REPUBLIC OF PERU
REPORT ON MINERAL EXPLORATION
IN
COTAHUASI AREA

PHASE III

GEOLOGICAL SURVEY
DRILLING EXPLORATION

JANUARY 1988

JAPAN INTERNATIONAL COOPERATION AGENCY
METAL MINING AGENCY OF JAPAN

PREFACE

In response to the request of the Government of the Republic of Peru, the Japanese Government decided to conduct a Mineral Exploration in the Cotahuasi Area Project 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 Peru a survey team headed by Mr. Kiyoharu Nakashima, from 28 June to 13 November, 1987.

The team exchanged views with the officials concerned of the Government of the Republic of Peru and conducted a field survey in the Cotahuasi 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 our two countries.

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

January, 1988

Kensuke Yanagiya

Kensuke Yanagiya
President
Japan International Cooperation Agency

Junichiro Sato

Junichiro Sato
President
Metal Mining Agency of Japan

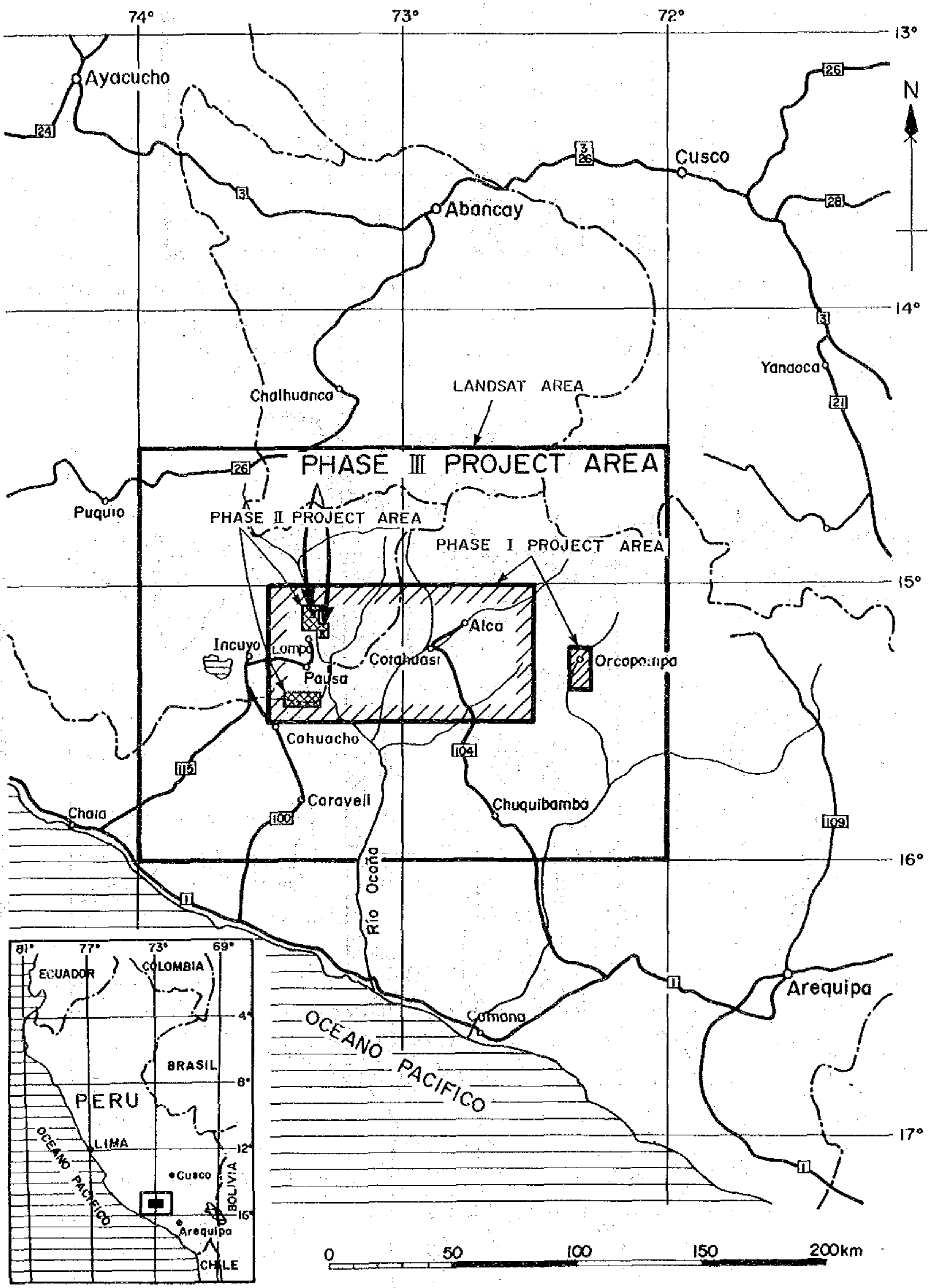

Fig. G-1 Location Map of the Project Area

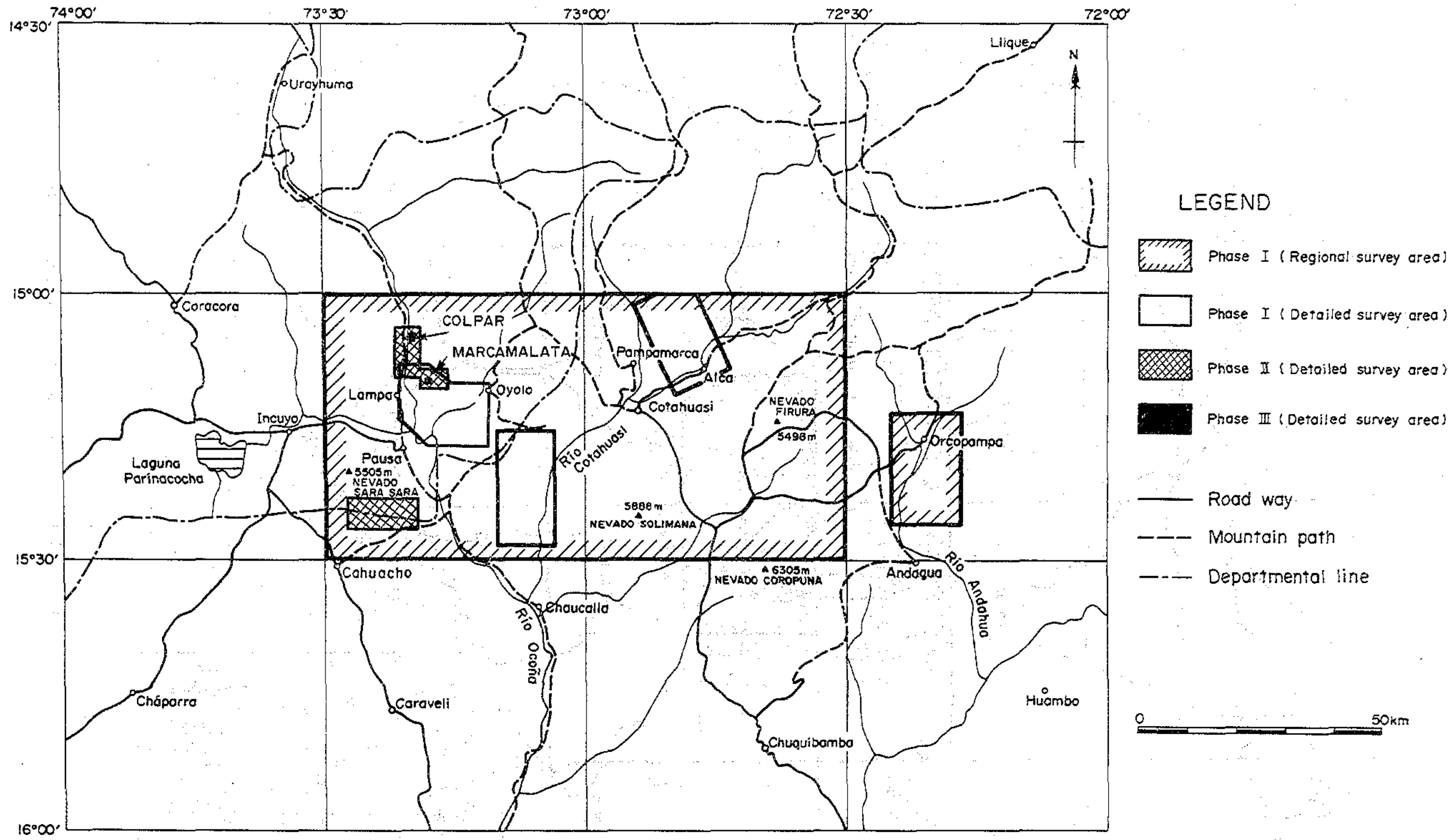

Fig.G-2 Location Map of the Project Area

ABSTRACT

The 3rd year investigation for the Cotahuasi Area in the Republic of Peru comprised the detailed geological prospecting and the exploratory drilling for the two target area, the Colpar and the Marcamalata, which had been selected on the basis of the results of the 2nd year investigation. The investigation resulted in outlining two promising zones for Au-Ag mineralization in the Colpar. The results of the 3rd year investigation are summarized as follows.

(1) The Colpar

Geology

The Tertiary and Quarternary rocks are distributed in this area. The Tertiary rocks are divided into two formations; the Tacaza formation (Tc) of andesitic volcanics interbedded with dacitic pyroclastics, and the overlying Alpabamba formation (Al) of rhyolitic volcanics. The Quarternary rocks consists of the Pausa volcano-sedimentaries (Vsp) and the alluvials (al) including river terrace, talus and river bed deposits. No intrusive body has been located in this area.

Geological Structures

Neither prominent fault nor folding structures have been observed. Joints or fractures are developed in the Tertiary rocks. The majority of them trend NE-SW but some indicate NW-SE or N-S trends.

Mineralization and Alteration

Two notable mineralized zones, the northern and the southern mineralized zones, are outlined in the Tacaza formation. The northern zone contains 4 mineralized veins and the southern zone 9 mineralized veins.

All of the veins in the northern zone and the most veins in the southern zone are associated with NE-SW trending fractures or fractured zones.

They occur in forms of quartz veins, quartz vein networks or intensively silicified zones containing Au-Ag minerals and Cu-Pb-Zn sulphides.

Main Au and/or Ag minerals are electrum, argentite, polybasite and pearceite in association with subordinate galena, sphalerite, chalcopyrite, and pyrite.
An identified alteration mineral assemblage is quartz-potash feldspar (aduralia)-sericite with or without chlorite.
The occurrences as above described suggest that the mineralization is of epithermal origin.

The N3 vein, best of all the vein in the northern mineralized zone, yielded a sample assayed at 5.79 g/t Au, 640 g/t Ag for a width of 1 m.

The drill holes MJP-11 and -12 intersected a number of quartz veins and intensively silicified zones including the N1 and N2 veins, some samples of which yielded interesting assay results such as, 3.54 g/t Au and 705 g/t Ag, 13.10 g/t Au and 360 g/t Ag, and 0.41 g/t Au, 104 g/t Ag, 0.34% Cu and 2.96% Pb.

A silicified zone, the northern silicified zone, is outlined to the northeast of the NE-SW trending northern mineralized zone. There is a good possibility that these silicied and mineralized zones would form a continuous mineralization-alteration zone approximately 0.3 km wide and 1.5 km long.

In the southern mineralized zone, surface samples of the N3 and N7 veins yielded assay results of 21.50 g/t Au and 410 g/t Ag for a width of 0.15 m, and 20.10 g/t Au and 1200 g/t Ag for a width of 0.30 m respectively.

The drill hole MJP-13 intersected S3, S4 and S5 veins, of which the intersection of the S4 vein was assayed at 5.04 g/t Au, 45.0 g/t Ag, 0.79% Cu, 1.37% Pb and 1.30% Zn for a core length of 0.16 m.

An alteration zone, the Quebrada Quermahuaico alteration zone is located along the Quebrada Quermahuaico to the southwest of the southern mineralized zone. The southern mineralized zone, covered by Screes to the southwest, may continue toward the Quermahuaico alteration zone and form a continuous mineralization-alteration zone approximately 0.2 km wide and 0.9 km long.

A number of abandoned old workings, which had been unknown for years, were located in the two mineralized zones during this year's prospecting. The results of the surface prospecting and the drilling suggest a possibility that the identified mineralized veins may be continuous for appreciable distances with commercial grades of Au-Ag mineralization. This year's work seems to be insufficient to reveal the values of the whole mineralization-alteration zones.

There is a good potential of Au-Ag mineralization of commercial values in the two mineralization-alteration zones which provide substantial area for further exploration.

(2) The Marcamalata

Geology

Cretaceous, Tertiary and Quarternary rocks are distributed in this area. The Cretaceous rocks are divided into the Hualhuani formation (Yu) consisting of arkosic sandstones and shales, and the Murco formation (Mu) consisting of brown shales. The Tertiary rocks consists of andestic pyroclastics of Miocene age. The Quarternary rocks comprise the Lampa volcanics (Vla) and alluvials (al) including talus deposits. The Accha stocks (Di) of quartz diorite intrude the Cretaceous and the Tertiary rocks.

Geological Structures

A NNW-SSE trending fault has been assumed to run from the central west to the south of the area. The majority of joints and fractures trend NE-SW, though some indicate E-W or NW-SE trends.

Mineralization and Alteration

The mineralization and alteration zones follow mostly NE-SW trending fractures as in the Colpar. Their occurrences are also similar to those in the Colpar but with inferior extension and intensity.

The best mineralization in the old working the SM-2 is hosted by arkosic sandstones and yielded a sample assayed at 1.99 g/t Au and 440 g/t Ag.

The two drill holes MJP-14 and -15 intersected a number of quartz veins, quartz vein networks and intensively silicified zones. However, no samples of these intersections yielded any values of commercial interest.

There may be a very little possibility of Au-Ag mineralization of commercial sizes and grades in this area.

(3) Exploration Targets

This 3rd year's work resulted in outlining the two promising mineralization-alteration zone in the Colpar, namely the northern mineralization-alteration zone (1.5 km long and 0.3 km wide) and the southern mineralization-alteration zone (0.9 km long and 0.2 km wide). These two zones are recommended to be followed up by further detailed prospecting and drilling.

On the other hand, the results of the work in the Marcamalata failed to provide any promising signs of commercial mineralization. No further exploration is recommended for this area.

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PART I SUMMARY REPORT

CHAPTER 1 INTRODUCTION

1-1 The Work of the Previous 2 Years

The resources development co-operation programme commenced in 1985 and this year is the 3rd year of the 3-year Programme.

