote syncline runs in N66°W-66°E direction, approximately parallel to the boundary between granitic rocks and the "sediments". An anticline paired to the syncline is inferred to occur near the boundary between granitic rocks and the "sediments". Other than these,three synclines and three anticlines of the second order are observed parallel to the major folds.

Faults

Four faults are drawn in the geologic map of the area(Fig.6, PL-1-1, 1-2). These are inferred mainly from the gap in lithological distribution and discontinuity of geochemical and geophysical anomalies. However a NNW-fault of the fours, which crosses the base-line between E14 and E16, is the one that was confirmed in the floor of a tributary that runs in the north-east of UN-6 drill site.

Furthermore, numerous faults are observed in drill cores, however, they have hardly been correlated to the surface geology so far, as the exposure is very poor on the surface in the alteration zone.

# 4. Mineralization

## 4-1 General features

The mineralization occurring in the area is skarn to hydrothermal replacement type associated with local concentration of sphalerite, magnetite, and chalcopyrite. During execution of this project, a promising intersection of sulphide mineralization was encountered in drill hole MJ-9 for a length of 9.5m between 88.6m and 98.1m from the surface, showing the assay grade of 12.76% Zn. This intersection is in the proximity of two drill holes in which"%-order Zn mineralization"was intersected. These are MJ-1 (oxidized ore for 5.9m, 1.42% Zn) and UN-4 (sulphide ore for 5.5m, 2.96% Zn). These three mineralized intersections are interpreted stratigraphically to occur in the skarn of the same horizon.

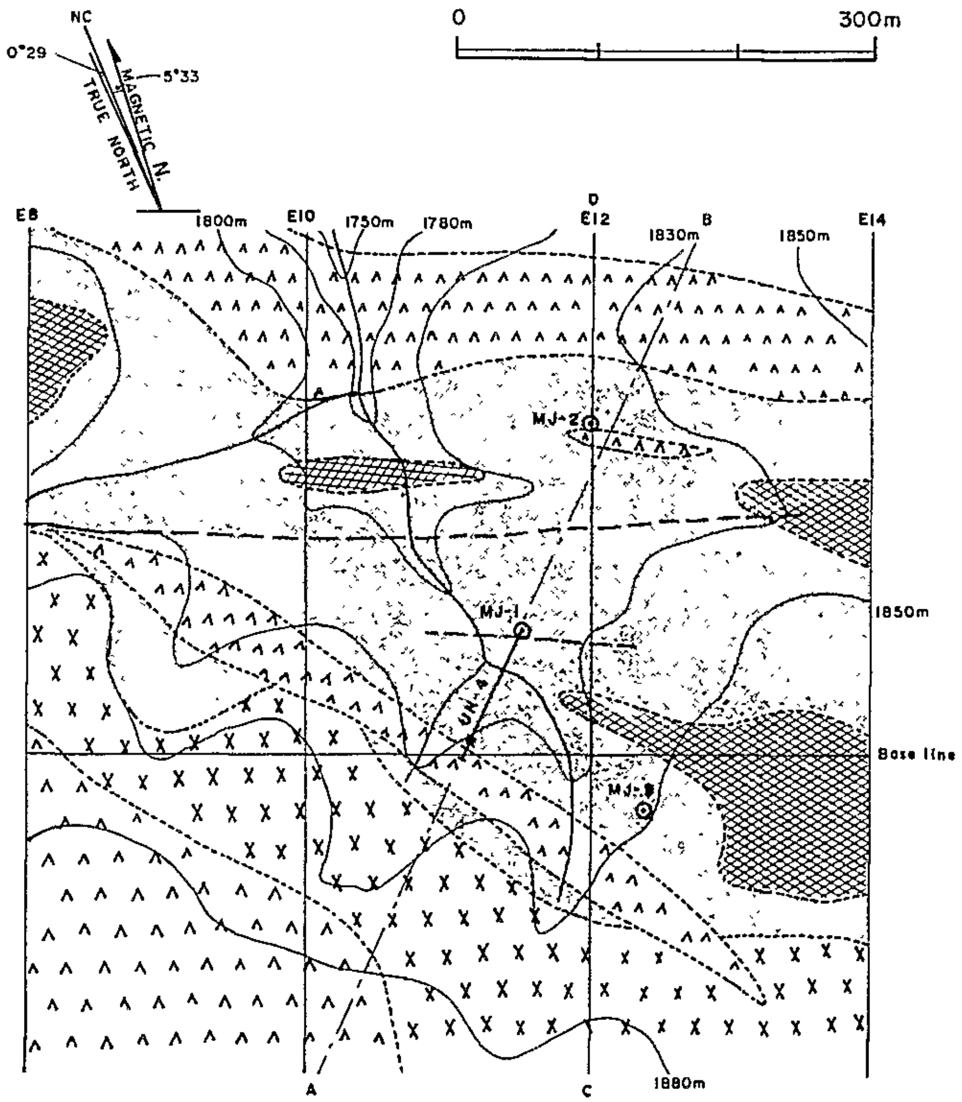
It is considered that the mineralization took place related with granitic rocks of the Cretaceous, and rhyolite to quartz porphyry of the Paleocene to Eocene. Both intruded sedimentary and metamorphic rocks of the Tactic and Chicol Formations. At least two phases of mineralization are considered to have occurred corresponding to the intrusions mentioned above. The major phase of the mineralization of zinc, copper, and silver may be attributed to the post igneous activity of the latter.

