REPORT
ON
THE COOPERATIVE MINERAL EXPLORATION
IN
THE JUNIN AREA
REPUBLIC OF ECUADOR

(PHASE II)

MARCH 1993

JAPAN INTERNATIONAL COOPERATION AGENCY
METAL MINING AGENCY OF JAPAN

PREFACE

In response to request of the Government of the Republic of Ecuador, the Japanese Government decided to conduct a Mineral Exploration Project in the Junin Area and entrusted the survey to the Japan International Cooperation Agency (JICA) and the Metal Mining Agency of Japan (MMAJ).

The JICA and MMAJ sent to the Republic of Ecuador a survey team headed by Hiroshi Kusaka from June 22, 1992 to January 5, 1993.

The team exchanged views with the officials concerned of the Government of the Republic of Ecuador and conducted a field survey in the Junin area. After the team returned to Japan, Further studies were made and the present report has been prepared.

We hope that this report will serve for the development of the Project and contribute to the promotion of friendly relations between the two countries.

We wish to express our deep appreciation to the officials concerned of the Government of the Republic of Ecuador for their kind cooperation extended to the team.

March, 1993

Kensuke Yanagiya

Kensuke Yanagiya
President
Japan International Cooperation Agency

Takashi Ishikawa

Takashi Ishikawa
President
Metal Mining Agency of Japan

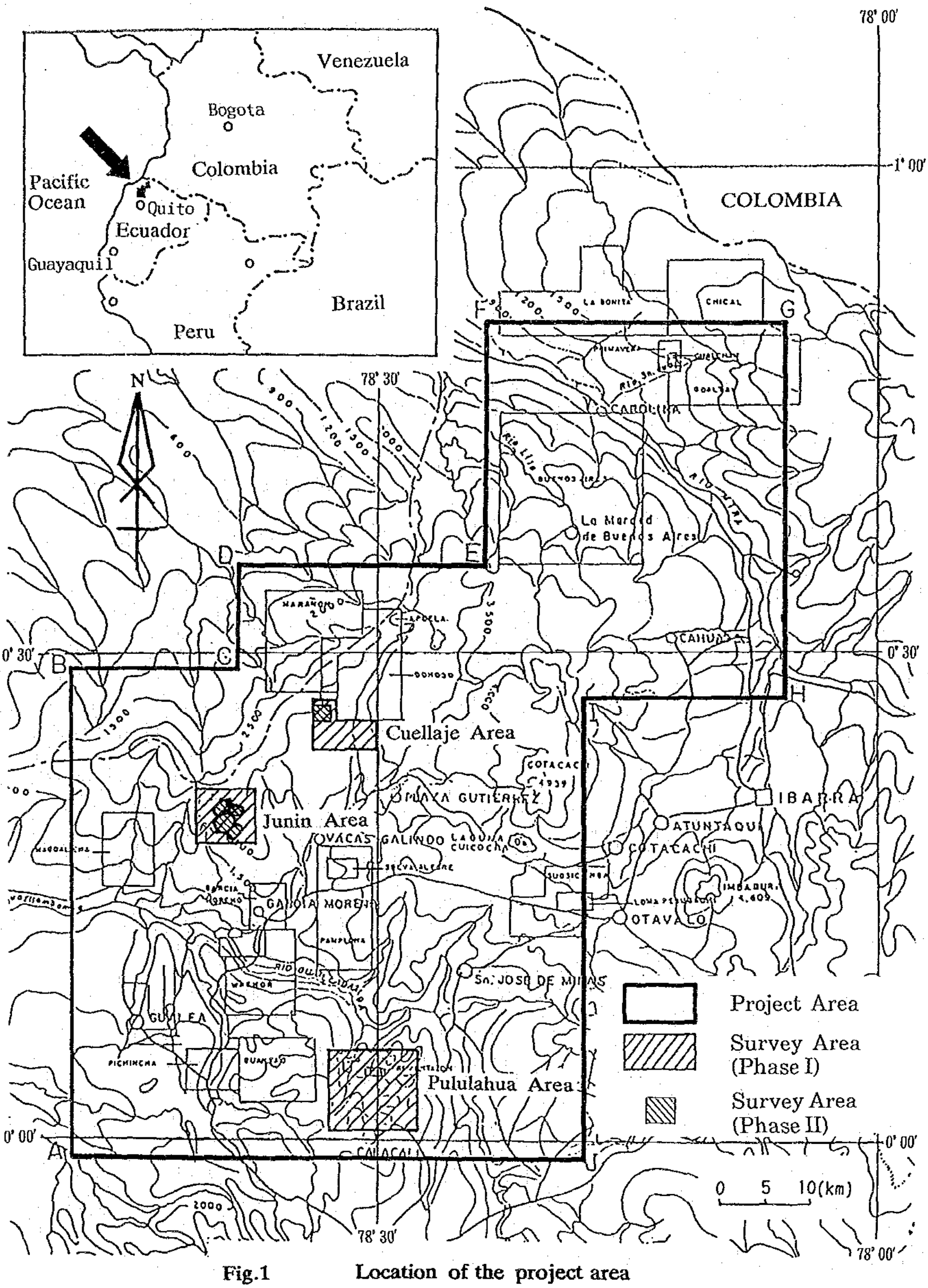


Fig.1 Location of the project area

ABSTRACT

The present survey was carried out in the Junin Area, which is located two Provinces of Imbabura and Pichincha in northern Ecuador, in conformity with the Scope of Work agreed between the governments of the Republic of Ecuador and Japan, in July 19th, 1991. The project covers an area of 5,000km^2 over a period of three years (Fig.1). This survey corresponds to the second year's, which was carried out by both Ecuadorian and Japanese members.

The survey area of the Phase II consists of the following Zones: the Central Zone of Junin area; the Surrounding Zone of Junin area; the Rio Magdalena Zone of Cuellaje area (Fig.I-1-1). Some promising mineralized zones were delineated in these zones (the latter two were confirmed in the Phase I survey), and were proved to have high potential of Cu-Mo-Ag dissemination and vein ore deposits.

In the Central Zone of Junin area, geological sketch of mineralized outcrops (5 mineralized zones) and drilling (1,585 m, 8 holes) were carried out. In the Surrounding Zone of Junin area, detailed geological and rock geochemical survey have been done (4 km^2, 215 samples for Cu,Pb,Zn,Au,Ag and Mo), furthermore, in the Rio Magdalena Zone of Cuellaje area, detailed geological and rock geochemical survey (4 km^2, 206 samples for Cu,Pb,Zn,Au,Ag,Mo,Fe and S)in addition to geophysical survey (IP;7 lines,14 km) were proceeded(Tables I-1-1).

The purpose of the Phase II survey is to confirm the existence of deposits by clarifying the geological setting of mineralization in the Junin Project area, and to transfer technology to counterparts of Ecuadorian organization through survey.

(1) Geology of Junin area (Figs.II-1-1 and II-2-1)

Geology of Junin area consists of Apuela-Nanegal batholith of granodiorite and stocks or dikes of quartz porphyry and diorite porphyry, which intrude into batholith of granodiorite. Distributional density of stocks tends to be dominate in the Central Zone of Junin area. Lineaments were also analyzed to radiate outlying section of the drainage system from the Junction of Q. Limonita and Q. Crysocola.

(2) Mineralization and alteration in the Central Zone of Junin area

Mineralized and alteration zones in this Zone were classified in three types based on their occurrences: Type I, Type II and Type III (Tables II-4-1 and II-1-2, and Fig.II-1-2). Type I and Type II are of the porphyry copper mineralization.

Type I was characterized by dissemination and film of Cu-Mo minerals accompanied with phyllic alteration zone, which occurred mainly in the granodiorite around quartz porphyry stocks or dikes.

Type II occurred as Cu-Mo-Ag veins in granodiorite, and was subdivided into Type IIA and Type IIB on their occurrences.

1) Type IIA : abundant in sulfide ore minerals which was scattered in clay as principal gangue mineral.
2) Type IIB : quartz veins with sulfide ore minerals.

Both phyllic and potassic alteration zones were identified along the vein contacts mentioned above.

This type mineralized zones were sketched geologically and mineralogically in this Phase.

Type III was observed to be as acidic alteration zone being accompanied with network quartz veins in granodiorite and diorite porphyry. Geochemical Au-Ag anomalies were delineated in a part of this alteration zone.

The Q.Limonita-Upper reach mineralized zone, which belongs to Type IIA, has a vein of 2 m wide and 140 m long. Ore assay result averages 10 % Cu and 15 g/t Ag.

The Q.Crisocola mineralized zone belongs to Type IIA mainly, and has 1.1 m in vein width and 50 m in length. Average ore assay result is 30 % of Cu.

The Rio Junin mineralized zone is observed in an area of 200 m in width and 500 m in length, where Type I, IIA and IIB coexists as mineralization in sequence. Ore assay result is 1 % Cu.

The Q.Controversia mineralized zone is overlapped by Type I, Type IIA and Type IIB on an area of 150 m in width and 200 m in length. The mineralization, however, is not intense.

The Q.Rica mineralized zone is also overlapped by Type I and Type IIB, but the area is limited.

(3) Drilling survey in the Central Zone of Junin area

Drilling survey was carried out in the Q.Limonita and Rio Junin mineralized zones, which predominated dissemination and film of bornite-chalcopyrite-pyrite-molybdenite.

The drilling results are as follows:

In the Q.Limonita mineralized zone, intense mineralization is recognized to increase and predominate to the northeasternward and to the depth over 150 m. As the assay result of 37 samples obtained from drill cores (between 8.00 m and 148.80 m of drill hole MJJ-4; direction to the northeast), the content was 3.84 % Cu in maximum and 1.30 % Cu in average.

In the Rio Junin mineralized zone, strong mineralization is also observed. According to the assay result of 112 samples obtained from drill cores (between 6.00 m and 233.45 m of drill hole MJJ-8; direction to the east), the content was 2.10 % Cu in maximum and 0.46 % Cu in average.

Since a large amount of bornite was observed in fractures of drill cores, predominant mineralized part was thought to exist in the lower parts of the northeastern ridge of and the eastern ridge of the Q.Limonita and the Rio Junin mineralized zone, respectively.

(4) Mineralization and geochemical exploration in the Surrounding Zone of Junin area

The Surrounding Zone of Junin area comprises three mineralized zones; Q.Cristal-Branch, Q.Esperanza and Q.Fortuna (Fig.II-2-3).

The Q.Cristal-Branch is divided into east mineralized zone and west. The former consists of Type I generally, and the latter Type II mainly.

Q.Esperanza mineralizes zone, which contains vein deposit of 1 m wide, 1 km long and 120 m high, is classified in Type II. Ore assay result averages 10 % Cu and 20 g/t Ag.

Q.Fortuna mineralized zone, which consists of Type I mainly and Type II additionally, is distributed on an area of 600 m in length, 200 m in width and 200 m in vertical difference. Ore assay result was 1 % Cu on average.

The distributional pattern of geochemical anomalous zones indicates a good coincidence with those of mineralization and/or alteration (Figs.II-2-7 and II-2-8). For instance, Cu-Mo geochemical anomalous zones includes the mineralized zones observed, while Pb-Zn anomalous zone are scattered around the mineralized zone. Stream sediment anomalies (Phase I) and rock geochemical anomalies (Phase II) are both interpreted to be from mineralized outcrops.

(5) Rio Magdalena Zone of Cuellaje area

Geology of Cuellaje area consists mainly of the Apuela-Nanegal batholith of granodiorite, and stocks or dikes of andesitic porphyry, dioritic porphyry and/or quartz porphyry, which intrude into the batholith (Fig.II-3-1).

In the Rio Magdalena Zone, the following mineralized zones are developed: mineralized zones A,B,C and E, all of which belong to Type I; two other mineralized zones in south belongs Type II; and mineralized zone D belongs to Type III. A part of the mineralized zone C is overlapped by the mineralized zone D.

The mineralized zone A is the biggest one observed in an area of 500 m x 400 m. Stockwork and dissemination deposits distribute in the center, film deposits around them. The mineral assemblage of alteration minerals shows zonal distribution which is in harmony with the mineralization types: quartz-sericite-chlorite-pyrite zone and chlorite-calcite zone in outward order. These zonal assemblages coincident with phyllic alteration zone and propylitic alteration zone of general porphyry copper deposit. The zoning of mineralization is also coincide markedly with that of general porphyry copper deposit. Average ore assay result is 0.6 % of Cu. The scale of the mineralization and Cu grade in this area ranks next to those of the Q.Limonita-Q.Verde mineralized zone of Central Zone of Junin area and the Q.Fortuna mineralized zone of Surrounding Zone of Junin area.

On the basis of correlation between geochemical anomaly and mineralization, high factor score distribution zones of Cu-Mo-Au-Ag were delineated on the mineralization A and E, south mineralized zone and northeastern part, high factor score distribution zones of Au-Ag on the mineralized zone D (Fig.II-3-6).

Owing to correlation between geophysical anomaly and mineralization, middle to low apparent resistivities and high to middle percent frequency effects were detected inside and/or beside the mineralized zones A and E, middle apparent resistivity and middle to low percent frequency effect inside and/or beside the mineralized zone D, and high apparent resistivity and high to middle percent frequency effect inside and/or beside south mineralized zone. IP anomaly zones detected inside and/or beside the mineralization A and the south mineralized zone continue toward western and lower parts from both mineralized zones.

As to evaluation of IP anomaly by contents of normative chalcopyrite-pyrite, IP anomaly is proportional to total amounts of sulfide minerals. It seems that IP anomalies on the mineralized zone A and E are caused by same amount of chalcopyrite and pyrite, IP anomaly on the south mineralized zone pyrite > chalcopyrite, and IP anomaly on the northeastern part pyrite.

Junin and Cuellaje areas were proved to have high potential of Cu-Mo-Ag dissemination and vein deposits. Followings are, therefore, recommended for Phase III survey including ore forming model (Fig.2).

(1) Central Zone of Junin area (Fig.3-1)

According to the steep topography, it is difficult to adopt the geophysical exploration. Drilling survey is, consequently, recommended to be continued although a transportation problem needs to be solved.

Taking the mobilization of diamond drilling machine into consideration, the recommended order of drilling survey is as follows:

1) The Q.Limonita mineralized zone, and intermediate area between the Q.Limonita and the Q.Verde mineralized zones (Type I, 250 m x 1 hole)

2) The Q.Verde mineralized zone (Type I, 100 m x 2 holes)

3) The Rio Junin mineralized zone (Types I and II, 100 m x 1 hole, 250 m x 1 hole)

4) The Q.Limonita-Upper reach mineralized zone (Type II, 100 m x 2 holes)

5) The Q.Crisocola mineralized zone (Type II, 100 m x 2 holes)

(2) Surrounding Zone of Junin area (Fig.3-1)

1) The Q.Fortuna mineralized zone (Type I):

Detailed geological sketch on mineralized zone, drilling of 100 m x 3 holes, and detailed geological survey in the southeast and east of quartz porphyry stock.

2) The Q.Esperanza mineralized zone (Type II):

Drilling of 100 m x 2 holes, underground exploration including Q.Limonita-Upper reach and Q.Verde mineralized zones.

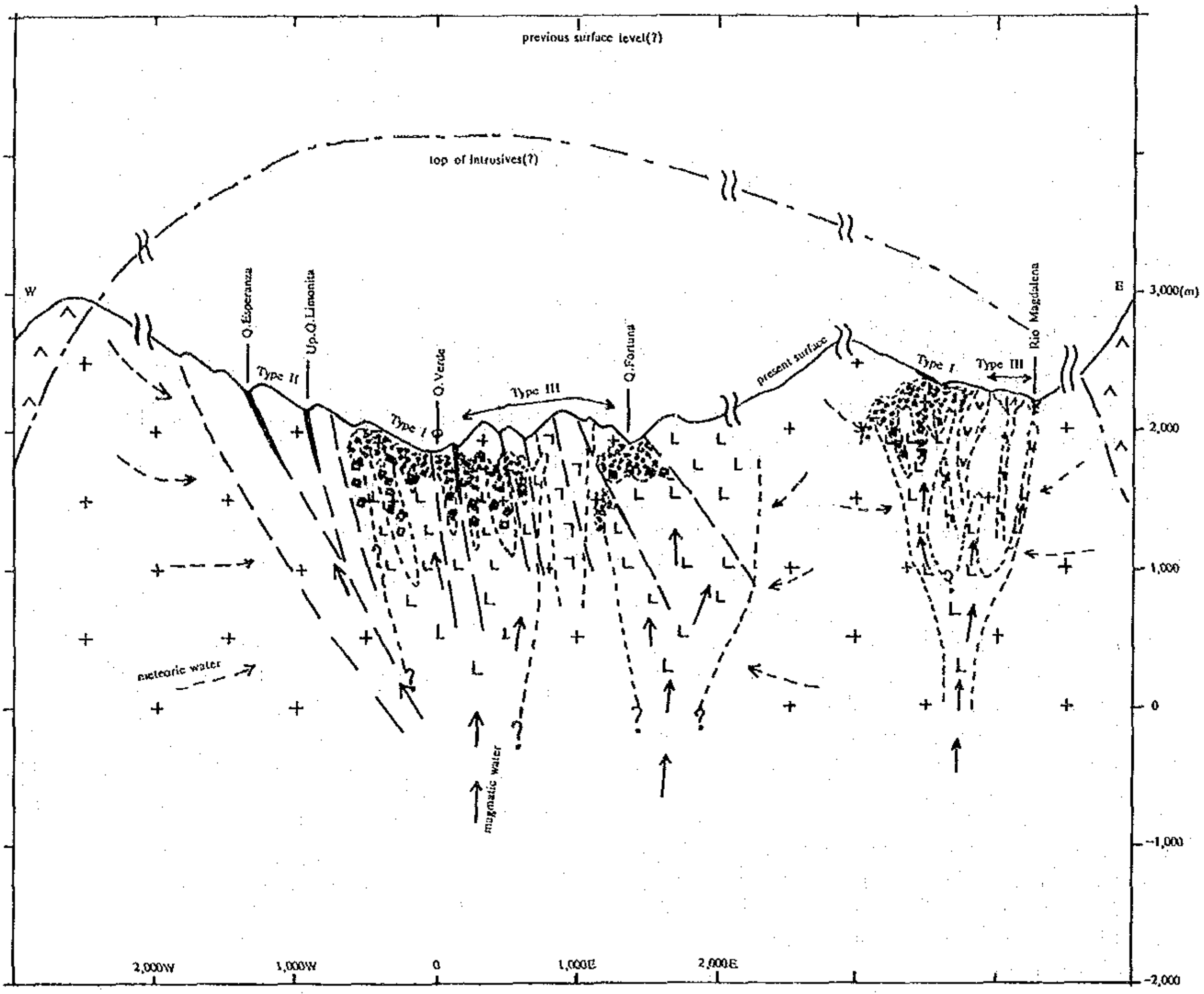
(3) Rio Magdalena Zone of Cuellaje area (Fig.3-2)

1) The Rio Magdalena-Branch mineralized zone (mineralized zone A) and its western extension:

Drilling of 100 m x 2 holes and of 300 m x 2 holes, and geophysical survey.