In the 1st Year work, the emphasis was placed on understanding the regional geology and geological structures in relation with occurrences of metalic mineral deposits in the general areas. With this intention, the regional geological and geochemical investigations were carried out on the basis of the results of the landsat imagery interpretation.

A number of known mineralized areas, the investigation pointed out (1) Mina Parapa, (2) Ianisca, (3) Mina Luicho, and (4) Pirca alteration-mineralization zones, of potential commercial mineralization.

However the Pirca and the geochemically anomalous Marcabamba Areas were selected for the 2nd Year Investigation due to private mining right ownership problems.

The 2nd Year Investigation resulted in turning down the Pirca Area for weak mineralization in spite of its notable alteration, and made parts of the Marcabamba area stand out for Au-Ag geochemical anomalies as a result of detailed geochemical investigation.

Therefore, the 3rd year investigation select, the geochemically anomalous Colpar and Marcamalata in the Marcabamba Area for a detailed geological investigation followed by a drilling test.

1-2 Conclusion and Recommendation from the 2nd Year Work

1-2-1 Conclusion

Two areas, the Marcabamba (80 km^2) and the Pirca (90 km^2) were selected for the 2nd year investigation. Both the areas were investigated geologically and geochemically. In addition, the Pirca Area was partly tested by drilling in accordance with the results of the geological and geochemical investigation.

Marcabamba Area

In this area, alteration and mineralization zones were located in the Tacaza Formation of Tertiary age or in the Hualhuoni Formation of late Cretaceous age. Three types of alteration zones have been identified, namely the alteration zones characterized (1) by dominant quartz veining and silicification, (2) by combination of silicification and argillization, and (3) by dominant argillization.

The former two types are occassionally associated with mineralization carrying significant values of Au and Ag.

Three types of mineral occurrences have been observed; (1) narrow quartz veins occasionally associated with Au and Ag (2) iron stained fractured zones orjoints occasionally associated with minor Au and Ag (3) pyritization in association with silicification and argillization. The former two types may warrant further explorations.

Five major mineralization-alteration zones were located in the course of the 2nd year exploration of this area. They are (1) Colpar, (2) Soncota, (3) Pomacocha, (4) Marcamalata and (5) Sequello. Of these, the Colpar and the Marcamalata were of particular interest; the former yielded a sample with values of 0.41 g/t Au and 39.3 g/t Ag, and the latter a sample with a value of 86.5 g/t Ag.

The geochemical prospecting located five major anomalous zones, namely (1) Colpar A, (2) Colpar B, (3) Machancha, (4) Soncota and (5) Marcamalata. Of these, the Colpar A and the Marcamalata anomalous zones superimpose the alteration-mineralization zones of the Colpar and the Marcamalata respectively.

The Colpar B anomalous zone, adjacent to the south of the Colpar alteration-mineralization zone, yielded a soil sample with a gold value exceeding 10 g/t and a silver value of 72 g/t, which might suggest subsurface mineralization.

With the above results, it was concluded that the Colpar district including both the Colpar A and B anomalous zones and the Marcamalata district would be promising.

Pirca Area

Alteration zones were located in an area distributed by the Tacaza Formation of Tertiary age.

As in the Marcabamba Area, three types of alteration zones have been identified, namely the alteration zones (1) dominated by silicification, (2) characterized by a combination of silicification and argillization and (3) dominated by argillization.

Of all the identified alteration zones, seven zones in the eastern part and three zones in the western part of the area are relatively sizable in their extentions.

A sample of a quartz vein network in the strongly silicified zone PW-1 of the western Pirca indicated Au and Ag values of 6.65 g/t and 10.0 g/t respectively, which were the highest of Au and Ag values obtained in the whole Pirca Area. However, samples of other parts of the same alteration zone were very low in Au and Ag, and the alteration zone as a whole were regarded as insignificant in mineralization.

Mineralization associated with other alteration zones was invariably weak, since no samples indicated Au and Ag values exceeding 0.07 g/t and 12 g/t respectively.

The geochemical prospecting failed to locate any anomalous zones higher in Au and Ag values and larger in extention than those in the Marcabamba Areas.

Relatively sizable anomalies were outlined at twelve locations in the eastern part and at 4 locations in the western part of the Pirca Area.

Alteration zones in association with geochemical anomalies were located at three places in the eastern Pirca. However associated mineralization was invariably very week and the geochemical anomalies were regarded as very low in their grades.

In the western Pirca, geochemical anomalies were generally small in their extensions for the sizes of the associated alteration zones and did not form significant areaa of superimposition with the alteration zones.

The drill holes MJP-1 to 4 in the eastern Pirca intersected the Pirca sediments which had not been recognized, and confirmed the stratigraphic succession.

The MJP-3 and 4 intersected quartz veins and alteration zones below the Pirca sediments. MJP-5 intersected a quartz vein of 2.45 m in core length at its depth. The whole section of the lower Barroso Formation was intersected by MJP-6, and the thickness and lithological variation of the Formation were confirmed.

The MJP-7 through MJP-10 intersected notable alteration zones generally dominated by argillization. Silicification and associated quartz veining were also observed in the MJP-8 and 9.

With significant intersections of the alteration zones in the holes, analytical results of 31 drill core samples indicated very low in metal values. Indication of mineralization was generally associated with narrow quartz veins, intensive silicification, iron oxide concentration or pyrite dissemination. The highest analytical results were 0.17 g/t Au, 2.8 g/t Ag, 0.028% As, 0.05% Cu, 0.01% Pb, and 0.08% Zn.

Summarizing the above results, it was concluded that the Pirca Area would have a very little potential for promising mineralization.

1-2-2 Recommendation for the 3rd Year Programme

According to the results of the 2nd year investigation, the Colpar and the Marcamalata districts, located respectively in the northeast and the southeast of the Marcabamba Area, were selected as promising targets.

The Pirca Area, without any signs of significant mineralization, was concluded to be of a little importance for commercial mineralization.

The methods and the scopes of the work in the Colpar and Marcamalata districts were recommended for the 3rd Year Programme as follows.

Methods	Scopes of the Work
Geological Prospecting	Clarify natures of mineralization and alteration by very detailed geological prospecting.
Trenching	Confirm the occurrences of mineralization and define their extention by following mineralized outcrops.
Drilling	Confirm the subsurface occurrences of mineralization and their sizes and grades at depth.

1-3 Outline of the 3rd Year Programme

1-3-1 Location

The selected two target area, the Colpar and the Marcamalata in the Marcabamba Area of the 2nd year campaign, are located approximately 20 km north of the Pausa village, about 250 km northwest of the second largest city, Arequipa, of the Republic of Peru (Fig. G-1. G-2).

The areas designated for the 3rd year programme were 5 km^2 for the Colpar and 2 km^2 for the Marcamalata (Table 1-1).

Table 1-1 Location of the Survey Area

Colpar Area		Marcamalata Area	
Latitude	Longitude	Latitude	Longitude
15° 04' 33"	73° 18' 40"	15° 09' 53"	73° 17' 14"
15° 04' 33"	73° 19' 35"	15° 09' 53"	73° 18' 08"
15° 06' 13"	73° 18' 40"	15° 10' 37"	73° 17' 14"
15° 06' 13"	73° 19' 35"	15° 10' 37"	73° 18' 08"

The access to the target areas are illustrated in Fig. I-1. The National Highway 1 leads from Arequipa to Atico. The nearby village, Sequello is accessible by an ordinary passenger vehicle along the State Highway from Atico via the villages of Caraveli and Pausa. It will take approximately 40 minutes on foot to reach the Colpar across Rio Huanca Huanca from the Sequello village.

The Marcamalata is reached by a 40 minutes walk from the Colta village. The village is accessible by a 4-wheel drive along a newly open road from the Vilcar village which is located approximately 4 km south of the Sequello.

It will require about 20 hours to reach the village of Sequello from Arequipa by a 4-wheel drive.

1-3-2 Purposes of the Work

A detailed geological prospecting and a drilling operation were planned for the two target areas selected according to the result of the 2nd year investigation.

The 3rd year's work was to verify occurrences of mineralization by clarifying the geology and geological structures in detail. Emphasis was placed on comprehending the relations between the geological backgrounds and the mineralization-alteration by the detailed geological prospecting and the drilling investigation.

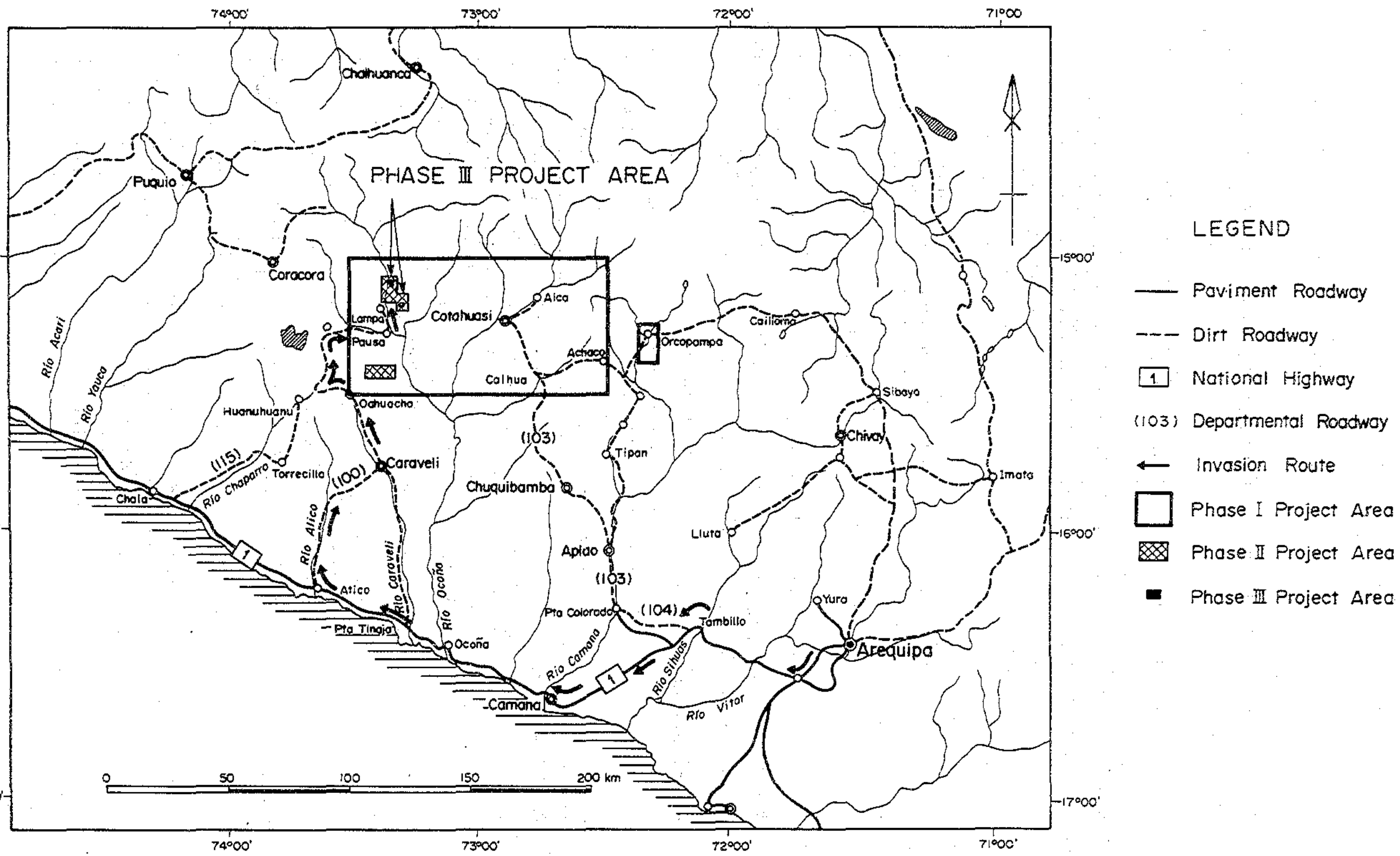


Fig. I – 1 Accessibility Map to the Project Area

It was the utmost purpose to narrow down the target for mineralization of commercial importance.

1-3-3 The Methods and the Quantities of the Work

The methods and the Quantities of the field and the laboratory work are summarized in Table I-2 (field work) and I-3 (laboratory work).

Table 1-2 Outline of the Field Work

Methods	Quantity of the Work			
Geological Survey				
(1) Colpar Area	Areas;			5 km^2
	Prospecting distances;			26.1 km
	Trending;			179.5 m
(2) Marcamalata Area	Areas;			2 km^2
	Prospecting distances;			16.2 km
	Trending;			153.0 m
Drilling Operation				
(1) Colpar Area	No.	Direction	Inclination	Length (m)
	MJP-11	SE 50°	-45°	251.05
	MJP-12	SE 50°	-45°	250.46
	MJP-13	SE 35°	-45°	250.20
		Subtotal		751.71
(2) Marcamalata Area	No.	Direction	Inclination	Length (m)
	MJP-14	SE 20°	-45°	200.65
	MJP-15	SE 20°	-45°	200.35
		Subtotal		401.00
		Grand total		1152.71

Table 1-3 Quantity of the Laboratory Work

Items and Analyzed Elements	Quantity
Thin Section	14 Samples
Polished Section	13 Samples
X-ray Diffraction Analysis	12 Samples
Chemical Analysis	
Mineralized Rocks; Au, Ag, (Cu, Pb, Zn)	102 Samples (249 total elements)

1-3-4 The Outline of the Work

The two target areas, the Colpar and the Marcamalata are apart from each other by approximately 9.5 km by air. A base camp was set at the village of Sequello which was located nearly the Colpar. An advanced camp was also set at the village of Colta, which was accessible by a 4-wheel drive from the Sequello, to serve for the Marcamalata.

(1) Detailed Geological Prospecting

The geological teams were everyday commuted from the Sequello base camp for the Colpar Area and from the Colta advanced camp for the Marcamalata Area.

The prospecting was based on 1 to 5,000 scale topographic maps which had been prepared by enlarging existing 1 to 100,000 scale topographic maps. The observation was plotted on the prepared 1 to 5,000 scale topographic maps which were corrected by using a transit compus or a branton compus and a chain in the course of the prospecting.

The prospecting results were compiled into 1 to 5,000 and 1 to 10,000 scale geological maps based on the corrected 1 to 5,000 scale topographic maps.

A number of abandoned underground workings, which were discovered by this year's prospecting, were examined in detail and sketch at a scale of 1 to 200.

A number of hand trenches were excavated where it was expected to effectively reveal occurrences of mineralization. A detailed examination was made for all of the trenches which were sketches at a scale of 1 to 100.