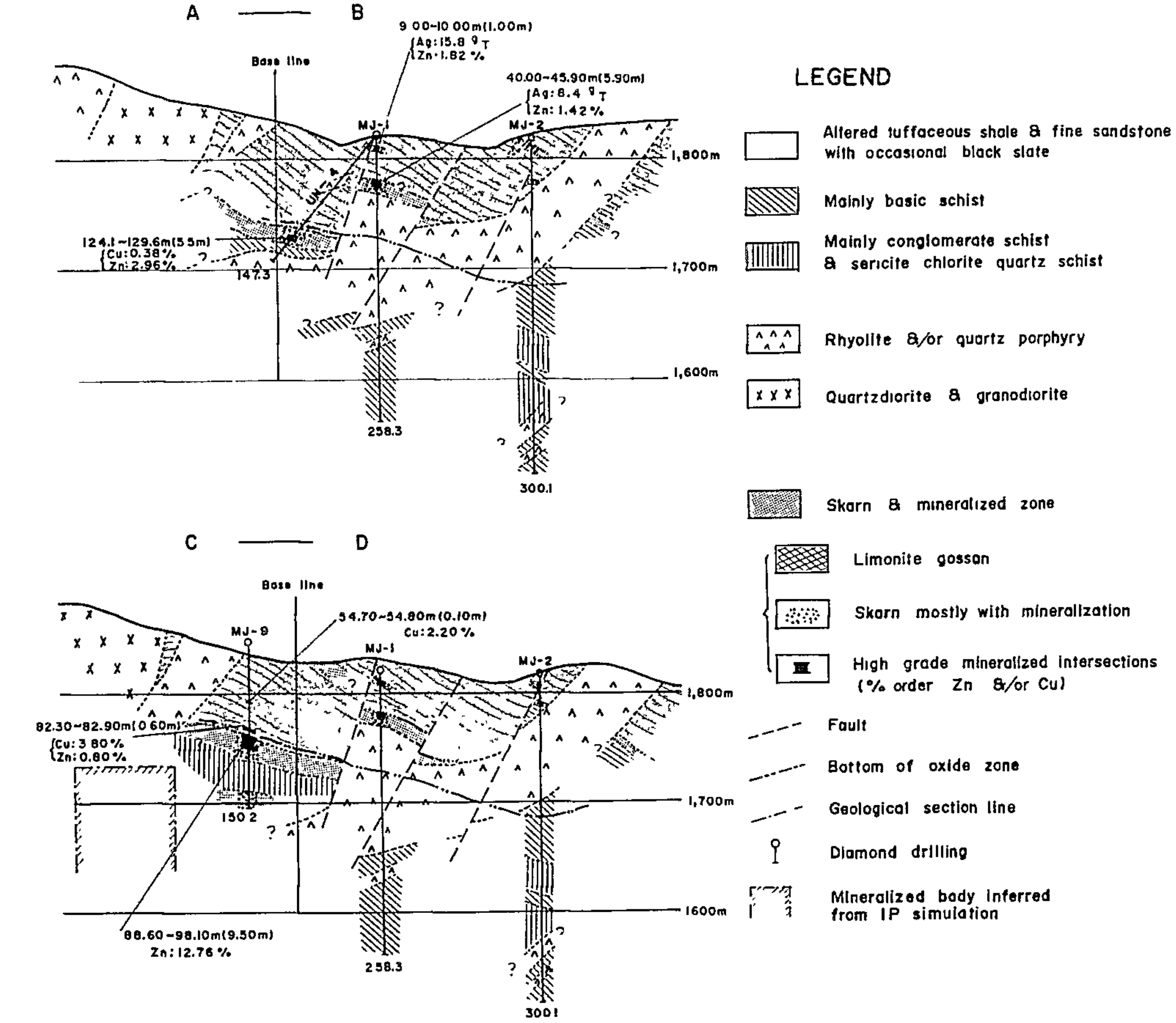
The mineralization affected all the "sediments" and the igneous rocks mentioned above, hydrothermally altering the rocks in the mineralized zone to form skarns in calareous beds of the Tactic and limestone of the Chicol. Skarns that have so far been confirmed are stratigraphically divided into three horizons. Among these, the intersections of"%-order zinc mineralization"in the above-mentioned three drill holes occur in a skarn horizon that is situated at the boundary between the Tactic and Chicol Formations. Although the detail is yet unknown due to the lack of exploration, the stratigraphical study of the unaltered facies may lead to the expectation of possible occurrences of more than two skarn horizons underneath the lower known horizon, though their presense has not been confirmed as yet.

The ore minerals so far confirmed comprise a large amount of pyrite, tolerable amounts of magnetite, and locally concentrated sphalerite, specularite, and minor amounts of chalcopyrite, native gold, and galena.

Fig. 8 GEOLOGY AROUND MINERALIZED INTERSECTIONS

MJ-9 — MJ-1 — UN-4



A unique mineral assemblage, especially Zn with practically no Pb, might suggest that the mineralization took place under rather oxidizing and acidic environment, due to the shortage of organic matters and lesser amount of carbonate rocks in the country rocks, compared with the volume of the ore solution.

The extent of mineralized zone on the surface is approximately coincident with the alteration zone described in clause 3-2-1, extending about 5.2 km in elongation (WNW-ESE) and 400m to 500m in width. Geophysical and geochemical anomalies are mostly distributed in these areas. However the horizon of the skarn in which major Zn-mineralization occur rarely exposes on the surface due to the stratigraphical and structural relations.

The surface of the area mentioned above has poor exposure of the bed rocks, which was suffered from pronounced leaching and weathering. Most of the area is tarnished with limonite stain with scattering boulders and outcrops of massive limonite and magnetite, with some green stain of copper oxide in several places.

The oxide zone extends to the depth of 50 to 100m from the surface, which, judging from the drill results, forms leached zone for the sulphide minerals of copper and iron though it may be incomplete. The primary sulphide minerals can not hardly be observed on the surface except for some relict of pyrite. Zinc is secondarily enriched locally in the oxidized zone, yielding secondary minerals such as chalcophanite.

The bottom plane of the oxidized zone is approximately parallel to the present surface plane, and some secondary enrichment of copper is observed in some places of the bottom of oxidized zone and in places directly below it. In the drill hole MJ-9, supergene chalcocite filling the crack of relict pyrite grain which showes euhedral shape was observed in massive limonite at the base of oxidized zone (MJ-9 0.60m between 82.3m and 83.9m, 3.80% Cu; appendix 3-1, 3-2, Table-4). In the drill hole MJ-1, thin film of chalcocite covers network veins of pyrite, right under the leaching zone (MJ-1, 1.0m between 90.6m and 91.6m, 0.19% Cu; PL-6-0).

Secondary ore minerals observed in supergene sulphide and oxide zones are a large amount of goethite, relatively pervasive hematite, maghemite, manganese oxides such as psilomelane, and a minor amounts of chalcocite, bornite, malachite, chrysocolla, and chalcophanite

A brief description will be made on the basis of host rocks.

## 4-2 Mineralization in skarns

As shown in the ore intersections in DDH MJ-9, MJ-1 and UN-4, this type of mineralization is the most important, and has been selected as the exploration target.