2) The south mineralized zone and its western extension:

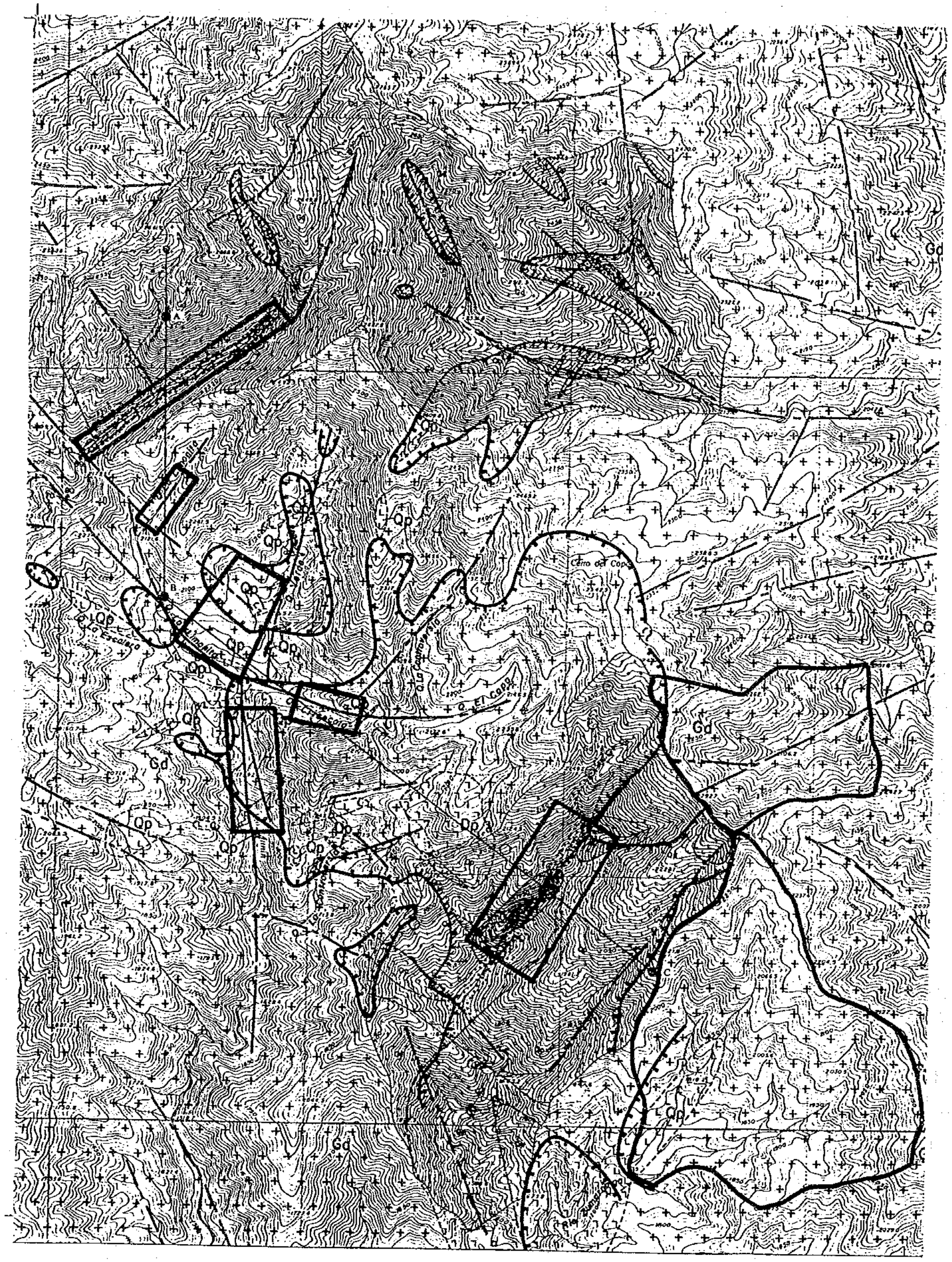
geophysical survey.

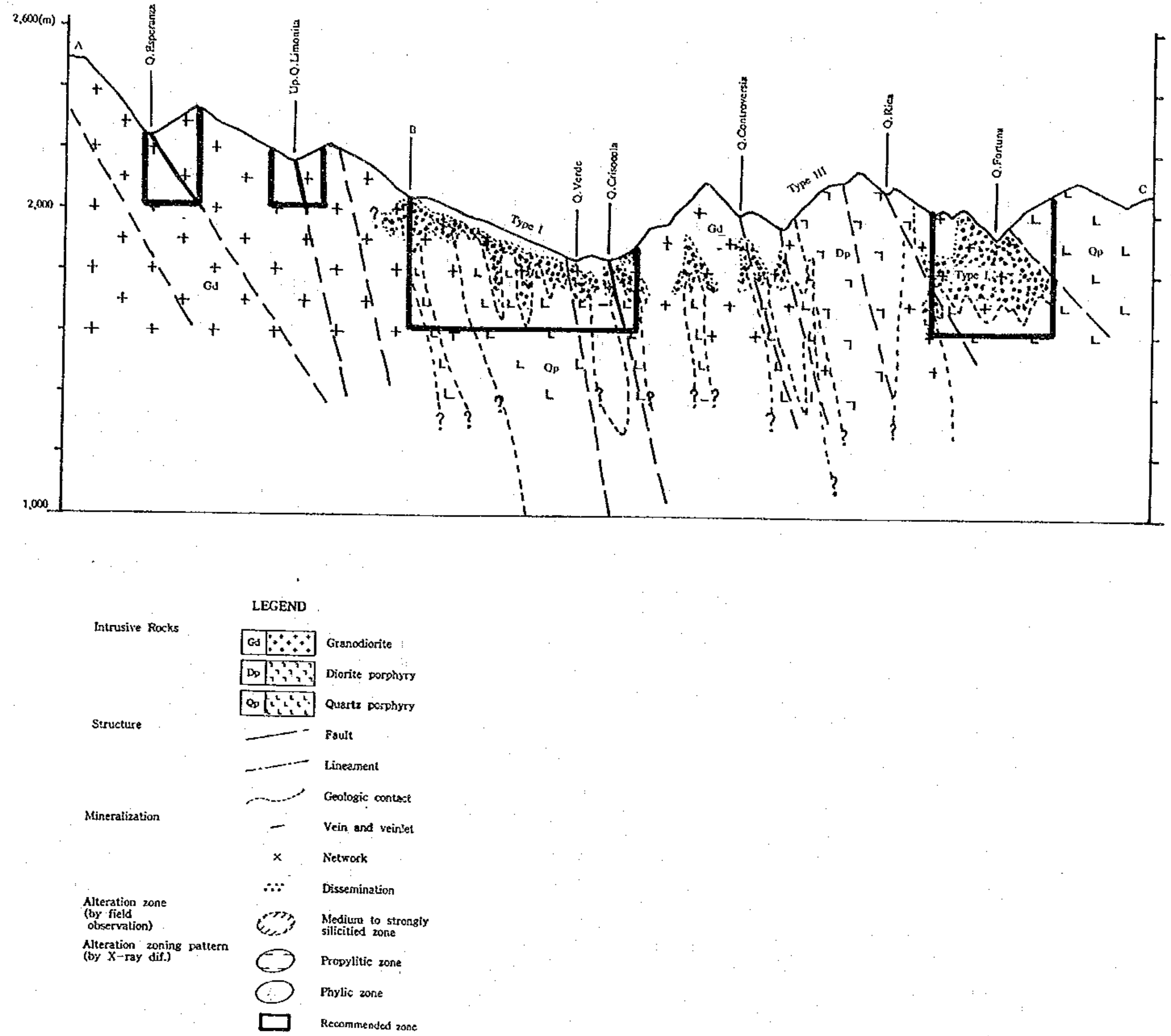


LEGEND

- Quartz porphyry(5.6±0.2~8.8±0.4Ma)
- Diorite porphyry(7.3±0.3Ma)
- Andesite porphyry(10.4±0.5~11.1±0.6Ma)
- Granodiorite(13.0±0.6~14.5±0.2Ma)
- Macuchi formation(Cretaceous)
- Propylitic alteration zone with Cp–Py–Cc–Bo–Td vein
- Phyllic alteration zone with Cp–Py film/dissem.
- Potassic alteration zone with Mo–Cp network

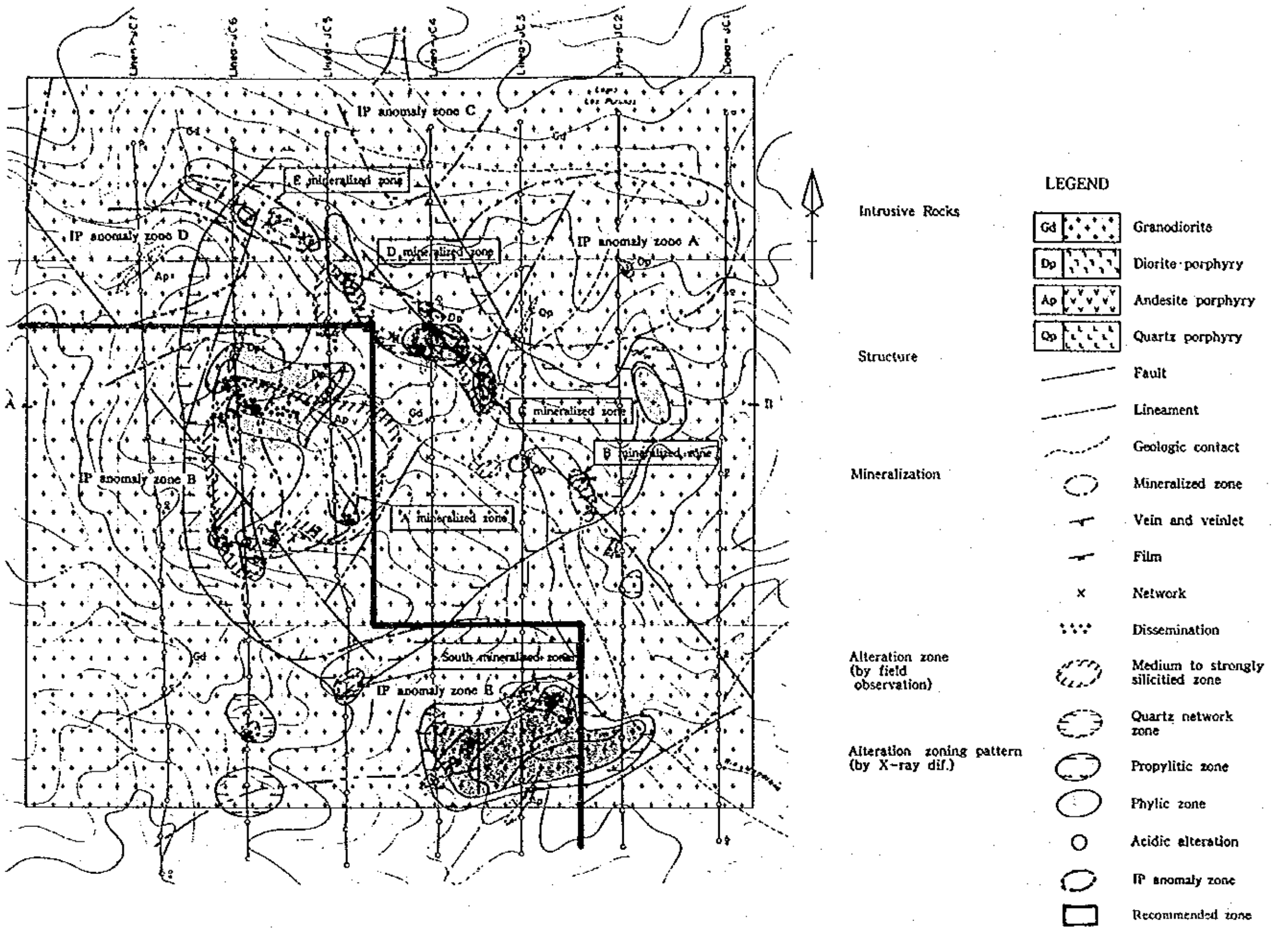
Fig.2 Ore forming model





0 500m

Fig.3–1 Survey results and recommendation for further survey (Central and Surrounding zones,Junin area)



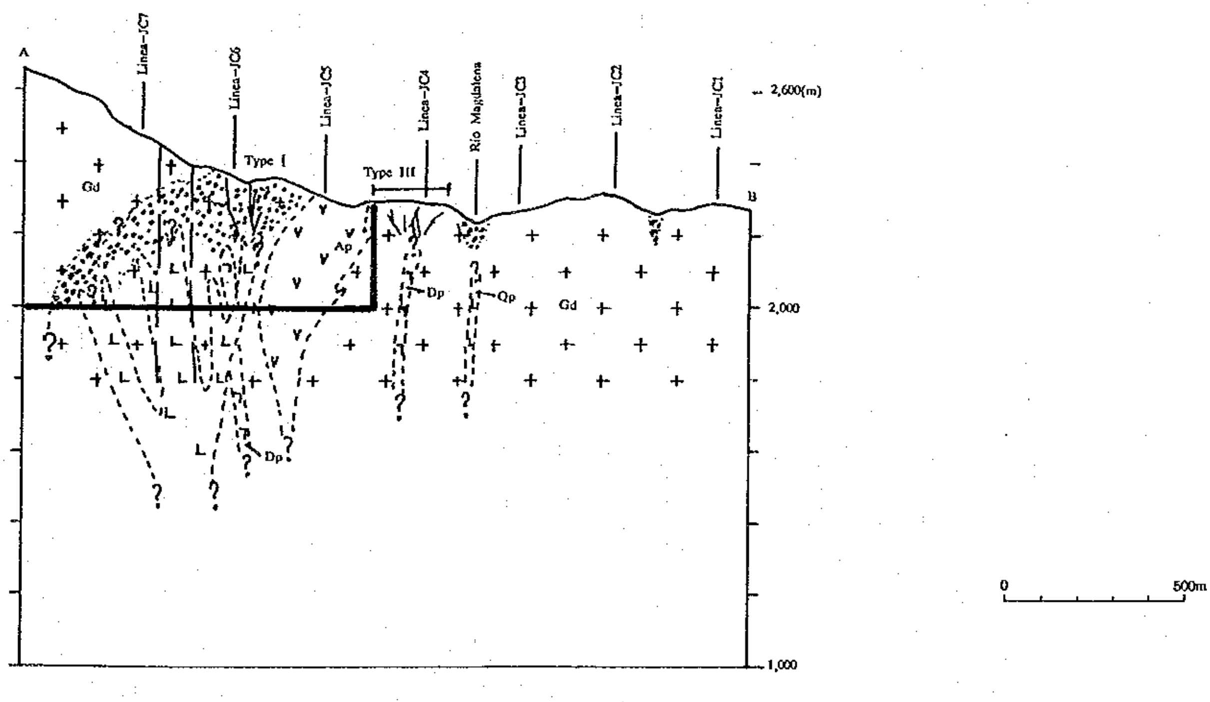


Fig.3–2 Survey results and recommendation for further survey (Rio Magdalena zone, Cuellaje area)

CONTENTS

PART II DETAILS

PART III CONCLUSIONS AND RECOMMENDATIONS

PART I GENERAL

Chapter 1 Introduction

1-1 Background of the Survey

The Junin Project area lies in the western flank of Occidental Cordillera of Ecuador, where predominates a porphyry copper belt which is known to run consistently from North to South of America.(Fig.1)

The present survey was carried out in the Junin area,in conformity with the Scope of Work agreed between the governments of the Republic of Ecuador and Japan,in July 19th,1991.The project covers an area of 5,000km^2 over a period of three years.

This survey corresponds to the second year's,and was carried out by both Ecuadorian and Japanese members.

The survey area of the Phase I was comprised of four areas: the Central Zone of Junin area(4km^2); the Surrounding Zone of Junin area(35km^2); the Cuellaje area(34km^2); and the Pululahua area(90km^2), which were selected in accordance with the geological data and information prepared by Ecuadorian Institution, INEMIN. In the Central Zone of Junin area, detailed geological and rock geochemical survey and drilling were carried out. In the Surrounding Zone of Junin area, semi-detailed geological and stream sediment geochemical survey have been done, furthermore, in the Cuellaje and Pululahua areas, geological reconnaissance survey were proceeded. As the results, some promising mineralized zones were delineated in the Central and Surrounding Zones of Junin area in addition to the Cuellaje area(the latter two were confirmed in the Phase I survey). Since the promising areas were proved to have high potential of Cu-Mo dissemination and vein deposits, further detailed surveys were recommended for the Phase II survey in the areas.

1-2 Conclusions and Recommendations of the Phase I Survey

1-2-1 Conclusions of the Phase I Survey

(1) Mineralization and alteration in the Central Zone of Junin area

Mineralized and alteration zones in this Zone were classified in three types based on their occurrences: Type I, Type II and type III.