(2) Drilling Operation

In the Colpar Area, three 250 m-long diamond core drill holes had been planned. Two holes were drilled by using a Long Year 44 machine and one by using a Long Year 38 machine.

As the drilling sites were located on steep hills on the other side of Sequello acrossing the Rio Huanca Huanca, a temporary bridge as well as winding paths were constructed for transportation. Drill machines were transported by self-propelling, and attachments, accessory facilities, other parts and materials by using manpower and donkeys.

In the Marcamalata Area, two 200 m-long diamond core drill hole had been planned and were drilled by using a Long Year 38 machine.

Though the drilling sites were located on a flat cultivated plain, steep hills had to be overcome to reach the sites. It was required to widen existing paths or to construct new paths for serving transportation.

The ways of the transportation were the same as in the Colpar Area.

All the holes for both the areas were drilled by adopting a wire-line method. The final diameter of the holes was the BX standard.

All the drill cores were observed in details and colour-photoed. The observation was described in drill hole sections at a scale of 1 to 200.

(3) Laboratory Work

Of all the rock samples collected in the field or from drill cores, the selected samples were submitted to microscopic observation of their thin or polished sections, to X-ray diffraction analysis for clay-mineral identification or to chemical analysis.

1-3-5 Members of the Teams

Those who contributed to the 3rd year work are as follows:

Management and Planing

Japan		Republic of Peru	
Kazunori Kano	Metal Mining Agency of Japan	Juan Zegarra Wuest	Instituto Geologico Minero y Metalurgico
Kenzo Hagio	ditto (Lima Office)	Gregorio Flores Ñañes	"
Yozo Baba	ditto	Cesar Vilca Neira	"
Naotaka Adachi	ditto	Hector Zarate Olazagal	"

Field Team

Japan			Republic of Peru	
Kiyoharu Nakashima	Leader	Sumiko Consultants Co., Ltd.	Cesar Vilca Neira	Instituto Geologico Minero y Metalurgico
Atsumu Nonami	Member	ditto	Hector Zarate Olazagal	"
Akihiko Murase	ditto		Walter Rodriguez Olarte	"
			Pedro Samame I.	Geotec S.A.

1-3-6 Periods of the Work

Planing and Preparation (MMAJ)	:	June 28, '87 - July 6, '87
Preparation in Japan	:	June 26, '87 - June 27, '87
Travelling	:	June 28, '87 - June 29, '87
Preparation in Peru	:	June 30, '87 - July 6, '87
Field Work	:	July 7, '87 - Nov. 7, '87
Reporting to INGEMMET	:	Nov. 8, '87 - Nov. 10, '87
Travelling	:	Nov. 11, '87 - Nov. 13, '87
Laboratory Work and Report Preparation	:	Nov. 14, '87 - Jan. 30, '88

CHAPTER 2 GEOGRAPHY

2-1 Topography

The two target areas, the Colpar and Marcamalata, are located on the left bank of Rio Huanca Huanca, the great Canyon, which has elevation differences ranging from 2,000 to 2,500 m between the bottom and the top of the Canyon.

The Colpar is located at elevations between 2,300 and 3,200 m on a steep hill side to the east of Rio Huanca Huanca, which runs through east of the village of Sequello from north to south.

Quebrada Quermahuaico, a brands of Rio Huanca Huanca and other small dry creeks are developed in the southern part of the area.

The Marcamalata is located at elevations between 2,800 and 3,300 m on a hill side. Quebrada Colta, a branch of Rio Huanca Huanca, runs through the central part of the area. Though some steep cliffs are developed along creeks, tops of ranges are mildly relieved.

2-2 Climate and Vegetation

The climate of the general area, being relatively warm and semiarid, can be separated into a dry season from April to September and a wet season from October to March.

It is fine almost everyday during the dry season with a day temperature reaching up to 35°C and a night temperature falling down to 5°C.

Corns, potatos, wheats, beans and other crops are cultivated in farming lands of the area.

Orchards of such as for figs, lemons, apples, oranges and other fruits are seen in the villages along Rio Huanca Huanca.

CHAPTER 3 GEOLOGY AND MINERALIZATION

3-1 Colpar Area

3-1-1 Geology

The major part of the Colpar is occupied by the Tacaza Formation (Tc) of Miocene age of Tertiary, which is overlain by the Alpabamba Formation (Al). The Quarternary Formations comprising Pausa volcano-sedimentaries (Vsp) and alluvials (al) are localized in their distribution.

Tacaza Formation (Tc)

The Formation consists mainly of andesite lavas and andesitic pyroclastics (Tc.an). The andesite lavas are generally purple brown to dark grey colored and compact rocks with a porphyritic texture. The andesitic pyroclastics comprise tuffbreccias, lapilli tuffs and tuffs which generally look light green due to ubiquitous alteration.

In addition to the above two rock types, dacitic pyroclastics are also interbedded with andestic pyroclastics and are composed of dacitic tuffs and lapilli tuffs, including angular essential fragments in part. These rocks, being light green in color and compact, contain characteristically quartz fragments and light green lenticular patches (3 cm or less in long axes).

The thickness of the Tacaza Formation, the bottom of which is not exposed, is unknown but is estimated to exceed 800 m in this area. The stratigraphic relation between the Tacaza Formation and the underlying formation is also unknown.

According to the explanatory notes for the Caraveli and the Pausa Geologic Maps, the volcanic activity of the Tacaza Formation and its equivalents have taken place in early Miocene.

Alpabamba Formation (Al)

This Formation is observed at elevations high than 3,050 m above sea level near the eastern edge of this area and comprises light grey or light purplish grey rhyolite lavas and pyroclastics containing phenocrysts of quartz, plagioclase and biotite.

Flow structures are observed in places.

Dacitic lavas with notable flow structure are locally interbedded with the rhyolite lavas and pyroclastics.

The age of the volcanic activity of the Alpabamba Formation is believe to be of middle to late Miocene.

The Quarternary Formations

The Quarternary Formations are sporadically distributed with limited extentions along Rio Huanca Huanca and comprise the Pausa volcano-sediments (Vsp), and alluvials (al) which are further subdivided into fluvial terrace deposits (al-t), talus deposits (al-d), and river gravels (al-sd).

The Pausa volcano-sediments, grey to greyish white in color, are unconsolidated or semiconsolidated sedimentary rocks consisting of alternations of tuffaceous silts, sands and gravels.

Of the alluvials, fluvial terrace deposits and river gravels consist of sand and gravel layers containing abundant rounded or subrounded cobles and boulders.

The talus deposits contain abundant angular boulders in sandy soil.

Structure

Neither prominent fault nor folding structure has been observed in this area. NE-SW trending joints or fractures with steep dips are most well developed with sub-ordinate occurrences of NW-SE or N-S trending joints.

3-1-2 Mineralization and Alteration

The 3rd year's surface work located a number of abandoned old workings and mineralized outcrops which had not been found by the first year's and second year's investigations.

The mineralization in these old workings and outcrops were found to be very promising according to the detailed prospecting and drilling results.

Distribution of the Mineralization and Alteration

The mineralization and alteration zones are hosted by the Tacaza Formation of Tertiary age and located in four places in this area; these are the northern mineralized zone in the central west, the northern silicified zone in the central north, the southern mineralized zone in the central south and the Quebrada Querumahuaico alteration zone in the south west of the area.

Occurrences of the Mineralization and Alteration

Of the four mineralization and alteration zones, the northern and the southern mineralized zone are prominent.

A total of 11 abandoned old workings were located in the northern mineralized zone where 4 mineralized veins had been worked in the underground. A total of 18 old workings were located in the southern mineralized zone, where 9 mineralized veins, had been worked in the underground.

All the mineralized veins of both the zones consist of quartz veins, quartz vein networks and silicified zones along fractures with the NE-SW trend most predominated in the general area.

The mineralization is of gold and silver associated with copper, lead and/or zinc in places and of epithermal origin.

The identified ore minerals are electrum, argentite, polybasite, pearceite, galena, sphalerite, pyrite, hematite, limonite and ferro-manganese minerals.

Silicification is the most predominated alteration in association with occasional argillization.

An ordinary clay mineral assemblage associated with the mineralization is quartz-potash felospar-sericte with or without chlorite.

Examples of assay results of mineralized samples are 5.97 g/t Au and 640 g/t Ag for a width of 1 m in the N3 vein, 20.1 g/t Au and 1,200 g/t Ag for a width of 0.3 m in the S7 vein, both in the northern mineralized zone, and

21.5 g/t Au and 410 g/t Ag for a width of 0.15 m in the S3 vein in the southern mineralized zone. Silver values tend to be high in comparison with gold values.

The major mineralized veins are summarized in Table I-4 together with their sizes, assay results of collected samples, and brief description of their occurrences.

Table I -4 Important Mineralized Vein in the Colpar Area

Name of Mineralized Zone	Vein No.	Probable length of Vein (m)	Direction Strike Dip	Probable width (m)	Tunnel No.	Sample width No. (m)	Assay Results Au g/t	Assay Results Ag g/t	Description of Mineralization
Mineralized Zone of Northern part	N1V	600	N50° ~60° E, 70° ~80° NW	0.5~1.2	N1, 10	MN--11 spot (phase II)	0.41	39.3	silicified and argilized rock with iron oxides
	N2V	200	N60° ~80° E, 80° ~90° NW	0.2~0.7	N-2, 6, 7, 8, 9	N-6-4 0.5	0.89	390	sheared zone with brown iron oxides and a little quartz vein
	N3V	300	N45° ~60° E, 80° ~90° SE	0.35~1.5	N-3, 4, 5	N-3-3 1.0	5.97	640	strongly silicified rock with quartz veinlet
Mineralized Zone of Southern part	S2V	120	N50° E, 75° ~90° SE	0.3~0.5	SN-1, 4	Mz-16 0.3	3.36	142	quartz vein with pyrite mangan oxides and iron oxides
	S3V	200	N40° ~45° E, 80° ~90° SE	0.1~0.5	SN-5	S-5-5 0.15 S-5-6 0.2	21.50 11.10	410 890	brown clay and altered rock of sheared zone
	S4V	150	N45° E, 80° ~86° NW	0.1~0.5	SN-6, 6', 6'', 18	S-6-1 0.1	10.10	540	brown and black clay along sheared zone
	S5V	100	N45° E, 70° NW	0.4~1.0	SN-16	S16-1 0.4	14.50	90.0	brown clay with iron oxides along many joint
	S6V	60	N35° E, 90°	0.4~0.8	SN-7, 8	Mz-12 0.45	0.14	10.5	strongly altered rock with iron oxides
	S7V	10	N55° E, ?	0.1~0.3 network	SN-9	Mz-11 0.30	20.10	1200	strongly silicified vein network with shalerite galena and pyrite

In the Colpar, 3 holes with depths of approximately 250 m were drilled; two in the northern mineralized zone and one in the southern mineralized zone. Mineralized intersections in these holes are summarized in Table I-5 together with other particulars of the holes.

The MJP-11 was drilled in the northeastern extension of the northern mineralized zone and intersected the northeastern extension of the N1 vein at depth. The intersection is 5.20 m wide in core length including the associated alteration. Assay results of a 0.35 m portion of the intersection indicated 0.41 g/t Au, 104 g/t Ag, 0.34% Cu and 2.96% Pb. The mineralization is dominated by Ag and Pb.

The hole MJP-12 was drilled in the northern mineralized zone and intersected the N1 vein with a core length of 3.20 m, N2 vein with a core length of 10.0 m, both including the associated silicification zones and also minor parallel quartz veins. Assay results of the intersections of the N1 and N2 veins were low for all the analized elements. However, a quartz vein intersected at the depth between 75.40 and 75.60 m yielded 3.54 g/t Au and 705 g/t Ag, and a part of a silicified zone indicated 13.10 g/t Au and 360 g/t Ag at the depth between 189.0 and 189.30 m.

This hole was too short to reach the N3 vein, which was the best mineralized vein of all on the surface in the northern mineralized zone.

The hole MJP-13 was drilled in the southwestern extension of the southern mineralized zone and intersected the S3, S4 and S5 veins. The intersection of the S3 vein was 0.65 m in core length including zones of intensive silicification and that of the combined S4 and S5 veins reached 7.10 m including associated alteration zones.

An intersection at the depth between 201.14 and 201.30 m, which was corelated to a part of the S4 vein, indicated assay values of 5.04 g/t Au, 45.0 g/t Ag, 0.79% Cu, 1.37% Pb and 1.30% Zn. The Au-Ag mineralization is apparently associated with Cu, Pb and Zn.

Identified ore minerals are electrum, argentite, polybasite, galena, sphalerite and limonite, and associated alteration minerals are generally quartz, potash feldspar and sericite with or without chlorite.

Table I −5 Important Mineralized Zones and Vein in Drilling Holes of the Colpar Area

Name of Mineralized Zone	Drilling №	Depth of Mineralized Zone (m)	Apparent width (m)	Name of Vein	Depth of Sampling (m)	Apparent width (m)	Assay Results Au g/t	Ag g/t	Cu %	Pb %	Zn %	Description of Mineralization
Mineralized Zone of Northern Part	MJP−11	117.00~122.20	5.20	N1V								silicified rock and quartz vein network with disseminated of py. 119.35~120.70m : disseminated Cp, Sp, Ga, Py
					119.35~119.70	0.35	0.41	104.0	0.34	2.96	0.01	(grey quartz vein with breccia of silicified rock and disseminated Cp, Sp, Ga, Py.)
	MJP−12	75.40~76.80	1.40	−	75.40~75.60	0.20	3.54	705	−	−	−	(quartz vein (w=0.13m) with Cp, Sp, Ga.)
		111.50~114.70	3.20	N1V								(strongly silicified rock with quartz vein (w=1.0))
					111.92~112.52	0.60	0.07	56.5	<0.01	0.01	0.10	(strong silicified rock)
					112.95~114.50	1.55	0.21	22.3	<0.01	<0.01	0.06	(quartz vein silicified rock)
		176.45~195.10	18.65	−								medium to strong silicified zone 186.30~193.70m (w=7.40m) : spot and lense of black mineral in silicified rock.
					189.00~189.30	0.30	13.10	360	−	−	−	(silicified rock with black lenticular vein)
		211.20~221.20	10.0	N2V								strongly silicified rock and quartz vein (w=1.7m) with disseminated py rite
					212.55~212.75	0.20	0.48	7.3	−	−	−	(black quartz vein)
Mineralized Zone of Southern Part	MJP−13	156.90~157.55	0.65	S3V	156.90~157.55	0.65	<0.07	3.6	−	−	−	(quartz vein network)
		198.70~205.80	7.10									strongly silicified rock with quartz vein (w=0.16m, w=0.70m)
				−	199.45~199.60	0.15	2.33	8.0	0.03	0.33	0.48	(silicified rock with Cp. Sp. Ga)
				S4V	201.14~201.30	0.16	5.04	45.0	0.79	1.37	1.30	(quartz vein network with Cp. Sp. Ga)
				S5V	203.50~204.20	0.70	0.21	18.0	0.18	0.86	1.62	(quartz vein network with Cp. Sp. Ga)

3-2 Marcamalata Area

3-2-1 Geology

The geology of this area comprises the Hualhuani (Yu) and the Murco (Mu) formation of Cretaceous age, which are unconformably overlain by the Tacaza (Tc) formation of Tertiary age, and the Lampa volcanics (Vla) and alluvials (al) of Quarternary age. Accha stocks (Di) intrudes the Cretaceous and Tertiary Formations.