It is inferred that the skarn is derived from limestone and calcareous intercalation of the Chicol and Tactic formations, several horizons of which are known within the extent so far as confirmed, having the width of several meters to about twenty meters, within the stratigraphical interval of 110 meters to 150 meters (3-2-4). The ore intersections above mentioned are interpreted to be localized at the contact between the Chicol and Tactic Formations. It is considered that each skarn body forms lenticular shape parallel to the bedding plane, though further confirmation is required.

As the skarn mineral, epidote, garnet, chlorite, tremolite, and actinolite are observed (cf. 3-2-4).

Primary ore minerals are pyrite, magnetite, and sphalerite, which are found in the skarn as irregular network, dissemination, and sometimes as massive ore. Sphalerite occurs filling intersticially grain boundaries of euhedral to subhedral pyrite, and occasionally as veinlets along cracks in pyrite (Appendix 2-1, 2-2, 3-1, 3-2; MJ-9 92.60m).

There is a rough correlation between the kind of ore minerals and skarn minerals, That is; epidote rich one is predominant in pyrite, and the amount of magnetite is proportional to that of garnet (for example, MJ-3 104, 5-110.5m, 0.10% Zn, 34.06% Fe, 16.13% S, etc.; Table 4). The portions with higher grade zinc are, without exception, relatively predominant in actinolite, tremolite, and chlorite, and shows greyish to dark green in color (Table 4; MJ-9 88.6-98.1m, 12.76% Zn, UN-4 120.8m 3.25% Zn, 0.3% Cu, DG-9 79.6-85.1m). It is possible that the chlorite is the alteration product of amphiboles in the skarn by later mineralization which brought zinc.

The skarn intersected in the drill hole MJ-9 in this phase is inferred, as described at the begining of this section, to be of the same horizon with those of the intersections of MJ-1 and UN-4 which pentrated zinc mineralization. The horizontal distance among these three holes were 85-150m respectively. The geological study of the adjacent area warrants the prospecting of the surroundings of MJ-9 to be continued

### 4-3 *Mineralization in rhyolite~quartz porphyry*

The swarm of dykes of so-called "acidic intrusives" are almost always altered and mineralized. The primary ore minerals are mainly pyrite and/or magnetite rarely with a minor amount of molybdenite (MJ-3 219.4m and 229.5m: PL-6-0).

The ore minerals occur mainly disseminated, and as veinlets and reticular veinlets (n m/m to n cm wide), showing sometimes the occurrence similar to that of porphyry copper. The magnetite sometimes forms irregular massive lenses more than one meter in diameter(on the floor of a tributary, east of Stations 12 and 13 on E-12 line; between 86.5m and 88m in MJ-2). Most of Floats of massive magnetite that are scattered in various places on the surface seem to be derived from the lenses in this rock. Most of pyrite veinlets are so-called "dry", but are sometimes associated with chlorite. Molybdenite occurs in pyrite veinlets, 1-3mm in width.

"Acidic intrusive rock" on the surface and in the oxidized zone are stained with iron oxide, reddish brown to red-purplish in color(chocolate to red wine color), forming leaching zone of the sulphides. Directly under the leached zone, supergene chalcocite is found coating the surface of pyrite veinlets, which shows a typical occurrence of secondary enrichment. However, Cu concentration of such part shows only as much as 0.2%, which is by far the lower than so-called economic grade (MJ-1 1m between 90.60-91.60m 0.19% Cu;PL-6-0).

Magnetite ore is black, massive, and compact, and comprises mainly magnetite. It accompanies a small amount of specularite and minor amounts of chalcopyrite, bornite, sphalerite, and native gold. Pyrite and chalcopyrite, occur as dots in magnetite and in gangue minerals. Sphalerite fills the cracks and cavities in magnetite. Specularite is replaced by magnetite. Native gold is included in magnetite as fine particles.

In the massive magnetite ore on the surface, maghemite, hematite, and psilomelane have been produced by weathering. Psilomelane is found in botryoidal structure filling the cavities.

The assay result of massive magnetite ore showes 23-67% Fe, n g/t Ag, 0.0n % Cu, 0.0 n % Pb, 0.0 n % Zn, and 0-20 % S.

As shown in the above, this rock is affected by considerable extent of mineralization, however it is considered that it could not be a target for further exploration.

### 4-4 Mineralization in granitic rocks

The rock is markedly subjected to limonitization on the surface at the contact with sedimentary rocks. It would be due to the fine dissemination of pyrite. Chalcocite film coating pyrite is occasionaly observed in some places where residual pyrite occurs. However, the copper grade concentrates only up to 0.08% Cu(RA-56; 2-3 in Phase-II Rept).

At present, no mineralization to warrant future exploration has been found in this rock.

### 4-5 Mineralization in altered shale, tuffaceous shale, and sandstone

The alteration facies in the Tactic Formation such as shale, tuffaceous shale, and sandstone, is distributed in the position close to the surface within the altered and mineralized zone due to the stratigraphical and structural relations. These rocks are often turnished by limonite stain, and also in places stained by dendritic manganese oxide which is likely to be derived from manganiferous zoisite, which makes one of the characteristic feature in the oxidized zones of these rocks. Although some pyrite impregnation can be observed (especially in portions rich in epidote), no conspicuous mineralization has not been found in the rocks which can distinctly determined to be originated in shale, tuff, and sandstone.

### 4-6 Mineralization in metamorphic rocks (schists)

A considerable amount of magnetite and/or pyrite is found in schistose rocks, especially in green schists. Magnetite occurs disseminated, and as seams parallel to the schistosity, and the veinlets cutting the schistosity, sometimes showing the concentration of magnetite which is estimated to be as much as 10-15 weight percent (MJ-3 75.2- 76.3m, 118.5- 138m, Appendix-7 of Phase-II Report).

Pyrite shows almost the same mode of occurrence to magnetite, sometimes occurring as the massive clot, and is often found to replace magnetite. The grade of sulphur is several percent in average. The mineralization found in the proximity of Guzanúm that resembles the banded ore in stratiform pyritic deposits(Kieslarger) might be derived.

from sulfidization of banded magnetite by a later-phase mineralization. The concentration of other elements than Fe associated with this type of mineralization in green schists is as follows; 3-14 g/T Ag, 0.0n% Cu, 0.00n% Pb, and 0.0n% Zn.

No further exploration is warranted.