Type I occurred mainly in the granodiorite around stocks or dikes of quartz porphyry. Mineralized zones, which are characterized by Cu-Mo mineral dissemination (> network of quartz stringers with sulfides), distributed in the down stream of Q.Limonita and in the middle to down stream of Q.Verde, accompanied with phyllic alteration zone. The assay result of ore samples were 1.35 % Cu and 1.44 % Cu respectively.

Type II were recognized in various zones such as the up stream of Rio Junin, the up stream of Q.Limonita, the Q.Crisocola, the down stream of Q.Controversia and the up stream of Q. La Rica. Type II, which occurred as veins composed of as same ore mineral assembly as Type I, was divided into two sub-type Type IIA and Type IIB on their occurrences.

1) Type IIA : abundant in ore minerals which was scattered in clay, principal gangue mineral.

2) Type IIB : quartz veins with ore minerals.

Both phyllic and potassic alteration zones were identified along the vein contacts. The assay results of ore samples were as follows: 0.3 g/t Au, 137.2 g/t Ag and 42.42 % Cu for Type IIA of Q.Limonita; 0.1 g/t Au, 4.6 g/t Ag, 2.17 % Cu and 0.97 % Mo for Type IIB of Rio Junin mineralized zone.

Type III was observed to be as acidic alteration zone being accompanied with network quartz veins.

The distribution of these three types of mineralized zones are summarized as follows: The Type I dominates in the Central Zone and extends southeastward and northeastward; Type II dominates in the Central Zone mainly and extends northwestward and southeastward, further to the Surrounding Zone of Junin area; and Type III is limited in the eastern half of the Central Zone.

(2) Drilling survey

Drilling Hole No. MJJ-1, which was carried out in the western edge of the Q.Limonita mineralized zone and drilled down to 151.50 m in depth. The MJJ-1 revealed that the lower part of the hole intersected and corresponded to the marginal section of the Q.Limonita mineralized zone.

(3) Mineralization in the Surrounding Zone of Junin area

The Q.Esperanza mineralized zone, which was proved to be similar to type IIA and Type IIB of the Central

Zone, were accompanied with phyllic alteration zone. Ore grade assayed was as follows: 0.6 g/t Au, 784 g/t Ag, 20.97 % Cu and 0.28 % Zn.

The Q. Fortuna mineralized zone was recognized to be similar to the Type I and the Type IIA of the Central Zone. A section corresponding to the Type I was accompanied with phyllic alteration zone and graded to be 8.3 to 1.1 g/t Ag, 2.68 to 0.33 % Cu and 0.09 % Mo or under, while the other section corresponding to Type IIA was assayed to be 0.2 g/t Au or under, 3.5 to 1.8 g/t Ag and 1.26 to 0.37 % Cu.

In the Q.Cristal branch alteration zone, several mineralized sections were recognized to be corresponded to Type I and Type IIB defined in the Central Zone.

(4) Result of geochemical exploration

As the results of rock geochemical exploration in the Central Zone of Junin area, the zoning of alteration mineral assemblage was proved precisely to be reflected on the distribution of geochemical anomalous zones which were corresponded also to each mineralized zones respectively . For instance, Cu-Mo geochemical anomalous zone was centered on a intense mineralized zone, on the other hand Pb-Zn anomalous zones were distributed generally in surrounding part of each mineralized center.

The Au-Ag anomalous zone was suspected only to show a vague relationship with mineralized zone. Every Au-Ag anomalous zone over 10 ppm of Au was, anyhow, delineated within the Type III acidic alteration zones.

Cu-Pb-Zn geochemical anomalies were detected by stream sediments in areas corresponding to the mineralized outcrops along the Q.Limonita, the Q.Fortuna, and a branch of the Q.Cristal of the Surrounding Zone of Junin area.

(5) Cuellaje area

The Rio Magdalena mineralized zone was accompanied with a zonal structure of three alteration mineral assemblages: the potassic alteration zone; the phyllic alteration zone; and propylitic alteration zone in outward order.

The assay result of ore samples there was 5.2 g/t Ag, 1.66 % Cu and 0.11 % Mo. These mineralized zones could be comparable in extension and intensity with those of the Central Zone of Junin area.

The Q.San Miguel mineralized zone was observed to be surrounded by the propylitic alteration zone.

Both the Rio Cristopamba mineralized zone and the mineralized zone between Rio Magdalena and Q.San Miguel contain Type II zones which are accompanied with contact zonal alteration in the vicinity of veins: the phyllic alteration zone at the central part, the propylitic alteration zone outwards.

The assay results of the Rio Cristopamba and the Q.San Miguel mineralized zones were as follows: 45.6 to 6.3 g/t Ag, 6.97 to 1.43 % Cu and 0.13 % Mo; 0.4 g/t Au, 36.5 g/t Ag, 7.98 % Cu and 0.03 % Mo respectively.

(6) Pululahua area

There are two areas of interest for prospect in this area, which are known as the Tanachi deposit and the Reventazon alteration zone.

The Tanachi deposit, which situates in the northwestern part of the area, occurs as secondary deposit of ore breccias. These ore breccias were supposed to be derived from polymetallic epithermal deposits formed in Quaternary age associating with the acidic hydrothermal activities, and to be transported possibly by landslide movement. The Reventazon acidic alteration zone situates in the central part of the Pululahua area. The assay result of ore was under detectable level.

1-2-2 Recommendations for Phase II Survey

Junin and Cuellaje areas were proved to have high potential of Cu-Mo dissemination and vein deposits. Followings were, therefore, recommended for Phase II survey.

(1) Central Zone of Junin area

According to the steep topography, it is difficult to adopt the geophysical exploration. Drilling survey is, consequently, commended although a transportation problem needs to be solved.

Taking the mobilization of diamond drilling machine into consideration,the recommended order of drilling survey is as follows:

1) Q.Limonita mineralized zone (Type I)
2) An area between Q.Limonita and Q.Verde mineralized zones (Type I)
3) Rio Junin mineralized zone (Type II)

A detailed geological survey is, furthermore, recommended to be carried out in the area of Q.Verde mineralized zone (Type I) and mineralized zones of Q.Limonita up stream, Q.Crisocola, Q.Controversia and Q.La Rica (Type II) in order to delineate promising mineralized zone for future drilling survey.

(2) Surrounding Zone of Junin area

To correlate mineralization between Central Zone and Surrounding Zone of Junin area, detailed geological survey and geochemical exploration are recommended to be carried out in the three mineralized zones, Q.Esperanza mineralized zone, Q.Fortuna mineralized zone, and Q.Cristal branch mineralized zone.

(3) Cuellaje area

Detailed geological survey, rock geochemical exploration, and geophysical exploration are recommended to be carried out in Rio Magdalena mineralized zone and a limited area between Rio Cristopamba and Q.San Miguel mineralized zones.

The reason of recommendation is as follows:

-Topography in Cuellaje area is comparatively gentler than that of Junin area, geophysical exploration method should be adoptable consequently.

-Occurrence of mineralization here is quite similar to that of Junin area, geological and geochemical survey could be efficient exploration methods.

1-3 Outline of the Phase II Survey

1-3-1 Survey Area

According to the above-mentioned "Recommendations for Phase II survey", the survey area of the Phase II consists of the following areas: the Central Zone of Junin area; the Surrounding Zone of Junin area; the Rio Magdalena Zone of Cuellaje area (Fig.I-1-1).

1-3-2 Purpose of the Survey

The purpose of the Phase II survey is to confirm the existence of deposits by clarifying the geological setting of mineralization in the Junin Project area, and to transfer technology to counterparts of Ecuadorian organization through survey.

1-3-3 Survey Method

In the Central Zone of Junin area, geological sketch of mineralized outcrops and drilling were carried out. In the Surrounding Zone of Junin area, detailed geological and rock geochemical survey have been done, furthermore, in the Rio Magdalena Zone of Cuellaje area, detailed geological and rock geochemical survey in addition to geophysical survey were proceeded(Tab. I-1-1). The details are mentioned bellow.

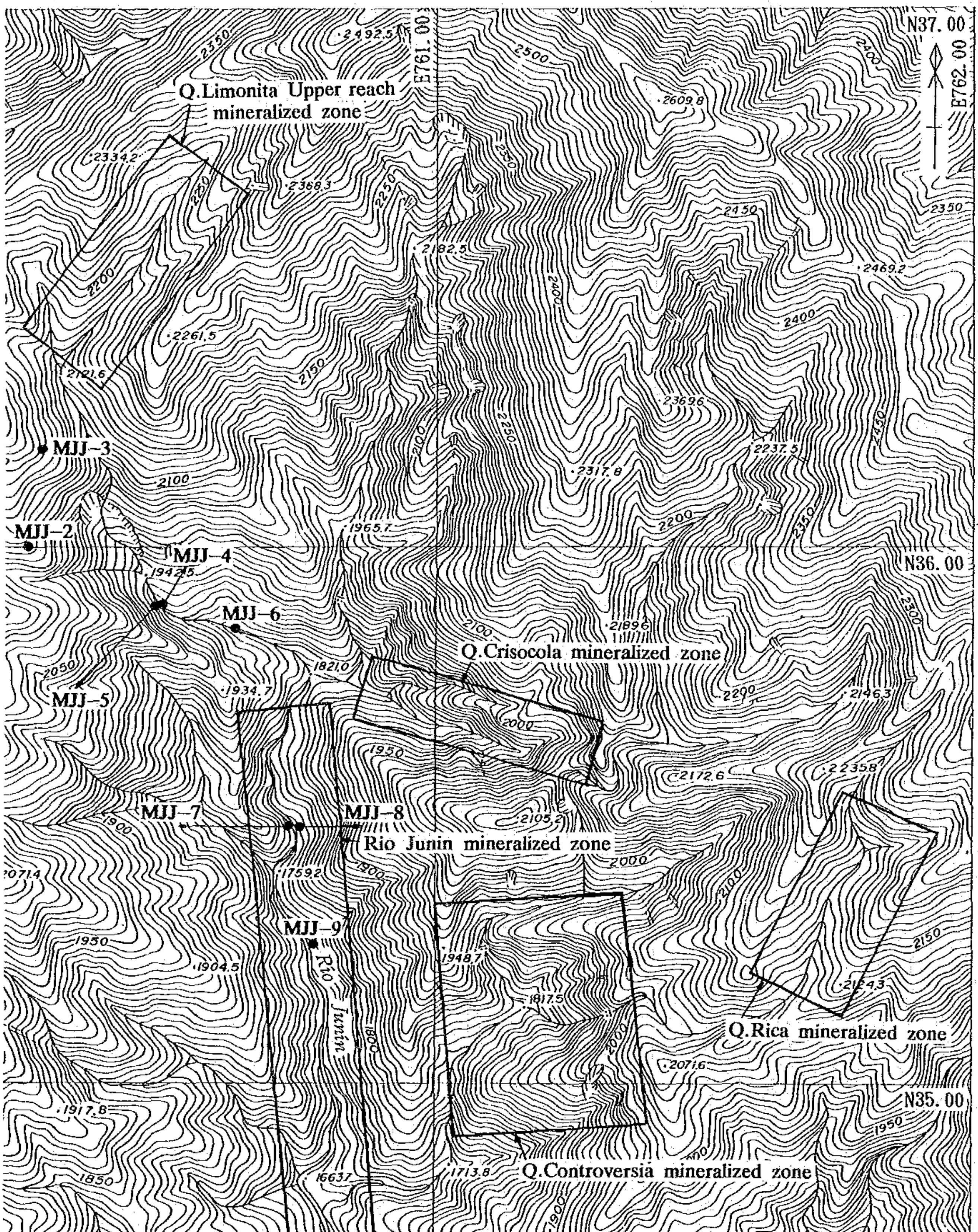


Fig.I-1-1(1) Location of the survey area(Central zone,Junin area)

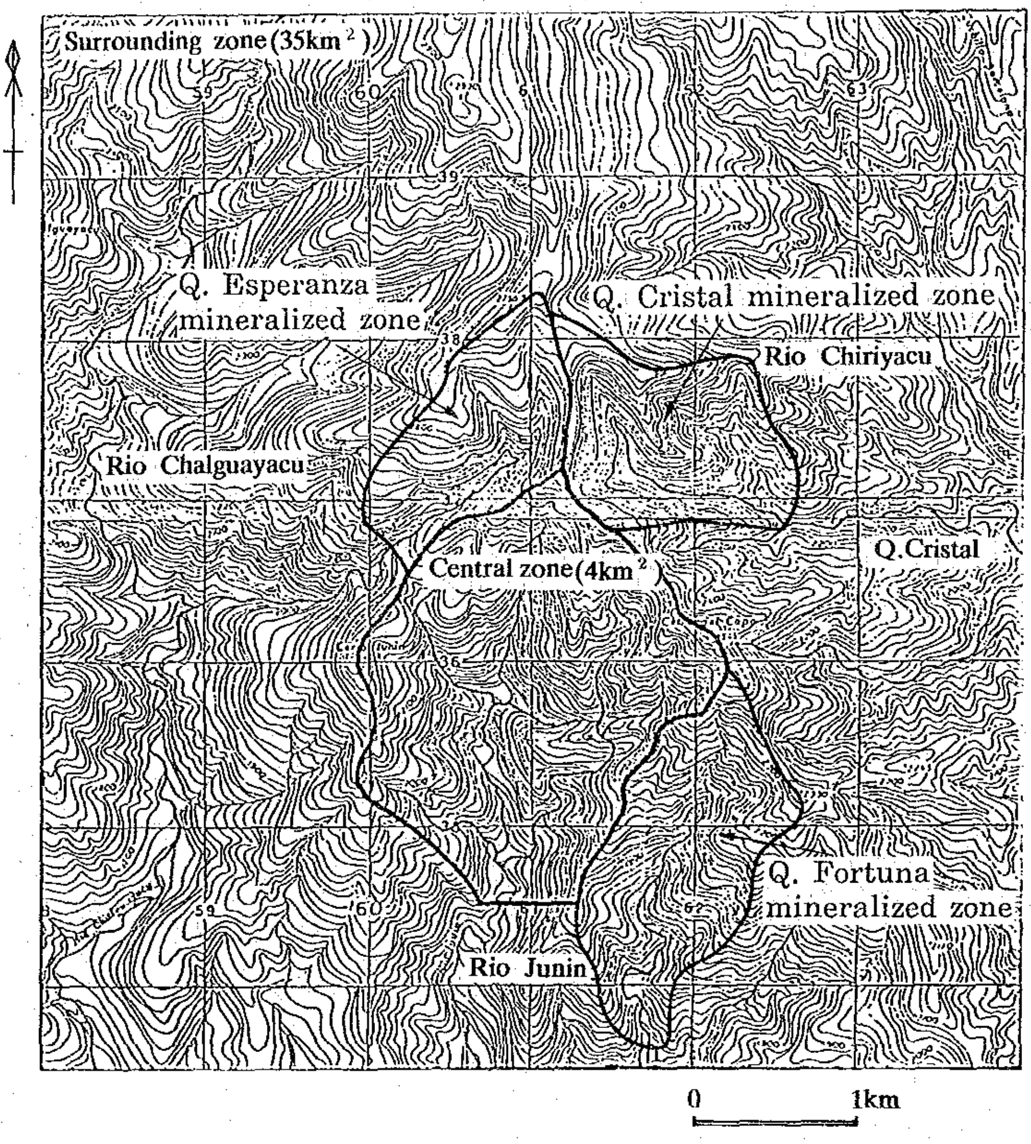


Fig.I–1–1(2) Location of the survey area(Surrounding zone,Junin area)

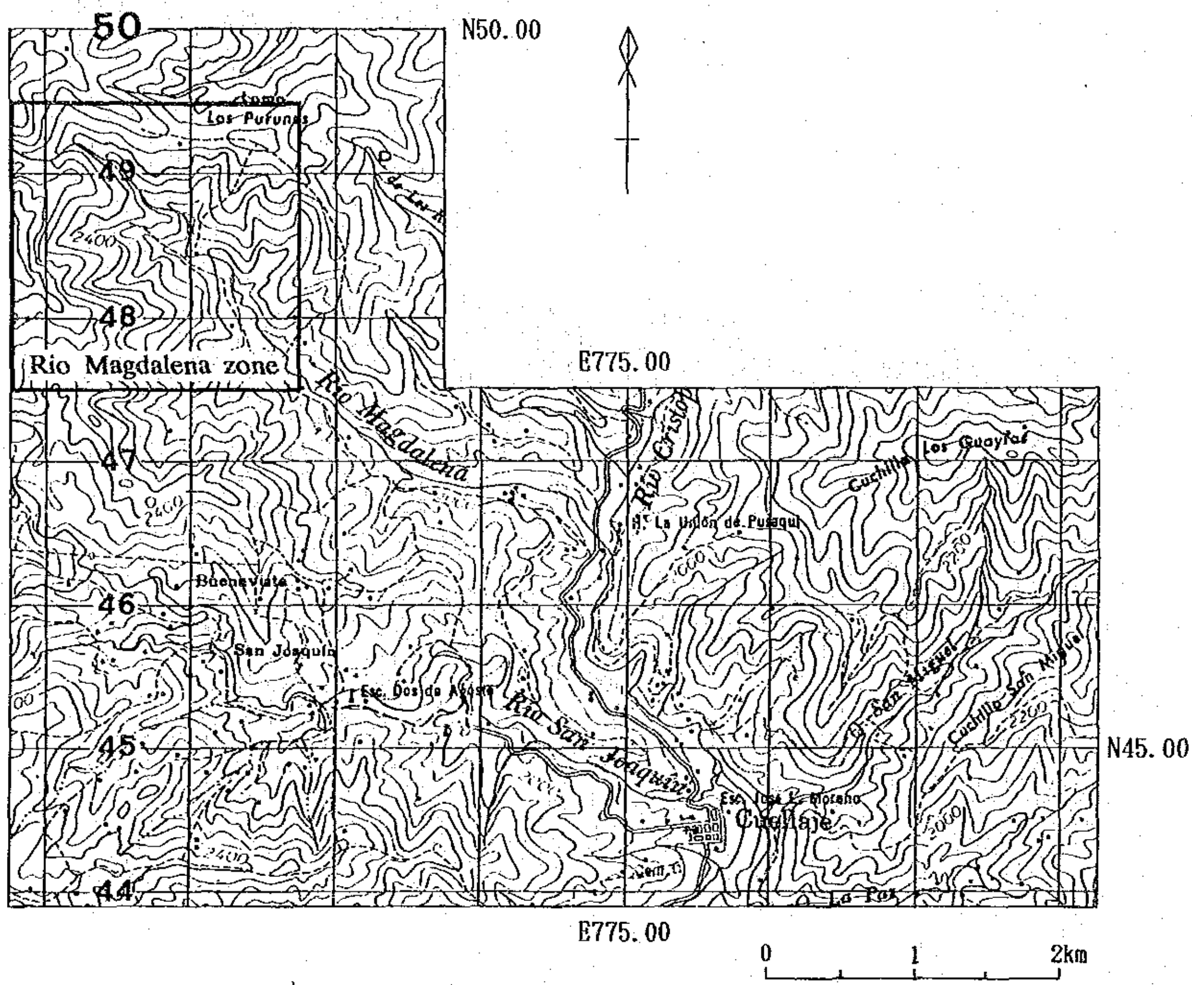


Fig.I-1-1(3) Location of the survey area(Rio Magdalena zone,Cuellaje area)