Hualhuani Formation (Yu)

This formation, being distributed from the centre to the south of the area, consists mainly of grey to light grey, fine to medium grained arkosic sandstones (Yu-ss) and grey to dark grey shales (Yu-sh). The thickness of the formation has been estimate at 300 m or more.

The formation is correlated to the upper Yura group and is believed to have deposited during the early Neocom stage of the late Cretaceous.

Murco Formation (Mu)

This formation, being distributed to the east of the Hualhuani Formation, consists mainly of light brown to purplish brown shales interbedded with thin layers of sandstones. Its thickness is estimated to exceed 200 m. The formation, conformably overlying the Hualhuani Formation, has been correlated to the late Neocom stage.

Tacaza Formation (Tc)

This Formation consists of dacitic lavas distributed in a limited area near the northern end and andesitic pyroclastics distributed in the eastern part of the area.

The formation spreads towards the east of the area and has a thickness more than 200 m.

The volcanic activity which extruded these volcanic materials is believed to be of the Miocene age of Tertiary.

Lampa Volcanics (Vla)

Being widely distributed in the northwestern part of the area, the volcanics consist of dark grey or purplish grey, porous basaltic andesite, andesite and pyroclastics of similar compositions. The thickness of the volcanics reaches approximately 100 m at its thickest part. The age of the volcanic activity which brought these volcanic materials has been estimated at an early Holocene.

Alluvials (al)

Alluvials are widely distributed in the central and northwestern part of this areas and consist of talus deposits containing abundant large boulders of dacite and andesite.

Accha Stocks (Di)

The stocks have been located at three places in the northeastern, southeastern and southwestern part of the area and consist of light grey to grey, holocrystalline quartz diorite. They intruded the Tacaza and the lower formations.

The age of the intrusion is estimated to be Miocene of Tertiary age.

Geological Structures

A NNW-SSE trending fault has been assumed, running from the central west to the south of the area.

The amount of dislocation by the fault is not well known but has been estimated at approximately 120 m vertically. The western block of the fault is relatively downthrown against the eastern block.

NE-SW trending joints are most well developed in the formations of Tertiary or earlier, with subordinate E-W and NW-SE trending joints.

3-2-2 Mineralization and Alteration

Nine old mine sites and a number of small surface workings were located by the detailed prospecting.

Distribution of Mineralization and Alteration

The mineralization and alteration occur in the sedimentary rocks of the Hualhuani and the Murco Formations of Cretaceous, and is found along a ridge running in the central southern part of the area.

Occurrences of Mineralization and Alteration

The mineralization consists of quartz veins or quartz vein networks in association with silicification along fractures or fractured zones, occasionally carrying some values of Au and Ag and is believed to be of epithermal origin.

The most prominent vein occurs in the abandoned old working SM-2 and is hosted by arkosic sandstones of the Hualhuani formation. A sample from the vein along brown colored oxidized fractures indicated values of 1.99 g/t Au and 440 g/t Ag, which suggested high silver mineralization.

Samples from other abandoned old workings yielded some Au and Ag values as well.

The two holes, MJP-14 and -15, drilled to the depth of the mineralized zone, intersected a mumber of quartz veins, quartz vein networks and intensively silicified zones but with only weak mineralization. The best assay results obtained for drill core samples were as low as 0.07 g/t Au and 3.3 g/t Ag.

CHAPTER 4 GENERAL DISCUSSION FOR THE RESULTS

4-1 Geological Structures, and Characters and Control of Mineralization

The Colpar

The mineralization found in the Colpar is associated with quartz veins or quartz vein networks in silicified zones, or with silicified fracture zones.

Associated commodities of commercial interest are Au and Ag, and secondarilly Cu, Pb and/or Zn.

Identified ore minerals are electrum, argentite, polybasite, pearceite, galena, sphalerite, chalcopyrite pyrite, hematite, limonite and ferromanganese minerals.

The composition of the electrum found in the drill core sample of the hole MJP-12 at the depth between 75.40 and 75.60 m was determined at 51.54 wt% Au and 48.35 wt% by EPMA.

Silver minerals were observed generally in association with galena. Observed mineral assemblages are galena-argentite and galena-polybasite in the northern mineralized zone and galena-pearceite in the southern mineralized zone.

Quartz-potash feldspar (adularia)-sericite with or without chlorite is a ubiquitous alteration mineral assemblage.

Judging from their occurrences, ore and alteration mineral assemblages and other natures, it may be presumed that the Au-Ag quartz veins of this area deposited along the NE-SW trending fractured zones under epithermal conditions.

The northern mineralized zone is composed of 4 NW-SE trending quartz veins and silicified zones developed inbetween. Strike lengths of these veins are estimated to range from 200 to 300 m according to distribution of mineralized outcrops and old workings. However, the strike length of the

N1 vein may reach about 600 m, judging from the location of the intersection of the vein at depth by the hole MJP-11. It is interesting to note that the northern silicified zone is located further to the northeast and continues for about 1 km northeastwards. The geometrical relations as above may suggest that the N2, 3 and 4 veins also continue further to the northeast than presently estimated.

It is presumed that the northern mineralized and the northern silicified zones would form virtually a continuous mineralization-alteration zone with an average width of approximately 0.3 km and a strike length of more than 1.5 km.

A total of 9 veins of variable sizes have been located in the southern mineralized zone. Of these, the S-1 vein trends in the ENE-WSW direction and the 6 veins, the S-2 through the S-7 in the NE-SW direction. However, the S-8 and the S-9 veins strike in the direction of N-S, acrossing the general trend of the veins.

Judging from distributions of abandoned old workings and mineralized outcrops, the strike lengths of these veins are estimated to be upto 200 m.

The hole MJP-13 was drilled through the southwestern extension of the mineralized zone and intersected the S-3, S-4, S-5 and possibly S-6 veins and associated silicification zones.

It may be interesting to note that a sizable area to the southwest of the drill location is covered by screes and an intensively silicified zone associated with weak Au-Ag mineralization has been located along the Quebrada Querumahuaico further to the southwest of the scree-covered area. Since the silicied zone has the same NE-SW trend as for the S-2 through the S-7 veins, it is presumed that the southern mineralized zone would continue southwestwards under the scree-covered area and form a continuous mineralizationalteration together with the silicied zone mentioned above. If it be true, the mineralization-alteration zone would have an average width of approximately 0.2 km and continue in the NE-SW direction for an approximate distance of 0.9 km.

The Marcamalata

The mineralization in the Marcamalata is accompanied by quartz vein networks in fractured zones or by silicified fracture zones and is generally weak both for Au and Ag.

Identified ore minerals are pyrite and a minor amount of tetrahedrite and sphalerite as well as indeterminable minerals composed of K-Fe-S or Fe-S. No Au and/or Ag minerals have been identified.

Quartz-jarosite and quartz-anhydrite-calcite are identified alteration mineral assemblages associated with the mineralization.

The holes MJP-14 and -15, were drilled below the mineralized zone outlined on the surface and intersected a number of quartz veins, quartz vein networks or intensively silicified zones which yielded disappointingly low values in Au and Ag. Though the vein at the old working SM-2 was appreciably well mineralized in Ag, the hole MJP-14 failed to intersect the extension of the vein at the estimated depth of approximately 90 m vertically from the surface. Accordingly the vein may be terminal above this level.

Most of the quartz veins and quartz vein networks intersected by the drill holes occur in arkosic sandstone and only a few in shales. The Ag mineralization in the old working SM2 is also hosted by arkosic sandstones and mineralization in shales is much weaker.

This is because of better developed fractures in arkosic sandstones than in shales, indicating host rocks to be also important for localization of mineralization.

4-2 Potentiality for the Vein Type Au-Ag Mineralization

The Colpar

A number of abandoned workings which seem to be very old, have been located in the northern and southern mineralized zones in the course of the 3rd year prospecting. There have been identified 4 mineralized veins in the northern zone and 9 veins in the southern zone. The two zones appear to be well continuous both to the strike and dip sides, and are thought to have considerable potentiality for mineralization of commercial sizes and grades from the following points.

Northern Mineralized Zone

(a) Identified 4 veins running parallel to each other were commercially mined in the underground in the past though in limited scales.

(b) Samples of the abandon workings, the surface outcrops and the drill cores indicate high grade Au-Ag mineralization occasionally accompanied by subordinate Cu, Pb and Zn.

(c) The N1 vein is expected to extend for more than 600 m in strike length and 250 m in dip length.

(d) The holes MJP-11 and 12 intersected the N1 and N2 veins but did not reach the N3 and the N4 veins. The N3 vein is the best mineralization of the 4 veins on the surface and should be explored by drilling to its depth.

(e) The northern silicified zone is located to the northeast of the NE-SW trending northern mineralized zone and is expected to form a continuous mineralization-alteration zone incorporated with the northern mineralized zone. The size of the mineralization-alteration zone is expected to extend for more than 1.5 km in length with an average width of approximately 0.3 km.

The Southern Mineralized Zone

(a) The identified 9 veins were commercially mined in the underground in the past, though in limited scales.

(b) Some of the samples of the abandoned old workings and the surface outcrops yielded interesting values in Au and Ag.

(c) The hole MJP-13 intersected the S3, S4 and S5 veins, parts of which were well mineralized with Au and Ag accompanied by subordinate Cu, Pb and Zn.

(d) An alteration zone associated with minor Au-Ag mineralization is located along the Quebrada Quermahuaico to the southwest of the NE-SW trending southern mineralized zone. A wide area between the alteration zone and the southern mineralized zone is cover by screes.

(e) The southern mineralized may continue under the scree cover and form a continuous mineralization-alteration zone incorporated with the Quebrada Quermahuaico alteration zone. The mineralization-alteration zone is expected to extend for more than 0.9 km with an average width of approximately 0.2 km.

The Marcamalata

The mineralization in the Marcamalata is much far smaller in scales of veins and in extension of associated alteration zone than in the Colpar.

The hole MJP-14 failed to intersect the vein in the abandoned old working SM-2, which was the best of all veins, at the expected depth.

The holes MJP-14 and -15 intersected a number quartz veins and silicified zones but with very minor values of Au and Ag.

There is no evidence to expect mineralization of a commercial size and grade in this area.

CHAPTER 5 CONCLUSION AND RECOMMENDATION

5-1 Conclusion

The Colpar

The two mineralized zones, the northern and the southern mineralized zones, hosted by the Tacaza Formation of Tertiary age, have been outlined in the area; 4 veins have been identified in the former and 9 veins in the latter.

All of the 4 veins in the northern and most of the 9 veins of the southern mineralized zones are associated with fractures trending NE-SW which is a major structural trend in the area. There have been observed variable occurrences of the veins, such as quartz veins, quartz vein networks and silicified fracture zones.

Major Au and Ag minerals are electrum, argentite polybasite and pearceite associated with galena, sphalerite, chalcopyrite and pyrite. Electrum contains about 52% Au and 48% Ag.

The alteration mineral assemblage is quartz-potash feldspar (aduralia)-sericite with or without chlorite in general.

The above features of the mineralization and alteration suggest that the mineralized veins are of epithermal origin.

A surface sample of the N3 vein in the northern mineralized zone yielded values of 5.79 g/t Au and 640 g/t Ag for a width of 1 m across the vein.

The hole MJP-11 in the northern mineralized zone intersected the N1 vein for a core length of 0.35 m, the sample of which was assayed at 0.41 g/t Au, 104 g/t Ag, 0.34% Cu, 2.96% Pb and 0.01% Zn.

The other hole MJP-12 in the same zone intersected a number of quartz veins, and intensively silicified zones, of which the veins correlated to the N1 and N2 veins were low in Au and Ag values. However, a quartz vein for a core length of 0.20 m yielded 3.54 g/t Au and 705 g/t Ag and an intensively silicified zone for a core length of 0.30 m indicated 13.10 g/t Au and 360 g/t Ag.

The surface indications and the drill intersections suggest that the N1 vein may extend for approximately 600 m along its strike.

The northern silicified zone, being located to the northeast of the northern mineralized zone, may form a continuous mineralization-alteration zone incorporated with the northern mineralization. The mineralization-alteration zone is estimated to be as extensive as 1.5 km long and 0.3 km wide.

In the southern mineralized zone, notable mineralization occurs in the S3 vein, a sample of which indicated 21.5 g/t Au and 410 g/t Ag for a width of 0.15 m, and in the S7 vein, a sample of which indicated 20.10 g/t Au and 1200 g/t Ag for a width of 0.30 m.

The hole MJP-13 in this mineralized zone intersected the S3, S4 and S5 veins, of which the S-4 vein gave assay results of 5.04 g/t Au, 45.0 g/t Ag, 0.79% Cu, 1.37% Pb and 1.30% Zn.

An alteration zone associated with weak Au and Ag mineralization is located to the southwest of the southern mineralized zone. A scree covered area separates the alteration zone from the mineralized zone and the two zones may be incorporated in a continuous mineralization-alteration zone more than 0.9 km long with a width of approximately 0.2 km.

A number of abandoned old workings, which had been unrecognized for years, were located in association with the two mineralization-alteration zone as above described during the 3rd year's campaign.

The two zones provide substantial areas for exploration of Au-Ag mineralization and may be expected to include Au-Ag deposits of commercial grades and sizes.

The Marcamalata

The mineralization and the alteration in this area are hosted by the Hualhuani or the Murco Formation of Cretaceous age and follow the similar structural trend, NE-SW to that in the Colpar.

Occurrences of the mineralization are also similar to those in the Colpar but without any Au and Ag minerals identified.