## 5. Results of Diamond Drilling

### 5-1 General features

Three holes with total length of 830.7m and seven holes with total length of 1,203m were drilled in the second and in the third phase of the project respectively, which makes the number of holes ten and total length 2033.7m in two years.

The purpose of the drilling of three holes in the second phase was as follows:
(1) to serve for the interpretation of the results of geological, geochemical, and geophysical surveys which would have been carried out in the same phase by the project teams, by testing the subsurface conditions beneath the anomalies detected by geochemical and geophysical surveys which had been conducted by the United Nations, and (2) to investigate the extention of the primary ore intersection exposed in drill hole UN-4 by the United Nations, which showed 2.96% Zn for a length of 5.5m.

The drilling program in the third phase was intended to explore the depths of the geochemical and geophysical anomalies that were located in the second phase, and the extension of the mineralized loci that by previous drills.

As the result, promissing sulfide mineralization with assay result of 12.76 % Zn for a length of 9.5m between 88.6m and 98.1m in the drill hole MJ-9 of this phase was intersected. This intersection is situated at 150m in horizontal distance to S13 E of the drill hole MJ-1 (oxidized ore for 5.9m, 1.42 % Zn) in which the ore was exposed in the second phase, and about 135m in horizontal distance to S 50° E of the drill hole UN-4 (2.96 % Zn for 5.5m) by the United Nations. All these three intersections are located in the skarn formed at the boundary between the Tactic and Chicol Formations. In the upper part of the intersection in MJ-9, supergene chalcocite (3.80% % Cu for 0.60m) was observed filling interstices of euhedral pyrite which is the relict mineral in massive limonite, showing copper grade of 3.8 % for 0.60m between 82.3m and 83.9m. This portion is near the bottom of the oxidized zone.

Table-3 Summary of Diamond Drill Holes

| | DDH No. [*1] | Location [*2] | | | Lengh (m) | Bearing | Inclination | Remarks |
|---|---|---|---|---|---|---|---|---|
| | | UTM Coordinates | | Collar Elevation(m) | | | | |
| | | X | Y | | | | | |
| | UN-1 | 690.173 | 1694.055 | 1,817 | 77.78 | S40°W | -60° | Nov.27-Dec.27,1969 Winkle |
| | UN-2 | 690.328 | 1693.930 | 1,855 | 83.88 | N | -60° | Feb.2-Feb.27,1970 Winkle |
| | UN-3 | 690.353 | 1693.018 | 1,833 | 79.30 | S | -65° | Mar.8-Apr.24,1970 Winkle |
| | UN-4 | 690.043 | 1693.658 | 1,820 | 147.32 | S42°W | -50° | Aug.3-Aug.26,1970 Boyles |
| | UN-5 | 690.062 | 1693.968 | 1,860 | 114.68 | N40°E | -70° | Aug.29-Sept.21,1970 Boyles |
| | UN-6 | 691.302 | 1693.280 | 1,830 | 96.38 | S40°W | -60° | Sept.27-Oct.16,1970 Boyles |
| | UN-7 | 691.198 | 1693.117 | 1,857 | 152.20 | N40°E | -70° | Oct.19-Nov.17,1970 Boyles |
| | DG-8 | ? | ? | ? | 104.62 | - | -90° | ? Winkle |
| | DG-9 | 690.122 | 1694.170 | 1,835 | 85.37 | - | -90° | ? Winkle |
| Phase II | MJ-1 | 691.042 | 1693.660 | 1,820 | 258.3 | - | -90° | Sept.25-Nov.19,1977 Tone |
| | MJ-2 | 691.137 | 1693.775 | 1,818 | 300.1 | - | -90° | Nov.26,1977-Jan.27,1978 Tone |
| | MJ-3 | 690.116 | 1693.998 | 1,825 | 272.3 | - | -90° | Feb.11-Mar.11,1978 Tone |
| Phase III | MJ-4 | 689.958 | 1694.023 | 1,881 | 150.20 | - | -90° | Jul.5-Aug.10,1978 Tone |
| | MJ-5 | 690.113 | 1693.927 | 1,846 | 151.30 | - | -90° | Jul.11-Jul.31,1978 Boyles |
| | MJ-6 | 690.848 | 1694.009 | 1,831 | 150.80 | - | -90° | Aug.1-Aug.14,1978 Boyles |
| | MJ-7 | 690.260 | 1693.890 | 1,837 | 300.10 | - | -90° | Aug.11-Sept.25,1978 Tone |
| | MJ-8 | 690.400 | 1694.198 | 1,810 | 150.20 | - | -90° | Aug.15-Aug.29,1978 Boyles |
| | MJ-9 | 691.075 | 1693.511 | 1,847 | 150.20 | - | -90° | Aug.30-Aug.25,1978 Boyles |
| | MJ-10 | 690.135 | 1694.175 | 1,832 | 150.20 | - | -90° | Sept.26-Oct.14,1978 Boyles |