1-3-4 Organization of the Survey

Personnel who were involved in the Project, as surveyors are as follows:

Japanese counterparts

Kenzo Masuta	Overseas Act.Dept.	MMAJ
Hiroshi Kusaka	Leader Geol.geochem.surv.	BEC
Norio Ikeda	Geol.geochem.surv.	BEC
Jun-ichi Yamagata	Geol.geochem.surv.	BEC
Manabu Kaku	Geophy.surv.	BEC
Kohei Sugawara	Geophy.surv.	BEC

Ecuadorian counterparts

Carlos Muirragui	Presisent	CODIGEM
Wilson Santamaria	Geol.geochem.surv.	CODIGEM
Luis Quevedo	Geol.geochem.surv.	CODIGEM
Salomon Brito	Geol.geochem.surv.	CODIGEM
Edgar Lopez	Geophy.surv.	CODIGEM
Bolivar Libero	Geophy.surv.	CODIGEM
Luis de La Torre	Drilling	CODIGEM
Alfonso Vaca	Drilling	CODIGEM
Ricardo Rosales	Drilling	CODIGEM
Rolando Torres	Drilling	CODIGEM

MMAJ:Metal Mining Agency of Japan
BEC:Bishimetal Exploration Co.,Ltd.
CODIGEM:Corporacion de Desarrollo e Investigacion Geologico-Minera y Metalurgica

1-3-5 Period of the Survey

Field survey

Geological and geochemical survey:
From 27th of July, 1992 to 10th of September, 1992

Geophysical survey:
From 29th of June, 1992 to 18th of August, 1992

Drilling
From 22th of June, 1992 to 5th of January, 1993

Analysis and Documentation
From 19th of August, 1992 to 1st of March, 1993

Tab.I-1-1 Amounts of field works and laboratory tests

Area	Survey contents	Survey amount			
		Area covered	Route length	Geochem. sample	Drilling Survey
Central zone, Junin	Geol.sketch Drilling	5 mine. zones	5.3km	---	 1,585.1m(8holes)
Surrounding zone, Junin	Geol.detail surv. Rock geochem.surv.	4km2	20.3km *	215 pcs	---
Rio Magdalena zone, Cuellaje	Geol.detail surv. Rock geochem.surv. Geophy.surv.(IP)	4km2 14km-length	20.4km 7-lines	206 pcs 560-times	---

*Fortuna:6.8km,Esperanza:4.3km,Crisral:9.2km

Items and contents of laboratory work \ Area	Central zone Junin		Surrounding zone, Junin			Rio Magdalena zone, Cuellaje	
	Geol.	Drill	Fortuna	Esperanza	Cristal	Geol.	Geophy.
Thin section	--	10	--	--	--	24	--
Polished section	24	12	9	9	7	15	--
Ore analysis	36	307	11	10	15	31	--
Rock geochem.analysis	--	--	215 (total) 85	37	93	206	--
X-ray diffraction	--	100	100 (total) 48	22	30	105	--
Geophy.measurement	--	--	--	--	--	--	26

Chapter 2 Geographic Features of the Survey Area

2-1 Location and Access

The Project area of Junin locates about 20 to 80 km north of Quito, the capital city of Ecuador. The area extends through two Provinces, the Provincia de Imbabura and the Provincia de Pichincha. The Phase II survey includes two survey areas, which are Junin and Cuellaje (Fig.I-1-1).

Junin area divides into two zones: Central Zone and Surrounding Zone (4 km2). Cuellaje area has 4 km2 as the Rio Magdalena Zone (TableI-1-1).

Support-camp was located at Nangulvi, which is about 180 km of road distance and four hours drive from Quito via Otavalo (110 km of paved road between Quito and Otavalo, and 70 km of unpaved road between Otavalo and Nangulvi). From Nangulvi to Chalguayacu Alto, the entrance of Junin, two hours drive approximately for 40 km of unpaved road via Garcia Moreno. From Chalguayacu Alto to "Junin Camp" in the Central Zone of Junin area, 7 km (estimated on the map) requires three hours and a half on horse back in dry season. From Junin Camp to the advance base (Junin arriba), which is used to for the survey of the Quebrada Esperanza mineralized zone, Surrounding Zone of Junin, and for the drilling of MJJ-2 and MJJ-3, it takes about one hours or more on foot.

From Nangulvi to the base of the Quebrada Cristal-Branch alteration zone, Surrounding Zone of junin, a village Barcelona, one hour and a half of drive by Jeep through 20 km of unpaved road.

From Nangulbi to the Cuellaje area, forty minutes of drive through 17 km of unpaved road.

2-2 Topography and Hydrography

The project area lies in the western flank of West-Andian mountain range. The topography of the project area is very steep, altitudinal difference is between 1,500 m and 3,000 m above sea level in Junin area, and between 1,800 m and 2,600 m above see level in Cuellaje area,

The prominent summit distributed inside of the Project area is Mt Cotacachi (4,937 m ASL) which occupies about 20 km east of the Cuellaje area, and the other prominent summit outside is Mt Cayambe (5,790 m ASL) which rises high at about 50 km east of the Pululahua area.

Junin and Cuellaje areas situate on the southern flank and southeastern flank of Cordillera de Toisan.

In the Project area, the principal drainage system originates from the Andian mountain rage and consists macroscopically of the E-W direction represented by Rio Guayllabamba running to the west in southern area and the NW-SE direction represented by Rio Mira streaming toward the northwest direction.

Adding to these directions, second degree drainage systems are developed, which are characterized with NE-SW system and N-S system. Two survey areas, Junin and Cuellaje, are distributed in an area along a Branch of upper stream of Rio Guayllabamba.

2-3 Climate and Vegetation

Climate in the survey area is tropical, high humidity in lower altitude area and temperate, dry in higher altitude area. The records show that annual humidity be from 50% to 75%. Precipitation sums up 2,000 mm to 3,000 mm annually.

The rain season runs from December to April. In Junin area,it is very common to start raining in the afternoon and decreasing temperature from October. It rains through day and night from December.

Pululahua area, which situates in the eastern part of the Project area and was the Phase I surveyed area, shows dry climate. Its altitude is the highest among the survey areas and its climates much more temperate. In the higher place than Pululahua area, perpetual snow gets covering summits and peaks (for instance,Mt Cotacachi etc).

Vegetation mainly consists of jungles. Plantations of sugar cane and banana exist along valleys, and fields of corn and beans or ranchos are developed partly in highland.

Chapter 3 Geological Features of the Survey Area

Ecuador situates in the northwestern part of South American Continent and occupies an area between Columbia and Peru geographically. Geotectonically, Ecuador belongs to so-called mobile belt of the Andian geosyncline, which is formed in a narrow stripe along the western margin of the Guiana-Brazil shield, and which is characterized such geotectonic structure with faults, folds and violent volcanic activities as eugeosyncline is.

The geology of Ecuador consists of rocks from Pre-Cambrians up to Quaternaries. Principal geologic structure shows NNW-SSE trend which reflects upon the distribution of the three geotectonic ranges: Coast; Mountains; and Orient.

Geology of coastal range is composed of Mesozoic marine formation (the Pinon formation), Tertiary formation and Quaternary formations.

Geology of Mountain ranges is composed of three geologic zones: the West-Cordillera; the Andian inner valley; and the East-Cordillera.

In the West-cordillera volcanic rocks, which are dated to be from Cretaceous to Paleogene (the Macuchi formation), are piled up enormously. In the southern part of this geologic range, Paleozoic and Pre-Cambrian basements are recognized to distribute. In the Andian inner valley, scattered are many depositional basins which are filled with sediments and volcanic detritus.

Geology of Orient is composed of sedimental layers from Carboniferous to Quaternary.

Ecuador has two major Metallogenic Provinces: Oriental and Occidental, each of which is subdivided into three and five Metallogenic Zones respectively (INEMIN, 1988). Classification of these zones is interpreted on Tab.I-3-1, and their distribution are shown in Fig.I-3-1.

The Junin area is situated in the Metallogenic Zone VII, a anticlinorium-synclinorium of Occidental Metallogenic Province. The Zone VII extends north-south: northern most limit may be around the Piedrancha deposits in Columbia (50Ma, JICA-MMAJ,1983); to the south, El Torneado mineralized zones (30/24Ma, JICA-MMAJ, 1989) and Chaucha deposits (Eocene, OMRD, 1972); and southern most limit may be around the Michiquillay deposits (46/21 Ma, Stewart et al, 1974).

In the vicinity of Piedrancha, Later stage auriferous mineralization is also recognized. Massive sulfide deposits have been mined at the La Plata mine and the Macuchi mine which are just south of Quito, and polymetallic deposits are being mined at the Portovelo mine in the southern part of Ecuador. Therefore the Zone VII may have a high potential of ore deposits, especially of porphyry copper type deposits.

Geology of Junin area consists of Cretaceous Macuchi formation, Silante formation and Yunguilla formation, which are intruded by acidic to intermediate granitic rocks (MRNE/DGGM, 1982). In the eastern part of the area, Quaternary volcanic detritus and lavas distribute extensively. The Macuchi formation is composed of basic to intermediate volcanic rocks, thickness of which is over 5,000 m. The Silante formation is composed of reddish volcanic debris, thickness of which is over 4,000 m. The Yunquilla formation is composed of shale, thickness of which is estimated to be over 2,000 m.

Limiting to the Phase II survey area, two areas consist entirely of granitic rocks.

Henderson (1979) described that within the Macuchi formation just outside of the Project area identified were marine fossil fauna (Inoceramus peruanas) and fossil foraminifera (Globotruncana sp.) corresponding to upper Cretaceous, and fossil foraminifera (Nummulites nummulitiformis Rutten, Amphistegina spp.) corresponding to Eocene; and that the Macuchi was dated to be 51.5 + 2.5 Ma with K-Ar method, which corresponded to Lower Eocene. Furthermore batholith of granodiorite in the Project area was determined to be 13 to 15 Ma; Stocks of porphyritic rocks were to be 6 to 11 Ma with K-Ar method.

Principal geologic structure show N-S and NNE-SSW directions which are represented by distributional characteristics of Apuela-Nanegal batholith.

Four types of mineralization and alteration were recognized in the Project area (JICA/MMAJ,1992).

-Type 1 : Cu-Mo mineralization observed as dissemination of copper and molybdenum minerals in granitic rocks
(Porphyry copper type).....(In Junin and Cuellaje areas)

-Type 2 : Cu-Mo mineralization observed as vein in granitic rocks
(Porphyry copper type).....(In Junin and Cuellaje areas)

-Type 3 : Acidic hydrothermal alteration observed in granitic rocks
(In Junin area).

-Type 4 : Cu-Pb-Zn mineralization observed in Quaternary volcanic detritus
(In Pululahua area).

Tab.I–3–1 Classification of metallogenic zones

Topography		Geology	Metallogenic Province	Metallogenic Zone	Metallogenic Sub-Province
Galapagos Islands		Pliocene ~ Quaternary			Cu-Ni-Co Sub-Province of Ocean Floor (Quaternary)
Coast		Pre-Cretaceous ~ Pleistocene (Pinion Formation)	Occidental (Ocean Crust, Eugeosyncline)	VIII. Coastal Zone	Fe-Ti-Pt Sub-Province of Coast (Jura ~ Early Cretaceous)
Mountain Range	Occidental Cordillera	Cretaceous ~ Paleocene (flysh) (Macuchi Formation)		VII. Anticlinorium-Synclinorium of Occidental Cordillera	Cu Sub-Province of Occidental Cordillera (Cretaceous ~ Miocene)
	Interandean Depression	Neogene ~ Holocene		VI. Catamayo Synclinorium Graben	Polymetalic Sub-Province of High Plateau (Paleocene ~ Quaternary)
				V. Azuay Basin	
				IV. Quito Graben	
	Real Cordillera	Metamorphic Rocks of Paleozoic and Mesozoic	Oriental (Continental Crust, Miogeosyncline)	III. Anticlinorium of Real, Moromoro and Mullepungo Cordillera	Sn-W-U Sub-Province of Real Cordillela (Later Paleozoic)
Orient		Carboniferous ~ Cretaceous		II. Oriental Pre-Andean Zone	Au Sub-Province of Orient Basin (Mesozoic ~ Cenozoic)
		Tertiary ~ Quaternary		I. Iquitos Basin	

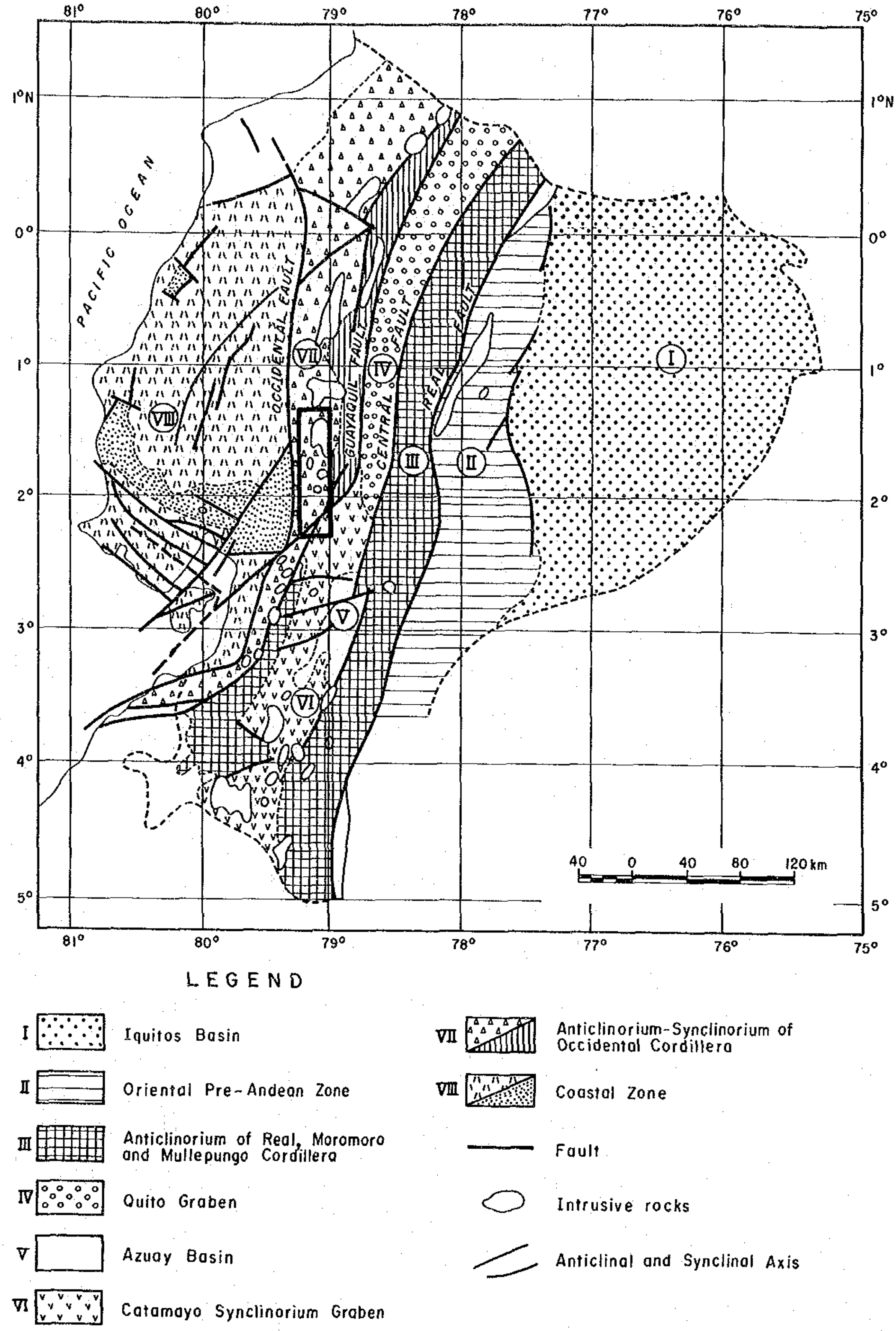


Fig.I–3–1 Geotectonic and metallogenic zones of Ecuador

Chapter 4 Overall Discussion on the Results

4-1 General Consideration on Geology, Geological Structure and Volcanic Activities

(1) Central Zone of Junin area and Surrounding Zone of Junin area

Geology of the Central Zone of this survey area consists of grandiorite, quartz porphyry and diorite porphyry. The granodiorite belongs to Apuela-Nanegal batholith.The quartz porphyry and diorite porphyry, which formed dikes or stocks, intruded into the granodiorite batholith (Figs.II-1-1, and II-2-1). The stocks of quartz porphyry and/or diorite porphyry distribute on a scale of 1 km in diameter as maximum, several tens of meter to several hundreds of meters as average and distributional density of stock tends to be dominate in the Central Zone of Junin area.

Most of three type of rocks were classified into the category of granodiorite, of I-type series, and of magnetite series (JICA/MMAJ,1992).