The mineralization looks better in sandstones than in shale. The best mineralization was found in association with a vein in the abandoned old workings SM-2, where a sample indicated assay values of 1.99 g/t Au and 440 g/t Ag. However, Au contents of the samples from other old workings were very low occasionally with some Ag values.

The two drill holes MJP-14 and -15 were carried out in the mineralization-alteration zone and intersected a number of quartz veins, quartz vein networks and intensively silicified zones but with only minor values of Au and Ag.

Neither of these holes intersected the extension of the vein in the old working SM-2 at the expected depth.

The mineralization-alteration zone is much smaller in its extension than those of the Colpar and may have a very little potential for mineralization of commercial importance.

5-2 Recommendation

Based on the results of the 3rd year's work, the two mineralization-alteration zones in the Colpar are judged to be potential areas for commercial mineralization and should be followed up by further detailed exploration.

The recommended methods are summarized in the Table below, together with purposes of the work.

The Marcamalata area, without positive evidences for commercial mineralization, does not warrant further exploration.

Method	Purposes
Detailed Surface Prospecting	To clear the mineralization and the alteration by mapping old workings and trending the two mineralization alteration zones
Drilling	To identify subsurface continuation of the mineralized veins both laterally and vertically and to verify Au and Ag contents of the vein.

PART II DETAILED REPORT

PART II DETAILED REPORT

CHAPTER 1 COLPAR AREA

1-1 Geological Prospecting

1-1-1 Methods

A base camp was set at an open ground in the village of Sequello at the end of the road passable by ordinary vehicles. It was only a half an hour or one walking to reach the Colpar prospecting site from the Sequello, and then the prospecting teams were commuted everyday on foot.

The prospecting was based on 1 to 5,000 scale topographic maps which had been prepared by enlarging existing 1 to 100,000 scale topographic maps. The observation was plotted on the prepared 1 to 5,000 scale topographic maps which were corrected by using a transit compus or a branton compus and a chain in the course of the prospecting.

The prospecting results were compiled into 1 to 5,000 and 1 to 10,000 scale geological maps based on the corrected 1 to 5,000 scale topographic maps.

A number of abandoned underground workings, which were discovered by the 3rd year's prospecting, were examined in detail and sketch at a scale of 1 to 200.

A number of hand trenches were excavated where it was expected to effectively reveal occurrences of mineralization. A detailed examination was made for all of the trenches which were sketched at a scale of 1 to 100.

1-1-2 Geology

The Colpar is located in the Marcabamba Area of the 2nd year's project in the northwestern part of the original Cotahuasi Area, and occupies an area of 5 km^2 to the northeast of the Sequello along the east bank of Rio Huanca Huanca (Fig. G-2).

In the general area including the Colpar, Tertiary volcanics are widely distributed with granodiorite intrusion to the south of the target area.

The major part of the Colpar is occupied by the Tacaza Formation (Tc) of Miocene age of Tertiary, which is overlain by the Alpabamba Formation (Al). The Quarternary Formations comprising Pausa volcano-sedimentaries (Vsp) and alluvials (al) are localized in their distribution (Fig. II-1, II-2).

[1] Tertiary System

(1) Tacaza Formation (Tc)

Distribution

Extensive distribution on the eastern slopes of Rio Huanca Huanca between the elevations of 2,350 and 3,050 m.

Lithology

The formation consists mainly of andesite lavas and andesitic pyroclastics (Tc.an) interbedded with dacitec pyroclastics. The andesite lavas are generally purple brown to dark grey colored and compact rocks with porphyritic textures.

Under the microscope, phenocrysts of plagioclase and quartz are observed in a hyalopilitic or cryptocrysalline groundmass.

Plagioclase phenocrysts, tabular or lath-shaped with lengths between 1.0 and 3.0 mm, have generally undergone sericitization, carbonitization and/or chloritization.

Quartz phenocrysts, less than 1.5 mm, are only locally observed.

Mafic minerals are completely sericitized and/or chloritized.

Groundmasses consists of acicular plagioclase and glasses partly sercitized.

The andesitic pyroclastics, consisting of tuffs and lapilli tuffs, are generally chloritized and show light green or green color. Angular fragments and lapillis in the pyroclastics are of andesite or dacite, and matrices are composed of light green to green tuffaceous materials.

The dacitic pyroclastics, comprising dacitic tuffs, lapilli tuffs and tuff breccias, are interbedded with in the andesitic lavas and pyroclastics.

The dacitic tuffs, light greenish grey and compact, characteristically contain quartz fragments. Under the microscope, the rocks include a large amount of lithic and crystalline fragments. The crystalline fragments are of plagioclase (1.0 - 1.5 mm), corroded quartz (less than 2 mm) and chloritized or sercitized mafic minerals. The lithic fragments (less than 5 mm) consist of andesite, decite and/or lenticular green patches. Groundmasses, weakly sercitized, are hyalopilitic or cryptocrystalline and contain very fine grained feldspars and quartz.

The dacitic lapilli tuffs and tuff breccias contain angular fragments (0.5 - 5.0 cm) of andesite or dacites in matrices of similar natures to the tuffs.

Thickness

The thickness is unknown because its bottom has not been exposed but is estimated to exceed 8,000 m.

Stratigraphic Relations

The stratigraphic relation to the lower formation is unknown. According to the Pausa and Caravelli, Geologic Maps, an absolute age of 19.1 Ma (early Miocene) has been obtained for the volcanic rocks correlated to the Tacaza formation.

[2] Alpabamba Formation

Distribution

On the slopes above the elevation 3,050 m near the eastern end of the Colpar and eastward.

Lithology

This formation comprises light grey or light purplish grey rhyolitic lavas and pyroclastics containing phenocrysts of quartz, plagioclase and biotite.

Flow structures are observed in places. Dacitic lavas with notable flow structures are locally interbedded with the rhyolite lavas and pyroclastics and characterized by phenocrysts of plagioclase and from black.

Under the microscope, the rhyolite lavas are porphyritic containing phenocrysts of euhedral plagioclase, anhedral quartz and flakey biotite in groundmasses mainly consisting of volcanic glasses.

The rhyolitic pryroclastics contain dacite and sphaleritic rhyolite fragment in matrices consisting of fine granules of glasses and minerals.

The dacitic lavas, have, under the microscope, vitreous porphyritic textures and contain phenocrysts of euhedral tabular or lath-shaped plagioclase (less than 3 mm), minor mafic minerals and opaques in cryptocrystalline or hyaline groundmasses composed of fine granules of quartz, plagioclase, iron minerals and glasses.

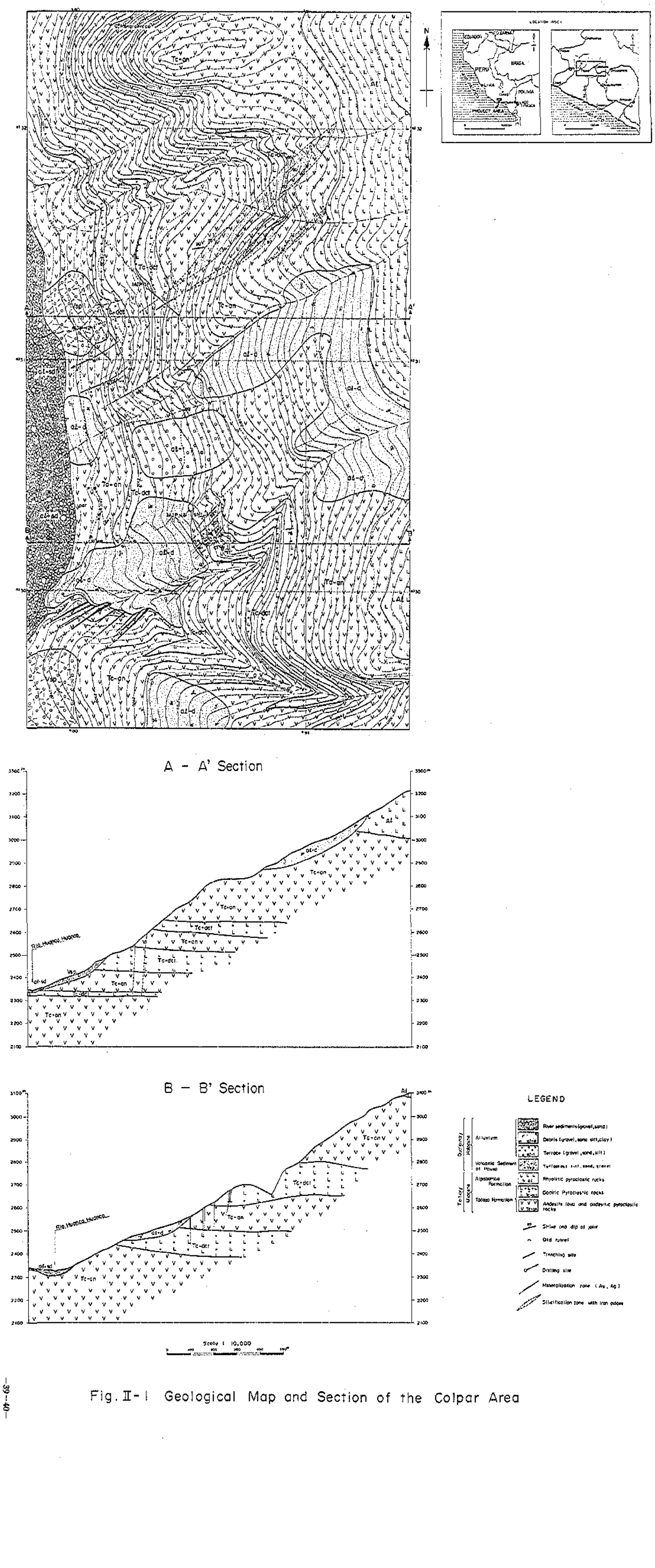
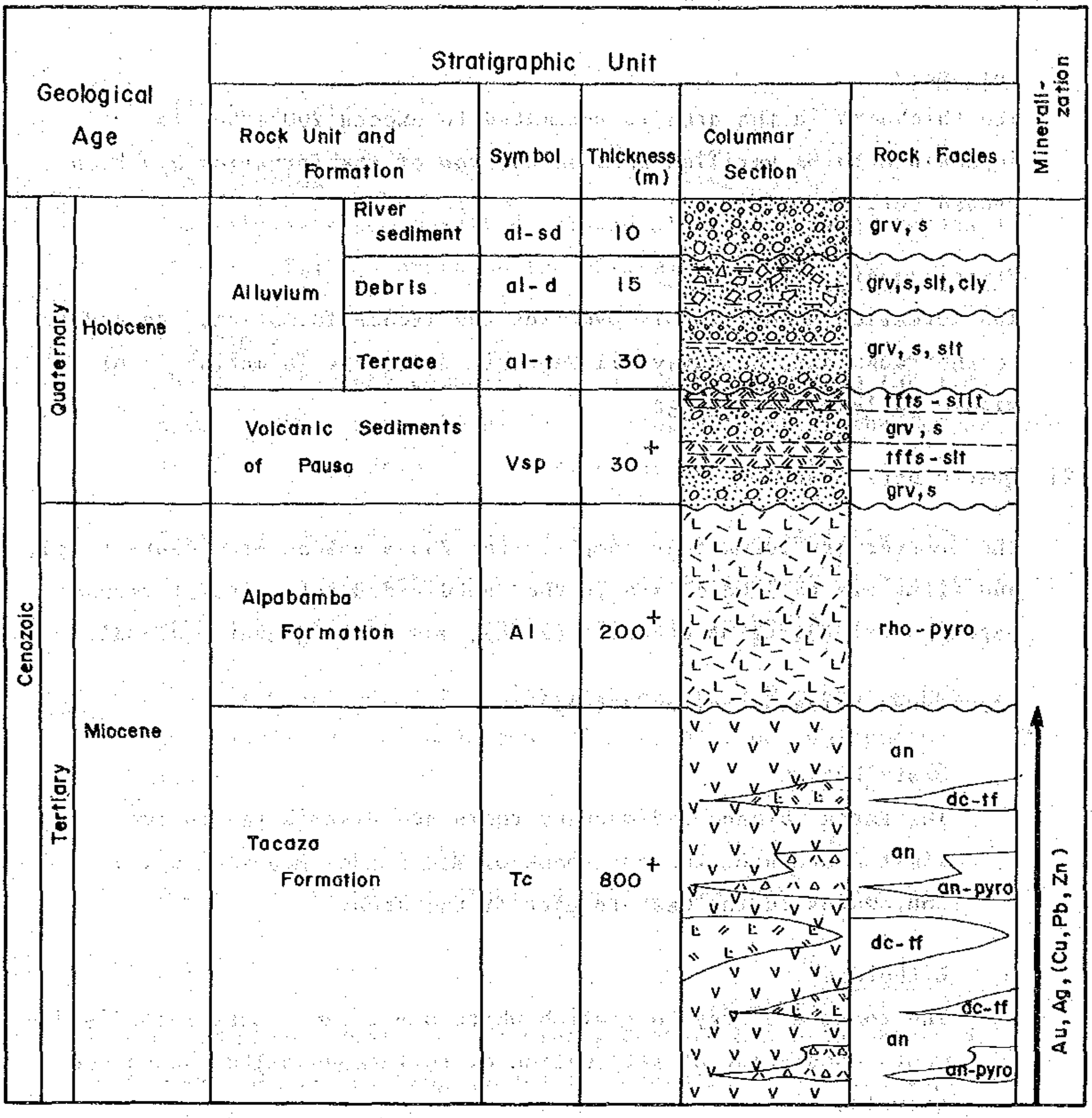


Fig. II-1 Geological Map and Section of the Colpar Area



Abbreviation

grv-----gravel , s----- sand , slt-----silt,

cly-----clay , tffs-slt----tuffaceous silt,

rho-pyro-----rhyolitic pyroclastic rocks,

an-----andesite lava, dc-tf-----dacitic tuff,

an-pyro-----andesitic pyroclastic rocks,

Fig. II-2 Stratigraphic Column of the Colpar Area

Thickness

The thickness in the area is estimated to exceed 200 m but is impossible to be verified because the top of the formation has been eroded out.

Stratigraphic Relations

The formation unconformably overlies the Tacaza formation. According to the Pausa and the Caravelli Geologic Maps, the formation is of middle to late Miocene age.

[2] Quarternary System

The Quarternary formations comprise the Pausa volcano-sediments (Vsp), and alluvials (al) which are further subdivided into fluvial terrace deposits (al-t), talus deposits (al-d), and river gravels (al-sd).

(1) Pausa Volcano-sediments (Vsp)

Distribution

The Pausa volcano-sedimentary rocks are distributed in two limited areas on the east bank of Rio Huanca Huanca running southwards in the western part of the area.