*1 UN-: By United Nations, DG-: By DGMH, MJ-: MMAJ·JICA/DGMH

## Table-4 Summary of Mineralized Diamond Drill Intersections (1)

| DDH No. | Depth (m) | Length (m) | Assay Results *1 | | | | | | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| | | | Ag(g/t) | Cu(%) | Pb(%) | Zn(%) | Fe(%) | S(%) | |
| MJ-1 | 9.00- 10.00 | 1.00 | 15.8 | 0.09 | - | 1.82 | - | - | * Gossan after garnet-epidote skarn with magnetite. |
| | 40.00- 45.90 | 5.90 | 8.4 | - | - | 1.42 | - | - | * Garnet-epidote skarn stained with limonite & manganese oxide. |
| | 51.70- 54.20 | 2.50 | 19.4 | - | - | 0.21 | - | - | * Gossan with altered quartz porphyry. |
| | 90.60- 94.00 | 3.40 | 10.4 | 0.11 | - | - | - | 4.27 | * Altered rhyolite with closely spaced pyrite veinlets. Chalcocite film coating pyrite veinlets(up to 2mm wide). |
| MJ-2 | 29.70- 37.60 | 4.00 | 10.3 | 0.06 | - | - | - | - | * (Garnet?) - epidote skarn stained with limonite. |
| | 86.50- 88.00 | 1.50 | 19.3 | 0.09 | - | - | 20.12 | - | * Rhyolite with partly limonitized magnetite. |
| MJ-3 | 41.75- 42.47 | 0.72 | 8.5 | 0.03 | 0.04 | 0.53 | 2.46 | - | * Chlorite - garnet skarn stained with limonite. |
| | 51.66- 56.48 | 4.82 | 20.4 | 0.07 | - | 0.22 | 27.79 | - | * Gossan with silicified shale or sandstone(?). |
| | 104.50-110.50 | 6.00 | 5.6 | - | - | 0.10 | 34.06 | 16.13 | * Garnet - epidote skarn with network of pyrite and magnetite. |
| UN-1 | 27.8 - 36.6 | 8.80 | N.A | 0.04 | - | 0.30 | - | - | * Epidote-quartz rock (Silicified shale with epidote) with yellow sphalerite(?). |
| UN-4 | 48.90- 49.40 | 0.50 | N.A | 0.12 | 0.38 | 2.55 | - | - | * Altered quartz porphyry(?) stained with limonite & hematite. |
| | 64.05- 65.05 | 1.00 | N.A | - | - | 0.72 | - | - | * Bleached & limonitized quartz porphyry or granite. |
| | 73.40- 74.83 | 1.43 | N.A | 0.10 | - | 0.37 | - | - | * Epidote skarn(?) stained with limonite. |
| | 118.95-122.0 | 3.05 | N.A | 0.02 | 0.02 | 0.46 | - | - | * Epidote - chlorite skarn. |
| | 124.1 -129.6 | 5.50 | N.A | 0.38 | 0.02 | 2.96 | - | - | * Epidote - chlorite skarn (dark green rock) with pyrite & sphalerite. |
| UN-5 | 85.4 -100.65 | 15.25 | N.A | 0.09 | - | 0.23 | - | - | * Epidote - chlorite skarn with rubby sphalerite dissemination. In situ limonite scattered moderately. |
| UN-6 | 74.63- 78.69 | 4.06 | N.A | 0.01 | - | 0.21 | - | - | * Silicified quartz porphyry with massive pyrite at 76.36-78.17m. |
| DG-9 | 79.6?- 85.1? | 5.50? | N.A | N.A | N.A | N.A | N.A | N.A | * Chlorite-hedenbergite(?) skarn with massive pyrite-sphalerite ore. Poor recovery & no assay results available. |

*1 : For all "UN- Drills", arithmetic averages are calculated from assay results described in Appendix-IV in UN Report,1973.
N.A.: Not assayed. —: Average is not calculated, as value is extremely low.

Table-4 Summary of Mineralized Diamond Drill Intersection-2

| DDH No. | Depth (m) | Length (m) | Assay Results | | | | | | | | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Au(g/t) | Ag(g/t) | Cu(%) | Pb(%) | Zn(%) | Fe(%) | S(%) | Mn(%) | |
| MJ-4 | 64.70 - 66.30 | 1.60 | N.A | 2 | 0.04 | - | - | 27.00 | - | 0.57 | * Limonite gossan |
| | 81.50 - 81.90 | 0.40 | - | 2 | 0.04 | - | - | 22.08 | - | - | * ditto |
| | 92.70 - 98.00 | 5.30 | N.A | - | 0.03 | - | 0.22 | 18.49 | 14.51 | - | * Skarnized rock with dense aggregate of pyrite |
| | 112.00 -114.65 | 2.65 | N.A | 4.4 | 0.10 | - | 0.49 | 11.64 | - | - | * Limonite stained part in altered rock |
| | 147.40 -148.40 | 1.00 | N.A | 1.6 | - | - | 0.42 | 14.20 | 8.45 | 0.69 | * Epidote rock with pyrite veinlets and dissemination. |
| MJ-5 | 80.30 - 81.60 | 1.30 | N.A | - | 0.07 | - | - | 14.61 | 9.49 | - | * Epidote rock with vein form aggregate & dissemination of pyrite. |
| | 83.20 - 83.90 | 0.70 | N.A | - | 0.07 | - | - | 12.62 | 8.86 | - | * ditto |
| | 84.60 - 85.30 | 0.70 | N.A | - | 0.04 | - | - | 9.36 | 6.30 | - | * ditto |
| | 91.90 - 94.20 | 2.30 | N.A | - | - | - | - | 15.76 | 15.10 | - | * Altered rock with dense pyrite dissemination |
| | 100.50 -101.10 | 0.60 | - | - | - | - | - | 16.40 | 16.67 | - | * ditto |
| | 116.40 -121.30 | 4.90 | 0.55 | 1.8 | 0.03 | - | - | 20.70 | 7.17 | - | * Garnet-epidote rock with dense pyrite dissemination. |
| | 130.60 -131.30 | 0.70 | N.A | - | 0.03 | - | - | 10.39 | 4.37 | - | * Chloritized rock with pyrite dissemination |
| MJ-7 | 15.00 - 18.90 | 3.90 | N.A | - | 0.05 | - | - | - | - | - | * Limonite gossan |
| | 75.60 - 75.80 | 0.20 | N.A | - | 0.02 | - | - | 13.38 | 13.34 | - | * Fault gouge with sporadic pyrite dissemination. |
| | 81.60 - 82.75 | 1.15 | N.A | 2 | 0.09 | - | - | 20.22 | 9.95 | - | * Chlorite-epidote skarn with dense aggregate of pyrite and magnetite |
| | 84.10 - 85.00 | 0.90 | N.A | - | - | 0.05 | - | - | 3.66 | - | * Granitic rock with galena dissemination |
| | 122.30 -127.00 | 4.70 | N.A | - | - | - | - | 18.11 | NAV | - | * Chlorite-tremolite-garnet skarn with magnetite and pyrite |
| | 187.90 -193.40 | 2.90 | - | - | 0.01 | - | - | 12.41 | NAV | - | * Magnetite-pyrite stringers or net-works in epidote skarn |
| MJ-9 | 54.70 - 54.80 | 0.10 | - | 4 | 2.20 | - | - | 22.02 | NAV | - | * Massive ∿ Semi-massive pyrite |
| | 82.30 - 82.90 | 0.60 | 1 | 11 | 3.80 | - | 0.80 | 34.32 | NAV | - | * Massive limonite with chalcocite(djurleite?) interstictical to relict pyrite. |
| | 88.60 - 98.10 | 9.50 | - | 4 | 0.19 | - | 12.76 | 23.06 | NAV | - | * Garnet-chlorite skarn with densely disseminated sphalerite. |
| | 98.10 -107.00 | 8.90 | - | 2 | 0.04 | - | 0.64 | 22.89 | NAV | - | * Chlorite-epidote-garnet skarn with pyrite & sphalerite. |
| | 138.40 -146.60 | 3.70 | - | 2 | 0.08 | - | 0.35 | 20.88 | NAV | - | * Garnet-epidote-actinolite-tremolite skarn with pyrite. |
| MJ-10 | 10.40 - 11.90 | 1.50 | N.A | 2 | 0.02 | - | 0.63 | 8.62 | NAV | 1.14 | * Epidotized rock with limonite stain |
| | 45.70 - 49.90 | 4.20 | N.A | - | 0.03 | - | 0.22 | 29.12 | NAV | - | * Massive hematite(after massive magnetite?) |
| | 53.60 - 63.90 | 9.30 | N.A | - | - | - | - | 26.55 | NAV | - | * Semi-massive pyrite-magnetite with 2ndary hematite. |