According to the results of isotopic age determination with K-Ar method for the batholith of granodiorite, dike or stock of quartz porphyry and diorite porphyry, these were 14.5+1.0 Ma, 5.6+0.2 to 6.1+0.2 Ma, and 7.3+0.3 Ma respectively (JICA/MMAJ,1992). The age determined shows that batholith be defined precisely in the middle Miocene of Tertiary Period, and that porphyries be defined in the later Miocene of Tertiary.

As the conspicuous structure, the lineaments are mainly developed the NE-SW and the NW-SE directions, and lineaments with the N-S and the E-W directions overlap on the former structures, especially in the Central Zone. Moreover, The radius lineaments develop from the area of the juncture of the Rio Junin and the Q.Limonita and the Q.Crisocola.

(2) Cuellaje area

The geology of this area consists of granodiorite mainly which forms batholith,and of andesitic and dioritic porphyries which intrude into granodiorite batholith as stocks or dikes, and then of quartz porphyry which forms dikes (Fig.II-3-1).

Most of these four kinds of rock were classified also into the category of granodiorite, of I-type series, and of magnetite series (JICA/MMAJ,1992).

On the basis of the results of isotopic age determination with K-Ar method for granodiorite, andesite porphyry and quartz porphyry, the age of each rock were as follows: 13.0+0.6 Ma for granodiorite; 11.1+0.6 to 10.4+0.5Ma for andesite porphyry;and 8.8+0.4 Ma for quartz porphyry (JICA/MMAJ,1992). The age showed the same tendency as Junin, granodiorite is corresponded to the middle Miocene of Tertiary, while porphyries are corresponded to the later Miocene of Tertiary. The rocks in Junin area seemed to be younger slightly than those in Balzapamba area.

The lineament with the directions of the NNE-SSW and the NW-SE are conspicuous,and lineaments the N-S and the E-W are also developed.

4-2 Characteristics of Mineralization and its Controlling Factor

(1) Central Zone of Junin area

The mineralized and alteration zones in the Central Zone of this area were divided into three types on their occurrences (Tabs.I-4-1,II-1-1,II-1-2 and Fig.II-1-2).

1) Type I: Mineralized zones consist of Cu-Mo dissemination and film deposit(>stockwork deposit) in the granodiorite beside quartz porphyry, which are observed typically in the lower reaches of Q. Limonita and the lower to middle reaches of Q.Verde. This type is associated with phyllic alteration.

2) Type II: Mineralized zones consist of Cu-Mo vein deposit in the granodiorite, which are observed typically in the upper reaches of Rio Junin, Q.Limonita and Q.Crisocola, in the lower reaches of Q.Controversia and in the upper reach of Q.La Rica, which are accompanied with the phyllic to potassic alteration zones in the vicinity of vein contact. According to the nature of veins, the veins were divided into the following two sub-types:

1) Type IIA : Vein of sulfide minerals with clay

2) Type IIB : Quartz vein with ore minerals.

This type is target for geological sketch of the Phase II survey.

3) Type III: Acidic alteration zone with stockwork quartz vein in granodiorite and diorite porphyry. Geochemical Au-Ag anomalies were delineated in a part of the alteration zone.

Type I and type II mineralization are porphyry copper type.

The Q.Limonita-Upper reach mineralized zone belongs to Type IIA, and has 2 m in vein width and 140 m in length. Average ore assay result is 10 % Cu and 15 g/t Ag.
The Q.Crisocola mineralized zone belongs to Type IIA mainly, and has 1.1 m in vein width and 50 m in length. Average ore assay result is 30 % Cu.
The Rio Junin mineralized zone is overlapped by Type I, Type IIA and Type IIB on an area of 200 m in width and 500 m in length. Average ore assay result is 1 % Cu.
The Q.Controversia mineralized zone is overlapped by Type I, Type IIA and Type IIB on an area of 150 m in width and 200 m in length. The mineralization is not intense.
The Q.Rica mineralized zone is also overlapped by Type I and Type IIB, but the area is limited.

Drilling survey was carried out at the Q.Limonita and Rio Junin mineralized zones, and predominant mineralized parts consisting of bornite-chalcopyrite-pyrite-molybdenite dissemination and film were intersected in both mineralized zones.
The drilling survey results are as follows:
In the Q.Limonita mineralized zone, intense mineralization is recognized to increase toward northeastern and lower part, and to continue for 150 m or more. As the assay result of 37 samples obtained from drill cores (between 148.80 m of drill hole MJJ-4; direction to the northeast), the content was 3.84 % Cu in maximum and 1.30 % in average.
In the Rio Junin mineralized zone, strong mineralization is also observed. According to the assay result of 112 samples obtained from drill cores (between 233.45 m of drill hole MJJ-8; direction to the east), the content was 2.10 % Cu in maximum and 0.46 % in average.
Since a large amount of bornite was observed in fractures in drill cores, existence of predominant mineralized part was thought to be in the lower parts of the northeastern ridge of the Q.Limonita and of the eastern ridge of the Rio Junin mineralized zone.

(2) Surrounding Zone of Junin area (Fig.II-2-3)
The Q.Cristal-Branch, Q.Esperanza and Q.Fortuna mineralized zones are distributed in the Surrounding Zone of Junin area.
The Q.Cristal-Branch mineralized zone is divided into east and west mineralized zones. The former consists mainly of Type I, the latter Type II.
Q.Esperanza mineralizes zone contains vein deposit belonging to Type II. The mineralization is observed on an area of 1 m in vein width, 1 km in length and 120 m in altitude difference, in the Q.Esperanza. Average ore assay result is 10 % Cu and 20 g/t Ag.
Q.Fortuna mineralized zone consists mainly of Type I and a few Type II which is distributed on an area of 600 m in length, 200 m in width and 200 m in vertical difference. Average ore assay result is 1 % Cu.

(3) Rio Magdalena Zone of Cuellaje area (Fig.II-3-2)
In the Rio Magdalena Zone, the following mineralized zones are developed: mineralized zones A,B,C and E belonging to Type I; two south mineralized zones belonging Type II; and mineralized zone D belonging to Type III. A part of the mineralized zone C is overlapped by the mineralized zone D.
The mineralized zone A is the biggest one among them and is observed on area of 500 m x 400 m. Stockwork to dissemination deposits distribute in the center, film deposits around them. The mineral assemblage of alteration minerals shows zonal distribution which is in harmony with the mineralization types: quartz-sericite-chlorite-pyrite zone and chlorite-calcite zone in outward order. These zonal assemblages coincide with phyllic alteration zone and propylitic alteration zone of general porphyry copper deposit. The zoning of mineralization is also coincide markedly with that of general porphyry copper deposit. Average ore assay result is 0.6 % of Cu. The scale of the mineralization and Cu grade in this area ranks next to those of the Q.Limonita-Q.Verde mineralized zone of Central Zone of Junin area and the Q.Fortuna mineralized zone of Surrounding Zone of Junin area.

Tab.I–4–1 Summary of survey results

Type of survey	Name of area investigated	Area (Km2)	Geology	Mineralization: Name of zone	Type (Occurrence)	Lateral Extension	Ore Minerals	Host Rock	Alteration	Cu (%)	Pb (%)	Zn (%)	Au (g/t)	Ag (g/t)	Mo (%)	Sample No.	Evaluation
Geol. sketch	Central zone, Junin	5 min. zones	Intrusives of: ho-bi gd., di. por. and qz. por..	Up. reach of Q. Limonita	sulfide-rich vein	140m*2.0m	Cp-Bo-Py--Cc-Chry	Gd	sil., arg.	5.45	0.01	0.01	<0.1	34.3	<0.01	C2127	A
										2.60	<0.01	<0.01	<0.1	5.2	<0.01	C2128	
										17.03	<0.01	0.01	<0.1	<0.1	<0.01	C2129	
					sulfide-rich vein	0.2m	Cp-Py	Gd	sil.	0.99	<0.01	<0.01	<0.1	<0.1	<0.01	C2131	
				Q.Crisocola	sulfide-rich vein with Cup	50m*1.1m	Cup-Chry-Cc	Gd	sil.,arg	43.00	<0.01	0.02	<0.1	<0.1	0.01	B2159	A
										23.49	<0.01	0.01	<0.1	<0.1	0.03	B2160	
										28.60	<0.01	0.02	<0.1	<0.1	0.14	B2163	
					q vein	0.1m	Chry-Py	Gd	sil.	4.94	<0.01	<0.01	<0.1	<0.1	0.01	B2157	
					q vein	2.5m	Chry-Lim	Gd	sil.	0.46	<0.01	<0.01	<0.1	<0.1	<0.01	B2161	
				Rio Junin	sulfide-rich q vein	1.0m	Cp-Py-Cc	Gd	sil.	0.61	<0.01	0.01	<0.1	<0.1	<0.01	B2172	A
						0.5m	Cp-Py-Cc-Mo	Gd	sil.	0.57	<0.01	<0.01	<0.1	<0.1	<0.01	C2139	
						1.5m	Cp-Bo-Mo-Py	Gd	sil.	1.10	<0.01	<0.01	0.1	6.9	0.01	C2140	
						1.1m	Py-Chry	Gd	sil.	3.53	<0.01	<0.01	<0.1	<0.1	<0.01	E2076	
					q vein	0.3m	Chry	Gd	sil.,arg	1.56	<0.01	<0.01	<0.1	<0.1	0.02	B2176	
						0.2m	Cp-Py	Gd	sil.	1.21	<0.01	<0.01	<0.1	<0.1	0.03	E2078	
					q vein/ntwk	0.5m	Mo-Cp-Py	Gd	sil.	2.40	<0.01	<0.01	<0.1	4.8	0.47	B2173	
					film/ntwk/diss	10m*3.5m	Cp-Py-Cc-Mo	Gd	sil.	0.39	<0.01	<0.01	<0.1	<0.1	0.01	C2135	
										1.63	<0.01	<0.01	<0.1	<0.1	0.01	C2136	
										0.77	<0.01	<0.01	<0.1	<0.1	0.01	C2137	
										0.34	<0.01	<0.01	<0.1	<0.1	<0.01	C2138	
				Q. Controversia	sulfide-rich	0.4m	Cp-Py-Cc-Chry	Gd	sil.,arg	6.51	<0.01	<0.01	0.1	18.3	0.03	B2165	B
					film	2.0m	Cc-Chry	Gd	sil.	0.33	<0.01	<0.01	<0.1	<0.1	<0.01	B2166	
					ntwk/film	5.0m	Py-Cp	Dp	sil.	0.35	<0.01	<0.01	<0.1	<0.1	0.01	B2167	
				Q. Rica	diss/ntwk	3.0m*1.8m	Chry-Cc	Gd	sil.arg.	0.54	<0.01	<0.01	<0.1	<0.1	<0.01	C2132	B
					q vein	1.0m	Py-Cp-Mo-Chry	Gd	sil.arg.	3.87	<0.01	0.01	<0.1	<0.1	0.04	D2126	
Detail	Surrounding zone, Junin	4	Intrusives of : ho-bi gd., di.por. and qz.por.	Branch of Q. Cristal	diss/ntwk/film in fault zone	250m	Py-Cp-Cc	Gd	sil.,arg.	0.50	<0.01	<0.01	<0.1	<0.1	<0.01	D2049	B
										0.11	<0.01	<0.01	<0.1	1.5	<0.01	D2051	
					sulfide-rich q vein	400mx0.25m	Py-Cp-Td	Gd	sil.,arg.	10.53	0.01	0.05	0.3	23.3	<0.01	B2096	
										4.14	0.06	0.56	0.3	114.5	<0.01	B2099	
					ditto	0.3m	Py-Cp	Gd	sil.	0.16	0.03	<0.01	2.4	59.7	0.01	C2094	
					diss		Py-Cp	Gd	sil.	0.78	<0.01	<0.01	<0.1	3.5	<0.01	D2066	
				Q. Esperanza	sulfide-rich vein	1km*1.0m	Cp-Py-Td-Bo-Cc	Gd	sil.,arg.	11.99	<0.01	0.01	4.2	36.5	<0.01	B2117	A
										13.98	<0.01	0.01	0.3	35.5	0.01	B2121	
										10.74	<0.01	0.01	0.2	43.7	<0.01	B2123	
										3.25	<0.01	<0.01	0.1	13.2	<0.01	B2126	
										2.61	<0.01	<0.01	<0.1	7.2	<0.01	B2128	
					q vein	1km*0.3m	Td-Cp-Py	Gd	sil.,arg	0.35	<0.01	0.12	<0.1	<0.1	<0.01	B2116	
				Q. Fortuna	diss/ntwk/vein	600m*200m	Cp-Py-(Mo-Cc-Bo)	Gd	sil.,arg.	0.64	<0.01	<0.01	0.1	2.3	<0.01	D2101A	A
										0.50	<0.01	<0.01	<0.1	3.4	0.03	D2104	
										0.81	<0.01	<0.01	<0.1	<0.1	<0.01	D2112	
										1.99	<0.01	<0.01	<0.1	2.9	<0.01	D2119	
					diss/film	1.5km	Py	Qp	sil.,arg.								
					diss	300m*200m	Py	Gd/Dp	sil.,prop.								
					diss/film	500m	Py-Cp	Gd	sil.,arg.	0.08	<0.01	0.01	<0.1	<0.1	<0.01	C2118	
					sulfide-rich vein	2.0m	Py-Cp-Td	Gd	sil.	2.26	<0.01	0.04	<0.1	<0.1	0.01	B2145	
										0.31	<0.01	<0.01	0.2	62.0	0.02	C2122	
					q vein	1.0m	Py-Cp	Gd	sil.	0.70	<0.01	<0.01	<0.1	<0.1	0.01	B2144	

Type of survey	Name of area investigated	Area (Km)	Geology	Mineralization														Evaluation
				Name of zone	Type (Occurrence)	Lateral Extension	Ore Minerals	Host Rock	Alteration	Cu (%)	Pb (%)	Zn (%)	Au (g/t)	Ag (g/t)	Mo (%)	Sample No.		
Detail	Rio Magdalena zone, Cuellaje	34	Inrusives of : ho-bi gd., di. por. ande. por. and qz. por.	Branch of Rio Magdalena (A)	diss/film/ntwk	400m*500m	Cp-Py-Chry-Mo-(Cc-Bo)	Gd	sil., arg.	0.20	<0.01	<0.01	<0.1	<0.1	<0.01	B2029		A
										1.40	0.01	<0.01	<0.1	1.4	0.16	B2032		
										0.21	<0.01	<0.01	<0.1	<0.1	<0.01	B2037		
										0.48	<0.01	<0.01	<0.1	2.0	0.01	B2046		
										0.31	<0.01	<0.01	0.2	7.3	<0.01	B2052		
				Rio Magdalena (B)	vein/film	100m*60m	Py-Cp-Chry	Gd	sil.	0.06	<0.01	<0.01	0.1	4.3	<0.01	C2030		B
										0.20	<0.01	<0.01	<0.1	<0.1	<0.01	C2037		
										0.30	<0.01	<0.01	<0.1	<0.1	<0.01	C2038		
				Rio Magdalena (C)	film/diss	300m*60m	Py-Cp-Chry	Gd	sil., arg.	0.37	<0.01	<0.01	<0.1	<0.1	<0.01	B2066		
										0.32	<0.01	<0.01	<0.1	1.5	<0.01	B2073		
				(D)	q. ntwk	400m*150m	Chry	Gd	sil.	Au geochemical anomaly								
				Rio Magdalena (E)	film/diss	400m*100m	Py-Cp-Chry	Gd	sil.	0.14	<0.01	<0.01	<0.1	<0.1	<0.01	D2035		
										0.32	<0.01	<0.01	<0.1	<0.1	<0.01	D2038		
				South	q vein	0.8m	Py-Cp	Gd	sil.	0.49	0.01	<0.01	<0.1	2.4	0.15	C2004		
										0.34	<0.01	0.01	<0.1	4.0	0.03	D2015		
Drilling	Central Zone, Junin			Q. Limonita	diss/film	CL. 148.80m	Bo-Cp-Py-Mo	Gd, Qp	sil., arg.	1.26	0.00	0.01	<0.1	<0.1	0.14	MJJ-4		A
						CL. 150.50m	Py-Cp-Mo-(Bo)	Gd, Qp	sil., arg.	0.17	0.00	0.00	<0.1	<0.1	0.01	MJJ-6		
				Rio Junin	diss/film	CL. 233.45m	Bo-Cp-Py-Mo	Gd, Qp	sil., arg.	0.45	0.00	0.00	<0.1	<0.1	0.02	MJJ-8		A
						CL. 150.00m	Py-Cp-Mo-(Bo)	Gd, Qp	sil., arg.	0.20	0.00	0.00	<0.1	<0.1	0.00	MJJ-9		

Ranking of evaluation : A > B > C > D > E

4-3 Correlation between Geochemical Anomaly and Mineralization

(1) Surrounding Zone of Junin area

The distribution pattern of geochemical anomalous zones limited extent of mineralization, and were corresponded with those of mineralization and/or alteration (Figs.II-2-7 and II-2-8). For instance, Cu-Mo gechemical anomalous zones were delineated over obvious mineralized zones, while Pb-Zn geochemical anomalous zone were scattered around the mineralized zone. Stream sediment-geochemical anomalies of the Phase I survey and rock-geochemical anomalies of the Phase II survey resulted from each mineralization.

(2) Rio Magdalena Zone of Cuellaje area

High factor score distribution zones of Cu-Mo-Au-Ag were delineated on the mineralization A and E, south mineralized zone and northeastern part, High factor score distribution zones of Au-Ag the mineralized zone D (Fig.II-3-6).

4-4 Correlation between Geophysical Anomaly and Mineralization

Middle to low apparent resistivities and high to middle percent frequency effects were detected in/beside the mineralized zones A and E, middle apparent resistivity and middle to low percent frequency effect the mineralized zone D, and high apparent resistivity and high to middle percent frequency effect south mineralized zone. IP anomaly zones detected inside and/or beside the mineralization A and the south mineralized zone continue toward western and lower parts from both mineralized zones.

As to evaluation of IP anomaly by contents of normative chalcopyrite-pyrite, IP anomaly is proportion to total amounts of sulfide minerals. It seems that IP anomalies on the mineralized zone A and E are caused by same amount of chalcopyrite and pyrite, IP anomaly on the south mineralized zone pyrite > chalcopyrite, and IP anomaly on the northeastern part pyrite.