Lithology

The rocks are grey to greyish white un-or semi-consolidated sediments consisting of alternation of tuffaceous silts, sands and gravels.

Thickness

Being eroded incessantly, the present thickness is estimated at approximately 20 m.

Stratigraphic Relations

The rocks unconformably overlies the Tacaza formation.

(2) Alluvials (al)

Distribution

The alluvials are mostly developed along Rio Huanca Huanca and also in limitted areas on the hill sides.

Lithology

The river terrace deposits (al-t), distributing in the limited areas on the steep slopes in the central part of the Colpar, consists of alternation of silts, sands and gravels.

The talus deposits (al-d), distributing sporadically in the central eastern and southwestern parts, consist of unconsolidated clayey soils and sands containing angular boulders.

The river bed deposits, distributing along Rio Huanca Huanca, consist of coarse sands contining rounded or sub-rounded boulders and cables.

Stratigraphic Relations

The alluvials unconformably overlies the Tacaza formation.

[3] Geological Structures

Neither prominent fault nor folding structure has been observed in this area. NE-SW trending joints or fractures with steep dips are most well developed with sub-ordinate occurrences of NW-SE or N-S trending joints.

1-1-3 Mineralization and Alteration

In the Colpar, 4 mineralized or altered zone were outlined, namely (1) the northern mineralized zone, (2) the northern silicified zone, (3) the southern mineralized zone and (4) the Quebrada Quermahuico alteration zone. The locations of these zones are shown in PL. 2 and Fig. II-3. Distribution of mineralized veins are shown in Fig. II-3, II-4 and II-5, and their occurrences and sizes are summarized in Table II-1.

Of the laboratory tests for the collected samples, the results of microscopic observation of this sections are shown in Apx. 3, those of EPMA in Apx. 4, those of X-ray analysis in Apx. 6, and those of chemical analysis of mineralized veins in the outcrops and in the underground in Apx. 7.

Also, sketches of the underground are shown in Apx. 9 through 17, those of the Quebrada Querumahuaico in Apx. 19, and those of the trenches in Apx. 20 through 24.

Distribution

The mineralization and alteration zones are hosted by the Tacaza formation of Tertiary age and located in four places in this area; these are the northern mineralized zone in the central west, the northern silicified zone in the central north, the southern mineralized zone in the central south and the Quebrada Querumahuaico alteration zone in the south west of the area.

The northern silicified zone is located to the northeast of the NE-SW trending northern mineralized zone and is continuous for about 1 km in length.

The Quebrada Querumahuaico alteration zone is located to the southwest of the NE-SW trending southern mineralized zone.

Brief Description of the Mineralized Zones

Prominent mineralization is associated with the northern and the southern mineralized zones.

In the northern mineralized zone, 11 abondoned old workings were located by the surface prospecting and 4 veins had been mined and explored by these workings in the past.

In the southern mineralized zone, 18 abandoned old workings were located by the surface prospecting and 9 veins had been mined and explored by these workings in the past.

Mineralization in the two zones is accompanied by quartz veins, quartz vein networks or silicified zone mostly along NE-SW trending fractures or fractured zones and contains Au, Ag, Cu, Pb and/or Zn.

The identified ore minerals are electrum, argentite, polybasite, pearceite, galena, pyrite and ferro-manganese minerals.

The most prominent alteration is silicification with argillization in places. An alteration mineral assemblage of quartz-potash feldspar-sericite with or without chlorite is usually associated with the mineralization.

The mineralization may be judged to be of an epitherme type from its occurrences and associated alteration features.

The notable veins are the N1 through the N3 veins in the northern mineralized zone and the S2 through the S6 veins in the southern mineralized as well as the high grade S7 vein.

Detailed Description of the Mineralization and Alteration

(1) The Northern Mineralized Zone

The 4 veins, the N1 through the N4 veins (Fig. II-4) trend in the direction of NE-SW and dips steeply to the northwest except the N3 vein dipping steeply to the southwest. The three veins the N1 through N3 veins, running parallel to each other, are apart approximately 100 m from the adjacent vein and the distance between the N3 and the N4 vein is approximately 50 m.

A trench between the N2 and N3 veins exposed a parallel vein with a width of 0.15 m and an associated silicification zone.

The inclusive width of these veins and the alteration zones in between totalled approximately 0.3 km for an extention of approximately 0.4 km in the direction of NE-SW.

The N3 vein appears to be most prominent in its surface expression. A past of the quartz vein itself ranges from 0.3 to 0.5 m but the total width including associated quartz vein networks and silicified than is estimated to reach 1.0 to 1.5 m taking the size of an old stope into account.

The assay results of the samples collected from the old workings are shown in Apx. 7 and in Table II-1.

A sample of the N3 vein for a width of 1 m indicated values of 5.97 g/t Au and 640 g/t Ag.

Three sample of the N2 vein ranged from 178 to 390 g/t in Ag values.

The microscopic observation of a sample of the N3 vein identified ore minerals of sphalerite > pyrite > galena >> chalcopyrite and a minor amount of argentite and polybasite.

The result of EPMA for argentite indicated 85.52 Wt% Ag, 0.29 Wt% Cu, 0.20 Wt% Zn, 0.02 Wt% Sb and 13.15 Wt%S (totalling 99.55 Wt%).

X-ray diffraction analysis for samples of the N2 and the N3 veins identified an alteration mineral assemblage of quartz-potash feldspar-sericite with a minor amount of gypsum and/or chlorite.

(2) The Northern Silicified Zone

The zone comprises 3 belts of the bleached and silicified Tacaza formation, running parallel to each other in the direction of NE-SW.

The northern most belt appears to be the most extensive of the 3 belts, and is estimated to continue for approximately 1 km with an average width of approximately 0.1 km.

The southern most belt, less extensive than the above, had been apparently explored in the past by the adit N-12, running in the direction of NE60°.

The total width inclusive of the 3 belts is estimated at about 0.3 km.

The northern silicified zone may be correlated to the northeast extention of the northern mineralized zone judging from its NE-SE trend.

An alteration mineral assemblage identified by the 2nd year's work is quartz-potash feldspar with a minor amount of sericite which is similar to that of the northern mineralized zone.

(3) The Southern Mineralized Zone

The 9 veins, the S1 through S9 veins (Fig. II-5), trend mostly in the direction of NE-SW dipping steeply to NW or SE except the S1 vein striking N80° E and dipping 65° to SE, and S8 and the S9 veins striking NS and dipping steeply to west.

The 2 through the S6 vein, running parallel to each other on the surface, may converge at depth, judging from their dips.

In the southern mineralized zone, 3 trenches were excavated (Apx. 20 - 22). The TC-1 trench revealed a quartz vein with a width of 0.2 m possibly correlated to the S3 vein and associated silicification zones.

The TC-2 trench exposed a quartz vein with a width of 0.25 m possibly correlated to the S4 vein and a narrow parallel quartz vein with a width of 0.10 m.

The TC-3 trench failed to reveal mineralization of any importance.

The total width of the zone inclusive of all the veins is estimated at about 0.2 km. The zone can be trace for a distance of 0.2 km in the direction of NE-SW but is concealed by an extensive scree cover in its southwestern extention.

The Au-Ag mineralization is associated with quartz veins, quartz vein networks and silicification along fractures or fractured zones, with a local development of argillization. The S7 vein of silicified networks is accompanied by Pb, Zn and a minor Cu mineralization in addition to Au and Ag.

The widths of the veins very considerably from one to another ranging from 0.2 to 1.2 m, but the S6 vein appears to be the widest ranging from 1.0 to 1.5 m, judging from the sizes of its old stopes.

The assay results of the samples collected from each vein are shown in Apx. 7 and Table II-1.

A sample of the S3 vein indicated assay values of 21.50 g/t Au and 410 g/t Ag for a width of 0.15 m and a sample of the network S7 vein gave assay values of 21.10 g/t Au and 1,200 g/t Ag for a width of 0.30 m.

The microscopic observation of a ore sample of the S7 vein identified ore minerals of pyrite > sphalerite > galena and a small amount of chalcopyrite, pearceite and covelline.

The result of EPMA for pearceite veinlet (0.3 x 1.0 mm) indicated the composition of the pearceite to be 73.36 Wt% Ag, 6.64 Wt% Cu, 0.49 Wt% Zn, 6.77 Wt% As. 0.88 Wt% Sb, 14.1 Wt% S (totalling 102.24%).

The X-ray-deffraction analysis of the samples collected from the S2, S3, S4 and S7 veins identified alteration minerals of quartz, potash feldspar and a minor amount of sericite and gypsum.

(4) The Quebrada Querumahuaico Alteration Zone

The sketches along the Quebrada Querumahuaico Alteration Zone are in Apx. 19 and the assay results of the sample from silicified zone in Apx. 7.

The alteration zone is exposed for about 300 m along the downstream of Quebrada Quelmahuaico and comprises 9 narrow intensively silicified bands accompanied by surrounding argillization , ranging from approximately 0.5 m to 6.8 m in their widths. They generally-trend NE-SW and dip steeply to NW.

Original textures ore very much oblitrated on greyish white outcrops which ore often stained by brown iron-oxides or back manganese oxides along fractures and occasionally disseminated with pyrite.

The argillization consists of brown, greyish white or white cleys often disseminated by pyrite.

The assay results of 17 samples collected from these silicified bands yielded the maximum values of 3.70 g/t Au and 9.5 g/t Ag.

It may be worthwhile to note that the alteration zone apparently tends NE-SW and is located to the southwest of the NE-SW trending southern mineralized zone, the southwestern end of which is concealed by an extensive scree cover.

There is a good possibility that the alteration zone be incorporated with the southern mineralized zone to form a continuous alteration-mineralization zone which provides an appreciable area for a mineral exploration target.

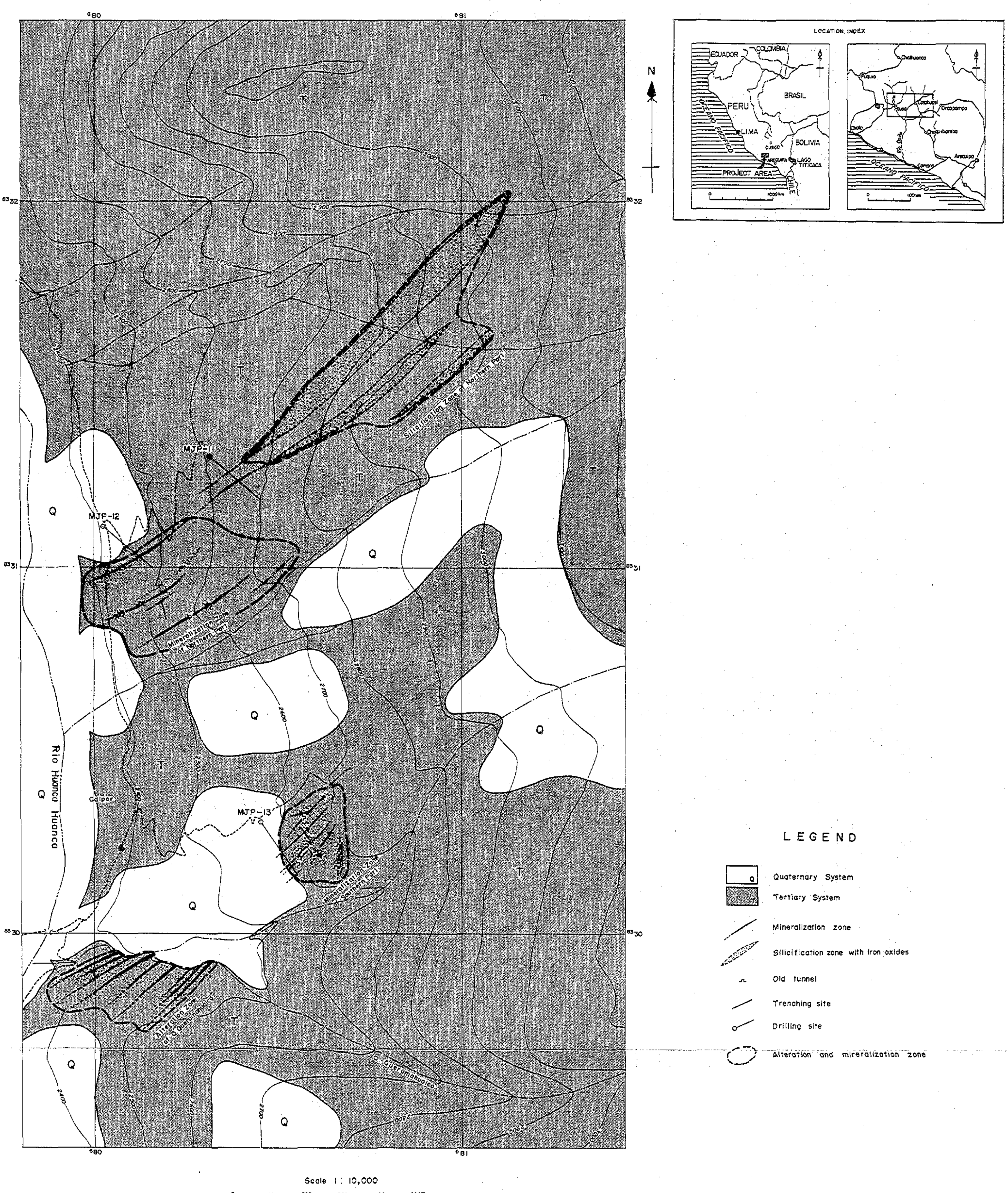
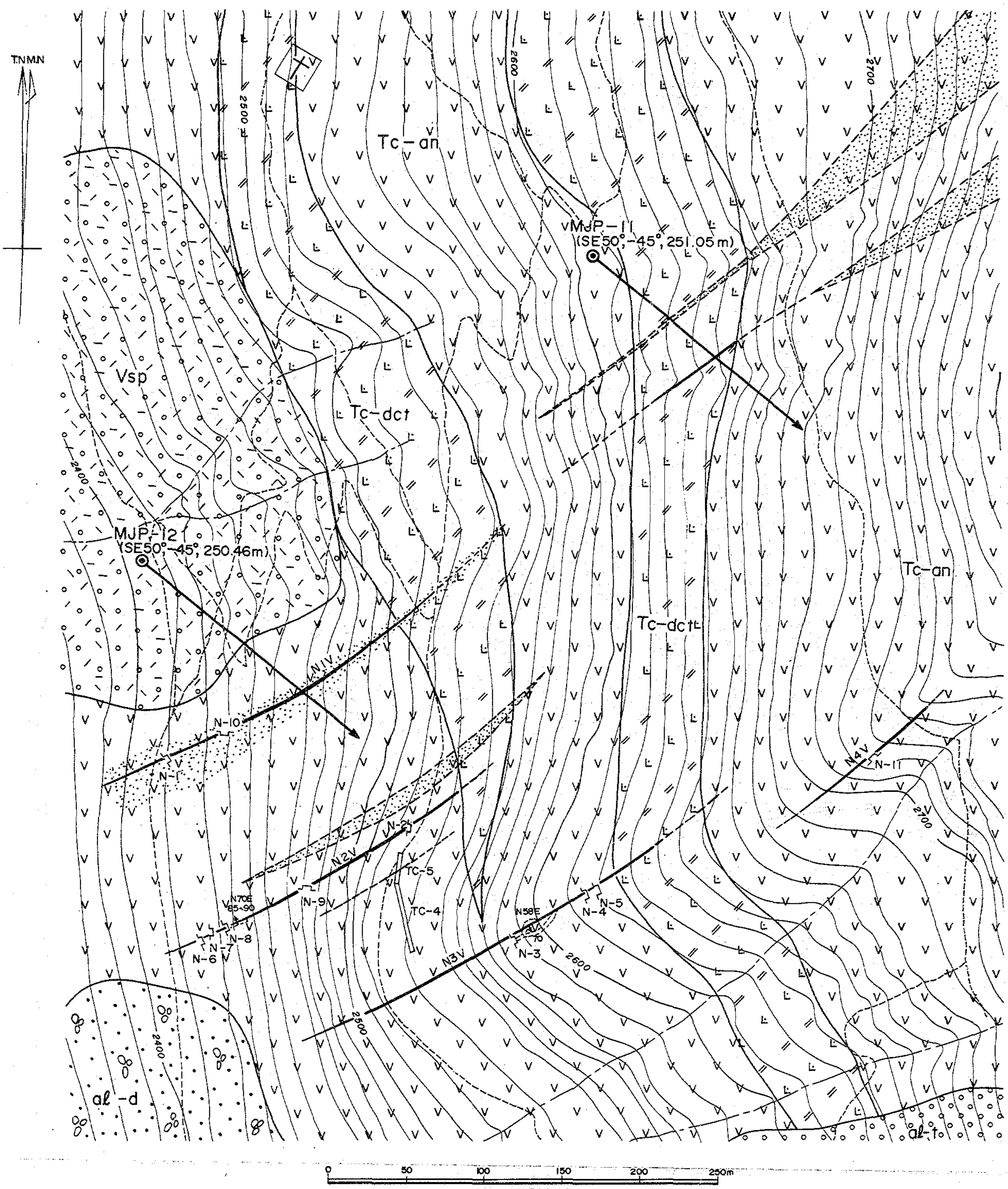