N.A.: Not assayed. NAV : Not available.

- : Average is not calculated, as value is extremely low.

Table-5 Correlation between Geochemical & Geophysical Anomalies, and DDH Results
(After Table-28 in Phase-II Report)

| No ( )*1 | | Location*2 (m) | Length (m) | What were originally inferred when drills were planned: Relationship with Geology & DDHs previously carried out | Relationship with Geochemical Anom. | Relationship with Geophysical Anom. at -150mL: FE | AR | MCF | Mag | IP Simul. | Summary of Results |
|---|---|---|---|---|---|---|---|---|---|---|---|
| MJ-1 | X<br>Y<br>Elev. | 691.042<br>1693.660<br>1,820 | 258.3 | To Explore expected deeper extension of sub-economic intersection in UN-4 by UN | | in Phase-II (MJ-1 to MJ-3) | | | | | No conspicuous mineralization at depth. only oxide min. 40.0-45.9m (5.9m) Ag.8.4g/t Zn 1.42% |
| MJ-2 | X<br>Y<br>Elev. | 691.137<br>1693.775<br>1,818 | 300.1 | At inferred quartz porphyry-meta sediment contact | To confirm deeper extension of Cu Anomary by UN | | | | | | Only intersected quartz porphyry |
| MJ-3 | X<br>Y<br>Elev. | 690.116<br>1693.998<br>1,825 | 272.3 | | To confirm a conspicuous IP anomaly by UN | | | | | | Semi-massive Pyrite intersected 104.5-110.5m(6m) Ag 5.6g/t S 16.13% Zn 0.10% Fe 34.6% |
| MJ-4 (1) | X<br>Y<br>Elev. | 689.958<br>1694.023<br>1,881 | 150.2 | In the vicinity of granitic dyke(?) - altered sedimentary rocks contact. To explore deeper extension of geochemical anomalies at both sides of a syncline. | On axis of a syncline, at both sides of which Cu & Zn anomalies occur. | Within anomaly (FE≧3%) | Within anomaly (AR≦75Ω-m) | Within anomaly (MCF≧40) | Within inferred magnetic body. | Within inferred mineralized body by simul. | 84.5-150.2m Py.Zone 92.7-98m(5.3m) Cu 0.03% S 14.5% Zn 0.22% Fe 18.5% |
| MJ-5 (3) | X<br>Y<br>Elev. | 690.113<br>1693.927<br>1,846 | 151.3 | To explore southern extension of the skarn zones intersected in MJ-3(oxidized skarn at 41.75-54.57m & 104.5-110.5m) | To explore southern-deep extension of Cu,Pb,Zn anom. at around E2-4, Station Nos.13-14 | " | " | " | At periphery of inferred magnetic body. | - | 116.4-121.3m(4.9m) Ga. Skarn, Mt-Py. |
| MJ-6 (6) | X<br>Y<br>Elev. | 690.848<br>1694.009<br>1,831 | 150.8 | To explore geochem. anomalies mentioned in the right column, which occur at both sides of a quartz porphyry dyke, at the southern side. | To explore deeper extension of Cu-Pb-Zn & Cu-Zn anomalies. | About 100 to 150m outside of anomalies. | | | | - | 29.3-57.3m only weak Mt. imp. in Q-Porph. |
| MJ-7 (5) | X<br>Y<br>Elev. | 690.260<br>1693.890<br>1,837 | 300.1 | To explore expected 3 horizons of skarns at their granitic contact. (On same section as MJ-8) | Not directly related with nearby anomaly. | Within anomaly (FE≧3%) | Within anomaly (AR≦75Ω-m) | Within anomaly (MCF≧40) | At periphery of inferred magnetic body. | Within inferred mineralized body by simul. | Granite between 84.1-118.7m, 124.5-128.8m(4.3m) Chl.-Diop.-Ep.-Ga. Skarn with Py.-Mct |
| MJ-8 (4) | X<br>Y<br>Elev. | 690.400<br>1694.198<br>1,810 | 150.2 | To explore the geochemical anomaly mentioned in the right column at around quartz porphyry contact. (On same section as MJ-7) | To explore northern-deep extension mentioned above. | About 50 to 100m outside of anomalies. | | | | - | No conspicuous mineralization |
| MJ-9 (7) | X<br>Y<br>Elev. | 691.075<br>1693.511<br>1,847 | 150.2 | To explore southern-deep extension of sub-marginal ores intersected by UN-4 & MJ-1 between granite & UN-4. UN-4:Zn 2.96% for 5.5m-interval. MJ-3: Zn 1.82% for 1.0m & Zn 2.74% for 2.1m | Not directly related with nearby anomaly. | About 20 to 30m outside of anomaly. | Within anomaly (AR≦75Ω-m) | Within anomaly (MCF≧40) | Within inferred magnetic body. | - | 18.4m 67.0-112.0m Ga-Ep Skarn zone 88.6-107.0 massive Py. |
| MJ-10 (2) | X<br>Y<br>Elev. | 690.135<br>1694.175<br>1,832 | 150.2 | Same location to DG-9, in which massive Zn ore was intersected at around hole end. To explore northern extension of 2 horizons of skarn intersected by MJ-3 as well as the above. | Within Zn anomaly | Within anomaly (FE≧3%) | " | " | At periphery of inferred magnetic body | - | 45.7-46.9m(1.2m) massive Hem. 53.6-60.9m(7.3m) massive Py. |

*1 Nos.in parentheses indicate proposed No. in Phase-II Report
*2 Coordinates & Elevations are taken from 1/10,000 Topo Map.
Elev.: Collar Elevation

The locations and lenths of the drill holes so far drilled are shown in Table-3 and the assay results of the major, mineralized intersections are listed in Table-4. In these tables, the results of drilling conducted by the United Nations and the Bureau of Mines are also summarized. The locations of the drill holes are shown in Fig. 6, PL 1-1 and PL 1-2. The relationship among the results of the diamond drilling, and the anomalies of geophysical and geochemical surveys, and the correlation of the geology assumed at the time of the planning are shown in Table-5.