4-5 Ore Forming Model and Potential of Ore Deposits

The metallogenetic process of above three mineralized and alteration zones are considered as follows: The trend of granodiorite batholith(Apuela-Nanegal batholith) is the N-S or NNE-SSW directions which is the same of the direction of Andes as a large structure. The distinguished direction of NE-SW and NW-SE of the lineaments is medium scaled structure. They are considered to be conjugate set. And, these three structures are presumed to have existed as a basement structure for quratzdiorite magma which rose through the structures and formed stocks.

The Central Zone of Junin area is considered to be a place where these structural and igneous activity concentrated. The radius lineament develops from the area of the juncture of Q.Limonita and Q.Crisocola. These fractures can be considered to have been the weak structure, and which have been intruded by porphyry accompanied with ore solution. By the mineralization and alteration of Type I together with Type II which occurred in this unique place, each type of ore deposit was formed (Type I and II are considered to be porphyry copper type).

The mineralization was finished by the acidic hydrothermal alteration of Type III in the final stage. After that, the secondary copper minerals are crystallized by the local circulation of ground water, however, oxidation zone or the zone of secondary enrichment are presumed not to be formed, because of extreme shortage of pyrite. (however, the zone of secondary enrichment was formed in Q.Crisocola mineralized zone, because the leaching progressed along the fault).

By the structural analysis of the fractures Type II and III, the thrust from the deeper part of Q.Verde toward the surface is presumed.

The Surrounding Zone of Junin area and the Rio Magdalena Zone of Cuellaje area are also thought to be comprised of the same geological environments as those of the Central Zone of Junin area.

Taking all the results of the Phase II and the Phase I surveys into consideration, ore forming model is made out (Fig. 2), and the area with high potential of dissemination type and vein type Cu-Mo-Ag ore deposits are as follows:

(1) Central Zone of Junin area (Fig.3-1)

1) The Q.Limonita mineralized zone, and intermediate area between the Q.Limonita and the Q.Verde mineralized zones

2) The Q.Verde mineralized zone

3) The Rio Junin mineralized zone

4) The Q.Limonita-Upper reach mineralized zone

5) The Q.Crisocola mineralized zone

(2) Surrounding Zone of Junin area (Fig.3-1)

1) The Q.Fortuna mineralized zone

2) The Q.Esperanza mineralized zone

(3) Rio Magdalena Zone of Cuellaje area

1) The Rio Magdalena-Branch mineralized zone (mineralized zone A) and its western part

2) The south mineralized zone and its western part

Chapter 5 Conclusions and Recommendations

5-1 Conclusions

(1) Geology of Junin area (Figs.II-1-1 and II-2-1)

Geology of Junin area consists of Apuela-Nanegal batholith of granodiorite and stocks or dikes of quartz porphyry and diorite porphyry, which intrude into batholith of granodiorite. Distributional density of stocks tends to be dominate in the Central Zone of Junin area. Lineaments were also analyzed to radiate outlying section of the drainage system from the Junction of Q. Limonita and Q. Crysocola.

(2) Mineralization and alteration in the Central Zone of Junin area

Mineralized and alteration zones in this Zone were classified in three types based on their occurrences: Type I, Type II and type III (Tables II-4-1 and II-1-2, and Fig.II-1-2). Type I and Type II are of the porphyry copper mineralization.

Type I was characterized by dissemination and film of Cu-Mo minerals accompanied with phyllic alteration zone, which occurred mainly in the granodiorite around quartz porphyry stocks or dikes.

Type II occurred as Cu-Mo-Ag veins in granodiorite, and was subdivided into Type IIA and Type IIB on their occurrences.

1) Type IIA : abundant in sulfide ore minerals which was scattered in clay as principal gangue mineral.
2) Type IIB : quartz veins with sulfide ore minerals.

Both phyllic and potassic alteration zones were identified along the vein contacts mentioned above.

This type mineralized zones were sketched geologically and mineralogically in this Phase.

Type III was observed to be as acidic alteration zone being accompanied with network quartz veins in granodiorite and diorite porphyry. Geochemical Au-Ag anomalies were delineated in a part of this alteration zone.

The Q.Limonita-Upper reach mineralized zone, which belongs to Type IIA, has a vein of 2 m wide and 140 m long. Ore assay result averages 10 % Cu and 15 g/t Ag.

The Q.Crisocola mineralized zone belongs to Type IIA mainly, and has 1.1 m in vein width and 50 m in length. Average ore assay result is 30 % of Cu.

The Rio Junin mineralized zone is observed in an area of 200 m in width and 500 m in length, where Type I, IIA and IIB coexists as mineralization in sequence. Ore assay result is 1 % Cu.

The Q.Controversia mineralized zone is overlapped by Type I, Type IIA and Type IIB on an area of 150 m in width and 200 m in length. The mineralization, however, is not intense.

The Q.Rica mineralized zone is also overlapped by Type I and Type IIB, but the area is limited.

(3) Drilling survey in the Central Zone of Junin area

Drilling survey was carried out in the Q.Limonita and Rio Junin mineralized zones, which predominated dissemination and film of bornite-chalcopyrite-pyrite-molybdenite.

The drilling results are as follows:

In the Q.Limonita mineralized zone, intense mineralization is recognized to increase and predominate to the northeasternward and to the depth over 150 m. As the assay result of 37 samples obtained from drill cores (between 8.00 m and 148.80 m of drill hole MJJ-4; direction to the northeast), the content was 3.84 % Cu in maximum and 1.30 % Cu in average.

In the Rio Junin mineralized zone, strong mineralization is also observed. According to the assay result of 112 samples obtained from drill cores (between 6.00 m and 233.45 m of drill hole MJJ-8; direction to the east), the content was 2.10 % Cu in maximum and 0.46 % Cu in average.

Since a large amount of bornite was observed in fractures of drill cores, predominant mineralized part was thought to exist in the lower parts of the northeastern ridge of and the eastern ridge of the Q.Limonita and the Rio Junin mineralized zone, respectively.

(4) Mineralization and geochemical exploration in the Surrounding Zone of Junin area

The Surrounding Zone of Junin area comprises three mineralized zones; Q.Cristal-Branch, Q.Esperanza and Q.Fortuna (Fig.II-2-3).

The Q.Cristal-Branch is divided into east mineralized zone and west. The former consists of Type I generally, and the latter Type II mainly.

Q.Esperanza mineralizes zone, which contains vein deposit of 1 m wide, 1 km long and 120 m high, is classified in Type II. Ore assay result averages 10 % Cu and 20 g/t Ag.

Q.Fortuna mineralized zone, which consists of Type I mainly and Type II additionally, is distributed on an area of 600 m in length, 200 m in width and 200 m in vertical difference. Ore assay result was 1 % Cu on average.

The distributional pattern of geochemical anomalous zones indicates a good coincidence with those of mineralization and/or alteration (Figs.II-2-7 and II-2-8). For instance, Cu-Mo geochemical anomalous zones includes the mineralized zones observed, while Pb-Zn anomalous zone are scattered around the mineralized zone. Stream sediment anomalies (Phase I) and rock geochemical anomalies (Phase II) are both interpreted to be from mineralized outcrops.

(5) Rio Magdalena Zone of Cuellaje area

Geology of Cuellaje area consists mainly of the Apuela-Nanegal batholith of granodiorite, and stocks or dikes of andesitic porphyry, dioritic porphyry and/or quartz porphyry, which intrude into the batholith (Fig.II-3-1).

In the Rio Magdalena Zone, the following mineralized zones are developed: mineralized zones A,B,C and E, all of which belong to Type I; two other mineralized zones in south belongs Type II; and mineralized zone D belongs to Type III. A part of the mineralized zone C is overlapped by the mineralized zone D.

The mineralized zone A is the biggest one observed in an area of 500 m x 400 m. Stockwork and dissemination deposits distribute in the center, film deposits around them. The mineral assemblage of alteration minerals shows zonal distribution which is in harmony with the mineralization types: quartz-sericite-chlorite-pyrite zone and chlorite-calcite zone in outward order. These zonal assemblages coincident with phyllic alteration zone and propylitic alteration zone of general porphyry copper deposit. The zoning of mineralization is also coincide markedly with that of general porphyry copper deposit. Average ore assay result is 0.6 % of Cu. The scale of the mineralization and Cu grade in this area ranks next to those of the Q.Limonita-Q.Verde mineralized zone of Central Zone of Junin area and the Q.Fortuna mineralized zone of Surrounding Zone of Junin area.

On the basis of correlation between geochemical anomaly and mineralization, high factor score distribution zones of Cu-Mo-Au-Ag were delineated on the mineralization A and E, south mineralized zone and northeastern part, high factor score distribution zones of Au-Ag on the mineralized zone D (Fig.II-3-6).

Owing to correlation between geophysical anomaly and mineralization, middle to low apparent resistivities and high to middle percent frequency effects were detected inside and/or beside the mineralized zones A and E, middle apparent resistivity and middle to low percent frequency effect inside and/or beside the mineralized zone D, and high apparent resistivity and high to middle percent frequency effect inside and/or beside south mineralized zone. IP anomaly zones detected inside and/or beside the mineralization A and the south mineralized zone continue toward western and lower parts from both mineralized zones.

As to evaluation of IP anomaly by contents of normative chalcopyrite-pyrite, IP anomaly is proportional to total amounts of sulfide minerals. It seems that IP anomalies on the mineralized zone A and E are caused by same amount of chalcopyrite and pyrite, IP anomaly on the south mineralized zone pyrite > chalcopyrite, and IP anomaly on the northeastern part pyrite.

5-2 Recommendations for Phase III Survey

Junin and Cuellaje areas were proved to have high potential of Cu-Mo-Ag dissemination and vein deposits. Followings are, therefore, recommended for Phase III survey including ore forming model (Fig.2).

(1) Central Zone of Junin area (Fig.3-1)

According to the steep topography, it is difficult to adopt the geophysical exploration. Drilling survey is, consequently, recommended to be continued although a transportation problem needs to be solved.

Taking the mobilization of diamond drilling machine into consideration,the recommended order of drilling survey is as follows:

1) The Q.Limonita mineralized zone, and intermediate area between the Q.Limonita and the Q.Verde mineralized zones (Type I, 250 m x 1 hole)
2) The Q.Verde mineralized zone (Type I, 100 m x 2 holes)
3) The Rio Junin mineralized zone (Types I and II, 100 m x 1 hole, 250 m x 1 hole)
4) The Q.Limonita-Upper reach mineralized zone (Type II, 100 m x 2 holes)
5) The Q.Crisocola mineralized zone (Type II, 100 m x 2 holes)

(2) Surrounding Zone of Junin area (Fig.3-1)

1) The Q.Fortuna mineralized zone (Type I):

Detailed geological sketch on mineralized zone, drilling of 100 m x 3 holes, and detailed geological survey in the southeast and east of quartz porphyry stock.

2) The Q.Esperanza mineralized zone (Type II):

Drilling of 100 m x 2 holes, underground exploration including Q.Limonita-Upper reach and Q.Verde mineralized zones.

(3) Rio Magdalena Zone of Cuellaje area (Fig.3-2)

1) The Rio Magdalena-Branch mineralized zone (mineralized zone A) and its western extension:

Drilling of 100 m x 2 holes and of 300 m x 2 holes, and geophysical survey.

2) The south mineralized zone and its western extension:

geophysical survey.

PART II DETAILS

Chapter 1 Central Zone of Junin Area

Gological sketch of the mineralized outcrops and drilling were carried out this year for some promising mineralized zones which were delineated as the results of the Phase I survey.

1-1 Geological Sketch of Mineralized Outcrops

1-1-1 Purpose and Method of Geological Sketch

The purpose of the survey is to clarify the size and occurrence of the follwing five Cu-Mo vein type mineralized zones which are distributed in the Central Zone of Junin area , in order to carry out the geological sketch of these mineralized zones on a scale of 1 :2,500 : Q.Limonita-Upper reach; Q.Crisocola; Rio Junin; Q.Controversia; Q.Rica mineralized zones (Fig.II-1-1).

The geological sketch was done by using brunton compass and measuring tape along the survey route.

The results of the survey were summarized in the geological sketch map on a scale of 1:2,500 (Fig.II-1-2) and the location map of samples are shown in Pl.II-1-1.

1-1-2 Geology and Geological Structure

Geology of the Central Zone of this area consists of granodiorite(Gd), quartz porphyry (Qp) and diorite porphyry(Dp). The granodiorite belongs to Apuela- Nanegal batholith. The quartz porphyry and diorite porphyry which forms dykes or stocks, which intruded into the granodiorite batholith.

(1) Granodiorite(Gd)

The Granodiorite shows greyish color and is medium grained, and includes biotite and hornblende as a mafic minerals. The rock shows massive, however, veinlets and films are distinct beside the contact to quartz porphyry.

(2) Quartz porphyry(Qp)

The scale of the distribution of quartz porphyry is 400 m of maximum extention,and 150m in width as dyke, and 250m in the maximum diameter as stock. The distribution is concentrated in Q.Limonita to Q.Escalera, Q.Verde, Q.Controversia and Rio Junin. The rock includes quartz phenocrysts of 2 to 5 mm in fine groundmass. Joint system develops more distinctively in the body of quartz porphyry in comparison with that of granodiorite, but the distribution density of the joint is rough.

(3) Diorite porphyry(Dp)

Stocks of diorite porphyry distribute on the scale of 500m in diameter in the southeastern part. The rock includes abundant hornblende phenocrysts and less quartz phenocrysts in comparison with those of quartz porphyry.

These three type of rocks were classified in magnetite series. According to the result of isotope age determination with K-Ar method, the age of granodiorite showed middle Miocene of Tertiary Period, while those of porphyries showed later Miocene of Tertiary (JICA/MMAJ).

(4) Geological structure

As the conspicuous structure, the lineaments are mainly developed the NE-SW and the NW-SE directions, and lineaments with the N-S and the E-W directions overlapping the former structures. Almost all the lineaments converge around the juncture of Q.La Limonita, Q.La Verde and Q.La Crisocola.

1-1-3 Mineralization and Alteration

According to the results of the Phase I's survey, mineralized and alteration zones in this Zone were classified in three types based on their occurrences: Type I, Type II and type III (Tabs. II-1-1 and II-1-2). Type I and type II are of the porphyry copper mineralization.

Type I occurred mainly in the granodiorite around stocks or dikes of quartz porphyry. Mineralized zones are characterized by Cu-Mo mineral dissemination and film accompanied with phyllic alteration zone.

Type II occurred as Cu-Mo-Ag veins in granodiorite, and was divided into two sub-type Type IIA and Type

IIB on their occurrences.

1) Type IIA : abundant in sulfide ore minerals which was scattered in clay as principal gangue mineral.
2) Type IIB : quartz veins with sulfide ore minerals.

Both phyllic and potassic alteration zones were identified along the vein contacts. This type is target for geological sketch of the Phase II survey.

Type III was observed to be as acidic alteration zone being accompanied with network quartz veins in granodiorite and diorite porphyry. Geochemical Au-Ag anomalies were delineated in a part of the alteration zone.

Characteristics of each mineralized zone are as follows:

(1) Q.Limonita-Upper reach mineralized zone (Fig.II-1-2(1))

The Q.Limonita-Upper reach mineralized zone belongs to Type IIA, and has 2 m in vein width and 140 m in length along NE-SW lineament.

Sulfide minerals observed were chalcopyrite, bornite and chalcocite (as secondary mineral) and pyrite. Oxide mineral was chrysocolla. The microscopic observation of polished sections are listed up on Appendix 2.

As alteration of wall rocks, silicification was recognized principally in the vicinity of vein deposites, which was distinguishable with naked eyes. The affected part, however, were limited in 2 m or 3 m in width. Quartz and serisite were identified as altered minerals there.

Acording to the ore assay result, the grade was analyzed to be as follows: 5.45 % Cu and 34.3 g/t Ag for the sample No.C2127; 17.03 % Cu for the sample No.C2129 (Appendix 4). Average ore assay result is 10 % of Cu and 15 g/t of Ag.

(2) Q.Crisocola mineralized zone (Fig.II-1-2(2))

The Q.Crisocola mineralized zone is overlapped by Type IIA and Type III.

The Type IIA mineralized zone is distributed along WNW-ESE lineament, and has 1.1 m in vein width and 50 m in length. The mineralized zone was intermittently observed between about 250 m until several yeas ago, but no outcrop on the lower reach of Q.Crisocola was found because of being covered by talus sediments on the current survey. The mineralized zone are chatracterized with its abundance of cuprite, tenorite, chalcocite, native copper and chrysocolla. Ore assay result shows 43.00 % Cu in maximam (sample No. B2159) and 30 % Cu in aberage.

The Type III mineralized zone consists of chrysocolla-quartz networked vein associated with silicification (acidic alteration), which extends to the direction of WNW-ESE and is separated into three lines to the eastern limit of the zone.

(3) Rio Junin mineralized zone (Fig.II-1-2(3))

The Rio Junin mineralized zone is overlapped by Type I, Type IIA and Type IIB on an area of 200 m in width and 500 m in length. The principal direction of the Type II is NW-SE system. Five quartz veins or more , width of which were over 1m, were observed and extention of which, however, were not estimable because quartz veins were recognized along the Rio Junin river only to be perpendicular or oblique against the N-S lineament.

Ore minerals observed were chalcopyrite, bornite, chalcocite (as secondary mineral), pyrite, chrysocolla and molybdenite.

The central part of the Type I mineralized zone was included in medium to strong silicification zone. The mineral assemblages identified by powderly X-ray diffractive analysis method were quartz-serisite-chlorite (phyllic alteration zone; by JICA/MMAJ,1992). Silicification in the surrounding of veins of the Type II was also recognized to be overlapped on the Type I.