Fig. II-3 Location Map of Alteration and Mineralization Zone of the Colpar Area



LEGEND

al-d	Debris (gravel, sand, silt)
al-t	Terrace (gravel, sand, silt, clay)
Vsp	Tuffaceous silt, sand, gravel
Tc-dct	Dacitic pyroclastic rocks
Tc-an	Andesite lava and andesitic pyroclastic rocks.

85	Quartz vein and silicified zone
	Iron oxides zone
80	Joint with iron oxides and clay
	Drilling site
	Trenching site
	Tunnel

Fig. II-4 Location Map of Mineralization Zones of the Northern Part of the Colpar Area

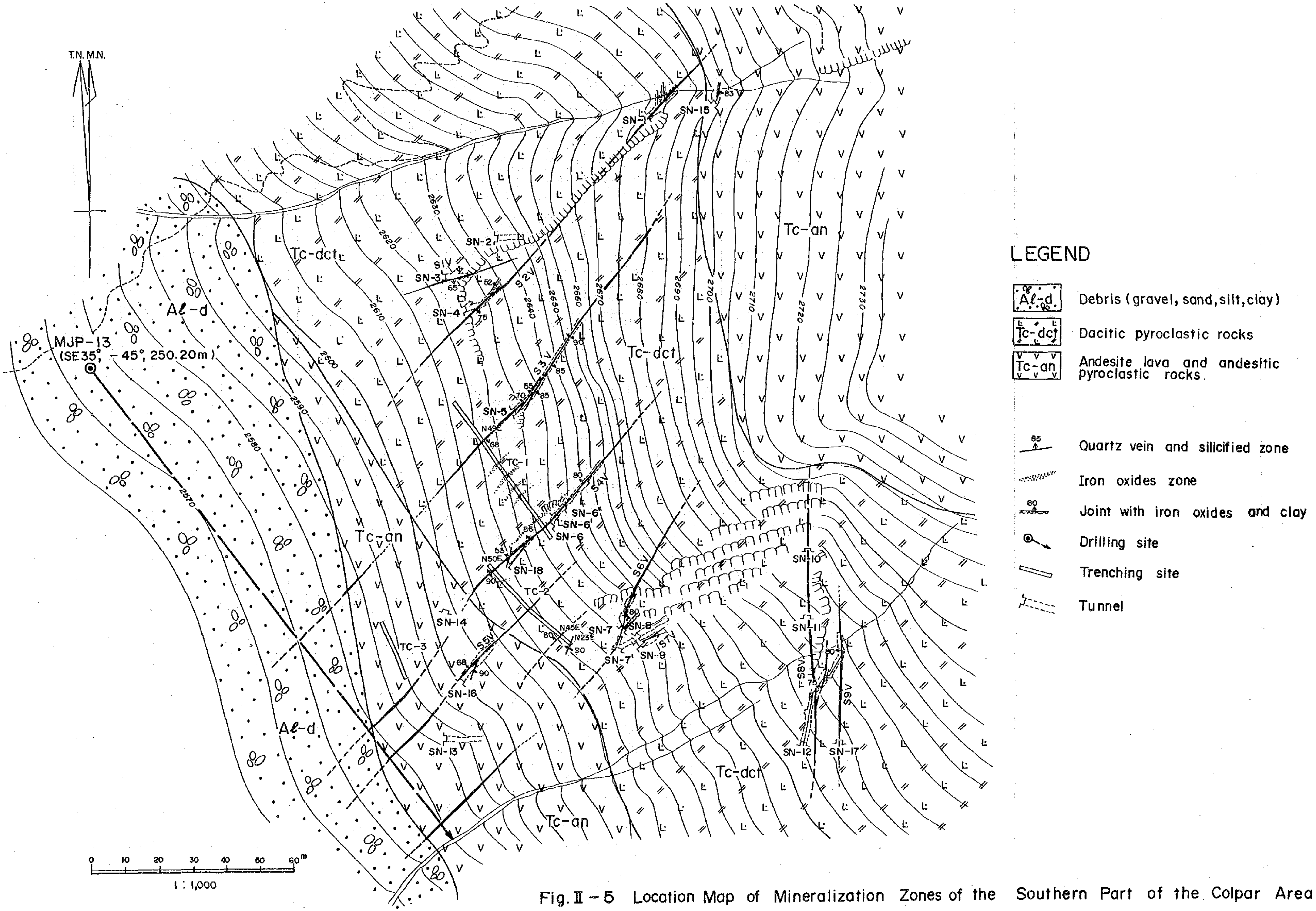


Fig. II-5 Location Map of Mineralization Zones of the Southern Part of the Colpar Area

Table II－1　List of Mineralization Zones of the Colpar Area

Name of Mineralization Zone	Mineralization			Tunnels			Assay results				description
	Name of Vein	Probable length of Vein	Strike and dip of Vein	Tunnel No.	Length of tunnel	Condition of tunnel	Sample No.	Width m	Au g/t	Ag g/t	
Mineralization Zone of Northern Part	N1V	600m±	N50°～60° E?・70°～80° NW	N－1	8m＋	inclined shaft	－	－	－	－	silicified and argillized rock with brown iron oxides
				N－10	?	shaft	－	－	－	－	siclicified rock with iron oxides
	N2V	200m±	N60°～80° E・80°～90° NW	N－2	?	shaft	－	－	－	－	network of iron oxides
				N－6	30m＋	inclined shaft	N6－4	0.5	0.89	390	brown to darkbrown sheared zone with brown iron oxides clay and a little quartz veinlet
				N－7	12m＋	inclined shaft	Mz－37	0.3	0.82	205	
				N－8	13m	inclined shaft	N8－2	0.5	0.89	178	
				N－9	?	shaft	－	－	－	－	
	N3V	300m±	N45°～60° E・80°～90° SE	N－3	33m＋	inclined shaft	N3－1	0.5	0.07	18.0	quartz vein with breccia of altered rock
							N3－3	1.0	5.97	640	strongly silicified andesitic tuff breccia with quartz veinlet
							N3－5	0.3	0.75	86.0	strongly silicified with zone with quartz veinlet
				N－4, N－5	?	cave－in of the tunnel	－	－	－	－	
	N4V	50m±	N50° E・50°～70° NW	N－11	19m	inclined shaft	－	－	－	－	argillized zone along crack with iron oxides and mangane oxides (w=0.07m)
Mineralization Zone of Southern Part	S1V	10m＋	N80° E・65° SE	SN－3	5m	drift and shaft	Mz－24	0.25	1.17	55.0	sheared zone with quartz veinlets, iron oxides and clay
	S2V	120m＋	N50° E・75°～90° SE	SN－1	12m＋	inclined shaft	Mz－17	0.5	0.41	33.0	brown argillized and silicified zone with quartz veinlet along crack
				SN－4	27m＋	inclined shaft	Mz－16	0.3	3.36	142.0	quartz vein with crystal pyrite, black mineral and iron oxides
	S3V	200m±	N40°～45° E・80°～90° SE	SN－5	34m＋	inclined shaft	S5－5	0.15	21.50	410	brown to dark brown clay along sheared zone
							S5－6	0.2	11.10	890	brown clay (w=3cm) and sheared zone (w=17cm)
				TC－1 (trench)	－	——	TC－1－2	0.2	0.69	71.0	gray strong silicified altered rock with quartz vein network
	S4V	150m±	N45° E・80°～86° NW	SN6, 6′, 6″	30m＋	inclined shaft	S6－1	0.1	10.10	540	brown and black clay along sheared zone
				SN－18	10m＋	inclined shaft	Mz－34	1.2	0.48	22.5	white grey hard silicified altered rock with iron oxides
							Mz－35	0.3	1.23	18.5	white grey strongly altered zone
	S5V	100m±	N45° E・70° NW	SN－16	12m＋	inclined shaft	S16－1	0.4	14.50	90.0	brown clay with iron oxides along joint
							S16－2	0.8	0.82	43.0	strongly altered rock along sheared zone
	S6V	50m＋	N35° E・90°	SN－7	12m＋	inclined shaft	Mz－12	0.45	0.14	10.5	light grey strongly silicified altered rock
				SN－8	11m	inclined shaft	Mz－10	0.45	0.55	31.5	silicified altered rock with limonite stain
	S7V	10m＋	N55° E・?	SN－9	10m	inclined shaft	Mz－11	0.3	20.10	1200	strong silicified vein network with sphalcrite galeepa and pyrite
	S8V	60m＋	NS・75°～80° W	S12	38.5m	inclined shaft	－	－	－	－	sheard zone with iron oxides
				SN10, SN11	?	cave－in of the tunnel	－	－	－	－	iron oxides along crack
	S9V	30m＋	NS・80° W	S12	38.5m	inclined shaft	S12－1	0.6	1.85	108.0	sheared zone with quartz veinlet along joint

1-2 Drilling Work

1-2-1 Summary

The drilling operation was intended to clarify occurrence of mineralization-alteration and associated geological conditions. The 3 inclined holes, MJP11 through MJP13, were drilled in the Colpar.

The performances of the drilling operation are summarized in Table II-2. The location of the drilled area are shown in Fig.II-6 and the drill sites in Fig.II-7

Table II-2 Generalized Drilling Results of the Colpar Area

Drill Hole	Working Period			Direction (°)	Angle (°)	Depth (m)	Location of Drill Hole		Elevation (m)
		Period	Days				E (km)	N (Km)	
MJP-11 (L-44)	T	14th Sep.~23th Sep.'87	10	SE50	-45	251.05	680.315	8,331.305	2,613.9
	I	24th Sep.~4th Oct.'87	11						
	D	5th Oct.~21th Oct.'87	17						
MJP-12 (L-44)	C	16th Jul.~5th Aug.'87	21	SE50	-45	250.46	680.023	8,331.110	2,404.2
	I	6th Aug.~7th Aug.'87	2						
	D	8th Aug.~12th Sep.'87	36						
	Di	13th. Sep.'87	1						
MJP-13 (L-38)	C	8th Sep.~25th Sep.'87	18	SE35	-45	250.20	680.455	8,330.305	2,571.3
	I	26th Sep.~28th Sep.'87	3						
	D	29th Sep.~29th Oct.'87	30						