## 5-2 Description of geology in drill holes

The geology of each drill hole carried out in two phases is briefly described below. Among these 10 DDHs, MJ-1∿MJ-3 were drilled in the second phase and MJ-4∿MJ-10 in the third, respectively. The geological relation among the holes is shown in PL-3 and 4, and the graphic geologic log of each hole is shown in PL 6-0 through 6-7. The details of geology of MJ-1∿3 are described in the Appendix-7 in the Phase-II Report, and the assay results are listed in the Appendix-4 of the same report. The assay results of MJ-4∿10 are listed in the Appendix 6-2.

### 5-2-1 MJ-1(cf. PL-2, PL-4, PL-6-0, Fig.8)

The hole was collared at the same station with that of UN-4 of the United Nations, and drilled vertically to test the lower extension of the ore intersection (0.38 % Cu and 2.96 % Zn for 5.5m) located between 124.1m and 129.6m in UN-4. As the result, (1) garnet-epidote skarn was encountered for a length of 5.9m between 40.0m and 45.9m, which was stained with limonite, showing the assay result of 8.4 g/T Ag and 1.42 % Zn. However, no skarn was encountered at the assumed position at 150 m ± 20 m, but in turn, appeared quartz porphyry. From the relation between silicified shale and sandstone, and the green schist, this skarn was interpreted to be the same horizon with the intersection in UN-4 and is localized at the boundary between the Tactic and Chicol Formations. Therefore a fault was assumed between these two intersections. (2) In this hole, the bottom of the oxide zone or leached capping occurs at 90.6m, and chalcocite film coating reticular pyrite-veinlets is observed in the run between the bottom and 97.5m in quartz porphyry, showing

typical appearance of "secondary enrichment zone". However, the Cu grade is as low as 0.19% for 1m even in the best intersection between 90.6 and 91.6m, where the most prominent chalcocite coating is observed.

### 5-2-2 MJ-2 (cf. PL-2,PL-4, PL-6-0, Fig.8)

The drill sites of UN-4 and MJ-1 were located in a copper anomaly detected by the United Nations' geochemical survey. MJ-2 was carried out to test the lower part of the above mentioned copper anomaly assuming that the horizon of mineralization dips to the northeast in parallel with the bedding plane of the country rocks.
The result is not so encouraging: (1) Four layers of gossan with total length of 2.26m (average grade of gossan; 10.3 g/T Ag, 0.06 % Cu) were encountered for a length of 7.9m between 29.7m and 37.6m, and (2) semi-massive magnetite (19.3 g/T Ag, 0.09 % Cu, 20.12 % Fe) replacing acidic intrusive rock was intersected for a length of 1.5m between 86.5m and 88.0m. Since the gossans are localized at the boundary between silicified shale and sandstone of the Tactic Formation and green schists of the Chicol Formation, it was interpreted that this horizon corresponds to the skarn intersections in UN-4 and MJ-1 and "was dislocated to the shallower part by fault". It is inferred that the bottom of the oxidized zone is located at about 131.1m of this hole.

### 5-2-3 MJ-3(cf. PL-2, PL-4, PL-6-0)

The drilling was carried out in order to confirm the IP anomaly obtained by the United Nations. As a result, following mineralized intersections were encountered. (1) Chlorite-garnet-epidote skarn (8.5 g/T Ag, 0.53 % Zn) for a length of 0.72m between 41.75m and 42.47m in silicified shale and sandstone, (2) gossan (20.4 g/T Ag, 0.07 % Cu, 0.22 % Zn, 27.79 % Fe) at the boundary between silicified shale and sandstone of the Tactic Formation and green schist of the Chicol Formation for a length of 4.82m between 51.66m and 56.48m, and (3) garnet-epidote skarn (5.6 g/T Ag, 0.10 % Zn, 34.6 % Fe, 16.13 % S) accompanying the network veinlets of pyrite and magnetite for a length of six meters between 104.5m and 110.5m.

The result of this drilling led to the confirmation that the IP anomaly was caused by a zone of pyrite and magnetite. In particular, it has a great significance to have demonstrated for the first time that a limestone horizon in green schists of the Chicol Formation had been skarnized in the mineralized and altered zone of the area.

5-2-4 MJ-4(cf. PL-4,PL-6-1)

The drilling was planned to investigate the depths of geochemical anomaly and IP anomaly to the west of Llano del Coyote syncline which was interred to run there in the initial stage of the planning. The drilling resulted in: (1) The skarn associated with semi-massive pyrite (0.22 % Zn, 14.51 % S for a length of 5.30 m) between 92.70 m and 98.00m. (2) Green schist (?) with the patches of epidote-garnet skarn (0.10 % Cu, 0.49 % Zn for a length of 2.0m) between 112m and 114m, and (3) A weak mineralization (0.42 % Zn for 1m) associated with epidote-chlorite skarn between 147.4 and 148.4 m.

As the boundary between the Tactic and Chicol Formations is interpreted to be at around 100m, "(1)" may be correlated to the skarn horizon that occurs at the boundary.

In this hole, the bottom of oxide zone is located at about 84.5m. It is reinterpreted that the axis of Llano del Coyote is shifted a little to the north.

5-2-5 MJ-5 (cf. PL-2, PL-4, PL-6-2)

The drilling was planned to test the extension of the gossan (51.66m-56.48m; mentioned above) which was intersected in MJ-3 at the boundary between the Tactic and Chicol Formations and the skarn (104.5m-110.5m; mentioned above) in the Chicol Formation. (70m in horizontal distance to S5°W of MJ-3). This hole is within the IP anomaly at -150m level.