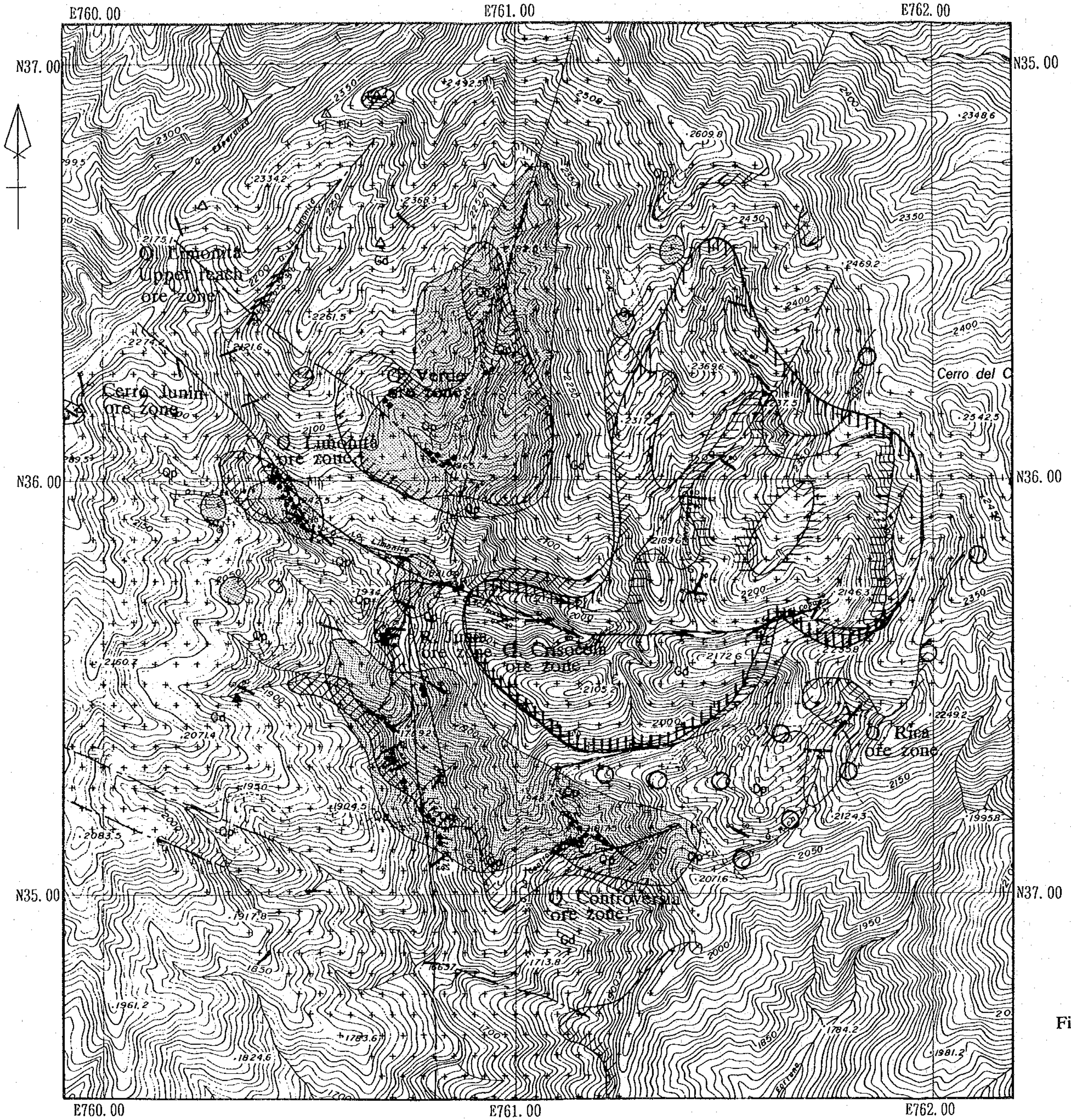
Ore assay result shows 3.53 % Cu in maximam (sample No. E2076) and 1 % Cu in aberage.

(4) Q.Controversia mineralized zone (Fig.II-1-2(4))

The Q.Controversia mineralized zone is overlapped by the Type I, Type IIA and Type IIB on an area of 150 m in width and 200 m in length. The Type II extends to NW-SE direction and has 10 to 30 cm in vein width.

Chalcopyrite and pyrite are mainly observed as ore minerals, alteration of host rocks is makedly silicification.

According to the ore assay result, the grade was proved to be 6.51 % Cu and 18.3 g/t Ag for sample No.B2165.



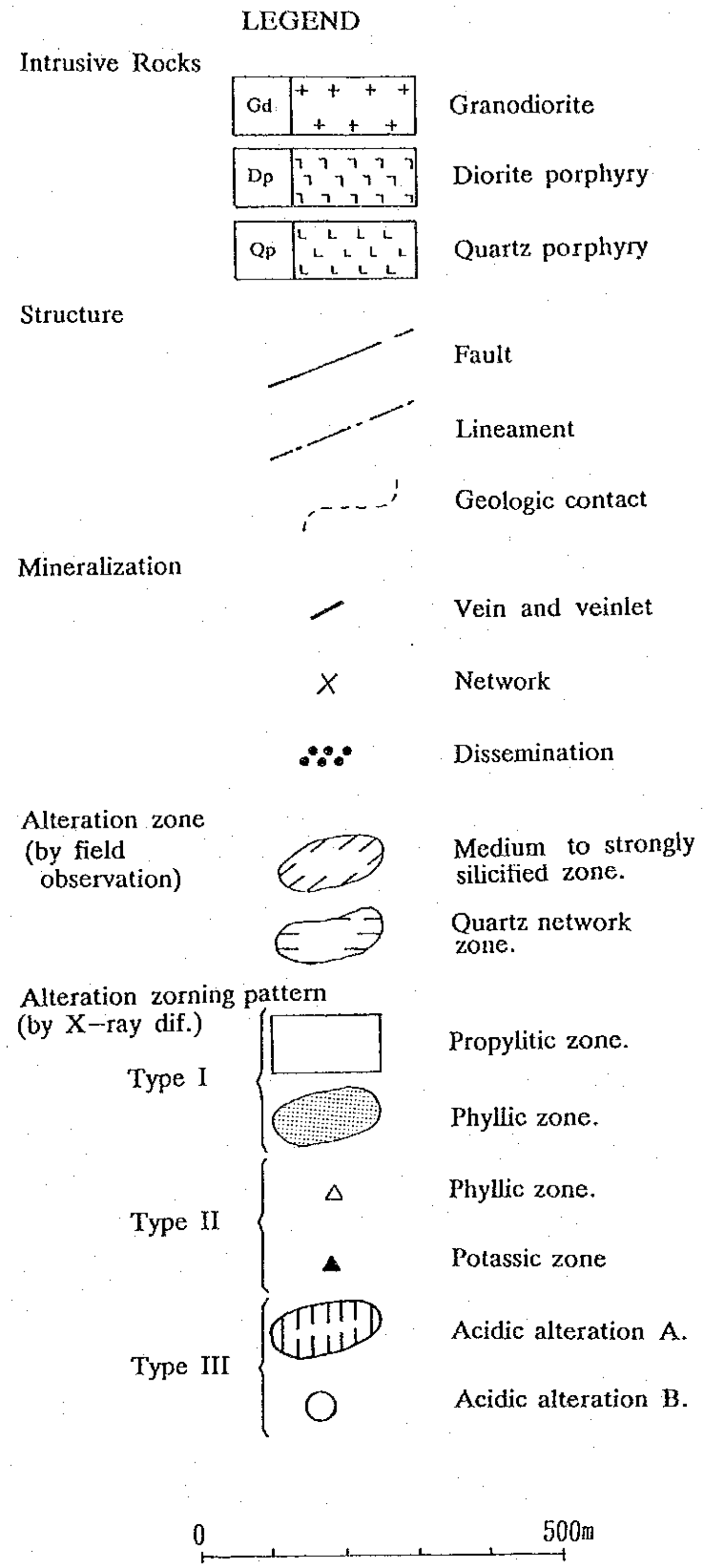


Fig.II-1-1 Mineralized and alteration zone map of the Central zone, Junin area (by JICA/MMAJ:1992)

Tab.II-1-1 Mineral assemblages of each alteration zone,Central zone,Junin area

Zones / Minerals	Type I-alteration (Dissem.type)		Type II-alteration (Vein type)		Type III-alteration (Acidic alteration)	
	Propylitic	Phyllic	Phyllic	Potassic	A	B
Quartz	———	———	———	———	———	———
Montmorillonite	- - -					
Sericite/Mont.	- - -					
Sericite	- - -	———	———	———	———	———
Chlorite	———	———	- - -	- - -		
Epidote	———					
K-feldspar				———		
Pyrite	- - -	- - -	- - -	- - -		
Kaolinite					- - -	
Halloysite					- - -	

(by JICA/MMAJ:1992)

Tab.II–1–2 Summary of each mineralized zone,Central zone,Junin area

Mineralized and alteration zones	Mineralized type					Alteration zoning pattern						Geochemical anomaly					
	I	II		III		I		II		III		Cu	Mo	Pb	Zn	Au	Ag
		A	B	A	B	Prop	Phyl	Phyl	Pota	A	B						
Q. Limonita miner. zone	◎	◎	◎	–	–	○	◎	–	○	–	–	◎	◎	○	○	●	●
Q. Verde miner. zone	◎	–	–	–	–	○	◎	–	–	–	–	◎	◎	○		●	●
Rio Junin miner. zone	○	–	◎	–	–	○	◎	◎	○	–	–	◎	◎	o	–	–	●
Up. reach of Q. Limonita miner. zone	–	◎	–	–	–	●	–	◎	–	–	–	◎	–	◎	◎	●	●
Q. Crisocola miner. zone	–	◎	–	◎	–	●	–	○?	–	◎	–	●	○	o	–	●	●
Q. Crisocola-Q. Controversia alter. zone	–	–	●	◎	–	–	–	–	–	◎	–	–	○	○	–	●	●
Q. Controversia miner. zone	○	◎	◎	–	–	○	◎	◎	–	–	–	◎	◎	○	–	–	●
Q. Rica miner. zone	o	–	○	–	–	◎	–	○	–	–	–	–	○	–	–	–	●
Cerro Junin miner. zone	–	–	o	–	–	–	–	○	–	–	–	●	–	◎	○	●	–
Southeast-East alter. zone	–	–	●	–	◎	–	●	–	–	–	◎	–	●	○	–	●	●

◎>○>o>●>–

(by JICA/MMAJ:1992)

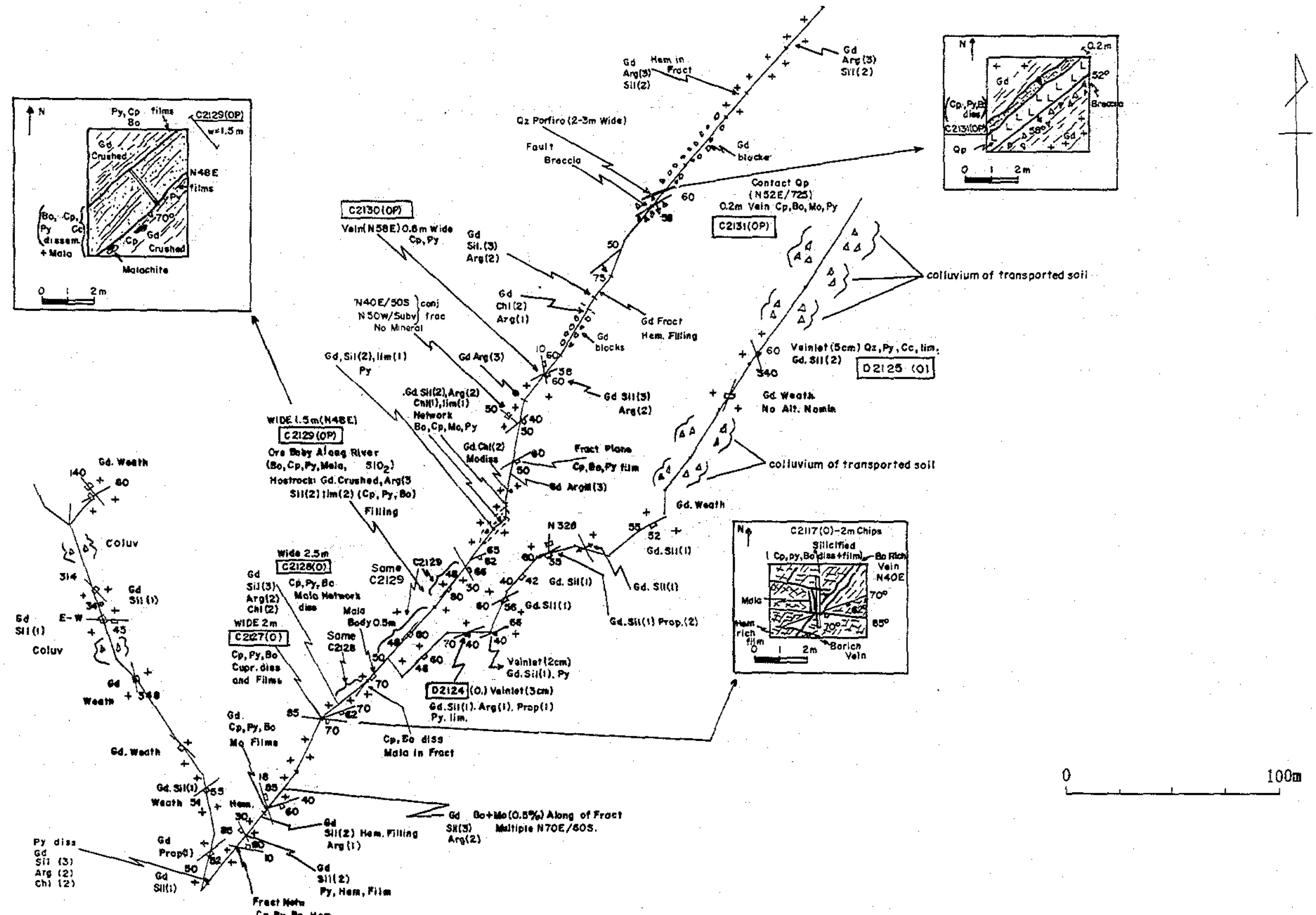


Fig.II–1–2(1) Geological sketch of the Quebrada Limonita Upper reach mineralized zone(1:2,500)

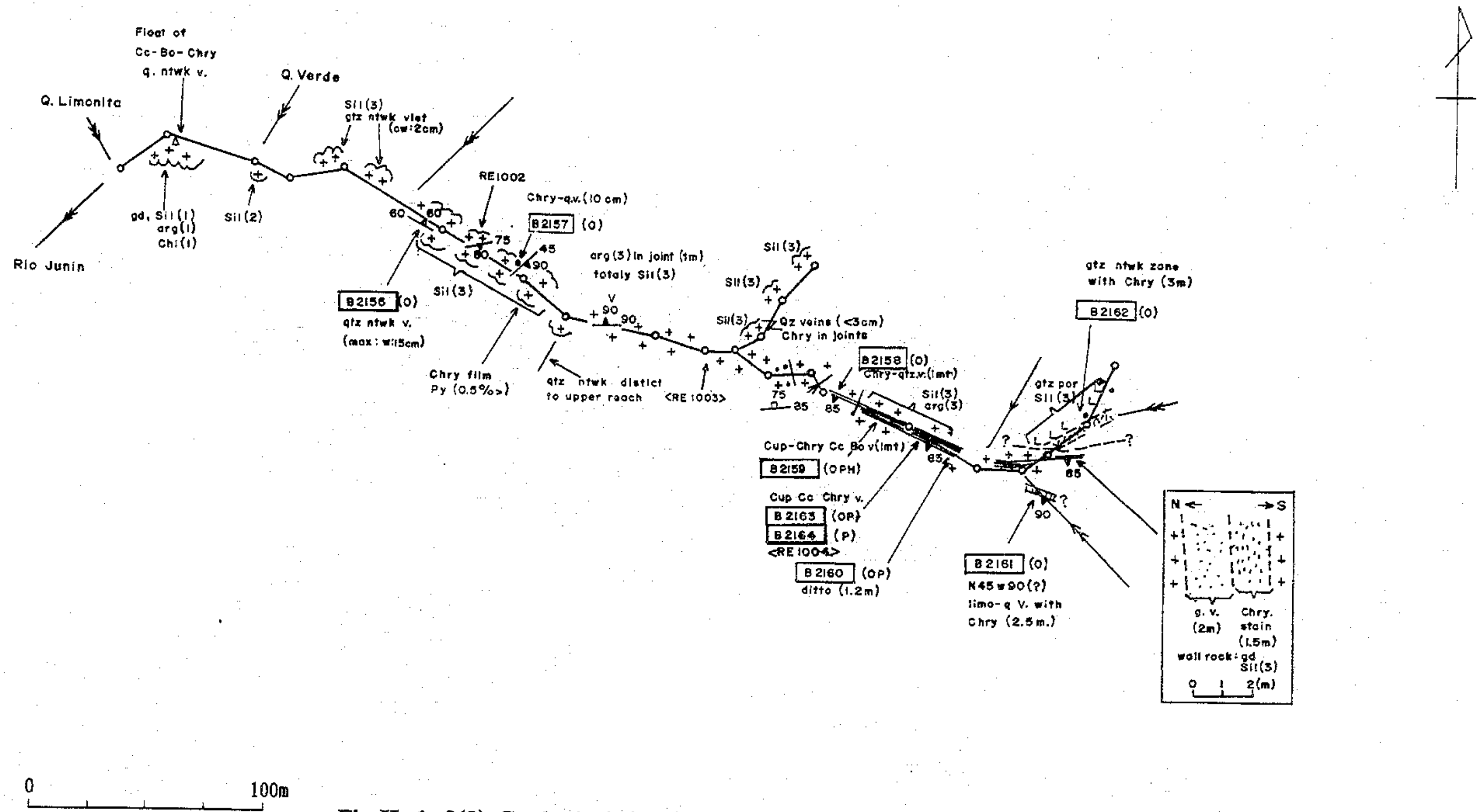


Fig.II–1–2(2) Geological sketch of the Quebrada Crisocola mineralized zone(1:2,500)