T: Transfer, I: Installation, D: Drilling, C: Carrying in, Di: Dismounting

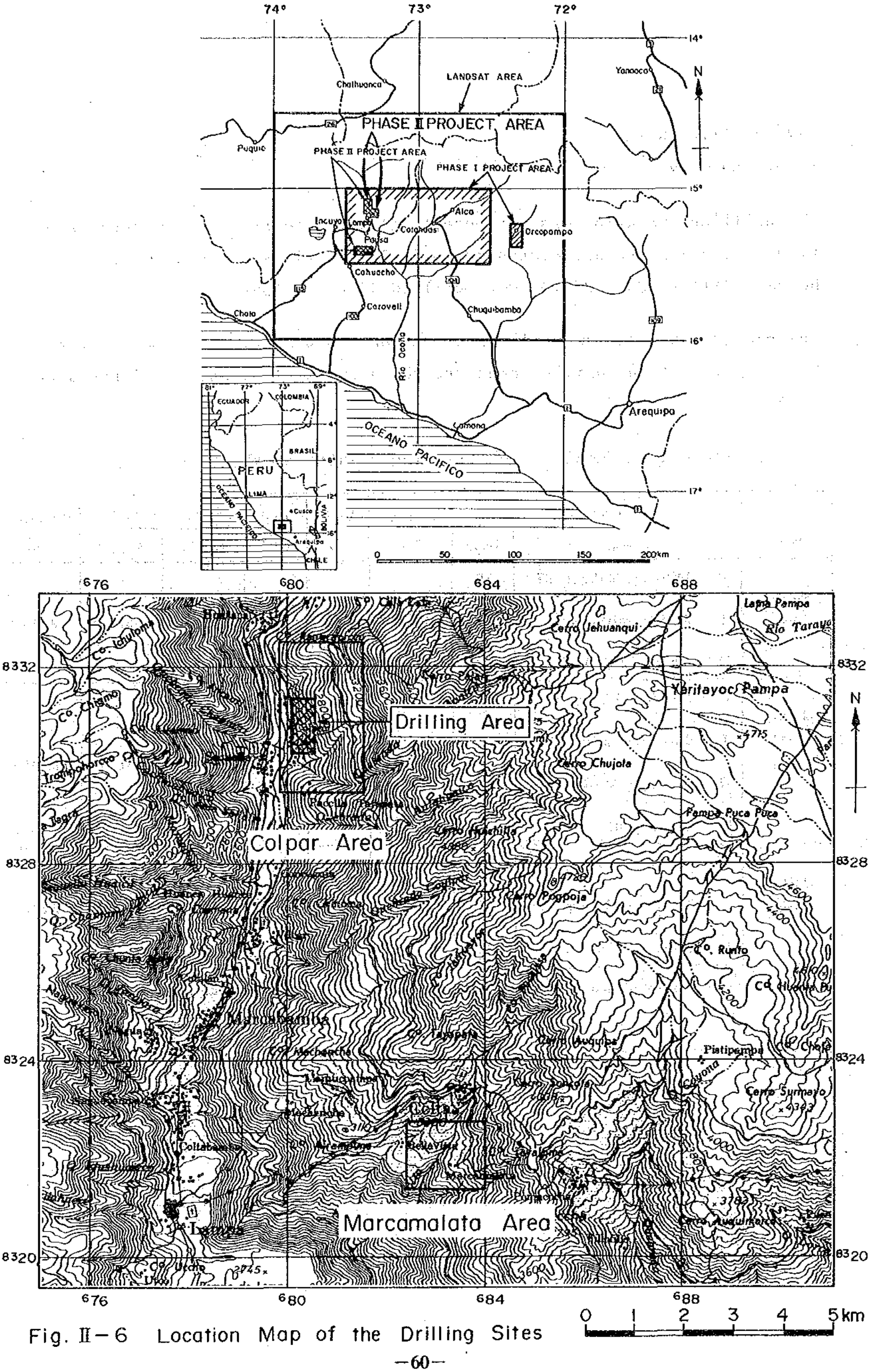


Fig. II－6 Location Map of the Drilling Sites

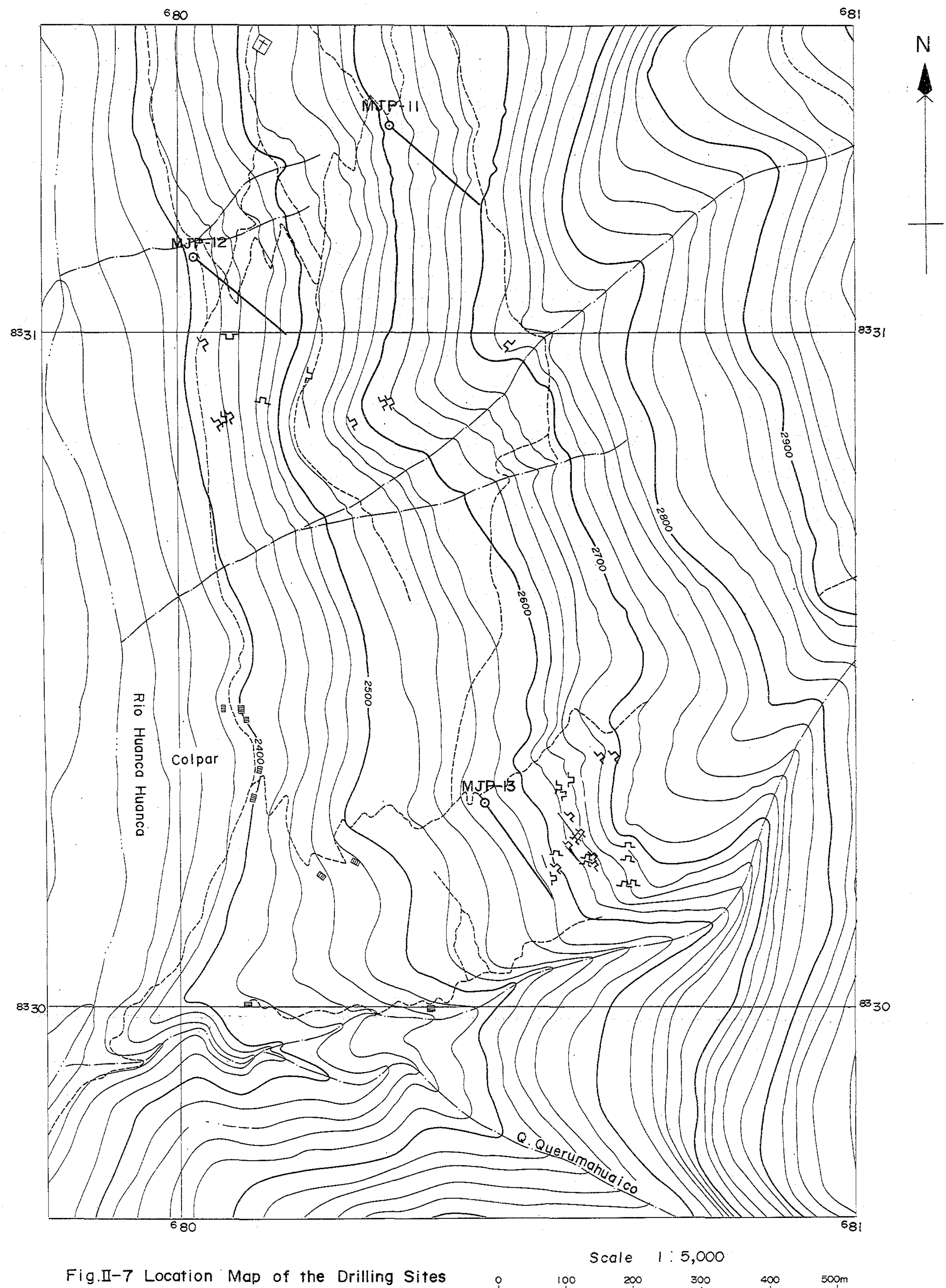


Fig.II-7 Location Map of the Drilling Sites in the Colpar Area

The drilling operation was performed by Geotec S.A. The duration of the operation was from July 16th to October 29th, 1987, totalling 106 days.

The staff and the workers involved were as follows.

Supervisor (in change of both the Colpar and Marcamalata)	1
Assistant Supervisor (in change of both the Colpar and Marcamalata)	1
Chief of Operator	1
Operators	4
Assistant Operator	8
Motor Vehicle Driver	1
Cook	1
Assistant Cook	1
Laborers	Numerous

A team of operators comprises an operator and two assistant operators under supervision of chief and assistant supervisors and a chief operator.

The 4 teams were prepared to operate two drill machines, Long Year-44 and -38.

One to three shifts operation was applied, depending availability of the machine, progress of access road preparation or other circumstantial situations.

The camp for the drilling team was located at the village of Sequello, from which the drilling sites were 40 to 60 minutes walk.

1-2-2 Drilling operation

(1) Move-in, Set-up and Mobilization

Drill machinery and necessary materials were transported from the Geotec's warehouse in Lima to the village of Sequello, via the National Highway 1 and the State Highway 100, by large-sized trucks.

With the total distance of 918 km between Lima and the Sequello, it required 3 to 4 days for the transportation due to rough roads in places.

Oils and fuels including diesel oil and gasoline were supplied at the village of Atico and transported by small-sized trucks at needs.

Access roads were prepared to move machines, equipment and other necessary materials from the base camp at the Sequello to each drill site. The drill machines were moved by self-propelling and other equipment and materials were transported by using man power and donkeys.

Total days required for the transportation from Lima to the drill site were 21 days for MJP-12 and 18 days for MJP-13.

Man power was used to make platforms and towers and to install drill machines

Drilling water were taken from channels for irrigation or from creeks and pumped up to drill sites through pipes of 1" diameter.

The preparation work required 11 days for MJP-11, 2 days for MJP-12 and 3 days for MJP-13.

It took 10 days to mobilized from the site for MJP-12 to that for MJP-11.

(2) Drilling

Details of drilling operations for the different drill holes are given in the Operatión Summary in Apx.28 (1)-(3), Schedule in Apx. 29 (1)-(3), list of Equipment used in Apx. 31, 32, Drilling Performance Record in Apx. 24.

1) Drill Hole MJP-11

0 - 32.80 m ---: Talus deposits

A NC cutter crown and a diamond bit were used for this section

Bit revolution: 100 - 200 RPM

Water supply : 70 ℓ/min

Bit Load : 500 kg

The talus deposits contained abundant angular boulders and cobbles of porphyritic andesite and were medium hard rocks.

On initial casing of $4^1/_2$" diameter was placed to the depth of 11.86 m. After placement of the initial casing, pressure in the hole started increasing due to lost circulation and wall destruction and became difficult to penetrate at the depth of 28.05 m.

To overcome the problem, cementation was applied to protect the wall. However, it became impossible to penetrate further than 32.80 m An NC casing was inserted to this depth.

The core recovery of this section was 89.3%.

32.80 m - 149.45 m: tuff breccias, tuffs, andesites

NX-WL diamond bits were used for this section

Water supply : 40 ℓ/min

Revolution : 150 - 300 rpm.

Bit load : 1,500 kg

The tuff breccias tuffs and andesites

The rocks of this section were medium hard and half-rod or rod shaped shaped cores were recovered.

In spite of continuous complete loss of circulation, drilling progressed smoothly without any problems in the hole.

An NX casing was inserted to the depth of 149.45 m.
The core recovery was 99.6% for this section.

149.45 - 251.05 m : tuffs, tuff breccias

BX-WL bits were use for this section.

Water supply : 30 ℓ/min
Revolution : 150 - 300 rpm
Bit load : 1,000 kg

The rocks of this section were medium hard and half-rod or rod shaped cores were recovered

In spite of continuous complete loss of circulation, drilling progressed smoothly without any problems in the hole.

The hole was completed at the scheduled depth of 251.05 m.
The core recovery of this section was 99.9%.

2) Drill hole MJP-12

0 - 15.14 m : Silts and Sands

A NC cutter crown and diamond bit were used for this section

Water supply : 70 ℓ/min 0
Revolution : 100 - 200 rpm
Bit load : 500 kg

The rocks consist of light grey tuffaceous silt and sand to the depth of 14.35 m, and of dark grey, compact andesite from 14.35 m to 15.14 m.

An initial casing of $4^{1}/_{2}$" diameter was placed to the depth of 5.65 m. Beyond the depth of 5.65 m, pressure in the hole started increasing due to lost circulation and destruction of the hole wall.

A NC casing was inserted to the depth of 15.14 m to overcome this problem.

The core recovery of this section was 84.5%.

15.14 - 218.72 m : andesites, tuffs

NX WL diamond bits were used for this section

Water supply : 40 ℓ/min

Revolution : 150 - 300 rpm

Bit load : 1,500 kg

The rocks of this section consisted of compact andesites and andesitic tuffs, and were medium hard.

Resistance in the hole gradually increased due to lost circulation and wall destruction.

An effort was made to prevent vibration by applying greese to rods and to reduce resistance in the hole.

In the case that this measure did not work, cementing by a rod injection was applied at the depths of 19.54 m, 33.92 m and 51,97 m.

When drilling at the depth of 186.97 m, an accident of rod breaking occurred. Through it was tried to recover rods by using a fishing gear, the fishing gear was broken and fragments of the gear were left in the hole.

All the rods were recovered by using a new fishing gear supplied from Lima, after having confirmed no debris of the wall or the broken fishing gear.

It took 7 days to completely recover from the accident.

After having recovered from the accident, the drilling recommenced.

However, pressure in the hole increased considerably at the depth of 218.72 m due to lost circulation and wall destruction, and a NX casing was inserted to this depth.

The core recovery of this section was 97.8%

218.72 - 250.46 m : tuffs

BX-WL diamond bits were used for this section

Water supply	:	30 ℓ/min
Revolution	:	150 - 300 1/min
Bit load	:	1,000 kg

The rocks consisted of dacitic tuffs and were medium hard. The recovered cores were mostly rod-shaped.

In spite of increased pressure in the hole due to lost circulation and wall destruction, drilling progressed smoothly without any accident.

The drilling was completed at the depth of 250.46 m exceeding the scheduled depth of 250 m.

The core recovery of this section was 100%.

It took a considerable time to complete this hole due to mechanical troubles and a rod breaking accident.

3) Drill hole MJP-13

0 - 4115 m : Talus deposits

A NC cutter crown and diamong bt was used for this section

Water supply	:	70 l/min
Revolution	:	100 - 200 rpm
Bit load	:	500 kg

The rocks consist of talus deposits containing abundant boulders of dacites and andesites.

It was difficult to drill through this section due to increased pressure in the hole by lost circulation and destruction.
The counter measures taken to overcome the problems are as follows:

i) Tried to reduce pressure in the hole by applying greese to rods.

ii) Tried to reduce pressure in the hole by injecting mud water and oil.

iii) Tried to reduce pressure in the hole by inserting casing into the hole with recovering cores by the wireline method

iv) Tried to prevent lost circulation and wall destruction by cementing.

v) A casing of $4^{1}/_{2}$" diameter was placed to the depth of 12.90 m.

However, a jarming accident occured at the depth of 41.15 m due to debris of wall.

Rods were released by inserting NC casing with reaming the hole to the depth of 41.15 m.

The core recovery of this section was 73.6%

41.15 - 126.25 m : Andesite, alternation of shales and sandstones, tuffs

NX diamond bits were used for this section

Water supply : 40 ℓ/min

Revolution : 150 - 300 rpm

Bit load : 1,500 kg

The rocks were talus deposits to the depth of 45.55 m, and then porphyritic andesites, alternation of tuffaceous shales and sandstones and dacitic tuffs which were medium hard.

Joints were well developed to the depth of about 87 m.

Resistance in the hole increased due to lost circulation and wall destruction caused by abundant joints.

A counter measure taken to overcome the problems was to prevent vibration by applying grease to rods or to apply cementing of the rod injecting method at the depths of 48.65 m and 55.65 m.

Increase of resistance in the hole made it difficult to penetrate at the depth of 126.25 m and an NX casing was inserted to this depth.

The core recovery of this section was 90.4%.

126.25 - 250.20 m : tuffs, tuff breccias.

BX diamond bits were used for this section

Water supply : 30 ℓ/min

Revolution : 150 - 300 rpm

Bit load : 1,000 kg