The results are as follows;

(1) As the position of granitic rocks was shifted northward than previously expected, the very boundary between the Tactic and Chicol Formations could not be observed, however, the presence of semi-massive pyrite was confirmed near the expected boundary(15.10% for 2.30m between 91.90m and 94.20m; 16.67% for 0.60m between 100.5m and 101.0m). The Zn grades for the intersections are as low as trace to 0.0n%. (2) Semi-massive magnetite (20.70% Fe for 4.90m) associated with pyrite in garnet-

epidote skarn was confirmed at 116.4-121.3m in the horizon corresponding to the skarn found in the Chicol Formation in MJ-3. However, the zinc grade is as low as 0.0 n %.

In this hole, the bottom of the oxidized zone is situated at the depth of about 63 m. Southward dip of the boundary of granitic rocks was also confirmed.

5-2-6 MJ-6 (cf. PL-2, PL-6-3)

This hole is located around 100-150m outside the IP anomaly, and was drilled to investigate the depths of geochemical anomaly detected on the south of quartz porphyry,which is exposed to the north of the hole. The drilling only revealed weakly disseminated pyrite and its seams: (1) Tuffaceous shale of the Tactic Formation stained with limonite in the oxidized zone (0.01 % Cu, 0.08 % Zn for 2.30m between 22.5-24.8m), and (2) the rocks rich in chlorite with disseminated pyrite (about 3-4 % S).

Both skarn and limestone were not found at the boundary between the Tactic and Chicol Formations in this drill hole.

The depth of the bottom of the oxidized zone is tentatively determined to be 57.2m. However, the exact position of the bottom is difficult to determine, due to the presence of transported limonite along the fractures.

5-2-7 MJ-7 (cf. PL-2, PL-6-4)

The purpose of this drill was not to explore a particular geochemical anomaly, but was intended to penetrate three horizons of the skarn, which had been geologically expected, at the contact with the granite. It was planned, at the same time, to confirm the mineralized body inferred by IP simulation.

The results were as follows: (1) No skarn was intersected at the boundary between the Tactic and Chicol Formations. (2) A dyke of granitic rock is observed in the Chicol Formation between 84.1m and 118.7m. Skarn zones associated with magnetite and pyrite were intersected at the both side of the dyke. Among these, the skarn of the footwall side is located about 55m to 65m below the inferred boundary between the Tactic and Chicol Formations. The skarn may correspond to (3) of MJ-3

and (2) of MJ-5 (mentioned above). Here chlorite-tremolite-epodote-garnet skarn is observed (124.5-128.8m; average grade, 18.11% Fe, % S for 3.8m assayed among 4.7m between 122.3-127m). (3) Galena was megascopically identified on the footwall of the granite close to the contact (0.05% Pb and 0.01 % Zn for 0.9m between 84.1m and 85.0m). (4) Semi-massive magnetite was found adjoining the quartz porphyry for a length of 4.5m between 187.9m and 192.4m (5) Beneath this point down to the bottom of the hole (300.1m), only green schists and dykes of quartz porphyry occur without intercalation of limestone.

The bottom of the oxidized zone is about 60m below the surface.

5-2-8 MJ-8

The hole is situated about 50-100m outside the IP anomally, and is almost on the same line with DDHs MJ-7, UN-2, and UN-3 (west of E-4 in PL-4). It was planned to investigate the depths of a copper and zinc anomaly located close to MJ-8, north of UN-3.(1) The mineralization is very week in general, and even disseminated pyrite was rarely found. (2) The mineralization which probably corresponds to the geochemical anomaly was intersected between 12.0m and 12.3m in the Tactic Formation (0.02 % Z n and 0.08 % S) and between 70.0m and 70.7m. Both intersections are in the alternation of shale and sandstone of the Tactic Formation. (3) Some disseminated magnetite is observed in the upper part of quartz porphyry. (4) The boundary between the Tactic and Chicol Formations was obscured by the presence of the quartz porphyry dyke.

This hole is located in the axial zone of the Llano del Coyote syncline and is 400m apart from the contract with the granite. It was confirmed that no significant mineralization occur in this portion.

5-2-9 MJ-9(cf. PL-2,PL-4, PL-6-6, Fig.8)

The most promising mineralized intersection of sulfide zinc (12.76 % for 9.5m) and that of secondary enrichment of copper (3.8 % Cu for 0.60m) were found in this hole.

The hole was intended to explore southern extension of the mineralized intersections in which %-order zinc was obtained. The inter-

sections are in MJ-1 (1.42 % Zn for 5.9m) and UN-4 (2.96 % Zn for 5.5m). This hole was drilled between these holes and the contact of granite. The hole was neither intended to explore the lower portion of a particular geochemical anomaly of copper or zinc, nor a geophysical anomaly, because the hole is located outside of the FE and MCF anomalies, and there is no geochemical anomaly of the target horizon in the nearby area.

The results were as follows: (1) Supergene chalcocite (3.80 % Cu for 0.60m) was observed between 82.3 and 82.9m (3.80 % Cu for 0.60m). Chalcocite occurs intersticially to the euhedral pyrite grains which are relicts in massive limonite. The bottom of the oxidized zone in this hole is situated at 88.6m from the callar, so that the secondary enrichment zone is still in the oxide zone, though it is in the lowermost part. (2) Garnet-chlorite skarn (chlorite after tramolite-actinolite?) associated with semi-massive to massive pyrite (between 88.6m and 107.0m) was observed. A 9.5m-intersection of the upper part contains a considerable amount of sphalerite (12.76 % Zn, 0.80 % Cu). In the lower 8.9m, a lesser amount of sphalerite is also found (0.64 % Zn for 8.9m between 98.1m and 107.0m). The grades of lead are lower than 0.01 % in the both. (3) Garnet-actionlite-tremolite skarn was observed for a length of 8.2m between 138.4m and 146.6m (average grade of assayed 3.70m in 8.2m is 0.35% Zn).

Among those mentioned above, (1) and (2) are located at the boundary of the Tactic and Chicol Formations, and are considered to be the same horizon with the intersections in MJ-1 and UN-4. On the other hand, (3) is in the Chicol Formation and is considered to be almost the same horizon to (3) in MJ-3, (2) in MJ-5, and (2) in MJ-7.

The spatial relationship among the three holes MJ-9, MJ-1 and UN-4 is described in detail in paragraph 5-1. Here it is reviewed below.

MJ-1 MJ-9; about 150m in horizontal distance

UN-4 MJ-9; " 135m " " "

Further exploration to the extension of these intersections is recommended, which will be discussed later.