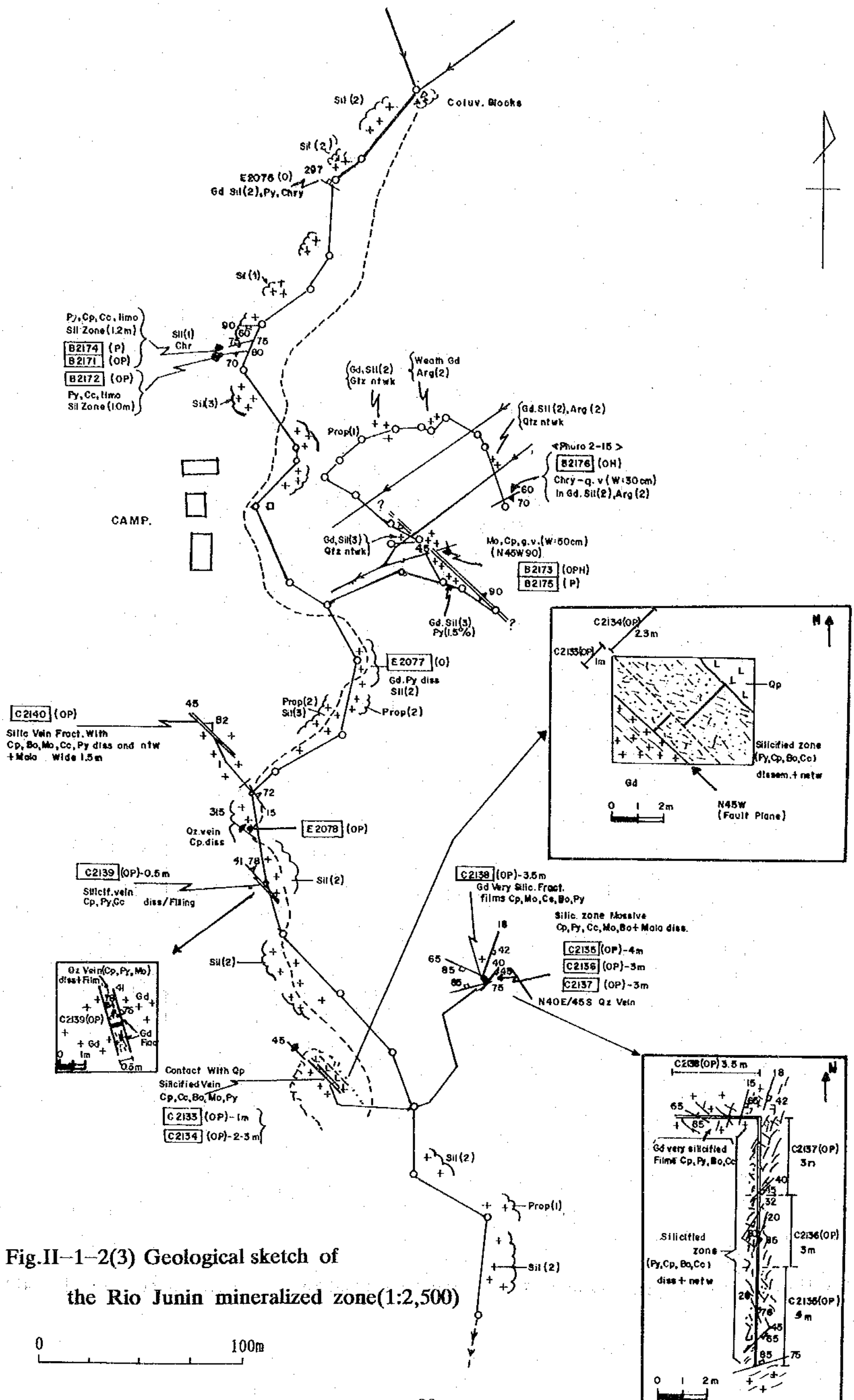


Fig.II-1-2(3) Geological sketch of the Rio Junin mineralized zone(1:2,500)

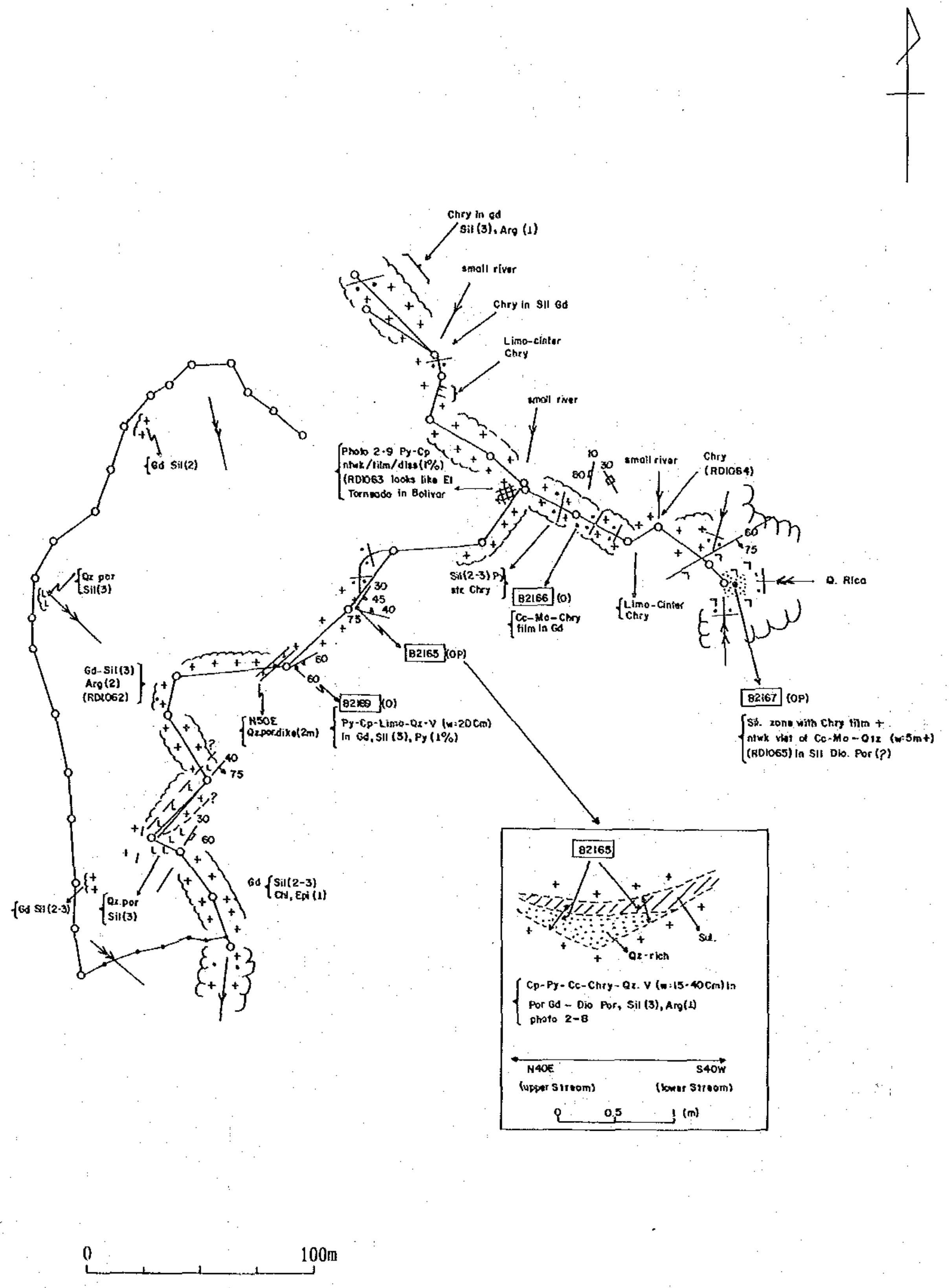


Fig.II-1-2(4) Geological sketch of the Quebrada Controversia mineralized zone(1:2,500)

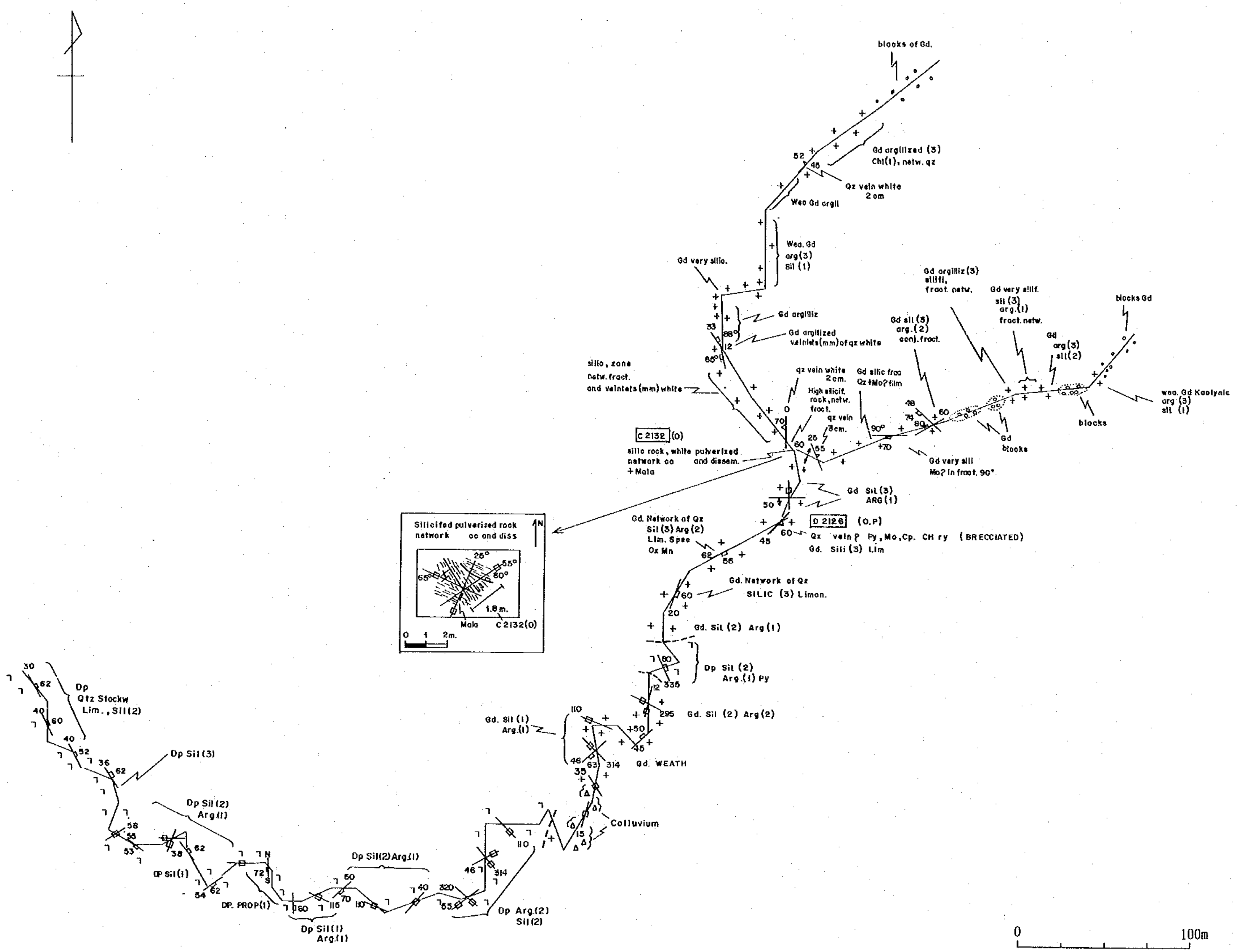


Fig.II-1-2(5) Geological sketch of the Quebrada Rica mineralized zone(1:2,500)

(5) Q.Rica mineralized zone (Fig.II-1-2(5))

The Q.Rica mineralized zone is also overlapped by type I and type IIB, but the area is limited.

Chalcopyrite and pyrite are mainly observed as ore minerals, alteration of host rocks is makedly silicification.

According to the ore assay result, the grade was proved to be 3.87 % Cu for sample No.D2126.

As regards the sampling method, all samples were collected by means of channel sampling method.

1-2 Drilling Survey

1-2-1 Purpose of Drilling Survey

The purpose of the drilling survey is to clarify the extension and intensity of mineralization which are confirmed on the outcrops along the river in the Central Zone of Junin area during the Phase I survey.

1-2-2 Details of Drilling Survey

(1) Location of the drill holes

The location of the drill holes are shown in Fig.II-1-3.

(2) Outline of drilling works

The drilling works were carried out from July 25, 1992 to December 20, 1992. Drilling work was proceeded, as a rule, for 24 hours a day. Drilling method adopted was wireline which would maximize recovery of drill cores and efficiency of its activities. Drilling performance of the hole are listed up on Tab.II-1-3, and Appendices 6 and 7.

As the mineralized rock body has tremendous fractures and contains underground water which cause some difficulties of drilling, cementation (injection of cement-milk) was needed to be done repeatedly. Main drilling machines and equipments adopted were listed up on Appendix 8.

(3) Transportation and preparation

All the machines, equipments and materials were transported to Magnolia, where new heliport was constructed. Another heliport was also constructed at the hill top near Junin, which was named "Junin heliport". Helicopter service was taken place between Magnolia and Junin heliport. But from Junin heliport to drilling sites, horseback and man's shoulder were utilized for mobilization.

Every existing narrow and snaky road was amplified and adjusted completely in order to supply foods and materials which were required for camp and/or drilling activities.

Drilling water was introduced directly from Junin River, to the drill holes located on the ridge, however, water was to be pumped up from up-reach of Q. Escalera where a tentative stream dam was facilitated.

(4) Drilling work

Actual drilling progress is shown on Appendix 6, actual drilling work on Appendix 7, and drilling machines, equipments and materials consumed on Appendix 8.

(5) Examination of drill cores

The drill cores were examined simultaneously with drilling operation at the sites and then at base camp in Garcia Moreno.

The results of this examination were compiled in columnar section (Appendix 9) and geologic section on a scale of 1 to 200. Drill cores were split with a diamond cutter after completing the examination of each hole. One half of split cores was taken as samples for laboratory tests and the others were reserved for the future reference.

All of the samples assayed were collected every 2 m carefully. Assay results are listed up on Appendices 4 and 9.

1-2-3 Results of Drilling Survey

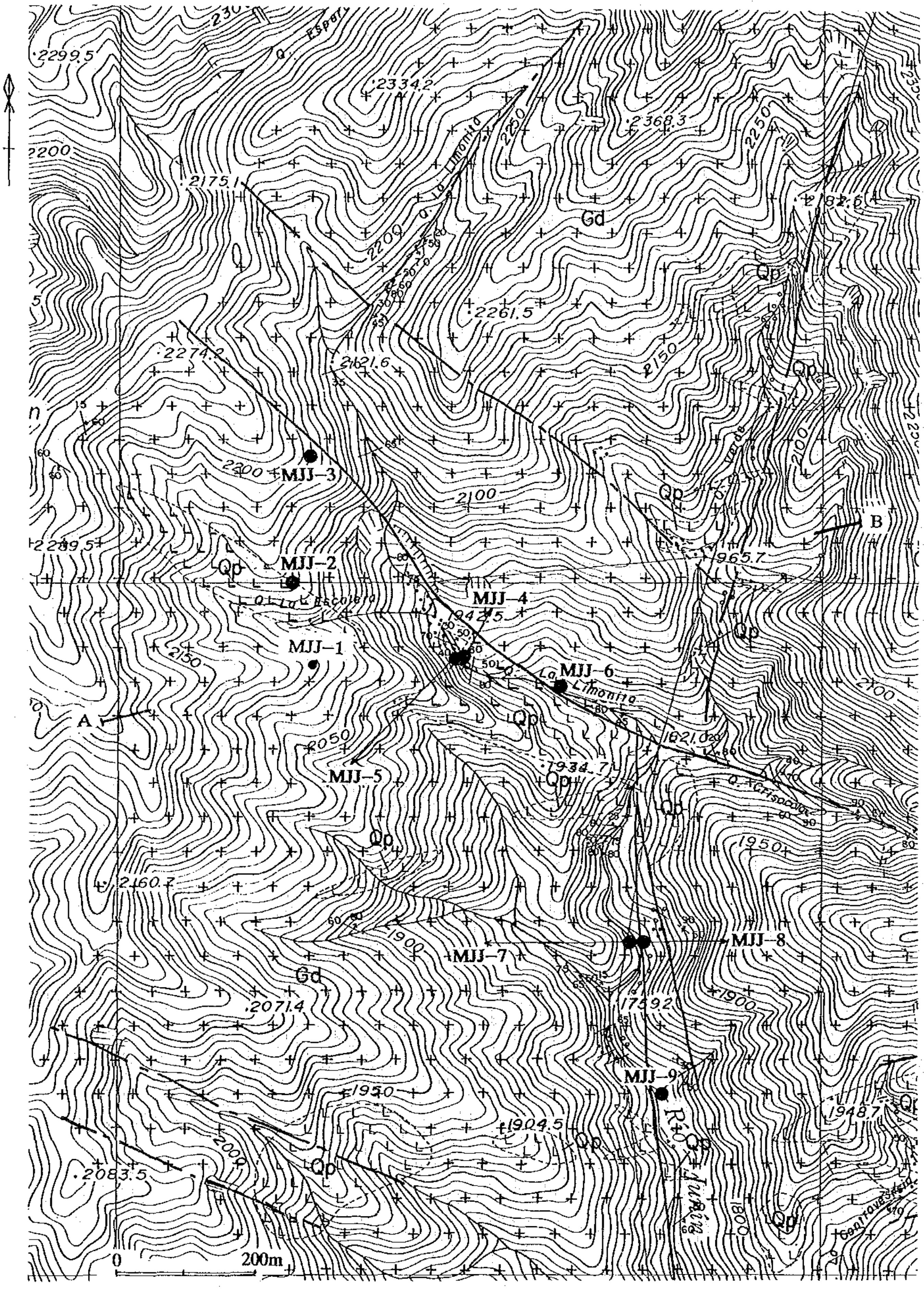


Fig.II–1–3 Location and geologic map of the drill hole MJJ–2 to MJJ–9